

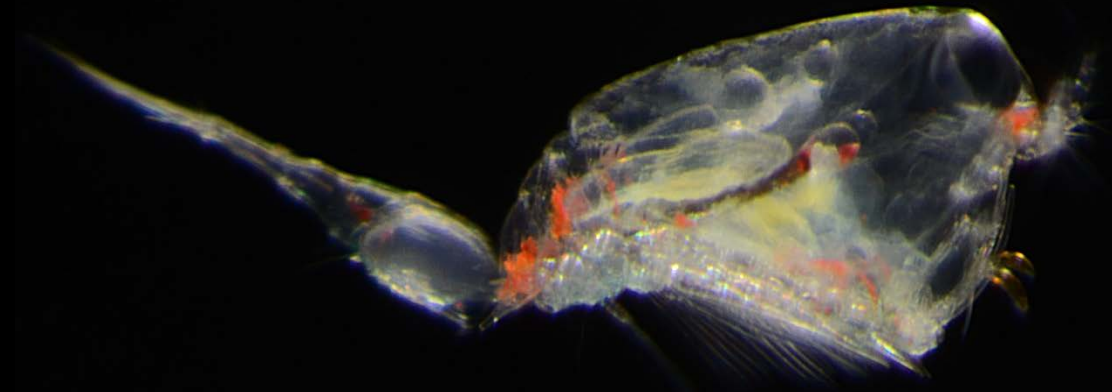
DigIn overview

- Digitization
- Extended specimen
- Extended fauna



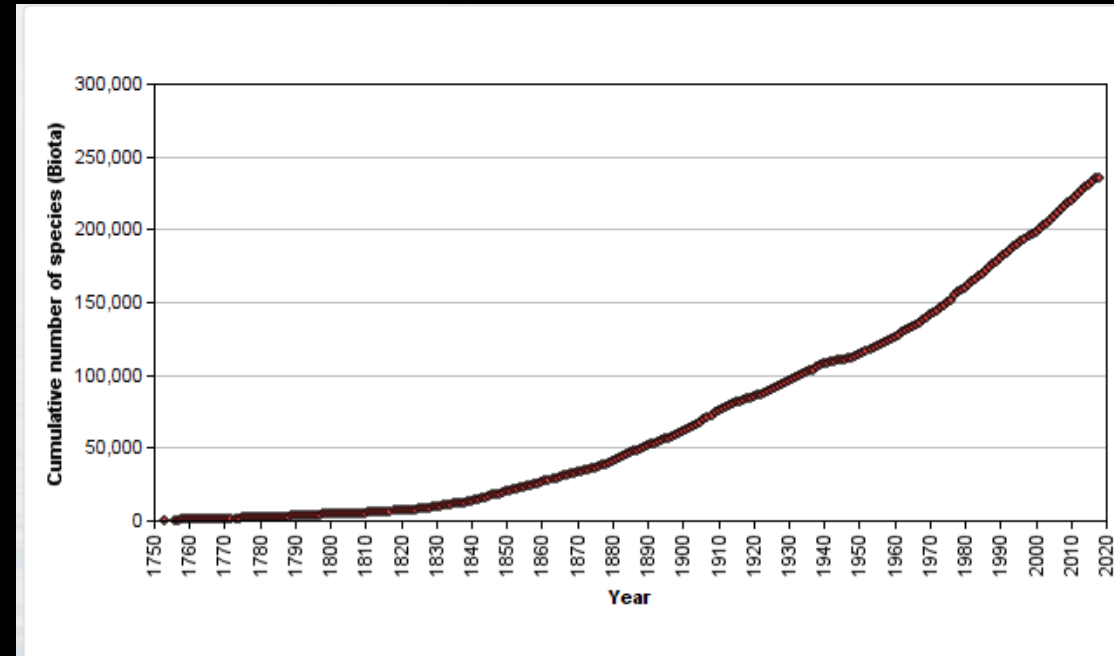
Why? part 1

- 70% of Earth covered by ocean
- 75% of species in ocean are invertebrate animals
- 116 million records in iDigBio
- <2 million marine invertebrate records from NA collections
- 0 of 23 TCNs on living marine life / invertebrates



What do we know about marine species diversity?

- ~250K described species globally
- → ~75% are “invertebrate” animals
- ~25K described species in N America
- 13% DNA sequence coverage
- Actual diversity poorly constrained
- > million multicellular organisms/animals

