Weed Risk Assessment for

Arctotheca calendula (L.) Levyns

capeweed

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Introduction

The Animal and Plant Health Inspection Service (APHIS) regulates noxious weeds under the authority of the Plant Protection Act of 2000. The Plant Protection Act defines a "Noxious Weed" as "any plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry or other interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment." Under this act, APHIS lists those plants specifically designated as federal noxious weeds (7 CFR § 360.200) to ensure transparency among all interest groups.

APHIS uses qualitative risk assessments as a basis for weed exclusion decisions and listing under federal noxious weed regulations (7 CFR § 360, January 1 2004). In a qualitative assessment, risk is estimated in terms of high, medium or low, as opposed to numerical terms, such as probabilities or frequencies.

This document is a qualitative weed risk assessment that will be used to determine whether or not *Arctotheca calendula* should be listed under the federal noxious weed regulations (7 CFR § 360.200).

Stage 1: Initiating Weed Risk Assessment Process

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

This organism-based assessment is part of Plant Protection and Quarantine's continuous effort to identify potential Federal noxious weeds. *Arctotheca calendula* was identified in 2001 as a target for risk assessment when PPQ officers detected achenes of this species in oats imported from Australia entering the United States for animal consumption. This assessment is being conducted to determine if this species meets the definition of a Federal noxious weed. The weed risk assessment 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, *Arctotheca calendula* (L.) Levyns

Synonym(s):

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Arctotheca *calendulaceum (L.) Lewin*
Arctotis calendula L. [basionym]
Cryptostemma calendula (L.) Druce
Cryptostemma calendulacea R. Br.
Venidium decurrens hort, (non *V. decurrens* Less.)

(USDA, ARS, 2002)

Common names:

capeweed, cape daisy, cape marigold, silverspreader (Randall, 2002)
Cape dandelion (Codex Plantarum Vascularium Mediterraneum, 2000)
dune calendula (Unite, 2002) (not to be confused with *Calendula officinalis* L., the calendula common in horticulture.)
plain treasure flower (HYPPA, 2002)
African calendula (Hortiplex Database, 2002)
South African capeweed (Bossard et al., 2000).
Cape gold (CDFA, 2002).
Tonteldoek, Soetgousblom, Kaapse Gousblom (Joffe, 2001).

Description, general morphology: Capeweed is a flat, stemless or short-stemmed, spreading, rosette-forming annual (Auld and Medd, 1987) or perennial in areas with frost-free climate, growing up to 50 cm high (CDFA, 2002). With age, capeweed forms an extensive carpet-like mass, by proliferation of stolons from rosettes (Bossard et al., 2000; Clemson, 1985).

Leaves: Basal leaves frequently form a rosette, the rest are alternate. Leaves are irregularly and deeply lobed and sharply toothed, rough and hairy above, woolly below, or sometimes woolly on both surfaces (Hussey et al., 1997; Clausen and Ekstrom, 1989; McClintock, 1993). Rosette leaves are 5-25 cm long, 2-6 cm wide. Teeth and lobe apices are more or less acute, often tipped with a short bristle. Leaves on flowering stems are none to few, alternate, much reduced, sessile, clasping the stem, pinnate-lobed to nearly entire (CDFA, 2002).

Stems: Stems are covered with minute hairs or fine down, or they may be densely pubescent with matted wool or short hairs. Stems are creeping to decumbent (lying or growing on the ground but with erect or rising tips), ribbed, and soft (McClintock, 1993).

Flowers: The yellow flower heads (capitula) measure up to 6 cm across. Capitula are solitary on hairy stalks about 15-20 cm long. The receptacle is flat and lacks chaff. Phyllaries (bracts of the involucre, the supporting structure below the flower head) strongly overlap in 3-6 rows, and are green with membranous margins and backwards curving tips. The ray flowers are less than 20 and sterile. Ray corollas are 15-25 mm long, pale yellow in upper half, sometimes darker yellow below, purple or greenish at the base. Disk flowers are blackish purple (Auld and Medd, 1987), dark purplish or yellow, numerous (Hussey et al., 1997; McClintock, 1993), becoming paler as

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they mature (Clemson, 1985). In California, the fertile type produces purple flowers (Hrusa, 2003).

