United States Department of the Interior

FISH AND WILDLIFE SERVICE
WASHINGTON, D.C. 20240

ADDRESS ONLY THE DIRECTOR,
FISH AND WILDLIFE SERVICE

In Reply Refer To:
FWS/MA

MAR 30 1994

Memorandum

To: Secretary

Through: George T. Frampton, Jr.
Assistant Secretary for Fish and Wildlife and Parks MAY 23 1994

From: for Mollie Beattie
Director

Subject: Intentional Introductions Policy Review - Report to Congress

Attached for Departmental and Office of Management and Budget (OMB) clearance is the Report to Congress on the Intentional Introductions Policy Review (Report) prepared by the Aquatic Nuisance Species (ANS) Task Force. The ANS Task Force is co-chaired by the Fish and Wildlife Service (Service) and the National Oceanic and Atmospheric Administration (NOAA). Section 1207 of the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (Act, P.L. 101-646) requires the ANS Task Force to provide Congress with recommendations for "reducing the risk of adverse consequences associated with intentional introductions of aquatic organisms."

Consistent with guidance in the Act, the Report was developed by the ANS Task Force after extensive consultation with State fish and wildlife agencies, other regional, State and local entities, potentially affected industries, and other interested parties. The Report has been reviewed and approved by the ANS Task Force. The recommendations in the Report promote education, cooperation, and accountability, with particular attention paid to more effective implementation of existing authorities.

NOAA is submitting a similar request for clearance to the Department of Commerce.

I encourage your endorsement of the Report and request approval for its submission to Congress. Questions or comments about the Report should be directed to Gary Edwards, Assistant Director--Fisheries, who may be reached at 208-6394.

Deputy

Attachment

Approved: _____ Date: AUG 16 1994

REPORT TO CONGRESS

FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS OF THE INTENTIONAL INTRODUCTIONS POLICY REVIEW

AQUATIC NUISANCE SPECIES TASK FORCE

MARCH 1994

EXECUTIVE SUMMARY

The Issue

Nonindigenous aquatic species have been and continue to be a source of socio-economic benefits and costs to many sectors of American society and a threat to the maintenance of biological diversity. Despite this significance, nonindigenous species issues in general are vastly under-recognized.

Nonindigenous species are used extensively in research, biocontrol, the aquarium industry, public and private aquaculture, and public fisheries management. Hundreds of species are imported by the aquarium industry on a regular basis for resale or as broodstock for domestic production. Much of marine aquaculture on the Pacific Coast is based on the nonindigenous Pacific oyster. Fisheries management in many States has involved the use of nonindigenous species. Pacific salmon, for example, are not indigenous to the Great Lakes but form the basis of a large recreational fishery.

Despite these benefits, there are risks associated with intentional introductions of nonindigenous species. In the context of this report, the definition of "intentional introduction" encompasses more than deliberate stocking activities. It includes escapes from aquaculture or aquarium facilities and activities such as dumping of baitfish and home aquarium species. Such introductions may lead to the decline of indigenous species through predation or competition for resources. Introduced species may alter habitat affecting human activities and those characteristics of the habitat on which indigenous species depend. If not properly screened, introduced organisms may carry serious pathogens or parasites. Local adaptations of wild stocks may be genetically based, and an inadequately considered introduction may affect their viability. Such risks are as likely to be associated with intentional introductions as with unintentional introductions.

The Framework

Primarily in response to the introduction of zebra mussels into the Great Lakes, Congress enacted the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (Act). Zebra mussels probably were unintentionally introduced via ballast water, and the major focus of the Act is to set up a framework to reduce the risk of unintentional introductions and to monitor and control nonindigenous aquatic nuisance species. The Act establishes an interagency Aquatic Nuisance Species Task Force (Task Force) responsible for developing a framework to address the problem of nonindigenous aquatic nuisance species. The Act also contains specific provisions for controlling zebra mussels and a mandate that the Coast Guard promulgate regulations to prevent further ballast water introductions into the Great Lakes. Several Federal

agencies have been involved in zebra mussel control activities. The Coast Guard ballast water management regulations became effective on May 10, 1993.

Section 1207 of the Act mandates that the Task Force conduct an Intentional Introductions Policy Review. The purpose of the review is to provide Congress with recommendations for "reducing the risk of adverse consequences associated with intentional introductions of aquatic organisms." This report is the product of that review. The policy review process involved a broad spectrum of potentially affected entities and benefitted greatly from their diverse views and approaches to these complex issues.

Two central concerns of the Task Force that reflect this complexity are: 1) the need to make ecologically credible decisions, and 2) the need to strike a balance between greater risk reduction and accommodating current activities and economies that depend on the use of nonindigenous species. Because of the difficulty in extirpating established aquatic species if they should become nuisance species, the Task Force has adopted the principle of adequate review before an introduction takes place. The Task Force concluded that: 1) to the maximum extent possible, decisions should be based on ecosystem considerations, and 2) the recommendations should generally apply only to new introductions. The first is consistent with the language of the Act and emphasizes the extent of shared ecological and evolutionary history rather than a jurisdictional boundary as the appropriate scale upon which biologically meaningful decisions should be based. The second represents a useful compromise between risk reduction and existing economic dependencies. The goal of both is to avoid creating situations that could lead to further establishment of nuisance species.

The Recommendations

In general, the recommendations promote education, cooperation, and accountability. Further, because prevention is key to risk reduction, most of the recommendations center around the decision-making process. The involvement of private industry and public organizations is essential to the effective implementation of Task Force recommendations.

General

> *For the recommendations in this report to be implemented effectively, both agency funding authorizations and appropriations must be consistent with the level of activity required by Congress in the authorizing statute, and requested in the President's budget.*

Education and Extension

1A Federal agencies should support the development of education and extension programs that promote or enhance: 1) general awareness of nonindigenous species issues, 2) understanding of the risks associated with introductions and how to minimize them, 3) understanding and enforcement of existing authorities, and 4) the preferred use of indigenous species.

1B Federal agencies should support and facilitate the coordination of a national network of clearinghouses for educational materials and other nonindigenous species information that would support the educational efforts presented in recommendation 1A.

Research

2 Federal agencies should support research that enables: 1) better understanding of the risks associated with introductions and how to minimize them, 2) identification of specific pathogens and parasites and methods of determining if proposed introductions are specific pathogen-free, 3) the use of indigenous species, and 4) more effective education and extension (i.e., evaluating the efforts made under recommendation 1A).

Existing Authority

3A Ongoing uses of nonindigenous species should be evaluated by their respective funding or permitting agencies (State or Federal) to determine their potential effects on indigenous species and adjusted as feasible to minimize risks.

3B Appropriate Federal agencies should more closely examine proposed new introductions to determine whether they constitute major actions with significant effects on the human environment and, if so, more fully and consistently employ the NEPA process in their considerations of proposed introductions. These same agencies should ensure that their NEPA guidance procedures reflect this concern.

3C Appropriate Federal agencies should formalize their compliance procedures to fully implement Executive Order 11987 and within one year of publication of this Report to Congress, submit to the ANS Task Force a report of what steps have been taken to achieve compliance.

3D Federal agencies should not provide financial assistance for new introductions of aquatic nonindigenous species (plant or animal) unless the proposed introduction is consistent with EO 11987 and other existing or new Federal authorities (e.g., Endangered Species Act, NEPA, and the recommended permit system [see 4A below] when developed).

3E Improvements in Federal activity that should be taken under the Lacey Act include:

1) expediting the injurious species listing process;

2) fostering compliance with interstate commerce clauses of the Lacey Act by maintaining and making available to all interested entities information on State lists (approved, restricted, prohibited) and regulatory requirements;

3) establishing a list of Federally approved and prohibited species to facilitate quick decisions on those species;

4) [under the Lacey Act or other appropriate authority], initiating a review system for all other species not so listed; and

5) making an effort to identify pathogens and parasites of concern.

3F The appropriate Federal agencies should: 1) expedite the listing process for noxious weeds, 2) develop the required undesirable plant management programs, and 3) encourage the use of Federal-State-private partnerships in developing the authorized control and prevention programs.

Prohibitions and Enforcement

The Task Force makes no specific recommendation under this option other than increased attention to the enforcement of existing authorities.

Permit Systems

4A Establish a Federal permitting system for imports from outside the United States to provide a credible review of proposed new introductions of nonindigenous aquatic organisms.

4B The USDA Animal and Plant Health Inspection Service (APHIS), the Fish and Wildlife Service, and the National Marine Fisheries Service should establish a joint permit review process. Congress should take appropriate legislative action recommended by the Administration to authorize the agreed-to process.

Protocols and Environmental Assessments

5 The ICES Code of Practice or other acceptable protocols shall be used as a tool to evaluate introductions.

Interjurisdictional Decision Methods

6A State and Federal officials should solicit review and approval from existing or newly developed interjurisdictional panels regarding new introductions that may affect the resources of multiple jurisdictions.

6B Interjurisdictional panels should serve as a forum for the sharing of nonindigenous species information; for the coordination, where desirable, of State laws; and for the development of regional policy.

6C Interjurisdictional nonindigenous species consultations should include representation from affected parties, i.e., Federal, State, Tribal, public and private interests and, where appropriate, the international community.

Model State Code

7 State legislative bodies should, in consultation with appropriate State agencies and other interested entities, enact comprehensive legislation to deal with nonindigenous species issues.

Good Business Practices

8 Where such codes do not already exist, private industry trade associations in consultation with the appropriate State and Federal agencies (and other interested entities), should develop Codes of Good Business Practices that promote continued commercial operation in a manner that is compatible with the conservation of natural ecosystems.

"... the Task Force shall, in consultation with State fish and wildlife agencies, other regional, State and local entities, potentially affected industries and other interested parties, identify and evaluate approaches for reducing the risk of adverse consequences associated with intentional introduction of aquatic organisms and submit a report of their findings, conclusions and recommendations to the appropriate Committees."

(Section 1207, NANPACA)

FRAMEWORK FOR FINDINGS AND RECOMMENDATIONS

Origin and Process of the Review:

The Nonindigenous Aquatic Nuisance Prevention and Control Act (Act) was passed by the 101st Congress and signed into law as P.L. 101-646 on November 29, 1990. The Act established the Aquatic Nuisance Species Task Force (Task Force) to carry out the many mandates of the law. Though the Act was passed primarily in response to current crises related to unintentional introductions (e.g., zebra mussel and European ruffe via ballast water), Congress recognized that there were potential problems with other forms of introduction as well. These other forms were referred to as "intentional" introductions but included accidental release from holding and production facilities (e.g., hatcheries, fish farms, aquarium plant or fish facilities) as well as those clearly intended for direct release to aquatic ecosystems (e.g., stocking programs).

While differences may exist between the various forms of release, the potential threat of adverse consequences from all forms was recognized. Congress, however, also recognized the importance of some nonindigenous species, particularly to private industry. In the face of this complexity, it was felt that insufficient information was available on the options for reducing adverse consequences to justify Congressional action. The purpose behind Section 1207 was to require an examination of the issues involved in intentional introductions and recommended actions before additional legislation would be enacted.

To accomplish this review, the Task Force formed the Intentional Introductions Policy Review Committee (Committee). The Committee held its initial meeting in November of 1991 to set an agenda for completion of the policy review and to begin developing a list of interested and potentially affected entities to consult. By December of 1991, the list had expanded to over 350 names representing the fish and wildlife conservation agencies and aquaculture coordinators of all 50 States, a number of Federal agencies, industry (aquaculture, fishing, aquarium trade), environmental and recreational organizations, academia, and professional scientific organizations. On December 20, 1991, the Task Force sent a letter to all identified entities to invite their involvement in the policy review process. Each was requested to identify potential options for meeting the goal of reducing the risks

associated with intentional introductions and to participate in a public meeting on February 26, 1992. A similar request was published in the Federal Register on January 22, 1992.

The public meeting, held at the Department of Commerce in Washington, D.C., was attended by a diverse group of 25 participants. A summary of the options that had been identified in the written responses was presented. Following presentation of the summary and an open microphone session for those in attendance to identify additional options or provide additional detail on previous submissions, Committee members and attendees held an open forum discussion of the options. The purposes of the discussion were to identify variations on the options and to allow participants the opportunity to begin assessing the potential advantages or difficulties of each option. Between the written comments and public meeting attendees, more than 100 non-Task Force individuals, groups, and organizations had contributed to the identification of options.

A summary of the identified options and the initially recognized advantages and difficulties with each was then prepared as an "Intentional Introductions Policy Review -- Options Paper," presented to the Task Force in April 1992, and made available to the public in May 1992. The options developed and discussed in the Options Paper will not be repeated in the text of this report but are presented as Appendix A. The mailing list for the Options Paper and accompanying request for review and comments had by then grown to over 450 names. An announcement of the availability of the Options Paper, information on a series of four public meetings, and a request for review and comments was also published in the Federal Register. During the comment period in June and July 1992, public meetings were held in Portland (OR), Vicksburg (MS), Valrico (FL), and Baltimore (MD) to present the Options Paper, answer questions, and solicit public comment. By the completion of the public meetings and the end of the comment period, the number of participants in the policy review process totaled over 200 individuals, groups, organizations, State agriculture agencies, and included fish and wildlife conservation agencies from nearly every State.

After reviewing all of the public comments, the Committee held two additional public meetings in September and October 1992 to discuss and finalize the draft recommendations. The committee's recommendations were presented to the Task Force on November 20, 1992.

The Proposed Report to Congress was cleared for public review with a notice of availability and request for public comment published in the Federal Register on August 27, 1993. The public comment closed on October 25, 1993 and 145 written comments were received from Federal agencies, State agencies, professional societies, academicians, individuals engaged in aquaculture, tropical fish businesses, and aquarium hobbyists. The Committee met in a public meeting on January 10, 1994, to consider the comments received and

modifications to the Proposed Report in light of those comments. The final report was forwarded to the Task Force for approval on March 1, 1994.

Baselines of the Review:

A number of important baseline assumptions and decisions were necessary to guide the review process and set a framework for the recommendations. In general, these relate to definitions, scope, and emphasis.

Section 1207 of the Act does not specify that the Intentional Introductions Policy Review should address itself to nonindigenous species but simply "aquatic organisms." The review could therefore have considered all aquatic introductions including re-introductions of indigenous species, e.g., hatchery programs that use native stocks or even re-introductions of endangered species. However, because Title I of the Act concerns problems presented by nonindigenous species, the review was limited to nonindigenous species. Even when limited to nonindigenous species, it should be noted that "aquatic organisms" covers a wide variety of organisms (e.g., aquatic plants, invertebrates, fish, bacteria, viruses etc.) for a wide range of intended uses (research, pest control, food production, recreation, ornamental, etc.).

The Act defines a nonindigenous species as "... any species or other viable biological material that enters an ecosystem beyond its historic range ...." This clearly defines the ecosystem as the scale upon which decisions are to be based. The Task Force has chosen to interpret "historic range" to mean the area occupied at the time of European colonization of North America (see Aquatic Nuisance Species (ANS) Program Table 1 definition of "transplants" and Appendix G "Research Protocol"). Therefore, the term "historic range" equates with natural distribution and the terms indigenous and nonindigenous are essentially synonymous with native and non-native, respectively.

Simply being nonindigenous does not constitute sufficient reason to confer nuisance species status. The Act provides a separate definition of an aquatic nuisance species as a nonindigenous species that "... threatens the diversity or abundance of native species or the ecological stability of infested waters, or commercial, agricultural, aquacultural or recreational activities dependent upon such waters." The importance of this definition in carrying out Section 1207 is that the Act makes it clear that threats to indigenous species and their aquatic ecosystems are the "adverse consequences" whose risks are to be reduced. Consideration of threats to user activities follow from their dependence upon indigenous species and the stability of their aquatic ecosystems.

The Act did not define intentional introduction but did provide examples of "unintentional" introductions such as

the transport of nonindigenous species in ballast water or in water used to transport fish, mollusks or crustaceans for aquaculture or other purposes. In other words, the 'riders' unknowingly brought in are considered to be unintentionally introduced while species knowingly brought in constitute an intentional introduction.

The Task Force's proposed ANS Program defines intentional introductions as: "The import or introduction of nonindigenous species into, or transport through, an area or ecosystem where it is not established in open waters for a specific purpose such as fishery management. Even when the purpose of such import or transport is not direct introduction into an open ecosystem (e.g., for aquaculture or display in an aquarium), eventual introduction into open waters as the result of escapement, accidental release, improper disposal (e.g., "aquarium dumping"), or similar releases are the inevitable consequence of the original import or transport, not an unintentional introduction." Though the inevitability of escapes may be improved upon, the important concept presented in this definition is its consistency with the Program's definition of ecosystems: "... natural or wild environments as well as human environments, including infrastructure elements." This would therefore include any holding facility as part of the larger ecosystem, with any later accidental release considered a consequence of the initial introduction.

The language of Section 1207 and the discussions during Congressional hearings also clearly signaled Congress's intent that the risks of escapes from public and private facilities be included in the policy review rather than moving immediately to regulatory actions as was authorized for unintentional introductions. Finally, with regard to use of the term "intentional introductions," it should be clarified that the Task Force in no way suggests that such escapes or releases into open aquatic ecosystems are or generally have been made "intentionally" in the narrower sense of the word.

Another term that needs clarification is "species." Although the Act does not define this term, the definition of "nonindigenous species" is broader than full species. It includes "species or other viable biological material." Similarly the policy review language in the Act refers to "aquatic organisms" rather than species. The species concept presented in the Task Force's proposed ANS Program is also adopted here: "A group of organisms all of which have a high degree of physical and genetic similarity, can generally interbreed only among themselves, and show persistent differences from members of allied species. Species may include subspecies, populations, stocks, or other taxonomic classifications less than full species." This means that just as introducing a European species anywhere in the United States would be considered an introduction of a nonindigenous species so also would the transfer of differentiable stocks of the same species (e.g., using Alsea River [OR] coho to stock the Elwha River [WA] or

the Florida subspecies of largemouth bass to stock a Wisconsin lake). This does not mean that such introductions should not be made. Rather, it again reflects an emphasis on the extent of shared ecological and evolutionary history rather than jurisdictional boundaries as the appropriate scale upon which biologically meaningful decisions on introductions should be based.

Some of those who commented on the proposed report expressed the view that the broader definition was unjustified and that the definition should be limited to full species. Individual State agencies stated that this definition was extreme and beyond the intent of the legislation. One State agency and one Federal agency commented that the definition lacked precision. There was concern that a lack of precision could inhibit the ability of management agencies to manage important game fish resources.

On the other hand, comments by the National Marine Fisheries Service (NMFS) strongly supported the definition and noted that it is consistent with the definition contained in the Endangered Species Act (ESA). The definition of species in the ESA "includes any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." NMFS also noted that it has had to address the decline of Pacific salmonid stocks under the ESA and that stocking of nonindigenous or maladapted hatchery stocks had exacerbated the decline of indigenous stocks.

This reflects increasing concern with the possibility that specific adaptations of genetically based wild stocks may be affected by interbreeding with introduced stocks. The North American Commission of the North Atlantic Salmon Conservation Organization has developed draft protocols that would prohibit the use of European strains of Atlantic salmon (*Salmo salar*) in aquaculture or stocking. In general terms, they have also adopted the concept of limiting stocking and aquaculture activities where viable wild stocks exist to use of the local wild stock (North Atlantic Salmon Conservation Organization 1992).

Several over-arching themes guided the development of recommendations. Perhaps most important among these is that although nonindigenous species have been and continue to be both a source of significant benefits to many sectors of American society and a serious threat to the maintenance of biological diversity, nonindigenous species issues in general are vastly under-recognized. A second current that ran though the deliberations and much of the public participation is that a better understanding of and accountability for the effects of introductions is needed at every level. It was also felt that a balance needed to be struck between greater risk reduction and accommodating the current activities and economies that depend on the use of nonindigenous species. At this stage therefore, it was concluded that a useful compromise

would be that the recommendations should generally apply only to "new" introductions. There is one departure from this general principle in the recommendations. As a general management practice, the Task Force recommended that ongoing introduction of nonindigenous species be periodically reviewed.

"New" introductions include movements of species into ecosystems where they do not presently occur. Thus, moving black bullhead (*Ameiurus melas*) from Illinois to Alaska or Pacific oyster (*Crassostrea gigas*) from waters or hatcheries in the State of Washington to the Chesapeake Bay would constitute a new introduction. This also specifically means that ongoing introductions into ecosystems where the species is nonindigenous but is already established (e.g., brown trout in the Madison River system, MT) would not be considered new and thus largely unaffected by the recommendations.

