



Assessment of Coastal Water Resources and Watershed Conditions at Apostle Islands National Lakeshore (Wisconsin)

Natural Resource Technical Report NPS/NRWRD/NRTR—2007/367



Cover photos:

Top Left: Outer Island Lighthouse, NPS Photo
Top Center: Sand River Estuary, Mainland Unit, Eric Epstein
Top Right: Sea Caves East of Meyers Beach, Mainland Unit, Dave Mechenich
Bottom Left: Outer Island Sand Spit, Eric Epstein
Bottom Center: Stockton Island Tombolo Interdunal Pool, Emmet Judziewicz
Bottom Right: Lake Superior from Trail East of Meyers Beach, Dave Mechenich

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Technical Report NPS/NRWRD/NRTR-2007/367

George J. Kraft
Center for Watershed Science and Education
College of Natural Resources
University of Wisconsin –Stevens Point
Stevens Point, WI 54481

Christine Mechenich
Center for Watershed Science and Education
College of Natural Resources
University of Wisconsin –Stevens Point
Stevens Point, WI 54481

David J. Mechenich
Center for Watershed Science and Education
College of Natural Resources
University of Wisconsin –Stevens Point
Stevens Point, WI 54481

Stanley W. Szczytko
College of Natural Resources
University of Wisconsin –Stevens Point
Stevens Point, WI 54481

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U.S. Department of the Interior
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Water Resources Division
Natural Resource Program Center
1201 Oak Ridge Dr.
Fort Collins, CO 80525

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Executive Summary

Apostle Islands National Lakeshore (APIS) is located at the tip of the Bayfield Peninsula in northern Wisconsin. It includes 21 of the 22 Apostle Islands in Lake Superior, a strip of the mainland, and the waters of Lake Superior out to 0.4 km from the islands' shores. The lakeshore encompasses 17,017 ha of land and 11,057 ha of Lake Superior, only 15% of the archipelago's total water area. APIS was designated and placed under the management of the National Park Service (NPS) by an act of Congress in 1970 and further strengthened by designation of about 80% of its land area as the Gaylord Nelson Wilderness in 2004.

Key features of APIS include Lake Superior, the largest and one of the cleanest freshwater lakes in the world. APIS also includes some of the most pristine sandscapes left in the Great Lakes region, including sand spits, cusped forelands, tombolos, a barrier spit, and numerous beaches; many of these sandscapes are recognized as Wisconsin State Natural Areas. Other outstanding features include colorful sandstone cliffs and sea caves, old-growth forests, and the largest collection of lighthouses in the National Park System. In 2001, approximately 48,000 visitors used private motorboats, kayaks, or sailboats to tour the islands. The NPS provides 20 docks, and nearly all the islands have natural anchorage areas that provide shelter from storm winds and opportunities for recreational activities. Inland surface water resources include lagoons on Michigan, Stockton, and Outer Islands, unnamed perennial streams on Stockton and Oak Islands, and the Sand River Estuary. Bogs, beaver ponds, and wetlands are common, and APIS has more kilometers of intermittent streams than any other Great Lakes national park.

The APIS area has long, cold winters and short, moderately warm summers, made somewhat more maritime by proximity to Lake Superior. APIS is located at the northern limit of the hemlock-white pine-northern hardwood forest and the southern limit of the boreal forest and is 96% forested. Much of adjoining Bayfield County is also forested. Major landowners on the Peninsula include the Wisconsin Department of Natural Resources, the USDA - Forest Service, and Bayfield County. The north and northeastern tip of the Peninsula is the Red Cliff Band of Lake Superior Chippewa Indian Reservation.

APIS includes a number of regionally rare habitats, including old-growth forest, boreal forest, five types of northern forests, forest seep, clay bluff communities, sandstone cliff communities, lagoon and bog communities, forested ridge and swale, coastal fen, Great Lakes barrens, and dune communities. It is officially home to five current Wisconsin-endangered plant species (including satiny willow, *Salix pellita*) and 12 current Wisconsin-threatened plant species [including coast sedge (*Carex exilis*), lenticular sedge (*Carex lenticularis*), Michaux's sedge (*Carex michauxiana*), drooping sedge (*Carex prasina*), broad-leaved twayblade (*Listera convallarioides*), flat-leaved willow (*Salix planifolia*), and narrow false oats (*Trisetum spicatum*)], as well as 23 plant species of special concern. APIS is also home to the federally endangered piping plover (*Charadrius melodus*) and the federally threatened bald eagle (*Haliaeetus leucocephalus*), as well as 11 bird species of special concern in Wisconsin. Other species of special concern include four-toed salamanders (*Hemidactylium scutatum*) and several types of aquatic and terrestrial insects.

