INTRODUCTION

From 2012 through 2014, the California Department of Fish and Wildlife (CDFW), in collaboration with California Wildlife Producers Association (CWPA), conducted seasonal aerial surveys (Southern California Coastal Pelagic Species Survey (SCCPPS)) to assess abundance and distribution of Pacific sardine (Sardinops sagax; sardine) and other coastal pelagic species (CPS) such as northern anchovy (Engraulis mordax; anchovy) within the Southern California Bight (SCB). While SCCPPS includes sampling components for open water and inland coastal areas, the focus here is upon observations made within 5.6 km of the mainland coast ("nearshore") extending from the U.S.-Mexico Border to Point Conception during the first five seasons of data collection.

Using data from these surveys, we asked the following questions:

- What were some of the characteristics of CPS schools observed along the SCB mainland coast?
- As an initial, coarse, spatial analysis: Were there any differences between north (N) and south (S) coastal areas with respect to (1) school size or rate of change in school size, (2) species observed, and (3) thermal and chlorophyll-a concentration ([Chl-a]) associated with CPS aggregations?
- What differences or similarities were notable in school or environmental characteristics across seasons?
- Is there any relationship of observation size / tonnage to water depth along the mainland coast?

METHODS

Methods have been described in detail in Lynn et al. (2014) and are briefly summarized in the Lynn et al. poster for CaCDFP 2014 Data. - including, daytime aerial estimates of school size and counts, GPS locations, high-resolution digital photographs, satellite sea surface temperature (SST) and chlorophyll-a concentration ([Chl-a]), and bathymetric contours - were analyzed using GIS, statistical and digital photogrammetry tools to explore characteristics of CPS aggregations and their associated nearshore environment. Tonny estimates and school counts were directly observed and recorded from the aircraft. GPS locations and digital images were collected via WAC-enabled GPS and PMC camera systems. N-S coastal division was set at latitude 33.8612° (Herencia Bracht Pier). Daytime estimates were produced using CDFW 10m bathymetric contour data manually queried in GIS. Aqua MODIS satellite data SST and [Chl-a] was downloaded from NOAA's CoastalWatch, and manually queried in GIS according to CPS observations locations. Nonparametric statistical testing was used with non-normal data.

RESULTS

Season - Year   | Target Species | Dates of Observation (NOS) | Number of Observations (NOS) | Species Observed
--- | --- | --- | --- | ---
Summer - 2012   | Sardine | 6/6-6/30 | 25 (6/29) | Sardine
Summer - 2013   | Anchovy | 6/2/225 | 12 (6/19) | Sardine
Summer - 2014   | Anchovy | 7/10/2014 | 12 (7/10) | Anchovy, Anchovy

- [Chl-a]

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SCHOOLS

- Observations by species: Sardine: 70 (64%), Anchovy: 12 (14%), Anchovy-Sardine: 3 (4%)
- Single schools observed during 33 (39%) and multiple schools during 52 (61%) of 85 observations
- Single schools ranged in size from less than one ton to 50 tons
- Multi-schools were single or mixed - sardine; school counts ranged 2 to 366, 5 to 13,130 tons
- Median size for all CPS observations: 20 tons; median size of sardine-only observations: 17.5 tons
- Per-observation total tonnage was highly and positively correlated with school count (r=0.966, p<0.0001)
- Sardine single-school size was less than multi-school size (single MD = 8 vs. multi MD = 35, U=438, p<0.001)

SPRING

- For Spring 2013 and 2014 together as well as for Spring 2013, SSTs associated with CPS in N did not differ from SSTs associated with CPS in S
- For Spring 2013 and 2014 together, [Chl-a] associated with CPS in North was significantly greater than in South (Md [Chl-a] = 17.0 mg/m³ vs. Md [Chl-a] = 5.4 mg/m³), U=69, p<0.01
- SSTs for Spring 2013 sardine-only observations were significantly less than SSTs for sardine and anchovy observations during Spring 2014 (Sp14 SST Md = 15.0°C vs. Sp14 SST Md = 16.5°C, U=65, p=3.78E-06)
- During Spring 2014, SSTs in association with CPS schools were significantly less than and chlorophyll-a concentrations significantly greater for North vs. South coast (N SST Md = 18.0 vs. S SST Md = 20.1, U=16, p=0.0006, N [Chl-a] Md = 16.8 vs. S [Chl-a] Md = 2.2, U=16, p=0.002)

SUMMER

- During Spring 2013, total CPS ions and sardine ions per observation were greater in the N than S (N Md ions = 70.1 vs. S Md ions = 9.5, U=31, p=0.021)
- During Summer 2012, SST in N was less than for S (Md SST = 18.3°C vs. Md SST = 22.3°C, U=26, p=0.0003)
- During Summer 2013, [Chl-a] in S was greater than for the N (Md [Chl-a] = 1.13 vs. S [Chl-a] = 0.51, U=31, p=0.005)
- For Summers 2012, 2013 and 2014 combined, SST and [Chl-a] were less in the N than S (5 SST Md = 21.7 vs. 26.7, U=217, p=2.01E-06, N [Chl-a] Md = 0.9 vs. S [Chl-a] Md = 1.2, U=217, p=2.01E-06 and p=0.05, resp.)

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REFERENCE

For more information on CPS management, visit the CPSHMS web page: http://www.cdfw.ca.gov/marine/cpsshms.asp

Sardines aboard 22 April 2013 / Capistrano Bight

Massive aggregation of anchovy observed at La Jolla Shores on 8 July 2014

In water less than 10m; offshore SST high; greater +15°C at La Jolla Canyon (Sharon Pier)

DISCUSSION

- It seems that sardine-only observations – in total observation count and tons – have been variable but net decreasing across seasons while mixed-species aggregations and anchovy school observations have been increasing in count and tons during recent seasons with sampling for all CPS.
- There is some evidence across seasons for specific coastal areas having more frequent occurrences of larger CPS aggregations / schools; however, the habitat variables associated with these events require further research and must be considered within a highly-dynamic, coast-wide context.
- A preliminary analysis of depth related to observation location suggests that larger schools occur closer to shore; but, it is likely that larger schools are more readily seen in shallower water? We would note that our observations are not for pronounced minimum estimates.
- Future effort will require more frequent and intensive boat-based sampling of fish to identify species, collect critical length-weight data, and measure environmental variables in situ.
- In addition, more refined spatial analyses, modeling with an emphasis toward the nearshore zone, and inclusion of fishery-dependent data can enhance our understanding of CPS abundance and distribution along the mainland coast.

More Information

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SCCPPS web page: http://www.cdfw.ca.gov/marine/cpsshms.asp

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More Information

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