A.12 GIANT GARTER SNAKE (*THAMNOPHIS GIGAS*)


photo courtesy USGS

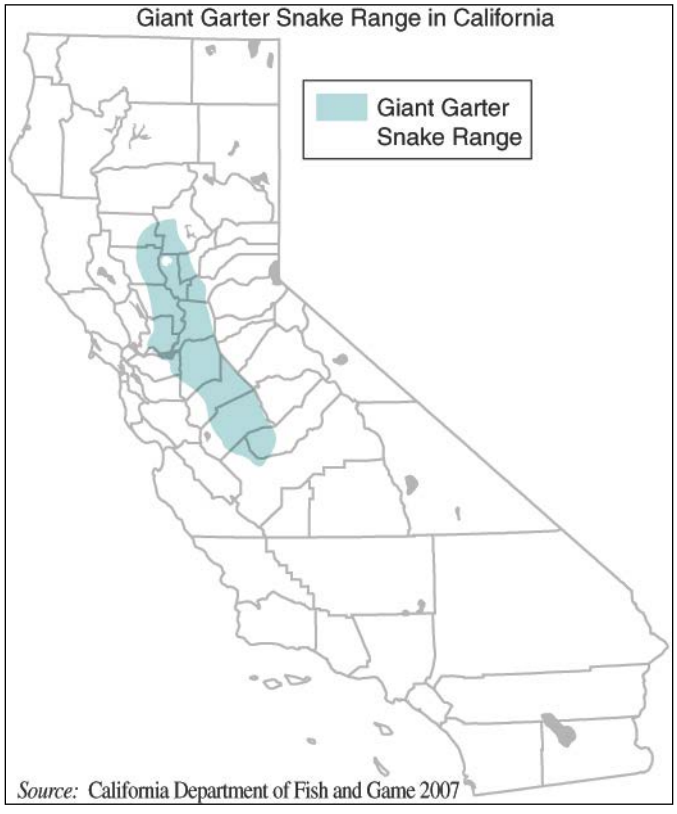
A.12.1 Legal and Other Status

The giant garter snake is listed as threatened under the ESA (58 FR 54053) and California ESA (DFG 2011). Critical habitat has not been designated for this species.

A.12.2 Species Distribution and Status

A.12.2.1 Range and Status

The giant garter snake is endemic to wetlands in the Sacramento and San Joaquin valleys and was historically distributed throughout the San Joaquin Valley from the vicinity of Sacramento and Antioch southward to Buena Vista and the Tulare Lake Basin (DFG 2000). Currently, this species' distribution extends from near Chico, Butte County, to the vicinity of Burrel, Fresno County. Due to the direct loss of natural habitat, the giant garter snake relies heavily on rice fields in the Sacramento Valley but also uses managed marsh areas in federal and state wildlife refuges. Only a few recent sightings of giant garter snakes have been reported in the San Joaquin Valley.



A.12.2.2 Distribution and Status in the Plan Area

In 1996, surveys were conducted in the rice fields of Butte Basin near Butte Sink (Butte County) and no giant garter snakes were found (USFWS 2006a). Three occurrences of the species were recently discovered in the vicinity of the City of Chico (USFWS 2006a). The giant garter snake has been found in numerous locations in the western portion of Butte County area near the Sacramento River, south of Chico and west of Biggs and Gridley, in the 1990s (CNDDB 2011) (see Figure A.12-1, *Giant Garter Snake Modeled Habitat and Recorded Occurrences*).

