

RECOVERY PLAN FOR THE
SAN FRANCISCO GARTER SNAKE
Thamnophis sirtalis tetrataenia

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A handwritten signature in black ink, appearing to be "Debra Linn", written over a horizontal line.

9/11/85

Date

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LITERATURE CITATIONS SHOULD READ AS FOLLOWS:

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Informatics General Corporation
6011 Executive Boulevard
Rockville, Maryland 20852
Telephone: 800-582-3421
In Maryland 301-770-3000

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Recovery Plan Executive Summary

1. Point or condition when the species can be considered recovered?

When 10 populations of the San Francisco garter snake are adequately protected and each supports at least 200 adult snakes (50:50 sex ratio) for 15 consecutive years, the garter snake may be considered for delisting.

2. What must be done to reach recovery?

Secure the 6 presently known populations each with at least 200 adult snakes (50:50 sex ratio); protect/establish 4 additional populations each with at least 200 adult snakes (50:50 sex ratio); determine population levels and enhance, if necessary; implement site specific management plans; undertake law enforcement and public awareness efforts.

3. What specifically must be done to meet the needs of #2?

Life history studies and habitat surveys must be completed and population trends and habitat needs determined; specific habitat areas must be delineated, secured, and habitat management plans developed; local planning agencies must be informed of SFGS management needs on a site-by-site basis.

4. What management/maintenance needs have been identified to keep the species recovered?

Successful implementation of management plans, public awareness programs, law enforcement efforts and integration of recovery plan objectives into local land-use planning.

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SAN FRANCISCO GARTER SNAKE RECOVERY PLAN

PART I

INTRODUCTION

Brief Overview

The San Francisco garter snake (SFGS) (Thamnophis sirtalis tetrataenia) is one of the eleven recognized subspecies of the common garter snake (Thamnophis sirtalis). The subspecies, T. s. tetrataenia, is endemic to the San Francisco Peninsula and is known only from San Mateo County, California. Because much of its range lies within an intensively urbanized area, this subspecies is primarily threatened by urban development, freeway and road construction, trampling, illegal collection, and the concomitant loss and alteration of suitable habitat. The SFGS was listed as a Federal endangered species in March 1967 (32 Federal Register 4001) and as a State endangered species in May 1971 [California Department of Fish and Game (CDFG) 1980].

Description

The genus Thamnophis (family Colubridae) includes the slender serpents commonly known as garter snakes. These harmless snakes are considered beneficial to man, because their prey items occasionally include small mammals, reptiles, amphibians and possibly invertebrates

that some consider nuisances and also because of their significance in the energetics of local ecosystems (Fitch 1965).

Because of its very distinctive coloration, the SFGS is considered one of the most beautiful snakes in North America (Figure 1). While most garter snakes have a conspicuous pale yellow or orange vertebral stripe and a pale stripe low on each side, the SFGS has a wide dorsal stripe of greenish-yellow edged with black, bordered on each side by a broad red stripe which may be broken or divided, followed by a black stripe. The belly is greenish-blue in color and the top of the head is red. The eyes are relatively large, and usually seven upper and ten lower labial scales are present. The body scales are in 19 rows and the dorsal scales are weakly to strongly keeled (California Department of Fish and Game 1980, Fox 1951). Adults grow to a maximum length of 130 cm (51 inches) (Stebbins 1966).

Taxonomy

Confusion resulting from a mislabeling of the first collected specimens delayed the proper taxonomic placement of the SFGS until 1951. Fox (1951) reviewed and clarified the complicated taxonomic history of the SFGS by demonstrating that specimens reported by Cope (in Yarrow 1875, Cope 1892) as Eutaenia sirtalis tetrataenia from the "Pitt" (Pit) River in northeastern California and from Puget Sound in Washington were assigned incorrect localities when labeled and were

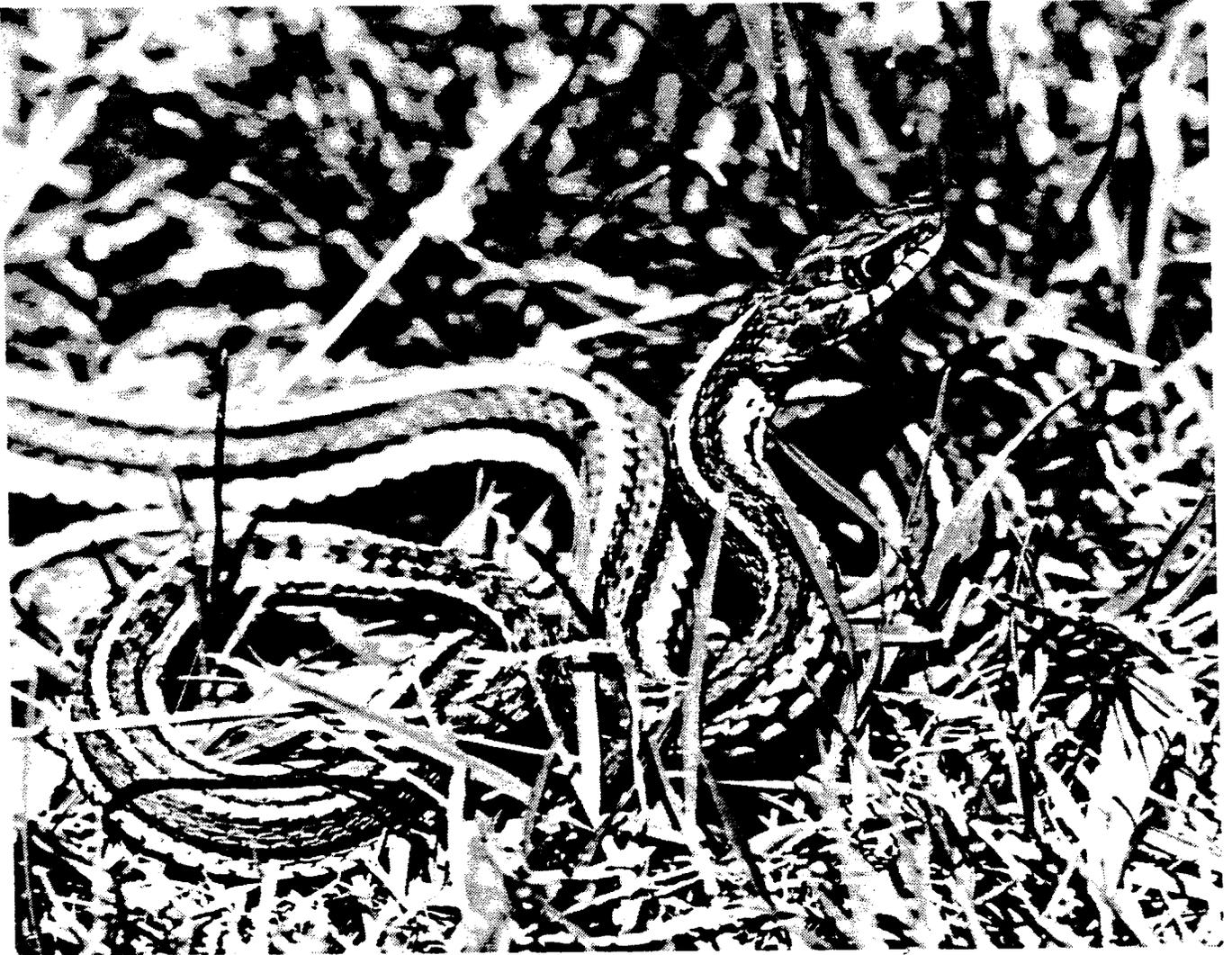


Figure 1. Photograph of the San Francisco garter snake by John Brode, California Department of Fish and Game.

actually collected on the San Francisco Peninsula. The subspecific name tetrataenia has since been applied only to I. sirtalis from San Mateo County. Fitch (1965), basing his description on individuals patterned as depicted in Figure 2A, considered tetrataenia to be the most distinctive of all sirtalis subspecies. However, subsequent investigators (Bury 1971, Barry 1978a) have noted that several populations exhibit varying percentages of individual snakes with an interrupted stripe (Figure 2B). The continuity of the lateral black and red stripes which characterize the type specimen of tetrataenia is broken to varying degrees in these populations. Some individuals in these populations exhibit color patterns similar to that of a neighboring subspecies, the California red-sided garter snake (I. s. infernalis). In I. s. infernalis lower black stripe is absent, and a series of regularly spaced black blotches are contiguous with the upper black stripe (Figure 2D).

The blotched pattern considered by Bury (1971) to be that of an "intergrade" or "hybrid" (Figure 2B) was judged by Barry (1978a) to be simply a "variation of the true I. s. tetrataenia." Barry (1978a) noted that the blotches occurred only in the region of the neck and that posteriorly, a pattern consisting of an unbroken lateral red stripe on each side persisted. Barry (1978a) compared percentages of population color pattern variation between specimens which he collected in the 1970's with museum specimens collected by Fox in the late 1940's and found no significant change.

← ANTERIOR



A. *T.s.tetrataenia*



B. *T.s.tetrataenia*
Variation



C. Intergrade



D. *T.s.infernalis*

C. van Dyck

Figure 2. Diagrammatic representation of the Black and red pigmentation on the sides of *T.s. tetrataenia*, *T.s. infernalis*, intergrade, and atypical forms. The anterior edge of pattern B corresponds to the 11th ventral scale. Figure taken from Barry (1978a).

Fox (1951) and Barry (1978a) both noted that intergradation between subspecies tetrataenia and infernalis was restricted to a localized area along the boundary between San Mateo and Santa Clara counties in the vicinity of Palo Alto. In these specimens, the lateral red stripes are completely broken (Figure 2C). Intergrade populations have been reported from Emerald Lake, Lake Lagunita, and Foothills Park. Barry (1978a) suggested that intergrades in this area probably were more numerous in the past, but that as the area became more urbanized, the two subspecies have become increasingly isolated from each other.

Life History

Few specific life history details have been established for the SFGS. Most information is inferred from studies of closely related subspecies or similar species. Studies specific to the SFGS must be undertaken before a complete management program can be developed.

Behavior: San Francisco garter snakes are extremely wary and when approached will flee into nearby water or cover. Thus these snakes are very difficult to locate, observe, and capture. SFGS are known to bask in the sun at the pond or stream edge much like other sirtalis subspecies (Fox 1951). They also have been observed to occur infrequently in upland grasslands away from streams and ponds (John Brode pers. comm.).

