To the User:

Element Stewardship Abstracts (ESAs) are prepared to provide The Nature Conservancy's Stewardship staff and other land managers with current management-related information on those species and communities that are most important to protect, or most important to control. The abstracts organize and summarize data from numerous sources including literature and researchers and managers actively working with the species or community.

We hope, by providing this abstract free of charge, to encourage users to contribute their information to the abstract. This sharing of information will benefit all land managers by ensuring the availability of an abstract that contains up-to-date information on management techniques and knowledgeable contacts. Contributors of information will be acknowledged within the abstract and receive updated editions. To contribute information, contact the editor whose address is listed at the end of the document.

For ease of update and retrievability, the abstracts are stored on computer at the national office of The Nature Conservancy. This abstract is a compilation of available information and is not an endorsement of particular practices or products.

Please do not remove this cover statement from the attached abstract.

Authors of this Abstract:
Cathy Macdonald, Mary J. Russo (Revision)

©
THE NATURE CONSERVANCY
1815 North Lynn Street, Arlington, Virginia 22209  (703) 841 5300
I. IDENTIFIERS

Common Name: Tansy Ragwort, Tansy Butterweed

General Description:
The following description of Senecio jacobaea is adapted from Munz and Keck (1973).

Senecio jacobaea is a member of the Groundsel Tribe (Senecioneae) of the Sunflower Family (Asteraceae=Compositae). It is a biennial or short-lived perennial, 3-10 dm tall, with one to a few coarse, erect purplish red stems, simple except above. The herbage is thinly floccose-tomentose, later becoming more or less glabrate. The leaves are well distributed, mostly 2-3 pinnatifid, about 5-20 cm long, with only the lower petioled.

The inflorescence is short, broad, and of several to many heads. The involucre is about 4 mm high. The are about 13 phyllaries, most with dark tips. The bracteoles are narrow, though sometimes quite evident. There are about 13 yellow rays, 5-10 mm long. The akenes of the disk flowers are pubescent, while those of the ray flowers are glabrous.

Senecio jacobaea can be distinguished from other Senecios by its perennial nature, being largely herbaceous but with a woody base; stems 3-10 dm; and leaves 5-20 cm long, not narrow linear or divided into linear segments, but being 2-3 times pinnatifid.

Diagnostic Characteristics:

II. STEWARDSHIP SUMMARY

III. NATURAL HISTORY

Habitat:
Senecio jacobaea is native to Europe and western Asia and has become a serious rangeland pest in New Zealand, Tasmania, Australia, South Africa, and North and South America (Baker 1982).

S. jacobaea is a disturbance area plant; it is found on creek bottom lands, in pastures, forest clearcuts, overgrazed pasture, and along roadsides. In Cascade Head Preserve, Oregon, it has even been found growing in the cracks and crevices of cliffs and on shallow soiled steep slopes (Macdonald 1983).
Reproduction:
S. jacobaea is considered a biennial species. It typically forms a rosette the first year and bolts into a single flowering stalk in the second year to flower, fruit, and die. However, this typical life cycle has many exceptions. Under extremely favorable conditions, tansy ragwort may behave like an annual (Forbes 1977). If conditions are poor or the plant is damaged, it may be induced into a mono- or polycarpic perennial habit (Cameron 1935, van der Meijden and van der Waals-kooi 1979). Polycarpic perennial plants often have large, woody rootstalks and more than one flowering stalk.

Ragwort flowers are arranged in capitula which in turn are arranged in a cymose inflorescence. Each capitula contains an outer row of radiate (ray) female flowers and many central tubular (disk) perfect flowers. The number of florets per capitula varies; Harper and Wood (1957) found an average of 57 disk florets and 13 ray florets. The number of capitula per plant is correlated with plant size; small plants may produce as few as ten capitula, while large, multi-stemmed plants may produce up to 4,000 capitula in a single year.

The morphologically distinct florets produce morphologically distinct achenes. Ray achenes are glabrous and shed their reduced pappus early in development. Disk achenes bear rows of trichomes and retain their pappus. The two achenes also differ in size, weight, dispersal mechanisms, germination requirements, and germination rates (Harper 1965, Burtt 1977).

