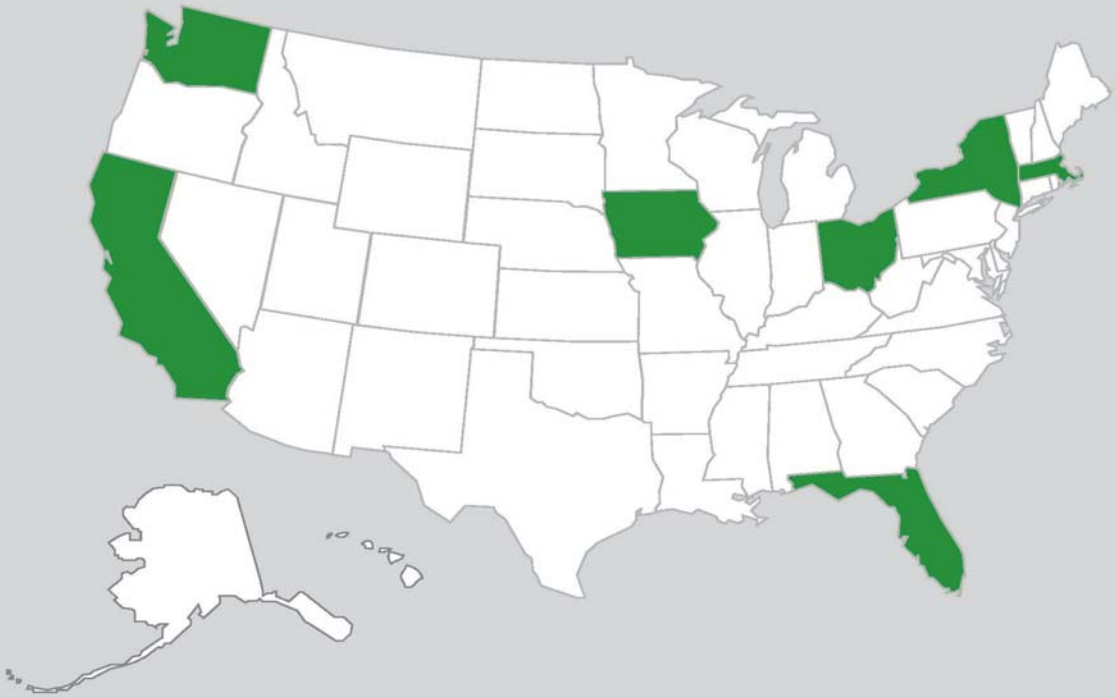
The Role of Aquatic Invasive Species in State Listing of Impaired Waters and the TMDL Program: *Seven Case Studies*



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Seven Case Studies

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Table of Contents

Summary of Findings

Introduction

There is much debate over whether and how to address the effects of aquatic invasive species in the Clean Water Act's Total Maximum Daily Load (TMDL)[1] program, but regardless of one's stance on that issue, these species have influenced and continue to affect state assessments of water quality and the administration of TMDL programs. Many aquatic invasive species degrade water quality by changing the natural characteristics of the water, reducing the abundance and diversity of native aquatic life, or impeding human uses of the water. The Environmental Law Institute (ELI), with funding from and in cooperation with the U.S. Environmental Protection Agency (U.S. EPA), conducted research on seven states representing a range of geography, number of aquatic invasive species present, water quality standards, 303(d) listings for invasive species, and aquatic invasive species management programs. The states selected for the study were California, Florida, Iowa, Massachusetts, New York, Ohio, and Washington.[2] ELI examined how the adverse effects of aquatic invasive species have influenced water quality listings and TMDL development and whether the TMDL program may affect other invasive species programs operated by the states.

ELI research indicates that the effects of aquatic invasive species appear in state water quality assessments. These effects may amount to a violation of state water quality standards and may lead to the identification of waters as impaired under Section 303(d) of the Clean Water Act. All seven case study states have water quality standards that could be violated by the effects of invasive species, and several of these states have found specific designated uses impaired by invasive species in certain instances. Every case study state except Florida has recognized aquatic invasive species as a cause of impairment at some time. Five case study states have listed water segments as impaired by invasive species on at least one of their periodic 303(d) lists. Presently, two case study states (California and Ohio) list waters as impaired by invasive species on their respective 303(d) lists, and four include such impairments in Category 4c, caused by a non-pollutant. When waters are placed on a 303(d) list for impairment by a pollutant, states are required to develop a TMDL. No case study state has yet submitted a TMDL for invasive species to the U.S. EPA for approval. However, four case study states have developed TMDLs for other causes of impairment that address invasive species, and two others have such TMDLs forthcoming. While states with a great number of invasive species tend to have more comprehensive invasive species management programs apart from their Clean Water Act programs, there is no correlation between existence of invasive species management programs and the state's approach to invasive species under the TMDL program. While the TMDL program has not yet proven to be an ideal means of addressing aquatic invasive species, it has proven capable of considering this cause of impairment.

The Invasive Species Problem

Advancements in transportation and growth in domestic and international commerce have led to the introduction of numerous species into new environments. Some species arrive intentionally as live produce, household plants or pets, or to serve a more utilitarian function such as preventing bank erosion or as a biocontrol for an invasive species. Others arrive more covertly, stored in ballast tanks of vessels, on or among commercial goods, or even in the packaging of those goods. Many species are unable to adapt to the conditions of the new environment and do not survive. Fewer still truly thrive. However, a non-native species can cause substantial ecological and economic damage where conditions are favorable for its proliferation.

Every state in the United States has some species in its waters that are not native to the state. The number of such identified species in any state varies from approximately 25 in Alaska to over 450 in California,

1. The term "Total Maximum Daily Load" is defined in the EPA Clean Water Act regulations as "The sum of the individual [waste-load allocations] for point sources and [load allocations] for non-point sources and natural background." 40 C.F.R. § 130.2(i). TMDL listing and program regulations are at C.F.R. § 130.7; detailed TMDL program information can be found at http://www.epa.gov/owow/tmdl/.

2. Detailed reports of ELI's findings for each of the case study states are attached as an appendix to this document.

with a median number of non-native aquatic species at roughly 90.[3] Some non-native species have had such significant effects on their new surroundings that they have caused harm to the environment, economy, or human health. These species often are referred to as "invasive species."[4] They adapt well to their new environment, spreading unchecked due to a lack of natural predators or other environmental controls. They often cause biological and economic harm by out-competing native species, shifting the balance in the local ecology, and interfering with human use of water resources. Zebra mussels alone have cost the Great Lakes region approximately $3 billion over the last 10 years just to mitigate the damage that they have caused by clogging water intake pipes, fouling beaches, sinking navigation buoys, and creating similar nuisances.[5]

Invasive species can have direct and substantial effects on water quality. For example, common carp, which are present in every state but Alaska,[6] directly increase turbidity by physically resuspending sediment in the course of eating and swimming.[7] They also increase nutrient levels in the water column through their excretions.[8] By increasing available nutrients in the water, carp also indirectly increase turbidity since phytoplankton, which cloud the water, feed on the nutrients.[9] Invasive aquatic plants such as Eurasian watermilfoil, present in every state but Alaska and Wyoming,[10] can increase nutrient loading, affect the integrity of aquatic communities, inhibit recreational uses, and degrade visual aesthetics.[11] Zebra mussels, present in nearly half of the states,[12] have been found to cause low dissolved oxygen in rivers during summer months on account of their respiratory activity, the decomposition of their waste products, and the decay of dead mussels.[13] Additionally, the phosphate and ammonia that zebra mussels excrete increases the levels of both of these compounds in the water.[14] In Saginaw Bay and Lake Erie, zebra and quagga mussels even have been shown to promote and maintain blooms of potentially toxic blue-green algae, *Microcystis*, by consuming competing algal strains, spitting the *Microcystis* back into the water, and fertilizing the *Microcystis* with phosphate and ammonia.[15] Since many aquatic invasive species have no natural predators and easily move or are inadvertently transported between bodies of water, these water quality problems become more severe and spread throughout a region if not controlled.

Research

The Environmental Law Institute, with funding from and in consultation with the U.S. EPA, designed and conducted a research project to evaluate the status of state TMDL programs in their consideration of aquatic invasive species problems. From these findings, ELI sought to compare and contrast the different state approaches to invasive species within the TMDL pro-

3. *See* U.S. Geological Survey, Nonindigenous Aquatic Species Lists by State, *at* http://nas.er.usgs.gov/queries/StateSearch.asp (last visited Dec. 3, 2007).

4. "Invasive species" commonly is defined as "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." Exec. Order No. 13,112, 64 Fed. Reg. 6,183 (Feb. 3, 1999). For more information on invasive species, see http://www.epa.gov/owow/invasive_species/.

5. National Aquatic Invasive Species Act of 2007, S.725, 110th Cong. § 2(5) (2007).

6. *See* U.S. Geological Survey, Nonindigenous Aquatic Species Lists by State, *at* http://nas.er.usgs.gov/queries/StateSearch.asp (last visited Dec. 3, 2007).

7. University of Michigan Museum of Zoology: Animal Diversity Web, Cyprinus carpio, *at* http://animaldiversity.ummz.umich.edu/site/accounts/information/Cyprinus_carpio.html (last visited Dec. 13, 2007).

8. *Id*.

9. *Id*.

10. *See* U.S. Geological Survey, Nonindigenous Aquatic Species Lists by State, *at* http://nas.er.usgs.gov/queries/StateSearch.asp (last visited Dec. 3, 2007).

11. Wisconsin Department of Natural Resources, Eurasian Water Milfoil (Myriophyllum spicatum), *at* http://www.dnr.state.wi.us/invasives/fact/milfoil.htm (last visited Apr. 30, 2008).

12. *See* U.S. Geological Survey, Nonindigenous Aquatic Species Lists by State, *at* http://nas.er.usgs.gov/queries/StateSearch.asp (last visited Dec. 3, 2007).

13. John F. Sullivan and Mark B. Endris, Presentation at the 54th Annual Meeting of the Upper Mississippi River Conservation Committee (Mar. 1998), http://dnr.wi.gov/org/water/fhp/papers/p1/misszmdo.htm.

14. National Oceanic and Atmospheric Administration, The Zebra Mussel Connection: Nuisance Algal Blooms, Lake Erie Anoxia, and other Water Quality Problems in the Great Lakes (2002), http://www.glerl.noaa.gov/pubs/brochures/mcystisflyer/mcystis.html (last visited Dec. 11, 2007).

15. *Id*.

gram context and to establish a factual basis for evaluating how invasive species best could be integrated into TMDL program procedures.

In order to gain a full understanding of the variety of ways in which states address invasive species in the TMDL program, without a detailed review of all 50 states, ELI and staff from the Watershed Branch of U.S. EPA's Office of Wetlands, Oceans, and Watersheds sought a balanced cross-section of states to study. Criteria considered in this selection process included diversity in geography, U.S. EPA regions, number and impact of aquatic invasive species, water quality standards, number of 303(d) listings for invasive species, number of TMDLs that address invasive species, and extent of other aquatic invasive species programs. The result was seven case study states: California, Florida, Iowa, Massachusetts, New York, Ohio, and Washington.

For each of these case study states, ELI first analyzed as many of the state's past Clean Water Act Section 303(d) lists,[16] Section 305(b) reports,[17] and Integrated Reports[18] as it could acquire, recording the water segments listed as impaired by invasive species, tracking the history of those segment listings, and noting the state's view of invasive species as a "pollutant" or "pollution" each year. Second, ELI sought the scientific or policy justification for listing or not listing water segments as impaired by invasive species. In some states, this included references to specific state water quality criteria for each impairment determination. ELI followed this inquiry with an analysis of the state's water quality standards, attempting to identify any other water quality criteria that could address the presence or effects of invasive species. ELI then researched the state's TMDLs for references to invasive species. The final aspect of this study was an analysis of the state's array of aquatic invasive species management programs, identifying the agencies involved, number of projects underway, and the degree of coordination among the agencies. To confirm the findings in each state and to gain a more accurate sense of the reasons behind the current approaches, ELI interviewed state TMDL and 303(d) listing staff, aquatic nuisance species management program staff, and knowledgeable outside individuals.

Water Quality Standards

All state TMDL programs begin with water quality assessments.[19] The data gathered from this process then is compared against the state's water quality standards to determine whether the water is impaired. Water quality standards are defined for various "designated uses." Thus, the water quality criteria that a specific water segment must meet depends on the use of that water, whether for drinking, fishing, recreation, aquatic life, or any other uses that the state designates. Additionally, states establish water quality criteria that apply to all waters regardless of use. When lacking numeric components, these criteria are referred to as "narrative" and commonly take the form of "waters shall be free from…" Although there are similarities in this structure and in some of the criteria, water quality standards vary from state to state. This variation influences the water quality issues addressed by the standards and ultimately what water segments may be listed as impaired and why.

Despite this variation, all seven of the case study states have water quality standards that either do or theoretically could reflect the effects of aquatic invasive species on the waters to which the standards apply. Case study states that have referenced specific water quality criteria when making an impairment determination based on invasive species always have specified a designated use, never a narrative criterion. Table 1 shows in **bold** the designated uses that the states have referenced when finding a water segment to be impaired by invasive species. Recreational uses commonly are found to be impaired by invasive species when an invasive aquatic plant covers the

16. The 303(d) list is a compilation of "those waters within [state] boundaries for which the effluent limitations … are not stringent enough to implement any water quality standard applicable to such waters.". 33 U.S.C. 1313(d)(1)(A).

17. The 305(b) report includes "a description of the water quality of all navigable waters in such State during the preceding year." and other information specified in the statute. 33 U.S.C. 1315(b)(1).

18. The Integrated Report is "a single report … that satisfies the reporting requirements of CWA sections 303(d), 305(b) and 314." Envtl. Prot. Agency, Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act 9 (2005).

19. See page 12 of this report for a chart depicting the Clean Water Act framework for determining and solving the impairment of state waters.

Table 1. Invasive Species-Relevant Water Quality Standards

State	Designated Uses that could reflect Aquatic Invasive Species
California	Aquaculture; Preservation of Biological Habitats of Special Significance; Cold Freshwater Habitat; Estuarine Habitat; Freshwater Replenishment; **Marine Habitat**; Migration of Aquatic Organisms; Rare, Threatened, or Endangered Species; Inland Saline Water Habitat; Spawning, Reproduction, and Development; **Warm Freshwater Habitat**; Wildlife Habitat; **Water Contact Recreation; Noncontact Water Recreation**
Florida	Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife (Aquatic Life Use Support), Recreation
Iowa	Cold Water Aquatic Life Type 1, Cold Water Aquatic Life Type 2, **Lakes and Wetlands**, Warm Water Type 1, Warm Water Type 2, Warm Water Type 3, **Primary Contact Recreational Use**, Secondary Contact Recreational Use, Children's Recreational Use
Massachusetts	**Aquatic Life** (Cold Water Fishery and Warm Water Fishery), **Primary Contact Recreation, Secondary Contact Recreation, Aesthetics**
New York*	Aquatic Life Use Support, Hydrology/Habitat, Public Bathing, Recreation, Aesthetics
Ohio	Coldwater Habitat, Seasonal Salmonid Habitat, **Exceptional Warmwater Habitat, Warmwater Habitat, Modified Warmwater Habitat**, Limited Resource Waters, Bathing Waters
Washington	Char Spawning and Rearing; Core Summer Salmonid Habitat; Salmonid Spawning, Rearing, and Migration; Salmonid Rearing and Migration Only; Non-Anadromous Interior Redband Trout; Indigenous Warmwater Species

Designated uses in **bold** have been used to determine invasive species impairment in that state
* New York's WI/PWL uses, not its less-specific designated uses, are included here

pond or lake surface, making swimming unpleasant.[20] Aquatic life uses commonly are found to be impaired by invasive species when an invasive species alters the biological community by consuming, out-competing, or altering the habitat of native species.[21] As "aquatic life use" is defined in Massachusetts, simply the presence of invasive species constitutes impairment.[22] Among New York's Waterbody Inventory/Priority Waterbodies List (WI/PWL) uses, which are more specific than the state's designated uses, is the Habitat/Hydrologic Use, a use that captures aquatic resource degradation caused by what the state classifies as "pollution."[23] This WI/PWL use reflects the effects of invasive species, but the state employs it as a means to collect "pollution"-caused impairments and divert them from subsequent steps in the TMDL program.[24] For a discussion of the role of the "pollution" vs. "pollutant" distinction in the TMDL program, see Section VI below.

In addition to the water quality criteria that have been singled-out as the basis for invasive species impairment determinations, the case study states have other designated uses and narrative criteria that could

20. *See* California Regional Water Quality Control Board, Santa Ana Region, Staff Report on the Nutrient Total Maximum Daily Loads for Big Bear Lake 46 (2005); Massachusetts Department of Environmental Protection, Massachusetts Year 2006 Integrated List of Waters 20-21 (2006).

21. *See* State Water Resources Control Board, Draft Staff Report Supporting the Recommended Revisions to the Clean Water Act Section 303(d) List (2006); Massachusetts Department of Environmental Protection, Massachusetts Year 2006 Integrated List of Waters 17 (2006).

22. Massachusetts Department of Environmental Protection, Massachusetts Year 2006 Integrated List of Waters 17 (2006); Massachusetts Department of Environmental Protection, Deerfield River Watershed 2000 Water Quality Assessment Report 127 (2004).

23. New York State Department of Environmental Conservation, New York State Water Quality 2006 70-71 (2007).

24. Telephone Interview with staff of the New York State Department of Environmental Conservation (Sept. 2007).

reflect the effects of invasive species. The designated uses listed but not bolded in Table 1 have not been cited by that state when determining impairment by an invasive species, but they have the potential to serve that purpose. ELI selected these designated uses from each state's full list of uses either because of their similarity to designated uses cited for invasive species impairment determinations in other case study states or because, by their very nature, the uses are likely to reflect the effects of common invasive species.

In addition to citing a designated use when listing water segments as impaired by invasive species, California also has referenced its narrative water quality criterion for toxic substances.[25] Aside from these instances, case study states have not used narrative criteria as a basis for designating water segments as impaired by invasive species. However, some case study states have used certain narrative criteria, particularly those pertaining to turbidity, aesthetics, and floating material, to target impairments to which invasive species contribute. For example, common carp increase turbidity in shallow ponds, Eurasian watermilfoil can degrade lake and pond aesthetics, and numerous invasive plant species could constitute noxious floating material. These criteria theoretically could be used to capture the impacts of aquatic invasive species.

