INT2019-04 Identification and storage of cold-water coral bycatch specimens

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Background

- Deep-sea protected coral samples taken as bycatch in commercial fishery operations are physically collected & / or photographed by government Observers on observed commercial fishing vessels
- NIWA receives the samples, facilitates their ID
- Physical samples or digital images are identified and counted by experts to the lowest taxonomic level
- Data loaded into databases (*niwainvert; COD*)
- This information, along with associated fishing data including fishing method, fishery area, and target fish species, is presented to CSP
- Data from this research:
  - helps to better characterise interactions between protected corals and commercial fishing activities
  - provides baseline information that can help to better inform research underpinning marine protection planning from habitat suitability modelling, benthic risk assessments, & management of benthic marine protected species
  - paves the way towards a more comprehensive mitigation framework to be implemented to protect cold-water corals in New Zealand waters.
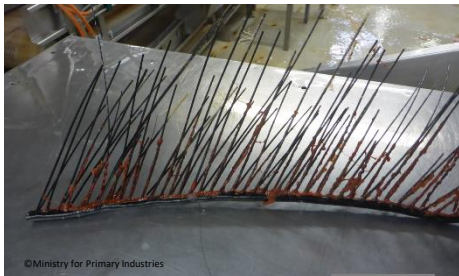
Background

NIWA carries out:

- the identification of protected coral specimens
  - Antipatharia (black coral)
  - Scleractinia (cup corals and stony corals)
  - Stylasteridae (hydrocoral)
  - gorgonian octocorals previously belonging to order Alcyonacea (plexaurid, acanthogorgid, primnoid sea fans, bamboo corals, bubblegum corals, golden corals etc.)

- the identification of protected coral specimens shown in digital images, the georeferencing and digital storage there-of

- the sub-sampling of protected coral tissue material for genetic studies
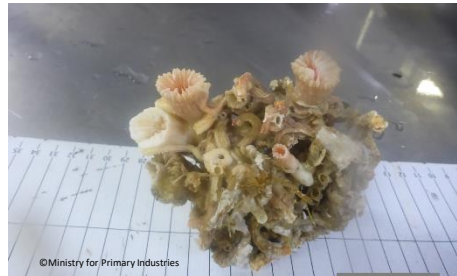
Objectives

To determine which protected cold-water coral species are captured in commercial fisheries, and the mode of their capture, and build a coral collection for future research

Specifically:

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

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

3. To assist with Observer training and the development/improvement of Observer training resources.

Here we report on all corals identified by specimens and images bycaught during the period **1 July 2021 – 30 June 2022**

Methods – Objective 1, At-sea coral data collection

Instructions to observers when carrying out at-sea protected coral data collection

Provided to DOC CSP in February 2023 for review, and subsequently also sent to Observer Programme Fishery Observer Supervisors.

Includes instructions for:

- Sample handling, labelling, freighting
- Digital collection of photographic images

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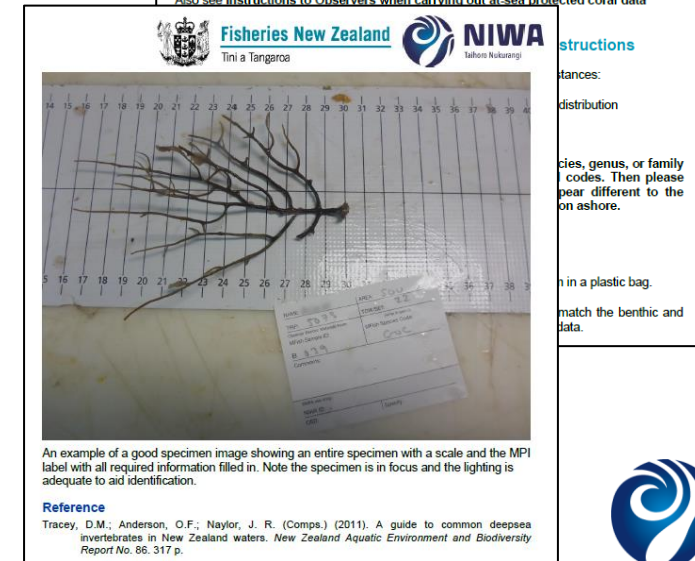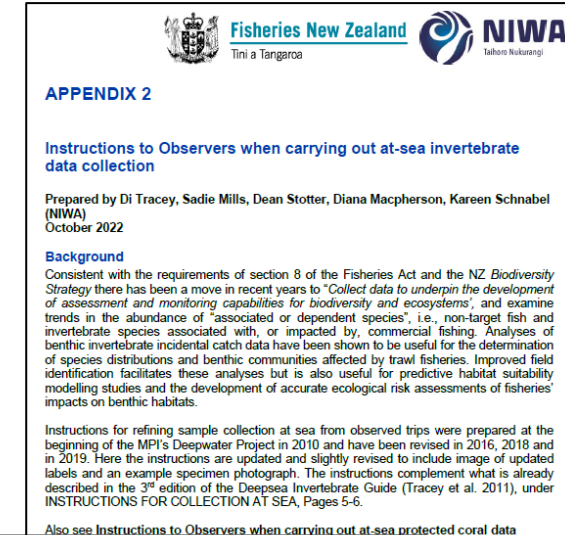
Methods – Objective 1, Physical specimens

