Chapter 3
Environmental Basis of Comparison– Special Status Species Accounts and Status in EWA Action Area

3.1 Introduction to Species Accounts

Chapter 3 presents species accounts for the species assessed in detail in this ASIP. The species addressed in this chapter are based on the screening process presented in Chapter 1, Section 1.4. In summary, the species addressed in the remaining portions of this ASIP were selected based on several considerations related to EWA asset acquisition and management actions that could affect the species or the habitat of species covered in this ASIP[1]. These considerations include:

- MSCS covered fish species that migrate upstream through the Delta to spawn in Delta tributary rivers and streams that may be affected by EWA pumping actions or alteration of Delta flows as a result of EWA pumping actions;
- MSCS covered fish species that inhabit Suisun Bay or the Delta that may be affected by EWA pumping in the Delta or reduced Delta outflows caused by EWA pumping;
- MSCS covered fish species that spawn in Delta tributary rivers and streams that may be affected by changes in the timing of stream flows (reduced flow due to water storage or increased flows when stored water is released);
- MSCS covered fish species that inhabit tributary rivers and streams whose habitat/water quality may be affected by reduced agriculture return flows due to EWA-related crop idling actions;
- MSCS covered terrestrial species whose life cycles are dependent on seasonally flooded agricultural land;
- MSCS covered species that extensively use agriculture water supply/return ditches as habitat; and
- MSCS covered species that use seasonally flooded agriculture land for a portion of their life cycle (e.g., nesting/forage during the summer, over-winter forage for winter migrants).

Not included in this ASIP are nonnative species (e.g., striped bass) or species that may occasionally visit, but are not dependent on, seasonally flooded agricultural land (e.g.,

[1] Based on the Proposed Action description provided in Chapter 2 the following EWA actions are most likely to affect covered species: 1) the pumping of EWA assets to the Export Service Area, 2) reduction in Delta outflows, 3) changes in timing of releases of water from reservoirs, and 4) crop idling involving seasonally flooded agriculture (rice).

migrants or species with broad home ranges). Terrestrial species that may be associated with lacustrine habitats (lakes, ponds, oxbows, gravel pits), such as bald eagles and osprey, are also not included because the analysis of EWA actions involving surface water purchase, storage, and release produced no adverse effect to fish populations, which can be a primary food source.

Chapter 3 presents basis of comparison descriptions at the species level. In accordance with FESA, the FESA environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in an action area, the anticipated impacts of all proposed Federal projects in an action area that have already undergone formal or early Section 7 consultation, and the impact of State or private actions that are contemporaneous with the consultation in process. [50 CFR 402.02.] Unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultation also are part of the FESA environmental baseline, as are the Federal and other actions within the action area that may benefit listed species or critical habitat (USFWS & NMFS 1998). As a part of this environmental basis of comparison, the EWA agencies will define a baseline of population and habitat quantity and quality for listed and proposed species and designated and proposed critical habitat.

Species accounts are provided in the following order: fish (Section 3.2), birds (Section 3.3), and reptiles (Section 3.4). The species are organized by Federal, then State designation within each of these sections.

3.2 Species Accounts for Fish

3.2.1 Central Valley Fall/Late Fall-Run Chinook Salmon (*Oncorhynchus tshawytscha*)

Legal Status. The Central Valley fall-run/late-fall-run Chinook salmon is a candidate species (formerly Category 1 species) under the federal Endangered Species Act (NMFS 1999) and is listed as a California species of special concern (CDFG 2003). The Central Valley fall-run/late-fall-run Chinook salmon ESU includes all naturally spawned fall- and late-fall run populations of Chinook salmon in the Sacramento and San Joaquin basins and their tributaries, east of Carquinez Strait, California (NMFS 1999). NMFS broadly defines candidate species as those whose status is of concern, but more information is needed before they can be proposed for listing. In California, species of special concern is an informal designation used by the California Department of Fish and Game (CDFG) to identify declining and vulnerable species in the state.

NOAA Fisheries has identified distinct populations of Pacific salmon, steelhead, and sea-run trout as Evolutionarily Significant Units (ESUs). For a fish population (or group of populations) to be considered an ESU, it must be: 1) reproductively isolated from other populations; and 2) contribute substantially to the ecological and genetic diversity of the species (Waples 1991; NMFS 1991). The Central Valley fall-run/late-fall-run Chinook salmon is identified as an ESU by NOAA Fisheries.

Historical and Current Distribution and Status. Fall-run/late-fall-run Chinook salmon historically inhabited many streams of the Sacramento-San Joaquin watershed. Fish barriers (typically dams) on many streams and rivers currently limit upstream habitat. Subgroups commonly referred to include 1) San Joaquin fall-run, which includes populations in the Stanislaus, Tuolumne, and Merced Rivers; 2) populations from eastside tributaries that include the Cosumnes and Mokelumne Rivers; 3) populations from westside tributaries that include the Putah, Clear, and Cottonwood Creeks; 4) fall-run populations in the Sacramento River and its tributaries; and 5) late-fall-run populations in the Sacramento River and selected tributaries. Late-fall-run Chinook are generally the second least numerous run in the Sacramento River (after winter-run) (CDFG 1995). NMFS (1999a) summarizes long-term population trends for fall-run salmon as generally stable to increasing. However, it is unclear if these populations are self-sustaining, because at least 20 to 40 percent of the spawners are of hatchery origin (NMFS 1999). In addition, 40 to 50 percent of spawning and rearing habitats have been lost or degraded. Fall-run Chinook are currently the most numerous of the Central Valley runs (Myers *et al*. 1998). The late-fall-run Chinook salmon population in the Sacramento River appears to be stable, despite its low abundance (NMFS 1999). Reliable estimates at Red Bluff Diversion Dam (RBDD) from years prior to 1992 suggest escapement was 6,700 to 9,700 adults. Estimates made from 1992-97 are considered unreliable. In 1998, a more reliable estimate of 9,717 adults was made using carcass survey methodology. The similarity in results suggests that late-fall-run populations appear to be stable; however, there is still much uncertainty due to changes in estimation methodology (NMFS 1999). Preliminary estimates for 1999 through 2002 for carcass counts of natural spawners and fish spawned at Coleman Fish Hatchery range from approximately 7,500 to 29,300 (PFMC 2003).

Distribution in the CALFED Solution Area and EWA Action Area. Fall-run/late-fall-run Chinook salmon are found in all the ecological zones of the Central Valley except the West San Joaquin Basin Ecological Zone. Adults migrate upstream through the bay and Delta ecozones from summer through early winter, generally migrating from September through February with a peak in late December-early January. Adults are found in river and tributary ecozones generally from late summer into winter. Most young move out of tributary spawning areas in winter and spring. Young may be found in the river, Delta, and bay ecozones from winter into early summer.

Life History and Habitat Requirements. Chinook salmon require cold, freshwater streams with suitable gravel for reproduction. Despite NMFS inclusion of fall- and late-fall-run Chinook salmon in the same ESU, Moyle (2002) suggests that fundamental differences exist between the two races that warrant separate designation. Fall-run Chinook salmon are ocean-type Chinook adapted for spawning in lowland reaches of big rivers and their tributaries; juveniles have a brief rearing period (1-7 months) before emigration (Moyle 2002). Late-fall-run Chinook salmon, on the other hand, are mostly stream-type Chinook, typically entering freshwater in an immature state and holding while their gametes mature; juveniles have an extended stream residency (7 to 13 months) and attain a comparatively large size

before emigration (Moyle 2002). Fall-run Chinook move upstream to freshwater from August to December, while late-fall-run Chinook move upstream from October to February (CDFG 1995). The fall-run Chinook salmon peak spawning period is October-November, whereas the late-fall-run peak spawning period is February-March (Moyle 2002). Females deposit their eggs in nests in gravel-bottom areas with relatively swift water, generally when water temperatures are less than 60°F. For maximum survival of incubating eggs and larvae, water temperatures must be between 39°F and 57°F. Incubation takes 3 to 4 months, with several weeks spent as alevins (sac-fry) (CDFG 1995). Fall-run Chinook salmon fry typically emerge December-March, and late-fall- run emerge April-June (Moyle 2002).

After emerging, many Chinook salmon fry tend to seek shallow, nearshore habitat with slow water velocities and move to progressively deeper, faster water as they grow. Many emerging fry are transported downstream into the lower rivers and the Delta, where they rear in shallow marshes and side channels. Shaded riverine aquatic habitat is important for providing cover from predators and access to food. Juvenile late-fall-run Chinook salmon typically rear in fresh water for up to a year before migrating to sea the following June-December; juvenile fall-run Chinook salmon exhibit a shorter rearing period of 1 to 7 months before emigrating January-July (Vogel and Marine 1991). Chinook salmon spend 2 to 4 years maturing in the ocean before returning to their natal streams to spawn. All Pacific adult Chinook salmon die after spawning (Moyle 2002, Beauchamp *et al*. 1983, Allen and Hassler 1986.)

Reasons for Decline. Loss and degradation of spawning and rearing habitat; alteration of streamflows; overharvest; entrainment into water diversions; blockage of migration routes; exposure to toxins; and, possibly, loss of genetic viability from interbreeding with hatchery stocks have contributed to the population decline of Central Valley fall-run/late-fall-run Chinook salmon. The human-caused factor that perhaps has had the greatest effect on the abundance of all Chinook salmon runs is loss of habitat, primarily in the rivers upstream from the Delta. Dams have presumably blocked some upstream access to habitat or impaired passage of adult fall-run and late-fall-run Chinook salmon (CDFG 1995). However, most of the historical spawning habitat for these runs has been downstream from impassable dams (Myers *et al.* 1998). Harvest rates of wild stocks are a potential contributing factor to the decline of the population; ocean harvest indices (i.e., percent of population harvested) range from 50 to 79 percent and averaged over 70 percent between 1990 and 1997 (PFMC 1998).

Designated Critical Habitat or Essential Fish Habitat. Critical habitat has not been proposed or designated. Essential fish habitat has been identified in the Pacific Coast Salmon Plan (PFMC 1997, 2000).

Conservation Efforts. The agencies implementing the CVPIA and CALFED actions are working to improve the quality of anadromous fish habitat, improving fish passage, and contributing to population recovery (AFRP 2001; CALFED 2000).

Recovery Plan and Recovery Guidance. Measures for recovery of the Sacramento late-fall-run and San Joaquin fall-run Chinook salmon populations are presented in the Anadromous Fish Recovery Plan (AFRP 2001), CDFG (1995), and the Native Fishes Recovery Plan (USFWS 1996).

Research and Monitoring Gaps. The specific habitat requirements and causes of population declines of the fall-run and late-fall-run Chinook are not well known (CDFG 1995). Research is needed to characterize the genetic makeup of all Central Valley fall-run Chinook to compare populations in the San Joaquin River to other watersheds (Myers *et al.* 1998). In addition, the amount of spatial and seasonal overlap and genetic introgression between all runs in the Sacramento River is an important topic for study (CDFG 1995).

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3.2.2 Sacramento River Winter-Run Chinook Salmon (*Oncorhynchus tshawytscha*)

Legal Status. The Sacramento River winter-run Chinook salmon ESU is listed as endangered under both the Federal (NMFS 1994) and California Endangered Species Acts (CDFG 2000, 2003). The Sacramento River winter-run Chinook salmon ESU includes populations in the Sacramento River and its tributaries in California (NMFS 1994).

NOAA Fisheries has identified distinct populations of Pacific salmon, steelhead, and sea-run trout as Evolutionarily Significant Units (ESUs). For a fish population (or group of populations) to be considered an ESU, it must be: 1) reproductively isolated from other populations and 2) contribute substantially to the ecological and genetic diversity of the species (Waples 1991; NMFS 1991).

Historical and Current Distribution and Status. Sacramento River winter-run Chinook salmon primarily spawn in the mainstem Sacramento River below Keswick Dam (NMFS 1997, CDFG 2002). Adult winter-run Chinook salmon immigration (upstream spawning migration) through the Delta and into the lower Sacramento River occurs from November through June, with peak immigration during the period extending from January through April (USFWS 1995, Myers *et al.* 1998). These salmon spawn between late-April and mid-August, with peak spawning generally from May to June (NMFS 1997, Myers *et al.* 1998). Most young move out of spawning areas in November through June. Young may be found in the Sacramento River, Delta, and Bay ecozones from winter into early summer.

The historical distribution of winter-run Chinook prior to construction of Shasta Dam included the headwaters of the McCloud, Pit, and Little Sacramento Rivers and tributaries like Hat Creek and Fall River (Myers *et al.* 1998, NMFS 1999, NMFS 2003). Since completion of Shasta Dam the Sacramento River, Battle Creek, and Calaveras River are the only habitats where winter-run Chinook have been known to occur (USFWS 1987, NMFS 1999). Fish still have access to Battle Creek through the Coleman National Fish Hatchery weir from a fish ladder that is opened during the peak of winter-run Chinook salmon migration period (Ward and Kier 1999). Currently, if a winter-run Chinook salmon population exists in Battle Creek its population size is unknown and likely very small. In addition, a winter-run to the upper Calaveras River took place between 1972 and 1984, but this population seems to have been eliminated by drought, irrigation diversions, and access blocked by the New Hogan Dam (NMFS 1997, NMFS 1999). Calaveras River winter-run Chinook salmon appear to be extirpated (NMFS 2003).

Winter-run Chinook salmon fry and juveniles generally emigrate past Red Bluff Diversion Dam (RBDD) from July through March, peaking in September and October (Hallock and Fisher 1985; USBR 1992; CDFG 2002; Vogel and Marine 1991). The abundance of juvenile salmon in the upper Sacramento River peaks during September, while the abundance of juveniles in the Delta generally peaks during December to March (CDFG 2002). The differences in peak periods of the river and Delta suggest that juvenile winter-run Chinook salmon may rear in the middle or lower Sacramento River or upper Delta prior to seaward migration. The location and extent of this middle-area rearing is unknown, but the duration of fry presence in an area may be related to the magnitude of river flows and water temperatures during the rearing period (Stevens 1989). In addition, Maslin *et al.* (1999) have found that substantial numbers of winter-run juveniles use tributaries for non-natal rearing. While small tributaries generally have insufficient flow for spawning adults, juvenile Chinook move upstream to rear, depending on the size, gradient, and quality of the tributary.

Historically, winter-run Chinook abundance during spawning was tens of thousands of adult salmon (NMFS 2003). Since 1970, winter-run salmon abundance has declined dramatically into the early 1990s, when averages returns were in the hundreds (PFMC 2003). Escapement Estimates of winter-run Chinook salmon between 1995 and 2002 ranged from approximately 600 to 7,600 adults (PFMC 2003). Some evidence suggests that the winter-run Chinook population has been growing since the 1990s, but still remain far below the proposed recovery level (NMFS 2003; PFMC 2003).

Distribution in the CALFED Solution Area and EWA Action Area. Winter-run Chinook salmon are generally found in the mainstem Sacramento River, with use of tributaries by rearing juveniles (NMFS 1997, Maslin *et al*. 1999). Winter-run Chinook salmon are found in the Sacramento River, Sacramento-San Joaquin Delta, and Suisun Marsh/North San Francisco Bay Ecological Zones. They also may rear in the lower portions of tributaries in the north Sacramento Valley (e.g., Battle Creek), Butte Basin, Feather River/Sutter Basin, American River Basin, Calaveras Creek, Cottonwood Creek, Yolo Basin, and Colusa Basin Ecological Zones (CALFED 2000).

Life History and Habitat Requirements. Winter-run Chinook salmon require freshwater streams with cold, constant summer flows and suitable gravel for reproduction (CALFED 2000). Adults move into freshwater in the winter months and delay spawning until late spring and early summer. In order to conserve energy for several months while maturing, the adults require water temperatures below a maximum of 60°F, and optimally below 56°F for maximum viability (NMFS 1993, 1997). Females deposit their eggs in nests in gravel-bottom areas with relatively swift water. For maximum survival of incubating eggs and larvae, water temperatures must be between 39°F and 57°F (CALFED 2000). After emerging, many Chinook salmon fry tend to seek shallow, nearshore habitat with slow water velocities and move to progressively deeper, faster water as they grow. Shaded riverine aquatic habitat is important for providing cover from predators and access to food. Many juvenile winter-run salmon are transported downstream into the estuary, where they forage in intertidal and shallow subtidal areas (NMFS 1997). Juveniles generally rear in freshwater for up to 5 months before migrating to sea after reaching a length of 4-6 inches (CALFED 2000). Chinook salmon spend 2-4 years maturing in the ocean before returning to their natal streams to spawn. Adult Pacific Chinook salmon die after spawning (Moyle 2002, Beauchamp *et al*. 1983, Allen and Hassler 1986).

Additional information on the life history and habitat requirements of winter-run Chinook salmon is contained in the NMFS Biological Opinion for this species, which was developed to specifically evaluate impacts to winter-run Chinook salmon associated with CVP and SWP operations (NMFS 1993).

Reasons for Decline. Loss and degradation of spawning and rearing habitat; alteration of streamflows, overharvest, high summer water temperatures, entrainment into water diversions, blockage of migration routes, predation of juveniles, exposure to toxins, and natural environmental variability have all contributed to the population decline of Sacramento River winter-run Chinook salmon (NMFS 1993, 1997, 2003; Myers *et al*. 1998; CALFED 2000, NMFS 2003). Sharp population declines of this

salmon roughly correlate with increased water exports, operation of the RBDD, and unsuitable water temperatures (NMFS 1997). Habitat has been altered through the construction of dams and export facilities which can cause unsuitable water conditions for adult migration and fry development with respect to flows, temperature, pollution levels, oxygen deficiency, sedimentation, and gravel availability (NMFS 1993, 1997). Structures such as these can also block access to upstream habitat, delay migration of adults, and potentially increase predation on downstream-migrating juvenile salmon (USBR 1983). Environmental fluctuations, such as drought and strong El Nino conditions, also exacerbate these poor habitat conditions (NMFS 1997).

Commercial or recreational harvest has not been implicated as a major factor in the decline of winter-run salmon, although historical harvests of substantial levels may have contributed to declines of specific annual classes in the past (NMFS 1997).

Designated Critical Habitat or Essential Fish Habitat. In 1993, critical habitat for winter-run Chinook was designated to include the Sacramento River from Keswick Dam (River Mile [RM] 302) to Chipps Island (RM 0) at the westward margin of the Sacramento-San Joaquin Delta (CALFED 2000). Also included are waters west of the Carquinez Bridge, Suisun Bay, San Pablo Bay, and San Francisco Bay north of the Oakland Bay Bridge (NMFS 1993). Essential fish habitat has been identified in the Pacific Coast Salmon Plan (PFMC 1997, 2000).

Conservation Efforts. The agencies implementing CVPIA and CALFED actions are working to improve the quality of anadromous fish habitat, fish passage, and contributing to population recovery (CDFG 2002). Recently initiated conservation actions include restoration of Battle Creek, ocean harvest reductions, screening of water diversions, remediation of Iron Mountain Mine, and improved water temperature control (NMFS 2003). The Winter-run captive Brood stock Program (WRCBP), designed as a hedge against the potential of a catastrophic cohort failure or extinction of the run in the wild, currently houses winter-run Chinook salmon at Bodega Marine Laboratory and Livingston Stone National Hatchery (CDFG 2002). In 2001 and 2002, USFWS released approximately 166,000 and 252,500, respectively, juvenile winter-run Chinook salmon brood stock progeny (CDFG 2002).

Recovery Plan and Recovery Guidance. The NMFS (1997) has prepared a proposed recovery plan for winter-run Chinook. The recovery goals include protecting and restoring spawning and rearing habitat; improving the survival of downstream migrants; improving adult upstream passage; reducing harvest; reducing impacts of management programs; and improving understanding of life history and habitat requirements. The delisting criteria are 1) mean annual spawning abundance of 10,000 females over 13 consecutive years; 2) a cohort replacement rate (CRR) greater than 1.0; and 3) a standard error less 25 percent of the spawning population estimate (CALFED 2000, NMFS 2003). Additional recovery guidance is presented in the Anadromous Fish Recovery Plan (AFRP 2001). Recently, NOAA Fisheries assembled a Central Valley Technical Recovery Team (TRT) in charge of developing recovery criteria for all listed ESUs in the Central Valley.

