

**Results of Surveys for the San Francisco Garter Snake and California
Red-legged Frog for the NCCWD Recycled Water Project in Pacifica,
San Mateo County, California
(Federal Permit # 815537/DFG Memorandum of Understanding)**

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1.0 INTRODUCTION

The purpose of this report is to present the results of surveys for the San Francisco garter snake (*Thamnophis sirtalis tetrataenia*) and the California red-legged frog (*Rana aurora draytonii*) in portions of the Upper and Lower Sanchez Creek Watershed, in Pacifica, San Mateo County, California (Figure 1). The survey was conducted to determine the status of the San Francisco garter snake (SFGS) and the California red-legged frog (CRF) in the areas potentially impacted by the implementation of a recycled water project in Pacifica. The Pacifica recycled water project is a joint effort between the North Coast County Water District (NCCWD) and the San Francisco Public Utilities Commission (SFPUC).

The surveys for SFGS were not designed to be protocol level surveys. The surveys were initiated to gather informational data on the species, not to attempt to secure a negative finding that would result in a conclusion that SFGS was absent from the site. The surveys were initiated well after the usual start time for protocol level surveys for SFGS and were not 90 days in duration, as is typically required for protocol level surveys.

The surveys were conducted under Federal Permit # 815537 and a Memorandum of Understanding from the California Department of Fish and Game. The areas potentially impacted are the Calera Creek and Sanchez Creek Watersheds. The specific aquatic habitats include Sanchez and Calera Creek, Laguna Salada, Horse Stable Pond (Figure 2), and the Archery Range irrigation pond (Figure 3). It was communicated to the SFPUC by Swaim Biological Consulting (Karen Swaim) prior to initiation of the SFGS surveys, that due to the proximity of the irrigation pond to occupied SFGS habitat and the presence of physically suitable habitat at the pond site, that DFG would not accept a negative finding for such a site with the proposed survey methods. Authorization to conduct trapping surveys under these conditions was provided by DFG (personal communication, David Johnston, DFG).

Two actions are proposed with this project that may impact these species and or their habitat: 1) elimination of water input from the San Francisco Jail in San Bruno and 2) use of tertiary treated water to irrigate Sharp Park Golf Course. The SFPUC and NCCWD intend to maintain all aquatic habitats (water level and period) physically suitable to support breeding CRF and SFGS. Sufficient data do not exist to determine if elimination of the water input from the San Francisco Jail will result in the pond drying before late summer, preventing successful breeding of CRF. A proposed study will monitor habitat conditions to determine if the proposed changes have negative impacts to CRF or SFGS. If monitoring shows that habitat is diminishing, an adaptive management program will be developed.

This project was undertaken to determine the status of SFGS and CRF within the potential impact area so that, if necessary, adaptive management strategies could be designed for these species.

1.1 Site Description

Two separate trapping areas, Lower Sanchez and Upper Sanchez, were identified. Laguna Salada, Horse Stable Pond, and a seasonal wetland on Golden Gate National Recreational Area (GGNRA) property make up Lower Sanchez (Figure 2). The Archery Range irrigation pond constitutes Upper Sanchez (Figure 3), which was treated as a separate site because of its geographical isolation from the other three wetlands. The vegetation at Lower Sanchez is dominated by ice plant (*Carpobrotus edulis*), cattails (*Typha* spp.), rushes (*Juncus* spp.), and tules (*Scirpus* spp.). The habitat at Upper Sanchez differs from Lower Sanchez in that it lacks typical marsh vegetation. The dominant vegetation at Upper Sanchez consists of a mixture of low shrubs (*Rubus* spp. and *Salix* spp.), forbs, and pine forest.

1.2 Species Accounts

1.2.1 SFGS

Physical Description

Adult SFGS have a yellowish-green dorsal stripe, bordered by thin black to broad red to thinner black stripes on either side. The belly is blue-green and the top of the head is red (Stebbins, 2003). Hatchlings are nearly all black above, except for a dull greenish dorsal stripe and faint grayish markings where the red stripe appears as the snake ages. Adult female SFGS are typically larger than males (females average 400-800mm total length [TL] and males average 300-600mm TL).

Distribution and Habitat Requirements

SFGS occupy a limited geographical range, purportedly restricted to San Mateo Co., CA, and enter into a zone of intergradation with the conspecific California red-sided garter snake (*T. sirtalis infernalis*) just south of Pulgas water temple (Crystal Springs Reservoir, San Mateo Co.) into extreme northern Santa Clara County (Stanford University campus) (Barry 1994). They can be found at permanent and seasonal freshwater wetlands that provide dense vegetation for cover, open space for basking and are proximate to upland areas where snakes may retreat into rodent burrows through winter (Barry 1994). The presence of preferred prey items, specifically Pacific chorus frogs (*Pseudacris regilla*) and California red-legged frogs (*Rana aurora draytonii*), is a key component of suitable SFGS habitat.

1.2.2 CRF

Physical Description

CRF (*Rana aurora draytonii*), one of two subspecies of *Rana aurora*, is California's largest native frog (Wright and Wright 1961) at 85.0-138.0 mm snout-vent length. It is brown to reddish-brown with diffuse moderate-sized dark brown to black spots that occasionally have light centers (Storer 1925). CRF can be easily identified by its distinct dorsolateral folds also present on larvae. Dark bands stripe the dorsal side of the hind legs and red coloration is typical of the ventral side of the hind legs (Stebbins, 2003).

