1.0 INTRODUCTION

The Unified Lower Eagle River Chain of Lakes Commission (ULERCLC) has been the successful recipients of Wisconsin Department of Natural Resources (WDNR) Aquatic Invasive Species (AIS) Control Grants for the past eight years as they conduct a project aimed at reducing the Eagle River Chain's Eurasian water milfoil (*Myriophyllum spicatum*; EWM) population. This report specifically discusses the control activities conducted during 2016. The chain-wide results will be presented first followed by results from each lake individually.

Additional information regarding the control actions completed in 2008-2015 can be found in their respective annual reports. Native aquatic vegetation inventories from whole-lake point-intercept surveys are conducted on the chain roughly every 5 years. Through funding from the ULERCLC (and WDNR grant funds), whole-lake point-intercept surveys on all lakes will take place in 2017 during the final phases of the Comprehensive Lake Management Planning Project and compared to surveys conducted in 2006 and 2012.

2.0 2016 CHAIN-WIDE EWM CONTROL STRATEGY RESULTS

From 2007 to 2015, the ULERCLC have coordinated strategically targeted herbicide spot treatments and limited large-scale treatments targeting EWM within the system. The lessons learned over this time period resulted in the ULERCLC developing a strategy where areas would be considered for spot treatment if they meet the following threshold (i.e. trigger):

colonized areas of EWM with a density of *dominant* or greater where a sufficiently large treatment area can be constructed to hold adequate herbicide concentrations and exposure times (CETs)

Based upon this threshold (trigger), no locations in the Eagle River Chain warranted herbicide treatment in 2016. Over the course of control program, EWM colonial acreage has been reduced from 278.2 acres in 2007 to 12.2 acres in 2015 (Figure 1). While no herbicide treatment was conducted in 2016, EWM colonial acreage remained low with a slight increase from 12.2 acres in 2015 to 19.7 acres in 2016 (Figure 1).

Please note that Figures 1 and 2 only represents the acreage of mapped EWM polygons, not EWM mapped within point-based methodologies (*single or few plants, clumps of plants,* or *small plant colonies*). Taken out of context, this figure can be misleading as large increases in EWM colonial acreage may be the results of low-density point-based data increasing to levels that now are best delineated with EWM colonies.

The colonial acreage from the 2016 EWM Peak-Biomass Mapping Survey was found to be 19.7 acres within the Eagle River Chain, a small increase over 2015 and much lower than when the control program started in 2007 (Figure 1). Approximately 77% of the remaining acreage is within Watersmeet Lake, of which the majority is in areas of high water exchange making attaining necessary herbicide concentration exposure times more difficult.

