



Changes in the ichthyoplankton in the northern California Current during the 2015-16 warm 'blob' and El Niño phenomena

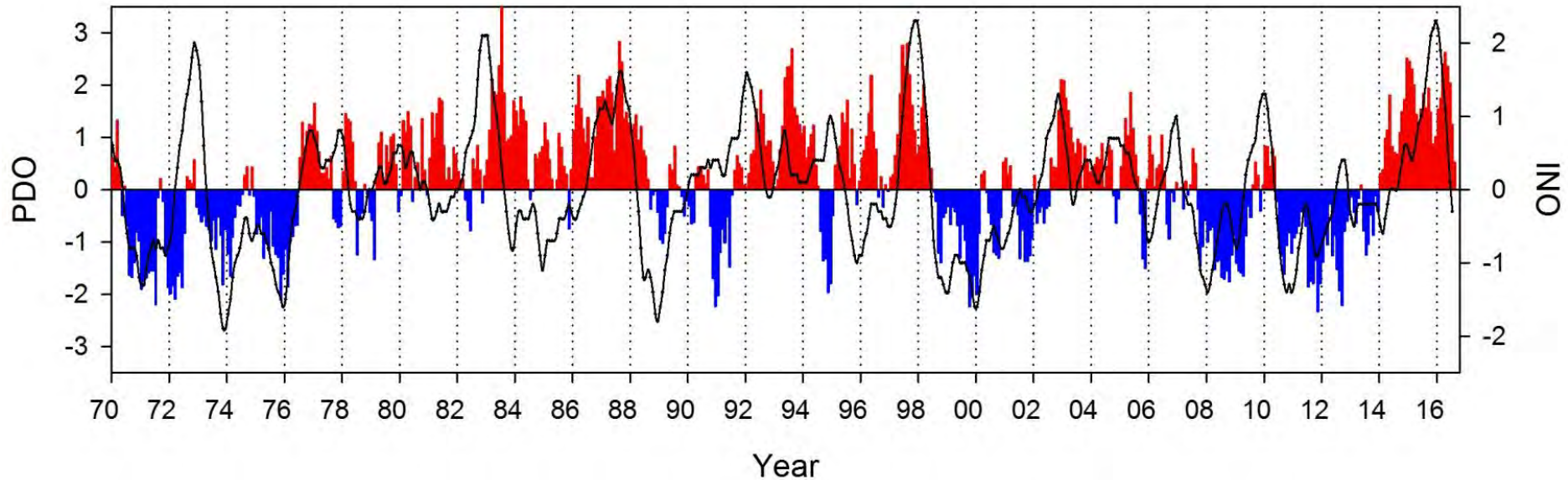
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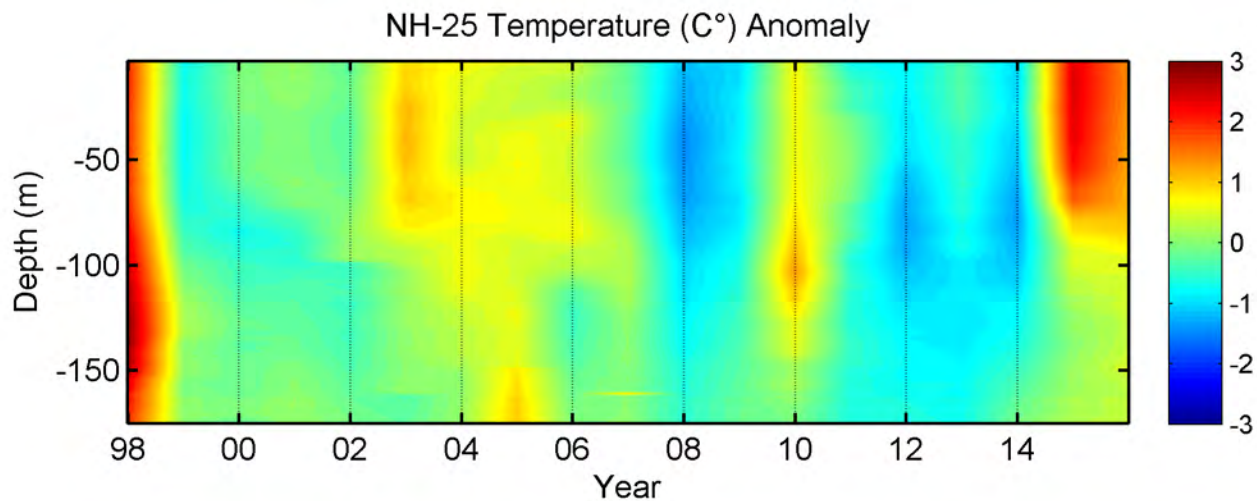
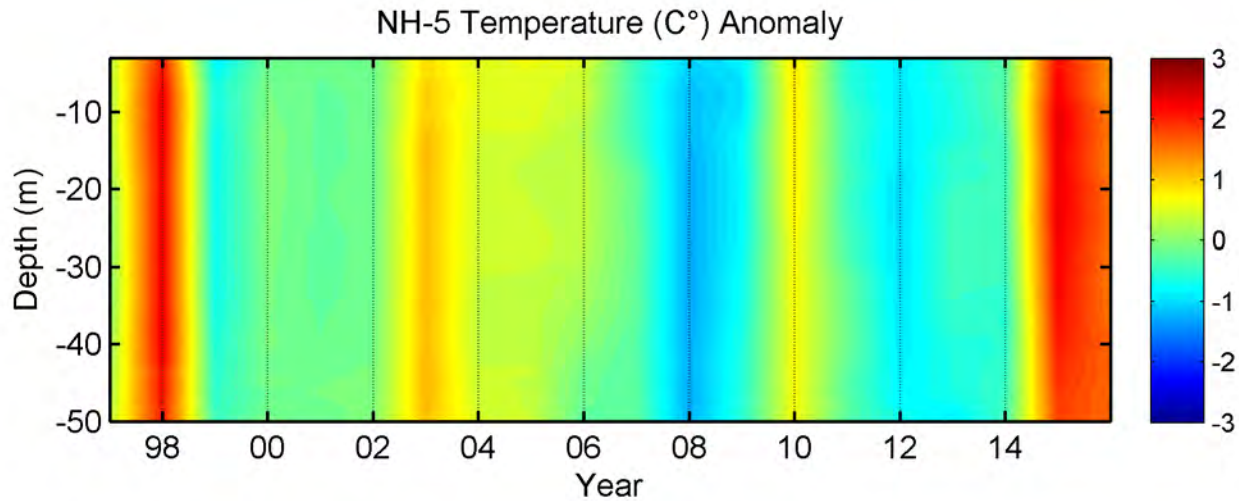
Basin Environment



Bars = PDO (Pacific Decadal Oscillation Index)
Line = ONI (Oceanic Niño Index)

Temperature Anomalies

Winter (January-March)



Objectives

- Examine changes to the ichthyoplankton in the northern California Current associated with the warming events of late 2014-2016.
- Focus on phenological changes to *Engraulis mordax* (northern anchovy), *Sardinops sagax* (Pacific sardine), and *Merluccius productus* (Pacific hake).

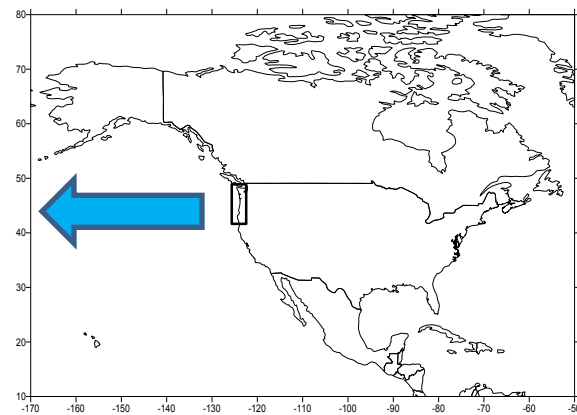
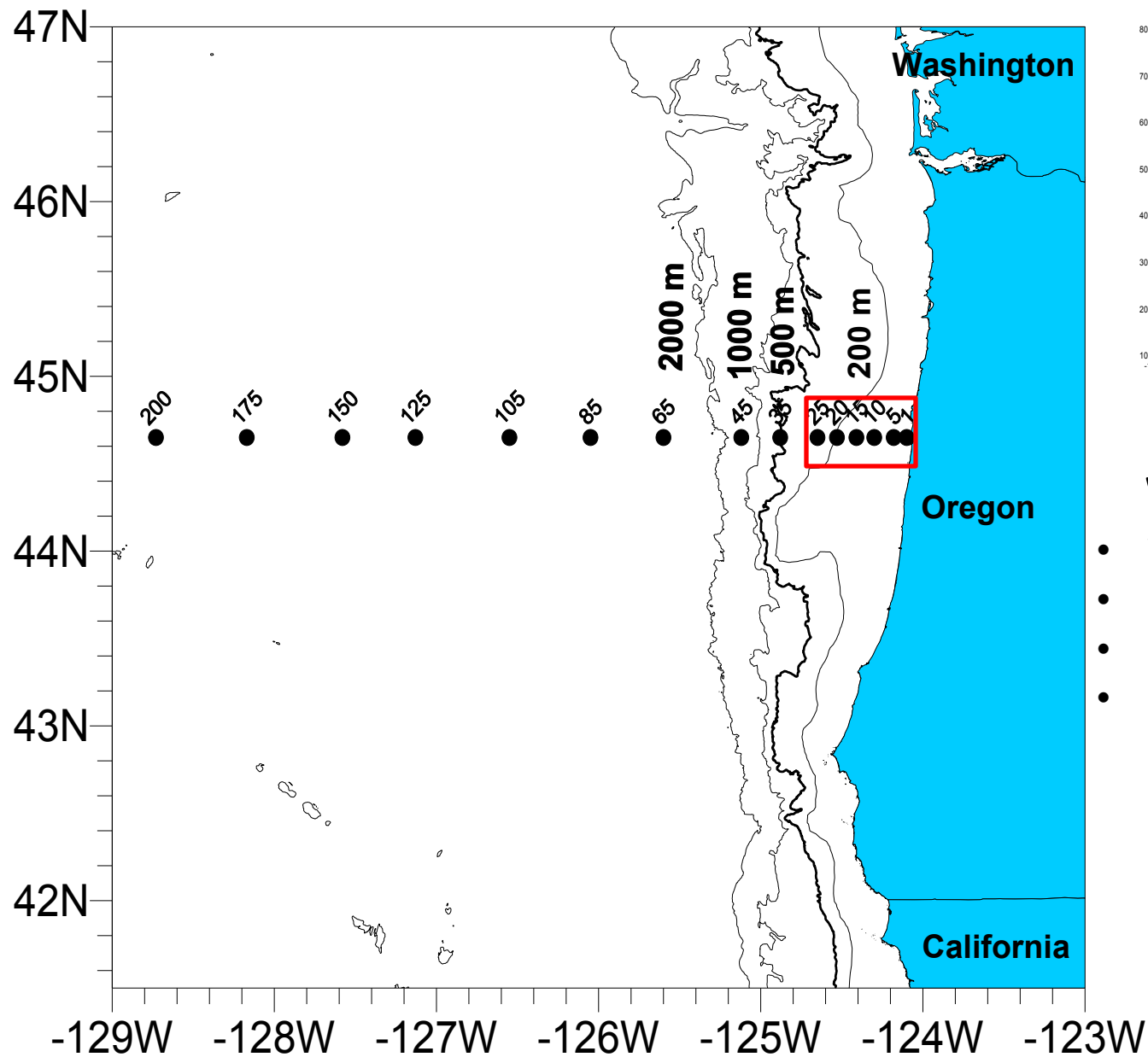
Methods



