Model for a Natural Resources Agency
Risk Assessment and Risk Management Process

Mississippi River Basin Panel on Aquatic Nuisance Species
Working Draft Version
May 12, 2009

<u>Background and Purpose of Risk Assessment and Risk Management</u>

This model, risk assessment and risk management process (Process) has been developed as a tool for use by either agencies (natural resources and agricultural agencies may have regulatory authority), to determine classifications of species and need for management action, or by industries to self-regulate species they use. The Mississippi River Basin Panel on Aquatic Nuisance Species (Panel) developed this Process, so all members and associates could provide their expertise in development of it. Neither the entire process nor any part of it is compulsory for any agency or industry to adopt. The following steps outline the Process, which integrates the full range of risk assessment and risk management actions. The Panel reserves the opportunity to revise this Process as new information and approaches become available.

The "Rapid **Screening" process** (**Step 2** below) is defined as an approach taken to quickly and efficiently evaluate a list of species (from **Step 1** below), and then decide which are assessed as: 1) low risk of impact (i.e., no need for regulation, additional risk assessment, or other action, at this time), 2) high risk of impact (i.e., immediately take action by regulating, conducting outreach and/or education, managing in public waters, etc.), and 3) species for which a more detailed risk assessment is recommended (**Steps 3 and 4** below). Detailed "risk assessments" require much more in-depth analysis than is required for screening species, so screening is recommended to minimize the number of risk assessments that an agency will conduct. "Species" refers to any nonnative organism. **Steps 5-7** describe the development, implementation, and evaluation and adaptation of agency regulation and management approaches. The entire Risk Assessment and Risk Management Process is depicted in Figure 1).

"Nonnative" is defined as, with respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem (Executive Order 13112). An "invasive" species is one whose introduction does or is likely to cause economic or environmental harm or harm to human health. The Panel recognizes that many nonnative species are not invasive, and support human livelihoods or a preferred quality of life (National Invasive Species Council 2006).

This draft was developed and revised as the result of: 1) first draft sent to the Panel for review, 2) revision based on Panel comments, 3) revision suggestions from three working groups facilitated at a Panel workshop convened on January 24, 2008, 4) additional considerations by the leader of this project, 5) comments submitted by Panel Members during February and March 2008, and 6) additional work to search for tools to help in decisions that address questions in Step 2. The **Appendix** contains notes from discussions during the January 2008 Panel workshop to refine the version of this Process available then.

Our Panel recognizes that our Rapid Screening process is not validated. We are attempting to conduct this validation by partnering with research and management entities to comparatively evaluate our Rapid Screening process (Step 2) with any available from around the world. Our recommended validation approach will require: 1) constructing a data base of species (e.g., Introduced and established in U.S.; Potential invaders to U.S.; Unlikely to establish in U.S.; and Were introduced into U.S., but failed to establish self-sustaining populations), 2) convening a panel of experts who will run each screening process for each species in the data base, 3) analyzing results of expert screenings to determine accuracy and precision of species categorizations, and 4) either recommending approaches to developing a "gold standard" screening process, or actually developing that process. Screening processes that do not incorporate climate may be suited to only one area of the U.S. However, our process incorporates a climate tool, so our process is intended to be suited to the entire Mississippi River Basin (and actually anywhere on the planet).

Due to differences in agency rulemaking, we have not included, in the following steps, where stakeholder and public comments would be included in the rapid screening process. Also, how and when industries would involve their stakeholders will vary. One option for agencies is to develop memberships of public and stakeholder groups early in the screening process, and then rapidly receive their input after the screening is completed. These groups may provide valuable information for decision makers.

Step 1 – Identify Species for Screening

In this step, a list of aquatic plant and animal species will be developed, and then screening will be conducted (**Step 2**) using that list. That list will include species in each of the following categories.
- Is the species listed as injurious under the Lacey Act or recognized as a noxious plant by USDA?
- Is the species listed as restricted, invasive, etc., by a neighbour State or region?
- Nonnative species in the waters of the State or region that have not been reviewed
- Nonnative species that are in nearby States, Provinces, or regions that have been problematic
- Nonnative species that are problematic in areas of similar climate to the State or regions where this process is applied, and that are in high risk pathways
- Nonnative species ranked, by the applicable State Invasive Species Council or other similar entity, as potentially impacting ecosystems, economies, infrastructure, and human health
- Nonnative species either currently traded or proposed for trade in the State, neighbouring jurisdiction, or region

Step 2 – Rapid Screening Process

This step contains the recommended rapid screening process to assess risk. The process begins at Question 1, and directs the assessor through a series of questions (below, and see also **Figure**

2, which graphically depicts the Rapid Screening Process) to a conclusion about whether the species is low risk, high risk, or recommended for a more detailed risk assessment (**Steps 3 and 4**). The same questions should be answered in this Step and in the detailed risk assessment (**Step 4**).

