Summary of Major Revisions to the April 2006 Draft Asian Carp Management and Control Plan

Revisions made to the April 2006 draft and reflected in the final October 2007 revised draft include a large volume of minor changes (additions, deletions, updates, corrections, and formatting) and the following major changes. Major revisions are presented by page number to help locate the revision in the October 2007 draft. Corresponding page numbers in the April 2006 draft are included where appropriate.

CHAPTER 3

Goal 1: Prevent Introductions

- **Page 35:** Pathways and risk levels were proposed based on the opinion of the prevention section drafting team. A proposed risk level was included with each pathway in the first draft (page 30 in April 2006 draft). Although the full Working Group agreed with all 22 pathways, there was agreement with only 6 of the 22 pathway risk levels proposed by the prevention section drafting team. The revised plan includes pathway risk levels for only the 6 pathways with broad agreement within the Working Group.

- **Page 37:** The following new recommendation was added under the pathway addressing 'Activities Related to Wild-caught Baitfish':

  Recommendation 3.1.1.2. Explore the use of baitfish grown in monoculture, and certified to be disease-free and uncontaminated by other aquatic species.

  Baitfish grown in monoculture, and certified disease-free and uncontaminated by other aquatic species may provide states with an alternative to the risks associated with wild baitfish harvest and transfer. Natural resources management agencies and aquaculturists should work together to explore the feasibility of producing, certifying, and shipping monocultured baitfishes as alternatives to wild-harvested baitfish.

- **Page 46:** The first draft divided the importation of Asian carps into the United States into two categories: commercial use and non-commercial use (page 40 in April 2006 draft). Two strategies were used to address these different categories [Strategy 3.1.9 'Take actions to prevent the importation of bighead, black, grass, and silver carps into the United States for "non-commercial use" (e.g., Internet sales and direct shipments from foreign sources to end users)' and Strategy 3.1.10 'Take actions to prevent the illegal importation and prohibit the legal importation of live bighead, black, grass, and silver carps for commercial use in the United States']. However the recommendations for the two strategies were the same and the two strategies were combined into a single strategy in the revised plan (Strategy 3.1.9 'Take actions to prevent the illegal importation and prohibit the legal importation of live bighead, black, grass, and silver carps into the United States'). Combining these two strategies resulted in the deletion of Strategy 3.1.10 from the plan.

- **Page 52:** Recommendation 3.1.15.10 *'UNRESOLVED ISSUE: Use of triploid black carp on aquaculture facilities'* was deleted from the plan as a Working Group recommendation (page 50 in April 2006 draft). The issue is now presented only as an 'unresolved issues' under Strategy 3.1.14 'Reduce potential risks of continued use of Asian carps on properly sited aquaculture facilities to the environment' and includes a brief explanation of the issue and why it remains unresolved. A detailed discussion of the unresolved issue is presented in

new Appendix 6.3 and includes several potential alternatives, along with some of the positive and negative aspects of each, for consideration by natural resources management policy and decision makers. The revised unresolved issue follows:

<u>UNRESOLVED ISSUE: Use of triploid black carp on aquaculture facilities.</u>

The Working Group was not able to reach consensus on recommendations regarding the use of triploid black carp on aquaculture facilities. Working Group members agreed that the desired endpoint is to have no black carp in use on aquaculture facilities (or in the wild), but did not agree on how long it should take to reach this endpoint. The Working Group also agrees that because black carp are not yet established in the wild, research to identify feasible alternatives to black carp for snail control is the highest priority research need and that all stakeholders should be actively pursuing alternatives to black carp.

Many members of the Working Group support an approach that discourages the use of all black carp, but until feasible alternatives are proven and available for snail control, certified triploid black carp (100% inspected/retested) would be permitted with appropriate controls for containment. The use of triploid black carp would require research to verify the functional sterility of black carp, a triploid inspection and certification program for black carp, and adequate and redundant controls for containment (see 3.1.14.1). Concurrent research for feasible alternatives to black carp for snail control is needed. However, there was disagreement on where triploid black carp should be permitted. Some members agreed that the limited use of triploid black carp should be restricted to the states and locations where black carp are currently produced or stocked (i.e., Arkansas, Mississippi, Missouri, and North Carolina), while others desire that triploid black carp should remain an option to any aquaculture facility that encounters the need for snail control. There was also disagreement on how long triploid black carp should be allowed in the absence of feasible alternatives.

Other members of the Working Group oppose even limited use of triploid black carp because six black carp have been collected (many more unconfirmed reports) from the Mississippi River Basin and because of the potential effects of introduced individuals or reproducing populations of black carp on imperiled native mussels. These members support an approach that prohibits the use of all black carp and the immediate application of all available resources to developing a solution to the problem of snail control, as opposed to validating a tool (i.e., triploid black carp) that is a risk to imperiled mussels. To prevent the black carp from becoming established in rivers of the United States, temporary subsidies to farmers for losses due to inadequate snail control may be warranted.

A detailed discussion on this unresolved issue and several potential alternatives regarding the use of triploid black carp on aquaculture facilities, along with some of the positive and negative aspects of each alternative, are presented in Appendix 6.3 for consideration by natural resources management policy and decision makers.

- **Page 53:** Recommendation 3.1.15.4 ‘States should encourage the use of only certified triploid grass carp on aquaculture facilities within watersheds where grass carp are self-sustaining in the wild’ (page 48 in April 2006 draft) was deleted from the plan as a Working Group recommendation and was added as a new unresolved issue under Strategy 3.1.14 ‘Reduce potential risks of continued use of Asian carps on properly sited aquaculture

facilities to the environment.' A detailed discussion of the unresolved issue is presented in new Appendix 6.4 and includes several potential alternatives, along with some of the positive and negative aspects of each, for consideration by natural resources management policy and decision makers. The new unresolved issue which includes a brief explanation of the issue and why it remains unresolved follows:

UNRESOLVED ISSUE: Use of grass carp on aquaculture facilities in watersheds with self-sustaining populations of grass carp.

The Working Group was not able to reach consensus on recommendations regarding the use of grass carp on aquaculture facilities in watersheds with self-sustaining populations of grass carp.

Some Working Group members support an approach consistent with recommendations addressing the use of grass carp on aquaculture facilities in watersheds where grass carp are absent or present but not reproducing. These members believe that the introduction of additional fish with reproductive potential exacerbates and directly conflicts with efforts to control feral populations. Therefore, at a minimum, states should encourage the use of triploid grass carp in watersheds with self-sustaining populations of grass carp.

Other members support the use of diploid grass carp in watersheds with self-sustaining populations of grass carp and do not believe that states should encourage or require the use of triploid grass carp on aquaculture facilities. The effect of requiring triploid rather than diploid fish will be felt by consumers (public and private) that are currently allowed to purchase diploid grass carp for vegetation control, and could have a substantial economic burden on some private aquaculturists who use large numbers of these fish. The majority of commercial aquaculture facilities are not connected directly to open waterways and the additional costs will only prevent the addition of a relatively few fish with reproductive potential to an already established population.

A detailed discussion on this unresolved issue and two potential alternatives regarding the use of grass carp on aquaculture facilities in watersheds with self-sustaining populations of grass carp are presented in Appendix 6.4 for consideration by natural resources management policy and decision makers.

- **Page 62:** Recommendation 3.1.18.1 *'UNRESOLVED ISSUE: Commercial, domestic transport of live farm-raised bighead and grass carps'* was deleted from the plan as a Working Group recommendation (page 59 in April 2006 draft). The issue is now presented only as an 'unresolved issues' under Strategy 3.1.17 'Reduce the potential risk to the environment from continued commercial, domestic transport of live farm-raised Asian carps' and includes a brief explanation of the issue and why it remains unresolved. A detailed discussion of the unresolved issue is presented in new Appendix 6.5 and includes several potential alternatives, along with some of the positive and negative aspects of each, for consideration by natural resources management policy and decision makers. The revised unresolved issue follows:

UNRESOLVED ISSUE: Commercial, domestic transport of live farm-raised bighead and grass carps.

The Working Group was not able to reach consensus on recommendations regarding all aspects of commercial, domestic transport of live farm-raised bighead and grass carps. Working Group members agreed that any commercial transport of live fish should be conducted with adequate controls to minimize escapes (Strategy 3.1.16) and with the requirement that all fish are killed at the point of sale, with the exception of authorized stockings of grass carp to control nuisance aquatic vegetation. As with other pathways, recommendations to address live transport were considered based on whether or not bighead and grass carps are absent, present without evidence of natural reproduction, or are self-sustaining in the wild.

<u>Watersheds where bighead and/or grass carps are self-sustaining in the wild:</u>
Working Group members agreed that commercial live transport of bighead and grass carps is acceptable within watersheds where these species are self-sustaining in the wild. However, the Working Group did not agree on whether or not live transport within these watersheds should be limited to certified triploid fish only or if diploid fish should be permitted.

<u>Watersheds where bighead and/or grass carps are absent or are not self-sustaining in the wild:</u>
Some Working Group members suggested that to prevent introductions or range expansions of these species, commercial live transport should be prohibited within any watershed where bighead and grass carps are not self-sustaining. Some members support prohibiting commercial live transport where the fish are completely absent in the wild, but allowing certified triploids to be live-hauled within watersheds where the fish are present but not self-sustaining. Other members support commercial live transport of certified triploids within watersheds where the fish are completely absent in the wild. Some members suggested that the commercial live transport of diploid bighead and grass carps should be permitted within any watershed.

A detailed discussion on this unresolved issue and several potential alternatives regarding the commercial transport of live bighead and grass carps, along with some of the positive and negative aspects of each alternative, are presented in Appendix 6.5 for consideration by natural resources management policy and decision makers.

- **Page 64:** The following new recommendation was added under the pathway addressing 'Accidental and Deliberate Unauthorized Releases by Individuals':

  Recommendation 3.1.18.5. Promote the national Aquatic Nuisance Species Hotline and encourage the general public to report illegal possession or stocking of Asian carps and other activity that could affect an introduction or rapid response.

  The general public can have an active role in helping to prevent accidental or deliberate unauthorized introductions of Asian carps. The USFWS sponsors a national Aquatic Nuisance Species Hotline (877-STOP- ANS). The hotline can be used to report sightings of new or unusual species of plants, animals, or other organisms. The hotline should be actively promoted to the general public as a tool for reporting possession, stocking, or other activity that could effect an introduction of Asian carps or other aquatic nuisance species. Reports that prevent an introduction or lead to rapid response actions should be publicized. States may want to consider developing programs of incentives to

encourage the general public to be aware of aquatic nuisance species issues and to take action to prevent their introduction.

- **Page 66:** The following new recommendation was added under the pathway addressing 'Research and Educational Facilities':

  Recommendation 3.1.20.3. Encourage states to prohibit the trade of live Asian carps by commercial biological supply companies.

  Currently there is no known trade of Asian carps by commercial biological supply companies. State regulations that prohibit the import and trade of Asian carps by commercial biological supply companies are needed to prevent such trade from occurring in the future. This recommendation should have no adverse effects on the biological supply industry and is an effective, proactive control for a potential pathway of introduction.

