Biology, Ecology and Management of

Flowering Rush

(Butomus umbellatus)

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Flowering rush is a non-native aquatic resembling a large sedge that grows along lake shores and slow moving water bodies. In Montana it was recorded in Flathead Lake in 1964 and has spread to Thompson Falls, Noxon Reservoir, Cabinet Gorge, portions of the Flathead River, and the Clark Fork River. Prolific growth in irrigation ditches reduces water availability, and dense stands in previously unvegetated areas inhibit boating, fishing and swimming. Minor disturbances cause the roots to fragment, providing long distance dispersal. At this time, control methods are limited. Hand digging has led to mixed results as rhizomes fragment easily, increasing dispersal. Studies on chemical control options are ongoing.

PLANT BIOLOGY

Identification

Flowering rush is an aquatic species resembling a large sedge (cover photo) that may grow as an emergent plant with upright foliage in shallower waters (shoreline to roughly 10 feet [or 3 m]), or a submerged plant with flexible leaves suspended in the water column in deeper waters (approximately 10-20 feet [3-6.1 m] depths). The roots are fleshy and **rhizomatous** (Figure 1). Leaves are triangular in cross section, narrow and twisted toward the leaf tip (Figure 2). Flowering rush belongs to its own family, Butomaceae.

Flowering rush is easy to identify when flowering; 20-50 flowers grow in a round cluster that resembles an umbrella, hence the species name *umbellatus* (cover). Individual flowers are ¾ to 1 inch (2-2.5 cm) wide, consisting of six light pink to rose-colored petals. The three outer petals, which are actually **sepals**, are smaller and may be slightly greenish. Flowers have nine **stamens** (Figure 3) arranged in an outer whorl of six and an inner whorl of three. There are six **carpels** (Figure 3), each of which can produce about 200 seeds.

FIGURE 1. Fleshy rhizomatous roots. The arrows point to the white knobby structures from which new leaves will emerge. (photo by Peter Rice)

FIGURE 2. Leaves are triangular in cross section. (photo by Gary Fewless)

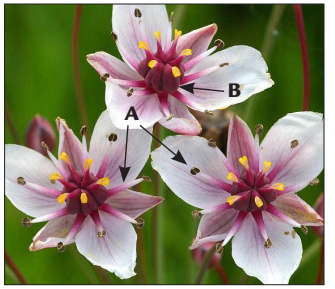

FIGURE 3. Close-up of flower - (A) Stamens, 9 total; (B) Carpels, 6 total. (photo by Christian Fischer)

Despite the name, not all flowering rush plants flower regularly. The plant occurs as two types: one that flowers regularly and produces viable seed, and a second type that flowers occasionally, but the flowers are sterile. Populations in Montana are the latter type; in some years flowering will occur sporadically, but in other years plants will not flower at all. For an explanation on the biology behind these types, see 'Genetics of fertile and sterile flowering rush' on page 7. When not flowering, identification can be difficult with only the large, sedge-like leaves. Refer to SpeedyWeed ID, and contact your county Extension agent or weed coordinator for assistance.

SpeedyWeed ID

You might have heard the saying 'sedges have edges, rushes are round', but unfortunately this memory jogger is not useful for flowering rush. Despite its common name, only the flowering stalks are round. While the leaves have edges like sedges, flowering rush is not a sedge either, but belongs to its own family, Butomaceae. Although it could be confused with sedges, flowering rush is typically much larger. Additionally, the leaves feel spongy and rebound when squeezed.

Leaves • Twist spirally at tips (when emerged). • Spongy and compressible. • Upright, triangular in cross section (Figure 2) and up to 6 feet (1.8 m) long (leaves of the submersed form are limp and may be up to 10 feet [3 m]).

Flowers • Umbrella-like form with 20-50 flowers per cluster (cover photo). • Six pink petals per flower (Figure 3). • Nine stamens per flower (Figure 3).

Roots • Fleshy, rhizomatous.

Accurately identifying invasive species is critical prior to initiating any control program. For example, the native bristly sedge *(Carex comosa)* resembles flowering rush (but is typically smaller), and it is a species of concern in Montana. There is only one known location in the state - the shore of Flathead Lake.

