STATUS OF THE GIANT GARTER SNAKE THAMNOPHIS COUCHI GIGAS (FITCH) IN THE SOUTHERN SACRAMENTO VALLEY DURING 1986 1/

by

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INTRODUCTION

Fitch (1940) described the original range of the giant garter snake (Thamnophis couchi gigas) as the Central Valley from the vicinity of Sacramento and Antioch southward to Buena Vista Lake near Bakersfield. By 1971, so much wetland habitat of the giant garter snake (GGS) had been reclaimed for other uses, especially agricultural development, that the California Fish and Game Commission classified this snake a rare animal. The GGS was reclassified to threatened by the California Endangered Species Act of 1985. In order to better understand the range and distribution of the GGS, the California Department of Fish and Game conducted field surveys in 1973, 1974 and 1976. The results of these surveys indicated that those GGS populations persisting in the Delta and Sacramento Valley areas faced no immediate major threats (Hansen and Brode 1980).

Recently, a resurgence of construction activity in the Sacramento area has resulted in the destruction of habitats known to support GGS. Other habitats known or suspected of supporting GGS are scheduled for development in the near future. This renewed threat prompted the California Department of Fish and Game to undertake this survey in 1986 to investigate the present status and needs of the GGS and its supporting habitat in the southern Sacramento Valley.

An attendant goal of this survey was to develop a system for assessing the potential of a habitat to support GGS. Such a system would by useful in predicting and subsequently mitigating the impacts on GGS of future land use changes.

STUDY AREA

The study area encompassed Sacramento County and adjacent portions of San Joaquin, Placer, Sutter, Yolo and Solano Counties, and included the northern portion of the Sacramento-San Joaquin Delta and its periphery (Figure 1). Known locations of GGS within the area prior to 1986 are shown in Table 1.

The area is divided by the Sacramento River and variations in local rainfall and topography into three distinct zones including a generally drier and more level Zone 1, a moister and more upland eastern Zone 2 and the low lying northern Delta Zone 3. Each zone is further subdivided by natural and man-made features into recognizable areas within which conditions are similar. For ease of reference these areas have been named (American Basin, Río Linda, Elk Grove, Galt and Tracy Lake Areas in the eastern Zone 2; Yolo Bypass and Woodland-Liberty Farms Areas of Zone 1; Delta Area of Zone 3) and their locations illustrated (Figure 1).

Local climate is characterized by hot, dry summers and cool, rainy winters, with most rainfall occurring December through February. Additional water enters the area annually

