ANS
Aquatic Nuisance Species
DIGEST

Volume 2 No. 4 August 1998

FRESHWATER FOUNDATION

Providing current information on monitoring and controlling the spread of harmful nonindigenous species.

Development, Implementation, and Benefits of a State ANS Management Plan: An Ohio Perspective

by Randall E. Sanders

The National Invasive Species Act of 1996 reauthorized the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 and expanded several of the Act's provisions, including those related to ANS management plans. As a result, three states have completed ANS management plans, and a number of states and interstate organizations are in the process of developing management plans. The objective of this article is to share an overview of the development, implementation, and benefits of the Ohio State ANS Management Plan. We hope that our experience may be useful in the development and support of ANS management plans throughout the U.S.

Federal Environmental Initiatives

Federal initiatives historically have been the crucial first step in the establishment of dedicated government programs to address complex environmental and natural resource problems throughout the U.S. Two good examples are the Clean Water Act of 1972 and the Endangered Species Act of 1973. Both of these acts, after several decades and a number of amendments, have helped establish a variety of state and national programs that have addressed complex problems and have achieved significant results by protecting and maintaining human and environmental health.

A more recent federal initiative is the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990. The Act addressed the serious problems caused by the introduction and spread of aquatic nuisance species (ANS) into U.S. waters. It addressed unintentional introductions by ballast water discharge, established the national ANS Task Force and the regional Great Lakes Panel on ANS, and provided for funding to states for prevention, control, and management of ANS upon approval of state management plans.

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Carp, an Old Enemy at Malheur National Wildlife Refuge, Oregon

by Gary L. Ivey

Common carp *(Cyprinus carpio)* were one of the treasures brought to Europe from Asia during trading expeditions inspired by Marco Polo in the 15th century, and were among the first aquatic nuisance species introduced to North America. Although poorly documented, common carp may have been in New York as early as the 1830s to provide a new food resource (DeKay 1842), and next appeared in 1872 in California (Moyle 1976). The U.S. Fish Commission imported common carp from Germany in the1870s and distributed them to most states and U.S. territories between 1889 and 1897 for sport fishing purposes (Courtenay 1991). With human help, common carp found their way into most major U.S. drainages by the turn of the century.

Soon after the introduction of common carp, adverse effects such as reductions in populations of aquatic plants and invertebrates resulted in reductions of native and sport fish and in lower waterfowl use and production in many wetland systems. During this century, attempts to eliminate carp became a common practice in management efforts to improve wetlands for waterfowl, since carp are detrimental to waterfowl habitat (Thrienan & Helm 1950; Robel 1961; King & Hunt 1967; Crivelli 1983).

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Aquatic Nuisance Species Digest

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Aquatic Nuisance Species Digest (ISSN 1083-8864) is produced by the Freshwater Foundation, a public nonprofit foundation whose mission is to pursue the sustainable use of freshwater resources through education, conferences, publications and research. *ANS Digest* is published quarterly in cooperation with the U.S. Fish and Wildlife Service and the national Task Force on Aquatic Nuisance Species.
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Editor's note: Many ballast-water treatment ideas have been suggested and some projects have been initiated. This issue of the ANS Digest takes a look at two of the technologies being studied. This article is drawn from a report written by three undergraduate students from Worcester Polytechnic Institute in Worcester, MA. The students were sponsored by the U.S. Coast Guard Office of Response in Washington, DC.

Port-Based Ballast-Water Treatment Systems: A Feasibility Study in the Port of Baltimore

by Debra Greenman, Kevin Mullen, Shardool Parmar
with advisor Lt. Chris Friese, USCG.

The goal of this project, commissioned by the U.S. Coast Guard and Worcester Polytechnic Institute, was to study strategies to help curb the spread of nonindigenous aquatic nuisance species (ANS) via ballast water in Baltimore Harbor. We investigated shore-based ballast treatment alternatives which could complement mid-ocean ballast exchange, studied their feasibility, and developed a ballast-water treatment flow-chart to determine the best method of transporting ballast from a vessel to a treatment facility within a port.

Ballast Water

Ballast is any solid or liquid that is brought on board a vessel to stabilize it by altering its weight and adjusting its center of gravity. Ships have been using ballast for stability control for centuries, and have been unintentionally transplanting nonindigenous species around the world by discharging their ballast in foreign ports. Safety considerations, weather and load conditions, fuel consumption, and shipping route dictate how much ballast is carried, which in turn controls the potential for transporting and introducing ANS.

There are three general reasons that ships carry ballast. Tankers and dry bulk carriers may make a home voyage with no cargo, so will use ballast to maintain stability. Military, passenger, and fishing vessels require ballast to adjust vessel control. Other vessels, such as heavy lift vessels, require ballast for loading and unloading operations. In this case, ballast is taken on in large volumes then is discharged to the same area when the task is completed; this creates problems when water mixes with possibly infested sediments in the bottom of the ballast tank, releasing the organisms when the water is discharged (CSBO 1996).

Approximately 79 million metric tons (MT)—almost 21 billion gallons—of ballast water arrived into United States waters in 1991 at a rate of 2.4 million gallons of ballast per hour (Carlton 1995). Based on a survey of 21 U.S. ports, New Orleans received the most ballast water discharged from ships, at an estimated 3.6 billion gallons per year. Norfolk, VA, received the second largest volume of ballast water, at 2.5 billion gallons per year. These two ports accounted for 30% of the ballast deposited in all of the ports surveyed. The Port of Baltimore ranked fifth with 747 million gallons of ballast water per year (Carlton 1995).