Achenes: Measuring about 3 mm long by 1.2 mm wide, the dark brown achenes are egg-shaped and flat, with the narrow end at the bottom. The faces are rounded, the back arched, with 3-5 ribs; the outer coat, or testa, is granular and rugose. The persistent pappus consists of 6-8 chaffy scales. Hidden by crinkly whitish hair, achenes appear as balls of wool 6-8 mm long (Reed, 1977; McClintock, 1993).

Stolons: Capeweed produces stolons, which root at the nodes and are often vigorous (CDFA, 2002).

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

The biology of capeweed is poorly understood. A variable species, *Arctotheca calendula* consists of both sterile and fertile types. A sterile, yellow-flowered type which reproduces vegetatively, is used as a groundcover in California (Clausen and Elkstrom, 1989; Hrusa, 2003); while a fertile, purple-flowered seed-bearing type rapidly colonizes open sites. Capeweed is annual in its native range and Southern Australia, but perennial in mild frost-free climates, such as California. Plants are damaged by frosts a few degrees below freezing and are killed by colder temperatures (CDFA, 2002). In Tasmania, capeweed seeds germinate over several weeks in autumn. Plants develop into rosettes, then flower in late spring and early summer (Department of Primary Industries, Water and Environment, 2002). In Victoria, capeweed is a winter growing annual that germinates after late summer and autumn rains. Plants flourish, flower and set seed in early spring. Once mature and dry, the plants break up, leaving little or no cover over summer (Schroder, 1998). In South Africa, capeweed is described as flowering anytime by Joffe (2001) and as flowering July to November by Manning and Goldblatt (1996). In California, it flowers most of the year, peaking in March-June (CDFA, 2002). Capeweed spreads by rooting stolons and seed.

Preferred habitat and climatic tolerance:

In its native South Africa, capeweed prefers sandy, well-drained soil, sand dunes, stream banks and rocky outcrops and is used as a groundcover (Joffe, 2001).

Although capeweed is found in all habitats throughout southwest Western Australia (Hussey et al., 1997), it thrives on soils of light texture and prefers fertile soil. It does not thrive on soils low in potassium or high in salt. Areas on light textured fertile soils devoid of vegetation during late summer/autumn are most likely to become infested with capeweed (Department of Primary Industries, Water and Environment, Tasmania, 2002). In Victoria, seedlings are tolerant of dry conditions (Schroder, 1998). In New South Wales, capeweed prefers bare ground such as road verges and heavily grazed pastures (Miles, 2002).

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In California, capeweed is a weed of disturbed, urban, and coastal habitats (McClintock, 1993). It prefers sunny locations on sandy, well-drained soil (Perry, 1992).

Native distribution:

The native distribution of capeweed is Africa: Lesotho and South Africa - Cape Province and into Natal (USDA GRIN database, 2002; Manning and Goldblatt, 1996).

Current world distribution beyond native distribution:

Capeweed has naturalized in central Portugal and southwestern Spain (Codex Plantarum Vascularium Mediterraneum, 2000), southern Portugal, Australia (Lazarides and Hince, 1993), New Zealand, and California (Documented in Sonoma and Del Norte Counties, specimens collected from Humboldt, Marin and Sacramento Counties) (CalFLora website). Capeweed has been raised as an ornamental in England since 1752 (Burry and Kloot, 1982).

Stage 2: Assessing pest risk

Step 4. Regulatory and Geographic Information

Federal noxious weeds are prohibited entry into the United States. According to the Plants Database (USDA, NRCS, 2002), *A. calendula* is known to occur within the United States only in California. A sterile, vegetatively reproducing race was introduced in 1963, propagated by Los Angeles State and County Arboretum, and has been used by the nursery trade since 1965 (Bossard et al., 2000). According to Senior Plant Systematist Fred Hrusa, the California Department of Food and Agriculture (CDFA) does not regulate the yellow-flowered, sterile *A. calendula* in the California horticultural trade. The invasive, weedy populations in California consist of a purple-flowered, seed-producing type, which is listed as a category A weed (CDFA, 2002). In California, category A weeds require eradication, containment, rejection, or other holding action at the state-county level. Noxious weed interceptions must be rejected or treated at any point in the state.

