

Annotated Literature Review
Model Rapid Response Plan for Great Lakes Aquatic Invasions

DRAFT: July 2003

Prevention

- Kolar, C.S. and D.M. Lodge. 2002. Ecological Predictions and Risk Assessment for Alien Fishes in North America. *Science*. 298: 1233-1236.

Summary: Using a generalizable risk assessment approach and statistical models of fish introductions into the Great Lakes, Kolar and Lodge developed a quantitative approach to target prevention efforts on species most likely to cause damage. The models categorize established, quickly spreading, and nuisance fish species. Fish that pose a high risk to the Great Lakes if introduced either intentionally or unintentionally are identified.

Application: Goals and objectives, detection and monitoring, prevention

- Li, H.W. and P.B. Moyle. 1981. Ecological Analysis of Species Introductions in Aquatic Systems. *Transactions of the American Fisheries Society* 110:772-782.

Summary: This article examines the likelihood that introduced species will produce cascading trophic effects related to ecosystem productivity. It goes on to layout an evaluation procedure for potential introductions. The information provided in this article may also help determine the risks if a species is introduced.

Application: detection and monitoring, adaptive management, risk assessment, prevention

- Midwest Natural Resources Group. February 2003. *Memorandum of Agreement: A Collaborative Agreement to Meeting the Threat of Invasive Species* (draft).

Summary: This memorandum of agreement provides objectives that work toward achieving the overarching goal of the Midwest Natural Resources Group “to develop processes, marshal resources among agencies and partners, seek opportunities for collaboration and communication, and provide timely assistance where it is needed” as it relates to invasive species issues.

Application: communication, organization, outreach, decision support, prevention

- Ricciardi, A. 2003. Predicting the Impacts of an Introduced Species From its Invasion History: An Empirical Approach Applied to Zebra Mussel Invasions. *Freshwater Biology*. 48:972-981.

Summary: Ricciardi suggests a model for predicting ANS impacts based on their invasion history. Because an invader’s impact is correlated with its abundance, a surrogate model may be generated (when impact data are unavailable) by relating the invader’s abundance to environmental variables.

Application: prevention

- Ricciardi, A. 2001. Facilitative Interactions Among Aquatic Invaders: Is an “Invasional Meltdown” Occurring in the Great Lakes? *Canadian Journal of Fisheries and Aquatic Sciences*. 58:2513-2525.

Summary: The idea of an “invasional meltdown” suggests that ecosystems become more easily invaded as the cumulative number of species introductions increases, and that facilitative interactions can exacerbate the impact of invaders.

Application: prevention, risk assessment

Rapid Response to Invasive Species Infestations

- Haack, R.A. and T.M. Poland. 2001. Evolving Management Strategies for a Recently Discovered Exotic Forest Pest: the Pine Shoot Beetle *Tomicus piniperda* (Coleoptera). *Biol. Invasions* 3:307-322.

Summary: Animal and Plant Health Inspection Service (APHIS) formed a New Pest Advisory Group to share information and develop response strategies for the discovery of the invasive pine shoot beetle during 1992 in Cleveland, Ohio. Through the process, the group was able to rapidly establish the extent of its distribution and its potential impacts on industry as well as start the process of developing a regulatory response.

Application: decision support

- Hirsch, J. February 1998. *Nonindigenous Fish in Inland Waters: Response Plan to New Introductions*. Minn. Dept. of Nat. Res., Section of Fisheries Special Publication Number 152.

Summary: This document describes the MDNR’s goals to prevent and manage newly introduced nonindigenous fish species in Minnesota’s inland waters. Descriptions of coordinated response development, new introduction prevention, containment of new nonindigenous fish species, and management practices are all given.

Application: goals and objectives, detection and monitoring, risk assessment

- Merkel, K. and Woodfield, R. 2000. *Rapid Response and Eradication Program for The Invasive Green Alga, *Caulerpa taxifolia* at Agua Hedionda Lagoon, Carlsbad, California*. Prepared for the Southern California *Caulerpa* Action Team.

Summary: This document serves as the plan/protocol for a rapid response to a *C. taxifolia* infestation. It includes elements such as leadership and organization, coordination, survey and detection, eradication, monitoring and restoration.

