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INTRODUCTION

The Dixon Field Station of the U.S. Geological Survey, Biological Resources Division, entered into an agreement with the Natomas Basin Conservancy to study giant garter snakes (*Thamnophis gigas*) in the Natomas Basin area of northern Sacramento County during the 2000 field season. Giant garter snakes are federally and state listed as threatened and, with Swainson's hawks, are the subject of a habitat conservation plan for the Natomas Basin. Our purpose is to develop information on distribution and abundance, habitat use, and demography of giant garter snakes in the Natomas Basin and to help develop strategies to properly manage and conserve giant garter snakes in this part of Sacramento County. We specifically surveyed property recently acquired by the Conservancy for giant garter snakes as well as continuing our assessment of giant garter snakes in other areas of the Natomas Basin. This agreement is a continuation of the giant garter snake project conducted at the Station since 1995. This document is a summary report of our findings for the 2000 field season.

METHODS

Study Sites

Because most lands in the Natomas Basin are privately owned, areas in which we could search for giant garter snakes were limited by specific permission to enter these properties. Our search areas are shown in Figure 1. Landowners associated with Northern Territories, Inc., allowed us access to their lands, principally north of Elverta Road and east of Highway 99. This includes the East Drainage Canal, which George Hanson and John Brode refer to as "snake alley." The Sacramento Metropolitan Airport granted us access to their property and Reclamation District 1000 also granted us permission to access the rest of their drainage canal system.

Capture

Beginning in June we spent considerable effort walking canal and ditch banks searching for giant garter snakes, which were captured by hand or with reptile snares when discovered. As our primary method of snake capture we deployed floating modified minnow traps along edges of ditches, canals, and wetland vegetation to passively trap snakes moving along the edge of these habitats (Casazza et al., 2000). All search and trap locations are shown in Figure 1. Frogs, tadpoles, and fish also caught in these traps may have acted as bait for the snakes. Traps were checked daily for captures from two to six weeks, depending on trapping success. We moved traps to new locations if we caught no snakes in a two-week period. We used global positioning system (GPS) units to determine the geo-coordinates of capture locations with an error of about 5 meters. We also recorded environmental characteristics of the sites of snake captures, such as vegetation and substrate types and ambient temperature.

Measuring and Marking

Each snake was processed as soon as possible after capture to determine weight, total length, snout to vent length, and sex. Taxonomic features were also quantified such as labial scale counts on the head and dorsal scale counts at mid-body. Individuals were implanted with passively induced transponder (PIT) tags for permanent identification. All snakes were released at the point of capture as soon as possible after they were processed.

Mark and Recapture Density Estimates

We made density estimates of snakes for trap lines where we had sufficient recaptures to justify making an estimate. We used the program CAPTURE to make the estimates and standardized results to number of snakes per kilometer of trap line. Each trap line was along a ditch, so we thought a linear index of density was a useful reproducible measure of snake abundance rather than attempt a population estimate based on surface area.

Results

From June through September we captured 48 female giant garter snakes and 33 male snakes, for a total of 81 individuals. Among these were 18 giant garter snakes we had caught and marked in previous study years (1998-1999). The size frequency distributions for the snakes caught in the 2000 field season are shown in Figure 2 and Figure 3. Generally the snakes we caught in 2000 are smaller than in previous years (Wylie et al. 2000), likely because we relied on trapping as our primary capture method compared to years in which we had more field staff and were able to capture larger, more visible snakes by hand. Capture locations are shown in Figure 4. To describe the distribution of giant garter snakes in the Natomas basin we added results from the 2000 field season to our database to illustrate all historical and recent locations of giant garter snakes in the Basin (Figure 5).

Density estimates ranged from 25 to 81 snakes per kilometer (Table 1) at various locals (Figure 6). Density estimates derived from 1999 data are also shown in Figure 5 and Table 1 for comparison to the 2000 locations. Our information shows an apparent shift of giant garter snakes from "snake alley" to ditches along rice fields just to the west, perhaps because of habitat degradation in "snake alley." The southern Bennett and Lucich properties have reasonably high giant garter snake densities judging from our estimates (Figure 6).

We did not find giant garter snakes on the northern Bennett or Lucich properties. To date the southern Bennett and Lucich properties of the NBC' land holdings have verified giant garter snake presence (Figure 7). Because of connectivity of existing ditches and drains there is potential for garter snakes in this area to colonize new habitat as it becomes available. The Betts-Kismat-Silva property has been used historically as upland pasture and presently does not support giant garter snakes. However, giant garter snakes inhabit lands immediately contiguous to this property, and there is potential for snakes to colonize new habitat as it becomes available.