<u>Tasks under FNZ Data Custodian Services project DAT2016-01P:</u>

- Protected coral samples sorted & identified to a coarse level
- Data entered into NIWA Observer Samples Database (OSD)
- Specimens fixed in ethanol
- Data from OSD uploaded into NIWA Invertebrate Collection (NIC) Specify database *niwainvert*

<u>Tasks under INT2019-04:</u>

- Experts identify corals to lowest possible level
- Assign a three-letter MPI code where possible
- Source position and fishing data from *COD*
- COD updated with expert/updated IDs

Expert	Affiliation	Taxon Group
Di Tracey	NIWA	Scleractinia, gorgonian octocorals
Peter Marriott	NIWA	Stylasteridae, Coralliidae
Rob Stewart	NIWA	Antipatharia
Jaret Bilewitch	NIWA	Plexauridae, Acanthogorgiidae, other gorgonian octocoral groups
Gustav Kessel	Independent	Soft corals and related gorgonian groups
Diana Macpherson	NIWA	Hydrozoa (excluding Stylasteridae)
Dennis Gordon	NIWA	Bryozoa
Sadie Mills	NIWA	Ophiuroidea
Dr Stephen Cairns	Smithsonian Institution, USA	Primnoidae
Dr Marcelo Kitahara	Universidade Federal de São Paulo, Brazil	Scleractinia
Dennis Opresko	Smithsonian Institution, USA	Antipatharia
Dr Phil Alderslade	Previously CSIRO, Hobart, Australia	Keratoisididae

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Methods – Objective 1, Specimens from digital images

- Images taken during reporting period sent to NIWA by CSP for processing and ID by experts

- Firstly they are sorted: only process images of coral taxa taken from within NZ EEZ.
  - Non-coral taxa are not processed, however non-coral specimens that have been ID'd by the Observer as a coral **are** processed as it may have been entered into *COD* as a coral taxa and this needs correcting (note: requires a label with the Observer ID 3-letter code on it, otherwise we can't tell what the Observer called it).
  - Accompanying spreadsheet shows which trips were conducted outside of NZ's EEZ

- Images processed, spreadsheet created to hold metadata, some metadata also embedded in image file, includes:
  - expert ID in the form of taxonomic name (species, genus or family level)
  - trip and tow number (tow number usually not shown in photo despite Instructions to Observers document, as such separate efforts are made to determine this)
  - initial Observer ID and expert ID (3-letter MPI species code)
  - specimen count
  - specimen comments
  - keywords relevant to the subject of the image
  - the NIC catalogue number (where applicable)
  - image rating (where the best rating is 1 (very good quality) and the worst is 5 (very poor quality))

