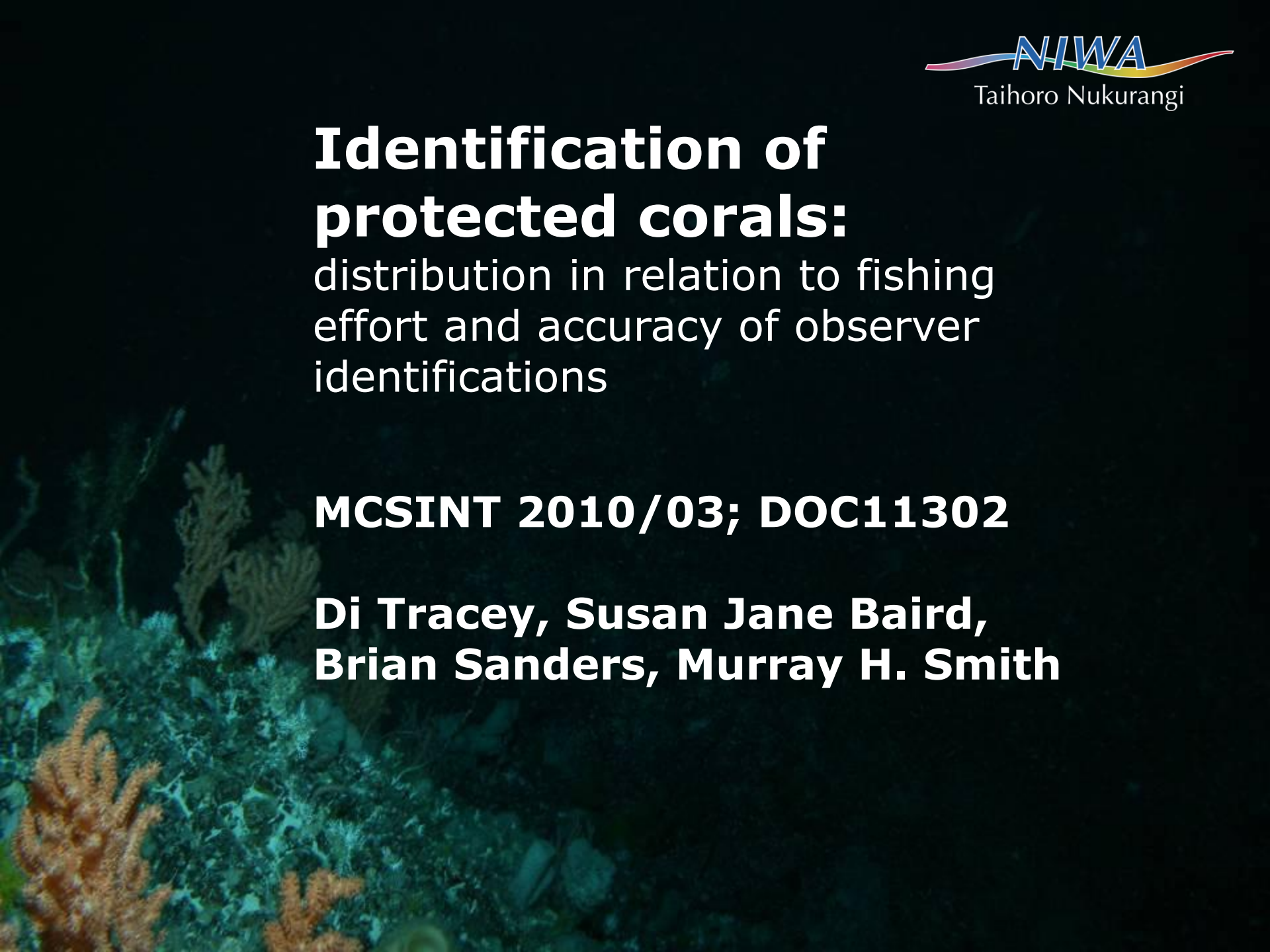


Identification of protected corals:

distribution in relation to fishing effort and accuracy of observer identifications

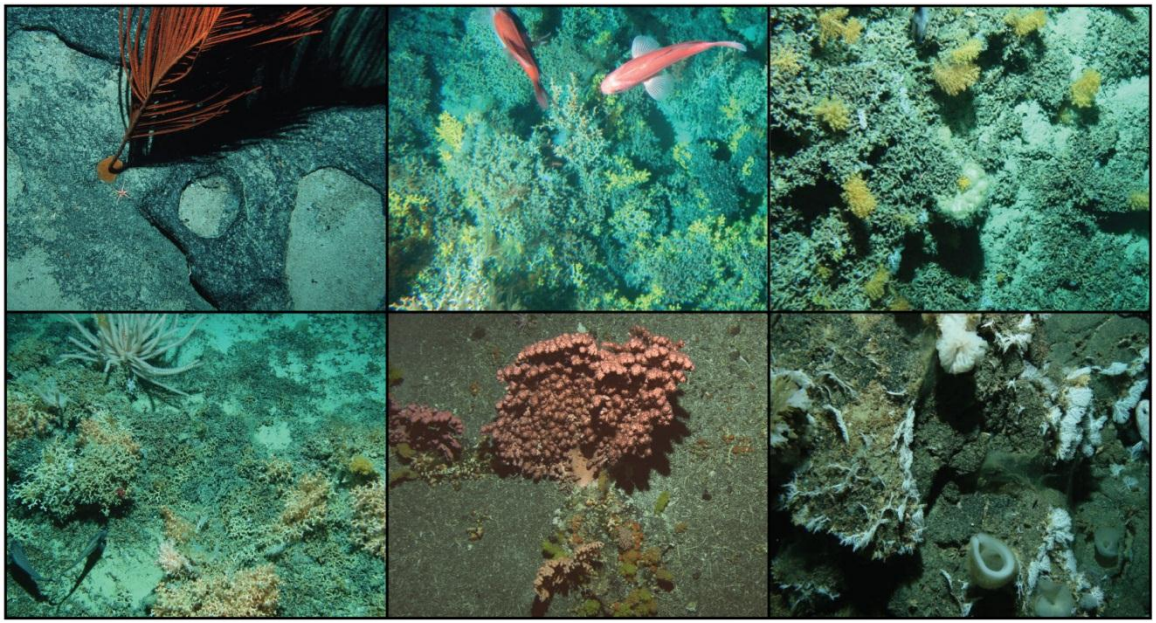
MCSINT 2010/03; DOC11302

Di Tracey, Susan Jane Baird, Brian Sanders, Murray H. Smith

Protected coral species

- Deepsea corals in the New Zealand region are abundant and diverse and, because of their vulnerability, are at risk from anthropogenic effects such as bottom trawling

- Schedule 7A of the Wildlife Act 1953 affords protection to all deepwater hard corals (all species in the orders Antipatharia, Gorgonacea, Scleractinia, and family Stylasteridae)



Protected coral species

A number of protected coral taxa are known to be caught incidentally during commercial fisheries in New Zealand, particularly deepwater trawls targeting orange roughy (*Hoplostethus atlanticus*) or oreo species (Family *Oreosomatidae)*

To understand the risk to protected corals, and ensure commercial fishing impacts on protected corals are minimised, it is important to quantify the spatial extent of these impacts

Overall Objective

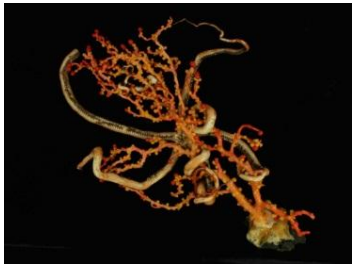
To analyse the spatial distribution of coral sub-samples returned through the CSP observer programme in relation to fishing effort (2007/08 – 2009/10)

Specific Objectives:

1) To identify areas where deep sea corals are at highest risk of interactions with fishing gear

2) To assess the value of identifying sub-samples of corals returned by observers and, specifically, whether there is an ongoing need to monitor and quantify the level of interaction between fisheries and protected corals

Background



- Previous 3 projects were to identify samples of corals returned through the CSP observer programme - 2007-2010
- Set protocol for coral data collection for deepwater fleet for observed effort inside and outside EEZ over 3 years
- All vessels record corals and other invertebrates on benthic form

Specific Objectives:

1) Samples of corals returned by observers to be identified to lower taxa (families, genera, species)

2) Update the Ministry of Fisheries Centralised Observer Database (*cod*) as necessary with correct species identifications

Background, main tasks

- Sorting observer returned frozen samples to putative identification level
- Entering data into NIWA 'Observer Samples Database' (OSD)
- Taxonomists confirm identification

- OSD data exported into NIWA Invertebrate Collection (NIC) *Specify* database

- OSD data exported into *cod* common link of trip_number & station_number

Summary of key activities 2010/11 Project

Obtain *cod* data extract

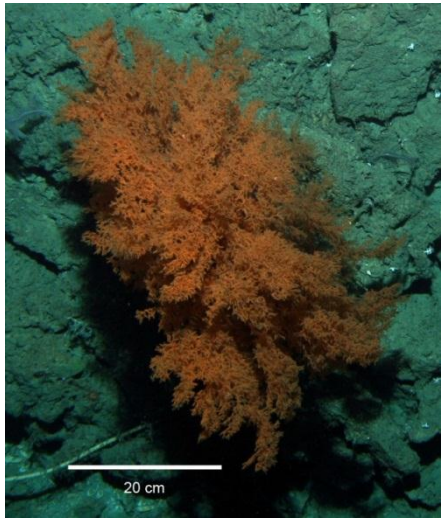
Groom the data (observer catch effort & coral catch)

Map the coral species (or coral groups where appropriate) against the observed fishing effort by target species

