Eurasian Watermilfoil Monitoring and Mapping In Noxon Rapids Reservoir for 2009

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Introduction

Littoral areas in freshwater lakes are the most productive regions within a body of water and an important component of high productivity is a diverse native aquatic plant community (Wetzel 2001). The importance of plants in these areas are paramount as they contribute to the structure, function, and diversity of aquatic ecosystems, aid in nutrient cycling, produce food for aquatic organisms, and provide habitat for invertebrates and fish (Carpenter and Lodge 1986, Ozimek et al. 1990, Madsen et al. 2001). Aquatic plants anchor soft sediments, stabilize underwater slopes, remove suspended particles, and remove nutrients from overlying waters (Barko et al. 1986, Doyle 2000, Madsen et al. 2001). However, across much of the United States littoral habitats are increasingly being threatened by the introduction of non-native species. Freshwater systems are very vulnerable to invasion due to repeated disturbance events, whether natural or anthropogenic, which favor the colonization and spread of non-native species (Shea and Chesson 2002).

Eurasian watermilfoil (*Myriophyllum spicatum* L.), is a non-native invasive plant that has invaded freshwater lakes across the United States. Eurasian watermilfoil has been associated with declines in native plant species richness and diversity (Madsen et al. 1991a, b, Madsen et al. 2008). It is becoming a wide spread problem in the Pacific Northwest, with significant nuisance populations already formed in the reservoirs of the Lower Clark Fork River (Madsen and Cheshier 2009). As the threat of non-native plant species such as Eurasian watermilfoil increases, the development and refining of methods to detect and monitor these species to mitigate negative impacts is critical. These methods need to be accurate, efficient, and cost effective.

The objectives of this project were to 1) conduct a point intercept survey of the littoral zone (depths < 30ft.) to assess the aquatic plant community in Noxon Rapids Reservoir, 2) quantify changes in the plant community between 2008 and 2009, and 3) assess differences in the aerial coverage of Eurasian watermilfoil between 2008 and 2009 as well between two survey methods.

Materials and Methods

Point Intercept Surveys. A point intercept survey was conducted in July 2009 using a 250 m grid to assess the plant community throughout the littoral zone (water depths < 30 ft.) of Noxon Rapids Reservoir. Survey methods were similar to those utilized during similar projects in the northwest (Madsen and Wersal 2008**,** 2009). A total of 150 points were surveyed. The surveys were conducted by boat using GPS (Global Positioning System) technology. A Dell Latitude E 6400 XFR ruggedized computer (Round Rock, Texas) outfitted with a Trimble AgGPS106^{tm} (Sunnyvale, California) GPS receiver was used to navigate to each point. Survey accuracy was 3-10 feet (1-3 m) depending on satellite reception. At each survey point, a weighted plant rake was deployed twice to determine the presence of plant species and water depth was recorded at this time as well.

Plant and spatial data were recorded electronically using FarmWorks Site Mate® software (Hamilton, Indiana). Collected data were recorded in database templates using specific pick lists constructed exclusively for this project. The software also provided an environment for displaying geographic and attribute data and enabled navigation to specific locations on the lake.

Plant species presence was averaged over all points sampled and multiplied by 100. Changes in the occurrence of plant species between points sampled in 2008 and 2009 were determined with a Cochran-Mantel-Haenszel test (Stokes et al. 2000). The test assesses the differences in the correlated proportions within a given data set between variables that are not independent, in this case sampling the same points in multiple years. In 2008 the entire reservoir was surveyed, however for comparison purposes, only points sampled (n=150 points for each year) in both years were included. All analyses were conducted using SAS® (Cary, NC) analytical software at a $p = 0.05$ level of significance.

Eurasian watermilfoil Bed Mapping. Eurasian watermilfoil beds were mapped in 2008 and 2009 using a combination of visual identification and hydroacoustic sensing (Lowrance LCX-28C depth finder). This technique offers finer-resolution point mapping to outline locations of Eurasian watermilfoil beds. During both years the entire circumference of the reservoir was mapped. Mapping of submersed aquatic plants is much more difficult than that of mapping terrestrial weeds, especially when plants are growing in 20 to 30 feet of water depth and finding every individual is unlikely.