<u>Goal 2: Contain Expansion of Feral Populations</u>

- **Page 77:** Strategy 3.2.5 and Recommendation 3.2.5.1 were modified to address the need to develop systems to identify the location of captive stocks of Asian carps in addition to the original wording which only addressed development of systems to notify appropriate agencies in the event of escapement (page 75 in April 2006 draft). The revised strategy and recommendation follows:

  Strategy 3.2.5. Develop systems to identify the location of captive stocks of Asian carps and for the notification of appropriate agencies in the event of escapement.

  State laws and regulations govern possession, culture, and sale of native and nonnative fishes. Each state has developed laws, rules, and policies relative to nonnative species. States should establish systems to identify the location of captive stocks of Asian carps within their jurisdiction. States that do not prohibit Asian carps may or may not require a nonnative species license and/or reporting. Licensing and reporting can be valuable tools to allow states to track nonnative species within their jurisdiction. To achieve basin-wide reporting, states are encouraged to develop a license and reporting system and coordinate their regulatory efforts regionally, and nationally. At a minimum, states should require the reporting of escaped Asian carps. A central coordination mechanism is needed so information is rapidly and widely available and to initiate a rapid response. Existing infrastructure such as the USGS Nonindigenous Aquatic Species Alert System (http://nas.er.usgs.gov/AlertSystem/default.asp) and USFWS sponsored national Aquatic Nuisance Species Hotline (1-877-STOP-ANS) may prove sufficient mechanisms, or starting points, if utilized fully.

  Recommendation 3.2.5.1. Encourage states to identify the location of captive stocks of Asian carps and to develop a communication network for the reporting of escapees.

  States should establish systems to identify the location of captive stocks of Asian carps at both private and public facilities within their jurisdiction. States should be encouraged to require the reporting of escaped Asian carps, particularly in waters where feral Asian carps are not established. A communication network with regulatory agencies, private aquaculture, and public facilities possessing Asian carps should be developed for the

reporting of escapees. Information awareness campaigns should be implemented to create awareness about the need to contain Asian carps, as well as how and why to report escaped fish. Reporting programs for escaped Asian carps should be linked to rapid response assessment programs and in such cases should be mandatory. Management agencies that regulate the possession of Asian carps should collaborate, potentially under the auspices of the ANS Task Force Regional Panels.

Goal 3: Extirpate or Reduce Abundances of Feral Populations

- **Page 86:** The following new strategy and recommendation were added to address physical removal of feral Asian carps by natural resources management agencies:

  Strategy 3.3.4. Physical removal by natural resources management agencies.

  Natural resources management agencies, universities, and others regularly sample aquatic organisms and their habitats. Asian carps are collected as both targeted and non-targeted catch during fisheries surveys, silver carp frequently jump and land in work boats, and specific actions may be implemented to target Asian carps for removal from distinct locations.

  Recommendation 3.3.4.1. Biologists should physically remove Asian carps collected as a result of management actions or research.

  Natural resources management agencies, universities, and others should review policies and protocols regarding the collection and release of aquatic nuisance species. In most situations it is highly undesirable to release live Asian carps and other aquatic nuisance species back to the wild following capture, with the exception of certain research projects which require the release of live individuals for study results. Protocols are warranted for the constructive use or humane destruction and appropriate disposal of aquatic nuisance species collected as a result of management actions or research.

Goal 6: Research

- **Page 105:** Research needs were refined from 4 broad categories to 6 categories for clarification. An original strategy was modified (Strategy 3.6.2 'Develop effective sampling and control methods for all life stages of Asian carps in both standing and flowing water environments'; page 103 in April 2006 draft) and two new strategies were added. Recommendations were re-aligned to better fit with the new strategies and no new recommendations were added to these sections. The modified and new strategies follow:

  Strategy 3.6.1. Develop effective sampling gears and monitoring methods for all life stages of Asian carps in both standing and flowing water environments.

  Development of scientifically sound and cost-effective sampling methods is essential to all aspects of management, control, and research of Asian carps. Sampling techniques are needed that provide natural resources managers with a high level of confidence (i.e., statistically meaningful) in the information collected about feral populations of Asian carps. Methodologies need to be evaluated to understand how well samples represent the entire population (i.e., accuracy), how repeatable the sampling results are (i.e., precision), and to understand biases associated with the collected data.

Strategy 3.6.3. Develop effective methods to contain feral Asian carp populations and prevent their further spread.

The need for effective barriers to prevent the continued spread of Asian carps into uninhabited waters is a high priority and requires more complete biological and physiological information about these fishes (Recommendation 3.6.1.4).

Strategy 3.6.4. Develop an integrated management strategy to extirpate or reduce abundances of feral Asian carps.

To control distribution and, where possible, reduce abundances or eliminate unwanted populations, techniques to eradicate or reduce abundances of all life stages of Asian carps are needed. Population control methods (physical, chemical, biological, and molecular) need to be developed to reduce the abundance of Asian carps, without unintended effects on native species and their habitats. Field assessments and predictive models that estimate effects of various control measures are needed. As developed, population control strategies should be integrated into a single management strategy to maximize effectiveness of available technologies.

- **Page 109:** The following revised recommendation was changed substantially from its original form (Recommendation 3.6.2.5 'Evaluate the potential for commercial harvest of feral Asian carps to control their abundance in public waters'; page 104 in April 2006 draft).

Recommendation 3.6.4.3. Evaluate the potential for physical removal of feral Asian carps to control their abundance in public waters.

Commercial and recreational fishers, and natural resources managers and researchers make targeted and untargeted collections of Asian carps. Managers have experimented with several methods (e.g., herding, angling, attracting, lift nets, and toxic fish baits) for removing grass carp from lake systems, however all techniques failed to remove a major portion of the carp population (Hoyer et al. 2005). Preliminary modeling of the bighead carp population in portions of the Illinois (LaGrange Pool) and Mississippi (Pool 26) rivers indicates that controlling adult stock size (not to exceed 0.05 adults/unit of fishing effort) will reduce recruitment and adult abundance over the long term (Hoff et al. *In press*). More research in this vein is needed.

Development of commercial uses of Asian carp biomass potentially could reduce abundance in the wild and concurrently provide useful products. A limited market currently exists for bighead carp as human food, but this specialized, ethnic market prefers purchase of live fish. Proposals have been made to commercially harvest Asian carps for pet foods, fish meal, surimi, and bio-fuel. Additional research will be needed to evaluate market acceptance of wild-caught, processed (e.g., dressed whole, fillets, smoked) Asian carps (Recommendation 3.6.4.2). If attractants can be developed, catches would increase, thereby benefiting commercial fishers while further reducing Asian carp populations. Additional research is needed to confirm the potential bioaccumulation of persistent toxins in these fishes and their suitability for human consumption, use as fish meal in aquaculture, and use as feedstuffs and fertilizers in agriculture (Recommendation 3.3.2.6).

- **Page 110:** The following revised recommendation was changed substantially from its original form (Recommendation 3.6.3.3 'Conduct analyses of economic effects'; page 106 in April 2006 draft).

  Recommendation 3.6.5.3. Conduct analyses of economic effects of feral bighead, black, and silver carps.

  Economic analysis is defined as "the study of how best to use limited means to pursue unlimited ends" (Baumol and Blinder 2005). Given the reality that "virtually all resources are scarce, choices must be made among a limited set of possibilities." Economics is the discipline that provides the framework for quantifying the possible outcomes of various decisions that affect the allocation of resources.

  In the context of economic analyses related to the issue of Asian carps, there are three basic questions that were discussed within the Working Group. These are:

  1. What are the economic value and effect of feral Asian carp populations?

  2. What are the economic value and effect of the commercial production and trade in Asian carps?

  3. What are the economic trade-offs associated with alternative policy options proposed for management and control of Asian carps?

  Research to quantify the economic value and effect of feral Asian carp populations will require a comprehensive effort that addresses the topic on a variety of levels. Economic value is estimated by quantifying both benefits and costs from perspectives of both the current situation and likely future scenarios. Economic costs to be estimated would include efforts to prevent unintentional distribution and spread; construction, operation, and maintenance of barriers to prevent dispersal; management efforts to reduce population abundances; any negative changes in landings of commercial harvests of other species; declines in recreational use of waters with jumping silver carp (e.g., declines in sport fishing and boating activities); personal injury; damage to watercraft; and breakage or loss of equipment. Economic benefits to be estimated would include the value of aquatic vegetation control by grass carp, sales of bighead and silver carp harvested, any positive changes in landings of other species (if such were the case) and recreational value of new Asian carp related activities (e.g., bowfishing and tours to view jumping silver carp). A comprehensive economic analysis would also include environmental benefits and costs. Environmental costs would occur if negative effects were to occur on imperiled species, native fishes, and water quality; environmental benefits would occur if positive effects occurred to those resources. A careful economic analysis would select the most appropriate valuation method for each variable and would likely include both market and non-market valuation techniques. Economic effects would be measured through impact analyses. There are two broad categories of analytical techniques to measure economic impacts: input-output analysis and social welfare analysis. Greater detail on these two categories and on specific analytical models, data requirements, and estimation procedures can be found from the Minnesota IMPLAN Group Inc. (2005) for input-output analysis and in Green (2000) for social welfare analysis. Comprehensive impact studies measure direct and indirect effects to various economic sectors, in other words, which sectors benefit and which sectors bear the greater cost burdens.

Research to quantify the economic value and effect of the commercial production and trade in Asian carps similarly would quantify the benefits and costs associated with production, transport, and sale of Asian carps. Economic benefits would include the revenue received at each stage in the supply chain and costs would include production inputs, labor, and management. Additional costs to other sectors to prevent and address unintentional introductions should also be considered. Economic effects would be measured through impact analyses as described above.

Research to quantify the economic trade-offs associated with alternative policy options proposed for management and control of Asian carps would draw upon the impact analyses described above. Various policy options proposed for the management and control of Asian carps would be modeled. These models would then be used to estimate the overall economic effect as well as differential economic effects to various geographic sectors, industry sectors, and user group sectors. Policy options to be analyzed would include those described in this plan, including analysis of various monitoring options and eradication alternatives as well as proposals to prohibit the sale of live fish, mandatory use of triploid bighead and grass carps, and prohibit the use of black carp.

APPENDICES

- **Page 160:** New Appendix 6.1 'Summary of State Regulations Pertaining to Asian Carps' was added at the request of the ANS Task Force following the presentation of the April 2006 draft at the May 2007 meeting in Erie, PA.

Appendix 6.1. Summary of State Regulations Pertaining to Asian Carps.

Some states prohibit or restrict the possession of certain species of Asian carps. State regulations pertaining to bighead, black, grass, and silver carps were obtained by contacting state natural resources management agencies and/or reviewing regulations posted on agency websites. Many states prohibit or restrict all stockings of any fish species into public waters. State regulations pertaining to the import, possession, or stocking of Asian carps in private waters were categorized as either prohibited, restricted (i.e., permit required), or not restricted (i.e., permit not required) and summarized in Table 6.1.1. State regulations for each species vary from prohibited to not restricted (Figures 6.1.1, 6.1.2, 6.1.3, and 6.1.4). Some states that restrict possession of Asian carps by approved permits effectively prohibit possession by only issuing permits under very limited circumstance (e.g., approved scientific research).