The information on giant garter snakes we have gathered for the last three years will help us assess the status of giant garter snakes in the Natomas Basin as populations change in response to

land use change in the Basin. In some cases development projects in the southern end of the Basin will destroy local snake populations, particularly when there is no avenue of escape from construction activity (Figure 8). In these cases the U.S. Fish and Wildlife Service should be consulted to determine the adviseablity of salvaging these snakes and relocating them in NBC property with suitable habitat where we have not found snakes.

Giant garter snakes were found in ditches with vegetative cover (Figure 9). The only place we found young of the year snakes was in a heavily vegetated ditch. In numerous instances we observed ditch banks scraped bare and ditch vegetation sprayed with herbicide (Figures 10 and 11). As in previous reports we recommend minimum ditch bank maintenance as the least costly and most immediately effective management strategy to benefit giant garter snakes in the Natomas Basin. Given the pace of development in the Basin, the Conservancy should proceed as rapidly as possible enhance the habitat values of their properties for giant garter snakes.

Literature Cited

Casazza, M. L., G. D. Wylie, and C. J. Gregory. 2000. A funnel trap modification for surface collection of aquatic amphibians and reptiles. Herpetological Review 31(2), 91-92.

Wylie, G. D., and M. L. Casazza. 2000. Investigations of giant garter snakes in the Natomas Basin: 1998-1999. Final report to the U.S. Fish and Wildlife Service. USGS-BRD, Dixon, CA.

Tables and Figures

Table 1. Trap line coordinates with corresponding density estimates (snakes/km).

Trap line	Density	Easting	Northing	Year
T5	40.6	623382	4291801	2000
T6	31.9	624964	4291859	2000
T17	25.3	625484	4284003	2000
T21	81.4	627619	4287532	2000
T23	25.5	628597	4287127	2000
T16	19.0	624823	4283748	1999
T17	8.6	625481	4283821	1999
T21	72.0	627528	4287549	1999
T22	106.9	627820	4286891	1999
T23	43.0	628588	4286818	1999
T24	56.3	629172	4287585	1999
T27	14.3	630232	4286635	1999

