Scaup and Coot Die-off at Lake Winnibigoshish – 2008 Update

Minnesota Dept. of Natural Resources, Section of Wildlife

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Approximately 6,000-7,000 scaup(*Aythya* spp.) and 200 coots (*Fulica americana*) died from intestinal trematodiasis on Lake Winnibigoshish in north central Minnesota from late October through mid-November, 2007 (Fig. 1). The vast majority of the dead scaup were lesser scaup, *Aythya affinis*, with a few greater scaup, *Aythya marila*. Scaup deaths were caused by *Sphaeridiotrema globulus*, a small trematode less than 1 mm in length. Coots had lesions in the intestine and cecae that were consistent with intestinal trematodes. The coots had *Cyathocotyle bushiensis*, *Leyogonimus polyoon* or *S. globulus* in small numbers. *C. bushiensis* and *S. globulus* can infect both scaup and coots, but *L. polyoon* is specific to coots and similar birds. All 3 trematodes use snails as one or both or their intermediate hosts. Trematodes have a complex life history and require two intermediate hosts, such as snails or aquatic insects, for the parasites to develop. When waterfowl consume the infected snails, the adult trematodes develop and then attach to the intestinal wall, causing hemorrhages while feeding on blood and tissues of the birds. Heavily infected birds appear lethargic and have difficulty diving and flying before eventually dying due to blood loss or shock.

Following the 2007 die-off, Minnesota Dept. of Natural Resources, in collaboration with several partners, prepared a proposal to monitor future losses and consider possible management actions to reduce or eliminate the losses (Lawrence et al. 2009). This summary documents activities to document the hosts/parasites and monitor mortality in 2008.

2008 North Central Minnesota Scaup/coot Die-off Monitoring Activities

Spring 2008: We expected a die-off of scaup and coots in north central Minnesota during the spring, because water bird loses due to trematodes have occurred annually during the spring and fall on the Upper Mississippi River National Wildlife Refuge since first recorded during fall 2002. DNR Wildlife staff from Grand Rapids monitored Winnibigoshish and other nearby lakes weekly from mid-April to Mid-May, and noted no loss of coots or scaup during the spring migration. A few thousand scaup were present on the lake in late April and early May. Prior to ice out, the birds used the mouth of the Mississippi river or along shoreline areas that were ice-free. Monitoring ended after most of the scaup had migrated from the area.

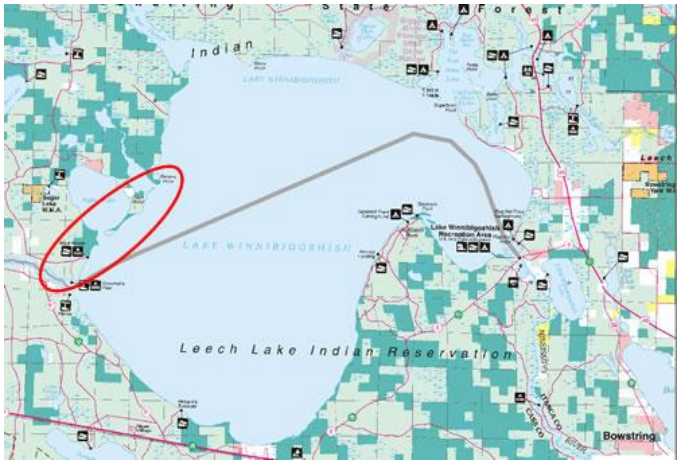


Fig. 1. Area of major scaup losses on Lake Winnibigoshish, Minnesota, 2007-08.

Ice-out was very late in 2008 and likely influenced the distribution of scaup and/or snails during the spring migration. Lake Winnibigoshish ice out was May 13, 2008, compared to a 10-year average of April 24 (Minnesota Climatology Working Group). Cold water temperatures may have influenced the distribution of the snails, too.

Fig. 2. Faucet snails found on Lake Winnibigoshish, August 2008.

Summer 2008: In July, DNR staff assisted Dr. Sarah Brant, University of New Mexico, collect snails for an unrelated study of swimmer's itch on Lake Winnibigoshish and other North Central Minnesota lakes. On 3 July 2008, we located 15 suspect faucet snails (*Bithynia tentaculata*) in shallow water along the west shore of Lake Winnibigoshish. These were sent to the National Wildlife Health Center (NWHC), who confirmed the identification. This is the same snail that is a host of trematodes causing die offs at the Upper Mississippi Fish and Wildlife Refuge. This was the first positive identification of faucet snails in Minnesota, other than from the Mississippi River along the border with Wisconsin.

