

*Trifolium amoenum*  
(Showy Indian Clover)

**5-Year Review:  
Summary and Evaluation**



Photo credit: Valary Bloom

**U.S. Fish and Wildlife Service  
Sacramento Fish and Wildlife Office  
Sacramento, California**

**June 2012**

## **5-YEAR REVIEW**

### ***Trifolium amoenum*/ Showy Indian Clover**

#### **I. GENERAL INFORMATION**

##### **Purpose of 5-Year Reviews:**

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act (Act) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing of a species as endangered or threatened is based on the existence of threats attributable to one or more of the five threat factors described in section 4(a)(1) of the Act, and we must consider these same five factors in any subsequent consideration of reclassification or delisting of a species. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process defined in the Act that includes public review and comment.

##### **Species Overview:**

*Trifolium amoenum* is an annual plant in the Fabaceae (pea) family which was first described by Edward L. Greene from specimens collected in 1890 near Vanden, Solano County, California (Greene 1891). The range of the species was originally from Mendocino County south to Sonoma, Marin, Alameda, and Santa Clara Counties, and east to Napa and Solano Counties. Currently, it is reduced to one natural population in Marin County, two small experimental populations in Sonoma County, and two experimental populations at Point Reyes National Seashore (PRNS), Marin County (Connors 2007). The species has been found in a variety of habitat including low, wet swales, grasslands, and grassy hillsides up to 310 meters (1,020 feet) in elevation.

The species was considered extinct until 1993 when a single plant was discovered on privately-owned property in Occidental, Sonoma County. That site has since been developed and the species is no longer present. Another native population was discovered in 1996 in Dillon Beach, Marin County, on privately-owned property. Results of a 2006 survey of that population indicate a dramatic decline in numbers to the second lowest level (behind 1998) in the entire 14-year monitoring period (Connors 2010). However, the 2010 population density on the transects was the second highest of the monitoring period, in both numbers of seedlings (1271 in 2010, higher only in 2003) and numbers of seeds produced (5532 in 2010, higher only in 2005).

## **Methodology Used to Complete the Review:**

This review was prepared by the Sacramento Fish and Wildlife Office (SFWO), following the Region 8 guidance issued in March 2008. We used survey information from experts who have been monitoring various localities of this species, and the California Natural Diversity Database (CNDDDB), maintained by the California Department of Fish and Game. Personal communications with experts were our primary sources of information used to update the species' status and threats. We received no response to our Federal Notice initiating this 5-year review. This 5-year review contains updated information on the species' biology and threats, and an assessment of that information compared to that known at the time of listing or since the last 5-year review. We focus on current threats to the species that are attributable to the Act's five listing factors. The review synthesizes all this information to evaluate the listing status of the species and provide an indication of its progress towards recovery. Finally, based on this synthesis and the threats identified in the five-factor analysis, we recommend a prioritized list of conservation actions to be completed or initiated within the next 5 years.

## **Contact Information:**

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### **Federal Register Notice Citation Announcing Initiation of this Review:**

On May 25, 2011, the U.S. Fish and Wildlife Service, announced initiation of the 5-year review for *Trifolium amoenum* and asked for information from the public regarding the species status (76 FR 30377). We received no response to this request for information.

## **Listing History:**

### Original Listing

FR notice: 62 FR 54791

Date listed: October 22, 1997

Entity listed: Species: *Trifolium amoenum*, a plant species

Classification: Endangered

**Associated Rulemakings:** There have been no associated rulemakings.

**Review History:** The last 5-year review for *Trifolium amoenum* was published on January 10, 2008 (73 FR 11945). No status reviews or other relevant reviews have been conducted since that time.

**Species' Recovery Priority Number at Start of Review:** The recovery priority number for *Trifolium amoenum* is 2 according to the Service's 2011 Recovery Data Call for the SFWO,

based on a 1 to 18 ranking system where 1 is the highest-ranked recovery priority and 18 is the lowest (Endangered and Threatened Species Listing and Recovery Priority Guidelines, 48 FR 43098, September 21, 1983). This number indicates that the taxon is a species that faces a high degree of threat and has a high potential for recovery.