Impairment of Water Quality

Despite the fact that a state's water quality standards could reflect the impact of invasive species on water quality, a state may not deem waters to be impaired by invasive species. Under the requirements of the Clean Water Act and U.S. EPA regulations, each state biennially must submit to the EPA, among other things, a report with analysis of the quality of the state's waters, known as a 305(b) report,[26] as well as a list of all waters for which effluent limitations and other required controls are not stringent enough to achieve applicable water quality standards, referred to as a 303(d) list.[27] As of 2002, the U.S. EPA recommends that states create an "Integrated Report," which combines the 303(d) list and the 305(b) report.[28] In practice, state 305(b) reports, and now the 305(b) portion of Integrated Reports, reveal and explain the different causes of impairment recognized by the state. The recognized causes include all materials considered to be "pollutants" under Clean Water Act Section 502(6), as those are required by federal law, but additional causes of impairment often are recognized by the state agency in charge of producing the 305(b) report and 303(d) list. Some of the case study states consistently have recognized invasive species as a cause of impairment.[29] Others have changed their views over time.[30] Florida is the only case study state never to have recognized invasive species as a cause of impairment.

Listing for Aquatic Invasive Species Impairment

Recognition of aquatic invasive species as a cause of impairment in the 305(b) portion of a state's integrated report does not mean that specific water segments will be identified as impaired by invasive species. For example, New York has recognized invasive species as a cause of water quality impairment in its 305(b) report since 2002, but it did not identify a specific water segment as impaired by invasive species until 2006. Conversely, states have listed specific water segments as impaired by invasive species on their 303(d) lists without recognizing aquatic invasive species as a cause of impairment in their 305(b) reports. Ohio has not identified invasive species as a cause of impairment since 1998, but it listed three water segments in 2004 and 2006 as impaired by, among other things, invasive species. This disconnect is due in part to changes in the recommended form of the 303(d) list and 305(b) report as well as the increased emphasis on the "pollutant"-"pollution" distinction.

A state's 303(d) list denotes the water segments that the state has deemed to be impaired.[31] Prior to the year

25. *See* State Water Resources Control Board, Staff Report: Revision of the Clean Water Act Section 303(d) List of Water Quality Limited Segments Vol. III (2006).

26. 33 U.S.C. § 1315(b)(1).

27. *Id*. § 1313(d)(1); 40 C.F.R. 130.7(d).

28. *See* Envtl. Prot. Agency, 2002 Integrated Water Quality Monitoring and Assessment Report Guidance (2001). U.S. EPA has updated this guidance for 2004, 2006, and 2008 listing cycles, http://www.epa.gov/owow/tmdl/policy.html.

29. California, Iowa, Massachusetts, and Washington

30. Ohio and New York

31. See 33 U.S.C. 1313(d)(1)(A).

2000, the U.S. EPA provided comparatively little guidance concerning the form and content of the 303(d) list.[32] In preparation for the 2002 lists, the EPA issued guidance quite distinct from those of previous years. The EPA recommended the creation of Integrated Reports and outlined a comprehensive list structure that would include all state waters. By combining the 305(b) report and the 303(d) list, the single Integrated Report includes both an analysis of the quality of the state's waters and a list of waters that are impaired. Under the U.S. EPA's recommended listing structure, water segments would be placed into one of five categories ranging from Category 1, not impaired, to Category 5, the 303(d) list.[33] Category 4 consists of three subparts: (a) a TMDL has been completed; (b) a TMDL is not needed because other measures are expected to result in attainment of water quality standards; and (c) the impairment is not caused by a pollutant.[34]

The U.S. EPA's 2002 Integrated Reporting Guidance made more significant for listing purposes the distinction between "pollutants" and "pollution" by identifying the 303(d) list as a record of water segments impaired by pollutants.[35] EPA policy is that if a segment is shown to be impaired, it should be placed on the state's 303(d) list "unless the state can demonstrate that no pollutant(s) causes or contribute to the impairment." [36] "Pollutants" include "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water."[37] "Pollution" is defined as "the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water."[38] Water segments placed in Category 5, the 303(d) list, are segments that need a TMDL.[39] Since states generally wish to minimize the burden of staffing the development of TMDLs, they are unlikely to list a segment in Category 5 unless a contributing factor to the impairment is a pollutant. Thus, few waters where the impairment is deemed to be "pollution" have appeared on case study state 303(d) lists since 2002.

California is the only case study state to consider aquatic invasive species to be pollutants according to its listing methodology. This decision was recent (2005) and heavily influenced by two court cases and a U.S. EPA response to state activities.[40] By 2005, California already had several water segments on its 303(d) list for impairment by invasive species. The state's pollutant determination made it necessary for California to establish a methodology for determining impairment by aquatic invasive species. The California State Water Resources Control Board found a solution simply by applying a pre-existing section of the state's listing policy, "trends in water quality," to invasive species.[41] Through this method, the only water segments that are listed for invasive species impairment are those for which data indicate a correlation between a rise in invasive species and a decline in water quality, usually as a reduction in native popula-

32. *See* Envtl. Prot. Agency, National Clarifying Guidance For 1998 State and Territory Clean Water Act Section 303(d) Listing Decisions (1997).

33. Envtl. Prot. Agency, 2002 Integrated Water Quality Monitoring and Assessment Report Guidance (2001).

34. *See id*.

35. U.S. EPA has updated Integrated Reporting Guidance in 2004, 2006, and 2008.

36. Envtl. Prot. Agency, Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d) and 305(b) of the Clean Water Act Sec. V.H.5 (2005).

37. The term "pollutant" is defined in the Clean Water Act as "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water." 33 U.S.C. § 1362(6).

38. The term "pollution" is defined in the Clean Water Act as "the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water." 33 U.S.C. § 1362(19).

39. *See* Envtl. Prot. Agency, Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d) and 305(b) of the Clean Water Act Sec. V.H (2005).

40. California's designation of invasive species as pollutants was influenced primarily by the decision in *Northwest Environmental Advocates v. U.S. Environmental Protection Agency*, 2005 WL 756614 (N.D. Cal. 2005); a complaint filed by the Ocean Conservancy against the U.S. EPA, No. C 04-1319 WHA (N.D. Cal.); and a letter from Diane Regas of U.S. EPA to Celeste Cantú of SWRCB dated December 17, 2004. State Water Resources Control Board, Staff Report: Revision of the Clean Water Act Section 303(d) List of Water Quality Limited Segments Vol. I 12 (2006); Telephone Interviews with staff of the California State Water Resources Control Board (Feb. 2007).

41. State Water Resources Control Board, Staff Report: Revision of the Clean Water Act Section 303(d) List of Water Quality Limited Segments Vol. I 12 (2006).

Table 2. Number of Water Segments Identified as Impaired due to Invasive Species

	1992	1994	1996	1998	2002	2004	2006
California				9	13	—	24
Florida		0	0	0	0	0	0
Iowa				3	10[4c]	3, 2[4c]	2[4c]*
Massachusetts			50	0	219[4c]	217[4c]	228[4c]
New York	0	0			0	0	3[4c]
Ohio			4	10	0	3	3
Washington			1	1	—	240[4c]	—

Blank = unable to locate the 303(d) list for that year
Dash [—] = no list produced for that year
Number = 303(d) listings for invasive species unless marked [4c], in which case it is the number in Category 4c
* At the time that this report was published, Iowa's 2006 303(d) list was not yet approved by the U.S. EPA.

tions, over time.[42] As a result of this method, the 2006 303(d) list included 11 new water segments listed as impaired by invasive species.[43] As shown in Table 2, of the seven case study states, California currently has the most water segments listed in Category 5 as impaired by invasive species.

As noted in Table 2, 303(d) listings for invasive species impairments have been inconsistent between states and over time. Each case study state, with the exception of Florida and New York, has included water segments impaired by invasive species on its 303(d) list at some point in time. Massachusetts was quick to remove its prior invasive species listings in 1998 on the ground that invasive species are "not considered a pollutant for which a TMDL [could] be calculated."[44] Ohio removed all reference to invasive species impairments in its 303(d) list in 2002.[45] Three of the ten listings were entirely removed from the 303(d) list: one for "insufficient information,"[46] another because the supporting data was more than 10 years old,[47] and the third without explanation. The seven other water segments remained on the state 303(d) list, but their causes of impairment no longer included invasive species.[48] Iowa and Washington delisted their respective invasive species impairments after the aforementioned 2002 U.S. EPA guidance was issued.[49] However, since its lull in 2002, 303(d) listings for invasive species impairments have rebounded slightly. Ohio included invasive species among the causes of impairment for three Lake Erie water segments,[50] and Iowa listed three segments as impaired by invasive species in 2004.[51]

42. State Water Resources Control Board, Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List 7-8 (2004).

43. *See* State Water Resources Control Board, 2006 California 303(d) List of Water Quality Limited Segments (2006).

44. Massachusetts Department of Environmental Protection, 1998 Massachusetts Section 303(d) List of Waters 4 (1999).

45. *See* State of Ohio Environmental Protection Agency, Ohio 2002 Integrated Water Quality Monitoring and Assessment Report (2002).

46. *Id*. at 22.

47. *Id*. at 21.

48. *Id*. at C-79.

49. *See* Iowa Department of Natural Resources, Iowa's Final 2002 Integrated Report (2003); Washington State Department of Ecology, 2004 Water Quality Assessment (2005).

50. State of Ohio Environmental Protection Agency, Ohio 2004 Integrated Water Quality Monitoring and Assessment Report (2004); State of Ohio Environmental Protection Agency, Ohio 2006 Integrated Water Quality Monitoring and Assessment Report app. D.2, E.4 (2006).

51. Iowa Department of Natural Resources, Iowa's Final 2004 Integrated Report (2006).

After the U.S. EPA issued its 2002 Integrated Reporting Guidance, Category 4c steadily became a popular means of documenting invasive species impairments among the case study states. Category 4c of the Integrated Report is designed to include water segment impairments not caused by a pollutant and therefore not needing a TMDL. For purposes of the Integrated Report, "pollution" impairments have an alternative location to the 303(d) list in which they could be recorded. This appears to be a significant reason for removing invasive species impairments from the 303(d) list in most of the case study states that view invasive species as pollution. When Iowa and Washington removed their invasive species impairments from their 303(d) lists in 2002 and 2004 respectively, they placed those water segments, along with others, in Category 4c or its equivalent.[52] Massachusetts began using Category 4c for invasive species impairments the first year that it was available, 2002.[53] New York, which had never reported a water quality impairment by invasive species prior to 2006, did so that year for three water segments and placed them in Category 4c.[54] Massachusetts and Washington have used Category 4c as an opportunity to record impairments by invasive species based on presence, which has resulted in over 200 segments being placed in Category 4c as impaired by invasive species in each state.[55]

The influence of aquatic invasive species on the 303(d) lists and, more broadly, the Integrated Reports of many states is obvious from the number of water segments denoted as impaired by invasive species on state 303(d) lists and under Category 4c. Yet, the extent of that influence is much more difficult to estimate. Invasive species affect many different aspects of water quality; whether or not a state lists water segments as impaired by them, invasive species affect the 303(d) list. Massachusetts has listed many water segments as impaired by noxious aquatic plants, and included in those plants are various invasive species.[56] Iowa has listed many water segments as impaired by one or more pollutants such as turbidity, algae, siltation, nutrients, and organic enrichment, but common carp have contributed to and may be directly responsible for these impairments.[57] Also, in California some water quality impairments by selenium are expressly related to the effects of invasive species.[58] Thus, the absence of invasive species from the list of water segment impairments should not be read as a lack of their influence on the list; more likely it is a decision by the state on how to list.

TMDLs Addressing Aquatic Invasive Species Impairment

No case study state has submitted a TMDL for invasive species to the U.S. EPA for approval.[59] However, California's San Francisco Bay Regional Water Quality Control Board developed, but never submitted, a draft invasive species TMDL in 2000. The draft TMDL, *Prevention of Exotic Species Introductions to the San Francisco Bay Estuary* TMDL, addresses invasive species as a whole, rather than individual species, and covers the entire San Francisco Bay Estuary.[60] It

52. See Iowa Department of Natural Resources, Iowa's Final 2002 Integrated Report (2003); Washington State Department of Ecology, 2004 Water Quality Assessment (Final) - Category 4C Listings (2005).

53. *See* Massachusetts Department of Environmental Protection, Massachusetts Year 2002 Integrated List of Waters pt. 2 at 54-62 (2003).

54. New York State Department of Environmental Conservation, 2006 Section 303(d) List of Impaired Waters Requiring a TMDL/ Other Strategy 37 (2006).

55. *See* Massachusetts Department of Environmental Protection, Massachusetts Year 2006 Integrated List of Waters (2006); Washington State Department of Ecology, Water Quality Assessment for Washington, http://apps.ecy.wa.gov/wats/WATSQBEHome.asp (last visited Dec. 3, 2007).

56. *See, e.g.,* Massachusetts Department of Environmental Protection, Massachusetts Year 2006 Integrated List of Waters 81-128 (2006); Massachusetts Department of Environmental Protection, Bare Hill Pond Phosphorus TMDL 7 (1999).

57. *See, e.g.,* Iowa Department of Natural Resources, Total Maximum Daily Load for Algae and Turbidity: Ingham Lake 14-15 (2004); Iowa Department of Natural Resources, Total Maximum Daily Load for Organic Enrichment: Crystal Lake 10 (2002); Iowa Department of Natural Resources, Total Maximum Daily Load for Nutrients and Siltation: Easter Lake 22-23 (2004).

58. State Water Resources Control Board, 2002 Section 303(d) List of Water Quality Limited Segments 30-55 (2006).

59. TMDLs that include loadings for invasive species have been approved for the Umpqua River Basin in Oregon (http://www.deq.state.or.us/wq/tmdls/umpqua.htm#fs) and Bayou Chauvin, Chicot Lake, and Cocodrie Lake in Louisiana (http://iaspub.epa.gov/tmdl/waters_list.control?state=LA&tmdl_pollutant=NOXIOUS%20AQUATIC%20 PLANTS&tmdl_pol_id=47&p_cycle=2004).

60. California Regional Water Quality Control Board, San Francisco Bay Region, Prevention of Exotic Species Introductions to the San Francisco Bay Estuary: A Total Maximum Daily Load Report to U.S. EPA (2000).

sets load allocations for invasive species at zero[61] and focuses primarily on ballast water sources.[62] The draft TMDL lacks an implementation plan, but it advocates for national and international programs to address the issue of aquatic invasive species and provides an overview of technologies designed to clean ballast water.[63]

While the case study states lack approved TMDLs for invasive species, some expressly have addressed invasive species in TMDLs for other pollutants. For example, numerous phosphorus TMDLs in Massachusetts identify the invasive aquatic plants present in the water at issue and propose management activities such as harvesting in the implementation plan.[64] Similarly, Iowa has referenced the effects of common carp in many TMDLs for other causes of impairment, most notably turbidity, nutrients, algae, siltation, and noxious aquatic plants.[65] New York and Washington also have TMDLs that reference invasive species,[66] and California and Florida each have such a TMDL forthcoming. In each of these cases, there is no load allocation for invasive species. Such a determination is not required according to these states because the TMDL is for a pollutant other than invasive species.

New York currently is deciding how to address a somewhat unique situation in which an invasive species is recognized as the primary source of a pollutant. In the lower portion of the Seneca River, a very dense zebra mussel infestation has substantially decreased the amount of dissolved oxygen in the water, affecting both aquatic life support and recreational uses.[67] While dissolved oxygen is the stated cause of impairment, the TMDL implementation plan will need to directly address the zebra mussels in the river for it to be effective.

Of the case study states, only California formally considers invasive species to be pollutants in its listing methodology, a determination that triggers the requirement to develop TMDLs for invasive species impairments. California has projected 2019 as the completion date for invasive species TMDLs, the latest date for the completion of a TMDL for any presently-listed water segment.[68] While those states that have not declared invasive species to be pollutants have avoided developing invasive species TMDLs by excluding such causes of impairment from the TMDL process, California is deferring the development of invasive species TMDLs as long as possible.

Other Aquatic Invasive Species Programs

Programs outside the TMDL process that are dedicated to aquatic invasive species management vary in both size and structure from state to state. Of the case study states, Florida arguably has the most extensive and comprehensive set of aquatic invasive species programs. The Florida Department of Environmental Protection leads the coordination of numerous programs run through multiple agencies in different geographic areas and at distinct levels of government.[69] Florida also appears to have had the most success of the case study states in managing certain common invasive species. Washington's set of aquatic invasive species programs may not be as extensive as Florida's, but they reflect substantial attention to integration and organization. The Washington legislature created the Aquatic Nuisance Species Committee to foster state, federal, tribal, and private cooperation and the Invasive Species Council to provide policy level direction.[70]

61. *Id*. at 87.

62. *See id*. at 55-63.

63. *Id*. at 29-48, 89-104.

64. *See, e.g.,* Massachusetts Department of Environmental Protection, Bare Hill Pond, Harvard, MA TMDL 7 (1999); Massachusetts Department of Environmental Protection, Total Maximum Daily Loads of Phosphorus for Lake Quinsigamond and Flint Pond 11 (2002).

65. *See, e.g.,* Iowa Department of Natural Resources, Total Maximum Daily Load for Algae and Turbidity, Tuttle Lake 15 (2004); Iowa Department of Natural Resources, Total Maximum Daily Load for Nutrients and Siltation, Easter Lake 16 (2004); Iowa Department of Natural Resources, Total Maximum Daily Load for Organic Enrichment and Noxious Aquatic Plants, Indian Lake 16 (2005).

66. *See,* New York State Department of Environmental Conservation and Vermont Department of Environmental Conservation, Lake Champlain Phosphorus TMDL 117 (2002); Oceans and Coastal Protection Division, U.S. Environmental Protection Agency, Peconic Bay Pathogens TMDL 91 (2006); Washington State Department of Ecology, Wind River Watershed Temperature Total Maximum Daily Load 54 (2002).

67. New York State Department of Environmental Conservation, Lower Seneca River Assessment Fact Sheet (2007) (on file with author).

68. *See* State Water Resources Control Board, 2006 California 303(d) List of Water Quality Limited Segments (2006).

69. Invasive Species Working Group, Statewide Invasive Species Strategic Plan for Florida 15-19 (2003).

70. Wash. Rev. Code § 77.60.130(1), 79A.25.310(2).

California's set of aquatic invasive species programs falls behind Florida in size and scope and behind Washington in organization, but the California Aquatic Invasive Species Management Plan is intended to fix these problems.[71] Massachusetts and New York presently are taking steps to improve and expand their limited respective aquatic invasive species programs. Ohio and Iowa each have aquatic invasive species management plans, but very few programs by comparison.

