1996 Progress Report for the Giant Garter Snake Study *

Prepared by

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INTRODUCTION

The National Biological Survey (NBS, later named National Biological Service) initiated a study of the life history and habitat use of the giant garter snake (*Thamnophis gigas*) in April 1995. The giant garter snake was listed as a threatened species by the state in 1971 and by the U.S. Fish and Wildlife Service in 1993. This snake is endemic to wetlands of the Central Valley and its populations have likely declined markedly from historic levels as over 95% of California's wetlands have been lost or converted in the last century. In 1994 an interagency team submitted "The Implementation Plan for the Giant Garter Snake Habitat Conservation Plan" to the NBS for consideration as an NBS Ecosystem Initiative. The major focus of the Implementation Plan was that the recovery of this species requires better scientific understanding of its life history and habitat requirements, particularly in developing viable habitat conservation plans. The NBS study in response to the Implementation Plan continues into 1997 under the auspices of the Biological Resources Division of the U.S. Geological Survey into which the NBS was legislatively transferred. This is a progress report for the U.S. Fish and Wildlife Service. This report discusses the progress of our study from spring 1996 into the winter of 1997.

STUDY AREAS

In 1996 we continued studying giant garter snakes at the Gilsizer Slough site where our 1995 field work was begun. We also initiated studies at the Colusa National Wildlife Refuge, Colusa County, after Refuge personnel alerted us to the possibility of snakes there. In addition, we eventually found giant garter snakes at the Badger Creek area (Sacramento County) of the Cosumnes River Nature Preserve after failing to find them earlier in the field season near Preserve headquarters farther downstream in the Cosumnes River drainage. We also surveyed some rice fields near the Butte Sink, Butte County, and failed to find giant garter snakes there. Therefore, our main 1996 study areas were Gilsizer Slough and Colusa National Wildlife Refuge, with a partial field season at Badger Creek (Figure 1).

METHODS

Capture

Beginning the first of April we spent considerable effort walking canal and ditch banks and searching areas with riprap looking for basking and mating snakes. Snakes discovered during theses searches were caught by hand and with reptile snares. We also deployed floating modified minnow traps along edges of ditches, canals, and marsh vegetation to passively trap snakes moving along the edge of these habitats. Frogs, tadpoles, and fish also caught in these traps may have acted as bait for the snakes. Traps were checked daily for captures. We used encrypted global positioning system (GPS) units to determine the geocoordinates of capture locations with an error of 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, sex, scale counts on its head and mid-body, and other physical features such as scars and tumors. We clipped ventral scales both to identify individuals and to archive tissue for future genetic analysis. Individuals were also 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 except for those who were selected for telemetry.

Telemetry

Larger individuals (generally over 200 grams for females and over 150 grams for males) were chosen to be implanted with radio transmitters for telemetry study. We used an eight-gram transmitter in the larger female snakes and a four-gram transmitter in males and smaller females. Signal pulse rates of both kinds of radios indicated temperature of the given snake. Surgery to implant radios in these snakes was done at the Wildlife Health Center, ITEH, University of California. Davis, by Lindsay Phillips, DVM. After recovery of ten days to two weeks, radio-implanted snakes were returned to the study areas at their point of capture.

Hand-held and vehicle-mounted telemetry systems were used to located snakes. For two occasions in which we could not located some snakes on the ground, we used aircraft to find them. Geocoordinates of all positive snake locations were recorded with GPS units. When we could not access areas occupied by radio-implanted snakes, we estimated their locations by triangulation. Snakes were monitored daily with a goal of obtaining at least two locations each week in each of five time periods throughout the daylight hours. Where possible, we recorded surrounding environmental characteristics of each positively identified snake location.

RESULTS

Populations

In 1996 we captured 66 giant garter snakes at Gilsizer Slough (not previously caught in 1995), 46 at Colusa NWR, and 36 at Badger Creek. In addition we saw 79 giant garter snakes at Gilsizer and 94 at Colusa that we did not capture. Captures at Gilsizer and Colusa began in March and became infrequent after June. Captures at Badger Creek began in June when we started trapping at this site; captures became infrequent after mid-July. Of those we captured at Gilsizer Slough 32% were caught by hand and 68% by trap. At Colusa NWR, 78% were caught by hand and 22% by trap. At Badger Creek all were caught by trap. The ratio of females to males was approximately 1:1 at the Gilsizer and Badger Creek sites and roughly 2:1 at Colusa. The higher proportion of females at Colusa was likely because traps were difficult to deploy there and most captures depended visual sightings of the larger snakes which tend to be female. Females attain greater size than males (Figures 2 and 3) and are thicker for their length than males.

Movements and Habitat Use

Most radio-marked snakes moved little from day to day, but total activity during the course of telemetry of individuals varied widely. At Colusa NWR, for example, snakes moved up to 8 km in a few days in response to dewatering of their habitat on the Refuge while maintenance was done on water control structures (Figure 4). Wintering locations of radio-marked snakes tended to be in the vicinity of where they were originally caught in spring (Figures 5 and 6).

