

# Cordell Bank Ocean Monitoring Program (CBOMP)

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## INTRODUCTION

Cordell Bank National Marine Sanctuary (CBNMS) initiated a long-term Monitoring Program in January 2004. Monitoring objectives include:

- Describe the planktonic and vertebrate fauna relative to oceanography
- Assess temporal and spatial variation in occurrence and abundance of fauna and oceanography
- Encourage collaborators to perform integrated ancillary research from the vessel

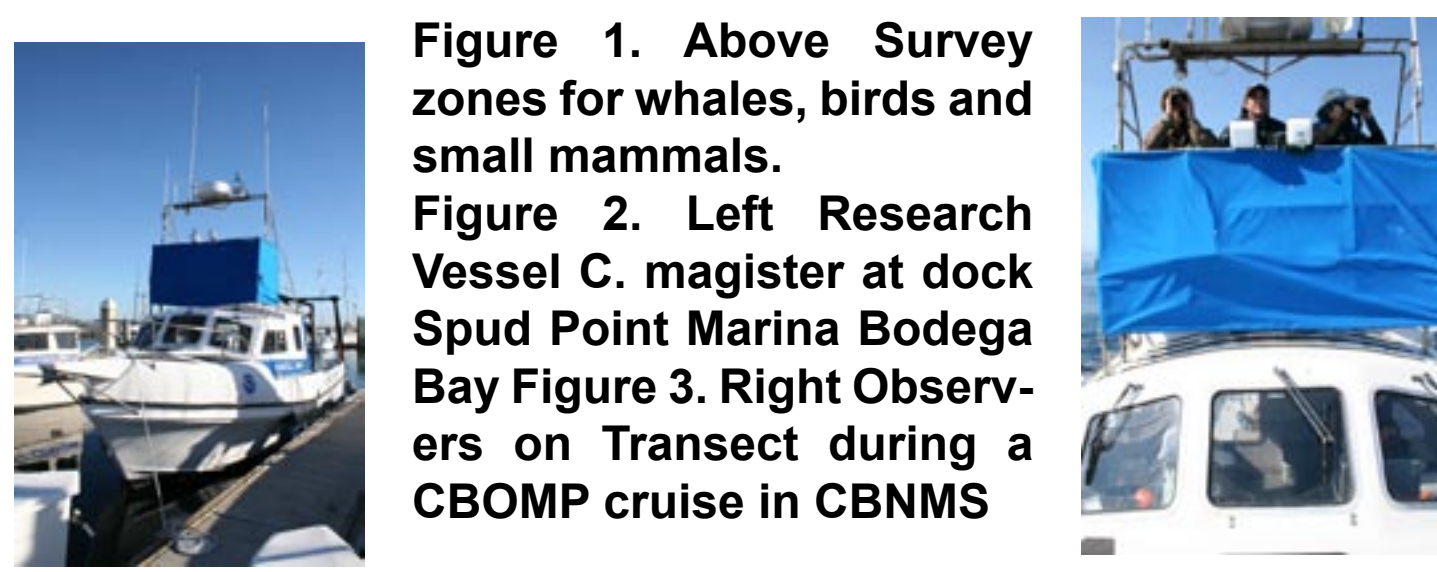
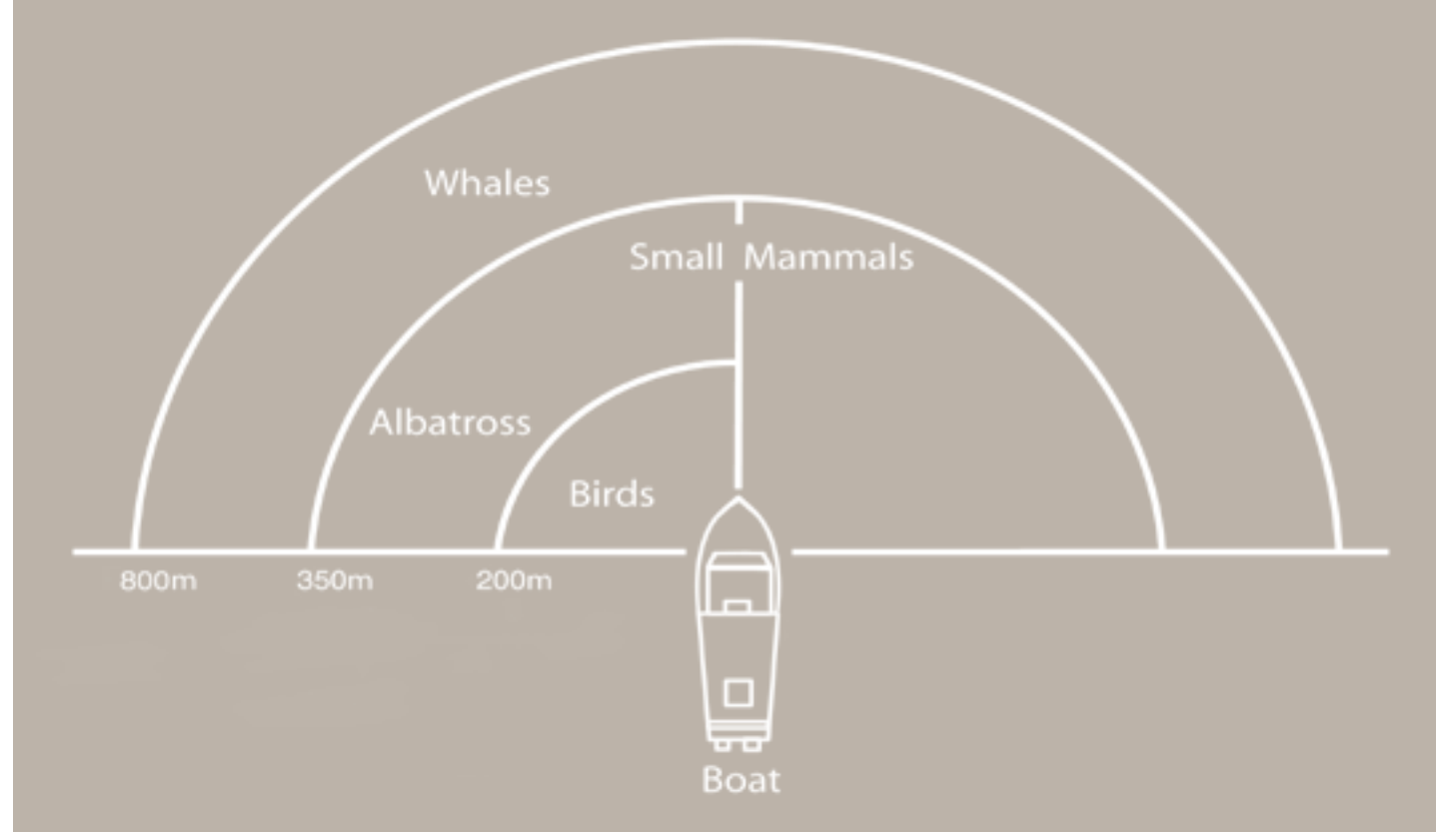


