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Introduction

Giant garter snakes (*Thamnophis gigas*) are both federally and state listed as a threatened species and as such there is a desire to increase their populations so that they may eventually be delisted. In 1998 the USFWS Sacramento National Wildlife Refuge Complex was awarded a grant from the CVPIA B1(other) funds to purchase agricultural lands adjacent to the Colusa National Wildlife Refuge and create wetland habitat that would specifically benefit the population of giant garter snakes on the refuge. Construction of these wetlands was completed in fall 1999. In 2000 the USGS-BRD Dixon Field Station was awarded CVPIA B1(other) funds to monitor giant garter snakes in these wetlands as they develop over time and assess their habitat benefits for giant garter snakes with the goal of adaptively managing these wetlands to benefit this species.

The Dixon Field Station has been conducting research on the life history and habitat use characteristics of giant garter snakes since 1995, work originally initiated by the now defunct National Biological Service. We studied giant garter snakes at the Colusa National Wildlife Refuge in 1996 and 1997 (Wylie et al. 1997). We have extensively marked snakes on this refuge and in the total course of our work we have developed protocols for trapping snakes as well as capturing them by hand. We are also monitoring giant garter snakes in the Natomas Basin area of northern Sacramento County (Wylie et al. 2000). This report summarizes our progress in the first year of our monitoring study for giant garter snakes at Colusa National Wildlife Refuge.

Goals and Objectives

The goals of our project is to assess the benefits of the restored wetland habitat for giant garter snakes at Colusa NWR and develop a site-specific management plan for giant garter snakes based on our observations. Our objectives are 1) document the phenology of snake colonization of the restored habitat, 2) evaluate habitat use in the restored habitat, and 3) estimate the densities of giant garter snakes in the restored habitat and compare them with estimates from other habitats.

Methods

We sampled giant garter snakes by hand captures and trapping as developed in our previous work (Casazza et al., 2000). We focused our search in and around the restoration site and on the main canal north of the intersection of Able and Ohm roads (Figure 1). This search area has the highest concentration of snakes based on our previous work and is the most pertinent to colonization and use of the restored habitat. Captured snakes were measured for length and weight and their sex was determined using sexing probes. Individuals were scanned to detect PIT tags implanted in previous studies and previously unmarked snakes were implanted with PIT tags. The program CAPTURE was used to estimate densities of snakes per linear distance along the ditches we trapped based on mark-recapture information.

Ten large (>300 g) female snakes were implanted with radio transmitters and were released after recovery from surgery in June. Their movements were monitored daily with hand-held and vehicle mounted telemetry units (White and Garrott, 1990). Habitats used by relocated snakes were characterized according to our protocols. Home range estimates for radio-implanted snakes were calculated with the adaptive kernal method of Worton (1989).

Results and Discussion

We caught 81 giant garter snakes of which 28 were male and 53 were female. Of these individuals 35 were caught by hand and 46 were caught in traps. Capture locations are shown in Figure 2. Individuals ranged up to a meter in length and 650 grams in weight (Figure 3). The size distribution shown in Figure 3 indicates a healthy population of giant garter snakes with successful recruitment of the young. Density estimates for the canal to the north of the restoration site and to the west of the restoration site are shown in Table 1.

Analysis of movements showed home ranges that varied from 1-35 ha with an average of 18 ha (Table 2). These estimates of home range are generally smaller than estimates we previously derived at Colūsa, Gisizer Slough, and the Natomas Basin. We think that maintaining water in the ditches and in nearby habitat, including the restoration area was effective in meeting the habitat needs of the snakes so they did not have to venture as far as in previous years to find habitat during the drier conditions that used to prevail during the summer on the Colusa NWR. This reduced movement also means snakes were less exposed to mortality factors such as predators and vehicles. Movements of individual snakes are shown in Figures 4-13. These movements show both a fidelity to refuge habitats and at least initial use of the restoration area (Figure). Three of our radio-marked giant garter snakes were observed using newly created habitat in the restoration area. One snake was even seen using a tule clump soon after it was placed by Refuge staff in a restored wetland to provide an vegetative habitat in the midst of open water. One individual, however, was killed by a predator (likely an otter) shortly after it was released with its radio implan.

Cover classes for habitats used by giant garter snakes are shown in Figure 14. Snakes were generally in or on the edge of ditches and wetlands and almost always used vegetative cover. Half of our observations of radio-marked snakes showed exclusive use of aquatic vegetation, 16% of observations showed exclusive use of terrestrial vegetation and 28% of observations showed use of a mix of aquatic and terrestrial vegetation. Although riprap accounts for only 1% of our observations, the riprap habitat at the intersection of Able and Ohm roads is extremely valuable as an over-wintering site for giant garter snakes.

Because of a delay in funding for 2000 we implanted only 10 giant garter snakes with radios in the 2000 field season. These radios also had a shorter battery life than the ones we had planned on using, and all 10 radios ceased to function by October. We received the long-lived radios we had originally intended to use at the end of summer, and have

them ready to use in the 2001 field season. We plan to radio-mark all snakes in the 2001 field season with these radios which will last up to two years.

Results of our 2000 field season show a healthy population of giant garter snakes in the vicinity of the restoration project. The potential for colonization and use of the restored habitat is great because of the immediate proximity of these snakes and the initial use of parts of the restored habitat by some of our radio-marked snakes. We have been successful in marking giant garter snakes and establishing base-line estimates of snake densities to monitor the effect the restored habitat will have on giant garter snake numbers on the Colusa National Wildlife Refuge in succeeding years as the restored habitat matures. The habitat measurements we are making will help us to devise a habitat management plant for the Refuge staff in procedures to further enhance habitat values for giant garter snakes on the Refuge and hopefully increase their population size.

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.

