



Web-enabled Condition Reporting and Integrated Ecosystem Assessment

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In collaboration with



Co-Design is Key

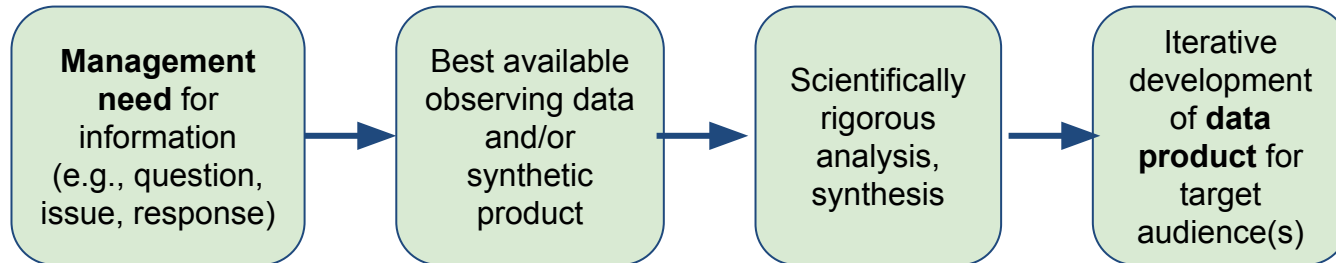
Start with the needs, identify the user, build and resource the team

Translation of data from observers and scientists to managers and the public is not automatic, it requires focus and resources

Co-design Team

- managers (e.g., science, policy, resource protection, education)
- data-specific technical expert
- data product and web developer
- science translation, application, interpretation

Process



Needs



- Apply observation data to assessment of management-relevant indicators at the scale of management
- Information updating at a frequency relevant to management and supported by data collection, management and analysis timelines
- Data summaries designed to meet the technical abilities of the audience
- Attractive interface that is easily accessible on digital platforms

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Condition Reports: Periodic Assessment



- Assessment of sanctuary condition every 8-10 years
- Feeds critical information into management plan review

Condition Reports: Periodic Assessment

- indicators selected for each condition report question
- apply available observation data to status and trend assessment
- when possible, scale the analysis to the spatial scale most relevant to sanctuary assessment and management



15 Questions

- Human Dimensions
- Water Quality
- Habitat
- Living Resources
- Maritime Heritage Resources



▲ = Improving — = Not Changing ▼ = Worsening ◆ = Mixed

? = Undetermined N/A = Not Applicable NR = Not Rated

Confidence Scale: Very High = 
High = 
Medium = 
Low = 
Very Low = 

Example: This symbol indicates the condition was rated "fair" with "medium confidence" and a "worsening" trend with a "very high confidence."

Confidence Status Trend Confidence
  **Fair**  

Condition reporting indicator portfolios as conceptual models

PELAGIC INDICATORS - Monterey Bay



KEY CLIMATE & OCEANOGRAPHIC DRIVERS

- Q2, Q6: Nitrogen: Phosphorus
- Q7: HABs - extent, duration, frequency
- Q8: Basin-scale indicators (MEI, NPGO, CUJ)
- Q8: pH
- Q8: Sea surface temperature
- Q8: Dissolved Oxygen



KEY HUMAN ACTIVITIES

- Q2, Q7 Contaminant levels in water, fish
- Q2: Shipping activity levels
- Q2: Marine debris abundance
- Q4: # strandings/entanglements
- Q4: Commercial fishing activity level
- Q4: Recreational fishing activity level



Q12: Phytoplankton/Chl a
Biomass

Q15: At-sea seabirds
Species richness

Q13: Local nesting birds
Colony size & productivity

Q15: Phytoplankton
Taxonomic structure

Q13: Leatherback
Abundance

Q12: Key forage invertebrates
Species abundance

Q13: Baleen whales
Local distribution & abundance

Q13: Pinniped
Pup production & growth

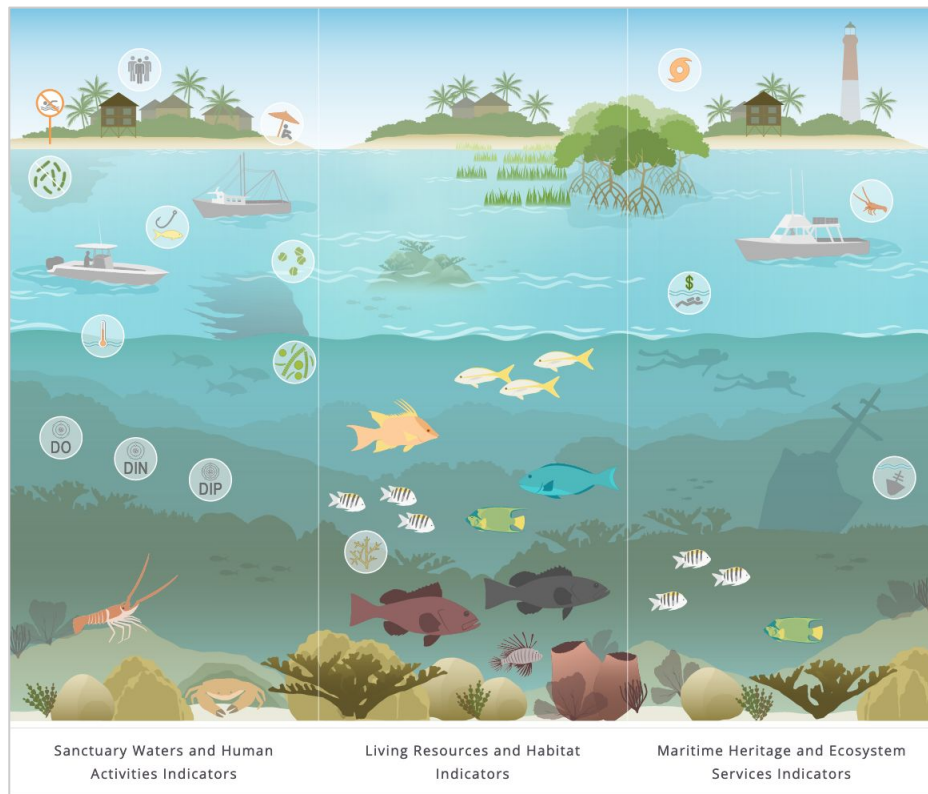
Q13: Gelatinous zooplankton
Relative abundance/biomass