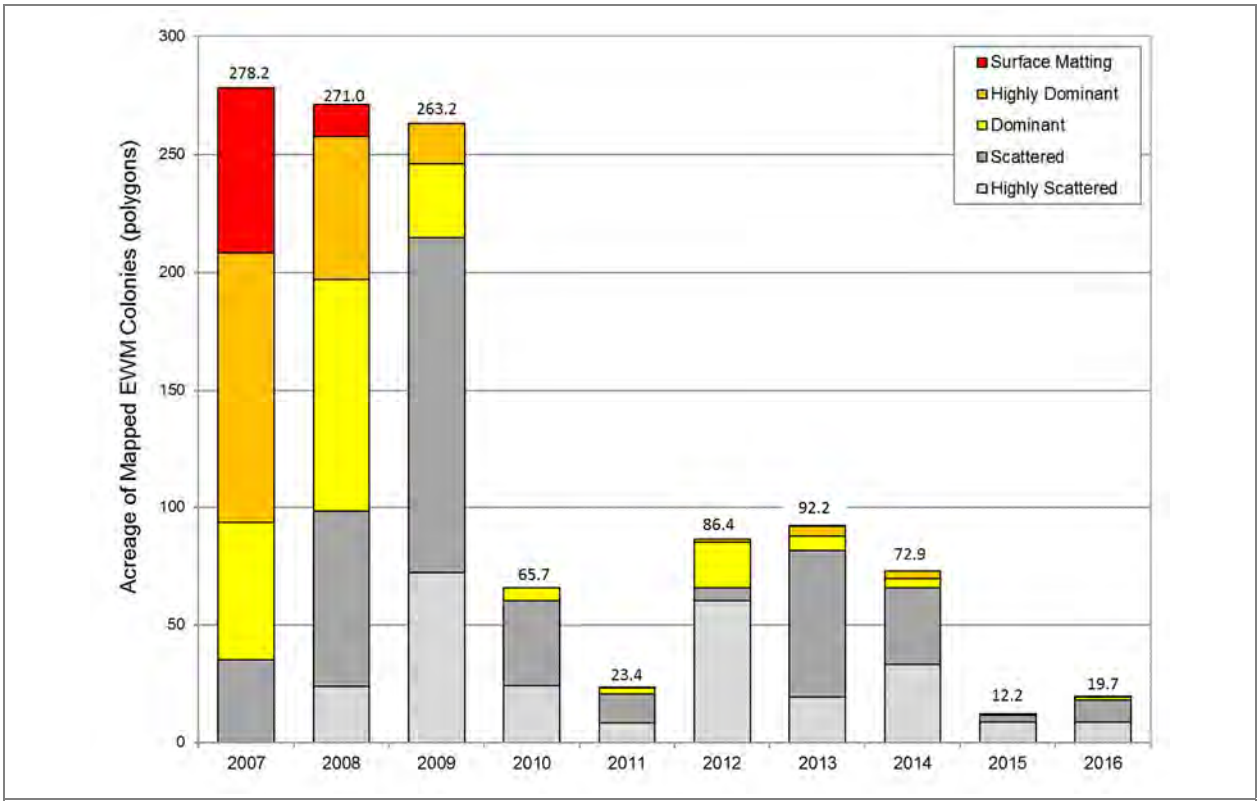


Figure 1. Acreage of mapped EWM colonies on the Eagle River Chain of Lakes from 2007-2016.