Food Habits: The principal prey items of the SFGS reported by Fox (1951) and Barry (1978a) are red-legged frogs (Rana aurora). However, recent investigations by CDFG indicate that the SFGS has a more generalized diet (John Brode pers. comm.). Red-legged frogs, Pacific tree frogs (Hyla regilla), immature California newts (Taricha torosa), recently metamorphosed western toads (Bufo boreas), the threespine stickleback (Gasterosteus aculeatus), and mosquito fish (Gambusia affinis) have also been recorded in the diet. Small mammals are not known to be taken but may occasionally be eaten as well. More information is needed on the diet, foraging activities, seasonal and age-specific food habits of the SFGS.

Reproduction: The reproductive cycle of the SFGS has been studied by Fox (1952, 1954, 1956) and is similar to other Pacific coast subspecies of I. sirtalis (Stewart 1968). Mating occurs either in the spring or fall but is especially concentrated in the first few warm days of March. In the closely related subspecies, I. s. parietalis and I. s. concinnus, the female's role in mating is almost entirely passive, and several or many males may simultaneously court the same female (Fitch 1965, Stewart 1968). Males actively search for females, which are found presumably by scent. Mating aggregations of the SFGS have been observed in late October and early November (Fox 1955) on open grassy sunny slopes on warm mornings. Additional details on reproduction in the SFGS can be found in the literature cited.

Ovulation in I. sirtalis generally occurs in late spring, pregnancy in early summer, and birth of young sometime in July or August. Like most garter snakes, I. sirtalis is ovoviviparous with litter sizes ranging from 3-85 young and average litters of 12-24 young (Fitch 1970). It is presumed that fecundity and litter sizes in the SFGS would be similar. Like many members of the genus Thamnophis, female SFGS can store sperm throughout the winter (Fox 1956). Some members of the genus Thamnophis are known to retain viable sperm for periods of 3 to 53 months (Rahn 1940, Hebard 1951, Stewart 1972).

Movements: Virtually nothing is known of the seasonal movements of the SFGS. Fitch (1965) found that males of the red-sided garter snake (I. s. parietalis) in Kansas moved an average of about 532 m and females about 347 m between their summer habitat and overwintering dens. Gregory and Stewart (1975) found that summer dispersal of the same subspecies in the Interlake region of Manitoba, Canada, involved long distances ranging from 4.3 km to 17.7 km. The average distance moved in Manitoba was 10.7 km. Distances for the SFGS probably are not as great, however, because of the more equable climate of the San Francisco Peninsula. It is anticipated that individual SFGS would have definite home ranges, determined largely by site conditions (i.e., availability of food, cover, etc.) as discussed by Stickel and Cope (1947). Specific details on movement patterns of the SFGS will require site-specific studies.

Habitat: SFGS are observed most often in the vicinity of standing water, chiefly ponds, lakes, marshes and sloughs (Fox 1951). However, temporary ponds and other seasonal water bodies are also used by them. Emergent and bankside vegetation such as cattails (Typha spp.), bulrushes (Scirpus spp.), and spike rushes (Juncus spp.) apparently are preferred and used for cover. The interface between stream and pond habitats and grasslands is used for basking, while nearby dense vegetation or water often provide escape cover. If floating algal or rush mats are available, snakes will utilize these, as they apparently offer more secure basking sites.

Recent field studies by CDFG found that differential use of habitat by SFGS may occur (John Brode pers. comm.). Observations suggest that upland sites such as grassy hillsides near drainages and ponds also are used for basking, rodent burrows away from standing water for shelter and escape, and low-lying marsh areas for feeding and reproduction. The degree to which upland sites are used, however, is not known. More studies are needed to clarify habitat usage by the SFGS, especially on a site-by-site basis.

Historic and Current Distribution

Historically, San Francisco garter snakes were found on the San Francisco Peninsula from approximately the San Francisco County line south along the eastern and western bases of the Santa Cruz Mountains,

at least to the Upper Crystal Springs Reservoir, and along the coast south to Ano Nuevo Point, San Mateo County, California (Barry 1978a) (Figure 3).

Although areas within southwestern San Francisco County appear suitable for the SFGS, no sightings or collections from this area have been reported in the literature or from museum records (Fox 1951, Banta and Morafka 1966). Sag ponds* along the San Andreas fault historically supported this snake (Fox 1951). Many of the historical locations where this subspecies was collected have been destroyed by urbanization, especially in the northern and possibly eastern portions of its range (Figure 4). Present distribution of the SFGS is depicted in Figure 3. Fox (1951) believed the purest populations of I. s. tetrataenia occurred on the coast around Sharp Park (Laguna Salada) and along the ridge of the San Francisco Peninsula (Skyline Boulevard) east of Sharp Park. Only 12 localities of the SFGS were identified by Fox and only 3 localities noted south of San Andreas Reservoir (near Crystal Springs Reservoir, La Honda and Point Ano Nuevo). Barry (1978a) reported 28 localities for the SFGS, but he also found that the sag pond habitats along Skyline Boulevard had been destroyed by housing developments and no longer supported the snake (Figure 3).

* The term "sag pond" refers to small seasonal ponds formed along the San Andreas fault in the northern part of the San Francisco Peninsula. They are collectively referred to as the "Skyline Ponds" in Figure 3.

- T. s. tetrataenia*
 ● Surviving
 ○ Extirpated
 ⊙ Unverified
INTERGRADES
 ▲ Surviving
 △ Extirpated
 ▲ Unverified
T. s. infernalis
 ■ Surviving

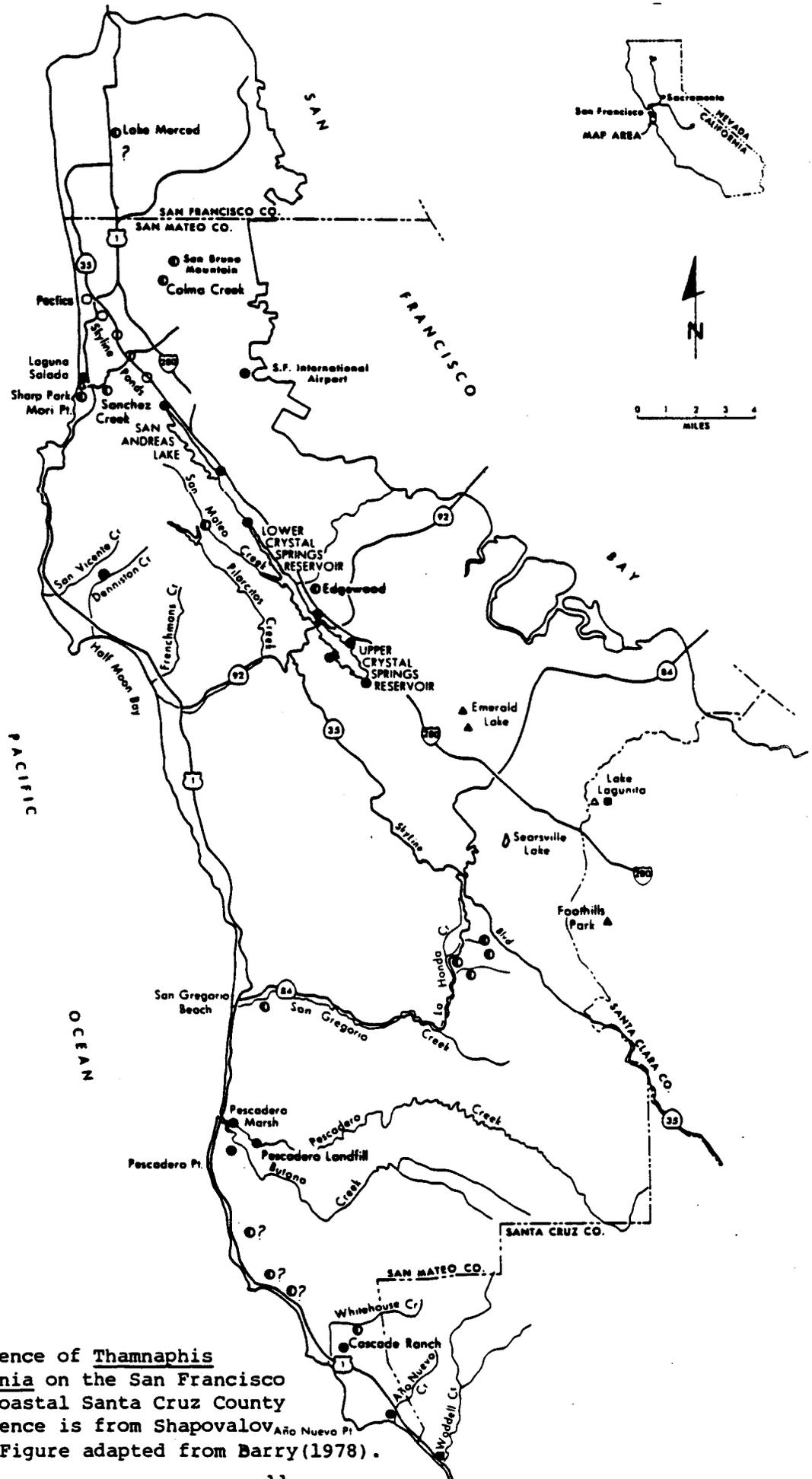


Figure 3. Occurrence of *Thamnaphis sirtalis tetrataenia* on the San Francisco Peninsula. The coastal Santa Cruz County *infernalis* occurrence is from Shapovalov and Taft (1954). Figure adapted from Barry (1978).