At Gilsizer Slough snakes used canal, marsh, and rice habitat similar to use we recorded in 1995 (Figure 7). In summer, rice was used during 20% of our observations of telemetered snakes, generally after rice had grown to full size. Marsh habitat and canals were used during 23% and 50% of our observations, respectively. Twelve of twenty-two telemetered snakes (55%) used rice fields at some time at this site. One rice field snakes used in 1996 was a tomato field the previous year, showing their ability to exploit newly created habitat connected to existing habitat. Overwintering sites varied from canal banks to marsh locations. Although water was high, flooding was not extensive at this site during January.

At Colusa NWR snakes used rice fields during summer for 19% of our observations, marsh habitat for 20%, and canals for 56% of our observations (Figure 8). When most of this area dried during August two radio-marked snakes continued to use the marsh areas even after they were dry. Eleven of twenty-three telemetered snakes (48%) used rice fields at some time at this site during summer. Overwintering sites of radio-implanted snakes were generally near sites of original capture and generally consisted of burrows and rip rap along canals. During extensive flooding of January four snakes moved immediately from their flooded burrows into nearby tules. Two radio-implanted snakes were positively located in burrows under ground under water for the duration of flooding, but did move out of these burrows after the flooding subsided.

At Badger Creek marshes and the adjacent uplands were the only habitats available to snakes. The four radio-implanted snakes at this site used the marsh edge most of the time, but two individuals used burrows up to 50 meters away from the marsh edge as refuge from periods of extreme heat in August. Three of these snakes used the rip rap of the railroad bed that bisects this site as their overwintering habitat; the other snake moved into a burrow on a hill 250 meters from the marsh near the railroad to overwinter (Figure 9). All overwintering locations were in the higher elevations of the study area and were above the highest water of the January floods. One snake moved into tules in the marsh from the railroad bed in response to the flood event of late January.

OBSERVATIONS

Because we added two new study areas at Colusa NWR and Badger Creek to our Gilsizer site we caught and observed many more giant garter snakes in 1996 than we did in 1995. With increased numbers of observations at different locations comes additional information on the behavior of these snakes. For example:

Use of dry habitat --

At Colusa NWR two snakes continued to used marsh habitats after they were dried. Two snakes at Badger Creek moved out of the wetland to spend weeks at a time in burrows in the surrounding pasture to escape the extreme heat of August.

Response to flooding --

Flooding during January also gave us new information on how these snakes respond to inundation of winter habitats. We observed two snakes that survived days of inundation in burrows, probably using air pockets in the burrows. Although snakes were displaced from their overwintering sites at Colusa, the only mortality was two weeks later when one of them was killed by a predator. The remaining telemetered snakes survived even the below freezing weather of February in the marsh habitat they occupied subsequent to flooding. The same is true at Badger Creek for the one snake that moved into the marsh in response to flooding there.

Overwintering --

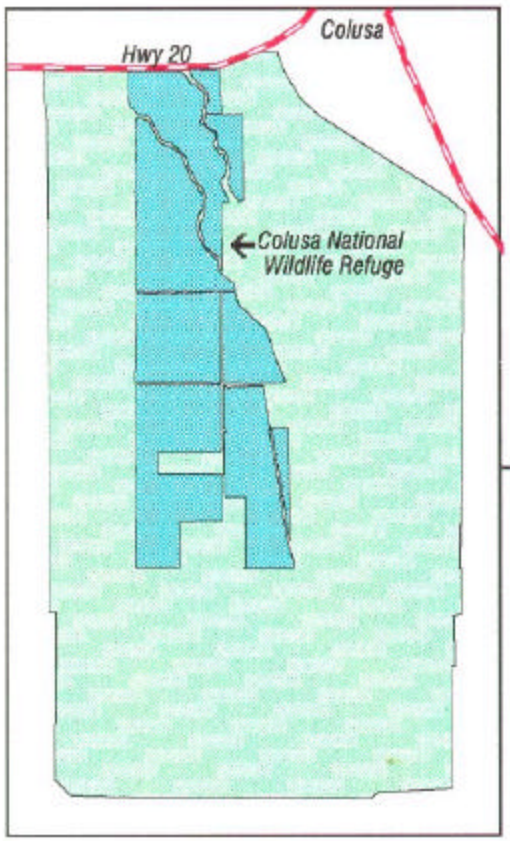
These snakes do not hibernate in winter as much as decrease movements in response to weather. From about mid-October to late November they individually seek habitats where they will be protected from weather extremes and predation during winter, but they are not immobile during winter; they apparently do not "den" with each other. Of our telemetered snakes 50% were seen outside of wintering habitat (burrows, rip rap, etc.) basking or moving a small distance during winter. Almost all telemetered snakes had documented movements during winter. Two snakes at Gillsizer were seen several times a short distance outside their burrow during cloudy cold days in winter with no other factors such as high water to explain their emergence. The four telemetered snakes at Badger Creek selected overwintering sites at the highest part of the landscape: the railroad bed. Snakes at Gilsizer overwinter in the wetland area even though the Sutter Bypass levee adjacent to this site is much higher. Little high ground exists at Colusa for overwintering, but telemetered snakes survived flooding there and were not displaced from the study area.