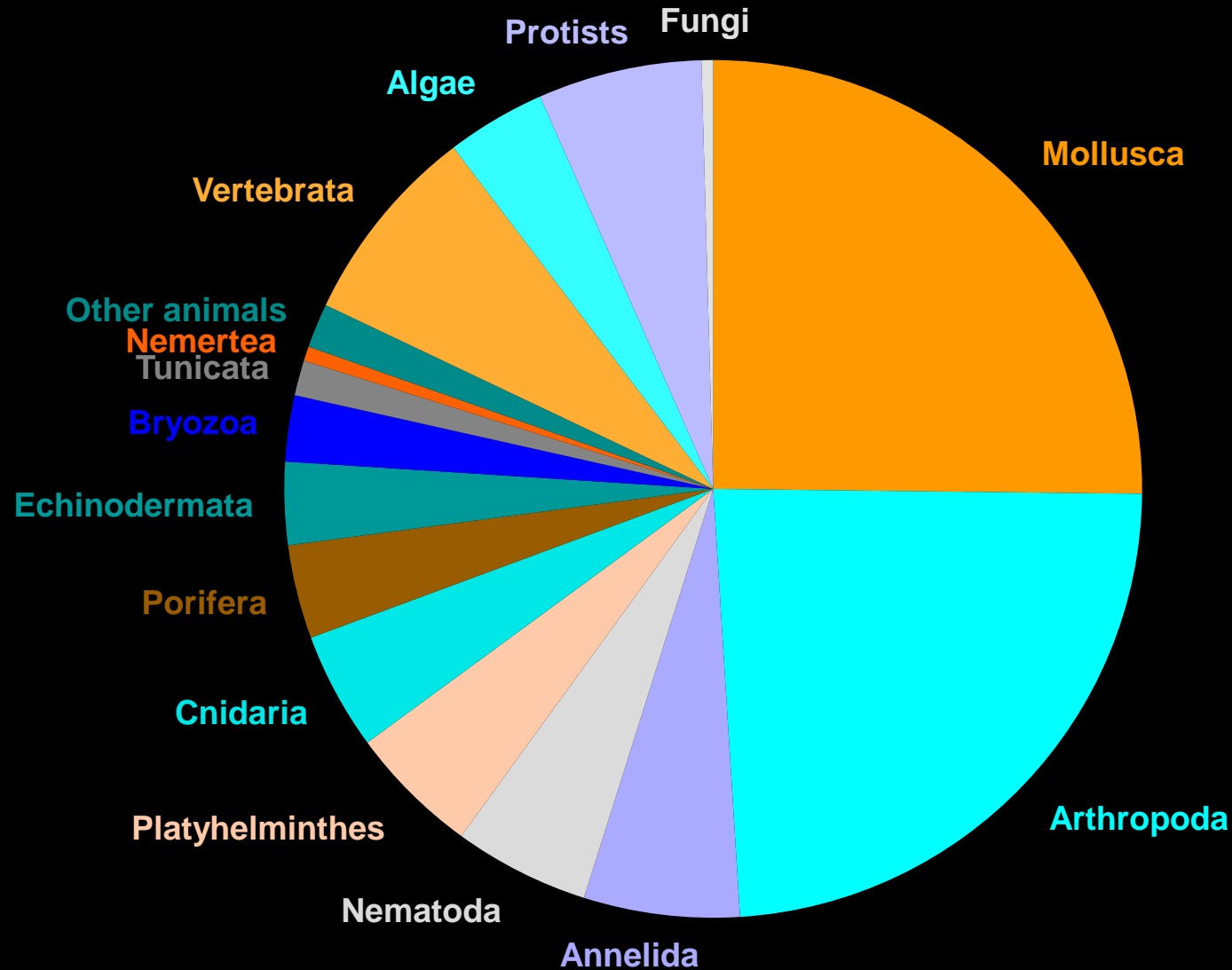


Described marine species
diversity through time

WoRMS
World Register of Marine Species

Sources: WoRMS; Michonneau et al unpublished;
Radulovici @ WCMB 2018

Described marine diversity



Mollusca in North American collections

- 8.5 million lots total
- 4.5 million digitized
 - 1.1 million georeferenced
- 1.7 million cataloged but not digitized
- 2.3 million *quality backlog*
 - “specimen lots that have good locality data and confident identifications that are ready for digitization with minimal physical curation necessary”
- *deep backlog* comparable to # cataloged
 - “materials that have locality data but are either not sorted into lots or are not (or poorly) identified, and require considerable physical curation prior to digitization”



MarInverts in NA collections

MarInverts = marine invertebrates other than mollusks

4.1 million lots:

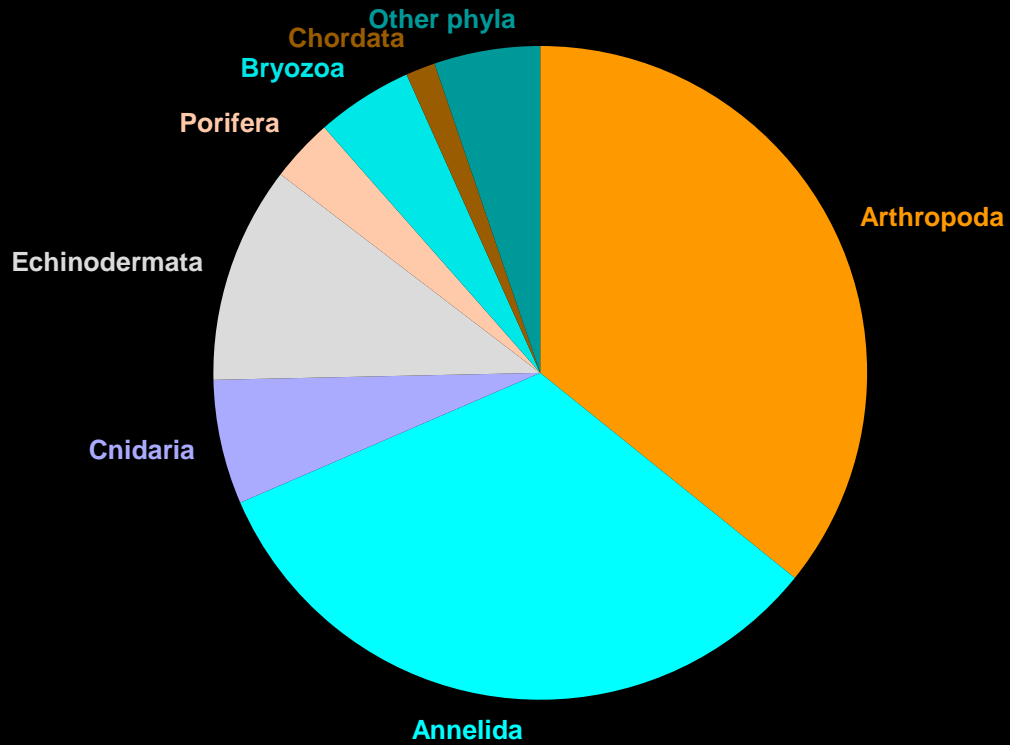
- 0.5 million - Canada
- 1.8 million – USNM*
- 1.8 million - non-federal US