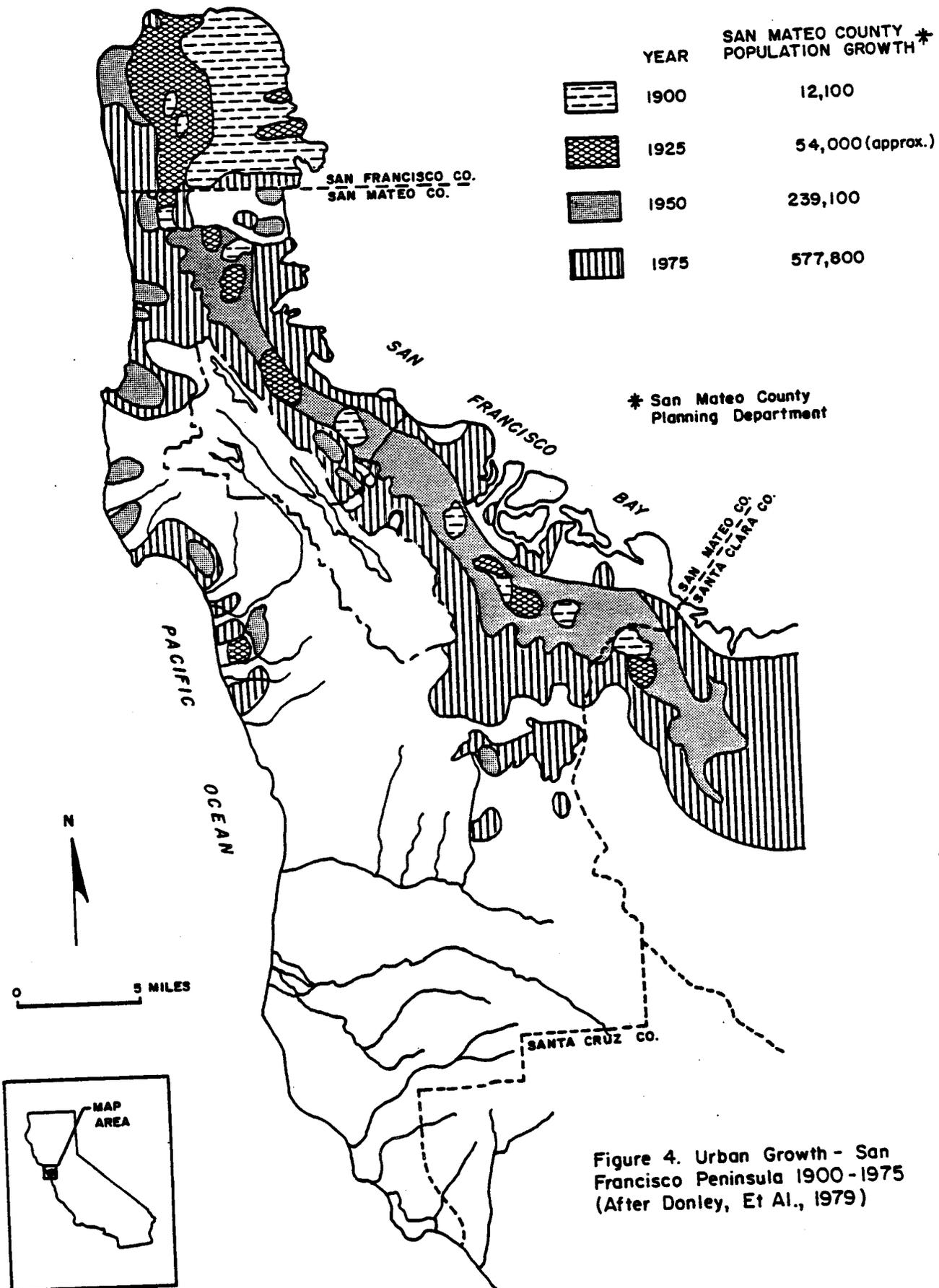


Figure 4. Urban Growth - San Francisco Peninsula 1900-1975 (After Donley, Et Al., 1979)

Reasons for Decline

Alteration and isolation of habitats resulting from urbanization is the principal reason for decline of the SFGS. This includes loss and adverse modification of wetland and adjacent upland habitat by urban, industrial, and recreational development, as well as agricultural conversion, stream and creek channelization, removal of emergent riparian vegetation, and riprapping of streambanks and shorelines. Although the snake's geographical range appears to be relatively extensive, recent field surveys conducted by the Service and CDFG suggest very limited and localized occurrence of I. s. tetrataenia in San Mateo County. Barry (1978a) reported 28 extant SFGS population sites and noted that 23 of the 28 (82 percent) were subject to human disturbance or threatened with destruction. The Skyline ponds near Pacifica, which formerly attracted large numbers of SFGS (and reptile collectors), have been eliminated by housing developments (Barry 1978a). At present, agricultural, commercial and urban development in the county continues to eliminate habitat for the SFGS (Figure 4) and is expected to continue through the 1980's (San Mateo County Planning Dept. 1976).

In addition to human-caused habitat loss and alteration, collection by reptile fanciers and dealers poses a significant threat to the SFGS because of its beautiful coloration. Barry (1978a) presented considerable evidence of collecting in areas such as the Skyline ponds,

Sharp Park and on the San Francisco Fish and Game Refuge (which includes both Lower and Upper Crystal Springs Reservoirs). Recent arrests by the CDFG and FWS of snake collectors possessing illegally taken SFGS indicate that this activity still poses a serious threat.

Previous Conservation Efforts

As mentioned earlier in the Brief Overview section, the San Francisco garter snake was listed as a Federal endangered species in March 1967 and as a State endangered species in May 1971. Although these acts recognized the plight of the SFGS, little progress has been made toward securing habitat for the snake or reducing the threats to its continued existence.

With the passage of the Endangered Species Act (ESA) of 1973 (Public Law 93-205) and subsequent amendments, all Federal agencies with jurisdiction within the range of the SFGS now are required to insure that their actions are not likely to jeopardize the SFGS. These agencies also are directed to use their authorities in furtherance of the purposes of the ESA.

Grant-in-aid funds, provided by FWS under a cooperative agreement with the CDFG have assisted in funding research on the SFGS. Law enforcement efforts which were strengthened with the passage of the Endangered Species Act of 1973, as amended, have helped to reduce the threats from illegal collection.

Although several State and local parks, open space reserves, recreation facilities, and ecological reserves have been established within the range of the SFGS, none provide protection specifically for the snake or its habitat. Only four managed areas are now known to harbor San Francisco garter snakes: Pescadero Marsh Natural Preserve, Ano Nuevo State Reserve, Laguna Salada at Sharp Park (part of a public golf course), and the San Francisco State Fish and Game Refuge (a 35 square mile land reserve managed primarily to provide municipal and industrial water for the City of San Francisco and San Mateo County). However, none of these areas can be considered a secure refuge for the SFGS because protection and management of the snake's habitat within these areas is largely inadvertent, or incidental to other goals or objectives for which the areas were originally established.

Current Status

Limited knowledge of the population size, life history and ecology of the San Francisco garter snake makes it difficult to precisely quantify the current status of the SFGS. Significant SFGS populations are known from Ano Nuevo State Reserve, Pescadero Marsh Natural Preserve, San Francisco State Fish and Game Refuge (including both Lower and Upper Crystal Springs Reservoirs), Sharp Park Golf Course (Laguna Salada), Cascade Ranch, and Milbrae (San Francisco Airport). Other SFGS sites reported by Barry (1978a, 1978b) have been surveyed for SFGS by CDFG personnel with limited success. A prior SFGS

inventory of 16 potential habitat sites located specimens in the Cascade Creek-Ano Nuevo drainage and areas adjacent to Pescadero Marsh (McGinnis 1984a). A much greater survey effort is necessary to identify suitable habitat, seasonal use areas, and actual habitat that supports San Francisco garter snakes.

The following locations and/or "populations" reported by Barry (1978a) have not been confirmed as extant by FWS or CDFG: San Bruno Mountain, Whitehouse Creek, Denniston Creek, La Honda Creek, Colma Creek, San Gregorio Creek, San Mateo Creek, Sanchez Creek, and near Edgewood and Canada roads. Barry's San Bruno Creek population corresponds to the Milbrae (Airport) site noted in this plan. Barry (pers. comm.) reports several additional SFGS sightings in pools situated along the immediate coast between Pescadero Point and the Cascade Ranch. Barry (1978b) has also reported the SFGS slightly south of Laguna Salada Marsh at Mori Point. The presence of the snake at this location has not been subsequently confirmed through trapping studies being conducted for the CDFG, although future investigations are planned.

Although Barry (1978a) provides the most recent published data on the occurrence and status of the SFGS, estimates of snake numbers (per population) were not given. In April of 1983, CDFG initiated a detailed life history study of the SFGS at the Milbrae (Airport) site (John Brode pers. comm.). Using a combination of drift traps, scute clipping, and observational techniques, data were collected on the

occurrence, numbers of snakes, their movements, food habits, and to a lesser extent, habitat relations. To date, in excess of 400 individual garter snakes have been captured, marked, and released. The study will be concluded during 1985 (John Brode pers. comm.).

Virtually no progress has been made since 1978 to secure habitat for the SFGS or to set aside a refugium specifically for the snake. None of the three known SFGS colonies on State managed land (Pescadero, Ano Nuevo, and the San Francisco watershed) can be considered secure, and the three known colonies on private land continue to be endangered by human activities that chronically degrade and destroy the snake's fragile wetland habitat. Finally, there is the continuing threat of illegal collection, which is difficult to quantify and nearly impossible to eliminate.

Current lack of detailed life history information on the snake, its habitat requirements, and confident population estimates prevents a determination as to when recovery may be achieved. Clearly, halting habitat loss and maintaining suitable population levels will be difficult tasks to accomplish in the face of rapid development. Fortunately, several areas of suitable habitat, some now occupied by SFGS, present prime opportunities to assure protection of the species. Provided adequate management programs can be developed and implemented over the next decade, recovery and eventual delisting of the San Francisco garter snake may become a reality.

PART II
RECOVERY

Objectives

The primary objective of this recovery plan is to protect and maintain a minimum of 10 San Francisco garter snake populations, each containing 200 adult snakes (50:50 sex ratio)*. If the above goal is obtained and maintained for 5 consecutive years for 6 of the 10 populations, consideration for threatened status would be appropriate. If these population levels at all 10 locations can be maintained for 15 consecutive years, consideration for delisting would then be appropriate. Achievement of the prime objective requires that basic life history studies be completed, population levels and boundaries of habitat areas be determined and secured throughout the range of the SFGS, and site-specific management plans be developed and vigorously implemented.

The ultimate objective of recovery planning for the SFGS is to remove it from the list of threatened and endangered species by reducing all threatening factors to a level where the species and its ecosystem are once again assured of their continued self-maintenance. The Service assumes that the above goal will be sufficient to delist this species

* This number is very flexible, and will ultimately vary with each site. A final "optimal" population number for each SFGS site will be based on detailed field estimates with consideration given for effective population size and projected survivorship.

but modifications may be required as additional information becomes available and as conditions change within the range of the snake. Moreover, we may find that additional areas will be required for movement corridors, breeding sites, foraging areas, and to maintain genetic interchange between populations.