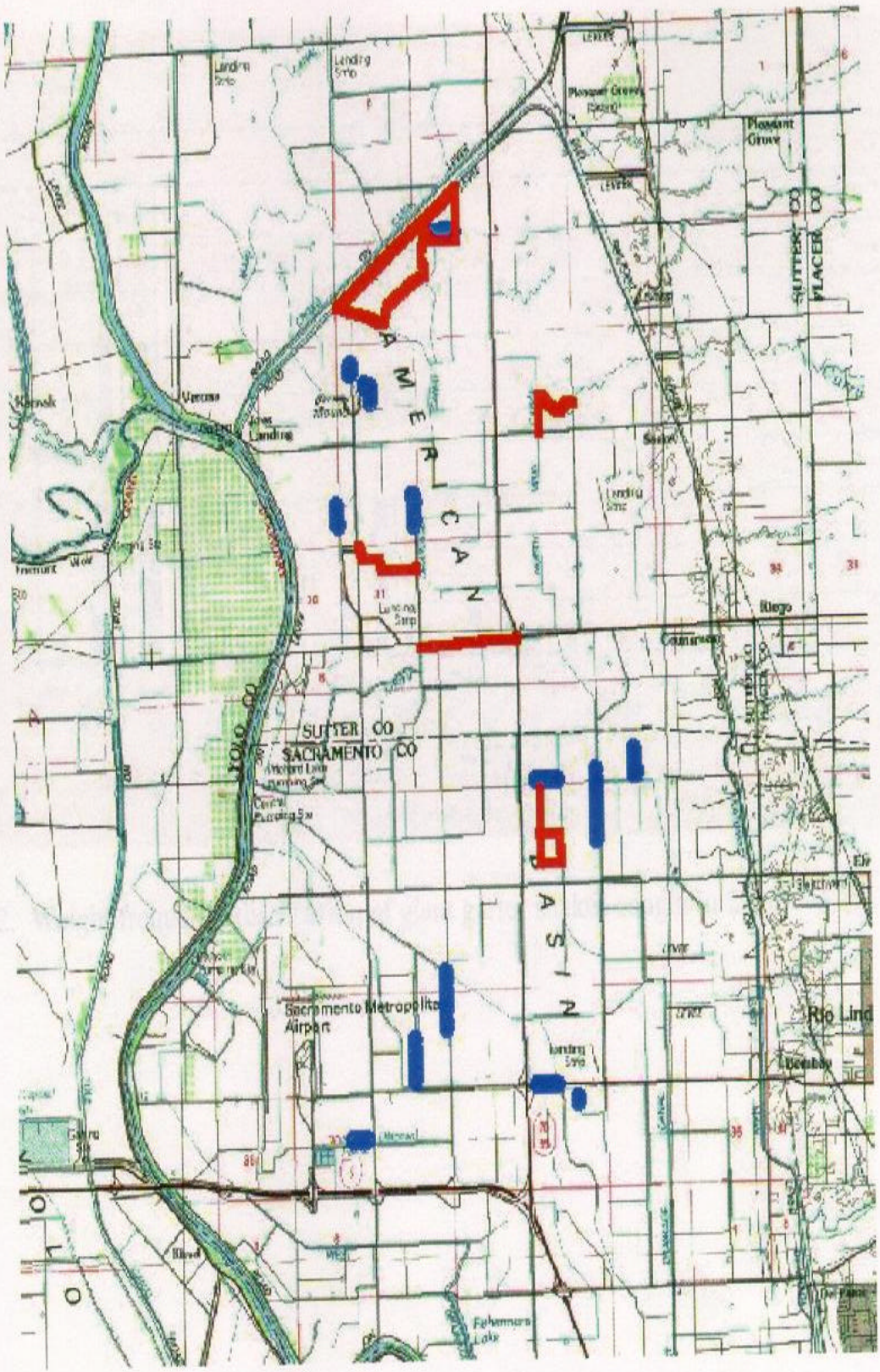


Figure 1. Search areas in 2000. Red denotes areas searched on foot and blue denotes trap lines.

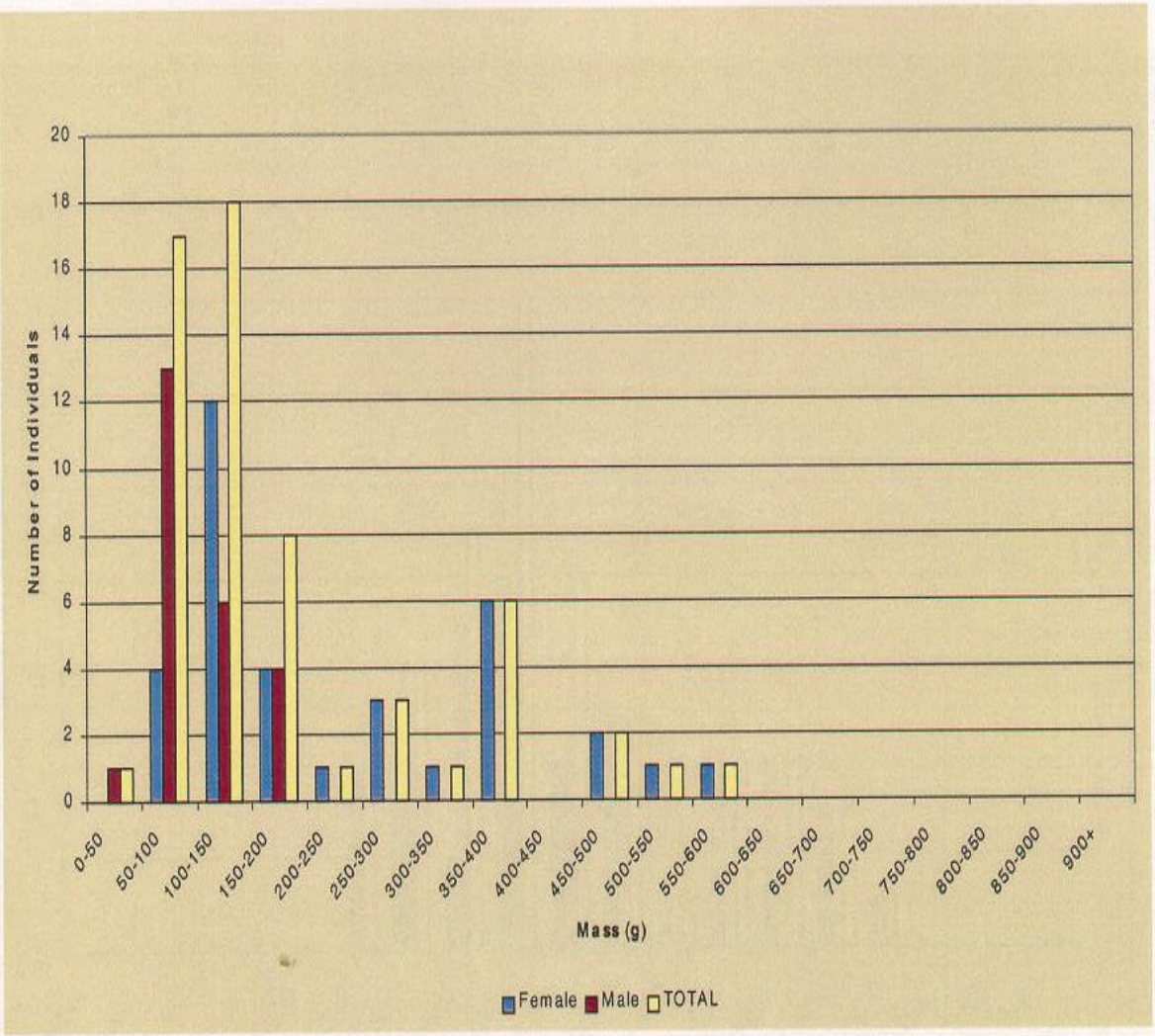


Figure 2. Weight frequency distribution of giant garter snakes caught in 2000.