- 60-cm bongos with 333- μ m meshed nets.
- Oblique tows 30 m (near-shore [1-25 nm from shore]) or 100 m (offshore) in depth.
- Preserved in a 10% buffered-formalin sea-water solution.
- Fish larvae enumerated, measured (0.1mm), and identified to the lowest taxonomic level possible in the lab.

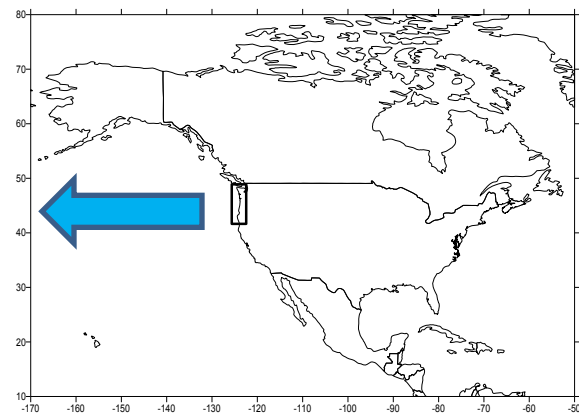
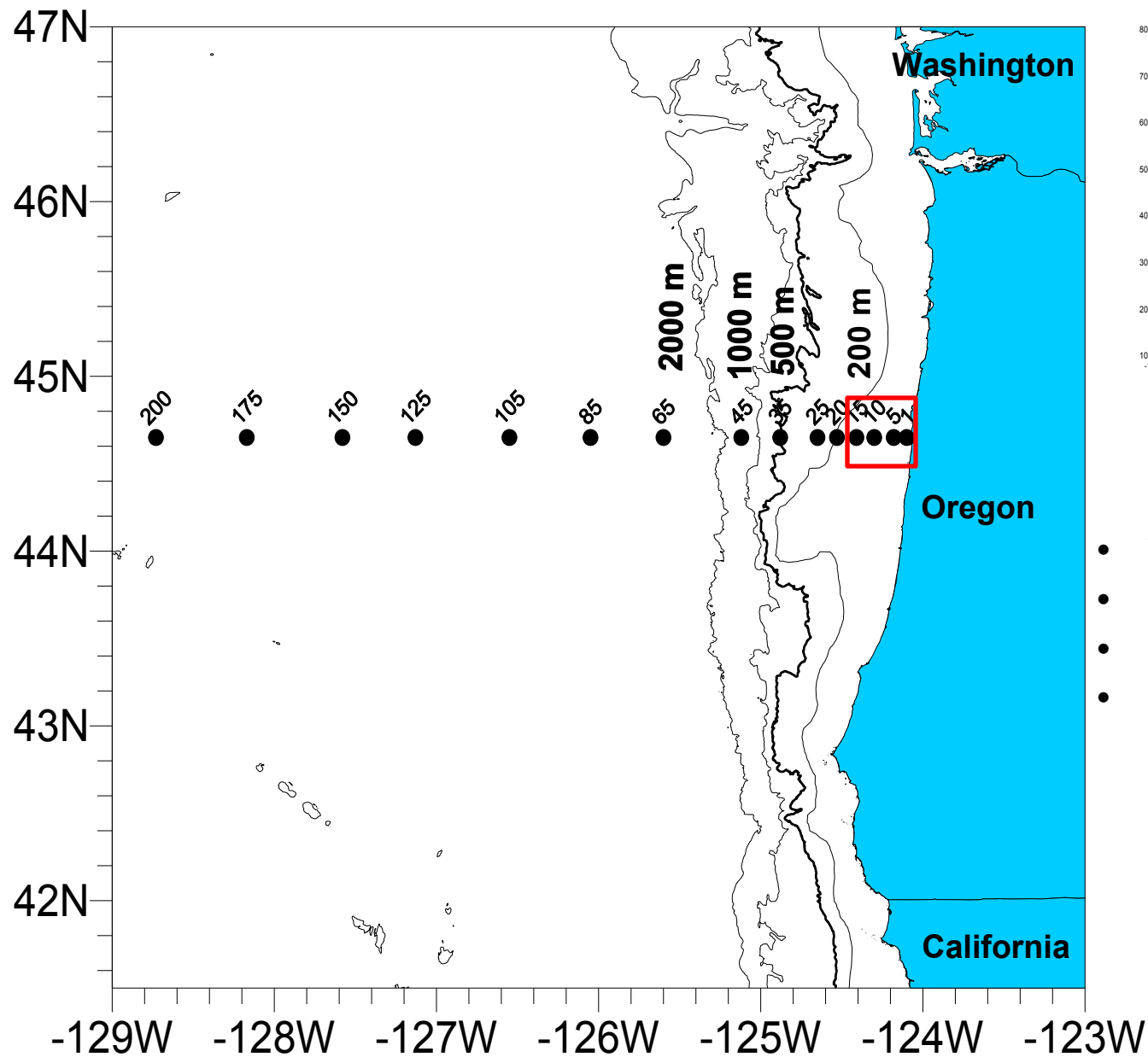


- 3 sampling regimes along Newport Hydrographic (NH) line off central Oregon coast:
 1. Winter
 2. Near-shore
 3. Cross-shelf



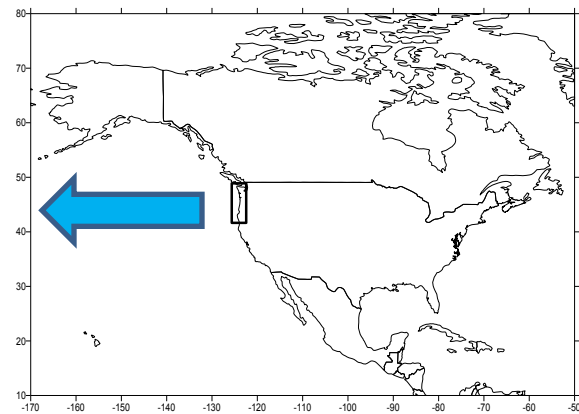
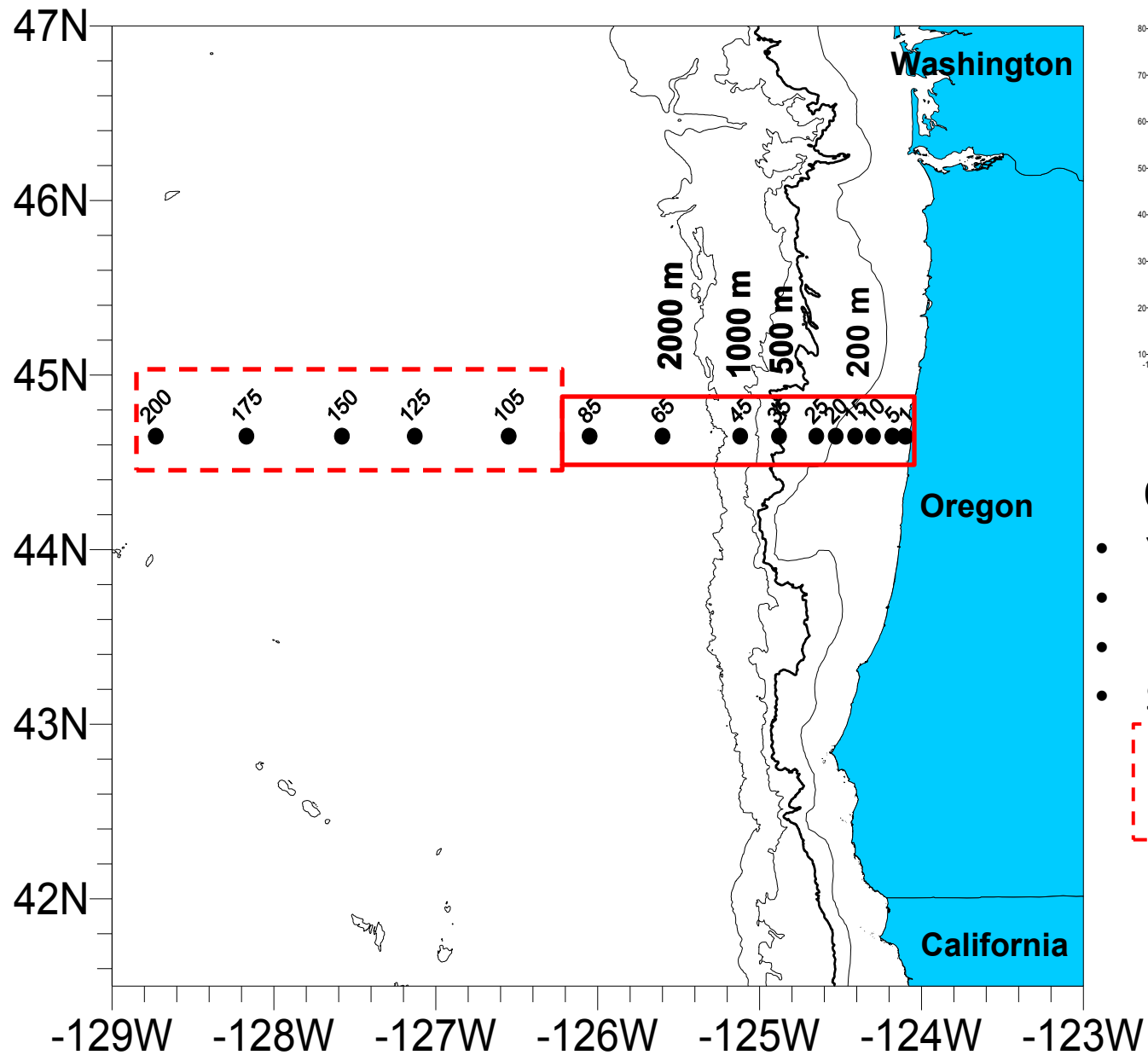
Winter Sampling