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.

Risk Element 1. Establishment potential or habitat suitability in the protected area.

Estimate the potential range in the United States, considering suitable climate conditions.

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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	In approximately one-third to two thirds of the United States (generally, in three or four plant hardiness zones).
Low	1	In less than one third of the United States.
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 CLIMEX climate prediction model using the known distribution of *A. calendula* in South Africa (Cape Town) and Australia (Adelaide, Fremantle, Albany, Sydney and Melbourne), the climatic correlation is high throughout the West Coast, Southwest, Southern and Central States, Southeast, and East, as far North as New Hampshire; roughly, hardiness zones 5-9. Some sources suggest a much more limited range. For example, an e-landscape web site (http://www.elandscape.com) suggests capeweed for USDA Zone 9 and describes its cold tolerance at 30 degrees F., an area smaller than one third of the United States. Clausen & Ekstrom (1989) recommend capeweed for zones 9-10 and mention that the plant tolerates only a few degrees of frost. Joffe (2001) labels capeweed as "frost hardy". The species' ability to produce biotypes and the fact that it has spread from its native habitat, which has a strongly Mediterranean (winter rain) climate, to areas of eastern Australia with year round precipitation and areas of California with warmer conditions suggest broad climatic tolerance.

Level of certainty = Uncertain. The prediction is based on climate preference, documented distribution in other parts of the world, and demonstrated adaptability. Some sources suggest a more limited range.

Risk Element 2. Spread potential after establishment, dispersal potential

Check each of the following that apply:

- Consistent and prolific seed production ✓
- 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
- Ability to persist as dormant long-lived propagules or underground parts, such as

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rhizomes, tubers, turions or stolons ✓

- Seed dormancy ✓
- Stress tolerance, ✓ including ability to resist herbicides ✓
- Ability to colonize a wide variety of habitats
- Lack of natural control agents
- Well-developed storage tissue (for example, tap root)
- Dispersal by wind✓, water, machinery✓, animals ✓, and/or humans ✓.

Assign rating as follows:

Rating	Numerical score	Explanation
High ✓	3 ✓	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 area (*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).
Negligible	0	Weed has no potential for natural spread in the WRA area.

Rationale for the rating and the level of certainty:

Capeweed has both high reproductive potential and highly mobile propagules.

The relative growth rate of capeweed is high in the early weeks of growth (McIvor and Smith, 1973). Joffe (2001) describes capeweed as "extremely fast growing" and recommends capeweed for planting "wherever a large area needs to be covered in a short period of time." Capeweed reproduces by seed and creeping stolons, rooting at nodes. One plant can spread to cover up to 200 square feet in one to two years (Mathias, 1982; CDFA, 2002).

Capeweed can form small tubers 1 cm thick and 3 cm long. Plants can be spread when tubers and stem pieces with nodes are moved from location to location by heavy equipment used for routine grading, resurfacing, or fill removal (Bossard, et al., 2000).

In an Australian experiment, capeweed plants produced about 4330 seeds per plant with no treatment applied. With fifty percent of their leaves and most of the buds and flowers removed

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at late flowering (simulating heavily grazed vegetation), capeweed still produced more than 2400 seeds per plant. These results may partially explain observed increases of capeweed under heavy grazing pressure, as seed setting by other species may be reduced by severe defoliation. The period between seed sowing and flowering was 149-157 days. The interval between first flower and shedding of the first seed varied from 32 days early in the season, to 15 days later in the season, as temperatures increased (McIvor, 1973).

