Crab Lake Yellow Flag Iris Abatement Report

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1.0 Executive Summary

An increasing effort to eradicate Yellow Flag Iris (***YFI,*** Yellow Iris) from Crab Lake has been invested since the infestation gained broader acknowledgement in 2017. The year 2020 brought about a significant increase in energy invested in abatement efforts and the consequent results have been very encouraging.

In 2017, a wider acknowledgement of ***YFI*** infestation on Crab Lake was realized. This started an organized effort to investigate eradication of the Yellow Iris from Crab Lake.

In order to gain an understanding of the infestation, surveys were begun and methods for abatement were investigated. A summary of the efforts to date is as follows:

1. Approximately 5 of an estimated 14 miles of shoreline has been surveyed to geolocate and document locations of ***YFI***. ***Section 4.0*** lists the survey results and ***Section 6.0*** describes purpose and methodology of surveying for ***YFI***.
2. Along the surveyed shore, 112 locations of Yellow Iris have been identified. A total of approximately 2870 total individual ***YFI*** plants exist across these locations.
3. A total of 71 locations were identified to contain Iris of an unknown species and 25 locations contain **native** Blue Iris.
4. Efforts to abate the known ***YFI*** were started in 2019 and ramped up significantly in 2020. Results of abatement efforts are discussed in ***Section 5.0*** and actual methods for abatement are discussed in ***Section 7.0***.
5. Abatement efforts have resulted in 75 % of the known ***YFI*** being abated in some fashion. 58% have been physically removed and 17% have been treated.
6. Abatement efforts have also removed 12% of plants identified as Unknown Species (unknown as to Yellow or Blue).

2.0 Yellow Iris

Yellow Flag Iris (***YFI***) (iris pseudacorus) is a non-native invasive species, native to Eurasia, that was introduced to the United States as a wetland ornamental and for erosion control. Like many invasive species that are introduced into non-native environments, introduction of ***YFI*** has resulted in unintended negative environmental consequences.

YFI does out-compete native riparian vegetation, including cattails, sedges and rushes, and it degrades native fish habitat, as well as bird nesting and rearing sites. The dense mats this iris forms can move into and crowd out native vegetation, trap sediment, inhibit flow in stream. In addition, the sap produced by this plant is noxious and can cause a negative reaction to humans.

Potential consequences for Crab Lake include:

1. Displacing native shoreline vegetation.
2. Potential introduction into the outlet creek and potential of inhibiting flow.
3. Potential Impact of Loon Nesting Sites.

Yellow Iris was added to the Wis. Admin. Code NR 40 [***2, 3***] Invasive Species Rule on May 1, 2015 as a Restricted Invasive Species. Since 2015, the State has identified that 109 [***4***] state waterbodies have an infestation of ***YFI***. This list is likely significantly shy of actual since records and citizen reporting only started in 2015. Crab Lake has not yet been added to the lists.

Yellow Iris was likely planted on Crab Lake, prior to being designated as restricted, when ***YFI*** was readily available and commonly planted throughout Wisconsin as a favored ornamental.

3.0 Crab Lake Yellow Iris History

The presence of Yellow Iris was first brought to the author's attention by Steve Smith, Greg Wilson, and Bob Wilson at the 2017 Annual CLPOA party. Study to understand and deal with the infestation was begun in 2018 with the expectation that actual abatement could begin in 2019.

Certain CLPOA members had already begun abatement on their own properties. This author would like to acknowledge Steve Smith's early efforts in removal and containment of the infestation. Steve also provided a source of counsel as plans for abatement ramped up.

Typically, by the time an invasive species has reached large-scale awareness, it is already fairly abundant and costs of eradication or control are high, while chances of success are low (***Fig. 3.1***). Infestation can reach a point of exponential growth or biological potential where eradication effort required to eradicate exceeds resources.

Where Crab Lake stands on the colonization curve is unknown due incomplete survey. However, I'm happy to say that I personally believe that eradication is feasible albeit it will be a multi-year effort.