Results and Discussion

Point Intercept Surveys. The plant community in Noxon Rapids Reservoir changed very little from 2008 to 2009 (Table 1). The only changes in species occurrence that were noted were for white water-buttercup that increased in occurrence, and sago pondweed that decreased in occurrence. The decrease in sago pondweed is largely attributed to seasonal effects and inter-annual variation as this species is impacted by temperature and water clarity (Wersal et al. 2006). Similarly, non-native, native, and total species richness did not change between the 2008 and 2009 surveys. Eurasian watermilfoil was found at 10% of points surveyed in 2008 and 13% in 2009, a 23% increase in Eurasian watermilfoil presence. (Figures 1 through 4).

Eurasian watermilfoil Bed Mapping.

Although the presence of Eurasian watermilfoil did not increase from 2008 to 2009, the total aerial coverage increased by 24-39% depending on the survey method (Table 2). This may indicate that Eurasian watermilfoil is not spreading rapidly to new areas of the reservoir, but expanding its coverage in the areas where it is currently found. In 2008 the point intercept survey estimated that Eurasian watermilfoil occupied 247 acres, in 2009 acreage was estimated at 323, a 24% increase. Eurasian watermilfoil bed mapping in 2008 resulted in 223 acres of Eurasian watermilfoil, by 2009 this had increased 39% to 364 acres (Figures 1 through 4). The difference in estimating the acreage of Eurasian watermilfoil between survey methods was 9 and 11% for 2008 and 2009 respectively. This would suggest that either method for estimating total acreage of Eurasian watermilfoil should yield similar results, although point intercept surveys are more time efficient, but physical mapping provides a better target for application.

Conclusions. A total of 17 aquatic plant species were observed in Noxon Reservoir during the 2009 littoral survey. The aquatic plant community did not significantly change between the 2008 and 2009 surveys. The total aerial coverage of Eurasian watermilfoil increased by 24-39% throughout Noxon Rapids Reservoir from 2008 to 2009. We believe that either the point intercept survey or directed bed mapping can accurately estimate the acreage of Eurasian watermilfoil. However, the point intercept survey requires less time to complete, and the results

are amenable to statistical testing. The Eurasian watermilfoil population should be of concern because if left alone there could be between 400 and 500 acres of Eurasian watermilfoil by 2010 based upon our estimates from 2008 and 2009.

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Table 1. Frequency of occurrence of aquatic plant species in the littoral zone of Noxon Rapids Reservoir between 2008 and 2009.

Plant Species	Common Name	2008 % (n=150)	2009 % (n=150)	p-value
***Butomus umbellatus* L.**	Flowering rush	2	1	**0.65**
***Ceratophyllum demersum* L.**	Coontail	20	23	**0.50**
***Chara* sp.**	Muskgrass	19	21	**0.58**
***Elodea canadensis* Michx.**	Elodea	32	37	**0.35**
***Heteranthera dubia* (Jacq.) Small**	Water stargrass	5	7	**0.48**
***Myriophyllum sibiricum* Komarov**	Northern watermilfoil	19	22	**0.49**
***Myriophyllum spicatum* L.**	Eurasian watermilfoil	10	13	**0.38**
***Nitella* sp.**		2	4	**0.31**
***Potamogeton crispus* L.**	Curlyleaf pondweed	17	11	**0.12**
***Potamogeton foliosus* Raf.**	Leafy pondweed	21	19	**0.54**
***Potamogeton illinoensis* Morong**	Illinois pondweed	1	3	**0.41**
***Potamogeton praelongus* Wulf.**	Whitestem pondweed	0	1	**0.15**
***Potamogeton richardsonii* (Ar. Benn.) Rydb.**	Clasping-leaved pondweed	11	17	**0.19**
***Potamogeton zosteriformis* Fernald**	Flat-stemmed pondweed	2	1	**0.31**
***Ranunculus aquatilis* L.**	White water-buttercup	2	7	**0.05**
***Stuckenia pectinata* (L.) Börner**	Sago pondweed	27	15	**0.01**
Vallisneria americana Michx.	Water celery	1	1	**0.99**
Non-Native Species Richness (No. per point)		0.28	0.25	**0.43**
Native Species Richness (No. per point)		1.6	1.7	**0.45**
Total Species Richness (No. per point)		1.9	2.0	**0.65**
Water Depth (ft)		14.9	16.1	

Table 2. Estimated acreage of Eurasian watermilfoil in Noxon Rapids Reservoir based on the point intercept surveys and bed boundary mapping. One point intercept survey point represents 15.4 acres.