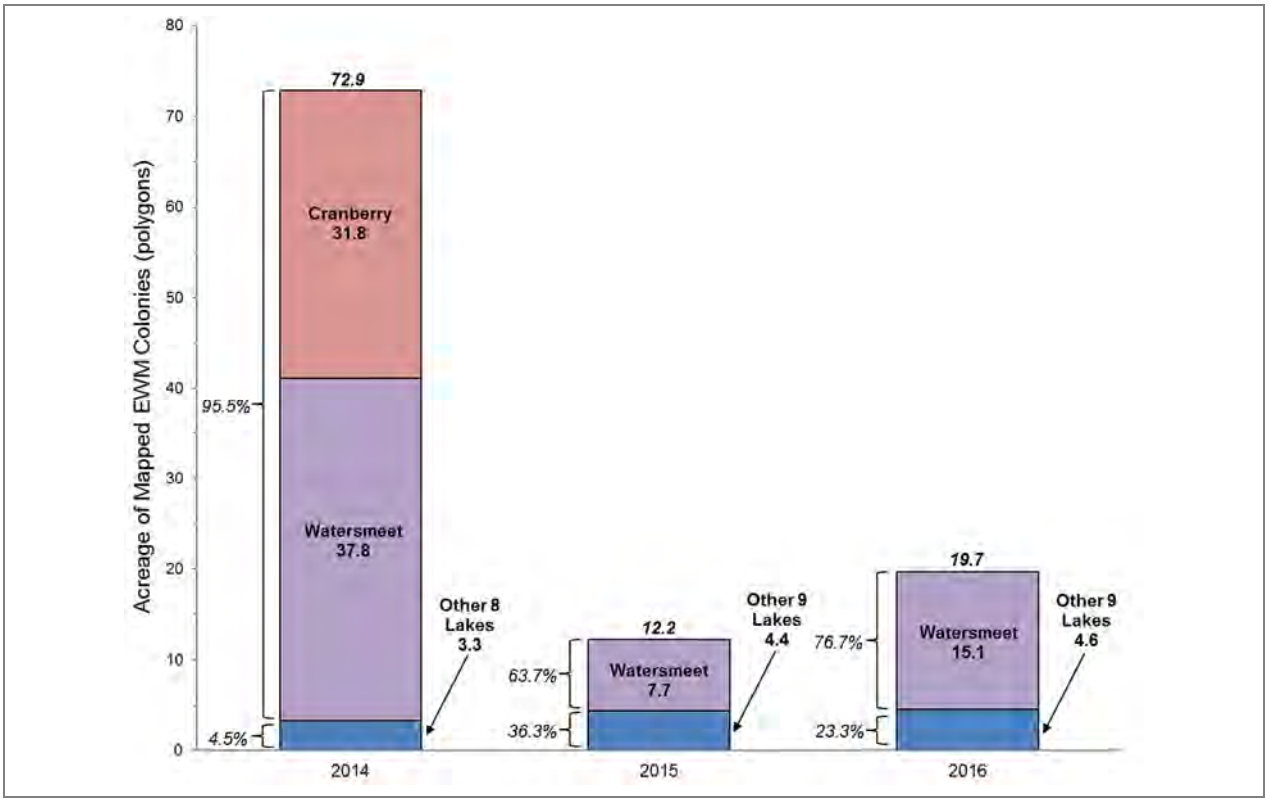


Figure 2. Acreage of mapped EWM colonies on the Eagle River Chain of Lakes from 2014, 2015, and 2016.

Following the 2015 herbicide treatment, the remnant EWM population on the Eagle River Chain of Lakes have been reduced to levels where herbicide treatment strategies are not an effective control strategy. It is extremely difficult in small spot treatment scenarios to keep a sufficient herbicide concentration exposure time (CET) to be effective. Therefore, for the first time since coordinated active management began in 2007, herbicide control strategies did not occur on the Eagle River Chain of Lakes in 2016.

The management strategy for the Eagle River Chain of Lakes has evolved into a strategy to maintain the positive strides in reducing the EWM population. The difficulty of any maintenance strategy is to balance a level of EWM population tolerance while not allowing the population to return to pre-management levels. The ULERCLC did not want to abandon management and simply wait for EWM populations to reach levels that are again applicable for herbicide control. Therefore, the ULERCLC entertained the applicability of a hand-harvesting program for 2016.

The ULERCLC gave consideration to multiple types of hand-harvesting. While volunteer efforts have their role in the management of many lakes, the ULERCLC decided that hiring a third-party firm to conduct these efforts would be appropriate for a pilot program. This would insure they would have an appropriate amount of effort (i.e. person-hours). Traditional hand-harvesting consists of a trained snorkelers or divers to swim to the bottom of the lake and extract an individual EWM plant, roots and all. The plants are transported to the surface one at a time, or are put in a mesh bag underwater until brought to the surface. While on the surface, the plants are placed onto a transport boat until disposal.

Where water clarity is high and target plants are growing in deeper water, a Diver Assisted Suction Harvesting (DASH) program is generally recommended. During this process a scuba diver manually extracts the plant (roots and all) and then feeds the removed plants into vacuum tube that transports the plant to a bin on a boat. They do not, however, simply vacuum the plants up, as that would also take in large amounts of sediment and would be considered suction dredging (requires elaborate permitting). A mechanical harvesting permit from the WDNR is needed (fee of $30 per acre) to use the DASH system. The DASH system is said to be more efficient, as the diver does not have to go to the surface to hand the pulled plants to someone on a boat. The DASH system also is theorized to cause less fragmentation, as the plants are immediately transported to the surface using the vacuum technology. However, the costs of conducting hand-harvesting with one of these firms is more expensive than just hiring trained divers and/or snorkelers.