Figure 1. Above Survey zones for whales, birds and small mammals.  
 Figure 2. Left Research Vessel C. magister at dock Spud Point Marina Bodega Bay Figure 3. Right Observers on Transect during a CBOMP cruise in CBNMS

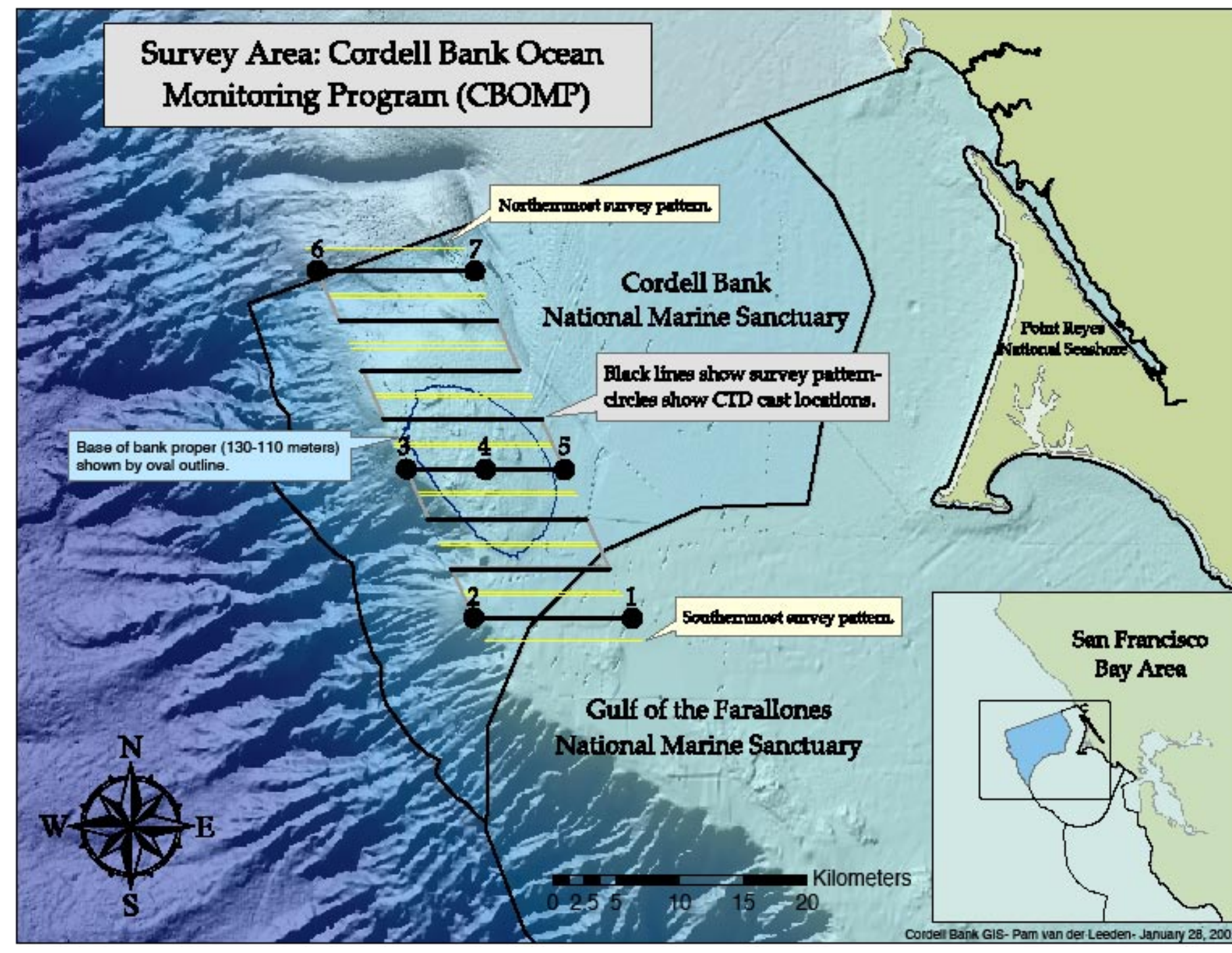


Figure 4. Location of transects and CTD casts (dark circles) within CBNMS.

## METHODS – FAUNA

- Surveys are conducted once/month using standard strip transect methodology (weather and ocean conditions permitting). Observers survey quarter-circular areas for birds and semi-circular areas for mammals, forward and abeam of observer location. All birds (except albatrosses), fish, and turtles are counted within 200 m strip; albatrosses are counted within 350 m strip; pinnipeds and small cetaceans are counted within 350 m on both sides of vessel; large cetaceans are counted within 800 m of both sides of the vessel, binned into 200 m strips. Line-transect methodology is also used to survey whales (for comparative purposes). Prior to each survey a float attached to a rod and reel is extended 200 and 350 m to calibrate individual observer distance estimations. Whale distances are estimated with reticular binoculars.