Research and Monitoring Gaps. Research into the behavior and use of juvenile winter-run Chinook in estuarine habitats would help ascertain key limiting factors for this species. For example, the effect of high water temperatures on growth and the cues for juvenile migration from the estuary are not well known (NMFS 1997). In addition, the extent and duration of juvenile salmon rearing in the middle to lower Sacramento River is not clear. Studying genetic differentiation of different Central Valley salmon runs has provided insight into the genetic status of the winter-run Chinook and development protocols for use in artificial propagation (CDFG 2002). Experimental captive rearing programs at Bodega Marine Laboratory and Livingston Stone National Fish Hatchery continue to rear winter-run Chinook salmon to maturity in captivity (CDFG 2002).

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3.2.3 Central Valley Spring-Run Chinook Salmon (*Oncorhynchus tshawytscha*)

Legal Status. The Central Valley spring-run Chinook salmon is listed as threatened under both the Federal (NMFS 1999a) and California Endangered Species Acts (CDFG 2000, 2003). The Central Valley spring-run Chinook salmon ESU includes populations in the Sacramento River and its tributaries in California (NMFS 1999a).

NOAA Fisheries has identified distinct populations of Pacific salmon, steelhead, and sea-run trout as an Evolutionarily Significant Units (ESUs). For a fish population (or

group of populations) to be considered an ESU, it must 1) be reproductively isolated from other populations; and 2) contribute substantially to the ecological and genetic diversity of the species (Waples 1991; NMFS 1991).

Historical and Current Distribution and Status. Historically, the Central Valley spring-run Chinook salmon was one of the most abundant and widely distributed salmon races in the rivers and creeks of the Central Valley, including the middle and upper reaches of the San Joaquin, American, Yuba, Feather, Sacramento, McCloud, and Pit Rivers (NMFS 1999b, NMFS 2002). Gold mining and agricultural diversions caused the first major declines in spring-run Chinook populations (Moyle *et al.* 1995). Further extirpations followed construction of major water storage and flood control reservoirs on the Sacramento and San Joaquin Rivers and their major tributaries in the 1940s and 1950s (Moyle *et al.* 1995; NMFS 1998). Spring-run Chinook salmon have been completely extirpated in the San Joaquin drainage. The only populations of spring-run salmon are currently restricted to accessible reaches in the upper Sacramento River mainstem, Antelope Creek, Battle Creek, Beegum Creek, Big Chico Creek, Butte Creek, Clear Creek, Deer Creek, Feather River, Mill Creek, and Yuba River (CDFG 1998; CALFED 2000a; NMFS 2002, 2003). In the 1980s, these populations reached low abundance levels (e.g., 5-year mean population sizes of 67-243 spawners), compared to historic peak abundance of 700,000 spawners (NMFS 2003). New abundance data suggest that these populations have started increasing since the 1990s, perhaps as the result of habitat improvements, reduced ocean fisheries, and a favorable terrestrial climate (NMFS 2003).

Distribution in the CALFED Solution Area and EWA Action Area. Spring-run Chinook salmon are found in the Suisun Marsh/North San Francisco Bay, Sacramento-San Joaquin Delta, Sacramento River, Feather River/Sutter Basin, Butte Basin, and North Sacramento Valley Ecological Zones (CALFED 2000a).

Life History and Habitat Requirements. Spring-run Chinook salmon require freshwater streams with cold temperatures over the summer and suitable gravel for reproduction (CALFED 2000a). Immature spring-run adults migrate into freshwater and upstream to headwaters between February and July with a peak in May to June. Adults typically hold in cold pools while maturing. These fish can reach higher elevations before the onset of high temperatures and low flows that inhibit access to these areas in the fall (Myers *et al.* 1998). Spawning occurs at the tails of holding pools between late August and early October, peaking in September (NMFS 2002). Females deposit their eggs in nests in gravel-bottom areas of relatively swift water. For maximum survival of incubating eggs and larvae, water temperatures must be between 39°F and 57°F. The length of time for eggs to develop depends largely on the water temperature; in Butte and Big Chico Creeks, emergence occurs from November through January and in the colder waters of Mill and Deer Creeks, emergence typically occurs from January through March (NMFS 2002).

After emerging, Chinook salmon fry tend to seek shallow, nearshore habitat with slow water velocities and move to progressively deeper, faster water as they grow. Spring-run juveniles may reside in freshwater habitat for 12-16 months, but many

juveniles migrate to the ocean as young-of-the-year in the winter or spring within 8 months after hatching (CALFED 2000a, NMFS 2002). Riverine and estuarine habitats of the Bay and Delta are important rearing areas for these migrants. Maslin *et al.* (1999) have also found that substantial numbers of spring-run juveniles use tributaries for non-natal rearing. While small tributaries generally have insufficient flow for spawning adults, juveniles can move upstream to rear, depending on the size, gradient, and quality of the tributary. Chinook salmon spend 2-4 years maturing in the ocean before returning to their natal streams to spawn. Adult Pacific Chinook salmon die after spawning (Moyle 2002, Allen and Hassler 1986).

Reasons for Decline. Factors related to the decline of spring-run Chinook salmon include loss of habitat in river reaches blocked by dams; water development and management activities that affect water quality, timing, and quality; entrainment in water diversions; land uses that degrade aquatic and riparian habitats; over harvesting through commercial fisheries; climatic fluctuations; predation and disease; and genetic threats from the Feather River Hatchery spring-run Chinook salmon program (CDFG 1998; CALFED 2000a; NMFS 2002, 2003). The human-caused factor that has had the greatest effect on the abundance of spring-run Chinook salmon runs is loss of habitat primarily in the rivers upstream from the Delta. Major dams (e.g., Shasta, Oroville, and Friant dams) have blocked upstream access to most Chinook salmon habitat in Central Valley rivers and streams, and smaller dams with ineffective ladders also impair passage of adult spring-run (CDFG 1998). Estimates suggest that up to 95 percent of spring-run salmon spawning and rearing habitat has been lost in the Central Valley (NMFS 2003). Water diversions and reservoir operations affect streamflow, which influences the quantity, quality, and distribution of Chinook salmon spawning and rearing habitat. Water diversions also reduce survival of emigrating juvenile salmonids through direct entrainment losses in unscreened or inadequately screened diversions. The Feather River Hatchery spring Chinook program is a threat to genetic integrity of the remaining wild spring Chinook populations through possible hybridization with fall stock and high rates of straying (NMFS 2003).

Designated Critical Habitat or Essential Fish Habitat. Critical habitat for the spring-run Chinook salmon was designated on February 16, 2000 (USFWS 2000). On April 30, 2002, the U.S. District Court for the District of Columbia approved an NMFS consent decree withdrawing the February 2000 critical habitat designation for this and 18 other ESUs (NMFS 2002). Essential fish habitat has been identified in the Pacific Coast Salmon Plan (PFMC 1997, 2000).

Conservation Efforts. Agencies implementing the CVPIA and CALFED actions are working to improve the quality of anadromous fish habitat, improving fish passage, and contributing to population recovery (CDFG 2002; CALFED 2000b). Recently initiated conservation actions include habitat improvements (e.g., removal of several small dams and increases in summer flows) and reduced ocean fisheries (NMFS 2003). CDFG (1998) presents suggestions for future management of spring-run Chinook salmon.

Recovery Plan and Recovery Guidance. Measures for recovery of spring-run Chinook populations are presented in the Anadromous Fish Recovery Plan (AFRP 2001), Delta Native Fishes Recovery Plan (USFWS 1996), CDFG status reports (1998, 2001, 2002), and an interim biological opinion of the NMFS (2002). In addition, an NOAA Fishery Technical Recovery Team for spring-run Chinook will be developing an updated, long-range plan. CALFED (2000b) will also provide support to NMFS in recovery efforts following the VSP framework (McElhany *et al.* 2000), which will target restoring four key Chinook salmon population characteristics: 1) abundance; 2) productivity; 3) spatial distribution; and 4) diversity.

Research and Monitoring Gaps. Current research for spring-run Chinook is focusing on intensive studies of Butte Creek spring Chinook and genetic clarification of Feather River Hatchery fish (NMFS 2003). Myers *et al.* (1998) also point out that additional genetic information would help elucidate the status of remnant spring-run populations in Butte, Deer, and Mill Creeks and their relationship to spring-run fish from the mainstem Sacramento and Feather Rivers. Studying emigration timing, migration pathways, and juvenile abundance will help to plan habitat restoration projects (CDFG 2000). Additional areas for research include extent and effect of diseases, hatcheries as conservation, effects of mixed-stock fisheries, assessment of relative roles of different mortality factors, experimental assessment of the effects of river operations, efficacy of various habitat improvements, stock identification for management, and constant fractional marking (CDFG 1998, NMFS 2003).

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3.2.4 Central Valley Steelhead (*Oncorhynchus mykiss*)

Legal Status. The Central Valley steelhead ESU was listed as a federally threatened species on March 19, 1998 (NMFS 1998). The Central Valley steelhead ESU includes all naturally spawned populations of steelhead (and their progeny) in the Sacramento

and San Joaquin Rivers and their tributaries. Also included are resident fish below historic barriers, but not those above long-standing natural barriers (NMFS 2003). Excluded are steelhead from San Francisco and San Pablo Bays and their tributaries.

NOAA Fisheries has identified distinct populations of Pacific salmon, steelhead, and sea-run trout as an Evolutionarily Significant Units (ESUs). For a fish population (or group of populations) to be considered an ESU, it must 1) be reproductively isolated from other populations and 2) contribute substantially to the ecological and genetic diversity of the species (Waples 1991, NMFS 1991).

Historical and Current Distribution and Status. Historically, the Central Valley ESU steelhead was well distributed throughout the Sacramento and San Joaquin River systems, from the upper Sacramento/Pit River systems south to the Kings and possibly Kern River systems in wet years (Yoshiyama *et al.* 1996, NMFS 2003). Because adults need to over-summer in deep pools in mid to high elevation tributaries, summer steelhead populations were probably eliminated with the construction of large-scale dams during the 1940s, 1950s, and 1960s.

The existing Central Valley steelhead ESU includes steelhead in all river reaches accessible to the Sacramento and San Joaquin Rivers and their tributaries in California (NMFS 1998). Central Valley steelhead populations are found in the Sacramento River and its tributaries, including the Feather, Yuba, and American Rivers, and many small tributaries, such as Mill, Deer, west side tributaries (including Clear, Cottonwood, Putah, Cache, Stony, Thomes, Alamo, and Ulatis Creeks), and Butte Creeks. The Cosumnes and Mokelumne Rivers also support steelhead.

In the San Joaquin River basin, the best available information suggests that the current range of steelhead is limited to reaches below major dams on the Stanislaus, Tuolumne, and Merced Rivers and to the mainstem San Joaquin River downstream from its confluence with the Merced River. Excluded are areas of the San Joaquin River upstream from the Merced River confluence and areas above specific dams identified or above longstanding, naturally impassable barriers (natural waterfalls in existence for at least several hundred years) (NMFS 2000). Also included are river reaches and estuarine areas of the Sacramento-San Joaquin Delta, all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait, all waters of San Pablo Bay westward from the Carquinez Bridge, and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge.

Currently, steelhead distribution is primarily limited by dams that block access to upstream reaches of main rivers and their tributary streams. NMFS (2003) estimated that more than 95 percent of historic spawning habitat is now inaccessible. Current abundance information suggest that Central Valley steelhead populations have declined drastically from an estimated one to two million spawners before 1850 to 40,000 spawners in the 1960s and to 3,628 spawners in the entire Central Valley (NMFS 2003). NMFS (2003) concluded that wild steelhead populations in the Central

Valley ESU area are continuing to decline and that they are currently "likely to become endangered" or "in danger of extinction" (NMFS 2003).

Distribution in the CALFED Solution Area and EWA Action Area. Central Valley steelhead are found in the Suisun Marsh/North San Francisco Bay, Sacramento-San Joaquin Delta, Yolo Basin, Sacramento River, North Sacramento Valley, west side tributaries (including Clear, Cottonwood, Putah, Cache, Stony, Thomes, Alamo, and Ulatis Creeks), Butte Basin, Feather River/Sutter Basin**,** American River Basin, Eastside Delta Tributaries, and East San Joaquin Basin Ecological Zones.

Life History and Habitat Requirements. Steelhead have a complex suite of life history traits, including the capability to be anadromous or to be a resident (called rainbow trout) (NMFS 2002a). Spawning and rearing habitat for steelhead is usually characterized by intermittent streams with clear, cool to cold, fast flowing water with a high dissolved oxygen content and abundant gravels and riffles. Preferred water depth for spawning is 6-24 inches, for fry 2-14 inches, and for parr 10-20 inches (Bovee 1978). Preferred water velocity for spawning is approximately 2 feet per second (range of 1-3.6 feet per second), although the optimal velocity depends in part on the size of the steelhead (i.e., larger steelhead will spawn in water with higher velocities) (Barnhart 1986). Steelhead use various mixtures of sand-gravel and gravel-cobble substrate for spawning, but the optimal substrate ranges from 0.2 inch to 4.0 inches in diameter (Bovee 1978, Reiser and Bjornn 1979). Optimal water temperatures for steelhead are 46-52°F for adult migration, 39-52°F for spawning, 48-52°F for incubation and emergence, 45-60°F for fry and juvenile rearing, and below 57°F for smoltification (Bovee 1978, Reiser and Bjornn 1979, Bell 1986). Steelhead rely on upstream tributary stream habitat because they require sufficient flows and habitat characteristics for spawning, rearing, and migration, such as shallow, cold riffles for spawning, deep pools with well-developed cover for rearing, and water flow year round to maintain rearing for 1 to 3 years before emigration.

Steelhead return to natal streams to spawn as 2- to 4- year-old adults. The fish migrate upstream from July through February and usually spawn between late December and March. Steelhead spawn in redds constructed by the female over a gravel and cobble substrate (Barnhart 1986). After choosing the redd site, females deposit their eggs in these redds, where they are then fertilized by the males. Adult steelhead do not necessarily die after spawning and may spawn on more than one occasion (Moyle 2002). Time of incubation and hatching varies with region, habitat, water temperature, and spawning season (USFWS 1983). Alevins emerge from the redd following yolk sac absorption and are ready to feed as fry or juveniles. Following emergence, fry live in small schools in shallow water along streambanks. As steelhead grow, they establish individual feeding territories; juveniles typically rear for 1 to 2 years (and up to four years) in streams before emigration as "smolts" (juvenile fish which can survive the transition from fresh water to salt water) (NMFS 1996). In the Sacramento River, juvenile steelhead migrate to the ocean in spring and early summer, with peak migration through the Delta in March and April (Reynolds *et al.* 1993). Steelhead may remain in the ocean from 1 to 4 years, growing rapidly as

they feed in the highly productive currents along the continental shelf (Barnhart 1986).

Steelhead are primarily drift feeders and may forage in open water of estuarine subtidal and riverine tidal wetland habitats. The diet of juvenile steelhead includes emergent aquatic insects, aquatic insect larvae, snails, amphipods, opossum shrimp, and small fish (Moyle 2002). Steelhead usually do not eat when migrating upstream and often lose body weight.

Oncorhynchus mykiss (i.e., rainbow trout or steelhead) with coastal access exhibit extreme plasticity in life history expression. A continuum of migratory behaviors exists from strongly migratory to non-migratory (resident). It is not uncommon for progeny of one life history form to assume a life history strategy that differs from their parents. One study in the Deschutes River, Oregon found non-anadromous steelhead females produce steelhead progeny and steelhead females produce non-anadromous progeny (Zimmerman 2000 cited in McEwan 2001). Recent analysis of three recently spawned adult fish in the Calaveras River indicated three different life history expressions: 1) a female steelhead was the progeny of a steelhead female; 2) a non-anadromous male was the progeny of a steelhead female; and 3) a non-anadromous male was the progeny of a non-anadromous female (Titus 2000 cited in McEwan 2001).

Reasons for Decline. Factors related to the decline of Central Valley steelhead include loss of habitat in river reaches blocked by dams, degradation of habitat conditions (e.g., water temperature), entrainment in water diversions, possible introgression from hatchery fish (NMFS 2002a, 2003). Loss of habitat has the greatest effect on steelhead abundance. Major dams are the primary barriers to steelhead access to Central Valley rivers and streams. Dams at low elevations on all major tributaries block access to an estimated 95 percent of historical spawning habitat in the Central Valley (Ewan 2001). Below dams, remnant steelhead populations are affected by varying flow conditions and high summer and fall water temperature. Unscreened agricultural, municipal, and industrial diversions in the Delta and rivers cause entrainment losses of emigrating juvenile steelhead (NMFS 2002a). Steelhead populations have declined from 20,000 fish in 1969 to less than 3,000 fish in 1993 (NMFS 2003).

Over 90 percent of the adult steelhead in the Central Valley are produced in hatcheries (Reynolds *et al.* 1990). Hatchery-produced fish may substantially affect the genetic integrity of wild populations. Adult and juvenile steelhead are harvested by sport anglers within the Central Valley watershed, mostly on the American and Feather Rivers (with large steelhead hatcheries) (NMFS 2003). There is no commercial or sport fishery for steelhead in the ocean and, for unknown reasons, steelhead are rarely taken by commercial or sport salmon trollers (Skinner 1962).

Designated Critical Habitat and Essential Fish Habitat. Critical habitat for the Central Valley steelhead ESU was designated on February 16, 2000. On April 30, 2002, the U.S. District Court for the District of Columbia approved a NMFS consent

decree withdrawing the February 2000 critical habitat designation for this and 18 other ESUs (NMFS 2002b).

Conservation Efforts. Agencies implementing the CVPIA actions are working to improve the quality of anadromous fish habitat, improve fish passage, and contribute to population recovery of anadromous salmonids (USFWS 2001). CALFED (2000a) has identified specific measures for steelhead recovery in the Ecosystem Restoration Program Plan, yet this plan is still in its initial stages of implementation. Recent, more restrictive, sport fishing regulations, such as those on the Yuba River, are intended to reduce adult steelhead take and incidental mortality.

Recovery Plan and Recovery Guidance. The National Marine Fisheries Service (NMFS) has formed a Central Valley Recovery Team to identify recovery requirements and prepare a recovery plan for steelhead. The Battle Creek Salmon and Steelhead Restoration Project has prepared a restoration plan to improve habitat and water flows along Battle Creek (Kier Associates 1998). CALFED (2000b) recovery criteria will follow the VSP framework (McElhany *et al.* 2000) developed by NMFS.

Research and Monitoring Gaps. NMFS (2003) noted that there are no ongoing population assessments for this species. The effect of catch-and-release mortality on wild populations and effect of trout fisheries on juvenile steelhead should be investigated (NMFS 2003). In addition, ecological conditions in the Sacramento and San Joaquin Rivers differ, and there is a potential for genetic differences \ among the different populations of these large river basins (NMFS 1997). There is also considerable uncertainty about the relationship between anadromous and non-anadromous *Oncorhynchus mykiss* forms, including the relationship with multiple subspecies of resident trout. It is likely that the abundant manmade barriers have greatly altered historical patterns of migration and anadromy (NMFS 2003). A comprehensive analysis of ecological and genetic information may help elucidate these complex issues (NMFS 1997). Steelhead have also been described spawning and rearing in seasonal habitats such as intermittent streams and streams that do not contain suitable year round habitat (McEwan 2001). McEwan (2001) suggests that further research should be done to determine the extent to which steelhead use seasonal habitats.

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3.2.5 Delta Smelt (*Hypomesus Transpacificus*)

Legal Status. The delta smelt was listed as a threatened species by the California Department of Fish and Game on December 9, 1993, and the U.S. Fish and Wildlife Service on March 5, 1993 (USFWS 1993). Delta smelt originally were classified as the same species as the pond smelt (*Hypomesus Olidus*), but Hamada (1961) and Moyle (2002, 1980) recognized the delta smelt as a distinct species (USFWS 1993). Delta smelt are the only smelt endemic to California and the only true native estuarine species found in the Sacramento-San Joaquin Estuary (known as the Delta) (Moyle and Herbold 1989, Stevens *et al.* 1990, Wang 1986).