Application: decision support, communication, organization

- Michigan Department of Agriculture. 2002. *Invasive Species Action Plan*.

Summary: (to be completed)

Application: communication and coordination, implementation

- Minnesota Department of Agriculture. 2003. *Invasive Species Action and Response Plan*.

Summary: (to be completed)

Application: communication and coordination, implementation

- U.S. General Accounting Office. *Invasive Species. Obstacles Hinder Federal Rapid Response to Growing Threat*. GAO-01-724. Washington, D.C.: August 2001.
<http://www.gao.gov/new.items/d01724.pdf>

Summary: This report reviews federal efforts to provide rapid response to invasive species. Specifically, the extent to which the federal government rapidly responds, the obstacles that impede rapid response, and how rapid response can be improved are all examined. Obstacles include the need for additional detection systems to identify new species, improved partnerships, and enhanced technologies to eradicate invasive species.

Application: communication, organization, detection & monitoring

- Western Regional Panel on Aquatic Nuisance Species. 2001. *Draft Rapid Response Plan*.

Summary: The plan described in this document identifies factors that affect the probability for developing a successful plan, common problems that may preclude success, and also presents examples of plans that failed and others that succeeded.

Application: general model, goals and objectives, decision support system

Outreach

- Information/Education Committee: Great Lakes Panel on Aquatic Nuisance Species. 2001. *Information/education strategy for aquatic nuisance prevention and control*.
<http://www.glc.org/ans/pdf/I-Estrategy.pdf>

Summary: The primary purpose of the I/E strategy is to provide regional direction and coordination regarding I/E activities for ANS prevention and control among the participating agencies, institutions and organizations. The I/E strategy is being established as a regional initiative for the benefit of all interested stakeholders.

Application: outreach

Detection and Monitoring

- Early Detection and Rapid Response Subcommittee. 2003. *Guidelines for Early Detection and Rapid Response Systems*. Invasive Species Advisory Committee of the National Invasive Species Council.

Summary: (to be completed)

Application: early detection & monitoring

- *Great Lakes Waterflea Report*. Michigan Sea Grant & National Oceanic and Atmospheric Administration/Great Lakes Environmental Research Laboratory.
<http://www.glerl.noaa.gov/seagrant/cercopagis/cercopagisreports.htm>

Summary: early detection website for reporting water fleas

Application: early detection & monitoring

- Hewitt, C. and Martin, R. 2001. *Revised Protocols for Baseline Port Surveys for Introduced Marine Surveys: Species Design, Sampling Protocols and Specimen Handling*. Centre for Research on Introduced Marine Pests Technical Report Number 22.

Summary: (to be completed)

Application: early detection & monitoring

- Marshall, T.R. and P.A. Ryan. 1987. Abundance Patterns and Community Attributes of Fishes Relative to Environmental Gradients. *Canadian Journal of Fisheries and Aquatic Sciences* 44 (Supplement 2):198-215.

Summary: This article shows how faunal composition of lakes can be predicted from area, mean depth, water transparency, and nutrient availability. This may be a useful addition to the toolbox for predicting what species are potential invaders to the Great Lakes basin.

Application: detection & monitoring, adaptive management, prevention

- Research, Information Sharing, Documentation and Monitoring Working Group. 2000. *Scoping Statement*. National Invasive Species Council.
- Wasson, K., Lohrer, D., Crawford, M., and Rumrill, S. 2002. Non-Native Species in our National's Estuaries: A Framework for an Invasion Monitoring Program. *National Estuarine Research Reserves Technical Report* 2002:1.

Decision Support and Rapid Scientific Assessment

- Hayes, Keith R. 1997. *A Review of Ecological Risk Assessment Methodologies*. CRIMP Technical Report Number 13. <http://crimp.marine.csiro.au/reports/TechReport13.html>

Summary: In this document, Hayes examines the current state of biological risk assessment. He argues that assessments of non-indigenous species introductions should achieve more than just a qualitative expression of risk. There needs to be a quantitative metric of invasion likelihood against which the efficacy of alternative management strategies can be gauged. He further believes that invasion risk assessment must involve both an examination of species specific AND site specific attributes.

