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OCEANS INSTITUTE

MINDEROO FOUNDATION

Ocean Genomes: reference genome resources for marine vertebrates

Shannon Corrigan, PhD | Minderoo Foundation | Minderoo OceanOmics Centre at UWA

scorrigan@minderoo.org | shannon.corrigan@uwa.edu.au

Overview

1. Acknowledgements
2. Ocean Genomes overview & progress
3. Reference genomes, so what?

Acknowledgement of Country

OceanOmics/Ocean Genomes operates on Whadjuk Noongar land.

The Noongar people remain the spiritual and cultural custodians of their land and sea country, continuing to practice their values, languages, beliefs and knowledge.

We pay respects to the first nations peoples, their elders and ancestors of the country where we live and work across Western Australia and Australia.

Team

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Liam Anstiss [2]


Philipp Bayer [1,2]


Emma DeJong [2]


Anna Depiazzi [2]


Adrianne Doran [2]


Lauren Huet [2]


Lara Parata [2]


Tyler Peirce [2]

Marcelle Ayad [1], Adam Bennett [2], Mike Bunce [1,2], Steve Burnell [1,2], Ibrahim Faseeh [2], Matthew Fraser [1,2], Priscila Goncalves [1,2], Sang Huynh [2], Anya Kardailsky [2], Laura Missen [2], Georgia Nester [2], Eric Raes [1,2], Ebony Thorpe [2]

[1] Minderoo Foundation, Perth, Australia

[2] Minderoo OceanOmics Centre at UWA, Oceans Institute, The University of Western Australia, Perth, Australia

EARTH BIOGENOME PROJECT

VGP VERTEBRATE GENOMES PROJECT
A PROJECT OF THE G10K CONSORTIUM

Darwin TREE of LIFE

PacBio

millennium science

WAM WESTERN AUSTRALIAN MUSEUM

Minderoo Foundation

OceanOmics

We seek to uplift communities, support gender equality, protect natural ecosystems and respond to emerging threats and challenges.

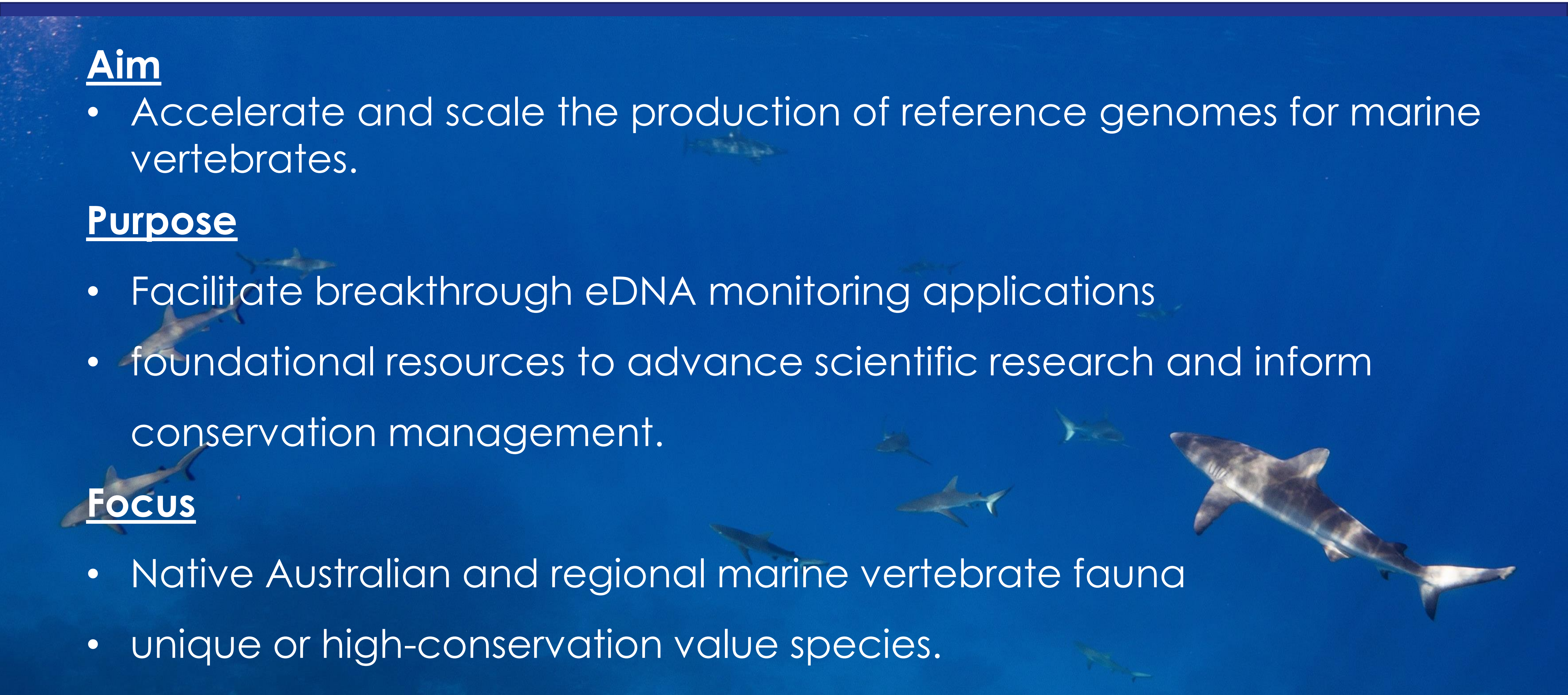
OceanOmics Centre

Genomics tools to transform marine biodiversity discovery & conservation.

Image credit: Giacomo d'Orlando / Ronin_Lab

eDNA biodiversity and reference genome datasets
Training, education & research opportunities

Ocean Genomes



Aim

- Accelerate and scale the production of reference genomes for marine vertebrates.

Purpose

- Facilitate breakthrough eDNA monitoring applications
- foundational resources to advance scientific research and inform conservation management.

Focus

- Native Australian and regional marine vertebrate fauna
- unique or high-conservation value species.

