DEPARTMENT of the INTERIOR

FISH AND WILDLIFE SERVICE

news release

For Release June 21, 1976

Levitt 202/343-5634

BIOLOGISTS DISCOVER HOW VITAMIN C HELPS FISH

Scientists have known for years that fish use vitamin C for proper bone growth and to increase their tolerance to environmental stresses. Yet, they never knew exactly how this occurred. Now they do, and the discovery may help biologists better combat the effects of pollution on fish, the Department of the Interior announced today.

Biologists at the U.S. Fish and Wildlife Service's Fish Pesticide Laboratory in Columbia, Missouri, first learned of the mechanism while studying channel catfish that were affected by the insecticide toxaphene. This pesticide is widely used on cotton crops in the South where channel catfish are also raised commercially.

About 6 years ago, biologists noticed that the channel catfish grown on fish farms in that area were developing a curvature of the spine that, in extreme cases, broke the fish's back and stunted growth as much as one-third. Last year, Fish and Wildlife Service scientists linked this syndrome to toxaphene residues in the water. Concentrations as low as 37 parts per trillion in the water were found to have serious long-term effects on catfish. Earlier this year, they documented for the first time the specific role vitamin C plays in this process, and the implications are significant for future fish culture as well as for a better understanding of the chronic effects of pollutants on fish.

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The mechanism works this way: Vitamin C is used by fish in a number of ways and in various parts of the body. One primary function of the vitamin is to aid in the formation of collagen--the protein framework or base upon which bone develops. Calcium and phosphate minerals are deposited within and around this framework forming a skeleton. An insufficient supply of vitamin C can increase the mineral ratio making the backbone brittle and finally snapping it, which can result in internal bleeding. If the fish survives, its growth is severely stunted. In addition, with a decrease of collagen, the ability of fish to heal wounds or regenerate tissue is affected. Finally, vitamin C is an essential nutrient of the liver and is used as a key defense to detoxify poisonous substances in the environment. Without it, fish cannot respond as well nor adapt to stresses.

Biologists at the Service's Fish Pesticide Research Laboratory found that when catfish were chronically exposed to toxaphene residues, even in trace amounts, their ability to form collagen was inhibited. Research showed that most of the vitamin C is diverted to the liver where it is used to neutralize the effect of toxaphene. So much of it is diverted that there isn't enough of the nutrient left for other metabolic processes.

The result is a functional deficiency of the vitamin, even though the amount may be the same as in a healthy fish, and reduced growth and the broken back condition can occur. Brook trout and fathead minnows exhibit similar symptoms when exposed to low concentrations of toxaphene.

Although there is no known method to increase the vitamin C content of fish in the wild, the discovery of its importance in fish metabolism has been quite beneficial to the multi-million dollar fish farming business of the South where up to 5 percent of pond-cultured catfish showed the symptom. Vitamin C is now included in many commercially prepared fish foods and its inclusion in the diet of farmed catfish is helping to eliminate the "broken back syndrome."

However, the discovery of vitamin C's importance in fish metabolism is equally beneficial to biologists tudying the chronic effects of pollutants. Biologists believe that the mechanism which fish use in detoxifying toxaphene is the same used to neutralize the effects of other pollutants, but further studies are necessary before any firm conclusions can be drawn.

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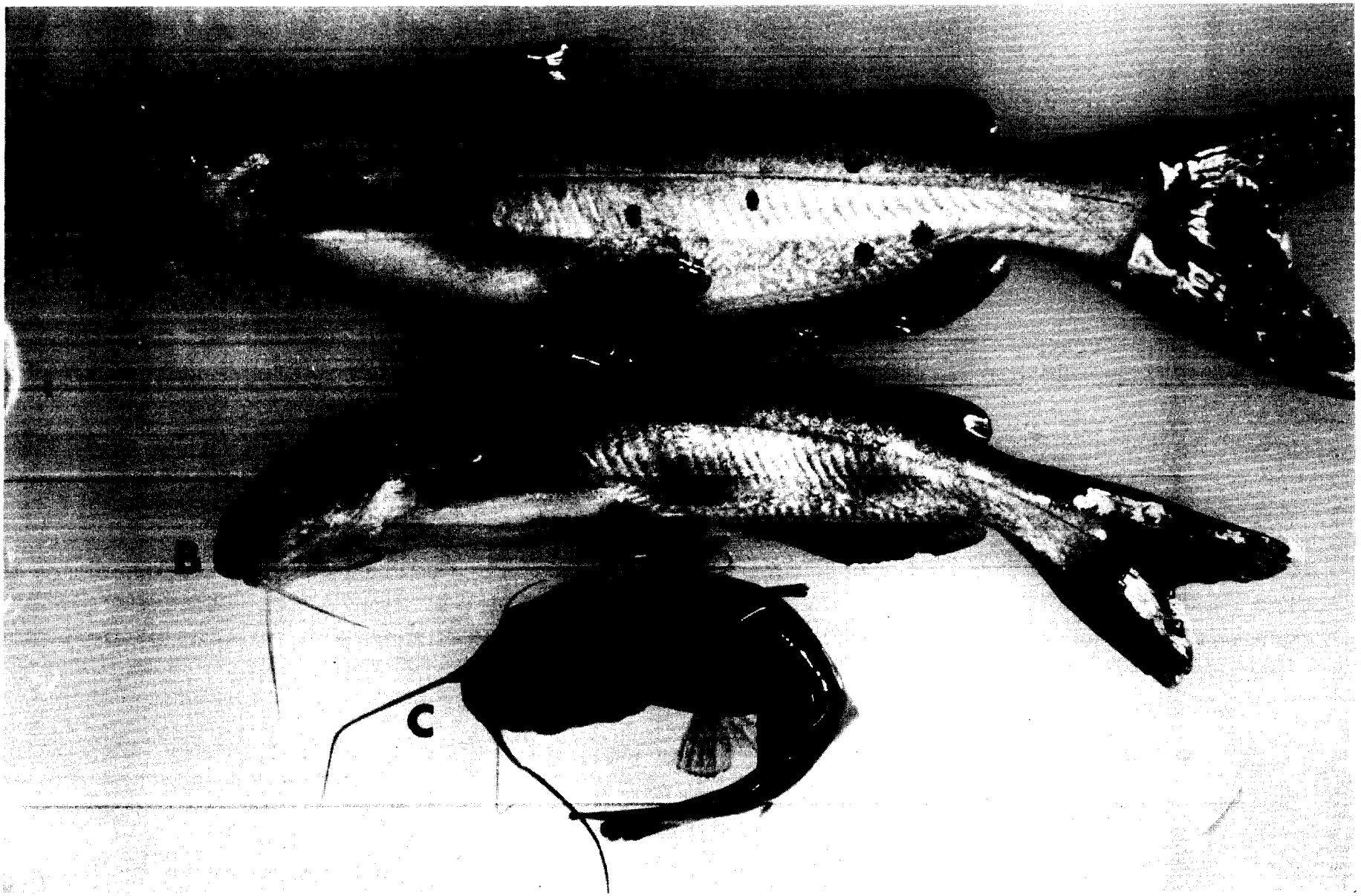

Effects of toxaphene and vitamin C on backbone structure of channel catfish. A is healthy fish with adequate vitamin C in diet and raised in water with no toxaphene. B is fish fed normal diet with adequate vitamin C but raised in water with low levels of toxaphene. C is fish exposed to very low levels of toxaphene, but also raised on a diet deficient in vitamin C.