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Man's Influence as an Environmental Threat to Limulus

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Today we find ourselves faced with an appalling fact. Species after species that has long been biologically successful is suddenly at the brink of extinction owing to human activities. It has recently been estimated that by the year 2,000 over a half million species will become extinct, some 15% of all species of plants and animals [2].

In recent years attention has focused on the more spectacular symbols of the problem—the endangered eagles, tigers, crocodilians. Even the humble frobish lousewort has been brought to our attention.

Terrestrial and freshwater species are, however, relatively easier to catalog and monitor than those of the ocean. Aside from the whales, the other marine mammals, and the sea turtles, little attention has been given to marine species of fish and invertebrates. Commercially important species of fish and shellfish have repeatedly been fished to depletion, with only their large natural fecundities to protect them from biological extinction. Modern fishing technology, industrialization of coastal areas, and exploding human populations have depleted coastal resources throughout the world.

Despite their ancient lineage [7,10] and their successful passage through several mass extinctions of the geologic past, horseshoe crabs are not exempt from this new threat.

In Japan, Tachypleus tridentatus has been depleted through habitat loss and collection to the point that it has been declared a national monument, and an Association for the Conservation of Horseshoe Crabs has been established [6] to protect it from total extinction. Although the eggs of Tachypleus gigas and Carcinoscorpus rotundicauda are eaten in Thailand, little information is available concerning the status of the populations involved or of these species in other parts of their range.

The fourth species, Limulus polyphemus, continues to be subjected to a variety of human impacts throughout its range in the United States. As early as the 1850s, literally millions of animals were harvested annually from the breeding beaches of Delaware Bay to be ground up for fertilizer and livestock food. This

fishery reduced the formerly huge population to tens of thousands by the 1950s [8]. In New England, fisherman have long regarded the crabs as pests to be destroyed whenever possible owing to their impact on bottom communities and their predation on juvenile clams [9,11], and bounties have been paid for Limulus. In addition, large numbers of animals are wantonly destroyed on breeding beaches every year by local residents [5].

Within the last several years, horseshoe crabs have become a preferred bait for newly developed fisheries for live American eels and whelks. The crabs are collected, frozen and then chopped up for bait. United States landings of eels for 1975 were 3.5 million pounds according to National Marine Fisheries Service statistics. Information on the quantities of horseshoe crabs used is not available, but three fishermen interviewed estimated that they each used some 2,000 crabs per year. As of 1980 several Gulf of Mexico shrimp trawlers began fishing for horseshoe crabs rather than shrimp in the Tampa, Florida, area for the first time (J. Rudloe, personal communication). Clearly, this is a rapidly developing use of horseshoe crabs, the magnitude of which should be determined.

Another fishery for horseshoe crabs has developed in recent years to support the production from horseshoe crab blood of Limulus amebocyte lysate by the pharmaceutical industry [1,3]. It is estimated by industry sources that approximately 30,000 crabs are collected annually and bled of varying amounts of blood, often 200–300 ml. What percentage of the total blood volume this represents is not clear, although some workers estimate it to be approximately one-third of the total [6]. Animals collected by licensed producers are returned to the water after bleeding, and our studies relate to postbleeding survival of horseshoe crabs under field conditions.

Animals are also collected by several biological supply companies for use in neurophysiological and other basic research. Our analysis leads us to estimate that this involves some 3,000–5,000 animals per year.

Habitat destruction is often the critical factor in depletion of a species, although overcollecting can also be important. The situation concerning habitat protection for Limulus is not at all clear at this time. Although large populations of horseshoe crabs continue to occur through the U.S. range, it must be remembered that Limulus is an estuarine species, and that significant amounts of our coastal wetlands have been seriously altered or destroyed within the last few decades. Many estuaries are also heavily stressed as a result of sewerage and industrial waste. The impact of these factors on Limulus's future is unknown.

Populations of crabs have again reached relatively high levels in Delaware Bay [8] following the termination of the fertilizer fishery, yet massive kills of crabs occur every summer in Delaware Bay. On one beach alone some 10,000 dead crabs were observed in one day during June 1979. It is not known whether this annual die-off is due in some way to natural causes or to some human alteration, but such kills are not known to occur routinely elsewhere.

In the Gulf of Mexico, undocumented reports of severe declines in Limulus populations in the last 30 years have been received from Escambia Bay (Pensacola, Florida) and from Mobile Bay, Alabama. The lack of baseline data for years past makes it difficult to evaluate such reports. However, both of these estuaries have significant concentrations of heavy industry located along their shores. Whether or not Limulus populations are affected by this is unknown.

Clearly, it is not possible at this time to make any definitive statement concerning human impacts on horseshoe crabs and whether or not they will continue their long crawl through geological time much beyond today. We do not have sufficient data concerning the status of existing populations, whether and where and how much they have declined or recovered from earlier exploitation, or how much pressure they are likely to be subjected to in the future. Most of our data on Limulus populations is based on breeding beaches [4,8]. Information on offshore nonbreeding populations is especially lacking.

Although the participants at the recent conference [1] on biomedical uses of horseshoe crabs expressed commendable concern for the impact of pharmaceutical uses, it may well prove that estuarine pollution and/or commercial fishermen will have more serious impacts.

What is clear is that better information must be developed if horseshoe crabs are to be managed as a renewable resource rather than left to uncontrolled exploitation. The mechanism for developing such information is available through the Fisheries Management Act of 1977. Even as efforts are underway to ensure the future of T. tridentatus in Japan, so should a fisheries management plan for Limulus polyphemus be developed and implemented in the United States.

With all of our detailed knowledge of ecological mechanisms, many of us have forgotten what primitive human societies knew well—that the earth is our life-giving mother, to be revered and protected, and that its other species have an equally valid claim to her bounty. One of the most valuable contributions of the space program may eventually prove to be the concept of Spaceship Earth, a modern restatement of that ancient wisdom.

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