**Recovery Plan or Outline:** There is no final recovery plan for this species.

## II. REVIEW ANALYSIS

### Application of the 1996 Distinct Population Segment (DPS) policy

The Act defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. This definition limits listing as distinct population segments (DPS) to vertebrate species of fish and wildlife. Because the species under review is a plant and the DPS policy is not applicable, the application of the DPS policy to the species listing is not addressed further in this review.

### Information on the Species and its Status

#### Spatial distribution

In general, spatial distribution of *Trifolium amoenum* has been severely reduced. Whereas it was once known from 20 historical occurrences in seven counties, by the mid 1900's, it had become rare and the species was listed as "presumed extinct" by the California Native Plant Society in 1985. *Trifolium amoenum* was considered extinct until 1993 when it was rediscovered. A second site was discovered in 1996. The site discovered in 1993 (near Occidental) has now been developed, and the plant is considered extirpated there. The only known natural site is on the bluffs at Dillon Beach in Marin County, discovered in 1996 (Service 1997), which includes a very small sub-population in some years, just 500 meters to the north of this main population. In addition to the natural site, two small experimental populations were reintroduced at the Bodega Marine Laboratory in Sonoma County (Connors 2006, see also discussion below). Both the natural and the experimental populations are of the prostrate coastal bluff form (growth forms discussed further below in the Genetics section). In addition, Diana Immel, a University of California, Davis, Ph.D. graduate, sowed seed of the upright inland form at two sites in Sonoma County and two sites on D Ranch at PRNS in Marin County in the fall of 2006 and 2010, respectively (described below). While it appears that the species has been extirpated from the two Sonoma County sites to which Dr. Immel reintroduced seed in Sonoma County, the two PRNS populations appear somewhat successful. It is too early to determine the ultimate success of this effort. There are no known natural populations of the upright inland form.

#### Abundance

Since the time of listing in 1997, Dr. Peter Connors, researcher with University of California, Davis, has conducted annual monitoring of the population at Dillon Beach (Table 1). He has found high interannual variability in number of plants and in seed production, with a general trend of a population increase through 2005. However, populations plummeted in 2006 from the relatively high numbers in 2005; with seedling number on the Dillon Beach transects declining

by 94% and seed productivity declining by 98%. The number of seeds produced in 2006 on the transects was the second lowest (behind 1998) of the entire 14-year monitoring period (Connors 2010). During 2005 monitoring of the Dillon Beach population, plants were identified about 500 meters (1,640 feet) north of the main population. Five plants at this northern site survived to set seed in 2005. The same site had no plants in 2006, 2007, and 2008, a single plant in 2009, but 12 plants in 2010, many of them branched, with a total of 47 heads present in early June, despite some herbivory of branches. Plants were spread over a larger area than in 2005, extending into areas beyond the original patch (Connors 2010).

**Table 1. Annual variability in seedling number and seed productivity on main Dillon Beach population study transects (Connors 2010, Connors *in litt.* 2011).**

Year	Seedlings	Seeds
1997	203	213
1998	20	825
1999	134	684
2000	278	2383
2001	416	1030
2002	388	5097
2003	1350	3377
2004	318	2034
2005	1105	12415
2006	63	191
2007	1265	4962
2008	762	579
2009	933	4496
2010	1271	5532
2011	“good”	“low”

Quantitative monitoring of the Bodega Marine Laboratory population was not conducted in 2006. However, a corresponding decline was observed in those as well (Connors 2006).

The 2010 population density on the Dillon Beach transects was the second highest of the 14 years of monitoring, in both numbers of seedlings (1,271) and numbers of seeds produced (5,532) (Connors 2010). In April 2010, densities of plants on the transects were high, and plants were robust, mostly with several-branched stems and very little insect damage. These factors pointed to a potential for record seed production. The final outcome was that seed production was very good, but less than expected, apparently because of heavy herbivory and disturbance by gophers and voles (Connors 2010). In 2011, the Dillon Beach population was not monitored as closely as in previous years, but three facts were observed: that numbers of seedlings was “good”; that seed production was “low”; that no plants were observed in the sub-population 500 meters north of the main population (Connors *in litt.* 2011). The seed production of the main population was estimated at 1,560 seeds, but this figure is not as precise as in previous years, because it is based only on numbers of heads maturing and an estimate of average seeds per head (Connors *in litt.* 2011). This estimate was only about one third of average production for the two previous years.