Ocean Genomes

EARTH BIOGENOME PROJECT
sequencing life for the future of life

- Tiered approach to reference resource generation

REPRESENTATIVE

reference genomes

CATALOGUE

VERTEBRATE GENOMES PROJECT
A PROJECT OF THE G10K CONSORTIUM

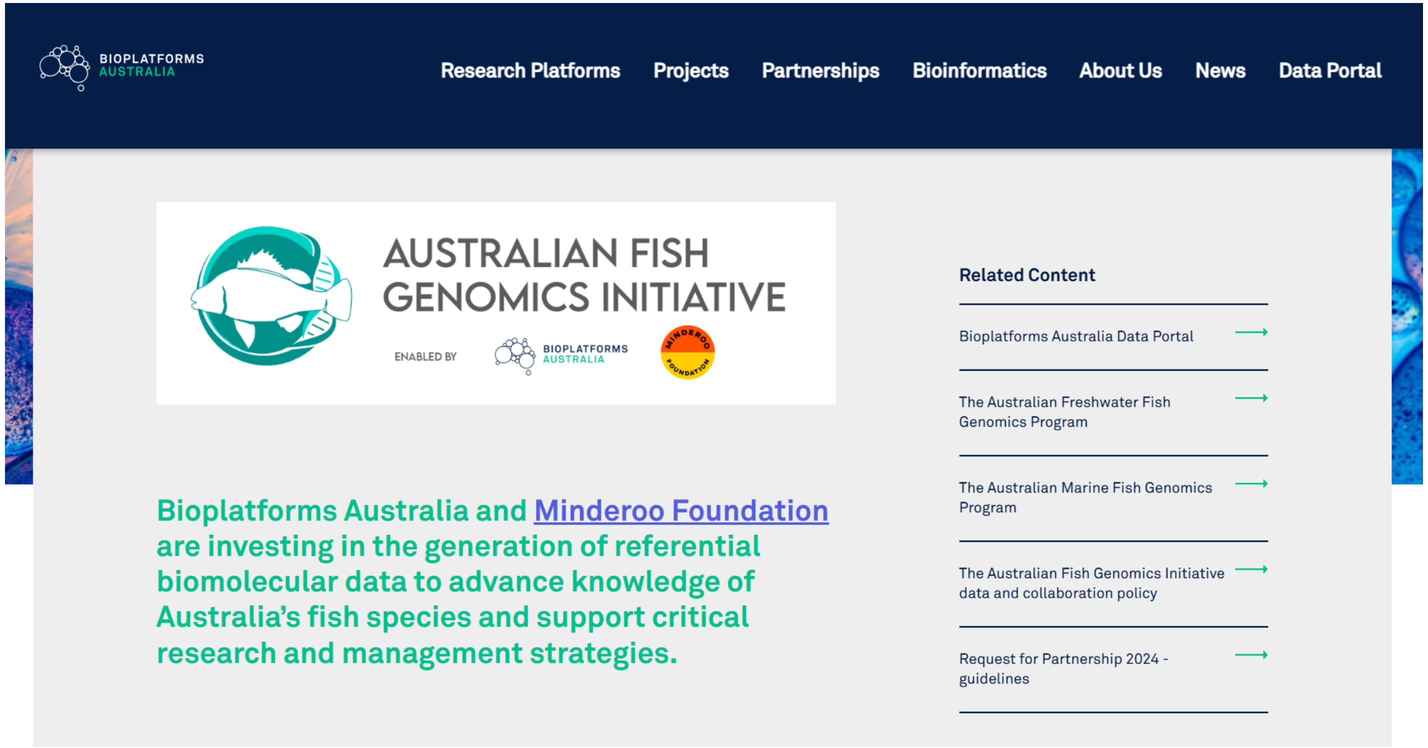
Threatened species

COMPREHENSIVE

‘draft’ genomes

Ocean Genomes

https://bioplatforms.com/projects/australian-fish-genomics-initiative/



Bioplatforms Australia and Minderoo Foundation are investing in the generation of referential biomolecular data to advance knowledge of Australia's fish species and support critical research and management strategies.

Fish play a crucial role in Australia's environmental health and economy. As the largest and most diverse group of vertebrates, with over 34,500 species described globally, Australia hosts approximately 5,000 fish species, including around 400 native freshwater species. A significant proportion of Australia's freshwater fish are endemic, and many species are still being discovered or described due to the challenges associated with access and identification. Advancements in our understanding of how aquatic organisms adapt to and interact with their environments, coupled with improved population monitoring and environmental assessment, are facilitated by genomics-informed technologies. These technologies address a broad range of needs related to fish evolution and biodiversity, conservation, fisheries, aquaculture, and environmental biosecurity, including pest and disease management.