Whether or not delisting is achievable with the above goal cannot be determined with certainty at this time. Besides the obvious lack of adequate biological information, the fact that urbanization in San Mateo County continues to modify important wetland and adjacent upland habitats for the snake creates by far the greatest difficulties for the recovery of the SFGS. Much of the former habitat of the snake has been eliminated by urban and industrial expansion, and most of the remaining habitat is threatened by continuing development or other human activities. Many of the known or suspected locations for the SFGS are adjacent to or surrounded by urban developments. Special protection measures and intensive management will be required to maintain SFGS populations close to urban areas where land-use conflicts often severely hamper attempts to protect the species and its habitat.

At this time, the 6 SFGS populations discussed within this Recovery Plan are essential to the long-term survival of the subspecies. In addition, because we know so little about snake movements within and between populations and population recruitment rates, it is necessary

to protect additional SFGS populations. Tentatively, a goal of managing four additional populations seems appropriate. This appears feasible at present, given the availability of seemingly suitable habitat within the county. Success, however, will depend on effective coordination and planning between involved local governments, the California Department of Fish and Game, and the U.S. Fish and Wildlife Service, and upon the continued availability of suitable SFGS habitat.

Step-down Outline

Primary Objective: Protect and maintain a minimum of 10 SFGS populations with approximately 200 adults (50:50 sex ratio) at each site within the snake's historic range for 15 consecutive years; delisting can then be considered. If 6 of 10 populations are protected and maintained, with as a minimum 200 snakes (50:50 sex ratio) for 5 consecutive years, reclassification to threatened status will be considered. (Note: Precise target numbers for SFGS populations will be based upon detailed analysis of area carrying capacity within each respective site.)

1. Use legal authorities to protect the SFGS and its habitat.
 11. Enforce existing laws and regulations to promote the conservation of the SFGS and its habitat.
 12. Evaluate success of law enforcement.
 13. Propose appropriate new regulations or revisions.
2. Protect the 6 known SFGS colonies through appropriate management.
 21. Pescadero Marsh Natural Preserve.
 211. Secure cooperation of the California Department of Parks and Recreation to manage and protect the SFGS.
 212. Develop and implement a management plan for the SFGS at Pescadero Marsh Natural Preserve.
 213. Monitor SFGS at Pescadero.
 214. Minimize degradation and/or loss of SFGS habitat at Pescadero.

22. Ano Nuevo State Reserve.
 221. Secure cooperation of the California Department of Parks and Recreation to manage and protect the SFGS.
 222. Develop and implement a management plan for the SFGS at Ano Nuevo State Reserve.
 223. Monitor the SFGS at Ano Nuevo.
 224. Minimize degradation and/or loss of SFGS habitat at Ano Nuevo.
23. San Francisco State Fish and Game Refuge.
 231. Secure cooperation of the San Francisco Water District (SFWD) and other involved agencies to manage and protect the SFGS on the San Francisco State Fish and Game Refuge.
 232. Develop and implement a management plan for the SFGS at the San Francisco State Fish and Game Refuge.
 233. Monitor the SFGS at the refuge.
 234. Minimize degradation and/or loss of SFGS habitat on the refuge.
24. San Francisco Airport/Milbrae site.
 241. Secure cooperation of the City of San Francisco and San Francisco Airport to manage and protect the SFGS at the Milbrae Site.
 242. Develop and implement a management plan for the SFGS at the San Francisco Airport/Milbrae site.

243. Prevent illegal entry.
 2431. Maintain the fence.
 2432. Provide frequent patrols.
244. Monitor the SFGS at the Milbrae site.
245. Minimize degradation and/or loss of SFGS habitat.
246. Identify areas at the Milbrae site that are important for the maintenance of the garter snake.
25. Sharp Park Golf course at Laguna Salada.
 251. Secure cooperation of the Sharp Park Golf Course administrators to manage and protect the SFGS at Laguna Salada.
 252. Develop and implement a management plan for the SFGS at the Sharp Park Golf Course at Laguna Salada.
 253. Minimize adverse impacts to garter snakes at Laguna Salada from foot traffic, human encroachment, illegal collecting and chemical treatments.
 254. Monitor the SFGS at Laguna Salada.
26. Cascade Ranch.
 261. Secure SFGS habitat on the Cascade Ranch.
 262. Develop and implement a management plan for the SFGS at the Cascade Ranch.
 263. Minimize adverse impacts to garter snakes from trampling and human encroachment.
 264. Monitor SFGS at Cascade Ranch.
3. Protect/establish at least 4 additional SFGS populations.

31. Determine the occurrence and abundance of SFGS throughout its range.
 311. Identify potential habitat.
 312. Conduct surveys at potential locations.
32. Secure each essential site.
33. Develop and implement a habitat management plan for each secured site.
4. Assess population trends and make modifications in management plans if necessary.
 41. Develop population estimation techniques.
 42. Conduct population surveys as necessary.
 421. Pescadero Marsh Natural Preserve and Ano Nuevo State Reserve.
 422. San Francisco State Fish and Game Refuge.
 423. Milbrae/Airport site.
 424. Laguna Salada site.
 425. Cascade Ranch.
 426. Other sites as identified in 31.
 43. Evaluate survey data and methods and make recommendations.
5. Identify additional recovery needs for the SFGS and modify prime objective/management plans accordingly.
 51. Obtain life history data necessary to manage and eventually delist the SFGS.
 511. Determine age-specific food habits.
 512. Investigate SFGS movements and activity patterns.

513. Identify and evaluate mortality factors and recruitment for each secured area.
52. Determine habitat relationships of the SFGS.
 521. Identify habitat types used by the SFGS.
 522. Determine the importance of various habitat parameters.
53. Reevaluate introgression between the red-sided garter snake and the SFGS.
54. Identify essential habitat and refine prime objective accordingly.
6. Provide for public information and awareness.
 61. Provide on-site interpretive programs on public lands.
 611. Pescadero Marsh Natural Preserve.
 612. Ano Nuevo State Reserve.
 62. Prepare a small brochure on the SFGS and the recovery program.
 63. Develop a slide-tape program for public presentations.

Narrative

1. Use legal authorities to protect the SFGS and its habitat.

Habitat losses resulting from intensive human use and urban development present the greatest difficulty to the recovery of the SFGS. Many of the known or suspected locations for the SFGS are adjacent to or surrounded by urban developments. SFGS populations and habitats are imperiled by development pressures, trampling caused by foot and off-road vehicle traffic, dredging, illegal collecting, and trash dumping. In addition, municipal maintenance activities such as mosquito abatement and weed control practices present threats to the garter snake, its food supply, and its habitat. Recovery of this species will therefore depend on successful reduction of these and less obvious threats. Many of these activities are addressed under Federal statutes and authorities of the U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, and California Department of Fish and Game. These agencies should use their authorities to prevent adverse impacts to the San Francisco garter snake from such activities.

11. Enforce existing laws and regulations to promote the conservation of the SFGS and its habitat.

To accomplish the primary objective of this recovery plan it is important that appropriate Federal and State agencies

rigorously enforce all laws and regulations which may effect conservation of the San Francisco garter snake. Foremost among these laws and regulations is the Endangered Species Act of 1973, as amended, and its associated regulations. Other relevant laws and regulations include the California Coastal Zone Protection Act, the National Environmental Policy Act, California Environmental Quality Act, the Clean Water Act (Section 404) and the California Endangered Species Act of 1970.

12. Evaluate success of law enforcement.

To insure that enforcement methods effectively promote the conservation of the SFGS, a procedure should be established to evaluate the law enforcement effort. For example, a tally should be kept of the number of man-hours spent on patrolling garter snake areas, reviewing dredge and fill applications within the species' range, or the total number of 404 permits issued.

13. Propose appropriate new regulations or revisions.

If, after evaluating the law enforcement effort and the effectiveness of the various laws that provide protection for the SFGS and its habitat, it becomes clear that they are not effective, new procedures, regulations or revisions of existing laws should be recommended. Such statutory or

policy changes could be recommended by the Service to the Director of the Fish and Wildlife Service, Governor of California, or to Congress.

2. Protect the 6 known SFGS colonies through appropriate management.

An essential step in the recovery of the SFGS is to protect all populations of the snake and the habitats upon which the species depends. At this time the 6 known SFGS colonies are critical to the long-term survival of the subspecies. Therefore, until a sufficient number of populations (now estimated at 10) can be secured for the SFGS, it will be necessary to protect and maintain these six populations and their habitats.

21. Pescadero Marsh Natural Preserve.

A population of San Francisco garter snakes of undetermined size is known from Pescadero Marsh Natural Preserve. Protection of this population is essential to the recovery effort.

211. Secure cooperation of the California Department of Parks and Recreation to manage and protect the SFGS.

Cooperation between CDPR personnel and the FWS will be necessary to conduct various recovery actions relating to management of SFGS populations and habitats at the preserve. To ensure the long-term cooperation of the

Preserve in protecting and managing the SFGS, a memorandum of understanding (MOU) or cooperative agreement should be developed between the CDPR, CDFG, and FWS.

212. Develop and implement a management plan for the SFGS at Pescadero Marsh Natural Preserve.

A management plan for the SFGS at Pescadero should be developed and implemented to assist with the management of the species there. At present no such plan exists and management is largely incidental to other Preserve activities. No specific details on the population at Pescadero are available. SFGS habitat at Pescadero Marsh is limited to a few sites around the periphery of the marsh. Severe siltation caused by agricultural and timbering activities within the watershed probably eliminated former marsh sites. Restoration of natural tidal action may decrease sedimentation and ultimately increase SFGS marsh habitat. It may also be possible to increase SFGS production at Pescadero by creating additional freshwater ponds adjacent to existing areas. Some planting of marsh vegetation may be required to speed vegetation development. In addition, some water management may be required to insure sufficient water

availability for the ponds. Development of a management plan for the preserve will require detailed surveys and studies to determine how many snakes use the area, where they occur, and what needs to be done to adequately manage and enhance the SFGS population.

213. Monitor SFGS at Pescadero.

An effective monitoring program is needed to assess habitat conditions and the SFGS population at Pescadero. Such a program will enable a timely response to changing conditions that may threaten the population, individual snakes or their habitat. Monitoring efforts for the snake should be concentrated during early spring to mid-summer and fall when the young are born. Habitat monitoring should provide information on seasonal habitat trends. Study efforts should also focus on upland habitats which may provide overwintering sites for the SFGS populations. Monitoring of likely and confirmed sites should be emphasized during the late fall to early spring months.

