Written Testimony of

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Representing California State Water Contractors
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Subcommittee on Water, Power and Oceans
United States House of Representatives

Legislative Hearing on H.R. 4582 (Denham, R-CA) the "Save Our Salmon Act"
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Chairman Fleming, Ranking Member Huffman and Members of the Subcommittee, I am Charles Hanson, Senior Biologist and Principal of Hanson Environmental, Inc., located at 446 Green View Court, Walnut Creek, California. Thank you for the opportunity to testify before you today. I am here representing the State Water Contractors, a statewide, non-profit association of 27 public agencies from Northern, Central and Southern California that purchase water under contract from the California State Water Project. Collectively the State Water Contractors deliver water to more than 26 million residents throughout the state and more than 750,000 acres of agricultural lands.

My academic training includes Bachelor of Science and Master of Science degrees in fisheries from the University of Washington, College of Fisheries, graduate studies in environmental engineering at the Johns Hopkins University and a Ph.D. in fisheries and ecology from the University of California, Davis. I have been involved in issues related to the status of fish species in the Sacramento-San Joaquin-San Francisco Bay-Delta since 1976. These issues include state and federal Endangered Species Act studies regarding fisheries populations, including the biological monitoring of listed fish species, preparation of biological assessments, preparation of habitat conservation plans, and service as a member of the United States Fish and Wildlife Service's (USFWS) Sacramento-San Joaquin Delta Native Fishes Recovery Planning Team and the National Marine Fisheries Service's (NMFS) Central Valley Salmonid Technical Recovery Team, Santa Ynez River Technical Advisory Committee, Kings River Technical Steering Committee, Mokelumne River Technical Advisory Committee, and San Joaquin River Restoration Program Technical Advisory Committee. I served as a member of the National Scientific Peer Review Panel for Stanislaus River Water Temperature Criteria for Salmonid Restoration. I serve as co-chair of the Collaborative Adaptive Management Team (CAMT) Salmon Scoping Team.

This morning I would like to discuss the inclusion of striped bass under the anadromous species doubling goal of the Central Valley Project Improvement Act (CVPIA). As

introduced, H.R. 4582 would eliminate striped bass from the CVPIA's doubling goal. I am not here to advocate a position on H.R. 4582, but to provide expert testimony on the impact of predation on salmon and steelhead species in the Sacramento – San Joaquin Delta.

Original Goals for CVPIA

The CVPIA was enacted in 1992 in an effort to improve the abundance of anadromous fish inhabiting the Central Valley rivers and streams including the Sacramento and San Joaquin River watersheds and the Bay-Delta estuary. Anadromous fish are those that spawn in freshwater but live a part of their life as juveniles and pre-spawning adults in saltwater, including native species such as Chinook salmon and steelhead.

Striped bass were intentionally introduced into the Bay-Delta estuary from the East coast to serve as a recreational and food resource for those living in the San Francisco Bay Area. Although they are not native to the Central Valley, striped bass were identified as one of the anadromous fish species under the CVPIA doubling goal. At the time the CVPIA was being developed, striped bass were considered to be a key indicator species on the health and condition of the Bay-Delta estuary as well as a valued recreational fish species. Part of the appeal of striped bass as a recreational species was their large size and aggressive predation foraging on smaller fish. Since striped bass actively forage on small fish, including shad, smelt, salmon, herring, anchovy, and others, they can be readily caught by recreational anglers fishing from boats and the shoreline throughout the Bay-Delta estuary and rivers.

Growing Concerns for Native Species

In the 1990s and later, a shift occurred in the fisheries' management priority away from non-native fish to native fish species, particularly those that have been listed for protection under the federal Endangered Species Act (ESA) and the California Endangered Species Act (CESA). These listed species include winter-run and spring-run Chinook salmon, Central Valley and Central Coast steelhead, green sturgeon, delta and longfin smelt. For purposes of this presentation I have focused on Chinook salmon, however, striped bass are known predators of all of the listed fish species inhabiting the estuary.

The Central Valley supports four species of Chinook salmon including winter-run (Endangered), spring-run (Threatened), fall-run and late fall-run. The name of each species is based on the seasonal time of year when the adults migrate upstream into freshwater prior to spawning.