Among the study states, California has the greatest number of recorded aquatic species not native to the state, followed by Florida, Washington, New York, Massachusetts, Ohio, and Iowa.[72] There appears to be a direct relationship between the number of non-native species present and how comprehensive and well-coordinated a state's set of aquatic invasive species programs is, with the possible exception of California.

There is no apparent correlation between a case study state's set of aquatic invasive species programs and its approach to invasive species in the TMDL program. Florida, which does not address invasive species in its TMDL program, has a robust set of other invasive species programs, while California, which is incorporating invasive species into its TMDL program, also operates a substantial set of invasive species programs. Washington and Massachusetts identify all water segments that are known to have aquatic invasive species present, but Washington has a substantial set of separate aquatic invasive species programs while Massachusetts has a smaller but growing set of programs. New York, Ohio, and Iowa have addressed invasive species in at least some water-related listings, but have varying degrees of separate invasive species programs, with none as detailed as those of Florida, Washington, or California.

Conclusion

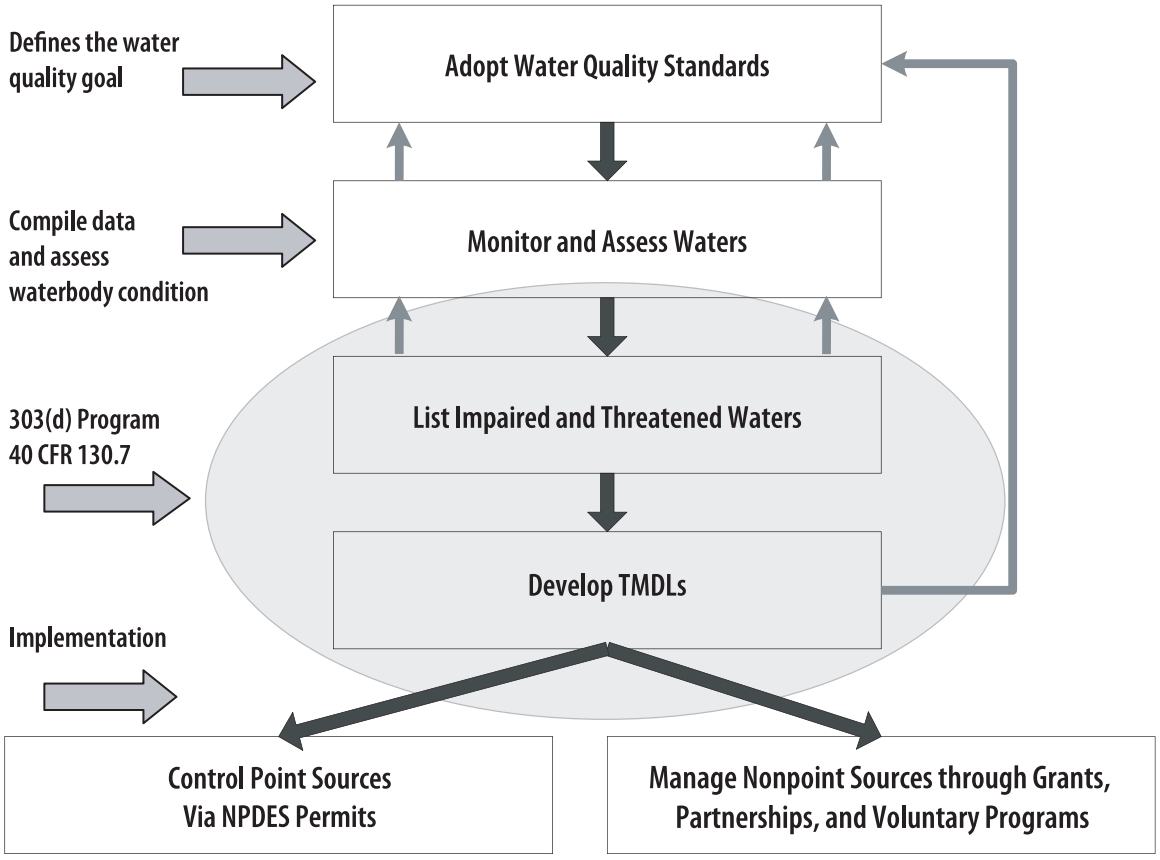
The experience of these seven states with aquatic invasive species and the TMDL program reveal multiple approaches in the absence of a standard interpretation of how these should be integrated. Florida has disconnected its fairly large aquatic invasive species control apparatus from its impaired waters listing and TMDL processes, resulting in no listings for invasive species despite the state's significant number of aquatic invasive species. Washington's policy decision to place all water segments impaired by invasive species in Category 4c led state regulators to determine such impairments by documenting the presence of invasive species; this has resulted in a thorough state list of waters affected by such species. Similarly, Massachusetts' definition of "aquatic life use," which includes presence of invasive species as an impairment, and its view of invasive species as "pollution," results in a reference to impairment by invasive species in every water segment known to have an aquatic invasive species, regardless of whether the water is placed in Category 4c or Category 5. Iowa, New York, Massachusetts, and Washington each have developed at least some TMDLs that address the effects of invasive species, but these are TMDLs that chiefly address other pollutants. Ohio, which has taken a number of approaches over the years, currently lists some waters as impaired on its 303(d) list where at least one of the impairments identified in the supporting assessments is due to aquatic invasive species, but it has not yet gotten to the TMDL stage. California, after identifying aquatic invasive species as pollutants, established a science-based means of determining impairment by invasive species and currently lists more segments as impaired by invasive species in Category 5 than any other state.

71. *See* The California Department of Fish and Game, California Aquatic Invasive Species Management Plan (2006).

72. *See* U.S. Geological Survey, Nonindigenous Aquatic Species Lists by State, *at* http://nas.er.usgs.gov/queries/StateSearch.asp (last visited Dec. 3, 2007).

Aquatic invasive species are an increasing problem across the country. As both the U.S. EPA and the states apply legal requirements in this emerging area of law and policy, the search for clear and effective ways to address invasive species in the Clean Water Act will benefit from this state information. Judicial decisions, U.S. EPA policies, and state experiences should lead toward preferred approaches, best practices, and improvements in water quality. This study focused on actual state practices. Looking forward to next steps in this area, law and policy will need to resolve clearly conflicting interpretations by states while recognizing where states have been and what practical lessons can be applied both in the near term and longer term. In making difficult choices, it is helpful for administrators to realize that aquatic invasive species are no strangers to the TMDL process.

Clean Water Act Framework



After U.S. EPA, Water Quality Standards Academy, TMDL Module (in press, June 2008).

Appendix:
State Case Study Reports

CALIFORNIA

1. The Invasive Species Problem

According to the U. S. Geological Survey, California has the largest number of reported aquatic alien species of any state, exceeding 450.[1] The state also has 19 of the 20 most common aquatic invasive species found in the United States.[2] Invasive species named in listing decisions include Eurasian watermilfoil, green crab, Asian clam, and various fish. Certain geographical regions, such as San Francisco Bay, are more affected by invasive species than others. Because of this, they receive more attention from the state, environmental organizations, and the public.

2. Invasives in Water Quality Standards

The California State Water Resources Control Board (SWRCB) recognizes 23 beneficial uses in its water quality standards.[3] Among these are twelve aquatic life support uses, including Aquaculture; Preservation of Biological Habitats of Special Significance; Cold Freshwater Habitat; Estuarine Habitat; Freshwater Replenishment; Marine Habitat; Migration of Aquatic Organisms; Rare, Threatened, or Endangered Species; Inland Saline Water Habitat; Spawning, Reproduction, and Development; Warm Freshwater Habitat; and Wildlife Habitat.[4] To date, California has listed water segments as impaired by "exotic species" for their effects on Warm Freshwater Habitat, which includes preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, and on Marine Habitat, which includes preservation or enhancement of marine habitats, vegetation, such as kelp, fish, shellfish, or wildlife.[5] Most of the aquatic life support uses listed above could reflect the effects of invasive species and lead to additional "exotic species" listings. Also, invasive species such as Eurasian watermilfoil have been deemed to impair Contact and Non-contact Water Recreation beneficial uses.[6]

Each of California's nine regional water quality control boards has established its own narrative and numeric water quality objectives.[7] Most regional boards have several narrative objectives that could reflect the effects of aquatic invasive species, including sediment, turbidity, temperature, floating and settleable material, and dissolved oxygen.[8] For example, Eurasian watermilfoil can cause increased temperatures and low dissolved oxygen, and common carp can increase sediment and turbidity in the water column. The Los Angeles Board includes in its narrative criteria a prohibition on "exotic vegetation": it "shall not be introduced around stream courses to the extent that such growth causes nuisance or adversely affects beneficial uses."[9]

3. Identifying Invasives as Impairments

California continues to separately release 303(d) lists of impaired waters and 305(b) reports of sources of impairment, but California will be shifting to the U.S. EPA-recommended integrated reporting, which combines the two, in 2008. As of the date that this paper was published, the SWRCB had yet to complete a 2004 or 2006 305(b) report, so the most recent details regarding sources of impairment are from 2002. In California's 2002 305(b) report, "exotic species" is a category in the list of causes of impairment.[10] In that year, invasive species were major contributors to impairment of 18 miles of rivers and streams as well as moderate to minor contributors to impairment of 170 miles of rivers and streams, 267,802 acres of bays and harbors, 85,404 acres of lakes and reservoirs, 5,664 acres of estuaries, and 289 acres of wetlands.[11] In 2002, the SWRCB viewed invasive species as pollution rather than pollutants; thus, impairment determinations for invasive species were not mandated.

4. Invasives in 303(d) Listings

Invasive species impairments have influenced California's 303(d) lists for many years. They first appeared as contributing to impairments by other pollutants. For example, Big Bear Lake has been listed since 1994 as impaired by noxious aquatic plants; Eurasian watermilfoil and Coontail, two alien plant species, comprised the majority of the plant matter in the lake.[12] Also, according to the 2006 303(d) list, selenium impairments are expressly related to the effects of invasive species.[13] These interrelations for listing purposes appear to be due more to scientific connection than any policy objectives.

In 1998, however, invasive species impairments began to be listed independently of other pollutants. California is divided into nine water quality control regions with the SWRCB serving as the overarching agency. Historically, the boards of these nine regions each compiled their own lists of impaired water segments, and the sum of those lists composed the state

303(d) list. The water quality control boards had independent authority over what constituted impairment, subject to approval of the SWRCB and the U.S. EPA. Under this structure, the San Francisco Bay Board and the Los Angeles Board placed water segments on their respective lists as impaired by invasive species in 1998.[14] In the San Francisco Bay Region, Carquinez Strait; Richardson Bay; the Sacramento-San Joaquin Delta; the Central, Lower, and South segments of San Francisco Bay; San Pablo Bay; and Suisun Bay were listed as impaired by "exotic species."[15] These listings were mostly a result of pressure from environmental groups and because state law precluded the San Francisco Bay Region from regulating ballast water, the main source of exotic species introductions to the Bay.[16] In the Los Angeles Region, the Ballona Creek Wetlands segment was listed as impaired by "exotic vegetation."[17]

These listings prompted the SWRCB in 1998 to seek the advice of EPA Region 9. The state indicated that Region 9 had responded by stating that neither California nor the U.S. EPA is obliged to develop TMDLs for these waters because they are not impaired by a pollutant.[18] California's 1998 303(d) list was approved by the U.S. EPA with these invasive species impairments in it. In 2002, the San Francisco Bay Board added 4 more water segments as impaired by "exotic species" to the 303(d) list.[19] These included San Francisco's Central Basin, San Leadro Bay, and two segments from the Oakland Inner Harbor.[20]

In 2004, the SWRCB adopted the Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (listing policy).[21] This established a standard across water quality control regions for determining impairment. However, the listing policy does not specify any requirements for listing waters based on invasive species impairment. This is due to the fact that the state still viewed invasive species as pollution rather than pollutants when the listing policy was created.[22]

In December of 2004, the U.S. EPA sent a formal letter to the SWRCB indicating that the EPA is evaluating the status of invasive species for 303(d) purposes; therefore, the SWRCB should not cite EPA Region 9's prior statement that invasive species are not pollutants as a basis for not listing additional water segments as impaired by invasive species.[23] Three months later, in *Northwest Environmental Advocates v. U.S. EPA*, the U.S. District Court for the Northern District of California found that ballast water, which "can contain 'biological materials,' such as fish and other forms of aquatic life," constitutes a "pollutant" under the Clean Water Act.[24] In the official explanation of the methodology used to develop the 2006 303(d) list, the SWRCB cited the *Northwest Environmental Advocates* case and U.S. EPA's 2004 letter in its rationale for deciding that, "In developing SWRCB staff recommendations, it was assumed that… Exotic or invasive species would be considered as pollutants and would be considered for inclusion on the section 303(d) list."[25]

Because the SWRCB had created the new listing policy, it developed the 2006 303(d) list itself as a demonstration to the regional water quality control boards of how to use the policy for future listings. To reconcile a new policy that considers invasive species to be pollutants with a listing policy that does not, the SWRCB used Section 3.10 of the California listing policy to determine whether the effects of invasive species rise to the level of an impairment.[26] Section 3.10 pertains to trends in water quality: if a declining trend in water quality is scientifically correlated to invasive species over time, usually through native species abundance, that water segment shall be placed on the 303(d) list.[27] This process offers the SWRCB an explanation as to why certain water segments are not deemed impaired by invasive species.

California's 2004-2006 303(d) list reflected this new view of invasive species as pollutants as well as the influence of the 2004 listing policy. That year, the SWRCB added eleven water segments to the list as impaired by "exotic species," all of which came from water quality control regions that had not previously listed for invasive species.[28] These included the central, eastern, northern, northwestern, southern, and western portions of the Delta Waterways; the Stockton Ship Channel and export area of the Delta Waterways; the Cosumnes River; and a portion of the San Joaquin River, all in the Central Valley Region.[29] These listings occurred against the wishes of the Central Valley Board coordinators. In the North Coast Region, Bodega Harbor was listed for "exotic species"

impairment.[30] No water segments listed in California for invasive species have ever been delisted.

Under California's listing structure, Category 4b or an equivalent is not presently considered an option. However, California is expected to adopt the U.S. EPA-recommended integrated reporting method as early as 2008.

5. TMDLs Addressing Invasives

In 2000, the San Francisco Bay Board developed a technical TMDL, one that lacks an implementation plan, for invasive species as a whole in San Francisco Bay.[31] Its load allocations for invasive species were set at zero.[32] The TMDL states the problem of invasive species traveling in ballast water, advocates for national and international programs to address this issue, and provides information on the recent, as of 2000, technologies for cleaning the ballast water.[33] The San Francisco Bay Board never submitted this TMDL to the SWRCB.

California also has addressed invasive species directly in a TMDL for a different impairment. The draft Big Bear Lake Nutrient TMDL addresses the lake's Eurasian watermilfoil and Coontail plant infestations and specifically calls for a reduction of these species.[34] Since it is structured as a TMDL for nutrients, there is no load allocation for invasive plants.

California has several TMDLs for waterbodies that are also impaired by invasive species, including Bodega Harbor, San Francisco Bay, Ballona Creek, and San Joaquin River, but the invasive species impairment is not addressed in any of these TMDLs.

California has yet to develop a TMDL for any of the water segments listed as impaired by invasive species. TMDLs for these waters are projected to be done by 2019, but this is the latest date for the completion of a TMDL for any presently-listed water segment.[35]

6. Implications of this Structure for Clean Water Act Activities

The shift to viewing invasive species as pollutants was a policy decision by the SWRCB, albeit one that was heavily influenced by outside forces. The SWRCB and the regional water quality control boards still are making the adjustment to this policy change. The SWRCB has developed a 303(d) list, but it has yet to complete a 305(b) report reflecting this shift. Also, it is unclear how the water quality control boards will handle invasive species impairments when responsibility for listings is returned to them in 2008. The SWRCB has formulated a way to use the 2004 listing policy for invasive species impairments, but there still exists debate in the state as to the functionality and appropriateness of Section 3.10 for that purpose. Finally, the SWRCB has established a very tentative schedule for invasive species TMDLs, but there exists no clear methodology for developing them.

7. Role of Other Aquatic Invasives Programs

California's diverse aquatic invasive species programs are dispersed among many agencies. According to the California Department of Fish and Game, "These activities are not adequately coordinated throughout the state and do not comprehensively manage current established [aquatic invasive species] or adequately prepare for new invasions."[36] However, the 2008 California Aquatic Invasive Species Management Plan may improve the effectiveness and efficiency of California's efforts in this regard.

The California Department of Fish and Game is one of the lead agencies for aquatic invasive species management.[37] It is responsible for enforcement of regulations concerning the aquaculture industry; the importation and transport of live wild animals, aquatic plants, and fish into the state; and the placement of any such animals in state waters.[38] The California State Lands Commission implements regulations governing ballast water management, as directed by the 2003 Marine Invasive Species Act.[39]

More region-specific, the California Department of Boating and Waterways manages the state's largest and oldest aquatic weed control program and works with other public agencies to control water hyacinth and Brazilian elodea in the Sacramento-San Joaquin

Delta and the Suisun Marsh.[40] Also, the California State Coastal Conservancy recently has focused on developing, funding, and operating the Invasive Spartina Project in San Francisco Bay, which aims to eradicate various invasive species of Spartina that threaten to destroy mudflats and drainage channels.[41] The California Department of Food and Agriculture regulates and manages aquatic and terrestrial weeds, particularly those that are agricultural pests or cause economic harm.[42] Many more federal, state, local, and non-governmental programs in California assist with managing aquatic invasive species infestations, but these are some of the larger and more influential ones.

Notes

1. U.S. Geological Survey, Nonindigenous Aquatic Species Lists by State, *at* http://nas.er.usgs.gov/queries/StateSearch.asp. "'Alien species' means, with respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem." Exec. Order No. 13,112, 64 Fed. Reg. 6,183 (Feb. 3, 1999).

2. *See* U.S. Geological Survey, Nonindigenous Aquatic Species Lists by State, *at* http://nas.er.usgs.gov/queries/StateSearch.asp. "Invasive species" is defined as "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." Exec. Order No. 13,112, 64 Fed. Reg. 6,183 (Feb. 3, 1999).

