



Financiación:

f SéNeCa(+)

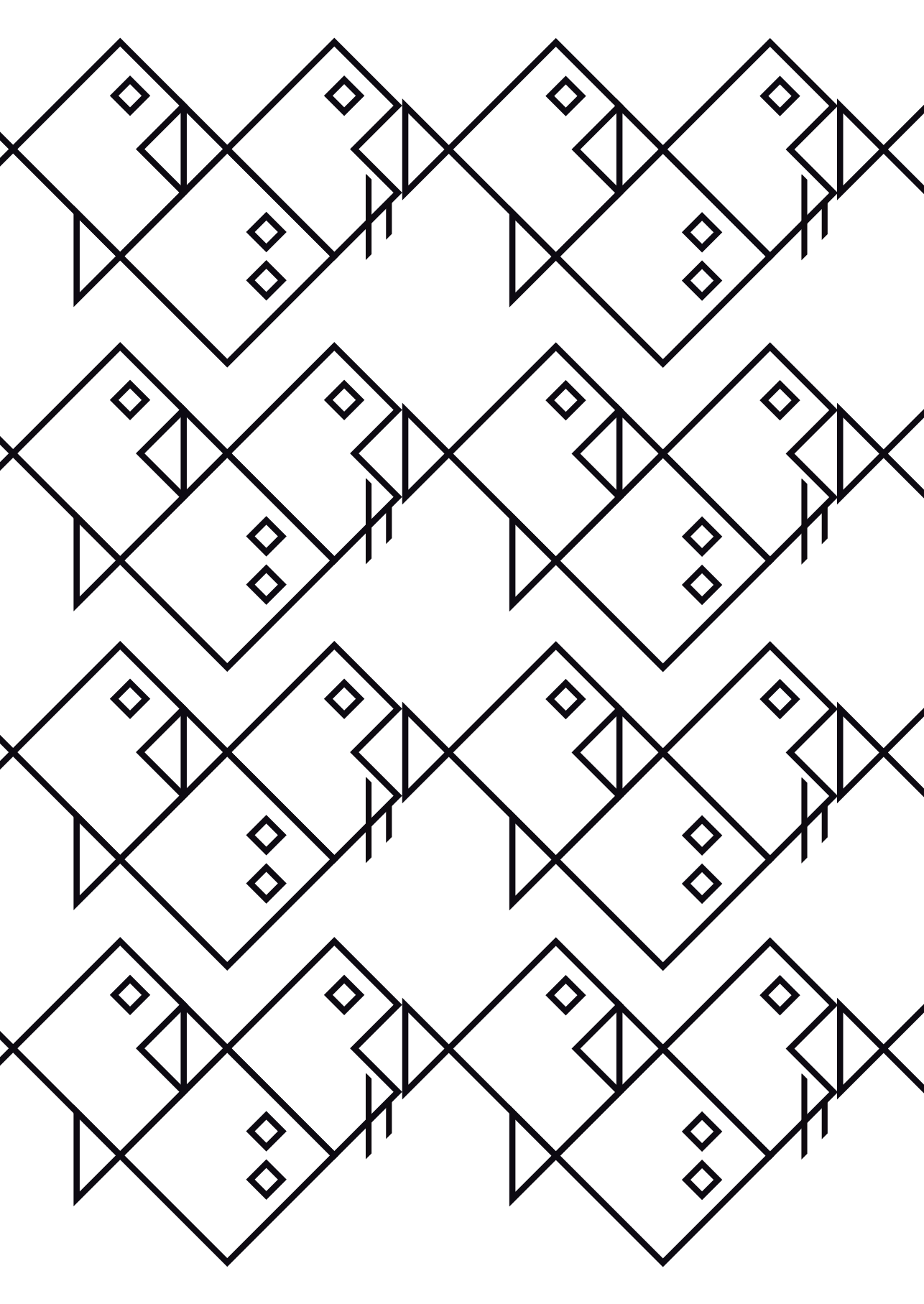
Agencia de Ciencia y Tecnología
Región de Murcia

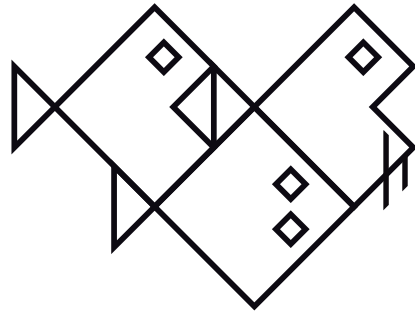
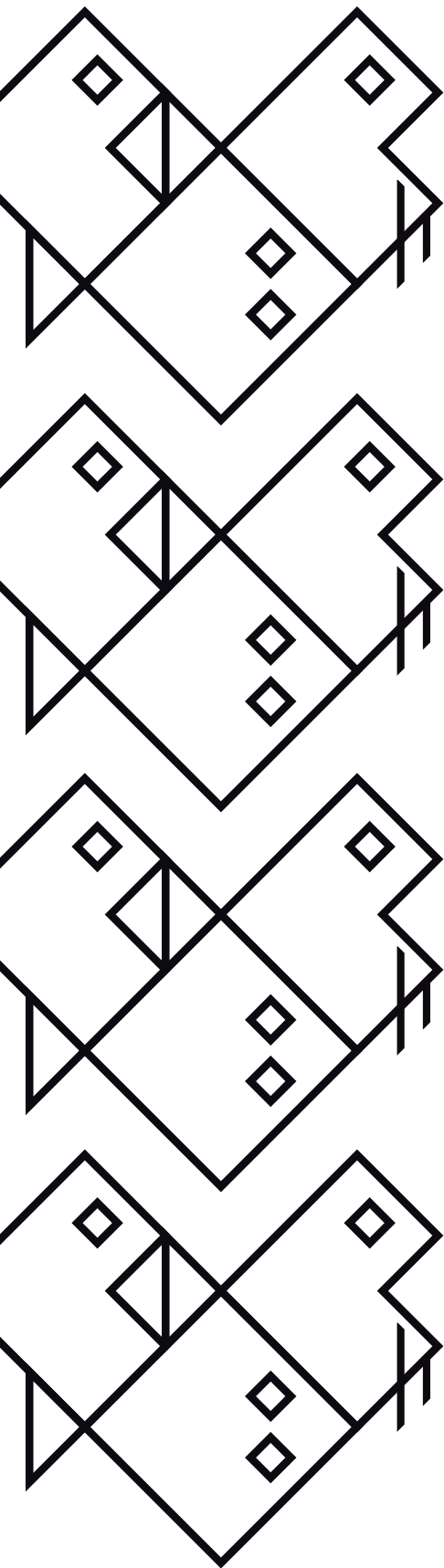
MURCIA 2016

SIBIC2016
VI IBERIAN CONGRESS OF
ICHTHYOLOGY / MURCIA

**SUMMARIES
BOOK**



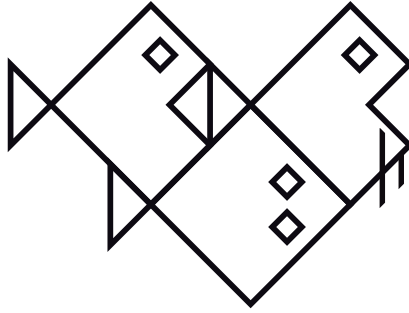




SIBIC2016

**VI IBERIAN CONGRESS OF
ICHTHYOLOGY / MURCIA**

**21st to 24th June 2016
Auditorium and Congress
Centre Victor Villegas
Murcia (Spain)**



SIBIC2016

**VI IBERIAN CONGRESS OF
ICHTHYOLOGY / MURCIA**

PRESIDENTA DEL VI CONGRESO IBÉRICO DE ICTIOLOGÍA

Mar Torralva Forero, Universidad de Murcia

COORDINA

- *Mar Torralva Forero*, Universidad de Murcia
- *Ana Sánchez Pérez*, Universidad de Murcia
- *José Manuel Zamora Marín*, Universidad de Murcia
- *Antonio Zamora López*, Universidad de Murcia
- *Fátima Amat Trigo*, Universidad de Murcia
- *Eduardo Lafuente Sacristán*, Confederación Hidrográfica del Segura
- *Francisco José Oliva Paterna*, Universidad de Murcia

EDITA

Sociedad Ibérica de Ictiología, SIBIC

COMITÉ ORGANIZADOR

Secretaría

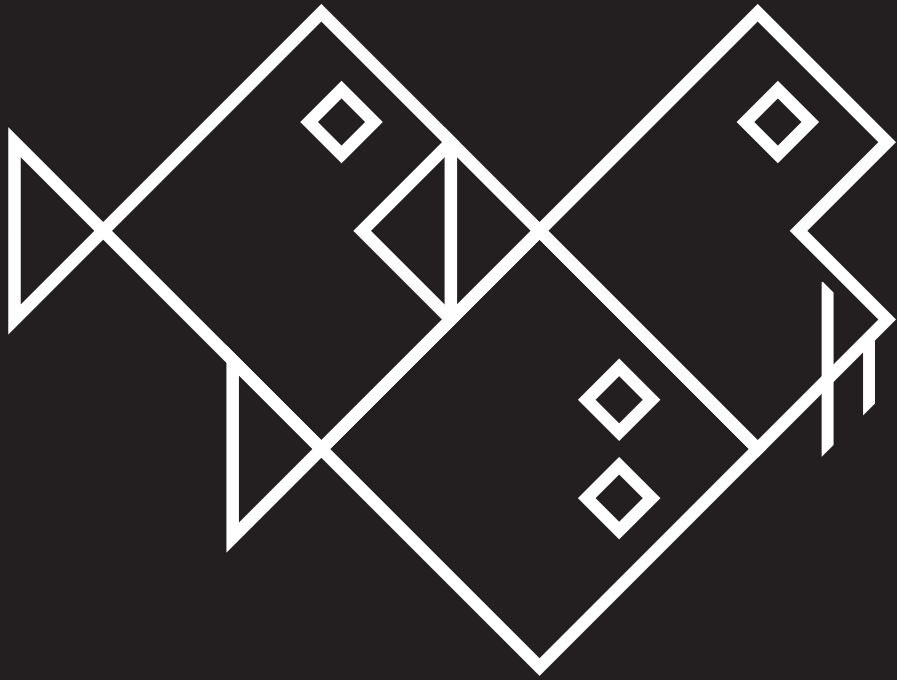
- *Ana Sánchez Pérez*, Universidad de Murcia

Vocales

- *Ana Ruíz Navarro*, Universidad de Murcia
- *Cristina González Muñoz*, Confederación Hidrográfica del Segura
- *Eduardo Lafuente Sacristán*, Confederación Hidrográfica del Segura
- *Fátima Amat Trigo*, Universidad de Murcia
- *Filipe Martinho*, Universidad de Coimbra
- *Francisco José Oliva Paterna*, Universidad de Murcia
- *Frederic Casals Martí*, Universidad de Lleida
- *Jaime Fraile Jiménez de Muñana*, Confederación Hidrográfica del Segura
- *Jorge Sánchez Balibrea*, Asociación de Naturalistas del Sureste
- *José Manuel Zamora Marín*, Universidad de Murcia
- *Juan Francisco Asturiano*, Universidad Politécnica de Valencia
- *Manuel Ramón García Garre*, Becario del Museo Laboratorio Lousteau
- *Rosa Olivo del Amo*, Typsa
- *Antonio Zamora López*, Universidad de Murcia
- *Juan Madrigal de Torres*, Oficina de Impulso Socioeconómico del Medio Ambiente-Consejería de Agricultura, Agua y Medio Ambiente de la Región de Murcia

Comité científico

- *Alfonsa García Ayala*, Universidad de Murcia
- *Amadora Rodríguez Ruíz*, Universidad de Sevilla
- *Ana Almodóvar Pérez*, Universidad Complutense de Madrid
- *Ana Veríssimo*, Centro de Investigación en Biodiversidad y Recursos Genéticos de Vairão (CIBIO)
- *Anabel Perdices*, Museo Nacional de Historia Natural de Madrid-CSIC
- *Ángel Pérez Ruzafa*, Universidad de Murcia
- *Benjamín García García*, Instituto Murciano de Investigación y Desarrollo Agrario y Alimentario (IMIDA)
- *Carlos Fernández Delgado*, Universidad de Córdoba
- *Carlos Granado Lorenzo*, Universidad de Sevilla
- *Estibaliz Díaz*, AZTI-Tecnalia
- *Fernando Cobo Gradín*, Universidad de Santiago de Compostela
- *Francisco José Oliva Paterna*, Universidad de Murcia
- *Frederic Casals Martí*, Universidad de Lleida
- *Filipe Martinho*, Universidad de Coimbra
- *Filipe Ribeiro*, Universidad de Lisboa
- *Javier Martínez López*, Universidad de Murcia
- *Francisco Javier Sanz Roda*, Universidad de Palencia
- *José Antonio García Chartón*, Universidad de Murcia
- *Juan Faustino Martínez Fernández*, Oficina de Impulso Socioeconómico del Medio Ambiente-Consejería de Agricultura, Agua y Medio Ambiente
- *Juan Francisco Asturiano Nemesio*, Universidad Politécnica de Valencia
- *Lluís Zamora Hernández*, Universidad de Girona
- *M^a Ángeles Esteban Abad*, Universidad de Murcia
- *Miguel Clavero Pineda*, Estación Biológica de Doñana-CSIC
- *Pedro Guerreiro*, Universidad del Algarve
- *Rafael Miranda Ferreira*, Universidad de Navarra
- *Rita Vasconcelos*, Universidad de Lisboa



PRESENTATION

Desde la Sociedad Ibérica de Ictiología (SIBIC) nos complace presentarle el VI Congreso Ibérico de Ictiología organizado en colaboración con la Universidad de Murcia y la Confederación Hidrográfica del Segura, que se celebra entre el 21 y el 24 de junio de 2016 en el Auditorio y Centro de Congresos Víctor Villegas de Murcia (España). Esta edición tiene como principal objetivo conformar un espacio de encuentro entre conservacionistas, investigadores y gestores dedicados a los peces de mar, a los peces de río y también a la acuicultura. Bajo el convencimiento de la necesidad de reunir a un conjunto de personas interesadas en el estudio y conservación de este grupo de vertebrados, celebramos este encuentro con la finalidad de fomentar el debate e intercambio de ideas y conocimientos que aporten diferentes perspectivas así como posibles soluciones a la problemática actual en relación con los peces, sus hábitats y su explotación.

Hace 25 años de la celebración de las I Jornadas de Ictiología Ibérica (León 1981) y desde entonces, esta joven pero fructífera disciplina ha experimentado un crecimiento vertiginoso en cuanto a la cantidad de personas dedicadas al estudio de los peces, el volumen de información generada y su contribución para la gestión y conservación de la fauna piscícola y de los ecosistemas acuáticos continentales y marinos. Con sólo seis años desde su fundación, SIBIC se ha hecho hueco entre las asociaciones científicas con más proyección en la conservación del medio natural en la Península Ibérica, sobre todo en la protección de nuestros ríos, estuarios y mares, principalmente a través del estudio de su ictiofauna.

Los peces son el grupo más diverso de vertebrados, no únicamente en sus formas o tamaños, sino también en su biología y ecología. Su elevado éxito evolutivo se refleja en la amplia variedad de hábitats que ocupan o en la notable diversidad de adaptaciones fisiológicas, morfológicas y etológicas que presentan. Actualmente, este grupo de fauna está sujeto a una altísima presión antrópica, lo que representa un gran desafío para su gestión y conservación. Por otro lado, suponen un recurso con una dificultad de gestión sostenible cada vez más compleja debido a los problemas causados por las alteraciones climáticas, particularmente en los ecosistemas dulceacuícolas, estuáricos y costeros. En este contexto, la acuicultura adquiere un papel muy importante erigiéndose las investigaciones realizadas en este campo como un valor singular a la ictiología.

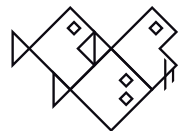
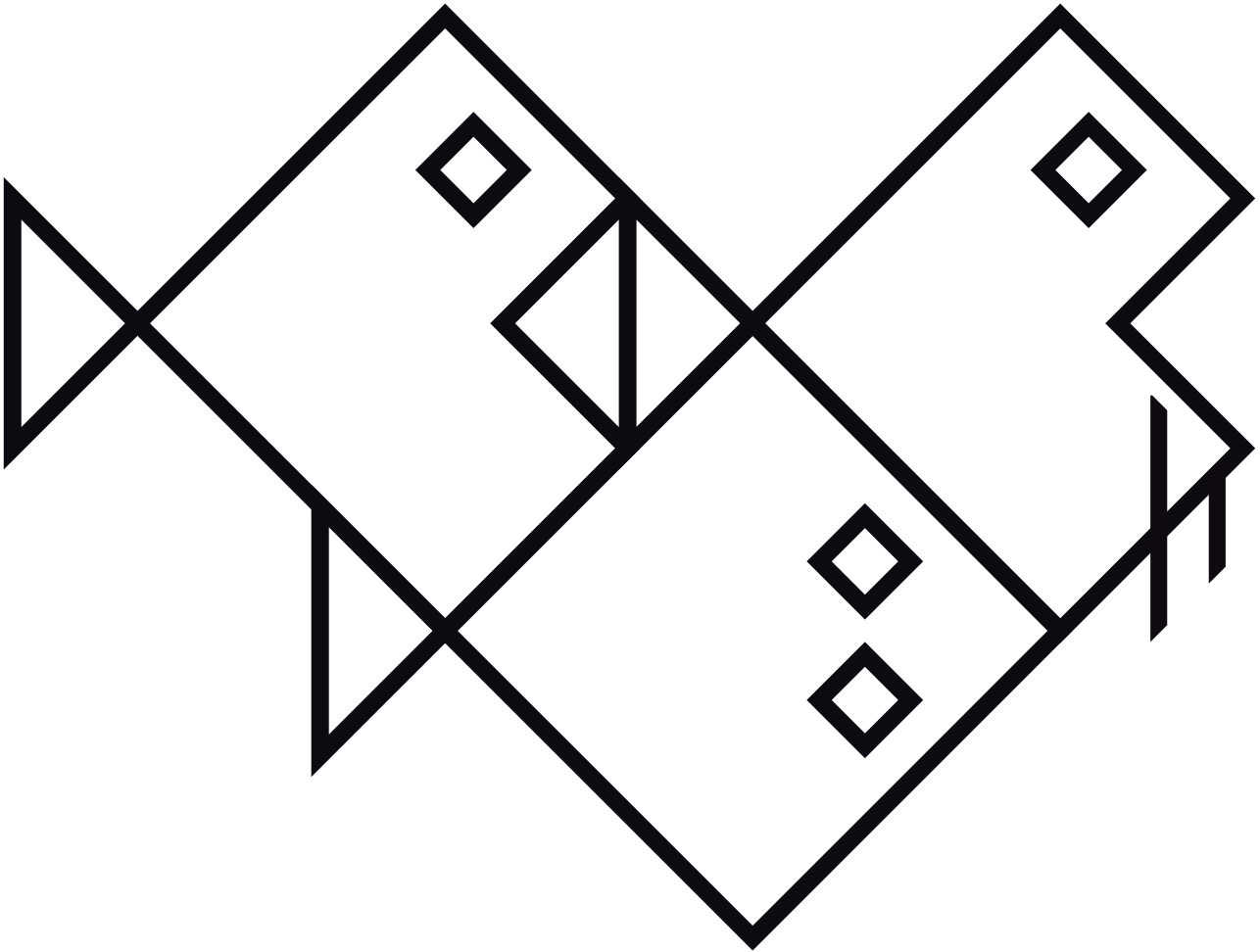
El título de esta edición *“Ictiología: vocación por los peces de mar, los peces de río y la acuicultura”* concuerda con el objetivo de expandir su espectro de influencia, haciendo por ello un gran esfuerzo en atraer a participantes de ámbitos diversos en el estudio y gestión de los peces. Los resultados obtenidos al inicio de este evento confirman que este objetivo ya ha sido alcanzado. Ahora solamente falta el debate, el intercambio de ideas, de conocimientos y de perspectivas.

Dra. Mar Torralva Forero

PRESIDENTA DEL VI CONGRESO IBÉRICO DE ICTIOLOGÍA
VICEPRESIDENTA DE SIBIC

Edita: Sociedad Ibérica de Ictiología, SIBIC
Imprime: Pictografía, S.L.
Diseño y maquetación: Publicidad Líquida, S.L.
ISBN: 978-84-608-9184-0
D.L.: MU 654-2016

ICTIOLOGÍA. VOCACIÓN POR LOS PECES DE MAR, LOS PECES DE RÍO Y LA ACUICULTURA
ICTIOLOGÍA. DEDICAÇÃO AOS PEIXES MARINHOS, PEIXES DE ÁGUA DOCE E AQUACULTURA
ICHTHYOLOGY. DEDICATION TO MARINE FISH, FRESHWATER FISH AND AQUACULTURE



SIBIC2016
VI IBERIAN CONGRESS OF
ICHTHYOLOGY / MURCIA

PROGRAM

June
21TH



SIBIC2016
VI IBERIAN CONGRESS OF ICHTHYOLOGY
MURCIA, SPAIN 21st - 24th June

19:00-21:00

REGISTRATION WELCOME COCKTAIL

June
22TH

	HALL 1 ↓	HALL 2 ↓	HALL 3 ↓
9:00-10:00	OPENING CEREMONY		
10:00-11:00	Plenary 1 PAUL KEMP		
11:00-11:30	COFFEE-BREAK		
11:30-11:50	001 (Ex)	042 (Ex)	078 (Ex)
11:50-12:05	O-02	O-43	O-79
12:05-12:20	O-03	O-44	O-80
12:20-12:35	O-04	O-45	O-81
12:35-12:50	O-05	O-46	O-82
12:50-13:05	O-06	O-47	O-83
13:05-13:20	O-07	O-48	O-84
13:20-13:35	O-08	O-49	O-85
13:35-13:50	O-09	O-50	
14:00-15:00	LUNCH		
15:00-16:00	Plenary 2 ANITA FRANCO		
16:00-16:15	O-10	O-51	O-86
16:15-16:30	O-11	O-52	O-87
16:30-16:45	O-12	O-53	
16:45-17:00	O-13	O-54	
17:00-17:30	COFFEE-BREAK		
17:30-20:00	POSTER SESSION	Special session: European eel	Special Session: LIFE
	CONGRESS DINNER		



SIBIC2016
VI IBERIAN CONGRESS OF ICHTHOLOGY
MURCIA, SPAIN 21ST - 24TH June

**June
23TH**

	HALL 1 ↓	HALL 2 ↓	HALL 3 ↓
9:00-10:00	Plenary 3 IBON CANCIO		
10:00-10:20	014 (Ex)	055 (Ex)	088 (Ex)
10:20-10:35	O-15	O-56	O-89
10:35-10:50	O-16	O-57	O-90
10:50-11:05	O-17	O-58	O-91
11:05-11:30	COFFEE-BREAK		
11:30-12:30	Plenary 4 FERNANDO DE LA GÁNDARA		
12:30-12:45	O-18	O-59	O-92
12:45-13:00	O-19	O-60	O-93
13:00-13:15	O-20	O-61	O-94
13:15-13:30	O-21	O-62	O-95
13:30-13:45	O-22	O-63	O-96
13:45-14:00	O-23	O-64	O-97
14:00-15:00	LUNCH		
15:00-16:00	Plenary 5 MARÍA TERESA FERREIRA		
16:00-16:15	O-24	O-65	O-98
16:15-16:30	O-25	O-66	O-99
16:30-16:45	O-26	O-67	
16:45-17:00	O-27		
17:00-17:30	COFFEE-BREAK		
17:30-20:30	POSTER SESSION		Special session: Dam removal
20:00-21:00	SIBIC ASSEMBLY		

WEBINAR:
Fish passage
2016

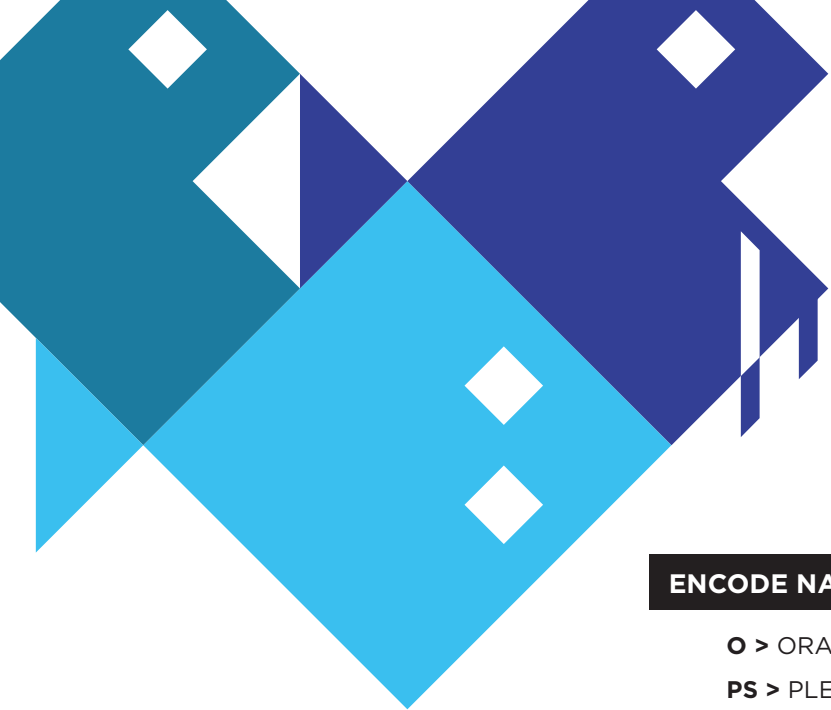
PROGRAM

June 24TH

	HALL 1 ↓	HALL 2 ↓	HALL 3 ↓
9:00-10:00	Plenary 6 CARLOS GRANADOS		
10:00-10:20	028 (Ex)	068 (Ex)	O-100
10:20-10:35	O-29	O-69	O-101
10:35-10:50	O-30	O-70	O-102
10:50-11:05	O-31	O-71	O-103
11:05-11:30	COFFE-BREAK		
11:30-11:45	O-32	O-72	O-104
11:45-12:00	O-33	O-73	O-105
12:00-12:15	O-34	O-74	O-106
12:15-12:30	O-35	O-75	O-107
12:30-12:45	O-36	O-76	O-108
12:45-13:00	O-37	O-77	O-109
13:00-13:15	O-38	VAKI	O-110
13:15-13:30	O-39		O-111
13:30-13:45	O-40		
13:45-14:00	O-41		
14:00-15:30	LUNCH - CLOSING CEREMONY		
16:00-21:00	Guide Visit: Visit to Cartagena		

June 25TH

9:00-14:00	Guided Visit: Visit to Fish Passage of the LIFE+ SEGURA RIVERLINK
------------	--



ENCODE NAME

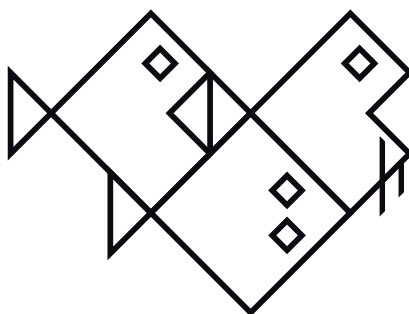
- O** > ORAL COMMUNICATIONS
- PS** > PLENARY SESSIONS
- SS** > SPECIAL SESSIONS
- P** > POSTER

CONGRESS

-  MIGRATION, CONNECTIVITY AND REGULATED RIVERS.
-  LIFE CYCLES, ECOLOGY AND CONSERVATION OF FRESHWATER FISHES.
-  AQUACULTURE, ENDOCRINOLOGY AND TOXICOLOGY.
-  INVASIVE ALIEN FISH.
-  LIFE CYCLES, ECOLOGY AND CONSERVATION OF MARINE AND ESTUARINE FISHES.
-  SYSTEMATICS, ZOOGEOGRAPHY AND POPULATION GENETICS.
-  MARINE PROTECTED AREAS.
-  FISHERIES.
-  CHALLENGES AND OPPORTUNITIES IN RESEARCH OF EUROPEAN EEL.
LIFE PROJECTS AND FISHES.
DAM REMOVAL.



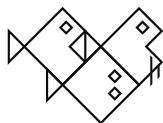
SIBIC2016
VI IBERIAN CONGRESS OF ICHTHOLOGY
MURCIA, SPAIN 21st - 24th June



SIBIC2016

**VI IBERIAN CONGRESS OF
ICHTHYOLOGY / MURCIA**





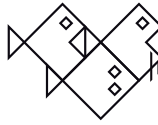
FISH PASSAGE IN THE EUROPEAN CONTEXT: CHALLENGES, FAILURES, AND POTENTIAL SOLUTIONS

Paul Kemp

International Centre for Ecohydraulics Research, University of Southampton, United Kingdom (P.Kemp@soton.ac.uk).

The need to provide routes of alternative passage for moving fish impeded by river infrastructure is well recognised. In Europe, understanding of the potential for impoundments to block the spawning migrations of fish and as a result cause population declines date back to before the reign of the English Monarch, Richard the Lionheart, in the 12th Century. Despite continuous development of fish passage solutions, such as fishways for upstream migrating fish, and bypass facilities designed to aid downstream movements, robust evaluation of their efficiency is rare when viewed from the global perspective. Where effectiveness has been monitored, results frequently fall below expectation and in some cases the fish passes are themselves a cause for concern as a potential impact on fish populations. This has led to current fish passage solutions being described as “half-way” technologies and partially explains why many populations have continued to decline, and in some case become extinct, despite mitigation.

The development of fish passes that effectively attract multiple species (taking a community perspective) to their entrances, allow successful entry and passage while minimising energetically costly delay and potential for predation remains a major and fundamental challenge. This presentation will outline some of the current problems and future challenges associated with fish passage development and provide recommendations for further progress in this field. These can be summarised as: 1) recognising the problem; fish passage may not provide a universal panacea; 2) developing realistic fish passage design criteria for multiple species; 3) embracing the influence of fish behaviour in passage efficiency; 4) improving understanding of population response and cumulative impacts; and 5) considering alternative mitigation options and developing techniques to effectively prioritise actions.



FISH AS ECOLOGICAL INDICATORS AND THE CHALLENGE OF CLIMATE CHANGE

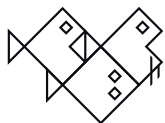
Anita Franco

Institute of Estuarine & Coastal Studies (IECS). University of Hull, Hull, HU6 7RX
United Kingdom (A.Franco@hull.ac.uk).

Estuaries and lagoons exist at the interface between marine and freshwater realms and are naturally characterized by marked gradients and fluctuations in the environmental variables. As such, their fish fauna is mostly composed of species of both marine and freshwater origin that temporary reside in the estuary or use it as a pathway of migration between the sea and fresh waters, while only a few species are adapted to spend the whole life cycle in this environment.

Functional groups are used to express the different ways fish use the estuarine environment and its resources (e.g. in terms of habitat use, feeding habits, reproductive modes) and a high similarity has been observed in the functional structure of fish assemblages across European estuaries, as opposed to the high variability in taxonomic composition recorded at both local and geographical scales. As a result, the abundance and diversity of functional groups have been largely used as metrics in the assessment of the ecological status of transitional waters throughout Europe, allowing to establish a reference for the functioning of estuarine ecosystems.

Climate-induced alterations of the estuarine environment (including temperature, hydrological regime, saline intrusion, water quality and habitat availability) are likely to affect fish use of estuaries, leading to physiological and behavioral responses, altering the performance of individuals and populations, influencing dispersal and recruitment and species interactions within communities and ultimately affecting the structure and functioning of estuarine fish communities. Therefore climate change has the potential to shift established baselines thus posing a challenge for the ecological status assessment of transitional waters. This paper presents the available knowledge on the structure and functioning of estuarine fish assemblages and examines the possible effects of climate change on the ability of using these biological components to assess ecological status.



MOLECULAR MARKERS OF FISH SEX DIFFERENTIATION FOR THE BIOMONITORING OF THE EFFECTS OF XENOESTROGENS IN COASTAL AREAS

Ibón Cancio

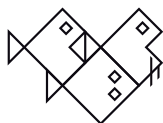
Department of Zoology and Animal Cell Biology, Faculty of Science and Technology, University of the Basque Country, Spain (ibon.cancio@ehu.es).

Fish being so diverse have evolved multiple mechanisms to adapt to alterations in their environment. As vertebrates sharing many molecular/physiological mechanisms with mammals they constitute good models to study responses to pollution and as such they are widely used as sentinel organisms in pollution monitoring programs.

A group of chemical compounds, xenoestrogens, are of especial interest as they interact with the sex-differentiation process in fish, severely affecting their reproductive capacity and population resilience to pollution. In the Basque coast we are studying different populations of thicklip grey mullets (*Chelon labrosus*), that as a consequence of exposure to xenoestrogens develop intersex condition; production of oocytes in testis. Oocyte differentiation in testis is preceded by an ovary-like transcriptional profile, which can be used as an early biological warning tool to identify environmental presence of xenoestrogens.

Our research group has described that a simple electrophoresis of total RNA extracted from gonads, allows identification of high levels of 5S rRNA present in oocytes, diagnostically identifying intersex testis. This is so because the oocyte is a cell investing in reproduction, and thus it needs to accumulate molecules that will allow early embryo development. All the genes necessary for 5S rRNA production (*gtf3a*) and ribosomal assembly (*42sp43*, *importins*, *rpl5*, *rpl11*), together with other more classical markers (*cyp19a1*, *amh*, *dmt1* or vitellogenin in liver) can be used as biomarkers of xenoestrogenic exposure and oocyte differentiation at the transcriptional level. They can also provide indication of intersex severity in a given fish population. Moreover, these markers have proved to be useful to study the process of complete sex reversal in zebrafish experimentally exposed to methyltestosterone or estradiol. Presently, our research group will use such markers to monitor the reproductive capacity of intersex affected populations.

Funded: Spanish MINECO (AGL2012-33477 & AGL2015-63936-R), Basque Government (IT810-13), UPV/EHU (UFI 11/37).



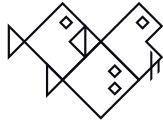
DOMESTICATION OF BLUEFIN TUNA, THE LAST GREAT CHALLENGE OF MARINE AQUACULTURE

Fernando de la Gándara García

Instituto Español de Oceanografía (IEO). Puerto de Mazarrón, Spain (fernando.delagandara@mu.ieo.es).

The bluefin tuna *Thunnus thynnus* (L., 1758) is a teleost fish belonging to the *Scombridae* family and is an emblematic species that has fed the Mediterranean populations for millennia.

From the 90's starts the process called «bluefin tuna fattening» which involves capturing live specimens by purse seiners in spawning areas, transferring them to nearby farms to the coast, feeding them for several months with small pelagic fish rich in fat and sent to market later, especially Japan. This activity led to severe exploitation of natural populations, risking the future of the fishery. To mitigate this, the International Council for the Conservation of Atlantic Tunas (ICCAT) established from 2007 a recovery plan, with a drastic limitation of catches and several conservation measures, which have made the fishery of Atlantic bluefin tuna one of the most regulated. Clearly, despite the undoubted positive effects on the recovery of the stock, limited catches will continue in the near future. Therefore, to ensure the supply of this iconic species in the quantity and quality required by an increasingly important and selective market, the bluefin tuna production has to come inevitably by techniques of integrated aquaculture completely independent of natural populations, such as it happens today with species such as gilthead sea bream, sea bass or turbot. This activity also promotes the recovery of natural stocks by reducing the fisheries pressure. The Oceanographic Centre of Murcia, belonging to Spanish Institute of Oceanography (IEO), has been developing for more than 10 years, techniques for the captive breeding of bluefin tuna and production of juveniles who have been subsequently raised to market size in floating cages companies the sector, within the framework of research projects with the IEO.

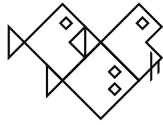


FISH AS BIOLOGICAL INDICATORS OF ECOLOGICAL STATUS, A PAN-EUROPEAN APPROACH

Maria Teresa Ferreira

Instituto Superior de Agronomia, Centro de Estudos Florestais (CEF), University of Lisboa, Portugal (terferreira@isa.utl.pt).

This session will focus in an overall description and an assessment of the current situation of fish species and fish metrics as indicators of ecological status in Europe. A review about the building up process of these indicators in the last decade, and the comparability among different countries will be done. In addition, the results of the first two exercises of management, planning, and implementation in watersheds according to the Water Framework Directive will be presented and analyzed, and the main problems and pressures that still persist and how these affect fish communities, will be identified. Finally, the gaps still exist to complete a thorough assessment of ecological quality based on fish will be evaluated in all aquatic environments.



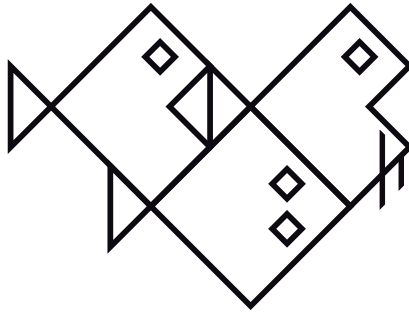
FISH AT BIRD'S EYE VIEW

Carlos Granado Lorenzo

Department of Plant Biology and Ecology. Faculty of Biology. University of Sevilla (granado@us.es).

Over the last few decades, the knowledge of richness patterns, width of geographical distribution and size of species are recurrent ideas in studies of ecology and biogeography. Many of them have revealed the existence of regularities, which are largely demonstrated in terrestrial ecosystems, being less abundant in aquatic ecosystems and species. It has been shown that these regularities are influenced directly by processes acting (or have acted) at large scale, even continental level. Macroecology, which can be considered a branch of ecology, has incorporated a new point of view in the assessment of life on Earth, not only descriptive but also methodological and mathematical.

The idea that organizational and functional processes are similar in aquatic and terrestrial ecosystems has generated interest in the research of unexplored groups, such as fish community. Currently, the large amount of data (FishBase, GBIF,...) allows to apply macroecologic approaches on fish, which are the most evolutionary success vertebrate group. From that perspective, advances in factors determining species richness, both in the marine and freshwater environment, as well as the width or rarity of their distribution or the role of the size of the species have been done. This communication present some results about freshwater species at regional and continental level, as well as the results obtained with new algorithms recently developed.

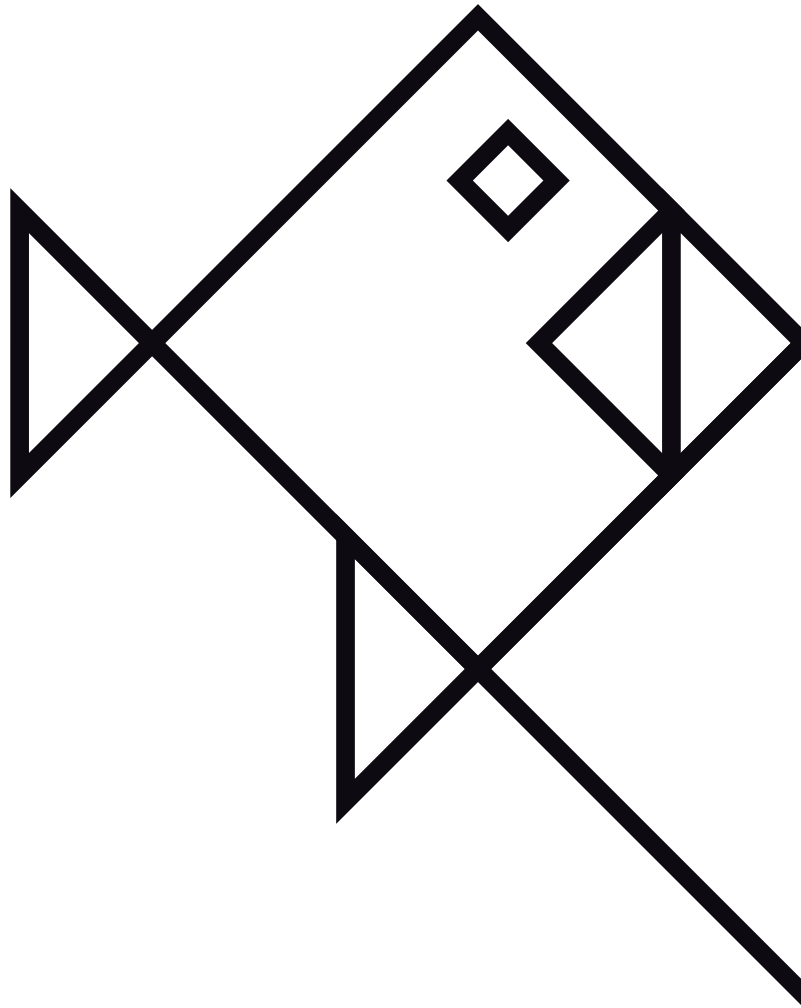


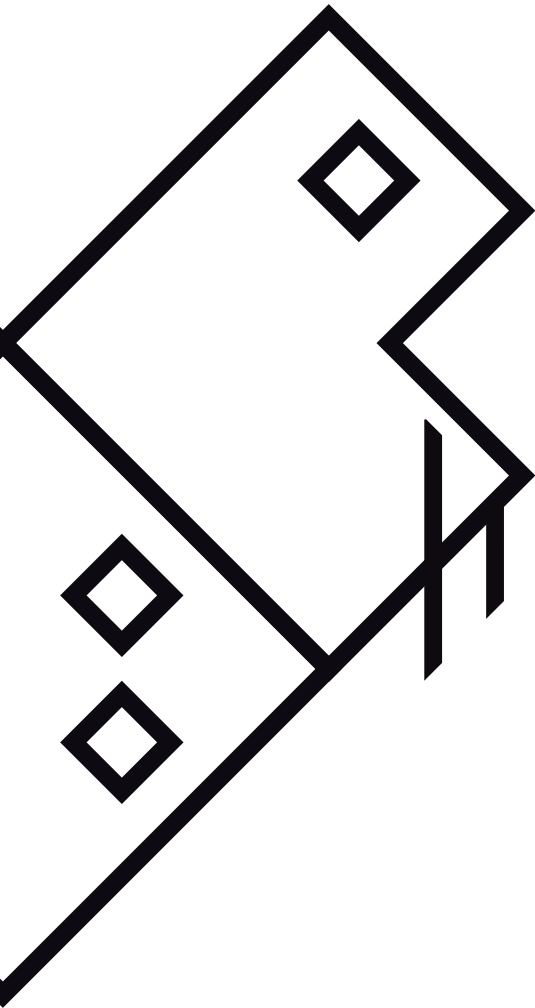
SIBIC2016

VI IBERIAN CONGRESS OF
ICHTHYOLOGY / MURCIA



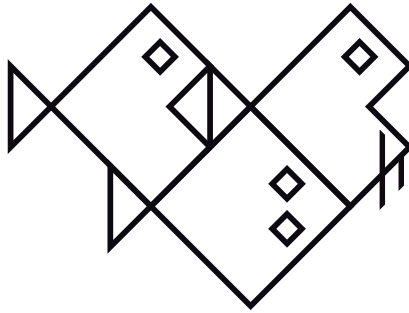
**ORAL
COMMUNICATIONS**





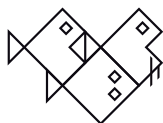
**ORAL
COMMUNICATIONS**

**MIGRATION,
CONNECTIVITY
AND REGULATED
RIVERS**



SIBIC2016

**VI IBERIAN CONGRESS OF
ICHTHYOLOGY / MURCIA**



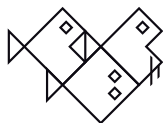
EVALUATE FOR UNDERSTANDING. THE CASE OF THE MOST ASSESSED FISHWAY IN SPAIN

Sanz-Ronda F.J., F.J. Bravo-Córdoba, J. Ruiz-Legazpi, J.F. Fuentes-Pérez, A. García-Vega, J. Valbuena-Castro & N.J. González-Alemán

U.D. Hidráulica e Hidrología, E.T.S.II.AA. Palencia (Universidad de Valladolid)
Grupo de Ecohidráulica Aplicada (www.gea-ecohidraulica.org).
Avda. Madrid 44, Campus La Yutera - aulario, 34004 Palencia, Spain
(escalasparapeces@gmail.com).

Human activities associated with irrigation, hydropower, flood control, etc. include placement of barriers on rivers. One of the most negative consequences is the change of longitudinal connectivity, particularly in the context of fish migrations. Depending on the type and height of obstacles and swimming ability of fish, some barriers avoid fish to reach feed or reproductive areas or delay their migration along the river. Fishways –*sensu lato*– can facilitate those upstream and downstream movements. Nevertheless, many managers assume that if the fishway is built, it works. Scientific hydraulic and biological evaluations are questioning this assumption in Iberian rivers. This research shows the importance of fishways evaluation to improve engineering design in a fish ladder placed in the middle reach of Tormes River, just upstream of Santa Teresa reservoir (Salamanca, Spain).

This fish ladder has a pool and weir with bottom orifice structure to let potamodromous fish (Iberian barbel –*Luciobarbus bocagei*–, Northern straight-mouth nase –*Pseudochondrostoma duriense*– and brown trout –*Salmo trutta*–) overcome a dam of 13 m high. All complex is being monitored since 2012 using different techniques: daily trapping and counting fish that reach the uppermost pool; fish passage video recording through orifices and notches; tagging fish (PIT, T-bar and others) and studying passage metrics (location, entrance, passage time, fishway performance). Upstream migration has been analyzed as a function of physical –flow discharge, water temperature, atmospheric pressure– and biological –species, sex, size, competition– variables. Downstream migration is also analyzed to locate fish routes and understand fish behavior. After every research, passage improvement options are detected, accomplished and assessed on next migration season. At this moment, this overall approach increased fish ladder efficiency and it offers important information about Iberian fish behavior and their preference under different environmental conditions.



LOCAL AND GLOBAL CLIMATE DRIVERS OF ATLANTIC SALMON DECLINE IN SOUTHERN EUROPE

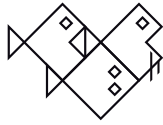
Nicola G.G.¹, B. Elvira², D. Ayllón³ & A. Almodóvar²

1 Department of Environmental Sciences, University of Castilla-La Mancha (UCLM), 45071 Toledo, Spain (graciela.nicola@uclm.es).

2 Department of Zoology and Physical Anthropology, Complutense University of Madrid (UCM), 28040 Madrid, Spain (aalmodovar@bio.ucm.es; belvira@bio.ucm.es).

3 Department of Ecological Modelling, Helmholtz Centre for Environmental Research - UFZ, 04318 Leipzig, Germany (daniel.ayllon@ufz.de).

The abundance of Atlantic salmon *Salmo salar* has dramatically declined in recent decades in almost all Europe. Further, it is expected that global warming will move northwards its thermal niche, with a decreased production and population extinction in the southern part of the distribution area. The species is of great economic and conservation importance; however, lack of understanding about the factors responsible for this decline is an obstacle to rational management. Local (freshwater habitat) and global (marine habitat) factors other than marine fisheries are likely contributing to continued low abundance of wild populations. Here, we analyze long-term population data (1949-2011) from one salmon fishery in Northern Spain (River Sella), using catch as a proxy for abundance. Our aim was to assess whether ongoing climate change is influencing the population decline through local and global factors. The analysis of 63 years of abundance data by time-series ARIMA models indicated a significant downward trend and a pronounced decline of returning salmon from 1973-1974. The time-series analysis of local (air temperature) and global (global land-ocean temperature index) temperature showed a significant upward trend and an abrupt shift in 1974-1975. The observed warming was negatively related to population abundance. Moreover, a gradual increase in the magnitude and duration of extreme water conditions dating from the 1970s was also detected. Indicators of extreme flow events were related to the abundance of returning fish. The observed warming and the prevalence of extreme flow events are associated with an ongoing population decline, most likely caused by a loss of suitable freshwater thermal habitat, a failure in recruitment and detrimental effects on marine performance. Empirical evidence is provided on how the interplay between local and global climate factors is actually driving the population decline of Atlantic salmon in Southern Europe.



WHEN AND WHY DO FRESHWATER FISH MIGRATE? OBSERVATIONS FROM THE IBERIAN PENINSULA

Ordeix M.¹ & F. Casals²

1 CERMA, Center for the Study of Mediterranean Rivers - Ter River Museum. Passeig del Ter, 2. 08560 Manlleu, Catalonia (marc.ordeix@museudelter.cat).

2 Department of Animal Production, Lleida University. Campus ETSEA – Edifici 1. Av. Alcalde Rovira Roure, 191. 25198 Lleida, Catalonia (fcasals@prodan.udl.cat).

This gives an *overview* of the periods and possible reasons associated to fish migration in Iberian freshwaters. The objective was to know fish migration basis to justify the promotion of connectivity improvements (dam removal and/or fish passages projects) in rivers, lakes and coastal lagoons, and their effective management.

We collected a significant portion of the available information (publications and databases) of fish passage assessments and freshwater fish biology and ecology, of the migrating and spawning periods and other possible associated causes to the migrations, from the whole Iberian Peninsula.

Almost all Iberian freshwater fish (95.7%; 66 species from 17 families) clearly migrate. The great majority are potamodromous species (70.0%; 49 species from 6 families), and also include diadromous species (25.7%; 18 species from 9 families); subdivided as anadromous (10 sp.) and catadromous (8 sp.).

Migratory movements for most of the fish are also important in and out of the spawning period, all around the year, at least, for feeding and refuge –except during the coldest months for several species-. A combination of inner and environmental factors is associated to fish migration behaviour.

Most of spawning and other migration movements of Iberian freshwaters fish are quite extensive and also often vary between different years. Combining the various present species in each river, it covers all or practically all the year. So, Iberian -and other Mediterranean- rivers, lakes and coastal lagoons should be always connected –without transversal obstacles- or fish passages should be always in operation.

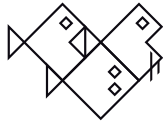


A PIONEER FISHERIES COMPENSATION PROGRAM TO REPLACE THE LOSS OF A RIVER SEGMENT BY DAMMING

Cortes R.M.V., S.G.P. Varandas, J.B. Jesus, V. Pereira, M. Lopes & C. Santos.

Centro de Investigação em Tecnologias Agro-ambientais e Biológicas (CITAB), UTAD, Quinta de Prados, 5000-911 Vila Real, Portugal (rcortes@utad.pt).

This work reports a compensatory measure derived from the regulation of the lower part of River Sabor, the last Portuguese wild river. The effect created by damming affects intensively cyprinid species, in particular the Iberian barbel (*Luciobarbus bocagei*) and the Northern straight-mouth nase (*Pseudochondrostoma duriense*). This is a pioneer compensation measure since the objective is, after all, to recreate a similar habitat for cyprinid species that may replace the lost segment of R. Sabor by another water course, R. Vilarça, a lower order stream in its vicinity, but impoverished by agricultural practices. A whole integrate program took place: riparian gallery was enhanced as well as fish habitats (lunkers disposal for shelter), introduction of riffle/run sequences by submersed weirs, bank reinforcement using bioengineering and, finally, a supplementary flow was diverted into R. Vilarça through the construction of an adduction system that collects water from Sabor reservoir. This study assessed the efficiency of this device, but also the global physical rehabilitation, particularly during the reproduction period for the mentioned taxa during the 1st year of the monitorization program. Multivariate analyses showed that current and depth were the environmental factors that explained mostly spatial patterns of fish distribution. Preference curves of type II for barbel (the dominant species) were computed for these 2 variables to determine the optimal conditions for the reproducers in order to settle to convenient flow that has to be diverted by the adduction. By releasing successive incremental flows into R. Vilarça from 0.57 m³/s (natural flow) to 2.5 m³/s it was possible to define the convenient discharge, which could maximize the optimal depth and current. It was also possible to observe that additional flow a caused quick stimulus to fishes, and that the proposed flow (around 1.5 m³/s) allowed the fishes to transpose the installed weirs and to reach the spawning areas.



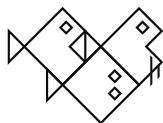
ANALYSING THE NATIONAL STRATEGY FOR RIVER RESTORATION: DAMS AND RIVERS CONNECTIVITY

Rodeles A.A., D. Galicia & R. Miranda

Department of Environmental Biology. University of Navarra. 31008 Pamplona (Navarra). Spain
(aangulo@alumni.unav.es).

Freshwater fish is one of the most endangered vertebrate groups of the world due to the increasing anthropogenic stress rivers endure. However, little attention has been given to the study of its biology, threats and conservation. The Iberian Peninsula has a high freshwater fish biodiversity and endemism and a long history of threats, which make it one of the most interesting European regions for the study and conservation of river ecosystems. One of the main threats to Iberian freshwater fishes is habitat fragmentation caused by dams. During the 20th century in Spain more than 1000 big dams and thousands of weirs have been built, altering river dynamics and causing the decline of numerous fish species. To restore and preserve the river ecosystems and their biodiversity, the Spanish Ministry of Agriculture, Food and Environment started the National Strategy for River Restoration (NSRR) with the aim of improve the water and sediment flow and restore the longitudinal connectivity of rivers.

Under the NSRR more than 170 dams and weirs of all Spain have been removed. Crossing data from the Iberian Society of Ichthyology, the NSRR and information from official entities, we analysed the direct implications of the national strategy from the point of view of river connectivity. Using ArcGIS geometric network tools we analysed the hydrological network's topology affected by the fragmentation impact of dams and weirs. The average longitude of liberated stretches varied considerably among river basins, although results are deeply affected by the public information available. Also, the biological data available for the affected courses allowed us to explore the role of fish communities on the underlying causes that drive the selection of dams for removal. Unfortunately, facts show that these species are rarely taken into account in the ecological evaluation of rivers.



APPLICATION OF A NEW PRACTICAL METHODOLOGY TO ASSESS FISHWAYS IN THE SEGURA RIVER BASIN

Valbuena-Castro J., F.J. Sanz-Ronda, F.J. Bravo-Córdoba, J. Ruiz-Legazpi & A. Martínez de Azagra-Paredes

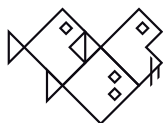
U.D. Hidráulica e Hidrología, E.T.S.II.AA. Palencia (Universidad de Valladolid) Grupo de Ecohidráulica Aplicada (www.gea-ecohidraulica.org) Avda. Madrid 44, Campus La Yutera - aulario, 34004 Palencia, Spain (jvalbuena@forest.uva.es).

There are a lot of different obstacles on the watercourses all around the world. These obstacles affect and prevent the movements of fish fauna. One of the most frequent solutions to solve this problem is the construction of fish passes. Although that a lot of them exist, just some have been assessed and so the functionality of most of them is not really known.

In order to increase the knowledge about how these structures work, Duero River Authority (CHD), the Ecohydraulic Applied Group (GEA), University of Valladolid (UVa) and Itagra Technological Center (Itagra.ct) are developing a technical methodology to assess stepped fishways.

This methodology considers 38 variables about design, topographical and constructive parameters that are scored with tables and graphics according to scientific references and many field experiences on this topic. Of these variables, 22 are necessary for a complete assessment while the other 16 are complementary. The methodology allows to quantify the suitability for fish of the attraction, entrance, passage, exit and all the device together according to fish swimming capabilities, and establishes if that fish pass needs improvements or works properly from a hydraulic point of view.

In addition, the methodology will be applied to most of the stepped fish ladders in the Segura river basin to assess their functionality and knowing the improvements that they need. This will help to guarantee one of the most important objectives of the project LIFE+ SEGURA RIVERLINK (LIFE12 ENV/ES/1140) that is the longitudinal connectivity in this basin.



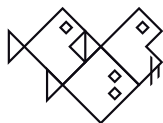
PRELIMINARY DATA OF THE FISH-BASED ASSESSMENT IN THE LIFE+ SEGURA-RIVERLINK

Sánchez-Pérez A.¹, F.J. Oliva-Paterna¹, J.M. Zamora-Marín¹, F. Amat-Trigo¹, A. Zamora-López¹, J.M. Franco¹, F.J. Bravo-Córdoba², A. Ruiz-Navarro¹, F.J. Sanz-Ronda² & M. Torralva¹

1 Departamento de Zoología y Antropología Física. Facultad de Biología. Universidad de Murcia (ana.sanchez15@um.es).
2 U.D. Hidráulica e Hidrología. ETS.II.AA. Palencia. Universidad de Valladolid.

The LIFE+ Segura-Riverlink is a project which aims to promote and support the recovery of fluvial connectivity in a sector of more than 50 km long in the Segura River. Its main purpose is to validate management measures for the development of a *Green Infrastructure* (GI) approach into the context of Mediterranean river basins characterized by high impacts. The project will recover the longitudinal connectivity removing a significant number of artificial barriers to restore fish passage and will also support other best practices of riverine restoration. Restoration actions will include the removal of small weirs and the construction of effective fish passage systems. Monitoring will assess the performance of these actions with the hope of validating the *GI* approach to river basin management and its possible extension to the official management programmes. The initial fish-based assessment was completed with baseline data showing a worrying conservation status of *Luciobarbus sclateri*, the target species of the project.

Since September 2015, six fish passes [Natural-like fishways (bypass and rocky-ramp) and Technical fishways (vertical-slot fishway)] have been implemented. During the next two migration periods we are going to evaluate the effectiveness of each fishway. Two main fish-based assessment programs have been developed. The first one focused on the fish assemblage and populations, and the second is a specified mark-recapture program. About 500 *L. sclateri* individuals larger than 25 cm length were marked since November 2014 with high recapture values at local scale downstairs of weirs. The occurrence of *L. sclateri*, *Gobio lozanoi* and *Pseudochondrostoma polylopes* individuals has already been confirmed into the implemented nature-like fishways.



DEVELOPMENT OF A FISH BEHAVIOURAL BARRIER: RESULTS OF THE ACOUSTIC STIMULI, LIGHT AND BUBBLE CURTAINS EFFECTS ON NATIVE SPECIES (*Salmo trutta*, *Pseudochondrostoma duriense* AND *Luciobarbus bocagei*)

De Jesus J.^{1,3}, A. Teixeira², R.M.V. Cortes¹, S. Natário³, C. Amorim⁴, P. Fonseca⁵, D. Costa³, J. Carrola¹, S. Varandas¹ & L.T. Pereira¹

1 CITAB- Centre for the Research and Technology of Agro-Environmental and Biological Sciences, University of Trás-os-Montes e Alto Douro, Quinta dos Prados, 5000-911 Vila-Real, Portugal (jjesus@utad.pt; rcortes@utad.pt; João@utad.pt; simonev@utad.pt; tpereira@utad.pt).

2 CIMO- ESA-IPB- Mountain Research Centre, School of Agriculture, Polytechnic Institute of Bragança, Campus de Santa Apolónia, CP 1172, 5301-855 Bragança, Portugal (amill@uatd.pt).

3 OriginAL Solutions, Estrada do Cando, nº 40, 5400-010 Chaves, Portugal (joaquimbarreira@gmail.com).

4 ISPA – Unidade de Investigação em Eco-etologia, Rua Jardim do Tabaco, nº34 1140-041 Lisboa, Portugal (amorim@ispa.pt).

5 Departamento de Biologia Animal e Centro de Biologia Ambiental, Faculdade Ciências, Universidade de Lisboa, 1749-016 Lisboa. Portugal (pjfonseca@fc.ul.pt).

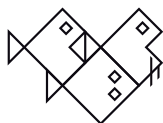
The use of acoustic or luminous stimuli, as a repulsive effect for fishes, allows for the development of behavioral selective barriers directed to their protection, both in steering them away from the hydraulic structures of dams and in guiding them to fish passages or substitution habitats. Both in an isolated and in a combined way, acoustic (Sweep-up: 0-2000Hz) and luminous (Strobe Light: 600 flashes/minute) stimuli, as well as a bubble curtain, were tested on *Salmo trutta*, *Pseudochondrostoma duriense* and *Luciobarbus bocagei*.

In the tests performed with isolated stimuli, a high repulsive sensitivity to the luminous stimulus has been verified in the Salmonid species, while the Cyprinid species showed higher sensitivity to the acoustic stimuli. The bubble curtain, in isolation, has not shown behavioral sensitivity in any of the species.

In the tests performed in a combined acoustic/light/bubbles way (behavioral barrier), all species showed similar and elevated repulsive sensitivities.

These results show the great potential of behavioral barriers for fishes based on combined systems acoustic/light/bubbles, especially in Salmo-Cyprinid water courses.

The development of behavioral barriers adapted to autochthonous freshwater species of Portugal is an important tool to guarantee the fish migration, considering the upstream and downstream movement of threatened potamodromous species near the dams. These systems will provide conditions to guide fish to fish passages (fishways, fishlifts) and repel from specific structures (channel turbines, pumping systems) avoiding the massive mortality detected in several dams and contributing to the conservation of autochthonous fish populations in regulation rivers.



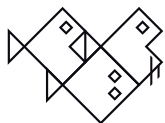
GONADSOMATIC INDEX IN IBERIAN BARBEL (*Luciobarbus bocagei*) AND NORTHERN STRAIGHT-MOUTH NASE (*Pseudochondrostoma duriense*) AT THE TIME OF MIGRATION AND FISHWAY PASSAGE IN TORMES RIVER (SALAMANCA)

González-Alemán N., F.J. Sanz-Ronda, F.J. Bravo Córdoba & J. Ruiz-Legazpi

U.D. Hidráulica e Hidrología, E.T.S.II.AA. Palencia (Universidad de Valladolid) Grupo de Ecohidráulica Aplicada (www.gea-ecohidraulica.org) Avda. Madrid 44, Campus La Yutera - aulario, 34004 Palencia, Spain (ngonzalezaleman@yahoo.es).

Iberian Barbel (*Luciobarbus bocagei*) and northern straight-mouth nase (*Pseudochondrostoma duriense*) are species belonging to the Cyprinidae Family and both migrate in many Iberian rivers. We determined the condition of sexual maturity for both species, using Vazzoler's visual characters, and other parameters such as sex, age and fertility. Gonadosomatic Index (GSI) at the moment of their passage along San Fernando's fishway was also established. The analysis was performed with 60 random samples (8 ma and 12 f of *L. bocagei*; 12 m, 23 f and 5 indeterminates of *P. duriense*) and 23 ovaries were analyzed (11 of *L. bocagei* and 12 of *P. duriense*). The average ratio female: male for the study was 1:0.52 for *P. duriense* and 0.6:1 for *L. bocagei*. During migration the highest GSI for *L. bocagei* occurred in the second half of June, for *P. duriense* was in the second half of May. The sample of *P. duriense* had an average Furcal Length (FL) of 16.53 cm, 5 age classes and an average number of oocytes of 2318, with a diameter of 1.89 +/- 0.10 mm: C.L. 95 %. For *L. bocagei* the average FL was 34.72 cm with 7 age classes and an average number of oocytes of 18393, with a diameter of 2.20 +/- 0.07 mm: C.L. 95 %.

The relationship between FL and Absolute Fecundity (AF) in *L. bocagei* can be represent by the quadratic model: $AF = \sqrt{-1.41E9 + 1.316E6FL^2}$ and $r^2 = 0.903$ in case of *P. duriense* the linear model: $AF = -1387.87 + 13.2783FL^2$ and $r^2=0.195$ was the best fit. The relationship between FL and total weight (W) was explained by the potential model $W = a * FL^b$, for both species, in the case of *L. bocagei* the model explained 94.1% of weight variability and *P. duriense* explained 90.1%. The Condition Factor (K) was 1.15 g/cm³ for *L. bocagei* and 1.16 g/cm³ for *P. duriense*. The values of the GSI at the time of passage by the fishway for both species exceeds 50% of the sample in EM III (mature). In *L. bocagei* the maximum IGS (11.4) is given and end of June, while in *P. duriense* happened late May (IGS = 29.3). The difference between P and weight of the gonad to *L. bocagei* was 11.47% in females and 1.5% in males, and for *P. duriense* was 7.92% in females and 2.92% in males. Every gram that increases the weight of the Female represents 374 oocytes potential for *L. bocagei* and 138 for *P. duriense*.



EFFECTS OF FLOW REGULATION ALONG LONGITUDINAL GRADIENT ON SIZE-RELATED METRICS OF FISH POPULATIONS FROM A MEDITERRANEAN BASIN

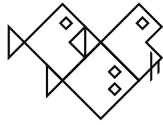
Amat-Trigo E., M. Torralva, A. Sánchez-Pérez, A. Ruiz-Navarro & F.J. Oliva-Paterna

Departamento de Zoología y Antropología Física, Facultad de Biología, Universidad de Murcia, Murcia, Spain (fatima.amat@um.es).

Population size structure of fish is considered an important ecosystem health indicator and can be used in fish management. The main goal of the present study was to assess how hydrological flow variability along the longitudinal gradient affects population size structure metrics of four fish species widely distributed in the Southern Iberian Peninsula, *Luciobarbus sclateri*, *Gobio lozanoi*, *Alburnus alburnus* and *Lepomis gibbosus*.

Populations were analysed at site level (29 sampling sites) along the longitudinal gradient in the main rivers of the Segura River basin, which is a highly regulated basin. A total of 4825 specimens (1560 *L. sclateri*, 1280 *G. lozanoi*, 1636 *A. alburnus* and 349 *L. gibbosus*) were caught during autumn and were measured in situ for length. Somatic condition and eleven population size metrics (number of size classes, size diversity and mean, maximum, minimum, size range, variance, coefficient of variation, 95th percentile, skewness and kurtosis of Fork Length) were examined.

Somatic condition and population size metrics significantly differed at site level and at sector level in each species. Sampling sites directly influenced by a potential refuge of the large reservoirs showed a higher variance in the population size structure of *A. alburnus* and *L. gibbosus*, but less variance in the *L. Sclateri* and *G. lozanoi* populations. *G. lozanoi* presented higher levels of somatic condition in river sectors with more mean daily base flow, flow variability and mean temperature while *L. Sclateri* showed populations with mayor size diversity and mean length. In fact, flow regulation and the presence of fish refuges to higher discharges have been shown as significant factors to explain the variability in several population size metrics. Size-related metrics at population levels can demonstrate trends in fishes at basin scale, however, the relationships with spatial gradients and the species-specific response could make it a difficult undertaking.



ECOFLOW – A MULTI-SCALE APPROACH TO THE EFFECTS OF FLOW REGULATION IN PORTUGUESE RIVERS

Alexandre C.M.^{1*}, P.R. Almeida^{1,2}, C.S. Mateus¹, J.L. Costa^{1,3}, A.F. Belo¹, E. Pereira¹, A. Rato¹, R. Monteiro¹ & B.R. Quintella^{1,3}

1 MARE – Centro de Ciências do Mar e do Ambiente, Portugal (cmalexandre@fc.ul.pt).

2 Departamento de Biologia, Escola de Ciências e Tecnologia, Universidade de Évora, Largo dos Colegiais 2, 7004-516, Évora, Portugal.

3 Departamento de Biologia Animal, Faculdade de Ciências da Universidade de Lisboa, Campo Grande, 1749-016, Lisboa, Portugal.

The exploitation of hydroelectric infra-structures is responsible for changing the natural flow regime of rivers, generally increasing their irregularity and causing significant alterations on the aquatic communities. The main objective of the project “ECOFLOW – Ecological impact of the flow regime on the fish community of Portuguese rivers” was to evaluate, at a multiscale level, the impact of stream flow alterations on the typical freshwater fish community of Portuguese watercourses. More specifically, the study aimed to assess regulation effects from the assemblage to the population and individual levels by: i) comparing species composition and structure of fish assemblages inhabiting non-regulated and regulated rivers; ii) analyzing the effects of short-term flow regulation on the home range and seasonal movement patterns of a cyprinid species, the Iberian barbell *Luciobarbus bocagei* (Steindachner, 1864); and iii) evaluating the fine-scale behavior, muscular activity and habitat use of the Iberian barbel in relation to peaking flows. Electrofishing campaigns in non-regulated and regulated rivers identified a higher abundance of exotic and limnophilic fish species in the non-regulated river and of eurytopic in the regulated one. A year-long radio-telemetry study on #30 Iberian barbels from regulated and non-regulated rivers showed that fish inhabiting the river regulated for hydroelectrical purposes had a larger and more continuous home and core ranges, together with an altered seasonal movement pattern. The continuous monitoring of #11 barbels tagged with ElectroMioGram (EMG) radio-transmitters, connected to barbels’ red muscle, revealed a reduction of barbels’ level of muscular activity during hydropeaking periods associated to a selection of marginal habitat with higher refuge value. This study provides suitable and integrated information that can be applied in management programs that aim to protect and restore natural flow variability in regulated river ecosystems.



NEGOTIATION OF SMALL WEIRS BY POTAMODROMOUS CYPRINIDS: THE EFFECT OF WATERFALL HEIGHT, PLUNGE POOL DEPTH AND FLOW DISCHARGE

**Amaral S.D.¹, P. Branco¹, A.T. Silva², C. Katopodis³, T. Viseu⁴, M.T. Ferreira¹, A.N. Pinheiro⁵
& J.M. Santos¹**

1 Centro de Estudos Florestais, Instituto Superior de Agronomia, Universidade de Lisboa, Tapada da Ajuda, 1349-017 Lisboa, Portugal (samaral@isa.ulisboa.pt).

2 Norwegian Institute for Nature Research, P.O Box 5685 Sluppen, 7485 Trondheim, Norway.

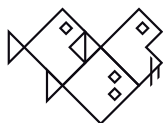
3 Katopodis Ecohydraulics Ltd., 122 Valence Avenue, Winnipeg, MB, R3T 3W7, Canada.

4 Departamento de Hidráulica e Ambiente, Laboratório Nacional de Engenharia Civil, Avenida do Brasil 101, 1700-066 Lisboa, Portugal.

5 CERis – Civil Engineering for Research and Innovation for Sustainability, Instituto Superior Técnico, Universidade de Lisboa, Avenida Rovisco Pais, 1049-001 Lisboa, Portugal.

With the increasing number of dams and small hydropower stations there has been a growing awareness for the problem of river fragmentation. Numerous studies have been carried out so as to mitigate the impacts of those infrastructures on fish populations and re-establish connectivity. Still, the impacts on the river system caused by the presence of small weirs, that are far more numerous than dams, have received much less attention for being considered as small barriers *a priori* permeable to fish movements. However, small weirs may lead to connectivity losses due to the creation of vertical drops that alters water depths and velocity patterns, changing the hydraulic environment both upstream and downstream the weir.

This study aims to evaluate the upstream passage performance of a potamodromous cyprinids, the Iberian barbel (*Luciobarbus bocagei*), when facing an experimental small broad-crested weir, considering the interaction of three key hydraulic variables: waterfall height (Δh), plunge pool depth (D), and flow discharge (Q). A total of 16 configurations were initially tested considering the combination of waterfall height ($\Delta h = 5, 10, 15, 25$ cm) and plunge pool depth ($D = 10, 20, 30, 50$ cm) at a constant flow discharge of 50 L.s⁻¹. Posteriorly, 3 new discharges ($Q = 25, 75, 100$ L.s⁻¹) were implemented on the configuration that had the highest passage success. Hydraulic environment downstream of the weir was characterized with a 3D Acoustic Doppler Velocimeter, to help understand weir negotiation behaviour of fish. Results demonstrated that all variables were significantly correlated with the number of successful fish passages. Counter-intuitively, increased passage did not occur at higher plunge pool depths combined with lower waterfall height and low discharge. Therefore, upstream passage appears to be a complex phenomenon, which is strongly dependent on the hydraulic environment that is formed by the interaction of these variables.



PRODUCTION OR ESCAPEMENT OF SILVER EELS?

Domingos A.I.^{1,2}, R. Monteiro¹, T. Pereira³, C. Alexandre³, J.L. Costa^{1,2}, P.R. Almeida^{3,4} & B. Quintella^{2,3}

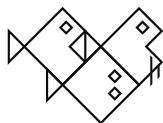
1 MARE - Centro de Ciências do Mar e do Ambiente, Faculdade de Ciências, Universidade de Lisboa, Lisboa, Portugal.

2 Departamento de Biologia Animal, Faculdade de Ciências, Universidade de Lisboa, 1749-016 Lisboa, Portugal (idomingos@fc.ul.pt).

3 MARE - Centro de Ciências do Mar e do Ambiente, Universidade de Évora, Évora, Portugal.

4 Departamento de Biologia, Escola de Ciências e Tecnologia, Universidade de Évora, Largo dos Colegiais 2, 7004-516 Évora, Portugal.

The advice of the ICES on the need to set a protection and restoration plan to stop the declining trend of the European eel stock was the trigger for the European Commission to create a regulation establishing measures for the recovery of the population. To comply with Regulation (EC) N° 1100/2007, Member States had to set a recovery plan that included measures to reduce anthropogenic mortality and guarantee the escapement to the sea of at least 40% of the silver eel biomass relative to the pristine situation, when there was no impact on the stock. Most assessments of the success of measures set in the Eel Management Plans (EMP) have however, been focused on production estimates which leads to an overestimation of real escapement. Recently, there has been some concern about the effectiveness of measures to recover the population because most assessments are based on indirect measures of escapement. Hence, a study using mark-recapture and telemetry techniques was conducted in 2014, in River Mondego basin in order to estimate the real number of silver eels that are successful in escaping to the sea. Silver eel escapement measured in this study indicates that only 30% of silver eel production succeeds in reaching the sea, suggesting mortality factors occurring along the river course are not being considered. In conclusion, management measures set to reach the target of 40% of silver eel escapement should be reviewed and a monitoring plan should be set to measure escapement.



MIGRATORY PATTERNS OF EELS IN THE ESTUARY OF THE GUADALQUIVIR RIVER (SOUTH OF SPAIN)

Fernández-Delgado C.¹, R.J. De Miguel¹, R. Moreno-Valcárcel¹, H.S. Dean^{1,2}, C. Arribas¹, S. Rubio³, M.D. González-Manga³ & M. Herrera¹

1 Departamento de Zoología. Edificio Charles Darwin. Campus de Rabanales. Universidad de Córdoba. 14071 Córdoba. Spain (carlos.fdelgado@uco.es).

2 School of Bioscience, Cardiff University, Cardiff, CF10 3AX, United Kingdom.

3 Agencia de Medio Ambiente y Agua. C/ Johann G. Gutenberg 1, 41092 Sevilla.

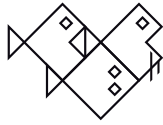
We present preliminary results of the two most important migratory events displayed by the eel (glass-eel recruitment and silver eel migration) in the most important estuarine area of Andalusia. This information forms part of the Eel Management Program developed by the Andalusian Environmental Regional Agency.

Glass-eel samples were taken monthly (January'13-May'15) over 72 hours using a boat and three nets. Each of the 16177 glass-eels captured were processed and included in one of the eight maturation stages (*sensu* Elie).

On the other hand, samples used to study the silvering process were obtained weekly (October'13-May'14) from commercial landings in 3000 hectares of marshlands devoted to extensive aquaculture production. 5812 specimens were processed and included in one of the six maturation stages established (*sensu* Duriff).

Mean TL for glass-eel samples was 64.87(mm) and mean mass was 0.2416(g). Mass-length relationship was: $M(g)=1.87 \cdot 10^{-6} \cdot TL(mm)^{2.81}$. Most of the glass-eels were included in the stage VA (10.9%) or VB (88.6%). Maximum migratory events varied between four-five months (December-February/March; 2014-15) or six months (January-June; 2013-14). Specimens entering during the peaks of the recruitment showed the highest condition. Migration density was related to low values of water temperature, salinity and water velocity.

Mean TL for silver males and females(FV) was 605.89mm and 408.7mm respectively. Mass-length relationship was: $M=8.68 \cdot 10^{-7} \cdot TL^{3.107}$ (silver females) and $M=2.92 \cdot 10^{-6} \cdot TL^{2.905}$ (silver males). Maximum migratory specimens were observed in December coinciding with minimum values of photoperiod (580 minutes) and water temperature (11.6 °C). From this month migratory specimens progressively decreased until the minimum in June. Overall migrant and pre-migrant specimens accounted for 16.4% and 23.6%, respectively. Mean TL and condition of silver migratory individuals were maximum in December and progressively decreased as the migration period evolved, suggesting that individuals starting their migration route earlier are those with better physical conditions.



ARE MEDITERRANEAN SILVER EELS ABLE TO CROSS THE STRAIT OF GIBRALTAR?

Amilhat E.^{1,2}, K. Aarestrup³, E. Faliex^{1,2}, G. Simon^{1,2}, H. Westerberg⁴ & D. Righton⁵

1 Univ. Perpignan Via Domitia, Centre de Formation et de Recherche sur les Environnements Méditerranéens, UMR 5110, F 66860, Perpignan, France (faliex@univ-perp.fr).

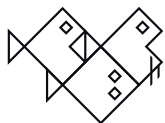
2 CNRS, Centre de Formation et de Recherche sur les Environnements Méditerranéens, UMR 5110, F 66860, Perpignan, France (faliex@univ-perp.fr).

3 Technical University of Denmark, National Institute of Aquatic Resources, Silkeborg, DK-8600, Denmark.

4 Swedish University of Agricultural Sciences (SLU), Institute of Freshwater Research, Drottningholm, SE-178 93, Sweden.

5 Centre for Environment, Fisheries and Aquaculture Science (CEFAS), Lowestoft, NR33 0HT, United Kingdom.

Despite improvement in marine species tracking technology, the migration route and the reproduction site of the European eel *Anguilla Anguilla* are still unknown. To date, only studies made on spawners from the Atlantic show evidence for a migration route towards the Sargasso Sea, the assumed reproduction site, but no one has ever documented an adult eel leaving the Mediterranean Sea. Here we show for the first time that European silver eels from Mediterranean Sea are able to cross the Gibraltar Strait and join the Atlantic Ocean. Eight female silver eels from South of France were equipped with pop-up satellite archival (PSAT) during the spawning migration season. They quickly establish characteristic Diel Vertical Migration (DVM) with mean depth of 371 m during the night and 563 m during the day. Most of the eels (at least 5) were predated in the Mediterranean Sea, either by a marine mammals or a non-lamnid shark. Two tags surfaced within the Atlantic Ocean after 6 months, period corresponding to the programmed time for tags' pop up, at 2157 km and 2296 km from their point of release respectively. We show that during the passage in the Strait the 2 eels stopped the DVM, progressively descending in the deep water, probably making advantage of the deep current exiting the Mediterranean Sea. Once in Atlantic they quickly re-established DVM with similar range of depth.