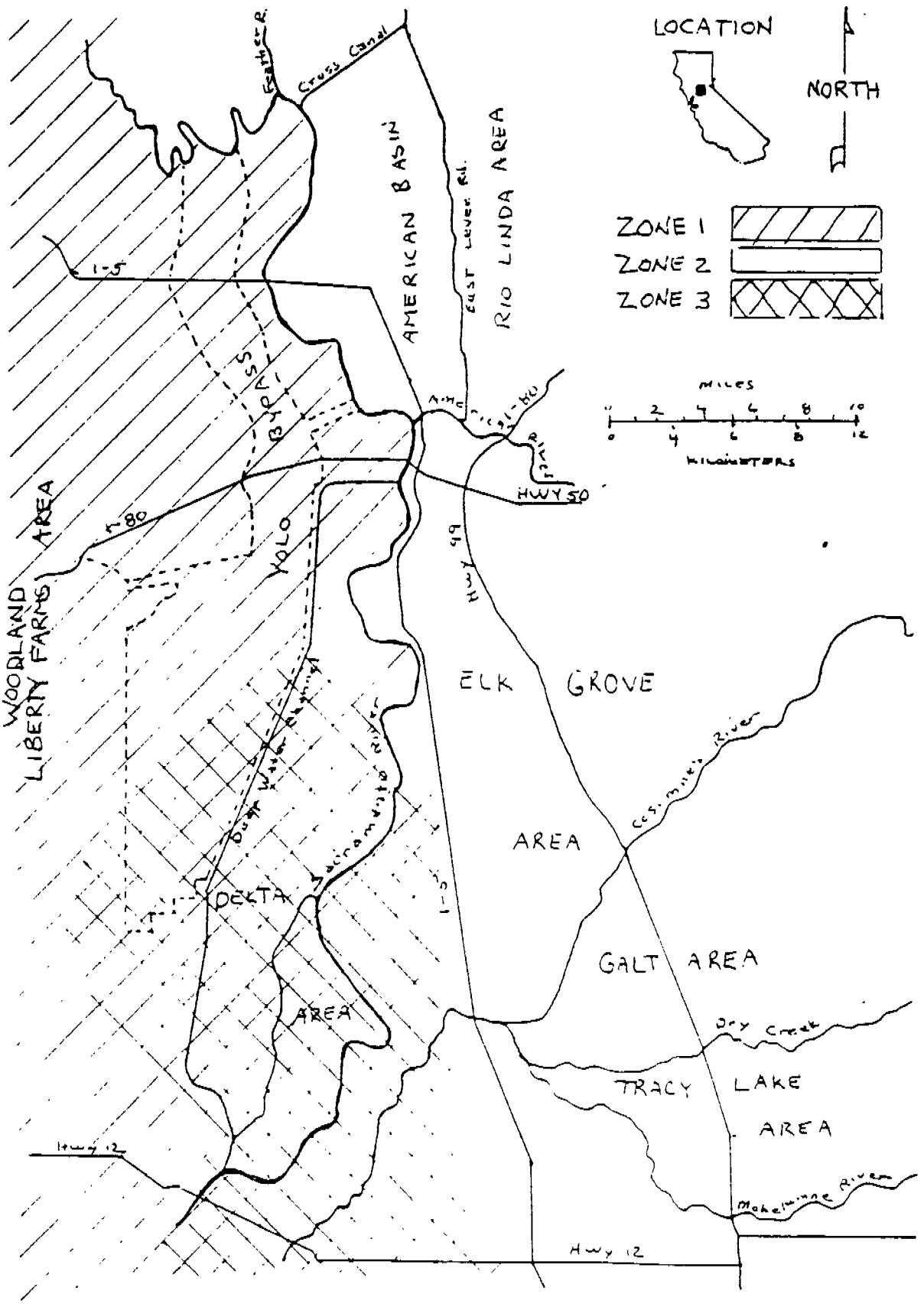

FIGURE 1. Location of and major features within the southern Sacramento Valley study area of the 1986 giant garter snake study.

TABLE 1. Localities of the Giant Garter Snake in the Study Area Prior to 1986, Based on Records of th California Department of Fish and Game.

Locality	County
Arno Rd., W side Hwy. 99	Sacramento
Franklin Blvd., 0.5 miles S Hood-Franklin Rd.	Sacramento
0.4 miles N Eld Grove Blvd., W side Hwy 99	Sacramento
0.5 miles S Sheldon Rd., 0.2 miles W Hwy 99	Sacramento
Sheldon Rd., 0.3 miles W Brucewille Rd.	Sacramento
Beach Lake Preserve, 1 mile S Freeport	Sacramento
West Drainage Canal, 1 mile W to 1 mile S intersection of El Centro Blvd. and Del Paso Rd.	Sacramento
Meister Rd., E Sacto. Metro. Airport	Sacramento
Del Paso Rd. at El Centro Blvd.	Sacramento
Del Paso Rd., 1.6 miles E El Centro Blvd.	Sacramento
Elverta Rd., 1.5 miles E Garden Hwy.	Sacramento
Reigo Rd., 0.5 miles W Hwy. 99	Sutter
Rd. 22, center of Yolo Causeway	Yolo
South Fork Putah Creek at Old Davis Rd., Davis	Solano
Swan Rd., 1.3 miles W Liberty Island Rd.	Solano

as several major stream systems carrying spring runoff from the northern Sierra Nevada Mountains (Sacramento, Feather, American, Cosumnes and Mokelumne Rivers) and inner North Coast Range Mountains (Cache, Willow, Putah and Ulatis Creeks) converge here. Much of this area lies at or near sea level, and prior to the completion of the Central Valley Project flooded annually, creating "....a maze of tule swamps extending north from the broad delta...." (Dasman 1966).

These streams have also carried enormous quantities of alluvium to the Central Valley, deposits of which now form the rolling prairies bracketing the flood plains east and west. Aside from the major streams mentioned, most surface water in these surrounding uplands is ephemeral, appearing briefly as intermittent streams and vernal pools.