In August, staff with NWHC, DNR, and Leech Lake Reservation Natural Resources Department collected snails from several sites on Lake Winnibigoshish (Appendix A). We located the invasive faucet snail (Fig. 1) at several sites in Winnie. Results indicate that many of the faucet snails were infected with trematode parasites (Appendix A). DNR Fisheries Managers helped collect snails during their trawling activities on Winnie, some of which are reported in Appendix A. In addition, they provided samples of snails from their trawl runs in late August (Table 1). These samples were not examined for trematodes, but provide a relative sample of *B. tentaculata* from several areas of the lake.

On 4 September 2008, we examined several sites on Bowstring Lake looking for faucet snails. We used similar techniques that we did on Winnie searching shallow areas both with emergent vegetation and rocks, set weights in deeper water, and used an underwater camera. We did not find any faucet snails. However, Banded Mystery snails are very abundant on Bowstring.

Fall 2008: Grand Rapids DNR Wildlife staff monitored the west shore of Lake Winnibigoshish and nearby areas beginning late September. Eagles and other scavengers may have consumed some of the few sick or dead birds that were present earlier. Trematode counts from specimens submitted to NWHC are in Appendix B.

- October 21, 2008: The first reports of sick and dead scaup were received this week.
- October 26, 2008: Approximately 50 sick and a few dead scaup observed by the mouth of the Mississippi on Lake Winnibigoshish.
- October 28, 2008: Examined most of the shore of west Winnie including the mouth of Sugar Lake and Raven Flowage. Estimate about 300-400 dead scaup from mouth of Mississippi to just N. of Raven Point. Many dead and sick birds in the bulrushes.

Table 1. Gastropods collected by DNR Fisheries during trawl samples for larval fish, Lake Winnibigoshish, August 2008.

Location	Date collected	GPS	Depth	N	Sample	Species	Abundance	Comments
Pigeon River	28 Aug 2008	N 47 30.621 W 94 09.871		2 gals	1 qt.	*Bithynia*	10-15%	Abundant, majority of live/recently dead snails
						Banded	absent	
						Other	remainder	
Judds	27 Aug 2008	N 47 22.629 W 094 16.816		1.3 gals	1 qt.	*Bithynia*	1% or less	26 individuals
						Banded	25%	Some large, dominant large snail
						Other	remainder	2 Chinese mystery snails, many Lymnaeidae (long), few planorbids
Ravens Point	27 Aug 2008	N 47 27.242 W 094 16.594		3 qts	0.3 qt	*Bithynia*	Absent	
						Banded	10%	Some medium-sized
						Fingernail clams	20-25%	
						Other	remainder	Lots of Lymnaeidae
Mallard Point	25 Aug 2008	N 47 30.352 W 094 15.202	4 ft	2 gals	0.5 qt.	*Bithynia*	5%	
						Banded	25%	Most medium-large banded, some small
						Other	remainder	Lymnaeidae, few planorbids. Some fingernail clams
High Banks	25 Aug 2008	N 47 25.844 W 094 08.470		2 qts	0.5 qt	*Bithynia*	Few present	4 individuals
						Banded	Absent	
						Other	remainder	Lymnaeidae, very abundant, also Physids, fingernail clams
Bowen's	25 Aug 2008	N 47 28.446 W 094 04.606	7.5 ft	1.5 gals		*Bithynia*	75-85%	Many algae covered
						Banded	Few	
						Other	remainder	Few Chinese, Stagicola

Cleaned 77 dead scaup from a stretch of the west shore S. of Raven Point. No dead coot observed in this area. Raft of 250 and a few smaller rafts of 25-50 sick scaup observed in this area.

