



**NIWA**

Taihoru Nukurangi

Climate, Freshwater & Ocean Science

# INT2019-05: Coral biodiversity in deep-water fisheries bycatch

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Climate, Freshwater & Ocean Science

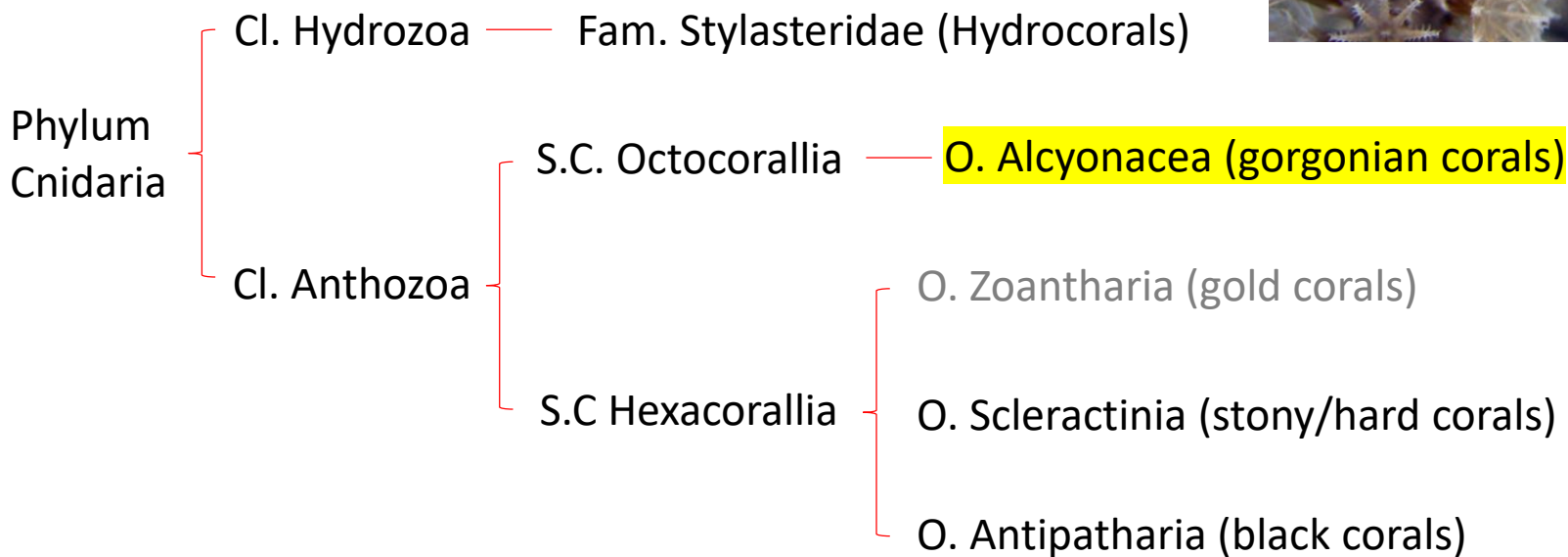


**NIWA**

Taihoro Nukurangi

# Protected corals

Diverse and distantly related assemblage of marine animals



“octocorals”      “gorgonians”

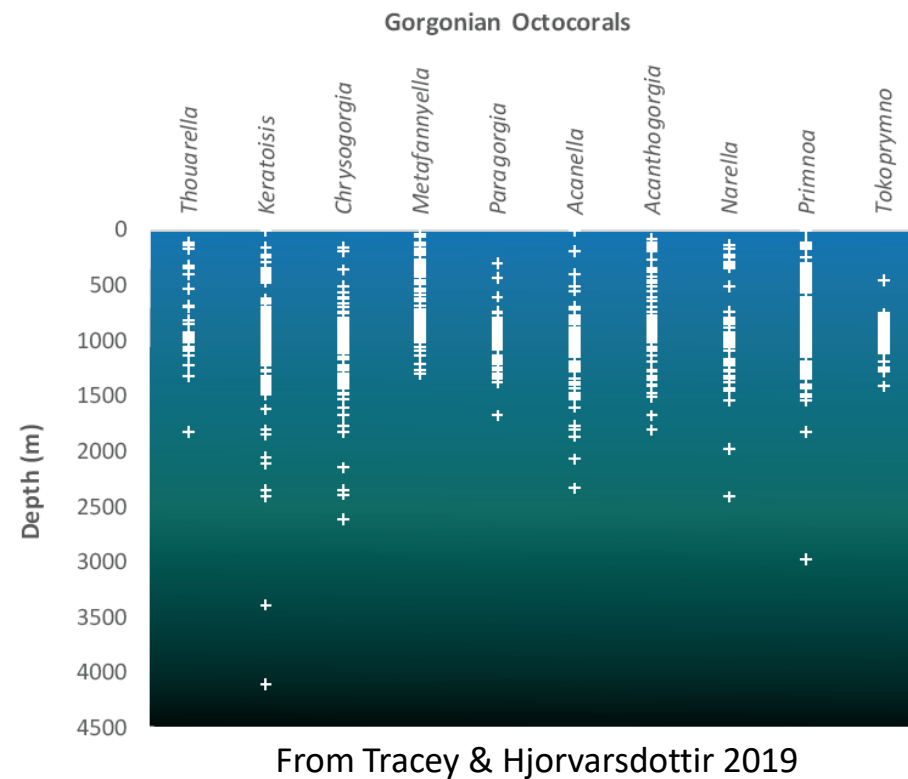
“sea whips”      “sea fans”

“bubblegum corals”

“gold corals”

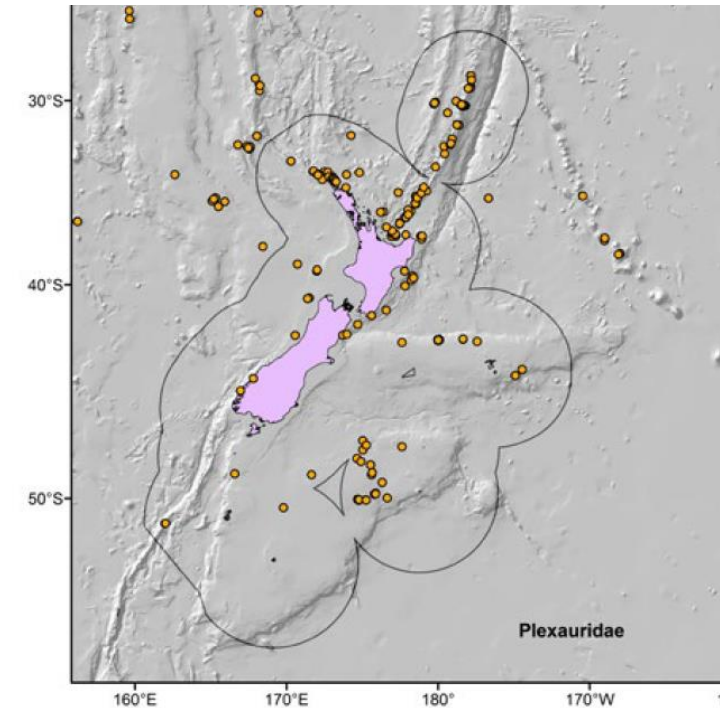
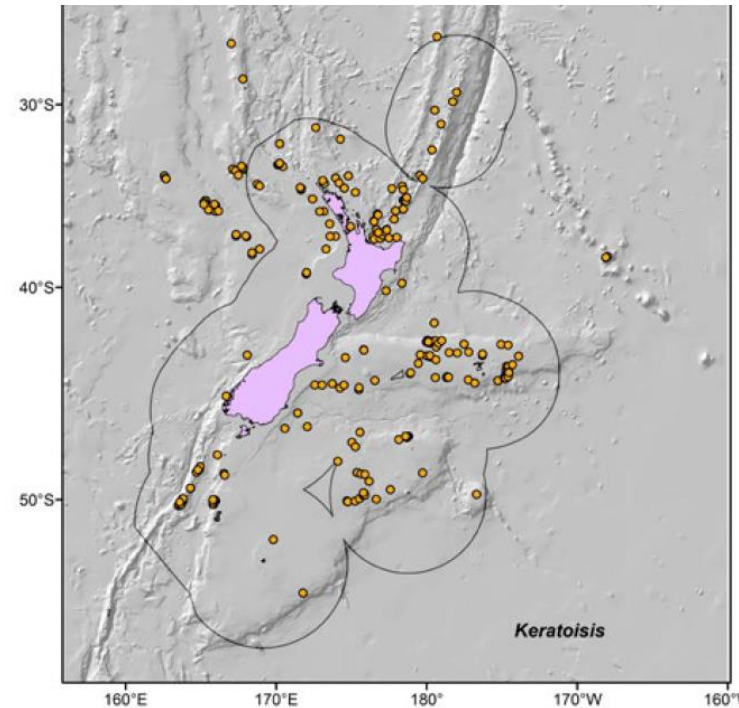
# O. Alcyonacea (= O. Gorgonacea)