If you think you've found flowering rush, contact the Montana Department of Agriculture at (406) 444-3140, the Montana Fish, Wildlife and Parks Aquatic Nuisance Species Coordinator at (406) 444-2449 or your county Extension agent or weed coordinator.

Life History

Flowering rush grows as a perennial. The fertile type of flowering rush has four different methods for reproduction. It can reproduce by seed, vegetative **bulbils** on the rhizomes, vegetative bulbils on the flowers, and by fragmentation of the rhizomes. The sterile type typically reproduces by rhizome fragmentation only. Rhizome fragmentation is facilitated by a constriction that develops between a bud and the main rhizome. This allows sections to break off easily with minor disturbances such as moving water, waves, passing boats or waterfowl.

Rhizomes initiate growth earlier in the spring than native aquatic plants. Over a three year period, emergence dates ranged from February 26th to April 15th on Flathead Lake in northwestern Montana. Plants continue growth throughout the season, and flowering occurs from early summer to mid-fall. With fall frosts, leaves collapse instead of remaining upright (like cattails).

ECOLOGY

Habitat

Flowering rush grows along lake shores, slow moving waters, irrigation ditches and in wetlands. It typically grows in shallow waters, but can survive and grow across a range of water levels. It has been observed in very clear water up to 20 feet (6.1 m) deep in Flathead Lake. When depths are greater than approximately 10 feet (3 m), it modifies its growth form. Submersed leaves persist, but they become limp and more ribbon-like.

FIGURE 4. Rhizome fragments are buoyant allowing long distance dispersal. (photo by Peter Rice)

Spread and Establishment Potential

While the sterile type of flowering rush cannot spread through reproductive means, spread by rhizome fragmentation is substantial. The buoyant rhizome fragments (Figure 4) facilitate long distance dispersal. Ideal conditions for rhizome establishment are shallow, sparsely vegetated or unvegetated silty substrates and water currents less than 2 mph. The large amount of carbohydrates stored in the rhizome fragments increases the probability of establishment.

More information is needed on the potential of native vegetation to suppress or outcompete flowering rush. In the Czech Republic under stable water levels, reeds were observed to provide a barrier to the advancement of flowering rush; flowering rush formed a band around the reeds, but did not advance into the reed patch.

Few water bodies have stable water levels, and research shows that water level draw downs promote the establishment and expansion of flowering rush. A decrease in water levels typically exposes unvegetated or sparsely vegetated substrate, and the shallow waters or exposed sediment warm quickly. These two conditions promote sprouting and accelerate growth of rhizome fragments.

On Flathead Lake, the timing of water level draw downs in relation to flowering rush growth and native plant growth can provide an additional advantage to flowering rush. Seasonal water levels are regulated by Kerr Dam to meet the needs of summer recreationists and to generate electrical power. Prior to dam operations, low water conditions occurred during mid to late summer, and native emergent vegetation dominated the low water zones. Since Kerr Dam became operational in 1935, lake levels have been held at full pool through the summer and are at low pool in the late winter-early spring. Flowering rush emerges and grows rapidly in response to shallow waters and warming temperatures at low pool in late winter-early spring. It receives little to no competition from native wetland and emergent species that evolved under and are adapted to low pool in the late summer and fall.

Flowering rush is established in the river channel and backwaters of the lower Flathead River where water levels are also affected by dam operations. Several dams on the Columbia River maintain similar seasonal pool levels and create suitable habitat for flowering rush. A large infestation in an irrigation system spills into American Falls Reservoir on the Snake River in Idaho. This is near the headwaters of the southern reach of the Columbia River system. This large infestation is expected to continue to spread downstream and infest much of the main stem of the Columbia River system.

