U.S. Fish & Wildlife Service

Forked Fanwort (*Cabomba furcata*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, May 2021
Revised, May 2021
Web Version, 7/23/2021

Organism Type: Plant
Overall Risk Assessment Category: High

Photo: Bernard DUPONT. Licensed under Creative Commons Attribution-Share Alike 2.0 Generic. Available: https://commons.wikimedia.org/wiki/File:Forked_Fanwort_(Cabomba_furcata)_flowers_(28233447251).jpg. (May 2021).

1 Native Range and Status in the United States

Native Range

From Ørgaard (1991):

"Brazil, Bolivia, Ecuador, Venezuela, Guyana, Trinidad, Isla de la Juventud (Cuba); also a few localities in Costa Rica, Panama, Colombia, and Peru […]"

From Liogier and Martorell (2000):

"[Distribution of synonymized *C. piauhyensis*:] Puerto Rico [but see Status in the United States]; Greater Antilles, Trinidad and from Mexico to Brazil."

Status in the United States

Both USACE (1978) and Liogier and Martorell (2000) describe *C. furcata* as a part of the Puerto Rican flora. Because introduced species in these two sources are typically described as such, it is implied but not explicitly stated that *C. furcata* is native to Puerto Rico. However, according to USDA, NRCS (2021), *C. furcata* is introduced in Puerto Rico. The most recent occurrence reported by GBIF Secretariat (2021) for Puerto Rico is a specimen collected in 1887.

According to IWGS (2021), all *Cabomba* spp. are regulated in Puerto Rico. No further English-language information was found on this regulation.

Currently, this species is readily available in the aquarium trade in the United States. For example, Arizona Aquatic Gardens (2021) offers one bunch of *C. furcata* for $4.99 and 100 or more bunches for $3.99 per bunch. The Bloomington, Indiana-based Rainforest Farms International (2020) offers *C. furcata* for $2.99. No information was found on overall volume or duration of trade.

Means of Introductions in the United States

No information available.

Remarks

According to WFO (2021), the following are scientific name synonyms of *C. furcata*: *Cabomba piauhiensis* [alternative spelling: *Cabomba piauhyensis*; see below], *Cabomba pubescens*, *Cabomba warmingii*, and *Nectris furcata*. All synonyms were used along with the valid name in searching for information for this report.

From Sharip et al. (2014):

*"*The species has been documented as being con-specific with *C. piauhyensis* (Orgaard 1991)."

From June-Wells et al. (2012):

"Our morphological identification of *Cabomba caroliniana* proved to be 2 different species based on DNA sequencing. Nine of the 11 individuals we obtained [from Connecticut aquarium retailers] matched exactly the sequences for *C. caroliniana* in GenBank for the small subunit rDNA and chloroplast genes. […] Two individuals were found to differ from *C. caroliniana* in the small subunit (6 bp) and chloroplast gene (38 bp). We identified these 2 specimens as *Cabomba furcata* […]"

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

According to WFO (2021), *Cabomba furcata* is the current accepted scientific name for this species.

From ITIS (2021):

Kingdom Plantae
Subkingdom Viridiplantae
Infrakingdom Streptophyta
Superdivision Embryophyta
Division Tracheophyta
Subdivision Spermatophytina
Class Magnoliopsida
Superorder Nymphaeanae
Order Nymphaeales
Family Cabombaceae
Genus *Cabomba*
Species *Cabomba furcata* Schult. & Schult. f.

Size, Weight, and Age Range

From Siti-Munirah and Chew (2010):

"[…] depending on water depth growing to 3–4 m."

From Ørgaard (1991):

"[…] perennial […]"

Environment

From Siti-Munirah and Chew (2010):

"In its native habitat, […], in shallow (up to 3 m deep), warm (18–30˚C), acidic to slightly acidic (pH 4–7), more-or-less stagnant water in lakes, streams and floodplains. It is a light-demanding

plant. It thrives on organic nutrients when it becomes fast growing (e.g., its stem can grow 12 cm a month)."

"It grew in full sun, as well as in deeply shaded areas […]"

Climate

From Ørgaard (1991):

"Equatorial with diurnal climate characterized by a brief period of dryness in winter and a monthly precipitation above 100 mm."

"Often located at higher altitudes in savannah areas."