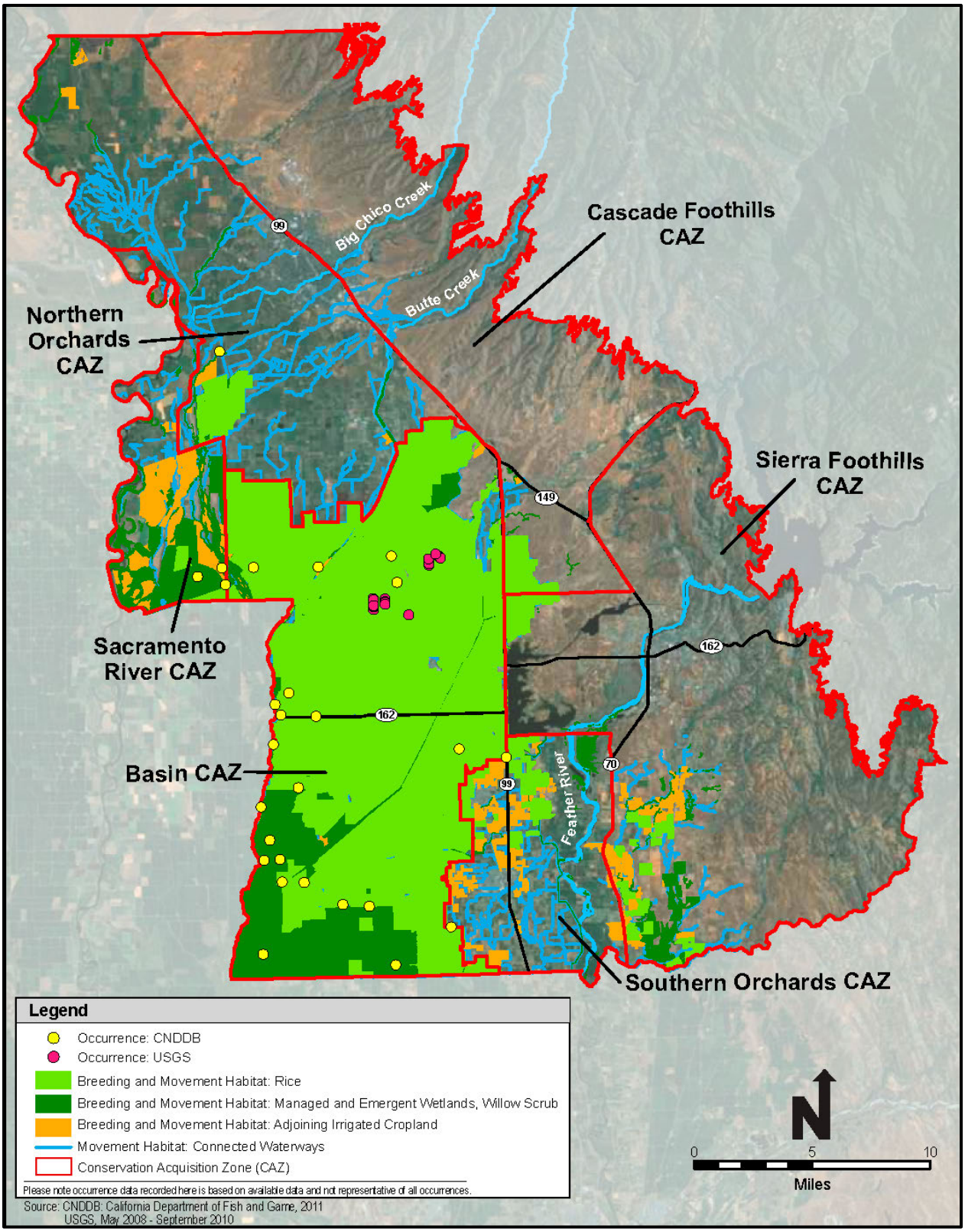


Figure A.12-1. Giant Garter Snake Modeled Habitat and Recorded Occurrences

In addition to CNDDB data, USGS research projects have documented the species based on captures and recaptures along 44 transects along linear canals within rice fields and in managed wetlands in Butte and Glenn County from 2008 through 2010 (Wylie et al. 2011).

A.12.3 Habitat Requirements and Special Considerations

Giant garter snakes are strongly associated with aquatic habitats such as marshes, ponds, sloughs, small lakes, low gradient streams, and other waterways, and in agricultural wetlands, including irrigation and drainage canals, rice fields, and the adjacent uplands (USFWS 1993). Typically, giant garter snakes overwinter in burrows and crevices near their active season foraging habitat (Hansen 2004). Individuals have been noted using burrows as far as 164 feet (50 meters) from marsh edges during the active season, and retreating as far as 820 feet (250 meters) from the edge of wetland habitats while overwintering, presumably to reach hibernacula above the annual high watermark (Hansen 1986, Wylie et al. 1997, USFWS 1999).