FIGURE 6. Chaining flowering rush to increase water availability in the Aberdeen-Springfield Canal System near American Falls, Idaho. (photo by Steve Howser)

FIGURE 7. Flowering rush at the mouth of Dayton Creek (a tributary to Flathead Lake), a previously unvegetated zone that is historic spawning habitat for migratory cutthroat trout. (photo by Alvin Mitchell)

Genetics of fertile and sterile flowering rush

The difference between the fertile and typically sterile types of flowering rush corresponds to differences in chromosome numbers. Fertile types are diploid, meaning they have two pairs of chromosomes, while sterile types are triploid, meaning they have three sets of chromosomes. In a Montana study, only 1 in 1,000 plants flowered. In another area, even though flowering rush flowered prolifically; none of the seeds were viable. It appears that the Montana triploid genotype is incapable of sexual reproduction. It also rarely creates flower or rhizome bulbils. Research is ongoing to fully understand the unusual reproductive biology of this species.

Damage Potential

Flowering rush grows prolifically in irrigation canals and can impede the distribution of irrigation water (cover photo). An infested irrigation canal system in Idaho must be chained every two or three years to reduce densities and increase water delivery and availability (Figure 6). Flowering rush also impacts recreational activities through colonization of previously open waters. Plants interfere with boat propellers, swimming, and fishing. Flowering rush also creates ideal habitat for the great pond snail that hosts parasites that cause swimmer's itch.

Flowering rush can adversely impact native fish species by forming dense stands in waters previously unvegetated or sparsely vegetated by aquatic plants (Figure 7). Some fish native to Flathead Lake such as cutthroat and bull trout are adapted to open water habitats. By contrast, introduced fish like largemouth bass, yellow perch, and northern pike prefer or require vegetated substrate to spawn. Piscivorous (fish-eating) species like largemouth bass and northern pike are ambush predators and the upright foliage of flowering rush creates cover for these introduced species. It has been documented that northern pike are significantly depredating cutthroat and bull trout in the Flathead River and impairing the recovery of these natives.

CURRENT DISTRIBUTION AND STATUS

Flowering rush is native to Eurasia. It was first recorded in North America on the St. Lawrence River in 1897 and spread to Lake Ontario and Lake Champlain. A second population, recorded in southwestern Lake Erie in 1918, spread to Michigan, Ohio and southwestern Ontario. Flowering rush was reported in the Snake River near Idaho Falls in 1949 and on the north shore of Flathead Lake in 1964 (Figure 8).

Since 1964 flowering rush has spread to the upper Flathead River (Figure 9). Rhizomes discharged through Kerr Dam have established in the lower Flathead River and populations continue down the Clark Fork River reaching the Clark Fork delta at the head of Lake Pend Oreille (Idaho). Estimates of acreages infested with flowering rush in Montana are approximately 2000 acres on Flathead Lake, 28 acres in Thompson Falls Reservoir, 46 acres in Noxon Reservoir and there are small, but not quantified, occurrences in Cabinet Gorge Reservoir. There is no current quantitative estimate for flowering rush in the Flathead and Clark Fork Rivers, but it occurs in sloughs, backwater eddies, low flow areas, and near boat launches.

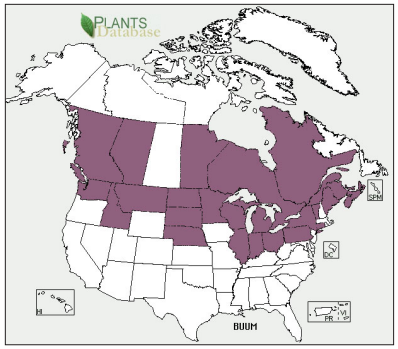

FIGURE 8. States and provinces in North America where flowering rush has been reported. (NRCS Plants Database, http://plants.usda.gov/)

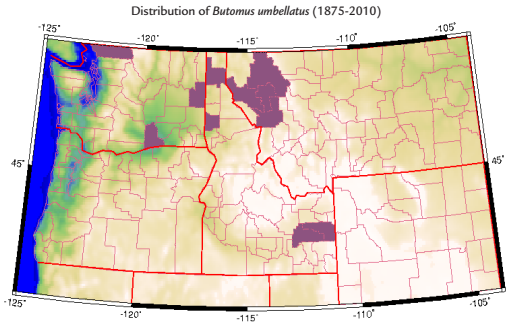

FIGURE 9. Counties in Montana, Wyoming, Idaho, Oregon, and Washington where flowering rush has been reported. (INVADERS Database System, http://invader.dbs.umt.edu)

MANAGEMENT ALTERNATIVES

Mechanical Control

Hand digging to remove all root fragments may be feasible for very small infestations, especially when water levels are low. Repeated digging will probably be required. Because hand digging can result in increased density, which occurred at a boat mooring area on Flathead Lake, it must be done very carefully and diligently. *Raking* will only disturb the root system and create rhizome fragments, therefore it is not recommended. Properly installed and maintained *bottom barriers* can effectively restrict flowering rush growth in small areas below boat moorings. Mechanical control that disturbs the bed of a lake or river and bottom barriers may require permits from the state, tribe, or agency.