Lake Superior has been classified as an ultra-oligotrophic lake, and its phytoplankton and zooplankton communities reflect that status. Diatoms and phytoflagellates contribute most of the

lakewide phytoplankton biomass. The zooplankton community is dominated by large calanoid copepods, with cladocerans also present (and perhaps becoming more numerous in western Lake Superior). The fish community includes as many as 96 species, including some of commercial importance, such as lake trout (*Salvelinus namaycush*), lake whitefish (*Coregonus clupeaformis*), and lake herring (*C. artedi*). The conditions of Lake Superior bays in the mainland unit and surrounding the islands generally mirror the open water conditions. The three major lagoons in the park on Outer, Stockton, and Michigan Islands also generally reflect oligotrophic conditions. Less is known about the biota of Sand River and Saxine Creek in the mainland unit, the many ephemeral and a few permanent streams on the islands, or the vernal pools that may provide important habitat for amphibians and other species.

Potential sources of pollution to APIS are numerous and vary greatly in magnitude. Toxic organic contaminants, which are of particular concern in Lake Superior, may originate as air pollutants as far away as Mexico and Central America. Local sources of air pollutants are better-regulated, but the potential impact on APIS of permitted local and regional emissions is unknown.

Point sources of water pollution to Lake Superior near APIS include five small municipal wastewater treatment plants, an electrical power generating facility, and a fish hatchery. Nonpoint sources include Great Lakes shipping activities, tour boats and private boats, marinas, and stormwater discharges. Great Lakes cargo ships travel within 8 km of Devils and Sand Islands, 6 km of Michigan Island, and 1 km of Long Island, and may come closer during storms. These have the potential to accidentally spill cargoes or fuel, or discharge bilge water or ballast water that could contain exotic species. Bayfield Peninsula municipalities are all too small to be covered by United States Environmental Protection Agency (USEPA) stormwater regulations. Potential sources of water pollution to the APIS mainland unit's streams and bays include on-site wastewater treatment systems, logging, and road building.

APIS's surface waters have generally been determined to be of high quality. Lake Superior waters continue to be notable for their clarity, but runoff from Peninsula streams sometimes creates sediment plumes that extend well into the islands. These sediments are mainly clay particles and are sometimes high in phosphorus, but to date, excessive phosphorus levels have not been found in routine Lake Superior monitoring. Some data indicate that nitrate has been increasing lakewide over the period of record, perhaps related to atmospheric deposition. Only a few exceedences of aquatic freshwater life or human health criteria have been recorded. Many fish species from Lake Superior have fish consumption advisories, especially for women and children, because of polychlorinated biphenyl (PCB), mercury or dioxin contamination. Limited data indicate that the quality of APIS groundwater resources is good, with a few aesthetic problems for domestic use related to iron and manganese.

Population growth in Ashland and Bayfield Counties has been slow since 1990, and population is much lower than the peak experienced around 1920. Ashland County's population is declining; Bayfield County is experiencing population growth around small unincorporated towns along major roads, rural towns around Ashland, and in the Town of Russell associated with the Red Cliff Indian Reservation. Housing growth is outpacing population growth, largely

because of second home development. Development and population pressures should be observed for possible impact on APIS resources.

Six aquatic invasive species are currently known to exist in the APIS vicinity: the sea lamprey (*Petromyzon marinus*), the Eurasian ruffe (*Gymnocephalus cernuus*), the threespine stickleback (*Gasterosteus aculeatus*), the spiny water flea (*Bythotrephes longimanus*), the Eurasian watermilfoil (*Myriophyllum spicatum*), and purple loosestrife (*Lythrum salicaria*). Other aquatic invasives that are known to exist in Lake Superior and may be considered to be encroaching on APIS include the alewife (*Alosa pseudoharengus*), New Zealand mudsnail (*Potamopyrgus antipodarum*), zebra mussel (*Dreissenia polymorpha*), Asian clam (*Corbicula fluminea*), round goby (*Neogobius melanostomus*), and white perch (*Morone americana*). Primary vectors for introducing exotic species to Lake Superior are the bilge and ballast water of commercial ships, boating, and angler activity.

Climate change could have major impacts on APIS resources, both by altering the habitats that enable certain rare species to survive as well as by allowing exotic species to compete more successfully. Some of the projected impacts include warmer inland waters with less dissolved oxygen and more phosphorus and mercury release from sediments, changes in fish communities away from coldwater species, and reductions in the size of wetland habitats. Climate change could change Lake Superior water levels with potentially severe effects on APIS sandscapes and on the configuration of the islands themselves. Sandscapes are also sensitive to trampling caused by human foot traffic.

The potential for degradation of APIS water resources is shown in Table i. Documented problems include water clarity issues related to phosphorus-laden sediment loss from Bayfield Peninsula watersheds; fish consumption advisories related to mercury, polychlorinated biphenyl and dioxin contamination; regional air pollution; visitor use intensity, especially on sandscapes; and aquatic invasive species.