In 1997, Dr. Connors started two very small experimental populations (approximately 20 seedlings total) at the Bodega Marine Laboratory with the seed collected from the Dillon Beach plants (Connors 2007). One population exists in a demonstration garden in front of the building and the other exists in back of the building, facing the Pacific Ocean. These populations have not been as closely monitored in recent years but appear headed toward extirpation, given results of recent brief surveys (Connors *in litt.* 2011). In 2011, there appeared to be no seeds produced in either population. The population in the demonstration garden produced several very small plants that were overtopped and crowded out by introduced weeds. The population on the ocean-side of the building produced no plants at all. The population at the Bodega Marine Laboratory is not considered extirpated because the seeds are long-lived and probably remain in the soil (Connors *in litt.* 2011).

As stated above, Dr. Immel, sowed seeds at two sites in Sonoma County (California Department of Fish and Game's Wright Unit of the Santa Rosa Plain Ecological Preserve, and Ocean Song Farm and Wilderness Center) and at PRNS in Marin County in fall 2006. Dr. Immel documented relatively poor germination at the Sonoma County sites and funding for monitoring in successive years became unavailable. Therefore, since the writing of the most recent 5-year review, we consider the Sonoma County experimental sites as extirpated. Sites where seed was sown in 2006 on PRNS continue to have low, but consistent germination success. Though Dr. Immel's contract for monitoring this population has expired, she and PRNS staff continue to monitor germination and seed production when possible, in conjunction with a second *Trifolium amoenum* project which began in fall 2010. For this latter project, also funded through the Sacramento Fish and Wildlife Office, seed was sown at a separate area of D Ranch on PRNS as part of a study to determine the efficacy of various management techniques (grazing and burning) in increasing survival of reintroduced *T. amoenum* populations. In winter 2010-2011, only a modest number of seeded plots produced seedlings, however, those that did, did so profusely (Immel *in litt.* 2011). It is too soon to know whether those seedlings will survive to set seed of their own. It is also too soon to know if either population on D Ranch will be self-sustaining in the long term.

For these projects, Dr. Immel used seed derived from the now-extirpated single-founder population identified near Occidental in 1993. She has used the same seed source to maintain approximately one dozen plants at her residence for seed multiplication and research (Immel *in litt.* 2006).

Prior to listing, seed multiplication of the Occidental plant by Dr. Connors had increased the number of available seeds to over 50,000 (Connors 2007). These are being stored at three California facilities: Rancho Santa Ana Botanic Garden in Claremont; the University of California at Berkeley Botanical Garden in Berkeley, and the University of California Bodega Marine Laboratory Herbarium in Bodega Bay. Seeds from the extant population in Dillon Beach have also been collected and multiplied to over 20,000 and are being stored at the University of California Bodega Marine Laboratory Herbarium (Connors 2007). However, seeds have not been collected since 2005 and therefore the bank of seeds stored has likely lost some degree of viability (Connors *in litt.* 2011). Seeds from both populations also have been submitted to the National Seed Storage Laboratory in Fort Collins, Colorado. These seed collections represent

both the prostrate form (from Dillon Beach bluffs) and the upright inland form (from near Occidental).

#### Habitat or Ecosystem

Areas of habitat similar to the sites of the Dillon Beach bluff population and the experimental population at Bodega Marine Laboratory exist in other parts of (at least) Sonoma and Marin Counties, primarily on private lands, but with some potential sites on public lands. Much of the habitat which was suitable at the time of listing has been altered and is now unsuitable due to urbanization, agricultural operations, and changes in the biological community and hydrological conditions. Areas such as PRNS, with relatively intact native communities, provide the best opportunities for reintroduction (Connors *in litt.* 2006). Most areas with appropriate habitat now set aside for conservation (*i.e.*, Tolay Lake, Wright Unit of Laguna de Santa Rosa Preservation Bank, etc.) are highly disturbed and require management to address problems such as overabundance of non-native plants and herbivore populations before reintroduction efforts could be considered (Immel *in litt.* 2006). Resources should be put toward resolving these problems soon so that otherwise appropriate habitat in conservation ownership may be considered for reintroduction.