214. Minimize degradation and/or loss of SFGS habitat at Pescadero.

Development of parking areas, road construction,

logging, riprapping, and spraying of herbicides or insecticides should be minimized or avoided within the watershed of Pescadero Marsh. Loss or degradation of upland habitats adjacent to marsh areas which may be utilized as overwintering sites by the SFGS population should also be minimized. Modification of such habitat has the potential to result in a severe reduction to this population. Care should be taken to avoid practices which increase siltation or reduce riparian and marsh vegetation. Downstream activities that may affect the tidal prism in the marsh should be carefully planned to avoid significant changes to the tidal dynamics.

22. Ano Nuevo State Reserve.

A seemingly stable population of San Francisco garter snakes (number probably fewer than 50) is known from Ano Nuevo State Reserve. Protection of this population is essential to the recovery effort.

221. Secure cooperation of the California Department of Parks and Recreation to manage and protect the SFGS.

Cooperation between CDPR personnel and the FWS will be necessary to conduct various recovery actions at Ano Nuevo relating to management and monitoring of SFGS

populations and habitats. To ensure the long-term cooperation of the reserve in protecting and managing the SFGS, a memorandum of understanding (MOU) or cooperative agreement should be developed between the CDPR, CDFG, and FWS.

222. Develop and implement a management plan for the SFGS at Ano Nuevo State Reserve.

A management plan for the SFGS at the reserve should be developed to assist with protecting and recovering the snake. At present no such plan exists and a substantial amount of visitor use may be adversely affecting the population. Population data are not available for this area either; consequently, development of a management plan for Ano Nuevo will also require baseline surveys and studies.

223. Monitor the SFGS at Ano Nuevo.

A monitoring program is needed at Ano Nuevo to assess the habitat conditions and SFGS population status. Movement corridors may be especially significant between Ano Nuevo and Cascade Ranch. Therefore, studies of snake movements are needed to develop a management plan for the Ano Nuevo area.

224. Minimize degradation and/or loss of SFGS habitat at

Ano Nuevo:

Development of parking areas, road construction, riprapping, and spraying of herbicides or insecticides should be minimized or avoided within wetland areas used by the snake. Care should be taken to avoid practices that increase siltation, or reduce riparian vegetation within the watershed. Careful visitor control may also be necessary to reduce impacts to the areas used by the snake.

23. San Francisco State Fish and Game Refuge.

A population of undetermined size of San Francisco garter snakes is known from the San Francisco State Fish and Game Refuge. Because the refuge may harbor substantial numbers of garter snakes, recovery will depend in part upon the abilities of the refuge, FWS and CDFG to protect and enhance this SFGS population.

231. Secure cooperation of the San Francisco Water Department (SFWD) and other involved agencies to manage and protect the SFGS on the San Francisco State Fish and Game refuge.

Cooperation among SFWD personnel (see 234), FWS, NPS, and CDFG will be necessary to conduct various recovery

actions on the refuge lands. Such activities would include monitoring of the snake population on the refuge, studies of snake biology (i.e., movements, reproduction, food habits), habitat improvement, and other activities as determined necessary. To ensure the continued long-term cooperation of the refuge in protecting and managing the SFGS, a memorandum of understanding (MOU) or other cooperative agreement should be developed among the SFWD, FWS, NPS, and CDFG.

232. Develop and implement a management plan for the SFGS at the San Francisco State Fish and Game Refuge.

Vegetation removal techniques for ponds and reservoirs should be modified so that snake use of these areas is enhanced. By changing the frequency or extent of vegetation removal or enlarging the pond areas, snake habitat could be improved. These enhancement measures should be examined and the most cost-effective methods implemented. In order to ensure a coordinated and focused program for the SFGS, a management plan addressing such actions for the SFGS on the refuge should be developed to help protect this significant population and recover the snake. At present, management of the refuge wetlands does not adequately

protect the SFGS. Other management actions are required to enhance the populations on the refuge.

233. Monitor the SFGS at the refuge.

Because the San Francisco State Fish and Game Refuge is very large, a well planned monitoring program will be necessary to assess garter snake population trends within the refuge boundaries. An adequate monitoring program will enable timely response to changing conditions that may threaten the population and individual garter snakes. A well planned and coordinated monitoring effort can assist with documenting changes in the habitat and populations of the garter snake.

234. Minimize degradation and/or loss of SFGS habitat on the refuge.

Certain management practices on the refuge are adversely affecting the SFGS population. Emergent growth of vegetation is periodically cut in certain areas to control siltation and buildup of decaying vegetation. This removes a favorable habitat component which provides basking sites and escape cover to the SFGS. Cooperative habitat management efforts with the SFWD are necessary to maintain and improve such habitats for the SFGS. The refuge should

also continue cooperative efforts with CDFG to minimize impacts of vegetation clearing on SFGS. In addition, grazing and new construction of roads and parking areas should be carefully evaluated for adverse effects on the SFGS.

Management practices should be modified if the evaluations indicate that this is necessary to prevent adverse impacts to the SFGS.

24. San Francisco Airport/Milbrae site.

The SFGS population at Milbrae is the only remaining population on the eastern side of the San Francisco Peninsula. Because the site supports the largest and most vigorous SFGS populations known, it is critical to the recovery effort. Population size for the SFGS is currently believed to exceed 200 snakes at this location (John Brode pers. comm.).

241. Secure cooperation of the City of San Francisco and San Francisco Airport to manage and protect the SFGS at the Milbrae site.

A MOU or other cooperative agreement should be developed between the involved agencies. A formal agreement would provide for long-term cooperation and

coordination in the management of the site for the recovery of the garter snake.

242. Develop and implement a management plan for the SFGS at the San Francisco Airport/Milbrae Site.

Snakes can frequently be found on the airport site despite disruptions such as disking in upland portions of the area, frequent and intense off-road vehicle trespass, heavy foot traffic, periodic removal of vegetation from the drainage canals supporting snakes, placement of fill in and near the wetlands of the site, and illegal collection. The site was formerly a large freshwater marsh formed by the confluence of several streams that have since been completely channelized as the surrounding urban area developed. Remnant marsh areas still occur on site. These primarily consist of low lying areas that fill with water during the winter rains. A portion of the area could be returned to marsh by installing water control structures on the existing channels and allowing flood waters to fill the basins. This not only would provide habitat for the SFGS, but would also help alleviate flood problems for the adjacent urban areas. A substantial amount of upland habitat would remain that could be used by the City of San Francisco or the

Airport for some type of revenue generating development. However, careful evaluation of any development proposal would be required to insure its compatibility with maintaining the marsh area and SFGS population. As the easternmost population of the SFGS and one of the most productive sites, it is critical that SFGS habitat on the site be secured and adequately managed. Development and implementation of a habitat management plan would provide a means of accomplishing this.

243. Prevent illegal entry.

Despite fencing, placement of "no trespassing" signs and periodic patrols, unauthorized trespass on the airport site occurs frequently. As a consequence, off-road vehicles (ORV) trails and "race tracks" have been established on the site. Most of the access areas used by vehicles and pedestrians are now barren ground, with aggressive and noxious weeds such as star thistle (Centaurea spp.) pampas grass (Cortaderia atacamensis), and prickly ox tongue (Picris echioides) occurring alongside the trails. On several occasions dead SFGS have been found on the site, presumably killed by vehicles. It is also evident that individuals knowledgeable of lizard and snake habits occasionally visit the site. Ground litter such as

trash and boards have been overturned, suggesting the area has been searched for snakes and lizards. Given the intensity and types of trespass that occur on the site, it will be necessary to increase the security of the area to protect the garter snake.

2431. Maintain the fence.

Portions of the Milbrae site are now fenced and the existing fence seems to be partially effective in reducing trespass. However, illegal encroachment by foot traffic, off-road vehicles, and collectors still is a problem as the fence is periodically vandalized. Consequently, continued maintenance of the fence will be required.

2432. Provide frequent patrols.

In addition to fencing, patrols by local game wardens, city police, and airport security would help to make the site even more secure. Arrangements should be made with the local city police to patrol the site periodically.

244. Monitor the SFGS at the Milbrae site.

To assess the stability and recovery of the SFGS

population at the Milbrae site, periodic monitoring will be required. Such a program will enable timely response to conditions that may threaten individual snakes, the entire population, or habitat of the SFGS. A planned and coordinated monitoring effort can also assist in documenting changes in habitat conditions and population trends. Population monitoring should be concentrated during early spring to mid-summer and again in the fall when the young are born.

245. Minimize degradation and/or loss of SFGS habitat.

It is important that areas of importance to the garter snake population be identified for planning purposes. Once the use areas have been identified and evaluated, specific development plans can be analyzed and modified to assure compatibility with maintenance of this SFGS population. In addition, no placement of fill should be allowed within or near the wetlands of the area. All spoils from canal dredging should be deposited off-site.

246. Identify areas at the Milbrae site that are important for the maintenance of the garter snake.

Breeding sites, foraging sites, denning areas, and areas used by garter snake prey (such as toads,

red-legged frogs, or small fish) should be identified and evaluated. SFGS migratory corridors and basking areas should also be identified.

Since the Milbrae site represents a possible revenue source for the City of San Francisco, it is critical that important SFGS habitat on the site be identified. Future development would need to consider SFGS use of the site including, but not limited to, overwintering sites, movement corridors, and other SFGS life history data. Other factors determining feasibility of potential development sites, including project design and flexibility, project size, and type of development, would also have to be considered on a case-by-case basis.

25. Sharp Park Golf Course at Laguna Salada.

The SFGS population at Laguna Salada is the northernmost known location of San Francisco garter snakes. As such it may provide for genetic interchange between the coastal populations further south and those on the Bay side of the Santa Cruz Mountains. The golf course pond apparently supports a small but vigorous population despite heavy foot traffic around the edge of the pond and possibly some disruption of the pond vegetation for periodic maintenance.

It is critical that the habitat at Laguna Salada be secured and managed.

251. Secure cooperation of the Sharp Park Golf Course administrators to manage and protect the SFGS at Laguna Salada.

Human intrusion and disruption of SFGS habitat at Sharp Park are currently uncontrolled. With appropriate management, the area can be made more secure for the SFGS. Some type of cooperative agreement should be worked out with the golf course administrators to secure the areas used by the SFGS.