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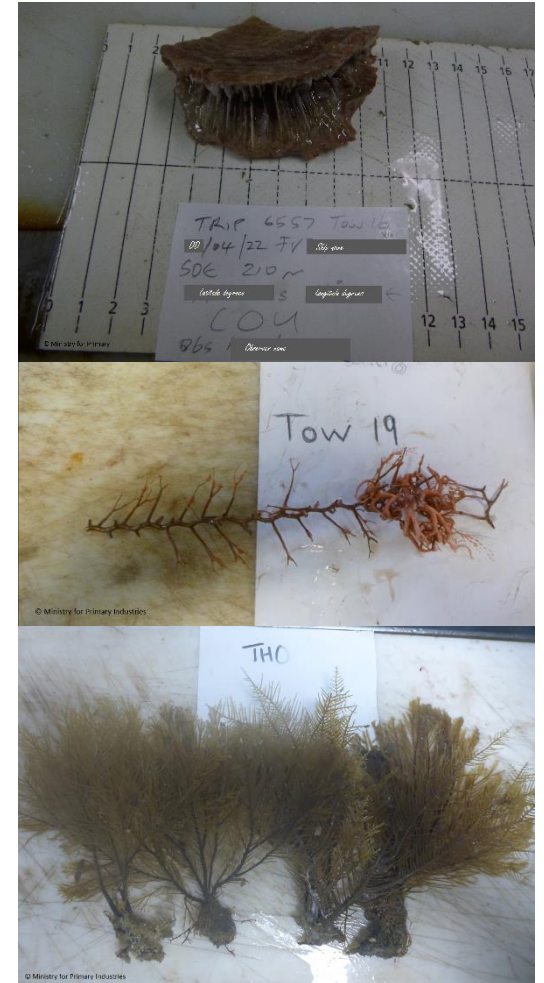
Methods – Objective 1, Specimens from digital images cont'd

- *COD* data sourced and added to spreadsheet, including:
    - position (the start and end coordinates of the tow that sampled the photographed coral)
    - depth (minimum and maximum depths)
    - collected date
    - fishing method
    - target species
    - Fisheries Management Area

- When tow number not available (due to lack of label showing in image) separate efforts are made to determine this
    - Use file date time stamp to find tow number immediately previous to that date time using *COD* data (assumes specimen was collected in previous tow - not accurate)
    - Use Observer forms (such as the 'Photos' tab of the MPI worksheet) to find best match

- Images distributed out to experts for ID

- Metadata spreadsheet updated with expert ID's and delivered at reporting milestones

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Methods – Objective 1, Updating FNZ Centralised Observer Database (*COD*)

Physical specimens

- Expert IDs extracted from *niwainvert* database provided to *COD* for loading & table updates. Initial Observer three-letter MPI species ID codes replaced with expert ID code if required

Images

- Expert ID codes are yet to be loaded into *COD* benthic tables.

- Permission to proceed with a new process, and whether or not to implement new data fields in COD for uploading data relating to images, is currently under discussion between FNZ RDM and the Fisheries Data Manager at NIWA.

Methods – Objective 2, Collect sub-samples for genetic analysis

- Tissue sub-samples are taken from all live-collected protected coral samples

- Sub-samples stored with their corresponding NIC registration label in standard vials in 99% high grade absolute ethanol

- Currently held in the NIC wet collection along with the parent samples

Results – Objective 1, Physical specimens

- 48 observer collected samples (54 specimens)

- 4 observer collected samples, historical (5 specimens) (i.e., collected prior to the current reporting year)

- 3 research trawl survey samples (3 specimens)

- 1 research trawl survey samples, historical (1 specimen)