Application: decision support, risk assessment

- *Roadmap to the U.S. Forest Service Decision Protocol, Version II*
<http://www.fs.fed.us/forum/nepa/dp2roadmap.htm>

Summary: An administrative aide to introduce the professional to the principles of decision science, outlines useful steps, and provides sources of information and techniques for improving decision quality.

Application: decision support

Management Options for Control/Eradication

- Ahmed, S.S., A.L. Linden, and J.J. Cech, Jr. 1988. A Rating System and Annotated Bibliography for the Selection of Appropriate Indigenous Fish Species for Mosquito and Weed Control. *Bulletin of the Society of Vector Ecologists* 13:1-59.

Summary: This journal article provides a system for rating the suitability of native fishes for aquatic pest control that could be modified for other purposes.

Application: decision support, management options

- Cailteux, R.L., L. DeMong, B.J. Finlayson, W. Horton, W. McClay, R.A. Schnick, and C. Thompson, editors. 2001. Rotenone and Fisheries: Are the Rewards Worth the Risks? American Fisheries Society, *Trends in Fisheries Science and Management 1*, Bethesda,

Maryland.

<http://www.fisheries.org/rotenone/rewardstoc.shtml> (partial)

Summary: This symposium proceedings contains eleven papers covering a wide variety of topics involving the use of rotenone to control fish populations including stewardship and use policies, environmental safety issues, and several case histories from California to New York.

Application: management options, risk assessment, public outreach

- Keppner, S.M. and E.A. Theriot. 1997. *A Recommended Strategy to Prevent the Spread of Round Goby, Neogobius melanostomus, in the Illinois Waterway System*. Prepared for the Aquatic Nuisance Species Task Force.

Summary: In this document, various prevention alternatives are reviewed and ranked according to potential effectiveness, cost, and regulatory restrictions. An integrated approach to prevention is recommended using both physical and chemical alternatives. The critical need for education programs is emphasized. This document also states that research is a key element to further refining effective prevention strategies.

Application: control options, prevention, outreach

- McEnnulty, F., Bax, N., Schaffelke, B., and Campbell, M. 2001. *A Review of Rapid Response Options for the Control of ABWMA Listed Introduced Marine Pest Species and Related Taxa in Australian Waters*. Centre for Research on Introduced Marine Pests. Technical Report Number 23. CSIRO Marine Research, Hobart. 101 p.

<http://crimp.marine.csiro.au/Reports/CRIMPTechRept23.pdf>

Summary: This Australian document reviews control and eradication options/treatments for several mostly marine invasive species. A risk assessment approach is recommended and a rapid response 'decision tree' is presented. Elements of the decision tree include: establishment of problem magnitude, setting and clarification of objectives, consideration of full range of alternatives, risk determination, risk reduction, and full-scale implementation and monitoring.

Application: goals and objectives, decision support, risk assessment, management options

- Schnick, R. A., F. P. Meyer, and D. L. Gray. 1986. *A Guide to Approved Chemicals in Fish Production and Fishery Resource Management*. University of Arkansas, Cooperative Extension Service Bulletin. MP-241, Little Rock.

Summary:

Application: chemical control options

- Sytsma, M.D. 1995. *Hydrilla Management in Oregon: Options, Obstacles, and Required Action*. Oregon State Weed Board, Oregon Dept. of Agriculture.

Summary: While focused specifically on hydrilla, this document states actions required to ensure an effective response to an invasion including surveillance efforts, lead agency designation, establishment of a management council and trust fund, permitting, and development of public education on impacts and management.

Application: organization, communication

Hazardous Materials/Oil Spill/Human Health Emergency Response

- Federal Emergency Management Agency. *Federal Response Plan - Hazardous Material Annex*. <http://www.fema.gov/rrr/frp/frpesf10.shtm>

Summary: This plan provides for a coordinated response to actual or potential discharges and/or releases of hazardous materials by placing the response mechanisms of the National Oil and Hazardous Substance Pollution Contingency Plan within the federal response plan coordination structure that ensures the most efficient and effective use of federal resources. The plan includes the appropriate response actions to prevent, minimize, or mitigate a threat to public health, welfare, or the environment caused by actual or potential hazardous materials incidents.

