Fish Tumors: Carcinogenic Indicators?

Using marine organisms as test animals, scientists may be able to determine pollution levels in water

by Deedee Pendleton

Catching a trout with an orange-sized tumor on its head may not appeal to too many fishermen, but it happens often enough to keep John C. Harshbarger busy full time. He's director of a joint cataloging project at the National Museum of Natural History of the Smithsonian Institution, in collaboration with the National Cancer Institute, and for eight years Harshbarger and his assistants have been dissecting and preserving neoplasms in cold-blooded invertebrate and vertebrate animals. Tumors, like warts, are something most people would rather not talk about, but they've become so prevalent in fish and mollusks feeding in polluted water that scientists are getting suspicious.

"We have no information that oil or any known pollutant is causing these tumors," C. Austin Farley, U.S. Department of the Interior, says. P. Paul Yevich of the National Marine Water Quality Laboratory, despite numerous laboratory experiments on fish, agrees. None of his experimental animals have developed tumors, but the only naturally occurring tumorous marine life he's found were in coastal waters near oil spill sites. Producing just the right combination of chemicals to simulate pollution in the lab is his chief problem, he says.

It has been only in the last 10 years that scientists have proved mollusks and arthropods get cancer, and as more and more of these lesions turn up, researchers are speculating on the possibilities of using marine animal neoplasms as models for further study of cancer in humans. Since invertebrates don't have advanced chordate-like immunity systems (with thymus glands and antibodies), a comparative study of tumor induction in vertebrates and invertebrates may yield information on the relationship between immunity and cancer. Lower animals may someday be used as test animals to screen possible carcinogenic chemicals. Because of the expense involved, no more than half of those chemicals commercially produced are adequately tested every year.

There is a strong possibility that viruses rather than chemicals may cause some of the lower animal tumors and that chemical stress of pollutants may enhance these viruses or cause latent viruses to grow, Harshbarger says. In addition, parasites may secrete growth-causing fluids that stimulate cellular proliferation. For example, fibrous papillomas (benign tumors) found in the skin of the green sea turtle often contain foreign material, such as leeches, barnacles and plant material.

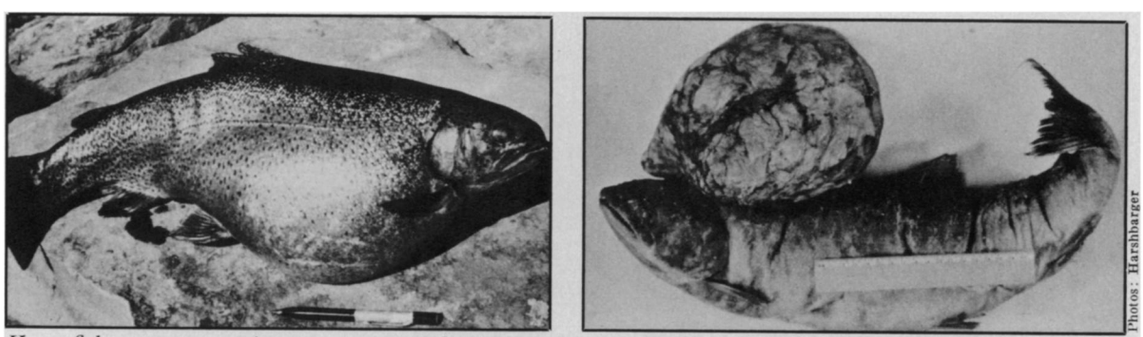
Although conclusions about tumors and other diseases in marine life, and their relationship to pollution are sketchy, these facts have been verified:

- Most aquatic animal papillomas have been found in bottom-feeding fish and filter-feeding mollusks, suggesting that those factors influencing tumor growth accumulate in sediments.
- Populations of catfish, croakers, salamanders and other marine animals found in polluted areas often have tumors, while the same species living in a clean environment do not.

Scientists have already proven that pollution may be passed along the food chain to people when aquatic organisms accumulate carcinogenic chemicals. Mollusks living in areas polluted with domestic sewage can be reservoirs for disease, and eating mollusks from such areas may cause typhoid and hepatitis.

But there may be solutions to infected marine life. Some shellfish flush pollutants from their systems when they are removed from the polluted environment and are placed in clean water, Rudolph Di Girolamo, a College of Notre Dame biologist, reports. Shellfish farmers may someday be required to hold their catches in purified water for a number of days to ensure natural sanitation. But Di Girolamo says accumulated viruses will survive in contaminated crabs chilled or frozen for up to a month, and even cooking can't kill some germs. But humans eat bacteria and tumor cells in the average diet of beef, eggs and chicken every day.

But despite these conclusions, proving that carcinogenic materials in sea water provoke tumors and ultimately kill wild marine organisms is difficult. Since migratory habits of many species of marine organisms are not known, it is difficult to correlate fish tumors with specific types or location of pollution. Mollusks in Yaquina Bay, Ore., extensively studied by Farley and others, were found with tumors only during



Photos: Harshbarger

Huge fish tumors are often easy to spot, but researchers wonder how many internal lesions go unnoticed.

BOOK ORDER SERVICE

For the convenient purchase of any U.S. book in print you may avail yourself of Science News Book Order Service, 1719 N St., N.W., Washington, D.C. 20036. We pay postage. Send 25¢ handling charge. Regular retail prices on all books.

certain times of the year, indicating a parasitic involvement. Intermittent pollution outbreaks, such as with an oil spill, or temperature changes with the seasons, may provoke virus growth.

Yevich, in studying soft-shell clams (*Mya arenaria*) in four coastal states, found an unusually high number of animals with tumor-like cell growths in the gill filament and kidney epithelium in both polluted and nonpolluted areas. In explaining the high incidence of lesions, Yevich suggested that carcinogenic chemicals released into the environment, including chlorinated hydrocarbons, metals and viruses, play a role in inducing damage. "Whether the lesions result from natural processes or from man's impact on the environment remains to be established," he says. Two California test sites producing high-lesion organisms were surrounded by rural development. Larger organisms seem to have lesions more frequently, suggesting that older animals chronically exposed to sublethal levels of various environmental stresses could be displaying latent effects resulting from short-term exposure.

Even if scientists could prove that sublethal toxic effects of individual chemicals cause tumors in representative species, it would be difficult to deduce effects on marine ecosystems. Many animal species reproduce in numbers that exceed those necessary for maintenance of the population, so a reduction in the reproductive rate might go unnoticed until numbers of fish dropped substantially. Even severe reductions in populations, if sufficiently local, might be replenished rapidly by immigration from neighboring unpolluted areas. Population levels in multispecies communities of fish vary depending on predation and competition, and a small change in surrounding conditions could lead to large changes in relative populations. Thus, the same toxic stress may lead in some circumstances to very little change in ecosystems, but in other circumstances to large change. Laboratory studies are consequently inadequate in providing a good guide to the behavior of a real marine ecosystem.

"If we accept the assertion that well-autheticated examples of neoplasia have been demonstrated in mollusks and arthropods," says Clyde J. Dawe of the National Cancer Institute, "the fact remains that the arthropods and mollusks comprise only two of some two dozen or more phyla of spineless animals, and that for all the remaining phyla, we have only a small number of examples of possible neoplasms or of 'neoplastic equivalents.' If we were to go by the numbers we would be forced to concede that species of invertebrates that have exhibited neoplasia are the exception rather than the rule." □