



PISCES LECTURE RESOURCES

The Ecology of Freshwaters

LECTURE 6 – Man's influence on freshwaters.

Introductory remarks:

Since the dawn of civilisation, man has made use of freshwater resources. More than simply a source of drinking water and food, waterways have had a spiritual significance and provide transport links, water for irrigation, and now in the industrial age, water for power generation, manufacturing, sewage treatment and recreation, among other uses. Pressure on freshwater systems has never been higher, and the following slides depict these various pressures clearly.

Slide One: Title slide.

Slide Two: Weirs are used to control flow, but they cause rivers to deepen upstream, they increase siltation by slowing flow speeds upstream, cause faster flow downstream and increase oxygen levels downstream. All of these effects are likely to impact the inhabitants and modify the habitat.

Slide Three: Water wheels, originally designed for grain milling, but then developed for industrial use, require a head of water in order to operate, and this requires the building of structures to constrain the flow, particularly in overshot wheels such as these.

Slide Four: Clearly the impact of interfering with water flows like this are likely to be huge, both upstream and downstream. In an upland habitat such as this, water flows are likely to vary considerably, so the downstream inhabitants may be adapted to periods of low water, but upstream there will now be a lake where once a river ran.

Slide Five: In some environments, the release of water in short bursts like this is also unnatural and may cause serious disturbance (i.e. death) to some downstream species. The water is jetted into the air like this in order to dissipate energy.

Slide Six: Locks. Where weirs control the level of a river, locks are usually constructed, alongside to facilitate navigation. They do however, tend to prevent animal and fish migration. On canals they are the means by which hills are negotiated.

Slide Seven: Historically, it has always been fashionable to emphasise power and wealth by the provision of water features around country houses and the like. At Beaulieu Abbey a large, natural-looking lake has been created by the construction of a sluice...

Slide Eight: ...but sometimes water features are completely unnatural.

Slide Nine: River straightening and/or bankside reclamation—carried out as an aid to navigation and also to enable the construction of buildings along riverbanks. The effects on wildlife can hardly be exaggerated.

Slide Ten: The steep-sided profile of canals makes them unsuitable for most riparian species. Emergent plants cannot establish themselves.

Slide Eleven: ...also seen here, in Seville.

Slide Twelve: River banks can also be stabilised by laying interlocking concrete blocks such as these to improve access and prevent meandering.



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Slide Thirteen: Agricultural drainage is practised in most lowland areas to keep fields dry and suitable for crops. Drainage like this tends to reduce the absorbance of soil and increase the amount of surface runoff from fields. Although ditches like these tend to be highly eutrophic, in an otherwise ecologically barren landscape they probably provide a certain amount of food and habitat for some animals.

Slide Fourteen: Watersheds – Man's impact on freshwaters is not limited to direct interaction with the water itself. Deforestation can have disastrous consequences, not only in terms of the sediment load in rivers. Serious and sometimes fatal mudslides occur on deforested hillsides after heavy rain, completely destroying existing river habitats.

Slide Fifteen: Some types of farming directly interact with freshwater resources, where the water level in the fields, or paddies, is the same as that in the adjacent river. The transfer of nutrients and sediment to the river is therefore all the more easy.

Slide Sixteen: Canals can act as a conduit for disease, they are believed to be implicated in the spread of crayfish plague, a fungal infection of the European Crayfish *Astacus fluviatilis*. The introduced North American Signal Crayfish *Pacifastacus leniusculus*, although resistant to the infection, is a carrier.

Slide Seventeen: Harbours such as this are likely to have comparatively little effect on local wildlife. Although there will certainly be increased disturbance and possibly pollution from the harbour, its impact will be nowhere near ...

Slide Eighteen: ...that created by development such as this. On both sides of the river the almost unbroken chain of development from estuary to well beyond London has been disastrous for wildlife and water quality.

Slide Nineteen: This is a cutter suction dredger, the spoil is taken ashore by the floating pipe. The effects on the river bed are likely to be considerable and long-lasting because it involves the removal of large amounts of natural substrate.

Slide Twenty: Biological Oxygen Demand – this is a measure of the amount of oxygen required by aerobic micro organisms in the breakdown of organic matter. If the level of organic matter, typically sewage, increases then so does the amount of oxygen required, reducing oxygen levels in the water, often with disastrous effects.

