Bidens beckii

Water-marigold

Asteraceae

Bidens beckii by J. S. Dodds, 2009

Bidens beckii Rare Plant Profile

New Jersey Department of Environmental Protection
State Parks, Forests & Historic Sites
State Forest Fire Service & Forestry
Office of Natural Lands Management
New Jersey Natural Heritage Program

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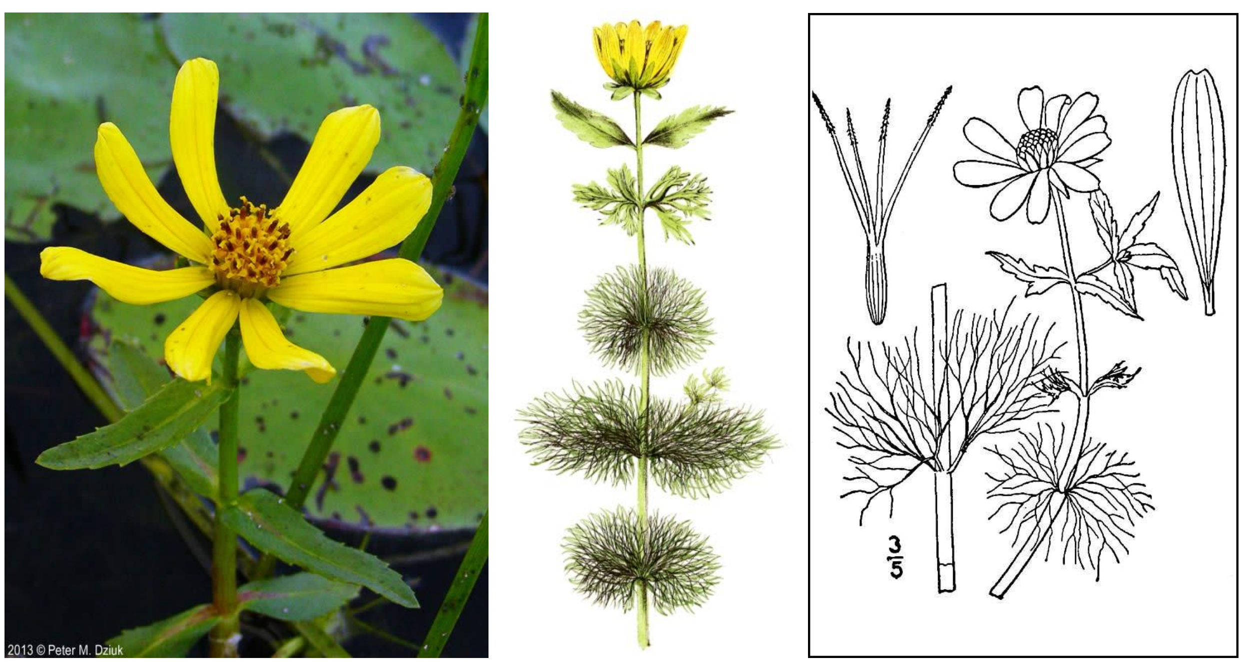
Life History

Bidens beckii (Water-marigold) is a perennial aquatic herb in the Asteraceae. The plants are firmly anchored to the substrate, but the stems rise through the water column and when flowers are produced they are held above the surface. Both aerial and submerged portions of the stem have large air cavities in the pith and cortex. Adventitious roots are often produced from nodes on the underwater part of the stem, branching into smaller divisions when they reach the bottom. Root hairs are present on the roots. *B. beckii* plants also produce lateral stems (rhizomes) that facilitate vegetative reproduction, particularly when growing in shallow water. (See Hoeck 1914, Roberts 1982, Shannon 1953, Les 2017). The stalkless leaves are arranged in pairs along the main stem, but submerged and aerial leaves are quite different. The underwater leaves are finely divided into threadlike segments while the upper leaves are simple, ovate, and toothed. An intermediate leaf type may also be formed, particularly when the water level has receded or plants are stranded on shorelines. The flowers of *Bidens beckii* are composite, bearing both disc and ray florets, and are typically solitary on the stem. A flower usually has 6–10 ray florets that are showy, yellow, and sterile. The 10–30 disc florets are pale yellow and have both pistils and stamens. *B. beckii* fruits are achenes that are round in cross-section and bear 3–6 long (13–25+ mm), slender awns with downward-pointing barbs near the tips. (See Britton and Brown 1913, Fernald 1950, Fassett 1957, Fairbrothers and Moul 1965, Roberts 1982, Gleason and Cronquist 1991, Strother and Weedon 2020).