Mortality --

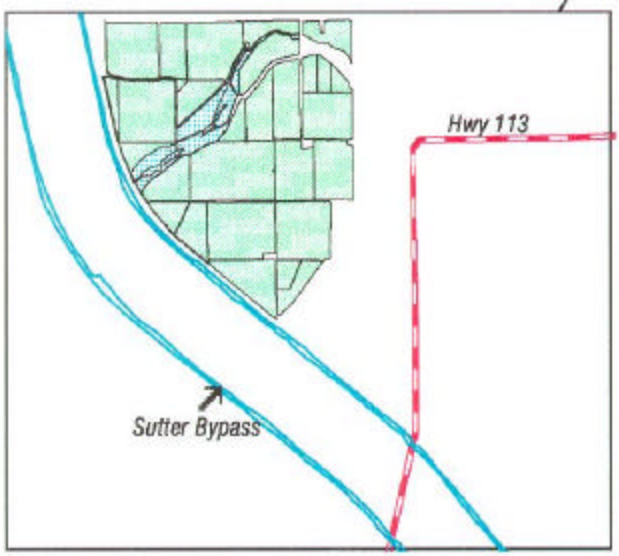
We also recorded snake mortalities from farming and earth moving equipment at Colusa NWR and surrounding rice farms. Giant garter snakes also moved, one to 8 km, into surrounding rice fields from their marsh and canal habitats as these were dewatered during summer at Colusa NWR; one snake was killed by being

run over on the road it was crossing while seeking new habitat. Although we have documented incidental mortality of giant garter snakes by certain management and farming activities, populations of giant garter snakes have been maintained in these areas, likely for decades, despite such mortality. All sites had abundant predators (fish, frogs, wading birds, hawks, otters, etc.) and all sites had abundant cover and high concentrations of food organisms. Predation does not appear to be a limiting factor in maintaining giant garter snake populations. Plentiful cover, connectivity to permanent water and high concentrations of prey maintained therein and are the features common to our study areas that are likely key to sustaining their populations of giant garter snakes.

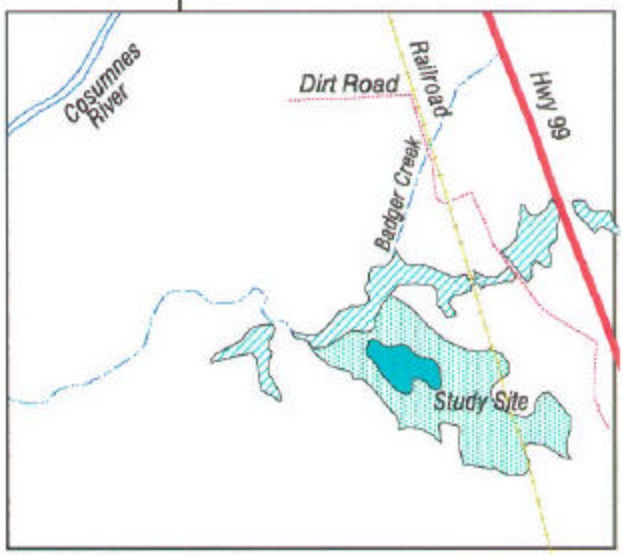
Giant Garter Snake Study Areas



Colusa Study Site



Gilsizer Slough Study Site



Badger Creek Study Site

United States Geological Survey
Biological Resources Division
California Science Center

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Figure 2.