Information included in this appendix was current as of August 2007. The information included in this appendix summarizes state regulations, however many states have very specific requirements. States should be contacted for full regulations prior to purchasing, shipping, or stocking Asian carps (or any aquatic organism).

Table 6.1.1. Summary of state regulations pertaining to import, possession, or stocking of bighead, black, grass, and silver carps in private waters (as of 8/2007). Regulations are categorized as either prohibited, restricted (i.e., permit required), or not restricted (i.e., permit not required).

State	Summary of State Regulations by Species
Alabama	**Bighead, silver, and grass carp are not restricted** (i.e., No regulations or restrictions for these species.) **Black carp are restricted** (i.e., Possession and import are restricted to accredited educational facilities, research facilities, and permitted rehabilitation facilities by permit.)
Alaska	**Bighead, black, and grass carp are restricted** (i.e., A permit is required to transport, possess, export, or release live specimens.) **Silver carp are prohibited** (i.e., A person may not import, own, possess, breed, transport, distribute, release, purchase, or sell live specimens.)
Arizona	**Bighead, silver, black, and diploid grass carp are restricted** (i.e., A permit is required to import, possess, or transport live specimens.) **Triploid grass carp are restricted** (i.e., Only triploid grass carp can be stocked.)
Arkansas	**Bighead and silver carp are restricted** (i.e., A permit is required to possess live specimens.) **Diploid black carp are restricted** (i.e., A permit is required to possess live diploid specimens.) **Triploid black carp are not restricted** (i.e., A permit is not required to import or trade live triploid specimens for aquaculture purposes.) **Grass carp are not restricted** (i.e., A permit is not required to possess, import, or trade live specimens for aquaculture purposes.)
California	**Bighead and silver carp are restricted** (i.e., A permit is required for importation, transportation, or possession of live specimens.) **Black carp are not restricted** (i.e., A permit is not required for importation, transportation, or possession of live specimens.) **Triploid grass carp are restricted** (i.e., A permit is required for importation, transportation, or possession of live specimens. Diploid grass carp are prohibited.)
Colorado	**Bighead, silver, and black carp are restricted** (i.e., A permit is required to import, transport, possess, or release live specimens.) **Grass carp are restricted** (i.e., A permit is required to import, transport, possess, or release grass carp. Only certified triploid grass carp may be stocked West of the continental divide and in the headwaters of the Colorado and Rio Grande rivers.)
Connecticut	**Bighead, silver, and black carp are restricted** (i.e., A permit is required to posses or import live specimens.) **Triploid grass carp are restricted** (A permit is required to possess, import, or liberate live specimens. Diploid grass carp are prohibited.)
Delaware	**Bighead, silver, and black carp are not restricted** (i.e., A permit is not required for any live specimens.) **Triploid grass carp are restricted** (i.e., A permit is required to import, possess, or liberate triploid grass carp.)

Table 6.1.1. Continued.

State	Summary of State Regulations by Species
Florida	**Bighead, silver, black carp, and their hybrids are conditionally restricted** (i.e., A permit is required to possess live specimens and specific production system conditions are imposed that regulate culture to prevent escape or unauthorized public access.) **Grass carp are conditionally restricted** (i.e., An assessment is made by state or local governments concerning whether triploid grass carp may be stocked and a specific stocking rate is determined prior to the issuance of a permit to take, possess, sell or otherwise transfer, buy or otherwise receive, transport, or stock grass carp.)
Georgia	**Bighead and silver carp are restricted** (i.e., A permit is required to possess live specimens.) **Black carp are not restricted** (i.e., A permit is not required to possess live specimens.) **Grass carp are restricted** (i.e., A permit is required to possess grass carp. Only triploid grass carp may be sold or stocked.)
Hawaii	**Bighead, silver, black, and grass carp are restricted** (i.e., A permit is required to import or possess live specimens.)
Idaho	**Bighead, silver, black, and grass carp are restricted** (i.e., A permit is required to import, propagate, or possess live specimens.)
Illinois	**Black carp, bighead carp, silver carp are restricted** species (i.e., A permit is required to "transport, stock, import, or possess" live specimens.) **Diploid and triploid grass carp are restricted** (i.e., A permit is required to possess live diploids in aquaculture facilities [for the production of triploids]. A permit is required to either ship or stock live triploids.
Indiana	**Black carp, bighead carp, and silver carp are restricted** species (i.e., A permit is required to "transport, stock, import, or possess" live specimens.) **Grass carp is a restricted species** (i.e., Triploids may be stocked in lakes and ponds. A permit is required to possess live diploids).
Iowa	**Black, bighead, and silver carp are restricted** species (i.e., A permit is required to "possess, introduce, import, purchase, sell, barter, propagate, or transport" specimens "in any form" (i.e., live or dead). **Grass carp are not restricted** (i.e., diploid and triploid grass carp may be possessed or stocked without a permit).
Kansas	**Bighead, silver, and black carp are restricted** (i.e., A permit is required to import or possess live specimens.) **Grass carp are not restricted** (i.e., A permit is not required to import or possess live specimens.)
Kentucky	**Bighead, silver, and black carp are restricted** (i.e., A permit is required to sell, possess, import, use, or release live specimens.) **Grass carp are restricted** (i.e., A permit is required to possess, import, sell, or propagate diploid grass carp. Only triploid grass carp can be stocked.)
Louisiana	**Bighead, silver, and black carp are restricted** (i.e., A permit is required to import or possess live specimens.) **Grass carp are restricted** (i.e., A permit is required to possess or sell grass carp. Only triploid grass carp can be stocked.)

Table 6.1.1. Continued.

State	Summary of State Regulations by Species
Maine	**Bighead, silver, black, and grass carp are restricted** (i.e., A permit is required to introduce, import, or transport live specimens.)
Maryland	**Bighead, silver, black, and grass carp are restricted** (i.e., A permit is required to import, transport, purchase, possess, propagate, or sell live specimens. A permit is not required for dead specimens.)
Massachusetts	**Bighead, silver, black, and grass carp are restricted** (i.e., A permit is required to import, transport, purchase, possess, propagate, liberate, or sell live or dead specimens.)
Michigan	**Black, bighead, grass, and silver carp (and hybrids) are restricted species** (i.e., A permit is required to possess or release live specimens).
Minnesota	**Bighead, black, grass, and silver carp are restricted** (i.e., A permit is required to "possess, sell, import, purchase, transport, or introduce" live and dead specimens.)
Mississippi	**Bighead, silver, black, and grass carp are restricted** (i.e., A permit is required to stock, place, release, possess, or import live specimens.)
Missouri	**Black and silver carp are restricted** species (i.e., A permit is required to culture diploids of these species. Certified triploid black carp can be cultured without a permit. A permit is not required to buy, sell, transport, take, or possess either live or dead silver carp.) **Bighead and grass carp not restricted** species (i.e., A permit is not required to buy, sell, transport, propagate, take, or possess either live or dead specimens).
Montana	**Bighead, silver, black, and grass carp are restricted** (i.e., A permit is required to possess live specimens.)
Nebraska	**Bighead, silver, and grass carp are restricted** (i.e., A permit is required to possess, sell, export, or transport live or dead specimens.) **Black carp are not restricted** (i.e., A permit is not required to possess, sell, export, or transport live or dead specimens.)
Nevada	**Bighead, silver, and black carp are restricted** (i.e., A permit is required to import, transport, or possess live specimens.) **Grass carp are restricted** (i.e., A permit is required to import, transport, or possess diploid grass carp. Only triploid grass carp can be stocked.)
New Hampshire	**Bighead, silver, and black carp are restricted** (i.e., A permit is required to import, display, propagate, or possess live or dead specimens. The release of these species is prohibited.)
New Jersey	**Bighead, silver, black, and grass carp are prohibited** (i.e., The release or stocking of any live specimen is prohibited.)

Table 6.1.1. Continued.

State	Summary of State Regulations by Species
New Mexico	**Bighead, silver, and black carp are restricted** (i.e., A permit is required to import, transport, or possess live specimens.) **Grass carp are restricted** (i.e., A permit is required to import, transport, or possess live specimens.)
New York	**Bighead, silver, and black carp are restricted** (i.e., A permit is required to sell, possess, transport, import, or export live or dead specimens.) **Grass carp are restricted** (i.e., A permit is required to import, export, own, possess, acquire, or dispose of live or dead specimens. Only triploid grass carp can be stocked.)
North Carolina	**Bighead and silver carp are not restricted** (i.e., A permit is not required to transport, purchase, possess, or sell live specimens.) **Black carp are restricted** (i.e., A permit is required to transport, purchase, or possess triploid black carp.) **Grass carp are restricted** (i.e., A permit is required for triploid grass carp to be bought, possessed, and stocked locally. Diploid grass carp are prohibited.)
North Dakota	**Bighead, silver, black, and grass carp are restricted** (i.e., A permit is required to possess, transport, or stock live specimens.)
Ohio	**Black, bighead, silver, and diploid grass carp and their hybrids are restricted** (i.e., A permit is required to possess, import, sell, or stock live specimens). **Triploid grass carp are restricted** (i.e., A permit is required to import or sell "certified" triploid grass carp).
Oklahoma	**Bighead, silver, and black carp are restricted** (i.e., A permit is required to possess live specimens for research purposes only.) **Grass carp are restricted** (i.e., A permit is required to possess, import, or stock grass carp into private waters.)
Oregon	**Bighead, silver, and black carp are restricted** (i.e., A permit is required to possess, import, sell, purchase, or transport live specimens.) **Triploid grass carp are restricted** (i.e., A permit is required to possess, stock, or import only triploid grass carp.)
Pennsylvania	**Bighead, silver, and black carp are prohibited** (i.e., It is illegal to import, stock, or possess live specimens.) **Grass carp are restricted** (i.e., Diploid grass carp are prohibited. A permit is required to import, stock, or possess triploid grass carp.)
Rhode Island	**Bighead, silver, black, and grass carp are restricted** (i.e., A permit is required to stock live specimens.)
South Carolina	**Bighead, silver, and black carp are restricted** (i.e., A permit is required to import, possess, transport, or stock live specimens.) **Grass carp are restricted** (i.e., A permit is required to possess reproducing grass carp for display or scientific purposes. A permit is required for stocking non reproducing grass carp.)

Table 6.1.1. Continued.