Substantial differences may exist between proposals to introduce species into open aquatic ecosystems and introductions to more secure facilities, e.g., many aquarium supply and aquacultural facilities. Though escape or spread from the site of introduction has certainly occurred under both conditions, one obvious difference is that containment measures can be under much greater control in the latter situations. In general then, somewhat different approaches may be appropriate - e.g., while direct introductions may require a full assessment of the potential environmental effects, a limited assessment in conjunction with containment, contingency, or liability measures may be appropriate for introductions into more secure facilities.

Finally, jurisdictional issues need to be clarified. The Task Force regards the importation of species into the United States as clearly falling under Federal jurisdiction. Similarly, with the exception of imports, introductions whose potential dispersal sites lie wholly within a single State are and should remain the responsibility of that particular State. There are many cases, however, that do not easily fall into either of these categories. Examples would include introductions directly into bodies of water that constitute interstate borders or that course through more than one State; introductions into other waters from which they are likely to spread to interstate waters; or introductions within State waters that may affect Federally significant resources (e.g., national parks, marine sanctuaries). The interstate movement of species is another area where State authorities are currently the primary guide to decision making (though Federal statutes such as the Lacey Act and Noxious Weed Act do come into play) but the resources of more than one jurisdiction may be affected by the decision. The recommendations address situations that fit into all of these jurisdictional settings.

The Task Force was acutely aware of the jurisdictional division between the Federal government and State governments. In several instances it

rejected options that would have provided a greater degree of Federal control over State management of introductions. It limited the permitting recommendation to imports from outside the United States despite one comment that pointed out that the interstate commerce clause provided constitutional authority to cover introductions from within the United States. It chose to make interjurisdictional recommendations nonbinding. The Task Force also chose not to tie either incentives or disincentives to the Model State Code.

Nevertheless, several State agencies expressed the view that the recommendations contained in the Proposed Report to Congress would unduly infringe on the traditional State authority for management of fish and wildlife resources. Some comments cited Section 1205 of the Act which provides: "Nothing in this title shall affect the authority of any State or political subdivision thereof to adopt or enforce control measures for aquatic nuisance species, or diminish or affect the jurisdiction of any State over species of fish and wildlife." The Task Force interprets this provision to apply to regulatory actions. A report to the Congress does not affect State jurisdiction over species. Any subsequent action based on the recommendations would be at the discretion of Congress.

Two broad categories to which the Task Force is not at this point prepared to extend the recommendations are microbial and transgenic organisms. This does not mean that the recommendations do not take microbial organisms into account. If a nonindigenous species of shrimp was proposed for introduction, the shrimp (and all of its allied ecological, pathogenic, genetic, and other risks), rather than one of its specific pathogens, would be subject to the type of review recommended herein. The latter would be the case if the pathogen alone was proposed for introduction, e.g., for research or as a biocontrol agent. For introductions like the latter (the microbe alone), the Task Force is unprepared to offer specific recommendations and criteria. However, the introduction of the shrimp in this example could not be adequately reviewed without consideration of its potential as a pathway for the spread of pathogens. This is addressed in the "Findings" and "Conclusions and Recommendations" sections below (see especially, Permit Systems, Education and Extension, and Research).

Because in their altered form transgenic organisms have as such no "historic range" and entry into <u>any</u> ecosystem would therefore constitute an introduction beyond its historic range, the Task Force does consider such organisms to fit the definition of a nonindigenous species. The Task Force is also in general agreement with the American Fisheries Society's position statement on transgenic fishes (Kapuscinski and Hallerman, 1990, reprinted here as Appendix B). The Task Force believes that specific recommendations on transgenic and microbial organisms (both pathogenic

and non-pathogenic) should be developed and proceed from a more detailed review of these organisms, perhaps by the National Research Council or the Office of Technology Assessment with ANS Task Force participation.

FINDINGS

This section describes some of the uses and economic dependencies on nonindigenous aquatic species, some of the risks associated with introductions of nonindigenous species, and examples of existing State regulatory authorities and policies. However, this section does not take an extensive look at any of these because there is a burgeoning mass of literature on the subject of introduced species and their use to which the reader may turn for additional information (see Rosenthal 1980, Courtenay and Stauffer 1984, DeVoe 1992, Rosenfield and Mann 1992, OTA 1993).

Although Congress recognized that there have been beneficiaries from the use of nonindigenous species, the focus of Section 1207 is "reducing the risk of adverse consequences." For this reason, while benefits are presented, the Intentional Introductions Policy Review has concentrated on developing recommendations intended to address risk reduction rather than on highlighting beneficial uses.

Current Uses:

The financial and recreational benefits of the use of some nonindigenous species are substantial. The aquarium trade, for example, is a large and complex business in the United States and nonindigenous species are an integral part of that trade. Hobbyists spend more than $2 billion a year on purchase of aquarium fish and associated products. Of this total, live fish purchases account for more than $600 million (Marshall Myers, Pet Industry Joint Advisory Council, pers. comm., 1994). The Florida Agricultural Statistics Service (1992) reported that in Florida in 1991, growers sold $7.1 million worth of tropical fish that had been imported for immediate resale. This was in addition to nearly $33 million in sales of tropical fish, many of them nonindigenous, that had been produced in Florida. Conniff (1989) reported in an article in Smithsonian magazine that 1 of every 11 homes in the United States had aquaria. Conniff also noted that a single firm may supply as many as 3000 different items (items = breedlines of distinct color, size or configuration). An interesting point raised at the Valrico (FL) public meeting was that while some retail facilities specialize solely in aquarium supplies, many more are general pet stores for which tropical fish sales may form a smaller yet reliable source of revenue - i.e., factors that affect the aquarium trade affect more than the tropical fish business.

U.S. aquaculture production in 1990 is estimated to have had a value of $761.5 million (Economic Research Service, U.S. Department of Agriculture, 1993). The industry serves both domestic and export markets. This production was based on the use of both native and nonindigenous species. For example, channel catfish (*Ictalurus punctatus*) one of the nation's leading aquacultural products, is cultured primarily in the lower Mississippi River drainage within its native range but is also produced in and distributed to many places outside its native range (e.g., California). Similarly, while much of the rainbow trout (*Oncorhynchus mykiss*) production takes place in the western United States within its native range, commercial rainbow trout producers were located in 48 of the 50 States in 1987 (Parker 1989). For both of these species, some fish are marketed as food and some as live fish for stocking programs. Baitfish production is also centered within the native range of its primary species, several shiner and minnow species, but "is the source of shipments to nearly all the 48 contiguous states" (Parker 1989). Tilapia and carp (*Cyprinus carpio*) are not native anywhere in the United States but are increasingly cultured for food and for vegetation control. Much of marine aquacultural production on the Pacific Coast is based on the Pacific oyster (*Crassostrea gigas*), a species originally imported from Japan (Stickney, 1992).

Sport fishery management is another area of considerable use of nonindigenous species. The brown trout (*Salmo trutta*), for example, is native to Europe and western Asia but has been widely introduced across the United States and has become a popular target of recreational fishing. Pacific salmon (*Oncorhynchus* spp.) are not native to the Great Lakes and are highly dependent on hatchery production, yet they support a "multi-billion dollar" fishery (Dan Thomas, Great Lakes Sport Fishing Council, pers. comm., 1992). Rainbow trout fishing in States like Virginia, Colorado, or Pennsylvania constitutes a nonindigenous species use. The millions of anglers who fish for largemouth bass (*Micropterus salmoides*) outside its native range (e.g. in Oregon, California, Arizona, and many other States) clearly depend on a nonindigenous species. These and other species have become major components of the current sport fishing programs in most States. Past management practices have thus created the expectation that such fisheries will continue to be available.

Nonindigenous species have also been used in situations where human activity has so altered an ecosystem that it can no longer support indigenous species. In these highly altered ecosystems, introduced species may play a role in maintaining ecosystem stability and productivity, and in providing social and economic benefits. For example, habitat alteration that restricted movement, coupled with siltation and elevation of stream temperatures led to the demise of native grayling (*Thymallus arcticus*) populations in stream habitats in northern Michigan. The ecosystem was so altered that

attempts to reintroduce similar grayling strains were unsuccessful. Introduced rainbow trout now provide a productive fishery where an indigenous species is unable to thrive.

Associated Risks:

The above accounting of some of the uses of nonindigenous species illustrates that they must be recognized as ongoing activities of significant socio-economic importance, but does not suggest that these and other species have not also been the source of significant economic and environmental impacts. To assess the impact of introductions generally, the Office of Technology Assessment (OTA) contracted for a series of studies on different types of introduced species. The studies reviewed 112 species of introduced fish and 77 species of introduced mollusks. They concluded that 45 species of fish and 32 species of mollusks have had harmful economic or environmental effects. In some instances introduced species had both beneficial and harmful effects. Although some of those who submitted comments on the proposed report expressed the view that unintentional introductions constitute the major problem, OTA concluded that intentional introductions are as likely to cause problems as unintentional introductions. Their definition of intentional introductions was narrower than that used in this report. As intentional introductions, they only considered species deliberately released into the natural environment. For fish, 35 of 76 intentional introductions and 10 of 26 unintentional introductions had some harmful effects. In the case of mollusks, five of ten intentional introductions and 27 of 67 unintentional introductions had harmful effects. In the case of intentional introductions, such figures may indicate a poor selection of species and inadequate screening (OTA 1993).

For many cultured species, effective containment is becoming an increasingly important aspect of culture techniques. For example, because tilapia are aggressive and compete with indigenous species for spawning sites and space, they have been prohibited from introduction into several States (Parker 1989). Shelton and Smitherman (1984) suggested that "escape is virtually inevitable" in fish culture. Similarly, Welcomme (1988) concluded that species used in aquaculture "eventually escape" and that "any introduction made for aquaculture must be thought of as a potential addition to the wild fauna." It will be important to both private industry and public agencies for all forms of aquacultural facilities (e.g., hatcheries, production ponds, holding facilities) to develop more effective containment strategies. If this impression of the inevitability of escape and any regulatory trend toward prohibition of potentially deleterious species are to be reversed, it will be necessary to demonstrate the feasibility of longterm escape control. Demonstration of such control may also go a long way toward easing decisions made under any current or future permit system.

The presence of an introduced species in an open environment necessarily involves an impact of some kind. In a recent text on "biological pollution," Courtenay (1993) summarized that "... every introduction will result in impacts to native biota, which may range from almost nil to major, including extinction with time." Nonindigenous species may affect indigenous species by competing for resources, preying on native fauna, transferring pathogens, or significantly altering habitat. The introduction of a nonindigenous species may work synergistically with other factors, such as water diversions or pollution, to alter the population and distribution of indigenous species. The factors are often cumulative and/or complementary. For example, habitat degradation may make a species more vulnerable to the introduction of nonindigenous species.

Moyle and Williams (1990) analyzed the status of native fish species in California. They determined that large water projects, in concert with introductions of fish species better able to cope in altered habitats, were largely responsible for the decline of California's fish fauna. The presence of introduced species was a "very important factor" or the "principal" factor in the status of 49% of those species described as extinct, endangered, or in need of special protection.

Miller et al. (1989) analyzed factors associated with the extinctions of three genera, 27 species, and 13 subspecies of North American fishes in the past 100 years, many of which occurred before the passage of the Endangered Species Act in 1973. In most cases, multiple factors were cited. Habitat alteration was cited in 29 (73%) of the 40 extinctions, and introduced species were a contributing factor in 27 (68%) of the cases. For those cases where introduced species were cited, 19 were apparently the consequence of intentional introductions, as defined herein (Appendix C).

Similar to the Miller analysis, a review of factors cited in the listings of 92 fish species under the Endangered Species Act (ESA) was conducted in conjunction with this report (Appendix D). The review identified that in most of the 69 cases for which adequate information was provided, more than one listing factor was cited. Among these cases, habitat alteration again appeared as the most frequently cited factor in 63 (91%) of the 69 listings. The effects of introduced species were cited as a cause of decline or potential threat in 48 (70%) of the 69 cases. Introductions related to sport fishing (game, forage, and bait species) were the most commonly cited (35 of the 48 cases). A majority of the introduced species cited appear to have been present in the ecosystem as the result of intentional introductions; again, as defined herein.

Introduced species have impacted indigenous fish species, whether habitat modification has occurred or not. In six of the ten cases where Miller et al. (1989) cited introduced species as a "major" or "primary" factor in the extinction of native fishes, habitat alteration was not a cited factor. Similarly, the desert pupfish (*Cyprinodon macularius*) is listed as endangered throughout its range of southeastern California and southern Arizona. Reasons for its decline include: habitat loss, habitat

modification, and pollution (USFWS 1993). But as the USFWS *Desert Pupfish Recovery Plan* states, "pupfish do not fare well in the presence of non-native fishes and incursions by exotics have typically resulted in decline or extirpation of pupfish" (USFWS 1993).

The spread of pathogenic organisms has not generally been attributed to intentional introduction of the pathogen (e.g., for research purposes) but in association with shipments of artificially reared organisms (Andrews 1980, Rosenthal 1985, Farley 1992). As pointed out in a summary of disease introductions by Sindermann (1993), a variety of serious diseases with major economic impact have been moved about accompanying organisms used in stocking programs or aquaculture programs. Such diseases have had an impact on a variety of organisms ranging from penaeid shrimp to salmonids to oysters. Even introductions of the same or closely related species can have negative impacts on native populations through the introduction of pathogens or parasites that may cause epizootics. Wild and farmed populations of Atlantic salmon in Norway have been devastated by the introduced monogean parasite *Gyrodactylus salaris* (Johnsen and Jensen 1991). Infectious hematopoietic necrosis virus appears to have been introduced into Japan with sockeye salmon eggs in the 1970s and has since affected the native masou salmon (*Oncorhynchus masou*). Similarly, when the American crayfish (*Pacifastacus leniusculus*) was introduced into Europe it brought with it the crayfish plague (*Aphanomyces astaci*). This fungal disease has little impact on the American crayfish within its native range but has eliminated the native crayfish from much of Europe (Thompson 1990). Pathogens and parasites associated with introduced species may also have an impact on species that are not released to the wild as in the case of the highly lethal shrimp virus infectious hypodermal and hematopoietic necrosis virus (IHHNV). Introduced into aquaculture facilities in Hawaii, Florida, Texas, Guam, and most recently Mexico, IHHNV has had a major economic impact on aquaculture facilities whenever it has been introduced (Lightner et al 1992).

Though such introductions would under the language of the Act be considered unintentionally introduced species, they are obviously inextricably linked to the organism that is being intentionally introduced. Current programs to assess introductions were often set up to limit the possibility that pathogens or parasites would be introduced with species to be stocked. The Great Lakes Fishery Commission requires notification of salmonid introductions and has set up a protocol to prevent introductions of salmonid diseases (Hnath 1993, Horner and Eshenroder 1993), and the Atlantic States Marine Fisheries Commission (ASMFC) has set up a procedural plan to deal with interjurisdictional transfers and introductions of shellfish to prevent the spread of disease (ASMFC 1989). As noted, any effort to reduce the risks associated with the introduction of an organism would have to include an assessment of its pathogens and other cryptic or associated flora or fauna.

Introductions of nonindigenous strains may have deleterious genetic impacts on indigenous species. Because the qualities selected for in stocking or

aquaculture programs may not necessarily be those that enhance survival in the wild, large scale releases or escapes of these strains may compromise the survivability of the indigenous species. Interbreeding of indigenous species with hatchery products or introduced strains may reduce adaptations that are genetically linked and thus result in a loss of natural genetic diversity. Such introductions may also lead to outbreeding depression (Waples 1991).

Although the record is limited, there is increasing concern that open system aquaculture and stocking programs may have deleterious impacts on wild stocks of the same species. More attention has been given to salmonids in this respect than to other species. There is increasing evidence that localized population units are adapted to specific environmental conditions. Such characteristics as timing and extent of migrations, size and shape at various life stages, optimal water temperatures, behavioral differences, and resistance to specific diseases may be genetically linked (Taylor 1991, Ferguson 1990). Although noting the limited information base, Hindar et al. (1991) concluded, "...any substantial influx of exogenous genes, may it be gene flow or complete displacement, has a negative effect on performance. In some instances, severe population reductions have followed introductions of cultured fish." Concern has been raised that large-scale escapes from open aquaculture facilities and stocking programs may threaten local wild stocks resulting in the loss of genetic adaptations (Gausen and Moen 1991, Waples, 1991). Two scientists have developed population models demonstrating that even if there is limited reproduction of nonindigenous stocks, introductions of large numbers of cultured fish may lead to extinctions of wild stocks (Hutchings 1991, Evans and Willox 1991).

Introductions of nonindigenous species also may affect indigenous species by altering habitat. The aquatic plant hydrilla (*Hydrilla verticillata*) was apparently released and spread both intentionally via aquarium dumping and unintentionally via transport on boat trailers. Hydrilla can clog water bodies and threaten both biotic resources and recreational activities (Courtenay and Williams 1992). Schardt and Schmitz (1990) reported that of Florida's nonindigenous aquatic plants "most were deliberately transplanted." For example, Australian melaleuca (*Melaleuca quinquenervia*) was imported to Florida for forestry purposes but has since extensively invaded the State's wetlands (Culotta 1991, Schmitz et al. 1991). At one point, melaleuca seeds were even scattered by airplane. Interestingly, a similar suggestion has recently been made for the aerial dispersal of "millions of killifish eggs" for mosquito control purposes (Kaczor 1992). Between the U.S. Army Corps of Engineers and the Tennessee Valley Authority, the Federal government spent $13 million on research and control of aquatic plants in Fiscal Year 1992.

Aquatic plants are a particularly important component of aquatic ecosystems because they make up the key interfaces between sediment, the water column and the atmosphere controlling both productivity and biogeochemical cycles as well as structuring aquatic habitats (Carpenter and Lodge 1986). Both fish and

invertebrates tend to be more abundant and diverse in macrophyte beds than in adjacent open water (Wiley et al. 1984, Killgore et al. 1989). Benthic populations under macrophyte beds can exceed 100 times that which occurs in open areas (Miller et al. 1989).

The introduction of macrophytes that become aquatic nuisance species tends to alter aquatic habitat. When introduced, such species often experience a rapid phase of dispersal and growth. Where indigenous plant species occur, the introduced species often have a competitive advantage due to a lack of natural predators or some morphological or physiological attribute. Hydrilla can withstand lower light and dissolved oxygen levels than most competing indigenous rooted aquatic plants. Hydrilla and other introduced species often create dense canopies that limit light to indigenous species.

Introduced nuisance aquatic plants can outcompete indigenous plants and form a monoculture that invades the entire littoral zone. Such introductions may have a negative impact on sport fisheries. For example, reduced predation success by largemouth bass in dense macrophyte beds contributes to diminished bass production (Savino and Stein 1982, Engel 1987).

Canopy formation also can influence dissolved oxygen levels and primary production within a specific habitat. Oxygen depletion beneath plant canopies is likely due to the physical barrier between the atmosphere and the water. This barrier reduces wind-driven water movement and impedes reaeration. Decomposition of decaying plant material associated with the rapid growth of introduced species also exerts an oxygen demand, further reducing ambient oxygen concentrations. Many nuisance aquatic plants are associated with water quality problems because their monoculture populations cover large expanses with extreme densities with extensive canopies at the water surface.

In some instances, the impact of aquatic species introductions may depend on where they are introduced. The smooth cordgrass (*Spartina alterniflora*) has been used to stabilize shorelines on the east coast. On the west coast, the introduction of the species has created problems necessitating removal efforts in estuaries. Grass carp (*Ctenopharyngodon idella*) have been used for aquatic vegetation control in some places. In other areas, there are concerns that the species could spread and become established because they can increase water turbidity and destroy habitat for juvenile fish. As a means of reducing the risk of grass carp becoming established, the Fish and Wildlife Service has developed a program to certify triploidy so that introduced individuals should not be able to reproduce. Nevertheless, there is still a degree of controversy over use of grass carp.

Lessons from the States:

The December 1991 request for input on the identification of options for reducing the risks associated with intentional introductions also included a request for information on existing State regulations that address this issue. The response was varied, with several States providing excellent and

extensive information on existing regulations and others responding with a statement of preferred options. By the time of the second request for reviews, this time for the Options Paper in May 1992, several of these same States responded with additional or different sets of regulations that had been put in place in the interim. Still others offered examples of proposed changes that might become State law, or might not. Because the regulation of nonindigenous species use is an area of increasing State attention and present requirements are so fluid, this report will not attempt to provide a State-by-State summary of existing regulations. This report will instead provide examples of the Task Force's findings on the range of State regulations made available for our review.

