

Songbird monitoring in the Golden Gate National Recreation Area: A MULTIFACETED TOOL FOR GUIDING THE RESTORATION OF REDWOOD CREEK

By

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The goal of many habitat restoration and management projects is to restore ecosystem function. Yet a paucity of basic ecological information exists for land managers to use in designing projects. Armed with such information, managers would have a “head start” toward achieving their goal. Additionally, effective restoration suffers from the difficulty of measuring success and the lack of informational means to make improvements.

Restoration of Redwood Creek, Golden Gate National Recreation Area (GGNRA, fig. 1), is currently under way thanks to funding from the National Park Service Recreational Fee Demonstration Program. One of the first steps is the large-scale removal of GGNRA’s highest priority exotic pest plant, cape-ivy (*Delairea*



Figure 1. Location of the restoration site at Redwood Creek and the reference site at Lagunitas Creek, both in Golden Gate National Recreation Area, California.



odorata). Cape-ivy is a fast growing, nonnative vine that blankets native plants (fig. 2), diminishes plant species richness, reduces structural diversity, and may reduce recruitment of light-dependent species such as red alder (*Alnus rubra*) trees in the riparian zone.

As part of GGNRA’s broader efforts to monitor songbirds, we have been studying the songbird community in Redwood Creek since 1997. We have found that songbird monitoring is a valuable tool because we can (1) examine the effect of nonnative plants on the bird community, (2) assess the immediate effects of

the restoration activities (i.e., disturbance created by removing of cape-ivy) on the songbird community while (3) simultaneously providing specific information on the habitat requirements of a diverse and healthy songbird community, (4) provide a practical means of measuring the success of the restoration project, and (5) act as an information feedback loop to refine and improve restoration and management (i.e., adaptive management).

To illustrate the utility of songbird monitoring for restoration and management programs we present preliminary results and specific recommendations based on three years of study.

CAPE-IVY REMOVAL AT REDWOOD CREEK

Redwood Creek is a coastal California stream that flows through Muir Woods National Monument into a relatively undeveloped valley and eventually into the Pacific Ocean, Marin County, California. To the millions of casual visitors who travel along Redwood Creek on their way to or from Muir Woods, the riparian corridor of willows

[To eradicate cape-ivy,] all roots must be grubbed out and removed from the site.

all roots must be grubbed out and removed from the site. To find the extensive roots on a densely vegetated site, the site must be cleared to expose the ground surface (fig. 3). Therefore, the removal method employed at GGNRA entailed “brushcutting” all herbaceous vegetation on a site, then raking it up. Roots of native species, such as blackberry (*Rubus ursinus*), thimbleberry (*Rubus parviflorus*), hedge nettle (*Stachys chamissonis*), and others were left undisturbed, but roots of cape-ivy were raked up or grubbed out by hand. Since cape-ivy resprouts quickly, roots that first escaped notice typically resprouted with only slight fog drip or light rains, making easy the task of finding and pulling them before the site was naturally revegetated. Initial clearing, cutting and raking required six weeks for an eight-person Marin Conservation Corp crew. However, follow-up removal of cape-ivy resprouts continued almost weekly for the following nine months.

To date, vegetation data from transects on both removal and control areas show cape-ivy removal has been very successful, virtually eliminating the plant. The