Within the floodplains of the major streams lie natural basins. Enclosed between upland prairie and natural river levees, these basins provided the persistent moisture required by the vast marsh habitats described by early settlers.

Today an extensive system of dams, levees, bypasses and channels has been constructed to control floodwaters and now conveys them, with few exceptions, safely through the Sacramento area. The natural floodplains and basins that formerly supported the marsh and other wetland habitats of the GGS have since been converted to agricultural, industrial and urban uses.

METHODS AND MATERIALS

Schedule

Field work was conducted from 23 April 1986 through 30 November 1986. In addition, sudden flooding of low lying areas during February 1986 provided an excellent opportunity to observe the effects of high water within the study area. I conducted field searches at that time of levee tops, railroad grades and elevated road grades for snakes seeking refuge from floodwaters.

Habitat Survey

Wetland habitats were located by searching the study area from roadways, by boat and on foot. Topographic maps (U. S. Department of the Interior, 7.5' and 15') were consulted extensively in planning and conducting field work. Data were gathered which might prove useful in future grading or assessment of habitats (i.e. stream size and flow, nature of substrate, vegetation type, current land use, evidence of recent flooding or other disturbance).

GGS Survey

GGS were sought by walking, wading and boating along canals, streams and marshes. Binoculars were helpful in searching potential basking spots and in identifying snakes at a distance. Wire mesh funnel traps were used sparingly at several locations. These were set mainly where bridges, culverts or other structures served as drift fences and provided protective shade.

GGS were also sought beneath surface objects, especially boards and other debris deposited by floodwaters. Boards were occasionally placed in promising locations to be checked on return visits. Sites known to support GGS (e.g. Arno Rd. locality) were often visited to determine whether GGS were active on that day prior to checking new areas.

During all phase of field work, roadways were search d for GGS. Any specimen found dead but in good condition was preserved and deposited with the California Department of Fish and Game, Rancho Cordova. Any GGS captured were examined briefly and released at the point of capture.

Field notes describing verified GGS habitats and behavior of GGS observed were recorded on California Native Species Field Survey forms and returned to the California Department of Fish and Game Natural Diversity Base. Copies of these notes accompany this report (Appendix 1).

RESULTS

During this study hundreds of sites were checked for the presence of GGS. Twenty-two of these sites, clustered mainly in the American Basin and Galt areas of the eastern Zone 2, produced sightings of GGS in 1986 (Table 2, Figure 2). Only one GGS was observed in the western Zone 1, and none were seen in the Delta Area of Zone 3. Environments in these areas appears similar to GGS habitats in the American Basin Area.

TABLE 2. Localities of the Giant Garter Snake in the Study Area in 1986, Based on Observations Recorded During This Study.

Site	Locality	County
1	Canal N Howsley Rd., 0.8 miles E El Centro Blvd.	Sutter
2	Canal W side El Centro Blvd., 0.4 miles N Sankey Rd.	Sutter
3	Canal crossing Riego Rd. 0.7 miles E Power Line Rd.	Sutter
4	Power Line Rd., 0.7 miles S Riego Rd.	Sutter
5	Prichard Lake Area 1 mile W Power Line Rd., 1 mile N Elverta Rd.	Sacramento
6	Small drain 0.5 miles N Elverta Rd., 1 mile W Power Line Rd.	Sacramento
7	Canal crossing Power Line Rd. 0.25 miles N Elverta Rd.	Sacramento
8	Canal-Marsh 0.3 miles W Power Line Rd., 0.3 miles S Elverta Rd.	Sacramento
9	Canal N Elkhorn Rd., E East Drainage Canal.	Sacramento
10	Canal E Power Line Rd., 0.9 miles S Elverta Rd.	Sacramento
11	Meister Rd. at Lone Tree Rd.	Sacramento
12	Bayou Way, 0.5 miles SW Hwy 99 x I-5 interchange, 1 mile E Power Line Rd.	Sacramento
13	Power Line Rd., 0.2 miles S Bayou Way	Sacramento
14	Fisherman's Lake area from El Centro Blvd. to Del Paso Rd.	Sacramento
15	Del Paso Rd. at El Centro Rd.	Sacramento
16	Canal N Del Paso Rd., W East Drainage Canal	Sacramento

TABLE 2 (Continued).

