From observation to action: Mobilizing long-term ocean biodiversity data through OBIS for a healthy ocean

PICES-2026 | S10: Using long-term ocean observations to understand ocean change and support resilient ecosystems and communities in the North Paci- c

Silas Principe (IOC/IODE/OBIS)

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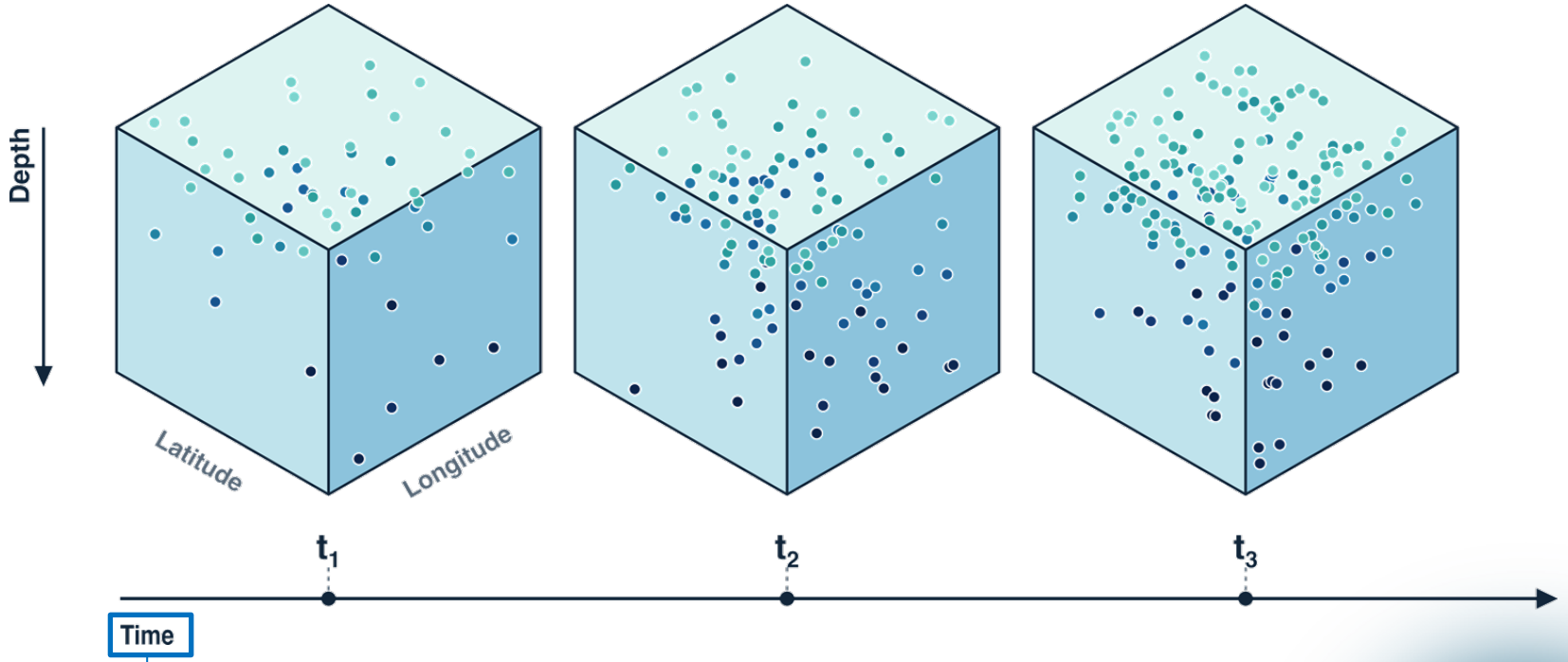
Port of Saint-Cast
Paul Signac - 1890






P.Signac 90
Op. 203

Every observation counts and helps us to better understand our world.



Understand ecosystem functioning (including natural variability)

Detect changes (natural and human-induced)

Improve forecasting capacity

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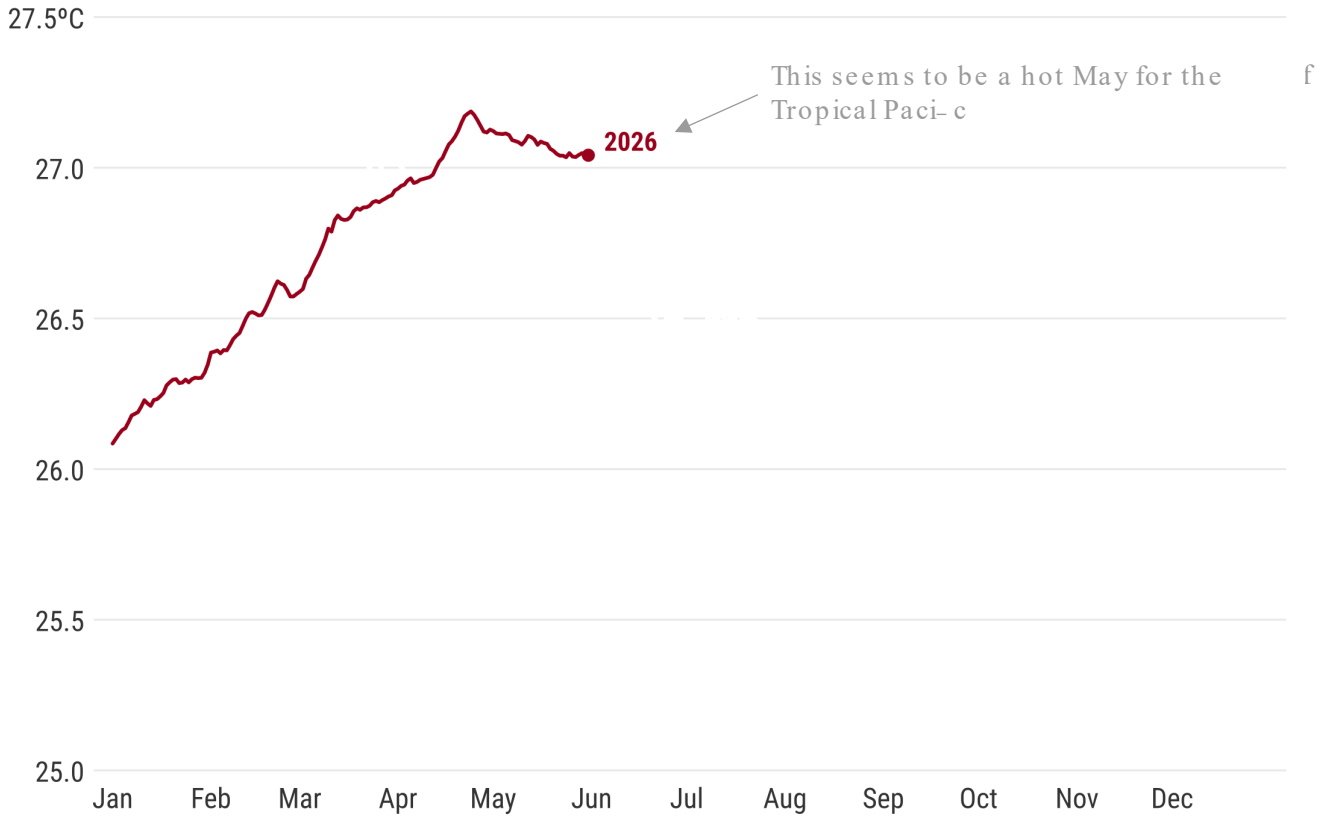
Daily sea surface temperature for Tropical Pacific

Data: ERA5 • Area: 155°E–90°W, 30°S–30°N • Credit: C3S/ECMWF



Marine Environmental Research 107 (2015) 24–34

Contents lists available at ScienceDirect

Marine Environmental Research

journal homepage: www.elsevier.com/locate/marenvrev

Community variability and ecological functioning: 40 years of change in the North Sea benthos

D.S. Clare*, L.A. Robinson, C.L.J. Frid [1]

