



DISTRIBUTION SURVEY FOR *POTAMOPYRGUS ANTIPODARUM*
(NEW ZEALAND MUDSNAIL) IN THE NORTH AND MIDDLE BASINS
OF CAPITOL LAKE, THURSTON COUNTY, WASHINGTON.



Potamopyrgus antipodarum (Gray, 1843). Height 4.7 mm.
Specimen from Capitol Lake, Olympia, Washington.

Final Report
Contract #FAC 10-026

Prepared for:
General Administration
Facilities Division
Olympia, Washington

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July 15, 2011

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July 15, 2011

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INTRODUCTION

Background

During a bird-watching trip on October 22, 2009, Olympian resident Bert Bartleson (president of the Pacific Northwest Shell Club), discovered the first evidence that *Potamopyrgus antipodarum* (Gray, 1843) (New Zealand mudsnail) (NZMS) had reached the Puget Sound Basin at Capitol Lake, Marathon Park, Olympia, Thurston County, Washington (Bartleson, 2010). He found 16 specimens of the NZMS inside a live *Anodonta* shell, which he showed to the author for confirmation on November 15th, 2009. The author contacted Kevin Aitkin at U. S. Fish & Wildlife Service (USFWS) on November 16th who subsequently contacted Washington State Department of Fish & Wildlife (WDFW) personnel. As a result, Washington State Department of General Administration (GA) closed Capitol Lake boat launches on November 24th, and signs were posted to inform the public of the introduction.

As a consequence of the find of NZMS in Capitol Lake, USFWS, WDFW, Washington Invasive Species Council (Washington State Recreation and Conservation Office), and GA, have come together to assess the situation and come up with a plan to inform the public and other government agencies, conduct surveys to determine the extent of the introduction, and to research ways to contain or control the introduction.

History of Introduction

Potamopyrgus antipodarum has become a worldwide invasive species in fresh and brackish water habitats in Europe, Australia, Japan, and North America. In the U. S., Dwight Taylor first discovered NZMS in the middle Snake River, Idaho (Taylor, 1987). He recognized the population as being all female (parthenogenic) and guessed the snails were from New Zealand. Since he did not see the snails during a previous survey in the area (Taylor, 1985), he estimated that the introduction possibly occurred 2-3 years previous to his discovery at The Nature Conservancy's Thousand Springs Preserve. Since its discovery over two decades ago, it has spread to 10 western states including Washington State at Long Beach in 2002 (Davidson *et al.*, 2008), Capitol Lake, Olympia, in 2009 (Bartleson, 2010; Benson, 2010; Johannes, 2010a) and has been recently found in Thornton Creek, Seattle (USGS, 2011; PBBS, 2011). It has been reported as far north as Port Alberni, Vancouver Island, British Columbia, Canada (Davidson *et al.*, 2008). A map in Anderson (2006) erroneously shows introductions of *P. antipodarum* in south Puget Sound and eastern Washington. With the exception of Long Beach, there were no reports of additional sites in Washington previous to 2009 (Davidson *et al.*, 2008; Benson, 2010).

Introductions in Capitol Lake

Even before the finding of NZMS, introductions in Capitol Lake were one of the major concerns of the GA (CLAMP, 2002). There was at least 9 introduced species known which included Eurasian watermilfoil (*Myriophyllum spicatum*), purple loosestrife (*Lythrum salicaria*), American bullfrog (*Rana catesbeiana*), nutria (*Myocaster coypus*), common carp (*Cyprinus carpio*), brown bullhead (*Ameiurus nebulosus*), smallmouth bass (*Micropterus dolomieu*), largemouth bass (*Micropterus salmoides*) and yellow perch (*Perca flavescens*) (Hayes *et al.*, 2008). In addition, both the introduced Asian clam (*Corbicula fluminea* (Müller, 1774)) and Big-ear radix (*Radix auricularia* (Linnaeus, 1758)) were first reported in Capitol Lake in 2003 (Herrera, 2004). Both mollusks were also found in the WDFW samples from Capitol Lake in 2009 (Johannes, 2010a) and during this survey. Neither occurred in great numbers in the lake. Including the NZMS, a total of three introduced mollusks are known to occur in Capitol Lake.