Assess value of observers carrying out IDs

- discuss coral distribution relative to fishing
- provide an assessment of the value of at-sea sampling / sub-sampling of protected corals
- help assess the ongoing need to monitor and quantify the level of interaction between fisheries and protected corals

General summary



Over three fishing years, 2007-08 to 2009-10

10% observed tows had coral catch records

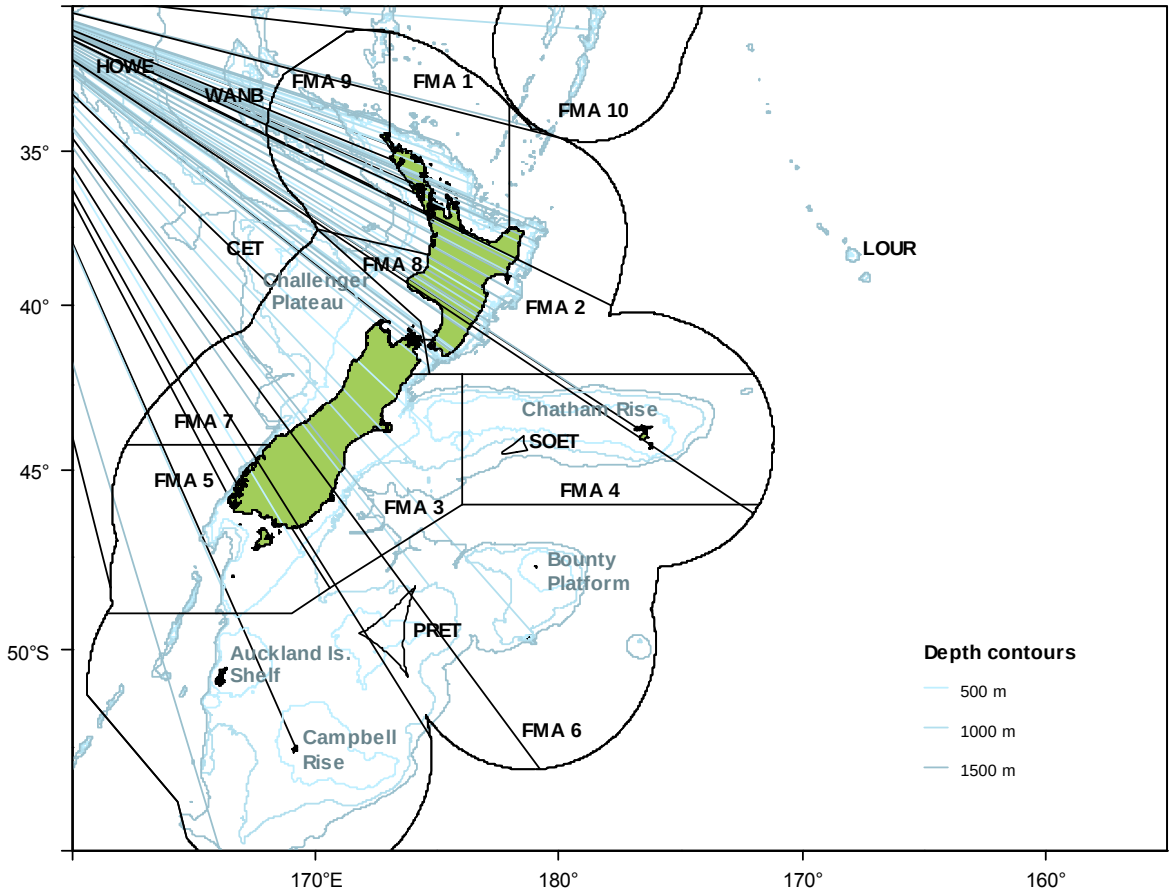
19% of observed tows for deepwater targets had coral records

1% observed BLL sets had coral records

Corals mainly from 800-1000 m fishing depths. Most from known fishing features

Nine coral groups - branching and cup stony corals, coral rubble, black corals, and bamboo corals most often recorded, followed by bubblegum corals. Least recorded were hydrocorals and precious corals

Observer effort data 2007- 08 to 2009-10



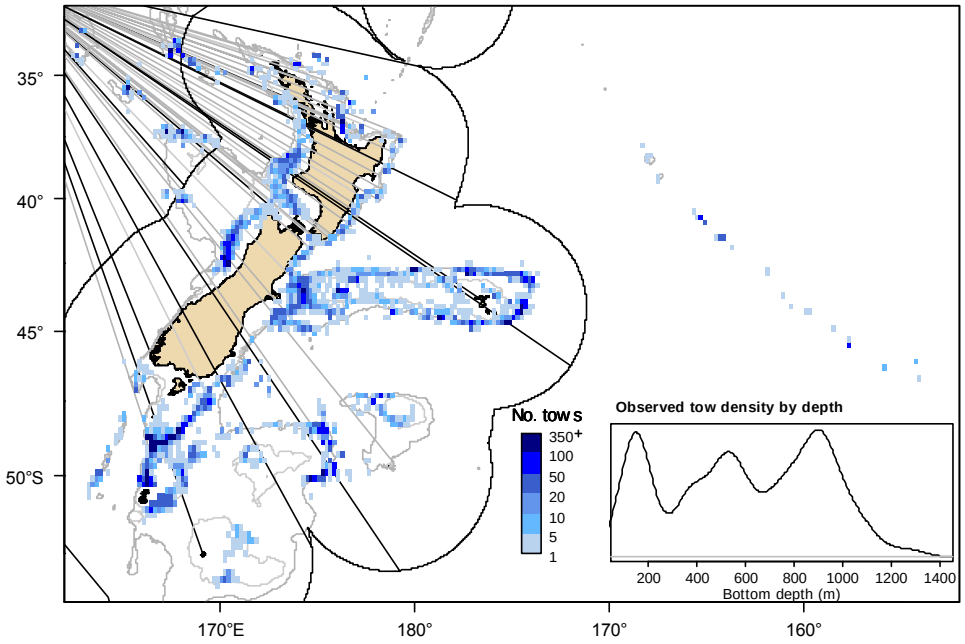
Trawl:

- 21 259 tows
- in the EEZ + in SPRFMO areas
- 82% used BT gear
- 100-1450 m
- ~ 33 target species

Bottom longline:

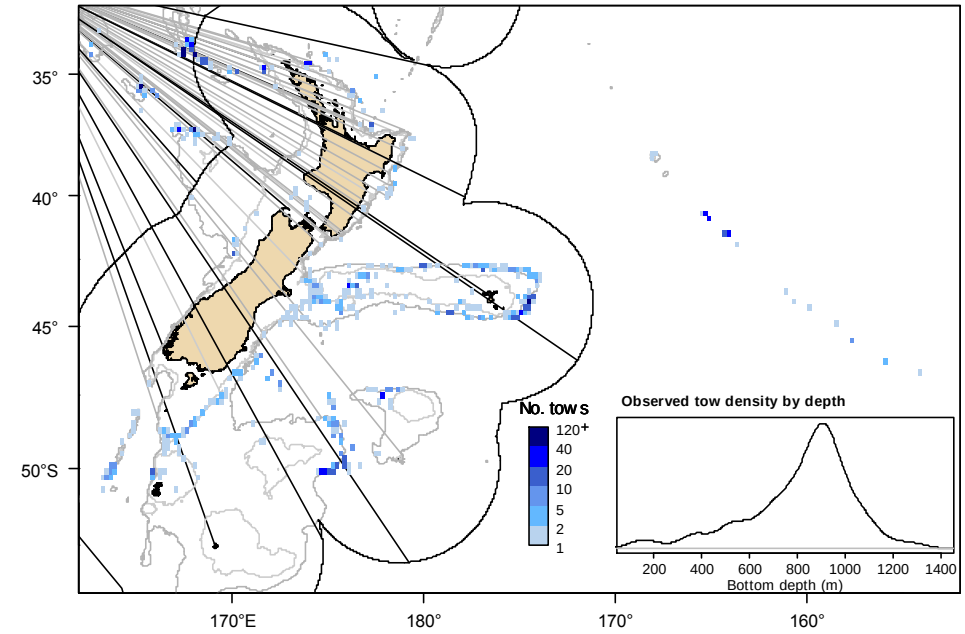
- 863 sets
- 5 targets

(95% LIN in FMAs 3,4,6)



observed tows *n* = 21 259

- 42.5% deepwater OEO ORH CDL
- ~ 25% middle depths HOK HAK LIN WWA
- 14% SQU
- 6% SCI
- 6% JMA (MW)
- 1.5-2% each BAR BYX SBW SWA