Dormancy allows weed seeds to escape the effects of control measures and provides a mechanism for prolonged seed survival in soil. Capeweed seeds are dormant at harvest. Subsequent ageing, exposure to light and growth regulators promote germination of capeweed seeds. Tillage during seed-bed preparation inverts the soil, stimulating germination of buried capeweed seeds that are brought to the surface (Chaharsoghi and Jacobs, 1998). Ecotypes have evolved differences in their seed dormancy, enabling adaptation to particular environments (Dunbabin and Cocks, 1999.)

Capeweed is stress tolerant. Described as a "tough evergreen", capeweed needs little watering or maintenance once established (Clausen and Elkstrom, 1989). In Australia, a biotype of capeweed, dominant in an alfalfa field after 20 years of herbicide use, is resistant to both diquat and paraquat (Powles et al., 1989; Preston et al., 1994). Capeweed tolerates drought (Joffe, 2001; CDFA, 2002), but only a few degrees of frost (Clausen and Elkstrom, 1989). Frost damaged plants can quickly regenerate from the crowns when the weather warms (Blossard et al, 2000). *Lasca Leaves* (1973) reports that established plantings can recover without treatment from damage caused by root rot, aphids, mites, slugs and snails.

Capeweed dispersal is predominantly by wind or in contaminated soil (Miles, 2002). Seeds and rooted stolons also spread aided by human activity and animals (CDFA, 2002; Wood, 1994). While no direct evidence is available that capeweed achenes survive the passage through an animal's digestive tracts, many plant propagules do. Achenes may become lodged in fur.

Level of certainty: very certain

Risk Element 3. 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). ✓
2. Lower commodity value (e.g., by increasing costs of production, lowering market price, or a combination. For both agricultural and environmental pests, consider the cost of control.) ✓
3. Loss of markets (foreign or domestic) due to presence of a new Federal noxious weed.

Assign ratings as follows:

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Rating	Numerical score	Explanation
High	3	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:

Capeweed is a major weed of crops, pastures, orchards, and market gardens in Australia (Hussey et al., 1997; Clemson, 1985).

1. **Reducing crop yield**: Capeweed is a weed of alfalfa in Australia (Powles et al., 1989) and canola, especially in Eastern Australia (Lemerle et al., 1999). In a field survey of weeds in 86 cereal crops in southern New South Wales, Australia, capeweed was the most widespread species (Lemerle et al., 1996). Capeweed was estimated to cost Australia 9.7 million (5.8 million US dollars) per annum in yield losses from residual weeds in annual winter crops including wheat, oats, barley, canola, pulses, and lupins, not counting pre and post emergent control costs (Jones et al., 2000). Capeweed often dominates pastures in Australia (Hussey et al., 1997).

In newly sown pasture, capeweed can smother grass and clover seedlings, reducing stock yields. Seeds are embedded in light brown wool which, if eaten in sufficient quantity, may form hair balls in an animal's stomach and sometimes prove fatal (Clemson, 1985). When grown on highly fertile soil, such as stock yards, capeweed can accumulate potentially toxic levels of nitrate. Application of 2,4-D can further increase nitrate levels in some plants. Symptoms of stock poisoning include abdominal pain, scouring, difficulty breathing, and sometimes death (Department of Primary Industries, Tasmania, Water and Environment, 2002).

2. **Costs of control/lowering commodity value**: Capeweed can reduce the value of stock by lowering their weight. Although comparable nutritionally to other pasture species, capeweed does not provide continuous ground cover over summer, providing no feed value during that time (Department of Primary Industries, Water and Environment, 2002). In one study, sheep fed only fresh capeweed lost body weight due to their inability, or lack of incentive, to eat enough dry matter (Pethick, 1991).

When fed on capeweed, dairy cattle may produce tainted milk (Department of Primary

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Industries, Tasmania, Water and Environment, 2002).

Capeweed accumulates cadmium, which is highly toxic to man and animals, in soils treated with a phosphate fertilizer. Cadmium occurs as a contaminant in phosphate fertilizers, even those made from low cadmium–bearing phosphate rocks. Cadmium accumulation detrimentally affects the quality of animal products and has an adverse affect on pasture production (Bramley and Barrow, 1994).