- October 29, 2008: Few dead and sick scaup (<30) reported on Bowstring Lake. Four birds from Bowstring were submitted to the National Wildlife Health Center in Madison, Wisconsin. A few dead or sick coots (<25) and scaup (<50) were documented on Third River flowage of Lake Winnibigoshish. The coots were submitted to Madison. Aerial surveys of Lake Winnibigoshish did not reveal large numbers of scaup, but visibility of ducks on the lake was poor.
- November 3, 2008: Check of Bowstring indicates only one potentially sick scaup, but high winds and waves make searching difficult.
- November 4, 2008: We cleaned 2 stretches of the western shore of Lake Winnibigoshish of 532 dead scaup (85% male), 2 redheads, and 1 white-winged scoter. A field necropsy of the scoter indicated no signs of being shot, snails in the gizzard, and intestinal characteristics consistent with death due to trematodes. The stretch of shoreline that was cleaned last week (Oct. 28) had 121 dead scaup compared to 77 the previous week. There were 411 dead scaup on the 0.7 mile stretch of shoreline we cleaned last year. Total losses were estimated at 1,200 scaup from the mouth of the Mississippi to just N. of Raven Point. Approximately 100 bald eagles, many immature, were present in this area. Low-level aerial checks of the Lake Winnibigoshish shoreline indicated some other areas had a few dead birds, but there were no areas where the losses were as large as the west side. We have collected and had reports of dead scaup and coots in Third River flowage, too. The relatively few sick birds that were seen in the major die-off area may indicate that losses are slowing down, although >5,000 scaup remain on portions of the lake. We

marked 5 dead scaup floating in the bulrushes with cable ties and recorded GPS locations for these birds.

- Nov. 6, 2008: DNR Fisheries received a call about 2 doz. dead scaup on shore at the NW landing of Bowstring Lake, Call from a Martin Running, 4 dead scaup on Tuesday and 4 additional ones on Thursday also at NW landing, could be the same ones.
- November 10, 2008: Grand Rapids Wildlife staff conducted surveillance on West Winnie (Rabbit flowage to the Mississippi) and the die-off was over. They walked the south segment of shoreline and found one dead scaup. 200+ eagles were observed, mostly in the Rabbit flowage area, which could have removed most dead/sick birds prior to our surveillance. Few ducks were observed in the immediate area and most appeared to be goldeneyes except one small flock of 25 scaup. Some large flocks of waterfowl were observed out on the open lake (thousands?), but they would take off and fly low to the water more like mergansers or goldeneyes. A couple hundred swans were flushed out of the area where we found lots of dead ducks but no dead or suspect swans were observed. They found four of the five ducks with cable ties on their legs, indicating a low rate of scavenging on these birds, at least when floating in the bulrushes. They examined 35 other ducks while looking for the cable ties, and only one or two looked fresher than the ducks with the cable ties. Did not find any fresh ducks to collect for AI sampling.
- November 12, 2008: Checked Bowstring Lake. The SW access was locked in with an inch of ice, but the NW access was open. We found one suspect (sick) scaup on the west shoreline. We then went through the middle of the lake and the numbers of scaup seem to be similar to what we saw on similar trips. When we boated through the raft, we observed several hundred scaup that were suspect (either dove rather than fly or have difficulty taking off and flying with some landing a short distance). We did not find any dead birds, but there are 20-30 eagles situated around the lake so dead ones at this low infection rate would be picked off quickly.
- Final Estimate of Losses:
    - Lake Winnibigoshish: Our estimate of losses on Winnie would be 2,000 scaup, 2 redheads, 1 white-winged scoter, and 50 coots. We handled 609 scaup, but based upon visual examination of other areas, believe that we handled about 1/3 of the dead birds, thus 2,000 would be a reasonable estimate. This is also comparable to our method of estimating losses from 2007. This estimate is likely conservative - there were approximately 200 eagles near the major die-off location on Winnie and these and other predators/scavengers likely consumed many birds that we did not detect. The die-off ended by Nov. 10, 2008.
    - Lake Bowstring: Perry's crews only handled a few birds, but did see sick birds and we did have hunter reports of dead birds. I would concur with Perry and guess 200-300 dead scaup. Given the sick birds on Bowstring on Nov. 12, I would put the end date there at Nov. 15.

2009 Sampling Activities:

- **Spring:** Late-April-end of spring migration, DNR Wildlife, Grand Rapids, will monitor Lake Winnibigoshish and nearby lakes to check for any losses in the spring.

- **Summer:** We will collect snails on Winnibigoshish, Bowstring, and possibly a few nearby lakes. A lake survey is scheduled to be completed on Drumbeater Lake this summer. This is an important ring-necked duck staging lake near Winnie. We will try to collect snails on Drumbeater to check for *B. tentaculata*.
- **Fall:** We will monitor for duck losses weekly or more beginning in late September – ice up.

Literature cited:

Lawrence, J. S., S. D. Cordts, R. A. Cole, and P. Loegering. 2008. Determining gastropod hosts of trematodes and monitoring lesser scaup and coot mortality in north central Minnesota. Unpublished Phase 1 Proposal, Minnesota DNR Wildlife Research.

Appendix A. Summary of August 2008 snail/parasite sampling in Lake Winnibigoshish. Prepared by R. Cole and J. Lawrence.