Q12: Key forage fishes
Species abundance

Q15: Forage assemblage
Species richness & diversity

Q15: Mid-water assemblage
Diversity metrics

Q14: Non-indigenous species
Abundance

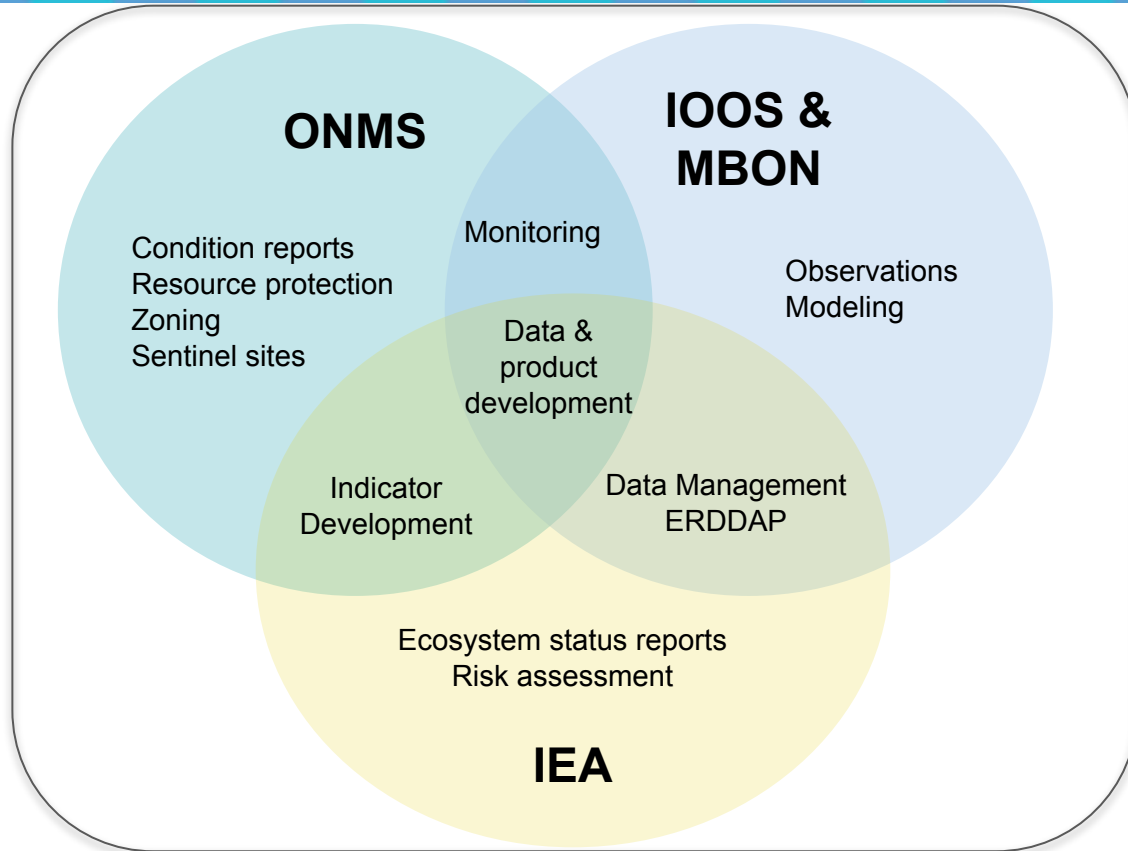


Sanctuary Waters and Human
Activities Indicators

Living Resources and Habitat
Indicators

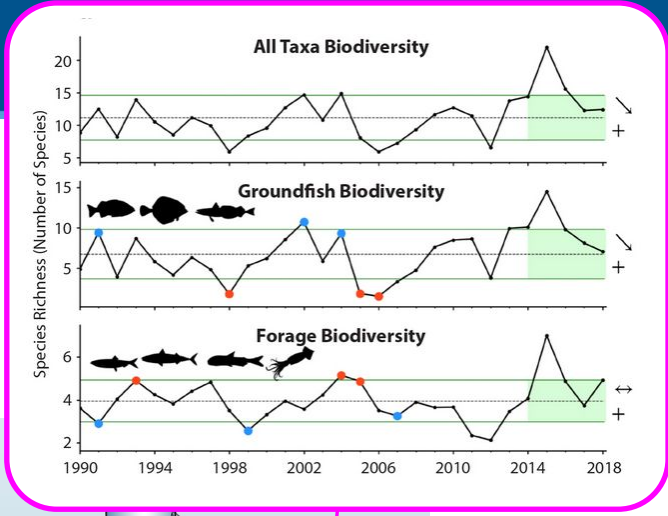
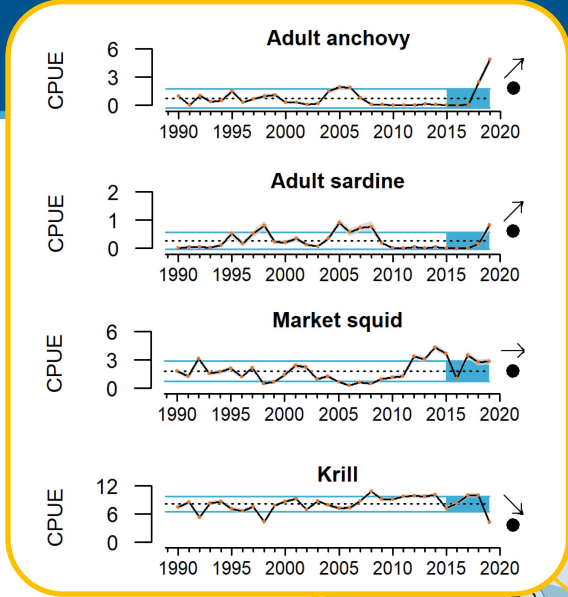
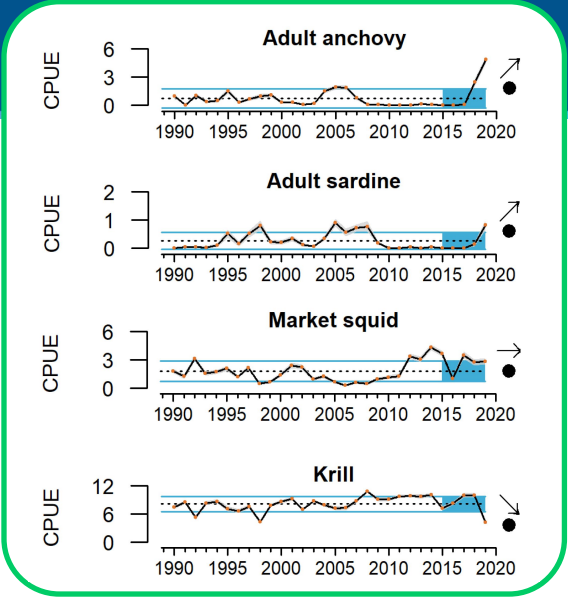
Maritime Heritage and Ecosystem
Services Indicators

Which observation data fits the need?



CCIEA Ecological Integrity Indicator Question 12: Foundation species

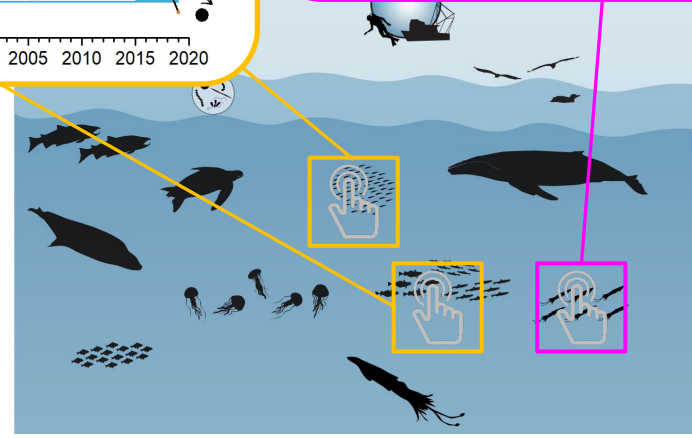
Question 15: Biodiversity



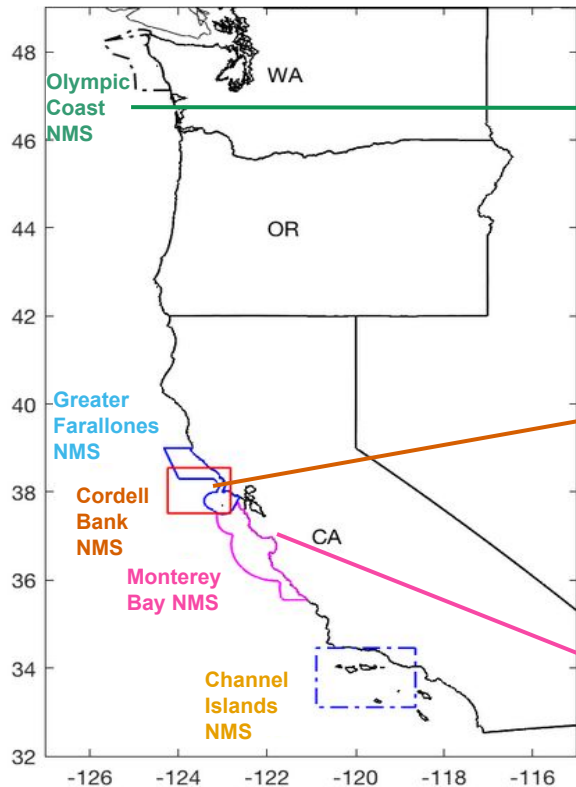
California Current Integrated Ecosystem Assessment