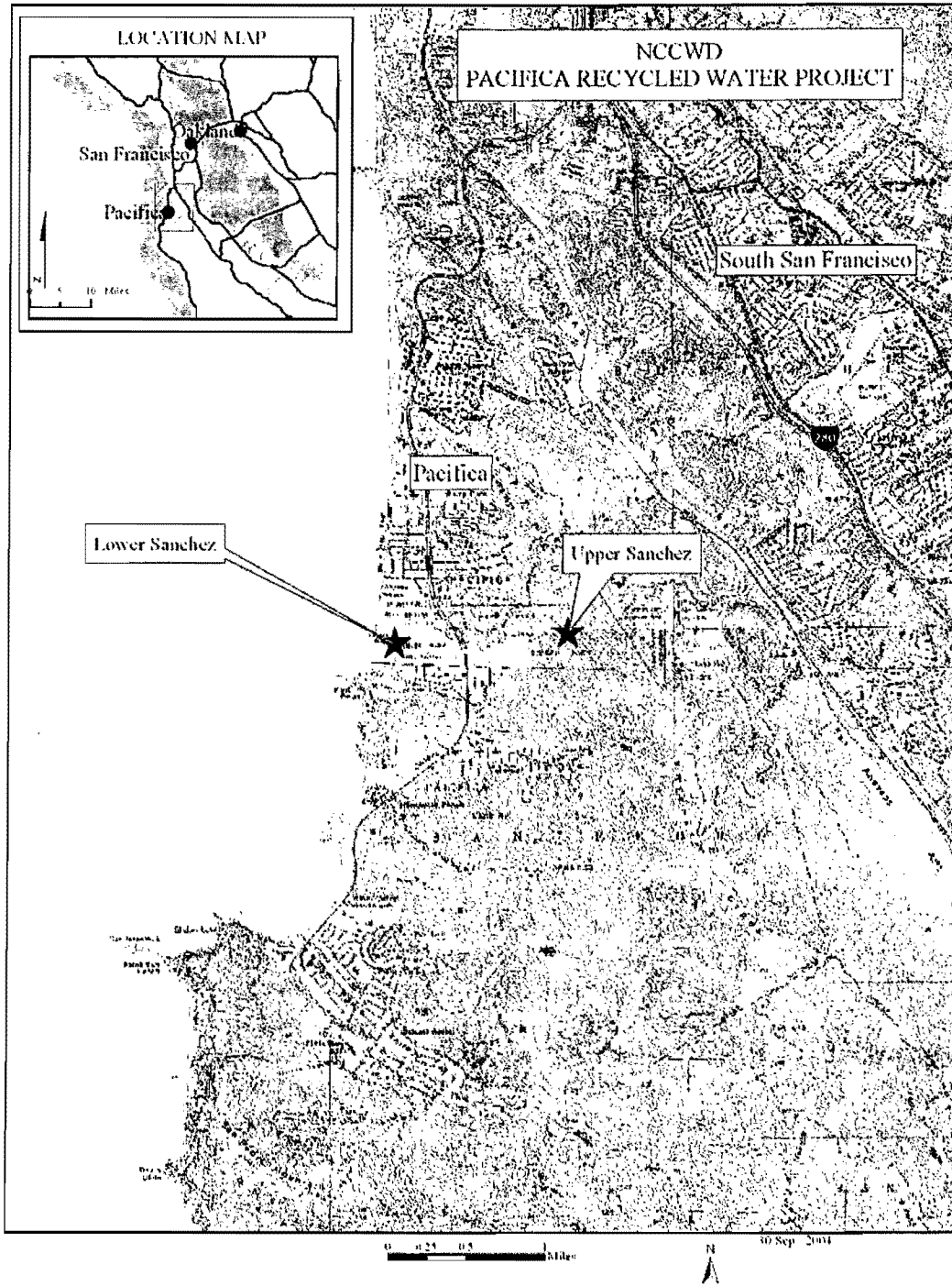


Figure 1. Regional Location

NCCWD - Lower Sanchez Creek Watershed

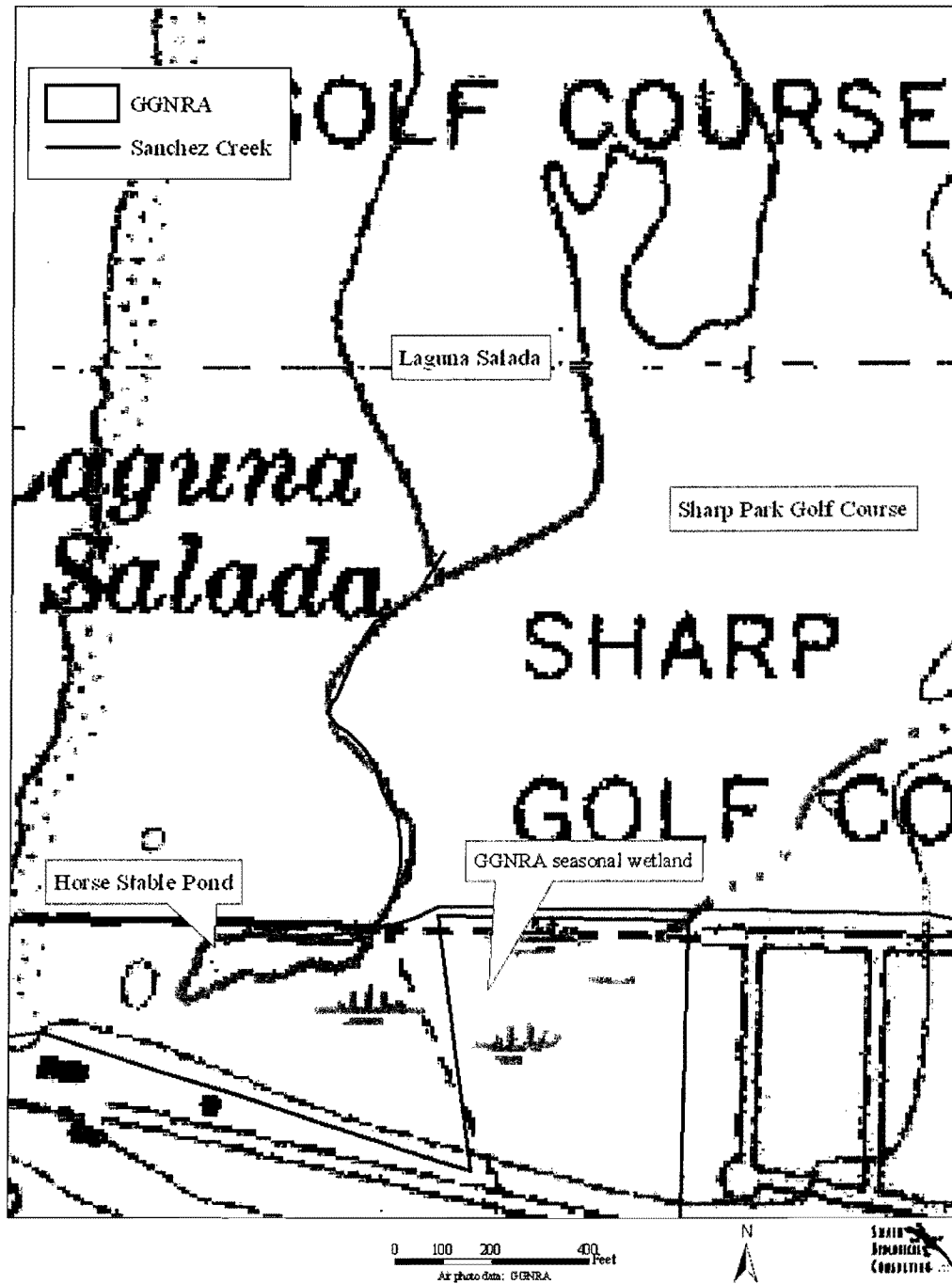


Figure 2. Habitats Surveyed in Lower Sanchez Creek Watershed

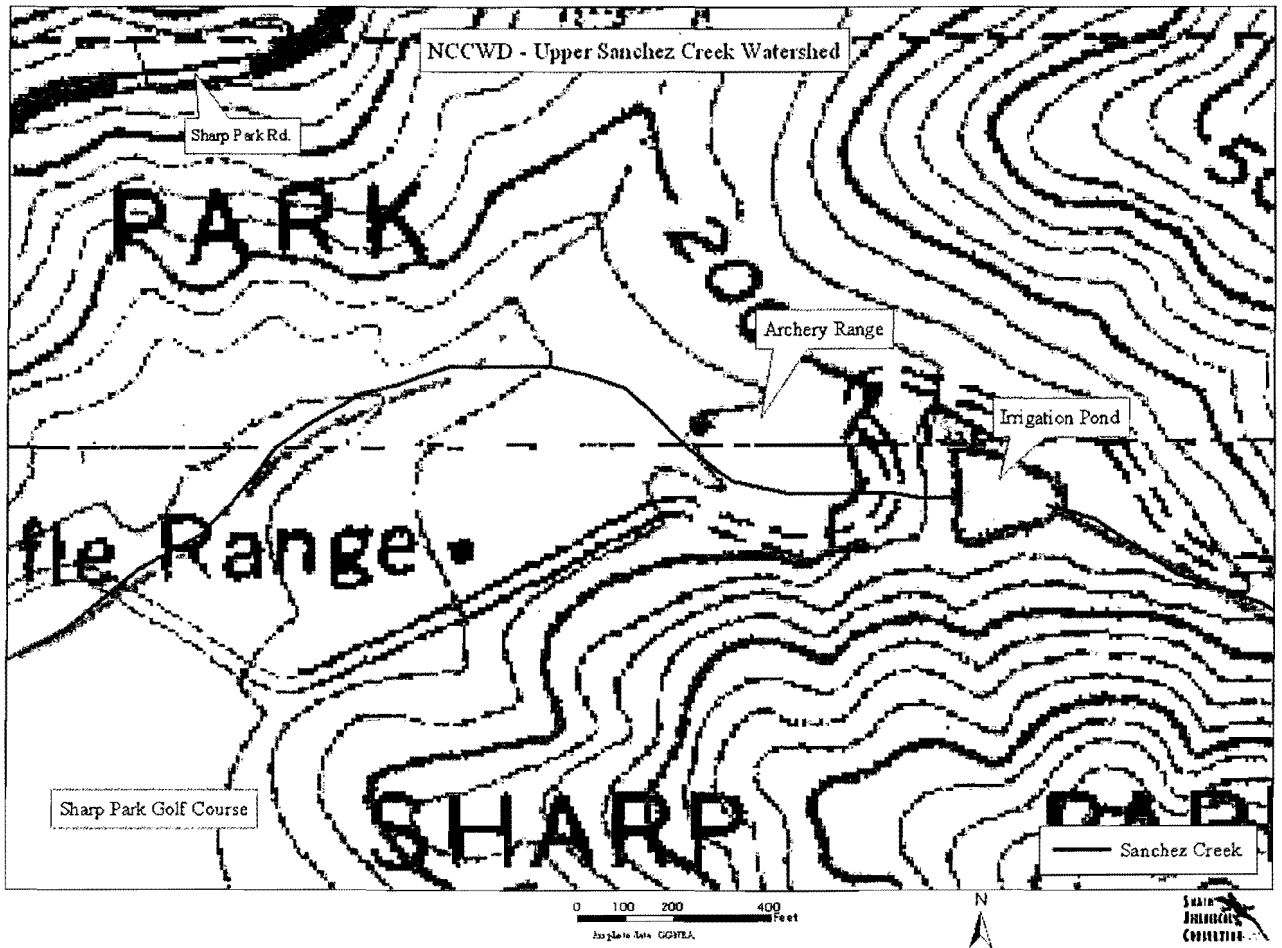


Figure 3. Habitats Surveyed in Upper Sanchez Creek Watershed

Distribution and Habitat Requirements

In California, CRF populations are distributed from Shasta County south to the Mexican border. Introduced populations also currently exist in south-central Nevada (Linsdale 1940, Green 1985). CRF inhabit humid forests, woodlands, grasslands, and streamsides (Stebbins, 2003) characterized by dense, shrubby riparian vegetation associated with deep (0.7 m), still, or slow-moving water (Hayes and Jennings 1988). Emergent vegetation is ideal for cover and egg attachment (Storer 1925). CRF are generally found in close proximity to water, but often disperse to upland habitat after rains (Stebbins, 2003).

2.0 METHODS

Trapping at Lower Sanchez was conducted from 6 May to 9 July of 2004, with a total of sixty-one days of trapping. Trapping at Upper Sanchez was conducted from 20 May to 4 August 2004, with a total of seventy days of trapping.

Thirty-six traplines were installed around potential habitat for SFGS. Traplines were distributed within the study site as follows: Traplines 1–8 (includes 3 arrays) at the GGNRA seasonal wetland, 9–15 at Horse Stable Pond, and 16–30 around Laguna Salada (Figure 2). Six traplines were distributed at the Archery Range irrigation pond (Figure 3). Traplines consisted of twenty-two foot long drift fence, approximately fourteen inches high, with two mesh wire funnel traps located at each end (Figure 4). Traps were checked at least once a day and frequently twice a day during warm or wet conditions to prevent SFGS and/or CRF mortality.

Every snake captured was identified to species, marked with a unique ventral scale clip, sexed, and released at the site of capture. All snakes, excluding SFGS less than 330 mm snout-vent length (SVL), were also marked by inserting a PIT (Passive Integrated Transponder) tag. SVL and total length (TL) to the nearest millimeter and weight to the nearest gram were recorded for all SFGS captured. Photos were taken to document distinct color patterns of SFGS (Appendix A). Other vertebrates captured were identified to species, with the exception of deer mice and shrews, which were identified to genera.

