From the Field

Translocation of California red-legged frogs (*Rana aurora draytonii*)

Galen B. Rathbun and Julie Schneider

Moving animals to conserve populations—including introductions, reintroductions, augmentations, and repatriations—is a relatively common technique with a long history with resource managers (e.g., Griffith et al. 1989, Dodd and Seigel 1991, Fischer and Lindenmayer 2000). Relatively little attention, however, has been given to translocating individuals out of harm's way at sites scheduled for alteration or destruction. Most observers assume that moving such individuals is in the animal's best interest and that the action benefits the population. However, little analysis of this type of translocation has been done to test these assumptions.

The California red-legged frog (*Rana aurora draytonii*), the only large native ranid found in California, is distributed from central California to northern Baja California. It is estimated that the species occurs in only about 25% of its historical range, largely because of human alterations to its habitat (United States Fish and Wildlife Service 2000). Since being listed by the United States Fish and Wildlife Service (1996) as threatened, permitting procedures have limited research opportunities on the frog, whereas management actions have increased, including translocating animals away from likely harmful human activities. Herein, we report and discuss data that we opportunistically gathered from a red-legged frog translocation that was intended to protect frogs from potentially harmful activities.

Study area

Our observations were made at the Guadalupe Dunes on the central coast of California, including the 930-ha Guadalupe Oil Field, which was active from the late 1940s to 1994. Red-legged frogs are common in many habitats in this area, and they breed in several ponds during winter. In 1994, the Union Oil Company (UNOCAL) began remediation and restoration of the oil field in cooperation with several state and federal regulatory agencies. These activities included moving, cleaning, and stockpiling large quantities of sand and soil contaminated with diluent, a petroleum product. These activities had the potential to also adversely affect several sensitive species, including the California red-legged frog.

Pond TB8W at the oil field was one of 2 9 × 61-m man-made basins lined with concrete and asphalt. The ponds, 2 m apart, were designed to capture contaminants if a nearby storage tank should rupture. A large asphalt pad used for stockpiling petroleum-contaminated soil and for parking heavy

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construction equipment was located next to TB8W. During winters 1999 and 2000, TB8W attracted amphibians when it accumulated rain water (the other pond remained dry). Approximately 8 adult red-legged frogs and several juveniles took up residence in the pond, which raised concerns that they might be harmed by UNOCAL cleanup activities. Regulatory agencies required UNOCAL to translocate the red-legged frogs from TB8W to nearby natural ponds.

Methods

We captured frogs by hand or with dip nets, measured the straight-line snout-urostyle length (S-U) of each frog to the nearest 1 mm, and determined gender of adults (≥80 mm S-U) by presence of nuptial pads on males. Frogs longer than 50 mm were tagged with passive integrated transponders ("PIT," Donnelly et al. 1994), and adults were radio-tagged with a belt around the waist (Figure 1; Rathbun and Murphey 1996). In compliance with biological regulations associated with the oil field cleanup, we removed the transmitters from the frogs soon after their translocation or post-translocation movement. We clipped the distal third of the third right rear digit of all frogs (Donnelly et al. 1994) as a backup should a radio-tag or PIT be lost or fail to read. We used a 164-MHz receiver, an H-style antenna, and standard homing techniques (Kenward 1987) to locate our frogs. Locations were determined to within 5 m, most were within 1 m, and many included visual confirmation. Data were plotted directly on aerial photographs (1:200 scale). We directly measured distances moved by the frogs using photographs.

Figure 1. A California red-legged frog (*Rana aurora draytonii*) with a radio-tag attached by a "belt" placed around the animal's abdomen.

We captured, tagged, and monitored frogs in TB8W from 1 through 15 February 2000. Juveniles (<80 mm) were translocated to pond C, whereas adults were radio-tagged and released back into pond TB8W during this time. On 16 and 17 February, we recaptured all adult red-legged frogs in TB8W and translocated them to ponds B2W1 or B2-3W1 and continued to keep the TB8W pond free of frogs. On 29 February, TB8W was pumped dry and maintained waterless for the remainder of the winter. In addition, UNOCAL covered the 2 ponds with a frog-proof barrier made of a suspended fine-mesh net sealed around the edges with sandbags and gravel. We monitored TB8W for frogs visually and by radio through 9 March 2000 and visually through June 2000.