#### Changes in Taxonomic Classification or Nomenclature

No change in either taxonomic classification or nomenclature has occurred since the last 5-year review.

#### Genetics

*Trifolium amoenum* uses a mating system of cross-, as well as self-pollination (*i.e.*, a mixed mating system). Through studies of both the Occidental seed source and the existing Dillon Beach population, a higher level of heterozygosity was indicated than would be expected in a predominantly self-pollinating species (Knapp and Connors 1999). In the same study, the authors suggested that the existence of genetic variation in the Occidental population provides empirical evidence that the seed from which the Occidental plant grew may have germinated from a long-dormant seed bank produced many years earlier when the population was much larger.

Genetic analysis of *Trifolium amoenum* has resulted in two relevant determinations. First, *T. amoenum* has already lost genetic variability. The seeds that Dr. Connors multiplied were derived from the single-founder population which he discovered in 1993 near Occidental; this population passed through an extreme population bottleneck that appears to have restricted its genetic variation. Studies conducted by Knapp and Connors (1999) suggest that, although the single individual found at the Occidental site had a relatively high degree of genetic variability, it is less genetically variable than the original *T. amoenum* population from which it was derived. This loss of genetic variability underscores the need for outcrossing, but only with additional individuals of the upright growth form.

Secondly, seeds from the population discovered by Dr. Connors on Marin County coastal bluffs in 1996 produce plants distinctly different in growth form from all the offspring of the Occidental plant and from all the herbarium specimens he has examined. The Dillon Beach bluffs plants grow almost prostrate and have more spherical heads than the very upright inland

form from near Occidental. When plants of both growth forms were grown in a common garden at an inland location near Occidental, the differences in plant morphology were maintained (Knapp and Connors 1999). Plants with the prostrate growth form appear to be genetically distinct, most likely a local adaptation to conditions on the windy coastal bluffs. The potential for genetic distinctness necessitates conservation of both growth forms.

#### Species-specific Research and/or Grant-supported Activities

Dr. Immel's research activities conducted at PRNS and described above have been funded through the Sacramento Fish and Wildlife Office's Recovery Branch since 2006. The National Park Service has contributed technical assistance for these projects benefitting *Trifolium amoenum* on PRNS lands, as well. Dr. Connors' monitoring activities in Sonoma County have been conducted with intermittent funding through the SFWO Recovery Branch.

### **Five-Factor Analysis**

#### **FACTOR A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range.**

The listing rule (Service 1997) and the 2007 5-year review noted that loss of habitat at the historically known 20 occurrences resulted primarily from urbanization and land conversion to agriculture and that loss of the site near Occidental was due to development. Widespread urbanization continues throughout the historic range of *Trifolium amoenum* (Immel *in litt.* 2006, Service 1997). Urbanization and agriculture may be preventing establishment of the plant within historic habitat where it is currently not known to occur.

The single known natural population is located on private property in a developed area. Construction of a house within 100 feet of the population, which was underway at the time of listing, has now been completed (Connors 2007). Future plans for development on this private property are not known.

The proximity of this population to a coastal bluff also threatens the population with extirpation through erosion. A small trail providing local homeowners with access along the bluffs runs directly through the population. Although current use of the trail does not appear to threaten the population, any increase in use or expansion of the trail could adversely affect the population (Connors 2006).

The Bodega Marine Laboratory experimental populations are small in area and in number of plants, and are located near heavily used buildings. These populations face the threat of trampling (Connors 2006). However, the area is signed to prohibit unauthorized entry and reduce unnecessary foot traffic.

