

FINAL REPORT
Biota Survey for Devils Lake, ND
Conducted July 25-30, 2005

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DISCLAIMER

This report presents additional technical information gathered through a survey of aquatic biota conducted in Devils Lake, North Dakota. Participation by the Council on Environmental Quality, Minnesota Department of Natural Resources, North Dakota Game and Fish Department, North Dakota Department of Health, North Dakota State Water Commission, Manitoba Water Stewardship, Environment Canada, Fisheries and Oceans Canada, U.S. Army Corps of Engineers, U.S. Department of State, and U.S. Fish and Wildlife Service in gathering data and/or reviewing and providing input into this report does not represent any jurisdiction's views as it relates to the State of North Dakota's Devils Lake outlet.

Coordination Team

The following personnel were involved in the coordination of the July 25-30, 2005 biota survey and preparation of this report:

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Executive Summary

This biota survey was undertaken to help address recognized data gaps about aquatic biota of concern in Devils Lake, North Dakota. This effort stems from a collaborative process that involved interested jurisdictions that could be affected by the operation of the State of North Dakota's Devils Lake outlet. These jurisdictions include the State of North Dakota, the State of Minnesota, the Province of Manitoba, and the federal governments of Canada and the United States. The purpose of this biota survey is to provide additional information regarding the presence of targeted aquatic biota of concern in Devils Lake. To assure scientific integrity, the results must be viewed and evaluated in relation to the following caveats:

The participants recognize that no sampling method is guaranteed to provide evidence of every single species present in a prescribed area. However, additional information is always useful, and the current survey provides an updated picture of Devils Lake's biota relative to previous studies.

Data collection efforts were focused primarily on detecting the presence or absence of a targeted list of biota of concern that all jurisdictions recognized to be of most concern and do not represent a comprehensive survey of biota in Devils Lake.

This effort did not survey and did not alleviate existing data gaps in the knowledge of the Sheyenne River, Red River and its tributaries, Lake Winnipeg or other parts of the Nelson River system, nor does it represent a risk assessment.

The present fish parasite and pathogens survey was based on samples at one point in time. The occurrence and prevalence of certain fish pathogens may be variably affected by life history characteristics and environmental factors at other times of the year, especially those that cause or increase stress in fish.

Due to the fact that the present survey represents results from a single time period, the survey results should inform, but not be the sole determinant of, the process to design and construct a more advanced filtration system and/or disinfection system for the Devils Lake outlet that may be required to prevent the potential transfer of biota of concern from Devils Lake to the receiving waters through the operation of an outlet.

The list of targeted biota of concern included:

Aquatic macrophytes of concern - flowering rush (*Butomus umbellatus*), Eurasian water milfoil (*Myriophyllum spicatum*), curly leaf pondweed (*Potamogeton crispus*), and brittle naiad (*Najas minor*).

Aquatic invertebrates of concern - rusty crayfish (*Orconectes rusticus*), zebra mussels (*Dreissena polymorpha*), Chinese mystery snail (*Cipangopaludina spp.*), spiny water flea (*Bythotrephes cederstroemi*), an exotic daphniid (*Daphnia lumholtzi*), quagga mussel (*Dreissena bugensis*), New Zealand mud snail (*Potamopyrgus antipodarum*), and an "exotic" amphipod (*Echinogammarus ischnus*).

Fish of concern – striped bass (*Morone saxatilis*).

Sampling was conducted from July 26 to July 30, 2005, utilizing agreed-upon methods for sampling aquatic biota of concern and for selecting sites to sample throughout the lake. This survey was based upon a rapid and cursory evaluation approach developed by the participating jurisdictions.

None of the target aquatic invertebrates or macrophytes of concern were recorded or collected during this survey. This may be because they are not present in Devils Lake. However, due to seasonal community composition shifts, some species of concern may not have been detected either because the sampling was during the summer or because they occur in low abundance.

Additionally, the U.S. Fish and Wildlife Service surveyed fish from Devils Lake for pathogens and parasites following the National Wild Fish Health Survey protocols.

Over 300 fish from seven species were examined and tested from Devils Lake using the protocols of the National Wild Fish Health Survey. Antigen of *Renibacterium salmoninarum*, causative agent of bacterial kidney disease, was detected in all fish species by the enzyme-linked immunosorbent assay (ELISA). Confirmation tests were conducted on a total of 21 fish representing seven different fish species and failed to confirm the presence of this agent. *Gyrodactylus hoffmani* was initially identified as a species of concern, but was not found during this survey. Striped bass was listed as a fish of concern, but no specific sampling occurred during this survey. However, over 11,000 hours of sampling (2000-2004), with 50,000 fish netted, and over a million angler hours a year, have failed to yield a single record of a striped bass since 1993.

We also report on other aquatic biota found during the course of this effort. The results of this effort must be considered in light of the applicable caveats listed above. Additionally, the limitations of the effort as it relates to detecting seasonal variations, if any, of Devils Lake biota must be recognized when evaluating the results since sampling only occurred during the summer period. All of the information gathered in this report should inform discussions about long-term monitoring efforts.

Introduction

This biota survey was undertaken to address recognized data gaps about aquatic biota of concern in Devils Lake, North Dakota. Within the context of this effort, biota of concern include a group of targeted species that all the interested jurisdictions recognized as undesirable because of their potential ecological impacts. This effort stems from a collaborative process that involved interested jurisdictions that could be affected by the operation of the State of North Dakota's Devils Lake outlet. These jurisdictions are the State of North Dakota, the State of Minnesota, the Province of Manitoba, and the federal governments of Canada and the United States. These jurisdictions are currently engaged in negotiations that will benefit from additional information on the aquatic biota in Devils Lake. Concerns are centered around the potential downstream dispersion of biota of concern via the State of North Dakota's Devils Lake outlet.

