APPENDIX D2

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DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

RIN 1018-AC26

Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Sacramento Splittail

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Final rule.

SUMMARY: We, the U.S. Fish and Wildlife Service (Service), determine threatened status for the Sacramento splittail (Pogonichthys macrolepidotus) pursuant to the Endangered Species Act of 1973, as amended (Act). Sacramento splittail occur in Suisun Bay and the San Francisco Bay-Sacramento-San Joaquin River Estuary (Estuary) in California. The Sacramento splittail has declined by 62 percent over the last 15 years. This species is primarily threatened by changes in water flows and water quality resulting from the export of water from the Sacramento and San Joaquin rivers, periodic prolonged drought, loss of shallow-water habitat, introduced aquatic species, and agricultural and industrial pollutants. Designation of critical habitat is not prudent at this time. This rule implements the protection and recovery provisions afforded by the Act for Sacramento splittail.

EFFECTIVE DATE: March 10, 1999.

ADDRESSES: The complete file for this rule is available for public inspection, by appointment, during normal business hours at the Sacramento Fish and Wildlife Office, U.S. Fish and Wildlife Service, 3310 El Camino Avenue, Suite 130, Sacramento, CA 95821-6340.

FOR FURTHER INFORMATION CONTACT: Michael Thabault, Deputy Assistant Field Supervisor, U.S. Fish and Wildlife Service (see ADDRESSES section) (telephone 916-979-2710).

SUPPLEMENTARY INFORMATION:

Background

As used in this rule, the term ``Delta" refers to all tidal waters contained within the legal definition of the San Francisco Bay-Sacramento-San Joaquin River Delta, as delineated by section 12220 of the State of California's Water Code. Generally, the Delta is contained within a triangular area that extends south from the City of Sacramento to the confluence of the Stanislaus and San Joaquin rivers at the southeast corner and Chipps Island in Suisun Bay. The term ``Estuary," as used in this rule, refers to tidal waters contained in the Sacramento and San Joaquin rivers, the Delta, and San Pablo and San Francisco bays. ``Export facilities," as used in this rule, refer to the Central Valley Project and State Water Project water export facilities in the South Delta.

Sacramento splittail were first described in 1854 by W.O. Ayres as Leuciscus macrolepidotus and by S.F. Baird and C. Girard as Pogonichthys inaeqilobus. Although Ayres' species description is accepted, the species was assigned to the genus Pogonichthys in recognition of the distinctive characteristics exhibited by the two California splittail species P. ciscoides and P. macrolepidotus (Hopkirk 1973). Pogonichthys ciscoides, endemic to Clear Lake, Lake County, California, has been extinct since the early 1970s. The Sacramento splittail (hereafter splittail) represents the only existing species in its genus in California.

The name splittail refers to the distinctive tail of the fish. Pogon-ichthys means bearded fish, referring to the small barbels (whisker-like sensory organs) on the mouth of the fish, unusual in North American cyprinids. Macro-lepidotus means large-scaled. The splittail is a large cyprinid fish that can exceed 40 centimeters (cm) (16 inches (in)) in length (Moyle 1976). Adults are characterized by an elongated body, distinct nuchal hump (on the back of the neck), and small, blunt head, usually with barbels at the corners of the slightly subterminal mouth. The enlarged dorsal lobe of the caudal fin distinguishes the splittail from other minnows in the Central Valley of California. Splittail are dull, silvery-gold on the sides and olive-gray dorsally. During spawning season, pectoral, pelvic, and caudal (tail) fins are tinged with an orange-red color. Males develop small vhite nuptial tubercles on the head. Breeding tubercles (nodules) also appear on the base of the fins (Moyle in prep).

Splittail are native to California's Central Valley, where they were once widely distributed (Moyle 1976). Historically, splittail were found as far north as Redding on the Sacramento River (at the Battle Creek Fish Hatchery in Shasta County), as far south as the present-day site of Friant Dam on the San Joaquin River, and up the tributaries of the Sacramento River as far as the current Oroville Dam site on the Feather River and Folsom Dam site on the American River (Rutter 1908). Recreational anglers in Sacramento reported catches of 50 or more splittail per day prior to the damming of these rivers (Caywood 1974). Splittail were captured in the past in southern San Francisco Bay and at the mouth of Coyote Creek in Santa Clara County, but they are no longer present there (Moyle in prep). The species was part of the Central Valley Native American diet (Caywood 1974).

In recent times, dams and diversions have increasingly prevented splittail from upstream access to the large rivers, and the species is now restricted to a small portion of its former range (Moyle and Yoshiyama 1992). However, during wet years, they migrate up the Sacramento River as far as the Red Bluff diversion dam in Tehama County, and into the lowermost reaches of the Feather and American rivers (Moyle in prep, Jones and Stokes 1993, Charles Hanson, State Water Contractors, in litt. 1993). Small numbers of splittail have recently been found in the upper Sacramento and San Joaquin rivers and their tributaries (Baxter 1995). Recent surveys of San Joaquin Valley streams found splittail in the San Joaquin River below its confluence with the Merced River, mainly following wet winters (Moyle in prep). Splittail have also been recorded using the Sutter and Yolo bypasses for spawning areas during wet winters (Sommer et al. 1997). Successful spawning has been recorded in the lower Tuolumne River during wet years in the 1980s, as well as in 1995. Both adults and juveniles were observed at Modesto, 11 kilometers (km) (6.6 miles (mi)) upriver from the mouth of the river (Moyle in prep). However, all of the sightings reported above were during wet years when splittail were able to exploit more spawning habitat. Except for very wet years, the species is for the most part now confined to the Delta, Suisun Bay, Suisun Marsh, and Napa Marsh. In the Delta, they are most abundant in the north and west portions when populations are low, but are more evenly distributed throughout the Delta following years of successful reproduction (Sommer et al. 1997).

Splittail are relatively long-lived, frequently reaching 5 to 7 years of age. An analysis of hard parts of the splittail indicate that larger fish may be 8 to 10

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years old (Moyle in prep). Females are highly fecund, with the largest females producing over 250,000 eggs (Daniels and Moyle 1983). Populations fluctuate annually depending on spawning success, which is highly correlated with freshwater outflow and the availability of shallow-water habitat with submerged vegetation (Daniels and Moyle 1983). Fish usually reach sexual maturity by the end of their second year. The onset of spawning is associated with rising water levels, increasing water temperatures, and increasing day length. Peak spawning occurs from the months of March through May, although records of spawning exist for late January to early July (Wang 1986). In some years, most spawning may take place within a limited period of time. For instance, in 1995, a year of extraordinarily successful spawning, most splittail spawned over a short period in April, even though larval splittail were captured from February through early July (Moyle in prep). Within each spawning season older fish reproduce first, followed by younger individuals (Caywood 1974). Spawning occurs over flooded vegetation in tidal freshwater and euryhaline habitats of estuarine marshes and sloughs and slow-moving reaches of large rivers. Larvae remain in shallow, weedy areas close to spawning sites for 10 to 14 days and move into deeper water as they mature and swimming ability increases (Wang 1986 and Sommer et al. 1997).

Splittail are benthic (bottom) foragers. In Suisun Marsh, they feed primarily on opossum shrimp (Neomysis mercedis, and presumably, the exotic Acanthomysis spp. as well), benthic amphipods (Corophium), and harpactacoid copepods, although detrital (non-living and detached organic) material makes up a large percentage of their stomach contents (Daniels and Moyle 1983). In the Delta, clams, crustaceans, insect larvae, and other invertebrates also are found in the diet. Predators include striped bass (Morone saxatilis) and other piscivores (Moyle 1976).

In recent years, splittail have been found most often in slow moving sections of rivers and sloughs and dead-end sloughs (Moyle et al. 1982, Daniels and Moyle 1983). Reports from the 1950s, however, mention Sacramento River spawning migrations and catches of splittail during fast tides in Suisun Bay (Caywood 1974). Because they require flooded vegetation for spawning and rearing, splittail are frequently found in areas subject to flooding. Historically, the major flood basins distributed throughout the Sacramento and San Joaquin valleys provided spawning and rearing habitat. These flood basins have all been reclaimed or modified for flood control purposes (e.g., Yolo and Sutter bypasses). Although primarily a freshwater species, splittail can tolerate salinities as high as 10 to 18 parts per thousand (ppt) (Moyle 1976, Moyle and Yoshiyama 1992). California Department of Fish and Game (CDFG) survey data from 1979 through 1994 indicate that the highest abundances occurred in shallow areas of Suisun and Grizzly bays.

Recent research indicates that splittail will use the Yolo and Sutter bypasses during the winter and spring months for foraging and spawning (Sommer et al. 1997). However, the Yolo Bypass may only be used by splittail during wet winters, when water from the Sacramento River over-tops the Fremont Weir and spills over the Sacramento Weir into the Bypass. In 1998, the Yolo and Sutter bypasses provided good habitat for fish, particularly splittail, when they were flooded for several weeks in March and April. In order to provide spawning habitat for splittail, water must remain on the bypasses until fish have completed spawning, and larvae are able to swim out on their own, during the draining process.

The decline in splittail abundance has taken place during a period of increased human-induced changes to the seasonal hydrology of the Delta, especially the increased exports of freshwater. These changes include alterations in the temporal, spatial, and relative ratios of water diverted from the system. These hydrological effects, coupled with severe drought years, introduced aquatic species, the loss of shallow-water habitat to reclamation activities, and other human-caused actions, have reduced the species' capacity to recover from natural seasonal fluctuations in hydrology for which it was adapted.

Analyses of survey data collected from 1967 to 1993 (Meng 1993, Meng and Moyle 1995) and data from 1967 to 1997 by Service, CDFG, and University of California at Davis biologists from several different studies indicate the following results--(1) Overall, splittail abundance indices have declined. Meng and Moyle (1995) demonstrated that on average, splittail have declined in abundance by 60 percent through 1993. The CDFG updated these data to include the most current data available and provided to the Service. The CDFG calculated the data using the updated information. The results were similar. These updated data demonstrate that on average, splittail have declined significantly in abundance by 50 percent since 1984. The greatest declines (over 80 percent) were found from studies that sampled the shallow Suisun Bay area, the center of the range of the species (Meng and Moyle 1995). The updated information also show a significant decline (43 percent) for the studies that sampled the shallow Suisun Bay area. A study that began in 1980 in the lower Estuary, at the outermost edge of splittail range, found the lowest percent decline (20 percent) (CDFG unpublished data) through 1993. The analysis completed on the updated data also showed the smallest decline for this study (6 percent). The number of splittail young taken at State and Federal pumping facilities (measured as number of individuals per acre-foot of water pumped), as of 1993, had declined 64 percent since 1984. With the updated data, the number of splittail young taken at State and Federal pumping facilities demonstrated a 97 percent increase. This percent increase is due to the unusually high salvage that occurred during

1995.

We estimate splittail populations to be 35 to 60 percent of what they were in the 1940s, and these estimates may be conservative (Moyle in prep). CDFG midwater trawl data indicate a decline from the mid-1960s to the late 1970s, followed by a resurgence, with yearly fluctuations, through the mid-1980s. From the mid-1980s through 1994, splittail numbers have declined in the Delta, with some small increases in various years. This decline is also demonstrated in the updated CDFG data.

(2) Overall splittail abundances vary widely among years. Sommer et al. 1997 also found that splittail recruitment success fluctuates widely from year to year and over long periods of time. During dry years abundance is typically low. During the dry years of 1980, 1984, 1987, and 1988 through 1992, splittail abundance indices for young-of-the-year were low, indicating poor spawning success. Additionally, all year class abundances were low during these years. In 1994, the fourth driest year on record, all splittail indices were extremely low.

We believe wet years provide essential habitat for splittail and allow populations to rebound from dry years. Successful reproduction in splittail is often highly correlated with wet years. Large pulses of young fish were observed in wet years 1982, 1983, 1986, and 1995. In 1995, one of the wettest years in recent history, an increase in all indices was recorded, as in 1986, which was another wet year following a dry year. However, young of the year taken per unit effort (for example, either the number of fish per net that is towed or

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the number of fish per volume of water sampled) has actually declined in wet years, steadily from a high of 12.3 in 1978 to 0.3 in 1993. The updated data from CDFG demonstrate this same decline in wet years, from 37.3 in 1978 to 0.6 in 1993. The abundance indices of splittail during the years of 1995, 1996, and 1997 were 44.5, 2.1, and 2.6, respectively. Year 1995 was a very wet year and splittail abundances were high. Years 1996 and 1997 were wet years, yet abundance indices were low. However, overall splittail declines remain high (82 percent/ 43 percent with updated data) in the shallow-water Suisun Bay area, the center of its distribution.

We believe high abundance indices in 1995 are an artifact of the highly unusual hydrological conditions that occurred. Therefore, we also calculated all of the percent declines, as stated above, without the 1995 abundance indices in the analysis. The overall decline is 67 percent. The decline from the studies in the shallow Suisun Bay area without 1995 is 80 percent. For the study in the lower Estuary, the decline is 39 percent. The salvage data collected at both the State and ederal pumping facilities demonstrate a 22 percent decline. Other than 1995, the salvage data include 1996 and 1997.

(3) A strong relationship exists between young-of-the-year abundance and outflow (i.e., river outflow into San Francisco Bay after water exports are removed). As outflow increases, annual abundance of young-of-the-year splittail increases. Changes in outflow explain 55 to 72 percent of the changes seen in young-of-the-year splittail abundance, depending on which survey data are analyzed.

(4) Splittail are most abundant in shallow areas of Suisun and Grizzly bays where they generally prefer low-salinity habitats. Salinities in Suisun and Grizzly bays increase when, as a result of water exports or drought conditions, the mixing zone (the freshwater-saltwater interface) shifts upstream.

(5) Concentration of splittail in shallow areas suggests that they are particularly vulnerable to reclamation activities, such as dredging, diking, and filling of wetlands.

The above data indicate that splittail abundances vary widely in response to environmental conditions, but the general population numbers are declining. The following are some reasons why the species is in decline. The splittail is primarily threatened by the altered hydraulics and reduced Delta outflow caused by the export of freshwater from the Sacramento and San Joaquin rivers through operation of the State and Federal water projects. These operations include not only the export of water from the Delta but also diversion of water to storage during periods of high run-off, which reduce instream flows and available submerged aquatic habitat for spawning and rearing. Additional threats to this species include--

(1) Direct and indirect mortality at power plants and in-Delta water diversion sites;

(2) Reduced river flows and changes in the seasonal patterns of flows in the Sacramento and San Joaquin rivers and their tributaries;

(3) The loss of spawning and nursery habitat as a consequence of draining and diking for agriculture;

(4) The loss of shallow-water habitat due to levee slope protection, marina construction, and other bank oriented construction activities;

(5) The reduction in the availability of highly productive brackish-water habitat;

(6) The presence of toxic substances, especially agricultural and industrial chemicals and heavy metals in their aquatic habitat;

(7) Human and natural disturbance of the food web through altered hydrology and introduction of exotic species;

(8) Flood control operations that strand eggs, larvae, juveniles, and adults;

(9) The increase in severity of these effects by six years of

drought; and

(10) Entrainment (pulling) of fish through unscreened or inadequately screened municipal and agricultural diversions.

