NEWSLETTER

of the Introduced Fish Section
American Fisheries Society

April 1989 Paul L. Shafland, Editor Volume 9, Number 2

NEWSLETTER CONTENTS

MESSAGE FROM THE PRESIDENT

I am one of a growing number of fisheries biologists who are starting to call themselves, at times, conservation biologists. This is partly to take advantage of a sexy new buzz word that characterizes many of the things we have been doing all along, such as managing native fishes. More importantly, the name change reflects an increasing concern for all aquatic biota and aquatic habitats, not just those of immediate economic importance. My interest in introduced species stems in good part from my interest in "conservation biology", which translates in my case to an interest in maintaining the diversity of aquatic organisms in California in the face of rapid declines of species. Introduced species are just one of many factors causing declines in the native fishes but they often act in synergism with other factors such as impoundments or pollution. They may be the final straw that drives a depleted fish species to extinction.

There is also the growing realization that fishes are often major regulators of aquatic ecosystems through predation, competition, or even energy transfer. Thus an introduced fish species may alter its new habitat in many unexpected ways, such as causing obscure species of invertebrates to disappear or reducing the growth and survival rates of favored native fishes. These subtle, complicated, and often long-term effects of introductions are often ignored when new introductions are proposed because the immediate effect of an introduction is to increase local biodiversity in a way apparently favorable to human interests.

For example, one of the oldest lakes in North America (100,000+yr) is Clear Lake, California, which had 12 native fish species. Today the fauna consists of 23 species, including seven of the original natives. The 16 introduced species are abundant in many places besides Clear Lake, but two of native species are globally extinct. Thus Clear Lake has a much richer fish fauna (at least temporarily) but the world has lost two species.

The point of this essay is to encourage IFS members to take a global perspective on the effects of introductions being made in their back yards. The world will be a much less interesting place if every lake or every stream contains the same fish fauna!

FROM THE EDITOR

While the pursuit of absolute objectivity is admirable, a better understanding of the existing biasnesses within our profession may be necessary before some important advancements are made. Ultimately, we may even discover ourselves to be just as biased and unobjective as we clearly know everyone who disagrees with us is! Perspectives that can sometimes become blinding biasnesses include, in no particular order, those originating in the following special interest groups: commercial, sport and subsistence fishermen, taxonomists, puristic preservationists, academics, local, state and federal resource managers, flood control agencies and the Army Corps of Engineers. If you do not think biasness plays a major role in fisheries management just try to imagine being asked to develop a comprehensive aquatic resource management plan that <u>had</u> to be wholeheartedly endorsed by all of these interest groups.

This Newsletter contains several articles that do not deal directly with aquatic organisms. The purpose of these is to help develop some seemingly obvious generalities (= my personal biasnesses?) that, if true, may be useful in understanding some of the conflicting 'scientific' reports that exist concerning introduced species. These generalities or PBI's (= partially baked ideas) are: 1. Good fisheries science is not always based in unbiased objectivity or actions that produce a single, definitive and non-debatable conclusion. 2. Principles of terrestrial ecology are often assumed to be directly applicable to aquatic ecosystems. It seems possible that this assumption may be inappropriate or even counterproductive in some situations. 3. One's use of fishes is neither always superior nor inferior to the sometimes conflicting uses espoused by other user groups (is a fish pickled for science more wisely used than one eaten by a hungry subsistence fisherman or caught by a wealthy sportfishermen?). 4. The effects of introduced species are both habitat specific and species specific (i.e., the effects of an introduced species in one situation may not resemble its effect in another). And 5. Exotic, introduced, and transplanted are terms that describe a physical <u>not</u> biological characteristic of a species (= their physical displacement by man). Unfortunately, these terms are commonly misused and many people now believe they refer to specific and generally detrimental biological attributes. As a result some scientists believe the only good exotic is a dead one. Partially because of these five PBI's, it would seem that the effects of introduced species are generally difficult if

not impossible to summarily assess; so beware of non-critical extrapolations of limited data sets, no matter how intuitively attractive they first appear.

One new (to me) idea that seems worth thinking about is given in the article 'How Safe Is Safe' by Waterstone and Lord. They write "Experts may be well-qualified to identify the hazards which can cause damages, to estimate the likelihood of loss, and to describe options for managing resultant risk. But are they well-qualified to make trade-offs which are required (since risk reduction is never free), to determine how much risk is acceptable to others, and what risk management measures are most desirable? ... in fact each profession [professional] holds its [their] own set of values which are often not those of the public it [they] serves" [brackets added by editor]. This suggests professionals should avoid considering themselves as judge and jury. Instead we should concentrate on being expert investigators who develop a factual knowledge base upon which society as a whole can make its decisions.

Hopefully, as you read through this issue, you will also obtain some new insights into introduced species risk analysis and management philosophies. By better understanding our limitations and biasnesses, we can continue moving towards more practical assessments of introduced species.

AQUARIUM FISHES COMMITTEE FORMED

An Aquarium Fishes Committee is being formed within the Introduced Fish Section. This committee's existence is primarily the result of a cooperative effort between Herbert Axelrod who had the idea, Carl Sullivan and the IFS Executive Committee. Herb has agreed to chair this committee through its formative stages. Recently he wrote:

> "The main objectives that I would have for the Aquarium Fishes Committee is to define problems which exist between the tropical fish world and the governmental institutions which regulate them, and to establish an American body which could interface with other bodies in other countries. Specifically, Australia is convulsing with laws protecting their environment from aquarium fishes. We have no official body that can supply either the government or the hobbyists and dealers over there with "official" opinions.
>
> "The final objective I would stress for the Aquarium Fishes Committee is the initiation of rules and regulations that we suggest for the aquarium industry. For example, we have a problem in that most of the drugs recommended for fish disease treatment are also prescription drugs and cannot easily be obtained. Further, standardization of scientific and common names of imported aquarium fishes is a problem which should be dealt with. A further longtime ambition would be to license tropical fish dealers to insure that they know something about the fishes that they sell in terms of their temperment, as well as a basic knowledge of fish diseases and the treatment thereof."

Other committee objectives, the list of which seems almost endless, include: 1. Establishing a forum for constructive exchange of ideas, problems and solutions among fishery scientists and professional importers, exporters, collectors, wholesalers, aquarists and farmers of aquarium fishes. Everyone concerned should benefit from the exchange of life history, ecological and behavioral observations made by these generally non-overlapping professionals. 2. Provide an interface between the airline and aquarium fish industries at the national level. And 3. To solicit and educate members of the various professional fisheries interests as to the benefits and risks associated with this very important industry.

A recent letter to Herb Axelrod from Carl Sullivan illustrates Carl's attitude towards this project: "I'm enthused by the progress that you and Paul Shafland have made in preparing for a campaign to attract aquarium and ornamental fish enthusiasts to membership in AFS. To date, AFS has no ornamental fish dimensions despite the size and importance of the aquarium industry. Under your leadership we can add that dimension, so I wish you success and offer my complete cooperation."

I concur with Carl in the belief that this committee can and will be a dynamic addition to IFS, as well as, AFS as a whole. Anyone interested in this activity can contact Herb at T.F.H. Publications, Inc., One TFH Plaza, Neptune City, New Jersey 07753, and stay tuned to your Newsletter for future developments.

INDUSTRY CONCERNED ABOUT THE SPREAD OF DISEASES

The entire aquatic industry could face "dramatic consequences" unless importers and dealers follow strict hygiene practices, according to Ornamental Fish International (OFI).

In the wake of last year's outbreak of the deadly fish disease spring viraemia of carp (SVC), which saw whole fish stocks slaughtered on the orders of the British Ministry of Agriculture, OFI says it's vital to keep the industry clean.

"If we do not, disaster could strike very soon with dramatic consequences for every sector of the industry," said OFI in a recent statement to members.

Fears following the SVC outbreak led to a call by OFI members who had lost fish stocks for a conference to study the SVC issue and prevent a further outbreak of the disease in the coming season. Causing particular concern is the increasing overlap between the coarse and ornamental industries, a dangerous link capable of transferring disease from one market to the other.

Most of the companies who had their stocks destroyed last year were dealing with coarse fish and ornamentals on the same premises. OFI says that any ornamental fish dealer who also handles coarse fish must take extreme care and must not overlook import license restrictions on such fish as tench and Wells catfish.