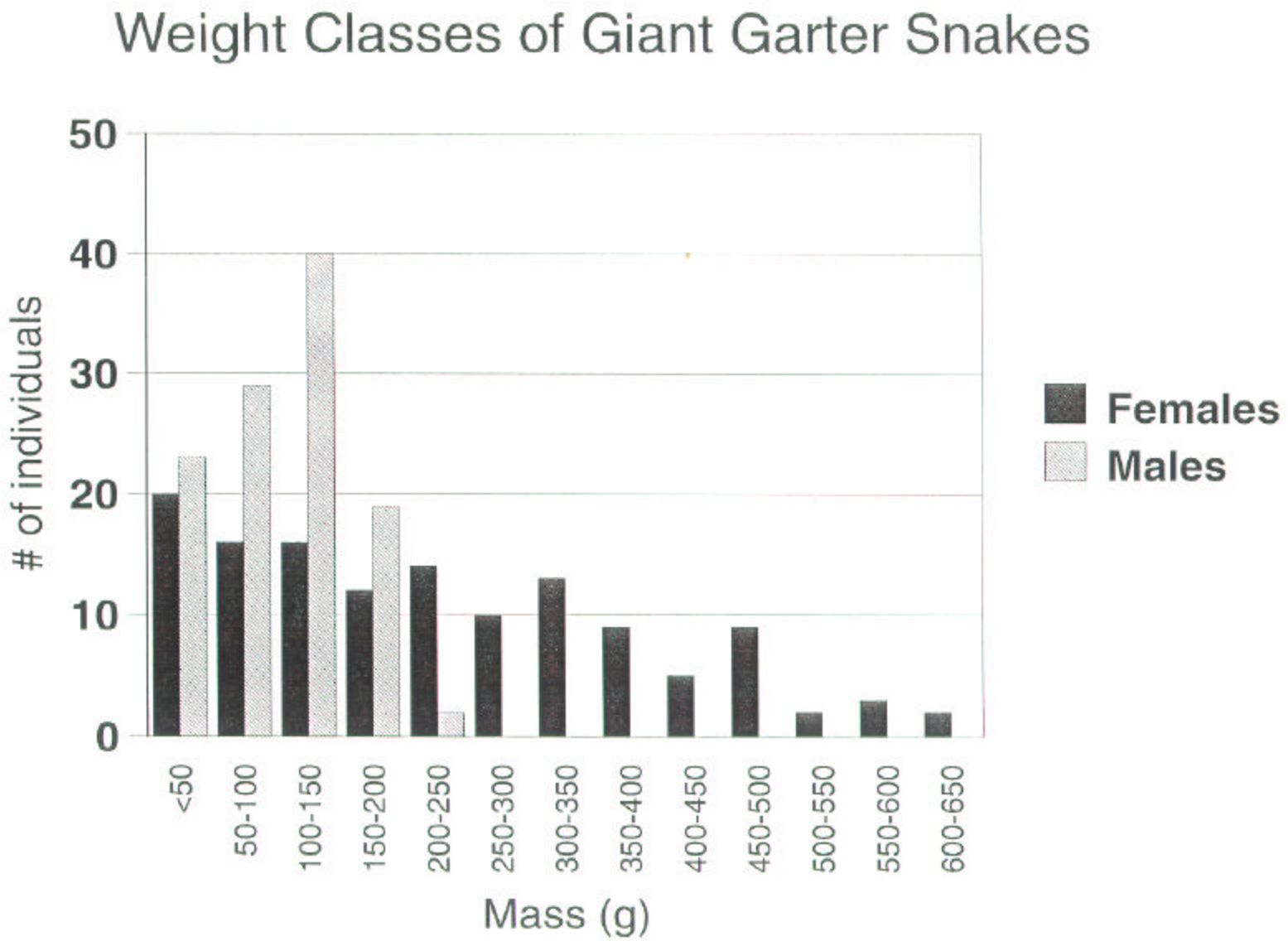

Weight Classes of Giant Garter Snakes
# of individuals
50
40
30
20
10
0
<50
50-100
100-150
150-200
200-250
250-300
300-350
350-400
400-450
450-500
500-550
550-600
600-650
Mass (g)
Females
Males

Figure 3.