- Ancient – over 500my
- Over 3000 species worldwide
- Found in all oceans, nearly all depths
- ‘Gorgonians’ = VME Indicator Taxa



# O. Alcyonacea

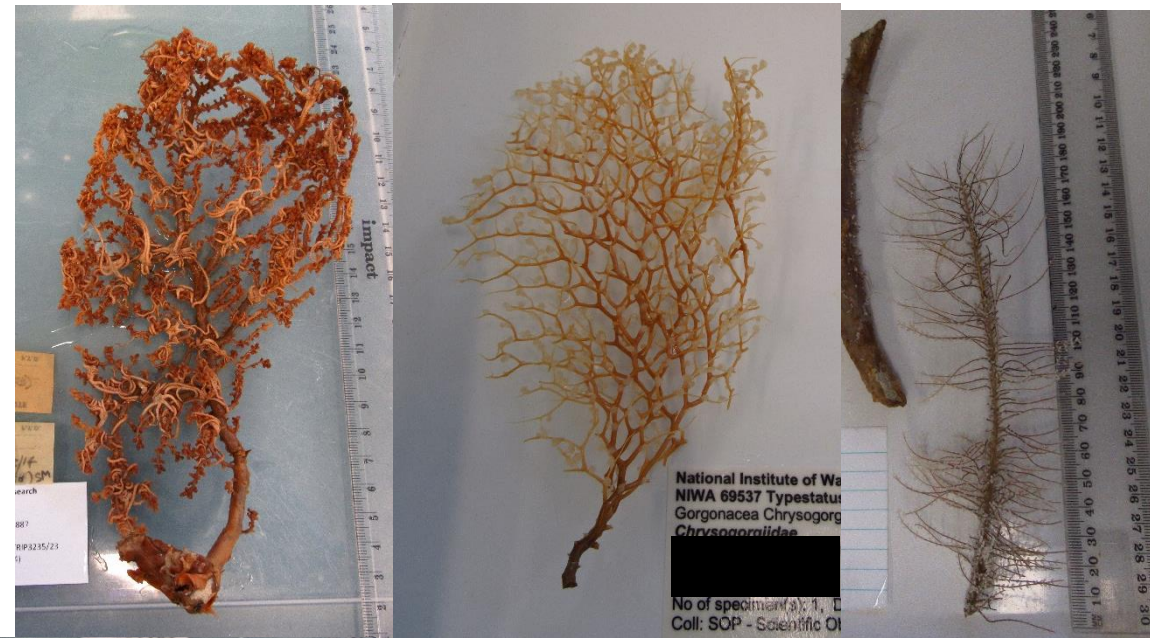
- In NZ, >250 species  
(most undescribed)
- Widely distributed across all FMAs
- All gorgonian octocorals are protected (Wildlife Act)



From Tracey & Hjørvarsdóttir 2019

# Protected gorgonian octocorals

- Extremely diverse in appearance



# Protected gorgonian octocorals

- Common amongst coral bycatch



# Protected gorgonian octocorals

- Coral bycatch from trawl fisheries (ORH, OEO, LIN, etc.)

Distribution of protected corals in relation to fishing effort and assessment of accuracy of observer identification

Prepared for  
Marine Conservation Services (MCS) Department of  
Conservation | Te Papa Atawhai

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Brian Sanders  
Murray H. Smith

Fish and invertebrate bycatch and discards in New Zealand orange roughy and oreo trawl fisheries from 2001–02 until 2014–15

New Zealand Aquatic Environment and Biodiversity Report No. 190

O.F. Anderson  
S.L. Ballara  
C.T.T. Edwards

ISSN 1179-6480 (online)  
ISBN 978-1-77665-719-3 (online)

November 2017

CSIRO PUBLISHING  
www.publish.csiro.au/journals/mfr

Marine and Freshwater Research, 2003, 54, 643–652

**Analysis of bycatch in the fishery for orange roughy, *Hoplostethus atlanticus*, on the South Tasman Rise**

Owen F. Anderson<sup>A,B</sup> and Malcolm R. Clark<sup>A</sup>

Tubinga 20: 33–40

Copyright © Museum of New Zealand Te Papa Tongarewa (2009)

**Invertebrate bycatch from bottom trawls in the New Zealand EEZ**

Wilma Blom<sup>1</sup>, Richard Webber<sup>2</sup> and Tom Schultz<sup>2</sup>

Vol. 213: 111–125, 2001

MARINE ECOLOGY PROGRESS SERIES  
Mar Ecol Prog Ser

Published April 4

**Seamount benthic macrofauna off southern Tasmania: community structure and impacts of trawling**

J. A. Koslow<sup>1,\*</sup>, K. Gowlett-Holmes<sup>1</sup>, J. K. Lowry<sup>2</sup>, T. O'Hara<sup>3</sup>, G. C. B. Poore<sup>3</sup>, A. Williams<sup>1</sup>

Deep-Sea Research Part II 150 (2018) 156–163

Contents lists available at [ScienceDirect](#)

Deep-Sea Research Part II

journal homepage: [www.elsevier.com/locate/dsr2](http://www.elsevier.com/locate/dsr2)



ELSEVIER

Incidence of disturbance and damage to deep-sea corals and sponges in areas of high trawl bycatch near the California and Oregon border

Mary M. Yoklavich<sup>a,\*</sup>, Thomas E. Laidig<sup>a</sup>, Kaitlin Graiff<sup>b</sup>, M. Elizabeth Clarke<sup>c</sup>, Curt E. Whitmire<sup>d</sup>



# Protected gorgonian octocorals

- Impacts on diversity?  
 → observer images  
 (but up to 50% error in IDs)

Tracey et al. 2011:

Distribution of protected corals in relation to fishing effort and assessment of accuracy of observer identification

Prepared for  
 Marine Conservation Services (MCS) Department of Conservation | Te Papa Atawhai

Authors/Contributors:

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 Susan Jane Baird  
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 Murray H. Smith

Table 4-3: List of species identified by images.