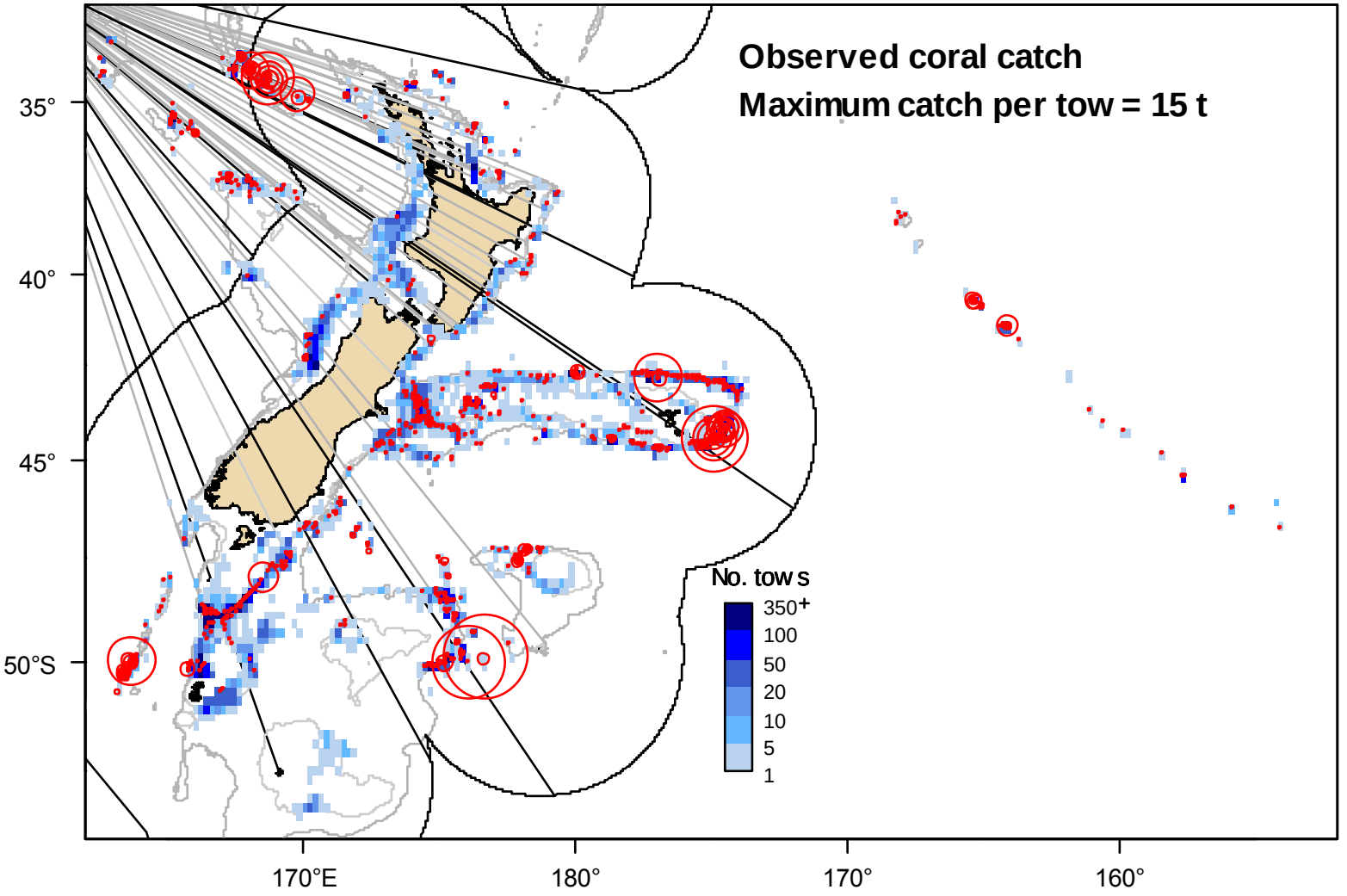


observed tows with coral
n = 2112

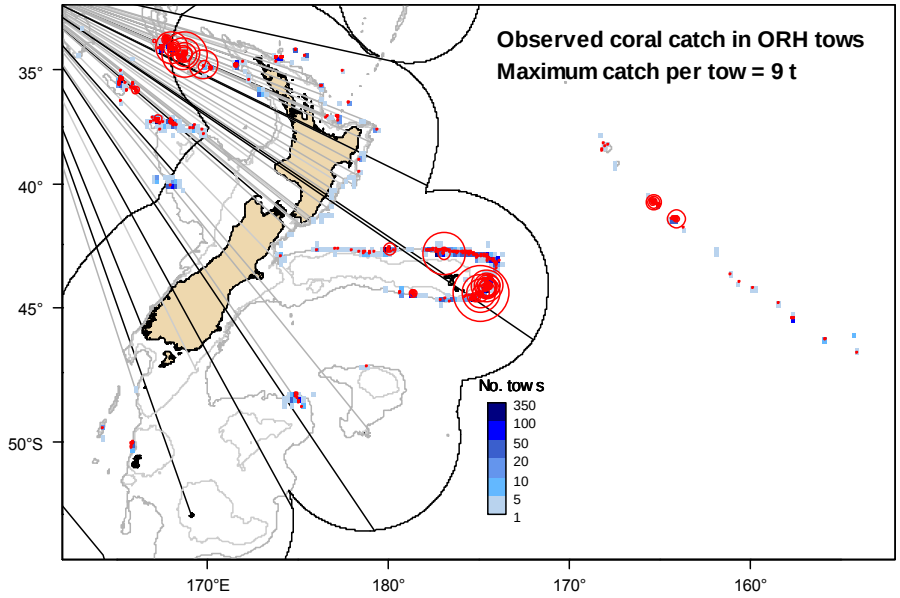
- 82% deepwater OEO ORH CDL
- 6.3% middle depths HOK HAK LIN WWA
- 2.7% SQU
- 3.1% SCI
- 1.6% BYX BAR BAS JMA MDO SBW SWA

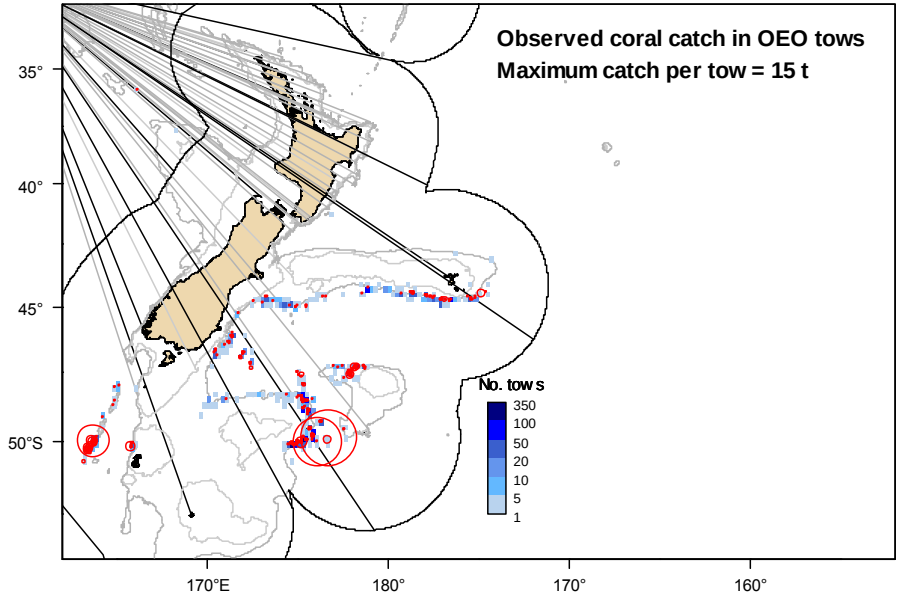
0.2° latitude x 0.2° longitude cells

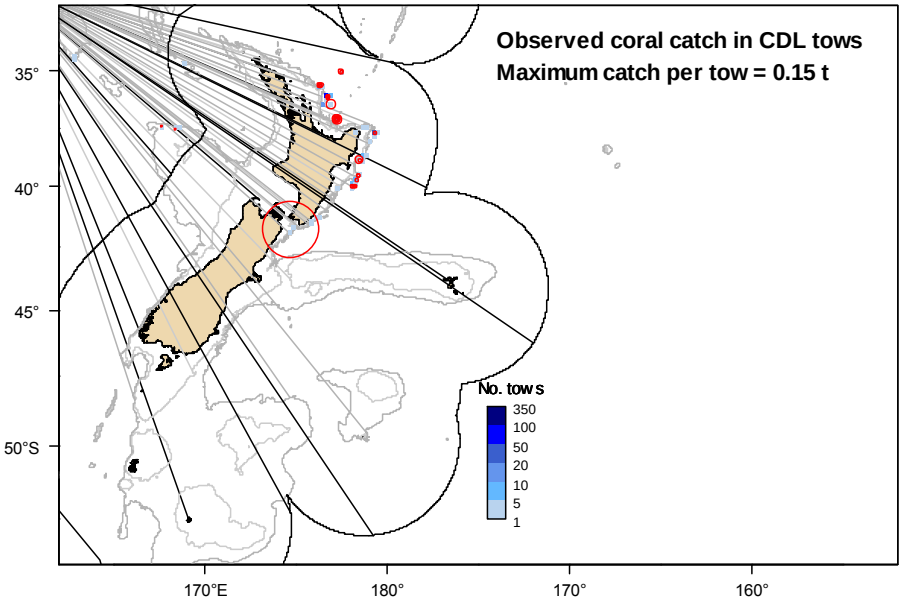
Distribution of observed effort and observer-estimated coral catch weights per tow, 2007-08 to 2009-10



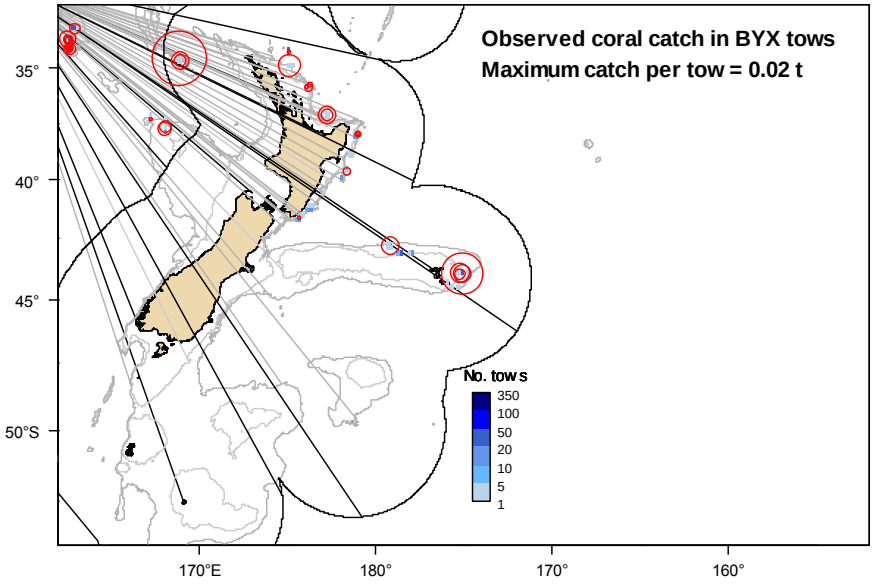
Observed tow density and estimated catch weights by target