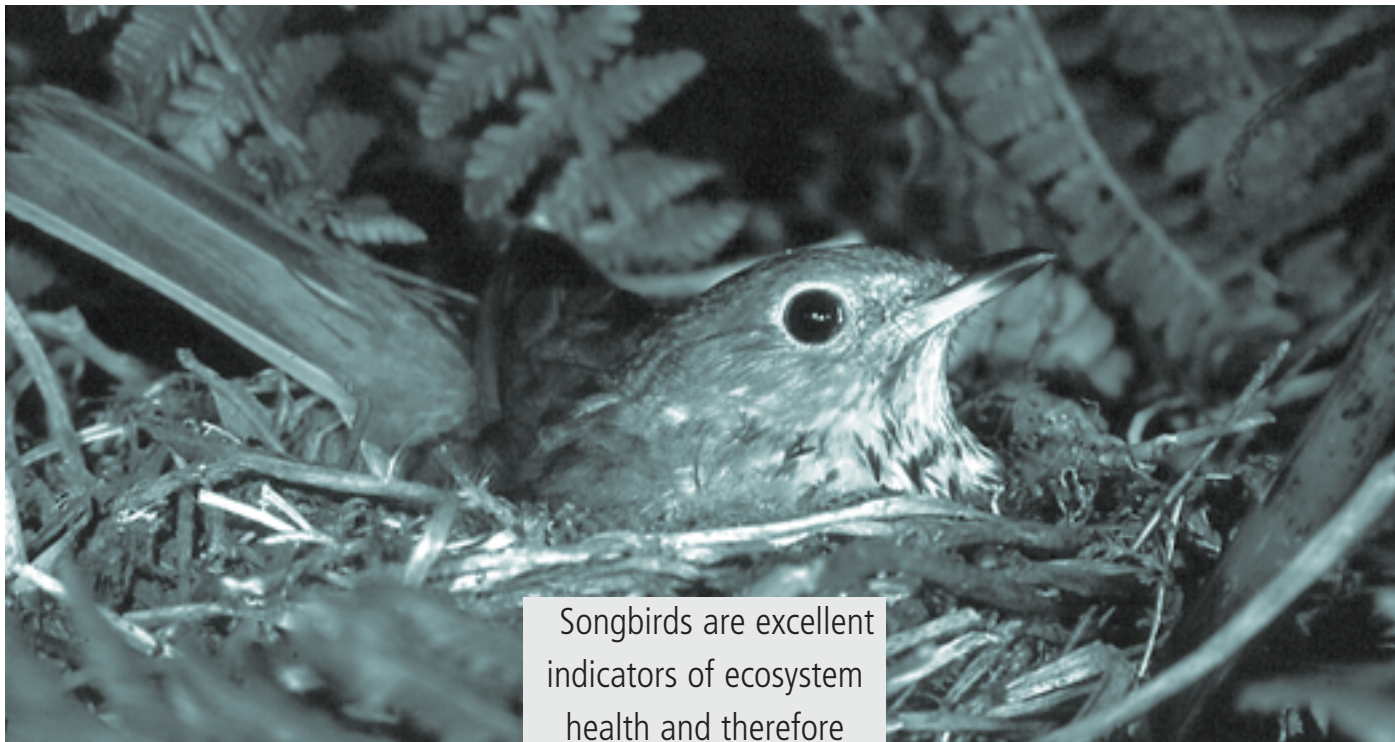
(*Salix* spp.) and red alder trees might appear to be well protected and “wild.” However, the valley has a history of various land uses including grazing and row crop agriculture and is currently threatened by the highly invasive cape-ivy.

Cape-ivy is notoriously persistent in its growth habit, and within the last 12 years data have shown that cape-ivy alone now makes up approximately 40% of the vegetation cover along the creek. Cape-ivy will resprout from the tiniest piece of root, stem, or even leaf. This eliminates mere cutting as a viable control mechanism. Instead,

Figures 2 (before, left) and 3 (after, above). Habitat restoration took place along Redwood Creek in Golden Gate National Recreation Area, Marin County, California, where cape-ivy—a persistent invasive plant species—blankets native vegetation. Able to resprout from root, stem, or leaf, cape-ivy must be completely removed, exposing the ground surface, and any remaining vegetation raked up. PHOTOS BY CAROLYN SHOULDERS.

natural appearance of the site rebounded immediately in the first growing season, with rooted native species growing well. Three years after removal, native plant species have recovered to numbers close





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Figure 4. *Swainson's thrush was one of three songbird species documented nesting in the native vegetation (lady fern).* COPYRIGHT IAN C. TAIT.

to those measured before removal. However, other exotic species, particularly nonnative grasses, as a group, may be establishing at a level of cover similar to that of cape-ivy's before its removal.

Further restoration of Redwood Creek is indicated. Specifically, locally cultivated native plant species will be planted in areas where the nonnative grasses have become established after cape-ivy removal. These plantings will augment the existing riparian vegetation, speed recovery efforts, and have the potential to shade out the nonnative grasses.

SONGBIRDS AS INDICATORS

There are many reasons why songbirds are excellent indicators of ecosystem health and therefore ideal organisms for guiding and measuring management and restoration. From a practical standpoint, songbirds are relatively easy and cost-effective to monitor—few other taxa announce their presence in song each spring making detection an easy endeavor. In addition, researchers using songbird monitoring protocols and analyses benefit from the existence of nationally standardized programs and guidelines that aid in repeatability and interpretation of results (e.g., Ralph et al. 1995, Martin et al. 1997, Nur et al. 1999).

From a biological perspective, songbirds serve as sensitive indicators of environmental health because of their high metabolic rate, abundance, and distribution within and across habitats, and relatively high position in the food chain. For example, songbirds are sensitive to changes in food supply, vegetative cover, and predator densities. With songbird studies, we have the advantage of being able to monitor changes at the community (versus single-species) level due to the ease of detection.