DATE	27-Jan	29-Mar	26-Apr	31-Aug	22-Sep	13-Oct	8-Nov	13-Dec
Survey lines completed	4	5	8	5	5	8	8	2
Km surveyed	37	96	96	97	61	105	104	26
TAXON								
BIRDS								
TOTAL	4	5	8	5	5	8	8	2
Laysan Albatross	1	1	18	1	6	6	7	1
Black-footed Albatross	2	1	1	3	1	6	6	4
Northern Fulmar	59	34	221	3	1	6	419	30
Pink-footed Shearwater	1	1	6	16	22	110	8	1
Fish-footed Shearwater	1	1	1	1	1	1	1	1
Buller's Shearwater	7	35	4	24	59	58	58	145
Sooty Shearwater	1	1	1	1	1	1	1	1
Short-tailed Shearwater	1	1	1	1	1	1	1	1
Manx Shearwater	1	1	1	1	1	1	1	1
Wilson's Storm Petrel	1	1	1	1	1	1	1	1
Fork-tailed Storm Petrel	1	1	1	1	1	1	1	1
Ashy Storm Petrel	10	1636	4	2	2	2	2	20
Black Storm Petrel	1	1	1	1	1	1	1	1
Least Storm Petrel	1	1	1	1	1	1	1	1
Brown Pelican	1	1	1	1	1	1	1	1
Red-necked Phalarope	361	39	1	1	1	1	1	400
Red Phalarope	4	4	7	42	18	7	1	1
South Polar Skua	1	1	1	1	1	1	1	1
Pomarine Jaeger	1	1	1	1	1	1	1	1
Parasitic Jaeger	1	1	1	1	1	1	1	1
Long-tailed Jaeger	1	1	1	1	1	1	1	1
Bonaparte's Gull	23	20	1	1	1	1	1	1
Heermann's Gull	24	18	16	5	6	86	39	289
California Gull	34	5	1	1	1	1	1	1
Herring Gull	1	1	1	1	1	1	1	1
Tray's Gull	1	1	1	1	1	1	1	1
Western Gull	1	25	66	53	29	24	74	50
Western K. Gull	1	1	1	1	1	1	1	1
Glaucous-winged Gull	1	1	1	1	1	1	1	1
Sabine's Gull	41	17	1	20	1	1	1	1
Black-legged Kittiwake	2	2	1	1	1	1	1	1
Unidentified Gull	1	1	1	1	1	1	1	1
Elk Island Tern	1	1	1	1	1	1	1	1
Common Tern	1	1	1	1	1	1	1	1
Common Noddy	1	1	1	1	1	1	1	1
Kermadec Murrelet	1	1	1	1	1	1	1	1
Academy Murrelet	1	1	1	1	1	1	1	1
Cassidy's Auklet	55	1855	919	728	123	2782	603	819
Horned Auklet	15	42	42	42	19	14	198	117
Cliffed Puffin	1	1	1	1	1	1	1	1
Bird taxa	13	18	17	25	14	14	18	12
Bird total	237	2084	1728	2729	276	3191	1484	1351

Table 1. Survey lines completed, number km surveyed, species, and number of seabirds observed during CBOMP surveys conducted during 2004. Species with asterisk (\*) were selected to summarize relative abundance of numerically dominant species; all other species were grouped as 'other'.

DATE	27-Jan	29-Mar	26-Apr	31-Aug	22-Sep	13-Oct	8-Nov	13-Dec
Survey lines completed	4	5	8	5	5	8	8	2
Km surveyed	37	96	96	97	61	105	104	26
TAXON								
MARINE MAMMALS								
TOTAL	4	5	8	5	5	8	8	2
Northern Fur Seal	2	1	1	2	0	7	3	0
Stellar Sea Lion	5	0	7	2	0	4	1	0
California Sea Lion	3	1	34	1	3	8	8	2
Northern Elephant Seal	2	1	1	2	1	2	4	1
Unidentified Pinniped	1	1	1	1	1	1	1	1
Minke Whale	1	1	1	1	1	1	1	1
Blue Whale	1	1	1	1	1	1	1	1
Humpback Whale	1	1	1	1	1	1	1	1
Unidentified Whale	1	1	1	1	1	1	1	1
Pacific White-sided Dolphin	14	1	215	1	1	20	250	1
Northern Right-whale Dolphin	1	1	1	1	1	1	1	1
Risso's Dolphin	1	1	14	1	1	1	1	1
Dall's Porpoise	4	1	26	32	3	7	70	1
Unidentified Cetacean	1	1	1	1	1	1	1	1
Mammal taxa	5	1	6	11	5	10	8	14
Mammal total	28	1	18	329	51	25	173	2
FISH								
Blue Shark	1	137	1	4	1	4	143	1
Tuna sp. (prob. Albacore)	1	1	1	1	1	1	1	1
Mola Mola	1	14	1	1	1	1	1	1
Fish taxa	3	3	3	2	2	2	3	3
Fish total	8	153	2	5	5	5	168	1
TOTAL TAXA	18	19	26	29	21	26	1657	1353
GRAND TOTAL VERTEBRATES	285	2085	1752	3211	329	3221	1657	1353
OTHER								
Boat	4	2	1	1	1	1	1	1
Albatross	1	1	1	1	1	1	1	1

Table 2. Survey lines completed, number km surveyed, species, and number of marine mammals and fishes observed during CBOMP surveys conducted during 2004.