REHABILITATION OF RIVER MONDEGO FOR DIADROMOUS FISH: AN INTEGRATED APPROACH

Quintella B.R.^{1,2}, C.S. Mateus¹, C.M. Alexandre¹, I. Domingos^{1,2}, J.L. Costa^{1,2}, A.F. Belo¹, E.D. Pereira¹, P.M. Félix¹, R. Monteiro¹, A. Telhado³, F. Quadrado³ & P.R. Almeida^{1,4}

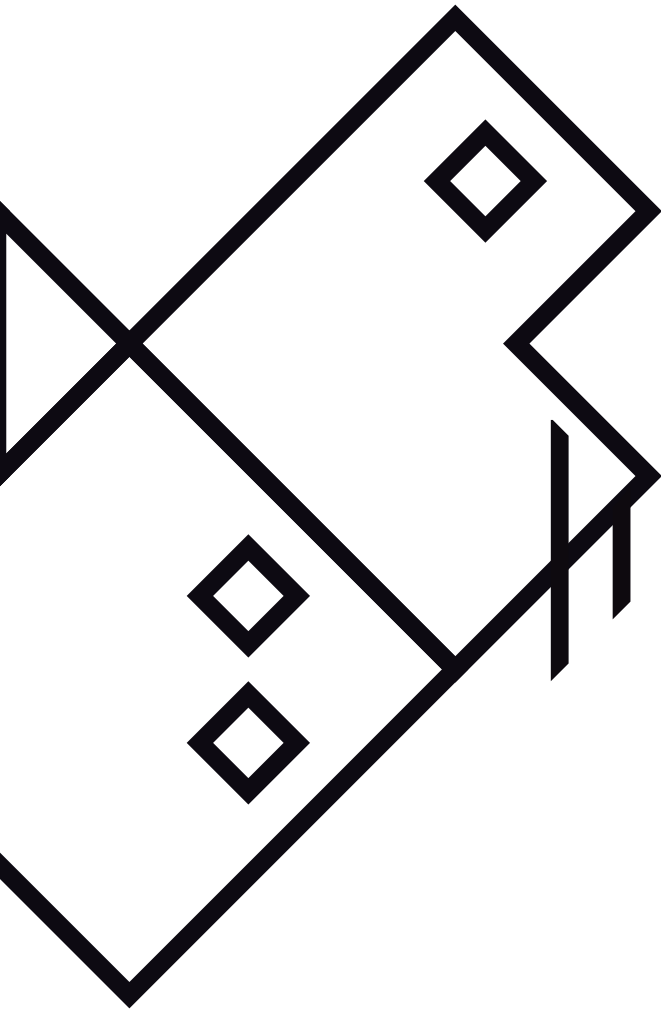
1 MARE – Centro de Ciências do Mar e do Ambiente, Portugal (bsquintella@fc.ul.pt).

2 Departamento de Biologia Animal, Faculdade de Ciências, Universidade de Lisboa, Campo Grande, 1749-016, Lisboa, Portugal.

3 Departamento de Recursos Hídricos, Agência Portuguesa do Ambiente, I.P., Rua da Murgueira, 9/9A - Zambujal Ap. 7585, 2610-124 Amadora, Portugal.

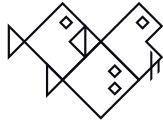
4 Departamento de Biologia, Escola de Ciências e Tecnologia, Universidade de Évora, Largo dos Colegiais 2, 7004-516 Évora, Portugal.

An integrated management approach is being applied in the Mondego River Basin, as a pilot basin, to promote the compatibility between the conservation of migratory fish. This is an important Portuguese basins for diadromous species, such as *Petromyzon marinus*, *Alosa alosa*, *Alosa fallax*, and *Anguilla anguilla*. Most of the management measures were to recover the longitudinal connectivity for fish migrations. The rehabilitation of River Mondego was boosted by the construction of a vertical slot fish pass at the Coimbra Açude-Ponte dam carried out in 2011 by the Portuguese Environmental Agency. During 2015, nature-like fish passages were installed in five small weirs located in the main stretch of Mondego River. Additionally, the construction of an eel passage (the first installed in Portugal) and experimental restocking actions using glass eels were assessed to promote the recovery of the eel population inhabiting this watershed. Several biotelemetry techniques (PIT antenna system, radio, acoustic and EMG telemetry) are being used to study the spawning migrations, which include the assessment of their behaviour when facing the obstacles and when negotiating distinct types of fish passes. Important data was collected to date, like for example the passage efficiency of the fish pass solutions that were installed and the fine-scale behaviour of the species when negotiating these infrastructures; 30% of the tagged silver eels manage to escape to sea; among other relevant information. Since the beginning of the restoration actions, abundance of sea lamprey larvae in the upstream reaches increased considerably, up to a 30 fold increase when compared with the pre-operational reference situation. An important component of this pilot study was directed to fisheries management. Data gathered so far highlights the importance of implementing intermediate closed fishing seasons during the peak of anadromous spawning migrations to maximize the number of adults (sea lamprey and shads) that reach the upstream spawning areas. A long-term monitoring program is still ongoing.



**ORAL
COMMUNICATIONS**

**LIFE CYCLES,
ECOLOGY AND
CONSERVATION
OF FRESHWATER
FISHES**

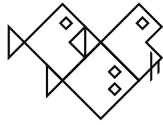


FISH OTOLITHS KEY TOOLS FOR BIOLOGICAL AND ECOLOGICAL STUDIES

Morales-Nin B.

IMEDEA CSIC/UIB, Miquel Marques 21, 07190 Esporles, Illes Balears, Spain (beatriz@imedea.uib-csic.es).

Implementation of ecosystem-based approaches to marine and freshwater management requires better knowledge of the life history of the exploited resources to support knowledge-based sustainable management and use. Calcified tissues have been employed since the XIX Century to gain knowledge about life traits, population structure and environmental relationships of fishes. The use of otoliths is based on their continuous growth along the life of the fish, their daily and seasonal growth rhythms and their incorporation of trace elements on their composition that reflects the environmental and diet characteristics experienced by the fish. My aim is to encourage the use of otoliths by means of showing some examples of studies carried out with different techniques and applications of otolith-based analysis in ecology, management, and conservation. I will shown applications of otoliths microstructure and microchemistry to contribute to recruitment and connectivity studies of Mediterranean species.



EXOTIC FISH IN PYRENEAN HIGH MOUNTAIN LAKES: INTRODUCTION PROCESS AND CURRENT PRESENCE

Miró A. & M. Ventura

Centre d'Estudis Avançats de Blanes, Consejo Superior de Investigaciones Científicas (CEAB-CSIC), Accés a la Cala St. Francesc, 14, 17300 Blanes, Spain (alexestany@gmail.com).

Pyrenean high mountain lakes are naturally fishless due to natural barriers that have prevented the colonisation from lower streams. However, there have been numerous introductions of fish to such ecosystems, both in historical and recent periods.

The objective of this study was to reconstruct the historical process of fish introduction in all the 520 high mountain lakes >0.5 ha of the southern Pyrenees and, by Generalized Additive Models, to quantify which particular factors either environmental or anthropogenic, best explained their current distribution.

Unlike other high mountain regions, some lakes in the Pyrenees were exploited traditionally for trout cultivation and fishing. This activity started some centuries ago and lasted until the 1950s, affecting approximately 25% of the lakes. Since 1950, and similarly to other high mountain regions, a wave of modern introductions of exotic species has affected between 35% and 85% of the lakes, depending on the valley. In recent decades (since 1970s), minnows have also been introduced mainly as a result of recreational trout fishing with live-bait. By 2000, minnows were present in 27% of the studied lakes.

Before 1950, walking distance from nearby villages was the dominant factor explaining 29–60% of the variation in fish distribution, indicating that historical trout introductions were in lakes closer to human settlements. In contrast, with the onset of modern fish management that took place during the period 1960–2000, the most significant factors were both the management practices and lake characteristics which are likely related with the probability of survival of the fish populations. Trout presence was the most explanative variable of minnow presence (27%), and confirmed that recreational trout fishing is likely responsible for these introductions.



DISTRIBUTION, HABITAT AND CONSERVATION OF THE RELICT DADES TROUT IN THE HIGH ATLAS, MOROCCO

Clavero M.¹, J. Calzada², J. Esquivias³, B. Bizzi⁴, A. Verissimo⁵, V. Hermoso⁶, A. Qninba⁷ & M. Delibes¹

1 Estación Biológica de Doñana – CSIC. Americo Vespucio s/n, 41092 Sevilla, Spain (miguelito.clavero@gmail.com).

2 Departamento de Biología Ambiental y Salud Pública, Universidad de Huelva, 21071 Huelva, Spain.

3 ECOTONO s.c.a. Tramallol, C /Pasaje Mallol 22, 41003 Sevilla, Spain

4 Kasbah les Amis, Tamtatouchte, M'semrir, Morocco.

5 CIBIO - Research Center in Biodiversity and Genetic Resources, Campus Agrário de Vairão, Rua Padre Armando Quintas, 4485-661 Vairão, Portugal.

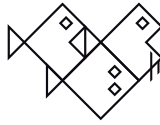
6 CEMFOR-CTFC, Forest Sciences Center of Catalonia, Solsona, 25280 Lleida, Spain

7 Département de Zoologie et Ecologie Animale, Institut Scientifique de Rabat, Université Mohammed V, Av. Ibn Battota, B.P. 703 Agdal, Rabat, Morocco.

Trout in the Dades and M'Goun rivers form a highly differentiated genetic lineage. Based on its genetic singularity, long-lasting isolation and morphological diagnostic features, the Dades trout was recently described as a new species, *Salmo multipunctata*. But very little is known about this singular trout, since all information available to the date comes from a few individuals captured at two localities. In August 2014 we sampled the whole potential habitat of the Dades trout in the Dades and the M'Goun rivers, analysed genetic samples and developed a complete assessment of its conservation status following IUCN guidelines.

The Dades trout inhabits a high-mountain area with difficult vehicle access, so most surveys were performed on foot, aided by mules. We sampled 37 sites above 1900 masl to find trout in 17 of them. The analysis of control region within the mitochondrial DNA confirmed the deep divergence of the Dades trout within the *Salmo trutta* complex, although the analysis of cytochrome b pointed towards a relative closeness to the Mediterranean trout lineage. Further genetic studies should clarify the relationships of *S. multipunctata* with other *Salmo* lineages. Dades trout occurrences were limited to an elevation range between 2150 and 2375 masl. Both the probability of occurrence and abundance of the Dades trout peaked at intermediate elevations within this range, although somatic condition of individuals increased linearly with increasing elevation.

The total distribution of the Dades trout is limited to no more than 22 km of stream channel, but at least 1/3 of this length is clearly suboptimal habitat. The species is highly threatened by global warming, since there are few permanent water courses above 2400 masl in the area. Therefore, we propose that the species should be considered as critically endangered (CR) and we propose management actions aimed at improving its conservation odds.



HIERARCHICAL BAYESIAN MODELLING OF SALMONID GROWTH USING 20 YEARS OF ELECTROFISHING DATA FROM NAVARRA: TEMPERATURE-DEPENDENCE?

Laplanche C.^{1,2}, P.M. Leunda³ & J. Ardaiz⁴

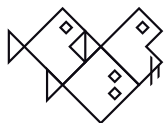
1 Université de Toulouse; INP, UPS; EcoLab (Laboratoire Ecologie Fonctionnelle et Environnement); ENSAT, Avenue de l'Agrobiopole, 31326 Castanet Tolosan, France

2 CNRS; EcoLab; 31326 Castanet Tolosan, France (christophe.laplanche@ensat.fr).

3 Gestión Ambiental de Navarra S.A., c/ Padre Adoallín 219 Bajo, 31013 Pamplona/Iruña, Navarra, Spain.

4 Gobierno de Navarra, Departamento de Desarrollo Rural y Medio Ambiente, c/ Gonzalez Tablas 9, 31005 Pamplona/Iruña, Navarra, Spain.

Growth is a fundamental trait of fish which is strongly interrelated to critical life history events. Fish length collected in removal sampling surveys is a widely-used practice to infer freshwater fish dynamics including growth. We test for the effect of temperature on riverine salmonid growth –presumed directly acting factor and expected to rise in alpine streams for the next decades due to global warming– processing 20 years of brown trout (*Salmo trutta*) removal sampling field data collected over 48 localities placed along a 100 km latitudinal gradient in Navarra, Northern Spain. Growth is predicted by an ordinary differential equation with age- and spatio-temporally structured growth parameters. Our implementation utilizes a hierarchical Bayesian model and we compare 15 competing models to statistically evaluate the level of significance of spatio-temporal variations of model growth parameters. Growth rate variations are essentially spatial and are modeled as the product of two components: the major one is positively correlated with watershed area ($r=0.72$; $p<10^{-8}$); a minor one reflects temperature suitability for growth. We rejoin other studies that identified factors connected to food intake as having a direct, strong effect on salmonid growth; temperature is of secondary importance. While the interest of net rate of energy intake models is ascertained, empirical models like ours appear as an essential tool to model salmonid growth at large spatio-temporal scales for fishery management.



RECRUITMENT DETERMINANTS IN STREAM-SPAWNING BROWN TROUT: THE IMPORTANCE OF DISCHARGE CONDITIONS DURING THE RECRUITMENT PROCESS

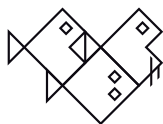
Lobón-Cerviá J.¹, G. Rasmussen² & E. Mortensen³

1 National Museum of Natural Sciences (CSIC). C/ José Gutierrez Abascal, 2. Madrid 28006 – SPAIN.

2 Technical University of Denmark. National Institute of Aquatic Resources. Vejlsøvej 39. Silkeborg 8600 – Denmark.

3 Deceased.

Recruitment is deemed to be a major determinant of year-class strength and population size. Elucidating factors underlying recruitment is central in ecological and fishery research. However, major difficulties to test hypotheses related to the role of density-dependent versus density-independent as determinant of recruitment is the need of long-term studies. The only two long-term studies available in the literature focused on the recruitment determinants of stream-spawning brown trout provided contradictory or opposing results. A compilation of eight long-term studies (> 15 years) encompassing four resident populations in tributaries of the Rio Esva (Spain); a lake-migratory and two sea-migratory populations in three tributaries of Gudenaa River (Denmark) and a sea-migratory population of northern England permitted a re-analysis. In all these populations recruitment was related to discharge at, during or soon after recruitment and described very similar ascend/descent, threshold-like patterns where recruitment is lowest in the years of lowest discharge and increases in years of increased discharge to attain maximum levels in years of intermediate discharge upon which recruitment declined with increased discharge to attain lowest levels. Strongly consistent patterns across populations emphasize the “modus operandi” of a single environmental factor namely stream discharge as a major determinant of annual recruitment strength. These results support the primacy of environmentally-determined recruitment, year-class strength and population size and strongly suggest that a unique determinant of recruitment via parental-dependence is most unlikely.



RECOVERY OF EUROPEAN STURGEON (*Acipenser sturio* L., 1758). PROJECT SOLLO

Dove C.¹ & F. Torrent²

1 Fundación Conde del Valle de Salazar. Escuela Técnica Superior de Ingenieros de Montes, Forestal y del Medio Natural. Universidad Politécnica de Madrid. Ciudad Universitaria s/n. 28040 Madrid (cdove.sti@gmail.com).

2 Escuela Técnica Superior de Ingenieros de Montes, Forestal y del Medio Natural. Universidad Politécnica de Madrid. Ciudad Universitaria s/n. 28040 Madrid.

European sturgeon (*Acipenser sturio* L., 1758) is an anadromous fish. Once one of the most widespread species of the Acipenseridae family, it was historically subjected to intense commercial exploitation.

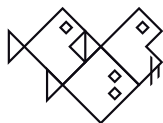
The dramatic decline of *A. sturio* began in the late nineteenth century in central Europe. By the mid-twentieth century overexploitation and habitat degradation had driven the species to almost full extirpation from its indigenous range. Currently, *A. sturio* is in critical danger of extinction, with only one population known to survive in the wild in the Gironde-Garonne-Dordogne basin. Significant efforts are being made across Europe to support the species' recovery.

Project SOLLO focuses on the initial stages of a full-scale reintroduction of *A. sturio* in Spain. The initiative has been endorsed by the Spanish national government and the regional governments of Andalucía, Extremadura and Galicia (territories within the species' historic range).

Project SOLLO is implementing the following work plan:

1. Assessment of the technical viability of the reintroduction of *A. sturio* in the rivers Guadalquivir, Guadiana and Miño.
2. Assessment of the socio-economic impact of the reintroduction.
3. Compilation and analysis of the regulations applicable to the reintroduction in order to confirm its legal feasibility. Definition of the required *in-situ* and *ex-situ* conservation actions in accordance with the regulatory framework.
4. Collaboration with Spanish authorities to define a National Strategy for the Recovery of *A. sturio*.
5. Stakeholder engagement to foster cooperation and seek support for the recovery and conservation of *A. sturio*.

Project SOLLO is supported by the Spanish Ministry of Agriculture, Food and Environmental Affairs through its funding agency Fundación Biodiversidad.



EUROPEAN STURGEON (*Acipenser sturio* L.) YOUNG OF THE YEAR PERFORMANCE IN DIFFERENT REARING ENVIRONMENTS -A STUDY WITHIN A STOCKING PROGRAM

Carrera-García E.^{1,2}, E. Rochard¹ & M.L. Acolas¹

1 IRSTEA, National Research Institute of Science and Technology for Environment and Agriculture. EABX, Aquatic ecosystems and global changes research unit. 33612 Bordeaux, France (erika.carrera-garcia@irstea.fr).

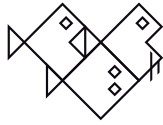
2 Department of Biological Sciences, Pontificia Universidad Católica del Ecuador. 170525 Quito, Ecuador.

Acipenser sturio is critically endangered and its remediation is based upon restoration plans in France and Germany. The French ex-situ approach involves

developing a captive stock to produce offspring for release in order to boost natural populations. The purpose of our study was to assess the effects of rearing environment before stocking on the survival, growth, and behavioral performance on three-month-old (6-92 days post hatch) sturgeons from two different crossings. Enriched rearing was designed to represent a small mesocosm imitating the variability of the natural environment using river water, natural photoperiod, substrate, submerged logs, different water current and depths. Traditional rearing was carried out with bare tanks, underground water, dark conditions, no water current and constant water depth. Fish survival was determined monthly and growth was estimated weekly through weight measurements. Behavior was assessed with exploration and novel prey tests in

solitary using video tracking. Results demonstrated that survival was high (>80%) during all the trial with no differences according to treatment. However, survival was lower during the second month in enriched environment. Enriched condition also resulted in bigger and more pigmented fish since the first month until the end of the trial. Growth curve analysis demonstrated that enriched environment made both fish crossings grow in a similar manner. In contrast, growth performance for both crossings differed when they were reared in traditional rearing which may traduced a genotype-environment interaction. Behavioral data highlighted that enriched-reared fish were slower to explore but more individuals engaged on doing so than traditional-reared fish. Our findings

advocate for the integration of enriched rearing practices within the juvenile production for release in order to boost the performance linked to fitness. Thus, stocking practices and life history research must work together to favor creative and adaptive aquaculture approaches which support species conservation.

**WARMING TRENDS PREDICT TROUT DECLINE 150 YEARS AFTER**

Hermoso V.¹, M. Clavero², M. Ninyerola³, A.F. Filipe⁴, M. Pla¹, D. Villero¹, L. Brotons^{1,5,6} & M. Delibes²

1 Forest Sciences Centre of Catalonia (CEMFOR-CTFC), InForest Joint Research Unit (CSIC-CTFC-CREAF), Crta. Sant Llorenç de Morunys, Km 2. 25280, Solsona. Spain. (virgilio.hermoso@gmail.com).

2 Estación Biológica de Doñana-CSIC, Américo Vespucio s.n., 41092 Sevilla, Spain.

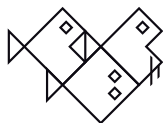
3 Dep. Biología Animal, Vegetal i Ecología, Autonomous University of Barcelona, 08193 Cerdanyola del Vallés, Spain.

4 CIBIO/InBIO Instituto Superior de Agronomia, Tapada da Ajuda 1349-017 Lisboa, Portugal

5 CREAM, 08193 Cerdanyola del Vallés, Spain.

6 CSIC, 08193 Cerdanyola del Vallés, Spain.

Bioclimatic envelope models are widely employed to forecast species ranges under future climatic scenarios, but their accuracy remains largely unknown because validation datasets will only be available within the time frame of the forecast. Historical species records offer an excellent opportunity to test the performance of distribution forecasts, by projecting past climate-distribution relationships to current climatic conditions. Here, we analyse thousands of brown trout (*Salmo trutta*) records from Spain in 1850 and 2000 to show that the current distribution of the species is accurately predicted based on historical records and only three temperature variables. The accuracy of the trout range forecast relies in the high temporal stability of its climate niche. Predictions and models robustly coincide in showing a suitability decline around 30% between 1850 and 2000, which will surpass 40% by 2050. We stress the huge, yet largely unexplored potential of historical species records to open a big-data pathway for long-term global change science.



PARTICIPATORY MONITORING IN THE ECUADORIAN AMAZON: STUDYING FISH TO UNDERSTAND ENVIRONMENTAL HEALTH AND LIVELIHOOD IMPLICATIONS IN INDIGENOUS COMMUNITIES

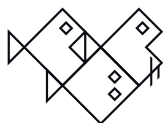
Tobes I.¹, H. Payaguaje^{2,4}, L. Weiss^{2,4}, R. Mulbry^{1,5}, A. Payaguaje², A. Piaguaje², D. Payaguaje², D. Lusitande², E. Lisitante², J. Payaguaje³, R. Payaguaje³, J. Payaguaje³, L. Piaguaje², L. Yiyokuro³, M. Yiyocuro³, R. Piaguaje³, R. Piaguaje² & B. Ríos-Touma¹

1 Centro de Investigación de la Biodiversidad y Cambio Climático (BioCamb) e Ingeniería en Biodiversidad y Recursos Genéticos, Ciencias de Medio Ambiente, Universidad Tecnológica Indoamérica, Machala y Sabanilla, Quito, Ecuador EC170103 (ibontobes@uti.edu.ec).

2 Nacionalidad Siekopai; 3 Nacionalidad Sionabai; 4 Fundación Alianza Ceibo.

5 US Student Fulbright Grantee.

This work presents the design and implementation of a community monitoring program carried out by Sionabai and Siekopai indigenous communities in the Ecuadorian Amazon, using fish to monitor environmental health. This region has endured long-term oil extraction and the accompanying environmental impacts, beginning in the early 1960s. More recently, pesticide-intensive oil palm plantations have expanded into the area. While it is common knowledge that 40 years of oil drilling have made local rivers unfit for drinking and cooking, community members still rely on fish from the rivers as a protein source. Therefore, these communities are deeply invested in using monitoring data to understand the accumulation of heavy metals, pesticides and hydrocarbons in the fish species they most frequently consume. The participatory nature of the project allowed participants to identify the end uses for the data and choose the methodology best-suited to meet their objectives. Academic collaborators contributed advice on designing a strong methodology that reflected the communities' desire for rigorous data. Furthermore, the monitoring campaign was designed to meet local needs by choosing ubiquitous, non-migrating and commonly-consumed fish and selecting sampling sites along the most visited and impacted rivers. A team of local monitors and researchers performed the data collection, which included training participants in environmental assessment and procedures for dissecting and storing fish tissues for laboratory analysis. After completing the early stages of the project, data collection continues and the first pollutant concentration analysis will soon be available to inform decision making about future monitoring efforts. Because the project is driven by community concern and informed by local knowledge, the data produced will be directly relevant to local decisions and advocacy. This ensures community ownership of the project and reaffirms the importance of environmental data as a tool to defend indigenous territories.



THREATS AND PROBLEMS AFFECTING THE DISTRIBUTION AND SURVIVAL OF STICKLEBACK (*Gasterosteus aculeatus*) IN BISCAY (BASQUE COUNTRY)

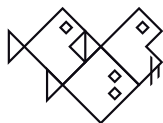
Antón A.¹ & L. Garcia-Arberas²

1 Didactics of Mathematics and Experimental Sciences. University of the Basque Country. Juan Ibáñez de Sto. Domingo

1. 01006 Vitoria-Gasteiz. Basque Country (alvaro.anton@ehu.eus).

2 Science Education. BAM Teacher Training University College. Barrainkua 2. 48009 Bilbao. Basque Country.

The three-spine stickleback (*Gasterosteus aculeatus*) is classified as “Vulnerable” in the Basque Catalogue of Endangered Species. Since 2009 five annual campaigns have been done in order to establish their distribution in the Historical Territory of Biscay (Basque Country). 121 sampling stations of 72 streams and 6 wetland areas of 13 different basins (all in the Cantabrian watershed) were studied using different sampling methodologies (direct observation, electrofishing and traps). The species was found in 19 stations of 12 streams and 3 wetlands. This distribution does not match to the one described in the Management Plan of the species: some populations were found outside it, and the absence of the fish was demonstrated for some other areas catalogued as of special interest for the species, probably due to extinction of these nuclei. In fact, some disappeared during this study. The stickleback is distributed in small isolated populations, and due to the fragmentation degree, any alteration affecting the niche can lead into a catastrophic and irreversible outcome for the species in our Territory. The main threat factors affecting the populations of stickleback are those affecting the habitat (physical disturbance, decreased water quality and altered flow regime), and others related to the presence of exotic species. These factors are analyzed and categorized by the evaluation of general state of the basin, channel and river banks conservation status, aquatic vegetation alteration degree, flow regime and water quality, riverside affecting expected works and the presence of exotic species. Risk or threats analysis allows prioritizing among action areas and a resource optimization. Used as a tool permits a categorization of the proposals of actions focused to avoid or minimize those threats to manage a species like stickleback, with an extremely complicated situation in Biscay, and whose preservation requires urgent measures and actions at different levels.



COMPARING FOUR METHODS FOR DECISION-TREE INDUCTION: A CASE STUDY ON THE INVASIVE IBERIAN GUDGEON (*Gobio lozanoi*; DOADRIO & MADEIRA)

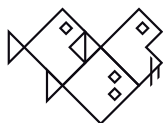
Muñoz-Mas R.¹, S. Fukuda², P. Veza³ & F. Martínez-Capel¹

1 Institut d'Investigació per a la Gestió Integrada de Zones Costaneres (IGIC). Universitat Politècnica de València, C/Paranimf 1, 46730 Grau de Gandia. València. Spain. (pitifleiter@hotmail.com).

2 Institute of Agriculture, Tokyo University of Agriculture and Technology, Saiwai-cho 3-5-8, Fuchu, Tokyo 183-8509, (Japan).

3 International Centre for Ecohydraulics Research (ICER) - University of Southampton, Highfield, Southampton, SO17 1BJ, (United Kingdom).

Invasion of freshwater ecosystems is a particularly alarming phenomenon in the Iberian Peninsula. Habitat suitability modelling is a proficient approach to extract knowledge from observational data and to guide adequate management actions. Decision-trees are an interpretable modelling technique widely used in ecology, able to model different types of variables, interactions and nonlinear relationships. Decision-trees recursively split the input space into two parts maximizing homogeneity. This recursive partitioning is typically performed with axis-parallel splits in a top-down fashion. However, recent developments of the R packages *oblique.tree*, that allows the development of oblique splits, and *evtree*, that performs globally optimal searches with evolutionary algorithms, seem to outperform the standard techniques (e.g. CART and C5.0). To evaluate their possible use in ecology, these two new algorithms were compared with CART and C5.0. The aim of our analysis was the presence-absence of the Iberian gudgeon, an invasive fish species that has spread across the Iberian Peninsula. The accuracy and complexity of the trees, the modelled patterns of mesohabitat selection and the variables importance were compared. None of the new R packages, namely *oblique.tree* and *evtree*, outperformed the C5.0 algorithm. They rendered almost the same decision-trees as the CART algorithm, although they were completely interpretable in comparison with C5.0, which showed higher complexity. Further, *oblique.tree* proved affected by prevalence. *Evtree* did not suggest a major improvement compared with the other three, although it could be used for regression tasks. Looking at the model results, the optimal habitats for the Iberian gudgeon were large pools in lowland segments with aquatic vegetation present and depositional areas. Iberian gudgeon seem to avoid habitats characterized by scouring phenomena and limited vegetated cover availability. Accordingly, we can assume that river regulation and artificial impoundment would have favoured the spread of this species across the Iberian Peninsula.



THE DECLINE IN RECRUITMENT OF THE EUROPEAN EEL (*Anguilla anguilla*): A PERSPECTIVE FROM SOUTHWEST EUROPE

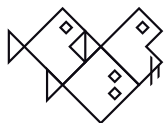
Correia M.J.¹, J.L. Costa^{1,2}, G. de Leo³ & I. Domingos^{1,2}

1 MARE - Marine and Environmental Sciences Centre, Faculdade de Ciências, Universidade de Lisboa, Lisboa, Portugal (mjcorreia@fc.ul.pt).

2 Departamento de Biologia Animal, Faculdade de Ciências, Universidade de Lisboa, PT-1749-016 Lisboa, Portugal.

3 Hopkins Marine Station, Stanford University, Stanford, California, United States of America.

The decline in the European eel recruitment observed in the 1980s remains largely unexplained. The impact of anthropogenic mortality on the eel population is certainly significant but the influence of ocean currents and local environmental conditions on recruitment success have also been pointed out. In the present study, the temporal variation in glass eel recruitment in the Minho estuary, a South European Atlantic estuary has been analysed and related to oceanic and local environmental conditions. By considering CPUE data from glass eel in the Minho estuary, time series analysis was carry out to represent the recruitment process. An analysis of empirical relationships with environmental series was also performed using generalized linear models (GLM), in order to identify the variables with the greatest influence on recruitment. Although the decrease in the abundance of European glass eels has been observed since the 1980s, there was no evidence of synchronous declines in glass eel abundance between the Minho estuary and other European estuaries. The observed decline does not follow the drastic trend reported by ICES Working Group on Eels. Relationships between recruitment and climatic variables (NAO) and local environmental conditions (rain, river flow, temperature) were identified, reinforcing their importance on recruitment. The analysis of the influence of each variable, namely precipitation, provided a good prediction of glass eel recruitment peaks, confirming that glass eels may use freshwater signals to enhance recruitment to continental waters.



DOES SIZE MATTER? GLASS EEL SIZE AND RECRUITMENT IN TWO ESTUARIES OF THE BAY OF BISCAY

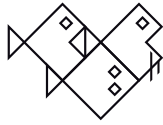
Díaz E.¹, A. Aranburu¹ & C. Briand²

1 AZTI-Tecnalia Txatxarramendi ugarte a z/g – 48395 Sukarrieta, Bizkaia, Spain (ediaz@azti.es).

2 IAV, bd de Bretagne, La Roche Bernard 56130 France.

The status of European eel is critical; the annual recruitment of glass eel to European waters in 2015 was 8.4% of the 1960–1979 level in the central southern European estuaries (ICES 2015). The causes of the decline are unclear, it has been hypothesized that it is linked to a strong reduction in the spawning stock due to overfishing, habitat destruction, migration barriers, contamination, diseases and parasitism. But statistically significant relationships between recruitment and different oceanographic parameters have also been found. Oceanographic conditions seem to determine larval transport and feeding, and therefore determine their successful oceanographic migration. Thus, in these years with unsuitable oceanographic feeding conditions, larval mortality would increase and even if the larvae are able to survive they would produce glass eel with lesser energy reserves. Our hypothesis, is therefore, that there might be a link between glass eel condition, as reflected by standard length and weight, and recruitment.

To test that hypothesis, we first model the seasonal biometrics change of glass eel, using sine wave curves, for years 2000 to 2015. Then, we compare the season's maximum size with the WGEEL recruitment index. Our results clearly show a positive relationship between glass eel size and recruitment which could be used to assert the influence of oceanic conditions during leptocephalus growth and transoceanic migration.



IS THE EEL MANAGEMENT PLAN WORKING? THE EXAMPLE OF GIPUZKOA

Azpiroz I.¹, E. Díaz² & I. Mendiola³

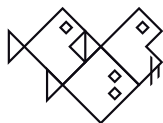
1 Ekolur Asesoría Ambiental SLL, Camino de Astigarraga 2—Pl. 4^a dcha—Of. 8 20180 Oiartzun, Spain (iker@ekolur.com).
2 AZTI-Tecnalia Txatxarramendi ugartea z/g – 48395 Sukarrieta, Bizkaia, Spain (ediaz@azti.es).
3 Gipuzkoa plz z/g, behe-gaina 20004, Donostia, Gipuzkoa, Spain (imendiola@gipuzkoa.eus).

The stock of the European eel *A. anguilla* is outside safe biological limits (ICES 1999 and thereafter). According to EU legislation launched in 2008, EU countries have to implement an eel management plan (EMP) including measures that allow 40 % of adult eels to escape from inland waters to the sea, where they can spawn. However, according to the latest ICES advice recruitment indices are well below the 1960–1979 un-impaired reference levels and there is no change in the perception of the status of the stock.

In the present study, we (1) analyze the eel stock evolution in the rivers of Gipuzkoa before and after the EMP was implemented in 2009 and (2) we test the effect of the different management measures on the population.

According to our analysis, the eel population has maintained a decreasing trend after the EMP was implemented. Nevertheless, firstly it has to be taken into account that the European eel most likely comprises one single stock and recovery does not rely only on the actions taken locally, but also on all the actions taken in the whole distribution range. Secondly, it has been estimated that the eel has a 15 years mean generation time (when the whole distribution area is considered); thus probably more time may be needed to see clear recovery signs in the population.

Anyway, taking into account the observed trends, both in Gipuzkoa and over the whole distribution area, we consider that the precautionary approach should be applied and that each region should assess the effect of the implemented measures and review the EMP in order to achieve the shared eel recovery goal.



LIFE+ CIPRÍBER: ACTIONS TOWARDS THE PROTECTION AND CONSERVATION OF IBERIAN CYPRINIDS OF COMMUNITY INTEREST

Marcos-Primo C.¹, J.C. Velasco-Marcos², G. González-Fernández³, F. Jimenez-Fernández⁴, J. del Nido-Martín² & L. Arenillas-Girola⁵

1 Confederación Hidrográfica del Duero. Muro, 5. 47004 Valladolid (cmp@chduero.es).

2 Consejería de Fomento y Medio Ambiente, Junta de Castilla y León.

3 Icthos Gestión Ambiental S.L.

4 Fundación Patrimonio Natural de Castilla y León.

5 Confederación Hidrográfica del Tajo.

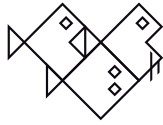
In recent years many studies have pointed out a decline in the populations of some threatened fish species in Duero and Tagus basins as well as an increase in distribution of invasive species. Mostly, this is due to river habitat deterioration by existing pressures over the river courses.

In order to protect and provide the basis for the recovery of these populations, the Duero Basin Authority as coordinating partner, and with the collaboration of the Tagus Basin Authority, the Department of Development and Environment of the Junta de Castilla y León (the regional government) and Natural Heritage of Castilla y León Foundation has promoted a project that has been selected in the 2013 call for the LIFE program.

The target species are endemic native cyprinids of Community interest (Sarda, Alagon stone loach, Duero nase, etc.) located in SCIs in the western of the Salamanca province (Spain).

This presentation sets out the targets and action lines of the project, among which demolition of obsolete dams and new fish pass passages on weirs in use are basic tools to achieve river habitat conditions that allow a better distribution and population status. Removing existing pressures in water courses and restoring habitat will allow to progress towards good environmental status. The river restoration appears, therefore, as essential instrument to achieve an improvement of biodiversity.

Other important objectives are the development of a breeding protocol to offset the current regression status, improve the scientific and technical knowledge on these species and define a fish and water management program. The project also has an important content of dissemination, communication and public participation as key elements to address some actions for longitudinal continuity recovery as dam removal, since some groups such as councilors, anglers, etc. are still reluctant to this kind of measures.

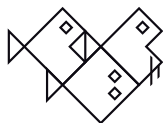


SEASONAL RECRUITMENT OF GLASS EELS (*Anguilla anguilla*) IN THE RIVER TER (NE SPAIN)

Zamora L.

Instituto de Ecología Acuática. GRECO. Universidad de Girona. Facultad de Ciencias, Campus de Montilivi s/n 17071 Girona, Spain (lluis.zamora@udg.edu).

Recruitment of the European eel has declined markedly in the last few decades and development of stock recovery plans are required by European Union Member States. Colonization of coastal rivers on the Mediterranean coast by glass eels, *Anguilla anguilla*, is poorly known due to a lack of annual monitoring of glass eels recruitment. Where a glass eel fishery exists, catch statistics are collected, but only during a limited period of time when this activity is not prohibited (October to March). In order to provide more scientific knowledge with regard to the estuarine entry phase of the eel life cycle in the Mediterranean coast, the arrival pattern of glass eels has been described in the River Ter (NE Spain) for two years. Fishing was carried out fortnightly for 3 h per night from January 2014 to December 2015 by means of three fyke nets with a fine-meshed, the same design used by local glass eel fishermen. Total catches were measured hourly and total length, weight and pigmentation stages were calculated for a subsample. The results show a clear seasonal pattern with highest recruitment in winter and lowest during summer with a peak in late spring. Abundance was positively correlated with body condition and significantly smaller sizes over the duration of the series. Synchronous arrival with Atlantic coast, despite the longer distance to reach the Mediterranean coast, is discussed.



BIOLOGICAL PARAMETERS AND POPULATION DYNAMICS OF THE EUROPEAN EEL (*Anguilla anguilla*) IN A MEDITERRANEAN RIVER OF SOUTHERN SPAIN

Herrera M.¹, R. Moreno-Valcárcel¹, R.J. De Miguel¹, H.S. Dean² & C. Fernández-Delgado¹

¹ Departamento de Zoología. Edificio Charles Darwin. Campus de Rabanales. Universidad de Córdoba. 14071 Córdoba, Spain (zo2hearm@uco.es).

² School of Bioscience, Cardiff University, Cardiff, CF10 3AX, United Kingdom.

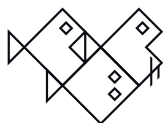
Conservation measures imposed by the EU to recover eel stocks make the study of the different developmental stages of this species necessary. This is due to the lack of information in some areas of Europe, including the southern part. Within the Eel Management Plan, developed by the Environmental Agency of Andalucía, we are carrying out different studies to learn more about several biological and population dynamic parameters displayed by the yellow eels in the Guadiaro River, a small Mediterranean river located at the most meridional area of Europe.

Between Oct 2014 and Jan 2016 we carried out a mark-recapture study (PIT-tags) within the sampling and statistical framework of the Robust Design.

We found two population types: residents, sedentary yellow eels, >25-30 cm total length (TL) with a territorial behavior, and transients, composed of nomad yellow eels (< 25-30 cm) and migrating silver eels (>30 cm).

The length of the eels increased daily (0.052-0.165 mm/day). Somatic condition of resident eels was maximum in the spring and minimum in autumn, with similar values to other European freshwater populations. Sex ratio of pre-migrating and migrating eels was 1:1.7. The silvering process began in late spring and migration took place in autumn and early winter, there was a clear relationship with photoperiod. Average total lengths for each maturation stage were lower than those of other northern eel populations.

Annual survival rate of residents was 0.68 (0.63-0.71), which was constant over the time period but increased with the eel's size. The average density was 0.05 individuals/m². Mean total biomass was 19.3 kg/ha and productivity 12.3±2.5 kg/ha/yr. Mark-recapture techniques allowed the calculation of large quantities of population parameters, which were not biased by the presence of transient eels in the population. Our results are in line with those obtained from other European populations, although it is noted that density and biomass were lower.



A PILOT STUDY ON THE ECOLOGICAL IMPACT OF A RESTOCKING EXPERIMENT WITH GLASS EELS (*Anguilla anguilla*, L., 1758)

Félix P.M.¹, J.L. Costa^{2,3}, P.R. Almeida^{1,4}, B.R. Quintella^{1,3} & I. Domingos^{2,3}

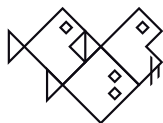
1 MARE – Marine and Environmental Sciences Centre, Universidade de Évora, Largo dos Colegiais, 7004-516 Évora, Portugal (pmfelix@fc.ul.pt).

2 MARE – Marine and Environmental Sciences Centre, Faculdade de Ciências da Universidade de Lisboa, Campo Grande, 1749-016 Lisboa, Portugal.

3 Departamento de Biologia Animal, Faculdade de Ciências, Universidade de Lisboa, 1749-016 Lisboa, Portugal.

4 Departamento de Biologia, Escola de Ciências e Tecnologia, Universidade de Évora, Largo dos Colegiais, 7004-516 Évora, Portugal.

The efforts to revert the declining trend of the European eel stock are mainly focused on the continental phase of its life cycle, which is also the phase when most impairments are believed to occur. The loss of longitudinal connectivity resulting from the presence of numerous obstacles along the freshwater systems, precludes this catadromous species from colonizing upriver habitats. Hence, restocking actions are a practice undertaken, in freshwater systems with low or no natural migration, to contribute to the recovery of the panmictic stock and increase fisheries production. The impact of such events remains, however, largely unknown. This pilot study aims to evaluate the ecological impact of a restocking event, during the first year, in order to assess the suitability of its future application as a rehabilitation measure for the European eel. A restocking action with glass eels was conducted in a selected inland river stretch where no current natural recruitment occurs. Three release sites and two control areas were set, according to the presence of obstacles and habitat similarity. To set a pre-stocking baseline, a sampling campaign was conducted before stocking. During the first year, after restocking, the released eels were monitored, along with the remaining fish species, using electrofishing, and the macroinvertebrate community with kick-sampling. The number of recaptures suggested low mortality rates and showed a higher dispersion in the areas with surmountable obstacles, registering a displacement up to 3.6 km, in contrast to areas below impassable weirs, where higher densities were observed. The growth of elvers increased towards the downstream sites, where a higher percentage of riverbed boulder coverage was found. Restocking caused no disruption on the fish assemblage structure during the first year, but changed the structure of the benthic community. Overall, during the first year, this inland freshwater habitat showed capacity to support a low density stock of glass eels.



HOME RANGE AND HABITAT DRIVERS OF THE EUROPEAN EEL (*Anguilla anguilla*) IN A MEDITERRANEAN RIVER OF SOUTHERN SPAIN

De Miguel R.J.¹, R. Moreno-Valcárcel¹, M. Herrera¹, H.S. Dean² & C. Fernández-Delgado¹

¹ Departamento de Zoología. Edificio Charles Darwin. Campus de Rabanales. Universidad de Córdoba. 14071 Córdoba, Spain (rjmiguel@uco.es).

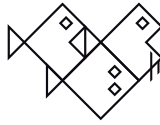
² School of Bioscience, Cardiff University, Cardiff, CF10 3AX, United Kingdom.

Within the objectives established by the Andalusian Environmental Regional Agency regarding the mandatory European Eel Management Program includes the furthered knowledge of the biology and population dynamics of this species in the Region. The results showed here are part of these studies.

A complete annual cycle monitoring (from October, 2014 to September, 2015) was performed monthly in the Guadiaro River. Two different but continuous fluvial stretches were set in a 1200 m section, with three daily replicates and 50 fyke-nets each. Position of each net was registered by GPS and different habitat variables were taken (vegetal coverage, refuges, undercuts, etc.). After measurement, caught specimens (> 25 cm total length, TL) were tagged (PIT tags). Capture-recapture analysis quantified the distance covered and the movement rates from every recaptured individual. Laboratory and field habitat data were used to perform a multiple regression analysis with CPUE (Catch per Unit Effort) as a response variable.

Average maximum distance covered was 114.55 m \pm 21.90 m, nevertheless 61.7 % of the registered movements were lower than 100 m. Significant differences were found according to fish length (ANOVA; $F= 8.195$, $p<0.001$), 65.02 m \pm 27.78 m and 258.76 m \pm 166.11 m, for individuals <30 cm and >50 cm TL, respectively. Major flow increment previous to sampling and moderate rainfall before or during the setting of nets, were shown as the main predictors accounting for 74% of the variance in CPUE.

This eel population besides being located in one of the most meridional areas of Europe, showed similar values to other northerly populations.



THE INFLUENCE OF PARASITES IN THE POPULATION STATUS OF THE EUROPEAN EEL, *Anguilla anguilla* L.

Saraiva A.^{1,2} & A. Pereira²

1 Faculdade de Ciências, Universidade do Porto, Departamento de Biologia, Rua do Campo Alegre, Edifício FC4, 4169 - 007 Porto, Portugal (amsaraiv@fc.up.pt).

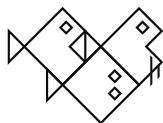
2 CIIMAR – Centro Interdisciplinar de Investigação Marinha e Ambiental, Rua dos Bragas, 4050-123 Porto, Portugal.

There has been a significant decline in the recruitment of *Anguilla anguilla* throughout its distribution range in the last decades. The causes of this decline are yet unclear but is thought to be the result of multiple, environmental and anthropogenic factors. Eel parasites, mainly invasive ones, are suspected to play an important role in the eel decline.

In our Lab. we did several surveys in eels collected in several northern Portuguese rivers (Lima, Cávado, Ave, Douro and Vouga). A total of 1097 eels were collected by electrofishing or acquired to fishermen and examined for the presence of parasites. A total of 28 parasite species were detected from which 15 are specific to eel host.

The levels of infection from all parasites will be reported and the know influence of this parasites in the host referred.

From all detected parasites the nematode *Anguillicoloides crassus* (Kawahara, Niimi et Itagaki, 1974) Moravec et Taraschewski, 1988, parasite of the swimbladder was presumably the most deleterious and probably influence the ability of eels to migrate to their spawning grounds in the Sargasso Sea. Additionally the monogeneans *Pseudodactylogyrus anguillae* (Yin & Sproston, 1948) Gussev, 1965 and *P. bini* (Kikuchi, 1929) Gussev can cause respiratory impairment especially when other gill parasites and/or in polluted waters are present with potential to compromise eel health and fitness.

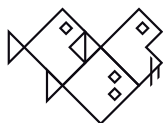


IBERIAN FRESHWATER FISH IN THE MID-19TH CENTURY AS INFORMED BY THE MADDOZ'S DICTIONARY

Blanco-Garrido F¹, M. Clavero¹ & V. Hermoso²

1 Estación Biológica de Doñana – CSIC, Avda. Americo Vespucio s/n; 41092 Sevilla, Spain (fblanco@ebd.csic.es).
2 Centre Tecnològic Forestal de Catalunya; Solsona, 25280 Lleida, Spain.

The dictionary edited by Pascual Madoz between 1845 and 1850 (simply Madoz, hereafter) extensively described the geography, population and socioeconomic aspects in Spain. The information contained in the Madoz is presented in articles with a fixed structure on population centres, rivers and topographical accidents. Many of the articles included information on wild species, with a special focus on socioeconomically relevant species, such as game and/or harmful terrestrial animals, as well as fish. We collected the fish records contained in the Madoz and georeferenced them when population centers could be placed with acceptable precision (i.e. avoiding information that referred to mountain ranges, whole river systems or large political entities). Altogether, we collected 10,223 freshwater fish records from a minimum of 16 species or genera and 419 records of crayfish (*Austropotamobius italicus*), corresponding to 5,427 localities. Trouts, eels and barbels (various species of the latter belonging to different basins) concentrated almost 90% of all fish records, denoting their importance as a food resource in the period covered by the Madoz. The comparison between Madoz's data and the current situation highlights the decline of the trout, in terms of reducing its range, and the spatial collapse of some migratory species, as the case of the eel. Finally, it is also remarkable the almost total absence of introduced fish species in the mid-19th century, except for the carp and the tench. Historical data can, and should, become a useful tool to describe long-term changes in the distribution of organisms in response to global change processes. Moreover, as historical sources can estimate the baseline ranges of many species, this can guide present-day management of endangered fishes by supporting the design of range recovery plans.



DYNAMIC SIMULATION MODEL OF THE LOCAL EXTINCTION OF *Hubbsina turneri* DE BUEN 1940 (CYPRINODONTIFORMES, GOODEIDAE)

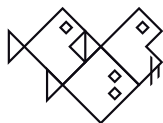
Moncayo-Estrada R.¹, J. De La Cruz-Agüero¹, C. Escalera-Gallardo² & J.P. Ramírez Herrejón³

1 Instituto Politécnico Nacional, Colección Ictiológica, Centro Interdisciplinario de Ciencias Marinas. COFAA. Av. Instituto Politécnico Nacional s/n Col. Playa Palo de Santa Rita, C. P. 23096, La Paz, B.C.S., México (rmoncayo@ipn.mx).

2 Instituto Politécnico Nacional, Centro Interdisciplinario de Investigación para el desarrollo Integral Regional, Unidad Michoacán. COFAA. Justo Sierra No. 28, Colonia Centro, C. P. 59510, Jiquilpan, Michoacán, México.

3 Facultad de Ciencias Naturales, Universidad Autónoma de Querétaro, Campus UAQ-Aeropuerto, Carretera a Chichimequillas s/n, Ejido Bolaños, C. P. 76140, Querétaro, Querétaro, México.

We describe, in a dynamic model, the factors that might promote the local extinction of *Hubbsina turneri* in the Lake Cuitzeo watershed, Mexico. The model was created using the STELLA program (v10.0, Isee Systems) and it incorporated and related information from different population characteristics with distinct habitat and degradation processes. We gathered an historical data base including management initiatives, temporary impacts and restoration practices whose synergy could affect the species development. An important impact, the construction of the Cointzio Reservoir at the beginning of the 1940s, fragmented the main tributary of the lake (Grande de Morelia River), and affected the fish distribution and movement. Isolation of the species into two populations was expected and imposed the creation of two sub-models: (1) upper and (2) lower part of the watershed. In sub-model 1, the population was mainly affected by land-use change, from forest to agriculture, aspect that promotes erosion, causing sedimentation, and affecting the trophic processes in the reservoir. In sub-model 2, the primary impact was the water quality degradation, related to the lack of treatment of wastewaters derived from the state capital, which had grown exponentially since the 1970s decade, the establishment of industrial activities, and a sensible increase in the use of agrochemicals. In both sub-models the hydrometeorological aspect also affected at different time periods, including the presence of wet and dry successive years. The increasing pollution along the river probable enhances the isolation of small populations, and the presence of exotic species could promote the loss of *H. turneri* individuals in low impacted areas like springs. Finally, at the end of the watershed, Lake Cuitzeo, the species was affected by the fishery practices (i.e., use of seine nets) and the desiccation of some areas of the water body.



HABITAT USE AND GROWTH OF THE WESTERN RUIVACO (CYPRINIDAE): IMPLICATIONS FOR ITS EX-SITU CONSERVATION AND PERSISTENCE IN THE WILD

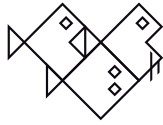
Mameri D.¹, C. Sousa-Santos², F. Magalhães¹, F. Gil³ & J.I. Robalo²

1 Centre for Ecology, Evolution and Environmental Changes, Faculty of Sciences, University of Lisbon; Campo Grande 1749-016 Lisboa, Portugal (dani.crm92@gmail.com; mfmagalhaes@fc.ul.pt).

2 MARE, ISPA - University Institute, Lisbon, Portugal; Rua Jardim do Tabaco, nº34 1149-041 Lisboa, Portugal (carla.santos@ispa.pt; jrobalo@ispa.pt).

3 Vasco da Gama's Aquarium, Rua Direita do Dafundo, 1495 718 Cruz Quebrada – Dafundo, Portugal (avg.aqua@marinha.pt).

Iberian cyprinids include a high number of endemic and highly threatened species. One of such species is the western ruivaco *Achondrostoma occidentale*, which shows a restricted distribution range, low genetic diversity, and is severely threatened by habitat loss and degradation. Although *A. occidentale* has been the target of an exsitu conservation program since 2007, baseline information on its biological traits remains scarce. This study aimed to gather data on habitat use and population abundance, condition and growth that could provide valuable guidelines to future restocking actions. Fish and habitat surveys were conducted in persistent summer pools across the Alcabrichel, Sizandro and Safarujo rivers, in western Portugal. Age and growth were determined for these wild populations and for the corresponding captive stocks, kept in ex-situ facilities. Fish tended to be more abundant in shallower pools, well covered with macrophytes. Wild populations included a significant proportion of young fish (aged 0+ and 1+), likely reflecting reinforcement by restocking actions. Nevertheless, growth rates and condition tended to be lower for wild than captive populations of the Alcabrichel and Safarujo rivers. These results suggest that captive breeding and restocking of wild populations may be important to potentiate recruitment and persistence of *A. occidentale*, and that future restocking actions should focus on persistent pools with abundant aquatic vegetation. Moreover, restocking should be accompanied by habitat restoration and annual fish surveys in order to assess the recovery of wild populations.

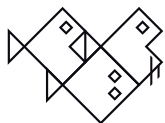


ICHTHYOFAUNA OF THE LOWER COURSE OF THE CHUBUT RIVER, PATAGONIA, ARGENTINA

Ruiz A.E., R.R. Fondacaro, A. Carbajo, L.F. Mendia, M. Soutric & A. Jones

Facultad de Ciencias Naturales, Sede Trelew, Universidad Nacional de la Patagonia San Juan Bosco. Inmigrantes 58, 9100 Trelew, Chubut, Argentina (anaruiztw@yahoo.com.ar).

In the present work, we studied the composition of the fish populations of the lower course of the Chubut river, Patagonia, Argentina. We explored the section between the Ameghino dam and its mouth on the sea (207.10 km). Five sampling sites were selected. Gillnets, coastal nets and electric fishing equipment were used. The most abundant species was the perch (*Percichthys trout*), with 47% of the total catch, followed by the Patagonian catfish (*Hatcheria macraei*) with 29%, and the Patagonian silverside (*Odontesthes hatcheri*) with 9% of the total catch. We also found the velvet catfish (*Diplomystes mesembrinus*) with 6%, the brown trout (*Salmo trutta*) with 5%, the rainbow trout (*Oncorhynchus mykiss*) with 3%, and the lamprey (*Geotria australis*) with 2% of the total catch, respectively. The estimated values of the Simpson index indicate that none of the species had a marked dominance. The seasonal distribution of gonadal stages suggests that spawning occurs between late winter and early spring, with temporary displacements among the different species. Native fish and salmonids share the same trophic resources and consumption varies with the seasonal availability of prey, the habitat, and the possibilities of fish to move in the water column. The results show that the velvet catfish has a limited distribution, related to its fidelity to the habitat. It is thus recommended to give it the highest priority. Besides, given the poverty of the fish fauna of the lower course of the Chubut river, it is recommended to preserve this environment and its gene pool. The changes occurred in the water regime due to the construction of the Ameghino dam in 1963, the introduction of exotic species, and the pollution of waters caused by the coastal population growth, are highlighted as factors that could affect these populations.



DISTRIBUTION OF MEXICAN GOLDEN TROUT (*Oncorhynchus chrysogaster*) IN THE SIERRA MADRE OCCIDENTAL BASED ON SPECIES DISTRIBUTION MODELS

Ruiz-Luna A.¹, R. Hernández-Guzmán², F. García De León³, C.A. Berlanga-Robles¹, M.A. Escalante-Sánchez^{3,4} & A.L. Ramírez-Huerta¹

1 Centro Investigación en Alimentación y Desarrollo A. C., Unidad Mazatlán en Acuicultura y Manejo Ambiental, Sábalo-Cerritos s/n. Estero del Yugo. CP 82000, Mazatlán, Sinaloa, México
(arluna@ciad.mx).

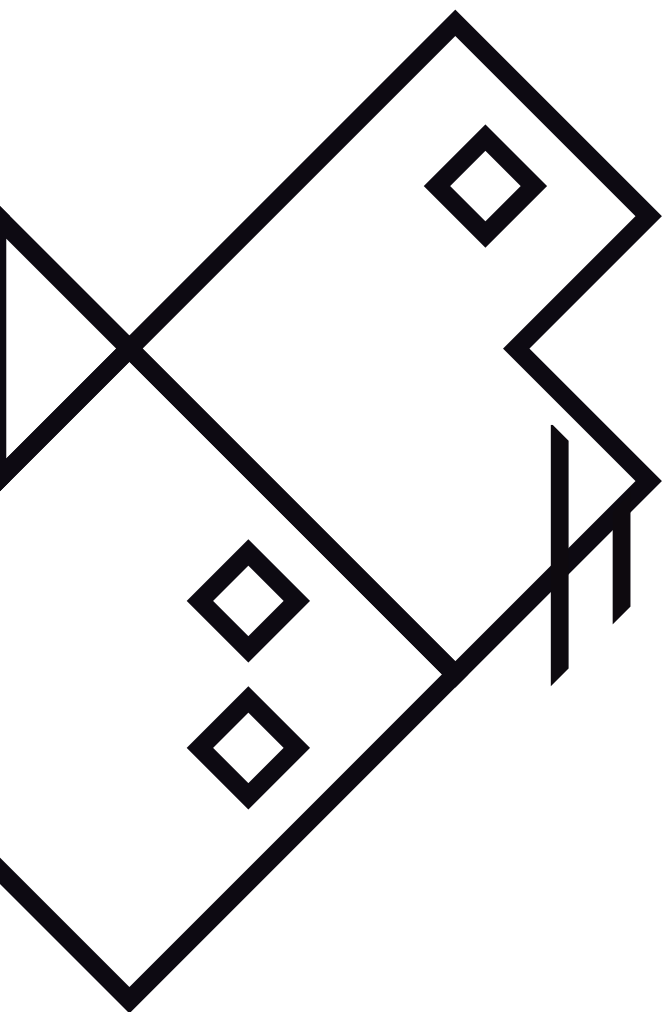
2 Catedrático CONACYT – Instituto de Investigaciones sobre los Recursos Naturales, Universidad Michoacana de San Nicolás de Hidalgo. Av. San Juanito Itzicuaró s/n, Col. Nueva Esperanza, 58330, Morelia, Michoacán, México.

3 Laboratorio de Genética para la Conservación, Centro de Investigaciones Biológicas del Noroeste, Instituto Politécnico Nacional, 195, Col. Playa Palo de Santa Rita, 23096 La Paz, BCS, México.

4 Direction de la Recherche et des Etudes Doctorales, Université de Montpellier. Place Eugène bataillon. 34095, Montpellier cedex 5. Francia.

The Mexican native trouts are the southernmost distributed salmonids, and some of their species are threatened even when they are not scientifically described yet. The Mexican golden trout (MGT) *O. chrysogaster* is one of two species formally described and included in national and international lists of concern. This species inhabit in three contiguous river basins of the Sierra Madre Occidental (SMO), in areas difficult to access because of particular environmental and social conditions. Consequently, the historic occurrence record series is limited and disperse, but despite this was formerly used to model the MGT potential distribution area, using the Bioclim and Maxent approaches. Because of data bias, both models output the best aptitude for the northern watershed (El Fuerte). Additional sampling was achieved (2014-2015) to complete a best dataset to model the Sinaloa and Culiacan basins, to the south. GARP and MaxEnt models based in six bioclimatic and physiographic variables were produced and improved with a landscape characterization from remote sensing analysis, validating both models with a jackknife method. A total surface around 4300 km² was first defined, with a hydrologic network of about 3000 km, with trout inhabiting consistently in 2nd to 3rd order streams at altitudes >2000 m. Regarding this, only a 50m-by-side fringe along the linear stream network was defined as potential distribution area, giving a final estimate about 275 km², mainly defined by streams of 2nd and 3rd order, included in a matrix of undisturbed forest ecosystems.

Present findings will be useful for future MGT survey and monitoring programs design, supporting conservation and management initiatives.



**ORAL
COMMUNICATIONS**

**AQUACULTURE,
ENDOCRINOLOGY
AND TOXICOLOGY**



SITUATION, PROSPECTS AND CHALLENGES OF AQUACULTURE IN THE IBERIAN PENINSULA

Jover-Cerdá M.

Professor of Aquaculture at the Universitat Politècnica of Valencia (mjover@dca.upv.es). Aquaculture, defined as the controlled production of aquatic organisms (fish, crustaceans, mollusks, algae, etc) has to be a profitable, safe and sustainable activity and also ought to be nearby, known and quality (freshness).

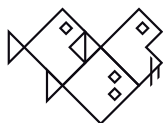
Today, aquaculture production is a reality in national and international markets and the consumer table, and is presented as the only alternative to increase sustainable supply of fish by creating jobs and wealth.

The Spanish production is the first of the European Union, with 189 thousand tons of mussels, 16 thousand of each of the main species of fish, trout, sea bream and sea bass, turbot and 8 thousand of turbot. However, the growth in activity is compromised because, according to the business sector, to an in - appropriate administrative framework and the lack of equal opportunities internationally.

Paradoxically, the situation of a clear institutional recognition of aquaculture is given, but the bureaucratic maze paralyzes the sector due to slow expansion concessions and new locations. In the business and social environment, there is a need to improve productivity and increase demand for aquaculture fish.

Whereas aquaculture is necessary to provide seafood to humanity, the fish aquaculture is a reality accepted by consumers, aquaculture is an economic activity that provides work and social welfare in rural and coastal areas, and that the quality fish aquaculture is guaranteed by a controlled production process, it is expected to double production for 2030, which will require 1) improvements in governance and international equal opportunities, 2) improvements in technology to optimize production and 3) recovering consumer confidence and increasing consumption (by appropriate labeling and trademarks).

To do this, a technological and managerial revolution must occur with a change in paradigm that allows consideration of aquaculture as a strategic sector based on the knowledge economy, innovation and collaboration between government, business and science.



BIVITOX DEVELOPMENT AND IMPLEMENTATION IN AGUAS DE MURCIA. TOXICITY MONITORING SYSTEM BY FISH SWIMMING BEHAVIOR

Hurtado Melgar I.M.¹, D. Verdiell², R. Montoliu³, M. Torralva², M. Frutos¹, M. Larrosa¹, A. Abellán¹, P. Cascales⁴, D. Campillo⁴ & M. Martín⁴

1 Aquatec (Suez). Av. Teniente Montesinos nº 8 Edificio INTI, Torre Z, Planta 8, 30.100 Murcia. Spain (imhurtado@aqualogy.net).

2 Departamento de Zoología y Antropología Física. Universidad de Murcia. 30100 Murcia. Spain.

3 Instituto de Nuevas Tecnologías de la Imagen (INIT). Universidad Jaume I. Av. de Vicent Sos Baynat, s/n 12071 Castellón de la Plana. Spain.

4 Aguas de Murcia. Plaza Circular, 9, 30.008 Murcia. Spain.

For the environmental risk assessment, Bivitox is an early warning system for online water quality monitoring, using computer vision techniques to quantify changes in the behavior of *Lepomis gibbosus* (Percasol) exposed to sublethal concentrations of toxic substances.

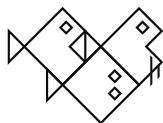
In surface water uptake, Bivitox Toxicity Vigilance System, it is useful for pollution episodes that can't be warned by the conventional methods of measurement.

This system has been designed by a multidisciplinary team, Aguas de Murcia lead through R+D+I project (this work was supported in 2007-2008 by the Spanish Ministry of Industry, Tourism and Trade), together with the Department of Zoology and Physical Anthropology at the University of Murcia, Department of Engineering and Computer Science at the University Jaume I and the Aquatec company (Suez).

As the main result of the project, Bivitox is installed in the Drinking Water Treatment Plant (DWTP) La Contraparada (Murcia), and in operation since early 2015 without significant incidences. In our current device fishes are video-recorder isolated in individual tanks, with continuous raw water supply (DWTP entry water).

The software was originally developed with an organophosphorus pesticide chlorpyrifos, and in a second step, it will be broad with a herbicide widely used in the Rio Segura. This software comprises some modules: capture, vertex identification, monitoring, analysis and decision. The mathematical algorithms identify whether each of the videos corresponding to a normal or contaminated fish behavior. For Bivitox management we have a desktop and a web application, where you can make query, play videos and from where alert managers tool alarms via email.

As a conclusion of this research project, we have developed a detection system toxicity by fish, which has been implemented in a DWTP.



ONTOGENY OF THE DIGESTIVE SYSTEM IN HATCHERY PRODUCED COMMON BREAM, *Abramis brama*

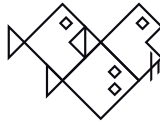
Sahraeian M.R.¹, S. Eagderi¹, G.R. Rafiee¹, A. Zibae², M.A. Esteban³ & J. Meseguer³

1 Department of Fisheries, Faculty of Natural Resources, University of Tehran, 31585-4314 Karaj, Iran (mrsahraeian@ut.ac.ir).

2 Department of Plant Protection, Faculty of Agricultural Sciences, University of Guilan, Rasht.

3 Department of Cell Biology and Histology, Faculty of Biology, University of Murcia, 30100 Murcia, Spain.

Common Bream, *Abramis brama*, is a freshwater fish of the family Cyprinidae and economically important in some European countries and western Asia. The natural stock of this fish species is declined due to overfishing and destruction of its habitats. Therefore, its artificial propagation has been established to produce the larvae for restocking programs and providing larvae for aquaculture, since it has a high potential for considering as a candidate for inland-water aquaculture. This process needs to provide a basic knowledge regarding its ontogeny especially its digestive system. Hence, this study was conducted to study the ontogeny of its digestive system during early development based on the histological technique. The results revealed that at hatching, the esophagus was a narrow and short lumen composing the pseudo stratified layer of squamous cells. The rudimentary intestine was composed of the columnar epithelium with median to basal nuclei at 1 dph. At 2 dph, the buccopharyngeal epithelium was developed as a single layer of the squamous cells along with opening of the mouth. In addition, the esophagus is connected to the intestine and the goblet cells were found on its epithelium layer at this day. At this time, the intestinal's short lumens are connected forming a canal that is opened to the anus. At 3 dph, the goblet cells were strongly increased in the esophagus' epithelium and also the yolk sack is completely absorbed. A crucial changes are occurred in the larval intestine during 3-5 dph when they start a mixture feeding. The taste buds were started to develop at 5 dph. The lipidic vacuoles were detected at 12 dph in the larval intestine and afterward a rapid increase in their number and volume was observed up to 14 dph. In conclusion, the ontogeny of the digestive system showed a similar pattern as other omnivorous and herbivorous species. Therefore, it is suggested the use of the commercial pellets at 12 dph for its feeding.



SOME PARTICULAR FEATURES OF THE TELEOST RETINA POORLY KNOWN

De Juan J., B. Boughlala, N. Martínez-Ruiz & A.I. de Juan

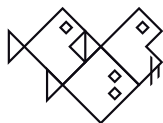
Department of Biotechnology, University of Alicante, Spain. Apartado 99, 03080 Alicante (jdj@ua.es).

Teleost is a successful vertebrate group, constituting more than half of vertebrate species. Its retinal structure is determined more by ecological and ethological factors, imposed to the visual system, than for its belonged to a given taxonomic group. Teleosts retinal structure was related to the feeding habits. Previously we observed that teleost species have a set of characteristics of them, such as a marked morphological plasticity. This plasticity is expressed as Cellular Retinomotor Movements (CRM) and synaptic plasticity. The aim of this work was to realize a systematization and description of these phenomena.

This work contains a synopsis of several works carried out by our group with the aim to make known the phenomena mentioned. The methodology used was the use of techniques of light and electron microscopy in several species of the teleost. The data obtained were morphological and morphometric and related to predatory and trophic characteristics.

Teleost retinas show dramatic changes related to light and dark adaptation. These CRM always are related to light and dark adaptation. In fact, light induces: (1) dispersion of melanin granules of the retinal pigment epithelium (RPE), (2) rod myoid elongation, (3) cone myoide contraction, (4) the size of the HCs body and the cone photoreceptor body decreases whilst the cone nuclei size increases, (5) invaginations of fingerlike protrusions (spinules) into cone pedicles from dendrites of HCs increases (6) decrease the number and size of nematosomes and (7) spinule-like formation in synaptic bipolar cells terminal. Darkness produces the contrary effects.

All these phenomena are closely related to predatory and trophic teleosts behavior, when the retinal and behavioral parameters are statistically related.



GB10, A MONOCLONAL ANTIBODY SPECIFIC TO GILTHEAD SEABREAM MAST CELLS

Gómez-González N.E.¹, M.C. Rodenas¹, A. García-Alcázar², M.P. Sepulcre¹, V. Mulero¹ & A. García-Ayala¹

1 Department of Cell Biology and Histology, Faculty of Biology, University of Murcia, 30100 Murcia, Spain (nuriaesther.gomez@um.es).

2 Centro Oceanográfico de Murcia, Instituto Español de Oceanografía, 30860 Puerto de Mazarrón, Spain.

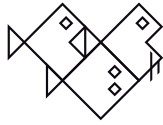
Mast cells are pro-inflammatory granular leukocytes located at host-environment interface, thus being exposed firsthand to invading microorganisms and environmental stressors. In fish, histamine-containing mast cells have only been observed in perciform fish (the largest and most evolutionarily advanced order of teleosts), including gilthead seabream. Histamine plays an essential role in the initiation of inflammation, but this role has only been demonstrated in specific groups of vertebrates (perciform fish, reptiles, birds, and mammals). The lack of information on many aspects of non-mammalian mast cells biology is partly due to the lack of available protocols for the isolation of mast cells from lower vertebrates.

Gilthead seabream (*Sparus aurata* L.) is a marine, protandrous hermaphrodite teleost, which have a great commercial value in the Mediterranean area.

Here, we have generated a monoclonal antibody against seabream mast cells, GB10. This antibody was obtained in BALB/c mice by the injection of highly pure populations of seabream mast cells. The cell suspension of the immunized mouse spleen was fused with the myeloid cell line SP2/0-Ag14 and antibody producing hybridomas were analysed by flow cytometry. Serial cloning of the positive mast cells labelling hybridomas resulted in a hybridoma line that produces a monoclonal antibody specific to seabream mast cells.

This new antibody will allow the better understanding of not only the role of mast cells but also histamine in the immune system of seabream. The development of methods to determine innate immune alterations in fish will improve future toxicological studies in aquaculture.

Financial Support: Fundación Séneca Agencial de Ciencia y Tecnología Región de Murcia 19883/GERM/15 and MINECO AGL2014-53167-C3-1-R.



MELANOCORTIN SYSTEM AND PUBERTY IN ZEBRAFISH: A STUDY MODEL APPLIED FOR AQUACULTURE

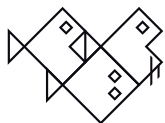
Navarro S., R. Guillot, R. Cortés, L. Soletto, S. Puchol, E. Sánchez & J.M. Cerdá-Reverter

1 Department of Fish Physiology and Biotechnology. Institute of Aquaculture of Torre de la Sal. Council of Scientific Investigations. 12595 Castellón. Spain (sandranavarro@iats.csic.es).

Pubertal precocity is a problem in intensive fish farming because adversely affects growth, food efficiency conversion and animal welfare. The slowed puberty can also be a problem for the aquaculture. Regulation of pubertal timing remains unresolved in most species. Recent experiments in *Xiphophorus* have demonstrated that the first sexual maturation is regulated by locus P, which is filled by multiple copies of the melanocortin receptor type 4 (MC4R).

Melanocortins are peptides derived from a complex precursor called proopiomelanocortin (POMC). These peptides include the different melanocyte-stimulating hormones (MSHs) and the adrenocorticotrophic hormone (ACTH). Melanocortin roles are mediated by five receptors (MC1R-MC5R). Also two endogenous antagonists regulate the melanocortin system, agouti-signaling protein (ASIP) and agouti-related protein (AGRP) that compete with the melanocortin peptides by binding to MCRs. ASIP regulates skin pigmentation by inhibiting MC1R signaling but also binds MC4R. AGRP works as an orexigenic factor, controlling food intake and growth by blocking hypothalamic activity MC4R.

Transgenesis experiments developed in our laboratory, have demonstrated that ASIP over-expression results in profuse alteration of the dorso ventral pigment pattern. We have carried out experiments to evaluate the puberty onset in zebrafish using same aged embryos from different ASIP and wildtype breeding mates. Our results demonstrate that ASIP males reach puberty earlier than wildtype fish, however studies on transgenics females suggest that puberty is delayed compared with wild type strain. We have determined the expression levels of MC4R in vitellogenic follicles and spermatozoa. In addition, we demonstrate the presence of MC4R in ovary and testis by in situ hybridization (ISH), suggesting that the inhibition of melanocortin signaling by ASIP may modulate to the zebrafish gonad development. These results represent a study model to describe the relationship between melanocortin system and pubertal timing, especially in species with growth and reproductive problems in aquaculture.



PHYSIOLOGICAL AND MOLECULAR RESPONSES TO DISTURBANCES OF PHOSPHATE BALANCE IN THE SEA BASS

Silva S.C, A. Alves, A.G. Becker & P.M. Guerreiro

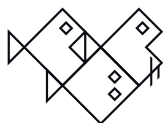
Comparative Endocrinology and Integrative Biology, Centro de Ciências do Mar, Universidade do Algarve, 8005-139 Faro, Portugal (pmgg@ualg.pt).

Our knowledge on the endocrine factors regulating inorganic phosphorus (Pi) homeostasis such as parathyroid hormone (PTH) or 1,25-dihydroxyvitamin D3 (VitD) arises from its association with calcium (Ca) but a novel factor, fibroblast growth factor-23 (FGF23) was described as a specific Pi regulator. Given its crucial importance, abundant amounts of Pi are provided in fish feeds, with deleterious effects to either fish or the environment, and further information on the mechanisms that control and regulate Pi usage by fish are valuable for the optimization of diets.

We evaluated the physiological regulation of plasma Pi levels and the molecular profiles of genes related to Pi metabolism in sea bass, *Dicentrarchus labrax* fed different Pi dietary regimes (0.05-0.3-1.1-3%, up to 70 days) or injected with saline containing excessive Pi or Ca as to induce immediate disequilibrium in sensing and regulatory mechanisms.

Excessive Pi induced changes in swimming behavior and alertness, causing death in higher dosages. Changes in expression of renal transporting proteins regulating reabsorption/excretion were seen within 4hrs and Pi levels had returned to control values at 24hrs. Fish fed 0.05% Pi-diet showed a marked decreased on plasmatic Pi levels, but Ca levels were not affected in any group. Surprisingly, altered dietary P had no effect on growth or survival rate but modified the incidence and type of skeletal malformations. Dietary imbalance produced significant alterations in expression of genes related to Pi uptake in kidney and pyloric caeca within 10 days, and in the receptors for PTHrP (PTHr3) and the co-factor α KLOTHO, after 30 days. FGF23, mainly produced in the Corpuscles of Stannius, the source of the anti-hypercalcemic factor stanniocalcin (STC), was just slightly modified by diet but changed with Pi injection. We provide information and discuss the complex network of molecular factors involved in the regulation of Pi uptake, utilization and excretion.

This work received national funds from FCT- Foundation for Science and Technology PTDC/BIA-ANM/4225/2012. AGB has a postdoctoral grant from FCT (SFRH/BPD/96187/2013).



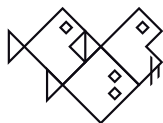
DAILY RHYTHMS OF LIPID METABOLIC GENE EXPRESSION IN ZEBRA FISH LIVER: RESPONSE TO LIGHT/DARK AND FEEDING CYCLES

Paredes J.F., J.F. López-Olmeda, F.J. Martínez & F.J. Sánchez-Vázquez

Department of Physiology, Faculty of Biology, Regional Campus of International Excellence "Campus Mare Nostrum", University of Murcia, 30100 Murcia, Spain (jf.paredessalas@um.es).

Despite numerous studies about fish nutrition and lipid metabolism, very little is known about the daily rhythm expression of lipogenesis and lipolysis genes. This research aimed to investigate the existence of daily rhythm expressions of the genes involved in lipid metabolism and their synchronization to different light/dark (LD) and feeding cycles in zebra fish liver. For this purpose, three groups of zebra fish were submitted to a 12:12 h LD cycle. A single daily meal was provided to each group at various times: in the middle of the light phase (ML); in the middle of the dark phase (MD); at random times. After 20 days of acclimation to these experimental conditions, liver samples were collected every 4 h in one 24-h cycle. The results revealed that most genes displayed a significant daily rhythm with an acrophase of expression in the dark phase. The acrophase of lipolytic genes (lipoprotein lipase – lpl, peroxisome proliferator-activated receptor – ppara and hydroxyacyl CoA dehydrogenase – hadh) was displayed between ZT 02:17 h and ZT 18:31 h. That of lipogenic genes (leptin-a – lepa, peroxisome proliferator-activated receptor – ppar γ , liver X receptor – lxr, insulin-like growth factor – igf1, sterol regulatory element-binding protein – srebp and fatty acid synthase – fas) was displayed between ZT 15:25 h and 20:06 h (dark phase). Feeding time barely influenced daily expression rhythms, except for lxr in the MD group, whose acrophase shifted by about 14 h compared with the ML group (ZT 04:31 h versus ZT 18:29 h, respectively).

These results evidence a strong synchronization to the LD cycle, but not to feeding time, and most genes showed a nocturnal acrophase. These findings highlight the importance of considering light and feeding time to optimize lipid metabolism and feeding protocols in fish farming.



SENSORY AND MICROBIOLOGICAL CHANGES DURING ICE STORAGE OF SEABREAM (*Sparus aurata*) FED WITH A DIET CONTAINING VEGETABLE OILS

Álvarez A., A. Hernández, B. García-García & M.D. Hernández

IMIDA-Acuicultura. 30740 San Pedro del Pinatar. Murcia. Spain (anam.alvarez2@carm.es).