Habitat requirements include (1) adequate water during the snake's active season (early spring through mid-fall) to provide food and cover; (2) emergent, herbaceous wetland vegetation, such as cattails and bulrushes, for escape cover and foraging habitat during the active season; (3) basking habitat of grassy banks and openings in waterside vegetation; and (4) higher elevation uplands for cover and refuge from flood waters during the snake's dormant season in the winter (USFWS 2006b). The giant garter snake resides in small mammal burrows and soil crevices located above prevailing flood elevations throughout its winter dormancy period (USFWS 2006b). Adequate burrows are typically located in sunny exposures along south and west facing slopes.

Due to lack of habitat and emergent vegetation cover, giant garter snakes generally are not present in larger rivers and wetlands with sand, gravel, or rock substrates. In addition, the major rivers have been highly channelized, removing oxbows and backwater areas that probably at one time provided suitable habitat. Riparian woodlands can provide suitable habitat, but it is not likely because most have excessive shade, lack of basking sites, and absence of prey populations (USFWS 2006b). In some rice-growing areas, giant garter snakes have adapted well to vegetated, artificial waterways and associated rice fields (Hansen and Brode 1993).

Changing agricultural regimes, development, and other shifts in land use create an ever-changing mosaic of available habitat. Giant garter snakes move around in response to these changes in order to find suitable sources of food, cover, and prey. Connectivity between regions is therefore extremely important for providing access to available habitat and for genetic interchange. In an agricultural setting, giant garter snakes rely largely upon the interconnected network of canals and ditches that provide irrigation and drainage to provide this connectivity.

A.12.4 Life History

Cool winter months are spent in dormancy or periods of reduced activity, and giant garter snakes typically emerge from late March to early April. With breeding taking place from March through early May, females give birth to live young from late July through early September. Activity peaks during spring emergence and declines significantly after courtship behavior declines towards the end of June, after which a second peak of activity is observed after females give birth to their young (Hansen and Brode 1993, Wylie et al. 1997, USFWS 1999, Hansen 2004). Giant garter snakes remain active through October, foraging and occasionally courting, until the onset of cooler fall temperatures.

Brood size is variable, ranging from 10 to 46 young, with a mean of 23. Young immediately scatter into dense cover and absorb their yolk sacs, after which they begin feeding on their own. Although growth rates are variable, young typically more than double in size within the first year. Sexual maturity averages three years for males and five years for females. Daily activity consists of emerging from burrows after sunrise, basking to warm bodies to active temperatures, and foraging or courting for the remainder of the day (Hansen and Brode 1993). Radiotelemetry studies show that the giant garter snake home range varies by location. Median home range estimates vary between 23 acres in a semi-native perennial marsh system and 131 acres in a managed refuge (USFWS 1999).

Giant garter snakes feed on small fishes, tadpoles, and small frogs (USFWS 1999), specializing in ambushing prey underwater (Brode 1988). Historically, giant garter snakes preyed on native species such as the thick-tailed chub (*Gila crassicauda*) and California red-legged frog (*Rana aurora draytonii*) (which have been extirpated from the giant garter snake's current range), as well as the pacific treefrog (*Pseudacris regilla*) and Sacramento blackfish (*Orthodox microlepidus*) (Cunningham 1959, Rossman et al. 1996, USFWS 1999). Giant garter snakes now utilize introduced species, such as small bullfrogs (*Rana catesbeiana*) and their larvae, carp (*Cyprinus carpio),* and mosquitofish (*Gambusia affinis*). While juveniles probably consume insects and other small invertebrates, giant garter snakes are not known to consume larger terrestrial prey such as small mammals or birds.

A.12.4.1 Plan Area Population

A.12.4.1.1 Population Density – Existing Information

Abundances and densities of giant garter snakes vary with context of habitat; they are lowest in managed seasonal marshes (dry in summer, flooded in winter for waterfowl habitat), greatest in natural marshes, and intermediate in rice fields (Wylie et al. 2011). In general, giant garter snakes select areas with a dense network of canals, often in close proximity to rice agriculture, with a relatively low density of streams and closer to open water and wetlands, compared to available environments in the Sacramento Valley (Halstead et al. 2010).