Worton, B. J. 1989. Kernal methods for estimating the utilization distribution in home range studies. Ecology 70(1): 164-168.

White, G. C. and R. A. Garrott. 1990. Analysis of wildlife radio-tracking data. Academic Press, San Diego, CA. 383 pp.

Wylie, G. D., M. L. Casazza, and J. K. Daugherty. 1997. 1996 progress report for the giant garter snake study. USGS, Dixon Field Station, Dixon, CA.

Wylie, G. D., M. L. Casazza, L. Martin, and E. Hansen. 2000. Investigations of giant garter snakes in the Natomas Basin: 2000 field season. Dixon Field Station, Dixon, CA.

Tables and Figures

Table 1. Density Estimates for Colusa 2000 in number of snakes per linear distance of ditch.

Trap line along ditch	Density (#/km)
North of restoration	104
West of restoration	53

Table 2. Home range sizes by radio frequency for radio-marked giant garter snakes at Colusa National Wildlife Refuge in the 2000 field season.

Frequency	Home Range Size (ha)
4314	35
4336	3.7
4354	33.3
4374	17.2
4395	28.5
4445	1
4464	33.2
4485	1.1
4505	9.3
4414	Mortality
Average	18

Figure 1. Traps deployed for giant garter snakes.

USGS

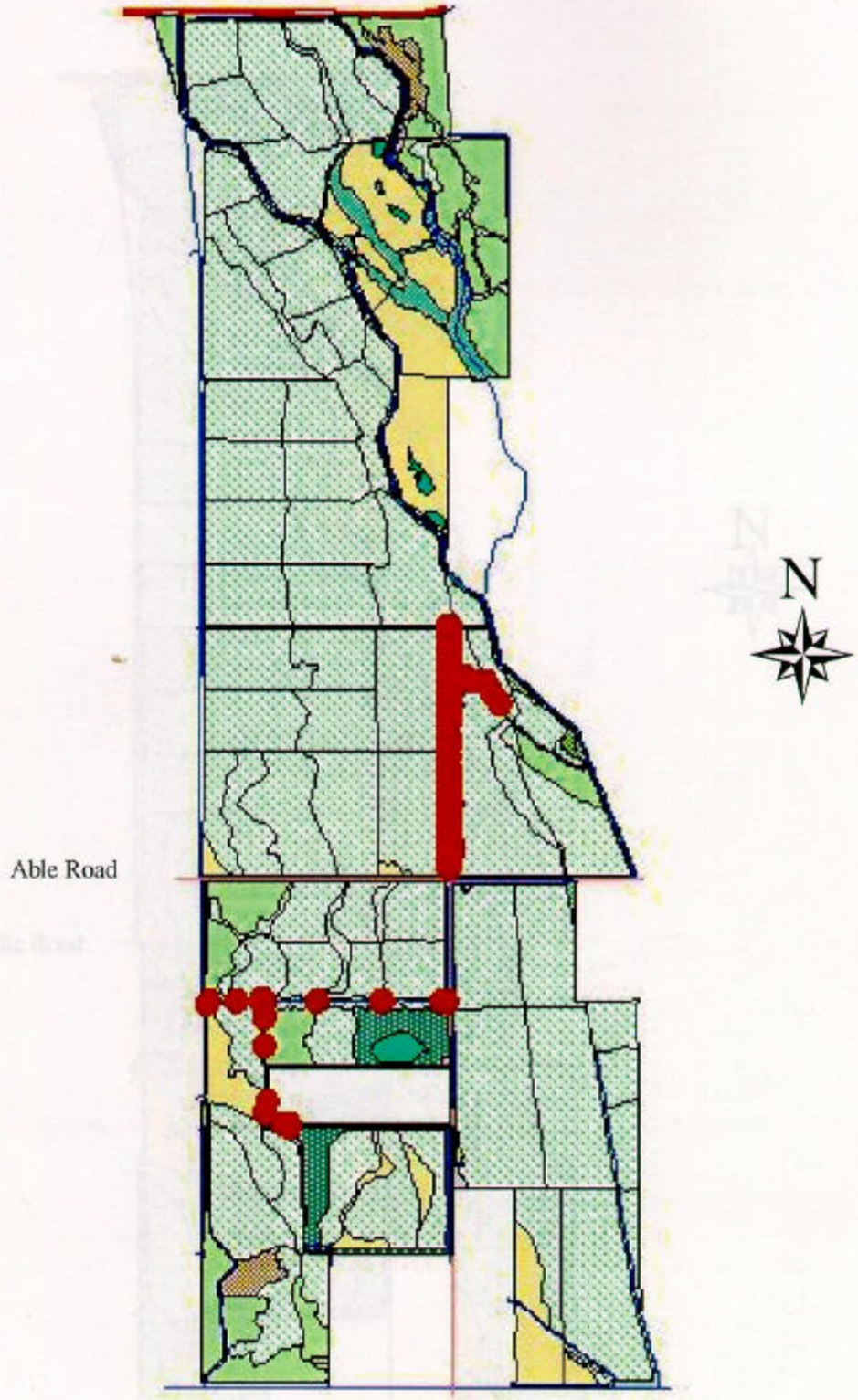


Figure 2. Trap locations for giant garter snakes at Colusa National Wildlife Refuge, 2000 field season.

