

**Kelp Surveying in the
Southern California Bight
Presentation
29 September 2009**

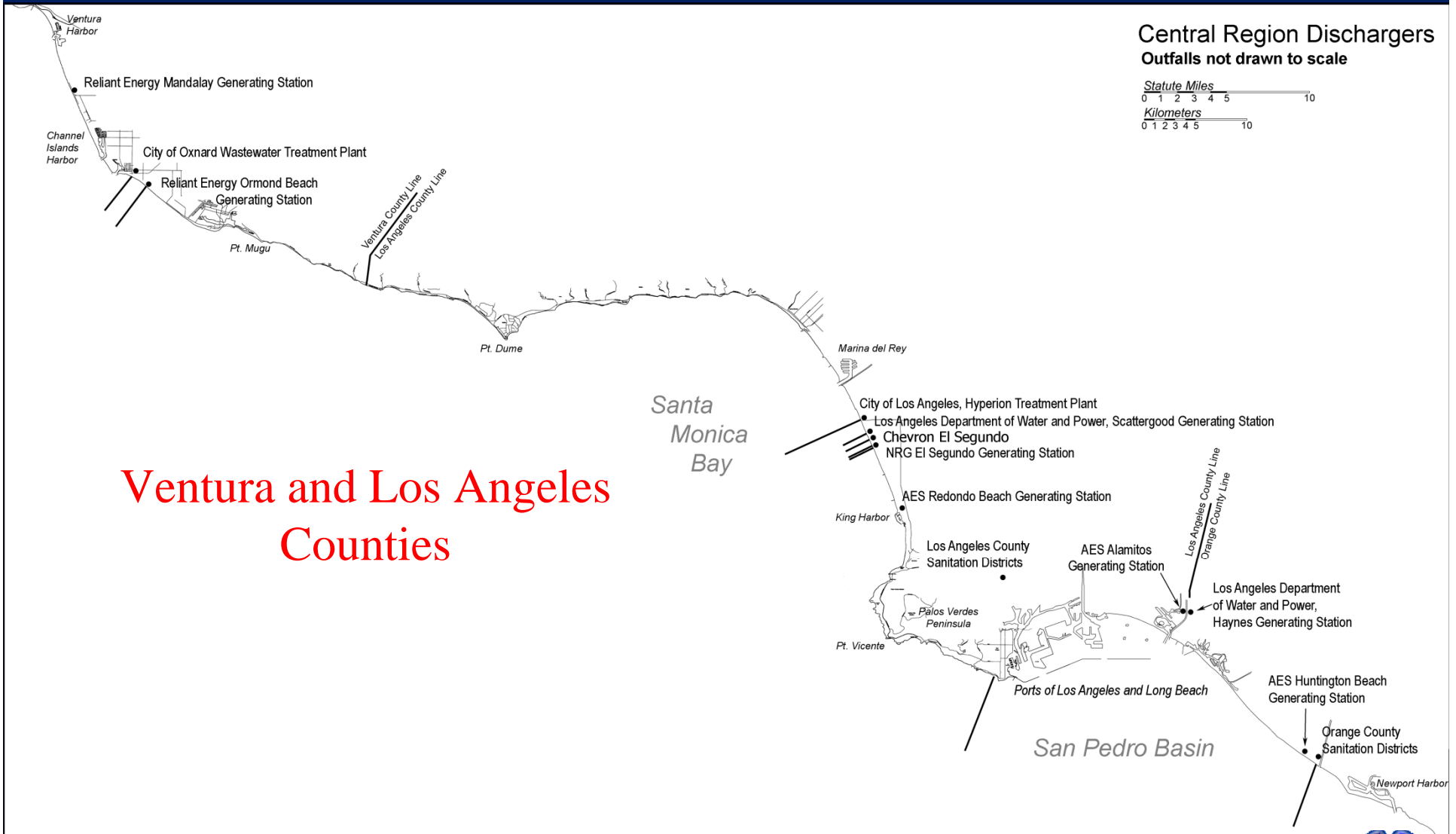
Michael Curtis MBC Applied Environmental Sciences
mcurtis@mbcnet.net

Outline

- Introduction
 - A Regional View
 - The Region Nine and
 - Region Eight Monitoring Programs
- Yearly Status of the Kelp Beds
 - Kelp Bed Areas
 - Comparison to Baseline
- Synopsis of Coastal Conditions
 - Precipitation
 - Phytoplankton Blooms (red tides)
 - Swells
 - Temperature



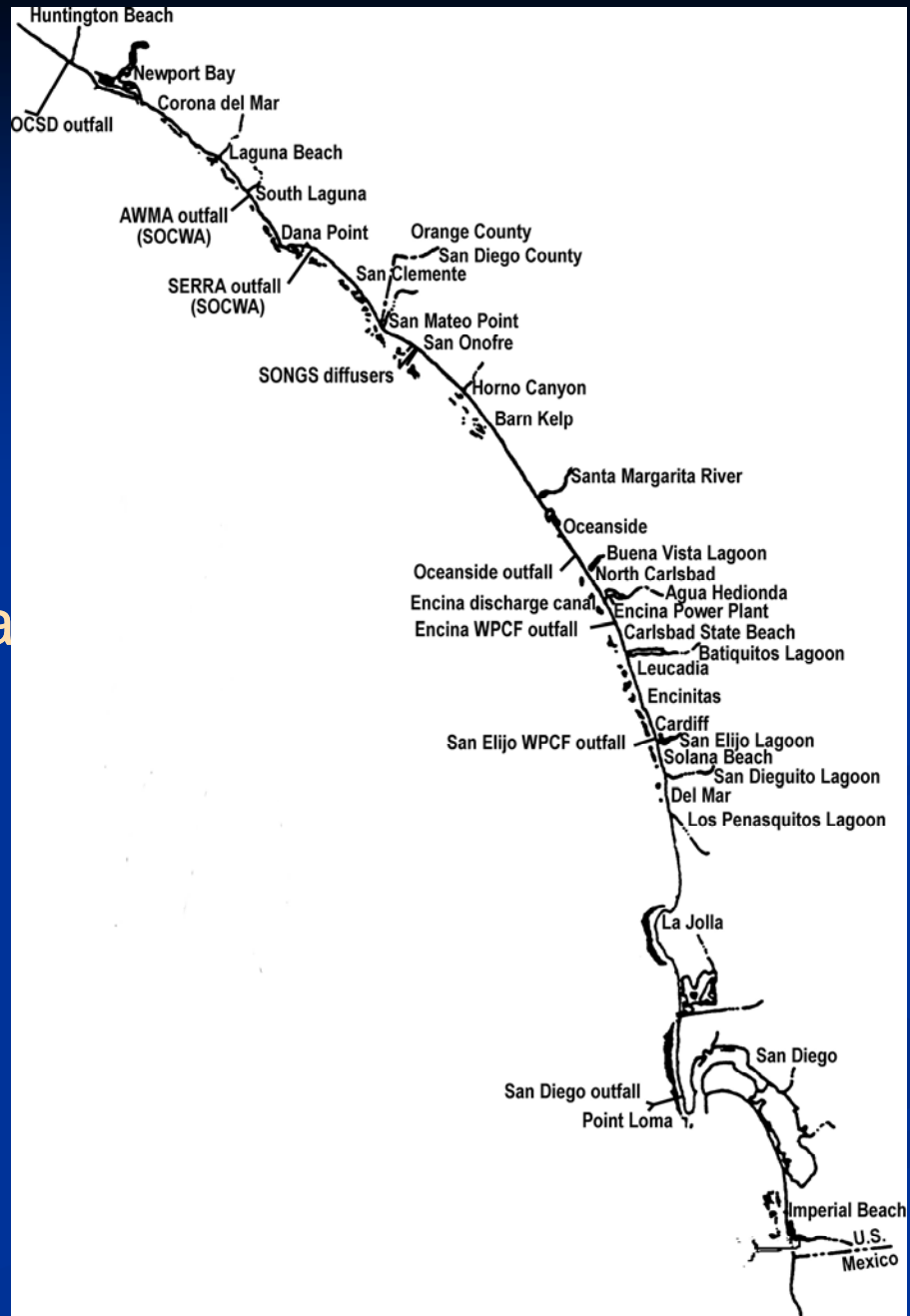
Regional View



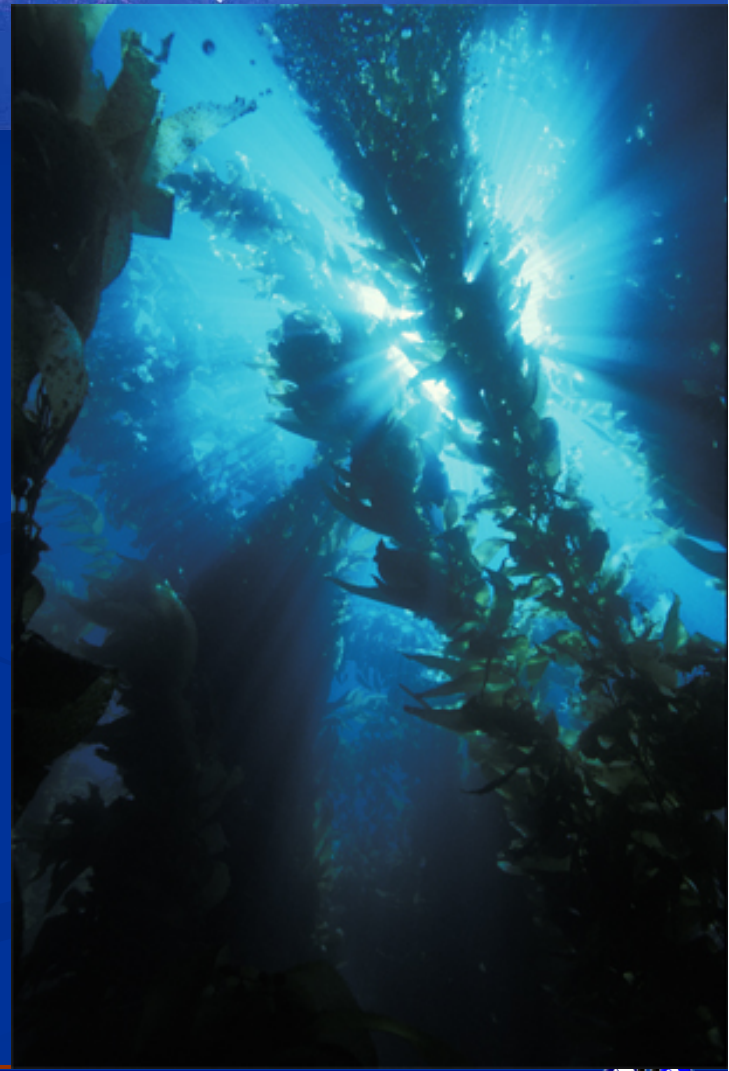
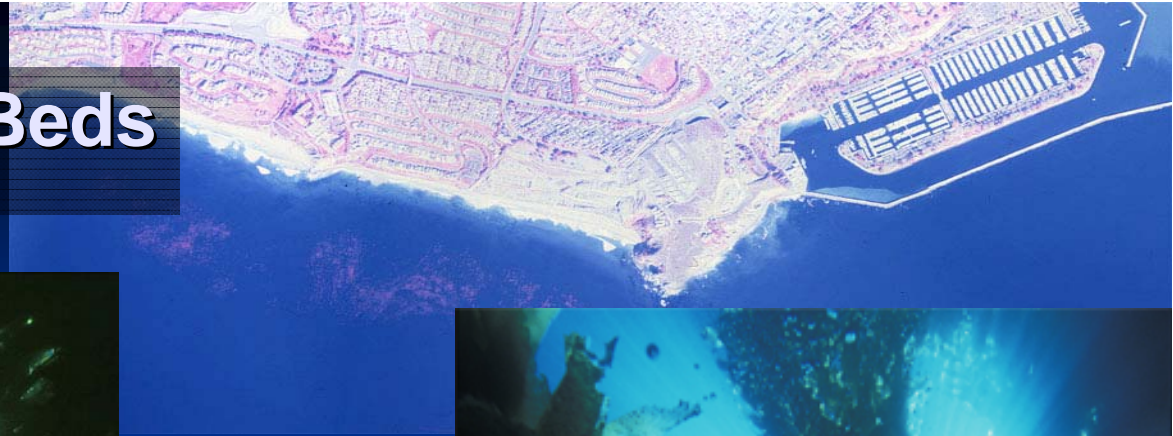
Regional View