The purpose of this effort is to provide additional information regarding the presence or absence of targeted aquatic biota of concern in Devils Lake. This report relies on results and analysis undertaken by Manitoba Water Stewardship (Williamson et al. 2005), Minnesota Department of Natural Resources (Montz 2005 and Perleberg 2005), North Dakota Game and Fish Department information, U.S. Fish and Wildlife Service (Hudson and Peters 2005), and on data and analysis by the survey participants (see List of Survey Participants). In order to assure scientific integrity, the results must be considered in relation to the following caveats:

The participants recognize that no sampling method is guaranteed to provide evidence of every single species present in a prescribed area. However, additional information is always useful, and the current survey provides an updated picture of Devils Lake's biota relative to previous studies.

Data collection efforts were focused primarily on detecting the presence or absence of a targeted number of species that all jurisdictions agreed to be of most concern and do not represent a comprehensive survey of biota in Devils Lake.

This effort does not alleviate existing data gaps in the knowledge of the Sheyenne River, Red River Basin and its tributaries, nor does it represent a risk assessment.

The fish parasite and pathogens survey conducted in support of this effort was based on samples at one point in time. The occurrence and prevalence of certain fish pathogens may be variably affected by life history characteristics and environmental factors at other times of the year, especially those that cause or increase stress in fish.

Due to the fact that the present survey represents results from a single time period, the survey results should inform, but not be the sole determinant of, the process to design and construct a more advance filtration system and/or disinfection system for the Devils Lake outlet that may be required to prevent the potential transfer of biota of concern from Devils Lake to the receiving waters through the operation of an outlet.

This effort is to increase our knowledge base regarding Devils Lake and hopefully serve as a model for future cooperation and the development of our collective understanding of not only Devils Lake, but also of the receiving waters.

The list of targeted biota of concern included:

Aquatic macrophytes of concern - flowering rush (*Butomus umbellatus*), Eurasian water milfoil (*Myriophyllum spicatum*), curly leaf pondweed (*Potamogeton crispus*), and brittle naiad (*Najas minor*).

Aquatic invertebrates of concern - rusty crayfish (*Orconectes rusticus*), zebra mussels (*Dreissena polymorpha*), Chinese mystery snail (*Cipangopaludina spp.*), spiny water flea (*Bythotrephes cederstroemi*), an exotic daphniid (*Daphnia lumholtzi*), quagga mussel (*Dreissena bugensis*), New Zealand mud snail (*Potamopyrgus antipodarum*), and an “exotic” amphipod (*Echinogammarus ischnus*).

Fish of concern – striped bass (*Morone saxatilis*)

Fish pathogens and parasites - The U.S. Fish and Wildlife Service performed fish examinations to assess the presence of any fish parasites (both ecto and endoparasites), bacterial and viral pathogens as described in the National Wild Fish Health Survey.

During this survey, no effort was focused on one species, striped bass (*Morone saxatilis*). All jurisdictions agreed that additional sampling for this fish species of concern would not be part of this limited survey due to the extensive annual netting efforts already undertaken by the North Dakota Game and Fish Department.

Sampling was conducted from July 26 to July 30, 2005. The methods utilized (see methods section below) were developed in close coordination among all of the jurisdictions through a consensus process facilitated by Council on Environmental Quality staff. On-site adjustments of the sampling methods were made, as needed, to ensure adequate coverage of the targeted areas and to reflect on-the-water realities that the teams faced given the limitations of available time and resources. Sampling was conducted by staff from Council on Environmental Quality (CEQ), Minnesota Department of Natural Resources (MNDNR), North Dakota Game and Fish Department (NDGFD), North Dakota Department of Health (NDHD), Manitoba Water Stewardship (MWS), U.S. Army Corps of Engineers (USACE), and U.S. Fish and Wildlife Service (USFWS).

During the course of the survey other aquatic biota were encountered. However, the focus of the survey was on identifying whether or not targeted biota of concern were present in the lake and to conduct additional work on fish pathogens and parasites. The sampling effort provided additional information on the lake’s phytoplankton, zooplankton, aquatic macrophytes and benthic invertebrates.

Study Area

Devils Lake is located in Ramsey and Benson Counties, North Dakota (Figure 1). Water levels in this system have fluctuated since the end of glaciation (USGS 2000). In 2003, the Lake was reported to have a surface area of approximately 124,000 acres and a maximum depth of at least 50 feet (NDGFD 2003). A more recent report estimated the surface acreage at 139,400 acres (Wetzel, 2005).

Devils Lake includes several basins that vary in water depth, alkalinity, clarity, wind exposure, shoal substrate, and history of water level fluctuations. Dissolved solids concentrations generally increase from west to east as water enters the western part of the lake and becomes progressively more concentrated by evaporation as it moves eastward (USGS 2000). These differences in physical, chemical and hydrologic properties likely influence the aquatic communities within each basin. Manitoba Water Stewardship conducted additional sampling in Stump Lake, which is located in Nelson County.