Distribution Outside the United States

Native

From Ørgaard (1991):

"Brazil, Bolivia, Ecuador, Venezuela, Guyana, Trinidad, Isla de la Juventud (Cuba); also a few localities in Costa Rica, Panama, Colombia, and Peru […]"

From Liogier and Martorell (2000):

"[Distribution of synonymized *C. piauhyensis*:] Puerto Rico [but see Status in the United States]; Greater Antilles, Trinidad and from Mexico to Brazil."

Introduced

From Siti-Munirah and Chew (2010):

"In Peninsular Malaysia, naturalized in Johor (Sg. Sedili Kechil and Sg. Mati), Pahang (Tasik Chini), Penang (stream from recreation forest and rice field, Taman Rimba Telok Bahang & Kubang Semang), Perak (black water stream near Bukit Merah lake and Taiping Lake Garden) and Selangor (stream from Klang Gates dam). However, it is likely to be more widespread (Chew and Siti-Munirah, 2010)."

From Chew and Siti-Munirah (2010):

"The Semelai people noticed its appearance [in Lake Chini] after the dam construction in 1995. The Cabomba probably got into Sg. Sedili Kechil more recently as its populations are restricted."

From Sharip et al. (2014):

"Since its naturalization, the *Cabomba* [*furcata/piauhyensis*] population has been found in various parts of peninsular Malaysia (Chew and Siti-Munirah 2009) and Sarawak (Salim et al. 2009)."

Wu et al. (2010) report *C. furcata* (as *C. piauhyensis*) as naturalized in Taiwan, with the first record in 2004.

From Mackey (1996):

"To date *C. caroliniana* is the only species of cabomba to have been naturalised in Australia, although two other forms: pink cabomba (*C. piauhyensis* now *C. furcata*) and green cabomba (*C. australis* now *C. c. var caroliniana*) are regularly traded by aquarists."

Means of Introduction Outside the United States

From Siti-Munirah and Chew (2010):

*"*It is not known when *Cabomba* species were first introduced into Peninsular Malaysia nor whether they were accidentally or purposely introduced. However, we strongly suspect that the introduction is related to the high demand for export [of aquatic plants] either from Malaysia or Singapore."

From Sharip et al. (2014):

"Similar to other non-native aquatic species, *Cabomba* was probably introduced to Malaysia through the aquarium trade (Orgaard 1991)."

"A high magnitude of flooding could dislodge a plant - especially the submerged *C. furcata* - and the species could further colonize other areas after the flood has receded."

Short Description

From Siti-Munirah and Chew (2010):

"Stems olive-green to reddish brown. *Submerged filiform leaves* dark purple, in whorls of three, at the apex often opposite; petiole *c*. 1–2 cm, lamina with linear divisions in one plane, *c*. 4 cm long. *Floating peltate leaves* olive-green, sometimes with a dark purple margin, lamina narrowly rhombic or linear to lanceolate, occasionally sagittate, 20–40 mm × 3 mm. *Pedicels* 2–5.5 cm long. *Flowers* purplish, 6–12 mm diameter, 5–10 mm long; sepals obovate-elliptic, 5–9 × 2–4 mm, apex obcordate, basal third yellow, distal two thirds purplish red to bluish violet with darker veins, with a darker rim at margin; petals ovate-oblong, 5–9 × 2–5 mm, base slightly auriculate, the lobes with two yellow, confluent patches, the claw whitish; stamens greenish yellow, 5 mm, anthers yellow; carpels 2, divergent at maturity. *Seeds* globose, 1–2 mm diameter, echinate, surface verrucate."

From Ørgaard (1991):

"*C. furcata* is characterized by the ternate phyllotaxi [sic] of the submerged leaves [i.e., arranged around the stem in sets of three] and a linear to rhombic lamina [blade] of the floating leaves in combination with the bright violet flowers with mostly 6 stamens. Seeds are smaller than those of *C. aquatica*, *C. haynesii*, and *C. caroliniana* and they are almost globose."

Biology

From Siti-Munirah and Chew (2010):

"It […] formed large masses over extensive areas."

"It propagates from plant fragments as well as from seed."

From Ørgaard (1991):

"[…] often coated by algae and a reddish brown sediment […] Often associated with species of *Utricularia, Sagittaria* and *Hydrocleys* (Kasselmann [1988]). During the rainy season it forms large, abundantly flowering stands, that are reduced during the dry season."

