INT2022-05 Determining the resilience of Fiordland corals to fisheries impacts

Department of Conservation
Te Papa Atawhai

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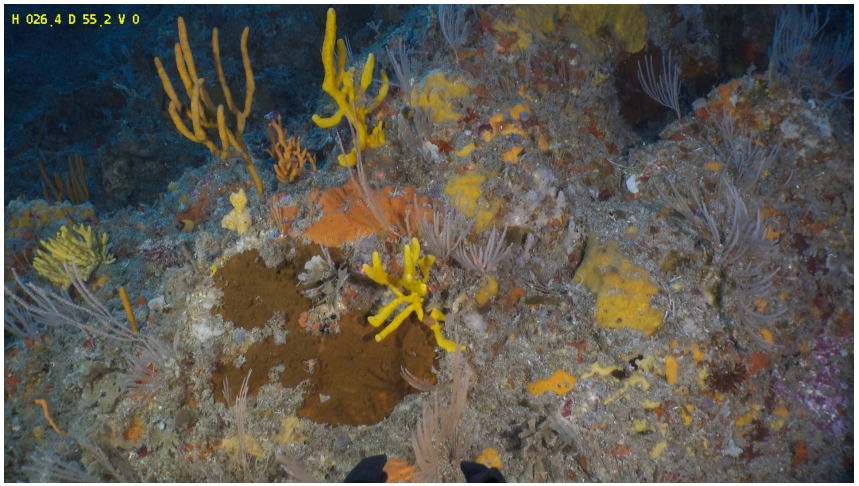

Broad project objectives:

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2. Increase understanding of the ecology and impacts of fishing on protected corals in Fiordland, including the black coral *Antipathella fiordensis* and stylasterid corals.

3. Use varied approaches (modelling, SCUBA and remotely operated vehicle ('ROV') surveys, pre-existing data) to inform our understanding of protected coral resilience to fishing impacts and threats in Fiordland, which can then be applied to these taxa in a wider context

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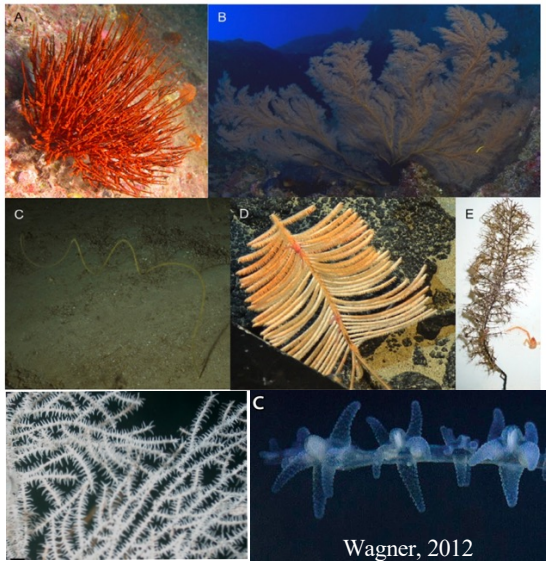
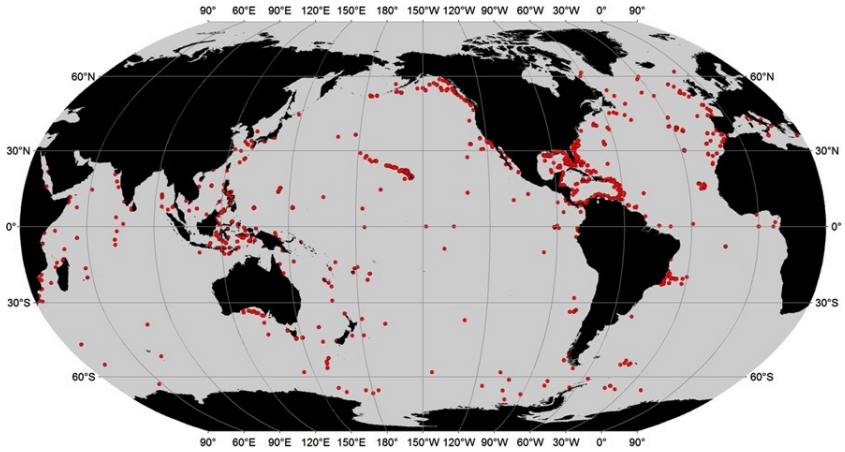
Antipatharians

Biology and Ecology

- Subphylum Anthozoan; class: Hexacorallia
- Colonial organisms with a wide range of morphology
- Ahermatypic
- 75% below 50 m
- Found in very low light environments below the photic zone





Global Antipatharians distribution
Wagner, 2012

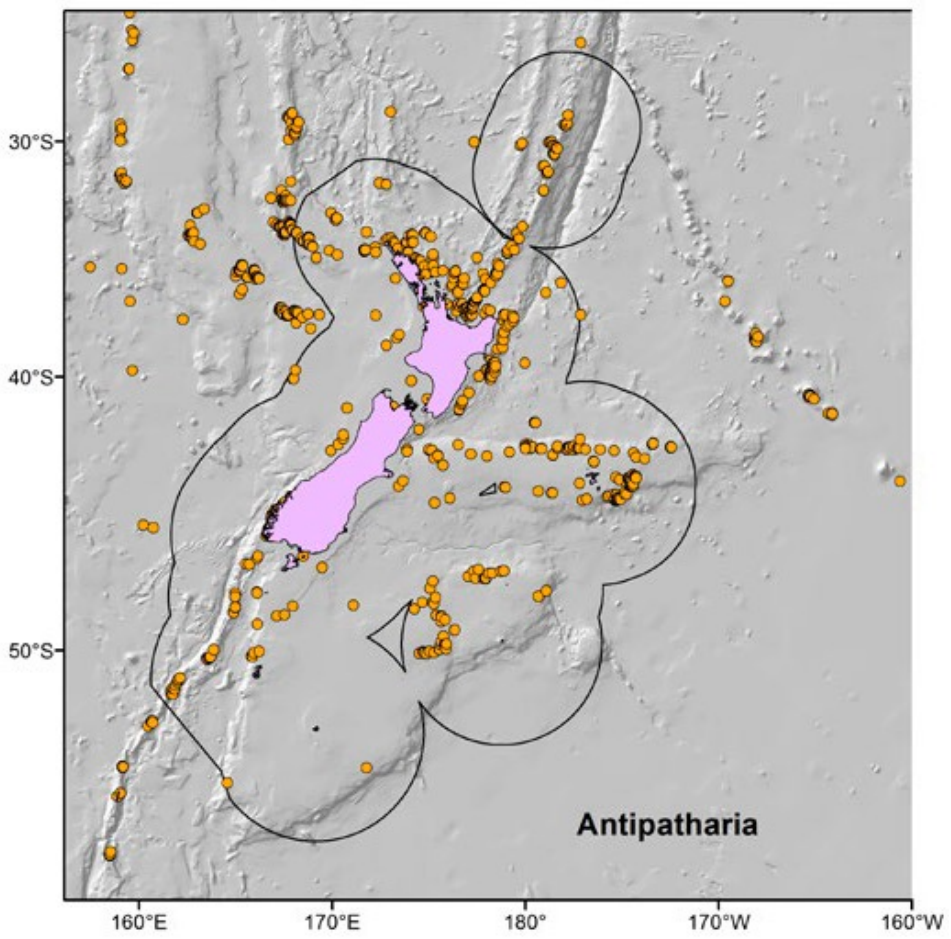
Antipatharians

Biology and Ecology

- Slow-grow rates / Longevity
- Habitat engineers
- Support sea-floor associated biodiversity and productivity
- Reproduction through both sexual and asexual processes. In general, polyps and colonies are gonochoric