Cutting flowering rush below the water surface is not recommended. It can temporarily reduce abundance, but it will not kill the plant so repeated cuttings are necessary, and all cut plant material must be removed

Responsible water gardening: Prevent plants in water features from escaping

Like yellowflag iris, purple loosestrife, and Eurasian watermilfoil, flowering rush was introduced intentionally to North America for water gardens. While water gardens can be a rewarding addition to a backyard, homeowners must purchase and dispose of plant materials responsibly. To avoid accidentally introducing non-native plants to surrounding water bodies, water gardens should never be placed near, or allowed to overflow into wetlands, streams or rivers. Non-native water garden plants should never be dumped into natural water bodies. Before purchasing plants, speak with a knowledgeable horticulturalist or local Extension agent to verify the aquatic plant is not invasive.

from the water. Ten years of mechanical harvesting in the Detroit Lakes (Minnesota) system only made the problem worse, and at great expense.

Cultural Control

Flowering rush quickly fills in areas without aquatic plants, but it appears to invade areas with existing vegetation more slowly. Any management that increases the abundance and vigor of native plants and reduces available habitat for flowering rush is recommended.

Biological Control

There are currently no biological control agents available for flowering rush.

Chemical Control

Currently there are no herbicides labels that have recommendations for flowering rush, but research is underway to find the most effective herbicides, rates, and application timings. Researchers at the University of Montana and Salish Kootenai College have investigated the use of a number of herbicides applied at low and high water levels. Preliminary results suggested that spring applications when 5-7 inches (12.7-17.8 cm) of leaves had emerged and plants were above the water line were most effective. Habitat® and Clearcast®* provided season long control, but none of these one-time herbicide applications provided a high level of rhizome kill, so reapplication would likely be necessary. Water column injection herbicide treatments may be more effective for killing rhizomes.

*Herbicides mentioned here are still being researched and are not listed as recommendations. Check www.greenbook.net for herbicide label updates. When herbicides do become available, note that a 308 permit from Montana Department of Environmental Quality is required before applying aquatic herbicides to water.

INTEGRATED WEED MANAGEMENT (IWM)

Prevention of further spread and education are the main priorities for flowering rush. Thoroughly wash all recreational equipment and remove any plant parts wrapped around boat propellers and stuck to trailers. Dispose of plant material away from the shores. This should reduce the probability of spreading flowering rush to other water bodies. Learn to identify flowering rush, keep a vigilant eye when recreating in Montana waters and report any findings to the Montana Department of Agriculture; Montana Fish, Wildlife and Parks; or your county Extension agent or weed coordinator.

Beyond prevention, education, and hand digging of small infestations, there are not enough tools available at this time to recommend a more comprehensive integrated weed management strategy. Ongoing research by the University of Montana, Salish Kootenai College and other organizations will help to develop effective management strategies in the future. Inventorying and predictive mapping will help estimate the current extent of infestation and predict areas susceptible to future invasion.

GLOSSARY

Bulbil - a small, bulb-like structure that separates from the parent plant and functions in vegetative reproduction.

Carpel - seed-bearing structure that constitutes the innermost whorl of a flower. Fertilization of an egg within a carpel by a pollen grain from another flower results in seed development within the carpel.

Diploid - having two homologous copies of each chromosome, usually one from the mother and one from the father.

Rhizomatous - growing from a rhizome, which is a horizontal, underground stem that sends out both roots and shoots.

Sepals - petal-like structures that surround the flower, are typically smaller than the petals but can occasionally be colorful like the petals.

Stamen - pollen-bearing reproductive organ of a flower.

Triploid - having three complete sets of chromosomes.

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