Method	2008 (Acres)	2009 (Acres)	% Change
Point Intercept	247	323	+ 24
Eurasian watermilfoil Bed Mapping	223	364	+ 39

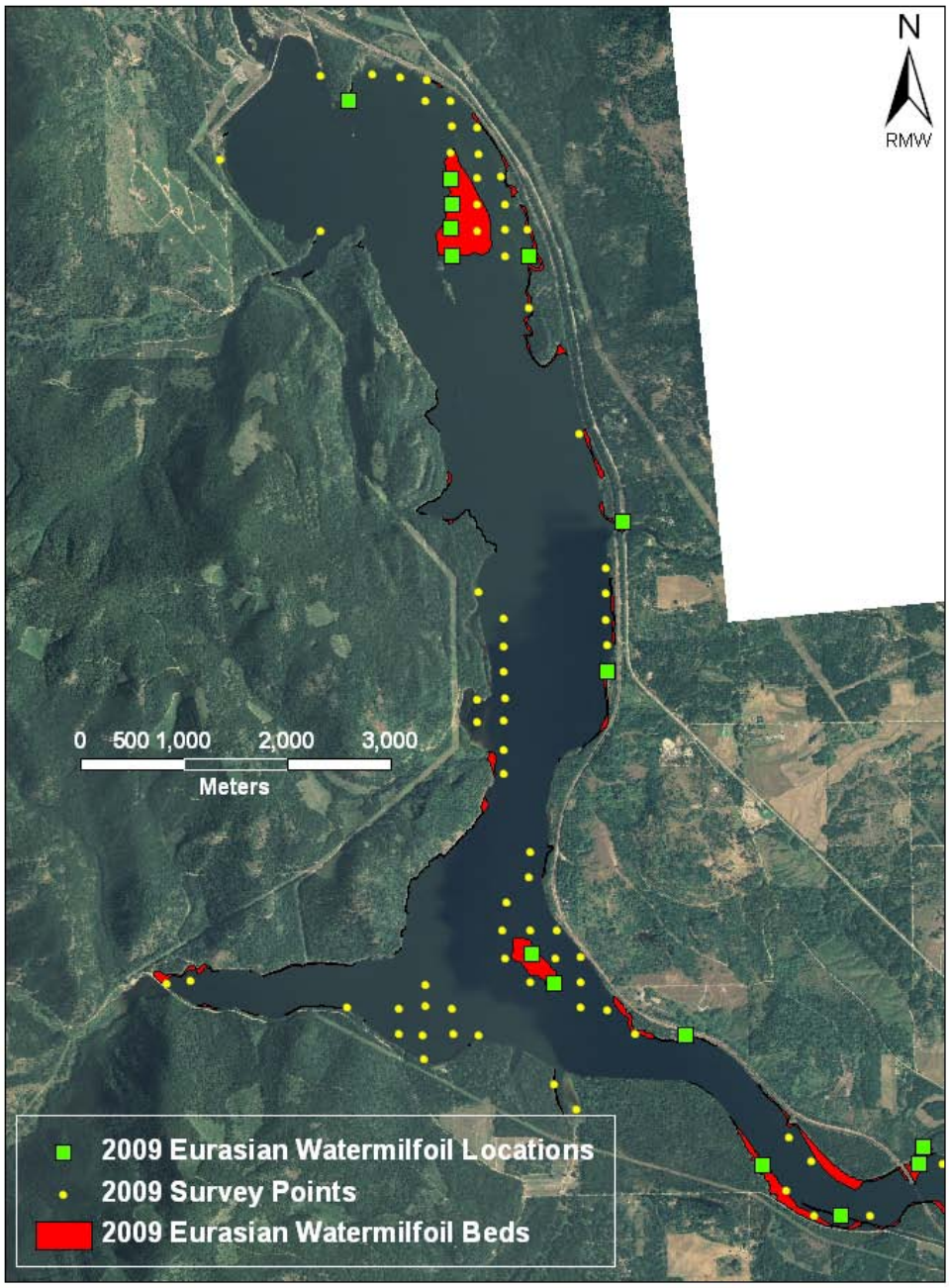

Figure 1. Locations of Eurasian watermilfoil plants and beds located near the dam on Noxon Rapids Reservoir during the 2009 point intercept and mapping surveys. Green squares are point intercept locations with Eurasian watermilfoil, yellow dots are adjacent points without Eurasian watermilfoil, and the red areas are Eurasian watermilfoil beds that have been directly mapped.