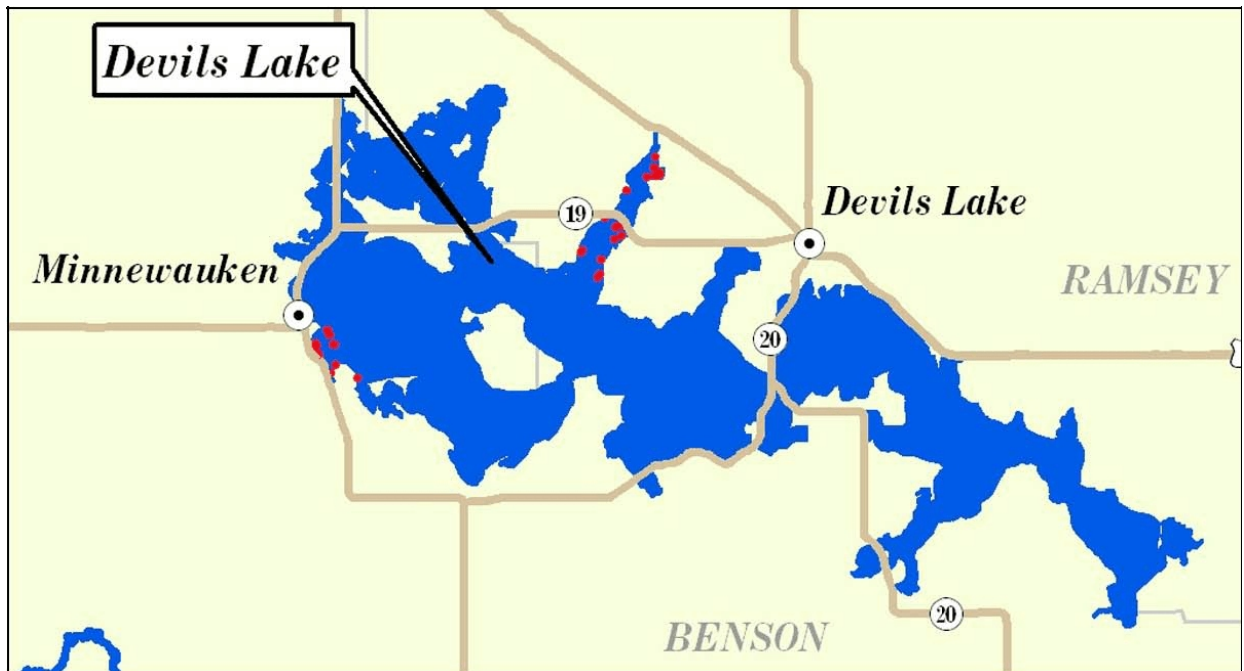


Figure 1 Devils Lake (from Hudson and Peters, 2005)

Methods

General

This biota survey was based upon a rapid and cursory evaluation approach that was agreed upon and utilized due to the extensive survey area and the limited time available. Surveyors would boat or wade through pre-selected sampling sites to collect and/or record aquatic macrophytes and an agreed upon small number of pre-selected aquatic invertebrate taxa. This method seemed especially appropriate for marinas (a likely location where species of concern might initially colonize), where establishing specific sampling points would be difficult. Additionally, it allowed for a greater number of areas to be surveyed. It was also agreed to develop a stratified sampling scheme, based upon major habitat types in and around the lake, with a special focus on the outlet intake, and areas that represent the diversity of major habitat types within Devils Lake.

This helped focus the use of available resources and accommodate the timeframe under which the survey effort was undertaken.

Consensus was reached to focus first on the in-lake populations and to stratify sampling across the “separate” bays/basins of Devils Lake. Areas of importance for survey work included:

Water depths less than two meters. Plant species diversity is typically greater in these shallower depths.

Protected shoreline, bays or backwaters. Waters that are sheltered from wave action are more likely to support aquatic vegetation.

Inlets and outlets.

Artificial harbors and marinas.

Public access locations.

Except for fish, sampling effort and locations were determined by a three-step process that included:

- 1) Identification of key habitat types in the lake;
- 2) Determination of the type(s) of sampling that should occur within each strata (method(s) selected should capture a broad range of taxa and are highly effective for targeted species of concern);
- 3) Ensure that all major habitat types have at least a limited survey. The basis for such an agreement resides in the participant’s agreement that a limited amount of effort in all the major habitat types is more valuable than a significant amount of effort in a few habitat types within the context of this limited biota survey.

The survey commenced on July 26, beginning on West Bay near the intake for the outlet and radiated outwards from this area to sample all the bays of the Lake. Based on these agreements, staff from the NDGFD divided the Lake into sections based on their familiarity with the Lake, with the intention to sample all major habitat types represented in the Lake (Figure 2). Each section was assigned an identification code for record-keeping purposes and coordination of team locations. Teams were assigned to specific areas to sample for particular taxonomic groups,