Approaches to Ballast-Water Treatment

To reduce or delay the introduction of ANS via ballast water, fish, invertebrates, plants, algae, fungi, protozoa, bacteria, and viruses must either be removed or made harmless. Although mid-ocean ballast-water exchange reduces the amount of marine organisms deposited in ports, it is not completely effective (Kabler 1996). Because ships are

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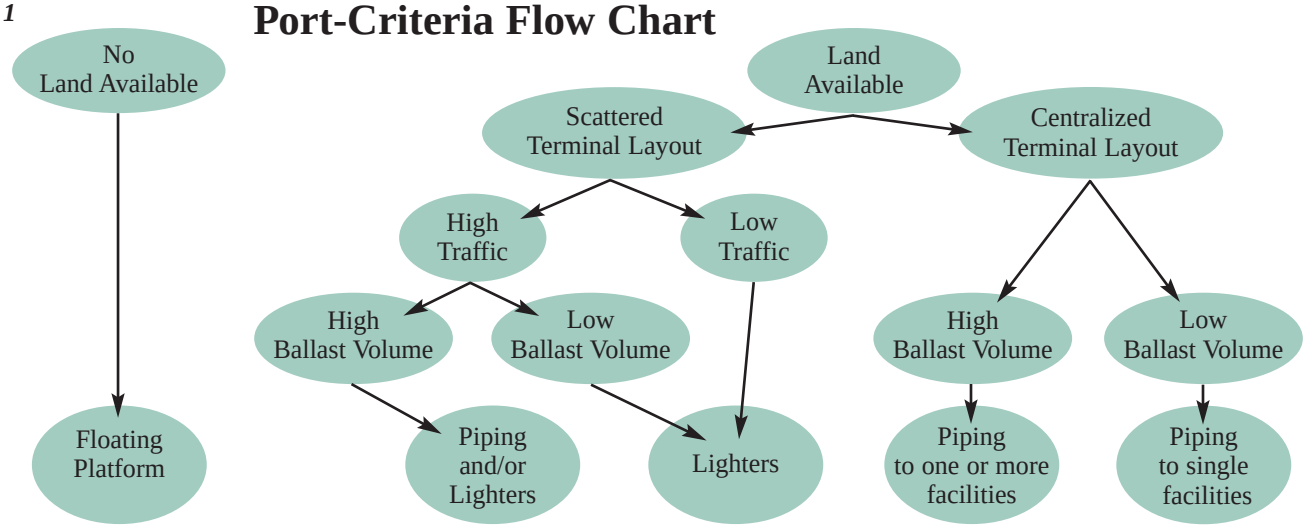
Figure 1

Port-Criteria Flow Chart



Use a permanently moored, decommissioned tanker. Operation, maintenance, and supply of treatment materials and of power are difficult due to its location.

In addition to lighters, a piping system may be necessary to reduce congestion in high traffic situations.

Size and availability of land parcels may factor into determining the number of facilities.

***Port** continued from previous page*

designed to load and discharge ballast in calm waters, concerns arise for the safety of ships conducting ballast-water exchange on the high seas, especially in stormy conditions. A potential complement to this practice is the treatment of ballast on land or at a water-based facility. In addition, ballast-water exchange is not effective for many near-coastal voyages.

Two broad categories of treatment methods are chemical and physical processes. The potential physical treatment options include ultraviolet light, heat, screening, filtering, floatation, centrifugation, and sedimentation. Chemical processes involve treating the water with compounds such as chlorine, other general toxicants, nonoxidizing molluscicides, ozone, or a ship's diesel exhaust to kill the organisms (AQIS 1993).

Ballast-Water Collection and Methods of Treatment

The ideal treatment system would remove or kill all organisms either before the ballast water enters the ballast tank or before a vessel enters the port of destination. Several approaches and technologies are being studied at this time. One option would be to collect ballast water for land-based treatment at central discharge sites or through a network of piping at dockside. In direct-deposit, a ship docks at a central shore-side facility and discharges its raw ballast before proceeding to its docking terminal. A variation of this method would be to pump the ballast water from a docked ship through a pipeline network to a treatment facility. The advantage of a land-based site is the ease in which the treatment process can be monitored and operated, and the ability to limit the effects of any spills (AQIS 1993).

Water-based systems could be either mobile or stationary. Mobile collection systems using "lighters"—smaller vessels such as tankers or barges that transfer cargo between ships and shore—would be able to service several docks and transfer ballast from incoming ships to shore-side storage and treatment facilities. Strategically placed stationary platforms could be used as a stopping point for ships to exchange their ballast. This option differs from its land-based counterpart only in the location of the central discharge point. Once the raw ballast is discharged, the vessel would then proceed to its dock to load cargo (AQIS 1993).

Cost Analysis

Port-based facilities, either floating platforms or on land, would cost from $9 million to $19 million to construct. Operating costs range from $90 to $400 per 1000 MT of ballast water treated (AQIS 1993); these costs would bear comparison to other options. Several port-specific criteria will determine the cost of the ballast treatment options and should be considered in the decision-making process:

- land availability;
- ballast volume deposited;
- port layout;
- port traffic; and
- cost and time efficiency.

While port-based treatment systems are very expensive when compared to the potential costs incurred by an invasive species, it could be argued that they become cost effective if they reduce the effects of a scenario similar to the outbreak of zebra mussels in the Great Lakes.

The Alyeska Ballast Water Treatment Facility

One ballast water treatment facility currently in use in the U.S. is the Alyeska Ballast Water Treatment Facility located at the Valdez Marine Terminal, Prince William Sound, Alaska (see "Preventing Nonindigenous Species Invasions in Prince William Sound" in *ANS Digest*, Vol. 1, No. 4). At the terminus of the trans-Alaska pipeline, the Alyeska facility is a land-based, direct-deposit facility serving a single terminal.

The purpose of the Alyeska facility is to remove oil, rather than organisms, from ballast water to prevent contamination of the Sound. Public and industry awareness

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State ANS Management Plan

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Development of an Ohio State Management Plan

The development of an Ohio State ANS Management Plan was initiated in October 1995 by the Ohio Department of Natural Resources, Division of Wildlife. Given the mission and authority of the Division of Wildlife (ODNR 1994), it was evident that it should take the lead in developing a plan. The first step was to assemble an interagency planning committee to begin drafting a state plan. The committee was composed of representatives from the Ohio Environmental Protection Agency, the Ohio Sea Grant Program, the Ohio Lake Erie Office, the Ohio Cooperative Fish and Wildlife Service, and three Ohio DNR divisions: Wildlife; Natural Areas and Preserves; and Real Estate and Land Management's Coastal Management Program.