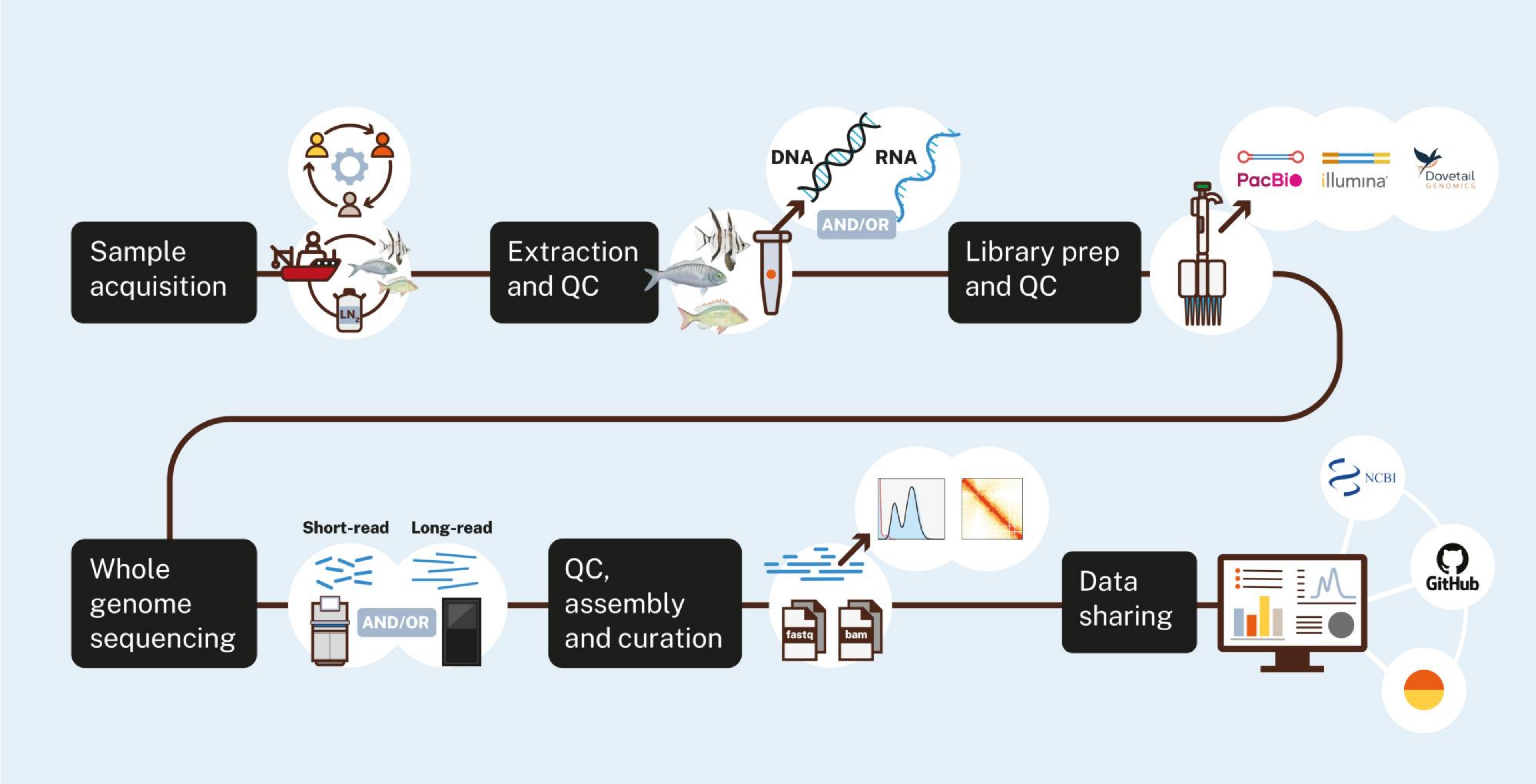
AIMS

The Australian Fish Genomics Initiative, in collaboration with the marine and freshwater research communities, aims to generate essential data for researchers and practitioners to accelerate the characterisation of Australia's fish species, enhancing our understanding of species adaptation, population dynamics, and evolutionary relationships.

Data types will include genomics, genetics (e.g., population genetics), transcriptomics, proteomics and metabolomics where required and include fish species from all major Australian habitats: freshwater, estuarine and marine environments. The Initiative will be progressing as two parallel themes:

- The Australian Freshwater Fish Genomics Program
- The Australian Marine Fish Genomics Program

Capabilities



Sample acquisition

Extraction and QC

Library prep and QC

Whole genome sequencing

QC, assembly and curation

Data sharing

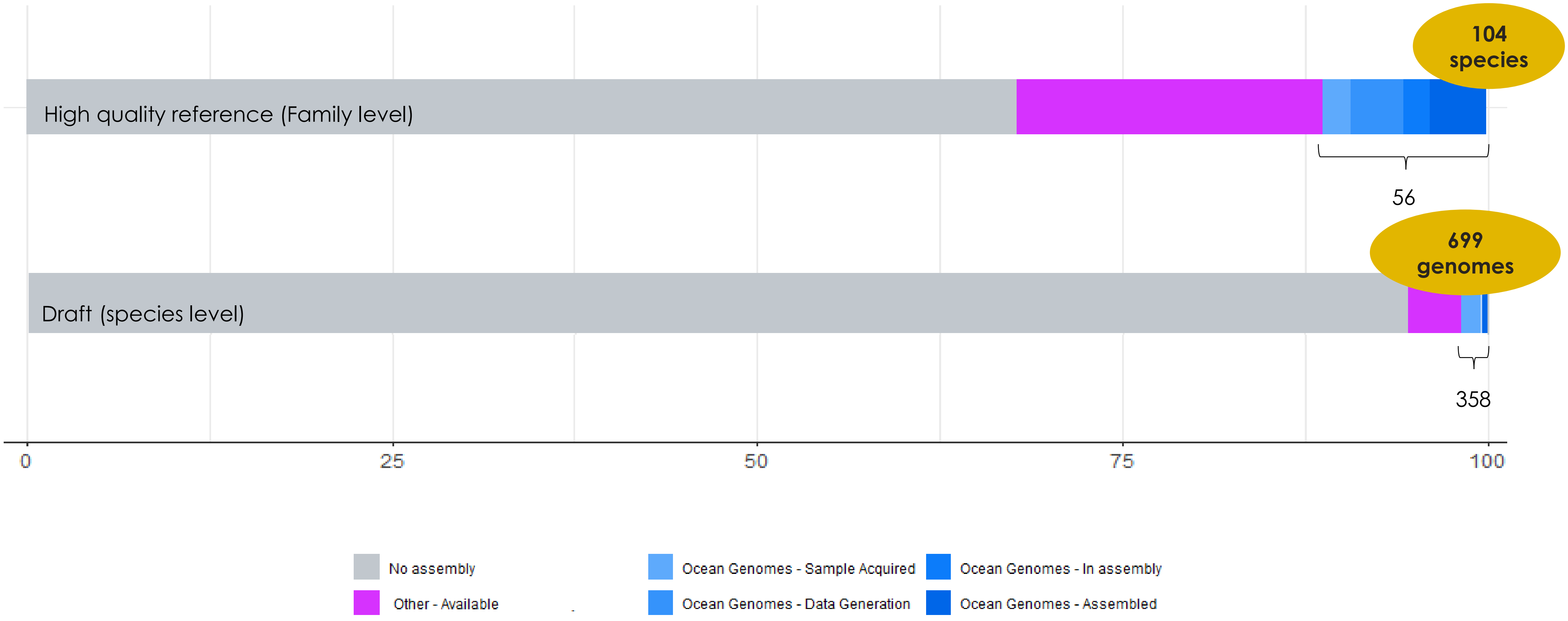
Scaling

- **PacBio Revio** increase throughput 5×
- **ultra-low input protocols** unlocking access to more diverse sample types
- **automated preparations** on Biomek i7 liquid handler
- **scalable & reproducible pipelines** for reference, draft & mito- assembly

