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Non-Native Invasive Aquatic Plant and Mussel Survey of Six Umpqua National Forest Area Lakes

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Abstract

Six lakes and ponds located within or near the Umpqua National Forest were surveyed for non-native aquatic plants and mussels during August, 2009. A diverse assemblage of native plants was identified along with one possible non-native aquatic plant hybrid in Herberts Pond. The possible hybrid between the non-native species *Myriophyllum spicatum* and the native species *M. sibiricum* requires genetic analysis for identification. Water chemistry is suitable for the establishment of invasive mussels in Buckeye Lake; however, no zebra or quagga mussel veligers were detected in any of the lakes.

Introduction

Non-native aquatic invasive plants and animals cause great ecological and economic harm to freshwater resources in the United States. For example, plant species such as Eurasian water milfoil (*Myriophyllum spicatum*) and animal species such as zebra mussels (*Dreissena polymorpha*) and quagga mussels (*Dreissena rostiformis*) displace native species, interfere with recreation, degrade fish habitat, and affect water chemistry. The economic costs of invasive aquatic plants and mussels in the United States are estimated at $110 million and $1 billion per year respectively (Pimentel et al. 2005). Given the ecological and economic costs of biological invasions, it is imperative that new introductions are prevented, introduced species are detected early, and established species are controlled or eradicated.

The primary goal of this survey was the early detection of non-native aquatic plant and mussel species in several high use lakes located in or near the Umpqua National Forest and Rogue-Umpqua Divide Wilderness. An additional goal of the survey was to determine the aquatic plant species composition of non-invaded lakes that can be used as a reference for invaded lakes.

Methods

Sampling sites

Freshwater plants, mussel veliger samples, and water chemistry data were collected from six high use lakes located in the Umpqua River watershed between August 4 and August 6, 2009. Three of the lakes, Cliff, Fish and Buckeye are in the Rogue-Umpqua Divide Wilderness; Hemlock Lake and Carmen Lake are located along roads within the Umpqua National Forest; and Herberts Pond is located along a road used to access the Forest (Figure 1). A seventh lake, Skookum Pond was not sampled due to forest fire activity during the survey period.

Luxuriant growth of macrophytes has been noted in Cliff, Buckeye (Eilers and Bernert 1990) and Hemlock Lake (Salinas 2003); however species were not identified. Cliff, Fish and Buckeye are relatively productive hardwater lakes in comparison to most other lakes in Oregon's Cascade Range (Eilers and Bernert 1990) while Hemlock Lake has softer water (Salinas 2003). These characteristics are relevant because hardwater lakes are thought to be more susceptible to the establishment of non-native zebra and quagga mussel populations (Wells et al. 2010; Whittier et al. 2008). Little is known about the water quality or macrophyte communities in Carmen Lake or Herberts Pond. A non-native snail species, big-eared Radix (*Radix auricularia*), is present in Carmen Lake, Hemlock Lake, Fish Lake and several other Umpqua National Forest waterbodies including Beaver swamp downstream of Fish Lake, Toketee Lake in the North Umpqua drainage, and Ash Pond in the South Umpqua drainage off F.S. road 2826-100 (Amy Rusk, Umpqua National Forest, personal communication, 7/12/2010).