Salmon Characteristics and Behavior

Chinook salmon have a life history (Figure 1) in which the adult salmon migrate upstream from the ocean into freshwater rivers where they dig a shallow depression in gravel deposits, known as a redd, where the female deposits her eggs which are then fertilized by a male and covered with gravel. Chinook salmon, unlike some of the other listed fish, die after

spawning. Incubation occurs with the eggs buried in the gravel over a period of months depending on factors such as water temperatures. After hatching from the egg the young salmon with their attached yolk sac remain in the gravel for a period of weeks while they grow and develop. As the young salmon develop into juveniles, they emerge from the gravels and begin rearing in the rivers near where they were hatched. A portion of the juvenile salmon, known as fry, may disperse downstream soon after emergence, where they rear in the lower reaches of the rivers and estuary. Other juveniles may continue to rear in the upper reaches of the rivers for months or up to one year until they are large enough to undergo the physiological transformation known as smolting which allows the juveniles (typically 2 to 4 inches in length) to migrate downstream from freshwater and enter coastal marine waters where they continue to grow and develop. The juvenile salmon reside in marine waters for a variable period of time ranging from approximately one to five years before returning to the freshwater rivers to spawn and complete their lifecycle.

Central Valley salmon spawn and juveniles rear in the upper reaches of larger rivers including the Sacramento, Feather, Yuba, American, Mokelumne, Consumes, Stanislaus, Tuolumne, and Merced rivers depending on salmon species. The red areas shown on Figure 2 are an illustration of the areas of the Central Valley where spring-run Chinook salmon spawn and are also primary areas of juvenile rearing. As a result of their life history and habitat requirements, all of the juvenile spring-run Chinook salmon produced in the Central Valley, in this example, migrate downstream in the Sacramento River and through the Delta during their passage to the ocean. The juvenile salmon downstream migration typically occurs during the late winter and spring months. A large portion of the Sacramento River used as the juvenile migration route is characterized by a trapezoidal channel with very little shallow water, riprap banks with little or no riparian vegetation, very little to no in-channel cover or protection from predators, with a river channel typically only 500 feet across through which all juvenile salmon must migrate.

Contributing Factors Impacting Salmon Survival

Survival studies have been conducted in both the Sacramento and San Joaquin Rivers over a number of years. In the past, survival of juvenile salmon was estimated based on the number of marked juveniles that were released into the river (juvenile salmon have typically been marked using a small metal wire implanted in the fish's nose – a coded wire tag) and the number of marked fish subsequently recaptured at a downstream location such as Chipps Island. More recently, advances in tag technology have led to the development of small battery powered tags that emit an underwater sound (acoustic tags) that can then be detected as an individual fish passes an acoustic detector. By placing acoustic tag detectors in a number of locations and channels in the river and Delta, juvenile salmon survival can be estimated. Figure 3 shows an example of juvenile Chinook salmon survival as the fish migrate downstream in the Sacramento River and Delta. In these studies, only about 10 percent of the juvenile salmon survived the migration down the Sacramento River to the

Golden Gate. Results of similar survival studies conducted on the lower San Joaquin River and Delta for juvenile Chinook salmon (Figure 4) have shown a pattern in which survival declined in the early 2000s and has been less than 5 percent every year for the past decade. A variety of factors have been identified that are thought to contribute to the poor survival of juvenile salmon in the Bay-Delta estuary including:

- Changes in habitat/wetland reclamation/channelization;
- Dams and water project operations';
- Natural hydrology/water quality (e.g., temperature);
- Food web changes;
- Invasive non-native species as predators and competitors –
  - Inadvertently introduced (Asian clam)
  - Intentionally introduced (striped bass)
- Entrainment at unscreened diversions;
- Loss of riparian vegetation;
- Loss of shallow channel margin habitat and seasonal floodplains;
- Reductions in suitable spawning gravels and juvenile rearing habitat;
- Ocean conditions; and
- Harvest (of some species).

The relative importance of these and other factors affecting habitat quality and availability and survival of native fish interact in dynamic ways geographically and in response to within and between-year biologic and environmental conditions.