Researches on the use of diets based on alternative raw materials in aquaculture production have become increasingly important in recent years. An important aspect when evaluating the use of vegetable sources is its effect on the quality changes and deterioration of the product over time in storage.

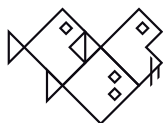
In order to study the effect of including vegetable oils in the diet on shelf-life of gilthead seabream, fish (197.2±14.1g initial body weight) were fed one of two diets containing either 100% fish oil (FO) or a 75% vegetable oil blend (VO) (50/50 soybean and rapeseed oil). When the animals reached commercial size (425.7±42.0 g), they were slaughtered and whole ungutted were stored on ice at 4°C for 0, 7, 14 and 21 days.

At each point during the sampling, microbiology analyses (aerobic mesophiles and psychrophiles, and *Pseudomonas* counts) and sensory evaluation (external appearance, muscular condition, body odour, appearance of eyes, and colour and odour of gills) were performed from each group to assess the degree of spoilage in fish. The sum of the scores given for each sensory parameter is the final Quality index, which uses a score of demerit points, increasing as the fish deteriorate.

Sensory and microbiology analyses were of great significance over storage time in fish fed either diet ($p < 0.001$). The results showed differences between the dietary groups for some of the sensory attributes and in the counts for some microorganisms. However, no significant differences were observed in the Quality index or in the mesophile count, which are the two factors that ultimately determine the acceptability of the product. Therefore, the partial replacing of fish oil by mixing vegetable oil tested in this study it would be feasible regarding that not significantly affect to the preservation of fish in cooling.

Acknowledges

This research was supported by grants from the project "Characterization of quality in farmed fish" financed by the Planes Nacionales de Acuicultura of JACUMAR (Spain). The study was also partially sponsored by the IMIDA grant program.



LIFE CYCLE ASSESSMENT (LCA) OF GILTHEAD SEA BREAM (*Sparus aurata*) CULTURED IN OFFSHORE FISH FARMS

García-García B.¹, C. Rosique-Jiménez², F. Aguado-Giménez¹ & J. García-García¹

1 IMIDA, Calle Mayor s/n, 30150 La Alberca, Murcia, España (benjamin.garcia@carm.es).

2 Universidad de Murcia, Edificio C, Campus de Espinardo, 30100 UM, Murcia (croisque@um.es).

Life cycle assessment (LCA) is an international standardized method (ISO, 2006) designed to evaluate the global environmental impacts of a product or a service. Life cycle includes all the different phases required for obtaining product-service and this includes the collection of raw materials and energy production, manufacturing, transportation, use, and wastes disposal.

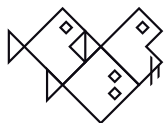
The aim of this study was to perform the LCA of the production of *Sparus aurata* in a offshore fish farm, in order to evaluate the environmental burdens of different system components.

We designed an ongrowing installation offshore sea cages as representative of Spanish Mediterranean exploitations with an annual production of 1,000 tonnes, based on the technology already in use for *Sparus aurata*.

The boundaries of the system include the following components: INSTALLATION consisting of 20 cages and anchoring them; FEED that includes the production of raw materials, transport, processing of the feed, and packaging and transportation to the farm; GROWTH that includes emissions of N and P produced by the biological transformation of feed; and FUEL consumption and emissions of diesel and lubricants for ships. SimaPro 8.04 was the software used for the computational implementation of the life cycle inventories. CML-IA was the method used for the environmental characterization.

Feed production represents a major contribution to the potential environmental impacts, while contributions from the installation are very low. The raw materials for the production of feed were those that had a greater contribution on the potential environmental impacts, especially fish meal and soybean meal. The feed formulation should be based not only on economic criteria and ongrowing performance (growth and conversion index) but also in relation to potential environmental burdens associated with raw materials.

Financing: Programa Operativo FEDER 2014-2020. Región de Murcia: 14-20-09.



IN VITRO MODULATION OF CYTOKINES BY PATHOGENS AND PROBIOTICS ON THE SKIN OF GILTHEAD SEABREAM (*Sparus aurata*)

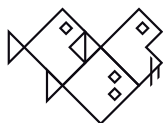
H. Cordero¹, M. Mauro^{1,2}, D. Ceballos-Francisco¹, A. Cuesta¹, M. Cammarata² & M.Á. Esteban¹

¹ Fish Innate Immune System Group, Department of Cell Biology and Histology, Faculty of Biology, Regional Campus of International Excellence "Campus Mare Nostrum", University of Murcia, 30100 Murcia, Spain (cordero@um.es).

² Marine Immunobiology Laboratory, Department of Biological Chemical Pharmaceutical Science and Technology, University of Palermo, Via Archirafi 18, Palermo, Italy.

Gilthead seabream (*Sparus aurata*) is the only species of the Sparidae family currently bred on a large scale. As one of the most important species on Mediterranean aquaculture. For this main reason, the knowledge of its immune system and their alterations it is crucial to avoid economic losses worldwide. Fish are in intimate contact with their environment and defending itself by a complex system of innate defence mechanisms, that is divided into physical barriers, cellular and humoral components. The skin as a physical barrier seems to be central to protection from pathogens such as *Photobacterium damsela* ssp. *piscicida*. Probiotics are microorganisms (usually bacteria) that promote different benefits on host. The aim of this work was to evaluate the *in vitro* capacity of *Shewanella putrefaciens* also known as Pdp11 (a probiotic isolated from skin of gilthead seabream) to improve the skin immune defence against *Photobacterium damsela*. Thus, we analyzed by qPCR the expression profile of different cytokines in seabream skin explants, in response to an exposure (of 2 and 4 hours) to the probiotic Pdp11 and the pathogen *Photobacterium damsela*. Our results showed that the different cytokines are modulated by both the pathogen (*P. Damsela*) and the probiotic (Pdp11), which could, at least in *in vitro* level, improve the gilthead seabream mucosal health. Further studies are necessary to unravel if the present findings *in vitro* can be confirmed through *in vivo* studies.

Acknowledgements: H.C. and D.C.F. wish to thank the Spanish Ministry of Economy and Competitiveness for each F.P.I. scholarships. This work was supported by the Spanish Ministry of Economy and Competitiveness (grant no. AGL2014-51839-C5-1-R) co-funded with the European Regional Development Funds (FEDER) and *Fundación Séneca de la Región de Murcia (Grupo de Excelencia* grant no. 19883/GERM/15).



SPERM QUALITY IN FISH: FACTORS TO CONSIDER FOR APPLICATION IN AQUACULTURE

Gallego V.^{1,2}, M. Yoshida¹, L. Pérez¹ & J.F. Asturiano¹

¹ Grupo de Acuicultura y Biodiversidad. Instituto de Ciencia y Tecnología Animal. Universitat Politècnica de València, 46022 Valencia, Spain (jfastu@dca.upv.es).

² Misaki Marine Biological Station. University of Tokyo. Miura, Kanagawa 238-0225, Japan.

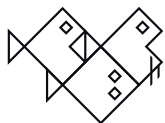
The use of high quality gametes from both males and females is essential in order to achieve high fertilization and hatching rates. Some studies have demonstrated that both sperm quantity and quality have a great influence on fertilization success, and the gradual appearance of CASA (Computer-assisted sperm analysis) systems has allowed estimating a higher number of sperm motion traits, which could be related with fertilization ability.

With this objective, pufferfish (*Takifugu niphobles*) were caught during the spawning season and moved to the MMBS facilities. Fresh sperm was obtained by abdomen pressure, diluted, activated by sea water and evaluated using a CASA software (ISAS, Proiser R+D, S.L.). Eggs were stripped applying gentle abdomen pressure just before the fertilization assay. In Trial 1, batches of eggs from 1 female were separately fertilized with sperm from 5 males at different post-activation times (5, 20 and 35 s); in trial 2, three different sperm/egg ratios (103, 104 and 105) were tested simultaneously using sperm activated after three different times (5, 20 and 40 s).

The obtained results demonstrated that sperm/egg ratio and sperm quality are factors strongly related to each other in the pufferfish. Our results suggest that both factors should be taken into account as unique interrelated elements, making possible to obtain high fertilization rates using a successful combination of small amount of high quality sperm or high amount of low quality sperm.

In addition, coefficients of correlation among all the sperm motion parameters provided by CASA software and fertilization/hatching rates were estimated for the first time in a marine species. Positive significant correlations were found in some parameters such as total and progressive motility (0.68 and 0.70, respectively). However, spermatozoa velocities showed the highest coefficients of correlation (>0.80). Thus, spermatozoa velocity appears to be a key factor in the fertilization process, especially when the number of spermatozoa per egg is limited in the aqueous environment.

Funded by the Spanish MINECO (SPERMOT: AGL2010-16009; BES-2009-020310; EEBB-I-12-05858).



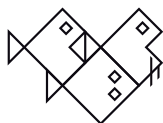
EVALUATION OF TOXA AND LYSATE *Vibrio parahaemolyticus* ON HUMORAL IMMUNE RESPONSE IN MUCUS AND SERUM AND IMMUNE-RELATED GENES IN PACIFIC RED SNAPPER

Reyes-Becerril M., C. Guluarte & C. Angulo

Centro de Investigaciones Biológicas del Noroeste (CIBNOR), Instituto Politecnico Nacional 195, Col. Playa Palo de Santa Rita, 23090 La Paz, B.C.S., Mexico (cguluarte@pg.cibnor.mx).

The administration of immunostimulants has appeared as a very promising biological control for aquaculture. *Vibrio parahaemolyticus* is a bacterium pathogenic that actually is the cause of anemia progressive in animals, lethargy and skin hemorrhages. Recent studies have demonstrated that bacterial extracts and pathogen extracellular proteins usually are potential immunogens. Therefore, the present study evaluated the effect of the administration of two immunostimulants: ToxA, a subunit of a toxin of *Vibrio parahaemolyticus* and lysate *V. parahaemolyticus* on humoral immune response and immune-related genes in Pacific red snapper (*Lutjanus peru*). Fish were injected with one of the three treatments: ToxA-Vp, Lysate-Vp and PBS (control). Two injections were administered and fish were sampled 24 hours or 1 week after each injection. One week after the second injection, fish were intraperitoneally injected with 1×10^9 cells/ml of live *V. parahaemolyticus* and samples were taken 7 days after exposition infection (day 21). It was found that ToxA-Vp can enhance the innate immune response in skin mucus of Pacific red snapper and IgM levels after second immunostimulation even after challenge with *V. parahaemolyticus*. Both treatments have a similar behavior in serum where ToxA-Vp and lysate-Vp were higher than control group. The up-regulation of immune-related genes was observed in cells and immune tissue following ToxA-Vp injection at any time of immunostimulation. Our results indicated that application of ToxA may be used to increase disease resistance against *Vibrio parahaemolyticus* in Pacific red snapper.

The Pacific red snapper *Lutjanus peru* specimens were kindly donated by Dr. Minerva Maldonado. We thank IBQ, Erika Alamillo Mendoza for their molecular technical support and Ms Pablo Monsalvo and Gabriel Robles Villegas for technical support with fish. The project was funded under CONACYT grants: INFR-2014-01/225924 and PDCPN2014-01/248033.



FISH SKIN MUCOSAL IMMUNITY. THE ROLE OF IMMUNITY IN SHAPING EVOLUTIVE ASPECTS OF LIFE

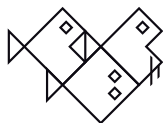
Esteban M.A., D. Ceballos-Francisco, H. Cordero, J. Meseguer & A. Cuesta

Fish Innate Immune System Group. Department of Cell Biology and Histology. Faculty of Biology, Campus Regional de Excelencia Internacional "Campus Mare Nostrum", University of Murcia, 30100 Murcia, Spain (dianacecilia.ceballos@um.es).

MALT (mucosa-associated lymphoid tissue) of vertebrates constitutes a very great area for the possible invasion of pathogens and contains defense mechanisms (both innate and adaptive) that constitute the first line of protection against an extensive spectrum of pathogens present in the environment. In the case of fish, MALT is present in skin, gill and gastrointestinal tract although its characterization has received little research interest till recent years. As part of this MALT, fish skin plays a critical role in the defense. The external constituent of this barrier is a mucous gel that forms a layer of adherent mucus covering the epithelial cells, both acting as the first biological barrier. Fish skin mucus contains several immune substances still poorly studied. We have evaluated some immune-related proteins (such as immunoglobulins, lysozyme, peroxidase, alkaline phosphatase, esterases, proteases and antiproteases) as well as terminal carbohydrate composition or the bactericidal activity against different fish pathogenic bacteria in different marine teleosts of interest in aquaculture. Furthermore, we have demonstrated that fish diet affects the skin mucus immunity and its antioxidant capacity. Now our interest is also focus on the characterization of immune defenses in free-living animals establishing new interdisciplinary collaborations that open new possibilities for understanding the trade-offs between immunity and other physiological mechanisms in wild fish populations.

Acknowledgements

D.C.F. and H.C. wish to thank the Spanish Ministry of Economy and Competitiveness for both F.P.I. scholarships. The financial support of the Spanish Ministry of Economy and Competitiveness (grant n° AGL2014-51839-C5-1-R) and the *Fundación Séneca de la Región de Murcia* (grant no. 19883/GERM/15, *Grupo de Excelencia de la Región de Murcia*, Spain) is also acknowledged.



APOPTOTIC EFFECTS OF INORGANIC ARSENIC EXPOSURE ON EUROPEAN SEA BASS (*Dicentrarchus labrax*)

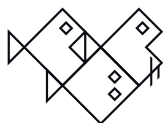
Cordero H.¹, P. Morcillo¹, F. Buonocore², J. Meseguer¹, A. Cuesta¹ & M.A. Esteban¹

¹ Fish Innate Immune System Group, Department of Cell Biology and Histology, Faculty of Biology, Regional Campus of International Excellence "Campus Mare Nostrum", University of Murcia, 30100 Murcia, Spain (cordero@um.es).

² Dipartimento di Scienze Ambientali, Università della Tuscia, 01100 Viterbo, Italy.

Inorganic arsenic (As) is one of the most toxic pollutants in the environment, especially in water. The accumulation and harmful effects of As are dangerous not only in fish but also for human consumption. To evaluate its impact on farmed fish, we have studied the histopathology and gene expression profile of apoptotic genes in liver, gill and skin of the marine teleost European sea bass (*Dicentrarchus labrax*) at 2 and 10 days of 5µl of As₂O₃ waterborne exposure. Our results showed accumulation of As in liver and gill, and through the histologic analysis of liver revealed a cellular disorganization and a temporary increase of apoptotic/necrotic processes and in the degree of vacuolization after 2 and 10 days of metal exposure. The expression profile of five genes (bax, bcl2, casp3, casp8 and casp9) involved in apoptosis cell death have confirmed apoptotic effects in liver, slight changes in gill and no effects in skin according with the histopathology findings. Overall, this work describes for first time the apoptotic effects of As exposure on European sea bass, one of the most consumed fish in Europe.

Acknowledgements: H.C. wishes to thank the Spanish Ministry of Economy and Competitiveness for a F.P.I. scholarship. This work was supported by the Spanish Ministry of Economy and Competitiveness (Grant no. AGL2011-30381-C03-01 and AGL2013-43588-P) co-funded with European Regional Development Funds (FEDER) and Fundación Séneca de la Región de Murcia (Grupo de Excelencia 19883/GERM/15).



METAL CONCENTRATION ASSESSMENT USING BLOOD SAMPLES OF TWO TOP PREDATOR FISH SPECIES: CABO DE PALOS- ISLAS HORMIGAS MARINE PROTECTED AREA, SPAIN

Pereñíguez J.M.¹, C. Ruiz-Olivares², R. Hernández-Andreu¹, V. Piquer³, E. Mañanós³, F.C. Félix-Hackrad⁴, C.W. Hackrad⁴, J.A. García-Chartón¹ & M. Motas⁵

1 Departamento de Ecología e Hidrología. Universidad de Murcia. 30100 Murcia. España (josemanuel.pereniguez@um.es).

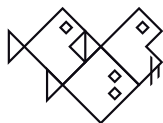
2 Departamento de biología marina y oceanografía. Instituto de Ciencias del Mar (CSIC). 08003 Barcelona. España.

3 Departamento de Fisiología de Peces y Biotecnología. Instituto de Acuicultura Torre de la Sal (CSIC). 12595 Castellón. España.

4 Centro de Formación en Ciencias Ambientales. Universidad Federal del sur de Bahia. 45810-000 Porto Seguro, Bahia. Brasil.

5 Departamento de Ciencias Sociosanitarias. Universidad de Murcia. 30100 Murcia. España.

Effects of metal accumulation in the marine biota are of great concern due to their possible effects on ecosystem function and productivity. Species of high trophic levels provide integrated information about bioaccumulation trends within their distribution range. Nevertheless, two factors constrain their current use as bioindicators of metal contamination: i) the difficulty of getting samples without sacrificing the organism, and ii) the lack of knowledge about how factors derived from fish behavior (e.g. feeding or usual distribution in the water column) may contribute to bioaccumulation. Here, we assessed the use of blood samples as a biomonitoring tool of metal contamination in two top predator fish species (*Epinephelus costae* and *Epinephelus marginatus*). For this aim, we studied the relationship among metals concentrations of Fe, Cu, Hg, Pb, Zn, Se, Cd and As, as well as their levels among species and by size through analyzing blood samples following ICP-MS technique. Detectable concentrations of Cd were not found for any of the species. Significant Zn/As, As/Se and Pb/As correlations were found for *E. costae*, while for *E. marginatus* only Cu/Pb and Zn/Se were related. A strong positive relationship between mercury concentration and size was found in both species, while zinc and copper levels were positive related to size only in *E. marginatus*. Selenium differed significantly between species, with higher concentrations in *E. costae*. Mercury concentrations found require further research in edible tissues (e.g. muscle) since there is no regulation establishing thresholds for mercury concentrations in blood. According to our results, the use of blood as a monitoring tool for metal contamination could be posed as an alternative to other techniques which need the sacrifice of the individuals, especially for those species that are in a critical state of conservation at local or/and global scale.



CONTRIBUTION TO THE CHARACTERIZATION OF FRESHWATER FISH WITH GASTRONOMIC INTEREST - FILLET NUTRITIONAL COMPOSITION AND METAL CONTAMINANTS

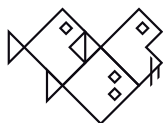
Rodrigues A.M.^{1,3}, **V.H. Oliveira**¹, **P. Antunes**², **L. Paulo**² & **L. Pinto de Andrade**^{1,2,3}

1 Escola Superior Agrária – Instituto Politécnico de Castelo Branco, Qt.ª da Sr.ª de Mércules, 6001-909, Castelo Branco, Portugal (amrodrig@ipcb.pt).

2 Centro de Apoio Tecnológico Agro-Alimentar (CATAA) – Zona Industrial de Castelo Branco, Rua A, 6000-459 Castelo Branco, Portugal.

3 CERNAS-IPCB, projeto UID/AMB/00681/2013 financiado pela FCT.

In some regions of Portugal largemouth bass (*Micropterus salmoides*, Lacépède, 1802), Iberian barbel (*Luciobarbus comizo*, Steindachner, 1864) and common carp (*Cyprinus carpio*, Linnaeus, 1758) are fish species much desired by anglers. In regions of Beira Baixa, Ribatejo and Alentejo those species have high gastronomic interest. However little is known about the nutritional composition and the presence of heavy metals in the edible part of this fish species used for human consumption. The aim of this work was to evaluate the nutritional composition and quantify the metals present on fish muscle tissue. For this study ten specimens of each fish species were captured in Beira Baixa region lentic systems (Ocreza, Ponsul and Tagus rivers and Santa Águeda and Tamujais dams). Once caught all the fish were frozen. In laboratory individuals were measured, weighed, sexed and filleted and the fillet were analyzed. Statistical analysis was performed using SPSS. There were no statistical differences in the fillet energy value of the three fish species. On the other hand, largemouth bass fillets had more K, Na and Mg ($p < 0.05$), Iberian barbell fillets had more protein, Ca and P ($p < 0.05$) and common carp fillets had more moisture, fat, and ash ($p < 0.05$). Cd, Cr and Pb presented concentrations below ICP-OES limit of quantification (0.05, 0.03 and 0.2mg/kg wet weight respectively) for all fillet samples. For other metals, it has been found that the carp fillets have higher Cu (0.34 ± 0.088 ; $p < 0.05$), Fe (10.55 ± 4.700 ; $p < 0.05$) Mn (0.19 ± 0.046 ; $p < 0.05$) and Zn (6.73 ± 1.513 ; $p < 0.05$) values (mg/kg wet weight). We concluded that edible part of largemouth bass, Iberian barbel and common carp had high contents of protein, low fat, low calorie and exhibit low levels of heavy metals below the maximum permissible for a safety utilization of these fishes in human nutrition.



TEMPERATURE MODULATES EEL MATURATION

Peñaranda D.S., L. Pérez, M. Morini, V. Gallego, M. Carmen-Vílchez, J.G. Herranz-Jusado, C. Rozenfeld & J.F. Asturiano

Grupo de Acuicultura y Biodiversidad. Instituto de Ciencia y Tecnología Animal. Universitat Politècnica de València. 46022 Valencia, Spain (jfastu@dca.upv.es).

Natural stocks of eel species (*Anguilla* spp.) have suffered a dramatic decrease due to various factors, such as overfishing, habitat reduction and pollution, and at the same time it is a highly valued species in the market. Reproduction in captivity seems an alternative to reduce the pressure on natural populations and supply glass eels to eel farms.

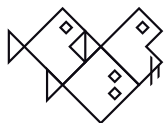
In some species, reproduction in captivity can be controlled using exclusively environmental factors (photoperiod, temperature, salinity) but often the use of exogenous hormones is the only effective method to induce the sexual maturation. Eel species do not mature spontaneously in captivity, thus it is necessary the application of long-term gonadotropic treatments, such as injections of carp or salmon pituitary extracts in females or of human chorionic gonadotropin in males. However, fish pituitary injections used to mature these species caused abnormal gonadotropin profiles.

The European eel (*Anguilla anguilla*) is a teleost with a peculiar life cycle in which pubertal individuals undertake a transatlantic migration until the spawning areas at the Sargasso Sea. Apparently, they swim in less depth and warmer waters through the night (means of 282 m and 11.7 °C), while at dawn they descend to deeper and colder waters (means of 564 m and 7-10 °C).

Classically, the water temperature in the spawning area of the European eel has been considered to be at 20 °C. Probably for this reason, European eels have been matured at a constant water temperature around 20 °C. Nevertheless, the influence of the temperature on maturation process of the European eel has been recently evidenced both in females and males.

In females, a variable thermal regime that increased from 10 to 17 °C induced higher endogenous FSH levels which increased E2 circulating level during vitellogenesis. In males, androgen synthesis happened even at low temperature (10 °C), inducing the spermatogenesis until meiosis step, but higher temperatures to 10 °C were necessary to induce a change in the steroidogenic pathway towards oestrogen and progesterin synthesis, and causing the full spermiation.

Acknowledgements. Funded by ITN IMPRESS (Marie Skłodowska-Curie Actions; Grant agreement n°: 642893), COST Office (COST Action FA1205: AQUAGAMETE) and MINECO (AGL2013-41646-R).



SEASONAL, ONTOGENETIC AND SEXUAL VARIATIONS OF PHYSIOLOGICAL PARAMETERS IN THE SMALL-SPOTTED CATSHARK (*Scyliorhinus canicula*) IN DEEP-SEA FREELIVING CONDITIONS

Valls E.¹, J. Navarro^{2,3}, C. Barría¹, M. Coll^{1,4}, J. Fernández-Borras⁵ & G. Rotllant¹

1 Institut de Ciències del Mar (ICM-CSIC), Passeig Marítim de la Barceloneta, 37-49, 08003 Barcelona, Spain (elisenda.vallsmateus@gmail.com).

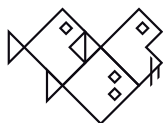
2 Department of Conservation Biology, Estación Biológica de Doñana CSIC), Avda. Américo Vespucio s/n, Sevilla 41092, Spain.

3 Centre d'Ecologie Fonctionnelle et Evolutive, UMR 5175, CNRS - Université de Montpellier - Université Paul-Valéry Montpellier - EPHE, Montpellier, France.

4 Institut de Recherche pour le Développement, UMR MARBEC, Avenue Jean Monnet BP 171, 34203 Sète cedex, France.

5 Departament de Fisiologia, Facultat de Biologia, Universitat de Barcelona, Avinguda Diagonal, 645, Barcelona E-08028, Spain.

Marine predators, such as elasmobranchs, exhibit variations in nutritional conditions related to both reproductive traits and food availability in the marine environment throughout the year. The main objective of this study was to examine changes in several blood physiological parameters in a demersal shark, the small-spotted catshark (*Scyliorhinus canicula*), in the wild in relation to season, sex and maturity stage. For this purpose, 108 individuals at different developmental stages were captured and released alive in the Western Mediterranean. Blood was obtained from caudal vessels and plasma lipid fractions (total cholesterol, triglycerides and phospholipids) and a ketone body (3- β -hydroxybutyrate) were measured. During summer, plasma triglyceride and phospholipid levels were lower in adults than in juveniles (mainly in females, probably related to breeding season and laying eggs). Plasma cholesterol levels also showed higher values in summer, indicating higher physical activities during summer and revealing that lipid fractions are more related to reproduction than to nutrition. Plasma 3- β -hydroxybutyrate variations showed a different pattern. No differences were found between sex or maturity stage during summer, although the highest values in adult and juvenile males during winter indicates higher physical activity of males. This study, uses an innovative methodology to establish a correlation between lipid fractions and ketone bodies from the blood of wild individuals and changes in sexual and nutritional status. This method was conducted without damage to the target species and provides new information on the physiology of this abundant elasmobranch in the Mediterranean Sea.



EFFECT OF THE HIDROACOUSTIC SAMPLING DESIGN ON THE ESTIMATION OF THE ABUNDANCE AND BIOMASS OF FISH IN LAND-PONDS AQUACULTURA

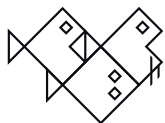
Encina L., V. Rodríguez-Sánchez, A. Rodríguez-Ruiz, C. Orduna & J.R. Cid-Quintero

Departamento de Biología Vegetal y Ecología. Universidad de Sevilla. 41012 Sevilla. Spain (lencina@us.es).

Aquaculture is a sector with growing demand in our country. For companies working in this sector, it is very important to control the number of fish and the biomass in the growing ponds, in order to optimize costs and control traceability. Currently these parameters are obtained using intrusive methods that cause stress on populations and whose results are often highly inaccurate. This work presents the results obtained in a study carried out to estimate fish density and biomass in shallow growing land-ponds of sea bream and bass, using a non-intrusive technique: the hydroacoustic. Land-ponds were less than 2,5m depth so horizontal hydroacoustic surveys were applied.

Surveys were made in ponds with newly stocked fish and ponds where the fish were later fully harvested, allowing to test the efficiency of the developed method as a reliable tool for fish density and biomass estimations. The sampling methodology was in all cases the linear transect, although several paths of prospecting were tested, in order to find less deviation comparing to the expected values.

The developed method is a pioneer in the sector and the results are very promising, obtaining adjustments of up to 95%, revealing that the horizontal hydroacoustic technique can become a highly effective management tool in the control of fish farms.



HOW TO IMPROVE THE PROGRAM FOR RESTOCKING OF NATIVE FISH IN COLOMBIA?: RESEARCH EXPERIENCES WITH THE BOCACHICO

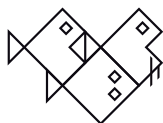
Prochilodus magdalenae

Narváez J.C.^{1,2}, G. Orozco¹, J. C. Aguirre¹, A. Torregróza¹, E. Muñoz¹, N. Chaparro¹ & L. Castro²

1 Grupo de Biodiversidad y Ecología Aplicada, Laboratorio de Genética Molecular, Programa de Ingeniería Pesquera, Universidad del Magdalena, 2-1-21630, Santa Marta. Colombia (jcnarvaezb@yahoo.es).

2 Grupo de Evolución, Sistemática y Ecología Molecular, Programa de Biología, Universidad del Magdalena, 2-1-21630, Santa Marta. Colombia.

The bocachico is the most important freshwater commercial fish in Colombia. Since three decades ago and due to its importance and threat status (vulnerable), restocking to recover the fish population are being developed. To assess this practice, the genetic structure of the natural populations of the bocachico were studied at the basins of the Magdalena, Sinu and Atrato rivers and in nine fish farms that conduct restocking. It was determined that the genetic variability of 8 microsatellite loci in the broodstock of the fish farms was very low ($H_o=0.018-0.308$), with high levels of inbreeding ($F_{is}=0.65-0.89$) that suggest improvement in the procedures to establish them. For example, having determined that there is a positive effect in the individual genetic quality of the broodstock over the production and quality of the breeds is a path to start the process. With respect to the natural populations, low levels of genetic variability were observed ($H_o=0.099-0.392$) due to overfishing and degradation of their habitat. Likewise, a high degree of genetic differentiation was observed among the three basins (AMOVA: $F_{st}=0.101$, $p<0.005$), suggesting that they should be managed as independent management units. Despite the above, it was demonstrated that during the 30 year period of restocking, genotypes of the population of the Sinu river were introduced towards the middle and lower part of the Magdalena river, with possible hybridization. This was consistent with the analysis of the mtDNA control region. The fish farms that maintain breeders from the Sinu River and that are used to repopulate in the Magdalena River were also identified. All the above suggests that it is necessary to improve the procedures both regulatory and technical to conduct the restocking of native fish from Colombia. The most important considerations to achieve this are proposed here.



SEXUAL MATURATION IN CAPTIVITY SHEEPSHEAD *Archosargus probatocephalus* (PERCIFORMES: SPARIDAE)

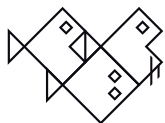
Merino-Contreras M.L.¹, F. Sánchez-Morales², M.L. Jiménez-Badillo¹ & C.A. Álvarez-González³

1 Institute of Marine Sciences and Fisheries, Veracruzana. Km. 12.5 highway Veracruz- Cordoba, Ver. Mexico (madelaluz.merino020@gmail.com).

2 University, Technological Institute of Boca del Río, National Technological Mexico.

3 Juárez Autonomos University. Mexico.

The sheepshead is a species that has been considered with great aquacultural, a priority for the development of mariculture in southeastern Mexico potential (RNIIPA, SAGARPA, 2012). Its biotech production is limited by the availability of young, so it is important to achieve maturity in captivity. The aim of this study was to achieve adaptation of a batch of bream (*A. probatocephalus*), and sexual maturation in captivity for induced spawning. To this end, they captured the middle 45 bodies were maintained for 12 months in a recirculating water salinity of 10 ppm, fed semi-moist pet food with 45% protein and 10% lipids. The increase in size and weight are recorded monthly. Sexual maturity was induced by gradually increasing the salinity of the set, 5 ppm each week, up to a salinity of 35 ppm. The degree of sexual maturity in organizations, it was found to have an intraovarian sample and gently squeezing the abdomen to check the output of semen. Spawning was induced with an intramuscular application of 500 IU/kg chorionic gonadotropin hormones and serum (PG 600 Intervet). All fish eat balanced food accepted within 30 days after their capture, recording an average increase in size and weight of 0.054 ± 0.02 cm/day and 1.7 ± 0.4 g./day, respectively. Agencies matured in January, in the same season in the wild, observed in both sexes III and IV stages of maturity, winning two spawns. Under these conditions the maturation and spawning bream achieved in captivity.



ALTERNATE DEVELOPMENT OF FISH FARMING IN MARINE AND CONTINENTAL WATER FRONTS FOR ARID CLIMATES OF MEXICO

Norzagaray-Campos M.¹, N. Muñoz-Sevilla², D. Beaz-Paleo³, D. Valdez-Martínez¹, A. Santamaría-Miranda¹, C. Omar-Llanes¹ & M. Ladrón de Guevara-Torres²

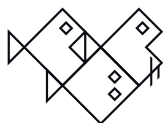
1 CIIDIR-IPN-Sinaloa. Carretera a Las Glorias, km. 1, Apdo. postal 280, Guasave, Sin., Méx. 81100. (mnorzacam@yahoo.com.mx)

2 CIIDIR-IPN-Oaxaca y CIITEC-IPN-México

3. Universidad Politécnica de Madrid.

Autores becarios de programa COFAA del IPN y EDI del IPN.

Saltwater intrusion, considered a coastal land problem, is in some countries an alternate resource for the breeding of different species. China and Australia are success cases. The objective of this project was to find in Northwest Mexico, in the coasts of Sinaloa and Sonora, environments of marine and continental water flows to associate them with potential sites for fish farming. These places were located with false colour satellite images on different combinations from the new satellite NASA LandSat 8 LDCM (Landsat Data Continuity Mission) with 12 bit OLI-radiometric resolution sensor; that cover the area to be studied. Through the program IDRISI "The selve edition" 17.0, its process visualized 8 places where monitoring was done to measure in situ, with terrestrial magnetometry, some variables like texture, apparent density, porosity of the pervaded system, water temperature, and the depth where the sedimentary packages are resting. The results show an annual average of 22 to 30 °C for the summer-winter temperature ideal for the farming of different fishes. An optimal of 15-27.5% average porosity was found for the supply of the hydrological resource influenced by a constant maritime-continental flux that flows through a not compacted granulometric composition of silts and sands that naturally guarantees the oxygenation of the system. These results of years of research and trials focused on the search of environments for the breeding and farming of species such as snapper, trout and striped bass among others, will allow guarantees in the profitability of projects of the Golf of California area and benefits that will be reflected for the nutrition and quality of life of the settlers. Due to the closeness to two of the most important agricultural valleys of Mexico, as a second phase of the project, a study concerning the relation between the environmental conditions and heavy metals, fertilizers and pesticides concentration, is recommended.



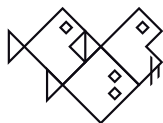
DEFINING THE SCALE OF GENOMIC DIFFERENTIATION IN THE SALMON LOUSE, *Lepeophtheirus salmonis*, IN THE NORTH EAST ATLANTIC

De Noia M.¹ & M. Llewellyn²

1 Dipartimento di Biologia, Università degli Studi di Padova, 35131 Padova (PD); Italy (michele_dni@hotmail.it).

2 Institute of Biodiversity Animal Health and Comparative Medicine, Glasgow University, 0141 330 6993, Glasgow, Scotland.

One of the most important diseases that trouble salmonids, farmed or wild, is a copepod ectoparasite: *Lepeophtheirus salmonis*. The salmon lice feed on scales, skin, underlying tissue and blood. Pathology arises through blood loss, osmoregulatory dysfunction, secondary bacterial and fungal infections. Estimated direct annual losses of €305 million (mostly the cost of treatment) A range of integrated methods are currently employed or being developed to control infestations of sea lice. Recent study detected two specific genomic regions under positive selection in pesticide resistance using SNPs as molecular marker. In this study we were trying to detect a population genetic structure in 4 sites across the North East Atlantic. The aim was to detect the scale of spatial genetic structure using a very large number of SNPs as a pilot to seascape genetic analysis. The 2bRAD (IIb restriction-site associated DNA) technique was used to detect single nucleotide polymorphisms (SNPs). Data from two endonuclease enzymes (AflI and CspCI) were merged to increase the coverage. SNPs calling has been done with Stacks. The population differentiation was detected using on Fst calculated with Arlequin, the clustering analysis was performed with adegenet package in performing PCA and DAPC. Outliers loci under positive selection were detected using Arlequin and all the analysis were performed also with these loci to refine the definition of the results. Isolation by distance was based on the distance matrix and the genetic distances were expressed by F_{st} among populations. None of the analysis performed, either with all loci either only with SNPs, show an evidence of population clustering and isolation by distance. These suggest that the salmon lice, *L. salmonis*, are a single panmictic population across the North East Atlantic.



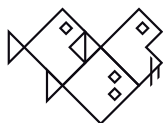
**EFFECT OF SEASONALITY, IN THE HEMATOLOGY AND BLOOD
CHEMISTRY PACIFIC RED SNAPPER
Lutjanus peru (NICHOLS AND MURPHY, 1922)**

**Santamaría-Miranda A.¹, J.P. Apun-Molina¹, M. Garcia-Marciano¹, C. Puento-Palazuelos¹,
U.V. Pelaez-Estrada², J.F. Escarrega-Roman¹ & M.I. Sotelo-Gonzalez¹**

¹ Instituto Politécnico – Nacional CIIDIR, Sinaloa, Blvd. Juan De Dios Batiz Paredes No. 250, Guasave, Sinaloa 81101
Mexico (asantama@ipn.mx.).

² Instituto Tecnológico S/N Col. Dispensario C.P. 71600, Santiago Pinotepa Nacional, Oaxaca, México.

Studies related to Pacific red snapper *Lutjanus peru* in Mexico-fishing limited to biological aspects as age and growth, sexual maturity, eating habits and some works of population dynamics of the species. However there are no published studies that analyze and describe the physiological condition and health status of *L. peru* in the Mexican Pacific, based on hematologic assessment, blood biochemistry. In the present study it is to establish benchmarks to support the determination of the health status of the species and seasonal effects on these. For this study fish caught in three different areas of the Mexican Pacific (Acapulco, Mazatlan, Topolobampo) and blood samples were obtained to determine the number of erythrocytes, leukocytes and hematocrit value in addition to the morphophysiological indices. The reference interval for erythrocytes obtained was 0.37-2.79 (x10⁶) cells / mm³ with a mean of 1.33 (x10⁶); hematocrit showed an average of 30.06%. The IRG and IH were significantly higher in Topolobampo with averages of 3.13 and 1.84% respectively. The data generated will help establish information that contributes to the sustainable management of wild populations of *L. peru* and its potential use in mariculture.



PHOTOPERIOD AFFECTS GONADAL DEVELOPMENT AND BLOOD CELL COUNTING IN PIRACANJUBA (*Brycon orbignyanus*)

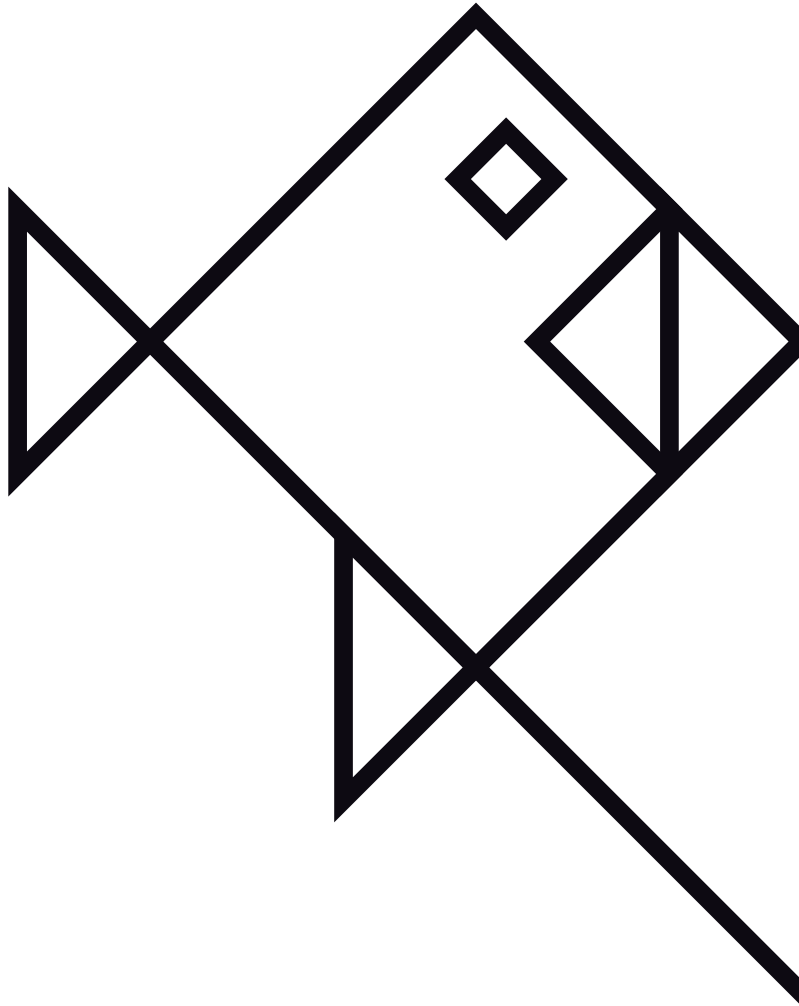
Ferreira Machado M.R.¹, E.A. de Andrade², E. de Souza-Andrade³, D.A. Paula³, A.C. Costa⁴ & L.D.S. Murgas³

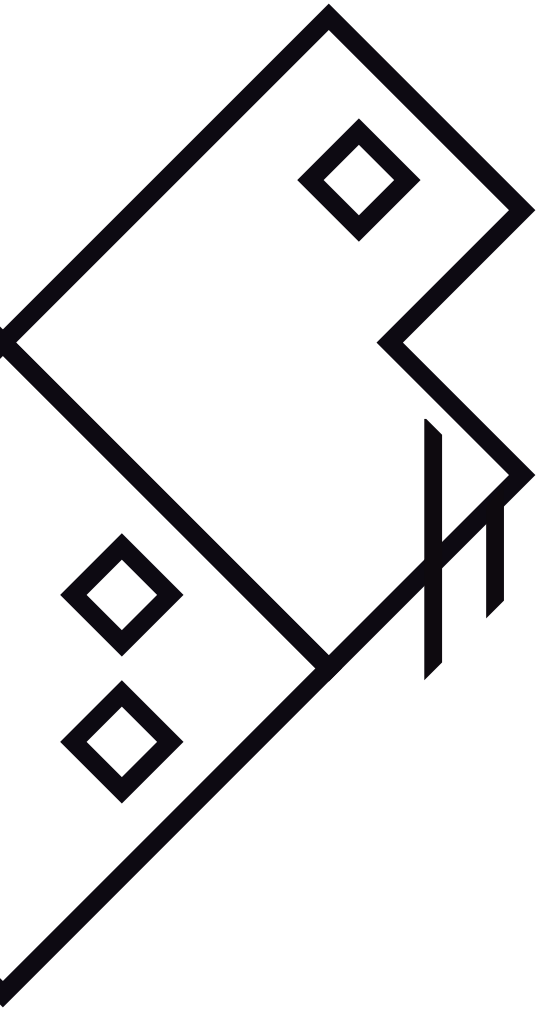
1 Bioscience institute, Jataí – Federal University of Goiás. BR364, Campus Cidade Universitária, Jataí – GO, Brasil (monicavet_2@hotmail.com).

2 Animal Science department, Federal University of Lavras, Lavras – MG, Brasil.

3 Instituto Federal Goiano, Campus Rio Verde, Rio Verde – GO, Brasil.

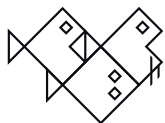
Photoperiodic treatment was evaluated on the growth of *Brycon orbignyanus*. 28 fish with 200 g, in a factorial design 2 x 2, two photoperiod 18: 6 and 6:18 light: dark and two moments of gathering 45 and 90 days. Seven fish were allocated in a 500 L polyethylene boxes with closed recirculation system and controlled photoperiod. Benzocaine 1% was used for euthanasia. The animals were weighed and measured. Visceral fat, liver and gonads were weighed separately. Hematocrit, total count of white cells, lymphocytes and segmented leucocytes were counted. There was no significant interaction for weight and standard length, and the means found were 117 g and 15.3 cm at 45 days and 136 g and 19.4 at 90 days ($p < 0.005$). Fat index and gonadosomatic index (GSI) presents a significant interaction ($p = 0.00018$) between photoperiod and time. At 90 days the fish kept in 18: 6 had a lower rate of fat (1.8) than the fish kept in 6:18 (3.0) ($p < 0.05$). The GSI was higher in the group 6:18 (0.7) compared with the 18: 6 (0.28) ($p < 0.005$). There was no interaction between photoperiod and period of treatment for total leukocyte count however with 90 days this count decrease ($p < 0.05$) from $9,5 \times 10^4$ to $4,5 \times 10^4$. A decrease of the hematocrit of 58.1% to 46.9% and an increase of lymphocytes from 31.5% to 43.5% was found in fish kept in 18: 6 after 90 days ($p < 0.05$). For segmented leukocytes no significant difference was found in this photoperiod. The fish kept in 6:18 presented an increase in segmented leukocytes and lymphocytes ($p < 0.05$). It is concluded that photoperiod maintained at 6:18, for piracanjubas, permit a greater gonadal development and an amount of immune cells over the photoperiod maintained in 18:6.





**ORAL
COMMUNICATIONS**

**INVASIVE
ALIEN FISH**

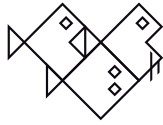


EXOTIC AND INVASIVE FISHES FROM NORTHWESTERN MEXICO AND ITS IMPACTS ON THE NATIVE FISH FAUNA

Ruiz-Campos G.

Cuerpo Académico Estudios Relativos a la Biodiversidad, Facultad de Ciencias, Universidad Autónoma de Baja California, Ensenada, Baja California, México (gruiz@uabc.edu.mx).

The current distributional status of the invasive exotic fishes in northwestern Mexico is documented for a total of 36 species (Baja California, 27 species; Baja California Sur, eight; Sonora, 26; and Sinaloa, seven) based in records of specimens collected between 1977 and 2012, and complemented with reports of literature or field observations. The hydrological basin with the highest specific richness of exotic forms is the Lower Río Colorado (21 species), resulted of the cumulative dispersion of exotic species via reservoirs and irrigation channels in the States of Arizona and California (US). The best represented families in exotic species were Cyprinidae, Poeciliidae and Centrarchidae (seven species each), followed by Ictaluridae with six species. Invasive species of wide distribution and high capacity of dispersion into the inland waters of northwestern Mexico are *Gambusia affinis*, *Poecilia reticulata*, *Lepomis cyanellus*, *Tilapia cf. zillii*, and *Oreochromis aureus*. The impacts of exotic fish species on native populations of *Cyprinodon macularius* (endangered), *Fundulus lima* (endangered), *Gila* spp., and the trouts or apariques (*Oncorhynchus* spp.) were analyzed. The introduction and dispersal of exotic fish species have been more significant in the Lower Río Colorado and Río Yaqui basins, where the introductions are mainly associated with sport fishery, stocking of foraging fish or aquaculture. Three fish species are of recent detection in the study area: amazon sailfin catfish (*Pterygoplichthys pardalis*) into the Río Culiacán (Sinaloa), the Pacific molly (*Poecilia butleri*) and gilt-head seabream (*Sparus aurata*) both in Bahía de La Paz (Baja California Sur).



YOUNG-OF-THE-YEAR COHO SALMON *ONCORHYNCHUS KISUTCH* RECRUIT IN FRESH WATERS OF REMOTE PATAGONIAN FJORDS (51°S)

Górski K.^{1,2}, J.F. González², E.M. Habit², D.E. Ruzzante³ & A. Vivancos⁴

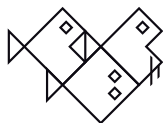
1 Departamento de Ecología, Facultad de Ciencias, Universidad Católica de la Santísima Concepción, Concepción, Chile (Konrad@UCSC.cl).

2 Departamento de Sistemas Acuáticos, Facultad de Ciencias Ambientales y Centro EULA – Chile, Universidad de Concepción, Concepción, Chile.

3 Department of Biology, Dalhousie University, Halifax, Canada.

4 Department of Zoology, University of Otago, Dunedin, New Zealand.

Salmonid invasions are currently the main threat to the conservation of freshwater ecosystems in Patagonia (southern South America). Among different salmonid species introduced in Patagonia there are different levels of success, and not all species have established widespread and large populations. To date, there are no current reports of coho salmon (*Oncorhynchus kisutch*) having established self-sustaining populations in southern Chile despite strong propagule pressure. Here, we analysed the microchemical composition of ear-bones (otoliths) of young-of-the-year coho salmon collected during a scientific expedition to estuaries as well as freshwater ecosystems (lakes and rivers) associated with remote Patagonian fjords (51°S) in order to assess their natal origins. Mean otolith edge concentrations for the different elements analysed showed variation among sites and clear differences between capture locations could be distinguished. Fish caught in the estuaries differed significantly from fish caught in lakes. These differences were mostly due to higher concentrations of strontium, manganese and magnesium and lower concentrations of barium and rubidium at the edges of the otoliths for fish caught in the estuaries. The average age of individuals caught was approximately two months, with older fish found in estuaries than in lakes. Low concentrations of strontium along line scans from the edge to the core in otoliths of fish collected in the lakes suggest freshwater residence until the moment of capture. Fish caught in the estuaries displayed higher strontium concentrations typical for estuarine fish only on the very edge of their otoliths, suggesting their very recent movement from freshwater into the estuary. Our findings, therefore, indicate that the juveniles of analysed coho salmon originate in the local freshwater ecosystem (lake) and suggest establishment of self-sustaining population.



PLASTIC RESPONSES FROM A NON-NATIVE FISH TO A DESERT DIET MENU

Gkenas C.¹, N. Campos-Martín², M.F. Magalhães³, F. Ribeiro¹ & M. Clavero⁴

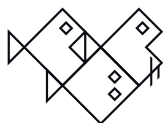
1 MARE, Centro de Ciências do Mar e do Ambiente, Faculdade de Ciências, Universidade de Lisboa, Campo Grande, 1749-016 Lisboa, Portugal (chrisgenas@gmail.com).

2 Facultad de Ciencias, Universidad de Extremadura, Av. De Elvas s/n, 06071, Badajoz, España.

3 CE3C, Centro de Ecologia, Evolução e Alterações Ambientais, Faculdade de Ciências, Universidade de Lisboa, 1749-106 Lisboa, Portugal.

4 Departamento de Biología de la Conservación. Estación Biológica de Doñana – CSIC. Av/ Americo Vespucio s.n. 41092, Sevilla, Spain.

Trophic plasticity has been suggested to contribute greatly to the success of non-native species in recipient communities. Diet generalists are more likely to utilize a wide range of prey resources in novel ecosystems, and this may favor their establishment and spread. The pumpkinseed sunfish (*Lepomis gibbosus*), one of the most successful invaders in the world, has successfully invaded Southern Moroccan rivers. These systems are shaped by strong hydrological variability, which may adversely impact on generalist diet fishes by altering prey resource availability. To address this issue, we quantified the spatial and ontogenetic variation in the diet composition and breadth of the pumpkinseed. Specifically, we analyzed the stomach content of 115 individuals, sampled at five sites in the Draa (4) and Ziz (1) rivers, in the fall of 2013. The importance of each prey category was estimated from its percentage of occurrence and the numeric abundance in the diet. Similar to what has been found elsewhere, diet displayed considerable variation in space and throughout ontogeny, being generally dominated by Chironomids, with Copepods remaining also a common prey for small fish. Nevertheless, large fish displayed a more benthic feeding than expected, broadening their prey base by consuming larger-bodied insects and also atyid shrimps. Overall diet breadth was broader in desert streams than in other invaded systems. These results add to previous ones, evidence indicating that pumpkinseed is able to alter its diet contingent on local prey resources, and suggest that generalist feeding may serve as an advantage to colonize extremely dynamic systems, such as Moroccan desert rivers.



INTER-POPULATION PLASTICITY IN GROWTH, REPRODUCTION AND DIETARY TRAITS OF INVASIVE BLEAK *Alburnus alburnus* IN IBERIAN FRESH WATERS

Latorre D.¹, G. Masó¹, A. Hinckley², A. Serhan-Tarkan³, A. Vila-Gispert¹ & D. Almeida¹

1 GRECO, Institute of Aquatic Ecology, University of Girona, 17071 Girona, Spain (danilatorre1@gmail.com).

2 Department of Ecology, Complutense University of Madrid, 28040 Madrid, Spain.

3 Faculty of Fisheries, Muğla Sıtkı Koçman University, 48000 Kötekli, Muğla, Turkey.

The bleak *Alburnus alburnus* is an invasive fish in the Iberian Peninsula, where this cyprinid species disturbs the highly endemic fish fauna. To provide insights into bleak autoecology, the aim of this study was to compare growth, reproduction and dietary traits across four Iberian streams (northeastern Spain): Muga, Fluvià, Cardener and Foix. These streams have similar environmental conditions at the regional scale (e.g. Mediterranean climate, geomorphology), which allow that variations among bleak populations are more likely to be attributable to environmental factors operating at the local scale (i.e. within stream). Bleak were collected in May-June 2012, just before the spawning period. In Cardener stream, bleak showed high back-calculated lengths at ages 1 and 2, growth rate, body condition and reproductive investment. In Foix stream, bleak showed low back-calculated length at age 2, growth rate, body condition and proportion of females, whereas length at maturity reached the highest value. Regarding dietary traits, Diptera larvae were the most common prey in percentage of occurrence. As percentage of ingested mass, flying insects (e.g. just emerged Ephemeroptera) was the most important food category in Muga and Fluvià streams, other benthic invertebrates (e.g. Gastropoda) in Cardener stream, and Diptera larvae in Foix stream. Remarkably, Foix population showed the highest intake of plant material and the lowest values for total ingested mass, prey richness, trophic diversity and trophic niche breadth. Overall, results indicate that population 'status' appears to be better in Cardener stream, whereas in Foix stream, environmental conditions may be poorer for bleak. Present findings suggest that the wide inter-population plasticity displayed by bleak allows this non-native fish to more successfully invade Mediterranean-type streams in the Iberian Peninsula. This better understanding of bleak population traits may facilitate the prediction of the most likely areas to be colonized by this invasive species throughout Iberian fresh waters.



DIETARY TRAITS OF INVASIVE BLEAK *Alburnus alburnus* BETWEEN CONTRASTING HABITATS IN IBERIAN FRESH WATERS

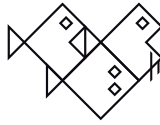
Almeida D.¹, E. García-Berthou¹, D.H. Fletcher², C. Rangel³ & E. da Silva³

¹ GRECO, Institute of Aquatic Ecology, University of Girona, 17071 Girona, Spain (david.almeida@udg.edu).

² Centre for Conservation Ecology, Bournemouth University, BH12 5BB Poole, UK.

³ Department of Zoology, University of Extremadura, 06071 Badajoz, Spain.

The bleak *Alburnus alburnus* is a limnophilic fish native to most of Europe, but not the Iberian Peninsula, where it is a successful invader that threatens its highly endemic fish fauna. Studies on bleak autoecology are scarce in this region, with few data on dietary traits. The aim of this work was to compare diet composition, seasonal variation of food intake, trophic diversity and ontogenetic shift of bleak populations between contrasting habitats in Iberian fresh waters. Bleak were seasonally collected from April 2007 to February 2008 in the small River Gévora and the Sierra Brava Reservoir (Guadiana River Basin, southwestern Spain). Log-linear analysis showed that the frequencies of empty guts were higher during winter, with this percentage being globally higher in the river. In terms of percentage of occurrence and ingested mass, plant material and planktonic Crustacea were the most important food categories in the river and the reservoir, respectively. Two-way analysis of covariance (covariate: standard length) revealed that the intake of limnetic prey was higher in the reservoir, especially during summer; benthic prey, plant material and detritus were more consumed in the river, especially benthos and detritus during spring, whereas plant intake decreased during this season; and Shannon index, as a measure of trophic diversity, was higher in the reservoir, except in spring. Generalised additive models provided a positive linear relationship (logtransformed data) between trophic diversity and fish size in the reservoir. These findings indicate that the high hydrological variability of Mediterranean-type rivers promotes harsher environmental conditions for bleak in the River Gévora. Also, the habitat-dependent seasonal variation in dietary traits demonstrates the opportunistic/generalist foraging strategy displayed by this species. Overall results suggest that this wide trophic plasticity will facilitate the bleak invasion process throughout Mediterranean Europe, which poses a serious risk to its highly valuable fish fauna.



ASSESSING THE SPATIAL DISTRIBUTION PATTERNS OF THE NON-NATIVE EUROPEAN CATFISH FROM MULTIPLE ONLINE SOURCES

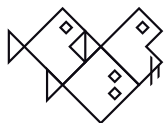
Gago J.^{1,2}, P. Anastácio³, F. Banha³, C. Gkenas² & F. Ribeiro²

1 Escola Superior Agrária, Instituto Politécnico de Santarém, Santarém, Portugal (joao.gago@esa.ipsantarem.pt).

2 MARE – Marine and Environmental Sciences Centre, Faculdade de Ciências da Universidade de Lisboa, Lisboa, Portugal.

3 MARE – Marine and Environmental Sciences Centre, Universidade de Évora, Évora, Portugal.

An effective management of invasive fishes depends on the availability of updated data about its distribution and spatial dispersion. A forensic analysis was performed using online and published data about European catfish, *Silurus glanis*, a recent invader in the Tagus basin (Iberian Peninsula). Eighty records were obtained mainly from anglers' fora and blogs and more recently from Youtube. Since the first record in 1998, *S. glanis* expanded its geographic range for approximately 700 km of river network, mainly occurring in reservoirs and in high order sections. Human mediated and natural dispersal events were identified, with the former occurring during the first years of invasion, in locations farther than 50 km from previous distribution. Downstream dispersal directionality was predominant. The analysis of online data from anglers provided extremely useful information about this non-native fish distribution and dispersal patterns and could be implemented as preliminary and exploratory evaluation for future studies.



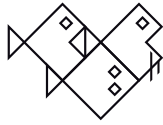
DISPERSION OF THE INVASIVE *Australoheros facetus* INTO UPPER ESTUARIES MAY BE DETERRED BY SALINITY-RELATED EFFECTS ON BOTH PHYSIOLOGY AND BEHAVIOUR

Baduy F.^{1,2}, D. Soares¹, D. Teixeira¹, M. Silva¹, J. Soares¹, A. Canário^{1,2}, J. Saraiva¹ & P. Guerreiro^{1,2}

¹ Comparative Endocrinology and Integrative Biology, Algarve Centre for Marine Sciences at
² University of Algarve, 8005-139 Faro, Portugal (flabaduy@gmail.com).

Ability to surpass osmoregulatory challenges posed by environmental salinity can be a key factor determining the colonizing success of invasive species. The neotropical cichlid *Australoheros facetus*, is invasive upstream the Guadiana and Arade estuaries in southern Portugal, where flash floods occur during the rainy season and could drag fish downstream. This work aimed at ascertain if this species can colonize the upper estuary, looking at physiological and behavioural responses of fish reared in a range of salinities. Set 1: fish (4-6cm, 2xN=30) were reared for 90 days at 0-6-12-18ppt, weighted every 15 days and sampled every 30 days. Set 2: fish (9-11cm, 3xN=60) were subject to an increase of 3ppt each 3 days. After 5 days of acclimation at 0-6-12-18ppt, blood and tissues were collected for osmoregulatory parameters and four social groups (5 fish/group at 0-6-12ppt) were formed and observed for one week for behavioural analyses. In set 1 growth reduction was obvious after 30 days of experiment at 18ppt when compared with other groups ($p < 0.05$). Aggressive behaviour was also absent and mortality reach 56% in this group. In set 2 survival rate was only 25% after 5 days at 18ppt. Muscle water content, plasma lactate and total protein showed a significant decrease, while plasma osmolality, chloride and glucose increased at 18ppt in relation to control group. For the other groups we did not observe salinity-related differences in plasma substrates or electrolytes (glucose, lactate and chloride), aggressive interactions, territorial status or dominance index. In salinities above the isosmotic point there was an increase in the activity of branchial Na/K-ATPase, an energy demand for the maintenance of hydromineral balance which may result in reduced growth and activity. Such conditions may lead to the exhaustion phase of the stress syndrome, not allowing this species to survive for long periods in estuarine environments.

Acknowledgments: FB is recipient of a doctoral fellowship from the Brazilian CNPq Program Science without Borders (245971/20122); JLS is recipient of an FCT grant SFRH/BPD/67008/2009. This study is partially funded by FCT grant CCMAR/Multi/04326/2013.



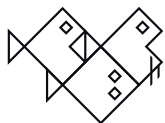
COMPETITION BETWEEN THE INTRODUCED SIGNAL CRAYFISH (*Pacifastacus leniusculus*) AND NATIVE FISHES

Vedia I., R. Miranda & E. Baquero

Department of Environmental Biology. University of Navarra. 31008 Pamplona. Spain
(ivanvedia@gmail.com).

Competitive interactions between fish and crayfish have two main focuses, food and shelter. In particular, we study the competition between the signal crayfish *Pacifastacus leniusculus* (Dana, 1825), one of the most successful crayfish invaders in Europe, and native fishes. This study is located in the Mediterranean rivers of the province of Navarra (Ebro Basin, Spain). The ethology and interspecific behavioural interactions of this crustacean fish species are widely reported in experimental aquaria. However, few studies analyse these interactions in natural settings. The goals of this study were to analyse the behaviour of *P. leniusculus* and to study its interactions with native fishes such as the stone loach (*Barbatula quignardi*), trout (*Salmo trutta*) or minnow (*Phoxinus phoxinus*). Furthermore, we evaluate the trophic competition between the crayfish and the native fish species using both stomach content and stable isotopes of carbon and nitrogen. For the ethological study we used underwater video cameras modified for night vision and infrared focuses to illuminate without disturb the natural behavior. The main behaviors of 260 individuals of signal crayfish and its interactions with native fishes were studied. Competition for habitat between signal crayfish and fishes was higher with benthic fish species. For the study of stomach content and the analysis of stable isotopes, a total of 85 individuals of signal crayfish were analyzed. The abdominal muscle of the same specimens was taken to measure the stable isotope ratios of crayfish. The trophic overlap between the crayfish and the native fishes was calculated in R with the Stable Isotope Bayesian Ellipses (SIBER). A similar diet and isotopic niche overlap was observed between the introduced crayfish and the native fishes, suggesting a trophic competition between the species when resources are limiting.

This research was funded by the Research Program of the University of Navarra (PIUNA 2014-16).



UNINVITED DINNER GUESTS – THE EFFECT OF INVASIVE FISH AND TEMPERATURE ON THE FORAGING EFFICIENCY OF SOUTHERN IBERIAN CHUB

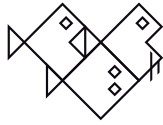
Kodde A.¹, C. Gkenas², G. Cheoo¹, F. Ribeiro² & M.F. Magalhães³

1 Faculdade de Ciências, Universidade de Lisboa, Campo Grande, 1749-016 Lisboa, Portugal (alexa_kodde1@hotmail.com).

2 MARE, Centro de Ciências do Mar e do Ambiente, Faculdade de Ciências, Universidade de Lisboa, Campo Grande, 1749-016 Lisboa, Portugal.

3 CE3C, Centro de Ecologia, Evolução e Alterações Ambientais, Faculdade de Ciências, Universidade de Lisboa, 1749-106 Lisboa, Portugal.

Biological invasions are a major cause of biodiversity loss, having multiple ecological effects on native biota, mainly through trophic interactions. Competition for food has potentially serious impacts on native fauna, and may be of great concern in respect to the highly valuable endemic fish fauna inhabiting streams in the Iberian Peninsula. The outcome of trophic interactions is often mediated by abiotic factors, such as temperature, and may thus be significantly affected under future climate scenarios. In this study we focused on the effects of temperature on trophic relationships between the endangered native Southern Iberian chub *Squalius pyrenaicus* and two ecologically damaging invaders, the pumpkinseed sunfish *Lepomis gibbosus* and the chameleon cichlid *Australoheros facetus*. We quantified prey capture rate and speed for each species in single and in pair (intra- and interspecific) trials, at 19, 24 and 29°C. Rate and speed of prey capture were variable among species and temperatures. Individually, chub was less efficient than both non-natives in capturing preys. In pair trials, the speed of prey capture by all species was reduced and contingent on temperature, but overall, the pumpkinseed and the cichlid were faster than the chub. Our findings demonstrated that the impact of invasive species is influenced by temperature, and will have severe implications on long term survival of native endemic fish, considering future climate projections.



GROWTH AND DEMOGRAPHY OF MINNOW (*Phoxinus phoxinus*) IN HIGH MOUNTAIN LAKES OF THE PYRENEES: INITIAL RESULTS OF THE PROJECT LIFE *LIMNOPIRINEUS*

Pou-Rovira Q.¹, E. Cruset¹, M. Bacardit¹, I. Jurado¹, M. Márquez¹, A. Fernández¹, C. Cárceles¹, I. Fernández¹, E. Andrés², I. Sabás², A. Miró², T. Buchaca² & M. Ventura²

¹ Sorelló, estudis al medi aquàtic. Parc Científic de la UdG, 17003, Girona (quim.pou@sorello.net).

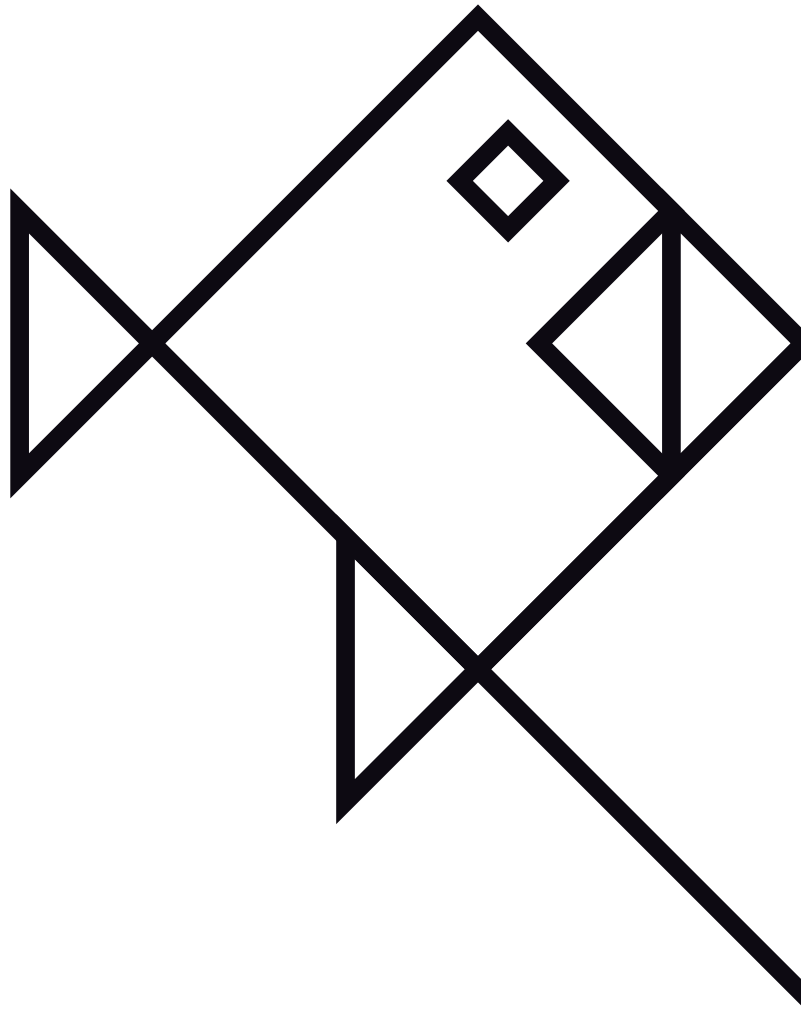
² Centre d'Estudis Avançats de Blanes (CEAB-CSIC).

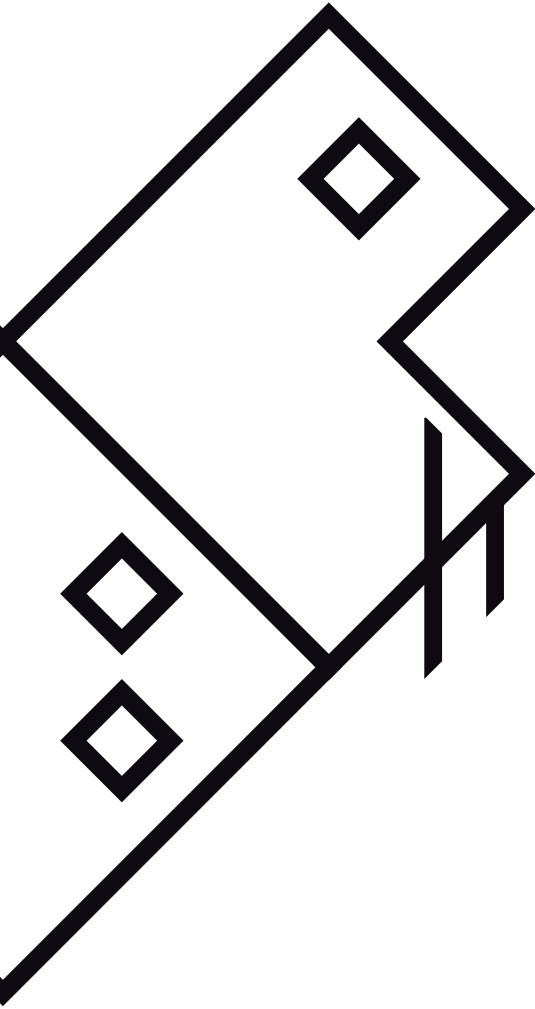
Nowadays, more than half of Pyrenean high mountain lakes are occupied by fish, as a result of a historical process of introductions dating back to centuries ago, and that has been accelerated during the last 60 years. Minnow (*Phoxinus phoxinus*) has been stocked in many lakes since the late 70s due to its use as live bait or forage fish for salmonids previously introduced. The specific impacts of the introduction of fish include, among others, the transformation of the ecosystem structure and trophic relations, and the reduction and extirpation of native species.

The project LIFE LimnoPirineus (LIFE13 NAT/ES/001210), started in 2014 and includes among its main objectives the restoration of eight high mountain lakes with fish (trout or minnow) and the recovery of native species of European interest, either by eradication or intensive control of introduced fish, depending on the size of the lake.

We have carried out surveys to assess fish populations in lakes in the area. We also have begun minnow removal operations in four of the planned lakes. Sampling was based on the combined use of nets, traps, and occasionally electrofishing. Catches have been measured, weighed and sexed, on site. Individual age has been determined by otolith reading. Initial results on individual growth and demography are presented for eight of the lakes surveyed.

Minnow had a high longevity in all lakes, which exceeds or equals the maximum for the species described so far. Natural mortality is generally low, but strongly dependent on the specific conditions of each lake. In Lake Closell, where the eradication of minnow has been practically completed, there has been a progressive increase in the growth rate, clearly attributable to the dramatic reduction of intraspecific competition.





**ORAL
COMMUNICATIONS**

**LIFE CYCLES,
ECOLOGY AND
CONSERVATION
OF MARINE AND
ESTUARINE
FISHES**



FISH ASSEMBLAGE IN THE DOÑANA PROTECTED AREA: COMPOSITION AND INFLUENCE OF THE TIDAL RESTRICTION

Moreno-Valcárcel R.¹, F.J. Oliva-Paterna² & C. Fernández-Delgado¹

¹ Department of Zoology. University of Córdoba (Spain). (raquel.moreno@uco.es).

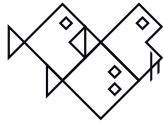
² Department of Zoology and Physical Anthropology. University of Murcia (Spain).

Doñana is one of the most recognized protected areas in Europe. Its environmental diversity includes aquatic systems with different origins that provide an extraordinary biodiversity. Their marshlands are tidally-restricted areas which are dominated by shallow and stagnant freshwater. In fact, the natural estuarine processes are limited to the main channel of the Guadalquivir River.

As a resume of a larger study to provide updated information of the Doñana fish assemblage, in the present study we feature the updated list and historical variation in its fish composition, we describe its structure and dynamic in the marshland areas, and we show the long-term effects of tidal restriction and loss of connectivity on fish assemblage from the external marshlands.

Historically, Doñana showed 34 fishes excluding marine straggler species. The trend has been a decline in native species and an increase in number and distribution of invasive species. Nowadays fish assemblage is completely dominated by exotics both in abundance and biomass. The spatial analysis in the marshland areas showed four significant fish groups corresponding to different habitats established a priori and related to the salinity gradient (external and internal marsh, streams, and ponds). Temporal dynamic in fish assemblages was mainly related to the hydrological cycle and the extreme drought events. The connectivity was more important than the habitat characteristics determining the fish community that inhabited the temporal ponds. By a BACI design approach, we detected significant spatial and temporal differences in the structure and functioning of fish assemblages between Doñana marshland and control sites which were not impacted by isolation and tidal restriction.

Our general results highlight biotic homogenization as one of the main consequences of tidal restriction and other anthropogenic pressures through the shift from native assemblages of specialized fish species towards assemblages of generalist, cosmopolitan and non-native species.



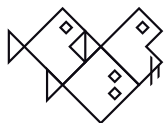
THE ROLE OF CONNECTIVITY AND ENVIRONMENTAL CONDITIONS IN THE ASSEMBLAGE STRUCTURE AND COMPOSITION OF ICHTHYOPLANKTON IN THE MAR MENOR COASTAL LAGOON

Pérez-Ruzafa A.¹, J.I. Quispe¹, M. Ghezzi², F. De Pascalis², G. Umgiesser² & C. Marcos¹

¹ Department of Ecology and Hydrology, University of Murcia, Murcia, Spain (angelpr@um.es).

² Institute of Marine Science - (ISMAR-CNR), Venice, Italy.

Far from be uniform, ichthyoplankton assemblages are very heterogeneous in coastal lagoons, both spatial and temporarily. Fish assemblages in these ecosystems are constituted by species with different guilds and life stories including estuarine residents but also a high percentage of marine stragglers and marine migrants. From these, only residents, that distribute by the entire lagoon, should be expected to contribute significantly to ichthyoplankton composition. However, previous studies showed that different ichthyoplankton assemblages can be identified inside the lagoon, depending on hydrological conditions, but at the same time a high spatial and temporal variability have been observed. The proposed models to explain lagoon assemblages configuration based on probabilities of colonization from the open sea would involve an important stochastic component and introducing some randomness that could lead to that high spatial and temporal variability at short and long-term scales. In this work we study the effect of lagoon hydrodynamics and the connectivity between sampling stations and open sea on ichthyoplankton assemblages in the Mar Menor. The results show a highly variable system with complex interactions between the different factors that lead to high cumulated richness and diversity of species, with a large proportion of occasional visitors and stragglers. These results suggest that the mechanisms of competitive lottery can play an important role in the maintenance of communities of coastal lagoons, where environmental variability occurs in a system with low connectivity, not only with the open sea, but also between locations within the lagoon.



JUVENILE EUROPEAN SEA BASS (*Dicentrarchus labrax*, L.) IN THE MONDEGO ESTUARY, PORTUGAL: A DECADAL RESPONSE TO CLIMATE PATTERNS

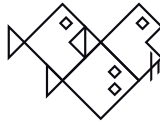
Bento E.G.¹, T. Grilo², M. Dolbeth³, D. Nyitrai¹, M.Â. Pardal¹ & F. Martinho¹

1 Centre for Functional Ecology - CFE, Department of Life Sciences, University of Coimbra, Calçada Martim de Freitas 3000-456, Coimbra, Portugal (edugraben@gmail.com).

2 MARE - Marine and Environmental Sciences Centre, Laboratório Marítimo da Guia, Faculdade de Ciências da Universidade de Lisboa, Av. Nossa Senhora do Cabo 939, 2750-374, Cascais, Portugal.

3 Department of Biology & CESAM, University of Aveiro, Campus Universitário de Santiago, 3810-193, Aveiro, Portugal.

Many commercially important marine fish depend on estuarine systems, which provide nursery grounds and recruitment advantages for several fish species. However, extreme events driven by climate changes may influence the functioning of nursery grounds and recruitment variability in fish populations. Performed in the Mondego estuary, Portugal, this study used an 11-year database (2003-2013) to analyze the variability in the population of a marine juvenile migrant fish, the European sea bass *Dicentrarchus labrax*, in order to relate with local and large-scale climatic variations. Abundance, population structure, growth rates, secondary production and annual day of peak abundance variations were estimated. Higher densities and production occurred at the beginning of the study. The relationship between large- and local-scale drivers, 0-group abundance, secondary production and annual day of peak abundance were evaluated using a Pearson correlation analysis on the cumulative sum (CUSUM) of the deviations from the mean of the 2003-2013 period for the biological and environmental data, considering the correspondent yearly values and with a time-lag of 1 year. The North Atlantic Oscillation (NAO) index, sea surface temperature (SST) and their respective winter values were tested as large-scale factors, while river runoff, salinity and water temperature were considered as local climate patterns. River runoff was the significant factor explaining sea bass 0-group abundances and the NAO and water temperature were also significant predictors considering the 1-year lag. Concerning 0-group secondary production, salinity, the NAO and water temperature were the significant predictors, while the NAO with 1-year lag explained annual day of peak abundance. The observed variability on the yearly trends in juvenile fish abundance was mostly associated to local-scale climate patterns, which can influence habitat use patterns, while large-scale factors (NAO, SST) seem to operate on a wider timeframe, as observed by the lag of 1-year influence on juvenile sea bass abundance.



SPATIAL DISTRIBUTION OF *RAJA UNDULATA* IN THE SOUTH-CENTRE OF PORTUGAL, BASED ON FISHERMEN TRADITIONAL KNOWLEDGE

Neves J.^{1,2}, C. Maia¹ & I. Figueiredo¹

1 Divisão de Modelação e Gestão de Recursos da Pesca, Instituto Português do Mar e da Atmosfera (IPMA), Rua Alfredo Magalhães Ramalho, 6, 1495-006 Lisbon, Portugal.

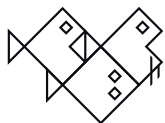
2 Centre for Functional Ecology (CFE), Department of Life Sciences, University of Coimbra, Calçada Martim de Freitas, 3000-456 Coimbra, Portugal (jfbneves@gmail.com).