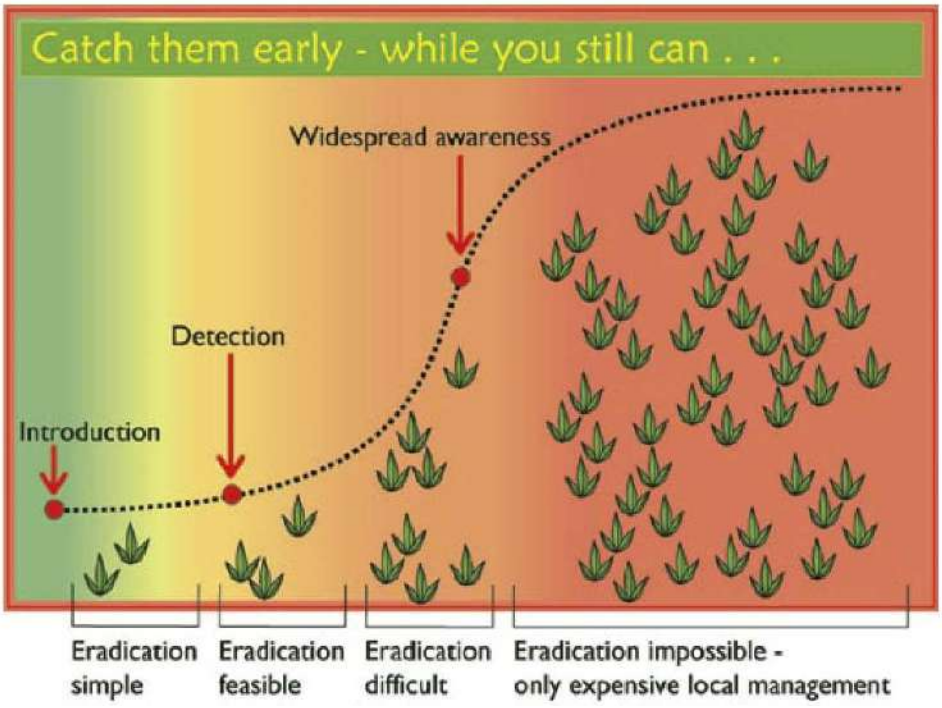

Figure 3.1 *Colonization curve showing relationship between early detection and cost of control. (Reprinted from Ref. 5)*

4.0 Survey Results to Date

Order of Critical Path Items were judged to be:

1. Survey Lake to Ascertain Extent of Infestation.
    a. A detailed description of Surveys is provided in ***Section 6.0***
2. Develop methods for Abatement.
    a. A short discussion on Abatement is provided in ***Section 7.0***
3. Perform Abatement
    a. Early efforts are small in scale to judge best methods and lessons learned.***0***

Surveys of the lake were performed on 6/22/2019, 6/23/2019 and 7/24/2020. The extent of the surveys are depicted in Figure 4.1. The surveys began in the known areas of highest infestation. Surveys have been performed predominantly by wading shore line with one contiguous boat based survey being performed.

The total surveyed shoreline amounts to 4.94 miles of shoreline. The WDNR Historical Lake Map [6] reports total shoreline length as 13.6 miles. Therefore, a total of 36.33% of shoreline has been observed as follows:

1. 3.01 miles (22.16%) has been surveyed in detail via wading.
2. 1.93 miles (14.17%) has been surveyed in detail via boat-based survey.

