PEST RISK ASSESSMENT FOR MILE-A-MINUTE WEED

PEST *Polygonum perfoliatum* L.

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I. Taxonomy, synonymy, common names

Polygonaceae
Section *Echinocaulon*
Polygonum perfoliatum Linnaeus

Synonyms: *Tracaulon perfoliatum* (L.) Greene and *Persicaria perfoliata* (L.) Gross (Reed, 1979c) (Ohwi, 1965).

Etymology of *perfoliatum* : with leaf surrounding stem.

Common Names: Mile-a-minute, giant climbing tearthumb, Devil's tearthumb, Asiatic tearthumb, "ishimakawa" in Japan (Ohwi, 1965) (Walker, 1976).

II. Description

Polygonum perfoliatum is a prickly, branching, annual vine. Growing from a base that may be herbaceous or woody with age, it rambles, climbs or reclines on other plants. It may grow at least 6 meters up into understory trees and shrubs. (Hickman & Hickman, 1978). The distinguishing features of this plant are its triangular leaves with peltate leaf attachment (Reifner, 1982), fleshy iridescent blue fruits, leaf-like saucer-shaped bracts which completely encircle the stem at the nodes, and downward-curving (retrorse) barbs on stem angles, petioles, and leaf-bottom veins. Because it spreads rapidly, *P. perfoliatum* is most often found in dense populations (Hill et al, 1981).

Technical description:

Stems are branched, 1-2 meters long, glaucous, procumbent and twining. Armed with stout short retrorse prickles, they may become woody with age (Riefner, 1982). Nodes are encircled by ocrea (tubular stipules).

Leaves are triangular (deltoid), basally peltate (Guener, 1984), thinly membranous, retrorsely prickly along the (three main) veins beneath, pale green (paler beneath), 3-6 cm. long and as wide (Ohwi, 1965). Leaf margins are usually minutely retrorsely scabrous, the petioles long and retrorsely prickly (Ohwi, 1965) (Reed, 1977). Apices of the foliage are acute to subacute and the bases are truncate to barely cordate (Hill et al, 1981).

Flowers are apetalous, 3-3.5 mm., and borne in sessile, compact heads at the end of branches, well concealed among upper leaves (Reifner, 1982). The perianth is pale yellowish-green, becoming purple or pink when mature (Guener, 1984), with wide variation in color intensity (Moul, 1948).

Fruits are spherical achenes with persistent calyces that thicken

and become iridescent blue as they mature, making the whole structure appear berry-like (Hickman and Hickman, 1978). Achenes are about 5 mm. in diameter, and are subglobose, smooth, and bright black (Guener, 1984) (Mountain, 1989).

Roots are few in number, fibrous, weak and do not penetrate the soil deeply (Moul, 1948).

III. Distribution

Polygonum perfoliatum is native to a wide area of eastern Asia and islands from Japan to the Philippines (Cusick and Ortt, 1987). This area includes Korea, China, the Malay Peninsula, Taiwan, Bangladesh and India (Moul, 1948) (Ohwi, 1965). *P. perfoliatum* has been introduced into Turkey (Guener, 1984) and the northeastern United States (PA, MD, NJ, WV, DE, VA, Washington, D.C., OH).

IV. Uses

Polygonum perfoliatum has "no apparent redeeming economic or social value." (Stevens, 1994).

The fruits are edible; of 40 wild fruits studied in Nepal, it had the highest sodium and potassium content (Bajracharya, 1980).

V. Life History

Polygonum perfoliatum is an annual in temperate climates (Mountain, 1989), but could behave as a perennial in tropical climates, such as in Florida (Oliver, 1994b).

P. perfoliatum prefers low wet ground, water-sides, wet thickets, and areas with abundant plant litter. It prefers moist soil and sunlight but tolerates shade and dryness, quickly colonizing disturbed areas such as roadsides, ditches, and fallow fields (Stevens, 1994).