Threat of Non-Native Predators

Predation mortality has been identified as an important factor effecting juvenile salmon survival in the rivers and Delta. Primary predator fish species in the Delta include both striped bass and largemouth bass (both introduced species). The geographic and seasonal co-occurrence of adult striped bass and juvenile Chinook salmon (Figure 5) in the Sacramento and San Joaquin Rivers is one of the factors that increase bass predation on juvenile salmon. Adult striped bass migrate upstream into the rivers during the spring where they stage and forage prior to spawning (typically during April-May). During the spring months (typically during April-May) a majority of the juvenile Chinook salmon migrate downstream through the rivers on their way to the ocean. The adult striped bass actively forage on juvenile fish in the size range of juvenile Chinook salmon. The adult striped bass and the juvenile salmon are both limited to the channelized river approximately 500 feet wide where the juvenile salmon have little or no cover or protection from predators. The result is increased vulnerability of juvenile salmon to predation. High levels of juvenile mortality contribute to reduced adult salmon abundance.

Subjecting Salmon to Ambush

In addition to predation that occurs throughout the rivers and Delta, specific locations have been identified where juvenile salmon are particularly vulnerable to predators. For example,

observations of acoustic tags from juvenile salmon released into the San Joaquin River showed an unusual accumulation of tags in the vicinity of several bridge crossings that were thought to provide structure and ambush locations for predatory fish. In other studies, evidence showed increased predation mortality of juvenile salmon that were exposed to a scour hole in the river channel. High levels of predation on juvenile Chinook salmon and steelhead have been observed experimentally within Clifton Court Forebay (Figure 6), part of the State Water Project diversion facility, where juvenile mortality attributable to predation was estimated to be approximately 80 percent.

Is Predation a New Problem?

There is no question that adult striped bass prey on juvenile Chinook salmon (Figure 7). The question that typically comes up is why would striped bass predation on juvenile salmon be a problem now if the fish have coexisted in the estuary for over 150 years? As noted above, there are a wide variety of factors that affect juvenile salmon survival in the rivers and Delta. Predation by striped bass is one of those factors. One potential scenario is that as a result of long-term degradation of aquatic habitats, in combination with a variety of sources of mortality, the Chinook salmon population resilience to adverse conditions has been degraded and the populations are now less able to withstand added stressors that result in greater mortality and further reductions in abundance. A second potential scenario is that salmon population resilience has declined as a result of cumulative stressors such as poor ocean rearing conditions, reduced river flows and increased water temperatures resulting from drought conditions, increased predator abundance, and other factors that reduce the ability of the population to withstand the incremental contribution of one or more stressors such as increased predation mortality. The low levels of survival observed for juvenile Chinook salmon migrating through the rivers and Delta are a major challenge in generating healthy and robust populations of salmon that contribute to ESA recovery and sustainable fisheries. Doubling the abundance of striped bass as part of CVPIA would be expected to contribute to an increase in the cumulative stressors affecting Central Valley Chinook salmon populations and would be expected to contribute further to low juvenile survival and reduced adult abundance.

SWP and CVP Inflow:Export Ratio Operations and Salmon Survival

As part of the overall effort to improve juvenile salmon and steelhead survival in the Central Valley and Delta, the National Marine Fisheries Service (NMFS) has identified a number of management actions related to SWP and CVP export operations. One of those actions specific to the lower San Joaquin River is the regulation of export rates as a ratio of San Joaquin River flow at Vernalis during April and May. The action, which was outlined in the 2009 Biological Opinion, is intended to improve survival of juvenile steelhead produced in San Joaquin River tributaries. Although steelhead survival studies have been conducted in the lower San Joaquin River over the past six years, a complete set of results from these studies is not yet available for use in assessing a potential relationship between the I: E (San

Joaquin River inflow: SWP and CVP export) ratio and juvenile steelhead survival. Available results from lower San Joaquin River juvenile salmon survival studies (Figure 4) have shown no improvement in survival (survival has been less than 5 percent) during the spring in every year since the mid-2000s despite variation in river flows, export rates, inflow-export ratios, and other environmental variables. Although more rigorous statistical analyses of the survival study results are currently underway, preliminary results suggest that the consistently low survival of juvenile salmon from the San Joaquin River over the past decade has occurred despite implementation of management actions targeting SWP and CVP export operations outlined in the 2009 Biological Opinion.