Introduction:

The faucet snail, *Bithynia tentaculata*, a non-indigenous aquatic snail from Eurasia, was introduced into Lake Michigan in 1871 (Mills et al., 1993) and has spread to the mid-Atlantic states, Great Lakes region, Montana, the Mississippi River (Pools 7-13) (Sauer et al., 2007) and was recently found to be in Lake Winnibigoshish, MN (NWHC, unpublished data). The faucet snail serves as intermediate host for three introduced trematodes responsible for several large scale mortality events among water birds, primarily lesser scaup (*Aythya affinis*) and American coot (*Fulica americana*), in the Great Lakes region, Montana, and Minnesota (NWHC unpublished data). The trematodes *Cyathocotyle bushiensis*, *Sphaeridiotrema globulus* and *Leyogonimus polyoon* were presumably introduced into the United States as early as the 1870's when the snail was introduced. The trematodes infect the small intestine (*S. globulus* and *L. polyoon*) or the ceca (*C. bushiensis*) and feed on blood and tissue. The life cycle of these 3 parasites require the faucet snail for development and in some cases dissemination of the larval stages. The adult worms are found in the intestine of the birds where the eggs of the worms pass into the environment with the feces. The eggs hatch or are eaten by the snails. Once in the snail, the parasite larvae undergo asexual reproduction forming the cercarial stage. Hundreds of cercariae are formed and leave the snail. In the case of *C. bushiensis* and *S. globulus* the cercariae reenter the same snail or a conspecfic or in some rare cases other species of snails and encyst, forming the metacercarial stage which becomes infectious to birds in a few days. When the snail infected with metacercariae is eaten, the metacercariae excyst in the bird's gut and infect the intestines. In the case of *L. polyoon* the cercariae infect aquatic insect larvae where they encyst and form metacercariae. The insect larvae are then eaten by coots or other gallinules and the worm matures in the bird's intestine.

In Wisconsin, the Upper Mississippi River National Wildlife and Refuge has experienced water bird mortality events caused by *S. globulus* and *C. bushiensis* each spring and fall on Lake Onalaska (Navigation Pool 7) and upper Pool 8 since the 2002 spring migration. In addition, starting with the 2005 fall migration and continuing through 2008, sick and dead water birds were also found downriver in lower Pool 8 and Pool 9. American coots and lesser scaup have been the two species most affected. In spring 2007, one American coot was found infected with *L. polyoon* and snails were found to be infected in June 2007, indicating that this parasite had moved into Pool 7 and was established. Since 2002, approximately 60,000 water birds, primarily American coots and lesser scaup, have been affected; however, parasite induced mortality also has been seen in blue-winged teal, ring-necked ducks, ruddy ducks, buffleheads, redheads, Northern shovelers, mallards, American black ducks, Northern pintails, and tundra swans.

In Montana, 3 water bodies (Georgetown and Smith Lakes and Rattlesnake Reservoir) have recently reported mortalities due to trematodiasis in water birds. Large-scale mortality events were reported in 2006 and were recurrent in 2007. Birds were found to be infected with *C. bushiensis* and *S. globulus* (which suggested that *B. tentaculata* had colonized the three water bodies). The following is a summary of the mortalities: Georgetown Lake: 2006 (1000), 2007 (2500) American Coot;

Smith Lake: 2006 (700), 2007 (100) American Coot; Rattlesnake Reservoir: 2006 (75) American Coot and various species of ducks. In July, 2008 *B. tentaculata* examined from Georgetown Lake and Rattlesnake Reservoir were found to be infected with both *C. bushiensis* and *S. globulus*.