3. State Water Resources Control Board, 2002 California 305(b) Report on Water Quality app. A (2003).

4. *Id.*

5. State Water Resources Control Board, Draft Staff Report Supporting the Recommended Revisions to the Clean Water Act Section 303(d) List (2006), http://www.waterboards.ca.gov/tmdl/303d_update.html.

6. *See* California Regional Water Quality Control Board, Santa Ana Region, Staff Report on the Nutrient Total Maximum Daily Loads for Big Bear Lake 46 (2005).

7. Bureau of Land Management, Water Quality Law Summary: California, *at* http://www.blm.gov/nstc/WaterLaws/california2.html.

8. Information Center for the Environment, Water Quality Standards Inventory Database, *at* http://www.ice.ucdavis.edu/wqsid/region.asp.

9. California Regional Water Quality Control Board, Los Angeles Region, Water Quality Control Plan: Los Angeles Region 3-9 (1994).

10. *See* State Water Resources Control Board, 2002 California 305(b) Report on Water Quality 86-94 (2003).

11. *Id.*

12. State Water Resources Control Board, Reduction of Nuisance Aquatic Plants in Big Bear Lake 1 (2006), http://www.swrcb.ca.gov/nps/docs/success/r8_nuisanceplants.pdf.

13. *See* State Water Resources Control Board, 2006 California 303(d) List of Water Quality Limited Segments (2006).

14. *See* State Water Resources Control Board, 1998 California 303(d) List of Water Quality Limited Segments (1998).

15. *Id.*

16. Telephone Interview with staff of the San Francisco Bay Water Resources Quality Control Board (Feb. 2007).

17. *See* State Water Resources Control Board, 1998 California 303(d) List of Water Quality Limited Segments (1998).

18. *See* Letter from Diane Regas, Director, Office of Wetlands, Oceans, and Watersheds, and Alexis Strauss, Director, Water Division of EPA Region 9, to Celeste Cantú, Executive Director, State Water Resources Control Board 2 (Dec. 17, 2004) (on file with author).

19. State Water Resources Control Board, 2002 California 303(d) List of Water Quality Limited Segments (2002).

20. *Id.*

21. State Water Resources Control Board, Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (2004).

22. State Water Resources Control Board, Staff Report: Revision of the Clean Water Act Section 303(d) List of Water Quality Limited Segments Vol. I 12 (2006), http://www.swrcb.ca.gov/tmdl/docs/303dlists2006/final/staffreport/v1sr_final.pdf.

23. Letter from Diane Regas, Director, Office of Wetlands, Oceans, and Watersheds, and Alexis Strauss, Director, Water Division of EPA Region 9, to Celeste Cantú, Executive Director, State Water Resources Control Board (Dec. 17, 2004) (on file with author).

24. 2005 WL 756614 12 (N.D. Cal. 2005).

25. State Water Resources Control Board, Staff Report: Revision of the Clean Water Act Section 303(d) List of Water Quality Limited Segments Vol. I 3-4, 12 (2006), http://www.swrcb.ca.gov/tmdl/docs/303dlists2006/final/staffreport/v1sr_final.pdf.

26. *Id.* at 12.

27. State Water Resources Control Board, Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List 7-8 (2004) ("3.10 Trends in Water Quality: A water segment shall be placed on the section 303(d) list if the water segment exhibits concentrations of pollutants or water body conditions for any listing factor that shows a trend of declining water quality standards attainment. This section is focused on addressing the antidegradation component of water quality standards and threatened waters as defined in 40 CFR 130.2(j) by identifying trends of declining water quality. Numeric, pollutant-specific water quality objectives need not be exceeded to satisfy this listing factor. In assessing trends in water quality RWQCBs shall: 1. Use data collected for at least three years; 2. Establish specific baseline conditions; 3. Specify statistical approaches used to evaluate the declining trend in water quality measurements; 4. Specify the influence of seasonal effects, interannual effects, changes in monitoring methods, changes in analysis of samples, and other factors deemed appropriate; 5. Determine the occurrence of adverse biological response (section 3.8), degradation of biological populations and communities (section 3.9), or toxicity (section 3.6); and 6. Assess whether the declining trend in water quality is expected to not meet water quality standards by the next listing cycle. Waters shall be placed on the section 303(d) list if the declining trend in water quality is substantiated (steps 1 through 4 above) and impacts are observed (step 5).").

28. *See* State Water Resources Control Board, 2006 California 303(d) List of Water Quality Limited Segments (2006).

29. *Id.*

30. *Id.*

31. California Regional Water Quality Control Board, San Francisco Bay Region, Prevention of Exotic Species Introductions to the San Francisco Bay Estuary: A Total Maximum Daily Load Report to U.S. EPA (2000), http://www.swrcb.ca.gov/rwqcb2/download/Tmdl.pdf.

32. *Id.* at 87.

33. *Id.* at 29-48, 89-104.

34. Heather Boyd, California Regional Water Quality Control Board, Santa Ana Region, Staff Report on the Nutrient Total Maximum Daily Loads for Big Bear Lake 37-40 (2005), http://www.waterboards.ca.gov/santaana/pdf/tmdl/bigbear/TMDL-Nutrient-Section1-2%20-%20Draft.pdf.

35. *See* State Water Resources Control Board, 2006 California 303(d) List of Water Quality Limited Segments (2006).

36. The California Department of Fish and Game, California Aquatic Invasive Species Management Plan 5 (2008).

37. *Id.* at 38.

38. *Id.*

39. *Id.* at 41.

40. *Id.* at 40.

41. *Id.*

42. *Id*. at 38.

FLORIDA

1. The Invasive Species Problem

According to the U. S. Geological Survey, Florida has the third largest number of reported aquatic alien species of any state, exceeding 300.[1] The state also has 13 of the 20 most common aquatic invasive species found in the United States.[2] Hydrilla, water-hyacinth, and the melaleuca tree are a few of the most harmful invasive species to Florida's aquatic ecosystems. Invasive species are an issue of great concern in Florida; between 1980 and 2003, state, federal, and local agencies spent more than $240 million to control the state's invasive nonindigenous aquatic, wetland, and upland plants just on publicly owned waterways and conservation lands.[3] Florida is particularly prone to these invasions because of its neotropic-like climate and the fact that the Port of Miami receives 85 percent of all live alien plant shipments to the United States each year.[4] Southern Florida is the most affected region of the state.

2. Invasives in Water Quality Standards

All surface waters in Florida are classified according to designated uses: Potable Water Supplies; Shellfish Propagation or Harvesting; Recreation; Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife (Aquatic Life Use Support); Agricultural Water Supplies; and Navigation, Utility, and Industrial Use.[5] While the water criteria of none of these designated uses expressly consider invasive species, the biological and nutrient threshold criteria under Aquatic Life Use Support could reflect the effects of invasive species in water quality analyses.[6] However, a biologically-impaired waterbody is included on the 303(d) list of impaired waters only if "There are water quality data reasonably demonstrating the particular pollutant(s) causing the impairment and the concentration of the pollutant(s)."[7] Until the state considers invasive species to be pollutants, it likely will not list impairments of Aquatic Life Use Support by invasive species.

Nutrient impairment listings are less restricted. Nutrient impairments primarily are determined by trophic state indices (TSIs) and annual mean chlorophyll a values, but other data indicating an imbalance in flora or fauna from nutrients, including changes in algal species richness, decrease in the distribution of submerged aquatic vegetation, and excessive macrophyte growth, also are considered.[8] These criteria more easily allow for consideration of aquatic invasive plant species in the listing process. Excessive growth of plants like hydrilla can signal an ecological imbalance related to increased nutrient discharges, and impairments by these invasive plants may be reflected in 303(d) listings for nutrient impairments.

Of Florida's narrative water quality criteria, one criterion could reflect the effects of aquatic invasive species: "domestic, industrial, agricultural, or other man-induced non-thermal components of discharges."[9] Potentially pertinent to aquatic invasive species, impairment under this criterion occurs when the components of discharges "Settle to form putrescent deposits or otherwise create a nuisance," "Float as debris, scum, oil, or other matter in such amounts as to form nuisances," or "Produce color, odor, taste, turbidity, or other conditions in such degree as to create a nuisance."[10] Many invasive species cause nuisances, Eurasian watermilfoil and water hyacinth could be classified as floating nuisances, and common carp increase turbidity in shallow ponds.

3. Identifying Invasives as Impairments

The Florida Department of Environmental Protection (DEP) began producing integrated water quality reports, as opposed to separate 303(d) lists and 305(b) reports, in 2004. In neither the older 305(b) reports nor the 305(b) portion of Integrated Reports has the Florida DEP explicitly identified invasive species as a source of impairment despite including "exotic and nuisance aquatic plants density" as an impairment category in 303(d) lists in the mid-1990s.

4. Invasives in 303(d) Listings

Invasive species impairments were recognized in some of Florida's early 303(d) lists. The state's 1994 and 1996 303(d) lists were written as grids, with the impaired waterbody identification information in the left columns and the water quality criteria assessed by the DEP each occupying a column to the right.[11] The criteria were divided into quantitative and qualitative assessments.[12] There were 13 quantitative criteria and 21 qualitative criteria, including "WEED – exotic and nuisance aquatic plants density impairing waterbody."[13] There was some overlap between the two assessments, including nutrients, bacteria, pH,

oxygen depletion, and salinity.[14] For each waterbody's row, the criteria that were exceeded were marked and those that were not were left blank. Some segments had nearly all criteria marked, while others had only a few marked. All but 2 of the 93 waterbodies that exceeded the WEED criterion also exceeded the nutrients criterion.[15] No segments exceeded only the WEED criterion. Thus, while these waterbodies appeared on the 303(d) lists in 1994 and 1996, it is unclear whether invasive species actually were a reason for any of those listings.

Florida's 1998 303(d) list was structured differently than its predecessors. The criteria, or "parameters of concern" as they were called in the 1998 list, were condensed into a single column within which one or a few parameters were listed as the cause of impairment.[16] Most of these parameters could be linked back to the qualitative and quantitative assessment criteria in 1994 and 1996, but exotic and nuisance aquatic plants were not among these. The only recognition of invasive species in the 1998 303(d) list is in the comments to the Lake Seminole listing for dissolved oxygen and nutrients; the Florida DEP mentions the lake's hydrilla infestation.[17] The lack of invasive species listings in 1998 did not equate to delisting; rather, the waterbodies that were noted as having invasive species impairments in 1996 were listed in 1998 for other sources of impairment, often nutrients.[18]

While the state has not made a formal decision regarding whether invasive species are pollution or pollutants, the Florida DEP presently does not view them as pollutants.[19] Impairments by invasive species still may be reflected in listings of affected waters for other causes of impairment such as nutrients.

The Florida DEP has not placed invasive species impairments in Category 4b, which it defines as "Impaired for one or more designated uses but does not require TMDL development because the water will attain water quality standards due to existing or proposed measures."[20] The Florida DEP has used Category 4b sparingly for other impairments,[21] partly because the U.S. EPA has stringent requirements for placement in this category and has denied several attempts by DEP to move waters into 4b.

5. TMDLs Addressing Invasives

The Florida DEP has not developed a TMDL for invasive species. It also has not directly addressed this problem in TMDLs for other causes of impairment such as nutrients. However, the Wakulla Springs Nutrient TMDL, scheduled to be completed in 2008, may expressly identify that location's hydrilla problem and propose a means of managing it.

6. Implications of this Structure for Clean Water Act Activities

Aside from a rather insignificant inclusion of invasive aquatic plants in early 303(d) water quality criteria headings, Florida has maintained its Clean Water Act activities without express consideration of one of the state's most significant environmental problems. There presently are no 303(d) listings for invasive species impairment, and no TMDLs have been developed for invasive species. Unlike some other states under these same circumstances, Florida does not address invasive species in TMDLs for other impairments, and the influence of invasive species on listing decisions is hard to follow. Thus, invasive species have little relation with Clean Water Act activities, even from an indirect perspective. While this arrangement allows the state's numerous invasive species programs to proceed with little involvement from the Clean Water Act, it also offers no precedent for addressing this problem through the regulatory mechanisms in the Clean Water Act.

7. Role of Other Aquatic Invasives Programs

Florida arguably has the country's most extensive set of aquatic invasive species programs. As with many other states, Florida's statewide invasive species plan, which was published in 2003, seeks to coordinate the numerous programs run through multiple agencies in different geographic areas and at distinct levels of government.[22] Primary among these agencies is the Florida DEP, which was designated by the Florida legislature in 1971 to lead the coordination and funding of aquatic plant management activities on public waterbodies.[23] Florida DEP directs the Aquatic Plant Management Program, which designs, funds, coordinates, and contracts for invasive aquatic plant control efforts as well as surveys for new infestations.[24] The DEP's primary prevention efforts revolve around permitting aquatic plant retail outlets and banning certain nonindig-

enous plant species for most retail use and possession without a permit.[25] DEP's Bureau of Invasive Plant Management administers a program involving federal, state, and local governments that promotes statewide management of noxious aquatic plants.[26]

The Florida Fish and Wildlife Conservation Commission (FWC) complements the DEP's activities by regulating the importation of vertebrate and invertebrate aquatic species as well as directing prevention, detection, control, monitoring, and restoration efforts concerning those organisms.[27] The FWC also identifies the species that may not be possessed by Florida aquaculturists.[28]

The Florida Department of Agriculture and Consumer Services (FDACS) and the Florida Department of Transportation (FDOT) also contribute to aquatic invasive species detection, control, monitoring, and restoration efforts.[29] FDACS also has a role in invasive species prevention and importation regulation.[30]

The water management districts in Florida contribute to invasive species prevention, detection, control, monitoring, and restoration.[31] For example, the Southwest Florida Water Management District (SWFWMD) has an invasive species control program with a weekly treatment schedule and water use restrictions for aquatic herbicides.[32] The SWFWMD also has a Surface Water Improvement (SWIM) program, a restoration project that is primarily geared toward preserving and restoring habitat and water quality through efforts such as planting various upland and aquatic native plants and managing invasive plants in estuarine areas and lakes.[33]

The federal government is also heavily involved in Florida's invasive species prevention and management efforts. The U.S. Army Corps of Engineers established the Aquatic Plant Control Operations Support Center within its Jacksonville District to serve as the Corps-wide center of expertise in operational aspects of aquatic plant management.[34] Additionally, the Corps established the Removal of Aquatic Growth (RAG) Program, which controls invasive aquatic plants in the Jacksonville District through mechanical and chemical treatments.[35] The U.S. Department of Agriculture's Animal and Plant Health Inspection Service (USDA-APHIS) is the primary federal agency charged with protecting Florida's animal and plant resources, including from invasive species threats.[36]

Notes

1. U.S. Geological Survey, Nonindigenous Aquatic Species Lists by State, *at* http://nas.er.usgs.gov/queries/StateSearch.asp. "'Alien species' means, with respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem." Exec. Order No. 13,112, 64 Fed. Reg. 6,183 (Feb. 3, 1999).

2. *See* U.S. Geological Survey, Nonindigenous Aquatic Species Lists by State, *at* http://nas.er.usgs.gov/queries/StateSearch.asp. "Invasive species" is defined as "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." Exec. Order No. 13,112, 64 Fed. Reg. 6,183 (Feb. 3, 1999).

3. Invasive Species Working Group, Statewide Invasive Species Strategic Plan for Florida 5 (2003).

4. *Id*.

5. Fla. Admin. Code Ann. r. 62-302.400(1).

6. *See id*. r. 62-303.310 – 62-303.350.

7. *Id*. r. 62-303.430(4)(a).

8. *Id*. r. 62-303.350(1).

9. *Id*. r. 62-302.500(1)(a).

10. *Id*.

11. *See* Florida Department of Environmental Protection, State of Florida 1994 303(d) List / TMDL List (1994); Florida Department of Environmental Protection, State of Florida 1996 303(d) List / TMDL List (1996).

12. *See* Florida Department of Environmental Protection, State of Florida 1994 303(d) List / TMDL List (1994); Florida Department of Environmental Protection, State of Florida 1996 303(d) List / TMDL List (1996).

13. Florida Department of Environmental Protection, State of Florida 1994 303(d) List / TMDL List 16-17 (1994); Florida Department of Environmental Protection, State of Florida 1996 303(d) List / TMDL List 61, 81 (1996).

14. *See* Florida Department of Environmental Protection, State of Florida 1994 303(d) List / TMDL List (1994); Florida Department of Environmental Protection, State of Florida 1996 303(d) List / TMDL List (1996).

15. *See* Florida Department of Environmental Protection, State of Florida 1996 303(d) List / TMDL List (1996).

16. *See* Florida Department of Environmental Protection, 1998 303(d) List (1998).

17. *Id*. at 4.

18. *See* Florida Department of Environmental Protection, 1998 303(d) List (1998).

19. Telephone Interview with staff of the Florida Department of Environmental Protection (June 2007).

20. Florida Department of Environmental Protection, Integrated Water Quality Assessment for Florida: 2004 305(b) Report and 303(d) List Update 75 (2004).

21. *See* Florida Department of Environmental Protection, Integrated Water Quality Assessment for Florida: 2004 305(b) Report and 303(d) List Update (2004).

22. Invasive Species Working Group, Statewide Invasive Species Strategic Plan for Florida 15-16 (2003).

23. *Id*. at 19.

24. Florida Department of Environmental Protection, Aquatic Plant Management, *at* http://www.dep.state.fl.us/lands/invaspec/2ndlevpgs/Aquaticplnts.htm.

25. Invasive Species Working Group, Statewide Invasive Species Strategic Plan for Florida 22 (2003).

26. Florida Department of Environmental Protection, Division of State Lands Frequently Asked Questions, *at* http://www.dep.state.fl.us/lands/invaspec/2ndlevpgs/faq.htm.

27. Invasive Species Working Group, Statewide Invasive Species Strategic Plan for Florida 13, 26 (2003).

28. *Id*. at 26.

29. *Id*. at 13.

30. *Id*.

31. *Id*.

32. Southwest Florida Water Management District, Aquatic Plant Management, *at* http://www.swfwmd.state.fl.us/waterman/apm/apm.htm.

33. Southwest Florida Water Management District, Report to the Legislative Sunset Advisory Committee (2006), http://www.swfwmd.state.fl.us/documents/reports/sunset_report.pdf.

34. U.S. Army Corps of Engineers, Project Operations - Partners and Support (Work Management Policies) 14-1 (1996), http://www.usace.army.mil/publications/eng-regs/er1130-2-500/c-14.pdf.

35. U.S. Army Corps of Engineers, Invasive Species Management, *at* http://www.saj.usace.army.mil/invasive_species/index.htm.