Site	Locality	County
17	East Drainage Canal at lateral drain, 0.3 miles S Del Paso Rd.	Sacramento
18	East Drainage Canal at lateral drain, 1.5 miles S Del Paso Rd.	Sacramento
19	North Fork Badger Creek at Riley Rd.	Sacramento
20	Marsh W Hwy 99 at Arno Rd.	Sacramento
21	Canal-Marsh E Hwy 99 at Arno Rd.	Sacramento
22	Canal crossing Swan Rd., 1.3 miles W Liberty Island Rd.	Solano

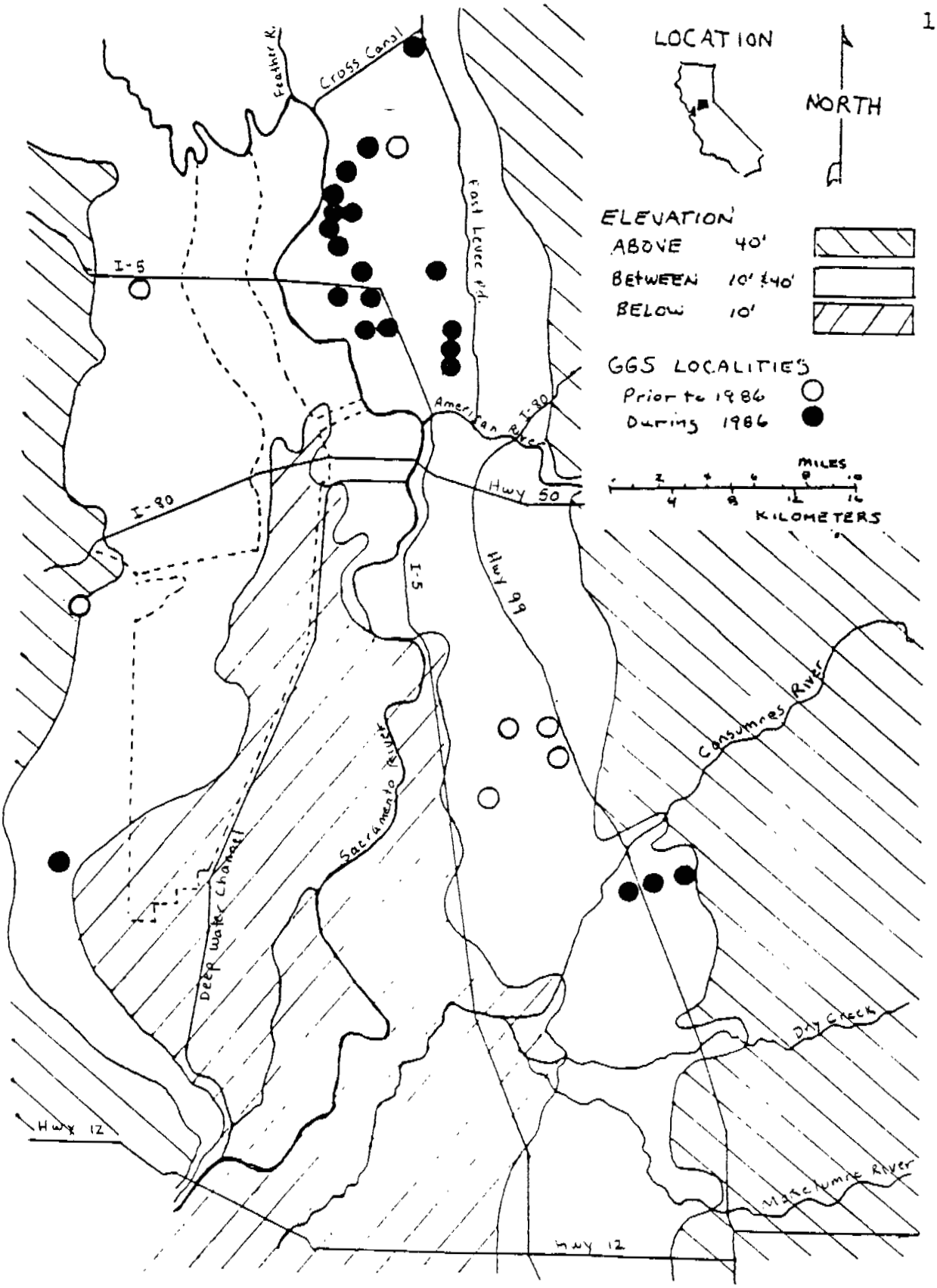

FIGURE 2. Known giant garter snake localities during 1986 within the southern Sacramento Valley. Solid circles indicate sites (new or previously known) where GGS were observed during this study. Open circles indicate sites where GGS were observed prior to but not during this study.

Features shared by those sites observed to support GGS in 1986 and behaviors exhibited by GGS encountered included:

1. These aquatic or semiaquatic environments were characterized by slow flowing or standing water with a mud substrate. Crayfish burrows were usually abundant.
2. Streamside, emergent and aquatic vegetation consisted of low growing thickets and mats of annual and perennial plants.
3. Trees, when present, were scattered or in small groves, and did not form continuous riparian "hedgerow" or "gallery" stands with unbroken canopies.
4. Most of these sites had escaped inundation during recent flooding. At those sites where flooding had occurred, nearby natural or man-made features such as bluffs, hummocks, railroad and road grades had protruded above the highest water level.
5. These sites formed a discontinuous band roughly encircling the Delta and river floodplains between 10 and 40 ft in elevation (Figure 2, Table 2).
6. Forage for GGS such as small carp and mosquitofish were usually abundant. In agricultural areas, small fish were usually introduced with

irrigation water and failed to grow to large size by the time the last pools dried in summer or fall.

7. Where large introduced predatory fish such as black bass, striped bass and catfish are known to have become well established, sightings of GGS were restricted to those of larger adults.
8. Nearly all GGS captured and examined possessed scars or recent injuries apparently acquired during attacks by predators.
9. Larger bodies of open, shallow water or those with lightly vegetated banks and shallows seemed to be avoided by GGS. This was especially apparent where vegetated backwaters and smaller weedy drains, creeks and canals were available nearby.
10. Clumps of tule were chosen over those of cattail by nearly all GGS found basking or resting where both plant types were present.
