Trends in Harbor Seal Numbers Illuminate Changing Conditions within SF Bay Estuary: Comparing 2015 Harbor Seal Counts to the 2000-2010 Benchmark

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Harbor seals are the only year round resident marine mammal in SF Bay. Researchers have been concerned about human impacts on the health of these seals dating back to the 1970s when premature births and elevated toxins were documented. Because seals forage, rest and breed in the bay, changes in population numbers can indicate perturbations to their prey or their habitats that are likely of concern to other species residing in the bay. We used a long term dataset of seal counts (1998 to present) at two representative haulout locations (Yerba Buena Island and the Richmond-San Rafael Bridge) to design a benchmark for evaluating and interpreting seal counts. We defined a benchmark as the average maximum number counted between May and July from 2000 to 2010. We defined 1 standard deviation (SD) or more above the benchmark as "good" and 1 SD or more below the benchmark as "poor". The benchmark is calculated as 328 seals; the range for "fair" is between 273 and 382 (i.e., 328 ± 54 [SD]) seals. Results of 2015 seal counts, which continue through July, will be evaluated against the benchmark and the results interpreted and compared with central California coastal counts for a regional perspective. We expect the occasional poor year due to environmental conditions like El Niño that may alter harbor seal prey assemblages; however, three sequential poor years likely are cause for concern and would precipitate actions such as monitoring and/or management actions (for example, seal protection zones around haulout locations to reduce effects of disturbance). We will evaluate the 2015 seal counts against the benchmark and interpret the results in context with the long term dataset, oceanic conditions, and disturbances observed in the 2015 season. We also will compare SFB counts with central California coastal counts for a regional perspective.

Keywords: Harbor seals, benchmark, changing conditions

Poster Topic: State of the Estuary Report 2015

Feast or Famine: Fish Food in the Upper San Francisco Estuary

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Zooplankton is an important component of the pelagic food web, providing a key trophic link between fish and phytoplankton. Most larval and juvenile fish in the upper San Francisco Estuary (SFE) feed on zooplankton, and some smaller fish like Delta Smelt and Longfin Smelt feed on zooplankton throughout their lives. Monitoring of zooplankton in the upper SFE is conducted by the California Department of Fish and Wildlife's Zooplankton Study as part of the Interagency Ecological Program. To assess trends in fish food resources, the Zooplankton Study has provided zooplankton abundance estimates since 1972. Since the late 1980s, zooplankton has decreased in most areas of the upper SFE, particularly in the low salinity zone. This decrease has been attributed in large part to *Potamocorbula amurensis*, an invasive clam found in the low salinity zone that was introduced in 1986. Competition with *P. amurensis* for phytoplankton, a shared food resource, as well as predation on copepod nauplii by *P. amurensis* has reduced zooplankton abundance. The decline is particularly evident in Suisun Bay, a region heavily impacted by *P. amurensis.* Calanoid copepods and mysids are crustaceans that were chosen for the zooplankton indicator for the State of the Estuary Report because they are important food items for Delta Smelt and Longfin Smelt, two listed fish species in the upper estuary. Mysid biomass has declined in both the Suisun and Delta regions of the upper San Francisco Estuary since monitoring began. Calanoid copepod biomass has declined in the Suisun region, but increased in the Delta region of the upper San Francisco Estuary since monitoring began. The resultant zooplankton decline in the low salinity zone has been implicated as one of the many causes of the pelagic organism decline (POD) which described the dramatic decline of several pelagic fish species beginning in the early 2000s.

Keywords: Zooplankton, Food web, State of the Estuary Report, fish food

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Increasing Dominance of Floating Aquatic Vegetation in the Sacramento – San Joaquin Delta over the Past Decade

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Invasive aquatic plants have far-reaching impacts on the Delta ecosystem. Aquatic plants change shoreline habitat by slowing water flow and increasing water clarity, which have reverberating effects across the entire food chain. Invasive aquatic plants also impede boat travel and are difficult and expensive to control. We measured the distribution and acreage of invasive and native aquatic plant species using remote sensing imagery from 2004 to 2008, and again in 2014. Results show that submerged aquatic vegetation (SAV) cover, dominated by Brazilian waterweed, decreased from almost 8000 acres in 2004 to 4300 acres in 2008 before increasing to 6070 acres in 2014. From 2004 to 2008, floating aquatic vegetation (FAV) cover varied between 800 to 1700 acres. During this time period, the two most dominant FAV species, native pennywort and invasive water hyacinth, had comparable cover followed by invasive water primrose. However, in 2014, FAV species cover increased three-fold covering 6500 acres over the entire Delta compared to its previous maximum measured in 2006 (1700 acres). Moreover, the FAV species cover is now comprised mainly of just the two invasive species, water hyacinth (69%) and water primrose (31%). The total invaded area in the Delta (SAV + FAV) has increased from the previous recorded maximum of 9000 acres in 2004 to almost 12500 acres in 2014. Both SAV and FAV have especially flourished in flooded islands in the Delta, colonizing new areas. The prolonged drought has likely reduced water levels and increased shallow habitat with slow moving water ideal for the establishment of SAV and FAV. Coincidently, mild winters and lack of large storms and floods have also favored the establishment and spread of these species.

Keywords: water hyacinth, submerged aquatic vegetation, invasive species, remote sensing, AVIRIS

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