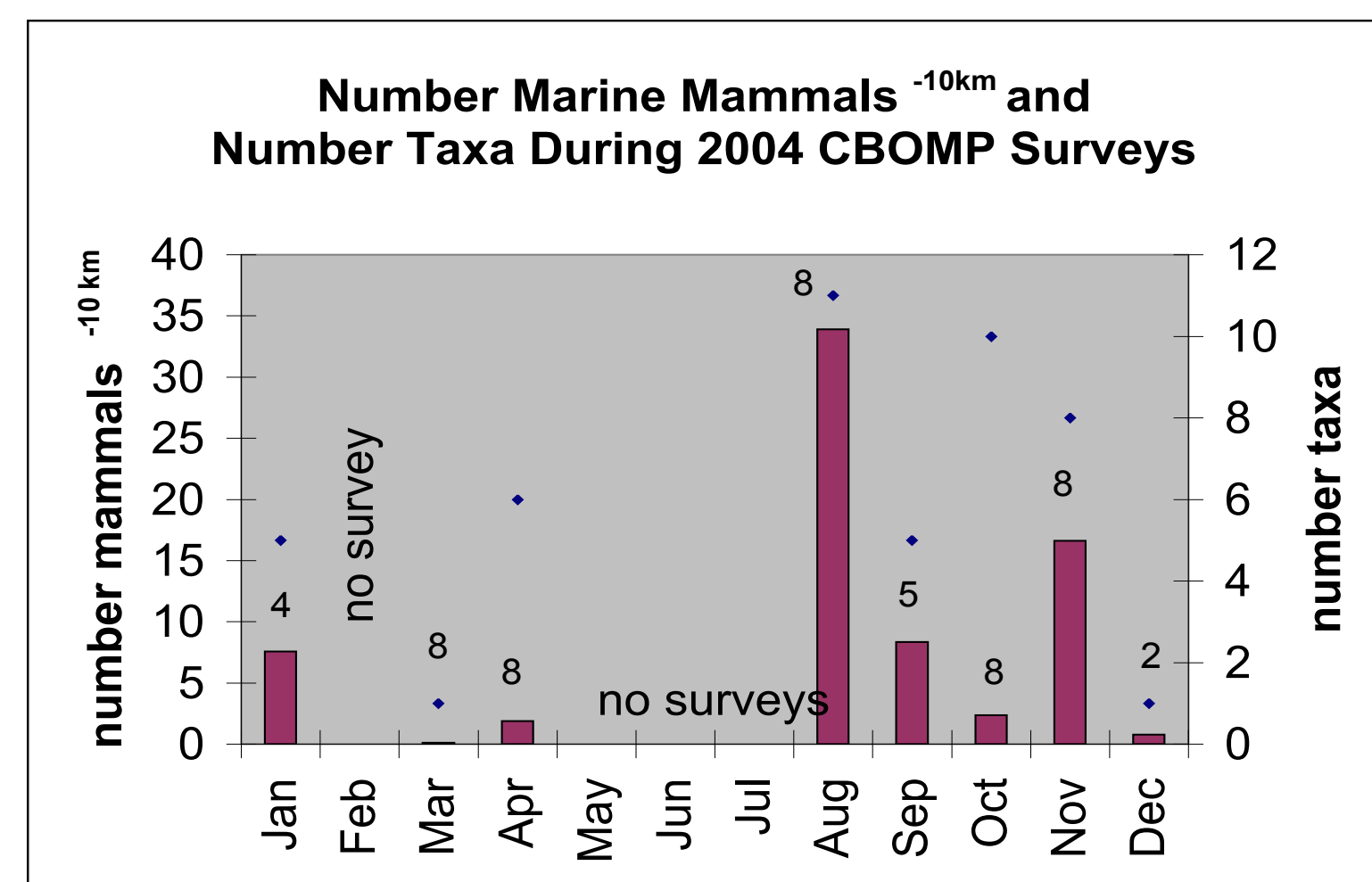


Figure 8. Number of marine mammals per 10 kilometers surveyed (bars) and number of taxa observed (points) during surveys conducted during 2004. Numbers over bars indicate number of transect lines completed during each survey.