Previous Federal Action

We included the Sacramento splittail as a category 2 candidate species for possible future listing as endangered or threatened in the January 6, 1989, Animal Notice of Review (54 FR 554). Category 2 candidates were defined as those species for which information in our possession indicated that proposing to list as endangered or threatened was possibly appropriate, but for which conclusive data on biological vulnerability and threats were not currently available to support proposed rules. We discontinued the use of multiple candidate categories on February 28, 1996 (61 FR 7596), and species meeting the definition of the former category 2 are no longer considered candidates.

On November 5, 1992, we received a petition from Mr. Gregory A. Thomas of the Natural Heritage Institute to add the Sacramento splittail to the List of Endangered and Threatened Wildlife and to designate critical habitat for this species in the Sacramento and San Joaquin rivers and associated estuary. Mr. Thomas identified eight organizations as co-petitioners, including the American Fisheries Society, the Bay Institute of San Francisco, the Natural Heritage Institute, the Planning and Conservation League, Save San Francisco Bay Association, Friends of the River, the San Francisco Baykeeper, and the Sierra Club. We published a 90-day finding on July 6, 1993 (58 FR 36184), that the petition presented substantial information indicating that the requested action may be warranted. We initiated a status review and analyzed available data on this species (Meng 1993).

On January 6, 1994, we published a proposed rule to list the splittail as a threatened species and requested public comment (59 FR 862). The proposed rule constituted a 12-month finding that the petitioned action was warranted, in accordance with section 4(b)(3)(B) of the Act.

On January 10, 1995, we published in the Federal Register (60 FR 2638) a notice of a 6-month extension to make a final listing determination and reopened a 45-day public comment period on the proposed rule to list the splittail. The basis for this extension was to address differences of scientific opinion concerning the status of splittail upstream of the Delta, especially the existence of a resident population upstream of the Delta. In April 1995, subsequent to the close of the extension period, a moratorium on the processing of all final listing proposals was established by Congress in Public Law 104-6. The moratorium was lifted on April 26, 1996. As mandated by the noratorium, we conducted no actions to finalize the proposed rule during the period April 1995 to April 1996.

As described in detail below, we reopened the comment period on May 18, 1998. We solicited the latest information regarding the abundance and distribution of the species. Additionally, we requested comments concerning the publication, ``Resilience of Splittail in the Sacramento-San Joaquin Estuary'' (Sommer et al. 1997).

The processing of this final rule follows our final listing priority guidance for fiscal years 1998 and 1999 published in the Federal Register on May 8, 1998 (63 FR 25502). The guidance clarifies the order in which we will process rulemakings giving highest priority (Tier 1) to processing emergency rules to add species to the Lists of Endangered and Threatened Wildlife and Plants; second priority (Tier 2) to processing final determinations on proposals to add

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species to the lists, processing new listing proposals, processing administrative findings on petitions (to add species to the lists, delist species, or reclassify listed species), and processing a limited number of proposed and final rules to delist or reclassify species; and third priority (Tier 3) to processing proposed and final rules designating critical habitat. Processing of this final rule is a Tier 2 action.

Summary of Comments and Recommendations

In the January 6, 1994, proposed rule (59 FR 862), we requested all interested parties to submit factual reports or information, that might contribute to the development of a final rule. We contacted State agencies, county governments, Federal agencies, scientific organizations, and other interested parties and requested comments. We held public hearings on the proposed splittail listing in conjunction with hearings on two other proposed Federal actions, the designation of critical habitat for delta smelt (Hypomesus transpacificus) (59 FR 852), and the United States Environmental Protection Agency's (USEPA's) water quality standards for the Estuary (59 FR 810). We published newspaper notices of the public hearings on February 4, 1994, in the Sacramento Bee, Fresno Bee, Los Angeles Times, and San Francisco Chronicle, all of which invited general public comment. We held public hearings on February 23, 1994, in Fresno; on February 24, 1994, in Sacramento; on February 25, 1994, in San Francisco; and on February 28, 1994, in Irvine. At each meeting, we took testimony from 1 p.m. to 4 p.m. and 6 p.m. to 8 p.m.

During the 3-month comment period from January 6 to March 7, 1994, we received comments (i.e., letters and oral testimony) from 133 individuals, organizations, or government agencies. Many of these comments were given at joint public hearings for the combined Federal rulemaking package for the Sacramento-San Joaquin Delta (including the proposal to list the Sacramento splittail, the proposal to designate critical habitat for the delta smelt, and final water quality standards for the Delta being proposed by the USEPA). Only 13 of the 133 commenters addressed the proposed rule to list the Sacramento splittail. Four of the 13 commenters that specifically addressed the proposed rule to list the Sacramento splittail provided oral testimony at the public hearings. Of the 13 commenters mentioned above, nine supported the listing of the splittail, two opposed the listing, and others provided comments considered as neutral. Five conservation organizations (or branches thereof), one sport fishing organization, two interested parties, and a Federal agency (the Bureau of Reclamation (BOR)) supported the proposed listing. The California Department of Water Resources (DWR) and the State Water Contractors opposed the proposed listing. We received no additional expert opinions from independent specialists concerning pertinent scientific or commercial data about the splittail.

On August 4, 1994, we received a letter dated August 3, 1994, from the State Water Contractors requesting a 6-month extension on the listing determination. The reasons provided in the request for extension were the same as those submitted during the public comment period, addressed below.

We granted a 6-month extension to address the status of splittail upstream of the Delta, and the importance of any such splittail to the population as a whole. Therefore, we reopened the public comment period for 45 days, beginning January 10, 1995, and ending February 24, 1995. During this second comment period we received one additional comment letter that opposed the listing of the splittail. The comment letter addressed this issue in part.

On March 19 and March 20, 1998, the DWR and the State Water Contractors, respectively, requested the comment period be reopened. The basis of this request was that substantial data had been collected since 1995 regarding the abundance and distribution of the splittail. We believe that consideration of this and any new information is significant to the final determination of the status of the Sacramento splittail. For this reason, we sought information concerning abundance and distribution data for this species from 1995-1997. Specifically, we sought comments regarding information presented in the publication, ``Resilience of Splittail in the Sacramento-San Joaquin Estuary'' (Sommer et al. 1997), and how the results affect our recommendation for listing the Sacramento splittail as a threatened species. The comment period was opened on May 18, 1998, and closed on July 17, 1998. We eceived comments from eight respondents, whose comments are summarized below.

The written comments and oral statements, questioning or opposing the listing of the splittail, or otherwise providing information, obtained during the public hearings and comment periods are combined into general issues that are summarized, discussed and responded to below. Most of the comments supporting the listing did not provide any additional information, so we have not prepared a discussion or response to these comments.

Issue 1: A respondent commented that our statement about splittail decline was based on data regarding splittail juveniles. The respondent argued that adult splittail are abundant and that our reliance on a limited portion of the year classes for a listing determination is inappropriate.

Service Response: We have reviewed the seven data sets used in the status review (Meng 1993). These data sets include--(1) a fall midwater trawl survey in the upper Estuary by CDFG; (2) a monthly midwater and otter trawl in the lower Estuary by CDFG (San Francisco Bay-Outflow Study, hereafter Bay Study); (3) a monthly otter trawl survey of Suisun Marsh (a tidal marsh next to Suisun Bay) by the University of California; (4) a midwater trawl survey that we conducted at Chipps Island in Suisun Bay; (5) a midwater trawl survey that we conducted in the Sacramento River; (6) a beach seine survey that we conducted in the Delta and Sacramento River; and (7) fish salvage data collected by CDFG and the BOR at the State and Federal pumping facilities located in the south Delta. The beach seine survey and Sacramento River midwater trawl were not used in the analysis of abundance trends because several years of data were missing. (See next comment for criteria used to identify data sets suitable for inclusion in abundance trend analysis.) Of the surveys that were used to establish abundance trends, ratios of young-of-the-year to adults were approximately equal for three out of five surveys (fall midwater trawl, Bay Study, and Suisun Marsh). Of the remaining surveys, the Chipps Island trawl was dominated by young-of-the-year, and fish salvage sampled five times as many young as adults. We calculated percent declines independently for each survey. When the two surveys dominated by young-of-the-year are removed from the analysis, overall average percent decline remains the same. Therefore, the contention that splittail adults are abundant, and that our analysis relied on a particular age-class of the species, is unfounded.

Issue 2: One respondent maintained that the studies we relied on were limited geographically (i.e., to the Estuary) and that splittail may occupy a wider range. Conversely, another respondent commented that the Estuary is the principal habitat of splittail and virtually all splittail are found in the Estuary for the first 2 years of their lives.

There was also disagreement about the gear types used for sampling. One respondent held that they were not appropriate, whereas another respondent stated that gear used by the studies, (i.e., bottom and midwater trawls) captured all sizes of splittail. The respondent that questioned gear suitability also commented that studies used in the listing determination were designed to capture striped-bass, were limited in their ability to sample shallow and inshore habitats, and that the use of the CDFG abundance index was inappropriate.

Service Response: We used several criteria to determine if a data set could be incorporated into the analysis of trends in splittail abundance and distribution. Data had to be collected for at least 10 consecutive years and effort had to be relatively constant or a core data set had to be available to extract for analysis. A core data set of at least 10 consecutive years provides the necessary information to conduct an analysis of long term trends in abundance. One respondent referred to the use of two data sets that sampled upstream of the Estuary. These data sets were not included in the analysis of abundance trends because time of year of sampling varied, sampling sites varied, and some years of sampling were missing. These data sets were examined however, for trends in distribution, and showed that capture of splittail decreased as sampling was conducted further upstream from the Estuary. One of the surveys referred to by the respondent consists of samples taken upstream of the Delta and catches young-of-the-year almost exclusively. Because splittail migrate upriver to spawn in the spring (Meng and Moyle 1995), it is likely that these catches are the offspring of splittail that reside further downstream for the remainder of the year.

Regarding gear suitability, a respondent suggested that certain gear used, especially tow nets and trawls, were not appropriate for sampling splittail because of their benthic habits and preference for shallow water. The respondent also referred to gillnetting as an effective method for capturing splittail.

We agree that the summer townet survey is inefficient in sampling splittail and therefore, was not included in the analysis of abundance. However, several trawling methods were included. Meng (1993) compared the effectiveness of three types of gear from one survey--bottom (otter) trawls, midwater trawls, and beach seines. Bottom and midwater trawls sampled equal proportions of all splittail year classes (i.e., young-of-the-year, fish 1 year or older, and fish 2 years or older). The beach seine was selective for young-of-the-year. High catches of young-of-the-year in midwater trawls are thought to reflect movement of young out of near shore areas when water recedes. They are frequently captured in channels, presumably as they move downstream (Meng and

Moyle 1995). The information outlined above suggests that regularly repeated bottom and midwater trawls are reasonably effective for sampling splittail and examining trends through time.

There are no long-term gillnetting data sets that meet the criteria above for inclusion in the analysis of abundance. Furthermore, gillnetting results in high fish mortality, and long-term sampling by gillnet is not feasible in waters with sensitive species. Almost all sampling techniques have biases. For the data used in the abundance analysis, the sampling remained constant. Therefore, the biases remained constant through time, and there was a consistent downward trend in splittail abundance.

Most of the sampling programs in the Estuary were initiated to track changes in striped bass or salmon (Oncorhynchus tshawytscha) populations. These long term data sets can be used to assess changes in abundance of other species as long as assumptions of sampling design are considered. Limitations of surveys designed for striped bass or salmon have been consistent through time. Problems with sampling shallow and inshore habitats have not changed and should not affect relative abundance trends. Therefore, trends or changes in splittail abundance reflected by these surveys should be unaffected by the various weaknesses identified by the respondent. The high correlation between the CDFG abundance index and numbers of fish (83 percent of the variability is explained) suggests that the index is a reasonable estimator of population trends.

Issue 3: One respondent commented that three separate data sets, including a gillnet survey, suggest that splittail are abundant throughout the Delta. Another respondent countered that gillnetting surveys cited as evidence of abundance were based on a single night of sampling in the American River when splittail were presumably concentrated for spawning. This respondent added that the 60 percent decline cited in the proposed rule is remarkable because one strong year class (such as occurred in 1983) can mask an overall decline in this long-lived species.

Service Response: The Act requires us to base listing determinations upon best available scientific and commercial data. The three data sets referred to by the respondent are limited temporally and geographically. One of the data sets referred to by the respondent covers one night of gillnet sampling in one location. The other two data sets refer to 2 years of sampling, separated by more than 10 years, at the Pacific Gas and Electric plant in Antioch. We considered all available data but determined that incorporation of sporadic or isolated sampling events was not appropriate because of problems associated with drawing conclusions from limited or sporadic data.

Issue 4: A respondent commented that no data were provided to support the conclusion that successful reproduction is highly correlated with wet years.

Service Response: Regression analyses of splittail young abundance versus spring outflow (February-May) show strong relationships. As spring outflow increases, abundance of splittail young increases. Changes in spring outflow explained varying percentages of changes in abundance of splittail young and ranged from 55 to 72 percent, depending on which survey data were analyzed (Meng and Moyle 1995). All of the regression analyses were significant (probability values ranged from less than 0.0001 to 0.0025) (Meng and Moyle 1995). This is a strong correlation between successful reproduction and wet years. The low and high abundance indices of juvenile abundance from 1994 and 1995, respectively, is consistent with this analysis.

Issue 5: One respondent commented that the data we used to determine the decline of splittail was biased by the fact that the time period used to determine pre-decline and post-decline was heavily weighted with wet years in the pre-decline period, thereby biasing the analysis.

