

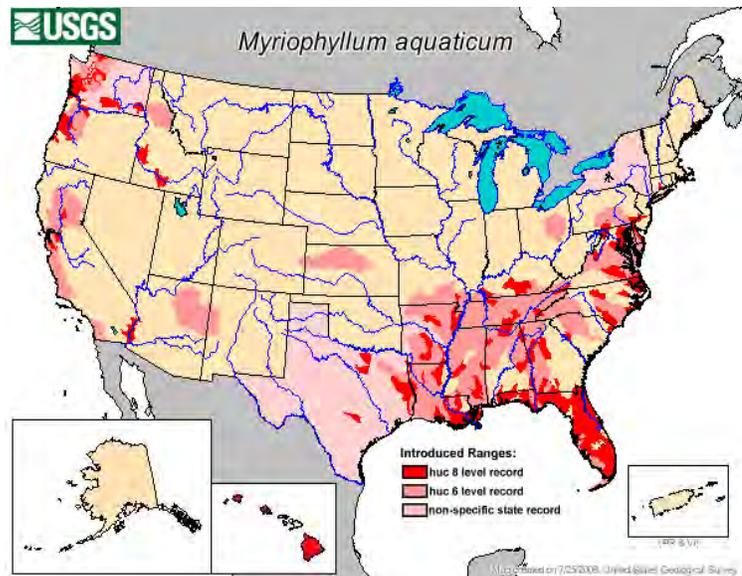


RISK ASSESSMENT FOR PARROTFEATHER (*Myriophyllum aquaticum*)

Myriophyllum aquaticum (Vell.) Verdc. is native to South America. The first known collection of parrotfeather in the United States was in 1890 (Nelson and Couch 1985). Because of its attractiveness and ease of cultivation, parrotfeather has been introduced worldwide for use in indoor and outdoor aquaria. It is also a popular aquatic garden plant. However, it has escaped cultivation and spread via plant fragments and intentional plantings. Parrotfeather is sporadically naturalized across much of the United States.

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Parrotfeather is found in freshwater lakes, ponds, sloughs, and sluggish streams, ditches, and canals. The plant appears to be adapted to high nutrient environments. It tends to colonize slowly moving or still water rather than in areas with higher flow rates. While it grows best when rooted in shallow water, it has been known to occur as a floating plant in the deep water of nutrient-enriched lakes. The emergent stems can survive on wet banks of rivers and lake shores, so it is well adapted to moderate water level fluctuations.



Because only pistillate (female) plants occur in North America, all reproduction is asexual. Even in South America, virtually all parrotfeather plants are female. Male plants are unknown outside of South America, so no seeds are produced in North American populations. Since parrot feather also lacks tubers or other specialized reproductive overwintering structures like turions, it spreads exclusively by plant fragments outside of its native range. Unlike Eurasian watermilfoil which is of the same plant genus, parrotfeather does not form autofragments. However, fragments can be

formed mechanically and will readily root. Parrotfeather forms creeping rhizomes which may give rise to multiple stems. With its tough rhizomes, parrot feather can be transported long distances on boat trailers. Rhizomes stored under moist conditions in a refrigerator survived for one year.

Populations of parrotfeather may become quite dense and completely colonize small ponds and sloughs and impede water flow in drainage ditches and irrigation canals. It may also outcompete and replace native species that are of more value to fish and wildlife. While parrotfeather may provide cover for some aquatic organisms, it can seriously change the physical and chemical characteristics of lakes and streams. Infestations can alter aquatic ecosystems by shading out the algae in the water column that serve as the basis of the aquatic food web. In addition, the plant provides choice mosquito larvae habitat. In California, the species is becoming an increasing problem in



irrigation and drainage canals. California indicated that parrotfeather infested nearly 600 miles of waterways and over 500 surface acres in 1985. In Washington, the Longview Diking District estimates that it spends \$50,000 a year on parrot feather control in drainage ditches. Dense infestations in southern Africa have caused flooding and drainage problems in shallow rivers and streams. The plant can also restrict recreational opportunities in these bodies of water.

