Management of Cape-ivy (*Delairea odorata*) in the Golden Gate National Recreation Area

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Abstract

The objective of this paper is to provide an overview of our Cape-ivy *(Delairea odorata,* formerly German-*ivy, Senecio mikanoides)* control program at the Golden Gate National Recreation Area (GGNRA). Like many preserves, lands of the GGNRA have an extensive history of human induced ecological change, now largely influenced by the introduction, establishment and spread of non-native plants and animals. Known as biological invasions, these introductions can affect ecosystem processes and accelerate the loss of biological diversity (Vitousek et al. 1996, Mooney et al. 1986). Park Service resource managers charged with "protecting and preserving all species of native flora and fauna within all management areas" are overwhelmed by the enormity of the task of managing biological invasions, particularly when so few ecological studies have been conducted to quantify threats. Without this basic information it is virtually impossible to identify which invasive species have the greatest impact on a given system and prioritize management decisions. Consideration must also be given to the extent and rate of spread, as well as the feasibility and cost of controlling invasive plant species. Taking these complex factors into account, we have begun a park-wide Cape-ivy containment program that also includes an adjacent park, the Point Reyes National Seashore. This paper provides a systematic approach to the control of Cape-ivy consisting of a variety of containment and removal methods which are being incorporated into existing community volunteer programs. Our primary goal is to stop the park-wide expansion of Cape-ivy and contribute to the science of conservation biology

Introduction

Cape-ivy *(Delairea odorata)* was introduced to the U.S. during the 19th century from Europe, as a Victorian-era houseplant. Originally native to the Cape region of South Africa, Cape-ivy is now a serious pest along the coasts of California and Oregon, and in Hawaii, Maui and Australia. Cape-ivy, formerly referred to as German ivy *(Senecio mikanioides),* currently infests twenty two plant community types in the park (Sawyer et al. 1995). The California Exotic Pest Plant Council (CaIEPPC) rates Cape-ivy as an A-1 pest. In the GGNRA, Cape-ivy is spreading more rapidly than any other non-native invasive plant species of concern. Resource managers consider the immediate containment of Cape-ivy to be their top vegetation management priority. Susceptible community types comprise approximately 70% of the park's terrestrial plant communities, ranging from steep salt exposed bluffs along the Pacific Ocean to shady inland alder riparian habitat. While serious, the problem still only affects a small percentage of park land; less than 0.5% of the park's acreage of approximately 75,000 acres is infested, making control feasible. Surveys in the Marin Headlands revealed that 1987 populations of 8.8 acres expanded to 67.3 acres in nine years (Vaghti 1997, Thomas 1987, Nelson 1995). The GGNRA has a total of 162 acres of Cape-ivy infestation which is in an exponential growth phase. Based on the current rate of spread and Cape-ivy's ability to invade a wide range of plant community types, it is estimated that within the next decade more than one thousand acres will be infested if no action is taken.

Cape-ivy expands vegetatively as a vine through the spread of stolons. Fragments as short as one half inch, carried by runoff or landscape machinery, can take root and colonize new areas. Growth rates of individual plants and populations have been measured at several locations with individual stems averaging one foot of growth per month (Alvarez 1995, Hillis 1994). Cape-ivy forms impenetrable mats in both shade and sun, and climbs native shrubs and trees forming a dark canopy layer up to nine meters in height. Patch size ranges from a few square meters to several acres in size. Although more research is needed on Cape-ivy's seed viability, tests suggest that it is not the primary method of reproduction or dispersal (Bossard 1995), making it possible to

contain the spread of larger Cape-ivy patches and completely remove smaller infestations without re-infestation due to seed production.

Biological Effects of Cape-ivy

Currently, I am concluding research for my Master's thesis at Sonoma State University on the influence of Cape-ivy on three GGNRA coastal plant communities consisting of coastal scrub, willow riparian, and alder riparian habitat. Although some of this work is ongoing, results already clearly show that Cape-ivy is associated with significant reductions in vascular plant species richness in all three habitat types (Alvarez and Cushman 1997). Grasses and annual species are consistently missing from Cape-ivy infested plant communities. In addition, the abundance and richness of seedling plants is significantly reduced indicating that as plants age and die, there may be little establishment of native plants in Cape-ivy infested sites. These trends imply that these habitats will likely be dominated by Cape-ivy to an even greater extent, affecting the future structure and composition of these plant communities potentially altering ecosystem function as well. There is also evidence that Cape-ivy is associated with a significant reduction in the abundance of two insect orders (Coleoptera and Diptera) for two riparian plant communities which could affect other species dependent on these insects (Fisher 1997).

Cape-ivy may also impact native stream communities where favorable growing conditions have allowed it to become more pervasive along the riparian corridors within the parks. Because Cape-ivy reduces plant diversity and alters vegetation structure, normal rates of riparian nutrient cycling may be reduced, thereby influencing other components of the food web (Fong pers. commun.) as well as contributing to the fragmentation of diverse plant communities.