Historical and Current Distribution and Status. Delta smelt are found mainly in the waters of the Delta and Suisun Bay, but are generally most abundant in the western Delta and eastern Suisun Bay (Honker Bay) (CALFED 2000). Their spawning distribution varies from year to year within the Delta. The species is endemic to the Sacramento-San Joaquin Estuary, and its population abundance varies substantially from year to year. Abundance has been uncharacteristically low since 1982, in large part because of the extended drought of 1987-92 and possibly to extremely wet years in 1983 and 1986 (Moyle *et al.* 1989). Population abundance has fluctuated recently from increases in some years to uncharacteristic decreases in other years (IEP 1998).

Distribution in the CALFED Solution Area and EWA Action Area. Delta smelt are confined primarily to the Delta and Suisun Marsh/San Francisco Bay Ecological Zones. They appear to move upstream from Suisun Bay into the Delta in winter and spring to spawn. After early rearing in the Delta, they tend to move downstream to low-salinity habitats in the western Delta (particularly in drier years) and Suisun Bay (in both wet and dry years). Small populations also occur in the Napa River estuary and Suisun Marsh (CALFED 2000).

Life History and Habitat Requirements. Delta smelt are a euryhaline species (species adapted to living in fresh and brackish water) that occupy estuarine areas with salinities ranging from 2-7 parts per thousand (ppt), though they can be found at salinities ranging from 0-18.4 ppt and can tolerate salinities up to 19 ppt (Moyle 2002). Delta smelt feed primarily on planktonic copepods, cladocerans and amphipods (Moyle 2002).

For a large part of their 1-year life span, delta smelt live along the freshwater edge of the mixing zone (saltwater-freshwater interface) where the salinity is approximately 2 ppt (USFWS 2002) or the area just upstream from it. This range is the principal habitat of delta smelt larvae and young juveniles (Herbold *et al.* 1992, Jassby 1993). The survival and growth of smelt larvae is best when the mixing zone occupies a large geographic area, including extensive shoal regions that provide suitable spawning substrates at depths less than 4 meters (USFWS 1993). Besides salinity, the distribution of delta smelt has also been shown to be related to prey abundance; in 1993 and 1994, delta smelt were found in Suisun Bay despite that ideal salinity conditions upstream. However, high levels of copepod *Eurytemora* were present (CDWR and USBR 1994).

Delta smelt spawn from February through May in shallow, fresh or slightly brackish water upstream from the mixing zone (Wang 1991), mostly in tidally influenced backwater sloughs and channel edgewaters where solid substrate (cattails, tules, tree roots, and submerged branches) are present for the attachment of eggs (Moyle 2002; Wang 1986, 1991; Sommer and Herbold 2000). They spawn in freshwater at temperatures from about 45-59°F (7-15 degrees Celsius) (USFWS 1993). In most years, delta smelt spawn primarily in the upper end of Suisun Bay, in Montezuma Slough, and in the northern and central Delta. In the Delta, they spawn mostly in the Sacramento River channel, central Delta, and adjacent sloughs (USFWS 1994).

Reasons for Decline. Delta smelt are considered environmentally sensitive because they live only 1 year, have a limited diet, have a low fecundity for a fish with planktonic larvae, are poor swimmers, are easily stressed, and reside primarily in the interface between saltwater and freshwater (CDFG 2000). The delta smelt has declined nearly 90 percent over the last 20 years and is primarily threatened by large freshwater exports from the Sacramento River and San Joaquin River diversions for agriculture and urban use (USFWS 1993). Other threats include drought, agricultural and industrial chemicals, introduced nonnative aquatic species, and reduction in abundance of key food organisms (USFWS 1993).

The principal concern for this species has been the diversion/reduction of freshwater into the Delta. Since 1983, the proportion of water exported from the Delta during October through March has increased (Moyle *et al.* 1992). Federal and State water diversion projects in the southern Delta export mostly Sacramento River water with some San Joaquin River water (USFWS 1993). During periods of high export pumping and low to moderate river outflows, reaches of the San Joaquin River reverse direction and flow to the pumping plants located in the southern Delta (USFWS 1993). A relationship has been found between the number of juvenile delta smelt salvaged at the State and Federal pumps and both the percent of inflow diverted and total Delta outflow (CDWR and USBR 1994). When total diversion rates are high relative to Delta outflow and the lower San Joaquin River and other channels have a net upstream (i.e., reverse or negative) flow, out-migrating larval and juvenile fish become disoriented. Mortalities occur as a result of entrainment and predation by striped bass at the various pumping plants and other water diversion sites. Delta smelt larvae require net positive riverine flows and estuarine outflows of sufficient magnitude in order to be carried downstream into the upper end of the mixing zone of the estuary instead of upstream to the pumping plants (USFWS 1993).

All size classes of delta smelt suffer near total loss when they are entrained by the pumping plants and diversions in the south Delta (USFWS 1993). Very few delta smelt are effectively salvaged at the State and Federal pumping plant screens, and the few that are transported into water project reservoirs or canals fail to reproduce. The smelt's embryonic, larval, and post-larval mortality rates also become higher as reduced western Delta flows allow increases in the salinity level and relocation of the mixing zone (USFWS 1993).

During periods of drought and increased water diversions, the mixing zone and associated smelt populations shifted farther upstream in the Delta. Prior to 1984, the mixing zone was usually located in Suisun Bay during October through March, while from April through September, the mixing zone usually was found upstream in the channels of the rivers (USFWS 1993). From 1984 to 1993, with the exception of the record flood outflows of 1986, the mixing zone had been located primarily in the river channels during the entire year because of increased water exports and diversions (USFWS 1993). When located upstream, the mixing zone becomes confined to the deep river channels; becomes smaller in total surface area; contains very few shoal areas of suitable spawning substrates; may have swifter, more turbulent water currents; and lacks high zooplankton productivity (USFWS 1993). Delta smelt reproduction is likely affected because the mixing zone is located in the main channels of the Delta, east of Suisun Bay (Moyle *et al.* 1992). In 1982, the delta smelt population declined significantly because of the shifted location of the mixing zone to the less favorable narrow, deep, and less productive channels in the lower rivers (USFWS 1993).

The delta smelt is especially vulnerable during periods of long drought. Deleterious effects of the 1987-92 droughts would have been exacerbated if additional alterations in hydrology caused by reductions of freshwater inflows to the Delta altered the timing and/or duration of water exports (USFWS 1993).

Agricultural chemicals and residues, chemicals from urban runoff, and heavy metal contaminants released from industry and mining also threaten delta smelt. Nichols *et al.* (1986) found that all major rivers in the delta smelt's historic range had been exposed to large volumes of agricultural and industrial chemicals that are applied in the California Central Valley watersheds. Toxicology studies of rice field irrigation drain water of the Colusa Basin Drainage Canal documented significant toxicity of drain water to striped bass embryos and larvae, medaka larvae, and the major food organism of the striped bass larvae and juveniles, the opossum shrimp (*Neomysis mercedis*) (USFWS 1993). Delta smelt could also be affected by run-off. Although the effects of heavy metal contaminating compounds on delta smelt larvae and their food resources are not well known, the compounds could potentially adversely affect delta smelt survival (USFWS 1993).

Several introduced species may adversely affect the delta smelt directly. There is as yet no direct evidence that suggests that disease, competition, or predation has caused delta smelt populations to decline, although these areas have not been widely studied (Moyle 2002). While not displacing delta smelt, hybridization with delta smelt may be occurring. Although the hybrids may be sterile, the attempts at interbreeding "cause the loss of viable gametes," further reducing the ability of this species to recover (Moyle 2002). Nonnative inland silversides have been known to prey on smelt larvae and may compete for similar prey such as copepods and cladocerans (Bennett 1995). An Asian clam (*Potamocorbula amurensis*), discovered in Suisun Bay in 1986, could affect the phytoplankton dynamics in the estuary by decreasing phytoplankton biomass and by directly consuming the delta smelt's primary food, *Eurytemora affinis* copepod nauplii (USFWS 1993). Additionally, the introduced

striped bass may have caused an increase in predation on all size classes of the delta smelt (USFWS 1993). Three nonnative species of euryhaline copepods (*Sinocalanus doerrii, Pseudodiaptomus forbesi,* and *Pseudodiaptomus marinus*) became established in the Delta between 1978 and 1987 (Carlton *et al.* 1990), while *Eurytemora affinis* populations, the native euryhaline copepod, have declined since 1980. These introduced copepod species are more efficient at avoiding the predation of larval delta smelt and exhibit a different swimming behavior that makes them less attractive to feeding delta smelt larvae. Because of reduced food availability or feeding efficiency, weakened delta smelt larvae are more vulnerable to starvation or predation (USFWS 1993). Factors that contribute to low abundance relative to historical conditions include change in flow patterns; entrainment in diversions; contaminants; and species interactions, particularly competition and predation associated with establishment of non-native species (Stevens *et al.* 1990, Herbold *et al.* 1992). Although effects of contaminants have not been specifically described for delta smelt, pesticides have been found in the Sacramento River in recent years at concentrations potentially harmful to fish larvae (Herbold *et al.* 1992). Recent bioassays by the Central Valley Regional Water Quality Control Board indicate that water in the Sacramento River is periodically toxic to larvae of the fathead minnow, a standard U.S. Environmental Protection Agency (USEPA) test organism (Stevens *et al.* 1990).

Food availability may be an important factor affecting survival of delta smelt larvae. Abundance of rotifers and phytoplankton has declined in recent years (Obrebski *et al.* 1992). Rotifers are small and may be important to the diet of larval delta smelt (CDWR and USBR 1994) and other fish larvae (Hunter 1981).

Designated Critical Habitat. Critical habitat for the delta smelt was designated on December 19, 1994 (USFWS 1994). Critical habitat for the delta smelt is contained within Contra Costa, Sacramento, San Joaquin, Solano, and Yolo Counties, California (USFWS 1994). Designated critical habitat includes all water and all submerged lands below ordinary high water and the entire water column bounded by and contained in Suisun Bay (including the contiguous Grizzly and Honker Bays), Goodyear, Suisun, Cutoff, First Mallard (Spring Branch) and Montezuma Sloughs, and the Sacramento/San Joaquin River Delta, as defined in Section 12220 of the California Water Code of 1969 (a complex of bays, dead-end sloughs, channels typically less than 4 meters deep, marshlands, etc.) as follows: bounded by a line beginning at the Carquinez Bridge, which crosses the Carquinez Strait; thence, northeasterly along the western and northern shoreline of Suisun Bay, including Goodyear, Suisun, Cutoff, First Mallard (Spring Branch), and Montezuma Sloughs; thence, upstream to the intersection of Montezuma Slough with the western boundary of the Delta as delineated in Section 12220 of the State of California's Water Code of 1969; thence, following the boundary and including all contiguous water bodies contained within the statutory definition of the Delta, to its intersection with the San Joaquin River at its confluence with Suisun Bay; thence, westerly along the south shore of Suisun Bay to the Carquinez Bridge (USFWS 1994).

Critical habitat for the delta smelt includes those areas possessing the primary constituent elements essential to the conservation of the delta smelt. These primary

constituent elements are the physical habitat, water, riverflow, and salinity concentrations required to maintain delta smelt habitat for 1) spawning; 2) larval and juvenile transport; 3) rearing; and 4) adult migration (USFWS 1994).

The final rule for the determination of critical habitat for the delta smelt provides details on these constituent elements (USFWS 1994). The primary constituent elements are organized by habitat conditions required for each life stage. The specific geographic areas and seasons identified for each habitat condition represent the maximum possible range of each of these conditions. Depending on the water-year type (i.e., wet, above normal, normal, below normal, dry, critically dry), each of the habitat conditions specified below requires fluctuation (within-year and between-year) in the placement of the 2 ppt isohaline (a line drawn to connect all points of equal salinity) around three historical reference points. These three historical reference points are the Sacramento-San Joaquin River confluence, the upstream limit of Suisun Bay at Chipps Island, and in the middle of Suisun Bay at Roe Island. The actual number of days that the 2 ppt isohaline is maintained at the three points varies according to water-year type. Additionally, the number of days at each reference point must simulate a level of water project development equivalent to that which historically existed in 1968. Hydrologic conditions in 1968 were such that delta smelt were abundant and anadromous and resident fisheries were relatively healthy (USFWS 1994).

Suitable habitat conditions must be maintained for recovery of the delta smelt. The naturally occurring variability found in healthy estuarine ecosystems must be preserved for the following reasons 1) temporal and spatial variability of the 2 ppt isohaline will be the most effective deterrent to further invasion of newly introduced species and continued competition by those that are already established; 2) placement of the 2 ppt isohaline in Suisun Bay will produce the high phytoplankton and zooplankton densities that characterize most healthy estuarine ecosystems; and 3) variability is needed to simulate natural processes and historical conditions (USFWS 1994).

The primary constituent elements in the Final Rule for the delta smelt (USFWS 1994) are defined as follows:

Spawning Habitat: Delta smelt adults seek shallow, fresh, or slightly brackish backwater sloughs and edge-waters for spawning. To ensure egg hatching and larval viability, spawning areas also must provide suitable water quality (low concentrations of pollutants) and substrates for egg attachment (e.g., submerged tree roots and branches and emergent vegetation). Specific areas that have been identified as important delta smelt spawning habitat include Barker, Lindsey, Cache, Prospect, Georgiana, Beaver, Hog, and Sycamore Sloughs; the Sacramento River in the Delta; and tributaries of northern Suisun Bay. The spawning season may start as early as December and extend until July (USFWS 1994).

Larval and Juvenile Transport: To ensure that delta smelt larvae are transported from the area where they are hatched to shallow, productive rearing or nursery habitat, the

Sacramento and San Joaquin Rivers and their tributary channels must be protected from physical disturbance (e.g., sand and gravel mining, diking, dredging, and levee or bank protection and maintenance) and flow disruption (e.g., water diversions that result in entrainment and in-channel barriers or tidal gates). Adequate riverflow is necessary to transport larvae from upstream spawning areas to rearing habitat in Suisun Bay. Additionally, riverflow must be adequate to prevent interception of larval transport by the State and Federal water projects and smaller agricultural diversions in the Delta. To ensure that suitable rearing habitat is available in Suisun Bay, the 2 ppt isohaline must be located westward from the Sacramento-San Joaquin River confluence during the period when larvae or juveniles are being transported, according to the historical salinity conditions which vary according to water- year type. Reverse flows that maintain larvae upstream in deep-channel regions of low productivity and expose them to entrainment interfere with these transport requirements. Suitable water quality must be provided so that maturation is not impaired by pollutant concentrations. The specific geographic area important for larval transport is confined to waters contained within the legal boundary of the Delta, Suisun Bay, and Montezuma Slough and its tributaries. The specific season when habitat conditions identified above are important for successful larval transport varies from year to year, depending on when peak spawning occurs and on the water-year type. In the biological opinion for the delta smelt (USFWS 1995), USFWS identified where additional flows might be required in the July-August period to prevent delta smelt that were present in the south and central Delta from being entrained in the State and Federal project pumps and to avoid jeopardy to the species. The long-term biological opinion on CVP-SWP operations (USFWS 1995) identifies situations where additional flows may be required after the February through June period identified by EPA for its water quality standards to protect delta smelt in the south and central Delta.

Rearing Habitat: Maintenance of the 2 ppt isohaline according to the historical salinity conditions described above and suitable water quality (low concentrations of pollutants) within the estuary is necessary to provide delta smelt larvae and juveniles a shallow, protective, food-rich environment in which to mature to adulthood. This placement of the 2 ppt isohaline also serves to protect larval, juvenile, and adult delta smelt from entrainment in the State and Federal water projects. An area extending eastward from Carquinez Strait, including Suisun Bay, Grizzly Bay, Honker Bay, Montezuma Slough and its tributary sloughs, up the Sacramento River to its confluence with Three Mile Slough, and south along the San Joaquin River including Big Break, defines the specific geographic area critical to the maintenance of suitable rearing habitat. Three Mile Slough represents the approximate location of the most upstream extent of tidal excursion when the historical salinity conditions described above are implemented. Protection of rearing habitat conditions may be required from the beginning of February through the summer.

Adult Migration: Adult delta smelt must be provided unrestricted access to suitable spawning habitat in a period that may extend from December to July. Adequate flow and suitable water quality may need to be maintained to attract migrating adults in the Sacramento and San Joaquin River channels and their associated tributaries,

including Cache and Montezuma Sloughs and their tributaries. These areas also should be protected from physical disturbance and flow disruption during migratory periods.

Conservation Efforts. The delta smelt will benefit from efforts by agencies implementing the CVPIA and CALFED actions to restore ecological health and improve water quality of the Delta (CALFED 2000).

Recovery Plan and Recovery Guidance. USFWS (1996) developed a Delta Native Fishes Recovery Plan to manage the estuary for improved native fish habitat and reduce the decline of native fish populations, including the delta smelt. Delta smelt will be considered restored when its population dynamics and distribution pattern within the estuary are similar to those that existed in the 1967-81 period (USFWS 1996). Distribution criteria include catches 1) in all zones 2 of 5 consecutive years; 2) in at least two zones in 1 of the remaining 3 years; and 3) in at least one zone, for the remaining 2 years. Abundance criteria are delta smelt numbers or catch; this catch must equal or exceed 239 for 2 out of 5 years and not fall below 84 for more than 2 years in a row (USFWS 1996).

Research or Monitoring Gaps. The California Department of Fish and Game initiated a monitoring and research program in 1992 to investigate all aspects of delta smelt biology (CDFG 2000). The results of this program are used to make informed water management decisions. The CALFED EWA Science Advisors recommend further research into artificial propagation as essential to recovery of delta smelt, as is further research on the collection, handling, transport, and release aspects of the fish salvage operation of the SWP and CVP's Delta fish protection facilities (CALFED 2002). The Interagency Ecological Program (IEP) Fish Team has identified several areas of emphasis for delta smelt, including habitat, behavior, and population impacts. Topics given high priority include 1) evaluating the quality of habitat in estuary areas; 2) conducting horizontal and vertical distribution studies; and 3) identifying impacts of predation by inland silversides and other species (IEP 2003).

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3.2.6 Sacramento Splittail (*Pogonichthys macrolepidotus*)

Legal Status. The Sacramento splittail is treated as a threatened species under the Federal Endangered Species Act. The final rule listing this species was published on February 8, 1999, but the comment period regarding this rule was reopened on January 12, 2001 (USFWS 2001), and remains open as of October 31, 2002 (USFWS 1999, 2001, 2002). This species is also listed as a California species of special concern (CDFG 2002).

Historical and Current Distribution and Status. Endemic to Central Valley lakes and rivers, adult splittail now primarily inhabit the Delta and Suisun Bay and Marsh (Moyle *et al.* 1995). The distribution of Sacramento splittail has been reduced to less than one-third of its original range (USFWS 1994). Fish surveys in the Sacramento-San Joaquin estuary indicate that splittail abundance there had declined by over 50 percent from 1980 through 1994, most likely in response to the drought of 1987-92 (Meng and Moyle 1995, Sommer *et al.* 1997). In 1995, abundance reached a record high, relative to historical conditions (Sommer *et al.* 1997). Strong year classes follow high-flow years (i.e., 1995), when portions of the estuary and river floodplains are flooded in winter and early spring. Preliminary surveys in 1998 indicated high larvae and juvenile abundance during this very wet year (CDFG 1998).

Distribution in the CALFED Solution Area and EWA Action Area. Splittail are found in all the ecological zones of the Central Valley except the West San Joaquin Basin Ecological Zone. Adults and juveniles live in the bay and Delta ecozones and migrate upstream during winter and spring. Adults are found in river ecozones generally from early winter through spring. Most young move out of upstream spawning and rearing habitat in spring and early summer.