Hand-harvesting control methods may pose a challenge on the chain due to dark stained water and plethora of native plants in the targeted areas. Because of these factors, using a DASH system on some parts of the Eagle River Chain of Lakes may not be worth the extra costs of implantation. Also, the agility of having professional divers/snorkelers may be advantageous. For these reasons, the ULERCLC piloted a professional-based hand-harvesting program in 2016 using a traditional hand-harvesting approach. Onterra's initial recommendations were to target areas in Voyageur Lake for this pilot program in 2016. The EWM colonies were relatively small and low-density, ideal for this control strategy. These locations were also within one of the higher areas of flow in the system and may not be applicable to future herbicide control strategies.

During the 2016 Early Summer AIS Survey (ESAIS), the mapping of the EWM populations within this part of the chain were refined and a final hand-harvesting strategy was derived (Map Voy 1). Onterra provided the hand-harvesting firm with the with the spatial data from the ESAIS Survey to coordinate the removal efforts.

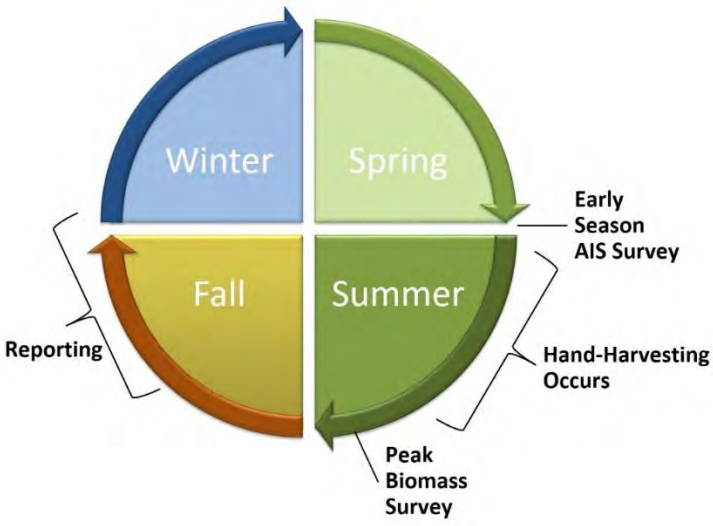


Figure 3. Hand-harvesting project timeline diagram.

As is discussed specifically within the Voyageur Lake Summary and Conclusions Section (4.5), the professional hand-harvesting actions occurred on Voyageur Lake over three days during July. The hand-harvesting strategy appeared to be moderately effective in controlling the EWM population at the targeted sites with an overall reduction in EWM observed between the early-July ESAIS survey and the August EWM Peak-Biomass survey.

3.0 2017 PRELIMINARY CHAIN-WIDE EWM CONTROL STRATEGY

The population of EWM continues to be widespread throughout the Eagle River Chain of Lakes with the majority of occurrences consisting of either point based or low density, polygon based colonies. At current, no areas of the lake exceed the threshold or "trigger" previously developed for implementing herbicide control actions in 2017. Several colonies of EWM in Watersmeet are approaching levels that may meet the predefined trigger. However, these EWM colonies are in areas of high flow were past spot-treatments have produced only short-term successes. Large-scale herbicide efforts have had longer-term results in these areas, but the current level of EWM within Watersmeet is far below levels that would justify this herbicide use pattern. A few locations within the upstream Cranberry Channel are also beginning to see an increase in the EWM population since the spring 2015 treatment, where the plants are forming large enough colonies such that area-based mapping techniques are used.