OFI also warned: "If you buy U.K. bred fish be sure that your source is genuine and clean. You could be the victim of another person's problem. When SVC is discovered, the Ministry traces both where the fish have come from and to where they have been sold. All premises in that chain are at risk."

In Britain the Ministry of Agriculture is responsible for the protection of natural stocks of fish in inland waterways. On sites where SVC is found there is no alternative but to destroy ornamentals.

OFI has had a number of meetings with the Ministry to discuss the ornamental fish industry and its future development. It is reported that more ornamental fish operators are joining OFI to add strength to the discussions.

"The outbreak of SVC last spring has made everyone very much aware of the fragility of the ornamental fish industry, particularly those who suffered immense emotional and financial pain in having their entire fish stock slaughtered by the Ministry," said OFI.

--R. Kemp. 1989. Report from England:
SVC Update. Pet Business 15(4):26 April

NEW YORK'S "NEW" BROWN TROUT

The state of New York is experimenting with stocking a lacustrine strain of brown trout (Salmo trutta) called the Seeforellen. This fish is native to Germany, Austria and Switzerland. The overall goal of stocking the Seeforellen is to improve sport fishing in the state. This strain has been shown in Europe to exhibit a larger size and greater longevity (i.e. 40-50 lbs and 10-12 years). The state will be stocking yearlings into 8-9 natural water bodies this year.

--Information provided by Dawn Jennings,
USFWS, with permission of Robert Brandt
N.Y. Dept. Envir. Conserv. (914) 255-5453

GRASS CARP CORRECTION AND PROPOSAL

Bill Fritz (Illinois Department of Conservation) writes: "Thanks for the Introduced Fish Section Newsletter. A clarification, Pool 24 is about 128 miles above St. Louis [i.e., bighead carp have been collected 128 miles north of St. Louis, not 28 miles north as reported in last IFS Newsletter]. If you contact Gordan Farabee (314-769-3528), Missouri DOC, he can tell you about grass carp fry being found in the Missouri River.

"Although I may sound like an alarmist, I'm still deeply concerned about the stocking of any grass carp other than triploids. If the diploid grass carp ever reproduce and populate the Mississippi River above Pool 19, the ecology of the river will be radically modified. I would certainly like to see the Introduced Fish Section take the lead role in encouraging all States to allow

the production and stocking of triploid grass carp only. I fully support your comments that we need to thoroughly evaluate the various non-indigenous species before they are ever released in our waters. The axiom 'Better Safe Than Sorry' should be the rule concerning introductions."

Editor's Note: Anyone interested in taking the lead role in the development of a Section position statement that would encourage states choosing to use grass carp to use only the triploid? This sounds like a good idea to me.

RECOMMENDATIONS TO PRESIDENT BUSH CONCERNING INTRODUCED AQUATIC ORGANISMS

The AFS Parent Society participated in preparation of the "Blueprint for the Environment," a report calling on President Bush to act on many issues of concern to conservation groups. Included in this report was the following statement on introduced aquatic organisms that was prepared by Lynn Starnes (USFWS).

BLUEPRINT FOR THE ENVIRONMENT

KEYWORDS: Introduced aquatic organisms, exotic fish, introduction protocols.

DEPARTMENT: Interior

ASSISTANT SECRETARY: Fish and Wildlife and Parks

AGENCY/BUREAU: U.S. Fish and Wildlife Service

OFFICE ADMINISTERING PROGRAM: Division of Fish and Wildlife Management Assistance.

PROGRAM: [x] Existing or Former Program (Injurious Wildlife)
[x] Proposed New Program (Introduced Aquatic Organisms)

DESCRIPTION OF ENVIRONMENTAL GOAL: Develop and implement strategies and procedures for reducing risks associated with introductions of aquatic organisms.

SUMMARY OF RECOMMENDED ACTION:

Based on existing and/or new statutory authorities, develop and implement effective strategies and programs that will ensure systematic biological evaluation of the desirability and feasibility of potential aquatic organism introductions. Any such initiative should focus on new introductions of exotic organisms--both intentional and accidental--from outside the United States as well as native species transplanted outside their natural or historic range. Every effort should be made to allow, even encourage, the States to assume the principal responsibility for achieving this goal; the Federal role should be limited to ensuring that consistent and effective policies and procedures are adopted and implemented in a timely fashion.

Introduction of fish and other aquatic organisms into North American waters is a longstanding practice. Beginning three centuries ago and continuing sporadically into this century, the introduction of exotic fish accelerated substantially after World War II and peaked in the early 1960s. Currently, more than 100 exotic fish species are known to occur in the United States, including at least 41 which have become established. Pressure to introduce additional species continues to build and could be even more difficult to deal with in the future. Effective action to address this problem is overdue.

While professional involvement with the introduction of fish and other aquatic organisms is longstanding, this practice has only been a concern of fishery and other resource managers for the past several decades. However, the potential benefits of introducing additional species still tend to overshadow often general and seemly speculative concerns about the immediate, long-term, and cumulative impacts of such introductions.

The time is opportune to reassess this policy issue. As documented evidence has been marshalled over the past two decades, greater attention has been devoted to the issue and voices continue to be added to the chorus of resource professionals urging that the issue be addressed. Given this enhanced awareness, several recent introductions such as the grass carp, proposals to introduce additional species such as the zander and rudd, and unintentional introductions such as the river ruffe have once again focused attention on this issue. A consensus is growing among resource professionals that the improper introduction of aquatic organisms is a real and urgent problem. As a consequence, several governmental entities, including Canada's Department of Fisheries and Oceans, the North Atlantic Salmon Conservation Organization, and the Great Lakes Fishery Commission have begun to take concrete steps to address this problem.

BUDGET RECOMMENTION:

F.Y. 89: increase of $200,000 F.Y. 90: increase of $800,000

BUDGET HISTORY (in millions of dollars by fiscal year):

	79	81	83	85	87	88	89
Authorized	-- Such sums as may be necessary ----------						
Requested	0.1	0.1	0.1	0.1	0.5	0.6	0.8
Appropriated	0.1	0.1	0.3	0.4	0.5	0.6	0.8

MANPOWER HISTORY (in F.T.E.'s by fiscal year):

	79	81	83	85	87	88	89
Authorized	-- As necessary ----------						
Actual	2	3	6	10	10	10	12

PRINCIPAL AUTHORIZING LEGISLATION (Expiration Date):
Fish and Wildlife Act of 1956 (16 U.S.C. 742a-742j); Fish and Wildlife Coordination Act (16 U.S.C. 661.661C); Lacey Act (18 U.S.C. 42)

CONGRESSIONAL JURISDICTION:
House Authorizing Committee/Subcommittee: Merchant Marine and Fisheries/Fisheries and Wildlife Conservation and the Environment
Senate Authorizing Committee/Subcommittee: Environment and Public Works/Environmental Protection
House Appropriation Subcommittee: Interior and Related Agencies
Senate Appropriation Subcommittee: Interior and Related Agencies

RECENT RELEVANT GOVERNMENT STUDIES:
FWS Discussion Draft: Policies for Reducing Risks Associated with Introductions of Aquatic Organisms

RELATED FEDERAL PROGRAMS: Agricultural Products Inspection (APHIS)

PRINCIPAL SUPPORT GROUPS/SOURCES OF EXPERTISE: Gainesville Fisheries Center, American Fisheries Society-Introduced Fish Section, GLFC, NASCO

SUMMARY OF RECOMMENDED IMPLEMENTATION STEPS:

A. Convene national meeting to reach consensus on introduced species issues and problems and identify/evaluate strategies and actions to address them.

B. Seek additional statutory authorities and mandates, as necessary, to address issues and problems.

C. Establish Federal coordination and technical assistance capability.

D. Enhance/redirect State authorities and programs, as necessary, to implement national initiative.

GREAT LAKES EXOTIC SPECIES PREVENTION ACT

In the House of Representatives, March 20, 1989, Mr. Davis (for himself and Mr. Hertel) introduced the following bill (HR 1497); which was referred to the Committee on Merchant Marine and Fisheries.