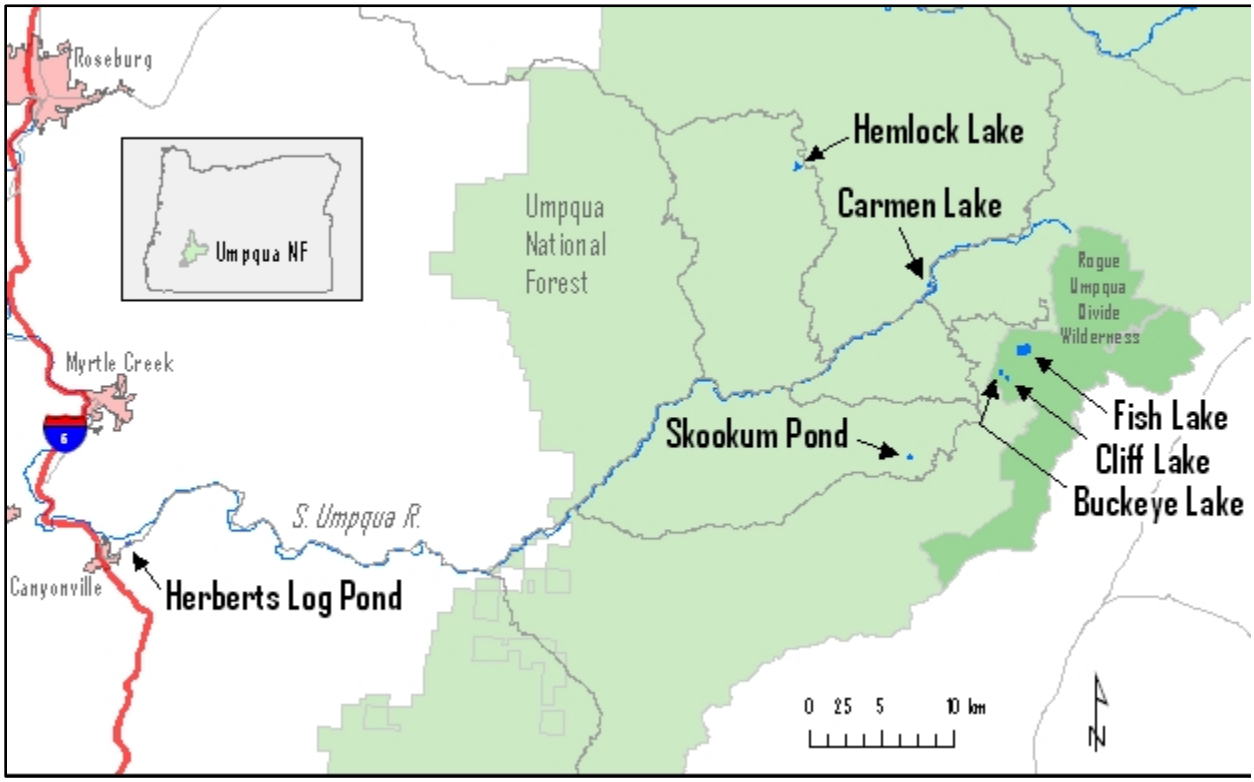

Figure 1. Location of sample lakes within or near the Umpqua National Forest.

Aquatic plant sampling and analysis

Aquatic plant samples were collected from shore at all lakes and from a float tube at Hemlock, Cliff, Buckeye, and Fish Lakes. Samples were collected by dragging a double sided thatch rake in the littoral zones of high traffic areas such as boat launches and the intersections of trails and lakeshores (Table 1). Plants recovered from the rake tines were identified to species when possible. Voucher specimens were delivered on ice to the PSU-CLR lab and were pressed, dried, and archived. Approximately 1 to 3 hours of aquatic plant sampling was conducted per lake.

Table 1. Sampling area descriptions and locations of the start of surveys.

Lake	Sampling area description	Latitude at start of survey (WGS84)	Longitude at start of survey (WGS84)
Herberts Pond	South shoreline near parking area and along west shore	43.936908	-123.258145
Hemlock Lake	North and east shoreline near boat launch and off shore to dam on west shore	43.187989	-122.698331
Fish Lake	North and east shoreline and off NE shore	43.079591	-122.498517
Cliff Lake	South and west shoreline and mid-lake	43.059478	-122.516277
Buckeye Lake	South and east shoreline and mid-lake	43.062907	-122.520855
Carmen Lake	South shoreline	43.116274	-122.585587

Zebra and Quagga mussel veliger sampling and analysis

Zebra and Quagga mussel veliger samples were collected from Hemlock, Cliff, Buckeye, and Fish Lakes using a 64 µm mesh zooplankton net. At least 2 vertical tows from near the sediment to the surface were collected and rinsed into composite sample bottles from each lake. Samples were preserved to a final ethanol concentration of 30% and transported to the Portland State University Center for Lakes and Reservoirs Laboratory for analysis. Samples were examined with a compound microscope and polarizing filter at 100 and 200X magnification.

Water quality sampling and analysis

Secchi transparency was measured at Hemlock, Cliff, Buckeye, and Fish Lakes using a 20cm disc. Surface water dissolved calcium samples were collected from the same set of lakes, filtered through 0.45 µm membrane filters, and transported on ice to the Corvallis Cooperative Analytical Lab for analysis. Carmen Lake and Herberts Pond were too shallow to collect transparency measurements and calcium samples were not collected.

Results

Aquatic plants

Twenty-two aquatic plant species were encountered during the surveys, fourteen of which are native species (Table 2). The remaining specimens could not be identified to species because of inconclusive morphology or missing reproductive parts.

Table 2. Aquatic plant taxa indentified in Umpqua National Forest survey lakes.

Lake	Species name	Common name/notes	Status
Carmen Lake	*Stuckenia pectinatus*	Sago pondweed	Native
	Potamogeton natans	Floating-leaf or broadleaf pondweed	Native
	Lemna trisulca	Star duckweed	Native
	Lemna minor	Common duckweed	Native
	Potamogeton sp.	Thin leaf pondweed, either *P. pusillus* or *P. foliosus*	Native
	Nuphar polysepala	Spatterdock	Native
	Unknown floating leaf plant	Possibly *Nuphar microphylla* or *Nymphoides peltata*, however no flowers were present	Unknown
Fish Lake	*Potamogeton amplifolius*	Bigleaf pondweed	Native
	Ceratophyllum demersum	Common hornwort	Native
	Nitella sp.	Nitella, brittlewort	Native
	Callitriche sp.	Water starwort, possibly *C. heterophylla* or *C. palustris*	Unknown
	Potamogeton pusillus	Small pondweed	Native
	Nuphar polysepala	Spatterdock	Native
	Eleocharis sp.	Spike-rush	Unknown
Cliff Lake	*Potamogeton praelongus*	White-stemmed pondweed	Native
	Najas flexilis	Slender water nymph	Native
	Eleocharis sp.	Spike-rush	Unknown
Herberts Pond	*Potamogeton amplifolius*	Big-leaf pondweed	Native
	Ceratophyllum demersum	Common hornwort	Native
	Nitella sp.	Nitella, brittlewort	Unknown
	Elodea canadensis	American waterweed	Native
	Myriophyllum sp.	Water milfoil. Either *M. sibericum* (native) or *M. spicatum* (non-native) or hybrid	Unknown, possible non-native
Buckeye Lake	*Potamogeton natans*	Floating-leaf or broadleaf pondweed	Native
	Ceratophyllum demersum	Common hornwort	Native
	Najas flexilis	Slender water nymph	Native
	Lemna minor	Common duckweed	Native
	Lemna trisculca	Star duckweed	Native
	Potamogeton pusillus	Small pondweed	Native
	Stuckenia pectinatus	Sago pondweed	Native
Hemlock Lake	*Scirpus subterminalis*	Water bulrush	Native
	Sparganium sp.	Bur reed	Unknown
	Nitella sp.	Nitella, bitterwort	Native
	Potamogeton epihydrus	Ribbonleaf pondweed	Native
	Eleocharis acicularis	Needle leaf spike rush	Native
	Carex sp.	Sedge	Unknown