The committee used the model plan developed during a 1995 workshop hosted by the Great Lakes Commission and the Michigan Coastal Zone Management Program as a template (Glassner-Shwayder 1996; see also "State Management Plans" in *ANS Digest*, Vol. 1, No. 1). In May 1996 the draft plan was completed and distributed for review to 70 groups and individuals, which included local and regional governments, conservation clubs, boating associations, marsh managers, academic institutions, industries, state and federal agencies, and the state legislature. Comments from 20 groups were received and incorporated into the final draft plan. The Governor of Ohio formally submitted the Ohio State ANS Management Plan to the national ANS Task Force in October 1996. The director of the Ohio Department of Natural Resources received conditional plan-approval from the co-chairs of the ANS Task Force in January 1997, subject to several clarifications and conditions. A few of the revisions were made in July 1997 (ODNR 1997a); however the Task Force allowed Ohio a year to complete the revisions after funding was provided by the U.S Fish and Wildlife Service for the initial implementation. Following New York and Michigan, Ohio became the third state to have an approved state plan and to receive federal funding for its implementation.

The Ohio plan includes an overview of the serious problems caused by nonnative species, policy background (federal, regional, and state roles), Ohio's related authorities and programs, and recommended actions or tasks for the prevention, control, and abatement of ANS. Overall, the plan is a strategic document for a unified regional and local approach to the serious ANS problem.

Administration and Annual Work Plan

Ohio's state plan provides guidance for the administration or implementation of specific projects. These projects were initiated in March 1997, when the Division of Wildlife hired a program coordinator and submitted a work plan to the ANS Task Force for consideration of funding. In June 1997 Ohio was awarded a $25,000 grant from the U.S. Fish and Wildlife Service to begin initial implementation of the plan, which contains three projects (ODNR 1997b):

◈ Regional and National Coordination of ANS Issues. The objective of this project is to participate in and contribute to regional and national prevention and control strategies. This includes supporting interjurisdictional approaches to facilitate legislative, regulatory, and other actions needed for the prevention of new ANS introductions into the Great Lakes and inland state waters. Specific activities include attendance and participation at the Great Lakes Panel meetings, attendance at ANS Task Force meetings, and presentations about Ohio's state plan and program at regional and national conferences. Benefits from the project include establishing relationships to facilitate the implementation of all of the strategies in the state plan, particularly those beyond the scope of Ohio alone. It also helps to ensure compatibility and consistency between state and federal agencies. Most importantly, this project serves as the linkage between Ohio's ANS program and those of the Great Lakes region and the nation.

◈ Interagency and Constituent Group Coordination. The objectives of this project are to establish an interagency coordinating committee and a user-group advisory team to oversee the implementation of the strategies and tasks within the plan. The interagency committee was formed by using the same representatives that drafted the state plan plus a representative from the Ohio DNR Division of Watercraft. Activities and functions of the steering committee include the prioritization of short and long-term ANS strategies for Ohio, review of input from the Advisory Team, development of annual work plans, and providing input and recommendations to other collaborating state agencies, regional ANS Panels, and the national ANS Task Force.

The multiconstituent ANS Advisory Team was formed by selecting representatives from potentially affected resource users such as aquaculturists, members of the aquarium trade, sport fishing groups, shipping companies, zoos, and environmental groups. The selections were primarily accomplished by reviewing a survey that was attached to the draft plan when it was distributed for review, which asked survey respondents if they were interested in participating in future committees and in selecting representatives from other important groups and organizations. Three Advisory Team meetings have been held to date. Meeting activities and expectations of the team included the review and assessment of existing ANS information and educational materials; the prioritization of Ohio's ANS species, issues, strategies, and tasks; and general discussions of ANS problems and issues. Members were also asked to fill out a questionnaire soliciting input on how their groups or organizations could help implement the goals and strategies of the state plan. Members were also informed of regional and national initiatives and expected to provide representation and coordination with constituent groups. This project formed a broad partnership between state agencies, universities, and other stakeholders, and established a useful means of communication between governmental and nongovernmental groups.

State ANS Management Plan *continued on next page*

State ANS Management Plan *continued from previous page*

◈ ANS Information Assessment and Development. The primary objectives of this project are to inventory existing sources of ANS information, develop new mechanisms to deliver ANS information, and assess existing ANS monitoring programs throughout the state. Specific activities include collecting information and education materials from other states, and evaluating how such items could be adapted for Ohio and the inventory of existing monitoring and control efforts in Ohio. Accomplishments include an improved ANS message in Ohio's fishing regulation pamphlet, participation in the reprinting of high-quality educational materials, such as the Goby and Ruffe Watch ID cards, and the publication of several ANS articles. When Ohio's ANS Advisory Team prioritized Ohio's ANS issues, "educating the public about ANS and their effects" was selected as the highest priority.

Benefits and Future Challenges

As the first year of Ohio's ANS program ends, many benefits are evident: the establishment of a dedicated state program; federal and state funding; a coordinated approach and improved networking and partnership capabilities among diverse governmental and private stakeholders; public involvement and input; and the ability to evaluate, monitor, and prioritize ANS problems and issues throughout the state. Presentations, articles, and the distribution of information and education materials have also helped increase awareness in Ohio, regionally, and nationally.

Future challenges for state management plans include staying focused on significant problems, securing higher levels of funding, and demonstrating successes. Perhaps the most important challenge will be convincing others that ANS problems are real, that they have accumulated over a long period of time and are ongoing, but that they can be managed with effective programs. Although there is still much to do, Ohio's ability to find solutions to ANS problems has been improved with the development and implementation of a state management plan for ANS.

Randall E. Sanders is the Program Administrator for Aquatic Nuisance Species, Aquatic Wildlife, Diversity and Endangered Species, and Streams in the Fish Management and Research Section of the Ohio Division of Wildlife. For more information about Ohio's ANS Program, he may be contacted at the Ohio Division of Wildlife, Fish Management and Research, 1840 Belcher Drive G-3, Columbus, OH 43224; (614) 265-6344; e-mail: randy.sanders@dnr.state.oh.us.