USGS

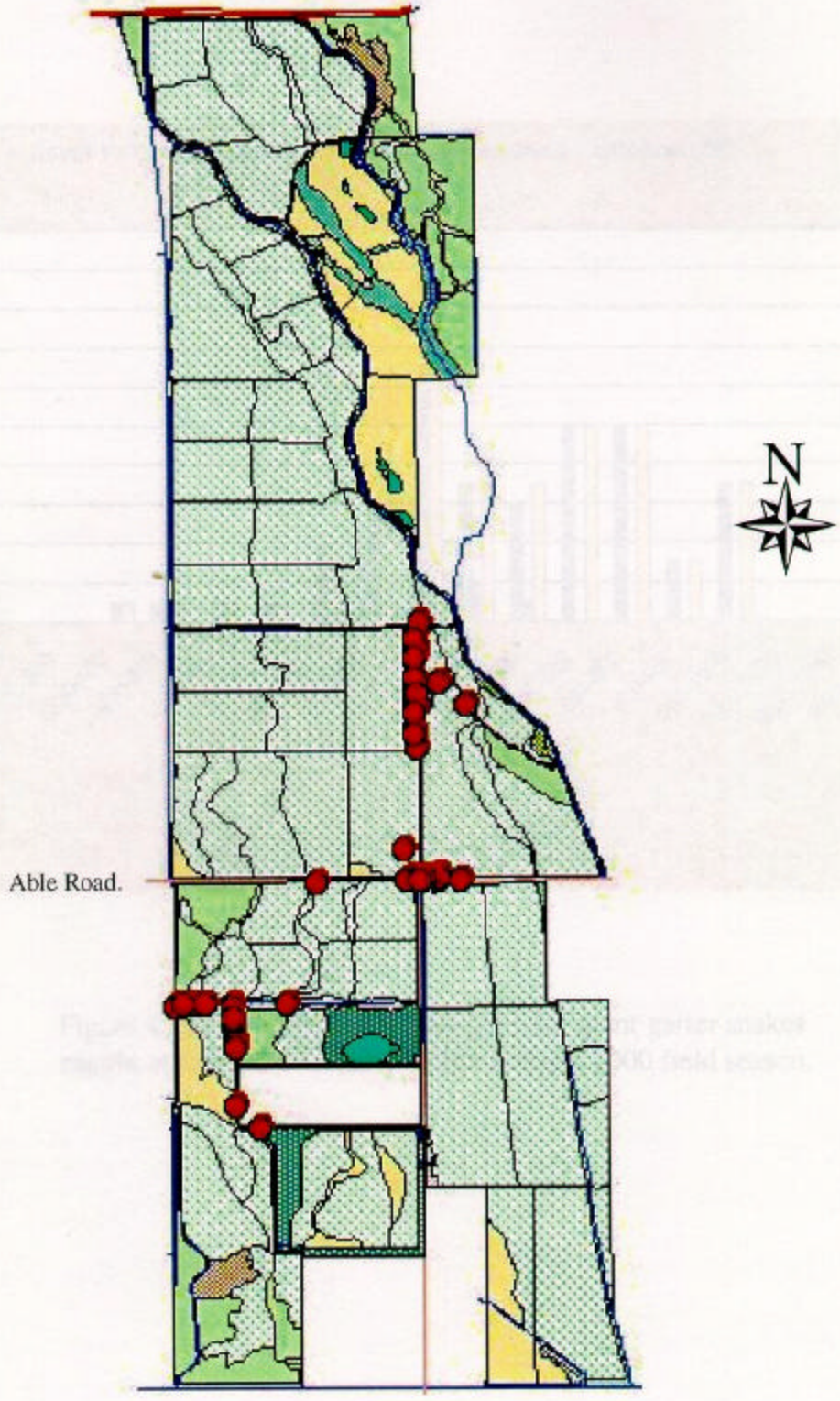


Figure 3. Capture locations of giant garter snakes at Colusa National Wildlife Refuge, 2000 field season.