Left: Peter M. Dziuk, 2013. Center: Cooper 1851, public domain. Right: Britton and Brown 1913, courtesy USDA NRCS 2022a.

Harman (1974) observed that *Bidens beckii* plants in central New York initiated seasonal growth around mid-May. Flowering may occur from July through September in the northeast (Hough 1983, Strother and Weedon 2020). The flowering stems collapse and disintegrate during the autumn months, but submerged stems produce wintering structures (turions) at the tips of their terminal and lateral shoots (Harman 1974, Roberts 1982). Turions are comprised of stem apices with short internodes that bear dense whorls of short, stiff leaves which are heavily laden with starch. The turions may remain attached to floating, dislodged stems or fall to the bottom (Roberts 1982, Knight 2014). Under some circumstances, submerged Water-marigold plants can remain physiologically active throughout the winter, even in a light-limited environment below a layer of ice (Boylen and Sheldon 1976). In spring, rapid growth is initiated from the winter buds (Harman 1974). Spring turion growth begins with elongation, leaf expansion, and the production of adventitious roots, and the process is triggered by day length (Roberts 1982). Most submerged aquatic plants rely heavily on vegetative reproduction (Knight 2014), and reportedly only a limited number of *B. beckii* populations flower on a regular basis (Les 2017).

Pollinator Dynamics

Roberts (1982) observed that the flowers of *Bidens beckii* were visited by numerous insects, including Diptera, Lepidoptera, Odonata, Coleoptera, and Hymenoptera. However, he noted that some of the visitors might be pollinators while others simply used the flower heads as safe landing places above the water surface. Grombone-Guaratini et al. (2004) found that Lepidoptera were frequent visitors to other *Bidens* species, but they did not observe pollen on the insects' bodies. There are a number of bees that are specialist pollinators on flowers in the aster family. One Halictid bee, *Dieunomia heteropoda*, is a narrow specialist that only visits *Bidens* or *Helianthus* (Fowler 2016). Other Asteraceae specialists that occur in New Jersey and are known to pollinate *Bidens spp*. belong to the Andrenidae (*Andrena aliciae*, *A. duplicata*, *Perdita bequaerti*, *Pseudopanurgus compositarum*), Apidae (*Melissodes niveus*), and Colletidae (*Colletes compactus*) (Fowler and Droge 2020). Generalist pollinators such as *Augochlorella striata* and *Halictus ligatus* have also been reported as pollinators of *Bidens spp*. in Maine (Stubbs et al. 1992). Roberts (1982) noticed that Hymenoptera only visited *B. beckii* flowers near the shore and did not venture out to plants that were growing in deeper water.

In the past, self-incompatibility has been inferred for *Bidens beckii* because its morphology was similar to that of outcrossing species of *Bidens* and isolated flower heads in cultivation did not develop fruit (Roberts 1982). However, many species of *Bidens* with comparable characteristics are capable of self-fertilization (Sun and Ganders 1988, Grombone-Guaratini et al. 2004). Studies of *Bidens pilosa*, which produces flower morphs with and without ray florets, found that style branches frequently trapped pollen grains as they were extending through the anther tubes and that seed set was high in the absence of pollinators regardless of the floral type (Sun and Ganders 1990). It is possible that *Bidens beckii* utilizes a mixed mating system, but at present there is not sufficient information for certainty.

