Mapping the Spread and Ecological Impacts of Invasive New Zealand Mudsnails in Spirit Lake

Meg Smith and Jim Gawel, Ph.D., UW Tacoma, Environmental Sciences

UNIVERSITY of WASHINGTON TACOMA

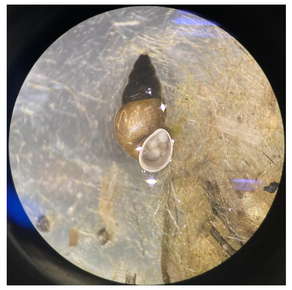

Figure 1: A NZMS under magnification.

Hypotheses

- The NZMS entered Spirit Lake around 2015 with a point of entry at the southern shore
- The NZMS's current range is limited by gaps in habitat continuity and distance from introduction point
- There is interspecific competition between the NZMS and two native snail species
- The presence of NZMS is dependent on vegetation type and density in Spirit Lake

Introduction

- NZMS were introduced to Spirit Lake around 2015, most likely with human assistance, as recorded in rainbow trout gut contents sampled yearly in Duck Bay (Crisafulli, unpublished).
- NZMS is an aquatic mollusk (4-6mm in length) **(Fig. 1)** commonly spread by infested recreational equipment and machinery (Oregon Sea Grant 2011). They are grazers that primarily feed on plant and animal detritus and algae.
- NZMS thrive in disturbed areas and benefit from nutrient rich receiving waters (Hoy et al. 2012).
- NZMS are parthenogenetic – they reproduce through cloning – and can achieve densities up to 500,000/m^2 (WFWS 2021).

Abstract

Invasive species cause approximately $120 billion in damages/year in the US. While the economic effects of the New Zealand Mudsnails (NZMS) are not well understood, there is strong evidence showing that NZMS have the potential to outcompete local species and disrupt food chains. NZMS introduced to Spirit Lake in 2015 may be contributing to the decline of local fish species and may cause a trophic cascade due to its lack of natural predators. We are currently studying the effects of the NZMS on Spirit Lake and its tributaries by mapping the spatial extent and relative abundance of NZMS and native snails in lake sediment, attached to plants, and in fish guts. Additional work includes stable isotope analysis of snail and fish tissues for trophic transfer analysis seeking the impact of NZMS on fish diet. We will present initial research results that will help improve our understanding of NZMS, the factors that may slow the spread of this species, and will be critical to lake management

Figure 3: Samples being agitated in water to remove snails from the macrophytes.

Methods

- Macrophytes were gathered using a plant rake at water depths ranging from 0.9-3.0m (**Fig. 2)**; at deeper locations a petite ponar dredge was used.
- Macrophytes were agitated by hand in water for 30 sec to remove any attached snails, which were allowed to sink to the bottom, separating them from the vegetation **(Fig.3)**. The majority of macrophytes were then removed by hand and vegetation volume was estimated using a graduated beaker. Remaining solids and detached snails were then transferred to plastic bags on ice for transport to UW Tacoma
- Snails, native and nonnative, were separated from any remaining plant material and manually counted under magnification **(Fig. 1)**.

Figure 2: A rake being used to gather plant samples in Spirit Lake.

Results

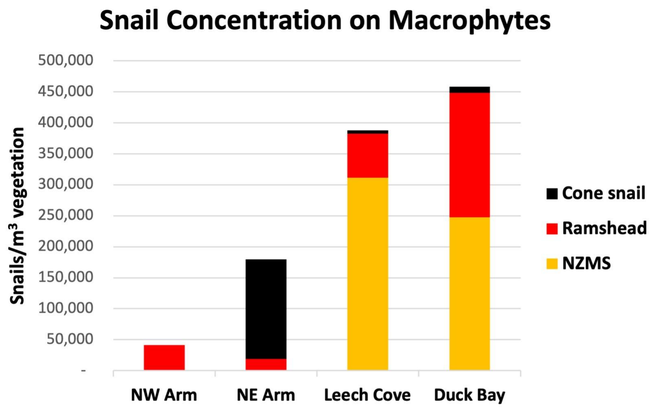

Figure 5: Snail concentrations per m^3 of vegetation in each quadrant of Spirit Lake.