Most of the States that responded cited some form of regulatory authority over the importation (to the State) or introduction of fishes, in some cases only game species. As noted by the New Mexico Department of Game and Fish (Montoya 1992), "this leaves an entire range of aquatic organisms that are unregulated ...," e.g., amphibians, insects, plants. For those species for which State natural resource agencies did have authority, the most commonly cited approach was to use some form of general prohibition on import or introduction that was linked to a permit system. Many States cited no particular criteria by which permit applications are judged. Others varied widely but included likelihood of survival over an annual cycle, potential as a pathway for the introduction of pathogens, actual or potential threats to indigenous species (genetic, competition, predation, or other biological considerations), human health hazard, and other biological and socio-economic ramifications.

Discussion by many States of components of their general approach and decision-making scheme were also useful to the Task Force in the development and consideration of recommendations. Texas uses a prohibited list approach where "the importation, sale, transport, release and possession" of listed species (of fish, shellfish and plants) are prohibited and all others are reviewed with "primary consideration" given to the possible adverse effects of the species. Illinois also has restricted and prohibited species lists but is largely guided by an approved list that primarily includes native and long-established nonindigenous species that the State feels pose no threat. It is illegal "to culture, transport, stock, import and/or possess" any species not on the approved list until such action has been the subject of a permit review; in the case of aquacultural species, by an interagency advisory committee. As can be seen, the approaches of the two States are quite different. However, an important similarity is that regardless of the form of the initial screening, all other species (for which they have authority) are subject to some type of formal review. Such reviews lend a measure of accountability to both the permittee and the agencies.

Other States have gone, or expect to go, a step further in terms of accountability by placing contingency or liability requirements on permittees. Draft rules for marine resources provided to the Task Force by the Florida Department of Natural Resources noted that applications for a special activity license for the culture of

a broad group of protected marine species must include "contingency plans in the event of a natural disaster, such as a hurricane, to prevent specimens from entering the state's waters." The draft rules also make it illegal "to release into waters of the state any nonindigenous marine animal" or to use nonindigenous species as bait. Hawaii adds accountability to its own decision-making process by including "extensive review by the scientific and environmental communities." Additionally, in cases where permit violations "result in the escape or establishment of any pest and caused the department to initiate a program to capture, control, or eradicate that pest, the court shall also require that person or importer to pay ... an amount ... based upon the cost of the development and implementation of the program."

In Florida, a State where the director of the Department of Natural Resource's Division of Resource Management suggested that "the spread of exotic species--biological pollution--is the most serious environmental problem facing Florida today" (Craft 1991), a number of additional measures have been taken to reduce the risks of adverse effects from introductions of nonindigenous species. The Florida Bureau of Aquatic Plant Management regularly monitors for the presence of nonindigenous aquatic plants; when necessary, dispatches personnel to remove those considered to be deleterious; and routinely examines imports and nursery facilities. Schardt and Schmitz (1990) report that these activities have prevented the entry and spread of a number of potentially problematic species. Florida also mandates very specific requirements for outdoor facilities that hold certain restricted aquatic species, e.g., the surrounding levee must be at least one foot above the 100-year flood level, have either no water discharge or a barrier system adequate to prevent escape of any life stage, and be inaccessible to the public. Though the 100-year floodplain was often cited by other review participants as an appropriate restriction, the important aspects of Florida's requirements are not its specific requirements so much as its clear recognition of the importance of effective containment.

The State of Washington has an extensive system of rules "to protect the aquaculture industry [finfish, shellfish, amphibians, and marine plants] and wild stock fisheries from loss of productivity due to aquatic diseases or maladies." The system variously involves geographic limitations, pathogen inspection certifications, quarantines, site and product inspections, user fees, and compliance with the State Environmental Policy Act. As in Washington, a few other States also cited the need to adhere to an environmental review process. In Montana, transplant or introduction of any wildlife is prohibited "unless it is determined through scientific investigation and after public hearing" that the species poses no significant harm to native wildlife and plants. At least in the case of fish, this scientific investigation requires preparation of an environmental review in compliance with provisions of the Montana Environmental Policy Act. The Montana Department of Fish, Wildlife and Parks expressed a sentiment shared by many other States in noting that it "has been taking an increasingly

cautious approach to intentional introduction of aquatic species."

The Illinois Department of Conservation reported that introductions into boundary waters are discussed at various interstate forums and may lead to "advisory decisions" by such bodies. Several of the Great Lakes area States cited the Great Lakes Fishery Commission as a forum for shared management decisions. Similarly, the Atlantic States Marine Fisheries Commission provides a structured forum for the examination of interjurisdictional transfers of shellfish. The Arizona Game and Fish Department goes a step further by stating in its own stocking policy that any introduction of a new species into the Colorado River drainage "shall require advance approval" of the Colorado River Wildlife Council, an interstate natural resource council. Representation on some of these panels may need to be broadened to effectively encompass potentially affected entities.

CONCLUSIONS AND RECOMMENDATIONS

This section presents the Task Force's conclusions and recommended approaches for reducing the risk of adverse consequences associated with intentional introduction of aquatic organisms. Various aspects of the recommendations are directed at a wide range of entities, including State and Federal agencies, private industry and Congress. Recommendations are accompanied by explanatory text and printed in bold face for easier recognition. A discussion of some of the options considered but not adopted by the Task Force is presented first.

In the Options Paper circulated for public review, the broad spectrum of options from total bans on introductions of nonindigenous species to total regulatory noninvolvement ("laissez faire") was discussed. Though a single participant in the review process expressed the sentiment that only "profit and image" should be primary considerations, no participant fully supported total regulatory noninvolvement nor does the Task Force. Several participants did support essentially total bans on introductions of nonindigenous species. The Task Force does not support total bans on the use of nonindigenous species (see also "Prohibitions and Enforcement" section below).

Other general approaches that the Task Force considered but does not recommend include requiring extensive Federal permitting for all interstate movements and linking tough, Federally mandated guidelines (e.g., a rigid Model State Code or set of Federal minimum standards) to financial disincentives (fines) for failure to comply. The Task Force felt that both would be extremely difficult to put in place (both financially and legislatively). An interesting twist to the linkage of a Model State Code to disincentives was to link compliance instead to indemnification - i.e., if a State does comply with the Model Code, it would not be subject to liability suit by an adjacent State or other entities with standing. Though the Task Force is not ready to recommend this approach, further consideration is warranted.

Despite the hesitance of the Task Force to support these particular variations on the approaches, the basic concepts of a Model State Code and some form of Federal involvement in interjurisdictional cases received considerable support and are at the core of some of the recommendations. The Task Force is not ready to support the punitive nature of such a linkage, the extent of Federal control, and the inordinate costs of implementation. Recommendations that the Task Force does support are ones that promote education, cooperation, and accountability. These were recurrent themes in participant responses throughout the review process. Further, because the Task Force believes that prevention is key to risk reduction, most of the recommendations center around the decision-making process.

A General Recommendation:

For the recommendations in this report to be implemented effectively, both agency funding authorizations and appropriations must be consistent with the level of activity required by Congress in the authorizing statute, and requested in the President's budget.

Effective implementation of the recommendations presented in this report will require the support of Congress - perhaps with additional legislation; in supporting the President's budget request for these activities; in all cases with appropriate oversight.

Education and Extension:

One of the most important conclusions of the policy review process was that there was broad consensus that while nonindigenous species issues were extremely important, in general they were poorly recognized and not well understood. Consequently, "education and extension" and "research" (following section) were by far the most widely supported concepts presented in the Options Paper. The Task Force therefore feels strongly that "education and extension" and "research" recommendations should be aggressively pursued regardless of the eventual form in which other options are adopted.

Recommendation 1A

Federal agencies should support the development of education and extension programs that promote or enhance: 1) general awareness of nonindigenous species issues, 2) understanding of the risks associated with introductions and how to minimize them, 3) understanding and enforcement of existing authorities, and 4) the preferred use of indigenous species.

While a broad approach is needed, much of the education effort needs simply to promote better understanding of existing regulations and why they are important. An excellent example of this targeted approach appeared in a recent issue of North Dakota Outdoors magazine (Umber 1992). The article chronicled the problems and costs that had resulted from well-intentioned but illegal and ill-advised transfers of fish between aquatic ecosystems. In many ways, other options overlap with education. For example, a Model Code could be considered an educational tool; the development of any form of lists would involve both education and research; and the development of Codes of Good Business Practices would be educational for both industry and government.

Education may be the most effective means of reducing the risk associated with specific introduction pathways, e.g., aquarium and baitfish releases. While such an approach is important, the Task Force does not believe that education is solely the responsibility of the Federal government, either financially or otherwise. Industries

should make an effort to inform end users of the consequences of inappropriate use or disposal of their products.

The case of baitfish introductions illustrates how education has the potential to reduce the risk of introductions. At the extreme, baitfish introductions could be stringently regulated. Indeed, several Canadian provinces have adopted a regulatory approach to reducing such risk. British Columbia, Alberta, and Saskatchewan all prohibit the use of live baitfish. Manitoba and Ontario both prohibit the import of live baitfish (Leach and Lewis 1991). Nevertheless, movement of baitfish beyond their natural range has continued in Ontario (Litvak and Mandrak 1993). In a survey of baitfish customers, Litvak and Mandrak found that almost half released unused bait, and most thought that they were helping the receiving ecosystem. To deal with such a problem, the most appropriate measure may be to seek an improvement in angler ethics through an educational program to help anglers understand why the release of live baitfish can be costly and environmentally unsound.

One commenter made the suggestion that end users be reached by providing educational materials through pet stores for aquarium organisms and with fishing licenses in the case of baitfish.

Recommendation 1A received the broadest support of all of the recommendations in the Proposed Report.

Recommendation 1B

Federal agencies should support and facilitate the coordination of a national network of clearinghouses for educational materials and other nonindigenous species information that would support the educational efforts presented in recommendation 1A.

Educational efforts that inform the public, user groups, and agency personnel of just what the issues are (both the benefits and risks) are an important first step to addressing these issues. Virtually all State fish and wildlife conservation agencies have ongoing educational efforts and are always looking for helpful materials. Extension Service programs across the country are in frequent contact with private pond owners, aquaculturists, 4-H clubs, and many other groups. Educational information "hotlines" for curriculum support services have contacted the Task Force looking for information on introduced species. Professionals within private industry can help identify the best means to reach those with whom education and extension efforts would provide the biggest payoff in risk reduction. Coordination of these many efforts and effectively reaching all appropriate audiences will require that the implementation of recommendations 1A and 1B involve State, Federal and Tribal governments in conjunction with private industry and other interested entities. Because many interjurisdictional councils and commissions already reach these same audiences, such panels may serve an integral part in the education and extension process. A specific recommendation to this effect is offered in the "Interjurisdictional Consultations" section below.

Research:

Considerable additional research is needed to assess the risks of nonindigenous species introductions and to help prioritize actions intended to minimize such risks. Research should include baseline information on indigenous organisms and analyses of pathogenic, genetic, ecological and other risks associated with different pathways of intentional introduction (e.g., rearing and release of hatchery products, aquarium and aquacultural trade shipments and holding facilities, movement of species for research purposes). Research that promotes and enables the use of indigenous species also needs to be sharply increased. An excellent (though not aquatic) example of this approach is provided by the Illinois Department of Conservation's internal look at its own nursery practices. This review prompted a 5-year, phased-in shift to the use of indigenous species for landscaping and habitat needs.

Recommendation 2

Federal agencies should support research that enables: 1) better understanding of the risks associated with introductions and how to minimize them, 2) identification of specific pathogens and parasites and methods of determining if proposed introductions are specific pathogen-free 3) the use of indigenous species, and 4) more effective education and extension (i.e., evaluating the efforts made under recommendation 1A).

Researchers are reminded that federally funded research carried out under Subtitle C of the Nonindigenous Aquatic Nuisance Prevention and Control Act must follow the ANS Task Force's "Protocol for evaluating research proposals concerning nonindigenous aquatic organisms" (see ANS Program Appendix G). Individuals, States, corporations, and institutions not otherwise covered by this research protocol are also encouraged to follow the protocol to prevent introductions of nonindigenous species as a consequence of research activities.

Several commenters said that insufficient attention was given to pathogens and parasites in the Proposed Report. The Task Force believes that identification of pathogens and parasites is an important activity that will have the effect of reducing the risks associated with introductions as well as providing economic benefits to industries such as aquaculture. Such research programs should be maintained and enhanced when feasible. To reflect this view, subitem 2) has been added to the final recommendation.

Existing Authority:

A variety of State and Federal authorities exist that address the use of nonindigenous species. A discussion of existing State authorities and policies was presented in the Findings section above and will not be repeated here. The Task Force recognizes existing State authorities and encourages those States that have not initiated a

thorough review of their own authorities related to nonindigenous species to do so (see Model State Code section below). Many aspects of the above-cited State authorities have been incorporated into the Task Force's specific recommendations or are reflected in the Model State Code (see below). As noted above, the Task Force has also concluded that the following recommendations should for the most part be limited to "new" introductions. However, the Task Force feels that State and Federal agencies should review existing uses.

Policy review discussions of Federal authority concentrated on several existing laws that should provide considerable guidance in the use of nonindigenous species. For various reasons, these laws have either not been effectively used with regard to nonindigenous species or have not been implemented. Federal authorities discussed in this section include the National Environmental Policy Act (NEPA), Executive Order 11987, Federal funding authorities (e.g., Federal Aid in Sport Fish Restoration Act, Sea Grant, Corps of Engineers grants), the Federal Noxious Weed Act, and the Lacey Act. In reviewing Federal authorities, the Task Force again emphasized opportunities to improve Federal leadership, cooperation, and accountability. Descriptions of Federal authorities presented in this section have been drawn in large part from the Department of Interior's Digest of Federal Resource Laws (USDI 1992).

Recommendation 3A

Ongoing uses of nonindigenous species should be evaluated by their respective funding or permitting agencies (State or Federal) to determine their potential effects on indigenous species and adjusted as feasible to minimize risks.

Although this recommendation is a departure from the general principle that the recommendations be limited to "new" introductions, the Task Force believes that this recommendation is consistent with good management practices. Under normal circumstances, activities such as stocking programs should be reviewed periodically to determine if they are meeting initial goals, are an effective use of public resources, and are not negatively impacting ecosystems.

Recommendation 3B

Appropriate Federal agencies should more closely examine proposed introductions to determine whether they constitute major actions with significant effects on the human environment and, if so, more fully and consistently employ the NEPA process in their considerations of proposed introductions. These same agencies should ensure that their NEPA guidance procedures reflect this concern.

NEPA requires that all Federal agencies prepare an environmental impact statement (EIS) for major Federal actions "significantly affecting the quality of the human environment." An environmental assessment (EA) may be prepared to help determine if the proposed action will have significant effects. The preparation of either type of document must include public involvement. NEPA also stipulates that agencies employ an interdisciplinary approach in related decision making and ensure that

unquantified environmental values are given appropriate consideration, along with economic and technical considerations. As noted in the Options Paper (Appendix A), the primary issue with NEPA was whether or not species introductions constitute major actions with significant effects. No official policy was found that directly addresses this question (categorically includes or excludes all nonindigenous species introductions) and the development of EAs that seek to answer the question have been inconsistent. However, the interpretation that introductions of nonindigenous species may constitute major actions is increasingly becoming the pattern. The State of New Jersey recently requested funds under the Federal Aid in Sport Fish Restoration Act for the introduction of Pacific salmonids into the Delaware River basin. In accordance with NEPA, this request resulted in the development of an EIS and was the subject of a series of public hearings. The Task Force agrees with this interpretation and concludes that many more introductions of nonindigenous species than are currently judged to be so, may in fact constitute major actions and should therefore be subject to the NEPA process.

Among the comments received on the Proposed Report were comments that NEPA alone should be sufficient to address the issue of intentional introductions. NEPA, however, addresses only Federal actions and does not address introduction by other governmental entities or by private individuals. The mandate of the Task Force was broader in scope than merely making recommendations on Federal actions related to intentional introductions.

Recommendation 3C

Appropriate Federal agencies should formalize their compliance procedures to fully implement Executive Order 11987 and within one year of publication of this Report to Congress, submit to the ANS Task Force a report of what steps have been taken to achieve compliance

Executive Order 11987 (see Appendix E) on "exotic species" was issued in May of 1977 but has not been formally implemented. EO 11987 defines exotic species as "all species of plants or animals not naturally occurring, either presently or historically, in any ecosystem of the United States" -- i.e., a species that does not or historically has not occurred naturally in an ecosystem is an "exotic species" with regard to that ecosystem. This is essentially the same as the definition of nonindigenous species provided by the Nonindigenous Aquatic Nuisance Prevention and Control Act. In both cases, the defining baselines are ecosystems within the natural range of the species. The Task Force has reserved the term "exotic" for species foreign to the United States as a whole rather than with respect to any ecosystem within the United States.

One of the difficulties in dealing with historic terminology is that over time meanings may change and go in and out of use. In examining EO 11987, the Task Force determined that the purpose of the Order was to protect receiving ecosystems by requiring adequate review of proposed introductions. Therefore, the Task Force believes that the definition of exotic species should be interpreted broadly and should apply to species not native to a receiving ecosystem. For example, although both

occur naturally in the United States the desert pupfish is not native to the Great Lakes nor is the walleye (*Stizostedion vitreum vitreum*) native to Ash Meadows, Nevada.

Among the comments on the proposed Report, was a comment that a broad interpretation of the definition was not justified. It was argued that a narrower definition was intended and that implementation of the Executive Order should be limited to introductions of foreign species that have not become established anywhere in the United States. The Task Force believes that Executive Order 11987 should generally apply to the movement of a nonindigenous species from any ecosystem to another as the result of human intervention and that without a broad definition of "exotic species" the Order would be of limited utility. Consistent with other recommendations, the Task Force believes that in implementing the Executive Order, the primary focus should be on new introductions and not on established nonindigenous species.

EO 11987 states that Federal executive agencies shall, to the extent permitted by law, restrict the introduction of exotic species into the natural ecosystem on lands and waters which they own, lease, or hold for purposes of administration (Section 2(a)) and, to the extent authorized, shall restrict the introduction of exotic species into any natural ecosystem of the United States (Section 2(b)). It further states that executive agencies shall, to the extent permitted by law, restrict the use of Federal funds, programs, or authorities to export native species for the purpose of introducing such species into ecosystems outside the United States where they do not naturally occur (Section 2(c)). The Executive Order does not apply if the Secretary of Agriculture or the Secretary of the Interior specifically finds that such introduction or exportation will not have an adverse impact on natural ecosystems (Section 2(d)). While some Federal agencies have developed internal procedures for complying with EO 11987, none has followed through with a rule making and adopted a published procedure. This leaves Federal agencies without any accountable system of assuring compliance. Though the Task Force has taken the position that only a broad interpretation of the Executive Order is ecologically credible, the question of definition is likely to remain unresolved until specific action is taken to implement it. The combination of NEPA and EO 11987 may be viewed as Federal policy on nonindigenous species and their use under existing Federal authorities. EO 11987 provides a baseline criterion while NEPA provides procedural guidance to the decision-making process.

Recommendation 3D

Federal agencies should not provide financial assistance for <u>new</u> introductions of aquatic nonindigenous species (plant or animal) <u>unless</u> the proposed introduction is consistent with EO 11987 and other existing or new Federal authorities (e.g., Endangered Species Act, NEPA, and the recommended permit system [see 4A below] when developed).

A number of Federal sources fund research on and use of nonindigenous species. The Department of Commerce and Department of Agriculture funds have been used to investigate the aquaculture potential of nonindigenous species. The U.S. Army Corps

of Engineers funded the use of a nonindigenous plant species, *Spartina alterniflora*, in San Francisco Bay. The Federal program that received the most attention in the policy review process was funding under the Federal Aid in Sport Fish Restoration Act. This program provides Federal aid to States for the management and restoration of fish having "material value in connection with sport or recreation in the marine and/or fresh waters of the United States." Funds raised through Federal excise taxes are permanently appropriated to the Secretary of Interior for paying up to 75% of the cost of approved projects (e.g., habitat improvement, fish stocking, fishery research and monitoring, and access facilities). Discussion of the Sport Fish Restoration Act concentrated on the use of Federal funds for projects that use nonindigenous species. As noted above, many States have become dependent upon the use of nonindigenous species. Similarly, many States rely upon Sport Fish Restoration Act funds to support their ongoing programs. Nonetheless, in light of the noted conflicts between sport fishing related introductions of nonindigenous species and the endangerment or extinctions of indigenous species, the Task Force feels that future expenditures of Federal funds for using nonindigenous species need to be reviewed.