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Nuisance Notes
from the Western Regional Panel on ANS

Western Governors Issue Resolution on ANS

The Western Governors' Association met in Alaska in June. They issued a resolution recognizing the problem of invasive aquatic and terrestrial species; supporting management actions to prevent the spread, intentional, and unintentional introductions of nonnative species, and to control existing invasions; calling for programs to incorporate education, prevention, early detection techniques based upon integrated pest management (IPM) practices; encouraging land management agencies, local governments, universities, and private groups to collaborate to enhance, develop, and implement IPM programs; and that urged support for the U.S. Department of Agriculture–Animal, Plant, and Health Inspection Service. For more information about Resolution 98-018, see the Western Governors' Association Web Site: www.westgov.org/wga/policy/98018.htm.

State Updates

Arizona, Nevada, and Wyoming: Are developing a regional management plan for the Colorado River Basin. AZ contact Joe Janisch (602) 789-3258; NV contact Jon Sjoberg (702) 486-5127; WY contact Mike Stone (307) 777-4559.

California: The U.S. Fish and Wildlife Service recently approved for field testing the herbicides Sonar, Komeen, and Diquat for the CA Department of Boating and Waterways to control the introduced aquatic weed *Egeria densa* in the Sacramento-San Joaquin Delta. The Service is concerned that the weeds are damaging habitat critical to delta smelt and splittail. Contact Randy Brown (916) 227-7531.

Kansas, Nebraska, North Dakota, Oklahoma: 100th Meridian Initiative boater education stations being put into place. KS contact Tom Mosher (316) 342-0658; NE contact Steve Schainost (402) 471-5443; ND contact Terry Steinward (701) 328-6313; OK contact Everett Laney (918) 669-7411.

New Mexico: Nonnative crayfish *Oroconectes virilis* identified and being monitored for effects on native populations. Contact Brian Lang (505) 827-9904.

Oregon: State and federal agencies in the Pacific Northwest have jointly funded a coordinator for ANS prevention and management in the region. Recent efforts have focused on a Coast Guard-funded survey of ANS in the Columbia River and development of a list server on ANS. New reports of the Japanese varnish clam *(Nuttallia obscurata)* continue to be made; it is now reported in five estuaries, and is expected to spread far to the south of Oregon. Contact Andrew Schaedel (503) 229-6121.

Texas: Hydrilla is an increasing problem; Governor Bush addressed the issue in a recent press conference. Contact Larry McKinney (512) 389-4394.

Utah: The Division of Wildlife has organized an interagency working group to address prevention and control issues. Contact Randy Radant (801) 538-4812.

Washington: Senate Bill 6114 passed, mandating prevention and control of zebra mussels and green crabs, and calling for a task force to lead the effort. The state ANS management plan has been submitted for public review. Contact Scott Smith (360) 902-2328.

Upcoming Meeting

The Western Regional Panel will hold its fall meeting on 23–24 September 1998 in Denver, CO. For information, contact Linda Drees, U.S. Fish and Wildlife Service, 315 Houston St., Suite E., Manhattan, KS 66502; (785) 539-3474 ext. 20.

This article is taken from the Winter issue of the ANS Update, Volume 4, Number 1, published by the Great Lakes Panel on Aquatic Nuisance Species and the Great Lakes Commission.

Exploring the Potential of Glutaraldehyde for Ballast-Water Treatment

by Russell Moll

Glutaraldehyde, a nonoxidizing **biocide***, will be studied as a possible tool to prevent introductions of nonindigenous aquatic nuisance species (ANS) through ballast water. This three-year project, conducted by investigators at the University of Michigan, is supported by a grant from the Great Lakes Fishery Trust, a new organization that supports Great Lakes research. The primary objective of this research, based on recommendations from a preliminary study funded by Michigan Department of Environmental Quality's Office of the Great Lakes, is to determine if glutaraldehyde can effectively treat microorganisms transported in the unpumpable ballast residue remaining in ships' ballast tanks in a manner that is not harmful to the environment. If this project proves a success, we may have a new weapon in preventing ANS introductions through ballast water.

One ballast management option that has yet to be explored is a class of compounds called nonoxidizing biocides. Use of a nonoxidizing biocide such as glutaraldehyde would require only minimal engineering modifications to ships, making it a good candidate for use in the existing fleet while other technologies are being developed. Glutaraldehyde is of particular interest because it is very effective in the control of microorganisms at a concentration of 10 to 25 parts-per-million. This chemical has a short half-life of one to two days and then breaks down into byproducts such as carbon dioxide.

Glutaraldehyde shows promise because it already has a wide range of applications that are environmentally acceptable. Most notable is its use as a sterilant in the medical and dental professions and to control microorganism growth in cooling water towers. Because glutaraldehyde is believed to be effective at low concentrations and breaks down quickly, it is a good candidate for additional environmental applications. Although it is relatively expensive, its use in the treatment of unpumpable ballast is expected to be economical since it will not be needed in the massive quantities that would be necessary to treat full ballast tanks. Projected per application costs range from $260 to $900, depending on the amount of residual ballast held in the tanks.

The first year of this project will be lab investigations to determine if glutaraldehyde can be used safely and effectively in treating ballast water. Examining the feasibility of using this chemical to effectively treat ballast residue without posing environmental risks will be a critical component of this research. If the first year proves successful, we will proceed to shipboard investigations in the second and third years. Important questions to be studied include interactions between gluteraldehyde and any compounds present in ballast sediments, crew health and safety, regulatory restrictions, effects on nontarget organisms, on-board handling procedures, and possible deleterious effects on the ship's structure.

Primary investigators include Dr. Russell Moll, an aquatic biologist and director of the Michigan Sea Grant Program, and Dr. Michael Parsons, a professor in the Naval Architecture and Marine Engineering Department. They will be joined by Larissa Lubomudrov, a graduate student in the School of Natural Resources and Environment.