Raja undulata is a Rajidae species with a very coastal and patchy distribution. It is frequent off Setúbal (South of Lisbon) where it represents an important resource for fishing communities leaving nearby. The information available for the species is scarce and due to that and to its vulnerability to fishing in 2009 the species has been included in the EU list of prohibited species.

IPMA has developed a dedicated study on the species under the UNDULATA Project (UNDULATA-Nº31-03-01 FEP186). One of the research lines involved enquiries to fishermen to recover historical information on the species. This work presents the information gathered on those enquiries in what concerns the spatial and temporal distribution of the species in southwestern coast of the Portuguese continental coast.

All the information collected was gathered in a database and analyzed using GIS software and the results obtained showed that the species mainly occurs down to 50m off the coast at bottoms with fine sand and gravel deposits, which agrees with the observed/identified specimens locations.

These results are consistence with what is admitted for the species in other geographical areas, proving that fishermen knowledge can provide valuable information on species biodiversity, ecology and preferred habitats, also showing that fishery-dependent data associated with traditional knowledge can be useful.

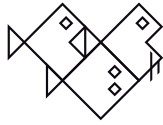


BIODIVERSITY HOTSPOTS AND COLDSPOTS OF MARINE FISH IN THE IBERIAN PENINSULA AND CANARY ISLANDS

Sanabria J.A.¹, N. Lazzari¹ & M. Becerro¹

¹ The BITES Lab. IPNA – CSIC. 38206 Tenerife. Spain (jose.sanabria@cisc.es).

Preserving biodiversity is a priority for national and international governments. At a global scale, areas with high diversity values (biodiversity hotspots) are concentrated in the tropics, driven by the high number of species found in tropical regions. Not surprisingly, protected areas flourish in tropical ecosystems as compared to their temperate counterparts. Biodiversity however is a complex concept beyond the number of species. Trophic and functional traits are critical biodiversity components that do not necessarily follow the latitudinal gradient described for species richness. Marine biodiversity is no exception and our study aimed to understand patterns of species, trophic, and functional diversity in marine fish along the Iberian Peninsula and Canary Islands. We used underwater visual census to quantify fish communities in 280 localities scattered over the 5 marine ecoregions of the world (MEOW) present in our geographic area. We then calculated species richness, species diversity, trophic diversity, taxonomic richness of families, functional richness, and functional diversity, which were used to detect local and regional areas of high (hotspots) and low (coldspots) biodiversity values. All six indexes varied significantly across the five MEOWs, but patterns of variation differed between the multiple indexes. The number of hotspots decreases with increasing latitude, with the Canary Islands having the larger number of biodiversity hotspots in our area. Our data showed that hotspots of functional diversity may occur in coldspots of species diversity, which received little conservation attention. Biodiversity conservation will benefit as we gain knowledge on the patterns and mechanisms behind trophic and functional diversity.



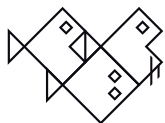
LIFE CYCLE AND STRUCTURE OF A POPULATION OF *Anableps anableps* (LINNAEUS, 1758) (CYPRINODONTIFORMES, ANABLEPIDAE) IN A MANGROVE SWAMP, MARANHÃO, BRAZIL

Pinheiro M.S.S.¹ & R. Goitein²

1 Universidade Federal do Maranhão - UFMA. Av. dos Portugueses s/n, Bacanga, CEP 65.085-580 São Luís, Maranhão, Brasil (spinheiro@elo.com.br).

2 Universidade Estadual Paulista – UNESP. Av. 24 A n° 1515 Bela Vista CEP 13.506-900, Rio Claro, São Paulo, Brasil.

This study analyzes aspects of a population of *Anableps anableps* present in a mangrove forest in the locality Raposa, São Luis Island, Maranhão, Brazil; the study cover length distribution, sex ratio, macroscopic analysis of the gonads. Sampling was done monthly, between August, 1999 and November, 2000. We collected 65 specimens of fish, 17 males, 34 females and 14 undetermined sex. Length varied between 144 - 285 mm, with a mean of 202.83 mm and a standard deviation of 33.88. Sex ratio was tested by Chi-square test with one degree of freedom ($\chi^2 < 3.840$, $p=0.005$); Chi - square was 5.66*, so there is a significant difference at 5%, so the hypothesis of equality between the sexes (1:1) was not accepted. *Anableps anableps* complete their life cycle in the mangrove, because they have been observed both immature individuals as mature, as well as individuals with spawning evidence.

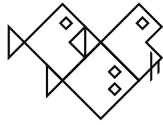


MARINE ECOREGIONS OF SPAIN DIFFER IN FISH TROPHIC ORGANIZATION

Lazzari N.¹, J.A. Sanabria¹ & M. Becerro¹

¹ The BITES Lab. IPNA-CSIC. 38206 Tenerife. Spain (n.lazzari@csic.es).

Marine ecoregions of the world is a classification of the world coastal areas representing broad-scale patterns of species and communities, linked to regional systems, and designed as a tool for biodiversity conservation. Spain is an ecoregion crossroad with the South European Atlantic Shelf, Macaronesia, and Saharan Upwelling ecoregions in Atlantic waters and the Western Mediterranean and Alboran Sea regions in Mediterranean waters. Although species and community organization is expected to change with ecoregions, the regional scale of Spanish crossroad may prevent for strong differentiation between ecoregions, as they share a large number of species. Here we looked at the trophic organization of the fish community in the five ecoregions and hypothesized that, because they share a large pool of species, ecoregions may show similar community organization at the trophic level, with species replacement but overall similar trophic structure across ecoregions. We used underwater visual census to quantify fish biomass at the species level, categorized each species into planktivore, herbivore, and carnivore trophic levels, and applied a number of univariate and multivariate techniques to test for differences in community organization between ecoregions. Our results showed evidence for both species and trophic differences between ecoregions, a pattern equally driven by species shared between or unique to ecoregions. We detected the highest and lowest values of planktivore fishes in the neighbor Macaronesia and South European Atlantic Shelf ecoregions while carnivores showed the opposite pattern. The three Mediterranean ecoregions had intermediate levels herbivores and carnivores, creating a strong geographic pattern in the three trophic groups. Our data suggest that the broad-scale patterns in community organization can operate at smaller regional scales, and showed major geographic patterns of variation in the biomass of herbivores, carnivores, and planktivores with strong implications for planning conservation of marine systems.

**FISH FAUNA OF THE EBRO DELTA BAYS****Franch N.¹, J.M. Queral¹, V. López¹, M. Clavero² & Q. Pou-Rovira³**

1 Parc Natural del Delta de l'Ebre. Av. Catalunya, 46 43580 Deltebre, Tarragona, Spain (nfranchv@gencat.cat).

2 Departamento de Biología de la Conservación, Estación Biológica de Doñana—CSIC, Avda, Américo Vespucio s/n, 41092 Sevilla, Spain.

3 Sorelló, estudis al medi aquàtic, Pl.St Pere, 15 baixos, 17007 Girona, Spain.

The Ebro Delta has two semi-closed bays, limited by sand spits: Alfacs (49 km²), to the south, and Fangar (9.2 km²). Both bays are shallow aquatic systems that attain maximum depths (4-6 m) in central areas. These are highly productive ecosystems that have for long been exploited by several activities, including professional and recreational fisheries and bivalve production. In spite of several studies dealing with hydrological and limnological issues, there is a lack of information about the biological communities of the bays. To fill this knowledge gap the Ebro Delta Natural Park has promoted the study of the fish fauna of the Ebro Delta Bays.

We performed fish surveys between 2008 and 2012 at 139 sites, 71 in Alfacs Bay and 68 in Fangar Bay. Due to the difficulty of characterizing the fish faunas of large water masses, we employed different sampling techniques, including passive gears (fyke and gill nets) and active trawling in 46 sites (total trawl distance of almost 20 km). Overall, we caught 6458 fish individuals, belonging to 71 species in 31 families. Sparidae, with 10 species, was the most species-rich family. Families Syngnathidae and Gobiidae had 7 and 6, respectively, while Mugilidae, Soleidae and Carangidae had 5 species each. Abundance and species richness was higher in coastal, shallower areas than in the deeper central area. The presence of abundant macrophyte cover in coastal areas favored the presence of several fish that are associated to seagrass beds, such *Sarpa salpa* and different species of Syngnathidae, 3 of which are protected.

Our results improve the knowledge of the biological communities of the Ebro Delta Bays and provide baseline data to promote their conservation by identifying priority areas and guiding the regulation of productive and leisure activities.

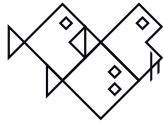


ASSESSING EFFECTS OF A FISHING PROTECTED ZONE ON FISH ASSEMBLAGES. ROSES' BAY CASE STUDY (NW MEDITERRANEAN SEA)

Fagín E., L. Recasens & U. Fernandez-Arcaya

Institut de Ciències del Mar (ICM-CSIC), Passeig Marítim de la Barceloneta, 37-49, 08003, Barcelona, Spain (elena.fagin@gmail.com).

The increase in abundance, biomass and diversity within protected areas has been well documented, especially in rocky littoral areas. In this study we assess the effects of a two years fishing ban in a muddy-sandy bottom Roses' fishing ground (NW Mediterranean) located at 130 m depth. This fishing ground was closed by fishermen during 2014-15, in order to protect hake (*Merluccius merluccius*) recruitment, the main target species of the trawl fleet in Roses. Population density, biomass, size and diversity were compared inside and outside the protected zone to evaluate changes in the fish community. Biological data were collected monthly on board of trawl fishery vessels from March to June 2015. A total of 51 fish species were found inside the protected and 40 outside. From the 13 species found exclusively in the protected area, stands out the presence of vulnerable species as *Raja polystigma*, suggesting that the closed area could act as a refuge for some species. Results showed significant higher values of density inside (mean value= 15.724 ind/km²) in comparison with outside (6.616 ind/km²) and also biomass (875 kg/km² inside, 299 kg/km² outside) for the overall community values, as well as for the most frequent species. The observed differences between areas were more marked in commercial species (i.e. *Merluccius merluccius*, *Lepidotrigla cavillone*, *Lepidorhombus bosquianus*, *Argentina sphyraena* and *Trachurus trachurus*) than in non-commercial ones (i.e. *Capros aper* and *Scylliorhinus canicula*). Moreover, both small-sized and large-sized individuals of the most frequent species were found mainly into the protected area. Our results suggest that the management measure adopted by Roses fishermen has positive effects on the demersal community.



FEEDING ECOLOGY OF TWO DEMERSAL OPPORTUNISTIC PREDATORS COEXISTING IN THE NORTHWESTERN MEDITERRANEAN SEA

López N.¹, J. Navarro^{2,3}, C. Barría¹, M. Albo-Puigserver¹, M. Coll^{1,4} & I. Palomera¹

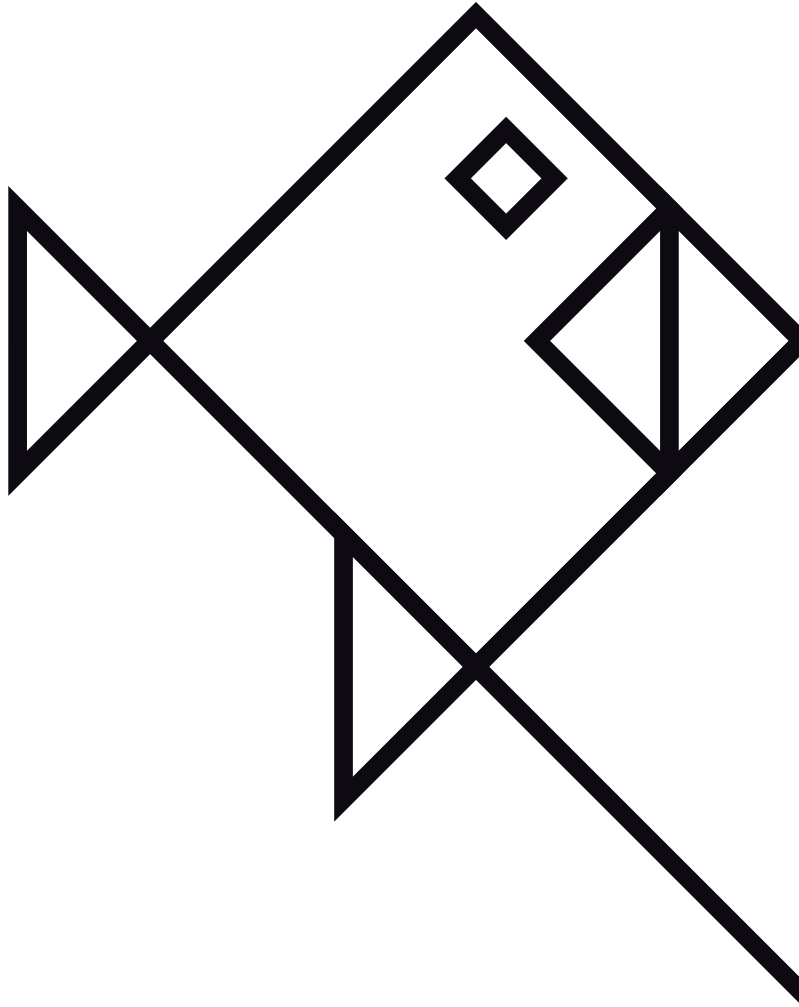
1 Institut de Ciències del Mar (ICM-CSIC), Passeig Marítim de la Barceloneta, 37-49, Barcelona 08003, Spain (nieves.lopez.nl@gmail.com).

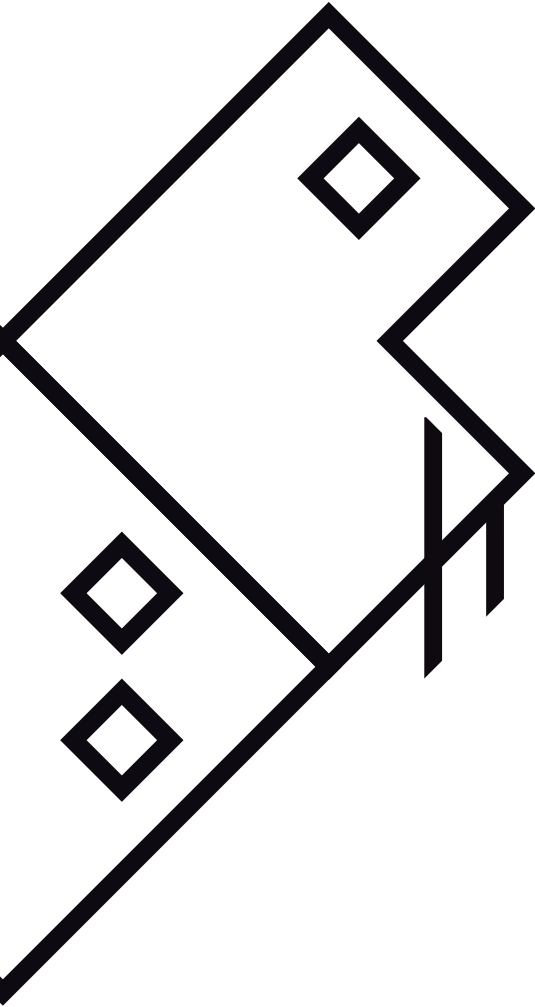
2 Department of Conservation Biology, Estación Biológica de Doñana (EBD-CSIC), Avda. Américo Vespucio s/n, Sevilla 41092, Spain.

3 Centre d'Ecologie Fonctionnelle et Evolutive, UMR 5175, CNRS - Université de Montpellier - Université Paul-Valéry Montpellier - EPHE, Montpellier, France.

4 Institut de Recherche pour le Développement, UMR MARBEC, Avenue Jean Monnet BP 171, Sète cedex 34203, France.

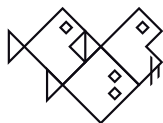
The aim of this study was to analyse the trophic ecology of two demersal predator species, black anglerfish (*Lophius budegassa*) and white anglerfish (*L. piscatorius*), in the northwestern Mediterranean Sea. Both species are important in the study area due to their high abundance and economic value, but information about their feeding behaviour is scarce. Here, we described the diet composition and ecological role of these two species, investigating whether trophic segregation exists between them and amongst fish of different sizes. In addition, by using experimental survey data we described the spatial distribution of both species to help us interpret trophic behaviour patterns. We gathered samples of two different sizes (small individuals of a total length <30 cm and large individuals ≥30 cm) of both species and combined stomach content analyses (SCA) and stable isotope analyses (SIA) of nitrogen and carbon with isotopic mixing models. Our results revealed that both anglerfish species are opportunistic predators, showing a diet composed mainly of fishes and, to a lesser extent, of crustaceans, with a small proportion of cephalopods, gastropods, bivalves and echinoderms. We found trophic segregation between the two species and the two sizes, indicating that they feed on different prey, in line with differences in their spatial distribution within the study area. This partial partition of food resources could also be explained by the differences in rhythms of activity that were reported in previous studies. In addition, although both species occupied a high position within the food web, our results showed that white anglerfish individuals and the large-sized fish of both species held higher trophic positions. This study demonstrates the usefulness of complementary approaches for trophic studies and confirms that both anglerfish species play an important role as predators in the northwestern Mediterranean Sea food web.





**ORAL
COMMUNICATIONS**

**SYSTEMATICS,
ZOOGEOGRAPHY
AND POPULATION
GENETICS**



LARGE SCALE TEMPORAL VARIATION OF GENETIC DIVERSITY AND EFFECTIVE POPULATION SIZE IN ATLANTIC SALMON POPULATIONS FROM NORTHERN SPAIN

Almodóvar A.¹, S. Leal¹, G.G. Nicola², J.L. Hórreo³, E. García-Vázquez⁴ & B. Elvira¹

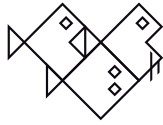
1 Department of Zoology and Physical Anthropology, Complutense University of Madrid (UCM), 28040 Madrid, Spain (aalmodovar@bio.ucm.es; mslealga@ucm.es; belvira@bio.ucm.es).

2 Department of Environmental Sciences, University of Castilla-La Mancha (UCLM), 45071 Toledo, Spain (graciela.nicola@uclm.es).

3 Museo Nacional de Ciencias Naturales, Consejo Superior de Investigaciones Científicas (CSIC), 28006 Madrid, Spain (horreojose@gmail.com).

4 Department of Functional Biology, University of Oviedo, 33006 Oviedo, Spain (egv@fq.uniovi.es).

Atlantic salmon *Salmo salar* is among the most important sport fish in Spain, but its populations are currently overexploited by angling and threatened by climate change. Further, its genetic diversity is endangered by stocking with non-local strains of hatchery fishes. Because of its geographical position, the rivers in Northern Spain play a major role in the present distribution of the species, and seem crucial for the conservation of its genetic diversity. We studied the temporal patterns of population genetic structure of Atlantic salmon from Northern Spain before and after population decline and heavy stocking with salmon imported from Northern Europe. For this purpose, five microsatellite loci were analysed in old (collected scales from 1958-1960) and recent (2007) samples from River Sella. The temporal analysis revealed a similar genetic variability between the historical population (average $He = 0.80$; average $AR = 11.24$) and the contemporary one (average $He = 0.83$; average $AR = 14.53$). However, a loss of 15 autochthonous alleles in the contemporary population has been observed. Our results pointed to a genetic differentiation among temporal populations ($F_{ST} = 0.042$, $p < 0.05$) and a genetic signal of population expansion in the contemporary one. Furthermore, estimates of effective population size (N_e) revealed a decreasing tendency of this parameter using both MIGRATE ($N_e(\text{historical}) = 532$ and $N_e(\text{contemporary}) = 327$) and LDNe approaches ($N_e(\text{historical}) = 301$ and $N_e(\text{contemporary}) = 137$). These results suggest that the enhancement of populations through stocking has negatively influenced the genetic variability of native salmon. Missing alleles and contemporary N_e decline could compromise the future fitness of populations and to have negative consequences for the persistence of local adaptation.

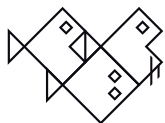


POPULATION ANALYSIS OF THE IBERIAN POPULATIONS OF THE RIVER BLENNY (*SALARIA FLUVIATILIS*) USING MICROSATELLITES MARKERS

Méndez L., A. Machordom & A. Perdices

Museo Nacional de Ciencias Naturales (MNCN-CSIC). Departamento de Biodiversidad y Biología Evolutiva. José Gutiérrez Abascal, 2. 28006 Madrid, Spain (aperdices@mncn.csic.es).

The river blenny (*Salaria fluviatilis*) is the unique freshwater representative in the Mediterranean area of the large and cosmopolitan marine fish family Blenniidae. It represents a benthic species that inhabits medium and lower courses of rivers, being also present in lakes and freshwater lagoons. Published works have identified *Salaria pavo* and *Salaria basilisca* as the closest relatives of the river blenny, being both marine species distributed in coastal areas with variable salinity (i. e. lagoons and river estuaries), in the Black Sea, Mediterranean (unique distribution of *S. basilisca*) and close Atlantic. Molecular studies have shown river populations of *S. fluviatilis* of distant areas genetically related, independently of their location. Otherwise, the pattern of genetic differentiation observed in these studies suggested that populations inhabiting lakes were well differentiated and were not related to populations inhabiting rivers in the neighborhood. In this study, we have analyzed the genetic variability of different Iberian river and lake populations of *S. fluviatilis* and the coastal species *S. pavo* using 12 microsatellites and mitochondrial markers. Our results address two important issues related to diversity and conservation of the river blenny: i) the identification of the phylogenetically closest marine species to *S. fluviatilis*, and ii) the genetic structure and population diversity of *S. fluviatilis* inhabiting lagoons, lakes and different river drainages of the Iberian Peninsula.



COMPARISON OF THE POPULATION STRUCTURE AND EVOLUTIONARY HISTORY OF *LUCIOBARBUS* SPECIES (TELEOSTEI, CYPRINIDAE) ON BOTH SIDES OF THE STRAIT OF GIBRALTAR

Casal-López M.¹, S. Perea¹, A. Yahyoui² & I. Doadrio¹

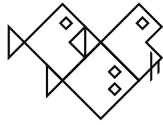
¹ Biodiversity and Evolutionary Group, Museo Nacional de Ciencias Naturales, CSIC, C/ José Gutiérrez Abascal, 2, 28006, Madrid, Spain (miriam@mncn.csic.es)

² UFR: Biodiversité et Aquaculture, Département de Biologie, faculté des Sciences, B.P. 1014, Rabat. Maroc.

The current configuration of the Strait of Gibraltar was mainly a consequence of the refilled of Mediterranean Sea 5.3 million years ago in the Plio-Miocene border period. The consequences of this catastrophic event to the fauna on both sides of the Strait have been largely studied in a widely range of species with the exception of freshwater fish. This was due to the poor diversity found on both sides of the Strait of Gibraltar. Within primary freshwater fish, only the genera *Cobitis* and *Luciobarbus* are present on both sides. The genus *Luciobarbus* is more diversified making it an interesting target for biogeography purposes.

In order to check how the different modulating forces, such as the Messinian crisis, the formation of the hydrographical network, affected freshwater fish species we studied the phylogeographical structure of the western Mediterranean *Luciobarbus*. The aim of this work was to compare the population structure of the barbels within the genus *Luciobarbus*, Heckel 1843, in southern Iberia, and northern Africa.

We used nuclear and mitochondrial DNA sequencing data of all the known populations of *Luciobarbus* present to both sides of the Strait of Gibraltar. Our results showed that mainly African and Iberian species of the genus *Luciobarbus* compounded two independent lineages that originated before the Messinian crisis. One exception was the closer relation found between *L. setivimensis* from Algeria and Iberian *Luciobarbus* species, which are clustered together in the mitochondrial DNA but not in the nuclear data. Moreover, for the first time, *L. guercifensis* from northern Morocco, recently described, was found to be nuclear and mitochondrial close to Iberian clade, shedding new light into phylogeographical relationships within this genus.



IS THE ORIGIN OF EUROPEAN GOBIES LINKED TO THE CLOSURE OF THE TETHYS?

Agorreta A.

Department of Zoology and Physical Anthropology. Complutense University of Madrid. 28040 Madrid. Spain (ainhoaag@ucm.es).

Gobies (Gobiidae), comprising nearly 1800 species, constitute the second largest family of fishes and are part of the suborder Gobioidi. Gobies show a spectacular variety in morphology, ecology and behaviour, and occupy most freshwater, brackish and marine environments worldwide. Recent studies have suggested that Gobiidae is a rapid-radiating family whose phylogenetic relationships still remain uncertain. This family includes also the largely endemic European gobies that comprise 36 genera and roughly 150 species, and include taxa distributed in the northeastern Atlantic, the warm temperate Atlantic along the African coast, the Mediterranean, the Ponto-Caspian region (Marmara, Black and Caspian Seas), and the European freshwaters. Our study includes multiple nuclear (*rag1*, *sreb2*, *zic1*) and mitochondrial (*cytb*, ribosomal fragment containing *12S-tRNAVal-16S*) genes for over 300 terminal taxa representing the vast diversity of Gobiidae as well as other major gobioid lineages. We have reconstructed a robust phylogeny of Gobioidi using maximum likelihood and Bayesian inference, and in order to investigate the historical biogeography and diversification times of European gobies, we have dated the main cladogenetic events with relaxed-clock molecular timetrees. The European gobies cluster in three distinct lineages (*Pomatoschistus*-, *Aphia*-, and *Gobius*-lineages), each with different affinities with gobies from the Indo-Pacific and the New World, from which they apparently separated during the Oligocene-Miocene. We are now evaluating the implications of our dating results in relation to paleogeographic events shaping current European diversity, in particular the closure of the Tethys Ocean (as Africa and Eurasia converged) and isolation from its northeastern branch, the Paratethys, during the Late Oligocene and Early Miocene.



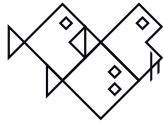
POPULATION GENOMICS OF THE SMALL-SPOTTED CATSHARK (*Scyliorhinus canicula*) ALONG THE WESTERN EUROPEAN COAST

Manuzzi A.¹, L. Zane¹ & A. Verissimo²

¹ Dipartimento di Biologia, Università degli Studi di Padova, 35131 Padova (PD); Italy (alice.manuzzi@gmail.com).

² CIBIO - Research Center in Biodiversity and Genetic Resources, Campus Agrário de Vairão, Rua Padre Armando Quintas, 4485-661 Vairão, Portugal.

The small-spotted catshark (*Scyliorhinus canicula*) is one of the most common elasmobranchs in the Northeast Atlantic. It is a small benthic shark, inhabiting continental shelves and upper slope waters (down to 400 m depth). It is mostly taken as by catch in various demersal fisheries but its commercial importance is growing. Life history traits such as female philopatry, sexual segregation, and low dispersal ability suggest that the species may form localized populations. Nonetheless, previous genetic studies found no evidence of population structure along the Northeastern Atlantic using traditional molecular markers. Population genomics is a powerful tool for fisheries management because it can provide increased resolution in identifying discrete population units that may require individual management at local scale. Here restriction-site associated DNA (RAD) sequencing was used in identifying hundreds of single nucleotide polymorphisms (SNPs) spread across the genome of *S. canicula* to assess its genetic diversity along the Western European coast and infer putative population structure undetected previously. The results suggest the presence of a genetic break around southern Iberia, which may be tied to distinct environmental conditions in this region. Also, a pattern of Isolation-By-Distance was detected in samples from the North Sea to western Iberia, in line with previous expectations based on the known life history of *S. canicula*. Thus, our results support the current management of the small-spotted catshark as local populations along western Europe.



COMPARATIVE ANATOMY OF THREE SPECIES OF ELECTRIC RAYS FROM THE GENUS *Narcine* HENLE, 1834 (TORPEDINIFORMES: NARCINIDAE)

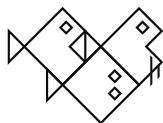
De la Cruz-Torres J.^{1,2}, A.F. González-Acosta² & M. González-Isáis³

1 Posgrado de Ciencias del Mar y Limnología, ICMyL, UNAM, Circuito Exterior s/n Ciudad Universitaria México, Ciudad de México, C.P. 04510 (jct_90@outlook.com).

2 Centro Interdisciplinario de Ciencias Marinas, Instituto Politécnico Nacional. Av. Instituto Politécnico Nacional, s/n, Col. Playa Palo de Santa Rita, La Paz, Baja California Sur, México, C.P. 23096.

3 Laboratorio de Morfología Animal, Facultad de Estudios Superiores Iztacala, UNAM, Av. De los Barrios S/N Col. Los Reyes Iztacala, Tlalnepantla Estado de México, C.P. 54090.

The anatomical studies are an important source of characters, which are of great importance in the systematic and taxonomy as auxiliaries for separating species of fishes. The electric rays are a group chondrichthyan characterized by the presence a pair of electric organs on head disk. A comparative analysis of the anatomy of three species of narcinids with distribution in Mexico (*N. bancroftii*, *N. entemedor* and *N. vermiculatus*) is presented. These species are characterized by an elongated chondrocranium, an wide anterior fontanelle, horn-like process of antorbital cartilage and the nasal capsule expands more or less ventrolaterally; the synarcual is triangular shaped, with a pair of lateral stay (shorter in *N. bancroftii*). In *N. vermiculatus* the suprascapulae it is strongly curved, in *N. bancroftii* is slightly curved and straight on *N. entemedor*. The iliac process pelvic is well developed in *N. entemedor*, but is smaller in the other species. The canals of the lateral line are associated with the dorsal region, where a great development of supraorbital (SO), infraorbital (IO), hyomandibular (HYO) channels and the posterior lateral line (LLP), but a ramification less evident that occurs in other groups or batoids. The HYO channel is located on the periphery of the electric organs, in *N. bancroftii* is characterized by increased branching toward the posterior region. The anterior branch of the OS and IO channels, suggest the relationship of these structures feeding and detection of water waves.



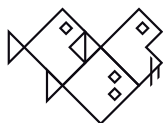
IMPROVEMENT IN THE IDENTIFICATION OF MEDITERRANEAN SKATES (CHONDRICHTHYES: RAJIDAE) FROM DNA BARCODING

Ramírez-Amaro S.^{1,2}, B. Terrasa¹, F. Ordines², C. Ramon¹ & E. Massuti²

¹Laboratori de Genètica, Universitat de les Illes Balears, 07122 Palma de Mallorca, Spain. (sergio.ramirez@ba.ieo.es).

²Instituto Español de Oceanografía, Centre Oceanogràfic de les Balears, Moll de Ponent s/n, 07015 Palma de Mallorca, Spain.

DNA-based identifications have been used across different taxonomic groups proving to be a useful tool in cases in which external morphological trait-based identification was problematic. Here, we use the DNA barcoding approach to improve the accuracy in the identification of elasmobranch fish species belonging to the Rajidae family, and to investigate their phylogenetic position. To do so, the cytochrome *c* oxidase subunit I (COI) was sequenced in 11 species (including three genera) inhabiting the continental shelf and slope bottoms of the north-western Mediterranean. The individuals examined were collected during the MEDITS surveys that take place in both the Iberian Peninsula and the Balearic Islands coasts. Bayesian phylogenetic analysis clearly support for the different genera present in the area. DNA barcoding was especially useful to confirm field identification of different species sharing similar morphological traits. It revealed some inconsistencies in the morphological classification of the group of species composed by *Raja montagui*, *Raja brachyura* and *Raja polystigma*, know to be prone to misidentification. In this case, DNA confirmation of species identification allowed determining the most reliable morphological traits for field classification. Furthermore, molecular data allowed confirming the first record of the Norwegian skate *Dipturus nidarosiensis* in the Alboran Sea. Elasmobranchs are considered among the most vulnerable species to fishing impacts. Our results provide useful information for the assessment of the biodiversity of this group of fishes, a critical step for the development of appropriate management plans aiming to preserve it.

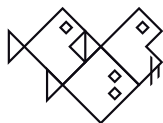


COMBINED MORPHOLOGICAL AND MOLECULAR DATA SUGGEST GENETIC STRUCTURE IN THE DEEP-SEA MORID CODLING *LEPIDION* *LEPIDION*

Barros-García D.^{1,2}, R. Bañón³, J.C. Arronte⁴ & A. De Carlos⁵

- 1 Centro de Apoyo Científico y Tecnológico a la Investigación (CACTI). Universidad de Vigo, Calle Fonte das Abelleiras s/n, 36310 Vigo, Spain. (davbarros@uvigo.es).
- 2 Programa de Doctorado en Metodología y Aplicaciones en Ciencias de la Vida, Facultad de Biología. Universidad de Vigo.
- 3 Programa de Doctorado en Biodiversidad y Ecosistemas, Facultad de Ciencias del Mar. Universidad de Vigo, C/ Fonte das Abelleiras s/n, 36310 Vigo, Spain.
- 4 Departamento de Biología de Organismos y Sistemas, Universidad de Oviedo, C/Catedrático Uría s/n 33003 Oviedo, Spain.
- 5 Departamento de Bioquímica, Genética e Inmunología, Facultad de Biología, Universidad de Vigo, C/ Fonte das Abelleiras s/n, 36310 Vigo, Spain.

The genus *Lepidion* Swainson, 1838, as currently recognized, belongs to the morid cod fish family Moridae and contains nine benthopelagic species, living on the continental slope and lower rise of the Atlantic, Indian and Pacific Oceans and the Mediterranean Sea. The description of the *Lepidion* species is incomplete because it is based only on a few specimens or on reiterated descriptions of earlier authors and, therefore, some taxonomic inaccuracies and uncertainties still persist. In the present study, five locations from West Mediterranean to North-West Atlantic were sampled. The morphological data and four different genetic markers -2 mitochondrial(COI, 16S), and one nuclear (exon 3 of RAG1) from 72 specimens were obtained to address a possible genetic structure in *L. lepidion* along its distribution area between North Atlantic Ocean and Mediterranean Sea. Pairwise F_{st} and locus-by-locus AMOVA showed significative differences between West Mediterranean Sea and North Atlantic specimens. Moreover, the STRUCTURE software indicated 2 different populations with no apparently geographic differentiation, and GeneClass2 highlighted the existence of migrants between Mediterranean Sea and Atlantic Ocean. A PCA analysis based on the morphological data showed a possibly gradient from the warm Mediterranean Sea, to the cold Atlantic waters. The results apparently support the existence of two populations (Mediterranean Sea and North Atlantic) with an overlapping distribution area around the temperate waters of the Iberian Peninsula. Further analyses using more markers and individuals will be required to fully resolve this issue.



HOW MUCH DO WE KNOW ABOUT THE DIVERSITY OF NATIVE TROUT IN MEXICO?

García-De-León F.J.¹, C.B. Dillman², A. De Los Santos-Camarena¹, A. Abadía-Cardoso³, A. George⁷, F. Camarena-Rosales⁴, I. De Los A. Barriga-Sosa⁵, C. Garza⁶ & R.L. Mayden⁷

1 Laboratorio de Genética para la Conservación, Centro de Investigaciones Biológicas del Noroeste, S.C., Baja California Sur, Mexico (fgarciadl@cibnor.mx).

2 Virginia Institute of Marine Science, Gloucester Point, VA, USA.

3 Facultad de Ciencias Marinas, Universidad Autónoma de Baja California, Ensenada, Mexico.

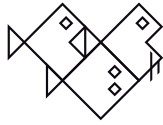
4 Facultad de Ciencias, Universidad Autónoma de Baja California, Ensenada, Mexico.

5 Departamento de Hidrobiología, Universidad Autónoma Metropolitana Iztapalapa, Mexico.

6 NOAA. Southwest Fisheries Science Center, Santa Cruz, CA, USA.

7 Department of Biology, Saint Louis University, St. Louis, MO, USA.

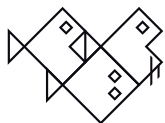
In high mountains of northwestern Mexico, an endemic and highly diverse group of native trout exists. Currently, only one species and one subspecies have been formally described from this region, but many other undescribed lineages have been identified in the last 16 years. However, the genetic integrity of this native trout could be at risk due to many threats including habitat loss and introgression from non-native rainbow trout (*Oncorhynchus mykiss iridius*). It is critical to recognize and preserve the existing genetic diversity of native trout before it is lost. Therefore, we seek to: (i) provide a multi-locus assessment of the genetic divergence among sampled populations and (ii) compare the genetic diversity among trout lineages between Mexico and the West Coast of the United States, and (iii) define geographic patterns of genetic differentiation and diversity between lineages, providing insights into the distinctness of these Mexican trout. To achieve our goals, we included populations from all the basins where native trout has been reported in Mexico. We used microsatellite and Single Nucleotide Polymorphism (SNP) loci, and multiple approaches: FST values, Principal Component Analysis (PCA), phenograms, and Bayesian methods. Our results strongly support a hypothesis of distinct, non-interbreeding lineages within the native Mexican trout complex. At least nine new evolutionary lineages were clearly identified, and generally consistent with the limits of the drainage basins, although some evidence of gene flow was detected. Species diversity remains to be described within the Mexican trout complex, however, we could anticipate that these lineages correspond to different species.

**POPULATION GENETICS OF THE BLUE SHARK *Prionace glauca* IN
ATLANTIC WATERS****Veríssimo A.^{1,2}, J. McDowell¹, Í. Sampaio², N. Queiroz², G. Mucientes² & P. Alexandrino²**

1 Virginia Institute of Marine Science, Gloucester Point 23062, VA, U.S.A.

2 CIBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, 4485-661 Vairão, Portugal (averissimo@cibio.up.pt).

The blue shark *Prionace glauca* is a cosmopolitan oceanic shark heavily targeted by tuna and billfish fisheries, particularly in the Atlantic Ocean. Despite its high fishing mortality, blue shark stock structure is still poorly understood and based almost exclusively on data from tag-recapture studies. Currently, a two-stock structure is assumed for the Atlantic Ocean, with a North and South stock divided by the warm tropical waters at low latitudes. To clarify the population structure of blue sharks within the Atlantic Ocean, we analyzed a large panel of SNP loci (~10 000) and sequenced a fragment of the mitochondrial DNA control region. The high dispersal ability of *P. glauca*, its complex movement patterns and spatial segregation by sex and size require a carefully designed sampling strategy in order to delineate the current genetic structure of the species. Thus, we sampled small juveniles (< 2 yr) at each of three reported Atlantic blue shark nurseries, i.e. western Iberia, Azores and South Africa, targeting the least mobile component of the population and avoiding sampling of highly mobile adults of unknown origin. The results will be discussed in light of the current assumption of stock structure in the Atlantic Ocean for fisheries management purposes.



FISHES FROM MANGROVE BIOTOPES OF THE SOUTHERN OF THE BAJA CALIFORNIA PENINSULA

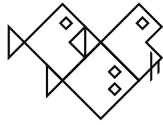
González-Acosta A.F.¹, G. Ruiz-Campos² & J. De la Cruz-Torres³

1 Instituto Politécnico Nacional-Centro Interdisciplinario de Ciencias Marinas, Av. Instituto Politécnico Nacional s/n, Col. Playa Palo de Santa Rita, La Paz, BCS, C.P. 23096, México (aacosta@ipn.mx).

2 Colección Ictiológica, Facultad de Ciencias, Universidad Autónoma de Baja California, Carretera Tijuana-Ensenada km 103, Ensenada, Baja California, México, C.P. 22860.

3 Posgrado de Ciencias del Mar y Limnología, ICMYL, UNAM, Circuito Exterior s/n Ciudad Universitaria México, Ciudad de México, C.P. 04510.

A systematic and zoogeographical checklist of fishes associated to mangrove biotopes of the Baja California Peninsula (BCP), with notes on their zoogeography, is provided on the basis of records of literature and verified voucher specimen housed in fish collections. A total of 228 species grouped in two classes, 23 orders, 72 families and 147 genera, comprise the fish diversity from the mangrove ecosystems of the BCP. The class Actinopterygii (208 spp) and the order Perciformes (125 spp) were the most representative taxa, where the Haemulidae, Sciaenidae, Gobiidae and Carangidae families, clustered more than 50% of the ichthyofauna of this order. The zoogeographic affinities by provinces: Cortez (84%), Mexican (73%), Panamic (70.3%) and Sandiegan (61.2%), result of a mixture of fish species from temperate and tropical derivation. The fish diversity reported here, highlights the important role of the mangrove biotopes of the BCP as primary habitat or nursery ground (for feeding and spawning) for many marine species during some phase of their biological cycle, contributing with the growth, recruitment and conservation of species with commercial or ecological value.



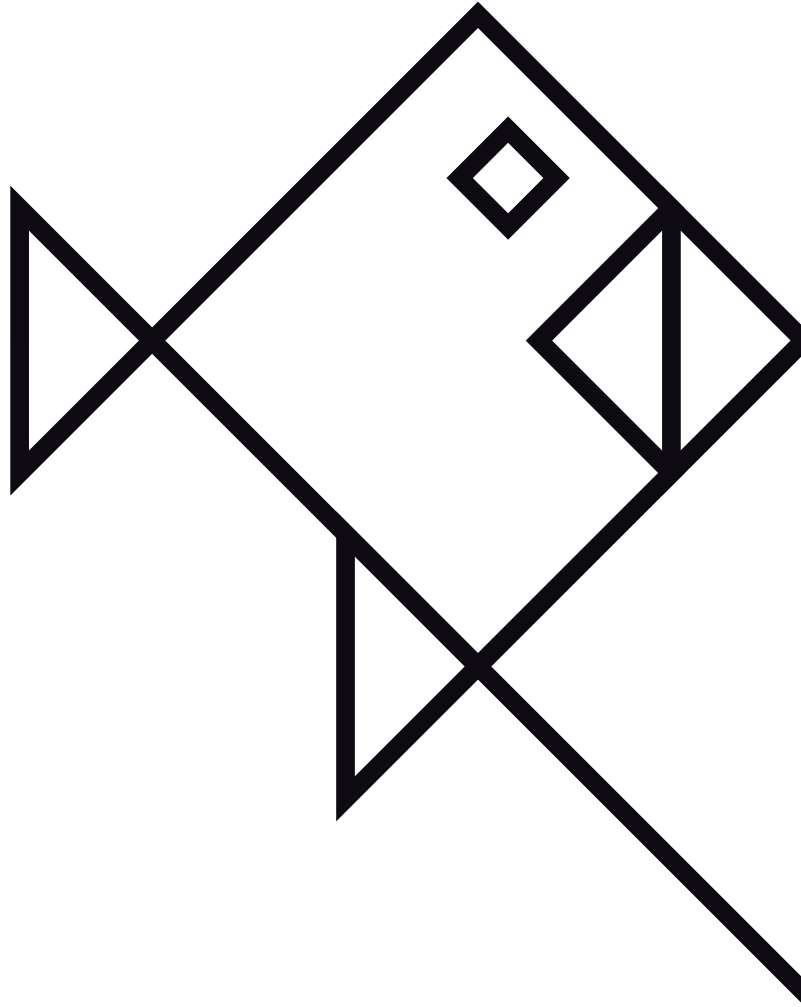
A CHECKLIST OF THE FRESHWATER ICHTHYOFAUNA FROM MIDDLE BASIN USUMACINTA RIVER, TABASCO, MEXICO

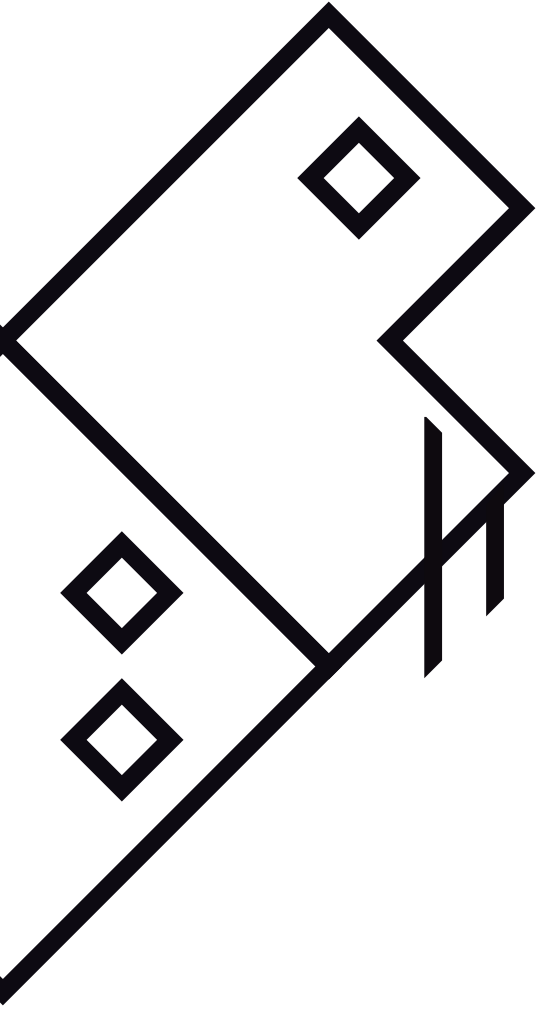
Castillo-Domínguez A.¹, C.E. Melgar¹, R. Rodiles-Hernández², A. González², C.A. Soria¹ & R.E. Gómez¹

1 Universidad Juárez Autónoma de Tabasco (UJAT). División Académica Multidisciplinaria de los Ríos.Km.1. Carretera Tenosique-Estapilla. 86901. Tenosique, Tabasco, México. (alfonso.castillo@ujat.mx).

2 Colegio de la Frontera Sur (ECOSUR). Unidad San Cristóbal. C.P.29290. San Cristóbal de Las Casas, Chiapas, México.

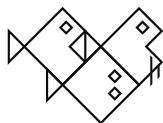
México is characterized by high diversity of freshwater fishes. Among the most important regions of biodiversity are basin Usumacinta and Grjalva in Tabasco, Mexico. We present an updated systematic list, comprising all species collected by us, and wich includes an exhaustive check list of literature records. A total of 23 collecting localities are included in this study. The total species number is 51, distributed in 38 genera, 24 families, and 12 orders. The zone study included 53.6% of the total estimated number of fish species for the entire country. The Cichlidae and Poeciliidae families are most diverse with five and 17 species, respectively. Of the total of 51 species, 11 are primary fishes, 22 are secondary, and six estuarine and nine vicarious according to Castro-Aguirre *et al.*(1999). Three species are new records for the Usumacinta province, and the scientific name of 11 species was updated. Six species are considered to be exotic: *Ctenopharyngodon idella*, *Cyprinus carpio*, *Oreochromis niloticus*, *Parachromis managuensis*, *Pterygoplichthys disjunctivus* and *Pterygoplichthys pardalis*. Most of the species that were added to the previously recorded species list of the middle basin Usumacinta. The actual condition of the basin Usumacinta-Usumacinta population for the majority of the fish species, including the endemics, is not known. This important of including more habitats in survey saimed at generating checklists, and of analysis the distribution of the fish species in Usumacinta province.





**ORAL
COMMUNICATIONS**

**MARINE
PROTECTED
AREAS**



EFFECTIVENESS OF MARINE RESERVES OF FISHING INTEREST FOR THE CONSERVATION OF ELASMOBRANCHS. USE OF SPACE BY ULTRASONIC TELEMETRY AND IMPLICATIONS FOR MANAGEMENT

Tubío A.¹, D. Fernández-Márquez², L. Rojo³, J. García⁴, P. Pita⁵, N. Souto¹, R. Muiño¹ & J.A. García-Chartón³

1 Department of Animal Biology, Vegetal Biology and Ecology. University of A Coruña. Rúa da Fraga 10, 15008 A Coruña (Galicia). Spain (ana.tubio.gomez@gmail.com).

2 Ministry of the Sea. Technical Coordination Section. Territorial Headquarters of A Coruña. Rúa Ramón y Cajal, 2 Casa do Mar 5ª Planta, 15006 A Coruña (Galicia). Spain.

3 Research Group Marine Ecology and Conservation. Department of Ecology and Hydrology. University of Murcia. Campus of Espinardo. 30100 Murcia. Spain.

4 IFREMER BP2059. 101 Promenade Roger Laroque. 98 800 Nouméa. Nouvelle Calédonie.

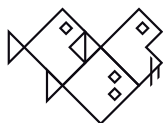
5 Department of Applied Economics. Faculty of Economics and Business Administration. University of Santiago de Compostela. Av. Burgo das Nacións s/n, 15782 Santiago de Compostela (Galicia). Spain.

Top predators, like sharks and rays, play an important ecological role in marine ecosystems and are important fishery resources worldwide. Increasing fishing pressures resulted in many threatened elasmobranch species. Thus, understanding movement patterns is essential for their management and conservation. This study analyzed the spatio-temporal dynamics of coastal ray and shark species in the Marine Reserve of Fishing Interest *Ría de Cedeira* (MRFI-RC; Galicia) and in the Marine Reserve *Cabo de Palos - Islas Hormigas* (MR-CP; Murcia) through ultrasonic telemetry to determine the efficacy of these reserves in the protection of coastal elasmobranchs.

A total of 54 individuals of four species were tagged with acoustic transmitters (Vemco© V9-2H): 18 *Raja undulata*, 2 *R. montagui* and 10 *Scyliorhinus canicula* in the MRFI-RC and 6 *R. montagui*, 13 *S. canicula* and 5 *S. stellaris* in the MR-CP. Animals were monitored by an array of 12 automatic acoustic receivers (Vemco© VR2w) placed in each marine reserve between August 2014 and December 2014.

R. undulata, *R. montagui* and *S. canicula* showed strong site fidelity in the MRFI-RC. *R. undulata* stayed in the reserve for long periods (up to 84 days); *R. montagui* and *S. canicula* showed greater preference for the outer areas of the reserve. In the MR-CP *R. montagui* and *S. canicula* also showed high site fidelities and small home ranges, while *S. stellaris* showed a much larger home range and low overlap with the other species.

Overall, home ranges of coastal elasmobranchs are larger than the protected areas in both marine reserves. Thus, conservation actions would require either an increase in the size of the main reserves or the creation of a network of small reserves aimed to protect essential habitats, such as breeding sites.



TECHNICAL SUPPORT FOR THE CREATION OF A MARINE RESERVE AS A FISHERIES MANAGEMENT TOOL IN CAPE ROCHE

Sarmiento J.¹, J. Sáez-Jiménez², F. Sobrado-Llompарт² & R. Cabrera-Castro³

1 Master Student ACUIPESCA. University of Cadiz (jesica.sarmientocarbaljal@alum.uca.es).

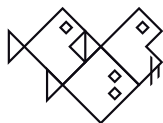
2 Society for the Development of Coastal Communities – SOLDECOCOS.

3 Biology department. School of Oceans and Environmental Sciences. University of Cadiz. 11510. Cadiz. Spain.

Marine Protected Areas are one of the main tools used worldwide in marine conservation, management and spatial planning due to they introduce an Ecosystem Based Approach (EBA). Also, they are a priority under the EMFF (European Maritime and Fisheries Fund) proposed by the EU during the period 2014-2020.

The fishermen association of Conil de la Fontera, alongside the OPP-74 (Organization of Aquiculture Producers in the Open Sea of Conil) and the OPP-72 (Organization of Artisanal Fishermen of the Fish Market of Conil) have shown in recent years an interest in the creation of a Co-managed Marine Reserve as a Fisheries Management Tool. This marine reserve lays between the Sancti Petri islet (Hercules Castle) and Trafalgar cape. A literature review has been produced to support the creation of this marine reserve. This literature review has gathered all the relevant information, such as current legislation, eco-cartography, vulnerable species, stake holders, etc., from the last years. The goal of this study is to propose the creation of a marine reserve as a marine governance tool with the implication of private stake holders and the administration.

The base of the marine reserve proposal came from the local fisheries sector. This proposal was implemented through workshops to technicians of NGOs and the University. The proposal includes priority objectives of the new FCP (Fisheries Common Policy), such as an approach towards sustainability, understood in a broad sense (ecological, economical, socio-cultural and political-institutional). In addition, this proposal is within the funding priorities of the new frame work of the European Maritime and Fisheries Fund – EMFF.

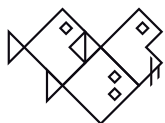


SPANISH MARINE PROTECTED AREAS HAVE MORE FISH BIOMASS BUT EQUAL DIVERSITY THAN UNPROTECTED AREAS

Sánchez-Martínez N., J.A. Sanabria, N. Lazzari & M.A. Becerro

The BITES Lab. IPNA-CSIC. 38206 Tenerife. Spain (nestorsanchezmartinez@gmail.com).

Protected areas are globally increasing with the awareness of the human mediated loss of biodiversity on earth. Spanish marine waters have a number of protected zones including marine protected areas, natural parks, and special areas of conservation among others (here after MPAs). It has been reported that MPAs need to comply with at least four out of the five NEOLI's attributes to cause a shift in community metrics and clearly deviate from unprotected sites. Spanish MPAs have three NEOLI attributes at best, and we wanted to test whether fish community and metrics such as species richness, diversity, and biomass differ between protected and nearby unprotected areas. We quantified fish communities using underwater visual census and used an ANOVA design to test whether fish communities and their metrics differed as a function of ecoregion (Mediterranean, South Atlantic, Alboran Sea, and Macaronesia), location (nested within ecoregion), and protection (full protection vs unprotected). Fish biomass and species richness were higher in protected than unprotected areas. Yet, differences in species diversity between protected and unprotected sites varied as a function of location, suggesting that the biodiversity benefits of protection may depend on specific traits linked to geographic location. Understanding the mechanisms behind the high diversity values of certain protected areas may be critical to improve the site selection and the efficiency of our conservation efforts.



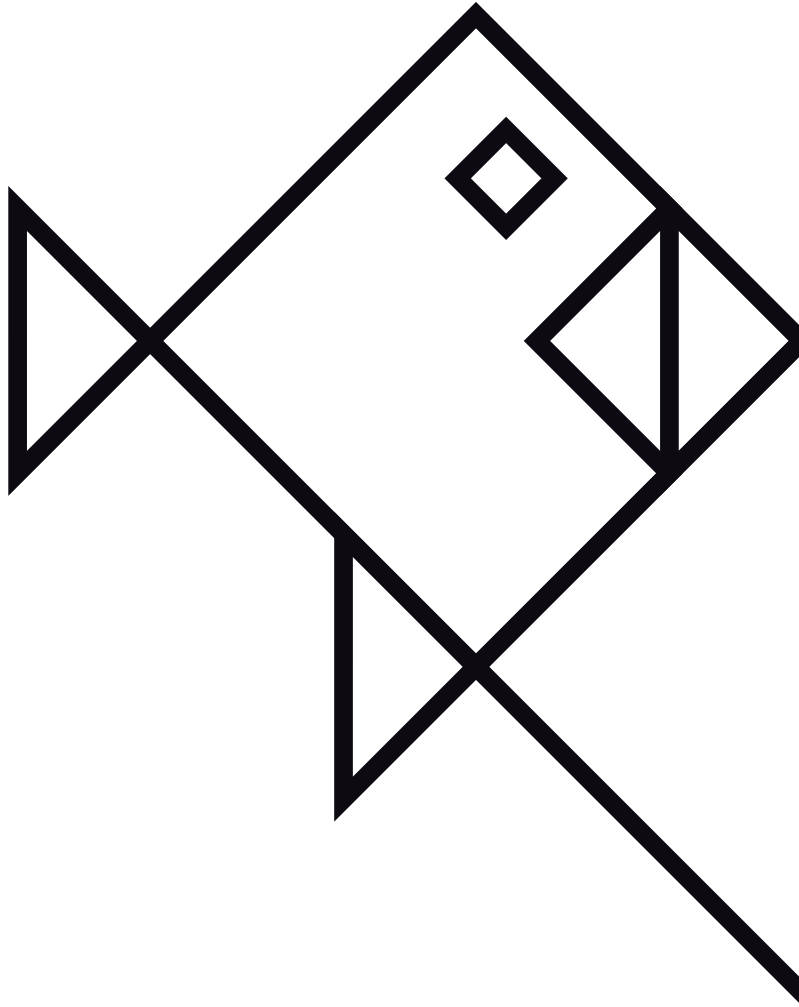
APPLICATION OF THE METHODOLOGY MANAGEMENT EFFECTIVENESS TRACKING TOOLS (METT), IN EIGHT COASTAL-MARINE PROTECTED AREAS OF THE PROVINCE OF CHUBUT, PATAGONIA, ARGENTINA.

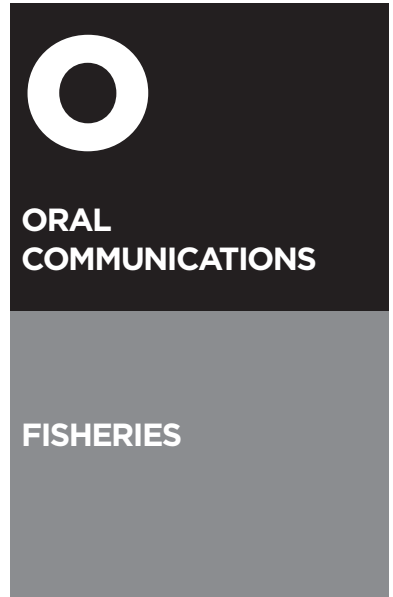
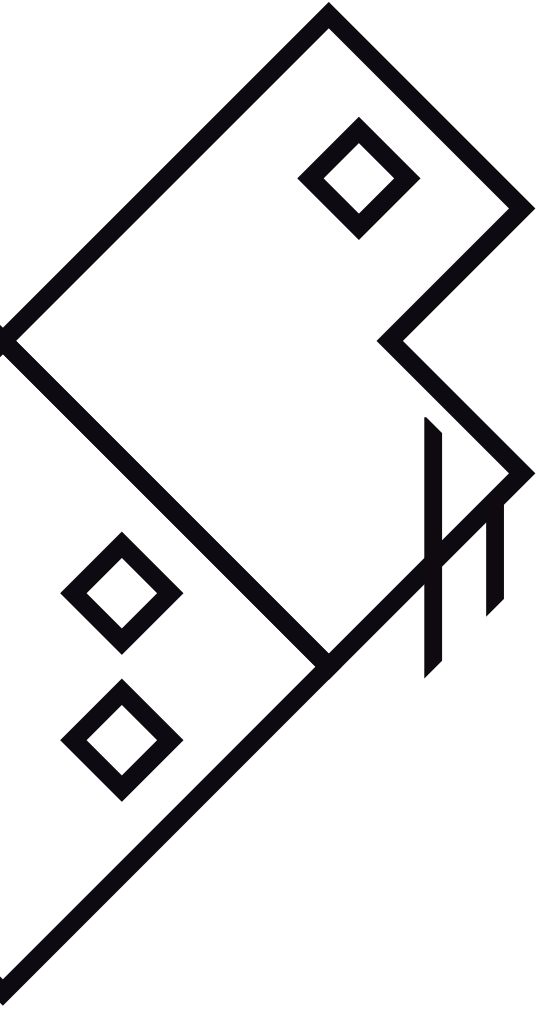
Fondacaro R.R.¹, R.D. Schenke² & G.M. Caille²

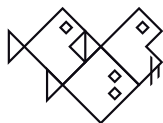
1 Facultad de Ciencias Naturales, Sede Trelew, Universidad Nacional Patagonia San Juan Bosco. Inmigrantes 58, 9100 Trelew, Chubut. Argentina (ricardofonda@gmail.com).

2 Fundación Patagonia Natural.

The management effectiveness in eight Coastal-Marine Protected Areas (CMPAs) of the province of Chubut, Patagonia, Argentina was evaluated, from the application of the methodology METT (Management Effectiveness Tracking Tools). This methodology was developed by the World Bank (WB) and World Wildlife Fund (WWF) to measure and improve the effectiveness of the management of protected areas; and it has been adopted by the World Commission on Protected Areas of the International Union for Conservation of Nature (IUCN) and the Global Environment Facility (GEF). For its implementation, work was done in coordination with the implementing authority, Secretary of Tourism and Protected Areas of the province, within the framework of participative workshops involving technicians in charge of Protected Areas (environmental guardians and provincial officials). The application of this tool allowed gathering information on the current situation of the CMPAs of the province, as well as the achievements of their management and their needs. According to the results, the CMPAs in the province reach a value of 72.5 % average management effectiveness; close to the value of high effectiveness; and above the reached in other Argentine provinces with coastline. However, there are deficiencies that need to be met to improve the effectiveness of the management in these areas. Finally we propose measures to improve the sustainability of economic activities which the APCMs give support; and recommended replication of this assessment, at least every two years.







TRANSPARENT GOBY (*Aphia minuta*) MANAGEMENT PLAN OF THE REGION OF MURCIA

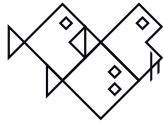
Peñalver J., E.M. Dolores, L. Bermúdez, I. Bas, M.Á. Carrión, M.L. Pla & E. Romero

Fisheries and Aquaculture Service. Regional Ministry of Water, Agriculture and Environment. Region of Murcia. Edificio Foro, 30201, Cartagena, Murcia, Spain (jose.penalver2@carm.es).

Regulation 1967/2006 concerning management measures for the sustainable exploitation of fishery resources in the Mediterranean Sea is the current regulatory framework, which establishes that it is necessary to request exceptions when some technical measures can be breached. This is the case of transparent goby fishery because it uses a net with a smaller size, and the fishery is carried out very close to the shoreline, and in lower depth. The Department of Fisheries and Aquaculture of Murcia presented a specific management plan, in order to continue fishing, due to its traditional character and its great social and economic impact on the local fishing. This exception was approved by Regulation 773/2013 and requires the completion of administrative and scientific controls.

Management measures include limiting the number and characteristics of vessels, net structure and size, closed season, time constraints and unloading areas, limiting catches, minimum level of fishing effort, establishing a “Goby Control Document” and a “Monitoring and Sampling Plan”. The Monitoring and Sampling Plan consists of statistical studies about sales (catches, fishing effort and economic data), analysis of the Goby Control Document, sampling and study of catches on board, sampling at market and analysis of biological samples: biological parameters, catches and impact assessment of the fishery the on the seabed.

This report describes the results of the scientific monitoring work developed from 2012 to 2016, and a preliminary assessment: a majority presence in catches of *Aphia minuta* compared with the other two target species (*Pseudaphia ferreri* and *Crystallogobius linearis*), it is confirmed like very selective fishery, because the by-catch is low (<1% by number and 10% by weight) and the survival after his release is very high and also does not cause any negative impact on the seabed. Additionally, biometrics data, sex ratio and reproduction data are provided for transparent goby.



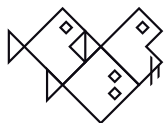
ELASMOBRANCH FISHING: CURRENT SITUATION IN THE EUROPEAN UNION AND SPAIN

Nos-Francisco D.¹ & R. Cabrera-Castro²

1 Alumno Máster de Oceanografía y Gestión del Medio Marino. Facultad de Biología. Universidad de Barcelona (dnos-fran7@ub.edu).

2 Departamento de Biología. Facultad de Ciencias del Mar y Ambientales. Universidad de Cádiz.

Concern about elasmobranchs has grown lately due to the poor condition of their populations. We can identify three major causes: first, the fishing overexploitation; second, the lack of control and disrepair of the taken data and third, its biological characteristics. However, its low market value has meant no investment has been made to increase knowledge. We have united data in a database with most important species to analyse the history, trend, and actual state of the European and Spanish elasmobranch captures. We have found an important lack of data before 1990 but in general it shows strong oscillations in captures that fall rapidly but which recovery is very slow. Of the 15 species selected, 2 are predominant in Europe; is the case of *Squalus acanthias* (82 %, before 1996) and *Prionace glauca* (65%, since 1996). This species are more abundant because of their major growth rate and higher fecundity than most of elasmobranchs and it allows them adapting to the fishing pressure and conserve a good population size. Taking account of it we conclude that a sustainable catch rate is possible if we select the appropriate species, improve fishing gears selectivity, reduce the fleet and apply plans of control and management for the fisheries.



SPATIAL AND TROPHIC ROLE OF HORSE MACKEREL (*TRACHURUS SPP.*) IN THE GULF OF ALICANTE

García-Rodríguez E., M. Vivas-Salvador, Á.M. Fernández-González, E. Herrera-Martínez, A. Esteban-Acón & J.M. Bellido-Millán.

Instituto Español de Oceanografía, Centro Oceanográfico de Murcia. 30740 San Pedro del Pinatar. Murcia (encarnacion.garcia@mu.ieo.es).

Horse mackerel is a quite exploited resource with important landings in the main fishing ports in the Gulf of Alicante.

This study aims to update the knowledge of its trophic and spatial habits to understand its behaviour and potential niche overlapping in the study area.

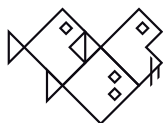
Samples of *Trachurus mediterraneus*, *Trachurus trachurus* and *Trachurus picturatus* were collected from MEDITS survey and fish market of Altea and Torrevieja in 2015. A total of 323 stomach contents were examined.

T. mediterraneus and *T. trachurus* were split in two range of size, resulting in five strata for the three species. Multidimensional scaling (MDS) analysis was made and species distribution maps were produced with ARCGIS software. Time series were studied in order to investigate changes in the trend on the landings of these species.

Results show the different trophic strategies of the five strata studied. The MDS analysis shows that small specimens of *T. mediterraneus* feeds mainly on mesozooplankton (26.2%) and non-pelagic peracarids (26.8%) whilst larger *T. mediterraneus* feeds mainly on fishes (83.8%). *T. picturatus* samples show overlapping with small individuals of *T. trachurus*.

Spatial distribution shows evidences of the different distribution of this species in the study area. *T. trachurus* and *T. picturatus* are distributed mainly in oceanic areas, while *T. mediterraneus* distribution mainly in neritic areas.

Based in the results, we concluded that horse mackerel present different feeding strategy depending to species and individual size while spatial distribution depends on the species.



ROLE OF CEPHALOPODS IN MARINE TROPHIC WEB IN WESTERN MEDITERRANEAN ECOSYSTEM

Vivas-Salvador M., E. García-Rodríguez, Á.M. Fernández-González, E. Herrera-Martínez & A. Esteban-Acón

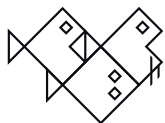
Instituto Español de Oceanografía, Centro Oceanográfico de Murcia. 30740 San Pedro del Pinatar. Murcia (miguel.vivas@mu.ieo.es).

Cephalopods are a group with significant landings in the ports of the Spanish Mediterranean. However, their populations are subject to significant seasonal and annual fluctuations. Moreover, despite its economic interest, we lack knowledge about how commercial species exploit this group as a trophic resource in our waters. In order to improve knowledge of the trophic structure of our marine ecosystems and the role that cephalopods have in it, diet of total of 63 species of fish representing the different levels of food webs was studied. For this, stomach contents of 9,456 specimens collected between 2011 and 2014 were analyzed.

Cephalopods were part of the diet in 37 of the studied species. Remains of cephalopods were found in 401 stomachs. The most abundant species were *Abralia veranyi*, *Rondeletiola minor*, *Sepietta oweniana* and *Illex coindetii*. *Eledone cirrhosa* and *E. moschata* were the only octopuses. For these four species, a study of linear regression between the size of the mantle and the peak size from cephalopods caught in the MEDITS survey was conducted. This allowed studying the size range of these species exploited by the fish community through the peaks found in the stomachs.

Different trophic indices were used to define resource utilization. MDS and Cluster analysis demonstrated clear differences in feeding strategies in different species studied. SIMPER analysis was used to determine species contributing the highest dissimilarity: *Chelidonichthys cuculus*, *Mullus surmuletus*, *Serranus cabrilla*, *Trachinus draco* or *Trisopterus minutus* have specialized in sepiolids, *Lophius piscatorius* or *Merluccius merluccius* in cuttlefishes, while *Micromesistius poutassou* and the elasmobranchs studied, show a clear preference for theutoidea.

Results show that (except octopuses) cephalopods constitute a trophic group to consider in food webs of Levantine-catalan waters. We found a high level of specialization among the different species studied, depending on the taxon of cephalopods present in these waters.



PHYSICAL-ECOLOGICAL CONSEQUENCES OF SOME INDICATORS OF CLIMATE CHANGE ON FISHERIES IN MARINE AND CONTINENT CAPTURE

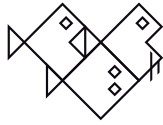
Llanes-Cárdenas O.¹, Norzagaray-Campos M.¹, Muñoz-Sevilla P.², Herrera-Moreno M.N.¹ & López-Pillado J.R.¹

1 CIIDIR-IPN-Sinaloa (oma_llanes@hotmail.com).

2 CIEMAD-IPN-México.

Becarios de los programas COFAA del IPN y EDI del IPN.

There are many evidences that the oceans and rivers in the world are warming, and this can be caused by changes in seawater and increased water runoff from rivers, among other affectations. The goal of this study was to calculate indicators of oceanic-continental climate changes and estimate physical-ecological consequences in marine and continental fishing practices on Northwest Mexico. To estimate the possible effects of physical-ecological consequences in capture fisheries was established two types of methodology; one for the marine zone and other for the continental zone. Referred to the continental zone, it was collected data of maximum temperature from 38 weather stations provided by the Comisión Nacional del Agua (CONAGUA) during the period of 1962-2013. To estimate the impact of climate change on marine zone and associate it with the capture fisheries, leaned indicators anomalies of sea surface temperature and outgoing long wave radiation through satellite images the optimally interpolated version 2 (OISSTV2) in the period of 1981-2010. The results show a significant trends that were calculated for each seasons using the nonparametric statistical tests of Mann-Kendall and estimation of Sen's Slope. The results denote a significant increase trend in the maximum temperature in 16 climatic stations (0.034 to 0.11°C year⁻¹). Specifically in the ocean, anomalies of surface temperature and radiation were presented. The importance of this study is the utility that it has under the necessity for generating management plans, prevention and adaptation of fish species to enhance the development of capture fisheries in these two zones.



ANALYSIS OF FISH TRADE FROM SURFACE LONGLINES IN ANDALUSIA, SPAIN

Arana D.¹, Sanz-Fernández V.², Muñoz-Lechuga R.², Cárdenas P.³ & R. Cabrera-Castro²

1 Agencia de gestión agraria y pesquera de Andalucía (AGAPA). Junta de Andalucía, España.

2 Departamento de Biología. Facultad de Ciencias del Mar y Ambientales. Universidad de Cádiz. 11510. Cádiz. España (reme.cabrera@uca.es).

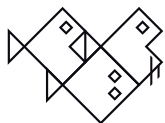
3 Alumno Máster ACUIPECA. Universidad de Cádiz.

Fisheries products traded in fish markets in the Andalusian (Spain) between January to October 2015 was 49.814 T with a market value of € 131,09 million.

By fishing gear, the coastal longline fleet in surface represents 3,9 % of the size of the total GT tonnage of the small – scale coastal fleet, with a volume of capture of 549.016,44 kg being 1 % of total fish production of the artisanal fleet. In 2011, this injected revenue worth € 3.053.873, 70 (2, 1 %) of the total traded value.

With an objective to evaluate the marketing channels of catches from the longline a comprehensive analysis of sales notes submitted to the fisheries authority during the period 2013-2015 was performed. In parallel, an in situ monitoring of the process of first sale of products in the fish market of El Puerto de Santa Maria in Cadiz (Spain) was done, as well as surveys of agents involved in the capture and subsequent marketing.

The analysis reveals that the main surface longline catches are, by order, swordfish (*Xiphias gladius*), blue shark (*Prionace glauca*) and to a lesser extent, mako (*Isurus oxyrinchus*). The study also provides valuable information about the seasonality of catches in relation to the fishery and the main landing points. With respect to market value, the swordfish was most valued, with average price of 6.05 € /kg, compared to 4.71 and 1.97 € / kg for the mako and blue shark respectively. In recent years there has increased decline in the catches of mako and blue shark to a lesser extent. This is caused by increasing demand for consumption and for shark fins.

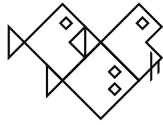


SITUATIONAL ANALYSIS OF FISHERY SECTOR IN THE COASTAL AREA OF PARAISO, TABASCO, MEXICO: ORGANIZATION AND COMMERCIALIZATION

D´artola-Barceló A.L.

Universidad Politécnica del Golfo de México. Carretera Federal Malpaso-El Bellote Km. 171. Ranchería Monte Adentro. CP 86611 Paraíso, Tabasco, México. (alainlois@hotmail.com; alaindartola@upgm.edu.mx).

The coastal area from Tabasco is distinguished by the importance of their fishing activities contributing to supply food demand of local and national population. However, the lack of current knowledge about conditions of fishing sector has generated a situation of ignorance concerning their problems and areas of opportunity resulting in the impediment to the development of management plans and optimal use of resources. The aim of this study is to describe the current situation of the fishery in Paraíso, Tabasco, under the context of organization and commercialization. The study was conducted in the coastal area of the municipality of Paraiso, Tabasco, comprising the three most important fishing ports: Puerto Ceiba, El Bellote and Chiltepec. The selected populations were: legal regulators fishing, fishermen and restaurateurs. were applied descriptive surveys about the exploitation of fishery resources like: Species marketed, technology and fishing methods, commercialization sites and processing activities. Was consulted current databases of Comisión Nacional de Acuacultura y Pesca of Mexico. Taxonomic identification was made in situ and ex situ. The activity of legal commercial fishing is carried out by 42 fisheries cooperatives societies and 42 fishermen with permission. Fishermen do the extraction of fish with an average frequency of 5 days a week, ranging from 5-75 miles per trip in coastal lagoons and / or high seas. 29 species were identified, of which Robalo fish and shellfish like shrimp and oyster represent as the most demanded. The best market known by fishermen is La Viga market in central Mexico, because the population of Paraíso demands a very low diversity of species. The analyzed results highlight the fact a poor use (consumption) of fisheries species by the people of Paradise due to low demand for other species that make up the coastal resources of Tabasco.

**REPRODUCTIVE TRAITS OF *Pimelodus grosskopfii* Steindachner, 1879
IN THE QUIMBO RESERVOIR (COLOMBIA) PRIOR TO FILLING****Villa-Navarro F.A.¹, García-Melo L.J.¹, Gualtero D.M.² & V.J. Ángel-Rojas²**¹ Grupo de Investigación en Zoología, Facultad de Ciencias, Universidad del Tolima (favilla@ut.edu.co).² Proyecto Hidroeléctrico El Quimbo, Emgesa S. A. E.S.P.

La pesca artesanal se constituye en una actividad de importancia comercial para numerosas familias ubicadas a lo largo del cauce principal y en los embalses de la cuenca del Alto Magdalena. *Pimelodus grosskopfii* es migratoria, representa una de las especies más importantes de estas pesquerías y se encuentra amenazada. Este trabajo tiene como objetivo analizar la biología reproductiva de *P. grosskopfii* a partir del monitoreo de los desembarques de pesca en los puertos del área de influencia del proyecto hidroeléctrico El Quimbo, antes de su llenado. El monitoreo cubrió un ciclo anual, agosto de 2011 a julio de 2012, determinando la proporción sexual, talla de maduración, relaciones somáticas y factor de condición. El total de individuos analizados fue de 676, con un rango de tallas entre 150 – 349 mm de longitud total, el coeficiente de regresión fue de $b = 2,4991$ con un $R^2 = 0,9095$. La talla media de madurez sexual se encuentra entre 220 y 259 mm. La proporción sexual varió entre los puertos de desembarque y a lo largo del año. Temporalmente el IGS presenta un pico en marzo, la mayor proporción de individuos maduros se encontró entre septiembre y marzo, sugiriendo que el pico de desove ocurre en marzo, periodo de inicio de altas lluvias.

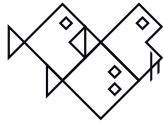


INAPRO: INNOVATIVE MODEL AND DEMONSTRATION BASED WATER MANAGEMENT FOR RESOURCE EFFICIENCY IN INTEGRATED MULTITROPHIC AGRICULTURE AND AQUACULTURE SYSTEMS

Vidal-Torrano M.

TILAMUR, www.tilamur.com/es (mariano@tilamur.com)

The objective of INAPRO is to mobilise industry, member states and stakeholders to promote a new and innovative technical and technological approach right up to an Aquaponic system which allows a nearly emission free sustainable production and contributes remarkably to global food security for the 21st century. Considering that traditional Aquaponic systems, combining aquaculture and hydroponics, have a great potential in saving water and energy and recovering nutrients from wastewater by value chains, the project aims at a real breakthrough for these systems towards commercialization. This will be achieved by a) the model based optimisation of the system concept in respect to water consumption and quality, environmental impact, waste avoidance, CO₂ release and nutrient recycling, energy efficiency, management efforts and finally costs and b) the integration of new technologies containing cutting edge approaches such as: 1) innovative one-way water supply for horticulture and water retrieval by condensation, 2) alternative water and energy sources, 3) optimized filter systems, 4) intelligent sensor and management network for an optimized system construction and operation. The viability of INAPRO systems will be proved in concept-based demonstration projects both in rural and in urban areas that offer a potential economic advantage while simultaneously reducing water and carbon footprint. The dissemination activities (to policy, public and end-users) will open new market opportunities and improve market access inside and outside Europe for producers and technology suppliers. These ambitions meet perfectly with the EU strategies under Europe 2020 to face the challenges of dramatic water resource developments in Europe and worldwide. The project supports particularly the Innovation Union with the EIP Water as one key initiative and further the Common Agricultural Policy and will consequently be closely connected to an EIP Action Group in agricultural water management.



FISH MIGRATION RIVER, AN INNOVATIVE LARGE SCALE FISH PASSAGE

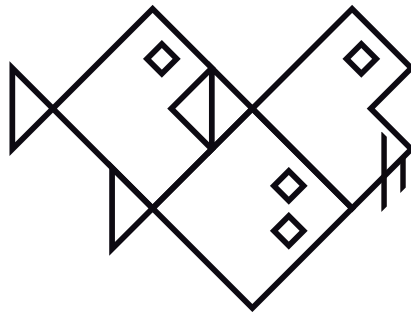
Van Herk J.