Life History and Habitat Requirements. Splittail are estuarine fish capable of tolerating moderate levels of salinity from 10-18 ppt. Adults migrate upstream from brackish areas to spawn in freshwater. Splittail typically spawn in dead-end sloughs and slow reaches of large rivers and river floodplains over submerged vegetation. Spawning begins by late January and early February and continues through July, with most spawning from February through April (USFWS 2002). Shallow, weedy areas inundated during seasonal flooding provide habitat for adult spawning and foraging and subsequent egg development and larval and early juvenile rearing. Larvae remain in the shallow, weedy areas inshore close to the spawning sites and migrate into the deeper offshore and more riverine habitat as they mature (Wang 1986). As flooded habitat disappears, larvae and juveniles use habitat along the margins of the main river and Delta channels. Although splittail use deeper, open water as they grow, much of the population continues to use shallow (<10 feet) edge habitat as adults (Meng and Moyle 1995). Juvenile splittail are commonly found in Delta sloughs in late winter and spring and are particularly abundant in the vicinity of Montezuma Slough. As summer progresses, juvenile splittail occupy the deeper, open-water habitats of Suisun and San Pablo Bays.

Splittail are benthic foragers that feed extensively on opossum shrimp (*Neomysis mercedis*). However, detrital material typically makes up a high percentage of their stomach contents. They will feed opportunistically on earthworms, clams, insect larvae, and other invertebrates (CDFG 2002).

Reasons for Decline. The human-caused factor that has had the greatest effect on the abundance of splittail is loss and degradation of floodplain and marsh habitat (CDFG 1992). Land reclamation, flood control practices, and agricultural development have eliminated and drastically altered much of the ephemeral and perennial shallow-water habitats in the lowland areas available to spawning adults, larvae, and juveniles. An estimated 96 percent of historical wetland habitats are either unavailable to splittail or have been eliminated (USFWS 1999). Splittail abundance is positively associated with high Delta outflows during primary spawning months (March through May) (CDFG 1992, Sommer *et al.* 1997). High Delta outflows during late winter and spring correlate with increased total surface area of shallow-water habitats containing submerged vegetation (used by spawning adults), both within and upstream form the Delta. During years of low riverflow, such as the 1986-92 drought, spawning success may be greatly reduced, contributing to reduced adult abundance.

Designated Critical Habitat. None.

Conservation Efforts. The splittail will benefit from efforts by agencies implementing the CVPIA and CALFED actions to restore ecological health and improve water quality (USFWS 1999).

Recovery Plan and Recovery Guidance. USFWS (1996) developed a Delta Native Fishes Recovery Plan to manage the estuary for improved native fish habitat and reduce the decline of native fish populations, including the Sacramento splittail. The objective of the plan is to 1) create meander belts along the Sacramento River by setting levees back; 2) create and reconnect wetlands to the floodplain in the lower San Joaquin, Tuolumne, and Stanislaus Rivers; 3) restore marsh habitat in the Delta and Suisun Marsh; 4) manage bypasses for fish; and 5) remove upstream barriers to migration. Specific criteria are stated in USFWS (1996) and include meeting two out of three possible restoration criteria regarding splittail abundance over a 15-year period.

Research or Monitoring Gaps. Despite the use of several monitoring techniques for estimating splittail populations, the USFWS (2002) acknowledges significant methodological weaknesses for each method. The abundance status of the splittail could be estimated more accurately with a rigorous survey designed specifically for this species. In addition, research into the mechanisms driving splittail population declines during low outflow-high diversion years would help ascertain key limiting factors for this species. Studying the characteristics of spawning and rearing areas, especially for young-of-year splittail, would aid identification of critical habitat areas (CDFG 2002).

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3.2.7 Green Sturgeon (*Acipsenser medirostis*)

Legal Status. The green sturgeon is a State of California species of special concern (CDFG 2003). NOAA Fisheries recently (2002) completed its ESA status review for North American green sturgeon and has since concluded that listing was not warranted (NOAA 2003). Green sturgeon has been added to the candidate species list and its status will be reevaluated in 5 years.

Historical and Current Distribution and Status. The green sturgeon is the most widely distributed member of the sturgeon family Acipenseridae (NOAA 2003). In North America, green sturgeon are found in rivers from British Columbia south to the Sacramento River, California, though their ocean range is from the Bering Sea to Ensenada, Mexico (Moyle 2002). In California, historical spawning populations existed only in the Sacramento, Eel, and Klamath-Trinity river systems. A number of presumed spawning populations (Eel River, South Fork Trinity River, San Joaquin River) have been lost, and the only known spawning in California occurs in the Sacramento and Klamath Rivers (Moyle 2002; NOAA Fisheries 2002). Green sturgeon are reported to spawn in the Feather River, though this claim is not substantiated (NOAA Fisheries 2002). There is no documentation suggesting green sturgeon spawn in the San Joaquin River presently; however, spawning may have occurred prior to large-scale hydropower and irrigation development. Recent accounts of young sturgeon rearing in the San Joaquin Delta area are likely the result of immigration from the Sacramento River (NOAA Fisheries 2003).

In assessing North American green sturgeon status, NOAA Fisheries determined two distinct population segments (DPSs) exist. The northern DPS ranges from the Eel River northward; the southern DPS includes any coastal or Central Valley populations south of the Eel River, with the only known population being in the Sacramento River (NOAA Fisheries 2002). The remaining information presented will focus on the southern DPS of green sturgeon. NOAA Fisheries concluded that, based on the available information, there is no evidence suggesting that the green sturgeon population is declining in the southern DPS. Population estimates for adult green sturgeon in the San Pablo Bay area have ranged from several hundred to 2000, with a high of over 8,000 in 2001 (NOAA Fisheries 2002). These estimates are based on incidental green sturgeon catch during CDFG's white sturgeon monitoring. However, the validity of the assumptions necessary for this estimation is questionable (Moyle 2002, NOAA Fisheries 2002). Annual juvenile abundance in the Sacramento River based on downstream migrant trapping ranges from zero to 2,068 with no apparent annual trend (NOAA Fisheries 2002).

Distribution in the CALFED Solution Area and EWA Action Area. Juvenile green sturgeon rear throughout San Francisco and San Pablo Bays, the Sacramento-San Joaquin Delta, and the Sacramento River. During spawning migrations, adult green sturgeon pass through the San Francisco Bay estuary and the Sacramento-San Joaquin Delta on their way to spawning grounds in the Sacramento River (NOAA Fisheries 2002, Moyle 2002).

Life History and Habitat Requirements. The green sturgeon is anadromous and the most marine-oriented of the Pacific coast sturgeon species (NOAA 2003). Green sturgeon are thought to spawn every 3 to 5 years, with mature males ranging from 139-199 cm FL (age 15-30 years) and mature females ranging from 157-223 cm FL (age 17-40 years) (NOAA Fisheries 2002). Green sturgeon migrate upstream between late February and late July. The spawning period is March-July, peaking mid-April to mid-June (Moyle 2002). Green sturgeon spawning takes place in deep, turbulent pools of large rivers. Preferred spawning substrate is likely large cobble, but it can range from clean sand to bedrock (Moyle 2002; NOAA Fisheries 2002). Green sturgeon larvae probably hatch at around 200 hours (at 12.7°C) after spawning and are dissimilar to other sturgeon species in that they lack a distinct swim-up or post-hatching stage (Moyle 2002, NOAA Fisheries 2002). Growth rates are optimal at temperatures of 15°C. Young sturgeon grow fast and appear to migrate to the ocean between 1-3 years at 30-66 cm TL (Moyle 2002, NOAA Fisheries 2002). They apparently remain near the estuaries at first, but then migrate considerable distances as they grow. Based on recoveries of green sturgeon tagged in the San Francisco Bay estuary, most green sturgeon migrate northward, in some cases as far as British Columbia (Moyle 2002, NOAA Fisheries 2002).

Some general information is available for green sturgeon feeding habits. Adult green sturgeon scour the Sacramento-San Joaquin Delta benthos for invertebrates, including shrimp, mollusks, amphipods, and small fish. Juvenile green sturgeon in the Sacramento River Delta are known to feed on opossum shrimp and amphipods (NOAA Fisheries 2002).

Reasons for Decline. The NMFS Biological Review Team for green sturgeon has identified several potential threats or risk factors to the southern green sturgeon DPS, including 1) harvest bycatch concerns; 2) the concentration of spawning in the Sacramento River and the apparent small population size; 3) loss of spawning habitat; 4) lack of adequate population abundance data; 5) potentially lethal water temperatures for larval green sturgeon; 6) entrainment by water projects in the Central Valley; and 7) the adverse effects of toxic materials and exotic species (NOAA Fisheries 2002).

Designated Critical Habitat or Essential Fish Habitat. Designation of critical habitat is not applicable for green sturgeon.

Conservation Efforts. Agencies implementing the CVPIA and CALFED actions are working to improve the quality of anadromous fish habitat, improving fish passage, and contributing to population recovery (CALFED 2000, AFRP 2001). The opening of the gates at the Red Bluff Diversion Dam (RBDD) primarily for winter-run Chinook salmon passage has provided a substantial increase in access to spawning habitat for green sturgeon (NOAA 2003). Other conservation measures targeted at anadromous salmonids, such as improving river thermal and flow regimes, are likely to improve conditions for green sturgeon as well.

Recovery Plan and Recovery Guidance. AFRP (2001) under authority of CVPIA states that the target production level for green sturgeon in Central Valley rivers is 2,000 fish. CALFED's (2000) goal is to achieve recovery objectives identified for green sturgeon in the recovery plan for the Sacramento-San Joaquin Delta native fishes (USFWS 1996). Green sturgeon will be considered restored when in the Sacramento-San Joaquin Delta once the median population of mature sturgeon (>1.0 m) has reached 1,000 individuals (USFWS 1996).

Research and Monitoring Gaps. NOAA Fisheries (2002) states there is a critical need to monitor population trends and identify potential risks to green sturgeon. AFRP (2001) identifies locating green sturgeon spawning sites and evaluating the availability, adequacy, and use by adult green sturgeon as a high priority.

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3.3 Species Accounts for Birds

3.3.1 Aleutian Canada Goose (*Branta canadensis* ssp. *leucopareia*)

Legal Status. The Aleutian Canada goose was removed from the list of threatened species under the Endangered Species Act on March 20, 2001, but this species is still

considered as a Federal Species of Concern for 5 years after delisting (CDFG 2003). This goose is also 1) protected under the Migratory Bird Treaty Act and Convention on International Trade in Endangered Species of Wild Fauna and Flora (U.S. Fish and Wildlife Service 2001), 2) considered a California Special Animal (CDFG 2003), and 3) listed as a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003).

Historical and Current Distribution and Status. Historically, Aleutian Canada geese wintered from British Columbia to California and northwestern Mexico (CALFED 2000). Although they occurred throughout California, the greatest concentrations were found in the Sacramento and San Joaquin Valleys (Grinnell and Miller 1944). The subspecies bred throughout the Aleutian Islands and into Russia (Springer 1977).

The present population of Aleutian Canada geese migrates along the northern California coast and winters in the Central Valley near Colusa and on scattered feeding and roosting sites along the San Joaquin River from Modesto to Los Banos (Jones & Stokes Associates and CH2M Hill 1986, Nelson et al. 1984). Fall migration usually begins in late August or early September, with birds arriving in the Central Valley between October and early November (USFWS 1980). Spring migration usually begins in mid-February and continues to early March (USFWS 1980). The population estimate in 2000 was approximately 37,000 individuals with an average annual growth rate of 20 percent (U.S. Fish and Wildlife Service 2001).

Distribution in the CALFED Solution Area and EWA Action Area. The Aleutian Canada goose is present during fall and winter in the Colusa Basin, East San Joaquin Basin, and West San Joaquin Basin Ecological Zones. During migration, it could also occur in the Butte Basin, Feather River/Sutter Basin, Yolo Basin, and Sacramento-San Joaquin Delta Ecological Zones (CALFED 2000) (Figure 3-1).

Life History and Habitat Requirements. Aleutian Canada geese breed exclusively on a small number of Aleutian islands (NatureServe Explorer 2001). This region is characterized by a polar maritime climate with high humidity, fog, rain, a small diurnal annual range of temperature, and near constant winds (NatureServe Explorer 2001). Nesting areas have been on grassy hillsides, along streams, in marshes and lagoons, and on rugged sea cliffs cut by watercourses where grasses and sedges grow in profusion (NatureServe Explorer 2001). Molting habitat is generally in the uplands. Night roosting areas include shallow pools and ponds on the islands.

Most Aleutian Canada geese that nest in the islands winter in California, primarily on agricultural lands. They arrive on the wintering grounds in mid-October (USFWS 1999). Aleutian Canada geese forage in harvested cornfields, newly planted or grazed pastures, or other agricultural fields (e.g., rice stubble and green barley). Lakes, reservoirs, ponds, and flooded fields are used for roosting and loafing (Grinnell and Miller 1944, USFWS 1982). They also roost in large marshes and stock ponds (CALFED 2000).

Aleutian Canada geese are omnivores, having a steady diet of arthropods, evergreen shrubs, roots, tubers, leaves, and stems during the breeding season. They also consume crowberries. The goslings are fed insects such as ground beetles. All their water is taken from vegetation. During the non-breeding season they feed on crops such as rice, corn, wheat, barley, oats, and lima beans. Water is taken from low-lying flooded areas.

The mating season is from May to June. Aleutian Canada geese become sexually mature around the age of 2 or 3. The incubation period is 28 days, with an average clutch of four to six eggs. Both the males and females guard the nest prior to setting, only the males after. They nest in treeless islands and areas covered with sedge, grass, and ferns with no source of freshwater.

Reasons for Decline. Predation by introduced Arctic foxes on the breeding islands is the primary reason for the population decline (Yparraguirre 1978). Predation by these foxes eliminated most breeding colonies of the Aleutian Canada goose and, by the 1930s, the subspecies was nearly extinct, with only one breeding colony on the tiny island of Buldir (USFWS 1982). Avian cholera is currently a major threat to the concentrations of Aleutian Canada geese in the Central Valley. This subspecies is particularly vulnerable to cholera outbreaks because most of the population overwinters in a small geographical area. Sport hunting has also added to the species' decline (USFWS 1982). In addition, suitable wintering habitat is disappearing due to urbanization and changing agricultural habitats, primarily in the California Central Valley. Adverse climatic conditions, such as drought, may accentuate the decline in available habitat and favor undesirable land use practices that could reduce the quality and availability of suitable habitat.

Designated Critical Habitat. None.

Conservation Efforts. Measures under the CALFED Bay-Delta Program are designed to restore and enhance suitable habitat for this species (CALFED 2000).

Recovery Plan and Recovery Guidance. The Aleutian Canada Goose Recovery Plan implemented in 1991 outlined three primary objectives to be achieved before considering delisting the species: to maintain the wild populations at or above 7,500 individuals, to reestablish self-sustaining breeding populations of 50 pairs or more on three former breeding areas other than Buldir Island, and to identify and manage 25,000 to 35,000 acres of feeding and roosting habitat (USFWS 2001). The substantial population increase led to the delisting of this species, although the second and third objectives have not yet been achieved. Habitat acquisition and improvement continue as high-priority conservation efforts for the Aleutian goose (USFWS 2001).

Research and Monitoring Gaps. Although goose abundance has increased and this species was delisted, USFWS will continue to monitor populations.

Aleutian Canada Goose Citations

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3.3.2 Black Tern (*Chlidonias niger*)

Legal Status. The black tern is listed as a California Species of Special Concern (CDFG 2002) and a Migratory Nongame Bird of Management Concern (USFWS 1995). This species is not listed under the California Endangered Species Act, but is considered a Federal Species of Concern (formerly a species under consideration for listing) (CDFG 2003).

Historical and Current Distribution and Status. The black tern is a common breeder throughout the northern United States and southern Canada (Dunn and Argo 1995). The black tern was also a common and even abundant summer breeder and migrant throughout much of California (Grinnell and Miller 1944). The species has declined and now breeds only in the northeast (Siskiyou, Modoc, and Lassen Counties) and Central Valley, although in much-reduced numbers (Zeiner et al. 1990). From April to early June, the black tern is a rare to common transient, uncommon to common at breeding areas and at the Salton Sea in summer, rare to common fall transient from August to mid-October, and very rare in northern California and along the southern coast between October and April (Small 1994). Although this species can be found in great numbers at the Salton Sea, it is not known to breed there (Small 1944).

Distribution in the CALFED Solution Area and EWA Action Area. This tern breeds in the Colusa Basin, Butte Basin, Feather River/Sutter Basin, and West San Joaquin Basin Ecological Zones. It also occurs as a migrant in the Yolo Basin, American River Basin, and Sacramento-San Joaquin Delta Ecological Zones (Figures 3-2 and 3-3).

Life History and Habitat Requirements. The black tern requires freshwater habitats for breeding grounds. Nesting sites are found on lakes, ponds, marshes, and agricultural fields (Grinnell and Miller 1944). During migration, this species can be common on coastal bays, river mouths, and well offshore over pelagic waters (Cogswell 1977). Nests are built on floating mats of dead vegetation among anchored vegetation or along the shore where they are built by scraping out the soil (Zeiner et al. 1990).

The black tern forages by hovering above wet meadows and fresh emergent wetlands. The tern catches insects in the air and also plucks them from water and vegetation surfaces. It eats grasshoppers, dragonflies, moths, flies, beetles, crickets, and other insects (Terres 1980). It also hovers above croplands, then drops to capture adult and larval insects from recently plowed soil. Another foraging technique is plunging to water surface for tadpoles, crayfish, small fish, and small mollusks. Young are fed insects (Cuthbert 1954). Adults drink during bathing or swoop to water to dip bill several times, particularly after swallowing prey (Dunn and Argo 1995).

Reasons for Decline. The draining of marshes and other freshwater habitats has been the main cause for this species' decline. The expansion of rice cultivation has offset this loss somewhat and has provided artificial nesting habitat (Cogswell 1977). Pesticide poisoning has also been very detrimental to the black tern (Zeiner et al. 1990).

Designated Critical Habitat. None.

Conservation Efforts. Measures under the CALFED Bay-Delta Program are designed to restore and enhance suitable habitat for this species (CALFED 2000).

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared, and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. The effects of human disturbances (e.g., marinas, campgrounds) near lakes and wetlands on black tern nesting and foraging requires further study (Beedy 1990).

Black Tern Citations

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3.3.3 Black-Crowned Night Heron (*Nycticorax nycticorax*)

Legal Status. The black-crowned night heron is listed as a U.S. Bureau of Land Management sensitive species and a State Sensitive Species (CDFG 2003). This heron is not a federally listed species, nor is it a California listed species or species of special concern.

Historical and Current Distribution and Status. The black-crowned night heron breeds in Washington, southern Idaho, Saskatchewan, Michigan, and Nova Scotia south to southern South America. The black-crowned night heron winters north to Oregon, and east and south to Utah, New Mexico, Texas, lower Ohio Valley, Gulf Coast, and southern New England. In the U.S., the highest winter densities are in the vicinity of inland wildlife refuges near the California-Oregon border, along the northern California coast, in the San Joaquin Valley of California, along the lower Colorado River, near Galveston Bay in Texas, and along the coast near Jacksonville, Florida (Root 1988).

The black-crowned night heron was and is a common year-long resident throughout most of California. The heron nests in large numbers in the Central Valley, Salton Sea, and the northeastern part of the state (Zeiner et al. 1990). Birds in the northern portions of the state migrate south during winter months. Many immature black-crowned night herons migrate to the north and central coasts of California from August to March (Small 1994).

Distribution in the CALFED Solution Area and EWA Action Area. The black-crowned night heron breeds in the Butte Basin, Colusa Basin, Yolo Basin, Feather River/Sutter Basin, American River Basin, Sacramento-San Joaquin Delta, Eastside Delta Tributaries, East San Joaquin Basin, West San Joaquin Basin, and Suisun Marsh/North San Francisco Bay Ecological Zones. During winter, they also occur in the North Sacramento Valley and Cottonwood Creek Ecological Zones (Figure 3-4).

Life History and Habitat Requirements. Throughout most of California, the black-crowned night heron's breeding season is from February to July; in the northeastern portion of the State, it is from April to August. Nesting takes place in thick-foliaged trees, dense fresh or brackish emergent wetlands, or dense shrubbery or vines near aquatic feeding areas. The nests are built of twigs or various marsh plants, and the clutch size is three or four, occasionally five. The incubation period is 24 to 26 days,

after which the young are cared for by both adults. The first flight attempts made by the young take place at 6 weeks of age, but they are not independent for some time after that (CDFG 1995).

