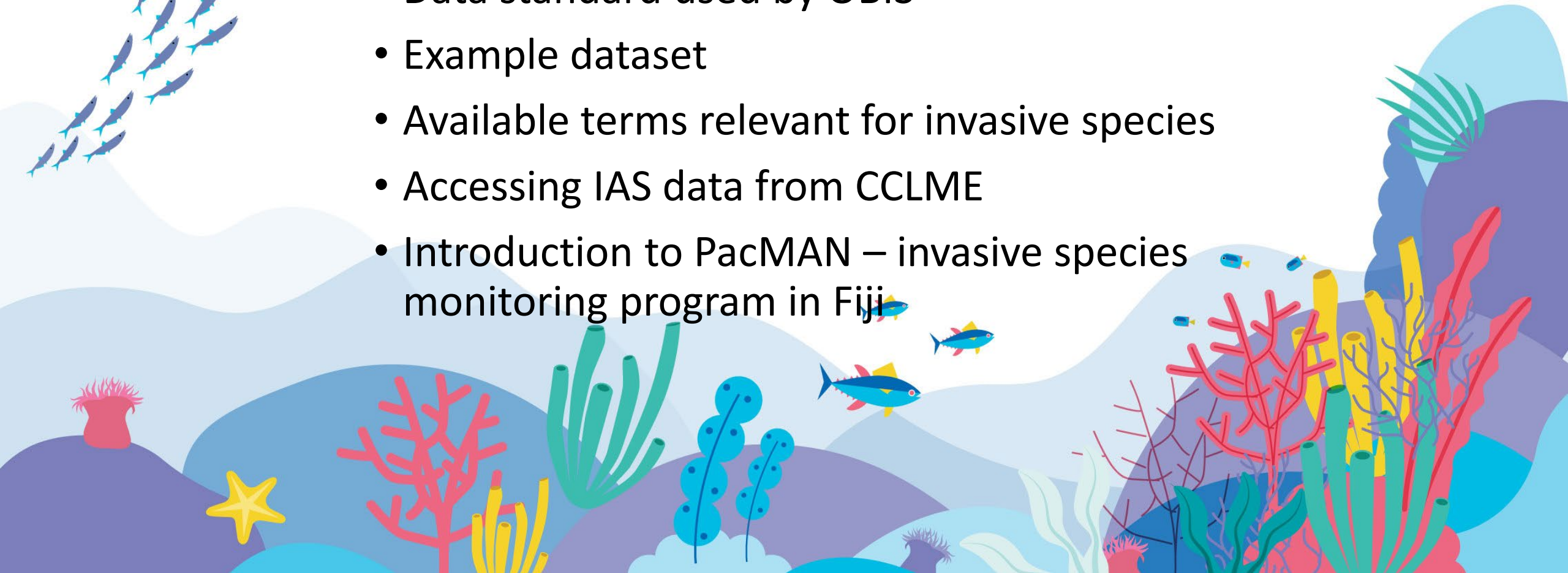
OBIS
OCEAN BIODIVERSITY
INFORMATION SYSTEM

A GLOBAL OPEN-ACCESS DATA AND INFORMATION CLEARING-HOUSE ON MARINE BIODIVERSITY FOR SCIENCE, CONSERVATION AND SUSTAINABLE DEVELOPMENT

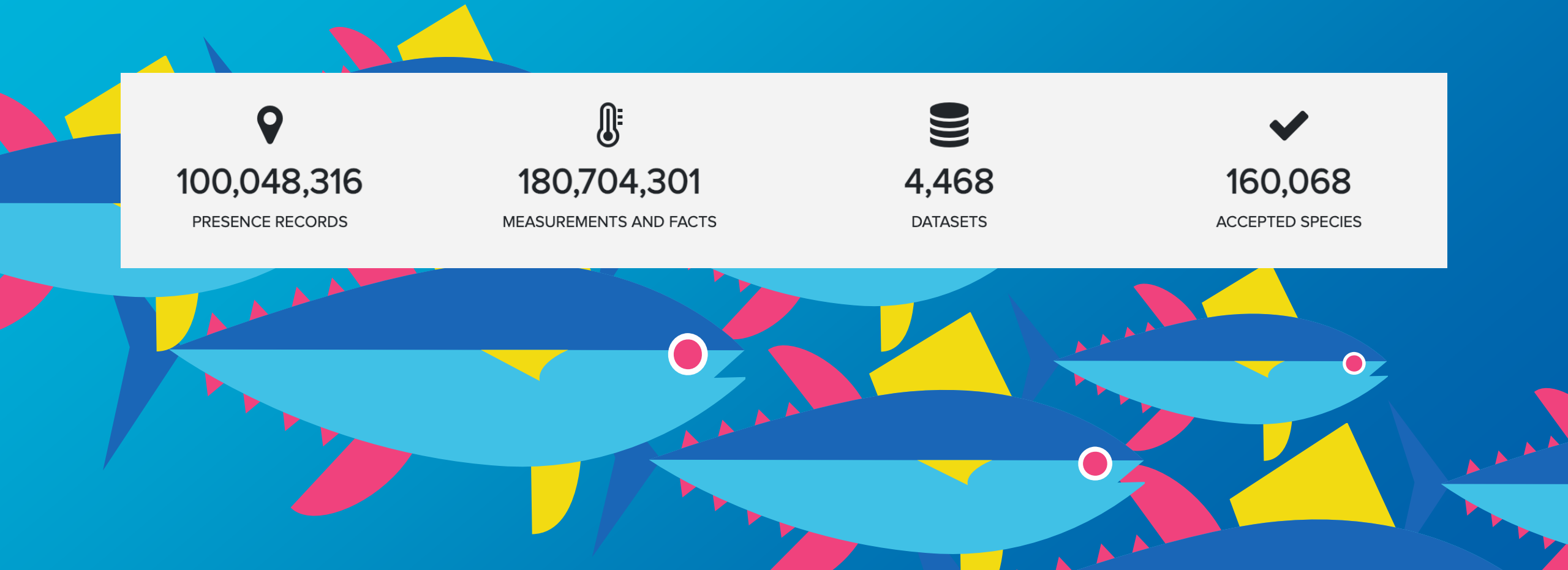
CCLME workshop 5.5.2022

Contents

- Introduction to OBIS
- Data standard used by OBIS
- Example dataset
- Available terms relevant for invasive species
- Accessing IAS data from CCLME
- Introduction to PacMAN – invasive species monitoring program in Fiji



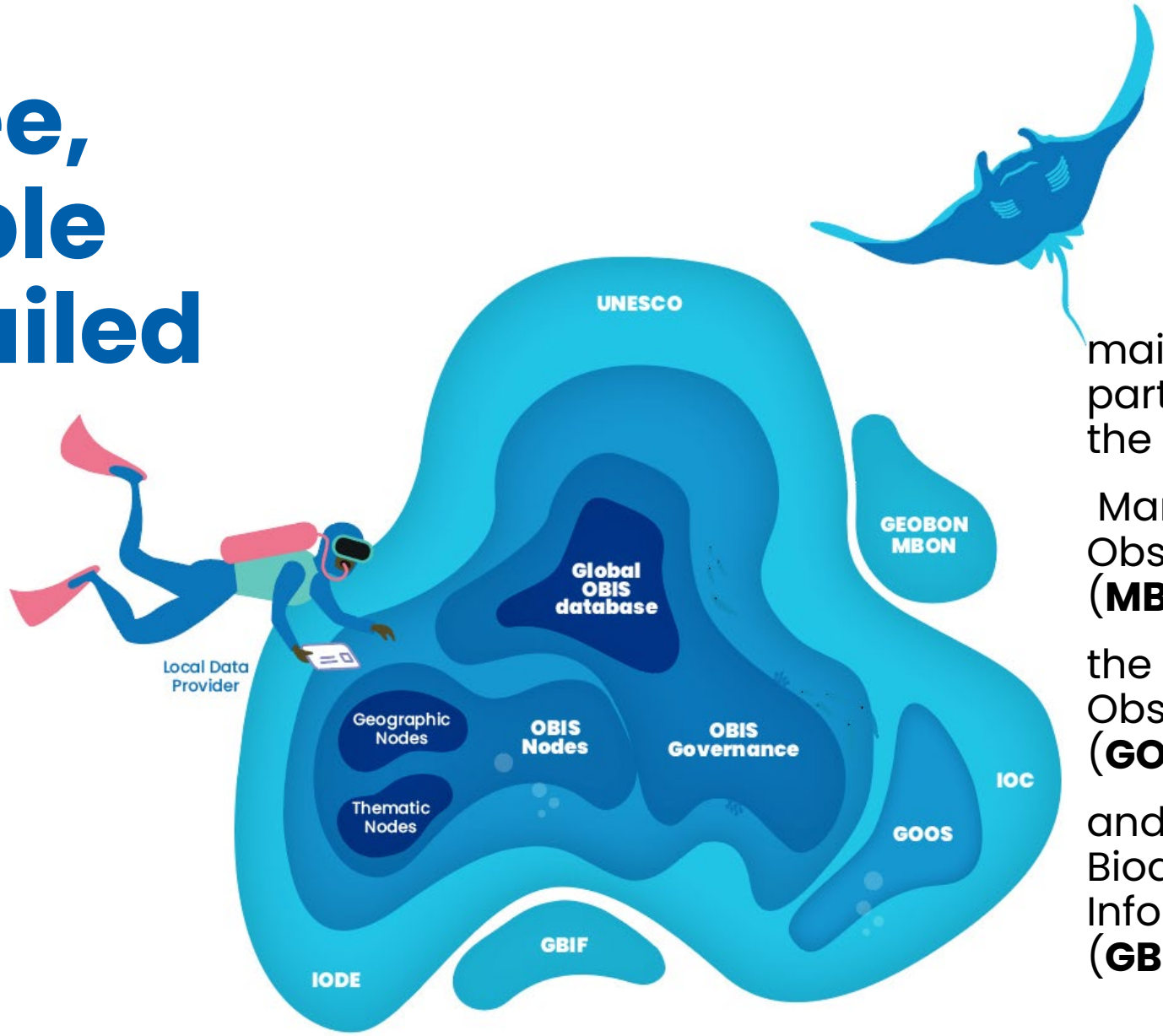
OBIS: Free, accessible and detailed marine data



100,048,316	180,704,301	4,468	160,068
PRESENCE RECORDS	MEASUREMENTS AND FACTS	DATASETS	ACCEPTED SPECIES

OBIS: Free, accessible and detailed marine data

- OBIS operates as a collaborative network of **regional and thematic nodes**
- More than 20 nodes
- 600 institutions



maintaining partnerships around the globe

Marine Biodiversity Observation Network (**MBON**),

the Global Ocean Observing System (**GOOS**)

and the Global Biodiversity Information Facility (**GBIF**).