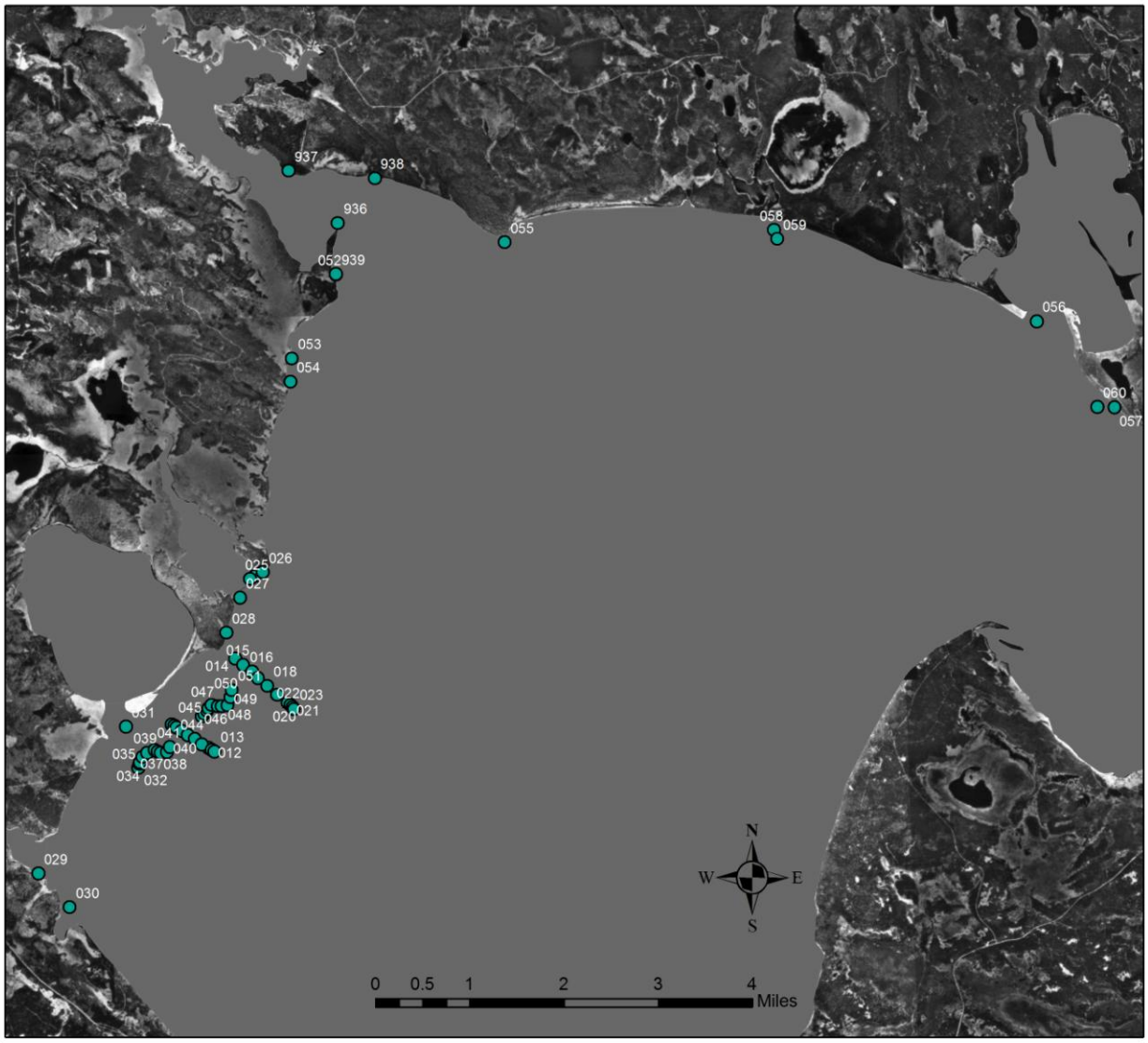
At Lake Winnibigoshish, approximately 7,000 lesser scaup and a few hundred coots died due to trematodiasis during fall 2007. Those losses prompted this study to evaluate snails and parasites in the lake. It is important to document the presence/absence of *B. tentaculata* at various sites to provide managers information as to the prevalence of the snails and their parasites. If a site is identified as having the snails, then any transportation of equipment or boats from these lakes should be done with caution so as to reduce the risk of transporting the snails. Beyond carrying the parasites, this snail has been documented to have a deleterious impact on native snails once it moves into an area (Harman, 1968).

METHODS: From August 11-13, 2008 staff from the USGS National Wildlife Health Center, Minnesota DNR and Leech Lake Band of Ojibwa sampled various sites (Figure, 1) on Lake Winnibigoshish, Minnesota to collect prevalence and infection data on *B. tentaculata*. This sampling effort had 2 objectives: 1) document the presence of *B. tentaculata* and 2) through dissection of snails from various sites document the presence and prevalence of larval *C. bushiensis, S. globulus* and *L. polyoon.*

Collections were conducted on the western portion of the lake where previous water bird mortalities had occurred. GPS coordinates were recorded for each site. (See Appendix A for GPS locations and additional collection and Site information). A combination of hand collections, deployment of artificial substrates and trawling was employed. Sites 1-13 and 14-23 were transects 1 and 2 respectively of concrete substrates deployed for 24 h. Sites 32-41 and 42-51 were transects 3 and 4 respectively where concrete substrates were deployed for 48 h. Sites 24-57 were shoreline sites where hand and net collections were conducted for 1 man-hour per site and Sites 58-60 were trawl locations (Figure 1 and Appendix A).