11. Active GGS were encountered most frequently and in greater numbers during the spring (March-June) when they were seen basking on the surface, resting beneath surface objects or prowling about during periods of fair weather. During that period, several individual GGS with whom I became familiar appeared to restrict their

movements within fewer than 100 ft of favored habitat.

12. Most GGS were encountered at the water's edge where they could and usually did escape into the water with one quick reflexive thrust. Exceptions included GGS found as far as 600 ft from the nearest water. These were limited to encounters during early spring or late fall near either the high water line of a previous flood or the sunny outside edge of thick riparian vegetation.
13. The valley garter snake (Thamnophis sirtalis fitchi) was found to coexist with the GGS in all areas that now support the latter.
14. The terrestrial garter snake (Thamnophis elegans elegans) was observed at locations in the Elk Grove and Galt Areas.
15. The marsh west of Highway 99 at Arno Rd. (Sacramento County) supported all three species of garter snakes in 1986.

DISCUSSION

Past Distribution of GGS and Supporting Habitat

The former distribution of GGS within the study area is poorly known. Available records indicate that GGS have long

occupied sites at or near the periphery of the Delta. While records of GGS are lacking within the low elevation floodplain of the Delta Proper, extensive marshes are known to have occurred there. Since GGS were observed to colonize tule patches far from shore on Buena Vista Lake (Van Denburgh 1922), it is probable that they once utilized the floodplain of the Delta to a much greater extent than is evident today.

Prior to the completion of an effective flood control system, periodic inundation within the study area probably influenced the distribution of GGS and its habitats by:

1. Providing the moisture, seeds and other plant material necessary for the establishment and maintenance of marsh, swamp or other habitats.
2. Providing forage fish, many of which would have been stranded in overflow pools and other waterways within the floodplain.
3. Dispersing individual GGS to areas peripheral to the floodplain, where such settlers could have colonized unoccupied habitats or contributed to genetic variation within existing populations.
4. Removing terrestrial competitors and predators of GGS from the floodplain and discouraging their reestablishment.