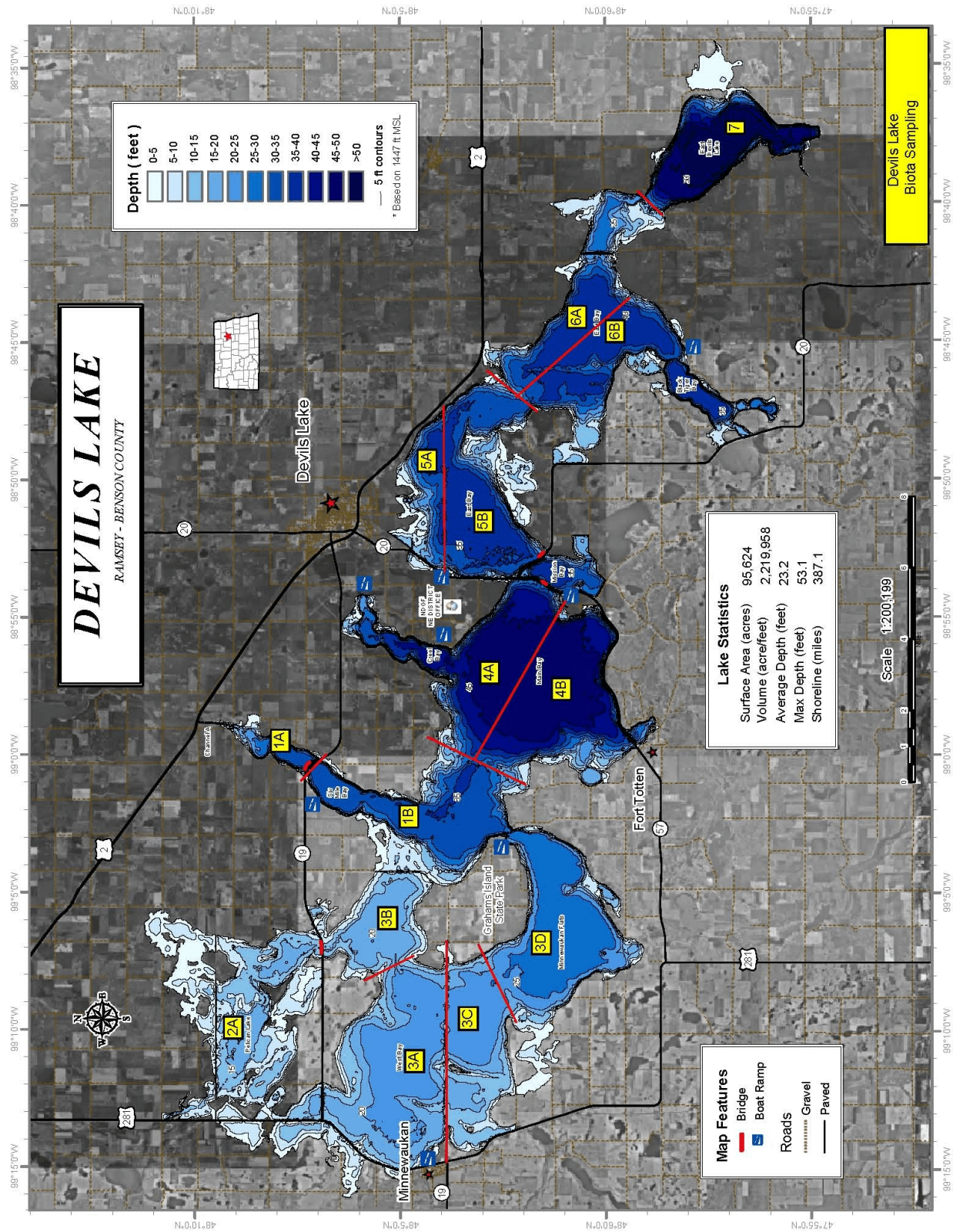


Figure 2 Devils Lake sections

based upon expertise and available equipment. Sampling sites were located at one-mile intervals. Because of the unexpected simplicity of the aquatic macrophyte community encountered, as teams moved eastward the distance between sampling sites was increased to two-mile intervals in Main Bay and three-mile intervals at both East Bay and East Devils Lake. This was done to more effectively sample larger areas of the Lake. Additionally, upon observing macrophyte growth, teams were requested to sample those locations regardless of distance from the previous sampling site. This provided further opportunities to sample the aquatic vegetation of the Lake. At each site sampled, a data sheet showing date, time, GPS location, surveyor, identification code as described previously, and sampling method used was completed.

Participants from MWS also collected samples from Stump Lake on July 29th. Teams completed the survey of pre-selected sites on Devils Lake by July 29 with the exception of the survey for zebra mussels, which took place using volunteer divers from North Dakota on July 30. Invertebrate samples collected by MNDNR and MWS staffs were preserved for future identification off-site.

Fish of Concern

Based on the existing and extensive Devils Lake fish surveys already conducted by NDGFD, additional fish surveys were not conducted as part of this survey effort. It was recognized that the survey techniques routinely used by NDGFD staff may not adequately sample certain benthic, less mobile species. Given the impracticality of sampling for benthic fish species in the time available to conduct this survey, it was agreed that no specific sampling would be attempted. However, any benthic fishes incidentally captured while surveying for macro-invertebrates were to be recorded.

Fish Pathogens and Fish Parasites of concern

Because of the expertise of the USFWS and the limited time available, it was decided that collection and analysis of fish pathogens and parasites would be done by the USFWS. The USFWS effort followed the National Wild Fish Health Survey protocols available at: <http://www.wildfishsurvey.fws.gov>. As noted above, sampling techniques available within the time constraints for this effort did not allow for sampling of the benthic fish community.

Aquatic Invertebrates of concern

Two teams collected and preserved aquatic macroinvertebrate samples from Devils Lake. Benthic invertebrate samples from the lake bottom were collected with a 23 cm by 23 cm by 32 cm Ekman dredge (Williamson et al. 2005). Dredge samples were washed through a Nitex nylon bag with a 500 µm mesh. Samples were immediately preserved with 70% alcohol. The MNDNR crew collected aquatic invertebrate samples at a subset of locations which were sampled for aquatic macrophytes (Montz, 2005 and Perleberg, 2005). Not all sites sampled for vegetation were sampled for invertebrates. Samples were collected with a D-frame sweep net,

either through wading along shorelines or by sweeping the net multiple times through aquatic macrophyte beds at different depths. Sampling also included margins of cattail beds, woody debris, rocks, sand and gravel shoals. Samples were qualitative with the primary focus being the snail fauna.

Survey areas of special focus included, but were not limited to:

1. Aquatic macrophytes: Submerged aquatic plant growth, particularly larger beds, are key habitat for macroinvertebrates. High species diversity can occur in these areas (e.g. snails, amphipods). These areas were sampled using sweep or kick nets.
2. Rock/cobble (consolidated) and/or larger stands of woody debris: Both of these habitats can support a different array of macroinvertebrate species than aquatic macrophyte beds. In particular, the consolidated substrate is ideal for crayfish. These areas were sampled by kick/sweep net and by conducting some qualitative hand picking.
3. Hard substrate at selected public boat access sites: Surveys for zebra mussels were conducted on July 30 by NDGFD personnel and divers from the Devils Lake search and rescue team. Six public boat ramps were visited and, at each, a diver dove to ten to fifteen feet to collect hard substrate samples. In the search for zebra mussels, hard substrates were collected by divers at depths of 10-15 feet to ensure that these substrates have been under water at least for the past three years and away from direct sunlight. Five-gallon buckets were used by the divers to collect the samples with approximate volume of samples of 3-4 gallons of hard substrates. The collected samples were transferred to plastic coolers for transport by NDGFD personnel to the Department's facilities for inspection and storage. Substrates were examined visually and with the aid of 10X hand-held magnifying glass for both adult and juvenile zebra mussels. The water in the transfer coolers was also examined for zebra mussels that may have been dislodged during transport. In addition, samples from plankton tows were examined with cross-polarized light to look for zebra mussel veligers by MNDNR personnel.