Indicator Status and Trends

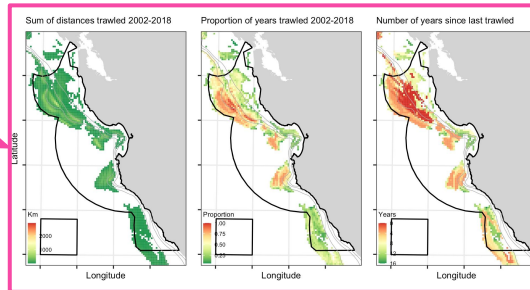
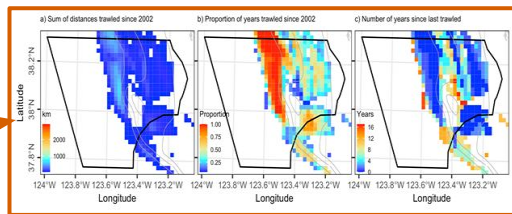
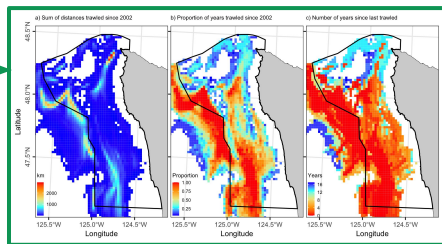
Forage Availability				
Adult anchovy - CCC	CCC	↗	●	1990 2019 ▲
Adult Sardine - CCC	CCC	↗	●	1990 2019 ▲
CA Market squid - CCC	CCC	↔	●	1990 2019 ▲
Krill - CCC	CCC	↘	●	1990 2019 ▲



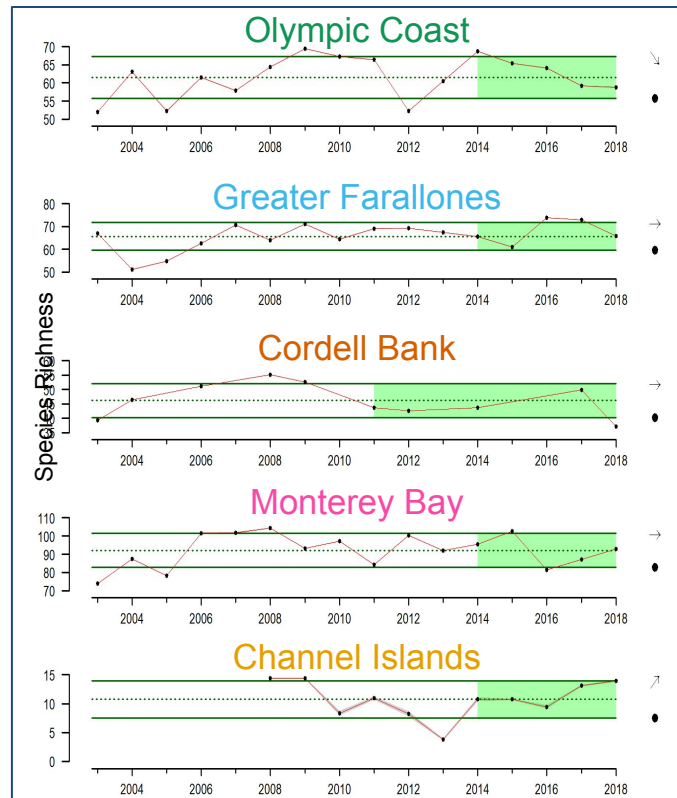
Downscaling CCIEA Regional Indicators to Sanctuary Scale



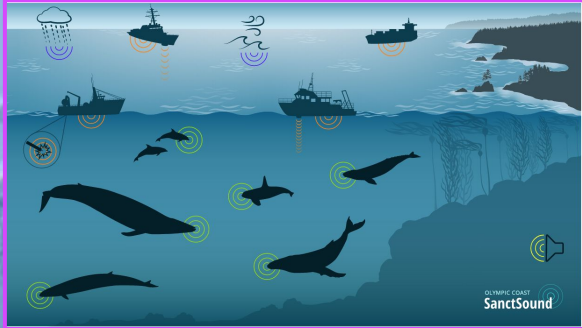
Trawl Bottom Contact Indicators



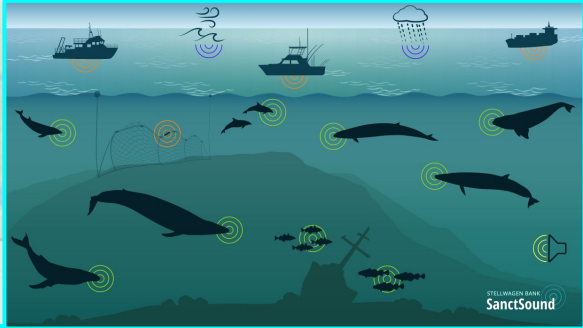
Groundfish Species and Assemblage Indicators



SanctSound



Olympic Coast



Stellwagen Bank

West Coast Region

Eastern Region

Mentawai Bay

Channel Islands

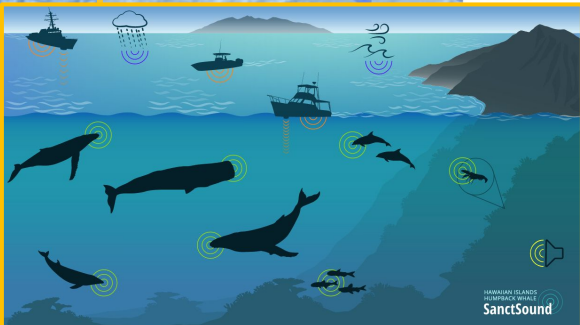
Gray's Reef

Florida Keys

Papahānaumokuākea

Pacific Island Region

Hawaiian Islands Humpback Whale



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Web-enabled Condition Reporting (WebCR)