Application: communication, organization

- Federal Emergency Management Agency. 1996. *Guide for All Hazard Emergency Operations Planning: State and Local Guide* 101. <http://www.fema.gov/pte/gaheop.htm>

Summary: (to be completed)

Application: (to be completed)

- U.S. Dept. Of Health and Human Services. *Medical Response in Emergencies: Health and Human Services Role*. January 25, 2001. <http://www.hhs.gov/news/press/2001pres/01fsemergencyresponse.html>

Summary: (to be completed)

Application: (to be completed)

General/Background Information on Invasive Species:

- Animal and Plant Health Inspection Service, Plant Protection and Quarantine. 2002. *Draft Action Plan for the Noxious Weeds Program*. <http://www.aphis.usda.gov/ppq/weeds/weedsjan2002-pub.pdf>

Summary: This draft document presents an action plan for updating the noxious weeds program of the Animal and Plant Health Inspection Service. It describes the components of the current APHIS noxious weeds program and recommends goals and strategies for 2001-2002.

Recommendations include both regulatory and policy changes.

Application:

- Baker, J. and J. Smith. 2001. Aquatic Invasive Species Management in Massachusetts: Problems with Developing a Coordinated Approach and Their Solutions. *From: Proceedings of the Second International Conference on Marine Bioinvasions*, New Orleans, La., April 9-11, 2001. p.2. http://sgnis.org/publicat/sicmb1_2.htm

Summary: In the fall of 2000, Massachusetts formed the interagency Aquatic Invasive Species Working Group. The AIS working group has sought to coordinate the patchwork of MA AIS management activities into a cohesive AIS Management Plan with the goals of 1) educating the public about the AIS problem, 2) reducing the potential for AIS introductions, 3) controlling the spread of established invaders, and 4) minimizing impacts from established invaders.

Application: Model “emergency response plan”

- Carlton, J.T. 2001. *Introduced Species in U.S. Coastal Waters: Environmental Impacts and Management Priorities*. Pew Oceans Commission, Arlington, Virginia.
http://www.pewoceans.org/reports/introduced_species.pdf

Summary: This document outlines some impacts caused by invasive species. It also gives management recommendations which include the need for national ballast and fouling management programs, an intentional introductions management program, a national rapid response and early warning invasions system, an expanded research program including monitoring surveys, and a greatly expanded education and public awareness campaign.

Application:

- Corn, M. L., E. H. Buck, J. Rawson, and E. Fischer. 1999. *Harmful Non-Native Species: Issues for Congress*. Congressional Research Service, Resources, Science, and Industry Division.
<http://www.cnie.org/NLE/CRSreports/Biodiversity/biodv-26.cfm>

Summary: This report highlights the prevention choices between single species approaches and pathway approaches. The choice between prevention and control is also examined. This report also describes existing federal laws and federal agency roles, and outlines effects, costs, and issues surrounding 31 selected harmful non-native species.

Application: prevention

- Great Lakes Commission. 2001. *A Great Lakes Action Plan for the Prevention and Control of Nonindigenous Aquatic Nuisance Species and Associated Addendum*.
<http://www.glc.org/ans/anspubs.html>

Summary: This Action Plan presents a vision statement, goals and principles drawn from existing laws, policies and programs, to guide nonindigenous ANS prevention and control efforts. The Action Plan Addendum includes objective to assist further in developing and evaluating jurisdiction-specific and collective actions. The overall purpose of the plan is to design and implement timely and effective control measures, strengthen interjurisdictional consultation, provide mechanisms for responses to documented infestations and enhance the efficiency and effectiveness of current efforts.

Application: prevention, coordination

- Herbold, B. And P.B. Moyle. 1986. Introduced Species and Vacant Niches. *American Naturalist*. 128:751-760.

Summary: This journal article argues that the niche is a characteristic of an organism, not the environment and that the lack of understanding of this idea has led to the introduction of species to fill “vacant” niches. The vacant niche concept confuses available resources of the aquatic habitat with the ecological function of an organism. This concept may be useful when predicting the likelihood of future invasions or assessing the impact of past invasions.