Seed Dispersal

The disc flowers of *Bidens beckii* rarely produce mature achenes (Fernald 1950) and seed set in natural populations is reportedly low (Les 2017). A study of *Bidens pilosa*, which produces multiple flowering heads on the same stem, found that seed set was highest in the heads that flowered first, suggesting that florets which failed to develop might be limited by resources other than pollen (Sun and Ganders 1990). When fruits are produced by *B. beckii*, the achenes are denser than water and sink slowly after they have been released (Roberts 1982). Water is probably the primary dispersal mechanism for seeds, and it can also aid in the distribution of potential vegetative propagules such as stem fragments and turions (Les 2017). Some transport by animals is likely to occur. The long, barbed awns on the achenes are structures which often facilitate dispersal by adhering to fur and feathers (Venable and Levin 1983). The fruits of *B. beckii* and other *Bidens* species are eaten by ducks (Martin and Uhler 1939, Fassett 1957, Fairbrothers and Moul 1965) which could also result in some long-distance seed dispersal.

Baldridge and Lodge (2014) indicated that the seeds of aquatic plants are typically more transient than those of many land plants, although there are exceptions, but Keddy and Reznicek (1986) identified *Bidens* as a genus with widespread occurrence in wetland seedbanks. No information was found regarding the length of time that propagules of *Bidens beckii* may remain viable.

Habitat

Bidens beckii is capable of dominating large areas when conditions are suitable (Keddy and Reznicek 1986). Water-marigold is most likely to be found in still or slow-moving waters of lakes, ponds, bogs, swamps, lagoons, rivers or streams at elevations up to 300 meters (Fairbrothers and Hough 1973, Les 2017, Strother and Weedon 2020). Collins et al. (1987) noted that the species was most abundant in areas where organic detritus was present. *B. beckii* often occurs in calcareous or nutrient-poor systems (Nichols 1984, Johnson and Ostrofsky 2004, Rhoads and Block 2007, Johnson and Walz 2013), but it has been found in waters with pH ranging from 5.6–9.8 (Les 2017). In calcareous settings the submersed leaves tend to be small and rigid, while plants growing in softer water produce larger, more flaccid underwater leaves (Roberts 1982).

Reports on water depth where *Bidens beckii* is likely to occur vary greatly. In Otsego Lake in New York, *B. beckii* was mainly found at depths of less than a meter (Harman 1974) and it was reported as abundant in water up to 1.5 meters in a small Wisconsin Lake (Nichols 1984). In New York's Lake George, *B. beckii* was found at depths of 2–7 meters by Sheldon and Boylen (1977), but a decade later observations from the same lake reported the species growing at depths of 1–5 meters with the greatest abundance at 3 meters (Collins et al. 1987). The greatest extreme was recorded at a Canadian lake, where *B. beckii* was found at depths of 12–14 meters during two consecutive growing seasons. Less than one percent of available light could reach the plants that far beneath the surface, but plant growth may have been facilitated by unusually warm water and oxygen in the sediment (Pip and Simmons 1986). Collins et al. (1987) found no difference in biomass among *B. beckii* plants grown at depths from 1–5 meters, but the species is more likely to produce emergent stems and flowers when growing in shallow water (Scribailo and Alix 2002, Les 2017).

Wetland Indicator Status

Bidens beckii is an obligate wetland species, meaning that it almost always occurs in wetlands (U. S. Army Corps of Engineers 2020).

USDA Plants Code (USDA, NRCS 2022b)

BIBE2

Coefficient of Conservatism (Walz et al. 2018)

CoC = 10. Criteria for a value of 9 to 10: Native with a narrow range of ecological tolerances, high fidelity to particular habitat conditions, and sensitive to anthropogenic disturbance (Faber-Langendoen 2018).

Distribution and Range

The global range of *Bidens beckii* is restricted to Canada and the United States (POWO 2022). The map in Figure 1 depicts the extent of Water-marigold throughout the North America.