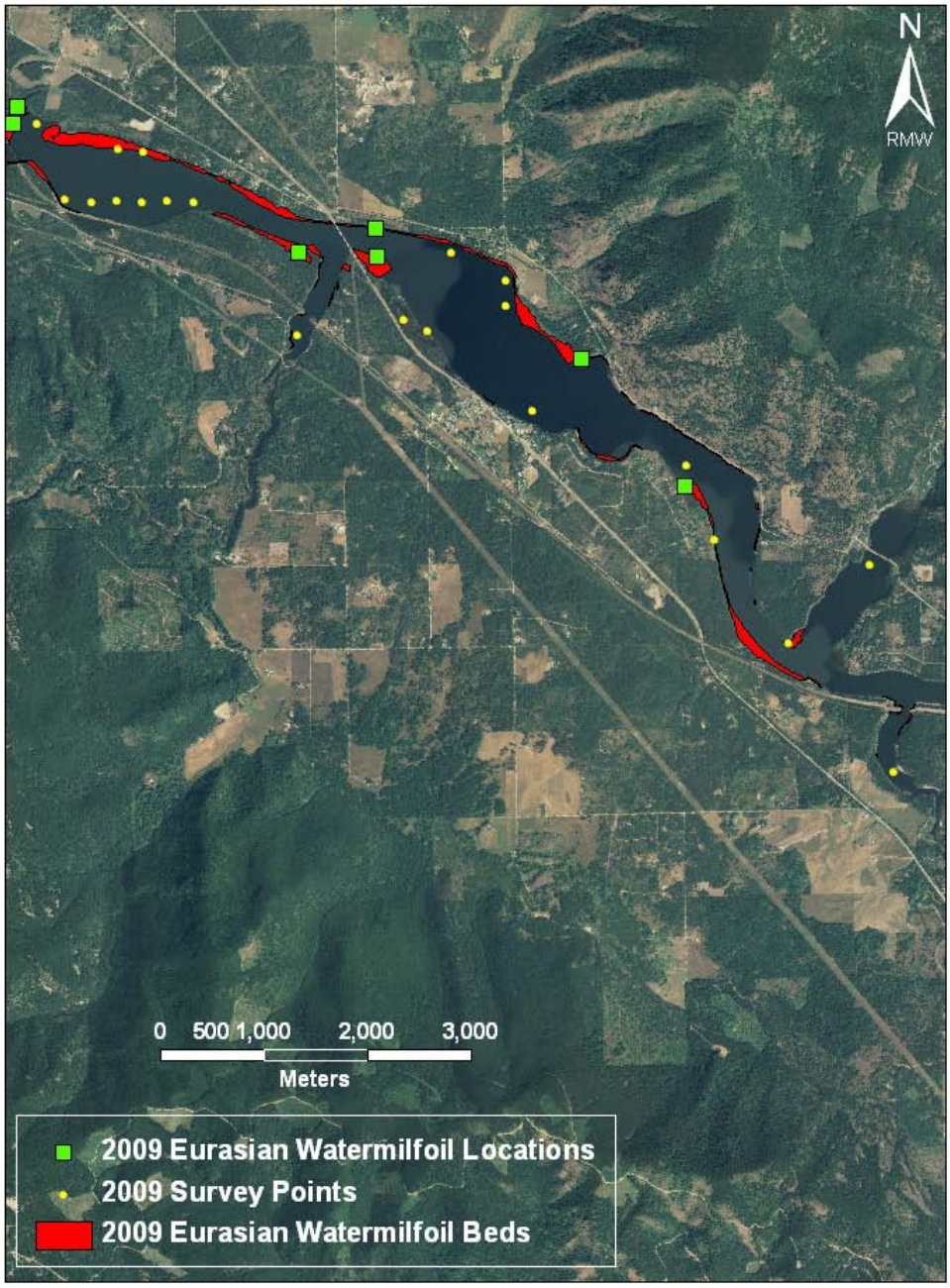

Figure 2. Locations of Eurasian watermilfoil plants and beds located in the central portion of Noxon Rapids Reservoir during the 2009 point intercept and mapping surveys. Green squares are point intercept locations with Eurasian watermilfoil, yellow dots are adjacent points without Eurasian watermilfoil, and the red areas are Eurasian watermilfoil beds that have been directly mapped.

