Aquatic Environmental Pollution (Review)

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Abstract: Today, we are cushioned against the vagaries of our climate by central heating and perhaps air-conditioning; modern agricultural practices and food preservation techniques provide us with a constant year-round supply of food and a varied diet. We tend to forget that natural populations of animals and plants can undergo considerable changes in abundance from year to year in response to fluctuations in climate and in predator-prey relationships. And we tend to expect our environment to remain constant and to regard any deviations as the result of human interference. Too often we overlook the role of climatic changes, especially the frequency and seasonal pattern of rainfall, on the balance of aquatic animal and plant communities. The relationship between additional loading and its effect on aquatic life in order to explain some of the terminology used. Pollution as defined above is caused when the effect of the loading on the resource is unacceptable. The point at which the load of a chemical is sufficiently.

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Introduction:

The introduction by man, directly or indirectly, of substances or energy (e.g. heat) into the marine environment (including estuaries) resulting in such deleterious effects as harm to living resources, hazards to human health, hindrance to marine activities including fishing, impairment of quality for use of seawater and reduction of amenities.

In this definition, the plants and animals that live in the sea are seen as a resource which needs to be conserved. If man's activities have a harmful effect on this resource, then pollution has occurred. No such accepted definition exists for freshwater, but the general concept is transferable between the two environments. Man-made alterations to water –flow-rates are understandably not included in this definition but the general perception of pollution is that it is caused by substances (e.g. chemicals) and heated effluents.

1) Direct abstraction to potable supply.
2) Food for human consumption derived form freshwaters.
3) Protection of freshwater fish.
4) Protection of aquatic life.
5) Irrigation of crops.
6) Livestock watering.
7) Industrial abstraction for food processing.
8) Recreational use for bathing and water contact sports.

Some of these uses apply to a limited number of locations in our rivers and lakes; others, such as the protection of type of research –separating the specific effects caused by a chemical which lead to death , from the effects which are secondary to the primary damage which has been caused elsewhere in the body.

One of the major changes in gill structure that can reflect a change in water quality concerns the relative proportion of certain cell types present – for example, increases in the abundance of the cells responsible for the excretion of mucus or the uptake of chloride (associated with the maintenance of osmoregulation) in relation to other types of epithelial cells.

Another important use of histopathology is in the identification of abnormal cells (e.g. tumours) in fish exposed to carcinogenic chemicals. These can occur in the liver as well as in other organs where they can be readily identified. It is possible that cold-blooded fish have a wider range of cellular variation which can be regarded as normal than that found in warm-blooded mammals where most of the experience of histopathology has been gained. So in general the main problem is in making the distinction between what is a harmless proliferation of cells and what is potentially harmful. The same problem occurs in the use of certain blood characteristics as a measure of fish health; whereas in a healthy man the concentration of red blood cells remains within a narrow range, in fish the range can be considerable and this may be correlate with the respiratory requirements for different levels of activity and with seasonality. As shown later the red blood cell concentration can be rapidly increased in fish undergoing respiratory stress.

Osmoregulation

The other important function of the gills is to control the salt content of the body fluids, as outlined. Special cells regulate the active uptake of sodium and chloride and the excretion of hydrogen and bicarbonate ions. These activities can be disrupted by those chemicals such as zinc and copper which have a direct effect on proteins in the cells.

The cellular level

Because toxic substances exert their harmful effects by interfering with normal chemical reactions within the body, the primary site of action will be iwhtin the cell. There are two ways by which such effects can be measured:

(1) Direct measurement can be made on the concentration of various chemicals which can affect the vital processes within the cell, such as enzymes and the substrates on which they act. This can give an insight into the mode of toxic action; for example the inhibition of acetyl cholinesterase in nerve cells by organophosphorous insecticides prevents the normal transmission of electrical impulses.

(2) Other reactions measured may be connected with the detoxification mechanism for a particular chemical. For example, metals such as copper, zinc and cadmium are transported in the blood throughout the body the protein molecules known as metallothioneins. Exposure of a fish to these metals in the water leads to an increase in the body levels of metallothioneins in order to remove them from the gills via the blood to sites where they can be safety stored or excreted. Therefore, metallothionein analysis can be used to determine whether fish have been exposed to higher levels of heavy metals in the environment. Another technique is the measurement of enzymes known as multifunction oxygenases (MFOs) that are responsible for the breakdown of organic molecules within.

Bioaccumulation of chemicals form the water and through the food chain

It is appropriate at this stage to consider the problem of the accumulation of chemicals in fish, because this is linked to the distribution of such substances in water, sediments and food organisms. Metals such as cadmium and mercury can enter fish by way of the gills or though the food chain, and they can accumulate in various organs, particularly the kidneys, as organometallic compounds or as solid granules in association with calcium and other metals . These granules can then be stored or excreted; it is doubtful whether the heavy metals in these granules can exert a harmful action on the fish, but they may be transferred through the food chain to fish-eating animals. Similarly, chemicals such as DDT and PCBs that have a very low solubility in water but a high solubility in fat can be taken up from the water and the food chain and accumulate in fatty tissue. Again, the harm caused by these chemicals when they are in storage organs is uncertain, but it is thought that at times of food shortage the fat can be metabolized and the chemicals redistributed to other organs where they can cause damage.

It is unfortunate that most of the toxicity tests carried out with these accumulating elements and compounds have provided information only on the relationship between concentrations in the water and harmful effects on the fish. The relationship between concentrations in fish tissues and harmful effects is rarely studied and yet there is an increasing amount of information on the levels of these substances in fish and their predators because of their importance in the diet of man. In particular, attention has been focused on eels because their high fat content allows them to accumulate a considerable amount of fat-soluble compounds.

Susceptibility to disease:

It is tempting to suppose that fish that have been weakened by pollution will be more susceptible to diseases. However, evidence for such an association is not clear-cut. For example, correlations between the incidence of epidermal diseases in marine flatfish with sources of pollution have not proved that such an association exists. Disease epidemics such as ulcerative dermal necrosis (UDN) of salmon, and roach ulcer disease in recent years were not associated with identifiable pollution. Outbreaks of disease in fish farms are usually associated with high temperature or overcrowding. It is possible that some chemicals at low concentrations will weaken the defences of fish against diseases, but it is clear that this is not a common property of pollutants.

However, there is evidence that the presence of significant carcinogenic chemicals in the water will cause tissue abnormalities, especially in the liver, but such examples are confined to areas which are heavily polluted by these substances.

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