252. Develop and implement a management plan for the SFGS at the Sharp Park Golf Course at Laguna Salada.

Snake use of this location appears to be limited by the availability of secure basking sites, foraging areas, and upland cover. It might be possible to increase snake use of the Laguna Salada pond by creating more useable edge. This could be accomplished by dredging small cove areas and creating shallow impoundments where appropriate vegetation could develop. Fencing around the pond and upland areas could prevent human encroachment from disturbing the snakes. Construction of rock or driftwood piles

adjacent to the pond may provide additional cover for the snakes. In addition, a study should be undertaken if pesticide use is adversely affecting the garter snake population or its prey. These issues should be addressed during the development of a management plan for this SFGS population.

253. Minimize adverse impacts to garter snakes at Laguna Salada from foot traffic, human encroachment, illegal collecting and chemical treatments.

Snake use of the Laguna Salada pond area may be enhanced by fencing or otherwise restricting human encroachment into the pond area. The pond area could become more productive for the SFGS by providing more secure sites for basking and feeding. "No Foot Traffic" signs may also provide additional benefits by limiting foot traffic around the pond.

Pesticide, herbicide, and fertilizer use may be especially concentrated in the golf course, since these chemicals are used for maintaining greens and fairways. Careful monitoring of chemical treatments should be undertaken to insure no harmful effects to the SFGS population. In addition, the area should be frequently patrolled to deter possible illegal collecting.

254. Monitor the SFGS at Laguna Salada.

An effective monitoring program is needed at Laguna Salada to assess the stability and recovery of the SFGS population. Such a program will enable timely response to conditions that may threaten individual snakes, the entire population, or associated habitats. A well planned and coordinated monitoring effort can also assist in documenting changes in habitat conditions and population trends. Monitoring should be concentrated during early spring to mid-summer and possibly again in the early to mid fall when young are born. Upland areas may provide important overwintering sites for this SFGS population. Specific SFGS overwintering sites should be identified and carefully monitored to ensure protection to these seasonally critical areas.

26. Cascade Ranch.

In 1983, a small population of SFGS was found at the Cascade Ranch in southern San Mateo County (McGinnis 1984b). The site may be closely linked with the SFGS population at Ano Nuevo. Thus protection of the Cascade Ranch population would also provide for gene exchange with Ano Nuevo.

261. Secure SFGS habitat on the Cascade Ranch.

SFGS habitat at Cascade Ranch consists primarily of

the creeks, intermittent drainages, associated wetlands and ponds of the property. Most of these habitats have been heavily impacted by past land uses (e.g., livestock production). The entire area is in private ownership and the owners would like to develop the property. Recent studies of the property funded by the landowner in conjunction with the County of San Mateo, the Service, and CDFG confirmed the presence of the SFGS on one portion of the property. Additional surveys will be required to determine which areas are used by the snake. In the interim, the wetland areas and ponds should be secured via management agreement, conservation easement or other instrument to protect such habitat.

262. Develop and implement a management plan for the SFGS at Cascade Ranch.

Most of the wetland habitat at Cascade Ranch has been heavily disturbed by many years of cattle grazing. Shoreline and emergent vegetation is absent from many of the ponds and creeks of the property but with protection could become reestablished as suitable SFGS habitat. Fencing of the pond and stream areas to exclude cattle would initiate recovery of the wetland vegetation. Some planting of wetland plants may be

required to speed the recovery process. A management plan is needed to help enhance the snake population at Cascade Ranch.

263. Minimize adverse impacts to garter snakes from trampling and human encroachment.

Access to the garter snake habitat at Cascade Ranch is currently unrestricted. Cattle trample and graze many of the streamside, pondside and wetland areas used by the garter snake. Some means of livestock control (e.g., fencing, modifying the grazing lease) should be undertaken to minimize adverse impacts to the SFGS habitat.

264. Monitor SFGS at Cascade Ranch.

Regular monitoring at Cascade Ranch is needed to assure that the SFGS habitat is adequately protected and that the management efforts are effective.

3. Protect/establish at least 4 additional SFGS populations.

To increase the likelihood that the garter snake population will be capable of self maintenance, additional populations must be sought and, if necessary, artificially established. Because seemingly suitable habitat exists throughout San Mateo County, it is likely that the SFGS may occur in several additional areas,

which may be discovered with more intensive survey efforts. Until the specific recovery goals are achieved, each confirmed location should be secured and appropriately managed. At present it does not appear necessary to captively propagate SFGS to enhance or increase the number of populations. However, with additional study this technique may indeed be required if the population level is insufficient to allow natural establishment or translocations to reach the recovery goals.

31. Determine the occurrence and abundance of SFGS throughout its range.

Areas that may harbor SFGS populations or provide suitable habitats for establishing additional populations include but are not necessarily limited to: San Bruno Mountain (saddle area and creek sides), wetlands near Edgewood and Canada Roads, San Mateo Creek, San Gregornio Creek, Whitehouse Creek-Cascade Ranch, Denniston Creek, Colma, Sanchez Creek, Lake Lagunita, and Woodside Road. Many of these areas have been noted in previous surveys or were accidentally discovered by field workers as having San Francisco garter snakes; however, the presence of the SFGS has not been recently confirmed. Other areas, such as Pescadero Landfill and Mori Point, have very recent SFGS observations (Barry 1978b, McGinnis 1984c) but require additional field investigation. Thus, intensive surveys will be necessary to update the occurrence and status of the SFGS throughout its range.

311. Identify potential habitat.

In addition to the areas previously mentioned, many other areas of seemingly suitable wetland habitat occur within the range of the SFGS. Those sites of potential habitat should be determined and delineated to identify all likely habitat for the garter snake throughout San Mateo County. Many of these areas can be identified using aerial photographs. Other survey methods, such as contacting local landowners, county park rangers and local naturalists would also assist in identifying potential habitats.

312. Conduct surveys at potential locations.

Once potential habitats have been identified, site-specific efforts should be undertaken to determine which areas support snake populations. Such an effort will likely require several years because of the rarity and elusiveness of the SFGS. Each confirmed and/or potential site should be assessed for its significance to the recovery program and the need for protection. McGinnis (1984a) has recently completed a survey for SFGS at 16 sites in coastal San Mateo County. Additional surveys of this nature are still required.

32. Secure each essential site.

Those sites which are determined to be essential in providing for long-term maintenance of viable, self-sustaining SFGS populations and ensuring eventual recovery of the SFGS, should be secured through a cooperative agreement, MOU, conservation easement or fee purchase. As extant SFGS populations are identified and evaluated each site should be precisely mapped and ownership determined so that specific management agreements can be undertaken. Those sites to be secured by the Service will require the preparation of a Land Protection Plan.

33. Develop and implement a habitat management plan for each secured site.

As new populations are discovered and secured, each should be properly managed. This requires that the number of snakes in each population as well as habitat conditions be periodically assessed. In some cases, water management may be required to maintain existing marshes. Planting of marsh vegetation may be necessary to speed vegetation development. In several locations, creation of additional ponding areas may be required to increase habitats and food supply. Introduction of food items such as red-legged frogs may also be necessary to improve habitat conditions. A management plan for each population should be developed and implemented to help assure proper management.

4. Assess population trends and make modifications in management plans if necessary.

A population assessment program should be established to evaluate the success of the recovery program. Trend surveys should occur periodically during early spring through mid-summer and again in the fall when the young are born. If information so indicates, this schedule may be modified. In addition to population data, each site should be observed for mortalities or unhealthy animals, and trespass or other problems.

41. Develop population estimation techniques.

At present there is no standardized method for assessing SFGS populations. Though some mark-recapture techniques have been used, there are many questions regarding the cost effectiveness and accuracy of such methods. It may therefore be necessary to modify existing techniques for evaluating snake populations at each site. Standardization of survey techniques to facilitate comparisons between extant populations is also required.

42. Conduct population surveys as necessary.

Once the survey methods have been developed they should be undertaken on a regular basis at selected sites. Initially, surveys should be conducted annually during the spring and fall peak activity periods. The survey should be ongoing to

assess long-term population trends. This would help to identify management needs.

421. Pescadero Marsh Natural Reserve and Ano Nuevo State Reserve.

See item 42.

422. San Francisco State Fish and Game Refuge.

See item 42.

423. Milbrae/Airport site.

See item 42.

424. Laguna Salada site.

See item 42.

425. Cascade Ranch.

See item 42.

426. Other sites containing SFGS populations.

See item 31.

43. Evaluate survey data and methods and make recommendations.

Periodic evaluations of the survey data will be necessary to evaluate the progress of the recovery program. As new

census methods are developed they should be evaluated and used if appropriate. If necessary, changes should be incorporated into the management programs to reflect the current SFGS population status.

5. Identify additional recovery needs for the SFGS and modify prime objective/management plans accordingly.

More information is needed regarding SFGS food habits, movements, reproduction, and other limiting factors before confident recovery goals can be determined. These data will be evaluated and new or modified recommendations incorporated into the various management plans as appropriate.

51. Obtain life history data necessary to manage and eventually delist the SFGS.

A number of life history features of the SFGS must be identified before specific management actions can be developed. As mentioned above, age-specific food habits must be determined to improve food availability through specific management actions. Movements, both diurnal and seasonal, must be studied to help in determining minimal areas for survival and maintenance. Movement corridors and overwintering sites also need to be identified.

511. Determine age-specific food habits.

Age specific food habits should be studied throughout

the range of the SFGS so that appropriate management actions can be developed on a site-by-site basis. Seasonal variation in food habit may be of considerable management significance. Hand palpating of individual San Francisco garter snakes to determine prey species has proven very successful and causes no apparent harm to the snakes. Care must be taken, however, to avoid injury to gravid females.

512. Investigate SFGS movements and activity patterns.

It is important that SFGS movements (within and between populations) be determined so that habitat areas and movement corridors can be identified and protected. Gene exchange between seemingly isolated populations may be entirely dependent upon small drainages connecting these sites. Long-term perpetuation of such populations may depend upon this occasional movement of individual SFGS through such corridors. Since intensive trapping will be necessary, the selected study sites must be secure from vandalism and sources of disruption.

513. Identify and evaluate mortality factors and recruitment for each secured area.

Some mortality causes are known (e.g., trampling),

other sources such as predation and disease are poorly known. Specific causes of mortality should be identified on a site-by-site basis to assist with the development of site-specific management plans. Eventually, it may be possible to reduce garter snake mortality rates and enhance population recruitment through various management actions. Restriction of vehicle trespass may enhance survival of the snake at a number of sites. Other protective actions should be examined and implemented if feasible. Possible management actions might include protective fencing, barriers to vehicles, and legal action resulting from increased patrols.