USGS

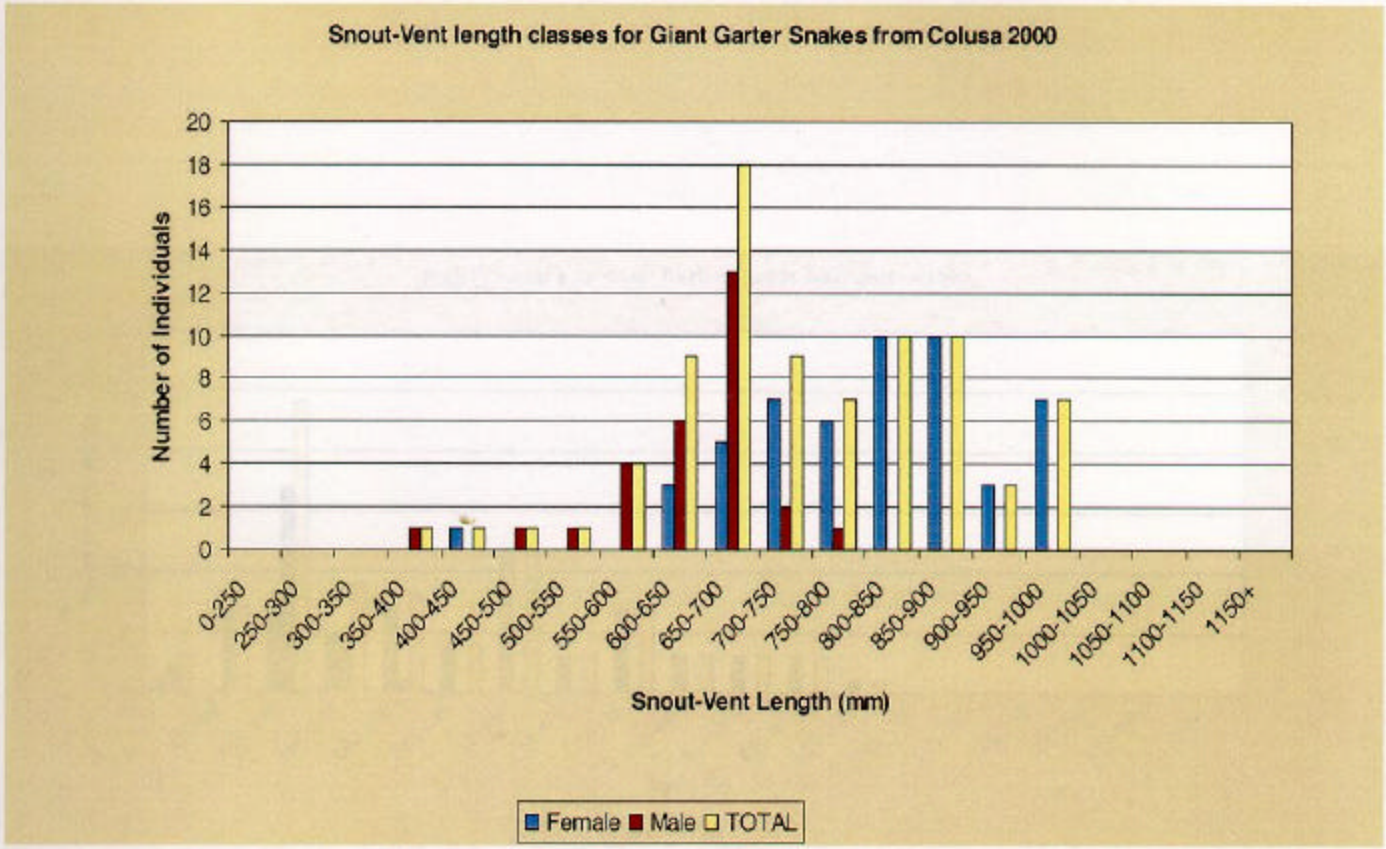


Figure 4. Length frequency histogram for giant garter snakes caught at Colusa National Wildlife Refuge, 2000 field season.

USGS

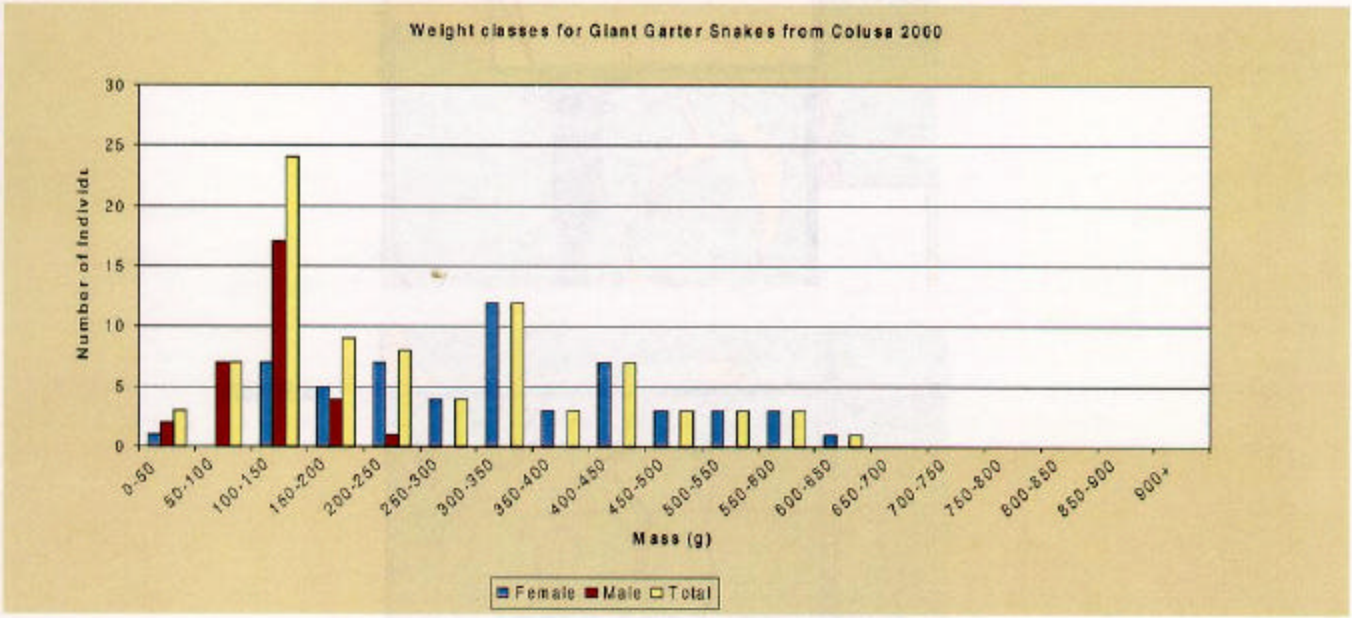


Figure 5. Weight frequency histogram for giant garter snakes caught at Colusa National Wildlife Refuge, 2000 field season.