Workflow	# samples	Manual prep	Automated prep	Throughput
PacBio SMRT Bell	96	24 hours	6 hours	4×
Illumina DNA Prep	96	24 hours	6 hours	4×
Dovetail Omni-C & LinkPrep	24	27 hours	6 hours	4.5×

https://github.com/MinderooFoundation/OceanOmics-OceanGenomes-ref-genomes
https://github.com/MinderooFoundation/OceanOmics-OceanGenomes-draft-genomes

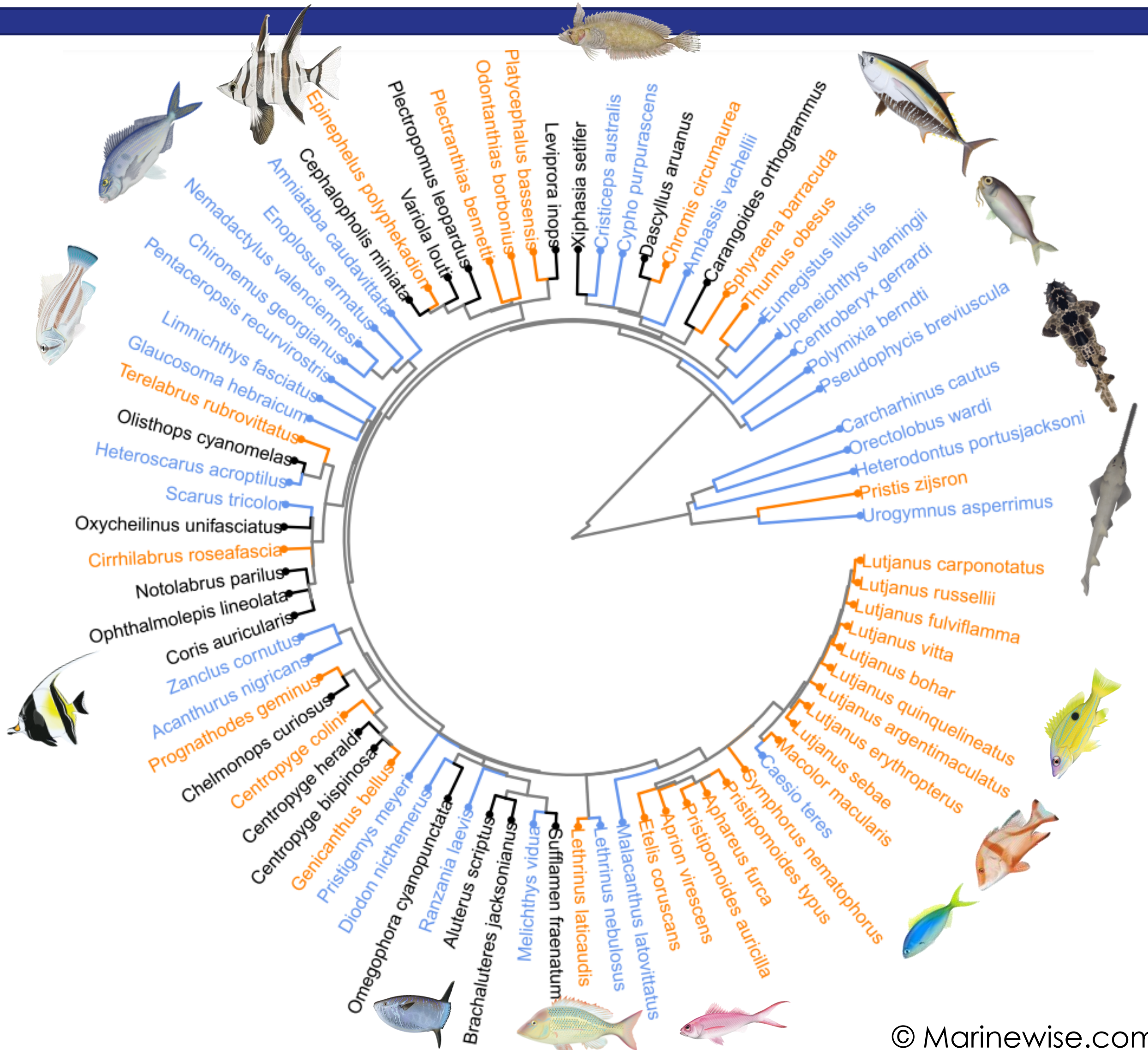
Reference genome progress



Capturing diversity

104 species, 56 families, 25 orders

- ✓ Encompass marine vertebrate diversity
- ✓ previously not represented in reference databases
- ✓ **first representative of a family**
- ✓ **high conservation value.**



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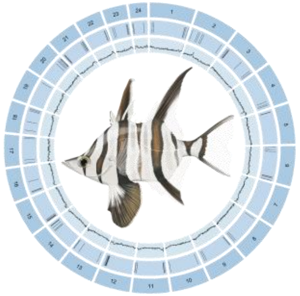
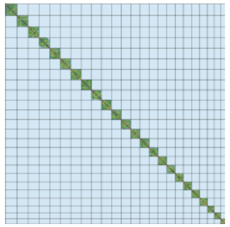
Reference genome quality