Based on the results of the 2016 professional hand-harvesting program, the ULERCLC would like to build upon the positive strides gained in 2016 through increasing the amount of professional hand-harvesting effort devoted to EWM control during the 2017 growing season. A preliminary hand-harvesting EWM control strategy for 2017 includes both DASH and traditional hand-harvesting methods. The ULERCLC has identified an EWM population in Scattering Rice Lake in which to implement a DASH harvesting methodology at two sites mapped during the late-summer 2016 survey (Map Scat 1). The ULERCLC would like to target EWM colonies within Voyageur and Watersmeet Lakes through conventional divers in 2017. An Early Summer AIS Survey (ESAIS) will be conducted in 2017 from which a final hand-harvesting strategy would derive. Onterra will provide the hand-harvesting firm with the spatial data from the early-July survey to aid the removal efforts. Following the hand removal efforts, a Late-Summer EWM Peak Biomass Survey will qualitatively assess the hand harvesting efforts (Figure 3).

4.0 INDIVIDUAL LAKE SECTIONS

The remainder of this repot will focus on 2016 EWM monitoring and control strategy assessments (if applicable) on a lake-by-lake basis. Some of the text may seem redundant if one reads each lake section. However, this is intentional to ensure the information is portrayed to those that just read the chain-wide sections and their individual lake-specific section.

4.10 Watersmeet Summary and Conclusions

Following a successful 2015 herbicide treatment in Watersmeet Lake, the EWM population was relatively low and no control actions were undertaken during 2016 (Figure 17, upper right). The EWM was monitored in 2016 through an early-summer and late-summer survey as well as ULERCLC volunteer led monitoring during the summer months.