The factors most positively correlated with species invasiveness are history of invasion, and climate-habitat matches of source and sink locations (Hayes and Barry 2008). Propagule pressure is a factor also positively correlated with species invasiveness, but the action of screening is intended to minimize or eliminate this pressure, so that factor will not be discussed further.

Decision-support tools that are appropriate for rapidly addressing the factors of history of species invasiveness and climate-habitat matches are:
- For history of species invasion - International Union for the Conservation of Nature (IUCN; In Preparation, 2008), Food and Agricultural Organization (2008), and Froese and Pauly (2008). Scientific literature about a species can be quickly assembled by searching Googlescholar (www.googlescholar.com), and then the most pertinent literature about species invasiveness should be read, synthesized, and documented. (Note: You can query the IUCN database, which is in preparation, by working through Mike Hoff [Michael_hoff@fws.gov, 612-713-5114].)
- For climate match - the Australia Bureau of Rural Sciences (2004)
- For river habitat match of source and sink locations - Department of Fisheries and Oceans Canada (In preparation).

Decision-support tools referenced above are ones known to be available at this time. As additional tools become available, they will be added to recommended tools associated with each question (and then this document will be updated).

Some situations may require only the most rapid and coarsest screening process supported by science. As stated above, the factors most positively correlated with species invasiveness are history of invasion and climate-habitat matches of source and sink locations (Hayes and Barry 2008). Therefore, the most rapid screening would address the questions of history of invasiveness, and climate-habitat match of source and sink locations. This screening process will only answer Questions 4 and 6, while using decision-support tools associated with those questions. In this most coarse screen, valuable information about regulations on the subject species will be included in the output.

Question:
1) Is there either a scientific basis (e.g., models, comparison with environmental variables in similar habitats, available risk assessments that are pertinent and applicable, and/or expert opinion) or enough other information to support a prediction that individuals of the species will survive (for any substantial time – not necessarily for the potential lifespan of the organism) in my State (or a neighbouring state or region)? (Yes/No/Unknown or Maybe) (The recommended tool for decision support include: Australia Bureau of Rural Sciences 2004, Froese and Pauly 2008).
   a) If Yes, then go to Question 2.

    b) If No, then the species is considered low risk, and the conclusion is reached that no management action (e.g., regulation) is needed, at this time.

    c) If unknown, then treat as Yes (Go to Question 2).

2) If climate change is accounted for, then is there enough information to support a prediction that individuals of the species could survive (for any substantial time – not necessarily for the potential lifespan of the organism) in my State (or a neighbouring state or region) at +2 degrees C conditions? (e.g., +2 degrees C mean temperatures in coldest month and warmest month 2 degrees higher than recent historic mean)(Yes/No/Unknown or Maybe) (Note: A recommended decision-support tool is Australia Bureau of Rural Sciences 2004, Froese and Pauly 2008.)

    a) If Yes, then go to Question 3.

    b) If No, then the species is considered low risk, and the conclusion is reached that no management action (e.g., regulation) is needed, at this time.

    c) If unknown, then treat as Yes (Go to Question 3).

3) Is there scientific basis that the organism is at risk to carry nonnative parasites or pathogens that are known to be detrimental? (Yes/No/Unknown or Maybe)

    a) If Yes, then either regulate trade, or require testing for parasites/pathogens prior to shipment.

    b) If No, then go to Question 4.

    c) If uncertain, then prioritize for a detailed risk assessment **(Step 3 below)**.

4) Is there either a scientific basis, or enough other information, to support a prediction that the species will develop self-sustaining populations in my State, neighbouring State, or region? (If climate change is accounted for, then will the species develop self-sustaining populations at +2 degrees C conditions? [e.g., mean temperatures in coldest month and warmest month 2 degrees higher than recent historic mean].) (Note: Recommended tools for decision support include: Department of Fisheries and Oceans Canada In preparation a, Kolar and Lodge 2002, Australia Bureau of Rural Sciences 2004, University of Kansas 2004, Phillips et al. 2006, Keller et al. 2007, Froese and Pauly 2008) (Yes/No/Unknown or Maybe)

    a) If Yes, then go to Question 6.

    b) If No, then go to Question 5.

    c) If uncertain, then prioritize for a detailed risk assessment **(Step 3 below)**.