USGS

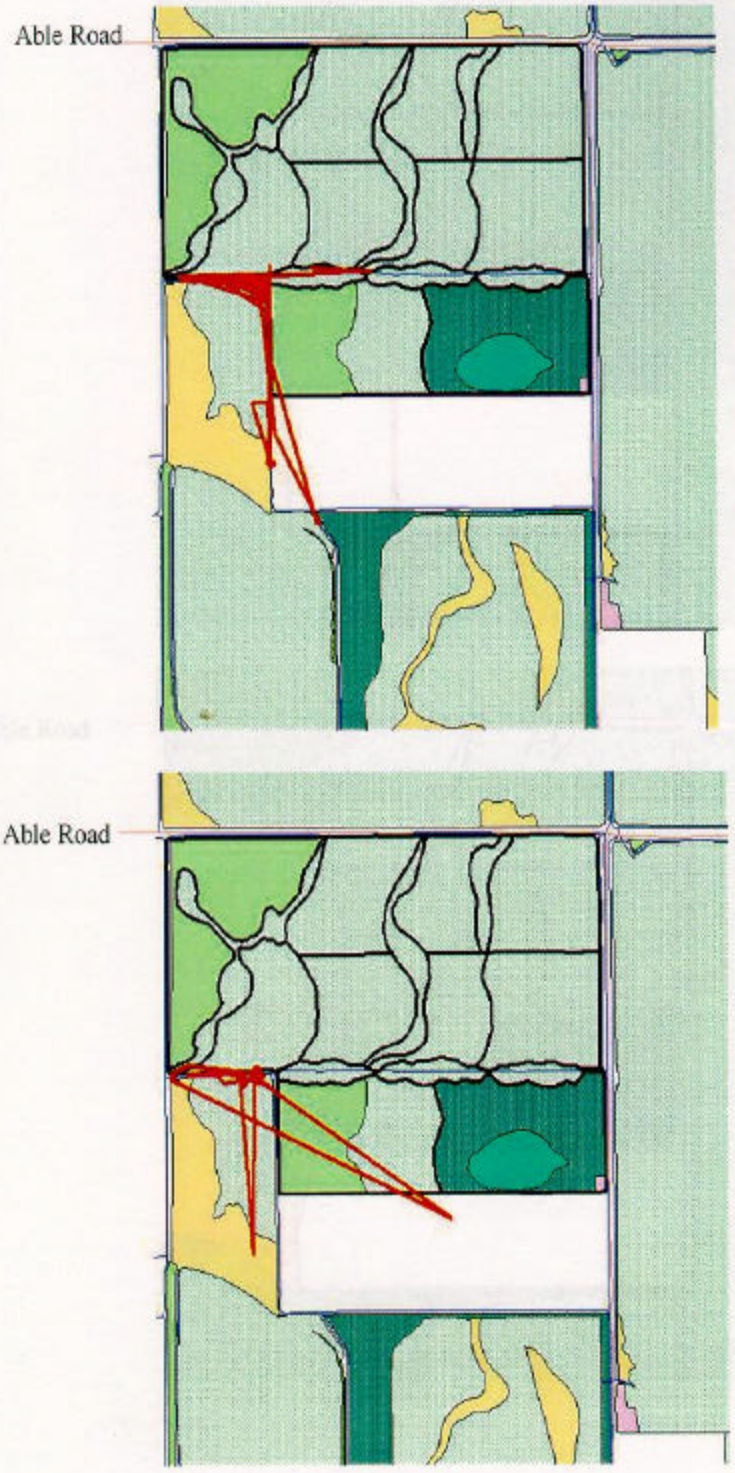


Figure 6. Movements of giant garter snakes at Colusa National Wildlife Refuge, 2000 field season. Radio frequency 4314 at top and 4336 at bottom.