*"To build and maintain a global alliance that **collaborates with scientific communities** to facilitate free and **open access** to, and application of, biodiversity and biogeographic data and information on marine life."*

iOBIS

Arctic OBIS

DeepSeaOBIS

OBIS Canada

Oceans Past

OBIS HAB

OTN

FishBase

OBIS USA

OBIS China

MicrOBIS

EurOBIS

Black Sea OBIS

KOBIS

OBIS Colombia

OBIS SEAMAP

MedOBIS

PEGO-OBIS

OBIS Japan

Caribbean OBIS

CPPS OBIS

OBIS Senegal

IndOBIS

SEA OBIS

WSAOBIS

ESPOBIS

AfrOBIS

OBIS Australia

South Western Pacific OBIS

ArOBIS

AntOBIS

OBIS

- OBIS collects species occurrence data from many sources.
- Provides **long term sustainable** storage of biodiversity data
- Stored in a **machine-readable format** with all **relevant metadata** including measurements of environmental parameters
- Reliable data that can be compared across time and space

OBIS Data life cycle

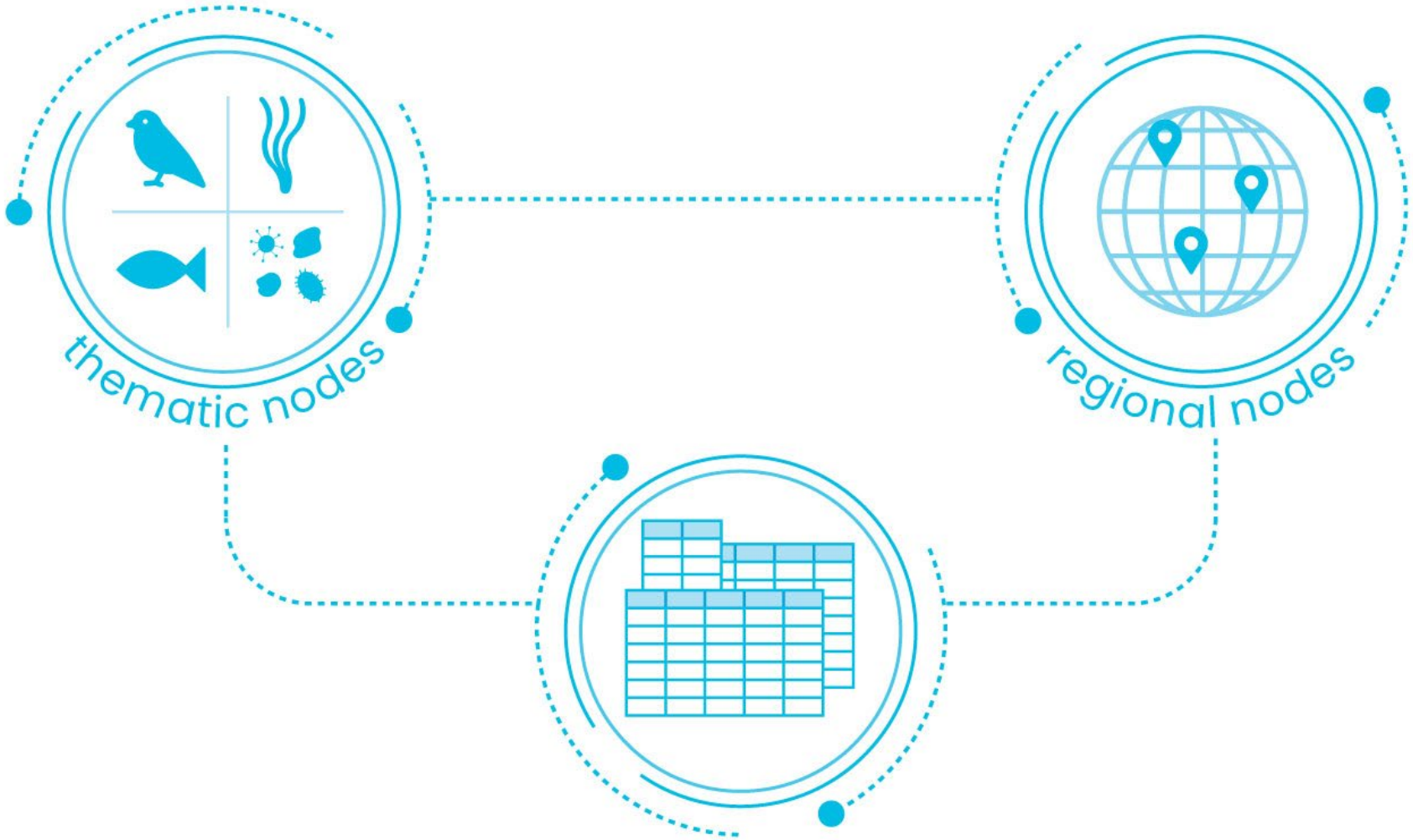
Collection:

- Data is compiled from multiple **observations**

OBIS Data life cycle

Contribution:

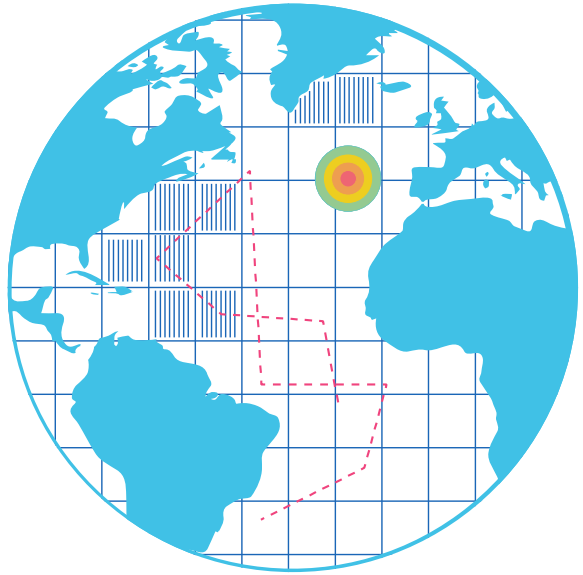
- During the **standardisation** process the OBIS thematic and regional nodes check data quality and apply **Darwin Core Standards**



OBIS Data life cycle

Contribution:

- The data is then deposited in the OBIS database and **made accessible to everyone**

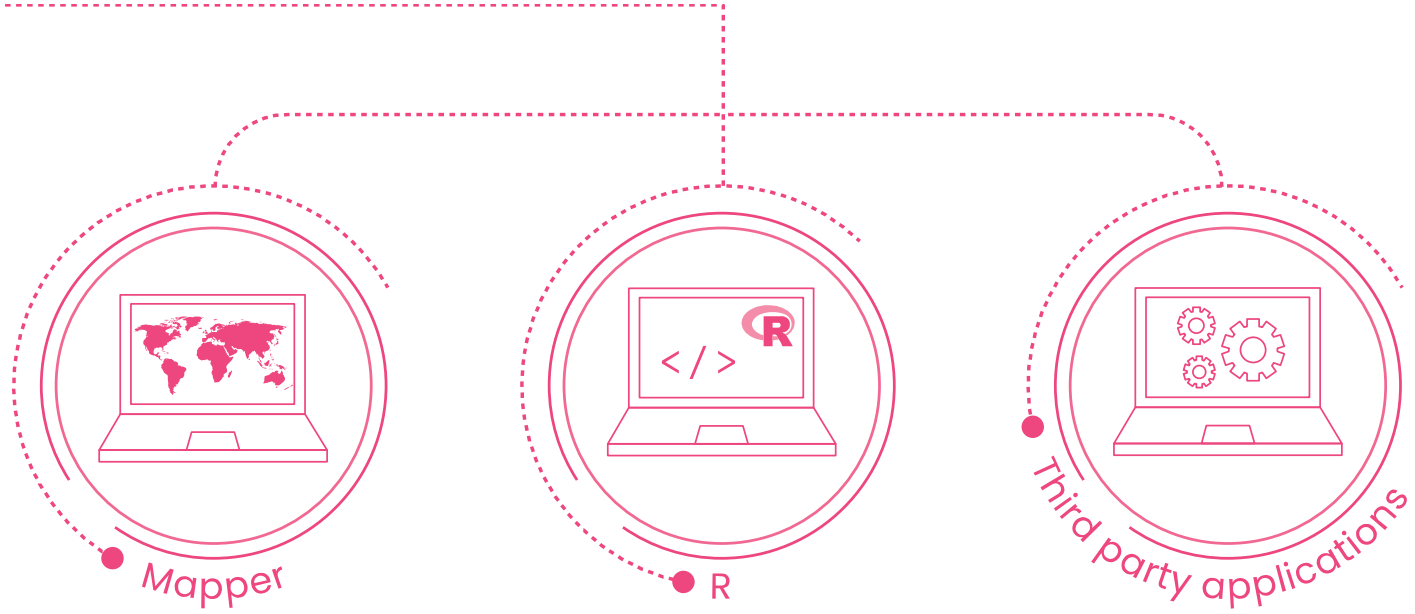


- The OBIS database follows **FAIR guiding principles** of scientific data management and stewardship