State	Summary of State Regulations by Species
South Dakota	**Bighead, silver, and black carp are restricted** (i.e., A permit is required to possess, propagate, or stock live specimens.) **Triploid grass carp are restricted** (i.e., A permit is required to possess triploid grass carp. Diploids are prohibited.)
Tennessee	**Bighead, silver, and black carp are restricted** (i.e., A permit is required to import or possess live specimens.) **Grass carp are restricted** (i.e., A permit is required to import and possess diploid grass carp. A permit is not required to import or possess triploid grass carp.)
Texas	**Bighead, silver, and black carp are restricted** (i.e., A permit is required to possess, propagate, transport, or sell live specimens.) **Triploid grass carp are restricted** (i.e., A permit is required to possess, propagate, stock, transport, or sell triploid grass carp. Diploid grass carp are prohibited.)
Utah	**Bighead, silver, and black carp are restricted** (i.e., A permit is required to produce, propagate, rear, culture, stock, import, sell, transport, or possess live specimens.) **Triploid grass carp are restricted** (i.e., A permit is required to import, possess, or stock triploid grass carp. Diploid grass carp are prohibited.)
Vermont	**Bighead, silver, black, and grass carp are restricted** (i.e., A permit is required to import or possess live specimens if intending to stock into public waters or chances of entering public waters. Permit not needed if for personal use like aquaria.)
Virginia	**Bighead, silver, and black carp are restricted** (i.e., A permit is required to import, possess, liberate, or sell live specimens.) **Grass carp are restricted** (i.e., A permit is required to import, possess, liberate, or sell grass carp. Only triploid grass carp can be stocked in private waters.)
Washington	**Bighead, silver, black, and grass carp are restricted** (i.e., A permit is required to possess, sell, transport, or release live specimens.)
West Virginia	**Bighead, silver, black, and grass carp are restricted** (i.e., A permit is required to possess or transport live specimens.)
Wisconsin	**Black, bighead, grass, and silver carp are restricted** species (i.e., A permit is required to import, stock, or use as bait live and dead specimens. DNR policy limits permits to a short list of species, and Asian carp are not being permitted).
Wyoming	**Bighead, silver, and black carp are restricted** (i.e., A permit is required to import, possess, stock, or transport live specimens.) **Grass carp are restricted** (i.e., A permit is required to import, possess, or transport grass carp. Only triploid grass carp can be stocked.)

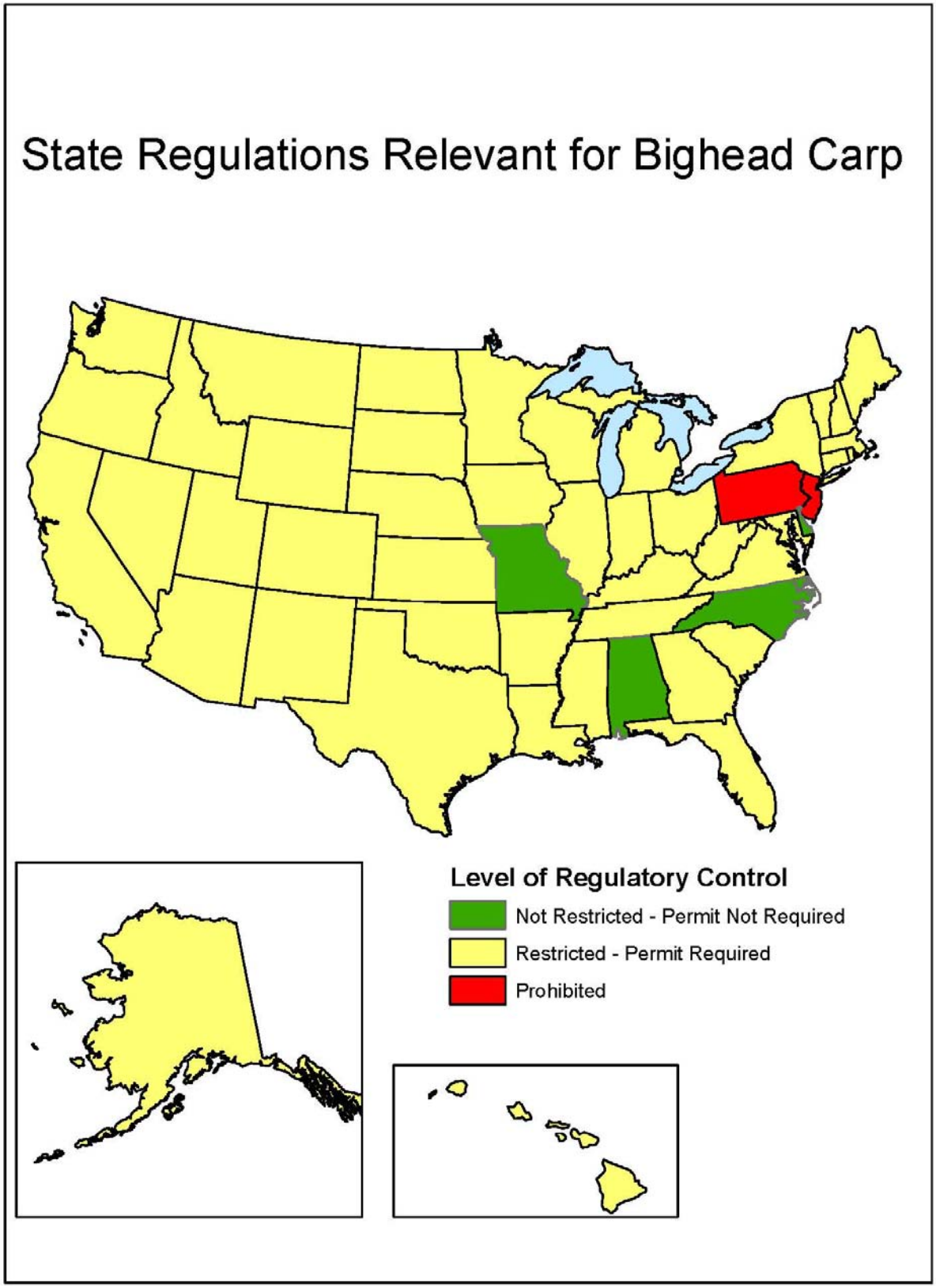

Figure 6.1.1. State regulations pertaining to import and possession of bighead carp (as of 8/2007). Regulations are categorized as either prohibited, restricted (i.e., permit required), or not restricted (i.e., permit not required).

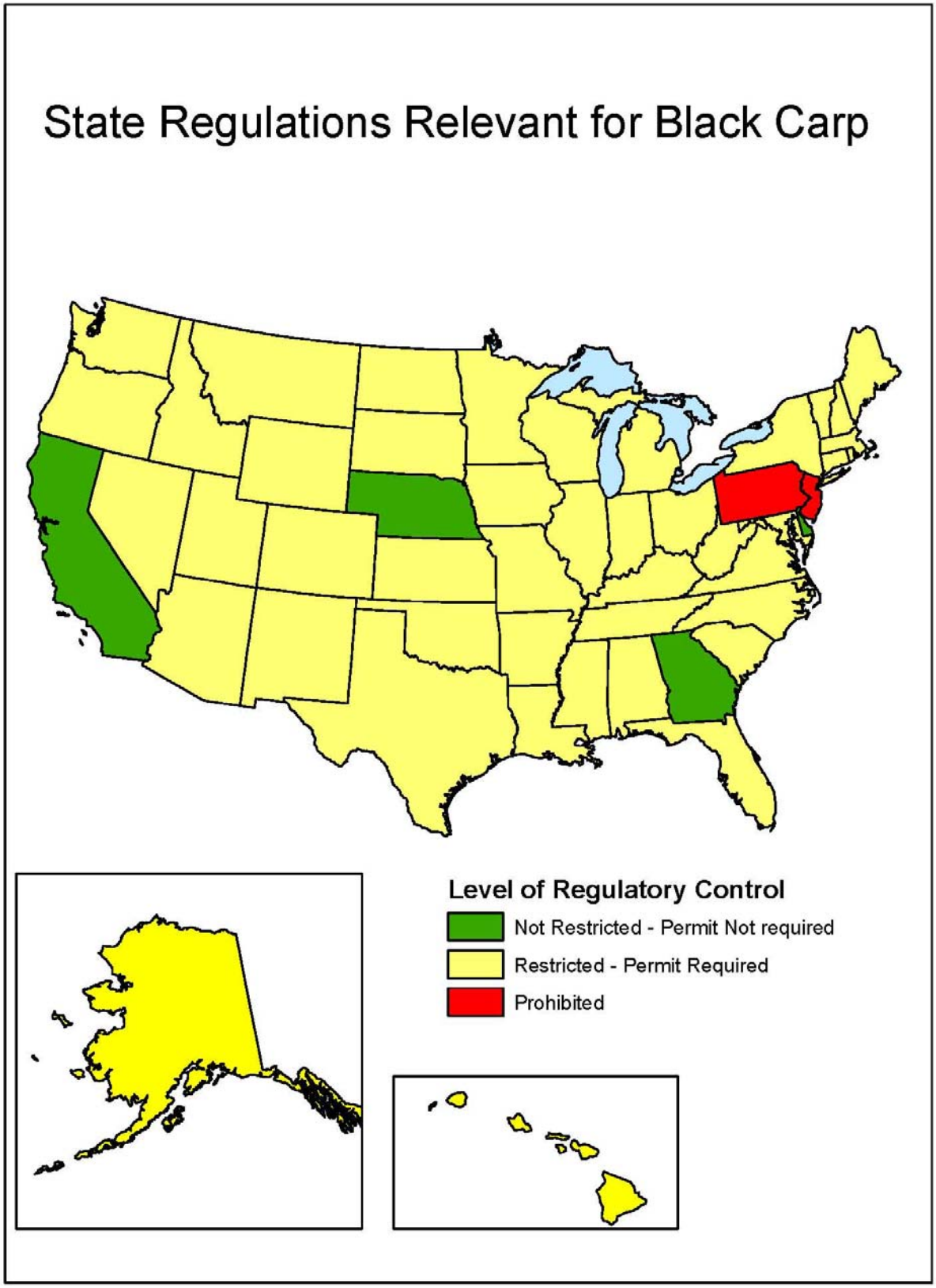

Figure 6.1.2. State regulations pertaining to import and possession of black carp (as of 8/2007). Regulations are categorized as either prohibited, restricted (i.e., permit required), or not restricted (i.e., permit not required).