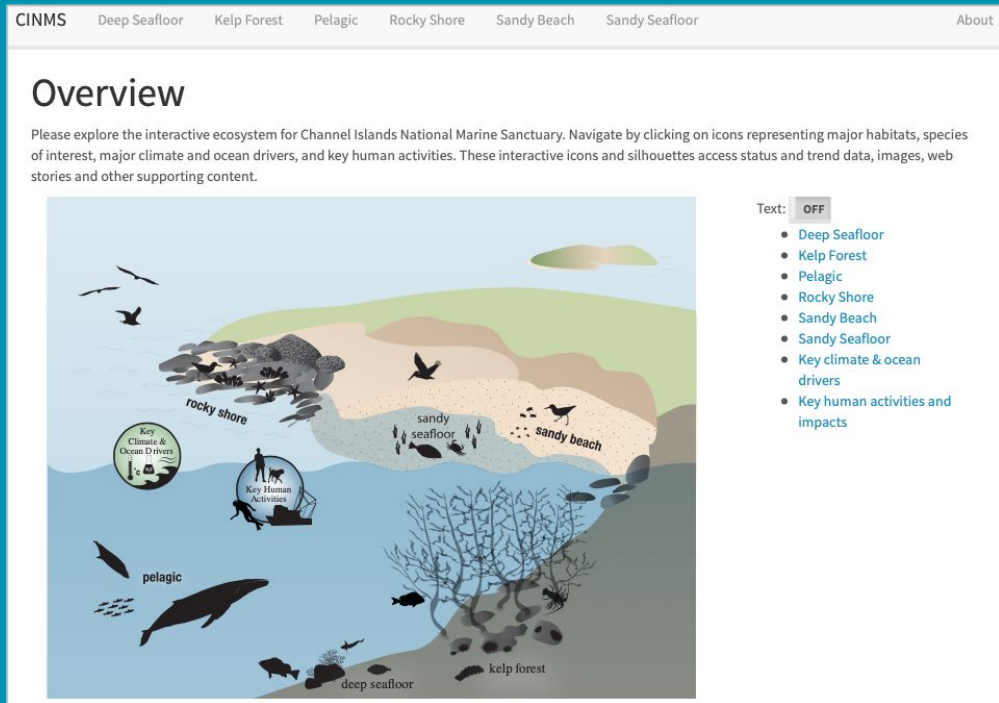
Goal = improve availability and timeliness of information for sanctuary management

Static, infrequent report



Time frame: Management plan review

Interactive, routinely updated web-enabled tool



Time frame: on-going condition tracking

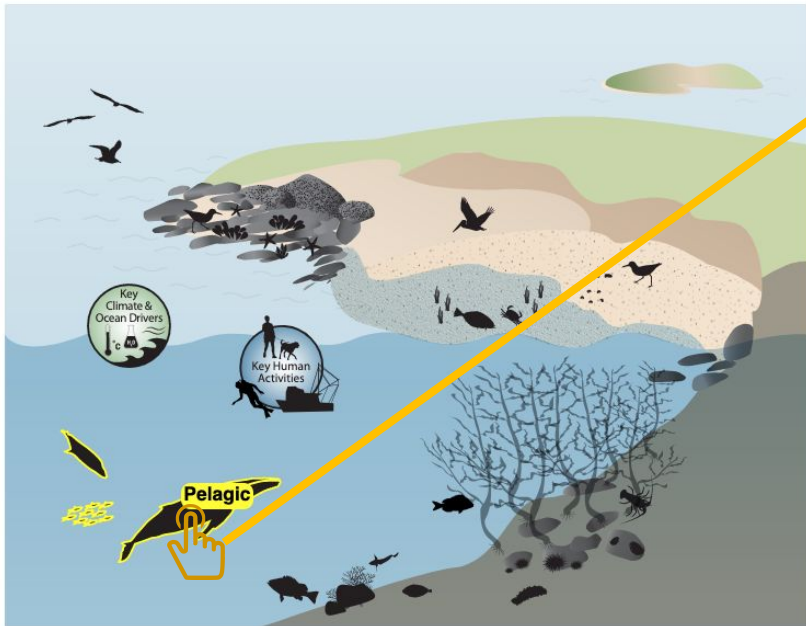
Web-enabled Condition Reporting (WebCR)

Step 1: access to information in Condition Report

CINMS Deep Seafloor Kelp Forest Pelagic Rocky Shore Sandy Beach Sandy Seafloor About

Overview

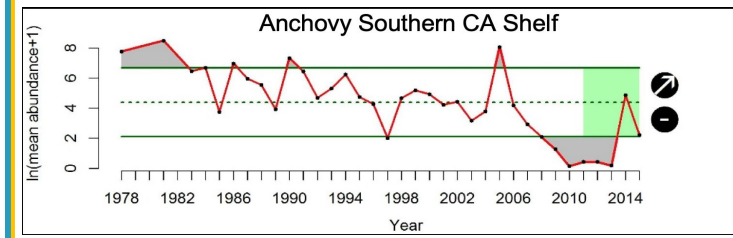
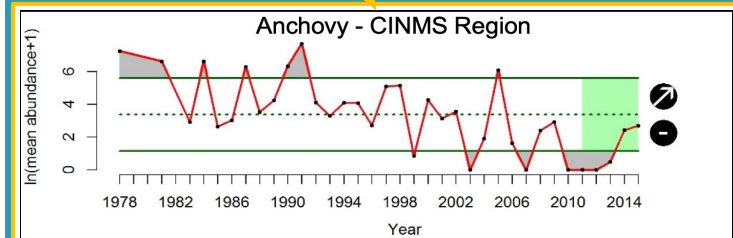
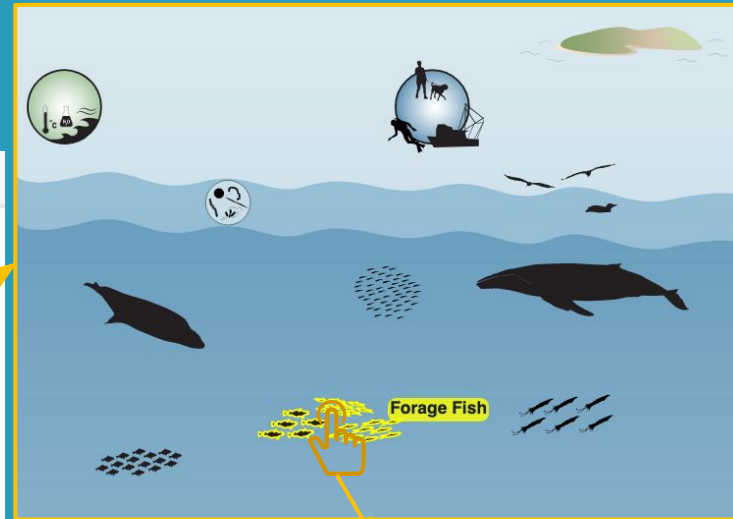
Please explore the interactive ecosystem for Channel Islands National Marine Sanctuary. Navigate by clicking on icons representing major habitats, species of interest, major climate and ocean drivers, and key human activities. These interactive icons and silhouettes access status and trend data, images, web stories and other supporting content.