Biological diversity was quantified using Simpson's Index. Simpson's Index takes into account two main factors, richness and evenness. Richness measures the number of different species present and evenness compares the similarity of the population size for each species present (Magurran, 1988).

Two surveys were conducted for CRF presence at Upper Sanchez on 26 August 2004; one daytime and one nighttime survey. Daytime surveys were conducted by slowly walking the perimeter of the irrigation pond, and visually searching for frogs. The same area was surveyed at nighttime by using a spotlight to search for eye-shine.

3.0 RESULTS

3.1 Lower Sanchez

There were seven individual SFGS captured a total of ten times at Lower Sanchez (Table 1, Appendix A). Five captures were at the GGNRA wetland, four at Horse Stable Pond, and one near Laguna Salada.

There was a total of seven CRF captures in traps during the survey period at Lower Sanchez. Four captures were near Laguna Salada, and three captures were at Horse Stable Pond. There were no CRF captured in traplines within the GGNRA wetland.

One hundred and forty-four individual snakes, other than SFGS, were caught at Lower Sanchez (Table 1). The Coast garter snake (*Thamnophis elegans terrestris*) accounted for 86% of the total captures followed by the western yellow-bellied racer (*Coluber constrictor mormon*) at 8.3 %, SFGS at 4.9%, and finally the Santa Cruz garter snake (*Thamnophis atratus atratus*) at 0.7% (Table 1, Figure 5). Out of the three wetlands in Lower Sanchez, the GGNRA seasonal wetland had the highest capture rate, followed by Horse Stable Pond and, finally, Laguna Salada ($\chi^2 = 12.677$; $df = 4$; $p = 0.013$) (Figure 6). Sex composition of the three main species shows more males than females except for the Coast Garter Snake (Table 2). There was a correlation between body size and mass of SFGS ($R^2 = 0.819$) (Figure 7). The figure also shows an even distribution of small, medium, and large size individuals. Seventeen total vertebrate species were captured during the trapping season (Table 3). Simpson's reciprocal Index $D = 5.4$ (The minimum value is 1 and the maximum value is the number of species found-17). Evenness $E = 0.32$ (the value ranges from 0–1, 1 being the highest evenness).

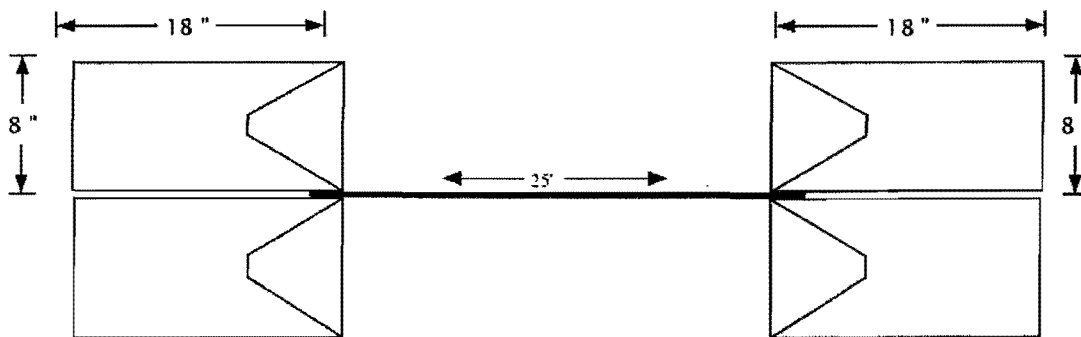
3.2 Upper Sanchez

No SFGS were observed in or around the Archery Range irrigation pond.