Most density estimates for giant garter snakes have been derived from linear trapping transects along canals, linear wetlands, or ecotones between deep water and upland habitat. Standard survey methodology for giant garter snake entails transects consisting of 50 floating aquatic funnel traps (Casazza et al. 2000) located along the open water/terrestrial or open water/emergent vegetation interface in areas of standing or slow-moving water and, where possible, emergent aquatic vegetation. Traps are spaced approximately 10 meters (33 feet) apart, resulting in traplines of approximately 500 meters (1,640 feet).

Hansen and Brode (1993) estimated a local population size of 1,000 snakes per square mile (1.56 snakes per acre) of rice lands based on year-to-year mark recapture rates (USFWS 1999). Giant Garter snake population densities (snakes per lineal mile of rice irrigation canal) in Yolo county ranged from 13 (95% confidence interval [C.I.] = 11 to 32) to 92 (95% C.I. = 72 to 135) in the Yolo Wildlife Area; 8 (95% C.I. = 8 to 8) to 27 (95% C.I. = 19 to 63) in the adjacent ricelands; and from 42 (95% C.I. = 18 to 193) to 108 (95% C.I. = 35to 518) within the Davis Wetlands Complex (Hansen in. litt. 2006, 2007, 2008). For the Colusa Drain and adjacent rice habitat, a mean density of 22.6 snakes per lineal mile of survey was determined for three consecutive years (Wylie and Amarello 2008). USGS (Wylie and Casazza 2000a, 2000b, Wylie et al. 2004) reported linear densities in selected trapping areas ranging from 13 (95% C.I. = 10–19) to 88 (95% C.I. not reported) giant garter snakes per linear mile from 1999 to 2003 in the Natomas Basin. Mean landscape-level densities of giant garter snakes reported from the Natomas Basin (all habitats combined) range from 5.1 to 22.7 giant garter snakes per linear mile (Table A.12-1, *Giant Garter Snake Densities (individuals captured per mile surveyed) Reported in Rice and Other Wetland Habitats from Various Sites in the Sacramento Valley, 1999-2010*) and have fluctuated considerably among the years.

Table A.12-1. Giant Garter Snake Densities (individuals captured per mile surveyed) Reported in Rice and Other Wetland Habitats from Various Sites in the Sacramento Valley, 1999-2010

Location	Habitat	Individuals captured	Miles	Individuals/ mile	Reference
Badger Creek (southern Sacramento County)	Natural wetlands	103	0.5	221.0	Wylie et al. 2010
Colusa NWR	Managed wetlands	22	1.1	20.2	Wylie et al. 2010
Colusa NWR	Restored wetlands	NA	NA	48–194	Wylie et al. 2002
Gilsizer Slough (Sutter County)	Rice	67	1.8	37.8	Wylie et al. 2010
Colusa Drain (2003)	Rice	40	2.4	16.8	Wylie and Amarello 2008
Colusa Drain (2004)	Rice	24	2.4	10.0	Wylie and Amarello 2008
Colusa Drain (2006)	Rice	30	2.4	12.4	Wylie and Amarello 2008
Natomas Basin	Rice	141	4.1	34.1	Wylie et al. 2010
Butte and Glenn Counties	Rice	28	3.5	7.5	Wylie et al. 2011
Natomas Basin Average (1999-2004)	All	NA	NA	22.7	Jones & Stokes 2005a and b
Natomas Basin 2009	All	155	19. 3	8.0	ICF 2010
Natomas Basin 2010	All	112	22.1	5.1	ICF 2011

NA = not applicable.

In general, higher densities of snakes were recorded in linear drainage and irrigation features associated with rice, compared with managed or seasonal marsh habitats (ICF 2011). The availability of managed marsh habitat has been deemed important for giant garter snakes when they emerge from winter dormancy and begin feeding, dispersing, and mating – at which times rice fields and other aquatic habitats are not available (ICF 2011). Core home range size of radio-tagged female garter snakes (Valcarel 2011) were smaller in rice habitats and overlapped considerably more, compared to those in restored wetlands in Gilsizer Slough (Sutter County).