FULL SCREEN

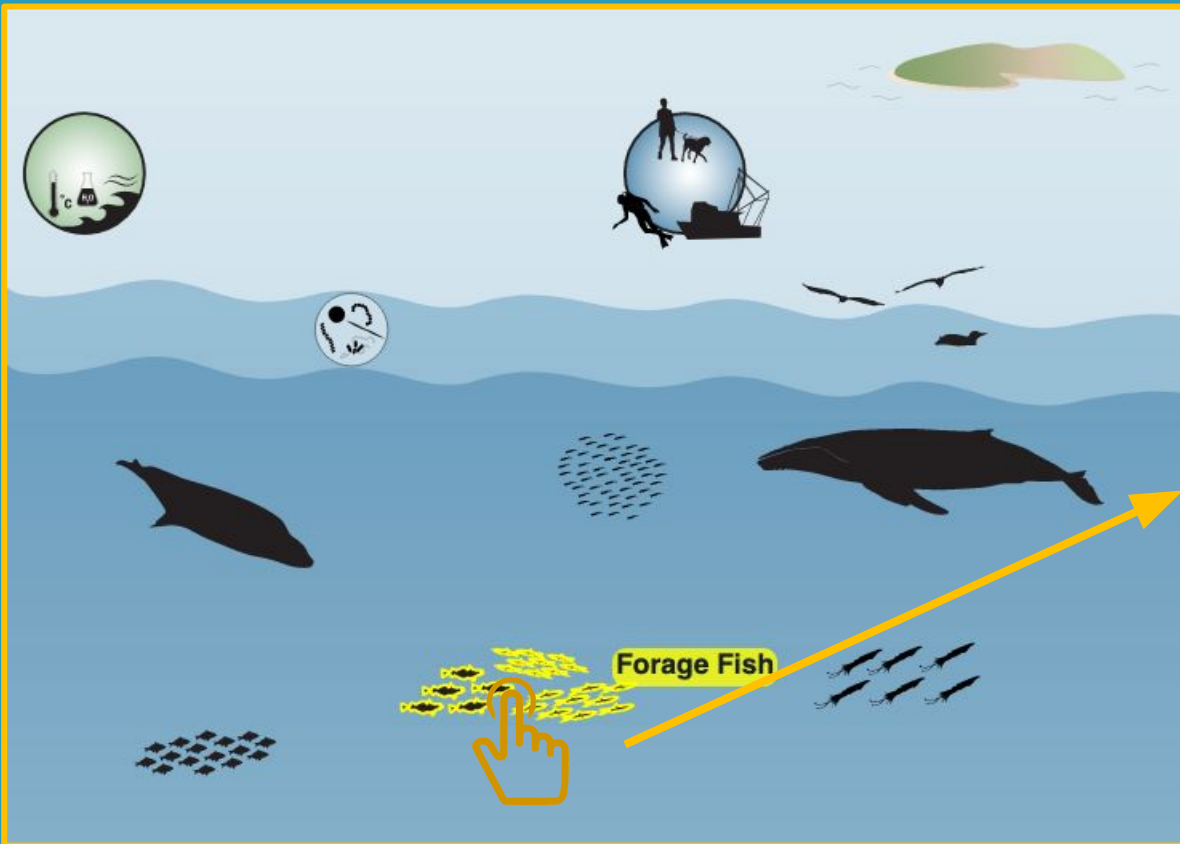
Text in image: Off

- Deep Seafloor
- Kelp Forest
- Key climate & ocean drivers
- Key human activities and impacts
- Pelagic
- Rocky Shore
- Sandy Beach
- Sandy Seafloor



Web-enabled Condition Reporting (WebCR)

Step 2: Transition to on-going tracking



Forage Fish

Forage fish, also called prey fish or bait fish, are small fish which are important food for larger predators including larger fish, seabirds, sea lions and whales. Forage fish, such as anchovies, sardines, feed near the base of the food chain on plankton.

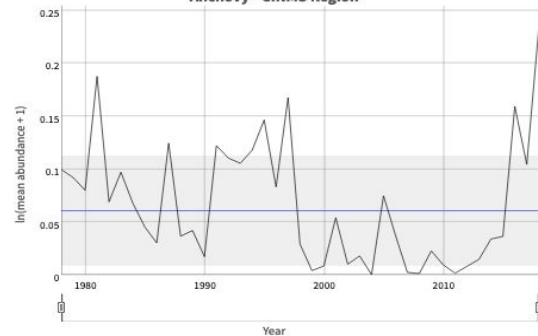
- Map of Regions
- Anchovies**
- Hake
- Myctophids
- Rockfish
- Sanddab
- Sardines

CINMS Region

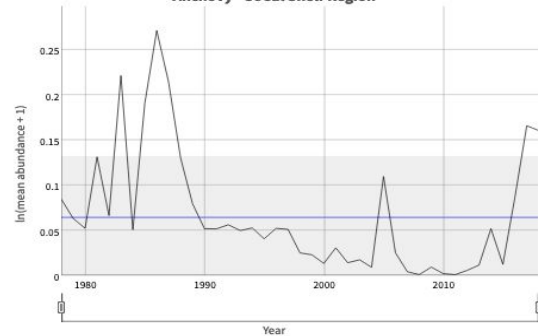
CalCOFI Monitoring Program

CalCOFI data

Anchovy - CINMS Region



Anchovy - SoCal Shelf Region



A figure showing the relative abundance of northern anchovy (*Engraulis mordax*) collected during the spring around the Southern California Shelf from 1978 to 2018. The bar at the bottom of the figure can be used to zoom in to specific dates, using the small slider buttons on either edge of the bar. The blue horizontal line indicates the mean value for the time series. The horizontal gray bar shows one standard deviation above and below the mean. Data source: CalCOFI; Figure credit: A. Thompson/NOAA; Ben Best/EcoQuants.

► Click for Details

Flexible design

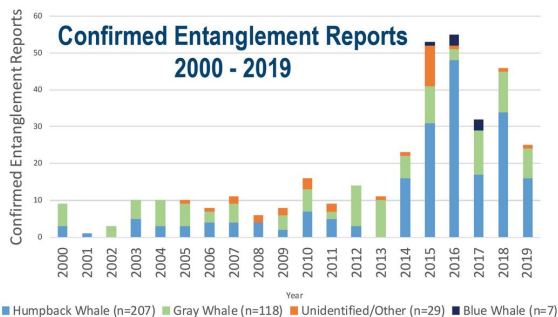
- * different data sets are currently available in different formats
- * data set can transition from static to interactive to auto-updating if interest and resources are available

Whale entanglement

Trends: By Species Map: Whale Overlap with Fishing

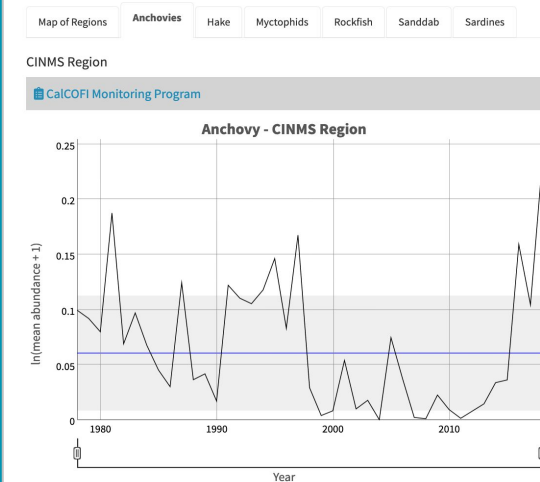
NOAA Entanglement Response Program Entanglement Data/Summary Reports

Static Figures

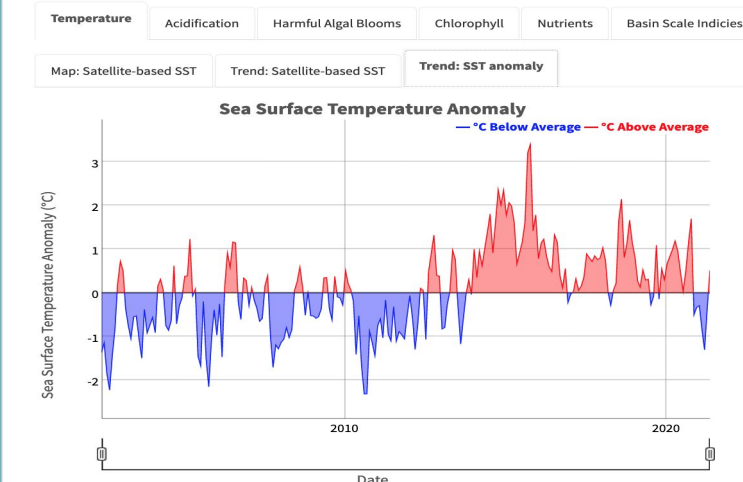


Number of confirmed reports of large whales, including humpback, gray, and blue whales entangled in fishing gear, ropes and other sources along the U.S. West Coast from 2000 to 2019. Graph from NOAA Fisheries 2019 West Coast Whale Entanglement Summary Report. Last updated April 2020. In the legend, color represents the different species of whales and "n" represents the total number of that species confirmed entangled in the study period. Of the 46 confirmed whale entanglements, 30 were reported off California, 6 of which originated from southern California (Santa Barbara, Los Angeles, Orange, and San Diego counties). However, the location where entangled animals are observed and reported does not necessarily reflect where and when the entanglement originated. Figure credit: D. Lawson/NMFS WCRO PRD.

