AFS Policy Statement #24:
Ballast Water Introductions
(Full Statement)

A. Issue Definition

The recent establishment of an exotic fish, *Gymnocephalus cernua,* an exotic cladoceran, *Bythotrephes cederstroemi,* the exotic zebra mussel, *Oreissena polymorpha,* and the Chinese mitten crab, *Eriocheir sinensis,* in the Laurentian Great Lakes has created an awareness of the growing problem of ballast water introductions. Most large ships use water for ballast for stability and maneuverability. The water is carried in separate tanks used just for ballast or in empty cargo tanks. Typically, water is pumped into the tanks when the ship is departing one port and discharged when the ship takes on a cargo at another port. Cargo ships can carry 1-8 million gallons of water as ballast. Not surprisingly, local organisms, usually in their planktonic life history stages, are transported with the ballast water. Sampled ballast water in 70 ships coming into Coos Bay, Oregon, from Japan. The samples contained over 200 species of zooplankton and phytoplankton. Use of water for ballast is not new; ships have been carrying it for at least 100 years, but its effectiveness in transporting organisms has been greatly enhanced in recent years by the development of separate tanks just for ballast water, the increase in average ship size (and therefore the amount of water transported), the increase in ship speeds, and the increase in ship traffic.

Evidence had been presented that hundreds of species of invertebrates and fish have become established in exotic locales after being transported in ballast water. The effect of most of these introductions is unknown, but there is growing evidence that the bay and estuarine faunas of the world are becoming increasingly homogeneous as endemic species decline and aggressive exotic species increase. The ballast water species now in the Great Lakes have the potential to cause ecosystem level changes or do major economic damage such as closing intakes to power plants or altering food chains leading to sport or commercial fishes. Likewise, the sudden invasion of a number of ballast water species into the Sacramento-San Joaquin Estuary in California has caused a major disruption of the estuary's ecosystem. It has been noted that an estuarine reserve in Oregon contained 32 species of introduced organisms brought in with ballast water, including some of the most abundant species in the preserve. Presumably the exotic species have replaced native species in many areas designated as estuarine sanctuaries. Unless new introductions are halted, additional alterations of these sanctuaries will take place.

The problems created by such introductions are no doubt much more widespread than these examples indicate, and the need to control the spread of organisms by ballast water is urgent. Some introductions may have positive effects; however, in the majority of cases, these introductions adversely affect existing commercial and recreational fisheries, thereby causing adverse economic impacts to local coastal communities. In addition, the effects of added ecological competition, predation, and new diseases may further exacerbate the condition of estuarine populations which are already stressed due to

dredging, pollution, and general water quality conditions. If such introductions push estuarine organisms to the threatened or endangered status, listing under federal or state endangered species statutes may prevent or protract estuarine development (dredge and fill, and general expansion) sought by many port authorities.

B. Impacts on Aquatic Ecosystems

Reviewed evidence for ballast water dispersal of marine organisms, including studies in which ballast water biota were monitored on ships in transit. He listed 58 examples of "probable" introductions and another 59 "possible" established introductions. These are certainly minimum numbers, as the studies needed to document such introductions are largely lacking and new ballast water introductions appear to be occurring at a rapid rate. Indeed, two of the recent Great Lakes introductions are not listed by Carlton, nor are four recent probable ballast water introductions into the Sacramento-San Joaquin Estuary. Traffic of ships with ballast water had been likened to "international biotic conveyor belts." Given the poor state of our knowledge of even which organisms have been or are being transported in ballast water, it is not surprising that the evidence for ecosystem effects is largely speculative.

A model developed of the dynamics of Lake Michigan plankton that predicts the exotic predatory cladoceran, *Bythotrephes cederstroemi,* will cause a decline in a number of grazing zooplankton species in the lake, with concomitant decreases in water clarity and changes in the abundances of plankton-feeding fishes. In the Sacramento-San Joaquin Estuary, the recently (ca. 1986) established Asiatic clam, *Potamocorbula amurensis,* can live in water of fluctuating salinity that previously lacked permanent clam populations and can achieve population densities capable of filtering a high percentage of the phytoplankton from the water column in shallow areas. This in turn may reduce zooplankton populations at a time when high densities are vital for the survival of larval fishes. Survival of larval fishes may be further reduced by the abundance of exotic copepods, especially *Sinocalanus doerrii,* which is able to avoid predation by larval fishes more effectively than native copepods. In the Sacramento-San Joaquin Estuary at least five species of Asiatic copepods have become established in recent years; native copepods have declined.