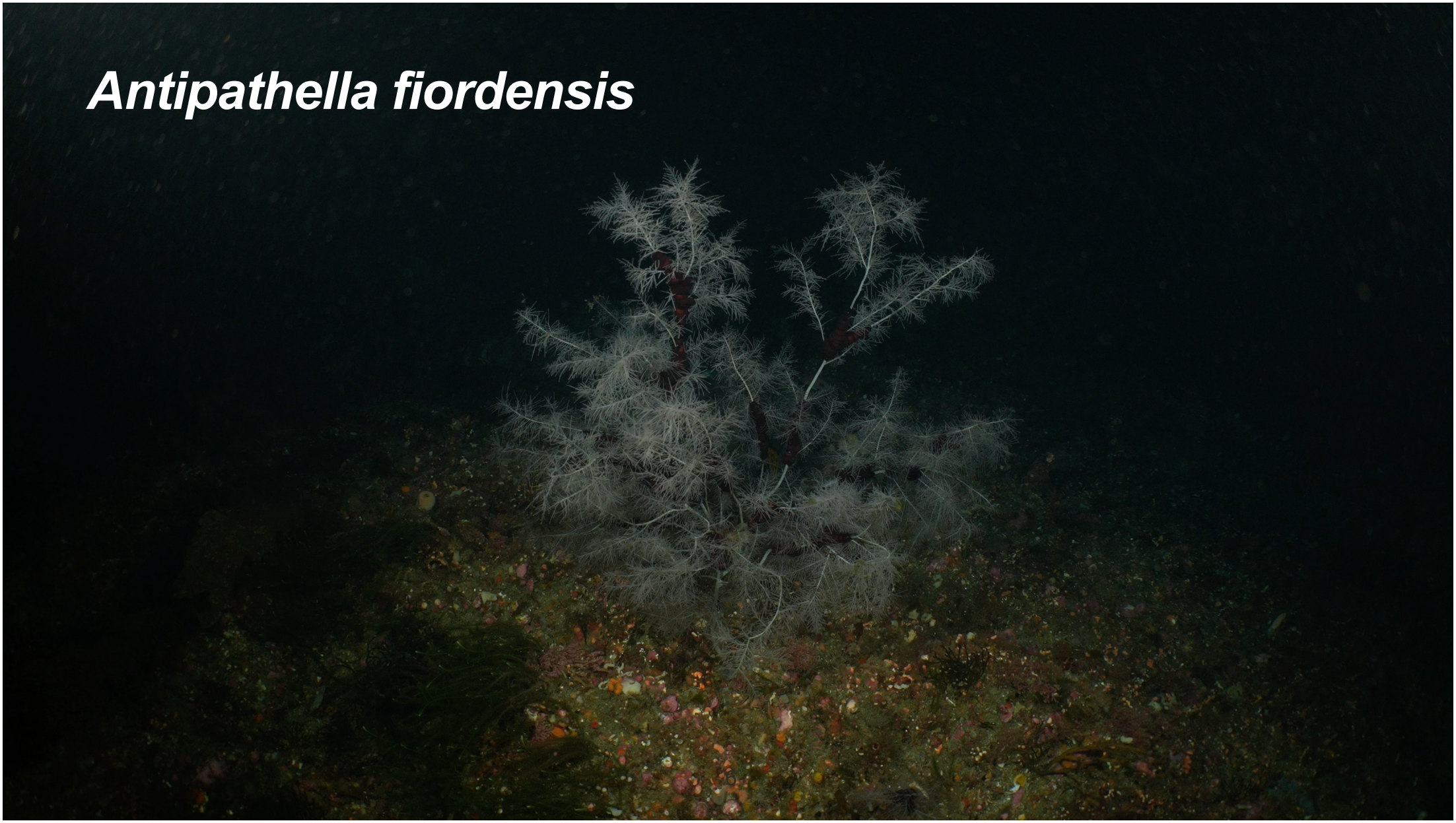
Black corals in New Zealand

- Predominantly deep-water group
- Around 60 described species found in New Zealand and another 20+ undescribed
- 1 ‘endemic' genus to the Fiordland region, *Antipathella fiordensis*.



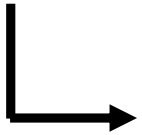
Recorded Distribution of Antipatharia around NZ

Anderson et al., 2016


Antipathella fiordensis

Current knowledge

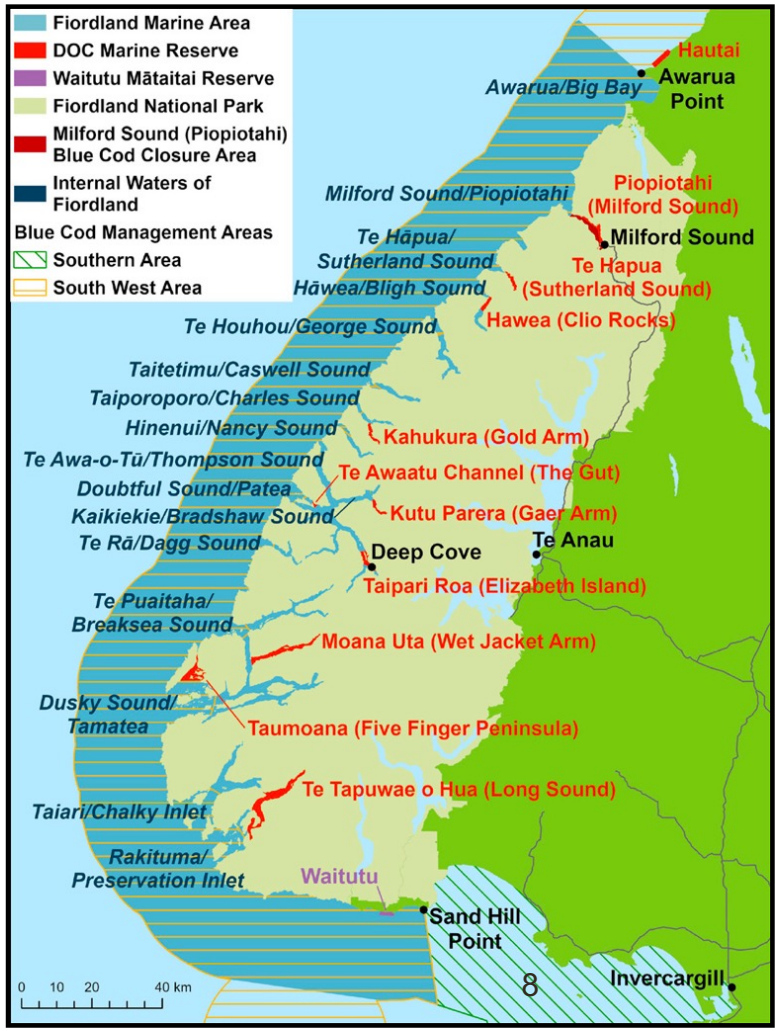
- Early reproductive and population genetic studies with allozymes (Grange, 1990; Miller, 1997)
- Growth/ultrastructure (Goldberg, 1991)
- Relationships with other mutualistic species (Parker et al., 1997) – *Astrobrachion constrictum*
- Distribution limits in relation to salinity (Jiang et al., 2015)
- Age (Hitt et al. 2020)



Less information on how resilient they are to different forms of disturbance and their recovery potential

Antipathella fiordensis

Fiordland Marine Management Act (FMMA 2005)



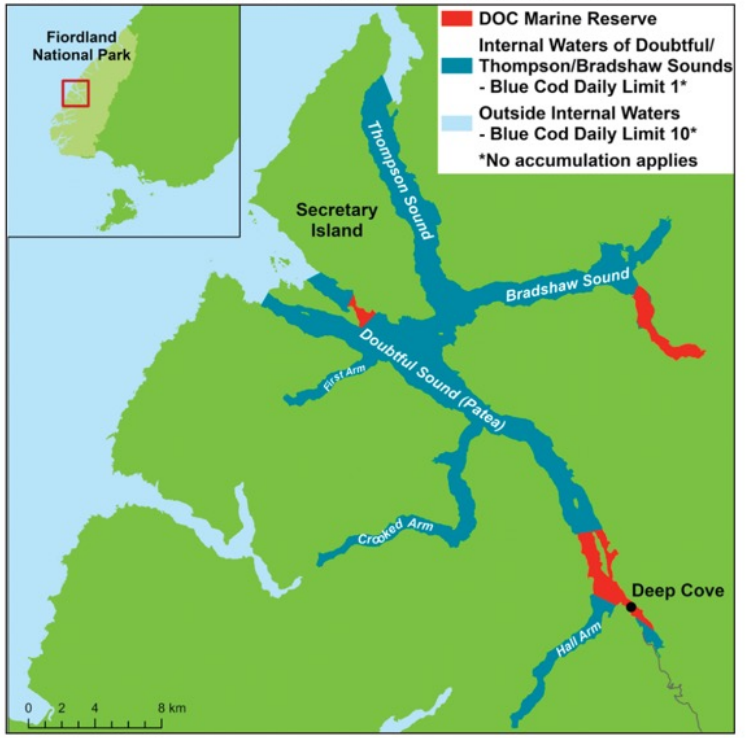
Fisheries New Zealand
Tini a Tangaroa

Recreational Fishing Rules
FIORDLAND

Effective from: November 2022 (subject to change without notice).

Doubtful Sound (Patea) fiord complex blue cod restricted area

Within the internal waters of Doubtful, Thompson and Bradshaw Sounds the daily tal and possession limit is one blue cod per person with no accumulation.



Study location

DOUBTFUL SOUND

40.4 km long, the deepest of all fiords (434 m)

Spit in 3 distinct arms - Hall Arm, Crooked Arm, First Arm and 2 outer Sounds- Bradshaw and Thompson Sounds

