Fish and plant community responses to non-native parrotfeather (*Myriophyllum aquaticum*) in the Chehalis River, Washington

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Introduction

A principal goal of aquatic weed control is to improve habitat for fish and wildlife, but limited resources can preclude evaluation of removal efforts. The nuisance species parrotfeather (*Myriophyllum aquaticum*) has spread along the Chehalis River in Washington State, raising concerns about impacts on habitat quality for native fishes, including Washington State's only endemic fish, Olympic mudminnow (*Novumbra hubbsi*), as well as its effects on native plant communities.

We collaborated with state and local agencies to assess the impacts of invasion and removal of parrotfeather on physical habitat characteristics and the fish and plant communities. Prior to chemical treatment of parrotfeather along the Chehalis River in 2013, we sampled 22 sites (approximately half with parrotfeather) for plant and fish community composition and habitat quality.

Study area and species of interest

The Chehalis River flows approximately 125 miles through southwest Washington, draining 2700 km^2. The second largest basin in Washington, the river maintains abundant and diverse fish populations including Olympic mudminnow (a state-listed and highly endemic species).

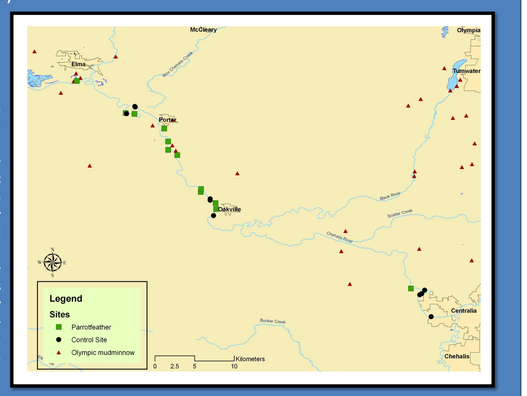
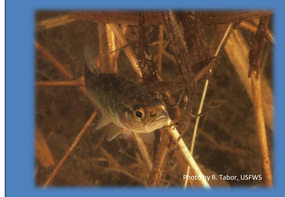


Figure 1. Study area between Centralia (RM 65) and Elma (RM 25). Previous occurrence data for Olympic mudminnow are shown as well as survey locations with and without parrotfeather. Half of the parrotfeather sites were chemically treated (imazapyr + glyphosate) in 2013 prior to resurveying in summer 2014.

The river is a low gradient, rain-dominated system typified by many semi- and partially connected habitats conducive to juvenile and small-bodied fish rearing (Fig. 1). These areas are often highly vegetated with native (typically submersed) plant species. Three species of non-native aquatic plant are currently found in the Chehalis River, and are being monitored and/or controlled by state and local agencies (Fig. 2).

Figure 2. Non-native aquatic species in the Chehalis River which may impact fish habitats are parrotfeather (Myriophyllum aquaticum, left), marshpepper smartweed (Polygonum hydropiper, top right), and Brazilian elodea (Egeria densa, lower right).

Olympic mudminnow: Washington's endemic fish



Olympic mudminnow (*Novumbra hubbsi*) were chosen as a focus for this study because the species is strongly associated with dense aquatic vegetation, and - though highly endemic and state listed 'Sensitive' – is poorly studied. Our sites were selected and sampled to detect mudminnow and determine habitat conditions associated with presence or absence.

Key Findings:

- We found mudminnow at 5 of 22 sites in both 2013 and 2014.
- The majority of these detections were at a very low catch-per-unit-effort (often only a single fish), indicating a need for comprehensive sampling to detect populations.

Fish community composition relative to parrotfeather infestation

Non-native aquatic plants can change composition and overall biomass of vegetation in systems, with cascading effects on fish communities. We used a transect design to deploy minnow traps and characterize plant composition and abundance. Fish were identified to species and abundance calculated as catch-per-unit-effort (CPUE). Degree of parrotfeather infestation was both qualitatively and quantitatively assessed (see next panel).

We used a scaled transect design to sample sites varying in size. Habitat characteristics and plants (percentage and species) were visually estimated at every trap quadrat.