"The growth habit of *Cabomba* is adapted to these [significant annual water level] fluctuations by rapid growth during the rainy season to keep pace with the rise in water level so that the assimilating shoots, situated near the water surface, obtain optimal light conditions. Like other aquatic plants they dry out or are swept away by receding water currents to the main river when waterlevels [sic] drop. Some plants survive in the mud often in a strongly modified terrestrial form (Junk & Howard-Williams 1984)."

Human Uses

From Siti-Munirah and Chew (2010):

"*Cabomba furcata* is an ornamental plant in the aquarium trade. It is cultivated commercially in Malaysia for its pretty reddish, feathery fan-leaves and is readily available for sale in aquarium shops."

Currently, this species is readily available in the aquarium trade in the United States. For example, Arizona Aquatic Gardens (2021) offers one bunch of *C. furcata* for $4.99 and 100 or more bunches for $3.99 per bunch. The Bloomington, Indiana-based Rainforest Farms International (2020) offers *C. furcata* for $2.99. No information was found on overall volume or duration of trade.

Diseases

No information was found on diseases associated with *Cabomba furcata*.

Threat to Humans

From Chew and Siti-Munirah (2009):

"IN MALAYSIA, THE *CABOMBA FURCATA* HAS ALREADY IMPACTED THE TOURIST VALUE OF TASIK CHINI, formerly famed for its lotuses. Dense patches of Cabomba prevent lotus regeneration, entangle boat engines, block waterways […]"

From Siti-Munirah and Chew (2010):

"[…] *Cabomba* is likely to become a problem where it grows in ditches by padi fields, e.g. in the Langkap area or near Sg. Mati [Malaysia], because it will impede water flow and quality for these agricultural areas."

3 Impacts of Introductions

From Siti-Munirah and Chew (2010):

"However, for natural ecosystems their introduction is cause for grave concern because *Cabomba* has been shown to outcompete native species, reduce water quality, and impede the passage of boats. This has already occurred in Tasik Chini where Rajah and Teoh (2004) reported that a combination of dam building in 1995, organic pollution from sewage effluent from tourist facilities, and run-off from agricultural practices has led to rampant growth of *C. furcata*, which now impedes the movement of boats and is implicated in the decline of the lotus population, a major tourist attraction for the lake. It has also led to the disappearance of the native *Utricularia punctata* Wall. ex A.DC., Lentibulariaceae (Chew and Siti-Munirah 2010). [*C. furcata*] is so extensive in Tasik Chini that its eradication is considered impossible."

From Sharip et al. (2014):

"Forming dense mono-specific stands, the *C. furcata* communities disrupted boat navigation and affected the potential for eco-tourism (Chew and Siti-Munirah 2009; Sharip and Jusoh 2010). The plant species has been thought to have replaced the floating-leaved *Nelumbo nucifera* (Idris 2007; Sharip and Jusoh 2010) and the submerged *Utricularia punctata* (Chew and Siti-Munirah 2009) and to have threatened biodiversity."

According to IWGS (2021), all *Cabomba* spp. are regulated in Puerto Rico. No further English-language information was found on this regulation.

4 History of Invasiveness

The history of invasiveness is High. *Cabomba furcata* has been introduced outside of its native range and has been confirmed as established in Malaysia and Taiwan. Negative impacts of introduction have been reported from multiple peer-reviewed sources. Impacts include impeding boat navigation, reducing water quality, reducing eco-tourism value, and outcompeting native species, including *Nelumbo nucifera* and *Utricularia punctata.*

5 Global Distribution

Figure 1. Known global distribution of *Cabomba furcata*. Observations are reported from Brazil, Bolivia, Peru, Ecuador, Colombia, Venezuela, Guyana, Panama, Costa Rica, Honduras, Guatemala, Mexico, Cuba, Puerto Rico, Malaysia, and Australia. Map from GBIF Secretariat (2021).

The location in Australia was not used in the climate matching analysis because the occurrence represents a cultivated individual, not a wild population (GBIF Secretariat 2021).

No georeferenced occurrences were available for the established range of *C. furcata* in Trinidad or Taiwan. An additional location in Malaysia was available from MyBIS (2021).