A BILL--To direct the Secretary of Transportation to report on methods available to control the influx of exotic species into the Great Lakes. Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

Section 1. Short Title: This Act may be cited as the "Great Lakes Exotic Species Prevention Act".

Section 2. Findings: The Congress finds that (1) the Great Lakes and their native species are resources of national importance, with an annual recreational and commercial fishery of $2,000,000,000; (2) several exotic species, including the ruffe, zebra mussel, and the zooplankton Bythotrephes cederstroemi, have invaded the Great Lakes and disrupted the normal food chain and species diversity of the Great Lakes; and (3) these

exotic species were likely transported into the Great Lakes in the ballast water carried by ocean-going vessels to steady them on rough seas, but later discharged into the Great Lakes to allow transit of shallow channels.

Section 3. Study: Not later than six months after the date of enactment of this Act, the Secretary of Transportation shall submit to the Congress a report on the options available to control the infestation of the Great Lakes by exotic species from the ballast water of vessels discharging into the Great Lakes. In preparing this report, the Secretary shall consult the Secretary of the Interior, the Secretary of Commerce, the Great Lakes Fishery Commission, and other appropriate parties.

Section 4. Definition: For the purposes of this Act, "exotic species" means nonnative Great Lakes fish, mollusks, crustaceans, zoolplankton, and other aquatic organisms, other than sea lampreys.

COMMENT ON THE REGULATION OF AQUATIC ANIMAL TRANSPORTS

Ralph Elston, Ph.D
Center for Marine Disease Control
Battelle Marine Research Laboratory, 439 W. Sequim Bay Rd.
Sequim, WA 98382

Over the past several years of working with commercial aquaculturists, I have developed some perspectives on the subject of transportation of fish and shellfish as this activity pertains to posing a risk for spreading infectious diseases. I would like to share these ideas and perhaps stimulate a dialogue on the subject. I wish to recount some general views as shaped by my experiences in working with both industry and government on these issues.

I think we all agree that we need some level of control on the transport of fish and shellfish in order to prevent the damaging effects which infectious diseases can have on both husbanded and natural populations of aquatic animals when spread to uninfected populations. It is important to recognize that workable regulations can reduce, but never eliminate, the risks of such diseases. Ineffective regulatory control of infectious disease can result from either no regulation on the one hand or, on the other hand, from an attempt to eliminate the risk posed by infectious diseases by a too conservative and unrealistic approach to the problem of disease control. Overzealous regulation, without a substantial technical base and without recognition of the realities of animal transports, simply encourages individuals and companies to disregard the law. There is no practical way that animal transport regulations can be effective without voluntary and active support by the user groups.

I believe that the transportation of aquatic animals throughout the continent of North America or between North America and other continents is inevitable. Often the aquaculture industry is regarded as the primary practitioner of this activity. In fact, the transport of aquatic animals or their tissues, which may contain viable infectious agents, is practiced by several other

user groups. These include commodity distribution of harvested or husbanded fishery products, the movement of aquatic animals for research purposes and movement of fish and shellfish by the general public. I have often felt that the aquaculture industry has been unfairly targeted as the primary offender in irresponsible aquatic transports. As you all know, the most catastrophic damage which can result from the introduction of an infectious disease does not necessarily occur from the movement of large numbers of a single species. I have at some times been appalled by the cavalier attitude of some researchers and resource management biologists who somehow rationalize that animal transport regulations do not apply to them, even though serious damage could result from the movement of a small number of animals which carry non-indigenous pathogens. I suspect that a larger diversity of aquatic animals is moved by the research community than by the aquaculture industry. The control of the spread of infectious disease organisms through commodity distribution activities are not usually covered by the same, if any, regulations which pertain to aquaculture products. And, although regulations may forbid the movement of aquatic animals by the public, these regulations are difficult, if not impossible, to enforce.

If these are the problems, what can we do to reduce the risk of spreading infectious aquatic animal diseases? Education is a key area needing attention. We can target education to the aquaculture industry relatively easily. My view is that the industry will act responsible when it recognizes that disease control is in its own interest and that such education will encourage self enforcement efforts--the most effective means of enforcement of disease control regulations. I think that those of us in the fish health field are the most effective professionals to educate the industry through workshops, publications and taking the opportunity to speak on this subject where appropriate. As fish health professionals we should begin a dialogue on how to effectively extend this education to the general public and other user groups involved in commodity distribution.

I believe that we should strive toward enacting regulation which is based on substantial technical information rather than incomplete information. If we are going to forbid movement of a particular animal species when it carries a particular disease, it should be because this disease is truly exotic to certain areas. While it is not a good practice to move animals which are sick, I think from a regulatory point of view, we cannot reasonably attempt to control the movement of disease organisms from one enzootic area to another. Regulations should be formulated with a view toward protecting both natural resources and the aquatic animal husbandry industry. Finally, and perhaps most importantly, we need to devise ways to address all avenues of risk for the introduction of aquatic animal diseases, not just the most visible and easily targeted avenue of risk such as the aquaculture industry.

There are certainly some outstanding technical needs if we are going to effectively prevent the spread of infectious aquatic animals diseases. We need to develop complete regional inventories of diseases. This is not the most glamourous research problem nor, necessarily, the highest priority of fisheries management agencies, but a disease inventory is one of the key elements on which effective disease control is based. We cannot rationalize excluding a disease or species from a region if we do not know of its

presence or absence from that region and conversely, we cannot know the risk of moving an animal population if we do not have a good idea of the diseases it harbors. We also need information on the significance of a given disease for all of the life stages of fish or shellfish which it affects. As fish health professionals, we know there is a great variety of pathogens and parasites found on host animals. Obviously some of these are much more important than others in their effects on the host. If we can strive to be more quantitative regarding these effects, we can rank the diseases according to their importance and apply appropriate regulations to each disease depending on its importance. We can thus also prioritize the expenditure of our limited resources for fish health research.

Finally, as all of those in regulatory roles in government know, decisions must usually be made in the face of insufficient technical information. Even as we strive to shore up our technical information base, resource managers will be faced with this state of affairs. Thus, it is of utmost importance to recognize that one's philosophy toward animal transports will often determine the character of regulations and their implementations (as much or more so than supporting technical information). Therefore, it is incumbent on those of us in resource management to adopt a reasonable and workable philosophy on aquatic animal transports, recognizing the need for a stronger technical information base and for the education of all user groups, without unfairly targeting the aquaculture industry.

--AFS Fish Health Section's
Newsletter 1988. 16(4):7

HOW TO ACHIEVE HIGH FISH YIELDS IN TROPICAL LAKES AND RESERVOIRS

C.H. Fernando and J. Holcik

Fish yields in tropical lakes and reservoirs vary greatly. Some of these differences are due to trophic status and morphometry, low fishing pressure and latitude. Our studies, begun independently in Sri Lanka and Cuba, pointed to another important factor, fish composition. The presence of lacustrine adapted fishes meant high yields. Otherwise, low to very low yields were recorded.

Riverine and Lacustrine Fishes--We looked at the fish composition in tropical standing waters worldwide. Lacustrine fishes are restricted to the old lakes. However, even in recent lakes natural colonization of the pelagic zone may occur provided that their watersheds are inhabited by species preadapted for lacustrine conditions. Fishes especially successful in colonizing lacustrine conditions are recruited mostly from families of marine origin (clupeids) or from secondary freshwater fishes (cichlids).

Raising Fish Yields--The most effective and cheapest way to increase fish yields is by constructing a lacustrine fish fauna using high-producing herbivorous littoral and planktivorous species. During the past 35 years sustained increases in fish yields have resulted from the introduction of

African lacustrine fishes in Africa, Asia, Australasia [sic?] and South America. In some cases these increases have been spectacular.

Our theory is that lacustrine fishes are very unevenly distributed and localized largely in Africa. If the lacustrine environment is to be exploited adequately by fishes, then the appropriate lacustrine fishes must be present. Large and even spectacular increases in fish yields have been recorded in tropical areas when African lacustrine fishes have been introduced. These fishes include the highly productive shallow-water-inhabiting tilapias and pelagic clupeids (herrings).