- Years: 1998-2016
- Months: January-March
- Frequency: biweekly-monthly
- Stations: NH 1-25



Near-shore Sampling

- Years: 2015-2016
- Months: January-November
- Frequency: biweekly-monthly
- Stations: NH 1-15



Cross-shelf Sampling

- Years: 2015-2016
- Months: February-November
- Frequency: Quarterly (~3 mo)
- Stations: NH 1-85

(NH 1-200 in April 2015
and February 2016)

Normal Phenology

- ***Engraulis mordax* (northern anchovy):**

- Northern California Current
- June-July
- Offshore (Columbia River plume)



- ***Sardinops sagax* (Pacific sardine):**

- Southern California Current
- April-May (June-July when north)
- Offshore

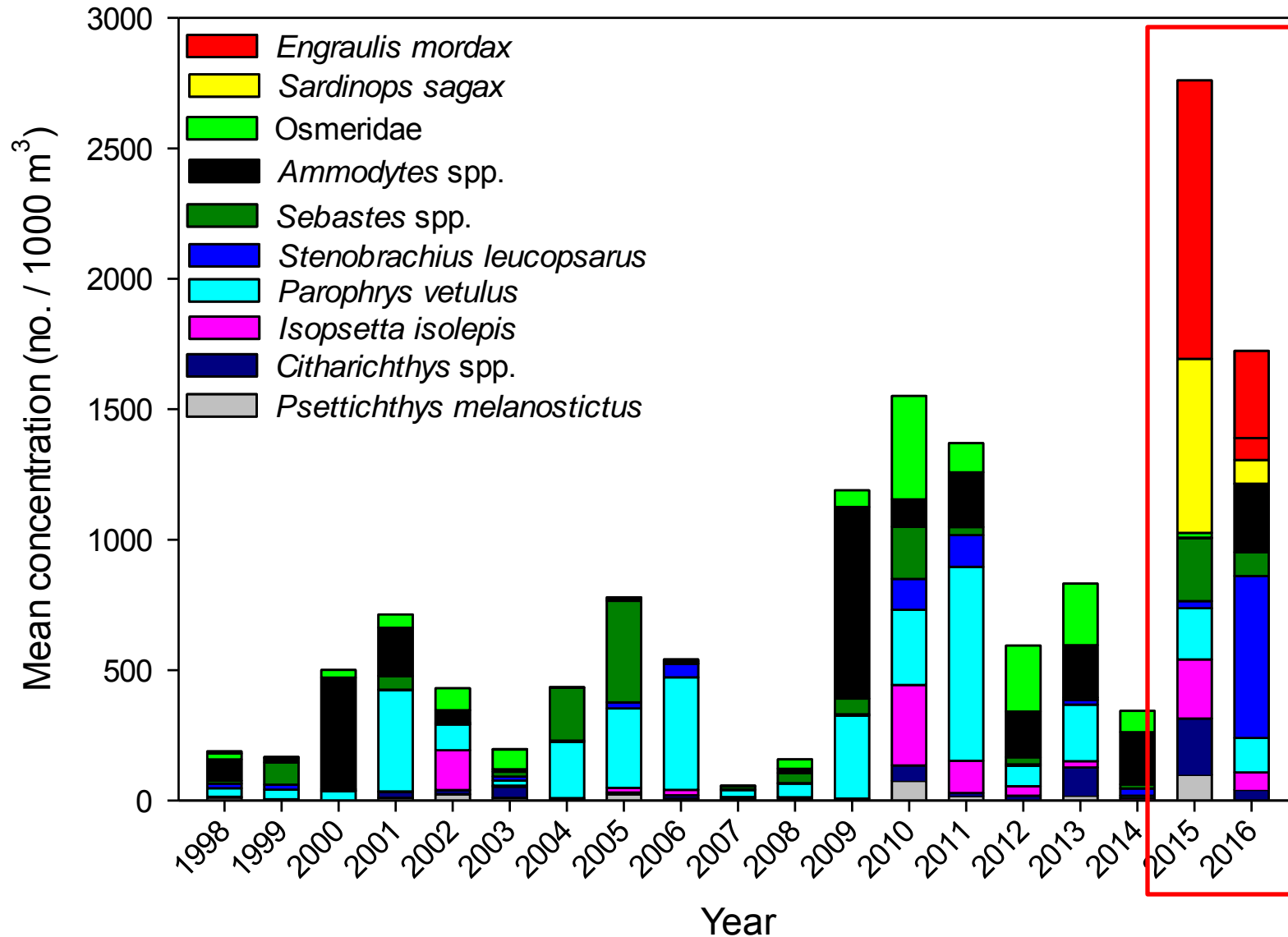


- ***Merluccius productus* (Pacific hake):**

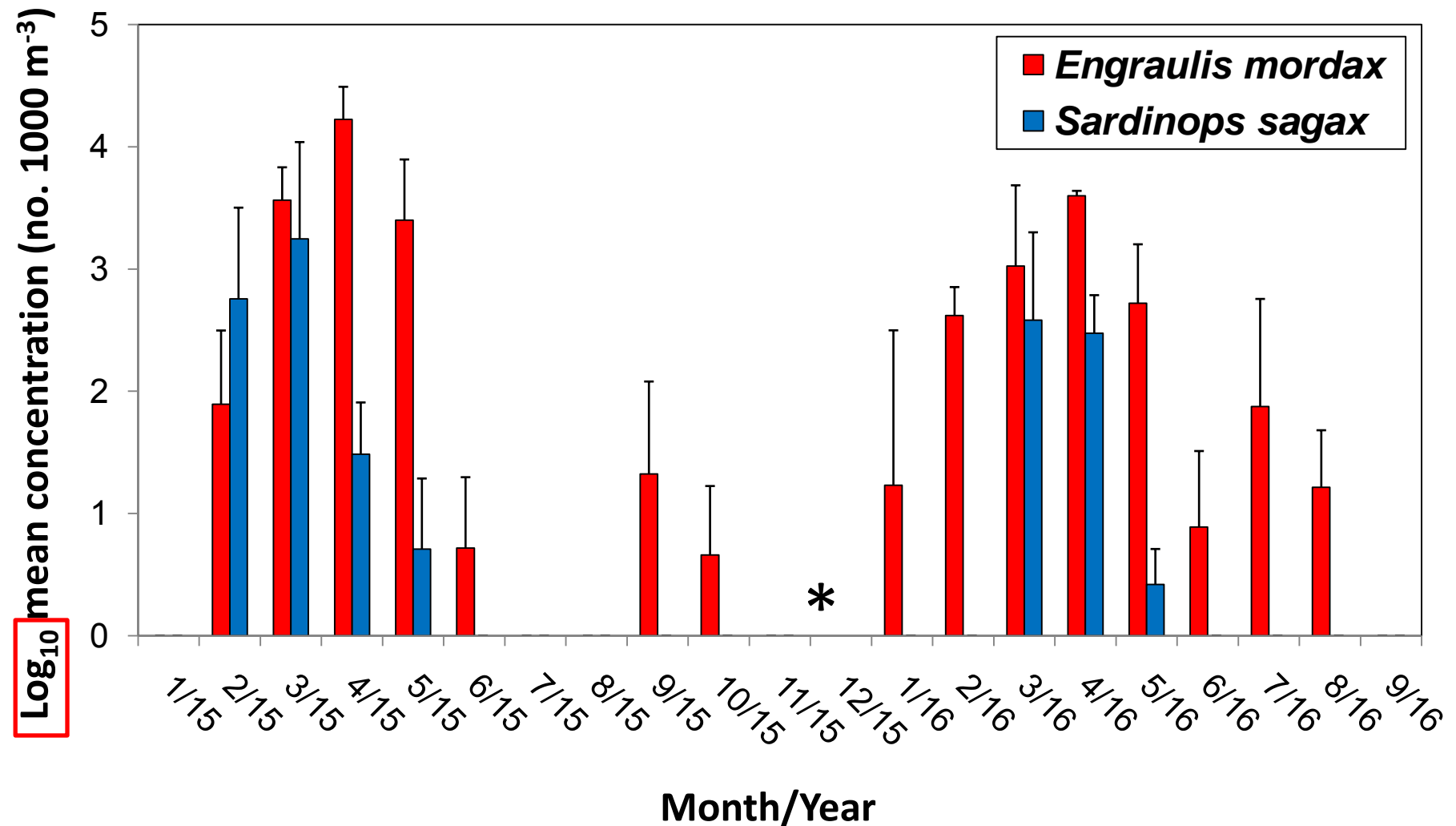
- Southern California Bight
- January-March (April-May when north)
- Offshore