Ragwort achenes are primarily dispersed by the wind. Disk achenes are dispersed earlier and farther than ray achenes. Ray achenes are retained in the capitula, pressed against the phyllaries. Eventually the ray achenes are shaken out of the capitula, usually falling near the base of the plant (Green 1937). Poole and Cairns (1940) studied the dispersal of ragwort achenes from an established stand. They found that 60% of the total seed shed landed within 4.6 m of the base of the plants; an additional 39% landed between 4.6 and 9 m from the plant. The distance an individual achene disperses depends on climatic conditions (humidity, wind velocity and direction), the structure of the surrounding vegetation, and at what height the achene is borne on the plant (McEvoy unpubl.).

On the Oregon coast, ragwort achenes mature in late summer and early fall. The achenes reach their maximum germination potential before dispersal; they do not possess an innate dormancy (van der Meijden and van der Waals-kooi 1979). There are two peaks of ragwort germination: fall and spring. However, some germination occurs year-round (Harper and Wood 1957).

Soil moisture, soil surface humidity, and light are important factors in ragwort germination. Van der Meijden and van der Waals©kooi (1979) found germination of ragwort achenes to be greater at soil moisture levels between 15 and 29% and a relative humidity at the soil surface of 100%. They also found that a covering of more than 4 mm of sand led to enforced dormancy due to screening of light.
The effects of plant competition (probably acting on ragwort's light requirements for germination) on ragwort abundance has been documented both experimentally and observationally. Cameron (1935) planted ragwort seeds in long turf, short continuous turf, overgrazed pasture vegetation, hard exposed soil, and open soil. He obtained high establishment rates in the overgrazed pasture vegetation (86,000/acre) and both soil condition types (860,000/acre and 2,000,000/acre, respectively), but none in the long turf or short continuous turf plots. Van der Meijden and van der Waals Kokooi (1979) also planted ragwort seeds in cleared and uncleared plots. Their results supported the hypothesis that ragwort needs an opening through some form of disturbance to become established. Several disturbance agents have been cited for increasing the abundance of ragwort in a community and include moles and gophers, ants, rabbits, livestock, and man (Harper and Wood 1957).

Ragwort seeds remain viable in the soil for several years. In this way ragwort can wait for the occurrence of favorable conditions. McEvoy (unpubl.) found 0.75 viable ragwort seeds/cc in the upper 3 cm of soil underneath a pasture heavily infested with ragwort. Viable seeds were encountered in samples taken as deep as 25 cm below the surface.

Ragwort can also regenerate vegetatively. This occurs primarily with damaged plants, but it also occurs in undisturbed populations in closed swards (Forbes 1977, Harris et al. 1979). Vegetative regeneration is possible due to storage of carbohydrate reserves in the stem bases and roots. The plant's capacity to regrow is related to the diameter of the plant and its root crown at the time of the damage (Baker 1982). A damaged root crown may produce a single new rosette or several. Propagation of ragwort from root fragments was first attempted by Cairns (1938). Within a month, he obtained shoots from root fragments as small as 1.5 cm in length. Roots from rosettes are more vigorous sprouters than are roots from flowering plants (Poole and Cairns 1940).

S. jacobaea is native to Europe and western Asia and has become a serious rangeland pest in New Zealand, Tasmania, Australia, South Africa, and North and South America (Baker 1982). Its complex reproductive and regenerative strategies have allowed it to undermine the action of most weed control methods and therefore spread rapidly. Furthermore, most ragwort control efforts (and the research on these control methods) have focussed on rangeland and agricultural land. The characteristics and dynamics of nonagricultural lands are quite different than those of agricultural lands. Therefore, the efficiency and feasibility of any weed control method must be judged on cost, effectiveness, and compatibility with other land use practices and management objectives. Because local climate and site conditions may affect control methods, such methods need to be designed on a site by site basis.

IV. CONDITION

V. MANAGEMENT/MONITORING

Management Requirements:
There are two basic rules of biological control: (1) you can never eradicate a species, you can only control it, and because of this (2) if you do control it, it is not a once-and-for-all proposition. As ragwort populations decline, introduced flea beetle populations should also decline. If ragwort densities drop low enough the flea beetles could become locally extinct. The ability of ragwort seeds to remain dormant in the soil for many years give it the ability to 'out-wait' the flea beetles. Any disturbance, natural or otherwise, could allow ragwort a new toehold. It is important that any management actions that might constitute a significant disturbance be monitored for ragwort.