The Rationale for Introduction and Cautions--Freshwater fish evolved independently on each continent. With regard to the tropics, only in Africa is there a lacustrine component of any magnitude. The presence of man-made lakes has created an extensive lacustrine environment throughout the world including the tropics. To obtain high yields of fish from the lacustrine environment, lacustrine fish are a prerequisite. These fish are available predominately, almost exclusively, in Africa and, secondarily, from lacustrine/marine fishes, mainly herrings.

It is generally accepted, with good reason, that transfers of living organisms transcontinentally must be done only with utmost care and for very weighty reasons. This principle must be borne in mind before any transfer of fish is undertaken. Also, experience has shown that the transfer of piscivorous fishes is contraindicated under almost any circumstance.

On the other hand, the transfer of herbivorous or omnivorous fishes has generally been beneficial and has raised fish yields spectacularly in some regions.

Perhaps we should consider this sort of introduction as a construction or reconstruction of a balanced fauna, rather than as a disruption of the fauna composition. To ban all introductions of alien species is hardly scientific. However, introduction of alien species carries serious risks and should be undertaken only for a greater good, both in the short and long term, and only after careful and objective assessment of previous introductions and local conditions.

--Excerpts: NAGA, THE ICLARM
Quarterly 11(4):8-9, 1988

A PERSPECTIVE ON INTRODUCED TILAPIAS IN INDONESIA AND THE PHILIPPINES

B.A. Coasta-Pierce, Sutandar Zainal and Pepen Effendi

During the 1960s tilapia aquaculture development in the Philippines and in Indonesia were quite parallel. Large populations had been established in such a short period of time through interbreeding. Stunting, rapid changes in body form and poor growth rates were inevitable. Market demand decreased as consumer preferences shifted to the more traditional and expanding

milkfish markets. From initial enthusiasm came charges of "environmental disaster" not only from the usual opportunists but also from reknown scientists. Much ridicule was heaped upon a number of scientists who, only 10 years before, had been hailed as visionaries.

Throughout the 1960s much hearsay, but little documented evidence, about the "environmental disaster" caused by the Java tilapia appeared. Stringent opposition to the spread of Java tilapia was led, to a large degree, by fisheries scientists from the developed countries.

As we look back upon these years of acrimony, debate, and transition from "old" to "new" tilapia breeds and technology seen today, one not-so-small consideration seemed to have been lost in our opinion. For the very poor in both Indonesia and the Philippines Oreochromis mossambicus has been and will always be a gift of immeasurable importance. No one will ever know the amount of suffering its introduction and spread have saved the poor people of Asia. To this day the much maligned fish is still an extremely important, low cost, and many times, "free" protein source for the poorest of the poor. In modern day Sri Lanka, Oreochromis mossambicus produces an average of 235 ± 160 kg/ha/year in 20 shallow reservoirs, accounting for 56 to 99% of the total fish yield, making the species the most important inland protein source for the poor people of that country.

In 1972 Mr. Domingo Tapiador imported to the Philippines Nile tilapia (O. niloticus) from Thailand. This and other importations of different varieties of Nile tilapia fueled an unprecedented boom in tilapia production in the Philippines. The Nile tilapia grew faster and had a greater consumer acceptance due to its higher flesh to bone ratio. Demand increased sharply until nearly all the tilapia growers and many of the milkfish growers in Laguna de Bay switched to Nile tilapia as prices soared.

By 1987 the Philippines was one of the largest tilapia producers in the world, producing over 50,000 t/year. Tilapia aquaculture production in the Philippines was higher than the aquaculture production of the entire African continent, original genetic home of all tilapia.

The situation in Indonesia developed quite differently. Although the Nile tilapia was imported to Java around the same time it went to the Philippines, strong market biases against any tilapia had been formed due to identical problems with genetic deterioration. In Java strong regional fish preferences for freshwater fish exist. The Sundanese in West Java prefer common carp. In East Java, Java carp (Puntius javanicus) is preferred. Fish preferences and biases became stronger with the deterioration of "Java" tilapia stocks. Biases did not allow market penetration for any new species, especially tilapia.

--Excerpts: 1988. ICLARM and South-South Technology Transfer: Philippine Aquaculture Technology and Indonesia -- Part I. NAGA, The ICLARM Quarterly 11(4):10-11.

MORE ON LAKE VICTORIA'S NILE PERCH QUESTION

The following is Section 5.1.6 "The Nile Perch Question": Summary and Conclusion from Reynolds, J.E. and D.F. Greboval. 1988. Socio-economic effects of the evolution of Nile perch fisheries in Lake Victoria: a review. CIFA Tech. Pap. 17:148p:

"Does Lates represent a boon or a bane for Lake Victoria and the people who rely on its fisheries?" This question does not lend itself to easy and unequivocal answer as the new fisheries are still in a transitional stage. Important elements of uncertainty in the situation make it difficult to predict exactly what the future holds in store.

The mission was concerned first and foremost with socio-economic or human welfare aspects of the "Nile Perch Question." In this connection, the information collected through observation and interviews during visits around the shoreline suggests that much of the alarm that has been expressed over the presence of Lates in Lake Victoria has simply been misplaced. For example, there are strong grounds to question the views of those authorities who insist that the fish has been an "economic tragedy" and is widely resented by fisherfolk and consumers. The mission found just the opposite to be the case.

From the time of their upsurge over a decade ago, the new fisheries for Nile perch have generated enormous socio-economic benefits. The value of fish production and fisheries-related employment have greatly increased for communities around the Lake, as has the supply of fish protein. Because of Nile perch, more people are eating more fish in more places than was ever the case under the old fishery regime.

This is not to deny that there are serious or potentially serious problems associated with the Lates fishery. The mission fully recognises these, and proposes further work to characterise and address them. There is cause for concern regarding issues of equity -- the distribution of opportunities for effective participation in the fishery and of advantages to be derived. At a more general level, the balance of interests between small-scale and industrial-scale enterprises is problematical.

Such an inventory of difficulties and bottlenecks must nevertheless be viewed in reference to the overriding advantages that have accrued as a result of Lates proliferation in Lake Victoria. On balance, Nile perch has proved a most invaluable fish in terms of human welfare considerations.

What of the other aspects to the "Nile Perch Question?" Alarms raised over the enormous loss of small cichlid species, with all its possibly grim implications for lacustrine ecology and evolutionary studies, cannot be casually dismissed. At the same time, some of the assumptions of the conservationist oriented arguments are very open to debate.

Much has been made of the productivity issue. Obviously in principle a fishery based on Nile perch and a few prey species would be far less productive than the former multispecific fishery because of energy loss

through conversion to predator biomass, as emphasised by Barel et al. (1985) and Coulter et al. (1986), for example. The argument does not stand up to the realities of Lake Victoria fisheries, however. Lower protein yield for human populations has not resulted from Nile perch introductions for the simple reason that haplochromines, which formerly made up most of the Lake's ichthyomass and became the chief prey for Lates, were not significantly exploited by fishermen. On the other hand, people are now eating lots of Nile perch.

The evolution of Nile perch into a resource base supporting a major and thriving industry was not anticipated by those who have been so outspoken in their opposition to the introduction of the species and alarmed about its presence in the Lake. As this report has shown, intensive fishing for Lates was well underway by the early 1980s -- not as a result of recommendations by scientific observers but as a result of local fisherfolk's adaptation to the new realities of their physical and socio-economic environments. Lack of knowledge about what was really happening on the Lake in recent years and a pre-occupation with "worst case" thinking have done much to fuel the controversy over Nile perch. It may be time now to lay such thinking to rest.

It is stressed again in conclusion that the mission regards the presence of Nile perch in the Victoria fisheries as an exceedingly positive development from a human welfare standpoint. Strong evidence exists to support this claim. The fish represents enormous food and cash resources to multitudes of people living around and even well beyond the lakeshore. Against these substantial community benefits must be weighed the apparent loss or serious decline of many endemic fish species, especially amongst the haplochromine cichlids. Whether such ecological disruption constitutes a "tragedy" in itself is a question that the mission cannot appropriately address. But it is surely possible to take conservation concerns into meaningful account as policy and management for the Lake Victoria fisheries are further developed. In terms of such future policy and management development too, the mission finds that additional and far more thorough pilot study work is urgently required on many of the socio-economic issues and problems that attend the Lates succession in the Lake.