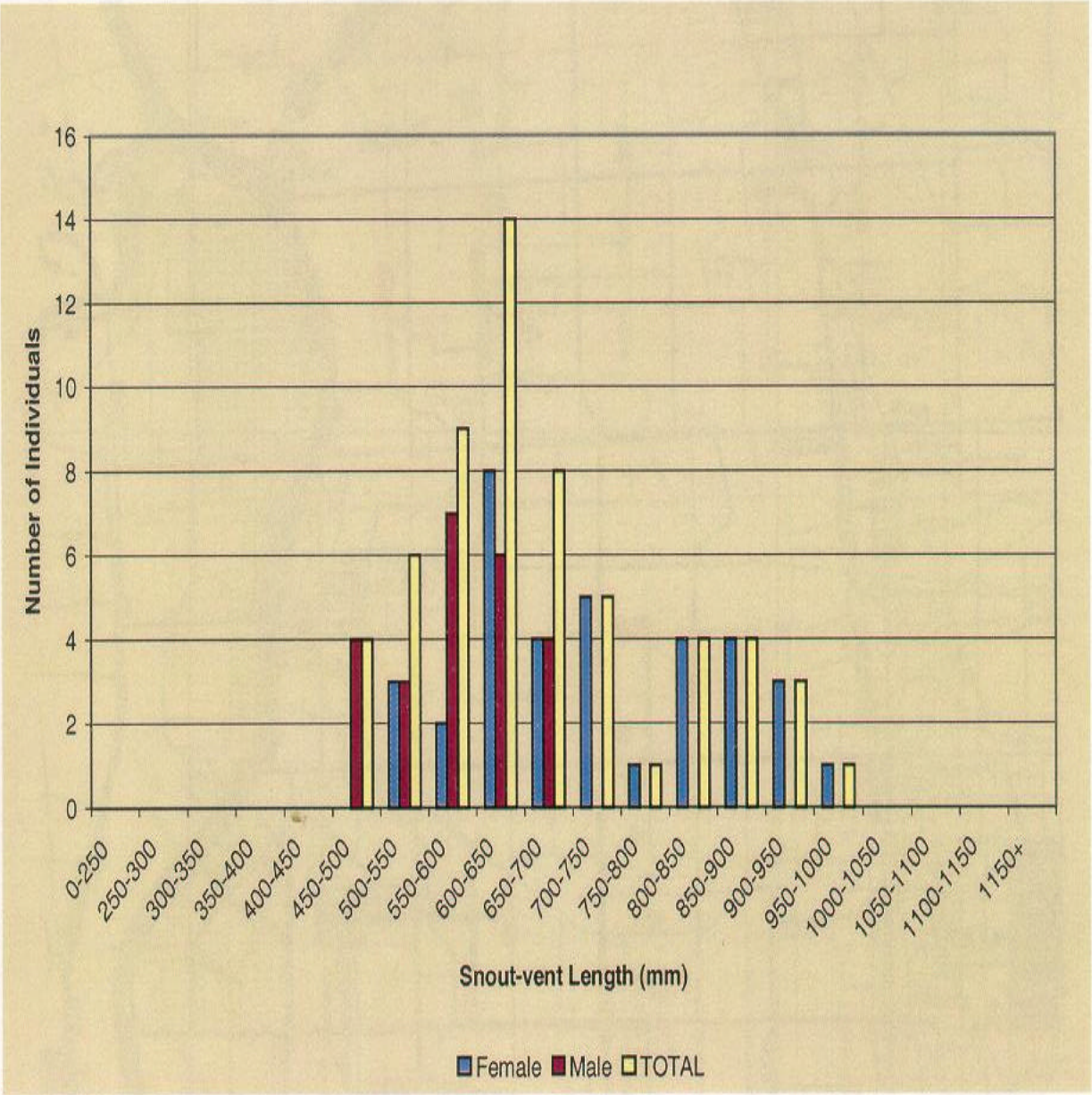


Figure 3. Length frequency distribution of giant garter snakes caught in 2000.