For all of these reasons songbirds are nearly ideal study organisms to track the dynamics of natural cycles and anthropomorphic (e.g., restoration and management) changes within an

ecosystem and may provide early warning signals of more broad-scale environmental change. Songbird monitoring, however, does not preclude monitoring of other targeted species or measures of ecosystem function. At Redwood Creek, the national recreation area also monitors federally threatened coho salmon and steelhead populations as well as stream flow and changes in channel morphology.

MONITORING TECHNIQUES

The primary field techniques we employed, point counts and nest monitoring, have been extensively used in bird studies (Martin and Geupel 1993, Ralph et al. 1995). Both methods possess a component of vegetation assessment that is done around the census station for point counts and the nest site for nest monitoring.

With the point count method it is possible to study the long-term and annual changes of bird populations, differences in species composition between habitats, and assess breeding status and relative abundance of species. One objective of point count vegetation assessment is to relate the changes in bird composition and abundance to differences in vegetation. These vegetative changes can either be over time or differences between habitats or study sites.

Nest monitoring provides direct information on reproductive success and the local habitat conditions that facilitate maintenance of viable populations, thereby providing specific vegetation information that can be used by land managers. Examination of nests also allows collection of life history data (e.g., clutch size, number of broods, numbers of nesting attempts) that provide important insight into “vulnerability of species to decimation or perturbations” (Martin and Geupel 1993).

RESULTS AND RECOMMENDATIONS

To assess the effects of the disturbance associated with cape-ivy removal, we compared bird species richness, diversity, and relative abundance from data collected before and after removal. We used a nearby creek, Lagunitas Creek, as a reference site. We found that songbird diversity (number of bird species weighted by abundance), richness (number of bird species), and relative abundance increased significantly from the breeding season before ivy removal to the breeding season after removal. Changes in these indexes at our reference site were also positive, although not significantly so. These preliminary findings show that there did not appear to be a negative impact to the songbird community resulting from cape-ivy removal. In fact, we observed three species of songbirds (Swainson's thrush, Wilson's warbler, and song sparrow) nesting in the vegetation that grew post-ivy removal (fig. 4). Additionally, many different species used cape-ivy removal areas for foraging and defended them as part of their nesting territory.

Management and restoration activities cannot avoid some disturbances to plants and animals. Indeed, successful cape-ivy removal requires pulling most of the understory plant species (see previous discussion and figs. 2 and 3). Minimizing these disturbances requires knowledge of the basic life histories of various taxa. For songbirds, the breeding season is a critical period and avoiding planned disturbance events during peak activity is desirable. Using data of the mean range of date of first egg laid and assuming that most songbirds require *at least* one month to raise and fledge young, we showed that the breeding season begins approximately mid-March and extends into mid-August. This range, for a given local area, should be taken into account when planning management activities, with particular attention given to avoiding disturbance during the peak of the breeding season.

In order to guide future restoration efforts for Redwood Creek, we examined structural and floristic vegetation characteristics that may influence bird species diversity, abundance, and nesting success. The following are some of the recommendations we made based on results from bird-habitat analyses (see annual reports Gardali et al. 1999, Holmes et al. 1999, Scoggin et al 2000).

RECOMMENDATIONS

Increase tree species richness (e.g., by planting red alder, willow, and California bay in suitable areas).

Small and total red alder trees showed a positive influence on the nesting success of song sparrows and Swainson's thrushes. Large California bay trees positively influenced the nesting success of Wilson's warblers. Willows were important nest substrates for 12% of all nests sampled ($n = 421$) and were predominantly used (~50%) by black-headed grosbeaks and warbling vireos. The abundance of warbling vireos, Pacific-slope flycatchers (e.g., fig. 5), Wilson's warblers, and black-headed grosbeaks were positively associated with tree species richness.

We found that songbird diversity, richness, and abundance increased significantly from the breeding season before ivy removal to the breeding season after removal.

Plant tree species to restore riparian forest structure.

California bay should be planted where the upland (mixed hardwoods) grades into the riparian forest. The mean number of bays around successful Wilson's warbler nests was 2.5 and only 0.37 for unsuccessful nests. Thus, "shrubby" willows should be planted in patches (clumps) in wet areas or areas that flood (or have the potential to flood). Concentrated plantings will create usable habitat quickly while at the same time mimic the natural establishment of vegetation after scouring or soil deposition from a flood (RHJV 2000). To recreate currently occurring red alder densities, the red alders should be planted at varying intervals (from 1–25 m or 3.3–82 ft) but at an average of 6–7 m ($6.37 \text{ m} \pm 1.14 \text{ m}$ or $20.9 \text{ ft} \pm 3.7 \text{ ft}$; $n = 25$ nests). This will also allow space for the propagation of understory plant species (see following discussion). Successful song sparrow nests had a mean of 4.5 red alder trees within 11.3 m (37 ft) of the nest while unsuccessful nests had 1.5.