#### **FACTOR B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes**

No new information exists regarding to the threat of overutilization for commercial, recreational, scientific, or educational purposes. As stated in the listing, "Any occurrences of *Trifolium*



*amoenum* that may be discovered in the future also may attract collectors of plants or seed because the species was previously thought to be extinct” (Service 1997). However, we have no evidence to suggest that this has occurred.

### **FACTOR C: Disease or Predation**

The listing rule (Service 1997) suggested that some historic locations of *Trifolium amoenum* may have been eliminated due to grazing. However, the one known natural population on the Dillon Beach bluffs was not threatened by grazing at the time of listing or the 2007 5-year review.

Since the time of listing and since the last 5-year review, a high level of gopher grazing has been observed to impact the *Trifolium amoenum* population at Dillon Beach. In fact, gopher activity accounted for most of the mortality observed during Connor’s 2007 survey of the population (Connors 2007). Other likely native herbivores include deer, rabbits, voles, snails, slugs, and insects. Although herbivory can have deleterious effects on plants, predation by gophers may also benefit *T. amoenum* by disturbing areas and reducing competition from non-native plants. The Bodega Marine Laboratory population faces herbivory by deer, voles, and introduced slugs. Early in the reintroduction work at PRNS, herbivory was observed to be due to native snails, insects, and small mammals; no non-native slugs were observed at Point Reyes. Later in the study, herbivory was attributable to larger mammals: gophers, rabbits, deer, and elk. Herbivory currently presents a threat to the reintroduced populations at PRNS, but likely due only to the small populations involved. A healthy-sized population of *T. amoenum* would likely be able to sustain moderate herbivory.

Herbivory at the Dillon Beach population has been substantial in some years; however, it has been via gophers and voles. As mentioned above, it is unclear whether this herbivory might also be advantageous to *T. amoenum* by disturbing areas and reducing competition from non-native plants.

### **FACTOR D: Inadequacy of Existing Regulatory Mechanisms**

#### **State Laws and Regulations**

The State’s authority to conserve plants is comprised of four pieces of legislation: The California Endangered Species Act (CESA), the Native Plant Protection Act (NPPA), the California Environmental Quality Act (CEQA), and the Natural Community Conservation Planning Act (NCCPA). *Trifolium amoenum* is not listed under CESA, therefore neither that Act nor the NPPA apply to this review.

The California Environmental Quality Act (CEQA) (chapter 2, section 21050 *et seq.* of the California Public Resources Code) requires government agencies to consider and disclose environmental impacts of projects to not only federally listed species, but also to those considered “rare” by other agencies or professional associations. *Trifolium amoenum*, although not state listed, is considered a List 1B plant by the California Native Plant Society. Any impacts to *T. amoenum* would be subject to evaluation through CEQA. The CEQA also requires the avoidance or mitigation of those impacts, where possible. Under CEQA, public agencies

must prepare environmental documents to disclose environmental impacts of a project and to identify conservation measures and project alternatives. Through this process, the public can review proposed project plans and influence the process through public comment. However, CEQA does not guarantee that such conservation measures will be implemented.

Currently there are no completed regional or county-wide Habitat Conservation Plans per the Federal Endangered Species Act (HCPs) or Natural Community Conservation Plans (NCCPs) per the Natural Community Conservation Planning Act at any of the known occurrences.

## **Federal Laws and Regulations**

The Federal Endangered Species Act: The Endangered Species Act of 1973, as amended (Act), is the primary Federal law that provides protection for *Trifolium amoenum*. Section 7(a)(2) requires Federal agencies to consult with the Service to ensure any project they fund, authorize, or carry out does not jeopardize a listed species. Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the “take” of federally-endangered wildlife. However, plants are not protected against take. Instead, plants are protected from harm in two particular circumstances. Section 9 prohibits (1) the removal and reduction to possession (*i.e.*, collection) of endangered plants from lands under Federal jurisdiction, and (2) the removal, cutting digging, damage, or destruction of endangered plants on any other area in knowing violation of a state law or regulation. Section 9 also makes illegal the international and interstate transport, import export and sale or offer for sale of endangered plants and animals. The protection of Section 9 afforded to endangered species is extended to threatened wildlife and plants by regulation. The Act affords protection to federally-listed plants if they co-occur with federally-listed wildlife species.