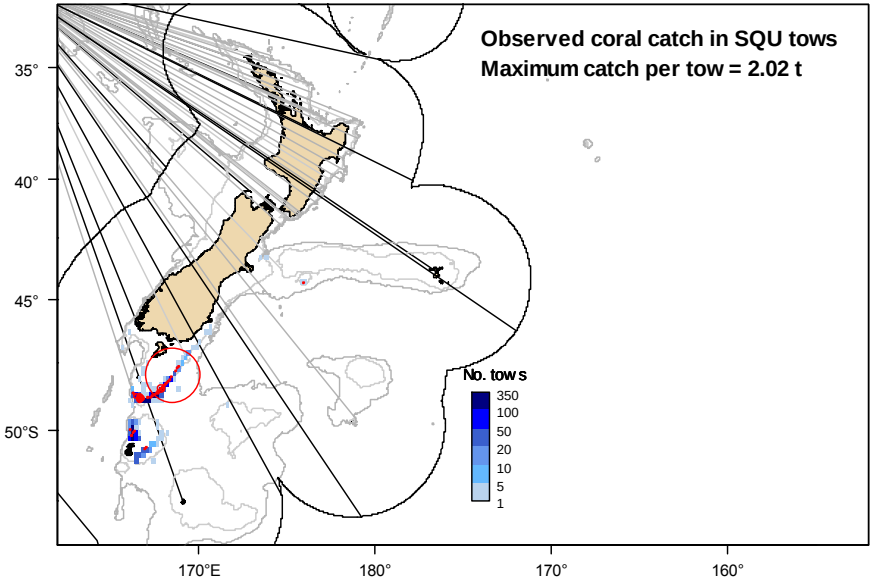


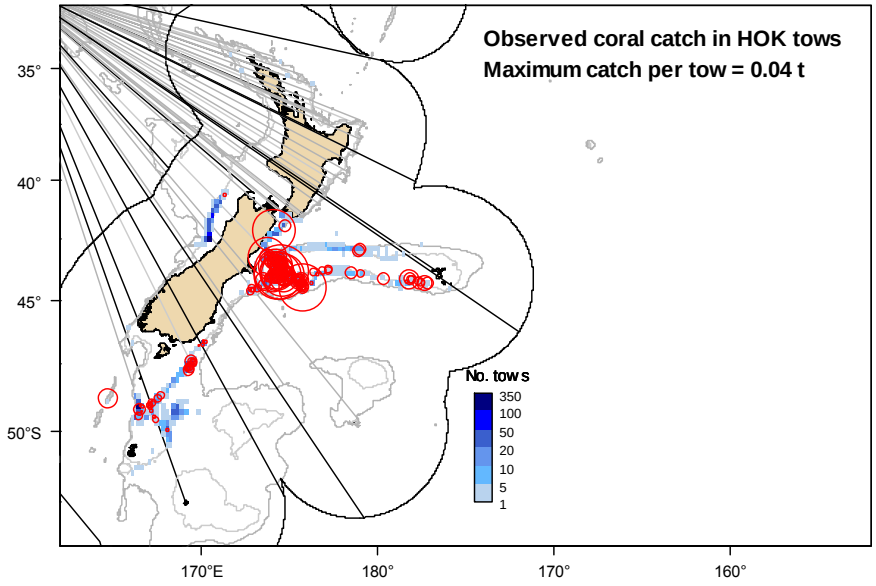


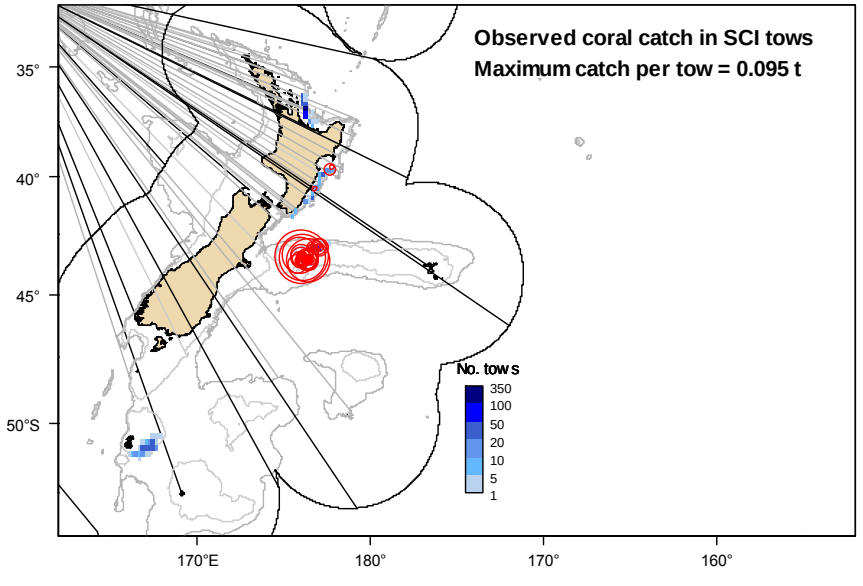


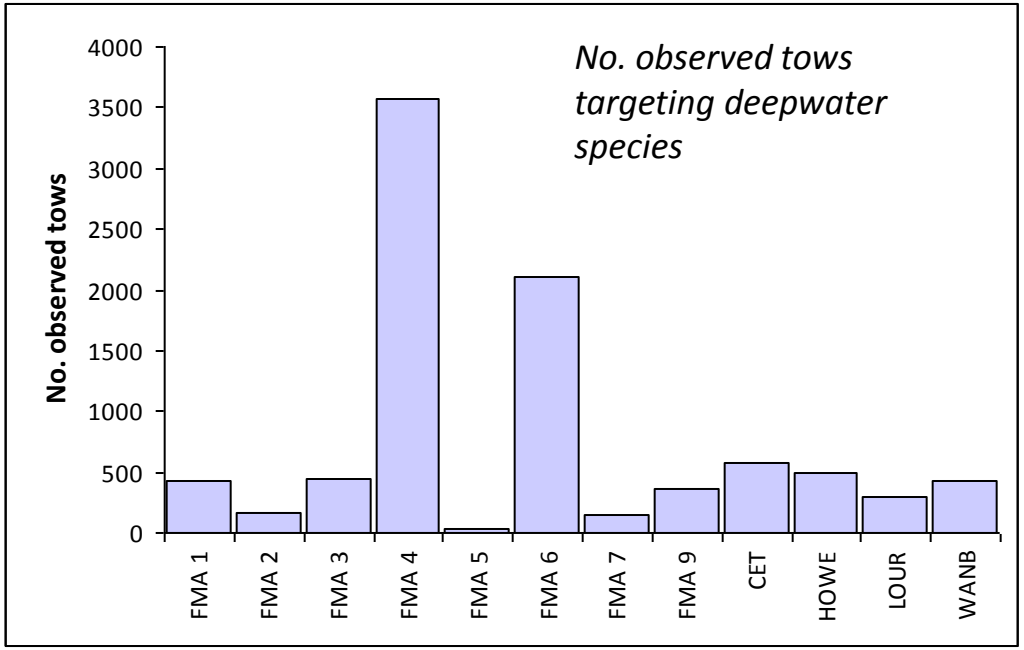
Observed tow density and estimated catch weights by target

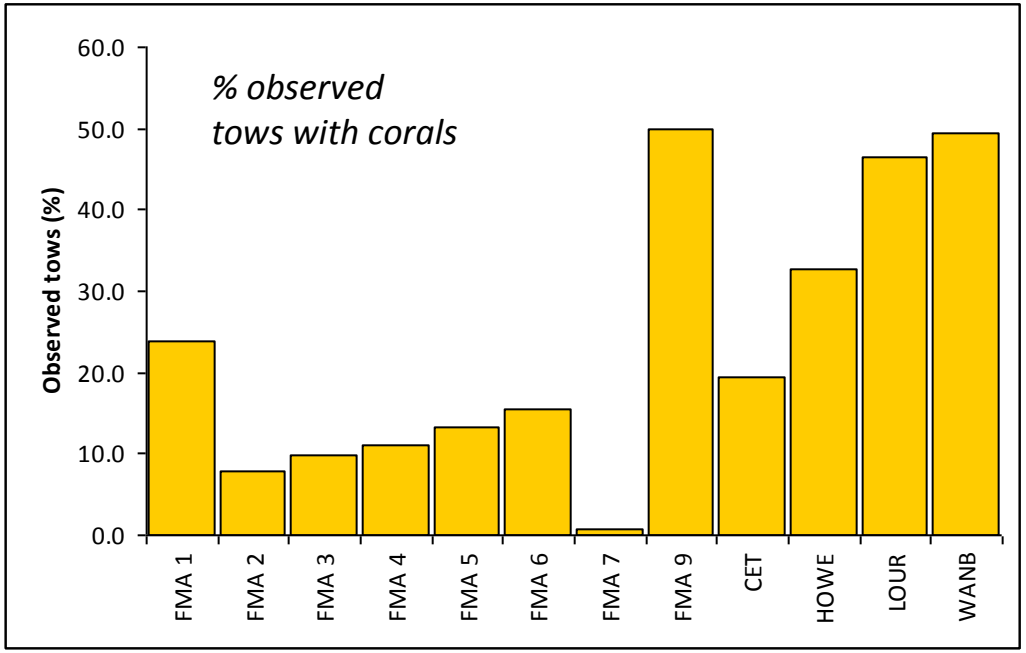












Deepwater targets & coral catches

- 9034 obs tows for OEO spp, ORH, CDL
- Coverage in all FMAs open to BT except FMA 8
- Most observed effort in FMA 4 and FMA 6
- Highest percentage tows with coral catch in northern FMAs and SPRFMO areas