Service Response: We analyzed only wet years to determine if there had been a decline within that year type. That analysis indicated that even in wet years, when one would anticipate substantially higher recruitment, there had been an overall decline in splittail abundance. Young-of-the-year abundance declined steadily in the annual Chipps Island trawl in wet years from 1978 to 1993. Abundance in 1993 was less than 3 percent of what it was in 1978. Abundance per unit effort was approximately 12.3 in 1978, 8.1 in 1982, 2.0 in 1983, 1.3 in 1986 and less than 0.3 in 1993. This first analysis was done using a catch-per-tow analysis. The second analysis of splittail abundance using a different analytical method that was based on a catch-per-volume of

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water sampled yields a similar result. The volumetric methodology yields a catch per unit effort (CPUE) at the Chipps Island trawl site of 2.6 in 1978, 0.97 in 1982, 0.77 in 1983, 0.73 in 1986, and 0.21 in 1993. These two analyses show that there is an overall reduction in abundance that is not solely a result of drought conditions. Using the second analytical method yields a CPUE for 1995 and 1996 of 2.1 and 0.63 respectively, which were both wet years. If there were a stable number of sexually mature fish throughout the period of decline, one would expect similar reproduction in both years. However, there was a substantial decline from 1995 to 1996, which may indicate that there were not as many adult fish, reflected by the lower CPUE in 1996.

Issue 6: One respondent commented that there is no evidence to support the statement that lower numbers of splittail young-of-the-year during the drought may affect the stock's ability to recover.

Service Response: Our status report (Meng 1993) and the proposed

APPENDIX E

Estimated Consumption of Listed Species by Striped Bass and the Impact of Stocking Net-Pen-Reared Yearling Striped Bass

Data for calculating these estimates are only available for the estuary and river system upstream from San Pablo Bay. While the estimates do not include potential predation in San Pablo or San Francisco bays, predation in those bays is minimized by several factors: 1) the buffering effect of abundant forage species such as anchovies and herring, 2) the rapid migration of salmon through the bays (based on captures of marked fall-run chinook salmon outmigrants), 3) the tendency of striped bass to be bottom oriented in the bays, while salmon migrate on the surface.

The NMFS also has suggested that the predation estimates do not account for more intense predation levels that may occur at man-made structures (letter, Ms. Hilda Diaz-Soltero to Miss Jacqueline Schafer, 2/21/97). Actually, because anglers tend to seek out areas where striped bass actively feed, the striped bass diet data probably do include striped bass caught at such structures. Neither NMFS nor CFG know to what extent "structure captured" striped bass are included in the samples.

Derivation of variables used for the predation estimates is described at the end of the chinook salmon section of this appendix.

FALL-RUN AND LATE-FALL-RUN CHINOOK SALMON

Consumption of juvenile fall-run chinook salmon by striped bass (stratified by striped bass age group, area, and season) was calculated as: frequency of salmon in striped bass stomachs x striped bass distribution x days in season x 6-month survival rate x change in total Sacramento River chinook salmon abundance between 1963 and 1992-1994 x fraction of juvenile salmon that are fall run.

This analysis resulted in annual estimates of fall-run salmon consumption by striped bass of 2.7%, 12.0% and 12.4% for 1993, 1994, and 1995. The mean estimate was 9%.

Striped bass predation impacts on late fall-run chinook salmon were not quantified directly; however, reasonable inference can be made based on the quantified estimates for the fall-and winter-runs and differences in late-fall-run life history. Late-fall-run chinook salmon smolts are larger during their outmigration and migrate in late fall and winter when water temperatures decline and turbidity increases due to storm run off. These factors will render them less vulnerable than fall-run chinook salmon (and perhaps winter-run chinook salmon which are smaller when they migrate) to striped bass predation. Thus, the estimate of mean consumption of late-fall-run salmon by striped bass in 1993-1995 was less than 9% (the estimate for fall-run chinook salmon).

Impact of Proposed Striped Bass Stocking

Returning abundance of adult striped bass to approximately the 1994 level of 712,000 fish by stocking various combinations of yearling and age 2 bass increases estimated predation on fall- and late-fall-run chinook salmon by 0.9-2.1% of the juvenile population compared to allowing the bass population to decrease to 515,000, as it would without stocking (Table E-1). This predation estimate varies depending on the ratio of yearling:age 2 fish stocked; the higher the proportion of yearlings, the higher the fraction of the fall- and late-fall-run population that is consumed because of the additional year that age 1 fish are in the estuary and river.

WINTER-RUN CHINOOK SALMON

Due to a substantial amount of uncertainty associated with making estimates of striped bass predation on winter-run chinook salmon, the CFG and NMFS used three approaches to estimate consumption of winter-run chinook salmon by striped bass.

Besides the three factors that minimize potential predation by striped bass in San Pablo or San Francisco bays listed in the introduction to this appendix, predation by striped bass on winter-run salmon is also reduced by the relatively small portion of the striped bass population inhabiting the bays during the peak of the winter-run chinook salmon outmigation.

Food Habits Estimate

Consumption of juvenile winter-run salmon by striped bass (stratified by striped bass age group, area, and season) was calculated as: frequency of salmon in striped bass stomachs x striped bass distribution x days in season x 6-month survival rate x change in total Sacramento River chinook salmon abundance between 1963 and 1992-94 x fraction of juvenile salmon that are winter run.

This analysis resulted in annual estimates of winter-run salmon consumption by striped bass of 2.6%, 5.1%, and 4.3% for 1993, 1994, and 1995. The mean estimate for this approach is 4.0%.

Fall-run Estimate

Food-habit estimates of fall-run chinook salmon are probably more reliable than the winter-run estimates due to the greater abundance of fall-run salmon, although fall-run are likely more vulnerable than winter-run chinook salmon to striped bass predation (because they migrate later when there is less turbidity and striped bass metabolic demands are greater). Since the outmigration of winter- and fall-run fish overlap, these fall-run consumption estimates of 2.7-12.4% (mean = 9%) were considered to be a crude surrogate for winter-run estimates.

Bioenergetics Estimate

This approach is based on a bioenergetics model for striped bass (Kitchell et al. 1977, Moore et al. 1993) and estimates of the composition of the potential prey field based on Interagency Ecological Program (IEP) trawl survey for bay fishes. As for the fall-run estimate above, fall-run salmon are used as a surrogate for winter run because winter-run juvenile catches in the IEP trawl survey for bay fishes were very low. The number of juvenile salmon consumed by each age class of striped bass in each area and season was calculated as: (daily consumption (in grams) for a striped bass x number of striped bass x number of days in season x fraction of the prey field biomass (in grams) that was salmon)/mean weight of a juvenile salmon. This approach only was used to estimate consumption in 1993. The estimate was 6.8%.

Winter-run Salmon Consumption by Striped Bass

The CFG and NMFS conclude, based on the above three approaches, that the present striped bass population likely consumes 4-9% of winter-run salmon outmigrants, and have agreed that 6% is an appropriate baseline level of winter-run chinook salmon consumption by striped bass in the Sacramento-San Joaquin system.

Impact of Proposed Striped Bass Stocking

Returning abundance of adult striped bass to approximately the 1994 level of 712,000 fish by stocking various combinations of yearling and age 2 bass increases estimated predation on winter-run chinook salmon by 0.7-1.6% of the juvenile population compared to allowing the bass population to decrease to 515,000, as it would without stocking (Table E-1). This predation estimate varies depending on the ratio of yearling:age 2 fish stocked; the higher the proportion of yearlings, the higher the fraction of the winter-run population that is consumed because of the additional year that age 1 fish are in the estuary and river.

SPRING-RUN CHINOOK SALMON

Consumption of juvenile spring-run chinook salmon by striped bass (stratified by striped bass age group, area, and season) was calculated as: frequency of salmon in striped bass stomachs x striped bass distribution x days in season x 6-month survival rate x change in total Sacramento River chinook salmon abundance between 1963 and 1992-1994 x fraction of juvenile salmon that are spring run.

This analysis resulted in annual estimates of spring-run salmon consumption by striped bass of 2.9%, 5.2% and 3.5% for 1993, 1994, and 1995. The mean estimate was 3.9%.

Impact of Proposed Striped Bass Stocking

Returning abundance of adult striped bass to approximately the 1994 level of 712,000 fish by stocking various combinations of yearling and age 2 bass increases estimated predation on spring-run chinook salmon by 0.3-1.0% of the juvenile population compared to allowing the bass population to decrease to 515,000, as it would without stocking (Table E-1). This predation estimate varies depending on the ratio of yearling:age 2 fish stocked; the higher the proportion of yearlings, the higher the fraction of the spring-run population that is consumed because of the additional year that age 1 fish are in the estuary and river.

Variables Used in Estimates of Chinook Salmon Consumption by Striped Bass

Estimation of Striped Bass Abundance

Present abundance of age ≥3 striped bass was calculated as the mean of the Petersen population estimates from 1992 to 1994, the 3 most recent years for which estimates are available. (Unlike the estimate for legal-sized fish only, this includes age 3 fish that are not legal-sized on May 1, the midpoint of the tagging season.) Age 1 and 2 abundances were back-calculated using best estimates of annual survival rates from age 2 to age 3 and age 1 to age 2 (Table E-1):

Age 1 = (age 1 to age 2 estimated survival [=0.25])*(estimated age 2 abundance the previous year.

Age 2 = (age 2 to age 3 estimated survival [=0.40])*(estimated age 3 abundance the previous year.

As these are the abundances of each age group of striped bass on May 1, the average abundance throughout the year was calculated by multiplying estimated abundance by the 6-month survival rate (square root of annual survival: 0.50 for age 1, 0.632 for age 2, and 0.723 for age ≥3).

The CFG striped bass model (Kohlhorst et al. 1992) was used to estimate future striped bass abundance over 5- and 10-year periods with several stocking alternatives and hydrology simulated by a Department of Water Resources operations study of conditions under the May 1995 SWRCB Water Quality Control Plan. This modeling accounts for the frequency of water-year types that actually occurred from 1922-1991.

Estimation of Striped Bass Distribution

The distribution of age ≥3 striped bass among the four areas of the Estuary and among seasons was estimated from the spatial and temporal pattern of tag returns within 1 year of release from legal-sized bass.

No data are available on temporal or spatial distribution of age 2 striped bass. About ½ of age 2 males, and no age 2 females, are mature. Winter-run chinook salmon probably are most vulnerable to predation in the upper Sacramento River (USR), a major striped bass spawning area. Therefore, accounting for potential predation by age 2 bass in that reach was particularly

Table E-2. Estimated effects (abundance of adult striped bass and annual consumption of winter-run chinook salmon and delta smelt after 5 and 10 years) of not stocking striped bass and seven potential stocking scenarios using combinations of yearling and age 2 striped bass.

Higher numbers of bass are stocked in the first 5 years to attain the goal of returning abundance to approximately the 1994 legal-sized adult population 9f 712,000. Stocking in the next 5 years is reduced to a level that maintains that abundance. Predictions of striped bass abundance assume initial abundance of 712,000 and hydrologic conditions equivalent to 1922-91 mean outflow and export produced by a Department of Water Resources operations study of the December 15, 1994 Delta Accord. With no stocking, this hydrology causes a reduction in adult abundance to 515,000.

First 5 Years		Second 5 Years		Estimated legal-sized striped bass abundance after		Estimated percent of fall- and late-fall run salmon outmigrants consumed annually[1] by stocked striped bass after		Estimated percent of winter-run salmon outmigrants consumed annually[1] by stocked striped bass after		Estimated percent of spring-run salmon outmigrants consumed annually[1] by stocked striped bass after		Estimated percent of the June delta smelt population consumed annually[1] by stocked striped bass after	
Yearlings stocked annually	Age 2 stocked annually	Yearlings stocked annually	Age 2 stocked annually	5 years	10 years	5 years	10 years	5 years	10 years	5 years	10 years	5 years	10 years
0	0	0	0	515,000	515,000	0	0	0	0	0	0	0	0
1,275,000	0	860,000	0	712,000	712,000	2.10	1.56	1.59	1.14	0.95	0.65	1.42	0.99
1,000,000	59,000	800,000	23,000	712,000	712,000	1.85	1.51	1.41	1.12	0.83	0.64	1.21	0.96
750,000	113,000	600,000	76,000	712,000	712,000	1.69	1.34	1.24	1.00	0.72	0.56	1.01	0.81
500,000	168,000	400,000	128,000	712,000	712,000	1.45	1.18	1.07	0.88	0.61	0.49	0.82	0.67
250,000	222,000	200,000	181,000	712,000	712,000	1.21	1.01	0.91	0.77	0.50	0.41	0.62	0.52
125,000	248.000	100,000	208,000	712,000	712,000	1.07	0.92	0.82	0.71	0.44	0.37	0.52	0.45
0	275,000	0	234,000	712,000	712,000	0.97	0.89	0.74	0.66	0.39	0.34	0.43	0.38

[1] Estimated percent consumed is based on the combination of yearlings and age-2 fish stocked, shown in the first 4 columns of this table. Estimated percent consumed would be less in years 1-4 than at 5 years because there would be fewer stocked fish in the population. Estimated percent consumed declines between 5 and 10 years because the number of stocked striped bass in the population declines due to the lower stocking rate after 5 years.

important. We assumed that mature age-2 bass behaved like older (≥age 5), fully-mature fish when migrating up the Sacramento River. Since about ½ of the age-2 males, and no age-2 females, are mature, this assumption concerning the relation between maturity and migration resulted in an estimate that 1/4 of age-2 bass migrate like older fish (1.2 mature males x ½ of the population that is male = 1/4). Hence, estimates of the proportion of the age-2 population migrating up the Sacramento River equal 1/4 of the proportion of older fish migrating there. The remaining age-2 bass were apportioned to areas and seasons based on tag returns from age-3 bass.

The distribution of age 1 striped bass was estimated from the distribution of DFG's midwater trawl (MWT) index for age 1 striped bass. This MWT survey only samples Carquinez Strait and Suisun Bay (CS & SB), the Delta, and the lower Sacramento River (LSR); summer is only represented by August and spring is only represented by March. No data are available for the fraction of age 1 SB in the USR. Therefore, it was assumed that if fraction of age 1 fish in the LSR = 0, then fraction of age 1 fish in the USR = 0; if fraction of age 1 fish in the LSR ≠ 0, then fraction of age 1 fish in the USR = (age 2 USR fraction/age 2 LSR fraction)*(age 1 LSR fraction). For example, if age 2 LSR = 0.10, age 2 USR = 0.05, and age 1 LSR = 0.03, then age 1 USR = (0.05/0.10)*(0.03) = 0.015.

The number of striped bass of each age in each area in each season was the product of the distribution matrix and the appropriate average annual abundance estimate.

Consumption Rates of Chinook Salmon by Striped Bass

Food habits studies of Thomas (1967) and Stevens (1966) were used to assign consumption rates to the three different age groups of striped bass in the four areas where Thomas observed that salmon were eaten (CS & SB, Delta, LSR, and USR). Food habits data were also stratified by season as described by Thomas (1967). It was assumed that the frequency of occurrence of salmon in striped bass stomachs represented the daily consumption rate; i.e., 1% occurrence meant that on a given day one in 100 striped bass ate a salmon or that an individual striped bass ate one salmon every 100 days.

