

Invasive New Zealand mudsnails in mid-Puget Sound (Salish Sea) lowland watercourses

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Highly invasive New Zealand mudsnails (*Potamopyrgus antipodarum*) are tiny, non-native species present in Salish Sea water bodies since at least 2009. Infested waters include lower Thornton Creek and adjacent Lake Washington shoreline (Seattle), Kelsey and Valley creeks (Bellevue), McAleer Creek (Lake Forest Park), Capitol Lake (Olympia), and the Snohomish River (Everett).

The snails are hardy, adaptable animals that reproduce quickly and can easily be transported to new areas by people, animals, and equipment. They threaten the stability of aquatic ecosystems because they crowd out native species—they have reached densities of over 400,000 snails per square meter in parts of the US.^{5,7} They have little or no nutritional value to fish or other species; however, they may be consumed instead of good food items.^{2,10} Studies suggest that New Zealand mudsnails can alter stream chemistry,^{1,6} drive out native animals,^{4,11} and disrupt natural food webs,^{3,8} causing further harm to threatened and endangered salmon runs. Once they are established in an area, it has proven to be nearly impossible to get rid of them. Therefore, containing their spread is a high priority to avoid negative impacts due to colonization.

King County has applied the habitat criteria developed by Therriault et al.,⁹ to predict the ability of WRIA 8 and 9 streams to support significant populations of mudsnails if they are introduced. To-date, by this measure, most streams appear to be at least moderately good candidates for successful colonization. This makes education and rigorous decontamination protocols a very high priority for equipment and field gear enter our streams for recreation, fishing, habitat improvement and restoration, flood protection, and road maintenance and construction.



Risk Assessment on King County streams

• Table derived from Therriault et al., 2010: conditions identified and critical tolerances assessed

• Response ranging from no adult survival to highly successful reproduction and infestation



WQ not favorable for NZMS

no risk	low	moderate	high risk
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WQ favorable for NZMS

Calcium	pH	Alkalinity	Hardness	Deg C-min	Deg C-Max	Spec Cond - range low	Spec Cond - range high	score	Risk
< 2 mg/L	< 6.0?	< 10	< 10	< 0	> 35	< 25 or	> 46,000	0	none < 0.5
2 - 4 mg/L	6.0-6.8	10 - 50	10 - 50	0 - 15	30 - 35	25 - 200 or	25,000 - 46,000	1	low 0.5 - 1.5
4 - 7 mg/L	6.9-7.5	50 - 100	50 - 100	15 - 20	26 - 30	200 - 1200	9,000 - 25,000	2	moderate 1.5 - 2.5
> 7 mg/L	7.5 - 8.5?	100 - 350	100 - 350	20 - 26	20 - 26	1200 - 9000	1201 - 9000	3	high > 2.5

Analysis of King County streams data from monthly routine monitoring: assessment for risk of invasion by NZMS

NOTES:

All values are medians of the data.

Maximum temperature values below 20 were not included in Therriault et al. Marked in blue, they were scored as moderate between 15-20 and as low between 10-15.

Comment	stream name	Calcium	pH	Alkalinity	Hardness	DegC-minimum	DegC-Maximum	Spec Cond - median	Score	Risk
Infested	Thornton	18.4	7.50	82.5	93.8	2.6	23.2	232	2.3	moderate
Infested	Kelsey/Mercer	17.6	7.39	84.3	85.5	2.0	17.7	208	2.0	moderate
Infested	McAleer	16.1	7.67	75.6	85.9	4.2	16.3	207	2.1	moderate
WRIA 8	Bear	11.1	7.40	51.2	53.9	0.9	20.9	130	2.0	moderate
WRIA 8	Issaquah	11.5	7.40	43.4	45.6	2.3	20.6	110	1.7	moderate
WRIA 8	Cedar	8.9	7.43	28.9	31.6	3.5	19.1	68.0	1.6	low-moderate
WRIA 8	Juanita	15.8	7.44	74.0	76.8	3.1	21.1	256	2.1	moderate
WRIA 8	Cottage	11.1	7.37	55.8	64.4	2.9	18.1	145	1.9	moderate
WRIA 8	Swamp	15.4	7.33	69.4	73.7	0.4	19.0	184	1.9	moderate
WRIA 8	Coal	34.9	8.09	160.0	160.0	2.9	16.6	471	2.4	moderate - high
WRIA 9	Big Soos	13.4	7.57	49.2	54.9	2.7	17.1	132	1.9	moderate
WRIA 9	Newaukum	14.9	7.70	50.9	56.1	0.9	16.4	147	1.9	moderate
WRIA 9	Crisp	13.1	7.40	47.5	51.9	5.3	15.2	121	1.7	moderate
West Seattle	Longfellow	23.1	7.54	114.0	133.0	3.0	17.4	302	2.4	moderate - high
Vashon Is.	Judd	11.4	7.60	51.9	68.1	0.4	14.2	130	1.7	moderate

