Weed Risk Assessment for

Ageratina riparia (Regel) R. M. King and H. Robinson

Mistflower

Addendum to a report, Analysis and Assessment of the Invasive risk of *Ageratina riparia*, submitted by Sarah Reichard and Lizbeth Seebacher, University of Washington, College of Forest Resources, Center for Urban Horticulture.

Reviewed by:
Curt Daehler, Department of Botany, University of Hawaii, Honolulu, HI

Adapted into weed risk assessment format by:

Polly Lehtonen, Botanist
United States Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine
Permits and Risk Assessment
4700 River Road Unit 133
Riverdale, MD 20737-1236

Revised by:

Shirley Wager-Pagé
United States Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine
Commodity Import Analysis and Operations
4700 River Road Unit 133
Riverdale, MD 20737-1236

.....

Weed Risk Assessment for *Ageratina riparia* (Regel) R. M. King and H. Robinson

Addendum to a report, Analysis and Assessment of the Invasive risk of *Ageratina riparia*, submitted by Sarah Reichard and Lizbeth Seebacher, University of Washington, College of Forest Resources, Center for Urban Horticulture.

This addendum provides a risk assessment that conforms to the USDA, Animal and Plant Health Inspection Service (APHIS) format for weed risk assessment. The information from the report was adapted to this format and risk ratings were assigned by Polly Lehtonen, USDA, APHIS, Plant Protection and Quarantine.

Stage 1: Initiating Weed Risk Assessment Process

Step 1. Document the Initiating Event(s) for the weed risk assessment.

This assessment is part of Plant Protection and Quarantine's continuous effort to identify potential Federal noxious weeds. The attached report was the product of a USDA Invasive Species Coordination initiative, a contract with Dr. Sarah Reichard of the University of Washington. The WRA area is the United States.

Step 2. Identify and Cite Previous Weed Risk Assessments.

This is the first USDA weed risk assessment for this species.

Step 3. Establish Identity of Weed.

Scientific Name: Order, Family, Genus, and species:

Asterales, Asteraceae, *Ageratina riparia* (Regel) R.M. King and H. Robinson

Synonym(s): *Eupatorium riparium* Regel, *Eupatorium cannabinum* L. (misapplied)

Common name(s): mistflower, creeping croftonweed, hamakua pamakani (Hawaii), river eupatorium, catspaw, small crofton weed, white weed, spreading snakeroot.

Description, general morphology: *Ageratina* consists of over 200 species from the warmer areas of the Americas. The inflorescences consist of many small, fluffy heads without ray florets. The flower heads are in terminal panicles and are either white or pale pink. Leaves are in opposite pairs on the cane-like stems and have a musky, unpleasant smell (Page & Olds, 1999).

.....

Ageratina riparia is a perennial erect or sprawling herb to subshrub, 0.3-1 m tall. The stems have purple striped hairs and are often tinged purple. The toothed leaves are opposite, lanceolate, tapering at each end, up to 10 cm long (Environment BOP, 2000; Auld and Medd, 1997; Wilson and Graham, 2000).

Flowers are white, grouped into flower heads that are in loose terminal clusters at the ends of long branches from upper leaf axils. The top of the plant dies after flowering and new shoots form at the base (Wilson and Graham, 2000).

Seeds are dark brown to black, 2mm long, with a pappus of fine white hairs that aid in wind dispersal (Wilson and Graham, 2000).

Pertinent information regarding life history, including growth, development, means of reproduction and dispersal:

Seeds germinate in the spring; seedlings grow rapidly and are capable of regenerating from the crown in 8-10 weeks. Established plants renew active growth about the same time. Both seedlings and mature plants grow rapidly during summer months, slowing as winter approaches. Growth continues slowly during winter and flowering begins in June (in Australia) and continues until September with ripe seed shed about 3-4 weeks after flowers open (Parsons and Cuthbertson, 1992). Existing colonies increase in density and size by spreading horizontally and rooting at the nodes where they contact the soil (Wilson and Graham, 2000). *Ageratina riparia* is propagated from seed, cuttings or division (Page & Olds, 1999).