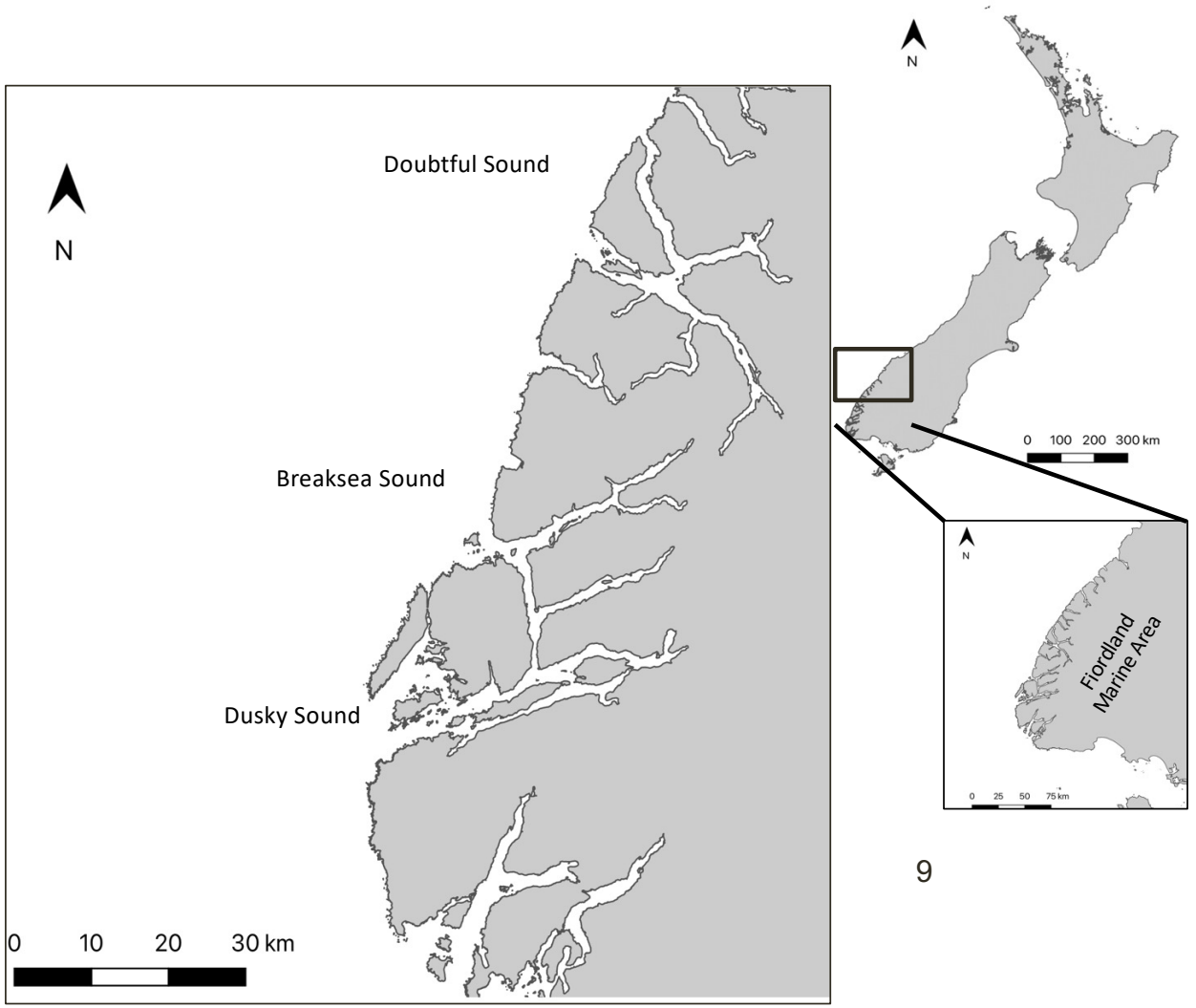
Manapouri Hydropower station

BREAKSEA-DUSKY SOUNDS SYSTEM

Biggest fiord complex with Acheron passage (15km) connecting the two Sounds

Breaksea (33km) split in 2 arms – Vancouver Arm and Broughton Arm

Dusky is the longest and most extensive fiord (43.9 km) split into 2 main channels



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Investigate the spatial distribution and population size-structure

- Assessing the spatial and size frequency distribution along a vertical and horizontal gradient to quantify the abundance and size structure within and across different fiords
- Characterise distribution patterns across fiords and with depth
- Identify environmental variables that best predict the distribution

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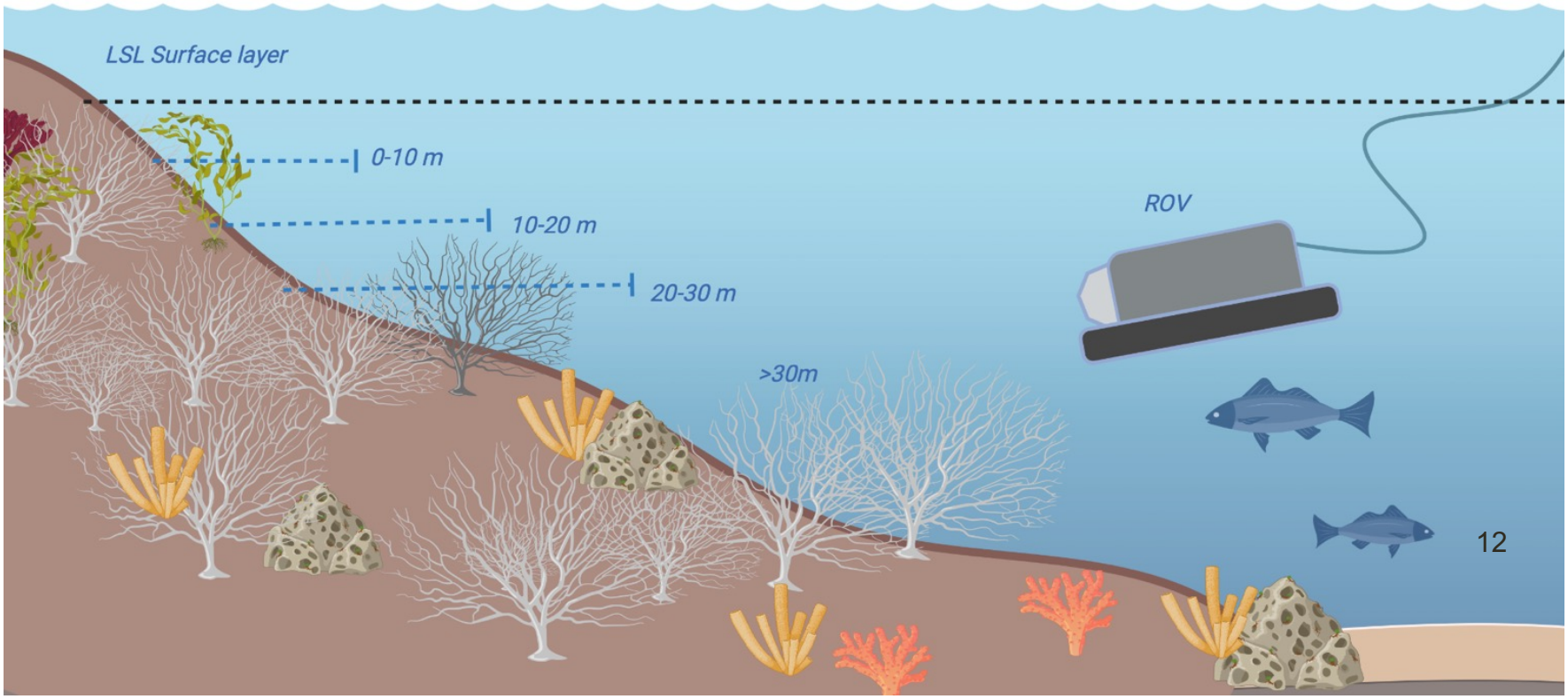
Methods

FIELD SAMPLING

Abundance and Size

SCUBA diving	ROV
3 x 15 m x 2 m transects	3 x 15 m x 2 m transects
15 m	>50 m



Data collection trips:

January 9th-14th 2023 – RV Southern Winds – focused on Doubtful and Thompson sounds

March 17th-22nd 2023 – MV Pembroke – focused on Dusky and Breaksea Sounds

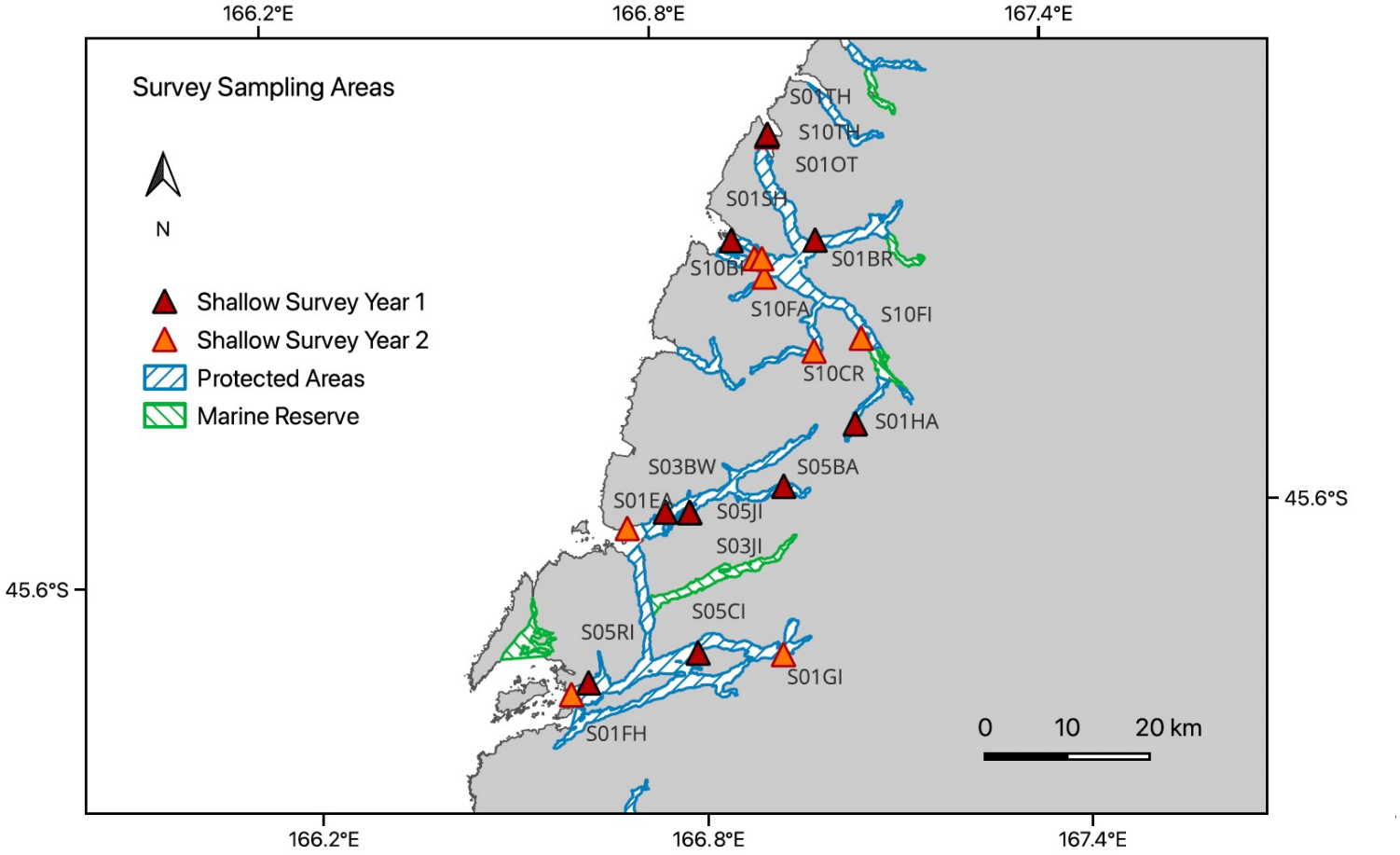
May 17th-13th 2023 - MV Pembroke – focused on Dusky and Breaksea Sounds