Plankton of concern:

Two teams collected plankton samples at Devils Lake. Samples were collected from all bays of Devils Lake and from Stump Lake. This was accomplished by vertical and horizontal tows of a plankton net with locations (GPS coordinates) and sample identification recorded on a data sheet. Sampling type and locations are shown in Figure 3. Samples were collected from Devils and Stump Lakes during the period July 27, 2005, to July 29, 2005. Samples were collected in duplicate in all cases and triplicate at some sites.

Boats were anchored during sample collection. Vertical tows were taken near the deepest location from each of the basins selected for sampling. Sampling was supplemented with horizontal near-surface tows in the near shore area. All species collected were to be identified and recorded.

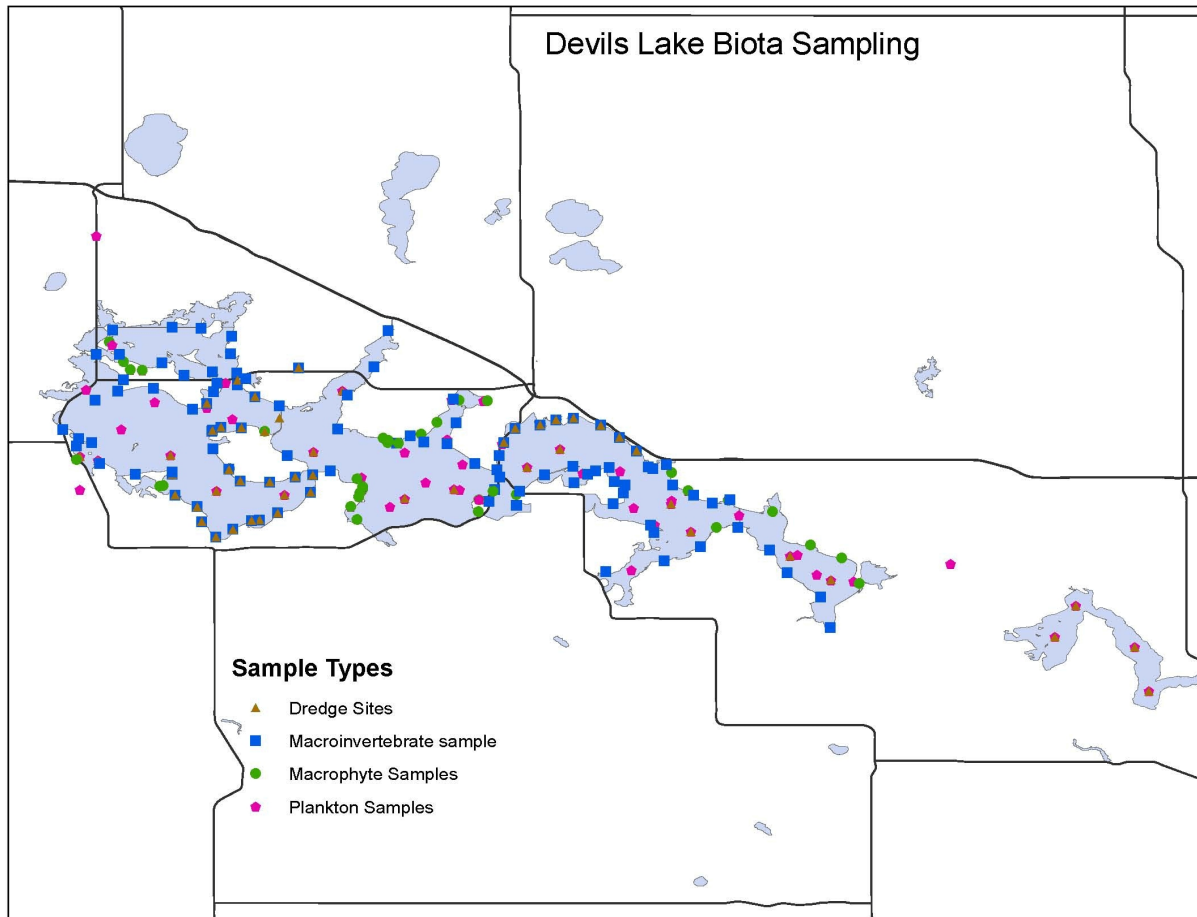


Figure 3 Devils Lake Sampling locations

Phytoplankton samples were collected with the use of a Wisconsin-style net with a mouth opening of 10 cm and a total length of 52 cm. The mesh size of the net was approximately 45 to 50 μm . Samples were fixed in the field with Lugol's solution, and 70 % alcohol was added later for full preservation. One quarter to $\frac{1}{2}$ mL aliquots were taken from each sample bottle and analyzed in a 2 mL utermohl chamber using an M40 Wild Inverted Microscope at magnifications of 234X, 468X, and 938X. The phytoplankton present were assessed qualitatively primarily for dominant taxa. The following taxonomic works were used for identifying the dominant cyanobacteria: Komarek and Anagnostidis (1999), Komarek and Komarkova (2002), Azevedo and Sant'Anna (2003), and Sant'Anna et al. (2004).

Zooplankton samples were collected with a Wisconsin-style net with a mouth opening of 25 cm and length of 100 cm. The first three sites (3C01, 3C02, and 3C03) were sampled with a net of 72 μm mesh, and the rest of the sites were sampled with a net of 65 μm . Use of the slightly finer second net, necessitated by damage to the first, did not bias zooplankton species composition. Samples were immediately preserved with 70 % alcohol. Two - 1 mL aliquots were taken from each sample and examined under a compound microscope at several magnifications (25X to 160X). The crustacean plankton present were qualitatively but not quantitatively assessed. Identifications followed Brooks (1957), Wilson (1959), and Yeatman (1959).