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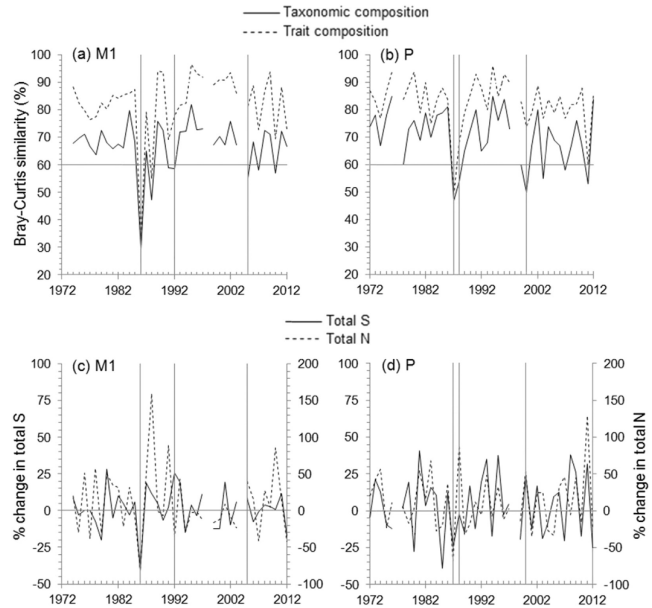


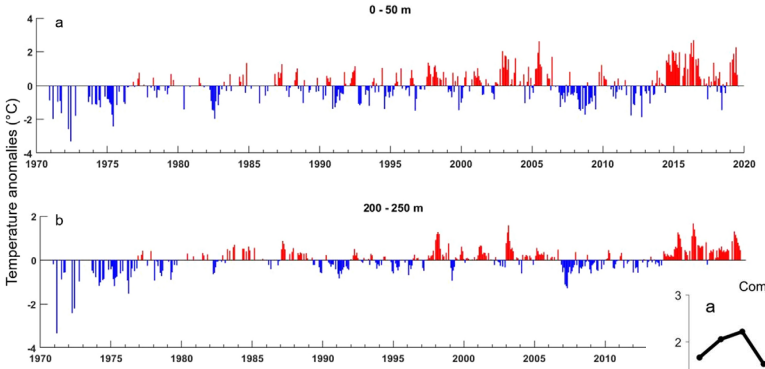
Fig. 2. Bray–Curtis similarity to the previous year in taxonomic and trait compositions (**a**, **b**) and total S and total N (**c**, **d**) of macroinfauna at Dove stations M1 (**a**, **c**) and P (**b**, **d**). Abrupt changes in taxonomic composition (<60% similarity to previous year, preceded or followed by ≥ five years of year-to-year stability) are marked by vertical grey lines.

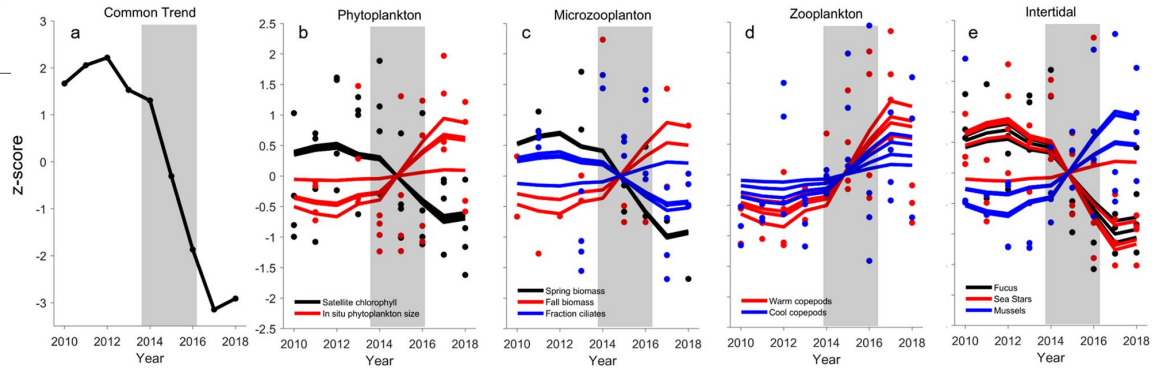
Article | Open access | Published: 18 March 2021

Ecosystem response persists after a prolonged marine heatwave

Robert M. Suryan ✉, Mayumi L. Arimitsu, Heather A. Coletti, Russell R. Hopcroft, Mandy R. Lindeberg, Steven J. Barbeaux, Sonia D. Batten, William J. Burt, Mary A. Bishop, James L. Bodkin, Richard Brenner, Robert W. Campbell, Daniel A. Cushing, Seth L. Danielson, Martin W. Dorn, Brie Drummond, Daniel Esler, Thomas Gelatt, Dana H. Hanselman, Scott A. Hatch, Stormy Haught, Kris Holderied, Katrin Iken, David B. Irons, ... Stephani G. Zador + Show authors

Scientific Reports **11**, Article number: 6235 (2021) | Cite this article





ARTICLES
https://doi.org/10.1038/s41558-020-0695-2
nature climate change
Check for updates

Evidence suggests potential transformation of the Pacific Arctic ecosystem is underway

Henry P. Huntington[1]✉, Seth L. Danielson[2], Fr
John J. Citta[6], Alex De Robertis[7], Danielle M.
Katrin Iken[2], David G. Kimmel[5], Kathy Kuletz[9], (
Phyllis Stabeno[10], Kathleen M. Stafford[11], Dea

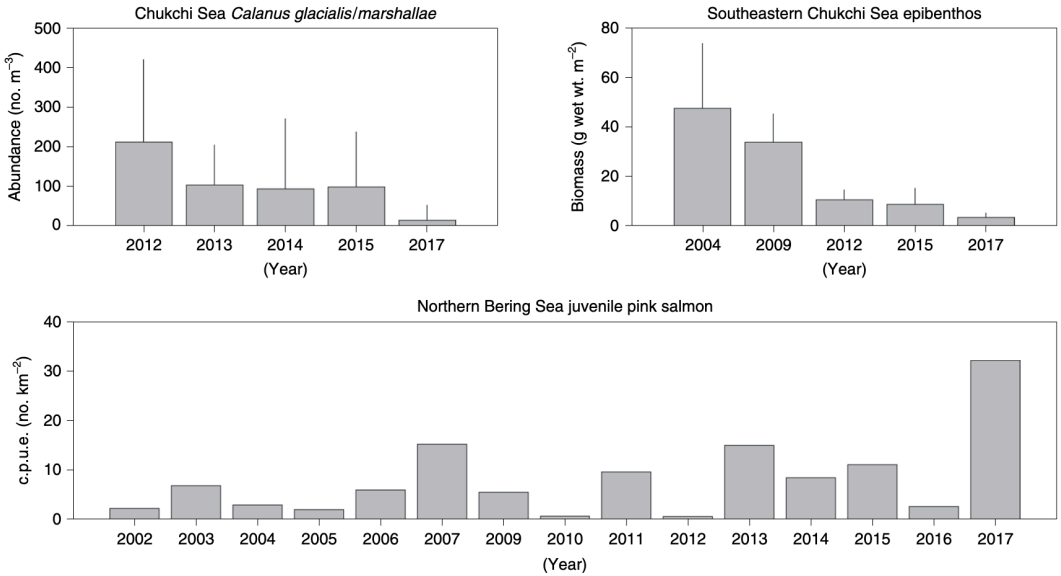


Fig. 4 | Biological changes in recent years. Observations show declines in *Calanus glacialis/marshallae* abundance (upper left) and epibenthic biomass (upper right) in 2017 relative to earlier years, and an increase in catch per unit effort (c.p.u.e.; bottom) for juvenile pink salmon. The upper two graphs show means and s.d. error bars.

