

# Thermal Pollution

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ADJUSTMENT to changing temperatures is one of the greatest problems facing living things. All animals and plants have adapted to normal temperature fluctuation by the slow, but effective process of evolution.

Temperature changes include day to night and season to season variation. In aquatic environments, the problem of temperature adaptation is especially important, since cold-blooded animals, like fish, cannot regulate body temperature.

All animals can adapt to some temperature changes, but there are limits beyond which survival is impossible. **Thermal pollution** exists when man's activities cause temperature changes which are detrimental to the environment.

Only recently has thermal pollution become a problem of general concern to the public, primarily because of the rapid increase in the number of electric power plants and the anticipated demand for even more electricity. The use of electric power has doubled over the last 20 years and is expected to double again in 15 more years.

Most electricity is now generated using fossil fuel (coal, oil and gas) plants, but future plans call for mostly nuclear plants. Steam is produced to rotate turbines, condensed to water, then reheated to produce steam. Condensation requires large quantities of cooling water. Nuclear plants are about 30% less efficient than fossil fuel plants, producing more waste heat per unit of generated electrical power.

The most economical way to condense the steam is to circulate water from a nearby lake or river through a cooling system. The circulated water returned to the lake or river has been warmed by absorbing the steam's heat.

A modification of this technique is to use cooling towers or ponds to lower the temperature of the circulated water. In towers, heated water flows through a series of baffles and is cooled by evaporation. The water is then recirculated through the condenser.

EVERY SPECIES has a temperature range within which it can most effectively carry on its

activities. This range varies between species and sometimes between different stages in the life cycle of a single species.

The introduction of heated water will have a varied effect, depending on the size and temperature of the discharge and receiving water, as well as the organisms present. A slow rise in temperature will allow fish and other animals time to adjust if the increase is within their tolerance range. However, rapid temperature change, such as would occur if the thermal discharge started or stopped, can cause thermal shock and death. Sudden changes are most harmful, since organisms don't have time to adapt.

Other, more subtle effects are common with thermal pollution. A rise in water temperature will increase metabolic activity in aquatic animals, which also increases their oxygen demand; but as water temperature rises, its dissolved oxygen content may decrease. For animals living near the limit of their tolerance range, warmer water may be fatal.

Algae, tiny green plants which form the food supply for many small fish and invertebrates, may also be affected. As temperature rises beyond certain levels, algae species used for food may decline, while less desirable forms flourish. These more temperature tolerant algae usually furnish little food and may even be toxic.

Behavior of fish may be adversely affected. Changes in temperatures stimulate spawning activity in many fish. Temperature follows a seasonal cycle, and if this cycle is altered by heated water, fish may spawn in the wrong season.

WARMER WATER often causes changes in the type of fish and insects present. Trash fish become more numerous than game fish in poor environments. Insects, the food of many fish, sometimes hatch early and emerge to an environment too harsh for survival.

Not all effects of heated effluent are detrimental if the temperature change is not extreme. Winter fishing might be improved in certain situations. Heated effluents have been used to culture oysters and catfish on a year-round basis. Other fish species



Keeping thermal pollution in check is vital to sports fishing, too

have been successfully cultured with heated water in some parts of the world.

All things considered, the effects of adding heated water to rivers and lakes cannot be reduced to general statements such as "no harm is being done," or "thermal pollution will wipe out everything." Each situation is unique and must be evaluated as such. Water flow, fluctuation, presence of other discharges, organisms present, and other factors, may vary greatly from site to site.

To maintain aquatic environments in a desirable state, we must carefully consider the impact of each

discharge and the alternative methods for dispersing excess heat. Although expensive, cooling towers and other treatment methods will often be necessary to maintain a quality aquatic environment. For esthetic as well as economic reasons, man cannot wantonly reduce the value of his water resources. 🐟

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