Interactive Figures



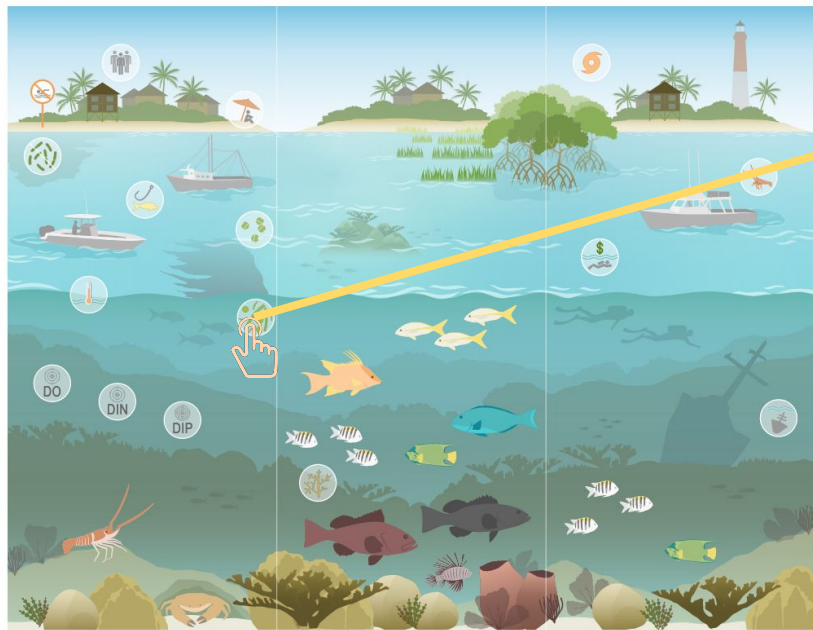
Auto-updating Figures



TRACKING ECOSYSTEMS AND HUMAN CONNECTIONS IN THE FLORIDA KEYS

Florida Keys National Marine Sanctuary Ecosystem Tracking Tool

This interactive graphic allows you to find data used to track the changing conditions of natural resources and levels of human use in the Florida Keys. Called "indicators," you can hover over each icon, or click the indicator from the menu on the right to learn more about it and see the data. This is a product of the Florida Keys NOAA Integrated Ecosystem Assessment program.



Sanctuary Waters and Human Activities Indicators

Living Resources and Habitat Indicators

Maritime Heritage and Ecosystem Services Indicators

FULL SCREEN

HABITAT

HUMAN CONNECTIONS

LIVING RESOURCES

MARITIME HERITAGE

SANCTUARY WATERS

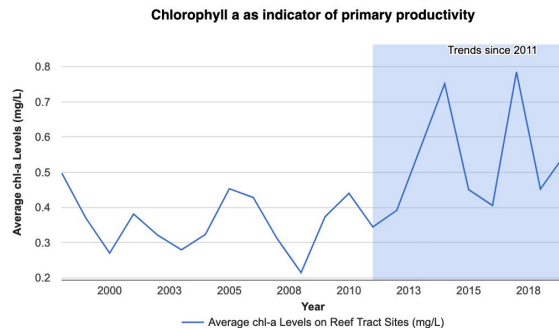
- Beach closures due to presence of fecal indicator
- Chlorophyll a as indicator of primary productivity
- Dissolved inorganic nitrogen
- Dissolved inorganic phosphorus
- Dissolved oxygen
- Red tide current status
- Sea Surface Temperature (SST)

Infographic Credits

Data is updated on various timelines based on the schedules of each monitoring program.

Florida Keys Web-enabled Ecosystem Tracking Tool

CHLOROPHYLL A AS INDICATOR OF PRIMARY PRODUCTIVITY



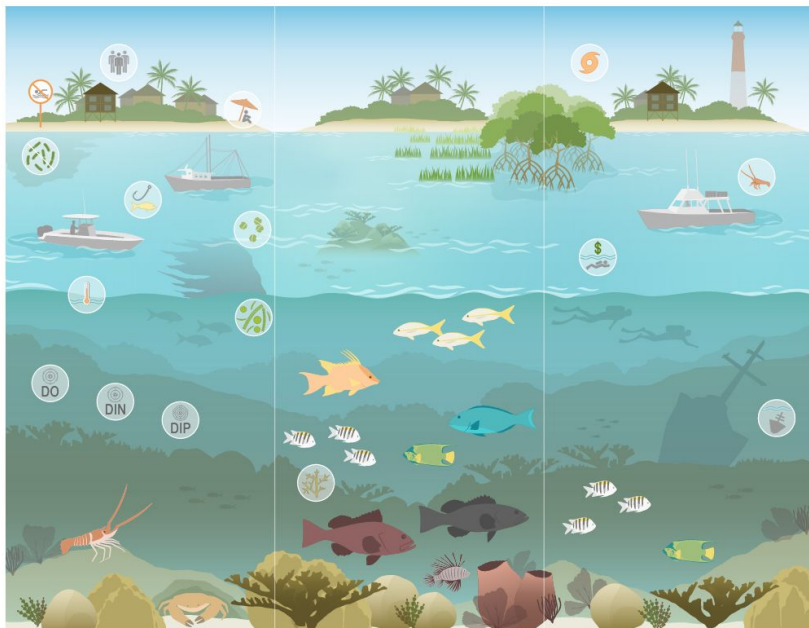
Chlorophyll a concentrations are often used as an indicator of phytoplankton abundance and presence in coastal and estuarine waters. In a balanced ecosystem, phytoplankton provide food for a wide range of sea creatures including shrimp, snails, and jollyfish. When too many nutrients are available, phytoplankton may grow out of control and form harmful algal blooms. Chlorophyll a is also used to approximate the amount of primary production occurring from phytoplankton. Chlorophyll a levels have been measured bimonthly since 1998 at reef tract sites in the Florida Keys. This time series data shows two increases in the time period of 2012-2013 and 2016-2017, though the overall trend has been stable since the last condition report. Source: NOAA Atlantic Oceanographic and Meteorological Laboratory's South Florida Project, Ocean Chemistry and Ecosystems Division.