Since all runs of chinook salmon using the Estuary have decreased substantially since the striped bass food habits studies of the late 1950s and early 1960s, a correction factor reflecting decrease in abundance since 1963 was used to reduce salmon consumption by striped bass based on the assumption that lower density of prey proportionally reduces the number of prey eaten.

Fraction of Juvenile Salmon Represented by Each Run

The fraction of juvenile salmon from each of the runs was estimated from relative spawning escapement (Frank Fisher, DFG) and temporal migration patterns (USFWS sampling). Fall-run spawning escapement for CS & SB, Delta, and LSR was the sum of escapement in the acramento, Feather, Yuba, and American rivers. Fall-run spawning escapement for the USR was equal to Sacramento River escapement + 1/5 Feather River escapement + 1/5 Yuba River escapement. Inclusion of 1/5 of Feather and Yuba River escapement in this calculation was based on the distribution of USFWS seining sites in the USR (eight sites above and two below the mouth of the Feather River).

Temporal migration patterns were used to estimate the proportion of a run that migrated though an area each season by calculating the fraction of annual USFWS catch captured in each season (USFWS 1994 and unpublished).

For each area, the proportion that were winter run in season i = (winter-run spawning escapement x fraction of winter-run from that year class caught that season)/(fall-run spawning escapement x fraction of fall-run from that year class caught that season).

As the spring value for winter-run in the Delta was 0 in 1994, and lower than either the Delta or CS & SB in the other years (both unreasonable results), spring Delta values for all years were calculated as the mean of CS & SB and LSR.

Estimates for other runs were analogous to those for winter-run; for example, by exchanging fall-run for winter-run (and vice-versa) in all calculations.

Estimation of Number of Outmigrants

The annual number of winter-run outmigrants from 1993 to 1996 was calculated by Gary Stern (NMFS). The mean of these four values (209,075) was used to estimate the average fraction of winter-run juveniles consumed by striped bass.

The annual number of outmigrants of other runs was calculated by multiplying escapement by the average number of winter-run outmigrants produced per adult (237). For fall-run, this is probably an underestimate as fall-run fecundity is greater that winter-run fecundity and, if survival to outmigration is similar, would lead to more smolts produced per spawner.

Estimation of Prey Field

The IEP trawl survey of bay fishes samples fishes and shrimp with both otter and midwater trawls. Fish biomass caught in the trawls was the sum of weights (in grams) of all fishes caught by the trawls in a location and season from 1980 to 1989, a period when both the otter trawl and midwater trawl were consistently fished together. Weights were calculated from weight-length relationships for each species (or similarly-shaped species) before summing. Minimum prey size was assumed to be 100 mm for age 1 bass, 150 mm for age 2 bass, and 250 mm for bass ≥age 3. Fish <30-40 mm (depending on species) were not measured (and, thus, were excluded from the prey field estimate) because the gear is not efficient for these small fish.

Shrimp biomass is the sum of weights (in grams) of all shrimp caught by the otter trawl a location and season from 1980 to 1989. Weights were calculated from weight-length relationships for each species before summing.

Density of prey was calculated from the bottom area swept by the otter trawl (density expressed as g/m^2) and water volume sampled by the midwater trawl (density expressed as g/m^3).

Total biomass of the prey field in each area was the sum of otter trawl density x surface area (assumed to be equal to bottom area) and midwater trawl density x water volume.

DELTA SMELT

Delta smelt consumption by striped bass was estimated in much the same way as for winter-run chinook salmon consumption, with differences described below.

Estimation of Striped Bass Distribution

Striped bass abundances were adjusted to average yearly values in each area of the Estuary where they consumed delta smelt rather than estimating abundance seasonally in each area, as was done to estimate predation on winter-run chinook salmon.

Consumption Rates of Delta Smelt by Striped Bass

Observations of delta smelt in striped bass food habits studies were too infrequent to permit stratification of estimates of consumption of delta smelt by striped bass by season, so consumption estimates were stratified by striped bass age (age 1, age 2, and age ≥3) and by location (CS & SB and Delta) only. Thomas (1967) found 15 delta smelt in 4,551 striped bass stomachs (0.00330 frequency of occurrence) in the Estuary from San Francisco Bay to the Sacramento River and Stevens (1966) observed 10 delta smelt in 4,781 stomachs from striped bass ≥age 1 (0.00196 frequency of occurrence in age 1 striped bass, 0.00242 in age 2 bass, and 0.00200 in age 3 bass) from the Delta. Since Thomas (1967) did not stratify his results by striped bass age, we apportioned his overall frequency of occurrence of delta smelt among bass ages in the same ratio as observed by Stevens (1966).

We adjusted striped bass predation rates on delta smelt in the same way that striped bass feeding rates on chinook salmon were adjusted for the decrease in abundance of prey since the food habits studies in the early 1960s. A significant time trend in the midwater trawl index of delta smelt abundance was used to simulate abundance in 1963, before the midwater trawl survey began in 1967. The adjustment factor for decrease in delta smelt abundance was the quotient of the midwater trawl indices in 1994 and 1963 (0.099).

Estimation of Delta Smelt Abundance

Delta smelt abundance was estimated from sampling the population in June 1994 with a 25-foot-wide and 6-foot-deep Kodiak trawl. Abundance was estimated by determining the number of trawls that would be necessary to strain all of the water within the delta smelt's habitat and multiplying that number by the average number of delta smelt caught per tow (J. Lott and D. Sweetnam, CFG). Two abundance estimates were made: 1) assuming all smelt were in the top 6 feet of water, 2) assuming smelt were randomly dispersed throughout the entire water column. Delta smelt tend to be surface oriented, but they also occur near the bottom (Radtke 1966); thus, the first approach would underestimate delta smelt abundance while the second approach would overestimate it. Hence, we used the mean of the two estimates as a "best estimate" of abundance. This approach probably provides minimum estimates of abundance because the Kodiak trawl is assumed to be 100% efficient, although some unknown fraction of the fish in its path undoubtedly evade it.

Consumption of Delta Smelt

Estimated numbers of delta smelt eaten by striped bass (stratified by striped bass age group and area) were the product of average striped bass abundance during the year, frequency of occurrence of delta smelt in striped bass stomachs in the early 1960s, number of days in the year, and the correction for the decrease in delta smelt abundance since the early 1960s.

Based on the 1994 abundance of delta smelt (4,803,000), annual consumption of delta smelt by the present (mean 1992-94) striped bass population in the Estuary is estimated to be 5.3% of the population.

Impact of Proposed Striped Bass Stocking

Returning abundance of adult striped bass to the 1994 level of 712,000 fish by stocking various combinations of yearling and age 2 bass increases estimated predation by 0.4-1.4% of the population of delta smelt compared to allowing the bass population to decrease to 515,000, as it would without stocking (Table E-1). As for winter-run chinook salmon, this predation estimate varies depending on the ratio of yearling: age 2 fish stocked: the higher the proportion of yearlings, the higher the fraction of the delta smelt population that is consumed.

To place these estimates of delta smelt consumption by striped bass in perspective, we compared them with an estimate of total delta smelt mortality between the juvenile stage in June 1994 and spawning in April 1995. Besides the June 1994 estimate of delta smelt abundance described above, two population estimates were available for July and one in November. A regression using these four points was extrapolated to April 1, 1995 to calculate abundance of spawning adults (262,000). Total mortality was estimated by subtracting the April estimate from the June estimate: 4,803,000 - 262,000 = 4,540,000. As total mortality is almost equal to initial abundance, the proposed striped bass restoration increment would account for 0.4-1.5% of total delta smelt mortality, similar to the fraction of the initial population consumed.

SACRAMENTO SPLITTAIL

None of the food habits studies since the late 1950s have found splittail in striped bass stomachs. Consumption of splittail by striped bass is extremely low and stocking artificially-reared striped bass would not have a measurable effect.

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Appendix E

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APPENDIX F

Principals for Agreement on Bay-Delta Standards Between the State of California and the Federal Government

2. March through June Protections: During March through June, expor   hall be no greater than 35% of Delta inflow, subject to the flexibility provisions described below.

3. July through January: During July through January exports shall be no greater than 65% of Delta inflow, subject to the flexibility provisions described below. Criteria for exercising this flexibility will be develcped by the Ops Group.

4. X-2 Protection Measures: X-2 protection shall be based on the CUWA/AG proposal with the following adjustment. The Chipps Island requirement in February will be zero days when the Eight River Index in January is less than 0.8 MAF and 28 days when it is greater than 1.0 MAF with linear interpolation between 0.8 and 1.0 MAF. The requirement at the confluence shall be 150 days, except that when the May 1 90% forecas' of the Sacramento River Index is less than 8.1 MAF, the maximum outflows for May and June shall be 4,000 cfs, with all other flow requirements removed. When the February index falls below 0.5 MAF, the requirement for March will be reviewed by the Ops Group. Additional refinements, which will involve no further water costs above those which are required for this paragraph may subsequently be made.

5. San Joaquin River Protection Measures: The protection measures will consist of the narrative standard and implementation provisions agreed to on December 12, 1994 (Attachment B). In addition, export limits during the April/May 30-day pulse flow period will be consistent with the CUWA/AG proposal. The parties agree to take immediate actions, as appropriate, to resolve the biological concerns related to the removal of t' barrier and to provide adequate transport of fisheries consistent with the CALFED process

identified in Attachment C. If biological problems arise before the solution(s) can be implemented, resolution of these concerns shall be made within CALFED.

6. Additional Modifications to CUWA/AG Proposal: Daily export limits shall be based on the average Delta inflow over the preceding three days under balanced conditions as defined in the Coordinated Operation Agreement or fourteen days under unbalanced conditions.

During the period November to January, the Delta Cross Channel will be closed a maximum of 45 days. The timing and duration of the closures will be determined by the Ops Group.

During the period May 21 through June 15, the Delta Cross Channel may be rotated closed four days and open three days, including the weekend.

ESA FLEXIBILITY

1. No Additional Water Cost: Compliance with the take provisions of the biological opinions under the Federal Endangered Species Act (ESA) is intended to result in no additional loss of water supply annually within the limits of the water quality and operational requirements of these Principles. To implement this principle, the Ops Group will develop operational flexibility through adjustment of export limits.

2. Real Time Monitoring: To the maximum extent possible, real time monitoring will be used to make decisions regarding operational flexibility. CALFED commits to aggressively develop more reliable mechanisms for real time monitoring.

3. Additional Study Programs: CALFED commits to aggressively pursue stuc programs to develop information allowing better decisions to be made about managing the Estuary and its watershed.

4. Operational Flexibility: Decisions to exercise operational flexibility under the Ops Group process may increase or decrease water supplies in any month and must be based on best available data to ensure biological protection and be consistent with the Federal and State Endangered Species Acts.

5. Dispute Resolution: Any disputes within the Ops Group will be resolved by CALFED, as set forth in Attachment A.

CATEGORY III -- NON FLOW FACTORS

1. Principles: Implementation of Category III principles will be consistent with the principles set forth in Attachment C.

2. Financial Commitment: The water user community agrees to make available by February 15, 1995, an initial financial commitment of $10 million annually for the three years of these interim standards to fund Category III activities. Metropolitan Water District of Southern California (MWD) will guarantee this commitment. Subsequent financial agreements relative to Category III will credit this early commitment of funds to MWD's obligation.

INSTITUTIONAL AGREEMENTS

1. EPA Standards: Consistent with the Framework Agreement, EPA commits to withdraw Federal standards pursuant to the Clean Water Act when the SWRCB adopts a final plan consistent with these Principles.

2. Endangered Species Act

a. Limitation To Aquatic Species: These Principles apply only to aquatic species affected in the Bay-Delta Estuary.

b. Impacts of Additional Listings: This Plan, in conjunction with other Federal and State efforts, is intended to provide habitat protection sufficient for currently listed threatened and endangered species and to create conditions in the Bay-Delta Estuary that avoid the need for any additional listings during the next three years. To the extent that due to unforeseen circumstances in the Estuary, or to factors not addressed in the Plan, additional listings may be required, it is understood that protection of these species shall result in no additional water cost relative to the Bay-Delta protections embodied in the Plan and will, to the maximum extent possible, use the flexibility provided within Section 4(d) of the ESA. Additional water needs will be provided by the Federal government on a willing seller basis financed by Federal funds, not through additional regulatory re-allocations of water within the Bay-Delta.

c. Other Endangered Species Issues: To the extent consistent with the requirements of Federal and State ESAs, all other actions related to this Plan required to implement the Acts as they affect the Bay-Delta, including but not limited to future biological opinions, incidental take statements, recovery plans, listing decisions and critical habitat designations, are intended to conform to these Principles, and decisions regarding ESA implementation will be made utilizing the CALFED process.

3. Central Valley Project Credits. All CVP water provided pursuant to these Principles shall be credited toward the CVP obligation under Section 3406 (b) (2) of the Central Valley Project Improvement Act to provide 800,000 acre feet of project yield for specified purposes.

4. Immediate Implementation:

a. Biological Opinions: It is agreed that there will be an immediate reconsultation on the biological opinions currently governing project operations with appropriate modifications by the end of 1994, to the extent practicable, to conform with the requirements of these Principles.

b. State Implementation: Consistent with the Framework Agreement, the SWRCB will finalize the Plan and immediately thereafter initiate water right proceedings to implement the adopted Plan. In implementing the Plan, the SWRCB will act in compliance with all provisions of law which may be applicable, including, but not limited to, the water rights priority system and the statutory protections for areas of origin.

STATE OF CALIFORNIA

Douglas P. Wheeler
Secretary, California Resources Agency

James M. Strock
Secretary for Environmental Protection
California Environmental Protection Agency

UNITED STATES OF AMERICA

Bruce Babbitt
Secretary of the Interior

Ronald H. Brown
Secretary of Commerce

Carol M. Browner
Administrator
Environmental Protection Agency

INTERESTED PARTIES

Walter J. Bishop
Contra Costa Water District
By: Greg Gartrell

Stephen K. Hall
Association of California
Water Agencies

Anson K. Moran
California Urban Water Agencies

David R. Schuster
Kern County Water Agency and
Tulare Lake Water
Storage District

Gary Bobker
The Bay Institute

John Krautkraemer
Environmental Defense Fund

Daniel G. Nelson
San Luis-Delta Mendota Water Authority

John R. Wodraska
Metropolitan Water District
of Southern California

INTERESTED PARTIES

David Fullerton
Natural Heritage Institute

Richard Golb
Northern California Water Association

Attachment A

The "CALFED process" referred to herein consists of the following steps:

Initial deliberations and decisions occur in the "Ops Group." "Ops Group" deliberations shall be conducted in consultation with water user, environmental and fishery representatives.