Application: detection & monitoring, risk assessment, prevention

- Ikuma, E.K., D. Sugano, J.K. Mardfin. 2002. *Filling the gaps in the fight against invasive species*. LRB Report No. 1, (109 pp). Legislative Reference Bureau, Honolulu, HI.
<http://www.state.hi.us/lrb/rpts02/gaps.pdf>

Summary: (to be completed)
Application: communication, organization

- International Association for Great Lakes Research. 2002. *Research and Management Priorities for Aquatic Invasive Species in the Great Lakes.*

Summary: Outlines recommended areas of research necessary to detect, respond, monitor and control aquatic invasive species in the Great Lakes. Arguments are made stating that eradication is not realistic goal for rapid response plans. A general framework for rapid scientific assessment of new aquatic invaders is presented.

Application: goals and objectives, detection & monitoring, decision support

- INVADER database - Western U.S. University of Montana. <http://invader.dbs.umt.edu/>

Summary: Online mapping inventory/database of invasive species

Application: monitoring

- Kohler, C.C. and W.R. Courtnay, Jr. 1986. American Fisheries Society Position on Introduction of Aquatic Species. *Fisheries* (Bethesda) 11(2):39-42.
http://www.fisheries.org/Public_Affairs/Policy_Statements/ps_15a.shtml

Summary: The American Fisheries Society has adopted a position statement that advises caution and restraint with respect to intentionally introduced aquatic species. As the title states, this document gives the AFS position on introductions.

Application: goals and objectives, outreach

- Lee, H. And J. Chapman. 2001. Nonindigenous Species - An Emerging Issue for EPA. Volume 2. *A Landscape in Transition: Effects of Invasive Species on Ecosystems, Human Health, and EPA Goals.*

Summary: This document is a post workshop paper that provides an overview of the types of impacts ANS have on ecosystem services, human health, and economics. It also explores how ANS can impact the implementation of the EPA's goals and mandates and how EPA's regulations relate to the management of invasive species.

Application: risk assessment, decision support

- Li, H.W. and P.B. Moyle. 1993. Management of Introduced Fishes. *In: Inland Fisheries Management in North America*, Kohler, C.C., and W.A. Hubert, Eds., American Fisheries Society, Bethesda, Maryland.

Summary: In this chapter, Li and Moyle provide an overview of the reasons for introducing aquatic organisms with examples of successes and failures, present ecological concepts important for understanding the effects of introductions, suggest some management alternatives to introducing new species and provide guidelines for evaluating proposed introductions.

Application: risk assessment, decision support

- Moyle, P.B. 1991. Ballast Water Introduction Policy Statement. *Fisheries* (Bethesda) 16(1):4-6.

Summary: In this policy statement, the American Fisheries Society (AFS) recognizes that given increased knowledge, ballast water introductions can no longer be regarded as accidental but instead as deliberate, preventable introductions. AFS regards ballast water introductions as a form of pollution, and the shipping industry as polluters who are externalizing the cost of their pollution. Furthermore, AFS supports Nonindigenous Aquatic Nuisance Prevention and Control Act, control measures and economic incentives to halt ballast water introductions.

Application: public outreach, goals and objectives
- National Invasive Species Council. 2001. *Meeting the Invasive Species Challenge: National Invasive Species Management plan*. 80 pp. <http://www.invasivespecies.gov/council/nmp.shtml>

Summary: Provides a basic framework for managing invasive species developed by the National Invasive Species Council. The plan includes nine interrelated areas that the Council considers priorities in addressing invasive species problems. They are: leadership and coordination, prevention, early detection and rapid response, control and management, restoration, international cooperation, research, information management, end education and public awareness.

Application: Though not very detailed, this plan is applicable to all of the sections of the GL Panel rapid response plan
- Nonindigenous Aquatic Species Information Resource. U.S Geological Survey.
[Http://nas.er.usgs.gov](http://nas.er.usgs.gov)

Summary: Online central repository for biogeographic accounts of nonindigenous aquatic species. Provided are scientific reports, online/realtime queries, spatial data sets, regional contact lists, and general information. The geographical coverage is the United States.

Application: detection & monitoring
- Schmitz, D. and Simberloff, D. 2001. Needed: A National Center for Biological Invasions. *Issues in Science and Technology*. p. 57-62.