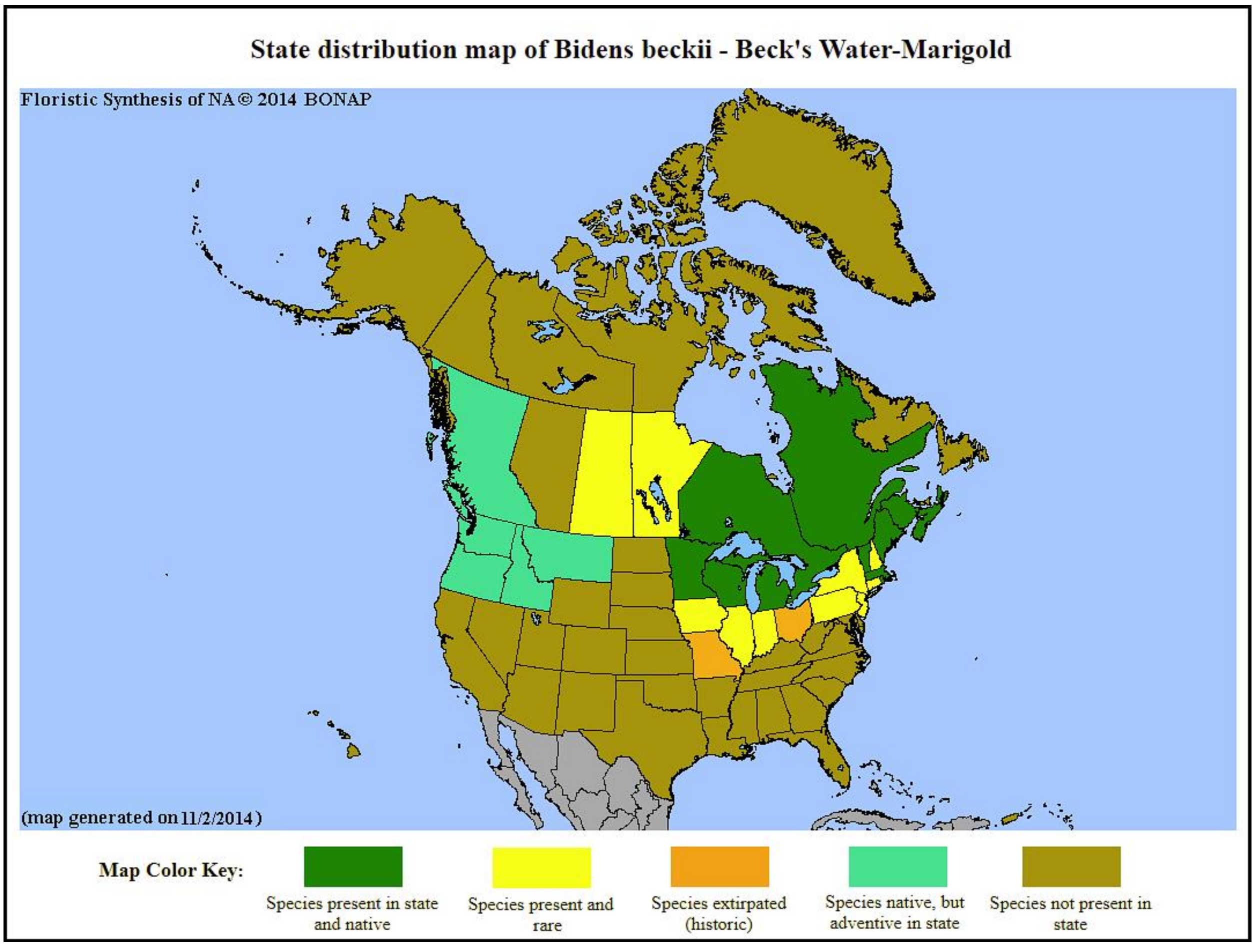


Figure 1. Distribution of B. beckii in North America, adapted from BONAP (Kartesz 2015).

The USDA PLANTS Database (2022b) shows records of *Bidens beckii* in two New Jersey counties: Morris and Sussex (Figure 2). The data include historic observations and do not reflect the current distribution of the species.