Long-term marine biodiversity observation are still rare

frontiers in Marine Science

ORIGINAL RESEARCH
published: 25 October 2021
doi: 10.3389/fmars.2021.737416

Establishing the Foundation for the Global Observing System for Marine Life

Erin V. Satterthwaite[1,2,3], Nicholas J. Bax[4,5], Patricia Miloslavich[6,7], Lavenia Ratnarajah[4,8], Gabrielle Canonico[9], Daniel Dunn[10], Samantha E. Simmons[11], Roxanne J. Carini[12], Karen Evans[4], Valerie Allain[13], Ward Appeltans[14], Sonia Batten[15], Lisandro Benedetti-Cecchi[16], Anthony T. F. Bernard[17,18], Sky Bristol[19], Abigail Benson[19], Pier Luigi Buttigieg[20], Leopoldo Cavaleri Gerhardinger[21], Sanae Chiba[22], Tammy E. Davies[23], J. Emmett Duffy[24], Alfredo Giron-Nava[25], Astrid J. Hsu[26], Alexandra C. Kraberg[27], Raphael M. Kudela[28], Dan Lear[29], Enrique Montes[30], Frank E. Muller-Karger[30], Todd D. O'Brien[31], David Obura[32], Pieter Provoost[14], Sara Pruckner[33], Lisa-Maria Rebelo[34], Elizabeth R. Selig[25], Olav Sigurd Kjesbu[35], Craig Starger[2], Rick D. Stuart-Smith[5], Marjo Vierros[36], John Waller[37], Lauren V. Weatherdon[33], Tristan P. Wellman[19] and Anna Zivian[38]*

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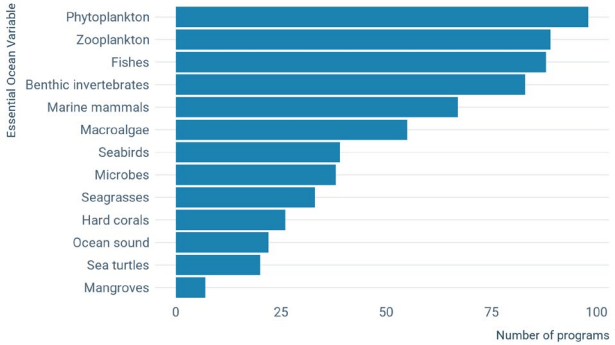
Reviewed by:
Michael William Lomas,
Bigelow Laboratory for Ocean Sciences, United States
Carrie Wall,

203 programs

> 5 years biological observing programs



6% of the ocean

With higher concentration in some areas

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Challenges for long - term observation



1

Lack of stable funding



2

Lack of coordination



3

Lack of capacity



4

Data standards & FAIR

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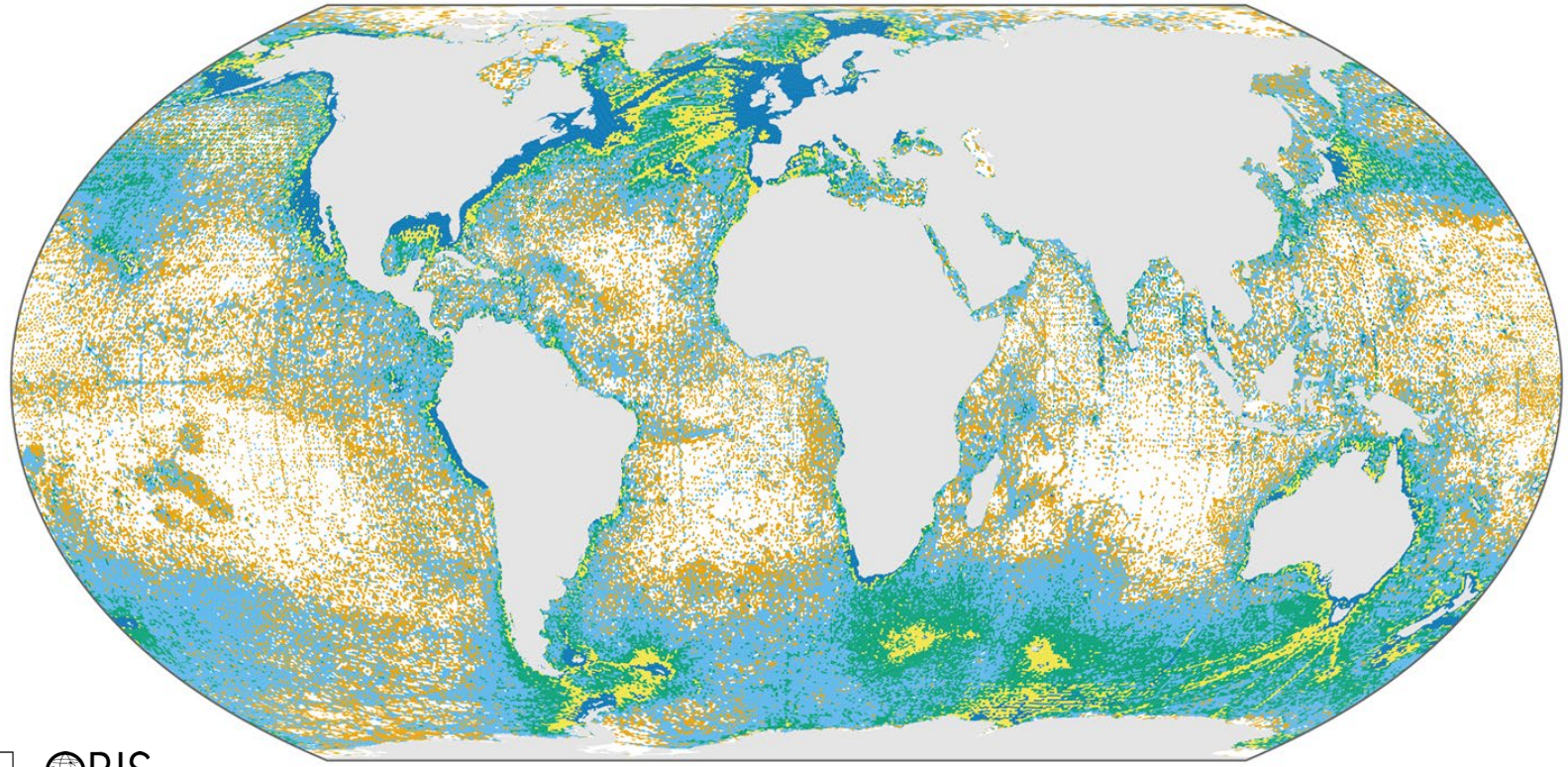
Gridded marine data from OBIS – number of sampled years