Previous surveys for *P. antipodarum* in Capitol Lake drainage

After the initial notification on November 16th, 2009, Will Morris (WDFW) collected snail samples on the next day from Marathon Park. WDFW identifies the snails as *Potamopyrgus antipodarum*. On November 18th, Kevin Aitkin (USFWS) checked Tumwater Falls Park, Tumwater Historical Park, Capitol Lake at Interpretive Center, and Capitol Lake at Marathon Park. He only found NZMS at Marathon Park area of Capitol Lake. On November 24th, 2009, an initial survey by WDFW of Capitol Lake was conducted using wading method. WDFW personnel also surveyed the outflow of Black Lake Ditch and Percival Creek from the mouth upstream approximately 0.75 mile using snorkel method. Allen Pleus (WDFW) conducted searches on December 3rd, 2009 in the Deschutes River at 3 sites. None had *P. antipodarum* present. On December 9th, 2009 five sites on Percival Creek were sampled and one additional site was surveyed in Capitol Lake at the north basin boat launch. None of the Percival Creek sites had the NZMS, but the Capitol Lake boat launch site did. In 2010, NZMS was found at the junction between the north and middle basins of Capitol Lake (Allen Pleus (WDFW), pers. comm).

PROJECT DESCRIPTION

Washington General Administration contracted with Deixis Consultants to conduct a more detailed New Zealand mudsnail survey of the middle and north basins of Capitol Lake. This survey was to determine the distribution of NZMS in Capitol Lake. The survey was conducted under the provisions of Washington Department of Fish and Wildlife Scientific Collection Permit No. 10-262a, issued to Edward J. Johannes, SeaTac, Washington.

The field portion of the study was carried out for a total of 3 days in June on the 20th, 21st, and 22nd, 2011. Edward J. Johannes (Deixis Consultants) and Tim J. Brown (Facilities Division, Washington General Administration) collected most of the samples, except on June 21st when Bert Bartleson (Olympia) also assisted in the field. A total of 31 sites were collected (**Figure 1; Appendix A**). Most localities, except site 31, were collected in Capitol Lake (**Figure 1**).

Methods

Sample Collection

Samples of the upper sediment layer were collected with a Wildco petite Ponar® sampler lowered by hand from a boat. The sampler has a 2.4 liter capacity with a sample area of 15.24 x 15.24 cm (232.3 cm²) and collects sediment to a maximum depth of 15 cm. The sampler has a pair of weighted jaws held open during descent to the sediment surface by tension from the retrieval cable to a catch bar. Upon contact with the sediment, the tension on the cable is released, the catch bar releases, and the overlapping jaws close. Upon retrieval, the tension on the cable keeps the jaws closed. A mesh screen (500 µm) with rubber flaps covers the upper portion of the dredge. The rubber flaps allow water to flow through the dredge during descent but close to minimize sediment losses during retrieval.

Upon collection all samples were sieved through a stacked brass sieve set (U.S.A Standard Testing Sieves) with mesh openings of 12.5, 4.0, 1.7, 0.0085 mm to remove large debris and fine sediment to ensure proper preservation back at the lab. Regardless of origin, the collected material was decanted into a labeled 16 oz. glass container. The containers were placed into a cooler until they were transported to the lab. Each site required an average of 1 hour or less to sample. Notes on collection conditions, substrate, habitat, and associated flora and fauna were made at each site (see **Appendix A** for details). Site coordinates were obtained using a Trimble GeoExplorer® II GPS receiver.