Each population should be evaluated to determine if recruitment is sufficient to maintain long-term viability. Confident prognoses from such studies require that data be collected over several years. Information obtained on recruitment, coupled with information on SFGS movements, will aid in determining the size and stability of each population.

52. Determine habitat relationships of the SFGS.

Because movements, food habits, and other SFGS life history features are not well known, habitat use by the SFGS also is

not well understood. It is presumed that the snake is mainly restricted to largely freshwater habitats, but few studies have actually been undertaken to confirm this. Studies should examine habitat use (including upland sites) during various seasons by various age classes of snakes. This information would be important in recovery planning and for determining essential habitat.

521. Identify habitat types used by SFGS.

The various habitats used by the SFGS should be identified so that essential habitat areas can be delineated and appropriate recovery tasks implemented. Such studies will most likely involve use of radio telemetry as well as mark-and-recapture methods.

522. Determine the importance of various habitat parameters.

It appears that certain habitat parameters [e.g., habitat size, habitat configuration, vegetation physiognomy and species diversity (plant and animal)] are very important factors affecting SFGS success and use of areas. An examination of these habitat parameters may reveal how habitat diversity relates to SFGS population maintenance. This will be important for long-term management of SFGS populations.

53. Reevaluate introgression between the red-sided garter snake and the SFGS.

It has been suggested that intergradation between the red-sided garter snake and the SFGS threatens the SFGS (Bury 1971); however, recent information indicates that the two may be completely isolated (Barry 1978a). Studies are needed to confirm if isolation is complete, or if introgression is a natural occurrence or a man-induced threat. Surveys should be conducted along the boundary between San Mateo and Santa Clara counties in the vicinity of Palo Alto to determine the occurrence of red-sided garter snakes, SFGS, and populations and individuals exhibiting characteristics intermediate between these two races.

54. Identify essential habitat and refine prime objective accordingly.

"Essential habitat" is herein defined as that habitat necessary to provide all requirements for maintaining a self-perpetuating population of the SFGS. It may include, but is not limited to, areas which provide escape cover, basking sites, food sources, overwintering sites, and corridor lands which provide for seasonal movement between such sites.

As life history and distributional information on the garter

snake become available, essential habitat areas should be delineated. Because the primary threat to the SFGS is habitat destruction, delineation of essential habitat will assist local land-use planning agencies to be more responsive to the recovery effort for the SFGS. In this way recovery goals can be integrated more effectively into local land-use plans, thus preventing costly conflicts.

An efficient means of information transfer must be developed so that local authorities can obtain up-to-date information on the SFGS and make timely adjustments to planned projects.

6. Provide for public information and awareness.

The general public must be educated about the threats and status the San Francisco garter snake. Such a program will benefit the recovery effort, and will serve to increase awareness of the causes of the species' endangerment. The public must be made aware of the ecological, historical, and aesthetic importance of saving endangered species. However, care should be taken to avoid drawing attention to specific sites where the snake occurs in order to reduce the potential for illegal collecting.

61. Provide on-site interpretive programs on public lands.

It may be possible to develop interpretive programs for the SFGS on publicly managed lands. Such programs could employ

slides and other visual aids to increase general awareness of the San Francisco garter snake. Interpretive programs could stress the interrelatedness of freshwater marsh systems and other life forms which also benefit by preserving the SFGS.

611. Pescadero Marsh Natural Preserve.

As a part of the interpretive nature program, presentation programs on the SFGS could be given to visitors at Pescadero Marsh Natural Preserve.

612. Ano Nuevo State Reserve.

An interpretive program should be developed for the SFGS at Ano Nuevo. A display board could be set-up showing photographs of the SFGS and its freshwater marsh habitat. Because poaching is a problem, care should be exercised to avoid revealing precise areas where the snake occurs.

62. Prepare a small brochure on the SFGS and the recovery program.

A small brochure should be developed, printed, and made available at public use areas where the SFGS occurs. Pescadero Marsh Natural Preserve, Ano Nuevo State Reserve, and the Sharp Park Golf Course are primary areas for distribution of the brochure.

63. Develop a slide-tape program for public presentations.

A slide-tape program will provide an excellent means to make the general public aware of the plight of the San Francisco garter snake. It will also provide a reliable method for interested individuals to "observe" the animal.

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PART III

IMPLEMENTATION SCHEDULE

The schedule that follows is a summary of actions and costs for the San Francisco garter snake recovery program. It is a guide to meet the objectives of the Recovery Plan, as elaborated upon in Part II, Action Narrative Section. This table indicates the general category for implementation, recovery plan tasks, corresponding action outline number, task priorities, duration of the tasks, which agencies are responsible to perform the tasks, and the estimated costs to perform the tasks. Implementing Part III is the action of the recovery plan, that when accomplished, will bring about the recovery of this endangered species.

GENERAL CATEGORIES FOR IMPLEMENTATION SCHEDULES

Information Gathering - I or R (research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information

Acquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Management - M

1. Propagation and education
2. Reintroduction
3. Habitat Maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Other - O

1. Information
2. Law enforcement
3. Regulations
4. Administration

RECOVERY ACTION PRIORITIES

- 1 = An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.
- 2 = An action that must be taken to prevent a significant decline in the species population/habitat quality, or some other significant impact short of extinction.
- 3 = All other actions necessary to provide for full recovery of the species.

Note: Priority 3 items appear in the implementation schedule without cost estimates.

PART III
Implementation Schedule-San Francisco garter snake

General Category	Plan Task	Task Number	Task Priority	Task Duration (Yrs.)	Task 1	Responsible Agency ³		Fiscal Year Costs (est.) ² in \$1,000's			Comments/Notes						
						FHS	Other Agencies	FY 1	FY 2	FY 3							
<u>Reduce threats</u>																	
02	Enforce laws and regulations to promote SFGS conservation.	11	1	Ongoing	1	LE*			2.5	2.5	2.5	2.0	2.0	2.0	2.0	2.0	
							CDFG		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
							COE		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
							EPA		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
							CDPR		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
04	Evaluate success of law enforcement.	12	2	Continuous	1	SE*			-	-	-	2.0	-	-	2.0	2.0	Every three years.
03	Propose appropriate new regulations or revisions.	13	2	Continuous	1	SE*						To Be Determined					Approx. every 5 years

* Indicates lead agency

1/ Ongoing = Task has begun and continues yearly

Continuous = When funding becomes available task will continue indefinitely.

2/ FY 1 = 1986

3/ Abbreviations

- LE - Law Enforcement Division (Fish and Wildlife Service)
- SE - Endangered Species Program (Fish and Wildlife Service)
- CDFG - California Department of Fish and Game
- CDPR - California Department of Parks and Recreation
- SFWD - San Francisco Water Department
- SPGC - Sharp Park Golf Course
- CSF - City of San Francisco
- NPS - National Park Service

- SFAD - San Francisco Airports Department
- CT - Caltrans
- COE - U.S. Army Corps of Engineers, San Francisco District
- EPA - Environmental Protection Agency
- FAA - Federal Aviation Administration
- CCR - Cascade Ranch Corporation
- FHWA - Federal Highway Administration
- SNC - San Mateo County

PART III
Implementation Schedule--San Francisco garter snake

General Category	Plan Task	Task Number	Task Priority	Task Duration (Yrs.)	Task 1	Responsible Agency ³		Fiscal Year Costs (est.) ² in \$1,000's			Comments/Notes
						FWS	Other Agencies	FY 1	FY 2	FY 3	
A3	Secure cooperation of the California Dept. of Parks and Recreation	211	1	2	SE		CDFG CDPR	1.0 1.0 1.0	1.0 1.0 1.0	- - -	
M3	Develop and implement a management plan for SFGS at Pescadero Marsh Preserve.	212	2	Continuous	1 SE		CDFG CDPR*	2.0 2.0 4.0	2.0 2.0 4.0	2.0 2.0 4.0	
I1	Monitor SFGS at Pescadero	213	1	Continuous	SE		CDPR*	1.5 1.5	1.5 1.5	1.5 1.5	
M3	Minimize degradation and/or loss of habitat.	214	2	Continuous			CDPR*	1.0	1.0	1.0	
A3	Secure cooperation of the Calif. Dept. of Parks and Recreation	221	1	2	1 SE		CDFG CDPR	1.0 1.0 1.0	1.0 1.0 1.0	- - -	
04	Develop and implement a management plan for SFGS at Ano Nuevo State Reserve.	222	2	Continuous	1 SE		CDPR*	0.5 2.5	0.5 2.5	0.5 2.5	
I1	Monitor SFGS at Ano Nuevo	223	1	Continuous	SE		CDPR*	1.5 1.5	1.5 1.5	1.5 1.5	
M3	Minimize degradation and/or loss of habitat.	224	2	Continuous			CDPR*	1.5	1.5	1.5	

PART III
Implementation Schedule--San Francisco garter snake

General Category	Plan Task	Task Number	Task Priority	Task Duration (Yrs.)	Region	Responsible Agency FMS	Fiscal Year Costs (est.) ² in \$1,000's			Comments/Notes
							FY 1	FY 2	FY 3	
A3	Secure cooperation of S.F. Water Department and National Park Service.	231	1	Ongoing	1	SE	1.0	1.0	-	FY-85 PA (5f)
							1.0	1.0	-	
							1.0	1.0	-	
							1.0	1.0	-	
M3	Develop and implement a management plan for SFGS at San Francisco Fish and Game Refuge.	232	2	Continuous	1	SE	1.0	3.5	2.5	NPS costs largely administrative
							1.0	8.0	4.5	
							1.0	7.0	4.5	
							1.0	1.0	1.0	
I14	Monitor SFGS at the San Francisco State Fish and Game Refuge.	233	1	Ongoing	1	SE	1.0	1.0	1.0	FY-85 PA (5f)
							2.0	2.0	2.0	
							2.0	2.0	2.0	
M3	Minimize degradation and/or loss of habitat.	234	2	Ongoing	1	SE	0.5	0.5	0.5	FY-85 PA (5f)
							1.0	1.0	1.0	
							1.5	1.5	1.5	
A3	Secure cooperation of the City of San Francisco and the S.F. Airport Department to manage and protect the Milbrae site.	241	1	2	1	SE	1.0	1.0	-	FY-85 PA (5f) CSF and SFAD costs largely administrative.
							1.0	1.0	-	
							1.0	1.0	-	
							1.0	1.0	-	
M3	Develop and implement a management plan for the San Francisco Airport/Milbrae site.	242	2	Continuous	1	SE	-	-	1.0	CSF costs largely administrative.
							-	-	2.5	
							-	-	.5	

PART III
Implementation Schedule-San Francisco garter snake

General Category	Plan Task	Task Number	Task Priority	Task Duration (Yrs.)	Task 1	Responsible Agency ³		Fiscal Year Costs (est.) ² in \$1,000's			Comments/Notes
						FWS	Other Agencies	FY 1	FY 2	FY 3	
M3	Maintain fence at Milbrae site.	2431	1	Ongoing	1	SE					FY-85 PA (5f)
02	Provide frequent patrols.	2432	1	Ongoing	1	LE					FY-85 PA (4a) Law enforcement occasionally patrols.
I1	Monitor SFGS at the Milbrae site.	244	1	Ongoing	1	SE					CSF and SFAD costs largely administrative. .FY-85 PA (5f)
M3	Minimize degradation and/or loss of habitat.	245	2	Ongoing	1	SF					SFAD, CSF, COE, and FAA costs largely administrative. FY-85 PA (5f)
I2	Identify important areas on Milbrae site.	246	2	3	1	SE					FY-85 PA (5f) SFAD, CSF costs largely administrative.