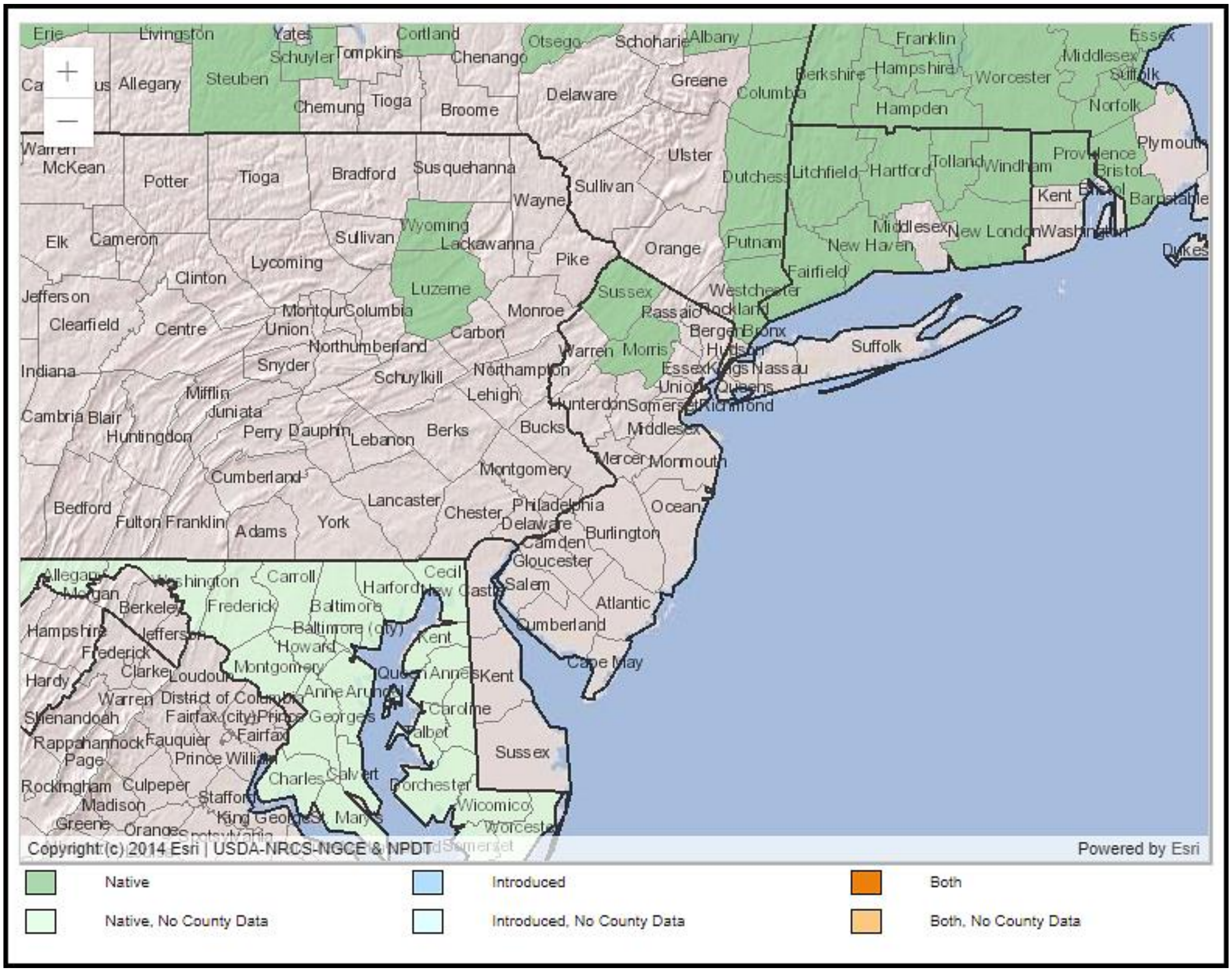


Figure 2. County records of B. beckii in New Jersey and vicinity (USDA NRCS 2022b).