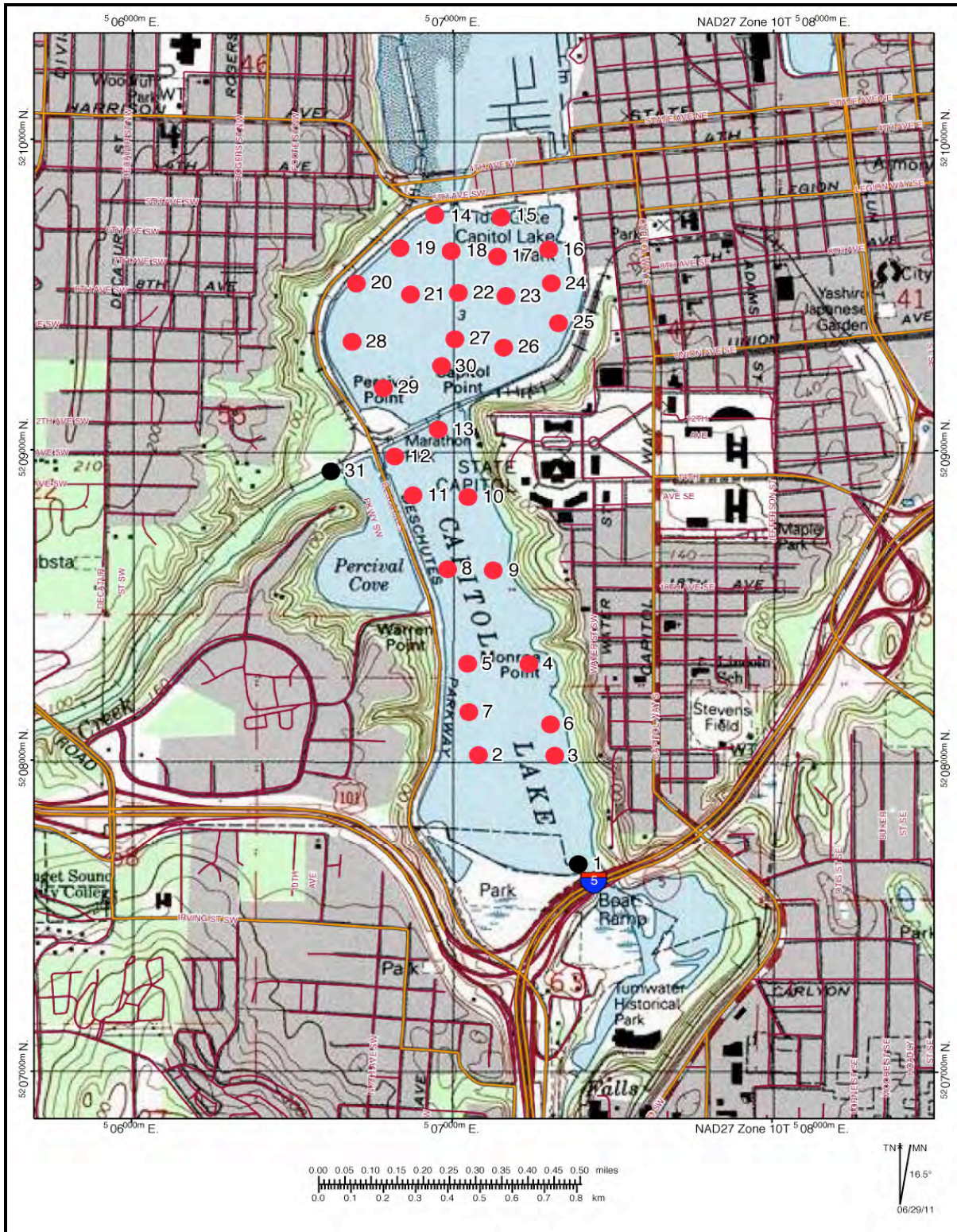


FIGURE 1. Map of Sites Collected in Capitol Lake, Olympia, Thurston County, Washington. Location of numbered mollusk sites collected in Capitol Lake (see **Appendix A** for details). Red dots indicate positive and black dots negative sites for the presence of the New Zealand mudsnail. Map created with National Geographic TOPO!® ©2006. Base map USGS 1: 24,000 Tumwater 7.5' Quadrangle.