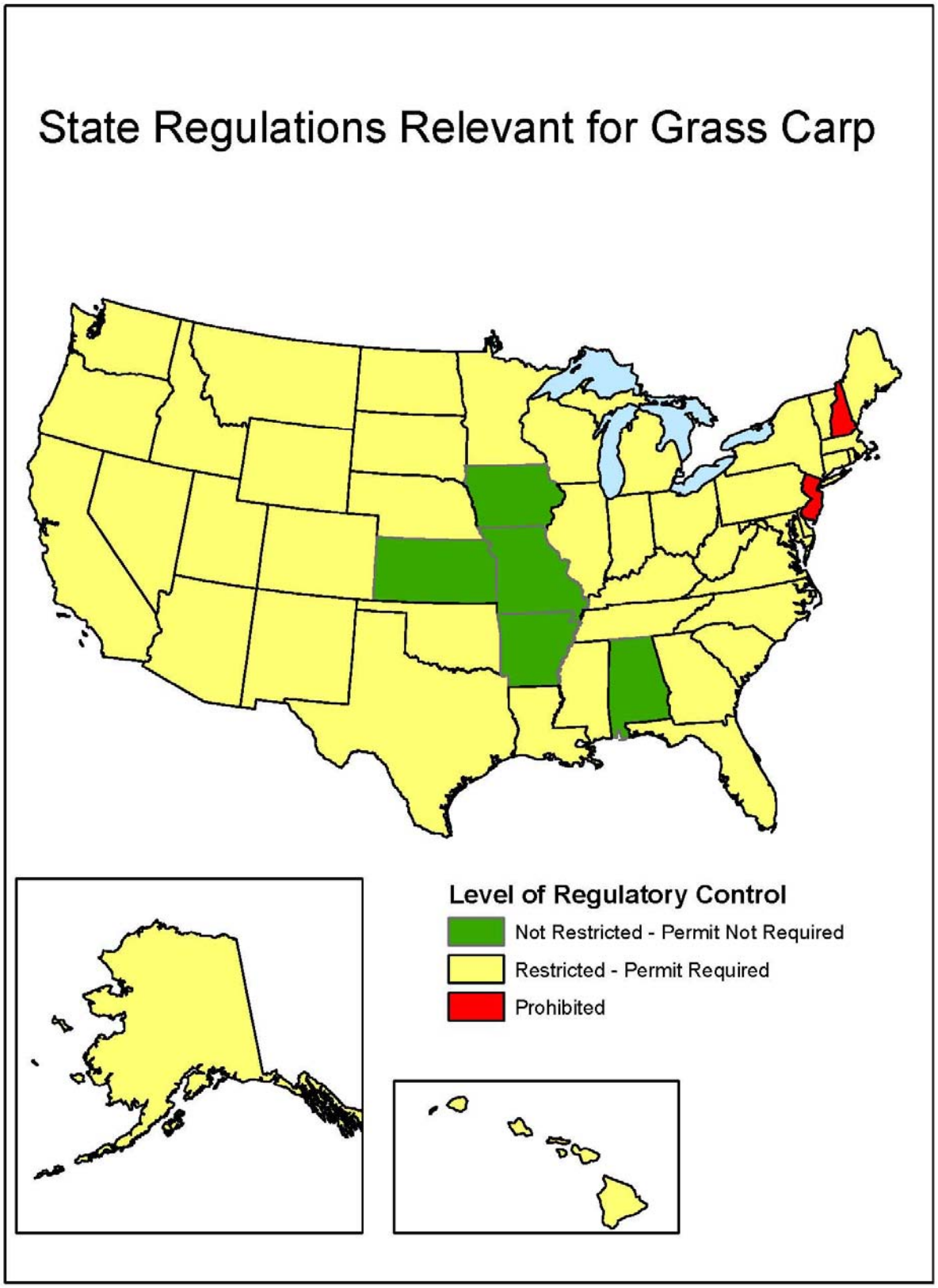

Figure 6.1.3. State regulations pertaining to import and possession of grass carp (as of 8/2007). Regulations are categorized as either prohibited, restricted (i.e., permit required), or not restricted (i.e., permit not required).

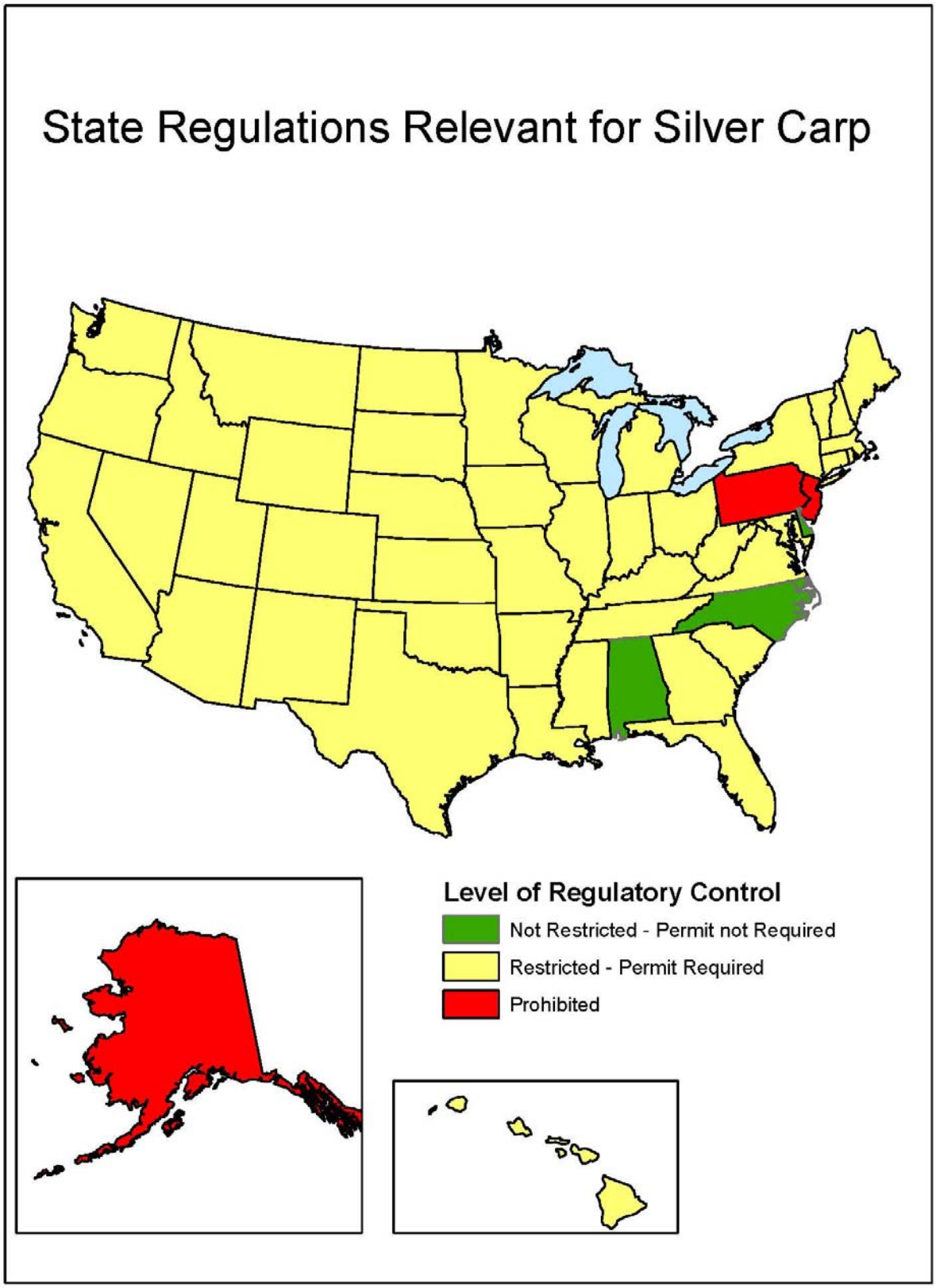

Figure 6.1.4. State regulations pertaining to import and possession of silver carp (as of 8/2007). Regulations are categorized as either prohibited, restricted (i.e., permit required), or not restricted (i.e., permit not required).

- **Page 172:** New Appendix 6.3 'Unresolved Issue: *Use of Triploid Black Carp on Aquaculture Facilities'* was added to the plan. The appendix provides a detailed discussion of the unresolved issue and includes potential alternatives, along with some of the positive and negative aspects of each, for consideration by natural resources management policy and decision makers. New Appendix 6.3 follows:

Appendix 6.3. Unresolved Issue: *Use of Triploid Black Carp on Aquaculture Facilities*.

Background

Aquaculture facilities have a critical need for effective control of snail-borne parasites (i.e., trematodes). The United States aquaculture industry is most concerned with several trematodes, particularly yellow grub, white grub, eye fluke, and one or more species of the genus *Bolbophorous*, that can adversely affect aquaculture production of several economically valuable food and bait fishes (Collins 1996; Venable et al. 2000; Terhune et al. 2002, 2003; Nico et al. 2005). In addition, a nonnative gill trematode that affects the health of both cultured and wild fish species, including endangered species, and its nonnative first intermediate host, the red-rim melania snail (*Melanoides tuberculatus*), is spreading in southern and western states (Mitchell et al. 2005). Since the mid-1990s, *Bolbophorous* trematode infestations have been of great concern to United State's channel catfish producers (Terhune et al. 2002).

The *Bolbophorous* trematodes have a complex life cycle involving one final host, the American white pelican (*Pelecanus erythrorhyncos*), and two intermediate hosts: ram's horn snails (*Planorbdella trivolvis*) and fish (Terhune et al. 2003). Evidence suggests that infection with this trematode is becoming widespread, with the more severely affected farms being in close proximity to pelican roosting or resting sites (Terhune et al. 2002; personal communication, David Wise, Thad Cochran National Warmwater Aquaculture Center). Channel catfish fry and fingerlings suffer high mortality rates and production of larger fish is reduced in severely affected production ponds (Terhune et al. 2002). Hanson and Wise (2005) estimated the net returns for channel catfish production ponds with relatively light infection of *Bolbophorous* trematodes were reduced by 80.8%, and production from ponds with more severe infection rates experienced net losses ranging on average from $1,251 to $1,560 per hectare. They further estimated the loss from *Bolbophorous* trematodes to producers in the main United States catfish-producing region as $45.4 million annually, more than 10% of the $450 million in catfish farm sales during 2004. Snail control is also a critical issue to commercial aquaculturists producing hybrid striped bass (Wui and Engle 2007).

No U.S. Food and Drug Administration approved therapeutic treatment for fish infected with trematodes currently exists (Terhune et al. 2002, 2003; Ledford 2003). In the absence of therapeutic drugs, control of *Bolbophorous* trematodes is limited to preventing infestations by breaking the life cycle of the trematode. Breaking the life cycle requires controlling or eliminating the introduction of trematode eggs by pelicans, the trematode's free swimming life stages within production ponds, or ram's horn snails, the only known intermediate host for *Bolbophorous* trematodes (Kelly 2000; Ledford 2003; Terhune et al. 2003; Avery et al. 2004). Control of snail populations is the most practical option for breaking the parasite's life cycle (Ledford 2003; Terhune et al. 2003). Optimal control of snail populations requires a combination of biological, chemical, and mechanical controls (Ledford 2003; Avery et al. 2004). Removing vegetative growth in ponds and limiting the presence of pelicans near ponds are additional prophylactic measures for lessening infestations (Terhune et al. 2002).

Several chemical treatments provide some control of snails in production ponds with limited effects on fish (Terhune et al. 2002). Hydrated lime, copper sulfate, and copper sulfate with citric acid can be effective in eliminating snails that live along pond margins, where most ram's horn snails are found (Venable et al. 2000). Bayluscide®, rock salt (NaCl), and copper sulfate can be effective options for treating some whole ponds (Kelly 2000; Mitchell 2002; Ledford 2003; Mitchell and Hobbs 2003; Terhune et al. 2003; Avery et al. 2004; personal communication, David Wise, Thad Cochran National Warmwater Aquaculture Center). Available chemical treatments each offer unique benefits and limitations (Ledford 2003; Mitchell and Hobbs 2003; Terhune et al. 2003). Preliminary evidence suggests that an integrated plan to control snails may have potential on some facilities (i.e., farms not located near pelican roosting areas) (personal communication, David Wise, Thad Cochran National Warmwater Aquaculture Center). However, statewide surveys of channel catfish ponds in Arkansas during 2006 and 2007 indicate that only triploid black carp had provided effective trematode control (unpublished data, Larry Dorman and Andrew Goodman, University of Arkansas at Pine Bluff). Chemical treatments must be repeated for long-term snail control (Terhune et al. 2003) which increases costs to producers and are not effective in all situations. For example, hydrated lime and copper sulfate can not be used in ponds with low alkalinity and Bayluscide can only be used to control snails in ponds with no fish (Terhune et al. 2003). Moreover, these compounds are not approved for use as a molluscicide. Therefore, it is not legal to use these for snail control.