Dr. Russell Moll is Director of the Michigan Sea Grant. For more information, he may be contacted at (734) 763-1437; e-mail: rmoll@umich.edu.

words in **bold type are defined in the glossary on page 47.*

• •NEW• • Publications and Web Sites

NEW PUBLICATIONS

Alien Invasion:
America's Battle with Nonnative Animals and Plants, by Robert Devine, published by National Geographic Society Books. This book explores both terrestrial and aquatic invasions, discusses the science and politics of nonnative introductions, and illustrates specific examples with personal stories. Now available in bookstores for $24.00, or write to the National Geographic Society, 1145 17th Street NW, Washington, DC, 20036-4688.

Biological Invasions,
a new quarterly journal edited by James T. Cartlon that aims to pull together research on biological invasion from many different subdisciplines. It will publish research papers on terrestrial, freshwater, and marine invasions. The first issue is planned for 1999. For more information about subscriptions or submitting articles, contact Rene Mijs, Kluwer Academic Publishers, PO Box 17, 3300 AA Dordrecht, The Netherlands; or e-mail Rene.Mijs@Wkap.Nl.

NEW WEB SITES

The national ANS Task Force's Web Site will soon be available at **ANSTaskForce.gov.** The page will provide information on aquatic nuisance species, on Task Force activities, have links to many other ANS-related sites, and also have an on-line version of the *ANS Digest*.

The Western Regional Panel on ANS now has a web page at **www.wrp-ans.org.** This web site will communicate issues of particular concern to the western region of the U.S.

News from the Great Lakes Panel on Aquatic Nuisance Species

ANS UPDATE

Winter 1998 Volume 4 No. 1

Great Lakes Panel Update

At its December 1997, meeting Gary Isbell, Ohio DNR, and Ron Martin, Wisconsin DNR, were elected as the new chair and vice chair, respectively. Jay Rendall, Minnesota DNR, was appointed to represent the Panel on the Recreational Activities Committee of the national ANS Task Force. The Panel also adopted a new policy statement titled, "A Binational Canadian–United States Water Research Strategy," as well as model ANS prevention and control guidelines for personal watercraft users, waterfowl hunters and scuba divers. Additional guidelines will be developed for agency field operations, laboratories and researchers, aquaculture operators, barges, firefighting operations, and the aquarium industry.

The Panel is developing model state ANS legislation and a regional ANS Action Plan (see the summer 1997 issue of the ANS Update for a summary of these initiatives). A drafting committee will advise on the Action Plan project, and a special symposium in conjunction with the Panel's spring meeting will address the model legislation. The next Panel meeting is scheduled for June 9–10, 1998 in Ann Arbor, Mich. Contact: Matt Doss, Great Lakes Commission, 734-665-9135, mdoss@glc.org.

Washington Watch

The federal appropriations process is underway for FY 99. The President's budget requests new funds to support National Invasive Species Act (NISA) programs, but these requests are inadequate to effectively implement critical components of the law, especially the national ballast management program and the ANS state management plans. Committee hearings are in progress.

The President's budget contains $3.192 million for activities under the U.S. Fish and Wildlife Service pursuant to NISA for which total authorization is $15.7 million. This increase of $1 million from the FY 98 allocation will be allocated to the state management plans ($250,000), ballast water management projects ($150,000), the Great Lakes and Western Regional panels and support for the Chicago dispersal barrier project ($120,000), 100th Meridian Initiative and the Alaska Ballast Water Program.

Funding for NISA programs within the National Oceanic Atmospheric Administration (NOAA) is limited to $800,000 under the President's budget. NOAA is authorized to receive more than $7.5 million for responsibilities under the Act, compared to $4.3 million appropriated by Congress in FY 98. In addition, $9 million is requested in the President's budget for NOAA to research the causes and impacts of harmful algal blooms (such as Pfisteria).

The U.S. Coast Guard was authorized $2 million in FY 98 to develop its new national ANS prevention program. In addition, the Act authorized $3 million for the implementation phase of the program, slated to begin in FY 99. The President's proposed level funding for the Coast Guard programs will not be sufficient to cover implementation, including field staff and monitoring costs. FY 98 funding for the U.S. Army Corps of Engineers was $2 million for zebra mussel control, while the President's request for FY 99 is $1.5 million. Congress appropriated $500,000 in FY 98 for the Corps to cooperate with the U.S. EPA to develop a dispersal barrier in the Chicago Sanitary and Ship Canal to prevent ANS dispersal between the Mississippi River and the Great Lakes. Additional funds are needed for construction of the downstream benthic barrier and design of a barrier that covers the entire water column. Contact: Rochelle Sturtevant, Senate Great Lakes Task Force, 202-224-4229, rochelle_sturtevant @glenn.senate.gov.

News From Around The Basin

Illinois: The DNR will complete a draft ANS state management plan, including a task list and budget, this spring. Dissemination of 2,500 brochures on Great Lakes Panel-approved guidelines for recreational boaters to reduce ANS dispersal occurred at DNR-sponsored safe boating classes. Contact: Mike Conlin, IL DNR, 217-782-6424, mconlin@dnrmail.state.il.us.

Indiana: Through a cooperative effort with the Illinois-Indiana Sea Grant Program, ANS signs will be posted at boat launch areas for state park and reservoir properties. Contact: Randy Lang, IN DNR, 317-232-4094, lang@dnr.state.in.us.

Minnesota: The DNR is controlling purple loosestrife using both herbicides and biological control insects through a cooperative program between County Agricultural Inspectors, the DNR and University of MN staff. Individuals or organizations wishing to obtain Ruffe WATCH and Round Goby WATCH ID cards should contact their state's Sea Grant office, a state/provincial natural resource management agency, or a U.S. Fish and Wildlife Service office. Contact: Jay Rendall, 612-297-1464, jay.rendall@dnr.state.mn.us.

New York: The Lake Erie Fisheries Unit is beginning a second year of monitoring the impacts of zebra mussel colonization on lake trout and walleye spawning shoals. The Finger Lakes monitoring project, assessing the impacts of zebra mussel colonization on aquatic ecosystems, is conducting the fourth year of data collection. Contact: Bill Culligan, NYS DEC, 716-366-0228, nysdecdk@netsync.net.