CVPIA Should Support Species Protections

The CVPIA specifically identifies striped bass as part of the goal of doubling abundance of anadromous fish inhabiting the Central Valley and Bay-Delta estuary. Policy and management priorities have changed, however, since enactment of CVPIA to include:

- In the later 1990s priorities shifted in response to the Endangered Species Act to emphasize protection of depressed native fish species;
- The Bay-Delta estuary provides spawning and rearing habitat for several ESA protected salmonid species;
- Results of juvenile salmon survival studies have shown low survival on both the Sacramento River (typically survival less than 10 percent) and San Joaquin River (typically survival less than 5 percent);
- A variety of factors interact to effect habitat conditions and survival of juvenile and adult salmonids including predation mortality;
- Striped bass are a predator of juvenile Chinook salmon and other listed fish species;
- Predation mortality by striped bass and other non-native fish has been identified as a major stressor;
- Research by California Department of Fish and Wildlife, U.S. Fish and Wildlife Services, NMFS, and others on predation is underway; and
- Increased striped bass abundance in response to CVPIA goals is expected to increase the risk of predation mortality for juvenile salmon and other protected species and contribute to reduced abundance of native fish species.

Conclusion

In conclusion, increasing the population of non-native species that prey on protected species is counter-productive to species recovery efforts currently underway in the Sacramento-San Joaquin Delta and surrounding watershed. Therefore, striped bass, a known predator of endangered native species, should be excluded from the doubling goal for anadromous species in the CVPIA and initiatives should be undertaken to address other stressors impacting these protected species to improve their chance of survival.

Thank you for the opportunity to provide comments on this important topic. I would be happy to answer any questions.

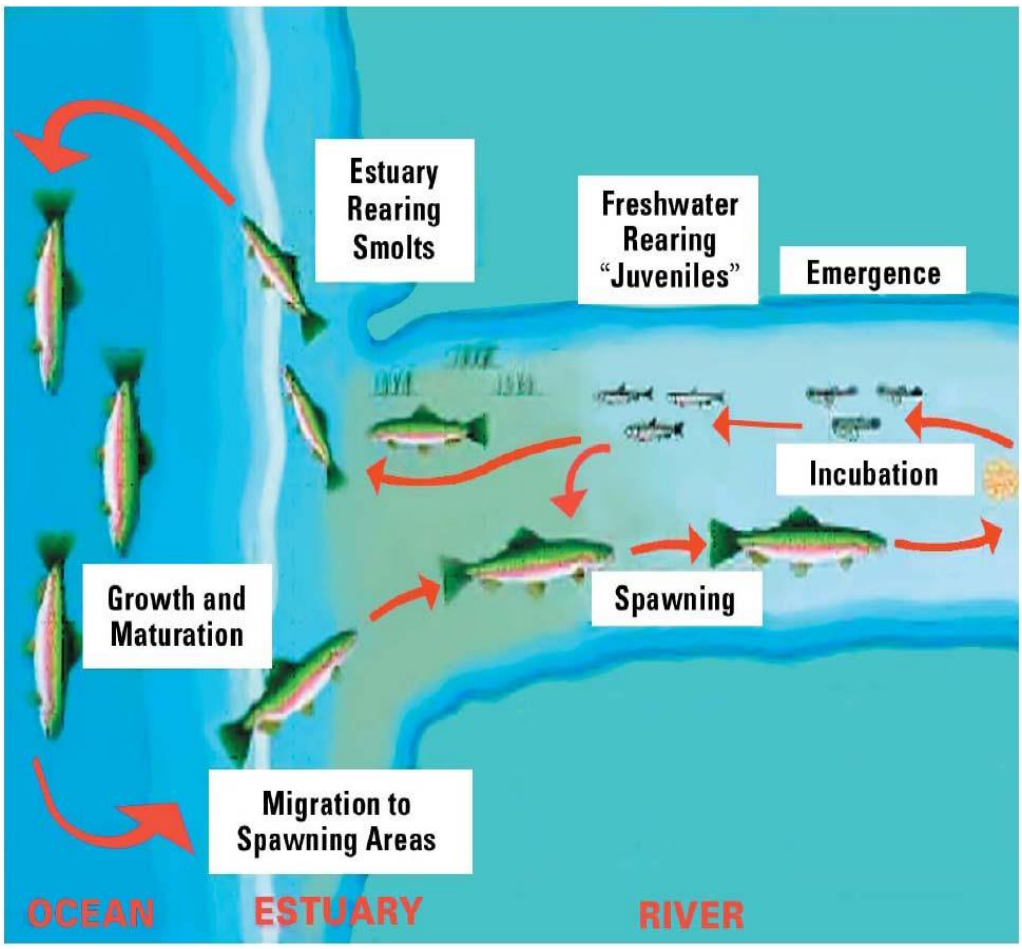

Figure 1: General anadromous salmonid lifecycle.