6 Distribution Within the United States

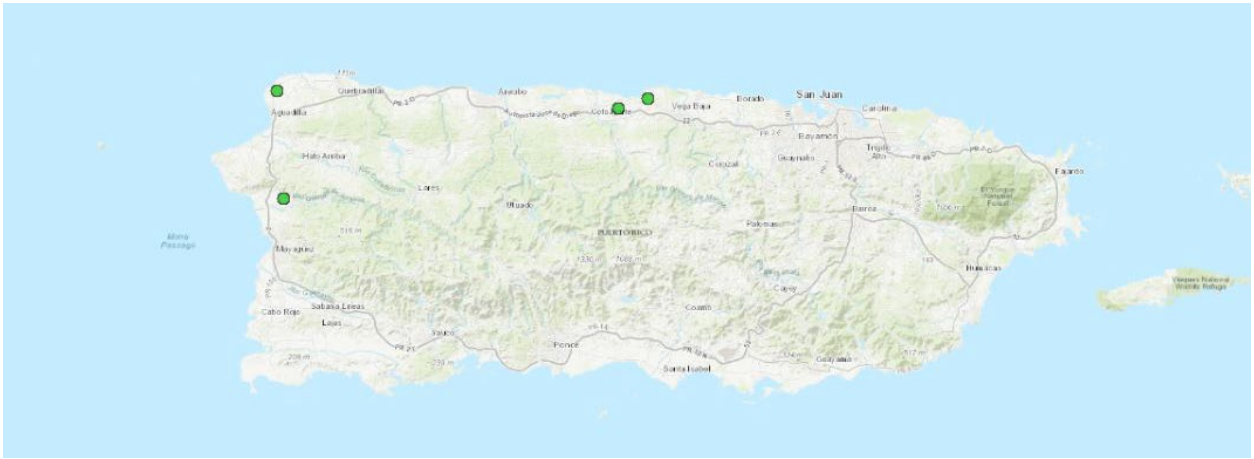

Figure 2. Reported distribution of *Cabomba furcata* in Puerto Rico in the United States. Map from BISON (2021).

7 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Cabomba furcata* was low across most of the contiguous United States. Low match was found throughout the North and a majority of the West. The area of highest match was found in peninsular Florida, with high match extending along the Atlantic Coast to South Carolina, and west along the Gulf Coast to southern Texas. Medium match was found in the Southeast, along the Mid-Atlantic Coast, and along the coast of southern California. The overall Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for the contiguous United States was 0.034, medium. (Scores between 0.005 and 0.103, exclusive, are classified as medium). The following States had high individual Climate 6 scores: Florida, Georgia, Louisiana, and South Carolina. Alabama, Mississippi, and Texas had medium individual Climate 6 scores. All remaining States had low individual scores.