5) Is there either a scientific basis, or enough other information, that non-reproducing populations of the species can cause substantial harm to the environment, economies, infrastructure, and human health (including as a carrier of a pathogen, or negatively impact Threatened, Endangered, or species of special concern)? (Note: Recommended decision-support tools include International Union for the Conservation of Nature In Preparation, 2008; Froese and Pauly 2008; Food and Agricultural Organization 2008) (Yes/No/Unknown or Maybe)

    a) If Yes, then take appropriate management action (e.g., regulate trade, and manage extant populations).

    b) If No, then the species is assessed as low risk, so no management action is needed at this time.

    c) If Unknown or Maybe, then prioritize for a detailed risk assessment **(Step 3 below)**.

6) Is there either scientific documentation, or enough other information that established, self-sustaining populations of the species can cause substantial environmental, economic, or infrastructural harm to the environment, economies, infrastructure, and human health

(including as a carrier of a pathogen, or negatively impact Threatened or Endangered species)? (Note: Recommended decision-support tools include International Union for the Conservation of Nature In Preparation, 2008; Froese and Pauly 2008; Food and Agricultural Organization 2008) (Yes/No/Unknown or Maybe)
   a) If Yes, then take appropriate management action (e.g., regulate trade, and manage extant populations).
   b) If No, then the species is assessed as low risk, so management action is not warranted at this time.
   c) If uncertain, then prioritize for a detailed risk assessment **(Step 3 below)**.

An alternate risk assessment process is available for freshwater fishes (Copp et al. 2005), and another alternate risk assessment process if available for plants. Another alternative risk assessment process is available for various taxa (Department of Fisheries and Oceans In Preparation b). However, those processes will probably not be completed rapidly. Certainly, using a second process for screening may either provide information supporting the initial screening results from the Panel's process, or may show a different result. Differing results from the two screenings support the need for a more detailed risk assessment.

Results of rapid screening should be accompanied by a qualitative description of screener certainty of risk categorization. For example, the screener may be highly certain, based on results of screening, that a species impact risk is either low or high. Screener certainty information will help guide the decision to regulate, self regulate, or not. As stated above, if a screener is highly uncertain, then the species should be considered for detailed risk assessment (**Step 3 below**).

Step 3 Prioritization for Detailed Risk Assessment

This step will prioritize the list of species recommended for detailed risk assessment **(result of Step 2)** using either the approach developed by the Aquatic Nuisance Species Task Force (1996) or another tenable approach (or more than one approach, if desired)**.** Detailed risk assessments **(Step 4)** will be conducted as staff and fiscal resources allow. The Panel directs the Prevention and Control Committee to develop a ranking system using criteria and weightings for those criteria. Some criteria include the following.
   • Is the species in the State or region (either in waters of the State or region, or presently traded)?
   • How many pathways (i.e., bait, live food, aquarium, water garden, aquaculture, or other) are used to trade or transport the species and fellow travelers?
   • What is the amount of the species in each pathway(s)?
   • What is the extent of potential geographic range (survival and recruitment) in the State or region?
   • What is the potential for significant, negative ecological impacts?
   • What is the potential for significant, negative economic impact?
   • What is the potential for significant, negative human health impacts?
   • Is there a scientific basis that the organism can be effectively and efficiently controlled **after introduction occurs**? Include cost-effectiveness of control mechanism.

- Is there a scientific basis that negative consequences of the importation/introduction can be effectively and efficiently **prevented**? (For example, importation of only triploid fish)
- Is a self-sustaining population established in a neighbouring State or interjurisdictional water body?
- What are the economic, social, etc., benefits of the species?
- Does the organism possess ease of movement via non-trade pathways (boats, animals, etc)
- Is the life history of the organism known and documented?

Step 4 –Agency Risk Assessment

In this step, detailed risk assessments will be conducted beginning with the highest priority species ranked in **Step 3**, and continuing until fiscal and staff resources are exhausted. The Panel considers it important to develop a set of recommended risk assessment approaches. Action to develop that set of approaches has not yet been taken by the Panel.