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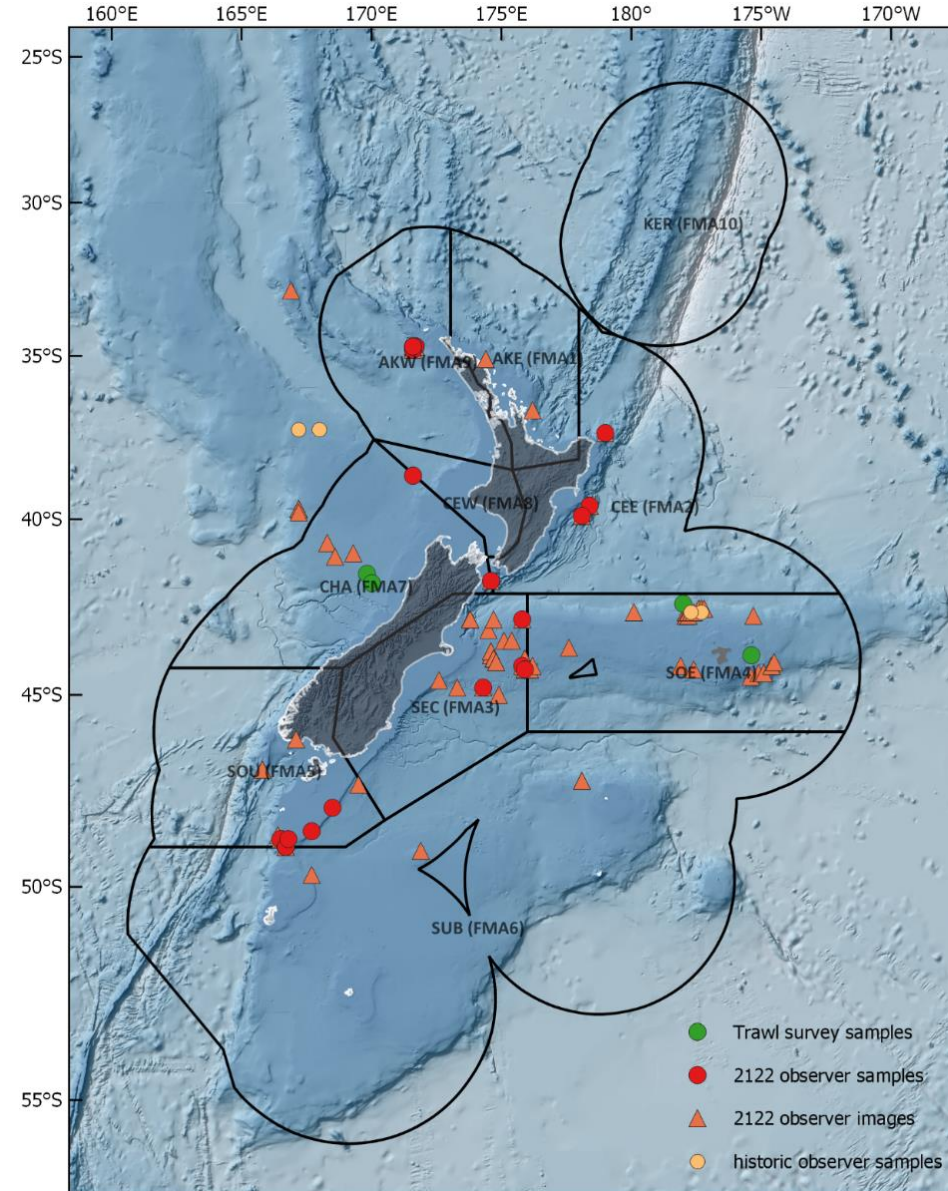
Results – Objective 1, Physical specimens

- 48 observer collected samples (54 specimens)

- A range of species identified:
  - Mostly gorgonian octocorals
  - 2 x black corals
  - Stony corals
  - 2 x hydrocorals
  - A few misidentified hydroids

Phylum	Class	Order	Family	Genus	Species	No. of specimens
Cnidaria	Anthozoa	Alcyonacea	Acanthogorgiidae	*Acanthogorgia*		4
			Chrysogorgiidae	*Chrysogorgia*		1
				Iridogorgia		2
				Metallogorgia		1
				Radicipes		1
			Chyrsogorgiidae	*Chrysogorgia*		1
			Keratoisididae	*Acanella*		1
				Isidella		1
				Isidella?		1
				Jasonisis		1
				Jasonisis?		1
				Keratoisis	sp. 11	1
				Keratoisis		4
				Keratoisididae indet.		2
			Paragorgiidae	*Paragorgia*		1
			Primnoidae	?*Calyptrophora*		1
				Calyptrophora	*clinata*	2
				Calyptrophora		3
				Metafannyella		1
				Primnoa		1
				Thouarella		2
				Primnoidae indet.		4
		Antipatharia	Leiopathidae	*Leiopathes*		1
			Schizopathidae	cf. *Dendropathes*		1
		Scleractinia	Caryophylliidae	*Caryophyllia*		3
				Caryophyllia?		1
				Desmophyllum	*dianthus*	4
				Solenosmilia	*variabilis*	1
			Flabellidae	*Flabellum*	*knoxi*	1
	Hydrozoa	Anthoathecata	Stylasteridae	*Conopora*	*verrucosa*	1
				Stylasteridae indet.		1
		Leptothecata	Lafoeidae	*Cryptolaria*	*prima*	3
Grand Total						54

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Results – Objective 1, Physical specimens

Data summaries

- Most protected corals identified from physical specimens in this period were collected from AKW Auckland West (FMA9) bottom trawl operations targeting orange roughy.