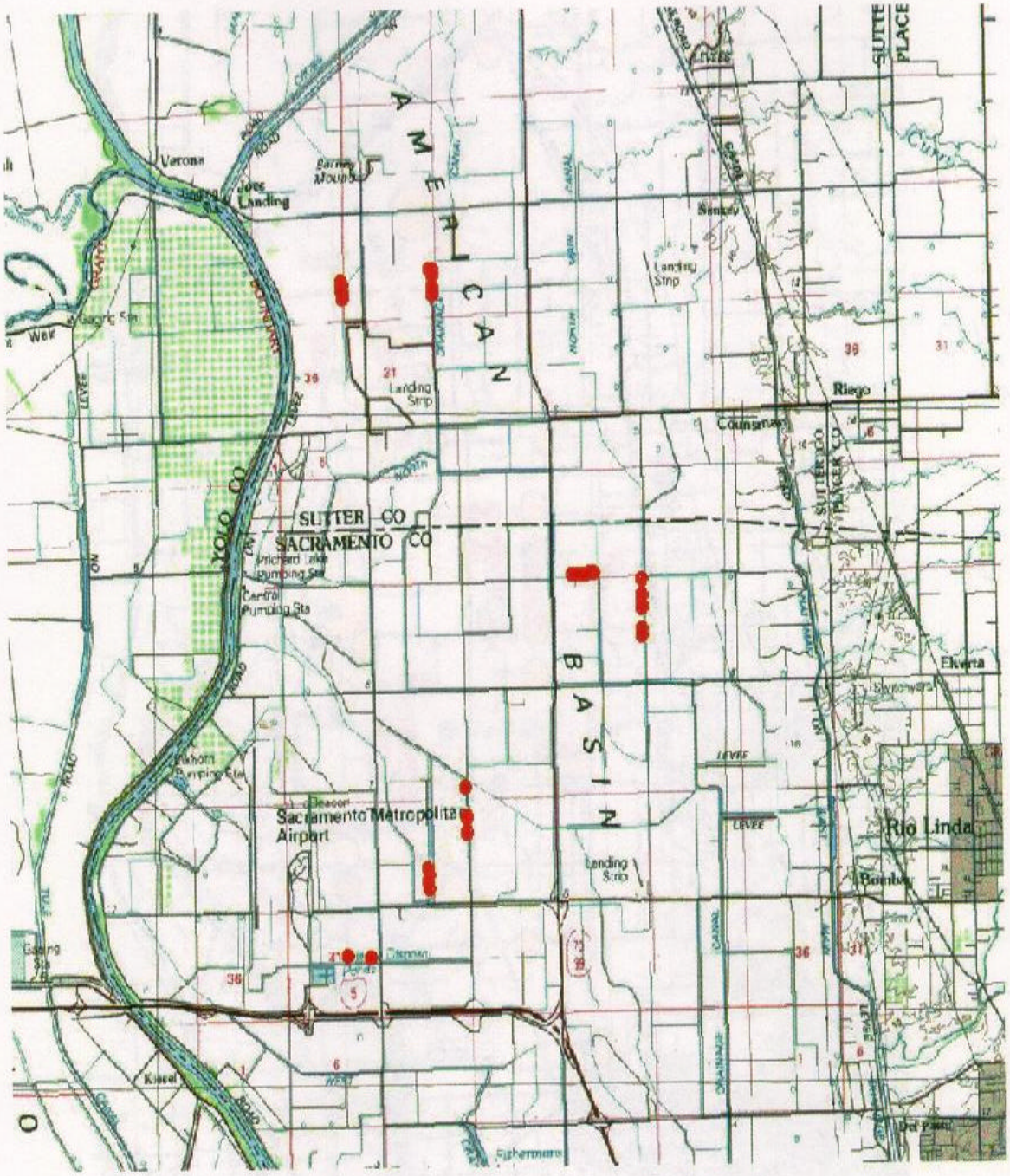


Figure 4. Capture locations for giant garter snakes in 2000.