Laboratory Procedures

Once brought to the lab, all sites were preserved with 90% ethyl alcohol. A total of 5 sites in which the NZMS were not seen in the field were resieved in the laboratory to remove any remaining fine sediment and picked under a low-power binocular microscope. These sites were picked until NZMS were found. The picked portion was retained in separate container from the unpicked portion of the sample. All samples collected during this project will be completely picked at later date. With many mollusk taxa (especially certain Physidae and Hydrobiidae), dissection, particularly of relaxed specimens, is necessary for proper identification. In regards to NZMS, relaxed specimens are not necessary for proper identification. No substantive identification problems were encountered with the material. Picked mollusks will be retained for further study.

RESULTS

A total of 31 sites were collected during this survey in which 30 (97%) had mollusks present. Thirty sites were sampled in Capitol Lake and 1 in Percival Creek (**Appendix A; Figure 1**). Twenty-nine (97%) of the 30 sites sampled in Capitol Lake had NZMS present. Site 31 collected above the mouth of Percival Creek had no NZMS present.

DISCUSSION

Introduced Mollusks Found In Capitol Lake

A total of 3 introduced species, the Big-ear Radix (*Radix auricularia* (Linnaeus, 1758)), Asian clam (*Corbicula fluminea* (Müller, 1774)) and *Potamopyrgus antipodarum*, were found during this survey. Common names, and species endings, are generally those of Turgeon *et al.* (1998) where possible. Higher taxonomic arrangement is that of Vaught (1989).

Introduced Mollusks

Family Hydrobiidae

***Potamopyrgus antipodarum* (Gray, 1853) (New Zealand mudsnail)**

The New Zealand mudsnail was first noticed in the Columbia in 1995, at Youngs Bay near Astoria, Oregon (Litton, 2000; Bersine *et al.*, 2008). Since then, it has been reported as far east as Cathlamet Bay, Oregon. Frest & Johannes (2004) extended the species range in the Columbia River eastward, to St. Helens, Oregon.

Specimens at Frest & Johannes (2004) two non-estuary sites are as yet quite rare; but massive increases are likely, to judge by the species' history in the middle Snake River. It is expected that the Columbia will provide sufficient degraded habitat as to allow this taxon to become a true nuisance species. While Mackie (1999) does not seem to regard this taxon as nuisance, except possibly to native mollusks, experiences in the middle Snake River (Bowler, 1991; Bowler & Frest, 1992; Frest & Johannes, 1992) suggest that it not only negatively impacts native mollusks but also can be both an aesthetic irritant and impediment to hydroelectric, trout rearing, and irrigation facilities. Aside from impacts on native species (USFWS, 1995; Richards *et al.*, 2001: see also earlier references in Frest *et al.*, 2002), the species is a biofouler. At one Idaho Power hydroelectric facility, for example, it has proved necessary to operations to remove some 30 tons of organic detritus per day. Half of that by weight is *P. antipodarum*.

The further spread of *Potamopyrgus antipodarum* has been a concern of Washington State legislature since 2008 (ANSC, 2007). In Capitol Lake it is estimated the population densities are 20,000 per square meter in limited areas of the North Basin (Allen Pleus, pers. comm., 2009). Based on the extent of the area invaded and population density of *P. antipodarum* in Capitol Lake, introduction probably occurred in 2008 or 2009 (Johannes, 2010a). There was no evidence of introductions of *P. antipodarum* outside of Capitol Lake in the Olympia area (Johannes, 2010b). However, this species has been recently found in Thornton Creek, Seattle, (PBBS, 2011; USGS 2011).

This species is fairly pollution tolerant and known to occupy a variety of habitats from freshwater (rivers, creeks, lakes and springs) to brackish and occupy various substrates from mud to bedrock (pers. obs.).

Family Lymnaeidae

***Radix auricularia* (Linnaeus, 1758) (Big-ear Radix)**

This Eurasian aquarium species was first collected from the Great Lakes in 1901 (Mills *et al.*, 1993). This taxon is now widely introduced over the whole State and is similarly common elsewhere in the western U. S.