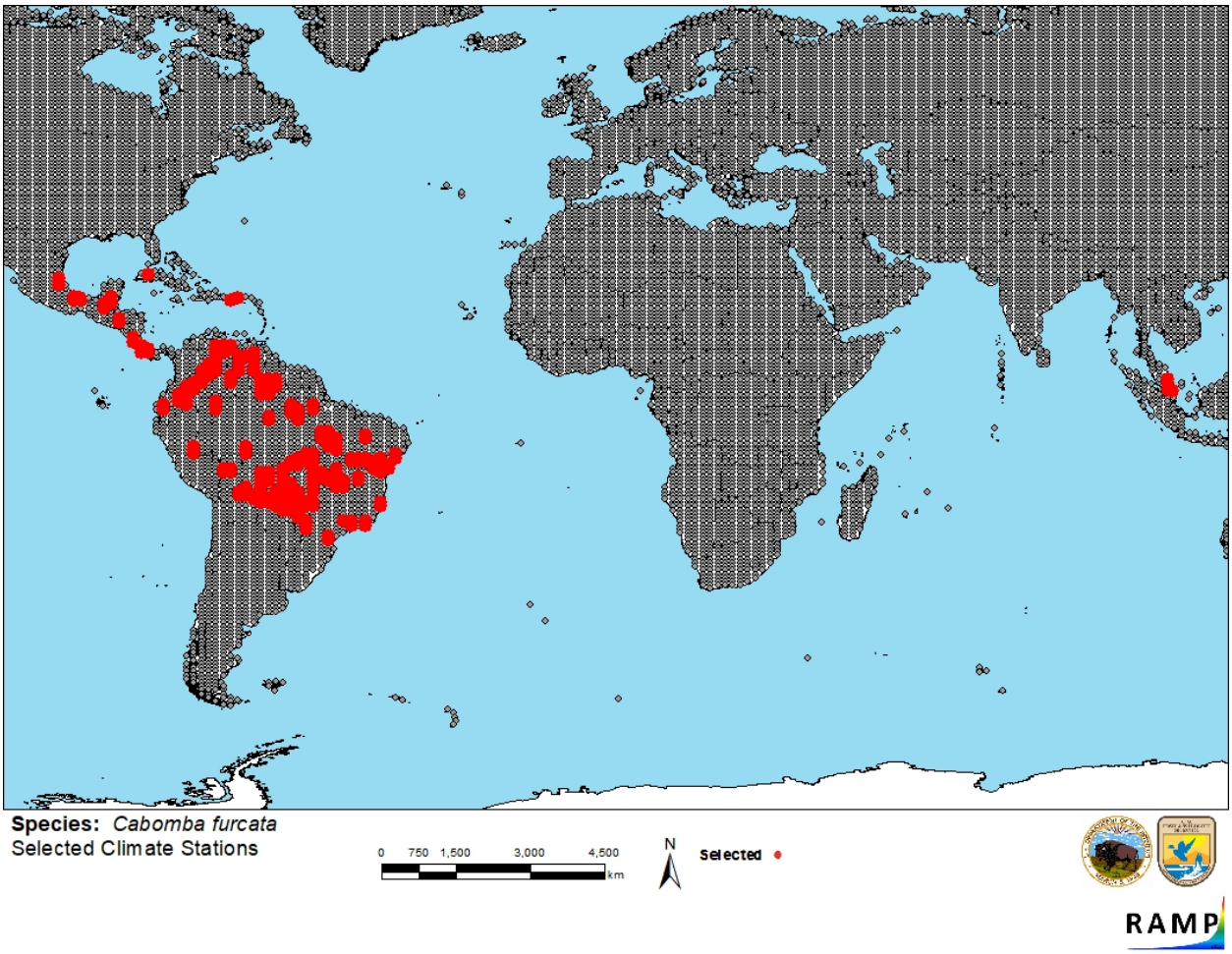

Figure 3. RAMP (Sanders et al. 2018) source map showing weather stations selected as source locations (red; Brazil, Bolivia, Peru, Ecuador, Colombia, Venezuela, Guyana, Panama, Costa Rica, Nicaragua, Honduras, Guatemala, Mexico, Cuba, Puerto Rico, and Malaysia) and non-source locations (gray) for *Cabomba furcata* climate matching. Source locations from GBIF Secretariat (2021) and MyBIS (2021). Selected source locations are within 100 km of one or more species occurrences and do not necessarily represent the locations of occurrences themselves.