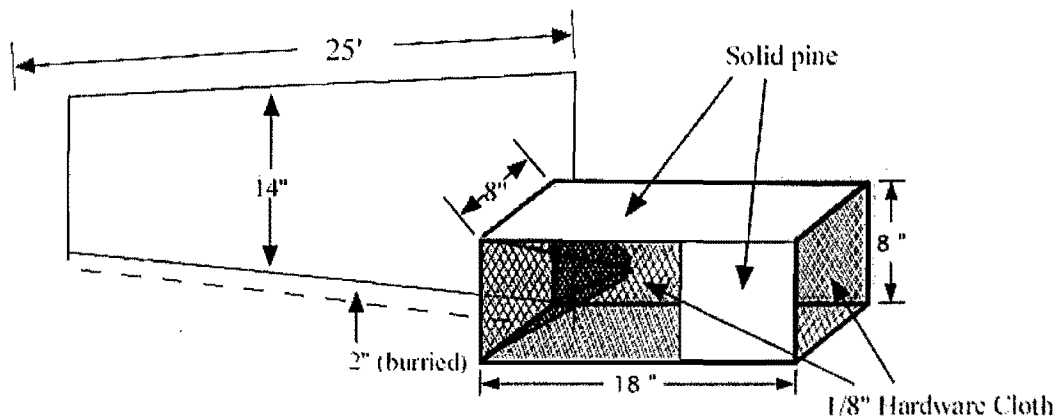
During the nighttime survey at the Archery Range irrigation pond, one healthy adult CRF was observed. The individual was located about 5 meters north of where Sanchez Creek flows into the irrigation pond. No CRF were observed during the daytime survey. There were no captures of CRF in the traplines set up around the irrigation pond.

Three different species of snakes, the Coast Garter Snake, 57.1%, the Santa Cruz aquatic garter snake, 28.6%, and the rubber boa, 14.3%, were found (Table 4) near the Archery Range irrigation pond. Seventeen total vertebrate species were captured with a total number of 80 individuals (Table 5). Simpson reciprocal Index $D = 10.2$ and Evenness $E = 0.59$.

Trapline Schematic (plane view)



Trapline Schematic (oblique view) Snake Trap Design and Dimensions



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5 Nov 2004

Figure 4. SFGS Funnel Trap

Table 1. Snake Species Found at Lower Sanchez

Species	Number of Individuals	(%)	Relative Frequency
<i>Coluber constrictor mormon</i> (Western Yellow-bellied Racer)	12	8.3	0.08
<i>Thamnophis sirtalis tetrataenia</i> (San Francisco Garter Snake)	7	4.9	0.05
<i>Thamnophis elegans terrestris</i> (Coast Garter Snake)	124	86.1	0.86
<i>Thamnophis atratus atratus</i> (Santa Cruz Aquatic Garter Snake)	1	0.7	0.01
Total No. of Individuals (N)	144	100.0	1.00

4.0 DISCUSSION

A small, but healthy population of SFGS was documented in the Lower Sanchez Creek watershed. The lack of SFGS captures at Upper Sanchez does not indicate absence of SFGS from the area, but does indicate habitat quality at the irrigation pond is marginal and any SFGS occurrence there under the current conditions is likely to be transient. SFGS would potentially inhabit the site on an irregular basis. The irrigation pond is situated between two known occupied SFGS localities. Irrigation pond is less than 0.80 miles west of and hydrologically connected to the Lower Sanchez Creek wetlands, which are occupied by a breeding population of SFGS. A breeding population of SFGS is also known from the San Andreas Lake less than 2.0 miles to the southeast of the irrigation pond (CNDDDB 2004).

Presence of CRF was documented at both Upper and Lower Sanchez. CRF were most abundant at Lower Sanchez, near Laguna Salada and at Horse Stable Pond.

CRF were determined to be present at the irrigation pond (upper Sanchez), but there does not appear to be successful breeding population there. The habitat at irrigation pond is very marginal for successful CRF breeding and rearing, due to the presence of predatory fish. The lack of any trap captures of CRF or other observations of CRF during at least 70 daytime visits to the site, also indicates very limited use of the pond by CRF, in its current condition.

The coast garter snake appeared to be the dominant species of the five species of snakes caught in the entire study area. Although the coast garter snake was more abundant in Lower Sanchez than in Upper Sanchez, it was found in the entire study area. SFGS showed a tendency towards the seasonal GGNRA wetland, as did the coast garter snake and the western yellow-bellied racer. The third most abundant species, the western yellow-bellied racer, was not found at Laguna Salada or the irrigation pond, but was present at the seasonal wetland on the GGNRA site. Even though there are considerable differences in the number of individuals of each species of snake captured, the population structure appears to be balanced between males and females. This could be interpreted to indicate a long residence of these species in this area. Figure 7 displays the positive correlation between mass and snout-vent length of SFGS in Lower Sanchez. The SFGS are not losing weight as they grow. This may be an indicator of a healthy population. This may also suggest that the population is equally composed of juveniles (small size) and adults (medium and larger size). This equal age distribution could maintain a viable population with low number of individuals.

In general, the biological diversity shown by Simpson's Index at Lower Sanchez was slightly lower than at Upper Sanchez. This is probably a result of the differences in the number of trapping days between the sites and the number of traplines placed in each site. The total number of species found was the same for Lower and Upper Sanchez, but the number of individuals caught from each site differed. This marks the differences in biodiversity between sites and consequently the difference in their evenness.

The higher abundance of species in the GGNRA wetland site and Horse Stable Pond may be a result of the lower disturbance level at these sites. Laguna Salada is a high-use area for people and domestic dogs. This has created sparsely-vegetated open areas that may consequently have low prey availability (i.e., tadpoles, frogs) and high risk of predation by birds (corvids), feral cats, or domestic dogs that play in the water.