San Diego and Orange Counties

Encina Wastewater



Status of the Kelp Beds



Implementing the Kelp Monitoring Program

4 Quarterly Aerial Infrared Surveys

2 March

12 June

2 October

14 December



2 March



12 June



2 October



14 December



Implementing the Kelp Monitoring Program

4 Quarterly Aerial Infrared Surveys

2 March

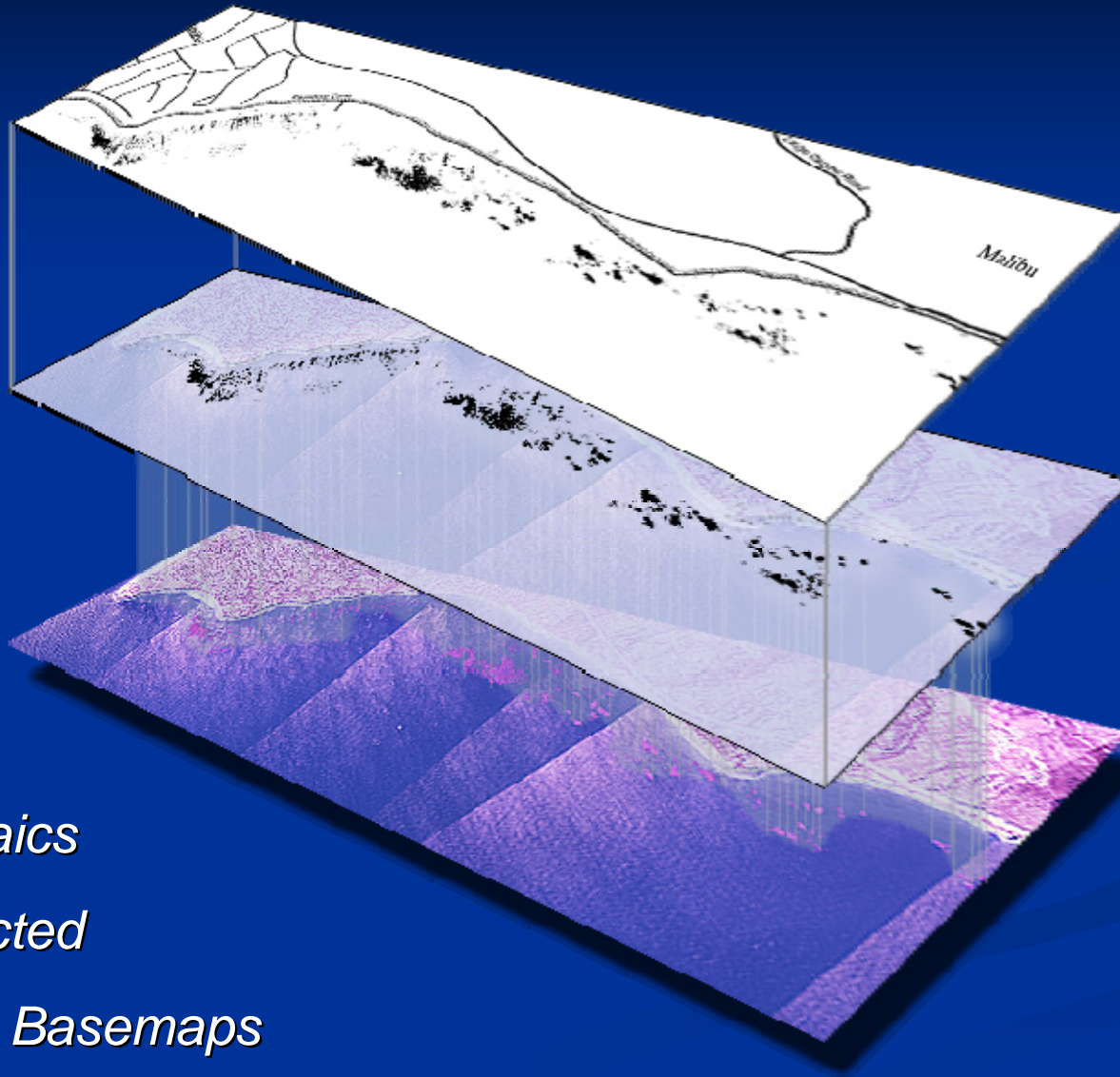
12 June

2 October

14 December



Implementing the Kelp Monitoring Program



Photomosaics

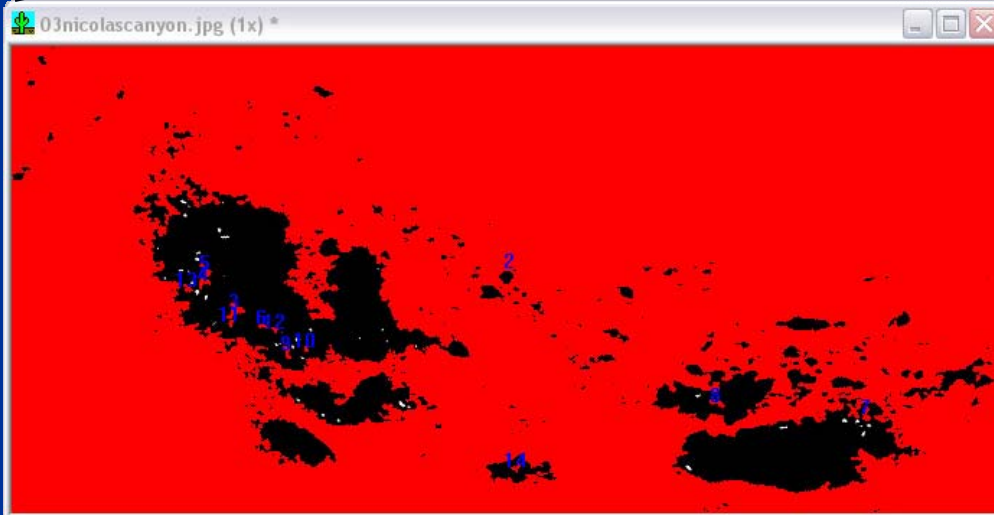
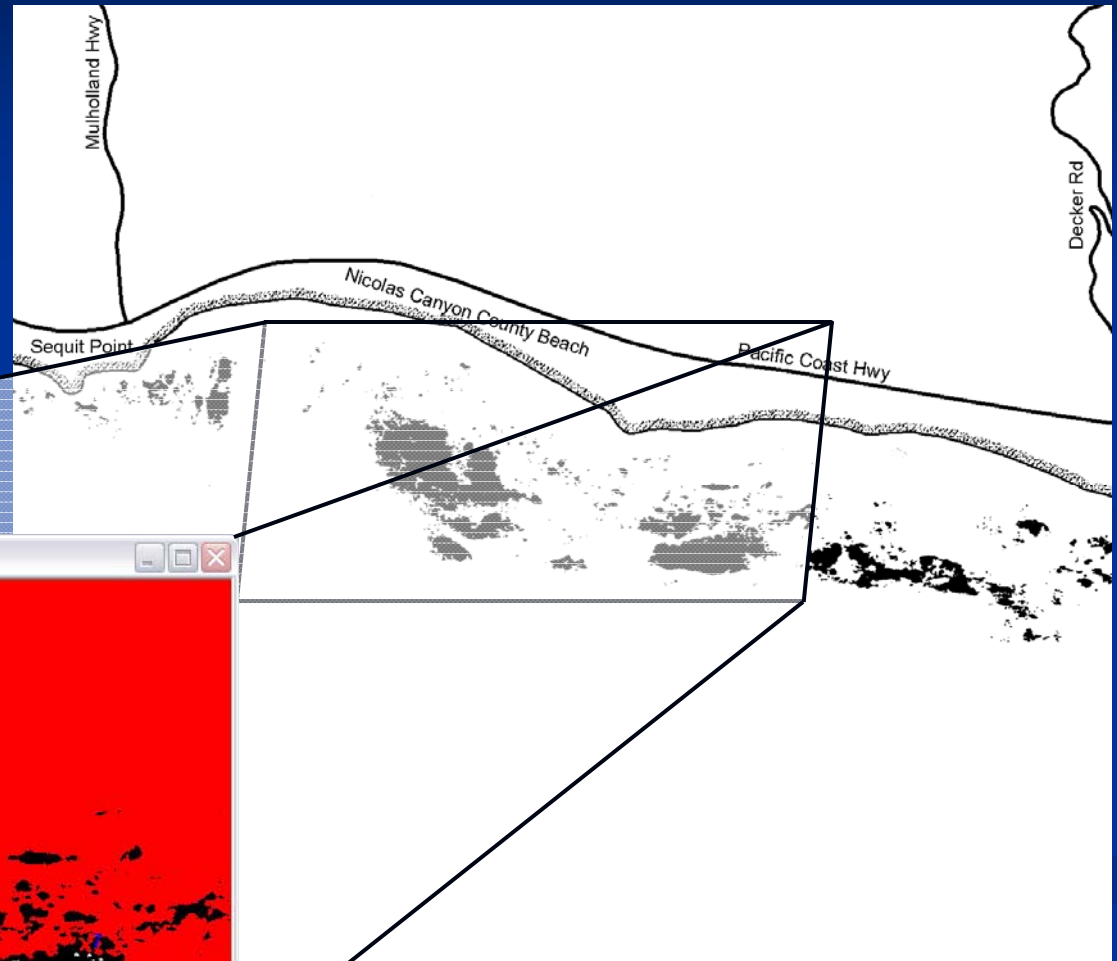
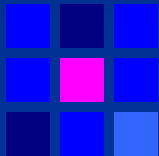
Kelp extracted

Layered to Basemaps

Implementing the Kelp Monitoring Program



CDF&G Coastal Shape Files
GIS Geo-Referenced
Surface Canopy Calculated

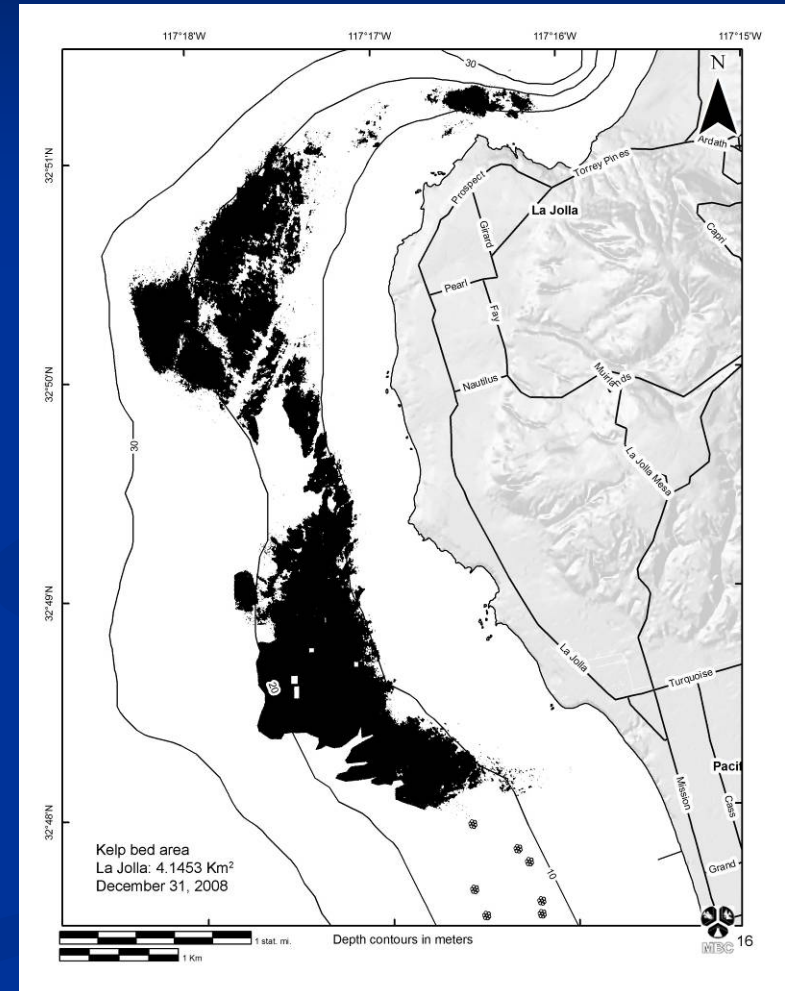
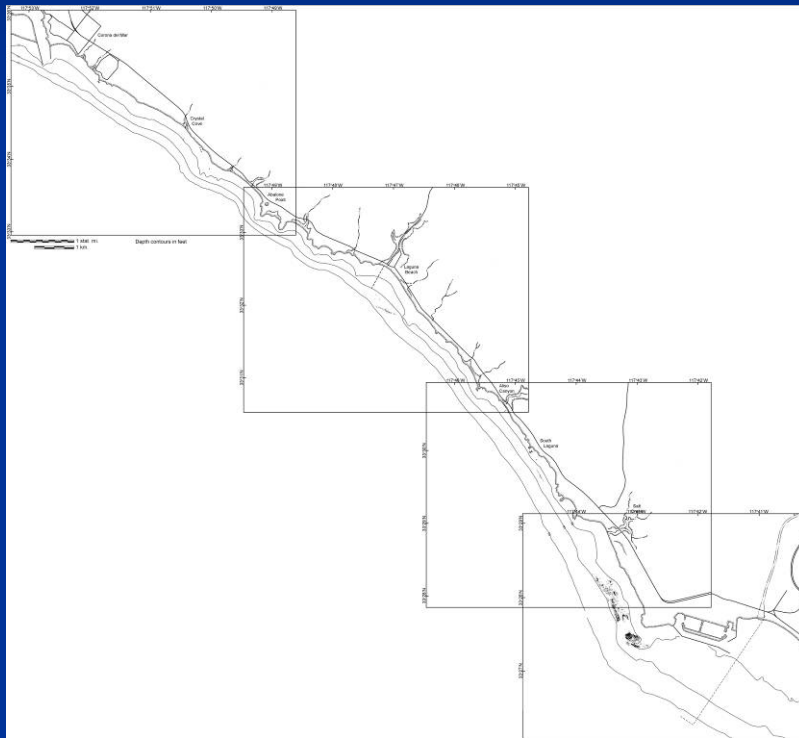


kelp bed with digitized kelp to determine area

Implementing the Region Nine Program



Standardized Basemaps of the Coastline

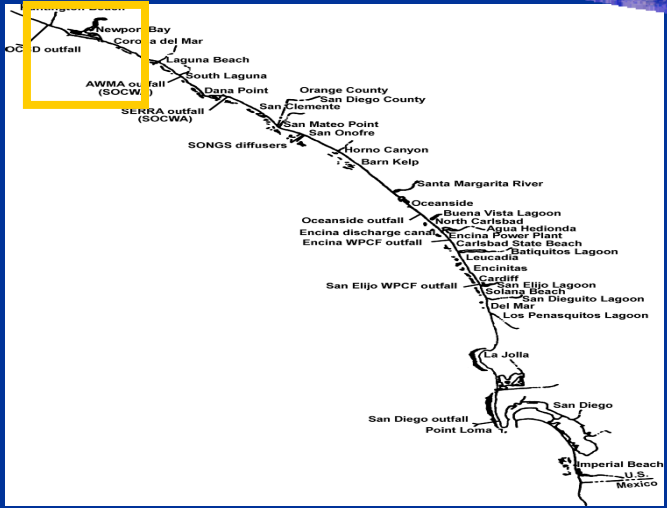
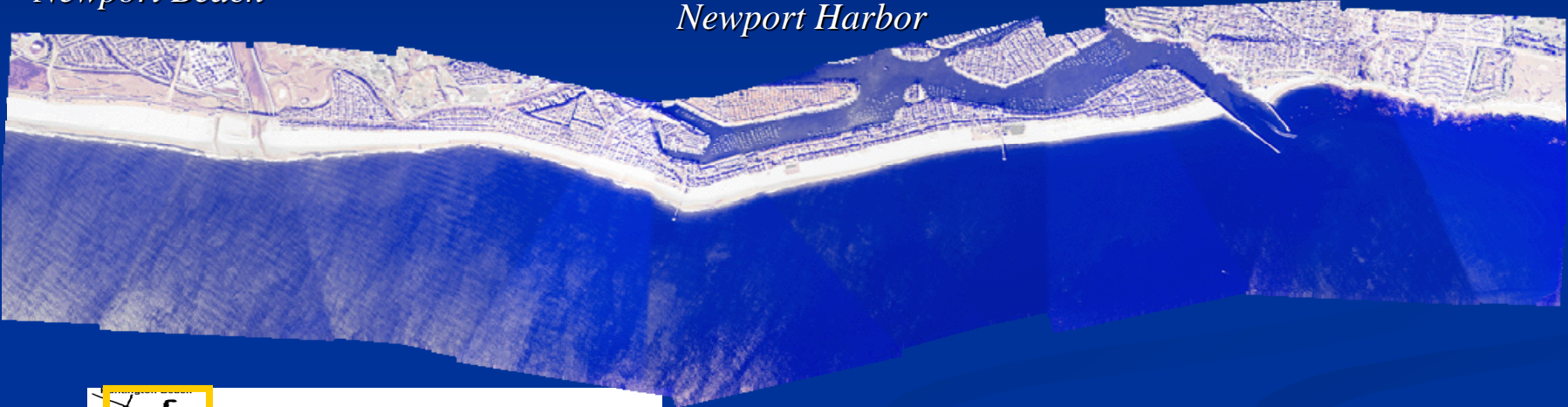


Status of the Kelp Beds — Region Nine north

Corona del Mar

Newport Beach

Newport Harbor



Palos Verdes Time Series

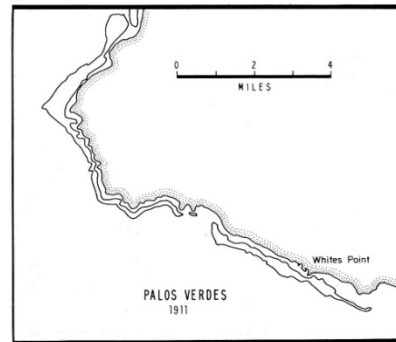
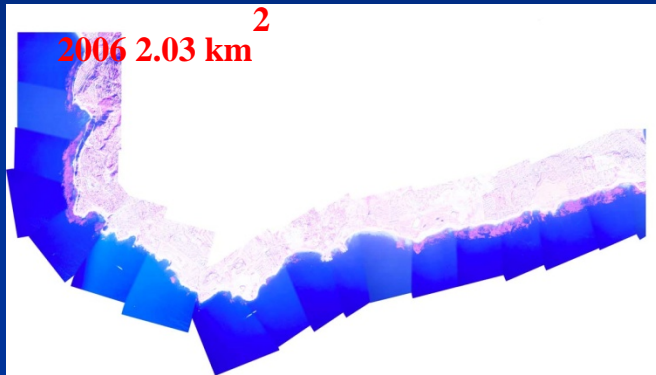


Figure 15. Chart of the Palos Verdes coast in 1911. The area of the kelp beds shown was estimated as 2.42 square miles.

1911 8.68 km²

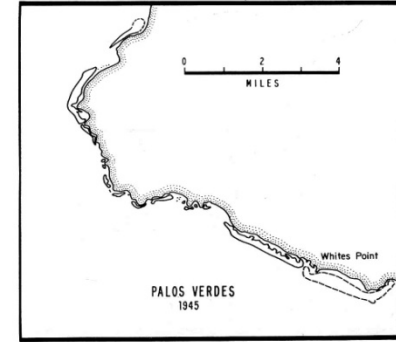


Figure 17. Chart of the Palos Verdes coast in 1945. The area of the kelp beds shown was estimated as less than 1.63 square miles.

1945 5.59 km²

1928 9.91 km²

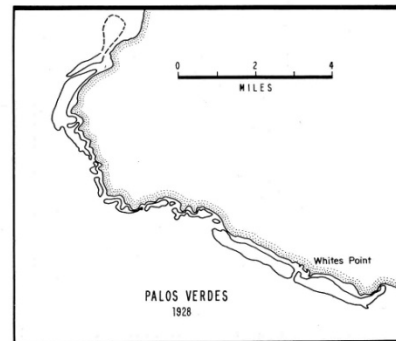


Figure 16. Chart of the Palos Verdes coast in 1928. The area of the kelp beds shown was estimated as less than 2.89 square miles.

1947 3.64 km²

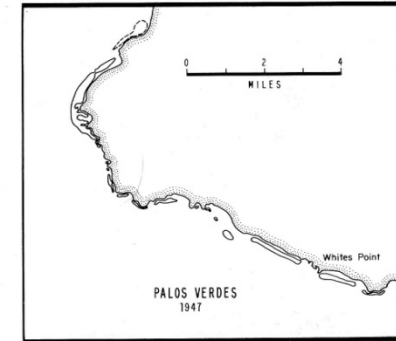
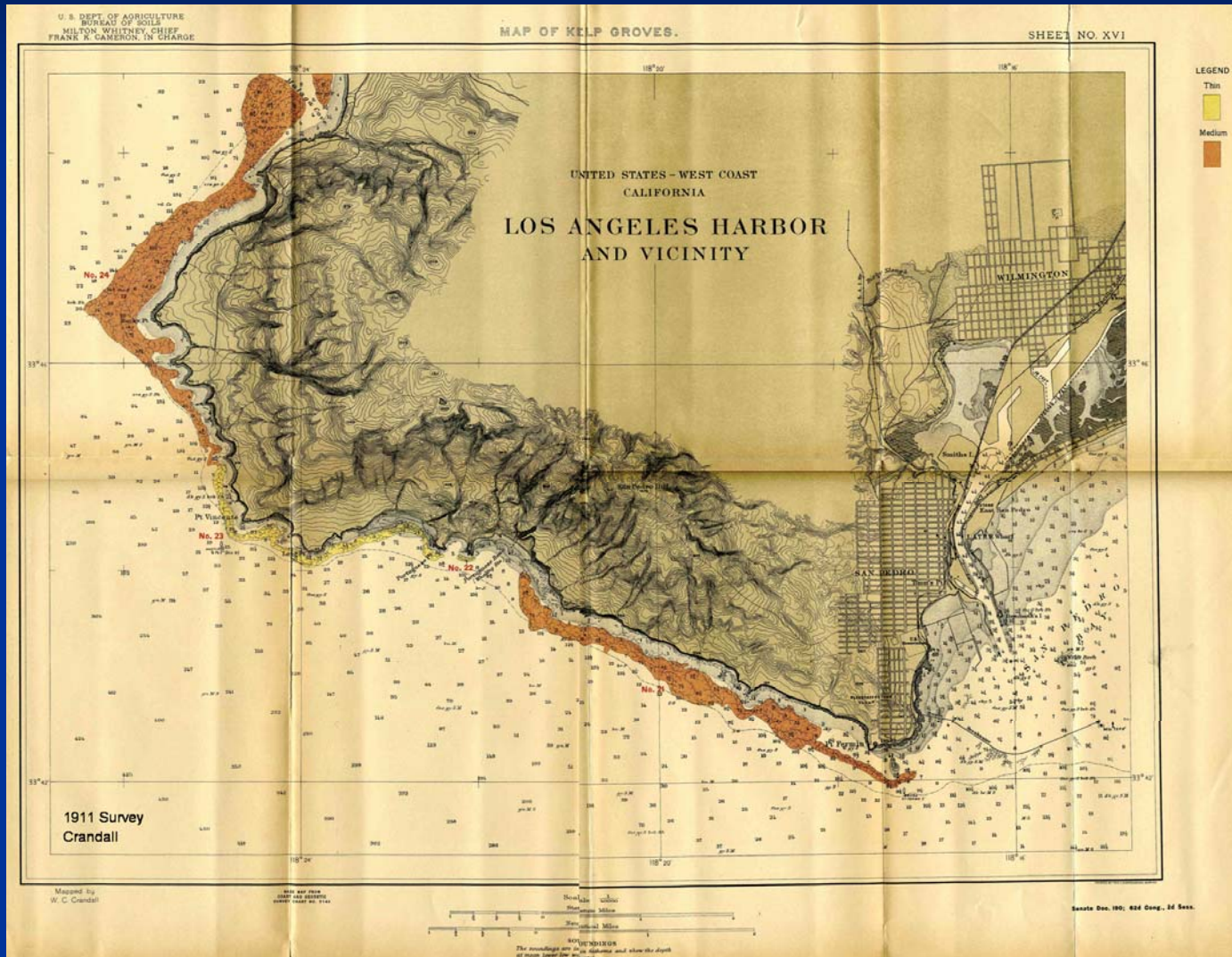


Figure 18. Chart of the Palos Verdes coast in 1947. The area of the kelp beds shown was estimated as less than 1.05 square miles.