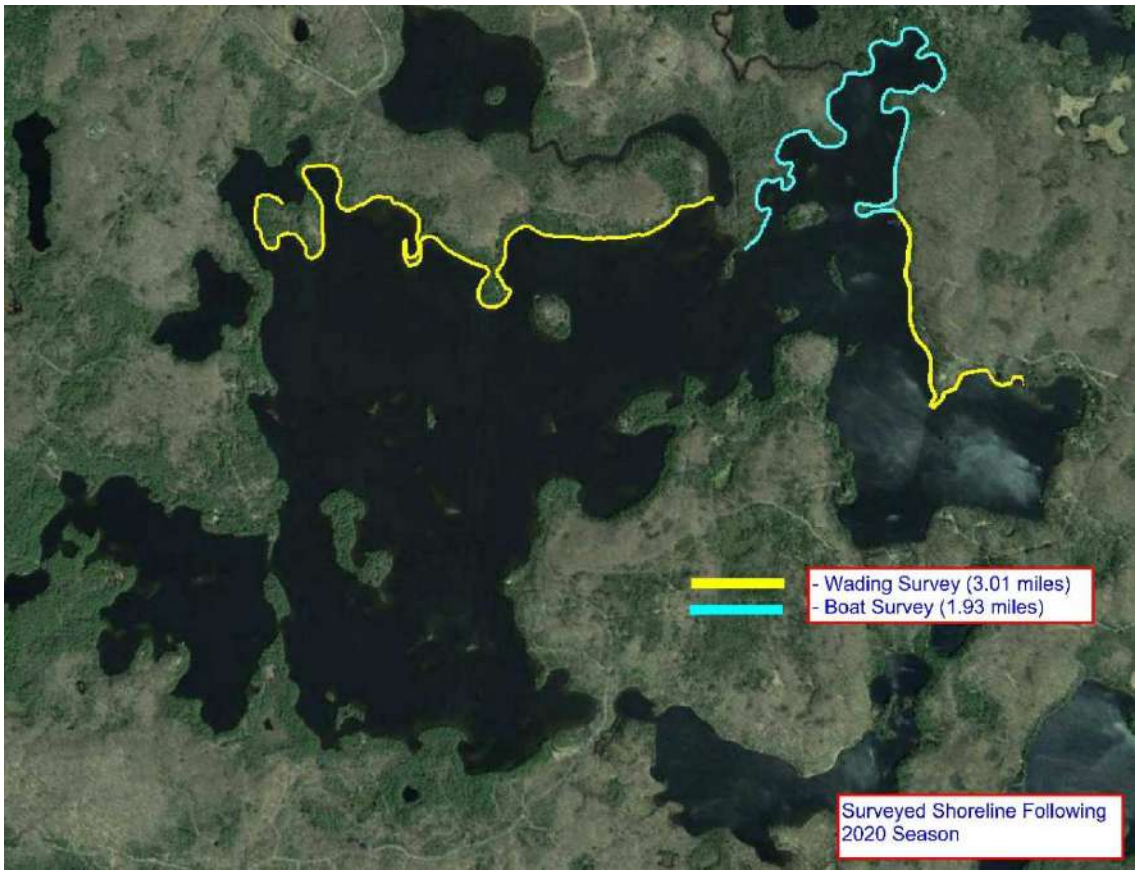

Figure 4.1 Extent of Surveys End of 2020

The Surveys identified locations of Iris and recorded the following information:

1. Geolocation (Latitude and Longitude) via a handheld Garmin 64sc.
2. Species is noted as **Yellow** or **Blue** or **Unknown**. Unknown is noted where neither Yellow nor Blue can be ascertained.
3. Quantity of Leaf Fans.

Early survey efforts recorded only Yellow or Unknown, leaving only Blue Iris unrecorded. As time progressed better practice and interest was identified and both Iris species, either Yellow or Blue, are now recorded. Even though Blue Iris recording has been lacking, it is very clear that the Yellow Iris is the dominant Iris species.

Iris tends to cluster together since propagation does occur via extension and growth from the root (rhizome). Locations exist where only one leaf fan is present while other locations have been found where up to 200 fans were judged to be present. Since every fan cannot be counted, the total fans are an estimate dependent on the accuracy of the author's judgment.

The results of the surveys are tabulated in Table 4.1 and depicted in Figure 4.2.