Three general approaches have been used to assess the risk of invasiveness. The three approaches listed below rely on identifying patterns in species traits that are predictive of invasion.
1. Statistical approaches (e.g., Keller et al. 2007, Kolar and Lodge 2002)
2. Quantitative questions (or trait ranking systems: e.g., Australian [Pheloung et al. 1999], New Zealand [Champion and Clayton 2000], and Florida (Gordon et al. 2008) weed and plant risk assessment tools), and
3. Detailed literature surveys, reviews, analysis and risk categorization (Aquatic Nuisance Species Task Force 1996).

The Panel recognizes that additional and alternative approaches are needed, and will facilitate and/or support development of those approaches, as our resources allow.

Step 5 – Develop Agency Actions to Regulate and Manage

In this step, agency actions, for each species that has been screened/assessed, can be recommended based on a decision tree or other decision support tool, but no such tool has been developed. Agency actions may include:
- Development of rules to designate species and infested waters
- Development of rules to prevent transport, trade, or use in waters of the State or region
- Development of management and control or program goals, objectives, strategies, and tactics
- Development of outreach and education programs

Step 6 -- Implement Agency Priority Actions

In this step, the agency will implement actions listed in **Step 5**.

Step 7 -- Evaluate Agency Actions, and Adapt Management Programs

In this step, the agency will evaluate the actions implemented in **Step 6**, and adapt programs as needed.

REFERENCES

Aquatic Nuisance Species Task Force. 1996. Generic Nonindigenous Aquatic Organisms Risk Analysis Review Process. Risk Assessment and Management Committee, Arlington, VA. (http://www.anstaskforce.gov/Documents/ANSTF_Risk_Analysis.pdf, accessed on October 7, 2008)

Australia Bureau of Rural Sciences. 2004. Climate. Canberra. (http://affashop.gov.au/product.asp?prodid=13506, accessed October 9, 2008)

Champion, P.D., and J. S. Clayton. 2000. Border control for potential aquatic weeds. Stage 1. Weed risk model. Science for Conservation No. 141, Department of Conservation Wellington, New Zealand.

Department of Fisheries and Oceans Canada. In preparation a. FRESHmap.

Department of Fisheries and Oceans Canada. In preparation b. Quantitative Risk Assessment Tool (QBRAT).

Food and Agricultural Organization. 2008. Database on Introductions of Aquatic Species (DIAS). Fisheries and Aquaculture Department. (http://www.fao.org/fishery/dias, accessed October 9, 2008)

Froese, R., and D. Pauly. Editors. 2008. FishBase. World Wide Web electronic publication. www.fishbase.org, version (07/2008). (accessed October 9, 2008)

Gordon, D. R., A. M. Fox, D.A. Onderdonk, and C. Gantz. 2008. IFAS Assessment – Predictive Tool. Florida Institute of Food and Agricultural Sciences. (http://plants.ifas.ufl.edu/assessment/, accessed on March 13, 2009)

Hayes, K. R., and S. C. Barry. 2008. Are there any consistent predictors of invasion success? Biological Invasions 10:483-506.

International Union for the Conservation of Nature. In preparation. Global register of invasive species. Invasive Species Survival Commission. University of Aukland, New Zealand.

International Union for the Conservation of Nature. 2008. Global invasive species database. Invasive Species Survival Commission. University of Aukland, New Zealand. (http://www.issg.org/database/welcome/, accessed October 9, 2008)

Keller, R. P., J. M. Drake, and D. M. Lodge. 2007. Fecundity as a basis for risk assessment of nonindigenous freshwater molluscs. Conservation Biology 21:191-200.

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

Morse, L. E., J. M. Randall, N. Benton, R. Heibert, and S. Lu. 2004. An invasive species assessment protocol: Evaluating non-native plants for their impact on biodiversity. Version 1. NatureServe, Arlington, VA.

(http://www.natureserve.org/library/invasiveSpeciesAssessmentProtocol.pdf, accessed on December 5, 2008)

National Invasive Species Council. 2006. Invasive species definition and clarification guidance white paper. Definitions Subcommittee of the Invasive Species Advisory Committee. (http://www.invasivespeciesinfo.gov/docs/council/isacdef.pdf, accessed on March 10, 2008)

Pheloung, P. C., P. A. Williams, S. R. Halloy. 1999. A weed risk assessment model for use as a biosecurity tool evaluating plant introductions. Journal of Environmental Management 57:239-251.