Successful control of capeweed relies on an effective management program. In New Zealand , a combination of chemical and nonchemical methods are needed, with follow up treatments as required. Pasture management, grazing management, cultivation, and hand pulling are used in addition to a number of herbicides, to achieve optimum control (Department of Primary Industries, Tasmania, Water and Environment, 2002).

3**. Loss of markets**: No other country lists *A. calendula* as a prohibited species (Excerpt database, 2002). The introduction of capeweed into cropland should not result in the loss of markets.

Level of certainty: reasonably certain.

Risk Element 4. Environmental impact

Check each of the following that apply. 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.). ✓
- 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.). ✓
- Cause impacts on community structure (*e.g.*, change density of a layer, cover the canopy, eliminate or create a layer, impact wildlife habitats, etc.).
- 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. ✓

Assign ratings as follows:

Rating	Numerical Score	Explanation
High ✓	3 ✓	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.

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Rating	Numerical Score	Explanation
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:

Ecosystem processes: Once mature and dry the plants break up quickly, leaving virtually no feed or cover over summer, increasing the risk of soil erosion (Schroder, 1998). However, capeweed spreads most often in areas that are open and disturbed to begin with.

Natural community composition: In Western Australia, cape weed is increasing rapidly in the arid zone. In many of the inland pastoral stations that had massive stands of many genera and species of annual everlastings, capeweed is replacing the everlastings (Randall, 2002a; Hussey, et al., 1997). Invasion by *A. calendula* is described as a serious threat to five types of vegetation formations in Victoria (dry coastal vegetation, heathland & healthy woodland, mallee shrubland, lowland grassland & grassy woodland, dry sclerophyll forest & woodland (Carr et al., 1992). Capeweed is escaping into native landscapes in northern coastal regions of California (Perry, 1992). An aggressive competitor for water and space, capeweed threatens native plant communities in California by crowding out grasses, herbs and small shrubs (Bossard et al., 2000).

A potential beneficial effect of capeweed is that it provides a food source for larvae of the Painted Lady butterfly (Joffe, 2001). Bee keepers regard capeweed as an important source of pollen (Department of Primary Industries, Water and Environment, 2002). However, according to Clemson (1985), some people do not favor the flavor of capeweed honey and capeweed pollen may have an undesirable effect on honey blends. In some seasons, before nectar is available, bees working capeweed pollen may suffer from compaction of pollen in the digestive tract.

When grown under certain conditions, capeweed is poisonous to mammals (Wiersema and Leon, 1999); some native fauna could be affected.

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Human health: Capeweed can cause hay fever (Lazarides and Hince, 1993) and handling plants can cause contact dermatitis in sensitive people (CDFA, 2002). A study in Australia identified *A. calendula* as one of several weeds in the aster family that cause dermatitis, as demonstrated by patch testing. The authors hypothesize that the dermatitis is caused by airborne dust forming from the breakdown of senescent tissue in the hot, dry conditions of the Australian bush (Burry and Kloot, 1982).

Sociological impacts: Common in school playgrounds, parks, domestic gardens and amenity areas, capeweed is a significant nuisance plant in Tasmania (Hanson, 2002), and can be problematic in turf (Harrington, 2000). In California, capeweed often escapes into lawns and adjacent planting areas (Perry, 1992). On the positive side, the horticultural type is considered a desirable groundcover, with positive attributes such as attractive flowers, ease of maintenance, and drought tolerance.

Control program stimulation: Once plants are established, they are best controlled by clopyralid (Lontrel) or herbicides containing dicamba or picloram. For young seedlings, bromoxynil or MCPA/bromoxynil should also be effective (Harrington, 2000). Potential biological control agents against capeweed have been identified in South Africa; a stem boring weevil has the most promise, followed by two leaf-feeding Chrysomelids and a root-feeding weevil. Biocontrol agents have not been assessed in Australia because of the dual status of capeweed, considered by some to be beneficial, considered by others to be an important weed (Scott and Way, 1990). In California, there are no registered biological agents for capeweed control and it appears to be rarely used by native California wildlife (CDFA, 2002).