The black-crowned night heron is a fairly common yearlong resident of the foothills and lowlands throughout most of California. The heron roosts during the day in dense trees or dense emergent wetland plants. The black-crowned night heron feeds primarily at night. Foraging is conducted largely along the margins of lacustrine, riverine, and fresh and saline emergent wetlands. The highly variable diet consists of fishes, crustaceans, aquatic insects, other vertebrates, amphibians, reptiles, some small mammals, and rarely a young bird. These birds hunt in shallow water, waiting motionlessly, but just as often they stalk their prey (CDFG 1995).

Reasons for Decline. Although this species is common throughout most of its range, it may have declined in some areas from the loss of marshes and other wetlands, pesticide use, human disturbance at nesting and roosting sites, and the removal of nesting and roosting trees (Airola 1980). The black-crowned night heron has been designated a "Special Animal" by California Department of Fish and Game because of its close association with a habitat that is continuing to decline in California. Additionally, any human disturbance of nesting colonies results in nest abandonment. Any project affecting the riparian corridor has the potential for affecting potential nesting and foraging sites of this species (CDFG 1995).

Designated Critical Habitat. None.

Recovery Plan and Recovery Requirements. A recovery plan has not been prepared, and recovery requirements have not been identified for this species.

Black-crowned Night Heron Citations

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3.3.4 Great Blue Heron (Ardea herodias)

Legal Status. The great blue heron is listed as a California Department of Forestry sensitive species (CDFG 2003). This heron is neither a federally listed species, nor is it a California listed species or species of special concern.

Historical and Current Distribution and Status. The great blue heron is a widely distributed species with breeding and wintering ranges that stretch from Canada south to northern South America and the Galapagos Islands (NatureServe Explorer 2002). In California this species is a yearlong resident throughout the State, except for mountains above the foothills (Granholm 1990). It is fairly common in shallow estuaries and fresh and saline emergent wetlands and less common along riverine and rocky marine shores, in croplands, pastures, and high mountains (Granholm 1990). The great blue heron can also be found in salt ponds where fish are numerous from July to October (Granholm 1990). It is locally common near rookeries (scattered frequently throughout northern California and infrequently in southern California) from February to June or July (Granholm 1990). Great blue herons in California display little regular migration, simply dispersing from rookeries to outlying areas after breeding in June or July (Granholm 1990).

The great blue heron is sensitive to human disturbance near nests and probably to pesticides and herbicides in nesting and foraging areas (Granholm 1990). The great blue heron is designated a "Special Animal" because of the close association it has with habitat that is continuing to decline in California (CDFG 1995). Additionally, tree cutting, water recreation, draining of wetland habitats, building, and highway construction have all contributed to rookery abandonment (CDFG 1995).

Distribution in the CALFED Solution Area and the EWA Action Area. The great blue heron occurs in all Ecosystem Restoration Program ecological zones and throughout the EWA Action Area (Figure 3-5).

Life History and Habitat Requirements. Great blue herons use shallow estuary systems and fresh and saline emergent wetlands year round. Tall riparian-type trees are needed for perching and roosting sites (CDFG 1995). Great blue herons forage mostly for fish, but also eat small rodents, amphibians, snakes, lizards, insects, crustaceans, and occasionally small birds. Hunting techniques include standing motionless, wading slowly, probing and pecking, and then grasping prey in bill (CDFG 1995, Granholm 1990). Foraging can occur both night and day, but mostly occurs around dawn and dusk (Granholm 1990).

Great blue herons nest colonially, typically in secluded groves of tall trees near shallow-water feeding areas; however, feeding areas may be up to 10 miles distant (Granholm 1990). The breeding season is from February to June or July, with clutch sizes averaging 3-4 (Granholm 1990). Great blue heron young are often fed by parents until 11 weeks old (Granholm 1990). Breeding typically begins at 2 years (Granholm 1990).

Reasons for Decline. The great blue heron is sensitive to human disturbance near nests and probably to pesticides and herbicides in nesting and foraging areas (Granholm 1990). The great blue heron is designated a "Special Animal" because of the close association it has with habitat that is continuing to decline in California (CDFG 1995). Additionally, tree cutting, water recreation, draining of wetland habitats, building, and highway construction have all contributed to rookery abandonment (CDFG 1995).

Designated Critical Habitat. None.

Conservation Efforts. Conservation efforts have not been identified for this species.

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. Research and monitoring gaps have not been identified for this species.

Great Blue Heron Citations

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3.3.5 Great Egret *(Casmerodius albus)*

Legal Status. The great egret is listed as a California Department of Forestry sensitive species and is a specified bird in Fish and Game Code Section 3505 (CDFG 2003). This egret is neither a federally listed species nor is it a California species of special concern.

Historical and Current Distribution and Status. The great egret is a widely distributed species with breeding and wintering ranges that stretch from Canada to South America (NatureServe Explorer 2002). In California, this species is a yearlong resident throughout the State, except for high mountains and deserts (Granholm 1990). Populations concentrate at nesting colonies from March to July; after breeding, these birds tend to wander widely (Granholm 1990). Seasonal movements also occur from the northeastern plateau to lowland areas from September to February.

Great egrets declined substantially at the turn of the century by plume hunting (CDFG 1995). This species is currently considered to be fairly common to common yearlong in the coastal lowlands, inland valleys, and Central Valley (Granholm 1990). However, recent water developments have negatively influenced population densities by affecting nesting environments (CDFG 1995).

Distribution in the CALFED Solution Area and EWA Action Area. The great egret occurs in all Ecosystem Restoration Program ecological zones and throughout the EWA Action Area (Figure 3-6).

Life History and Habitat Requirements. Great egrets use a wide variety of fresh, brackish, and saltwater habitats including coastal estuaries, fresh and saline emergent wetlands, ponds, slow moving rivers, mudflats, salt ponds, and irrigated croplands and pasture (Granholm 1990). These egrets feed on fishes, amphibians, snakes, snails, crustaceans, insects and small mammals (NatureServe Explorer 2002). Hunting is diurnal. The great egreat stalks slowly or waits for prey, then rapidly striks with the bill (Granholm 1990).

This species is a colonial rooster and nester and requires thick riparian stands of large trees near aquatic foraging areas relatively isolated from human activities (Granholm 1990, CDFG 1995). Great egrets construct their nests of sticks, stems, and wetland plants in large trees from 3 to 25 meters off of the ground (CDFG 1995). Nesting generally occurs from March to July with clutches averaging 3 to 5 eggs. Downy, semi-altricial young are born after 26 days incubation (CDFG 1995). Young egrets depart the nest approximately 5 to 6 weeks after hatching. Once young are independent, individual egrets tend to separate and explore other areas (Granholm 1990). The average lifespan of a great egret is approximately 23 years (Klimkiewicz 2002).

Reasons for Decline. Egrets are sensitive to human proximity and may abandon nests if they feel threatened (Granhom 1990). Other human disturbances in nesting environments, such as thinning at riparian nest sites, can reduce clutch success, decrease protection against high winds, and increase exposure to avian predators

(CDFG 1995). Other threats to egrets include pesticides, loss of suitable wetland habitat, and high winds that can destroy nests, eggs, and nestlings (Granholm 1990).

Designated Critical Habitat. None.

Conservation Efforts. Conservation efforts have not been identified for this species.

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared, and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. Better information on the current abundance of this species and identification of rookeries would increase understanding of this species in the study area (CDFG 1995).

Great Egret Citations

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3.3.6 Greater Sandhill Crane *(Grus canadensis tabida)*

Legal Status. The greater sandhill crane is listed as threatened under the California Endangered Species Act and is a fully protected species under the California Fish and

Game Code (CDFG 2003). It is also listed as a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003).

Historical and Current Distribution and Status. The greater sandhill crane breeds from southwestern British Columbia south to northern California and northern Nevada, in the Rocky Mountain region from Montana to northern Colorado, in the central plains and Great Lakes region from southern Manitoba and northern Minnesota to central Wisconsin and southern Michigan, and also southeastern Ontario. The historic breeding range included southern British Columbia, central and southern Alberta, Saskatchewan, northern Manitoba, southwestern Ontario, and Michigan, south to northeastern California, northern Nevada, Arizona, northern Utah, northwestern Colorado, Nebraska, Iowa, Illinois, Indiana, and central Ohio.

The Great Lakes population winters in Florida, the Rocky Mountain population winters along the Rio Grande in New Mexico and in northern Chihuahua, and westernmost breeding populations winter in California, including the Central and Imperial Valleys (Johnsgard 1983). Between 3,400 and 6,000 greater sandhill cranes winter in the Sacramento Valley and Sacramento-San Joaquin River Delta (Pogson and Lindstedt 1991, California Department of Fish and Game 1997, Pacific Flyway Council 1997). There are breeding populations present in the northern counties of California.

Distribution in the CALFED Solution Area and EWA Action Area. Greater sandhill cranes winter in the North Sacramento Valley, Butte Basin, Colusa Basin, Yolo Basin, Feather River/Sutter Basin, American River Basin, and Sacramento-San Joaquin Delta Ecological Zones (Figures 3-7 and 3-8).

Life History and Habitat Requirements. California populations of the greater sandhill cranes nest in extreme northern California in open areas of wet meadows that are often interspersed with emergent marsh and usually build their nests over shallow water. No nesting occurs within the EWA Action Area.

Within the EWA Action Area, favorable roost sites and an abundance of cereal grain crops characterize the winter concentration areas. Rice is the primary food source for cranes near Gray Lodge WA, Butte County, and corn is the most important food at the majority of other concentration areas in the Central Valley, particularly in the Sacramento - San Joaquin delta. Irrigated pastures are used extensively as loafing sites in some wintering areas

Greater sandhill cranes have an omnivorous diet consisting primarily of vegetable matter such as small grains; however, they will consume almost any available food. They feed in pastures, flooded grain fields, and seasonal wetlands. Toads, frogs, eggs, young birds, small rodents, invertebrates, roots, and tubers are all included in their diet. However, animal matter, except for certain invertebrates, is taken primarily opportunistically and should not be considered a major component of the diet of cranes.

Reasons for Decline. The greater sandhill crane has declined for a variety of reasons, including loss of wetlands in breeding and wintering habitats, human disturbance at nesting sites, and mower-caused mortality on the breeding grounds (Littlefield 1982, Littlefield et. al 1994, California Department of Fish and Game 1997).

A 5-year status review of the greater sandhill crane conducted by California Department of Fish and Game Wildlife Management Division Nongame Bird and Mammal Program identified the following threats to the greater sandhill crane in California: increased occurrence of flood and drought conditions, predation from increasing raven populations, powerline collision, habitat loss due to cattle grazing and crop growth, the lowering of water table which decreases stream and creek flows, disease, and parasites (Schlorff 1994).

Designated Critical Habitat. None.

Conservation Efforts. Measures under the CALFED Bay-Delta Program are designed to restore and enhance suitable habitat for this species (CALFED 2000).

Recovery Plan and Recovery Guidance. A recovery plan will be completed as a provision of AB1280 and will be submitted by the California Department of Fish and Game for approval by the Fish and Game Commission (California Department of Fish and Game 2000). The CDFG did not meet the 2001 deadline for getting an approved recovery plan. A Federal Flyway Management Plan has existed since 1983 and was revised in 1997 (Pacific Flyway Council 1997). Both documents are consistent with the provisions of CESA regarding the recovery of the greater sandhill crane in California.

Research and Monitoring Gaps. The extent of disease and parasites in California nesting populations is not well known. Predator populations should also be monitored (CDFG 1994).

Greater Sandhill Crane Citations

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3.3.7 Long-Billed Curlew (*Numenius americanus*)

Legal Status. The long-billed curlew is designated as a California Species of Special Concern (CDFG 2002), a Migratory Nongame Bird of Management Concern (USFWS 1995), and a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003). This species is not listed under the California Endangered Species Act, but is considered a Federal Species of Concern (formerly a species under consideration for listing) (CDFG 2003). This species is also listed on the Audubon Watchlist (CDFG 2003).

Historical and Current Distribution and Status. The long-billed curlew breeds from southern British Columbia, southern Alberta, southern Saskatchewan, southern Manitoba south to eastern Washington, northeastern California, Nevada, Utah,

southern Colorado, New Mexico, and northern Texas east to southwestern Kansas. Non-breeding populations have been found in central California, southern Arizona (rarely), extreme northern Mexico, southern Texas, southern Louisiana, coastal South Carolina south to southern Mexico (Oaxaca, Veracruz, Yucatan Peninsula) and northern Gulf Coast east to Florida, irregularly to Guatemala, Honduras, Costa Rica, and Venezuela (Natureserve 2001).

In California the long-billed curlew is a migrant with two seasonal influxes: wintering visitors and summer breeders. Summer breeding populations occur in the Siskiyou, Modoc, and Lassen Counties in northeastern California. Winter transients occur along the coast, in the Central and Imperial Valleys, where their numbers are greatest (Zeiner et al. 1990). Both winter visitors and summer breeders are fairly numerous, but Grinnell and Miller (1944) had documented that numbers had declined dramatically since 1900. Small numbers of nonbreeders remain on the coast in summer, and larger numbers remain in some years in the Central Valley (Cogswell 1977, Page et al. 1979, Garrett and Dunn 1981, Swarth 1983).

Distribution in the CALFED Solution Area and EWA Action Area. During the nonbreeding season, the long-billed curlew occurs in the Butte Basin, Colusa Basin, Yolo Basin, Feather River/Sutter Basin American River Basin, Eastside Delta Tributaries, Sacramento-San Joaquin Delta, East San Joaquin Basin, West San Joaquin, and Suisun Marsh/North San Francisco Bay Ecological Zones. This species does not breed in any of the ecological zones associated with the EWA Action Area (Figure 3-9).

Life History and Habitat Requirements. Summer populations arrive in northern California in April and leave by September. Preferred breeding habitats are elevated grasslands adjacent to lakes or marshes. Nests are built on the ground, away from water, and close to cover (Zeiner et al. 1990). Winter visitors arrive in July and stay until early April. Wintering flocks favor coastal estuaries, marshes, grasslands, and croplands (Small 1994). They nest on the ground, usually in flat areas with short grass, sometimes on more irregular terrain, often near rock or other conspicuous objects (NatureServe 2001). Central Valley wintering and non-breeding summer populations utilize grassland and cropland habitat.

The long-billed curlew is a fairly opportunistic feeder. This species normally feeds on various insects (grasshoppers, beetles, caterpillars, etc.) and eats some berries. During migration they also feed on crayfishes, crabs, snails, and toads. They may obtain insect larvae by probing into loose soil (Allen 1980). Predation on nestling birds has been observed. The pick food from ground or water, probe with their bill in sand or mud in or near shallow water, and pluck berries (NatureServe 2001).

Reasons for Decline. The loss and fragmentation of marshes and coastal estuaries have contributed to the decline of the long-billed curlew. Pollution, urban runoff, and sewage discharge have contaminated many of the feeding grounds of this species.

Designated Critical Habitat. None.

Conservation Efforts. Conservation efforts have not been identified for this species.

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared, and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. More research is needed on the potential effect of mammalian predators on the long-billed curlew (NatureServe Explorer 2001).

Long-billed Curlew Citations

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3.3.8 Snowy Egret (*Egretta thula*)

Legal Status. The snowy egret is listed on the United States Bird Conservation Watch List (CDFG 2003). This species is also considered a Federal Species of Concern (formerly a species under consideration for listing), but is not listed under the California Endangered Species Act (CDFG 2003). The snowy egret is a specified bird in Fish and Game Code Section 3505 and has legal protection.

Historical and Current Distribution and Status. The snowy egret is a widely distributed species with breeding and wintering ranges that stretch from the U.S. to South America (NatureServe Explorer 2002). In California, this species is considered to be a year-round resident below 1,000 feet elevation in the southern three-fourths of the State (Bousman 2000). It is abundant in the seashore, coastal, interior, and Great Basin areas of the State and less common inland and north of Sonoma County (Bousman 2000). Snowy egrets from Central California migrate to Mexico for the first fall and winter; therafter, the egrets are generally nonmigratory. Seasonal movements tend to occur from nesting colonies and northern California areas to coastal and southern regions in the winter months (Granholm 1990). Populations along the central California coast leave for southern California coast locations from December to February; San Francisco Bay and Central Valley populations are common, year-round residents (Granholm 1990, Bousman 2000).

Before 1880, the snowy egret was considered to be locally common in the State. From the 1880s through 1920s, this egret was devastated by hunting and almost extirpated from the State. The egret has been recovering since the 1940s, and current abundance records estimate that populations in the bay area have reached carrying capacity (Bousman 2000). Data from Christmas Bird Counts (CBC) record a minimum population estimate for the bay area at 1,112 birds. While the data also show that population sizes fluctuate from year to year, populations have remained relatively stable over the past 25 years (Bousman 2000). While populations seem to have recovered, there is still concern about the availability of suitable rookery areas (CDFG 1995).

Distribution in the CALFED Solution Area and the EWA Action Area. The snowy egret occurs in all Ecosystem Restoration Program ecological zones and throughout the EWA Action Area (Figure 3-10).

Life History and Habitat Requirements. Snowy egrets use a wide variety of fresh, brackish, and saltwater habitats, including coastal estuaries, fresh and saline emergent wetlands, ponds, slow moving rivers, irrigation ditches, and wet fields (Granholm 1990). Egrets will be concentrated where suitable fish species are concentrated, such as seasonal wetlands, impoundments, and salt ponds (Bousman 2000). Egrets forage for fish, crayfish, amphibians, reptiles, worms, arthropods, small mammals, and snails in shallow water or along shores. Hunting techniques include stalking, waiting, luring, or flushing prey (Granholm 1990, CDFG 1995).

Snowy egrets nest colonially in marshy areas near brackish or saltwater areas. Nests are generally constructed of sticks in low trees about 1.5 to 3 meters from the ground; San Francisco Bay residents nest closer to the ground on Grindelia humilis, Salicornia pacifica, and Baccharis pilularis species. The main nesting requirements are protection and security from disturbance and predation and nearness to suitable wetland feeding areas (Bousman 2000). The breeding season is from late March to mid-May in central California with clutch sizes of 3 to 4; young leave the nest at 20 to 25 days (Granholm 1990). The lifespan of a snowy egret is approximately 17.5 years (Klimkiewicz 2002).

Reasons for Decline. A major threat to snowy egrets includes increased predation by burgeoning populations of nonnative red fox. One successful colony near Redwood City was abandoned for no clear reason, but researchers hypothesize that the decline may have been linked to red fox predation (Bousman 2000). In addition, populations near the Salton Sea have declined due to competition with cattle egrets (Granholm 1990). The success of egrets is likely linked to the general health of the estuary system, including secure riparian areas for nesting, adequate wetland area and prey base for foraging, and protection from direct disturbance by humans (CDFG 1995, Bousman 2000).

Designated Critical Habitat. None.

Conservation Efforts. Conservation efforts have not been identified for this species. Bousman (2000) provides management suggestions for the conservation of snowy egrets and their habitat.

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared, and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. This species seems to be able to use a wide variety of habitats, but there are no quantitative data on the use of estuarine habitats for foraging. In addition, the factors behind the decline and abandonment of previously successful colonies require further study (Bousman 2000).

Snowy Egret Citations

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3.3.9 Tricolored Blackbird (*Agelaius tricolor)*

Legal Status. The tricolored blackbird is designated as a California Species of Special Concern (CDFG 2002), a Migratory Nongame Bird of Management Concern (USFWS 1995), a BLM Sensitive Species (CDFG 2003), and a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003). This species is not listed under the California Endangered Species Act, but is considered a Federal Species of Concern (formerly a species under consideration for listing) (CDFG 2003). This species is also listed on the Audubon Watchlist (CDFG 2003).

Historical and Current Distribution and Status. Historically, tricolored blackbirds nested throughout much of California west of the Sierra Nevada, in coastal southern California, and in portions of northeastern California. Flocks and breeding colonies were observed in the Shasta region, Suisun Valley, and Solano County; and in or near Stockton, San Diego, Los Angeles, and Santa Barbara; Glenn, Sacramento, Butte, Colusa, Yolo, and Yuba Counties (Heermann 1853, Belding 1890, Baird 1870, Neff 1937, Orians 1961, Payne 1969). Extensive marshes that provided ample breeding

habitat for tricolors in the Central Valley from overflowing river systems had been reduced by 50 percent by the mid-1980s (Frayer et al. 1989). Additionally, native perennial grasslands, which are primary foraging habitat, have been reduced by more than 99 percent in the Central Valley and surrounding foothills (Kreissman 1991).