A.12.4.1.2 Habitat Types and Population Densities in the BRCP Area

Aquatic habitat availability is the primary determinant of giant garter snake abundance. Therefore, aquatic habitats are considered an obligate habitat prerequisite for the species. Aquatic habitat types and their corresponding landscape level population densities of giant garter snakes[1] are described below and are categorized as follows:

Rice: Within the giant garter snake focal areas of the BRCP Plan Area (i.e., predominantly in the western portion of Butte County area near the Sacramento River, south of Chico and west of Biggs and Gridley), rice land habitat is an important element of the species' life history. Wylie et al. (2011) provide the currently best available landscape level estimates of giant garter snake density in the rice-dominated agricultural areas of Butte County, based on captures and recaptures at 44 transects along linear canals within rice fields and in managed wetlands in Butte and Glenn County from 2008 through 2010. They developed a habitat suitability model (Halstead et al. 2010), which predicted that relatively little suitable habitat exists east of California highway 99 or north of California Highway 32. Extensive sampling in the southwestern portion of Butte County (i.e., Butte Sink area) did not yield any captures, because of the flood-proneness of the area. To estimate average giant garter snakes across the landscape and to make the results of Wylie et al. (2011) more applicable to the rice in the Plan Area, the total density of snakes per lineal mile of canal habitat from all transects, including those that did not result in snake captures was $\bar{x}$ **Error! Bookmark not defined.**= 7.48, (standard deviation [sd] = 8.10, range = 0 to 19.65; Wylie et al. 2011). These estimates are lower than those of other recent studies in adjacent areas (Table A.12-1), but probably are realistic estimates for a large landscape area, since Wylie's et al. (2011) study included transects that did not yield captures. Wylie et al. (2011) established a lower confidence interval boundary of 0.2 snakes per ha (= 0.49 per acre) at the study site with the lowest overall density of snakes (excluding sites that had no snake captures), which translates into a low estimate of 6.34 snakes/mile for occupied sites. This estimate is also well within the range of data for giant garter snakes in Sacramento Valley (Table A.12-1). An upper estimate of snake density was derived as the mean plus one standard deviation from Wylie et al. (2011). Thus, a high estimate of the area-wide density of snakes was calculated as ($\bar{x}$ + sd) = 15.58 snakes/mile. The distribution of giant garter snakes in the Plan Area is probably clumped and likely disjunct (Glenn Wylie, pers. comm.), with large areas of

[1] Population estimates presented here are based for evaluations of the impacts and conservation effects only. These estimates are based on the currently available, best scientific information, from the published literature. However, they are intended for "order-of-magnitude comparisons only."

unoccupied habitat interspersed by patches of higher population densities. Such distributions have been related to historical (Paquin et al. 2006) and spatial dynamics of habitat manipulations and conveyance management (Hansen and Brode 1993). In addition, the presence and abundance of prey and non-native and native predators (e.g., bull frogs, predatory fish, egrets, and herons) may also affect the metapopulation structure of giant garter snakes in the Plan Area.

The total length of conveyances (in miles) that are potential habitat for giant garter snakes multiplied with the conservative mean estimate of 7.48 snakes per lineal mile of canals, yields an estimate of giant garter snakes for the entire 120,225 acres of rice habitat of the BRCP Area, containing a total of 578 miles of canals, is 4,323 (mean) to 9,002 (high) giant garter snakes (or 0.039 to 0.075 snakes per acre on a landscape level).

Irrigated croplands: Although the habitat model for giant garter snake included also irrigated croplands, for the purpose of estimating snake population size this habitat type was assumed not to provide year-round stable habitat and thus was not included for the calculation of a population estimate.