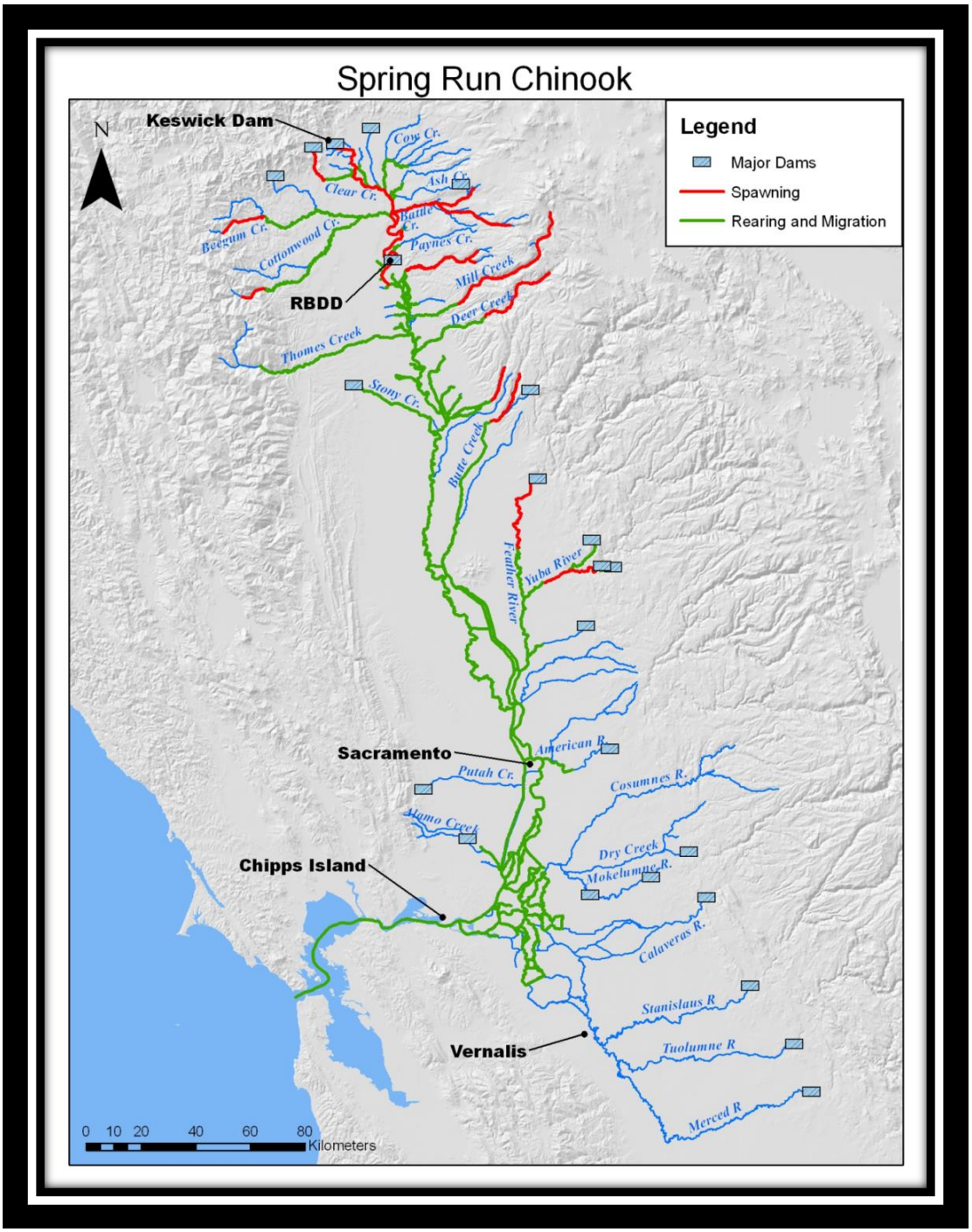

Figure 2: Spawning areas for spring-run Chinook salmon.

