



Determining Factors for Eurasian Watermilfoil (*M. spicatum*) Spread in and around Lake Tahoe, CA-NV

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Invasive aquatic species pose serious ecological and economic threats to lakes, reservoirs and rivers. This study investigates vectors of introduction of aquatic nuisance species in California and Nevada's water bodies. Our findings show that lakes and reservoirs in California and Nevada are connected by way of recreational and transient boating, which is a major source of non-native species introductions.

Rivers, lakes and reservoirs are among the most invaded environments in the world; recreational boaters are a major source of non-native species introduction both within and between fresh water bodies. Boaters use California's waterways intensely, and create significant potential for the spread of non-native species such as Eurasian watermilfoil (*Myriophyllum spicatum*). New aquatic nuisance species (ANS) regularly appear in neighboring states, so California's waters are at constant risk of further invasion.

This research investigates patterns of Eurasian watermilfoil spread within Lake Tahoe, as well as to water bodies connected to Lake Tahoe via recreational boating. Lake Tahoe receives a high amount of boat traffic, and is centrally located in proximity to a number of popular lakes in California and Nevada. Eurasian watermilfoil is estimated to have arrived along the south shore of Lake Tahoe during the 1960's and has since spread to numerous locations around the lake.

We are exploring the following: (1) What are the processes of spread within a lake; i.e., is watermilfoil limited by available habitat or by dispersal mechanisms? (2) What other water bodies are Lake Tahoe boaters using? Do they act as potential sources of aquatic invasion? (3) Are there recognizable travel patterns for boaters in this region? What impact do these patterns have on

invasion risk? (4) Are boaters aware of damages associated with invasive species?

During the 2005-2006 boating seasons approximately 800 boater interviews were carried out at 7 Lake Tahoe boat launch facilities. Information was collected regarding lakes visited before and to be visited after present use, travel within Lake Tahoe, invasive species awareness, boat cleaning habits, and vessel inspections for vegetation caught on boats and equipment. A survey of Lake Tahoe for Eurasian watermilfoil and Curly pondweed was carried out with the USDA Exotic and Invasive Plant Unit. Additionally, sediment and water quality testing of 13 popular boating destinations assessed habitat appropriateness for potential colonization. In 2007, similar sediment and water quality assessments were carried out at the top 10 visited water bodies in CA and NV as indicated by the 2005-06



Invasive plants like Eurasian watermilfoil easily get caught in propellers and engines. This boater pulled out a clump of plants that was clogging his intake at the Tahoe Keys Marina.

boater interviews. These assessments also included surveys for other high risk invaders such as the New Zealand Mudsnail, Quagga mussel, and Curly pondweed at lake access points.

Findings of these efforts include: Lake Tahoe boaters previously use lakes with known aquatic invaders; 15% of boats leaving Lake Tahoe carry fragments of invasive plant species on equipment; habitats within Lake Tahoe that are not yet invaded by Eurasian watermilfoil are not significantly different from those that are--suggesting that the invasion is still in progress; Eurasian watermilfoil and Curly-leaf pondweed continue to spread in Lake Tahoe; a majority of Lake Tahoe boaters never conduct visual inspection of boats or boating equipment for ANS; a number of CA and NV lakes contain ANS that have not been previously discovered or reported. This information has been presented to homeowner's associations, science and management consortiums and published in local newspapers.

Moving forward, within-lake boater movement data will be combined with a 3-dimensional flow model designed by UC Davis researchers to understand dispersal mechanisms within Lake Tahoe. Sediment and water quality data collected for lakes other than Lake Tahoe will be analyzed to determine whether habitat or dispersal is the limiting factor for Eurasian watermilfoil invasion. These data are currently being used as the foundation for a multi-institutional collaborative proposal for a regional expansion of this study.



Graduate student Marion Wittmann collects some invasive Eurasian watermilfoil plants in North Lake Tahoe

Publications

Chandra, S. and Wittmann, M., 2007. *Invading Lake Tahoe: Dangers of invading organisms*. Keep Tahoe Blue News: Summer Newsletter: pg 2.

Professional Presentations

Wittmann, Marion E. *Pathways for Invasions by Aquatic Species*, Invasive Species Workshop, Incline Village, NV, May 2007.

Wittmann, Marion, E. *Boater mediated dispersal of Myriophyllum spicatum in CA-NV*. Western Aquatic Plant Management Society, San Diego, CA, March 2006.

Wittmann, Marion E., *Boater mediated dispersal of an invasive aquatic macrophyte, Eurasian Watermilfoil (Myriophyllum spicatum) in and around the Lake Tahoe Basin, CA-NV*. ESA Ecology in an Era of Globalization. Merida, MX, January 2006.

Collaborative Efforts

Researchers from the USDA Agricultural Research Service assisted with this study: Bob Blank (Soil Science Lab) provides sediment quality analysis; Lars Anderson (Aquatic Plant Research Lab) has provided survey data and culture tanks. The UC Davis--Tahoe Environmental Research Center provided data, facilities, field assistance, and instrumentation. UN Reno researchers provided field assistance.

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