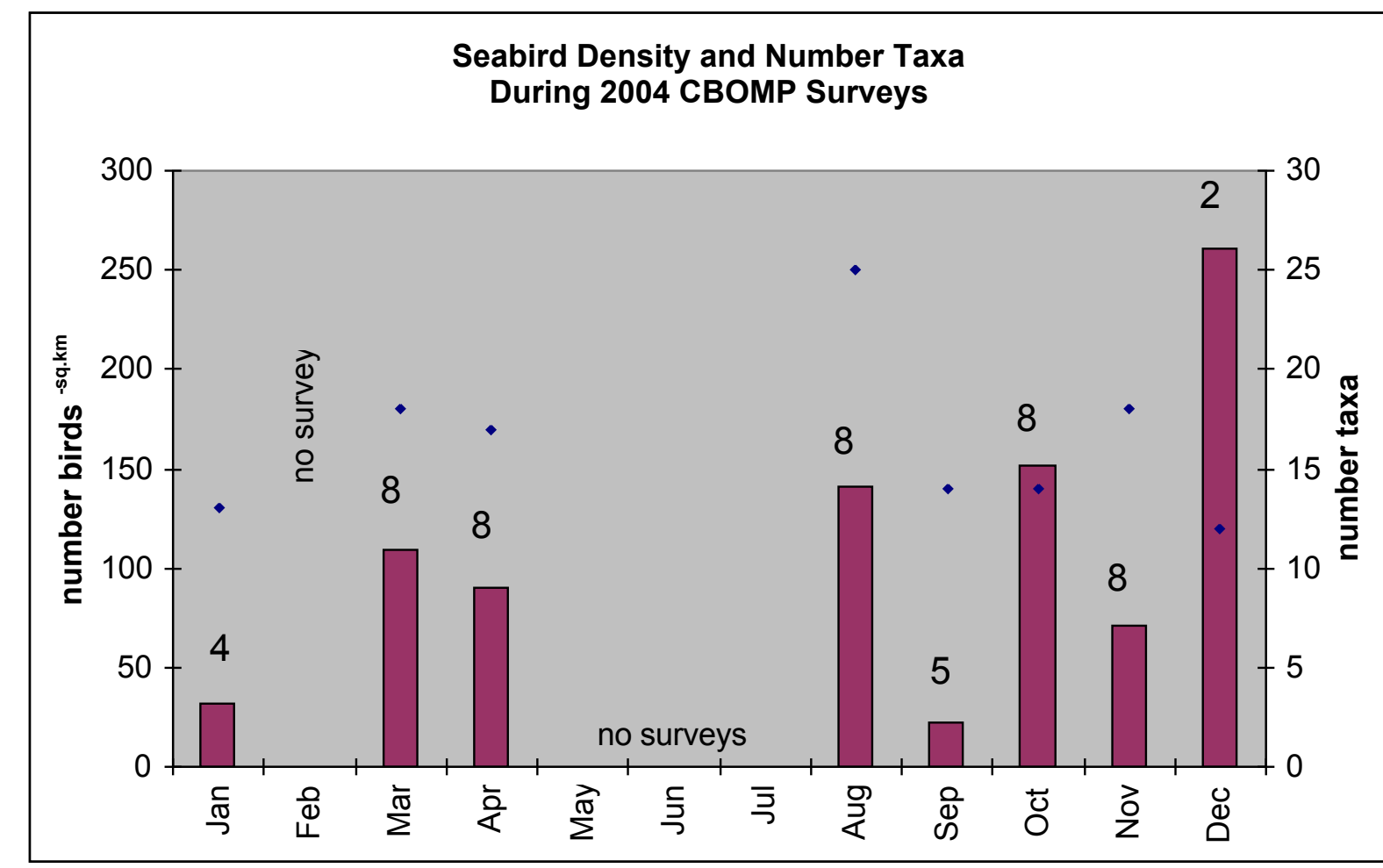


Figure 9. Seabird density (number of birds per km²; all species pooled and uncorrected for flight direction) and number of taxa observed (points) during Cordell Bank Ocean Monitoring Program (CBOMP) surveys conducted in 2004. Numbers over bars indicate number of transect lines completed during each survey.

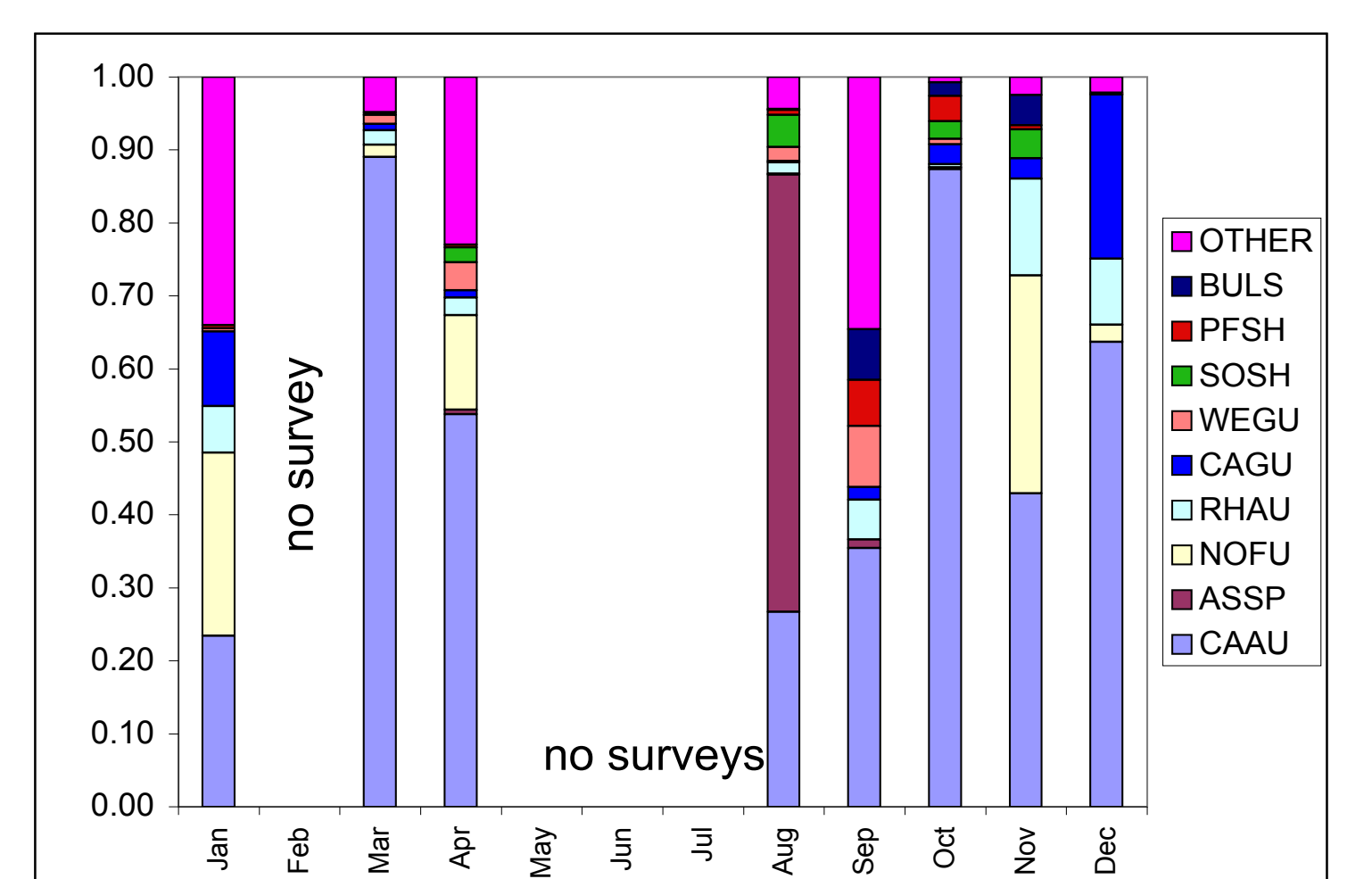


Figure 10. Relative proportion of Cassin's Auklet (CAAU), Ashy Storm-Petrel (ASSP), Northern Fulmar (NOFU), Rhinoceros Auklet (RHAU), California Gull (CAGU), Western Gull (WEGU), Sooty Shearwater (SOSH), Pink-footed Shearwater (PFSH), and Buller's Shearwater (BULS) during (CBOMP) surveys conducted in 2004.