Summary: This article argues for the establishment of a new “National Center for Biological Invasions” that would serve as the coordinating mechanism between disparate agencies. It is suggested that the Center be structured similar to the Center for Disease Control’s Epidemic Intelligence Service and the National Interagency Fire Center. The new Center would serve to coordinate early detection and rapid response between federal, state, and local agencies. Key to the Center’s existence is its neutral party stance.

Application: communication, organization, decision support
- U.S. General Accounting Office. 2000. *Invasive Species: Federal and Selected State Funding to Address Harmful, Nonnative Species*. GAO/RCED-00-219.
<http://www.gao.gov/new.items/rc00219.pdf>

Summary: This report summarizes a survey of ten federal departments and seven states to determine the amount of money that was spent on invasive species during 1999 to 2000.

Application: Communication/organizational structure

- Wiley, R.W. and R.S. Wydoski. 1993. Management of Undesirable Fish Species. *In: Inland Fisheries Management in North America*, Kohler, C.C., and W.A. Hubert, Eds., American Fisheries Society, Bethesda, Maryland.

Summary: This chapter describes criteria of undesirable fish species and provides descriptions of several chemical, biological, and mechanical control options. The authors also list “Items for Consideration” for planning chemical treatments and “Important Factors” for choosing biological control methods. Additionally, several good references are given for more detailed reading about control options.

Application: decision support, risk assessment, management options, implementation

Policy/Legislation

- Cangelosi, A. 2002. *Northeast-Midwest Institute’s provisions for NISA reauthorization: Proposed provisions on rapid response*. Presented at 11th International Conference on Aquatic Invasive Species.

Summary: This short document gives suggestions for the NISA reauthorization that could help ensure federal, state, and regional authorities are prepared for future invasions of ANS. Specific suggestions include: developing national guidelines for rapid response, encouraging states to develop rapid response plans, encouraging regional and state coordination, and providing federal funding.

Application: communication, organizational structure

- Glassner-Shwayder, K. 1999. *Legislation, Regulation and Policy for the Prevention and Control of Nonindigenous Aquatic Nuisance Species: Model Guidance for Great Lakes Jurisdictions*. Great Lakes Commission. <http://www.glc.org/ans/ansmodellegis.html>

Summary: This report serves to coordinate consistency for the prevention and control of ANS in the multi-jurisdictional region of the Great Lakes.

Application: communication, organization

- *Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990*. As amended through P.L. 106-580, Dec. 29, 2000. <http://www.senate.gov/~epw/nanpca90.pdf>

Summary: The enactment of the NANPCA of 1990 has provided federal legislative support for programs aimed at ANS prevention and control. As enacted, the legislation has five purposes: to prevent unintentional introductions, to coordinate research, control and information dissemination, to develop and carry out environmentally sound control methods, to minimize economic and ecological impacts, and to establish a research and technology program to benefit state governments. This legislation also established the ANS Task Force.

Application: goals and objectives, communication, organizational, legislative/political foundation

ANS Management Plans

The following state ANS management plans, approved by the National ANS Task Force, hold institutional relevancy for the development of the model rapid response plan.

- Illinois: *Illinois State Comprehensive Management Plan*. 1999
http://anstaskforce.gov/illinois_state_plan.htm
- Michigan: *Nonindigenous Aquatic Nuisance Species State Management Plan*. Michigan Department of Environmental Quality.
<http://www.deq.state.mi.us/documents/deq-ogl-ANSPlan2002.pdf>
- New York: *Nonindigenous Aquatic Species Comprehensive Management Plan*. New York Department of Environmental Conservation. 1993.
<http://www.dec.state.ny.us/website/dfwmr/habitat/noninsp.pdf>
- Ohio: *Ohio Comprehensive Management Plan*. <http://anstaskforce.gov/ohiomgt.htm>
- Wisconsin: *Wisconsin's Comprehensive Management Plan: To Prevent Further Introductions and Control Existing Populations of Nonindigenous Aquatic Nuisance Species*. Wisconsin Department of Natural Resources. 2001.
http://www.dnr.state.wi.us/org/water/wm/glwsp/exotics/compplan_913_01.pdf