36. Florida Senate Committee on Agriculture and Consumer Services, Review of Programs Pertaining to the Interception and Eradication of Agricultural Pests and Diseases in the State 2 (2001), http://www.flsenate.gov/data/Publications/2002/Senate/reports/interim_reports/pdf/2002-103ag.pdf.

IOWA

1. The Invasive Species Problem

According to the U. S. Geological Survey, Iowa has one of the smallest numbers of reported aquatic alien species of any state, totaling a little over 50.[1] The state has 7 of the 20 most common aquatic invasive species found in the United States.[2] Invasive species named in Iowa's listing methodology for waters include common carp and purple loosestrife.[3] Invasive species are viewed as a high stress to native aquatic species, and the Iowa Department of Natural Resources (DNR) considers aquatic invasive species to be a significant threat to Iowa's lakes and streams. Some regions of the state are more affected by invasive species than others.

2. Invasives in Water Quality Standards

The Iowa DNR recognizes 13 beneficial uses in its water quality standards.[4] Of these uses, 9 have the potential to reflect the adverse effects of invasive species, including Primary and Secondary Contact Recreational Use, Children's Recreational Use, Cold Water Aquatic Life Types 1 and 2, Warm Water Aquatic Life of Lakes and Wetlands, and Warm Water Aquatic Life of Rivers and Streams Types 1, 2, and 3. To date, Iowa has listed waterbodies as impaired by "exotic species" for their effects on Lakes and Wetlands aquatic life use, which concern physical and chemical characteristics suitable to maintain a balanced community normally associated with lake-like conditions, and Primary Contact Recreational Use, namely waters in which recreational or other uses may result in prolonged and direct contact with the water.[5]

Of Iowa's narrative water quality criteria, four criteria could reflect the effects of aquatic invasive species, the most pertinent of which states that "Such waters shall be free from substances attributable to wastewater discharges or agricultural practices producing objectionable color, odor or other aesthetically objectionable conditions."[6] Other relevant criteria include: turbidity, floating materials, and undesirable or nuisance aquatic life.[7] Depending on the species, aquatic invasive species can degrade aesthetic conditions, increase turbidity, cause a nuisance as floating plant material, or potentially constitute "nuisance aquatic life."

3. Identifying Invasives as Impairments

Iowa began producing integrated water quality reports, as opposed to separate 303(d) lists and 305(b) reports, in 2004. In both the older 305(b) reports and the 305(b) portion of the more recent Integrated Reports, Iowa DNR has designated invasive species to be a source of impairment. The draft 2006 305(b) portion mentions impairment by various invasive species for 15 waterbodies.[8]

4. Invasives in 303(d) Listings

Invasive species impairments have influenced Iowa's 303(d) lists for many years. Section 303(d) listings for these impairments primarily have been due to the effects of common carp on lakes and wetlands through sediment re-suspension. This relationship between sediment and invasive carp has resulted in an unusual listing history for the waterbodies with this impairment.

In 1998, Iowa DNR listed three waterbodies as impaired by "exotic species": Lake MacBride, Swan Lake, and Black Hawk Wildlife Area.[9] For each of these listings, another source was included in the description of the impairment: Lake MacBride was also impaired by siltation and nutrients; Swan Lake was also impaired by bacteria; and Black Hawk Wildlife Area was also impaired by siltation.[10] Lake MacBride and Swan Lake were impaired by common carp, and the Black Hawk Wildlife Area was impaired by purple loosestrife.[11]

No 303(d) list was required of any state for the year 2000 as the U.S. EPA reformed the listing process that year. Iowa's 2002 303(d) list included four sections: waterbodies impaired by one or more pollutants, waterbodies impaired by pollution, waterbodies with a TMDL, and waterbodies without an identified cause of impairment.[12] Iowa DNR placed ten waterbodies, including the three listed in 1998, on the "waterbodies impaired by pollution" section of the list as impaired by "exotic species." The additional seven waterbodies were Arbor Lake, Big Marsh, Big Wall Lake, Little Clear Lake, Lizard Lake, Sunken Grove Lake, and Ventura Marsh.[13] The "waterbodies impaired by pollution" section of the 2002 303(d) list was intended to be the equivalent of Category 4c, impairment by a non-pollutant, under U.S. EPA's recommended struc-

ture.[14] Thus, based on the "pollutant"-"pollution" distinction in the recommended structure, Iowa's 2002 list represents a delisting of the three waterbodies impaired by invasive species in 1998.

In 2004, Iowa DNR listed three waterbodies as impaired by "exotic species" in Category 5.[15] One of those was Ventura Marsh, which had appeared in the "waterbodies impaired by pollution" section of the 2002 list.[16] The other two were Pierce Creek Pond and Avenue of the Saints Lake.[17] Pierce Creek Pond was listed in the "waterbodies impaired by one or more pollutants" section of the 2002 303(d) list for non-algal turbidity,[18] which is related to the invasive species impairment for which it was listed in 2004.[19] Avenue of the Saints Lake did not appear anywhere on the list in 2002.[20] Unlike the three listings for invasive species in 1998, the only stated source of impairment for these listings in 2004 was "exotic species." The other waterbodies that had been included in the "waterbodies impaired by pollution" section of the 2002 list for invasive species impairment fell into different categories in 2004. Arbor Lake and Swan Lake appeared under Category 4a, waterbodies for which a TMDL has been approved by the U.S. EPA.[21] Big Wall Lake and Little Clear Lake appeared under Category 4c, waterbodies impaired by a non-pollutant stressor.[22] Big Marsh, Black Hawk Wildlife Area, Lizard Lake, and Sunken Grove Lake appeared under Category 3b, insufficient information but with at least one use potentially impaired.[23] Lake MacBride disappeared from the Integrated Report, but a TMDL for nutrients and siltation had been created for it in 2005.[24]

The draft 2006 303(d) list does not include any waterbodies as expressly impaired by invasive species.[25] Pierce Creek Pond appears under Category 4a in 2006 on account of its 2005 TMDL for non-algal turbidity. Ventura Marsh remains in Category 5 but as impaired by algae and turbidity rather than invasive species.[26] The invasive species impairment was removed as a pollutant because invasive species are viewed as non-pollutant stressors in Iowa.[27] Avenue of the Saints Lake also appears in Category 5, but the separate listing for invasive species impairment was removed.[28] The listings for algae and turbidity remain for that waterbody just as they were in 2004.[29] The rationale for the turbidity listing expressly states that the turbidity problem is due in part to common carp.[30]

In Iowa's final 2004 Integrated Report and its draft 2006 303(d) list, no waterbodies were placed in Category 4b, waters that are threatened or impaired but a TMDL is not needed because other required control measures are expected to result in attainment of water quality standards.[31] Thus, Category 4b likely is not seen as a currently viable option to Category 5 listings in Iowa.

5. TMDLs Addressing Invasives

Iowa DNR has not created a TMDL for invasive species, but many of the state's TMDLs address common carp infestations. Lake MacBride and Swan Lake, which were listed in 1998 as impaired by "exotic species," have TMDLs for nutrients/siltation and algae/turbidity respectively, but each of them addresses the role of common carp in those impairments.[32] Pierce Creek Pond, which was listed in 2004 as impaired by invasive species, had a TMDL written in 2005 for its non-algal turbidity impairment, the stated reason for the waterbody's listing in 2002. This TMDL included the removal of common carp in its solutions to the non-algal turbidity impairment.[33] Arbor Lake, which was included in the "waterbodies impaired by pollution" section of the 2002 list as impaired by "exotic species," had a TMDL written for its nutrients and sediment impairments in 2003. This TMDL also identified the role of common carp in these impairments and suggested a means of removing them.[34]

TMDLs for other waterbodies that have not been listed as impaired by invasive species have addressed the effects of common carp, occasionally including solutions to carp infestations in their implementation plans. These include the Ingham Lake, North Twin Lake, Little Spirit Lake, Mariposa Lake, Tuttle Lake, Silver Lake, draft Lake Cornelia, and draft Five Island Lake TMDLs for algae and turbidity; the Lake Smith, Indian Lake, and Upper Gar Lake TMDLs for noxious aquatic plants; the Lake Meyer and Lake Icaria TMDLs for siltation; the Crystal Lake and Don Williams Lake TMDLs for organic enrichment; the Clear Lake TMDL for nutrients; the Ottumwa Lagoon TMDL for chlordane, turbidity, and algae; the Storm Lake TMDL for turbidity; and the Easter Lake TMDL for nutrients and siltation. Since these TMDLs are for impairments other than invasive species, there is no load allocation for common carp.

6. Implications of this Structure for Clean Water Act Activities

If the draft 2006 303(d) list is any indication of the trend in Iowa, the state is becoming more stringent in its view of invasive species as non-pollutant stressors. Iowa DNR is not listing for invasive impairments or writing TMDLs for them. However, such impairments are still being reflected in the Integrated Reports and being addressed in TMDLs. Iowa DNR appears to be placing most invasive species impairments in Category 4c, non-pollutant stressor, with some relegated to Category 3b, insufficient information, and some still being recognized in Category 5, albeit not expressly for the effects of invasive species. Since the most-often addressed invasive species impairments, common carp and purple loosestrife, are closely linked to other sources of use impairment, such as turbidity and siltation, and no TMDLs were created expressly for invasive species even when waterbodies were listed for such impairments, changes in Iowa's listing of invasive species impairments likely will not have much real effect on the state's handling of invasives in its Clean Water Act activities.

7. Role of Other Aquatic Invasives Programs

Iowa has few aquatic invasive species programs as compared to other states. Like an increasing number of states, Iowa has a state invasive species management plan, which entitles Iowa to money from the federal Aquatic Nuisance Species Task Force. According to the state plan, "The State of Iowa currently has a very limited number of statutory and regulatory authorities with which it addresses or potentially can address the issue of prevention and control of ANS. Those that do exist were developed in response to individual target species and specific concerns as they arose. Because of this, Iowa does not have a comprehensive, coordinated, and vigorously enforced policy framework to deal with ANS and their impacts."[35] The state plan is intended to identify gaps in these policies and statutes and to recommend improvements.[36]

Iowa has an Aquatic Nuisance Species Program Coordinator and Invasive Species Working Group, which is a collaboration of federal, state, county, and university staff that discusses invasive species issues and plans. Additionally, Iowa DNR watercraft inspections started in the summer of 2004 and address the extent of transportation of aquatic invasive species by boaters in Iowa and the level of public knowledge on the issue.[37]

The U.S. Army Corps of Engineers is conducting a feasibility study of zebra mussel control in the upper Mississippi River, including alternatives such as large-scale alterations of the river's hydrodynamics, small-scale alterations of the river's hydraulics, closing portions of the river, cleaning and coating technologies, and barriers to prevent transport of zebra mussels.[38] Also, the Corps of Engineers is addressing the bighead carp issue in the Mississippi River.

Notes

1. U.S. Geological Survey, Nonindigenous Aquatic Species Lists by State, *at* http://nas.er.usgs.gov/queries/StateSearch.asp. "'Alien species' means, with respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem." Exec. Order No. 13,112, 64 Fed. Reg. 6,183 (Feb. 3, 1999).

2. *See* U.S. Geological Survey, Nonindigenous Aquatic Species Lists by State, *at* http://nas.er.usgs.gov/queries/StateSearch.asp. "Invasive species" is defined as "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." Exec. Order No. 13,112, 64 Fed. Reg. 6,183 (Feb. 3, 1999).

3. Iowa Department of Natural Resources, Methodology for Iowa's 2004 water quality assessment, listing, and reporting pursuant to Sections 305(b) and 303(d) of the federal Clean Water Act 24, att. 4 (2005).

4. *See* Iowa Admin. Code r. 567-61.3(1).

5. *See* Iowa Department of Natural Resources, Iowa's Final 2004 Integrated Report (2006); Iowa Department of Natural Resources, Iowa's Final 2002 Impaired Waters List (2003).

6. Iowa Admin. Code r. 567-61.3(2).

7. *See id*.

8. Iowa Department of Natural Resources, Iowa's Draft 2006 Integrated Report (2007).

9. Iowa Department of Natural Resources, Final Approved Iowa 1998 303(d) List (1999).

10. *Id*.

11. *See* Iowa Department of Natural Resources, Water Quality in Iowa During 2002 and 2003: Assessment Results (2004), http://wqm.igsb.uiowa.edu/wqa/305b/2004/2004_305b.html.

12. Iowa Department of Natural Resources, Iowa's Final 2002 Impaired Waters List (2003).

13. *Id*.

14. *See* Iowa Department of Natural Resources, Public Participation Responsiveness Summary for the 2004 Section 303(d) List of Impaired Waters (2005), http://wqm.igsb.uiowa.edu/WQA/303d/2004/2004ResponsivenessSummary.pdf.

15. *See* Iowa Department of Natural Resources, Iowa's Final 2004 Integrated Report (2006).

16. *Id.*; Iowa Department of Natural Resources, Iowa's Final 2002 Impaired Waters List (2003).

17. Iowa Department of Natural Resources, Iowa's Final 2004 Integrated Report (2006).

18. Iowa Department of Natural Resources, Iowa's Final 2002 Impaired Waters List 8 (2003).

19. *See* Iowa Department of Natural Resources, Water Quality in Iowa During 2002 and 2003: Assessment Results 479 (2004), http://wqm.igsb.uiowa.edu/wqa/305b/2004/2004_305b.html.

20. *See* Iowa Department of Natural Resources, Iowa's Final 2002 Impaired Waters List (2003).

21. Iowa Department of Natural Resources, Iowa's Final 2004 Integrated Report (2006).

22. *Id*.

23. *Id*.

24. Iowa Department of Natural Resources, Total Maximum Daily Load for Nutrients and Siltation, Lake Macbride (2005), http://www.epa.gov/waters/tmdldocs/11377_Macbride%20TMDL%20Final.pdf.

25. *See* Iowa Department of Natural Resources, Iowa's Draft 2006 Integrated Report (2007).

26. *See* Iowa Department of Natural Resources, Iowa's Draft 2006 Integrated Report (2008).

27. *See* Iowa Department of Natural Resources, Iowa's Final 2004 Integrated Report (2006).

28. *See* Iowa Department of Natural Resources, Iowa's Draft 2006 Integrated Report (2007).

29. *See id*.

30. *Id*. at 16.

31. Iowa Department of Natural Resources, Iowa's Final 2004 Integrated Report (2006); Iowa Department of Natural Resources, Iowa's Draft 2006 Integrated Report (2007).

32. Iowa Department of Natural Resources, Total Maximum Daily Load for Nutrients and Siltation, Lake Macbride (2005); Iowa Department of Natural Resources, Total Maximum Daily Load for Algae and Turbidity, Swan Lake (2004), http://www.epa.gov/waters/tmdldocs/Swan%20TMDL%20FINAL%20revised%202.pdf.

33. Iowa Department of Natural Resources, Total Maximum Daily Load for Non-Algal Turbidity, Pierce Creek Lake (2005), http://www.epa.gov/waters/tmdldocs/11278_PierceCreekLakeTMDL%20Final.pdf.

34. Iowa Department of Natural Resources, Total Maximum Daily Load for Siltation and Nutrients, Arbor Lake (2002), http://www.epa.gov/waters/tmdldocs/arbor.pdf.

35. Iowa Department of Natural Resources, Plan for the Management of Aquatic Nuisance Species in Iowa 6 (1999).

36. *Id*.

37. Aquatic Nuisance Species Task Force, Aquatic Nuisance Species Task Force Report to Congress 35 (2004), http://www.anstaskforce.gov/Documents/ANSTF_RTC_Final.pdf.

38. U.S. Army Corps of Engineers, Zebra Mussel Control Feasibility Study on the Upper Mississippi River 1 (2003), http://www.fws.gov/midwest/mussel/documents/coe_zebra_mussel_feasability_study.pdf.

MASSACHUSETTS

1. The Invasive Species Problem

According to the U. S. Geological Survey, Massachusetts has a large number of reported aquatic alien species, approximately 150.[1] The Commonwealth also has 10 of the 20 most common aquatic invasive species found in the United States.[2] Invasive species named in water quality assessments include Eurasian watermilfoil, curly leaf pondweed, fanwort, water chestnut, and purple loosestrife.[3] Invasive species are an issue of significant concern among government agencies, but the public generally is not as aware of the problem. Over 50% of the freshwater lakes and ponds in Massachusetts are affected by invasive species, reducing the diversity of native plants and animals, impairing recreational uses, degrading water quality, diminishing property values, and reducing native fish populations.[4] Massachusetts also faces a variety of adverse effects from aquatic invasive species in its coastal waters.[5]

2. Invasives in Water Quality Standards

The Massachusetts Department of Environmental Protection (DEP) recognizes seven designated uses in its water quality standards[6] including four that it has determined to be impaired by "exotic species" in some water segments: Aquatic Life, Primary Contact Recreation, Secondary Contact Recreation, and Aesthetics.[7] Aquatic Life use is deemed impaired by the Massachusetts DEP when "there are frequent or severe violations of chemical criteria, presence of acute toxicity, or a moderate or severe modification of the biological community."[8] The biological aspect of this determination includes an analysis of macrophytes, and the mere presence of "exotic species" constitutes an imbalance in the native biotic community.[9] Primary and Secondary Contact Recreation and Aesthetics are all linked; a finding of impairment of one use often results in such a finding for the others. Primary and Secondary Contact Recreation uses are deemed impaired by the Massachusetts DEP when "frequent or prolonged violations of criteria, or severe aesthetic conditions that preclude the use" exist in a water segment.[10] Overabundant growth of noxious native or non-native plants is one of the criteria that can trigger a determination of impairment of Primary or Secondary Contact Recreation.[11] Aesthetics use is deemed impaired by the Massachusetts DEP when a water segment frequently or for a prolonged period suffers from objectionable conditions, including "undesirable or nuisance species of aquatic life."[12]

Of Massachusetts' narrative water quality criteria, two criteria could reflect the effects of aquatic invasive species:

(a) Aesthetics. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

(b) Bottom Pollutants or Alterations. All surface waters shall be free from pollutants in concentrations or combinations or from alterations that adversely affect the physical or chemical nature of the bottom, interfere with the propagation of fish or shellfish, or adversely affect populations of non-mobile or sessile benthic organisms.[13]

However, the definition of "pollutant" may affect whether and how invasive species are reflected in these two criteria.