Emergent wetlands: The BPRCP Area contains 3,787 acres of modeled emergent wetlands. Natural emergent wetlands are thought to represent the original habitat type in which the giant garter snake evolved and to which it is adapted. Some of the highest density of giant garter snakes have been reported for natural wetlands (Wylie et al. 2010), reaching up to 221 individuals per mile (2.76 snakes per acre). However, the BRCP modeled emergent wetland habitat category contains an unknown proportion of high-functioning natural wetlands and emergent wetlands that are degraded (e.g., by invasive predators) and not suitable to support giant garter snakes. No landscape level estimates of giant garter snakes in natural emergent wetlands exist. For the purpose of density analyses, it was assumed that only 10 percent of these wetlands consistently provide habitat functions to sustain resident garter snakes in densities comparable to natural wetlands. Thus, the density of giant garter snakes on a landscape-level was estimated to .276 snakes per acre. The sensitivity of the overall impact and conservation outcome estimates to this density estimate is considered low as only very few acres of natural wetlands will be affected by covered activities.

Summer Flooded/Perennial Wetlands: A total of 29,480 acres of managed wetland, managed seasonal wetland, and major canal land cover types supporting wetlands are present within the Plan area, the majority of which are managed and managed seasonal wetlands (27,583 acres). Only a fraction of managed wetlands and managed seasonal wetlands, however, are managed in a way conducive to snake hibernation habitat and summer foraging habitat, thus providing year-round habitat. Wetlands that are flooded during summer or are perennial provide the highest quality habitat for giant garter snake. Since existing summer-flooded, perennial or natural wetlands could not be distinguished from the fresh emergent wetland data layer in the BRCP GIS database, it was necessary to estimate the proportion of summer flooded wetlands that potentially provide garter snake habitat functions. Based on a similar evaluation for Yolo County and using visual estimates from summer aerial imagery (September 2011), approximately 20% of all

mapped managed wetlands are summer flooded and may provide sufficient warm-water habitat for the species. Assuming that at least 20 percent of managed wetlands in the Plan Area are suitable, the estimated actual acreage of managed wetlands that provide suitable year-round habitat for garter snakes at 20% or 5,896 acres. Only one local density estimate (i.e., 20.2 snakes/mile of transect) exists for giant garter snakes in managed wetlands from a study on the Colusa NWR, which was translated into a density of 0.25 individuals/acre (based on a 100 m buffer on each side of the transect as described by Wylie et. al 2011). Much of Colusa NWR was formerly agricultural fields but has largely been restored to wetlands managed for multiple species, vernal pools, and wintering waterfowl habitat.

Seasonal/Managed Wetlands – winter-flooded: These seasonal wetlands comprise approximately 80% of the mapped aquatic habitat for the giant garter snake; the habitat is usually flooded in winter and thus potentially put snakes at risk of drowning in their hibernacula. Consequently, snake densities were assumed to be zero for winter flooded habitats

Restored Wetlands: Wetlands restored specifically for giant garter snake habitat provide an opportunity to produce high densities of snakes. Ideally, these habitats function as natural perennial wetlands and provide year-round habitat function for the species. Studies of restored wetlands specifically as habitat for giant garter snake are only just beginning. Local density estimates for giant garter snakes in restored wetlands in the Colusa Wildlife Refuge range from 48 to 194 snakes per mile depending on the trapping location on the Refuge, similar to values in a previous year (87-169/mile, Wylie et al. 2002). Framed by a minimum density estimate of 0.063 snakes/acre (or 5.8 snakes/mile; ICF 2010, 2011) and a conservative maximum density value of 0.46 snakes/acre (37.6 snakes/mile; Wylie et al. 2010), an average landscape-level density estimates from all studies (except natural wetlands, Wylie et al. 2010) results in a mean of 0.21 snakes/acre of restored wetland (sd=0.137), with a low to high estimate ($\bar{x} \pm sd$) of 0.073 to 0.348 snakes/acre.

Connected waterways: This habitat type does not provide "stand-alone" support for giant garter snakes, but is a vital element in seasonal wetlands and rice agriculture. Most covered activities do not completely eliminate connected waterways, but re-route or modify them, while still maintaining their conveyance functions. Thus, no density estimate was assigned to the acreage of connected waterways that would be lost/removed under the BRCP.