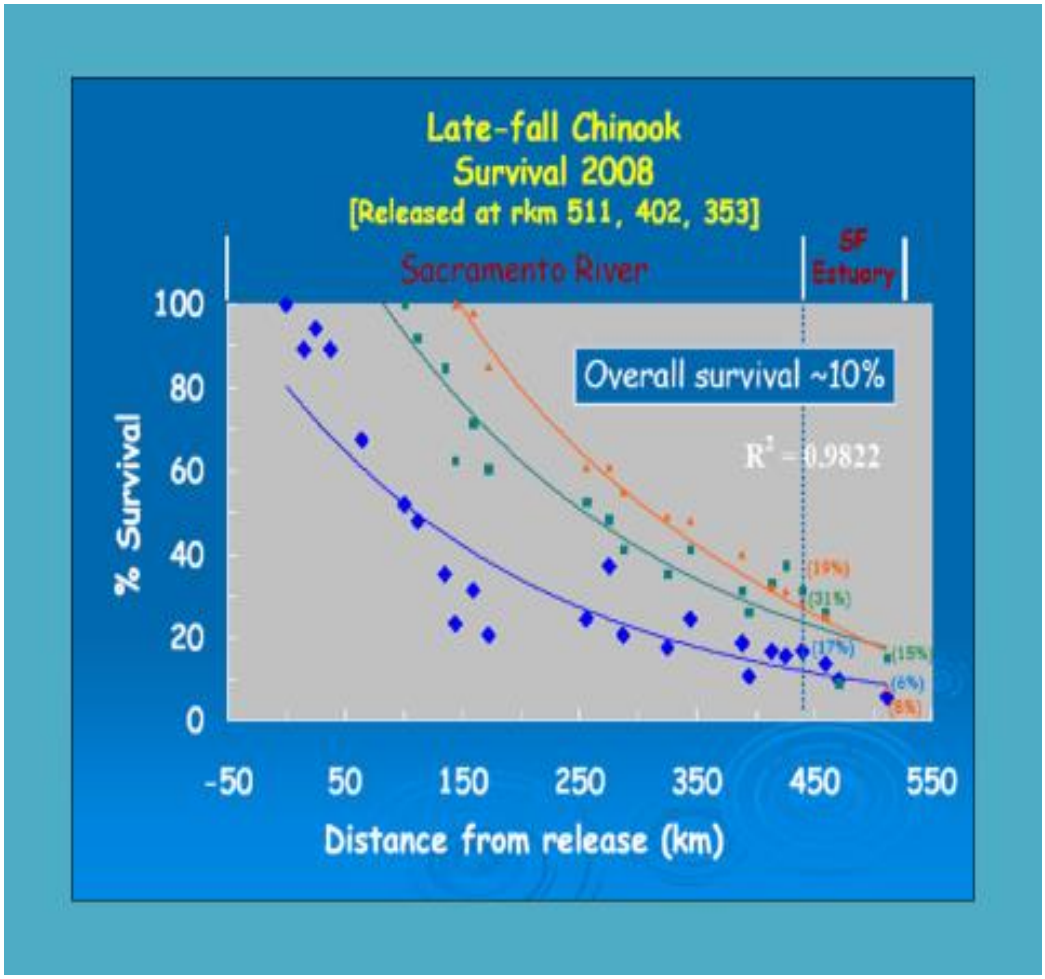

Figure 3: Survival estimates for acoustically-tagged late fall-run Chinook salmon in the Sacramento River *(Source: Michel 2010)*.