This does not mean that Sport Fish Restoration Act or other Federal funds should not be used to support activities that employ nonindigenous species, particularly if potential unanticipated release and dispersal are adequately addressed. Other than the recommended report in 3C, this recommendation is simply a reiteration that Federal agencies should improve their compliance with already existing authorities. As noted below (see "Protocols and Environmental Assessments" section), adherence to the International Council for the Exploration of the Sea (ICES), American Fisheries Society (AFS), the research protocol developed under this Act, or other protocols for introductions may provide useful mechanisms to assure such compliance.

Several State agencies and sportfishing groups indicated opposition to this recommendation during the comment period and questioned the authority of the Federal Government to place limitations on utilization of funds under the Federal Aid in Sport Fish Restoration Act. Such action is not without precedent, however. In two recent cases, the U.S. Fish and Wildlife Service did not approve funding of nonindigenous introductions without an adequate assessment of potential impacts. As indicated above, when the State of New Jersey requested funds to stock chinook salmon in the Delaware River, a full EIS was required. In late 1993, the State of Maryland was told that such funds could not be used to stock cutthroat trout without adequate consideration of potential impacts.

There is clear Federal authority to place such a condition on such projects. The regulations covering such funding require that any project "utilize accepted fish and wildlife conservation and management principles, sound design, and appropriate procedures..." (50 CFR 80.13(c). Further, 50 CFR 80.21 provides, "The State must agree to and certify that it will comply with all applicable Federal laws, regulations, and requirements as they relate to the application, acceptance and use of Federal funds under the Act."

Provision of project funds for species introductions under any of the programs mentioned constitutes a Federal action under both NEPA and the ESA. As such, an EA or an EIS may be required under NEPA, and consultation may be required under Section 7 of the ESA. Executive Order 11987 restricts the use of funds for exotic species introductions unless it has been determined that the introduction will not have an adverse effect on natural ecosystems.

Recommendation 3E

Improvements in Federal activity that should be taken under the Lacey Act include: 1) expediting the injurious species listing process; 2) fostering compliance with interstate commerce clauses of the Lacey Act by maintaining and making available to all interested entities information on State lists (approved, restricted, prohibited) and regulatory requirements; 3) establishing a list of Federally approved and prohibited species to facilitate quick decisions on those species; 4) [under the Lacey Act or other appropriate authority], initiating a review system for all other species not so listed; and 5) making an effort to identify pathogens and parasites of concern.

The Lacey Act, administered by the U.S. Fish and Wildlife Service, has two major purposes: 1) preventing commerce in unlawfully taken wildlife; and 2) preventing the importation of injurious wildlife. Under the Lacey Act, it is unlawful to import, export, receive, acquire, or purchase fish or wildlife or plants taken, possessed, transported, or sold: 1) in violation of U.S. or Indian tribal law, or 2) in interstate or foreign commerce any fish or wildlife taken, possessed or sold in violation of State law or regulation or foreign law (or, in relation to plants, in violation of State law or regulation). The effectiveness of the Lacey Act in influencing the movement of nonindigenous species is thus in large part a reflection of the strengths or weaknesses of the laws of other jurisdictions. The legislative history accompanying the Lacey Act Amendments of 1981 illustrated the intent of the Congress to support State regulation of non-native species in interstate commerce by specifically citing interstate commerce in grass carp as an example of appropriate use of the Lacey Act to support State regulations.

The Lacey Act also prohibits importation of wild vertebrates and other "injurious" animals listed in the Act or declared by the Secretary of the Interior by regulation to be potentially harmful to human beings or the interests of agriculture, horticulture, forestry, or fishes and wildlife of the United States. Few species have been listed under this provision. Only three aquatic species (zebra mussels, mitten crabs, and walking catfish) and four viruses affecting salmonid fishes (VHSV, IHNV, IPNV, and OMV) are currently on the list. However, Lacey Act listing is a slow process and many species listed under the act were only added <u>after</u> they had already become established.

Improvements need to be made in Federal responsibility for imports through increased responsiveness of Lacey Act activities and more systematic and thorough review of proposed imports of aquatic organisms. One means of expediting injurious species listings may be through the use of expert panels for initial listing recommendations

and creating the authority for emergency listings. While perhaps appropriate for a few very widely distributed species or controlled uses, the Task Force does not endorse the use of a uniform national approved list (="clean list") approach because regional environments vary sufficiently that a species approved for one area may more appropriately be prohibited in another (see Prohibitions and Enforcement section below). Some form of regionally approved list may help deal with this complication but the Task Force instead supports more of a case-by-case approach. Further discussion of this approach and the import review system cited in #4 above is presented in the "Permit Systems" section below.

In response to comments received, the Task Force recommends that additional attention be given to identification of pathogens and parasites of concern that may have impacts on wild populations or on species being raised in aquaculture facilities. It is suggested that priority be given to diseases affecting crustaceans and mollusks and to fish that may be stocked into open waterways. The existing regulations on salmonid diseases require certification that imports are specific pathogen-free, but industry has indicated that it would appreciate clarification as to who might be competent to make such certifications. The Task Force recommends that the appropriate Federal agencies work with industry to set meaningful certification requirements.

Recommendation 3F

The appropriate Federal agencies should: 1) expedite the listing process for noxious weeds, 2) develop the required management programs for undesirable plants, and 3) encourage the use of Federal-State-private partnerships in developing the authorized control and prevention programs.

The Federal Noxious Weed Act delegates to the Secretary of Agriculture the authority to designate plants (including aquatic plants) as noxious weeds and prohibits the movement of such species in interstate and foreign commerce except by permit. Permits are obtained through the USDA Animal and Plant Health Inspection Service (APHIS). Authority was also given to inspect, seize, and destroy products, or quarantine areas and to develop cooperative programs as needed to control, eradicate, or prevent the spread of noxious weeds. The 1990 amendments to the Noxious Weed Act broadened the concept of noxious weeds to undesirable plants and included plants "that are classified as undesirable, noxious, harmful, exotic, injurious, or poisonous, pursuant to State or Federal law." They also required Federal land management agencies to develop undesirable plant management programs.

As with the Lacey Act, there often has not been adequate review of potential problem species under the Noxious Weed Act prior to introduction. In many instances, species are listed after they have become established and created problems.

As under the Lacey Act recommendations, one means of expediting the listing process may be to involve expert panels in a more proactive review of potential noxious weeds

in order to maintain an up to date listing. Again, a further discussion of an import review system is presented in the "Permit Systems" section below.

Prohibitions and Enforcement:

The Task Force makes no specific recommendation under this option other than increased attention to the enforcement of existing authorities. Instead, several related recommendations are re-emphasized and additional observations are presented on the Task Force's view of the utility of some of the suggested approaches to prohibition and enforcement.

As noted, several policy review participants supported essentially total bans on the use of nonindigenous species. Obviously if there is no introduction, there is no associated risk. An effective total ban on the use of nonindigenous species would represent the option with the greatest risk reduction and the least disruption of the ecological and evolutionary integrity of ecosystems. However, as a number of State agencies attested, the simple existence of a ban does not mean that introductions will not occur. Such drastic action would be extremely damaging to a wide range of private entities and would dramatically alter many public and private sector research and recreational programs. The Task Force does not recommend that this approach be adopted on a national scale though some species should remain on nationally prohibited lists.

The Task Force does not specifically endorse strict adherence to either an approved list or a prohibited list approach, though this may work well for individual States. As was noted in the discussion of existing State laws, both can be useful as a general approach but are more commonly combined. Again, the important aspect is that all species are subject to formal review. For both prohibited and approved lists, the primary concern was that ecological variation among receiving ecosystems may supplant the usefulness of the list. For example, a tropical species with a narrow temperature tolerance may appropriately be prohibited in warmer regions of the U.S. while the same species may have no problem being approved for use in a colder region where it could not survive an open ecosystem release. Some form of regional listings may help address this concern but the Task Force is not recommending this approach at this point. Improvements in the listing of prohibited species under the Lacey Act were discussed and recommendations for appropriate review of species not on such lists are presented below ("Permit Systems" section).

Many State agencies suggested that better awareness and enforcement of existing prohibitions and enforcement authorities may represent the most effective means of reducing ill-considered, illegal introductions. The Task Force agrees and has reflected this in our recommendations in the "Education and Extension" and "Research" sections above. In general, better enforcement via education, tougher and well-advertised penalties, and Federal support for State nonindigenous species programs were most often recommended by the States. Federal funding under Section 1204 (State Aquatic Nuisance Species Management Plans) of the Nonindigenous Aquatic

Nuisance Prevention and Control Act was frequently cited as the Federal authority under which such funding could be provided. To date, the Task Force has received only a few such plans for approval and no appropriations to fund the grant program.

Permit Systems:

With the exception of imports, introductions whose potential dispersal sites lie wholly within a single State are and should remain the responsibility of that particular State. Though the coverage and implementation varied widely, nearly all of the States that participated in the policy review cited some form of permit system as a component of their system of accountability for the movement of aquatic species. Similarly, the Task Force regards the importation of species into the United States as a Federal responsibility. The USDA Animal and Plant Health Inspection Service has authority over and issues permits for importation of plants, insects, biocontrol organisms, birds, and other terrestrial animals. However, no Federal permit system is in place that applies generally to the importation of nonindigenous aquatic organisms.

Recommendation 4A

Establish a Federal permitting system for imports from outside the United States to provide a credible review of proposed new introductions of nonindigenous aquatic organisms.

An import permitting system for foreign nonindigenous aquatic organisms could be new or based on the expansion of an existing permit system. In either case, substantial additional personnel will likely be required as well as new legislative authority.

Though the form and mechanics of a permit system will continually evolve with its implementation, the following account represents the permit system structure that the Task Force initially recommends. As a guiding principle, the Task Force believes that the rigor of review should be related to the degree of risk involved. The risks involved in a planned release of a species into open waters are greater than the risks involved in introductions intended for closed systems. However, if a permit system is authorized, it may be necessary to set standards for closed systems by regulation.

Individuals, organizations or institutions proposing to import nonindigenous aquatic organisms would be required to apply for a formal permit to import the species desired. All applications would include information on the source, characteristics (physical, behavioral, biological, ecological), and health status of the species to be imported, the purpose and destination of the importation, the containment/confinement conditions under which the species is to be maintained, and means of decontamination (if applicable) and eventual disposal at the termination of permitted use of the species. Additionally, for importations for proposed direct releases into open aquatic ecosystems, an environmental assessment document (e.g., that follows the ICES Code of Practice) would be required.

Permit applications would be evaluated by a permanent professional staff with appropriate expertise. Applications may be granted, granted subject to certain conditions, or denied. Site visits may be necessary to evaluate conditions and adequacy of facilities. Testing of organisms or source of organisms to be imported may be required to provide information of certain disease organisms or parasites, strain or other genetic identification, or behavioral characteristics. Species for which little or no information is available would require more stringent containment, confinement, or isolation facilities than would species and specific importations about which much information is known.

Recommendation 4B

The USDA Animal and Plant Health Inspection Service, the Fish and Wildlife Service, and the National Marine Fisheries Service should establish a joint permit review process. Congress should take appropriate legislative action recommended by the Administration to authorize the agreed to process.

This recommendation capitalizes on the expertise of many different agencies and interests, and would in a tangible way protect the interests of aquaculture, natural resources, and marine and coastal fisheries. An example of a joint approval of permits presently takes place between APHIS and the Environmental Protection Agency for genetically engineered microbial pesticides.

Consistent with recommendation #3E.2 and the discussion of prohibitions, some organisms (e.g., those currently listed under the Noxious Weed Act and Lacey Act, and others as appropriate) will be prohibited from permit issuance because of their behavioral or other characteristics detrimental to plants, animals, natural ecosystems or human health or activity, or their potential for such effects. Exceptions would be granted only when considered advisable by an interagency multidisciplinary panel or advisory committee (as currently practiced by APHIS' Parent Committee on Importation of Foreign Pathogens), under strictly prescribed containment.

Permits will generally need to be issued on a case-by-case basis. However, for some species or species groups for which there is a great deal of information and experience, species with a history of use in existing commercial practice with no detrimental effects either evident or suspected (e.g., tropical aquarium fishes in northern States), or species already established in an area, categorical exclusions or simplified permit processes can be developed. Processes for the assessment of potential environmental effects would have to be developed and implemented. Adequate authority and capabilities for site and import inspections and, if necessary, quarantines will be needed. The need for quarantines would be lessened should the proposed receiving facility have a closed water circulation system or be equipped with adequate effluent treatment systems to avoid the spread of the organism and its pathogens. Standards for the classification of open and closed systems would need to be developed. A schematic flow chart of the decision-making process under the proposed permit system is presented in Appendix F.

Of all of the recommendations made in the proposed report, the recommendation for a permitting system generated the most controversy. Both the aquarium and aquaculture industries had strong misgivings over the recommendation.

A number of tropical fish dealers expressed the view that such a requirement would put them out of business. They noted that it is not always possible to identify species contained in live fish shipments in advance. With up to 3,000 different fish species being imported and little advance notice, they said that adequate assessment would not be possible during the short period of time required to keep fish alive. Home hobbyists indicated concern that a permitting system would limit their access to different species.

Many in the aquaculture industry also opposed a permitting system. They expressed concern that the review process would result in economic costs because of paperwork requirements and delays caused by the review process. They were particularly concerned by what they termed "layering" in relation to this issue. There was fear that because there are multiple recommendations in the review that members of the industry would have to make multiple applications to different agencies for the same assessment. The Task Force considers this to be a legitimate concern and does not intend that there should be multiple Federal reviews of the same introduction.

Protocols and Environmental Assessments:

Recommendation 5

The ICES Code of Practice or other acceptable protocols should be used as a tool to evaluate introductions.

The United States has been a member of the International Council for the Exploration of the Sea (ICES) since 1973 and is a signatory to the ICES Code of Practice (protocol) for reducing the risks of adverse effects from the introduction of nonindigenous marine species. The Task Force considers that the appropriate Federal agencies, rather than individual States as is often the current practice, should serve as the point of contact and coordination for foreign governments. This would ease the burden of foreign nations in dealing with the United States and would allow for a more consistent interpretation of the code.

The major thrust of the recommendations in this report is that potential risks related to intentional introductions of nonindigenous species be reduced by careful consideration of an introduction before it occurs. As examples, recommendations for application of NEPA, implementation of Executive Order 11987, and the permitting system for imports from outside the United States are all designed to ensure that introductions are evaluated before being made. As a means of evaluating proposed introductions, a number of protocols have been developed. The Task Force recognizes that any one "generic" protocol may not work in all situations. However, general support is given for the use of protocols in meeting the information needs of the

decision-making process. Examples of protocols that may serve as guidelines for satisfactorily addressing environmental concerns include the ICES Code of Practice (ICES 1984), American Fisheries Society protocol (Kohler and Courtenay 1986), and the research protocol developed under this Act. Summaries of these three protocols are presented in Appendix G.

Protocols and environmental assessment documents were generally favored by the Task Force because they are information-rich decision tools. As was noted in the discussion of Permit Systems, the Task Force recommends the use of environmental assessment documents for proposed importations. Similar use of environmental assessment documents is also recommended as one aspect of a Model State Code (see below).

Interjurisdictional Consultations:

In the Options Paper two variations of interjurisdictional decision methods were discussed, secondary review and panel review. The former received little support during the review process and will not be discussed here. However, the use of interjurisdictional review panels was one of the more broadly supported options. The Task Force concurs that interjurisdictional panels are an appropriate forum for consultations on introductions that may affect the resources of multiple jurisdictions.

Recommendation 6A

State and Federal officials should solicit review and approval from existing or newly developed interjurisdictional panels regarding new introductions that may affect the resources of multiple jurisdictions.

This consultative role was also reflected in the proposed permit system (see above). The interjurisdictional panel concept was primarily modeled after the various interstate and international councils and commissions but could easily be adapted, if a State so chose, to multiple jurisdictions within a single State (e.g., multiple counties within the same drainage, or multiple agencies with overlapping responsibility).

Interjurisdictional panels represented something of a dilemma for resource management agencies that participated in the policy review. Many Federal and State agencies expressed support for interjurisdictional consultation and noted that they would like to have a voice in decisions that may significantly impact their ability to manage resources for which they are responsible. Nearly all of these same management agencies agreed that decisions on the introduction of nonindigenous species could have such impacts. The hesitance of some State agencies to support interjurisdictional consultations reflected a similar fear of the loss of control over important decisions. In effect, most States wanted a voice in but feared a "veto" over decisions that could affect their ability to set and attain their own management goals and objectives.

Though the Task Force believes that binding decisions reached through interjurisdictional consultation may produce fewer "maverick" decisions and result in a greater reduction in the risks of adverse consequences, the policy review process revealed little precedence for Federally mandated binding authorities for interstate panels. Examples do exist of two or more States voluntarily designating (e.g., through Memoranda of Understanding) a regional panel as a joint regulatory agent with such power as they may jointly confer for the regulation of shared resources. Such a procedure has been set up by the Atlantic States Marine Fisheries Commission. The Task Force recognizes therefore that the deliberations of interjurisdictional panels will constitute advisory rather than binding decisions. This in no way suggests perfunctory deliberations by such panels. As is the case in existing interstate councils on other issues, deliberations should be broadly participative and scientifically and publicly credible. This deliberative process, even if not binding, serves to clarify intentions and helps flesh out potential or previously unforeseen problems. Indeed, the utility of interjurisdictional panels regarding nonindigenous species issues should extend well beyond consultations on the actual decisions of whether or not to introduce a given species. Useful information exchange could include notifications of escape, unexpected dispersal, illegal introductions that may affect others, and alterations to State approved or prohibited species lists.

Recommendation 6B

Interjurisdictional panels should serve as a forum for the sharing of nonindigenous species information; for the coordination, where desirable, of State laws; and for the development of regional policy.

Recommendation 6C

Interjurisdictional nonindigenous species consultations should include representation from affected parties, i.e., Federal, State, Tribal, public and private interests and, where appropriate, the international community.

Implementation of a system of interjurisdictional review could be based either upon more formal acceptance of this role by existing panels or through the creation of new panels. Existing panels could include the large river basin groups (e.g., Mississippi Interstate Cooperative Resource Agreement participants, Colorado River Fish and Wildlife Council, Columbia Basin Fish and Wildlife Authority) or the regional commissions (e.g., Great Lakes Commission, regional marine fisheries commissions). Many of these same panels already discuss species introductions on an ad hoc basis, but would likely need additional staff and financial support if they accepted the functions recommended above. While many of these existing panels already encompass a wide spectrum of participants, others may need to alter their by-laws to allow for such participation.

Model State Code

State regulation of nonindigenous aquatic organisms is evolving rapidly. It currently varies from very limited authority or specific involvement to extensive and inclusive management and decision-making approaches. To increase awareness of the approaches used by others, improve State-to-State consistency, and present what the Task Force viewed as an appropriate mix of the examples reviewed, the Task Force has developed a "conceptual" Model State Code (Table 3). The elements are largely drawn from approaches cited by various States (see Findings section). However, apparently no single State currently encompasses all elements of the Model Code. We believe that it incorporates most of the important concepts that States and others suggested would enable decision making that minimizes the risk of adverse consequences from intentional introductions and would make an effective goal for States to pursue.

Several review participants suggested linking a Model State Code to disincentives (e.g., fines or withholding Federal aid funds) for failure to comply. The Task Force does not recommend this linkage. Neither the model code provided herein nor the details of how to establish compliance are adequately developed at this point to take such a step. There is also no current legal authority under which to establish such linkage. The alternative approach to enhanced compliance that did receive considerable support was linking positive incentives to adoption of the code (e.g., increased access to Federal funds). The most commonly suggested Federal funding mechanism, as noted in the discussion of "Prohibitions and Enforcement," was under the grant program outlined in Section 1204(b) of the Nonindigenous Aquatic Nuisance Prevention and Control Act. As with the disincentive option, this approach would require refinement of the model code and the development of criteria by which to judge compliance.