Biological control for the intermediate hosts of *Bolbophorus* trematodes offers a practical approach and may provide the best long-term control (Ledford 2003; Avery et al. 2004). Black carp, which feeds on snails, are an economical and effective tool for long-term biological control of snails (Slootweg et al. 1994; Shelton et al. 1995; Huckins 1997; Ledford 2003), especially in high risk areas where other means of snail control have been unsuccessful. In aquarium studies by Ledford (2003), black carp were the most effective consumers of ram's horn snails (mean=98%), irrespective of size of snail or water temperature. Collins (1996) reported that it is difficult for black carp to control snails that burrow into the pond bottom and that snail control is greatly reduced by the amount of vegetation in the pond. Black carp have additional limitations such as eating channel catfish fry, reduced snail consumption when catfish feed is available, and potential environmental consequences due to the escape of a nonnative molluskivore (Ledford 2003).

There have been limited studies to date to evaluate the effectiveness of native molluskivores for the control of ram's horn snail in production ponds (Ledford and Kelly 2006). In aquarium studies by Ledford (2003), redear sunfish consumed significantly less snails (mean = 38%) than black carp but were the most effective native species evaluated in the study. Ledford (2003) recommended redear sunfish for the biological control of ram's horn snail based on comparisons with other native species and the possible prohibition of black carp. However, when redear sunfish were presented with a range of snail sizes, the largest snails were uneaten or consumed in relatively small quantities (Ledford 2003); only fish >32 cm (12.5") total length were capable of consuming all sizes of snails offered (Wang et al. 2003). Preliminary evaluations of additional native species have shown the potential to provide some control of ram's horn snails, especially in combination with other control techniques, and warrant evaluation (Kelly 2000; Ledford 2003; Nico et al. 2005).

It is likely that no single method is the solution for snail control; rather different methods should be evaluated for use in conjunction with one another (Venable et al. 2000; Ledford 2003; Terhune et al. 2003; Avery et al. 2004). Several chemical and biological alternatives to the use of black carp for snail control in ponds have been studied (e.g., Venable et al.

2000; Mitchell 2002; Ledford 2003; Mitchell and Hobbs 2003; Terhune et al. 2003), but are less effective or present other limitations to their effective use. The escape of black carp due to a natural disaster is possible (e.g., flood, tornado, or hurricane). The Southern Regional Aquaculture Center had an on-going, multi-state project related to *Bolbophorus* trematodes that included work on native species and chemical alternatives to snail control. This $598,947 project of 20 scientists at 9 different institutions was not able to develop an economically viable alternative to the use of black carp (www.msstate.edu/dept/srac/). It is evident that additional research is needed to further evaluate alternative techniques for snail control. Consequently, the North Central Regional Aquaculture Center has issued a request for proposals to address possible methods of snail control using native fish species or a combination of native fish species and approved chemical controls for elimination of snail populations from commercial aquaculture ponds.

Beginning in the 1980's, private production facilities attempted to market black carp, primarily as a biological control agent for snails (Nico et al. 2005). Currently, triploid black carp are the only form of black carp sold. They are used primarily in Arkansas, Missouri, Mississippi, and North Carolina as a biological control agent for nuisance snails (personal communication, Mike Freeze, Keo Fish Farm). However, the functional sterility of triploid black carp has not been evaluated, nor is there an established inspection and certification program for black carp.

If functionally sterile, the inability of triploid black carp to reproduce in the wild would greatly reduce the long-term effects of escaped black carp, but would not eliminate the potential effects of non-reproducing fish on critically imperiled mussel fauna. Freshwater mussels are more diverse in eastern North America than any other continent in the world, yet more than half of the mussel species of the Midwest are threatened or endangered (Cummings and Mayer 1992). Nico et al. (2005) examined mouth gape of black carp and concluded that all size-classes of 12 (85%) of the 14 federally endangered unionid species in the Midwestern United States are within the gape limits of a 2-meter long black carp. Based on the results of their work, Nico et al. (2005) believe that black carp, whether introduced individuals or a reproducing population, could pose a serious threat to many of the remaining populations of endangered and threatened mollusks. However, other scientists question the extent of potential damage if only a limited number of non-reproducing individuals escape to the wild.

Some commercial fishers operating in the Mississippi River and its tributaries have been capturing black carp in the wild since the early 1990s and black carp captures have reportedly been an annual event in portions of the lower Mississippi Basin for more than a decade (Nico et al. 2005; personal communication, Leo Nico, USGS). Most of the fish captured were not retained, however at least 14 of the wild-caught black carp specimens were examined by experts and their identifications verified (Nico et al. 2005; Nico 2007; personal communication, Mark McElroy, Louisiana Department of Wildlife and Fisheries). The reported and verified collections, including one fish that blood tests indicated was triploid (Nico et al. 2005), confirms the difficulty of containing black carp on aquaculture facilities. However, triploid black carp are used on hybrid striped bass (*Morone saxatilis x M. chrysops*) farms in North Carolina, but no black carp have been reported in the wild in North Carolina (personal communication, Jeff Hinshaw, North Carolina Cooperative Extension Service).

A synopsis of the following potential alternatives regarding the use of triploid black carp on aquaculture facilities is presented below for consideration by natural resources management policy and decision makers:

a. Permit the use of certified triploid black carp (100% inspected/retested), with appropriate controls for containment, until feasible alternatives are proven and available for snail control;
b. Permit the use of certified triploid black carp (100% inspected/retested), with appropriate controls for containment, until December 31, 2008;
c. Immediately prohibit the use of all black carp.

This list of potential alternatives is not intended to be exhaustive, but highlights the principle ideas that have been discussed during the development of this plan. Working Group members agreed that the desired endpoint is to have no black carp in use on aquaculture facilities (or present in the wild), but did not agree on the manner or how long it should take to reach this endpoint. Each alternative includes a discussion divided into 'pro' and 'con' positions. These different positions represent the differing views and opinions of Working Group members. The order in which the alternatives are presented does not reflect any preference among the alternatives.

Potential Alternatives

a. Permit the use of certified triploid black carp (100% inspected/retested), with appropriate controls for containment, until feasible alternatives are proven and available for snail control.

Triploid black carp would be permitted until such time that alternatives for snail control are proven and available. This alternative would require that 100% of black carp be screened for ploidy prior to being inspected and then each fish would be retested during an inspection. All black carp would be used with appropriate controls for containment (e.g., Recommendation 3.1.14.1). This approach was supported by both aquaculture and a number of natural resources management representatives on the Working Group.

Pro. Allowing the use of certified triploid black carp until feasible alternatives for snail control are proven and available assures fish farmers of a long-term, effective approach to minimize production losses as a result of trematode infestations. This approach also assures fish farmers of adequate time to develop alternatives, prove that these are effective and economically viable, and make them available on a commercial scale. Aquaculturists have developed the procedures to produce triploid black carp. Triploid black carp are thought to be effectively sterile and if so, should not establish a reproducing population if any should escape and survive in the wild.

Con. The effective sterility of triploid black carp has not been established through peer reviewed research. Regardless, allowing the use of certified triploid black carp until feasible alternatives for snail control are proven and available may lead to the indefinite use of triploid black carp and may not adequately protect the nation's natural resources. The USFWS and some states agencies are concerned that the use of triploid black carp for any period of time presents an unacceptable level of risk to the nation's natural resources. To produce triploid black carp, fish farmers must maintain stocks of diploid black carp that are also a continued risk for escape. Black carp have been captured in the wild for more than a decade (Nico et al. 2005; Nico 2007). The continued use of triploid black carp may result in the continued introduction of black carp to the wild.

b. Permit the use of certified triploid black carp (100% inspected/retested), with appropriate controls for containment, only until a predetermined date (e.g., December 31, 2008) after which all use of black carp would be prohibited.

This alternative would allow the use of certified triploid black carp only until a predetermined date (e.g., December 31, 2008) specified by state management agencies that currently permit their use. Use of all black carp would be prohibited after this date. This alternative would require that 100% of black carp be inspected and retested during an inspection. All black carp would be used with appropriate controls for containment.

Pro. The continued use of triploid black carp violates the charge to the Working Group of developing a management plan that first and foremost is protective of the Nation's natural resources. Black carp are capable of consuming all size-classes of 85% of federally endangered unionid species in the Midwestern United States (Nico et al. 2005). The use of black carp has already resulted in the annual collection of black carp from the wild for more than a decade. The continued use of triploid black carp for any duration of time may result in the continued introduction of black carp to the wild and risks ecologic and economic consequences. Some proposed chemical and biological alternatives have shown the potential to provide some control of ram's horn snails (Kelly 2000; Venable et al. 2000; Mitchell 2002; Terhune et al. 2002, 2003; Ledford 2003; Mitchell and Hobbs 2003; Avery et al. 2004; Nico et al. 2005), although not enough to prevent serious economic losses on infested catfish farms.

Con. This alternative violates the charge made to the Working Group of leaving a viable aquaculture industry standing. Research to date on alternatives has shown the difficulty of developing a viable alternative to the use of black carp. It is highly unlikely that a viable alternative can be developed in less than 18 months (the time remaining before the deadline). Thus, this alternative condemns fish farmers to severe economic losses. Compensation programs to cover the losses to farmers must accompany this alternative so that fish farmers can remain competitive and stay in business. These losses have been estimated at $45 million/year to the catfish industry alone, based on the current distribution of the trematode (Hanson and Wise 2005).

c. Immediately prohibit the use of all black carp.

This alternative would immediately prohibit the use of all black carp.

Pro. This alternative provides the greatest level of resource protection by immediately eliminating all captive stocks of black carp and preventing continued unintentional introductions and consequences to imperiled mussels and aquatic ecosystems. Available resources would be directed at developing alternative long-term strategies to the problem of snail control, rather than using limited resources to validate a tool (i.e., triploid black carp) and establish a program that presents a continued risk to imperiled mussels.

Con. This alternative violates the charge made to the Working Group of leaving a viable aquaculture industry standing and condemns fish farmers to severe economic losses. Compensation programs to cover the losses to farmers must accompany this alternative so that fish farmers can remain competitive and stay in business. These losses have been estimated at $45 million/year to the catfish industry alone, based on the current distribution of the trematode (Hanson and Wise 2005). The states that will be highly

affected by restrictions on the use of black carp are highly rural and among the most impoverished states.