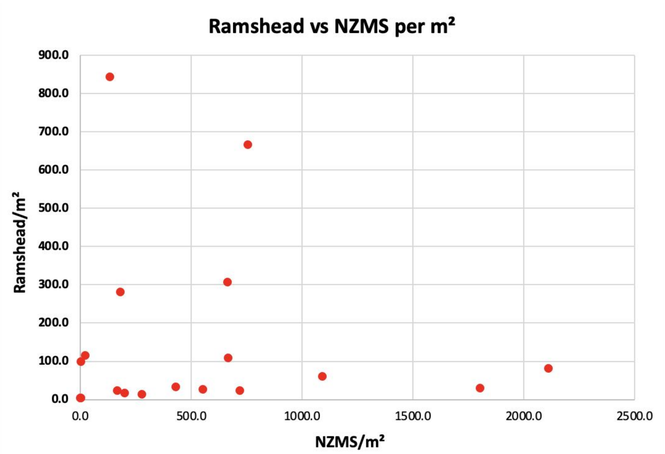

Figure 6: Ramshead versus NZMS per m^2, indicating interspecies competition.

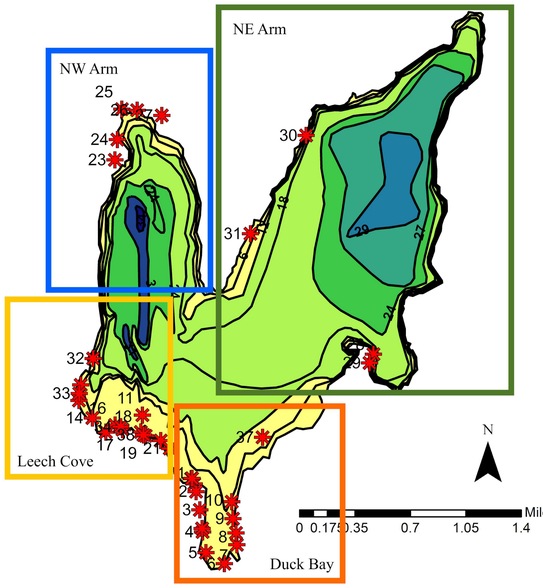

Figure 4: A map of all sampling sites, broken down into 4 sampling quadrants: Duck Bay, Leech Cove, NW Arm, and NE Arm.

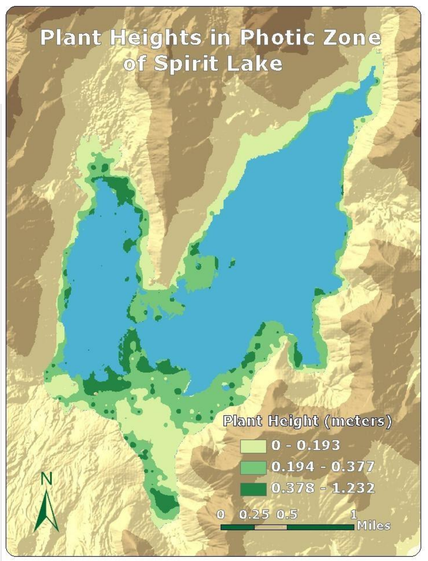

Figure 7: A map of plant heights throughout Spirit Lake (Gawel et al. 2018).

Discussion

- NZMS appear to be at highest densities in Leech Cove **(Fig. 5)**, highlighted in yellow, followed by Duck Bay, in red. This corroborates the hypothesis that the NZMS entered the lake along the southern shore. The NZMS were not present in NE or NW Arms, suggesting that they have yet to spread to those sections of the lake. This could be due to the fact that vegetation is sparse **(Fig. 7)**, and water depth is deeper **(Fig. 4).**
- Leech Cove and Duck Bay were predominantly vegetated with Eurasian milfoil, an invasive species, and stonewort/muskgrass. The highest densities of NZMS were found in vegetation samples that included filamentous algae, Eurasian milfoil, and coontail. Relatively lower densities of NZMS were found on stonewort and pondweed where ramshead made up a higher percentage, suggesting that NZMS may have a vegetation preference **(Fig. 8)**.
- There is evidence of interspecies competition between NZMS and the native snails – where NZMS were at highest densities, ramshead counts were lower and cone snails were largely absent. Conversely, ramshead reached their highest densities when NZMS abundance was lower **(Fig. 6)**, and cone snails reached their highest densities in the NE Arm where NZMS were absent **(Fig. 5).**

Snails/m^3 vegetation	NZMS	Ramshead	Spiral Cone
Eurasian Milfoil	560	96	7
Stonewort	344	204	3
Coontail	548	105	4
Floating Pondweed	154	105	2
Filamentous Algae	991	156	0

Figure 8: Snail counts per vegetation type.