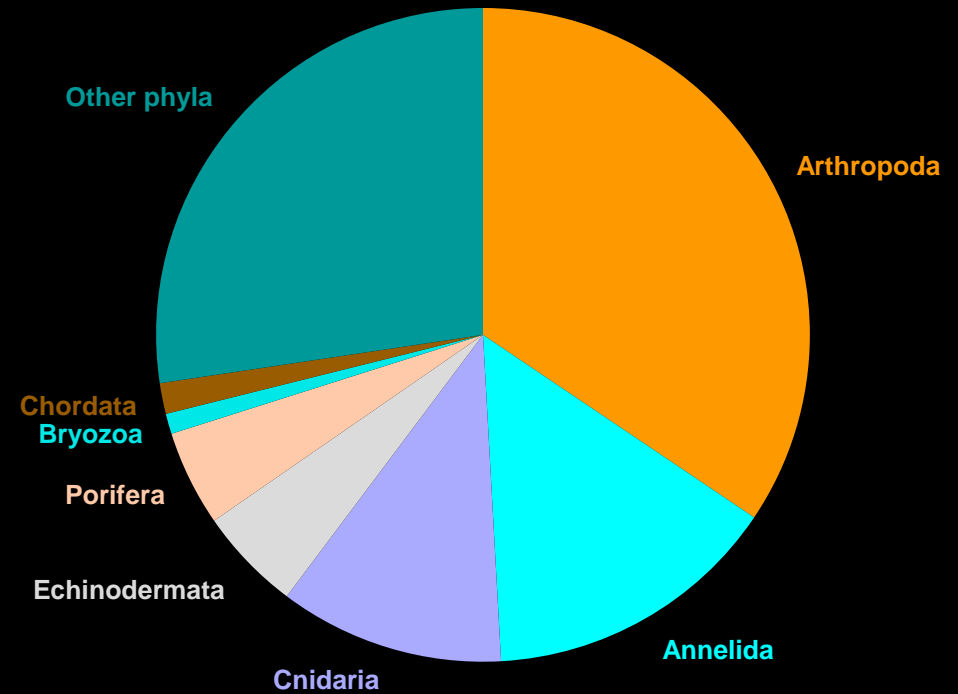
* includes ~0.4 million mostly non-marine parasites

MarInverts in NA collections

Not USNM
1.75 million



USNM
1.84 million*



*USNM other phyla
– mostly parasitic nematodes and flatworms – not marine

MarInvert digitization

1.9 million NA lots digitized

2.2 million NA lots not digitized:

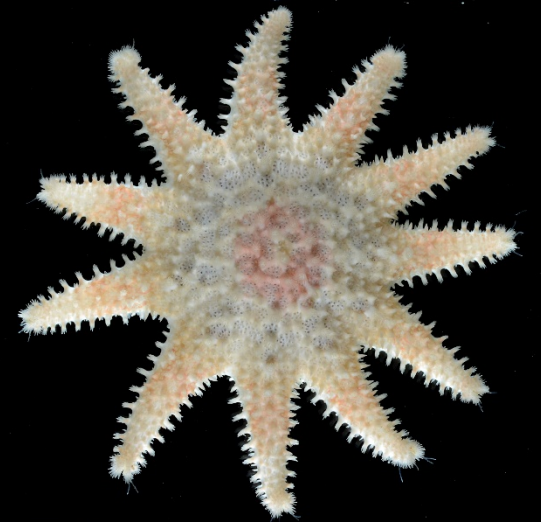
- 257K - Canada
- 837K - USNM
 - ~500K MarInverts
 - ~300K non-marine parasites
- 1.1 million - non-federal US → TCN target
- > half of this at LACM
- much deep backlog



Why? part 2

Uses of basic digitized collection data

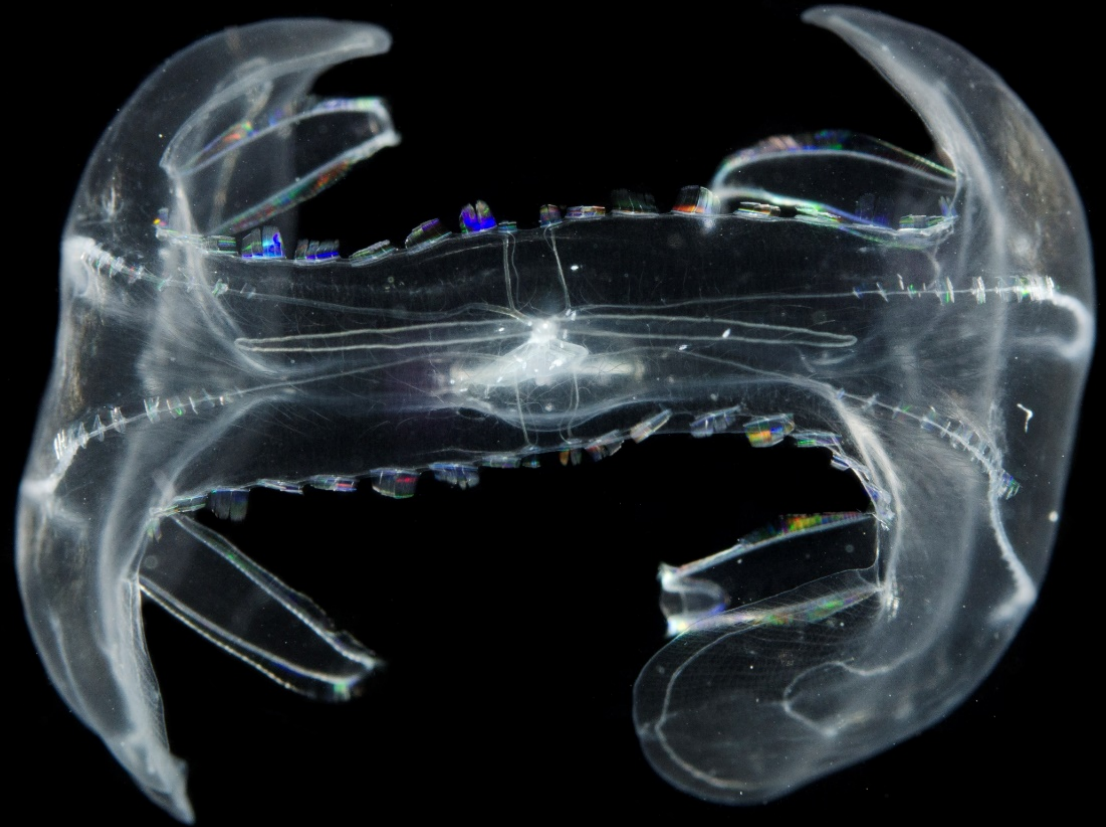
- Biodiversity - what, where, when?
 - diversity, occurrence, ecology, etc
 - diverse research, management, education, etc applications
- Available through aggregators
 - iDigBio, GBIF, iOBIS, etc
- Vouchering
 - GenBank, BOLD, publications, etc.



Beyond the label

What else to capture?