Currently, tricolored blackbirds are found in the Sacramento Valley, San Joaquin Valley, San Francisco Bay and Delta, along the north coast and central coast, southern California, and the northeast interior of California; however, sizes of populations in many of these areas have been greatly reduced (Beedy and Hamilton 1997). In 1992, there were an estimated 250,000 adults in California (NatureServe Explorer 2001).

Distribution in the CALFED Solution Area and EWA Action Area. The tricolored blackbird nests in the American River Basin, Butte Basin, Colusa Basin, Cottonwood Creek and Yolo Basins, and the Sacramento-San Joaquin Delta, East San Joaquin Basin, Eastside Delta Tributaries, and in the Feather River/Sutter Basin Ecological Zones (Figure 3-11).

Life History and Habitat Requirements. For breeding-colony sites, tricolored blackbirds require open accessible water, a protected nesting substrate that is usually flooded or has thorny or spiny vegetation, and a foraging area that provides adequate insect prey within a few kilometers of the nesting colony (Beedy 1989, Hamilton et al. 1995). Types of vegetation in the colony area include cattails, tules, willow, blackberry, wild rose, and tall herbs. Nests are usually a few feet over, or near, freshwater and also may be hidden on ground among low vegetation. Nests are built of mud and plant materials. In addition to consuming insects, the tricolor also eats seeds and cultivated grains, such as rice and oats. It will often forage in croplands, pastures, grassy fields, flooded land, and along edges of ponds (Zeiner et al. 1990).

Tricolored blackbirds leave wintering areas in the Sacramento-San Joaquin Delta and along coastal central California in late March and early April. Its breeding season is from mid-April to late July. Breeding colonies will return to the same area year after year if the site continues to provide adequate nesting sites, water, and suitable foraging habitat (Dehaven et al. 1975).

Reasons for Decline. Decline of tricolored blackbird populations can be attributed to predation by numerous mammalian and avian species, habitat loss and alteration, poisoning to regulate the number of blackbirds preying on crops (Neff 1942), contaminants and pollution, and human disturbance (Beedy and Hamilton 1997). Habitat loss has occurred due to drainage of wetlands and conversion of former nest and roost sites to agriculture. The tricolored blackbird habitat is also possibly threatened by the growth of nonnative vegetation (Nature Serve Explorer 2001).

Designated Critical Habitat. None.

Conservation Efforts. Measures under the CALFED Bay-Delta Program are designed to restore and enhance suitable habitat for this species (CALFED 2000).

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared, and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. Future research efforts could focus on developing an effective non-lethal control method for when the blackbird becomes a pest on agricultural fields (Nature Serve Explorer 2001). The current abundance of the blackbird in California is not well known and requires study.

Tricolored Blackbird Citations

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3.3.10 White-Faced Ibis (*Plegadis chihi*)

Legal Status. The white-faced ibis is designated as a species of special concern by the California Department of Fish and Game (CDFG 2003) and is listed as a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003).

Historical and Current Distribution and Status. In California the white-faced ibis was once common, but, even by the 1940s, the white-faced ibis' population was declining (Grinnell and Miller 1944). By the 1970s, there were virtually no breeding white-faced ibises in California (Remsen 1978). In the 1980s, after decades of decline, the population of this species began to rebound. Since 1980, rookery sites have been recorded in Colusa, Yolo, Fresno, Kings, Siskiyou, and Modoc Counties (Natural Diversity Database 1998).

Outside of California the white-faced ibis is known to breed in eastern Oregon, southern Idaho (Taylor et al. 1989), Montana, southern North Dakota, and (formerly) southwestern Minnesota south into Mexico (to Colima, Zacatecas, State of Mexico,

Veracruz), Texas, and southwestern Louisiana, southern Alabama, Florida (occasionally or formerly); also locally in South America in Bolivia, Paraguay, Uruguay, southern Brazil, northern and central Chile, and northern and central Argentina (AOU 1983). The world's largest nesting aggregation occurs probably in the marshes around the Great Salt Lake, Utah (D. Paul, in Paton et al. 1992). In non-breeding times the white-faced ibis can be found commonly from northern to southern California, Baja California, southern Texas, and Louisiana, south through lowlands to Guatemala and El Salvador, and more generally across its breeding range in South America (AOU 1983). In the United States, the highest winter densities occur near San Diego in California and on the coast of Texas and western Louisiana (Root 1988). It sometimes wanders outside its usual range and is a rare straggler to Hawaii.

Distribution in the CALFED Solution Area and EWA Action Area. The white-faced ibis nests and winters in the Yolo Basin, Colusa Basin, and West San Joaquin Basin Ecological Zones. It also winters in the Butte Basin, Feather River/Sutter Basin, American River Basin, Sacramento-San Joaquin Delta, and Suisun Marsh/North San Francisco Bay Ecological Zones (Figure 3-12).

Life History and Habitat Requirements. The white-faced ibis requires freshwater marshes and other wetlands for nesting sites and for wintering foraging grounds. The ibis forages in shallow waters, including seasonal wetlands and rice fields, or on muddy banks where it probes for invertebrates, small fish, and amphibians (Zeiner et al. 1990).

The species nests from May to July in dense freshwater marsh vegetation near foraging areas (Zeiner et al. 1990). Nests are built among tall marsh plants out of dead tules or cattails. It may also nest in very low trees (Cogswell 1977). Although white-faced ibises were formerly more common, especially in the San Joaquin Valley, some sources claim they no longer breed regularly anywhere in California (CDFG 2002). However, others believe that breeding populations can be found, and are increasing in number, in isolated areas of the Central Valley (CDFG). Clutch size usually is 3-4. Incubation lasts 21-22 days (NatureServe Explorer 2001).

The white-faced ibis is an uncommon summer resident in sections of southern California, a rare visitor in the Central Valley, and is more widespread in migration (CDFG 2002). In California, the white-faced ibis winters mainly in San Joaquin Valley and Imperial Valley, but is widely recorded as a transient. The population at Salton Sea is reduced sharply from October to March, suggesting a southward migration. It is resident in the southern part of its breeding range, and migrates in northern areas. Northern populations winter from the southern U.S. south to northern Central America (NatureServe Explorer 2001).

Reasons of Decline. The loss of freshwater marshes and other wetlands is the main reason for this species' decline. White-faced ibises are vulnerable to fluctuating water levels, which further limits the number of breeding locations (NatureServe Explorer 2001). Pesticide contamination, especially by DDT, resulted in nest failures and

caused population declines in areas where suitable habitat was available (Remsen 1978).

Designated Habitat. None.

Conservation Efforts. Conservation efforts have not been identified for this species. CDFG (2000) provides management recommendations for restoring white-faced ibis breeding habitat.

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared, and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. Habitat loss and degradation are major factors in the decline of the white-faced ibis in California. Other factors are probably involved but have not been identified (CDFG 2000).

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3.4 Species Accounts for Reptiles

3.4.1 Giant Garter Snake *(Thamnophis gigas)*

Legal Status. The giant garter snake is listed as threatened under the California and Federal Endangered Species Acts (CALFED 2000).

Historical and Current Distribution and Status. Historically, the giant garter snake was found throughout the Central Valley, from Butte County south to Kern County (CALFED 2000). However, the giant garter snake was probably absent from the northern portion of the San Joaquin Valley because the floodplain of the San Joaquin River is confined to a narrow area. Because extensive marshes are known to have once occurred in the Delta, it is possible that giant garter snakes historically occupied this area (Hansen 1986, 1988).

Today, populations of the giant garter snake are found in the Sacramento Valley and isolated portions of the San Joaquin Valley, making up 13 recognized populations representing a cluster of discrete locality records (USFWS 1993, 1999). The 13 extant populations largely coincide with historical riverine flood basins and tributary streams throughout the Central Valley (G. Hansen 1980, Brode and Hansen 1992): 1) Butte Basin, 2) Colusa Basin, 3) Sutter Basin, 4) American Basin, 5) Yolo Basin/Willow Slough, 6) Yolo Basin/Liberty Farms, 7) Sacramento Basin, 8) Badger Creek/Willow Creek, 9) Caldoni Marsh, 10) East Stockton – Diverting Canal and Duck Creek, 11) North and South Grasslands, 12) Mendota, and 13) Burrel/Lanare. Agricultural and flood control activities have extirpated the giant garter snake from the southern 1/3 of its range in the former wetlands associated with the historic Buena Vista, Tulare, and Kern lakebeds (Hansen and Brode 1980, R. Hansen 1980, CDFG 1992, G. Hansen 1986, G. Hansen 1988).

Populations in the Colusa, Butte, Sutter, and American River Basins are associated with rice production and occupy the agricultural water delivery and drainage ditches (58 FR 54053, October 20, 1993). Since April of 1995, the Biological Resources Division (BRD) of U.S. Geological Survey has further documented occurrences of giant garter snakes at the Sacramento and Colusa National Wildlife Refuges within the Colusa Basin, at Gilsizer Slough within the Sutter Basin, at the Badger Creek area of the Consumnes River Preserve within the Badger Creek-Willow Creek area, and in the Natomas Basin within the American Basin (Wylie 1999, Wylie and Cassaza 2000, Wylie et. al. 2000). These populations of giant garter snakes represent the largest extant populations.

Distribution in the CALFED Solution Area and EWA Action Area. The giant garter snake is present in the Ecological Zones of the Butte, Feather River/Sutter, Colusa,

Yolo, and American River Basins; the Eastside Delta Tributaries, Sacramento-San Joaquin Delta; East San Joaquin Basin; and West San Joaquin Basin (CALFED 2000) (Figure 3-13).

Life History and Habitat Requirements. The giant garter snake is endemic to emergent wetlands in the Central Valley (CALFED 2000). The species' habitat includes marshes; sloughs; ponds; small lakes; and low-gradient waterways, such as small streams, irrigation and drainage canals, and rice fields (58 FR 54053, October 20, 1993).

Rice Fields: Ricelands, associated waterways, and adjacent uplands provide the most important agricultural habitat for the giant garter snake, particularly in the Sacramento Valley portion of their range (USFWS 1999). Gravid female garter snakes have been observed to utilize maturing rice fields and to remain in the rice fields to feed after parturition; neonate garter snakes have also been observed feeding in rice fields (Hansen pers. comm.). In current studies being conducted by the U.S.G.S. Biological Resources Division (BRD), 50 percent of radio-telemetered giant garter snakes have been observed in rice fields, especially along the edges of the fields and when the rice plants are high enough to provide sufficient cover (Glenn Wylie, pers. comm.). Giant garter snakes seasonal activity associated with rice cultivation typically occurs as follows:

Spring: Rice is planted and the fields are flooded with several inches of water. Prey species (e.g., small fish and frogs) migrate into rice fields from ditches and drains that retain water year round and where they over winter, eventually attracting giant garter snakes into the fields.

Summer: Once the rice plants are high enough to provide cover, giant garter snakes use the rice fields to feed and bear their young (see above). They will use the fields so long as there is sufficient water and quantities of prey.

Late Summer/Fall: The water is drained from the rice fields and garter snakes move off the fields to other adjacent habitats. The rice is harvested. At this time female garter snakes have just borne young and need food to regain their body weight. Prey species that were in the rice fields now concentrate in the ditches and drains where the snakes can find a ready food source.

Winter: Giant garter snakes enter a dormant period inside winter retreats (e.g., small mammal burrow). During the winter rice fields are often flooded or burned for rice straw decomposition.

Irrigation Canals/Drainage Ditches: Giant garter snakes adapt well to manmade waterways as represented by conveyance systems. In fact, irrigation canals and drainage ditches, together with their associated levees and adjacent embankments, are probably an essential component of giant garter snake habitat in the EWA Action Area. Irrigation canals provide an essential habitat component, but also create dispersal corridors allowing garter snakes to move from one area to another in search

of mates, new territories, summer habitat, etc. Irrigation ditches and canals constituted 50 percent of all habitat use by giant garter snakes.

The giant garter snake requires adequate water with herbaceous, emergent vegetation for protective cover and foraging habitat (Hansen and Brode 1980). Generally quite aquatic, these garter snakes forage primarily in and along streams taking fish and amphibians and amphibian larvae Fitch 1941). Most current food may be introduced species such as carp, mosquitofish, and bullfrogs, because the native prey such as blackfish, thick-tailed chub, and red-legged frog, is no longer available (Rossman et al. 1996) (WHRS 1988-90).

Open areas and grassy banks are needed for basking. Small mammal burrows and other small crevices at higher elevations provide winter hibernation sites and refuge from floodwaters (58 FR 54053, October 20, 1993). The nature of the home range of garter snakes in California is not well known. There is likely considerable overlap in the home ranges of neighboring individuals. The garter snake is not thought to be territorial. Although this species is not well studied, other garter snakes have not been observed exhibiting behaviors suggesting territoriality (CWHR 1988-1990).

All three habitat components (cover and foraging habitat, basking areas, and protected hibernation sites) are needed. Because of their lack of basking areas and the lack of prey populations, riparian woodlands usually do not support the giant garter snake (Hansen and Brode 1980). Additionally, larger rivers generally do not support the snake because they are highly managed and channelized and do not provide suitable habitat such as emergent vegetation, slow moving waters, and adequate basking sites.

Reasons for Decline. Habitat loss to agricultural development has been the primary factor in the decline of giant garter snake populations. Small remaining populations are susceptible to predation by fish, mammals, and birds. Additional causes of mortality include vehicular traffic, agricultural practices, and maintenance of water channels.

Perhaps California's most aquatic garter snake, populations have been eliminated or decimated by the elimination of natural sloughs and marshy areas. Heavy use of pesticides is suspected as a contributing factor in the decline of this once-abundant garter snake of the Central Valley. Protection of waterfowl habitat may allow it to survive in a small portion of its original range (CWHR 1988-1990).

USFWS (1993) listed threats as habitat loss (e.g., through large-scale urbanization in the American River Basin, dewatering of habitat through water diversions, and impoundments), flooding (in rice production areas), contaminants (e.g., selenium and salinity in North and South Grassland areas), agricultural and vegetation maintenance activities (e.g., on levees and canal borders), vehicular traffic (on levees and roads along canals), livestock grazing, and introduced predators (e.g., house cats, bullfrogs, perhaps bass). See USFWS (1993) for information on threats to specific populations (NatureServe 2001).

Designated Critical Habitat. None.

Conservation Efforts. Measures under the CALFED Bay-Delta Program are designed to restore and enhance suitable habitat for this species (CALFED 2000).

Recovery Plan and Recovery Guidance. The USFWS developed a Draft Recovery Plan for the Giant Garter Snake (Federal Register 64:36033; July 2, 1999). The overall objective of this recovery plan is to delist the giant garter snake. Interim goals are twofold, to stabilize and protect existing populations and to conduct research necessary to further refine recovery criteria. The plan has five main recovery objectives that will advance efforts towards the attainment of this goal. They include 1) habitat protection; 2) public participation, outreach, and education; 3) habitat management and restoration; 4) surveying and monitoring; and 5) research.

Research or Monitoring Gaps. Research throughout the Central Valley on distribution and the biological requirements of the giant garter snake needs to continue, including the relationship between giant garter snakes and rice. Research should also be conducted on demographics, population genetics, and habitat use.

Giant Garter Snake Citations

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3.4.2 Western Pond Turtle (*Clemmys marmorata)*

Legal Status. The western pond turtle is designated as a California species of special concern by the California Department of Fish and Game (CDFG 2003) and is listed as a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003). It is identified by CALFED as a species of concern.

Historic and Current Distribution and Status. The western pond turtle is the only abundant turtle native to California (Zeiner et al. 1988). It was historically found in most Pacific slope drainages between the Oregon and Mexican borders (Jennings and Hayes 1994). The species is still found in most suitable habitats west of the Sierra-Cascade crest in California, but trends show populations to be declining (Jennings and Hayes 1994). The species is absent from desert regions except in the Mojave Desert along the Mojave River and its tributaries. The western pond turtle in found at elevations ranging from sea level to 1,830 m (6,000 ft) (California Wildlife Habitat Relationship (CWHR) System 1988-90).

Distribution in the CALFED Solution Area and EWA Action Area. The western pond turtle occurs in all Ecosystem Restoration Program ecological zones (Figure 3-14).

Life History and Habitat Requirements. The western pond turtle is generally associated with permanent or nearly permanent water in a variety of habitat types. Individuals normally associate with permanent ponds, lakes, streams, irrigation ditches, or permanent pools along intermittent streams. Hatchlings may be subject to rapid death by desiccation if exposed to hot, dry conditions (CWHR System 1988-90). The western pond turtle inhabits waters with little or no current (Behler and King 1998). The banks of inhabited waters usually have thick vegetation, but basking sites such as logs, rocks, or open banks must also be present (Zeiner et al. 1988). Turtles slip from basking sites to underwater retreats at the approach of humans or potential predators. Hibernation in colder areas is passed underwater in bottom mud (CWHR System 1988-90).

Pond turtles lay their eggs in nests in upland areas, including grasslands, woodlands, and savannas. The nest sites are typically found on a slope that is unshaded and has a high clay or silt composition (Jennings and Hayes 1994). Storer (1930) suggested that two distinct habitats may be used for oviposition. Along large slow-moving streams, eggs are deposited in nests constructed in sandy banks. Along foothill streams, females may climb hillsides, sometimes moving considerable distances to find a suitable nest site. Nussbaum et al. (1983) reports a nest in a clover field 100 m (325 ft) from water. Nests have been observed in many soil types from sandy to very hard (CWHR System 1988-90). Turtles lay their eggs from March to August, depending on local conditions, and incubation lasts from 73-80 days (Zeiner et al. 1988). Western pond turtles are omnivorous and feed on aquatic plant material, aquatic invertebrates, fishes, frogs, and even carrion (Zeiner et al. 1988).

During the spring or early summer, females move overland for up to 100 m (325 ft) to find suitable sites for egg-laying. Other long distance movements may be in response

to drying of local bodies of water or other factors. The home range of the turtle is normally quite restricted (Bury 1970, 1972) except for occasional long distance movements as described above (CWHR System 1988-90).

The western pond turtle is not known to be territorial, but aggressive encounters including gesturing and physical combat (Bury and Wolfheim 1973) are common and may function to maintain spacing on basking sites and to settle disputes over preferred spots (CWHR System 1988-90).

This is the only abundant native turtle in California. Hatchlings and juveniles are preyed upon by a variety of vertebrate predators including certain fishes, bullfrogs, garter snakes, wading birds, and some mammals. Competitive interactions with other species have not been reported (CWHR System 1988-90).

Reasons for Decline. Studies showing a bias toward adults indicate that little or no recruitment is taking place. Many nesting sites are being affected during the incubation period by agricultural or livestock activities, leading to annual nesting failures (Jennings and Hayes 1994). The loss and alteration of wetlands, streams, and ponds have contributed to the species' decline.

Introductions of nonnative predators (bullfrogs and bass) probably have been detrimental. Decline is due also to alteration, loss, and fragmentation of habitat; many populations have been lost as a result of urbanization and agricultural development in the area south of central California (R. B. Bury and D. Holland, Rathbun et al. 1992, NatureServe 2001). Disease and mortality from fishing is also implicated in the decline of this species (CDFG 2000).

Designated Critical Habitat. None.

Conservation Efforts. Conservation efforts have not been identified for this species. CDFG (2000) presents important issues to consider in the protection of this species.

Recovery Plan and Recovery Guidance. A recovery plan for this species in California has not been prepared, and requirements have not yet been identified for this species. The Washington State Department of Fish and Wildlife has prepared a recovery plan for this species (Hays 1999).

Research and Monitoring Gaps. While there may be a couple hundred extant occurrences of the pond turtle in California, the viability of these populations is not known, and better information on the demography of this species is needed. (NatureServe Explorer 2001). Studying metapopulation dynamics, movement responses, and recolonizing ability would help elucidate the status and ecology of this species in California (CDFG 2000). The role of introduced predators in the decline of this species requires further study. Recovery efforts would be enhanced by developing better monitoring and management methods (NatureServe Explorer 2001).