Preferred habitat and climatic tolerance:

A. riparia thrives in misty, upland pastures and mountainous areas with high rainfall (Barreto & Evans, 1988). In Australia, mistflower prefers humid subtropical and tropical rainforests, primarily along shaded riverbanks (Parsons & Cuthbertson, 1992). In New Zealand it is found within forest, river systems, open rocklands, freshwater wetlands, steepland forest, damp forest areas including coastal, alluvial forests, low epiphytic niches, forest light gaps, roadsides, quarries, exotic plantations, and in improved pasture and wastelands (Environment BOP, 2000).

Native distribution:

Mexico. The center of origin is in the mountainous, coffee-growing zone of Vera Cruz. Three separate collections were made between 1839 and 1842 from a canyon in the Jalap Cordoba region (Barreto & Evans, 1988).

Current world distribution beyond native distribution:

Escaping from cultivation, mistflower has become a serious weed in parts of Africa, India, Indonesia, Papua New Guinea, Southeast Asia, Australia, New Zealand, Jamaica, Hawaii,

.....

(Parsons and Cuthbertson, 1992) and Madagascar (W³Tropicos, 2001).

Stage 2: Assessing pest risk

Step 4. Regulatory and Geographic Information

Federal noxious weeds are prohibited entry into the United States. *Ageratina riparia* is recorded in the United States in Hawaii, on the islands of Kana'i, O'ahu, Moloka'i, Maui and Hawai'i (Herbst & Wagner, 1996). Hawaii lists *Ageratina riparia* as a noxious weed for eradication and control purposes, which authorizes the State department of Agriculture to conduct control activities for those weeds as time and resources permit (USDA, NRCS, 1999; Hawaii Admin. Rules, 1992). It is being successfully controlled with three biological control agents in Hawaii (Nakahara, 2001). *Ageratina riparia* is of limited distribution and under official control.

Step 5. Assess Economic and Environmental Importance: Consequences of Introduction.

After each of the four risk elements (A-D) in step 5, we discuss the rationale for the rating and the level of certainty.

A. **Establishment potential or habitat suitability in the protected area**. Estimate the potential range in the United States, considering suitable climate conditions.

Assign rating as follows:

Rating	Numerical Score	Explanation: A suitable climate and habitats would permit the weed to survive and establish:
High	3	In most or all of the United States (generally, in more than four plant hardiness zones).
Medium	2	Approximately one-third to two thirds of the United States (generally, in three or four plant hardiness zones).
Low T	1 T	Approximately one third or less of the United States (one or two plant hardiness zones).
Negligible	0	No potential to survive and become established in the WRA area.

Rationale for the rating and the level of certainty:

Based on the Climate prediction model using Queensland as the primary known distribution, the .....

climatic correlation is very high in the states of Florida and Texas with medium correlation locations in parts of the southeast. Mistflower prefers humid sub-tropics and does not tolerate freezing winters.

Level of certainty = uncertain. The estimated potential range is borderline between low and medium, at about one third of the United States. The prediction is imperfect, based on climate preference and documented distribution in another part of the world.

B**. Spread potential after establishment, Dispersal Potential**

Check each of the following that apply:

- Consistent and prolific seed production 3
- Rapid growth to reproductive maturity
- High germination rate under a wide range of conditions
- Ability to suppress the growth of other plants by releasing a chemical inhibitor 3
- Ability to persist as dormant long-lived propagules or underground parts, such as rhizomes, tubers, turions or stolons
- Seed dormancy
- Stress tolerance, including ability to resist herbicides 3
- Ability to colonize a wide variety of habitats
- Lack of natural control agents
- Well-developed storage tissue (for example, tap root)
- Dispersal by windT, waterT, machinery T, animals T, and/or humans T

Assign rating as follows:

Rating	Numerical score	Explanation
High T	3 T	Weed has potential for rapid natural spread throughout its potential range in the WRA area (*e.g.*, high reproductive potential ***AND*** highly mobile propagules).
Medium	2	Weed has potential for natural spread throughout a physiographic region of the WRA within a year (*e.g.*, it has either high reproductive potential ***OR*** highly mobile propagules).
Low	1	Weed has potential for natural spread locally in the WRA area within a year (some reproductive potential and/or some mobility of propagules).