TABLE 4.1 SURVEY RESULTS

	IRIS TYPE			TOTAL
	YELLOW	UNKNOWN	BLUE	
LOCATIONS	112	71	25	208
FANS	2870	447	357	3674
% of TOTAL LOCATIONS	54%	34%	12%	-
% of TOTAL FANS	78%	12%	10%	-

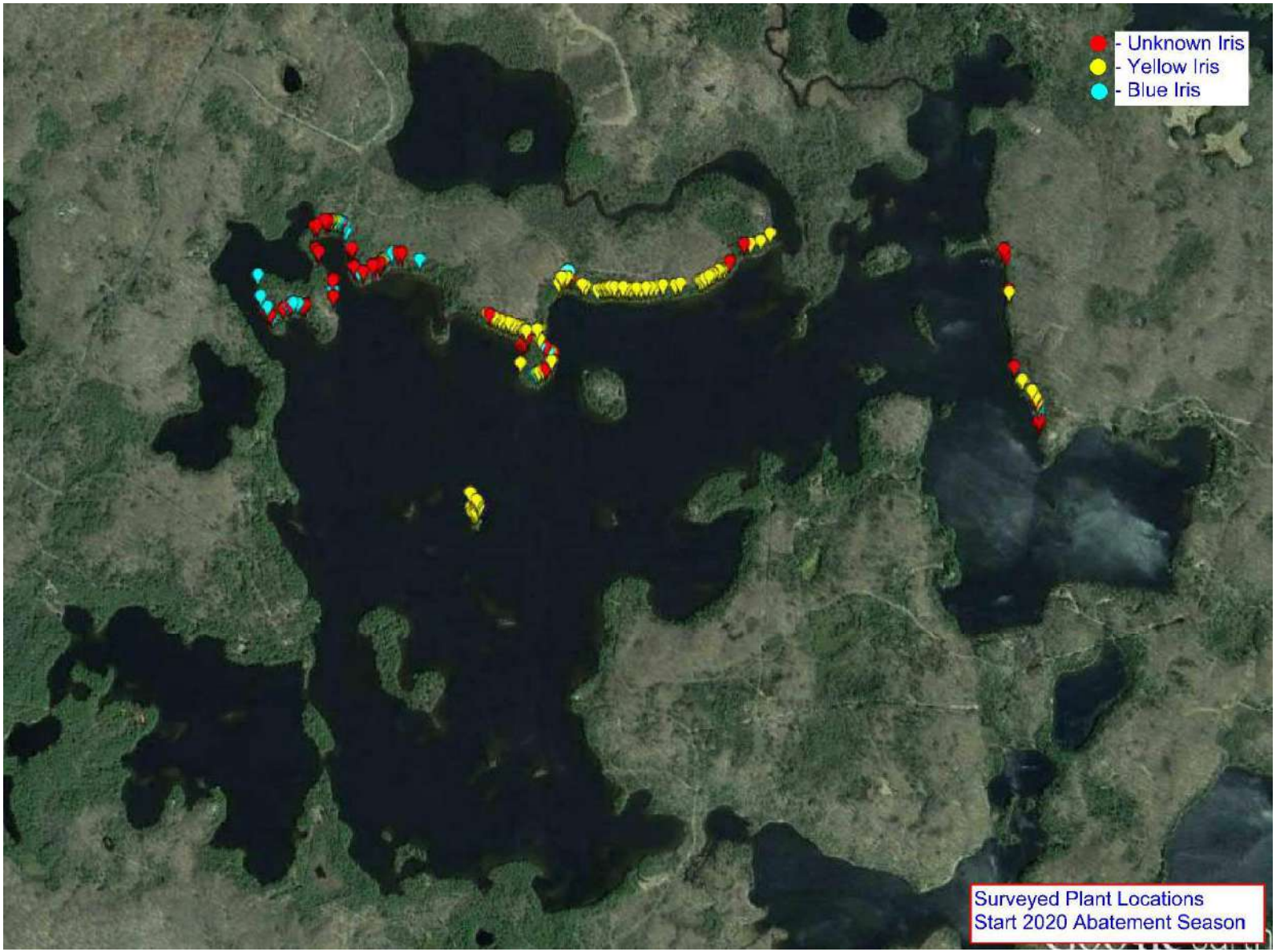

Figure 4.2 Survey Result – All Iris Locations

Figure 4.3 Survey Result – West Extent of Survey Area

Figure 4.4 Survey Result – West Extent of Survey Area

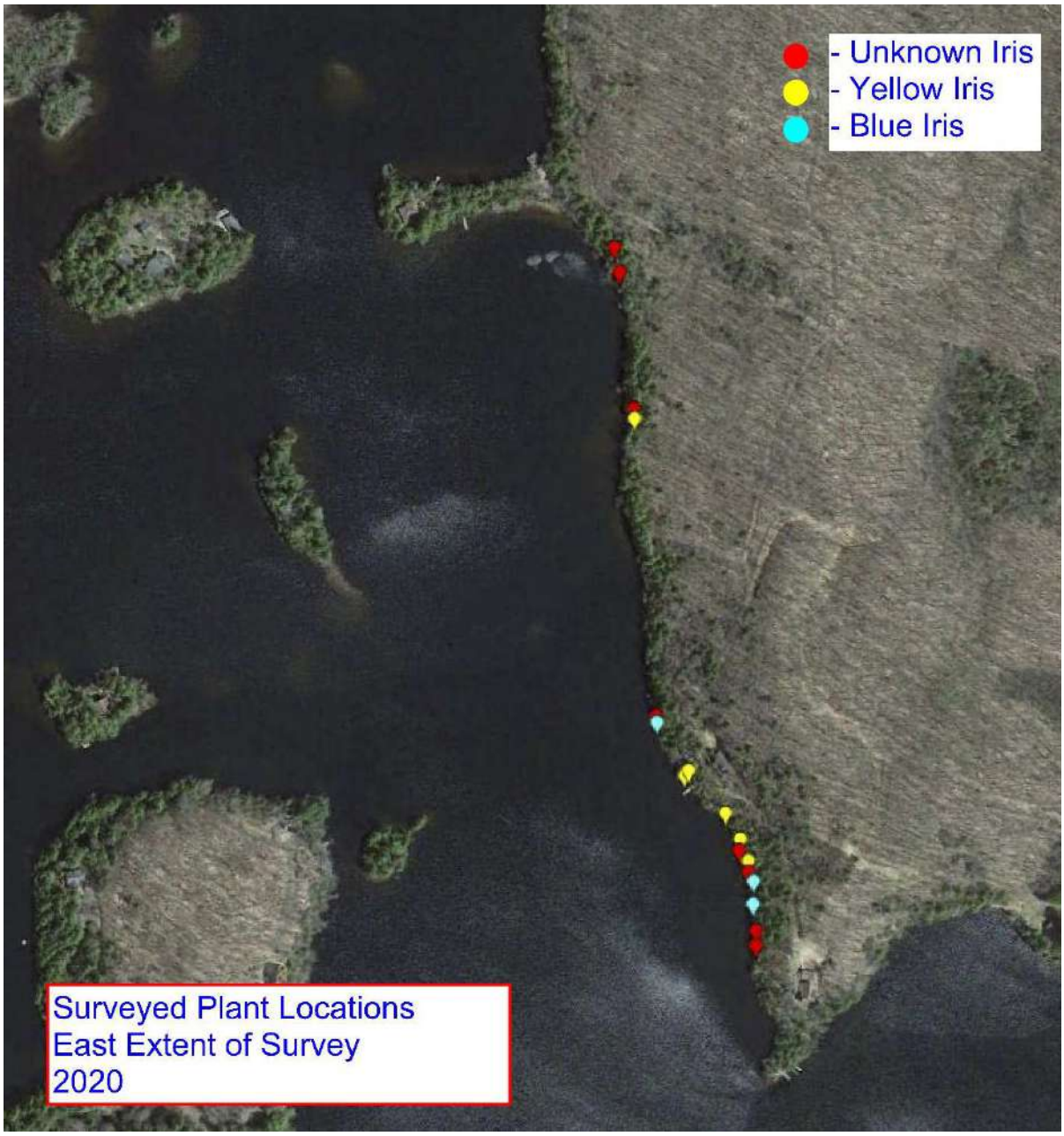

Figure 4.5 Survey Result – East Extent of Survey Area

5.0 Abatement Results to Date

Abatement started in 2019 with removal (via laborious digging) of plants in 3 locations and small scale testing of treatment to ascertain efficacy. Lessons learned contributed to an effective abatement season in 2020. 2020 Abatement focused on the heaviest concentration of Yellow Iris which was along the Graham-Spackling-Smith shoreline. Focusing on this high concentration resulted in favorable results relative to overall reduction of both ***YFI*** locations and Total ***YFI*** Mass (Total leaf fans can be equated with total plant mass).