October 9th-14th 2023 - RV Southern Winds – focused on Doubtful Sound

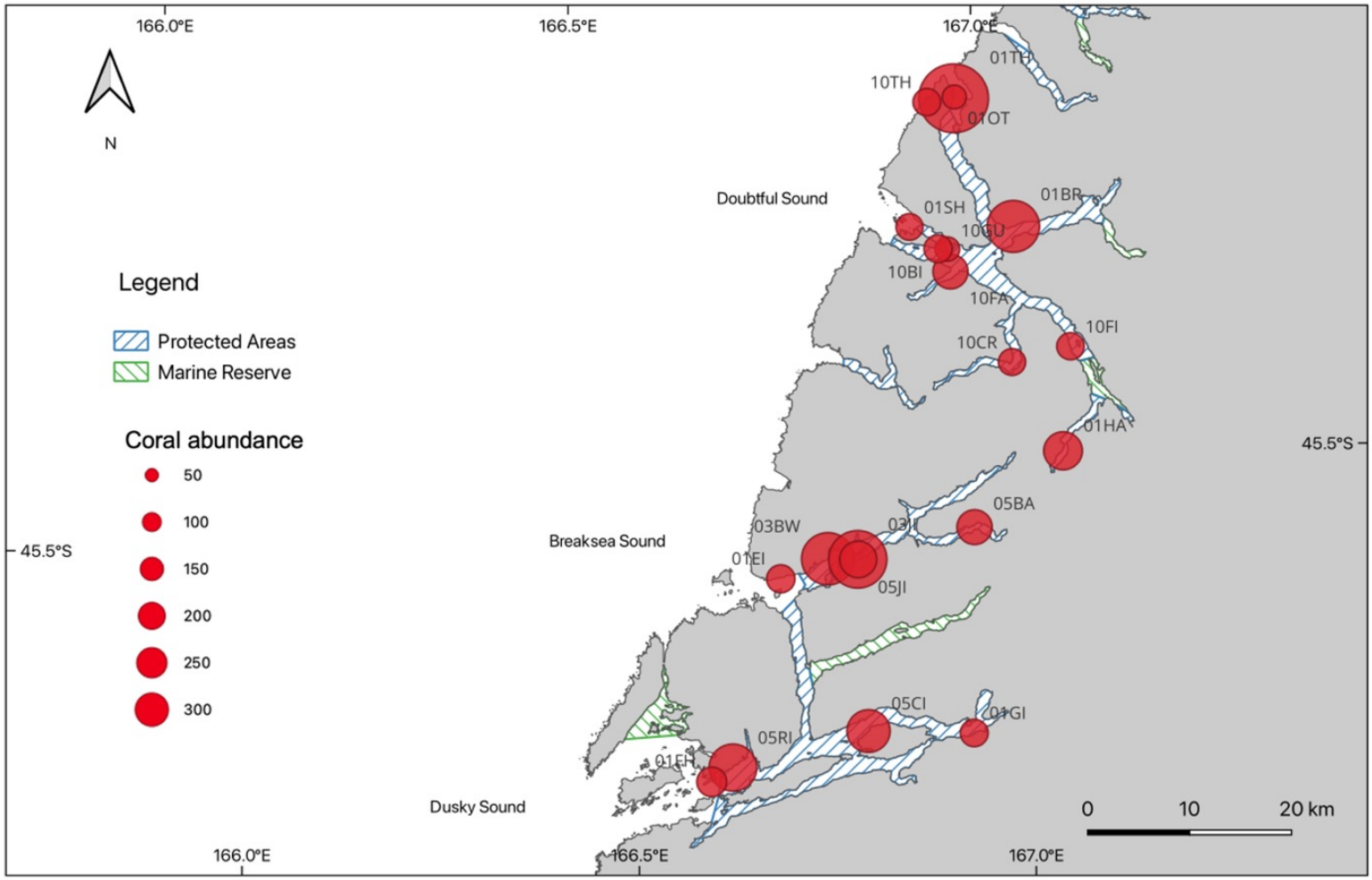
January 8th-13th 2024 - RV Southern Winds – focused on Doubtful and Thompson sounds

May 12th-18th 2024 - MV Pembroke – focused on Dusky and Breaksea Sounds (only included the collection of the remaining genetic samples, no other sampling)

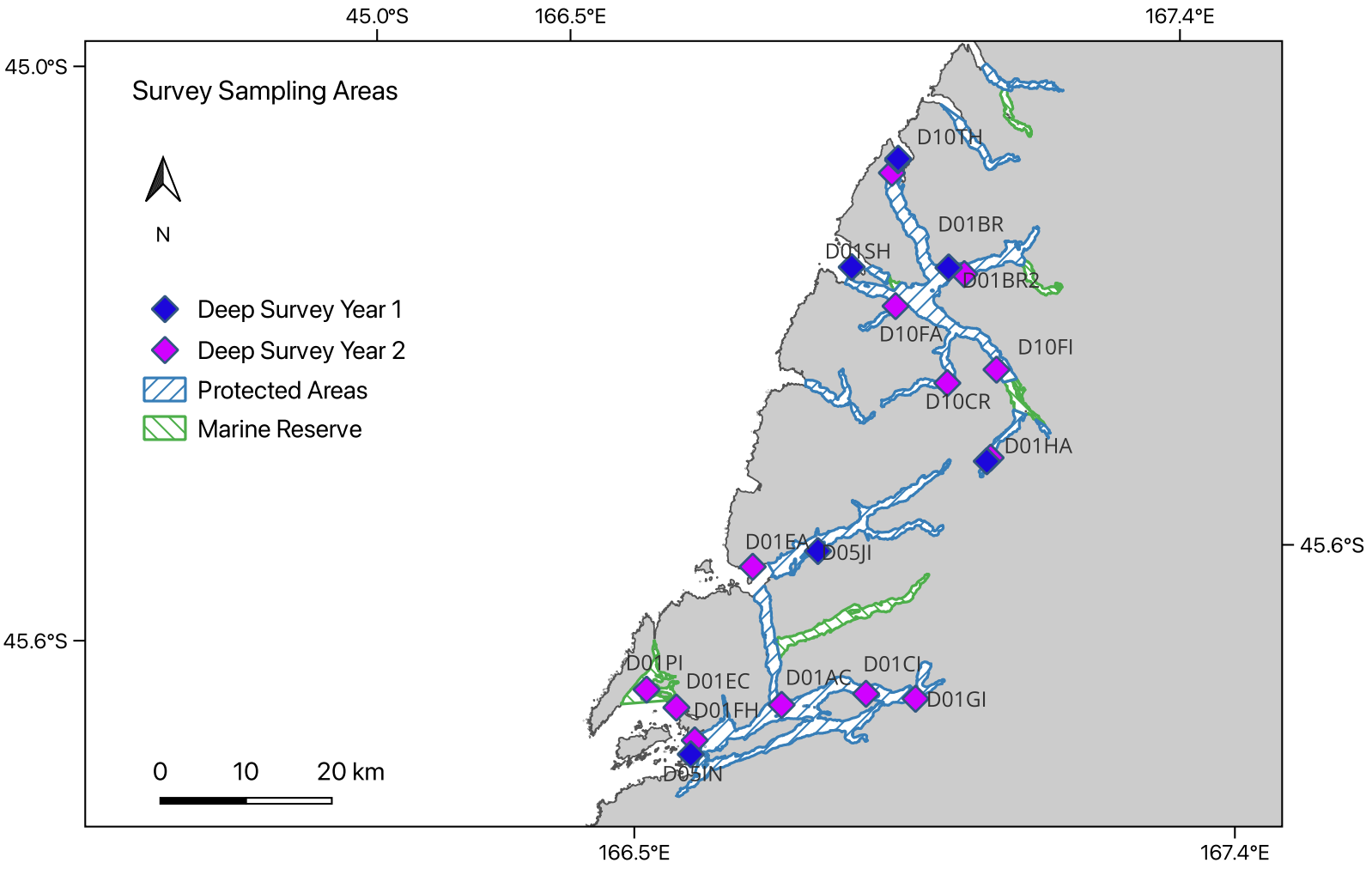
Black Coral Abundance



Location of shallow black coral abundance surveys in Doubtful, Breaksea and Dusky Sounds



Total abundance of black corals (based on 3 x 15 x 2 m transects) across Doubtful, Breaksea and Dusky Sounds



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Location of deep black coral abundance surveys in Doubtful, Breaksea and Dusky Sounds