Under the terms of section 7(b)(4) and section 7(o)(2) of the Act, taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of an incidental take statement. Sections 7(b)(4) and 7(o)(2) of the Act generally do not apply to listed plant species. However, limited protection of listed plants from take is provided to the extent that the Act and the implementing regulations prohibit the removal and reduction to possession of federally listed threatened or endangered plants or the malicious damage of endangered plants on areas under federal jurisdiction, or the destruction of endangered plants on non-federal areas when in violation of state law or regulation or in the course of any violation of a state criminal trespass law.

## **FACTOR E: Other Natural or Manmade Factors Affecting Its Continued Existence**

The listing rule (Service 1997) and 2007 5-year review indicated that *Trifolium amoenum* may be adversely affected by non-native invasive species as well as by the effects of small population size and low number of extant populations. These factors continue to threaten the species as described below.

Non-native invasive species. The most significant long-term threat to the Dillon Beach

population is invasion by the non-native *Carpobrotus edulis* (iceplant or sea fig). This plant, which competes for habitat with *Trifolium amoenum*, was planted for fire and erosion control in the adjacent yard and reached the *T. amoenum* population for the first time in 1999. Dr. Connors has developed an agreement with that landowner on an iceplant control program involving both hand-pulling and herbicide (Roundup) application (Connors 2006). Though the landowners do not follow any practices that would be harmful to the population, the status of iceplant removal is unknown. Other invasive competitors already present at the site, including *Lolium multiflorum* (Italian ryegrass) and *Plantago lanceolata* (English plantain), may gain in population size or density at the expense of *T. amoenum* (Connors 2006, *in litt.*). In addition, the non-native grass *Holcus lanatus* (velvet grass) is not currently at the site but has invaded many coastal bluff plant communities in the area. It could be a strong invader of the *T. amoenum* population if it became established at the Dillon Beach site (Connors 2006).

The experimental populations of *Trifolium amoenum* at the Bodega Marine Laboratory also face competition from non-native invasive plant species. Staff of the Bodega Marine Laboratory reduces competition with *Medicago polymorpha* (California burclover), *Plantago coronopus*, and *Plantago lanceolata*, among other species, by weeding (Connors 2006).

#### Erosion and Geological Events

In addition to the threat from erosion of the hillside, in a 2010 annual report, Dr. Connors states the possibility of an earthquake that could result in a significant portion of the Dillon Beach population being lost in a landslide since it is very close to the eroding cliff (Connors 2010).

#### Small Population Size and Few Populations

As discussed in the listing rule (Service 1997) and the 2007 5-year review, the conservation biology literature commonly notes the vulnerability of taxa known from one or very few locations and/or from small populations (*e.g.*, Shaffer 1981, 1987; Primack 1998; Groom *et al.* 2006). In these situations, genetic diversity can become dangerously low. Also, as Dr. Connors reports, annual plants like clovers naturally fluctuate annually, likely due to regional patterns in amounts and timing of rainfall (Connors 2010). Yearly fluctuations in the Dillon Beach population have been large, with occasional 15 to 20-fold changes between subsequent years. Seedling density was high and quite similar in 2007, 2009 and 2010, but much lower in 2008 (Connors 2010). Seed production has been even more variable. *Trifolium* seeds are typically long-lived in suitable soils, and the importance of a seedbank in sustaining this *T. amoenum* population has been demonstrated by the strong rebounds of the population in 2007 and 2009 (Connors 2010). However, if several years of low germination in a small population are followed by a disruption to or removal of the seedbank, genetic diversity may be further diminished.

That *Trifolium amoenum* occurs in small numbers and at few locations has not changed since the time of listing or the last 5-year review. Therefore, threats associated with these factors remain. The combination of a single native population, small range, and restricted habitat makes this species highly susceptible to extinction or extirpation due to random events, such as flood, drought, disease, or other occurrences.

### III. RECOVERY CRITERIA

No approved final or draft recovery plan for *Trifolium amoenum* has been completed or is in preparation.