CRANDALL'S 1911 KELP SURVEY PALOS VERDES 8.68 km²



Status of the Kelp Beds

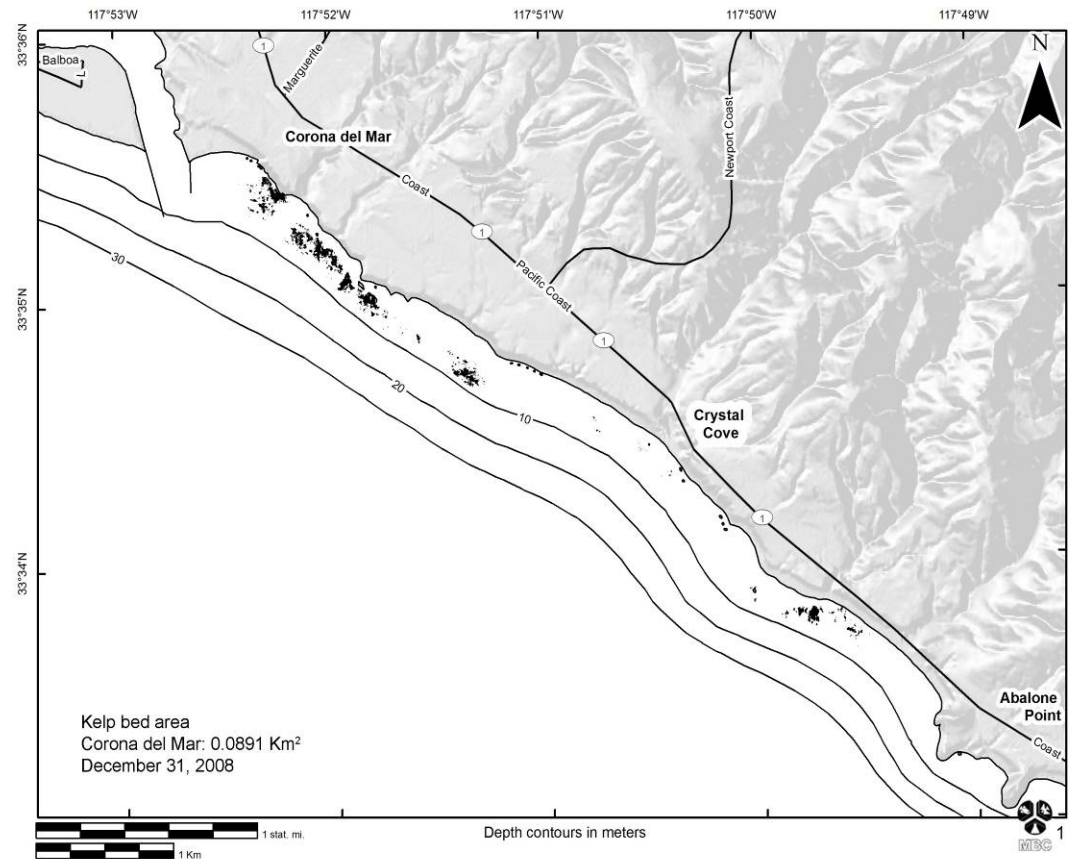
Corona Del Mar Kelp Bed

In CDF&G Bed 10

0.0517 km²
(2007)

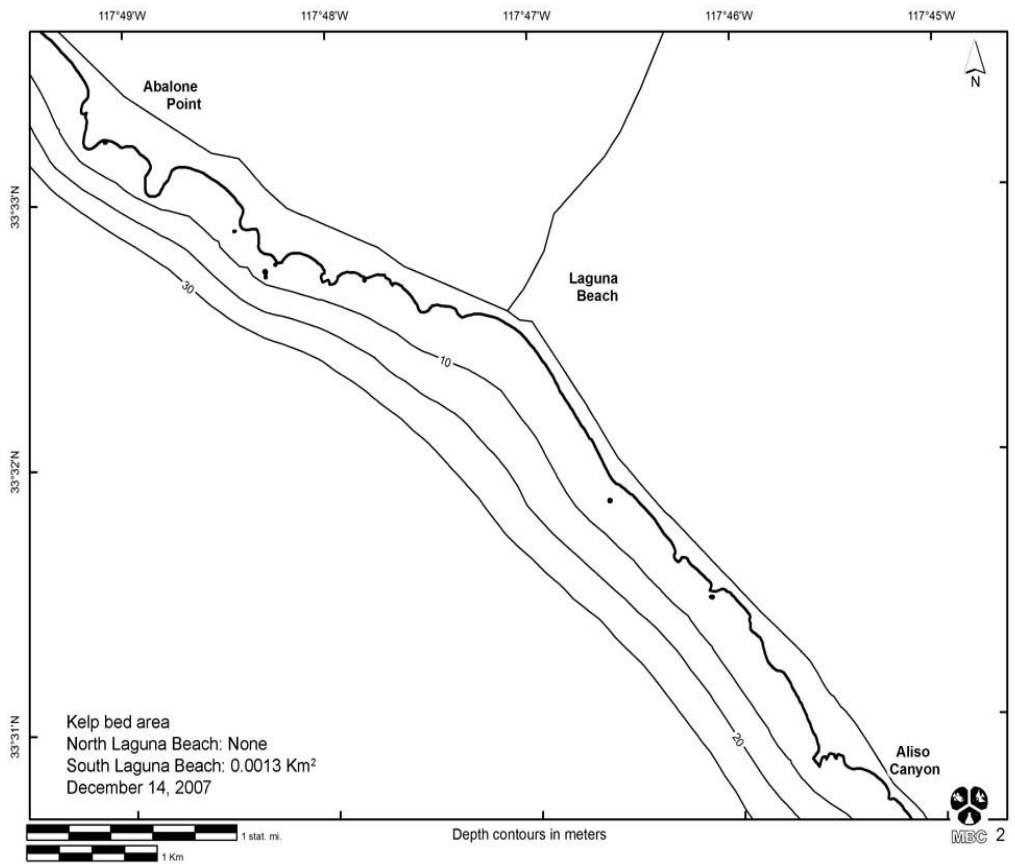
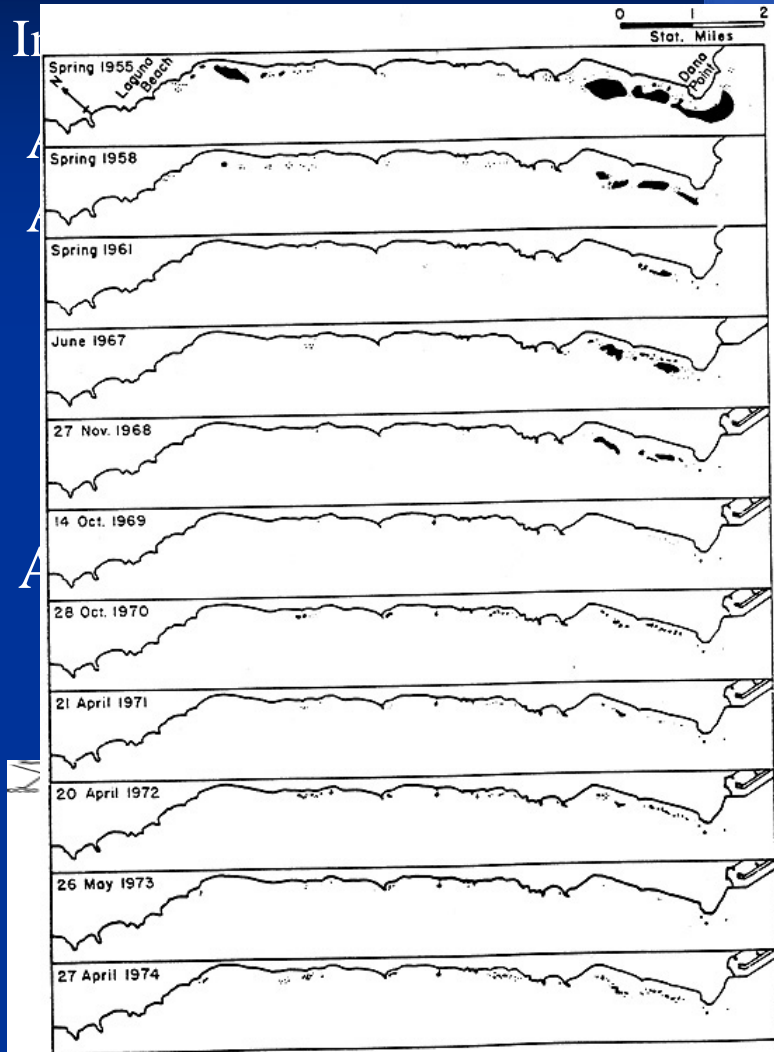


0.0891 km²
(2008)



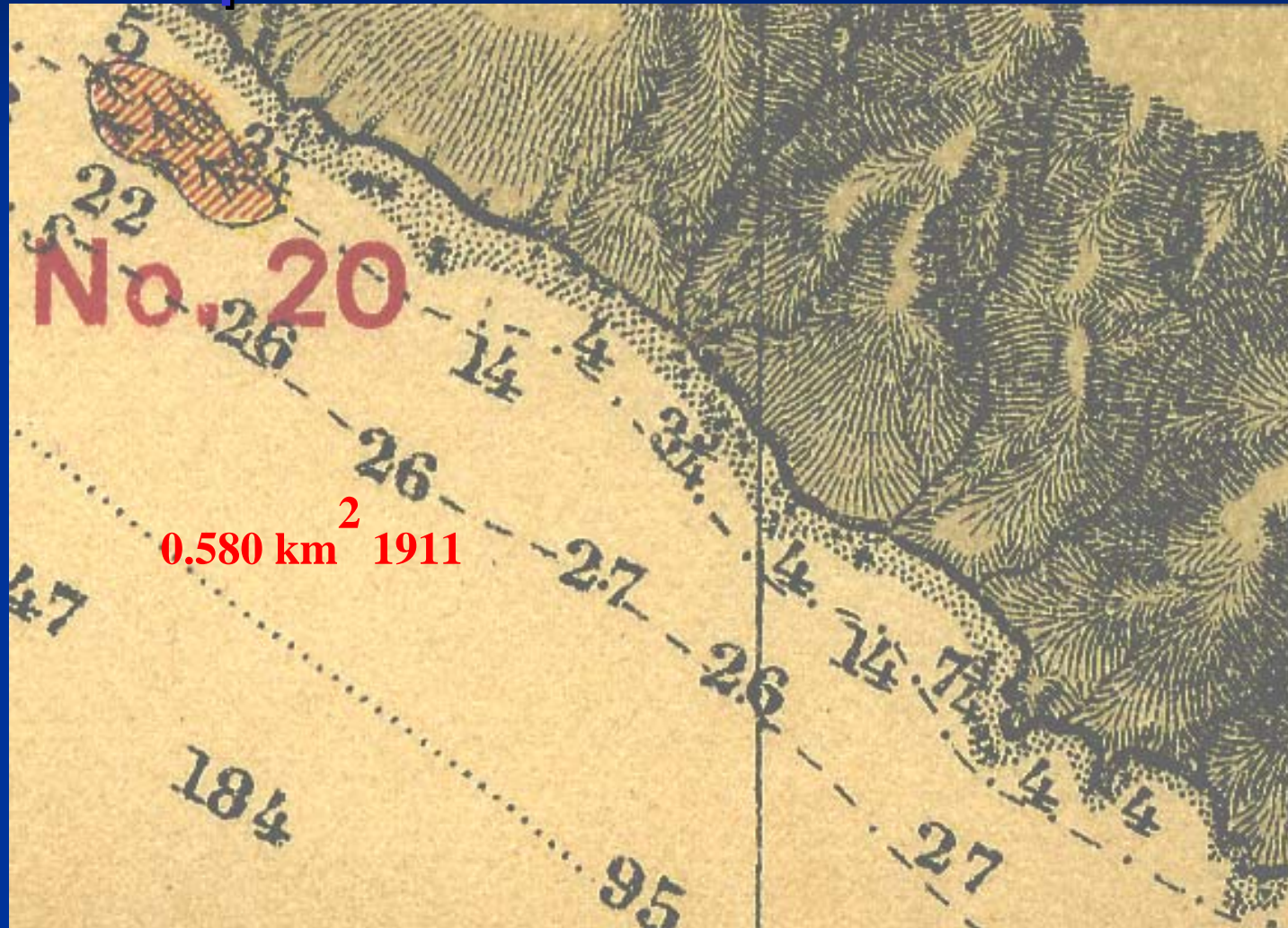
Status of the Kelp Beds

North Laguna Beach and South Laguna Beach Kelp Beds



Historical charts of kelp beds from Laguna Beach to Dana Point, 1955 to 1974.

Newport Beach to Laguna Kelp Beds 1911 Crandall



Status of the Kelp Beds

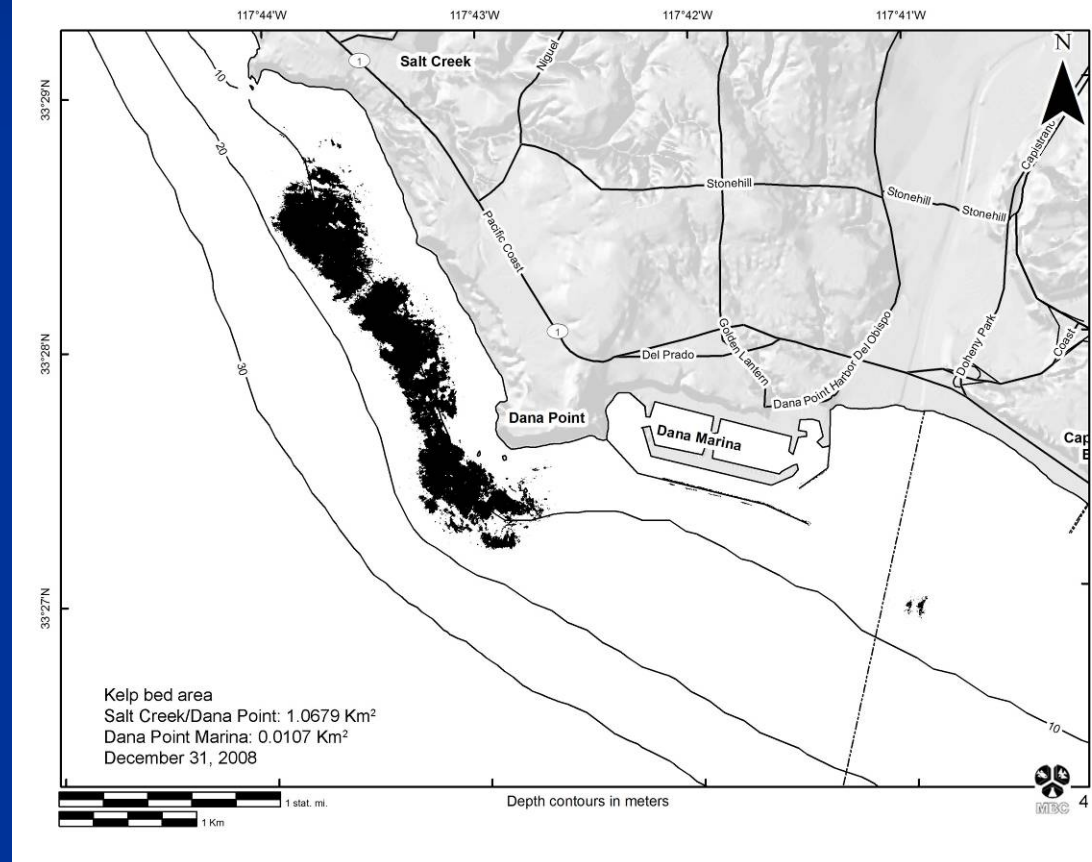
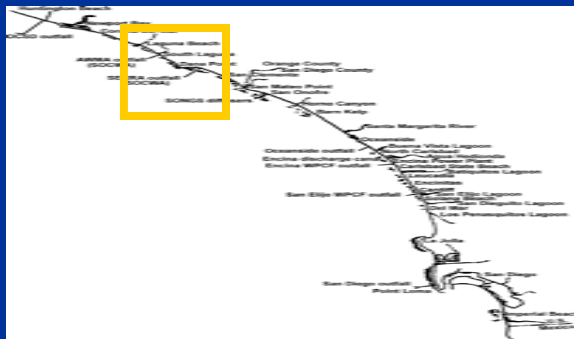
Dana Point/Salt Creek Kelp Bed

In CDF&G Bed 9

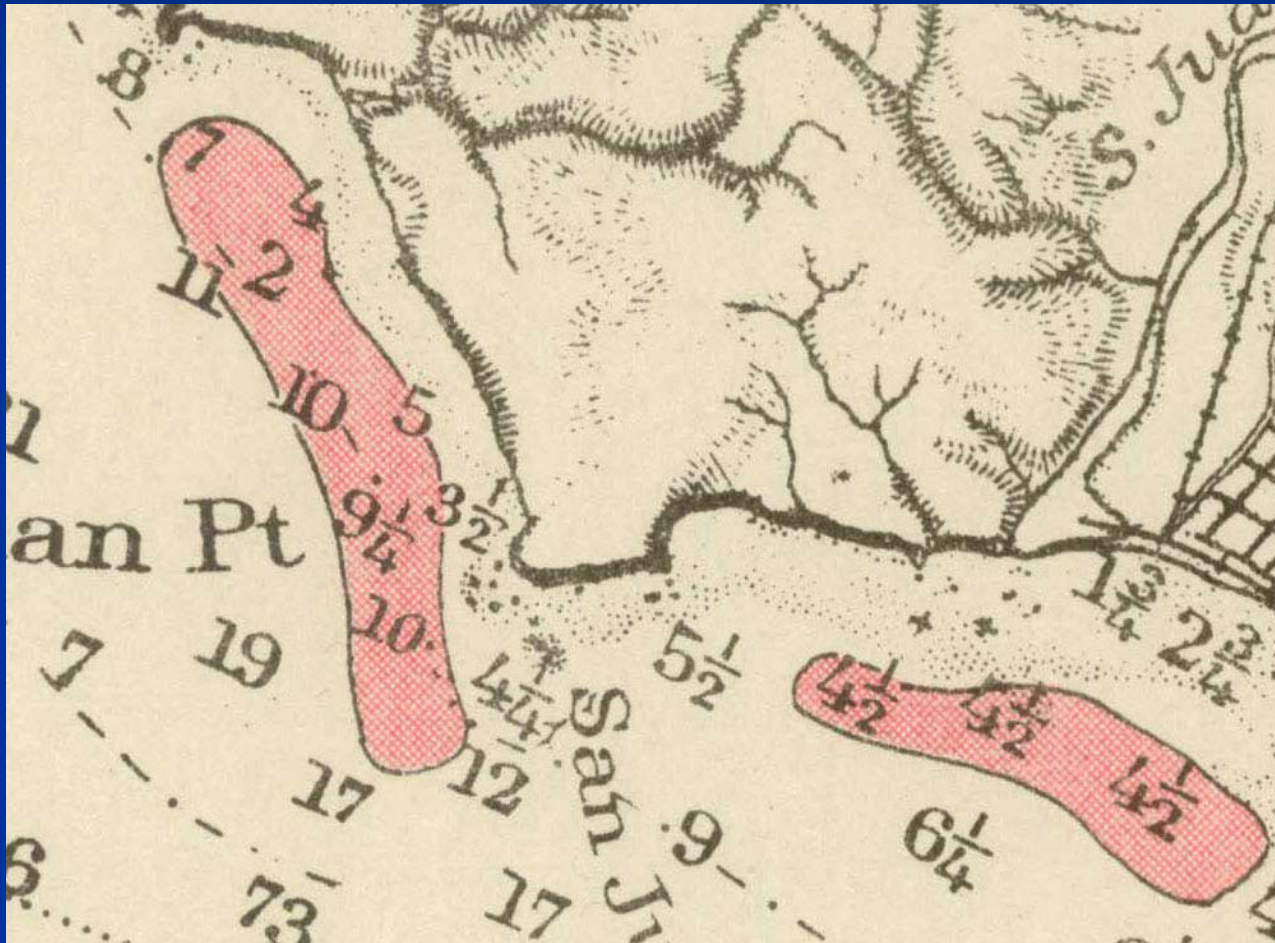
0.2996 km²
(2007)