The transport of organisms in ballast water is contributing to the increased homogenization of bay and estuarine faunas around the world. Presumably local endemic forms are becoming increasingly rare as a consequence, although the nearly universal heavy pollution of such habitats is no doubt also contributing to this loss. It is likely that the organisms that survive successful transport are also those capable of surviving in stressed ecosystems. Ballast water introductions may also cause the mixing of genomes of geographically isolated populations of the same species, with unknown results. For example, the known transport in ballast water of European threespine sticklebacks, *Gasterosteus aculeatus,* to North America may create problems for biologists who study local stickleback populations for evolutionary trends.

C. Effects on Fisheries

The effects of ballast water introductions on fisheries are undocumented but are of major concern. A press release from the Ontario Natural Resources Agency (1988) discussed the ability of ruffe, *Gymnocephalus cernua,* to "devastate a fishery," especially that of whitefish, *Coregonus spp.,* through egg predation and that of yellow perch, *Perca flavescens,* through competition. The Wisconsin Department of Natural Resources diverted considerable manpower and resources to study the ruffe invasion of Lake Superior. Likewise, in California, resources are being diverted to study the potential effects of the various invertebrate invaders on striped bass, *Morone saxatilis,* populations because of the strong possibility that the invaders may permanently depress the striped bass fishery by decreasing survival rates of larval bass. Ballast water introductions are often permanent, irrevocable changes to ecosystems that make fisheries management of affected waters increasingly difficult as more species become established.

D. Needed Actions

Article 196 of the United Nations' Law of the Sea Convention reads: "States shall take all measures necessary to prevent, reduce, and control the intentional or accidental introduction of species, alien or new, to a particular part of the marine environment, which may cause significant and harmful changes thereto." The American Fisheries Society should support this statement and should work with the U.S. Congress and other political bodies to find solutions to the problem, as well as with federal, state, and provincial agencies that have an interest in and concern over the general issue. AFS should also work with such organizations as the Food and Agriculture Organization (FAO) and the International Maritime Organization (IMO), both agencies of the United Nations. In addition, the International Council for the Exploration of the Seas should be consulted. Ballast water introductions are a problem in the United States, so they must be a problem elsewhere as well; therefore, the problem should be addressed on a worldwide basis. Perhaps a logical international forum might be to bring up the matter through the IMO and the MARPOL Convention that governs matters of marine pollution. There is a MARPOL annex, ratified by the U.S., which governs the dumping of plastics at sea that could serve as a model for a convention on ballast water introductions.

The principal means that have been proposed to halt the introductions is to either have ships exchange ballast water at sea or to treat the ballast water with chlorine or other toxicants. Because of potential pollution problems to restricted waters of harbors, the former method is preferred. It is assumed that an exchange of coastal water for water of the open ocean would reduce the possibility of suitable species being introduced. Other mechanisms, such as filters on pumps and toxic paints also need to be investigated.

Studies have summarized that have been conducted on organisms in ballast water and their survival rates in the tanks. More such studies need to be conducted to determine the effects of transit time and port of origin and port of dumping on the potential for ballast water organisms to becoming established. Procedures need to be developed for monitoring the ballast water of ships coming into North American ports, from both other

continents and from other North American ports. In places where ballast water species are established and are reaching pest status, modeling efforts need to be conducted to predict their long-term effects. If necessary, factors controlling the abundance of the introduced species in their native ecosystems should be studied, to see if "natural" methods of control are possible. There is also a need to encourage measures to restrict the range of newly established species, such as preventing the ruffe from being used as a bait fish or zebra mussels as aquarium species.

The American Fisheries Society should promote the idea that ballast water introductions are immediate, serious, and ongoing problems for which interim measures are needed to reduce their frequency and for which studies are needed to find ways to halt them on a permanent basis.