Ohio: Implementation of the ANS state management plan continues. The document is being updated with monitoring and control programs. A conference titled Development and Implementation of State Management Plans for Aquatic Nuisance Species will be held in conjunction with the 60th Midwest Fish and Wildlife Conference in Cincinnati, Ohio, the week of December 7, 1998. Contact: Randy Sanders, OH DNR, 614-265-6344, randy.sanders@dnr.state.oh.us.

Pennsylvania: Volunteers for the state's Zebra Mussel Monitoring Program have submitted their reports for the 1997 season. While data entry is not yet completed, early indications suggest that there are no new observations of zebra mussels at the monitoring network stations. Contact: Tony Shaw, PA DEP, 717-787-9637, shaw.tony@a1.dep.state.pa.us.

Wisconsin: An initial draft of the ANS state management plan is undergoing agency review. The interstate management plan on the Lower St. Croix River is completed and will be sent to the ANS Task Force for approval. A DNR report, Zebra Mussel Induced Water Quality Impacts in the Mississippi Observed in the Summer of 1997, was released in January 1998. Contact: Ron Martin, WI DNR, 608-266-9270, martir@dnr.state.wi.us.

***Great Lakes Update** continued on page 47*

A full copy of the latest issue of the *ANS Update* (Vol. 4, No. 1), a quarterly newsletter prepared by the Great Lakes Panel on Aquatic Nuisance Species, is available upon request from the Great Lakes Commission. The feature article of this issue is authored by Dr. Russell Moll, Director of the Michigan Sea Grant; and is titled, *Exploring the Potential of Glutaraldehyde for Ballast-Water Treatment.* **Contact:** Kathe Glassner-Shwayder, Great Lakes Commission, 313-665-9135, shwayder@glc.org.

Carp, an Old Enemy

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Effects of Carp

Carp destroy aquatic vegetation, and their foraging, spawning, and feeding habits increase water turbidity which decreases aquatic plant and invertebrate production, resulting in reduced waterfowl food supplies (Berry 1983). The carp's primary foods are aquatic invertebrates, putting them in direct competition with waterfowl and waterbirds for those resources. Studies have found a high percentage of invertebrates in the diets of carp, especially midge larvae (Chironomidae) (Sigler 1958). Midge larvae are important food for fish, breeding ducks, and ducklings, and also have been shown to be important to some duck species during migration season (Swanson 1984). Female ducks laying eggs eat invertebrates to acquire protein for egg production. This protein source is crucial to diets of ducklings, which are dominated by invertebrates (Krapu 1979; Eldridge 1990). Finally, invertebrates may also be an important nutrient source to ducks during molt (Brown 1985).

In shallow wetlands, carp often dominate the aquatic fauna to the exclusion of other fish species. Carp outcompete other fish for food and will consume eggs and fry of other species. While feeding they stir up silt, creating muddy water, making it difficult for predatory fish to find food. When the silt settles out, it can fill in gravel spawning sites used by other species. Carp monopolize the food chain, locking up much of the productivity as carp biomass. If carp populations could be reduced or eliminated from wetland systems, it would be beneficial to waterfowl, other fish, and native fauna and flora.

In 1981 the Malheur National Wildlife Refuge staff distributed a questionnaire to the national wildlife refuges in the lower 48 states to determine the extent of the problem. One hundred sixty-two refuges were surveyed, and of the refuges with freshwater impoundments, 80% had carp problems. If these results were extrapolated to the rest of the nation, it would suggest that a large percentage of our wetlands, lakes, and rivers are degraded by carp.

Carp Management in Malheur National Wildlife Refuge

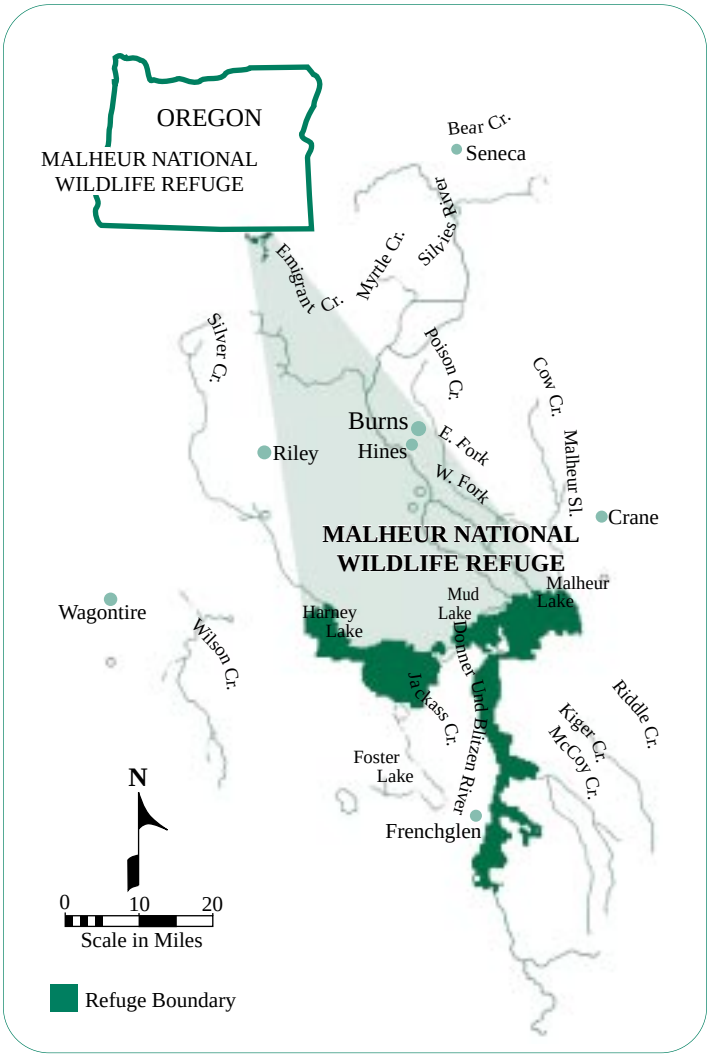
Malheur Refuge is the largest national wildlife refuge managed as waterfowl production and migration habitat in the West (see map). Encompassing over 186,000 acres, the refuge is the most important waterfowl breeding area in Oregon and among the major migratory bird production sites in the Pacific Flyway. Located in the northern Great Basin, Malheur Refuge lies within southeast Oregon's Harney Basin. The most prominent feature of Malheur Refuge is Malheur Lake, the largest unaltered freshwater marsh in the western U.S. The refuge is an oasis in a shrub-steppe desert.