OBIS Data life cycle

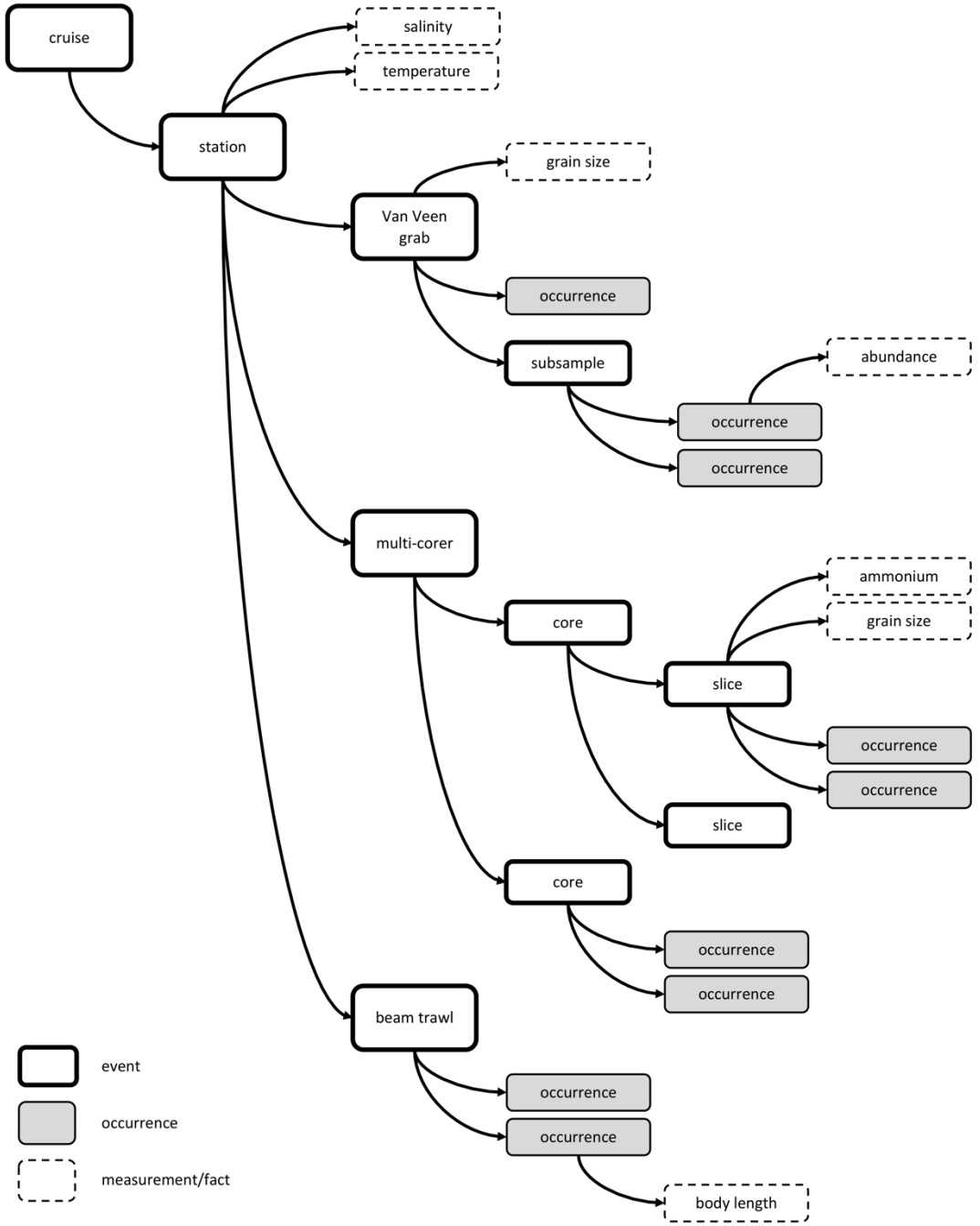
Access:

- Mapper on OBIS server
- R (analytical platform) & robis package
- Third party application



Data standards

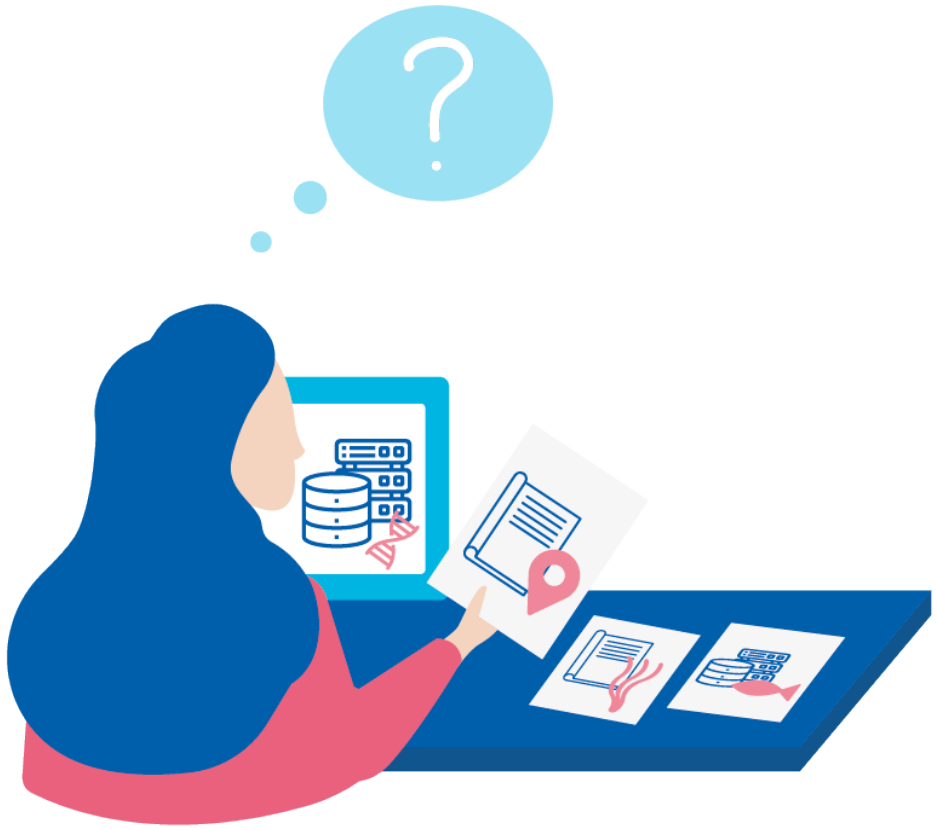
Biological sampling is more than just collecting species occurrences



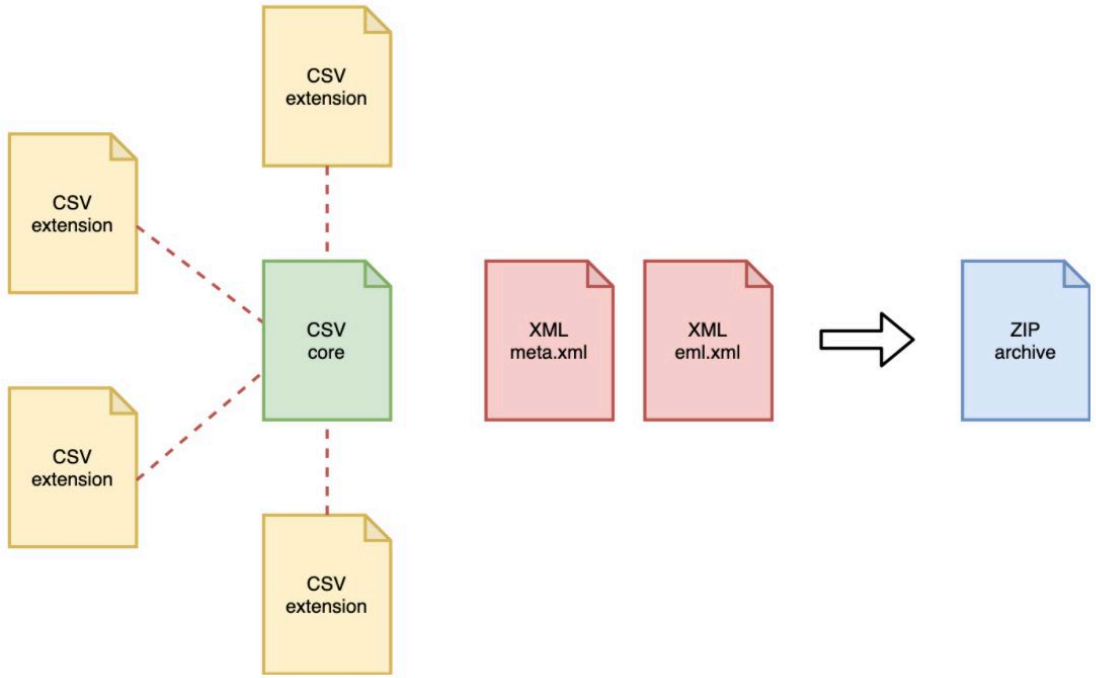
Data is stored in a standard format:

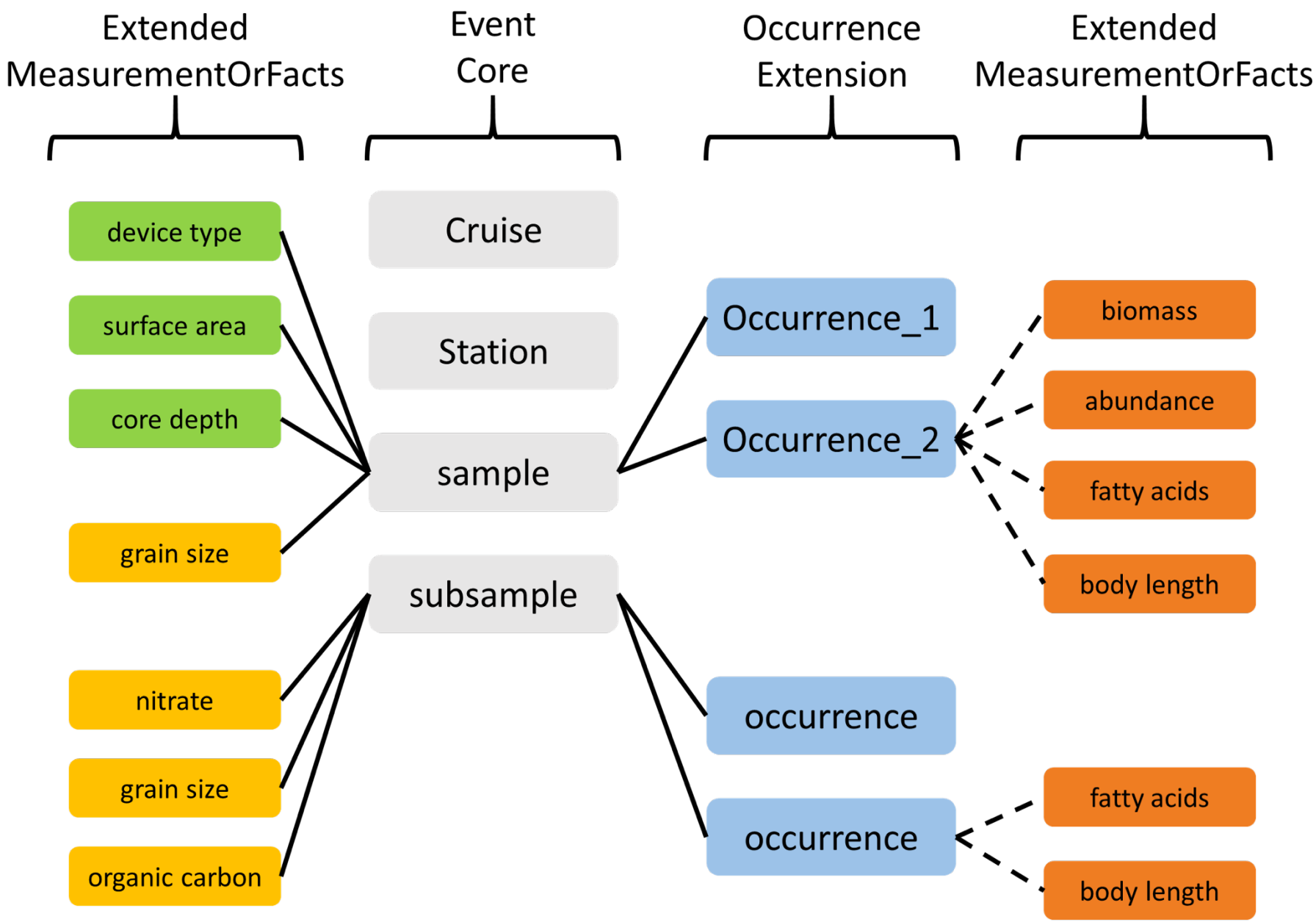
Universal and **comparable language** use