.....

Rating	Numerical score	Explanation
Negligible	0	Weed has no potential for natural spread in the WRA area.

Rationale for the rating and the level of certainty:

In Hawaii, A. riparia is a prolific seeder and grows very fast, becoming the dominant vegetation in an invaded area (Barreto & Evans, 1988). In Australia, mature plants produce between 10,000 and 100,000 seeds annually. The seed can germinate immediately when in light (Parsons and Cuthbertson, 1992).

In Australia, spread is mainly by seed, which is dispersed by wind, water, as impurities in agricultural produce, in sand and gravel used in roadwork, in mud sticking to animals, machinery, other vehicles, clothing and footwear. Existing colonies increase in size and density by layering, forming mats of interwoven stems (Parsons and Cuthbertson, 1992). The trailing branches root when they come into contact with the soil (Morris, 1991).

Disturbance by flooding opens up stream habitat and helps distribute the seeds (Environment BOP, 2000).

Leachates from leaves and plant litter have an allelopathic effect on other plants. It is resistant to many herbicides, but can be controlled if treated repeatedly (Parsons and Cuthbertson, 1992).

The combination of factors above result in a high probability of establishment and spread.

Level of certainty = Reasonably certain

C. **Economic Impact**.

Discuss the potential economic importance of the species in the WRA area. Consider three primary types of damage:

1. Reduced crop yield (*e.g.*, by parasitism, competition, or by harboring other pests). T
2. Lower commodity value (e.g., by increasing costs of production, lowering market price, or a combination); or if not an agricultural weed, by increasing costs of control.T
3. Loss of markets (foreign or domestic) due to presence of a new Federal noxious weed.T

Assign ratings as follows:

Rating	Numerical score	Explanation

.....

High T	3 T	Weed causes all three of the above impacts, or causes any two impacts over a wide range (over 5 types) of economic plants, plant products, or animals.
Medium	2	Weed causes any two of the above impacts, or causes any one impact to a wide range (over 5 types) of economic plants, plant products, or animals.
Low	1	Weed causes any one of the above impacts.
Negligible	0	Weed causes none of the above impacts.

Rationale for the rating and the level of certainty:

Mistflower has been found to be unpalatable to grazing animals and has been shown to cause lung lesions in horses. In laboratory tests, alcohol extracts of the plant leaves killed sheep, but so far there are no field reports of animal deaths attributed to mistflower (Barreto & Evans, 1988, Parsons and Cuthbertson, 1992). *A. riparia* reduces carrying capacity of pastures and restricts the movement of stock and machinery (Parsons and Cuthbertson, 1992; Western Australia weed web site).

The weed is reported to form dense stands and is a threat to the forest industry as this species tends to seed prolifically and the trailing branches root when they come into contact with the soil (Morris, 1991).

New Zealand and South Africa list *Ageratina riparia* as a prohibited noxious weed for import purposes. Agricultural commodities produced in the United States and exported to New Zealand and South Africa would be refused entry if propagules of the weed are found.

Possible economic impacts include reduction of pasture and rangeland carrying capacity, control costs, possible loss of markets overseas, and reduction of yield in the forest industry.

Level of certainty = reasonably certain.

D. **Environmental Impact**

Consider whether or not the weed, if introduced, could:

- Cause impacts on ecosystem processes (alteration of hydrology, sedimentation rates, a fire regime, nutrient regimes, changes in productivity, growth, yield, vigor, etc.). T
- Cause impacts on natural community composition (*e.g.*, reduce biodiversity, affect native populations, affect endangered or threatened species, impact keystone species, impact native fauna, pollinators, or microorganisms, etc.). T

.....