The data on the 2019-2020 abatement effort is reported in ***Table 5.1*** and ***Table 5.2.*** A summary of the results is as follows:

1. Of a total of 112 *known* Yellow Iris locations, 41.1% were removed and 15.2% treated for a total of 56.5% having been addressed in some fashion.
2. Of a total of 2870 *known* Yellow Iris Leaf Fans, 57.5% were removed and 17.0% were treated.
3. The high percent of plant mass removed relative to locations removed is indicative of the fact that focus was on the heaviest concentrations of Yellow Iris.
4. The total volume of removed plant mass amounted to approximately 3.7 cubic yards (100 cu. Ft.) removed from shore, transported via boat, and disposed of in a burn pit.

The remaining locations of Yellow Iris are more distant relative to each other and contain less mass per location. Therefore, the efficiency of effort achieved in 2020 should be viewed as a very high bar and should not represent expectations moving forward.

Treatment and Removal cannot be expected to be 100% successful. There is an expectation that some unknown percentage of plants that were addressed will return to viability. Continued survey and return for abatement is expected.

TABLE 5.1 ABATEMENT RESULTS
TOTAL LOCATIONS

	IRIS SPECIES	
	YELLOW	UNKNOWN
SURVEY TOTAL	112	71
REMOVED	46	10
TREATED	17	0
% REMOVED	41.1%	8.9%
% TREATED	15.2%	0.0%
SUM=	56.3%	8.9%

TABLE 5.2 ABATEMENT RESULTS
TOTAL MASS

	IRIS SPECIES	
	YELLOW	UNKNOWN
SURVEY TOTAL	2870	447
REMOVED	1650	53
TREATED	488	0
% REMOVED	57.5%	11.9%
% TREATED	17.0%	0.0%
SUM=	74.5%	11.9%

The main 2020 abatement effort is visually represented in the before and after surveys presented in ***Figure 5.1*** and ***Figure 5.2.*** The reasons that ***YFI*** does remain in ***Figure 5.2*** varied. For some ***YFI***, the difficult access precluded removal (digging) and in some cases the lower hanging fruit was targeted to make hay while the sun shined.

Figure 5.1 Survey Result – Pre 2020 Abatement

Figure 5.2 Survey Result – Post 2020 Abatement

6.0 Yellow Iris Surveys

Surveys are performed for two primary reasons:

1. Ascertain extent of infestation.
2. Identify specific plants and areas for abatement.

Surveys are performed using three primary methods:

1. **Wading**:
    a. Most detailed and preferred method due to the natural state of the shoreline. Density of forest and littoral vegetation frequently obscures Iris from view. Close proximity gained by wading is the only option to find some plants.
    b. Close proximity allows for distinguishing:
        i. Type of Plant: Iris, Cattail, Grasses, etc.
        ii. Plant Species: Yellow, Blue, Unknown.
    c. Close proximity allows for more accurate geolocation:
        i. Geolocation (Waypoints) allow for:
            1. Conveying information (see report).
            2. Tracking removal success year over year (see report).
            3. Planning/Discussing removal of specific plants or clusters of plants.
            4. Planning future surveys.
    d. More time consuming relative to boat tour.
    e. Wading is the most accurate and preferred method.
2. **Boat Tour**:
    a. Covers distance rapidly relative to other methods.
    b. Can only identify Iris that is not obscured by adjacent vegetation and is readily visible.
    c. Requires repeated beaching to provide proximity required for identification and geolocation.
3. **Hiking Landside of Shoreline**
    a. Natural shoreline, more often than not, provides either difficult access or inadequate visual perspective for surveying.
    b. Hiking in certain circumstances can provide for an easier and better visual perspective relative to wading.
    c. Hiking is best used as an alternative while wading.

7.0 Abatement

7.1 Abatement Seasons

The species of Iris on the lake is readily identified with accuracy. Therefore, Yellow Iris can be found and removed. However, abatement of the ***YFI*** population is complicated by the presence of native Blue Iris (*Iris versicolor*) on the lake. With a goal of preserving Blue Iris, efforts at removal of ***YFI*** are necessarily limited to periods of the plants lifecycle when the differences between the two are readily discerned.

There are two physical attributes between the two plants:

1. Blossom Color.
2. See Pod Configuration.

The differences in blossom color and seed pod configuration are depicted in ***Figure 7.1***. The difference between the seed pods is very distinct which provides for easy identification when seed pods are present. The Yellow Iris has a 6 sided pod with three seeds per cross section while the blue is 3 sided with 6 seeds.

Figure 7.1 Distinguishing Features Between Yellow and Blue Iris

The distinct differences are only readily apparent during short time frames in the plants life cycle. This essentially creates two seasons for plant abatement where Yellow Iris can be readily and affirmatively distinguished from Blue Iris. The blossoms start to appear between late June to early July and last from approximately 7-10 days. The seed pods develop immediately after the blossoms disappear. Within a week the seed pods mature to a point where

distinguishing features are evident and last until the seed pods fall. The duration that seed pods will remain available for identification is an unknown.

Abatement Seasons:

1. Blossom Season:
    a. Start: Approximately between June 15th to July 4th.
    b. Duration: Approximately 7 days.
    c. Varied Start and Duration presents difficulty in planning. i.e. periodic visitors can entirely miss this season. (someone has to let me know when blossoms show up).
    d. Best time for performing Surveys.
    e. Best time for marking plants for later abatement.
2. Seed Pod Season:
    a. Start: Early July.
    b. Duration: Unknown, likely 2-3 weeks.
    c. Best time for harvesting seed pods to preclude propagation.

A typical abatement step is to remove all Yellow Iris seed pods to preclude further propagation. This action tends to truncate the season where ***YFI*** can be identified by seed pods. However, Yellow Iris can subsequently be recognized by observation for cut flower stems which can inform that the plant had previously been identified as ***YFI***.

Cutting Yellow Iris flower stems during blossom can also preclude further propagation. However, doing this also eliminates the easiest and most distinct feature that distinguishes ***YFI*** form ***BFI***. Since we are currently in the process of identifying extent of infestation, cutting Yellow Iris blossoms is counterproductive, especially since the same plant can be readily identified by the seed pod. Therefore, for the time being, cutting of Yellow Iris blossoms is discouraged unless it is a known cluster.

7.2 Abatement Methods

Yellow Iris can be eradicated with four primary methods.

1. **Removal by Excavation**: Dig out entire root.
2. **Aggressive Cutting**
    a. Continue to cut it back multiple times during each season. This causes plant to expend all energy to sustain growth and will stop blooming, seed production and eventually it will die.
3. **Ground Cover**: Cover plant to block sun light
    a. This method has been judged to be prohibitive based on:
        i. Negative effect on adjacent native plants. Cannot eliminate impact on off-target plants.
        ii. Cost of significant amounts of ground cover.
        iii. Excessive labor to install and maintain cover.
4. **Herbicide**: Via DNR Permit, apply herbicides approved for aquatic use.