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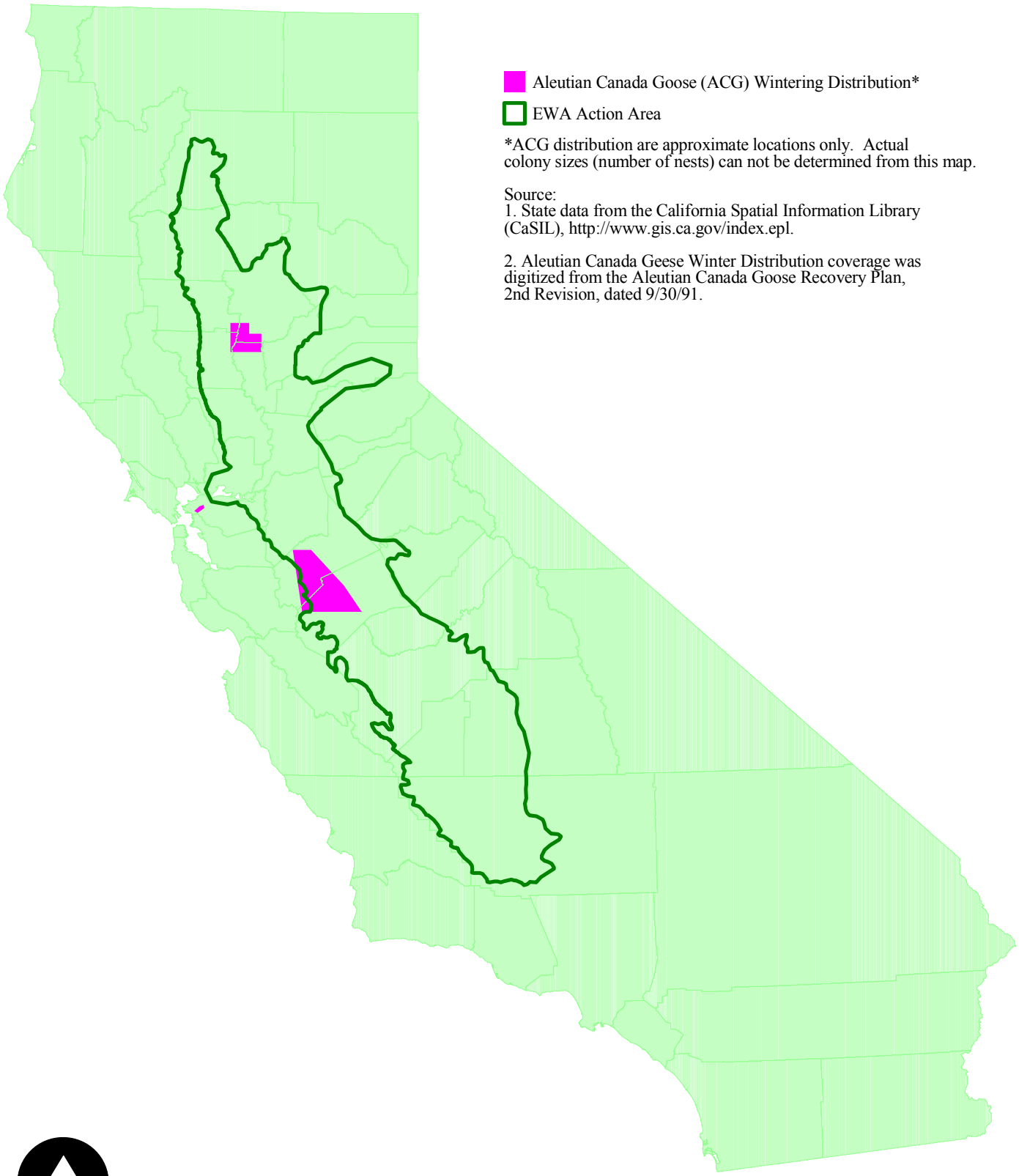
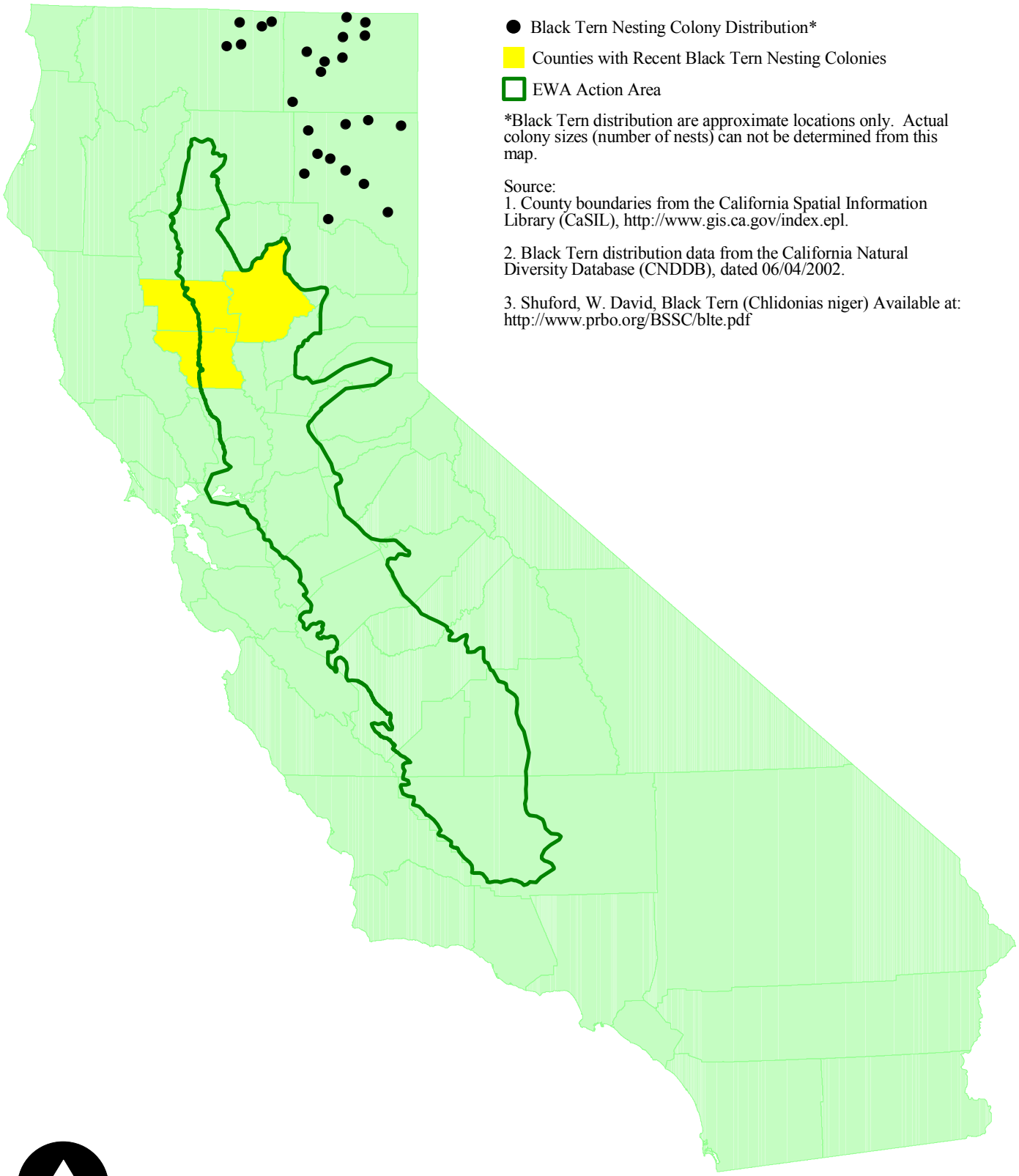
Distribution of Aleutian Canada Geese Winter



No Scale

Figure 3-1
Distribution of Aleutian Canada Geese Winter

Northern California Distribution of Black Tern Nesting Colonies



*Black Tern distribution are approximate locations only. Actual colony sizes (number of nests) can not be determined from this map.

Source:
1. County boundaries from the California Spatial Information Library (CaSIL), http://www.gis.ca.gov/index.epl.

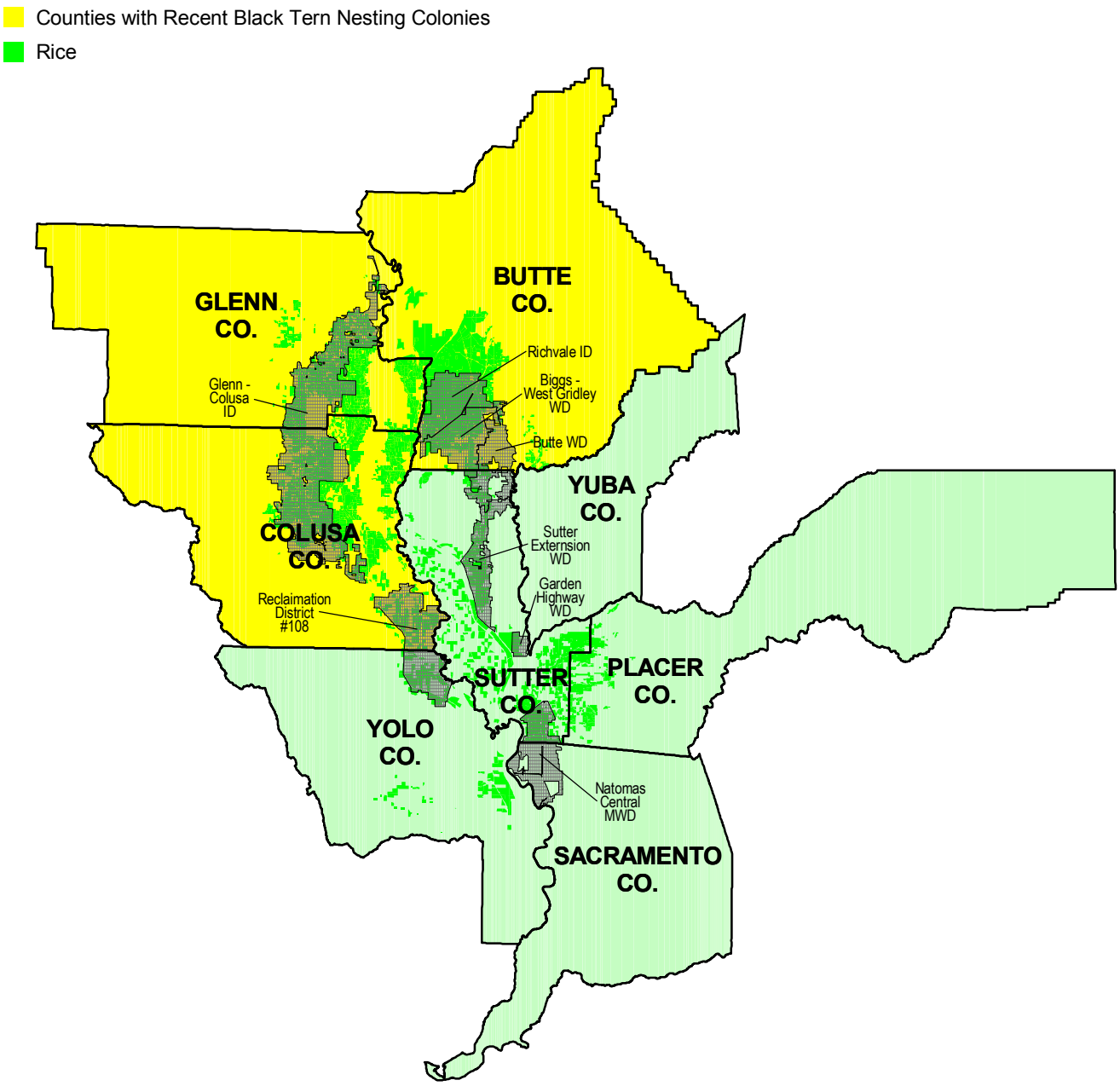
2. Black Tern distribution data from the California Natural Diversity Database (CNDDB), dated 06/04/2002.

3. Shuford, W. David, Black Tern (Chlidonias niger) Available at: http://www.prbo.org/BSSC/blte.pdf

No Scale

Figure 3-2
Distribution of Black Tern

Distribution of Black Tern Nesting Colonies in Potential Rice Idling Areas



No Scale

Figure 3-3
Distribution of Black Tern

Distribution of Black-crowned Night Heron Rookery

Figure 3-4
Distribution of Black-crowned Night Heron Rookery

Distribution of Great Blue Heron Rookery

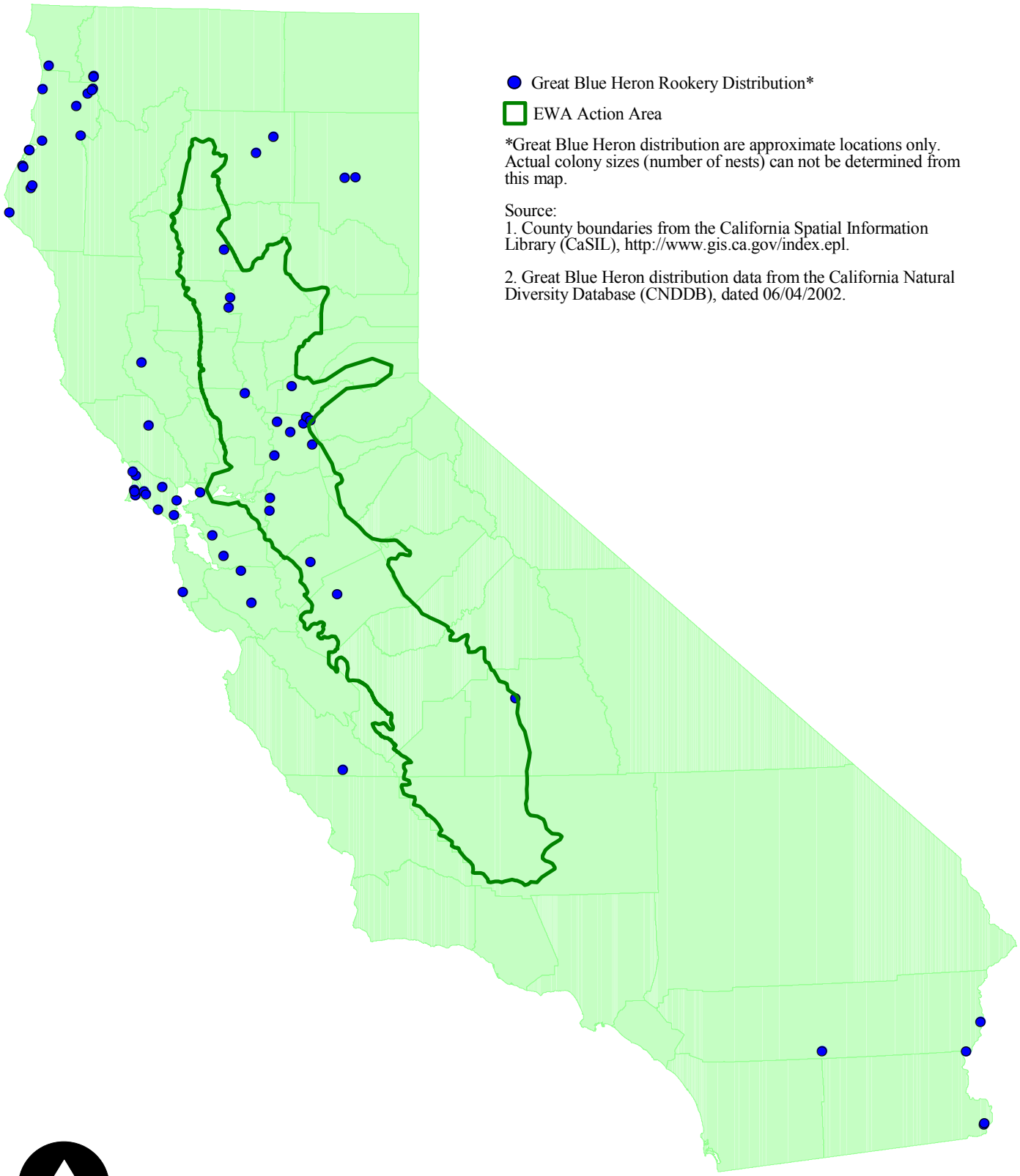


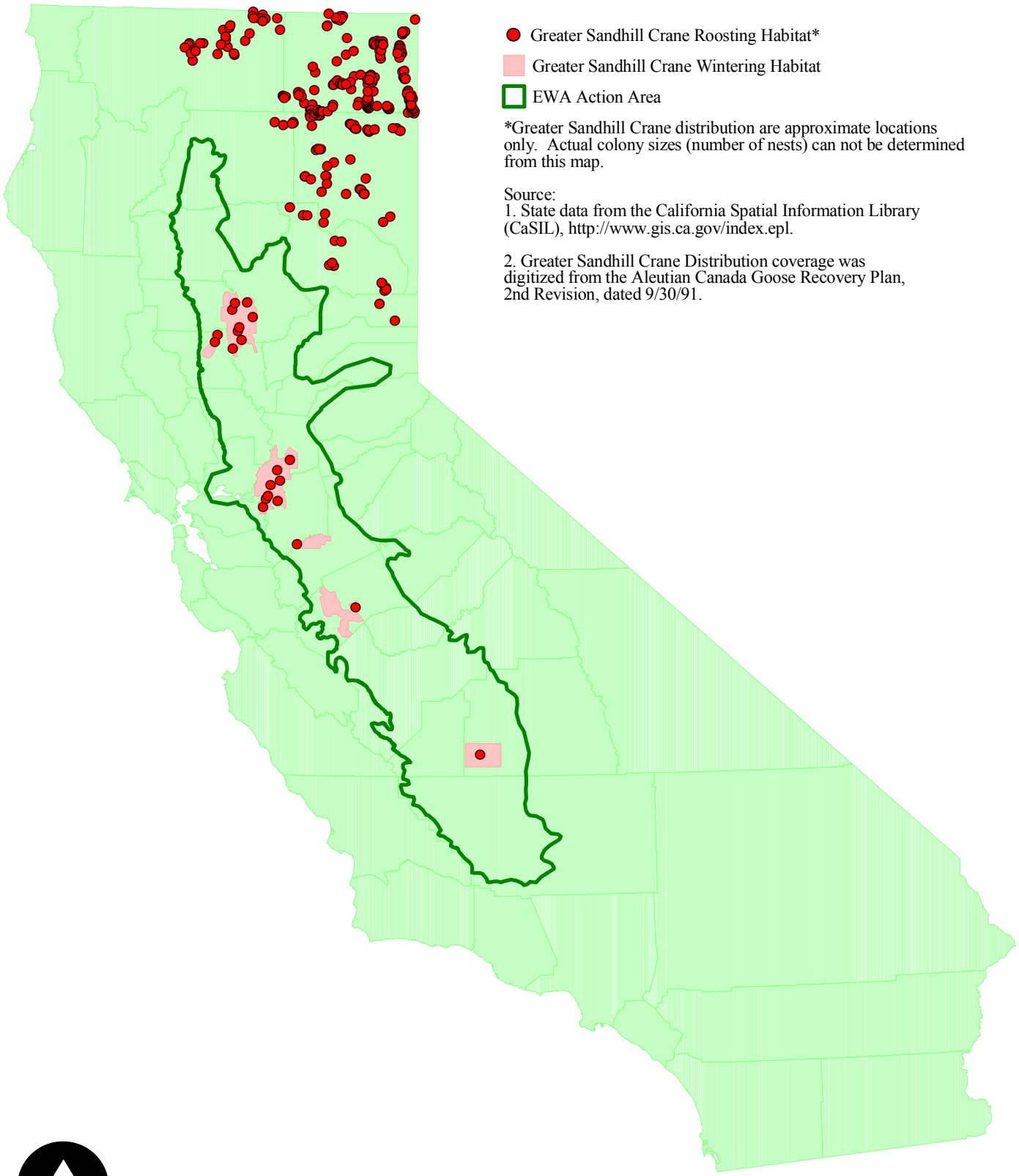
Figure 3-5
Distribution of Great Blue Heron Rookery