One of the unidentified specimens collected from Herberts Pond exhibited morphological characteristics consistent with the native species *Myriophyllum sibiricum* (northern watermilfoil) or a hybrid with the non-native species *Myriophyllum spicatum* (Eurasian watermilfoil). Genetic analysis is

required to identify the species or the hybrid (Moody and Les 2007). Another possible non-native species was also collected from Carmen Lake. The specimen could not be identified since no flowers were present; however leaf shape and size and size were consistent with either *Nuphar microphylla* which has not been identified in Oregon or the non-native invasive species *Nymphoides peltata* (yellow floating heart) which has been identified in several ponds in Oregon (USGS 2004).

The aquatic plant communities of all the lakes surveyed, with the possible exception of *Myriophyllum sp*. in Herberts Pond, consisted primarily of native species. Hemlock and Cliff Lake were overwhelmingly dominated by the native species *Potamogeton epihydrus* (ribbon-leaf pondweed) and Potamogeton praelongus (white-stemmed pondweed) respectively. Buckeye Lake, Fish Lake and Carmen Lake hosted a diverse set of native species.

Mussel veliger

No zebra or quagga mussel veligers were detected in any of the samples. In addition, New Zealand mud snails (*Potamopyrgus antipodarum*), an invasive species present in Oregon, were not encountered in any of the lakes.

Water Quality

Secchi transparency measurements ranged from 1.7 m in Cliff Lake to 5.6 m in Fish Lake (Table 2). Transparency measured in Fish and Buckeye Lakes were considerably less than prior measurements by Eilers and Bernert (1990) and Rinella (1979). Dissolved calcium concentrations were similar to historic measurements. Calcium concentrations in Buckeye Lake are high enough to support the establishment of zebra and quagga mussels based on the risk assessment models of Wells et al. (2010) and Whittier et al. (2008). Concentrations in Cliff, Fish, and Hemlock Lakes suggest a very low risk of mussel establishment.

Table 2. Water quality measurements Umpqua National Forest and Rogue-Umpqua Divide Wilderness lakes.

Lake	Date	Reference	Secchi (m)	Dissolved calcium (mg/l)	Calcium based mussel risk[1]
Cliff	8/5/09	This survey	1.7	10.8	Very low
	9/17-19/90	Eilers and Bernert 1990	-	9.9	Very low
Buckeye	8/5/09	This survey	4.6	19.2	Low to med.
	9/17-19/90	Eilers and Bernert 1990	8.0	19.4	Low to med.
	9/19/78	Rinella 1979	7.9	20	Low to med.
Fish	8/5/09	This survey	5.6	7.0	Very low
	9/17-19/90	Eilers and Bernert 1990	12.1	8.6	Very low
	9/19/78	Rinella 1979	7.9	8.6	Very low
Hemlock	8/4/09	This survey	4.5	4.9	Very low
	8/15/03	Salinas 2003	4.0	-	-

[1] Based on Wells et al. 2010 and Whittier et al. 2008.

Discussion and Recommendations

All macrophyte species identified in the six lakes, with the possible exception of the *Myriophyllum sp.* in Herberts Pond, are native to the United States. It is not possible to determine based on morphological characteristics whether the *Myriophyllum sp.* is *M. spicatum*, a non-native invasive species, *Myriophyllum sibericum,* a native species, or a hybrid of the two (Moody and Les 2007). Due to the highly invasive character of *M. spicatum* and hybrid, it is highly recommended that the species be positively identified using genetic methods. If genetic analysis confirms the species is *M. spicatum* or a hybrid, an aggressive eradication or control approach should be adopted to reduce the potential for infestation of other nearby waterbodies.

Zebra and quagga mussel veligers were absent in all of the samples. Although water chemistry is suitable for the establishment of these non-native mussels in Buckeye Lake, we assume the risk of invasion is low due to the lack of boat access. Inspection and cleaning of float tubes, transportable boats, and waders is recommended to prevent the introduction of non-native mussels, plants, or other organisms.

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