Summary of protected coral samples by Fisheries Management Area (FMA) or from high-seas regions (ET), for Observer collected protected coral samples.
Collected during the current reporting year (1 July 2021-30 June 2022)

FMA	Description	Count of samples	No. of specimens
AKW	Auckland West (FMA9)	29	33
SUB	Subantarctic (FMA6)	5	5
CEE	Central East (FMA2)	4	4
SOU	Southland (FMA5)	4	4
SEC	South-East (Coast) (FMA3)	4	6
CHA	Challenger/Central Plateau (FMA7)	2	2
Total	All areas	48	54

Historical samples identified in this reporting period but collected prior to July 2021

FMA	Description	Count of samples	No. of specimens
SOE	South-East (Chatham Rise) (FMA4)	2	3
CET	Challenger Plateau, beyond the EEZ (ET)	2	2
Total	All areas	4	5

Count of tows and specimens by fishing method and target fishery for physical specimens.
BLL = Bottom Longlining; BT = Bottom Trawl; MW = Midwater Trawl; PRB = Precision Seafood Harvesting Bottom Trawl.
Samples collected in the current reporting year (1 July 2021–30 June 2022)

| Target Fishery (common name)	FNZ Code	Fishing method	Count of tows	Count of samples	No. of specimens
Orange roughy	ORH	BT	16	32	36
Arrow squid	SQU	BT	4	4	6
Hake	HAK	BT	3	5	5
Alfonsino & long-finned beryx	BYX	BT	2	2	2
Silver warehou	SWA	BT	2	2	2
Hoki	HOK	BT	1	1	1
Rubyfish	RBY	MW	1	1	1
Smooth oreo	SSO	BT	1	1	1
Total			30	48	54

Historical samples identified in this reporting period but collected prior to July 2021

Target Fishery (common name)	FNZ Code	Fishing method	Count of tows	Count of samples	No. of specimens
Orange roughy	ORH	BT	3	3	4
Alfonsino	BYS	BT	1	1	1
Total			4	4	5

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Results – Objective 1, Specimens from images

- NIWA received 382 digital images - 273 processed. Remaining 109 not processed either because they were of non-protected coral taxa, they were of coral bycatch taken outside EEZ or taken outside the reporting period

- 290 specimens identified from the 273 images that were processed

- Of 290 specimens, 170 were protected coral taxa, and all were able to be georeferenced. The remaining 120 specimens were determined non-protected taxa

- Observers provided a label showing trip and tow number information for **88 of the 273 processed images.** Tow numbers for the remaining images determined using methods described earlier – very time consuming