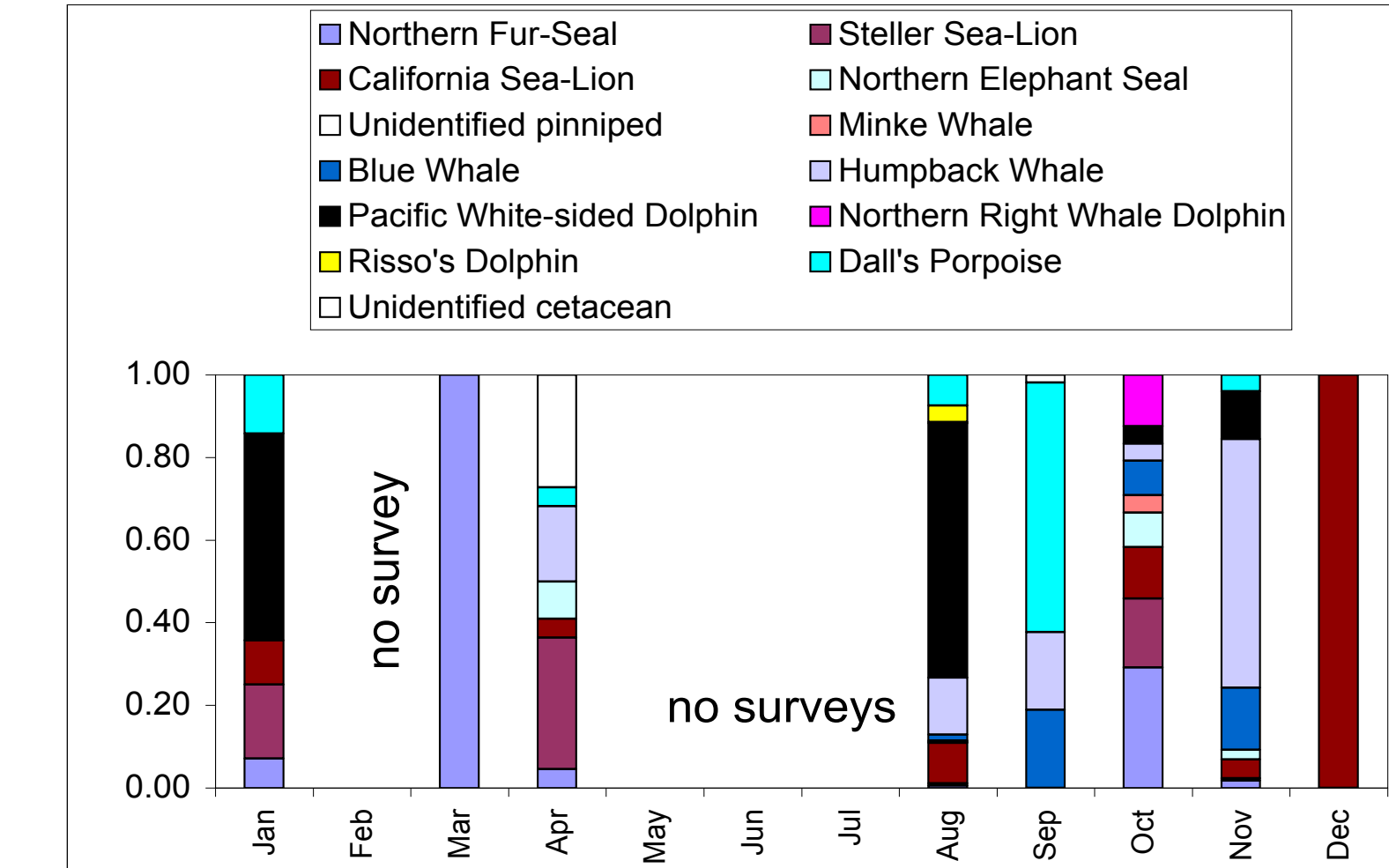
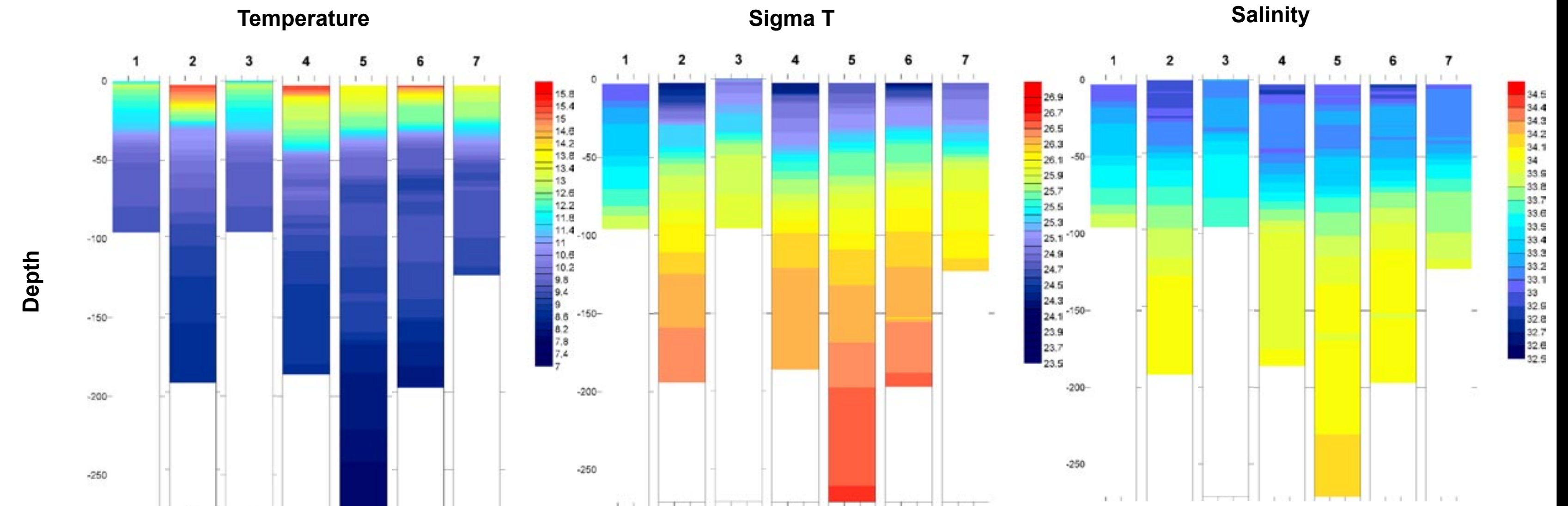


Figure 11. Relative proportion of Northern Fur Seal, Stellar Sea Lion, California Sea Lion, Northern Elephant Seal, Unidentified Pinniped, Minke Whale, Blue Whale, Humpback Whale, Pacific White-Sided Dolphin, Northern Right Whale Dolphin, Risso's Dolphin, Dall's Porpoise, and unidentified cetaceans observed during CBOMP surveys conducted during 2004.