Winter (Jan-Mar; NH 1-25) Density



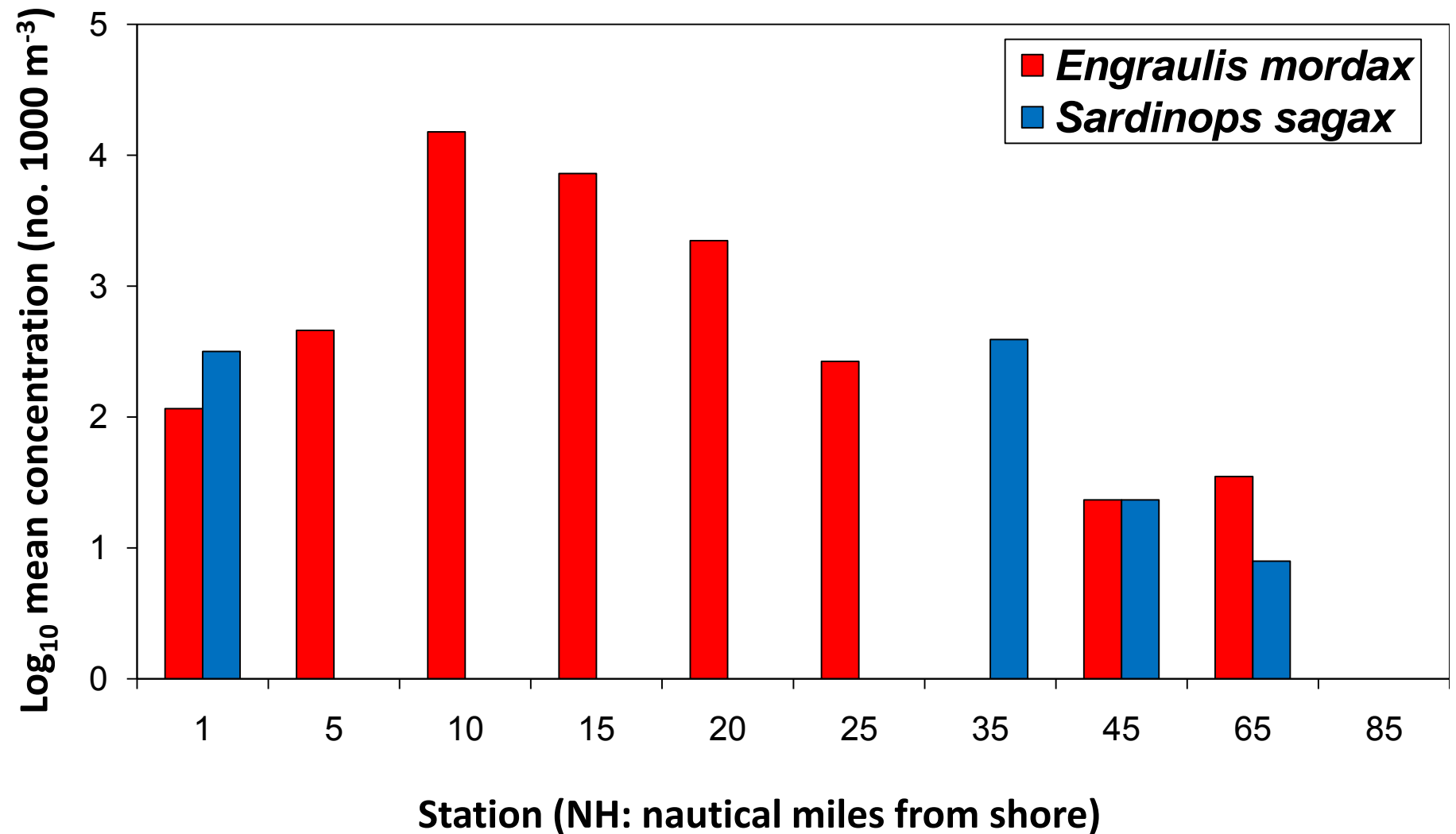
Near-shore (NH 1-15) Density



* No samples collected

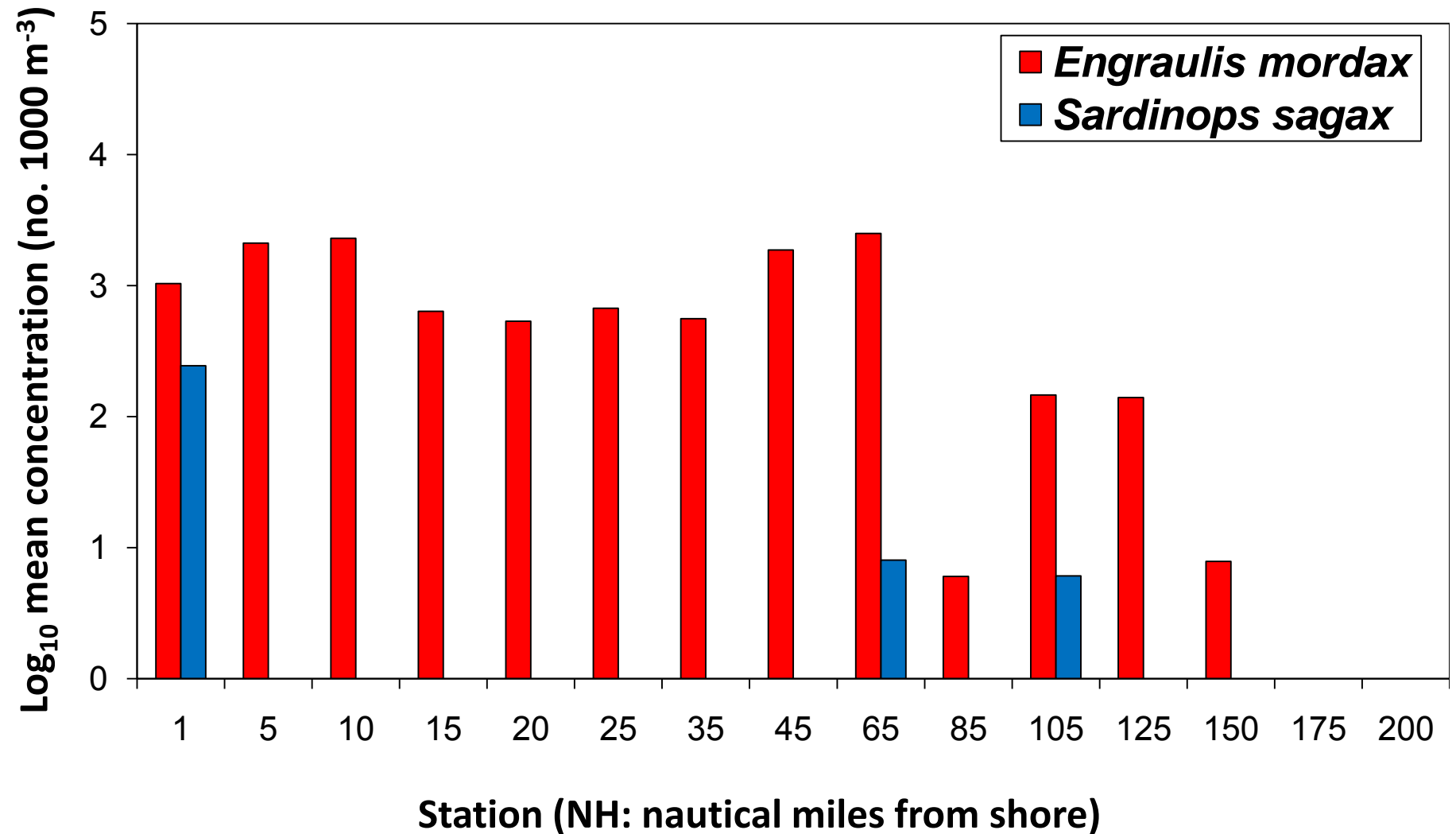
Cross-shelf Density

4-5 March 2015



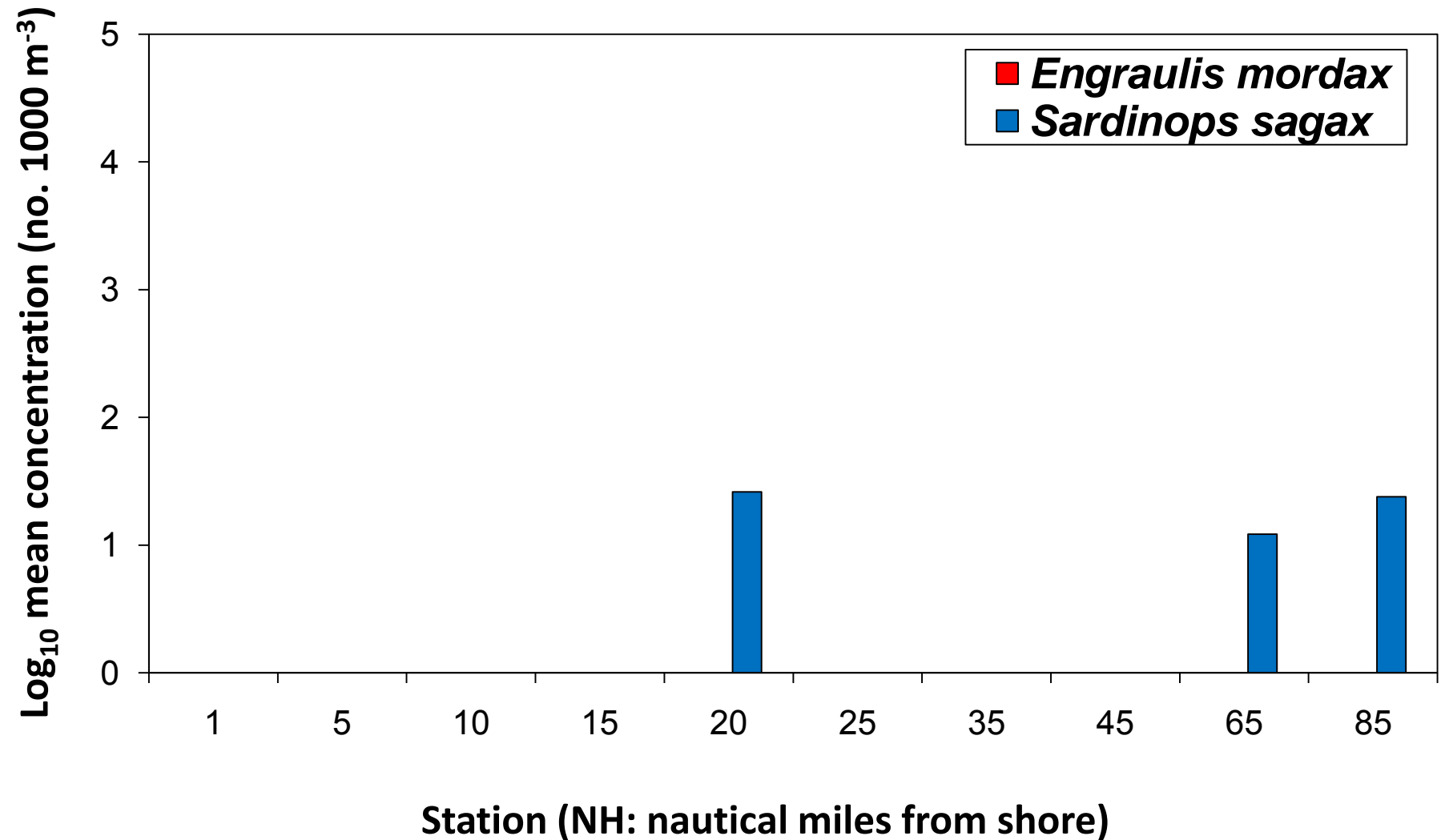