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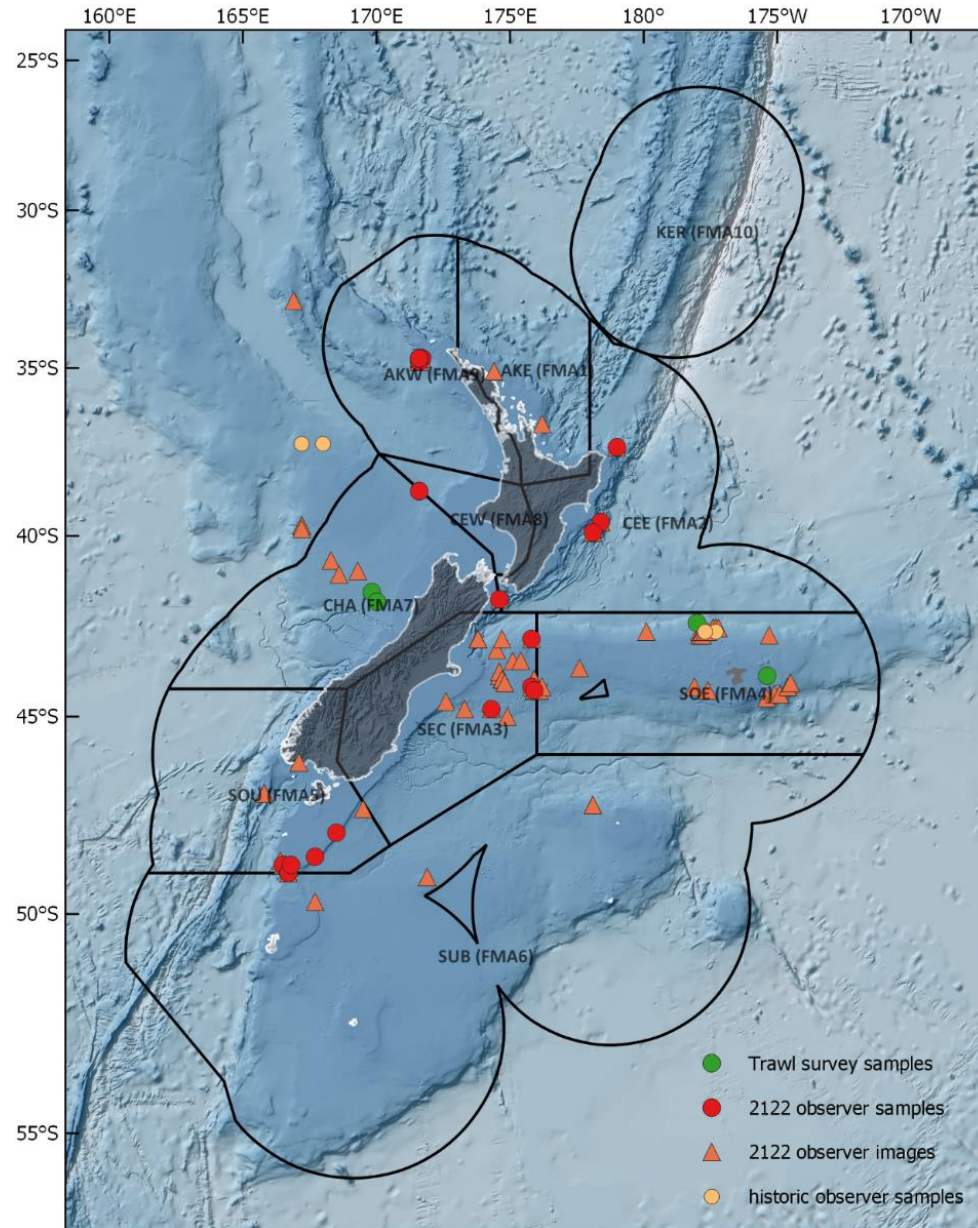
Results – Objective 1, Specimens from images

- The taxa that was photographed the most was the cup coral *Flabellum* sp. (33 specimens)

- Then stony coral species *Solenosmillia variabilis* bamboo coral *Keratoisis* spp. & sea fan *Thouarella* spp. (14 specimens each)

- A range of Primnoidae (sea fans, sea whips) Antipatharia (black corals) & Scleractinia (stony corals) also present

Results – Objective 1, Specimens from images

Data summaries

- The FMAs with the highest number of protected coral bycatch were the SOE South-East (FMA4, Chatham Rise) and SEC South-East Coast (FMA3) regions. Most were taken by bottom trawl targeting orange roughy & hoki.

Summary of imaged specimens by Fisheries Management Area (FMA)

Area	Description	Total no. of specimens
SOE	South-East (FMA4)	45
SEC	South-East Coast (FMA3)	43
AKE	Auckland East (FMA1)	19
CEE	Central East (FMA2)	18
SOU	Southland (FMA5)	13
AKW	Auckland West (FMA9)	12
SUB	Subantarctic (FMA6)	9
CET	Challenger Plateau, beyond the EEZ (FMA) (ET)	6
CHA	Challenger (FMA7)	3
ET	Beyond the EEZ (ET)	1
SOI	Southern Offshore Islands – Auckland & Campbell Is. (FMA 6A)	1
Total		170

Count of tows by fishing method and target fishery for imaged specimens.
BLL = Bottom Longlining; BT = Bottom Trawl; MW = Midwater Trawl; PRB = Precision Seafood Harvesting Bottom Trawl; POT = Potting; SN = Set netting