Slide Twenty-one: Here, we see two examples of ways in which agriculture can affect aquatic systems. Cattle hooves generate considerable disturbance and 'poaching' of riverbanks, and direct input of cattle manure into the water, elevating nutrient levels.

Slide Twenty-two: Again, when terrestrial animals are in close proximity to water for extended periods nutrient levels are likely to be affected by the input of manure slurry. These cows are fed on the floating vegetation, so there is a degree of recycling going on here!

Slide Twenty-three: Although limited by legislation, in many parts of the world industry is still allowed to discharge chemical waste into aquatic systems. Here, the outfall plume from a paper mill into a river is being investigated using Rhodamine dye.

Slide Twenty-four: Diffuse sources – Although legislation in some countries has improved matters considerably, in some countries, particularly the developing nations, lack of controls means that water contamination is still a problem.



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Slide Twenty-five: Salination – As freshwater is extracted from the ground, usually for irrigation but also for domestic and industrial use, seawater moves in to take its place. This has happened in large areas of Australia, creating salinated land that is no longer suitable for crops, reducing land values and making them unsuitable for native species too.

Slide Twenty-six: To prevent fouling within the cooling system of power stations, the intake water is treated with a biocide. The warmed, treated water is then returned to the source. Raised temperatures exclude some species while encouraging others, although most aquatic organisms cannot survive temperatures over 40°C. Warmer temperatures reduce oxygen levels in the water too.

Slide Twenty-seven: This animation of the thermal plume from a power station on the River Severn illustrates clearly how far-reaching these effects can be. Being tidally influenced, the temperatures cycle up and down twice a day as water moves past the outfall. Few animals can tolerate the cyclical thermal shock that this causes.

Slide Twenty-eight: The provision of drinking and domestic water makes considerable demands on our freshwater systems. Having exhausted local supplies near some cities, water is often piped for several hundred miles.

Slide Twenty-nine: Ecologically, the extraction of freshwaters can be damaging by reducing water flows in natural watercourses. Low river levels can expose submerged plants and reduce the total amount of habitat available for other occupants.

Slide Thirty: Aquaculture – Fish farming imposes considerable stress on natural systems. In lakes, uneaten food can fall through the pens and cause eutrophication, the use of antibiotics to ward off disease can affect native species too and when un-naturally dense populations do cause disease to spread, again native species are vulnerable. Fish escapes from farmed populations can contaminate the gene pool of natural populations.

Slide Thirty-one: Aquaculture – The above problems are listed here.

Slide Thirty-two: Angling is one of the most popular participation pastimes in the world. The scale of its impacts therefore can be considerable. Obviously the removal of fish, stocking with non-native species and bank damage are all serious problems, but in some places angling societies and bodies may have had positive effects on river conservation and management and may have increased public awareness of freshwater conservation.

Slide Thirty-three: Commercial fishing, both in marine and freshwater systems has been responsible for some of the most severe problems of aquatic systems. Over-fishing, whereby young fish are removed before spawning, the problem of by-catch, where non-target species are killed even though not targeted and the destruction of underwater structures by heavy equipment all make commercial fishing a serious and continuing problem for natural systems.

Slide Thirty-four: Waterways have been used for transport for millenia. Some large rivers carry huge amounts of commercial traffic and are vital to some economies. As a result, ecological considerations have tended to be rather low on the list of priorities. Other water bodies, be they lakes, rivers or canals are used heavily for recreation, with all the disturbance that causes. Logging on some rivers can also cause great disruption to wildlife.



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Slide Thirty-five: People enjoy water, and water quality is vital to that enjoyment. Some of the most vigorous efforts to improve water quality have been for the purposes of recreation. As a spin-off, where water has been improved then wildlife has probably benefited too, although the disturbance caused by people enjoying water can be considerable.

Take-home message. There are many ways in which man's activities impact upon freshwaters. We change the shape and structure of waterways, we put chemicals into the water, we introduce warm water and we extract water from lakes and rivers. We remove the fish and put non-native species back. Think about all the different influences we have seen and how they affect all the different groups of organisms that inhabit freshwaters.