Cross-shelf Density

27-29 April 2015



Cross-shelf Density

26-27 August 2015



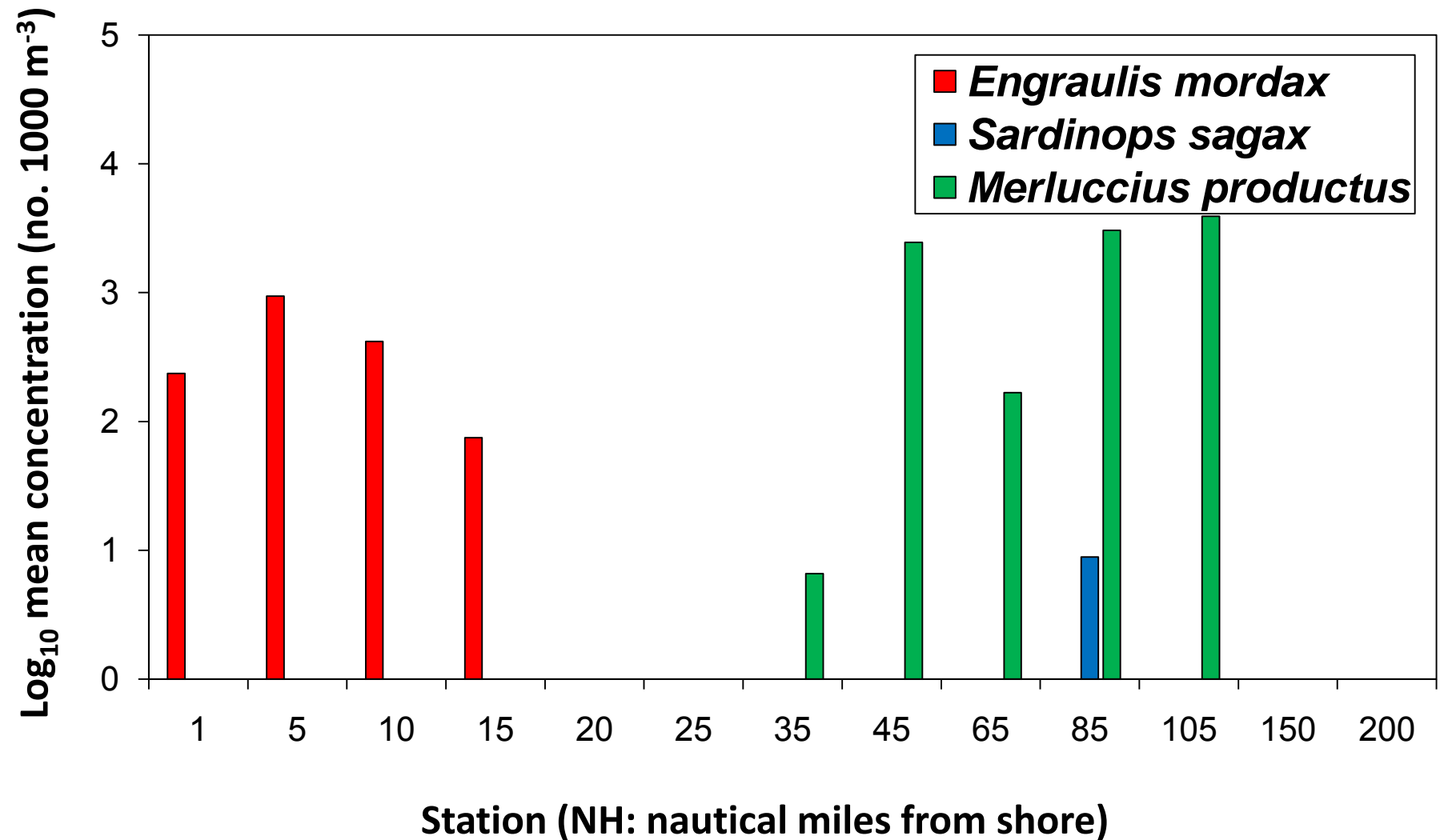
Cross-shelf Density

3-4 November 2015

- No *Engraulis mordax* or *Sardinops sagax* larvae found.