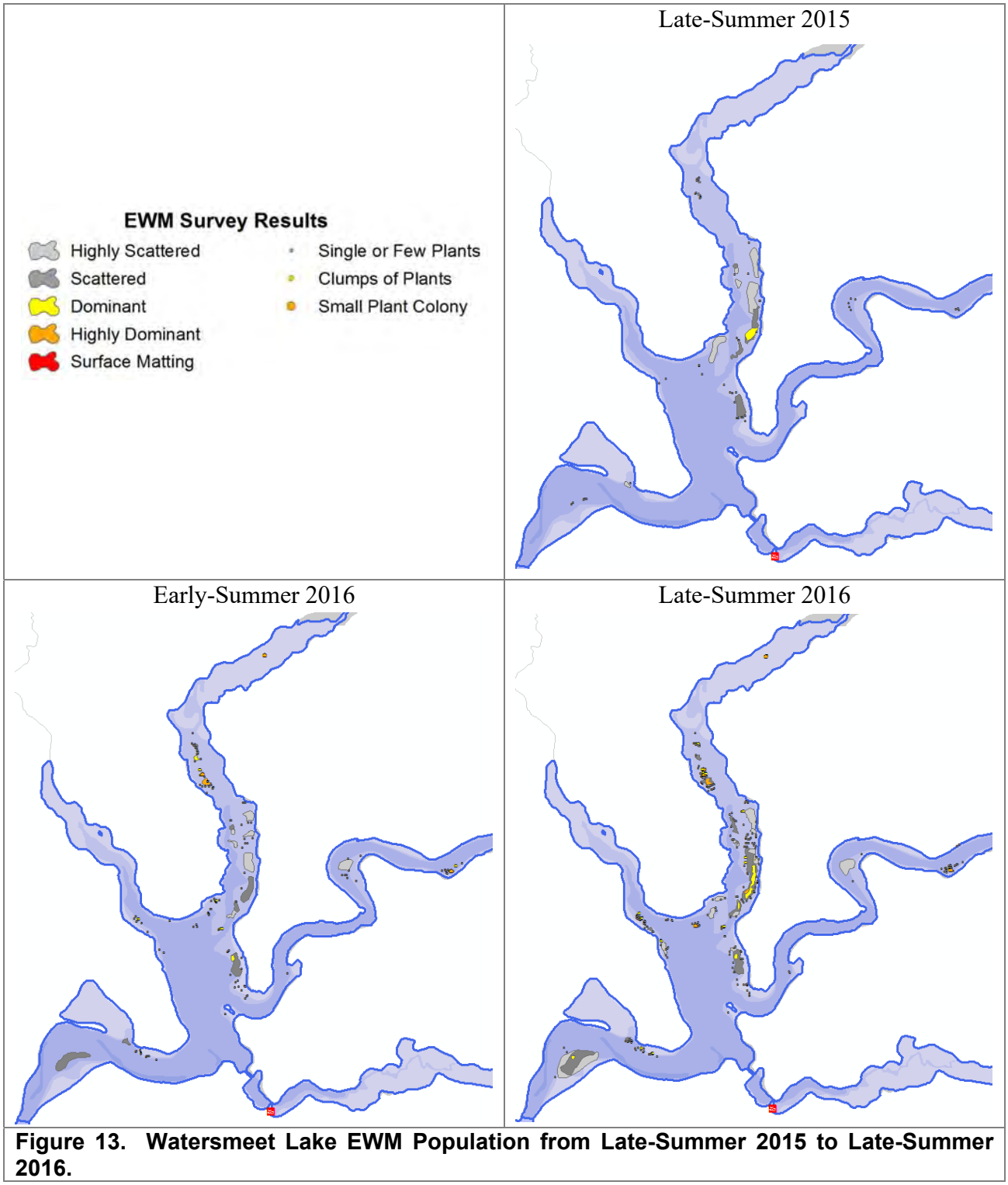


Figure 13. Watersmeet Lake EWM Population from Late-Summer 2015 to Late-Summer 2016.

During the early-summer survey, the entire littoral zone of the Eagle River Chain of Lakes was searched for EWM by Onterra field staff. Completing the Early-Season AIS (ESAIS) Surveys present numerous advantages. Typically, the water is clearer during the early summer allowing for more effective viewing of submersed plants. While not at their peak growth stage (peak biomass), EWM plants are higher in the water column than most native plants during this time of year which increases the chances that even low-density and isolated EWM occurrences would be located.

A small increase in EWM was observed from the 2015 EWM Peak-Biomass Survey (Figure 13, top right frame) to the 2016 ESAIS (Figure 13, bottom left frame). During the 2016 ESAIS survey, low-density point-based EWM including several *single or few plants* and a few *clumps* and *small plant colonies* was mapped. Colonized EWM (polygons) including a few *highly scattered* and *scattered* colonies, two *dominant* colonies, and one *highly dominant* colony were also located during the survey (Figure 13). The results of Onterra's ESAIS survey were loaded onto specific ULERCLC GPS units and trained volunteers were challenged to locate additional EWM occurrences within the chain during the remainder of the summer. The volunteer data were provided to Onterra prior to the late-summer 2016 EWM surveys and integrated into the onboard GPS-enabled computer system.

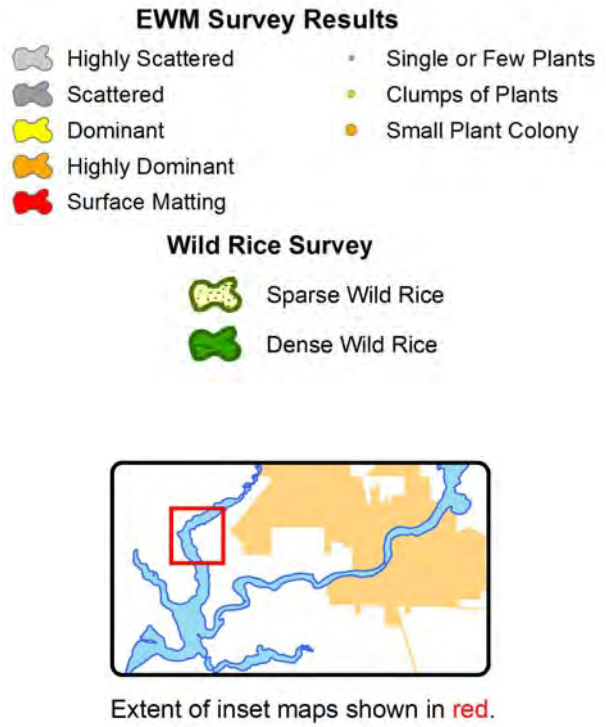
During the Late-Summer 2016 EWM Peak-Biomass Survey, Onterra field crews visited the following areas: all 2015 final herbicide treatment sites, all EWM locations that were located during the Early-Summer ESAIS Survey, and all EWM locations the volunteers located during their mid-summer surveys. The former 2015 herbicide treatment site D-15, located between the Wisconsin River and Rice Creek in the main body of the lake, saw a slight increase in EWM with small, low density colonies and point-based occurrences located in the area during the 2016 Late-Summer EWM Peak-Biomass Survey (Figure 13, lower right; Map Wat 1). While these colonies are approaching levels that may meet the predefined triggers for spot treatment, the water exchange in these areas makes the likelihood of reaching sufficient concentrations and exposure times (CETs) with a systemic herbicide like 2,4-D almost impossible. Therefore, they are not recommended for herbicide control at this time.