While most likely to be found in relatively quiet situations on soft substrates, often with common macrophytes, this taxon is effectively a poikilothermophile and has been noted from streams of all sizes, lakes, ponds, and springs, spring runs, and spring pools. It appears most successful in warmer areas with little current and definite nutrient enrichment; and has even been seen occasionally in cattle troughs. While often an epiphyte scraper, then species is also believed to be able to survive on aquatic macrophytes.

Note that Taylor (1981) has sometimes considered the species, at least in Alaska, native. However, its rapid spread in much of the western U.S. in recent years suggests that it was not recently present historically. Has been noted by Frest & Johannes (unpub.) at a number of sites elsewhere in the State, especially in eastern Washington. Capitol Lake is a perfect habitat for this introduced species but it has not become a major component of the benthic fauna of the lake (Johannes, 2010a; this survey). First reported in the lake in 2003 (Herrera, 2004).

Strangely, it was not found at any sites surveyed outside of Capitol Lake (Johannes, 2010b).

Family Corbiculidae

***Corbicula fluminea* (Müller, 1774) (Asian clam)**

Corbiculids were native residents of North America for a considerable time before becoming extinct on the continent relatively recently (Taylor, 1988a, b). The first known introduction, in North America, occurred in the Columbia River and it has been known to be present there since perhaps 1937 (Burch, 1944; Counts, 1985). Since its introduction, it is now found in 38 states and the District of Columbia (Foster *et al.*, 2009). It can be a major biofouler of intakes (Isom, 1986; Isom *et al.*, 1986). Its method of dispersal in North America is not well understood. Unlike all freshwater native North American species, *Corbicula* has a free larva that may drift for days in a current (Taylor, 1987). This may help in the rapid spread of this species.

Corbicula is uncommon in more pristine oligotrophic habitats and more common in somewhat disturbed settings, especially if waters are warm. The local example thrives best in flowing water, although slow flow situations can support dense populations.

Taxonomic status of *Corbicula* in North America is still somewhat cloudy, with claims for at

least two taxa. More recently, morphological differences within the introduced populations have been ascribed to origin as separate clones of uncertain number, distribution, and status. Despite the early introduction, *Corbicula* is only moderately successful as an invader in Washington and Oregon, especially as compared with, say, the Tennessee Valley. It is a pest species with considerable economic impact in the central and eastern states. In Capitol Lake, it does not occur in great numbers (Johannes, 2010a; this survey) and was first reported in 2003 (Herrera, 2004).

This species was found at 1 location in the nearby Black Lake during a survey of sites outside of Capitol Lake (Johannes, 2010b). Black Lake is connected to Capitol Lake by the Black Lake ditch, which flows into Percival Creek.

CONCLUSIONS

The primary objective of this study was to survey Capitol Lake and determine the distribution of NZMS in the lake. The survey covered the north and middle basins of Capitol Lake. The NZMS was found at 29 out of 30 sites in the lake. The NZMS has invaded all of the north basin and more than 2/3 of the middle basin of Capitol Lake. Only a small portion of the southern part of the middle basin has not been invaded by NZMS as of yet. It is only matter of a short time before the NZMS invades the south basin.

ACKNOWLEDGEMENTS

I would like to thank Tom Brown (Washington General Administration) for operating the boat and for assisting in collecting the samples. Thanks also to Bert Bartleson (Olympia) for accompanying me into the field and helping collect the samples. Much thanks goes to the efforts of Wendy Brown (Washington Invasive Species Council) in arranging the use of the Washington Department of Ecology's petit Ponar sampler and to Washington Department of Ecology for loaning it. Finally, I would like to especially thank Nathaniel Jones (Washington General Administration) for pushing this project through despite the current tight State budget and for making sure the contract went smoothly.

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APPENDIX A: SITE DESCRIPTIONS.