Target Fishery (common name)	FNZ code	Fishing Method	Count of Tows	Total no. of specimens	Remarks
Orange roughy	ORH	BT	40	79	
Hoki	HOK	BT	12	32	
Squid	SQU	BT	15	21	
Smooth oreo	SSO	BT	5	9	
Cardinalfish	CDL	BT	4	8	
Alfonsino	BYX	BT	5	6	
Hake	HAK	BT	3	5	
Hoki	HOK	PRB	1	4	
Snapper	SNA	BLL	1	2	
Bass groper	BAS	BLL	1	1	ET FMA
Ruby fish	RBY	MW	1	1	
School shark	SCH	SN	2	1	
Squid	SQU	MW	1	1	
All			91	170	

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Results – Objective 1, Data loaded into *COD*

Physical specimens

- Revised identifications from *niwainvert* provided for uploading into *COD*
- Of the 52 rows of Observer-collected physical specimen data (47 current year, 5 historical):
  - 42 rows able to be matched to the catch record for the specimen & were updated
  - 10 rows not able to be matched to the catch record for the specimen & so inserted as new records (mainly split lots, or old data with no link to original code used)

Images

- Expert ID codes are yet to be loaded into COD benthic tables for this project. New process under development by NIWA Fisheries Data Management team, with further discussion and approval required from FNZ RDM.

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Results – Objective 1, Observer ID accuracy

While no formal 'analyses of accuracy' have been carried out between Observer / NIWA expert identifications, a summary of the accuracy of Observer ID is presented & will be useful for on-going Observer training exercises

Physical specimens

Observers correctly identified 21 of the 48 samples, 14 correctly identified to genus or species level, 3 to family or family group level, 2 to order level and 1 to phylum level. This indicates a **42% accuracy** of Observer code use overall for the physical samples, regardless of the taxonomic level of the ID

Images

Observers assigned identification codes for 118 out of the 273 specimen images identified by experts. Observers correctly identified 81 of the specimens to at least Order level (**69% accuracy**)

Note that in some cases codes are only available to higher levels for some taxa.

Accuracy has varied year to year through this project, which may be for a variety of reasons: e.g., level of observer experience, encountering different species that are trickier to identify etc.

Results – Objective 2, Sub-samples of protected coral specimens for genetic analysis

- Tissue sub-samples taken from 32 specimens

- Accumulated protected coral tissue sub-samples retained for future genetic studies now = 156

- DOC projects using these samples for molecular studies - carried out or underway:
  - Sub-samples of many black coral and octocoral specimens have now been analysed and the results are reported in Bilewitch & Tracey (2020a; 2020b) and Bilewitch (2022)
  - genetic diversity of octocoral species in the family Primnoidae Chatham Rise was identified by CSP biodiversity project:
    - 12 of the 17 species identified occur in trawl bycatch of HOK, OEO, ORH or SCI
    - A potentially new family has been discovered
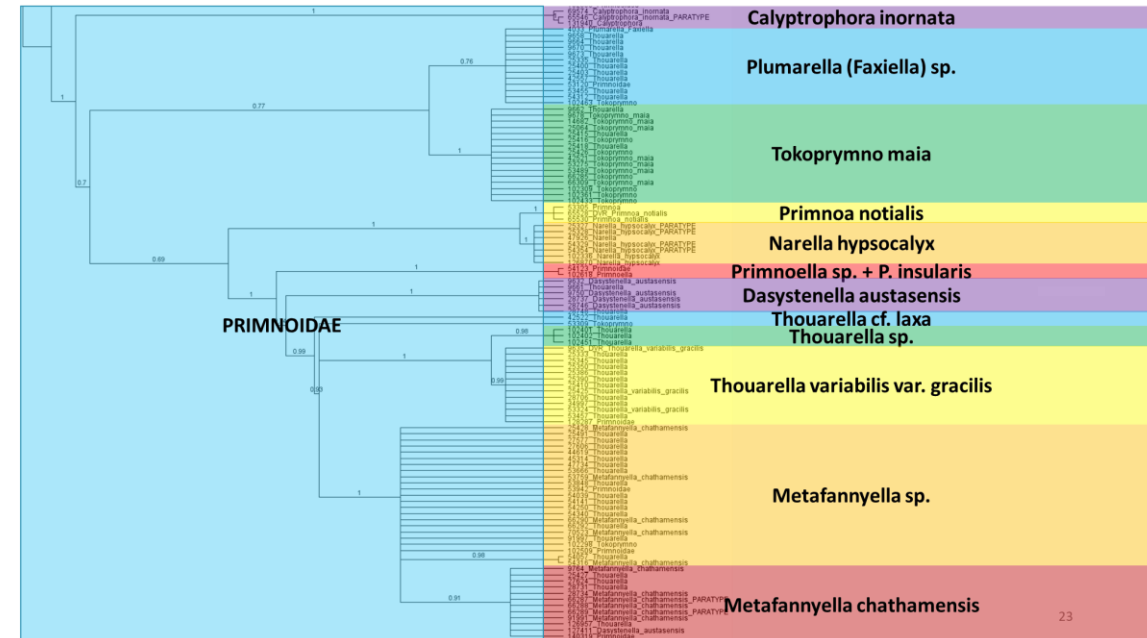
Objective 3, Assist with Observer training resources