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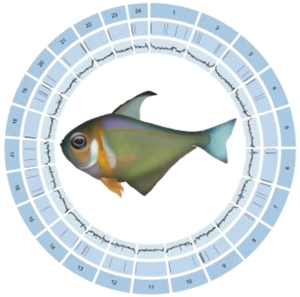

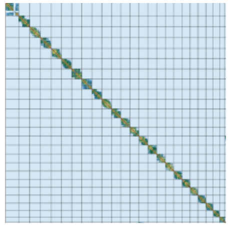

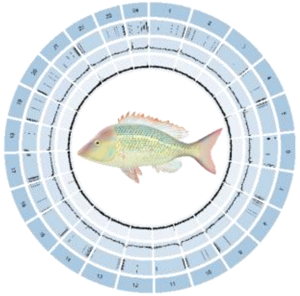

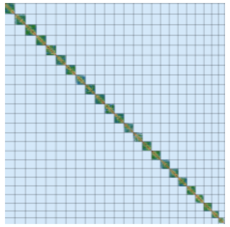

	Enoplosus armatus (fEnoArm2.1)		*Pempheris klunzingeri* (fPemKlu1.1)		*Lethrinus nebulosus* (fLetNeb1.1)	
	Haplotype 1	Haplotype 2	Haplotype 1	Haplotype 2	Haplotype 1	Haplotype 2
Assembly size (Mb)	579		591		1093	
scaffolds	135	94	442	84	226	151
Scaffold NG50 (Mb)	25.6	25.6	27.8	28.1	24.0	20.8
Contig NG50 (Mb)	17.1	16.0	13.7	14.9	48.5	47.5
BUSCO (%)	98.9	99	99.3	99.3	99.3	99.4
Gaps	114	100	87	93	196	244
Assigned (%)	99.5	99.7	96.9	99	99	99.2
QV	61.2	60.2	59.4	62.4	61.2	61.2

Data sharing & accessibility

- Commitment to open science & equitable access to data & benefit sharing

https://www.ncbi.nlm.nih.gov/bioproject/1046164

https://goat.genomehubs.org/projects/OG

https://edna.minderoo.org/
AWS open data S3://minderoo-oceanomics

Talk to me!

Philipp Bayer

eDNA biodiversity surveys

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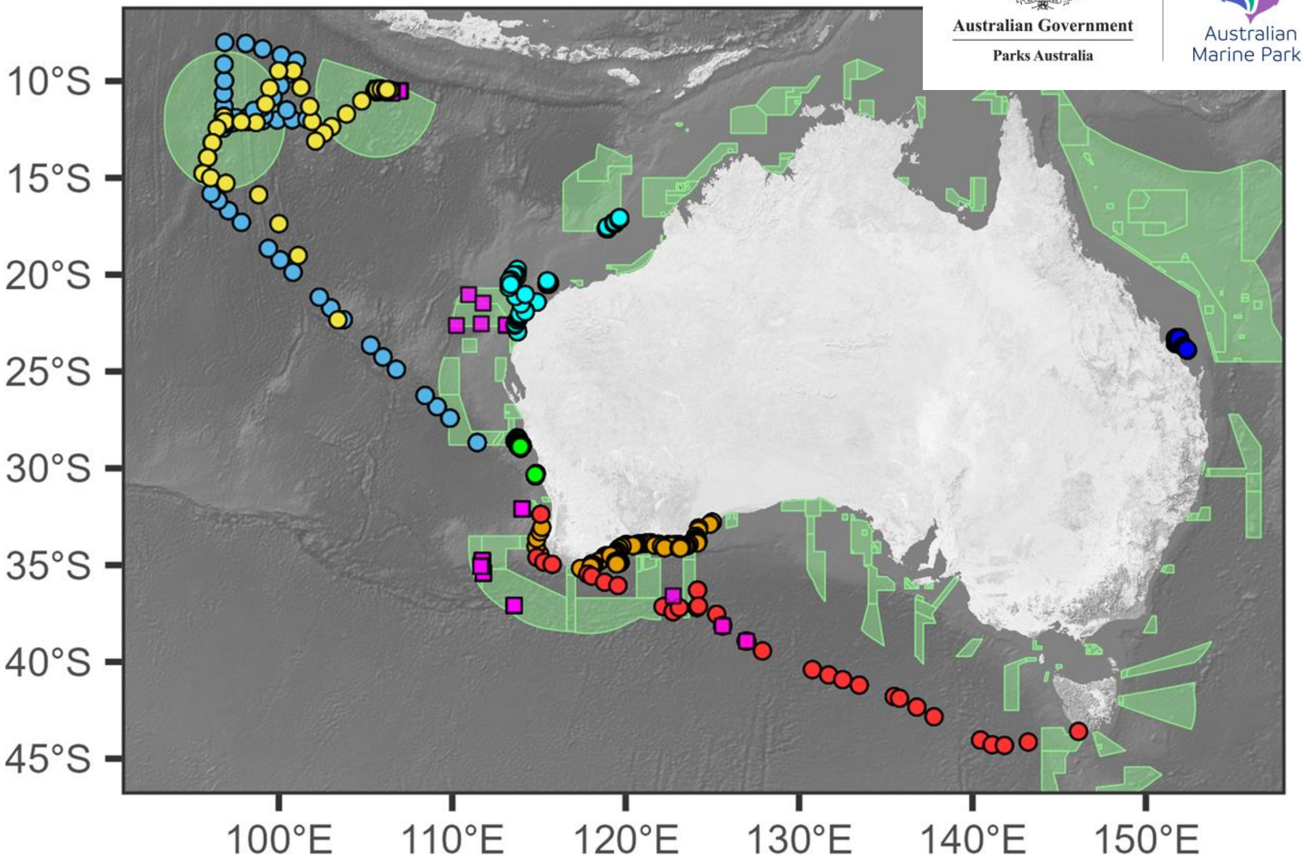
eDNA campaigns

Australian Government
Parks Australia

Australian Marine Parks

- ● Indian Ocean Territories 2023
- ● Cocos (Keeling) Islands 2022
- ● Abrolhos Islands 2021, 2022, 2023, 2024
- ● Great Southern Reef 2022, 2023
- ● Ningaloo Reef, Rowley Shoals, Montebello Is 2019, 2021, 2023
- ● Great Barrier Reef 2020
- ● Southern Ocean transect 2024
- ● Deep-sea Discovery 2022, 2023
- ■ Australian Marine Parks



SWWA sampling campaign

- Outstanding natural value
- high proportion of endemic species
- 100’s of islands & reefs, many uncharted
- new marine park zones late 2026.