- Images
- Tissues
- Sequences
- Associations
- etc

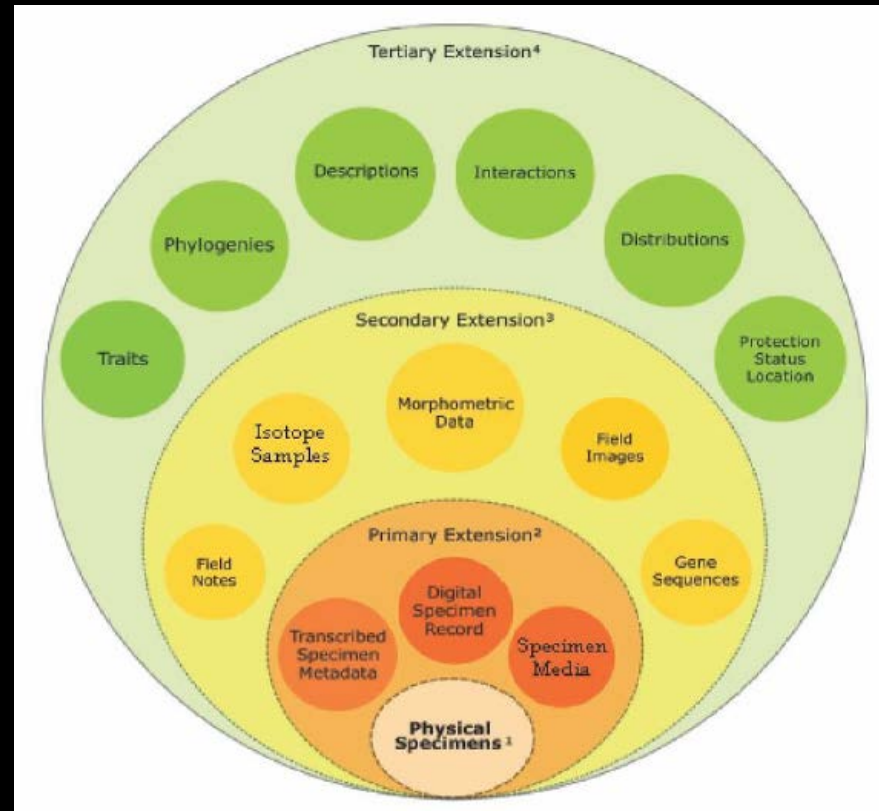


NextGen Collection Digitization

BCoN 2019: Extending U.S. Biodiversity Collections to Address National Challenges

- White paper from workshop, 30 October - 1 November 2018, under the leadership of the Biodiversity Collections Network (BCoN) addressed the future deployment of data held in U.S. biodiversity collections for research, policy and education.
- “focus future biodiversity documentation on building a network of extended specimens that represent the depth and breadth of biodiversity held in U.S. collections institutions. The extended specimen will consist of the physical voucher and any preparations (e.g. tissue samples); digitized representations such as occurrence records and images; derivative products such as gene sequences or metagenomes; and taxon- or locality-specific data such as observations, phylogenies or species distributions.”
- “New collections, needed now more than ever to inform solutions to societal problems, should be “born-extended”, i.e., accessioned with a full suite of supplemental data.”

The extended specimen



What are we tracking?

- Almost all databases deal only with published species
- ~Half of marine invertebrates are complexes of multiple cryptic species
- BOLD deals with cryptics
 - Barcode Index Number (BIN)
- To document biota – need to get down to complexes
- → sequence data, BINs, temporary names



Connectivity for extended specimens

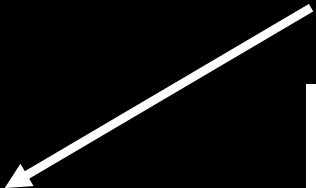
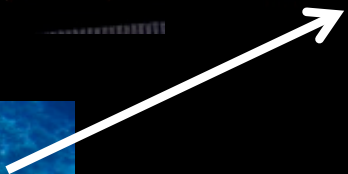
FLMNH-IZ example



BOLD SYSTEMS



CalPhotos



Knowing your backyard / coast

Extended digitized biodiversity data

- Authoritative checklist
 - Who, where, how, when?
- Identification resources
 - Images
 - DNA barcodes, sequences
 - Interactive keys



State of knowledge of NA MarInverts

- Dated, basic checklists, without source information
- Unreviewed occurrence data through aggregators
- Unreviewed DNA barcodes through BOLD
- Scattered, limited images resources
- Local identification keys of limited taxonomic scope



Need extended, integrative fauna

Recommendation: Produce a comprehensive checklist and identification guide to the marine organisms of US waters

- Duffy, J. E. et al. 2013. Envisioning a Marine Biodiversity Observation Network. *BioScience* 63: 350-361



US Marine Invertebrates

~25K species; nothing comprehensive / online

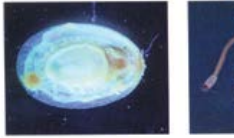
Common and Scientific
Names of Aquatic Invertebrates
from the United States and Canada:

Cnidaria and Ctenophora Second Edition



Common and Scientific
Names of Aquatic Invertebrates
from the United States and Canada

Mollusks Second Edition

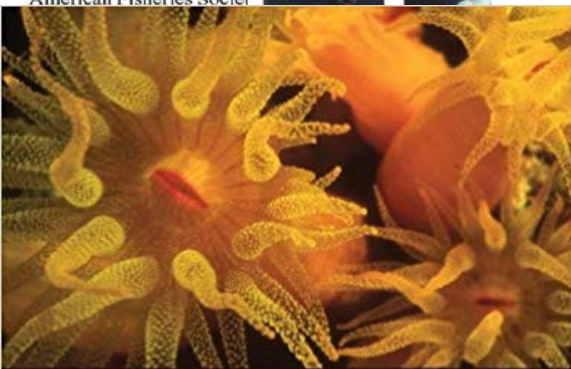


Common and Scientific
Names of Aquatic Invertebrates
from the United States and Canada