Sampling by artificial substrate was not productive in that very few *B. tentaculata* were collected. Snails were collected from shoreline sites by turning over rocks, netting or by examining floating logs, plants etc. Serendipitous sampling of snails from benthic substrates varying in depth from 3-7 feet of water was conducted using a trawl net that was employed to sample for young of the year walleye. Sampling crews on fish surveys provided large samples of snails from which subsamples of *B. tentaculata* were examined. All snails were transported to NWHC counted, measured for length, crushed and examined for parasites using a dissection scope. Larval stages of parasites were fixed and stored in 100% molecular grade ethanol and stored under refrigeration. A maximum of 60 snails (except Sites 937 and 60 which were 63 and 90 respectively) were examined from each location. Previous work on this snail-parasite system (Cole, unpublished data) at the Upper Mississippi River National Wildlife and Fish Refuge, LaCrosse indicated that for statistical significance ($p \leq .01$) a minimum of 50 snails should be examined when comparing sites for parasite prevalence and abundance.

Figure 1. Satellite Image of Lake Winnibigoshish, MN with Sites surveyed for *Bithynia tentaculata*, August, 2008.



Results:

Table 1. Sites and Data on *Bithynia tentaculata* Collected in Lake Winnibigoshish, MN, August, 2008.

Site	N*	Mean Size (mm)	% Infec'd	CbM ≤ 10 (%)	CbM ≥11 (%)	Sg M ≤ 10 (%)	Sg M ≥ 11 (%)	Cb C (%)	Sg C (%)	Lp C (%)
13	1	4.32	0	0	0	0	0	0	0	0
24	60	10.38	85	58	22	30	2	2	3	3
25	8	10.02	38	13	0	13	0	0	25	0
26	19	10.13	32	21	0	0	11	0	5	0
27	11	7.71	0	0	0	0	0	0	0	0
28	1	12.79	1	0	0	0	0	0	1	0
30	5	4.68	0	0	0	0	0	0	0	0
31	3	9.7	68	33	0	67	0	0	0	0
32	1	11.22	0	0	0	0	0	0	0	0
936	60	9.90	93	15	67	17	15	2	15	15
937	63	9.88	60	22	2	8	2	0	44	0
939	60	9.3	80	55	23	23	0	2	5	2
53	15	10.58	7	7	0	0	0	0	0	0
54	11	10.19	9	9	0	0	0	0	0	0
55	13	9.90	0	0	0	0	0	0	0	0
56	21	9.38	29	29	0	0	0	0	0	0
57	2	7.39	50	50	0	0	0	0	0	0
58+	60	8.75	2	2	0	0	0	0	0	0
59+	60	9.30	13	13	0	0	0	0	0	0
60+	94	9.32	13	13	0	0	0	0	0	0

*Number of snails examined.
+ Trawl Sites

Discussion:

Only sites where a minimum of 50 *B. tentaculata* were examined are considered in this discussion. Weather conditions were not optimal for hand collection of snails in that rain and clouds made it difficult to collect and also caused the snails to seek refugia and were less available for collection. Site 936 had the highest prevalence (93%) of *B. tentaculata* infected. This site had abundant numbers of *B. tentaculata* (133 specimens collected in 1 hour of effort) present at the edge of wild rice (*Zizania aquatica*) and bulrushes (*Schoenoplectus fluviatilis*) that were collected easily by hand and with netting. Site 24 which had the second highest prevalence (85%) of infected snails also had a predominance of bulrushes and cattails (*Typha* spp). Snails were abundant with 191 snails collected in 1 hour of effort of primarily netting. Sites 939 and 937 had a prevalence of infection of 80% and 60% respectively. Snails at Sites 939 and 937 were found primarily on the underneath sides of rocks near the shore (939) or on floating logs (937). Site 939 had the largest abundance of snails with a total of 1,006 snails collected in 1 man hour. Site 937 had 63 snails collected in 1 man hour. No *B. tentaculata* were collected at site 938. The highest prevalence (82%) of *C. bushiensis* metacercariae was found at Site 936 with metacercariae of *S. globulus* highest at Site 24 and 936 (32%). Prevalence of *C. bushiensis*