Taxa	Count of Specimens
<b>Annelida</b>	2
<b>Bryozoa</b>	6
<b>Chordata</b>	
Ascidiacea	1
<b>Mammalia</b>	
Cetacea (whale bone)	1
<b>Cnidaria</b>	
<b>Anthozoa</b>	
Actiniaria	3
Alcyonacea	
<b>Chrysogorgiidae</b>	
<i>Chrysogorgia</i>	1
<i>Iridogorgia</i>	1
<b>Coralliidae</b>	
<i>Corallium</i>	2
<b>Isididae</b>	
<i>Acanella</i>	1
<i>Isidella</i>	1
<i>Keratoisis</i>	14
Isididae undet.	11
<b>Paragorgiidae</b>	
<i>Paragorgia arborea</i>	4
<i>Paragorgia</i> undet.	4
<b>Primnoidae</b>	
<i>Metafannyella</i>	18
<i>Perissogorgia</i>	1

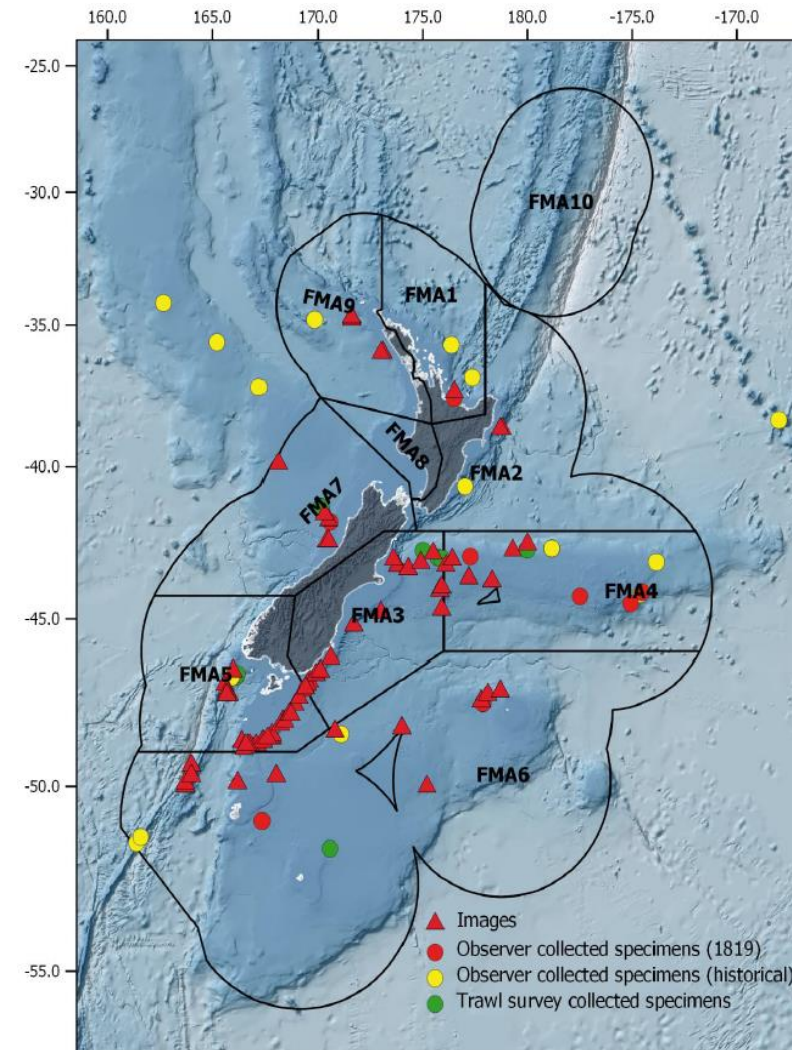


Figure 4-1: Location of identified protected coral samples within the Fisheries Management Areas (FMAs),

From Tracey et al. 2019

# Protected gorgonian octocorals

- Impacts on diversity?
  - observer images
  - observer sampling

Identification and storage of cold-water coral bycatch specimens  
INT2015-03

Objective 1: To determine, through examination of returned cold-water coral specimens and photos, the taxon, and where possible the provenance of cold-water corals killed in New Zealand fisheries (for returned dead specimens)

→ Expert morphological IDs

Objective 2: To collect sub-samples of all protected cold-water coral specimens for genetic analysis in the future.

→ Genetic IDs

## Study goal

- Use genetic analysis (DNA barcoding) of collected bycatch specimens in NIWA Invertebrate Collection to examine coral species diversity
- Is morphological study providing accurate diversity/identity info?
- How much bycatch diversity exists among trawl bycatch?
- Given sampling breadth, can it tell us something about gorgonian diversity in general?

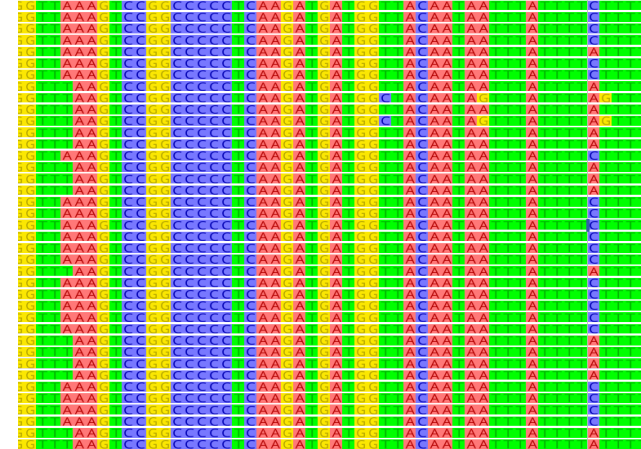
# Study design

- NIWA Invertebrate Collection: 1190 octocoral bycatch specimens
- Approx. 700 in ethanol
- 129 identified as suitable for this study
  - specimen <10 yrs old, protected status
  - from within EEZ (some neighboring SPRFMO samples)
  - bottom-trawl bycatch (few bottom long-line specimens)



# Study design

- Explored ~~two~~ three genetic markers for barcoding:
  - 5'-mtMutS – ‘universal’ octocoral barcode (families/genera)  
(lots of pre-existing data but low-res)
  - 3'-mtMutS – bespoke barcode (genera/some species)  
(little pre-existing data but reliable & high-res)
  - 28S rDNA – ‘universal’ species-level barcode  
(high-res but too variable; heterozygosity; multicopy gene)