USGS

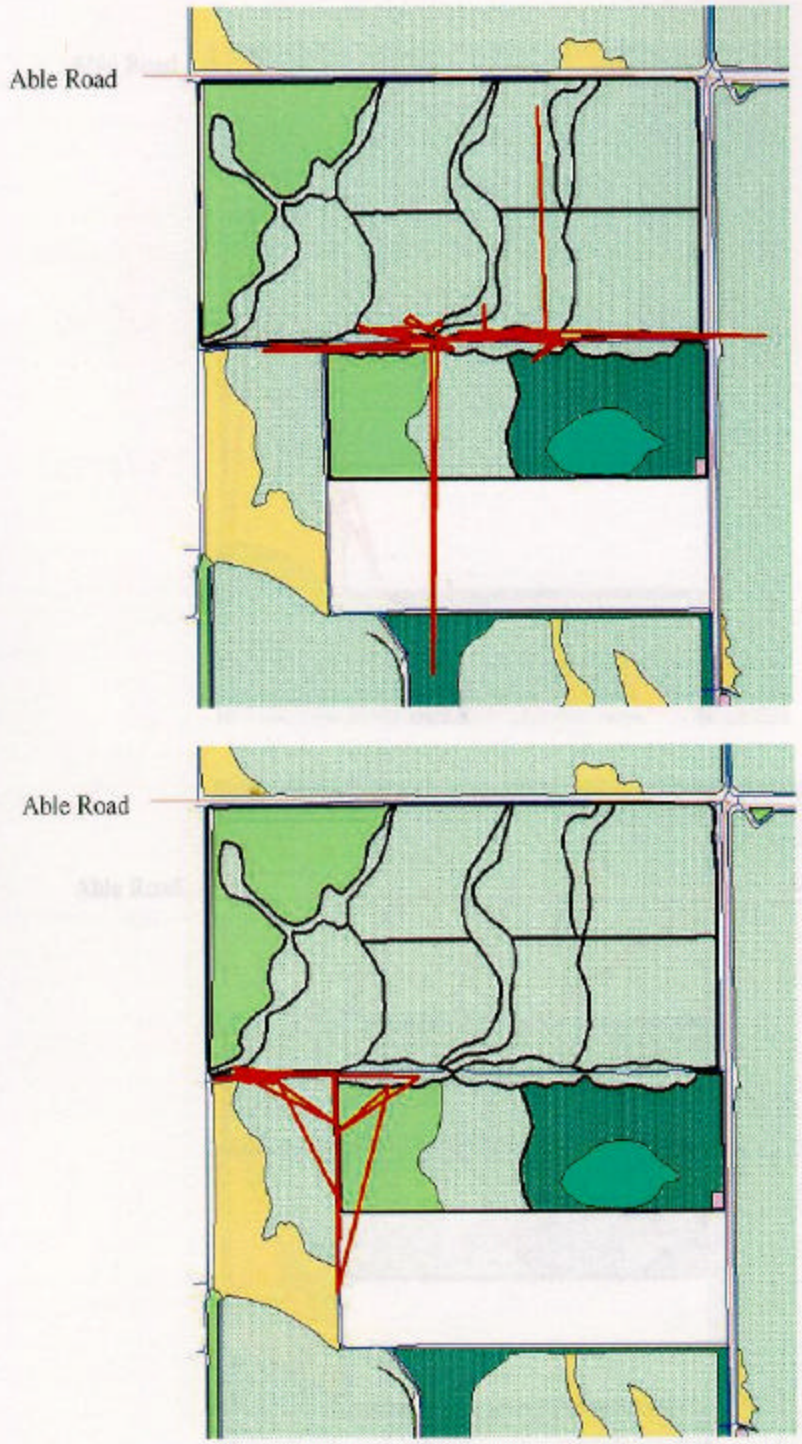
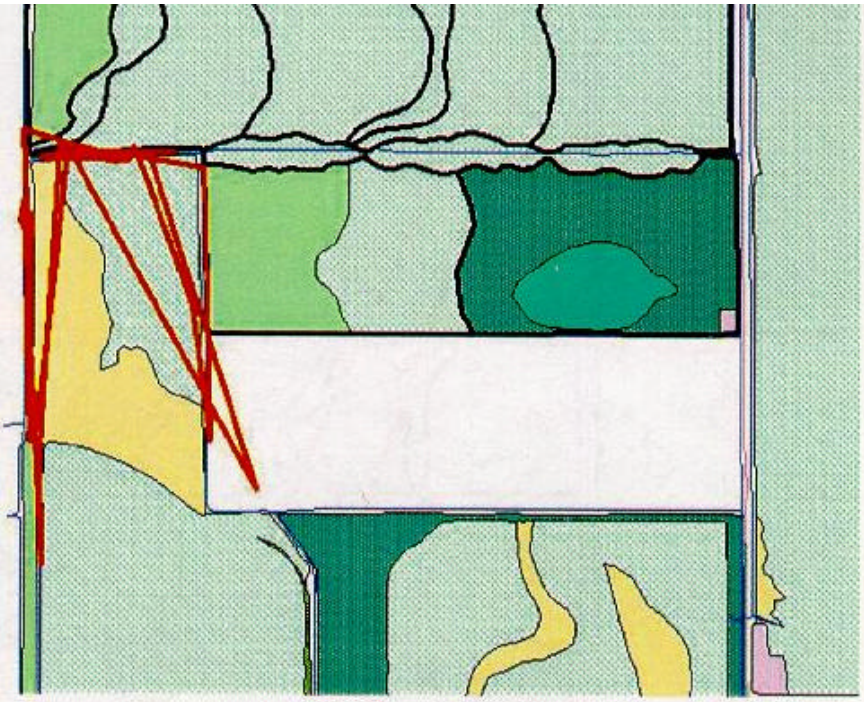
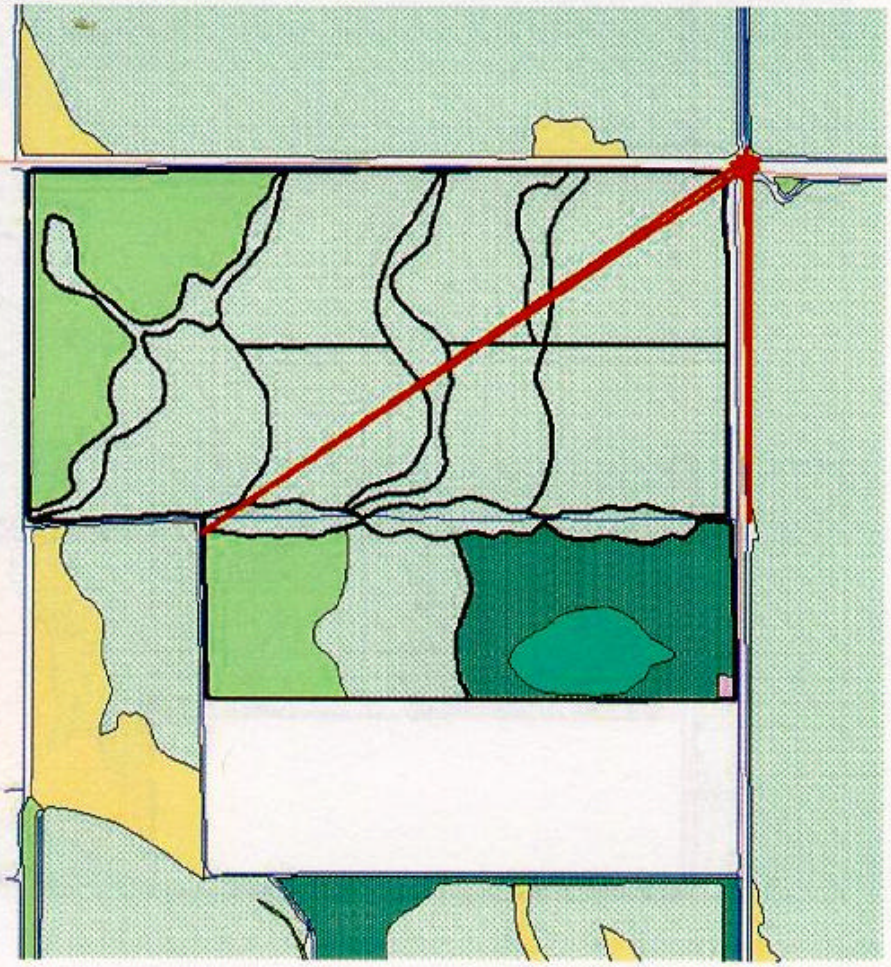


Figure 7. Movements of giant garter snakes at Colusa National Wildlife Refuge, 2000 field season. Radio frequency 4354 top and 4374 bottom.