Crustaceans



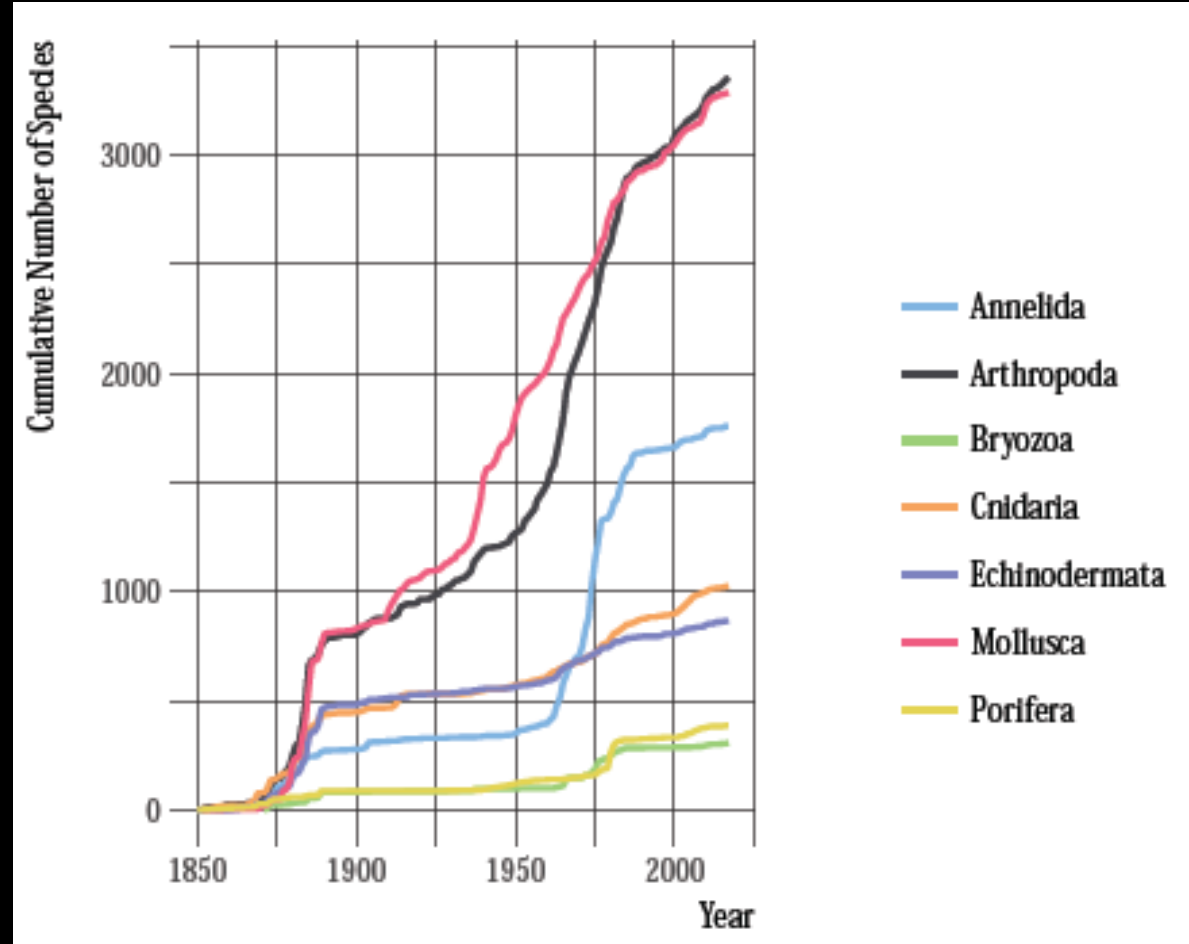
American Fisheries Society Special Publication 31



Gulf of Mexico Origin, Waters, and Biota

Volume 1, Biodiversity

Edited by Darryl L. Felder
and David K. Camp



Cumulative species diversity in US, from OBIS & iDigBio
– Michonneau et al, in prep

Australian models Atlas of Living Australia Australian Faunal Directory

Atlas of Living Australia
ala.org.au

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ANIMALIA / ECHINODERMATA / HOLOTHUROIDEA / ASPIDOCHIROTIDA / HOLOTHURIIDAE / *Holothuria* / *Holothuria (Halodeima)* / *Holothuria (Halodeima) atra*

Holothuria (Halodeima) atra Jaeger, 1833

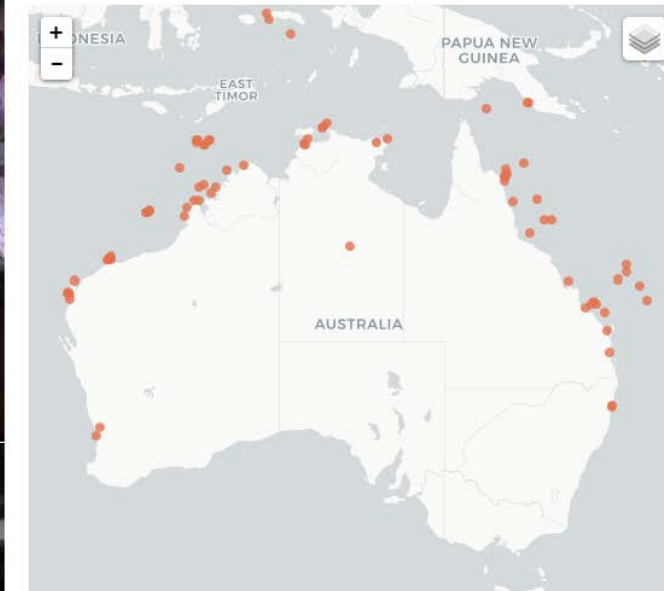
Lollyfish (Sea Cucumber)

species Accepted Name authority: AFD

Overview Gallery Names Classification Records Literature Sequences Data Partners



Occurrence records map (237 records)



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ent of the Environment and Energy

Australian Biological Resources Study
Australian Faunal Directory

Contact us search

You are here: Environment home > Biodiversity > ABRIS > AFD > ANIMALIA (Kingdom) > ECHINODERMATA (Phylum) > HOLOTHUROIDEA (Class) > ASPIDOCHIROTIDA (Order) > HOLOTHURIIDAE (Family) > *Holothuria* Linnaeus, 1767 (Genus) > *Holothuria (Halodeima)* Pearson, 1914 (Subgenus) > *Holothuria (Halodeima) atra* Jaeger, 1833

Species *Holothuria (Halodeima) atra* Jaeger, 1833

Holothuria atra Jaeger, G. Fr 1833. *De Holothuriis*. Turici 41 pp. 3 pls. [22].