Results

We captured 4 juvenile frogs in TB8W and moved them 380 m to pond C. One of these returned 3 times to TB8W (and was translocated back to pond C each time) at intervals of 13, 15, and 10 days. Another marked juvenile returned to TB8W twice (and was returned to pond C each time) at intervals of 26 and 44 days. Two of the 4 juveniles were never relocated.

We translocated 7 adult frogs (4 males) with radio-tags. Four (one male) were released 270 m away in pond B2W1 (one female shed her radio after translocation, but was still relocated) and 3 (2 males) were released 540 m away in pond B2-3W1. All 7 frogs left their release ponds. Five remained in their release ponds up to 24 hours, and one remained for 2 days before leaving (we have no details on the female that shed her radio). Six of the 7 homed to pond TB8W, and a female moved 100 m to pond C. One of the homing males first moved 120 m to pond B2W1; after 15 days he moved again, this time 50 m to pond B2W2, where he remained until we removed the transmitter 4 days later. On 7 June 2001 this male was found, dead and mummified, at the frog barrier surrounding the pond adjacent to TB8W. Apparently, he died of dehydration while attempting to return to his home pond.

The 6 frogs that we radio-tracked after their translocation took an average of 3.4 days (S.D. = ±3.1, range = 1 to 9 days) to return to TB8W or move to new ponds. The 4 quickest returns (1, 1, 3, and 3 days) moved directly overland, whereas the 2 others moved from pond to pond to reach TB8W and pond C in 6 and 9 days. On land, the frogs moved only at night.

We translocated the 5 radio-tagged frogs that homed to TB8W a second time, to pond P1W1. Four of these frogs remained at this pond for 10–17 days, when we were required to remove their radios. However, after 4 days, one male left the pond and traveled overland. Two days later, about 460 m west of P1W1 near pond N1W1 and in direct line with TB8W, he shed his radio in the sand dunes. This frog was recaptured and identified by his PIT tag on 27 March 2000 at TB8W pond during routine monitoring. He had traveled at least 2,860 m (straight-line distance) between the 2 ponds in less than 32 days. We moved him to pond C, but without a radio-tag.

Discussion

If biologists and resource managers are to successfully conserve declining species with translocations, they must assess the benefits of their action to the population and species (Hull et al. 1998, Plummer and Mills 2000). Clearly, neither populations nor species can be conserved without regard for individuals, but we do not believe that wildlife managers always appreciate the risks of moving individuals, especially amphibians (Dodd and Seigel 1991, Burke 1991, Reinert 1991, Cooke and Oldham 1995, Muths et al. 2001). For example, animals that are translocated face an uncertain fate if they return home, as we and others have found (Rogers 1988).

In our case, the homing problem might be reduced in the Mediterranean climate of coastal California by moving frogs during the dry summer months that coincide with the nonbreeding season (Jennings 1988, United States Fish and Wildlife Service 2000). The Guadalupe Dunes translocation was conducted during the wet winter season, when red-legged frogs can make remarkably complicated and long (up to 2.8-km) movements across uplands between summer and winter breeding habitats (Rathbun et al. 1997; Bulger et al., unpublished data).

Until additional data are collected, resource managers need to be aware that simply moving an individual animal from one place to another does not necessarily mean that it has been successfully "saved." This is especially the case if the action results in its death or a compromised population (O'Bryan and McCullough 1988, Jones and Witham 1990).

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Literature cited

Burke, R. L. 1991. Relocations, repatriations, and translocations of amphibians and reptiles: taking a broader view. Herpetologica 47:350–357.

Cooke, A. S., and R. S. Oldham. 1995. Establishment of populations of the common frog, *Rana temporaria*, and common toad, *Bufo bufo*, in a newly created reserve following translocation. Herpetological Journal 5:173–180.

Dodd, C. K., Jr., and R. A. Seigel. 1991. Relocation, repatriation, and translocation of amphibians and reptiles: are they conservation strategies that work? Herpetologica 47:336–350.