A.12.4.2 Plan Area Population Estimate

No systematic density evaluation or survey of giant garter snakes in the BRCP Plan Area has been conducted to date. Thus, an estimate of a total population size of giant garter snakes cannot be derived based on systematic demographic studies. Instead, landscape-level densities observed in multiple studies to estimate population sizes, based on the acreage or spatial extent of the respective habitat type were applied. Population estimation was separated by habitat type, based on the different observed densities of giant garter snakes in rice and seasonal/managed wetlands.

The acreage of giant garter snake aquatic habitat types and resulting population estimates are presented in Table A.12-2.

Table A.12-2. Acreage of Giant Garter Snake Aquatic Habitat and Corresponding Estimates of Giant Garter Snakes

Aquatic Habitat Type	Acres	Average Snake Density/Acre	Estimated Number of Snakes
Rice	120,225	0.036	4,328
Managed/seasonal wetland summer flooded and major canal land cover types [1]	5,896	0.25	1,474
Emergent wetland	3,787	0.276	1,045
Total	**153,492**	**0.045**	**6,847**

[1] Estimated to be 20 percent of managed wetland, managed seasonal wetland, and major canal land cover types within modeled giant garter snake habitat areas.

A.12.5 Threats

Habitat loss and fragmentation, flood control activities, changes in agricultural and land management practices, predation from introduced species, parasites, and water pollution are the main causes for the decline of giant garter snake. Continued loss of wetland or other suitable habitat resulting from agricultural and urban development is the greatest threat to giant garter snake. Conversion of Central Valley wetlands for agriculture and urban uses has destroyed approximately 95 percent of historical giant garter snake habitat (Wylie et al. 1997). Where this species has adapted to agriculture, maintenance activities such as vegetation and rodent control, bankside grading or dredging, and discharge of pollutants, threaten their survival (Hansen and Brode 1993, USFWS 1999, Wylie et al. 2004). In developed areas, the threat of road mortality is increased. Paved roads may pose a greater threat due to increased traffic and traveling speeds. Approximately 31 giant garter snake traffic mortalities were reported during a four-year period in the Natomas Basin (Hansen and Brode 1993). Giant garter snakes are also threatened by the introduction of exotic species. Gut content studies confirm that introduced bullfrogs (*Rana catesbeiana*) prey on juvenile giant garter snakes throughout their range (Treanor 1983, Dickert 2003, Wylie et al. 2003). While the extent of this predation is not well understood, preliminary data from a study conducted at Colusa National Wildlife Refuge suggests that 22 percent of newborn giant garter snakes succumb to bullfrog predation (Wylie et al. 2003).

A.12.6 Relevant Conservation Efforts

Conservation efforts for the giant garter snake include restoration activities on wildlife refuges and mitigation banking. Due to continued loss of habitat, this species has become increasingly dependent on 10 refuges and wildlife management areas in the Central Valley (Czech 2006). The absence of giant garter snake in apparently suitable habitat in the refuge system suggests that factors such as winter flooding and predation (especially by nonnative species such as bullfrogs) may be limiting in some areas. Giant garter snake prefers summer flooding and winter drying, but Central Valley refuge system properties are likely managed intensively for wintering

waterfowl with a reversed water regime, resulting in habitat features that are problematic for giant garter snake conservation. These opposing requirements suggest that separate conservation areas for the snake are necessary.

Efforts to restore the ecological integrity of the land at Colusa National Wildlife Refuge have proven beneficial to giant garter snake, and some mitigation banks designed specifically for giant garter snake, including the 565-acre (229-hectare) Gilsizer Slough South Giant Garter Snake Conservation Bank in Sutter County, are also beneficial for giant garter snake. Giant garter snake is a covered species or a proposed covered species in several regional conservation plans in the Central Valley region of California, including the Placer County Conservation Plan, the Natomas Basin Habitat Conservation Plan, the San Joaquin County Multi-Species Habitat Conservation and Open Space Plan, and the East Contra Costa County Habitat Conservation Plan/Natural Community Conservation Plan, the Solano County Multispecies Habitat Conservation Plan, the South Sacramento County Habitat Conservation Plan, the Yolo Natural Heritage Program Plan, and the Bay Delta Conservation Plan.