Prior to agricultural and other developments, arid upland areas peripheral to the floodplain also supported a greater abundance of environments suitable for GGS. Aided in part by

the activity of beavers, moisture from seeps, springs and small streams accumulated in swales or basins and encouraged the establishment of marsh habitats and populations of forage fish.

Reasons For Decline

As a result of human activities, wetland habitats and the GGS they once supported have been seriously depleted throughout the study area. For example, during 1985 approximately two miles of Elk Grove Creek (Sacramento County) was channelized and the surrounding area graded during development of the area for light industry. Field searches that I conducted during this study suggest that habitat loss there was complete, that GGS I saw there as recently as 1982 were displaced or destroyed during construction, and that no GGS appear to have returned to the area. Similarly, recent construction north of Morrison Creek (Sacramento County) and throughout the American Basin (e.g. Arco Arena, South Natomas residential and business developments) has altered or destroyed environments known to have supported GGS.

Human activities have effected GGS through:

Urbanization

Housing, business, industrial and recreational developments have replaced GGS habitats with broad urban areas entirely unsuitable for these snakes. Wetlands have been drained

and streams channelized, concreted, and even routed through underground pipes. Other habitats have been converted to landscaped green belts and managed as parks or other uses detrimental to GGS. Those GGS remaining in or near urban areas have been subjected to a host of hazards including loss of habitat, pollution, destruction of food sources, predation by native and introduced species and removal by amateur and commercial collectors.

Agriculture

While agriculture may benefit GGS under certain conditions by providing habitat and food along irrigation canals, many agricultural practices are detrimental to GGS. As a result, most GGS habitats once found within the study area have been degraded or destroyed. For example, prior wetland environments throughout the Delta and American Basin areas have been drained and converted to cultivation or other agricultural uses.

Factors contributing to habitat loss include:

Cultivation. GGS have been lost during tilling, grading, harvesting and other operation of mechanical equipment within supporting habitats through direct physical injury and through exposure to predators and other stresses related to loss of shelter.

Livestock Grazing. GGS habitats have lost their ability to support GGS when exposed to heavy grazing due to loss of protective plant cover (including tules). Soil compaction resulted in the destruction of underground and aquatic

retreats such as rodent and crayfish burrows and other cracks and holes. Remaining GGS have been exposed to predators and other stresses related to loss of shelter.

Pest Control. GGS, functioning near the top of aquatic food chains, have been exposed to a wide array of chemical and other pest control measures. The effects of such measures as agricultural pest control and mosquito abatement (both of which applied large quantities of DDT and its successors within the habitats of GGS) remain unknown. Weed abatement and rodent control measures, especially along canal or other stream banks, has destroyed surface and underground shelter.

Introduced Predators and Competitors

Human activities have resulted in widespread introductions of non-native species and redistributions of native species with the potential to compete with or prey on GGS.

Terrestrial Species. Congeners such as the terrestrial garter snake (TGS) and Valley garter snake (VGS) and a host of other animals such as skunks, raccoons, and housecats have been provided access to previously aquatic or semiaquatic environments through the conversion of these habitats to other uses.

Aquatic Species. Man has introduced large predatory "gamefish" species into nearly all permanent freshwater environments within the study area. Since such aquatic predators did not previously occur here, these introductions effected GGS by preying on GGS and by competing with them for

smaller forage fish. The tendency of these snakes to enter the water fo forage or to escape enemies now places them at greater risk than previously.

Flood Control

Modern flood control has effected GGS dramatically by enabling man to expand his activities throughout the extensive floodlands of the study area. Prior marsh habitats were drained and protected from flooding with subsequent losses of habitat to urbanization, cultivation and grazing. Elevated flood control and other structures such as levees, railroad and road grades have provided permanent terrestrial habitats. Channelized streams and "toe drains" accompanying these structures have provided permanent freshwater habitats for introduced gamefish.

Present Status of GGS and Supporting Habitat

Zone 1

Located west of the Sacramento River and Delta, this region produced only one observation of GGS during this study.