1.0679 km²
(2008)



Salt Creek/Dana Pt./ Doheny Kelp Beds 1911 Crandall

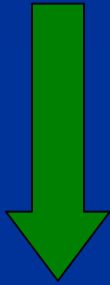


Status of the Kelp Beds

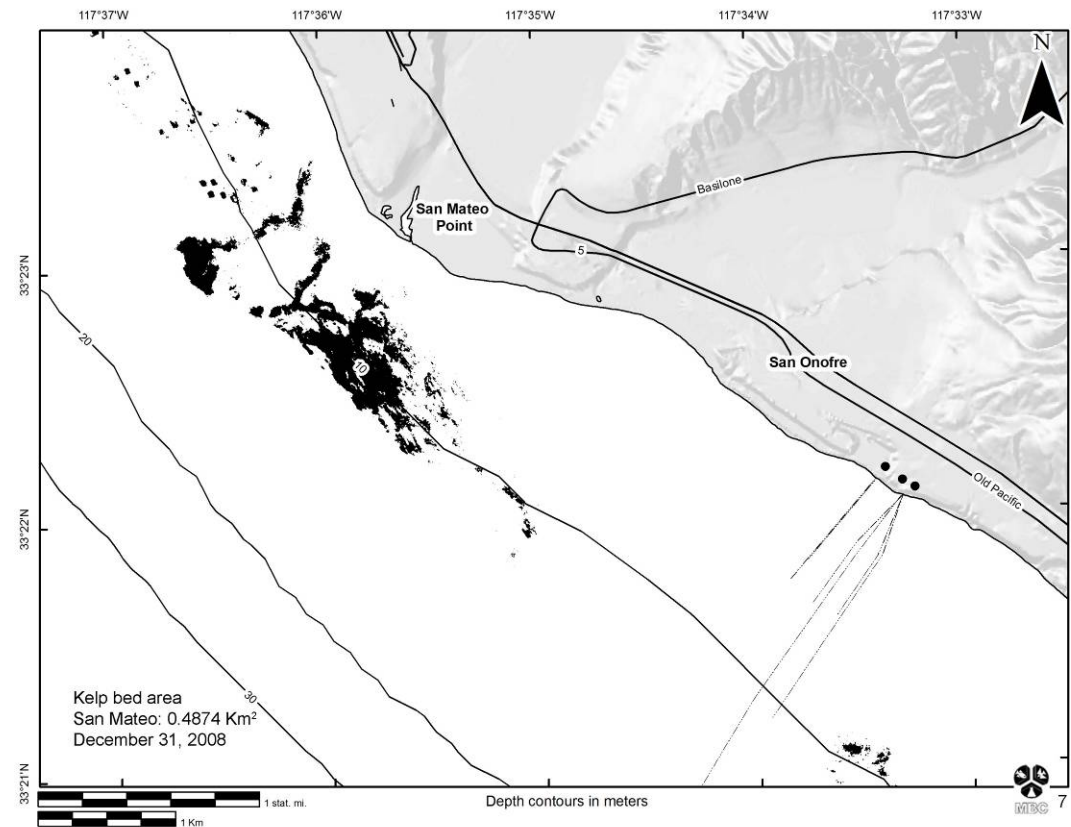
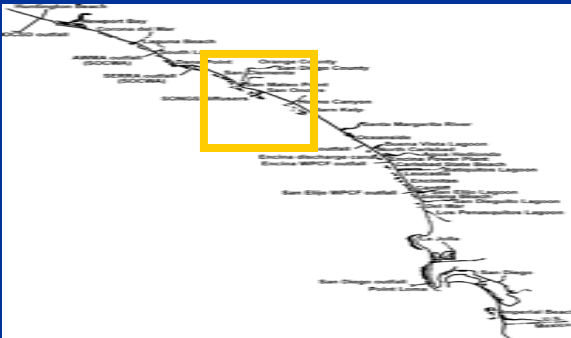
San Mateo Point Kelp Bed

In CDF&G Bed 8

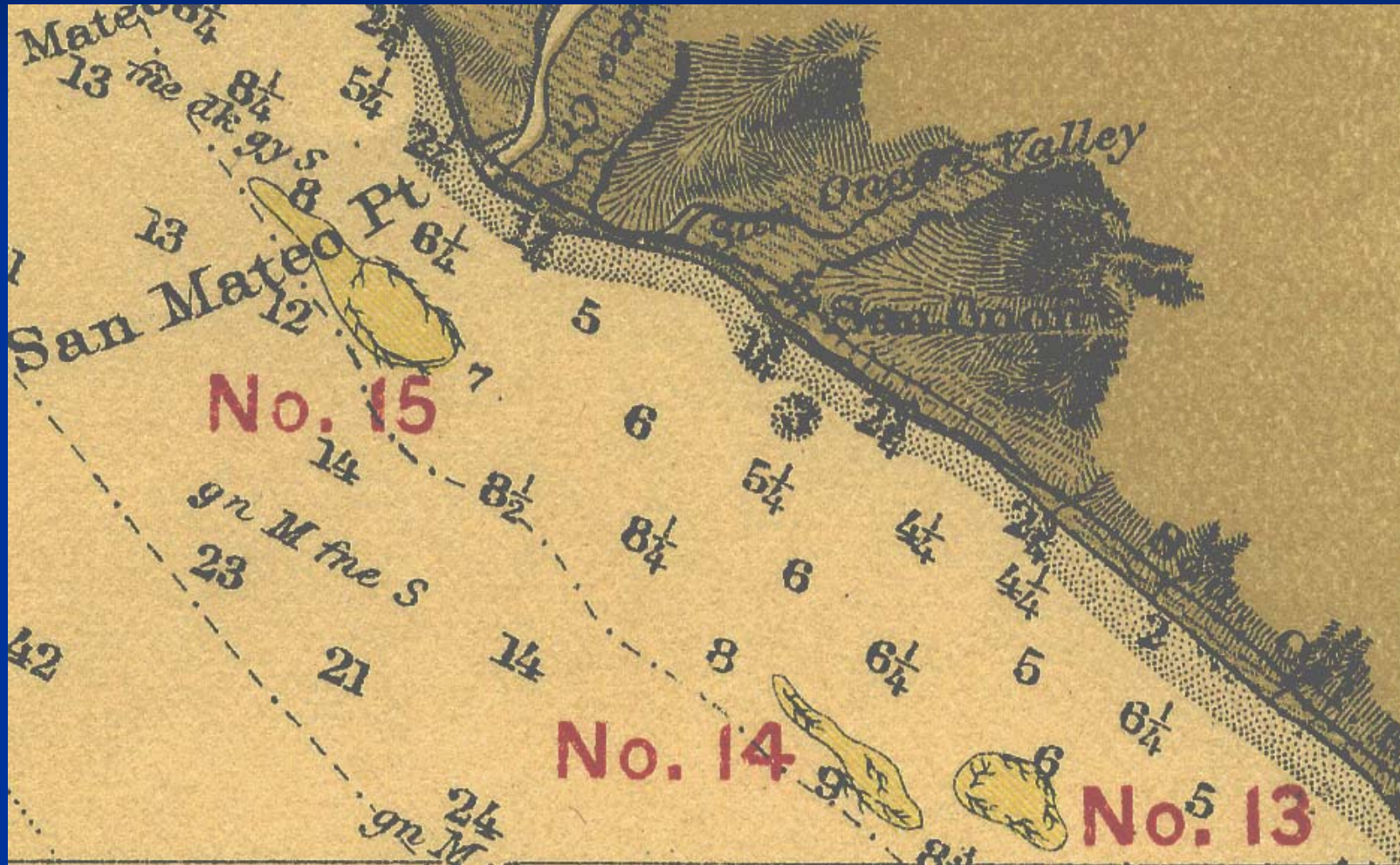
0.2009 km²
(2007)



0.4874 km²
(2008)



San Mateo to San Onofre Kelp 1911 Crandall



Status of the Kelp Beds

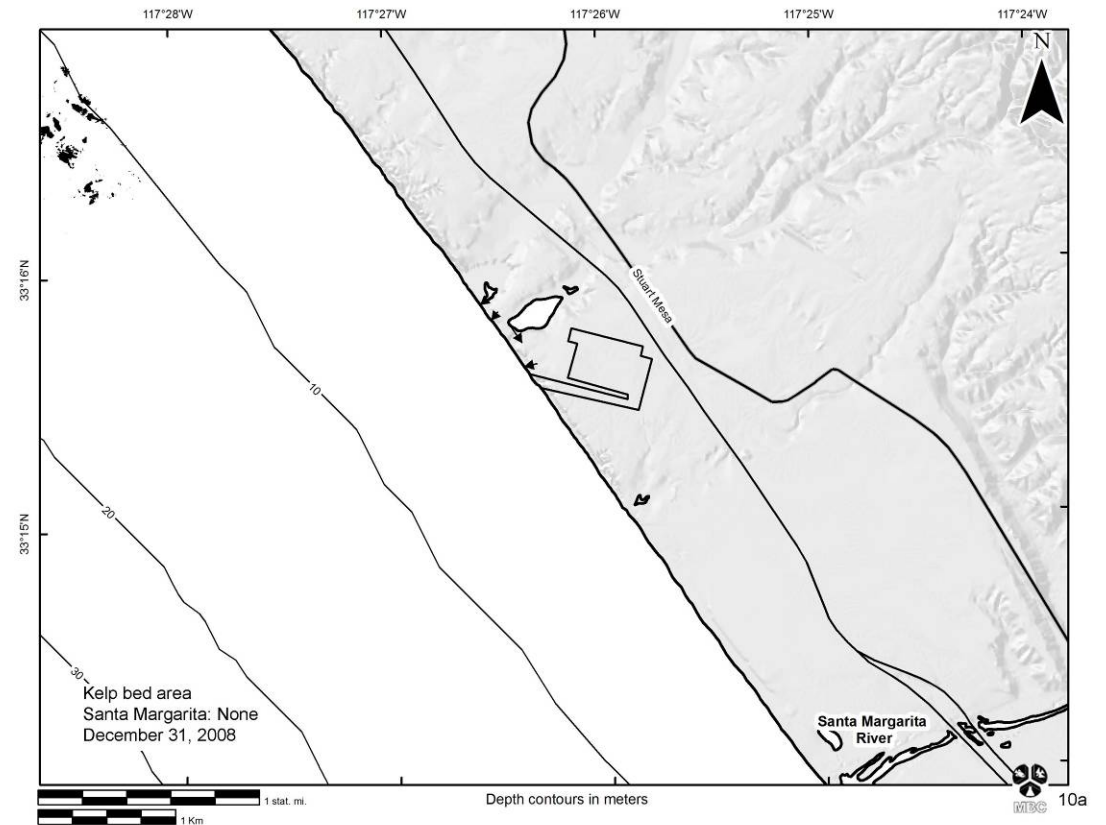
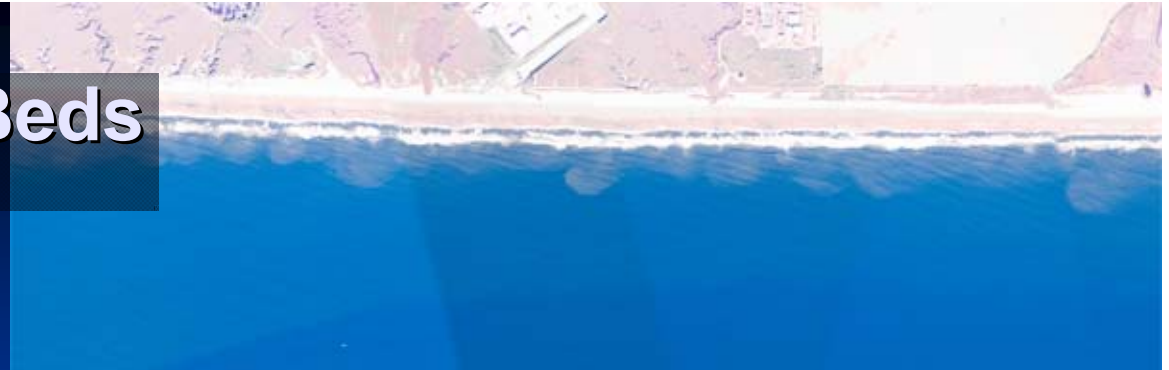
Santa Margarita Kelp Bed

In CDF&G Bed 7

Absent 0.0 km²
(2007)



Absent 0.0 km²
(2008)



Santa Margarita Kelp 1911 Crandall



Status of the Kelp Beds

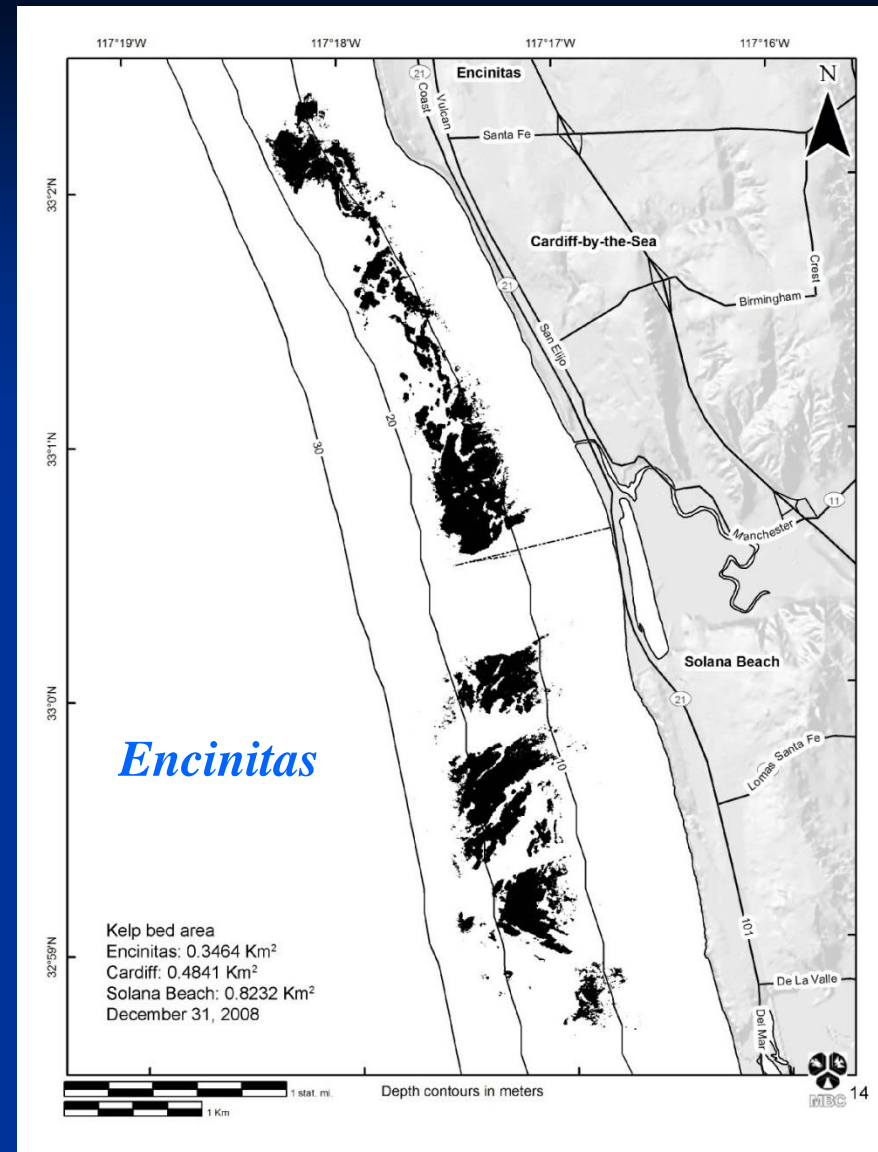
Encinitas Kelp Bed

In CDF&G Bed 6

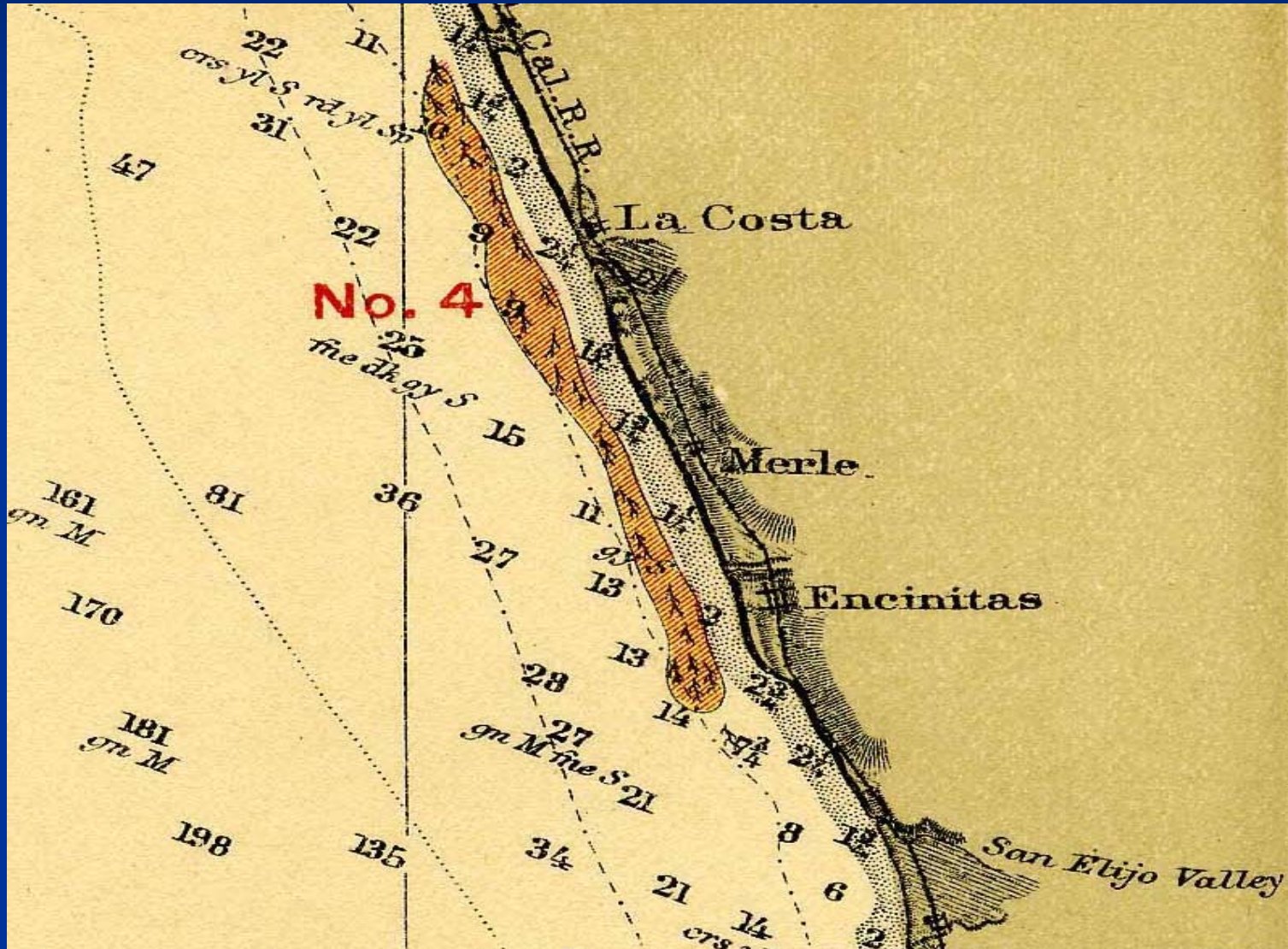
0.2054 km²
(2007)



