



The "Blob" Brings Subtropical Visitors to the San Francisco Estuary

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Introduction

- The California Department of Fish and Wildlife's San Francisco Bay Study (Bay Study) has sampled the fish, shrimp, and crabs in the San Francisco Estuary monthly since 1980.
- A "blob" of warm ocean water was first noticed off of Alaska in late 2013, and now extends south to Baja California. Water temperatures are at least 3°C warmer than normal (Figure 1).
- This event is reportedly the most extensive and longest-lasting temperature anomaly in the eastern Pacific Ocean in the modern record.
- Bay Study first noticed increased catches of species associated with warmer ocean water in 2013, and by 2015 collected several subtropical species normally found off of Southern or Baja California. Several other monitoring projects also collected subtropical species not typically found in the estuary.

Noteworthy Catches

- Juvenile California Halibut CPUE has increased dramatically in the last 2 years, with one of the largest year classes since the 1997-1998 El Nino event.

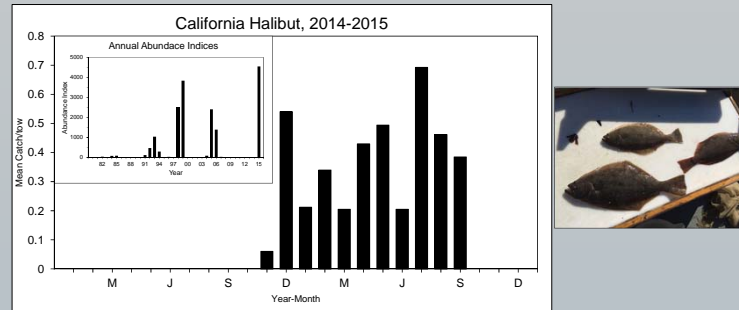


Figure 2. Monthly CPUE (# fish/tow) of juvenile California Halibut (age 0&1, <200mm), 2014-2015. Inset: Annual abundance indices of juvenile halibut, otter trawl, February-October, 1980-2015 (2015 index is preliminary).



SPECIES	POTENTIAL TRANSPORT MECHANISMS
California Halibut	Local recruitment
California Tonguefish	Long planktonic larval duration, northern transport
Spotted Cusk-eel	Transport of pelagic juveniles
Shovelnose Guitarfsh	Adult migration
White Seabass	Adult migration, followed by local spawning
Queenfish	Transport of pelagic juveniles
Brown Shrimp	Adult migration
Pacific Bonito	Adult migration
Yellow Rock Crab	Long planktonic larval duration, northern transport
Striped Mullet	Adult migration, followed by local spawning

Table 1. Noteworthy species collected and potential mechanisms for their presence in the estuary.

Not everyone is moving into the estuary...

- The abundance of many cold-water species has declined, including Dungeness Crab and Pacific Herring.

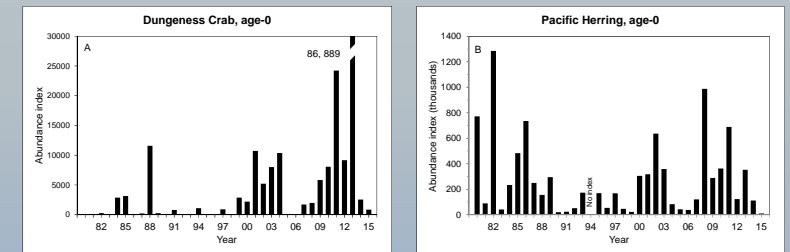


Figure 4. Annual abundance indices of two cold water species: A) age-0 Dungeness Crab, Bay Study otter trawl, May-July; and B) age-0 Pacific Herring, Bay Study midwater trawl, April-September (2015 indices are preliminary).

Discussion

- The recent warm-water event in the eastern Pacific Ocean impacted species differently depending on several life history traits, including planktonic larval duration, spawning temperature cues, and their normal northern distribution. For subtropical fauna, the warmer ocean temperatures resulted in increased local recruitment (California Halibut), increased northerly transport of larvae (California Tonguefish), or migration northward by adults (White Seabass, Bonito). However, warm ocean temperatures were not beneficial to all species, as abundance of several cold-water species that dominated our catches since the early 2000s declined in 2014 and 2015.

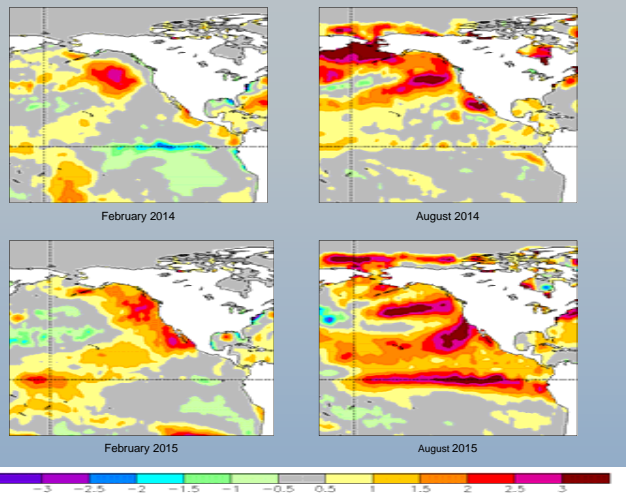


Figure 1. Map of northeastern Pacific Ocean showing sea surface temperature (SST) anomalies. From NOAA's National Centers for Environmental Information.

- California Tonguefish abundance first increased in 2013, and it was the dominant flatfish in the estuary in 2014 and 2015. The 2015 annual abundance index (all sizes) was the highest on record.

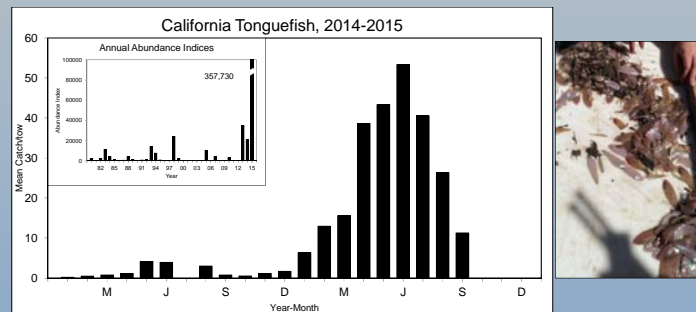


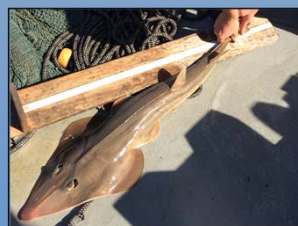
Figure 3. Monthly CPUE (# fish/tow) of California Tonguefish (all sizes), 2014-2015. Inset: Annual abundance indices of tonguefish, otter trawl, February-October, 1980-2015 (2015 index is preliminary).



Other Subtropical Species of Interest



Spotted Cusk-eel
Chilara taylori



Shovelnose Guitarfsh
Rhinobatos productus



White Seabass
Atractoscion nobilis



Queenfish
Serphus politus



Brown Shrimp
Farfantepenaeus californiensis



Pacific Bonito
Sarda chiliensis



Yellow Rock Crab
Cancer anthonyi