Yolo Bypass Area. Within the Yolo Bypass, snakes of any kind were rare. Those found were usually restricted to the vicinities of levees or road and railroad grades providing refuge from frequent flooding. While irrigation canals, toe drains and natural sloughs and marshes provide apparently suitable habitats during low water, I observed no GGS in the Yolo

Bypass during this study. However, during the spring of 1985 I found a dead GGS adult of Road 22 where it crosses the north end of the Yolo Bypass. An earth and rock railroad grade interrupting the long trestle there had protruded from flood-waters two months earlier and had probably provided this snake refuge at that time.

Woodland-Liberty Farms Area. I observed only one GGS west of the Yolo Bypass in 1986. This was the second sighting in the area where I recorded a GGS dead on Swan Road in 1985. There, irrigation and drainage canals served grazing and more upland farming interests. Flooding of several areas occurred there following storms, with levee tops again providing the only stable winter shelter. From Woodland south to Yolano are only a small number of irrigation canals and streams which may support GGS.

No GGS were observed between the Sacramento River and the Yolo Bypass. Prior to the construction of the Yolo Bypass, much of this area flooded frequently. Today, this region is protected from flooding but agricultural canals and sloughs provide favorable habitats for the GGS.

Zone 2

Rio Linda Area. No GGS were observed in this area even though they were numerous in the American Basin to the west. This area consists of rolling grasslands and open oak woodlands, supporting few suitable wetlands. However, several small streams and agricultural canals may support GGS.

American Basin Area. Eighteen of the 22 sites shown to support GGS during this study occurred here. Although conditions seemed most favorable in areas devoted to rice culture, most or all waterways are probably frequented by GGS during the active season.

In recent years, the conversion of this area from agriculture to urban, industrial, recreation, highway, airport and quarry uses has increased dramatically. Of the approximately 50 square miles of this area located in Sacramento County, 15 have recently been developed (North and South Natomas, Sacramento Metropolitan Airport) and at least 5 more are in various phases of planning or development. Industrial developments are also being planned within GGS habitats in southern Sutter County. Loss of habitats in this area may result in the fragmentation of this panmictic population into smaller and more fragile subpopulations.

Elk Grove Area. No GGS were observed here during this study, although I did see them here as recently as 1982.

Those sites known to have supported GGS located west of Franklin Blvd. and south of Morrison Creek were inundated by flooding early in 1986. Known localities east of Franklin Blvd. were either inundated during 1986 (Laguna Creek, Morrison Creek) or urbanized (Elk Grove Creek). Data gathered during spring flooding and throughout the remainder of the active period in 1986 indicated that GGS may have been seriously depleted in this area during the last two years.

Habitats suitable for GGS persist in this area, although overgrazing and urbanization pose a very real threat to any GGS remaining.

Galt Area. This area consists of grazed grassland, open oak woodland, riparian, and marsh environments. GGS were found at three sites within this area.

Small marshes persist in shallow basins along the lower reaches of Badger and Willow Creeks at the eastern edge of the Delta Floodplain. The marsh located west of Highway 99 at Arno Road flooded during February 1986 to the level of the frontage road (west side of highway 99) and the crushed rock railbed atop the railroad grade and trestle bisecting the marsh, thereby inundating known and suspected hibernating spots. Although the floodwaters receded and the site returned to its usual appearance, this site produced fewer observations of GGS than in prior years (Personal, unpublished data).

Most of the habitats remaining along the various small streams east of Highway 99 have suffered from overgrazing. One exception, a small tule-cattail marsh persisting along the North Fork of Badger Creek east of Riley Road, has been protected from grazing by livestock and represents the highest elevation (40 ft) GGS sighting of this study.

Evaluation of Habitats

From available information it appears that the distribution of GGS within the study area is influenced by several factors,

each of which can be evaluated on a site by site basis.

Food

GGS is an aquatic feeder specializing in ambushing fish underwater. It also readily takes larvae and young of the widely introduced bullfrog.

During the GGS active period, a site may support no fish (0 points), a few fish or frogs (1 point) or well established populations of such forage fish as carp or other minnows, and mosquitofish (2 points).

Shelter During the Active Season

A site must provide GGS protection (both in and out of water) from predation and other mortality factors during the active season. This shelter may take the form of vegetation or debris, or the burrows of rodents and crayfish.

A site may provide no shelter (0 points), aquatic shelter (1 point), terrestrial shelter (1 point) or both (2 points).

