Preventing Spread of Non-Target Species

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Several cases of unintended spread of non-target species through aquaculture shipments or stockings are recorded. A brief review of Nonindigenous Fishes Introduced into Inland Waters of the United States by Fuller, Nico and Williams, 1999, revealed 16 species of fish introduced to new waters through an aquaculture pathway. Some of these species spreads were traced by researchers back to 1918 stockings. Aquaculture activities are important resource conservation tools that have lasting impacts and effect, not all of them benefiting species and habitats. The unintended spread of non-target species or hitchhikers has been a problem since the early beginnings of aquaculture. Preventing this type of species spread has been addressed with varying degrees of success. Concern by biologists and researchers about the biological pollution they were observing did not outweigh the need to move species for recreation, conservation or human needs. These important needs still appropriately drive professional resource management decisions to collect, move, rear and stock fish and other aquatic species. Sea Grant universities adapted an industry planning tool to assist private aquaculture in preventing the spread of aquatic nuisance species such as zebra mussels. Hazard Analysis and Critical Control Point (HACCP) planning has been further modified for natural resource work. This planning concept has great potential to reduce the threat of non-target species spread through natural resource pathways.

Natural resource management (HACCP-NRM) planning is a comprehensive review of planned actions providing a systematic method to identify threats of contamination by non-targets. The planning process strategically highlights critical control points where specific actions should be used to eliminate or significantly reduce the risk of non-target

species contamination. Plans also provide an important reference source allowing procedures and processes to improve and evolve through time. The science of species-specific fish culture has grown significantly, now relying on sophisticated DNA modeling and microbiology techniques while many of the related processes in the aquaculture pathway have remained basically unchanged. HACCP planning is a concept that identifies where to concentrate research and development to prevent spread of non-target species through the aquaculture pathway. A plan is just a plan. Planning is everything!

It is often difficult to identify specific pathways for introductions. Research and biological deduction are used to accurately explain species distributions and communities. The reference book by Fuller, Nico and Williams thoroughly reviews fish species distribution in the United States and compares this with native ranges. The means of introduction often relies on official stocking records and biological deductions of fishery scientists and researchers to identify the pathway. A few examples from this book are used to highlight the need to appropriately address this critical issue for natural resource work.

The spread of highly invasive species such as gizzard shad *Dorosoma cepedianum* is always a concern but species without this reputation could be just as detrimental. Although gizzard shad have been intentionally stocked as forage fish, the records of accidental spread indicate how easily they are spread and how important planning is to prevent unintended introductions. A small stocking of about 1000 gizzard shad into Lake Havasu on the Lower Colorado River created a population that rapidly spread throughout

the river and related canals and into Mexico in just 18 months (Burns 1966). In Pennsylvania, gizzard shad were accidentally introduced with a stocking of American shad (Denoncourt et al. 1975). The rapid spread of Asian carp throughout the Mississippi River basin is alarming to management agencies, biologists and stakeholders. Records reveal how easily these species spread as non-target contaminants. Native to Asia, the black carp *Mylopharyngodon piceus* first arrived in the United States as a non-target contaminant within a shipment of grass carp (Nico and Williams 1996). The second introduction occurred in the early 1980's when the species was imported as a biological control for snails in aquaculture ponds and as a food fish. The silver carp *Hypophthalmichthys molitrix* was imported in 1973 for phytoplankton control in eutrophic water and as a food fish. This species hitchhiked to Florida in a shipment of grass carp for vegetation control (Middlemas 1994).

Also alarming are those fish species that have been spread "over the hump" to new waters where the pathway has literally been human-driven via stocking trucks. Smallmouth and black buffalo, *Ictiobus bubalus and I. niger*, were both accidentally introduced in Arizona as hitchhiking contaminants in a 1918 stocking of bigmouth buffalo *Ictiobus cyprinellus* for recreational fishing (Minckley 1973; Rinne 1995). They are now established in Arizona. By 1945, Trautman (1981) notes that the bullhead minnow *Pimephales vigilax* was a common contaminant in tanks of commercial bait dealers in Ohio. Sigler and Miller (1963) report that this species was accidentally introduced into the Seiver River drainage in Utah along with several thousand channel catfish received from San Angelo, Texas. Mexican tetra *Astyanax mexicanus*, native to

subtropical North America, including parts of Texas, was first noted out of its range in a Yuma, Arizona, bait shop in 1950. It probably spread here as a contaminant in a minnow shipment (Evans and Douglas 1950; Miller 1952). The black bullhead *Ameiurus melas* was accidentally introduced in Idaho, where it became established, as a hitchhiking non-target species in a stocking of brown bullheads A. *nebulosus* and channel catfish *Ictalurus puntatus* (Liner 1963). The tadpole madtom *Noturus gyrinus* was spread to and established in the northwest as a contaminant in catfish and bullhead stockings (Linder 1963; Taylor 1969; Simpson and Wallace 1978; Wydoski and Whitney 1979; Hartel 1992). The rainwater killifish *Lucania parva* is native to marine and coastal freshwater rivers and streams from the Gulf to Massachusetts. The rainwater killifish became a common hitchhiking contaminant in several fish stockings (Sigler and Miller 1963; Hubbs and Miller 1965; Moyle 1976a, 1976b) and was introduced into Utah in a stocking of largemouth bass (Sigler and Sigler 1987). Bigscale logperch *Percina macrolepida* is native to the Sabine River, Louisiana, the Red River, Oklahoma/Texas and to the Rio Grande drainage. It was introduced into California with a fish stocking from the Trinity River, Texas, in 1953 (Moyle 1976a; Dill and Cordone 1997).

Records of other aquatic species that have been relocated through fish stockings are not well documented but are sure to have occurred. The spread of the Rio Grande leopard frog *Rana berlandieri*, native to southwest Texas, southeast New Mexico and Mexico, is a well-documented example. It was first collected out of range on the Colorado River near Yuma in 1981 (Platz et al. 1990). Extensive surveys in the early 1970's found no evidence of leopard frogs. Stocking records showed one shipment of fish from Uvalde,

Texas, 1965, was made to the Gila River near Wellton, Arizona, and several fish stockings were made to the Yuma area from the Dexter National Fish Hatchery in eastern New Mexico between 1968-71 (Platz et al. 1990). In this same study (Platz et al. 1990) the Arizona population was genetically compared to populations of the Rio Grande leopard frog in its native range and was found to be most similar with specimens collected from the southern New Mexico area. This suggests that the Yuma population was introduced along with fish stockings from New Mexico.

Scientists suggest that any addition to the biota of a given body of water will affect niches of resident species, whether native or from earlier introductions. It is beyond our capabilities to predict how any additional species will affect resident communities. Lassuy (1995) reviewed the factors cited in Endangered Species Act fish listing through 1991. Where documentation was sufficient, his analysis found that introduced species were cited in 48 (70%) of 69 listed species. Preventing unintentional introductions of non-target species, contaminants, will make the task of biological assessment and prediction for natural resource management less complicated and more likely to achieve agency goals and objectives. HACCP (Hazard Analysis and Critical Control Point) planning has withstood the test of time in industry and has the potential to become a valuable natural resource management tool. U.S. Fish & Wildlife Service field stations are using and applying HACCP planning principles. A support website is being developed by the Service to provide HACCP planning forms, instructions and guidance. The website will include a searchable database of completed forms to provide quick access to best management practices and methods to filter out and remove non-target

species. The database also provides biological review to predict what non-target species may be problematic and not easily removed from specific natural resource actions so that screening decisions can be made before an action is completed. Planning is everything! Without a plan, you're just guessing.

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