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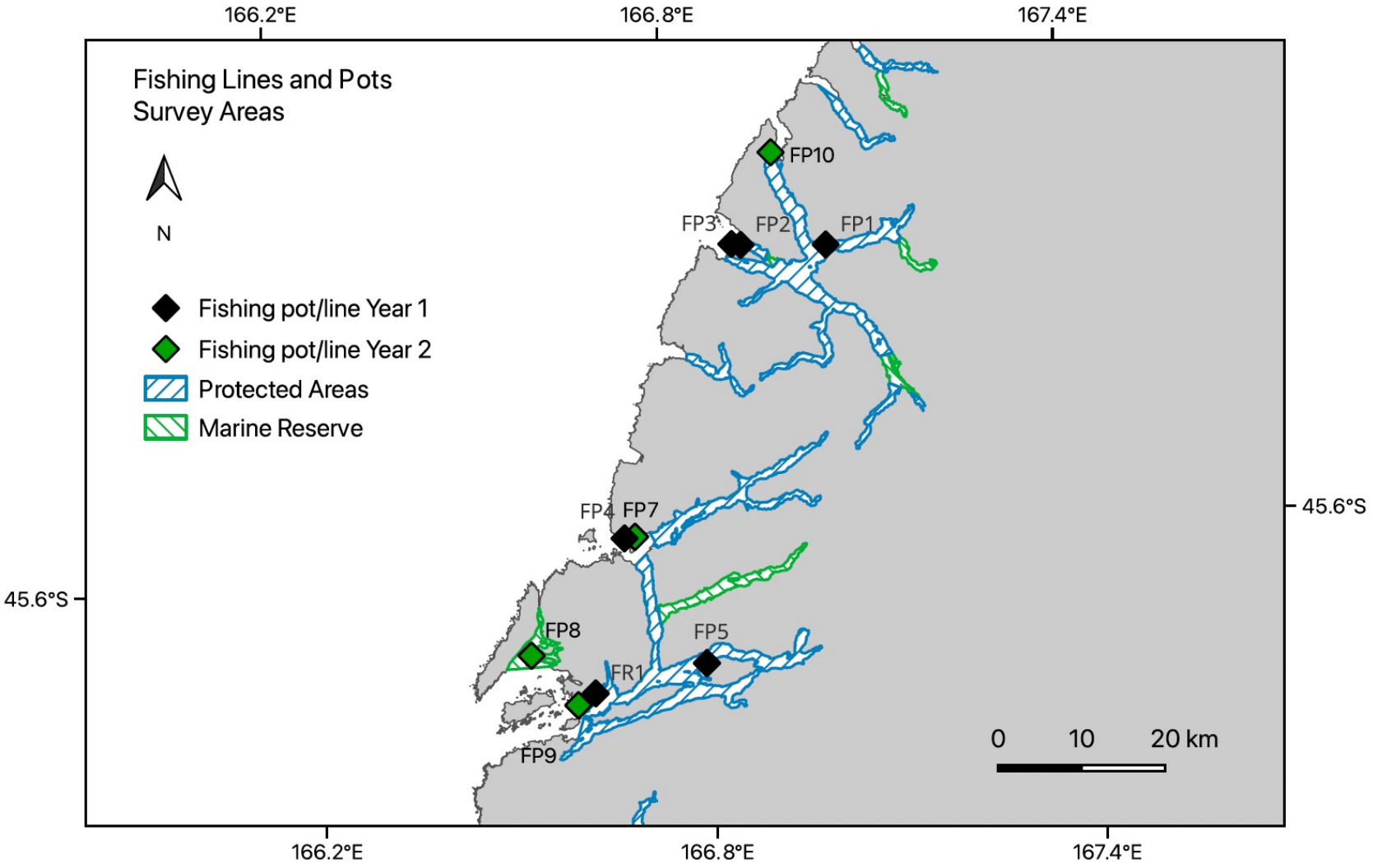
Approaches to this include:

- Document ‘lost’ pots and ropes
- Assess any damage to black coral populations
- Use previous catch databases and records to assess overlap between black coral and fisheries



Locations where ‘lost’ fishing pots have been found

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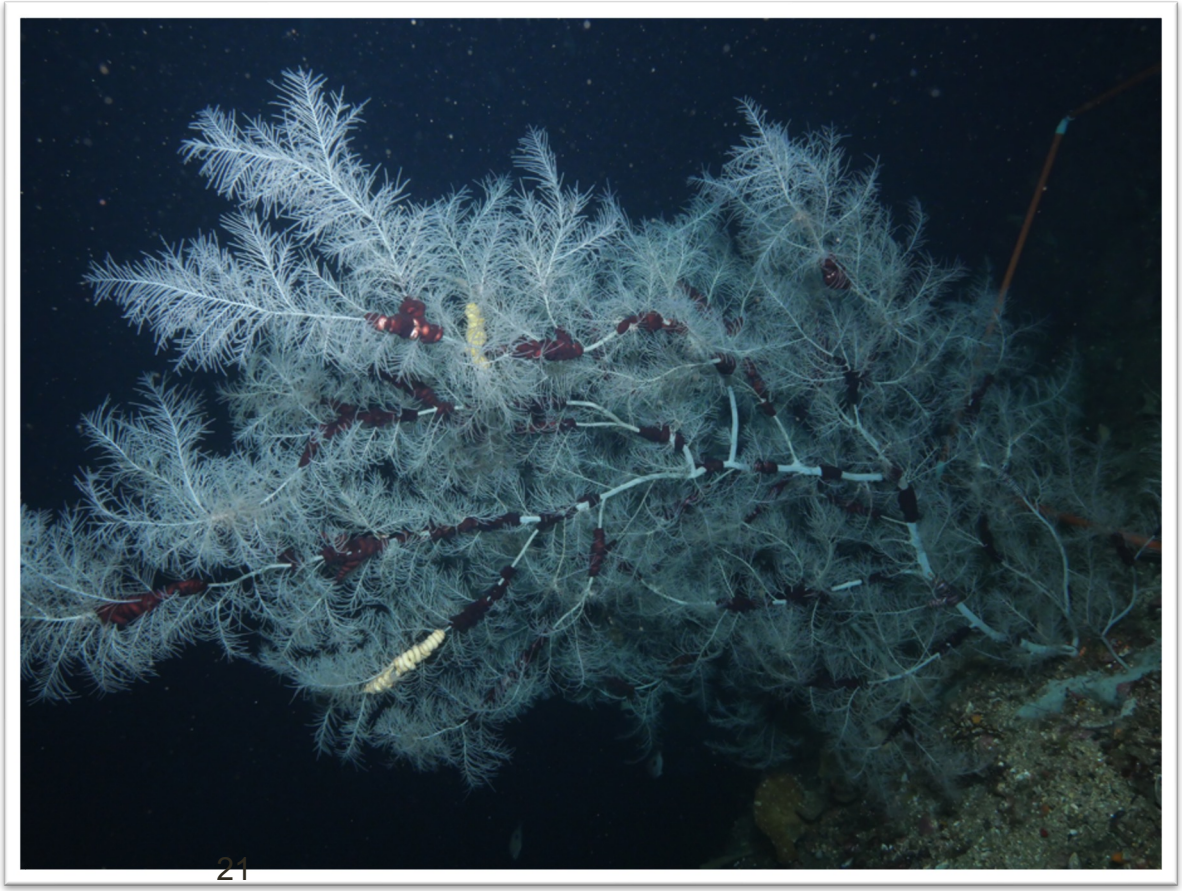
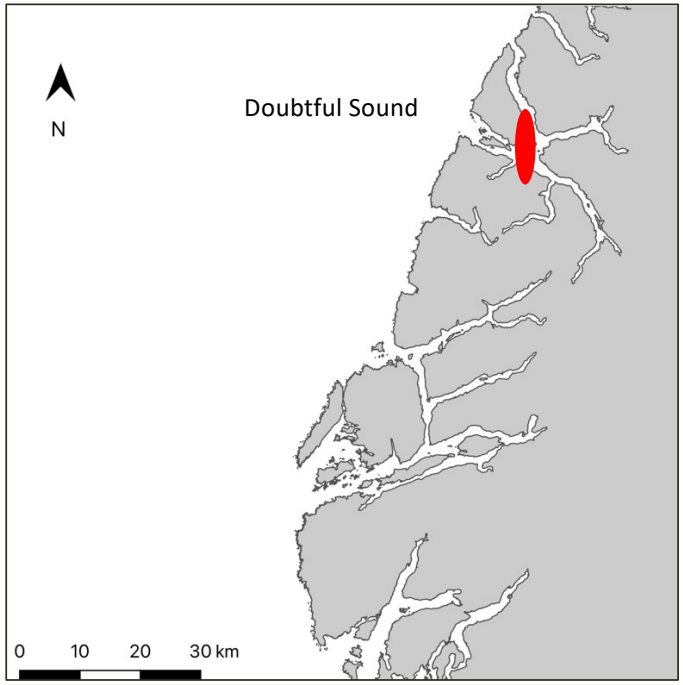
Develop a population model to investigate how population may be impacted by changing environmental conditions

- Determine how demographic processes affect population dynamics and viability under different scenarios
- Predict the recovery of populations from environmental impacts



Methods

DATA SOURCING



MODELING/STATISTICAL ANALYSIS

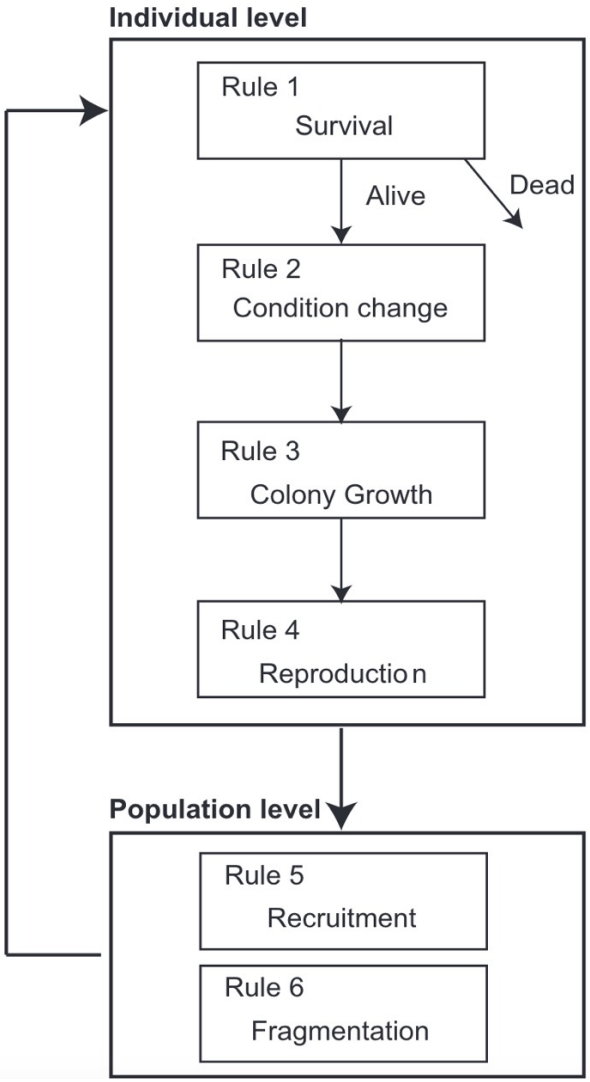
Size-age records from NIWA/Cawthron Institute dataset for Doubtful Sound