0.3464 km²
(2008)



Leucadia to Encinitas Kelp 1911 Crandall

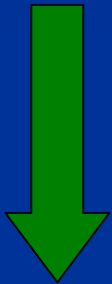


Status of the Kelp Beds

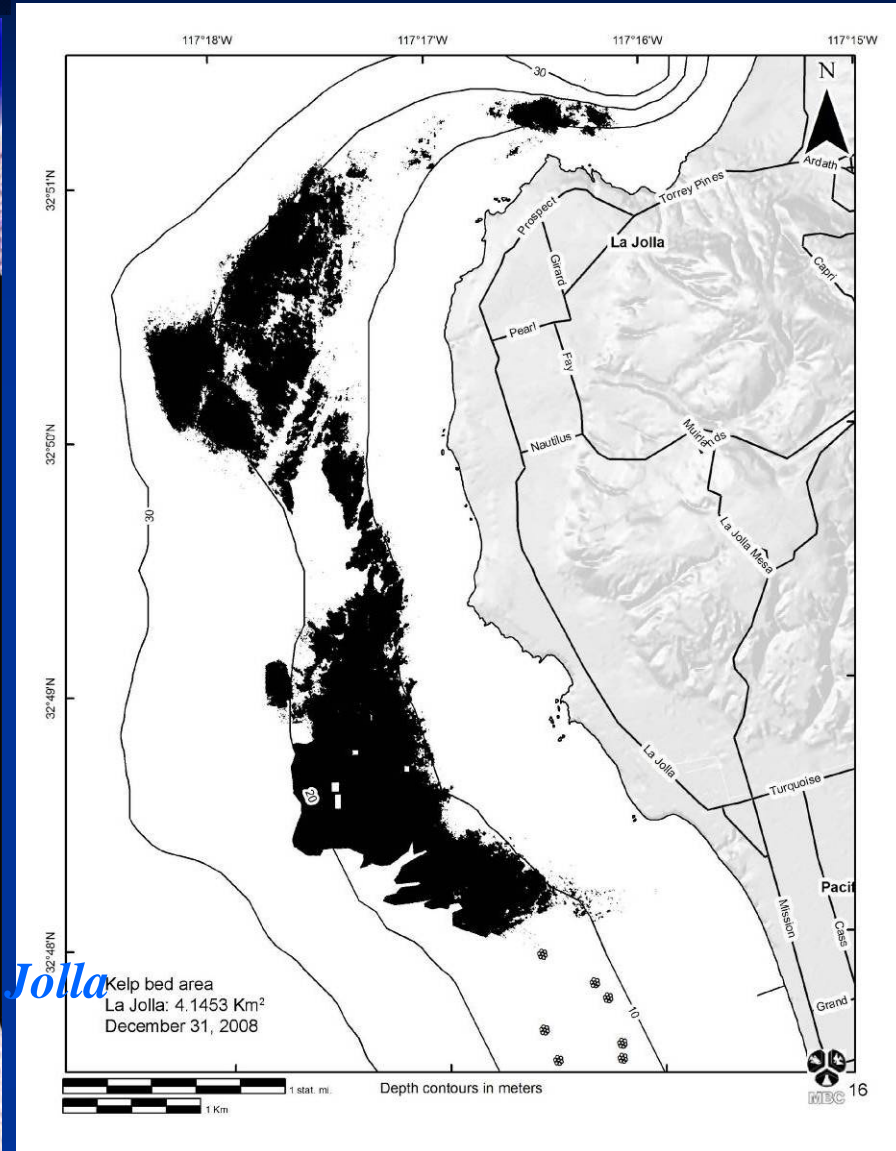
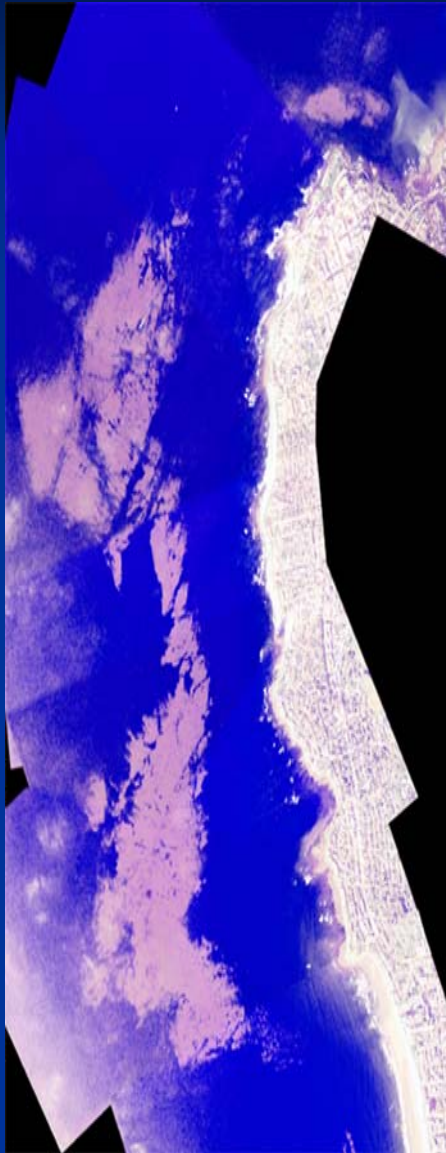
La Jolla Kelp Bed

In CDF&G Bed 4

2.7495 km²
(2007)

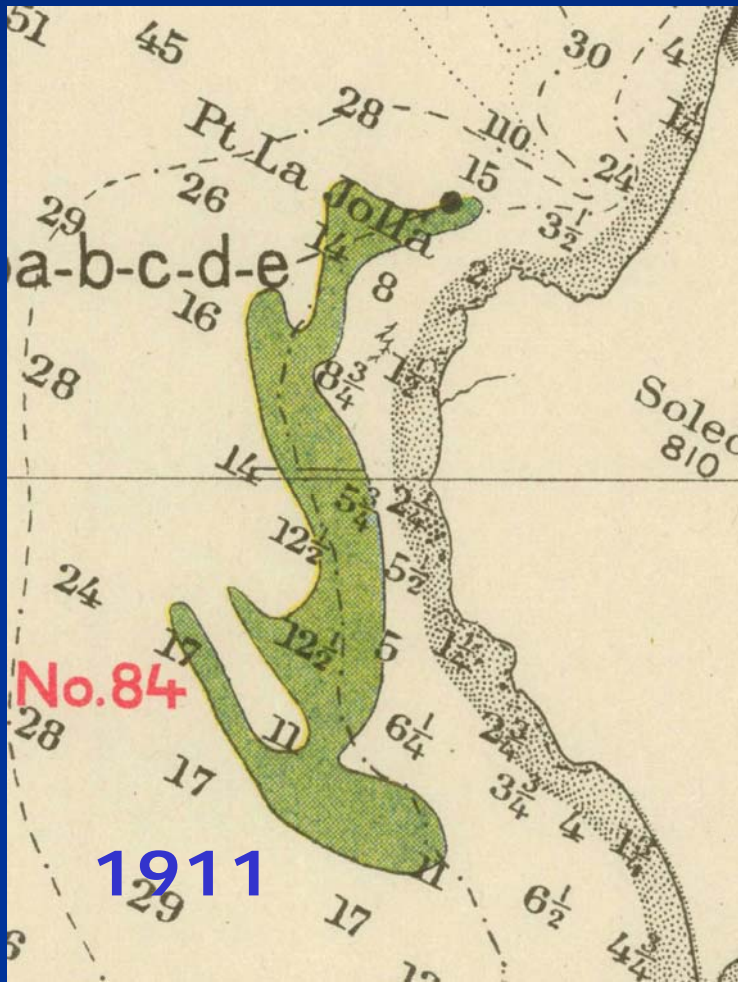


4.1453 km²
(2008)

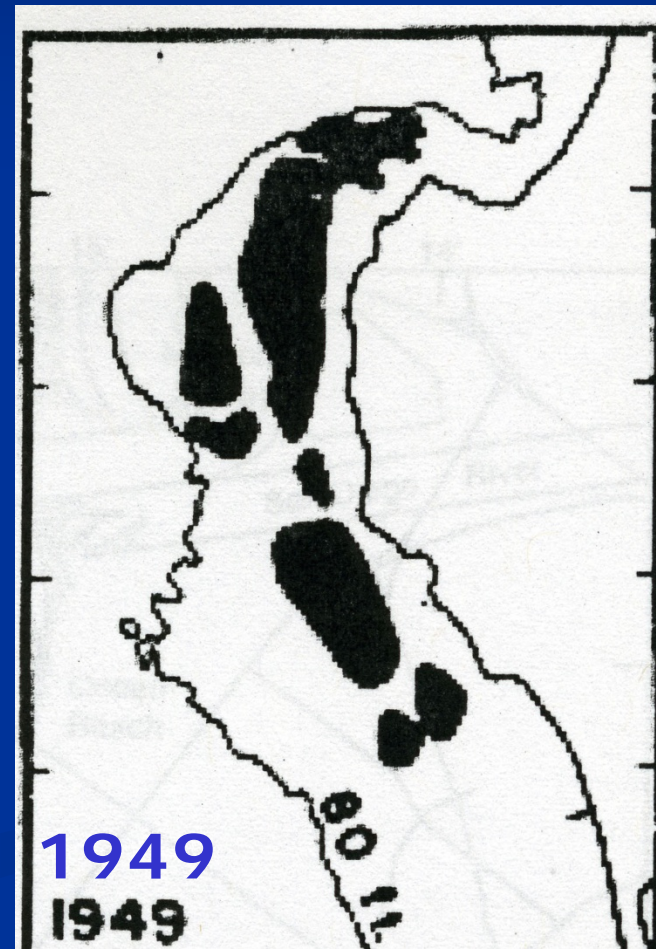


LA JOLLA KELP BED 1911 CRANDALL

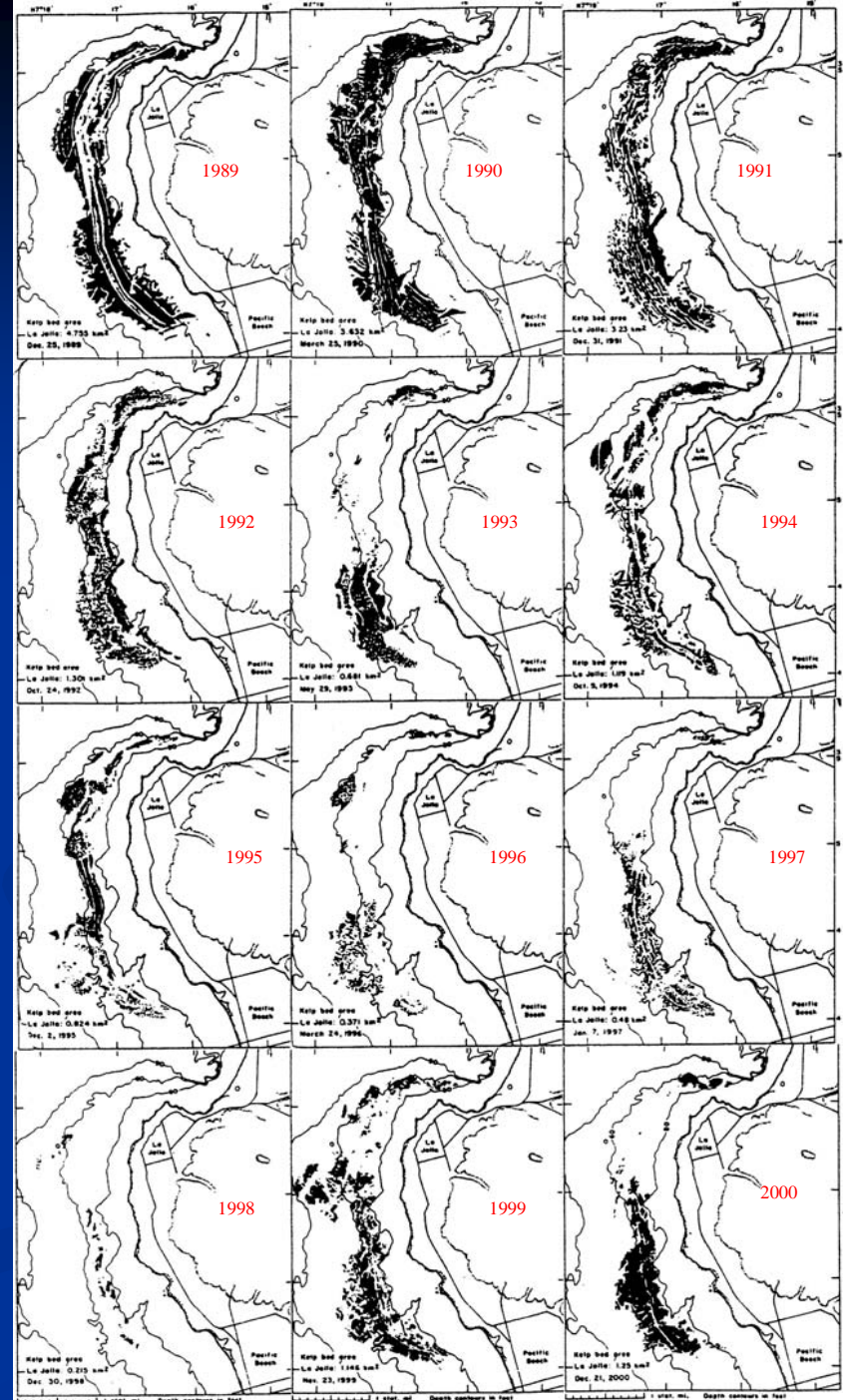
6.06km²



1.99 km²



La Jolla kelp canopies showing onset and recovery from 1997-1998 El Niño

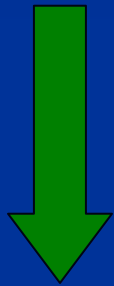


Status of the Kelp Beds

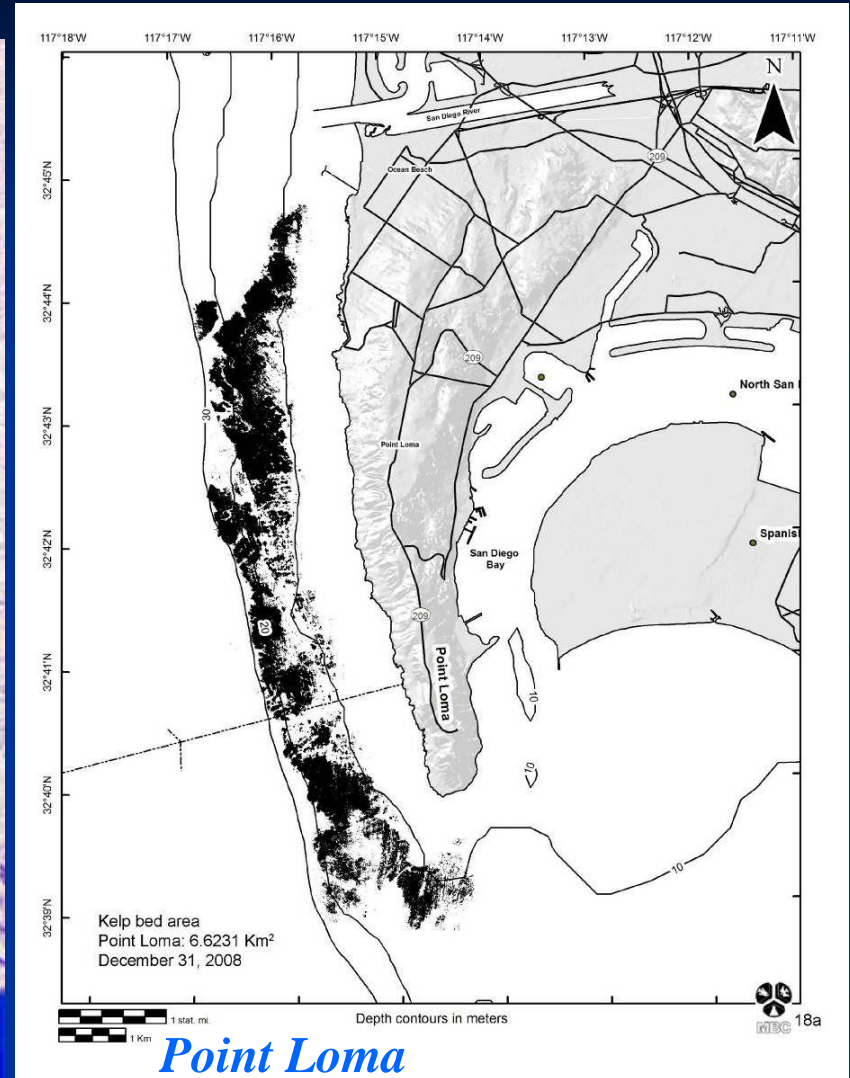
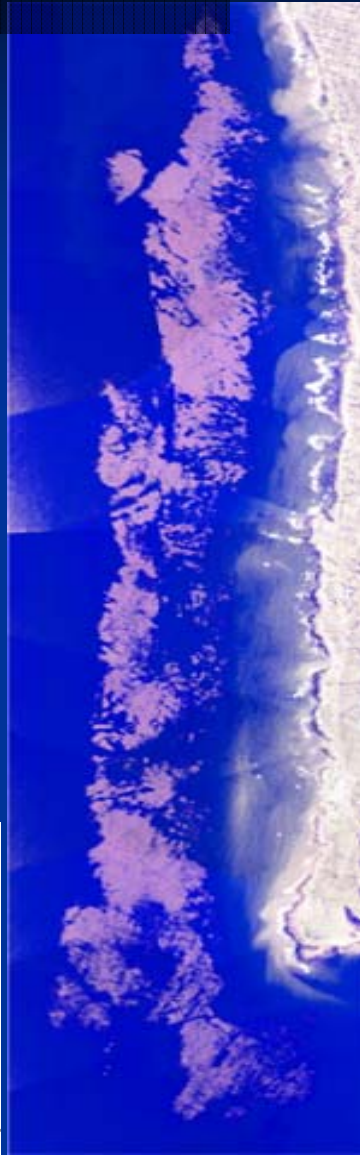
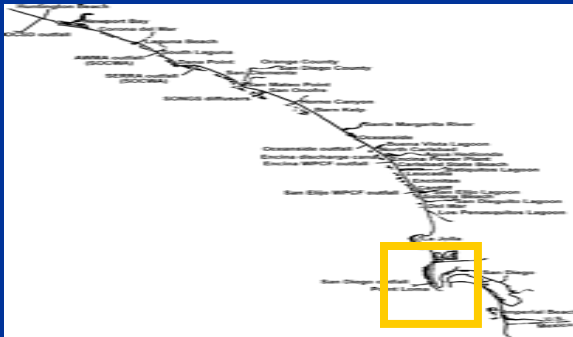
Point Loma Kelp Bed