cercariae was highest (2%) at Site 24, 936 and 939. Typically, cercariae of *C. bushiensis* are very ephemeral and are present for only a brief period during the summer months (Menard and Scott, 1986). Prevalence of *S. globulus* cercariae was most prevalent (44%) at site 937. Cercariae of *L. polyoon* was most prevalent at Site 936 with 15% of snails examined infected. *Leyogonimus polyoon* was first reported in Lake Winniebigoshish from American Coot during the 2007 mortality event and again in 2008. Finding the parasite in the snails indicates that the parasite has established itself in this system. Heretofore *L. polyoon* was only seen in the Wolf River system in Wisconsin (1997) (Cole, 2001) and the Mississippi River at Lake Onalaska (2007) (Cole, 2007)

Fifteen banded mystery snails (*Viviparus georgianus*) and 4 Chinese mystery snails (*Cipangopaludina chinensis*) were examined and were not infected with the parasites of concern. It would be important to examine both the banded and Chinese mystery snails in areas were numbers of *B. tentatculata* were found to have high prevalences of infection such as Sites 24, 936, 937 and 939 to explore the possibility of a new host capture by these parasites.

The presence of metacercariae of *C. bushiensis*, *S. globulus* and *L. polyoon* indicates that there is a risk of birds becoming infected with the parasites while feeding in the lake. Metacercariae of *C. bushiensis* and *S. globulus* are often infectious for as long as the snail is alive and can even be viable after the snail is dead and only the shell is left. Thus the risk of infection for birds is extended beyond the present migratory season. As birds become infected on this lake by ingesting the parasite infected snail, the birds then seed the snail communities with parasite eggs allowing the cycle to continue. As the birds move to different bodies of water the parasite can spread if the faucet snail is present. *Leyogonimus polyoon* infects larval aquatic insects after it emerges from the snail and can also spread distances as the insects mature and move to different bodies of water.

At this time there is not a chemical that is licensed that will kill the faucet snail (Mitchell and Cole, 2007). Efforts should be made to discourage the transport of faucet snails to other lakes or reservoirs on boats etc. As part of management activities, continued monitoring of mortality events need to occur to confirm that the events are parasite induced and not a different disease agent.

In conclusion, the main findings of interest in this survey was that snails from trawl sites sampled at 3-7ft in depth had low infection prevalences and were infected only with metacercariae of *C. bushiensis*. Feeding and loafing areas of birds such as shallow protected Sites like 936, 937, 939 and 24 may offer more of an opportunity for parasite eggs in the bird feces to hatch and find the snail intermediate host. Similarly snails in shallow sites may be more available as food items for birds. In addition, *L. polyoon* was found in snails from Sites 24, 936 and 939 indicating that this parasite is established in Lake Winnibigoshish which is a new geographical record for this parasite.

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Mills, E. L., J. H. Leach, J. T. Carlton, and C. L. Seacor. 1993. Exotic species in the Great Lakes: a history of biotic crises and anthropogenic introductions: Journal of Great Lakes Research 19(1):1–54.

Mitchell, A. and R. Cole. 2008. The survival of the faucet snail *Bithynia tentaculata* following chemical disinfection, pH extremes, and heated water bath treatments. North American Journal of Fisheries Management 28: 1597-1600.

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Appendix: GPS Locations for Collection Sites, Lake Winniebigoshish, MN, August, 2008

LAT	LONG	WAYPT
47.43450898	-94.29536909	001
47.43429559	-94.29478323	002
47.43405780	-94.29430552	003
47.43079581	-94.28716693	004
47.43348468	-94.29306167	008
47.43282010	-94.29174572	009
47.43221648	-94.29018641	010
47.43136286	-94.28871723	011
47.43046655	-94.28637375	012
47.43023485	-94.28580591	013
47.44457406	-94.28075842	014
47.44356215	-94.27899180	015
47.44248317	-94.27705392	016
47.44148951	-94.27572895	017
47.44020931	-94.27366489	018
47.43883153	-94.27156478	019
47.43756955	-94.26922130	020

