ELEMENT STEWARDSHIP ABSTRACT
for

Polygonum cuspidatum

Japanese knotweed, Mexican bamboo

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The Nature Conservancy
Element Stewardship Abstract
For *Polygonum cuspidatum* Sieb. & Zucc.
(*Reynoutria japonica* Houtt.)
(*Fallopia baldschuanica*)

I. IDENTIFIERS

Common Name: Japanese knotweed, Mexican bamboo

General Description:
Polygonum cuspidatum was classified as Reynoutria japonica by Houttuyn in 1777 and as Polygonum cuspidatum by Siebold in 1846. It was not until the early part of the 20th century that these were discovered to be the same plant (Bailey, 1990). The plant is generally referred to as Polygonum cuspidatum by Japanese and American authors and as Reynoutria japonica in the United Kingdom and Europe. Recent evidence suggests that this plant should be reclassified as Fallopia japonica (Bailey, 1990).

The following is based on descriptions by Fernald (1950), Muenscher (1955), Locandro (1973,1978), and Ohwi (1965).

Polygonum cuspidatum is an herbaceous perennial which forms large clumps 1-3 meters high. It is fully dioecious and can reproduce by seed and by large rhizomes which may reach a length of 5-6 meters. The stout stems are hollow and bamboo-like, extend from an erect base and are simple or little branched and glabrous with thinly membranous sheaths. Leaves are broadly ovate, truncate to cuneate at base, abruptly cuspidate, 5-15 cm long, 5-12 cm broad, with petioles 1-3 cm long. Greenish white flowers 2.5-3 mm long, densely arranged in axillary panicles; 3 styles; 8-10 stamens with longitudinally dehiscing anthers. Fruiting calyx wing-angled, 6-10 mm long. Achenes shiny black-brown, 3-4 mm long, acutely trigonous. Male flowers have branched panicles on upright racemes with the distal end of the raceme in the highest position; individual panicles generally point up. Female flowers are drooping or decumbent with the distal end in the lowest position; individual panicles are not oriented in a particular direction. Both male and female flowers possess vestigial organs of the other sex.

Polygonum cuspidatum closely resembles Polygonum sachalinense (Reynoutria sachalinensis), an exotic species native to northern Japan and the Sakhalin Islands (Ohwi, 1965). P. sachalinense can be distinguished primarily by its larger size, greenish flowers and cordate leaves which gradually taper to the tip (Fernald, 1950). Polygonum cuspidatum is known to hybridize with Polygonum sachalinense and with Fallopia baldschuanica (Bailey, 1985,1988). Hybrids between Polygonum cuspidatum and Polygonum sachalinense have been frequently mistaken for Polygonum cuspidatum in the U.K. (Bailey, 1990).

II. STEWARDSHIP SUMMARY

Polygonum cuspidatum is widely distributed in much of the eastern U.S. In western Pennsylvania it already occupies hundreds of acres of wetlands, streambanks and hillsides and has spread along the banks of the Allegheny and Ohio Rivers and dominates the edges of many of the islands in these rivers (Wiegman, pers.comm.).It is present on at least two sites belonging to the Pennsylvania Chapter of The Nature Conservancy (Long Pond in the Poconos and Bristol Marsh, an urban preserve near Philadelphia)and has become a problem on creeks in suburban Philadelphia (Broaddus, pers. comm.). It is also a serious problem in Rock Creek Park, a national park in Washington D.C. In the U.K., it is considered a major weed and a threat to conservation, and it is legally prohibited to introduce Japanese knotweed into the wild (Beerling, 1990; Nature Conservancy Council, 1989; Palmer, 1990). Its early emergence and great height combine to shade out other vegetation and prohibit regeneration of other species (Sukopp and Sukopp, 1988). Thus it reduces species diversity and damages wildlife habitat (Palmer, 1990; Scott and Mars, 1984; Wiegman, pers. comm.). It does not appear to be a threat in undisturbed forest and other low light areas, but it is likely that, if unchecked, it will continue to expand its range in open habitats. Once Polygonum cuspidatum has established it forms large, almost pure stands which are extremely persistent and difficult to eradicate.

III. NATURAL HISTORY

Habitat:

Polygonum cuspidatum is native to eastern Asia. It was introduced from Japan to the United Kingdom as an ornamental in 1825, and from there to North America in the late nineteenth century (Conolly, 1977; Patterson, 1976; Pridham and Bing, 1975). In Japan, Polygonum cuspidatum is widely distributed and is usually found in sunny places on hills and high mountains (Kanai, 1983; Ohwi, 1965). It is a dominant pioneeer in the primary succession of volcanic slopes and is frequently a colonizer in secondary succession (Hirose, 1984).