↓

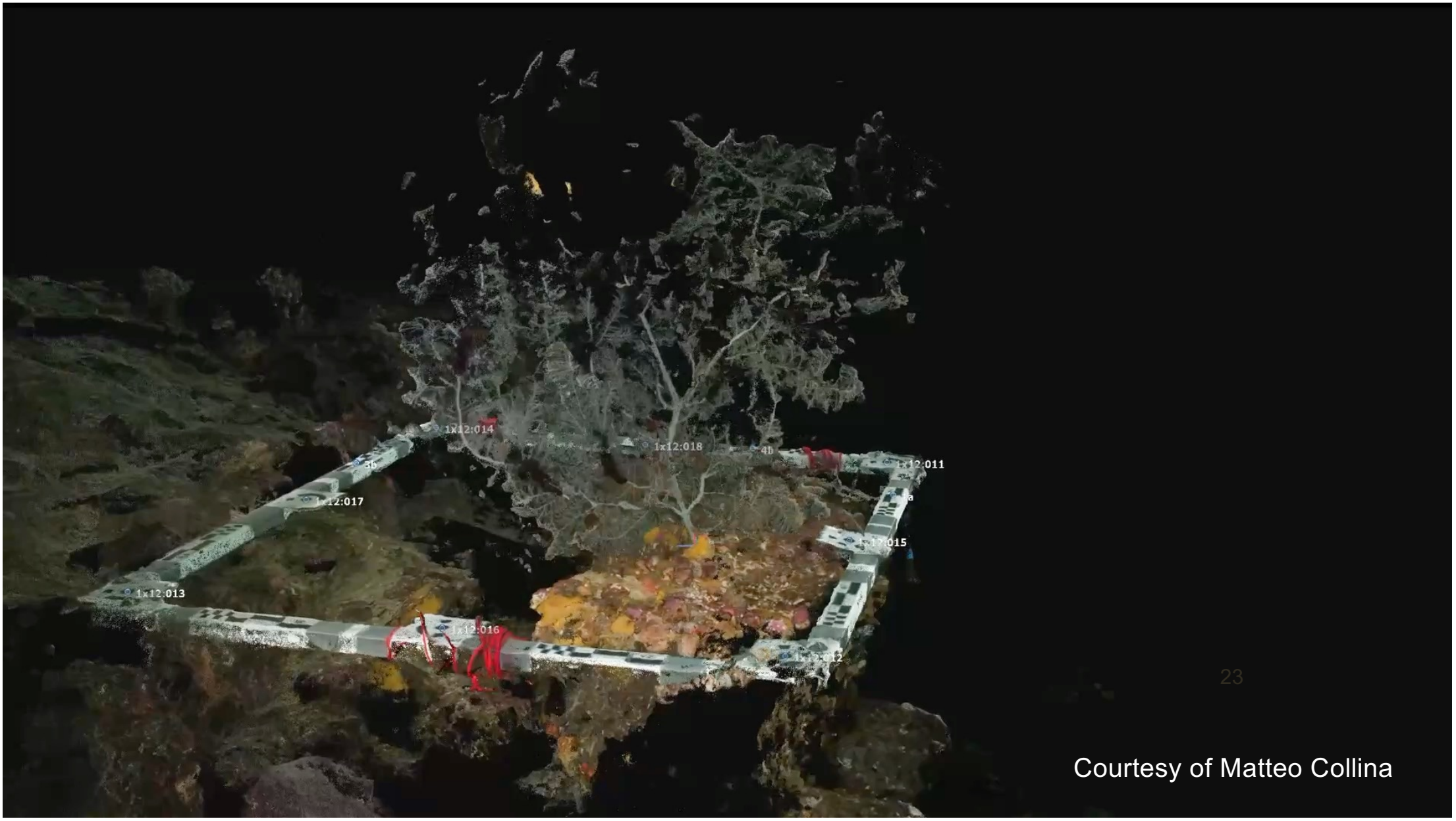
Report growth, recruitment and mortality

↓

Simulate over time different scenarios with different recruitment rates



Muko et al, 2014



Courtesy of Matteo Collina

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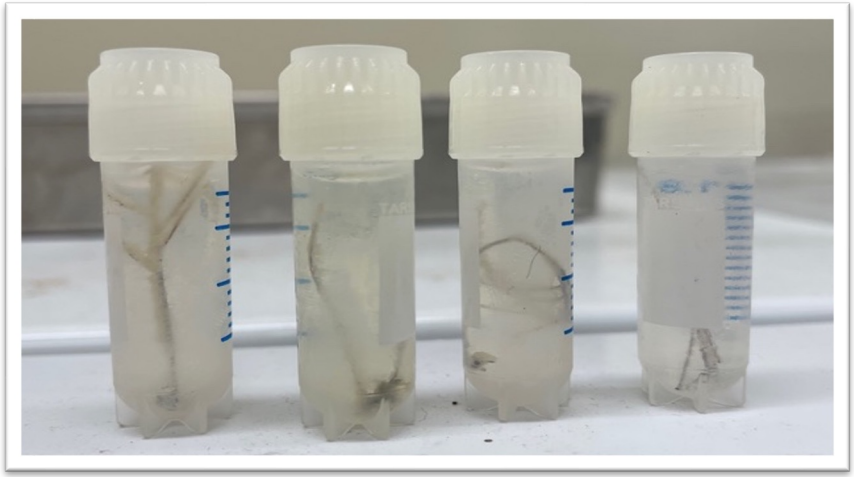
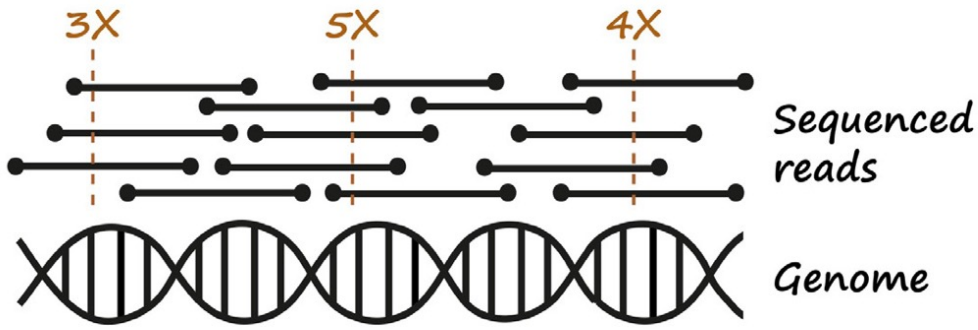
Assessing connectivity between populations using Genome-Wide SNPs

- Reconstruct a whole genome sequence to develop SNPs markers
- Assess whether populations are genetically distinct using SNPs markers
- Assess the extent of genetic connectivity across fiords and with depths





Methods

FIELD SAMPLING

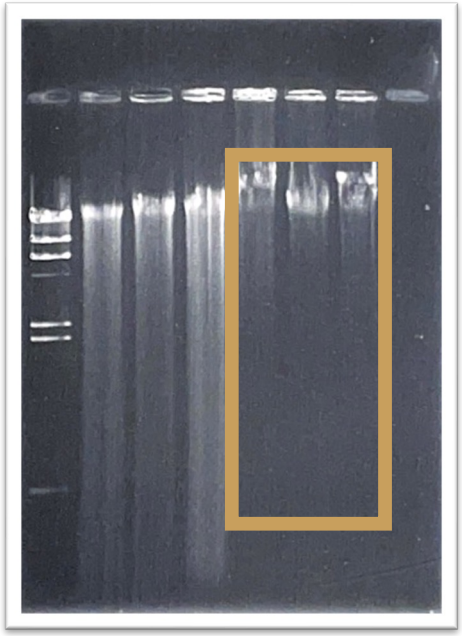
10 Sampling sites

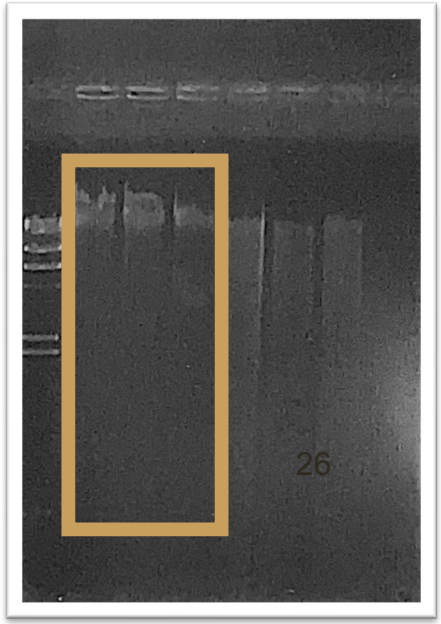
8 shallow populations (0-20m)

2 shallow + deep populations (70-100m)