USGS




Able Road

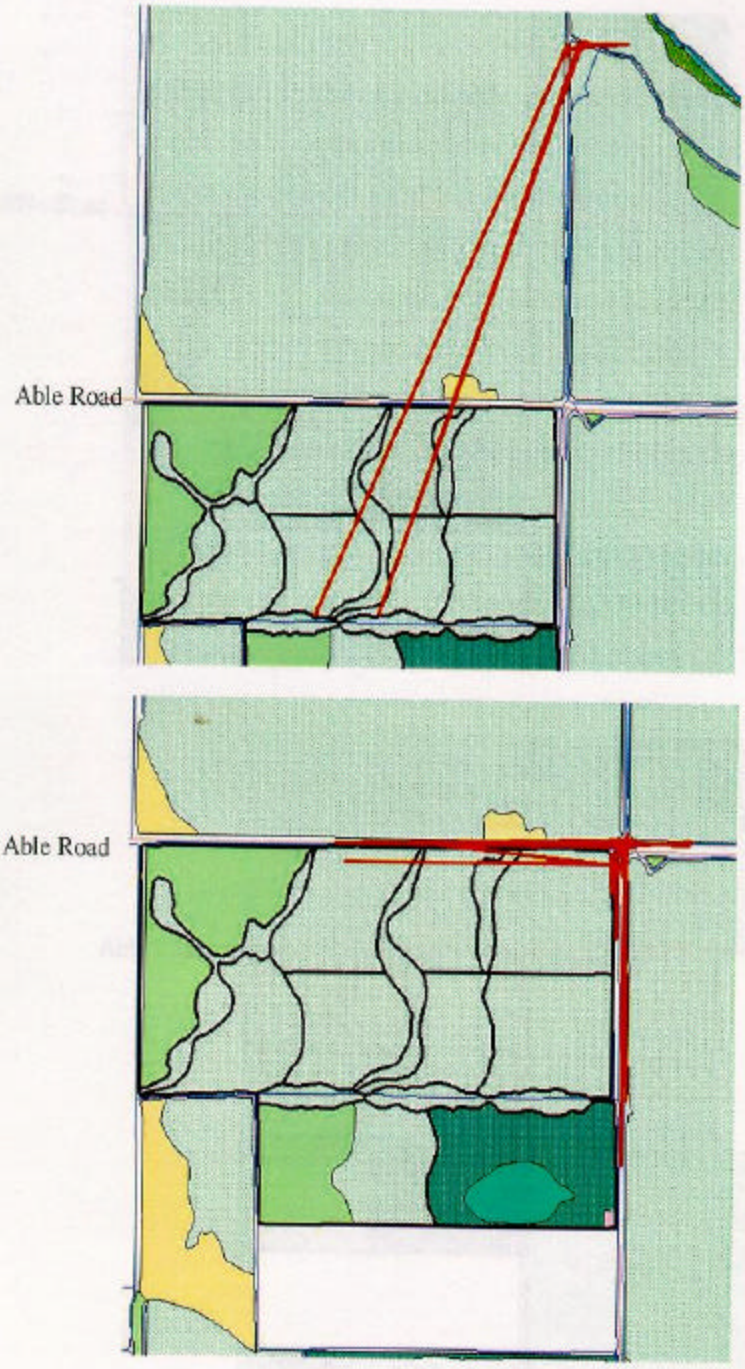


Figure 9. Movements of giant garter snakes at Colusa National Wildlife Refuge, 2000 field season. Radio frequency 4445 top and 4464 bottom.