In the U.K., Polygonum cuspidatum has spread extensively, occurring in virtually every 10 km square (Nature Conservancy Council, 1989). Stands range in size from individual plants to clumps more than 500 square meters (Palmer, 1990). Polygonum cuspidatum has also become naturalized in much of central Europe (Sukopp and Sukopp, 1988). In North America, it is widely found in the eastern U.S. and has been observed as far north as Nova Scotia and New Foundland, as far south as North Carolina, in much of the midwest and in the coastal areas of Washington and Oregon (Locandro, 1978; Patterson, 1976; Pauly, 1986). Large stands have been noted in western Pennsylvania, in particular along the banks of the Ohio and Allegheny Rivers and on the islands in these rivers (Wiegman, pers. comm.). Polygonum cuspidatum spreads primarily along river banks, but also grows in wetlands, waste places, along roadways, and in other disturbed areas (Beerling, 1990; Conolly, 1977; Muenscher, 1950).

Polygonum cuspidatum can thrive in a wide variety of habitats. In Japan, it can grow on volcanic soils high in sulfur and having a pH less than 4 (Conolly, 1977). In the U.S., it has been observed growing in a variety of soil types, including silt, loam, and sand, and in soils with pH ranging from 4.5 to 7.4 (Locandro, 1973). Analyses of soils from 17 stands in Wales showed no correlation between stand size and vigor and soil chracteristics. The stands studied grew in soils with a broad range of pH, organic matter and nutrients (Palmer, 1990). In Japan, Polygonum cuspidatum growth is slow, but steady in nutrient poor sites, and rapid in nutrient rich sites (Hirose, 1984). In areas where Polygonum cuspidatum has been introduced, it is found primarily in moist, unshaded habitats. Distribution maps from the U.K. show that it is generally associated with regions of high precipitation (Conolly, 1977). Locandro (1973) reports it growing on xeric as well as hydric sites in the U.S. Its distribution appears to be limited by light. It is found primarily in open sites, and its growth and abundance are depressed in shady sites (Beerling, 1991; Seiger, unpublished data).

Polygonum cuspidatum flowers from July to October in Japan (Ohwi, 1965) and in August and September in the U.K. and North America (Conolly, 1977; Fernald, 1950; Muenscher, 1955). It is pollinated by bees and other insects (Bailey, 1990; Locandro, 1978). Seeds appear about two weeks after flowering (personal observation) and are wind dispersed (Maruta, 1976). In Japan, reproduction in Polygonum cuspidatum is characterized by high seed production and low seedling survival, but plants have a very high probability of survival once established (Hirose and Tateno, 1984). However, in the U.S., U.K, and Europe, seeds do not appear to be a significant mode of reproduction. In a study of the reproductive ecology of Polygonum cuspidatum populations in New Jersey, Locandro (1973) found viable pollen, but noted that fertile males were rare. Seedling germination was observed in the presence of males, but no seedling survival was recorded during five years of observation. In the absence of males, females produced empty achenes. In the U.K., fruit set is very rare. This was originally attributed to the rarity of male fertile flowers (Conolly, 1977). It has since been found that there are no male fertile forms of Polygonum cuspidatum in England and that the pollen source is actually a hybrid between Polygonum cuspidatum and Polygonum sachalinense (Bailey, 1990). Polygonum cuspidatum also hybridizes with Fallopia baldschuanica (Bailey, 1985,1988,1990). In the U.S., hybrids morphologically similar to those between Polygonum cuspidatum and Fallopia baldschuanica have been grown from seeds collected in the field, but seedling establishment has not been observed in the wild (Seiger, unpublished data).

The primary mode of reproduction in the U.S., U.K. and Europe is through extensive rhizomes which can reach 15-20 meters in length (Conolly, 1977; Locandro, 1973). Dispersal can occur naturally when rhizome fragments are washed downstream by the current and deposited on banks or, as more commonly occurs, when soil is transported by humans as fill dirt (Conolly, 1977; Locandro, 1978). Rhizomes can regenerate from small fragments, and have even been observed to regenerate from internode tissue (Locandro, 1973). Rhizomes can regenerate when buried up to 1 meter deep and have been observed growing through two inches of asphalt (Locandro, 1978; Pridham and Bing, 1975). The ability of rhizomes to generate shoots was found to be affected by the source of rhizome fragments, fragment size and depth planted, the optimal depth being just below the surface (Locandro, 1973).