Seedlings are established by late April in temperate climates, growth is rapid during May through August (Hill et al, 1981). In the northeastern United States, flowering is first noticed in June (Reifner, 1982). Hickman and Hickman (1978) report some populations flowering as late as mid-October. Fruits ripen late in the season, during mid-September into November (Hill et al, 1981). Plants are killed by light frost, but seeds overwinter and germinate the next spring (Moul, 1948). Greenhouse trials in Pennsylvania suggest that seeds require cold and moist treatment to germinate. Germination in Pennsylvania begins around April 1 (Oliver, 1994b).

According to Professor Hartwig, Weed Scientist at Penn State

University (Delmarva Farmer, 1991), mile-a-minute can grow up to six inches in one day and produce a vine up to 25 feet long in one growing season.

VI. History of domestic introduction

The first American record is a specimen in the Gray Herbarium of Harvard University, dated 1890, from ship ballast near Portland, Oregon. That population was apparently short-lived, as the plant was never collected again in the Pacific Northwest (Hickman and Hickman, 1978).

In 1937, Dr. Joseph Ewan of USDA reported *P. perfoliatum* in Glenn Dale Plant Introduction Station, Prince Georges County, Maryland, from a site planted with *Meliosa* seed from China. This population was eradicated by routine weeding practices (Moul, 1948) (Riefner, 1982).

Other early collections are from York County, Pennsylvania around 1946 from an old orchard near Stewartstown, where the plants were first noticed in a rhododendron nursery. The plant made its first appearance around 1938, probably introduced in *Ilex* (holly) seeds from Japan. The nursery owner, impressed by the beauty of the fruits, allowed the plant to reproduce and spread (Moul, 1948). Hickman and Hickman (1978) document a case where *P. perfoliatum* was introduced into Swarthmore College campus on rhododendron from Stewartstown, Pennsylvania.

Once established in Pennsylvania, *P. perfoliatum* spread into surrounding countryside and along watersheds, aided by birds, other animals, and water. By 1987, it was well-established in riverine habitats in the lower Potomac and Susquehanna River drainages in York County, Pennsylvania, in the District of Columbia, in eleven counties of Maryland, and in Mineral and Wood Counties, West Virginia where it is common along the C. & O. Railroad (Cusick and Ortt (1987). By 1983, it was discovered in Virginia (Bradley, 1983). By 1991, it was reported in Salem County, New Jersey (Anderson, 1992). McAvoy (1994) reports it is a recent introduction into Delaware, especially abundant in New Castle County. It was collected in Washington County, Ohio in 1991 (Passoa, 1994).

VII. Associated pests

Insect surveys conducted in Pennsylvania from 1981 to 1983 detected 34 species, representing 5 orders and 15 families, that develop on the plant and 12 species that appear to use the plant only for adult feeding. All members of the fauna feeding on *P. perfoliatum* are ectophagous. No leafminers, stem borers, internal fruit feeders or gall makers are utilizing the resources of the plant as yet (Wheeler and Mengel, 1984).

Japanese beetles damage above-ground parts of the plant during peak growth but plants recover rapidly and continue to grow and reproduce until late October or early November (Moul, 1948).

VIII. Rating elements of risk model

(Please see appendix B for an explanation of codes.)

Estimate probability of pest spreading beyond colonized area: HIGH - VC

Professor N.L. Hartwig, an expert on mile-a-minute in the United States, asserts "It's a definite possibility that this weed could spread from coast to coast" (Wall Street Journal, 1991).

The fruits are buoyant and well adapted for water-borne dispersal (Reed, 1979) (Cusick & Ortt, 1987). The small, palatable, bright and attractive fruits are well-adapted for dispersal by birds. Unusually rapid invasion results from this plant's spread along waterways and drainage areas due to the buoyancy of fruits combined with dispersal by birds east and west across geologic drainage barriers (Reifner, 1982).

During fruit ripening in fall, the plant shares habitat with large number of winter birds, which may disperse the seed in uncolonized areas (Hill et al, 1981). Birds and rodents eat the fleshy fruits in the fall and broadcast the seeds (Stevens, 1994).