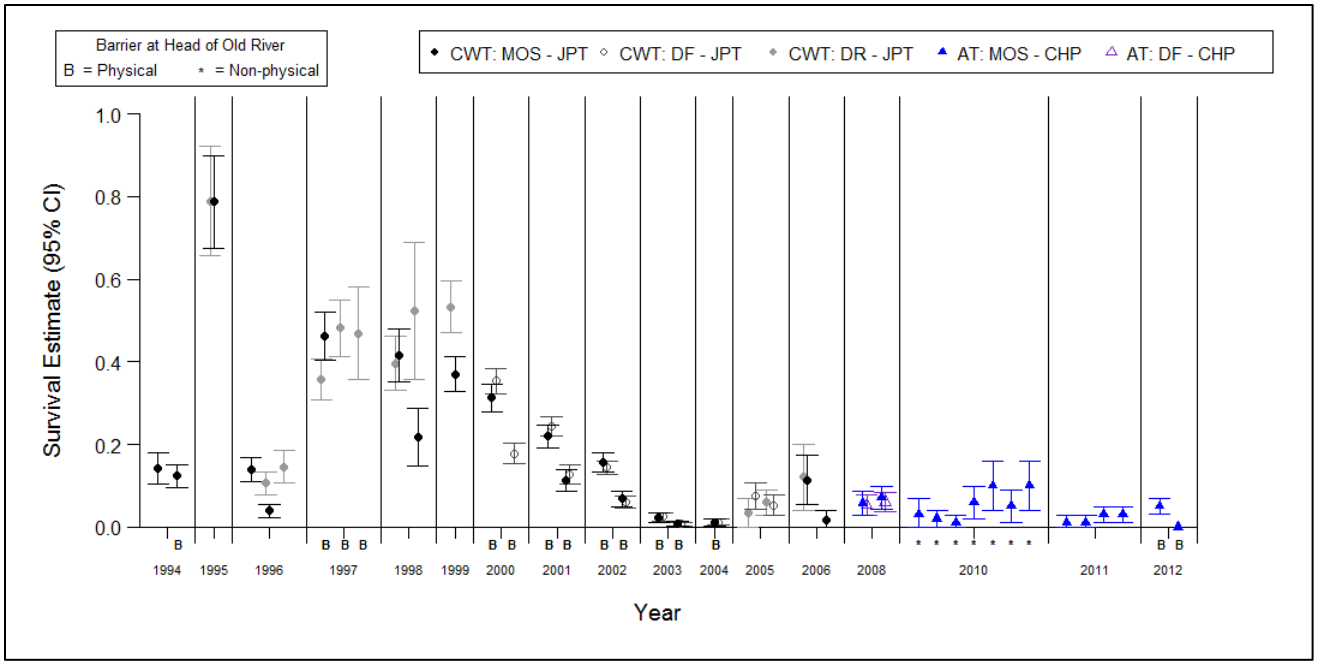

Figure 4: Estimated survival of Fall-run Juvenile Chinook Salmon from Mossdale (MOS), Durham Ferry (DF), or Dos Reis (DR) to either Jersey Point (JPT; CWT) or Chipps Island (CHP; AT). Intervals are 95 percent confidence intervals, truncated to 0 if necessary.