SWWA sampling campaign

- Survey marine vertebrate fauna
- > 1000 km of coastline, spanning marine park boundaries
- 845 eDNA samples
- 162 tissue samples

SWWA results summary

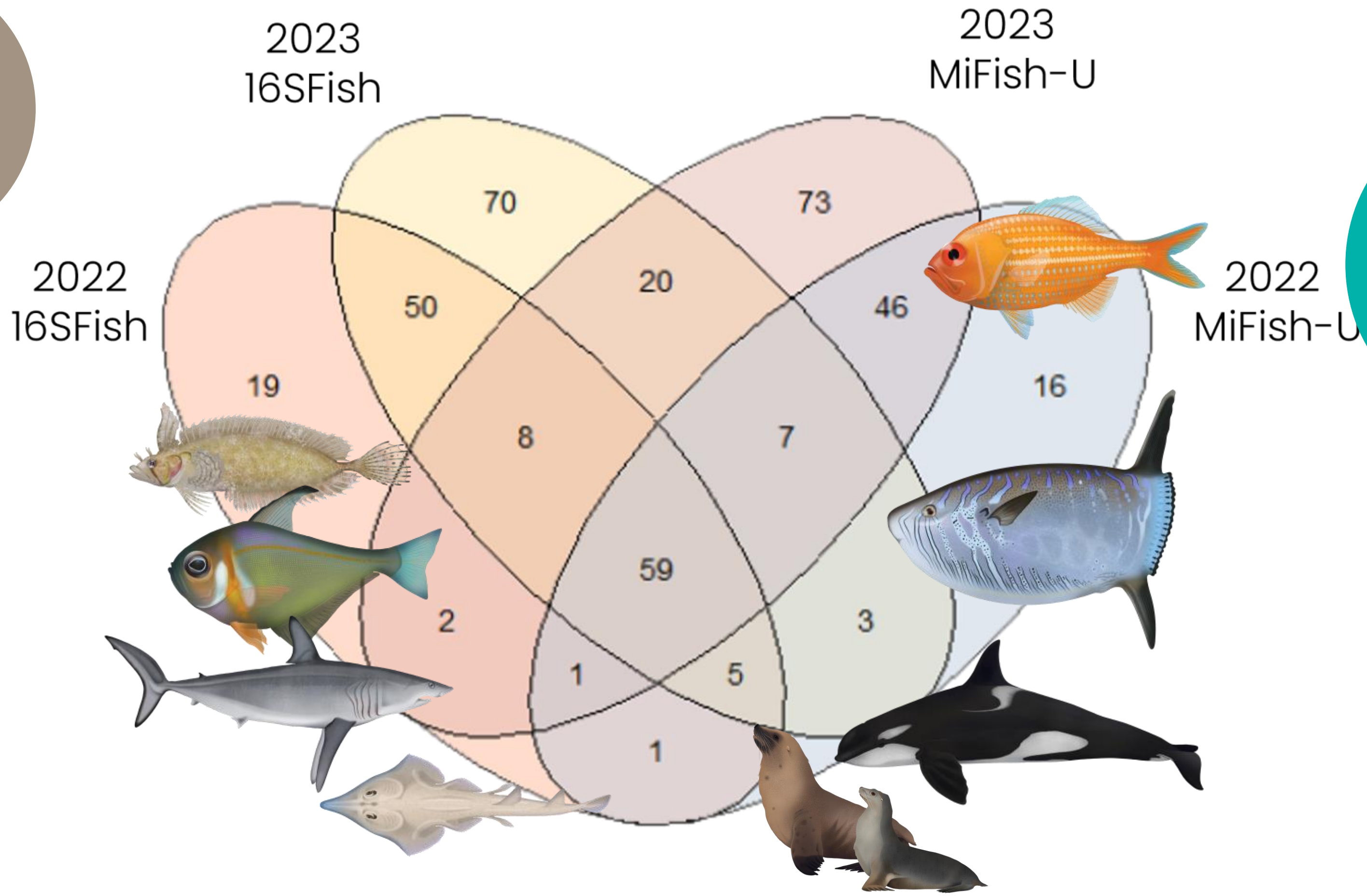
eDNA

86
sites

845
eDNA
samples

144
families

349
species



Genomes

73
species

14
draft

34
reference

20
first in
family

29
endemics

Rough Bullseye, *Pempheris klunzingeri*

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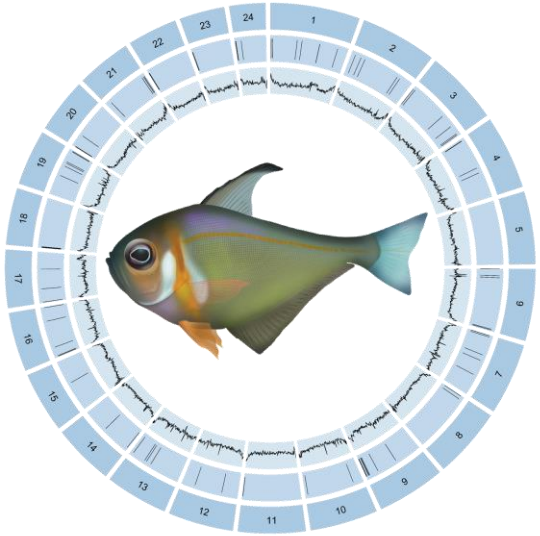

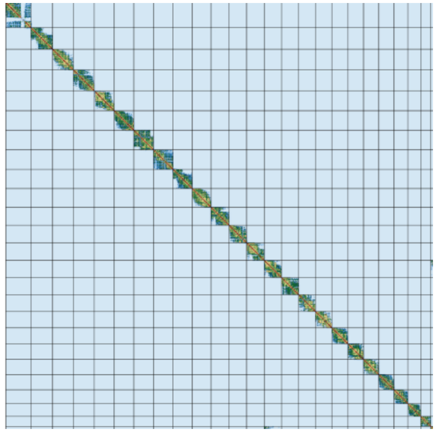

- Australian endemic
- first high-quality reference for Pempheridae
- first publicly available genetic data for this species.