The plant is well-adapted for dispersal from nursery to nursery or from nursery to planting bed. Seeds collect within the circular bracts on above-ground portions of the plant. After the vine dies, the retrorse prickles allow it to adhere to the "host" plants, which may be moved or transplanted. New populations may then establish in the disturbed soil under the transplants. Viable seeds also can be transported in rootballs of nursery stock (Hickman and Hickman, 1978) (Hill et al., 1981).

Cusick and Ort (1987) speculate that seeds may have been transmitted into West Virginia by railroad cars or in mud on gas well drilling equipment.

Mile-a-minute is difficult to control by mowing, because too many seeds are left behind (Stevens, 1994.)

Estimate economic impact of establishment: Medium-RC

The plant has no known economic value, but can produce economic damage. *P. perfoliatum* takes over the ground in clear-cut forests, smothering the seedlings of replanted trees and preventing the forest's regeneration. "This weed is a danger to Christmas tree growers, nurseries, orchards, the ornamental shrub

industry, and those who are reforesting previously cut areas." (Hartwig quoted in The Delmarva Farmer, 1991).

"Recent appearance of this plant in orchards and nurseries suggests that it is a potential weed of economic importance." (Hill et al, 1981). Infestation of apple trees can cause some defoliation (Moul, 1948).

P. perfoliatum could damage money-generating hunting and tourism by taking over natural areas (Oliver, 1994b).

Although *P. perfoliatum* is not currently infesting cropland, it could become a costly problem (Hartwig in Delmarva Farmer, 1991). McAvoy (1994) has observed the weed growing on the edges of corn and soybean fields in Delaware.

It is considered harmful throughout Japan by Kasahara (1954), but Mountain (1989) suggests that in Korea and Japan, plant scientists consider it a weed with little or no agricultural significance.

Estimate environmental impact of establishment: HIGH-RC

Although *P. perfoliatum* has been observed mostly in disturbed areas, it is also found in undisturbed areas such as wet meadows and streambanks (Oliver, 1994b).

P. perfoliatum colonizes rapidly and may out-compete much of the native flora. Even the troublesome Japanese honeysuckle has been displaced (Hill et al, 1981) (Moul, 1948). *Sambucus canadensis* L. and *Rubus* spp. were overgrown and killed by the competition (Moul, 1948). Replacement of existing vegetation will deprive native animals of habitat and food (Oliver, 1994b).

In Washington, D.C, it has invaded areas where kudzu has been eradicated, preventing the re-establishment of native vegetation. It outcompetes many native plants, climbing over shrubbery and small trees, its shade killing grasses and wildflowers (Stevens, 1994).

Estimate impact from social and/or political influence: Low/Medium - RC

An increasing number of newspaper and magazine articles are bringing this invasive species to the public's attention. For example, in the New York Times (1994), Stevens labels *P. perfoliatum* "Son of Kudzu" with "no apparent redeeming economic or social value."

The weed is quickly becoming an annoyance in parks, gardens, and private property (Stevens, 1994). Picnickers and campers have been annoyed by dense thickets of this prickly species (Reed,

1979b).

Ecologists fear it could spread to Florida where warm, wet conditions could turn the annual into a perennial, making it a potential agent of ecological disaster (Stevens, 1994).

IX. Pest Risk Potential Rating (low, medium, high) **HIGH**

This calculation is based on the high ratings for spread probability and environmental impact potential, combined with the medium rating for economic consequences of establishment.

X. Summary and discussion

Polygonum perfoliatum is spreading quickly in the northeastern United States. Though this vine prefers sunlight and moist conditions, it is tolerant of shade and dryness. Mile-a-minute could proliferate in the south. Mechanical control is ineffective, chemical control is being evaluated, biological control is as yet unknown. The plant poses a significant threat to natural and restored ecosystems (Oliver, 1994a).

Riefner (1982) writes, "Without question, *P. perfoliatum* is the most important and noxious weedy species to invade the Central Atlantic States in recent decades." The plant has spread rapidly within a few years and has become common in Maryland and Pennsylvania. The plant has the potential to invade the South, and perhaps spread coast to coast (Wall Street Journal, 1991).