Source: SJRGA 2013, USFWS 2014

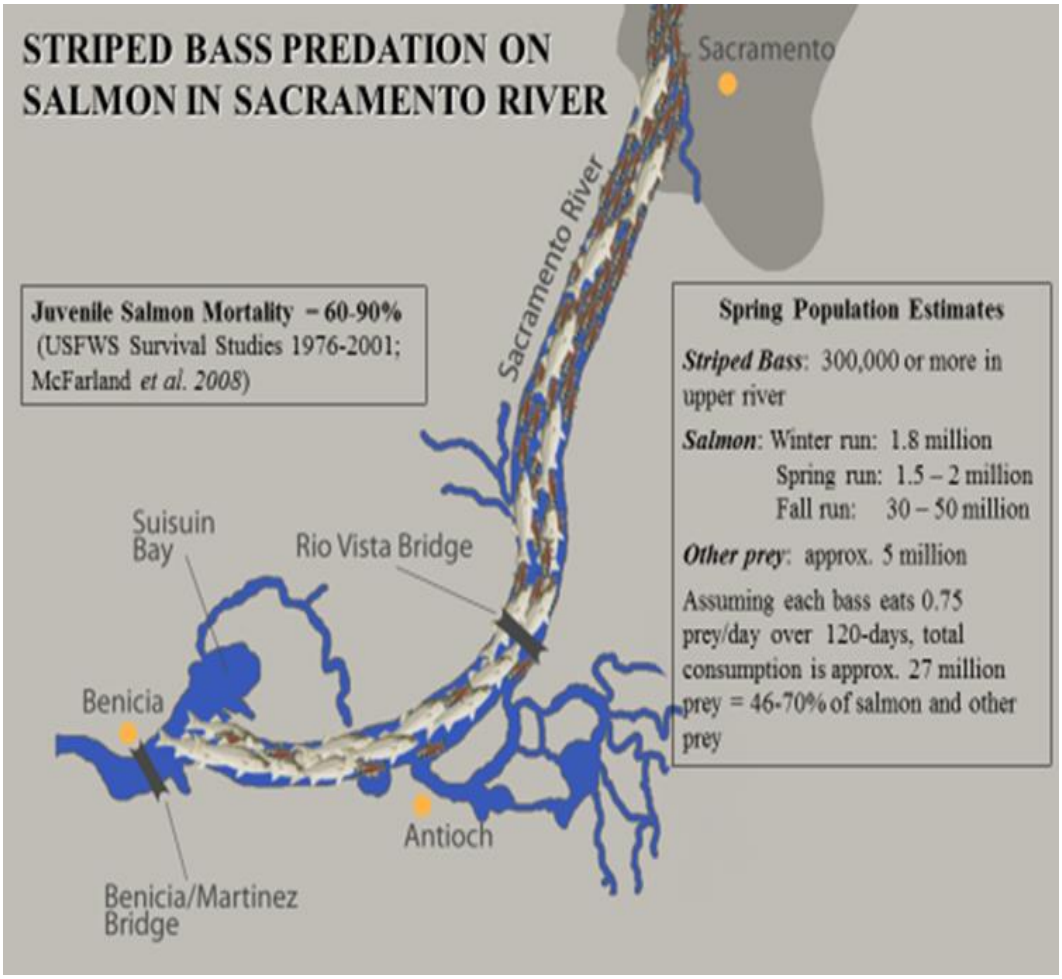

Figure 5: Co-occurrence of adult striped bass and juvenile Chinook salmon in the Sacramento River during spring.

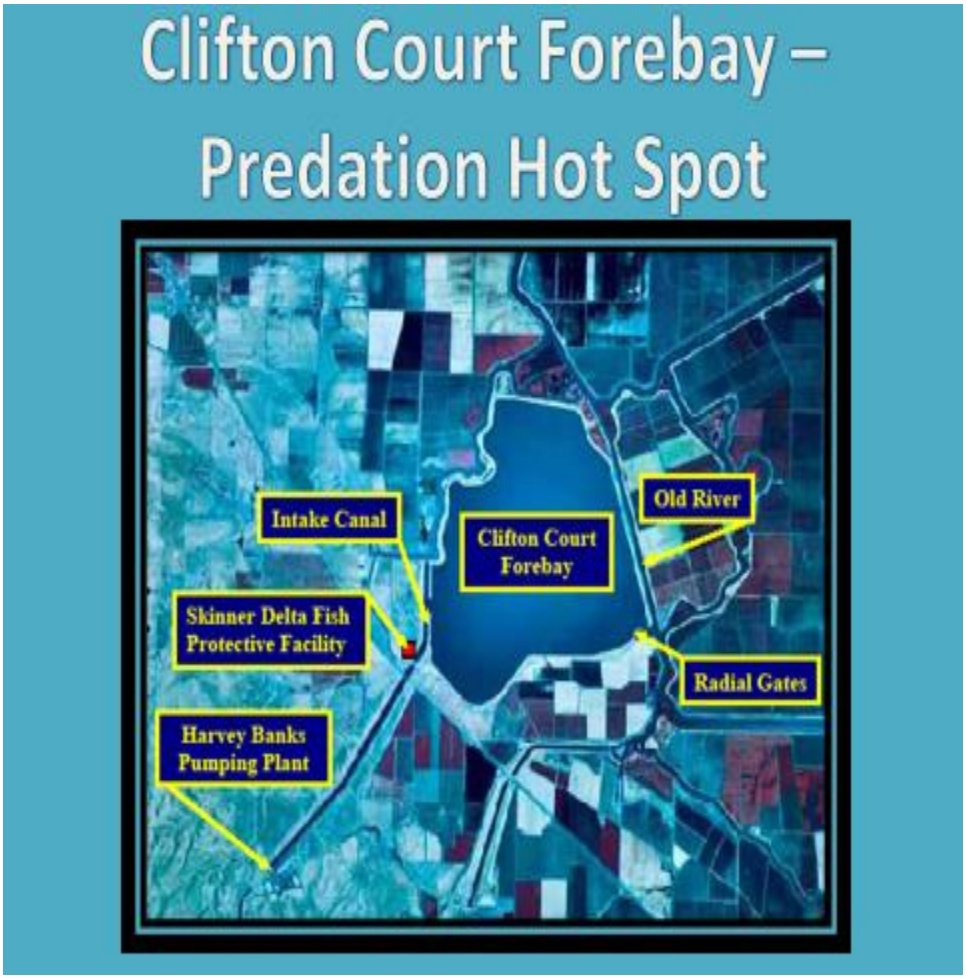

Figure 6: Clifton Court Forebay: Juvenile salmon and steelhead predation mortality is approximately 80 percent between the radial gate and the Skinner Delta Fish Protective Facility.

Figure 7: Juvenile Chinook salmon preyed upon by an adult striped bass.