47.43719766	-94.26856332	021
47.43685015	-94.26802252	022
47.43656970	-94.26777015	023
47.45717861	-94.27610752	024
47.45678857	-94.27710800	025
47.45779413	-94.27424175	026
47.45395462	-94.27942444	027
47.44854226	-94.28271432	028
47.41184178	-94.32596950	029
47.40652879	-94.31900216	030
47.43430168	-94.30566237	031
47.42788119	-94.30310257	032
47.42853974	-94.30279611	033
47.42874706	-94.30261585	034
47.42954584	-94.30209307	035
47.43019827	-94.30098443	036
47.43064338	-94.29923583	037
47.43040558	-94.29862292	038
47.43018607	-94.29791988	039
47.43025924	-94.29648675	040
47.43103361	-94.29587384	041
47.43570397	-94.28851893	042
47.43606368	-94.28801418	043
47.43653922	-94.28726607	044
47.43689892	-94.28704074	045
47.43739885	-94.28637375	046
47.43722814	-94.28490457	047
47.43717327	-94.28402126	048
47.43731350	-94.28267827	049
47.43852061	-94.28203832	050
47.43967893	-94.28165975	051
47.50364547	-94.25656652	052
47.49077800	-94.26679670	053
47.48717844	-94.26715724	054
47.50814499	-94.21839489	055
47.49435904	-94.09891361	056
47.48078876	-94.08171610	057
47.50925307	-94.15769883	058
47.50785275	-94.15695974	059
47.48090450	-94.08567297	060
47.50372463	-94.25658455	939
47.51844556	-94.24739091	938
47.51158483	-94.25594460	936
47.51983342	-94.26677868	937

Snail Sampling Locations on Lake Winnibigoshish – August 2008

Waypoint nos.	Date	Comments
Concrete Fisheries Weights		
Transect 1: 1, 2, 3, 8, 9, 10, 11, 4, 12, 13 Transect 2: 14-23 in order	Deployed 11 Aug. 2008 Snails removed 12 Aug. 2008	Weights left approximately 24 hours. Transect 1 starts off of opening to Sugar Lake, runs shallow to deep Transect 2 starts off of Sugar Point, runs shallow to deep
Transect 3: 32-41 in order Transect 4: 42-51 in order	Deployed 12 Aug. 2008 Snails removed 14 Aug. 2008	Weights left approximately 48 hours. Transect 3 runs in 13-20 ft. depth off the opening to Sugar Lake Transect 4 is between transects 1 and 2 and runs in 7-12 ft. depth
Intensive 1-hour shoreline sampling		
24	11 Aug 2008 (from W. Winnie access)	Ravens Flowage just inside mouth, S. side
25		Ravens Flowage just inside mouth, S. side
26		N side of opening of Ravens Flowage,Ravens Pt
27		Winnie side of Sugar Island, S of Raven Pt
28		Winnie side of Sugar Island, S of Raven Pt
29		Winnie, S shore by mouth of Mississippi
30		Winnie, by opening to Lake Harry
31		Winnie, by opening to Sugar Laek
936	12 Aug 2008 (from Third River access)	Third River
937		Third River
938		Third River
939		Winnie W shore S of 3rd River mouth, also pt. 52
53		Winnie W shore between 3rd R. & Raven Pt.
54		Winnie W shore between 3rd R. & Raven Pt.
55		Stony Point
56	13 Aug 2008 (from Pug Hat Point access, by dam)	N Winnie, Sugarbush Pt. (opening Cut Foot Sioux Lake)
57		NE Winnie, shore SE opening Cut Foot
DNR Fisheries Trawl		
58	13 Aug 2008	Trawl off Pigeon Dam Lake
59		Trawl off Pigeon Dam Lake
60		Trawl off sampling pt 57 (by Bowen's Resort)

Summary Compiled by:

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Appendix B. Reports from U.S. Geological Survey National Wildlife Health Center (Anne E Ballmann, DVM, PhD, Rebecca Cole, PhD):

Lake Winnibigoshish

Lesser Scaup: all Lesser scaup from Lake Winnie (22333) were negative for avian influenza by RT-PCR screening. The birds from L. Winnie appeared to be in good body condition so death was acute.

22333-001 - 5,250 *Sphaeridiotrema globulus*
22333-002 - 4,470 *S. globulus*
22333-003 - 15,570 *S. globulus*
22333-004 - 1,250 *S. globulus*
22333-005 - 2,990 *S. globulus*, 4 *Cyathocotyle bushiensis*
22333-006 - 15,580 *S. globulus*, 6 *C. bushiensis*

American Coots – collected 29 October 2008

22335-004 80 *Leyogonimus polyoon*
22335-005 4,540 *L. polyoon*, 31 *C. bushiensis*

Bowstring Lake

Lesser Scaup:

22336-001 - 4680 *S. globulus* and a few coccidia in the intestines
22336-002 - 860 *S. globulus*.
22336-003 & 004 saved for full necropsy as this represents a new location