Interestingly, APHIS's now-disbanded Technical Committee to Evaluate Noxious Weeds (TCENW) reviewed this species in 1981. In a letter dated May 14, 1981, Staff Officer Paul Sand (since retired) notified the Northeast Regional Director of Plant Protection Quarantine (PPQ) that TCENW decided *P. perfoliatum* was not a serious enough pest to be placed on the Federal noxious weed list. At that time environmental concerns were less a part of APHIS's umbrella.

With APHIS's new weed policy and current emphasis on environmental consequences, this weed would certainly be a candidate for listing, were it not for its current distribution. The plant has become pervasive in the northeast and the opportunity for eradication has passed.

Control options are as follows:

Mechanical control: *P. perfoliatum* can be controlled by mowing or

cutting with a scythe or weed whacker (Mountain, 1989). Gloved hand or rake removal may be used in small areas (Oliver, 1994b). However, this type of control is only effective before plants set seed.

Herbicides: Various herbicides are being evaluated (Hartwig, 1994). Potentially useful herbicides for local control are Roundup (Glyphosate) for non-selective eradication, and Banvel (Dicamba), which selectively kills *Polygonum* species (Riefner, 1982). A late postemergence application of Arsenal (imazapyr) killed the vines in a reforestation clear-cut area (Mountain, 1989). Velpar at 2 qts./acre or 1 lb./acre was effective for preemergence and postemergence treatments, respectively (Oliver, 1994b). Goal (oxyfluorfen) at 1 qt./acre or 0.4 lb./acre provided almost total control when applied preemergence, and excellent control when applied postemergence (Hartwig, 1994).

Habitat Manipulation: Heavy deposits of dead and decaying plant matter should be cleared to reduce the mulch available to seeds (Mountain, 1989). Brush piles and old wood piles should be eliminated where appropriate as they provide ideal habitats (Oliver, 1994b).

Biological Control: Insect surveys in Pennsylvania detected 34 species of insects that develop on the weed and 12 species that feed on *Polygonum* as adults. However, no insect or pathogen in the northeast United States causes significant damage and several niches on *P. perfoliatum* remain unfilled (Wheeler and Mengel, 1984).

In China, the beetle *Gastrophysa atrocyanea* was tested and found to attack *P. perfoliatum* (Xiaoshui, 1991). However, the beetle also attacks other species of Polygonaceae, and is probably not an appropriate biological control agent (Oliver, 1994b).

XI. Recommendations

Because of its distribution in at least seven states, *P. perfoliatum* no longer meets the definition of a noxious weed as required for listing under the Federal Noxious Weed Act. Eradication is no longer feasible. The primary spread mechanisms (birds and water) are not controllable.

Most importantly, APHIS should investigate the potential of classical biological control for this species. Research cooperators would explore eastern Asia, Japan and the Philippines, searching for natural enemies. Potential biological control agents would be studied for host specificity. Following the development of an environmental assessment and approval for release by the "Biological Control of Weeds Technical Advisory Group" and APHIS, field releases of selected biological control agents would be implemented for establishment. This technology

would be transferred to each State department of agriculture concerned with this invasive weed.

In line with the APHIS Weed policy (1994), APHIS should conduct or cooperate in integrated management of this weed only with states or other government agencies that are willing to share the cost of control. For example, Cusick and Ortt (1987) suggested a population in Boaz, West Virginia should be eliminated before the weed spreads along the Ohio River to the Mississippi drainage. In cooperation with West Virginia, APHIS could investigate this site, survey downstream areas, and determine the feasibilty of controlling this pathway.

Finally, APHIS Weed Team members should participate in a symposium now being planned by Professor Hartwig in Pennsylvania to discuss control options and the results of research now being initiated in Virginia and Pennsylvania.