Contextual information on how data was acquired



Darwin core archive




Extended MeasurementOrFacts
Event Core
Occurrence Extension
Extended MeasurementOrFacts
device type
surface area
core depth
grain size
nitrate
grain size
organic carbon
Cruise
Station
sample
subsample
Occurrence_1
Occurrence_2
occurrence
occurrence
biomass
abundance
fatty acids
body length
fatty acids
body length

DwC terms

Stable terms and vocabularies maintained by TDWG (Biodiversity information standards)
https://dwc.tdwg.org/terms/

OccurrenceID

EventDate

decimalLongitude

decimalLatitude

OBIS deals with **georeferenced** data

- coordinateUncertaintyInMeters
- geodeticDatum
- footprintWKT
- minimumDepthInMeters
- maximumDepthInMeters
- locality
- waterBody
- islandGroup
- island
- country

scientificName

scientificNameID

Taxonomic backbone of OBIS:
World Register of Marine Species
www.marinespecies.org

- scientificNameAuthorship
- kingdom, phylum, class etc..
- taxonRank
- taxonRemarks

occurrenceStatus

Present, absent

basisOfRecord

Specimen, humanObservation, machineObservation…

- associatedMedia
- associatedReferences
- associatedSequences
- catalogNumber

Event core

- **Event core** allows:
  - Associate measurements with event (instead of each occurrence in the event)
- **ExtendedMeasurementOrFact Extension (eMoF)** allows:
  - Linking measurements to both the event core and occurrence extension tables
    - ID
    - occurrenceID
    - measurementType measurementTypeID
    - measurementValue measurementValueID
    - measurementUnit measurementUnitID
  - Free text fields, but
  - IDs from external vocabularies recommended:
    - NERC Vocabulary Server, developed by the British Oceanographic Data Centre (BODC)

Example dataset

Non-indigenous (NIS) and cryptogenic species in European regional seas and adjacent areas

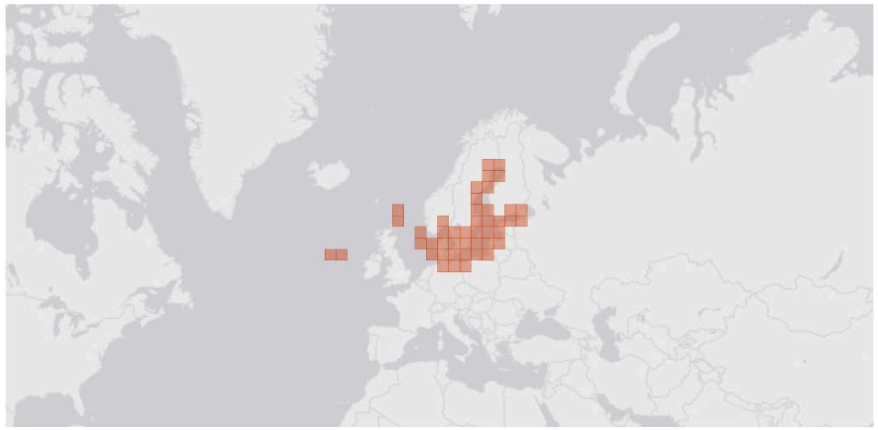
URL	http://ipt.vliz.be/eurobis/resource?r=non_indigenous_and_cryptogenic_species	
Repository URL	http://ipt.vliz.be/eurobis/	
Node	EurOBIS	
Published	2022-03-28 14:20	
First registered	2020-12-10 02:59	
Abstract	The dataset includes 3305 georeferenced points/records. The data records were gathered using three types: digitatalization, exact occurences and expert judgement. The georeferenced data was extracted from the scientific publications and specialized databases (AquaNIS, ICES and Google scholar).	
Citation	AquaNIS. Editorial Board, 2020. Information system on Aquatic Non-Indigenous and Cryptogenic Species. World Wide Web electronic publication. www.corpi.ku.lt/databases/aquanis. Version 2.36+. Accessed 2020-09-09	
Rights	To the extent possible under law, the publisher has waived all rights to these data and has dedicated them to the Public Domain (CC0 1.0)	
Keywords	Introduced species, Non-native marine species, Samplingevent	
Contacts	Creator	Sergej Olenin Klaipeda University; Marine research institute
	Creator	Greta Srėbalienė Klaipeda University; Marine research institute
	Contact	Flanders Marine Institute (VLIZ)
	Metadata Provider	Flanders Marine Institute (VLIZ)

report issue | source DwC-A | to mapper

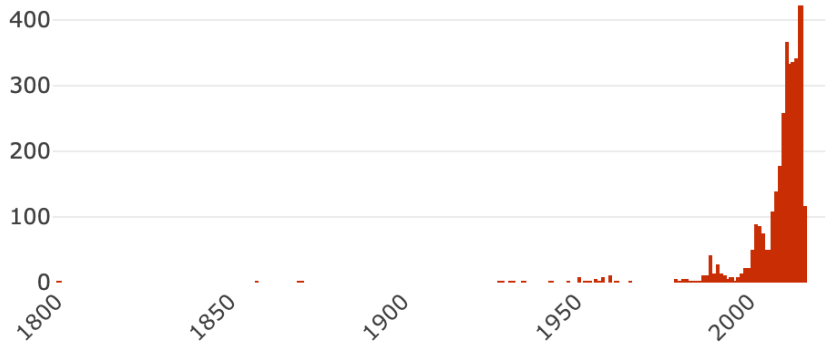
https://obis.org/dataset/2b43830c-60c7-4110-a0f1-84269a4b39d3

Example dataset

DISTRIBUTION



RECORDS



TOP TAXA

IUCN Red List | All taxa

Scientific name	Records
Mya arenaria Linnaeus, 1758 Phylum Mollusca > Class Bivalvia	428
Amphibalanus improvisus (Darwin, 1854) Phylum Arthropoda > Class Thecostraca	427
Neogobius melanostomus (Pallas, 1814) Phylum Chordata > Class Actinopteri	398
Marenzelleria viridis (Verrill, 1873) Phylum Annelida > Class Polychaeta	392
Prorocentrum cordatum (Ostenfeld) J.D.Dodge, 1976 Phylum Myzozoa > Class Dinophyceae	326
Acartia (Acanthacartia) tonsa Dana, 1849 Phylum Arthropoda > Class Hexanauplia	223
Ethmodiscus punctiger Castracane, 1886 Phylum Ochrophyta > Class Bacillariophyceae	133
Rangia cuneata (G. B. Sowerby I, 1832) Phylum Mollusca > Class Bivalvia	129
Penilia avirostris Dana, 1849 Phylum Arthropoda > Class Branchiopoda	126
Cercopagis (Cercopagis) pengoi (Ostroumov, 1891) Phylum Arthropoda > Class Branchiopoda	108

Example dataset

- Event core

id	KUMRI_AQUANIS_NISES_01
datasetID	https://marineinfo.org/id/dataset/6578
datasetName	Non-indigenous (NIS) and cryptogenic species in European regional seas and adjacent areas
eventID	KUMRI_AQUANIS_NISES_01
eventDate	2009-10-19
year	2009
month	10
day	19
decimalLatitude	56.6205
decimalLongitude	9.0758

Example dataset

- Occurrence extension

id	KUMRI_AQUANIS_NISES_01
datasetID	https://marineinfo.org/id/dataset/6578
collectionCode	NISES
basisOfRecord	HumanObservation
occurrenceID	KUMRI_NISES_1
occurrenceStatus	present
eventID	KUMRI_AQUANIS_NISES_01
scientificNameID	urn:lsid:marinespecies.org:taxname:233891
scientificName	Proasellus coxalis
kingdom	Arthropoda
phylum	Malacostraca
class	Isopoda
order	Asellidae
scientificNameAuthorship	Monod, 1924

Example dataset

- eMoF extension

id	KUMRI_AQUANIS_NISES_2465	KUMRI_AQUANIS_NISES_2465
occurrenceID	KUMRI_NISES_2465	KUMRI_NISES_2465
measurementType	sampling instrument name	Sampling net mesh size
measurementTypeID	http://vocab.nerc.ac.uk/collection/Q01/current/Q0100002/	http://vocab.nerc.ac.uk/collection/Q01/current/Q0100015/
measurementValue	Hand net	5
measurementValueID	http://vocab.nerc.ac.uk/collection/L22/current/TOOL0981/	
measurementUnit		mm
measurementUnitID		http://vocab.nerc.ac.uk/collection/P06/current/UXMM/

Available extra fields: Invasive species

Elements needed for risk assessment, horizon scanning, species management, and monitoring (Groom et al 2019):

1. Introduction pathway
2. Degree of establishment
3. Species status
    1. Present or absent?
    2. Native or alien?
4. (Impact mechanism) -> generally not included in original occurrence records

https://biss.pensoft.net/article/38084/

dwc:establishmentMeans

Statement about whether an organism or organisms have been introduced to a given place and time through the direct or indirect activity of modern humans.

value	definition
native	A taxon occurring within its natural range.
nativeReintroduced	A taxon re-established by direct introduction by humans into an area that was once part of its natural range, but from where it had become extinct.
introduced	Establishment of a taxon by human agency into an area that is not part of its natural range.
introducedAssistedColonisation	Establishment of a taxon specifically with the intention of creating a self-sustaining wild population in an area that is not part of the taxon's natural range.
vagrant	The temporary occurrence of a taxon far outside its natural or migratory range.
Uncertain	The origin of the occurrence of the taxon in an area is obscure.

https://dwc.tdwg.org/terms/#dwc:establishmentMeans
http://rs.gbif.org/vocabulary/dwc/establishment_means_2022-02-02.xml

dwc:occurrenceStatus

A statement about the presence or absence of a Taxon at a Location.

value	definition
present	The occurrence was present at the location and time of the observation.
absent	The occurrence was not present at the location and time of the observation.

https://dwc.tdwg.org/list/#dwc_occurrenceStatus
http://rs.gbif.org/vocabulary/gbif/occurrence_status_2020-07-15.xml

dwc:pathway

The process by which an Organism came to be in a given place at a given time.