Donnelly, M. A., C. Guyer, J. E. Juterbock, and R. A. Alford. 1994. Techniques for marking amphibians. Pages 277–284 *in* W. R. Heyer, M. A. Donnelly, R. W. McDiarmid, L. C. Hayek, and M. S. Foster, editors. Measuring and monitoring biological diversity: standard methods for amphibians. Smithsonian Institution, Washington, D.C., USA.

Fischer, J., and D. B. Lindenmayer. 2000. An assessment of the published results of animal relocations. Biological Conservation 96:1–11.

Griffith, B., J. M. Scott, J. W. Carpenter, and C. Reed. 1989. Translocation as a species conservation tool: status and strategy. Science 245:477–480.

Hull, C. L., M. A. Hindell, R. P. Gales, R. A. Meggs, D. I. Moyle, and N. P. Brothers. 1998. The efficacy of translocating little penguins *Eudyptyla minor* during an oil spill. Biological Conservation 86:398–400.

Jennings, M. 1988. Natural history and decline of native ranids in California. Pages 61–72 *in* H. F. DeLisle, P. R. Brown, B. Kaufman, and B. M. McGurty, editors. Proceedings of the conference on California herpetology, 10–11 October 1987, Van Nuys, California, USA. Southwestern Herpetologists Society Special Publication 4, Sunlight, Lakeside, California, USA.

Jones, J. M., and J. H. Witham. 1990. Post-translocation survival and movements of metropolitan white-tailed deer. Wildlife Society Bulletin 18:434–441.

Kenward, R. 1987. Wildlife radio-tagging: Equipment, field techniques and data analysis. Academic, London, United Kingdom.

Muths, E., T. L. Johnson, and P. S. Corn. 2001. Experimental repatriation of boreal toad (*Bufo boreas*) eggs, metamorphs, and adults in Rocky Mountain National Park. The Southwestern Naturalist 46:106–113.

O'Bryan, M. K., and D. R. McCullough. 1988. Survival of black-tailed deer following relocation in California. Pages 230–237 *in* L. Nielsen and R. D. Brown, editors. Translocation of wild animals. Wisconsin Humane Society, Milwaukee, USA.

Plummer, M. V., and N. E. Mills. 2000. Spatial ecology and survivorship of resident and translocated hognose snakes (*Heterodon platirhinos*). Journal of Herpetology 34:565–575.

RATHBUN, G. B., AND T. G. MURPHEY. 1996. Evaluation of a radiobelt for ranid frogs. Herpetological Review 27:187–189.

RATHBUN, G. B., N. J. SCOTT, AND T. G. MURPHEY. 1997. *Rana aurora draytonii* (California red-legged frog). Behavior. Herpetological Review 28:85–86.

REINERT, H. K. 1991. Translocations as a conservation strategy for amphibians and reptiles: some comments, concerns, and observations. Herpetologica 47:357–363.

ROGERS, L. L. 1988. Homing tendencies of large mammals: a review. Pages 76–92 in L. Nielsen and R. D. Brown, editors. Translocation of wild animals. Wisconsin Humane Society, Milwaukee, USA.

UNITED STATES FISH AND WILDLIFE SERVICE. 1996. Endangered and threatened wildlife and plants: determination of the threatened status for the California red-legged frog. Federal Register 61(101):25813–25833.

UNITED STATES FISH AND WILDLIFE SERVICE. 2000. Draft Recovery Plan for the California red-legged Frog (*Rana aurora draytonii*). United States Fish and Wildlife Service, Portland, Oregon, USA.

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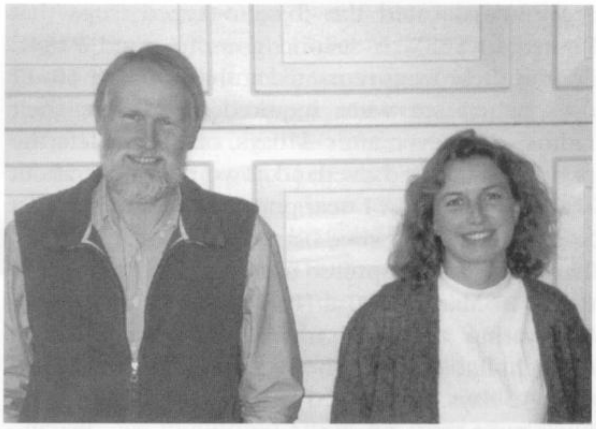

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