### IV. SYNTHESIS

Our analysis indicates that the threats to *Trifolium amoenum* have not substantially changed since the time of listing or from the 2007 5-year review. The primary threats continue to be potential destruction and modification of habitat and the effects associated with small population size and/or few locations (such as susceptibility to catastrophic random events). The only known natural population has not been protected, and neither it nor the experimental populations at Bodega Marine Laboratory are managed strictly for the conservation of *T. amoenum*. Secondary threats to the species at the only known natural site are erosion and geological events.

Although some additional progress has been made in reintroducing seed to suitable habitat at two other sites within the historic range, it is too soon to know if these efforts will result in self-sustaining populations, which could reduce the threat of extinction due to demographic fluctuations, loss of genetic diversity, and random catastrophic events. Though the reintroductions at the two Sonoma County sites have essentially failed, it will be a positive step toward recovery if the *Trifolium amoenum* seeds sown at the two sites at PRNS in Marin County exhibit high germination and seed production rates and ultimately become self-sustaining. In addition, the *ex situ* seed banking should provide an additional safety net should the single natural or experimental populations decline further.

After reviewing the best available scientific data, the Service has concluded that *Trifolium amoenum* continues to meet the definition of endangered.

### V. RESULTS

#### Recommended Listing Action:

- Downlist to Threatened
- Uplist to Endangered
- Delist (indicate reason for delisting according to 50 CFR 424.11):
  - Extinction*
  - Recovery*
  - Original data for classification in error*
- No Change

**New Recovery Priority Number and Brief Rationale:** No change in recovery priority number is recommended.

## VI. RECOMMENDATIONS FOR ACTIONS OVER THE NEXT 5 YEARS

The following recommendations for future actions are based on discussions of the status of the species and the species' needs with recognized *Trifolium amoenum* experts:

- 1) Complete and implement a recovery plan for *T. amoenum* which outlines specific recovery criteria and recovery tasks.
- 2) Continue to monitor known populations of *T. amoenum* so as to discern population sizes and the differences between natural and unnatural population fluctuations.
- 3) Conduct range-wide surveys to identify additional populations for protection and out-crossing purposes.
- 4) Expand the genetic base of the Occidental population, currently used for reintroduction experiments, to prevent further loss of evolutionary potential and the possibility of deleterious effects associated with inbreeding. Any additional plants found as a result of (3) above should be used to expand the genetic variability. If no additional individuals are identified, the Dillon Beach population should be used. Much care must be used during this process, however, as phenotypic difference between the two populations are likely adaptive. Through "controlled introgression", a small proportion of the non-local Dillon Beach source seed could be mixed into the Occidental population over time, such that local adaptive variation is maintained while promoting adequate levels of within population genetic variation (Knapp and Connors 1999).
- 5) Reintroduce both growth forms into suitable habitat. The two forms of *T. amoenum* should be treated separately in any reintroduction efforts, however, because these forms have morphological differences which may be adaptive. The establishment of a self-sustaining population in a preserved area would greatly increase the likelihood of recovery of this species. Suitable habitats might be found at the Bodega Marine Laboratory or on State or Federal lands in the area.
- 6) Conduct research into (a) the role of herbivory, (b) whether the presence of gophers is beneficial or detrimental, (c) reasons for interannual variability in population numbers and seed productivity, (d) the tolerance of *T. amoenum* to different soil types, and (e) the effect of disturbance regimes on *T. amoenum*, among other topics.

## VII. REFERENCES CITED

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**U.S. FISH AND WILDLIFE SERVICE**  
**5-YEAR REVIEW of Showy Indian Clover (*Trifolium amoenum*)**

**Current Classification:** Endangered

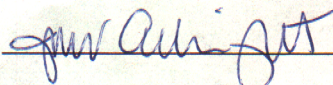
**Recommendation resulting from the 5-Year Review:**

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change is needed

Review Conducted By Valary Bloom, Sacramento Fish and Wildlife Office

**FIELD OFFICE APPROVAL:**

**Lead Field Supervisor, Fish and Wildlife Service**

Approve  Date 20 June 2012