Recommendation 7

State legislative bodies should, in consultation with their appropriate State agencies and other interested entities, enact comprehensive legislation to deal with nonindigenous species issues.

The Task Force provides the conceptual Model State Code presented in Appendix H as a starting point for this effort.

Good Business Practices:

Reliance upon Codes of Good Business Practices did receive some support both from within and outside private industry but was not a broadly supported option. Some within private industry felt that existing regulatory guidelines had already surpassed the utility of such codes. However, others suggested that the exercise of trying to develop Codes of Good Business Practices would prove a useful educational tool to

both private industry and the relevant public agencies. The Task Force concurs with this suggestion.

Recommendation 8

Where such codes do not already exist, private industry trade associations in consultation with the appropriate State and Federal agencies (and other interested entities), should develop Codes of Good Business Practices that promote continued commercial operation in a manner that is compatible with the conservation of natural ecosystems.

SUMMARY

Section 1207 of the Aquatic Nuisance Prevention and Control Act charged the Task Force with developing findings, conclusions, and recommendations with respect to the intentional introduction of nonindigenous aquatic species.

The Task Force has found that there are risks associated with such introductions. Historically, intentional introductions have been as likely as unintentional introductions to create problems in receiving ecosystems. The problems associated with intentional introductions in the past often have been caused by inadequate knowledge and/or review of introductions before they occurred.

Given the nature of aquatic systems, control of established species after introduction is, at best, difficult. Recognizing this, the Task Force recommendations are directed toward education of user groups and adequate review of introductions before they occur. Such measures would minimize the risks associated with introductions of nonindigenous species. If implemented, adequate authority for review of introductions involving the Federal government already exists. For introductions sponsored by State governments, the Task Force recommends a model State code and interjurisdictional consultation. For imports of species from outside the United States, the establishment of a permitting system is recommended.

BIBLIOGRAPHY

Andrews, J.D. 1980. A review of introductions of exotic oysters and biological planning for new importations. Mar. Fish. Rev. 42(2):1-11.

Aquatic Nuisance Species Task Force. 1992. Protocol for evaluating research proposals concerning nonindigenous aquatic species. ANS Task Force, c/o USDI/USFWS, Washington, DC. 20pp.

Atlantic States Marine Fisheries Commission. 1989. A procedural plan to control interjurisdictional transfers and introductions of shellfish. Fisheries Management Report No. 13. 58 pp.

Carlton, J. 1992. Dispersal of living organisms into aquatic ecosystems as mediated by aquaculture and fisheries activities. (pp. 13-48) In: A. Rosenfield and R. Mann (*eds.*) Dispersal of living organisms into aquatic ecosystems. Univ. of Maryland Press, College Park, MD. 471 pp.

Carpenter, S.R. and D.M. Lodge. 1986. Effects of submersed macrophytes on ecosystem processes. Aquatic Botany 26:341-370.

Conniff, R. 1989. Flashy new "items" make a big splash in the aquarium world. Smithsonian 20(2):90-101.

Courtenay, W.R., Jr. 1993. Biological pollution through fish introductions. pp. 35-61. In: B.N. McKnight (ed.) Biological pollution: the control and impact of invasive exotic species. Indiana Acad. Sci., Indianapolis, IN. 261 pp.

Courtenay, W.R., Jr. and J.R. Stauffer, Jr. (*eds.*). 1984. Distribution, biology, and management of exotic fishes. Johns Hopkins University Press, Baltimore, MD.

Courtenay, W.R., Jr. and J.R. Stauffer, Jr. 1990. The introduced fish problem and the aquarium fish industry. J. World Aquac. Soc. 21:145-159.

Courtenay, W.R., Jr. and J.D. Williams. 1992. Dispersal of exotic species from aquaculture sources, with emphasis on freshwater fishes. (pp. 49-82) In: A. Rosenfield and R. Mann (*eds.*) Dispersal of living organisms into aquatic ecosystems. Univ. of Maryland Press, College Park, MD. 471 pp.

Culotta, E. 1991. Biological immigrants under fire. Science 254:1444-1447.

DeVoe, M.R. (*ed.*) 1992. Introductions and transfers of marine species: achieving a balance between economic development and resource protection. Proceedings of a Conference and Workshop, Hilton Head Island, SC, October 30 - November 2, 1991. South Carolina Sea Grant Consortium, Charleston, SC. 201 pp.

Engel, S. 1987. Impact of submerged macrophytes on largemouth bass and bluegills. Lake and Reservoir Management 3:227-234.

Evans, D.O. and C.C. Willox. 1991. Loss of exploited, indigenous populations of lake trout, Salvelinus namaycush, by stocking of non-native stocks. Can. J. Fish. Aquat. Sci. 48(Suppl. 1): 134-147.

Farley, C.A. 1992. Mass mortalities and infectious lethal diseases in bivalve molluscs and associations with geographic transfers of populations. (pp. 139-154) In: A. Rosenfield and R. Mann (*eds.*) Dispersal of living organisms into aquatic ecosystems. Univ. of Maryland Press, College Park, MD. 471 pp.

Ferguson, M.M. 1990. The genetic impact of introduced fishes on native species. Can. J. Zool. 68:1053-1057.

Florida Agricultural Statistics Service. 1992. Aquaculture: June 1992.

Gausen, D. and V. Moen. 1991. Large scale escapes of farmed Atlantic salmon (Salmo salar) into Norwegian rivers threaten natural populations. Can. J. Fish. Aquat. Sci. 48:426-42

Gudjonsson, S. 1991. Occurrence of reared salmon in natural salmon rivers in Iceland. Aquaculture 98:133-142.

Hindar, K., N. Ryman, and F. Utter. 1991. Genetic effects of cultured fish on natural fish populations. Can. J. Fish. Aquat. Sci. 48: 945-957.

Hnath, J.G. (ed.). 1993. Great Lakes fish disease control policy and model program. Great Lakes Fish. Comm. Spec. Pub. 93-1: 1-38.

Horner, R.W. and R.L. Eshenroder (eds.). 1993. Protocol to minimize the risk of introducing emergency disease agents with importation of salmonid fishes from enzootic areas. Great Lakes Fish. Comm. Spec. Pub. 93-1: 39-54.

Hutchings, J.A. 1991. The threat of extinction to native populations experiencing spawning intrusions by cultured Atlantic salmon. Aquaculture 98: 119-132.

International Council for the Exploration of the Sea. 1984. Code of practice to reduce the risks of adverse effects arising from introduction of nonindigenous marine species. ICES Cooperative Research Report No. 130.

Johnsen, B.O. and A.J. Jensen. 1991. The Gyrodactylus story in Norway. Aquaculture 98:289-302.

Kaczor, B. 1992. Instant fish no cheap trick; part of research efforts. The Aquaculture News 7(12):13.

Kapuscinski, A.R. and E.M. Hallerman. 1990. AFS position statement: transgenic fishes. Fisheries 15(4):2-4.

Killgore, K.J., R.P. Morgan, II, and N.B. Rybicki. 1989. Seasonal and temporal distribution and abundance of fishes association with submersed aquatic plants. North Amer. J. Fish Manage. 4: 111-119.

Kohler, C.C. and W.R. Courtenay, Jr. 1986. American Fisheries Society position on introductions of aquatic species. Fisheries 11(2):34-38.

Leach, J.H. and C.A. Lewis. 1991. Fish introductions in Canada: provincial laws and regulations. Can. J. Fish. Aquat. Sci. 48(Suppl. 1): 156-161.

Lightner, D.V., R.M. Redman, T.A. Bell, and R.B. Thurman. 1992. Geographic dispersion of the viruses IHHN, MBV, and HPV as a consequence of transfers and introductions of penaeid shrimp to new regions for aquaculture purposes. (pp. 155-173). In: A. Rosenfield and R. Mann (eds.) Dispersal of living organisms into aquatic ecosystems. Univ. of Maryland Press, College Park, MD. 471 pp.

Litvak, M.K. and N.E. Mandrak. 1993. Ecology of freshwater baitfish use in Canada and the United States. Fisheries (Bethesda) 18(12): 6-13.

Miller, A.C., D.C. Beckett, and E.J. Bacon. 1989. The habitat value of aquatic macrophytes for macroinvertebrates: benthic studies in Eau Galle Reservoir, WI. (pp. 190-201). In: Proceedings, 23rd annual meeting, aquatic plant control research program, Misc. Paper A-89-1, Environmental Laboratory, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Miller, R.R., J.D. Williams, and J.E. Williams. 1989. Extinctions of North American fishes during the last century. Fisheries (Bethesda) 14(6): 22-38.

Minckley, W.L. 1991. Native fishes of the Grand Canyon region: an obituary? pp. 124-177. In: Colorado River ecology and management. National Acad. Press, Washington, DC.

Moyle, P.B. and J.E. Williams. 1990. Biodiversity loss in the temperate zone: decline of the native fish fauna of California. Conservation Biology 4(3): 275-284.

Montoya, B. 1992. Letter of 01-27-92 responding to ANS Task Force request for information on State regulations. In FWS files.

National Research Council. 1992. Marine aquaculture: opportunities for growth. National Academy Press, Washington, DC. 290 pp.

North Atlantic Salmon Conservation Organization (NASCO). 1992. Draft protocol for the introduction and transfer of salmonids. North American Commission/NASCO Report NAC(92)19. 69 pp.

Office of Technology Assessment (of U.S. Congress). 1993. Harmful non-indigenous species in the United States. U.S. Government Printing Office, Washington, DC. 391 pp.

Parker, N.C. 1989. History, status, and future of aquaculture in the United States. Rev. in Aquat. Sci. 1(1):97-109.

Rosenfield, A. and R. Mann (*eds.*). 1992. Dispersal of living organisms into aquatic ecosystems. University of Maryland Press, College Park, MD. 471 pp.

Rosenthal, H. 1980. Implication of transplantations to aquaculture and ecosystems. Mar. Fish. Rev. 42:1-14.

Rosenthal, H. 1985. Constraints and perspectives in aquaculture development. GeoJournal 10:305-324.

Savino, J.F. and R.A. Stein. 1982. Predator-prey interaction between largemouth bass and bluegills as influenced by simulated submersed vegetation. Trans. Amer. Fish Soc. 111: 255-266.

Schardt, J.D. and D.C. Schmitz. 1990. Florida aquatic plant survey report. Tech. Rept. No. 91-CGA, Florida Department of Natural Resources, Tallahassee, FL.

Schmitz, D.C., B.V. Nelson, L.E. Nall, and J.D. Schardt. 1991. Exotic aquatic plants in Florida: a historical perspective and review of the present aquatic plant regulation program. (pp. 303-326) In: U.S. National Park Service. Proceedings of the symposium on exotic pest plants. USDI, Washington, DC.

Shelton, W.L. and R.O. Smitherman. 1984. Exotic fishes in warmwater aquaculture. (pp. 262-301). In: W.R. Courtenay, Jr. and J.R. Stauffer, Jr. (*eds.*). 1984. Distribution, biology, and management of exotic fishes. Johns Hopkins University Press, Baltimore, MD.

Sindermann, C.J. 1993. Disease risks associated with importation of nonindigenous marine animals. Mar. Fish. Rev. 54(3): 1-10.

Stickney, R.R. 1992. The importance of introduced marine species to the development of the marine aquaculture industry in the United States and Puerto Rico. (pp. 17-22). In: M.R. DeVoe (*ed.*) 1992. Introductions and transfers of marine species. South Carolina Sea Grant Consortium, Charleston, SC. 201 pp.

Taylor, E.B. 1991. A review of local adaptation in Salmonidae, with particular reference to Pacific and Atlantic salmon. Aquaculture 98: 185-207.

Thompson, A.G. 1990. The danger of exotic species. World Aquaculture 21(3):25-32.

Umber, H. 1992. Eradication/rehabilitation: a new commitment to fishing lakes. North Dakota Outdoors. 54(9):18-23.

United States Department of Interior. 1992. Digest of federal resource laws of interest to the U.S. Fish and Wildlife Service. USDI/USFWS Office of Legislative Services. 105 pp.

U.S. Fish and Wildlife Service. 1993. Desert pupfish recovery plan. USFWS Region 2, Phoenix, AZ. 67 pp.

Waples, R.S. 1991. Genetic interactions between hatchery and wild salmonids: lessons from the Pacific Northwest. Can. J. Fish. Aquat. Sci. 48(Suppl. 1):124-133.

Welcomme, R.L. 1988. International introductions of inland aquatic species. FAO Fisheries Technical Paper No. 294.

Wiley, M.J., R.W. Gordon, S.W. Waite, and T. Powless. 1984. The relationship between aquatic macrophytes and sport fish production in Illinois ponds: a simple model. North Amer. J. Fish Manage. 4: 111-119.

APPENDIX A

OPTIONS PAPER

INTENTIONAL INTRODUCTIONS POLICY REVIEW

BACKGROUND:

The adverse consequences of several recent introductions, particularly the zebra mussel, resulted in the passage of the Nonindigenous Aquatic Nuisance Prevention and Control Act (P.L. 101-646) in November of 1990. The Act defines nonindigenous species as "any species or other viable biological material that enters an ecosystem beyond its historic range." Under the Act, a Federal interagency Aquatic Nuisance Species (ANS) Task Force was established to assure a coordinated and cooperative effort among Federal, State, and other officials and the private sector. The bulk of the Act and its required activities concentrate on unintentional introductions. These activities include the establishment of a Zebra Mussel Demonstration Project, a national ballast water control program, and a grant program for the development of State ANS management plans. The Act also calls for the implementation of an ANS Program to prevent, monitor, and control aquatic nuisance species; carry out research and education programs; and provide technical assistance. A draft of the ANS Program should be available soon.

Though the Act was passed largely in response to current crises related to unintentional introductions, Congress recognized that there were potential problems with other forms of introduction as well. These other forms were referred to as "intentional" introductions but included accidental release from aquacultural facilities (e.g., hatcheries, fish farms, aquarium plant or fish holding facilities) as well as those clearly intended for direct release to aquatic ecosystems. While these differences were understood and the potential threat of adverse consequences from all forms of release were recognized, Congress also recognized the importance of some nonindigenous species, particularly to private industry. In the face of this complexity, it was felt that insufficient information was available on the options for reducing adverse consequences to justify Congressional action at that time. Section 1207 was therefore included in the Act to begin to gather the needed information.

Section 1207 required that the Task Force "...in consultation with State fish and wildlife agencies, other regional, State and local entities, potentially affected industries and other interested parties, identify and evaluate approaches for reducing the risk of adverse consequences associated with intentional introductions of aquatic organisms and submit a report of the findings, conclusions and recommendations to the appropriate Committees." Notice that this is not limited to finfish, but includes all aquatic organisms. To accomplish this Congressional mandate, the Task Force formed the Intentional Introductions Policy Review Committee. While some of the

options discussed in this document (if recommended, authorized, funded, and implemented), could entail new regulatory actions, **this Committee is not empowered to set in place any new regulations. Its final product will be a Report to Congress.**

The Committee held its initial meeting in November of 1991 to set forth an agenda for completion of the policy review and to begin developing a list of contacts to initiate the process of consulting with the interested and potentially affected entities. By December of 1991, the list had expanded to over 350 names representing the fish and wildlife conservation agencies and aquaculture coordinators of all 50 States, a number of Federal agencies, industry (aquaculture, fishing, aquarium trade), environmental and recreational organizations, academia, and professional scientific organizations. On December 20, 1991, the Task Force sent a letter to all identified entities to invite their involvement in the policy review process. Each was requested to identify potential options for meeting the goal of reducing the risks associated with intentional introductions and invited to participate in a public meeting on February 26, 1992. A similar request and invitation were published in the Federal Register on January 22, 1992. The public meeting, held in the Department of Commerce Building in Washington, D.C., was attended by a very diverse group of 25 participants.

At the public meeting, a summary of the options identified in written responses that were received prior to February 26th was presented. Following presentation of the summary and an open microphone session for those in attendance to identify additional options or detail previous submissions, Committee members and attendees held an open forum discussion of the options. The purposes of the discussion were to tease out any additional variations and allow participants the opportunity to begin assessing the potential advantages or difficulties of each option. To date, more than 100 non-Task Force individuals, groups, and organizations have already contributed to the identification of options, including over 90 written responses from a wide range of interests.

Summaries of these options are presented in the following pages and are intended to reflect both the written responses and comments made at the public meeting. In most cases, the participant's suggested approach combined aspects of several of the outlined options. However, there were so many variations in how the elements were packaged that the Committee felt it would be useful to discuss each option separately rather than attempt to address all of the different combinations. At the broadest policy level, potential approaches might be summarized as just three alternatives - laissez faire, a total ban on introductions, or some intermediate level of control. None of the participants suggested that the first was appropriate; several approximated the second; most came closer to the third. However, the Committee needs your help in assessing the more specific options cited or suggested for use in implementing these broad strategies.

For the purposes of this paper, the identified options have been categorized as: 1) prohibitions & enforcement, 2) permit systems, 3) protocols or NEPA-like review, 4) interjurisdictional decision methods, 5) model State codes, 6) education and extension, 7) more judicious use of existing authority, and 8) industry-based codes

of good business practices. These options are not listed in any particular order. All of the options, with the exception of #8, were suggested by more than one respondent and, as mentioned above, most often two or more of the options were combined to form an overall approach. The following discussions of these options and their potential advantages or difficulties are **not** presented here as the recommendations of the Aquatic Nuisance Species Task Force and are **not** intended to be assessments of the value or validity of the cited concerns. Further, their utility is not suggested to be limited to Federal implementation. Many, in fact, are currently used by and applicable to State government. They are presented only for the purposes of identifying and clarifying a range of options available for "reducing the risk of adverse consequences associated with the intentional introduction of aquatic organisms" and to better enable you to assist the Committee in its evaluation of these options. Once all comments on the Options Paper have been received and reviewed, the Committee will prepare a draft Report to Congress on its "findings, conclusions, and recommendations." At that time, opportunity will again be provided to comment on the document.

THE OPTIONS:

#1. PROHIBITIONS & ENFORCEMENT:

Variations of both this (Prohibitions and Enforcement) and the following option (Permit Systems) were suggested by many participants but were particularly commonly cited as existing forms of State regulation. Cited or suggested prohibitions varied widely and employed a range of enforcement tools. Forms of prohibition included near total bans (on international, interstate, and/or interbasin introductions), "dirty lists," "clean lists," a combination of clean and dirty lists, or often a general prohibition tied to some form of permit system.

Suggestions for "total" bans often included exceptions, for example, for the recovery of threatened or endangered species or for licensed breeders to establish certified "clean" broodstocks of aquarium fishes. The latter exception was specifically suggested to be a means of promoting a more U.S.-based industry and reduce potential overexploitation of native stocks in the countries of origin. Some of the suggested broader advantages of an effective ban on introductions were administrative simplicity, ecological and evolutionary consistency, and the obvious reduction in risks of adverse consequences absent any introductions. Suggested difficulties with such sweeping prohibitions were the decreased availability of products and uses based on introduced species and potentially costly changes in the operating methods of industries that are based on promotion, production, or support services for such products and uses. It was additionally suggested that introductions may continue even in the face of prohibitions and that unless enforcement efforts were significantly increased, some form of regulatory involvement would be better than the consequences of unchecked illegal introductions.

Clean lists basically represent a decision that certain species need little or no further review and will be allowed to be introduced subject to other existing regulatory requirements. Clean lists were suggested by several respondents to represent a more likely means of promoting biologically conservative decision-making than dirty lists. This was because clean lists generally include native species, already established species, or other relatively well studied species. Introductions of species not included on a clean list are generally prohibited until their potential impacts are better understood and the proposed introduction has cleared some form of review process. The most frequently cited difficulty with this approach has been that it may restrict trade and increase the costs of dealing with nonindigenous species if each species is subject to review.

Dirty lists exclude particular species from being introduced, usually because they represent an unacceptable risk to some existing natural or agricultural resource. Species not included on a dirty list may be unrestricted from introduction or subject to other limitations on their transport or release. Suggested advantages of a dirty list approach included potentially less effect on trade and generally strong agreement on a species' nuisance status once listed. The most frequently cited problem with dirty lists was that species are often not listed until after they have already become a nuisance, at which point little can be done to alleviate the associated problems. This was often linked to the concern that the ecological and evolutionary flexibility of many species and the uniqueness of each new receiving ecosystem make it difficult to predict the behavior and thus the effects of the species being introduced, i.e., what appears to be "clean" may ultimately become "dirty."