In CDF&G Bed 3 and 2

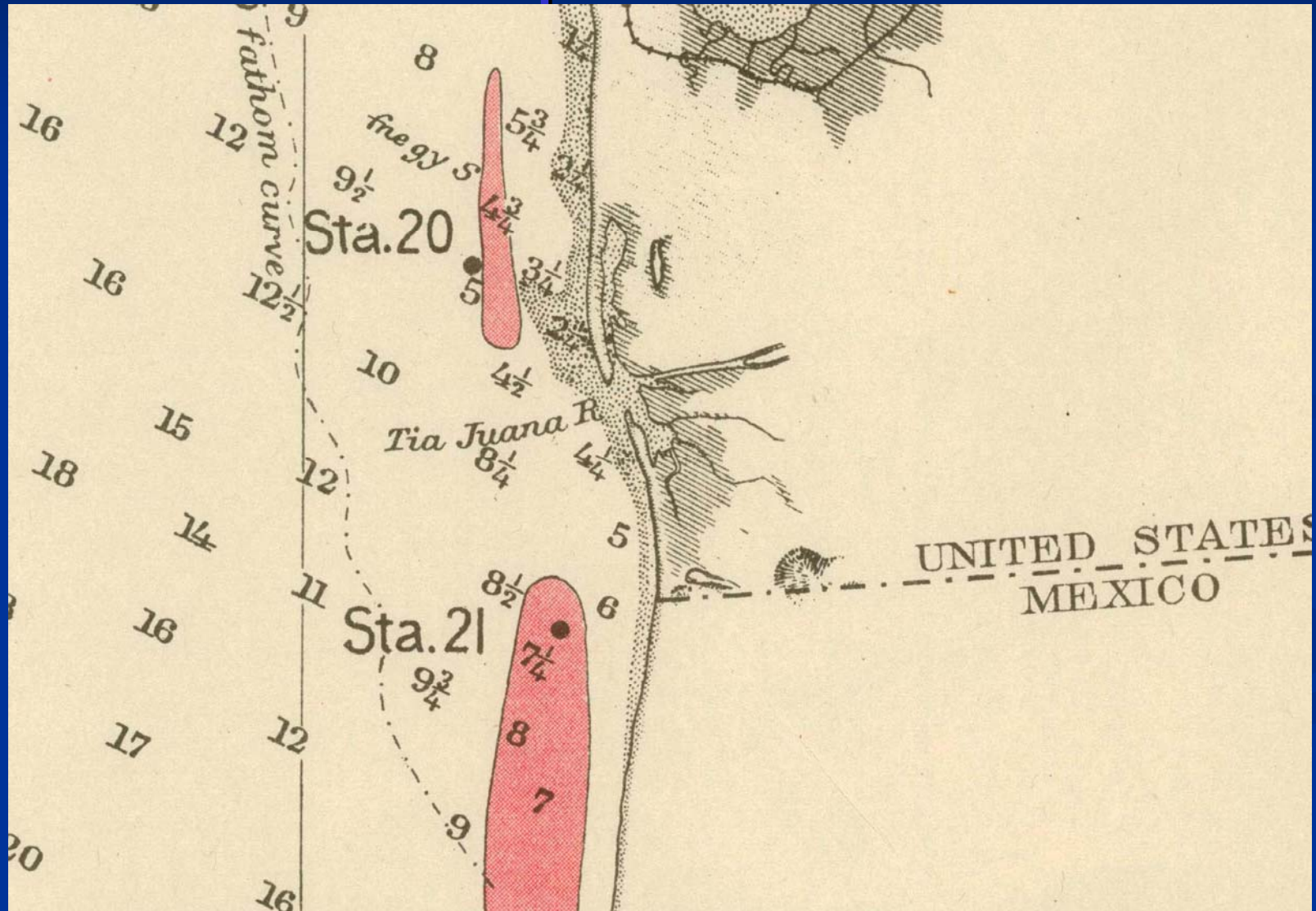
3.6162 km²
(2007)



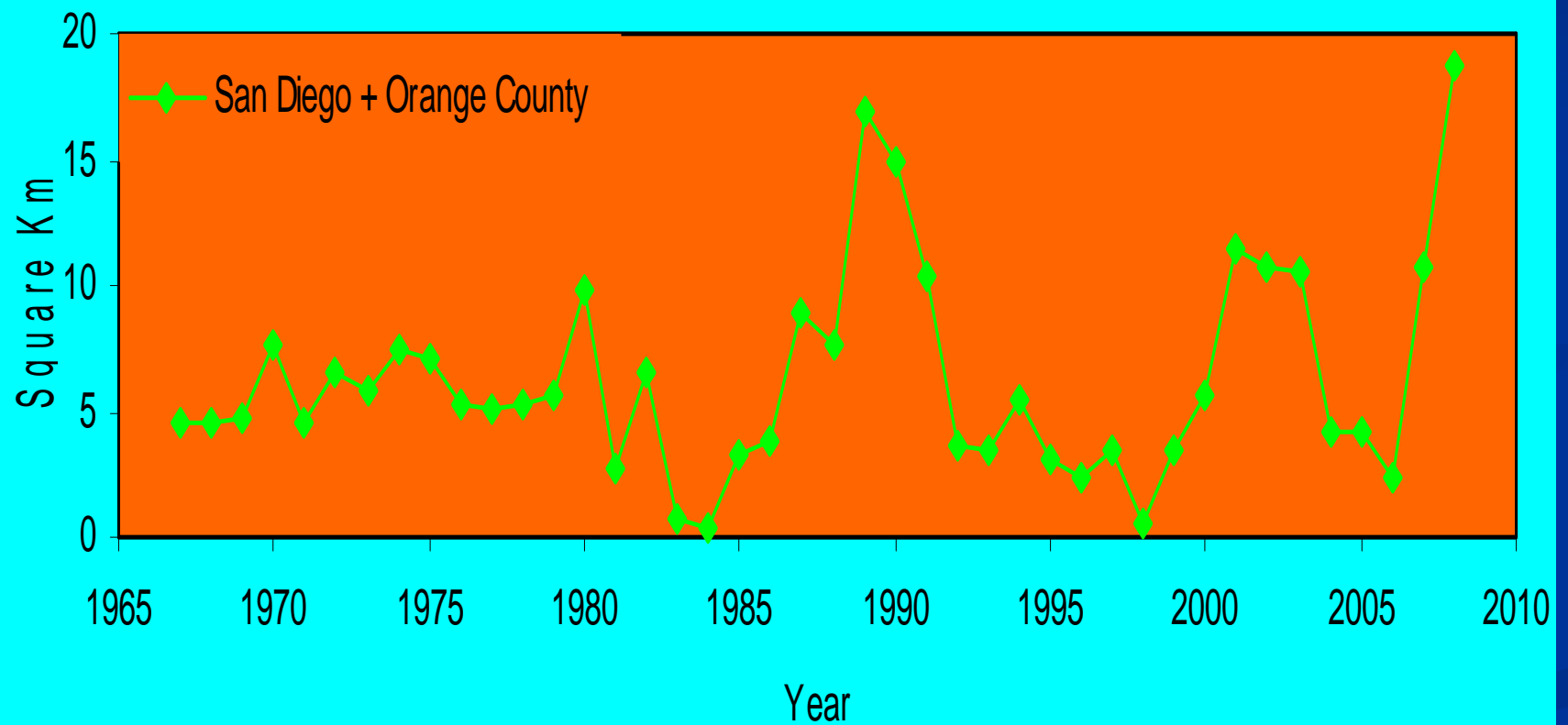
6.6231 km²
(2008)



Imperial Beach to Mexican Border Kelp 1911 Crandall



TOTAL REGION KELP CANOPY COVERAGE 1967 TO 2008



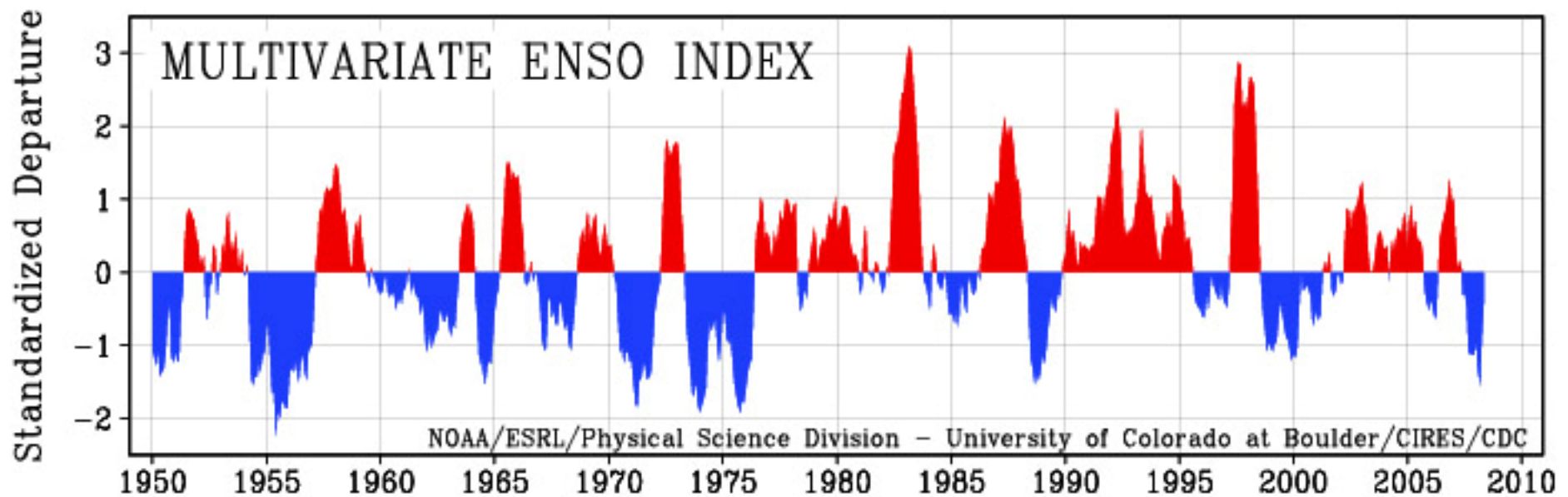
Relationship of Temperature to Nutrients

Monthly NQ based on average sea surface temperature per month

Relationships between seawater temperatures, nitrate concentrations, and nitrate uptake rates by *Macrocystis pyrifera* at each concentration level. Values of nitrate vs. temperature are from North and Jones 1991.* Nitrate uptake rates are from Haines and Wheeler 1978 and Gerard 1982.

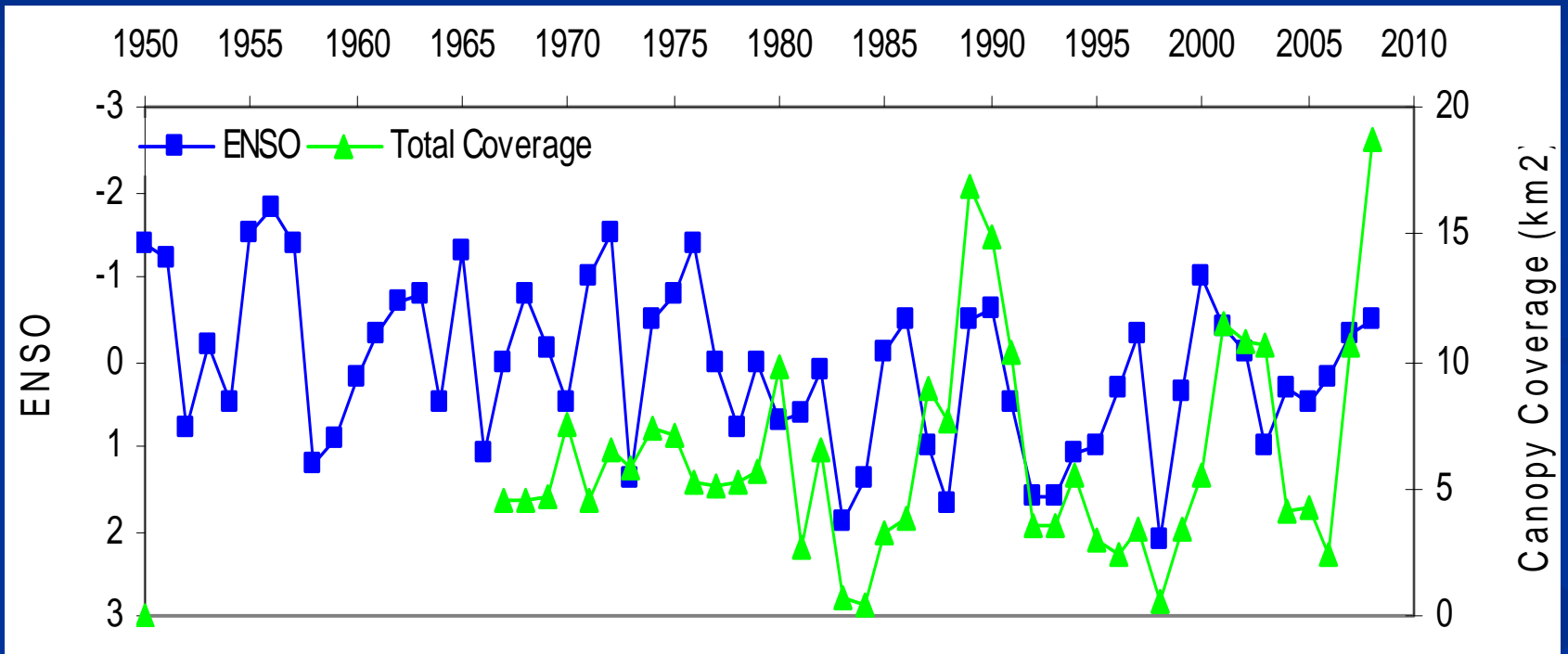
Temperature (°C)	NO ₃ = AMT	[NO ₃], µg/l	Uptake, µg/g/h (Haines & Wheeler)	Uptake, µg/g/h (Gerard)
16	1	ca 1	-	1
15	2	14	-	2.5-4.1
14	4	28	-	4.3-7.1
13	8	56	8.4	8.3-11
12	14	112	16.1	13-15
11	17	182	22.4	17.1-17.2