USGS

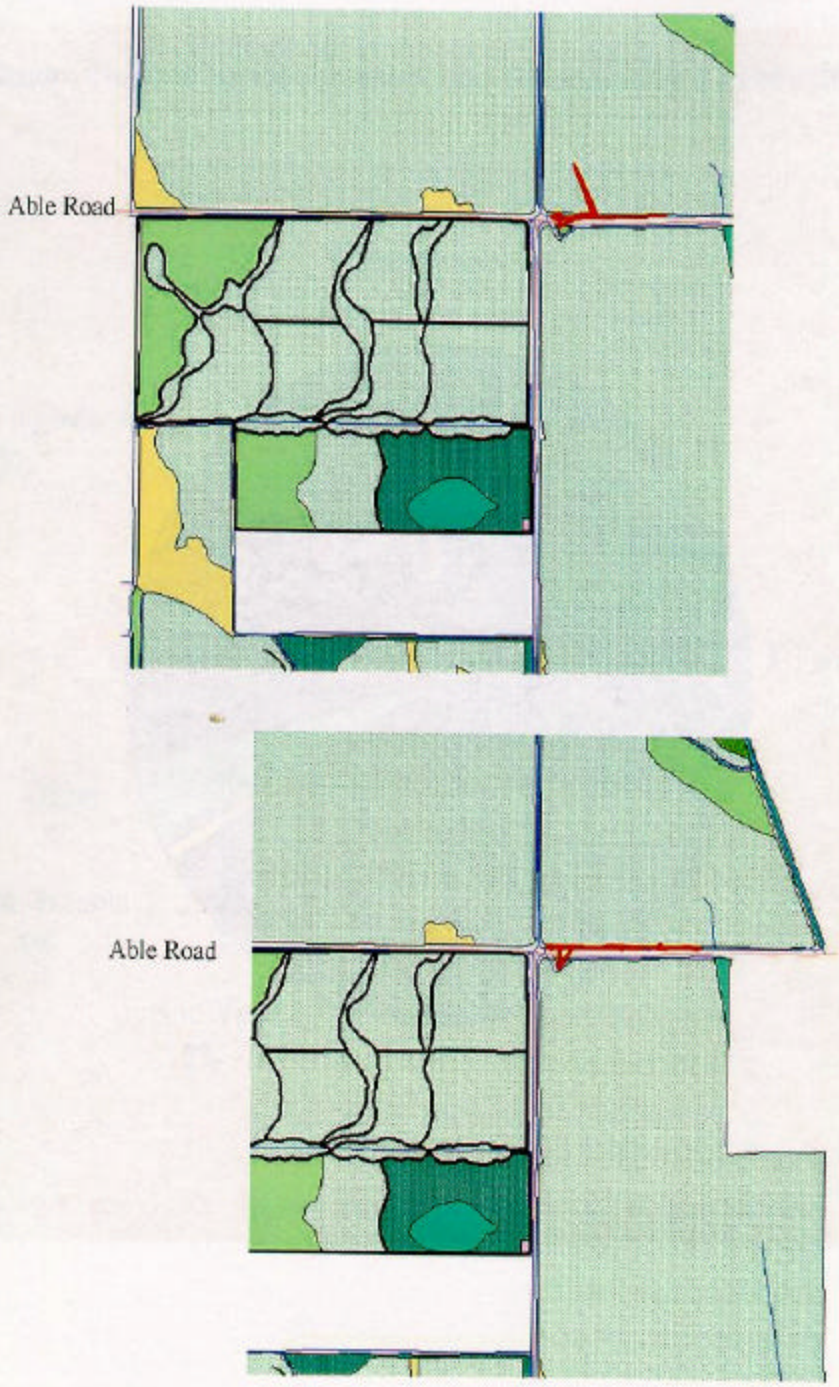


Figure 10. Movements of giant garter snakes at Colusa National Wildlife Refuge, 2000 field season. Radio frequency 4485 top and 4505 bottom.

USGS

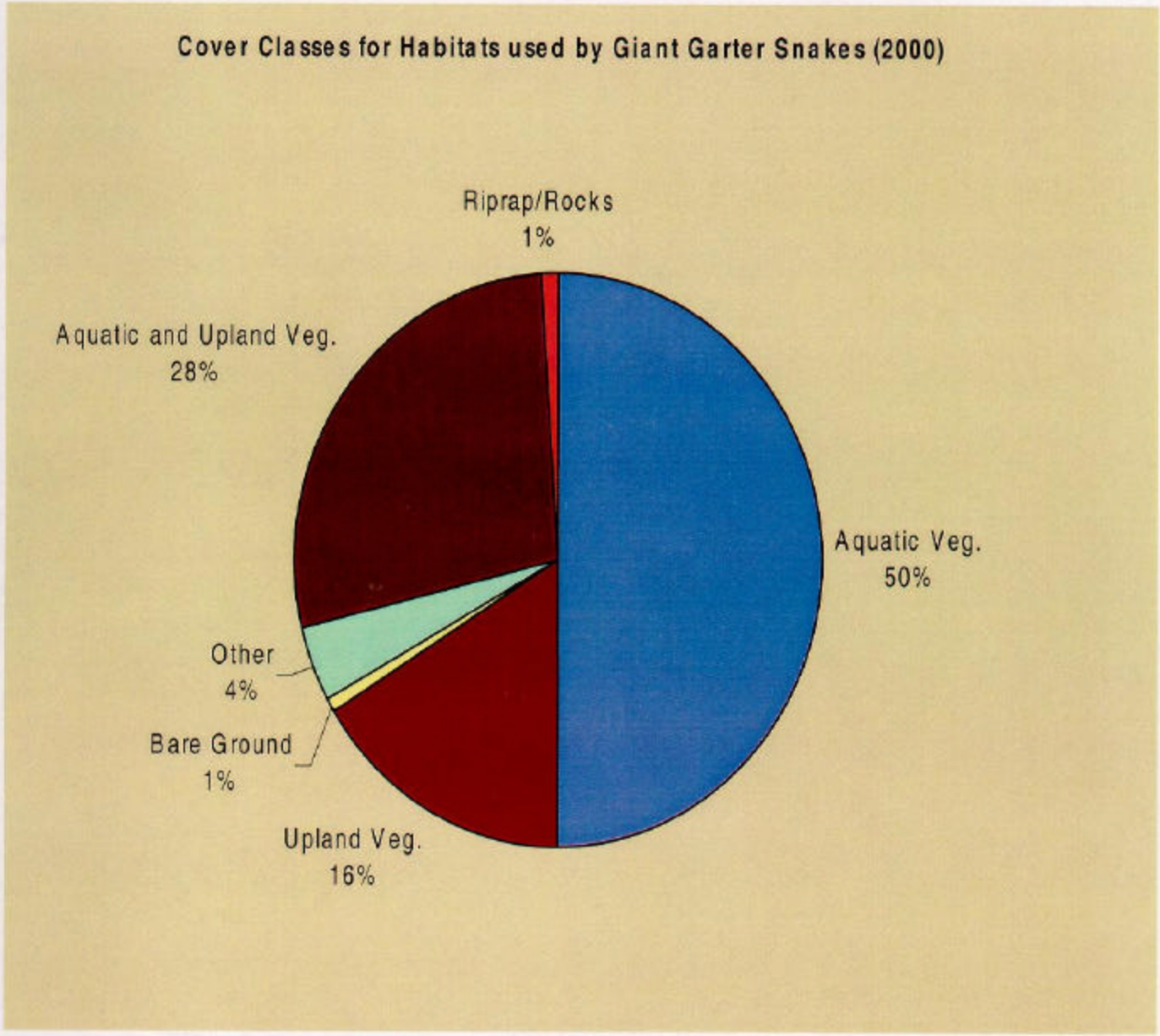


Figure11. Cover classes used by radio-marked giant garter snakes at Colusa National Wildlife Refuge, 2000 field season.

USGS