



PISCES LECTURE RESOURCES

The Ecology of Freshwaters

LECTURE 5 – Animal life in freshwaters – Vertebrates

Introductory remarks:

In this lecture, we can only begin to describe the huge numbers of species and the great diversity of vertebrate life to be found in freshwaters. We illustrate the various types of fish, conveniently categorized by food type and touch upon the roles of amphibians, reptiles, birds and mammals in aquatic environments. It is intended that the images here will stimulate further research and discussion among the audience.

Slide One: Title slide.

Slide Two: Introduces the different vertebrate groups to be found in and near freshwaters. The bony fish are, by far, the most diverse. Other groups have members that are capable of existing in other environments.

Slide Three: This is the result of a day's gill netting in a tributary of the Amazon. It emphasizes the diversity of the group from several different standpoints.

Slide Four: The lamprey is a member of the primitive jawless fishes, the Agnatha, and is parasitic on other fish, as shown here. This is the river lamprey, in a notable example of species invasion, the sea lamprey, *Petromyzon marinus*, (marine but spawns in freshwater) has colonized the American Great Lakes, following the opening of the Welland Canal, bypassing Niagra Falls, in 1829.

Slide Five: The cartilaginous fish are almost entirely marine, but some rays are adapted to freshwater. The 26 species of the *Potamotrygonidae*, all found in the Amazon river system are now permanently adapted to freshwater and cannot survive in seawater.

Slide Six: Seed-eating fish are unusual, but are not uncommon in the Amazon flood plain where nuts and seeds rain down from the canopy during the fruiting season. Often shells are extremely tough but species such as *Colossoma macropomum* have especially strong jaws.

Slide Seven: These Amazon predators, display the usual attributes of such species, large sharp teeth, wide-opening jaws large eyes, and, in the case of *Acestrorhynchus*, a streamlined body.

Slide Eight: Scavengers fulfil a vital role in consuming dead and dying animals. Some species, such as the Pirhana, cross the boundary between predator and scavenger and will take injured or live animals.

Slide Nine: Bottom feeders are often detritivores, some graze on algae that develop on the decaying vegetation while some consume invertebrates and other small animals.

Slide Ten: Bottom-feeding fish can usually be identified by body shape. Many have a triangular or square body cross-section, such as these catfish.

Slide Eleven: In temperate waters, the fish are somewhat more familiar, yet still retain these body shape characteristics.

Slide Twelve: In open waters it is important to be able to escape from fast-swimming predators. Fish have evolved many different strategies, including leaving the water for a few seconds.



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Slide Thirteen: Lungfish have adopted air-breathing as a strategy to cope with drying pools and water with low oxygen levels. Some are able to *aestivate*, i.e. go into a torpor during hot periods, enabling them to survive in the dried mud even when their pool dries out.

Slide Fourteen: Amphibians are inescapably tied to freshwaters by the lack of a waterproof membrane to their eggs. Spawn must be laid in freshwater to avoid desiccation. If laid in saltwater, the osmotic difference between the internal and external environment of the egg would cause it to lose water and die.

Slide Fifteen: Frog spawn is laid in huge quantities in suitable ponds and the simultaneous hatching of all the eggs must result in extreme intra-specific competition for food as the tadpoles develop. When small, they are easy prey for a wide variety of invertebrate and vertebrate predators.

Slide Sixteen: Toads are less dependent on freshwater than frogs during their adult phase but are still dependent on it for breeding, as are newts and salamanders. Some species of salamander tend to breed in ephemeral (and therefore fishless) pools to reduce predation on the larvae.

Slide Seventeen: Many reptiles spend all or most of their time in freshwater. Although in a complete reversal of the situation for amphibians, reptiles must come ashore to breed. Some lay soft-shelled eggs that exchange oxygen and CO₂ across their membranes, while many species of lizard and snake bear live young.

Slide Eighteen: Although some species of crocodylian can be very agile and fast on land, the majority spend most of the time in water, where their bodily weight is supported and metabolic requirements are at a minimum. The positioning of their eyes and nostrils makes it easy for them to lie almost completely submerged.

Slide Nineteen: Freshwater turtles (also called terrapins) are not capable of mating or swallowing food unless submerged in water. Although they come ashore to bask in the sun and lay eggs, they will eventually dehydrate unless they return to water.