Observed corals allocated to 9 groups

Name	Combined coral code	Coral codes
Black corals	COB	COB, TPT, CIR, LSE, LEI, BTP, DEN, PTP
Stony corals*	SIA	SIA, CBB, CBD
Stony corals – branching	CBR	CBR, ERO, GDU, MOC, SVA
Stony corals - cup	CUP	DDI, CAY, STP, COF, CUP
Gorgonian corals	GOC	GOC, MTL, IRI, CHR, PLE, THO, PMN, NAR, PRI, CLG, CTP, PLL,
Precious coral	CLL	CLL
Bamboo corals	ISI	ACN, ISI, LLE, BOO
Bubblegum coral	PAB	PAB
Hydrocorals	COR	COR, LPT, ERR, CRE

Identification; Overall 9 to species level, remaining to genus and family level, e.g., CBR 4 species, 1 unspecified

Observed coral catch weights (kg)

	No. tows	Minimum	1st quantile	Median	Mean	3rd quantile	Maximum
COB	359	0.006	0.20	0.5	0.95	1.0	10.0
SIA	440	0.100	1.00	2.0	89.12	7.6	8005.0
CBR	576	0.040	0.60	2.0	100.80	8.0	15000.0
CUP	355	0.001	0.21	1.0	13.56	2.0	2500.0
GOC	377	0.001	0.10	0.3	3.64	1.0	400.0
ISI	333	0.002	0.20	1.0	3.21	1.2	200.0
PAB	117	0.100	0.50	2.0	18.09	10.0	376.1
COR	35	0.048	0.20	1.0	0.97	1.0	8.0
CLL	13	0.100	0.30	1.0	1.05	1.0	3.8

- Most commonly reported coral groups were stony corals (branching CBR, cup CUP, coral rubble and unspecified SIA), gorgonian GOC, black COB group, and bamboo ISI.
- Hydrocorals COR & precious corals CLL reported infrequently
- Median catch weights by group usually 1-2 kg

Co-occurrence by FMA of coral groups from deepwater tows

No. of observed **deepwater** tows by the number of coral groups represented in the catch, by fishery area.

81% no coral, 14% one coral group, 5% with 2-6 groups

	Number of coral groups							Total
Area	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**tows**
FMA 1	331	66	29	9	0	0	0	435
FMA 2	151	12	1	0	0	0	0	164
FMA 3	397	34	7	1	1	0	0	440
FMA 4	3 176	321	54	16	2	0	1	3 570
FMA 5	26	4	0	0	0	0	0	30
FMA 6	1774	227	77	16	8	0	0	2 102
FMA 7	150	1	0	0	0	0	0	151
FMA 9	184	137	34	11	1	1	0	368
CET	462	94	12	5	1	0	0	574
HOWE	328	111	36	9	3	0	0	487
LOUR	157	125	9	1	1	0	0	293
WANB	212	133	53	15	5	2	0	420
	7 348	1 265	312	83	22	3	1	9 034

Plots in following slides:

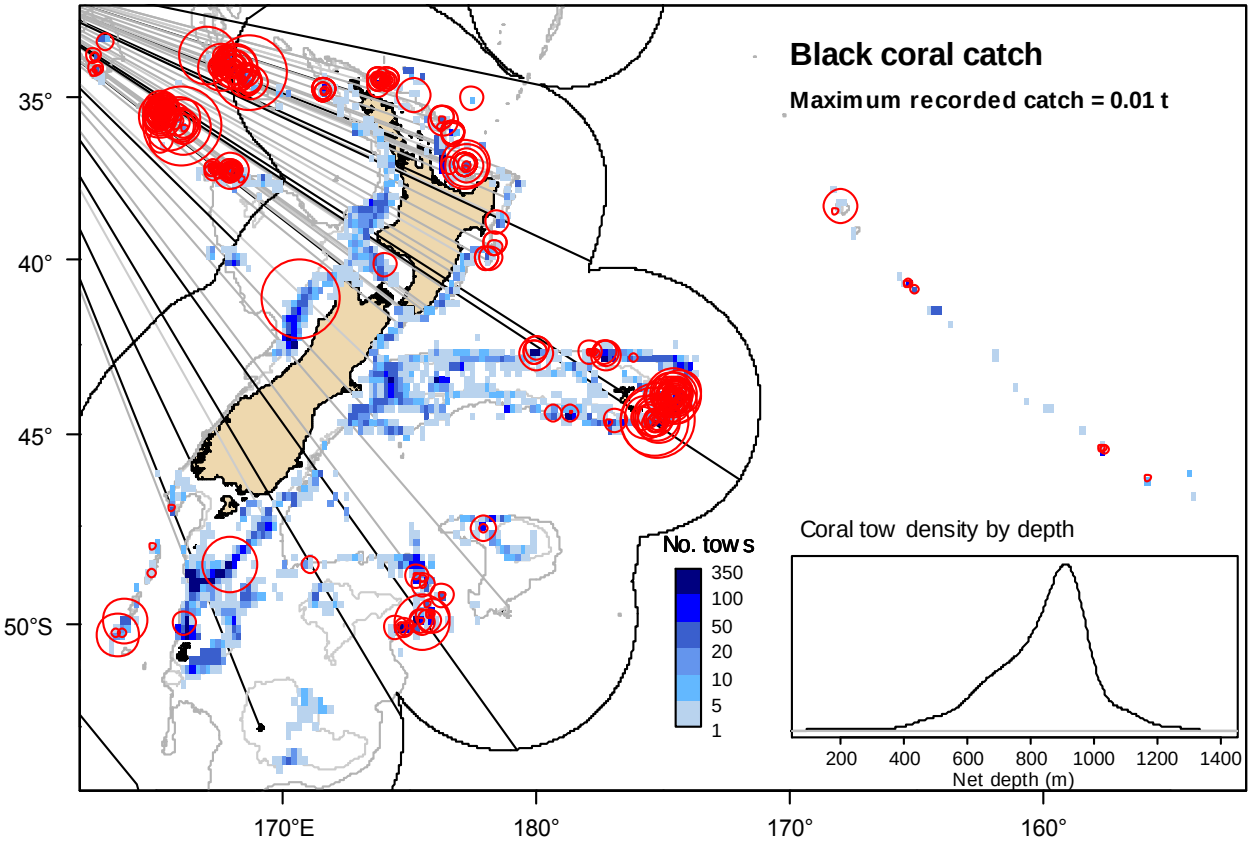
The distribution of observed
tows over the 3 fishing years and the distribution of those tows with each coral groups bycatch (red)

0.2° latitude x 0.2° longitude cells

All data combined (includes verified samples) & [mean catch kg]

Some examples of verified data plots – overall and by species

Black coral
(359 tows)