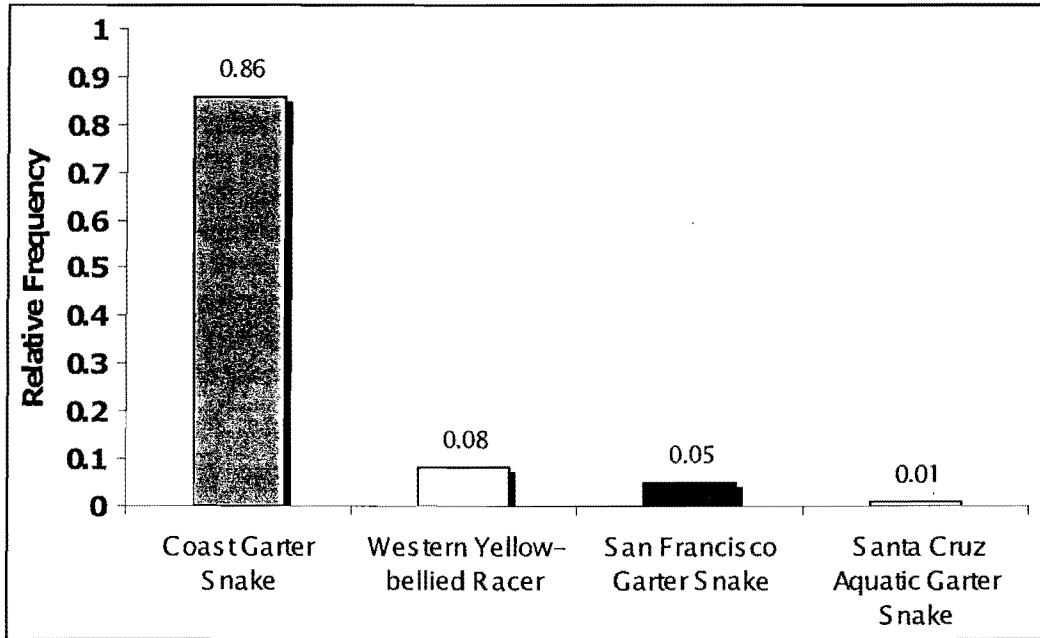


Figure 5. Relative Frequency of Snake Species at Lower Sanchez

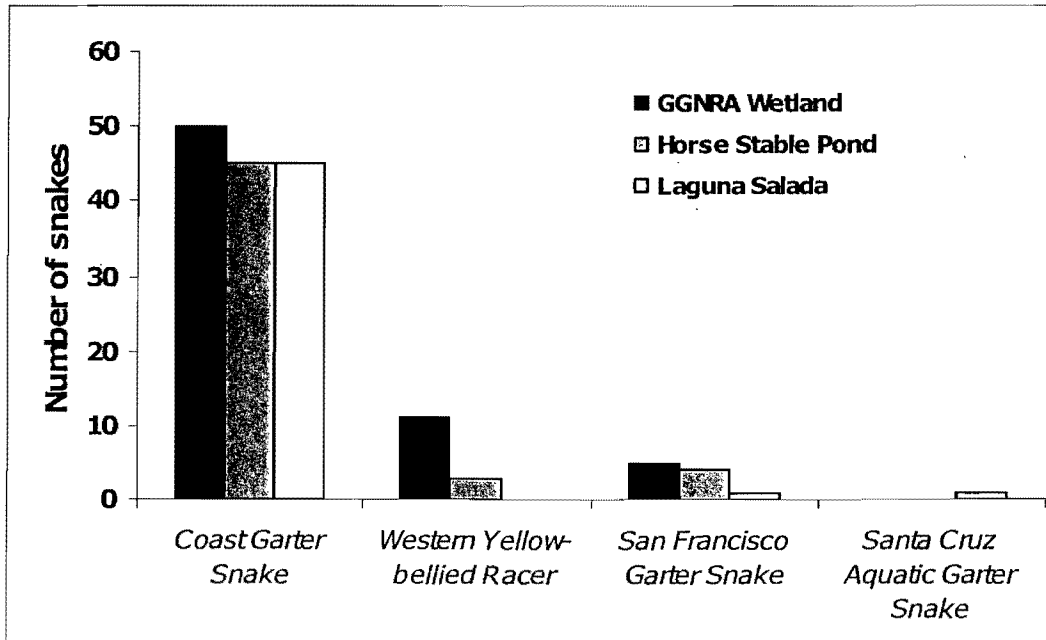


Figure 6. Total Number of Individual Snakes Captured at Lower Sanchez

Table 2. Sex Composition of Three Snake Species Found at Lower Sanchez

	<i>Coluber constrictor mormon</i> (Western Yellow-bellied Racer)	<i>Thamnophis sirtalis tetrataenia</i> (San Francisco Garter Snake)	<i>Thamnophis elegans terrestris</i> (Coast Garter Snake)
Male (M)	8	4	60
Female (F)	4	3	64
Total	12	7	124
Sex ratio (100M/Total)	66.7%	57.1%	48.4%

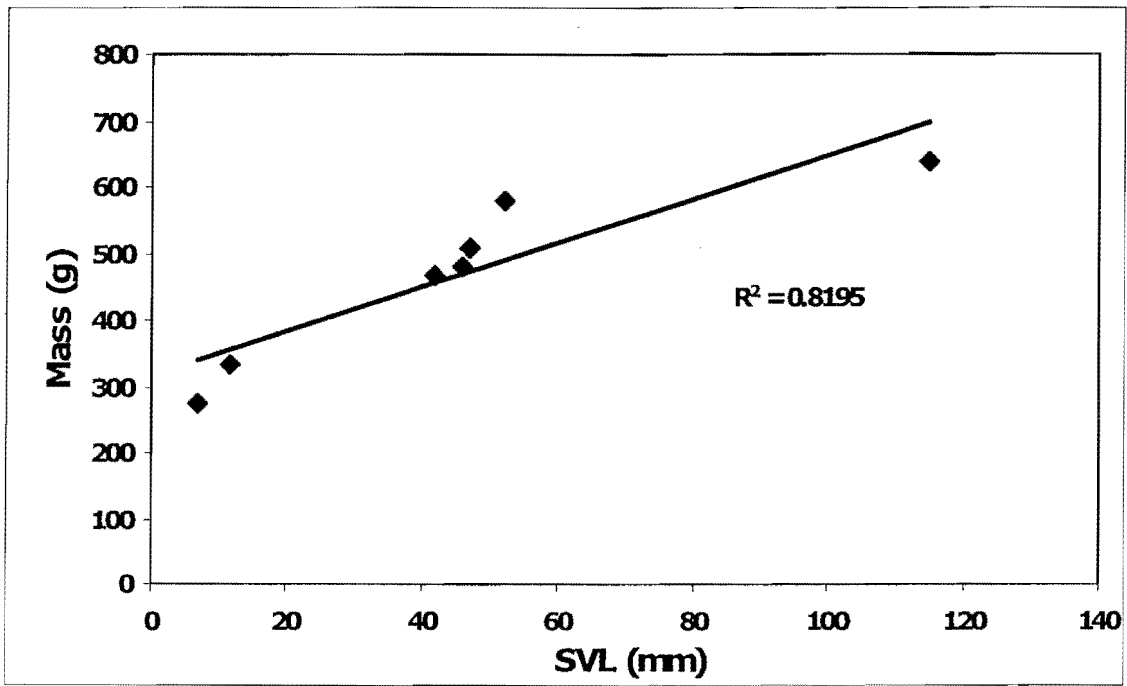


Figure 7. Relationship Between Mass and Total Length for SFGS at Lower Sanchez

Table 3. Total Vertebrates Caught at Lower Sanchez

Data for number of individuals is unknown for species that were not marked.