DNA The New Afsluitdijk / LINKit consult; Coehoornstraat 17, 6811 LA Arnhem, The Netherlands (jeroen@linkitconsult.nl)

The Fish Migration River is an opening in the Afsluitdijk in the Netherlands through which migratory fish can swim to reach the IJsselmeer from the Wadden Sea and vice versa. This is because migratory fish require fresh and salt water for their life cycle. Due to dykes and dams such as the Afsluitdijk, this is either hardly possible, or entirely impossible. This had led to a strong decline in fish populations in the Wadden Sea and the Lake IJsselmeer.

De Nieuwe Afsluitdijk wants to eliminate the obstacle for migratory fish with the innovative Fish Migration River. Millions of fish are now waiting in the Wadden Sea in front of the discharge sluices, like surfers. They can smell the fresh water and want to get inside. But the current is usually too strong for these migratory fish to swim against. A permanent opening via the Fish Migration River should make it possible again for these migratory fish to swim freely from salt to fresh water. Rijkswaterstaat is also taking measures to boost fish migration between the Wadden Sea and the IJsselmeer: fish-friendly sluice and lock management is used and a small scale fish passage is being constructed at Den Oever.

The Fish Migration River is a system that remains close to nature and functions optimally for fish and the ecosystem in a tidal environment with fresh and salt water. This makes it a unique project for the Dutch Water sector with an international appeal.

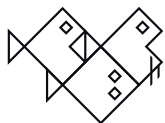


SIBIC2016

**VI IBERIAN CONGRESS OF
ICHTHYOLOGY / MURCIA**

SS

**SPECIAL
SESSIONS**



IS THE EUROPEAN EEL (*Anguilla anguilla*) RECOVERING?

Díaz E.

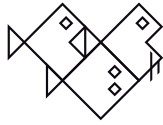
AZTI-Tecnalia Txatxarramendi ugartea z/g – 48395 Sukarrieta, Bizkaia (Spain) (ediaz@azti.es)

In 1999 the ICES working Group on eel stated that the stock of the European eel was outside safe biological limits. In 2007, the EU launched the regulation (1100/2007) forcing countries to implement an eel management plan (EMP) including measures that would allow 40 % of adult eels to escape from inland waters to the sea, where they can spawn.

According to the last review (ICES 2015), the status of eel remains critical. The annual recruitment of glass eel to European waters in 2015 decreased compared to 2014, from 3.7% to 1.2% of the 1960–1979 level in the ‘North Sea’ series, and from 12.2% to 8.4% in the ‘Elsewhere Europe’ series. The annual recruitment of young yellow eel to European waters decreased to 11% of the 1960–1979 level. These recruitment indices are well below the 1960–1979 un-impaired reference levels, and there is no change in the perception of the status of the stock.

In 2015, EU Member States post-evaluated the implementation of their EMPs and based on the stock indicators they provided, it was concluded that the stock in most reporting countries/ areas was not within the biomass limits of the Eel Regulation and in most management units, anthropogenic mortality is not at a level that can be expected to lead to recovery. The stock in the reporting areas as a whole remains outside biomass limit, as defined in the Regulation, and average mortality over this area was not at a level that can be expected to lead to recovery.

ICES advised that when the precautionary approach is applied for European eel, all anthropogenic mortality (e.g. recreational and commercial fishing on all stages, hydropower, pumping stations, and pollution) affecting production and escapement of silver eels should be reduced to – or kept as close to – zero as possible.



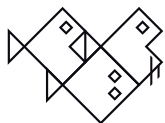
TRENDS IN THE EUROPEAN EEL FISHERY

Díaz E.

AZTI-Tecnalia Txatxarramendi ugartea z/g – 48395 Sukarrieta, Bizkaia (Spain) (ediaz@azti.es)

There is a great heterogeneity in the manner in which landing data are reported in each country, which makes the European eel fishery overall trend analysis a complicated task. Some countries have an official system, which then reports either total landings or landings split by Management Unit or Region. Some countries do not have any centralized system for reporting. The ICES WGEEL (2015) made a compilation combining the most recent update of the FAO data, with national information sources, and a reconstruction of the remaining missing data, that constitutes the best available view on the trend in landings of eel.

The compiled landings show a continuous decreasing trend in catches that started in the 70ies. In addition, in the years since the implementation of the Eel Regulation, fishing restrictions in many countries appear to have reduced the catches considerably; thus care should be taken with the interpretation of the landings as indicators of the stock as such, since the catch statistics will now reflect the status of the stock as well as the effect of fishing restrictions.



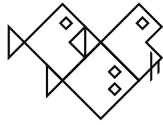
BARRIERS TO MIGRATION DURING THE CONTINENTAL PHASE OF THE EUROPEAN EEL

Fernández-Delgado C.

Departamento de Zoología. Edificio Charles Darwin. Campus de Rabanales. Universidad de Córdoba. 14071 Córdoba. Spain. (carlos.fdelgado@uco.es)

Three stages of its complex life cycle are severely affected by barriers in the European eel: anadromous migration during the elver phase, local movements during the resident stage and catadromous migration during the silvering phase.

Every one has a different problematic. Besides there is a universe of obstacles which affect the movements in different graduation and finally the density of these obstacles within the same river basin complicates even more if possible the status of the species. As a colophon of all of this, the morphology of the eel does not allow the usage of the traditional fish passes. Thus habitat connectivity is one of the most difficult and interesting challenges for conservation of the European eel during its continental life. In this section I will describe the general problematic of the species, with a summary of the most abundant barriers and how each of these affect a particular developmental stage. Finally I will also describe the different eel passages that can be built to mitigate this loss of movements.



PREDATION ON THE EUROPEAN EEL DURING ITS CONTINENTAL PHASE

Fernández-Delgado C.

Departamento de Zoología. Edificio Charles Darwin. Campus de Rabanales. Universidad de Córdoba. 14071 Córdoba. Spain. (carlos.fdelgado@uco.es)

Natural mortality of eels is a major, but relatively unknown, factor in the population dynamics of the species. Mortality caused by predation is one of the factors contributing to this natural mortality. Eel populations represent a significant component of the aquatic ecosystems, including their considerable contribution to the diet of other fish and semi-aquatic predators such as, cormorants and otters. All the life stages of the eel, in coastal and inland aquatic habitats, can be an important part of the diet for these predators and can therefore add to the natural mortality of the eel. Moreover fish eating birds such as cormorants may also have a role in extending the distribution of *A. crassus* through fish regurgitation. The EU Regulation lists reducing predation as a possible management option that could be employed when attempting to reach escapement targets. Nevertheless most of these predators have a high conservation status and it is likely to be extremely difficult to obtain permission for potential mitigation activities.



THE EUROPEAN EEL QUALITY ASSESSMENTS

Muñoz P.

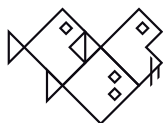
Campus de Excelencia Internacional Regional "Campus Mare Nostrum". Dpto. Sanidad Animal.
Universidad de Murcia. E-30100, Murcia. Spain (pilarmun@um.es)

The stocks of the European eel *Anguilla anguilla* are in decline and there are indications that poor quality of the spawners might be a key factor in explaining this decline. Infestation of the swimbladder nematode *Anguillicola crassus* may affect the capacity of European eels to complete their spawning migration; some virus produces haemorrhages and extreme anemia in actively swimming eels which apparently forced them to stop swimming; contamination might impair fertility and energy reserves might be insufficient to cover energetic requirements for silver eel migration and reproduction (Van den Thillart et al 2009). Hence, the collection of data on the disease status, pollution as well as lipid content of eels, is required in order to identify areas producing high-quality spawners. The Joint EIFAC/ICES Working Group on Eels initiated the set up of an European Eel Quality Database to collect data of eel health status (Belpaire et al 2011). Although, many countries have started compiling these data and there is a large amount of information, procedures with respect to sampling, analysis and reporting are not harmonized, hindering stock wide assessments and risking inefficient use of resources. For this reason, standardized protocols for the estimation of the eel quality were proposed (ICES, 2014). An overview of the current eel quality assessments in the Member States and considerations regarding general issues on sampling of eel quality assessments will be presented.

Belpaire C., Geeraerts C., Evans D., Ciccotti E. & Poole R. (2011). *Environ. Monit. Assess.* 183.

ICES (2014). Workshop of a Planning Group on the Monitoring of Eel Quality: Development of standardized and harmonized protocols for the estimation of eel quality. ICES CM 2014/SSGEF: 14.

Van den Thillart G., Dufour S., Rankin J.C. (2009). *Fish Fisheries* 30.



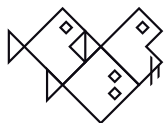
POTENTIAL THREATS TO THE EUROPEAN EEL

Domingos I.^{1,2}

1 MARE - Centro de Ciências do Mar e do Ambiente, Faculdade de Ciências, Universidade de Lisboa, Lisboa, Portugal.

2 Departamento de Biologia Animal, Faculdade de Ciências, Universidade de Lisboa, 1749-016 Lisboa, Portugal (idomingos@fc.ul.pt).

The European eel population has been subject to a number of threats that impacted the stock. Some have been quantified but the vast majority remains difficult to quantify and, in most cases, poorly understood. They occur both in the ocean and in continental waters and include, among others, climate change, introduction and invasion of non-native species and the emergence of new diseases, as a result of these introductions. In addition, rising energy demands and an increase in renewable energy production offshore, raises serious concerns. The impact of climate changes on the eel stock is difficult to assess and quantify but it is widely accepted that changes in ocean currents are likely to impact the migration of larvae as they are passively transported until they reach the continental shelf. Some studies have correlated the number of glass arriving at continental waters to oceanic factors in the Sargasso Sea and the NAO in the Atlantic but climate change may also affect the continental eel stages through shifts in biotic communities of aquatic ecosystems and an increase in temperature, with positive and negative impacts throughout the species distribution. The potential impacts of the introduction of non-native species include disease transmission, competition with native species and possibly changes in food web structure. The effects on the eel population remain poorly understood, but there is some evidence of severe impacts on a local scale, affecting the distribution and abundance of the species. Furthermore, the impacts of the presence of submarine cables (offshore energy) are unknown but it is suspected that they may affect the migration of silver eels due to the production of electromagnetic fields. A review on potential threats that have been presented in the last WGEEL will be analysed and discussed in the light of current knowledge.



EUROPEAN EEL MIGRATION: HOW, WHEN, WHERE

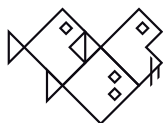
Díaz E.¹ & L. Zamora²

1 AZTI-Tecnalia Txatxarramendi ugarteia z/g – 48395 Sukarrieta, Bizkaia (Spain) (ediaz@azti.es)

2 Instituto de Ecología Acuática. GRECO. Universidad de Girona. Facultad de Ciencias, Campus de Montilivi s/n 17071 Girona. Spain (lluis.zamora@udg.edu)

Since Schmidt identified the presumed spawning area of European eel in 1920, scientists have tried to discover how glass eels and silver eels performed the round trip of at least 6000 km to the North African and European coasts. The availability of new technics has allowed solving partially some of the mysteries. During this communication, we will review the latest hypothesis regarding glass eel migration routes, trip duration, diet, existence of an active swimming behavior and the influence of oceanic factors in migration. In the case of the silver eel, recent technologies such as pop-up satellite tags (PSAT) and electronic data storage tags have allowed new discoveries regarding migration routes, trip duration, diet, vertical migration diel periodicity. Also, some studies point to the existence of a magnetic mechanisms for the orientation of both glass and silver eels in their migrations.

Anyway, although the new technics have allowed solving some of the mysteries, we will also point out many fundamental questions about eel migration that remain unanswered.



REPRODUCTION OF EUROPEAN EEL IN CAPTIVITY: WHERE WE ARE?

Asturiano J.F., D.S. Peñaranda, V. Gallego & L. Pérez

Grupo de Acuicultura y Biodiversidad. Instituto de Ciencia y Tecnología Animal. Universitat Politècnica de València. 46022 Valencia, Spain (jfastu@dca.upv.es).

The European eel was categorized as a critically endangered species by the IUCN in 2010 and listed by CITES under Appendix II in 2009. Fisheries control (in especial of glass eels, being the base of the eel aquaculture), habitat restoration and plans for the management of populations will help. However, nowadays, reproduction in captivity seems the only realistic alternative to reduce the pressure on natural populations and supply glass eels to eel farms.

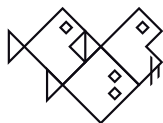
First attempt to reproduce the European eel under captivity was carried out in 1964 in Paris. From then, several research groups from different countries of Europe and Africa have tried to obtain viable eggs, but larvae were obtained only from a few groups from Belarus, Denmark, Italy, Spain and Hungary. The European Project PRO-EEL (2010-2014) established the protocols for the induction of massive spawnings and high production of larvae. Moreover, first experiments on larval feeding were carried out. However, the diet composition must be improved as the maximum survival reached only 26 days after hatching.

Obviously, research on this field has got some results, but has proved difficult due to the complex reproductive physiology of the eels. The required hormonal treatments are long (2-3 months for males, 4-5 months for females) and expensive, and to synchronize the production of sperm and eggs is difficult. Often, the use of wild animals (females) means to face pathologies and parasites, potential accumulated pollutants, as well as not optimal body composition (in especial PUFAs profile) which could limit the gametogenesis and the final gamete quality.

Thus, improvements are crucial on the use of environmental factors, innovative hormonal treatments, broodstocks management, specific diets (for breeders and larvae), gamete evaluation and handling, breeding and hatchery methods, and specific culture techniques for a self-sustained eel aquaculture.

Moreover, the development of biotechnology techniques, such as production of recombinant hormones, spermatogonia and sperm cryopreservation and germ cell xenotransplantation could become complementary tools.

Acknowledgements. Funded by the European Training Network IMPRESS (Marie Skłodowska-Curie Actions; Grant agreement n^o: 642893) and COST Office (COST Action FA1205: AQUAGAMETE).

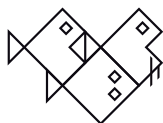


LATEST ON EEL RESEARCH: STOCKING AS A MANAGEMENT OPTION

Zamora L.

Instituto de Ecología Acuática. GRECO. Universidad de Girona. Facultad de Ciencias, Campus de Montilivi s/n 17071 Girona. Spain (lluis.zamora@udg.edu).

Under the European Eel Regulation EG 1100/2007, Member States establish Eel Management Plans (EMP), which includes a set of measures as stocking (or restocking when this action is repeated over time). It is defined as “the repeated injection of fish into an ecosystem in which a population of that species already exists from one external to it”. Although eel restocking has been reported since 1870 to enhance fish stocks, today this practices lean more towards sustainability. Various countries in Europe use different size and weight classes, from glass eels to young yellow eels, for stocking purposes. Stocking of glass eel peaked in the late 1970s and early 1980s (140M), followed by steep declined to a low in 2009 (2M) with an increase until now presumably caused by the implementation of EMPs. Stocking with young yellow eels is less frequent and reported data show an increase in last thirty years until reaching 16M in 2013. But little is known about the success of these measures, especially in rivers where stocking eels has generally been less favoured and studied than lakes due to methodological problems involved in monitoring eels stocks. Well-planned, properly funded and long-term studies of survival and growth rates are needed to encompass the years between stocking and final capture or to evaluate which percentage of migrating silver eels becomes from stocking. Best practice guidelines for the stocking of eels are needed. Mortality of stocked eels has been mainly related with operation (handling) but also with source of individuals, duration of stalling (captivity) and body condition. In this communication, some experiences will be presented as examples of planning and implementing stocking programmes as well as a review of the main outstanding questions response.



MIGRATORY FISH RECOVERY AND IMPROVED MANAGEMENT IN THE FINAL STRETCH OF THE EBRE RIVER (CATALONIA, NE IBERIAN PENINSULA; LIFE+ MIGRATOEBRE)

Martín J.¹, M. Ordeix², M. Rafa³, E. Gisbert⁴, F. Vidal⁵ & J. Gómez⁶

1 IDECE, Institute for the Development of the Regions of the Ebre River). Av. Generalitat, 116. 43500 Tortosa. Catalonia. (juanmanuel.martin@gencat.cat)

2 CERM, Center for the Study of Mediterranean Rivers - Ter River Museum.

3 Catalunya - La Pedrera Foundation.

4 IRTA's Aquaculture Centre of Sant Carles de la Ràpita.

5 Natural Park of Delta de l'Ebre, Ministry of Territory and Sustainability of the Government of Catalonia.

6 DG Fisheries and Maritime Affairs, Ministry of Agriculture, Livestock, Fisheries, Food and Environment of the Government of Catalonia.

The aim of this project is to promote the recovery of ecological connectivity within 10-20 years in the lower Ebre River and Delta (in a stretch of 115 km from the Mediterranean Sea), and a healthy and sustainable population of migrating fish: European sturgeon (*Acipenser sturio*), European eel (*Anguilla anguilla*), twaite shad (*Alosa fallax*) and sea lamprey (*Petromizon marinus*), among others aquatic native species.

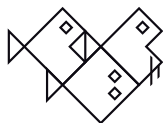
It is focused on long-term sustainable investments adapting all present river obstacles to allow fish migration (upstream and downstream); increasing twice the river spawning habitat availability, and the distribution and growth areas of migrating fish.

Main activities of the LIFE MIGRATOEBRE project (LIFE13 NAT/ES/000237) are:

1. Apply ship locks fish-friendly improved management at Xerta's weir (located at 58 km from the sea) and at Flix dam (located at 115 km from the sea), and to monitor it regularly.
2. Install a fish lock at Xerta's weir, and a fish ramp at Ascó's weir (located at 104 km from the sea), and to monitor it regularly.
3. Undertake a pilot project of European sturgeon restocking through an experimental release in the lower Ebre (downstream and upstream Xerta's weir).
4. Develop a communication campaign and a community involvement plan for students, general public, farmers, fishermen, anglers, electric companies, tourism stakeholders, regional and local authorities. It will include the production of a great temporary exhibition and a network of volunteers.

This LIFE project started in 1/07/2014 and will finish in 30/06/2018.

More information in: www.migratoebre.eu



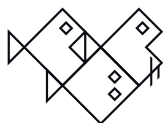
LIFE+ IREKIBAI PROJECT: IMPROVING CONNECTIVITY AND HABITATS IN RIVERS SHARED BY NAVARRA AND GIPUZKOA

Mendiola I.¹ & P.M. Leunda²

1 Diputación Foral de Gipuzkoa, Departamento de Promoción Económica, Medio Rural y Equilibrio Territorial, Plaza Gipuzkoa s/n, 20004 Donostia, Gipuzkoa, Euskadi (imendiola@gipuzkoa.eus)

2 Gestión Ambiental de Navarra S.A., Calle Padre Adoain 219 Bajo, 31015 Pamplona/Iruña, Navarra (pleundau@ganasa.es)

The main objective of the LIFE Irekibai project is the improvement of conservation status of river habitats and species on European interest at the Natura 2000 sites located in the Bidasoa and Leizaran river basins. For doing so, the project seeks to reverse the main issue shared by rivers along the Cantabrian coast: fragmentation. With this objective, 11 concrete actions have been designed that contain 26 measures of weir removal and permeability, restoration of fluvial habitat and riparian forest, and the control of invasive species. The impact of the project actions will be monitored in several levels, from geomorphology and sediment transport to the assessment of habitat and species (Pyrenean desman, Allis shad, sea lamprey and Atlantic salmon), as well as the evaluation of the socioeconomic impact and changes in ecosystem services of the entire project. Likewise, the effectiveness of 15 fish-ways recently installed in the area will be evaluated. Among the expected results of the project are the removals of 11 weirs, and permeability of another 2, the elimination of more than 5 kilometers of dammed rivers sections, the rehabilitation of 1.5 hectares occupied by industrial ruins, and the restoration of 3.5 hectares of alder and mixed forest. The project will disseminate its results in order to raise public awareness on the project values and the ecosystem services provided by rivers. The project LIFE Irekibai started in July 2015 and will continue until the end of 2020, with a total budget of nearly 3 million Euros from which the 60% will be contributed by the European Union.



LIFE+ SEGURA RIVERLINK: A GREEN INFRASTRUCTURE APPROACH TO RESTORE THE LONGITUDINAL CONNECTIVITY

Lafuente E.¹, R. Olivo del Amo², F.J. Sanz-Ronda³, J. Sánchez-Balibrea⁴, R. Díaz⁵, M. Torralva & F.J. Oliva-Paterna⁶

1 Confederación Hidrográfica del Segura. Coord. Beneficiary. (eduardo.lafuente@chsegura.es)

2 TYPESA, Ingenieros, Consultores y Arquitectos. Murcia

3 U.D. Hidráulica e Hidrología. ETS.II.AA. Palencia. Universidad de Valladolid.

4 ANSE, Asociación de Naturalistas del Sureste, Murcia,

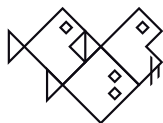
5 Oficina de Impulso Socioeconómico del Medio Ambiente. CARM.

6 Dpto. Zoología y Antropología Física. Universidad de Murcia. (fjoliva@um.es)

Habitat connectivity is a central factor in shaping fish assemblages and populations, however, few tools are developed to maintain and restore this attribute at a large scale in fluvial Mediterranean systems. The Segura-Riverlink is a LIFE Programme project which aims to promote and support the environmental recovery of a fluvial sector of the Segura River Basin (more than 50 km long in its main river). The main purpose is to demonstrate and validate management measures for the development of a *Green Infrastructure* (GI) approach into the context of Mediterranean river basins characterized by a high impact in their connectivity. The project will restore the longitudinal connectivity removing a significant number of small artificial barriers to re-establish fish movement and will also support other best practices of riverine restoration. The restoration actions will include the removal of a small weir and the construction of effective fish passage systems and monitoring will assess the performance of these actions with the hope of validating the *GI* approach to river basin management and its possible extension to the official management programmes. The project will also develop a Land Custody Network to integrate private owners in the river management and in agreeing good practices.

In sum, the project's outcomes will protect local aquatic and riverine habitats, allow fish reproductive movements along an important fluvial sector, improve ecosystem services, and build a framework of scientific and social knowledge to improve river management quality and to help the implementation and enforcement of EU policy and legislation on biodiversity conservation.

More information: www.segurariverlink.eu; www.facebook.com/segurariverlink

**LIFE+ RIPISILVANATURA: A MULTIDISCIPLINARY APPROACH TO RESTORE RIVERINE HABITATS AND CONTROL INVASIVE ALIEN SPECIES****Fraile J.¹, A. Mérida¹, R. Olivo del Amo², J. Sánchez-Balibrea³, R. Díaz⁴, M. Torralva⁵ & F.J. Oliva-Paterna⁵**

1 Confederación Hidrográfica del Segura. (Coord. Beneficiary) (jaime.fraile@chsegura.es)

2 TYPASA, Ingenieros, Consultores y Arquitectos, Murcia.

3 ANSE, Asociación de Naturalistas del Sureste, Murcia.

4 Oficina de Impulso Socioeconómico del Medio Ambiente. CARM.

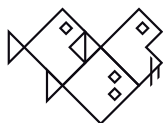
5 Dpto. Zoología y Antropología Física. Facultad de Biología. Universidad de Murcia.

The Segura-Ripisilvanatura is a LIFE Programme project which aims to promote and support the recovery of riparian habitats in a large fluvial sector of the Segura River Basin (57 km long in its main river surrounding the municipalities of Moratalla, Calasparra and Cieza). The aim of the project is to recover and protect the riparian zones mainly those dominated by willows and poplar (habitat 92A0) and associated habitats.

The loss and degradation of the original habitat represents an advantage for opportunistic and exotic species of both fauna and flora, which entails a reduction of the rich biodiversity that was traditionally bound to the riparian forest or Ripisilva (Populus and Salix-dominated riparian gallery). Moreover, as one of the main actions, the project will develop a strategy for the control and eradication of Invasive Alien Species in the Segura River Basin, directly focused on both riparian and aquatic species being invasive exotic fishes one of the most important target group.

The project's outcomes will protect the riparian habitats allowing fish refuge, establish the background and the strategy for control exotic species, improve ecosystem services, and build a framework of scientific and social knowledge to improve river management quality and to help the implementation and enforcement of EU policy and legislation on biodiversity conservation.

For more information: www.ripisilvanatura.eu



CONSERVATION OF AQUATIC HABITATS AND SPECIES IN THE HIGH MOUNTAINS OF THE PYRENEES (LIFE+ LIMNOPIRINEUS)

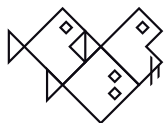
Ventura M.¹, T. Buchaca¹, A. Miró¹, Q. Pou-Rovira², A. Pérez-Haase³, E. Carrillo³ & J.M. Ninot³

1 Centre d'Estudis Avançats de Blanes (CEAB-CSIC). Accés a la Cala Sant Francesc, 14. 17300 Blanes. (ventura@ceab.csic.es)

2 Sorelló, estudis al medi aquàtic. Parc Científic de la UdG, 17300, Girona.

3 Departament de Biologia Vegetal. Facultat de Biologia, Universitat de Barcelona. Av Diagonal 643, 08028 Barcelona.

Aquatic continental systems are scarce environments with a very specific and sensitive fauna and flora where threatened species are abundant. In the Pyrenees, these wetland ecosystems are generally considered very natural landscapes. However, despite their remote location, anthropogenic perturbations have not been absent. The introduction and spread of alien species, especially various species of fish, is considered one of the main threats in high mountain lakes and streams originally fishless. Other threats include changes caused by the hydroelectric water level fluctuations and the excessive presence of both livestock and people around springs or peat bogs crossed by tourist path. LIMNOPIRINEUS (LIFE13 NAT/ES/001210) is a project aimed at improving the conservation status of species and aquatic habitats of European interest in the high mountains of the Pyrenees. Among the habitats of interest, there are certain types of peat bogs, tufa-forming springs, rivers and lakes. The target species include some amphibians, some mammals that feed on the aquatic environment including two species of bats. The project includes also species with populations that are now in danger of extinction decimated by various anthropic actions. As part of this project, conservation actions will be taken in the National Park Aigüestortes i Estany de Sant Maurici, the Natural Park of Alt Pirineu, and the Estanho of Vilac located in the Val d'Aran. Conservation actions to be undertaken includes developing conservation plans and assessment protocols for the management of species and natural habitats, improving the quality of peat bogs under heavy pressure from tourism by building elevated platforms, and restoring the natural state of some lakes through the elimination and control of alien fish species allowing the recovery of native species. The project aims also to disseminate the heritage value of natural areas and the impact of invasive species to students and general public through awareness campaigns.



LIFE+ POTAMO FAUNA, A PROJECT FOR THE RECOVERY AND CONSERVATION OF ENDANGERED RIVER FAUNA IN THE BASINS OF THE TER, FLUVIÀ AND MUGA RIVERS (CATALONIA)

Pou-Rovira Q.¹, M. Campos¹, I. Camós¹, C. Feo-Quer¹, P. Feliu, T. Puigvert², J. Montserrat³, E. Bassols³, X. Capelleres⁴, J. Budó⁴, M. Macias⁵, F. Torres⁵ & B. Gómez⁶

1 Consorci de l'Estany. Plaça dels Estudis, 2. 17820, Banyoles (Girona) (qpou@consorcidelestany.org)

2 Consorci del Ter

3 P.N. de la Zona Volcànica de la Garrotxa (Generalitat de Catalunya)

4 Associació d'Amics de la Tortuga de l'Albera

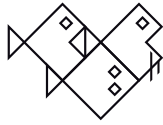
5 Forestal Catalana

6 Universidad del País Vasco (UPV/EHU)

In January 2014 has started Potamo Fauna LIFE project: Conservation of river fauna of European interest in the Natura 2000 Network of the basins of the Ter, Muga and Fluvia rivers (LIFE12 NAT/ES/001091). With a total budget of 1.9 million euros, involve six partners (Consorci de l'Estany, Consorci del Ter, Generalitat de Catalunya, Associació d'Amics de la Tortuga de l'Albera, Forestal Catalana y Universidad del País Vasco) an 6 cofinancers, apart from the European Union, which provides 50% of the overall budget. The overall objective of this project is the recovery and long-term preservation 12 endangered native species of aquatic fauna, including 3 species endangered in Catalonia and Spain, through a wide range of measures: captive breeding, population reinforcements, habitat improvement, control of exotic species, and dissemination and research on the status of these species and the value of river and lake systems.

Among the planned conservation action, the main lines of action planned are:

1. Conservation and recovery of riverine populations of three threatened species, mainly with specimens coming from captive breeding centers: *Unio elongatulus*, *Austropotamobius pallipes* and *Emys orbicularis*.
2. Conservation and recovery of populations of three endangered species, mainly through translocations of individuals coming from healthy populations: *Vertigo moulinsiana*, *V. angustior*, and *Barbus meridionalis*.
3. Improvement of populations of an aquatic turtle and of 5 amphibians in the Ter river, by creating micro wetlands: *Mauremys leprosa*, *Triturus marmoratus*, *Alytes obstetricans*, *Pelobates cultripes*, *Bufo calamita* y *Hyla meridionalis*.
4. Fight against various invasive alien species of crabs, fish, and freshwater mollusks, to mitigate its negative effects on aquatic fauna and their habitats, through a battery of different actions: population control, experiments against aphanomycosis, prevention of penetration, and other.



LIFE+ BIODIVERSITY CONSERVATION IN MIERA RIVER

Sánchez-Martínez C. & B. Serrano-García

Fundación Naturaleza y Hombre. Avda. España, 25, El Astillero 39610 (Cantabria). (serrano@fnyh.org; fundacion@fnyh.org).

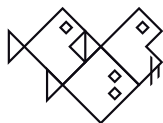
Biodiversity conservation in river Miera (LIFE 13 NAT/ES/899) is a LIFE+Nature project has started in July 2014. During three and a half years, Fundación Naturaleza y Hombre, as coordination beneficiary, will be working with its associated beneficiaries, Consejería de Medio Ambiente del Gobierno de Cantabria and MARE, to achieve the recovery of habitat types and species populations of Community interest along the full length of the Miera River.

The Miera River is located in northern Spain, flowing 41 km from the Cantabrian Mountains into the Bay of Santander. It has a significant role as an ecological corridor in the region. Four SCIs in Cantabria and Burgos are located all along its course, where Miera river basin is placed and the actions take place.

During the project 27 actions will take place, in order to create, restore and improve the conservation status of a series of targeted habitats selected for their scarcity, ecological importance and/or representativeness in the Natura 2000 areas along the river, including: Sphagnum acid bogs; riparian forests; montane forests; coastal sand dunes; dry Atlantic coastal heaths; and estuaries.

Habitat restoration actions will include the planting of native species, removal of invasive species, cleaning up of waste, protection from human disturbance and adaptation of river barriers. Where appropriate the project will also deliver land stewardship and hunting agreements to ensure good habitat management.

The project will seek to improve basic knowledge of the population conservation status and habitat used by a number of targeted animal and plant species. These will be selected for their ecological, educational and socio-economic importance, including: Atlantic salmon, (*Salmo salar*), European otter (*Lutra lutra*) and European chain fern (*Woodwardia radicans*). More information in: www.lifemiera.org



LIFE PROGRAM, AN OPPORTUNITY FOR OUR RIVERS AND WETLANDS. CASE STUDY: CIPRIBER LIFE+ PROJECT

**Marcos-Primo C.¹, J.C. Velasco-Marcos², G. González-Fernández³, F. Jimenez-Fernández⁴,
J. del Nido-Martín² & L. Arenillas-Girola⁵**

1 Confederación Hidrográfica del Duero. Muro, 5. 47004 Valladolid. (cmp@chduero.es).

2 Consejería de Fomento y Medio Ambiente, Junta de Castilla y León.

3 Ichthios Gestión Ambiental S.L.

4 Fundación Patrimonio Natural de Castilla y León.

5 Confederación Hidrográfica del Tajo.

In recent years several studies have shown a decline in populations of some cyprinid fish species of the Duero and Tajo river basin, as well as an increase of the spread of exotic species. As a result of these studies, it is necessary to take urgent actions to prevent the regression of the fish populations.

The *Confederación Hidrográfica del Duero* as coordinating beneficiary, and *Junta de Castilla y León*, *Fundación Patrimonio Natural*, and *Confederación Hidrográfica del Tajo*, submitted a LIFE+ Project in order to protect and recover the populations of these endemic species of cyprinids in the SCIs of the southwest of the province of Salamanca, by restoring and conserving the river habitats and developing an innovative captive breeding protocol.

The LIFE+ Project area is located in the southwest of the province of Salamanca because the composition and abundance of cyprinids is high and the degree of protection of some endemic fishes occurred in this area, moreover, because there are several SCIs associated to rivers located in this area. The target species are *Achondrostoma arcasii*, *Pseudochondrostoma popylepis*, *Iberochondrostoma lemmingii*, *Iberocypris alburnoides* and *Cobitis taenia*. The main objectives are:

Develop an innovative captive breeding protocol for the endemic species based on natural conditions.

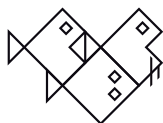
Performance Framework Document in Rivers and the assessment of the initial situation regarding the ecological status and the river connectivity.

Captive breeding for reintroduction of the target species making a fish resource stock in Galisancho.

Assessment of the evolution of the fish community developing a protocol for action against invasive species.

Improvement of river connectivity by demolition of barriers and construction of fish passages, and restoration of degraded river areas.

Water Management Plan and Fish Management Plan. Establish a framework for actions in order to guarantee conservation goals and future sustainability of the Project.



CONSERVATION OF THE SARAMUGO (*Anaecypris hispanica*) IN THE GUADIANA BASIN (PORTUGAL). LIFE13 NAT/PT/000786

Silva R.¹, R. Alcazar¹, H. Lousa¹, N. Silva¹, A. Cardoso², C. Carrapato², M. Ilheu³, P. Matono³, J. Bernardo³, J. Almeida⁴ & P. Pinheiro⁴

1 Liga para a Proteção da Natureza, Estrada do Calhariz de Benfica, 187, 1500-124 Lisboa, Portugal.(ricardo.silva@lpn.pt).

2 Instituto da Conservação da Natureza e das Florestas, Parque Natural do vale do Guadiana, Rua D. Sancho II, n.º 15, 7750-352 Mértola.

3 Universidade de Évora, Colégio Luis Verney,R. Romão Ramalho, 59, 7000-671 Évora.

4 Aqualogus, Rua do Mar da China, n.º 1 Escritório 2.4, Parque das Nações, 1990-137 Lisboa.

Saramugo (*Anaecypris hispanica*) is a freshwater fish endemic of the south of Iberian Peninsula, known to occur only in the middle and lower sections of the Guadiana river basin and a tributary of Guadalquivir river.

Its distribution is strongly fragmented and a very reduced, both in terms of abundance and distribution. It has been recorded mainly in the upper and central region of the Guadiana River Basin in Portugal. Currently its presence is only detected in 5 sub-basins of Guadiana.

Saramugo is classified as “Critically Endangered” in Portugal, and globally as “Endangered”, also it is listed in Annexes II and IV of the Habitats Directive.

Some of the threats to saramugo already identified are water pollution, construction of small dams or alike, the expansion of exotic fish species and habitat loss and degradation. Projet LIFE Saramugo aims for the conservation of saramugo populations mainly by improving its habitat.

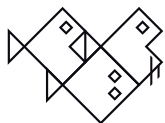
This project is ongoing since July 2014 and will last up to three and a half years. Actions will take place in 3 different Sites of Community Importance (SCI) of Natura 2000 Network, namely Guadiana, Moura/Barrancos and São Mamede

The main objectives of the project are:

- To update the species’ populational situation in Portuguese Guadiana River basin;
- The rehabilitation of aquatic and riparian corridors (shelter, feeding and reproduction habitats);
- The clarification of potential impact that may derive from the co-existence of bleak (*Alburnus alburnus*) in saramugo’s populations;

the reduction of pollution in waterlines due to livestock, in order to safeguard and improve water quality;

- The demonstration of techniques applicable to exotic species removal and control of its expansion, in order to reduce the impact of this threat;
- Contribute to the long-term conservation of saramugo through the involvement of landowners, farmers, fishermen and other stakeholders.



DAM REMOVAL EUROPE MOVEMENT

Van Herk J.

LINKit consult. Coehoornstraat 17, 6811 LA Arnhem (www.linkitconsult.nl; jeroen@linkitconsult.nl).

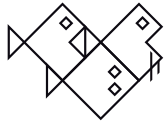
Free-flowing rivers are the freshwater equivalent of wilderness areas. The larger part of the European biodiversity is present in the rivers, wetlands and deltas. Free-flowing rivers boost an enormous amount of wildlife and the deltas of these rivers are of crucial importance for their migration, spawning and feeding. European species like salmon, sturgeon, crane birds, otters and dolphins depend on these rivers and deltas.

However, free-flowing rivers are a rare phenomenon in Europe. Europeans have been fragmenting rivers for centuries due to dam construction. Today it is estimated that there are more than 7,000 large dams in the EU (European Environmental Agency, 2008). The number of small dams and weirs is unknown and can be into the hundreds of thousands.

The overall ambition of Dam Removal Europe is to preserve Wild rivers and restore free flowing Rivers. There are still some wild rivers left in Europe. These very unique rivers we want to preserve for future generations. And there are some rivers which would ecologically flourish if the dams and weirs would be removed. The ambition is to 'free' these rivers by removing the dams and hence make the first important steps to an ecologically healthy, economically profitable and socially valuable river.

The goals of the Dam Removal Europe are:

- To preserve the last 'Wild' rivers in Europe and to restore free flowing rivers: Remove 20 dams with local partners in the next 5 years.
- To create an inspiring European Dam Removal movement.
- To generate and share knowledge with partners throughout Europe.
- To put dam removal on the agenda as an interesting option for river restoration.



DAM REMOVAL IN USA & EUROPE: WHY AND WHAT IS THE STATUS? PRESENTATION OF AMBER

Fernández-Garrido P. & H. Wannigen

World Fish Migration Foundation.

WFMF Spanish Office, 12594 Castellón, Spain, (pao@fishmigration.org).

WFMF Dutch Office, 9728 Groningen, Netherlands, (herman@fishmigration.org)

Why have US citizens removed already more than 1,200 dams and weirs in their rivers? Where do they get the money to fund all these projects? Why and how all this started? What is the situation in Europe? How many dams and weirs have Europeans removed? Do we even know the number of obstacles we have in our rivers? These and other questions will be answered in this presentation.

In addition, a new Horizon2020 project will be presented for the first time in Europe: Adaptive Management of Barriers in European Rivers (AMBER). This project will start in July of 2016 thanks to twenty partners from twelve different European countries. AMBER will deliver innovative solutions to river fragmentation in Europe through an integrated adaptive barrier management approach. The AMBER approach is based on the integration of programme design, management, and monitoring to systematically test assumptions about barrier mitigation, adapt and learn and is guided by the overall principle 'think globally, act locally'. It will create, among other things: the first global atlas of stream barriers in Europe, a global model for assessing and predicting barrier effects on local biota, a rapid barrier assessment toolkit for the assessment of connectivity for multiple taxa, field-tested and ready to be used by managers and practitioners and a practical guide for the application of the AMBER toolkit for solving problems of barrier effects.

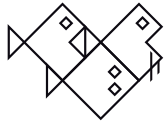


DAMS' REMOVAL IN THE SÉLUNE RIVER (FRANCE): OVERVIEW OF THE RELATED LONG-TERM RESEARCH PROGRAM

Fraisse S., J.M. Roussel & J.L. Baglinière

UMR 0985 INRA Ecologie et Santé des Ecosystèmes, 65 rue de Saint Briec, 35 042 Rennes, France (stephane.fraisse@rennes.inra.fr).

Dam removal constitutes a major action to restore connectivity in rivers. A lot of dam removal operations have been scheduled in the USA notably, and half the dam removal operations ever recorded have been done since 2000 only. However, the risks/benefits balance of such operations remains poorly documented, and long-term studies are lacking. In France, a 16-year scientific program has been initiated in 2013 to monitor the removal of two dams in the Sélune River (flowing into the Bay of Mont Saint-Michel, UNESCO's world heritage site), and planned in 2020. The ultimate aim of the project is to characterize the nature and the dynamic of ecological changes due to dam removal, and to identify the underlying mechanisms. Assessing changes of ecosystem services is also a major goal of this project. Involving 22 labs from complementary research fields, the scale of studies conducted ranges from the particle to the watershed. Several studies are currently running according to four interconnected tasks. The first task relates on aquatic biota and its goal is to characterize the evolution of diadromous and resident fish, invertebrates, crayfish, and vegetal (including macro- and microalgae) communities after dam removal. It aims to evaluate the changes in water quality, identify successful evolutionary strategies for diadromous fishes, and highlight fundamental changes in the functioning of freshwater ecosystem after the ocean-river reconnection. The second task focuses on hydrology and geomorphology. Its goal is to characterizing changes in physico-chemical, sediments and water fluxes, and resulting impact on geomorphology and aquatic habitats. The third task deals with landscape ecology and intends to monitor changes of riparian vegetation and interactions with agricultural landscape. Finally, the fourth task relies on social geography and aims to study the appropriation process of dam removal by inhabitants of the valley, evaluate the success criteria of this large-scale restoration program.



LAW AND DAM REMOVAL: HOW TO CARRY OUT DAMS AND WEIRS REMOVAL PROJECTS SUCCESSFULLY

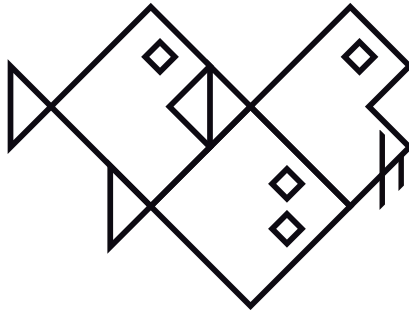
Brufao Curiel P.

Área de Derecho Administrativo. Facultad de Derecho. Universidad de Extremadura. 10003 Cáceres. Spain (pbrufao@unex.es).

Rivers restoration and dam removal projects are subject, as any other activity, to law. No matter how good a project may be, whether it lacks some of the steps foreseen generally in Administrative Law procedure or does not abide by the law related to environmental and property issues, it can be stalled or even finally rejected, which can lead to compensations and sanctions on behalf of those legally affected.

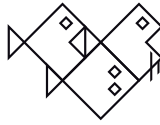
In order to get a project properly developed and executed, the main characteristics of the special rules pertaining dam removal and river restoration projects will be shown in this presentation, mainly those ones dealing with public water courses and their planning, expropriation or taking of private property and water rights, urban planning law and flooding areas, the diverse governments jurisdictions, public contracts, and environmental impact statements, among others.

P
**POSTER
SESSIONS**



SIBIC2016

**VI IBERIAN CONGRESS OF
ICHTHYOLOGY / MURCIA**



COMPARING ASCENT ABILITY FOR IBERIAN BARBEL, *Luciobarbus bocagei*, IN TWO OF THE MOST COMMON FISHWAY TYPES

Bravo-Córdoba F.J., F.J. Sanz-Ronda, J. Ruiz-Legazpi, J.F. Fuentes-Pérez & A. García-Vega

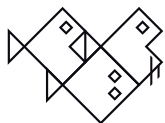
U.D. Hidráulica e Hidrología, E.T.S.II.AA. Palencia (Universidad de Valladolid) Grupo de Ecohidráulica Aplicada (www.gea-ecohidraulica.org).
Avda. Madrid 44, Campus La Yutera - aulario, 34004 Palencia, Spain (francisco.bravo@iaf.uva.es).

Some structures in rivers can behave as barriers for free movement of fish. In order to solve this problem, in the last decade many fishways have been designed and built. However, there are still some uncertainties in their overall performance and sometimes they are not having the expected results, particularly for less studied species, as the Iberian endemic species.

Thus the present study is focused on one of the most extended potamodromous species in the Iberian Peninsula, the Iberian barbel (*Luciobarbus bocagei*). The passage performance of this species is studied in two of the most common types of technical fishway in Spain: vertical slot fishway and submerged notch with bottom orifice fishway, both located on the Duero River (province of Burgos, Spain). To achieve our objective hydraulic and biological assessments were conducted in the spawning season using PIT tag technology.

Motivation and passage were analyzed to determine the ascent ability. Among others, any problems or important delays have not been detected for the Iberian barbel in the studied fishways and both fish passes performed similarly, being the fish length negatively related with the transit time.

These results may help for fishway designers in their decision making supporting the use of both designs, mainly in Mediterranean areas with similar habitat and species.



NORTHERN STRAIGHT-MOUTH NASE SPRINTING BEHAVIOR IN AN OPEN CHANNEL FLUME: INFLUENCE OF BIOMETRIC PARAMETERS, FLOW CONDITION AND WATER TEMPERATURE ON VOLITIONALLY SWIMMING PERFORMANCE

Ruiz-Legazpi J., F.J. Sanz-Ronda & F.J. Bravo-Córdoba

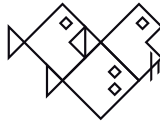
U.D. Hidráulica e Hidrología, E.T.S.II.AA. Palencia (Universidad de Valladolid).
Grupo de Ecohidráulica Aplicada (www.gea-ecohidraulica.org).
Avda. Madrid 44, Campus La Yutera - aulario, 34004 Palencia, Spain. (jorge.ruiz.legazpi@iaf.uva.es).

Swimming capacity of fish is important to detect movement limitations through hydraulic structures: fish passes weirs and slots, gauging stations, culverts, bridge foundations and others. All these obstacles are collectively referred as “velocity barriers”.

The passage of these structures is determined by fish behavior, through combination of fish swimming performance and motivation. Once the fish decides to enter the barrier, it must swim faster than flow velocity to advance. Thus, the swimming performance depends on the fish speed and fatigue time.

To estimate these values, we experimented in an open channel flow with fish samples of different size, swimming volitionally against several high-velocity flows (1.5, 2.5 and 3 m/s) and water temperature (5.5, 13.5 and 18.5 °C). The movement of fish was controlled by PIT telemetry systems and video recording. Information obtained (fish speed, ascent time, distance traveled and motivation) was processed using survival analysis techniques.

Northern straight-mouth nase (*Pseudochondrostoma duriense*) is the target species of this research. It is an endemic cyprinid of the Iberian Peninsula and have IUCN (International Union for Conservation of Nature) protection status, being categorized as “vulnerable” and it is mentioned on Annex II of the European Union Habitats Directive (92/43/EEC). Biometrics parameters, flow velocity and water temperature had a significant influence on fish behavior. Endurance, swimming ability and motivation of this species were higher than obtained values using other methods as respirometers, and they were similar to other cyprinids like barbel, and even did not differ greatly with salmonids like brown trout.



EFFECTS OF EL VAL RESERVOIR ON QUEILES RIVER BIODIVERSITY (EBRO RIVER BASIN, ZARAGOZA, SPAIN)

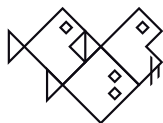
Ginés E.¹, A. García¹ & S. Lapesa²

¹ Gobierno de Aragón, Departamento de Desarrollo Rural y Sostenibilidad, Servicio Provincial de Zaragoza. 50071 Zaragoza. Spain (egines@aragon.es).

² SARGA. Sociedad Aragonesa de Gestión Ambiental.

The Queiles River is a tributary on the right banks of the Ebro River basin. The regulation system of the Queiles River started in 2001, building up a reservoir in a tributary of the Queiles River, named as Val River. Besides that, part of this tributary along with part of the Queiles River were channelized. Previously, in 2000 a study of fish community was carried out in both rivers in order to establish accurate measures to minimize adverse consequences of these infrastructures on fish community.

Fifteen years later fish community composition has been reviewed. The same sites has been sampled to analyse long-term effects of these infrastructures on the fish community biodiversity. A reduction in species diversity and changes in the structure and density of the population of brown trout (*Salmo trutta*) have been found.



PIT-TAG EFFECT ASSESSMENT ON EELS IN THE EUROPEAN SOUTHERN TIP

De Miguel R.J.¹, R. Moreno-Valcárcel¹, M. Herrera¹, H.S. Dean² & C. Fernández-Delgado¹

¹ Departamento de Zoología. Edificio Charles Darwin. Campus de Rabanales. Universidad de Córdoba. 14071 Córdoba. Spain (rjmiguel@uco.es)

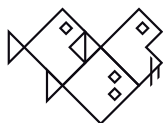
² School of Bioscience, Cardiff University, Cardiff, CF10 3AX, United Kingdom.

According to the Eel Management Plan implemented in the most southwestern European region (Andalusia, Spain), reliable data on age, growth, migration, survival rate and abundance estimations are required. In order to address this lack of regional information, a capture-recapture experiment based on the use of PIT-tags in eels (*Anguilla anguilla*) is currently being performed. Nevertheless, prior to this study and as the focus of this communication, an study on the PIT-tag effect in similar individuals to those studied was conducted to ensure the survival and proper development of the marked sample.

Using fyke-nets, individuals were captured from the lower Guadalquivir River (southern Iberian Peninsula) and were translocated to the Zaporito Aquaculture Center facilities (Cádiz). Two different tests were carried out with the 222 captured individuals. For the first test, between June and October 2014, longer specimens (average length 49.7 cm) were used, marking 80 eels, leaving the other 18 as a control. While for the second, between January and September 2015, smaller individuals (average length 31.3 cm) were tested, marking 100 eels and 82 as a control. In order to find differences in mortality rate between marked and control eels, a t-test was performed per monthly samples (14 t-tests considering both essays). Likewise, monthly ANCOVAs were conducted to test differences in length-weight slopes between marked and control samples.

In both essays, the control samples showed an early higher mortality rate than the marked samples. However, at the end of the study period, the t-test yielded no significant differences between marked and control samples. Similarly, ANCOVA found no significant differences in most of the 14 performed replicates on length-weight slopes.

According to this study, the use of PIT-tags in different sized eels has no significant effect on mortality rate or somatic condition. Consequently, these results support the use of this method for capture-recapture experiment on eels under Mediterranean climate conditions.



PRELIMINARY DATA ON FEEDING BEHAVIOUR OF YOUNG OF THE YEAR (YOY) TWAITE SHAD, *ALOSA FALLAX* (LACÉPÈDE, 1803), DURING THEIR DOWSTREAM MIGRATION IN TWO RIVERS OF THE NW OF THE IBERIAN PENINSULA

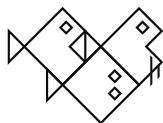
Nachón D.J.¹, R. Vieira², M.J. Servia³, S. Barca^{1,2}, S. Silva¹, L. Lago¹, M.T. Couto¹, P. Gómez¹, C. Morquecho¹, M.C. Cobo¹, J. Sánchez¹ & F. Cobo^{1,2}

1 Laboratorio de Hidrobiología, Departamento de Zooloxía e Antropoloxía Física, Universidade de Santiago de Compostela, c/Lope Gómez de Marzoa s/n, Campus Vida, 15782, Santiago de Compostela, Spain (davidjose.nachon@usc.es).

2 Estación de Hidrobiología "Encoro do Con", Universidade de Santiago de Compostela, Castroagudín s/n, 36617, Vilagarcía de Arousa, Pontevedra, Spain.

3 Departamento de Biología Animal, Biología Vegetal y Ecología, Facultad de Ciencias, Universidad de A Coruña, Campus da Zapateira s/n, 15008, A Coruña, Spain.

Young-of-the-year (YOY) twaite shad, *Alosa fallax* (Lacépède, 1803), seaward migration takes place in schools, during summer and autumn, and before 1 year of age. Very little information is available concerning the feeding behaviour during this phase of the cycle. Therefore, in the present work we perform a preliminary study on the diet composition of YOY during their downstream migration in the Ulla and Miño rivers (NW Iberian Peninsula). The YOY were caught by beach seine nets in the estuary area of both rivers (2012). Prey items were identified to the lowest taxonomic level possible and data are offered on relative abundance and frequency of occurrence of preys. Quality of the diet in terms of energy budget (kJ/g), proteins, lipids and carbohydrates (in %) was also analyzed. In the Ulla River a total of 560 preys spread over 14 items were identified in the 20 stomachs analyzed. The diet composition was [mean \pm SE (range)]: number of prey consumed = 28 ± 8.21 (1-108); number of items = 2.5 ± 0.27 (1-5); energy = 12.14 ± 2.57 kJ/g (1.47-37.27 kJ/g); proteins = 51.83 ± 8.44 % (3.94-144.48 %); lipids = 8.83 ± 1.42 % (0.07-21.73 %) and carbohydrates = 2.93 ± 0.46 % (0.31-7.24 %). In the Miño River 304 preys corresponding to 20 items were identified in the 14 stomachs analysed. The diet composition was: number of prey consumed = 22.8 ± 6.6 (0-82.9); number of items = 4.6 ± 0.27 (3-6); energy = 8.61 ± 1.78 kJ/g (1.31-22.29 kJ/g); proteins = 22.37 ± 4.83 % (1.76-58.32 %); lipids = 3.49 ± 0.89 % (0.10-12.02 %) and carbohydrates = 2.28 ± 0.42 % (0.14-4.7 %). A close relationship between the condition factor and consumed amounts of energy and proteins was detected.



RECOVERY OF ECOLOGICAL CONNECTIVITY FOR *Salmo salar* IN MIERA RIVER

Serrano-García B.¹, C. Sánchez Martínez¹ & J. Díaz Ortiz²

¹ Fundación Naturaleza y Hombre. Avda. España, 25, El Astillero 39610, Cantabria. (serrano@fnyh.org / fundacion@fnyh.org).

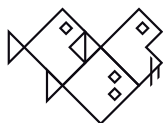
² Dirección General de medio Ambiente. Gobierno de Cantabria. C/ Lealtad, 24, Santander, 39002 Cantabria.

Fundación Naturaleza y Hombre (FNYH) is the coordination beneficiary of LIFE+Nature Project name Biodiversity conservation in river Miera (LIFE 13 NAT/ES/899) which is developed in the four SCIs in Cantabria and Burgos where Miera river basin is placed. Along with its associated beneficiaries, D.G. Medio Ambiente of Cantabria Government and MARE, S.L, it works to improve fluvial connectivity for *Salmo salar*, listed in Natura 2000 Annex II. Before LIFE+ Miera Project, *Salmo salar* habitat was limited to the lower course and a part of the middle course of Miera river, that is due to the presence of 3 river dams located in Liérganes.

LIFE+ Miera Project has designed different technical solutions to achieve the permeability for salmon in these dams: Revolve (5 meters high and located in the First place), Arral (3 m) and Rubalcaba (2 m). These technical solutions will be expected done during 2016 summer, in order to evaluate their effectiveness before the end of the Project. These solutions include a fishway in Revolve, the partial demolition of Arral and improving a natural step and the rehabilitation of a nonworking existing fishway in Rubalcaba dam, so there would be two possible paths for the salmon.

The evaluation of the effectiveness will be guaranteed by the installation of a fish trap in one of the pools of the fishway of Revolve dam, below this barrage of historical interest every year salmon reproduce, without any possibility of success. Other actions to improve the salmon habitat will be done during the Project, such as improving spawn areas, shelter and shadow areas and elimination of flora invasive species.

More information in www.lifemiera.org



VARIABILITY OF SWIMMING PERFORMANCE AND ECOMORPHOLOGY OF AN IBERIAN CYPRINID SPECIES, THE RUIVACO, *Achondrostoma oligolepis*

Silva S. ¹, C.M. Alexandre¹, B.R. Quintella^{1,2} & P.R. Almeida^{1,3}

1 Mare – Centro de Ciências do Mar e do Ambiente, Portugal (cmalexandre@fc.ul.pt).

2 Departamento de Biologia Animal, Faculdade de Ciências, Universidade de Lisboa, Campo Grande, 1749-016, Lisboa, Portugal.

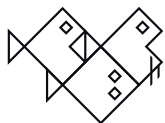
3 Departamento de Biologia, Escola de Ciências e Tecnologia, Universidade de Évora, Largo dos Colegiais 2, 7004-516, Évora, Portugal.

Knowledge about the swimming performance of freshwater fish species, and its relationship with morphology and habitat variability is a key aspect in fish ecology, but there is a scarcity of studies about this theme conducted at reduced spatial scales. The main objective of this study was to compare the swimming performance, and related eco-morphology, of different populations of a resident cyprinid species inhabiting the same river basin. Specifically, we focused on the ruivaco (*Achondrostoma oligolepis*, Robalo, Doadrio, Almada & Kottelat, 2005), a relatively abundant cyprinid in central-northern Portuguese rivers, to: i) evaluate the species swimming performance, through the determination of its critical swimming speed (U_{crit}); and ii) compare the critical swimming speed and morphology of four populations of the target species inhabiting rivers with different environmental characteristics within the same basin.

In the spring of 2015, 40 *A. oligolepis* of similar size (between 80-100 mm) were captured from each of four populations, and subjected to critical swimming speed tests in a swim tunnel. Fish were captured in the Arunca, Mondego, Alva and Dão rivers, all from the Mondego river basin, representing a gradient of environmental variability, especially what concerns to the river gradient, flow regime, substrate type and other habitat characteristics. Successfully tested fish were also analyzed in terms of overall body shape, using geometric morphometric methods.

Results show that critical swimming speed was statistically similar between all populations (average $U_{crit} = 0.27$ m.s⁻¹) and genders. Morphological analyses suggest a phenotypical segregation between the four studied populations that does not seem to be related with swimming abilities.

Knowledge about the swimming performance of freshwater fish species, and its relationship with environmental features, can be used as a baseline tool for the definition of suitable water velocity profiles in fishways and culverts and to assess potential impacts of instream flow alterations.



EVALUATION OF THE FISH PASSAGE DESIGN AND SUITABILITY IN THE PAREJA LIMNO-RESERVOIR (GUADALAJARA, SPAIN)

Morcillo F.¹, S. Martínez-Pérez², S. Perea³, E. Molina-Navarro⁴, A. Sastre²

1 Department of Ecology, University Complutense of Madrid, 28040 Madrid, Spain (fmorcill@ucom.es).

2 Department of Geology, Geography and Environment, University of Alcalá, 28871 Alcalá de Henares, Spain (silvia.martinez@uah.es) and (antonio.sastre@uah.es).

3 Biodiversity and Evolutionary Group, Museo Nacional de Ciencias Naturales, 28006 Madrid (sperea2@gmail.com).

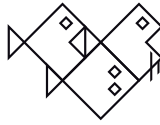
4 Department of Bioscience, Aarhus University, 8600 Silkeborg, Denmark (emna@bios.au.dk).

Parejalimno-reservoir is an infrastructure with public interest located in one of the Entrepeñas Reservoir branches (upper Tajo river, South Guadalajara, Spain) and it's fed by Ompóveda stream (a portion declared as River Natural Reserve) and its tributary, Valdetrigo. This limno-reservoir was built to the hydro-environmental recovery and the economical promotion of the area. A 155 m long fish passage, which overcomes a level difference of 13 m, was designed to reduce the barrier effect for fish. This fish passage consists of three stretches from downstream to upstream: a nature like fish passage, a submerged orifice and weir fish pass and a canal towards the water body of the reservoir.

As a first step to the fish passage evaluation, target species were proposed based on data records and the monitoring of the limno-reservoir influence area and Ompóveda stream. Secondly, the existing fish passage and flow were characterized. Finally, all the critical points for a correct operation were determined. The preliminary conclusion was that the current fish passage is not operational.

As solution, three alternative interventions were proposed. The first one involves the repair of the current fish passage dealing with the aforementioned critical points. The second one implies a new design for a new fishway, dealing with the critical points and other features as the entry location, dimensions of the pools, among others. The last alternative is the "non-intervention" option, which is established as consequence of the presence of exotic and/or invasive fish species downstream, upstream and into the dam.

The results suggest, on one hand, the potential function of limno-reservoirs as fish-passable barriers to stop the invasion of exotic and/or invasive species and, on the other, the need of a risk assessment case by case for the different fish passage options to evaluate the trade-offs between invasive and native species.



DIVULGATIVE AND EDUCATIONAL INICIATIVES ABOUT FISH MIGRATION: THE CASE OF SOUTHERN BARBEL (*Luciobarbus sclateri*) IN THE SEGURARIVERLINK LIFE+PROJECT

Sánchez-Balibrea J.¹, D. Hernández¹, P. García¹, C. López¹, R. Olivo-del Amo², F. J. Almansa-Paredes³ & E. Lafuente⁴

1 Asociación de Naturalistas del Sureste. Pza. Pintor José María Párraga nº 11 bajo (araar@asociacionanse.org).

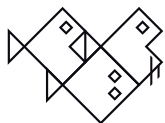
2 Typsa. Ingenieros Consultores y Arquitectos.

3 TRAGSATEC.

4 Comisaría de Aguas. Confederación Hidrográfica del Segura.

The Segura river constitutes a basin very intervened with an obvious loss of longitudinal connectivity. To reverse this situation, the project launched LIFE+SEGURARIVERLINK LIFE 12/ ENV/ES001140 funded with the assistance of the European Union LIFE program. The project is focused on the only native fish species present in the section *Luciobarbus sclateri*.

It is launched different divulging initiatives that aim to achieve all of sectors of population. Among others, it develops an Environmental Volunteer Program, with a fortnightly, in collaboration with other organizations and has included all kinds of activities, like interpretation routes, plantations on the banks of the river, sampling electrofishing or cleanings spawning grounds. During the summer, this program is replaced by a Workcamp. It has also developed a Program of Activities in Schools that includes various possibilities for schools (lectures, expositions, interpretive tours, plantations). In addition, it has developed an extensive Teaching Unit on the river, ranging from pre-school to university education. The application of Land Stewardship tools is allowing the project to involve owners, farmers, fishermen and people watering in the development and maintenance of conservation actions. The field of divulgation is exceeded due to the installation of an informative tank at the Aquarium of the University of Murcia. Complementing this, the project has had a strong presence in the media specialist or generalist media, like social networks (Twitter, Facebook).

**SEXUAL VARIATION IN RNA/DNA RATIO, PROTEINS, LIPIDS AND GLYCOGEN IN ADULTS OF SEA LAMPREY (*Petromyzon marinus* LINNAEUS, 1758).****Barca S.^{1,2}, S. Silva², R. Vieira¹, M.J. Servia³, D.J. Nachón², L. Lago², M.T. Couto², M.C. Cobo², P. Gómez², C. Morquecho² & F. Cobo^{1,2}**

1 Estación de Hidrobiología "Encoro do Con". Universidade de Santiago de Compostela. Castroagudín-Cea. 36617 Vilagarcía de Arousa. Pontevedra, Spain (sandra.barca@usc.es).

2 Laboratorio de Hidrobiología, Departamento de Zooloxía e Antropoloxía Física, Facultade de Bioloxía, Universidade de Santiago de Compostela, Campus Vida s/n, 15782 Santiago de Compostela, Spain.

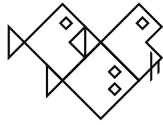
3 Departamento de Biología Animal, Biología Vegetal y Ecología, Facultad de Ciencias, Universidad de A Coruña. Campus da Zapateira s/n, 15008 A Coruña, Spain.

The measure of energy reserves has been proposed as a very sensitive indicator of the state of condition in fishes. In the case of lampreys, a decrease or interruption of growth occurs during the upstream migration while the supply of oxygen to the muscle tissue and other organs slows down during the reproduction, especially in females due to gonads development. As a result, the state of nutritional deficiency and depletion has a drastic effect on the levels of stored glycogen, lipids, protein and RNA/DNA ratio.

The RNA/DNA ratio has been proposed as a sensitive measure (days to weeks) of growth rate in fishes. An increase in the RNA/DNA ratio reflects a recent growth and it provides information about the nutritional condition of the specimens. Glycogen is the main source of energy to meet the metabolic demands of fishes. Most energy required for sudden reactions like escaping from predators or swimming against the current is often derived from the degradation of glycogen stores. The amount of total protein in an individual provides a measure of long-term growth as well as for energy storage. Lipid storage play critical roles in the health of fishes by influencing energy allocation strategies, responses to environmental stressors, overwintering survival and reproductive fitness.

In the present study, we show the results of the variation in the RNA/DNA ratio, glycogen, proteins and lipids in different organs (muscle, liver, heart and tegument), in males and females of sea lamprey during the spawning migration.

The results showed only significant differences in RNA/DNA ratio and the concentration of proteins between sexes in the liver of the analyzed individuals, being higher in females.



INVENTORY OF EEL (*Anguilla anguilla*) MIGRATION BARRIERS IN ANDALUSIA

González M.D.¹, S. Rubio¹, F. Bustamante² & I. Redondo²

1 Agency for the Environment and Water. C/ Johan Gutenberg, nº1. Isla de la Cartuja. 41092. Sevilla. Spain. (mdgonzalez@agenciamedioambienteyagua.es).

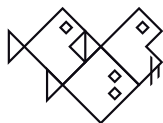
2 Andalusian Institute for Inland Fisheries and Hunting, Department of Environment Management, Regional Government for Environment and Spatial Planning.

One of the main causes for the decline of the European Eel population in Andalusia is habitat fragmentation due to the presence of obstacles along streams. These structures prevent their free migration, both upstream as elvers and downstream as adults, affecting their development. The ultimate goal of the Eel Management Plan is to allow 40% of the biomass of silver eel to reach the sea, therefore it is essential to have a thorough knowledge of the structures that may represent barriers to their migration and conceive specific measures for their permeation.

Studies to improve river permeability have focused on sections of the Atlantic, Mediterranean and the Guadalquivir management units occupied by eels. For the inventory of structures, both color and infrared digital 0.5m orthophotography of the SW and NW quadrants of Andalusia have been employed from the National Ministry of Development as well as from the Regional Government of Andalusia 2010-2011 digital photogrammetric flight.

Each one of the obstacles has been visited in situ, allowing for the collection of information concerning location data, accessibility, type of obstacle, functionality and dimension of the structure, existence of other disturbances and impermeability rate. This has allowed for the proposal of specific measures and a very defined characterization of the surrounding terrain.

A total of 21 Andalusian rivers have been inventoried, with 267 obstacles detected, 55 of which are impassable to eel migration. Five projects have been drafted in order to improve their permeability, three of which have already been carried out.



PREVIEW STUDY: SPERM MOTILITY EVALUATION FOR SOME FISH SPECIES USING THE INTEGRATED SPERM ANALYSIS SYSTEM (ISAS)

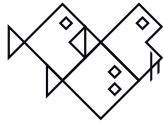
Caldeira C.^{1,2}, B. Dzyuba³, M. Rodina³, J. Cossom³ & C. Soler^{1,2}

1 PROISER R+D, Av. Catedrático Agustín Escardino, 9, Building 3 (CUE), F 1, 46980 Paterna, Spain (carina.caldeira@proiser.com).

2 University of Valencia, Faculty of Biological Sciences, Campus de Burjassot, C/ Dr. Moliner 50, 46100 Burjassot, Valencia, Spain.

3 University of South Bohemia in České Budějovice, Faculty of Fisheries and Protection of Waters, South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenoses diverzity hydrocenóz, Zátíší 728/II, 389 25 Vodňany, Czech Republic.

It is essential to define a standard method to assess the fish sperm quality and minimize the differences between the results obtained by different laboratories, and transfer from academia to industry. This study presents preliminary validation of CASA software for two freshwater fish, Russian sturgeon (*Acipenser gueldenstaedtii*) and Common carp (*Cyprinus carpio*). To attain this goal, different technical and data processing methods were tested: 1) counting chambers, as glass slide and Spermtrack® reusable chambers (10µl or 20µl), 2) magnification lens (10x or 20x), 3) frame rates (≤ 200 fps), and 4) time of video analysis (0.25, 0.50 or 1 s). The counting chambers did not affect the sperm motility parameters. On the contrary, the magnification lens showed variation in the acquired data, being 10x the most accurate lens for *A. gueldenstaedtii* and 20x for *C. carpio*. The different data processing methods resulted in a effect in some sperm kinetic parameters, suggesting that the sperm analysis should be performed at 50 fps and 150 fps for *A. gueldenstaedtii* and *C. carpio*, respectively. However, the time of video analysis is not relevant since did not affect the sperm motility. The protocol variables in sperm analysis for different fish species, using CASA system, could be related to sperm morphology due to a huge variability in shapes, sizes, and structures of the aquatic species. In conclusion, several procedural and technical settings should be validated to each fish species before comparing results between laboratories.



PRELIMINARY RESULTS OF THE SILVERING PROCESS OF THE EUROPEAN EEL (*Anguilla anguilla* L., 1758) IN THE MAR MENOR LAGOON (WESTERN MEDITERRANEAN, SPAIN)

Barcala E.^{1,2}, P. Muñoz^{1,3}, D. Romero^{1,4}, E. Mariadolores^{1,5}, C. Boza^{1,2}, C. Bultó^{1,2}, E. Romero^{1,5} & J. Peñalver^{1,5}

1 Campus de Excelencia Internacional Regional "Campus Mare Nostrum".

2 Instituto Español de Oceanografía. Centro Oceanográfico de Murcia, C/ Varadero s/n, 30740 San Pedro del Pinatar, Murcia (elena.barcala@mu.ieo.es).

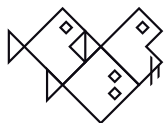
3 Dpto. Sanidad Animal. Universidad de Murcia. E-30100, Murcia, Spain.

4 Área de Toxicología. Universidad de Murcia. E-30100, Murcia, Spain.

5 Servicio de Pesca y Acuicultura. Consejería de Agua, Agricultura y Medio Ambiente. Campos, 4, E-30201, Cartagena, Spain.

Despite the economic importance of eel captures in the Mar Menor, a hypersaline coastal lagoon, few studies have been conducted in relation to the biology and ecology of this specie. The aimed of this study was to describe the relationship between some biological and morphological parameters and the silvering process of the European eel in this lagoon. A total of 290 yellow and silver eels were anaesthetized and the following measures were obtained: total length (TL, mm), total weight (gr), horizontal and vertical eyes diameters, pectoral fin length. Ocular (OI) and fin (FI) indexes as well as scaled mass index (SMI) were calculated. Additionally, 63 eels were euthanized with an overdose of anesthetic and gonads were dissected, weighted, fixed in Bouin's fixative and routinely processed for histology. The gonadosomatic index (GI) was calculated. Sex was identified macroscopically and microscopically. Results indicated that Mar Menor eel population is dominated by females which may be due to local conditions, such as the density as it was previously reported in eels from other environments. A significant GSI increase was detected with the silvering process. Although silver eel average size (63.9 cm, range 37-83.5) was smaller than data reported in eels from other lagoons, the GSI increment starts at the same size, around 50 cm TL, as previously reported. Due to the marked overlap in TL of yellow and silver eels between 300 and 400 gr, it was difficult to establish the starting size of the silvering process. A decrease of the SMI with the silvering process was detected. FI showed significant differences in relation to silvering in specimens around 300 gr, while no significant differences in OI were observed (OI). Implications in eel management in the lagoon are discussed.

Work supported by "Programa de Apoyo a la Investigación de la Fundación Séneca-Agencia de Ciencia y Tecnología de la Región de Murcia".



EUROPEAN EEL (*Anguilla anguilla*) UNDER CLIMATIC CHANGE

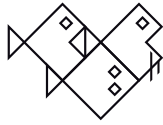
Díaz E.¹, M. Korta¹, G. Chust¹, J. Ribalaygua², J. Pórtoles² & R. Monjo

¹ AZTI-Tecnalia Txatxarramendi ugartea z/g – 48395 Sukarrieta, Bizkaia (Spain) (ediaz@azti.es).

² Climate Research Foundation (FIC), C/ Tremps 11, Madrid 28040, Spain.

Factors as commercial exploitation, habitat loss, dam and weir construction, hydropower, pumping stations and surface water abstractions are mentioned to explain the critical eel population situation. However, oceanic and climatic factors should also be considered since they influence the viability of first eel stages and larval migration. Thus, the assessment of the relations between eel recruitment and oceanic conditions may allow to foresee the potential effect of climatic change on the future eel recruitment.

In the present study, we analyzed the relation between oceanic and climatic factors and glass eel recruitment, using as a proxy the historic glass eel catches series since the fifties, in two Mediterranean (*La Albufera* and *Delta del Ebro*) and two Atlantic (*Nalón* and *Miño*) estuaries. To determine these relations, we used an ocean reanalysis (Simple Ocean Data Assimilation; SODA) and we found significant relationships between recruitment and different oceanic (Surface Downward Stress, Sea Water Temperature and Sea Water Velocity) and atmospheric (NAO Index, AMO Index) variables. Then, we applied the results of three climate models (GFDL-ESM2M, CanESM2 and CNRM-CM5), associated with the Coupled Model Intercomparison Project Phase 5 (CMIP5) under two simulations of climate change (RCP4.5 and RCP8.5), both associated with the 5th Assessment Report of the IPCC. Preliminary results show that the predicted evolution of the variables significantly related to glass eel recruitment would negatively affect eel population in the future. It has been proposed that the European eel suffers strong depensation (Dekker 2004); the size of the population has fallen below a threshold where the stock suffers decreases in recruitment more severe than would be expected based on the decline in spawning stock. Although the relations we have found are weak, according to the precautionary approach all possible recovery measures should be taken to protect the European eel.



FINDING THE LISBON ARCHED-MOUTH NASE: FIRST POPULATION ASSESSMENT ON ONE OF THE MOST ENDANGERED FRESHWATER FISH IN THE IBERIAN PENINSULA

Ribeiro F.¹, A. Veríssimo², C.D. Santos³ & H. Gante⁴

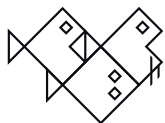
1 MARE – Marine and Environmental Sciences Centre, Lisboa, Portugal (fmvribeiro@gmail.com).

2 CIBIO-InBIO – Centre for Research on Biodiversity and Genetic Resources, Vairão, Portugal.

3 Departamento de Biologia, Centro de Ciências Biológicas e da Saúde, Universidade Federal do Maranhão, São Luís, Brazil.

4 University of Basel, Zoological Institute, Vesalgasse 1, 4051 Basel, Switzerland.

The Lisbon arched-mouth nase, *Iberochondrostoma olisiponensis* (Gante, Santos & Alves, 2007) is one of the rarest freshwater fishes in Portugal. This species was only discovered in 2006 and is currently known to occur in three tributaries of the lower Tejo drainage, presenting a very restricted distribution range of less than 10 km². Little is known about this species' habitat requirements, current population status and distribution. In 2016, an intensive sampling scheme was done to reassess the species distribution, evaluate populations' abundances, and collect the first ecological data on the Lisbon arched-mouth nase. About 70 sites were sampled with electric fishing covering 19 different tributaries in the lower Tagus drainage. All the specimens sampled were identified to species, and individuals of the Lisbon arched-mouth nase were counted, measured for fork length, weighed and sexed (whenever possible). Environmental characterization was done at each site to assess the species' habitat preferences. The results presented here will provide an update on the species conservation status, and be used to propose conservation areas to national government agency aiming at the species' long-term persistence.



MODELLING THE HABITAT SUITABILITY FOR BROWN TROUT SPAWNING TO EVALUATE THE POTENTIAL HABITAT IN A BYPASSED RIVER SEGMENT (PALANCIA RIVER, SPAIN)

Muñoz-Mas R.¹, F. Martínez-Capel¹, F.J. Martínez-García², I. Ferrando³ & J.A. Marí³

1 Institut d'Investigació per a la Gestió Integrada de Zones Costaneres (IGIC) Universitat Politècnica de València, C/ Paranimf 1, 46730 Grau de Gandia. València. Spain. (pitifleiter@hotmail.com).

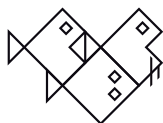
2 Servicio de Caza y Pesca. Generalitat Valenciana. Calle Castán Tobeñas 77, Ciudad Administrativa 9 de octubre - Torre 1, 46018 Valencia (Spain). Calle Castán Tobeñas 77, Ciudad Administrativa 9 de octubre Torre 1, 46018 Valencia (Spain).

3 VAERSA. Avda. Corts Valencianes, 20. 46015 Valencia (Spain).

During the last two decades, studies of brown trout habitat selection have been conducted across the Iberian Peninsula. The subsequent habitat suitability (probability of presence) models allowed the application of the physical habitat simulation (or habitat evaluation), which is commonly a fundamental step in environmental flow assessment. However, the critical activity of spawning has been overlooked thus nowadays there are no regional habitat suitability models. The present study encompassed eight Mediterranean rivers where the suitable hydraulics (depth and velocity) and substrates for brown trout spawning were characterized at the microhabitat scale in three points inside the redd (*i.e.* presence), and at four points around the redd (*i.e.* absence).

The microhabitat suitability was modelled with a multivariate fuzzy rule base model. The fuzzy model proved proficient (Sensitivity=0.67 and Specificity=0.61) indicating that the optimal habitats for spawning (suitability index > 0.8) comprise gravel and fine gravel, low to medium flow velocity – [0.2, 0.6] m/s – and small depth – [0.1, 0.4] m.

One segment of the Palancia River (eastern Iberian Peninsula), which suffers year-round water diversion of approximately 100 % of the river flow, was sampled and evaluated with the fuzzy model as the preliminary step for environmental flow assessments. Ninety-one percent (0.253 m³/s) of the available flow was diverted to the irrigation canal in February (out of the irrigation season) suggesting a relevant loss of fish habitat for spawning. Under those conditions, 18% of the sampled aquatic area was suitable for spawning. The release of an adequate environmental flow regime in the bypassed river segment would permit the restoration of the brown trout population in the segment, *i.e.* approximately 25% of the river length in the trout zone. These results highlight the need of sustainable water management actions, especially by the owners and managers of the water rights.



FISH DIVERSITY IN THE CHOCOAN-TROPICAL ANDES OF ECUADOR: THE ROLE OF HABITAT AND ELEVATION

Tobes I.^{1,2,3}, R. Miranda², C. Morocz⁴, A. Morabowen¹, C. Ibarra¹, S. Walls^{3,5} & B. Ríos-Touma¹

1 Centro de Investigación de la Biodiversidad y Cambio Climático (BioCamb) e Ingeniería en Biodiversidad y Recursos Genéticos, Facultad de Ciencias de Medio Ambiente, Universidad Tecnológica Indoamérica, Machala y Sabanilla, Quito, Ecuador EC170103. (ibontobes@uti.edu.ec).