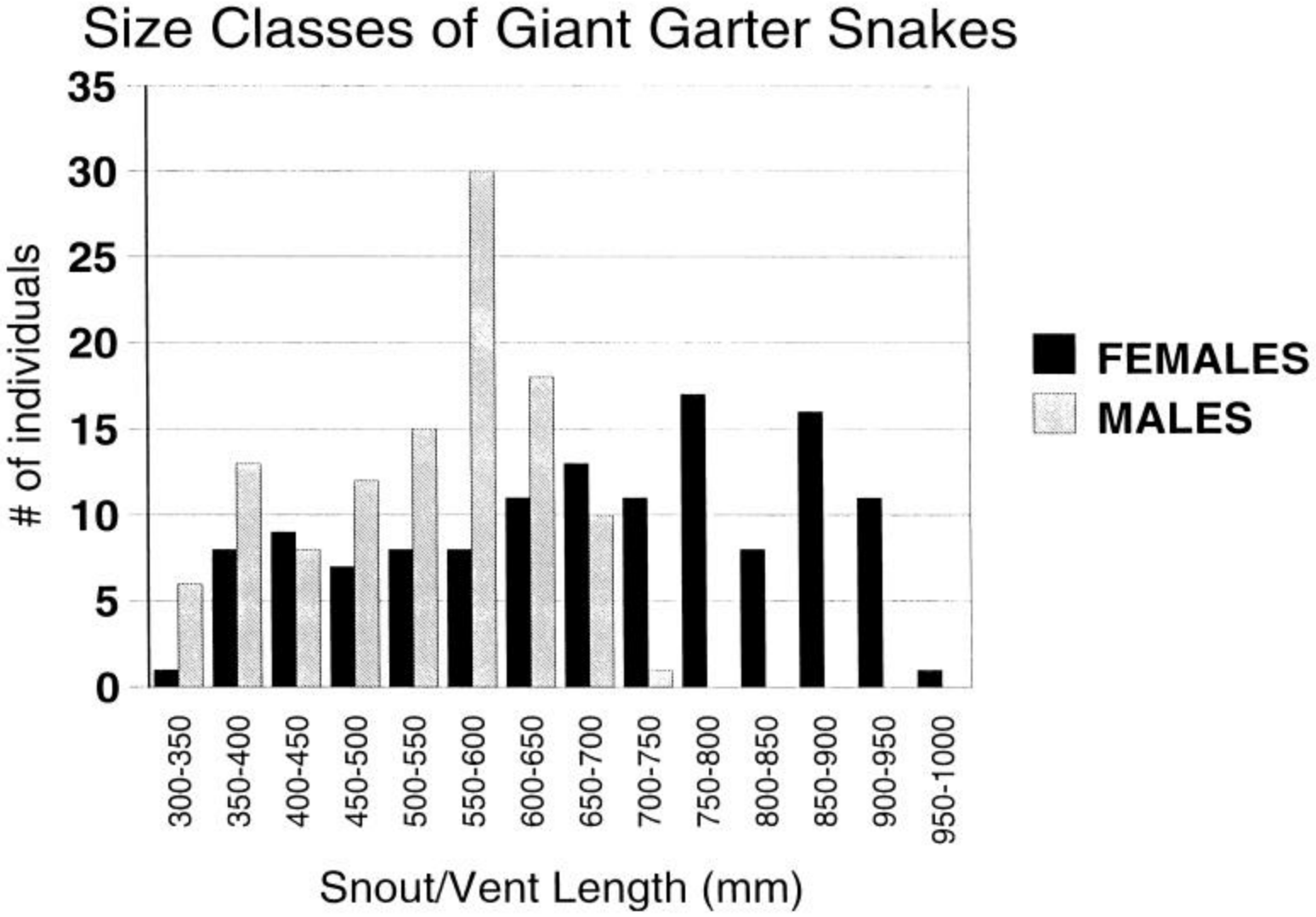
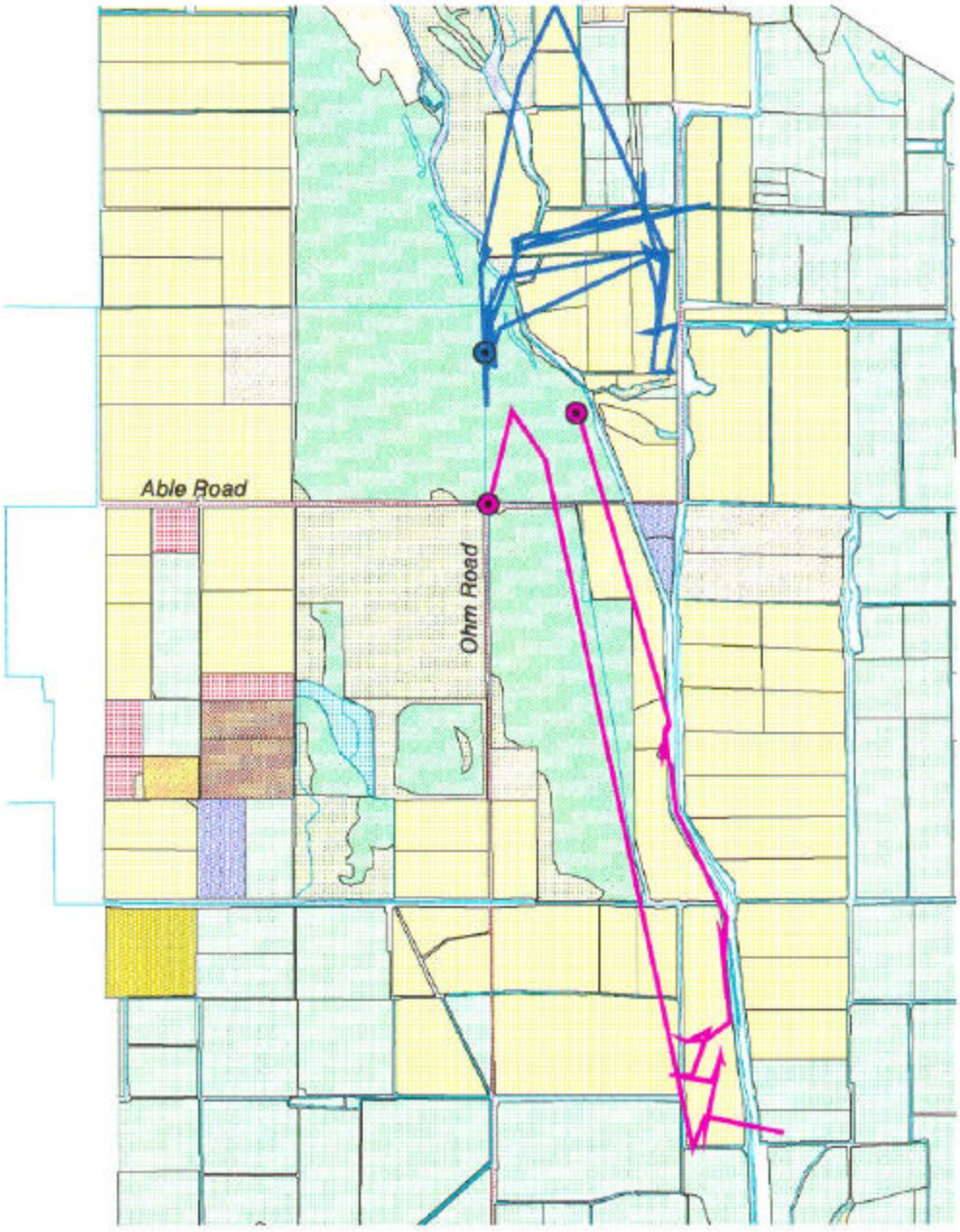

Size Classes of Giant Garter Snakes
# of individuals
35
30
25
20
15
10
5
0
300-350
350-400
400-450
450-500
500-550
550-600
600-650
650-700
700-750
750-800
800-850
850-900
900-950
950-1000
Snout/Vent Length (mm)
FEMALES
MALES

Figure 4. Examples of extensive movements of giant garter snakes at Colusa NWR.

Snake Locations From Capture To Wintering Site
Colusa Study Site



Agricultural Land
- Corn
- Cucumber
- Fallow
- Marsh
- Other
- Rice
- Safflower
- Tomatoe
- Unknown Ag.
- Wheat

Habitat Types
- Irrigated Marsh
- Permanent Pond
- Seasonally Flooded Marsh
- Summer Water
- Upland

Capture/Winter Locations
- 4942
- 5845

N

0 1000 2000 3000 Meters

Figure 5. Locations where telemetered giant garter snakes were originally captured at Colusa NWR compared to their overwintering locations.