- **Page 177:** New Appendix 6.4 'Unresolved Issue: *Use of Grass Carp on Aquaculture Facilities and Farm Ponds in Watersheds with Self-Sustaining Populations of Grass Carp'* was added to the plan. The appendix provides a detailed discussion of the new unresolved issue and includes potential alternatives, along with some of the positive and negative aspects of each, for consideration by natural resources management policy and decision makers. New Appendix 6.4 follows:

Appendix 6.4. Unresolved Issue: *Use of Grass Carp on Aquaculture Facilities and Farm Ponds in Watersheds with Self-Sustaining Populations of Grass Carp*.

Background

Millions of dollars are spent on aquatic vegetation management in the United States annually (Greenfield et al. 2004). While many control measures exist, the use of grass carp is the least expensive, costing $45 to $125 per acre (Greenfield et al. 2004). A substantial trade in the species exists for use in commercial aquaculture facilities, private ponds and lakes, public ponds and lakes, and municipal irrigation projects. Grass carp are used widely for vegetation control by private aquaculture facilities; approximately 42% of catfish production facilities use grass carp for vegetation control (APHIS 2003).

Both diploid and triploid grass carp have been widely stocked in the United States to control nuisance aquatic vegetation for more than 35 years. The vast majority of the grass carp populations in the wild have resulted directly from stocking programs by state and federal natural resource programs, although stocking grass carp in some private waters may contribute to feral populations. Reproducing grass carp populations in the wild have continued at relatively constant levels (LTRMP 2007) and environmental effects of feral populations generally have not been studied or well documented. Ten states (nine within the Mississippi River Basin and Hawaii) continue to authorize the stocking of diploid grass carp for aquatic vegetation control (see Table 2.3.1). Self-sustaining populations of grass carp are established within or along the borders of at least nine states, reproducing in rivers such as the Mississippi, Missouri, Ohio, and Trinity (Elder and Murphy 1997; Schofield et al. 2005; Nico et al. 2006). Twelve states (and the District of Columbia) prohibit the use of any grass carp in their waters, and 29 states restrict the stocking of grass carp to triploids only.

Triploid grass carp are functionally sterile and can be considered sterile for management purposes (Allen et al. 1986; Allen and Wattendorf 1987; Thorgaard and Allen 1987; Van Eenennaam et al. 1990; Benfey 1999; Devlin and Nagahama 2002; Nico et al. 2005). However, triploid grass carp are more expensive to produce and are sold at approximately 2-3 times the price of diploid fish (personal communication, Mike Freeze, Keo Fish Farm). Stocking triploid grass carp will create a higher cost for consumers, including state natural resources management agencies, private pond owners, and aquaculture facilities. Typical stocking rates in commercial catfish ponds, for example, are about 10 fish/acre, which can quickly make the additional cost to stock triploids instead of diploids substantial.

A synopsis of the following potential alternatives regarding the use of grass carp on aquaculture facilities in watersheds with self-sustaining populations of grass carp is presented below for consideration by natural resources management policy and decision makers:

a. Allow the continued use of diploid grass carp on aquaculture facilities in watersheds with self-sustaining populations of grass carp.
b. Restrict the use of grass carp to certified triploids only for aquatic vegetation control on aquaculture facilities in watersheds with self-sustaining populations of grass carp.

This list of potential alternatives is not intended to be exhaustive, but highlights the principle ideas that have been discussed during the development of this plan. Each alternative includes a discussion divided into 'pro' and 'con' positions. These different positions represent the differing views and opinions of Working Group members. The order in which the alternatives are presented does not reflect any preference among the alternatives.

Potential Alternatives

a. Allow the continued use of diploid grass carp on aquaculture facilities in watersheds with self-sustaining populations of grass carp.

States that currently allow diploid grass carp to be stocked on aquaculture facilities for aquatic vegetation control within watersheds with self-sustaining populations of grass carp could continue to do so.

Pro. This alternative would not impose additional cost on the private or public sectors that depend on grass carp for aquatic vegetation control. The cost of requiring private individuals to stock only certified grass carp would be substantial. The Catfish 2003 survey of the major catfish producing states showed that 42% of foodsized catfish surface acres stock grass carp (APHIS 2003). Thus, of the 170,000 acres in catfish production in the U.S. in 2006, 71,400 acres would be stocked with grass carp. Typical stocking rates in commercial catfish ponds are about 10/acre. Thus, 714,000 grass carp would be present at any point in time in commercial catfish ponds. If these are replaced at the rate of every 4 years, 178,500 fish would be replaced each year. At an additional cost of $2 per fish, the increased cost would be $357,000 per year for the catfish industry alone. This estimate does not include grass carp stocked in commercial ponds dedicated to production of other species. It also does not include acreage in fish production by state and federal agencies.

Many states refer to having more than 100,000 farm ponds in each state. If half of these farm ponds are stocked with grass carp, and if each averages only 1 acre, then each state would have about 50,000 acres of farm ponds stocked with grass carp. Stocking at the rate of 4 grass carp per acre would mean 200,000 grass carp stocked in farm ponds in each state. If these are replaced at the rate of every 4 years, and triploid grass carp cost $2 more each than certified grass carp, then an additional $100,000 would be spent each year in each state to stock certified triploid grass carp instead of diploid grass carp. If only 10 states opt for this, the annual cost of this recommendation is $1 million.

It is clear that the additional cost of using certified triploid grass carp only could be in the millions of dollars each year. The above estimates of costs are conservative because, if diploids were no longer available, the demand for triploid grass carp would increase and, as with any other product, the increased demand would be expected to, at least initially, push the price of grass carp higher. This, combined with the other conservative assumptions used above, makes these estimates of costs conservative. However, increased demand could also foster more growers, increasing supply and competition, and could potentially lower costs for triploid grass carp.

The majority of commercial aquaculture facilities are not connected directly to open waterways. The escape of diploid grass carp from those that are will only add a few more fish with reproductive potential to an already established population. Since grass carp are already established in these watersheds, the likelihood of benefit to the environment from encouraging use of triploid grass carp only is very low, however the additional costs to private aquaculturists would be substantial. This cost will be born entirely by private individuals who were not responsible for the stocking programs of state and federal agencies.

The call for additional regulations are based either on studies in which grass carp were intentionally overstocked in closed systems with the purpose of defining optimal stocking rates or largely anecdotal observations. The environmental effects of feral populations generally have not been studied or well documented. The existence of reproducing grass carp populations in the wild resulted in large part from deliberate stockings allowed by natural resource agencies, and therefore the costs should not be imposed strictly on private individuals.

Con. The Working Group agreed that the desired endpoint for this management plan is the extirpation of Asian carps in the wild, except for non-reproducing (i.e., sterile triploid) grass carp contained within planned locations. This management plan recommends spending millions of dollars for management related to feral populations of grass carp. Grass carp can escape from both aquaculture and non-aquaculture waters and enter natural systems. Measures such as the use of only sterile, triploid grass carp are warranted to prevent the introduction of additional fertile, diploids into any watershed, including those with self-sustaining populations. The continued stocking of diploid grass carp contradicts efforts to reach the desired end-point agreed to for this plan.

Although diploid grass carp are more cost-effective than triploid grass carp, triploids remain a more cost effective approach to aquatic vegetation control than other available options (e.g., chemical or mechanical removal) and have less risk of prolonged unintended consequences to the environment than fertile, diploid grass carp. In fact, based on the estimated additional cost of using triploid grass carp in a 1-acre farm pond as presented above, the additional annual cost to farm pond owners using triploid grass carp would only be approximately $2.00/acre/year more than diploid grass carp. Thus, the cost burden ranges from $2 for a 1-acre pond to $200/year for a 100-acre pond. The additional annual cost would be greater for fish farmers and could range from $500/year to $10,000 a year depending upon the size and acreage of ponds owned. Shireman and Smith (1983) concluded that grass carp stockings should proceed with caution because of potential unintended environmental effects and that stocking sterile (triploid) grass carp offers a desirable margin of safety. Wattendorf and Phillippy (1996) concluded that “a sound permit system for triploid grass carp, with occasional checks and legal action, is the best approach for those states authorizing the use of herbivorous fish for plant control.”

Grass carp are stocked for the purpose of altering “undesirable” habitats. Effects of grass carp introductions have been most extensively evaluated in closed systems where it is well documented that grass carp are an extremely powerful management tool capable of manipulating and rapidly changing whole lake ecosystems (Cassani 1996). There has been little research completed to document the abundance or environmental effects of feral grass carp populations in open systems; consequently, the effects of self-

sustaining populations to native ecosystems is poorly understood (Cassani 1996). Grass carp have the potential for being a nuisance in open aquatic systems because of their ability to consume large volumes of aquatic vegetation, tolerate a wide range of environmental conditions, and disperse widely from target waters (Bain 1996).

This ability of grass carp to disperse widely from target waters once they enter an open system creates a regional management issue. The majority of states, several with self-sustaining feral grass carp populations, prohibit the use of diploid grass carp. Diploid grass carp can escape, disperse beyond the state where it was stocked, and adversely affect the management efforts of a neighboring or distant state. Dispersal and distant congregations can be significant through time and difficult to manage (Bain 1996). Rules and regulations for the use of grass carp vary from state to state and create a mosaic of jurisdictions and associated regulations that has been ineffective in preventing grass carp from occurring in areas where they were unwanted (Cassani 1996) and enforcement of regulations arduous. The additional costs of using triploid grass carp, by all grass carp users, are reasonable and warranted.

b. Restrict the use of grass carp to certified triploids only for aquatic vegetation control on aquaculture facilities in watersheds with self-sustaining populations of grass carp.

States that currently allow diploid grass carp to be stocked on aquaculture facilities for aquatic vegetation control in watersheds with self-sustaining populations of grass carp would restrict the future use of grass carp to certified triploids only, with adequate and redundant controls to prevent escape.

Pro. This alternative provides a redundant measure that minimizes risks associated with the escape of fish from farm ponds and properly sited aquaculture facilities. This alternative and Strategy 3.1.2 would bring the use of grass carp in non-aquaculture and aquaculture waters into agreement and compliments recommendations within this management plan to control and eradicate feral populations of fertile, diploid grass carp. Although diploid grass carp are more cost-effective than triploid grass carp, triploids remain a more cost effective approach to aquatic vegetation control than other available options (e.g., chemical or mechanical removal) and have less risk of prolonged unintended consequences to the environment than fertile, diploid grass carp. Although the increased costs appear substantial when considered on a national or regional scale, the additional annual cost of triploid grass carp to individual farm pond owners would only be approximately $2.00/year more than diploid grass carp, based on the estimates provided above for a 1-acre farm pond. Thus, the cost burden ranges from $2 for a 1-acre pond to $200/year for a 100-acre pond. The additional annual cost would be greater for fish farmers and could range from $500/year to $10,000 a year depending upon the size and acreage of ponds owned. The additional costs of using triploid grass carp are reasonable and warranted for both small farm ponds and larger aquaculture facilities.