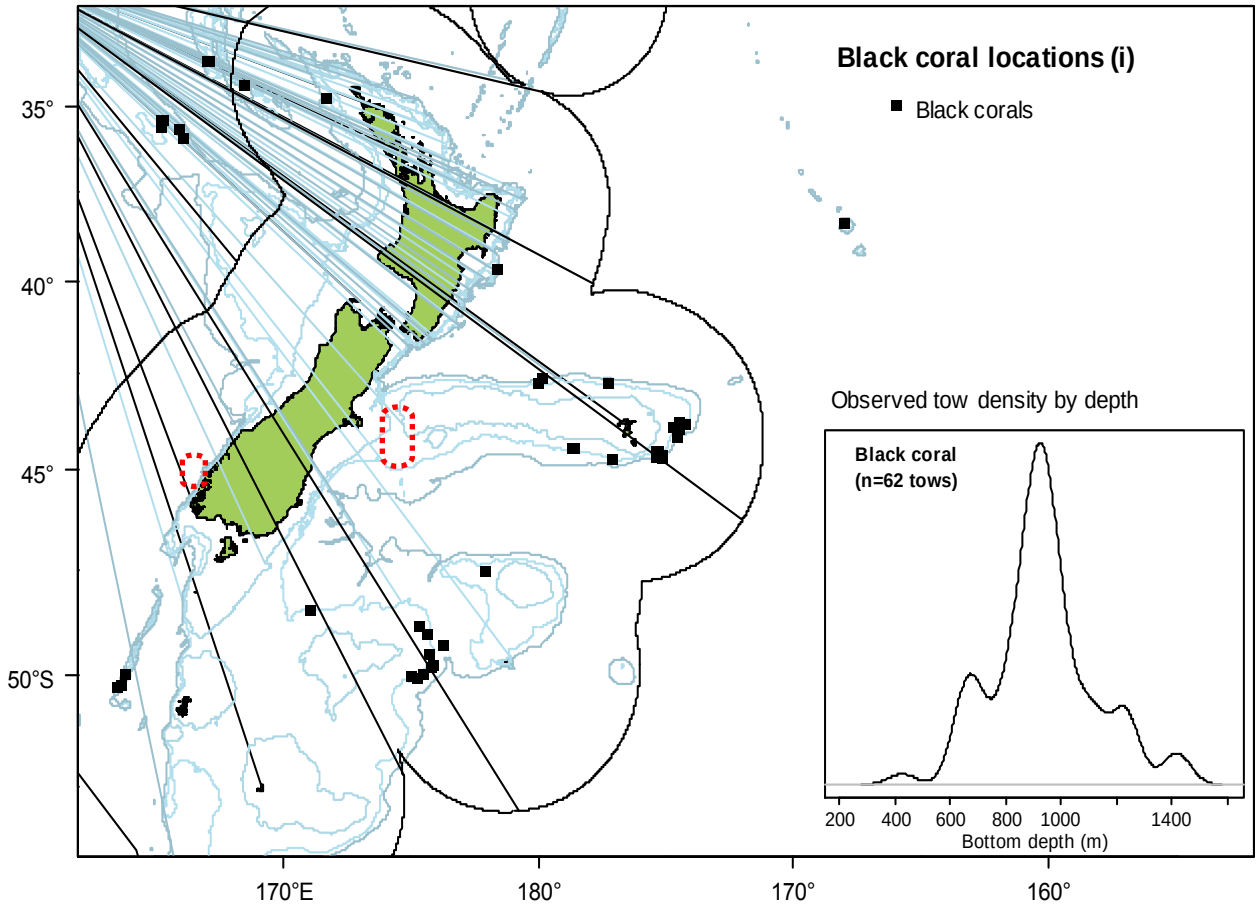


Estimated weight: Small catch weights – 0.006-10.000 kg [median 0.5 kg]

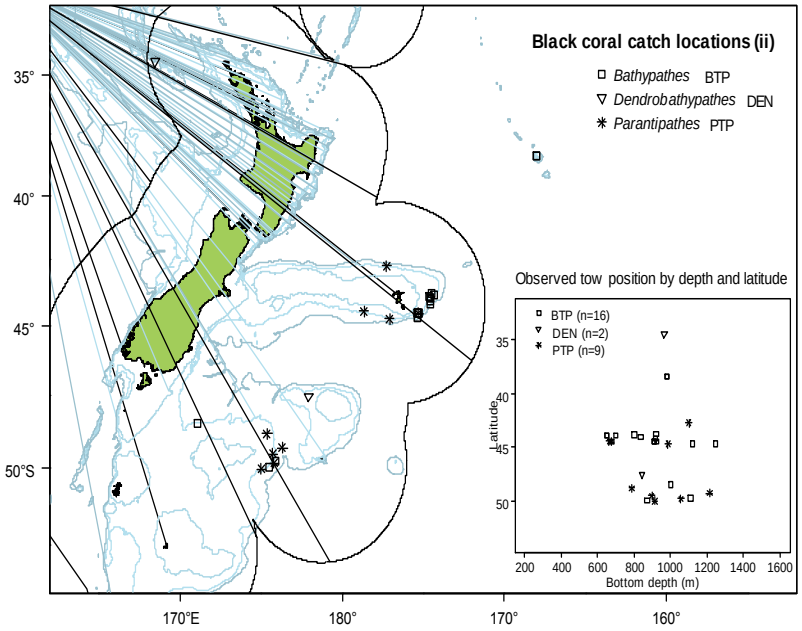
Depth: 800 -1000 m

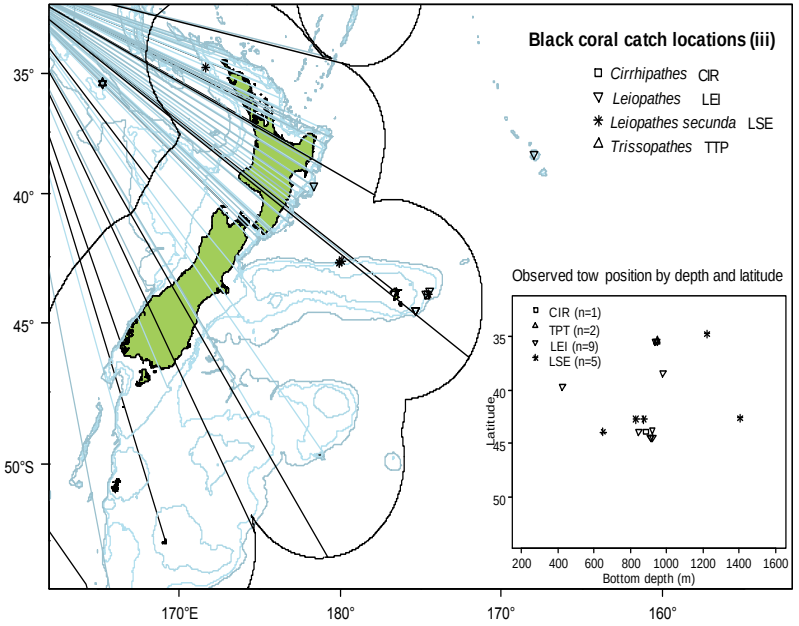
Target: from 11 targets, mostly deepwater targets on features

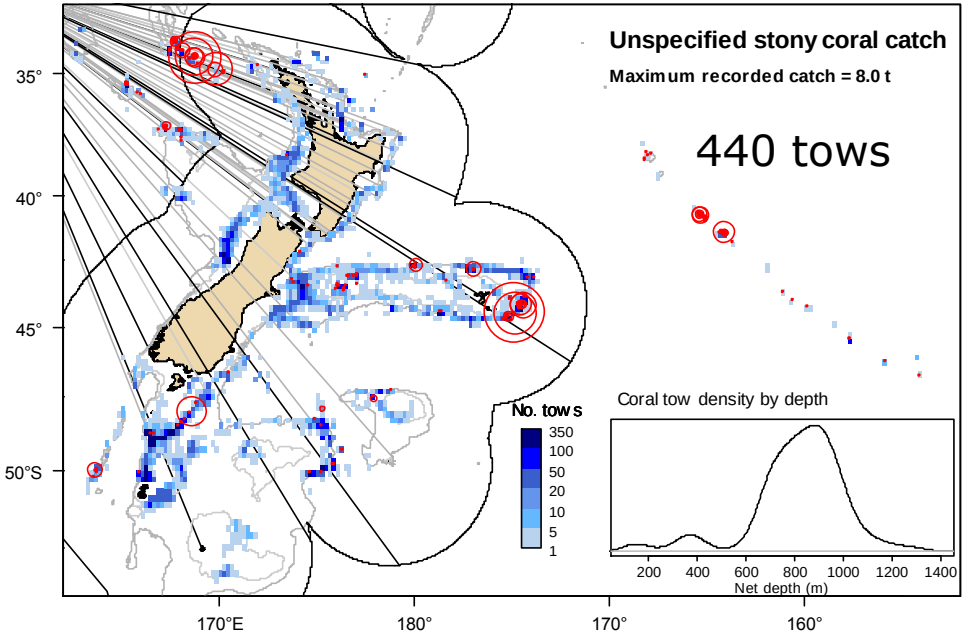
Black coral – verified samples



Black coral – verified samples (by genus, species)







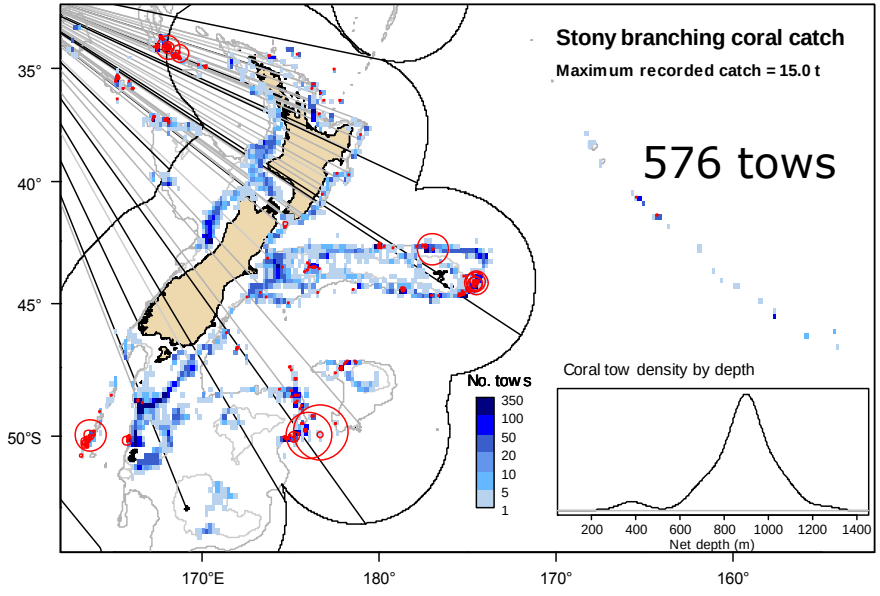
Stony coral catch

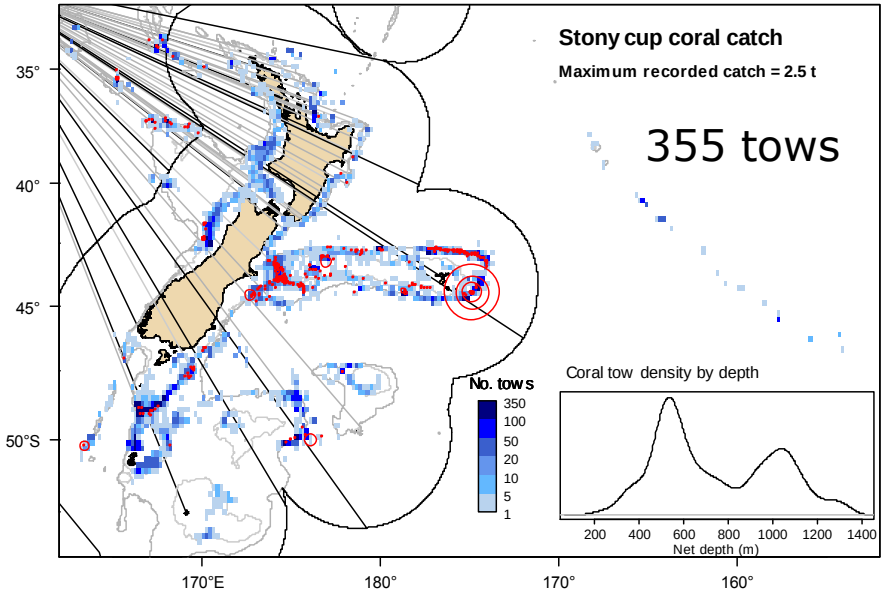
Est. wgt: 0.1-8005.0 kg SIA [2 kg]
0.04-15 000.0 kg CBR [2 kg]
0.001-2500.0 kg CUP [1 kg]