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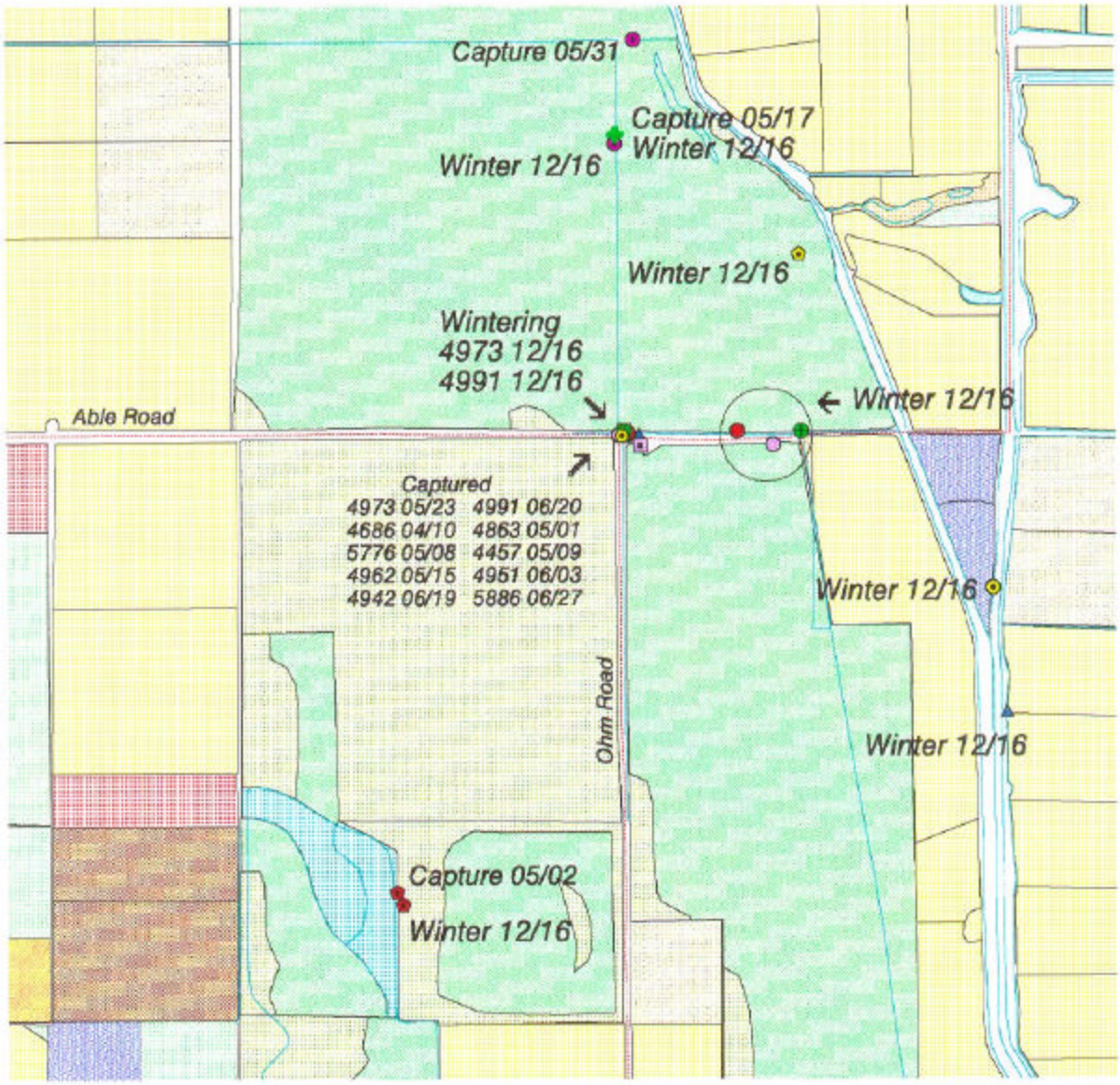
Capture/Winter Locations
Colusa Study Site



Agricultural Land
- Corn
- Cucumber
- Fallow
- Marsh
- Other
- Rice
- Safflower
- Tomatoe
- Unknown Ag.
- Wheat

Habitat Types
- Irrigated Marsh
- Permanent Pond
- Seasonally Flooded Marsh
- Summer Water
- Upland