Aggressive cutting and Ground cover were never seriously considered for use on Crab Lake. Removal by excavation was adopted as the method of choice with herbicide being pursued to test for efficacy and best practices for use where excavation is not feasible or judged to be too destructive to the shore and adjacent vegetation.

The ***YFI*** expands through growth of the root, called a Rhizome. Rhizomes grow laterally, up to two feet, and fragment creating a clone [*7*]. Large ***YFI*** clumps, comprised of multiple fragments/clones can grow up to a dozen feet or more which has been found on Crab Lake in a number of locations. Rhizomes often become intertwined with adjacent ***YFI*** and native vegetation, and typically achieve a firm grasp on terrain making removal of ***YFI*** labor intensive. The Rhizome must be completely removed as new plants can be generated from portions that remain.

Since ***YFI*** can regenerate from Rhizomes, those that are removed should be burned or properly disposed of at a landfill. Rhizomes should not be composted as there is a significant potential that this will only lead to regrowth and further propagation. Per discussions the Vilas County Invasive Species Coordinator, composting in the north woods typically does not generate enough heat to properly compost and kill plants such as ***YFI***.

Plants should not disposed of away from the shoreline, typically referred to as upland areas, because although ***YFI*** cannot thrive in such areas, it can grow and propagate upland. Iris has been found at Crab Lake to be growing under the forest canopy at a distance approaching 30 feet. Proper disposal of ***YFI*** is crucial to ensuring it does not return to areas that are believed to be remediated.

The removal of ***YFI*** entails the following multiple steps:

1. Complete removal of the ***YFI*** rhizome. Often the leaf fan and other adjacent native vegetation are removed with the rhizome due to what is often an entangled mass. ***Figure 7.2*** shows a typical rhizome for a ***YFI***. ***Figure 7.3*** shows an actual Crab Lake rhizome mass after removal.
2. Collection of rhizome and associated plant material in pails is typical. See ***Figure 7.4*** .
3. Transport via boat to an available landing. See ***Figure 7.5***.
4. Transport to a burn pit, landfill, or other appropriate disposal site. See ***Figure 7.6***.

Figure 7.2 Yellow Iris Rhizomes

Figure 7.3 Entangled Rhizome Mass

Figure 7.4 Harvesting and Collecting Yellow Iris

Figure 7.5 Yellow Iris Boat Transport – Nine 17 gallon pails.

(One of Five Loads removed July 23rd, 2020)

Figure 7.6 Yellow Iris Transport

8.0 Acknowledgements

The author would like to express appreciation and thanks to the following:

- The Graham, MacLean, Smith and Sprackling, families for granting access to their properties and allowing for the 2020 abatement results.
- Barry MacLean for providing access to substantial labor and providing for disposal of all waste from the 2020 abatement effort.
- Jim Giffin who leads the Yellow Iris removal on Lake Minnesuing, Douglas County, WI, and who has offered the benefit of his experience through consultation on lessons learned and best practices for removal of Yellow Iris.
- Steve Smith for his removal efforts and consultation on planning for removal of Crab Lake's Yellow Iris. Steve routinely removed Yellow Iris from his and other's properties as well as cut seed pods to prevent propagation.
- Preston Carli, John MacLean, Marjie Zander for their labor invested in removal of Yellow Iris.

9.0 References

1. WDNR Fact Page Yellow Flag Iris (iris pseudacorus)
2. WDNR Topic Page Invasive Species Rule – NR 40
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4. WDNR AIS List Yellow Iris
5. Higman, Phyllis & Slaughter, Bradford & Campbell, Suzan & Schools, E.. (2020). Early Detection of Emerging Aquatic and Wetland Invasive Plants in Michigan.
6. Wisconsin DNR Lake Map, Crab Lake - Vilas County, Date – Sep 1970 - Historical Lake Map
7. Sutherland, William J. "Iris Pseudacorus L." Journal of Ecology 78, no. 3 (1990): 833-48. Accessed August 30, 2020. doi:10.2307/2260902.