<https://noaa-iea.github.io/fk-esr-info/infographic.html>

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Sanctuary Waters and
Human Activities Indicators

Living Resources and Habitat
Indicators

Maritime Heritage and
Ecosystem Services
Indicators

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 FULL SCREEN

HABITAT 

HUMAN
CONNECTIONS 

LIVING RESOURCES 

MARITIME
HERITAGE 

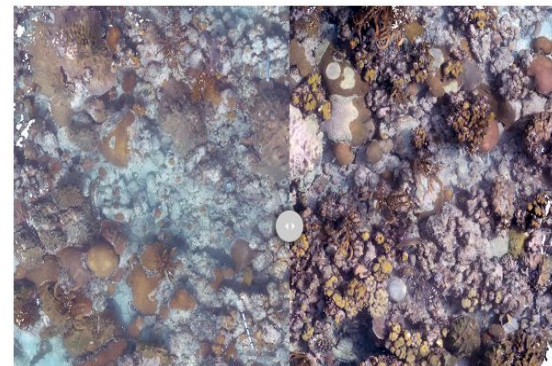
SANCTUARY
WATERS 

- Beach closures due to presence of fecal indicator
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Florida Keys Web-enabled Ecosystem Tracking Tool

CORAL DISEASE

The below interactive visualization tools represent changes due to the spread of the stony coral tissue loss disease in the Florida Keys. The site, Cheeca Rocks, in the Middle Keys, is monitored regularly and changes are documented via high resolution photo mosaics. Click the gray circle to show the pre-disease spread reef in March 2018, the reef during the disease spread in June 2018, and post disease event in July 2019.



<https://noaa-iea.github.io/fk-esr-info/living-resources.html>

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Audience matters...

Knowledge producers

Knowledge users

Technical experts

Researchers

Advisory councils,
working groups

Decision makers,
engaged public,
educators

Data archives
and services

Data portals

Curated Data
Views, Shiny
apps

WebCRs,
interactive ESRs

Least

Most

Level of **Interpretation**

Level of **Technical expertise**



Most

Least

Sanctuary Audience



- Resource management & policy makers
 - Federal, state, agencies, tribal management
 - Advisory council working groups
 - NGOs, etc.
- Science
 - State, federal, academic, tribal researchers
 - Regional research partners
- Education/Outreach
 - ONMS education team and partners
 - Teachers and students
 - Engaged public



Harmful algae species and biotoxins in shellfish are naturally present on the Olympic Coast, but increasingly they pose potential risks to the health of humans and other vertebrates that may consume contaminated shellfish. Shellfish in Washington that are harvested for human consumption are tested regularly to detect toxins like domoic acid, and in 2015-2016 high domoic acid levels in Dungeness crabs and razor clams prompted a devastating fishery closure that had negative consequences for coastal treaty tribes and adjacent coastal communities. Additional shellfish harvest closures have occurred more recently as well. Please consult official sources for updated information about shellfish safety.

PLEASE NOTE: for real-time information about shellfish harvesting in Washington, please visit the [Washington Department of Health shellfish safety information map](#)

Trends - Biototoxin closures

Trends - Domoic Acid, all beaches (CCIEA)

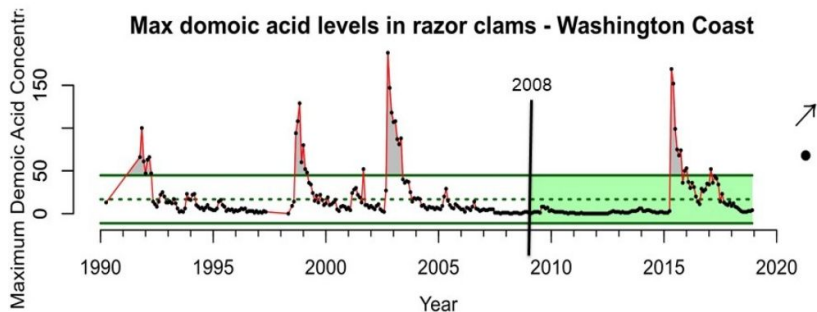
Trends - Kalaloch Domoic Acid Levels

Trends - Mocrocks Domoic Acid Levels (CCIEA)

Trends - Mocrocks Domoic Acid Levels (WDFW)

Safe Shellfish Harvest Map

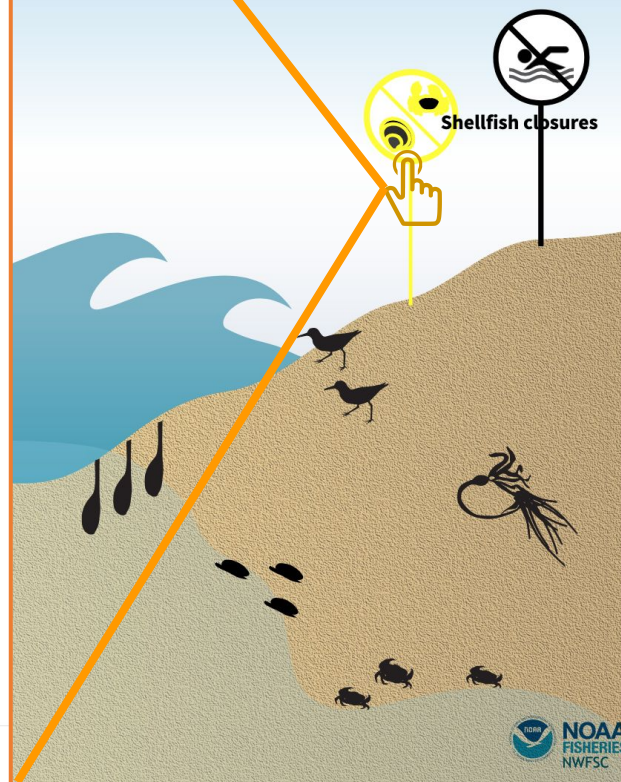
CCIEA Ecological Integrity Indicators



Maximum Domoic Acid in Razor Clams for Washington Coast 1991-2018, CCIEA

Close

Olympic Coast



California Current 2022 Ecosystem Status Report Infographic

<https://www.integratedecosystemassessment.noaa.gov/regions/california-current/california-current-2022-ecosystem-status-report-infographic>

2021-22 CCIEA Ecosystem Status Report Highlights



Favorable Physical Conditions Over Much of the Shelf and Slope

- Above-average upwelling season, coolest shelf conditions since 2013
- Good nutrient supply to the base of the food web
- La Niña conditions, Negative Pacific Decadal Oscillation (PDO)

Unfavorable Conditions and Risk Factors

- Marine Heatwave**
7th largest marine heatwave on record since 1982, largely remained offshore US EEZ
- Terrestrial Disturbances**
Early snowmelt, drought, warm streams
Record heat, extreme & widespread wildfires
- Hypoxia**
Widespread near-bottom hypoxia off OR/WA May-October
- Fishery Landings & Revenue**
Landings continued to decline in 2021 for several target groups (though revenue improved for many)

Positive Ecological Responses

- Lipid-rich northern copepods highly abundant off Oregon
- Favorable conditions for juvenile salmon off Washington and Oregon
- Further south, continued very high abundances of anchovies in surveys and in predator diets
- Positive trends in productivity and growth rates of upper level predators