Type data: Status unknown, whereabouts unknown, Sulawesi (as Celebes), Indonesia.

Distribution

States

Queensland, Western Australia

Extra Distribution Information

Fremantle, WA to Heron Is., Qld and Tasman Sea; Indo-Pacific Ocean, eastern Pacific Ocean. Depth range 0-30 m. Afrotropical Region, Nearctic Region, West Pacific Ocean

Note that conversion of the original AFD map of states, drainage basins and coastal and oceanic zones to IBRA and IMCRA regions may have produced errors. The new maps will be reviewed and corrected as updates occur. The maps may not indicate the entire distribution. See further details below.

IBRA and IMCRA regions

Species *Holothuria (Halodeima) atra* Jaeger, 1833

- Checklist
- Statistics
- Host Taxa
- Bibliography
- Names List
- Complete Preview

Museums

- Museum list

Regional Maps

- IBRA Regions
- IMCRA Regions
- Original AFD map

Among other national or regional data aggregators, Atlas of Living Australia (ALA), the most mature national biodiversity resource, provides an excellent model for developing user interfaces that meet the needs of the broader community.



European model



Introduction Geography Datasets **ERMS** EurOBIS

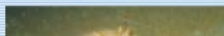
The European Register of Marine Species

What is ERMS

The European Register of Marine Species (ERMS) is an authoritative taxonomic list of species occurring in the European marine environment, defined as up to the strandline or splash zone above the high tide mark and down to 0.5 (psu, ppt) salinity in estuaries. The register is actively maintained and daily updated in the framework of the MarBEF EU Network of Excellence by a board of taxonomic editors, which are world experts on the taxonomy of their relevant taxa. It is anticipated that the Register will become a standard reference (and technological tool) for marine biodiversity training, research and management in Europe. ERMS is served from a relational database. The most recent version of the data will always be available through [this search interface](#). At regular intervals, a snapshot of the database will be archived; these archive copies will be kept available through the ERMS web site.



Enter the database!



ERMS taxon details

★ *Holothuria (Panningothuria) forskali* Delle Chiaje, 1823

AphiaID 124501 (urn:lsid:marinespecies.org:taxname:124501)
Classification Biota [★ Animalia](#) [★ Echinodermata](#) [★ Echinozoa](#)
[★ Holothuroidea](#) [★ Holothurida](#) [★ Holothuriidae](#)
[★ Holothuria](#) [★ Holothuria \(Panningothuria\)](#)
[★ Holothuria \(Panningothuria\) forskali](#)

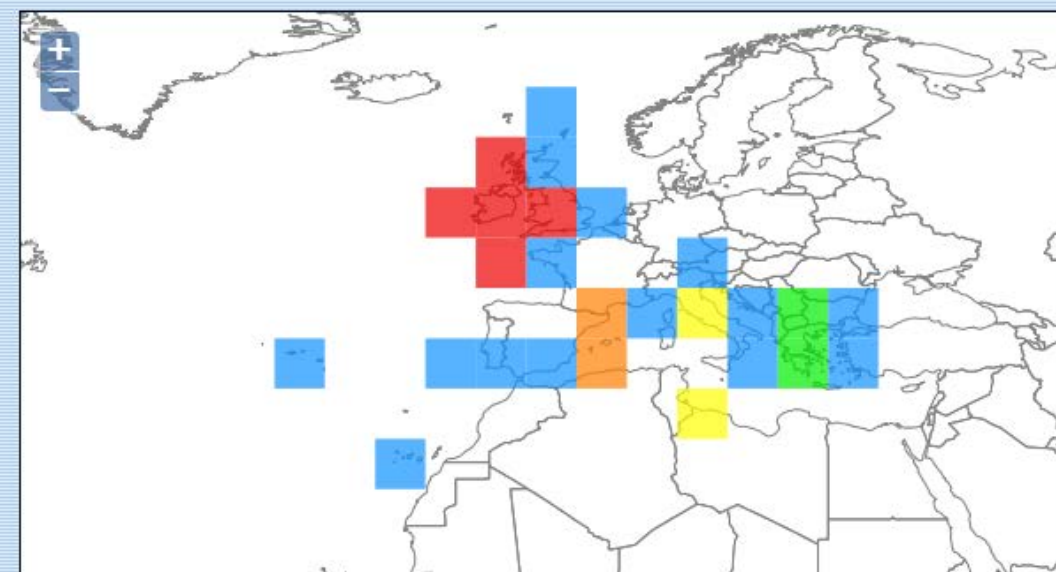
Status accepted
Rank Species
Typetaxon of [★ Holothuria \(Panningothuria\) Rowe, 1969](#)
Parent [★ Holothuria \(Panningothuria\) Rowe, 1969](#)
Orig. name [★ Holothuria \(Panningothuria\) forskali Delle Chiaje, 1823](#)



★ *Alcyonium glomeratu...*

Synonymised names [★ Holothuria catanensis Grube, 1840 \(synonym\)](#)

[Sources \(6\)](#) [Documented distribution \(4\)](#) [Attributes \(7\)](#) [Links \(14\)](#) [Images \(9\)](#)



- GEBCO 2014 [i](#)
- NOAA ETOPO1 [i](#)
- Countries
- Google satellite
- OBIS occurrences (2758) [i](#)
- >101
- 51-100
- 11-50
- 6-10
- 1-5
- Polygons

Present Inaccurate Introduced: alien Containing type locality

Global marine biodiversity – taxonomy model

WORMS
World Register of Marine Species

Home About Subregisters Users Photogallery Documents LifeWatch Contribute

Quick search...