Shelter During the Dormant Season (Hibernacula)

Those sites that were populated by GGS provided access to upland retreats during runoff or flooding. Vegetation, burrows and other shelter from predators at these upland retreats enhance the suitability of the site.

A site may provide no upland retreats or shelter (0 points), upland retreats present but little shelter from predators provided (1 point), or upland retreats present and shelter provided there (2 points).

Basking Spots

GGS bask during the active season in order to raise the body to activity temperatures. Basking may be an especially important aid to digestion, gestation and healing (personal, unpublished data) and in rewarming the body following emersion in cool waters. While basking spots may be provided by vegetation and debris present within the habitat, dense overstories of riparian growth may block warming sunlight. Conversely, a lack of screening vegetation on a sunny stream bank exposes basking GGS to view by predators. If too few suitable basking spots are present in an otherwise favorable habitat, avian or other predators may concentrate their activities at those spots to the detriment of GGS.

A site may provide either a sunny bank with no sheltering vegetation or the shade of an unbroken riparian overstory (0 points), little emergent or streamside vegetation or only scattered sunlight through riparian overstory (1 point) or sunny expanses of emergent or streamside vegetation (2 points).

Site Location

Since known locations of GGS within the study area roughly encircle the Delta and river floodplains between 10 and 40 feet elevation, it is probable that past and present conditions favored the presence of GGS there to a greater degree than elsewhere. For this reason, it appears that habitats located within this zone may have a greater probability of supporting GGS than identical habitats located above or

below this zone.

A site may be located either at or below sea level within the Delta or at higher elevations (75 feet or higher) in the surrounding foothills (0 points), adjacent to the peripheral zone at low elevation (1 point) or within the peripheral zone between 10 and 40 feet elevation (2 points).

Grade-Total

Hypothetically, sites examined could have earned scores ranging from 0-10, with favorable habitats represented by high scores. As examples, the 22 sites at which GGS were observed during this study were graded and the results shown in Table 3.

RECOMMENDATIONS

As a result of human activities, the GGS and its supporting habitat are depleted throughout the study area and degraded or threatened in those areas that still support them. Intervention on their behalf could be successful if efforts were made to:

1. Protect existing GGS and their habitats, dispersal corridors and other support systems.
2. Continue survey efforts to locate unknown GGS populations and identify habitats critical to their survival.
3. Continue efforts to gather the life history data

TABLE 3. Evaluation of Habitats at Sites Shown to Support GGS During this Study (Site numbers correspond with those in Table 2. Headings and scoring are explained in the preceding section. High scores indicate favorable conditions).

Site	Scoring					Total Score
	Food	Active Season Shelter	Dormant Season Shelter	Basking Spots	Site Location	
1	2	2	2	2	2	10
2	2	1	1	2	2	8
3	2	2	2	2	2	10
4	0	2	2	1	2	7
5	2	2	2	2	2	10
6	2	2	2	2	2	10
7	1	2	2	2	2	9
8	2	2	2	2	2	10
9	2	2	2	2	2	10
10	1	2	2	2	2	9
11	2	2	2	2	2	10
12	2	2	2	2	2	10

TABLE 3 (Continued).

Site	Scoring					Total Score
	Food	Active Season Shelter	Dormant Season Shelter	Basking Spots	Site Location	
13	2	2	2	2	2	10
14	2	2	2	2	2	10
15	1	2	2	2	2	9
16	2	2	2	2	2	10
17	2	2	2	2	2	10
18	2	2	2	2	2	10
19	1	2	2	2	2	9
20	2	2	2	2	2	10
21	2	2	2	2	2	10
22	2	2	2	2	2	10

necessary for the effective management of the GGS and its habitat.

4. Continue to test the habitat grading system and revise as necessary.
5. Study the feasibility of rehabilitating or enhancing present or prior GGS habitats.
6. Study the feasibility of introducing or reintroducing GGS into favorable habitats within its prior range.

SUMMARY

During this study, GGS and their habitats were found to be depleted throughout the study area. Human activities continue to threaten GGS and those habitats still supporting them in the American Basin and Galt areas. Recovery efforts are recommended and include the protection, enhancement and acquisition of GGS habitats. Continued research is also recommended to better assess the distribution and needs of GGS.

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