Cape-ivy is also a threat at the species level, with four federally listed species and nine California Native Plant Society (CNPS) and/or state-listed species threatened by habitat modification, displacement and shading from Cape-ivy. Host and nectar plant populations for two federally endangered butterflies, the Mission Blue *(Icaria icarioides)* and the San Bruno Elfin *(Callophyrs mossii bayensi)* are also threatened by Cape-ivy's spread. Cape-ivy contains pyrrolizidine alkaloids which may have a toxic effect on aquatic organisms. Pyrrolizidine alkaloids of a related species *Senecio jacobea*, resulted in growth depression, mortality, and development of hepatic lesions to rainbow trout (Hendricks et al. 1981). Research is currently underway to determine whether Cape-ivy may have similar effects; if it does, endangered wildlife such as threatened coho salmon *Oncorynchus kisutch*, steelhead, and the California freshwater shrimp *(Syncaria pacifica)* could be directly affected.

GGNRA Cape-ivy History

In 1992 park managers knew very little about Cape-ivy, except that it was rapidly spreading. By 1993, nine small infestations of Cape-ivy were actively managed among six restoration sites; removal was difficult and concern began to grow. In 1994 Cape-ivy was unanimously identified as a threat to uninvaded plant communities and it became clear that in order to halt its spread we would need to mobilize resources, conduct studies, and acquire additional funding. From 1994-1996 a CalEPPC working group conducted studies on Cape-ivy biology and control. In 1996 1 began my Master's thesis studies to identify what effect Cape-ivy was having on three park plant communities. In 1996 we wrote a project statement and began to develop a park-wide control plan which included mapping all Cape-ivy populations, drafting control prescriptions, and developing a prioritization process for treating infestations. We then identified what we could do with existing volunteer programs and began containment actions with a larger park-wide goal. By early 1997, Habitat Restoration Team intern, Gavin Hoban, had drafted a Cape-ivy control plan and we were about 60% through the total mapping effort. By the end of 1997 intern Alison Fisher completed a study on Cape-ivy's influence on insect abundance and we also received funding that allowed us to conduct additional containment work at priority locations and further test our methods.

Methods

Our Cape-ivy containment strategy consists of the following goals/objectives:

- Achieve parkwide containment
- Remove highest priority infestations, and remove all small or remote Cape-ivy patches

- Improve control methods to secure long-term control
- Expand community-based involvement in long-term control program

The control program consists of the following elements:

Survey the park:

- Map and label every discrete Cape-ivy infestation
- Prescribe containment treatments to every location

Develop an annual work plan:

- Prioritize containment/removal based on sensitive species, habitats and remote infestations
- Maintain containment lines and reduce overall area of infestation
- Map and contain new infestations as they arise; if they are small, remove them
- Revise prescriptions/methods to match the status of each infestation and maximize reduction
- Revise annual work plan
- Track and report progress

Control methods have come from field experience among diverse plant communities and consist mainly of mechanical methods. Containment is conducted through a combination of volunteer programs, conservation corps, and consultants. Specific site prescriptions are designed to match geography, hazards, complexity and cost with skill to determine appropriate labor sources. Although an experimental study on removal methods (Bossard and Benefield 1996) found that a combination of herbicides (0.5% Triclopyr and 0.5% glyphosate) provided the greatest initial reduction in Cape-ivy in a Eucalyptus forest, the primary control method continues to be manual removal due to the lack of funding, the predominance of Cape-ivy in riparian areas, vegetation structure, and the great progress and success of the current containment efforts. The application of clear plastic to solarize plants at the same site was unsuccessful.

Mechanical control:

It's a good idea to prescribe several kinds of treatments in case the ideal method is unavailable or not feasible. Prescriptions should be flexible to change as the infestation is contained or new strategies and methods are developed. Although each infestation situation is unique, certain patterns have become predictable and result in the following general containment methods. Containment lines are 1-2 meters wide and consist primarily of herbaceous plants, topped shrubs, and limbed trees. Ideally, containment lines should be constructed within the perimeter of the Cape-ivy infestation which also reduces the size. When time and hazards, such as dense poison oak are limiting, install the line outside the infestation's perimeter. In general, it is always ideal to reduce the total perimeter by removing finger-like projections. Cape-ivy is often lightly rooted on the leading edges of the infestation; therefore, much future work can be saved by thoroughly peeling back these edges. In order to do a thorough initial containment or removal job it is important to reduce and remove as much vegetation and debris as possible. The stature of most woody shrubs in the containment zone is reduced by cutting them to within 0.5 meters of ground level with hand tools, (loppers, rakes, McClouds, gas powered hedge trimmers, brush cutters, or chainsaws). Native shrubs such as *Baccharis* spp., *Artemisia* spp., *Rubus* spp., and *Toxicodendron diversilobum* usually resprout vigorously. Trees are also limbed to facilitate Cape-ivy root removal and reduce Cape-ivy's upward spread. Once the area is initially cleared of vegetation and debris, then a second more thorough weeding is conducted. The soil surface is raked over to a depth of several inches or until most of Cape-ivy's purplish-red stem and root fragments are no longer seen.