The six states of Alabama, Connecticut, Maine, Massachusetts, Vermont, and Washington currently regulate the possession of parrotfeather. Horticulture industry lists parrotfeather as a Zone 4 hardy plant which would place the northernmost range in the northern Lower Peninsula of Michigan according to 1990 USDA Plant Hardiness Zone Map and well into the Upper Peninsula according to the proposed 2006 National Arbor Day Foundation Plant Hardiness Zone Map.

CONTROL OPTIONS

Although parrotfeather is considered by some to be susceptible to herbicides, it is difficult to achieve complete control. The emergent stems and leaves have a thick waxy cuticle and it requires a wetting agent to penetrate this cuticle. Often the weight of the spray will cause the emergent vegetation to collapse into the water where the herbicide is washed off before it can be translocated throughout the plant. Westerdahl and Getsinger report excellent control of parrotfeather with 2,4-D, diquat, diquat and complexed copper, endothall dipotassium salt, and endothall and complexed copper. Fair control was obtained with glyphosate. Control of parrotfeather may be achieved with low-volatility ester of 2,4-D sprayed onto the emergent foliage. The granular formulation of 2,4-D was

needed to control parrotfeather for periods greater than 12 months. It is more effective when applied to young, actively growing plants. In actual practice, the Longview diking district (Washington) report little success with using herbicides to control parrotfeather. Glyphosate causes the emergent vegetation to turn black but within two weeks the plants have recovered. An experimental fall application of triclopyr to parrotfeather also proved to be ineffective.

Because this plant can spread readily through fragmentation of rhizomes, mechanical controls such as cutting, harvesting, and rotoation (underwater rototilling) should be used only when the extent of the infestation is such that all available niches have been filled. Using mechanical controls while the plant is still invading, will tend to enhance its rate of spread. Parrotfeather populations can be successfully harvested, but the dense tough rhizomes are very heavy and the plant regrows rapidly.

Parrotfeather has a high tannin content, so most grazers, including grass carp, find it unpalatable. Grass carp also prefer soft plants, like *Elodea canadensis* and the tough, woody parrotfeather stems are not preferred. While biological control agents are not presently available, potential agents do exist. A complex of insects feed on parrot feather in its native habitat. *Lysathia flavipes* (Boheman), a flea beetle found on parrot feather in Argentina, causes moderate damage to parrotfeather under field conditions. Also found in Argentina is a weevil, *Listronotus marginicollis* (Hustache), that apparently feeds only on parrotfeather in its native range.

Additional insects have been found on parrotfeather in Florida. *Lysathia ludoviciana* (Fall.), a flea beetle native to the southern U.S. and Caribbean, will use parrotfeather as a host plant for larvae under laboratory conditions. However, the flea beetle is not often found on parrotfeather in the field. Two members of the tortricidae family, *Argyrotaenia ivana* (Fernald) and *Choristoneura parallela* (Robison) have also been found on parrotfeather in Florida, but their effect on the plant is unknown. In addition, larvae of the caterpillar, *Parapoynx allionealis* (Walker), mine parrotfeather leaves, but the impact these larvae could have on parrotfeather is also unknown.

Fungal control options exist, as well. An isolate of *Pythium carolinianum* Matt. collected in California has shown some promise as a potential biocontrol agent. Parrotfeather stems that were experimentally inoculated with this fungus produced significantly less growth than control plants.

ASSESSMENT OF THREATS

There is no question that all of Indiana has climate conditions suitable for the establishment of parrotfeather. The extent of the plant's hardiness is well north of Indiana no matter what zone map is used. In addition, parrotfeather has established in one of the northern tier counties in the state confirming that this plant more commonly found in the south can overwinter in Indiana. This plant has also been reported from several private ponds in central and southern Indiana. Since the plant is not currently

regulated in Indiana, chemical treatment has been suggested to pond owners but not required.