1 year
2 to 5 years
6 to 10 years
11 to 20 years
More than 20 years

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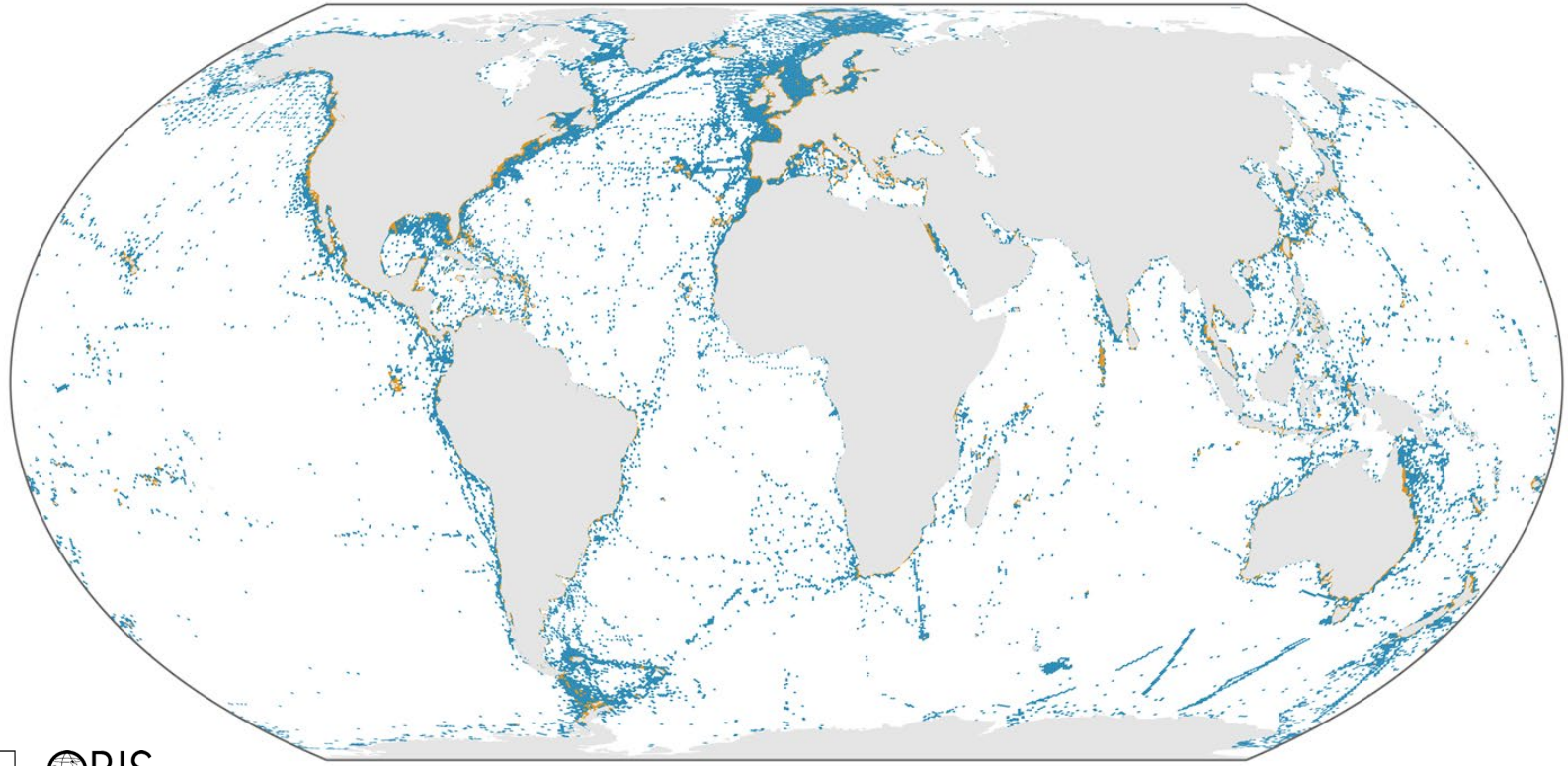
Aggregated marine data from OBIS – sampling on the last 5 years



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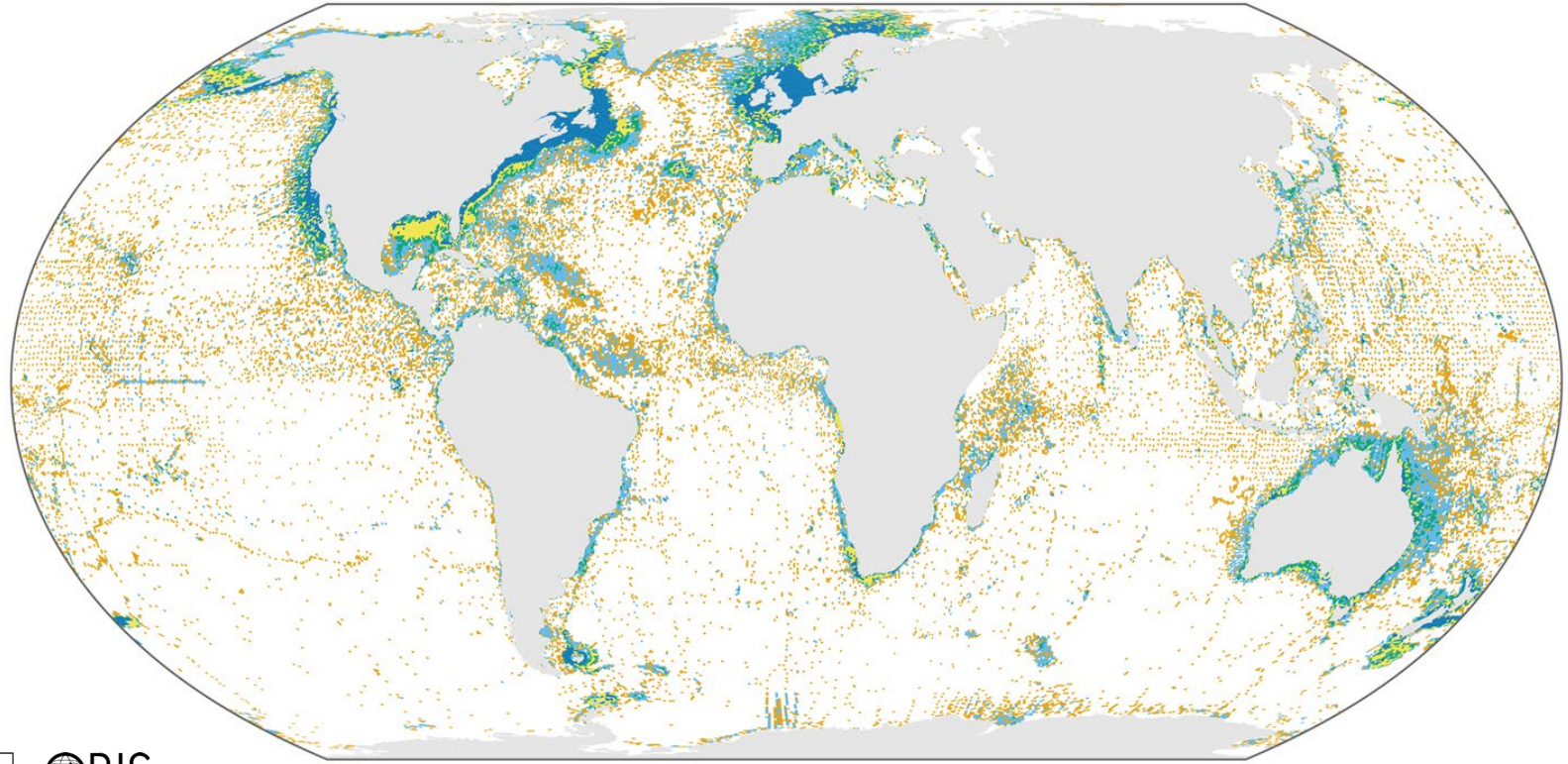
Aggregated marine data from OBIS for **Teleostei** – number of sampled years



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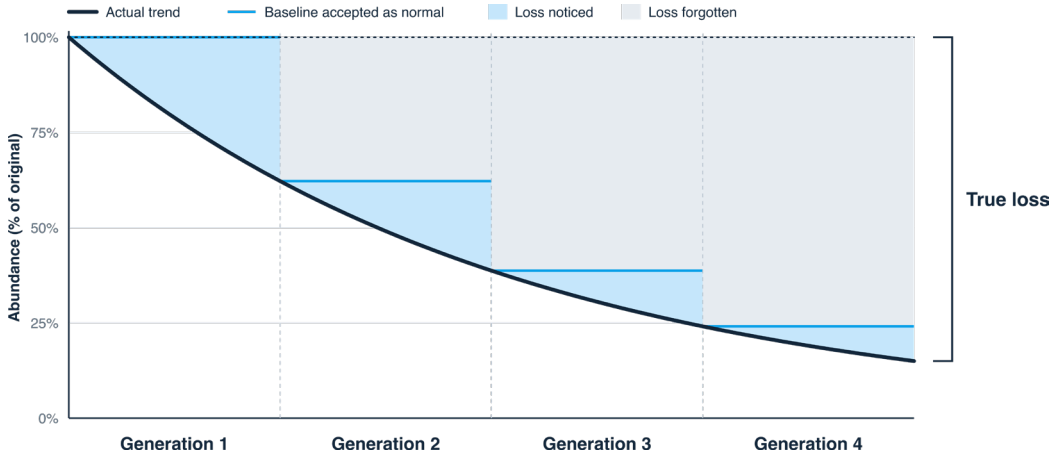
[Shifting baseline syndrome] has arisen because **each generation of fisheries scientists** accepts as a **baseline** the stock size and species composition that occurred at **the beginning of their careers**, and uses this to evaluate changes. When the next generation starts its career, the stocks have further declined, but it is the stocks at that time that serve as a new baseline. The result obviously is **a gradual shift of the baseline.**

Daniel Pauly, 1995 TREE



We need to monitor and share more!