Scientific name	Common name	No. Captures	No. Individuals
<i>Ensatina eschscholtzii xanthoptica</i>	Yellow-eyed Salamander	2	Unknown
<i>Batrachoseps attenuatus</i>	California Slender Salamander	7	Unknown
<i>Rana aurora draytonii</i>	Red-legged Frog	7	Unknown
<i>Hyla regilla</i>	Pacific Treefrog	2	Unknown
<i>Elgaria multicarinata multicarinata</i>	California Alligator Lizard	1	Unknown
<i>Elgaria coerulea coerulea</i>	San Francisco Alligator Lizard	23	Unknown
<i>Coluber constrictor mormon</i>	Western Yellow-bellied Racer	14	12
<i>Thamnophis sirtalis tetrataenia</i>	San Francisco Garter Snake	10	7
<i>Thamnophis elegans terrestris</i>	Coast Garter Snake	140	124
<i>Thamnophis atratus atratus</i>	Santa Cruz Aquatic Garter Snake	1	1
	Unknown bird	6	Unknown
<i>Sorex sp.</i>	Shrew	58	Unknown
<i>Thomomys bottae</i>	Botta Pocket Gopher	11	Unknown
<i>Reithrodontomys megalotis</i>	Western Harvest Mouse	60	Unknown
<i>Peromyscus sp.</i>	Deer Mouse	10	Unknown
<i>Microtus californicus</i>	California Meadow Vole	75	Unknown
<i>Rattus rattus</i>	Black Rat	1	Unknown
<i>Mus musculus</i>	House Mouse	2	Unknown

Table 4. Snake Species Found at Upper Sanchez

Species	Number of Individuals	Sex M/F	(%)	Relative Frequency
<i>Charina bottae</i>	1	1/-	14.3	0.14
<i>Thamnophis elegans terrestris</i>	4	2/2	57.1	0.57
<i>Thamnophis atratus atratus</i>	2	1/1	28.6	0.28
Total No. of Individuals (N)	7		100.0	1.00

Table 5. Total Vertebrates Caught at Upper Sanchez

Scientific name	Common name	No. Captures	No. Individuals
<i>Taricha granulose</i>	Rough-skinned Newt	2	Unknown
<i>Taricha torosa torosa</i>	Coast Range Newt	5	Unknown
<i>Ensatina eschscholtzii xanthoptica</i>	Yellow-eyed Salamander	6	Unknown
<i>Aneides lugubris</i>	Arboreal Salamander	1	Unknown
<i>Batrachoseps attenuatus</i>	California Slender Salamander	4	Unknown
<i>Hyla regilla</i>	Pacific Treefrog	6	Unknown
<i>Sceloporus occidentalis</i>	Western Fence Lizard	15	Unknown
<i>Charina bottae</i>	Rubber Boa	1	1
<i>Thamnophis elegans terrestris</i>	Coast Garter Snake	4	4
<i>Thamnophis atratus atratus</i>	Santa Cruz Aquatic Garter Snake	2	2
<i>Sorex sp.</i>	Shrew	4	Unknown
<i>Scapanus latimanus</i>	Broad-handed Mole	1	Unknown
<i>Thomomys bottae</i>	Botta Pocket Gopher	1	Unknown
<i>Reithrodontomys megalotis</i>	Western Harvest Mouse	1	Unknown
<i>Peromyscus sp.</i>	Deer Mouse	11	Unknown
<i>Microtus californicus</i>	California Meadow Vole	14	Unknown
<i>Mustela frenata</i>	Long-tailed Weasel	1	Unknown

5.0 LITERATURE CITED

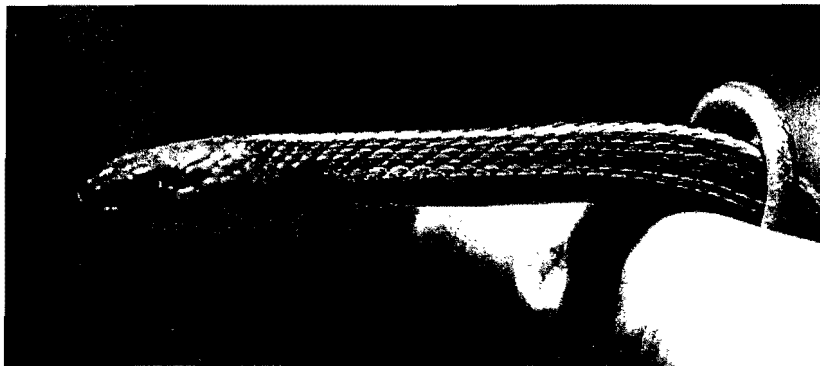
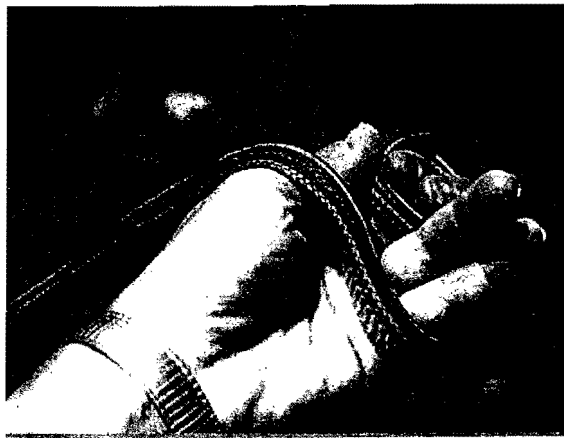
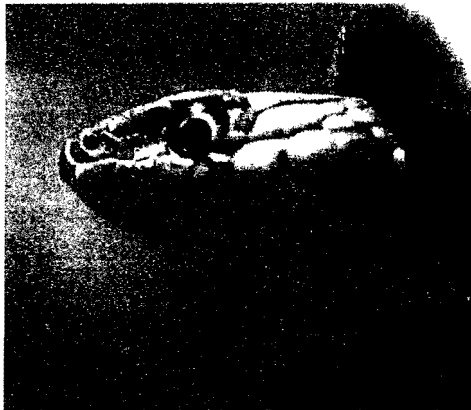
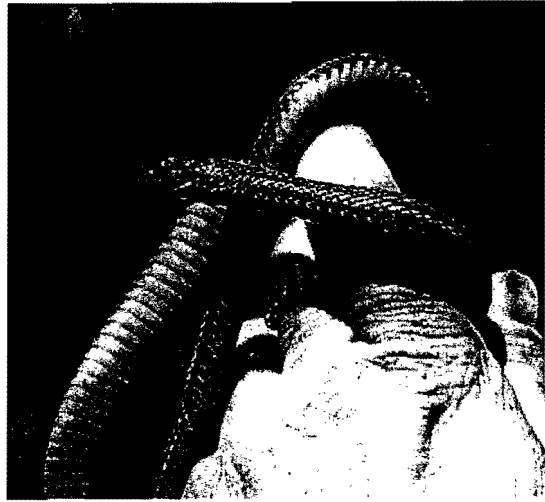
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6.0 PERSONAL COMMUNICATIONS