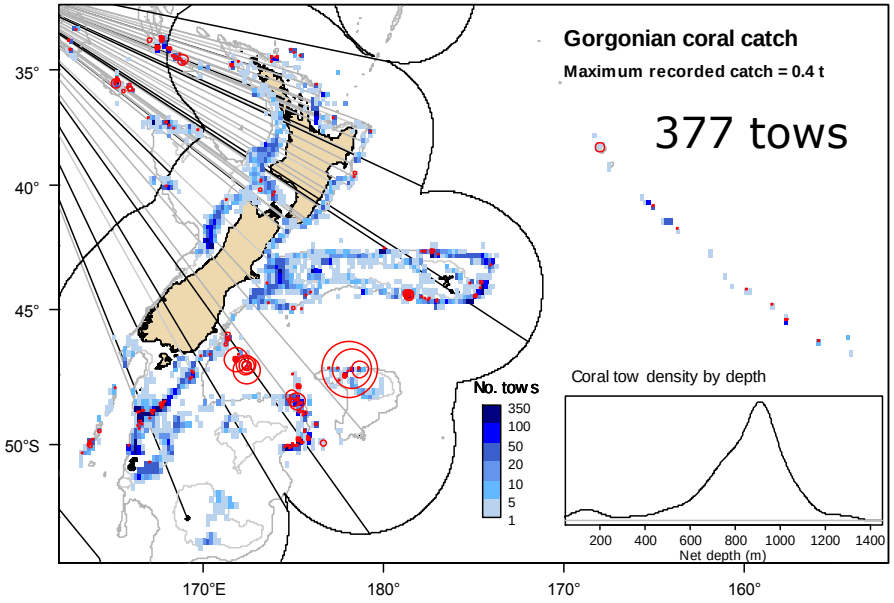
Depth: wider depth range for CUP

Target: mainly deepwater targets on feature fisheries + SCI

CUP also from HOK, HAK, LIN, SWA, BAR





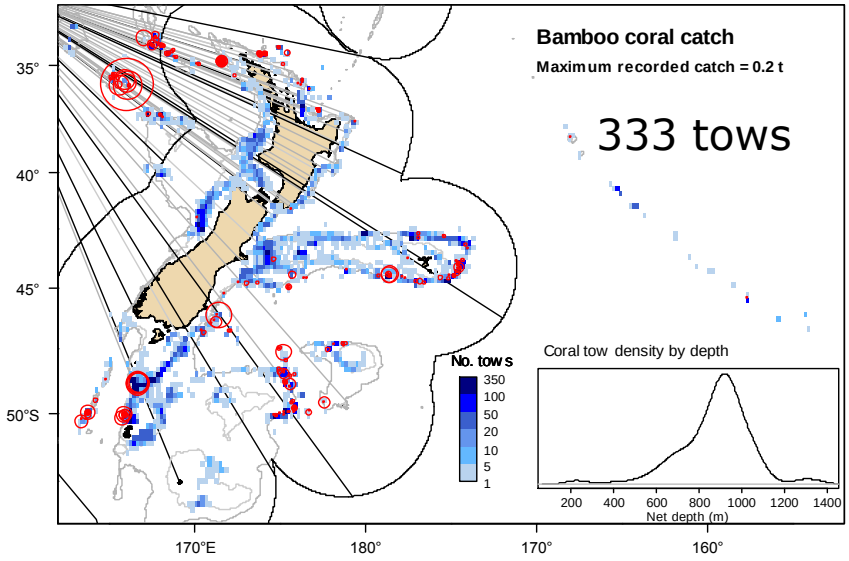


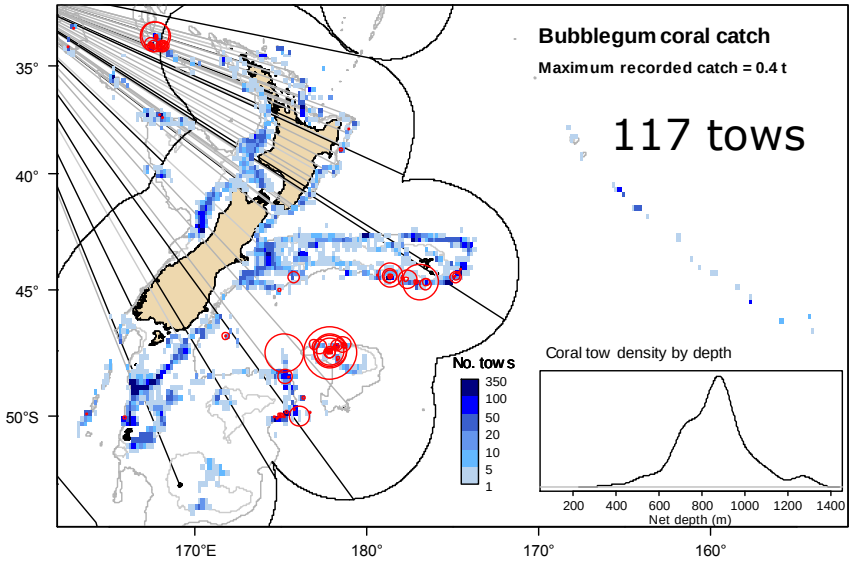
Gorgonian, bamboo, bubblegum

Est. wgt:0.001-400.0 kg GOC [0.3 kg]
0.002-200.0 kg ISI [1 kg]
0.100-376.0 kg PAB [2 kg]

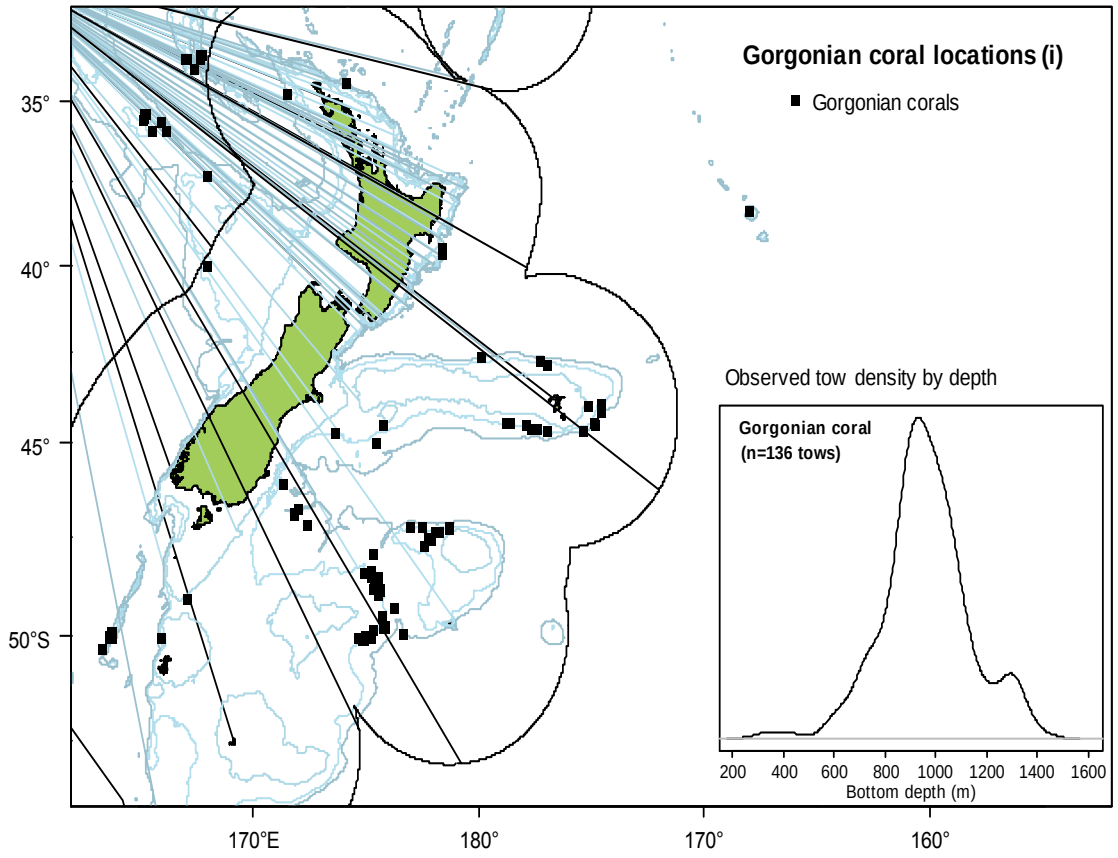
Depth: most 800-1000 m

Target: mainly deepwater targets on feature fisheries + alfonsino
Also middle depths targets for GOC + bamboo