Water
County Road

Capture/Winter Locations

4457	4962
4481	4973
4686	4991
4863	5776
4931	5845
4942	5886
4951	

N

0 1000 2000 Meters

Snake Locations From Capture To Wintering Site
Gilsizer Slough Study Site

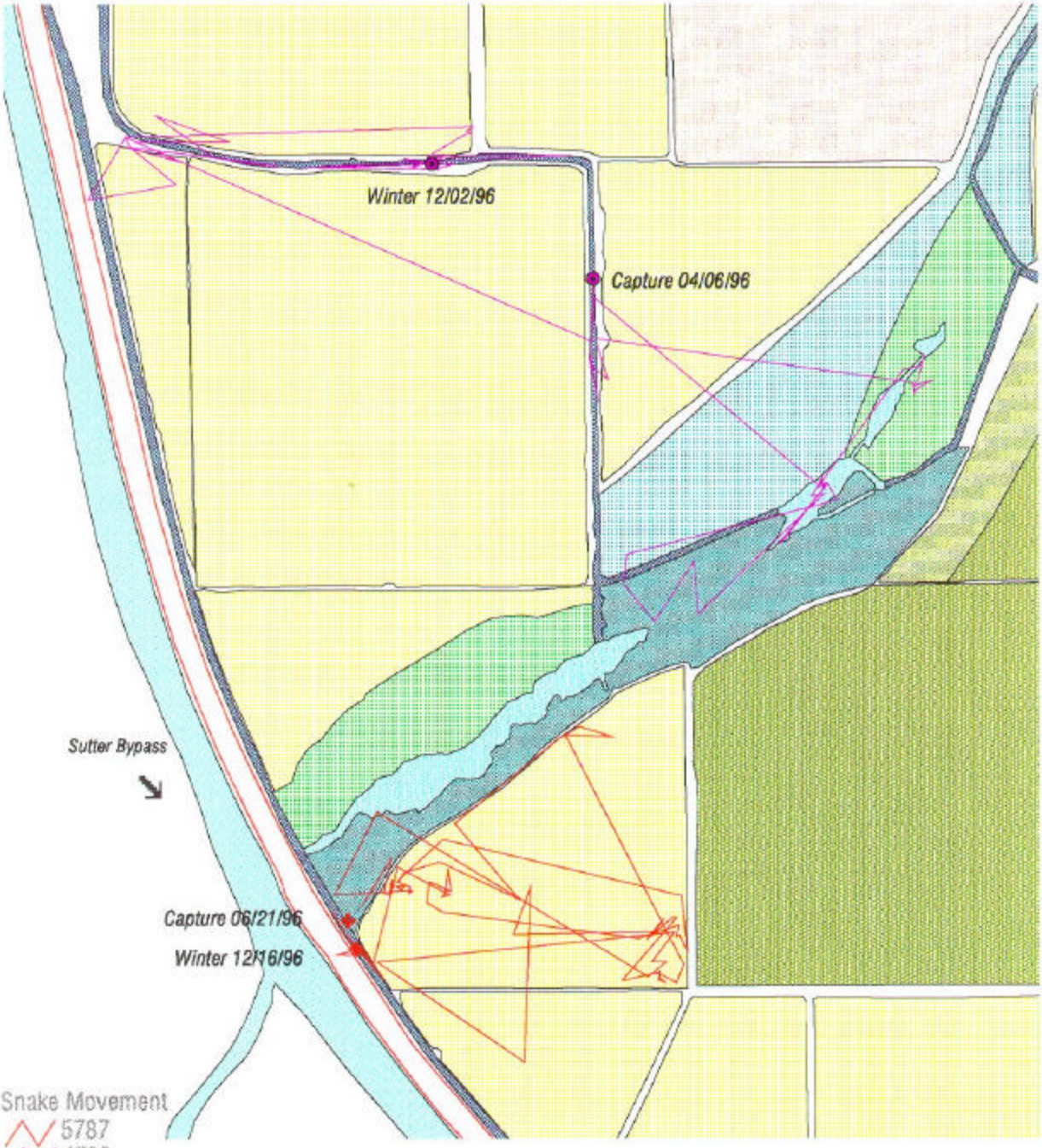


Figure 7.