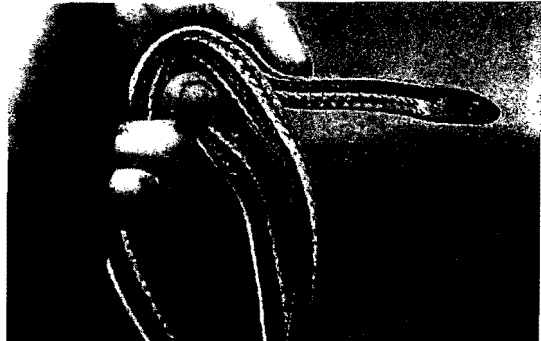
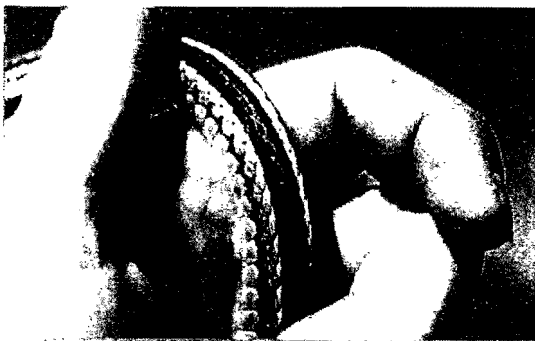
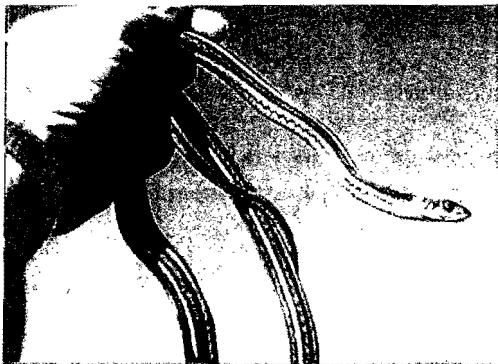
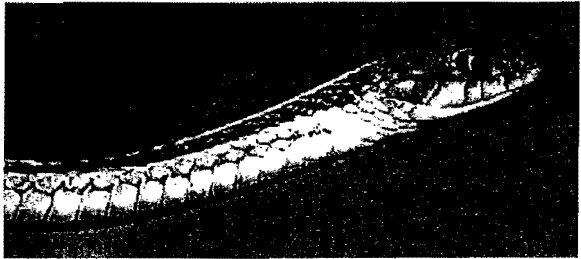
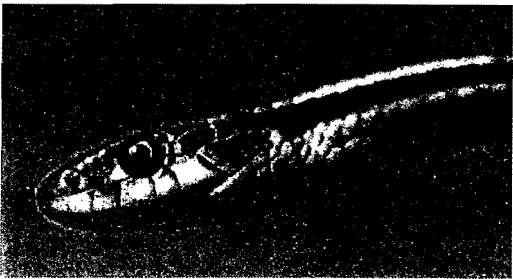
- David Johnston, California Department of Fish and Game Biologist, Santa Cruz, CA
May, 2004.

APPENDIX A
SAN FRANCISCO GARTER SNAKE PHOTOS

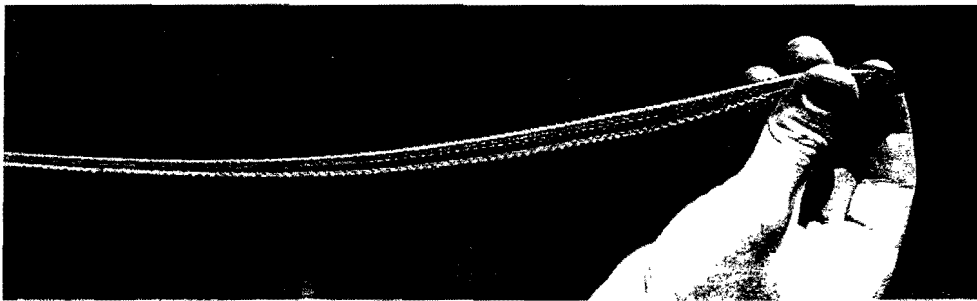
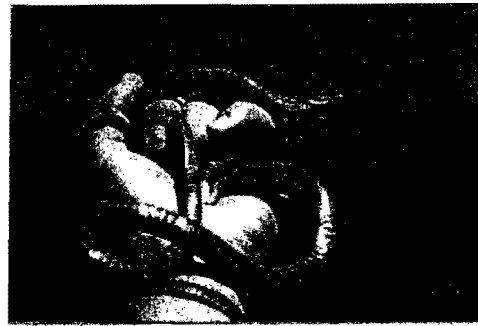
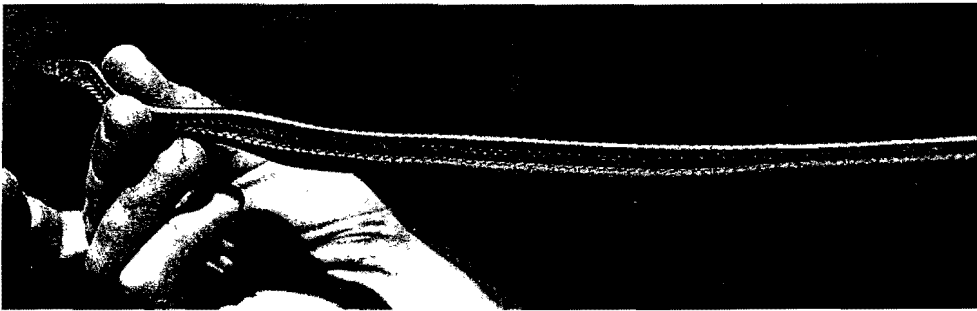
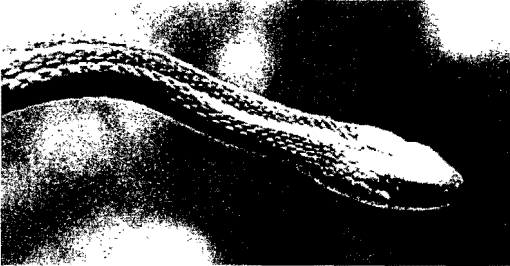
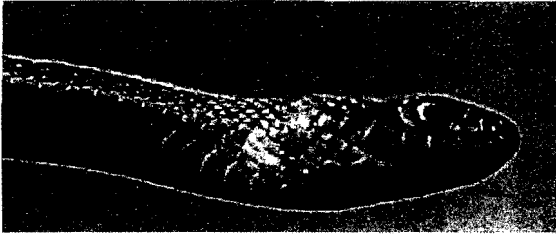
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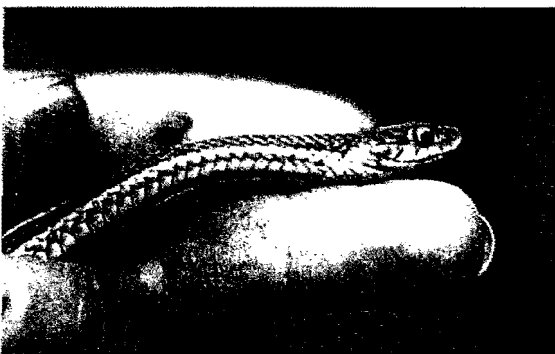
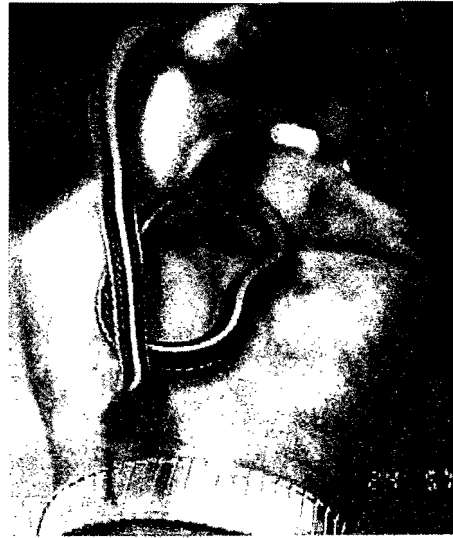
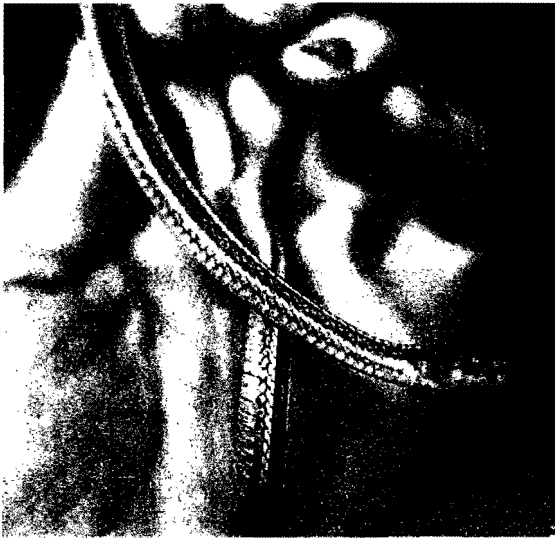
SFGS #2