Slide Twenty: A huge number of bird species rely on freshwater for resources of one type or another. Even species that do not feed on aquatic species themselves are attracted to water by the presence of other prey species. Birds such as these, however, are found in freshwater systems throughout the world and feed directly on fish, amphibians and reptiles.

Slide Twenty-one: Predatory birds such as these are found throughout the world, this is clearly a very successful strategy for fish eating species.

Slide Twenty-two: The snake bird is very obviously a member of the cormorant family, *Phalacrocoracidae*. They all reside along freshwater and saltwater shores and actively swim through the water to hunt and catch fish.

Slide Twenty-three: Rather than swimming through the water, the kingfishers (Family *Alcedinidae*) dive upon unsuspecting fish from above. Most kingfisher species eat fish, although some, such as the Australian Kookaburra live mainly on reptiles and amphibians.

Slide Twenty-four: Two groups of birds obtaining their food in different ways. The egret is a typical ambush predator while the cormorants are actively swimming hunters. Because they do not directly compete, they are able to coexist without depleting each other's food supply.



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Slide Twenty-five: Swans and geese (Family *Anatidae*) along with ducks all have webbed feet and swim primarily on the surface. The majority of species are found on freshwaters. Swans' long necks enable them to locate and consume plant material that may be out of reach to other species and saves them the energy required for continual diving.

Slide Twenty-six: Another good example of niche differentiation, the rails (Family *Rallidae*) are shy, secretive birds that normally nest and hide among reed beds. Diets vary according to species with varying degrees of omnivory. They are weak fliers and remain near freshwater for most of the time.

Slide Twenty-seven: There are not many species of filter-feeding birds. The flamingos are the only members of the Family *Phoenicopteridae*. Depending on the species they will either eat algae and diatoms (those species having a deep-keeled bill) or small fish, insects and crustaceans (shallow keeled bill).

Slide Twenty-eight: In some parts of the world, cormorants are considered pest species as they are believed to deplete freshwater fisheries.

Slide Twenty-nine: Niche differentiation among the mammals is very high and species range from the completely aquatic (dolphins) to those that use freshwater for what might be called 'recreational' purposes (elephants).

Slide Thirty: Freshwater dolphins differ from their marine counterparts. They are larger, up to 3m in length, have larger pectoral fins and reduced dorsal fin. Their eyes are reduced as much of the time visibility is nil in the muddy waters. Their bodies are also more flexible, enabling them to negotiate underwater branches and roots.

Slide Thirty-one: Dugongs and manatees are herbivores, eating sea-grasses and mangroves. They are highly social animals and congregate in estuaries and coastal bays in tropical regions but migrate into warmer freshwaters in winter, if the seawater temperature falls below 20°C. Only the Amazonian manatee is found exclusively in freshwater.

Slide Thirty-two: We are moving along a continuum, from complete dependence on water via partial dependence to occasional use. The pygmy hippopotamus, found only in a limited part of West Africa, like the much larger river hippopotamus spends most of its time immersed in water. They feed on river vegetation.

Slide Thirty-three: Members of the stoat and weasel family, *Mustelidae*. Although otters use freshwaters as a source of food, they also seem to use it for play, sliding down mud-banks and the like. They are solitary animals with a non-seasonal breeding pattern. They have very dense fur, in two layers, for waterproofing.

Slide Thirty-four: Tapirs have an unusual global distribution—they are found in the forests of South America and Southeast Asia only. They are often found near water, they swim well and can also walk on river/lake beds.

Slide Thirty-five: Elephants use freshwaters to bathe and cool themselves, and also as sources of mud for ridding themselves of skin parasites. Like otters, elephants seem to use water as a play resource.



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Slide Thirty-six: Habitat modification by mammals is exemplified by the beaver. By the construction of dams and the creation of freshwater pools they can have an enormous effect on local ecology. Here we see a beaver lodge – but sadly, no beavers.

Take home message

Vertebrates make use of freshwater in many different ways and the range of dependence upon it varies from obligate to extreme facultative. Many vertebrates, particularly mammals, need freshwater for drinking and, although they may not need it in any other sense their dependence on water as a resource is as great as that of some of the other animals in these slides.