Habitat Use of Radio-Marked Snakes
Gilsizer Slough

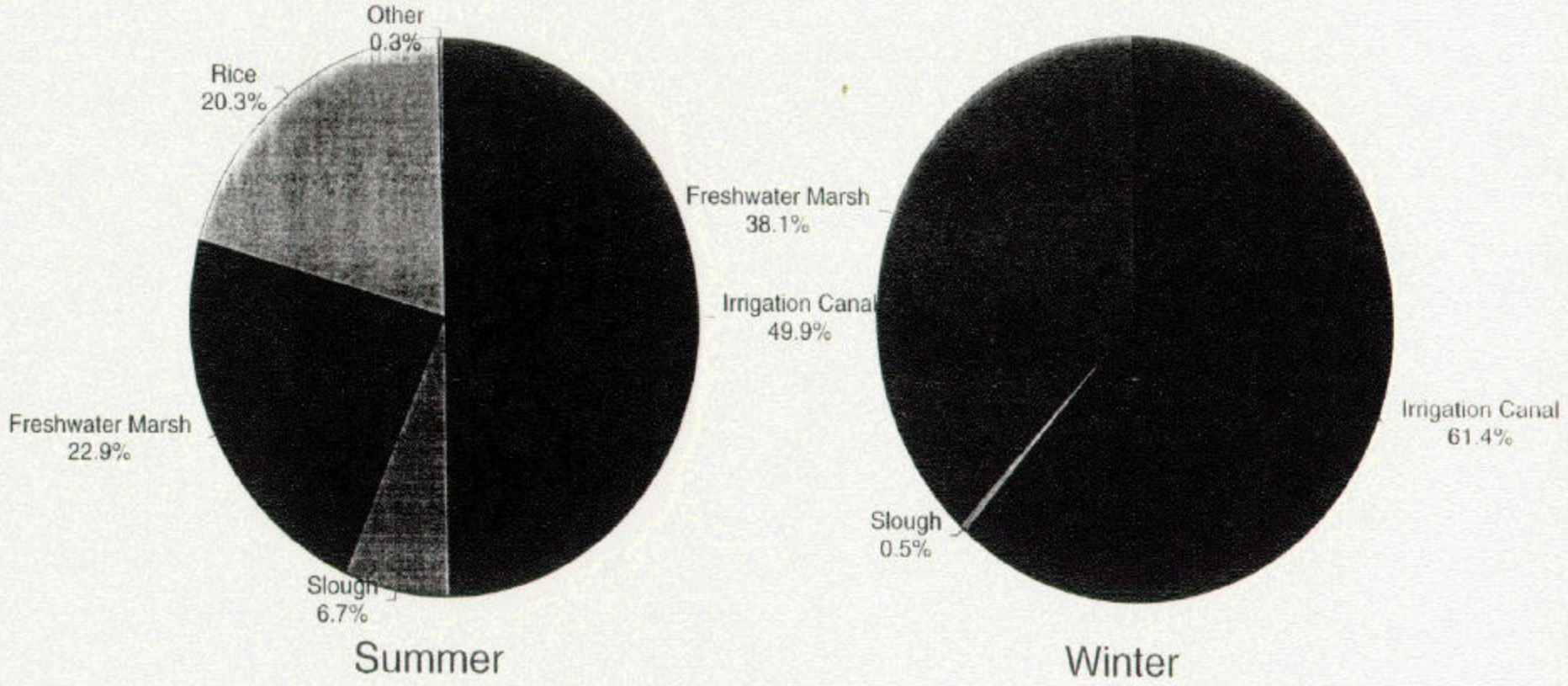


Figure 8.

Habitat Use of Radio-Marked Snakes
Colusa NWR

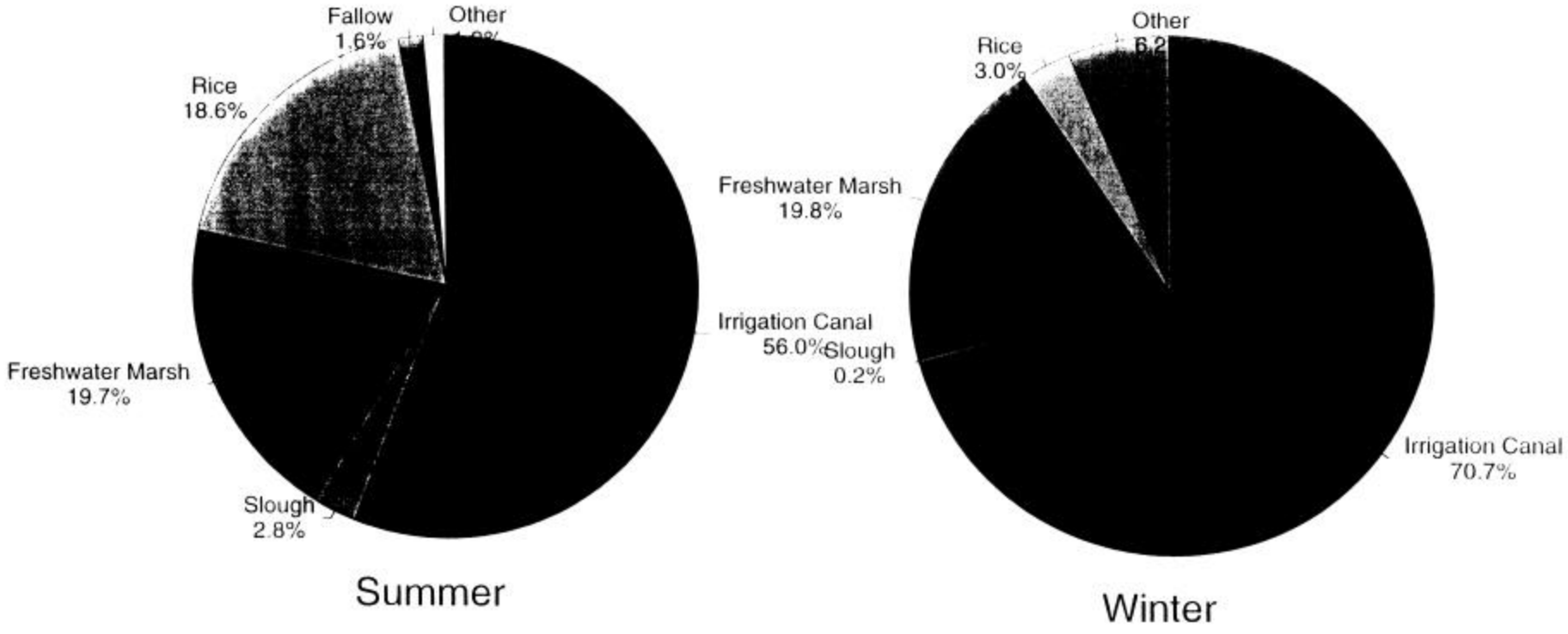


Figure 9. Locations where telemetered giant garter snakes were originally captured at Badger Creek compared to their overwintering locations.

Capture/Winter Locations
Badger Creek Study Site