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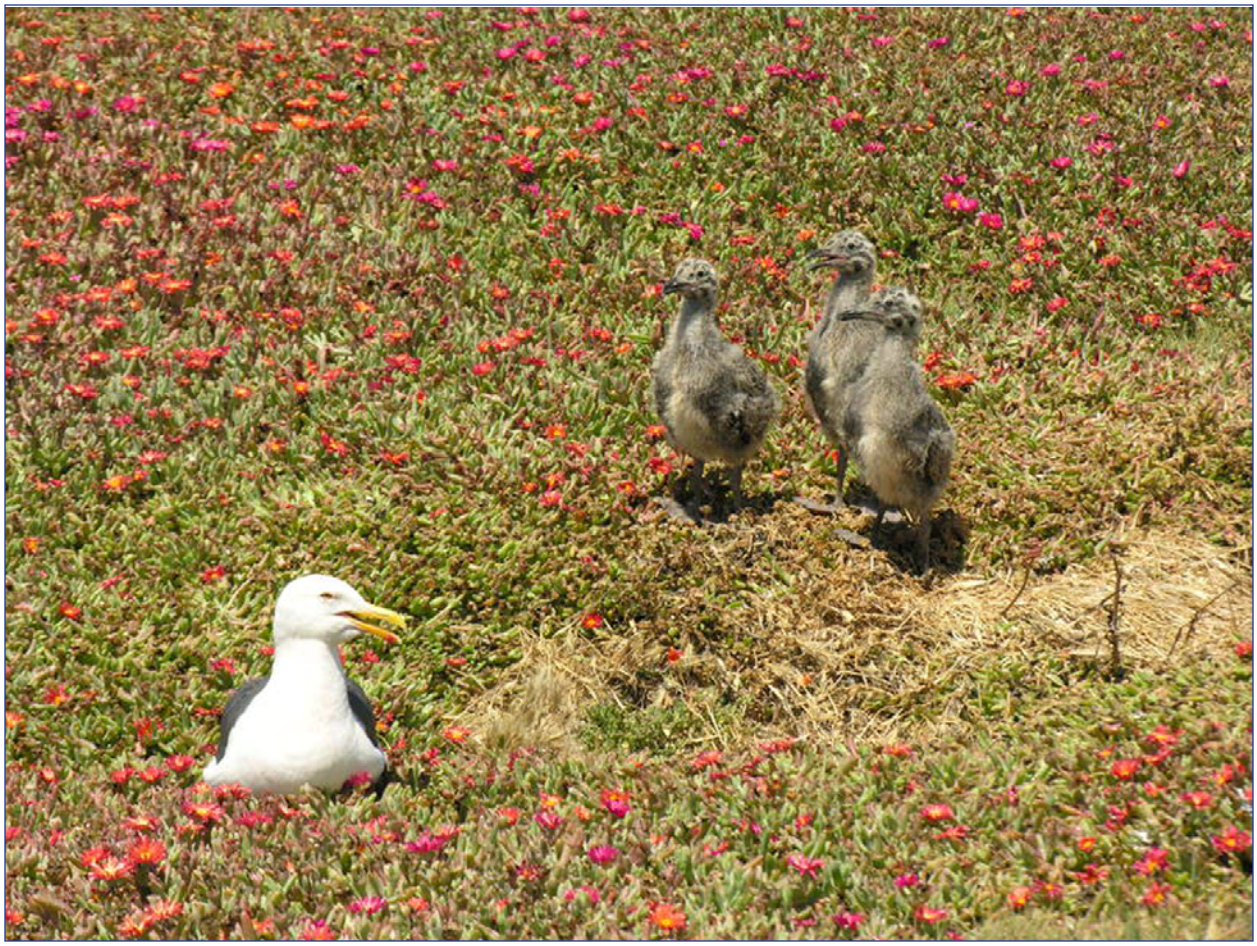

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On the cover: Karen Flagg of Growing Solutions describes a project to restore native plants at the Foothill Open Space preserve on the Santa Barbara field trip. Photo: John Ekoff

On the title page: Coppery iceplant doesn't make the best nesting habitat on Anacapa Island. Photo: John Knapp, The Nature Conservancy

Herbicide Treatment of Invasive *Vinca major* Growing with Endangered *Galium buxifolium*, An Island Endemic

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Introduction

Galium buxifolium E. Greene [Rubiaceae] (sea-cliff bedstraw) is a small shrub restricted to San Miguel and Santa Cruz Islands, in the California Channel Islands. Almost all of the 26 known populations grow on vertical north-facing sea cliffs in native scrub, sandwiched between the sea below and non-native annual grasslands on the terraces above. A notable exception is a population at Pelican Bay on Santa Cruz Island, growing on the cliff and on thin terrace soils above the cliff in a stand of coastal bluff scrub that is recovering from more than a century of sheep

grazing (Figure 1). Ironically, this stand is near the location of the historic Eaton Resort, a char-