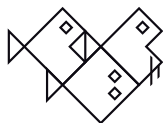
2 Departamento de Biología Ambiental, Facultad de Ciencias, Universidad de Navarra, Iruñea/Pamplona, Spain.

3 International Watershed Partners (<http://www.iwpartners.org/>).

4 Reserva de Biodiversidad Masphi, Quito, Ecuador.

5 Walls land+water, 320 Alamo Ave, Santa Cruz, California 95060.

This work provides insight into a Choco-Andean river system by conducting a comprehensive study of fish diversity and ecological processes in a poorly studied neotropical freshwater ecosystem. Masphi watershed, in the northwestern Ecuador, is part of the Choco-Darien Global Biodiversity Hotspot and harbors a rich and largely unknown biodiversity. The territory is subject to increasing anthropogenic impacts caused by rapid land use changes and exploitation of natural resources. The basin ranges from 1400 m.a.s.l. in the higher reaches, to 500 m.a.s.l. in the lower areas. During August of 2015, 21 sites were sampled. Changes in natural habitat characteristics along the basin were analyzed and related to the distribution of fish and macroinvertebrates. Fish sampling was conducted using electrofishing gear, and macroinvertebrates were sampled by applying the BMWP procedure. Besides, four environmental quality indices were applied for assessing ecological integrity of river ecosystems. Fish and macroinvertebrate communities notably changed along the altitudinal gradient in response to natural habitat changes, consistent with distribution patterns observed for similar basins and apparently showing a good ecological integrity. Nevertheless, some sites presented remarkable differences both in faunal composition and habitat characteristics and were correlated in some cases with lower environmental quality scores, pointing out the ongoing habitat degradation. Besides, slope and flow were determinant in explaining fish community composition. We were able to establish new records for the area and understand fish distribution along an altitudinal and land use gradient. This information is of major relevance to local communities that are facing a decline in fisheries resources, agro-pollution of rivers and the unknown effects of species introductions, like Tilapias. We found a high community interest on fish diversity. This constitutes a major opportunity to use fish as bioindicators of water quality but also to explore potential native fisheries alternatives to Tilapia.



IMPROVEMENT PROJECT OF THE RIVER CHANNEL BY ENTERING WOOD IN THE ARAXES RIVER (ORIA RIVER BASIN-GIPUZKOA)

Agirre K.¹, I. Mendiola², I. Bañares², A. Elozegi³ & M. Sarriegi⁴

1 Ekolur Asesoría Ambiental SLL, Camino de Astigarraga 2-Pl.4º dcha-Ofic.8-20180 Oiartzun- Gipuzkoa, Spain (kori@ekolur.com).

2 Diputación Foral de Gipuzkoa, Gipuzkoa Plaza s/n, 20004 Donostia, Gipuzkoa, Spain.

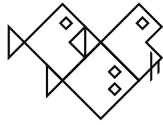
3 UPV/EHU, Departamento de Biología Vegetal y Ecología, Facultad de Ciencia y Tecnología, Barrio Sarriena s/n, 48940 Leioa-Bizkaia, Spain.

4 Basoinsa Ingeniería Medioambiental SL, Dr.Luis Bilbao Libano,11-Entr.D, 48940 Leioa-Bizkaia, Spain.

There has been a serious decline in the population of brown trout in the Araxes river belonging to the Oria basin (Gipuzkoa), especially in recent years, so that today the species is in a rather delicate situation. In order to improve the situation of brown trout's population in this river, there has been developed a project of introduction of wood (Large Woody Debris) led by Provincial Government of Gipuzkoa. This project aims to increase the structural complexity of the river channel and thereby, promote the natural wealth of river habitats, increasing the shelter capacity for different aquatic species and, particularly for the brown trout population.

This project follows BACI pattern (Before After Control Impact). Is the study of two sections, one control and one experimental, before and after the execution of the project, which allows to observe the differences arising in the river ecosystem once the project is completed. These differences are evaluated by a specific monitoring program that consists of controlling both abiotic and biotic parameters.

The results show a significant retention of sediments, especially small, in the experimental section, which benefits the presence of appropriate areas for locating spawning areas. It also benefits the creation of shelters and pools, which is of interest to the adult specimens of brown trout. On the other hand, the analysis of trophic groups of benthic macroinvertebrates indicates the existence of significant differences in shredders and filtering collectors, which may be related to the increase in fish biomass and a greater presence of pools. A significant increase of adult specimens of brown trout in the experimental section is observed as well, which is reflected in a significant increase in brown trout biomass.



FACTORS AFFECTING RECRUITMENT OF GLASS EELS (*Anguilla anguilla*) INTO THE RIVER TER (NE SPAIN)

Zamora L.¹, J. Margaleg¹, J. Gómez², J. Rodón² & R. Allué²

1 Instituto de Ecología Acuática. GRECO. Universidad de Girona. Facultad de Ciencias, Campus de Montilivi s/n 17071 Girona, Spain (lluis.zamora@udg.edu).

2 Dirección General de Pesca y Asuntos Marítimos, Generalitat de Catalunya. Avd. Diagonal 523-525, 08029 Barcelona, Spain.

The arrival pattern of glass eels (*Anguilla Anguilla*) was studied over a four successive migration seasons in the River Ter (NE Spain) based on professional fisheries records. Although the behavioral and environmental processes modulating glass eel migration patterns are reasonably well understood in the Atlantic coast, few is known in Mediterranean rivers where the influenced of tides is neglected. Fisheries were carried out during October to March, from 2010 to 2015. Environmental variables affecting recruitment differed between years, but common variables for both years were water temperature, water discharge, sampling date, sea waves and moon phase. During the year of higher discharge variability, both increasing discharge and increased turbidity were also important. The tide did not seem to have a significant role in explaining catches.



PREVALENCE OF ANGHV-1, EVE AND EVEX IN EUROPEAN EEL (*Anguilla Anguilla*) CAPTURED IN ANDALUCÍA (SOUTHERN SPAIN)

**Ruiz de Ybáñez R.¹, L. del Río¹, C. Flores², E. Berriatua¹, M. Engelsma³, S. Rubio⁴, P. Muñoz¹,
M. González¹, I. Redondo⁵, F. Bustamante⁵ & C. Martínez-Carrasco¹**

1 Dpto de Sanidad Animal, Facultad de Veterinaria, Campus de Excelencia Internacional Regional "Campus Mare Nostrum", Universidad de Murcia, Spain (cmcpleit@um.es).

2 Sección de Biología Molecular (Servicio de Apoyo a la Investigación), Edificio SACE-CAID, Campus de Espinardo, Universidad de Murcia, Spain.

3 Laboratory for Fish and Shellfish Diseases, Central Veterinary Institute of Wageningen UR, 8200 AB Lelystad, The Netherlands.

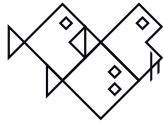
4 División de Actuaciones del Medio Natural, Agencia de Medio Ambiente y Agua de Andalucía, Granada, Spain.

5 Instituto Andaluz de Caza y Pesca Continental, Dirección General de Gestión del Medio Natural, Consejería de Medio Ambiente y Ordenación del Territorio, Sevilla, Spain.

A virological survey was conducted on 182 wild European eels (*Anguilla anguilla*) captured between May 2013 and December 2014 in 12 rivers and lagoons from Huelva, Sevilla, Cádiz, Málaga, Granada and Almería provinces (Andalucía, Southern Spain). Eels were apparently healthy, with body length and weight ranging 310-820 mm and 40-798 g, respectively. Presence of Anguillid Herpesvirus 1 (AngHV-1), eel virus European (EVE), and eel virus European X (EVEX) in a tissue homogenate of spleen, liver, kidney and gills from each eel was determined by real time-PCR. AngHV-1 PCR-prevalence was 35.2% (64/182); however, EVE and EVEX were not detected in sampled eels. The prevalence of AngHV-1 depended on the geographical origin of the sample: high in eels captured in Laguna Los Tollos (100%), Guadalhorce river (62.5%) and Isla Mayor (41.9%), while the virus was absent in samples analyzed from Guadalfeo and Antas rivers. These results indicate that AngHV-1 is widely but unevenly distributed in Andalucía, and could be absent or its presence below the detection limit of the real time-PCR used in some areas.

The apparent absence of EVE and EVEX is encouraging given that management of these infections is difficult in wildlife. However, further health status monitoring of eels should be conducted in Andalucía in order to determine the geographical spread of these viruses. Our results suggest that AngHV-1, EVE and EVEX-free areas could serve as a restocking source for future eel conservation programs. Moreover, care should be exerted to prevent the introduction of infected eels in these areas.

This work was supported by The European Fisheries Fund (Consejería de Medio Ambiente y Ordenación del Territorio. Junta de Andalucía, Spain).



ANALYSIS OF BIODIVERSITY PATTERNS AND CONSERVATION STATUS OF FRESHWATER FISHES IN MOROCCO: WHAT THE SPECIES TELL US?

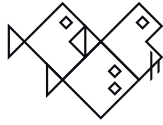
Campos N.¹, C. Numa² & M. Soriguer³

1 Facultad de Ciencias. Universidad de Cádiz. Campus Universitario de Puerto Real, Polígono Río San Pedro, 11510, Cádiz. España (nazacamposm@gmail.com).

2 Programa Mediterráneo de Especies. UICN-Centro para la cooperación con el Mediterráneo. Calle Marie Curie Nº 22 (PTA), 29590 Campanillas, Málaga, España. Catherine.numa@iucn.org

3 Departamento de Biología. Universidad de Cádiz. Campus Universitario de Puerto Real, Polígono Río San Pedro, 11510, Cádiz. España (mila.soriguer@uca.es).

Morocco has a biogeographic history marked by regional extinction and speciation. For these reasons, the country has the richest freshwater fish fauna of North Africa. In the context of contemporary changes in rivers, understanding biodiversity distribution patterns is a central issue for managers concerned with the current conservation situation. Therefore, identifying the highest biological diversity in a minimum number of areas is a key issue for the design of protected areas and alternatives for building infrastructures. This work assessed the species composition at a basin scale which was used to analyse distribution patterns of different components of biodiversity (taxonomic richness, endemism, taxonomic singularity, complementarity) and conservation status of freshwater fish in 12 Mediterranean-climate basins of Morocco. An extensive literature review identified, at least, 41 native species, being 33% non-native species. The presence of these non-native species showed no significant relationship with any of the biodiversity components. On the other hand, climatic factors explained 70% of variation in endemism and singularity of native species. Singular species were located in the north while endemism was higher in the south. Non-native species were widespread across Morocco. Northwestern basins showed the higher biological diversity but had the worse conservation values. Species complementarity between basins is high, as it is needed a combination of at least seven of the 12 basins analysed to represent the whole set of 24 native species. Moreover, the northern and southern ends of the study area are the most complementary areas for the conservation of native fish fauna. These results highlight the urgent need to evaluate the distribution and composition of the freshwater fish communities in Morocco. Additionally, a depth analysis of the factors that influence fish distribution and richness latitudinal gradient is needed to improve freshwater fish conservation in this region.

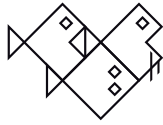
**LARVAL HABITAT OF SEA LAMPREY
Petromyzon marinus LINNAEUS, 1758****Silva S.², S. Barca^{1,2}, R. Vieira¹, M^aJ. Servia³, D.J. Nachón², C. Morquecho², L. Lago², P. Gómez², M. Couto², M^aC. Cobo² & F. Cobo^{1,2}**

1 Estación de Hidrobiología "Encoro do Con", Universidade de Santiago de Compostela Castroagudín s/n, 36617 Vilagarcía de Arousa, Pontevedra, Spain (sandra.barca@usc.es).

2 Laboratorio de Hidrobiología, Departamento de Zoología y Antropología Física, Facultad de Biología, Universidad de Santiago de Compostela. Campus Vida s/n, 15782 Santiago de Compostela, Spain.

3 Departamento de Biología Animal, Biología Vegetal y Ecología, Facultad de Ciencias, Universidad de A Coruña. Campus da Zapateira s/n, 15008 A Coruña, Spain.

Lamprey population assessments are usually focused on sampling patches of larval habitat and in some cases differentiating between optimal and suboptimal habitat. However, most studies concerning the description of larval habitat give a special attention to the granulometric analysis, without determining precisely optimal habitat conditions for other variables. Therefore, in the present study data on 48 variables: 9 hydromorphologic, 18 mesologic and 21 water quality parameters, were collected to research the relation between these abiotic parameters and the larval density and biomass of *Petromyzon marinus* Linnaeus, 1758. Taken together, the results confirmed that the larval stage of *P. marinus* can survive in a variety of conditions. Nevertheless, high larval density and biomass appeared in more specific situations. It was confirmed that larger basins with sinuous and productive rivers host more abundant populations of ammocoetes; this could be explained by a greater availability of food and suitable habitats. Banks of sediment in which higher biomass or densities were recorded were constituted by sand (particle size of 0.125 mm to 2mm), with a higher percentage of gravel (>2 mm) for larger larvae and individuals in metamorphosis. These patches of habitat were recorded in shallow areas (~30 cm depth) with mild organic enrichment and slow to moderate water flows (~8 cm s⁻¹) along with a good-acceptable oxygen saturation rate (>70%). Finally, *in situ* differentiation between optimal and suboptimal larval habitat in population studies is not recommended, due to the large number of variables involved and the difficulty or impossibility to properly characterize them on field. Thus, it is recommended to conduct the sampling in the existing patch -or patches- of larval habitat in the selected section of river that better matches the optimal conditions.



LONG TERM MONITORING OF BROWN TROUT (*Salmo trutta*) SPAWNING HABITAT IMPROVEMENT IN THE GUADALOPE RIVER BASIN (C.H. EBRO)

Lapesa S.¹, E. Ginés², J.M. González³ & E. Escudero⁴

1 Sociedad Aragonesa de Gestión Agroambiental (S.A.R.G.A.), Polígono Industrial La Paz, C/Londres, parcela 256, 44195-Teruel (slapesa@sarga.es).

2 Departamento de Desarrollo rural y Sostenibilidad, Servicio Provincial de Zaragoza. Edificio Pignatelli - Paseo de Maria Agustín, 36. planta 1, pta. 7, 50004 Zaragoza.

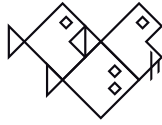
3 Departamento de desarrollo rural y sostenibilidad, Servicio Provincial de Teruel. C/San Francisco, 4, 44001-Teruel.

4 Departamento de Desarrollo Rural y Sostenibilidad, Servicio de Caza, Pesca y Medio Acuático. Plaza de San Pedro Nolasco, 7, 50071 Zaragoza.

Limestone streams in the Iberian Peninsula are affected by calcium carbonate precipitation processes which increase substrate cohesion, dealing to reproductive depletion in those rivers that harbour fish species as brown trout (*Salmo trutta*) that dig into the substrate when spawning.

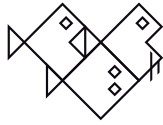
Spawning habitat improvement was carried out in 2011 in the Guadalope River, which is a tributary of the Ebro River in Spain. The main actions consisted on breaking the substrate using manual methods to ease *Salmo trutta* female to dig in the gravel, as well as to improve intragravel porosity to increase embryos survival. Results of the first year of monitoring provided encouraging results in the quality of the spawning areas and brown trout age-0 production. Nevertheless, preliminary results must be tested for many years to determine how long substrate modification influences brown trout breeding.

This contribution shows Brown trout spawning habitat and population density results along 4 years after habitat improvement. Data analysis are discussed to achieve methodology effectiveness to increase brown trout recruitment and its utility as an alternative to stocking trout in fishing streams.

**BAYESIAN ESTIMATION OF ENDEMIC TAREK GROWTH
(*Alburnus tarichi*, GLDENSTADT, 1814) IN LAKE ERCEK, TURKEY****Gündođdu S.**

Cukurova University, Faculty of Fisheries Department of Basic Sciences 01330 Adana/
TURKEY, (sgundogdu@cu.edu.tr).

In this paper, a Bayesian growth modeling method is introduced for modeling tarek (*Alburnus tarichi*, Gldenstadt, 1814) growth. 560 tareks were sampled 12 times by using 20 mm, 22 mm and 24 mm trammel nets between the months of January 2008 and January 2009. The Bayesian method was used to estimate weight-length relationship parameters and von Bertalanffy growth parameters. Length weight relationships were calculated with the Bayesian method for male, female, and combined sexes as , and respectively. The von Bertalanffy growth equations were estimated as for males, for females and for combined sex. Considering the estimation of von Bertalanffy growth parameters and weight-length parameters, results indicated that the biological plausibility of the Bayesian method is satisfactory.



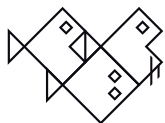
PRELIMINARY RESULTS ON THE PRESENCE OF *CRYPTOSPORIDIUM* IN *Salmo trutta* FROM GALICIA (NW SPAIN)

Couso-Pérez S., A. Piñeiro-Rodríguez, R. Campo-Ramos, A. Cañizo-Outeiriño, E. Ares-Mazás & H. Gómez-Couso

Laboratory of Parasitology, Department of Microbiology and Parasitology, Faculty of Pharmacy, University of Santiago de Compostela, Campus Vida, 15782 Santiago de Compostela, A Coruña, Spain (hipolito.gomez@usc.es).

Cryptosporidium is a genus of protozoan parasites which species infect a wide range of vertebrate hosts, including humans. The infection has been described in both wild or cultured piscine species living in fresh and marine water with parasitic stages located either on the stomach or intestinal surface, or at both sites. The presence of this waterborne parasite was investigated in a total number of 191 specimens of brown trout (*Salmo trutta*) captured during the 2015 fishing season from Furelos River (A Coruña, NW Spain). Pyloric caeca and intestinal content from each trout were collected, homogenized and concentrated in phosphate buffered saline/diethyl ether. Using a direct immunofluorescence method with monoclonal antibodies against *Cryptosporidium*, oocysts were detected in 26 samples (13.6%), corresponding to 12 pyloric caeca samples (46.2%); 7 intestinal contents (26.9%); and the 7 remaining samples showed parasitic forms in both locations (26.9%). Further histological and molecular studies are needed to confirm the natural infection or if the brown trout can act as dissemination vehicle of *Cryptosporidium* oocysts which are transported in runoff from agricultural lands and cattle farms that show a high prevalence of neonatal cryptosporidiosis.

The authors thank to *Asociación de Troiteiros do Río Furelos* for their collaboration. This study was funded by the Department of Culture, Education and University of the Autonomous Government of Galicia (Grant no. GPC2014-069).



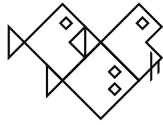
PREVALENCE OF *ECHINORHYNCHUS TRUTTAE* IN BROWN TROUT (*Salmo trutta*) FROM TWO GALICIAN WATERSHEDS (NW SPAIN)

Couso-Pérez S., A. Cañizo-Outeiriño, R. Campo-Ramos, E. Ares-Mazás & H. Gómez-Couso

Laboratory of Parasitology, Department of Microbiology and Parasitology, Faculty of Pharmacy, University of Santiago de Compostela, Campus Vida, 15782 Santiago de Compostela, A Coruña, Spain (hipolito.gomez@usc.es).

The Water Framework Directive 2000/60/CE establishes biological, physicochemical and hydromorphological indicators to determine the water quality defined as ecological status. In the case of the rivers, the composition and abundance of ichthyological and invertebrate benthic faunas are among the biological indicators. Aquatic macroinvertebrates are organisms without backbones that can be seen without the aid of a microscope. Macroinvertebrates live on, under and around rocks and sediments on the bottom of lakes, rivers and streams. Several species of macroinvertebrates are part of the food chain of fresh water fishes and can act as intermediate hosts in the biological cycle of some endoparasitic helminthes. Thus, the amphipods of *Gammarus* genus present in rivers are intermediate hosts of the acantocephalan *Echinorhynchus truttae* that uses *Salmo trutta* as definitive host. This study shows the results obtained on the presence of this parasite in 303 specimens of brown trout (*S. trutta*) captured from the Tambre (n=88) and Ulla (n=215) watersheds (Galicia, NW Spain). Remarkable differences between the prevalence rates obtained in both watersheds were observed (34.1% and 3.7% for Tambre and Ulla watersheds, respectively). These findings can be explained according to the differences detected in the relative abundance of *Gammarus* spp., bioindicators of a moderate ecological status. Similarly, *E. truttae* prevalences could be indicative of the ecological status of fresh water bodies.

The authors thank to the anonymous fishermen for their collaboration. This study was funded by the Department of Culture, Education and University of the Autonomous Government of Galicia (Grant no. GPC2014-069).



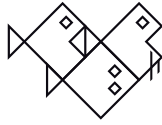
INTESTINAL HELMINTH PARASITES IN BROWN TROUT (*Salmo trutta*) FROM THE FURELOS RIVER (GALICIA, NW SPAIN)

Couso-Pérez S., A. Cañizo-Outeiriño, R. Campo-Ramos, E. Ares-Mazás & H. Gómez-Couso

Laboratory of Parasitology, Department of Microbiology and Parasitology, Faculty of Pharmacy, University of Santiago de Compostela, Campus Vida, 15782 Santiago de Compostela, A Coruña, Spain (hipolito.gomez@usc.es).

Between March to August 2015, a total number of 191 specimens of brown trout (*Salmo trutta*) were captured from Furelos River (A Coruña, NW Spain). The stomach, the pyloric caeca and the intestinal content from each trout were collected. After an initial macroscopic examination, the samples were homogenized, concentrated in phosphate buffered saline/diethyl ether and the sediments obtained were examined under bright field microscopy. Among the 191 samples analyzed, helminth parasites were observed in 179 samples (93.7%): *Crepidostomum* spp. (n=144, 75.4%; mainly *Crepidostomum metoecus*, Digenea); *Cystidicoloides* spp. (n=115, 60.2%; Nematoda); *Raphidascaris acus* (n=23, 12.0%; Nematoda); *Capillaria* spp. (n=9, 4.7%; Nematoda); and *Echinorhynchus truttae* (n=4, 2.1%; Acantocephala). Single, double, triple and quadruple parasitisms were detected in 49 (25.6%); 83 (43.4%); 19 (9.9%); and 1 (0.5%) samples, respectively. Co-infection by *Crepidostomum* and *Cystidicoloides* was observed in 92 samples of the 179 positive samples (51.4%). This double parasitism could be justified by the existence of a common intermediate host in their biological cycle, aquatic insects of the Ephemeroptera order, which are part of the benthic community from the analyzed river.

The authors thank to *Asociación de Troiteiros do Río Furelos* for their collaboration. This study was funded by the Department of Culture, Education and University of the Autonomous Government of Galicia (Grant no. GPC2014-069).



BROWN TROUT (*Salmo trutta*) STOCKS RESTORATION PROGRAM IN ANDALUSIA

Rubio S.¹ & B. Nebot²

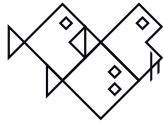
1 Agency for the Environment and Water. Av. Joaquina Eguaras, No. 10. 18013 Granada. Spain. (srubio@agencia-medioambienteyagua.es)

2 Regional Government for Environment and Spatial Planning.

In 2005, the Andalusian Regional Government changed the modality for brown trout fishing to release fishing throughout the Andalusian territory. At the same time the Brown Trout Populations Recovery Program was launched, which included, among other actions, the Andalusian Operational Tool for Fisheries Census. This tool has improved the knowledge concerning this species populations, its evolution over the past decade, and better knowledge of the pressures and impacts they endure.

The results indicate that there exists a relationship between the density of brown trout populations with droughts and high rainfall periods, which have significant impacts on their effective population. Thus, during the ten years sampling period, trout populations have experienced rise and fall cycles, and although some populations have recorded maximum values of density and biomass in recent years, the general trend of the populations in Andalusia is decreasing.

Over the past 11 years recovery works for the oldest populations, which have already disappeared in several Andalusian provinces, have been implemented, consisting in reintroductions of specimens with pure genetic lines of the common trout. Other management measures have also been implemented, such as the eradication of rainbow trout breeding populations (an exotic species competitive with brown trout) as well as various studies concerning the brown trout's diet, historical distribution of the species in Andalusia, characterizing their breeding migration patterns by acoustic telemetry or determination of ecological flows in certain Andalusian rivers.



STATUS AND CONSERVATION OF EEL (*Anguilla anguilla*) POPULATION IN ANDALUSIA

Rubio S.¹, M.D. González¹, J. Prenda², A. Ramos², F. Bustamante³ & I. Redondo³

1 Agency for the Environment and Water. Av. Joaquina Eguaras, No. 10. 18013 Granada. Spain. (srubio@agencia-medioambienteyagua.es).

2 University of Huelva.

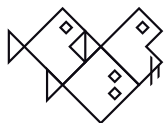
3 Andalusian Institute for Inland Fisheries and Hunting, Environmental Management Department, Regional Government for Environment and Spatial Planning.

The 18 September 2007 Regulation of the European Council of the European Union No. 1100/2007 requires Member States which account for river basins that include habitats for eels to define and implement Eel Management Plans. The Eel Management Plan of Andalusia includes a series of studies and actions, among which are the studies of the Atlantic and Mediterranean Eel management units, which highlights the current distribution range of the species. The characterization of their conservation status, habitat description and analysis, the preferences shown by the eels, as well as human disturbance level in the sampled locations and a general diagnosis of their status are also part of the actions carried out.

A total of 121 sites have been sampled, distributed along the Atlantic and Mediterranean area. 8 pairs of fish traps (each pair consisting of an eel trap and a shrimp trap) have been used, each of them set during 12 hours at each sampling point.

The data obtained shows that there exists an extraordinarily precarious and difficult situation of eel stocks in the Atlantic and Mediterranean management units, based on:

1. Low rate of catches obtained: 489 individuals with a biomass of 41 kg in the Atlantic Management Unit and 156 individuals with a biomass of 17 kg in the Mediterranean Management Unit.
2. Absence in many localities: present in 51 of the 76 locations in the Atlantic Management Unit (67%) and in 23 of the 45 locations in the Mediterranean management Units (51%).
4. Density of eels in quantitative terms was low or very low throughout the study area.
5. Recession in its distribution scope.



EEL (*Anguilla anguilla*) MANAGEMENT PLAN IN ANDALUSIA

González M.D.¹, S. Rubio¹, C. Fernández-Delgado², F. Bustamante³ & I. Redondo³

1 Agency for the Environment and Water. C / Johan Gutenberg, No. 1. Isla de la Cartuja. 41092. Sevilla. Spain. (mdgonzalez@agenciamedioambienteyagua.es).

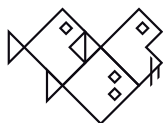
2 Department of Zoology, University of Cordoba.

3 Andalusian Institute for Inland Fisheries and Hunting, Department of Environment Management, Regional Government for Environment and Spatial Planning.

Since 1980 the European eel (*Anguilla anguilla*) has suffered a remarkable and rapid decline in its population. Two major initiatives have been carried out throughout the EU with aims to reverse this situation: Regulation of the European Council of the European Union No. 1100/2007 of 18 September 2007 and the inclusion of the species in Appendix II of the Convention on International Trade in Endangered species of Wild Fauna and Flora (CITES).

In order to comply with this EU requirement, the Regional Decree 396/2010 was published by the Regional Government for Environment and Spatial Planning, in which a 10-year moratorium on European eel fishing, regarding any stage of development, was set, as well as a number of collaboration initiatives with aquaculture facilities.

Since the beginning of the Eel Management Plan in Andalusia in 2012, a series of studies for the assessment of the evolution of the elver population in the main rivers of Andalusian management units have been carried out. At the same time, studies were also made concerning their epidemiological status and the level of organochlorine accumulation in their bodies. On the other hand, efforts for restocking the yellow and silver eels elver populations have been carried out in several river sections of the Andalusian geography in order to facilitate their migration to the Sargasso Sea, as well as to strengthen the populations whose current conservation status is precarious. Additionally, obstacles and barriers in eel populated rivers have been inventoried so as to determine the level of permeability for the anadromous and catadromous migrations. 5 obstacle permeation strategies have been drafted, three of which are presently running: one in "Riviera Huelva" and two in the "Guadaira" River.



DESCRIPTIVE PROFILING OF GILTHEAD SEABREAM (*Sparus aurata*) FED WITH DIETS CONTAINING THYME ESSENTIAL OILS AND ROSEMARY EXTRACT

Álvarez A., A. Hernández, B. García-García & M.D. Hernández

IMIDA-Acuicultura. 30740 San Pedro del Pinatar. Murcia. Spain (anam.alvarez2@carm.es).

The use of herbal essential oils as preservatives against spoilage during the storage of fish has been studied by many authors. Their addition in the fish diets could delay these processes because of their antioxidant and antimicrobial activity. But the possible changes in the sensory attributes have to be considered, since the final product must be accepted for consumers.

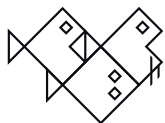
The effects on flesh quality were assessed for gilthead seabream fed with five diets containing different additives: control (without treatment); BHT (butylated hydroxytoluene at 200 mg/kg); rosemary (rosemary extract of *Rosmarinus officinalis* at 600 mg/kg); carvacrol (essential oil of *Thymbra capitata*, carvacrol chemotype, at 500 mg/kg); and thymol (essential oil of *Thymus zygis*, thymol chemotype, at 500 mg/kg).

An trained panel conducted a sensory analysis by assessing the following attributes: (i) characteristic odour; (ii) oily odour; (iii) other odours; (iv) characteristic flavour; (v) oily flavour; (vi) other flavours; (vii) colour (whiteness); (viii) quantity of liquid loss; (ix) firmness; (x) juiciness; (xi) fatness; (xi) chewiness. These attributes were scored on a scale from 1 (low intensity) to 10 (high intensity).

The results showed subtle differences between the experimental groups. The thymol group, demonstrated lower intensity of other odours and flavours, however characteristic odour and flavour were more intense for this diet than other groups. The color of fillets was whiter in both dietary groups containing thyme. The quantity of liquid loss scored lowest for the diet without treatment, well as, firmness and chewiness.

Descriptive profiling has been used to quantify sensory characteristics of fish from different farming system, diets and feeding cycles. In the present study, the differences observed were very low and were not statistically significant. So, the thyme essential oils and rosemary extract could be used at the doses tested as a feed additive without compromising on product quality.

This research was supported by Grants from the project (RTA2009-00145) of the Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria (INIA). The study was also partially sponsored by the IMIDA grant programme.

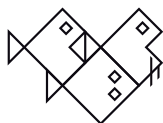
**EFFECT OF *TETRASELMIS CHUII* MICROALGAE ON *SPARUS AURATA* L. IMMUNE SYSTEM****Cerezuela R.¹, C. Espinosa¹, M.D. Hernández² & M.A. Esteban¹**

¹ Departamento de Biología Celular e Histología. Universidad de Murcia. 30100 Murcia. Spain (aesteban@um.es).

² Instituto Murciano de Investigación y Desarrollo Agrario y Alimentario (IMIDA), Calle Las Salinas, 7, San Pedro del Pinatar, Murcia, Spain.

Marine organisms are a potential alternative source of substances for the prevention and treatment of infectious diseases. Algae are used as supplementary nutrients in many countries, because they are products rich in proteins, vitamins and minerals. For this reason, algae have been studied as immunostimulants in fish and can be good candidates to be used as prebiotics. Most studies examining the immunostimulatory ability of algae have been carried out by *in vitro* incubation of immune cells with algal extracts, and information of the *in vivo* effects of whole algal cells is still scarce. The aim of this study was to investigate the effects of algae *Tetraselmis chuii* on some immune parameters of the gilthead seabream (*Sparus aurata* L.). Thirteen groups of fish (45.4 g mean body weight) were randomly distributed on tanks and fed with five diets (three replicates by diet): standard diet (control) or standard diet supplemented with microalgae at 2.5, 5, 10 and 15%. Fish were sacrificed after four weeks of trial. Head kidney leucocytes were used to determine the respiratory burst, peroxidase and phagocytic activity, and serum samples were collected to evaluate the peroxidase activity and IgM levels. Our results demonstrated that fish fed 2.5% microalgae supplemented diet showed a significant increase in respiratory burst and serum IgM levels. However, no significant differences were observed in phagocytic or peroxidase activity (both in serum and leucocytes). These results suggested that dietary *Tetraselmis chuii* administration has an immunostimulant effect on some immune parameters of gilthead seabream.

Acknowledgements: This work was supported by the *Programa Operativo FEDER 2014-2020. Región de Murcia* (14-20-10), Spanish Ministry of Economy and Competitiveness (Grant no. AGL2014-51839-C5-1-R) co-funded with Fondos Europeos de Desarrollo Regional/European Regional Development Funds) and *Fundación Séneca de la Región de Murcia (Grupo de Excelencia 19883/GERM/15)*.



SEASONAL CHANGES IN THE FILLET AND PROXIMATE COMPOSITION OF GILTHEAD SEA BREAM (*Sparus aurata*) CULTURED IN OFFSHORE CAGES IN THE MEDITERRANEAN SEA

García García B., M.D. Hernández, F. Aguado-Giménez & J. Cerezo Valverde

IMIDA, C/Mayor s/n, 30150 La Alberca, Murcia, España (benjamin.garcia@carm.es).

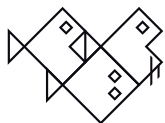
Growth rates of fish may exhibit wide variability, and how such variability affects fish quality is a central issue in aquaculture. Changes in gross chemical composition, important for quality, result from alterations in the turnover and retention of various chemical components such as proteins, lipids, carbohydrates and minerals within specific tissues as the fish develops and grows. Many exogenous factors, both environmental (temperature, etc.) and dietary (diet composition, feeding frequency, etc.) have also been reported to affect the proximate composition of cultured fish, and, therefore, some parameters that define the quality of the fillet.

In the areas of the Mediterranean Sea where intensive ongrowing in offshore cages is carried out, the water temperature varies widely from 14 °C in winter to 27 °C in summer. This seasonal variation in temperature, together with body weight, strongly affects the fish growth rate and food intake.

The objective of this study was to analyze, in gilthead sea bream (*Sparus aurata*) commercial size (500 g) from a offshore fish farm, the relationship between the fillet and the body weight and proximate composition of the fillet in two seasons (March and October) in which they must obtain the maximum and minimum values due to variations in annual temperature of sea water.

The average value of the fillet varied in a narrow range between $43.9 \pm 1.3\%$ (\pm confidence limits 95%) in March and $45.8 \pm 0.9\%$ in October, although the differences were statistically significant ($P < 0.05$). Significant differences were found in the proximate composition of the fillet. These differences were very large in the lipid content with values of $17.67 \pm 0.86\%$ in October and $8.10 \pm 0.78\%$ in March, and small in the protein content values of 19.16 ± 0.14 and $20.69 \pm 0.33\%$ respectively.

Financing: Programa Operativo FEDER 2014-2020. Región de Murcia: 14-20-09.



THE EFFECT OF RAW MATERIAL USED IN THE MANUFACTURE OF AQUAFEED ON THE CATEGORIES OF ENVIRONMENTAL IMPACT OF THE LIFE CYCLE ASSESSMENT (LCA) OF OFFSHORE CAGE GILT-HEAD SEABREAM (*Sparus aurata*)

Calle Lobo S.¹, C. Rosique Jiménez², M.D. Hernández¹ & B. García García¹

1 IMIDA, Calle Mayor s/n, 30150 La Alberca, Murcia, España (s.calle.lobos@gmail.com).

2 Universidad de Murcia, Edificio C, Campus de Espinardo, 30100 UM, Murcia (crosique@um.es).

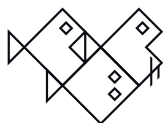
Life cycle assessment (LCA) is a methodology aimed at assessing the environmental aspects and potential impacts associated with a product by compiling an inventory of relevant inputs and outputs of the product system, evaluating the potential environmental impacts associated with those inputs and outputs, and interpreting the results of the inventory analysis and the impact assessment phases in relation to the objectives of the study (ISO, 2006).

The LCA of offshore cage gilt-head sea bream has shown that aquafeed is the component with the highest contribution on the impact index, particularly regarding ecotoxicity (fresh water, marine and terrestrial). This is mainly due to raw materials used for aquafeed production, specifically fish meal and soybean meal.

The current study compares the LCA of gilt-head sea bream from a offshore fish farm using only standard aquafeed (wheat 14 %, soybean meal 22%, fish meal 20%, wheat gluten meal 13%, fish oil 8%, soybean oil 5% and rapeseed oil 5%) and from another using an alternative aquafeed with a higher gluten content (wheat 14 %, fish meal 10%, wheat gluten meal 18%, corn gluten meal 25%, peas 10%, fish oil 8%, soybean oil 5% and rapeseed oil 5%). SimaPro 8.04 was the software used for the computational implementation of the life cycle inventories. CML-IA was the method used for the environmental characterization.

According to environmental impact indices, alternative aquafeed shows a general reduction in negative effects, especially with regard to global warming (47 %), fresh water aquatic ecotoxicity (70 %), marine aquatic ecotoxicity (55 %) and terrestrial ecotoxicity (80%).

Financing: Programa Operativo FEDER 2014-2020. Región de Murcia: 14-20-09.



FATTY ACID TRANSFER FROM AQUACULTURE WASTES TO MARINE MEDITERRANEAN COMMUNITIES

González-Silvera D.¹, D. Izquierdo-Gómez², V. Fernández-González, J.A. López Jiménez¹, P. Sánchez-Jerez² & F.J. Martínez López¹

1 Departamento de Fisiología, Facultad de Biología, Campus Regional de Excelencia Internacional "Campus Mare Nostrum", Universidad de Murcia 30100 Murcia, Spain (danielgs@um.es).

2 Departamento de Ciencias Marinas y Biología Aplicada, Universidad de Alicante, Alicante, Spain.

Current aquaculture activities imply the use of aquafeeds with high inclusions of vegetable oils of terrestrial origin. These vegetable oils are rich in n-6 polyunsaturated fatty acids but scarce in n-3 long-chain polyunsaturated fatty acids, which are essential for marine teleost and generally abundant in marine organisms. The submerged structure of the sea-cages attracts a high number of species due to the availability of high amounts of feed rich in energy and nutrients, in the form of lost pellets and faeces. In this work, we check whether the use of organic matter derived from aquaculture activities by the aggregated fauna modifies their natural fatty acid profiles.

Four teleost species and eighteen macroinvertebrate species aggregated to a fish farm were analysed and compared with controls. In the case of teleost fish, controls were obtained by trawlers at a minimum of 5 km from fish farms; and in the case of macroinvertebrate species, controls were sampled from a fish farm not used for production for the previous two years. Fatty acid extraction and purification were prepared according to the methods of Folch et al. (1957) and Christie (2003), and fatty acid methyl esters were separated and quantified by gas-liquid chromatography.

Most of the analysed species showed significant differences between the fatty acid profiles of aggregated and control specimens. These differences were due to the accumulation of the main fatty acids (linoleic acid and oleic acid) present in fish feeds and faeces from the fish farm. There exist modifications of the fatty acid profile in almost the whole ecosystem due to aquaculture activities, with no apparent negative effects. Nevertheless, long term effects of the modification of dietary habits and the accumulation of n-6 fatty acids at the expense of n-3 polyunsaturated fatty acids along the trophic chain, remains unknown and deserve better consideration.



CHEMICAL AND BACTERIOLOGICAL EVALUATION OF EUROPEAN SEA BASS (*Dicentrarchus labrax*) PRESERVED IN ICE

Djamal M.¹, A. Cuesta², M.A. Esteban², D. Ceballos-Francisco², A. Sonia¹ & O. Mustapha³

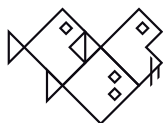
1 Institut des Sciences Vétérinaires, Université de Blida 1, Algérie.

2 Fish Innate Immune System Group, Department of Cell Biology and Histology, Faculty of Biology, Regional Campus of International Excellence "Campus Mare Nostrum", University of Murcia, 30100 Murcia, Spain (aesteban@um.es).

3 Faculté des Sciences de la Nature et de la vie, Université Dr. Yahia Fares, Médéa, Algérie.

Seafood rapidly deteriorates and several preservation techniques are needed to maintain their nutritional components and deliver fresh to the consumer. The most commonly used is cooling. Thus, we have evaluated the storage in ice at temperatures between 0-3°C of the farmed European sea bass fish (*Dicentrarchus labrax*). Fish were cultured in two different intensive farms from Algeria: one consisting on ponds with heated water from a power plant (Djinet) and the other in floating cages at open sea (Zemmouri). Both farms are in the region of Boumerdes, east of Algiers, and separated each other about 16 Km. Two lots of sea bass from the two farms were stored in ice and organoleptic and analytical (chemical and bacteriological) analyses were performed during 15 days. The shelf life of sea bass was of 13 days for those cultured in heated-water ponds and 15 days for those from floating cages. The chemical monitoring shows that pH, volatile basic total nitrogen (TVB-N) and trimethylamine (TMA) are appropriate indices for evaluating alteration of fish food and coincide with the organoleptic acceptability. The results obtained in this study show that European sea bass raised in floating cages at sea have a shelf life superior to those reared in ponds with heated water discharged by power stations that promote development certain pathogenic bacteria.

Acknowledgements. The authors wish to thank the officials of the Central Laboratory of the Stewardship of the National Army in Algeria (Laboratoire Central de l'intendance de l'Armée Nationale populaire) for their support and cooperation. Financial support by grants AGL2011-30381-C03-01 and AGL2013-43588-P (MINECO and FEDER) and 19883/GERM/15 (*Fundación Séneca de la Región de Murcia*, Spain) is gratefully acknowledged.



APPLICATION OF FISH CELL LINES AND PRIMARY CULTURES FOR MARINE ECOTOXICOLOGICAL STUDIES

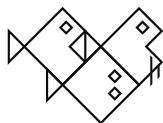
Morcillo P.¹, D. Romero², D. Ceballos-Francisco¹, J. Meseguer¹, M. Á. Esteban¹ & A. Cuesta¹

¹ Fish Innate Immune System Group, Department of Cell Biology and Histology, Faculty of Biology, Regional Campus of International Excellence "Campus Mare Nostrum", University of Murcia, 30100 Murcia, Spain (alcuesta@um.es).

² Department of Toxicology, Faculty of Veterinary, Campus Regional de Excelencia. Internacional "Campus Mare Nostrum", University of Murcia, 30100 Murcia, Spain.

To assess the toxicity of aquatic pollutants, fish cell cultures are a potential alternative to fish bioassays. Moreover, the development of alternative methods applies to the strategy of 3 Rs, which stands for reduction, refinement and replacement of laboratory use of animals. In this study, two cell lines (commercial SAF-1 cell line derived from gilthead seabream *Sparus aurata* and in-house generated DLB-1 cell line from the brain of European sea bass *Dicentrarchus labrax*, both important fish species for the Mediterranean aquaculture) and seabream and sea bass primary cultures of head-kidney leucocytes (HKLs), peripheral blood leucocytes (PBLs) and circulating erythrocytes were exposed *in vitro* for 24 h to metals: cadmium chloride (CdCl₂), methylmercury (II) chloride [CH₃HgCl (MeHg)], lead (II) nitrate (Pb(NO₃)₂) and trioxide arsenic (As₂O₃) (0.1 μM to 10 mM) and the resulting cytotoxicity was evaluated. Exposure to metals produced a dose-dependent reduction in the viability, and in general, methylmercury or Cd showed the highest toxicity while Pb was the less toxic metal in all cases. Interestingly, DLB-1 cell line was more sensitive to metal exposure than SAF-1 cell line, whilst primary cultures from European sea bass are more resistant to metal exposure than those from gilthead seabream. In addition, whatever the fish species, HKLs and erythrocytes are always more sensitive than PBLs. Thereby, in the endpoint assays, the fish species, the origin of the cell population as well as the metal used may affect in a different level. This report provides a comparison to evaluate the potential application of marine fish cell lines and primary cultures with ecotoxicological purposes.

Acknowledgements. Financial support by grants AGL2011-30381-C03-01 and AGL2013-43588-P (MINECO and FEDER), PCIN-2015-187-C03-02 (MINECO, JPIOceans: Microplastics, EPHEMARE) and 19883/GERM/15 (*Fundación Séneca de la Región de Murcia*, Spain) is gratefully acknowledged.



NEUROTOXICITY OF NEONICOTINOIDS TO THE DEVELOPING AQUATIC VERTEBRATES

García-Camero J. P.¹, C. Berberana² & F. Morcillo³

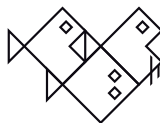
1 Toxicology Area. National Centre for Environmental Health, Institute of Health Carlos III. Ctra Majadahonda-Pozuelo km

2. 28220 Majadahonda, Madrid. Spain (jesuspgc@isci.es).

2 Faculty of Health Sciences. Alfonso X El Sabio University. Avenida de la Universidad 1. 28691 Villanueva de la Cañada. Spain (cmornber@uax.es).

3 Department of Ecology. University Complutense of Madrid. C/ José Antonio Novais 12. 28040 Madrid. Spain (fmorcill@ucm.es).

Neonicotinoid pesticides are used extensively in a variety of agricultural crops and veterinary formulations. They are highly toxic to insects, whereas mammalian toxicity is rather low. In mammals, some neonicotinoids produced neurological effects related to nicotine effects accompanied with other systemic effects. The OECD studies have concluded that there is no concern about neurodevelopmental toxicity. However, at the environmental level, there is controversy about its toxicity to bees, as some neocotinoides have been linked to a gradual decrease in the number of bee colonies. For the aquatic environment, few studies have addressed the neurotoxicity of neonicotinoids on aquatic vertebrates. The purpose of this communication is to present data on the neurotoxicity of neonicotinoid insecticides on developing aquatic vertebrates (fish). To do this, the neurotoxicity of imidacloprid, thiacloprid and clothianidin was evaluated by means of an embryo-larval zebrafish model. Embryos were exposed to concentrations between 100 and 3.2 mg L⁻¹ in aqueous solution, from 0h to 144h, at 28.5°C temperature and 14 / 10h light / dark regimen. During the exposure, mortality, effects on development (hatching, malformations, length), cardiovascular effects (edema presence, heart beat rate), and effects on the nervous system (locomotion, AChE activity) were assessed. The effects of neonicotinoids on the zebrafish embryos were qualitatively similar to those found in mammals (rat), with systemic toxicity as well as neurotoxicity. Like mammals, locomotion was the critical effect after the exposure to neonicotinoids. Nevertheless, AChE activity of exposed embryos remained similar to negative controls, which indicated that effects on locomotion may be not related to neurotoxicity. Given the similarities between the two vertebrate models, our embryo-larval model could be useful in evaluating the presence of neonicotinoids in the aquatic environment.



LOCOMOTION IN ZEBRAFISH PROLARVAE AS ENDPOINT IN THE ASSESSMENT OF NEUROTOXICITY

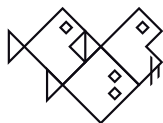
García-Camero J.P.¹, I. Borrás², C. Berberana² & F. Morcillo³

1 Toxicology Area, National Centre for Environmental Health, Institute of Health Carlos III. Ctra Majadahonda-Pozuelo km 2. 28220 Majadahonda, Madrid. Spain (jesuspgc@isciii.es).

2 Faculty of Health Sciences. Alfonso X El Sabio University. Avenida de la Universidad 1. 28691 Villanueva de la Cañada. (sapersi@hotmail.com) and (cmornber@uax.es).

3 Department of Ecology. University Complutense of Madrid. C/ José Antonio Novais 12. 28040 Madrid. Spain (fmorcill@ucm.es).

Locomotion at early developmental stages (larvae) of a fish plays a vital role in activities such as searching for food, sociability and escape response. The presence of toxic substances in the water body can alter the locomotion pattern in that crucial stage of development, causing dramatic consequences. Locomotion in zebrafish larvae (4-6 days post fertilization) is currently evaluated by means of automated tracking systems. Since the swimming larva behavior can be affected by extrinsic variables associated to the evaluation system, standardization of the assessment paradigms is essential to ensure reliability and reproducibility of the results obtained in toxicity studies. The aim of this work was to study how the main extrinsic factors can alter the locomotion of zebrafish prolarvas, in order to scientifically validate a paradigm for locomotion assessment. For this purpose, the zebrafish embryos were reared in egg water (28 °C, 14/10 h light/dark), and when they reached 144 h after fertilization, the total distance travelled and mean velocity were evaluated using Daniovision system (Noldus). The studied extrinsic factors were light intensity, plate type, well acclimation time, light-dark conditions, physical characteristics of the medium, inclusion or not in a toxicological assay, and time of day. The results showed that the acclimatization to the wells and the inclusion in toxicological studies did not modify the total distance travelled and the mean velocity of the 144h-prolarvas. By contrast, the light-dark regimen, temperature, conductivity of the medium, time of day and type of plate significantly altered the results. In conclusion, we propose that the most suitable paradigm with Daniovision system is 6-well plate with 1 larvae per well, 2% light (250 lux), medium at 26 °C and conductivity near 250 μ S/cm, between 9.30 and 13h, and without any acclimatization time to the well.



TISSUE DISTRIBUTION OF LIPID AND FATTY ACID METABOLISM AND TRANSCRIPTION FACTORS GENES IN ADULT ATLANTIC BLUEFIN TUNA (*Thunnus thynnus* L.)

Betancor M.B.¹, A. Ortega², F. de la Gándara², D.R. Tocher¹ & G. Mourente³

1 Institute of Aquaculture, University of Stirling, FK9 4LA, Stirling, Scotland, UK

2 Planta Experimental de Cultivos Marinos, Instituto Español de Oceanografía (IEO), 30860, Puerto de Mazarrón (Murcia), Spain.

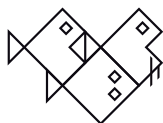
3 Departamento de Biología, Facultad de Ciencias del Mar y Ambientales, Universidad de Cádiz, 11510 Puerto Real (Cádiz), Spain (gabriel.mourente@uca.es).

To determine expression of the major lipid pathways in tissues of adult bluefin tuna 8 individuals were used for collecting samples for tissue expression of key lipid metabolism genes. Triplicate sets of samples of brain, gills, heart, kidney, spleen, liver, intestine, white muscle, red muscle, adipose tissue ovary and testis were collected. Expression of genes was determined by qPCR.

Tissue expression profiles showed that PUFA biosynthetic pathway genes were expressed in all tissues examined, highest expression in brain, liver and testis. Elongase *elov15* showed higher expression than desaturase *fads2d6* in all other tissues, with low expression of in red muscle and ovaries.

Transcription factors, *ppara* and *ppary* showed parallel expression, with adipose tissue with the highest relative copy number, followed by intestine>testis>liver. The expression of *lrx* was low in liver, with highest expression in testis, brain and kidney. Similarly, *rxr* was poorly expressed in liver with higher expression in muscle, spleen and brain. The rank order of expression of *srebp1* was brain, testis, ovary, intestines, kidney, gill, liver, white muscle, spleen, heart and red muscle. For *srebp2* the highest expression was shown in brain, testis and adipose with lowest expression in heart and white muscle. Expression of *fabp2* was highest in intestine, brain and heart with lower levels in liver, red muscle, adipose and kidney. *fabp4* showed highest expression in ovaries with liver showing the lowest. *fabp7* showed highest expression levels in brain and testis with lowest values in liver. *cpt1* expression was highest in brain and lowest in liver. Similarly, the relative copy number for *fas* was highest in brain followed by gonads, gill and liver, with white muscle showing lowest expression. The expression of *aco* was highest in adipose and intestine, followed by liver, kidney and brain. The expression of *hmgcl* was highest in ovary followed by adipose, brain and testis, with lowest expression in liver. Expression of *lpl* was highest in testis and lowest in ovary, with liver and white muscle, adipose, heart, gills and red muscle, kidney, intestine showing intermediate levels of expression.

This research was supported by projects from the Junta de Andalucía, Proyecto de Excelencia de Promoción General del Conocimiento Ref. RNM 0733, and Programa Estatal de Investigación del Ministerio de Economía y Competitividad Ref. AGL2014-52003-C2-1-R.



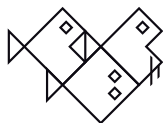
EFFECT OF DIETARY SUPPLEMENTATION WITH YEAST *Sacharomyces cerevisiae* ON SKIN REGENERATION OF GILTHEAD SEABREAM (*Sparus aurata*)

Espinosa C., H. Cordero & M.A. Esteban

Department of Cell Biology and Histology, Faculty of Biology, University of Murcia, (aesteban@um.es).

In aquatic organisms, the skin has a main role in the defense and is an important osmoregulatory organ. Skin wounds heal rapidly in fish and the surface is quickly covered by mucus and re-epithelization from the wound margin occurs within a few hours. So, the critical events of the regeneration happens 3 and 7 days after the damage occurs. On other hand, low levels of inactive brewer's yeast have been shown to improve growth performance in different fish species. The aim of the current study was to know the effect of the dietary supplementation with *Sacharomyces cerevisiae* on the skin regeneration of gilthead seabream. For this purpose, forty gilthead seabream specimens were randomly established in eight running sea water aquaria. The experimental diets contained 0 (control), and 10 mg per Kg of heat killed (30 min, 60°C) *S. cerevisiae*. After four weeks of trial, ten animals of both control and yeast group received a wound all of them in the same place. Samples of blood, skin and mucus were obtained three and seven days after the injury. Antioxidant enzymes activities were measured on mucus and relevant genes expression were analysed in the skin samples. Calcium concentration was significantly elevated in the plasma of damaged animals respect to the others groups, but only three days after damage. Catalase activity increased in the mucus of control fish but did not increase in the fish fed the yeast in fish sampled 3 days after the damage. The expression of relevant genes in skin regeneration changed between control and damaged fish groups.

Acknowledgements: This work was supported by the Spanish Ministry of Economy and Competitiveness (Grant no. AGL2014-51839-C5-1-R) co-funded with *Fondos Europeos de Desarrollo Regional* (European Regional Development Funds) and *Fundación Séneca de la Región de Murcia* (Grupo de Excelencia 19883/GERM/15).



EFFECT OF DIETARY SUPPLEMENTATION WITH *Tetraselmis chuii* MICROALGA ON *Sparus aurata*: OXIDATIVE STATUS AND MORPHOLOGY OF LIVER AND INTESTINE

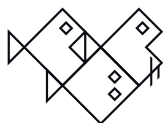
Espinosa C.¹, H. Cordero¹, R. Cerezuela¹, M.D. Hernández² & M.A. Esteban¹

¹ Department of Cell Biology and Histology, Faculty of Biology, University of Murcia, Spain (aesteban@um.es).

² Instituto Murciano de Investigación y Desarrollo Agrario y Alimentario (IMIDA), Calle Las Salinas, 7, San Pedro del Pinatar, Murcia, Spain.

Microalgae research has achieved great importance due mainly to the combination of uses may have. They comprise a vast group of photosynthetic heterotrophic organisms. *Tetraselmis chuii* is a prasinophyte algal genus which is used widely as a food source in mariculture. It has been proposed to have rich nutritional properties as high protein content, lipids, essentials fatty acids and sterols and presents chlorophyll a and b, carotene, zeaxanthin and violaxanthin. The aim of the current study was to evaluate the effect of dietary *T. chuii* on the intestinal morphology of gilthead seabream, as well as this effect in the oxidative status. For this purpose, fifteen groups of animals (45.4 g mean body weight) of the hermaphroditic protandrous sea water teleost gilthead seabream (*Sparus aurata* L.), were randomly established in running sea water aquaria (three replicates per treatment). The animals were fed with five diets (three replicates by diet): standard diet (control) or standard diet supplemented with microalgae at 2.5, 5, 10 and 15%. Liver and intestine samples were obtained after 6 weeks. Catalase (CAT), superoxide dismutase (SOD) and glutathione reductase (GR) activities were measured in liver. Fragments of 0.5 cm of the anterior intestine and liver were collected and prepared for light microscopic examination. CAT and SOD activities did not change in the liver of gilthead seabream treated with the diet with different doses of *T. chuii* and only a trend to increase was seen concomitantly as the algal dose rises. Nevertheless, the higher dose administered in the diet (15%) significantly increased both activities (CAT and SOD). However, GR activity significantly decreased respect to the control activity with all the treatments of *T. chuii*. Morphology of liver and intestine did not suffer any morphological alterations as a consequence of the experimental diets.

Acknowledgements: This work was supported by the *Programa Operativo FEDER 2014-2020. Región de Murcia* (14-20-10), Spanish Ministry of Economy and Competitiveness (Grant no. AGL2014-51839-C5-1-R) co-funded with Fondos Europeos de Desarrollo Regional/European Regional Development Funds) and *Fundación Séneca de la Región de Murcia (Grupo de Excelencia 19883/GERM/15)*.



DEHYDRATED LEMON BARK AS DIETARY ADDITIVE IN GILTHEAD SEABREAM (*Sparus aurata*)

García Beltrán J.M., C. Espinosa, H. Cordero & M.A. Esteban

Department of Cell Biology. Faculty of Biology. Universidad de Murcia. 30100 Murcia, Spain (aesteban@um.es).

Aquaculture is a very important production worldwide sector and it has a number of problems that cause animal and economic losses. One option to avoid this is the addition of immunostimulant compounds in the diet, including medicinal plants that stimulate the immune system, weight gain and growth rate. Dehydrated lemon bark, has different properties that make it a possible candidate to be added in the diet of fish. In this work the effect of the addition to the gilthead seabream diet of dehydrated lemon bark on the immune system was studied over a period of 30 days. The experimental diets had an incorporated amount of 0 (control), 1.5% and 3% dehydrated lemon bark. After 15 and 30 days of trial leucocytes from head kidney were sampled to study their innate activity. After 15 days of trial, head kidney leucocytes of gilthead seabream fed 1.5% and 3% diets showed a significant increase of the respiratory burst and peroxidase activities compared to the values recorded for leucocytes from control fish. Regarding the phagocytic activity, only 3% diet provoked a significant increase in the leucocyte activity, compared to the control one. After 30 days of trial, no significant differences were recorded among the different experimental groups. Regarding the weight, only fish fed 1.5% diet showed significant weight gain after 30 days. In conclusion, we observed that lemon bark as feed additive in commercial fish produced immunostimulation at 15 days, but not after 30 days.

Acknowledgements: H.C. wishes to thank the Spanish Ministry of Economy and Competitiveness for a F.P.I. scholarship. This work was supported by the Spanish Ministry of Economy and Competitiveness (Grant no. AGL2013-43588-P) co-funded with European Regional Development Funds (FEDER) and Fundación Séneca de la Región de Murcia (Grupo de Excelencia 19883/GERM/15).



BRAIN AND GONAD TRANSCRIPTIONAL PROFILES OF HPG-AXIS RELATED GENES IN FEMALE, MALE AND INTERSEX THICKLIP GREY MULLET (*Chelon labrosus*)

Valencia A., J. Andrieu, A. Nzioka, I. Cancio & M. Ortiz-Zarragoitia

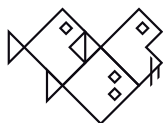
CBET Research Group, Research Centre for Experimental Marine Biology and Biotechnology of Plentzia (PiE-UPV/EHU), University of the Basque Country (UPV/EHU). 48620 Plentzia, Basque Country, Spain (maren.ortiz@ehu.eus).

The reproductive cycle of teleosts is regulated by the hypothalamus-pituitary-gonad axis (HPG-axis). The participation of this HPG-axis in the development of the intersex condition in fish is not understood, although the axis is known to be affected by endocrine disrupting chemicals. On the other hand, the expression profile of certain genes in those organs differs in females and males during the gametogenic cycle. In this work, genes belonging to this neurohormonal system and playing key roles in gametogenesis control were sequenced and analyzed by qPCR in female, male and intersex *Chelon labrosus*, at different gametogenic stages. Partial sequences for gonadotropin releasing hormone-1 (*gnrh1*), gonadotropin hormone common α -subunit (*gth-a*), luteinizing hormone β -subunit (*lh- β*), follicle stimulating hormone β -subunit (*fsh- β*), kisspeptin-2 (*kiss2*), kisspeptin-1 receptor (*gpr54*), luteinizing hormone receptor (*lh-r*) and follicle hormone receptor (*fsh-r*) were successfully obtained.

Gametogenic stage dependent differences in transcript levels were detected, but without marked sex related differences. Transcription levels of *gnrh1*, *gth-a*, *kiss2* and *gpr54* increased during gametogenesis in females and males. At late gamete maturation stages transcript levels decreased regardless of sex and maintained low during spawning and post-spawning stages in females. However in male mullets transcription levels increased after spawning. Intersex mullets showed a female-like transcript profile during early gametogenic stages, but at maturation, spawning and post-spawning stages they resembled males.

In conclusion, transcriptional profiles of genes in the HPG-axis change during gametogenic cycle in *C. labrosus*; both males and females. Intersex mullets showed female-like transcription during gametogenesis but thereafter they behave like males. Thus, results suggest the participation of neurohormonal signalling in the promotion of intersex condition in mullets. Ongoing work on gonadotropins regulation will offer a better understanding of oocyte formation in testis.

Funded: Spanish MINECO (AGL2015-63936-R), Basque Government (IT810-13, PhD fellowship AV), UPV/EHU (UFI 11/37).



CALL TO BUILD A COLLABORATIVE NETWORK FOR THE PROFILING OF FISH GONADAL RIBOSOMAL RNA

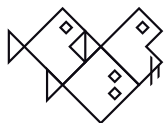
Rojo-Bartolomé I., A. Valencia, M. Ortiz-Zarragoitia, I. Cancio & O. Diaz de Cerio

CBET Research Group & Research Centre for Experimental Marine Biology and Biotechnology of Plentzia (PiE-UPV/EHU), University of the Basque Country (UPV/EHU). 48620 Plentzia, Basque Country, Spain (ibon.cancio@ehu.es).

Fish constitute the most diverse group within vertebrates involving a wide array of specialized developmental/physiological traits, reflected for instance in an ample spectrum of sex determination/differentiation mechanisms. Our research group has described that a simple electrophoresis of total RNA extracted from gonads, allows identification of high levels of 5S rRNA present in oocytes, diagnostically distinguishing fish ovaries, testis and intersex testis in a wide array of teleost species. 5S rRNA is the prevailing transcript in previtellogenic oocytes and 18S and 28S rRNAs accumulate as oogenesis progresses. Thus, a 5S/18S rRNA index has been developed that allows identifying sex and ovarian developmental stage. It also works as a quantitative method to rank intersex severity in fish exposed to xenoestrogens.

The objective hereby is to create a collaborative network to extend this quantitative/objective molecular approach as a robust method to identify sex and female reproductive stage across different fish species, laboratory set-ups, and environmental scenarios. In a Cloud computing based survey (GoogleDrive user: userfishoo, Password: UserFishO) researchers can share Agilent 2100 Bioanalyzer files used to assess their fish gonad/eggs RNA quality. File submission will not take longer than 10 minutes. Requested information will be: RNA quality files (Bioanalyzer original XAD files), RNA extraction method, fish species and individual characteristics when available. Our research group will then calculate 5S/18S rRNA index from files and correlate values to the characteristics detailed for each individual. Data coming from intersex fish will be most welcome, as this will allow establishing threshold values for intersex severity indexes in different species. The metadata generated will offer research and collaboration opportunities for the study of fish sex differentiation, opening new avenues for applications in fish fecundity analysis.

Funded: Spanish MINECO (AGL2015-63936-R), Basque Government (IT810-13, PhD and Postdoctoral fellowship to IRB, AV & ODC), UPV/EHU (UFI 11/37), COST Action FA1205.



THE RATIO BETWEEN OUTER/INNER NUCLEAR LAYER THICKNESS IS A USEFUL PREDICTOR OF THE HABITAT AND PREDATORY BEHAVIOR OF TELEOSTS

Martínez-Ruiz N., B. Boughlala, A.I. de Juan¹, J. De Juan

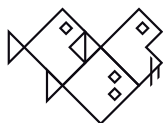
¹ Department of Biotechnology, University of Alicante, Spain. Apartado 99, 03080 Alicante (j dj@ua.es).

Teleosts represent more than 50% of all vertebrate species and present a wide distribution in all types of habitats and large differences in predatory behavior. Moreover, taking account that the visual system of fish is very similar to other vertebrates, makes them an important experimental model to study the adaptation to different environmental conditions.

Here, we calculate the ratio between the thickness (μm) of the retinal outer and inner nuclear layers (ONL/INL ratio) in several species of teleosts belonging to six families, and its relationship to habitat and predatory behavior.

Retinas from twelve species of teleost belonging to following families: Moronidae (*D. labrax*; *D. punctatus*; *M. Americana*), Sparidae (*S. aurata*; *D. vulgaris*; *P. acarne*), Labridae (*C. julis*; *S. tinca*; *S. roissali*), Scianidae (*A. regius*), Centrarchidae (*M. salmoides*) and Cyprinidae (*C. carpio*) were studied. The fish are adapted to light prior to their sacrifice. Retinas were removed, fixed and embedded in Epon-82 resin, then one-micron sections were stained with toluidine blue and the thicknesses of the two nuclear retinal layers were measured. The differences of ONL/INL ratios from fishes were analyzed using an ANOVA. Trophic a predatory data were obtained from FishBase and several publication data.

The ONL/INL ratio is lower in diurnal fishes and in those who are fewer predators, regarding the other ones. This ratio is an important indicator but no sufficient, to define the fish predatory behaviors. Therefore, this ratio could be used as an indicator of the habits of different fish species but taking account other parameters.



NEUROECOLOGICAL EXPLANATION OF THE DIFFERENT DISTRIBUTION OF SPINULES AND GANGLION CELLS IN THE RETINA OF THE TELEOST

Boughlala B., N. Martínez-Ruiz, A.I. de Juan & J. De Juan

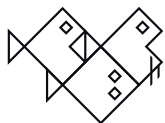
Department of Biotechnology, University of Alicante, Spain. Apartado 99, 03080 Alicante (jdj@ua.es).

Teleosts are a highly diverse group of vertebrates occupying all kinds of aquatic environment. During light adaptation, dendrites of teleosts retinal horizontal cells (HCs) invaginate deeply into cone pedicles, forming finger-like processes called "spinules". In dark-adaptation, spinules are retracted. Spinules are exclusive of teleost and have been considered the site of negative feedback, visual acuity and color opponent processes, from HCs to cone pedicles. The aim of this work is to determine the density and distribution of spinules through the retina and its correlation with the distribution of retinal ganglion cells (RGCs).

Two different teleost species were used, *Dicentrarchus labrax* and *Sparus aurata*. For the quantitative and topography analyses of RGCs, retinas were prepared as whole-mounts then stained by the Nissl method and after RGCs counted. Quantitative data were processed and translated into isodensity maps. For the analyses of distribution and density of spinules, representative retinal areas were embedded in EPON for transmission electron microscopy study. The spinule number per cone pedicle was calculated in each area.

D. labrax and *S. aurata* revealed a peak density of GCRs near the temporal margin of the retina, subtending a frontal binocular region field. However, the density of spinules was higher in the dorso-nasal peripheral area, specialized in the panoramic perception.

In both species, the density of spinules is higher in the zone of the retina with less visual acuity and specialized in to detect the environment. Thus, it is possible that spinules can permit to teleosts to detect movements in their environment as a mechanism to perceive press and predators.



THE INVAGINATIONS INTO THE CONE PEDICLES OF STURGEONS ARE SPINULES? A COMPARATIVE STUDY WITH THE SPINULES OF TELEOST RETINA

De Juan J.¹, B. Boughlala¹, A.I. de Juan¹, N. Martínez-Ruiz¹ & M. A. Esteban²

¹ Department of Biotechnology, University of Alicante, Spain. Apartado 99, 03080 Alicante (j dj@ua.es).

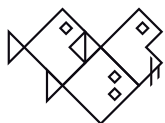
² Department of Cell Biology and Histology, University of Murcia, Universidad de Murcia. 30100 Murcia. Spain.

In teleost retinas, cone pedicles are invaginated by finger-like protrusions (spinules) from horizontal cell (HC) dendrites. The spindles appeared during light adaptation and retracted during darkness. Teleost is the only vertebrate group that has spinules. Data suggest that the spinules may be the sites of feedback from HC to the cone pedicles. Actinopterygians are the largest and most diverse vertebrate group. They are formed by teleostean, holostean and chondrosteans. Teleosts are a successful vertebrate group, constituting more than half of vertebrate species. Given the phylogenetic proximity between teleost and chondrosteans, the aim of this work is to verify whether sturgeons (chondrosteans) have spinules.

Six sturgeon (*Acipenser ruthenus*) and six teleosts (*Dicentrarchus labrax*) were used. Before to sacrifice, fishes were adapted two hours in light or darkness. Retinas were removed and processed for transmission electron microscopy studies. The number of spindles and synaptic ribbons, per cone pedicle, were calculated.

Six sturgeon (*Acipenser ruthenus*) and six teleosts (*Dicentrarchus labrax*) were used. Before to sacrifice, fishes were adapted two hours in light or darkness. Retinas were removed and processed for transmission electron microscopy studies. The number of spindles and synaptic ribbons, per cone pedicle, were calculated.

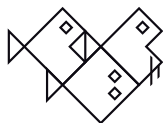
Acipenser ruthenus has spinules-like invaginations in cone pedicles comparable to teleosts spinules. Both invaginations are more abundant in light-adapted retinas than dark-adapted ones. These data suggest that sturgeon spinule-like can be a precursor of teleosts spinules.

**ANALYSIS OF METABOLIC CONDICTION IN TILAPIA *Oreochromis niloticus* CULTIVATED IN SEAWATER IN MONO AND POLY CULTURE WITH SHRIMP *Litopenaeus vannamei*****Apun-Molina J.P., A. Santamaría Miranda & M. Garcia-Marciano**

1 Instituto Politécnico – Nacional CIIDIR, Sinaloa, Blvd. Juan De Dios Batiz Paredes No. 250, Guasave, Sinaloa 81101 México (japun@ipn.mx).

Polyculture of shrimp and tilapia in Mexico is not a common practice; it is an alternative to minimize problems in shrimp farming (environmental pollution, disease) many benefits could be obtained if several species are cultivated trophic levels with tilapia. Polyculture of tilapia and shrimp is common practice in other countries, where the contribution of tilapia as biomanipulador control certain bacterial diseases, at the same time significantly improve production yields per unit area, because the resources available for cultivation, mainly natural food (Bardach et al, 1972 and Landau, 1992) take advantage of better, efficient occupation of physical space of the pond and the use of different trophic niches (Zimmermann and New, 2000).

The present work pretended evaluate the metabolic indicators of tilapia *O niloticus* cultivated in seawater in monoculture and co cultured with marine shrimp *L. vannamei*. Noting that protein concentrations in blood plasma was lower for tilapia monoculture 73.0 ± 4.85 mg mL and the concentration of glucose 40.91 ± 1.19 mg mL also triglycerides and cholesterol concentrations were very high in monoculture, this could be due exclusively to the type of balanced feed.

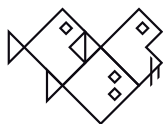
**EFFECTS OF *TRIGONELLA FEONUM-GRAECUM L*, SINGLE OR IN COMBINATION WITH PROBIOTIC STRAINS, ON *GILTHEAD SEABREAM*****Guardiola F.A.¹, A. Bahi², A. Mahdhi², R. Cerezuela¹, A. Bakhrouf² & M.A. Esteban¹**

1 Fish Innate Immune System Group. Department of Cell Biology and Histology. Faculty of Biology, Campus Regional de Excelencia Internacional "Campus Mare Nostrum", University of Murcia, 30100 Murcia, Spain (aesteban@um.es).

2 Laboratory of Analysis, treatment and valorization of pollutants of the environment and products. Faculty of Pharmacy, University of Monastir, Tunisia.

The use of immunostimulants is considered as a promising alternative preventative practice that may help to maintain a high animal welfare as well as a healthy environment, resulting in better production and higher profits. The purpose of this study was to evaluate the effects of dietary administration of fenugreek (*Trigonella foenum graecum*) single or combined with different probiotic strains: *Bacillus licheniformis* (TSB27), *Lactobacillus plantarum* and *Bacillus subtilis* (B46), on gilthead seabream (*Sparus aurata L.*). The dietary effects of the supplemented diets were evaluated on growth and humoral immune response (seric level of total IgM antibodies, complement activity, peroxidase, protease and antiprotease activities) after 2 and 3 weeks of feeding. Simultaneously, the expression levels of some immune-related (*igm*, *tcr-β*, *csfr1* and *β-defensin*) and antioxidant (*sod*, *cat* and *gr*) genes were measured in head-kidney and liver, respectively, by using real time PCR. Generally, humoral immune parameters were significantly affected by the dietary supplementation at different times of the experiment. The results showed a significant increase in most of the innate immune parameters, principally in fish fed with the combined diets with *B. licheniformis* followed by *B. subtilis* and *L. plantarum*. Furthermore, the real time PCR reveals that dietary supplementation significantly enhances the HK gene expression in gilthead seabream specimens, especially after 2 weeks. The experimental diets also alter the expression of the studied antioxidant genes in the liver. These results suggest that fenugreek single or combined with one of the probiotic strains modulates the immune response, alters the antioxidant system and stimulates growth of the gilthead seabream, one of the species with the highest rate of production in Mediterranean aquaculture.

Acknowledgements: This work was supported by the Spanish Ministry of Economy and Competitiveness (Grant no. AGL2014-51839-C5-1-R) co-funded with Fondos Europeos de Desarrollo Regional/European Regional Development Funds) and *Fundación Séneca de la Región de Murcia (Grupo de Excelencia 19883/GERM/15)*.



CELLULAR, HUMORAL AND MUCOSAL INNATE IMMUNE RESPONSES IN SENEGALESE SOLE (*SOLEA SENEGALENSIS*, KAUP) CHALLENGED WITH *TENACIBACULUM MARITIMUM*

Guardiola F.A.^{1,3}, M. Mabrok¹, M. Machado^{1,2}, R. Azeredo¹, A. Afonso^{1,2}, M.A. Esteban³ & B. Costas^{1,2}

1 Centro Interdisciplinar de Investigação Marinha e Ambiental (CIIMAR), University of Porto, Rua dos Bragas 289, 4050-123 Porto, Portugal.

2 Instituto de Ciências Biomédicas Abel Salazar (ICBAS-UP), University of Porto, Rua de Jorge Viterbo Ferreira 228, 4050-313 Porto, Portugal.

3 Fish Innate Immune System Group. Department of Cell Biology and Histology. Faculty of Biology, Campus Regional de Excelencia Internacional "Campus Mare Nostrum", University of Murcia, 30100 Murcia, Spain (aesteban@um.es).

Tenacibaculosis, caused by *Tenacibaculum maritimum*, continues to inflict substantial losses among marine cultured species, particularly in *Solea senegalensis*. To date, the immune mechanisms involved against this pathogen are still poorly understood in fish. Thus, the aim was to investigate the haematological profile as well as several immune-related enzymes (lysozyme, peroxidase, proteases and antiproteases), haemolytic activity of complement and the bactericidal activity in skin mucus and plasma of Senegalese sole in a time-course basis following bath challenge with *T. maritimum*. In general, our results demonstrated a delay in the skin mucus immune response compared to that found in plasma. A significant increase in skin mucus lysozyme, complement, proteases and antiproteases activities was observed at the end of the experiment (14 days post challenge). The higher activity of these enzymes was positively related with the skin mucus bactericidal capacity, suggesting that these enzymes play an important role in the defence against Gram-negative bacteria. Similarly, lysozyme activity in plasma increased from the third day after challenge until the end of the trial, in line with the augmentation of both protease and antiprotease activities at the same time. Finally, the haematological profile revealed a significant increase of peripheral lymphocytes in challenged fish after 14 days following infection. Although the route of entry and the survival strategy of *T. maritimum* is still not fully elucidated, results from the present study suggest a crucial role of the skin mucus as defence barrier. Nevertheless, further investigations would be required in order to better understand the interactions of this particular pathogen with the immune system.

This work was supported by Project PEst-C/MAR/LA0015/2013 NSRF, ERDF, COMPETE and POPH Programmes and national funds through FCT- Foundation for Science and Technology. F.G., M.M., R.A. and B.C. benefited from grants by *Fundação para a Ciência e Tecnologia*, Portugal (SFRH/BPD/104497/2014, SFRH/BD/108243/2015, SFRH/BD/89457/2012 and SFRH/BPD/77210/2011, respectively). M.Mabrok supported by Erasmus Mundus Programme grant ALFI/201503. Financial support by grant 19883/GERM/15 (*Fundación Séneca de la Región de Murcia, Grupo de Excelencia*) is gratefully acknowledged.

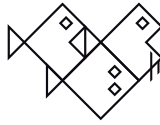


DETERMINATION OF HAEMATOLOGICAL AND BLOOD BIOCHEMICAL PARAMETERS IN THE SNAPPER *Lutjanus peru* (NICHOLS AND MURPHY, 1922) IN THE NORTH PACIFIC MEXICO: COMPARISON BY SIZE, SEX AND SEASONALITY

Liera Sandoval M.A., A. Santamaría Miranda & M. García Marciano

Centro Interdisciplinario de Investigación para el Desarrollo Integral Regional Unidad Sinaloa (CIIDIR-SIN), Blvd. Juan de Dios Batiz Paredes no. 250, Colonia San Joachin, Guasave, Sinaloa 81101, México (Marco.a.l.s_@hotmail.com).