Conservation Status

Bidens beckii is considered globally secure. The G5 rank means the species has a very low risk of extinction or collapse due to a very extensive range, abundant populations or occurrences, and little to no concern from declines or threats (NatureServe 2022). The map below (Figure 3) illustrates the conservation status of Water-marigold throughout its range. *B. beckii* is critically imperiled (very high risk of extinction) in seven states, imperiled (high risk of extinction) in four states and one province, and vulnerable (moderate risk of extinction) in one state and two provinces. The species has not been ranked in other states where it occurs and it is considered secure or apparently so in four provinces.

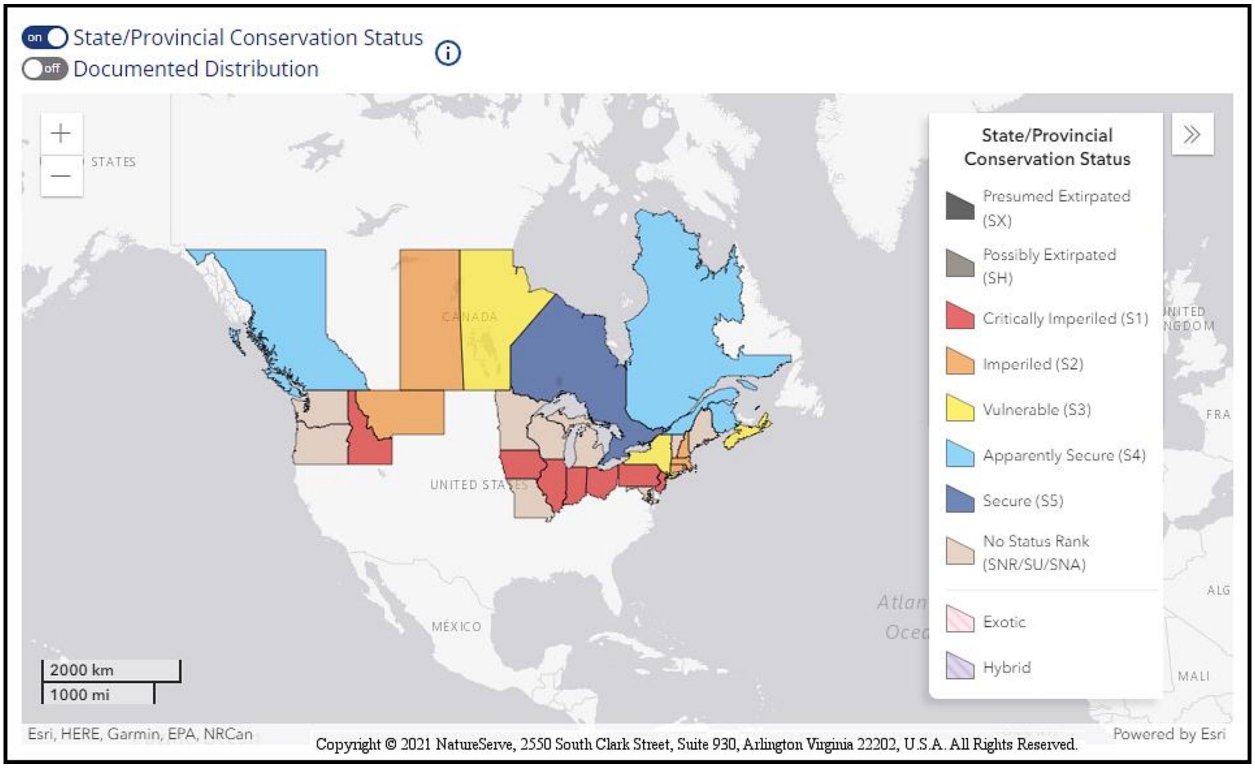


Figure 3. Conservation status of B. beckii in North America (NatureServe 2022).

New Jersey is one of the states where *Bidens beckii* is critically imperiled (NJNHP 2022). The rank signifies five or fewer occurrences in the state. A species with an S1 rank is typically either restricted to specialized habitats, geographically limited to a small area of the state, or significantly reduced in number from its previous status. *B. beckii* is also listed as an endangered species (E) in New Jersey, meaning that without intervention it has a high likelihood of extinction in the state. Although the presence of endangered flora may restrict development in certain communities such as wetlands or coastal habitats, being listed does not currently provide broad statewide protection for the plants. Additional regional status codes assigned to *B. beckii* signify that the species is eligible for protection under the jurisdictions of the Highlands Preservation Area (HL) and the New Jersey Pinelands (LP) (NJNHP 2010).