UTM coordinates (based on NAD27 all in Zone 10) derived from a GPS receiver. Elevations are derived from National Geographic TOPO!® ©2006. Geographic names, road names and numbers were confirmed using DeLorme Mapping's Washington Atlas and Gazetteer; USGS 7.5' series topographic maps; and from National Geographic TOPO!® ©2006. Site descriptions are a partial dump from Deixis MolluscDB™. For map of the sites see **Figure 1**.

Site entry format:

Project site number; Deixis locality number [in brackets]; locality name; coordinates (UTM: legal); quadrangle (name and year); county; state; drainage; mountain range; valley; geographic description; elevation; depth; locality remarks; habitat description; collector remarks; date collected, and collectors.

Collector abbreviations as follows:

BB= Charles A. "Bert" Bartleson
EJ= Edward J. Johannes
JB= Jim J. Brown

1. Capitol Lake 1. Zone 10: 507,394E 5,207,669N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. Middle basin of Capitol Lake at S. end near the fishing dock, N. of I-5 bridge, Olympia. Elev. 3'. Depth 6'. Lake with mud substrate; abundant *Potamogeton*. Mollusks collected with petite Ponar sampler. No NZMS present. 6/20/2011 EJ, TB!
2. Capitol Lake 2. Zone 10: 507,081E 5,208,019N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. W. side of middle basin of Capitol Lake, near S. end, Olympia. Elev. 3'. Depth 2'. Lake with mud substrate; *Potamogeton*. Mollusks collected with a petite Ponar sampler. NZMS present. 6/20/2011 EJ, TB!
3. Capitol Lake 3. Zone 10: 507,316E 5,208,017N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. E. side of middle basin of Capitol Lake, near S. end, Olympia. Elev. 3'. Depth 2'. Lake with mud substrate; *Potamogeton*. Mollusks collected by petite Ponar sampler. NZMS present. 6/20/2011 EJ, TB!
4. Capitol Lake 4. Zone 10: 507,239E 5,208,312N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. E. side of middle basin of Capitol Lake, mid basin near Monroe Point, Olympia. Elev. 3'. Depth 6'. Lake with mud substrate; abundant *Elodea* and *Potamogeton*. Mollusks collected by petite Ponar sampler. NZMS present. 6/20/2011 EJ, TB!
5. Capitol Lake 5. Zone 10: 507,047E 5,208,312N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. W. side of middle basin of Capitol Lake, mid basin opposite Monroe Point, Olympia. Elev. 3'. Depth 4'. Lake with mud substrate; abundant *Elodea* and *Potamogeton*. Mollusks collected with petite Ponar sampler. NZMS present. 6/20/2011 EJ, TB!
6. Capitol Lake 6. Zone 10: 507,303E 5,208,119N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. E. side of middle basin of Capitol Lake, near S. end, Olympia. Elev. 3'. Depth 9'. Lake with mud substrate; abundant *Elodea* and *Potamogeton*. Mollusks collected by petite Ponar sampler. NZMS present. 6/20/2011 EJ, TB!
7. Capitol Lake 7. Zone 10: 507,052E 5,208,156N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. W. side of middle basin of Capitol Lake at S. end, Olympia. Elev. 3'. Depth 2'. Lake with mud substrate; abundant *Potamogeton*. Mollusks collected with petite Ponar sampler. NZMS present. 6/20/2011 EJ, TB!
8. Capitol Lake 8. Zone 10: 506,986E 5,208,619N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. W. side of middle basin of Capitol Lake, E. of Percival Cove, Olympia. Elev. 3'. Depth 6'. Lake with mud substrate; abundant *Potamogeton*, *Elodea*, and algae. Mollusks collected with petite Ponar sampler. NZMS present. 6/20/2011 EJ, TB!
9. Capitol Lake 9. Zone 10: 507,133E 5,208,614N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. E. side of middle basin of Capitol Lake, E. of Percival Cove, Olympia. Elev. 3'. Depth 10'. Lake with mud substrate; abundant *Potamogeton*, *Elodea*, and algae. Mollusks collected with a petite Ponar sampler. NZMS present. 6/20/2011 EJ, TB!
10. Capitol Lake 10. Zone 10: 507,050E 5,208,850N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. E. side of middle basin of Capitol Lake, near N. end, E. of Percival Cove, Olympia. Elev. 3'. Depth 12'. Lake with mud substrate; abundant *Potamogeton*, *Elodea*, and algae. Mollusks collected by petite Ponar sampler. NZMS present. 6/20/2011 EJ, TB!
11. Capitol Lake 11. Zone 10: 506,880E 5,208,854N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. W. side of middle basin of Capitol Lake, near N. end, E. of Percival Cove,