## METHODS – OCEANOGRAPHY

- Thermosalinograph used to record sea surface temperature (SST) and sea surface salinity continuously along transect lines.
- CTD casts performed at selected locations using a SEABIRD SBE 19; data processed using SBE software and displayed using Surfer 7.0 .
- Simrad EK60 echosounder with single 120Khz split-beam transducer used to estimate krill abundance.
- ArcView 9.0 Geographical Information System (GIS) used to integrate backscatter, fauna, and oceanography. SSTs were interpolated from TSG data using kriging.



Figures 5-7. CTD casts for October 13, 2004. Each colored bar represents an individual CTD cast of the 7 CTD cast locations shown in Figure 4. Depth of each cast is shown on the Y axis.

## PRELIMINARY RESULTS - 2004

- Eight surveys were conducted (due to weather and mechanical problems no surveys were conducted in Feb, May, June, July).
- 10,243 birds of 40 taxa, 501 marine mammals of 13 taxa, and 168 fish of 3 taxa were censused.
- Depth, sea surface temperature, and backscatter mapped, and sighting locations of fauna for the October 2004 survey overlaid. High backscatter was documented along the shelf-break and this likely reflected krill abundance (based on similar work being conducted during the Wind to Whales surveys in Monterey Bay).
- CTD casts showed stratified and unstratified profiles depending on wind conditions. A cold water cell was embedded in the warmer stratified water between 50 - 100M and was apparent in profiles 4-6 in the late fall and into winter.

## SEABIRDS

- Cassin's Auklet were the most abundant seabird observed during all surveys; Densities varied spatially and temporally, likely reflecting variation in krill densities.
- Ashy Storm Petrel was the most abundant species during the August survey, when >6000 were estimated on and off transect.
- Unusual species sighted included the Laysan Albatross, Manx Shearwater, Black and Least storm petrels, and Xantus' Murrelet.

## MARINE MAMMALS

- Humpback and Blue Whales were relatively abundant in September and November.
- Dall's Porpoise were relatively abundant in September.
- Pacific white-sided dolphins were relatively abundant in January and August.
- Greatest diversity of marine birds and mammals occurred in August.

## FUTURE PLANS and ANALYSIS

- Add a Wetlabs fluorometer comparable to the fluorometer on the CTD which will sample continuous surface chlorophyll.
- Ground-truth backscatter data to classify as krill or other plankton.
- Conduct spatial analysis to test for mechanistic relationships between oceanography, prey, and marine birds and mammals.
- Document how relationships may change seasonally and annually in the context of the larger-scale distribution of predators in the Cordell Bank, Gulf of the Farallones and Monterey