Hand pulling of the occasional plant is recommended as a follow-up control. At Cascade Head Preserve, ragwort abundance should be visually monitored in mid-August every year and transects should be re-read once every five years. Some local fluctuation in ragwort populations should be expected, but if the density starts to increase greatly, surveys for flea beetles should be conducted. Adult flea beetles and flea beetle damage is surveyed easiest in fall. If flea beetle density does not increase with the ragwort, new colonies should be introduced.

MANUAL/MECHANICAL CONTROL
Mowing: This is probably the most commonly used method of control. The main objective of mowing is to stop the plants from producing seed. It is most effective if done just prior to flowering when the plant has exhausted the greatest amount of its stored reserves but before its seeds have started to develop. Although mowing can prevent flowering (if done more than once) it appears to increase rosette density, rather than reduce it (Hawkes pers. comm.).

Hand Removal: Hand pulling is an effective method of eliminating ragwort, especially if it is done when soils are moist and the hole left after pulling is mulched. Mulching creates an unsuitable habitat for ragwort germination by removing necessary light. Pulling is most often used only after the population has been brought under control.

CHEMICAL CONTROL
Herbicides: S. jacobaea can be controlled chemically with 2,4-D, dicamba, or a combination of the two (Baker 1982). For effective control, the herbicides must be applied during specific developmental stages. 2,4-D is most effective when applied to seedlings and first year rosettes or second year plants prior to bolting. Brewster et al. (1978) obtained between 96 and 100% control from spring applications of 2,4-D at 20 western Oregon locations. Following bolting, a combination of 2,4-D and dicamba is more effective; it does not eliminate seed production (Peabody 1980) but does reduce viability if sprayed in the early bud stage and prevents viability if sprayed in the late bud/early flowering stage (Baker 1982). As with all herbicides, there is concern over the long-term effects on the environment and on human health.

BIOLOGICAL CONTROL
Sheep Grazing: Unlike cattle and horses, sheep appear to be unaffected by ragwort's toxicity. They may be either grazed exclusively as a pre-treatment to cattle grazing or
grazed with cattle. Continuous heavy grazing will prevent flowering and, in many cases, reduce density (Bedell et al. 1981, Sharrow and Mosher 1982). However, sheep eat most herbaceous plant species, and their grazing has side effects. Disturbance due to their feeding and bedding down will leave openings in vegetation. If there is an abundant ragwort seed bank, these openings will allow for reestablishment.

Biocontrol: In its native habitat three insects (cinnabar moth, tansy ragwort seed fly, and tansy ragwort flea beetle) have been identified as important population regulators (Cameron 1935, Frick 1970). Unfortunately, ragwort has been introduced to other habitats without its associated natural predators. Without them it gained the competitive advantage it needed to become established. The aim of biological control is to reduce that advantage and restore the target weed’s natural herbivore/host plant population balance.

The cinnabar moth was first introduced into Oregon in 1960. Subsequent research has shown that the cinnabar moth can reduce ragwort populations by 50-75% on sites favorable for their survivorship (Isaacson and Ehrensing 1977). Adult cinnabar moths begin to emerge in late spring/early summer. Mating commences quickly, and females lay their eggs on the underside of ragwort leaves. Larvae hatch in about two weeks and begin feeding on ragwort foliage. By the third instar, larvae have migrated to the top of the plant to feed on the buds and flowers. With a good population of larvae, plants are stripped of flowers, buds and leaves.

Cinnabar moths are released in colonies of at least 1,000 individuals. Release sites should be well-drained and unlikely to be disturbed (plowing, logging, etc.) for five years following the introduction. Third, fourth, and fifth instar larvae are usually collected for release. It is important to keep the colony cool and well fed during the transport. Five to ten individuals should be allocated to each plant.

Cinnabar moths have been reported on three close relatives of S. jacobaea: S. vulgaris (another introduced weedy species), S. seneca (a garden species), and S. triangularis. The chances of cinnabar moths damaging native species are minor.