Con. Opponents of this alternative point to the substantial costs associated with encouraging states to restrict use of grass carp to only triploid. This unresolved issue is related to watersheds with self-sustaining populations of grass carp. Since grass carp are already established in these watersheds, the likelihood of benefit to the environment from encouraging use of triploid grass carp only is very low. Regulations that impose costs to members of society with little or no benefit to the environment would do not

constitute good policy. The risk to the environment is low because grass carp are already established in these watersheds and environmental effects of feral populations generally have not been studied or well documented. The use of diploid grass carp is also good policy because it does not impose additional costs to society with little or no benefit to the environment.

- **Page 181:** New Appendix 6.5 'Unresolved issue: *Commercial, domestic transport of live farm-raised bighead and grass carps'* was added to the plan. The appendix provides a detailed discussion of the unresolved issue and includes potential alternatives, along with some of the positive and negative aspects of each, for consideration by natural resources management policy and decision makers. New Appendix 6.5 follows:

Appendix 6.5. Unresolved issue: *Commercial, domestic transport of live farm-raised bighead and grass carps.*

Background

Farm-raised bighead and grass carps are sold live to specialty food markets as a live product. Grass carp are also sold live and stocked for aquatic vegetation control. The major markets for live bighead and grass carps are in states other than those where they are raised. This requires transport of live fish to market. Live fertile, diploid bighead and grass carps are transported and sold, however only triploid grass carp are transported to states that do not allow the import or stocking of diploid grass carp.

Most live foodfish markets for bighead and grass carp are located outside the range of self-sustaining populations of these species in the wild (e.g., Canada represents over 50% of the market for bighead and grass carps cultured in the U.S.; Mandrak and Cudmore 2004). Bighead and grass carps generally are transported by commercial live haulers. Some working group members believe that even a single accident could potentially introduce large numbers of these fish into new waters. Additional or improved containment measures to prevent escape during commercial transport may further reduce the probability of escapes (Recommendation 3.1.16.4). Studies of live transport have been suggested to provide an understanding of the frequency that accidents and potential introductions might be expected to occur. However, it is generally accepted that the probability of an accident occurring is low. What is not generally accepted is whether the low probability of an accident occurring and the potential introduction of bighead or grass carp into a new watershed is a substantial enough risk to the environment to warrant management actions that would likely have an economic impact on the farmed carp industry.

A synopsis of the following potential alternatives regarding the commercial transport of live bighead and grass carps is presented below for consideration by natural resources management policy and decision makers:

Bighead carp

a. Allow the unrestricted transport of live diploid bighead carp;
b. Allow the live transport of only triploid bighead carp;
c. Allow only intra-state transport of live bighead carp within portions of the United States where feral bighead carp are determined to be self-sustaining as of a pre-established date (e.g., December 31, 2007);
d. Prohibit all transport of live bighead carp;

Grass carp

e. Allow the unrestricted transport of live diploid grass carp;
f. Allow the live transport of triploid grass carp only;
g. Prohibit all transport of live grass carp.

This list of alternatives is not intended to be exhaustive, but highlights the principle ideas that have been discussed during the development of this plan. Each alternative includes a discussion divided into 'pro' and 'con' positions. These different positions represent the differing views and opinions of Working Group members. The order in which the potential alternatives are presented does not reflect any preference among the alternatives.

Potential Alternatives

Bighead carp

a. **Allow the unrestricted transport of live diploid bighead carp.**

This alternative would allow the unrestricted transport of live diploid bighead carp.

Pro. Diploid bighead carp could be shipped across all watersheds regardless of whether or not bighead carp are absent, present without evidence of natural reproduction, or are self-sustaining within a given watershed. The unrestricted transport of live diploid bighead carp provides the greatest flexibility, lowest production costs, and highest gross returns to fish farmers. High volumes of live bighead carp have been transported throughout North America for more than two decades with few reports of unintentional releases or escaped fish. Additional actions are recommended in this plan to reduce the risk of an unintentional introduction as the result of live commercial transport (Strategy 3.1.16).

Con. This alternative does not adequately protect the Nation's natural resources and is counter productive to efforts to manage and control feral populations. Although the likelihood of an introduction via this pathway is small, the risks of ecologic and economic consequences due to unintentional introductions are high in watersheds without established populations of these species. Self-sustaining populations of feral bighead carp are currently confined within the Mississippi River Basin; however, each shipment of live diploid bighead carp outside the current distribution of feral populations of this fish creates the opportunity for a new introduction and establishment.

b. **Allow the live transport of only triploid bighead carp.**

This alternative would continue to allow transport of live bighead carp, but it requires that all bighead carp be sterile, triploids.

Pro. Aquaculturists have developed processes to produce triploid bighead carp on a commercial scale. Allowing the live transport of triploid bighead carp could provide fish farmers with the continued opportunity to grow, transport, and sell live bighead carp in food fish markets. This alternative provides greater natural resource protection than allowing the unrestricted transport of diploid bighead carp. Triploid bighead carp, though not confirmed through peer-reviewed research, are thought to be effectively sterile and if so, should not establish a reproducing population if any should escape and survive in the wild.

Con. The economic feasibility of raising only triploid bighead carp for the food fish market is unknown. Research would be needed prior to implementation of this alternative to develop viable recommendations for triploid bighead carp production. The effective sterility of triploid bighead carp has not been established through peer reviewed research and should be confirmed prior to adopting this alternative. Moreover, a triploid bighead carp inspection and certification program would need to be developed and operated.

c. **Allow only intra-state transport of live bighead carp within portions of the United States where feral bighead carp are determined to be self-sustaining as of a pre-established date (e.g., December 31, 2007).**

This alternative would not allow interstate transport of live bighead carp. Live bighead carp could be transported within portions of the U.S. where feral bighead carp are known to be self-sustaining as of a pre-established date (e.g., December 31, 2007), but only dead bighead carp could be transported across state lines.

Pro. This alternative is highly protective of the nation's natural resources by minimizing the potential for a transport related accident near a waterway to result in an unintentional introduction of bighead carp into new waters as a result of live commercial transport. Many state (Appendix 6.4) and local governments have already adopted regulations that restrict or prohibit the possession and/or sales of live Asian carps. In the absence of live bighead carp, some consumers in California have purchased "freshly dead" bighead carp, but at a much lower price.

Con. This alternative violates the charge made to the Working Group of leaving a viable aquaculture industry standing. Disallowing interstate transport of live bighead carp would abolish the live bighead carp industry in the U.S. by eliminating access to the markets for this product. It is not known to what extent an equivalent or viable market could be developed for dead bighead carp.

d. **Prohibit all transport of live bighead carp**.

This alternative would not allow the transport of any live bighead carp, regardless of whether diploid or triploid.

Pro. This alternative provides the highest level of resource protection by eliminating the risk of unintentional introductions of bighead carp into any waters as a result of live commercial transport. The risks of introducing live bighead carp into waters with existing self-sustaining populations are counter-productive to efforts to eradicate the species from the wild. Freshly dead bighead carp products are currently marketed in a few locations within the U.S., but at a much lower price. Additionally, grass carp are more in demand and sell for a higher price than bighead carp in ethnic live fish markets (Stone et al. 2000) and are already widely distributed in the wild (Fuller et al. 1999). Therefore live triploid grass carp may provide a viable alternative to the live bighead carp food fish industry.

Con. This alternative violates the charge made to the Working Group of leaving a viable aquaculture industry standing. Disallowing interstate transport of live bighead carp would abolish the live bighead carp industry in the U.S. by eliminating access to the markets for this product. It is not known to what extent an equivalent or viable market

could be developed for dead bighead carp. The states that will be highly affected by a prohibition on all transport of live bighead carp are highly rural and among the most impoverished states.

Grass carp

e. **Allow the unrestricted transport of live diploid grass carp.**

This alternative would allow the unrestricted transport of live diploid grass carp. Diploid grass carp may be shipped across all watersheds regardless of whether or not grass carp are absent, present without evidence of natural reproduction, or are self-sustaining within a given watershed.

Pro. The unrestricted transport of live diploid grass carp provides the greatest flexibility, lowest production costs, and highest gross returns to fish farmers. High volumes of live grass carp have been transported throughout North America for more than two decades with few reports of unintentional release or escaped fish. The likelihood of an introduction via this pathway is small and additional actions are recommended in this plan to reduce the risk of an unintentional introduction as the result of live commercial transport (Strategy 3.1.16).

Con. This alternative does not adequately protect the nation's natural resources and is counter productive to efforts to manage and control feral populations. A single accident could potentially introduce large numbers of these fish into new waters. The risks of ecologic and economic consequences from an unintentional introduction of grass carp in a watershed without established populations of these species is likely high (Mandrak and Cudmore 2004). Most states have watersheds without self-sustaining populations of grass carp. Each shipment of live diploid grass carp outside the current distribution of feral populations of grass carp is an opportunity for a new introduction and establishment.

f. **Permit the live transport of triploid grass carp only.**

This alternative would allow the live transport of triploid grass carp only.

Pro. This alternative provides fish farmers with the continued opportunity to grow, transport, and sell live grass carp for both nuisance aquatic vegetation control and food fish markets. Thirty-eight states authorize triploid grass carp stocking for aquatic vegetation control, twenty-nine of which permit triploid fish only. Restricting all live transport to triploid grass carp only provides greater natural resource protection than allowing the transport of diploid grass carp. Triploid grass carp have been rigorously evaluated and are considered effectively sterile. An unintentional introduction of sterile triploid grass carp would not result in a newly established population and the potential consequences of an introduction are therefore greatly reduced. Commercial transport of live triploid grass carp places fewer watersheds at risk of a transport related accident that results in an unintentional introduction than does the transport of live diploid bighead or grass carp.

Con. Some state natural resource management agencies, primarily within the Mississippi River Basin, have stocked, or authorized stocking, diploid grass carp in open waters for more than 30 years. Disallowing the transport of live diploid grass carp would

abolish the current market for diploid grass carp in the U.S. The economic effect of such an action on federal and state agencies that rely on diploid grass carp for aquatic vegetation control is not known. The economic feasibility of producing and selling certified triploid grass carp is not known for the live food fish market. The majority of the grass carp populations in the wild have resulted directly from stocking programs conducted or authorized by state and federal natural resources management agencies. Some members of the Working Group do not believe that it is reasonable to impose costs on farm pond owners and fish farmers by preventing them from continued access to diploid grass carp. Escape of some additional diploid grass carp will only add a relatively few more fish with reproductive potential to an already-established population that in many places had been stocked intentionally.

g. **Prohibit all transport of live grass carp**.

This alternative would not allow the transport of any live grass carp, regardless of whether diploid or triploid.

Pro. This alternative provides the highest level of resource protection by eliminating the risk of a transport related accident that results in an unintentional introduction of grass carp into new waters. Currently, 12 states either prohibit possession or do not issue permits to authorize stocking grass carp (Appendix 6.4).

Con. This alternative violates the charge made to the Working Group of leaving a viable aquaculture industry standing. Grass carp are in wide demand for nuisance vegetation control and this market is dependent upon the transport and stocking of live fish. Disallowing interstate transport of live grass carp would abolish the live grass carp industry in the U.S. by eliminating access to the markets for this product. It is not known to what extent an equivalent or viable food fish market could be developed for dead grass carp.