Distribution of Great Egret Rookery

No Scale

Figure 3-6
Distribution of Great Egret Rookery

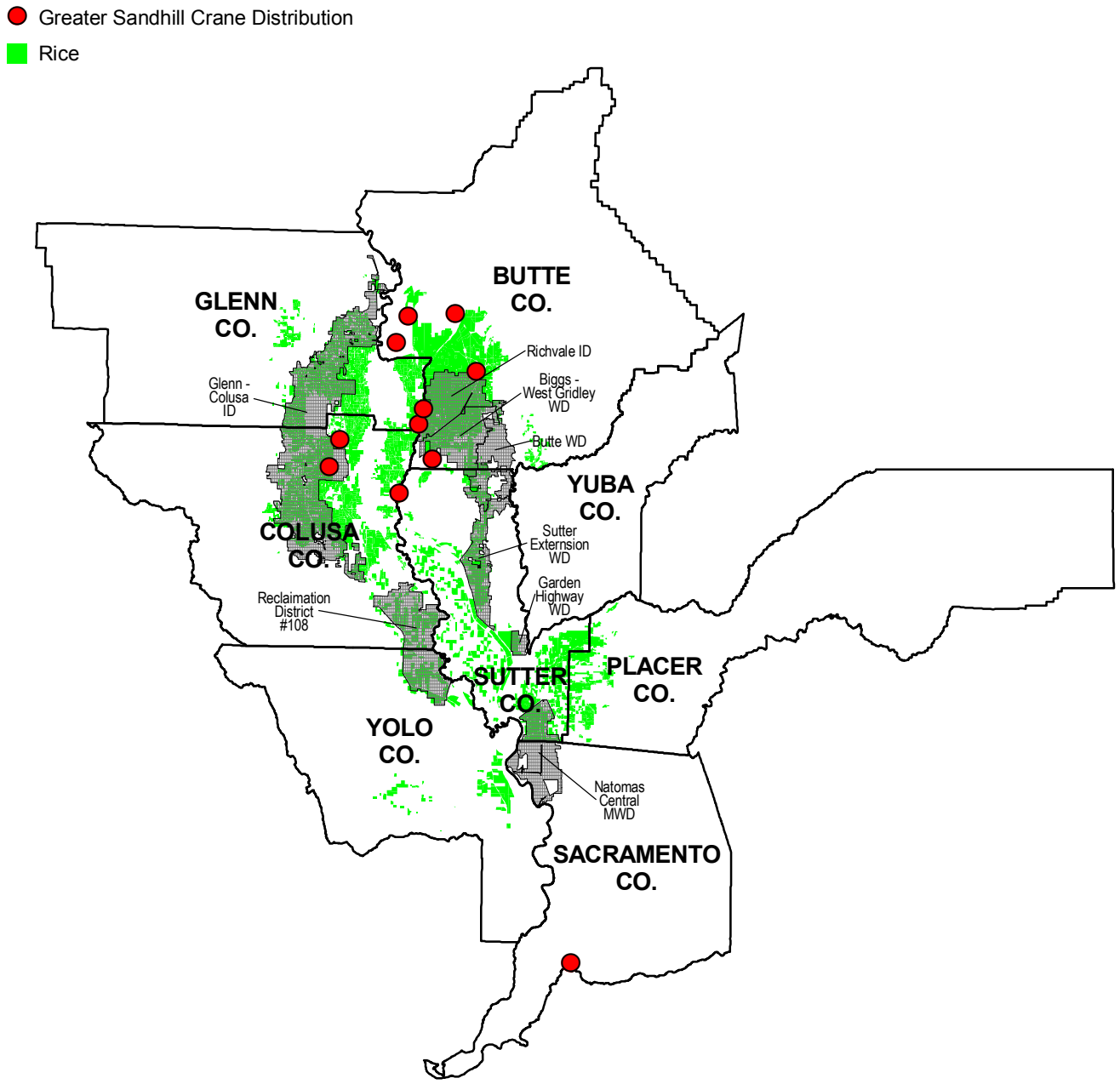
Distribution of Greater Sandhill Crane



No Scale

Figure 3-7
Distribution of Greater Sandhill Crane

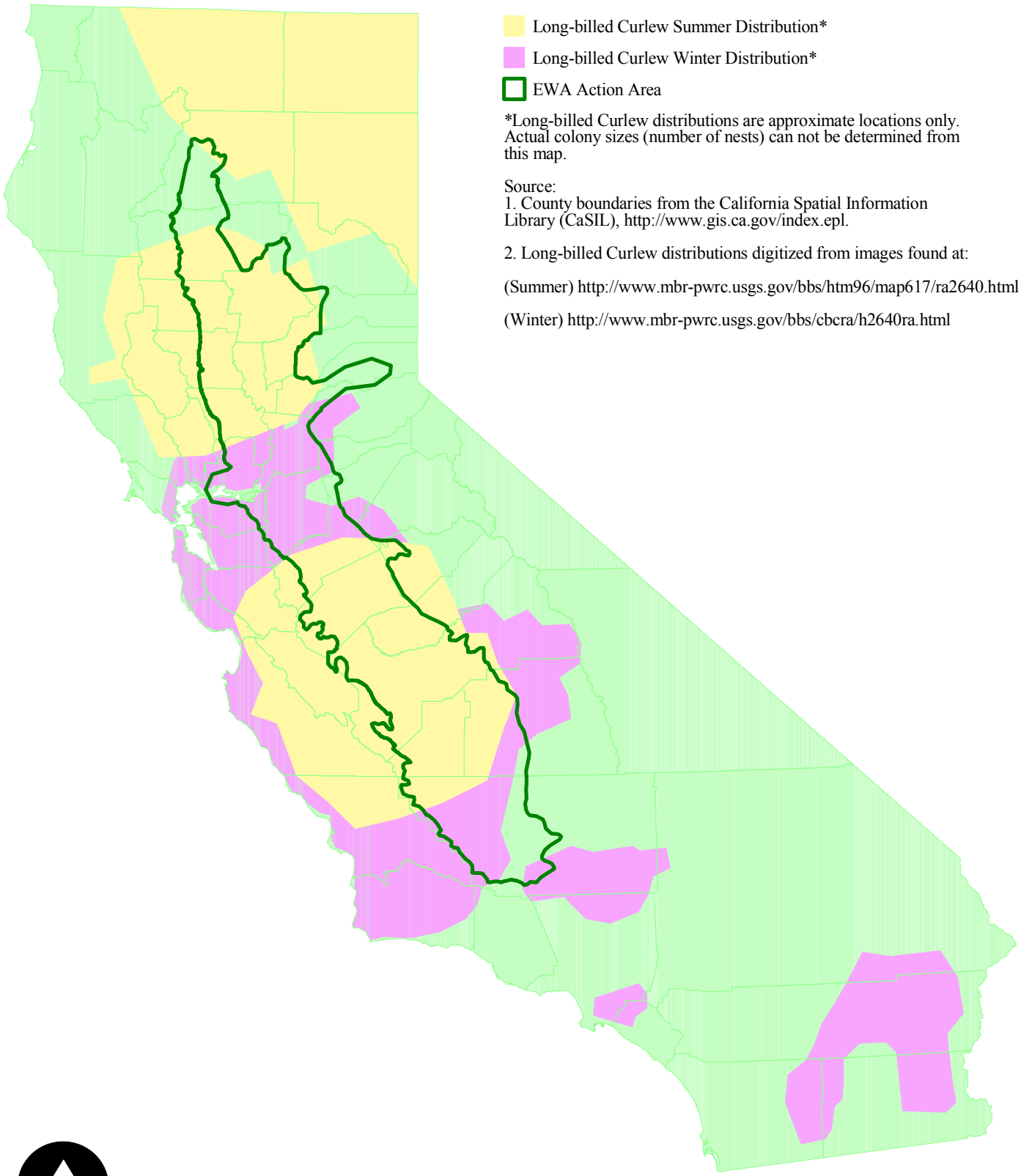
Distribution of Greater Sandhill Crane Colonies in Potential Rice Idling Areas



No Scale

Figure 3-8
Distribution of Greater Sandhill Crane

Distribution of Long-billed Curlew



No Scale

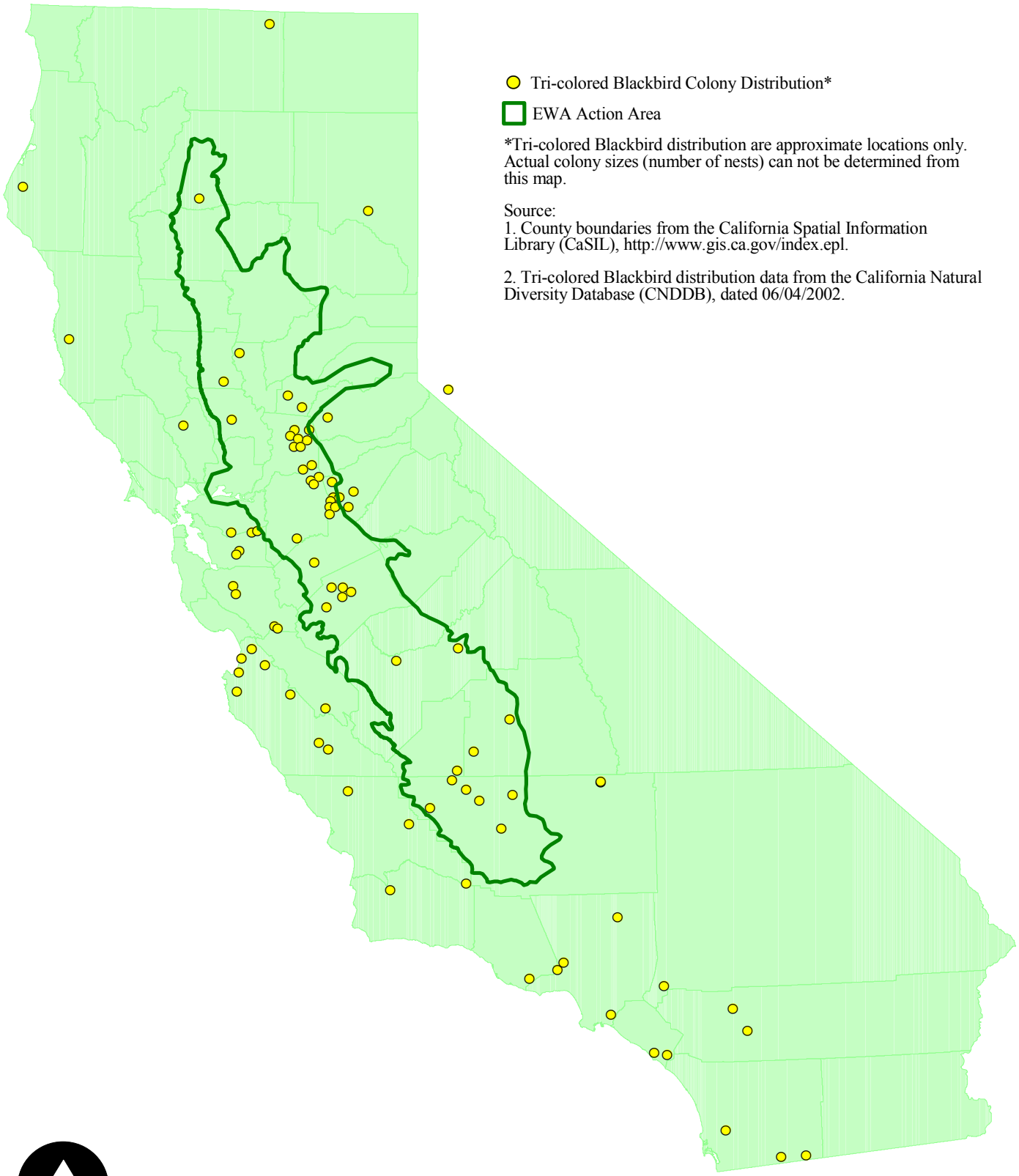
Figure 3-9
Distribution of Long-billed Curlew

Distribution of Snowy Egret

No Scale

Figure 3-10
Distribution of Snowy Egret

Distribution of Tri-colored Blackbird Nesting Colonies



No Scale

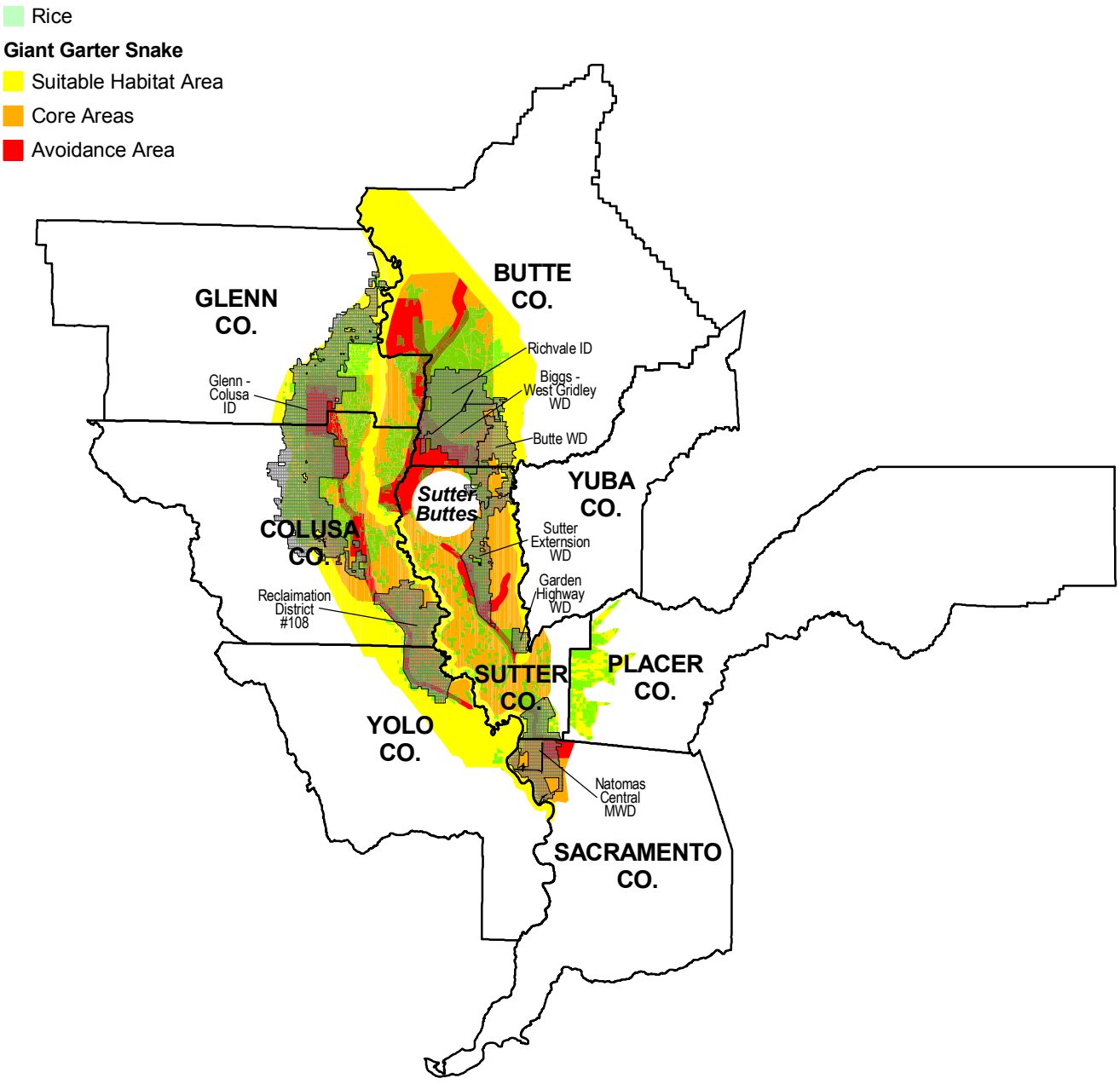
Figure 3-11
Distribution of Tri-colored Blackbird Nesting Colonies

Distribution of White-faced Ibis Nesting

No Scale

Figure 3-12
Distribution of White-faced Ibis Nesting

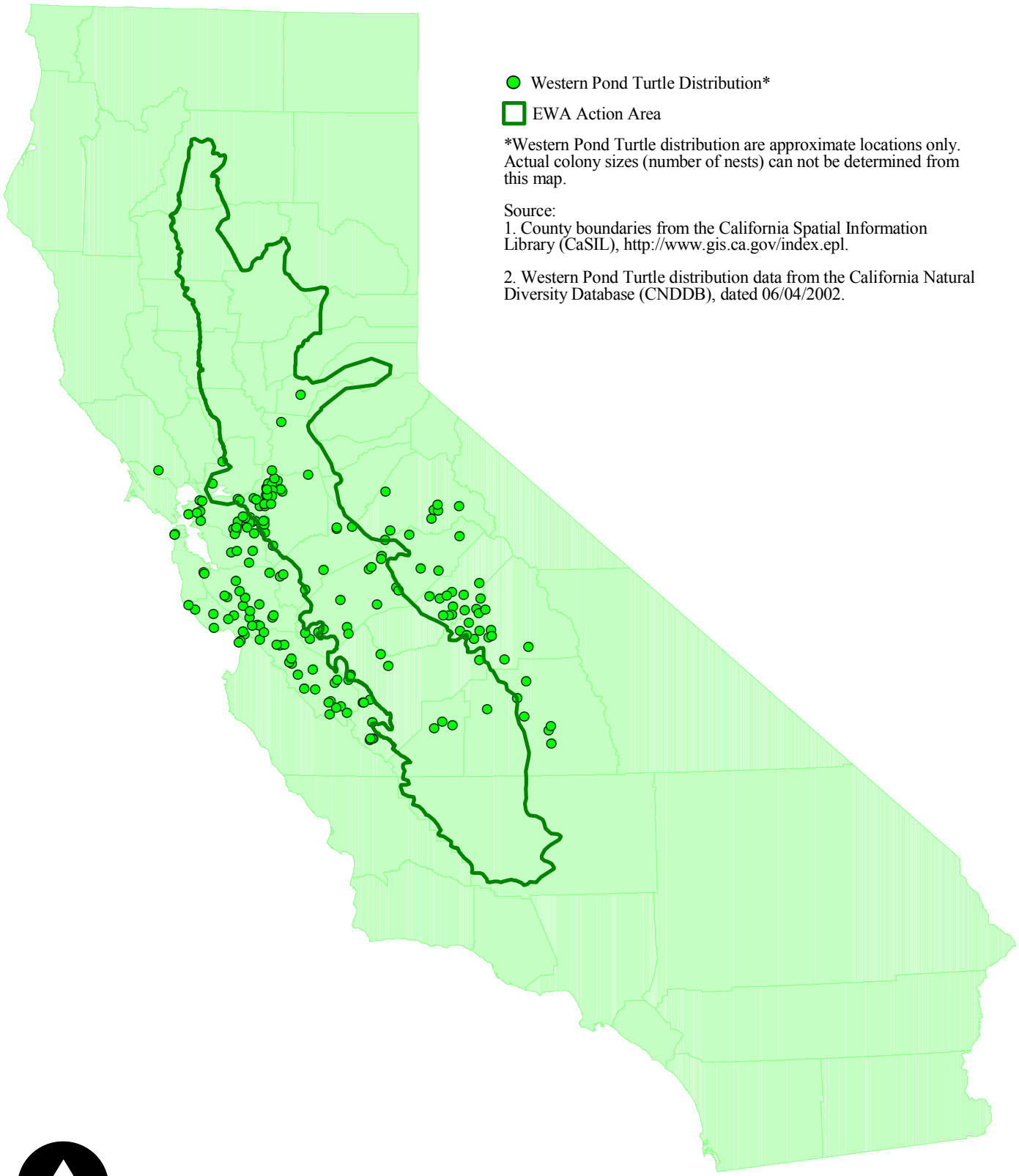
Distribution of Giant Garter Snake



No Scale

Figure 3-13
Distribution of Giant Garter Snake

Distribution of Western Pond Turtle



No Scale

Figure 3-14
Distribution of Western Pond Turtle