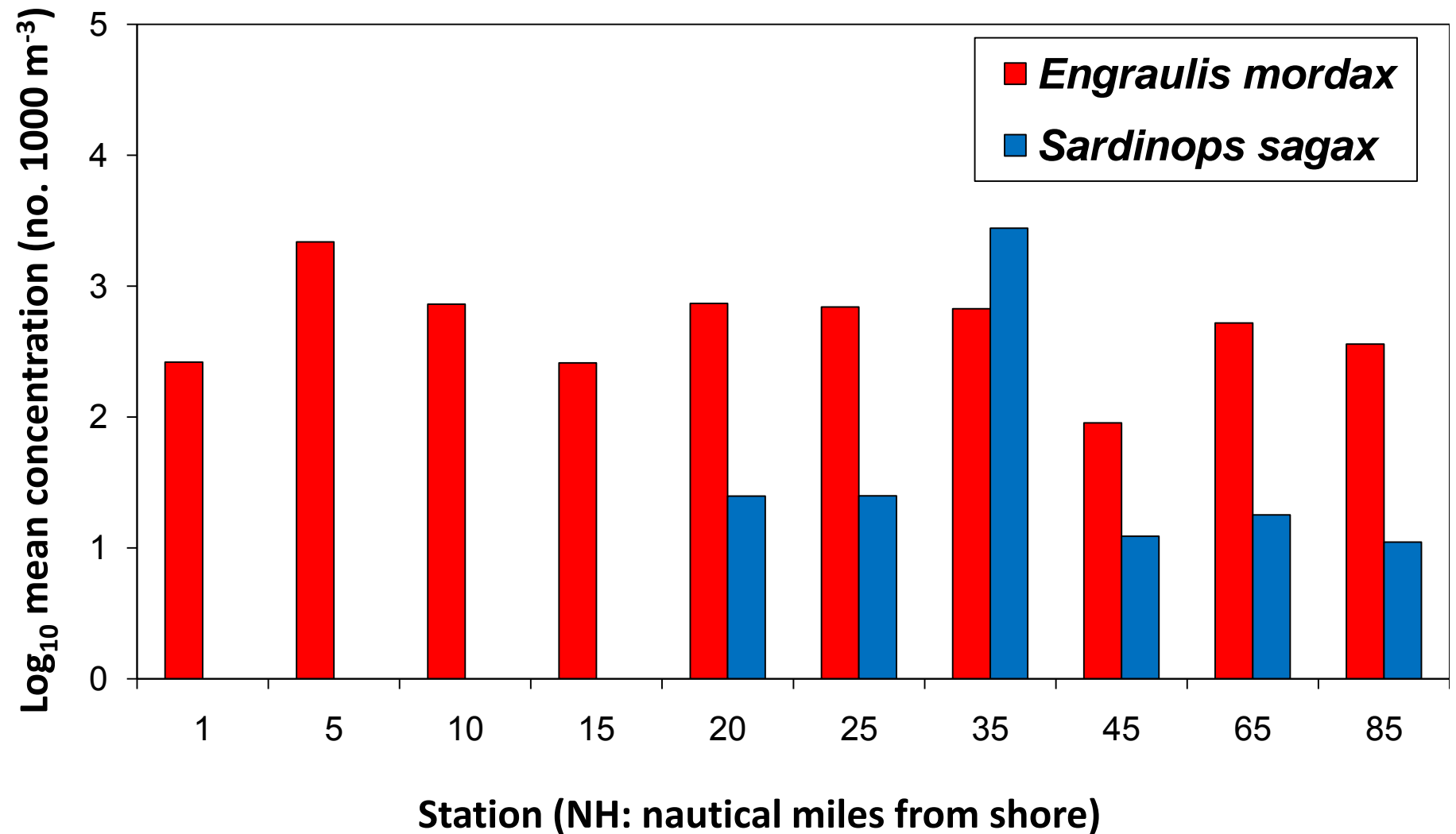
Cross-shelf Density

14-17 February 2016



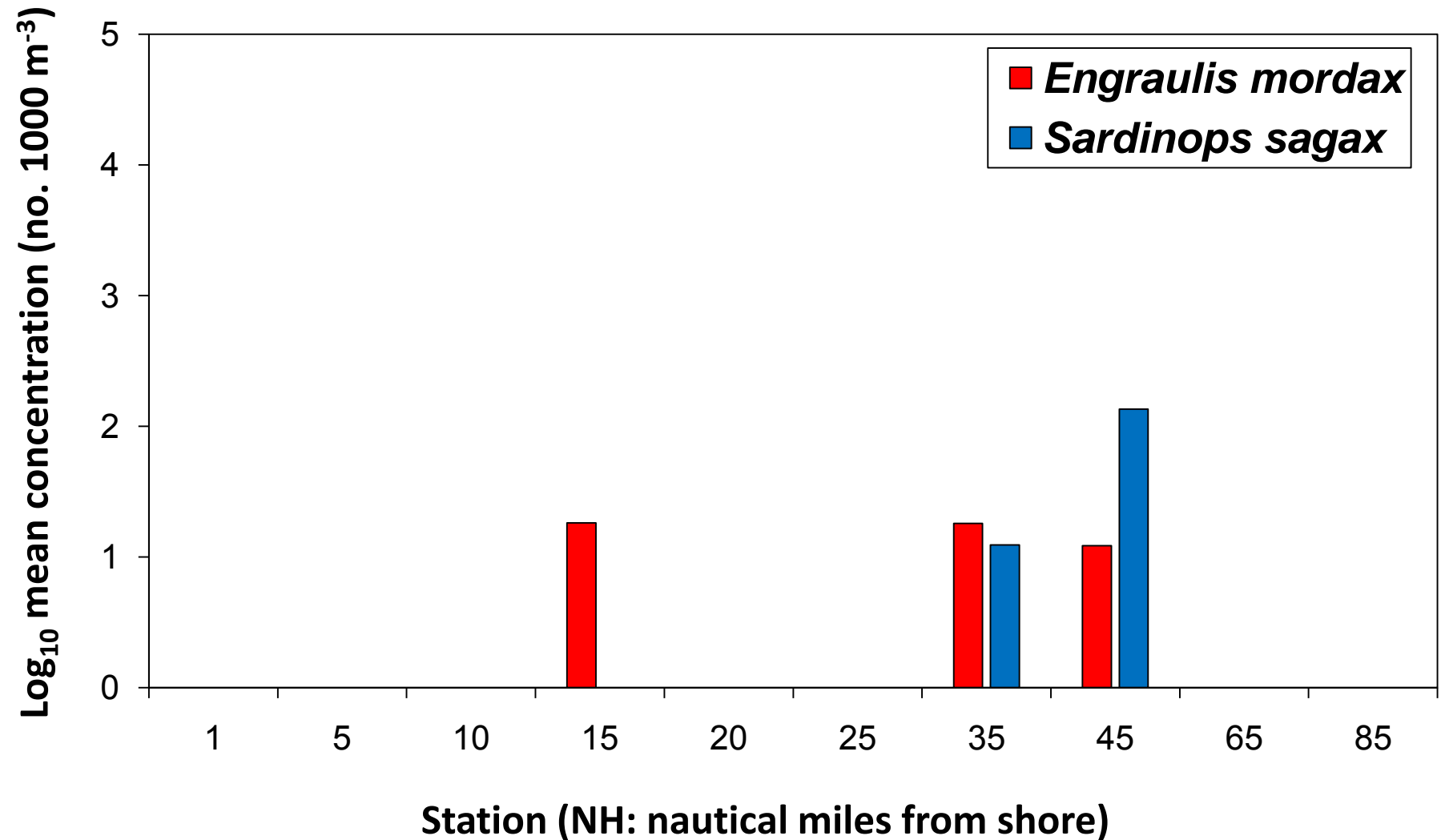
Cross-shelf Density

24-25 May 2016



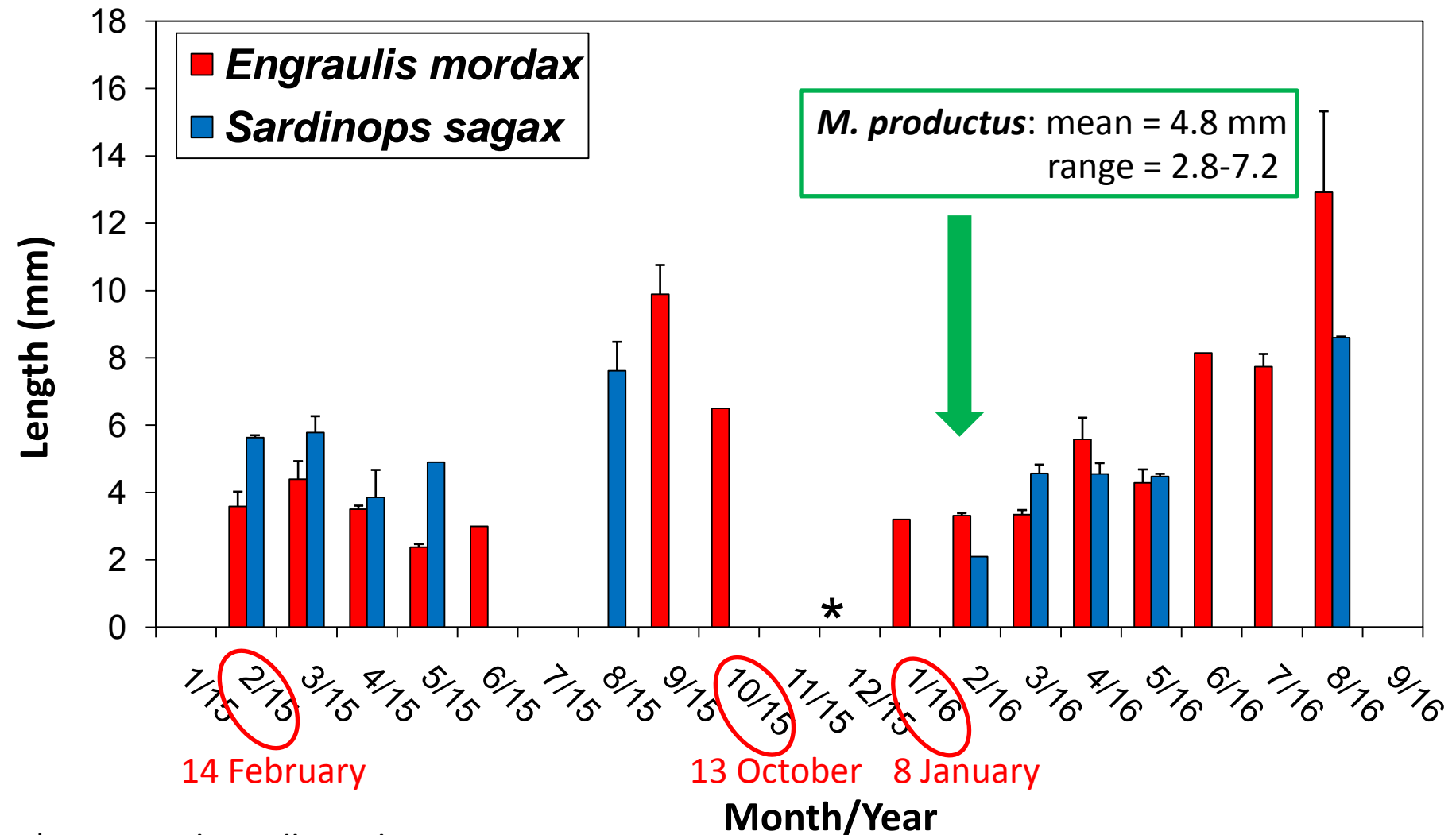
Cross-shelf Density

21-23 August 2016



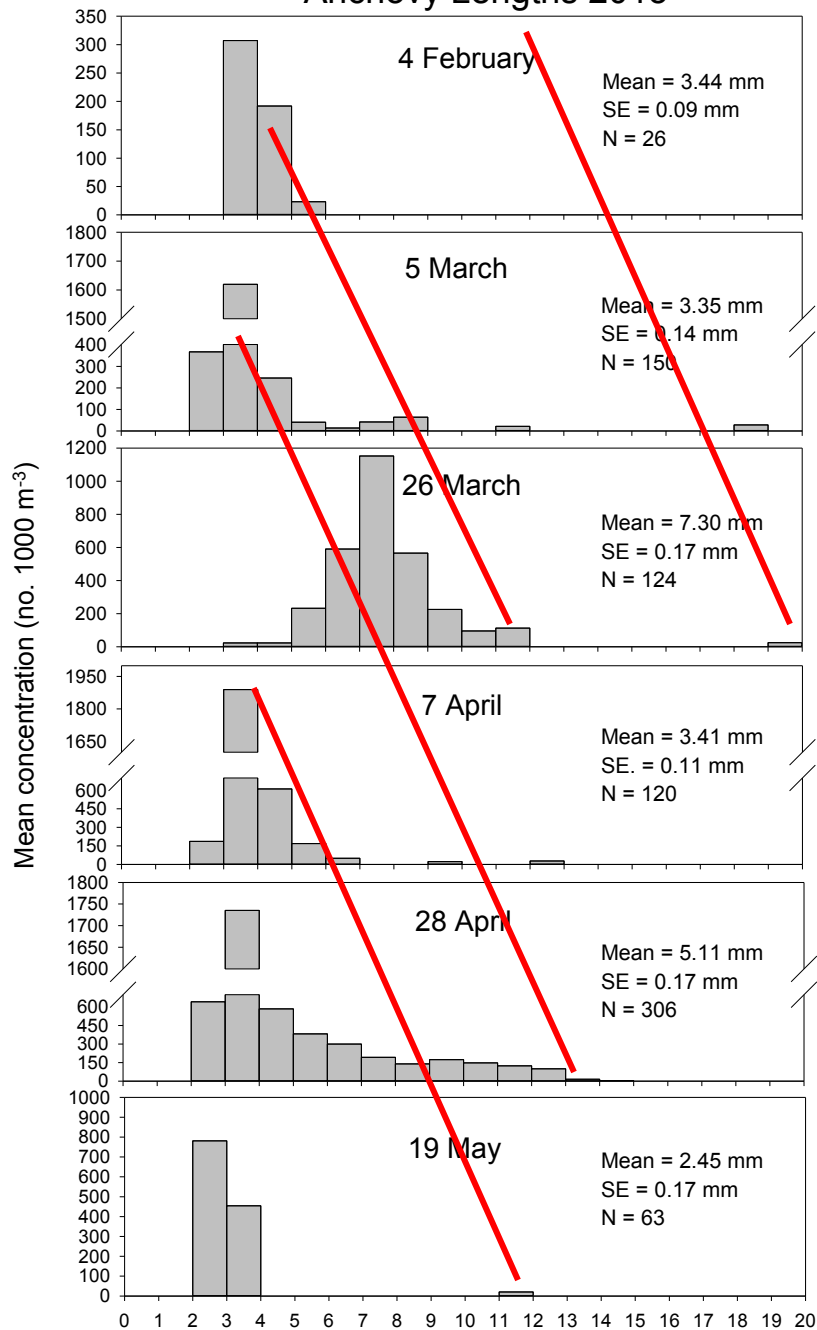