Figure 1

Galium buxifolium E. Greene (Rubiaceae) (sea-cliff bedstraw) population at Pelican Bay, Santa Cruz Island, California.

ismatic inn frequented by Hollywood glitterati in the early 1900s. Several landscape ornamentals planted there persist today in the area of the *Galium* population. Italian stone pine (*Pinus pinaea*) and eucalyptus (*Eucalyptus* spp.) tower over the site while the invasive groundcover *Vinca major L*. [Apocynaceae] (greater periwinkle) forms dense mats at the cliff edge that are spreading into the developing native plant stand.

Wherever the *Galium* is found it is intermixed with other native scrub plants in dense communities on moist ocean bluffs. Historic notes and herbarium collections indicate that it may have been more widespread on nearshore terraces adjacent to sea-cliff populations before conversion to grassland. Since Pelican Bay is the only site that we know of where *Galium* is spreading onto the nearby terrace, we wanted to know whether the *Vinca* posed a roadblock to upslope population expansion. In 2005 we mapped *Vinca* and *Galium* at the site. We also measured *Galium* individuals to see where the smaller, younger plants were to better understand where the population is expanding. We observed that 1) both the *Galium* and the *Vinca* appear to be spreading from the cliff face upslope onto a series of rock outcrops, stone walls and benches, 2) the native scrub community is recovering at the site and 3) the *Vinca* appears to be moving into the native scrub where it overtops small plants, including those *Galium* in the smallest size classes. This observed pattern of *Vinca* displacement of native vegetation has been noted in other places, where it is treated as an invasive weed.

We concluded that *Vinca* may pose a threat to the expansion of both the native scrub and the *Galium* population that it supports. Therefore, we worked with the US Fish and Wildlife Service and others to develop a research project investigating 1) best techniques for killing *Vinca* within the boundaries of an endangered plant population and 2) demographic response of *Galium* to the treatment. Our intent is to push *Vinca* back to the vertical cliff face to give the natives a chance to establish a vigorous stand. Our conservation goal is to encourage natural establishment of new *Galium* plants on the terrace along with expansion of the native coastal bluff scrub and Galium population. Our immediate treatment objective is to reduce live *Vinca* cover by 90 % on the accessible upslope portions of the habitat. Our recovery objective is no net loss of *Galium* plants 2006-2016.

Methods

We are implementing *Vinca* treatment in two stages, each accompanied by *Vinca, Galium* and plant community monitoring:

Stage 1 – Heavy treatment to reduce *Vinca* on the terrace by 90% (2009-2010)

Stage 2 – Maintenance treatment to keep *Vinca* cover less than 10% (2011-2015)

Monitoring

Our monitoring objectives are to 1) document rates of *Vinca* reduction and 2) follow individual *Galium* plants before, during and after treatment to document effects on population growth. In spring 2006 we established a 15 x 50 meter plot encompassing and expanding beyond all of the *Galium* and *Vinca* above the cliff face. We mapped and tagged each *Galium* plant in the plot. We recorded plants as seedlings when they had seed-leaves (cotyledons) indicating that they had just germinated that season, otherwise they

were recorded as older established plants. We repeated these measurements in spring 2008 and 2010 and will continue through 2016. In 2006 we also recorded pre-treatment plant community composition and mapped *Vinca* cover in the plot. Finally, as insurance against loss, we collected and banked *Galium* seed in each monitoring year.

Vinca treatment

We began site preparation in December 2008 with the development of a rigging system for climbing ropes to be used whenever working near the cliff edge in a way that would not damage the vegetation. We flagged the *Galium* plants in the plot. Then, we pruned the lower branches of some shrubs, hand-cut bunch grasses and removed dead branches for better *Vinca* access. We were careful not to cut *Vinca* vines so that herbicide would travel effectively throughout the plant when treated.