3. Identifying Invasives as Impairments

Massachusetts began producing integrated water quality reports, as opposed to separate 303(d) lists and 305(b) reports, in 2002. Both before and after this change, "non-native" species were identified as a source of impairment, but only as a non-pollutant.[14] In 1998, all water segments listed solely for impairment by invasive species were removed from the 303(d) list because of this non-pollutant designation.[15] In 2002, 219 water segments were placed in Category 4c, "impairment not caused by a pollutant."[16] The effects of invasive species also are identified in some 303(d) listings for noxious aquatic plants or nutrients because the abundance of aquatic plants, whether native or non-native, triggers such listings.[17]

4. Invasives in 303(d) Listings

Prior to 1998, the Massachusetts 303(d) list contained water segments that were deemed by the state DEP to be impaired solely by "non-native species."[18] However, in 1998, the DEC removed all fifty of these segments from the list because invasive species were "not considered a pollutant for which a TMDL [could]

be calculated."[19] In 2002, 41 of these water segments reappeared under Category 4c, "impairment not caused by a pollutant": Ashland Reservoir, Benton Pond, Berkshire Pond, Billings Street/East Street Pond, Buffum Pond, Caprons Pond, Chauncy Lake, Chebacco Lake, Clark Pond, Cook Pond, Dark Brook Reservoir, Ellis Pond, Flint Pond, Goose Pond, Griswold Pond, Hardwick Pond, Lake Lashaway, Lake Lorraine, Lake Nippenicket, Laurel Lake, Long Pond, Low Pond, Lower Pond, Mansfield Pond, Massapoag Lake, North Pond, Oldham Pond, Onota Lake, Pinewood Pond, Ponkapoag Pond, Reservoir Pond, Riverlin Street Pond, Sargent Pond, Scarboro Golf Course Pond, Spring Pond, Stevens Pond, Stockbridge Bowl, Turkey Hill Pond, Waldo Lake, Webster Lake, and Whitin Pond.[20] These water segments appear in the 2004 and 2006 Integrated Reports just as they did in the 2002 report except that Chebacco Lake, Lake Lashaway, Lake Nippenicket, and Massapoag Lake also are deemed impaired by mercury and listed in Category 5.

Of the remaining nine water segments originally listed as impaired solely by "non-native species," six reappeared in Category 3, "no uses assessed," in 2002: Forge Pond, Ice House Pond, Merino Pond, Sluice Pond, Sunset Lake (Boston Harbor), and Sunset Lake (Millers River Watershed).[21] Fivemile Pond reappeared in Category 2 of the 2002 Integrated Report.[22] Spectacle Pond and Lake Shirley reappeared in Category 5 in 2002, Spectacle Pond as impaired by organic enrichment/low dissolved oxygen, noxious aquatic plants, and exotic species and Lake Shirley as impaired by turbidity, noxious aquatic plants, and exotic species.[23] All nine of these water segments appear in the 2004 Integrated Report just as they did in the 2002 report. In the 2006 Integrated Report, only Forge Pond is listed differently, Category 5 for mercury.[24]

The Massachusetts DEP currently references "exotic species" impairments in Category 5, the 303(d) list, but only when other causes of impairment also exist for that water segment. In the 2006 Integrated Report, "exotic species" appears as a cause of impairment in 113 water segment listings in Category 5, many of which were also deemed by the Massachusetts DEP to be impaired by noxious aquatic plants.[25]

Since 2002, the state DEP has chosen to place water segments that it deems to be impaired only by "exotic species," or in combination with other non-pollutants, in Category 4c. In 2002, the DEP placed 219 such segments in Category 4c.[26] That number increased to 228 in 2006.[27]

In 2004 and 2006, the Massachusetts DEP proposed using Category 4b, "waters expected to attain all designated uses through pollution control measures other than TMDLs," for select water segments impaired by mercury.[28] But the U.S. EPA did not approve this portion of the report for either year, instead requiring that those water segments be listed in Category 5. The Massachusetts DEP has never included a water segment impaired by invasive species in Category 4b.

5. TMDLs Addressing Invasives

Massachusetts DEP has not developed a TMDL expressly for invasive species, but many of the Commonwealth's TMDLs address invasive aquatic plant infestations. In Massachusetts, TMDLs for phosphorus often are written to address excessive growth of noxious aquatic plants, both native and non-native species.[29] Phosphorus TMDLs for Bare Hill Pond, Lake Boon, Selected Connecticut Basin Lakes, Selected French Basin Lakes, Selected Millers River Basin Lakes, Northern Blackstone Lakes, Quaboag and Quacumquasit Ponds, and Lake Quinsigamond and Flint Pond mention the invasive aquatic plants present in the respective waters. But, for TMDL purposes, the noxious aquatic plants, whether native or non-native, are addressed as a whole. While reduction in phosphorus loading is the primary objective, these TMDLs often also reference plant management activities, such as harvesting and winter drawdowns, as part of the solution to the noxious aquatic plant impairment.[30] Since these TMDLs are all for phosphorus, there are no load allocations for invasive species.

6. Implications of this Structure for Clean Water Act Activities

The Massachusetts DEP made a deliberate decision to label invasive species as pollution rather than pollutants. On the basis of this label, the DEP has refrained from creating TMDLs for invasive species impairments and from including on its 303(d) list those water segments that it deems impaired solely by invasive

species. Despite this, the effects of invasive species are reflected in many aspects of the Commonwealth's Clean Water Act activities. Massachusetts DEP expressly considers the effects of invasive species in its water quality assessments. It has placed over 200 water segments in Category 4c as impaired by "exotic species." The DEP references "exotic species" impairments in water segments listed in Category 5. It also addresses the effects of "non-native" species in some TMDLs.

With no requirement eventually to write a TMDL for invasive species, the Massachusetts DEP has no immediate disincentive to use of a low threshold for what constitutes impairment by invasive species. Currently, presence of an invasive species qualifies as an imbalance in the native biotic community. Thus, presence of invasive species equals impairment. This low threshold results in the numerous invasive species impairments identified in the Massachusetts Integrated Report, a characteristic of the report that aids public awareness of the invasive species problem. Yet, if the U.S. EPA determines that invasive species must be recognized as pollutants under the Clean Water Act, Massachusetts could have many new 303(d) listings to handle, a concern that has discouraged other states from following Massachusetts' lead.

7. Role of Other Aquatic Invasives Programs

In Massachusetts, authority over aquatic invasive species management is dispersed among many Commonwealth agencies. To date, these activities primarily have concerned the management of invasive aquatic plant species in the Commonwealth's lakes and ponds.[31] Massachusetts seeks to address aquatic invasive species more comprehensively, specifically by expanding existing freshwater programs and developing marine programs so as to address more of the effects of invasive species.[32] The Massachusetts Aquatic Invasive Species Management Plan is designed to increase the number and effectiveness of state aquatic invasive species programs as well as improve coordination between them.[33] The Massachusetts Aquatic Invasive Species Working Group, author of the management plan and a subcommittee of the Massachusetts Secretary of Environmental Affairs' Council on Invasive Species, is composed of representatives from state and federal agencies with a role in aquatic invasive species management in Massachusetts.[34]

The Massachusetts DEP, through its Watershed Planning Program in the Division of Watershed Management, has a lake monitoring and assessment program, which has included the identification of aquatic macrophytes, both native and non-native.[35] The Watershed Planning Program also licenses aquatic herbicide application projects for native or non-native plants on individual waterbodies.[36]

The Lakes and Ponds Program of the Department of Conservation and Recreation, which maintains and manages private and state-owned forests and parks, has an aquatic nuisance species control program designed to address freshwater species.[37] The program manages lake improvement projects and provides technical assistance, education, and outreach to the Commonwealth's lake and pond managers.[38]

Within the Massachusetts Department of Fish and Game (DFG), the Division of Fisheries and Wildlife (DFW) has enacted regulations prohibiting the importation of fish, amphibians, reptiles, birds, and mammals into Massachusetts without a permit.[39] DFW also has non-regulatory programs relating to invasive species management, including: 1) identifying problem species through biological surveys; 2) educating the public about invasive species; 3) maintaining a database that identifies habitats threatened by invasive species; and 4) removing invasive species through the Habitat Restoration Program.[40] The Division of Marine Fisheries (DMF) regulates the transport of any species designated as a threat to shellfish resources and created guidelines for acceptable shellfish seed sources, each with the goal of protecting native shellfish resources from introductions of diseases, parasites, and predators.[41]

The Massachusetts Department of Food and Agriculture (DFA) maintains the state Noxious Weeds List, those species prohibited for import and sale in Massachusetts.[42] The DFA also annually inspects all nurseries and water garden suppliers for prohibited non-indigenous plants, plant pests, and noxious weed species.[43]

Notes

1. U.S. Geological Survey, Nonindigenous Aquatic Species Lists by State, *at* http://nas.er.usgs.gov/queries/StateSearch.asp. "'Alien species' means, with respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem." Exec. Order No. 13,112, 64 Fed. Reg. 6,183 (Feb. 3, 1999).

2. *See* U.S. Geological Survey, Nonindigenous Aquatic Species Lists by State, *at* http://nas.er.usgs.gov/queries/StateSearch.asp. "Invasive species" is defined as "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." Exec. Order No. 13,112, 64 Fed. Reg. 6,183 (Feb. 3, 1999).

3. *See* Massachusetts Department of Environmental Protection, Blackstone River Basin 1998 Water Quality Assessment Report 15 (2001); Massachusetts Department of Environmental Protection, French and Quinebaug River Watersheds 2001 Water Quality Assessment Report 5 (2002); Massachusetts Department of Environmental Protection, Connecticut River Basin 1998 Water Quality Assessment Report 8 (2000).

4. Massachusetts Aquatic Invasive Species Working Group, Massachusetts Aquatic Invasive Species Management Plan 18 (2002).

5. *Id*.

6. *Id*. at 16.

7. *See* Massachusetts Department of Environmental Protection, Buzzards Bay Watershed 2000 Water Quality Assessment Report 7, 11 (2003); Massachusetts Department of Environmental Protection, Chicopee River Basin 1998 Water Quality Assessment Report 16-17 (2001); Massachusetts Department of Environmental Protection, French and Quinebaug River Watersheds 2001 Water Quality Assessment Report 5, 8 (2002); Massachusetts Department of Environmental Protection, Hudson River Watershed 2002 Water Quality Assessment Report 6, 9 (2006).

8. Massachusetts Department of Environmental Protection, Massachusetts Year 2006 Integrated List of Waters 17 (2007).

9. *Id*.; Massachusetts Department of Environmental Protection, Deerfield River Watershed 2000 Water Quality Assessment Report 127 (2004).

10. Massachusetts Department of Environmental Protection, Massachusetts Year 2006 Integrated List of Waters 20-21 (2007).

11. *Id*.

12. *Id*. at 21.

13. Mass. Regs. Code tit. 314, § 4.05(5).

14. *See* Massachusetts Department of Environmental Protection, 1998 Massachusetts Section 303(d) List of Waters 4 (1999); Massachusetts Department of Environmental Protection, Massachusetts Year 2002 Integrated List of Waters pt. 2 at 4, 54-62 (2003); Massachusetts Department of Environmental Protection, Massachusetts Year 2004 Integrated List of Waters 19, 69-76 (2005); Massachusetts Department of Environmental Protection, Massachusetts Year 2006 Integrated List of Waters 27, 72-79 (2007).

15. Massachusetts Department of Environmental Protection, 1998 Massachusetts Section 303(d) List of Waters 4 (1999).

16. *See* Massachusetts Department of Environmental Protection, Massachusetts Year 2002 Integrated List of Waters pt. 2 at 54-62 (2003).

17. Massachusetts Department of Environmental Protection, 1998 Massachusetts Section 303(d) List of Waters 4 (1999).

18. *See id*.

19. *Id*. at 4.

20. Massachusetts Department of Environmental Protection, Massachusetts Year 2002 Integrated List of Waters pt. 2 at 54-62 (2003).

21. *Id*. at 34-43.

22. *Id*. at 16.

23. *Id*. at 99, 105.

24. Massachusetts Department of Environmental Protection, Massachusetts Year 2006 Integrated List of Waters 113 (2007).

25. *Id*. at 80-131.

26. *See* Massachusetts Department of Environmental Protection, Massachusetts Year 2002 Integrated List of Waters pt. 2 at 54-62 (2003).

27. *See* Massachusetts Department of Environmental Protection, Massachusetts Year 2006 Integrated List of Waters 72-79 (2007).

28. *See* proposed Massachusetts Department of Environmental Protection, Massachusetts Year 2004 Integrated List of Waters 19, 67-68 (2005); proposed Massachusetts Department of Environmental Protection, Massachusetts Year 2006 Integrated List of Waters 70-71 (2006).

29. *See, e.g.,* Massachusetts Department of Environmental Protection, Bare Hill Pond, Harvard, MA TMDL 7 (1999); Massachusetts Department of Environmental Protection, Total Maximum Daily Loads for Selected Northern Blackstone Lakes 4 (2002).

30. *See, e.g.,* Massachusetts Department of Environmental Protection, Bare Hill Pond, Harvard, MA TMDL 7 (1999); Massachusetts Department of Environmental Protection, Total Maximum Daily Loads of Phosphorus for Lake Quinsigamond and Flint Pond 11 (2002).

31. Massachusetts Aquatic Invasive Species Working Group, Massachusetts Aquatic Invasive Species Management Plan 12 (2002).

32. *Id*.

33. *Id*.

34. *Id*. at i.

35. *Id*. at 12.

36. *Id*. at 13.

37. *Id*. at 12.

38. *Id*.

39. *Id*. at 15.

40. *Id*. at 15-16.

41. *Id*. at 14.

42. *Id*. at 13.

43. *Id*.

NEW YORK

1. The Invasive Species Problem

According to the U. S. Geological Survey, New York has the fourth largest number of reported aquatic alien species of any state, over 200.[1] The state also has 13 of the 20 most common aquatic invasive species found in the United States.[2] Eurasian watermilfoil, fanwort, curlyleaf pondweed, and purple loosestrife have been documented as causing water quality problems in New York.[3] Different regions of the state have been affected in different ways and by different species. For example, efforts in the Adirondacks have centered on preventing the introduction of purple loosestrife and other similar species while most regions of the state are already infested and have resorted to control programs. Overall, public awareness of the invasive species problem is growing, and the issue has become rather high-profile recently.

2. Invasives in Water Quality Standards

New York recognizes eight Waterbody Inventory/ Priority Waterbodies List (WI/PWL) uses, which are more specific than the state's designated uses.[4] Of these uses, five have the potential to reflect the adverse effects of invasive species – Natural Resources Habitat/Hydrologic Use Support, Aquatic Life Use Support, Public Bathing Use, Recreation Use, and Aesthetics. The Habitat/Hydrologic Use is the best suited of New York's WI/PWL uses to reflect invasive species infestations because it is intended to capture the degradation of natural resources, including causes classified as "pollution."[5] While the primary objective of this relatively new category is to reflect changes in the physical characteristics of the watercourse and alterations in streamflow, the indicator criteria, such as habitat and fish and wildlife populations,[6] make it likely that invasive species will affect the outcome of this assessment. The recent change from Fish Propagation and Fish Survival to the broader category of Aquatic Life Use more fully conveys the results of the monitoring used by New York to assess water quality and allows tracking of aquatic changes that are not severe enough to be apparent in the fishery.[7] Macroinvertebrate populations are most frequently used for Aquatic Life Use monitoring; however, the program has incorporated assessment of periphyton and, to a lesser degree, fish.[8] The Public Bathing, Recreation, and Aesthetics WI/PWL uses historically have identified excessive growth of noxious plants, whether invasive or native. Two of the three waterbodies currently listed under Category 4c as impaired by "problem species," Lincoln Pond and Lake George, historically were identified by New York State Department of Environmental Conservation (DEC) as impaired for bathing.[9] Also, of the listings in the early 1990s based on excessive plant growth, two waterbodies (Meadow Lake and Willow Lake) were deemed impaired for aesthetics, and a third (Van Cortlandt Lake) was found to be impaired for bathing.[10]

Of New York's narrative water quality criteria, three criteria have the potential to reflect the effects of aquatic invasive species: turbidity, suspended solids, and deleterious substances.[11] Invasive aquatic fauna species can affect these criteria through their activities; for example, carp can cause suspended sediment and turbidity problems. Also, invasive aquatic plant species can affect these criteria through their excessive growth.

3. Identifying Invasives as Impairments

The New York DEC continues to separately release 303(d) lists of impaired waters and 305(b) reports of sources of impairment. In New York's 2006 305(b) report, "exotic/problem species" is a category in the list of causes of impairment.[12] That year, exotic/problem species were reported to be "major contributors" to water quality problems in 48,729 lake and reservoir acres as well as "moderate contributors" to problems in 97,165 lake and reservoir acres, on 120.9 miles of rivers and streams, along 20 miles of Great Lakes shoreline, and in 0.1 square miles of estuaries.[13] These numbers are similar to or higher than those in New York's 2002 and 2004 305(b) reports.[14]

4. Invasives in 303(d) Listings

The New York DEC categorizes "exotic, invasive and/or non-native species" as "pollution."[15] Therefore, according to the state, such causes of impairment do not require a TMDL and need not be placed on the state 303(d) list. Consequently, New York's 303(d) list has never included a waterbody listed as impaired by invasive species. In 2006, however, New York DEC placed three waterbodies in Category 4c, impaired by a non-pollutant, for "problem species": Lincoln Pond, Lake George, and Bartlett, Mud, North Ponds.[16] "Problem

species" likely refers to the Eurasian watermilfoil infestation in each of these waterbodies.

Despite not being explicitly listed as the cause of impairment for any waterbody on New York's 303(d) list, invasive species influence the list. These effects can be among the mass of noxious aquatic plants that leads to listings for pollutants such as nutrients. Invasive species also can cause or contribute substantially to the pollutant for which the waterbody is listed as impaired. For example, the population of zebra mussels in the Seneca River is so large that it is decreasing the dissolved oxygen content in the river, the cause of impairment for which the Seneca River appears on the 2006 303(d) list.

In 2006, the New York DEC first used Category 4b (no TMDL is needed because other required control mechanisms are expected to restore the water in a reasonable period of time). That year it placed 12 waterbodies in this category. None of these were for impairment by invasive species.[17]

5. TMDLs Addressing Invasives

Not having listed waterbodies as impaired by invasive species, New York DEC has not developed a TMDL for invasive species. However, the Lake Champlain Phosphorus TMDL and the Peconic Bay Pathogens TMDL both mention the possible role of invasive species in their respective impairments. The Lake Champlain TMDL suggests a connection between zebra mussel infestation and internal loading from phosphorus stored in lake sediments via zebra mussel biomass or zebra mussel feces.[18] The Peconic Bay TMDL cites migratory waterfowl that have become resident (Canadian geese) and invasive species (mute swans) as possible contributors to bacteria in the bay.[19] Waterfowl management is a part of the TMDL mitigation strategy, beginning with research by the Peconic Estuary Program on waterfowl populations in and around the bay.[20]

New York DEC is deciding how to structure a dissolved oxygen TMDL for Seneca River. Since the source of this impairment is the dense population of zebra mussels in the river, the TMDL will need to address the invasive species problem. Consequently, this TMDL may look similar to a TMDL for invasive species when it is finished.