- Cause impacts on community structure (*e.g.*, change density of a layer, cover the canopy, eliminate or create a layer, impact wildlife habitats, etc.). T
- Have impacts on human health such as allergies or changes in air or water quality.
- Have sociological impacts on recreation patterns and aesthetic or property values.
- Stimulate control programs including toxic chemical pesticides or introduction of a nonindigenous biological control agent. T

Assign ratings as follows:

Rating	Numerical Score	Explanation
High T	3 T	Three or more of the above. (Potential to cause major damage to the environment with significant losses to plant ecosystems and subsequent physical environmental degradation. Population reduction of endangered or threatened species would elevate that one impact to a high rating.)
Medium	2	Two of the above. (Potential to cause moderate impact on the environment with obvious change in the ecological balance, affecting several attributes of the ecosystem, as well as moderate recreation or aesthetic impacts.)
Low	1	One of the above, unless the factor is potential to reduce populations of endangered or threatened species, which rates High. (Limited potential impact on environment.)
Negligible	0	None of the above. (No potential to degrade the environment or otherwise affect ecosystems.)

Rationale for the rating and the level of certainty:

In New Zealand, *A. riparia* is an invasive weed of natural and rural areas in the North Island. It has been observed smothering existing plant communities that are less than one meter tall. Dense persistent mats of semi-woody stems prevent the regeneration of other plants beneath the infestation. Compared to the native species typically found in steepland gullies and streams, *A. riparia* causes more rapid build up of sediments and less stability. It is considered a threat to native specialized streamside plants and to any open streamside, even in an unmodified forest. This plant is prohibited from propagation, sale and distribution in New Zealand (Environment BOP, 2000).

In Hawaii Volcanoes National Park, the weed competes with native plants and occupies

.....

disturbed areas. According to the U.S. Fish and Wildlife Service, (US Dept. of Interior, 1996), *Ageratina riparia* is among the primary threats to *Lepidium arbuscula*, *Lobelia monostachya*, *Meliocope saint-johnii*, three endangered species on the island of Oahu. Mistflower forms dense mats with other alien plants and prevents the regeneration of the endangered species.

Mistflower can be controlled by slashing, ripping, plowing, burning and spraying with herbicide. The disturbed area must be replanted to prevent re-infestation (Wilson and Graham, 2000).

Biological control agents have been released in Hawaii, South Africa and New Zealand (Fröhlich et al, 1999; Morris, 1991). The fungal pathogen *(Entyloma ageratinae)* was collected from Jamaica, and later released in Hawaii with impressive results. The pathogen reduced mistflower populations by 80% over a nine-month period with over 50,000 hectares of rangeland rehabilitated. However, in its native habitat of Mexico, the fungus has an almost non-deleterious effect on *Ageratina riparia*, exhibiting the traits of co-evolution (Barreto & Evans, 1988). Released into South Africa in 1998, *E. ageratinae* shows early indications that it will provide useful control (Morris, 1991; Wilson and Graham, 2000).

Procecidochares alani (Diptera: Tephritidae), a gall fly, was imported to Hawaii in 1974. *P. alani* produces galls on mistflower which can eventually debilitate the plant (Hapai & Chang, 1986). The white mist gall fly was introduced into Australia, but has had little impact due to attack by native parasites (Wilson and Graham, 2000).

Oidaematophorus beneficus, a Plume Moth was introduced from Mexico (Yang & Heppner, 1983) in 1973 by the Hawaii Department of Agriculture. The three agents listed above have substantially controlled the weed in most of the affected areas on the island of Hawaii (Conant, 1998).

With probable impacts to ecosystem processes, composition and structure, mistflower rates a high risk rating for environmental impact.

Level of uncertainty: very certain.

ECONOMIC and ENVIRONMENTAL IMPORTANCE SUMMARY: Consequences of Introduction: Cumulative Risk Element Score

Add together the numerical estimates for the four risk elements to produce an overall estimate of the Consequences of Introduction Risk Rating for the weed. The overall risk rating is used to assign a Consequences of Introduction Risk Score as follows:

Risk: Consequences of Introduction (Sum Risk Elements #1-4) (1+3+3+3 = 10)		
Cumulative Risk Element Score	Risk Rating	Risk Score

.....

