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Additional case-studies from around the globe

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Re-introduction of the San Francisco forktail damselfly into an urban park, California, USA

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Introduction

The San Francisco forktail damselfly (*Ischnura gemina*) remained largely unknown after its description (Kennedy, 1917) until rediscovered in 1978 (Garrison and Hafernik, 1981a). It is endemic to the San Francisco Bay Area of California, a region that has experienced considerable habitat loss due to urbanization. The World Conservation Union classifies *I. gemina* as vulnerable with population trends decreasing (IUCN 2009). Hybridization with a widespread relative *I. denticolis* may also threaten *I. gemina's* genetic integrity (Leong & Hafernik, 1992). Studies of *I. gemina* in Glen Canyon Park, San Francisco detailed the species' population structure and mating behavior (Garrison and Hafernik 1981b; Hafernik and Garrison 1986). In the late 1980's, habitat degradation caused extinction of *I. gemina* in the park. We re-introduced *I. gemina* into Glen Canyon after the damselfly's habitat was restored; monitored the damselfly's movements and population dynamics; and compared our data to the prior studies in the park (Hannon & Hafernik, 2007). Recapture rates were lower than in prior studies due to a larger initial decline in marked individuals. The re-introduction was initially successful and damselflies reproduced throughout the summer and into following year. However, the population failed to persist because its habitat became degraded with excess vegetation.

Goals

- Goal 1: Test whether it is possible to re-establish a population of *I. gemina* by releasing adults.
- Goal 2: Test whether the newly released population behaves like prior *I. gemina* populations in Glen Canyon as documented in Garrison and Hafernik, 1981a and Hafernik and Garrison, 1986.

Success Indicators

- Indicator 1: Observation of mating and oviposition.
- Indicator 2: Observation of newly emerged adults.

San Francisco forktail Damselfly mating pair

- Indicator 3: Observation of second-year adults and reproductive activities.
- Indicator 4: Estimation of longevity and movement patterns similar to previous studies.
- Indicator 5: Self-sustaining populations established at re-introduction site.

Project Summary

Feasibility: Most of the watershed that drains into Glen Canyon has been lost to urbanization. However, *I. gemina* persists in small, isolated wetlands similar to those in the canyon. Because adults usually move only short distances during their lifetimes, damselflies released at a site have a good chance of remaining and reproducing at that site enhancing prospects for success. The Glen Park neighborhood also is home to a group of citizens committed to maintaining native plants and animals in Glen Canyon. Their participation in active management of introduction sites could be key to future success.

Implementation: We conducted a project during 1996 and 1997 to re-introduce *I. gemina* into Glen Canyon. The receiving site for adult damselflies was a linear asphalt channel on the rim of the easternmost slope of Glen Canyon Park. The channel carries water from a permanent seep. This channel was the sole breeding area for *I. gemina* in Glen Canyon prior to its local extinction (Garrison & Hafernik, 1981b; Hafernik & Garrison, 1986). We surveyed surrounding wetlands on the San Francisco Peninsula to find a source of stock for reintroduction. Our surveys indicated that the nearest large population of *I. gemina* was in a wetland approximately 12 km south of Glen Canyon. We assessed biotic and abiotic characteristics of the receiving site and found adequate larval food for *I. gemina* in the channel and in newly created ponds in the canyon bottom. Neither habitat contained fish, although the ponds contained larval dragonflies (*Aeshna* sp.), which could prey on *I. gemina* larvae. To restore habitat for *I. gemina*, we cleared aquatic vegetation that had grown in and over the channel. This work left the site relatively free of aquatic vegetation with open and sun-exposed areas. In addition, the California Conservation Corps implemented a habitat restoration project in the bottom of the canyon. They removed riparian trees and shrubs (e.g., *Salix* spp.) from a large seep and constructed three new pond-like habitats in Islais Creek near the seep. At the source site, we collected approximately 40 mating pairs on three separate days. This number was deemed appropriate since it was not likely to negatively impact the source population, it provided an adequate sample of genetic diversity of the source population, and it allowed new releases to approximate the number of adult damselflies previously found at the channel. We carefully transferred damselflies into small plastic vials with a source of moisture. We transported them to our laboratory in a cooler containing ice to limit stress from handling, warm temperatures, and light. In the laboratory, we marked individuals on their wings with a unique number using an indelible ink pen. We released the damselflies at the channel the following morning to give them a chance to feed before their midday peak mating period.

We chose mating pairs because they provided an equal number of males and females for reintroduction. Secondly, it assured that individuals transferred were reproductively active, which increased the chance of oviposition at the receiving

Damselfly habitat before (*left*) and after restoration (*right*)

site. Thirdly, pairs are conspicuous while unpaired females are usually cryptically colored and forage and rest away from the water (Hafernik, 1989). Lastly, we chose mating adults because juvenile damselflies are more easily damaged in handling than reproductively mature ones. We re-introduced captured adults instead of lab-reared adults because re-introducing mated females maximized the likelihood of establishing a new population quickly. Alternatively, another life history stage, such as eggs or larvae, could have been used for the re-introduction. However, this procedure would have been more labor intensive and would not have allowed comparison of the behavior of newly released adults with prior research in the canyon.

Post-release monitoring: We monitored the re-introduced population daily to estimate mortality and movement patterns and to observe their behavior. After a large initial decrease in recapture rate compared to previous years, survival and movement patterns were similar to those of previous studies. As in previous studies, some damselflies dispersed from the channel to the ponds below. We observed damselflies behaving normally and mating and ovipositing into aquatic vegetation. At least two generations of new adults were observed in 1996. In 1997, damselflies emerged in the spring, but did not persist into the fall. Subsequent yearly visits to Glen Canyon have found no individuals of *I. gemina*. Future plans by the City of San Francisco call for re-introducing the damselfly again if it is not observed in the next five years. Success will require active management of wetlands in the canyon to control invasive vegetation. Additional re-introductions are being considered in restored wetlands in the Presidio of San Francisco, a U.S. National Park.

Major difficulties faced

- Habitat upkeep is needed due to loss of natural ecological processes, habitat requires vigilance and proper maintenance.
- Lack of nearby populations to provide natural reestablishment and gene flow.

Major lessons learned

- Re-introductions using adult damselflies can work.
- Because of the loss of the natural processes that maintained appropriate habitat for the damselfly, active management will be needed for it to persist in places like Glen Canyon.
- A partnership of co-operative stakeholders that includes representatives of the San Francisco Parks and Recreation Department, citizen groups and local scientists needs to be established to make management decisions quickly and review their success.

Success of project

Highly Successful	Successful	**Partially Successful**	Failure
		√	

Reason(s) for success/failure:

- Successfully trans-located the species.
- Species behavior upon release was not impacted.
- Unable to maintain or "re-create" natural processes to keep habitat suitable through time.

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