value (not exhaustive)	definition
biologicalControl	Organisms occuring in an area because they were introduced for the purpose of biological control of another organism.
fisheryInTheWild	Fish stocked into the wild either to create a fishery or for recreational angling.
conservationOrWildlifeManagement	Organisms introduced for conservation purposes or wildlife management.
aquacultureMariculture	The analog of agriculture and farmed animals, specifically related to aquatic organisms.
publicGardenZooAquaria	Organisms in public collections of plants and/or animals.
hullFouling	Organisms that attach themselves to the subsurface hull of boats and ships.
fishingEquipment	Aquatic organisms moved between sites on equipment of recreational anglers and professional fishermen.
hitchhikersShip	Organisms that enter directly onto boats or ships and are transported by them to another location.
ballastWater	Organisms transported within the water pumped into boats and ships to provide ballast.

https://dwc.tdwg.org/terms/#dwc:pathway
http://rs.gbif.org/vocabulary/dwc/pathway_2022-02-02.xml

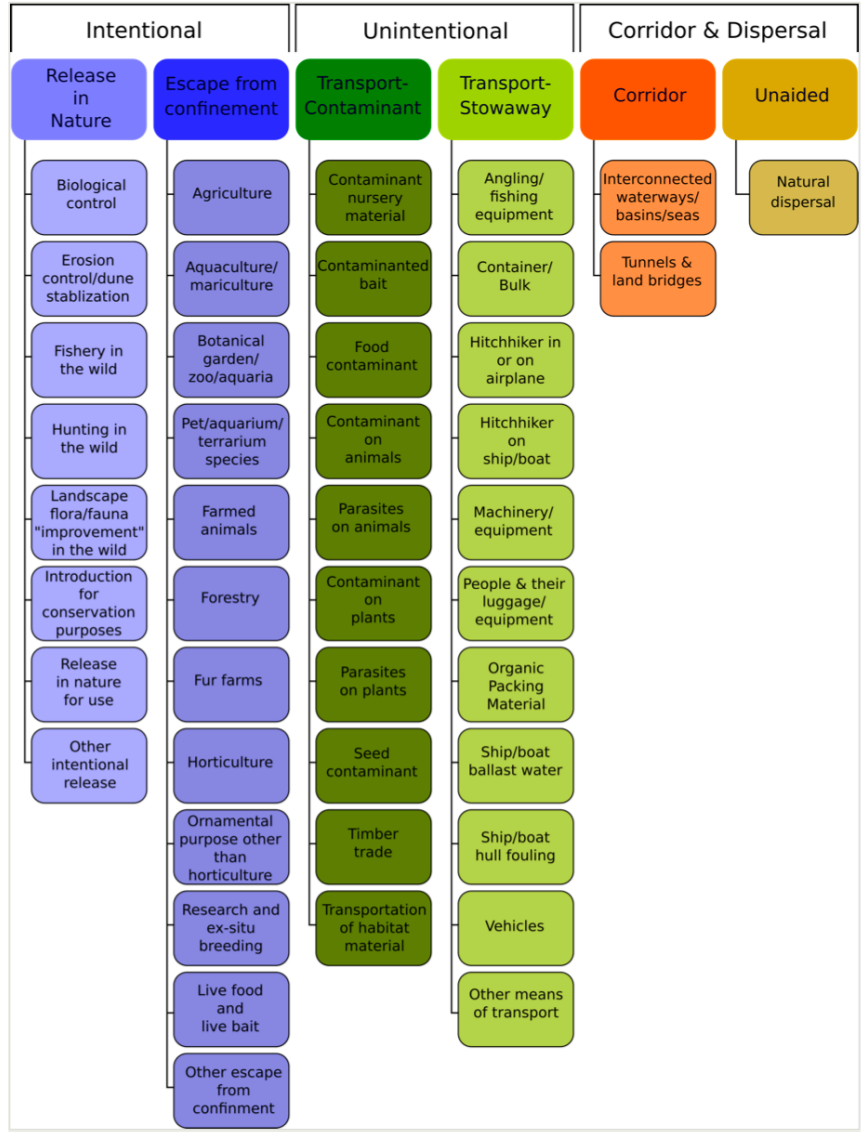


Figure 1.

A summary of the pathways categorisation scheme reproduced with permission from Harrower et al. (2017). The pathways are classified into three types:

1. intentional transport of taxa (blue)
2. unintentionally transported (green)
3. taxa moved between regions without direct transportation by humans and/or via artificial corridors (orange & yellow).

dwc:degreeOfEstablishment

The degree to which an Organism survives, reproduces, and expands its range at the given place and time.

value (not exhaustive)	definition
native	Not transported beyond limits of native range.
cultivated	Individuals in cultivation (i.e., individuals provided with conditions suitable for them, but explicit measures to prevent dispersal are limited at best).
released	Individuals directly released into novel environment.
failing	Individuals released outside of captivity or cultivation in a location, but incapable of surviving for a significant period.
reproducing	Individuals surviving outside of captivity or cultivation in a location. Reproduction is occurring, but population not self-sustaining.
established	Individuals surviving outside of captivity or cultivation in a location. Reproduction occurring, and population self-sustaining.
colonizing	Self-sustaining population outside of captivity or cultivation, with individuals surviving a significant distance from the original point of introduction.
invasive	Self-sustaining population outside of captivity or cultivation, with individuals surviving and reproducing a significant distance from the original point of introduction.

https://dwc.tdwg.org/terms/#dwc:degreeOfEstablishment
http://rs.gbif.org/vocabulary/dwc/degree_of_establishment_2022-02-02.xml

World Register of Introduced Marine Species

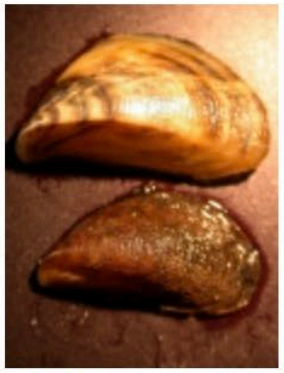
Sou

Sources (9) Documented distribution (27) Notes (26) Attributes (11) Links (11) Images (6)

- ☆ To Barcode of Life (115 barcodes)
- ☆ To Biodiversity Heritage Library (410 publications)
- ☆ To European Nucleotide Archive (ENA)
- ☆ To GenBank (2360 nucleotides; 173 proteins)
- ☆ To Global Biotic Interactions (GloBI)
- ☆ To Global Invasive Species Database (GISD)
- ☆ To Information system on Aquatic Non-Indigenous and Cryptogenic Species (AquaNIS)
- ☆ To IUCN Red List (Least Concern)
- ☆ To PESI

8)

Sources (9) Documented distribution (27) Notes (26) Attributes (11) Links (11) Images (6)



☆ Dreissena polymorph...

☆ Dreissena polymorph...

☆ Dreissena polymorpha

Canary Current LME robis demo

This notebook is a quick demonstration of the robis R package for fetching occurrence data relevant to the Canary Current LME.

Dependencies

```
library(robis)
library(dplyr)
library(ggplot2)
library(sf)
library(rnaturalearth)
```

https://iobis.github.io/notebook-cclme/

Fetching occurrences

The OBIS database has a number of geographic areas against which the occurrence data are indexed. This includes LMEs. Use the `areas()` function to get a list of LME area identifiers.

```
areas <- area() %>%
  filter(type == "lme")

areas %>% rmarkdown::paged_table()
```

id <chr>	name <chr>	type <chr>
40003	California Current	lme
40018	Canadian Eastern Arctic - West Greenland	lme
40066	Canadian High Arctic - North Greenland	lme
40027	Canary Current	lme
40012	Caribbean Sea	lme
40024	Celtic-Biscay Shelf	lme
40064	Central Arctic	lme
40001	East Bering Sea	lme
40016	East Brazil Shelf	lme
40041	East Central Australian Shelf	lme

11-20 of 66 rows

Then use the Canary Current LME area ID as a filter in the `occurrence()` function.

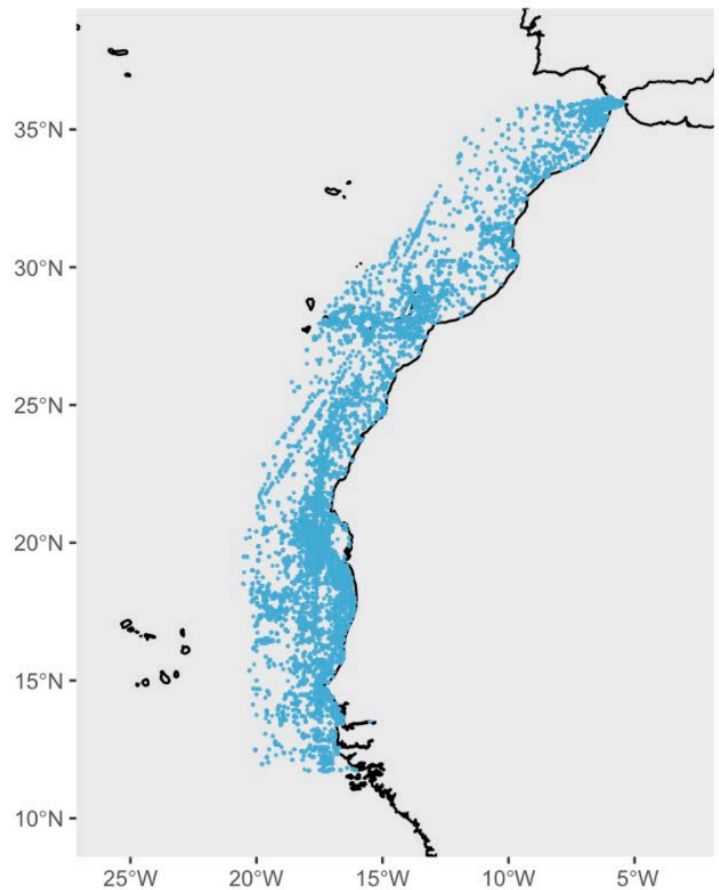
```
occ <- occurrence(areaid = 40027)
occ
```

```
## # A tibble: 98,765 × 197
##    country    date_year scientificNameID superorder year  scientificName abse
##    <chr>          <int> <chr>            <chr>      <chr> <chr>          <lgl
##  1 FRANCE          1971 urn:lsid:marine… Peracarida 1971  Hyperiidea     FALS
##  2 <NA>              NA urn:lsid:marine… <NA>       <NA>  Katsuwonus pe… FALS
##  3 <NA>            1921 urn:lsid:marine… Elopomorp… 1921  Anguilla       FALS
##  4 <NA>            1975 urn:lsid:marine… <NA>       1975  Paragloborota… FALS
##  5 <NA>            1996 urn:lsid:marine… <NA>       1996  Reophax biloc… FALS
##  6 <NA>            1984 urn:lsid:marine… Peracarida 1984  Leucon (Epile… FALS
##  7 FRANCE          1975 urn:lsid:marine… <NA>       1975  Biota          FALS
##  8 <NA>              NA urn:lsid:marine… <NA>       <NA>  Katsuwonus pe… FALS
##  9 <NA>            1981 urn:lsid:marine… <NA>       1981  <NA>           FALS
## 10 SOVIET UN…      1970 urn:lsid:marine… Podoplea   1970  Microsetella … FALS
## # … with 98,755 more rows, and 190 more variables: dropped <lgl>,
## #   superorderid <int>, aphiaID <int>, decimalLatitude <dbl>, subclassid <int
## #   originalScientificName <chr>, marine <lgl>, minimumDepthInMeters <dbl>,
## #   phylumid <int>, subphylumid <int>, occurrenceStatus <chr>,
## #   basisOfRecord <chr>, superclass <chr>, date_mid <dbl>,
## #   maximumDepthInMeters <dbl>, id <chr>, class <chr>, order <chr>,
## #   suborder <chr>, superclassid <int>, orderid <int>, dataset_id <chr>, …
```