Risk: Consequences of Introduction (Sum Risk Elements #1-4) (1+3+3+3 = 10)		
Cumulative Risk Element Score	Risk Rating	Risk Score
0 - 2	Negligible	0
3 - 6	Low	1
7 - 10 T	Medium T	2
11 – 12	High	3

The Consequences of Introduction Risk Rating, an indicator of the potential of the weed to become established and spread, and its potential to cause economic and environmental impacts, is medium for *Ageratina riparia*.

Step 6. Assess Likelihood of Introduction.

Discuss entry potential and establishment potential. What is the likelihood that the species will enter the United States, survive the shipment and find a suitable habitat for establishment?

Assign ratings as follows:

Rating	Numerical Score	Explanation: Introduction is
High T	3 T	Very likely or certain
Medium	2	Likely
Low	1	Low, but clearly possible
Negligible	0	Extremely unlikely

Rationale for rating and the level of certainty:

Mistflower has been introduced into several countries as an ornamental and as an agricultural contaminant. In both pathways, no treatments are applied to devitalize the seed. The same pathways provide a high likelihood of further introduction into the mainland United States.

Level of certainty = reasonably certain

Step 7. Conclusion: Pest Risk Potential of Weed.

Produce an estimate of the pest risk potential by considering the Consequences of Introduction and the Likelihood of Introduction using the following table as a guide. The pest risk potential will be obtained from the combination of the scores for likelihood of introduction and

.....

consequences of introduction, and will be assigned as follows:

Likelihood of Introduction (Rating and Score)	Consequences of Introduction (Rating and Score)	Overall Pest Risk Potential
Negligible (0)	Negligible (0)	Negligible
Negligible (0)	Low (1)	Negligible
Negligible (0)	Medium (2)	Negligible
Negligible (0)	High (3)	Negligible
Low (1)	Negligible (0)	Negligible
Low (1)	Low (1)	Low
Low (1)	Medium (2)	Low
Low (1)	High (3)	Low
Medium (2)	Negligible (0)	Negligible
Medium (2)	Low (1)	Low
Medium (2)	Medium (2)	Medium
Medium (2) T	High (3) T	Medium- High T
High (3)	Negligible (0)	Negligible
High (3)	Low (1)	Low
High (3)	Medium (2)	Medium-High
High (3)	High (3)	High

Summary and Conclusion:

Introduced to many parts of the world as an ornamental and escaping from cultivation, *Ageratina riparia* is a serious weed in Africa, India, Indonesia, Papua New Guinea, Southeast Asia, some Pacific Islands, New Zealand and Australia. *Ageratina riparia* has a medium consequences of introduction rating and a high likelihood of introduction rating, for an overall risk rating of medium-high. This species is known to occur in the United States only in Hawaii, where it is regulated as a prohibited noxious weed. The species could likely establish in Florida, Texas, and in moist habitats within the warm southeast. In other parts of the world into which it has been introduced, it is both an agricultural and environmental weed. The species has the potential to invade disturbed areas and riverbanks. Chemicals from leaf litter suppress the growth of other plants, giving mistflower a competitive advantage. *Ageratina riparia* is among the primary threats to 25 endangered species on the island of Oahu in Hawaii. Having no value as feed, it reduces the carrying capacity of pastures and rangeland and restricts movement of machinery and .....

stock. The potential negative impacts outweigh any limited value the species has as an ornamental.

Step 8. References.

Agriculture Western Australia Weed Science Page. 2000. Agriculture Dept. Western Australia. <http://www.agric.wa.gov.au/progserv/plants/weeds/weedlist.htm> 28 October 2000.

Auld, B.A. and R.W. Medd 1997. Weeds, an illustrated botanical guide to the weeds of Australia. Agricultural Research and Veterinary Centre, Orange NSW Agriculture.