Phillips, S. J. R. P. Anderson, and R. E. Schapire. 2006. Maximum entropy modeling of species geographic distributions. Ecological Modeling 190:231-259.

University of Kansas. 2004. Desktop GARP. (http://www.nhm.ku.edu/desktopgarp/Download.html, accessed October 9, 2008)

Figure 1. Flow chart summarizing the entire risk assessment and risk management process described in Steps 1-7.
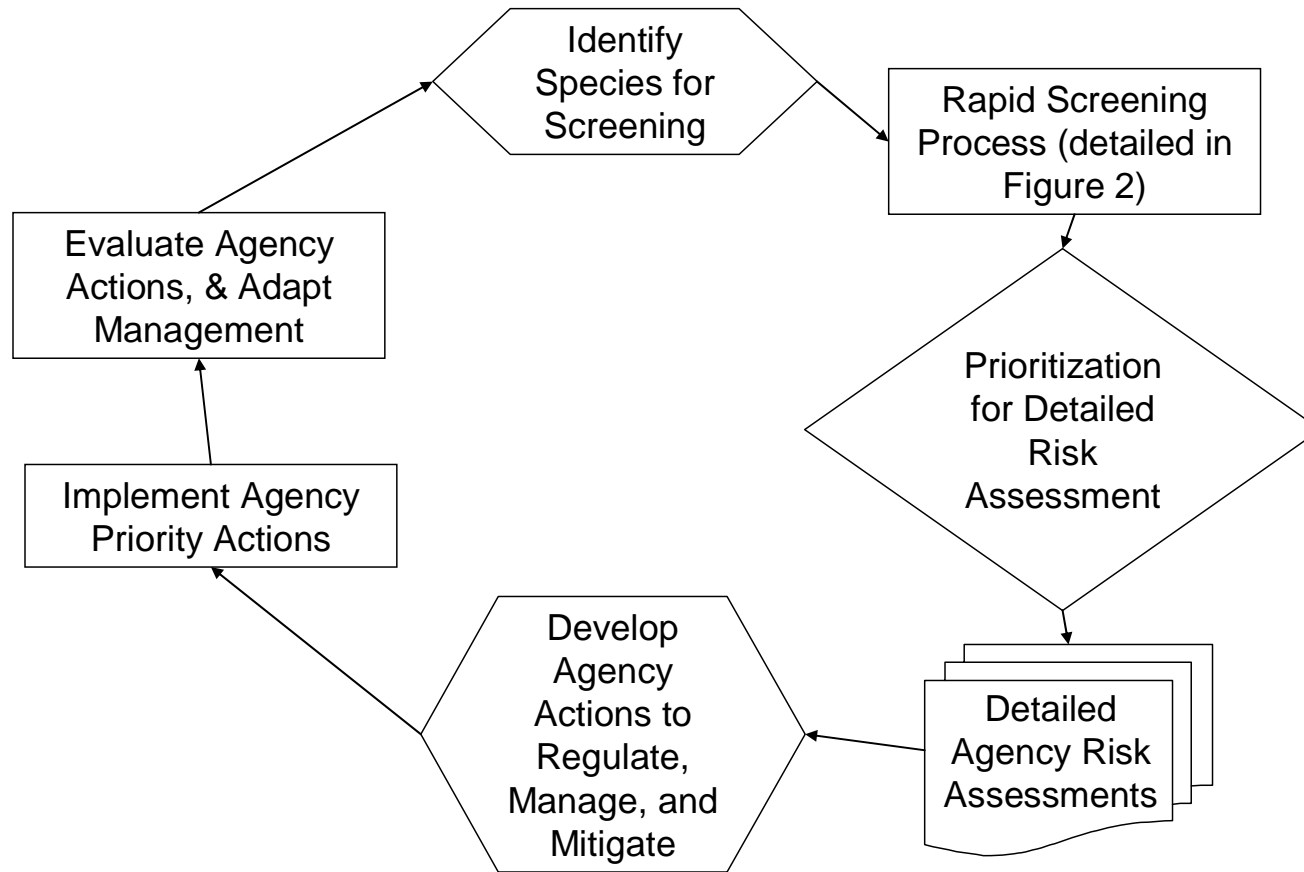
Figure 2. Flow chart summarizing the rapid screening process described in Step 2.