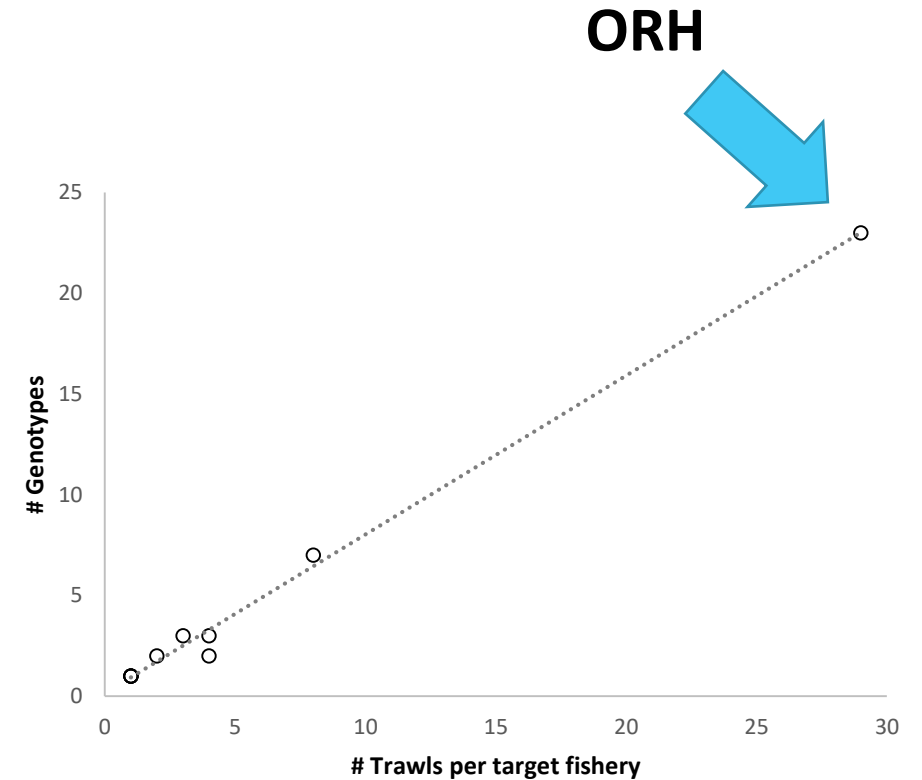
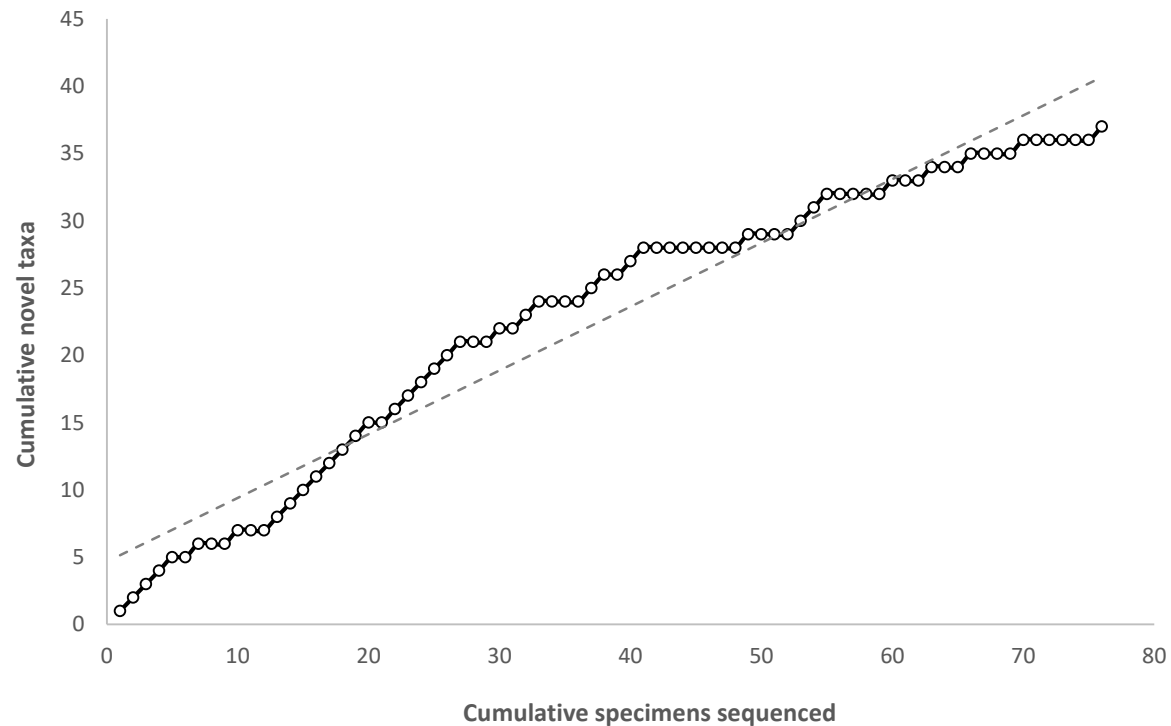
# Results

- Sampled 91 bycatch specimens
- +8 pre-existing sequences
- +16 'reference' specimens
- Sequence data for 75 specimens
- Trawl bycatch from 6 families

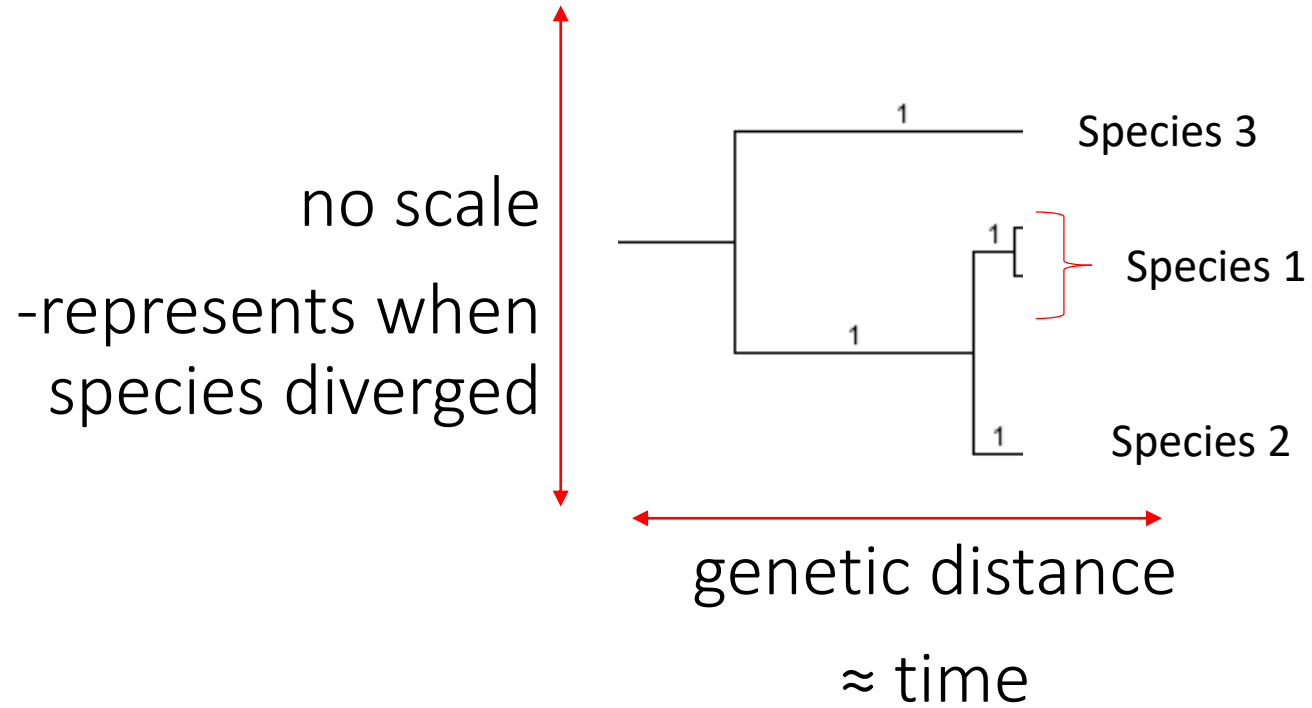
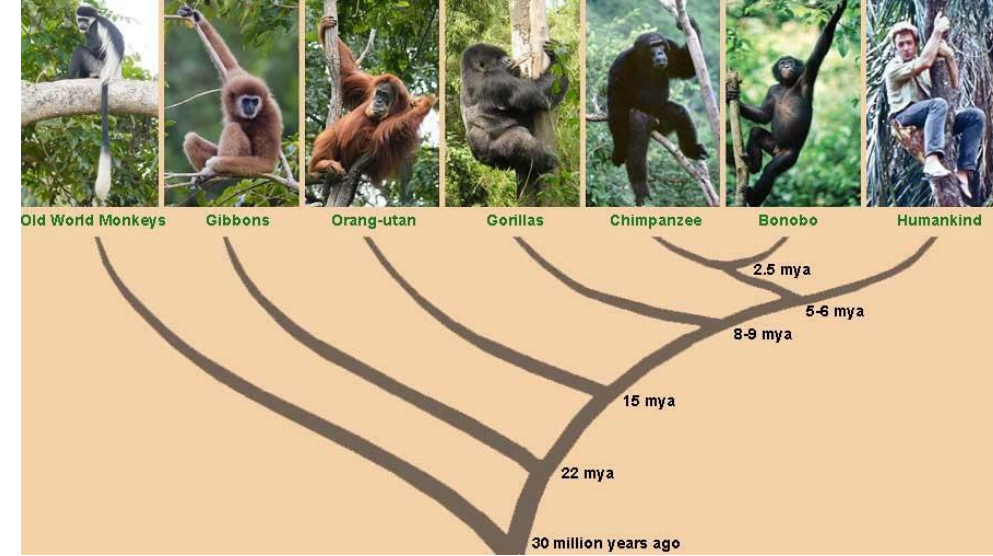
<b>Protected Families</b>	<b># Sequenced</b>
Acanthogorgiidae	3 (+1)
Chrysogorgiidae	8
Coralliidae	(+3)
Isididae	15
Paragorgiidae	9 (+1)
Plexauridae	7 (+7)
Primnoidae	9 (+4)