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But an important note about sharing



F

Findable

Persistent identifiers and rich metadata in a searchable resource

e.g. a dataset DOI, an OBIS record



A

Accessible

Retrievable by identifier via open standard protocols, with clear access conditions

e.g. open download from OBIS



I

Interoperable

Shared formats and vocabularies let datasets be combined with others

e.g. Darwin Core terms



R

Reusable

Clear licence, provenance and community standards so others can trust and reuse it

e.g. a CC-BY 4.0 licence

Often not done

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OBIS OCEAN BIODIVERSITY INFORMATION SYSTEM

IOC's Ocean Biodiversity Information System

OBIS delivers 4 new dataset per day,
>5 million new records per month

Since 2000, OBIS provides high impact data on marine biodiversity

228M
occurrences records

208K
marine species

7,380
datasets

200
scienti- c papers/year

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ק ט י ת נ ל ס א ת א ל כ ב א ל ק ט ך ת נ ש א ל ש ש ת ך פ ל כ ת ש ך ז מ ת א ש | ר ת ך ל ך ט ש פ
ך כ ת מ א ת נ ו ע י ץ ך

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OBIS
OCEAN BIODIVERSITY INFORMATION SYSTEM

Findable and accessible → Many ways of accessing

Part of the IOC data infrastructure

Interoperability → Darwin Core (TDWG)

Reusable:
Clear license and provenance tracking → DOI service

Adds a DOI to exports of the OBIS data linked to all associated dataset.

Datasets have clear Licenses (CC)

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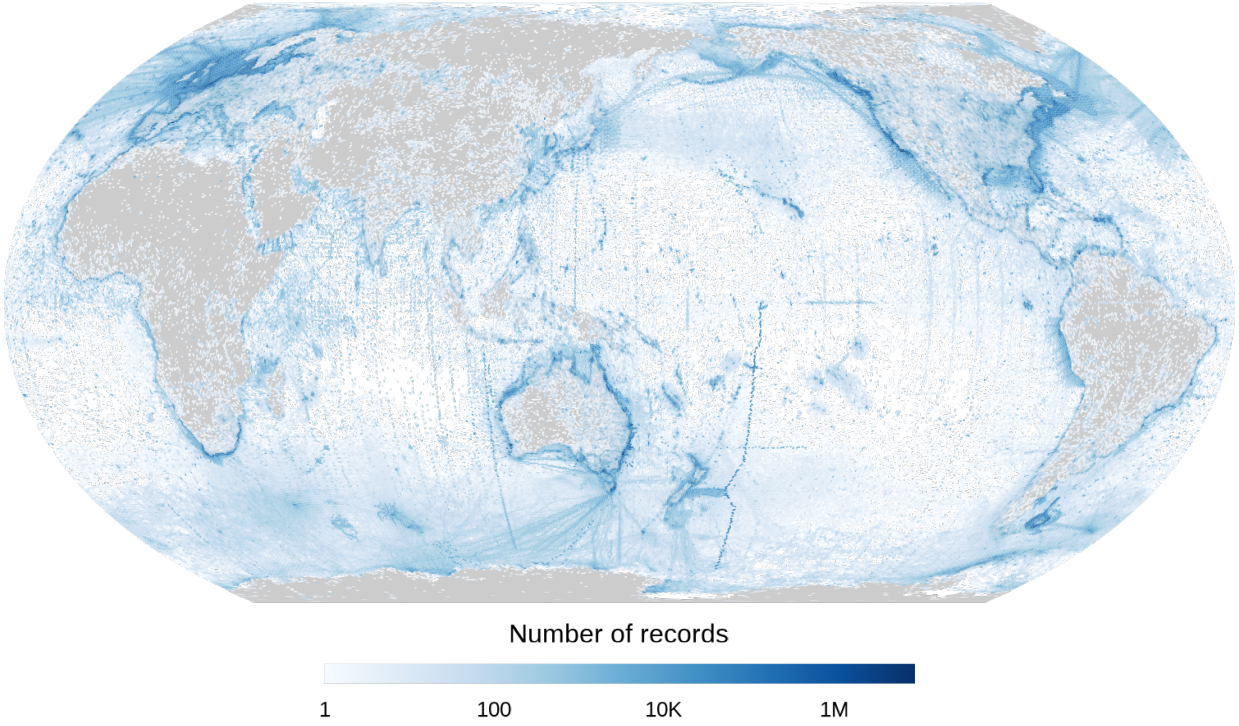
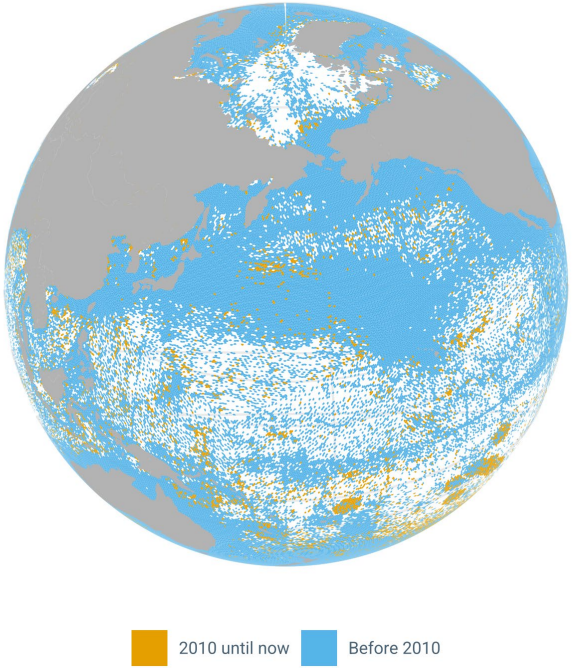
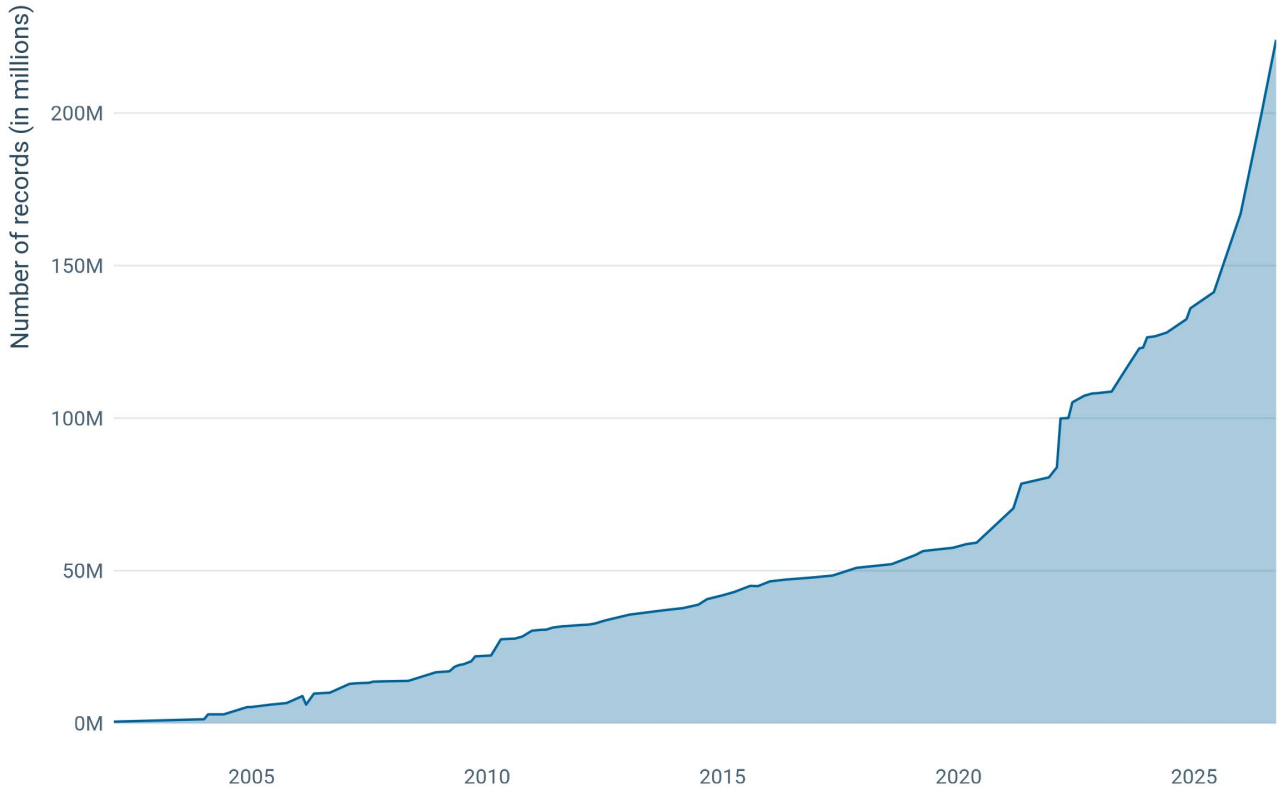
IOC’s Ocean Biodiversity Information System