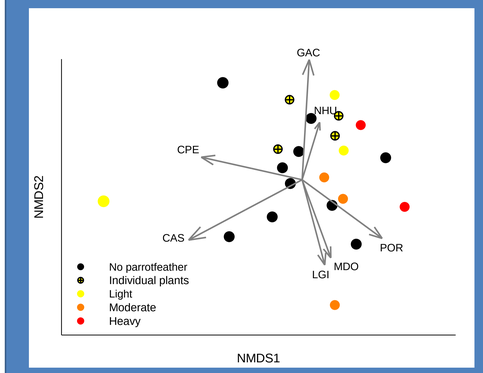


Figure 3. Ordination of sites based on CPUE of fish species (NMDS; stress = 0.16). Significant ($p < 0.05$) species vectors are depicted: GAC (three-spine stickleback), POR (northern pikeminnow), MDO (smallmouth bass), LGI (pumpkinseed sunfish), CAS (prickly sculpin), and CPE (reticulate sculpin). Focal species Olympic mudminnow (NHU) is also depicted. Non-significant species vectors (not shown) were: brown bullhead, rock bass, common carp, largescale sucker, warmouth, bluegill, Coho salmon, redside shiner, and speckled dace. Sites are colored to show degree of parrotfeather infestation as determined by qualitative assessment (legend).

Key Findings:

- Species community composition does not appear to be strongly structured by degree of parrotfeather infestation (Fig. 3).
- Olympic mudminnow were associated with parrotfeather sites, particularly at low levels of infestation (Fig. 3).
- Olympic mudminnow co-occurred primarily with stickleback. In particular, community analysis also shows an inverse relationship with occurrence of non-native smallmouth bass and pumpkinseed sunfish (Fig. 3).

Native and non-native plant communities

Plant community composition was assessed visually in the field (dominant, secondary, and tertiary species) and using biomass of dried samples. Using a point-transect design and a standardized rake turn method, plant samples were collected, sorted to species, and later dried in the lab. We conducted community analysis for sites (NMDS) and also compared biomass of native and non-native species.

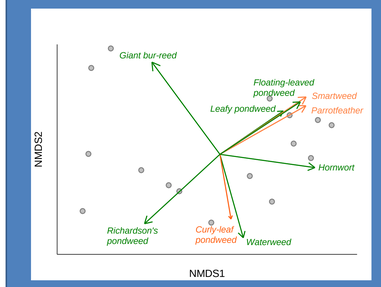


Figure 4. Ordination of sites based on relative abundance of plant species biomass (NMDS; stress = 0.10). Significant species vectors ($p < 0.05$) are shown for native (green) and non-native species (orange).

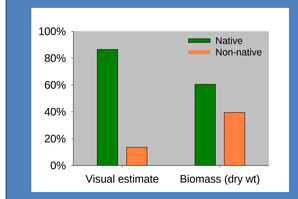


Figure 5. Contrasting proportions of native and non-native plants by visual estimate and biomass.

Key findings:

- Non-native parrotfeather and marshpepper smartweed abundance is correlated and a major determinant of plant community composition at some sites (Fig. 4).
- Non-native species were present in only 13% of visual observations, but made up 40% of biomass (Fig. 5). This is due to strongly contrasting physical structure (emergent leaves and woody stems) compared with the majority of native species (Fig. 2).

Before-After-Control-Impact: 2014 Survey

Parrotfeather sites were chemically treated in late summer 2013. We resurveyed all 22 sites in 2014 to document changes in fish and plant species composition and abundance. Lower than average rainfall and summer flows in 2014 may have preferentially benefited parrotfeather; we will use the contrasting conditions to assess the role of environmental factors on control efforts.

Implications and Discussion

- There are no strong differences in fish community composition related to parrotfeather infestation (as qualitatively assessed).
- Olympic mudminnow are patchily distributed at riverine sites along the Chehalis River, often in low abundance. Given an association with parrotfeather sites, removal efforts should consider present fish use.
- Non-native parrotfeather and marshpepper smartweed are a significant component of plant communities in some areas. We are currently investigating environmental factors which may facilitate non-native dominance at those sites.
- Non-native plants are disproportionate contributors to plant biomass. Our 2014 survey was designed to examine the effects of increased biomass on fish habitat structure, shading, and dissolved oxygen.