If the Ops Group disagrees on a particular issue, or if an Ops Group action requires additional water that it is believed cannot be made up within existing requirements, the issue will be decided by CALFED.

If CALFED cannot reach agreement, and if the issue involves listed species, a final decision will be made by the appropriate listing agency. Other issues not involving ESA will be decided by the appropriate regulatory or resources management agency.

Attachment B

Narrative Criteria for Chinook Salmon on the Sacramento and San Joaquin Rivers

Water quality conditions shall be maintained, together with other measures in the watershed, sufficient to achieve a doubling of production of chinook salmon, consistent with the mandates of State and Federal law.

Implementation Measures - San Joaquin River System

1. Not later than three years following adoption of this Plan, the SWRCB shall assign responsibility for the following flows, together with other measures in the watershed sufficient to meet the narrative criteria, in the San Joaquin River at Vernalis among the water right holders in the watershed. During this three-year period, the Bureau of Reclamation shall provide these flows, in accordance with the biological opinion for Delta smelt. These flows are interim flows and will be reevaluated as to timing and magnitude (up or down) within the next 3 years.

Feb-June Flows (cfs)*		April-May pulse flows (cfs)*
C	710-1140	3110-3540
D	1420-2280	4020-4880
BN	1420-2280	4620-5480
AN	2130-3420	5730-7020
W	2130-3420	7330-8620

*higher flows provided when the 2 ppt isohaline (x2) is west of Chipps Island.

2. Install a barrier at the head of Old River during the April-May pulse flows.

3. During the 3-year period, decisions by the Federal Energy Regulatory Commission (FERC) or other regulatory orders may increase the contribution from other upstream water users into the Estuary. These additional flows will benefit the Delta resources. These flows will be recognized by ClubFED in its calculation of flows available to the Delta and be considered by the SWRCB in its assignment of responsibility among the water rights holders in the watershed during its water rights proceeding.

The SWRCB will initiate a water rights proceeding to assign responsibility for meeting these flow requirements. Actions of the NMFS and FWS in the FERC proceedings will be in furtherance of their authority and responsibility under the ESA. Such actions shall not be intended to assume the responsibility of the SWRCB to assign responsibility for meeting water quality standards in the Delta.

Sacramento River System - Additional Measures

Close the Delta Cross Channel gates from February-May 20, and during half of the period from May 20-June 15.

Attachment C

PRINCIPLES FOR IMPLEMENTATION OF CATEGORY III

The State and Federal governments and agricultural, urban and environmental interests are committed to the implementation and financing of "Category III" measures as an essential part of a comprehensive ecosystem protection plan for the Bay-Delta Estuary.

To achieve this objective we agree to the following principles:

1) Level of funding:

Category III activities are expected to require a financial commitment estimated to be $60 million a year.

2) Sources of funds:

It is anticipated that new sources of funds will be required to adequately finance Category III activities. A process for evaluating existing funding and possible reprioritization will be used to finance a portion of Category III activities. Additional funds will be secured through a combination of Federal and State appropriations, user fees, and other sources as required.

3) Monitoring:

It is further agreed that monitoring is a high priority in addition to the Category III elements, and has a high priority for separate funding.

4) Unscreened Diversions:

It is agreed that the highest priority Category III activity for funding is the screening of currently unscreened diversion points in the Bay-Delta watershed. An evaluation of the benefits of a screening program for listed species will be conducted immediately and used to improve listed species survival no later than during the 95/96 water year.

5) Consensus Process:

CUWA/Ag will work with CALFED and environmental interests in an open process to determine precise priorities and financial commitments for the implementation of all Category III elements. The CUWA/AG work plan currently being developed will be revised consistent with these Principles.

6) Deadline:

This process will be under the sponsorship or CUWA/AG, which commits to an open and collaborative approach involving CALFED and the environmental community. It is agreed that detailed implementation for these Principles will be finalized before publication of the final SWRCB standards, which is currently planned by March 31, 1995.

APPENDIX G

State and Federal-Listed Endangered, Threatened, Candidate, and Rare Species That Occur Within the Estuary

FISHES

Species	Status[a]
1. Winter-run chinook salmon (Oncorhynchus tshawytscha)	SE, FE
2. Spring-run chinook salmon (Oncorhynchus tshawytscha)	SC, FPE
3. Fall/late-fall-run chinook salmon (Oncorhynchus tshawytscha)	FPT
4. Delta smelt (Hypomesus transpacificus)	ST, FT
5. Sacramento perch (Archoplites interruptus)	FC
6. Tidewater goby (Eucyclogobius newberryi)	FE
7. Sacramento splittail (Pogonichthys macrolepidotus)	FPT
8. Green sturgeon (Acipenser medirostris)	FRC
9. Longfin smelt (Spirinchus thaleichthys)	FRC

AMPHIBIANS

Species	Status[a]
1. Red-legged frog (Rana aurora draytonii)	FT
2. California tiger salamander (Ambystoma californiense)	FC

3. Western spadefoot toad
(Scaphiopus hammondi hammondi) FRC

4. Foothill yellow-legged frog
(Rana boylii) FC

5. Alameda whipsnake
(Masticophis lateralis euryxanthus) FPE

REPTILES

Species	Status[a]
1. Giant garter snake (Thamnophis couchi gigas)	ST, FT
2. Southwestern pond turtle (Clemmys marmorata pallida)	FC
3. Northwestern pond turtle (Clemmys marmorata)	FC
4. San Francisco garter snake (T. sirtalis tetrataenia)	SE, FE

PLANTS

Species	Status[a]
1. Delta coyote thistle (Eryngium racemosum)	SE, FC
2. Salt marsh bird's beak (Cordylanthus maritimus ssp maritimus)	SE, FC
3. Contra Costa wallflower (Erysimum capitatum var angustatum)	SE, FE
4. Antioch Dunes evening-primrose (Oenothera deltoides spp. howellii)	SE, FE
5. Pitkin Marsh indian paintbrush (Castilleja uliginosa)	SE, FE

6. Soft bird's-beak (Cordylanthus mollis ssp mollis) FE, SR

7. Hispid bird's-beak (Cordylanthus mollis ssp hispidus) FC, SR

8. Mason's lilaeopsis (Lilaeopsis masonii) FC, SR

9. Slough thistle (Cirsium crassicaule) FC

10. Suisun marsh aster (Aster chilensis spp. lentus) FC

11. San Joaquin saltbush (Atriplex patula spp. spicata) FC

12. California beaked-rush (Rhynchospora californica) FC

13. California hibiscus (Hibiscus californicus) FC

14. Delta tule pea (Lathyrus jepsonii) FC

INSECTS

Species	Status[a]
1. Lange's metalmark butterfly (Apodemia mormo spp. langei)	FE
2. Valley elderberry longhorn beetle (Desmocerus californicus spp. dimorphus)	FT
3. Sacramento anthicid beetle (Anthicus Sacramento)	FC
4. Delta green ground beetle (Elaphrus viridis)	FT

OTHER INVERTEBRATES

Species	Status[a]
1. Longhorn fairy shrimp (Branchinecta longiantenna)	FE
2. California freshwater shrimp (Syncaris pacifica)	FE
3. Conservancy shrimp (Branchinecta conservatio)	FE
4. Vernal pool fairy shrimp (Branchinecta lynchi)	FT
5. California linderiella (Linderiella occidentalis)	FC
6. Vernal pool tadpole shrimp (Lepidurus packardi)	FE

[a] SE = State endangered; ST = State threatened; SC = State Candidate, FE = Federally endangered; FT = Federally threatened; FC = Federal candidate species; FPE = Federally proposed endangered; FRC = Federally recommended candidate.

APPENDIX H

Incidence of Chinook Salmon, Central Valley Steelhead, Delta Smelt, and Sacramento Splittail in Striped Bass Stomachs Sampled During 1994-1998

Striped Bass Stomachs – Totals

	1994	1995	1996	1997	1998	Total All Years
# Stomachs	704	324	84	30	142	1284
# W/food	389	158	43	14	59	663
# W/Id'd fish	161	65	14	7	9	256
# of Id'd fish	225	78	16	9	9	337
Chinook salmon	2	1				3
Steelhead						0
Delta smelt						0
Splittail						0
Threadfin shad	166	40	8	7	4	225
Anchovy	20	25	2		1	48
Sardine	6	3				9
Catfish		2				2
Gobies	18	2	1		1	22
Lamprey	2	2			1	5
Tule perch	3	1		1		5
White croaker					1	1
Mackerel		1	4		1	6
Longfin smelt	1	1				2
Striped bass	4					4
Golden shiner	1			1		2
Sculpin	1		1			2
# W/ Unid'd fish	217	62	28	8	16	331

'umber of Striped Bass Stomachs Examined - 1994

Area	Season				
	W (Dec-Feb)	Sp (Mar-May)	Su (Jun-Aug)	F (Sep-Nov)	Total
Sacramento R. above Feather R. and Feather R.		5			5
Sacramento R. from Feather R. to Collinsville	133	16		166	315
Delta	61	2	1	174	238
Suisun Bay and Marsh	24			90	114
Carquinez Strait			7	6	13
San Pablo Bay				19	19
Total	218	23	8	455	704
Salmon Observed in Striped Bass Stomachs - number (approximate length)					
Sacramento R. from Feather R. to Collinsville				1 (very large: 30-35 cm)	
San Pablo Bay				1 (unknown)	

Number of Striped Bass Stomachs Examined - 1995

Area	Season				
	W (Dec-Feb)	Sp (Mar-May)	Su (Jun-Aug)	F (Sep-Nov)	Total
Sacramento R. above Feather R. and Feather R.		71	21		92
Sacramento R. from Feather R. to Collinsville	76	43	2	2	123
Delta	26	37	2	2	67
Suisun Bay and Marsh	15	21		1	37
Carquinez Strait			2		2
San Pablo Bay	1			2	3
Total	118	172	27	7	324
Salmon Observed in Striped Bass Stomachs - number (approximate length)					
Sacramento R. from Feather R. to Collinsville	1 (unknown)				

'umber of Striped Bass Stomachs Examined - 1996

Area	Season				
	W (Dec-Feb)	Sp (Mar-May)	Su (Jun-Aug)	F (Sep-Nov)	Total
Sacramento R. above Feather R. and Feather R.		12			12
Sacramento R. from Feather R. to Collinsville	16	13			29
Delta	12	13	1		26
Suisun Bay and Marsh	7	1			8
Carquinez Strait					0
San Pablo Bay	5	2		2	9
Total	40	41	1	2	84

Number of Striped Bass Stomachs Examined - 1997

Area	Season				
	W (Dec-Feb)	Sp (Mar-May)	Su (Jun-Aug)	F (Sep-Nov)	Total
Sacramento R. above Feather R. and Feather R.					0
Sacramento R. from Feather R. to Collinsville	2	9			11
Delta	15	3			18
Suisun Bay and Marsh					0
Carquinez Strait					0
San Pablo Bay	1				1
Total	18	12	0	0	30

ïumber of Striped Bass Stomachs Examined - 1998

Area	Season				
	W (Dec-Feb)	Sp (Mar-May)	Su (Jun-Aug)	F (Sep-Nov)	Total
Sacramento R. above Feather R. and Feather R.	46	12			58
Sacramento R. from Feather R. to Collinsville	3		4	1	8
Delta			1		1
Suisun Bay and Marsh	1			1	2
Carquinez Strait				1	1
San Pablo Bay	15			57	72
Total	65	12	5	60	142

11/12/99

APPENDIX I

IMPLEMENTING AGREEMENT

by and between

CALIFORNIA DEPARTMENT OF FISH AND GAME

U.S. FISH AND WILDLIFE SERVICE and
NATIONAL MARINE FISHERIES SERVICE

TO ESTABLISH A PROGRAM FOR ENDANGERED, THREATENED, AND FEDERAL PROPOSED SPECIES IMPACTED BY THE CALIFORNIA DEPARTMENT OF FISH AND GAME'S PROPOSED STRIPED BASS MANAGEMENT PROGRAM FOR THE SACRAMENTO-SAN JOAQUIN ESTUARY AND RIVER SYSTEM, CALIFORNIA.

This Implementing Agreement ("Agreement"), made and entered into as of the ___ day of ________, 1999 by and among the CALIFORNIA DEPARTMENT OF FISH AND GAME (CDFG), the UNITED STATES FISH AND WILDLIFE SERVICE (USFWS) and the NATIONAL MARINE FISHERIES SERVICE (NMFS) (NMFS and USFWS may be referred to collectively, as the Services), hereinafter collectively called the "Parties," defines the Parties' roles and responsibilities and provides a common understanding of action that will be undertaken to minimize and mitigate the effects of take of the subject listed and unlisted species incidental to the Striped Bass Management Program for the Sacramento-San Joaquin Estuary and river system.

1.0 <u>RECITALS</u>

This Agreement is entered into with regard to the following facts:

WHEREAS, the Striped Bass Management Program (Program) after environmental review has been determined to impact the Sacramento winter-run chinook salmon (*Oncorhynchus tshawytscha*) federally listed as endangered, the Central Valley spring-run chinook salmon *(Oncorhynchus tshawytscha)* federally listed as threatened, the Central Valley steelhead (*Oncorhynchus mykiss*) federally listed as threatened, the delta smelt (*Hypomesus transpacificus*) federally listed as threatened, and the Sacramento splittail (*Pogonichthys macrolepidotus*) federally listed as threatened, and potentially impact the giant garter snake (*Thamnophis gigas*) federally listed as threatened; and,

WHEREAS, the proposed Program also has been determined to potentially impact the Central Valley fall/late fall-run chinook salmon (*Oncorhynchus tshawytscha*) a federal candidate species; and,

WHEREAS, the CDFG, with technical assistance from the Services, has developed a series of measures, described in the November 12, 1999 *Conservation Plan for California Department of Fish and Game Striped Bass Management Program*, to minimize and mitigate to the extent practicable the effects of take of the subject listed and unlisted species incidental to the program,

THEREFORE, the Parties hereto do hereby understand and agree as follows:

2.0 DEFINITIONS

The following terms as used in this Agreement shall have the meanings set forth below:

2.10 **Terms defined in the Endangered Species Act.** Terms used in this agreement and specifically defined in the Endangered Species Act (Act) or in regulations adopted by the USFWS or NMFS under the Act have the same meaning as in the Act and those implementing regulations, unless this agreement expressly provides otherwise.

2.11 The term "**Permit**" or "**Permits**" shall mean incidental take permits issued by the USFWS and NMFS to the CDFG pursuant to Section 10(a)(1)(B) of the Endangered Species Act (ESA).