Ongoing field trials are assessing the efficacy (EWM control) and selectivity (collateral native plant impacts) of herbicides like diquat that may be effective with a shorter exposure time. On some lakes, the preliminary results appear promising. As a contact herbicide, diquat does not move (translocate) through plant tissue. Therefore, only the exposed plant material is impacted by the herbicide. Concern exists whether this herbicide has the capacity to kill the entire plant, or simply removes all the above ground biomass and the plant rebounds from unaffected root crowns. Diquat also has a high affinity for binding with organic particles. In shallow waters where the application equipment creates disturbance of the lake bottom, the diquat being applied will quickly bind to the suspended particles and be instantly unavailable to cause impacts to the target plants. The velocity of water movement in the Wisconsin River may allow carrying of suspended organic particles, that would also bind to the diquat and neutralize its effectiveness.

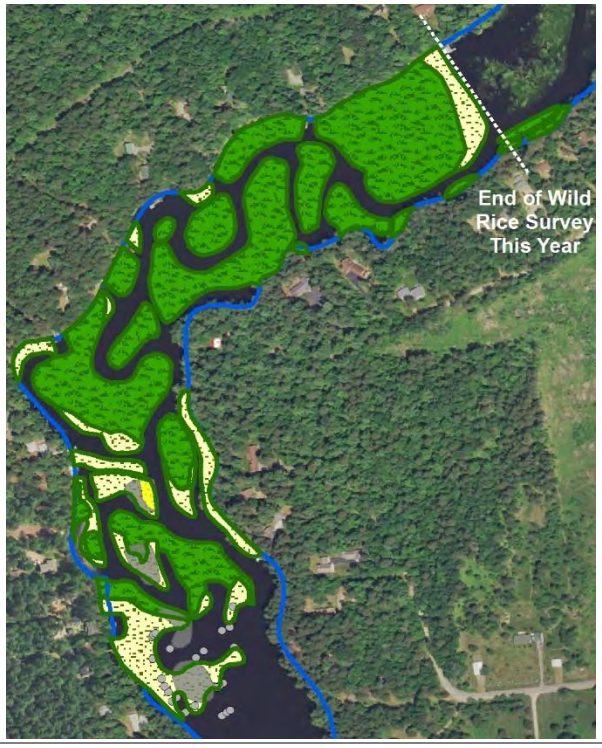
Onterra does not anticipate the use of contact herbicides are appropriate at this time as an insufficient amount of EWM would be targeted to warrant a trial using a new herbicide use-pattern on the Eagle River Chain of Lakes considering the potential challenges to reaching control and unknown selectivity towards the native plant community.

Understanding the current and future limitations of herbicide control actions in Watersmeet, the ULERCLC would like to evaluate the potential role of a professional hand-harvesting effort in 2017. Tentatively, the EWM occurrences along the east shore of Watersmeet between the inlets of the Wisconsin River and Eagle River would be targeted in 2017. This area is relatively shallow and likely most applicable to traditional hand-harvesting methods (i.e. not with DASH). An Early Summer AIS Survey (ESAIS) will be conducted in 2017 from which a final hand-harvesting strategy would derive.