LITERATURE CITED

- Arango, C. P., L. A. Riley, J. L. Tank, and R. O. Hall. 2009. Herbivory by an invasive snail increases nitrogen fixation in a nitrogen-limited stream. *Canadian Journal of Fisheries and Aquatic Sciences* 66:1309-1317.
- Bersine, K., V. Brennels, R. Draheim, A. Rub, J. Zamon, R. Litton, S. Hinton, M. Sytsma, J. Cordell, and J. Chapman. 2008. Distribution of the invasive New Zealand mudsnail (*Potamopyrgus antipodarum*) in the Columbia River Estuary and its first recorded occurrence in the diet of juvenile Chinook salmon (*Oncorhynchus tshawytscha*). *Biological Invasions* 10:1381-1388.
- Brennels, V., A. Sih, and C. de Rivera. 2011. Integration of an invasive consumer into an estuarine food web: direct and indirect effects of the New Zealand mud snail. *Oecologia* 167:169-179.
- Cada, C. A. 2004. Interactions between the invasive New Zealand mud snail, *Potamopyrgus antipodarum*, Baetid mayflies, and fish predators. Montana State, Bozeman, Montana.
- Hall, R. O., M. F. Dybdahl, and M. C. VanderLoop. 2006. Extremely High Secondary Production Of Introduced Snails In Rivers. *Ecological Applications* 16:1121-1131.
- Hall, R. O., J. L. Tank, and M. F. Dybdahl. 2003. Exotic snails dominate nitrogen and carbon cycling in a highly productive stream. *Frontiers in Ecology and the Environment* 1:407-411.
- Kerans, B. L., M. F. Dybdahl, M. M. Gangloff, and J. E. Jannot. 2005. *Potamopyrgus antipodarum*: distribution, density, and effects on native macroinvertebrate assemblages in the Greater Yellowstone Ecosystem. *Journal of the North American Benthological Society* 24:123-138.
- Krist, A., and C. Charles. 2012. The invasive New Zealand mudsnail, *Potamopyrgus antipodarum*, is an effective grazer of algae and altered the assemblage of diatoms more than native grazers. *Hydrobiologia* 694:143-151.
- Therriault, T. W., A. M. Weise, G. E. Gillespie, and T. J. Morris. 2010. Risk assessment for New Zealand mud snail (*Potamopyrgus antipodarum*) in Canada. Department of Fisheries and Oceans Canadian Science Advisory Secretariat.
- Vinson, M. R., and M. A. Baker. 2008. Poor growth of rainbow trout fed New Zealand mud snails *Potamopyrgus antipodarum*. *North American Journal of Fisheries Management* 28:701-709.
- Wikström, S., and H. Hillebrand. 2012. Invasion by mobile aquatic consumers enhances secondary production and increases top-down control of lower trophic levels. *Oecologia* 168:175-186.

Mudsnail Field Card produced by King County Department of Natural Resources and Parks in 2012



New Zealand mudsnails

(Potamopyrgus antipodarum)

IDENTIFICATION GUIDE FOR KING COUNTY, WA

This identification guide is intended to help distinguish between the NZMS and native snails similar in size and appearance.

A hand lens and flashlight will be helpful for seeing some features.

IDENTIFIABLE AND DISTINGUISHING FEATURES OF NZMS AND NATIVE SNAILS

Hold snail with tip up and opening facing you. Please note that measurements are approximate and will vary.

New Zealand mudsnail (NZMS)
Potamopyrgus antipodarum

- Usually less than 6 mm long
- Elongate shells with 5 to 8 whorls
- Right opening
- Variable shell color; gray to brown
- Has operculum (opening lid)

Juga sp., no common name

- Juvenile similar in size to NZMS
- Right opening
- Reddish-brown shell
- Thin spiral incised lines and raised folds
- Has operculum
- Only known from Soos Creek basin and Mill Creek

Pondsnails, Stagnicola and similar species in family Lymnaeidae

- Broader shell relative to length
- D-shaped right opening with twisted inner lip
- No operculum

Galba sp., formerly Fossaria, no common name

- Thin, broader shell relative to length
- Oval right opening half of the entire shell length
- No operculum

Physella sp., no common name

- Thin, fairly transparent shell
- Left oval opening that is ¼ the length of the shell
- No operculum

Pristine pyrg (Pristincola hemphilli)

- Very narrowly conical shell
- Clear to white coloration
- Oval, elongate right opening
- Lives in springs, unlikely to make large populations in streams or lakes
- Has operculum

New Zealand mudsnail Identification Guide *continued*



Snails found in local streams (left to right) NZMS, Pristincola, Galba, Physella, Juga (juvenile), Stagnicola



These boots were worn while walking in the mud at the edge of Capitol Lake in Olympia. Over 120 NZMS were found while cleaning the boots.

THIS CARD IS AVAILABLE AS A PDF ONLINE. PLEASE VISIT:

www.kingcounty.gov/environment/animalsAndPlants/biodiversity/threats/Invasives/Mudsnails.aspx

ACKNOWLEDGMENTS:

The authors would like to thank the following people and agencies for help and information leading to the production of the field card: Ed Johannes from Deixis Consultants, Kit Paulsen from City of Bellevue, Jonathan Frogde from Seattle, Allen Pleus and Jesse Schultz from Washington Department of Fish and Wildlife, and Jennifer Vanderhoof and Kate O'Laughlin from King County Water and Land Resources Division.

Resources

For more information including up-to-date King County infestation sites, please visit: www.kingcounty.gov/environment/animalsAndPlants/biodiversity/threats/Invasives/Mudsnails.aspx

Search "New Zealand mudsnail" on the internet for additional information about NZMS and field gear decontamination.

Thank you

Jennifer Vanderhoof for creating the technical illustrations. Ed Johannes, Deixis Consultants, for technical content.

King County
Department of Natural Resources and Parks
Water and Land Resources Division
Science and Technical Support Section

King County-Area Basins with Confirmed Presence of New Zealand Mudsnails

Basins with New Zealand mudsnails present

Field decontamination procedures for gear and equipment are encouraged on all waterbodies, but please be especially vigilant in the New Zealand mudsnail infested basins.

Confirmed New Zealand Mudsnail Locations

- King County Boundary
- NZMS Sites outside of King County

NZMS Spread in Western U.S.

From: Oregon SeaGrant brochure 2010

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Produced by: King County DNRP Natural Resources Information System & E-Government Unit
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