Polygonum cuspidatum requires high light environments and effectively competes for light in such environments by emerging early in the spring and using its extensive rhizomatous reserves to quickly attain a height of 2-3 meters. Shoots generally begin to emerge in April and growth rates exceeding 8 cm per day have been recorded (Locandro, 1973). In addition, its deep root system gives it an advantage in foraging for nutrients and water, and contributes to soil stabilization on disturbed sites (Hirose and Tateno, 1984; Nakamura, 1984). Hirose and Tateno (1984) found that organic nitrogen levels on Mt. Fuji increased following colonization by Polygonum cuspidatum on bare volcanic desert and concluded that Polygonum cuspidatum contributes to the development of the ecosystem, in part, by acting as a nutrient reservoir.

Polygonum cuspidatum is found on open sites and does not appear to be able to invade forest understory due to its high light requirements (Beerling, 1991). Studies of the very closely related Polygonum sachalinense indicated that Polygonum sachalinense plants grown in low light did not have higher photosynthetic rates than plants grown in high light, and thus would not be expected to adapt to sites with low light intensity (Patterson, Longstreth and Peet, 1977). Transplant studies of Polygonum cuspidatum in closed understory sites showed poor survival and growth compared to open bank sites, confirming that it was environmental factors and not limitations on dispersal which exclude Polygonum cuspidatum from understory sites (Seiger and Merchant, 1991). Follow-up studies in the greenhouse showed that Polygonum cuspidatum grown under light levels comparable to those foundin the understory had significantly less rhizomatous reserves at the end of the season than did plants grown under full sunlight (Seiger, unpublished data).

Polygonum cuspidatum occurs in much of the temperate U.S. Though not yet a major weed in the U.S., it is spreading, particularly in the eastern states. Dispersal is limited to areas where rhizome fragments from existing stands are washed downstream or soil containing rhizomes is transported by humans. Once established, it forms large, monospecific stands which displace virtually all other vegetation. Establishment can be prevented by monitoring for the introduction of Polygonum cuspidatum and manually removing the entire plant. Small stands may be controlled by repeated cutting, which may need to be supplemented by revegetation once growth of Polygonum cuspidatum has been reduced. At present, the only method to control large stands is with repeated application of herbicides. Complete eradication may not be possible.

IV. CONDITION

V. MANAGEMENT/MONITORING

Management Requirements:

Current control methods (mechanical, herbicidal) require continued treatment to prevent reestablishment of Polygonum cuspidatum. It may be feasible to reintroduce competitors as an alternative to continued treatment. There is a need for more research on whether native species might serve effectively as competitors and methods of reintroduction. Only very preliminary work has been done towards developing a biological control for Polygonum cuspidatum and much research remains to be done (see below).

The International Institute for Biological Control in conjunction with the National Agricultural Research center in Japan has produced a partial list of insect herbivores in Japan which are associated with Polygonum cuspidatum. A number of pathogens have been collected from Japan by CAB International and are held at the International Mycological Institute (Fowler and Schroeder, 1990). Plans are under way to begin a study of Polygonum cuspidatum in its native habitat (Fowler, pers. comm.). Contact:

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Recent studies in Rock Creek park, Washington, D.C. indicate potential for control by mechanical means combined with revegetation (Seiger, unpubished data). Field tests will be conducted in 1992. Contact:

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In areas where Polygonum cuspidatum has not yet become established, the focus of management should be to prevent establishment by monitoring areas for introductions of Polygonum cuspidatum and eradicating newly established stands before they can become established.

Manual control consists of digging out the rhizomes or cutting the stalks. Digging is extremely labor intensive and tends to spread the rhizome fragments and promote disturbance and is not recommended (Palmer, 1990). Cutting, on the other hand, may be quite effective in eliminating Polygonum cuspidatum. It has been observed that Polygonum cuspidatum does not establish where grazing pressure is high (Beerling, 1990; Palmer, 1990). In a review of control methods, Palmer (1990) noted that eradication is not complete with cutting alone, but has been nearly achieved in some cases and should be feasible with persistence. A number of authors claim that cutting is ineffective (Pauly, 1986; Pridham and Bing, 1975; Orchowski, 1991). These conclusions are based on the observation that shoots are regenerated following cutting. However, a greenhouse study found that cutting stems results in a significant reduction of rhizomatous reserves. The same study also found that cutting was equally effective at any time during the growing season prior to the beginng of senescence (Seiger and Merchant, 1990). A study of the effects of repeated cutting showed that at least three cuts are needed in a growing season to offset rhizome production (Seiger, unpublished data). Manual control can be labour intensive, but where populations are small and isolated, may be the best option. No research has been done to test the effectiveness of burning. It may act similarly to cutting by removing above ground material.