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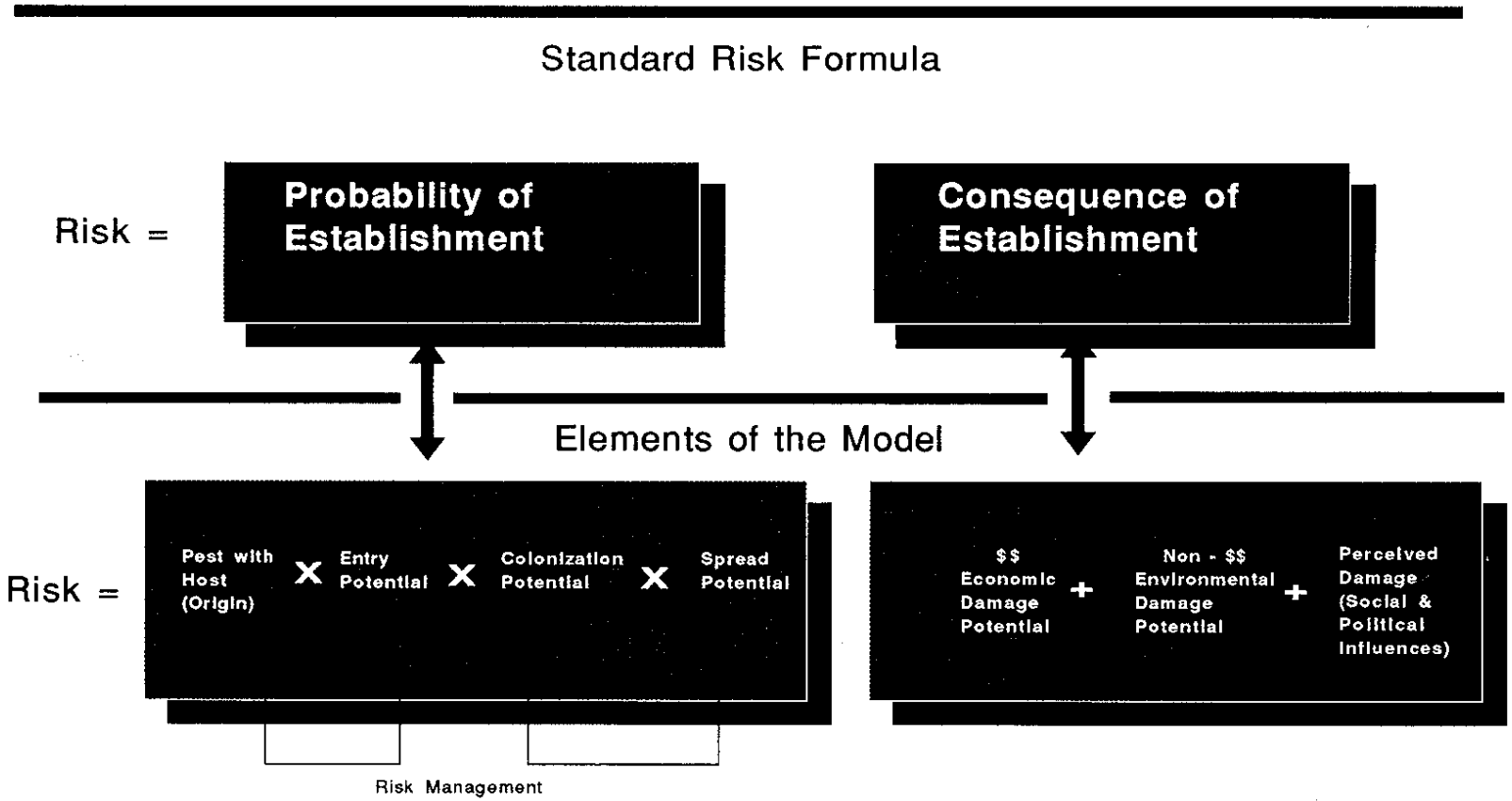
Pest Risk Assessment Model



- For model simplification the various elements are depicted as being independent of one another
- The order of the elements in the model does not necessarily reflect the order of calculation.

Appendix B

UNCERTAINTY CODES TO INDIVIDUAL ELEMENTS

Uncertainty Code	Symbol	Description
Very Certain	VC	As certain as I am going to get
Reasonably Certain	RC	Reasonably certain
Moderately Certain	MC	More certain than not
Reasonably Uncertain	RU	Reasonably uncertain
Very Uncertain	VU	A guess