# Rate of new species discovery

- Many left to be discovered



# Phylogenetics crash course

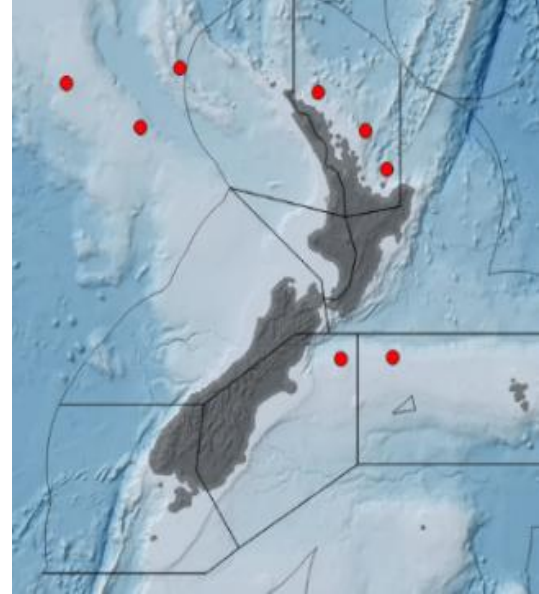
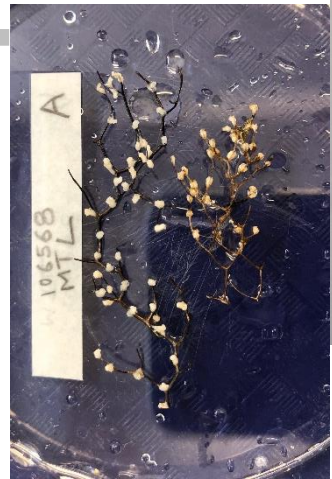
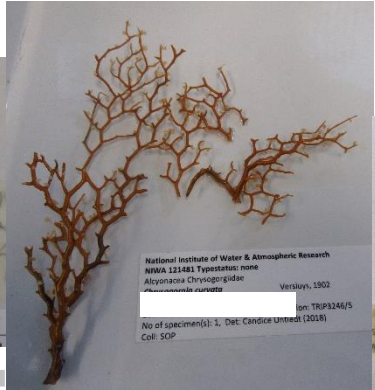
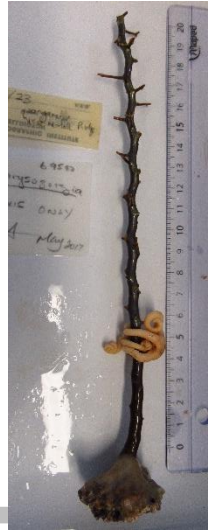
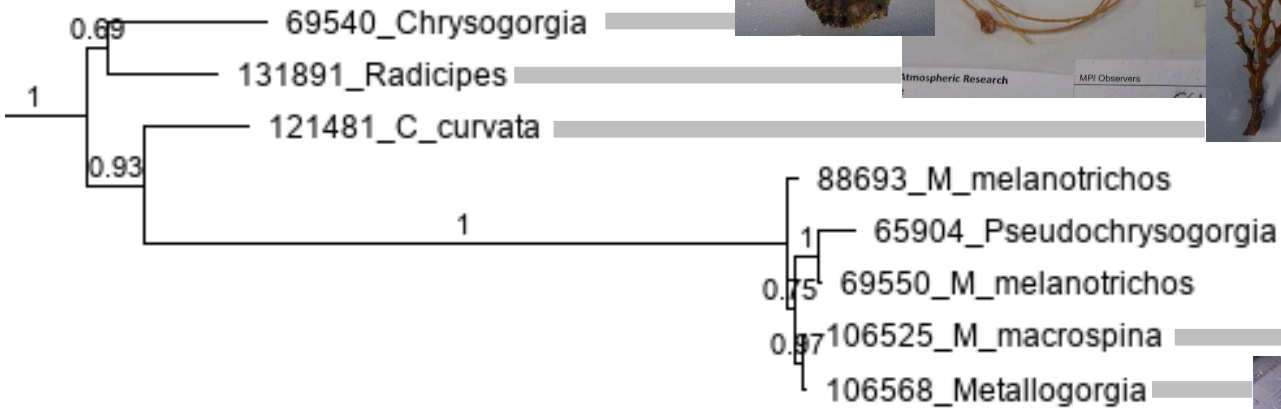






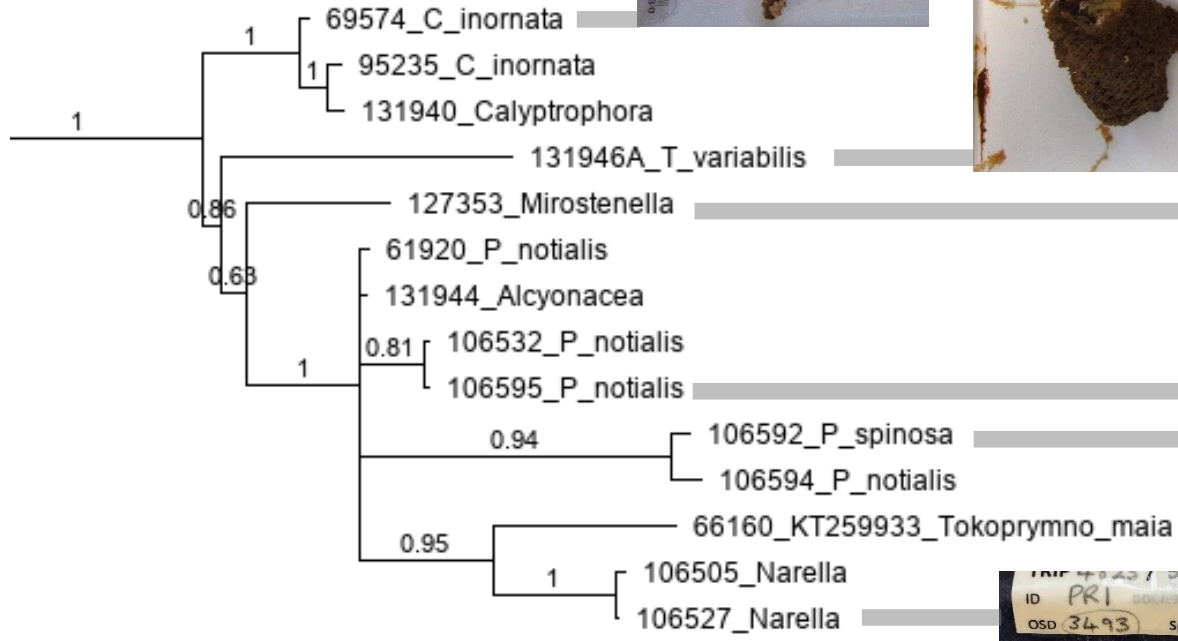
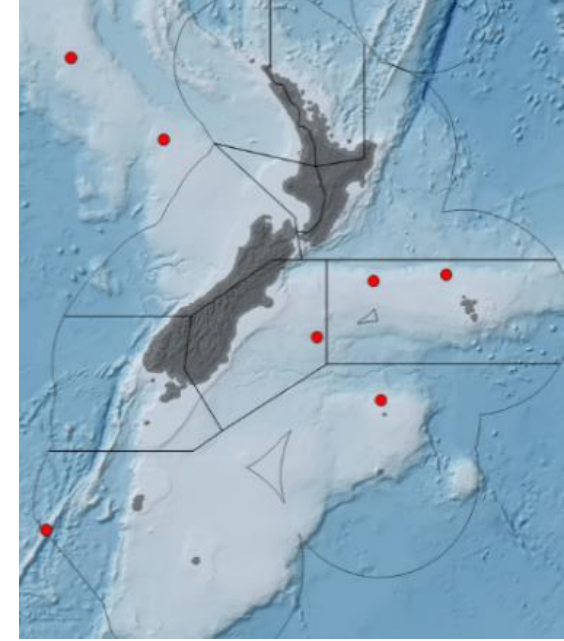
# Results: Chrysogorgiidae