A NEW PUBLICATION: ATLAS OF ALIEN AND TRANSLOCATED INDIGENOUS AQUATIC ANIMALS IN SOUTHERN AFRICA

I.J. DeMoor and M.N. Bruton

At least 33 species of introduced alien aquatic animals and 25 species of translocated indigenous species have frequently been recorded in natural waterbodies in southern Africa, and of these at least 29 alien species and 23 translocated indigenous species have established populations in natural or semi-natural aquatic habitats. Nine species (8 alien and one indigene) which were previously introduced into natural water bodies have failed to establish populations and most of these are now locally extinct. An additional 26 alien and 30 translocated indigenous species are suspected to have established populations in natural waterbodies but their status in southern

Africa is poorly known. At least 14 alien aquatic species which are currently in captivity in southern Africa could prove to be a nuisance if they escape. Seven alien species have established breeding populations in semi-captive situations but have not established populations in the wild although they have had the opportunity to do so.

All major southern African river systems are inhabited by alien animal species. Whereas freshwater environments have been invaded by 54 species, only 4 alien animal species have invaded the seas surrounding southern Africa, but more are likely to be found when research in this area intensifies.

Of the [introduced] animals which are frequently recorded in natural waters, 7 species can be regarded as pests, and a further 5 as nuisance animals. Twelve species have the potential to have a serious detrimental effect on the environment should their ranges be extended (either intentionally or unintentionally by man or as a result of the invasive abilities of the introduced animal), and a further 13 species have had an unknown but probably detrimental effect on the environment. A number of species (such as bass, trout and carp) are regarded as "equivocal" i.e., they may have a negative impact on the environment, but are valued by certain interest groups such as sport fishermen.

--Above excerpts from: de Moor, Irene J. and M.N. Bruton. 1988. Atlas of alien and translocated indigenous aquatic animals in southern Africa. South African National Scientific Programmes Report No. 144:310 pages. Copies available from Foundation for Research and Development, Council for Scientific and Industrial Research, P.O. Box 395, Pretoria, South Africa 0001.

Editor's Note: This well-illustrated, comprehensive and informative listing of introduced aquatic animals in southern Africa is an excellent reference for those interested in this topic. The major short-coming of this publication, as with many other similar publications, is the seemingly parochial treatment given to the impact assessments of introduced species. For example, there is too strong of a reliance on qualitative observations and modifiers such as 'probably', 'maybe' and 'potential'. Furthermore, references to impacts often include seemingly inconsistent statements, such as: Brown trout "has had a major detrimental impact on certain indigenous species particularly Oreodaimon quanthlambae in the Umkomazana River in Natal" (page 87) versus "Generally brown trout are not regarded as such a serious threat to indigenous species as some other introduced predators such as bass. It was also noted that there was considerable deterioration of the habitat during the first half of the century due to the denudation of the catchment resulting in an increase in the severity of floods after heavy rains. The degraded habitat as well as the presence of S. trutta probably both contributed to the disappearance of O. quanthlambae from the Umkomazana River (Jubb 1966a). Crass (1960) suggests that since O. quanthlambae and S. trutta co-existed in the Umkomanzana River for 20 years, the presence of trout could not have been an important factor leading to the local extinction of O. quanthlambae" (page 91). While I concur that we should error on the side of being cautious, the literature is so full of unsubstantiated claims

of major detrimental and even catastrophic effects that it is difficult, if not impossible to realistically assess the true effects of many introduced species from these accounts. The bottom line seems to be that we need less rhetoric and more quantitative data and analyses of these very important and complicated biotic and abiotic relationships.

HOW SAFE IS SAFE?

M. Waterstone and W.B. Lord

The Issue of Acceptable Risk. Decisions about acceptable risk levels are derived in a variety of ways. The standard project flood, for example, represents an accepted professional standard. The one in one million cancer risk level (frequently applied in setting water quality standards) is based upon accepted, but unexamined past practice. These decisions about acceptable risk and how to achieve it are made by a mix of scientists, engineers, other technical experts, and public policy makers. Experts may be well-qualified to identify the hazards which can cause damages, to estimate the likelihood of loss, and to describe options for managing resultant risk. But are they as well-qualified to make the trade-offs which are required (since risk reduction is never cost free), to determine how much risk is acceptable to others, and what risk management measures are most desirable? Such decisions involve value judgments as well as factual ones. Experts by definition possess certain specialized knowledge not available to most of us. Their values, however, may not represent our own, and in fact each profession holds its own set of values which are often not those of the public it serves.

Determining Acceptable Risk. Acceptable risk is a changeable concept. What it means for a risk to be acceptable depends largely upon the context in which the risk is being evaluated, who is evaluating the risk, and the criteria (including the perceptions, attitudes, and values) that are being used. What is an acceptable risk to an individual under one set of circumstances might be unacceptable under other conditions. Likewise, a risk that is acceptable to some would be seen as unacceptable to others. A further complication arises in most public resource decisions. In these cases, policymakers must define a societal level of acceptable risk rather than an individual level. This means that the values held by different segments of society must be weighed against each other by policymakers.

Implications. In areas of resource management, including water resources, most (perhaps all) decisions must be made under conditions of risk and uncertainty. In addition, in most situations policymakers (and the citizens they represent) do not have the choice of reducing risk to zero. Therefore, decisions must be based upon a notion of "acceptable" risk. The term "acceptable" is slippery, and immediately raises such questions as, to whom is the risk acceptable? Under what conditions is the risk acceptable?

Another set of issues involves the proper roles for experts and policymakers in the determination of acceptable risk. Clearly this process for determining risks requires the interaction of scientific analysts with public

policymakers. The scientific role is primarily one of providing information and placing the risk analysis in context. If trade-offs are to be made, policymakers must understand the nature of the risk and the costs and/or benefits of alternative courses of action. However, at least in a democracy, the final choice must be made by individuals (in appropriate cases) or by elected or appointed policymakers who are accountable to their constituents. This ultimate social choice cannot be made properly by experts.

It is possible to postulate several varied roles for government (and, consequently, for individuals) in determining acceptable risk levels. Is the role of government simply to provide individuals with enough information to allow them to make their own decisions? Or should governmental policymakers take a more protectionist position and actually intervene to reduce hazardous situations? Or should government's role lie somewhere between these positions? These policy orientations lead to fundamentally different views of risk management and of the requirements for communicating risk information.

The final set of issues pertains to the rationality of risk decision making. We scientists often proclaim that if only the public could be educated and informed, their perceptions of risk would more closely match our own. Very-high-probability events are overlooked, while the significance of very-low-probability events is exaggerated. Risk levels accepted in one context are not tolerated in other situations.

We seem quite willing to assume substantial risks if we assume them voluntarily, and if we have to bear the costs of reducing them ourselves. We seem quite unwilling to assume much smaller risks if they are imposed upon us involuntarily and if the benefits associated with the risky activities accrue to others. First, we all want to reduce our exposure to risk, and if someone else can be persuaded to pay for the reduction, we will find risk far less acceptable than if we must pay for its reduction ourselves. In this case, "safe" is very safe, indeed. Second, we will find reduction in levels of risk far more acceptable if we can shift the costs to others than if we must bear those costs ourselves. In this case, "safe" is not very safe at all. Setting a stringent standard of acceptable risk can mean spending more for risk reduction than society should pay. Setting a lenient standard may mean incurring losses greater than the costs of averting them. If we cannot impose the costs of managing risks upon those who would benefit from risk reduction, we may create incentives for individuals to act in ways which are undesirable for the group. The sum total of all of our actions to avoid or shift risk can carry a price tag far higher than we as taxpayers can or should accept.

One question that arises out of all this is: Are these really inconsistencies? As we have stated, risk assessments vary depending upon the context (i.e., the mix of perceived risks, benefits, and alternatives) in which the risk is presented, upon the perceived controllability (personal) of the risk, upon the magnitude of the likely adverse effects (small vs. catastrophic), and upon a whole host of other considerations. It is quite unlikely that analysis will be able to capture all of these components. What is clear, is that it is highly inappropriate to attribute these differential

assessments to irrationality. How safe is safe? What levels of risk are acceptable? These are complex and challenging questions for water managers, for others involved in the business of making public policy, and for each of us, who ultimately must bear the risks and the costs of avoiding those risks which we choose to avoid.