Olympia. Elev. 3'. Depth 15'. Lake with mud substrate; abundant Potamogeton, Elodea, and algae. Mollusks collected with petite Ponar sampler. NZMS present. 6/20/2011 EJ, TB!

12. Capitol Lake 12. Zone 10: 506,822E 5,208,980N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. W. side of middle basin of Capitol Lake, at N. end, SE of Marathon Park, Olympia. Elev. 3'. Depth 9'. Lake with mud substrate; abundant Potamogeton, Elodea, and algae. Mollusks collected with petite Ponar sampler. NZMS present. 6/20/2011 EJ, TB!

13. Capitol Lake 13. Zone 10: 506,957E 5,209,066N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. E. side of middle basin of Capitol Lake, at N. end, W. of Capitol Point, Olympia. Elev. 3'. Depth 6'. Lake with mud substrate; abundant Potamogeton, Elodea, and algae. Mollusks collected with petite Ponar sampler. NZMS present. 6/20/2011 EJ, TB!

14. Capitol Lake 14. Zone 10: 506,948E 5,209,753N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. N. end of north basin of Capitol Lake, near dam tide gate, Olympia. Elev. 3'. Depth 20'. Lake with mud substrate; abundant Potamogeton. Mollusks collected by petite Ponar sampler. NZMS present. 6/21/2011 EJ, BB, TB!

15. Capitol Lake 15. Zone 10: 507,152E 5,209,757N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. N. end of north basin of Capitol Lake near E. side of lake, Olympia. Elev. 3'. Depth 15'. Lake with mud substrate; Potamogeton abundant. Mollusks collected with petite Ponar sampler. NZMS present. 6/21/2011 EJ, BB, TB!

16. Capitol Lake 16. Zone 10: 507,300E 5,209,646N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. N. end of north basin of Capitol Lake on E. side of lake, Olympia. Elev. 3'. Depth 8'. Lake with mud substrate; Elodea and Potamogeton abundant. Mollusks collected with petite Ponar sampler. NZMS present. 6/21/2011 EJ, BB, TB!

17. Capitol Lake 17. Zone 10: 507,140E 5,209,627N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. N. end of north basin of Capitol Lake, middle of lake, Olympia. Elev. 3'. Depth 12'. Lake with mud substrate; Elodea and Potamogeton. Mollusks collected by petite Ponar sampler. NZMS present. 6/21/2011 EJ, BB, TB!

18. Capitol Lake 18. Zone 10: 506,997E 5,209,643N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. N. end of north basin of Capitol Lake, W. side of lake, Olympia. Elev. 3'. Depth 12'. Lake with mud substrate; Elodea and Potamogeton. Mollusks collected by petite Ponar sampler. NZMS present. 6/21/2011 EJ, BB, TB!

19. Capitol Lake 19. Zone 10: 506,838E 5,209,650N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. N. end of north basin of Capitol Lake, on W. side of lake, Olympia. Elev. 3'. Depth 6'. Lake with mud substrate; Elodea and Potamogeton. Mollusks collected by petite Ponar sampler. NZMS present. 6/21/2011 EJ, BB, TB!

20. Capitol Lake 20. Zone 10: 506,701E 5,209,539N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. W. side of north basin of Capitol Lake, Olympia. Elev. 3'. Depth 6'. Lake with mud substrate; Elodea and Potamogeton. Mollusks collected with petite Ponar sampler. NZMS present. 6/21/2011 EJ, BB, TB!