6. Implications of this Structure for Clean Water Act Activities

The New York DEC expressly refers to invasive species as "pollution." This categorization has resulted in the exclusion from the state 303(d) list of water quality impairments caused by invasive species. However, the DEC recognizes the effects of invasive species on water quality in its 305(b) reports and in some of its TMDLs. Additionally, New York DEC recently began including some waterbodies in Category 4c for "problem species." Thus, while invasive species impairments may not garner the public notice and stepwise response that the 303(d) list creates, being referenced in another category as well as in the 305(b) report does raise the issue. Furthermore, DEC's references in some TMDLs to the problems caused by invasive species suggest that Clean Water Act activities can address invasive species even without formal 303(d) listings.

7. Role of Other Aquatic Invasives Programs

New York has few aquatic invasive species management programs, particularly when compared to other states with a similar severity of infestation. However, the state currently is taking steps to improve and expand its efforts in this area. New York was the first state to create an Aquatic Nuisance Species Management Plan.[21] It was approved by the Federal Aquatic Nuisance Species Task Force in 1994.[22] The plan recently was revised, and beginning in 2008, the $5 million per year operating budget for implementing the revised plan will be dispersed to invasive species programs.[23] The money comes from the Environmental Protection Fund, which is supported by a tax on real estate transfers.[24]

In 2003, the New York legislature created the Invasive Species Task Force "to explore the invasive species issue and provide recommendations to the Governor and the Legislature."[25] The Task Force was co-led by the New York DEC and New York Department of Agriculture and Markets.[26] In 2007, with the objectives of the Task Force completed, the legislature created the New York Invasive Species Council, a permanent coordinating body for invasive species programs consisting of 9 agencies and an advisory committee of stakeholders.[27]

The Aquatic Invasive Species Eradication Grant Program through the New York DEC provides state assistance through matching funds for local projects that eradicate aquatic invasive species within New York waterbodies and wetlands.[28] The grant program distributes $1 million and was recently extended to terrestrial species eradication.[29] It funds roughly 30 projects for aquatic invasives and half that for terrestrial invasives. The New York DEC carefully chooses among the projects based on an ecosystem analysis of effectiveness.

Based on the weed management area concept, New York established the Partnerships for Regional Invasive Species Management (PRISM) Program.[30] The state is divided into 8 PRISMs, each containing local organizations of private and public land managers, landowners, and educators who work together to manage invasive plants, including those in aquatic environments.[31]

New York also has several successful non-governmental and inter-governmental programs, the most notable of which are the Adirondack Park Invasive Plant Program (APIPP), the Great Lakes Fishery Commission, and biological control of purple loosestrife.[32] The APIPP is a national award-winning partnership of state agencies, non-profits, and resident groups created to inventory, map, monitor, and manage invasive species to prevent their spread in the Adirondacks.[33] Program successes include creating an invasive plant training program and establishing a volunteer invasive plant monitoring program.[34] The Great Lakes Fishery Commission was created in 1954 to develop and coordinate Great Lakes research on native lake trout productivity and to formulate and implement a program to reduce Sea Lamprey populations in the Great Lakes.[35] Among other examples, the Sea Lamprey Control program in Lake Ontario has been successful, with "wound rates" on indicator species being maintained within the target levels.[36] A federally-funded biological control program for purple loosestrife was developed in the mid-1980s and hosted at Cornell University.[37] This resulted in the identification and mass-production of host-specific insects that since have been released, with some funding by the New York DEC, at hundreds of sites across New York, as well as other states, reducing loosestrife infestations in many wetlands.[38]

Notes

1. U.S. Geological Survey, Nonindigenous Aquatic Species Lists by State, *at* http://nas.er.usgs.gov/queries/StateSearch.asp. "'Alien species' means, with respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem." Exec. Order No. 13,112, 64 Fed. Reg. 6,183 (Feb. 3, 1999).

2. *See* U.S. Geological Survey, Nonindigenous Aquatic Species Lists by State, *at* http://nas.er.usgs.gov/queries/StateSearch.asp. "Invasive species" is defined as "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." Exec. Order No. 13,112, 64 Fed. Reg. 6,183 (Feb. 3, 1999).

3. New York State Department of Environmental Conservation, New York State Water Quality 1990 (1990).

4. New York State Department of Environmental Conservation, New York State Water Quality 2006 56 (2007).

5. *Id*. at 70-71.

6. *See id*. at 70.

7. *Id*. at 69.

8. *Id*.

9. *See* New York State Department of Environmental Conservation, New York State Water Quality 1994 app. A at 227, 229 (1994).

10. New York State Department of Environmental Conservation, New York State Water Quality 1990 app. A at 121 (1990).

11. N.Y. Comp. Codes R. & Regs. Tit. 6, § 703.2.

12. *See* New York State Department of Environmental Conservation, New York State Water Quality 2006 100-104 (2007).

13. *Id*.

14. *See* New York State Department of Environmental Conservation, New York State Water Quality 2002 89-93 (2002); New York State Department of Environmental Conservation, New York State Water Quality 2004 98-102 (2004).

15. New York State Department of Environmental Conservation, New York State Water Quality 2006 76 (2007).

16. New York State Department of Environmental Conservation, 2006 Section 303(d) List of Impaired Waters Requiring a TMDL/ Other Strategy 37 (2006).

17. *Id*. at 37-38.

18. New York State Department of Environmental Conservation and Vermont Department of Environmental Conservation, Lake Champlain Phosphorus TMDL 117 (2002).

19. Oceans and Coastal Protection Division, U.S. Environmental Protection Agency, Peconic Bay Pathogens TMDL 91 (2006).

20. *Id*.

21. The New York State Invasive Species Task Force, Final Report of the New York State Invasive Species Task Force 75 (2005).

22. *Id*.

23. New York Assembly Standing Committee on Environmental Conservation, Notice of Public Hearing (Sept. 17, 2007), http://assembly.state.ny.us/comm/Encon/20070824.

24. *Id*.

25. The New York State Invasive Species Task Force, Final Report of the New York State Invasive Species Task Force 15 (2005).

26. *Id*.

27. N.Y. Environmental Conservation Law § 9-1705 to -1707.

28. New York State Department of Environmental Conservation , Aquatic Invasive Species Eradication Grant Program, *at* http://www.dec.ny.gov/animals/32861.html.

29. *Id*.

30. New York Sea Grant, Invasive Species Policies – New York State, *at* http://www.nysgextension.org/ans/anspages/ISPolicyNY.html.

31. *Id*.

32. The New York State Invasive Species Task Force, Final Report of the New York State Invasive Species Task Force 10 (2005).

33. *Id*. at 70.

34. *Id*.

35. *Id*. at 71.

36. *Id*.

37. *Id*.

38. *Id*.

OHIO

1. The Invasive Species Problem

According to the U. S. Geological Survey, Ohio has a large number of reported aquatic alien species, exceeding 100.[1] The state also has 10 of the 20 most common aquatic invasive species found in the United States.[2] Zebra mussels and their effect on water intakes are the primary concern; however, past water quality assessments in Ohio also have identified the spiny water flea, river ruffe, tube-nosed goby, and round goby.[3] Purple loosestrife and Eurasian watermilfoil also have gained significant attention in the state.[4] Awareness of aquatic invasive species in Ohio is high, particularly with regard to Lake Erie.

2. Invasives in Water Quality Standards

The Ohio Environmental Protection Agency (OEPA) recognizes three designated uses in its water quality standards: Aquatic Life, Recreational Activity, and Water Supply.[5] Each of these designated uses has multiple sub-categories. Aquatic Life designated uses include Coldwater Habitat, Seasonal Salmonid Habitat, Exceptional Warmwater Habitat, Warmwater Habitat, Modified Warmwater Habitat, and Limited Resource Waters.[6] Recreational Activity designated uses include Bathing Waters and Primary and Secondary Contact Recreation. Water Supply designated uses include Public, Agricultural, and Industrial Water Supply.[7] All of the water segments that OEPA has listed as impaired in part by "exotic species" were impaired for one of the three Warmwater Habitat designated uses.[8] The Primary and Secondary Contact Recreation designated uses appear not to be structured in a way that reflects invasive species impacts since they are based only on water depths and fecal coliform counts, not broader criteria.[9] The Bathing Waters designated use could capture the effects of invasive aquatic plant species since beach closings, which could occur from excess plant mass, are a factor in determining impairment. But, this does not appear to have occurred yet. Some water segments designated for both Bathing Waters and Warmwater Habitat uses have been listed as impaired by "exotic species," but only for the latter designated use.[10]

Of Ohio's narrative water quality criteria, four criteria have the potential to reflect the effects of aquatic invasive species: suspended solids "that will adversely affect aquatic life;" floating debris "in amounts sufficient to be unsightly or cause degradation;" substances that are "toxic or harmful to human, animal or aquatic life;" or color, odor, or other nuisance conditions.[11] Depending on the species, aquatic invasive species can cause or be one of the substances in these criteria. For example, Eurasian watermifloil can cause nuisance conditions or be classified as unsightly floating material by forming a thick mat of plant matter that affects recreation, blocks light to lower portions of a pond or lake, and can reduce dissolved oxygen when it decays.

3. Identifying Invasives as Impairments

OEPA's 305(b) reports, 1998 and earlier, included "exotic species" in the charts of causes of impairment and magnitude of impact.[12] Those reports also devoted several paragraphs to the effects of invasive species on the state's waters.[13] In 2002, OEPA began producing integrated water quality reports, as opposed to separate 303(d) lists and 305(b) reports. The Integrated Reports have not referenced invasive species in the charts or in discussions of water quality and causes of impairment, the 305(b) portion of the report. But in the 303(d) list of Ohio's 2004 and 2006 Integrated Reports, the OEPA listed three segments of Lake Erie that were noted as impaired by, among other things, "exotic species."[14]

4. Invasives in 303(d) Listings

The OEPA identifies each impaired water segment in Ohio's 303(d) list only once, regardless of how many causes of impairment a segment may have. Prior to 2002, OEPA referenced each cause of impairment for each impaired water segment in the row designated for that segment. Starting in 2002, the 303(d) list did not contain this data, only the beneficial use or uses impaired. A separate document that is also included in the Integrated Reports, the Watershed Assessment Unit Results, explains the causes of impairment for each assessment unit. Under both the pre- and post-2002 method of identifying causes of impairment, stating multiple causes for a single segment listing does not specify which cause or causes were determinative in the listing decision. The OEPA has included "exotic species" as a cause of impairment for listed segments, but this cause always has been accompanied by several other causes of impairment. Whether "exotic

species" by itself could or ever did lead to a water segment being listed is unclear.

In 1996, Lower Cuyahoga River (Wingfoot Lake out to Cuyahoga River), Cuyahoga River (Headwaters to Black Brook), Tinkers Creek (Headwaters to Brook Pond), and Pond Brook appeared on the 303(d) list with one of the causes of impairment being "exotic species."[15] Ohio's 1998 303(d) list included these four water segments and six new segments impaired by, among other things, "exotic species": Harmon's Pond (Sunny Lake), Grand River Wildlife Area Lake, Van Buren Lake, Cambridge Reservoir, New Concord Reservoir, and Echo Lake.[16]

In 2002, Ohio condensed its water segments into fewer and larger assessment units. Thus, the ten water segments impaired by "exotic species" did not appear in Integrated Reports starting in 2002, but they are presumed to be a part of the larger assessment units with which they are associated. In the 2002 Integrated Report, none of the assessment units that include the aforementioned ten water segments were listed as impaired by "exotic species," and three were removed from the 303(d) list entirely. Grand River (headwaters to above Swine Creek), which includes Grand River Wildlife Area Lake, was removed from the list for insufficient information.[17] Wills Creek (below Leatherwood Creek to below Birds Run, except Salt Fork), which includes New Concord Reservoir, was removed from the list because "the data used to support the listing was more than 10 years old."[18] Great Miami River (below Plum Creek to above Spring Creek), which includes Echo Lake, was delisted in 2002 without explanation.

In the 2004 and 2006 Integrated Reports, the Wills Creek and Great Miami River assessment units were placed in Category 3 for insufficient data.[19] In both of those reports, the Grand River unit appeared in the 303(d) list for impairment of fish consumption.[20] The other assessment units that include water segments formerly listed as impaired by "exotic species" remained on the 303(d) list in 2004 and 2006, but "exotic species" was not among the causes of their impairment.[21] However, the 303(d) list for 2004 and 2006 included three new water segments impaired by, among other things, "exotic species": Lake Erie Central Basin Shoreline, Lake Erie Islands Shoreline, and Lake Erie Western Basin Shoreline.[22]

OEPA has not made a formal declaration as to whether invasive species are pollutants or pollution, but past 305(b) reports and the definition of "pollutant" in the Ohio Administrative Code suggest that the state considers invasive species to be pollution, not pollutants.[23] This does not appear to affect listing decisions as the OEPA has and continues to include "exotic species" as a cause of impairment for listed water segments.

None of the water segments ever included by Ohio in Category 4c or 4b of its Integrated Reports have been identified as impaired by invasive species. Moreover, Ohio's only two segments listed in Category 4b in 2004 were switched to Category 5, the 303(d) list, in 2006, leaving no segments currently in Category 4b.

5. TMDLs Addressing Invasives

OEPA has not developed a TMDL for invasive species despite its listing of segments for such impairments in 1996 and 1998 as well as 2004 and 2006. Ohio writes its TMDLs for an entire watershed rather than by water segment. The 2003 Lower Cuyahoga River TMDL included water segments listed as impaired by "exotic species" in 1996 and 1998, but no mention of these species as causes of impairment was made in the TMDL.[24]

6. Implications of this Structure for Clean Water Act Activities

The structure of Ohio's 303(d) list raises the question of whether "exotic species" have ever been determinative in OEPA's decisions to list water segments. Since each listed water segment that has been deemed impaired by "exotic species" by the OEPA also has been deemed impaired by other causes, "exotic species" may have been included as a cause of impairment simply for the sake of information, and no listing decision actually was made on this basis. However, if disseminating information was the primary objective of including "exotic species" as a cause of impairment, not stating the causes of impairment on the 303(d) list itself makes public awareness of invasive species through the list much more difficult to accomplish. Additionally, no Ohio TMDL to date has referenced invasive species in implementation plans or otherwise. Thus, while invasive species appear to have affected Ohio's TMDL program, these Clean Water Act activities appear to have little influence on addressing the state's invasive species problem.

7. Role of Other Aquatic Invasives Programs

Ohio's statutory and regulatory authorities that address the prevention and control of aquatic invasive species were developed over time and usually in response to individual species as specific problems arose.[25] According to the Ohio Comprehensive Management Plan for aquatic invasive species, this structural development resulted in gaps in the laws and a lack of coordination among the state's invasive species programs.[26] As with many states, Ohio sought to address this regulatory problem through a comprehensive management plan created through collaboration among state agencies.[27] The prioritized goals of the plan were to "prevent[] new introductions of nonindigenous [Aquatic Nuisance Species (ANS)] into the Great Lakes and inland waters of the state, limit[] the spread of established populations of nonindigenous ANS into uninfested waters of the state, [and] abat[e] harmful ecological, economic, social and public health impacts resulting from infestation of nonindigenous ANS."[28] Thus, Ohio's objectives with regard to aquatic invasive species place more emphasis on prevention than eradication.

The Ohio Department of Natural Resources has divided aquatic invasive species issues among three divisions. The Division of Wildlife monitors and seeks to preserve wildlife diversity, which includes controlling invasive species through the Aquatic Nuisance Species Program.[29] The Division of Natural Areas and Preserves addresses the invasive species issue primarily through education, conferences, pamphlets, etc.[30] It also has plans for addressing non-native flora that are tailored to the specific preserve or area and prescribe the treatment appropriate for each species depending upon the habitat type, extent of invasion, and management goals for the area.[31] The Division of Parks and Recreation engages in control of invasive species, including phragmites, purple loosestrife, and milfoil on state park lands.

Under the Comprehensive Management Plan, the OEPA was named as a member of the aquatic invasive species oversight committee along with other state entities, a representative from the governor's office, members of the public, and individuals from the original task force who authored the management plan.[32] OEPA also conducts invasive species research as well as runs education and outreach programs on that topic.[33]

Notes

1. U.S. Geological Survey, Nonindigenous Aquatic Species Lists by State, *at* http://nas.er.usgs.gov/queries/StateSearch.asp. "'Alien species' means, with respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem." Exec. Order No. 13,112, 64 Fed. Reg. 6,183 (Feb. 3, 1999).

2. *See* U.S. Geological Survey, Nonindigenous Aquatic Species Lists by State, *at* http://nas.er.usgs.gov/queries/StateSearch.asp. "Invasive species" is defined as "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." Exec. Order No. 13,112, 64 Fed. Reg. 6,183 (Feb. 3, 1999).

3. State of Ohio Environmental Protection Agency, Ohio Water Resource Inventory Executive Summary 62-63 (1996), http://www.epa.state.oh.us/dsw/documents/exsumm96.pdf.

4. Ohio Department of Natural Resources, Ohio Comprehensive Management Plan 5 (1997).

5. State of Ohio Environmental Protection Agency, Ohio 2006 Integrated Water Quality Monitoring and Assessment Report 41-42 (2006), http://www.epa.state.oh.us/dsw/tmdl/2006IntReport/IR06__text_final.pdf.

6. *Id*. at 42.

7. *Id*.

8. See *id*. at app. E.4; State of Ohio Environmental Protection Agency, Ohio TMDL Priority List for FFY 1999-2000 (1998), http://www.epa.state.oh.us/dsw/tmdl/303tab16.pdf.

9. *See* State of Ohio Environmental Protection Agency, Ohio 2006 Integrated Water Quality Monitoring and Assessment Report 42 (2006).

10. *See id*. at app. D.2, E.4.