Plant understory species in suitable and appropriate areas to restore riparian forest structure and increase foliage (e.g., California blackberry, willow, sword fern, lady fern, and red elderberry were important nesting substrates for many species).

Bird species diversity was positively associated with a diverse shrub structure. Therefore, understory species should be planted below existing tree canopy where removal of nonnative plant species has occurred and in between new tree plantings. In general, sword fern grows in the upper, dryer areas while lady fern is found more commonly at the stream edges or in the floodplain. California blackberry occurs throughout the watershed as large patches in forest openings and as dense "mats" below tree canopy.

Promote system-wide high structural diversity.

As supported by this study, the presence of early to late successional stages of riparian woodland systems has been identified as a key feature for the successful management of riparian bird communities (RHJV 2000). For example, warbling vireos prefer to establish territories in areas with large trees but have higher nesting success when nest placement is lower in smaller trees. The importance of

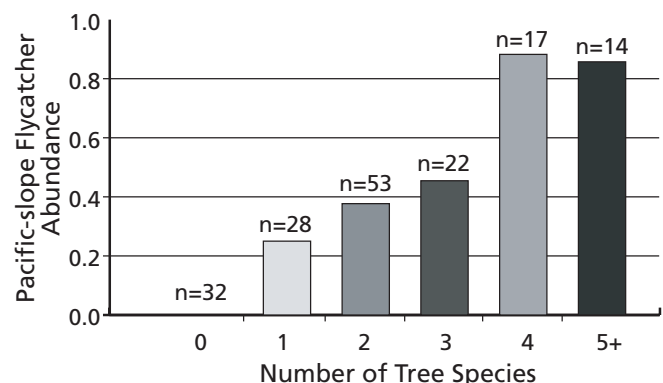


Figure 5. Tree species richness related to mean Pacific-slope flycatcher abundance.



small red alder trees for both song sparrows and Swainson's thrushes suggests improved productivity in early successional habitats.

Manage or create wide riparian corridors that approximate 100 meters.

Abundance of warbling vireos (e.g., fig. 6), Swainson's thrushes, and common yellowthroats were positively correlated with width of the riparian corridor.

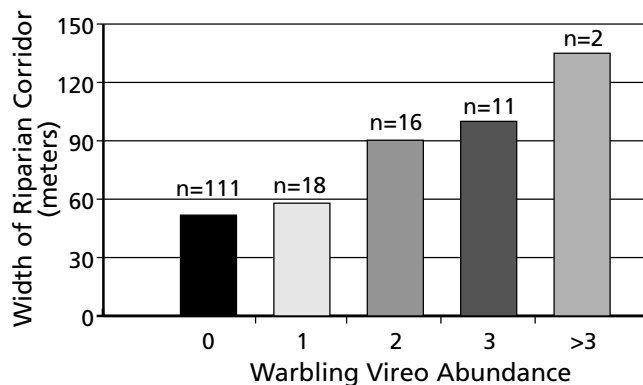


Figure 6. Warbling vireo abundance related to mean riparian corridor width.

Remove nonnative plant species

Nonnative plant species may decrease structural diversity by decreasing plant species richness. Structural diversity is an important habitat characteristic for reproductive success and bird species diversity and abundance. Shrub species diversity and structural complexity had a positive influence on bird species richness and diversity.

Protect and restore adjacent upland habitats.

Upland areas adjacent to riparian corridors may be of critical importance to the maintenance of healthy bird populations. Some species may benefit from a contiguous transition from low-land riparian to upland mixed hardwoods or coastal scrub. For example, we may interpret the positive relationship between Wilson's warbler nest success and California bay as testimony to the importance of adjacent habitats.

CONCLUSIONS

Land managers need many tools to repair and manage ecosystems. Restoration challenges such as cape-ivy removal benefit from the immediate feedback and the long-term planning information that songbird monitoring can supply. Additionally, monitoring can be supplemented with specific research questions to further assess restoration activities as well as investigate other processes that may limit populations of birds and other wildlife. As our preliminary results and recommendations have shown for Redwood Creek, songbird monitoring has the potential to contribute greatly to the informational needs of resource managers. 

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