Shading, particularly in conjunction with cutting, may be another useful means of control on smaller stands. Studies showing that P. cuspidatum requires high light environments suggest that covering stands with black plastic or shade cloth may reduce growth. Pridham and Bing (1975) state that applying several layers of black polyethylene film covered by asphalt, blocks or stones to a leveled soil surface may provide some control. However, they also note that P. cuspidatum is able to emerge through asphalt. If shade cloth (or plastic) is to be applied without cutting, then, to prevent P. cuspidatum from emerging through the covering, shade cloth should be placed over shoots after the plants have reached their full height or placed well above newly emerging shoots, or raised as plants grow.

A number of biocidal chemicals have been found to be effective against Polygonum cuspidatum. Most of these are undesirable for use in conservation areas because they are nonselective, may be persistent in the soil and/or are not safe for use near water. One frequently used way to minimize the effects of non-selective herbicides on non-target species is to paint herbicides directly onto the target plants (Broaddus, pers. comm.). In the case of P. cuspidatum, this would probably require prior cutting for easier access if herbicides are to be applied after the plants have reached their full height. Herbicides appear to be more effective when combined with cutting (Scott and Mars, 1984; Orchowski, 1991).
Glyphosate [N-(phophonomethyl)glycine] has been found to be very effective against Polygonum cuspidatum (Ahrens, 1975; Beerling, 1990; Pauly, 1986). Glyphosate is a nonselective systemic herbicide with a short

residual life (Ahrens, 1975; Lynn, Rogers and Graham,1979). Application is more effective in the fall when leaves are translocating to rhizomes (Lynn, et al, 1979). The British Nature Conservancy Council (1989) recommends applying 2.0 kg/ha in August with a prior cut in late spring or early summer. Glyphosate is available from Monsanto under the trade names RoundupTM and RodeoTM. Only Rodeo has been approved for use near water (Bender, 1988). Glyphosate has been used with limited success on some nature reserves in the U.K. (Palmer, 1990). Repeated applications over several years may be necessary (Beerling, 1990; Palmer, 1990; Pauly, 1986).

The Nature Conservancy Council (1989) also recommends picloram to be applied at a rate of 2.6 kg/ha in the spring. Picloram is a selective herbicide which is persistent in the soil. It must not be used near water, thus excluding its use in many of the areas where Polygonum cuspidatum is a problem (Gritten, 1990; Scott and Mars, 1984). Dicamba (3,6-dichloro-o-anisic acid) has also been found to be effective against Polygonum cuspidatum, but is persistent in the soil and nonselective (Pridham and Bing, 1975). A number of other herbicides have been tested against Polygonum cuspidatum, both alone and in combination with other herbicides (Orchowski, 1991; Scott and Mars, 1984). Herbicide may have to be used on stands that have been allowed to attain a large size. However, their use is not recommended in nature reserves because of their undesirable effects on other biota and the need for repeated applications to maintain control of Polygonum cuspidatum.

Regardless of whether control is manual or chemical, as long as some rhizomes remain in the soil Polygonum cuspidatum returns once management is relaxed (Beerling, 1990; Nature Conservancy Council, 1989; Palmer, 1990). It has been suggested that the reintroduction of effective competition might be possible (Eaton, 1986).

Research has only recently begun on biological control. The herbivores and pathogens of Polygonum cuspidatum in Wales have been examined for their potential as control agents (Fowler and Schroeder,1990). A program is underway at the International Institute of Biological Control to identify biological control agents (Fowler, pers. comm.). The genetic uniformity of Polygonum cuspidatum makes it a good candidate for biological control (Bailey, 1990). Biological control may be necessary where Polygonum cuspidatum has taken over vast areas as it has done in the U.K., but it may be years before a successful control agent can be found.

The following individuals are familiar with Polygonum cuspidatum and its control in natural areas:

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VI. RESEARCH

Management Research Programs:
It is extremely difficult, if not impossible to eradicate large established stands of Polygonum cuspidatum. However, establishment can be prevented fairly easily by removing Polygonum cuspidatum before it becomes firmly entrenched. Areas known to be near established stands of Polygonum cuspidatum, particularly those downstream from such stands, should be monitored for the introduction of Polygonum cuspidatum.

The following individuals have direct experience monitoriing Polygonum cuspidatum:
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VII. ADDITIONAL TOPICS

VIII. INFORMATION SOURCES

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IX. DOCUMENT PREPARATION & MAINTENANCE

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