437-1200m depth



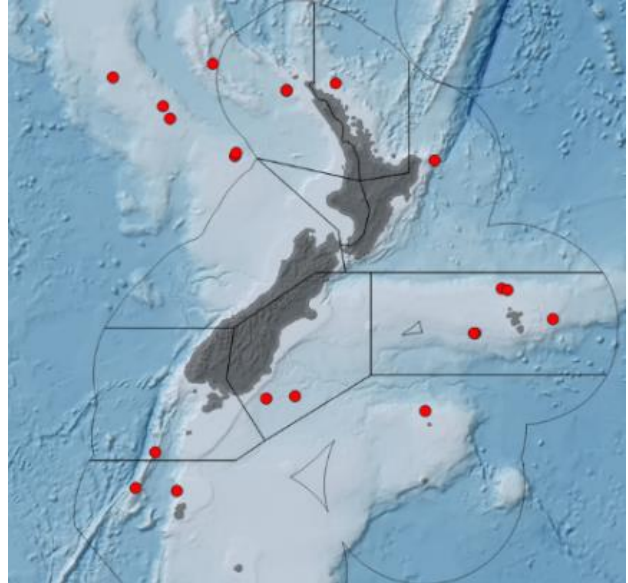
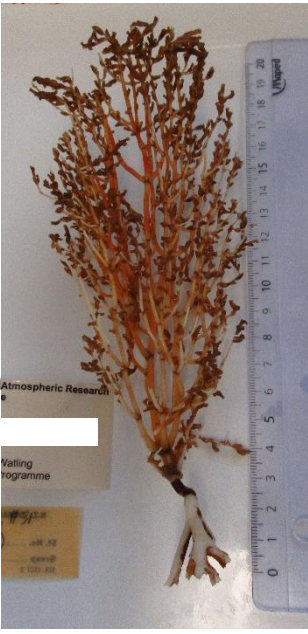
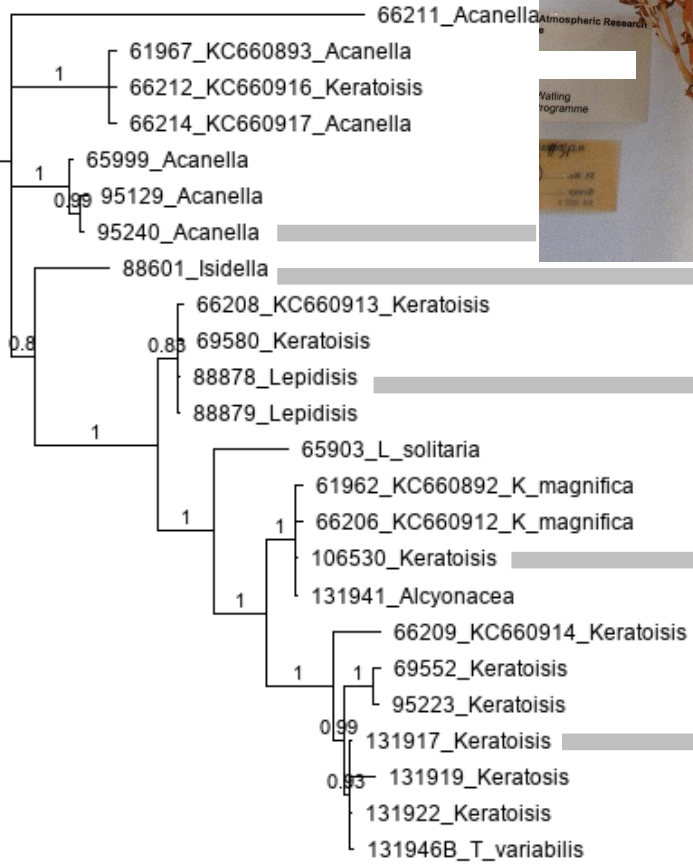
# Results: Primnoidae

447-1100m depth



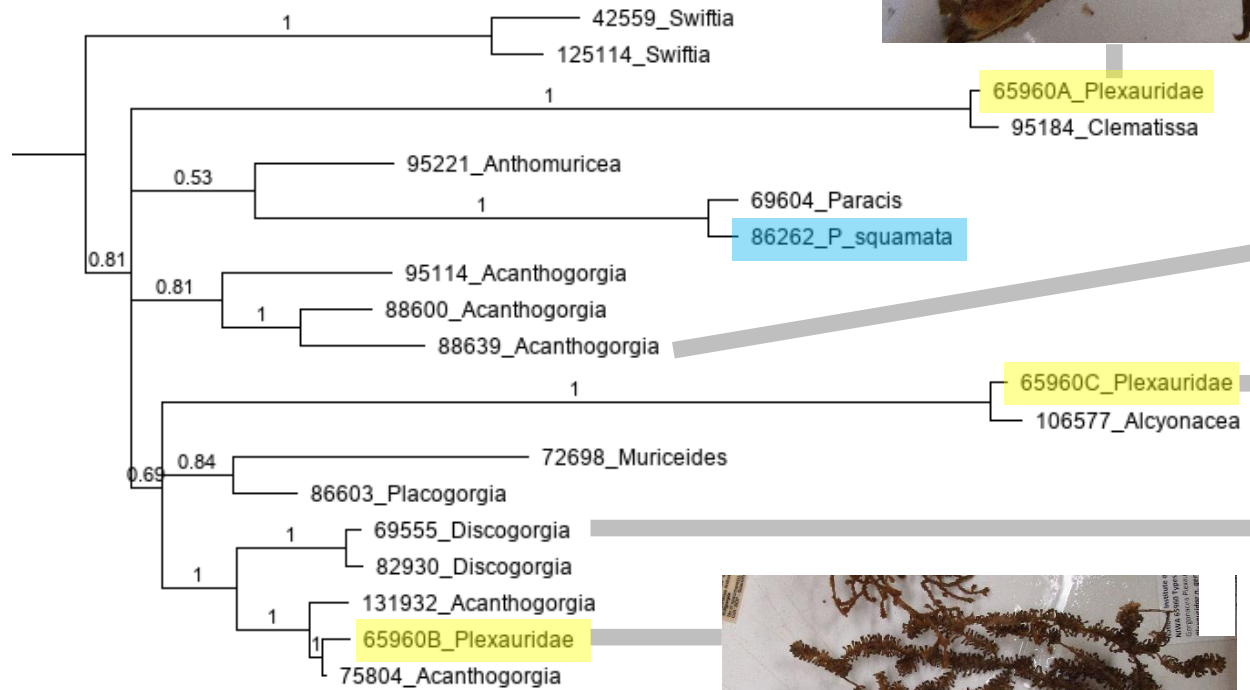
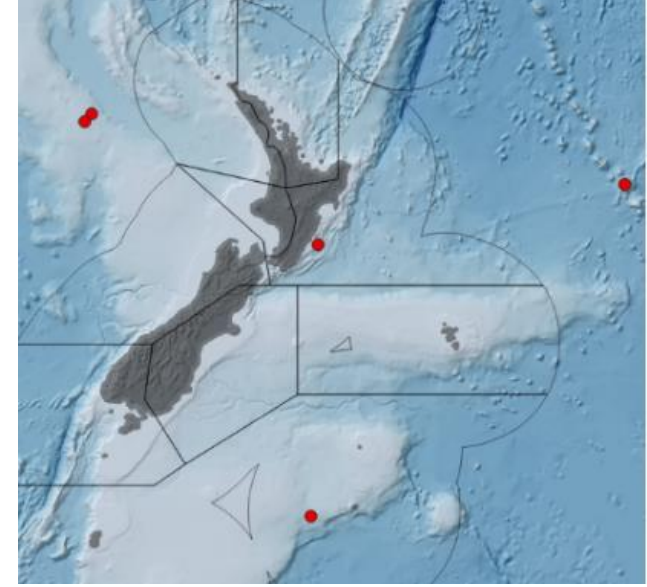
# Results: Isididae