Barreto, Robert W. and Evans, Harry C. 1988. Taxonomy of a Fungus Introduced into Hawaii for Biological Control of *Ageratina riparia* (Eupatorieae; Compositae), with Observations on Related Weed Pathogens. Transactions of the British Mycological Society 91: 81-97.

Conant, Patrick. 1998. A New Host Record for *Oidaematophorus beneficus* Yano & Heppner (Lepidoptera: Pterophoridae). Proceedings of the Hawaiian Entomological Society 33: 151-152.

Davis, C. J. et al. 1992. Biological control of lantana, prickly pear, and hamakua pamakani in Hawaii: a review and update, in Alien Plant Invasions in Native Ecosystems of Hawaii, Management and Research, edited by C.P. Stone, C.W. Smith and J.T. Tunison, pp.411-432.

Environment BOP Page. The Bay of Plenty Regional Council. Last updated December 21, 2000. <http://www.boprc.govt.nz/www/green/weed81.htm~ 13January2001.

Fröhlich, J. et al. 1999. Biological control of mistflower (*Ageratina riparia*, Asteraceae) in New Zealand. Proc. 52nd N.Z. Plant Protection Conf. pp. 6-11.

Hapai, Marlene N. and Chang, Franklin. 1986. The Induction of Gall Formation in *Ageratina riparia* by *Procecidochares alani* (Diptera: Tephritidae). I. Gall Histology and Internal Gross Morphology of the Third Instar. Proceedings Hawaiian Entomological Society 26: 59-63.

Hawaii Administrative Rules, 1992. Title 4, Dept. of Agriculture, Subtitle 6, Division of Plant Industry, Chapter 68, Noxious Weed Rules.

Herbst, Derral R. and Wagner, Warren L. 1996. Contributions to the Flora of Hawai'i. Bishop Museum Occasional Papers No. 46: 9-11.

Ministry of Agriculture and Forestry (MAF), Wellington, New Zealand, 1999. MAF Biosecurity Authority Standard 155.02.05, importation of seed for sowing.

Morris, M.J. 1991. The Use of Plant Pathogens for Biological Weed Control in South Africa.

.....

Agriculture.Ecosystems and Environment 37: 239-255.

Nakahara, L. 2001. Personal communication. Manager, Plant Pest Control Branch, Hawaii Department of Agriculture.

Page, Susan and Olds, Margaret. 1999. Botanical. Welcome Rain Publisher LLc, New York, New York.

Parsons, W. T. & E. G. Cuthbertson. 1992. Noxious weeds of Australia. Inkata Press, Melbourne, Sydney.

South Africa's Declared Weeds/Invaders list: http://www.plantzafrica.com/miscell/aliens6.htm

USDA, NRCS. 1999. The PLANTS database <http://plants.usda.gov/plants>. National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

U.S. Department of the Interior, Federal Register notice of October 10, 1996 (Volume 61, Number 198)] [Rules and Regulations] [Page 53089-53108] From the Federal Register Online via GPO Access [wais.access.gpo.gov] , 50 CFR Part 17, Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for Twenty-five Plant Species From the Island of Oahu, Hawaii

W³Tropicos, Missouri Botanical Garden's VAST (VAScular Tropicos) nomenclatural database: http://mobot.mobot.org/W3T/Search/vast.html. 2001.

Western Australia Government weed web site: http://www.agric.wa.gov.au/programs/app/Weeds/stemless.htm . 2001.

Wiersema, J. H. & B. León. 1999. World economic plants: a standard reference. CRC Press, Boca Raton, London, New York, Washington, D.C.

Wilson, C. and N. Graham. 2000. Mistflower (*Ageratina riparia*), Northern Territory of Australia Agnote No. 628.

Yano, Koji and Heppner, John B. 1983. Description of *Hamakua Pamakani* Plum Moth from Hawaii (Lepidoptera: Pterophorida). Proceedings' Hawaiian Entomological Society 24: 335341.

.....