A.12.7 Habitat Suitability Model

A.12.7.1 Breeding and Movement Habitat

Breeding and movement habitat for the giant garter snake includes the following land cover types and conditions that are present below 200 feet mean sea level:

- Rice;
- Managed wetland;
- Emergent wetland;
- Willow scrub;
- Irrigated cropland adjoining rice, managed wetland, emergent wetland, and willow scrub; and
- Canals, sloughs, and permanent or intermittent low-gradient streams (except the Sacramento River, Feather River, and Big Chico Creek) that are within 8 kilometers (km) of patches of rice, managed wetland, emergent wetland, and willow scrub. Portions of streams internal to patches of rice, managed wetland, emergent wetland, and willow scrub have not been included within the aquatic model because this linear extent is accounted for within the land cover type that encompasses the stream feature.

Additionally, patches of habitat identified based on the above model that were less than 50 acres and greater than 1 mile from larger patches of habitat were not considered to function as habitat because they are isolated and not likely to support giant garter snakes.

A.12.7.2 Assumptions

Giant garter snakes inhabit marshes, ponds, sloughs, small lakes, low gradient streams, and other waterways, and agricultural wetlands, including irrigation and drainage canals, rice fields, and the adjacent uplands (USFWS 2006b). In the Sacramento Valley, their habitat requirements include (1) adequate water during the snake's active season (early spring through mid-fall) to provide food and cover; (2) emergent herbaceous wetland vegetation for escape cover and foraging habitat during the active season; (3) basking habitat of grassy banks and openings in waterside vegetation; and (4) higher elevation uplands for cover and refuge from flood waters during the snake's dormant season in the winter (USFWS 2006b). Due to lack of habitat and emergent vegetative cover, giant garter snakes generally are not present in larger rivers with sand, rock, and gravel substrates (e.g., the Sacramento River, Feather River, and Big Chico Creek). Riparian woodlands are unlikely to provide suitable habitat due to excessive shade, lack of basking sites, and absence of prey populations (USFWS 2006b). Irrigated cropland adjoining rice, managed wetland, emergent wetland, and willow scrub is included as habitat because canals associated with irrigated cropland in close proximity to these other habitat types may also be used by giant garter snakes.

The giant garter snake has been observed to relocate to new resource patches during the breeding season and when threatened (Wylie pers. comm., Hansen pers. comm.). Under extreme situations the snake has been known to migrate up 8 km along low gradient stream corridors (Wylie pers. comm., Hansen pers. comm.). To address this potential movement, low gradient waterways that are hydrologically connected to identified breeding and movement habitat (excluding the Sacramento River, Feather River, and Big Chico Creek) have been included as movement habitat. All streams within 8 km of identified breeding and movement habitat, and with a gradient of less than 2 percent were classified as movement habitat. Portions of streams internal to breeding and movement habitat have not been included within the model because this linear extent is accounted for within the landcover type that encompasses the stream feature.

A.12.8 Recovery Plan Goals

In 1999 the Draft Recovery Plan for the Giant Garter Snake was prepared by the U.S. Fish and Wildlife Service. The overall objective of this recovery plan is to delist the giant garter snake. The goals are (1) stabilizing and protecting existing populations, and (2) conducting research necessary to further refine recovery criteria. Recovery criteria in this plan are in the preliminary stages because at the time there was not enough data of the giant garter snake population dynamics upon which to base decisions.

The recovery plan divided the Central Valley into four recovery units to aid in the recovery process. These units are (1) the Sacramento Valley Unit, extending from the vicinity of Red Bluff south to the confluence of the Sacramento and Feather Rivers; (2) the Mid-Valley Unit, extending from the American and Yolo Basins south to Duck Slough near the City of Stockton;

(3) the San Joaquin Valley Unit, extending south of Duck Slough to the Kings River; and (4) the South Valley Unit, extending south of the Kings River to the Kern River Basin.

Butte County populations of giant garter snake are included in the Sacramento Valley Unit. Recovery criteria for this unit are as follows:

1. Monitoring shows that in 17 out of 20 years, 90 percent of the subpopulations in the recovery unit contain both adults and young.
2. The three existing populations within the recovery unit are protected from threats that limit populations.
3. Supporting habitat within the recovery unit is adaptively managed and monitored.

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