The good news: we are improving

More data is being openly shared in an interoperable format



> 224 million

occurrence records on OBIS, covering over 208,000 marine species

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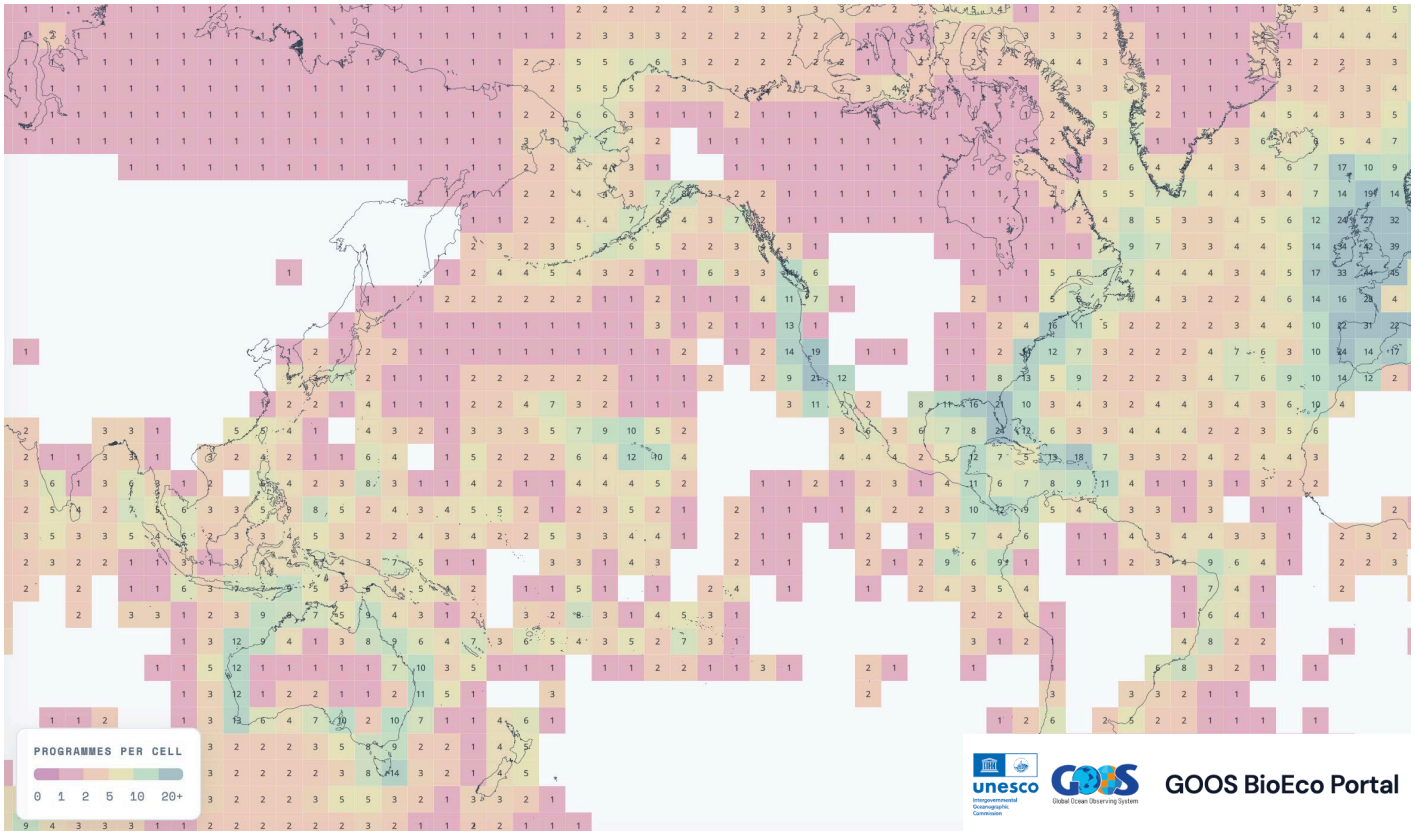
And also more long - term programs are sharing data



640 programs
collecting EOVs

Top 4 EOVs:

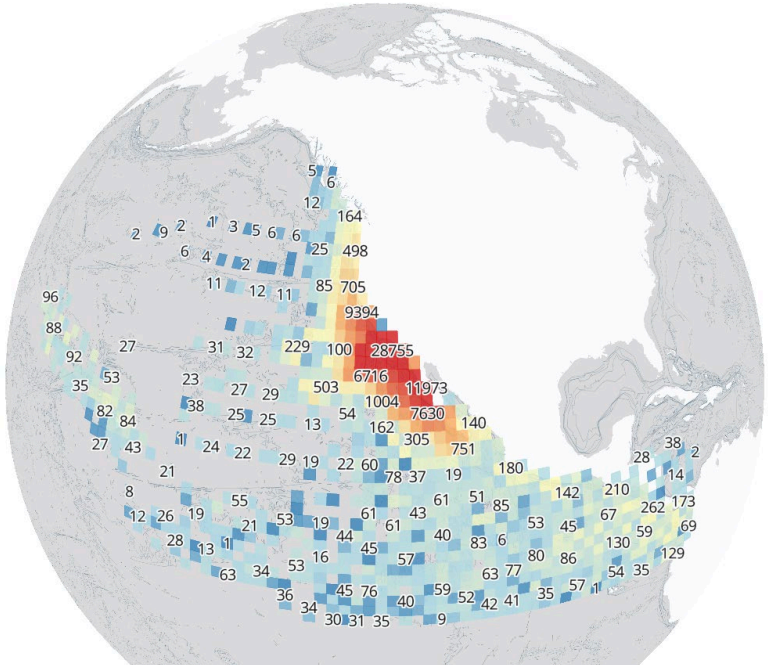
Phytoplankton
Zooplankton
Benthic invertebrates
Fish

bioeco.goosocean.org

Many good examples from the North Pacific

California Cooperative Oceanic Fisheries Investigations (CalCOFI)