Let's create a map:

```
land <- ne_coastline(returnclass = "sf", scale = "large")

ggplot() +
  geom_sf(data = land, size = 0.5) +
  geom_sf(data = occ %>% st_as_sf(coords = c("decimalLongitude", "decimalLatitud
  coord_sf(xlim = c(-26, -3), ylim = c(10, 38), default_crs = sf::st_crs(4326))
  theme(panel.grid.major = element_blank(), panel.grid.minor = element_blank())
```



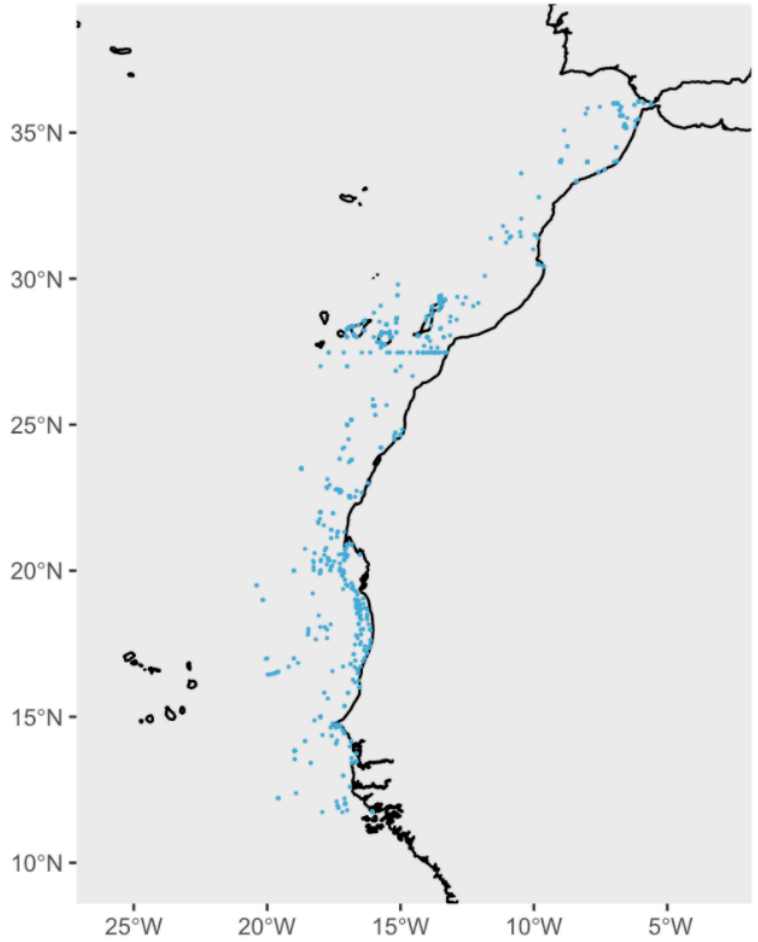
WRiMS taxa

While it's possible to filter the dataframe we downloaded earlier based on value in the `wrims` column, the `occurrence()` function also has a `wrims` filter which restricts results to species listed in the World Register of Introduced Marine Species (WRiMS). Note that this currently does not take into account native versus introduced ranges.

```
occ_wrims <- occurrence(areaid = 40027, wrims = TRUE)
occ_wrims
```

```
## # A tibble: 2,428 × 151
##    infraphylum   date_year scientificNameID         year  scientificName drop
##    <chr>             <int> <chr>                    <chr> <chr>          <lgl
##  1 Gnathostomata      2003 urn:lsid:marinespecies.… 2003  Chromis limba… FALS
##  2 Gnathostomata      2003 urn:lsid:marinespecies.… 2003  Chromis limba… FALS
##  3 Gnathostomata        NA urn:lsid:marinespecies.… <NA>  Microchirus a… FALS
##  4 <NA>               1971 urn:lsid:marinespecies.… 1971  Acteocina kno… FALS
##  5 Gnathostomata      2004 urn:lsid:marinespecies.… 2004  Chromis limba… FALS
##  6 <NA>               1966 urn:lsid:marinespecies.… 1966  Pulleniatina … FALS
##  7 Gnathostomata        NA urn:lsid:marinespecies.… <NA>  Seriola lalan… FALS
##  8 <NA>               2014 urn:lsid:marinespecies.… 2014  Palaemon eleg… FALS
##  9 Gnathostomata        NA urn:lsid:marinespecies.… <NA>  Conger conger  FALS
## 10 Gnathostomata        NA 127240                   <NA>  Pontinus kuhl… FALS
## # … with 2,418 more rows, and 145 more variables: gigaclassid <int>,
## #   aphiaID <int>, language <chr>, decimalLatitude <dbl>, subclassid <int>,
## #   gigaclass <chr>, infraphylumid <int>, phylumid <int>, familyid <int>,
## #   catalogNumber <chr>, occurrenceStatus <chr>, basisOfRecord <chr>,
## #   terrestrial <lgl>, modified <chr>, maximumDepthInMeters <dbl>, id <chr>,
## #   day <chr>, parvphylum <chr>, order <chr>, dataset_id <chr>,
## #   decimalLongitude <dbl>, collectionCode <chr>, date_end <dbl>, …
```

```
ggplot() +
  geom_sf(data = land, size = 0.5) +
  geom_sf(data = occ_wrims %>% st_as_sf(coords = c("decimalLongitude", "decimalL
  coord_sf(xlim = c(-26, -3), ylim = c(10, 38), default_crs = sf::st_crs(4326)) +
  theme(panel.grid.major = element_blank(), panel.grid.minor = element_blank())
```



Let's take a look at the most common WRiMS species for the CCLME:

```r
occ_wrims %>%
  filter(!is.na(species)) %>%
  group_by(class, species) %>%
  summarize(records = n()) %>%
  arrange(desc(records)) %>%
  rmarkdown::paged_table()
```

class <chr>	species <chr>	records <int>
Actinopteri	Chromis limbata	294
Globothalamea	Pulleniatina obliquiloculata	174
Actinopteri	Mycteroperca fusca	87
Actinopteri	Conger conger	85
Actinopteri	Anguilla anguilla	82
Hexanauplia	Oithona plumifera	67
Actinopteri	Nemichthys scolopaceus	66
Actinopteri	Zenopsis conchifer	59
Actinopteri	Sarpa salpa	58
Actinopteri	Solea senegalensis	55

PacMAN

Pacific Islands Marine
Bioinvasions Alert Network

Saara Suominen, Pieter Provoost, Joape Ginigini, Gilianne Brodie, Paayal Kumar, Matthias Obst, Craig Sherman, Neil Davies, Christopher Meyer, Pier Luigi Buttigieg, Pascal Hablutzel, Nic Bax, Frank Muller-Karger, John Deck, Ward Appeltans

IODE International Oceanographic Data and Information Exchange

OBIS OCEAN BIODIVERSITY INFORMATION SYSTEM

unesco Intergovernmental Oceanographic Commission

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

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Bioinvasions Alert Network

- Increased marine traffic in the Pacific Islands is accelerating the spread of invasive species
- Detecting invasive species on their arrival is crucial for effective management.
- DNA analyses of water samples can be used to detect marine species
- The PacMAN project aims to develop a monitoring plan and decision support tool

PacMAN

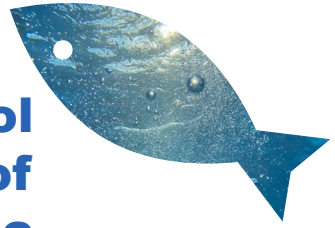
Pacific Islands Marine
Bioinvasions Alert Network

2. Developing Monitoring Plan With eDNA

1. Close work with partners and stakeholders

3. Standardized bioinformatics and data management

4. A decision support tool for early warnings of invasive species presence



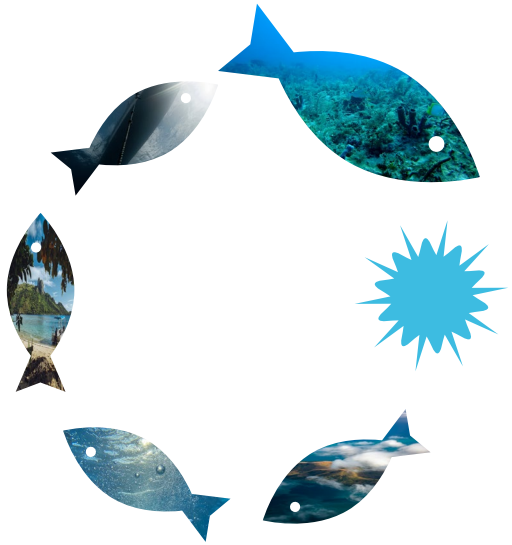
5. Training Program for local scientists and environmental managers

1. Close work with partners and stakeholders

PacMAN
Pacific Islands Marine Bioinvasions Alert Network

- Implemented with the **University of South Pacific**

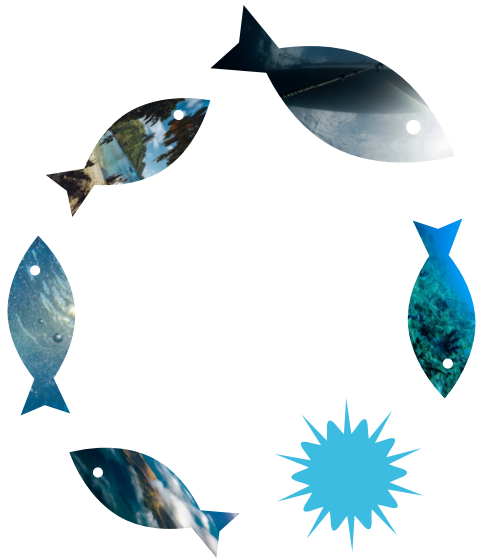
- Coordination team in Fiji
  - Joape Ginigini – Project manager
  - Dr. Gilianne Brodie – Marine Science Advisor
  - Miriama Vuiyasawa – Project Assistant
  - Payaal Kumar – (previous) Project Assistant