Aquatic Macrophytes of concern

In addition to general macrophyte sampling, the MNDNR crew targeted specific areas of the Lake for additional vegetation surveys. Those methods are outlined in Perleberg, 2005. Within each of the basins they visited, MNDNR surveyors focused additional effort on areas where submerged or floating-leaved macrophytes were most likely to occur. The MNDNR crew used 2003 Farm Service aerial photos and a contour map that were quickly reviewed to select areas of potential macrophyte growth. In the field, surveyors navigated to a general area of the basin and then selected sample areas based on water depth, site protection and accessibility. Sampling focused on water depths less than nine feet. Wave-swept shorelines with extensive rip-rap were avoided because site conditions appeared unfavorable for macrophyte growth. Areas with visible surface growth of macrophytes and protected backwater areas were a priority for sampling.

This sampling effort is qualitative and most effective at detecting commonly occurring species (Perleberg 2005). This approach should be effective in detecting any of the species of concern if they have well established populations in suitable habitats.

Although the purpose of this survey was to target a number of species of concern and was not a comprehensive survey of Devils Lake's macrophyte community all species collected were identified. At each selected sample area, surveyors recorded a GPS location, water depth and macrophyte species present. Visual surveys were made where feasible, particularly in areas where vegetation reached the water surface. The MNDNR used a double-headed, weighted rake to sample submerged vegetation. Voucher specimens were collected for each macrophyte species found.

Terrestrial Plants of concern

Surveyors were to make observations along the shoreline specifically for flowering rush because this plant can grow in both terrestrial and aquatic habitats. If any suspect plants were observed voucher specimens and data sheets were to be completed and submitted.

Results

A total of 375 samples were collected from 196 sites while sampling for aquatic macrophytes, aquatic invertebrates and plankton. Some sites were sampled for multiple taxonomic groups (e.g., aquatic macroinvertebrate sampling occurred amongst aquatic macrophytes). Sampling locations were scattered throughout the different basins of Devils Lake (see Figure 3), with some samples taken from Stump Lake. Adopting the 139,400- acre figure from Wetzel (2005) for Devils Lake's surface area, approximately one dredge sample/2,966 acres and one plankton sample/1,936 acres were collected. Based on 2003 available figures Devils Lake had 387.1 miles of shoreline (Steinwand, pers com.). During this effort, one macrophyte sample/3.6 miles

and one macroinvertebrate sample/2.7 miles were collected. Manitoba Water Stewardship analyzed 19 samples for phytoplankton, 21 samples for zooplankton, and 57 samples for benthic aquatic invertebrates. The MNDNR analyzed 24 samples for zebra mussel veligers, at least 44 samples for zooplankton, and the Corps of Engineers analyzed 58 samples for snails. The NDGFD analyzed 10 samples for zooplankton specifically focused on *Daphnia lumholtzi*. Additionally, the Corps of Engineers and the MNDNR analyzed all of the aquatic macrophyte samples. Below we report the findings of these analytical efforts.

Fish of Concern

Sampling locations established by NDGFD utilized from 2000 to 2005 are presented in Figure 4. The striped bass was introduced into Devils Lake in 1977 and has been frequently identified as a species of concern. Between 2000 and 2004, NDGFD has netted over 50,000 fish with over 11,000 hours of netting effort and over a million angler hours of recreational fishing occurs annually without striped bass being recorded. An angler caught the last striped bass recorded from Devils Lake, an adult, in 1993.