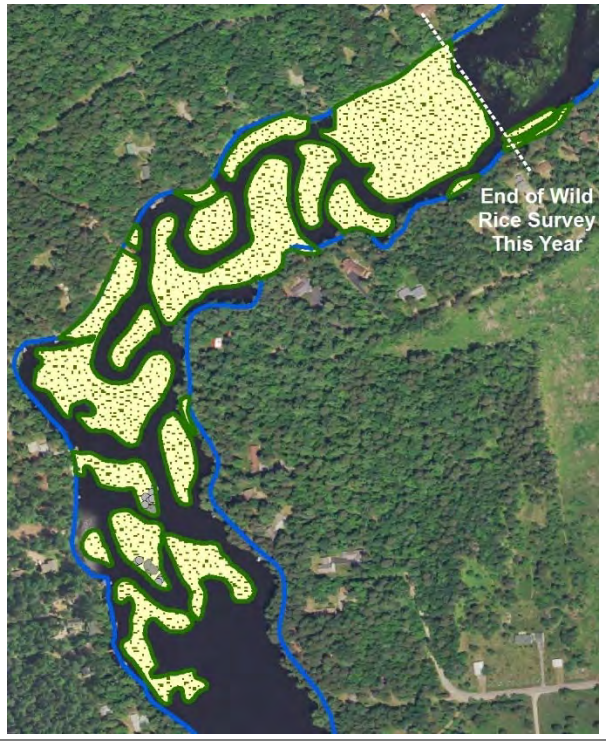
As part of the ongoing control project on Watersmeet, wild rice populations in the upstream Wisconsin River have been monitored from 2011 to current. Colonized, and at times, dense areas of EWM have co-existed in these areas. As can be observed from Figure 14, the populations of both these species have been dynamic during the last 3 years, with 2014 containing the largest and most dense wild rice populations within this time frame and EWM having the lowest population since 2007. The wild rice mapped in 2016 was slightly denser than in previous years and the EWM found within the wild rice colonies consisted of several *single or few plants*, a few *clumps* and *small plant colonies*, one small *highly dominant* colony, and three small *scattered* colonies.



Late-Summer 2014



Late-Summer 2015



Late-Summer 2016

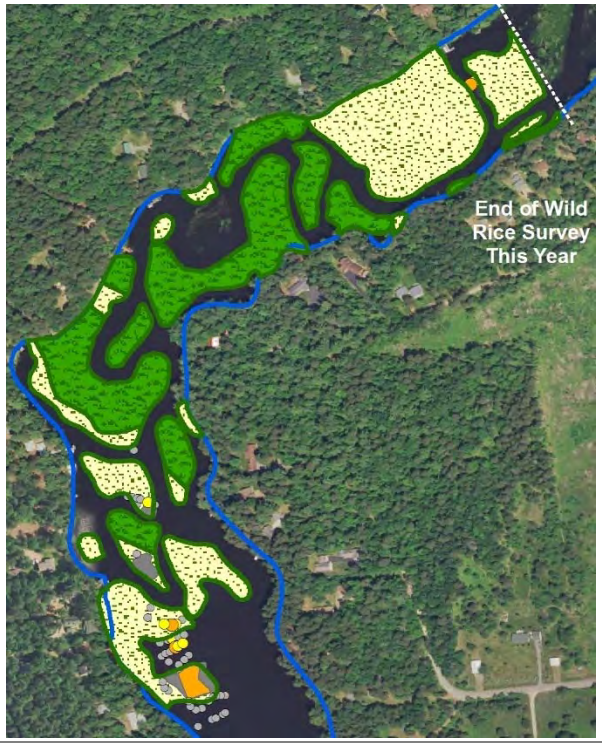


Figure 14. Watersmeet Lake Overlapping EWM and Wild Rice Population from 2014-2016.