Total Weighted Mean Length

(Winter [NH 1-25], Near-shore [NH 1-15], Cross-shelf [NH 1-200])

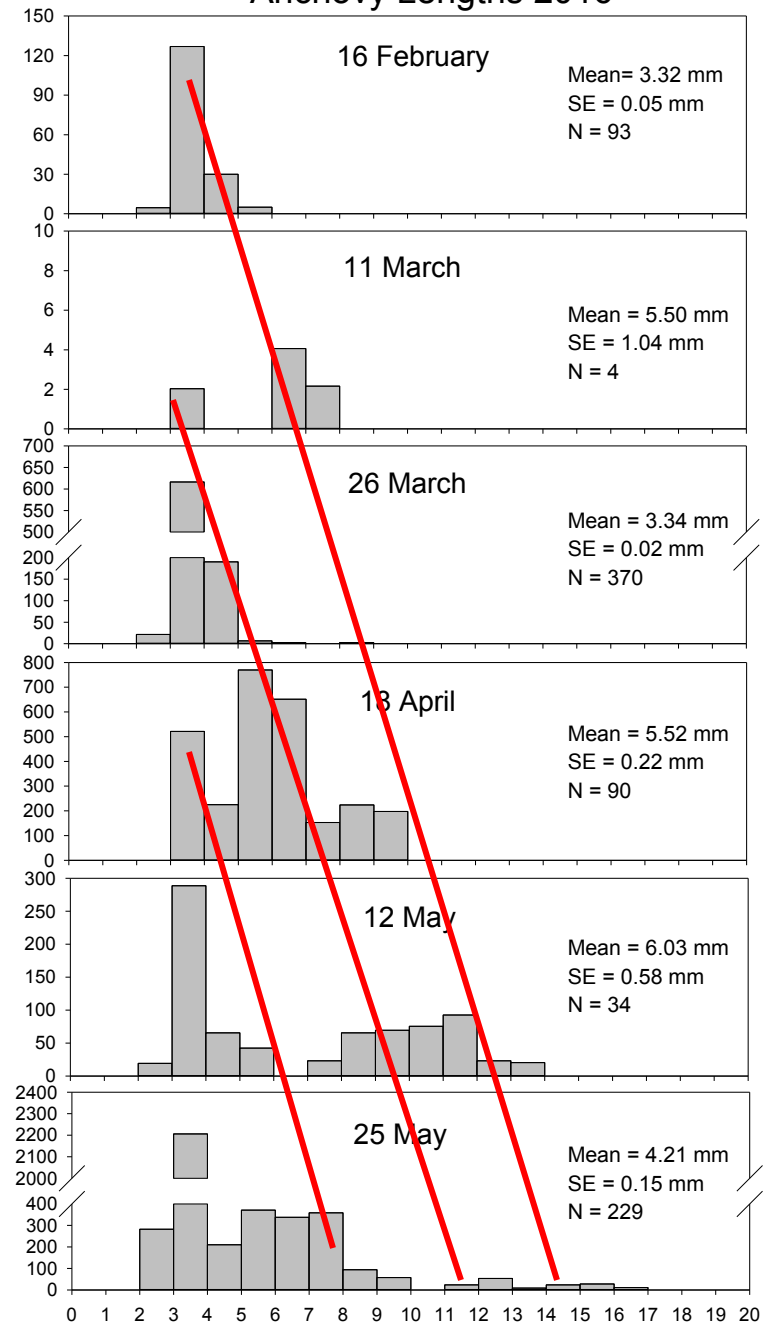


* No samples collected

Anchovy Lengths 2015

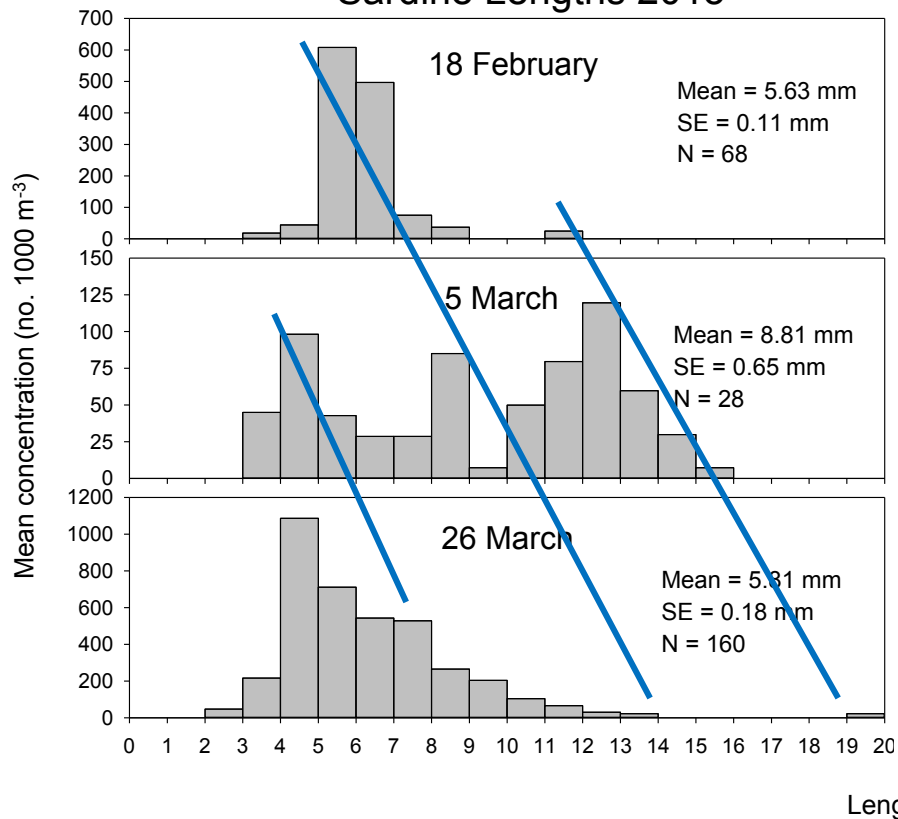


Anchovy Lengths 2016

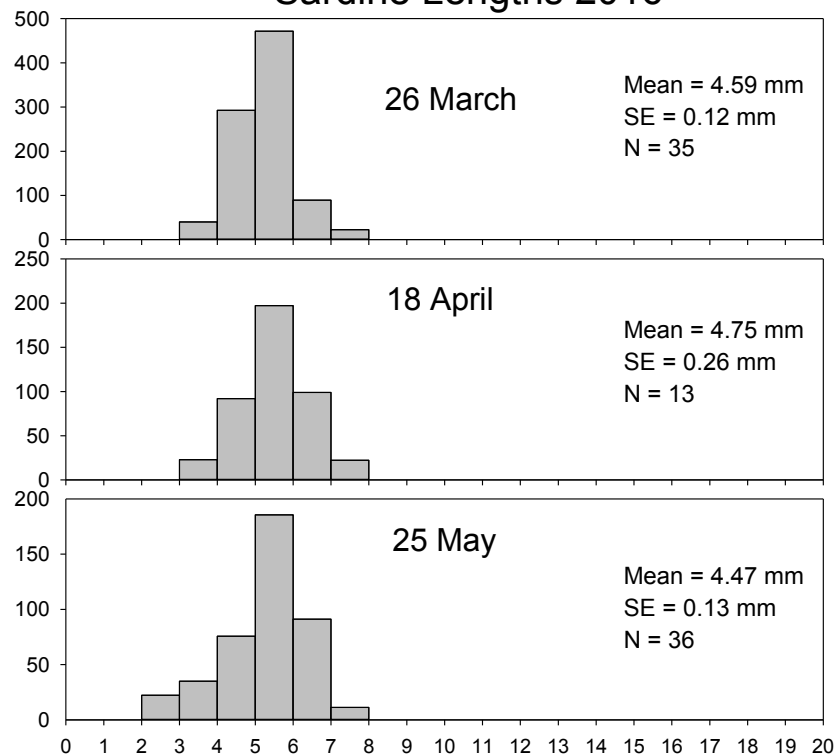


Length (mm)