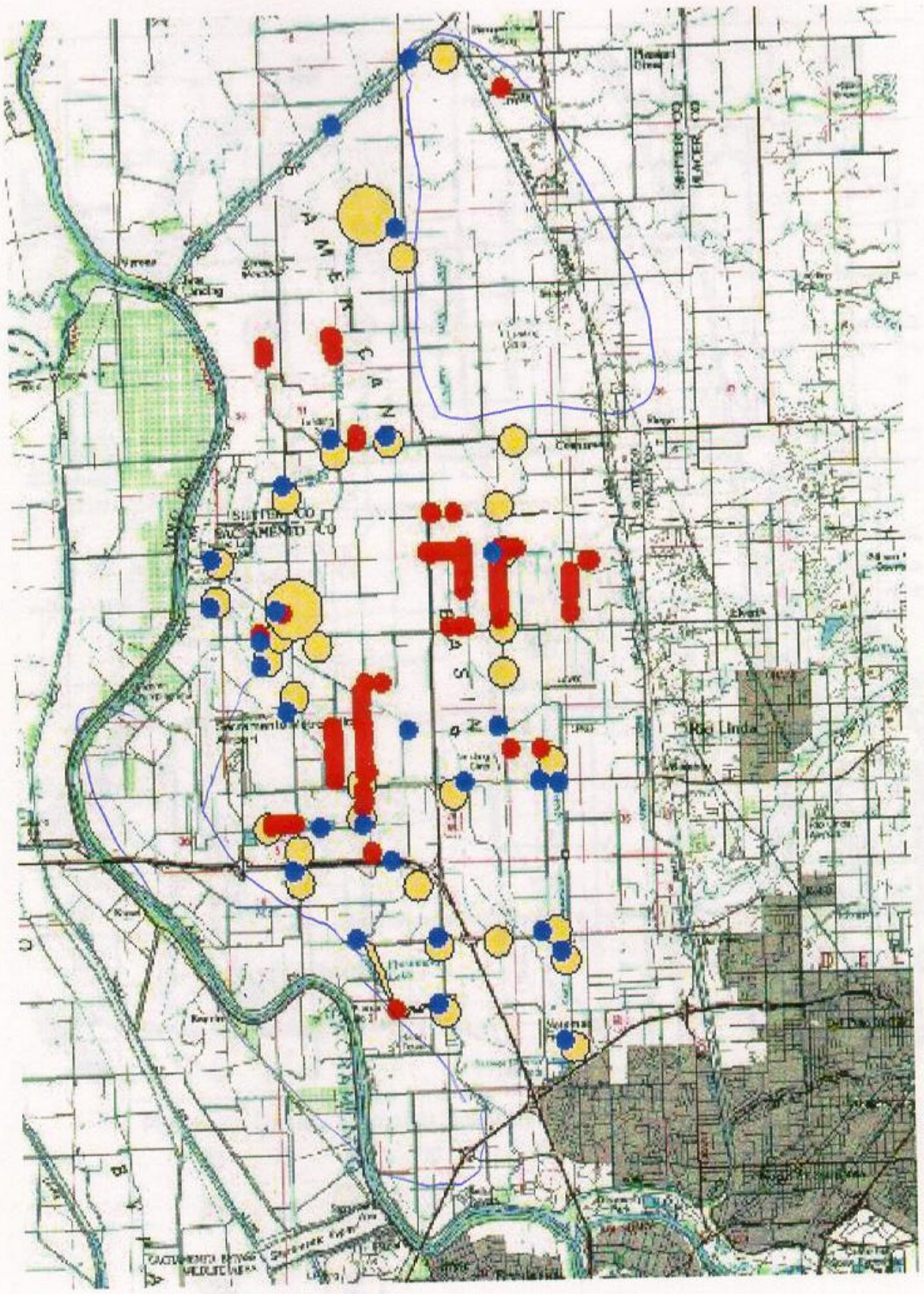


Figure 5. Historical and recent locations of giant garter snakes in the Natomas Basin. Yellow circles are from the NDDB (size indicates uncertainty), blue circles are from George Hansen's records, and red circles are from USGS surveys from 1998-2000.