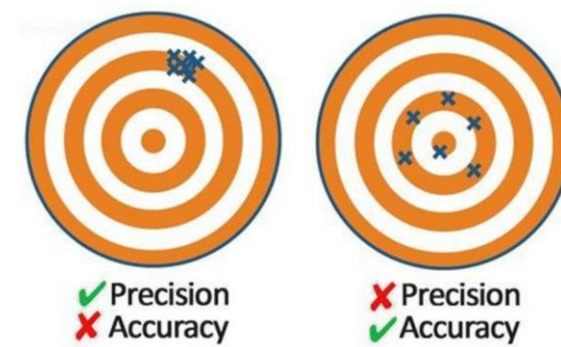
431-1208m depth



# Results: Plexauridae + Acanthogorgiidae

137-1182m depth





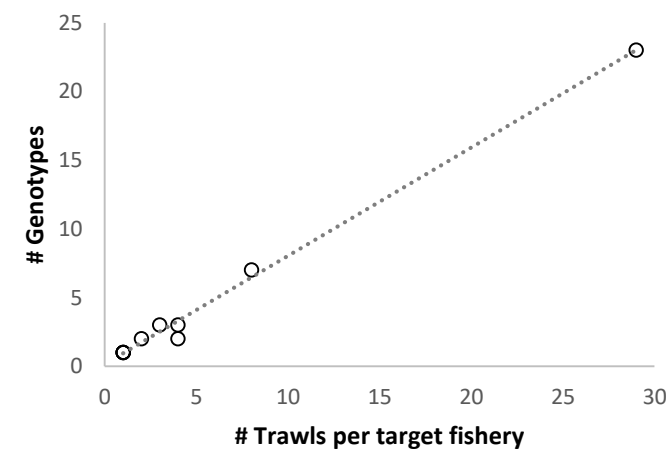
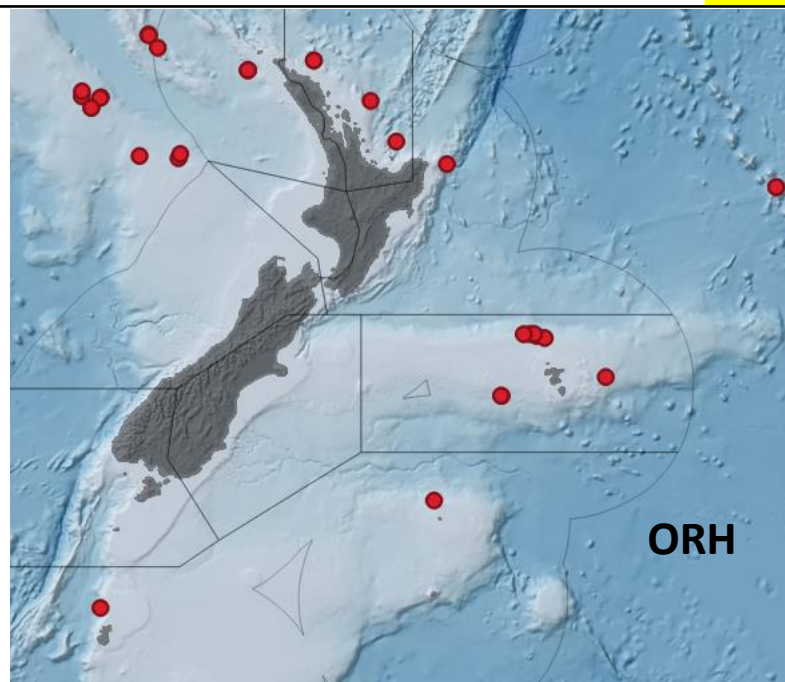
# Identification Accuracy & Precision

- Are IDs the same?
- Are IDs the same, to the same level?

	Strict		
Relaxed	Observer	Morpho-taxonomy	Phylogenetics
Observer	-	19% (12/64)	33% (15/45)
Morpho-taxonomy	11% (7/64)	<b>Accuracy</b>	<b>Precision</b> 21% (16/76)
Phylogenetics	22% (10/45)	8% (6/76)	-