ENSO Index Warm and Cold Periods Since 1950



- Strong Relationship Between Kelp Canopy Size and Warm and Cold Periods

TOTAL REGION KELP CANOPY COVERAGE WITH MEAN AND STANDARD DEVIATION



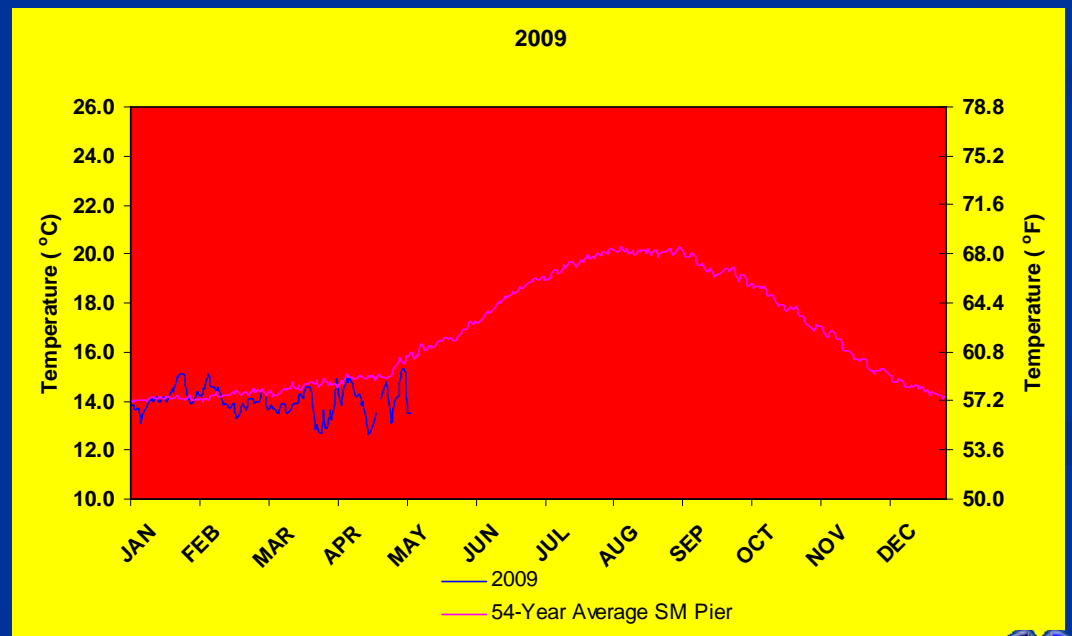
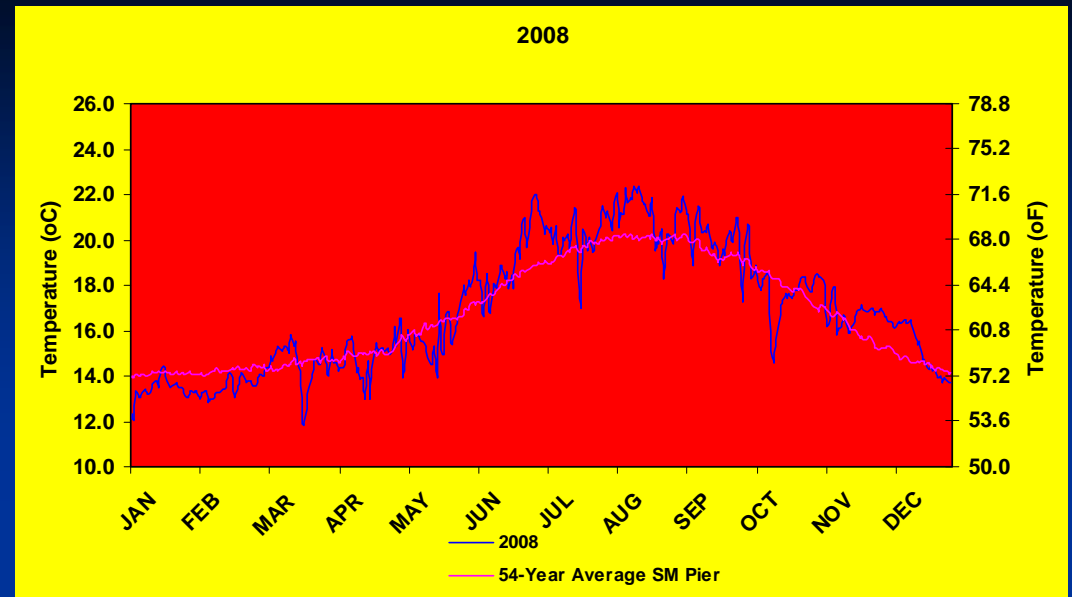
2008 Synopsis of Coastal Conditions

Sea Surface Temperature (SST)

Santa Monica Pier
automated sampler

NQ Index = 33 (2007-2008)
25 (2008-2009)

from North and Jones (1991),
Gerard (1982),
and Haines and Wheeler (1978)



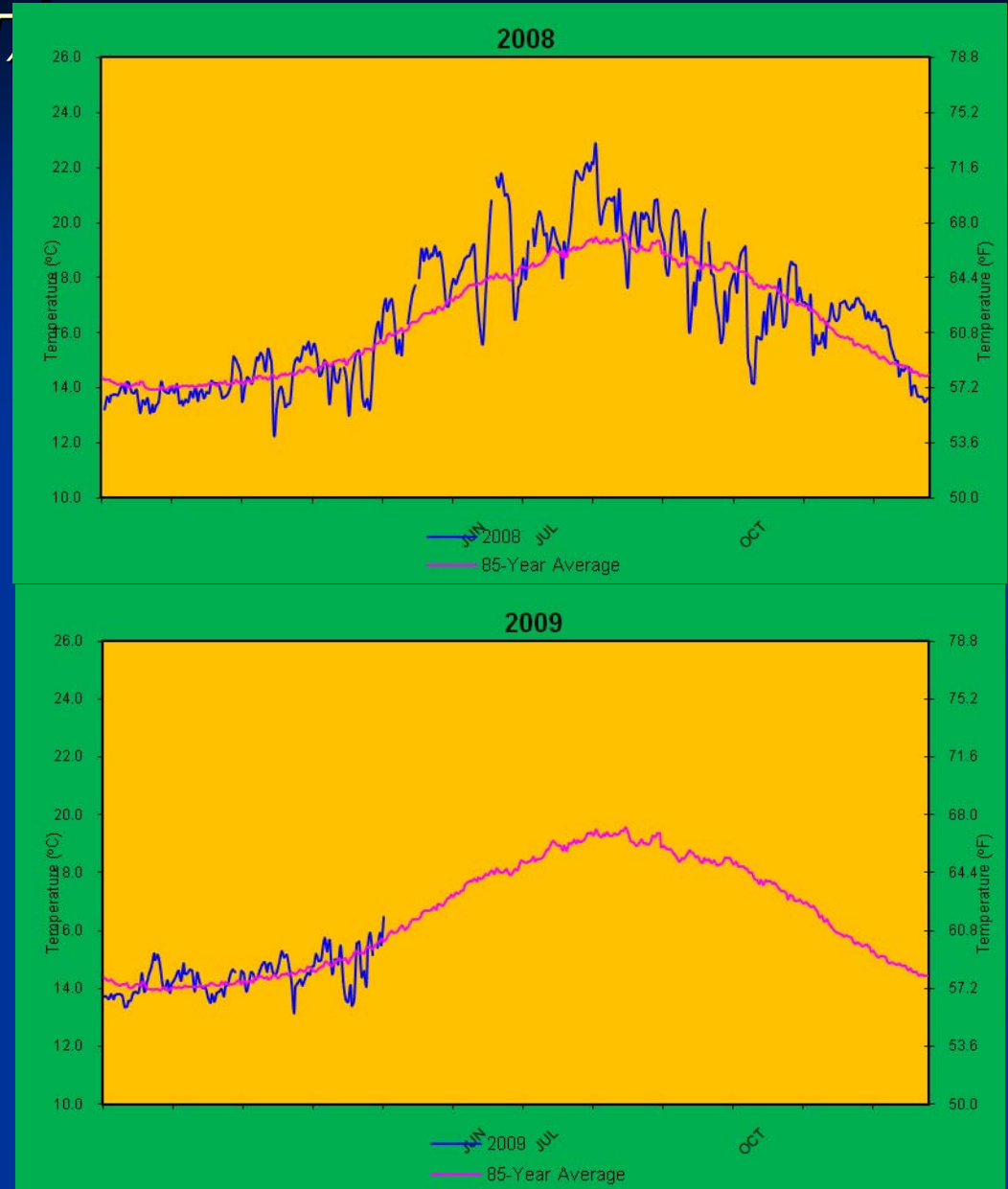
2006 Newport Pier Synopsis of Coastal Conditions

Sea Surface Temperature (SST)

Newport Pier
automated sampler

NQ Index =20 (2008-2009)
Newport Pier =29 (2007-2008)

from North and Jones (1991),
Haines and Wheeler (1978),
and Gerard (1982)



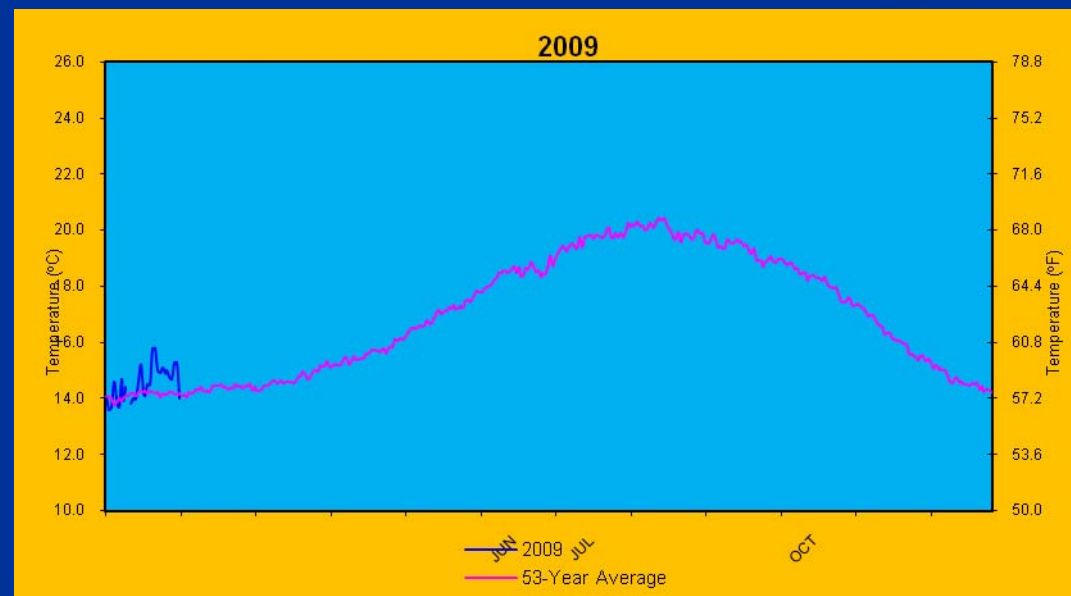
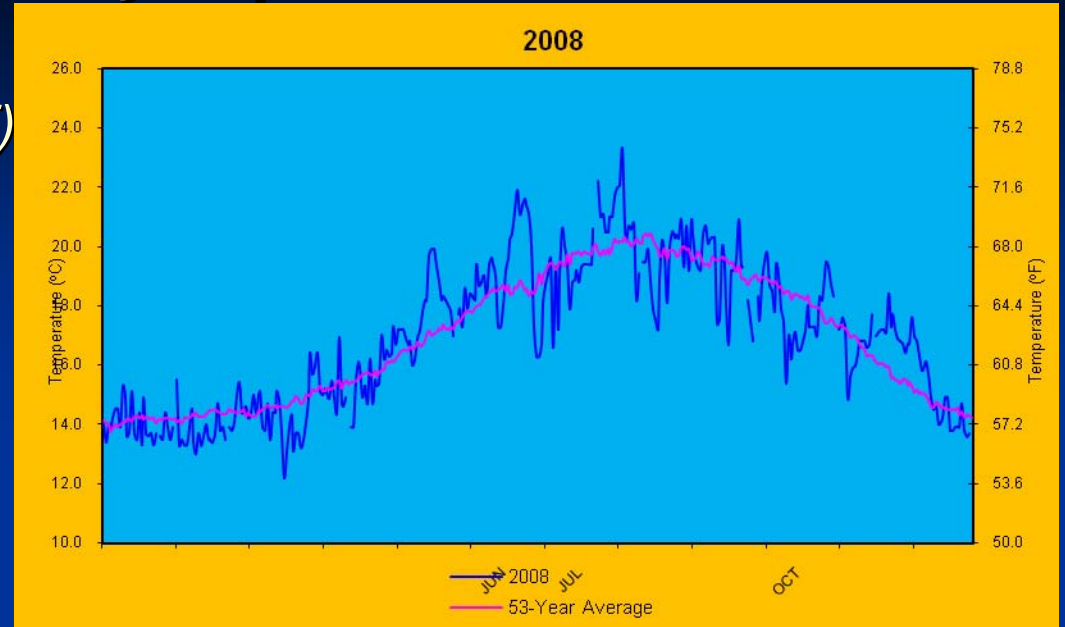
2008 San Clemente Pier Synopsis of Coastal Conditions

Sea Surface Temperature (SST)

San Clemente Pier
automated sampler

NQ Index = 24 (2008-2009)
San Clemente 24 (2007-2008)

from North and Jones (1991),
Haines and Wheeler (1978),
and Gerard (1982)



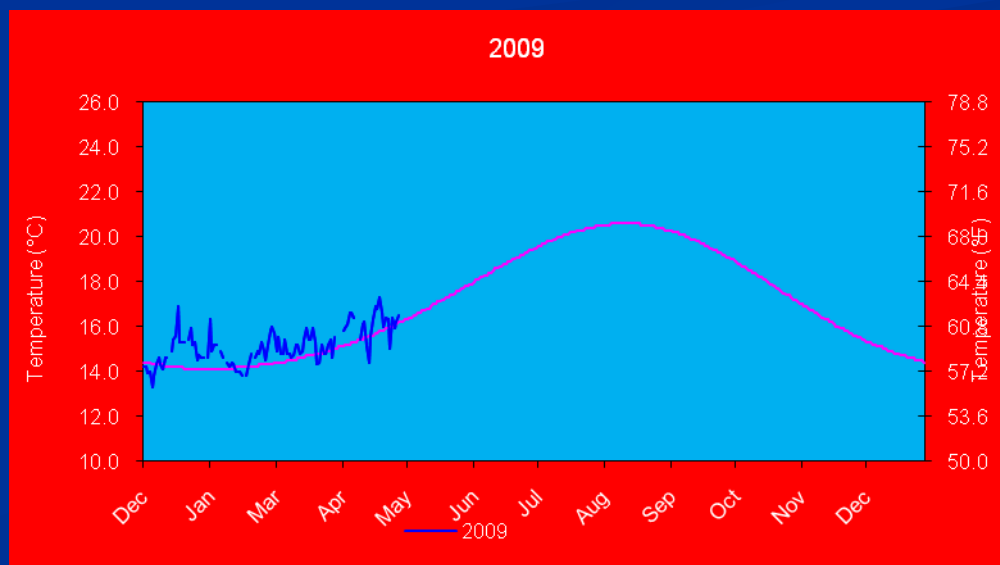
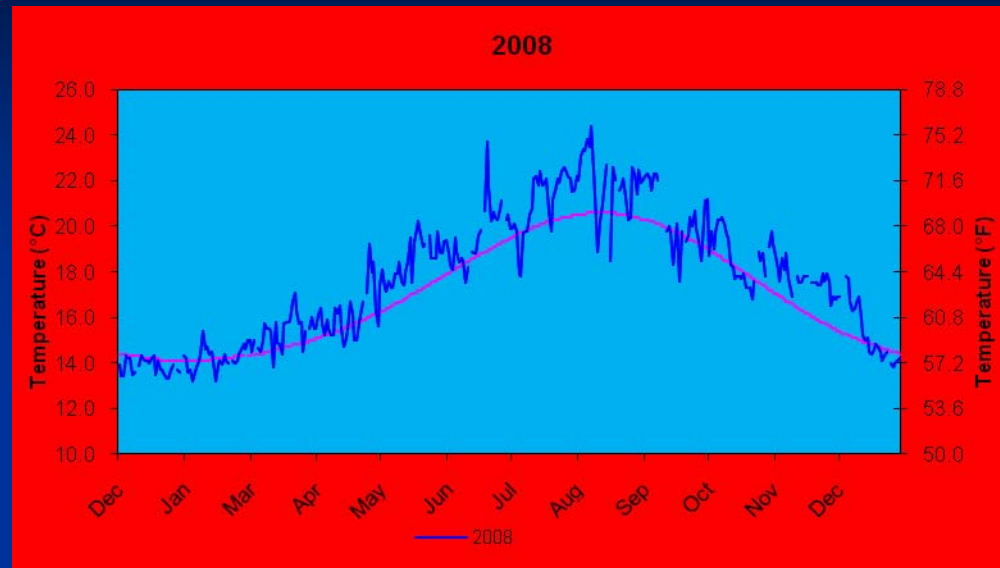
2008 Scripps Pier Synopsis of Coastal Conditions

Sea Surface Temperature (SST)

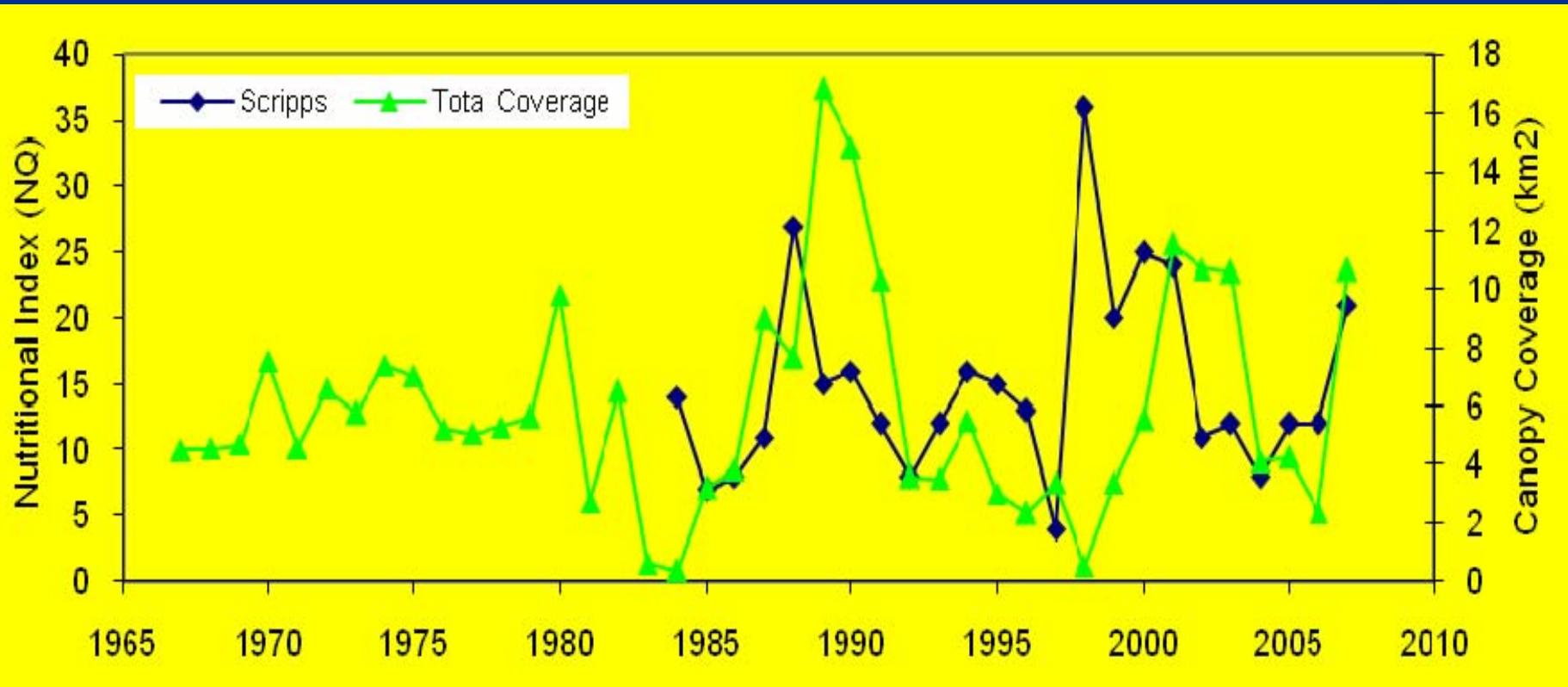
Scripps Pier,
Scripps Institution of
Oceanography