Several issues were suggested to represent potential problems with either clean or dirty lists. For example, regional environments may vary sufficiently that a species that is "clean-listed" in one area should be "dirty-listed" in another. Both types of lists also require correct and recognizable taxonomic classification. This may therefore require the collection of voucher specimens and a significant increase in the training of enforcement personnel. One suggestion for reducing this problem was "lumping" taxa in the review process (e.g., whole genera or families) instead of listing species-by-species. However, others saw little value in lumping because the range of behavioral traits that characterize even individual species makes it difficult to assess its potential to adversely affect native species and their ecosystems. Another concern with both forms of lists, but most commonly suggested for dirty lists, was that to truly reflect the range of potential nuisance species the lists may need to include many hundreds or even thousands of species. Under current Federal regulation, this could therefore be very cumbersome and time-consuming.

Many of the State fish and wildlife conservation agencies cited general prohibitions on the possession, transport, and release of live aquatic organisms except by permit. The inclusions or exclusions of these general prohibitions vary widely, but often include only game fish species or exclude commercial aquarium and baitfish species. Other than disagreement on taxonomic coverage, the most frequent comment on general prohibitions was their difficulty of enforcement and the inadequacy of associated penalties.

The prevention of unauthorized intentional introductions was a broad concern of many of the respondents. Suggested means of improving enforcement included increased vigilance, tougher and well-advertized penalties for violations, and increased public education about the legal and ecological/evolutionary consequences of such introductions. The types of penalties suggested included fines, suspensions of licenses or permits, incarceration, destruction of the illegal import or transplant, and various forms of liability. In Hawaii, for example, State quarantine statutes provide that in cases where a violation results in escape or establishment, the offender may be subject to fines "based upon the cost of the development and implementation" of a program of capture, control or eradication. Liability will be discussed in more detail under "Permit Systems" but, for illegal introductions, others suggested that the introducer should be liable for direct reimbursement of such costs as damage to other fish and wildlife resources and damage assessment costs as well as the cost of removal or control.

#2. PERMIT SYSTEMS:

Both Federal and State permit systems are potential options. However, State permit systems were far more commonly cited, usually along with the suggested need for their more uniform or extensive use. One Federal permitting system that was cited was the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS). Most APHIS programs are run cooperatively with the States, territories, or foreign nations.

APHIS programs are designed to protect the health of all plants and agricultural and related animals in the U.S. by preventing importation and dissemination of animal and plant pests and diseases. APHIS sets conditions for the importation and movement within the U.S. of animals, plants, animal and plant products and byproducts, embryos and semen, disease organisms, and pests or parasites (including prospective biological control agents) of these groups and conducts control and eradication programs. APHIS evaluates applications and issues permits for interstate movement; endorses interstate health certificates; provides or monitors inspections, precautionary treatments, and testing; and administers or monitors quarantines in government- and privately-owned facilities in the U.S. and abroad. In its export programs, APHIS provides or monitors testing and certification, consults and negotiates health-related requirements of importing countries, and endorses export certificates.

Importers and owners or shippers of regulated plants, animals, and disease or pest organisms must complete permit applications which provide information on the organism or product, its origin and destination, facilities, and the purpose of the shipment. Applications are evaluated and may be granted, granted with conditions, or denied. For applications which involve high risk organisms or in especially problematic situations, advisory committees of scientists from APHIS and other Federal agencies (e.g., Centers for Disease Control, National Institutes of Health, Agricultural Research Service, Army Corps of Engineers) meet to assist the agency in evaluation and decision making. Site visits may be made to the premises of permit

applicants (especially those requesting organisms for use in research or manufacturing). Compliance with permit conditions is also monitored.

As mentioned in the Prohibitions and Enforcement option, many State agencies cited current use of permit systems in conjunction with a general prohibition on the possession, transport, and release of aquatic organisms into State or private waters. Critical issues that emerged in considering permit systems included the criteria used in reviewing permit applications, the form of the responsible decision-making body, the types of required inspections and certifications, appropriate permit conditions, and the associated costs.

In some States, no criteria were listed and permits appeared to be used primarily to create a paper trail to track shipments. In other States, disease-free certification from the State of origin or pre-introduction and post-introduction inspections of organisms or holding facilities were required. Still other States included criteria specifically aimed at avoiding negative interactions with native species.

Suggested permit review bodies included decisions from within a single State agency, coordination between agencies with common resource concerns within the same State, interstate coordination, or Federal review. In the State of Illinois, for example, coordination of the aquaculture industry is in the hands of the Department of Agriculture and regulation is in the hands of the Department of Conservation (DOC) which issues annually renewed permits. For species not on the State's "Aquatic Life Approved Species List" (a form of "clean list"), an "Aquaculture Advisory Committee ... composed of a diverse group of interested entities" provides non-binding advice to the DOC's Chief of Fisheries who then makes the decision on whether or not to permit introduction. This system "allows the various state agencies showing interest in this subject as well as the industry to voice their opinions."

Suggested inspections concentrated on two areas, inspection of organisms for nonindigenous pathogens and inspection of sites for escape-proofing. Many respondents expressed particular concern for shellfish pathogens.
Suggested difficulties with inspections and certifications included the comment that many diagnostic techniques cannot simply be done "at the border" and may take considerable time to complete. This, in turn, may require quarantine facilities and the associated risks of loss from the stress of additional transfers. An alternative suggestion was point of origin certification. However, it was suggested that while this may work for interstate transfers, many imports are likely to come from less developed nations which may lack the finances or capabilities to perform the necessary inspections. Another suggested alternative to extensive inspections and certifications for aquacultural, hatchery, or aquarium fish breeding or distribution facilities was the use of closed systems and sterilization of effluents.

Beyond the species and site specific conditions unique to each permit, some general permitting conditions were also suggested. For example, to reduce the likelihood of accidental release or interference with other activities, siting requirements were often recommended (e.g., avoiding the 100-year floodplain or proximity to shipping lanes

and "habitats of special significance"). Access to the site for on-ground inspections was also mentioned. Some form of user fee, cost reimbursement, or liability responsibility was also often cited or suggested as a condition of permit issuance. At least two State agencies, however, noted that while such conditional costs may be included, their permits are free (or nearly so) because they felt it was important to encourage participation in the permitting process.

Suggested costs to be covered by the party responsible for the introduction included permit administration costs, organism and facility inspections, liability for a number of potential expenses, and post-introduction detection and monitoring. Regardless of the funding source, the capability for early detection was often stressed as being particularly critical to any successful program for minimizing the risks of adverse consequences associated with introductions - be they intentional or unintentional.

Suggested liability costs included responsibility for unanticipated resource damages, damage assessment, and, if necessary, removal or control. The concept of liability costs was usually forwarded with the suggestion that this responsibility would make the introducer more apt to be thorough in assessing the anticipated effects and in the development of contingency plans. If there are damages, it was also suggested that this approach represents a "biological pollution" equivalent to the concept of "the polluter pays" so that taxpayers are not burdened with the costs. The suggested mechanisms for covering these costs included establishment of an Aquatic Nuisance Fund (a sort of "superfund"), the posting of performance bonds, or other forms of insurance coverage.
Some of the suggested difficulties with liability requirements included identifying the source of "escapees" and the determination, if necessary, of appropriate liability caps. With regard to the latter, for example, if a species becomes an established nuisance and cannot be removed or effectively controlled, should damage costs continue in perpetuity? Another issue with some participants was whether such liability requirements should also be applicable to government entities.

#3. PROTOCOLS OR NEPA-LIKE REVIEW:

Because the informational content of National Environmental Policy Act (NEPA) documents (e.g., Environmental Assessments, Environmental Impact Statements) is often similar to the information needed to complete all of the steps in a checklist or protocol-driven decision-making process, these two have been combined. The most commonly cited protocols were those of the American Fisheries Society, the International Council for the Exploration of the Seas, and the North Atlantic Salmon Conservation Organization. Call was also made for the development of genetic protocols which include specific gene conservation standards. A few respondents cited State Environmental Protection Act requirements or environmental assessment requirements built into their permitting systems.

Both NEPA-like documents and protocols or checklists usually offer an opportunity to consider alternatives to a particular proposal. Both may also include suggestions for mitigation and additional research needs. Progression through many protocols require

that the needed information be available and a YES/NO decision be made before proceeding to the next step. In this sense, several respondents felt that while NEPA-like documents may support a protocol process, the requirements of protocols may result in more effective decision making.

Other issues were broadly applicable regardless of the specifics of the protocol or the format of the document. For example, what constitutes a sufficient "trigger" to initiate this form of review? Under NEPA, the trigger is any "major Federal action" that significantly affects the human environment. Is this a sufficiently defined trigger or, given the uncertainty cited above, should each introduction of every species require a new environmental assessment or protocol review. If not, should only some subset of these (a cited example was those not on a "clean list") receive such attention? How would the distinction be made and by whom? Who should apply the protocol or review the NEPA-like documents and at what stage in the process? Should the findings of such a review be binding or used only as guidance? At least one respondent suggested that there may be legal problems with making the findings of an interstate decision body binding upon the individual States.

#4. INTERJURISDICTIONAL DECISION METHODS:

Two general forms of interjurisdictional review were mentioned in the written responses, secondary review and panel review. In the former, a second agency or commission either within a State, interstate, or on the Federal level would review the decision to assure that a "second opinion" was given by a body with different and potentially broader resource concerns. Though structurally different, review panels may perform a similar function. As suggested above, however, such panels may also serve as a "filter" to decide which introductions may need more intensive review. The impetus for suggesting an interjurisdictional forum was generally a recognition that many introduced species have the potential to spread across a broad geographical range and the consequent desire, therefore, to be involved in decisions which may affect resources within the respondent's jurisdiction.

As the geographic scale of the potential effects may vary, so also did the suggested forms of panels. National, regional, interstate, and intrastate panels were all suggested or cited. The State of Arizona, for example, cited a fish stocking policy which states that any introduction of a new species to the State of Arizona in the Colorado River drainage shall require advance approval of the Colorado River Fish and Wildlife Council, an interstate fish and wildlife conservation coordinating body.

The suggested membership of review panels variously included biological experts, State or Federal regulatory personnel, industry representatives, a range of user groups, and other interested public. Other issues with interjurisdictional methods were similar to those for other approaches - i.e., should the deliberations of such a panel be advisory or binding; should existing panels (e.g., interstate commissions and councils) or newly created panels be used; what criteria should be used in reaching a decision? Regardless of the answers to these questions, the suggested advantages

of interjurisdictional panels nearly always emphasized their improved facilitation of information exchange and communication.

#5. MODEL STATE CODES:

Several respondents suggested that, in consultation with State agencies and other interested entities, a Federally-legislated model code or set of Federal standards could be developed which individual States could then adopt. Model codes could be based on any number of the different options discussed here. However, few specific combinations were forwarded as suggestions for a model code. There was also a diversity of opinion on whether a truly "model" (optimum) code or minimum standards would be more appropriate.

As in other approaches, respondents varied on whether or not the model code should be strictly advisory or a requirement. If the model code was required, what would be the consequences of failure to comply? One suggestion was to link noncompliance to some form of disincentive. For example, failure to adopt the code could result in a loss of funding source (similar to how some Federal Highway funds are restricted) or regulatory authority (as with some Occupational Safety and Health Administration functions). A suggested alternative was to link adoption instead to some form of financial incentive (similar to funding under the Coastal Zone Management Act) to help States with implementation. Some concern was expressed over whether sufficient Federal funds would be found to support the latter approach. Others simply suggested some unspecified "Federal oversight." In nearly all cases where codes and standards were suggested, it was commented that such a model could help ensure greater consistency between States.

#6. EDUCATION AND EXTENSION:

Broad concern was expressed that the issues surrounding species introductions were simply too low of a priority among regulatory agencies, industry, and the general public. In response, many participants cited the need for some form of education and extension effort in order to increase awareness of these issues. The suggested form, forum, and content of the educational effort varied widely.

Educational efforts may include active dissemination of a wide range of materials via any number of outlets - informational pamphlets and posters at public facilities, active encouragement of radio and television programming, assisting in classroom instruction, and so on. However, education and extension could also be limited strictly to the provision of technical assistance when requested. The source of information and the mechanism for its transfer are similarly open for consideration. Informational materials could be developed by a range of entities (government agencies, private industry, private organizations, educational institutions) and made available to a similar range of entities for use as they wish or as a requirement, for example, at the point of sale or distribution of the introduced species. Some concern was expressed that information (e.g., pamphlets) dispersed at the point of sale may not be read.

Respondents from a wide range of interests suggested that the most effective longterm progress in this arena would come from extensive involvement in programs, virtually from grade school to continuing education, which stressed an understanding of biological diversity and the natural functioning of ecosystems. Recent campaigns on littering and recycling were suggested as models of how to reach a very broad audience. They were also noted for linking actions to their consequences so that the message "hit home" more effectively.

More directed efforts were also mentioned. For example, it was suggested that a more active role be taken in encouraging the use of native species. Assistance in this area could either be by the dispersal of information on how to do so or, if such information does not yet exist, by carrying out research aimed at achieving this goal. Others cited the need for a "clearinghouse" for introduced species information and educational materials. The purposes of this clearinghouse would be to facilitate communication among researchers and educators and to avoid duplication of efforts in the development of materials. It was also suggested that the facilitated exchange of information on species of interest could expedite the clean listing or dirty listing process should either of those options be adopted.

#7. EXISTING AUTHORITY:

Discussions of this approach generally reflected either a suggestion to maintain the "status quo" or to employ existing authority differently than is currently practiced by State or Federal governments. Most discussion was directed toward Federal authorities. Frequently cited laws included the Lacey Act, NEPA, the Federal Aid in Sport Fish Restoration Act (Dingell-Johnson), and the 1977 Executive Order No. 11987 (EO 11987) on "Exotic Organisms."

The injurious wildlife provisions of the Lacey Act, under the current regulatory scheme, prohibit the importation or possession of a relatively small number of species that according to regulation are potentially harmful to human beings or the interests of agriculture, horticulture, forestry, or fishes and wildlife of the United States. While some respondents suggested that the Lacey Act needn't be altered, others suggested that both current and past implementation of the Act has failed to fully exercise its authority "to regulate the introduction of American or foreign birds or animals in localities where they have not heretofore existed." As discussed above, the "dirty list" approach of the Lacey Act was also criticized as being too slow; streamlining of the listing process was suggested.

As noted by several respondents, species introductions which involve Federal agencies would be subject to the general requirements of the NEPA review process. While no particular protocol or checklist is prescribed in NEPA documents, discussion of alternatives to the proposed action are required. Some concern was expressed that introductions not treated by the Federal agency as a "major action" may not receive proper NEPA attention.

Other respondents expressed a similar concern in suggesting that a number of nonindigenous species introductions have actually been supported by grants under

the Federal Aid in Sport Fish Restoration Act. The basis of their objection to such funding was that introductions of species into ecosystems in which they had not historically occurred could not properly be called "restoration" and were therefore inconsistent with the purposes of the Act. Further, it was argued that such introductions with Federal funding were prohibited by EO 11987.

Executive Order No. 11987, in furtherance of "the purposes and policies of the Lacey Act ...and the National Environmental Policy Act," ordered federal agencies, to the extent permitted by law, to restrict the introduction of exotic species into the natural ecosystems of the United States; encourage States, local governments, and private citizens to similarly restrict such introductions; and restrict the use of Federal funds, programs, or authorities to export native species for introduction into ecosystems outside the United States where the species does not naturally occur. Proposed regulations were developed for the implementation of EO 11987 but have never been finalized. Some federal agencies have nevertheless adopted the proposed regulations as guidelines for discharging their responsibilities under the Executive Order.

The Convention on International Trade in Endangered Species (CITES) and the Endangered Species Act (ESA) were also cited as playing a role in decisions on species introductions. Under the ESA, a Federal agency may not participate in any action (which therefore could include the introduction of a nonindigenous species) that "will jeopardize the continued existence" of a threatened or endangered species. Any Federal agency whose actions "may affect" a listed species is also required to consult (under Section 7 of the ESA) with the Fish and Wildlife Service or National Marine Fisheries Service to discuss means to reduce or eliminate those effects or identify reasonable and prudent alternatives.

Other Federal Acts which may play a role in Federal decision-making on introduced species include the Federal Insecticide, Fungicide, and Rodenticide Act, the Noxious Weed Act, the 1952 International Plant Protection Convention to which the United States is a signatory, and the U.S./U.S.S.R. Convention Concerning Conservation of Migratory Birds and Their Environment. The latter calls on each contracting party to "undertake measures for the control of the import, export and establishment in the wild of live animals and plants that may be harmful to migratory birds or their environment." However, this convention has also not been formally implemented.

Several respondents questioned the linkage between the "purposes" section of many Federal laws and their regulatory implementation. Others also suggested an immediate need for government-wide or department-wide statements of national policy on species introductions to give direction to the implementation existing Federal authorities.

#8. CODES OF GOOD BUSINESS PRACTICES:

An option not identified in the written responses, but common in many business arenas, is a code of good business practices or industry standards generated by participants in the industry itself. In essence, these represent a form of self-

regulation and are most often set forth as voluntary guidelines with compliance a matter of professional ethic and public image. An example of this is the National Poultry Plan where Federal, State, and private industry members have established national standards. Acceptance of the Plan is optional for States and individual members of the industry within those States. Suggested advantages to this approach were the avoidance of additional regulatory requirements and the suggestion that any potential certification of compliance could serve as a "Seal of Quality" for the participant. Possible complications with this approach included its voluntary nature (i.e., all parties may not live up to the code) and the complexity of dealing with many rather than a single species. It was also noted that such codes are often developed by industry organizations with the organization's newsletter serving as the primary means of communicating information about the code. Therefore, anyone active in the industry but not a member of such an organization may not be covered. Others simply expressed doubt that such codes were necessary because "profit and image" were a sufficient code in the marketplace.

PARTICIPATION IN THE REVIEW:

This "Options Paper" has been developed by the ANS Task Force explicitly for the purposes of encouraging your participation in the policy review process. It is being mailed directly to a very wide range of interest groups, many of whom participated in the identification of the options here explained. Its availability is also being announced in the Federal Register. Your participation, and that of any others whom you wish to contact, is strongly encouraged. The comment period for the document will extend for 60 days from the date of publication of a Notice of Availability in the Federal Register, after which time the Committee will prepare a draft of its Report to Congress. The draft report will also be available for comment, probably in early Fall of 1992. Please direct your comments to: Intentional Introductions Policy Review Committee, c/o Dr. Dennis Lassuy, U.S. Fish and Wildlife Service (820 ARLSQ), U.S. Department of Interior, 1849 C Street, NW, Washington, D.C., 20240.

AFS Position Statement

Transgenic Fishes

A. R. Kapuscinski and E. M. Hallerman

Issue Definition

The advent of gene transfer techniques has introduced the development of lines of fishes, as well as other aquatic organisms, bearing introduced genes (Kapuscinski and Hallerman 1990). Such modifications are typically aimed at substantial changes of performance characters (e.g., faster growth), extension of environmental tolerance (e.g., cold resistance), or expression of novel proteins. Most fisheries professionals would agree that (1) traits other than those targeted by gene transfer are likely to be affected, (2) overall phenotypic performance of such fishes is virtually uncharacterized, and (3) introduction of such fishes into natural aquatic communities is likely to cause ecological impacts.

Because the performance and ecological impacts of transgenic organisms in natural ecosystems are unknown (Tiedje et al. 1989), uncontrolled release of transgenic fishes is undesirable. Public policies for regulating development and release of transgenic organisms are currently being formulated (Hallerman and Kapuscinski 1990). It is important that fisheries scientists become involved in evaluations of the performance and ecological impact of transgenic fishes, and in development of relevant public policies to ensure that rational, carefully considered decisions are made regarding development and release of transgenic fishes. While this position statement focuses on transgenic fishes the concerns and recommended courses of action apply equally to all transgenic aquatic organisms.

Technical Background

Transgenic Fish

Within their cellular genetic material, transgenic fish bear copies of novel DNA produced by recombinant DNA methods. Such fish are produced by insertion of copies of the novel DNA into newly-fertilized eggs or by reproduction of the individuals so produced. Production of some 14 species of transgenic fishes has been carried out as of July 1989 (Kapuscinski and Hallerman 1990). Genes that have been transferred into fish of different species have included those coding for growth hormone, antifreeze protein, and a variety of easily detected marker proteins. An increase in types of transgenic fishes is expected because the number of isolated single genes is rapidly increasing. In cases where transgenic fish have been reared to sexual maturity, germline transmission of the inserted genes and normal fertility have been observed. Besides the expected direct effects of inserted DNA, indirect phenotypic effects might occur as a consequence of uncontrolled genomic integration or expression of the introduced DNA. Although performance data for transgenic fish are limited, predictions of indirect effects are supported by findings in other transgenic animals.