20-25 individuals each

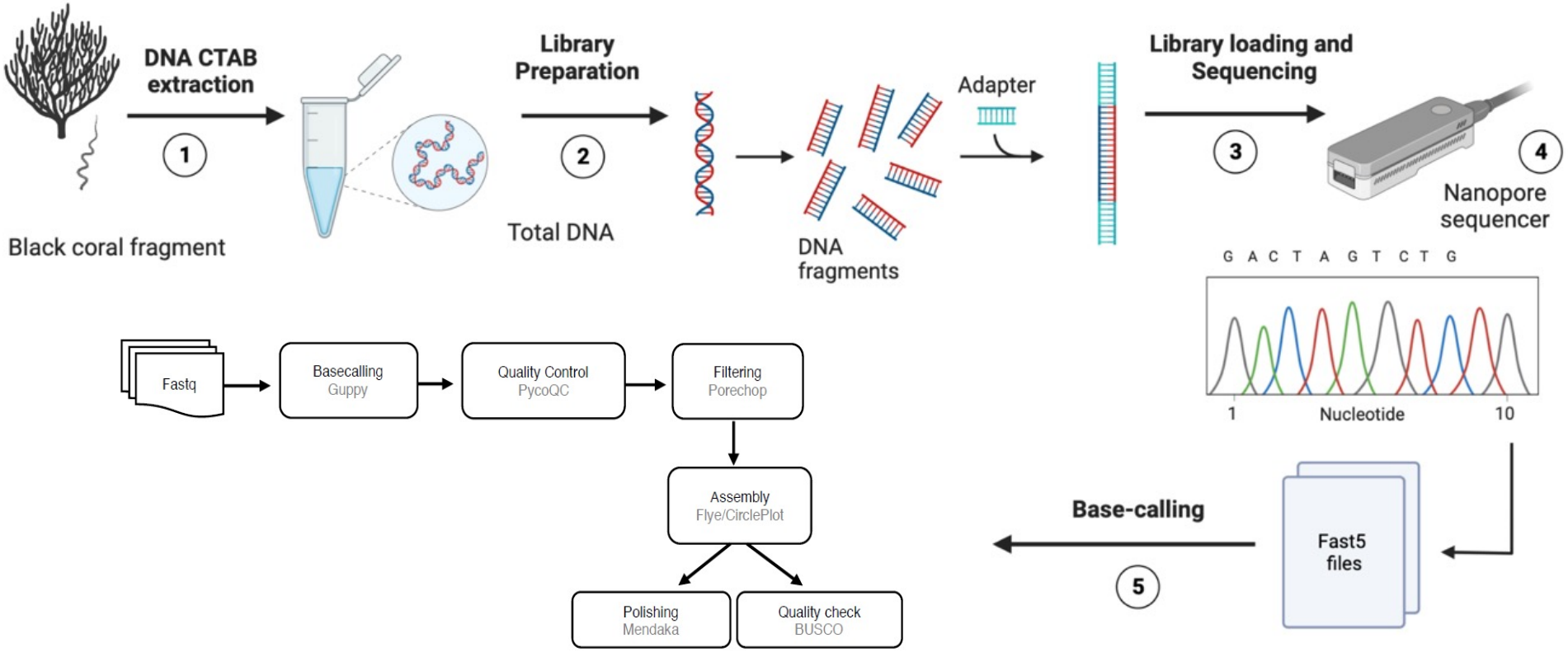
- DNA extraction
- Sequencing
- Genome assembly
- Library composition
- Population genetics





Reference genome assembly workflow

Methodology



DNA extraction protocol

Results

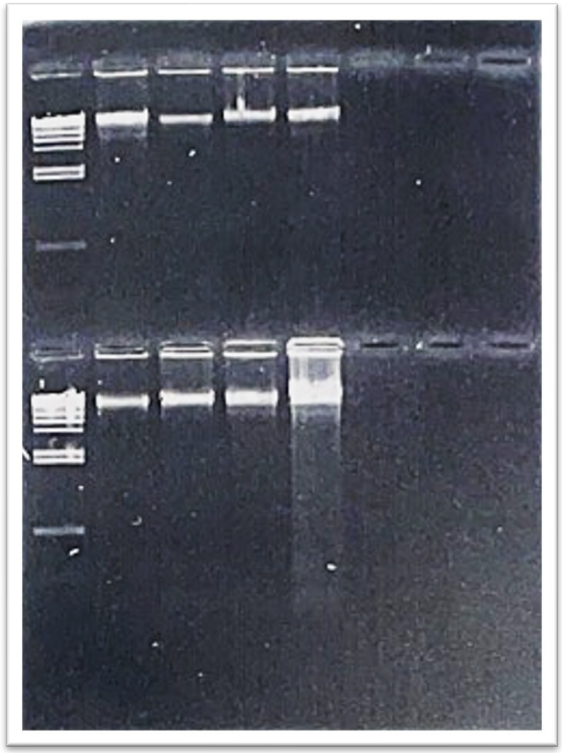
✗ Trial 1 → Rapid Salt Extraction Protocol

✗ Trial 2 → Qiagen DNeasy Blood & Tissue Kit

✗ Trial 3 → CTAB (1%) extraction protocol

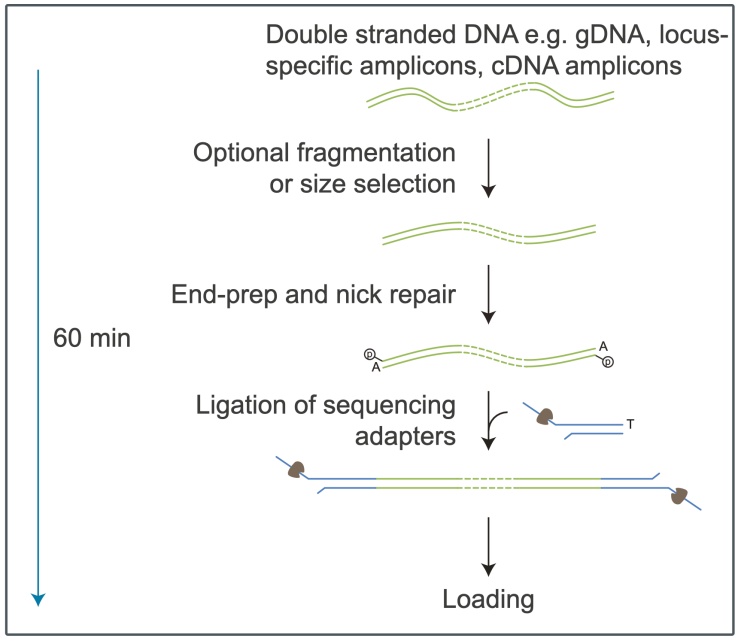
✗ Trial 4 → CTAB(2%) 1 Phenol : Chloroform : Isoamyl (25:24:1) +
1 Chloroform : Isoamyl (24:1) extractions

✓ Trial 5 → CTAB (2%) 2 Chloroform: Isoamyl (24:1) extractions



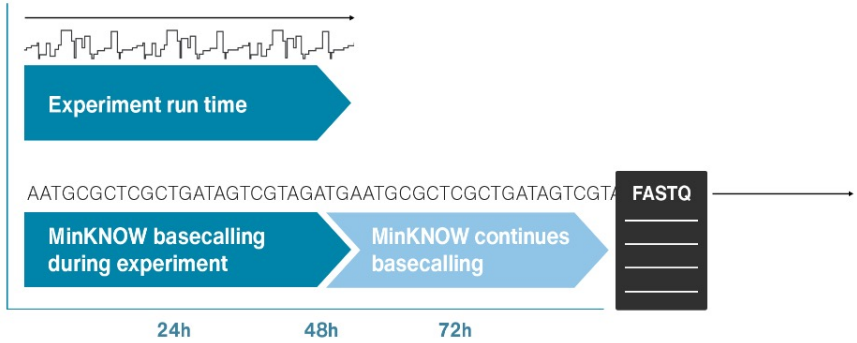
Library Preparation
Methodology

- Kit V14 SQK-LSK114
- Input 1 µg of gDNA
- DNA repair and end-prep (Repair the DNA and prepare the DNA ends for adapter attachment)
- Adapter ligation and clean-up (attach the sequencing adapters to the DNA ends)



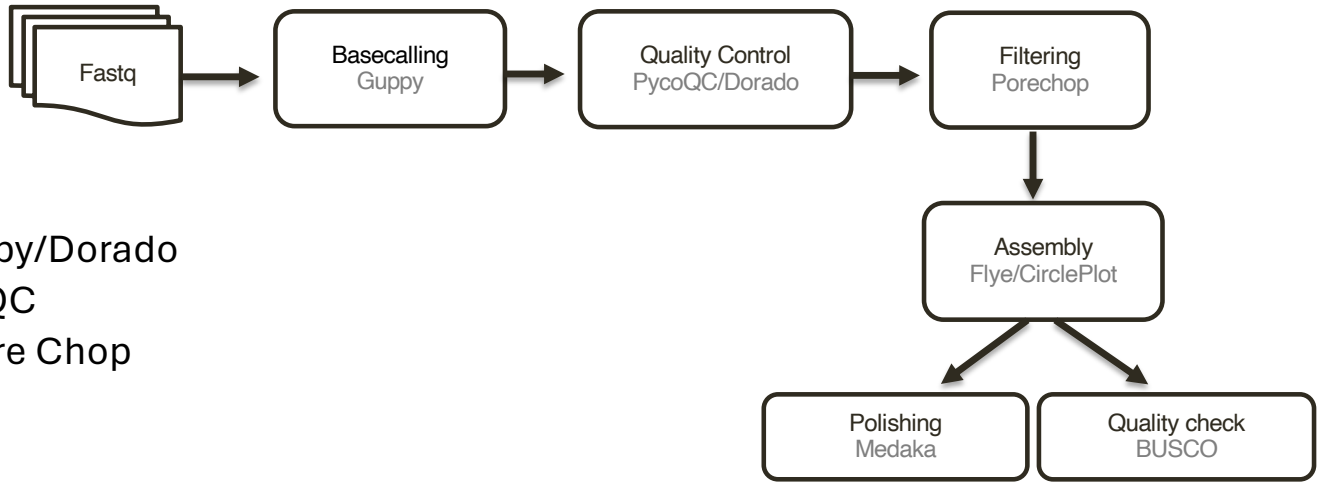
Basecalling
Methodology

- The signal is stored in POD5 files
- Processed into FASTQ/BAM files
- Single PromethION gDNA run → 90Gb of sequence