Recommendations detailed in the report include the following:

Water quality and biotic evaluation and monitoring

- Routine water quality monitoring should continue as outlined in GLKN protocols and Axler et al. (2006).
- The potentially ecologically significant vernal pools and the abundant and diverse wetland resources need additional study and long-term monitoring.
- An assessment of all APIS streams and rivers should be conducted using standardized rapid bioassessment techniques to determine existing water quality, and monitoring should continue on a five year basis to document changes and trends in water quality throughout APIS.
- Intermittent streams at APIS need further water quality and biological investigation and monitoring.
- Continued cooperation with WDNR, USFWS, and the tribes is encouraged to ensure that resource protection goals for APIS fish populations are met.

Table i. Potential for degradation of water resources in Apostle Islands National Lakeshore.

Stressor/ Environmental Indicator	Lake Superior open waters	Mainland Unit Lake Superior coastline and bays	Mainland Unit streams	Islands Lake Superior coastline and bays	Islands inland waters and wetlands
Water quality indicators					
Water clarity	OK	PP	EP	EP	NA
Nutrients	PP	PP	EP	PP	PP
Dissolved oxygen	OK	OK	OK	PP	EP
Fecal bacteria	OK	OK	NA	PP	OK
Sediment	OK	PP	EP	EP	NA
Biological indicators					
Zooplankton populations	PP	PP	NA	PP	PP
Fish consumption advisories	EP	EP	EP	EP	EP
Land use-related stressors					
Regional atmospheric deposition and air pollution	EP	EP	EP	EP	EP
Local air pollution sources	PP	PP	PP	PP	PP
Wastewater discharges covered by NPDES permits	OK	NA	NA	PP	NA
Stormwater	OK	OK	OK	PP	NA
Agriculture	OK	OK	OK	OK	NA
Landfills	OK	PP	PP	OK	NA
Septic systems	OK	PP	PP	OK	OK
Residential development	OK	PP	PP	PP	NA
Road building	OK	PP	PP	NA	NA
Logging	OK	PP	PP	NA	NA
Recreational and commercial use					
Land-based visitor use intensity	NA	PP	OK	EP	OK
Recreational boating	PP	PP	NA	PP	NA
Commercial tour boating	PP	OK	OK	PP	NA
Commercial fishery	OK	OK	NA	OK	NA
Great Lakes shipping	EP	PP	NA	PP	NA
Invasive species	EP	EP	EP	EP	EP
Climate change	PP	PP	PP	PP	PP

Definitions: EP= existing problem; PP = potential problem; OK= no detectable problem

shaded =limited data; NA= not applicable.

- The genetic makeup of coaster brook trout stocks around the islands should be investigated, and the need for a locally developed brood stock more appropriate to the islands should be evaluated (Lafrancois and Glase 2005).

Stressor monitoring, evaluation, and management

- Surveys for known and encroaching aquatic invasive species in APIS should be expanded, and control programs should be undertaken where feasible.
- Specific pollutants in local and regional air emissions and their potential effects on APIS water resources should be evaluated, and monitoring should be conducted where warranted.
- Water level fluctuations should be monitored at unique island habitats such as splash pools and temporary beach habitats, and habitat losses should be documented.
- Water and sediment monitoring should be evaluated for heavily-used recreational boating areas, including Presque Isle Bay, for marine engine – related contaminants such as MTBE (methyl tertiary butyl ether), PAHs (polyaromatic hydrocarbons), BTEX (benzene, toluene, ethylbenzene, and xylene) and heavy metals such as copper.
- Locations of stormwater discharges on the Bayfield Peninsula should be documented and evaluated for potential impacts.
- The WDNR’s proposal to quantify the effects of erosion control practices on Lake Superior tributaries by monitoring suspended solids and flow should be supported, and the results should be examined for possible impacts or mitigation opportunities for mainland unit streams.
- Population trends in the watershed of the mainland unit should be monitored, and ways to monitor the effects of local land use practices (logging, road building, and residential development) on APIS mainland unit waters should be developed and implemented in proportion to increased use.
- Effects of recreation on shoreline habitat and shoreline processes should continue to be monitored at heavily visited sites. In particular, physical damage to sensitive shoreline resources from boat wakes, groundings or other recreational boating impacts need to be assessed and monitored.
- The town of Russell landfill should be discussed with WDNR specialists to define whether or not it is in the Sand River basin and to determine if further investigation of the site is warranted.

Planning

- A plan should be developed to mitigate impacts of future climate change where feasible strategies can be identified.

Education

- Emphasis should be placed on boater education about current regulations and risks posed by fuel spills, human waste discharge, or discharge of bilge water or bait buckets into nearshore Lake Superior waters.