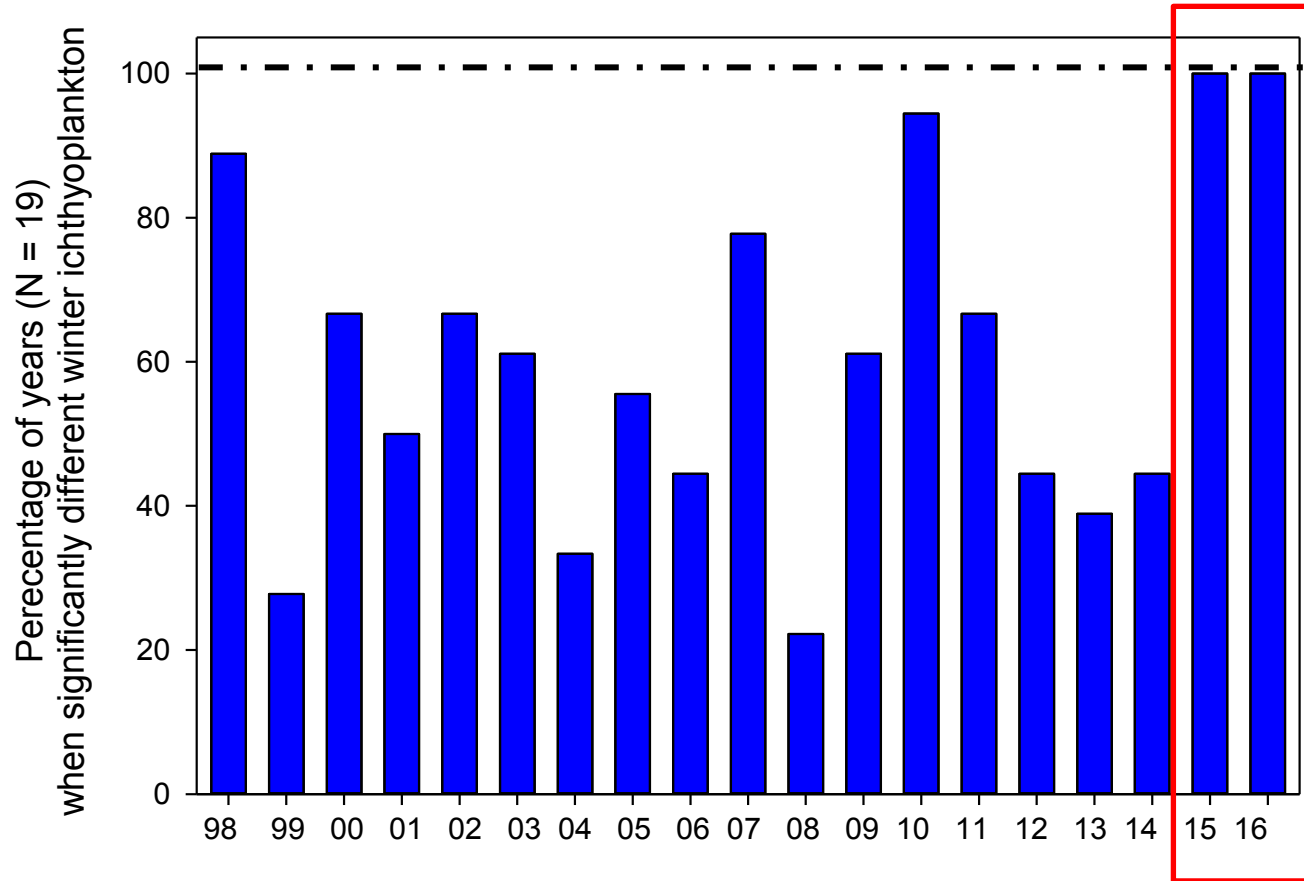
Sardine Lengths 2015



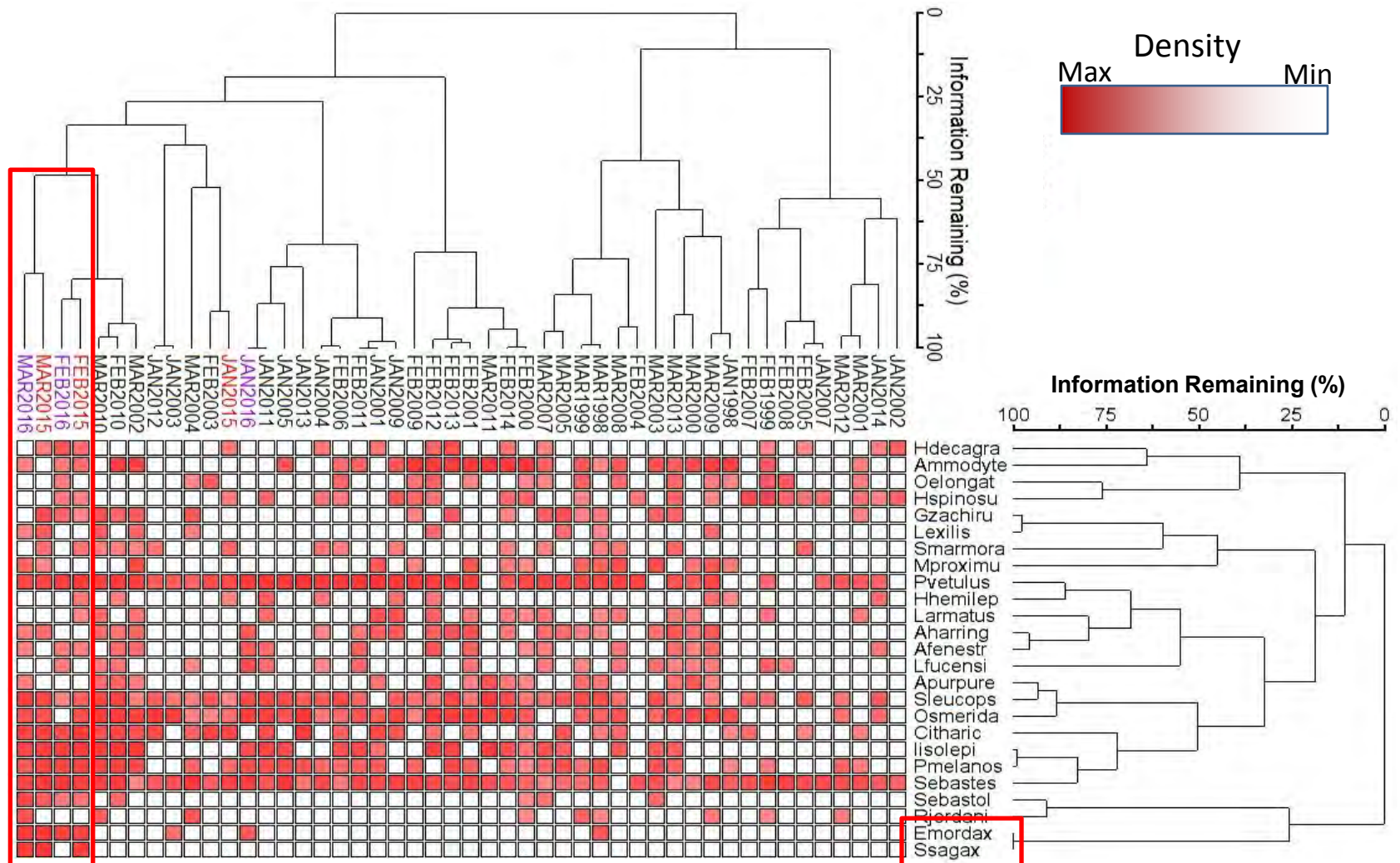
Sardine Lengths 2016



Winter MRPP Analysis



Winter Cluster Analysis



25 Top Taxa (most abundant)

Winter ISA Analysis

Scientific name	Common name	Year	IV	p
<i>Engraulis mordax</i>	Northern anchovy	2016	25.6	0.0018*
<i>Sebastolobus</i> spp.	Thornyheads	2016	24.9	0.0018*
<i>Sardinops sagax</i>	Pacific sardine	2015	25.7	0.0022*
<i>Citharichthys</i> spp.	Pacific or speckled sanddab	2015	16.6	0.0046*
<i>Microgadus proximus</i>	Pacific tomcod	2002	14.0	0.0138*
<i>Isopsetta isolepis</i>	Butter sole	2010	12.4	0.0208*
<i>Ammodytes personatus</i>	Pacific sand lance	2000	12.6	0.0212*
<i>Lyopsetta exilis</i>	Slender sole	2002	12.9	0.0334*
<i>Liparis fucensis</i>	Slipskin snailfish	1999	11.1	0.0448*

* Only significant indicator taxa shown

Summary/Conclusions

- 2015-16 stand out as highly anomalous years for the ichthyoplankton in the northern California Current (NCC).
- *Engraulis mordax* and *Sardinops sagax* spawned throughout most of the year in 2015-16 (normally just summer for *E. mordax*, and *S. sagax* far south [or summer when north]).
- Earliest occurrence of *E. mordax*, *S. sagax*, and *M. productus* larvae ever recorded in NCC.
- Highest concentrations of *E. mordax*, *S. sagax*, and *Merluccius productus* larvae in the winter and spring ever recorded in NCC.
- Could have major implications on food chain in the NCC.
- Maybe loss of *E. mordax* and *S. sagax* in southern California Current is just a move north?
- Need for continuous and cross-shelf sampling in future.

Acknowledgements

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 - R/V **Elakha**, R/V **Shimada**, R/V **Pacific Storm**, R/V **Oceanus**, F/V **Timmy Boy**, F/V **Lady Law**, F/V **Michele Ann**
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