2.12 The term "**Permit Area**" shall mean the Sacramento-San Joaquin Estuary including San Francisco, San Pablo, and Suisun bays; the Sacramento-San Joaquin Delta and rivers; and the various channels, embayments, and streams tributary to these bays, delta, and rivers as depicted in Figure 1 of the Conservation Plan for the California Department of Fish and Game Striped Bass Management Program.

2.13 The terms "**Conservation Plan**" or "**Plan**" shall mean the November 12, 1999 conservation plan prepared for the Program.

2.14 The term "**Plan Species**" shall mean species adequately covered in the Plan and identified in Section 1.0 of this agreement.

2.15 The term "**Adequately Covered**" means that the Plan has satisfied the permit issuance criteria under Section 10(a)(2)(c) of the ESA for listed Plan Species and the permit issuance criteria under Section 10(a)(1)(B) that would otherwise apply if the unlisted Plan Species were actually listed (50 CFR Para 17.3 and Para 2.22.3).

2.16 The term **"Operating Conservation Program"** means the conservation and management measures provided under the Plan to minimize, mitigate, and monitor the impacts of take of the Covered Species as described in Chapters 13, 14, and 15 of the Plan.

2.17 The term **"Take"** means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect any Covered Species. Harm means an act that actually kills or injures a member of a Covered Species, including an act that causes significant habitat modification or degradation where it actually kills or injures a member of a Covered Species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering.

2.18 The term "**Unforeseen circumstances**" means changes in circumstances affecting a species or geographic area covered by a conservation plan that could not reasonably have been anticipated by plan developers and the Services at the time of the conservation plan's negotiation and development, and that result in a substantial and adverse change in the status of the covered species (50 CFR Part 17.3 and Part 222.3).

2.19 **"Changed circumstances"** means changes in circumstances affecting a Covered Species or the Permit Area that can reasonably be anticipated by the Parties and that can be planned for (e.g. the listing of a new species, or a fire or other natural catastrophic event in areas prone to such event). Changed circumstances and the planned responses to those circumstances are described in Chapter 14 of the Plan. Changed circumstances are not Unforeseen Circumstances.

2.20 **"Covered activities"** means certain activities carried out by the CDFG in the Permit Area that may result in incidental take of Covered Species. Covered activities means the following activities related to CDFG's Program, provided that these activities are otherwise lawful: rearing and stocking yearling and two-year old striped bass; maintaining or in accordance with the Plan, changing angling regulations allowing harvest of striped bass; monitoring abundance of striped bass and the Covered Species; other monitoring activities required by the permits and/or this agreement such as monitoring of predation on the covered species; and mitigation activities such as fish screen installation, operation, and maintenance, if such activities are consistent with all applicable regulations and conducted under the supervision/jurisdiction of CDFG.

3.0 CONSERVATION PLAN

Pursuant to the provisions of Section 10(a)(1)(B) of the ESA, the CDFG has prepared a Conservation Plan and submitted it to the Services with a request that the Services issue Permits to allow Covered Species to be incidentally taken within the Permit Area as depicted and described in Figure 1 of the Plan. The Plan describes a minimization and mitigation program for the Covered Species.

4.0 INCORPORATION OF CONSERVATION PLAN

The Plan and each of its provisions are intended to be, and by this reference are, incorporated herein. In the event of any direct contradiction between the terms of this Agreement and the Plan, the terms of this Agreement shall control. In all other cases, the terms of this Agreement and the terms of the Plan shall be interpreted to be supplementary to each other.

5.0 LEGAL REQUIREMENTS

In order to fulfill the requirements that will allow the Services to issue the Permits, the Plan sets forth measures that are intended to ensure that any take occurring within the Permit Area will be incidental; that the impacts of the take will, to the maximum extent practicable, be minimized and mitigated; that procedures to deal with changed and unforeseen circumstances will be provided; that adequate funding for the Plan will be provided; and that the take will not appreciably reduce the likelihood of the survival and recovery of the Covered Species in the wild. It also includes measures that have been suggested by the Services as being necessary or appropriate for purposes of the Plan.

6.0 COOPERATIVE EFFORT

In order that each of the legal requirements as set forth in Paragraph 5.0 hereof is fulfilled, each of the Parties to this Agreement must perform certain specific tasks as more particularly set forth in the Plan. The Plan thus describes a cooperative program by Federal and State agencies to minimize and mitigate the effects of the Program on the Covered Species.

7.0 TERMS USED

Terms defined and utilized in the Plan and the ESA shall have the same meaning when utilized in this Agreement, except as specifically noted.

8.0 PURPOSES

The purposes of this Agreement are:

8.1 To ensure implementation of each of the terms of the Plan;

8.2 To describe remedies and recourse should any Party fail to perform its obligations, responsibilities, and tasks as set forth in this Agreement; and,

8.3 As stated in paragraph 12.2.a hereof, to provide assurances to the CDFG that as long as the terms of the Plan and the Permits issued pursuant to the Plan and this Agreement are fully and faithfully performed, no additional mitigation will be required except as provided for in this Agreement and the Plan or required by law.

9.0 TERM

9.1 Stated Term. This Agreement and the Plan are effective this ___ day of ___, 1999. This Agreement, the Plan, and the incidental take permits issued by USFWS and NMFS will remain in effect for a period of 10 years from the effective date contained in the preceding sentence unless terminated as provided below.

9.2 Mutual Termination. This Agreement may be terminated at any time upon the unanimous consent of the CDFG, NMFS, and USFWS.

9.3 Permit Suspension or Revocation. Each Service may suspend or revoke the Permit that it issued for cause in accordance with applicable laws and regulations. (See 5 U.S.C. § 558; 50 C.F.R. §§ 13.27-13.29, 222.306; 15 C.F.R. Part 904.) Such suspension or revocation may apply to an entire permit, or only to specified Covered Species, Permit Areas, or covered activities. In the event of suspension or revocation, the CDFG's obligations under this Agreement and the Plan will continue until the appropriate Service(s) determine(s) that all unauthorized take of Covered Species that occurred under that Permit has been fully mitigated in accordance with the Plan. Permits issued by USFWS and NMFS are severable; suspension or revocation of one Permit shall not automatically cause suspension or revocation of the other Permit, provided that suspension or revocation of one of the Permits may require a reevaluation of the other Permit to ensure that the take authorized by the remaining Permit shall not result in unauthorized take of or jeopardy to the continued existence of any Covered Species, or adverse modification of the critical habitat of any Covered Species.

9.4 Treatment of Unlisted Plan Species. For purposes of Section 9.3, unlisted Plan Species will be treated as though they were listed species in determining the amount of take and the mitigation required. Subject to compliance with all other terms of this Agreement and the Plan, the Permits shall become effective as to each Covered Species that is not a listed species concurrent with the listing of such species under the ESA.

9.5 Permit Relinquishment. This Agreement shall terminate upon the relinquishment of both Permits by the CDFG.

10.0 FUNDING

The CDFG will provide such funds as may be necessary to carry out its obligations under the Plan. The CDFG should notify the Services, if the CDFG's funding resources have materially changed, including a discussion of the nature of the change, from the information provided in Chapter 16 of the Plan.

11.0 RESPONSIBILITIES OF THE PARTIES IN CONSERVATION PLAN IMPLEMENTATION

11.1 Responsibilities of CDFG.

a. A properly implemented conservation plan means that the Plan, this Agreement, and the Permits have been or are being fully implemented.

b. CDFG shall undertake all measures set forth in the Plan to minimize and mitigate the impacts of the Program on the Covered Species, as summarized in subparagraphs (c) and (d) below.

c. CDFG will implement all measures described in Chapter 13, Section C of the Plan to minimize take of the Covered Species. The key minimization measures are summarized below:

(1) Stock striped bass at times and locations that avoid immediate

conflict between striped bass and the Covered Species.

(2) Comprise the striped bass stocking allotment of yearling equivalents with some proportion of two-year-old bass to reduce predation impacts on the Covered Species as described in Chapter 13 and Table 13 of the Plan.

(3) If monitoring demonstrates that incidental catches of chinook salmon and/or steelhead by striped bass anglers are significant, CDFG will work cooperatively with NMFS to develop and recommend to the Fish and Game Commission striped bass fishing regulations that will reduce or eliminate such incidental take.

(4) Modify adult striped bass gill netting activities to reduce impacts to the Covered Species.

(5) Cease gill netting and fyke trapping for striped bass monitoring when the catch of adult winter-run chinook salmon or adult spring-run chinook salmon reaches 1% of the escapement of the corresponding run three years earlier or ten winter-run salmon, whichever occurs sooner.

(6) If sampling indicates giant garter snakes are taken in excess of the authorized level, CDFG shall immediately consult with USFWS regarding appropriate minimization measures. Such measures may include placing escape structures in water diversions to allow snakes to climb out of the water, and/or acquisition of wetland and associated upland areas to provide foraging and basking habitat.

d. CDFG will implement all measures described in Chapter 13, Section D of the Plan to mitigate for adverse effects of the Program on the Covered Species. The key mitigation measures are summarized below:

(1) To mitigate take of chinook salmon and Central Valley steelhead, CDFG will provide funding for the installation, operation, and maintenance of fish screens on water diversions in the Sacramento River totaling a minimum of 200 cubic-feet-per-second (cfs). If NMFS determines that listing of Central Valley fall/late fall-run chinook salmon is not warranted, CDFG will provide funding for the installation, operation, and maintenance of fish screens on Sacramento River water diversions totaling 150 cfs.

(2) To mitigate take of delta smelt and Sacramento splittail, CDFG will install or provide funding for installation of fish screens in the western Delta or Suisun Marsh and ensure operation and maintenance of those screens. The amount of cfs to be screened will be based on the total number of striped bass stocked and the proportion of yearlings and two-year-olds, as described in Chapter 13, Section D.2 of the Plan.

(3) If sampling indicates giant garter snakes are taken in excess of the authorized level, CDFG shall immediately consult with USFWS regarding appropriate mitigation measures.

e. CDFG shall undertake all measures set forth in Chapter 13, Section A of the Plan to monitor the impacts of the Program on the Covered Species. Below is a summary of the key elements CDFG will monitor:

(1) Striped bass predation on the Covered Species.

(2) Abundance of chinook salmon, Central Valley steelhead, delta smelt, and Sacramento splittail.

f. CDFG will prepare annual written reports for each year during which the Plan is in effect, as described in Chapter 15 of the Plan. Annual reports will be submitted to the Services by February 28 of the year following the calendar year to which the report applies. A summary of the key contents of each annual report is provided below:

(1) An estimate of the population of striped bass, chinook salmon, Central Valley steelhead, delta smelt, and Sacramento splittail.

(2) Actual or estimated incidental take of Covered Species during monitoring activities.

(3) Numbers, age composition, location, and dates of striped bass stocked.

(4) The results of striped bass stomach content analyses.

(5) An estimate of the likely predation rates of striped bass on the Covered Species based on the stomach content analyses.

(6) Estimated total levels of take of the Covered Species.

(7) A description of the mitigation activities conducted.

g. CDFG will provide adequate funding for implementation of the Plan as described in Chapter 16 of the Plan. CDFG may utilize funding provided by a number of sources, including the Striped Bass Stamp Fund; if adequate funding is not available from sources other than the Striped Bass Stamp Fund, CDFG will fund implementation of the Plan using the Striped Bass Stamp Fund. If adequate funding to implement the Plan is not secured, CDFG will suspend the striped bass stocking program; further, lack of adequate funding could result in suspension or revocation of the Permit.

h. Incidental take of any of the Covered Species due to installation, operation, and/or maintenance of the screens shall be covered by the Plan and associated Section 10(a)(1)(B) permits, if such activities are consistent with all applicable regulations and conducted under the supervision/jurisdiction of CDFG.

11.2 Responsibilities of the Services.

a. The Services shall cooperate and provide, to the extent funding is available, technical assistance to CDFG as detailed in the Plan and summarized below. Nothing in this Agreement shall require the Services to act in a manner contrary to the requirements of the Anti-Deficiency Act.

(1) The USFWS shall work cooperatively with CDFG to evaluate potential adjustments to the Plan as described in Chapter 13, Section B and Chapter 14 of the Plan, and review mitigation proposals as described in Chapter 13 Section E.2 of the Plan.

(2) The NMFS shall conduct testing of winter-run chinook salmon cohort replacement rates (as described in Chapter 14, Section A.1.2 of the Plan); work cooperatively with CDFG to evaluate potential adjustments to the Plan as identified in Chapter 13, Section B and Chapter 14 of the Plan; and review mitigation proposals as described in Chapter 13, Section E.1 of the Plan.

b. After issuance of the Permits, the Services shall monitor the implementation thereof, including each of the terms of this Agreement and the Plan in order to ensure compliance with the Permits, the Plan and this Agreement.

12.0 REMEDIES AND ENFORCEMENT

12.1 REMEDIES IN GENERAL

Except as set forth below, each Party shall have all remedies otherwise available to enforce the terms of this Agreement, the Permits, and the Plan, and to seek remedies for any breach hereof, subject to the following:

a. NO MONETARY DAMAGES

No Party shall be liable in damages to the any other Party or other person for any breach of this Agreement, any performance or failure to perform a mandatory or discretionary obligation imposed by this Agreement or any other cause of action arising from this Agreement. Notwithstanding the foregoing:

(1) Retain Liability

All Parties shall retain whatever liability they would possess for their present and future acts or failure to act without existence of this Agreement.

(2) Land Owner Liability

All Parties shall retain whatever liability they possess as an owner of interests in land.

(3) Responsibility of the United States

Nothing contained in this Agreement is intended to limit the authority of the United States government to seek civil or criminal penalties or otherwise fulfill its enforcement responsibilities under the ESA.

b. INJUNCTIVE AND TEMPORARY RELIEF

The Parties acknowledge that the Covered Species are unique and that their loss as a species would result in irreparable damage to the environment and that therefore injunctive and temporary relief may be appropriate to ensure compliance with the terms of this Agreement.

12.2 LIMITATIONS AND EXTENT OF ENFORCEABILITY

a. CONSERVATION PLAN ASSURANCES

Consistent with the final rule addressing Habitat Conservation Plan Assurances (*Federal Register* Vol. 63, No. 35, February 23, 1998), subject to the availability of appropriated funds as provided in Paragraph 14.6 hereof, and except as otherwise required by law, the Services will not require the commitment of additional land, water, or financial compensation or additional restrictions on the use of land, water, or other natural resources beyond the level otherwise agreed upon for the Covered Species without the consent of CDFG, provided that the Plan is being properly implemented. If additional conservation or mitigation measures are deemed necessary to respond to unforeseen circumstances, the Services may require additional measures of CDFG only if such measures are limited to modifications to the Plan's operating conservation program for the affected species and maintain the original terms of the Plan to the maximum extent possible. Such additional conservation and mitigation measures will not involve the commitment of additional land, water, or financial compensation or additional restrictions on the use of land, water, or other natural resources otherwise available for development or use under the original terms of the Plan without the consent of CDFG.