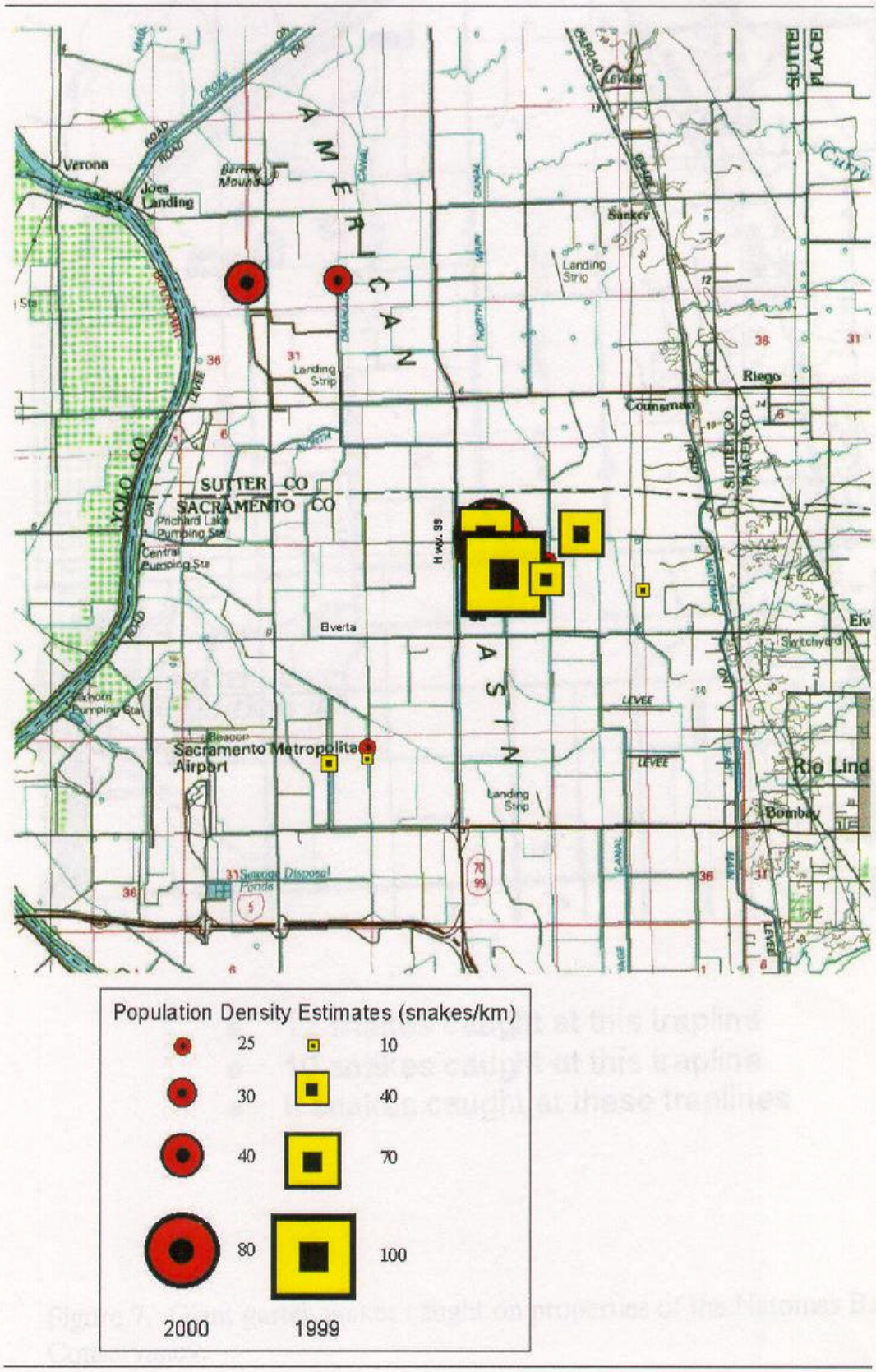
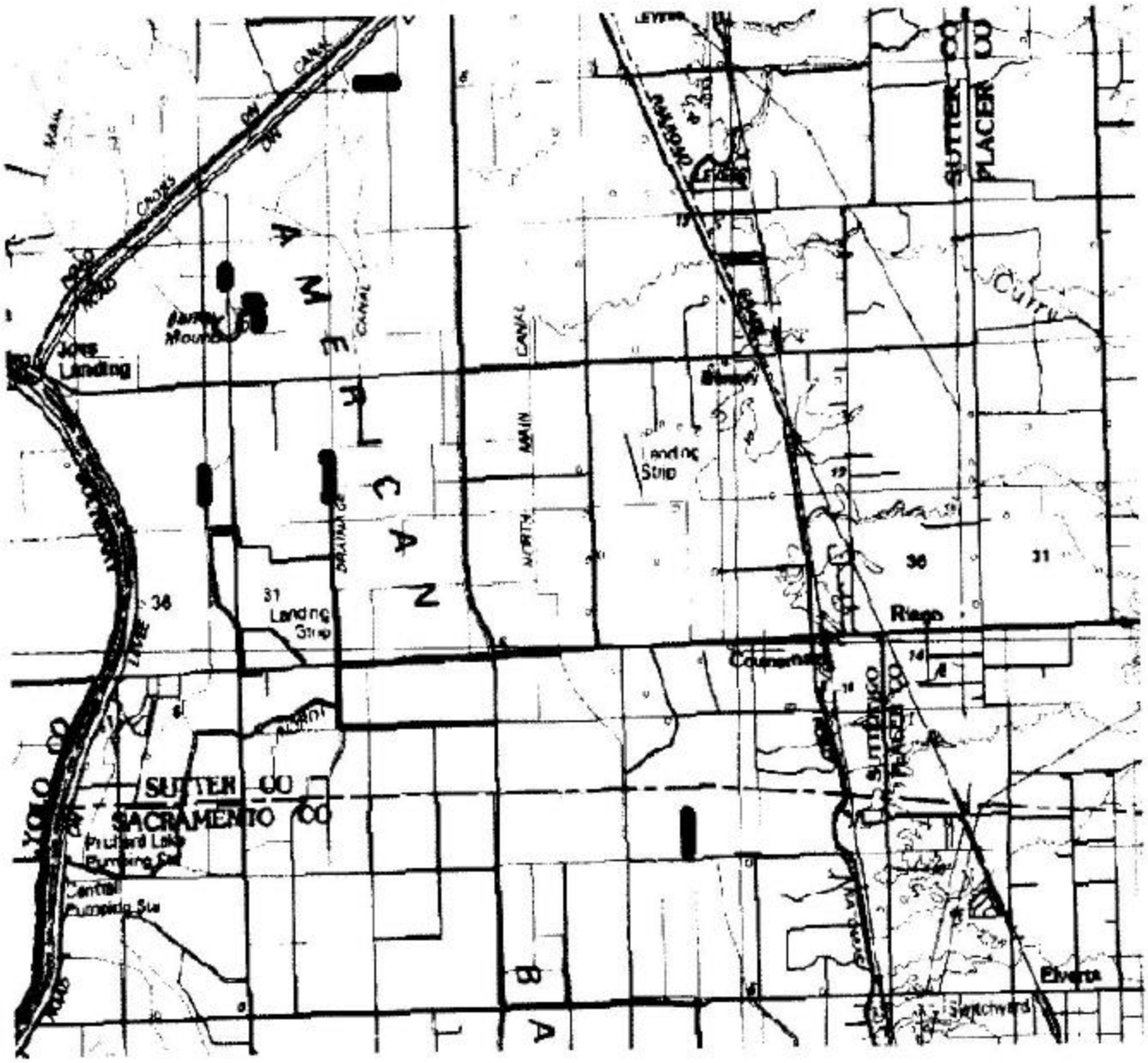