The Continuous Plankton Recorder Survey of the North Pacific



CalCOFI Fish Larvae & Egg Tows
Dataset on OBIS

463,655
occurrences records

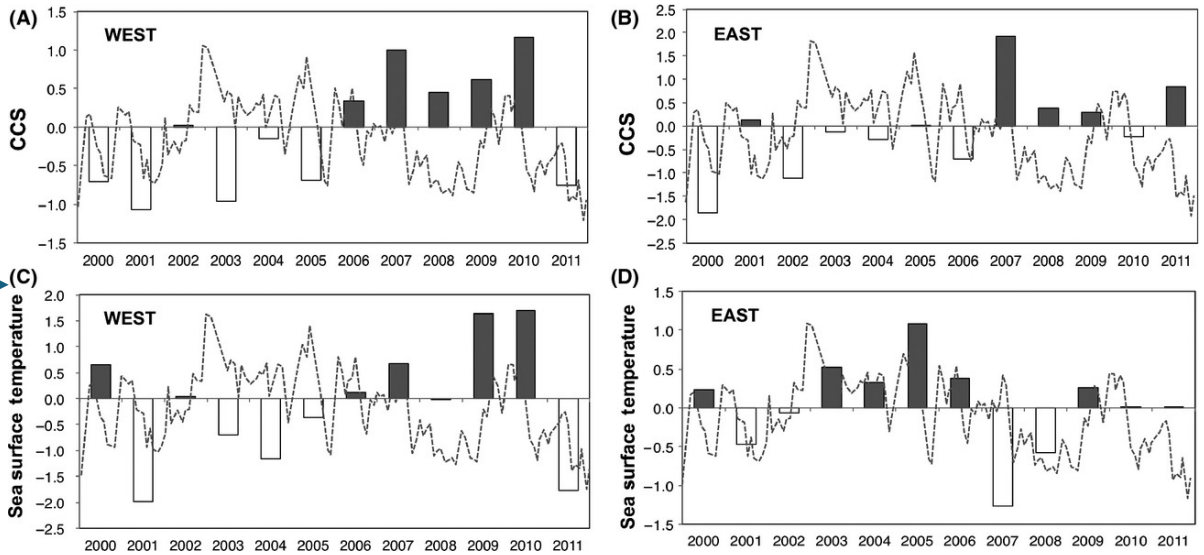
610,816
measurements and facts

539
species

Many good examples from the North Pacific

California Cooperative Oceanic Fisheries Investigations (CalCOFI)

The Continuous Plankton Recorder Survey of the North Pacific



Interannual variation of copepod community size

Chiba et al. 2015
Ecology and Evolution

Looking ahead
Emerging technologies are accelerating data collection

- Automated plankton imaging/automated image classification
- Seabed cameras
- Passive and active acoustics
- New sensors
- Biologging
- **eDNA**

eDNA Expeditions 2026-2028



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Looking ahead
New tools to accelerate data application

Digital Twins of the Ocean
AI for data processing and integration
Cloud-efficient data formats
Models
Ready to use datasets

MOZAÏEK

Unlocking the potential of ocean biodiversity data for informed action

Flanders State of the Art · fust · unesco Intergovernmental Oceanographic Commission · OBIS OCEAN BIODIVERSITY INFORMATION SYSTEM · GOOS Ocean Observing Co-Design

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OBIS exports: full and gridded *(speciesgrids)*

obis.org /data/access

GeoParquet of the full OBIS data (AWS Open Data)

Large scale analysis

R package `robisdb` (github.com/iobis/robisdb)

Gridded product (H3) - speciesgrids

All marine data from OBIS and GBIF

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OBIS Species Grid Explorer

Ask Gemini

iobis.github.io/speciesgrids/

New Chrome available

speciesgrids explorer Docs ↗

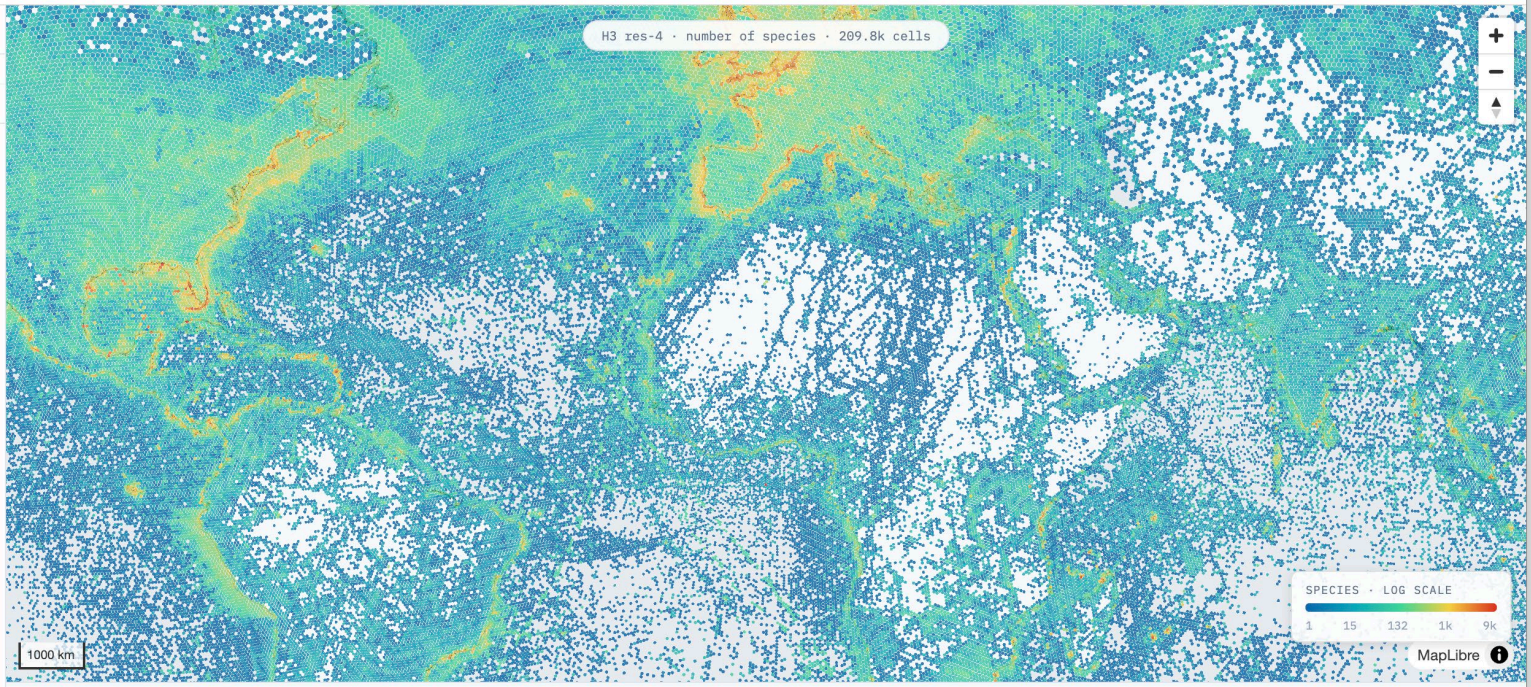
209.8k cells loaded

OVERVIEW | EXPLORE

Global overview showing the number of distinct marine species observed per H3 resolution-4 cell (~300 km), loaded from a pre-aggregated Arrow file.

209.8k cells loaded

Switch to the **Explore** tab to browse pre-computed queries against the full dataset.



SQL 209.8k cells · pre-computed Copy

```
SELECT COUNT(DISTINCT species) AS total_species,
       h3_cell_to_parent(cell, 4) AS cell_h4
FROM read_parquet('s3://obis-products/speciesgrids/h3_7/*')
GROUP BY cell_h4
```