Lutjanus peru is the main target to which the fishing effort is directed. *L. peru* has high demand in the market and therefore reports to the higher income fishermen. however, in the Mexican Pacific, this species is overexploited and the fisheries do not have chances of development. Because of this, in recent years there have been several studies to bring this species to aquaculture and mariculture. Few is known about the blood and biochemical parameters of these fish in the natural environment, which are of importance as data reference. Sampling in spring, summer, autumn and winter we have captured 293 fish in the north and center of the state of Sinaloa aiming to know the state of health of these organisms in their natural environment. Were removed 1.5 ml of blood of the fish with a syringe with heparin (Sintex S.A. de C.V.) and total protein concentration, triglycerides, cholesterol, lactate and glucose was determined using comercials kits (RANDOX®). Hematological studies to count red cells (RBC), white cells (WBC) and thrombocytes was determined using the Natt & Herrick solution. Hematocrit was determined with hematocrit tubes. The values obtained are consistent with reports of other healthy marine fish.



RNA-seq TRANSCRIPTOMIC ANALYSIS OF THE EUROPEAN SEA BASS TESTIS UNDER NODAVIRUS INFECTION

Valero Y.¹, T. Alioto^{2,3}, J. Gómez^{2,3}, S. Heath^{2,3}, A. Esteve^{2,3}, J. Meseguer⁴, M.A. Esteban⁴, A. Cuesta⁴ & E. Chaves-Pozo¹

1 Centro Oceanográfico de Murcia, Instituto Español de Oceanografía (IEO), Carretera de la Azohía s/n. 30860, Puerto de Mazarrón, Murcia, Spain.

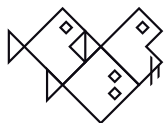
2 CNAG-CRG, Centre for Genomic Regulation (CRG), Barcelona Institute of Science and Technology (BIST), Baldri i Reixac 4, 08028 Barcelona, Spain

3 Universitat Pompeu Fabra (UPF), Barcelona, Spain.

4 Fish Innate Immune System Group, Department of Cell Biology and Histology, Faculty of Biology, Regional Campus of International Excellence "Campus Mare Nostrum", University of Murcia, 30100 Murcia, Spain (aesteban@um.es).

Viruses are threatening pathogens for fish aquaculture. Some of them are transmitted through gonad fluids or gametes as occurs with nervous necrosis virus (NNV). In order to be transmitted through the gonad, the virus should colonize and replicate inside some cell types of this tissue and avoid the subsequent immune response. However, how NNV reach the gonad and evades the immune response is unknown. We have demonstrated for the first time the presence and localization of NNV into the testis after an experimental infection in the European sea bass (*Dicentrarchus labrax*), a very susceptible host fish species, and the alteration of antimicrobial and interferon responses in this tissue. In this work, we investigated the transcriptome of European sea bass testis and the alterations produced by NNV infection by means of RNA-seq technology and bioinformatic analysis. We have identified 16,376 transcripts in the testis samples but only 46 were significantly altered being 11 down-regulated and 35 up-regulated after NNV infection. Deeper analysis is in process to ascertain the molecular and cellular pathways and genes involved in the European sea bass response in the testis to nodavirus infection.

Acknowledgements. Financial support by grants AGL2011-30381-C03-01 and AGL2013-43588-P (MINECO and FEDER) and 19883/GERM/15 (*Fundación Séneca de la Región de Murcia*, Spain) is gratefully acknowledged.

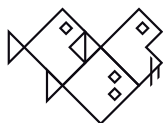
**MODULATION OF PROSTAGLANDIN RECEPTORS in the testis of
GILTHEAD SEABREAM (*Sparus aurata* L.)****Rodenas M.C.¹, M. Sánchez-Hernández², N.E. Gómez-González¹, M. Arizcun², J. Meseguer¹, V. Mulero² & A. García-Ayala¹**

¹ Department of Cell Biology and Histology, Faculty of Biology, Regional Campus of International Excellence "Campus Mare Nostrum", University of Murcia, 30100 Murcia, Spain (mariacarmen.rodenas1@um.es).

² Centro Oceanográfico de Murcia, Instituto Español de Oceanografía (IEO), Carretera de la Azohía s/n, Puerto de Mazarrón, 30860 Murcia, Spain.

The gilthead seabream, *Sparus aurata* L., is a seasonally breeding, marine, protandrous hermaphrodite teleost with a great commercial value for the Mediterranean area. Specimens are males at least during the two first reproductive cycles (RCs), in which the gonad has a functional testicular area and a non-functional ovarian area. The first male RC is divided into four stages: spermatogenesis (SG), spawning (S), post-spawning (PS) and resting (R). During the following RCs, resting is substituted by a testicular involution (TI) stage. Prostaglandins are oxygenated lipid molecules produced by various cell types. They regulate a wide variety of physiological responses and pathological processes including various aspects of both innate and adaptive immunity. Prostaglandins E2 (PGE2) is the most abundantly produced prostanoid in the body. It has an important role in a number of inflammatory disorders. Focus on the gonad as an immunologically important site, we examined the modulation of different receptors for this prostaglandin by qPCR in the testis of gilthead seabream during two RCs in order to study its involvement in the regulation of the immune response of the gonad.

Financial support: Ministerio de Economía y Competitividad and FEDER (AGL2014-53167-C3-1-R; AGL2014-53167-C3-2-R) and the "Fundación Séneca" (19883/GERM/15).



FINASTERIDE AFFECTS THE TESTICULAR PHYSIOLOGY OF GILTHEAD SEABREAM MALES

García-García M.¹, M. Sánchez-Hernández², A. García-Alcazar², M.P. García-Hernández³, A. García-Ayala³ & E. Chaves-Pozo²

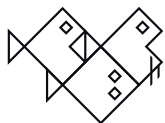
1 Sección de Microscopía, Servicio de Apoyo a la Investigación. University of Murcia. 30100 Murcia. Spain.

2 Centro Oceanográfico de Murcia, Instituto Español de Oceanografía. Puerto de Mazarrón, 30860 Murcia. Spain.

3 Department of Cell Biology and Histology, University of Murcia. 30100 Murcia. Spain (piligar@um.es).

Spermatogenesis, which is really a continuum comprising spermatogonial proliferation, meiosis, and spermiogenesis, is regulated by pituitary gonadotropins and sex steroids. 5 α -dihydrotestosterone (DHT) is an important androgen in the male physiology of some fish species, although its function has not been fully established. 5 α -reductase, the enzyme responsible for the conversion of testosterone (T) into DHT, is specifically inhibited by finasteride (FIN). Gilthead seabream is a protandrous marine perciform extensively produced in the southwest of the Mediterranean Sea. Males, with a gonad consisting of a functional testicular area and an immature ovarian area, were implanted with 1mg T/kg body weight (bw) in coconut oil as vehicle. After seven days, the specimens were injected with 1mg FIN/kg bw in PBS as vehicle. A control group (C) was injected with both vehicles. This provided four experimental groups: C, FIN, T, and T+FIN treated fish. The recorded DHT serum levels confirmed the effective inhibition of 5 α -reductase as they were lower in all fish treated with FIN (FIN and T+FIN groups). Moreover, FIN promoted an initial increase in T, 11-ketotestosterone (11KT) and 17 β -estradiol (E2) serum levels, while T+FIN caused an initial down-regulation of T and E2 serum levels. Interestingly, the proliferative activity observed in both gonadal areas was higher in FIN and T+FIN treated fish than in the C and T groups. However, the gonadosomatic index only increased in T treated fish at the end of the experiment. Despite these observations, no treatment threatened the male status of the fish, since the expression of *dmrt1* gene (related to testis functionality) remained unchanged. Taken together, these data shed light on the role of DHT in a hermaphrodite teleost fish species, the gilthead seabream.

Supported by the "Ministerio de Economía y Competitividad" and FEDER (AGL2014-53167-C3-1-R; AGL2014-53167-C3-1-R, RYC-2009-05451 to ECP) and the "Fundación Séneca" (19883/GERM/15).

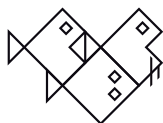
**ONTOGENY OF THE OSTEOCRANIUM IN THE COMMON BREAM,
Abramis brama (TELEOST: CYPRINIDAE)****Sahraeian M.R.¹, S. Eagderi¹, G.R. Rafiee¹, A. Zibae², M.A. Esteban³ & J. Meseguer³**

1 Department of Fisheries, Faculty of Natural Resources, University of Tehran, 31585-4314 Karaj, Iran (mrsahraeian@ut.ac.ir-8050120).

2 Department of Plant Protection, Faculty of Agricultural Sciences, University of Guilan, Rasht.

3 Department of Cell Biology and Histology, Faculty of Biology, University of Murcia, 30100 Murcia, Spain.

The osteological development of the osteocranium in common bream, *Abramis brama* (Cyprinidae), was described from hatching up to juvenile stage for better understanding of its feeding regime during early development. For this purpose, the specimens were cleared and stained using the two-colour acid-free cartilage, and bone stain method. Then, the trends in ossification patterns of the osteocranium are examined. The results showed that at hatching, *A. brama* has no ossified structure. On the day 1, two otoliths viz. lapillus and sagitta were calcified in the otic capsule. On the 2 dph, a thin parasphenoid bone was observed, and the neurocranium was separated from the viscerocranium and the anterior part of the notochord was also formed. The fifth ceratobranchial and opercle bones were visible on 5 dph and at the same time, larvae started to mix feeding. On 6-7 dph, the dentary and maxillary were started to be ossifying and first part of the neurocranium, i.e. the exoccipital was appeared ossifying above the notochord. Differentiation and ossification of the mandibular arch was started on 9-10 dph. On 12-14 dph, in the branchial arch, the first branchiostegals, hyoid bar and permaxillary bones as well as osteological elements of the opercular series were ossified. Therefore, fish larvae were able to support the gill filaments by increasing the capacity of the urobranchial cavity. On day 18-20, Prootics, Orbitosphenoids and Pterosphenoids were developed. On 25 dph, The Frontals, Pterotics, Sphenotics, Parietals, Basisphenoid and Supraorbitals were observed at this time. On 35 dph, the elements of the neurocranium including, kinethmoid, Epioccipitals (Epiotic), Posttemporals and vomer approximately ossified. After 45 dph, others of the skull bones in common bream were ossified such as Hypobranchials, Pharyngobranchials and Preethmoids. The results revealed that the neurocranium tends to develop slowly than the viscerocranium and with some minor differences in the timing of ossification, similar to other members of Cyprinids. In addition, the sequence of formation in *A. brama* is a response to primary functional demands such as feeding and respiration.



OSTEOLOGICAL DEVELOPMENT OF THE VERTEBRAL COLUMN AND FINS' SKELETON IN COMMON BREAM, *Abramis brama* (TELEOST: CYPRINIDAE)

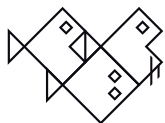
Sahraeian M.R.¹, S. Eagderi¹, G.R. Rafiee¹, A. Zibae², M.A. Esteban³ & J. Meseguer³

1 Department of Fisheries, Faculty of Natural Resources, University of Tehran, 31585-4314 Karaj, Iran. (mrsahraeian@ut.ac.ir-8050120)

2 Department of Plant Protection, Faculty of Agricultural Sciences, University of Guilan, Rasht.

3 Department of Cell Biology and Histology, Faculty of Biology, University of Murcia, 30100 Murcia, Spain.

The development and ossification of vertebral column and fins' skeleton were studied in common bream, *Abramis brama* (*Cyprinidae*) from hatching up to juvenile stage. For this purpose, the specimens were cleared and stained using the two-colour acid-free cartilage, and bone stain method. The results revealed that the pectoral fin girdle, and the anterior part of the notochord were the first elements of the axial skeleton which have been developed at 2 day post hatching. Two important events were occurred on the 5 day post hatch, including calcification of the 5-7 vertebral centra and formation of the cartilaginous caudal fin ray causing the flexion of the notochord. On the day 7, while the ossification of other centra started from the anterior to posterior direction. At this time, 15 vertebral centra were formed, and the pectoral girdle (Coracoid – Scapula) was developing. On the day 9, 20 vertebral centra were formed and caudal fin ray started to classification. The ossification of the hypurals (3 dorsal and 2 ventral one), urostyle and 2 haemal spine proceed in the caudal region on 12 dph. The development of the dorsal and anal fins began at 14 dph with formation of 9-10 cartilaginous dorsal and anal fin ray. Classifications of the dorsal and anal fins were started on 16 dph. On the day 18, two epurals were observed dorsal to the urostyle. The proximal petriophores of the dorsal and anal fins were developed during 20-25 dph. On the day 25, differentiation of the cleithrum was occurred and the coracoid and pectoral fin ray were fully classified. The pelvic fin skeleton was the last fin that started to develop on 25 dph. After day 45, most part of the vertebral column and fins' skeleton of common bream were ossified. These data provide a reliable baseline for further studies for comparisons with other described cypriniforms.



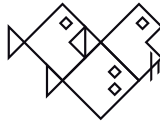
BEHAVIOUR OF THE MEDITERRANEAN BARBEL (*Barbus meridionalis*) EXPOSED TO INCREASING CONCENTRATIONS OF AMMONIA

Soler P.¹, P. Manning², B. Lorentre¹ & D. Vinyoles¹

¹ Departamento Biología Evolutiva, Ecología y Ciencias Ambientales. Universidad de Barcelona. Avda Diagonal 643, 08028 Barcelona. Spain (patrisoler89@gmail.com).

² Faculty of Life Sciences. University of Manchester. UK.

Historically Mediterranean rivers have always suffered anthropogenic pollution. A common pollutant in aquatic systems, which can be toxic to fish, is ammonia. Ammonia exposure causes behavioral changes and can even lead to death upon interacting with the central nervous system. The aim of this study was to analyze locomotion and feeding behavior (voracity and satiety) of the Mediterranean barbel (*Barbus meridionalis*) exposed to three concentrations of total ammonia (TAN), 1mg/L, 5mg/L and 8mg/L, over eight days. 72 specimens of *B. meridionalis* were used in total and two experiments were carried out. The first experiment (experiment 1) consisted of N=40 individuals which were taken from a stretch of river in an industrial area of the River Congost (Besòs basin), close to the wastewater treatment site known as EDAR Granollers. The second experiment (experiment 2) consisted of N=32 individuals which were taken from a pristine stream of water located in the Castelló stream (also part of the Besòs basin). The tests were performed with fish in individual aquaria which size rank were between 6-11cm across both tests. In each experiment, there was a control group (with aquaria of 0 mg/L ammonia) as well as the three treatments each with ten replicates in experiment 1 and eight replicates in experiment 2. Temperature and pH were for both experiments: experiment 1, pH=8.3 ± 0,2 and T^a=20.9°C ± 0,4; experiment 2, pH=8.4 ± 0,2 and T^a=21.6°C ± 0,6. The concentration of unionized ammonia (NH₃) was between 0.002-0.595 mg/L and 0.011-0.709 mg/L respectively. Analysis of preliminary results for this experiment indicates that the behavior of *B. meridionalis* was not significantly altered under the ammonia concentrations used in both experiments. Therefore, it would appear that this species is extremely tolerant to this particular anthropogenic pollutant.



HIGH AMMONIA TOLERANCE AND FACULTATIVE UREOTELY IN THE LUSITANIAN TOADFISH – WHAT IS THAT ALL ABOUT?

Jordão V., T. Modesto, A. Alves & P.M. Guerreiro

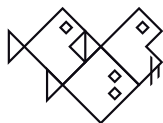
Comparative Endocrinology and Integrative Biology, Centro de Ciências do Mar, Universidade do Algarve, 8005-139 Faro, Portugal (pmgg@ualg.pt).

Most teleosts excrete nitrogen waste by diffusing highly toxic ammonia to the water. Members of the Batrachoididae family display high tolerance to ammonia and excrete large amounts of urea via metabolically expensive pathways but the ecological/evolutionary significance of such behavior is not completely understood. In this study we aimed to assess the tolerance to environmental ammonia and degree of ureotely in the Lusitanian toadfish (*Halobatrachus didactylus*).

Fish were exposed to increasing concentrations of environmental ammonia and survival rates were determined. The LC50 at 96hr was estimated at 3.28 mM. Plasma ammonia rose from 1.5 to 4mM in fish at 0 to 4mM ammonia for 120h, but was as high as 6 mM in fish at 12.5mM for 48h. Plasma urea rose steadily with increasing ammonia and plateaued at about 16 mM after 3mM. A similar profile was observed in cortisol levels. However, actual *in vitro* liver GSase enzymatic activity did not show any changes in relation to ammonia levels in incubation media and injection with cortisol had no effect over plasma urea or ammonia nor on GSase activity. Interestingly, liver expression of GSase and CPSase were elevated in low ammonia concentrations (0-2 mM) and significantly reduced above 3mM. A similar reduction occurred in gill UT gene expression.

High urea and ammonia production rates were measured hourly in individual tanks during 5 consecutive 24 hour periods. Large variability was observed among individuals/days although the frequency of pulses was elevated during the nocturnal period. The lack of a clear pattern of urea excretion over time suggests that ureotely is facultative in this species, but the reasons remain elusive.

The authors thank Dr John Barimo, Prof Patrick Walsh and Prof Chris Wood for the preliminary work leading to this study.



CHARACTERISTICS OF SPLEEN MACROPHAGE AGGREGATES IN *Anguilla anguilla* FROM MAR MENOR LAGOON (WESTERN MEDITERRANEAN) RELATED TO METALLOID AND METALS EXPOSURE

Romero D.^{1,2}, J. Peñalver^{1,3}, E. Barcala^{1,4}, E. María-Dolores^{1,3}, C. Boza^{1,4} & P. Muñoz^{1,5}

1 Campus de Excelencia Internacional Regional "Campus Mare Nostrum".

2 Área de Toxicología. Universidad de Murcia. E-30100, Murcia, Spain.

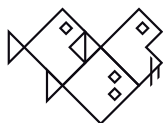
3 Servicio de Pesca y Acuicultura. Consejería de Agua, Agricultura y Medio Ambiente. Campos, 4, E-30201, Cartagena, Spain.

4 Instituto Español de Oceanografía, Centro Oceanográfico de Murcia, Varadero, 1, E-30740 San Pedro del Pinatar, Murcia, Spain.

5 Dpto. Sanidad Animal. Universidad de Murcia. E-30100, Murcia. Spain (pilarmun@um.es).

Melano-macrophage aggregates (MMAs) located in different organs of non-mammalian vertebrates, play a role in the destruction, detoxification or recycling of endogenous and exogenous materials and they are considered a biomarker for contaminant toxicity. To elucidate the relationship between MMAs and metals exposure, 40 European eels (*Anguilla anguilla*), 12 yellow eels and 28 silver ones, were sampled from Mar Menor lagoon. Metals (Fe, Zn, Pb, Cu, Ni, Cd and Mn) and metalloid (As) concentrations in liver and muscle were determined by Inductively Coupled Plasma Optical Emission Spectrophotometer. Spleen samples were fixed with 10% buffered formalin, processed for routine paraffin embedding, sectioned at 5µm and stained with hematoxylin and eosin. Each of 5 fields of view at 100x magnification were photographed. The mean percentage coverage of MMAs, in relation to the field of view, the size and density of MMAs were calculated by using Leica Qwin software. Additionally, the hepatosomatic index (HI) and corporal condition (K) were obtained. Statistically differences were found in Fe, Zn, Cu, Pb concentration in muscle between the two group of eels, as well as between Zn, Ni, Cd, As and Mn concentrations in liver. Negative correlations were observed between Cd concentrations in kidney and HI and K index, and between Ni concentration in kidney and IH. No correlation between the MMA measured parameters and inorganic element concentrations in liver were observed while negative correlations were observed between MMA density and Zn, Cu and Mn concentration in muscle, and between areas occupied by MMAs and Cu concentration in muscle. The implications of metal levels, tissue distribution and the relationship with measured indexes are discussed.

This work was supported by "Programa de Apoyo a la Investigación de la Fundación Séneca-Agencia de Ciencia y Tecnología de la Región de Murcia" (grant 19370/PI/14).



IS POSSIBLE THE INFECTION OF CULTURED TURBOT (*Psetta maxima*) BY CRYPTOSPORIDIUM PARVUM? PREVIOUS EXPERIMENTAL RESULTS

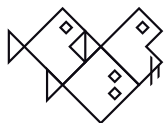
Couso-Pérez S.¹, J.M. García-Estévez², J.M. Leiro Vidal³, E. Ares-Mazás¹ & H. Gómez-Couso¹

1 Laboratory of Parasitology, Department of Microbiology and Parasitology, Faculty of Pharmacy, University of Santiago de Compostela, Campus Vida, 15782 Santiago de Compostela, A Coruña, Spain (hipolito.gomez@usc.es).

2 Laboratory of Parasitology, Experimental Building of Experimental Sciences, Faculty of Biology, Campus Lagoas-Marco-sende, University of Vigo, 36310 Vigo, Spain.

3 Laboratory of Parasitology, Institute of Food Research and Analyses, University of Santiago de Compostela, Campus Vida, 15782 Santiago de Compostela, A Coruña, Spain.

Turbot (*Psetta maxima*) is one of the main marine fishes farmed in Europe and its intensive cultivation can be endangered by several pathogens, including protozoan parasites of the genus *Cryptosporidium*. Endogenous stages of this parasite were found in the gastrointestinal tract of young cultured turbot from different farms. *Cryptosporidium scophthalmi* was described in this host but, currently, it is not considered a valid species until genetic sequences are provided. The possibility that *Cryptosporidium* infective forms (oocysts) from the water supply get at the on-growing tanks cannot be disregarded. *Cryptosporidium parvum* is a waterborne parasite responsible of animal and human infections which oocysts have been detected in surface waters (sea, river, lake...). This study raises the possibility that cultured turbot can be infected by *C. parvum*. Twenty-five specimens of turbot (20-40 g) were maintained during two hours under stress conditions in a tank contaminated with 25×10⁶ purified *C. parvum* oocysts. Every two days between 3 and 28 days postexposure, two fishes were removed and their gastrointestinal tracts were processed. Then, pyloric caeca and intestine of each turbot were dissected, homogenized, concentrated and the sediments were examined under epifluorescence microscopy using a direct immunofluorescence method with monoclonal antibodies against *Cryptosporidium*. The presence of *C. parvum* oocysts was detected in the intestine and the pyloric caeca from samples collected days 7 and 10 postexposure, respectively. These results suggest that *C. parvum* can be infective for young cultured turbot although further histological studies are needed to confirm the infection. This study was funded by the Department of Culture, Education and University of the Autonomous Government of Galicia (Grant no. GPC2014-069).



EVALUATION OF TOXA AND LYSATE *Vibrio parahaemolyticus* ON HUMORAL IMMUNE RESPONSE IN SKIN MUCUS AND GENE EXPRESSION IN GILTHEAD SEABREAM

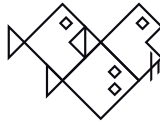
Guluarte C.¹, C. Angulo¹, M. Reyes-Becerril¹ & M.A. Esteban²

¹Centro de Investigaciones Biológicas del Noroeste (CIBNOR), Instituto Politecnico Nacional 195, Col. Playa Palo de Santa Rita, 23090 La Paz, B.C.S., Mexico (cguluarte@pg.cibnor.mx).

²Fish Innate Immune System Group. Department of Cell Biology and Histology. Faculty of Biology, Campus Regional de Excelencia Internacional "Campus Mare Nostrum", University of Murcia, 30100 Murcia, Spain.

The immunogenicity of ToxA, a novel antigen isolated from *V. parahaemolyticus* and lysate-*V. Parahaemolyticus* will be evaluated on humoral innate immune response and gene expression in gilthead seabream *Sparusaurata*. Three groups of gilthead seabream will be intraperitoneal (i.p) injected with PBS (control group), ToxA of *V. parahaemolyticus* (ToxA-Vp group) and lysate *V. parahaemolyticus* (lysate-Vp group). Finally, fish will be infected with live *V. parahaemolyticus*. On 1, 7, 8 and 14 days post-immunostimulation and 7 days post-infection, humoral immune parameters in skin mucus and gene expression will be analyzed in different tissues in order to know the immunostimulant effect of ToxA or lysate *V. parahaemolyticus* in the Mediterranean fish gilthead seabream *Sparusaurata*.

We thank A. Salvá for excellent technical assistance. This work was supported by the Spanish Ministry of Economy and Competitiveness (Grant no. AGL2014-51839-C5-1-R) co-funded with Fondos Europeos de Desarrollo Regional/European Regional Development Funds) and *Fundación Séneca de la Región de Murcia* (Grupo de Excelencia 19883/GERM/15).



LONG TERM PATTERNS IN THE TROPHIC NICHE OF THE INVASIVE PUMPKINSEED SUNFISH *Lepomis gibbosus*

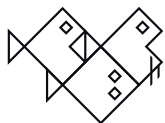
Gkenas C¹, M.F. Magalhães², J. Cucherousset³, I. Domingos¹ & F. Ribeiro¹

1 MARE, Centro de Ciências do Mar e do Ambiente, Faculdade de Ciências, Universidade de Lisboa, Campo Grande, 1749-016 Lisboa, Portugal (chrisgenas@gmail.com).

2 CE3C, Centro de Ecologia, Evolução e Alterações Ambientais, Faculdade de Ciências, Universidade de Lisboa, 1749-106 Lisboa, Portugal.

3 CNRS, Université Paul Sabatier, ENFA, UMR 5174 EDB (Laboratoire Évolution et Diversité Biologique), 118 Route de Narbonne, 31062, Toulouse, France.

Quantifying the trophic dynamics of invasive species in novel habitats is important for predicting the success of potential invaders and evaluating their ecological effects. The North American pumpkinseed sunfish *Lepomis gibbosus* is a successful invader in Europe, where it has caused negative ecological effects primarily through trophic interactions. Here, we quantified variations in the late summer trophic niche of pumpkinseed during establishment and integration in the mainstem of the Guadiana river, using stomach content analyses over a period of 40 years. Pumpkinseed showed a shift from trophic specialization during establishment to trophic generalism during integration. These results were concomitant with an increase in diet breadth that was accompanied by higher individual diet specialization particularly in large individuals. Irrespective of their drivers, these changes in trophic niche suggest that the potential ecological effects of pumpkinseed on recipient ecosystems can vary temporally along the invasion process.



OCCURRENCE OF NEW MARINE FISH SPECIES BY A TROPICALIZATION PROCESS: THE CASE OF GALICIAN WATERS

Bañón R.¹, D. Barros-García^{2,3}, J.C. Arronte⁴ & A. De Carlos⁵

1 Programa de Doctorado en Biodiversidad y Ecosistemas, Facultad de Ciencias del Mar. Universidad de Vigo, C/ Fonte das Abelleiras s/n, 36310 Vigo, Spain

2 Centro de Apoyo Científico y Tecnológico a la Investigación (CACTI). Universidad de Vigo, Calle Fonte das Abelleiras s/n, 36310 Vigo, Spain (davbarros@uvigo.es).

3 Programa de Doctorado en Metodología y Aplicaciones en Ciencias de la Vida, Facultad de Biología. Universidad de Vigo, C/Fonte das Abelleiras s/n, 36310 Vigo, Spain.

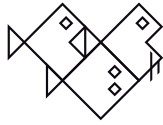
4 Departamento de Biología de Organismos y Sistemas, Universidad de Oviedo, C/Catedrático Uría s/n 33003 Oviedo, Spain.

5 Departamento de Bioquímica, Genética e Inmunología, Facultad de Biología, Universidad de Vigo, C/ Fonte das Abelleiras s/n, 36310 Vigo, Spain.

The marine fish fauna of Galician waters is mostly composed by Lusitanian species, with minor representation of Boreal and African groups. A bigger sampling and monitoring effort led to the discovery of unreported fish species in this area.

In the past 20 years, several southern marine fishes of tropical affinities have been registered in Galicia (NW Spain) for the first time. As a result, a total of 21 fish species belonging to 11 different families have been identified, implying a new northern limit distribution for seven of these species in the NE Atlantic. Carangidae, with 8 species is the best represented family, followed by Sparidae and Kyphosidae with 2 species each. Oceanographic changes, including water warming, linked to climate change are the most plausible causes of these unexpected records.

While it is well known that Boreal species have existed in Galician waters for a long time, and that their number has remained stable, the discovery of representatives of the African group is very recent, mainly due to the arrival of new species over the last decades. This would also support the idea that the recent discovery of tropical species of African origin is more a consequence of natural changes than a result of an increased sampling effort.



THERMAL ENDURANCE MECHANISMS IN *Australoheros facetus*, AN INVASIVE FRESHWATER FISH IN PORTUGAL

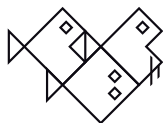
Baduy F.^{1,2}, J. Soares², M. Silva², A. Canário^{1,2}, J. Saraiva¹ & P.M. Guerreiro^{1,2}

1 Comparative Endocrinology and Integrative Biology, Algarve Centre for Marine Sciences at

2 University of Algarve, 8005-139 Faro, Portugal (flabaduy@gmail.com).

Invasive fish may expand their geographical distribution through thermal tolerance mechanisms that allow them to endure severe temperature variations. In this work we provide critical thermal maximum (CTMax) and minimum (CTMin) for *Australoheros facetus*, a neotropical cichlid found in Southern Portugal, and assess physiological mechanisms of thermal regulation using metabolic substrates and cortisol as stress indicators. Control fish were maintained at 7°C, 12°C, 18°C and 24°C to simulate seasonal averages, and additional groups were heated or cooled from 12°C and 24°C at 3°C per hour until loss of equilibrium was observed in at least 50% of fish (N=20 in each duplicate). Fish were anesthetized (n=10-12 per group), blood samples taken and then euthanized by cervical section. CTmax and CTmin values were 36.5°C and 4.5°C respectively for the 12°C acclimated group, and 39.1°C and 5.8°C for the 24°C acclimated group. No significant differences in plasma glucose and lactate were observed between control groups at different temperatures. Glucose increased in both acclimation regimes but values in heated groups were twice those in cooled fish. As for lactate, a significant drop was observed in the cooled groups while the heated fish showed values well above the respective controls. Surprisingly cortisol had the opposite pattern with slightly lower plasma values in heated vs control fish and twofold higher in cooled groups. Biochemical reactions are greatly affected by temperature and increases in glucose and lactate could reflect a change in energy utilization, expected to occur at higher temperatures. Higher cortisol in the abruptly cooled group (but not in the cold acclimated fish) could indicate that this situation can be more stressful than rapid warming. The differences in CTmax and CTmin in relation to acclimation temperature could reflect a temperature tolerance safety margin, since seasonal fluctuations in temperature could afford sufficient time for organisms to acclimatize.

Acknowledgments: FB is recipient of a doctoral fellowship from the Brazilian CNPq Program Science without Borders (245971/20122); JLS is recipient of an FCT grant SFRH/BPD/67008/2009. This study is partially funded by FCT grant CCMAR/Multi/04326/2013.



CONSERVATION OF AQUATIC HABITATS AND SPECIES IN THE HIGH MOUNTAINS OF THE PYRENEES

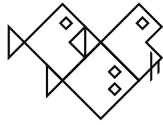
Ventura M.¹, T. Buchaca¹, A. Miró¹, Q. Pou-Rovira², A. Pérez-Haase³, E. Carrillo³ & J.M. Ninot³

1 Centre d'Estudis Avançats de Blanes (CEAB-CSIC). Accés a la Cala Sant Francesc, 14. 17300 Blanes (ventura@ceab.csic.es).

2 Sorelló, estudis al medi aquàtic. Parc Científic de la UdG, 17300, Girona.

3 Departament de Biologia Vegetal. Facultat de Biologia, Universitat de Barcelona. Av Diagonal 643, 08028 Barcelona.

Aquatic continental systems are scarce environments with a very specific and sensitive fauna and flora where threatened species are abundant. In the Pyrenees, these wetland ecosystems are generally considered very natural landscapes. However, despite their remote location, anthropogenic perturbations have not been absent. The introduction and spread of alien species, especially various species of fish, is considered one of the main threats in high mountain lakes and streams originally fishless. Other threats include changes caused by the hydroelectric water level fluctuations and the excessive presence of both livestock and people around springs or peat bogs crossed by tourist path. LIMNOPIRINEUS (LIFE13 NAT/ES/001210) is a project aimed at improving the conservation status of species and aquatic habitats of European interest in the high mountains of the Pyrenees. Among the habitats of interest, there are certain types of peat bogs, tufa-forming springs, rivers and lakes. The target species include some amphibians, some mammals that feed on the aquatic environment including two species of bats. The project includes also species with populations that are now in danger of extinction decimated by various anthropic actions. As part of this project, conservation actions will be taken in the National Park Aigüestortes i Estany de Sant Maurici, the Natural Park of Alt Pirineu, and the Estanho of Vilac located in the Val d'Aran. Conservation actions to be undertaken includes developing conservation plans and assessment protocols for the management of species and natural habitats, improving the quality of peat bogs under heavy pressure from tourism by building elevated platforms, and restoring the natural state of some lakes through the elimination and control of alien fish species allowing the recovery of native species. The project aims also to disseminate the heritage value of natural areas and the impact of invasive species to students and general public through awareness campaigns.



FIRST SIGNS OF RECOVERY FOLLOWING REMOVAL OF INTRODUCED FISH IN A HIGH MOUNTAIN LAKE OF THE PYRENEES

Ventura M.¹, Q. Pou-Rovira², T. Buchaca¹, I. Sabás¹, E. Cruset², V. Osorio¹, M.A. Puig¹ & A. Miró¹

1 Centre d'Estudis Avançats de Blanes (CEAB-CSIC). Accés a la Cala Sant Francesc, 14. 17300 Blanes (ventura@ceab.csic.es).

2 Sorelló, estudis al medi aquàtic. Parc Científic de la UdG, 17300, Girona.

3 Departament de Biologia Vegetal. Facultat de Biologia, Universitat de Barcelona. Av Diagonal 643, 08028 Barcelona.

High mountain lakes are naturally fishless, but there have been numerous trout and minnow introductions to such ecosystems since the 19th century, mainly associated with angling activities. These introductions cause ecosystem alterations, since they occupy the highest trophic position. In July 2013 we started a pioneer pilot study of minnow, *Phoxinus* sp., eradication from the lake Closell (Pallars Sobirà), an hydrographically isolated lake situated in the southern slope of the Pyrenees, at 2072 m of altitude, with 0.75 ha of surface area and 3 meters of maximum depth. The objective was to test different fishing tools and study the speed of the lake recovery. Minnows were caught during the ice-free season using fyke nets and electrofishing at the littoral zone and gill nets in the pelagic zone. At the same time, a monitoring program was started to evaluate the lake's recovery and changes in the ecological status. After three years of work we estimate that we have reduced a 99% of *Phoxinus* sp. initial population. Limnological monitoring showed clear signs of lake recovery. At the end of the first summer we detected the presence of palmate newt, *Lissotriton helveticus*, for the first time in the lake, and confirmed its reproduction and survival of larvae. We also found a clear recovery of macroinvertebrates such as dragonflies, beetles and caddisflies at the second year. The last year we also found a substantial increase of the crustacean *Daphnia longispina* that was also accompanied with a recovery of the lake's original transparency. Results showed that high mountain lake restoration is fast when recently introduced fish are removed. Lake Closell has recovered some sensitive fauna even before complete fish eradication. We are now continuing exotic fish removal in Lake Closell and in other seven Pyrenean lakes through the LIFE+ project LIMNOPIRINEUS (2014-2019).



AN UPDATE OF THE INVASION OF MUMMICHOG (*Fundulus heteroclitus*) IN EBRO DELTA AND ITS IMPLICATIONS FOR THE CONSERVATION OF FARTET (*Aphanius iberus*)

Franch N.¹, Q. Pou-Rovira², J.M. Queral¹, V. López¹, E. Cruset² & M. Clavero³

1 Parc Natural del Delta de l'Ebre. Av. Catalunya, 46 43580 Deltebre, Tarragona, Spain (nfranchv@gencat.cat).

2 Sorelló, estudis al medi aquàtic, Pl.St Pere, 15 baixos, 17007 Girona, Spain.

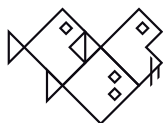
3 Departamento de Biología de la Conservación, Estación Biológica de Doñana—CSIC, Avda, Américo Vespucio s/n, 41092 Sevilla, Spain.

The Mummichog (*Fundulus heteroclitus*) was detected in the Ebro Delta in 2005. In the Delta, exotic fish dominate most low salinity systems. In this context, Mummichog proliferation constitutes a new threat to the conservation of many native fish species that have refuge habitats in saline environments, especially the Fartet (*Aphanius iberus*).

Since 2006 Mummichog has been monitored in the Delta, based on fyke net surveys. The aims of this monitoring are to determine the success of the Mummichog invasion in the Delta, describe its expansion process and habitat use, and especially the interaction with native species.

Our results confirm the full establishment of Mummichog in the Delta. Since its first detection, Mummichog has been found to expand along a coastal strip of the Alfacs Bay and the surroundings of large nearby lagoons. In 2015 was also detected in Cape Banyà, at the opposite side of the Alfacs Bay. It occupies a wide variety of habitats, including lagoons, marshes, drainage channels, ditches, connections between lagoons and the bay, and old fish farms. However, high Mummichog densities during these early invasion stages have only been found in some marsh areas, small ponds and degraded saline drainage channels.

The most serious immediate conservation issue of Mummichog expansion is the occupation of marshes where the Fartet had been traditionally abundant. When the two species coexist, the Fartet tend to decline, and even disappear. If current trends are maintained, Mummichog will probably occupy all favorable habitats in the Delta. It is thus necessary to adopt active conservation strategies, for which our results could be useful. Large lagoons and some well-preserved marshes are the only saline environments where the Mummichog has not fully established yet. These habitats offer thus an opportunity to promote the maintenance of important Fartet stocks.



NEW CITATIONS AND REVIEW OF THE CURRENT TREND OF ALIEN FISH IN THE WATERSHEDS OF NORTHEASTERN CATALONIA

Pou-Rovira Q.^{1,2}, E. Cruset¹, X. Llopart¹, C. Feo-Quer², M. Campos², G. Dalmau², R. Casadevall², A. Juscafresa², I. Camós², T. Puigvert³, E. Bassols⁴ & M. A. Fuentes

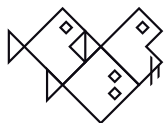
1 Sorelló, estudis al medi aquàtic. Parc Científic de la UdG, 17003, Girona (quim.pou@sorello.net).

2 Consorci de l'Estany; 3 Consorci del Ter; 4 Parc Natural de la Zona Volcànica de la Garrotxa. Generalitat de Catalunya.

New citations of exotic fish species for the basins of the rivers Muga, Fluvià, Ter, Tordera, and other watersheds of Girona are given, all them accumulated over the past six years. These citations have been obtained under several samplings of aquatic fauna and specific observations, carried out in the context of various research or conservation projects, including the ongoing LIFE Potamo Fauna (LIFE12 NAT/ES/001091).

Moreover, based on new data and existing information in the available literature, as well in certain angling forums, we analyze the current situation (distribution and trends) of exotic fish species recorded along the last three decades in the area (37): *Oncorhynchus mykiss*, *Esox lucius*, *Blicca bjoerkna*, *Abramis brema*, *Alburnus alburnus*, *Rutilus rutilus*, *Scardinius erythrophthalmus*, *Pseudorasbora parva*, *Parachondrostoma mieggi*, *Luciobarbus graellsii*, *Carassius auratus*, *C. carassius*, *Cyprinus carpio*, *Tinca tinca*, *Ctenopharyngodon idella*, *Gobio occitaniae*, *G. lozanoi*, *Phoxinus bigerri*, *P. phoxinus*, *P. septimaniae*, *Squalius cephalus*, *Aspius aspius*, *Cobitis bilineata*, *C. paludica*, *Misgurnus anguillicaudatus*, *Barbatula barbatula*, *B. quignardi*, *Ameiurus melas*, *Ictalurus punctatus*, *Silurus glanis*, *Poecilia reticulata*, *Gambusia holbrooki*, *Hypostomus plecostomus*, *Lepomis gibbosus*, *Micropterus salmoides*, *Perca fluviatilis* y *Sander lucioperca*. Of these, at least 3 species records are not fully confirmed. On the other hand, there are still doubts about the validity of some of the citations from species of the genera *Barbatula*, *Gobio* and *Phoxinus*, which could significantly change the relationship of species.

Seven of these alien species are of recent appearance (<10 years) in the area. In the case of *A. aspius*, this would be the first citation in the Iberian Peninsula. 13 species are clearly expanding, while only 3 are in apparent regression; rest of the species maintain a stable situation, or no data are available to determine their status.



SIX YEARS OF POPULATION CONTROL OF EXOTIC FISH IN LAKE BANYOLES IN THE CONTEXT OF TWO LIFE PROJECTS

Pou-Rovira Q., M. Campos, C. Feo-Quer, I. Camós, R. Casadevall, A. Juscafresa & G. Dalmau

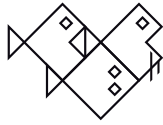
1 Consorci de l'Estany. Plaça dels Estudis, 2. 17820, Banyoles, Girona (qpou@consorcidelestany.org)

Currently, invasive alien species constitute the main challenge for the management of Lake Banyoles, especially fish such as Largemouth bass (*Micropterus salmoides*), Pumpkinseed (*Lepomis gibbosus*), Perch (*Perca fluviatilis*) and Carp (*Cyprinus carpio*). Their proliferation has led to the extinction or rarefaction of native fish (*Gasterosteus aculeatus*, *Barbus meridionalis*, *Squalius laietanus* and *Salaria fluviatilis*).

Between 2010 and 2014, LIFE Projecte Estany (LIFE08 NAT/E/000078) had as main objective to design and implement a global action to reverse the decline of species and habitats of Community interest, through control of invasive species and population, among other actions. Currently, under the LIFE Potamo Fauna (LIFE 12 NAT/ES/001091), has continued part of this strategy. The results obtained with the control of exotic fish fauna are presented.

Control of exotic fish populations was based on population culling, through intensive fishing combining various capture techniques: electric fishing, nets, large traps and longlines. Near 160.000 fish of alien species were captured. For Largemouth bass, till the fourth year, was achieved a reduction of more than 90% of the population fraction with size above 40cm; during the last two years, due to a diminution in the intensity of capture, there has been a partial recovery of the population of this species. In the case of Carp, initially, a greater than 80% reduction of the total starting population has been achieved; the two last years, its population has recovered slightly. However, for the Pumpkinseed and Perch there are not significant results.

Another challenge for these projects is focused on optimizing techniques and procedures, with a reasonable cost, to maintain sufficient pressure on populations of exotic fish that will ensure conservation of native species.



GROWTH AND DEMOGRAPHY OF BROWN TROUT (*Salmo trutta*) IN HIGH MOUNTAIN LAKES OF THE PYRENEES: INITIAL RESULTS OF THE PROJECT LIFE LIMNOPIRINEUS

Pou-Rovira Q.¹, E. Cruset¹, I. Jurado¹, M. Márquez¹, L. Busquets¹, O. Jorba¹, S. Sopena¹, A. Porcar¹, I. Sabás², A. Miró², T. Buchaca² & M. Ventura²

1 Sorelló, estudis al medi aquàtic. Parc Científic de la UdG, 17003, Girona (quim.pou@sorello.net).

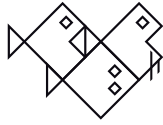
2 Centre d'Estudis Avançats de Blanes (CEAB-CSIC).

Nowadays, more than half of Pyrenean high mountain lakes are occupied by fish, as a result of a historical process of introductions dating back to centuries ago, and that has been accelerated during the last 60 years. Brown trout (*Salmo trutta*) was the first introduced fish species in these lakes, initially from indigenous populations located in the nearest Pyrenean rivers, and more recently using trout from local hatcheries originary from central Europe. The specific impacts of the introduction of fish include, among others, the transformation of the ecosystem structure and trophic relationships, and the reduction and extirpation of native species.

The project LIFE LimnoPirineus (LIFE13 NAT/ES/001210), started in 2014 and includes among its main objectives the restoration of eight high mountain lakes with fish (trout or minnow) and the recovery of native species of European interest, either by eradication or intensive control of introduced fish, depending on the size of the lake.

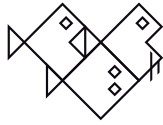
We have carried out surveys to assess fish populations in lakes in the area. In most of the lakes sampled so far, trout fishing has been forbidden for last 25 years. Sampling was based on the use of nets. Catches have been measured, weighed and sexed, on site. Individual age has been determined by otolith readings. Initial results on individual growth and demography are presented for five of the lakes surveyed and also for a small stream.

Brown trout has a high longevity in most lakes, although it is higher in the case of Mediterranean stocks (20 years), compared with populations of Central European origin (12 years). Mean growth is very low (<5mm/year) above 6 years old. Natural mortality is generally low.

**INDIVIDUAL GROWTH VARIABILITY IN WHITING
(*MERLANGIUS MERLANGUS*) FROM THE NORTHEAST ATLANTIC****Barrios A., V. Trenkel, M.J. Rochet**

Ifremer, Laboratoire d'Ecologie Halieutique, Rue de l'Île d'Yeu. B.P 21105, 44311 Nantes
Cedex 3, France (Alexander.Barrios@partenaire-exterieur.ifremer.fr).

Growth is generally assumed to follow the von Bertalanffy model with growth parameters that are constant over time and the same for all fish, but the analysis of the individual variability is useful to understand the factors which determine the variations in growth at population level. This study examines individual growth variability in whiting (*Merlangius merlangus*), an important commercial species in the northeast Atlantic. We used a non-linear random effects model, which explicitly assumes that individual growth rate (K) and asymptotic length (L_{inf}) represent samples taken from a multidimensional population of growth parameters characteristic of a species or population. The method was applied to measures of length and age obtained by the technique of back calculation using otoliths from 18219 whiting sampled in the northeast Atlantic between 2007 and 2014. We used the modified Fry model to back-calculate the length at age for fish from different regions. The relation between fish length and otolith radius is allometric at individual level. We examined the correlation between individual growth rate and asymptotic length.

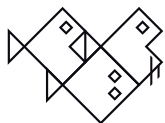


VARIATIONS IN FLATFISH EARLY LIFE STAGES ALONG A LATITUDINAL GRADIENT – DOES COUNTER-GRADIENT GROWTH COMPENSATION EXIST?

Martinho F., A. Vaz, & M.A. Pardal

Centre for Functional Ecology - CFE, Department of Life Sciences, University of Coimbra, Calçada Martim de Freitas, 3000-456 Coimbra, Portugal (fmdm@ci.uc.pt).

Recruitment variability in marine flatfish is mainly determined in the pelagic stage, with newly hatched larvae being transported to estuarine and coastal areas, after which they metamorphose into benthic juveniles. At this stage, the main ontogenic processes are driven by environmental conditions, whose stochastic characteristics convey a great deal of variability in growth and survival of early life stages. These processes are also known to vary across a latitudinal gradient, which hasn't yet been thoroughly investigated for flatfishes. We studied the colonization patterns of two marine flatfish with distinct biogeographical ranges (European flounder, *Platichthys flesus*, temperate, and common sole, *Solea solea*, sub-tropical), by estimating the duration of the pelagic and metamorphic stages, as well as the duration of the spawning period, in several nursery areas across their geographical distribution range in the Western Atlantic and Mediterranean coasts, using otolith microstructure analysis. A general latitudinal cline was observed for the onset of each stage (spawning, larval pelagic and metamorphosis) for both species, with up to two months delay between the southernmost and the northernmost areas, as well as a shorter duration of pelagic and metamorphosis at the extremes of each species distribution. These results point to the existence of a counter-gradient growth compensation mechanism in the northernmost populations, where individuals further north have developed micro-evolutionary adaptation responses for specific climatic patterns, which result in differential physiological performance. Apart from the response to the temperature gradient, differences between sites were also related with species-specific tolerance and habitat features, such as the extension of the continental platform and adaptations to transport and retention mechanisms.

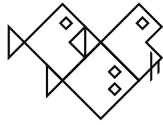


EFFICACY OF SINGLE AND MULTI-METRIC FISH-BASED INDICES IN TRACKING ANTHROPOGENIC PRESSURES IN ESTUARIES: AN 8-YEAR CASE STUDY

Martinho F.¹, D. Nyitrai¹, D. Crespo¹ & M.A. Pardal¹

¹ Centre for Functional Ecology - CFE, Department of Life Sciences, University of Coimbra, Calçada Martim de Freitas, 3000-456 Coimbra, Portugal (fmdm@ci.uc.pt).

Facing a generalized increase in water degradation, several programmes have been implemented for protecting and enhancing the water quality and associated wildlife, which rely on ecological indicators to assess the degree of deviation from a pristine state. Here, single (species number, Shannon–Wiener H' , Pielou J') and multi-metric (Estuarine Fish Assessment Index, EFAI) community-based ecological quality measures were evaluated in a temperate estuary over an 8-year period (2005–2012), and established their relationships with an anthropogenic pressure index (API). Single metric indices were highly variable and neither concordant amongst themselves nor with the EFAI. The EFAI was the only index significantly correlated with the API, indicating that higher ecological quality was associated with lower anthropogenic pressure. Pressure scenarios were related with specific fish community composition, as a result of distinct food web complexity and nursery functioning of the estuary. Results were discussed in the scope of the implementation of water protection programmes.



ASSESSING TEMPORAL VARIATION IN ECOSYSTEM FUNCTIONING AND SERVICES VIA FUNCTIONAL TRAITS OF AN ESTUARINE FISH ASSEMBLAGE

Monteiro M.¹, F. Monteiro¹, M. Dolbeth^{2,3}, M.A. Pardal³, F. Martinho³, R.P. Vasconcelos¹ & S. Henriques¹

1 MARE - Marine and Environmental Sciences Centre & FCUL - Faculdade de Ciências da Universidade de Lisboa. Campo Grande, 1749-016 Lisboa, Portugal (fmdm@ci.uc.pt).

2 Biology Department of the University of Aveiro & CESAM - Centre for Environmental and Marine Studies. Campus Universitário de Santiago, 3810-193 Aveiro, Portugal.

3 Centre for Functional Ecology - CFE, Department of Life Sciences, University of Coimbra, Calçada Martim de Freitas, 3000-456 Coimbra, Portugal.

Biodiversity loss is a pressing global issue. Yet there is limited knowledge on the consequences of species loss for ecosystem functioning and services. To explore links between fish biodiversity and ecosystem functioning and services we reviewed the literature for evidence on relationships between fish functional traits (e.g. body size, mobility) and ecosystem functioning and/or service provision to humankind (e.g. provisioning of biomass for nutrition, regulation of water conditions). In addition, as a practical case-study for further developing our approach we used a time-series on the taxonomic composition of an estuarine fish assemblage (Mondego estuary, Portugal, sampled every two months between 2003 and 2013). For each fish species we assembled data on several functional traits and identified functional life-history groups of species (e.g. through ordination analysis), since the adaptive value of each trait is context dependent. Based on the links between fish functional traits and ecosystem functions/services identified in the review, and on the determination of functional life-history groups, we characterized the contribution of the Mondego fish assemblage to the functioning of this ecosystem and its service provision. In addition, we used functional indices to determine the degree of functional redundancy in the fish assemblage, aiming at evaluating the degree of resilience of this assemblage in contributing to ecosystem functioning and service provision.



TEMPORAL CHANGES IN TAXONOMIC, FUNCTIONAL AND PHYLOGENETIC BIODIVERSITY OF THE FISH ASSEMBLAGE IN A TEMPERATE ESTUARY

Monteiro F.¹, M. Monteiro¹, C. Sousa-Santos², J. Robalo², M. Dolbeth^{3,4}, M.A. Pardal⁴, F. Martinho⁴, S. Henriques¹ & R.P. Vasconcelos¹

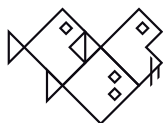
1 MARE - Marine and Environmental Sciences Centre & FCUL - Faculdade de Ciências da Universidade de Lisboa, Campo Grande, 1749-016 Lisboa, Portugal.

2 MARE - Marine and Environmental Sciences Centre & ISPA - Instituto Universitário. Rua Jardim do Tabaco, 34, 1149-041 Lisboa, Portugal.

3 Biology Department of the University of Aveiro & CESAM - Centre for Environmental and Marine Studies. Campus Universitário de Santiago, 3810-193 Aveiro, Portugal.

4 Centre for Functional Ecology - CFE, Department of Life Sciences, University of Coimbra, Calçada Martim de Freitas, 3000-456 Coimbra, Portugal.

Biodiversity is currently viewed as the variety of life, embracing variation from genes to ecosystems. Yet, it is most commonly studied through taxonomic entities, with limited knowledge on links between its several dimensions. We used a time-series on an estuarine fish assemblage to explore the relationship between taxonomic, functional and phylogenetic diversity and environmental changes through time, aiming at a better understanding of processes of biodiversity change and loss. We hypothesize that even a relatively small assemblage can have a high degree of redundancy, with changes in one biodiversity dimension not necessarily followed by changes in other dimensions. We sampled the fish assemblage of the Mondego estuary (Portugal) every two months between 2003 and 2013, simultaneously with environmental variables (temperature, salinity, precipitation and river runoff). In addition, for each species we assembled data on several functional traits and mitochondrial genes. We determined diversity indices for each biodiversity dimension (taxonomic, functional and phylogenetic) and analyzed the temporal variability (annual and seasonal) of the indices, as well as the relationship between indices. Moreover, we investigated the relationship of environmental features of the estuary with different indices of biodiversity, to explore their importance as regulating drivers. Results should improve current understanding of processes of rapid change in biodiversity.



PREFERENTIAL AGGREGATION SITES FOR THE MAIN RAJIDAE SPECIES IN THE NORTH OF PORTUGAL

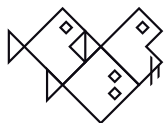
Pereira B.S.¹, J. Neves^{1,2}, C. Maia¹, K. Erzini³ & I. Figueiredo¹

1 Divisão de Modelação e Gestão de Recursos da Pesca, Instituto Português do Mar e da Atmosfera (IPMA), Rua Alfredo Magalhães Ramalho, 6, 1495-006 Lisbon, Portugal.

2 Centre for Functional Ecology (CFE), Department of Life Sciences, University of Coimbra, Calçada Martim de Freitas, 3000-456 Coimbra, Portugal (jfbneves@gmail.com).

3 Centro de Ciência do Mar (CCMAR), Faculdade de Ciências e Tecnologia (FCT), Ed. 8, Universidade do Algarve, Campus de Gambelas, 8005-139 Lisboa.

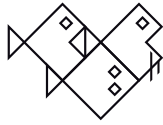
Skates (Rajidae) are known to aggregate in particular geographical areas. The selection of certain sites by different ontogenic stages are close related to habitat features, like the type of sediment. Fishermen are aware of such habitat preferences and possess a great deal of knowledge on the distribution of the species. For this reason, the present study aims to use fishermen knowledge together with scientific observations to identify the main aggregation sites for skate species in the north of Portugal: between Viana do Castelo (41.6° N) and Figueira da Foz (40.3 °N), from near shore to 35 nautical miles west (around 9.5°W). Interviews, self-interviews and onboard observations were conducted to collect information on the geographical coordinates, depth, sex, length and maturity (when available) by species. Sites were classified as potential Essential Fish Habitats (EFH) according to the occurrence of egg-laying and nursery grounds for the different skate species in analysis. A total of 14 preferential fishing sites for skates were identified, to capture five different species: *R. clavata*, *R. brachyura*, *R. microocellata*, *R. montagui* and *R. undulata*. In most sites identified, below 50 m depth, due to the geomorphology characterized by underwater beaches with sand and gravel grounds, *Raja undulata* was the most common skate species. In deeper areas, from 50 to 173 m, especially in the northern and most offshore sites with rocky bottoms, *R. clavata* was the most common species. Egg-laying grounds were identified for *R. undulata* and *R. clavata*. Spatial sex segregation was identified for *R. undulata*, *R. clavata* and *R. microocellata*. Based on the occurrence of juveniles, nursery sites were identified for all species. EFH can usefully be applied to propose regional management measures, such as spatial closure areas based on their importance for the reproduction of these commercially exploited species.

**LIFE CYCLE AND STRUCTURE OF A POPULATION OF *Batrachoides surinamensis* (BLOCH & SCHNEIDER, 1801) (OSTEICHTHYES, BATRACHOIDIFORMES) IN A MANGROVE SWAMP, MARANHÃO, BRAZIL****Pinheiro M.S.S.¹ & G. Roberto²**

1 Universidade Federal do Maranhão - UFMA. Av. dos Portugueses s/n, Bacanga, CEP 65.085-580 São Luís, Maranhão, Brasil (spinheiro@elo.com.br).

2 Universidade Estadual Paulista – UNESP. Av. 24 A nº 1515 Bela Vista CEP 13.506-900, Rio Claro, São Paulo, Brasil.

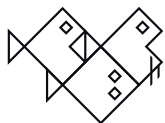
This study analyzes aspects of a population of *Batrachoides surinamensis* present in a mangrove forest in the locality Raposa, São Luis Island, Maranhão, Brazil; the study cover length distribution, sex ratio, macroscopic analysis of the gonads. Sampling was done monthly, between August, 1999 and November, 2000. We collected 39 specimens of fish, 6 males, 22 females and 11 undetermined sex. Length varied between 151-434 mm, with a mean of 299.7 mm and a standard deviation of 58.23. Sex ratio was tested by Chi-square test with one degree of freedom ($\chi^2 < 3.840$, $p=0.005$); Chi - square was 9.14*, so there is a significant difference at 5%, so the hypothesis of equality between the sexes (1:1) was not accepted. *Batrachoides surinamensis* complete their life cycle in the mangrove, because they have been observed both immature individuals as mature, as well as individuals with spawning evidence.

**STRUCTURE OF A POPULATION OF *Sciades herzbergii* (BLOCH, 1794)
(SILURIFORMES, ARIIDAE) IN A MANGROVE OF SÃO LUÍS ISLAND,
MARANHÃO, BRAZIL****Pinheiro M.S.S.¹ & G. Roberto²**

1 Universidade Federal do Maranhão - UFMA. Av. dos Portugueses s/n, Bacanga, CEP 65.085-580 São Luís, Maranhão, Brasil, (spinheiro@elo.com.br).

2 Universidade Estadual Paulista – UNESP. Av. 24 A nº 1515 Bela Vista CEP 13.506-900, Rio Claro, São Paulo, Brasil.

This study analyzes aspects of a population of *Sciades herzbergii* present in a mangrove forest in the locality Raposa, São Luis Island, Maranhão, Brazil; the study cover length distribution, sex ratio, macroscopic analysis of the gonads. Sampling was done monthly, between August, 1999 and November, 2000. We collected 316 specimens of fish, 6 males, 7 females and 303 undetermined sex. Length varied between 100-406 mm with a mean of 167.32 mm and a standard deviation of 44.41. Sex ratio was tested by Chi-square test with one degree of freedom ($\chi^2 < 3.840$, $p=0.005$). Chi-square obtained (0.08) indicates no significant difference. So the hypothesis of equal proportion of the sexes (1:1) was accepted. *Sciades herzbergii* not complete their life cycle in the mangrove, although they have been observed both immature individuals as mature, it was not observed individuals with spawning evidence. Most juveniles were observed individuals (95.89%). *Sciades herzbergii* not complete their life cycle in the mangrove, although they have been observed both immature individuals as mature, it was not observed individuals with spawning evidence.



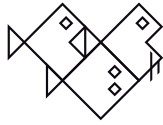
LIFE CYCLE AND STRUCTURE OF A POPULATION OF *Genyatremus luteus* (BLOCH, 1790) (PERCIFORMES, HAEMULIDAE) IN A MANGROVE SWAMP, MARANHÃO, BRAZIL

Pinheiro M.S.S.¹ & G. Roberto²

1 Universidade Federal do Maranhão - UFMA. Av. dos Portugueses s/n, Bacanga, CEP 65.085-580 São Luís, Maranhão, Brasil (spinheiro@elo.com.br).

2 Universidade Estadual Paulista – UNESP. Av. 24 A nº 1515 Bela Vista CEP 13.506-900, Rio Claro, São Paulo, Brasil.

This study analyzes aspects of a population of *Genyatremus luteus* present in a mangrove forest in the locality Raposa, São Luis Island, Maranhão, Brazil; the study cover length distribution, sex ratio, macroscopic analysis of the gonads. Sampling was done monthly, between August, 1999 and November, 2000. We collected 322 specimens of fish, 8 males, 23 females and 291 undetermined sex. Length varied between 56-206 mm, with a mean of 117.08 mm and a standard deviation of 19.85. Sex ratio was tested by Chi-square test with one degree of freedom ($\chi^2 < 3.840$, $p=0.005$); Chi - square was 7.26*, so there is a significant difference at 5%, so the hypothesis of equality between the sexes (1:1) was not accepted. Although most of the observed individuals (90.37%) were juveniles, there are strong indications that *Genyatremus luteus* complete their life cycle in the mangrove, because both were observed immature individuals as mature, as well as individuals with spawning evidence. But this system uses *Genyatremus luteus* preferably for growth.



IMPACT OF ANTI- JELLYFISH NETS ON LONGSNOUT SEAHORSE POPULATION (*Hippocampus guttulatus*) IN THE MAR MENOR LAGOON

Mena Sellés C.¹, M. Vivas Salvador¹, J.D. López Giraldo¹, J.A. Oliver Hernández¹, J.L. Alcaide¹, A. Pinar¹ & E.M. Dolores Pedrero²

1 Asociación Hippocampus. 30740 San Pedro del Pinatar. Murcia (miguel.vivas@mu.ieo.es).

2 Servicio de Pesca y Acuicultura. Consejería de Agua, Agricultura y Medio Ambiente.

Longsnout Seahorse (*Hippocampus guttulatus*) is a singular species in the Mar Menor ecosystem. Despite its ecological and cultural value, *H. guttulatus* population has suffered a significant size decline of due to fishing and changes in their environmental conditions.

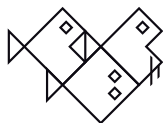
One of the main changes in lagoon ecosystem is the availability of increased nutrients in the water column. Eutrophication causes jellyfish outbreaks during summer, causing important uncertainty for tourist activities.

In response to these high jellyfish densities, public regional fishing authorities anchored to the seafloor a system of nets with floats and weights protecting beach bathing areas. After summer season, nets are removed and stored until the following summer.

However, Longsnout Seahorses are using this artificial device as an habitat and a handhold. During autumn while removing those fishing nets, Seahorse usually die.

This paper describes a joint actuation between Hippocampus Association and Regional Fishing Public authority to quantify the negative effect of anti-jellyfish nets on Longsnout Seahorse population. On 2015, 216 Seahorses were removed from the nets before these were collected, avoiding a massive die off.

The study suggests urgent implementation of preventive measures before these nets are removed to protect seahorses due to its low population numbers.



MANGROVE FISH OF SÃO TOMÉ ISLAND (GULF OF GUINEA): NEW OCCURRENCES AND HABITAT USAGE

Félix P.M.¹, P. Chainho¹, R.F. Lima^{2,3}, J.L. Costa^{1,4}, A.J. Almeida^{4,5}, I. Domingos^{1,4} & A.C. Brito^{1,6}

1 MARE – Marine and Environmental Sciences Centre, Faculdade de Ciências da Universidade de Lisboa, Campo Grande, PT-1749-016 Lisboa, Portugal (pmfelix@fc.ul.pt).

2 CE Centre for Ecology, Evolution and Environmental Changes, Faculdade de Ciências, Universidade de Lisboa, PT-1749-016 Lisboa, Portugal.

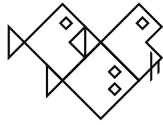
3 Associação Monte Pico, Monte Café, Mé Zóchi, CP 1119, São Tomé e Príncipe.

4 Departamento de Biologia Animal, Faculdade de Ciências, Universidade de Lisboa, PT-1749-016 Lisboa, Portugal.

5 MARE (Marine and Environmental Sciences Centre), Laboratório Marítimo da Guia, Avenida Nossa Senhora do Cabo, 939, 2750-374 Cascais, Portugal.

6 Departamento de Biologia Vegetal, Faculdade de Ciências, Universidade de Lisboa, PT-1749-016 Lisboa, Portugal.

Mangroves are recognised as important nursery and feeding areas for a wide range of resident and marine fish species. However, the importance of West African mangroves for the life cycle of fish communities remains poorly understood. This is the first record of fish species using tropical insular mangroves for this region and the aim of the study was to assess habitat usage by fish species. Two mangroves located in São Tomé Island (Praia das Conchas and Malanza) were sampled with a multi-habitat approach and using different fishing gear, to maximise the diversity of fish species collected. Several environmental parameters, like salinity, dissolved oxygen and temperature, were also measured in the water column, as well as sediment grain size and respective organic content. Both mangroves act as opportunistic feeding grounds and as nursery and settlement areas for resident and marine species. The highest number of juveniles and adults (inshore and resident species) was observed at the Malanza mangrove, which is the largest and the one with the highest habitat heterogeneity. Four new occurrences were reported for the São Tomé e Príncipe area, namely *Pomadasys jubelini*, *Bostrychus africanus*, *Dalophis cephalopeltis* and the introduced species *Oreochromis mossambicus*. Two additional species, classified as vulnerable in the International Union for Conservation of Nature (IUCN) Red List, also use these mangroves as feeding grounds: (*Megalops atlanticus*), in Malanza, and a resident species (*Awaous bustamantei*), in Praia das Conchas. Two major limiting factors for the mangrove fish communities were identified, namely: i) the limited mangrove-sea connections that constrained tidal influence, leading to hazardous physical-chemical changes of the brackish system; and ii) an established population of the introduced Mozambique tilapia, with the potential for ecological disruption.

**RESPONSES OF THE ANTARCTIC FISH *Notothenia rossii* AND
Notothenia coriiceps TO ENVIRONMENTAL STRESS**

Guerreiro P.M., B. Louro, A. Alves, E. Couto & A.V.M. Canario

Comparative Endocrinology and Integrative Biology, Centro de Ciências do Mar, Universidade do Algarve, 8005-139 Faro, Portugal (pmgg@ualg.pt).

The Antarctic Peninsula is exposed to the fastest climate change rate in the planet, up to ten times higher than the global average. To which extent can coastal notothenioid fish adjust to the warming conditions forecasted by the models of climate change, possibly leading to ice melting and freshening of shallow waters in enclosed areas?

Experiments were performed in Arctowski (PL) and Great Wall (CN) stations in King George Island. Fish collected by boat were transferred to experimental tanks (0-2°C) and exposed to rapid/gradual changes in water temperature (to 4-6-8°C using thermostat-controlled heaters) and water salinity (to 20-10‰ by addition of freshwater to recirculating tanks) over a period of up to 10 days. In a second experiment the HPI axis was manipulated by injecting known blockers/agonists of cortisol release and its receptors prior to environmental acclimation. Subsets of fish at each temperature were subjected to additional handling stress and air exposure for 2 minutes. Time-course of the stress response was followed over 24 hours. Fish were deeply anesthetized and upon blood collection, sacrificed by spinal section. Tissue samples were collected for gene expression and enzymatic analysis.

Exposure to altered conditions had no effect in immediate mortality. Increased temperature reduced overall activity and behavioral response to stimuli, although it had no clear effect on mobilization of energetic substrates. Fish responded to HPI manipulation in a way similar to temperate species. Cortisol and gene expression of metabolic-related proteins were modified after heat shock, but the cortisol response to handling appeared to be reduced, indicating loss of sensitivity. The rise in temperature induced a dependent decrease in plasma osmolality while increasing branchial and renal Na⁺/K⁺-ATPase activity, thus reducing osmoregulatory efficiency. In conclusion, Antarctic fish are reactive to environmental change, but their ability to accommodate rapid or adaptive responses may be compromised.

Funded by CCMAR/Multi/04326/2013, PTDC/BIAANM/3484/2014, and Programa Polar Português FCT - Fundação para a Ciência e a Tecnologia. On-site Support from Polish Academy of Sciences and Chinese Antarctic Research Expedition.



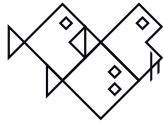
ONTOGENETIC DIETARY SHIFTS AND FEEDING STRATEGIES OF *Galeus melastomus* AND *Galeus atlanticus* IN THE PORTUGUESE CONTINENTAL SLOPE

Mateus C.¹, M.J. Gaudêncio¹, T. Moura¹, J. Neves^{1,2} & I. Figueiredo¹

¹ Departamento do Mar e Recursos Marinhos, Instituto Português do Mar e da Atmosfera, Rua Alfredo Magalhães Ramalho, 6, 1495-006 Lisboa, Portugal (celia.mateus13@gmail.com).

² Centre for Functional Ecology (CFE), Department of Life Sciences, University of Coimbra, Calçada Martim de Freitas, 3000-456 Coimbra, Portugal.

The blackmouth catshark *Galeus melastomus* and the Atlantic sawtail catshark *Galeus atlanticus* are two common demersal sharks in the Portuguese continental slope. In this study, the feeding habits and ontogenetic dietary shifts of these two species are assessed from stomach content data of 205 *G. melastomus* and 77 *G. atlanticus* caught during IPMA research surveys. Forty four different prey items were identified for *G. melastomus* and 23 for *G. atlanticus*. Prey items of both species were similar, both in terms of major taxonomic groups and species identified. The vacuity index, frequency of occurrence and frequency by number were estimated for each species by major length groups (MLG) defined through a cluster analysis of prey relative significance in relation to predator length size. Three MLGs for *G. melastomus* and two MLGs for *G. atlanticus* were admitted in the analysis. In both species the smallest specimens feed mainly on Euphasiacea, particularly on *Meganyctiphanes norvegica* which remain an important prey item in the diet of larger specimens. In *G. melastomus* ranging from 35-55 cm, Caridea crustaceans increased their frequency. In larger specimens of both species (>55 and >30 cm, in *G. melastomus* and *G. atlanticus*, respectively), prey diversity was higher and teleosts became more frequent. Both species present ontogenetic dietary variations, with shifts from a specialized to a more generalized diet. Results obtained are in line with other elasmobranch diet studies for which ontogenetic variations are known to occur. In addition to the increase of body size, these shifts may be related to differences in habitat preference or improvement of foraging skills.

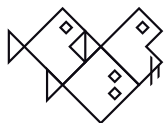


FISH COMMUNITY ORGANIZATION VARIES AS A FUNCTION OF HABITAT FUNCTIONAL TRAITS

Rodríguez-González M., L. Palacín-Fernández, N. Lazzari, J.A. Sanabria & M.A. Becerro

The BITES Lab. IPNA-CSIC. 38206 Tenerife. Spain (maria.riguez92@hotmail.com).

Habitats are a critical biodiversity component as geographic, biotic, and abiotic factors shape species distribution and abundance. Beyond the environmental needs, many fish species require specific associations with other species, which provide a number of functions necessary for the fish to succeed. Yet information on the functional traits behind the organization of fish communities is scarce. Here, we investigated whether shallow rocky fish communities in the Alboran Sea varied across functional habitats. We used underwater visual censuses to quantify both sessile and fish communities in multiple locations and used factor analysis based on percent cover of algal functional groups to characterize functional habitats. For each habitat, we then looked at the relationship between percent cover of functional groups with the abundance of fish families. Our results showed strong relationships between multiple seaweed functional groups and fish families. Some fish families were associated with the same algal functional group in multiple habitats, such as *Sparidae* and filamentous algae. However, other fish families showed functional preferences limited to a particular habitat, as *Serranidae* or *Scorpaenidae* with corticated macrophytes algae. Our results highlight the consistency and dependency of certain algae-fish relationships, leading to a high spatial heterogeneity with strong implications for biodiversity and its conservation.



CONSERVATION STATUS AND THREATS OF *APHANIUS IBERUS* IN SALINE WETLANDS FROM THE MAR MENOR COASTAL LAGOON

Zamora-Marín J.M.¹, A. Zamora-López¹, J.M. Vidal², M. Torralva¹ & F.J. Oliva-Paterna¹

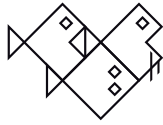
¹ Departamento de Zoología y Antropología Física. Facultad de Biología. Universidad de Murcia (josemanuel.zamora@um.es).

² TECOMA Ingeniería y Ambiente SL.

The Spanish toothcarp *Aphanius iberus* (Valenciennes) is an endemic cyprinodontid of the Iberian Peninsula which is currently catalogued as Endangered (EN) by International Union for Conservation of Nature (IUCN) and protected by national and international laws. The species is restricted to a few populations along the Spanish Mediterranean coastline, being the Mar Menor coastal lagoon and its associated wetlands one of the most important areas. In this ecogeographical area, the role of salt exploitation wetlands as the most typical habitat for the species has been previously reported. In fact, *A. iberus* is able to become locally abundant in this type of wetlands, however, for the last decades these aquatic systems have been subjected to severe anthropogenic disturbances.

In this study we present the current conservation status of *A. iberus* populations established in salt exploitation wetlands from the Mar Menor area. We focused on threats on the habitat and we evaluate the strengths and weaknesses in management actions for conservation purposes that have been developed.

Our results suggest the importance of management programmes that consider biological criteria in salt exploitation type wetlands, the status of the species is directly related to the flow management of the wetlands and the abandonment of traditional salt works which are presented as the major challenges for its conservation.



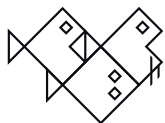
TAXONOMIC AND PHYLOGENETIC BETA DIVERSITY PATTERNS IN FRESHWATER FISHES FROM CENTRAL MÉXICO

García-Andrade A.B.¹, L. Garrido-Olvera² & O. Domínguez-Domínguez¹

1 Laboratorio de Biología Acuática, Facultad de Biología, Universidad Michoacana de San Nicolás de Hidalgo, C.P. 58030, Morelia, Michoacán, México (aberenicega@gmail.com).

2 Facultad de Ciencias, Universidad Nacional Autónoma de México, Av. 3000, Circuito Exterior s/n, Delegación Coyoacán, Cd. Universitaria, C.P. 04510, Ciudad de México, México.

Nowadays the incorporation of phylogenetic data on the community ecology is more common, one of the objectives is to understand the origin and evolution of species in communities. In this manner can be linked the processes that structured communities such speciation and extinction with phylogenetic dissimilarity data. Central Mexico has an extraordinary diversity of fishes: high species richness and endemism percentage of more than 70%. This zone represents one of the most important diversity hotspot in Mexico. The origin of this diversity is associated with vicariants processes, mainly tecto-volcanic events that have led to the current complex physiographic of the Mexican volcanic belt and besides the climatic changes during the Pliocene and Pleistocene. We used a phylogenetic reconstruction by the mitochondrial gene cytochrome b, which includes 73 species and seven families. The aim of this study is to evaluate the diversity patterns of ichthyofauna in 20 biogeographic regions established for Central Mexico. We estimated the taxonomic dissimilarity using the Sorensen index and PhyloSor for the phylogenetic dissimilarity, we obtained the two components the turnover and the nested. We also estimated the null models values for the PhyloSor index. Taxonomic average dissimilarity is high (0.75), mainly explained by the turnover species component. However the phylogenetic community dissimilarity average is very low (0.37) explained in greater proportion for the phylogenetic diversity component. These results are associated to neoendemic species with limited distribution ranges. These features are present in the fish fauna of central Mexico, we have high percent of endemism and some of this species live in small springs. Moreover, species in communities are closely related and that is why the turnover lineages is very low although the species turnover is higher.



INTEGRATIVE TAXONOMY OF THE GENUS *Lepidotrigla* (SCORPAENIFORMES; TRIGLIDAE) FROM IBERIAN WATERS

Barros-García D.^{1,2}, R. Bañón³, J.C. Arronte⁴ & A. De Carlos⁵

1 Centro de Apoyo Científico y Tecnológico a la Investigación (CACTI). Universidad de Vigo, Calle Fonte das Abelleiras s/n, 36310 Vigo, Spain (davbarros@uvigo.es).

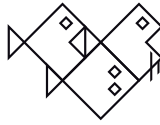
2 Programa de Doctorado en Metodología y Aplicaciones en Ciencias de la Vida, Facultad de Biología. Universidad de Vigo, C/Fonte das Abelleiras s/n, 36310 Vigo, Spain. Tel. no. +34 986 812576

3 Departamento de Ecología y Biología Animal. Facultad de Biología, Universidad de Vigo, C/ Fonte das Abelleiras s/n, 36310 Vigo, Spain.

4 Departamento de Biología de Organismos y Sistemas, Universidad de Oviedo, C/Catedrático Uría s/n 33003 Oviedo, Spain.

5 Departamento de Bioquímica, Genética e Inmunología, Facultad de Biología, Universidad de Vigo, C/ Fonte das Abelleiras s/n, 36310 Vigo, Spain

The family Triglidae currently comprises 8 genera and about 125 species worldwide. However, only 8 gurnard species are found in the NE Atlantic and Mediterranean waters. In the Iberian waters, there are two recognized species belonging to genus *Lepidotrigla*, the Large-scaled gurnard *Lepidotrigla cavillone* and the Spiny gurnard *Lepidotrigla dieuzeidei*. However, their distribution range in Atlantic waters is poorly known. A total number of 146 individuals from these two species were caught in 3 different sampled sites around the Iberian Peninsula waters (Gulf of Cadiz, Balearic and Galician waters). The morphological data from all the specimens was obtained. Furthermore, the barcoding mitochondrial marker (COI, 658 bp) was sequenced in 30 individuals, representing every species and location. The resulting NJ tree distinguished between *L. cavillone* and *L. dieuzeidei*, and showed that all the specimens captured in the Galician waters belong to *L. dieuzeidei*, with no representation of *L. cavillone*. Despite the genetic results, a PCA analysis of morphological data did not discriminate between these two species. This apparent contradiction between genetic and morphological data could be explained by recent speciation phenomena, but further analyses will be required to confirm this hypothesis.