--Excerpts from National Forum
LXIX(1):22-25, Winter Issue,1989

ACTIVISTS BLOCK 'GENE THERAPY' TRIALS ON HUMANS

C. Joyce

Opponents of genetic engineering in the U.S. this week mounted a two-pronged attack to block the first approved test of gene therapy on humans. Jeremy Rifkin, author and professional activist against biotechnology, has filed a lawsuit in Washington DC to halt an experiment to insert tailored genes into people with terminal cancer.

The National Institutes of Health (NIH) recently approved the experiment, which took more than a year to prepare and underwent several preliminary reviews. Ironically, the extra precautions taken by the government's scientists, who anticipated controversy over the experiment, opened the door for the lawsuit. The trial is not technically "therapy", but consists of inserting a foreign gene as a marker for particular lymphocytes into cells from the patient.

On 29 July 1988, three scientists at the NIH proposed a plan to treat patients suffering from melanoma--a virulent form of skin cancer--using cells called tumour-infiltrating lymphocytes (TILs). The scientists proposed taking these cells of the immune system from patients, fortifying them in the laboratory with a substance found in white blood cells, called interleukin-2, and injecting them back into the donor, where they would attack tumours.

Before injecting the cells back into the patient, the scientists planned to infect the cells with part of a mouse retrovirus that carries a gene conferring resistance to neomycin, an antibiotic. The gene has no therapeutic value, explains Michael Blaese, who shares credit with French Anderson and Steven Rosenberg for devising the experiment. Instead, the gene will help doctors to track the TILs in the body. The team considered this to be a modest and safe first step toward real gene therapy and a test of their ability to splice a working gene into human cells.

Tests on animals subsequently proved that scientists could retrieve genetically labeled TILs from blood. As for safety, Blaese says: "It is a remote but finite possibility" that a gene inserted into a human cell could cause it to mutate and affect neighouring cells. His team has tried without success to induce mutations in tissue culture using the gene.

Blaese says that only those patients with less than three months to live can participate in the experiment. Rosenberg has shown already that therapy with

TILs that lack the foreign gene can reduce tumours in patients with melanoma, one of the most difficult forms of cancer to treat. Last month, the Recombinant DNA Advisory Committee (RAC) approved the test by mail and the NIH gave its final authorisation for the test to go ahead.

However, Andrew Kimbrell, a colleague of Rifkin, said: "We were denied a full hearing on the human gene therapy experiment." Kimbrell claims that the NIH changed the experiment after public review in October. Then the RAC approved it by mail. "Were they worried that some of these things made the proposition more controversial?" Kimbrell queried.

An official at the NIH suggested that Rifkin "hasn't got a leg to stand on" and claims that the final protocol of experiment is identical to the one reviewed in public. Rifkin, who has been working closely with the green parties in Europe, has demanded the creation of a supplementary panel to review gene therapy. He believes that if left to scientists, these experiments could lead to human engineering. One example cited by Kimbrell could be the engineering of workers to be resistant to pollutants that cause cancer.

--Excerpts from New Scientist
121(1650):22, 4 February 1989.

Editor's Note: Much of the debate surrounding genetically-modified organisms center on issues that are directly applicable to introduced organisms in general. For more on these issues see also the following two articles.

REPORT OF THE MEETING ON GENETICALLY DESIGNED ORGANISMS IN THE ENVIRONMENT

James Drake

Rapid advances in our scientific understanding of molecular genetics have recently made it possible to modify an organism's genome to alter specific functions. While humans have had the ability to modify organisms to better suit their needs for some time (e.g. plant breeding and animal husbandry) these new techniques offer the promise of more precise and rapid changes, as well as novel applications.

Because many proposals to release genetically-modified organisms (GMO's) are pending, and we have so little information about the behavior of such organisms in the environment, concern has been expressed about the introduction of such organisms. To this end, a joint meeting was organized by SCOPE (Scientific Committee on Problems of the Environment) and COGENE (Committee on Genetic Experimentation), both committees of the International Council of Scientific Unions. This meeting brought together an international group of ecologists and molecular biologists to evaluate the salient issues. The meeting broadly addressed the issues, but centered around several topics, including:

- population and evolutionary consequences of genetic engineering
- ecological application of genetic engineering tools
- epistatic and pleiotrophic effects of genetic manipulation
- stability of genetic systems
- constancy and invasibility in ecological and evolutionary time
- patterns of establishment, growth and spread
- risk assessment
- analysis and comparison of current national regulations

A product of the meeting was a joint SCOPE/COGENE communique that addresses the points mentioned above (see next article). The overwhelming consensus was that a genetically-modified organism poses no greater risk to the environment than the introduction of any other organism. This is not to say that such introductions are hazard free.

Indeed, many introduced organisms (e.g. the Mediterranean fruit fly in California, the gypsy moth in the northeast United States, the Nile perch in Lake Victoria) have directly impacted the environment, in some cases significantly. Conversely, over one thousand species of non-native insects have been introduced as biological control agents with essentially no adverse effects.

Risk assessment is a primary determinant of the safety of any activity. In this case, risk assessment includes an intangible component, the cost of inaction as well. The previous moratorium on recombinant viral research in the United States is a case in point. One can construct many scenarios about the cost of inaction. For example, had the AIDS epidemic arisen five years earlier, during the moratorium, the absolute rate of increase of cases would likely have increased further (assuming the development of effective vaccines now in human trials). At that time r-DNA techniques that have helped identify the virus and its structure were simply not yet available.

A number of additional issues were raised as to the proper protocol of pre-introduction screening. Issues surrounding the population dynamics of an introduced species are critical in ensuring a successful introduction. The minimum population size required for an introduced population to persist (and multiply) is a difficult multidimensional problem.

Although it may be comparatively easy to engineer a microorganism to behave in a specific way, generally it will be considerably more difficult to successfully introduce that organism to the environment. Again, the biological control literature provides some useful statistics. Of all insect species introductions, somewhat less than 50% became successfully established. This is noteworthy because this rate is perhaps enhanced because of significant pre-introduction screening, where the organism is "matched" to the environment. Genetically-modified organisms have the added disadvantage that their function can be lost; the stability of the genome is critical. Further, introduction of certain species may be ineffectual because the species genome may be rapidly swamped by native non-engineered forms (e.g. Pseudomonas syringae ice-minus and ice-plus).

Ecological concerns about the potential escape of GMO's into non-target ecosystems must also be addressed. The legal implications of an escape altering a neighboring ecosystem are currently untested. Hence, the ability to leash organisms with the propensity for substantial dispersal or further engineer controls may be essential. For example, an organism that degrades a pollutant, say PCB, can be engineered such that once a substrate (PCB in this case) is gone, the organism self destructs.

The success of this meeting stemmed directly from a conscious effort by both ecologists and molecular biologists to shed preconceptions. What was the take-home message? Aside from the scientific issues which are mentioned above, there are not two sides here, simply different levels of scale and organization that must be reconciled.

--Excerpts from aticle in ICSU/SCOPE Newsletter No. 29, December 1987. SCOPE SECRETARIAT, 51 Boulevard de Montmorency, 75016 Paris, France.

SCOPE/COGENE COMMUNIQUE ON THE INTRODUCTION OF GENETICALLY-MODIFIED ORGANISMS INTO THE ENVIRONMENT

A Statement from the Scientific Committee on Problems of the Environment (SCOPE) and the Committee on Genetic Experiment (COGENE) - Bellagio, Italy, September 1987.

Introduction

Genetic change is a fundamental biological phenomenon and is the basic process of evolution. It has been exploited by humans for their own purposes throughout history. Recent methodological developments, such as advances in the application of recombinant DNA (rDNA) techniques have expanded these capabilities and provide the opportunity for addressing a wide variety of pressing human needs including solutions to environmental problems. Efforts to reduce pollution, to combat microbial infection, and to improve food production may require applications that involve the large-scale introduction of genetically modified organisms into the environment.

Any human intervention into the environment carries an element of risk. The natural response to this uncertainty is to proceed cautiously; but one must weigh any risks that might attend the implementation of the methodology against the benefits, and against any risks that might be associated with delaying implementation.