Q Taxa Literature Distribution Specimen Editors Statistics Tools Manual Paulay, Gustav

Aphia taxon details

Taxon editable: Yes

★ **Holothuria Linnaeus, 1767** [Edit taxon] [Add child taxon] [Mark as orig. name]

AphiaID 123456 (urn:lsid:marinespecies.org:taxname:123456)

Classification Biota > Animalia (Kingdom) > Echinodermata (Phylum) > Echinozoa (Subphylum) > Holotheroidea (Class) > Holothuriida (Order) > Holothuriidae (Family) > **Holothuria (Genus)**

Status accepted

Rank Genus

Typetaxon ★ *Holothuria tremula* Linnaeus, 1767 accepted as ★ *Holothuria (Holothuria) tubulosa* Gmelin, 1791 (type by subsequent designation)

Typetaxon of ★ Holothuriidae Ludwig, 1894

Parent ★ Holothuriidae Burmeister, 1837

Synonymised names ★ *Ananus* Sluiter, 1880

★ *Psolus* Lesson, 1830 (junior homonym of *Psolus* Oken, 1815)

Direct children (557)

[show all]

[sort alpha...]

Subgenus ★ *Holothuria (Acanthotrapeza)* Rowe, 1969

» Species ★ *Holothuria (Acanthotrapeza) coluber* Semper, 1868

» Species ★ *Holothuria (Acanthotrapeza) kubaryi* Ludwig, 1875

» Species ★ *Holothuria (Acanthotrapeza) pyxis* Selenka, 1867

» Species ★ *Holothuria (Acanthotrapeza) tripilata* Massin, 1987

Subgenus ★ *Holothuria (Bohadschia)*

» Species ★ *Holothuria (Bohadschia) inermis* Bell, 1887 (nomen dubium)

» Species ★ *Holothuria (Bohadschia) whitmaei* Bell, 1887 accepted as ★ *Holothuria (Microthele) whitmaei* Bell, 1887

Subgenus ★ *Holothuria (Cucumaria)*

» Species ★ *Holothuria (Cucumaria) crocea* Lesson, 1830 accepted as ★ *Cladodactyla crocea crocea* (Lesson, 1830)

Subgenus ★ *Holothuria (Cystipus)* Haacke, 1880

» Species ★ *Holothuria (Cystipus) casoae* Laguarda-Figueras & Solis-Marín, 2009

» Species ★ *Holothuria (Cystipus) cubana* Ludwig, 1875

» Species ★ *Holothuria (Cystipus) dura* Cherbonnier & Féral, 1981

» Species ★ *Holothuria (Cystipus) hartmeyeri* (Helfer, 1912)

» Species ★ *Holothuria (Cystipus) inhabilis* Selenka, 1867

» Species ★ *Holothuria (Cystipus) jousseauae* Cherbonnier, 1954

» Species ★ *Holothuria (Cystipus) mammosa* Cherbonnier, 1988

» Species ★ *Holothuria (Cystipus) occidentalis* Ludwig, 1875

» Species ★ *Holothuria (Cystipus) pseudofossor* Deichmann, 1930

» Species ★ *Holothuria (Cystipus) rigida* (Selenka, 1867)

» Species ★ *Holothuria (Cystipus) sucosa* Erwe, 1919

» Species ★ *Holothuria (Cystipus) turnsimperfecta* Cherbonnier, 1965

» Species ★ *Holothuria (Cystipus) yann* Samyn in Samyn & Vandenspiegel, 2016

» Species ★ *Holothuria (Cystipus) sulcata* Ludwig, 1875 accepted as ★ *Holothuria (Cystipus) occidentalis* Ludwig, 1875

Subgenus ★ *Holothuria (Fistularia)*

Sources (7) Documented distribution (20) Specimens (0) Notes (3) Attributes (7) Vernaculars (11) Links (16) Images (9) Contexts (6)

Responsible editors (3)

[link source] [add new source]

original description (of ★ *Holothuria catanensis* Grube, 1840) Grube, E. (1840). Actinien, Echinodermen und Würmer des Adriatischen- und Mittelmeers, nach eigenen Sammlungen beschrieben von Adolph Eduard Grube. *Koenigsberg*. 92 pp., available online at <https://www.biodiversitylibrary.org/item/40483#page/5/mode/1up> [details]

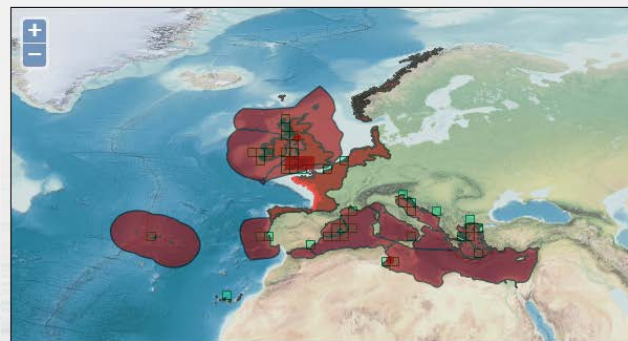
original description (of ★ *Stichopus selenkae* Barois, 1882) Barois, T. (1882). Catalogue des Crustacés podophthalmes et des Echinodermes recueillis à Concarneau. Catalogue des Crustacés podophthalmes et des Echinodermes recueillis à Concarneau : Unpaginated., available online at <https://doi.org/10.5962/bhl.title.53806> [details]

original description (of ★ *Holothuria forskahli* Della Chiaje, 1824) Della Chiaje, S. 1823 [1824?]. Descrizione zoologica ed anatomica di alcune specie di Oloturie. In: Memorie su la

Sources (7) Documented distribution (20) Specimens (0) Notes (3) Attributes (7) Vernaculars (11) Links (16) Images (9) Contexts (6)

Responsible editors (3)

[add distribution] [add map distribution(s)]



● GEBCO 2014

● NOAA ETOPO1

● Countries

● Google satellite

OBIS occurrences (402)