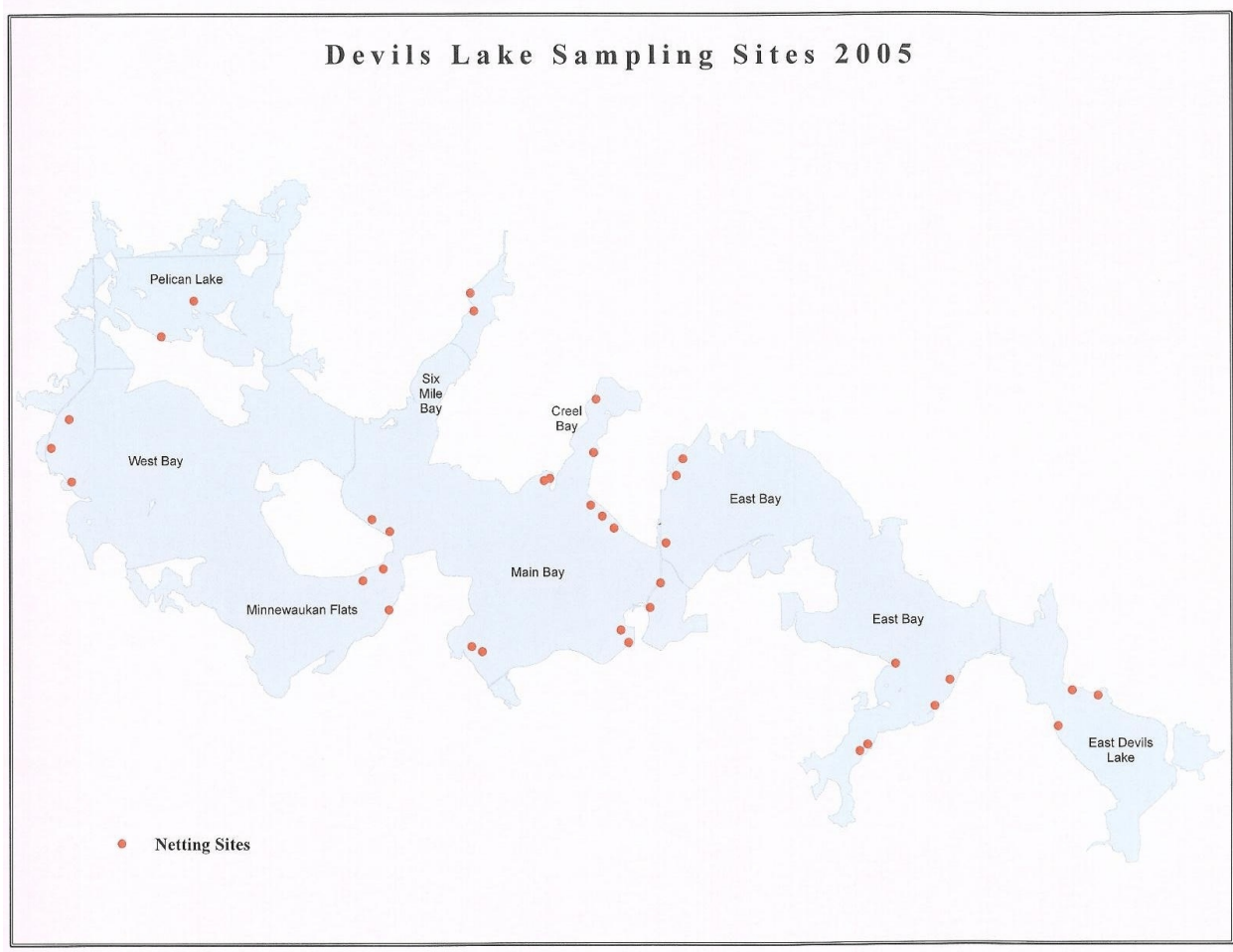


Figure 4 NDGFD Fish sampling sites

Fish Pathogens and Fish Parasites of concern

Over 300 fish from seven species were examined and tested from Devils Lake using the protocols of the National Wild Fish Health Survey. Overall, the health and condition of fish from Devils Lake appeared very good (Hudson and Peters 2005). None of the fish examined had any external or internal clinical signs that would indicate infection of a fish pathogen. Antigen of *Renibacterium salmoninarum*, causative agent of bacterial kidney disease, was detected in all fish species by the enzyme-linked immunosorbent assay (ELISA). Confirmation tests were conducted on a total of 21 fish representing seven different fish species and failed to confirm the presence of this agent. The external parasite *Gyrodactylus hoffmani* was found during a previous survey at Devils Lake (Reinish 1981). This parasite was not detected during the present survey. It is not certain whether this parasite is still present in Devils Lake. To date, *Gyrodactylus hoffmani* has not been reported elsewhere in the basin, although *Gyrodactyloidea* were reported in 1951 and 1952 from three species of fish in the Turtle River, a tributary of the Red River near Arvilla, North Dakota. (Hoffman, 1953).

While an adequate sample size was obtained for some species, in many cases too few fish of other species were caught and examined to establish the presence or absence of fish pathogens with an appropriate level of confidence within the limited timeframe of this effort. It must also be recognized that fish pathogens and prevalence of fish pathogens may be variably affected by several life history stages and environmental characteristics and elements (Hudson and Peters, 2005). In-depth results of the USFWS fish pathogens and parasites analyses are available at: <http://www.wildfishsurvey.fws.gov>.

Aquatic Invertebrates of concern

The sampling methodology was primarily focused on larger-bodied taxa that are associated with aquatic vegetation. This approach increased the number of sampling sites visited, because macroinvertebrates could be sampled concurrently. This limited our sampling in other substrate types such as rocks, soft sediments, woody debris and other habitat types where macroinvertebrates occur. These limitations need to be considered in evaluating the results of this survey.

Many areas were dominated by amphipods. All specimens examined were *Gammarus lacustris*, a native amphipod whose range encompasses most of the northern part of the continent, (including North Dakota) and is often abundant in hard waters. .

The snails collected were determined to be native species with no exotic snails recorded. No specimens of Chinese mystery snails (*Cipangopaludina spp.*) or New Zealand mud snails (*Potamopyrgus antipodarum*) were collected. Benthic invertebrates collected and identified by the MWS's and MNDNR crews in soft sediment are listed in Montz 2005 and Williamson et al. 2005. No unique taxa were found in the benthic invertebrate community from Devils and Stump Lakes that have not been previously found downstream. No crayfish were collected or observed,

and NDGFD biologists suggested that they do not think there are any, as they have seen no evidence of any living crayfish or remnants thereof. However, sampling was not focused on crayfish.

Substrates from six Devils Lake locations were examined for the presence of zebra mussels, including rocks of 3 to 8 inches in diameter, beverage containers, boat trailer bunk rollers, bow guide, fishing lure, golf ball, and several other items. None of the substrates examined had any unusually thick layer of algae or sediment that would impede zebra mussels from attaching or hindering their growth. No zebra mussels were recorded or observed attached to these substrates. Examination of the coolers and water used in transporting the substrates to the NDGFD facilities contained no dislodged zebra mussels. No other mussel species was found on the substrates, transport coolers, or water examined. Additionally, no zebra mussel veligers were recorded in any of the 24 zooplankton samples that were examined by MNDNR.

None of the target aquatic invertebrates of concern were recorded in the samples that have been analyzed. The crustacean zooplankton community data is listed in Montz 2005 and Williamson et al. 2005. The network of sampling stations on Devils Lake and Stump Lake was determined to be adequate to characterize the mid-summer zooplankton community composition.

Aquatic Macrophytes of concern

None of the target aquatic macrophytes of concern were found in Devils Lake. Aquatic macrophytes of Devils Lake were most often found in areas protected from heavy wave action and in depths less than ten feet of water where sufficient sunlight reaches the lake bottom. The current macrophyte community of Devils Lake includes at least eight submerged and three free-floating species and is characterized by species that tolerate high alkalinity and turbidity. Given the limited timeframe under which this survey was undertaken, it was not possible to address any seasonality shifts in community composition.