We began herbicide application when the *Vinca* came out of dormancy in early February, 2009. We worked on very small sections at a time (approximately 0.5 x 0.5 meters). Within each section we covered the *Galium* plants with plastic trash bags and then prepared the *Vinca* by wounding the leaves with a wire brush to break the waxy leaf cuticle (Figure 2). This was followed immediately by application of a 3%

solution of Aquamaster and 3% solution of Agridex surfactant. We used painting sponges to wipe on the herbicide. These allow for more precise application of the herbicide than a wick applicator. The technique seems like a very safe but slow way to treat *Vinca*; it took between 4 and12 hours to treat several 3x3 meter patches where Vinca is growing in close proximity to the *Galium*. Rain, wind and high seas precluded further work in 2009 and delayed our 2010 start until mid-April. We treated about 25% of the site in 2009, focusing the bulk of our work in *Vinca* areas outside of and encroaching into edges of the Galium population. In April 2009, site inspection showed that about 95% of the treated *Vinca* was dead while the *Galium* looked healthy. Therefore, we treated the remainder of the accessible *Vinca* at the site using the same techniques in April and May, 2010. In several spots re-sprouting and seedling *Vinca* emerged from the tangle of dead vines; we treated these spots as well.

Results

There has been little change in species composition at the site 2006-2010. Inspection in April, 2009 and May, 2010 indicated almost total kill of the treated *Vinca* across the plot; more than 95% of the *Vinca* vine and leaf tissue was dead. In 2006 we found 107 non-seedling *Galium* plants in the plot and that number increased to 131 in 2008 (Table 1). In 2010 there was a huge increase to 292 established plants; about 75%

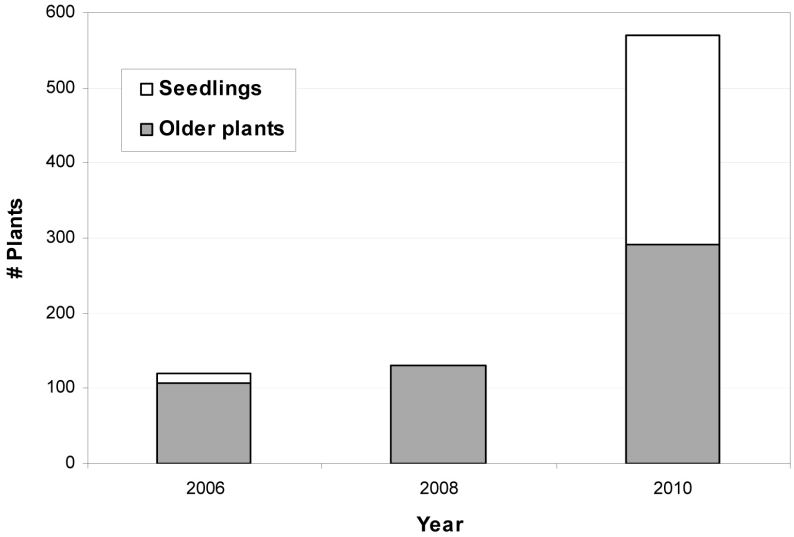

Table 1

Number of *Galium buxifolium* seedlings and older plants 2006-2010, Pelican Bay plot, Santa Cruz Island

of those appeared to have germinated in 2009 across both treated and non-treated areas. We counted 12 seedlings in 2006, none in 2008 and 277 new seedlings in 2010. Altogether, there were totals of 119, 131 and 569 *Galium* plants and seedlings in the plot in 2006, 2008 and 2010, respectively. We have lost 23 tagged plants

Figure 2

Vinca major leaf wounded with a wire brush to improve herbicide uptake before painting with herbicide.

2006-2010; mostly small plants and seedlings of the previous year, evenly distributed within and outside of the treatment zone. Since 2006, not counting seedlings, there has been a net gain of 185 plants in the plot for a near doubling of pre-treatment plant numbers.

Conclusions

This has been a logistically difficult project to implement. It is about a six-mile round-trip hike over steep terrain to the site from the pier. Weather often precluded work at the best time of the growing season. Working near a sea cliff edge required extra safety equipment beyond the routine protective gear. Our biggest treatment challenge was devising a way to kill *Vinca* with an herbicide without harming the endangered *Galium*. We worked to make herbicide treatment very efficient to minimize the number of times we needed to be in the habitat. This was done by careful pruning for best access to *Vinca*, and by wounding the *Vinca* leaves immediately before applying herbicide. We minimized the possibility of herbicide contact with *Galium* by covering it before application and by hand-painting herbicide directly onto the *Vinca*.

Despite the logistical and technical challenges, we have met our project goals so far: we have killed more than 90% of the *Vinca* with no net loss of *Galium*. At this point we see no need to adjust our approach. We do not know whether the high rate of seedling recruitment from 2009 and new seedling establishment in 2010 are the direct result of *Vinca* reduction. It could be that these would have been "good" seedling years for *Galium* anyway. It is encouraging that we did have this increase in the face of such potentially harmful site work. Results of such treatments are often striking in the short-term. However, we want to encourage population growth over the long term. Our monitoring through at least 2016 should show whether our careful work in 2008-2010 makes a difference in the long run.

Use of trade names does not imply endorsement by the U.S. Geological Survey.