Bounding boxes

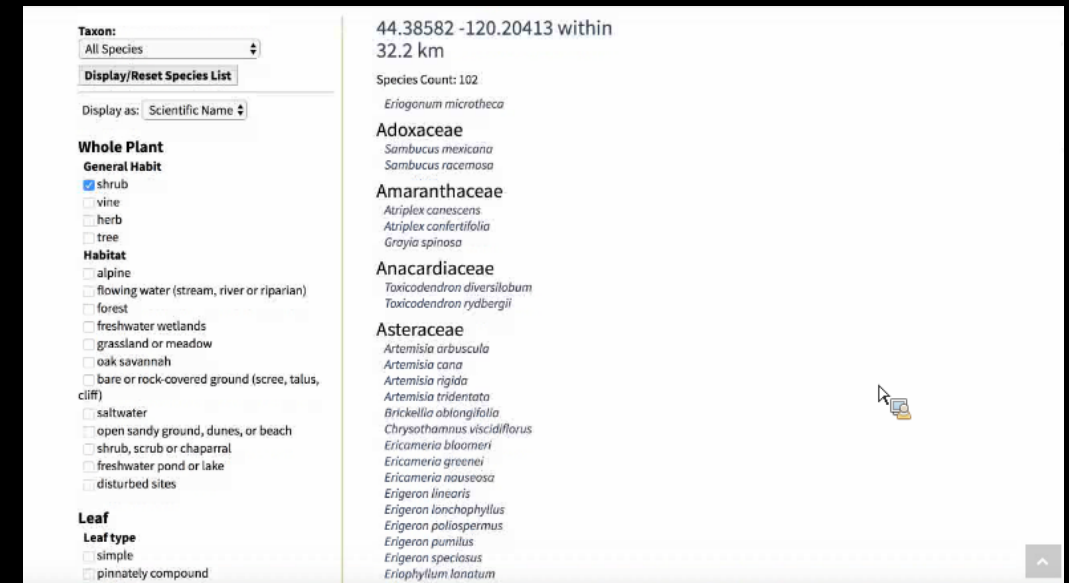
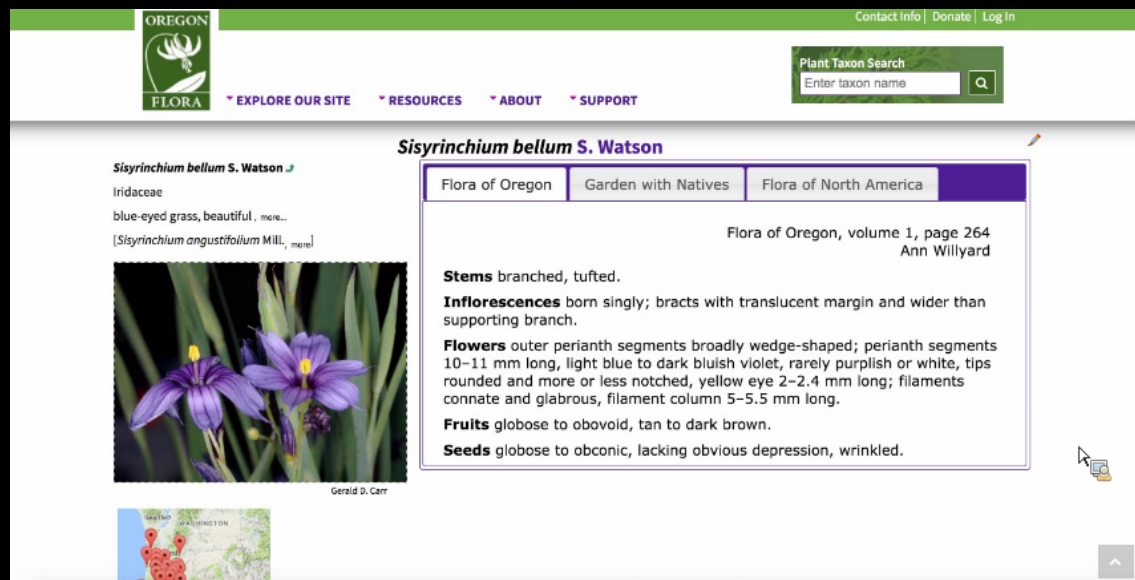
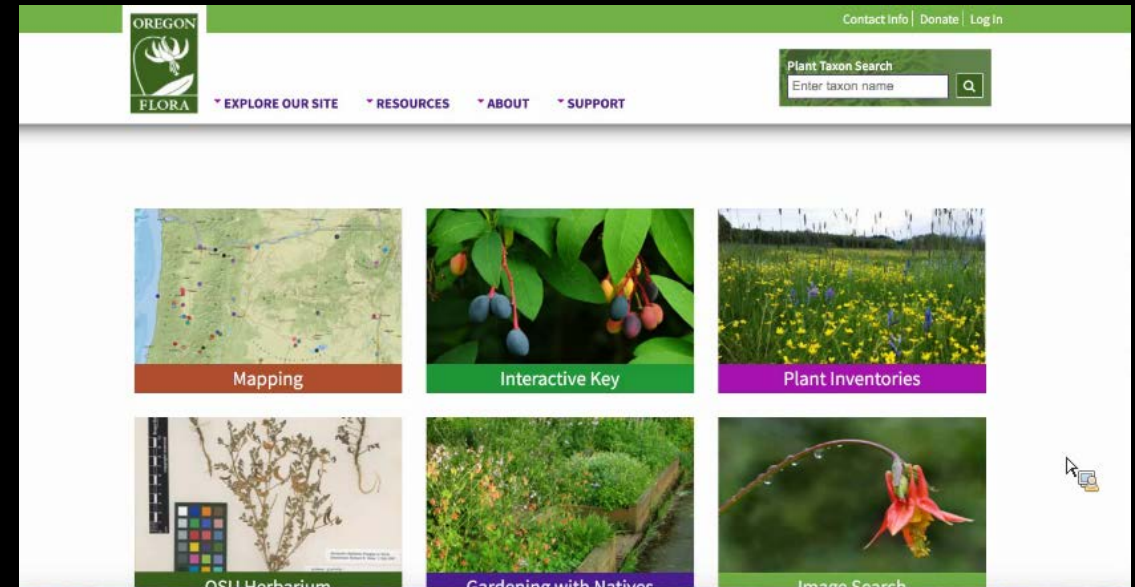
Centroid points

Polygons

● Present ● Inaccurate ● Introduced: alien ● Containing type locality

US model - Oregon Flora driven by Symbiota

- Authoritative checklist
- Integrated with vouchers
- Species pages
- Interactive keys
- Mapping



Summary

- 1.1 million lots to database
- Extended specimens
 - images, tissues, sequences, associations...
- Extended fauna
 - need for marine biodiversity synthesis