(1) Interim obligations upon a finding of unforeseen circumstances.

If the Services make a finding of unforeseen circumstances, during the period necessary to determine the nature and location of additional or modified mitigation, CDFG will avoid contributing to appreciably reducing the likelihood of the survival and recovery of the affected species.

b. LEGAL AUTHORITIES UNAFFECTED

Nothing in this Agreement shall absolve the CDFG from such other limitations as may apply to the permitted activities under other laws of the United States and the State of California.

13.0 CHANGED CIRCUMSTANCES

13.1 CDFG-INITIATED RESPONSE TO CHANGED CIRCUMSTANCES

CDFG will give notice to the Services within seven days after learning that any of the changed circumstances listed in Chapter 14 of the Plan has occurred. As soon as practicable thereafter, but no later than 30 days after learning of the changed circumstances, CDFG will modify its activities in the manner described in Chapter 14 of the Plan, and will report to the Services on its actions. CDFG will make such modifications without awaiting notice from the Services.

13.2 SERVICE-INITIATED RESPONSE TO CHANGED CIRCUMSTANCES

If the Services determine that changed circumstances have occurred and that CDFG has not responded within 30 days in accordance with Chapter 14 of the Plan, the Services will so notify CDFG and will direct CDFG to make the required changes. Within 30 days after receiving such notice, CDFG will make the required changes and report to the Services on its actions. Such changes are provided for in the Plan, and hence do not constitute unforeseen circumstances or require amendment of the permit or Plan.

13.3 LISTING OF SPECIES THAT ARE NOT COVERED SPECIES

In the event that a non-covered species that may be affected by covered activities becomes listed under the ESA, CDFG will implement the "no-take/no-jeopardy" measures identified by the Services until the Plan is amended to adequately cover such species and the permit is amended to include such species, or until the Services notify CDFG that such measures are no longer needed to avoid jeopardy to, take of, or adverse modification of the critical habitat of the non-covered species. Permit amendments may require additional minimization and mitigation measures to adequately cover non-covered species

14.0 ADAPTIVE MANAGEMENT

14.1 CDFG-INITIATED ADAPTIVE MANAGEMENT

CDFG will implement the adaptive management provisions in Chapter 13 of the Plan, when changes in management practices are necessary to achieve the Plan's biological objectives, or to respond to monitoring results or new scientific information. CDFG will make such changes without awaiting notice from the Services and will report to the Services on any actions taken pursuant to this section.

14.2 SERVICE-INITIATED ADAPTIVE MANAGEMENT

If the Services determine that one or more of the adaptive management provisions in the Plan have been triggered and that CDFG has not changed its management practices in accordance with Chapter 13 of the Plan, the Services will so notify CDFG and will direct CDFG to make the required changes. Within 30 days after receiving such notice, CDFG will make the required changes and report to the Services on its actions. Such changes are provided for in the Plan, and hence do not constitute unforeseen circumstances or require amendment of the permit or Plan, except as provided in this section.

14.3 REDUCTIONS IN MITIGATION

CDFG will not implement adaptive management changes that may result in less mitigation than provided for covered species under the original terms of the Plan, unless the Services first provide written approval. CDFG may propose any such adaptive management changes by notice to the Services, specifying the adaptive management modifications proposed, the basis for them, including supporting data, and the anticipated effects on covered species, and other environmental impacts. Within 120 days of receiving such a notice, the Services will either approve the proposed adaptive management changes, approve them as modified by the Services, or notify CDFG that the proposed changes constitute permit amendments that must be reviewed under Section 12.1 of this agreement.

14.4 NO INCREASE OR CHANGE IN TAKE

This section does not authorize any modifications that would result in an increase in the amount or change the nature of take, or increase the impacts of take, of covered species beyond that analyzed under the original Plan and any amendments thereto. Any such modification must be reviewed as a permit amendment under Section 12.1 of this agreement.

15.0 <u>MODIFICATIONS AND AMENDMENTS</u>

Except as otherwise set forth herein, the Plan and this Agreement may be amended consistent with the ESA and with the written consent of each of the Parties hereto. Amendments to the Conservation Plan and/or the Permits are described in Chapter 18 of the Plan.

15.1 MINOR MODIFICATIONS

Any party may propose minor modifications to the Plan of this agreement by providing notice to all other parties. Such notices shall include a statement of the reason for the proposed modification and an analysis of its environmental effects, including its effects on operations under the Plan and on Covered Species. The parties will use best efforts to respond to proposed modifications within 60 days of receipt of such notice. Proposed modifications will become effective upon all other parties' written approval. If, for any reason, a receiving party objects to a proposed modification, it must be processed as an amendment of the permit in accordance with subsection 12.2 of this section. The Services will not approve minor modifications to the Plan of this agreement if the Services determine that such modifications would result in operations under the Plan that are significantly different from those analyzed in connection with the original Plan, adverse effects on the environment that are new or significantly different from those analyzed in connection with the original Plan, changes in the amount or extent of take, or additional forms of take not analyzed in connection with the original Plan.

Minor modifications to the Plan and Agreement processed pursuant to this subsection may include but are not limited to the following:

(1) corrections of typographic, grammatical, and similar editing errors that do not change the intended meaning;

(2) correction of any maps or exhibits to correct errors in mapping or to reflect previously approved changes in the permit or Plan;

(3) minor changes to survey, monitoring or reporting protocols;

(4) other types of modifications that are minor in relation to the Plan, that the Services have analyzed and agreed to, and on which the public has had an opportunity to comment; and

(5) any other modifications to the Plan or Agreement will be processed as amendments or the permit in accordance with subsection 12.2 of this section.

15.2 AMENDMENT OF THE PERMIT

The permit may be amended in accordance with all applicable legal requirements, including but not limited to the ESA, the national Environmental

Policy Act, and the Services' permit regulations. The party proposing the amendment shall provide a statement of the reasons for the amendment and an analysis of its environmental effects, including its effects on operations under the Plan and on Plan species.

16.0 MISCELLANEOUS PROVISIONS

16.1 NO PARTNERSHIP

Except as otherwise expressly set forth herein, neither this Agreement nor the Plan shall make or be deemed to make any Party to this Agreement the agent for or the partner of any other Party.

16.2 SUCCESSORS AND ASSIGNS

This Agreement and each of its covenants and conditions shall be binding on and shall inure to the benefit of the Parties hereto and their respective successors and assigns. Assignment or other transfer of the permit shall be governed by the Services' regulations.

16.3 NOTICE

Any notice permitted or required by this Agreement shall be delivered personally to the persons set forth below or shall be deemed given five (5) days after deposit in the United States mail, certified and postage prepaid, return receipt requested and addressed as follows or at such other address as any Party may from time to time specify to the other Parties in writing:

Assistant Regional Director
United States Fish and Wildlife Service
911 NE 11th Avenue
Portland, Oregon 97232-4181

Field Supervisor
United States Fish and Wildlife Service
Sacramento Fish and Wildlife Office
2800 Cottage Way, Suite W2605
Sacramento, CA 95825

Regional Administrator
National Marine Fisheries Service
501 West Ocean Boulevard, Suite 4200
Long Beach, CA 90802-4213

Northern California Manager for Protected Resources
National Marine Fisheries Service
777 Sonoma Avenue, Room 325
Santa Rosa, CA 95404

Director
California Department of Fish and Game
1416 Ninth Street
Sacramento, CA 95814

16.4 ENTIRE AGREEMENT

This Agreement, together with the Plan and the Permits, constitutes the entire Agreement between the Parties. It supersedes any and all other Agreements, either oral or in writing among the Parties with respect to the subject matter hereof and contains all of the covenants and Agreements among them with respect to said matters, and each Party acknowledges that no representation, inducement, promise or Agreement, oral or otherwise, has been made by any other Party or anyone acting on behalf of any other Party that is not embodied herein.

16.5 ELECTED OFFICIALS NOT TO BENEFIT

No member of or delegate to Congress shall be entitled to any share or part of this Agreement, or to any benefit that may arise from it.

16.6 AVAILABILITY OF FUNDS

Implementation of this Agreement and the Plan by the Services is subject to the requirements of the Anti-Deficiency Act and the availability of appropriated funds. Nothing in this Agreement will be construed by the parties to require the obligation, appropriation, or expenditure of any money from the U.S. treasury. The parties acknowledge that the Services will not be required under this Agreement to expend any Federal agency's appropriated funds unless and until an authorized official of that agency affirmatively acts to commit to such expenditures as evidenced in writing.

16.7 DUPLICATE ORIGINALS

This Agreement may be executed in any number of duplicate originals. A complete original of this Agreement shall be maintained in the official records of each of the Parties hereto.

16.8 THIRD PARTY BENEFICIARIES

Without limiting the applicability of the rights granted to the public pursuant to the provisions of 16 U.S.C. § 1540(g), this Agreement shall not create any right or interest in the public, or any member thereof, as a third party beneficiary hereof, nor shall it authorize anyone not a Party to this Agreement to maintain a suit for personal injuries or property damages pursuant to the provisions of this Agreement. The duties, obligations, and responsibilities of the Parties to this Agreement with respect to third parties shall remain as imposed under existing Federal or State law.

16.9 RELATIONSHIP TO THE ESA AND OTHER AUTHORITIES

The terms of this Agreement shall be governed by and construed in accordance with the ESA and other applicable laws. In particular, nothing in this Agreement is intended to limit the authority of the Services to seek penalties or otherwise fulfill their responsibilities under the ESA. Moreover, nothing in this Agreement is intended to limit or diminish the legal obligations and responsibilities of the Services as agencies of the Federal government.

16.10 REFERENCES TO REGULATIONS

Any reference in this Agreement, the Plan, or the Permits to any regulation or rule of the Services shall be deemed to be a reference to such regulation or rule in existence at the time an action is taken.

16.11 APPLICABLE LAWS

All activities undertaken pursuant to this Agreement, the Plan, or the Permits must be in compliance with all applicable State and Federal laws and regulations.

IN WITNESS WHEREOF, THE PARTIES HERETO have executed this Implementing Agreement to be in effect as of the date last signed below.

BY ______________________________ Date ________

Thomas Dwyer
Deputy Regional Director
United States Fish and Wildlife Service
Portland, Oregon

BY ______________________________ Date ________

Rodney R. McInnis
Acting Regional Administrator
National Marine Fisheries Service
Long Beach, California

BY ______________________________ Date ________

Robert C. Hight
Director
California Department of Fish and Game
Sacramento, California

APPENDIX J

Status of Giant Garter Snake

Population Status

There are thirteen identified giant garter snake subpopulations as described below:

1. Butte Basin: There are seventeen California Natural Diversity Database (NDDB) records for the Butte Basin population of giant garter snakes. These records include sightings on Butte Creek, Gray Lodge Wildlife Area, and Upper Butte Basin Wildlife Area (Little Dry Creek, Llano Seco, and Howard's Slough Units). Giant garter snakes have been sighted during 1997 along Butte Creek and adjacent agricultural ditches, and on Gray Lodge Wildlife Area (Service files 1-1-97-F-9 and 1-1-97-F-61). The Biological Resources Division (BRD) of USGS also recently surveyed the Butte Sink NWR. Though giant garter snakes were found during this survey in the Butte Sink area, the snakes were not present in high enough numbers to be a viable study site for the BRD telemetry study (Glenn Wylie, pers. comm.). Existing records indicate the species is widely distributed in low population numbers/densities, primarily in water delivery/drainage facilities, perhaps associated rice fields, and in duck clubs and managed marsh. Although giant garter snakes are still extant in the Butte Basin, the size and status of this population is not known.

   Gray Lodge Wildlife Area, a known location of giant garter snakes, encompasses 8,400 acres in Sutter and Butte Counties and currently manages approximately 4721 acres as wetlands, some of which provide giant garter snake habitat. Gray Lodge receives water from the Feather River and Thermalito Afterbay. Surface water sources are supplemented by groundwater wells. Gray Lodge also diverts water from the RD 833 Drain and the RD 2054 Drain, which carry agricultural return flows. (U.S. Department of the Interior).

2. Colusa Basin: Ten NDDB locality records are known from the basin and tributary streams/canals. These records include sightings on Delevan National Wildlife Refuge (NWR), Glenn-Colusa Canal, Colusa Trough, Colusa Basin Drainage Canal, and several tributary streams between the towns of Williams and Maxwell. Currently, Colusa and Sacramento NWRs support populations of giant garter snakes and are study sites for the BRD telemetry study (Glenn Wylie, pers. comm.). These represent stable, relatively protected populations of giant garter snakes. However, available information indicates a tenuous connection between localities clustered at the north and south end of the basin.

Sacramento, Delevan, and Colusa Refuges receives Central Valley Project (CVP) water through Glenn-Colusa Irrigation District (GCID) facilities. The main water source is the Sacramento River. Water is also obtained from Black Butte Reservoir through Stony Creek. Delevan and Colusa NWRs both currently receive agricultural return flows. Currently, Colusa NWR receives most of its water from the 2047 Drain (Colusa Basin Drainage Canal). Both Delevan and Colusa NWRs receive CVP water through GCID; however, a portion of this is agricultural return flow. (U.S. D.I.)

3. Sutter Basin: Five NDDB locality records are known from the Sutter basin and tributary streams/canals. These locality records include the Snake River, Gilsizer Slough, and various canals within the basin. Gilsizer Slough, adjacent to the Sutter Bypass, is currently a BRD study site. Giant garter snakes have also been tracked using the East Borrow Ditch within the Sutter Bypass/Sutter NWR. Although Gilsizer Slough and the Sutter NWR are relatively protected and support a large population of giant garter snakes, no protected wetland areas exist outside these two adjacent sites.

Sutter NWR encompasses 2591 acres in Sutter County. More than 85% of the water supply for Sutter NWR comes from irrigation and return flows in the East and West Borrow Ditches of the Sutter Bypass. Agricultural return flows make up the majority of the summer and fall flows to Sutter NWR. The main water sources are the Feather River and Thermalito Afterbay (U.S. Department of the Interior).