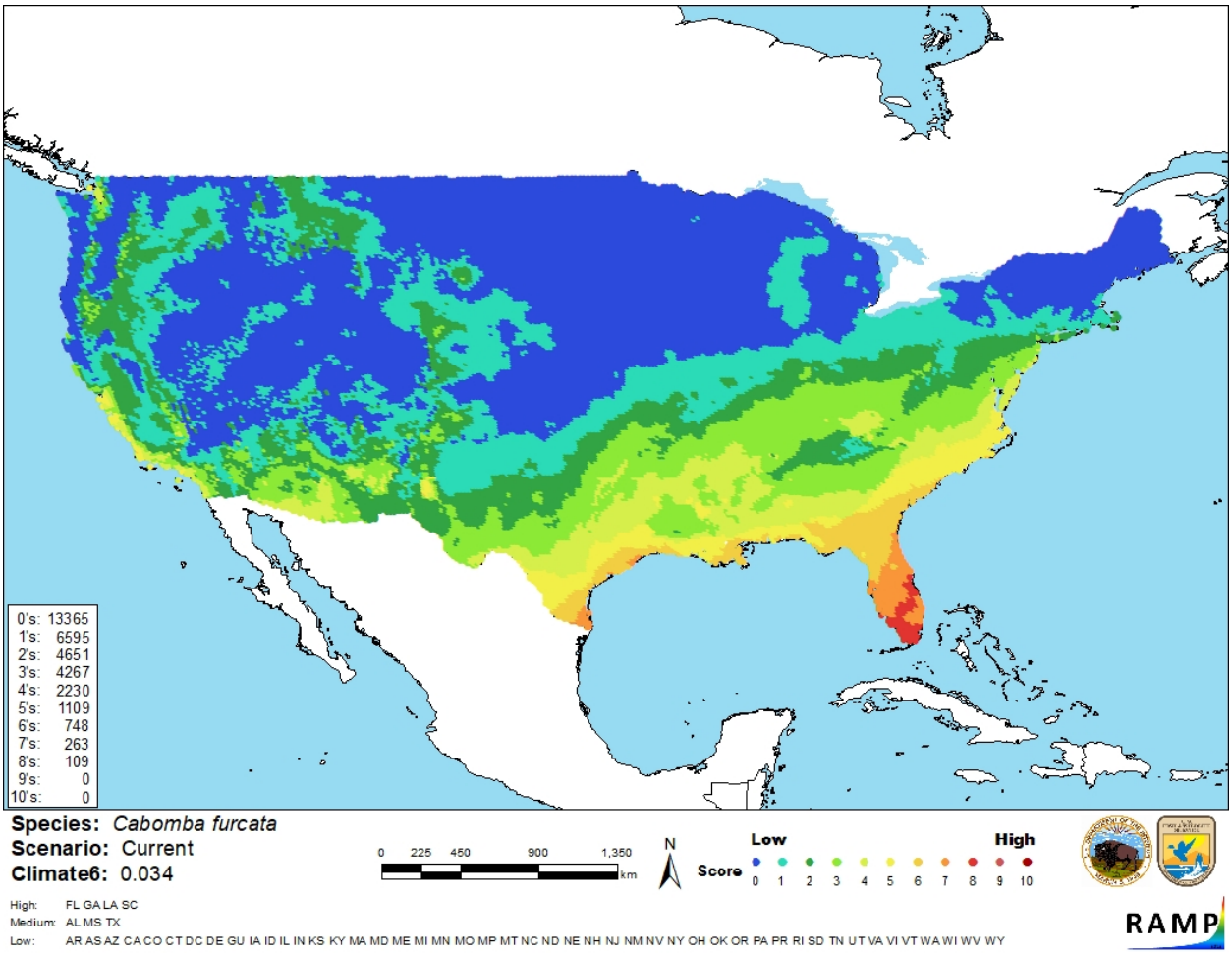

Figure 4. Map of RAMP (Sanders et al. 2018) climate matches for *Cabomba furcata* in the contiguous United States based on source locations reported by GBIF Secretariat (2021) and MyBIS (2021). Counts of climate match scores are tabulated on the left. 0/Blue = Lowest match, 10/Red = Highest match.

The High, Medium, and Low Climate match Categories are based on the following table:

Climate 6: (Count of target points with climate scores 6-10)/ (Count of all target points)	Overall Climate Match Category
0.000≤X≤0.005	Low
0.005<X<0.103	Medium
≥0.103	High

8 Certainty of Assessment

The certainty of this assessment is High. Information on the biology and ecology of *C. furcata* is available. Information is also readily available on established populations, particularly in Malaysia. Multiple negative impacts of introduction have been documented through peer-reviewed research.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Forked Fanwort, *Cabomba furcata,* is an aquatic plant native to northern South America, Central America, and the Greater Antilles. It has been reported in Puerto Rico (where it is also a regulated species) although it is unclear whether *C. furcata* is native or nonnative to Puerto Rico. This species is widely available in the aquarium trade in the United States and internationally; in trade, it is occasionally confused with the conspecific *C. caroliniana*. *C. furcata* has been introduced to Malaysia and Taiwan, and its negative impacts of introduction have been well studied in a lake in peninsular Malaysia. *C. furcata* clogs waterways and impedes boat movement, reduces water quality, affects eco-tourism potential, and displaces native aquatic plants. The history of invasiveness is High. The overall climate match for the contiguous United States was Medium. Areas of high match were scattered along the Southeast coastline from Texas to South Carolina, with the highest match being found in peninsular Florida. The certainty of this assessment is High. The overall risk assessment category for *Cabomba furcata* is High.

Assessment Elements

- **History of Invasiveness (Sec. 4): High**
- **Overall Climate Match Category (Sec. 7): Medium**
- **Certainty of Assessment (Sec. 8): High**
- **Remarks, Important additional information: No additional information**
- **Overall Risk Assessment Category: High**

10 Literature Cited

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 11.

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11 Literature Cited in Quoted Material

Note: The following references are cited within quoted text within this ERSS, but were not accessed for its preparation. They are included here to provide the reader with more information.

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