Bioinformatic pipeline

Methodology

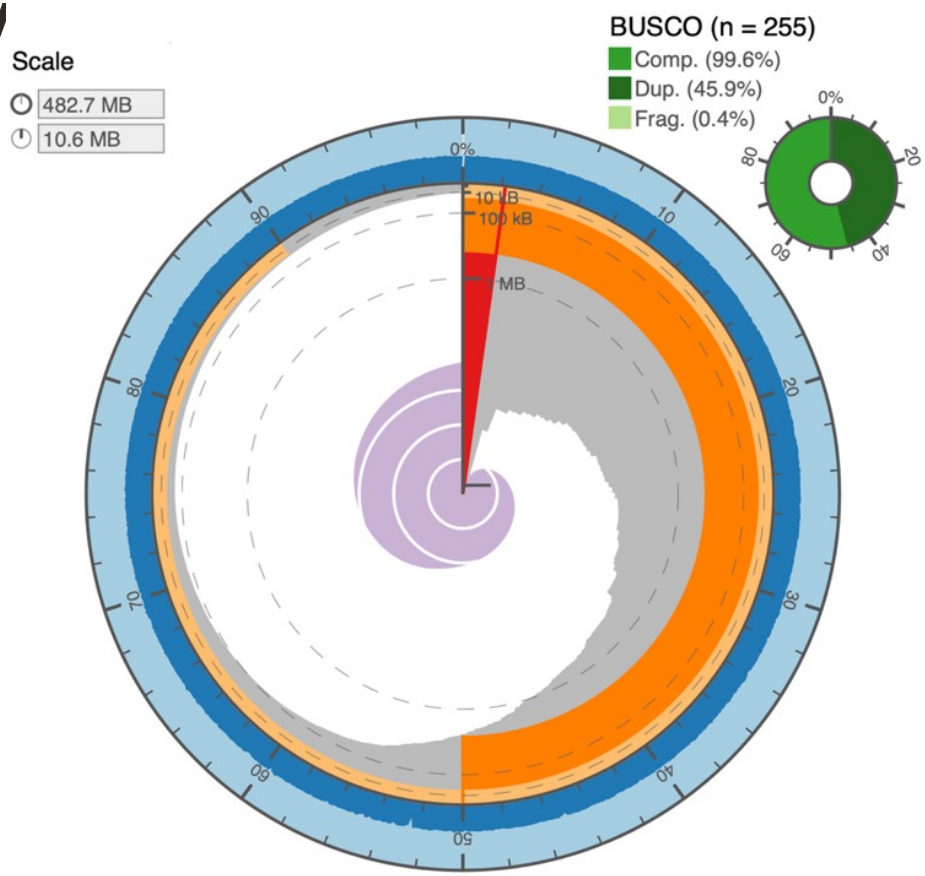


- Basecalled reads with Guppy/Dorado
- Quality control using PycoQC
- Filtering the reads using Pore Chop
- Assembled (Flye)
- Polishing
- Quality check

Reference genome assembly

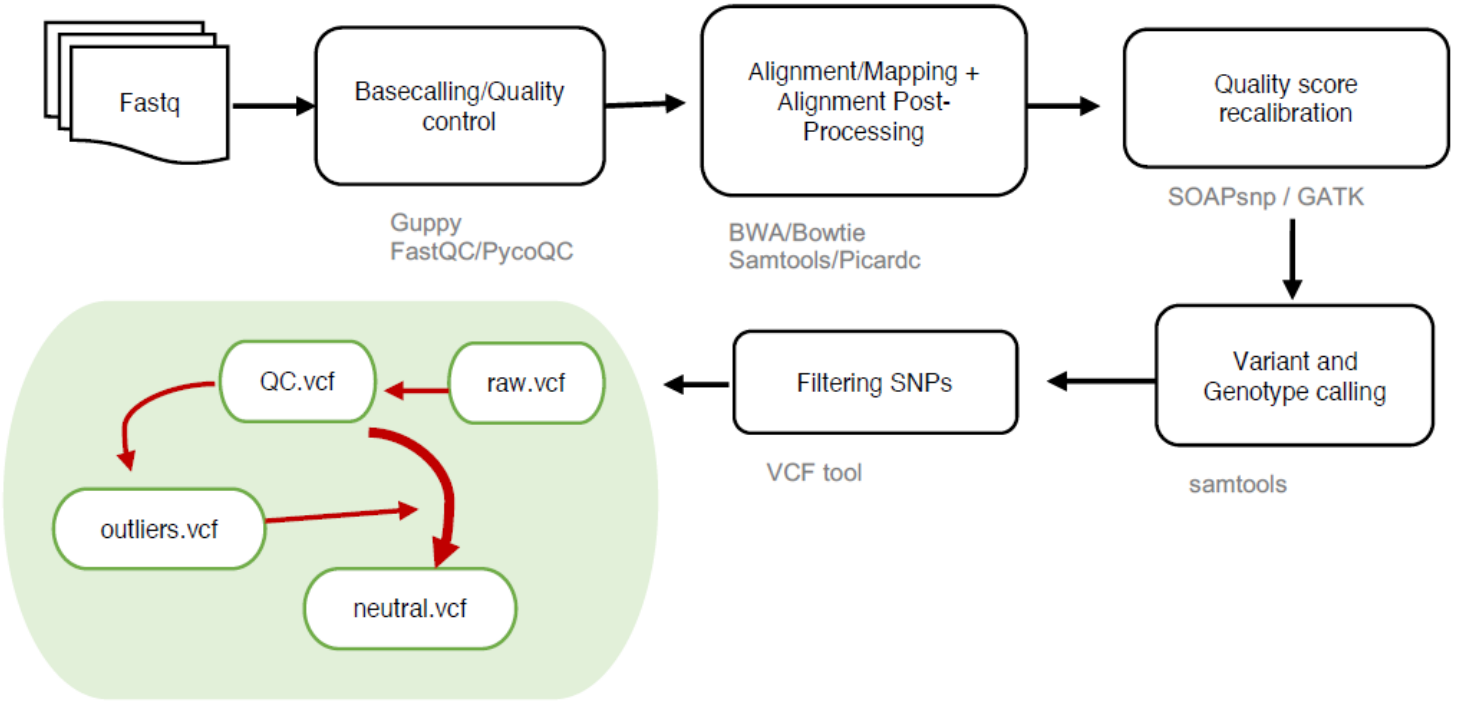
Preliminary results

- WGS provides a comprehensive view of an organism's entire genome
- Detection of various types of genetic variations, including single nucleotide polymorphisms (SNPs), insertions, deletions, copy number variations (CNVs), and structural rearrangements
- allows for retrospective analysis and future investigations without the need for additional sequencing

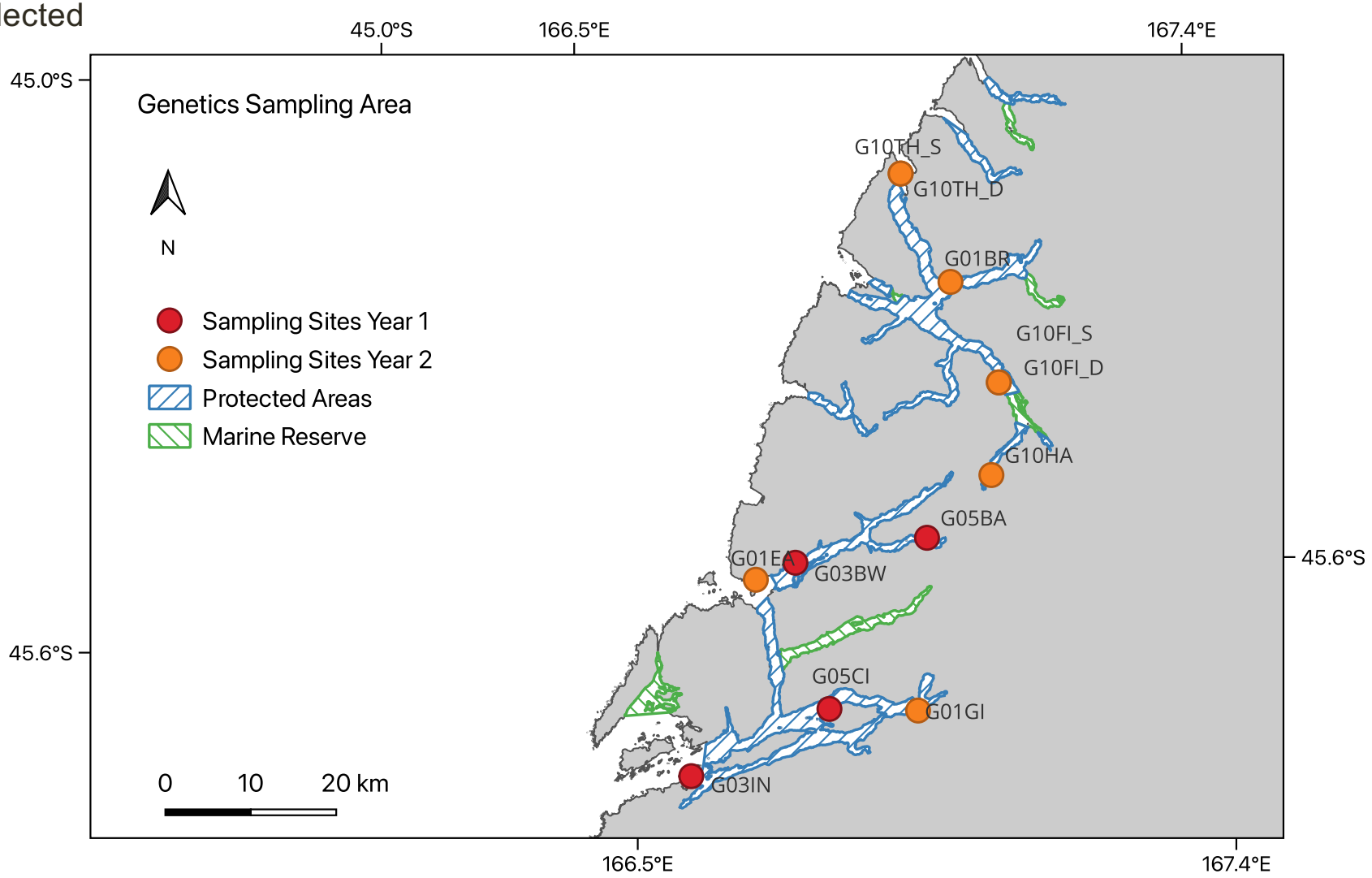


Genetic population analysis pipeline

Preliminary results



Locations of genetic samples collected



Next steps….

Acknowledgments

Bell research group
Richard Kinsey and other crew/skippers on RV Southern Winds
Dr Lyndsey Holland - Department od Conservation
Southern Fiordland Initiative – Kathryn and Paul Mitchell
Fiordland Marine Guardians – Rebecca McLeod

BOXFISH® RESEARCH

Southern Fiordland Initiative

GEORGE MASON CHARITABLE TRUST

Department of Conservation
Te Papa Atawhai

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MAI I TE IHO KI TE PAE

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