The tansy ragwort flea beetle was first released in Oregon in 1971 (Isaacson and Ehrensing 1977). Adult flea beetles begin emerging in late spring. The beetles feed for several weeks, leaving shot hole damage on ragwort foliage. During mid-summer, the adults estivate. Short days and cooler temperatures bring the beetles out of estivation, and feeding and egg laying begin. Flea beetles lay their eggs in the soil near the base of ragwort plants. Egg laying continues through winter. Eggs hatch following a three week developmental period, and larvae migrate to ragwort root crowns and petioles. Feeding continues through the winter and spring. Pupae develop in spring and early summer. While adult flea damage is visible, it is the larval feeding that damages the plant. Feeding on the root crown of rosettes uses up carbohydrate reserves needed for bolting. There is some speculation that larval feeding may introduce a fungus that is partially responsible for plant death (Holden pers. comm.).
Host specificity studies found that the tansy ragwort flea beetle will feed to a limited extent on other Senecio species and on Emilia coccinea, Erechtites arguta, Adenostyles alpina, Helianthemum nummularium, Cynoglossum amabile, and Ligularia clivorum. Full development of the larvae only occurred on S. vulgaris and S. erucifolius.

More recently, the tansy ragwort seed fly was released as a control agent. Adult emergence of the seed fly coincides with the appearance of ragwort flower buds. Eggs are laid between the involucral bracts and the outermost florets. Egg hatch and larval development occur within a one-month period. The larvae feed on developing seeds. At a release site in New Zealand, ragwort seed flies infested 98% of all capitula and were responsible for an 87% reduction in viable seed production (Frick and Andres 1967).

Host specificity tests were conducted prior to the seed fly introduction into the U.S. (Frick and Andres 1967). Forty-four species in the Asteraceae were tested for host suitability. Of these, eggs were laid on S. vulgaris, S. cineraria, Cota tinctoria, Chrysanthemum segetum, Erigeron canadensis, a species of Calendula, and Cichorium endivia. Eggs laid on these species failed to develop. Apparently, larval development can only occur on species with similar chemical composition and capitular structure in which budding is closely synchronized with the emergence of the adult fly.

These three biological control agents compliment one another by being targeted on different plant parts. The cinnabar moth feeds primarily on summer foliage, the flea beetle feeds on the root crown in winter, and the seed fly feeds on the seeds in summer. The combined pressure of these three insect species should have greater control than any of the agents alone. Overlap between the cinnabar moth and seed fly may limit population levels of one of the two, but this has not yet been studied.

PRESERVED BURNING
Although fire is important in the management of grassland systems, there are no data available on which to judge the effectiveness of it as a control for ragwort. Observations suggest that fire actually increases ragwort abundance (Holden pers. comm.).

VI. RESEARCH
Management Research Programs:
A monitoring program is being undertaken at TNC's Cascade Head Preserve in Oregon.

Research has been done on controlling this weedy species (particularly with respect to rangeland and agricultural land use). Monitoring should tell whether or not further research is needed.

There have been active control efforts made at Cascade Head Preserve in Oregon. The distribution, abundance, and vigor of S. jacobaea was measured there in 1980 and 1982. Ragwort flowering plants and rosettes were counted, and the height and number of
capitula per flowering plant were recorded from ten half-square-meter plots along 14 transects. Aerial photographs of the preserve were taken in late August of both years. The intensity of yellow in the photographs was used to map the distribution of four ragwort density classes.

Biological control proved to be the most attractive method here. On July 15, 1980, 6,000 third, fourth and fifth instar cinnabar moth larvae were released. On October 10, 1980, four colonies (300 individuals/colony) of ragwort flea beetles were released. The populations of these bio-control agents and evidence of their damage was monitored from 1980 to 1983. A dramatic decline in ragwort abundance in a zone around the flea beetle release sites was documented in 1982. Flea beetle abundance on the preserve is high, and the flea beetles have spread to most parts of the preserve. Cinnabar moths are still present but in small numbers. The decline in ragwort abundance between 1980 and 1982 is attributed to flea beetle feeding.

For a more complete description of the control efforts at Cascade Head, see Macdonald (1983).

Management Research Needs:
(1) Identify those places where ragwort is a problem.
(2) Determine control method (if biological control methods are used, determine the effect such controls might have on native species).
(3) Implement program.
(4) Monitor results.

VII. ADDITIONAL TOPICS

VIII. INFORMATION SOURCES

Bibliography:


Macdonald, C.A. 1983. Ragwort abundance and distribution on the Cascade Head Preserve and efforts to control it. The Nature Conservancy, Oregon Field Office, 1205 NW 25th Ave, Portland, OR.


OTHER (UNCITED) REFERENCES


IX. DOCUMENT PREPARATION & MAINTENANCE

Edition Date: 89-2-1

Contributing Author(s): Cathy Macdonald, Mary J. Russo (Revision)