	Haplotype 1	Haplotype 2
Assembly size (Mb)	591	
scaffolds	442	84
Scaffold NG50 (Mb)	27.8	28.1
Contig NG50 (Mb)	13.7	14.9
BUSCO (%)	99.3	99.3
Gaps	87	93
Assigned (%)	96.9	99
QV	59.4	62.4

Rough Bullseye,
Pempheris klunzingeri

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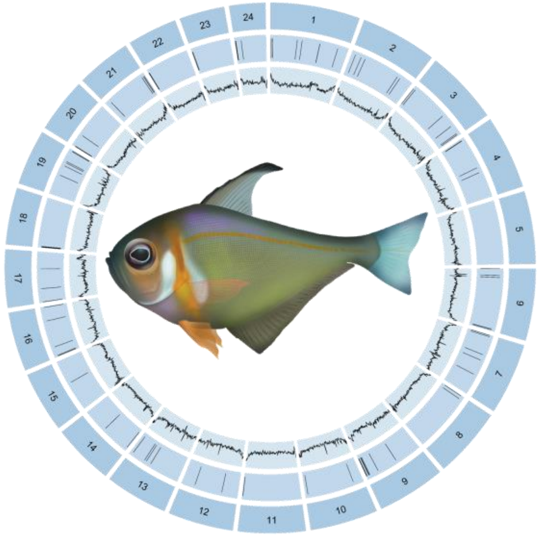

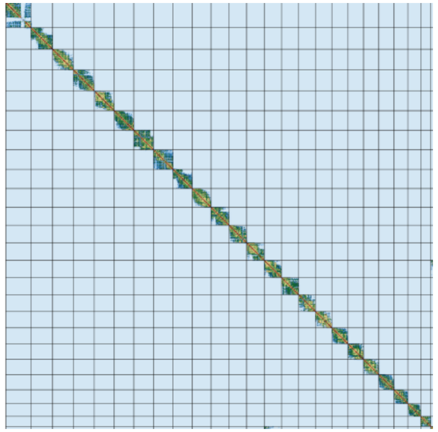

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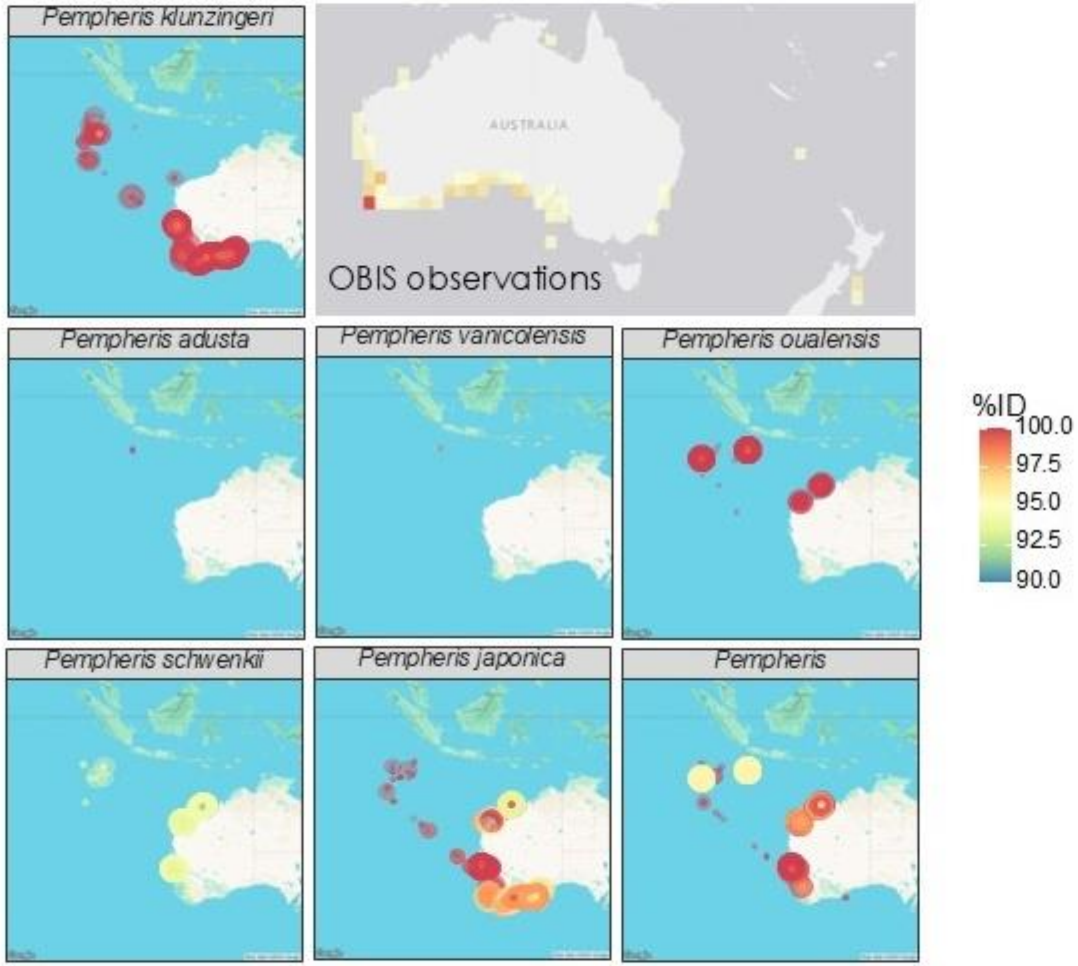
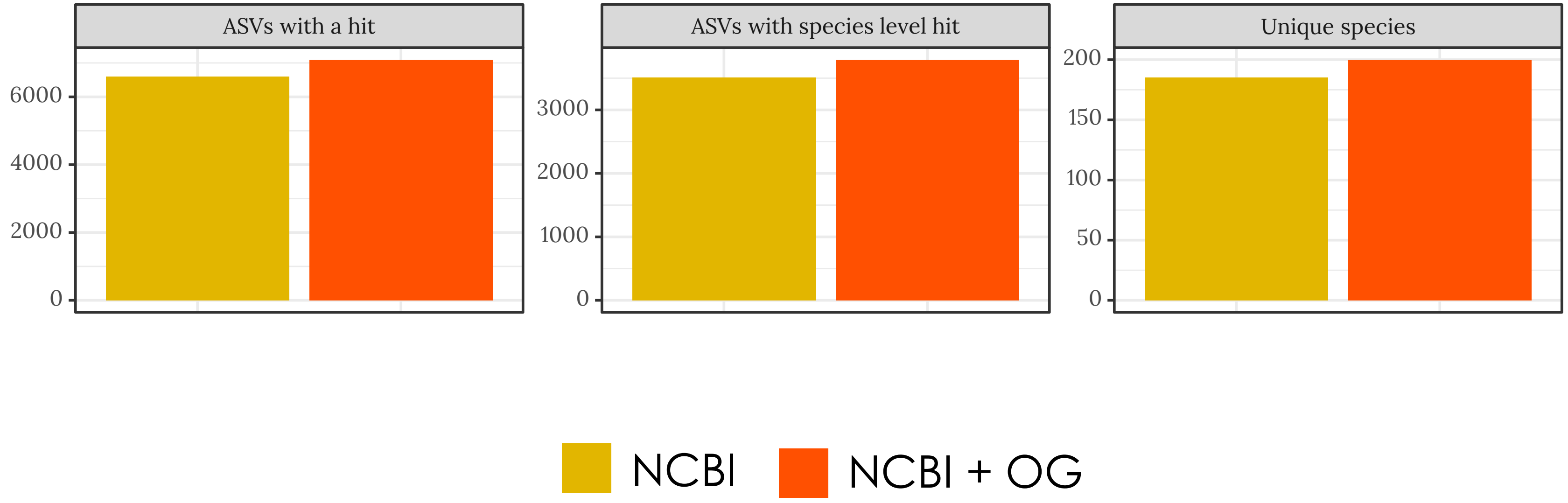