According to water garden growers and aquarium hobbyists involved with the Indiana aquatic plant assessment work group, all indications are that parrotfeather is one of the more popular aquatic plants in trade. Water gardens have grown in popularity in the last 10 years or more. As more water gardens are used, it is likely that more parrotfeather will be planted and some of it will either escape through pond outfalls or it may be intentionally disposed of in a natural waterway. Some purchasers of parrotfeather may even plant this species in natural bodies of water when they are unaware of the invasiveness of this plant.

Unlike most other invasive aquatic plants already in the state, parrotfeather has the ability to colonize a wide range of niches. The plant is capable of establishing in relatively deep water, shallows, and even in moist sediments. In Meserve Lake parrotfeather is found established in water 12 feet and deeper and all the way up to the shoreline. Due to its wide range of habitat preferences it has the ability to compete with submersed, emergent, and floating leaved plants.



Parrotfeather has proven to be a difficult plant to control, often requiring multiple treatments to eliminate. Fortunately herbicides that selectively eliminate broadleaf plants can be used to control parrotfeather. When these types of herbicides are used, the extent of non-target damage is minimized. As with most plant controls, it is recommended that herbicide treatments occur when plants are young and actively growing.

The only method of reproduction of parrotfeather is through fragmentation. As the plant is fragmented, other suitable areas of the waterway can become infested. In addition, downstream areas are at risk of invasion as fragments float with water currents. Finally, poorly inspected watercraft and trailers moving from a parrotfeather infested body of water is a threat to transport viable fragments long distances. Without controls applied, the plant can easily be spread from its original site of infestation.

When comparing parrotfeather to other Indiana aquatic plant invaders it is certainly not the most worrisome plant, but there are enough reasons to be concerned. Fortunately parrotfeather only reproduces by one means, fragmentation. Hydrilla has two important means of reproduction, fragmentation and tubers, and two less important, seeds and turions. Curlyleaf pondweed spreads by fragmentation and turions. Eurasian watermilfoil's main means of reproduction is fragmentation and Brazilian elodea's only means is fragments. Both Eurasian watermilfoil and Brazilian elodea go through a period of autofragmentation where the plants intentionally break apart to allow spread. Fortunately parrotfeather, though closely related to Eurasian watermilfoil, does not autofragment. While reproduction of parrotfeather is not as threatening as other invasives, the difficulty of control is of great concern. Plants like hydrilla, Eurasian watermilfoil, and curlyleaf pondweed are relatively easy to kill with herbicides. Parrotfeather is reportedly difficult to treat and often requires multiple treatments to achieve good control.

At this time, parrotfeather has limited distribution in Indiana. As a new invader, there is still a chance that this species can be eradicated from the state but only if new introductions are halted and eradication steps begin where existing populations occur.

RECOMMENDATIONS

The following are recommendations to prevent the introduction and spread of parrotfeather in all Indiana waters:

1. Develop an administrative rule that prevents the sale and possession of parrotfeather in Indiana. This is one plant that the Indiana aquatic plant assessment work group has recommended banning due to its invasiveness. In the meantime, those involved in the water garden trade (wholesale, retail, and customers) should be advised about the invasiveness of parrotfeather and urged to not sell or purchase this plant.
2. Require that only lawful methods of control must take place in locations where parrotfeather is established. (i.e. herbicides without an aquatic use label may not be used).
3. Most chemical controls should begin on large parrotfeather infestations when the plant begins actively growing in the spring or early summer. Treating when young and actively growing generally results in better plant kills. In addition when less biomass is being eliminated early in the season, there is less risk of oxygen related fish kills. In instances where a large parrotfeather infestation is discovered well into the growing season, treatment during less than optimal times may be performed when there is a threat of spreading to other waters. When single plants or small patches of parrotfeather are found, treatment should begin immediately so that the population is not allowed to expand.
4. Boaters should thoroughly inspect boats and equipment to prevent moving parrotfeather or other aquatic invasive species to other waters.

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Compiled by: Doug Keller, AIS Coordinator
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