- Instructions to Observers passed onto to CSP at beginning of project

- Recommendations highlighted in various Client reports

- Provided input this reporting period into revised & updated coral identification guide (revised from Coral Identification Guide (Tracey et al. 2014))

- 16 new or revised identification sheets for protected corals and taxa easily confused with corals

- Approached by FNZ Observer Supervisor for assistance with in-person Observer training for coral identification in future

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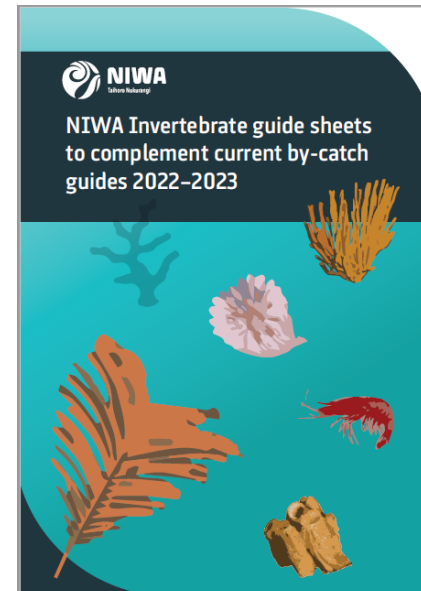
Recommendations

Acknowledge workload placed on Observers at sea, recommendations are made on their at-sea data collection methods, specifically labelling specimens and images with comprehensive information

- Images need to be taken with a label showing in the frame that includes trip and tow numbers and the Observers initial ID species code

- The coral specimen, or a sub-sample of the specimen, needs a label including the trip & tow numbers, MPI sample number, Observers initial ID - species code

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MPI observer:	Photo number(s):
Trip:	Tow/Set:
Observer Benthic Materials Form	(write in pencil)
MPI sample ID:	MPI Species Code:
Comments:	
(NIWA use only)	
NIWA ID:	
OSD:	Specify:

Recommendations cont'd

MPI sample number and the initial Observer three-letter identification code are crucial components in the data matching process used for updating *COD* with the expert ID of the physical specimens.

- We reiterate the recommendation that the initial MPI sample number and three-letter code written on the specimen label corresponds to the sample number and code used on the benthic form.

- If Observers decide to change their identification code later while filling out electronic or paper catch forms, we ask that they please provide a comment in the benthic form if they are not able to amend the specimen labels to match the benthic forms.

- Observer comments are extremely valuable where a match cannot be made with sample numbers or codes alone.

Summary

- 3rd and final year of a 3-year project, which follows previous projects.
- A new 3-year project (INT2022-03) begins July 2023.
- 54 physical specimens in 48 samples collected by Observers identified during the reporting period
  - Additionally, 4 historical physical samples collected by Observers with revised higher-level identifications made during the reporting period. A total of 4 research trawl-collected specimens in 4 samples are also reported here
- Sub-samples from each live specimen taken for future genetic studies (n=32)
- 290 specimens identified from digital images - 170 were protected coral taxa
- Database updates made
  - Georeferencing of images can be challenging due to lack of labelling by Observers
- Most protected coral samples taken by bottom trawl targeting orange roughy, and hoki, from the South-East (Chatham Rise) (FMA4) and South-East Coast (FMA3)
- Brief summaries of accuracy provided – *Note: no formal analysis*
  - Stony cup corals, some gorgonian octocorals and bubblegum coral IDs accurate to genus or species level
  - Other taxa remain problematic, some confusion with hydroid identification
- We continue to make recommendations for Observers to improve their labelling (specimens and images)

Ngā mihi

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