Prior to 1900 *Bidens beckii* was only known from a single location in New Jersey (Britton 1889), and Taylor (1915) described Water-marigold as "a rare and local species whose distribution is little understood." Several other occurrences were found in the state during the early part of the twentieth century, but Fairbrothers and Hough (1973) observed that the species was known from only a few ponds where it faced a number of threats so they classified it as endangered. *B. beckii* is presently considered to be extant at three sites in Sussex County and historical or extirpated at three other New Jersey locations (NJNHP 2022).

Threats

Freshwater aquatic plant communities in glaciated portions of the northeastern United States have been significantly altered by human activities that have either resulted in degraded water quality (e.g. siltation, eutrophication, acidification) or fostered the establishment and spread of exotic species (Collins et al. 1987). At most of the sites where *Bidens beckii* populations have been reduced or eradicated the cause can be traced back to one of those two categories, although in some cases the damage has been more direct. For example, one occurrence was eliminated by dredging in a Wisconsin lake. Because infrequent flowering and low seed production make it difficult for *B. beckii* to re-establish following a disturbance, the post-dredge community became dominated by plants that were able to rapidly exploit the newly opened habitat (Nichols 1984).

Bidens beckii is intolerant of turbidity, and has disappeared from a number of lakes after they became eutrophic (Les 2017). Water pollution was reported as a threat to New Jersey populations of *B. beckii* (Fairbrothers and Hough 1973), and habitat degradation from shoreline development has eliminated some Indiana occurrences and threatened others (Scribailo and Alix 2002). In addition to development, impacts from adjacent land used for agriculture or transportation can change the water quality and chemistry of calcareous ponds (Johnson and Walz 2013).

Another possible threat to *Bidens beckii* identified by Fairbrothers and Hough (1973) was the excessive use of weed control measures, and the application of herbicides in an effort to control an invasive plant (*Myriophyllum spicatum*) may have been responsible for the disappearance of New Jersey's first known occurrence of Water-marigold (Snyder 2000). Exotic plants can become dominant in aquatic communities, and *B. beckii* has been diminished at sites where *M. spicatum* proliferated (Boylen et al. 1999). The need to balance control of invasive aquatics and protection of native plants has been recognized, and research focusing on ways to eradicate exotics without harming sensitive species has been initiated (e.g. Nelson et al. 2002, Poovey et al. 2004). Recently Smith et al. (2021) asserted that the relative quantity of invasive *Myriophyllum spp*. did not accurately predict the abundance of *Bidens beckii*—in fact, they observed that the plants had niche overlaps and noted that active management of the exotic aquatics could be more harmful to the rare species. More work is needed in this area.

Although *Bidens beckii* may be able to coexist with non-native plants to some extent, detrimental impacts from invasive fauna have been documented. Eurasian Carp (*Cyprinus carpio*) were introduced into midwestern waters during the 1880s and are now established in 48 states (MNDNR 2022). Carp can damage native aquatic vegetation by increasing turbidity and by eating or uprooting the plants (Crivelli 1983). While the experimental exclusion of the fish in a Lake Ontario coastal marsh facilitated the re-establishment of a number of aquatic plants, *B. beckii* did not recover (Lundholm and Simser 1999). Johnson (2011) reported more abundant growth of *B. beckii* and other aquatic macrophytes following the installation of carp barriers in a Wisconsin Lake, but it was not clear whether some Water-marigold plants were already present before the fish were excluded.