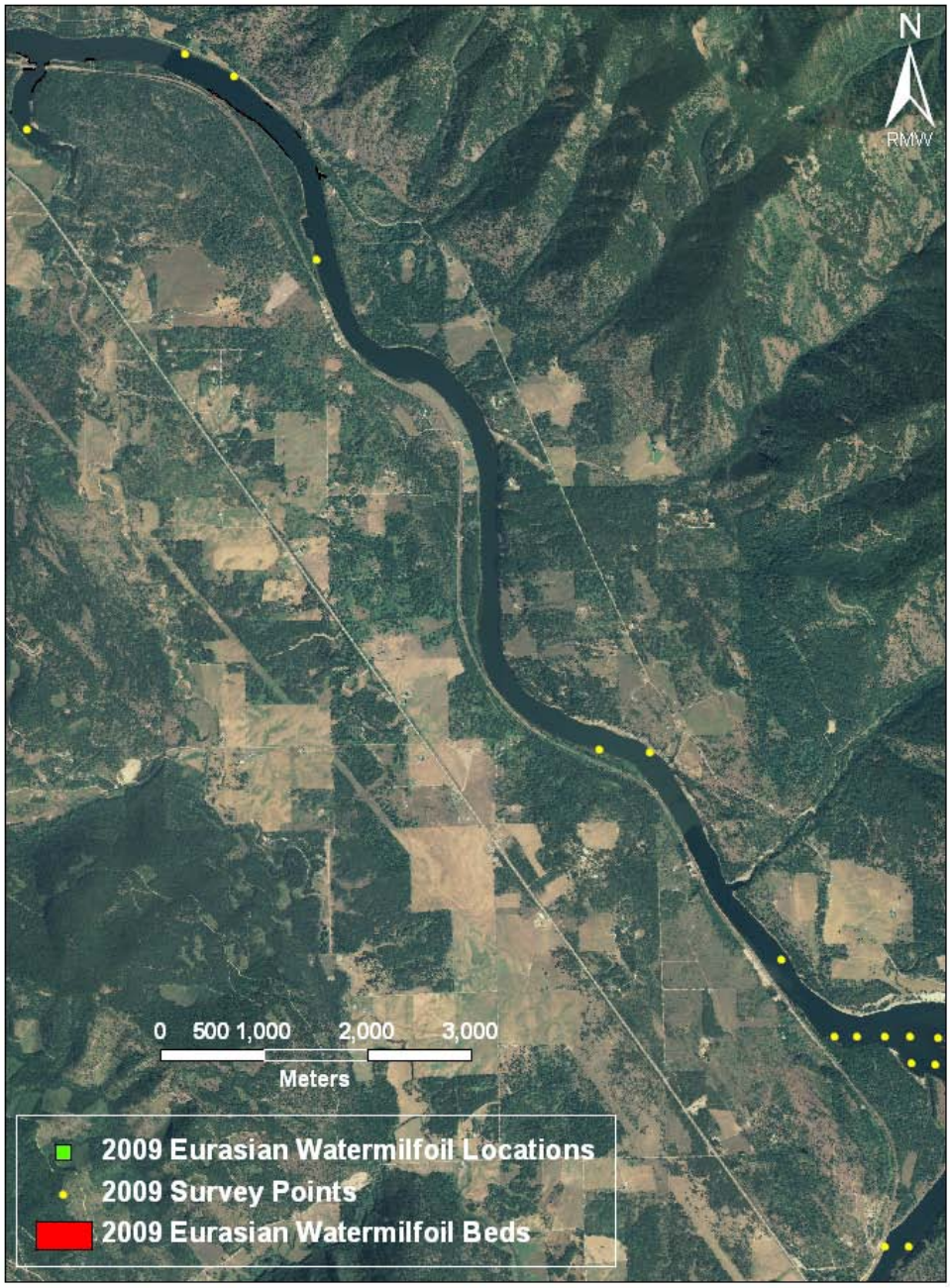

Figure 3. Locations of Eurasian watermilfoil plants and beds located near Finley Flats on Noxon Rapids Reservoir during the 2009 point intercept and mapping surveys. Green squares are point intercept locations with Eurasian watermilfoil, yellow dots are adjacent points without Eurasian watermilfoil, and the red areas are Eurasian watermilfoil beds that have been directly mapped.