21. Capitol Lake 21. Zone 10: 506,867E 5,209,502N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. W. side of north basin of Capitol Lake, Olympia. Elev. 3'. Depth 10'. Lake with mud-silt substrate; Elodea and Potamogeton. Mollusks collected by petite Ponar sampler. NZMS present. 6/21/2011 EJ, BB, TB!

22. Capitol Lake 22. Zone 10: 507,017E 5,209,507N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. Middle of north basin of Capitol Lake, Olympia. Elev. 3'. Depth 10'. Lake with mud-silt substrate; Elodea and Potamogeton. Mollusks collected by petite Ponar sampler. NZMS present. 6/21/2011 EJ, BB, TB!
23. Capitol Lake 23. Zone 10: 507,165E 5,209,496N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. E. side of north basin of Capitol Lake, Olympia. Elev. 3'. Depth 8'. Lake with mud-silt substrate; Elodea and Potamogeton. Mollusks collected with petite Ponar sampler. NZMS present. 6/21/2011 EJ, BB, TB!
24. Capitol Lake 24. Zone 10: 507,308E 5,209,538N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. E. side of north basin of Capitol Lake, Olympia. Elev. 3'. Depth 6'. Lake with mud-silt substrate; Elodea and Potamogeton. Mollusks collected by petite Ponar sampler. NZMS present. 6/21/2011 EJ, BB, TB!
25. Capitol Lake 25. Zone 10: 507,332E 5,209,412N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. E. side of north basin of Capitol Lake, Olympia. Elev. 3'. Depth 3'. Lake with mud-silt substrate; Elodea and Potamogeton. Mollusks collected with petite Ponar sampler. NZMS present. 6/21/2011 EJ, BB, TB!
26. Capitol Lake 26. Zone 10: 507,161E 5,209,344N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. E. side of north basin of Capitol Lake, NE of Capitol Point, Olympia. Elev. 3'. Depth 12'. Lake with mud-silt substrate; Elodea and Potamogeton. Mollusks collected with petite Ponar sampler. NZMS present. 6/21/2011 EJ, BB, TB!
27. Capitol Lake 27. Zone 10: 507,010E 5,209,360N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. Middle of north basin of Capitol Lake, NW of Capitol Point, Olympia. Elev. 3'. Depth 3'. Lake with mud-silt substrate; Elodea and Potamogeton. Mollusks collected with petite Ponar sampler. NZMS present. 6/21/2011 EJ, BB, TB!
28. Capitol Lake 28. Zone 10: 506,686E 5,209,349N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. E. side of north basin of Capitol Lake, N. of Percival Point, Olympia. Elev. 3'. Depth 6'. Lake with mud-silt substrate; Elodea and Potamogeton. Mollusks collected with petite Ponar sampler. NZMS present. 6/22/2011 EJ, TB!
29. Capitol Lake 29. Zone 10: 506,787E 5,209,203N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. W. side of north basin of Capitol Lake, just N. of Marathon Park at Percival Point, Olympia. Elev. 3'. Depth 6'. Lake with mud-silt substrate; Elodea and Potamogeton. Mollusks collected by petite Ponar sample. NZMS present. 6/22/2011 EJ, TB!
30. Capitol Lake 30. Zone 10: 506,966E 5,209,270N. Tumwater 1994 quad., Thurston Co., Washington. Capitol Lake. North basin of Capitol Lake, just N. of Capitol Point, Olympia. Elev. 3'. Depth 6'. Lake with mud-silt substrate; Elodea and Potamogeton. Mollusks collected with petite Ponar sampler. NZMS present. 6/22/2011 EJ, TB!
31. Percival Creek above Percival Cove. Zone 10: 506,620E 5,208,933N. Tumwater 1994 quad., Thurston Co., Washington. Percival Cr.-Capitol Lk. Percival Creek above where empties into Percival Cove, W. of Deschutes Parkway SW, Olympia. Elev. 3'. Depth 0-10". Creek with silt-cobble substrate; no macrophytes. No mollusks found. 6/22/2011 EJ!