GENETIC STRUCTURE AND PHYLOGEOGRAPHICAL PATTERNS OF LERMA LIVEBEARER *Poeciliopsis infans* (WOOLMAN, 1894), AN ENDEMIC FISH OF CENTRAL MEXICO

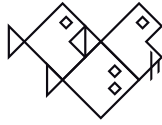
Beltrán López R. G.¹, I. Doadrio² & O. Domínguez Domínguez³

1 Programa Institucional de Doctorado en Ciencias Biológicas, Facultad de Biología, Universidad Michoacana de San Nicolás de Hidalgo, 58000, Morelia, Michoacán, Mexico (rosa.beltran@uaem.mx).

2 Departamento de Biología Evolutiva y Biodiversidad, Museo Nacional de Ciencias Naturales, 28006, Madrid, Spain.

3 Laboratorio de Biología Acuática, Facultad de Biología, Universidad Michoacana de San Nicolás de Hidalgo, 58000, Morelia, Michoacán, Mexico.

Central Mexico is characterized by high species richness of freshwater fishes. In different phylogeographical works on the fishes from Central Mexico a well-defined genetic structure of the species inhabiting this area has been found, with an origin and evolution associated with the hydrographic history. The species *Poeciliopsis infans* is a good model to evaluate the influence of historical processes in the evolution of the fish fauna of central Mexico, as it is widely distributed inhabiting rivers and lakes across this region. In this work, we describe the evolutionary history of *P. infans* using the mitochondrial genes Cytochrome b and Cytochrome oxidase I and the nuclear genes rhodopsin and ribosomal protein S7. The phylogenetic results obtained through concatenated genes showed that populations of this species were grouped in two clades. The first clade included populations of Middle and Lower Lerma Basin, Zacapu, Pánuco, Chapala, Cotija, Pátzcuaro and Cuitzeo. On the other hand, the second clade included populations of biogeographic regions Sayula, Coahuayana-Tamazula, Zapotlán, Etzatlán-San Marcos, Santiago, Atotonilco and Magdalena. The genetic distance between these two clades was 2.6% with Cytb. The haplotypes networks showed the same grouping as the one obtained in the phylogenetic analyses. The analysis of molecular variance showed that the highest percentage of variation was obtained between the two clades recovered (Cytb) (71.55% ϕ_{CT} = 0.715). The divergence time estimated suggested a separation between the two clades of 1.28 to 4.92 million years ago, during the Plio-Pleistocene. The populations of *P. infans* showed a well-defined genetic structure among them, which may have been associated with the historical processes that shaped watersheds where the species is currently distributed. Moreover, the genetic divergence between the two clades is consistent with volcanic, tectonic and climatic processes that took place in the Pliocene and Pleistocene in Central Mexico.



EVOLUTION OF THE ICHTHYOFAUNA OF THE PROVINCE OF SALAMANCA (NORTH WEST SPAIN) IN THE LAST 25 YEARS (1990-2015)

**González Fernández G.¹, J.C. Velasco Marcos², C. Marcos Primo³, F. Jiménez Fernández⁴,
J. del Nido Martín² & L. Arenillas Girola⁵**

1 Ichthios Gestión Ambiental S.L. Pablo Ruiz Picasso, 38. 24009 León. Spain (info@ichthios.es).

2 Consejería de Fomento y Medio Ambiente, Junta de Castilla y León.

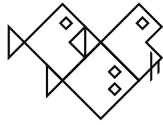
3 Confederación Hidrográfica del Duero.

4 Fundación Patrimonio Natural de Castilla y León.

5 Confederación Hidrográfica del Tago.

Taking as reference the Atlas of distribution of fish in the province of Salamanca (whose samplings were done mainly during the years 1989-1991), the evolution of the distribution areas of the species present is analyzed over the past 25 years. Like in most of the peninsular areas, we find two antagonistic tendencies:

- a regression range of endemic species and
- an increase of the presence of invasive alien species in both the range occupied and the number of species (in fact, new species such as bleak or walleye have arrived). The evolution of the fish fauna in the watersheds of the province of Salamanca (Tormes, Uces, Huebra, Agueda and Alagón) as well as Special Areas of Conservation of Natura 2000, is valued. Finally, some conservation measures that can be carried out mainly under the Life Project Cipriber are listed. This project has focused on species of Community interest set out in the Habitats Directive and which are present in the province of Salamanca.



**THE COLONIZATION OF THE WESTERNMOST TIP OF IBERIA BY
Achondrostoma oligolepis (ROBALO, DOADRIO, ALMADA & KOTTELAT,
2005) AND ITS RELATION WITH THE EVOLUTION OF PALEOBASINS**

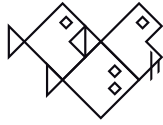
Almeida R.¹, J.I. Robalo², M.F. Magalhães³ & C. Sousa-Santos²

1 Faculty of Sciences, University of Lisbon; Campo Grande 1749-016 Lisboa, Portugal (ritapalmeida93@gmail.com).

2 MARE, ISPA – University Institute; Rua Jardim do Tabaco 34, 1149-041 Lisboa, Portugal

3 Centre for Ecology, Evolution and Environmental Changes, Faculty of Sciences, University of Lisbon; Campo Grande 1749-016 Lisboa, Portugal

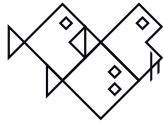
Achondrostoma oligolepis (Robalo, Doadrio, Almada & Kottelat, 2005) is a small cyprinid endemic to north and central Portugal. At the southern limit of its distribution area, in the Extremadura region, this species occurs in five small independent coastal drainages, isolated from the contiguous Mondego and Tagus river basins by the Sicó-Aire-Candeeiros mountain ranges. Since *A. oligolepis* is a primary fish species, its dispersal could only have occurred through ancestral links between river basins. Consequently, its evolutionary history, particularly regarding the colonization of the small rivers in Extremadura, is expected to be intimately related to the evolution of the paleobasins of the region. Using the mitochondrial cytochrome *b* gene we assessed the genetic diversity of the populations and estimated their divergence time from the populations of Mondego and Tagus basins. We found that the colonization of the westernmost tip of Europe by *A. oligolepis* occurred recently, in the Holocene. Hypothetical colonization and dispersal routes are proposed based on genetic and geological dating.

**PHYLOGENY, PHYLOGEOGRAPHY AND GENETIC DIVERSITY
OF THE IBERIAN ENDEMIC SPECIES *SQUALIUS PYRENAICUS*
(ACTINOPTERYGII, CYPRINIDAE)****Perea S.¹, C. Sousa-Santos², J. Robalo² & I. Doadrio¹**

1. Museo Nacional de Ciencias Naturales. Biodiversity and Evolutionary Group. C/ José Gutiérrez Abascal, 2. 28006 Madrid (sperea2@gmail.com).

2. MARE-Marine and Environmental Sciences Centre, ISPA. Instituto Universitário de Ciências Psicológicas, Sociais e da Vida, Lisbon, Portugal.

The Cyprinid genus *Squalius* is distributed throughout Eurasia. Nine species of this genus are endemic to the Iberian Peninsula, being *S. pyrenaicus* the one with the wider distribution range in this region, occupying mainly the southern half of Iberia and some small areas in the Ebro Basin. Since this primary freshwater fish species occurs in different isolated river systems and inter-basin dispersal is prevented due to its intolerance to marine salinity, a high genetic structure is expected among populations from distinct basins, as well as a higher genetic diversity in the larger basins as a consequence of historical factors and geomorphological configuration of Iberian basins. In this study we tested these hypotheses by characterizing several populations from the whole distribution area of *S. pyrenaicus*, using one mitochondrial and one nuclear gene. We reconstructed the phylogenetic and phylogeographic history of *S. pyrenaicus* and estimated genetic diversity indices for its populations. We also inferred the divergence times among the populations of *S. pyrenaicus* using molecular clock analyses.

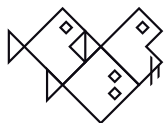


RECORDS OF DEEPWATER TELEOSTEAN FISHES TRAWLED OFF THE WESTERN COAST OF NORTHER MEXICO

Cota-Gómez V.M., R. Moncayo-Estrada & J. De La Cruz-Agüero

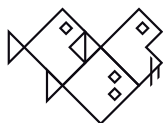
Instituto Politécnico Nacional, Centro Interdisciplinario de Ciencias Marinas (CICIMAR-IPN).
Departamento de Pesquerías y Biología Marina. Colección Ictiológica. Avenida IPN s/n,
Colonia Playa Palo de Santa Rita, La Paz, Baja California Sur 23096, México (vcotag@ipn.mx).

In mid-2014, an acoustic survey along the west coast of the peninsula of Baja California, Mexico was carried out by a joint initiative between the National Fisheries Institute (INAPESCA) and the Interdisciplinary Center of Marine Sciences - Instituto Politecnico Nacional (CICIMAR-IPN). Fishing activities were made aboard the oceanographic vessel “Buque de Investigacion Pesquera y Oceanografica” (R/V BIPO-INAPESCA). The main objective was to determine the species composition, distribution, and relative abundance, as well as the basic fisheries information of the midwater and demersal fish and shellfish resources that live in the exclusive economic zone of Mexico. Fishes were caught in surveys carried out during the months of July, August and November 2014 along the coast of the peninsula of Baja California, Mexico. Fourteen stations were located on perpendicular transects from the coast and on the parallel transects among them, from the isobath 50 m to the limit of the exclusive economic zone with a maximum depth of approximately 4500 m. The sampling gear was a four-layer midwater trawl with a 33.5 m headline and a bag of 6.4 mm mesh size towed at an average speed of 3 knots for 30 min periods. We identified 46 species that belong to 36 families. From this list, three midwater species are important because they represent the first record for the Mexican ichthyofauna (*Holtbyrnia laticauda*, *Brama dussumieri* and *Cubiceps baxteri*). The known range of these species were extended northward in the eastern Pacific, ranging from 3495 to 8300 km.

**THE ICHTHYOLOGIC COLLECTION (CI) OF
CICIMAR-IPN, MEXICO****Cota-Gómez V.M., R. Moncayo-Estrada & J. De La Cruz-Agüero**

Instituto Politécnico Nacional, Centro Interdisciplinario de Ciencias Marinas (CICIMAR-IPN).
Departamento de Pesquerías y Biología Marina. Colección Ictiológica. Avenida IPN s/n,
Colonia Playa Palo de Santa Rita, La Paz, Baja California Sur 23096, México (vcotag@ipn.mx).

Since its founding in 1976, the Interdisciplinary Center of Marine Sciences (CICIMAR-IPN) of La Paz, Baja California Sur, Mexico has been dedicated to the study of biological resources with emphasis in Northwestern Mexico. In this context, the Ichthyological Collection (CI) of the CICIMAR-IPN, in the last years has been depurating the biological inventory, updating the nomenclature, developing the digital database and publishing the information in the Internet. The different actions on the academic field of human resource training, teaching, research, extension and dissemination of research. The CI contains information on over 114, 632 specimens of marine fish in more than 8,000 curatorial records. It includes 132 families, 330 genera and 580 species, collected at 500 sites in 395 locations and more than 3,500 sampling events. Currently there are four interacting collections (skeleton, otolith, urohyal and tissues). The database of the CI is part of the Mexican Biodiversity Information Network (REMIB-CONABIO: www.conabio.gob.mx/remib), as well as being the only Latin American ichthyology collection FISHBASE (www.fishbase.org) and it has its own web site <http://coleccion.cicimar.ipn.mx>.



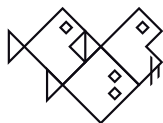
ICHTHYOFAUNE OF THE GALICIA BANK SEAMOUNT

Bañón R.¹, D. Barros-García^{2,3}, J.C. Arronte⁴ & A. de Carlos⁵

- 1 Programa de Doctorado en Biodiversidad y Ecosistemas, Facultad de Ciencias del Mar. Universidad de Vigo, C/ Fonte das Abelleiras s/n, 36310 Vigo, Spain
- 2 Centro de Apoyo Científico y Tecnológico a la Investigación (CACTI). Universidad de Vigo, Calle Fonte das Abelleiras s/n, 36310 Vigo, Spain. E-mail: davbarros@uvigo.es
- 3 Programa de Doctorado en Metodología y Aplicaciones en Ciencias de la Vida, Facultad de Biología. Universidad de Vigo, C/Fonte das Abelleiras s/n, 36310 Vigo, Spain. Tel. no. +34 986 812576
- 4 Departamento de Biología de Organismos y Sistemas, Universidad de Oviedo, C/Catedrático Uría s/n 33003 Oviedo, Spain.
- 5 Departamento de Bioquímica, Genética e Inmunología, Facultad de Biología, Universidad de Vigo, C/ Fonte das Abelleiras s/n, 36310 Vigo, Spain

The Galicia bank is an isolated, non-volcanic, large and deep seamount located in the Northwestern of the Iberian Peninsula (North-east Atlantic), between 42° 15'N and 43°N and from 11° 30'W to 12° 15'W, at water depths from 625 to 1,800 m and approximately 125 nautical miles offshore the coast.

Based on nine prospecting and research surveys carried out from 1980 to 2011, 139 species of marine fishes are reported at the Galician Bank. The ichthyofauna list is diversified in 2 superclasses, 3 classes, 20 orders, 62 families and 113 genera. The largest family is Macrouridae, with 9 species, followed by Moridae, Stomiidae and Sternoptychidae with 7 species each. The trachichthid *Hoplostethus mediterraneus* and the morid *Lepidion lepidion* were the most abundant species. Biogeographically, the Atlantic group, with 113 species (81.3%) is the best represented, followed by the Lusitanian one with 17 species (12.2%). The vulnerability and conservation status of each fish species were compiled from two global Red List (IUCN and FishBase) and one regional (OSPAR) Inventories. Due to the different criteria used to estimate the vulnerability status, the resulting lists are very different. Only 5 species (3%) are considered as threatened according to OSPAR, 9 (6%) to IUCN and 58 (42%) to FishBase, which is considered the most appropriate criterion. This is the first attempt to catalogue the fish biodiversity of the Galicia Bank seamount. The results obtained, showing a high fish biodiversity and a sensible number of threatened species, strongly support the recent declaration of the Galicia Bank as a Marine Protected Area.



MONITORING EEL (*Anguilla anguilla*) FISHING IN THE MAR MENOR

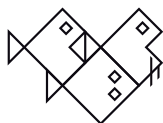
Peñalver J., E.M. Dolores, L. Bermúdez, E. Viuda, M. Martínez, J.J. Pérez & E. Romero

Fisheries and Aquaculture Service. Regional Ministry of Water, Agriculture and Environment.
Region of Murcia. Edificio Foro, 30201, Cartagena, Murcia, Spain (jose.penalver2@carm.es).

The European eel (*Anguilla anguilla*) has suffered a major decline in their populations. The European Union enacted Regulation of the European Council of the European Union No. 1100/2007 establishing measures for the recovery of the stock of European eel, which obliges to member countries to design management plans for this species. The Department General of Agriculture, Livestock, Fisheries and Aquaculture developed a management plan for eels in Murcia which joined the Spanish Management Plan.

One of the measures incorporated is the study of biology, populations and fishery. For the study of the fishery in 2013 a monitoring program was initiated in collaboration with the Association of Fishermen of San Pedro del Pinatar. The study is based on completion, for each batch of eels, a file with the following data: date, ship, kilograms of eel, eel class (silver or yellow) method to capture and capture zone.

In the present study the results of the first two years of monitoring are presented: 2013/2014 and 2014/2015. A total of 52,126 kg were caught, distributed in 1,032 batches, with an average of 50.5 kg (range 1- 659). In the first campaign they caught 33,537 kilograms, of which 59.7% were silver, being December the month with more catches of eels. In the 2014/2015 campaign they caught 18,589 kilograms, with a percentage of 73% of silver eel, being January the month with more catches. Of the two fishing methods used (paranza and longline), the paranza was the most used during the two years. Of the 20 fishing areas, during the two years, the largest catches were obtained in the same area "La Chanca" with 7,880 and 6,230 kg respectively. These results are discussed with respect to the eel life cycle.

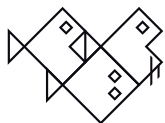


SUSTAINABLE MANAGEMENT OF THE EEL FISHERY IN SANTO ANDRÉ LAGOON (PROJECT PELSA)

Domingos I.^{1,2}, J.L. Costa^{1,2}, P. Felix¹, M.J. Correia¹, B. Quintella^{2,3}, P.R. Almeida^{3,4}, T. Cruz^{3,5}, J.P. Marques¹, J. Santos¹, F. Silva¹, R. Monteiro¹, A. Vidal⁶, S. Nóbrega⁶, S. Bruxelas⁷, A. Franco⁷ & G. Lopes⁷

- 1 MARE - Centro de Ciências do Mar e do Ambiente, Faculdade de Ciências, Universidade de Lisboa, Lisboa, Portugal.
- 2 Departamento de Biologia Animal, Faculdade de Ciências, Universidade de Lisboa, 1749-016 Lisboa, Portugal (idomin-gos@fc.ul.pt).
- 3 MARE - Centro de Ciências do Mar e do Ambiente, Universidade de Évora, Évora, Portugal.
- 4 Departamento de Biologia, Escola de Ciências e Tecnologia, Universidade de Évora, Largo dos Colegiais 2, 7004-516 Évora, Portugal.
- 5 Laboratório de Ciências do Mar, Universidade de Évora, Apartado 190, 7521-903 Sines, Portugal.
- 6 RNLSAS - Reserva Natural das Lagoas de Santo André e da Sancha, Passeio da Fraternidade - Bairro Azul, Coletiva C4, r/c Dto, 7500-100, Vila Nova de Santo André, Portugal.
- 7 ICNF – Instituto de Conservação da Natureza e das Florestas, Avenida da República, 16, 1050-191 Lisboa, Portugal.

The eel fishery in Portugal is particularly relevant in estuaries and coastal lagoons, which are among the marine habitats with the highest biological productivity. Santo André Lagoon is one of the most important Portuguese coastal lagoons for the eel fishery, providing a considerable income for local fishermen. As are most coastal lagoons, Santo André Lagoon is a small and shallow coastal lagoon with an area of 150-250 ha, located in SW Portugal. It is isolated from the sea by a sandbar and the opening of the lagoon to the sea is managed artificially, occurring each year during an equinoctial spring tide. Recruitment by marine species occurs during spring and because fish can find protection and abundant food, they grow fast and support important fisheries. As the migration of eels (recruitment of glass eels and escapement of silver eels) occurs during Autumn and Winter, when the lagoon is isolated from the sea, the aim of the project PELSA is to understand the dynamics of the eel in the lagoon and to quantify recruitment and silver eel escapement, as well as to identify the periods when these occur. Besides addressing the mechanisms behind the dynamics of each life stage (glass eel, yellow eel and silver eel) and their migration patterns, this study also includes the characterization of the fishery by means of estimating effort and profitability. Several field experiments and sampling methods have been used to sample glass eels, yellow and silver eels, including fyke nets, trawl and stow nets, mark-recapture and telemetry procedures (yellow and silver eel), together with the monitoring of the fishery and fishermen interviews. The ultimate goal of the project is to identify adequate measures to achieve sustainable management, reconciling the eel fishery with the measures established in the Eel Management Plan.



FISHES: SCIENTIFIC DISSEMINATION USING PANELS-MURALS

Correia F.J.S.¹, C.S.Mateus² & B.R. Quintella²

¹ Laboratório de Ilustração Científica, Departamento de Biologia, Universidade de Aveiro, Campus de Santiago, 3810-193 Aveiro, Portugal (fjorgescorreia@sapo.pt).

² MARE – Centro de Ciências do Mar e do Ambiente, Universidade de Évora, Largo dos Colegiais 2, 7004-516 Évora, Portugal.

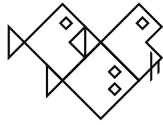
Contemporary society lives immersed in a sea of information/knowledge, and the way people acquire knowledge has changed over time.

High technology solutions are usually seen as one of the applicable strategies, but suffers from three major problems: 1) development of dedicated applications/software needs (costly and done by specialized technicians); 2) the use of specific visualization terminal/hardware (expensive and not always in generalized use); 3) momentary massification impact, which quickly dilutes in time (causing rapidly loss of interest and replacement).

Scientific communication (CC) is one of the process phases of scientific knowledge construction that allows science evolution (based on circulation/discussion of ideas/processes, and its legitimization by peers; CC strict sense, or primary), as well as promoting scientific literacy of general and non-specialized public (CC lato sense, or secondary, or Scientific Dissemination/SD). Scientific illustration (SI) is also a SD subdomain, in which scientific messages are encoded in drawn images.

The present study focus their operating area in SD/IC (conservation/ecology of marine/freshwater fish) using low technology solutions (low cost, extended reach and longevity) to publicize scientific projects implemented on the ground, using oversized and self-explanatory panels (static and immovable murals) and unify all the set by a quadriptic folding brochure (portable, offered to visitors).

This solution and strategy was successfully tested to publicize the Codfish Aquarium (Ilhavo Maritime Museum; 1 panel), the National Conservation Plan for Brook and European River lampreys, funded by EDP – Energias de Portugal (exhibition in Mora Fluviário, 3 panels). and, more recently, in the framework of the project Habitat restoration for diadromous fish in River Mondego (2013-15), funded by the Ministry of Agriculture and Sea, and cofunded by the European Fisheries Fund through PROMAR 2007-13 several panels were placed near weirs which were modified (10 panels placed in banks near weirs, showing what are fish passages and others transposition devices for the 8 diadromous species that currently use it). The methodologies and strategies for its development are discussed in terms of the objectives and required methodologies in each of the 3 study cases.



STUDY ON TURTLE EXCLUDER DEVICE USED BY A SHALLOW WATER SHRIMP FISHING COMPANY ON SOFALA BANK- MOZAMBIQUE

Palha de Sousa B.

Instituto Nacional de Investigação Pesqueira. Mao Tse Tung Avenue, 389, Maputo, Mozambique (bsousa2@gmail.com).

Shallow water shrimp in Sofala Bank-Mozambique is caught by three different sectors: an artisanal fishery and semi-industrial and industrial fleets that operate to 60 m. *Penaeus indicus* and *M. monoceros* are the main shrimp species. By catch fish species in the industrial fishery are *Otolithes ruber* (croaker), *Johnius amblicephalus* (croaker), *Johnius dussumierii*(croaker), *Pomadasy maculatum* (grunt), *Trichiurus lepturus* (largehead hairtail), *Pellona ditchela* (Indian sardine), *Thryssa vitirostris* (orangemouth thryssa) and *Arius dussumierii* (blacktip sea catfish), small shrimps, Brachyura crab and cephalopods including *Loligo* sp (squids) and *Sepia* sp (cuttlefish).

A study based on data collected on a shallow water shrimp trawler with nets with and without turtle excluder devices was undertaken during one trip on Sofala Bank in order to compare species and size composition of the shrimp and fish caught in the two kind of nets and to know if the use of the devices gives clean catches avoiding some species such as rays and trash.

Some results are presented regarding species and size composition in the two nets and recommendations.



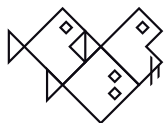
POPULATION STRUCTURE AND SOME LIFE HISTORY TRAITS OF THE BLIND MEXICAN CAVE FISH *ASTYANAX MEXICANUS*

Vázquez-Cruz M.L. & V. Hugo Reynoso

Departamento de Zoología, Instituto de Biología, Universidad Nacional Autónoma de México.
70-367. Ciudad de México. México. (biolilu@ciencias.unam.mx).

Ecological surveys for blind Mexican Cave fish *Astyanax mexicanus* are scarce, thus the actual state of their populations is unknown. As a model for evolutionary and developmental biology studies, it is imperative to know the current status of their populations and assess the risk caused by the individual's remove. Descriptive and comparative analysis of seven populations of *A. mexicanus* in different caves in northeast Mexico is presented. Population structure by size was analyzed for each study site, based on the relative frequencies by standard length classes. The length-weight relationship was determined for females and males. The sex ratio and condition factor was performed for each sample population. The gonadosomatic index (GSI), and relative fecundity were also analyzed. Finally density was obtained for each sample site. Eight sizes classes were established. Populations were significantly different in structure and sex ratio. While some populations had all size classes, other are composed only by juvenile or adult stages. The highest values of condition factor was obtained for "Jos" and "Molino" caves. The population with a higher proportion of young classes and lacking of adults was «Pachón», suggesting that continuous extraction of individuals is negatively affecting the structure of the population. It is suggested to apply more stringent regulations to prevent the continuous plundering of blind Mexican cave fish and enhance their population's conservation.

**AUTHORS
INDEX**



AUTHORS INDEX

A

Agirre K..... **P18**
Agorreta A..... **O91**
Alexandre C.M. **O11**, O16, **P7**
Almeida D..... O71, **O72**
Almeida R..... **P91**
Almodóvar A..... O2, **O88(Ex)**
Álvarez A..... **O50**, **P31**
Amaral S.D. **O12**
Amat-Trigo F. O7, **O10**
Antón A. **O26**
Amilhat E..... O15
Apun-Molina J.P..... O66, **P49**
Asturiano J.F. O53, O59, **SS08**
Azpiroz I. **O30**

B

Baduy F..... **O74**, P65
Baglinière J.L. SS21
Barca S. P5, **P10**, **P22**
Barcala E..... **P13**, P60
Barrios A..... **P72**
Barros-García D. **O95**, P64, **P88**, **P95**
Beltrán López R.G. **P89**
Bento E.G. **O80**
Blanco-Garrido F. **O37**
Brufao Curiel P. **SS21**

C

Cabrera-Castro R. O101, O105, **O109**
Caldeira C..... **P12**
Calle Lobo S..... **P34**
Campos N. **P21**
Cancio I. **PS/ Plenaria 3**, **P44**, **P45**
Carrera-García E..... **O23**
Casal-López M..... **O90**
Casals F. O03
Castillo-Domínguez A. **O99**
Ceballos-Francisco D. ... **O52**, O55 (Ex),
P36, **P37**
Clavero M..... **O19**, O24, O37, O70, O68,
O85
Cobo F..... P05, P10, P22

Cordero H..... O52, O55 (Ex), **O56**, **P41**,
P42, **P43**
Correia M.J..... **O28(Ex)**, O97
Cortes R.M.V..... **O04**, O08
Couso-Pérez S..... **P25**, **P26**, **P27**, **P61**

D

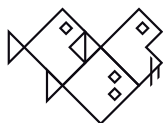
D´artola-Barceló A.L..... **O110**
De Jesus J. **O08**
De Juan J..... **O45**, **P46**, **P47**, **P48**
De la Cruz-Torres J. **O93**, O98
De la Gándara F. **PS/ Plenaria 4**, **P40**
De Miguel R.J... **O35**, **P4**, O14 (Ex), O33
De Noia M..... **O65**
Díaz E..... **O29**, O30, **P14**, **SS01**, **SS02**,
SS07
Domingos A.I. **O13**
Domingos I. ... **O97**, **SS06**, O16, O28 (Ex),
O34, P63, P82
Dove C..... **O22**

E

Encina L. **O61**
Esteban M.A. ... O52, **O55(Ex)**, O56, O61,
P32, P36, P37, P41, P42, P43,
P48, P50, **P51**, **P53**, P52, P62

F

Fagín E. **O86**
Faliex E. O15
Félix P.M..... O16, **O34**, **P82**
Fernández-Delgado C.. **O14(Ex)**, **SS03**,
SS04, O33, O35, O78 (Ex), P04, P30
Fernández-Garrido P..... SS20
Ferreira Machado M.R. **O67**
Ferreira M.T..... **PS/ Plenaria 5**, O12
Fondacaro R.R..... O40, **O103**
Fraile J..... **SS13**
Fraisse S..... **SS21**
Franch N..... **O85**, **P68**
Franco A..... **PS/ Plenaria 2**
Frutos M..... O43



AUTHORS INDEX

G

Gallego V. SS8, **O53**, O59
García García B. **P33**, P34
García-Andrade A.B. **P87**
García-Ayala A. O46, P54, P55
García-Chartón J.A. O57, O100
García-De-León F.J. O41, **O96**
García-García B. O50, P31, **O51**
García-Hernández M.P. **P55**
García-Rodríguez E. **O106**, O107
Ginés E. O23, **P3**
Gkenas C. **O70**, O73, O76, **P63**
Gómez-González N.E. **P54**, **O46**
González Fernández G... SS17, O31, **P90**
González-Manga M.D. O14 (Ex)
González M.D. **P11**, P29, **P30**
González-Acosta A.F. O93, **O98**
González-Alemán N. O01 (Ex), **O09**
González-Silvera D. **P35**
González M. **P20**
Górski K. **O69**
Granado-Lorencio C. **PS/ Plenaria 6**
Guerreiro P.M. **O48**, **P59**, P65, O74, **P83**
Guluarte C. **P62**, **O54**
Gündoğdu S. **O24**

H

Hermoso V. O19, **O24**, O37
Hernández D. P09
Herrera M. O14(Ex), **O33**, O35, P4,
Hurtado Melgar I.M. **O43**

J

Jesús J.B. O04
Jover-Cerdá M. **O42 (Ex)**

K

Kodde A. **O76**
Kemp P. **PS/ Plenaria1**

L

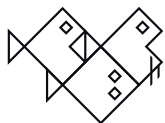
Lafuente E. P09, **SS12**
Lapesa S. P03, **P23**
Laplanche C. **O20**
Latorre D. **O71**
Lazzari N. O82, **O84**, O102, P85
Leunda P.M. O20, SS11
Llanes-Cárdenas O. O64, **O108**
Lobón-Cervía J. **O21**
López N. **O87**

M

Mameri D. **O39**
Manuzzi A. **O92**
Marcos-Primo C. **O31**, **SS17**, P90
Martín M. **O43**
Martinho F. O80, **P73**, **P74**, **P75**, **P76**
Martínez-Capel F. O27, P16
Martínez-García F.J. P16
Martínez-López F.J. P35
Mendiola I. **SS11**, O30, P18
Merino-Contreras M.L. **O63**
Miranda R. O05, O75, P17
Moncayo-Estrada R. **O38**, **P93**, **P94**
Morales-Nin B. **O17**
Morcillo F. **P8**, **P38**, **P39**
Moreno-Valcárcel R. O14 (Ex), O33,
O35, **O78 (Ex)**, P04
Muñoz P. P13, P20, **P60**, **SS05**
Muñoz-Mas R. **O27**, **P16**

N

Nachón D.J. **P5**, P10, P22
Narváez J.C. **O62**
Navarro S. **O47**
Neves J. **O81**, **P77**, **P84**
Nicola G.G. **O02**, O88 (Ex)
Norzagaray-Campos M. **O64**, O108
Nos-Francisco D. **O105**



AUTHORS INDEX

O

- Oliva-Paterna F.J.O07, O10, 078(Ex),
SS12, SS13, P86
Olivo del Amo R. SS12, SS13, P09
Ordeix M.**O03**, SS10

P

- Palha de Sousa B. **P99**
Paredes J.F. **O49**
Peñalver J. **O104**, P13, P60, **P96**
Peñaranda D. S. SS8, **O59**
Perdices A. **O89**
Perea S. 090, P8, **P92**
Pereira A.R. O36
Pereñíguez J.M. **O57**
Pérez-Ruzafa A. **O79**
Pinheiro M.S.S. **O83**, **P78**, **P79**, **P80**
Pou-Rovira Q. **O77**, 085, P66, P67,
P68, **P69**, **P70**, **P71**, SS14, **SS15**

Q

- Quintella B.R. 011, O13, **O16**, 034, P7,
P97, **P98**

R

- Ramírez-Amaro S. **O94**
Recasens L. O86
Redondo I. P11, P20, P29, P30
Ribeiro F. 070, **O73**, 076, **P15**, P63,
Rodeles A.A. **O05**
Rodríguez A.M. **O58**
Rodríguez-González M. **P85**
Rojo I. **O100**
Rubio S. 014 (Ex), P11, P20, **P28**, **P29**,
P30
Ruiz A.E. **O40**
Ruiz-Campos G. **O68 (Ex)**, 098
Ruiz-Luna A. **O41**
Ruiz-Navarro A. 007, O10

S

- Sahraeian M.R. **O44**, **P56**, **P57**
Sanabria J.A. **O82**, 084, 0102, P85
Sánchez-Balibrea J. **P9**, SS12, SS13
Sánchez-Martínez N.S. **O102**
Sánchez-Pérez A. **O07**, O10
Santamaría-Miranda A. 064, **O66**,
P48, **P52**
Sanz-Ronda F.J. **O01 (Ex)**, **P1**, **P2**,
006, 007, 009, SS12
Saraiva A. **O36**
Sarmiento J. **O101**
Serrano-García B. **P6**, **SS16**
Silva R. **SS18**
Simón G. O15
Soler P. **P58**

T

- Tobes I. **O25**, **P17**
Torralva M. 007, O10, 043, SS12,
SS13, P86

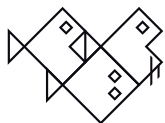
V

- Valbuena-Castro J. **O06**, 001 (Ex)
Valls E. **O60**
Van Herk J. **SS19**
Vázquez-Cruz M.L. **P100**
Vedia I. **O75**
Ventura M. **P66**, **P67**, **SS14**, **O18**,
077, P71
Veríssimo A. P15, **O97**
Vidal M. O112
Vieira R. P05, P10, P22
Vila-Gispert A. 071
Villa-Navarro F.A. **O111**
Vivas Salvador M. O106, **O107**, **P81**

Z

- Zamora L. **O32**, **P19**, SS07, **SS09**
Zamora-López A. 07, P86
Zamora-Marín J.M. 07, **P86**

PARTICIPANTS INDEX



PARTICIPANTS INDEX

Agorreta Calvo, Ainhoa

Universidad Complutense de Madrid
ainhoaag@ucm.es

Alexandre, Carlos Manuel

MARE - Centro de Ciências do Mar e do Ambiente
cmalexandre@fc.ul.pt

Almeida Real, David

Universidad de Girona
dalmeidareal@yahoo.es

Almodóvar Pérez, Ana

Universidad Complutense de Madrid
aalmodovar@bio.ucm.es

Álvarez Trujillo, Ana

IMIDA Instituto Murciano de Investigación y Desarrollo Agrario y Alimentario IMIDA
anam.alvarez2@carm.es

Amaral, Susana

Instituto Superior de Agronomia
samaral@isa.ulisboa.pt

Amat Trigo, Fátima

Departamento de Zoología y Antropología Física, Universidad de Murcia
fatima.amat@um.es

Amilhat, Elsa

Université de Perpignan Via Domitia
faliex@univ-perp.fr

Angulo Paredes, Amaia

Universidad de Navarra
aangulo@alumni.unav.es

Antón Baranda, Álvaro

University of the Basque Countryalvaro.
anton@ehu.es

Apun Molina, Juan Pablo

CIIDIR-UNIDAD SINALOA-IPN
japun@ipn.mx

Asturiano Nemesio, Juan Francisco

Universitat Politècnica de València
jfastu@dca.upv.es

Azpiroz Colmenero, Iker

Ekolur Asesoría Ambiental SLL
iker@ekolur.com

Baduy Vaz da Silva, Flávia

Centre of Marine Sciences, University of Algarve
fbsilva@ualg.pt

Baglinière, Jean-Luc

National Institute for Agricultural Research, Department of Ecology, UMR ESE
jean-luc.bagliniere@rennes.inra.fr

Baraut Plarromaní, Joan

Forestal Catalana SA
joan.baraut@gencat.cat

Barca Bravo, Sandra

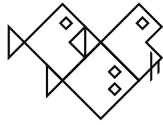
Estación de Hidrobiología "Encorodo Con". Universidad de Santiago de Compostela
sandra.barca@usc.es

Barcala Bellod, Elena

Centro Oceanográfico de Murcia, Instituto Español de Oceanografía
elena.barcala@mu.ieo.es

Bárcena Orbe, Antonio

Tragsa
abarcena@tragsa.es



PARTICIPANTS INDEX

Barrios Rodriguez, Alexander José

Institut Français de Recherche pour
l'exploitation de la mer
Alexander.Barrios@partenaire-exterieur.
ifremer.fr

Barros-García, David

Centro de Apoyo Científico
Tecnológico a la Investigación (CACTI)
University of Vigo
Davbarros@uvigo.es

Beltrán López, Rosa Gabriela

Museo Nacional de Ciencias Naturales
rosa.beltran@uaem.mx

Benejam Vidal, Lluís

Universitat de Vic
lluisebenejam@uvic.cat

Blanco Garrido, Francisco

Estación Biológica de Doñana, CSIC
paquito.blanco@gmail.com

Blaya, Luis

OSEPSA
luis.blaya@osepsa.es

Brufao Curiel, Pedro

Universidad de Extremadura
pbrufao@hotmail.com

Cabrera Castro, Remedios

Universidad de Cádiz
reme.cabrera@uca.es

Caldeira, Carina

Proiser R+D
carina.caldeira@proiser.com

Calle Lobo, Sergio

Instituto Murciano de Investigación y
Desarrollo Agrario y Alimentario
s.calle.lopez@gmail.com

Campos Martín, Nazaret

Universidad de Cádiz
nazacamposm@gmail.com

Cancio, Ibon

Estación Marina de Plentzia (PiE-UPV/
EHU)
ibon.cancio@ehu.es

Carrera García, Erika

IRSTEA (National Research Institute
of Science and Technology for
Environment and Agriculture)
erika.carrera-garcia@irstea.fr

Casal López, Miriam

Museo Nacional de Ciencias naturales
miriam@mncn.csic.es

Casals Martí, Frederic

ETSEA Universitat de Lleida
fcasals@prodan.udl.cat

Castillo Domínguez, Alfonso

División Académica Multidisciplinaria
de los Ríos, Universidad Juárez
Autónoma de Tabasco
alfonso.castillo@ujat.mx

Castiñeira Lemus , Maximino

VAKI
maxi@i-dea.es

Ceballos, Diana

Fish Innate Immune System Group,
Department of Cell Biology and
Histology, Faculty of Biology, University
of Murcia
dianacecilia.cebillos@um.es

Clavero Pineda, Miguel

Estación Biológica de Doñana - CSIC
miguelito.clavero@gmail.com



PARTICIPANTS INDEX

Cobo Gradín, Fernando

Estación de Hidrobiología "Encorodo Con". Universidad de Santiago de Compostela.

fernando.cobo@usc.es

Cordero, Héctor

University of Murcia

cordero@um.es

Correia, Maria João

MARE - Marine and Environmental Sciences Centre

mjcorreia@fc.ul.pt

Couso Pérez, Seila

Facultad de Farmacia, Universidad de Santiago de Compostela

seila.couso@rai.usc.es

de Almeida Ferreira, Inês

Escola Superior de Turismo e Tecnologia do Mar

ginkgoferreira@gmail.com

de Juan Herrero, Joaquín

Universidad de Alicante

jdj@ua.es

de la Cruz Torres, Jonathan

Posgrado de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México

jct_90@outlook.com

de la Gándara García, Fernando

Instituto Español de Oceanografía

fernando.delagandara@mu.ieo.es

de Miguel Rubio, Ramón J.

Universidad de Córdoba

rjmiguel@uco.es

Díaz Silvestre, Estibaliz

Fundación AZTI

ediaz@azti.es

Domenain Fau , Alberto

Caviar de Ríofrío S.L.

alberto@caviarderiofrio.com

Domingos, Isabel

Faculdade de Ciências, Universidade de Lisboa

idomingos@fc.ul.pt

Dove, Clive

Fundación Conde del Valle de Salazar

cdove.sti@gmail.com

Encina Encina, Lourdes

Universidad de Sevilla

lencina@us.es

Esteban, M^a Ángeles

Fish Innate Immune System Group, Department of Cell Biology and Histology, Faculty of Biology, University of Murcia

aesteban@um.es

Fagín García, Elena

Institut de Ciències del Mar (ICM-CSIC), Barcelona

elena.fagin@gmail.com

Faliex, Elisabeth

Université de Perpignan Via Domitia

faliex@univ-perp.fr

Felix, Pedro

MARE - Marine and Environmental Sciences Centre

pmfelix@fc.ul.pt

Fernández Delgado, Carlos

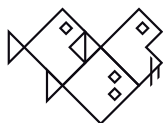
Universidad de Córdoba

carlos.fdelgado@uco.es

Fernández Garrido, Pao

World Fish Migration Foundation

pao@fishmigration.org



PARTICIPANTS INDEX

Ferreira, Teresa

Department of Natural Resources,
Environment and Landscape, School of
Agriculture
terferreira@isa.ulisboa.pt

Fondacaro, Ricardo R.

Facultad de Ciencias Naturales, sede
Trelew, Universidad Nacional de la
Patagonia, San Juan Bosco
ricardofonda@gmail.com

Fraile Jiménez de Muñana, Jaime L.

Confederación Hidrográfica del Segura
jaime.fraile@chsegura.es

Fraisse, Stéphane

National Institute for Agricultural
Research, department of Ecology, UMR
ESE
stephane.fraisse@rennes.inra.fr

Franch Ventura, Nati

Parc Natural del Delta de l'Ebre
nfranchv@gencat.cat

Franco, Anita

Institute of Estuarine and Coastal
Studies, University of Hull
A.Franco@hull.ac.uk

Franco Galera , Juan María

Departamento de Zoología y
Antropología Física, Universidad de
Murcia
franco.juanm@gmail.com

Frutos Sansano, María

Aquatec (Suez). Av.Teniente
Montesinos nº 8 Edificio INTI, Torre Z,
Planta 8, 30.100 Murcia, España
mfrutos@aqualogy.net

G. Nicola, Graciela

Facultad de Ciencias Ambientales y
Bioquímica, Universidad de Castilla-La
Mancha (UCLM)
graciela.nicola@uclm.es

Gallego Albiach, Victor

Universitat Politècnica de València
vicgalal@upvnet.upv.es

Gallés Gabarró, Anna

Fondo Andrena
agalles@andrena.cat

García Andrade, Ana Berenice

Universidad Michoacana de San Nicolás
de Hidalgo
aberenicega@gmail.com

García Ayala, Alfonso

Facultad de Biología
agayala@um.es

García Charton, José Antonio

Departamento de Ecología e
Hidrología, Universidad de Murcia
jcharton@um.es

García de León, Francisco

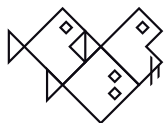
Centro de Investigaciones Biológicas
del Noroeste, SC
fgarciadl@cibnor.mx

García García, Benjamín

Instituto Murciano de Investigación y
Desarrollo Agrario y Alimentario
benjamin.garcia@carm.es

García Hernández, María del Pilar

Department of Cell Biology and
Histology, University of Murcia
piligar@um.es



PARTICIPANTS INDEX

García Moreno, Pedro

Asociación de Naturalistas del Sureste
pedrogm@asociacionanse.org

García Rodríguez, Encarnación

Instituto Español de Oceanografía
encarnacion.garcia@mu.ieo.es

Gil Santos, Miguel Ángel

FORUM SAN PATRICIO, S. A.
miguelgil@forumsanpatricio.com

Ginés Llorens, Ester

Gobierno de Aragón
egines@aragon.es

Gkenas, Christos

MARE - Centro de Ciências do Mar e do Ambiente
chrisgenas@gmail.com

Gómez Caruana, Francisco

Autónomo
f.caruana@hotmail.com

Gómez González, Nuria Esther

Department of Cell Biology and Histology, Faculty of Biology, University of Murcia
nuriaesther.gomez@um.es

González Acosta, Adrián Felipe

Instituto Politécnico Nacional, Centro Interdisciplinario de Ciencias Marinas
aacosta@ipn.mx

González Alemán, Néstor Joel

Universidad de Valladolid, Recinto La Yutera
ngonzalezaleman@yahoo.es

González Fernández, Gustavo

Ichthios
gustavo@ichthios.es

González Manga, María Dolores

Agencia de Medio Ambiente y Agua
mdgonzalez@
agenciamedioambienteyagua.es

González Muñoz, Cristina

Confederación Hidrográfica del Segura
cristina.gonzalez@chsegura.es

González Silvera, Daniel

Departamento de Fisiología, Facultad de Biología, Universidad de Murcia
danielgs@um.es

González Juan, Moisés

Departamento de Sanidad Animal, Facultad de Veterinaria, Universidad de Murcia
cmcpleit@um.es

Górski, Konrad

Departamento de Ecología, Facultad de Ciencias, UCSC, Concepción
konrad@ucsc.cl

Granado Lorenzo, Carlos

Universidad de Sevilla
Granado@us.es

Granja Bento, Eduardo

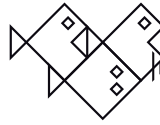
Centre for Functional Ecology - CFE, Department of Life Sciences, University of Coimbra
edugraben@gmail.com

Guerreiro Costa, Pedro Miguel

Centre for Marine Sciences - Universidade do Algarve
pmgg@ualg.pt

Guluarte Vélez, Crystal Alejandra

Centro de Investigaciones Biológicas del Noroeste/crystalguluarte@um.es



PARTICIPANTS INDEX

Gundogdu, Sedat

Cukurova University
sedat.gundogdu.65@gmail.com

Hermoso Lopez, Virgilio

Centre Tecnològic Forestal de
Catalunya
virgilio.hermoso@gmail.com

Hernández Mármol, Diana

Asociación de Naturalistas del Sureste
dianahm16@gmail.com

Herrera Arroyo, Mercedes

Dpto. de Zoología. Universidad de
Córdoba
zo2hearm@uco.es

Hurtado Melgar, Isabel M^a

Aquatec (Suez). Av.Teniente
Montesinos nº 8 Edificio INTI, Torre Z,
Planta 8, 30.100 Murcia, España
imhurtado@aqualogy.net

Irigoién Goikoetxea, Gaizka

ACUIITEC S.L.
gaizka@acuitech.es

Jesús, Joaquim

Universidade de Trás-os-Montes e Alto
Douro
joaquimbarreira@gmail.com

Jiménez Herrero, Fernando

Centro de Experimentación Pesquera,
Consejería de Desarrollo Rural y
Recursos Naturales, Principado de
Asturias
fernando.jimenezherrero@asturias.org

Jover Cerdá, Miguel

Universidad Politecnica Valencia
mjover@dca.upv.es

Kemp, Paul

University of Southampton
p.kemp@soton.ac.uk

Kodde, Alexa Philippa

MARE, Centro de Ciências do Mar e
do Ambiente, Faculdade de Ciências,
Universidade de Lisboa, Campo Grande
alexa_kodde1@hotmail.com

Lafuente Sacristán, Eduardo

Confederación Hidrográfica del Segura
eduardo.lafuente@chsegura.es

Lapesa Lazaro, Sara

SARGA
slapesa@sarga.es

Laplanche, Christophe

INPT ENSAT
christophe.laplanche@ensat.fr

Latorre, Daniel

Universidad de Girona
anna.vila@udg.edu

Lazzari, Natalí

Instituto de Productos Naturales y
Agrobiología (IPNA-CSIC)
n.lazzari@csic.es

Lecuona Alzugaray, Aitor Javier

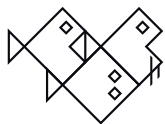
Diputación Foral de Gipuzkoa
alecuona@gipuzkoa.eus

Leunda, Pedro M

LIFE Irekibai - Gestión Ambiental de
Navarra S.A.
pleundau@ganasa.es

Llanes Cárdenas, Omar

CIDIIR-IPN-Sinaloa
oma_llanes@yahoo.com.mx



PARTICIPANTS INDEX

Lobón-Cerviá, Javier

Museo Nacional de Ciencias Naturales
(CSIC)
MCNL178@mncn.csic.es

Loné Pérez, Pedro Pablo

Estudios y Conservación S.L.
pplonep@yahoo.es

López Aledo, Teresa

Oficina de Impulso Socioeconómico del
Medio Ambiente, Murcia
salinasdesanpedro@gmail.com

López López, Nieves

Institut de Ciències del Mar (ICM-CSIC),
Barcelona
nieves.lopez.nl@gmail.com

Mameri, Daniel

Centre for Ecology, Evolution and
Environmental Changes, Faculty of
Sciences, University of Lisbon
dani.crm92@gmail.com

Manuzzi, Alice

Univeristy of Padua
alice.manuzzi@gmail.com

Marcos Primo, Carlos

Confederación Hidrográfica del Duero
cmp@chduero.es

Márquez Llano-Ponte, Isabel

Servicio Regional Investigación
Asturias (SERIDA)
imarquez@serida.org

Martín, Manuel

Centre for Functional Ecology - CFE,
Department of Life Sciences, University
of Coimbra
edugraben@gmail.com

Martínez Capel, Francisco

GIC, Universitat Politecnica de Valencia
fmcapel@dihma.upv.es

Martínez Fernández, Juan Faustino

Oficina de Impulso Socioeconómico del
Medio Ambiente, Murcia
juanf.martinez@carm.es

Martínez García, José Antonio

Dirección General de Desarrollo Rural y
Forestal
josea.martinez11@carm.es

Martínez López, Francisco Javier

Universidad de Murcia
javmaraq@um.es

Martínez Sánchez, José

jose.martinez.sanchez.med.amb@gmail.
com

Martinho, Filipe

Centre for Functional Ecology - CFE
fmdm@ci.uc.pt

Mendiola Gómez, Iñigo

Diputación Foral de Gipuzkoa
imendiola@gipuzkoa.eus

Miranda, Fábio

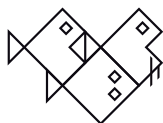
Escola Superior de Turismo e
Tecnologias do Mar
fabio.s.miranda@hotmail.com

Miranda Ferreiro, Rafael

Universidad de Navarra
rmiranda@unav.es

Moitinho Rodrigues, António

Escola Superior Agrária - Instituto
Politécnico de Castelo Branco
amrodrig@ipcb.pt



PARTICIPANTS INDEX

Moncayo Estrada, Rodrigo

CICIMAR-Instituto Politécnico Nacional.
rmoncayo@hotmail.com

Morales Nin, Beatriz

IMEDEA CSIC/UIB
beatriz@imedea.uib-csic.es

Morcillo Alonso, Felipe

Departamento de Ecología. Universidad
Complutense de Madrid
fmorcalo@yahoo.es

Moreno Valcarcel, Raquel

Universidad de Córdoba
raquel.moreno@uco.es

Muñoz Mas, Rafael

Institut d'Investigació per a la Gestió
Integrada de Zones Costaneres (IGIC),
Universitat Politècnica de València
pitifleiter@hotmail.com

Muñoz Ruiz, Pilar

Universidad de Murcia
pilarmun@um.es

Nachón García, David José

Estación de Hidrobiología "Encoro
do Con". Universidad de Santiago de
Compostela .. davidjose.nachon@usc.es

Narváez Barandica, Juan Carlos

Universidad del Magdalena, Santa
Marta, Colombia
jcnarvaezb@yahoo.es

Navarro Rojas, Sandra

Instituto de Acuicultura de Torre de la
Sal (CSIC)
sandranavarro@iats.csic.es

Neves, Joao

CFE - Centre for Functional Ecology
jfbneves@gmail.com

Norzagaray Campos, Mariano

CIIDIR-IPN-Sinaloa
mnorzacam@yahoo.com.mx

Nos Francisco, David

Universidad de Barcelona
david.nos@hotmail.com

Oliva Paterna, Francisco J.

Dpto. Zoología y Antropología Física..
fjoliva@um.es

Olivo del Amo, Rosa

TYPSA, Ingenieros, Consultores y
Arquitectos. Murcia
rolivo@typsa.es

Ordeix i Rigo, Marc

CERM, Centre d'Estudis dels Rius
Mediterranis - Museu del Ter
marc.ordeix@museudelter.cat

Paredes Salas, Juan Fernando

Universidad de Murcia
juanfernandops@gmail.com

Pena Álvarez, José Carlos

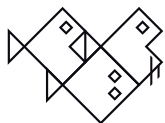
Universidad de León
jcpena@unileon.es

Peñalver García, José

Consejería de Agricultura y Agua
jose.penalver2@carm.es

Perdices, Anabel

Museo Nacional de Ciencias Naturales
CSIC
aperdices@mncn.csic.es



PARTICIPANTS INDEX

Perea Aranda, Silvia

Museo Nacional de Ciencias Naturales
CSIC
sperea2@gmail.com

Pereira de Almeida, Ana Rita

Faculty of Sciences, University of
Lisbon
ritapalmeida93@gmail.com

Pereñíguez López, José Manuel

Departamento de Ecología e
Hidrología, Universidad de Murcia
josemanuel.pereniguez@gmail.com

Pérez Ruzafa, Ángel

Departamento de Ecología e
Hidrología, Universidad de Murcia
angelpr@um.es

Pertusa Ibáñez, José Manuel

Tecnología y Servicios Agrarios, S.A.
jpertusa@tragsa.es

Piccinini, Armando

Biomark
armando.piccinini@biomark.com

Pinheiro, Maria Do Socorro

Universidade Federal do Maranhão -
UFMA, Brasil
spinheiro@elo.com.br

Pou-Rovira, Quim

Sorelló / Consorci de l'Estany
quim.pou@sorello.net

Prudhomme, Goulven

Nautilus Oceanica
apalmeiro@nautilusoceanica.com

Quintella, Bernardo

MARE - Marine and Environmental
Sciences Centre
bsquintella@fc.ul.pt

Ramírez, Sergio

Instituto Español de Oceanografía,
Centre Oceanogràfic de les Balears
sergio.ramirez@ba.ieo.es

Ramón García-Garre, Manuel

Facultad de Biología
manuel.ramon@um.es

Recasens, Laura

Institut de Ciències del Mar del Mar de
Barcelona
laura@icm.csic.es

Redondo Morales, Isabel María

Consejería de Medio Ambiente y
Ordenación del Territorio. Junta de
Andalucía
isabelm.redondo@juntadeandalucia.es

Reza, Mohamad

Department of Fisheries, Faculty of
Natural Resources, University of Tehran
rezai.davood@ut.ac.ir

Ribeiro, Filipe

MARE - Centro de Ciências do Mar e do
Ambiente
fmvribeiro@gmail.com

Rodrigues Ferreira Machado, Monica

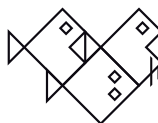
UFG - Brasil
monicavet_2@hotmail.com

Rodríguez González, María

IPNA - CSIC
maria.riguez92@hotmail.com

Rojo Moreno, Irene

Departamento de Ecología e
Hidrología, Universidad de Murcia
irenerojo@um.es



PARTICIPANTS INDEX

Rubio Rubio, Silvia

Agencia de Medio Ambiente y Agua
srubio@agenciamedioambienteyagua.
es

Ruiz, Ana E.

Facultad Ciencias Naturales, sede
Trelew, Universidad Nacional Patagonia
San Juan Bosco
anaruiztw@yahoo.com.ar

Ruiz Luna, Arturo

Centro de Investigación en
Alimentación y Desarrollo, A.C.
arluna@ciad.mx

Ruiz-Campos, Gorgonio

Universidad Autónoma de Baja
California
gruiz@uabc.edu.mx

Ruiz-Navarro, Ana

Bournemouth University
anaruiz@um.es

Saad, Dante David

Uader
pisciculturaldl@gmail.com

Sáez Gómez, Pedro

Universidad de Huelva
pedro.saez@ciecema.uhu.es

Sanabria Fernández, José Antonio

Consejo Superior de Investigaciones
Científicas (IPNA-CSIC)
jose.sanabria@csic.es

Sánchez Balibrea, Jorge

Asociación de Naturalistas del Sureste
araar@asociacionanse.org

Sánchez Martínez, Néstor

Instituto de Productos Naturales y
Agrobiología, IPNA, CSIC
nestorsanchezmartinez@gmail.com

Sánchez Peñaranda, David

Universitat Politècnica de València
dasncpea@upvnet.upv.es

Sánchez Pérez, Ana

Departamento de Zoología y
Antropología Física, Universidad de
Murcia
ana.sanchez15@um.es

Sánchez Santa, Julián

Independiente
zoot.juli@gmail.com

Sancho Cabrero, David

Consejería de Agricultura, Agua
y Medio Ambiente. Servicio de
Diversificación de Economía Rural
david.sancho@carm.es

Santamaría, Apolinar

Instituto Politécnico Nacional
asantama@ipn.mx

Sanz-Ronda, Francisco Javier

ETSIIAA Palencia-Universidad de
Valladolid
escalasparapeces@gmail.com

Saraiva, Aurélio

Faculdade de Ciências, Universidade
do Porto
amsaraiv@fc.up.pt

Sarmiento Carbajal, Jesica

Universidad de Cádiz
jesica.sarmientocarbajal@alum.uca.es

Sellarès i Oró, Núria

CERM, Centre d'Estudis dels rius
mediterranis - Museu del Ter
nuria.sellares@museudelter.cat

Serrano García, Blanca

Fundación Naturaleza y Hombre
serrano@fnyh.org



PARTICIPANTS INDEX

Silva, Ricardo

Liga para a Proteção da Natureza
ricardo.silva@lpn.pt

Simon, Gael

Université de Perpignan Via Domitia
faliex@univ-perp.fr

Soler Vilaplana, Patricia

Universidad de Barcelona
patrisoler89@gmail.com

Strand, Preben

VAKI
preben@vaki.no

Tobes Sesma, Ibon

Centro de Investigación de la
Biodiversidad y Cambio Climático -
BioCamb, Universidad Tecnológica
Indoamérica
ibontobes@gmail.com

Torralva Forrero, Mar

Departamento de Zoología y
Antropología Física, Universidad de
Murcia
torralva@um.es

Valbuena Castro, Jorge

Grupo de Ecohidráulica Aplicada de la
Universidad de Valladolid
jvalbuena@forest.uva.es

Valls Mateus, Elisenda

Institut de Ciències del Mar (ICM-CSIC),
Barcelona
elisenda.vallsmateus@gmail.com

Van Herk, Jeroen

LINKit consult
jeroen@linkitconsult.nl

Vázquez Cruz, María de Lourdes

Universidad Nacional Autónoma de
México
biolilu@ciencias.unam.mx

Vedia Jiménez, Ivan

Universidad de Navarra
ivedia@alumni.unav.es

Ventura, Marc

Centro de Estudios Avanzados de
Blanes (CEAB-CSIC)
ventura@ceab.csic.es

Verissimo, Ana

CIBIO - Research Center in Biodiversity
and Genetic Resources, Vairão Portugal
averissimo@cibio.up.pt

Vidal Torrano, Mariano

TILAMUR
mariano@tilamur.com

Vieira-Lanero, Rufino

Estación de Hidrobiología "Encoro
do Con". Universidad de Santiago de
Compostela
rufino.vieira@usc.es

Vila Gispert, Anna

Univeridad de Girona
anna.vila@udg.edu

Vitor Cortes, Rui Manuel

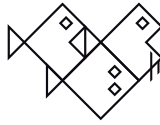
Centro de Investigação em Tecnologias
Agro-ambientais e Biológicas (CITAB),
Vila Real, Portugal
rcortes@utad.pt

Vivas Salvador, Miguel

Instituto Español de Oceanografía
miguel.vivas@mu.ieo.es

Zamora Hernández, Lluís

Universidad de Girona
lluis.zamora@udg.edu



SIBIC2016

VI IBERIAN CONGRESS OF ICHTHYOLOGY
MURCIA, SPAIN 21st - 24th June

PARTICIPANTS INDEX

Zamora López, Antonio

Departamento de Zoología y
Antropología Física, Universidad de
Murcia
antonio.zamora2@um.es

Zamora Marín, José Manuel

Departamento de Zoología y
Antropología Física, Universidad de
Murcia
josemanuel.zamora@um.es



Logging Life Science
STAR : ODDI

Temperature, pressure and conductivity loggers

Multiparameters probes



MULTIPARAMETER PROBES NETWORKS PROFILERS DEEP SEA

INTOVA



Intova ConneX

All the features of a traditional action camera, plus a proprietary cable system that delivers uninterrupted power and provides a live video feed to the screen of your choice.

Cost effective fish monitoring!



Song Meter SM4

The smallest and lightest dual-channel, weatherproof acoustic recorder available.

- > Deploy for up to 400 hours
- > Store more than a terabyte of recordings
- > Simultaneously record above and below the surface of the water

NAUTILUS OCEANICA Distributor of Wildlife Acoustics equipment in Spain and Portugal
www.nautilusoceanica.com

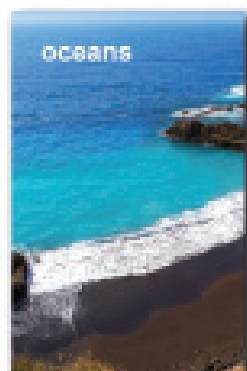
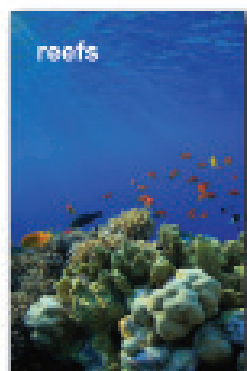
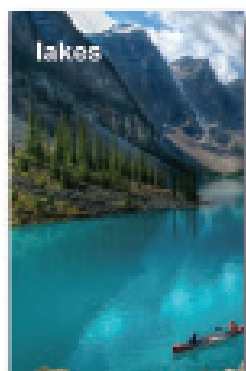
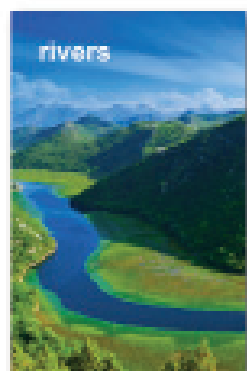
wildlife
ACOUSTICS
ACQUISITION, ANALYSIS, STORAGE, AND DISPLAY
www.wildlifeacoustics.com



**fish tracking and
monitoring equipment**

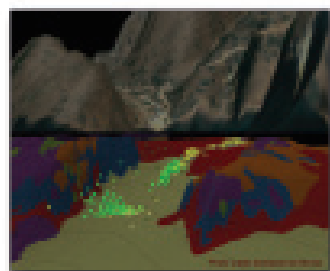
Study Behaviour and Migration of Animals

VEMCO is the global leader in the design and manufacture of underwater acoustic telemetry monitoring and tracking systems used by researchers around the world for behaviour, migration and positioning studies of aquatic animals in fresh and saltwater environments.

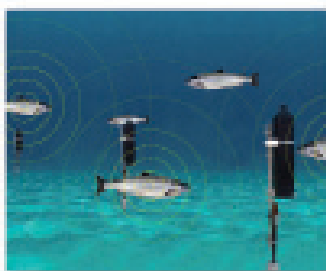


Active Tracking • Passive Monitoring • Fine Scale Positioning

VEMCO products include various types and sizes of acoustic transmitters (pingers and sensor tags with integral pressure, temperature and accelerometers), automated receivers for long term behavioural studies, high-resolution positioning capabilities information, and temperature data loggers.



The VEMCO Positioning System (VPS) uses off-the-shelf receivers and tags to conduct fine scale positioning studies.



With over 25,000 VR2W receivers deployed worldwide, researchers can collaborate, leverage each others' equipment and share data.



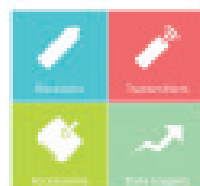
Coded transmitters range in size from 5mm to 16mm diameter. (V4 and V5 are 180kHz; V7, V8, V9, V13 and V16 are 68kHz.)



info@nautilusoceanica.com
www.nautilusoceanica.com

**Exclusive distributor of
VEMCO equipment in
Spain and Portugal**

**Phone: +34 916320508
Mobile: +34 656382129**



PRÖJSER
Projectes | Serveis R+D

...because sperm matters!

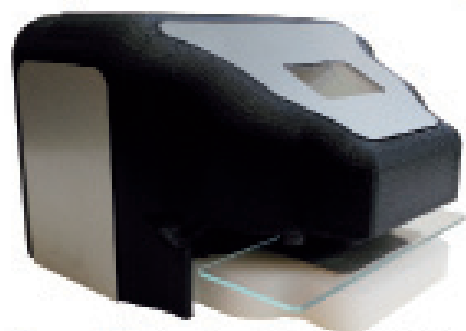
Seminal analysis in fish



Find us on **stand n. 5**

TRUMORPH®

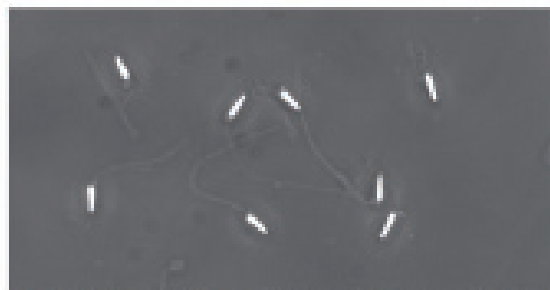
Preparation of seminal samples for **morphological evaluation**



- **Trumorph®** is the ultimate observation technique of the sperm morphology.
- **Trumorph®** is comprised of a device and an objective 40x/50x PH (-). After placing a drop between conventional slide and cover, the device applies light pressure. Thus, the cells are immobilized, allowing their observation.
- **Trumorph®** is supported by various scientific publications. The results show comparable morphologies to those observed after using conventional stains, with the added advantages of not introducing visual artefacts and saving time.



Fish semen sample, prepared with Trumorph® and observed at 40x



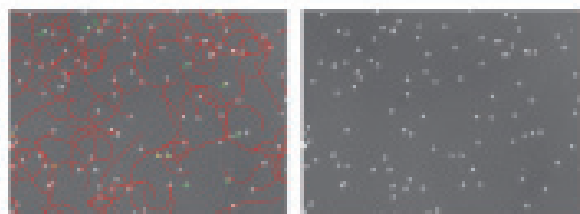
Sturgeon sample, prepared with Trumorph® and observed at 40x

ISAS® V1 MOT

Evaluation of motility with the **new High Speed videocamera** (up to 500 fps)



The new **HS videocamera** can work up to 500 fps, being suitable to capture and to analyse fish semen samples.



The best **analysis of fish sperm tracks**, obtaining kinematic values of nine parameters (VLC, VSL, VAP, ...). The camera is compatible with the **ISAS® v1 Motility module**.

IMPRESS

Improved production strategies for endangered freshwater species



NEXT LAUNCHES

In collaboration with IMPRESS we are developing, specially for fish semen analysis, new **cell counting chambers** and a **sample cooler devices**.

We will keep you informed!

For further information:
proiser@proiser.com

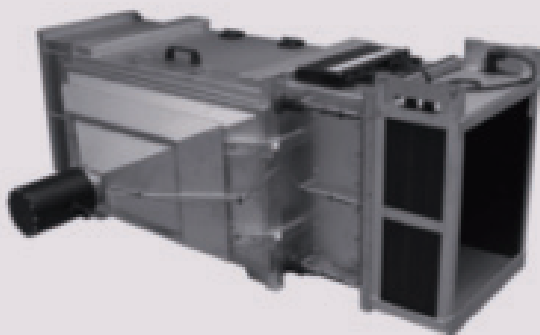


RIVERWATCHER

FISH COUNTER

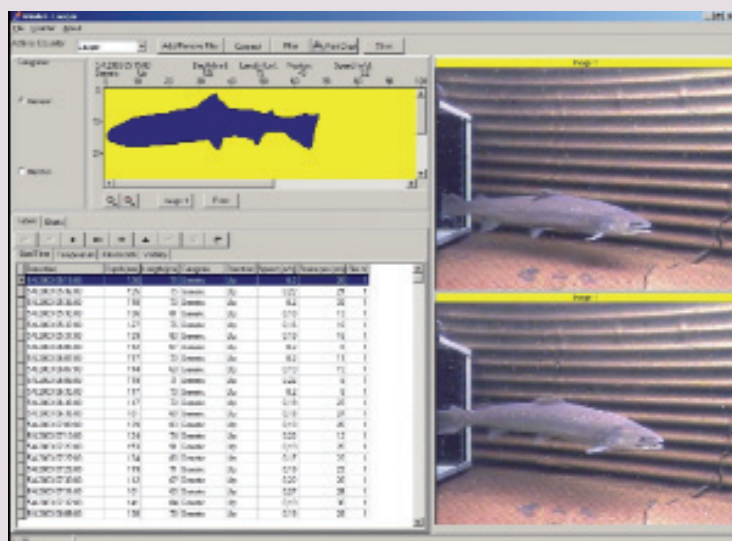
CONTADOR DE PECES RIVERWATCHER FISH COUNTER DE VAKI

Muchos años de desarrollo y de investigación con el Contador de Peces Riverwatcher tiene un historial muy probado de fiabilidad y precisión. El Contador de Peces Riverwatcher está en funcionamiento para monitorear los patrones de migración de los peces en más de 300 ríos a escala mundial en una amplia variedad de escalas para peces, presas y pasos de ictiofauna. Hay varias opciones diferentes instalaciones están disponibles para adaptarse a casi cualquier río y localización. El Contador de Peces Riverwatcher puede ser personalizado para adaptarse a necesidades y características especiales.



El Contador de Peces Riverwatcher se utiliza para controlar la migración de peces. El uso de la tecnología de escaneo infrarrojo y cámaras de alta resolución hacen que sea posible reconocer las diferentes especies y validar los recuentos con imágenes de la silueta y fotos.

El Contador de Peces Riverwatcher se utiliza en más de 300 ubicaciones en todo el mundo, incluyendo Islandia, Escandinavia, Irlanda, Reino Unido, EE.UU., Canadá, España, Portugal, Polonia, la República Checa, Alemania y Suiza.



PRINCIPALES CARACTERÍSTICAS

- Conteos de peces con más del 98% de precisión.
- Mide el tamaño de cada individuo con más del 95% de precisión.
- La unidad de control almacena una imagen de todos los peces que pasa el escáner, por lo que el conteo se puede verificar después.
- La fecha y la hora del día que cada pez pasa el escáner se registra.
- La temperatura del agua se mide a intervalos frecuentes.
- Se puede alimentar con paneles solares y una batería de ciclo profundo, lo que lo convierte en autónomo.
- El almacenamiento y la presentación de todos los datos en un software para PC que realiza informes.
- Control remoto.
- El Contador de Peces Riverwatcher se puede utilizar con una cámara de vídeo.

VENTAJAS

- La comparación de las cifras de muestreo y el patrón de movimiento de los peces para el cálculo de la tasa de explotación.
- La comparación del patrón de movimiento de los peces de un año a otro.
- Evaluación de los resultados de explotación.
- Evaluación de la influencia de diferentes factores ambientales.
- Evaluación de la eficiencia de la escala de peces.
- Datos valiosos para mejorar la ordenación pesquera.
- La identificación de las especies, el sexo, etc.



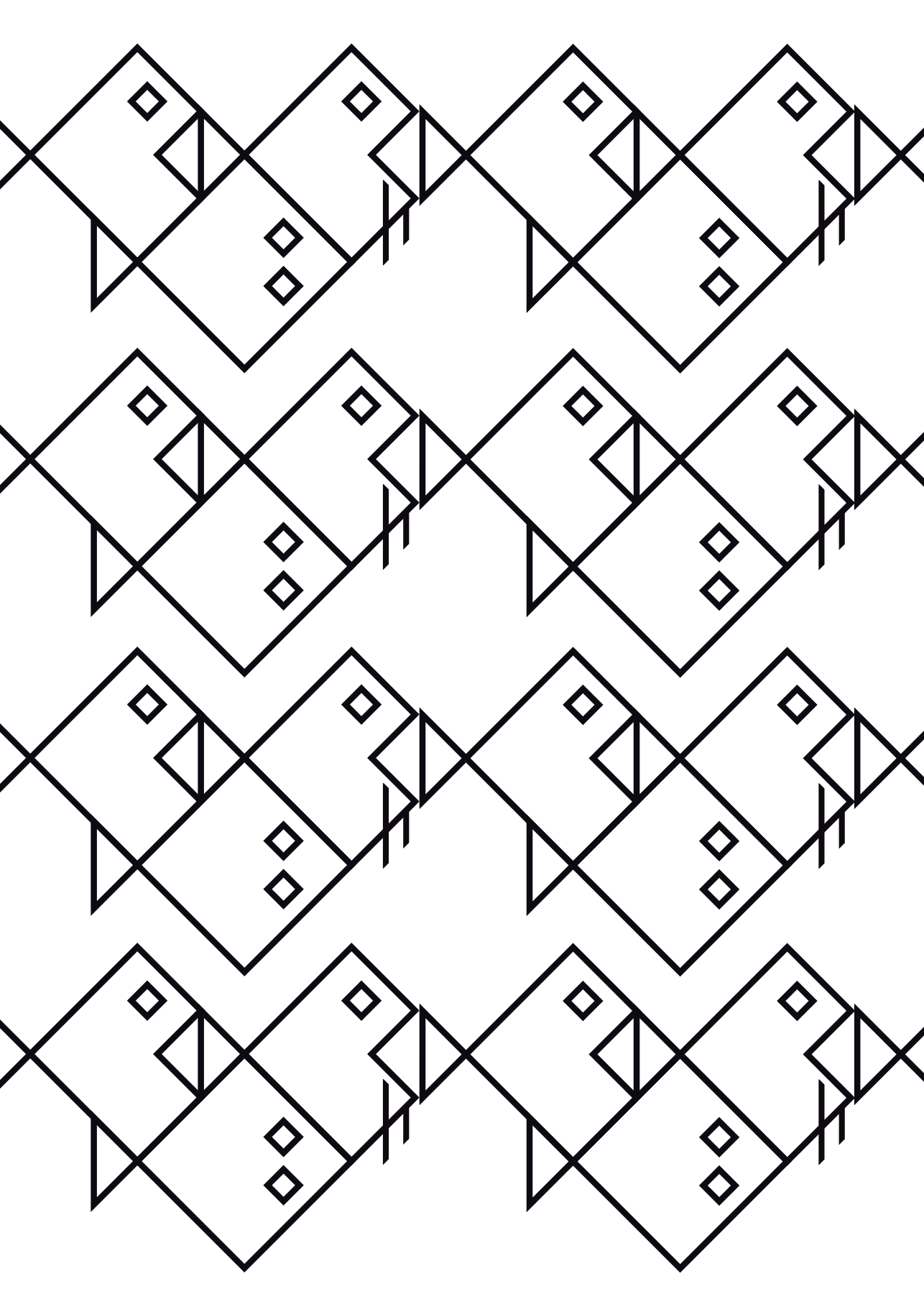
VAKI AQUACULTURE SYSTEMS LTD.

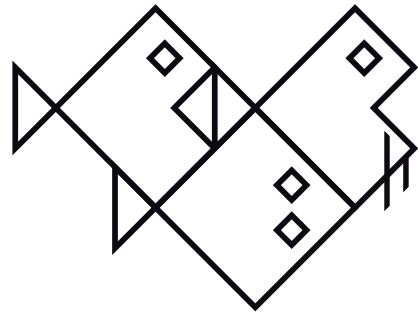
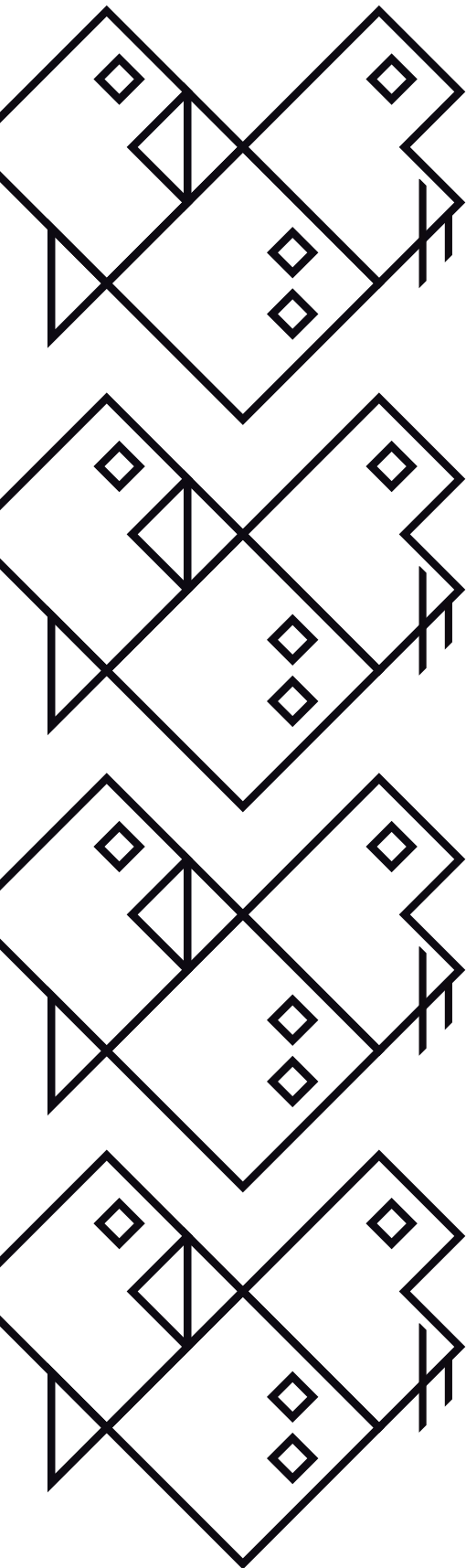
WWW.RIVERWATCHER.IS

3001 AGENTE PARA ESPAÑA, INNOVACIÓN Y DESARROLLO AMBIENTAL, I-DEA, S.L.

WWW.I-DEA.ES

CONTACTO: maxi@i-dea.es Tfno: 981 264 026 - 690 328 530

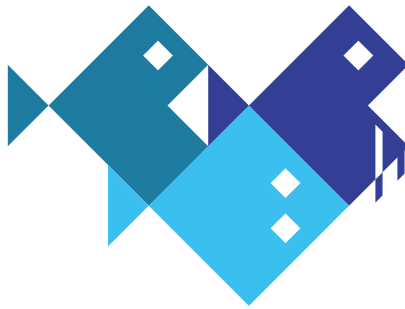




SIBIC2016

**VI IBERIAN CONGRESS OF
ICHTHYOLOGY / MURCIA**

**21st to 24th June 2016
Auditorium and Congress
Centre Victor Villegas
Murcia (Spain)**



SIBIC2016

VI CONGRESO IBÉRICO DE ICTIOLOGÍA / MURCIA

Sponsors



Colaboradores