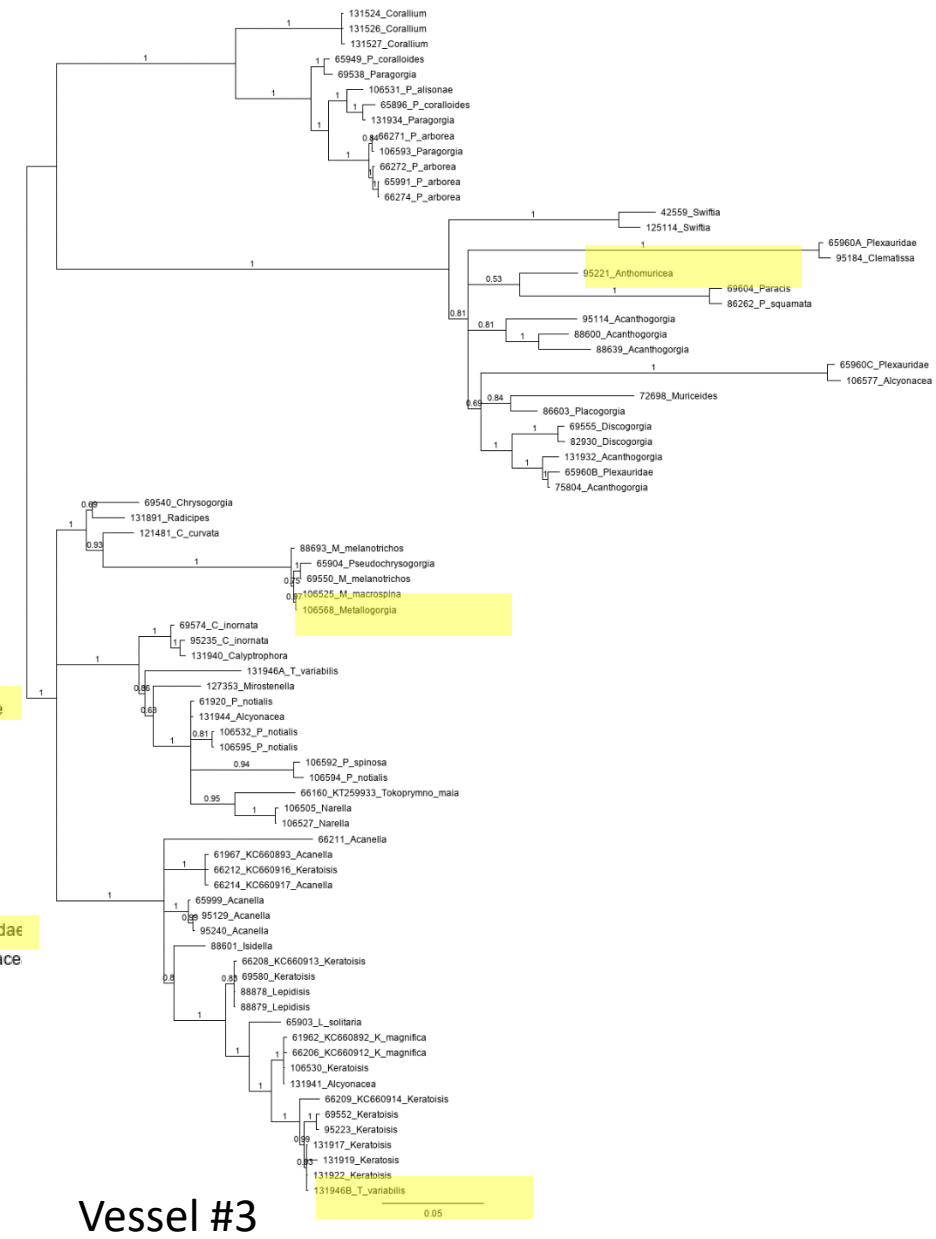
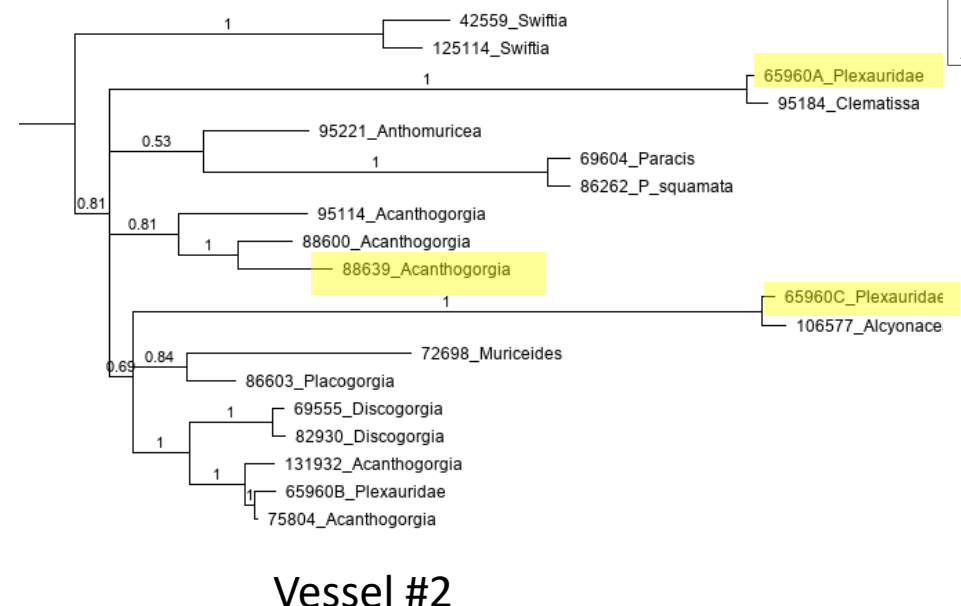
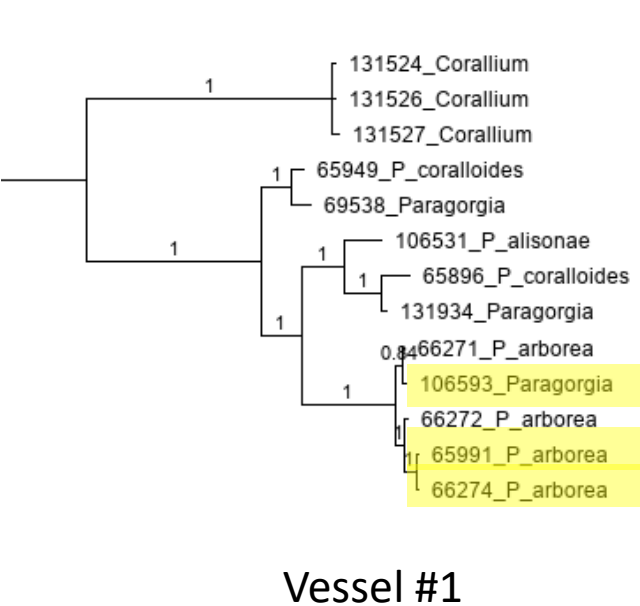
# Bottom-Trawl Fisheries Interactions

Row Labels	BOE	BYS	BYX	HOK	HPB	LIN	ORH	SSO	TAR	WWA	Total
Acanthogorgiidae	-	-	-	-	-	1/1	2/3	-	1/1	-	2/5
Chrysogorgiidae	-	1/1	-	2/2	-	-	4/5	-	-	-	7/8
Isididae	1/2	1/1	-	-	-	-	7/16	3/3	-	1/1	10/23
Paragorgiidae	1/2	-	1/1	-	-	-	3/4	2/2	-	-	4/9
Plexauridae	-	-	1/1	-	1/1	-	4/4	1/1	-	-	5/7
Primnoidae	-	1/2	-	1/1	-	-	4/5	1/2	-	-	5/10
<b>Total Species/Samples</b>	<b>2/4</b>	<b>3/4</b>	<b>2/2</b>	<b>3/3</b>	<b>1/1</b>	<b>1/1</b>	<b>23/37</b>	<b>7/8</b>	<b>1/1</b>	<b>1/1</b>	<b>32/62</b>
<b># Trawls</b>	<b>4</b>	<b>4</b>	<b>2</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>29</b>	<b>8</b>	<b>1</b>	<b>1</b>	<b>54</b>



# Fisheries Interactions - Impacts

- Not just about the numbers
- *E.g.:* 3 species from one tow...







# Fisheries Interactions & Biodiversity

- Not just about the numbers
- Genetic diversity (species diversity) carries implicit evolutionary component



biomass, prevalence, productivity, genetic distinctiveness

→ fisheries impacts/intrinsic value of biodiversity

# Study goals

- Is morphological study providing accurate diversity/identity info?

**Not always, but it does relate specimens to described species**

- How much bycatch diversity exists among trawl bycatch?

**More than we know**

- Given sampling breadth of observer collection, can it tell us something about gorgonian diversity in general?

**We have a *lot* of NZ diversity left to discover & describe - observer samples can play a vital role**

# Recommendations

- Encourage increased Observer coral bycatch sampling
- Examine bycatch (genetic) diversity in more target fisheries or gear (OEO; long-line)
- (again) Routine DNA barcoding for protected coral bycatch can improve our knowledge of fisheries impacts and NZ biodiversity  
*e.g.* can incorporate genetic diversity into habitat suitability models

ORIGINAL RESEARCH

WILEY [Ecology and Evolution](#) Open Access

**When phylogeny and ecology meet: Modeling the occurrence of Trichoptera with environmental and phylogenetic data**

Bruno Spacek Godoy<sup>1</sup>  | Lucas Marques Camargos<sup>2</sup> | Sara Lodi<sup>3</sup>  
*Ecology and Evolution*. 2018;8:5313–5322.

# Acknowledgements

- Fisheries Observers
- Sadie Mills & Diana Macpherson (NIWA Invertebrate Collection)
- Jade Maggs & Aiden Liu (NIWA Fisheries Data Service)
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- Lyndsey Holland (MPI-FNZ)

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Di Tracey (NIWA)

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