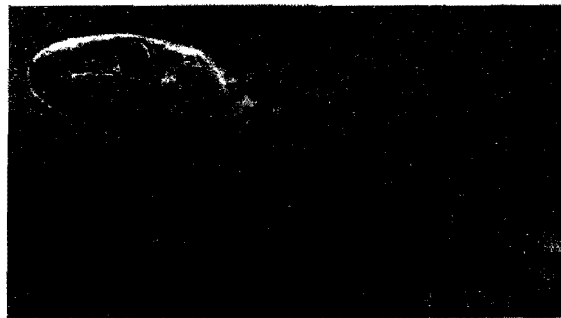
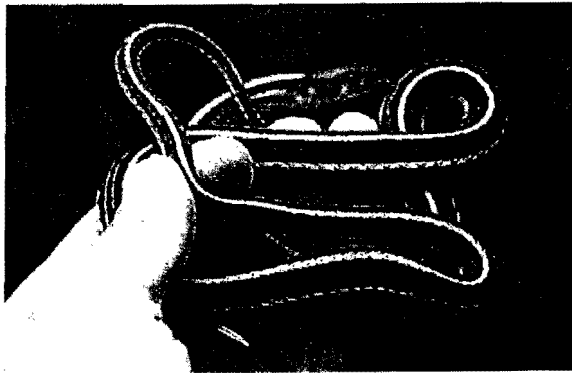
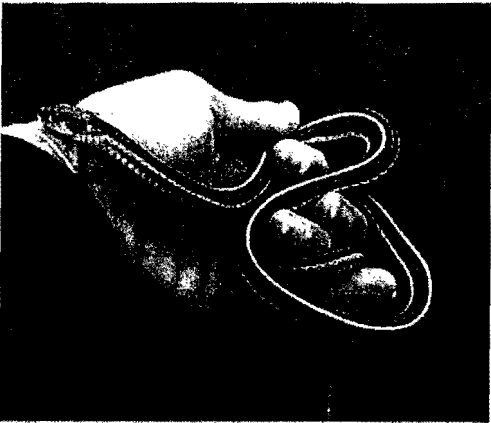
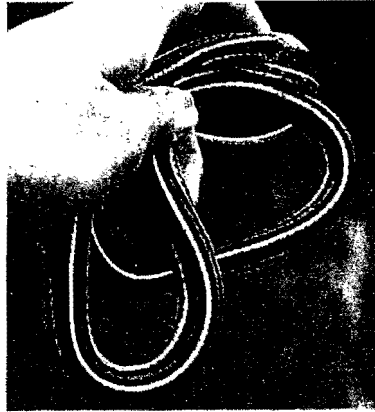
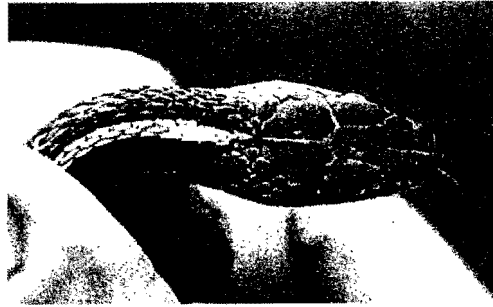
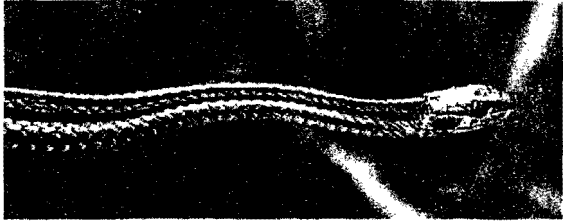
SFGS #3



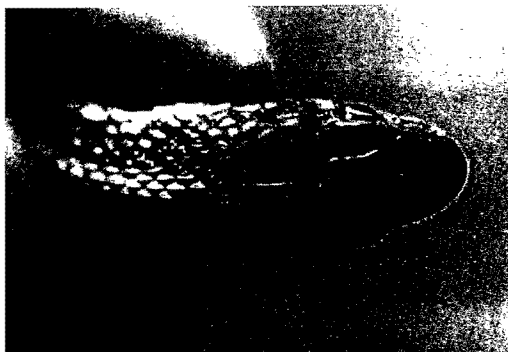
SFGS #4



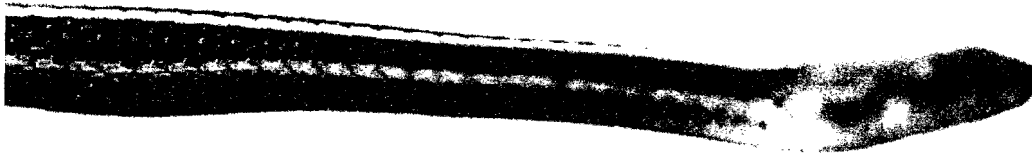
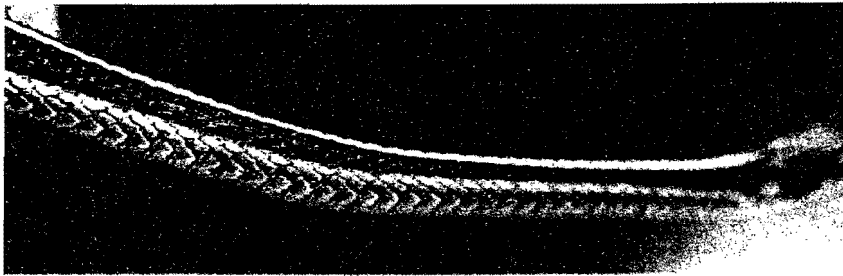
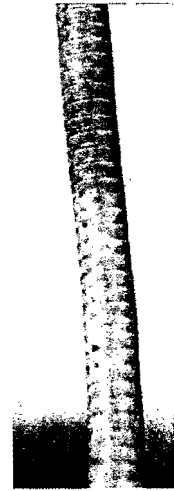
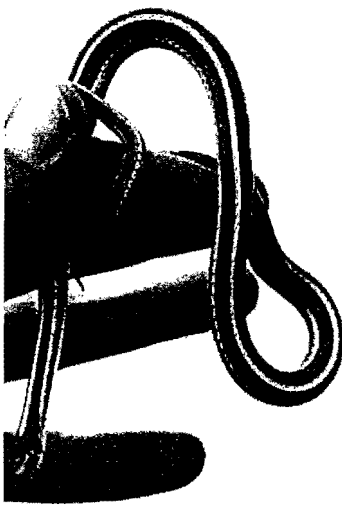
SFGS #6,7



SFGS #7



SFGS #8



SFGS #8, cont'd.