Debris is disposed of by piling it within or outside the containment line (depending on contamination) or, if off-site disposal is necessary, it can be disposed of as green waste at the landfill. Cape-ivy contains little cellulose so it breaks down quickly. Each site will be evaluated for revegetation and erosion control needs. Straw mulch may be used to enhance the reestablishment of existing native species, suppress the establishment of other invasive plants or mitigate erosion if necessary.

To maintain a Cape-ivy-free zone around populations, containment lines require frequent monitoring, and follow-up removal. Cape-ivy will also be removed during the containment process, leading to an overall reduction in the infestation during the initial containment actions and during each follow-up visit. Ideally, containment follow-up is scheduled on 12-week intervals to remove any Cape-ivy that has entered or resprouted in the containment zone. The follow-up schedule will depend somewhat on the quality of initial work and the habitat and season. It is important to document follow-up needs and observed growth rates in order to refine future containment efforts.

Infestations are revisited after the initial containment actions for further perimeter and patch reduction six weeks to three months after initial work, every 2-3 months for the first year, and quarterly in subsequent years. Only extremely large infestations in difficult terrain are kept in a "contained only" state to allow us to halt the spread first and later return when resources are available for removal and restoration.

Results

Each year priority containment and removal sites are identified for each major watershed based on the previous year's progress and set forth in the annual containment plan. Knowledge about sensitive species, communities, infestation size, expansion potential, and the feasibility and cost of long term control are all taken into account. Containment priorities focus simultaneously on isolated infestations in pristine regions, those among rare plant habitat, and all other feasible sites given available resources.

Systematic containment of Cape-ivy in the GGNRA began in 1995 by increasing mechanical control efforts. In just two years, without additional funding, over 25% of the park's approximately two hundred Cape-ivy infestations were contained. This initial success confirmed that containment is generally more feasible than removal efforts since only twelve infestations have been totally removed since 1993. In addition to containment, over 75% of all Cape-ivy has been mapped and labeled for tracking, and each infestation has a containment prescription implemented as resources become available. Containment lines installed in 1995 have successfully stopped Cape-ivy spread. Systematic removal or containment work is also on-going, particularly in rare plant habitat or locations where work has already been initiated.

Our control efforts have proven extremely valuable in identifying which techniques work best in which environments. We have explored different control methods, including solarization, herbicides, and mulching, but in the majority of cases, mechanical removal is the most efficient choice. However, herbicides will be applied to non-sensitive habitat types such as where native plants are already severely reduced or entirely absent.

Volunteers provide the largest and most consistent management force in our parks. Since 1992 annual volunteer hours contributed towards Cape-ivy control have gone from less than 150 hours to over 8,000 in 1997. The park is working with volunteer programs to maintain containment of most infestations and gradually reduce them. We are optimistic about our prospects for control but recognize that Cape-ivy may never be removed from a few inaccessible locations along cliff faces.

Volunteers in the Habitat Restoration Team or Invasive Plant Patrol also play an important role in long-term exotic plant detection programs. Only eight new patches have been discovered in the last two years, all relatively small sizes ranging from four square meters on Bolinas Ridge to 900 square meters on Milagra Ridge. Fewer than ten cases of single stem strands have been discovered in frequently visited locations, underscoring the need to re-survey and develop an eye for small Cape-ivy infestations. Progress should be reassessed several times a year in order to revise prescriptions, maximize reduction and update workplans, keeping the goal of park-wide containment in mind. It is easy to become too focused on eradication and lose ground in other areas. Monitoring also provides the opportunity to report results in volunteer newsletters.

To stay current with the latest knowledge about Cape-ivy, park staff also maintain regular contact with local colleges, universities, and conservation agencies. The GGNRA has also completed or encouraged biological studies to determine Cape-ivy's impacts among different plant communities. The parks are also coordinating with adjacent land management agencies (California State Parks, Marin Municipal Water District) and with park partners (Green Gulch Zen Center and The Headlands Institute) to reduce Cape-ivy populations on adjacent lands and reduce the potential for reinfestation. Both Green Gulch Zen Center and the Audubon Canyon Ranch

(ACR) are removing Cape-ivy. Audubon Canyon Ranch has identified Cape-ivy removal as their highest resource management priority (Peterson pers. comm.). ACR volunteers have removed several acres in riparian habitat over the last four years. We have also developed informational materials to alert park personnel about Cape-ivy's impact on park ecosystems and how to avoid spreading it. A press release and flier has been generated to alert park neighbors and reduce illegal dumping. All of these efforts are important to the long-term success of our Cape-ivy control program.

Today Cape-ivy's extent is still limited and control is possible if park-wide containment and removal is conducted systematically and consistently. The growth and dispersal capabilities of Cape-ivy are very different from those species we have effectively managed in the past because Cape-ivy requires a year-round sustained removal effort, testing the ability of resource managers to stop its spread. Invasive species like Cape-ivy also underscore the need for systematic invasive plant control programs and studies that can assess relative impacts of targeted invasive species.

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