The environmental introduction of any organisms, modified or unmodified, should be undertaken within a framework that maintains appropriate safeguards for the protection of the environment and human health while not discouraging innovation. This implies that an ecological perspective is essential to the assessment of risks associated with any introduction.

There is considerable experience in the introduction of organisms into the environment. Familiar examples include vaccines, agricultural varieties, and biological control. The positive and negative lessons learned from these experiences provide a basis for the rational development of safeguards. Nevertheless, there is much that still needs to be known about such topics as systematics; community structure; the factors governing the survival, growth, and spread of populations of introduced organisms; and techniques for monitoring.

Risks

In view of the great potential of new technologies for addressing environmental and other problems, and because most introductions of modified organisms are likely to represent low or negligible ecological risk, generic arguments against the use of new genetic methodologies must be rejected. Indeed, the spectrum of available tools represents an evolving and expanding continuum, which includes conventional methods, rDNA techniques, and others. While much attention has been focused on the methods used to modify organisms, it is the products of these technologies and the uses to which they will be put that should be the objects of attention, rather than the particular techniques employed to achieve those ends.

Similarly, one must reject generic safety arguments based on the assertion that all introductions must have occurred sometime during the course of evolution. Therefore, each introduction of an organism, whether modified or not, must be judged on its own merits, within the context of the scale of the application and the possible environmental costs and benefits.

Size, geographical scale, and frequency of introduction are among the factors that are important in determining whether a particular introduction will become established or spread. Therefore, small-scale field testing involves different considerations than does large-scale (e.g. commercial) application. This is not to suggest that small-testing should be exempt from examination for regulations, but simply that any risks are likely to be much smaller and more easily managed than are those for large-scale applications. Nor does this suggest that all large-scale applications will be problematical, since we have many examples to the contrary, including vaccines, biological control methods, and the use of rhizobia in agriculture.

One must bear in mind that the greatest impact on the biosphere is through human activity. For example, deforestation; the widespread use of antibiotics, vaccines, herbicides, and pesticides; or the widespread introduction of a single type of organism in agriculture, has led to a loss of genetic diversity. Such loss has had dramatic and unfortunate consequences for human survival because it has led to environmental degradation, loss of stability, and a depletion of biological resources that are valuable for food, fiber, medicines, and other purposes.

As the ability to manipulate our environment increases, so must an awareness of these problems and of the need to exercise our power wisely.

Risk Assessment

As already discussed, the risks of making a specific introduction must be weighed against the perceived benefits and the risks of not making the introduction. This balancing is part of risk management. This section addresses only the assessment of risks of introduction; but it is important that it be integrated into the management framework.

The properties of the introduced organism and its target environment are the key features in the assessment of risk. Such factors as the demographic characterization of the introduced organisms; genetic stability, including the potential for horizontal transfer or outcrossing with weedy species; and the fit of the species to the physical and biological environment.

Each proposed introduction must be treated on its own merits, but this does not suggest that each needs to be considered de novo. As experience accumulates with particular kinds of introductions in particular environments, more generic approaches to these classes of introductions can be developed. The bases for classification should be refined continually, providing a set of criteria that will allow any proposed introductions judged to be innocuous to be carried out speedily, and those judged to be problematical to be given the attention they deserve.

It is important to note that generalizations developed for particular groups of organisms (e.g. microorganisms) cannot be extended automatically to other groups (e.g. plants), which may have very different genetic and demographic characteristics, dispersal and reproductive mechanisms, and trophic positions.

In the development of assessment procedures, the potential for containment, monitoring, and mitigation must receive consideration. In this regard, it should generally be assumed that the likelihood of being able to recall introduced organisms that have escaped containment is very small.

Coda

The new genetic methodologies add additional tools to the spectrum of techniques available to improve the human condition. These will lead to rapid improvements in the development of ecologically sound approaches to agriculture and to environmental management, and in the acquisition of a better understanding of biological systems. These benefits in their various forms should be available to everyone, and know no national boundaries. It is therefore essential that the broadest possible international cooperation and data-sharing be supported by all countries. Each improvement in our capacity to modify the environment carries with it responsibilities to use that capability wisely, with special attention to the importance of maintaining biological diversity.

--Excerpts from article in ICSU/SCOPE Newsletter No. 29, December 1987. SCOPE SECRETARIAT, 51 Boulevard de Montmorency, 75016 Paris, France.

THE ISLE AND THE PUSSYCAT

Nigel Leader-Williams and David Walton

Almost every island on Earth has its share of alien species--animals and plants that followed in the wake of explorers, sailors and settlers. Many of these introductions were deliberate, some accidental. But however these exotic species arrived, the results were often unforeseen and disastrous. The rabbits that overran Australia are the classic example.

Such thoughtless introductions are rare today. In most cases, an alien species, introduced, say, as part of a programme of biological control, has to go through a rigorous assessment to rule out the possibility that it will damage the local ecosystem. Yet even such vigorous vetting cannot guarantee that the newcomer will not harm the native vegetation nor displace a native species.

Current conservation policies usually assume that the best way to protect the native flora and fauna of an island is to eradicate the introduced species or at least to control them very strictly. Yet this is not always the best policy, a point illustrated by the problems raised by introduced animals on the subantarctic island.

The subantarctic islands lie far from any continental land, right in the middle of the storm tracks that continually move around the Antarctic continent. The islands are among the least exploited terrestrial habitats in the world and so are of immense value scientifically and in terms of conservation. The remoteness of the islands and their inhospitable climate are reflected in the small number of species that have colonised them. A key feature of terrestrial life on all the islands is the lack of any native herbivore larger than a beetle.

Despite their extreme remoteness, the subantarctic islands host their share of introduced species. Many of the original introductions failed but of those that are now well established, four illustrate the logic of making appropriate policies for conservation rather than simply trying to eradicate the aliens. These four species are rabbits, cats, reindeer and rats. Each introduced species constitutes a different ecological problem and each requires a different type of management to solve it.

Concern over these introduced species varies among the national authorities responsible for managing each island and also between different types of biologists: botanists worry about protecting the plants, ornithologists the birds, and some zoologists even consider that the introduced species are worth protecting. Scientifically, the most important considerations when deciding the fate of an alien species are how likely the introduced species is to drive an endemic species (one that lives nowhere else) to extinction and the preservation of representative communities of native plants and animals. In practice, the most important factors are the alien's feeding habits and the stage it has reached in its population cycle. For instance, some island have both its introduced predators (cats) and introduced prey (rabbits). The size of the populations of both animals depends on two

factors; first, how many native birds there are to provide an alternative prey for the cats and, secondly, on what stage the populations of rabbits and cats have reached--that is, are they still growing or have they reached equilibrium? These factors may determine how practical any controls would be.

For example, cats have lived on Macquarie Island and the Crozet Islands for more than a century. Those on Marion Island and the Kerguelen Islands arrived much latter--1949 and 1951. Cats are opportunistic predators--they eat what they can kill most easily. The cats on Marion Island eat mostly petrels, which nest in holes in the ground. With a population of around 2000 cats, the annual toll is almost half a million birds. On the Kerguelen Islands, which have more than twice as many cats, the toll is more than 1.2 million birds a year. The cats on these islands have not yet driven any native species to extinction. On Macquarie Island, however, cats are responsible for the loss of two endemic species. The cats in these older populations no longer rely entirely on native species as prey. Rabbits on Macquarie Island and rats on the Crozet Islands are now an important part of the cats' diet. But this does not relieve the pressure on native species; it merely maintains a large population of cats.

Bearing this in mind, we can rank the four populations of cats according to how much of a threat they are to native species and what chance there is of controlling them. The cats on Marion Island rank highest for three reasons. First, although they have not caused any extinctions yet, they might well do in the future; secondly, the population is still increasing; and, finally, the cats are present over the whole of the island. At the other extreme, cats on Crozet rank lowest because during their long residence on the islands they have not caused any extinctions. Moreover, they live in a restricted area and, should the need arise, it ought to be a simple job to clear them from the island.

A somewhat unexpected introduction is the reindeer. Norwegian whalers brought the first animals to South Georgia in 1911, and introduced another herd in the 1920s. These now form three herds on the island. In 1956, the French introduced two small groups of reindeer to two islands in the Kerguelen archipelago. The herds on South Georgia are restricted to limited areas of the island by glaciers stretching down to the sea. The reindeer seem unable or unwilling to cross the ice to reach new areas.