Impact

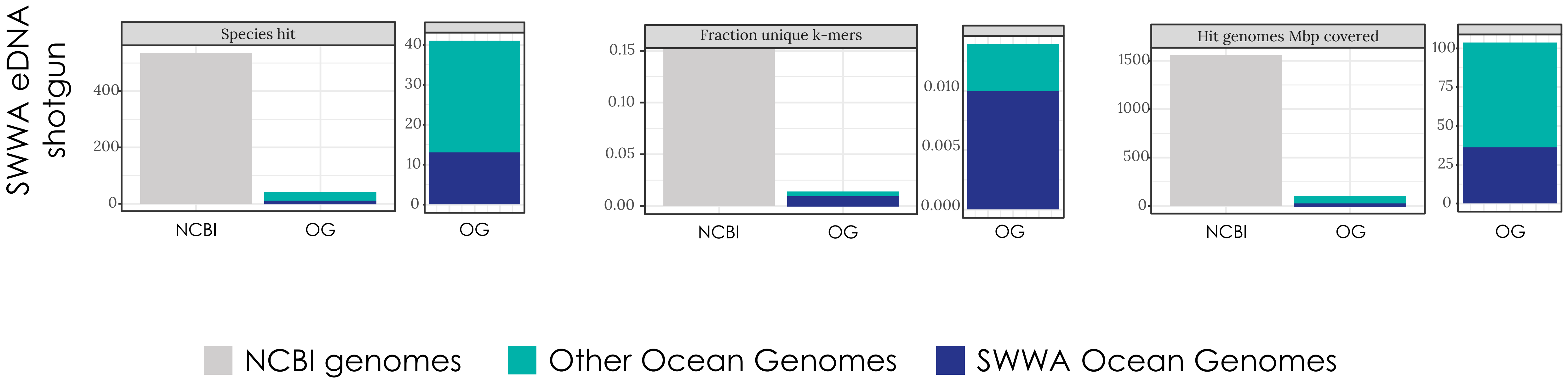
How much do we gain by adding new **mitogenome** references to databases?

SWWA eDNA
12S/16S
metabarcoding



Impact

How much do we gain by adding new **whole genome** references to databases?



Capacity building

Image credit: Giacomo d'Orlando / Ronin_Lab

Call to action

- Facilitate specimen & sample collection to represent unique diversity in reference databases
- best practice sequencing in place of provenance
- future proof reference & eDNA biodiversity collections.

scorrigan@minderoo.org | shannon.corrigan@uwa.edu.au
OceanOmicsCentre@uwa.edu.au

Acknowledgements

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Marcelle Ayad
Philipp Bayer
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Earth BioGenome Project
VGP Vertebrate Genomes Project — A project of the G10K Consortium
Darwin Tree of Life
Department of Primary Industries and Regional Development — Government of Western Australia
BushBlitz
CSIRO
illumina
Australian Museum
WAM Western Australian Museum
Ocean Diagnostics
Wagyl Kaip Southern Noongar Aboriginal Corporation
Flinders University
Oxford Nanopore Technologies
TrEnD Trace & Environmental DNA
Pawsey
Australian Government Parks Australia — Australian Marine Parks
Beckman Coulter
Promega
Cantata Bio
Australian Institute of Marine Science
Esperance Tjaltjraak Native Title Aboriginal Corporation
SARDI South Australian Research and Development Institute