Figure 6. Density estimates of giant garter snakes for trap lines in which we had sufficient recaptures to make an estimate.



- 12 snakes caught at this trapline
- 10 snakes caught at this trapline
- 0 snakes caught at these traplines

Figure 7. Giant garter snakes caught on properties of the Natomas Basin Conservancy.

Figure 8. A main ditch near El Centro dried for construction with no escape for snakes.

Figure 9. Examples of habitat in which we found giant garter snakes in the Natomas Basin.

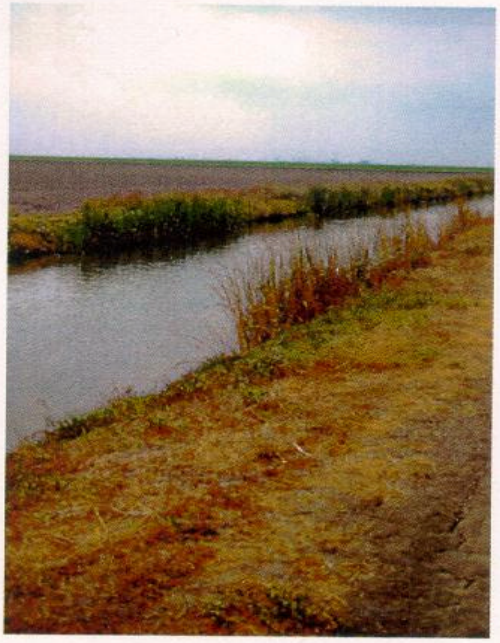


Figure 10. Sprayed vegetation.

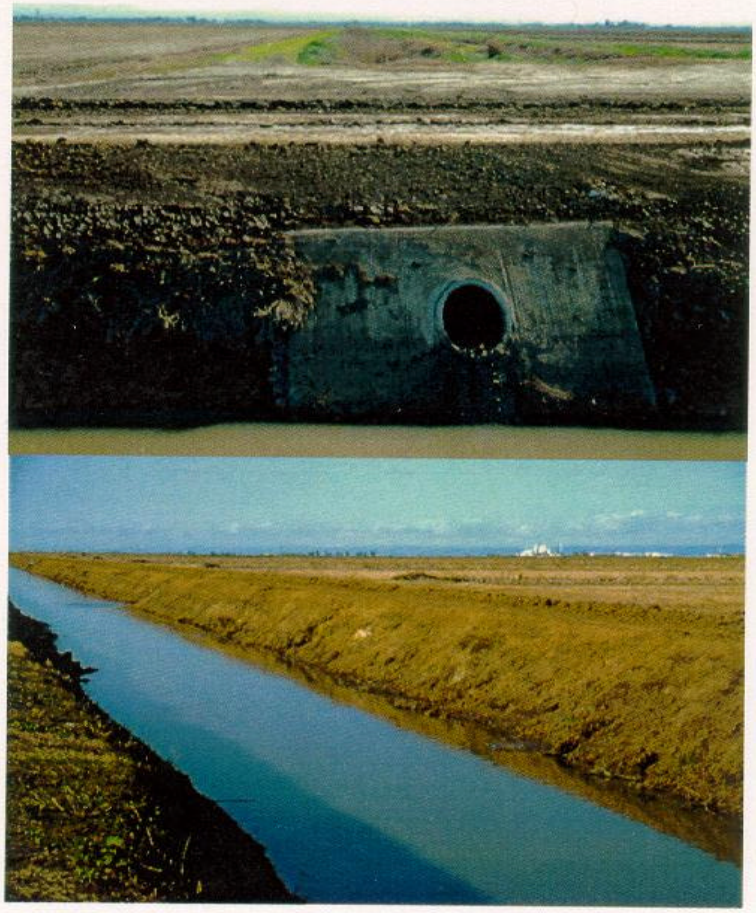


Figure 11. Ditch banks and tops scraped bare.