Ecological Impacts

The potential impacts of transgenic fishes on natural ecosystems might be manifested through a large number of pathways. Impacts will result from altered performance of such fish. At least three conceptual classes of phenotypic changes for transgenic fish might be anticipated. These include changes in: physiological rates, tolerance of physical factors, and behavior. Based on current understanding of community-level impacts of stocking non-transgenic piscivorous fish, the release of certain transgenic fishes, especially those exhibiting substantially altered performance, could destabilize and reorganize aquatic ecosystems (Kapuscinski and Hallerman 1990). Because aquatic ecosystems function through complex interactions involving transfers of energy, organisms, nutrients, and information, it is reasonable to expect difficulty in predicting the community-level impacts of releasing transgenic fishes that exhibit one or more type of phenotypic change.

Ecological risks of releasing transgenic fishes could be reduced by making them sterile, although sterilization itself may cause other problems. Sterility may be accomplished by ploidy manipulation, hormone treatment, hybridization, surgery, or combinations of these methods. When sterilization is accomplished via induction of triploidy or administration of hormones, there is the added risk that not all individuals are truly sterile. Phenotypic effects of these sterilization methods could be confounded with effects of the introduced gene, thus making it difficult to evaluate performance effects of transgenes. Surgery also has its drawbacks, since some fishes have regenerated gonads and viable urogenital ducts following complete gonadectomies. Sterilization procedures may pose practical problems when applied on a large scale or when used upon some species. Releases of sterile transgenic fish would still involve short-term risks because sterile fish can alter community dynamics through processes such as competition and altered predation (Kapuscinski and Hallerman 1990).

Legal Background

Regulation in the United States

Development of animals bearing recombinant DNA molecules is regulated under the Coordinated Framework for the Regulation of Biotechnology, a policy document directing various federal agencies to oversee such development activities. Promulgation of the Coordinated Framework was an administrative attempt to regulate development of a technically broad field in a comprehensive manner, and its coverage consequently included a number of oversights which could prove problematic (Hallerman and Kapuscinski 1990), as discussed below. Certain state agencies also may have regulatory jurisdiction over transgenic animals.

Under the Coordinated Framework, different federal agencies have promulgated their own definitions of transgenic organisms. The definitions were supposed to be made consistent by an interagency committee, but this has not been accomplished as of June 1990. These definitions share the feature of being product rather than process oriented, hinging upon the origin and nature of the DNA introduced. Under the Framework, a new organism has been defined as one containing "an intergeneric combination of genetic material." Specifically "excluded are organisms that have resulted from the addition of intergeneric material that is well characterized and contains only noncoding regulatory regions." Thus, transgenic organisms that contain DNA constructs bearing such regulatory regions and *intra*generic protein-encoding sequences are not legally considered transgenic (Hallerman and Kapuscinski 1990), and hence might prove more readily certifiable for deliberate release, distribution, or final use. Yet, regardless of the source of the expression-regulating or protein-encoding sequences in the introduced DNA, alterations of gene expression and gross phenotype are possible and form the bases for the novel performance and ecological impact of transgenic animals. From the viewpoint of environmental impact, distinctions about the particular sources of introduced DNA are largely irrelevant.

Research with transgenic animals at institutions receiving federal support is regulated under guidelines promulgated by the National Institutes of Health (NIH) or, for USDA-funded projects, under guidelines being developed by USDA. These guidelines specify proper laboratory practices and levels of biological containment for work involving recombinant DNA methodology. Among institutions not receiving federal funding, voluntary compliance with NIH guidelines is expected under terms of the Coordinated Framework.

The natural environmental conditions required for the attainment of sexual maturity in certain species and the normal culture conditions required for identification of high performance lines dictate the need for environmental release (i.e., outdoor containment) during development of transgenic lines in many fish species. Provisional policy guidelines for outdoor testing of transgenic animals have been promulgated by the USDA Office of Agricultural Biotechnology. It is noteworthy that these guidelines specifically regulate environmental release of only those animals produced as part of USDA-funded research. After reviewing a research proposal involving release of transgenic carp into a secure, outdoor research facility, the release was recommended for approval in spring 1989 by the USDA Agricultural Biotechnology Research Advisory Committee. The proposal was not funded by USDA and, thereafter, transgenic broodfish were stocked into research ponds.

Within the next decade the first genetic lines of transgenic fish will likely emerge from field testing and development and become potentially available for distribution and final use in aquaculture or fisheries management. As transgenic fish are distributed for final use, they will enter a wide range of less secure containments, from which entry into natural systems and impacts upon natural aquatic communities will become more likely. Under the Coordinated Framework, public policy regulating distribution and final use of transgenic animals is not well defined, with a number of federal agencies responsible for particular aspects of such oversight, but none with overall responsibility as a lead agency.

Regulation in Canada

There are a number of Canadian Federal Acts that might regulate the development of biotechnology products (Government of Canada 1988). The National Biotechnology Advisory Committee (1989) has urged the federal government to clarify the coverage of biotechnology products under such legislation. Although the process is well underway, several fundamental issues remain.

Production of transgenic animals is regulated under guidelines promulgated by the Medical Research Council (MRC). The guidelines clearly apply to laboratory research but are not intended to cover environmental release, or distribution and final use of transgenic organisms. Compliance with the guidelines is required only in projects funded by MRC or the Natural Sciences and Engineering Research Council. Furthermore, the guidelines are not enforced by either Council, except by withholding of funds.

The application of existing legislation (such as the Food and Drug Act, the Quarantine Act, and the Animal Disease and Protection Act) to biotechnology hinges upon specific product categories (e.g., veterinary biologics, foods, or drugs) without regard to the process of manufacture. Biotechnology products, specifically transgenic animals, intended for use in the open environment are not well covered by existing legislation.

The recently-enacted Canadian Environmental Protection Act (CEPA) is intended to have wide applicability covering safety in the research, production, use, and disposal of a wide range of products (Government of Canada 1988). The Act will ostensibly cover situations where regulatory coverage under existing legislation may be absent or unclear. Draft regulations promulgated under the Act are still in development. For example, criteria are still being developed for assessing permit applications for field trials and for containment during testing. Apparently, regulations covering distribution and final use of transgenic organisms have not yet been addressed by Agriculture Canada.

Courses of Action

Development of public policies on transgenic organisms is at a pivotal stage. It is important that fisheries professionals participate in development of public policies with possible impacts on fisheries resources. Advocacy by the American Fisheries Society of policies endorsed by the membership will provide a powerful impetus towards development of sound policies. We suggest advocacy of the following positions regarding transgenic fishes, in the areas of research, regulation, and proprietary rights:

1. **Support research to provide data for rational policy decisions.**

Timely progress of scientific understanding and production technology will fill critical needs for development of environmentally sound uses of fertile or sterile transgenic fishes. Needs include: phenotypic characterization of transgenic lines, evaluation of the performance of transgenic lines, improvement of sterilization techniques, and development of ecological risk assessment models and protocols.

2. **Advocate caution in uses of transgenic fishes.**

Because evaluations of the performance of transgenic fishes will provide meaningful and needed data for assessing the benefits and risks associated with uses of such animals, well-defined studies in secure indoor and outdoor research facilities should be encouraged and approved.

No introductions of transgenic fishes into production-scale aquaculture facilities, whether public or private, should be permitted until completion of risk assessment studies and demonstration of minimal environmental risk on a case-by-case basis.

Criteria should be developed for containment of fertile transgenic broodstocks. Whenever practical, transgenic fishes used in aquaculture should be sterile.

Stockings of transgenic fishes into natural waters should be barred unless and until a body of research strongly indicates the merits of and ensures the ecological safety of stocking a particular transgenic fish into a particular receiving natural system, and only following public comment and approval by the appropriate fisheries management agencies.

3. **Advocate regulations improving comprehensiveness of the Coordinated Framework in the United States.**

The American Fisheries Society should support full application of the existing NIH and USDA guidelines regulating production and handling of transgenic organisms, and should support revisions of the guidelines to address the following concerns:

The definition of a transgenic animal within the Coordinated Framework must be changed to hinge upon the process by which the novel animal was produced rather than upon sources of introduced DNA. The definition must be made consistent across the various federal agencies involved in the Coordinated Framework.

Production of transgenic animals in non-federally funded laboratories should be required, rather than simply expected, to follow NIH guidelines. Monitoring and enforcement provisions of the guidelines should be strengthened.

The scope of regulations regarding environmental release of transgenic animals should be expanded to include experiments not specifically funded by USDA.

The American Fisheries Society should advocate mandatory federal regulatory review of proposed releases of transgenic fishes. An AFS committee of technical experts should monitor both the regulatory process and early releases of transgenic fishes. As experience with releases of transgenic fishes accumulates, the degree of federal review should be reassessed. A greater degree of public involvement should be incorporated into decision-making upon release permit requests.

The American Fisheries Society should advocate and participate in early development of policies regulating distribution and final use of transgenic fishes, pressing for adoption of an ecologically conservative philosophy. Granting of separate permits for distribution and final use of transgenic organisms should be considered on a case-by-case basis, as set out in H. R. 1557, the proposed Transgenic Animal Regulatory Reform Act (Kastenmeier 1989). Evaluation of permit applications should include review of results from an environmental risk assessment that considered the particular genetic and phenotypic modifications and the receiving environment at issue.

The American Fisheries Society should advocate designation of a lead agency, including Society representation on appropriate advisory committees, for development of policy and enforcement of regulations regarding distribution and uses of transgenic fishes. Federal regulatory authority must be established over release of transgenic fishes by the private sector and over transport of such animals within states.

4. **Advocate further consolidation of Canadian regulatory authority over development of transgenic organisms.**

The American Fisheries Society should advocate further definition or extension of the Canadian Environmental Protection Act or other regulatory instruments to specifically address these areas of concern:

The definition of terms within existing legislation needs to be reviewed to determine whether transgenic organisms are covered and whether they are adequately controlled within the scope of such laws. For example, it may be appropriate to broaden the definition of "substances" under the Canadian Environmental Protection Act. As in the U.S., regulation of transgenic organisms should be built upon a process-based definition.

Field testing of transgenic animals is not subject to a clearly defined regulatory framework. Nonetheless, a 365-day notification for field experimentation is required, leading to complaints from the Canada biotechnology community. Greater definition and streamlining of regulatory process is called for.

Explicit incorporation of transgenic animals into Agriculture Canada's regulations covering distribution and final use of biotechnology is crucial. Encouragement for developers of transgenic animals to contact Agriculture Canada for preparation and planning of such developmental activities is too weak a regulatory approach.

The Canadian provinces and territories play a prominent role in regulation, sharing responsibility with the federal government for environmental protection. However, the applicability of existing regulations to biotechnology products is uncertain and may vary from province to province. Consistency in approach among jurisdictions is essential for effective regulatory control.

References

Government of Canada. 1988. Biotechnology regulations: a user's guide. Ministry of State for Science and Technology, Cat. En 40-357/1988 E, Ottawa, ON.

Hallerman, E. M., and A. R. Kapuscinski. 1990. Transgenic fish and public policy: regulatory concerns. Fisheries (Bethesda) 15(1):12–20.

Kapuscinski, A. R., and E. M. Hallerman. 1990. Transgenic fish and public policy: anticipating environmental impacts of transgenic fish. Fisheries (Bethesda) 15(1):2–11.

Kastenmeier, R. 1989. Transgenic Animals Regulatory Reform Act. H.R. 1557, 101st Congress, first session.

National Biotechnology Advisory Committee. 1989. The regulation of biotechnology: a critical issue for Canadian research and industrial development. Industry, Science and Technology Canada, Ottawa, ON.

Tiedje, J. M., R. K. Colwell, Y. L. Grossman, R. E. Hodson, R. E. Lenski, R. N. Mack, and P. J. Regal. 1989. The planned introduction of genetically engineered organisms: ecological considerations and recommendations. Ecology 70:298–315.

APPENDIX C

Analysis of information presented by Miller et al. (1989) on introduced species as a factor associated with fish extinctions in North America.

Extinct Taxon	Unintent.	Unclear	Intent.	Type of Species
Longjaw cisco	X			
Deepwater cisco	X			
Lake Ontaria kiyi		X		
Blackfin cisco		X		
Yellowfin cutthroat trout*			X	S[1]
Alvord cutthroat trout*			X	S
Silver trout*			X	S
Maravillas red shiner*			X	unclear
Independence Valley tui chub*			X	S
Thicktail chub			X	S
Pahranagat spinedace*			X	C[2]
Ameca shiner			X	O[3],A[4]
Durango shiner*			X	S
Phantom shiner		X		
Rio Grande bluntnose shiner		X		
Clear Lake splittail			X	S,A
Banff longnose dace			X	C,O
Grass Valley speckled dace*			X	S
June sucker			X	unclear
Tecopa pupfish			X	C
Monkey Spring pupfish*			X	S
Raycraft Ranch poolfish			X	A
Ash Meadows poolfish*			X	unclear
Whiteline topminnow			X	A,O
San Marcos gambusia			X	S,O
Blue pike		X		
Utah Lake sculpin	X			
TOTALS	2(7.4%)	6(22.2%)	19(70.4%)	

Unintentional = Unknowingly introduced, e.g., lamprey.
Intentional = Knowingly introduced.
* = Introduced species were identified as a primary reason for extinction. (Those without asterisk, introduced species were identified as a contributing factor in extinction.)

Type of Action:
[1]S = Introduction related to sportfishing (game, forage, bait species).
[2]C = Introduction related to pest control (mosquitofish).
[3]O = Introduction of ornamental species.
[4]A = Introduction of aquacultural species (other than public hatcheries and ornamental species); includes common carp (introduced for pond culture).

The last step in the Endangered Species Act (ESA) listing process is to publish a "final rule" in the Federal Register. It includes a description of factors which led to a listing of "endangered" or "threatened."

Under the (ESA), a species may be determined threatened or endangered if one or more of the following factors apply: 1) the present or threatened destruction, modification, or curtailment of its habitat or range; 2) overutilization for commercial, recreational, scientific, or educational purposes; 3) disease or predation; 4) the inadequacy of existing regulatory mechanism; and, 5) other natural or manmade factors affecting its continued existence.

Federal Register Notices detailing final rule files of the Fish and Wildlife Service were examined to determine what factors contributed to listings of fish species. Adequate information existed for 69 of 92 U.S. species. Most of the early listings were made prior to the requirement under the ESA to provide listing factors and provided little information beyond the name of the species being listed.

Similar to Miller et al. (1989), most cases cited more than one listing factor, with habitat degradation as the most frequently cited factor (63/69 cases, 91%). The effects of introduced species were cited as a cause of decline in 40 cases (58%) and a potential threat in eight others (12%) for a total of (48/69 cases, 70%).

As in Appendix C, the information in this appendix is categorized by the "type of species" introduced. Introductions related to biological control (primarily Gambusia), ornamental use (cichlids, goldfish, mollies [though mollies are sometimes also used as baitfish]), and private aquaculture of species other than ornamentals (channel catfish, tilapia [sometimes used as ornamental fish]) were all cited as having contributed to the listing of fish species under the ESA. However, among cases that cited introduced species as a factor, introductions related to sport fishing (game, forage, bait species) were the most commonly cited (35/48 cases, 73%).

Often several species were cited. Members of the bass and sunfish family (Centrarchidae) were the most frequently cited sport fish group contributing to ESA listings. The largemouth bass (*Micropterus salmoides*) was the most frequently cited individual species. Other centrarchids included the green sunfish, bluegill, crappie, "other sunfish," and smallmouth bass. Members of the freshwater catfish and bullhead family (Ictaluridae) were the second most commonly cited group. Channel catfish (*Ictalurus punctatus*) and several species of bullhead were mentioned. Various bait species were another frequently cited group and included most commonly the red shiner (*Cyprinella lutrensis*), the fathead minnow (*Pimephales promelas*), and "other baitfish." Rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*) were cited in seven and six cases, respectively, primarily for having caused problems through hybridization with native trout species or as predators of smaller species. In most cases, it was not noted whether the species had been introduced by a public agency or as the result of an illegal introduction.

Analysis of causes of decline and continuing threat for fish species listed under the Endangered Species Act.[1]

Common Name	Listing Factor(s)			Type of Species			
	(H)[2]	(P)[3]	(I)[4]	(S)[5]	(C)[6]	(O)[7]	(A)[8]
Catfish, Yaqui	H	I	S				
Cavefish, Alabama		P					
Cavefish, Ozark		P					
Chub, bonytail	H	I	S			A	
Chub, Borax Lake	H		I[9]				
Chub, Chihuahua	H	P	I	S	C		
Chub, humpback	H		I	S			A
Chub, Hutton tui	H	P[9]	I[9]				
Chub, Owens tui	H		I	S			
Chub, slender	H	P					
Chub, Sonora		I	S				
Chub, spotfin	H	P					
Chub, Virgin River	H		I	S			
Chub, Yaqui	H		I	S			
Dace, Ash Meadows	H		I	S	C		
Dace, blackside	H		I	S			
Dace, Clover Valley	H		I	S			
Dace, desert	H	I[9]					
Dace, Foskett	H	I[9]					
Dace, Independence Valley	H		I	S			
Dace, Moapa	H		I			O	
Darter, amber	H	P	I[9]				
Darter, bayou	H	P					
Darter, Elk River	H						
Darter, goldline	H	P					
Darter, leopard	H	P					
Darter, Niangua	H		I	S			
Darter, slackwater	H						
Darter, snail	H						
Logperch, Conasauga	H	P	I[9]				
Logperch, Roanoke	H	P					
Madtom, Neosho	H	P					
Madtom, Scioto	H						
Madtom, Smokey	H	P					
Madtom, yellowfin	H	P					
Minnow, loach	H		I	S			
Pupfish, Ash Mdw. Amargosa	H		I	S	C	O	
Pupfish, desert	H	P	I	S		O	A
Pupfish, Devils Hole	H						
Pupfish, Leon Springs	H		I	unclear			
Sculpin, pygmy	H	P					
Shiner, beautiful	H		I	S			

(cont'd on next page)

Common Name	Listing Factor(s) (H)[2]	(P)[3]	Type of Species (I)[4]	(S)[5]	(C)[6]	(O)[7]	(A)[8]
Shiner, blue H P							
Shiner, Cahaba		P					
Shiner, Cape Fear	H	P					
Shiner, Pecos bluntnose	H	P	I	unclear			
Silverside, Waccamaw		P	I[9]	S[9]			
Spikedace	H		I	S			
Spinedace, Big Spring	H		I		C		
Spinedace, Little Colorado	H	P	I	S			
Spinedace, White River	H	P	I		C	O	
Springfish, Hiko White R.	H		I	S		O	
Springfish, RR Valley	H		I			O	A
Springfish, White River	H		I	S		O	
Squawfish, Colorado	H		I	S			
Sturgeon, pallid	H						
Sturgeon, Gulf H	P	I[9]				A[9]	
Sucker, June H	P	I	S			A	
Sucker, Lost River	H	P	I	S			
Sucker, Modoc	H		I	S			
Sucker, razorback	H		I	S			A
Sucker, shortnose	H	P	I	S			
Sucker, Warner	H		I	S			
Topminnow, Gila	H		I	S	C		
Trout, Apache H		I	S				
Trout, greenback cutthroat	H		I	S			
Trout, Lahontan cutthroat	H		I	S			
Trout, Little Kern golden	H		I	S			
Trout, Paiute cutthroat	H		I	S			

[1] Analysis limited to those species for which information in Fish and Wildlife Service ESA final rule file was adequate to make a determination.
[2] Habitat alteration cited as factor in listing of species.
[3] Pollution (non-biological) cited as factor in listing of species.
[4] Introduced species cited as factor in listing of species.
[5] S = Introduction related to sportfishing (game, forage, bait species).
[6] C = Introduction related to pest control (mosquitofish).
[7] O = Introduction of ornamental species.
[8] A = Introduction of aquacultural species (other than public hatcheries and ornamental species); includes common carp (introduced for pond culture but sometimes used for weed control and as sport fish).
[9] Cited as listing factor as continuing threat rather than cause of decline.