- Advisory board with international scientific experts and key local stakeholders

2. Developing Monitoring Plan With eDNA

PacMAN
Pacific Islands Marine Bioinvasions Alert Network

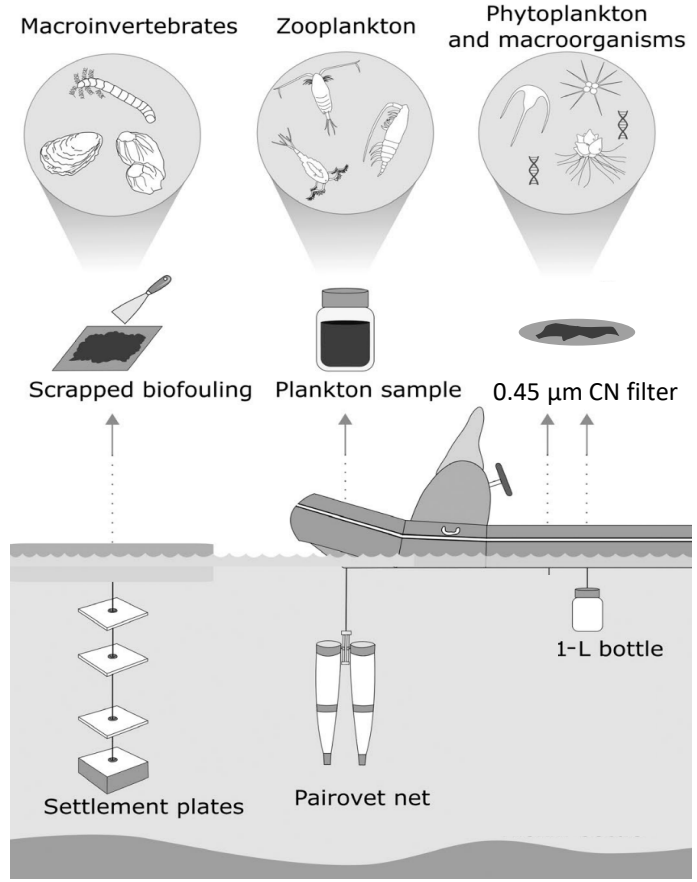


2. First phase: Initial Port Survey

- Sample different substrates (water, plankton, biofilm)
- Focus on specimen collection and metabarcoding

3. Second phase: Monitoring

- More frequent
- Focus on rapid detection of high-risk species with qPCR

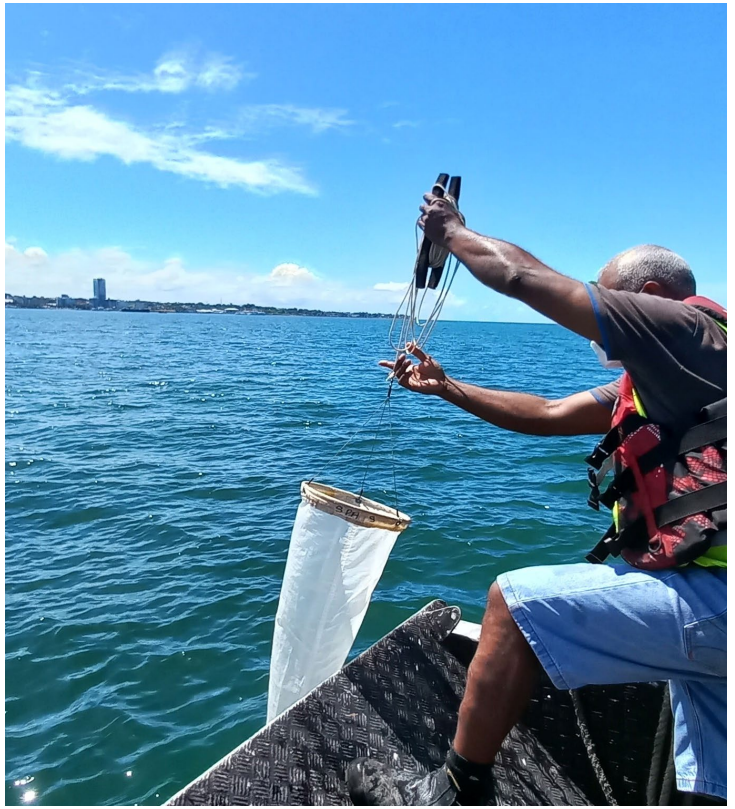


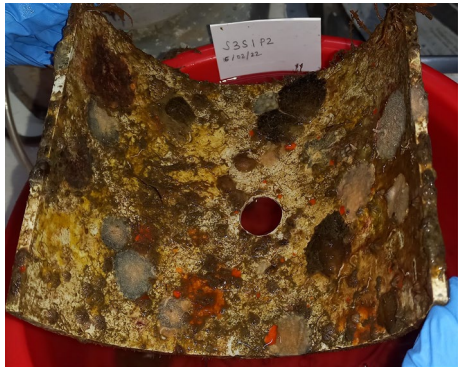
Modified from: Rey, A., Basurko, O.C., and Rodriguez-Ezpeleta, N. (2020). Ecol Evol 10: 2452–2465. Fig: Carlota Bermejo

2. Developing Monitoring Plan With eDNA

PacMAN

Pacific Islands Marine Bioinvasions Alert Network





3. Standardized bioinformatics and data management

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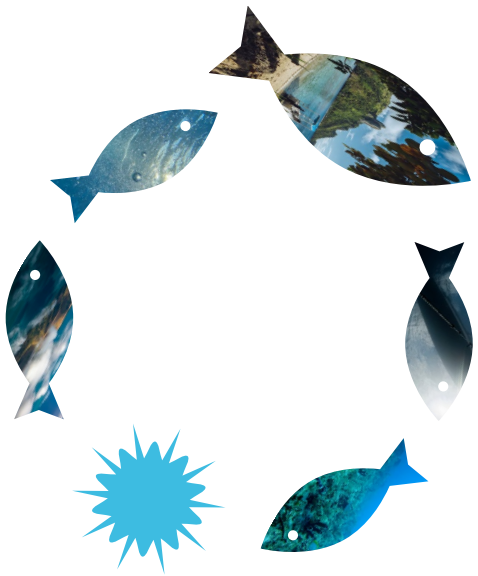
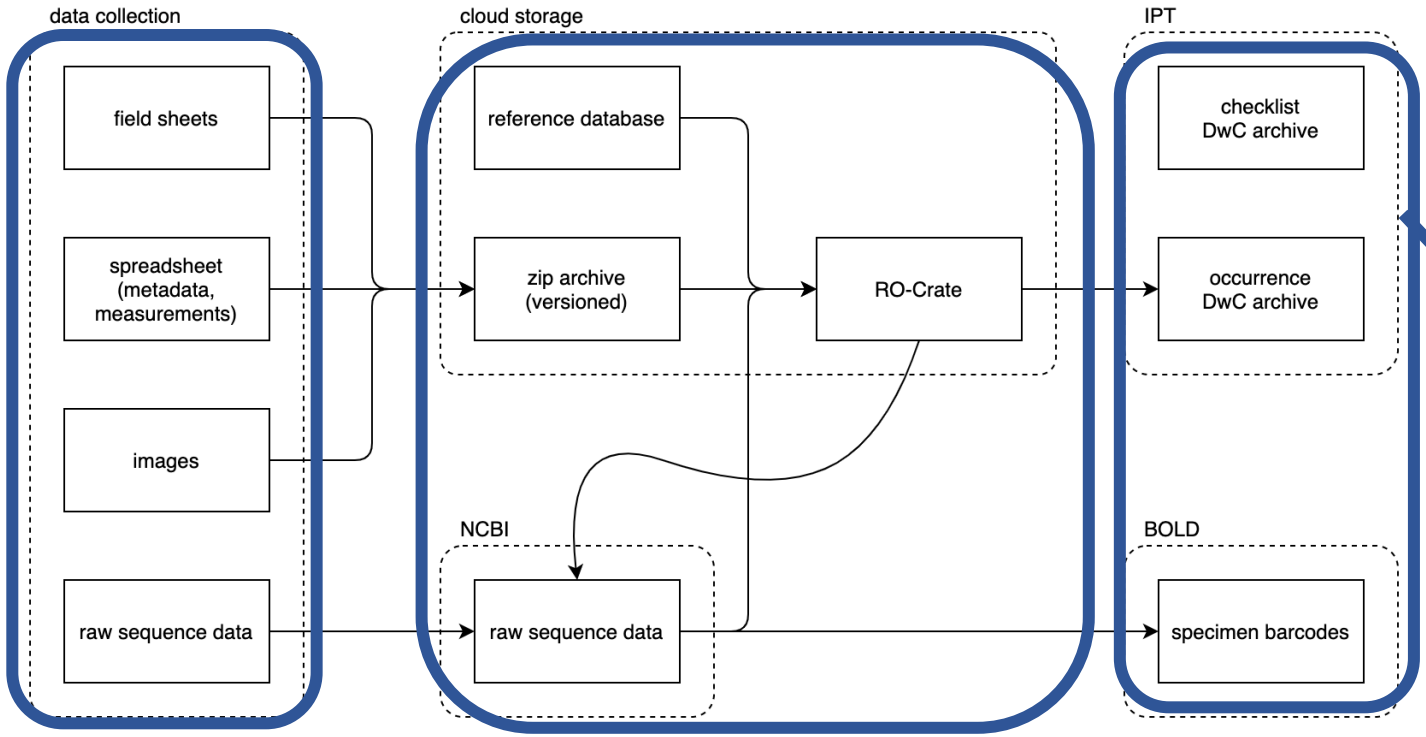
Pacific Islands Marine Bioinvasions Alert Network

1. Data collection, storage and preservation
2. Data analysis
3. Data sharing and reuse

As automated and standardized as possible:

Easily reproducible in other projects



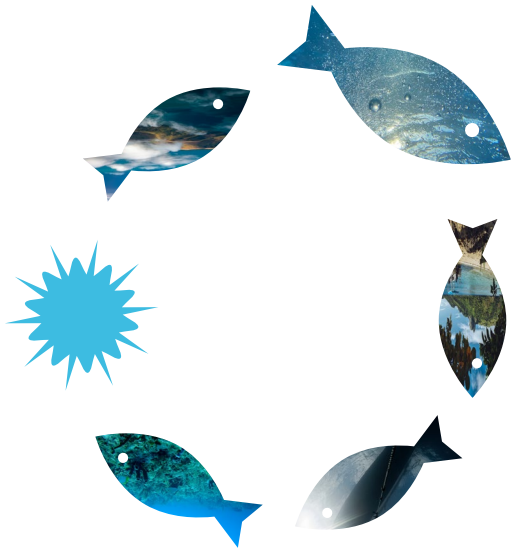


OBIS
OCEAN BIODIVERSITY INFORMATION SYSTEM

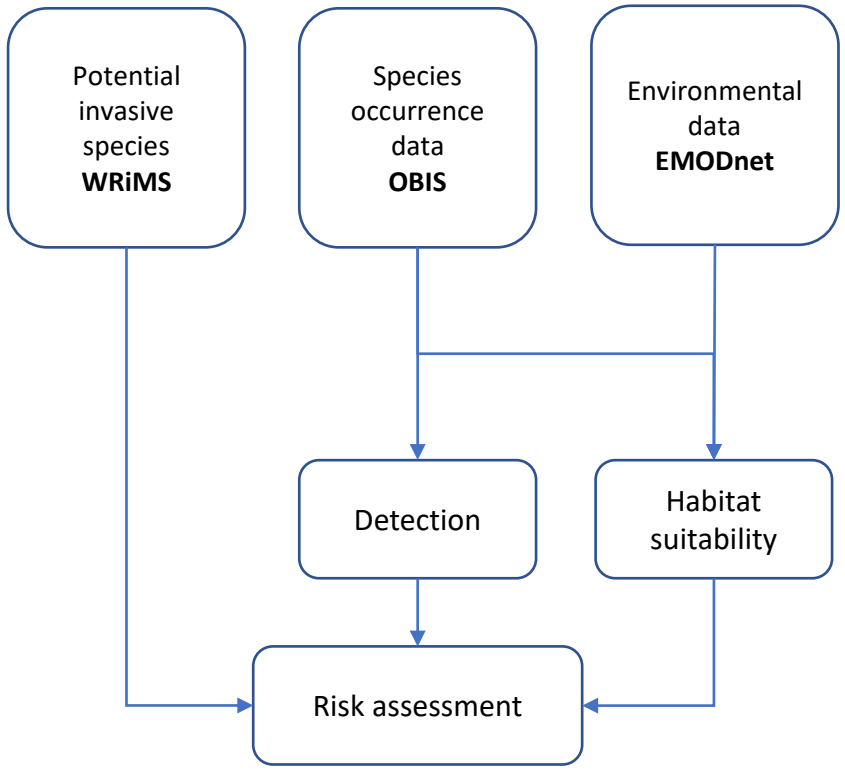
4. A decision support tool for early warnings of invasive species presence

PacMAN
Pacific Islands Marine Bioinvasions Alert Network

- **Final outcome of the project:**
  - A decision support tool



- **The decision support tool will highlight possible risk species based on:**
  - Invasive species lists
  - Species distribution models taking into account species traits and habitability

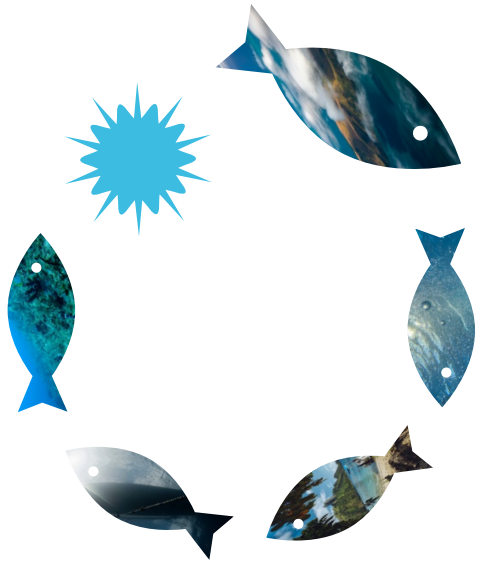


5. Training Program for local scientists and managers

PacMAN
Pacific Islands Marine Bioinvasions Alert Network

- **To ensure the longevity of the program**
  - Strong engagement and capacity development in the local community

OTGA
OceanTeacher Global Academy



- **In collaboration with OTGA**
  - Training courses for local stakeholders in
    - Sampling and sample/data handling for monitoring purposes
    - Interpretation and communication of analytical results through the decision support tool

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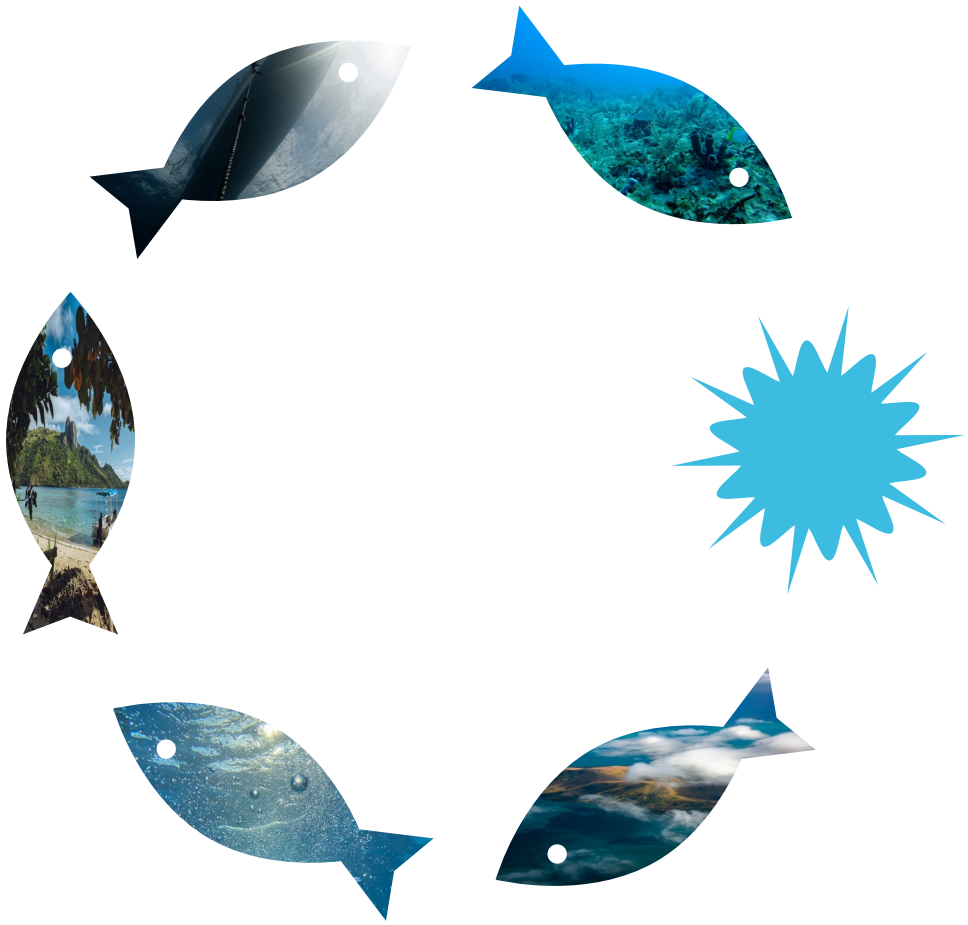
Pacific Islands Marine
Bioinvasions Alert Network



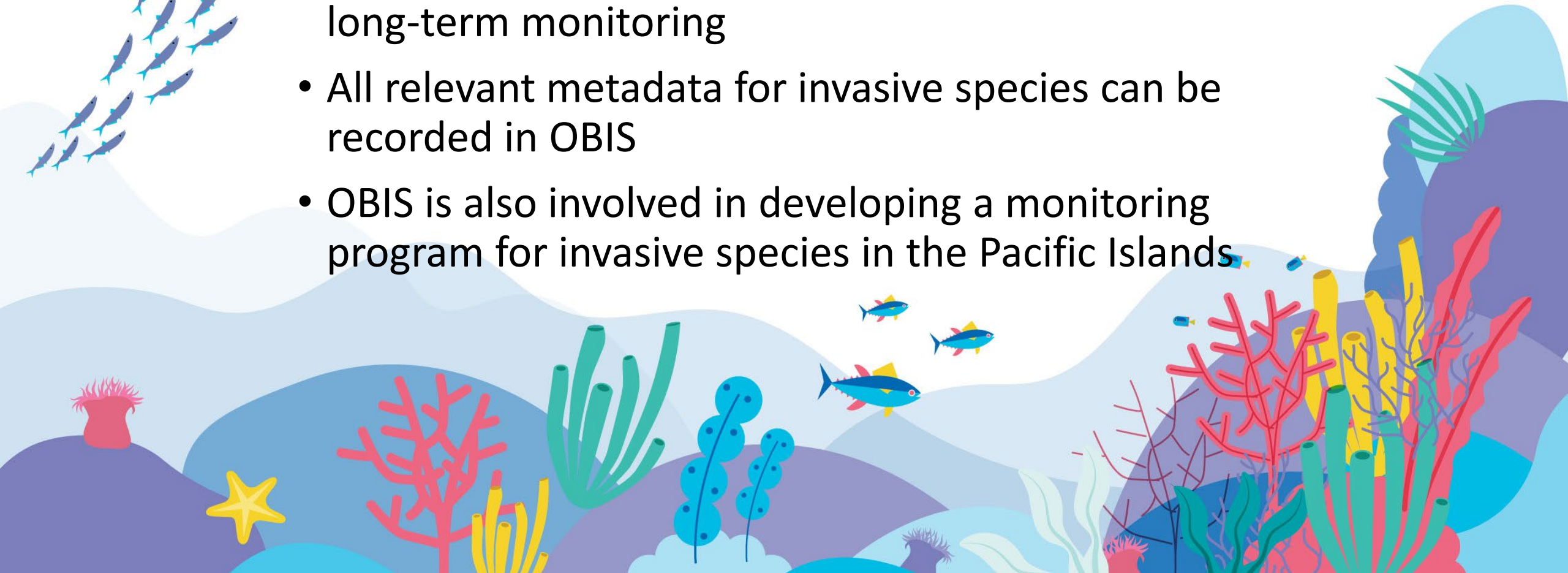
Outlook

The goal

- a working long-term monitoring program that becomes a routine in risk areas
- Including workflows based on best practices both in the field and in data management

Conclusions

- OBIS is an efficient way to store and share marine biodiversity data: making sure that it is available for long-term monitoring
- All relevant metadata for invasive species can be recorded in OBIS
- OBIS is also involved in developing a monitoring program for invasive species in the Pacific Islands



United Nations Educational, Scientific and Cultural Organization

Intergovernmental Oceanographic Commission

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OBIS
OCEAN BIODIVERSITY INFORMATION SYSTEM

Thanks