11. Ohio Admin. Code § 3745-1-04.

12. State of Ohio Environmental Protection Agency, Ohio Water Resource Inventory vol. I (1994); State of Ohio Environmental Protection Agency, Ohio Water Resource Inventory vol. I (1996); State of Ohio Environmental Protection Agency, Ohio Water Resource Inventory vol. I (1998); State of Ohio Environmental Protection Agency, Ohio Water Resource Inventory (2000).

13. State of Ohio Environmental Protection Agency, Ohio Water Resource Inventory vol. I 167-9 (1994); State of Ohio Environmental Protection Agency, Ohio Water Resource Inventory Executive Summary 61-3 (1996); State of Ohio Environmental Protection Agency, Ohio Water Resource Inventory (2000).

14. State of Ohio Environmental Protection Agency, Ohio 2004 Integrated Water Quality Monitoring and Assessment Report (2004); State of Ohio Environmental Protection Agency, Ohio 2006 Integrated Water Quality Monitoring and Assessment Report app. D.2, E.4 (2006).

15. State of Ohio Environmental Protection Agency, Ohio Water Resource Inventory vol. I app. A-2 (1996).

16. State of Ohio Environmental Protection Agency, Ohio TMDL Priority List for FFY 1999-2000 (1998).

17. State of Ohio Environmental Protection Agency, Ohio 2002 Integrated Water Quality Monitoring and Assessment Report 22 (2002).

18. *Id*. at 21.

19. State of Ohio Environmental Protection Agency, Ohio 2004 Integrated Water Quality Monitoring and Assessment Report app. D.2-197, -260 (2004); State of Ohio Environmental Protection Agency, Ohio 2006 Integrated Water Quality Monitoring and Assessment Report app. E.2-197, -260 (2006).

20. State of Ohio Environmental Protection Agency, Ohio 2004 Integrated Water Quality Monitoring and Assessment Report app. D.2-90 (2004); State of Ohio Environmental Protection Agency, Ohio 2006 Integrated Water Quality Monitoring and Assessment Report app. E.2-90 (2006).

21. *See* State of Ohio Environmental Protection Agency, Ohio 2004 Integrated Water Quality Monitoring and Assessment Report app. D.2 (2004); State of Ohio Environmental Protection Agency, Ohio 2006 Integrated Water Quality Monitoring and Assessment Report app. E.2 (2006).

22. State of Ohio Environmental Protection Agency, Ohio 2004 Integrated Water Quality Monitoring and Assessment Report app. D.4 (2004); State of Ohio Environmental Protection Agency, Ohio 2006 Integrated Water Quality Monitoring and Assessment Report app. E.4 (2006).

23. *See, e.g.,* Ohio Admin. Code § 3745-1-02(68) ("'Pollutant' means sewage, industrial waste or other waste as defined by [(B) "Sewage" means any liquid waste containing sludge, sludge materials, or animal or vegetable matter in suspension or solution, and may include household wastes as commonly discharged from residences and from commercial, institutional, or similar facilities. (C) "Industrial waste" means any liquid, gaseous, or solid waste substance resulting from any process of industry, manufacture, trade, or business, or from the development, processing, or recovery of any natural resource, together with such sewage as is present. (D) "Other wastes" means garbage, refuse, decayed wood, sawdust, shavings, bark, and other wood debris, lime, sand, ashes, offal, night soil, oil, tar, coal dust, dredged or fill material, or silt, other substances that are not sewage, sludge, sludge materials, or industrial waste, and any other "pollutants" or "toxic pollutants" as defined in the Federal Water Pollution Control Act that are not sewage, sludge, sludge materials, or industrial waste]").

24. *See* State of Ohio Environmental Protection Agency, Total Maximum Daily Loads for the Lower Cuyahoga River (2003).

25. Ohio Department of Natural Resources, Ohio Comprehensive Management Plan 9 (1999).

26. *Id*.

27. *Id*.

28. *Id*. at 13.

29. *See* Division of Wildlife, Ohio Department of Natural Resources, Invasive Species: Aliens Among Us, *at* http://www.dnr.state.oh.us/Home/wild_resourcessubhomepage/dealing_with_wildlifeplaceholder/NuisanceSpecieslandingpage/terrestrialnuisancewildlife/resourcesmgtplansinvasives/tabid/5825/Default.aspx.

30. *See* Division of Natural Areas and Preserves, Ohio Department of Natural Resources, Invasive Plants of Ohio, *at* http://www.dnr.state.oh.us/invasives_main/tabid/2005/Default.aspx.

31. *See* Division of Natural Areas and Preserves, Ohio Department of Natural Resources, Preserving Ohio's Native Plants, *at* http://www.dnr.state.oh.us/Education/prairies/moser/tabid/9538/Default.aspx; Division of Natural Areas and Preserves, Ohio Department of Natural Resources, Introduction – Invasive Plants of Ohio, *at* http://www.dnr.state.oh.us/dnap/invasive/factsheetintro/tabid/2006/Default.aspx.

32. Ohio Department of Natural Resources, Ohio Comprehensive Management Plan 22 (1999).

33. *Id*. at 12.

WASHINGTON

1. The Invasive Species Problem

According to the U. S. Geological Survey, Washington has the fourth largest number of reported aquatic alien species of any state, exceeding 200.[1] The state also has 14 of the 20 most common aquatic invasive species found in the United States.[2] Invasive species identified in Washington's water quality assessments have included Eurasian watermilfoil, green crab, Brazilian elodea, swollen bladderwort, parrotfeather, fanwort, hydrilla, water primrose, water fringe, and European frog-bit.[3] The profile of invasive species in Washington is rising rapidly, but to a large extent the perceived magnitude of the problem depends on the watershed or the economic sector affected. The economic sectors most affected are the shellfish industry, the power industry, and nursery and pet industries. The Columbia and Snake Rivers are waters of particular concern.

2. Invasives in Water Quality Standards

The Washington Department of Ecology (DOE) recognizes four freshwater designated uses in its water quality standards: aquatic life, recreational, water supply, and miscellaneous uses.[4] Aquatic life designated uses are divided into six subcategories in Washington: char spawning and rearing; core summer salmonid habitat; salmonid spawning, rearing, and migration; salmonid rearing and migration only; non-anadromous interior redband trout; and indigenous warmwater species.[5] Temperature, total dissolved oxygen, and turbidity standards for each of these subcategories may reflect the effects of invasive species. The recreational designated uses are divided into extraordinary primary contact recreation, primary contact recreation, and secondary contact recreation.[6] Because the standards for determining impairment of this designated use are based on bacteria levels, recreational uses may not capture the effects of invasive species in Washington as well as they do in other states. However, the 1998 Pend Oreille River 303(d) listing for "exotic aquatic plants" was influenced by the effects of Eurasian watermilfoil on fish habitat and recreation.[7]

The Washington DOE also has two narrative criteria that could reflect the effects of aquatic invasive species: "Toxic … or deleterious material concentrations must be below those which have the potential, either singularly or cumulatively, to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those waters, or adversely affect public health."[8] Also, "Aesthetic values must not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste."[9] Invasive species such as common carp and Eurasian watermilfoil can affect characteristic water uses and aesthetic values.

3. Identifying Invasives as Impairments

Washington began producing integrated water quality reports, as opposed to separate 303(d) lists and 305(b) reports, in 2004. In Washington DOE's discussions of sources of impairment in the older 305(b) reports, it did not explicitly identify invasive species despite listing water segments as impaired by invasives on the 303(d) list. However, the 2004 Integrated Report identified 240 water segments as impaired by invasive species, placing them in Category 4c, impaired by a non-pollutant.[10]

4. Invasives in 303(d) Listings

Invasive species impairments were recognized in some of Washington's 303(d) listings in the 1990s. In 1996, the Washington DOE placed Number Twelve Lake on its 303(d) list as impaired by "exotic aquatic plants."[11] The invasive species primarily responsible for this impairment was Eurasian watermilfoil.[12] This listing was removed in 1998 because King County had begun implementing an integrated aquatic plant management plan, the elements of which the Washington DOE deemed sufficient for excluding the water from its 303(d) list in accordance with 40 CFR 130.7(b)(1)(iii) (other pollution control requirements preclude the need for a TMDL).[13] In 1998, the Washington DOE added to its 303(d) list an "exotic aquatic plants" impairment for the Pend Oreille River.[14] The invasive species responsible for this impairment also was Eurasian watermilfoil.[15] This decision was based on several reports confirming the source and severity of the impairment.[16]

In 2000, the U.S. EPA reformed its recommended listing structure for the integrated 303(d) list and 305(b) report. The traditional 303(d) list became Category 5. Among the other new categories, 4c was designed to

capture impairments caused by non-pollutants, which do not require TMDLs. Washington's 2004 Integrated Report, the state's only such publication since the 2000 reforms, did not include any listings for invasive species impairment in Category 5. However, Category 4c included 240 water segments as impaired by "invasive exotic species," including Number Twelve Lake and Pend Oreille River.[17] The specific species that led to these 240 impairments varied among water segments, but Eurasian watermilfoil was the most common.[18]

The Washington DOE made a deliberate decision to include invasive species impairments in Category 4c, impairment by a non-pollutant, as opposed to Category 5, the 303(d) list, after the U.S. EPA reformed its listing structure. Many factors contributed to this decision; state officials noted that invasive species are addressed through other state programs, referred to the limited resources of the state's TMDL program, and some indicated that TMDLs are inappropriate for invasive species impairments because invasives are self-replicating. The officials also noted that prior to making this decision the DOE staff spoke with representatives from EPA Region 10 who indicated that they would not require waters impaired by invasive species to be listed in Category 5 and that Category 4c would be appropriate.

One consequence in Washington of placing invasive species-impaired waters in Category 4c, as opposed to Category 5, appears to have been a more liberal standard for what constitutes impairment by an invasive species. The previous two 303(d) lists had each included only one impairment by invasive species. The 2004 Integrated Report included 240 such impairments, although 82 of those came from Willapa Bay and Grays Harbor.[19] Decisions regarding which water segments are impaired by invasive species are based on Washington DOE and Department of Fish and Wildlife data on whether an invasive species is present in them.

While most invasive species impairments fell into Category 4c in 2004, a few were placed in Category 2, insufficient data. Nina Lake appeared in Category 2 because parrotfeather milfoil had not been found in the lake for several years.[20] Diving surveys in Shoecraft Lake after an herbicide lake treatment in 2000 had not revealed any Eurasian watermilfoil.[21] A 2002 active aquatic weed management program that included annual milfoil eradication had resolved the problem in Steel Lake.[22] Finally, Eurasian watermilfoil that had been present in the 1980s and early 1990s in Stevens Lake had not been seen in recent years.[23]

The Washington DOE has not included any invasive species impairments in Category 4b, water segments with a pollution control plan, but it has placed segments impaired by fecal coliform, temperature, and total PCBs in that category. The DOE has a policy, based loosely on the U.S. EPA's 2004 Integrated Reporting Guidance, that to be placed in Catgeory 4b, "the pollution control plan must meet all of the following criteria: have enforceable pollution controls or actions stringent enough to attain the water quality standard or standards …; be problem-specific and waterbody-specific; have reasonable time limits established for correcting the specific problem, including for interim targets when appropriate; have a monitoring component; have adaptive management built into the plan to allow for course corrections if necessary; be feasible, with enforceable legal or financial guarantees that implementation will occur; and be actively and successfully implemented and show progress on water quality improvements in accordance with the plan."[24]

5. TMDLs Addressing Invasives

Washington DOE has not developed a TMDL for invasive species despite the listings for such in 1996 and 1998. However, one TMDL, the Wind River Watershed Temperature TMDL, mentions the role of invasive species in this impairment. It states that "Eurasian watermilfoil is known to slow water currents, reduce dissolved oxygen levels, and raise water temperatures in infested water bodies."[25] It concludes by suggesting the development and implementation of a milfoil control plan as part of the solution to reducing Wind River water temperatures.[26] Since this is structured as a TMDL for temperature, there is no load allocation for Eurasian watermilfoil.

Washington has several other TMDLs for waterbodies that also are included in Category 4c as impaired by invasive species: Chehalis River, Lake Chelan, Columbia River, Grays Harbor, the Nisqually Watershed, and the Snake River, but the invasive species impairment is not addressed in any of these TMDLs.

6. Implications of this Structure for Clean Water Act Activities

Because of the deliberate decision by the Washington DOE to place water segments impaired by invasive species in Category 4c as opposed to Category 5, there presently are no 303(d) listings, Category 5, for invasive species impairment. No TMDLs have been developed for invasive species. Additionally, Washington rarely addresses invasive species impairments through associated listings, such as temperature or nutrients, or mentions them in TMDLs. However, relegating invasive species impairments to Category 4c has made possible a very low threshold for what constitutes such impairment since Washington is not required by the Clean Water Act to address those impairments. This has resulted in a very large number of water segments being deemed impaired by invasive species in the state's Integrated Report, which aids public awareness of the invasive species problem. Yet, if the U.S. EPA ever determines that invasive species are pollutants under the Clean Water Act, Washington could have many new 303(d) listings to handle, a concern that has discouraged other states from following Washington's lead.

7. Role of Other Aquatic Invasives Programs

Washington has extensive aquatic invasive species programs. Coordinating these efforts and identifying gaps in and impediments to implementation, the Washington State Aquatic Nuisance Species Management Plan was first published in 1998 and subsequently revised in 2001.[27] In 2000, the Washington legislature created the Aquatic Nuisance Species Committee, which was composed of state and federal agency staff, tribal leaders, and representatives of other stakeholders, with the goal of "fostering state, federal, tribal, and private cooperation on aquatic nuisance species issues."[28] The committee was charged with, among other things, revising and implementing the state plan and coordinating education, research, regulatory authorities, monitoring, and control programs.[29] In 2006, the Washington legislature created the Invasive Species Council to work in collaboration with the Aquatic Nuisance Species Committee and other state groups to "provide policy level direction, planning, and coordination for combating harmful invasive species throughout the state and preventing the introduction of others that may be potentially harmful."[30] As with the Aquatic Nuisance Species Committee, "The council is a joint effort between local, tribal, state, and federal governments, as well as the private sector and nongovernmental interests."[31]

The Washington Department of Fish and Wildlife administers a ballast water management program and implements treatment standards for ballast water discharged to state waters.[32] The agency also can designate certain non-native animal species as deleterious, making it illegal to import or possess them.[33] The Washington Department of Agriculture maintains a plant quarantine list of species that may not be transported, bought, or sold in the state.[34] It is also the lead state agency for the eradication of Spartina and Japanese knotweed and the control of purple loosestrife.[35]

The Washington Noxious Weed Control Board lists nonnative noxious plants that adversely affect agricultural and natural areas and oversees the work of county noxious weed control boards to control the introduction and spread of these species.[36] The Washington Department of Ecology administers the Freshwater Aquatic Weeds Management Program, a financial and technical assistance program designed to eliminate noxious non-native aquatic plants in Washington's lakes and rivers.[37] The Department of Natural Resources manages, controls, and eradicates aquatic nuisance plant and animal species on state-owned lands.[38]

Notes

1. U.S. Geological Survey, Nonindigenous Aquatic Species Lists by State, *at* http://nas.er.usgs.gov/queries/StateSearch.asp. "'Alien species' means, with respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem." Exec. Order No. 13,112, 64 Fed. Reg. 6,183 (Feb. 3, 1999).

2. *See* U.S. Geological Survey, Nonindigenous Aquatic Species Lists by State, *at* http://nas.er.usgs.gov/queries/StateSearch.asp. "Invasive species" is defined as "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." Exec. Order No. 13,112, 64 Fed. Reg. 6,183 (Feb. 3, 1999).

3. Washington State Department of Ecology, 2004 Water Quality Assessment (Final) - Category 4C Listings (2005), http://www.ecy.wa.gov/Programs/wq/303d/2002/2004_documents/wria_pdfs-5final/kk-active-4C.pdf.

4. Wash. Admin. Code § 173-201A-200.

5. *Id*. § 173-201A-200(1)(a).

6. *Id*. § 173-201A-200(2).

7. *See* Washington State Department of Ecology, Final 1998 Section 303(d) List - WRIA 62 20 (2000), http://www.ecy.wa.gov/programs/wq/303d/1998/wrias/wria62.pdf.

8. Wash. Admin. Code § 173-201A-260(2)(a).

9. *Id*. § 173-201A-260(2)(b).

10. Washington State Department of Ecology, 2004 Water Quality Assessment (Final) - Category 4C Listings (2005).

11. Washington State Department of Ecology, 303(d) listed Waterbodies in Washington State (1996).

12. *See* Washington State Department of Ecology, 2004 Water Quality Assessment (Final) - Category 4C Listings 6 (2005).

13. Washington State Department of Ecology, Final 1998 Section 303(d) List - WRIA 9 298 (2000), http://www.ecy.wa.gov/programs/wq/303d/1998/wrias/wria9.pdf.

14. Washington State Department of Ecology, Final 1998 Section 303(d) List 131 (2000), http://www.ecy.wa.gov/programs/wq/303d/1998/wrias/1998_water_segs.pdf.

15. Washington State Department of Ecology, Final 1998 Section 303(d) List - WRIA 62 20 (2000).

16. *See id*.

17. Washington State Department of Ecology, 2004 Water Quality Assessment (Final) - Category 4C Listings (2005).

18. *Id*.

19. *Id*.

20. Washington State Department of Ecology, 2004 Water Quality Assessment (Final) - Category 2 Listings 79 (2005), http://www.ecy.wa.gov/Programs/wq/303d/2002/2004_documents/wria_pdfs-5final/kk-active-2.pdf.

21. *Id*. at 84.

22. *Id*. at 125.

23. *Id*. at 88.

24. Washington State Department of Ecology, Water Quality Listings by Category: Overview of Category 4B – Has a Pollution Control Plan 1 (2005).

25. Washington State Department of Ecology, Wind River Watershed Temperature Total Maximum Daily Load 54 (2002).

26. *Id*.

27. Washington Department of Fish and Wildlife, Washington State Aquatic Nuisance Species Management Plan (2001).

28. Wash. Rev. Code § 77.60.130(1).

29. *Id*. § 77.60.130(3).

30. *Id*. § 79A.25.310(2).

31. *Id*. § 79A.25.310(3).

32. Washington Department of Fish and Wildlife, Washington State Aquatic Nuisance Species Management Plan 6 (2001).

33. *Id*. at 5.

34. *Id*. at 6.

35. *Id*. at 7.

36. *Id*. at 6.

37. *Id*. at 7.

38. Puget Sound Water Quality Action Team, 2000 Puget Sound Water Quality Management Plan 18 (2000), http://www.psat.wa.gov/Publications/manplan00/MGMTPLAN.pdf.

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