APPENDIX E

Text of Executive Order 11987

Title 3 - The President

Executive Order 11987 May 24, 1977

EXOTIC ORGANISMS

By virtue of the authority vested in me by the Constitution and statutes of the United States of America, and as President of the United States of America, in furtherance of the purposes and policies of the Lacey Act (18 U.S.C. 42) and the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.), it is hereby ordered as follows:

Section 1. As used in this Order:

(a) "United States" means all of the several States, the District of Columbia, the Commonwealth of Puerto Rico, American Samoa, the Virgin Islands, Guam, and the Trust Territory of the Pacific Islands.

(b) "Introduction" means the release, escape, or establishment of an exotic species into a natural ecosystem.

(c) "Exotic species" means all species of plants and animals not naturally occurring, either presently or historically, in any ecosystem of the United States.

(d) "Native species" means all species of plants and animals naturally occurring, either presently or historically, in any ecosystem of the United States.

Section 2.

(a) Executive agencies shall, to the extent permitted by law, restrict the introduction of exotic species into the natural ecosystems on lands and waters which they own, lease, or hold for purposes of administration; and, shall encourage the States, local governments, and private citizens to prevent the introduction of exotic species into natural ecosystems of the United States.

(b) Executive agencies, to the extent they have been authorized by statute to restrict the importation of exotic species, shall restrict the introduction of exotic species into any natural ecosystem of the United States.

(c) Executive agencies shall, to the extent permitted by law, restrict the use of Federal funds, programs, or authorities used to export native species for the purpose of introducing such species into ecosystems outside the United States where they do not naturally occur.

(d) This Order does not apply to the introduction of any exotic species, or the export of any native species, if the Secretary of Agriculture or the Secretary of Interior finds that such introduction or exportation will not have an adverse effect on natural ecosystems.

Section 3.

The Secretary of Interior, in consultation with the Secretary of Agriculture and the heads of other appropriate agencies, shall develop and implement, by rule or regulation, a system to standardize and simplify the requirements, procedures and other activities appropriate for implementing the provisions of this Order. The Secretary of the Interior shall ensure that such rules or regulations are in accord with the performance by other agencies of those functions vested by law, including this Order, in such agencies.

(signed by the President)

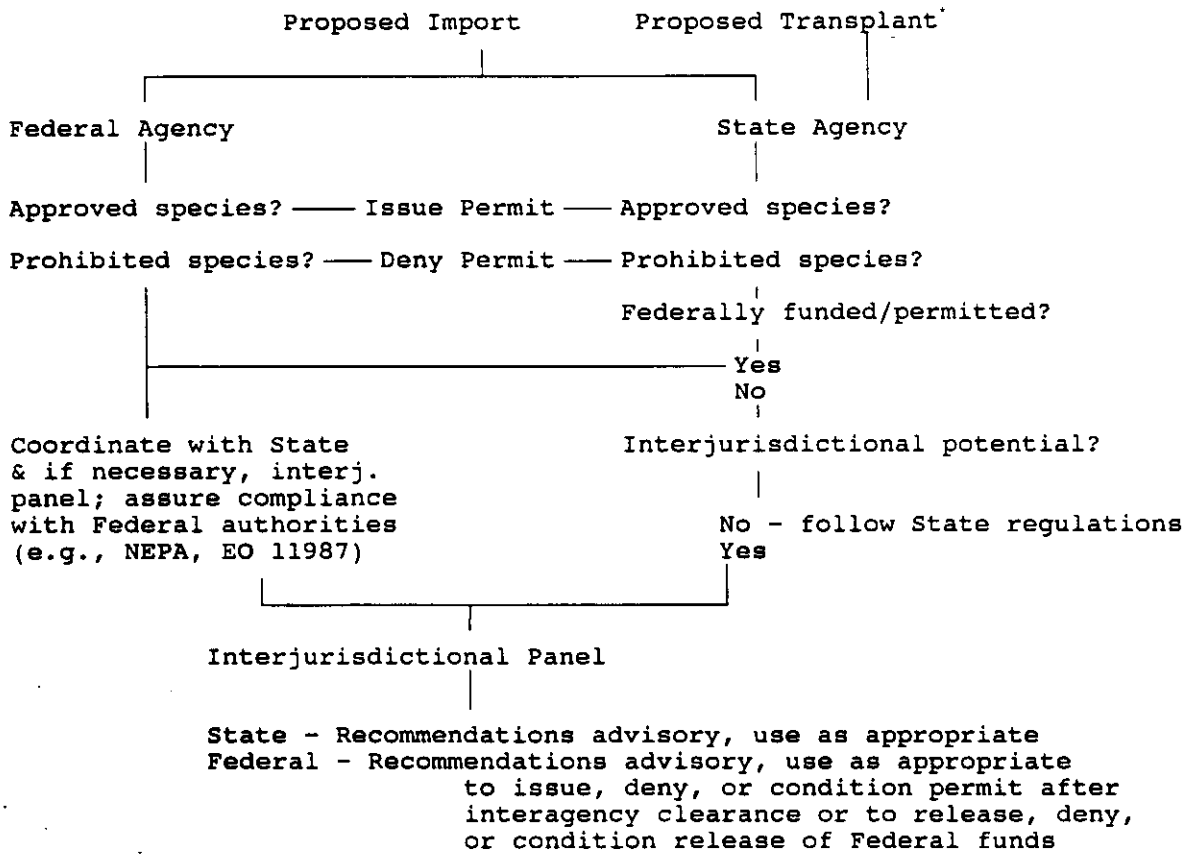
THE WHITE HOUSE,
May 24, 1977

[FR Doc.77-14120 Filed 5-24-77; 1:41 pm]

FEDERAL REGISTER, VOL. 42, NO. 101 -- WEDNESDAY, MAY 25, 1977

APPENDIX F

Flow chart of decision-making process under proposed permitting and interjurisdictional panel recommendations



**The term "transplant" is used here to mean transfers of nonindigenous species within the United States - e.g., moving walleye from Minnesota to an ecosystem in California where there are not already established.*

INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA (ICES) CODE OF PRACTICE TO REDUCE THE RISKS OF ADVERSE EFFECTS ARISING FROM INTRODUCTIONS AND TRANSFERS OF MARINE SPECIES (Revised 1990)*

I. Recommended procedure for all species prior to reaching a decision regarding new introductions. (A recommended procedure for introduced or transferred species which are part of current commercial practice is given in Section IV).

(a) Member countries contemplating any new introduction should be requested to present the Council at an early stage information on the species, stage in the life cycle, area of origin, proposed plan of introduction and objectives, with such information on its habitat, epifauna, associated organisms, potential competition to species in the new environment, etc., as is available. The Council should then consider the possible outcome of the introduction, and offer advice on the acceptability of the choice.

(b) Appropriate authorities of the importing country (including fishery management authorities) should examine each "candidate for admission" in its natural environment, to assess the justification for the introduction, its relationship with other members of the ecosystem, and the role played by parasites and diseases.

(c) The probable effects of an introduced species in the new area should be assessed carefully, including examination of the effects of any previous introduction of this or similar species in other areas.

(d) Results of (b) and (c) should be communicated to the Council for evaluation and comment.

II. If the decision is taken to proceed with the introduction, the following action is recommended:

(a) A brood stock should be established in a quarantine situation approved by the country of receipt, in sufficient time to allow adequate evaluation of its health status.

The first generation progeny of the introduced species can be transplanted to the natural environment if no diseases or parasites become evident in the F_1 progeny, but not the original import. In the case of fish, brood

stock should be developed from stocks imported as eggs or juveniles, to allow sufficient time for observation in quarantine.

(b) The F_1 progeny should be placed on a limited scale into open waters to assess ecological interactions with native species.

0 (c) All effluents from hatcheries or establishments used for quarantine purposes in recipient countries should be sterilized in an approved manner (which should include the killing of all living organisms present in the effluents).

(d) A continuing study should be made of the introduced species in its new environment, and progress reports submitted to ICES.

II. Regulatory agencies of all member countries are encouraged to use the strongest possible measures to prevent unauthorized or unapproved introductions.

III. Recommended procedures for introduced or transferred species which are part of current commercial practice:

(a) Periodic inspection (including microscopic examination) by the receiving country of material prior to mass transplantation to confirm freedom from introducible pests and diseases. If inspection reveals any undesirable development, importation must be immediately discontinued. Findings and remedial actions should be reported to ICES.

(b) Inspection and control of each consignment on arrival.

(c) Quarantining or disinfection whenever possible and where appropriate.

(d) Establishment of brood stock certified free of specific pathogens.

V. It is appreciated that countries will have different attitudes toward the selection of the place of inspection and control of the consignments, either in the country of origin or in the country of receipt.

DEFINITIONS

(For application of this code, the following definitions should be used.)

Marine species: Any aquatic species that does not spend its entire life cycle in freshwater.

Introduced species: (= nonindigenous species, = exotic species) Any species intentionally or accidentally transported and released by humans into an environment outside its present range.

DEFINITIONS CONTINUED

Transferred species: (= transplanted species) Any species intentionally or accidentally transported and released within its present range.

Quarantined species: Any species held in a confined or enclosed system that is designed to prevent any possibility of the release of the species, or any of its diseases or any other associated organisms into the environment.

County of origin: The country where the species is native.

Exporting country: The country from which a specific consignment of a species (regardless of its native region) is received.

Brood stock: Specimens of a species, either as eggs, juveniles, or adults, from which a first or subsequent generation may be produced for possible introduction to the environment.

Disease: For the purposes of the Code, "disease" is understood to mean all organisms, including parasites, that cause disease. (A list of prescribed disease agents, parasites, and other harmful agents is made for each introduced or transferred species in order that adequate methods for inspection are available. The discovery of other agents, etc., during such inspection should always be recorded and reported.)

Current commercial practice: Established and ongoing cultivation, rearing, or placement of an introduced or transferred species in the environment for economic or recreational purposes, which has been ongoing for a number of years.

Established species: Species with existing reproductive populations.

Maintained species: Species which are reproducing in aquaculture for several generations without artificial spawning.

NOTE:

(a) It is understood that an introduced species is what is also referred to herein as an introduction; a transferred species as a transfer; and a quarantined species as a species in quarantine.

(b) Introduced and transferred species, as defined above, include those species subject to the ICES Code of Practice, parts I to III, and IV, respectively.

(c) Introduced species are understood to include exotic species, while transferred species include exotic individuals or populations of a species. It is, thus, understood that the general term "exotic" can include both introduced and transferred species.

(d) It is understood for the purpose of the Code that introduced and transferred species may have the same potential to carry and transmit disease or any other associated organisms into a new locality where the disease or associated organism does not presently occur.

---

*For further details see ICES (1984).

POSITION OF THE AMERICAN FISHERIES SOCIETY ON INTRODUCED AQUATIC SPECIES*

1. Encourage fish importers, farmers, dealers, and hobbyists to prevent and discourage the accidental or purposeful introduction of aquatic species into their local ecosystems.

2. Urge that no city, county, state, province, or federal agency introduce, or allow to be introduced, any species into any waters within its jurisdiction which might contaminate any waters outside its jurisdiction without official sanction of the exposed jurisdiction.

3. Urge that only ornamental aquarium fish dealers be permitted to import such fishes for sale or distribution to hobbyists. The "dealer" would be defined as a firm or person whose income derives from live ornamental aquarium fishes.

4. Urge that the importation of fishes for purposes of research not involving introduction into a natural ecosystem, or for display in public aquaria by individuals or organizations, be made under agreement with responsible government agencies. Such importers will be subject to investigatory procedures currently existing and/or to be developed, and species so imported shall be kept under condition preventing escape or accidental introduction. Aquarium hobbyists should be encouraged to import rare ornamental fishes through such importers. No fishes shall be released into any natural ecosystem upon termination of research or display.

5. Urge that all species considered for release be prohibited and considered undesirable for any purposes of introduction into any ecosystem unless that species shall have been evaluated upon the following basis and found to be desirable:

   (a) Rationale: Reasons for seeking an import should be clearly stated and demonstrated. It should be clearly noted what qualities are sought that would make the import more desirable than native forms.

   (b) Search: Within the qualifications set forth under "Rationale," a search of possible contenders should be made, with a list prepared of those that appear most likely to succeed, and the favorable and unfavorable aspects of each species noted.

(c) Preliminary Assessment of the Impact: This should go beyond the area of rationale to consider impact on target aquatic ecosystems, general effect on game and food fishes or waterfowl, on aquatic plants and public health. The published information on the species should be reviewed and the species should be studied in preliminary fashion in its biotope.

(d) Publicity and Review: The subject should be entirely open and expert advice should be sought. It is at this point that thoroughness is in order. No importation is so urgent that it should not be subject to careful evaluation.

(e) Experimental Research: If a prospective import passes the first four steps, a research program should be initiated by an appropriate agency or organization to test the import in confined waters (experimental ponds, etc.).

(f) Evaluation or Recommendation: Again publicity is in order and complete reports should be circulated among interested scientists and presented for publication.

(g) Introduction: With favorable evaluation, the release should be effected and monitored, with results published or circulated.

Because animals do not respect political boundaries, it would seem that an international, national, and regional agency should be involved at the start and have the veto power at the end. Under this procedure there is no doubt that fewer introductions would be accomplished, but quality and not quantity is desired and many mistakes might be avoided.

---

*For further details see Kohler & Courtenay (1986).

PROTOCOL FOR EVALUATING RESEARCH PROPOSALS CONCERNING NONINDIGENOUS AQUATIC SPECIES

The Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 requires that an intergovernmental Aquatic Nuisance Species Task Force develop and follow a protocol to ensure that research carried out under Subtitle C of the Act does not result in the introduction or dispersal of nonindigenous aquatic nuisance species to the waters of the United States. This protocol fulfills the requirements of the Act and will supplement other existing federal protocols established to control activities with specific major classes of organisms, such as those already established for research on nonindigenous plants and insects or involving recombinant DNA molecules. The Task Force established a Research Protocol Committee composed of representatives from the Federal agencies on the Task Force. The purpose of the Committee is to review all proposals submitted to it and make recommendations to the agencies funding the research concerning the adequacy of the methods incorporated in the proposal to prevent the escape or release of the species.

This protocol must be used when research is carried out under Subtitle C of the Act. Individuals, States, corporations, and institutions not otherwise covered by this research protocol are encouraged to follow the protocol to prevent introductions of nonindigenous aquatic nuisance species through research activities.

The research protocol consists of two parts: a risk assessment and a set of guidelines outlining required preventative containment and confinement procedures. The risk assessment requires the Principal Investigator and the research institution to evaluate the risk that the species, if it escapes or is released, will be a nuisance, and to determine if preventative measures must be taken to prevent the species from escaping or being released. Research may be conducted with minimal special preventative measures if: 1) the research site is within the present established or historic range of the species, 2) the species is free of nonindigenous diseases, parasites, or other extraneous viable material, 3) the species is not likely to be a nuisance if released, and 4) the species cannot survive in the waters adjacent to the research location, or 5) only nonviable forms are used, or 6) the research does not involve actual handling or transfer of the species (e.g., computer modelling and in situ data collection). The evaluation of the proposal by the risk assessment will determine if preventative measures must be taken.

The second part of the protocol is a detailed set of preventative containment and confinement measures that the Principal Investigator may be required to follow to prevent escape or release of any research species that fails to meet one or more of the conditions listed above. If directed by the risk assessment to do so, the Principal Investigator must take preventative measures that will contain or confine the species to the research facility. The protocol contains a list of some of the existing guidelines and protocols that may be used as guides by investigators to identify the types of

precautions that can be taken to prevent releases of organisms used in research. The specific precautions needed (which include procedural and facility design and use elements) will depend on the species to be studied, its life stage and size (e.g., macroscopic and/or microscopic, and size range within each), the scope of the project, the characteristics of the research site with regard to the species' critical environmental factors, and the potential of the species to survive in that locale and to be a nuisance. If the species is a disease-causing organism or a parasite, or the species or the source of the species under consideration is not free of nonindigenous diseases or parasites, extra precautions may be necessary. Most of the guidelines listed require that test species be contained or confined by some combination of physical, biological, chemical, and/or environmental barriers, or by limiting the scope of the research. The number and types of barriers needed depends on the species and the potential problems the species could create if it escapes or is released from the research site. It is recommended, if at all possible, that research on nonindigenous species be conducted in an area where the species is already established.

The Protocol also contains the process that must be followed to have the proposals evaluated by the Protocol Committee. Completed risk assessments must be submitted in narrative form to the funding agency along with a full description, if needed, of the preventative measures. The reasoning behind each answer to the risk assessment must be stated. The funding agencies will provide the technical and programmatic review; determine if the proposals are complete and which proposals will be funded; and send the proposals to the Protocol Committee for its review and recommendations. Some species-specific protocols may be developed for a few high profile, high risk species, such as the zebra mussel. If these protocols are approved by the Protocol Committee, they can be used without modification thus avoiding the need to develop individual protocols.

The risk assessment will ask for answers to the following questions. Failure to adequately answer a question could delay funding or result in the recommendation by the Protocol Committee that the proposal not be funded.

Does the research concern a nonindigenous aquatic species as defined by the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990?

Does the species carry any known nonindigenous diseases, parasites, or any other nonindigenous species or viable biological material?

Do or could transportation waters, media, sediments, or sampling equipment carry any nonindigenous diseases, parasites, or other viable material (extraneous organisms)?

Will live, viable, or fresh specimens be required?

Will the species be transferred away from the site where collected?

Will the species be transported through areas that are free of the infestation?

Is the species under investigation presently established within one mile of any facility that will receive live nonindigenous species or other nonpreserved field material that may be contaminated with a nonindigenous species?

Can the species survive in the surrounding waters?

Can the species be a nuisance if released?

Have you previously been approved for research with this species at your present location using the same facilities?

If the proposal has reached this point in the risk assessment, a preventative containment/confinement plan must be developed, and described in detail, that will ensure that the species or any disease or parasite it might carry cannot escape or be released into the surrounding waters. The preventative plan should use a combination of physical, biological, environmental, and/or chemical barriers to contain or confine all life stages of the organism. Reducing the scope of the research should also increase the safety of the research.

Compliance with the approved proposal and preventative plan can be ensured by inspection of the research and the facilities at any time by the research institution, funding agency, Protocol Committee, or the appropriate State authorities. All research proposals should be reviewed and approved by all appropriate State and local authorities before the proposal is submitted to the funding agency. Failure to comply with the proposal or preventative plan or the escape or release of the nonindigenous species could result in the suspension of research funding by the funding agency.

The major responsibility for compliance with the Research Protocol falls to the Principal Investigator and the research institution.

A copy of the Research Protocol may be obtained from the ANS Task Force Coordinator, U.S. Fish and Wildlife Service (820 ARLSQ), U.S. Department of Interior, 1849 C Street NW, Washington, DC, 20240.

APPENDIX H

Recommended components of Model State Code

- Adequate State authority to:
  - regulate importation, transportation, possession, and introduction of aquatic species (Note: This should not be limited to finfish and should include aquarium species though they needn't necessarily be given the same subsequent scrutiny as open releases.)
  - establish such "lists" as are needed (e.g., approved, restricted, and/or prohibited species lists)
  - require permits for regulated actions

- Above authorities should be applicable to interstate and intrastate transfers and to both State and private waters.

- Some form of evaluation of the potential environmental impacts of the introduction should be required with permit applications. At a minimum, evaluations should include analyses of:
  - longterm potential effects on native species and ecosystems
  - purpose and need for the introduction
  - potential for use of native species to meet same purposes
  - review of information on pathogen status of proposed introduction

- Required approval of (or at least consultation with) all potentially affected jurisdictions.

- Opportunity for public involvement prior to final approval.

- Some form of clause(s) protective of stock-to-stock genetic integrity.

- Containment and siting requirements for introductions into facilities (e.g., hatcheries, production ponds, holding facilities) adequate to prevent accidental release into open ecosystems. (Note: This need not include small "facilities" such as individual aquaria and live seafood displays.)

- Introducer responsibility (including public agencies) for "escapee" control or eradication in the event of demonstrated or anticipated negative impacts. (Note: Many different mechanisms were suggested to implement this approach -- e.g., required payments into some form of aquatic nuisance "superfund," liability laws, insurance programs, dedicated user fees and fines, required contingency plans with permit applications.)

- Monitoring and review programs (e.g., as described for aquatic plants in Florida -- see "Lessons from the States" section).

- If supported by Federal incentive funds, link to:
  - required information sharing on changes in State laws and lists
  - required notification of escapes and unanticipated dispersal
  - recommended coordination and sharing of educational materials