Carp were introduced in the late 1920s into the Silvies River, which flows into Malheur Lake, but were not found in Malheur Lake until large numbers of adult carp were flushed into the lake by high flows in 1952. Refuge biologists observed that large numbers of carp caused an 80% decline in sago pondweed *(Potamogeton pectinatus)* between 1953 and 1954. Before carp invaded the refuge, duck production averaged over 101,000 ducks annually in the 1940s, and peaked at 139,000 ducks in 1946. During the 1950s, with carp established in Malheur Refuge wetlands, duck production was significantly lower ($P<0.0001$), averaging fewer than 38,000. By 1955, no sago pondweed was evident in the lake and carp were abundant. This prompted the U.S. Fish and Wildlife Service to undertake a major carp control project using the **piscicide** rotenone in the Malheur Lake drainage in 1955. Since then, six other major rotenone projects for carp control have been completed in the drainage. Generally, waterfowl use and production greatly increased following use of rotenone. However, because carp were never eliminated, the beneficial effects of the treatments were limited to a few years, until the carp population rebounded.

Carp in Malheur Refuge wetlands lowered the refuge's potential for waterfowl production and maintenance to about 25% of its historic capability. If carp could be eradicated, the refuge could produce an additional 80,000 ducks a year, at least in years of abundant water. If these data are extrapolated to other carp-infested wetlands in North America, this would suggest that carp could be reducing continental waterfowl production by several million ducks each year. Besides crippling waterfowl production, carp have detrimental effects on other native **fauna** as well, especially other fish. Carp affect our economy by reducing sport hunting and fishing opportunities, increasing costs to agencies, and diminishing our native biological diversity.

Rotenone treatments are very expensive and at Malheur can only be applied during drought periods when water levels are low. Every year, state and federal agencies spend large sums of money on this chemical, with only short-term success. Based on experiences at Malheur, rotenone treatments are not the long-term solution to carp problems. Continued management of carp requires an integrated approach, using a combination of strategies such as barriers, traps, removal by electroshocking, redesign of wetland impoundments for better water management, and occasional application of rotenone as needed to improve habitat for waterfowl. Even so, this approach will likely never eliminate the problem which will continue to require action and funds for years to come.

***Carp** continued on next page*



Carp *continued from previous page*

Research Needed

Better tools for carp control are needed. With research, a technique may be found to reduce carp to tolerable levels, if not totally eliminate carp from wetlands and river systems. Possible control methods include genetic manipulation, introduction of sterile hybrids, or exploration of biological control agents that could kill carp or interfere with their reproduction. An ideal method would target only carp while safeguarding native and sport fish. Because Malheur Refuge is within a closed system, it would be both an ideal and challenging area for designing and testing experimental carp eradication schemes—and would serve as a model for carp control in other wetlands on the continent.

Gary L. Ivey is a Wildlife Biologist at the Malheur National Wildlife Refuge in Princeton, OR 97721;
e-mail: gary_ivey@mail.FWS.GOV.

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Upcoming Meetings

ANS Task Force Fall Meeting and Field Trip

17–18 November 1998
U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, MS
Contact: Dr. Ed Theriot,
U.S. Army Corps of Engineers (601) 634-2678, or
Bob Peoples, U.S. Fish and Wildlife Service (703) 358-2025

Workshop on the Development and Implementation of State/Interstate Management Plans for Aquatic Nuisance Species at the 60th Midwest Fish and Wildlife Conference

6–9 December 1998
Cincinnati, OH
Contact: Randy Sanders, Ohio Division of Wildlife
(614) 265-6344; e-mail: randy.sanders@dnr.state.oh.us

The First National Conference on Marine Bioinvasions

24–27 January 1999
Cambridge, MA
Contact: Judith Pederson, MIT Sea Grant College Program,
292 Main Street E38-300, Cambridge, MA 02139;
fax: (617) 252-1615; e-mail: jpederso@mit.edu.

Send meeting announcements to:

Editor, ANS Digest
2500 Shadywood Rd., Navarre, MN 55331
e-mail: freshwater@freshwater.org

Deadline for the next issue is 15 October 1998

100th Meridian Initiative May Prevent Westward Spread of Zebra Mussels

by Bob Pitman

Coordinated activities concentrated along the 100th meridian present a unique opportunity to stop or slow the westward spread of zebra mussels and other ANS. The 100th meridian is the longitudinal line that defines the north-south border between Oklahoma and Texas, crossing the western sections of Texas and Oklahoma, and central Kansas, Nebraska, South and North Dakota, and the Canadian province of Manitoba (see map). At present, no states west of the 100th meridian other than Oklahoma are known to have populations of zebra mussels. The primary way zebra mussels could spread west is by being carried overland on trailered boats and other contaminated equipment. Areas at risk include waters over a large portion of North America and many federal, state, tribal, and private water projects that would be severely affected by zebra mussels. In a recent survey of boats entering Lake Powell, California, trailered from states with zebra mussel infestations, 27 boats had mussels attached. But because the pathway is known, it is now possible to greatly reduce the chances of any further westward spread.

The 100th Meridian Initiative is intended to be a major partnership effort. Collaboration among federal, state, and provincial agencies, tribal governments, municipalities, nongovernmental organizations, businesses, and industries is essential for a this partnership to function effectively. A principle component of the Initiative will focus on voluntary inspections and cleaning of boats and trailers being towed westward through 100th meridian states, supported and facilitated by a comprehensive information and education campaign. The inspection efforts will also generate data that will help to determine the extent of westward transport of zebra mussels and other ANS. High risk waters throughout the West will be monitored for zebra mussel infestations, and rapid-response plans to eradicate or contain new infestations will be developed and put in place.