Terrestrial Plants of concern

Flowering rush was not observed or collected during this survey of Devils Lake. However, sampling did not focus on flowering rush.

Additional Findings

While the focus of this effort centered on the list of targeted biota of concern reported above, we also report on other species found during this survey.

The internal fish parasite, *Ligula intestinalis*, was found during this survey; however, this parasite is not considered a species of concern since it has already been recorded from Manitoba (Williamson, pers comm.). The external fish parasite *Epistylis* sp., previously known to exist in Devils Lake (Peterson, 2002) was found during this survey. *Trichodina* sp., an external fish

parasite, was found for the first time in Devils Lake. Literature suggests that *Trichodina* and *Epistylis* are widespread in freshwater bodies in the United States. Literature suggests that *Trichodina* is frequently reported from perch, pike, sunfishes, and striped bass in North America, and *Epistylis* has been reported from a variety of fishes in North America. (Hudson and Peters, 2005).

Several snail species were collected as part of this effort. Native snails collected included: *Physella* sp. and possibly two different species of *Stagnicola*. Three other snail species, *Pseudosuccinea columnella*, *Helisoma anceps*, *Planorbula* sp, were detected, but there is some uncertainty regarding their taxonomic identifications (Montz 2005).

Except for one species, *Diaptomus nevadensis*, each of the zooplankton species identified in the Devils Lake and Stump Lake samples is known to occur in the Nelson River drainage basin and other parts of Canada (Patalas *et al.*, 1994). The copepod *D. nevadensis* was found in Stump Lake during this survey, but has not been reported from Devils Lake or Lake Winnipeg (Williamson *et al.* 2005). This species has been found elsewhere, including Canada, in closed basins with highly saline aquatic habitats.

The phytoplankton species *Nodularia spumigena*, *Chaetoceros muelleri*, *Campylodiscus clypeis*, and *Surirella peisonis* prefer highly saline aquatic habitats (Williamson *et al.* 2005). Williamson *et al.* 2005 report that morphotypes of the nitrogen-fixing cyanobacteria *Aphanizomenon* and *Anabaena* from Devils Lake appear to be similar to those found in downstream systems.

At the time of sampling the cyanobacterial component of the phytoplankton community in Devils and Stump Lakes was dominated by several species in the *Microcystis* complex (Williamson *et al.* 2005). There is some taxonomic uncertainty regarding these species. In Devils Lake, species that have been recorded include *M. cf panniformis*, *M. cf protocystis*, and what appears to be a species similar to *Pannus spumosa* in cell arrangement and colony format but with larger cells arranged in 1 to 3 layers. These specimens also appear similar to species described from Belgium as *Pannus leloupii* but recently transferred to the genus *Sphaerocavum* (Azevedo and Sant'Anna 2003). Additional algae specimens from Devils Lake were identified as *Sphaerocavum* sp. To date, species of both *Pannus* and *Sphaerocavum* are not known to produce toxins but available information is limited. Some of these *Microcystis* species have not been found in Lake Winnipeg in studies conducted between 1994 and 2004. (Williamson *et al.* 2005).

Eleven species of aquatic macrophytes were identified during this survey. All species found are native to the upper Midwestern region of the United States. The following aquatic macrophytes were located in Devils Lake during this survey:

Stuckenia pectinata (Sago pondweed)
Ruppia maritima (Widgeon grass)
Myriophyllum sibiricum (Northern watermilfoil)
Ceratophyllum demersum (coontail)
Potamogeton richardsonii (Clasping-leaf pondweed)
Potamogeton pusillus (Small pondweed)

Zannichellia palustris (horned pondweed)
Alisma gramineum (water plantain)
Lemna trisulca (Star duckweed)
Lemna minor (Lesser duckweed)
Wolffia columbiana (watermeal).

Perleberg (2005) provides the following summary of macrophytes in different basins of the Lake:

Main Basin (surveyed July 27, 2005)

Submerged vegetation was found in approximately two to nine feet of water, and plants reached the water surface in depths of about five to seven feet. Sago pondweed was the most common species found, and it formed beds at scattered locations. Widgeon grass was occasionally found interspersed within these beds. Northern watermilfoil was less commonly found but also formed beds, particularly in well-protected areas. Clasping pondweed and small pondweed were found in a few isolated locations. Coontail was found infrequently. Free-floating species (the duckweeds and watermeal) accumulated in a few locations along the leeward shorelines. A Secchi disc reading measured approximately five feet.

East Bay (surveyed July 28, 2005)

Submerged vegetation was found in three to seven feet of water and in protected areas it reached the water surface. Water depths greater than seven feet were not sampled. In protected areas, beds of northern milfoil, sago pondweed and widgeon grass were common. Small pondweed and duckweeds were found occasionally. Secchi disc reading was about four feet.

Pelican Bay (surveyed July 28, 005)

Submerged vegetation was abundant and reached the surface in the areas surveyed, which included depths from three to six feet. Clasping-leaf pondweed was more commonly found in the surveyed area of this bay than in the surveyed areas of the Main Bay or East Bay. Sago pondweed, widgeon grass, northern milfoil, small pondweed, coontail and horned pondweed were also found occurring in mixed beds. Submerged water plantain occurred near the access location along with several wetland emergent macrophytes that were not included in this survey. Secchi disc reading was about two feet.

Summary

None of the targeted biota of concern were recorded during this limited biota survey. However, these results must be considered in light of the caveats included in the Introduction to [of] this report. Additionally, the limitations of the effort as it relates to seasonal variations of Devils Lake biota must be recognized when evaluating the results obtained and in making management decisions.

The current survey is insufficient to fill in gaps in our knowledge of the biota of Devils Lake and the receiving waters. However, this collaborative effort has improved our knowledge of the biological community of Devils Lake.

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