Salmon Returns

Salmon Returns

RECENT OCEAN CONDITION INDICATORS TREND

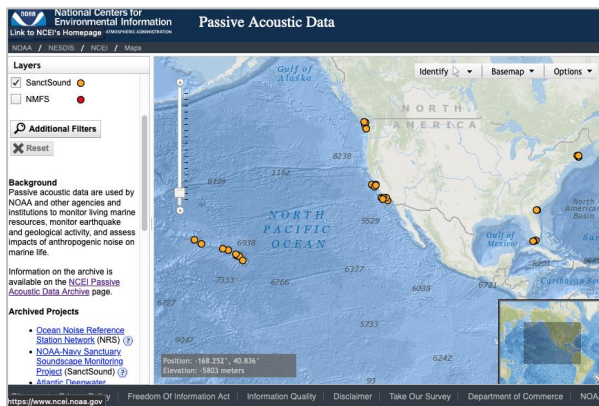
ECOSYSTEM INDICATORS		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
CLIMATE ATMOSPHERIC	PDO (SUM; Dec-Mar)	good	fair	fair	poor	poor	poor	poor	poor	poor	poor
	PDO (SUM; May-Sep)	poor	poor	poor	poor	poor	poor	poor	poor	poor	poor
	ONI (AVG; Jan-Jun)	good	fair	fair	poor	poor	poor	poor	poor	poor	poor
OCEAN PHYSICAL	SST NDBC Buoys (°C; May-Sep)	poor	poor	poor	poor	poor	poor	poor	poor	poor	poor
	Upper 20 m T (°C; Nov-Mar)	poor	poor	poor	poor	poor	poor	poor	poor	poor	poor
	Upper 20 m T (°C; May-Sep)	poor	poor	poor	poor	poor	poor	poor	poor	poor	poor
	Deep Temp (°C; May-Sep)	poor	poor	poor	poor	poor	poor	poor	poor	poor	poor
OCEAN BIOLOGICAL	Deep Salinity (May-Sept)	poor	poor	poor	poor	poor	poor	poor	poor	poor	poor
	Copepod richness	good	good	good	poor	poor	poor	poor	poor	poor	poor
	N copepod biomass	good	good	good	poor	poor	poor	poor	poor	poor	poor
	S copepod biomass	poor	poor	poor	poor	poor	poor	poor	poor	poor	poor
	Biological transition	poor	poor	poor	poor	poor	poor	poor	poor	poor	poor
	Nearshore Ichthyoplankton	poor	poor	poor	poor	poor	poor	poor	poor	poor	poor
	Nearshore & offshore Ichthyoplankton	poor	poor	poor	poor	poor	poor	poor	poor	poor	poor
Chinook salmon juvenile catch	poor	poor	poor	poor	poor	poor	poor	poor	poor	poor	
Coho salmon juvenile catch	poor	poor	poor	poor	poor	poor	poor	poor	poor	poor	

"Stoplight" table of conditions for smolt years 2012-2021 for coho salmon originating in coastal Oregon and Chinook salmon from the Columbia Basin. Green = "good," yellow = "intermediate," and red = "poor," relative to the full time series (1998-present). Chinook salmon from smolt year 2020 and coho salmon from smolt year 2021 (columns outlined in blue) represent the dominant age classes likely to return to their respective spawning rivers in 2022. In 2021, this suite of ecosystem indicators was the most favorable for northern California Current salmon productivity in the last decade and the second most favorable of the

- o Seabirds Yaquina Head
- Human Communities**
- o Fishery Landings All (Coastwide)
- o Fishery Landings California
- o Fishery Landings Oregon
- o Fishery Landings Washington

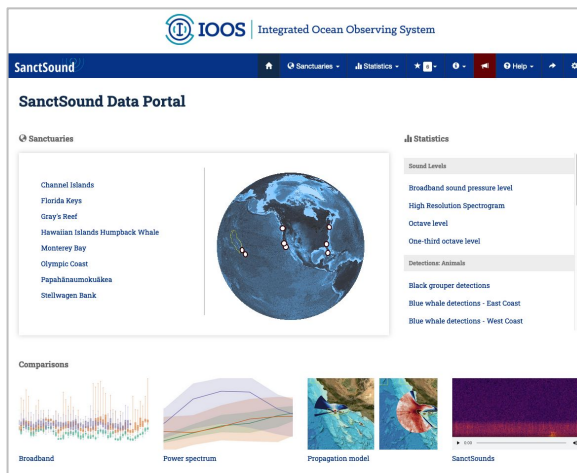
Continuum of Products to Match Target Audience

NCEI Raw Data Archive

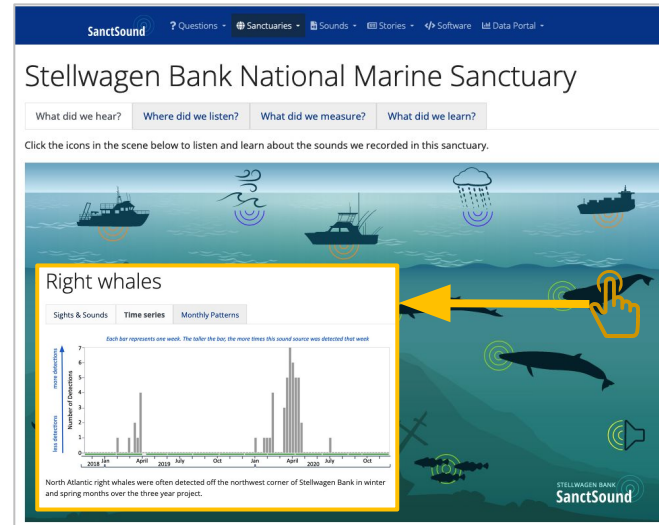


& extracted standard measurements via ERDDAP

SanctSound Data portal



SanctSound Web portal



Level of Interpretation

Level of Technical expertise



Needs

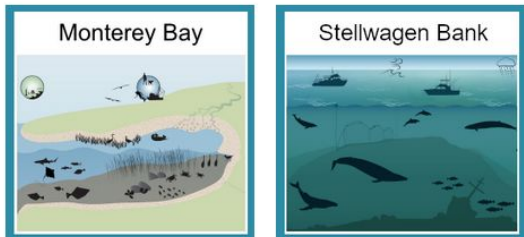
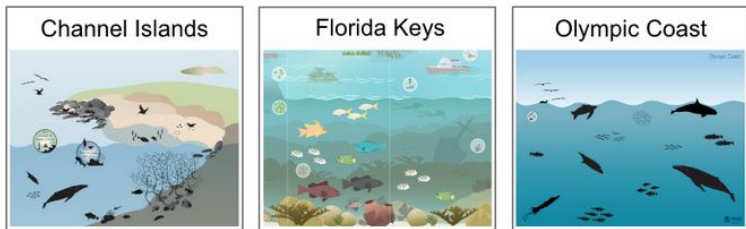


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WebCRs - Ecosystem Tracking Tools for Condition Reporting

The web-enabled Condition Reporting (WebCR) platform pairs artwork with information to make it easy to explore and track how ecosystem conditions are changing at a sanctuary. Select a sanctuary below to start exploring that sanctuary's ecosystem. Navigate by clicking on icons representing major habitats, species of interest, climate and ocean drivers, and human connections. Interactive icons and silhouettes are linked to status and trend data, images, web stories and other related content. The goal of WebCRs are to help us keep our finger on the pulse of these dynamic ecosystems and to help us to better understand and manage our sanctuaries together. Tiles for other sanctuaries will be added below as those tools become available.



Coming soon

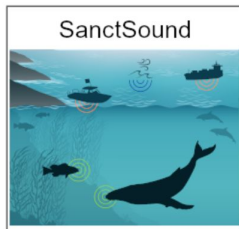
Coming soon

Sanctuary Watch

- *centralized location for tools used in Sanctuary management*
- *tools that connect to system-wide needs and priorities*
- *Public access to synthesized information used in decision-making*

Conservation Issues - Tools to Inform and Improve Management

A number of pressing issues are facing sanctuaries, such as ocean noise, invasive species, marine debris, and climate change. We are building interactive tools that improve access to monitoring and characterization information that address these issues. Our first tool is focused on soundscapes and ocean noise. Tiles for other issues will be added as those tools become available.



Product Landscape

- There are many tools, dashboards, portals, etc.
- Determine how new products and tools relate to existing websites, data portals, dashboards, etc.
- Sanctuary Watch
 - increase transparency of what information is supporting management and highlight the value of those data collection efforts
 - facilitate discovery of supportive content to increase interpretation and related products/tools to dive deeper



Questions? Comments?

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