Groups and individuals that frequently move potentially contaminated boats or other equipment westward from infested waters, such as commercial boat transport companies and participants in professional fishing tournaments, are more likely to transport zebra mussels and other ANS and so will be a focus of the Initiative. These companies and individuals will be encouraged to participate and assisted in reducing the risk associated with their activities through educational outreach and technical assistance.

With limited funding appropriated to the U.S. Fish and Wildlife Service to lead the 100th Meridian Initiative, ways to create partnerships with other federal agencies, state agencies, potentially affected trade organizations, and other interested groups are being explored. Several western agencies, industries, and programs have already expressed their willingness to contribute to the Initiative. The Fish and Wildlife Service will use its funds and any additional contributions to help those states straddling the 100th meridian to defray costs related to this effort. The Western Regional Panel of the ANS Task Force will provide coordination, guidance, and advice for the successful operation of this network.

We have the opportunity, and share the responsibility, to protect noninfected watersheds for as long as possible.

Bob Pitman is with the Oklahoma Fishery Resources Office in Tishomingo, OK 73460, and is the Nonindigenous Species Coordinator for the Southwest Region of the U.S. Fish and Wildlife Service; e-mail: bob_pitman@fws.gov.

States and Province straddling the 100th meridian

ANS Update continued from page 43

National ANS Task Force

The Task Force has constituted the following committees since November 1997: Recreational Activities, ad hoc Voluntary Ballast Water Effectiveness Criteria, Ballast Water and Shipping, and ad hoc Public Awareness. The statutory principals of the Task Force met in December 1997 and decided to establish a small staff to coordinate Task Force activities and to pursue a unified budget initiative for FY 2000 to enhance funding and avoid fragmentation in the current appropriations process.

The Task Force met March 19–20, 1998 in Sacramento, Calif. Agenda items included: policies on membership, committees, and establishment of regional panels; state management plans; ballast water activities; and problems caused by the green crab. Presentations were also made on the status of zebra mussel knowledge ten years after the first detection. The U.S. Fish and Wildlife Service has published a biological study of nonindigenous species in San Francisco Bay. Contact: Bob Peoples, U.S. FWS, 703-358-2025, robert_peoples@fws.gov.

On The Bookshelf

- *Harmful Exotic Species of Aquatic Plants and Wild Animals in Minnesota:* Annual Report 1997; MN DNR. Contact: Debbie Hunt, MN DNR, 612-296-2835, debbie.hunt@dnr.state.mn.us.
- *Great Lakes Research Review:* Great Lakes Exotic Species II. Vol. 3, No. 2; February, 1998. Contact: Helen Domske, Great Lakes Program, 716-645-2088, hdomske@cce.cornell.edu.

Glossary

Biocide:
In this context, a nonspecific chemical used to kill fish, crustaceans, and a wide range of other aquatic organisms.

Fauna:
The animals of a given region.

Piscicide:
A chemical used to selectively kill fish.

Port-Based Ballast-Water Treatment Systems

continued from page 39

is much higher in Alaska due to the publicity surrounding the 1989 *Exxon Valdez* oil spill. A portion of the ballast water on oil tankers is carried in the cargo holds when they do not contain oil, and it is only this portion of the ballast water that is treated. The facility extracts residual oil from the ballast water. Once treated, the water is diffused throughout the port by jets located on the bottom of the bay.

Tankers are able to load their oil cargo at the same dock where their ballast water is discharged to the treatment facility. About 70 tankers are loaded with oil each month, at a rate of up to 100,000 barrels per hour. The entire treatment facility covers 1,000 acres of land, and removes oil residue from about 16 million gallons of ballast water daily (Alyeska, 1994).

Discussion

The ballast-water treatment selection flow-chart (Figure 1) shows what we consider to be the most desirable method of transporting ballast water from a ship to a storage or treatment facility. The most cost-effective method of collecting ballast water is by pipeline or lighter at the dock where the ship is loading or unloading its cargo, then transporting the ballast water to a treatment facility; but this is not possible in all ports.

Except in very specific circumstances, the direct-deposit method, whether at a stationary floating platform or shore-side, is the least satisfactory method of ballast-water handling. It is inefficient due to the time delays it causes. Extra time is required for a vessel to dock at a facility and to exchange its ballast, costing shipping companies vast amounts of money. Further, it is an ineffective means of controlling foreign species introductions. Once the ballast is exchanged and the vessel proceeds to its docking terminal, the clean ballast water mixes with the organism-infested sediment at the bottom of the ballast tanks. The ballast must then be discharged as the vessel loads its cargo, releasing potentially invasive foreign organisms.

Based on the flow-chart, a land-based ballast-water treatment facility serviced by lighters would be the best way to transport ballast water in Baltimore Harbor. Because the terminal distribution within the Port of Baltimore is very scattered, the number of vessels depositing foreign ballast water is relatively low, and problems with the fouling of pipelines, the use of a piping network was deemed impracticable.

For such a port-based treatment system to be effective as a stand-alone treatment method, nationwide regulations would have to be enacted requiring that all ports around the country employ some type of treatment facility. This would prevent any ports from losing revenue due to reduction of commerce and to the costs of a treatment facility and ship modifications. If only a few ports were to require ballast-water exchange at such a facility, shipping agencies would quickly find less expensive ports. Such a nationwide initiative would require national legislation, funding, and enforcement. To prevent putting U.S. ports at a disadvantage, a worldwide regulation by the International Maritime Organization would be desireable. Due the high costs of a port-based treatment system—and the difficulty of resolving who would bear the costs—it is unlikely any large-scale facilities will be constructed as a stand-alone ballast treatment method.

Debra Greenman, Kevin Mullen, and Shardool Parmar are engineering students at the Worcester Polytechnic Institute in Worcester, MA. Lt. Chris Friese, is with the U.S. Coast Guard in Portland, OR. If you would like a copy of the complete report, contact Lt. Mary Pat McKeown at (202) 267-0500, or e-mail: mmckeown@comdt.uscg.mil.

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