PART III
Implementation Schedule-San Francisco garter snake

General Category	Plan Task	Task Number	Task Priority	Task Duration (Yrs.)	Task 1 Responsible Agency FWS	Region	Program	Other Agencies	Fiscal Year Costs (est.) ² in \$1,000's			Comments/Notes
									FY 1	FY 2	FY 3	
A3	Secure cooperation of Sharp Park Golf Course to manage and protect SFGS.	251	1	2	1	1	SE	CDFG* SPGC SMC	-	1.0 3.0 0.5	1.0 3.0 0.5	SPGC, SMC costs largely administrative.
M3	Develop and implement a management plan for SFGS at Sharp Park Golf Course	252	2	2	1	1	SE	CDFG* SPGC	-	-	1.0 2.0 0.5	SPGC cost largely administrative.
14	Minimize adverse impacts from trampling and human encroachment at SPGC.	253	2	Ongoing	1	1	SE	CDFG* SPGC SMC	1.0 3.0	1.0 3.0	1.0 3.0	SPGC costs largely administrative. FY-85 PA (5f)
14	Monitor SFGS at SPGC.	254	1	Ongoing	1	1	SE	CDFG SPGC	1.0 2.0 0.5	1.0 2.0 0.5	1.0 2.0 0.5	SPGS costs largely administrative. FY-85 PA (5f)
A13	Secure SFGS habitat on the Cascade Ranch	261	1	2	1	1	SE	CDFG* CDPR CCR SMC	-	1.0 2.0 0.5	1.0 1.0 2.0 0.5	Depends on cooperation of the landowner.

PART III
Implementation Schedule-San Francisco garter snake

General Category	Plan Task	Task Number	Task Priority	Task Duration (Yrs.)	Region	Responsible Agency ³		FY 1	FY 2	FY 3	Comments/Notes
						FWS	Other Agencies				
M4	Develop and implement a management plan for SFGS at Cascade Ranch.	262	2	Ongoing	1	SE		1.0	1.0	4.0	
							CDFG*	2.0	2.0	8.0	Depends on cooperation of the landowner.
							CDPR	1.0	1.0	3.0	FY-85 PA (5f)
							CCR	0.5	0.5	0.5	
							SMC	0.5	0.5	0.5	
I4	Minimize adverse impacts to SFGS from trampling and human encroachment.	263	2	2	1	SE		-	1.5	1.5	Depends on cooperation of the landowner.
							CDFG*	-	2.5	2.5	
							CCR	-	0.5	0.5	
							SMC	-	0.5	0.5	
I4	Monitor SFGS at Cascade Ranch.	264	2	Ongoing	1	SE		1.0	1.0	1.0	FY-85 PA (5f)
							CDFG*	2.0	2.0	2.0	
							CDPR				
I2	Identify potential habitat.	311	2	3	1	SE		1.0	1.0	1.0	FY-85 PA (5f)
							CDFG*	3.0	3.0	3.0	
I1	Conduct periodic surveys at suspected locations.	312	2	5	1	SE		2.0	2.0	2.0	FY-85 PA (5f)
							CDFG*	6.0	6.0	6.0	Section 6 funding
A7	Secure each essential site.	32	2	5	1	SE					To be determined
							CDFG*				
							CDPR				
M3	Develop and implement a management plan for each secured site.	33	2	8	1	SE					To be determined
							CDFG*				
							CDPR				

PART III
Implementation Schedule-San Francisco garter snake

General Category	Plan Task	Task Number	Task Priority	Task Duration (Yrs.)	Task 1	Responsible Agency		Fiscal Year Costs (est.) ² in \$1,000's			Comments/Notes
						FMS	Other Agencies	FY 1	FY 2	FY 3	
I4	Develop population survey techniques.	41	2	3	1	SE	CDFG*	5.0	5.0	5.0	
								2.0	2.0	2.0	
I1	Conduct survey at Pescadero and Ano Nuevo State Areas.	421	2	Continuous	1	SE	CDFG CDPR*	-	-	0.5 1.0 4.0	Survey frequency to be determined in #41.
I1	Conduct survey at San Francisco State Fish and Game Refuge.	422	2	Continuous	1	SE	CDFG* SFSFGR	-	-	0.5 2.5 2.5	Census frequency to be determined in #41.
I1	Conduct survey at Millbrae site.	423	2	Continuous	1	SE	CDFG* CSF	-	-	1.0 2.5 0.5	Census frequency to be determined in #41.
I1	Conduct survey at Laguna Salada site.	424	2	Continuous	1	SE	CDFG* SPGC	-	-	1.0 2.5 0.5	Begin FY 3 SPGC costs largely administrative. Frequency determined in #41.
I1	Conduct survey at Cascade Ranch.	425	2	Continuous	1	SE	CDFG* CDPR	2.0	2.0	2.0 5.0 2.0	Every year for first 3 years, then as determined in #41. FY-85 PA (5f)
I1	Conduct surveys of other sites.	426	2	Continuous	1	SE	CDFG*	To be determined	To be determined		Frequency determined in #41.

PART III
Implementation Schedule-San Francisco garter snake

General Category	Plan Task	Task Number	Task Priority	Task Duration (Yrs.)	Task 1	Responsible Agency		Fiscal Year Costs (est.) ² in \$1,000's			Comments/Notes	
						FMS	Other Agencies	FY 1	FY 2	FY 3		
I4	Evaluate survey data and methods.	43	2	Continuous	1	SE*		CDFG	-	-	3.0	Every 3 years Begin FY 3
I14	Determine age-specific food habits.	511	2	3	1	SE		CDFG* CDPR	0.5 3.5 2.0	0.5 3.5 2.0	0.5 3.5 2.0	Begin FY 1
I14	Investigate SFGS movements and activity patterns.	512	2	5	1	SE		CDFG* CDPR	-	5.5 6.5 6.0	5.5 6.5 6.0	Begin FY 2
I16	Identify and evaluate mortality factors and recruitment for each secured area.	513	1	5	1	SE		CDFG* CDPR	-	2.0 10.0 2.0	2.0 10.0 2.0	Begin FY 2
I13	Identify habitat types used by SFGS.	521	1	3	1	SE		CDFG* CDPR	-	-	2.0 10.0 3.0	Begin FY 3
I13	Determine the importance of habitat size and diversity.	522	2	3	1	SE		CDFG* CDPR	-	-	-	To begin FY 5; estimated cost 9.0K/yr.
I11	Reevaluate Introgression	53	2	3	1	SE		CDFG*	1.0 3.0	1.0 3.0	1.0 3.0	

PART III
Implementation Schedule--San Francisco garter snake

General Category	Plan Task	Task Number	Task Priority	Task Duration (Yrs.)	Responsible Agency		Fiscal Year Costs (est.) ² in \$1,000's	Comments/Notes		
					Region	Other Agencies				
03	Identify essential habitat.	54	2	5	1	SE*	-	-	Begin FY 4. Costs largely internal administration.	
04	Provide interpretive program at Pescadero.	611	3	Continuous		CDPR	4.0	4.0	4.0	
04	Provide interpretive program at Ano Nuevo.	612	3	Continuous		CDPR	4.0	4.0	4.0	
04	Prepare brochure on SFGS recovery.	62	3	2		CDFG	-	-	-	Costs estimated at 3K/yr. Begin FY 7
04	Develop slide-tape program.	63	3	1		SE	-	-	-	Cost about 4K. Begin FY 5

APPENDIX I

Agencies Requested to Provide Comments During Agency Review -

Director
California Department of
Fish & Game
1416 9th Street
Sacramento, CA 95814

Director
California Department of
Parks & Recreation
P.O. Box 2390
Sacramento, CA 95811

California Coastal
Commission
631 Howard Street
San Francisco, CA 94104

Director
California Coastal
Commission
Central Coast District
701 Ocean Street, Rm 310
Santa Cruz, CA 95060

San Mateo County Planning
Department
County Government Center
Redwood City, CA 94063

Engineer
Colma City Planning Dept.
El Camino Real at
Serramonte Blvd.,
Rt. 1, Box 235
Colma, CA 94014

Director
San Francisco Planning Dept.
100 Larkin Street
San Francisco, CA 94102

City Planner
Burlingame City Planning Dept.
501 Primrose Road
Burlingame, CA 94010

Director
Half Moon Bay City Planning
Dept.
P.O. Box 67
Half Moon Bay, CA 94019

Director
Pacific City Planning Dept.
170 Santa Maria Ave.,
City Hall
Pacifica, CA 94044

Director
San Bruno City Planning Dept.
567 El Camino Real
San Bruno, CA 94066

Director
Woodside Town Planning Dept.
P.O. Box 4005
Woodside, CA 94062

Cont'd

Director
San Francisco Airports
Dept.
San Francisco International
Airport
San Francisco, CA 94128

Superintendent
Golden Gate National
Recreation Area
Fort Mason
San Francisco, CA 94123

Regional Director
National Park Service
450 Golden Gate Avenue
Box 36036
San Francisco, CA 94102

District Engineer
U.S. Army Corps of Engineers
San Francisco District
211 Main Street
San Francisco, CA 94105

Regional Administrator
Environmental Protection Agency
215 Fremont Street
San Francisco, CA 94105