4. Yolo Basin - Willow Slough: Five NDDB records are known from the Yolo Basin - Willow Slough subpopulation of giant garter snakes. These records occur along Willow Slough, Willow Slough Bypass, and the Yolo Bypass near the Cache Creek Settling Basin, and Putah Creek. The Putah Creek population within this basin apparently has been extirpated (G. Hansen, 1992) because of stream desiccation caused by upstream water diversions and impoundments (USFWS 1994). Available habitat is limited, degraded, and largely unnatural. Based on habitat scarcity and an associated small population size, threats are imminent and severe. Because of its small size, this population is vulnerable to extinction from stochastic (random) environmental, demographic, and genetic processes. Primary threats include proposed urban development, flood control and agricultural practices, flooding, road mortality, and predatory fish.

The Cache Creek watershed is contaminated by mercury from mining activities. Shallow groundwater wells within Yolo County contain high levels of selenium. Potential synergistic effects of mercury and selenium contamination could occur within this subpopulation.

5. Yolo Basin - Liberty Farms: Two NDDB records from an irrigation canal network, combined with an absence of suitable, natural habitat in the area, suggest this population is restricted entirely to degraded, artificial habitat. Livestock grazing appears to be a primary threat. Based on habitat scarcity and an associated small population size, threats are imminent and severe, similar to those at Willow Slough, absent the threat of urban development.

Water sources for this area are primarily the agricultural waterways associated with the Delta. The Yolo Bypass and the upstream sources described in the Yolo Basin - Willow Slough subpopulations also are potential sources of water.

6. American Basin: The numerous records distributed throughout most of the basin indicate a large giant garter snake population inhabits this rice production district. Scattered natural habitats comprise a small component of this larger, agricultural habitat complex. Flooding and development threats imperil this population.

The Sacramento and Feather Rivers are the main water sources for the American Basin. Creeks draining the Sierran foothills (i.e., Auburn Ravine, Coon Creek) also contribute water to the Basin.

7. Sacramento Basin: Seven NDDB locality records are known for the Sacramento Basin subpopulation. These records date 1992 and prior. These locality records include Beach Lake, Snodgrass Slough, Stone Lakes NWR, and Laguna, Morrison and Elk Grove Creeks. Surveys conducted by the Biological Resources Division (BRD) of the USGS during the summer of 1997 did not detect giant garter snakes on Stone Lakes NWR (G. Wylie, pers. comm.). Because the Stone Lakes NWR has little upland refugia, Dr. Wylie concluded that giant garter snake populations in the area may have been severely reduced by the prolonged flooding during January 1997, and that the giant garter snake populations have not had sufficient time to recover. However, Stone Lakes NWR contains suitable supporting habitat. Numerous development projects have been constructed in or near giant garter snake habitat in this rapidly urbanizing area. Any remaining populations are vulnerable to secondary effects of urbanization, such as increased predation by house cats and increased vehicular mortality. Most documented localities have been adversely impacted by development, including freeway construction, flood control projects, and commercial development. Several former localities are known to have been lost and/or depleted to the extent that continued viability is in question (Hansen, 1992, G. Hansen, pers. comm., 1992). The scarcity of remaining suitable habitat, flooding, stochastic processes, and continued threats of habitat loss pose a severe, imminent threat to this population.

Stone Lakes NWR is the largest remaining parcel of giant garter snake habitat in this subpopulation. Currently, the refuge receives water from Morrison and Laguna Creeks and from the Delta via Snodgrass Slough.

8. Badger/Willow Creeks: Three NDDB locality records are known from Badger and Willow Creeks and the marsh at their confluence. These drainages are tributary to the Cosumnes River. The Badger Creek Marsh is currently a BRD study site for giant garter snake telemetry studies. Though the marsh supports a large population of giant garter snakes, it is restricted to less than about 200 acres of natural, emergent marsh. Habitat scarcity and limited population size render the giant garter snake vulnerable to extinction in this area from stochastic environmental, demographic, and genetic processes. This subpopulation is an important stable population linking the Sacramento and San Joaquin Valley subpopulations and may be vital to the recovery of the species in the southern portion of its current range.

The Cosumnes River and its tributaries drain the Sierran foothills. Gold mining activities in the foothills may contribute to mercury contamination in these drainages.

9. Caldoni Marsh: Four NDDB locality records are known from the Caldoni Marsh area. Also known as White Slough Wildlife Area, only about 50 acres of suitable habitat remains, the most valuable portion situated on private land. Approximately 280 acres of habitat was eliminated during the construction of Interstate 5 around 1978 to 1979. Restricted to such a small patch size of remaining habitat, this population is highly vulnerable to extinction from stochastic processes. A locality record along Eight Mile Road possibly connected with this population apparently has been extirpated due to habitat loss (J. Brode, CDFG, pers. comm. 1992; G. Hansen, in litt., 1992). Several giant garter snakes were observed in the Caldoni Marsh area during 1995 surveys (G. Hansen, 1996).

White Slough is on the eastern periphery of and is hydrologically part of the Delta. The Delta hydrology could significantly affect contaminants distribution within the Caldoni Marsh - White Slough area. Contaminants distribution in this area would depend on predominant flow. Location within the San Joaquin Valley combined with Delta hydrology could produce high concentrations of contaminants, particularly selenium, in this area.

10. East Stockton: Two NDDB locality records are known from this subpopulation. Known from only a few locality records along the Diverting Canal and Duck Creek, the status of this population is unknown. Surveys during 1995 did not

detect giant garter snakes at previously recorded localities (G. Hansen, 1996). Suitable habitat is dependent upon vegetation maintenance practices in flood control bypass channels, and is highly degraded. Impacts associated with channel maintenance and vehicular mortality represent the most imminent and severe threat. The age of giant garter snake records raise questions regarding the long-term viability of this population. Stochastic threats to this population, if it is still extant, are similar to those described for the other smaller populations.

11. North and South Grasslands: Twenty-four records in the California Natural Diversity Data Base, all prior to 1976. These localities include Los Banos Wildlife Management Area, San Luis NWR, Salt and Mud Sloughs, Los Banos and Garza Creeks, agricultural canals and waterways, and duck clubs. These records delimited a formerly extensive complex of occupied suitable habitat, probably the largest regional population in the San Joaquin Valley since the demise of the Tulare and Buena Vista lakebeds. However, Hansen (1988) searched 38 localities in 1986 to 1987, and Beak (1992) searched seven localities in 1992. Neither survey found any giant garter snakes. As discussed in more detail in the final rule (58 FR 54053 under Factor E - Contaminants) the prevalence of selenium and salinity contamination throughout this area and absence of any giant garter snake sightings since the 1970's indicates this population is at risk. Surveys in 1995 of previously recorded locations and adjacent waterways detected only two giant garter snakes south of the town of Los Banos (G. Hansen, 1996). In many areas, the restriction of suitable habitat to water canals bordered by roadways and levee tops renders giant garter snakes vulnerable to vehicular traffic and vegetation maintenance practices. In addition, livestock grazing has heavily impacted certain areas in proximity to known locality records (J. Brode, pers. comm., 1992). Overall, threats to this population are imminent and severe.

As discussed in more detail in the final rule (58 FR 54053 under Factor E - Contaminants) the prevalence of selenium and salinity contamination throughout this area and the apparent decline of giant garter snakes in the San Joaquin Valley indicates this population is at risk.

12. Mendota: Five NDDB locality records are known from the Mendota area. As recently as the late 1970's and perhaps early 1980's, a relatively small acreage of habitat in and around the northern portions of the Mendota Waterfowl Management Area and to a lesser extent, Mendota Pool, supported a robust population of giant garter snakes. Mendota Waterfowl Management Area yielded 20 captures in a single day in April 21, 1976 (58 FR 54053). However, flooding during the winter of 1985 to 1986, presence of predatory fish, vehicular mortality, poor water quality, and disturbance and persecution by

fishermen and recreationists, apparently has depleted population levels at this former stronghold (J. Brode, pers. comm., 1992; G. Hansen, pers. comm., 1992). Recent survey efforts by Hansen (1988) failed to observe any giant garter snakes. Surveys in 1995 of previously recorded locations detected one road-killed giant garter snake and sighted one presumed giant garter snake (the snake was not captured to verify identity) on the Mendota Wildlife Area (G. Hansen 1996).

Water sources for the Mendota Waterfowl Management Area are supplied from Fresno Slough. The Mendota Pool is supplied by the San Joaquin River.

13. Burrell/Lanare: Two NDDB locality records are known from this area, both prior to 1980. These localities are on Fresno Slough and near Turner and Burrell Ditches between the towns of Burrell and Lanare. The remnant population in this area never was secure or prevalent, based on the limited amount of fragmented habitat available along a few irrigation/drainage canal networks. Surveys during 1986 and 1995 did not detect giant garter snakes in this subpopulation. Recent observations (J. Brode, pers. comm., 1992; G. Hansen, pers. comm., 1992) found deteriorating habitat conditions caused by canal maintenance practices, public use, and presence of predatory fish. Accordingly, Hansen (Brode, J. and G. Hansen 1992) concluded that this population apparently has been extirpated. If still extant, threats are imminent and severe, including threats associated with small population size, such as stochastic events.

The two records in this area both occurred in agricultural waterways with unknown water sources.

Problems affecting giant garter snake

Certain agricultural and flood control practices can destroy habitat that supports the giant garter snake. For example, intensive vegetation control activities along canal banks can fragment and isolate available habitat. In addition, Hansen (1982, 1986), G. Hansen (pers. comm.), and J. Brode (pers. comm.) have observed livestock grazing threats to four populations of the species. Studies on other garter snake species have established a negative cause and effect relationship between livestock grazing and snake population demographics (Szaro *et al.* 1989). The giant garter snake requires dense vegetative cover in proximity to waterside foraging and basking habitats in which to seek refuge from predators and other forms of disturbance. Livestock grazing along the edges of water sources degrade habitat quality by reducing vegetative cover, water pollution, and directly and indirectly reducing or eliminating fish and amphibian prey populations.

Predation levels on the giant garter snakes have increased due to a number of factors. A number of native mammals and birds are known or likely predators of giant garter snakes, including raccoons, skunks, opossums, foxes, hawks, egrets, and herons. The abundance and diversity of predators and a paucity of escape cover in remaining giant garter snake habitat suggest that predation pressure on this species probably is severe (Hansen and Hansen 1990). The high fecundity (Hansen and Hansen 1990) and extremely wary behavior (Hansen 1980 and references cited herein) of the species provide additional evidence that the species has developed physiological and behavioral adaptations to help withstand predatory pressure. Hansen (1986) observed that nearly all giant garter snakes captured and examined possessed scars or recent injuries presumably acquired during attacks by predators.

Few, if any, native fish species pose a predatory threat to the giant garter snake. However, introduced largemouth bass and catfish are voracious, opportunistic predators of many species of invertebrates, fish, reptiles, amphibians, birds, and small mammals, and have become established in virtually all permanent and semipermanent waters throughout the Central Valley (Dennis Lee, pers. comm.). These introduced predatory fishes have been responsible for eliminating many species of native fishes and aquatic vertebrates in the western United States (Minkley 1973; Moyle 1976).

Introduction of the bullfrog *(Rana catesbianna)* to virtually all areas inhabited by the giant garter snake further increases the threat of predation facing the species. The spread of bullfrogs has contributed to the demise of numerous species of native amphibians and reptiles (S. Sweet, University of California at Santa Barbara *in litt.*, 1992; Schwalbe and Rosen 1989; Holland, 1992). Bury and Whelan (1984) cited 14 cases of bullfrogs eating snakes. These studies documented (1) bullfrog ingestion of garter snakes up to 80 cm (31.5 in) in length, (2) depletion of giant garter snake age class structure less than 80 cm length (snout-vent), and (3) disappearance and resurgence of garter snake populations coincident with the introduction and decline of bullfrog populations. Schwalbe and Rosen (1989) concluded that bullfrogs have a high potential for eliminating garter snake populations. Treanor (1983) found that unidentified garter snakes *(Thamnophis spp.)* comprised 6.0 and 6.4 percent volume of bullfrog stomach contents in the month of July and August at Gray Lodge Waterfowl Management Area, a known garter snake location.

Contaminants, such as fertilizers, pesticides, and heavy-metals could adversely affect giant garter snake populations by degrading water quality and reducing prey populations. Selenium contamination of agricultural drain water appears to pose a severe threat to any giant garter snake population that still may inhabit the Grasslands region of Western Merced County in the San Joaquin Valley. High levels of selenium contamination have been documented in biota form (from?) at least six major canals and water courses in the Grasslands (Saiki *et al.* 1991, 1992) that have giant garter snake records. The bioaccumulative food chain threat of selenium contamination on fish, frogs, and fish-eating birds in the region has been well documented (Ohlendorf *et al.* 1986, 1988; Saiki and Lowe 1987; Saiki and May 1988; Hothem and Ohlendorf 1989; Saiki *et al.* 1991, 1992, 1993). Contaminant studies on aquatic organisms and their habitats in the Grasslands and neighboring areas documented elevated levels of waterborne selenium in many representative water bodies in this region that exceeded known toxicity thresholds for giant garter snake prey species (San Joaquin Valley Drainage Program 1990; Central Valley Water Quality Control Board 1992; Hermanutz 1992; Hermanutz *et al.* 1992; Hermanutz *in litt.*, 1992; Nakamoto and Hassler 1992). Elevated salinities of waters in the Grasslands due to a sodium sulfate based salt have also been

documented at deleterious levels in resident fishes and amphibians (Ohlendorf *et al.* 1986, 1988; Saiki *et al.* 1992), the major food source of giant garter snakes.

Mercury also is present in numerous drainages in the Central Valley due to past mercury and gold mining activity. Sacramento Valley refuges and other areas supporting giant garter snake populations also receive water from drainages which may contribute mercury to the aquatic systems. These drainages include the Sacramento, Feather, American, and Cosumnes Rivers, and Laguna, Morrison, Stony, Auburn Ravine, Putah, and Cache Creeks.

Giant garter snakes sometimes seek refuge in habitat at higher elevations (*i.e.*, at Gilsizer Slough, snakes overwinter in the wetland area even though the Sutter Bypass levee is much higher in elevation -Wylie 1996) where they retreat during the winter dormancy period. Commercial development, agricultural conversion, and levee maintenance along the edges of wetlands have eliminated much of the historical habitat, forcing giant garter snakes to overwinter in disturbance prone and unsuitable areas where they may experience greater risk of predation or other sources of mortality.

Habitat loss throughout the range of the giant garter snake has resulted in fragmented and isolated habitat remnants. Such small populations confined to limited habitat areas are likely vulnerable to extirpation from stochastic (*i.e.*, random) environmental, genetic, and demographic events (Schonewald-Cox *et al.* 1983). When an existing population becomes extinct, there is virtually no chance of recolonization from any remaining populations. In addition, the breeding of closely related individuals can cause genetic problems in small populations, particularly the expression of deleterious genes, known as inbreeding depression.

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