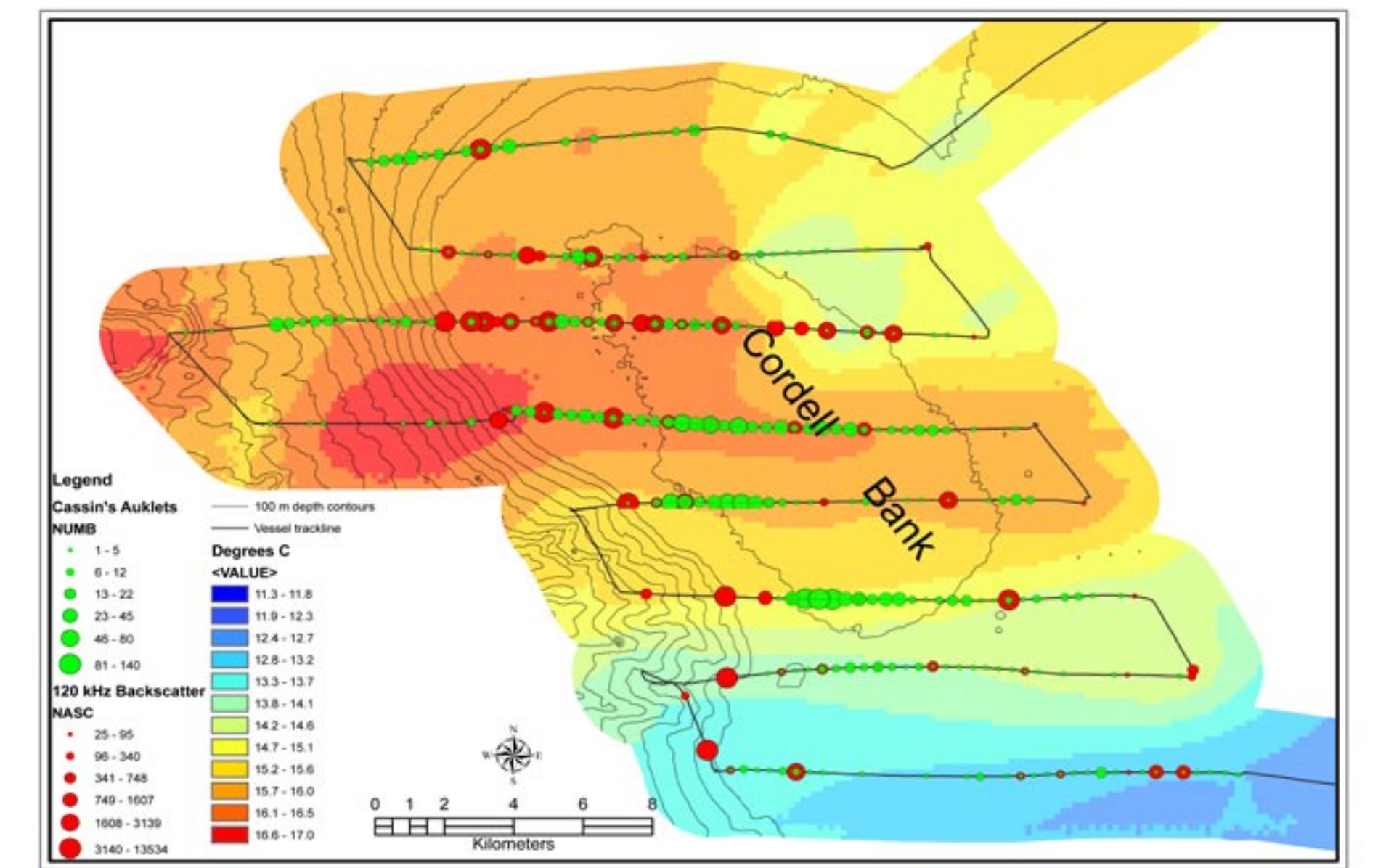


Figure 12 Cassin's Auklets and 120 kHz echosounder backscatter for October 13, 2004. Backscatter along shelf-break is likely krill.

## ACKNOWLEDGEMENTS

CBOMP would not be possible without the countless hours put in by Alan Hopkins, Steve Howell, Lisa Hugg and Tristan McKee as at-sea observers. CBOMP would like to thank Brie Lindsey, Dale Roberts, Jeff Condiotti, Jaime Jahnckeand and Pam van der Leeden for help with mapping and data processing. CBOMP would also like to acknowledge the inspiration and advice of Don Croll, Baldo Marinovic and Kelly Newton. CBOMP is also indebted to Rowena Forest for keeping us organized.

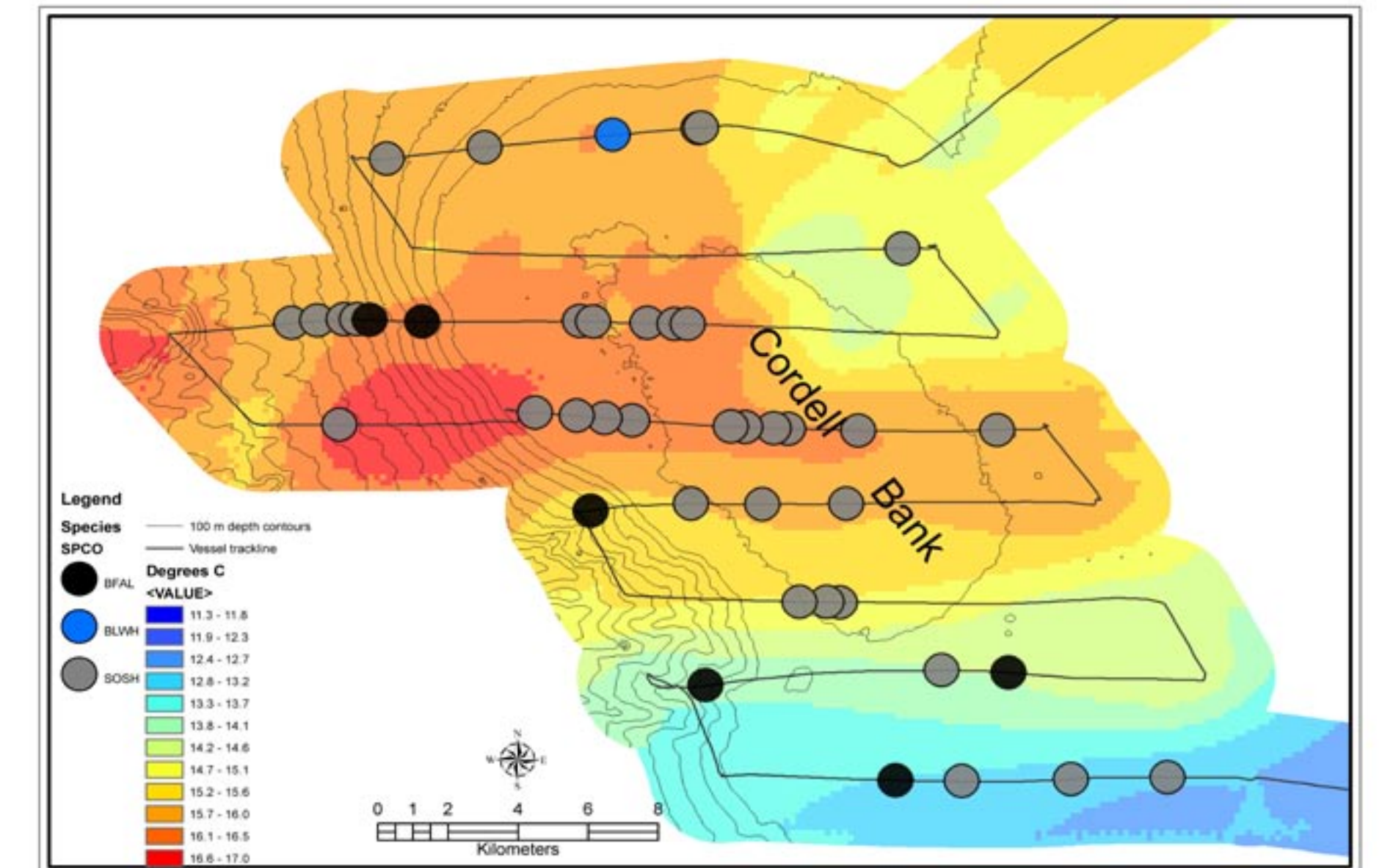


Figure 13. Blue whale (BLWH), Black-Footed Albatross (BFAL) and Sooty Shearwater (SOSH) sightings from the October 13, 2004 cruise. The BLWH was a pair, the SOSH groups ranged from 1-10, and the BFAL were all individuals.