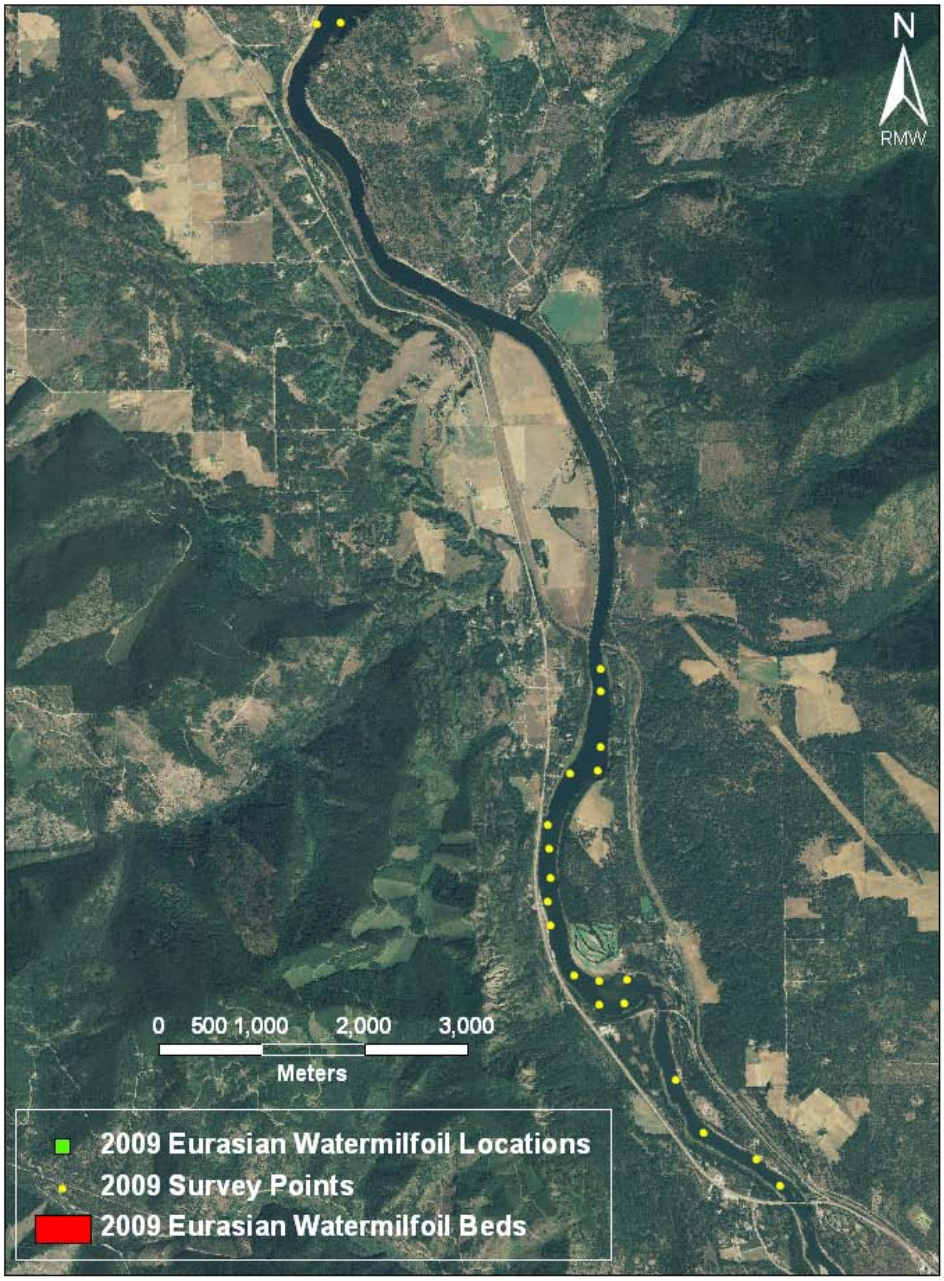

Figure 4. Locations of Eurasian watermilfoil plants and beds located near Thompson Falls on Noxon Rapids Reservoir during the 2009 point intercept and mapping surveys. Green squares are point intercept locations with Eurasian watermilfoil, yellow dots are adjacent points without Eurasian watermilfoil, and the red areas are Eurasian watermilfoil beds that have been directly mapped.