The reindeer are the largest animals on the island and have no natural enemies. In the absence of predators, the availability of food is the key factor controlling the population. In the Arctic, reindeer graze on deep carpets of lichens, or "reindeer moss". These lichens are rare in the subantarctic, where the reindeer graze mainly on the native tussock grass and burnet. The reindeer have severely overgrazed most of the areas where they were first introduced. Biologists initially believed the damage to the native vegetation was irreversible. Experiments with "exclosures", areas fenced to keep out reindeer, show that much of the damage can be remedied given enough time. After 12 years of protection from grazing, the burnet has grown back and some native species have replaced the introduced meadow grass.

Tussock grass has not recovered, however, carpets of mosses have grown over the peaty remains of the tussocks. Although native species can re-establish themselves in areas protected from grazing, the structure of the community usually differs from that of the original vegetation.

Culling or extermination of the 2000 reindeer on South Georgia is a more realistic proposition than control of either rabbits or rats. The animals are large and conspicuous in the open tundra of the subantarctic islands. Yet there does not seem to be a strong case for action. The animals have altered small areas of native vegetation but, because they cannot cross glaciers, much of the island remains inaccessible to them. Botanists have shown that no species of plant is threatened with extinction even in the places the reindeer graze. Moreover, these displaced reindeer are of great biological interest. The reindeer adopted a new diet and reversed their breeding cycle. They also formed three large herds from two small groups of animals; two herds from an introduction of ten animals, and the third from just seven animals. Unlike their Arctic relatives, these reindeer are unmanaged, they have no predators and they are free from the radioactive contamination that has afflicted northern reindeer since the explosion at Chernobyl. The South Georgian reindeer provide researchers with material for comparative studies of the population dynamics of large mammals.

To a greater or lesser extent, cats, rats, reindeer and rabbits have changed the ecosystems of almost all the subantarctic islands--with little obvious benefit to any of the islands. Ironically, on South Georgia an interaction between brown rats and reindeer may protect populations of a native petrel. Brown rats make their homes among the stools of tussock grass where burrowing petrels nest. Under the protection of the grassy canopy, rats move freely from burrow to burrow, eating the petrels' eggs and chicks, safely out of sight of predatory skuas--which eat both birds and rats. In areas where reindeer graze, rats lose the protection of the tussocks. The petrels, however, still nest in the bare areas, where they lose fewer chicks to rats and no more than usual to the skuas.

There are no simple answers to questions of conservation and introduced animals. Before deciding simply to destroy the aliens, those responsible for introducing the control measures should consider how likely it is that the disturbed ecosystem will revert to its original state and whether there might be any advantages in keeping introduced species. Those who decide the fate of introduced species must balance the scientific merits of keeping the species with the practicality of control or eradication. There is always the chance that the wrong decision might be made.

--Excerpts from: New Scientist
121(1651):45-51, 11 Feb 1989

Editor's Note: While on a guided nature walk in a Florida state park, the tour guide described an example of how a rigid exotic elimination policy may not always be the best management policy. The guide told of their efforts to eliminate exotic species and how one exotic species (Australian pine) had been removed from an area. This exotic was quickly replaced by two other exotics (Brazilian pepper and Asiatic coffee). Unfortunately, he said the

latter species are even harder to control and more detrimental than the exotic species that had originally invaded the area.

SPORTFISHING ECONOMICS IN THE UNITED STATES

The economic impact of sport fishing is calculated for the Nation. The analysis estimates the National economic impact of sport fishing for 1985 to be:

* Expenditures	- $27.2 billion
* Output	- $70.6 billion
* Earnings	- $19.7 billion
* Jobs	- 1,178,129
* Person-Years	- 1,071,243
* State Sales Tax	- $1.3 billion
* Federal Income Tax	- $963.8 million
* State Income Tax	- $398.2 million
* Wallop-Breaux Tax	- $34.1 million

This analysis uses data collected by the U.S. Fish and Wildlife Service for the 1985 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. This data set is used to obtain information on expenditures by fishermen who are 16 years of age and older. This expenditure information is combined with a regional input-output model called RIMS-II that generates multipliers for use in estimating the indirect and induced impacts of economic activity.

--Executive summary of a December 1988 report titled, 'The economic impact of sport fishing in the United States' by the Sport Fishing Institute, Suite 100, 1010 Massachusetts Avenue, N.W., Washington, D.C. 20001.

Editors Note: Most fisheries managers believe responsible fisheries management includes man's direct utilization of fishes for sport. As a result, the above statistics are of considerable importance, as they provide a measure of the socio-economic value of sportfishing in the U.S. Regardless of one's personal philosophies, these statistics clearly confirm sportfishing is one of, if not the most socio-economically important use of these natural resources.

FOCUS ON EXOTICS

The AFS Fisheries Administrators Section's annual meeting agenda for 14-16 May 1989 includes a major segment on 'Approaches to Stocking Exotic Species.' The intent of this session is to answer the question: "When and How Does Administration make Decisions on the Introduction of Exotic Species?" The tentative agenda includes the following topics: AFS Exotic Fish Policy, USFWS Viewpoint, Illinois-Kansas-Utah Approaches and Experiences, as well as, comments from the Sport Fishing Institute. Program Coordinator Robin Knox has agreed to forward a summary of this session, though input from others who

attended this meeting would be appreciated. For more information Robin can be contacted at 303-291-7362.

WORLD FISHERIES CONFERENCE

The American Fisheries Society, Asian Fisheries Society and over 20 other organizations worldwide are sponsoring a five day World Fisheries Congress scheduled for April 1991 in Athens, Greece. The purpose of the Congress is to assess the state of fisheries resources--marine, freshwater and aquaculture--worldwide, and to promote long-term collaboration among the world's fisheries resources scientists, managers and administrators.

Of special interest to IFS members is that one of the topics to be emphasized at the Congress is 'Impacts of introduced species in the world ecosystems and the development of a scientific basis for introduction and control.' For additional information contact: World Fisheries Congress, 5410 Grosvenor Lane, Suite 110, Bethesda, Maryland, 20814 USA (telephone 301-897-8616; FAX 301-897-8096).

CONTINUING EDUCATION SHORT COURSES

Two short courses are scheduled to take place 2-4 September in conjunction with the 1989 Annual AFS meeting in Anchorage, Alaska. Course titles are 'Analyzing and Managing User-Group Conflicts' and 'Using Socioeconomics in the Fishery Policy Process.' For more information contact Court Smith 503-754-4515.

FIRST INTERNATIONAL AQUARIUM FISH AND ACCESSORIES EXHIBITION AND CONFERENCE, 15-18 JUNE 1989 WORLD TRADE CENTRE, SINGAPORE.

A total of 29 papers covering major aspects of the ornamental fish trade--from fish health, breeding and water management, to packing, market potential and recent industry developments--will be presented over three days, culminating in a visit to fish farms in Malaysia and Singapore. Breeders, farm managers, fish exporters/importers and researchers will find this meeting a useful avenue, not only to gather information but also to make contact with their local and foreign counterparts.

Ornamental fish hobbyists too will be able to learn from experts on fish care and maintenance. Eight topics ranging from the general to the specific will be presented by prominent professionals in the trade. This is a not-to-be-missed opportunity for hobbyists to discuss their doubts and problems with the experts.

For further information, please contact: Academic Associates Pte Ltd, Block 808 French Road, #03-185 Kitchener Complex, Singapore 0820, Tel: 2926166, Fax: 2924625, Tlx: RS 34032 ACADEM.

1988-89 IFS OFFICERS

President: Peter B. Moyle, Department of Wildlife and Fisheries Biology University of California, Davis, CA 95616 (916-752-6355).

President-Elect: Paul L. Shafland, Florida Game and Fresh Water Fish Commission, 801 N.W. 40th Street, Boca Raton, FL 33431 (407-391-6409).

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Past-President: Nick C. Parker, Texas Cooperative Fish and Wildlife Unit, Department of Wildlife Sciences, Texas Tech University, Lubbock, Texas 79401 (806-742-2851).