Level of uncertainty: Uncertain. The evidence is thin for ecosystem processes and sociological impacts. We have no evidence that the human health impacts, hay fever and contact dermatitis, are more frequent or severe than for other plants chosen at random.

Economic and environmental importance summary: 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) (3+3+2+3= 11)		
Cumulative Risk Element Score	Risk Rating	Risk Score
0 – 2	Negligible	0
3 – 6	Low	1
7 - 10	Medium	2
11 – 12 ✓	High ✓	3

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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 high for *A. calendula*.

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 ✓	3 ✓	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:

Potential pathways into the United States are similar to those by which capeweed entered Australia. In Australia, capeweed was introduced from South Africa, most likely as a contaminant of packing material, stock fodder and sheep fleeces moving from the Cape of Good Hope into Australia (Burry and Kloot, 1982). It is likely that some capeweed was deliberately introduced as an ornamental (Wood, 1994) or for medicinal purposes. A South African website recommends a combination of flower essences, including dune calendula, for a variety of herbal uses, including pregnancy, childbirth, coping with adolescence, midlife crisis, etc. (Unite, 2002).

Although capeweed is mentioned in references such as *Perennials for American Gardens* as "useful for covering slopes and other open areas" (Clausen and Elkstrom, 1989), capeweed is not widely available in the U.S. nursery trade. The Anderson Horticultural Library's Source Guide (Isaacson and Allen, 2002) identified no sources, and an Internet search detected only one U.S. site, a mention by eLandscape in their plant library (http://www.elandscape.com). McKeown Inc., a landscape design firm that links to the eLandscape plant dictionary, has never sold the plant, nor offers it for sale (Allen, 2002).

Likely pathways into the United States are contaminated fleece, grain or seed shipments from South Africa and Australia, and intentional introduction by humans for use as a groundcover or herbal remedy. No devitalizing treatments are applied to any of these pathways, and seed would likely survive the shipments and (in the absence of regulation) would not be intercepted by agriculture inspectors. In most of the pathways, i.e., seed for planting as herbal remedy or as

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groundcover, and fodder, the intent of importation is release into the environment. This combination of factors leads to a high likelihood that seeds would be imported, survive, and be repeatedly introduced into a suitable habitat for establishment.

Level of certainty = very certain. A high likelihood of introduction is confirmed by the fact that capeweed has already been introduced into California, probably as an escape from cultivation (CDFA website).

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:

Consequences of Introduction (Rating and Score)	Likelihood 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)	High (3)	Medium- High
High (3)	Negligible (0)	Negligible
High (3)	Low (1)	Low
High (3)	Medium (2)	Medium-High
High (3) ✓	High (3) ✓	High ✓

Summary and Conclusion:

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With likely impacts to both agriculture and the environment, *A. calendula* earns a pest risk rating of high. Capable of infesting turf and pasture, competing with many kinds of crops, causing allergies and dermatitis in sensitive people, and negatively affecting stock production, *A. calendula* meets the definition of a Federal noxious weed. Capeweed is of limited distribution in the United States (reported only in California), and the seed fertile type is subject to control. The seed-producing race is highly invasive (McClintock, 1993). The self-sterile clone used in the horticultural trade in California is reported to be less invasive, but Hickman (1993) mentions that even the sterile race escapes from cultivation, and Mathias (1982) reports that it is extremely vigorous, quickly spreading by rooting stolons.

Capeweed has some positive attributes, such as providing a pollen source for bees (Clemson, 1985), providing fodder for sheep and pigs (Wood, 1994), and providing fast-growing groundcover. However, honey produced from capeweed nectar is less palatable than other honey, livestock poisoning may result under certain conditions, and mass plantings as groundcover may suffer from root disease than can damage large areas of a planting (Perry, 1992). Alternative groundcovers are available. The potential negative impacts of capeweed outweigh any expected benefit from its unregulated movement into and through the United States.

Step 8. Cite References

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