NQ Index = 11 (2008-2009)
21 (2007-2008)

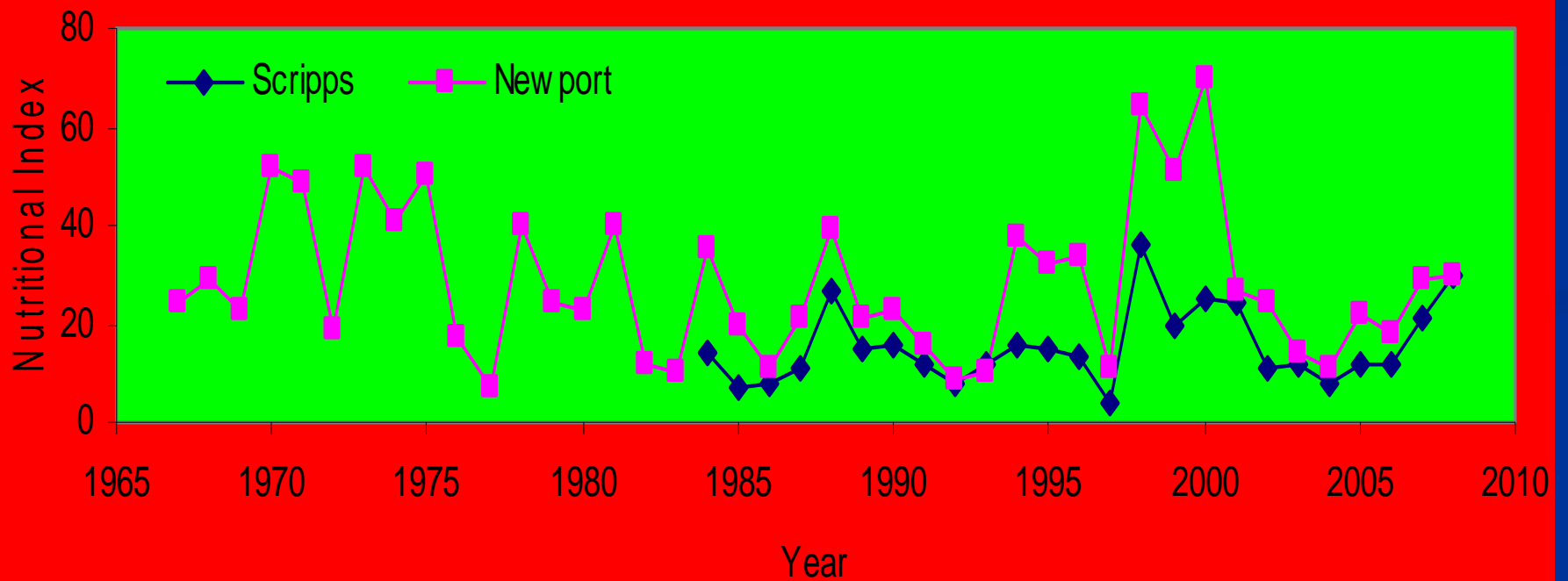
from North and Jones (1991),
Gerard (1982),
and Haines and Wheeler (1978)



YEARLY SCRIPPS NUTRIENT QUOTIENT AND TOTAL REGION KELP CANOPY COVERAGE



NUTRIENT QUOTIENT SCRIPPS VS. NEWPORT BEACH



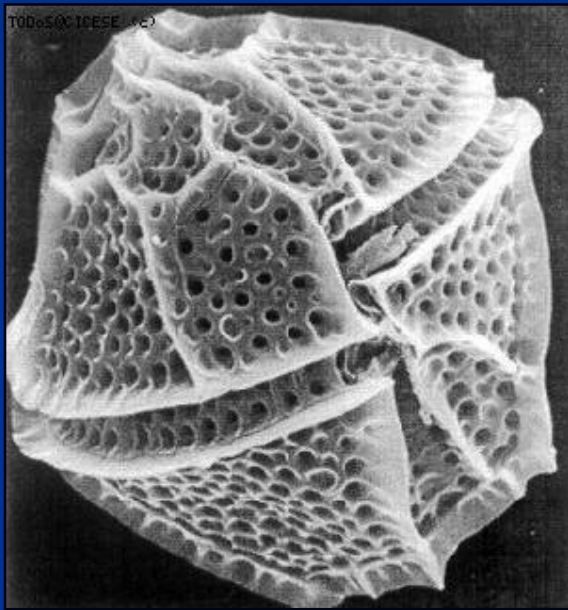
Turbidity Effects on Kelp Beds

**Portuguese
Bend Land
Slide
Showing
Sediment
Plume**



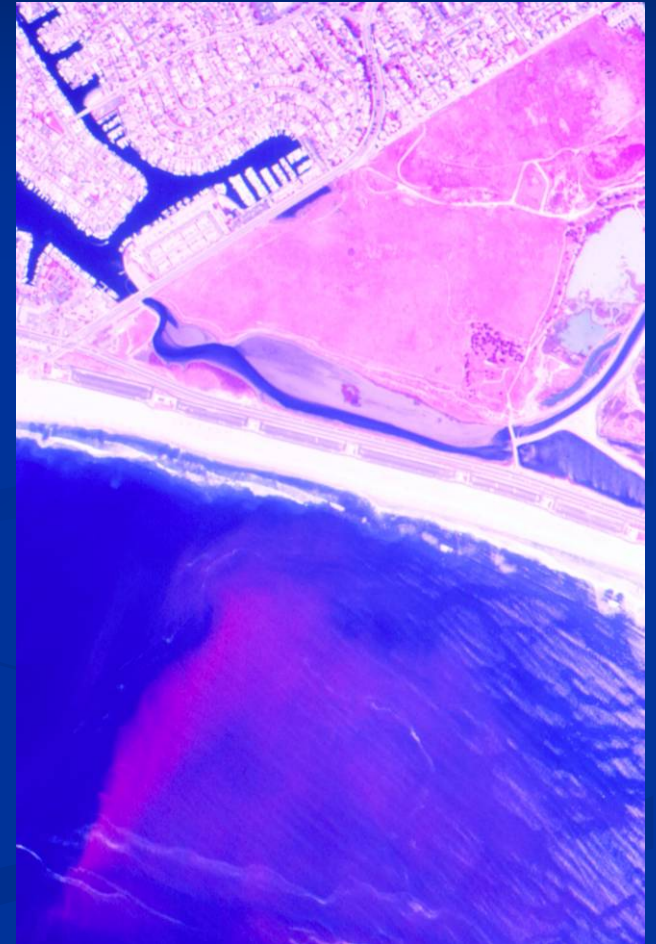
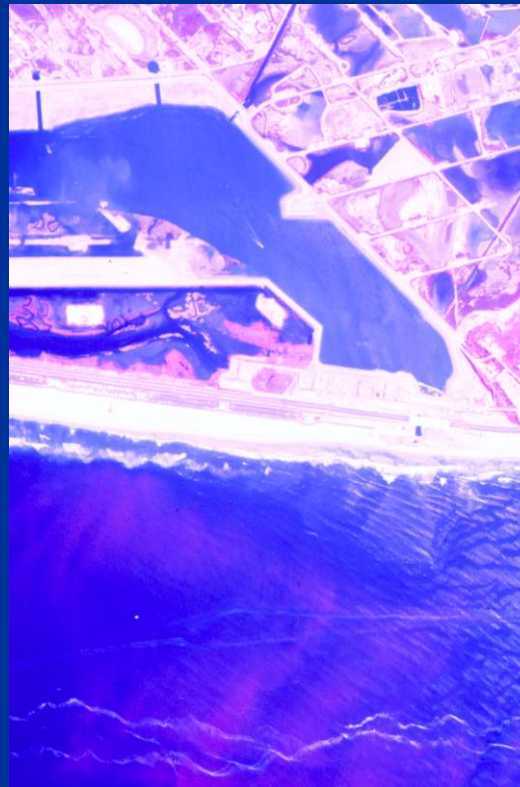
*Phytoplankton Blooms “red tides”
were not an adverse factor in
2008*

Phytoplankton Blooms



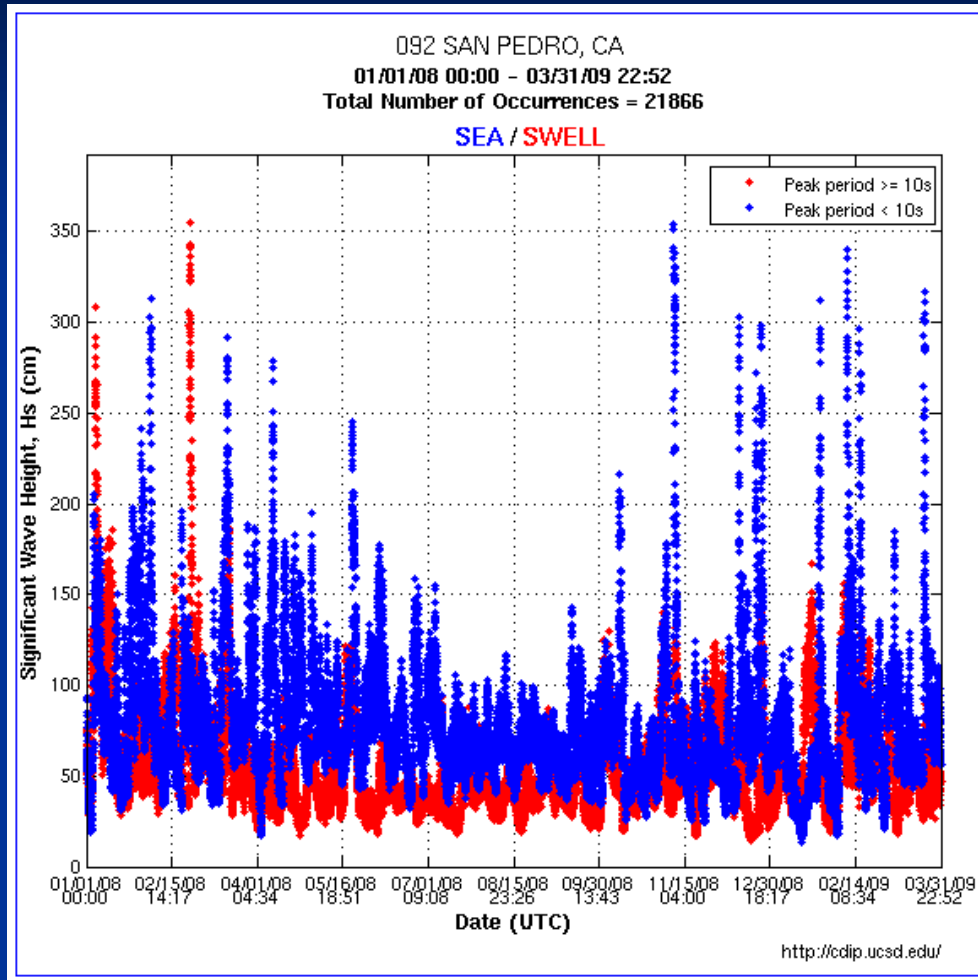
Lingulodinium polyedrum bloom, August-September 2005

20 April 06
aerial survey



2008 Synopsis of Coastal Conditions

Swells



Coastal Data Information Program (CDIP) 092 San Pedro Buoy

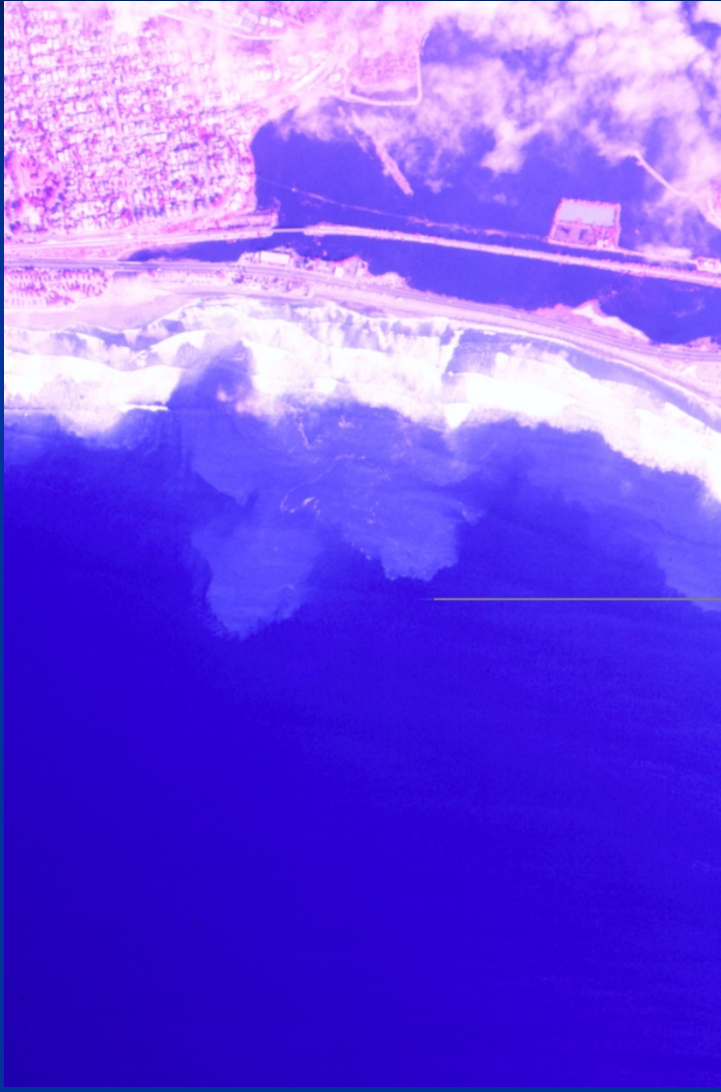


And here's Backwash City, inside Seal Beach, closer to the pier. Photo: Ron Woolhether/awefoto.com

2008 Synopsis of Coastal Conditions

Swells

"Agua Hedionda"



Oceanside Harbor



January 7, 2006
survey



Sea Urchins Feeding on Kelp

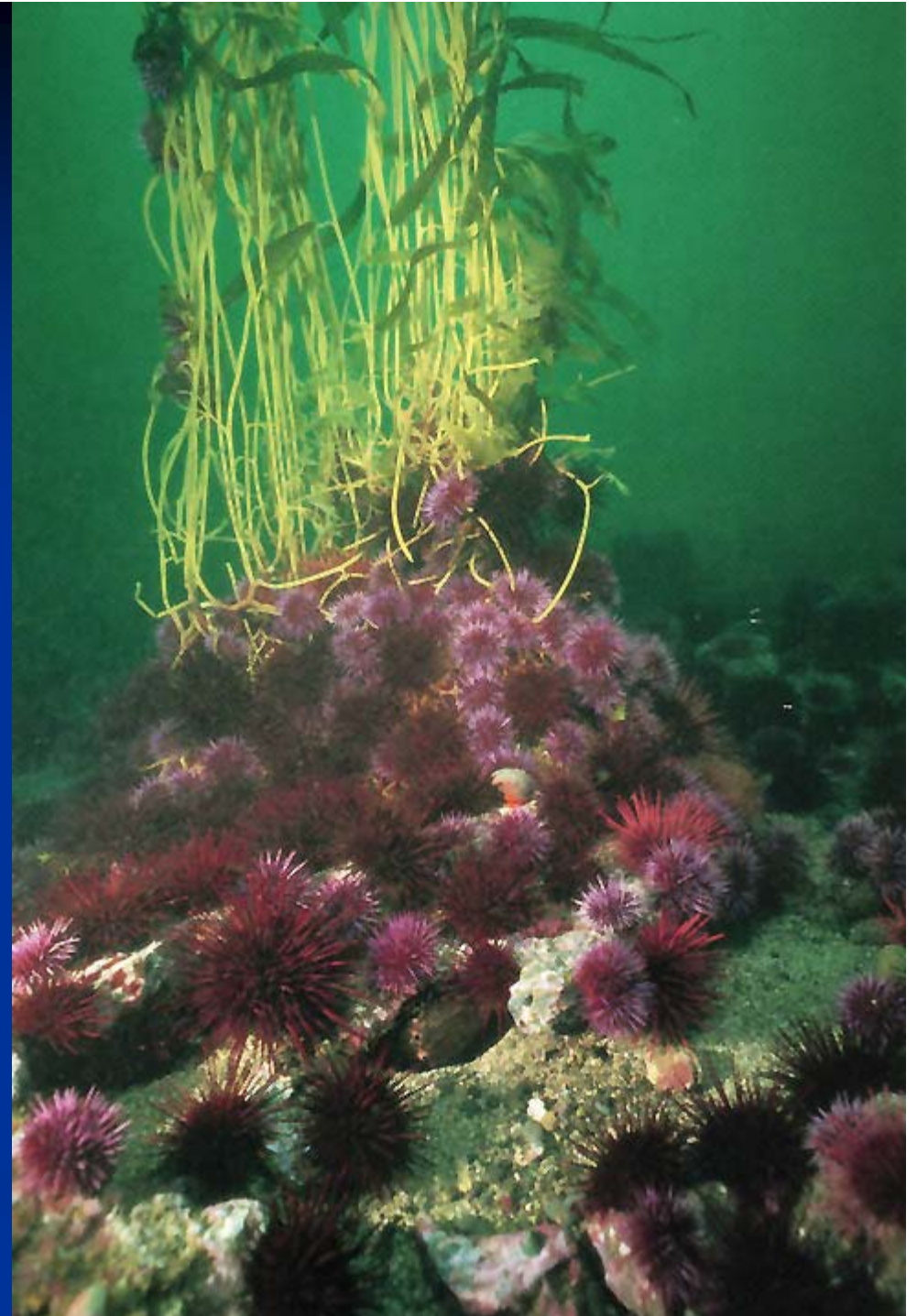


Photo source: *The Amber Forest*

A photograph of a person's profile on the left side, looking towards the right. The person is wearing a red and white striped shirt. In the foreground, there are yellow kelp stalks with air bladders. The background is a bright, slightly blurred outdoor scene. The text is overlaid in the center-right area of the image.

Dedicated to Dr. Wheeler North

Who Observed Patterns in Kelp

Persistence and Began

Long-Term Monitoring