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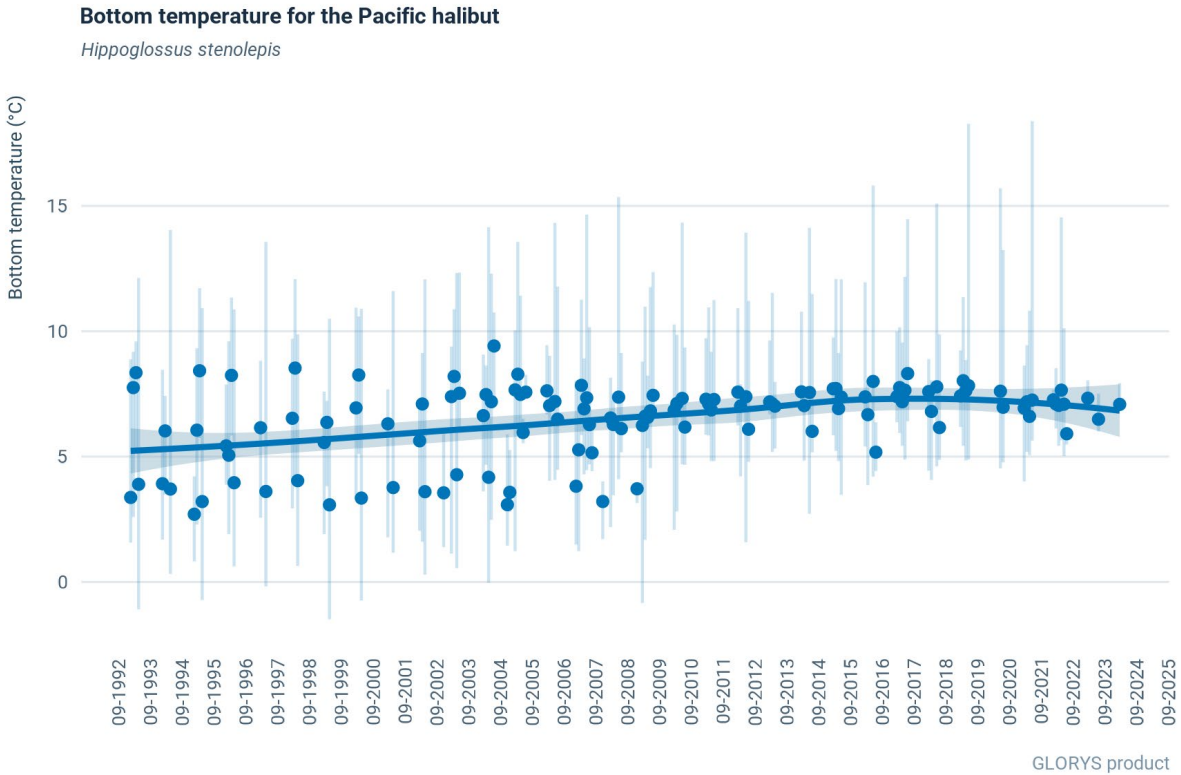
Documentation · obis.org · GitHub

OBIS exports: extension of OBIS data with monthly seawater temperature *(obistherm)*



Alex Munday – CC-BY-NC



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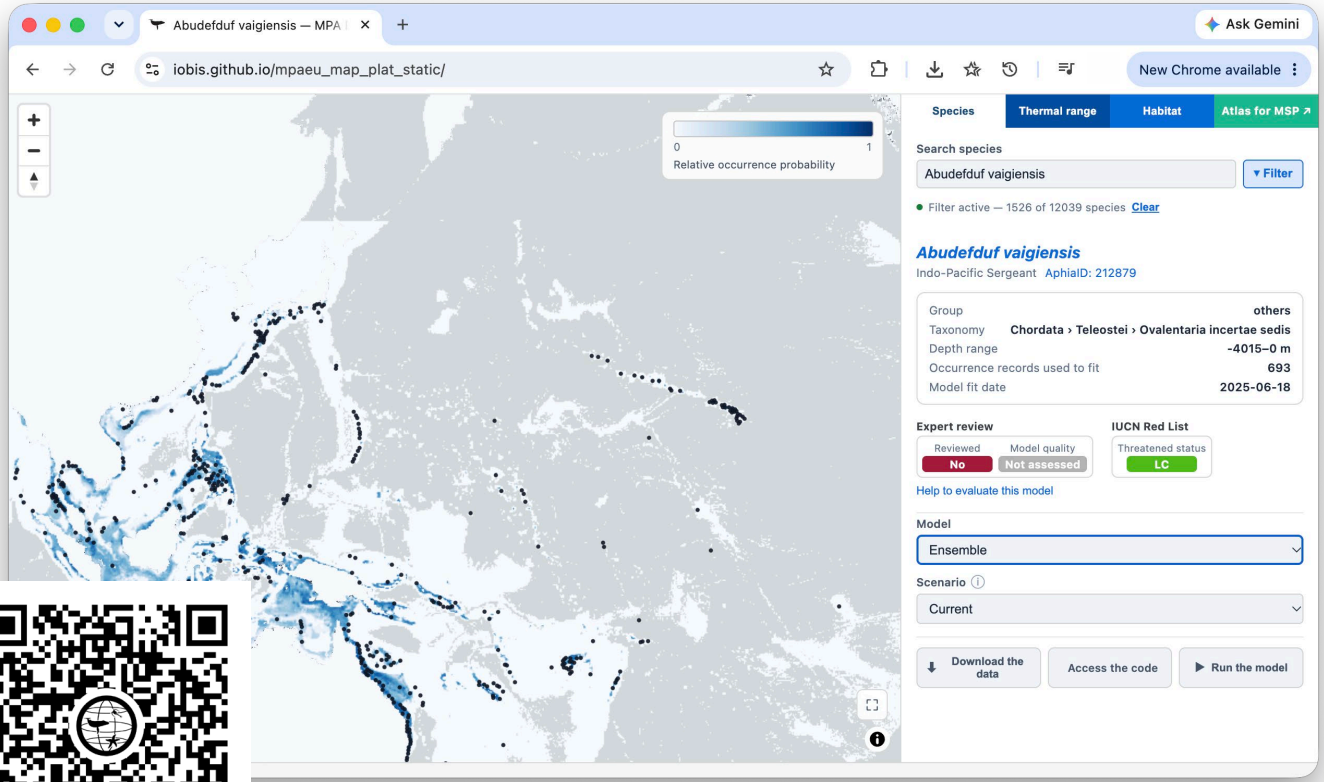
Models: Species Distribution Models



Species range

maps for over 12,000 species

Future predictions

SSP1 5 | 2050 - 2100

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Looking ahead

Emerging frameworks and programs - coordination and collaboration



EOVs are the minimum set of ocean variables that are needed to assess ocean state and variability for important global ocean phenomena, and to provide essential data for applications that support societal benefit.

OCEANEYE
The power of ocean knowledge

The OceanEye International Alliance is an international initiative to strengthen long-term support for the Global Ocean Observing System (GOOS) and help build a more resilient, sustained and globally connected ocean observing system.

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We do **not** need **just more** data…

We need sustained observations, with improved spatial coverage and data openly shared.

Cooperation is essential – and OBIS is part of that.



Records

1

10

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Building and using long - term observations

Observing systems, infrastructure and management

- OceanECO dashboard: monitoring data into information *Sezginer*
- SCCOOS: long-term observations, real-time action *Medina*
- California ocean monitoring inventory and CalCOFI *Gold*
- Ocean Networks Canada, from abyss to shoreline *Harris*
- CalCOFI for ecosystem-based fisheries management *Bowlin*
- Bering Sea habitat conservation areas *Alabia*
- Salmon spawner abundance from stream surveys *Carturan*

Community, Indigenous and local knowledge

- Community monitoring of acidification and HABs, Chugach *Moeser, Wheat*
- Local knowledge and technology for salmonid restoration *Holman et al.*
- Indigenous knowledge and geoscience for tsunami risk *Romer*

Ocean acidification, carbon and harmful algae

- Ocean acidification across agencies, Alaska *Monacci*
- Oregon's early-warning HAB system *Crawford*
- Surface pCO2 trends, coastal British Columbia *Evans*

What the long - term record shows

Ecosystem change: biodiversity, food webs and range shifts

- Fish range shifts in the California Current over seven decades *Thompson*
- 70 years of California Current variability *Appelgate*
- Northern Bering Sea ecosystem changes *Keister*
- *Velella velella* pulses, U.S. West Coast *Cimino*
- Trait-based food webs under climate change *Gleiber*
- Multi-trophic phenology, Gulf of Alaska shelf *Block*
- Seabird density as a food web indicator *Sydeman*

Phytoplankton, productivity and microbes

- CPR data on Northeast Pacific phytoplankton *Kléparski*
- Mesopelagic prokaryotes, California Current *Kim*
- Spring bloom seasonality, Hokkaido and Okhotsk Sea *Oida*
- Drivers of primary productivity, Washington shelf *Buzby*