Another emerging threat is the Rusty Crayfish (*Orconectes rusticus*). The species is native to western Ohio and adjacent states, but as a result of the live bait trade the large crayfish has become widely established throughout the continental United States during the past 50 years (Lodge et al. 2000). Crayfish are omnivorous and their diet includes aquatic vegetation, which is obtained by clipping the stems of plants near the substrate. The process is somewhat wasteful, as large fragments are often inadvertently released, and the presence of the crayfish can reduce the density of *B. beckii* and other aquatic plants (Lodge et al. 1994). Wilson et al. (2004) tracked the spread of Rusty Crayfish after their introduction into a Wisconsin Lake, reporting that once they became abundant in areas where aquatic macrophytes were growing the species richness and abundance of the flora declined. Current range information indicates that the invasive crayfish has become established in northern New Jersey (Durland et al. 2022).

In New Jersey, *Bidens beckii* has been categorized as moderately vulnerable to climate change. The assessment status indicates that the abundance or range extent of the species is likely to decrease in the region by 2050 (Ring et al. 2013). Some *B. beckii* populations are located in calcareous ponds, a community type that is highly vulnerable to climate change (Johnson and Walz 2013). In addition to rising temperatures, shifting precipitation patterns in New Jersey are resulting in more extreme episodes of both heavy rainfall and drought (Hill et al. 2020). Changing weather patterns that alter a habitat's hydrologic regime can make the site less suitable for specialist species like *B. beckii*. Wilcox and Meeker (1990) studied the impact of changes in hydrologic regime on aquatic vegetation in three Minnesota lakes: One natural lake with mean annual water level fluctuations of 1.6 meters was compared to two managed lakes in the same watershed where the mean annual fluctuations had either been reduced to 1.1 meters or increased to 2.7 meters. Water-marigold was present in the natural lake but had a diminished presence at the site where fluctuations were reduced and was absent from the lake with enhanced fluctuations (Wilcox and Meeker 1990). In addition to altering hydrologic patterns, more intense storms increase the likelihood that silt, nutrients, salts, or other contaminants will be introduced into aquatic ecosystems via flood runoff.

Management Summary and Recommendations

Hoeck (1914) observed that *Bidens beckii* "is rather abundant in the places where it is found, but has not been reported from many localities in our region." Habitat sensitivity appears to be a limiting factor for the species, so management efforts should focus on community-level protection at sites where *B. beckii* is established. Conservation of aquatic ecosystems requires maintenance of both stable hydrology and water quality. The guidelines for calcareous sinkhole ponds (Johnson and Walz 2013) cover a number of topics that should be considered when developing site-specific management plans for Water-marigold habitats, including both onsite threats and practices on adjacent land. Monitoring of extant populations should focus on water quality in order to identify and control sources of contamination that could reduce clarity, increase acidity, or introduce excessive nutrients.

While a reliance on vegetative propagation may serve *Bidens beckii* well under normal circumstances, the role of sexual reproduction increases in importance when changes in local habitat or climactic conditions require the species to colonize new sites or adapt to different circumstances in order to persist. Research is recommended on topics related to that aspect of the species' life history. More specific information is needed regarding pollinators, self-compatibility, the factors that limit seed set, and propagule longevity.

Synonyms

The accepted botanical name of the species is *Bidens beckii* Torr. ex Spreng. Orthographic variants, synonyms, and common names are listed below (ITIS 2021, USDA NRCS 2022b, POWO 2022). *B. beckii* was previously set apart from other *Bidens spp.* as *Megalodonta* primarily due to morphological characters which could also be interpreted as adaptations to the aquatic environment, but current molecular evidence supports the species' inclusion in *Bidens* (Roberts 1985, Weakley 2015).

Botanical Synonyms	**Common Names**
Megalodonta beckii (Torr. ex Spreng.) Greene	Water-marigold
Megalodonta beckii var. *beckii* (Torr. ex Spreng.) Greene	Beck's Water-marigold
Megalodonta beckii var. *hendersonii* Sherff	Henderson's Water-marigold
Megalodonta beckii var. *oregonensis* Sherff	Oregon Water-marigold
Megalodonta beckii var. *typica* Sherff	Water Beggar-ticks
Megalodonta nudata Greene	
Megalodonta remota Greene	
Bidens beckii f. *scissa* E. Sheld.	

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