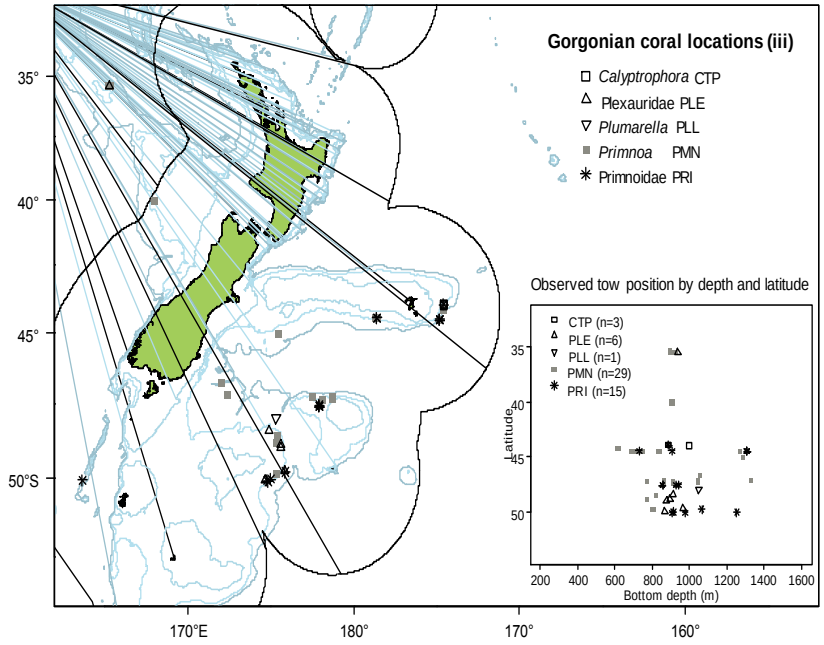


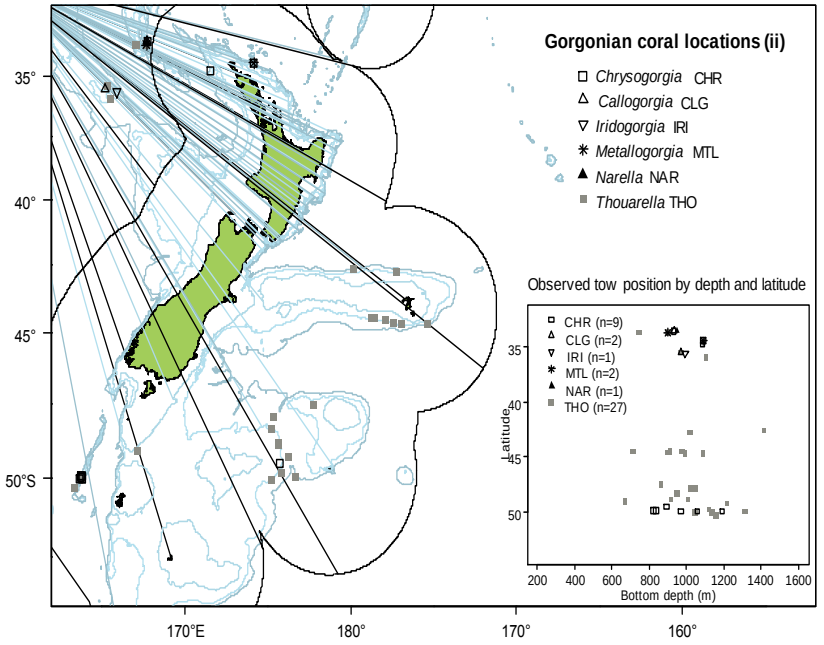


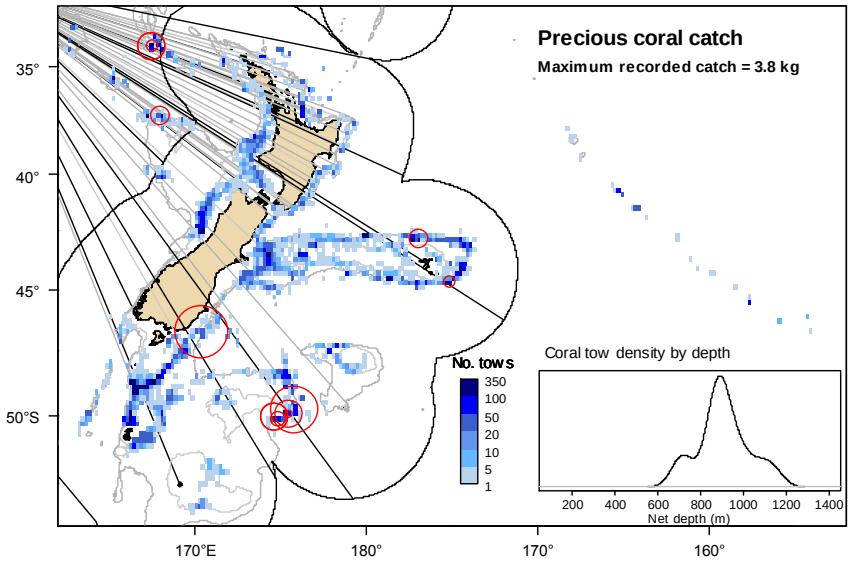
Gorgonian coral – verified samples



Gorgonian coral – verified samples (by genus, species)





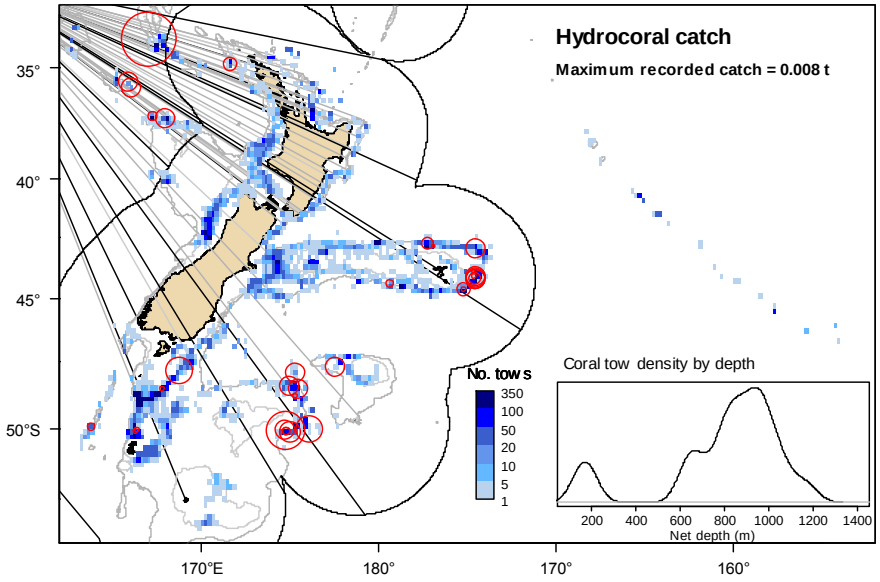


Precious coral (13 tows)

Est. wgt:
0.1-3.8 kg [1 kg]

Depth:Most 800-1000 m

Target: Deepwater targets



Hydrocoral (38 tows)

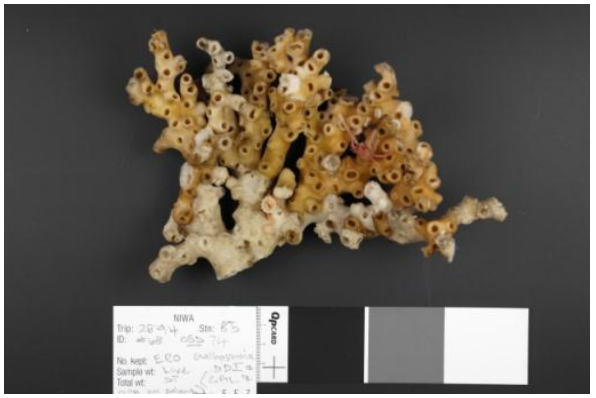
Est. wgt:0.048-8.000 kg [1 kg]

Depth: 150-200 m, 700-1000 m

Target: Deepwater targets + squid

Bottom longline summary

- 9 of the 833 sets had coral
- primarily targeting ling predominantly from one vessel
- most from Chatham Rise



Groups: unspecified stony coral, stony cup coral, stony branching coral, bubblegum coral, gorgonian coral

Data considerations

Trawls as a sampling tool

- not efficient tool for quantitatively sampling fragile organisms such as corals
- Observer data come from an uneven sampling effort

Identification and taxonomic consistency often a problem, some inconsistencies in data recording

Why not seeing corals

- lack of protected corals in area
- low catchability if they are present
- poor retention in the net
- a low detection rate by the observer

A lack of corals could be reflect the true distribution of protected corals (e.g., lack of suitable bottom type for species to attach), or coral cover on the seafloor in may have been removed already through fishing activity

Conclusion: Fisheries & areas where corals are at risk

- The spatial distribution of the observer coral data reflects interactions with trawl gear and locations of target fishery areas

- **In deeper waters: tows with coral records highlight areas with feature-based fisheries**
  - **Orange roughy (all coral groups but precious)**
  - **Black and smooth oreo species (all coral groups)**
  - **Black cardinalfish (all coral groups except precious and hydrocoral)**
  - **Down to > 1450 m**
  - **Within and outside the EEZ**

- **Hoki** off Canterbury Bight to Mernoo Bank, Stewart-Snares shelf
  - Mostly stony cup corals. No black, precious, or hydrocorals. Few catches of bubblegum and bamboo

- **Alfonsino** in 250-730 m north of 44° S
  - All groups except stony cup, precious, + hydrocorals

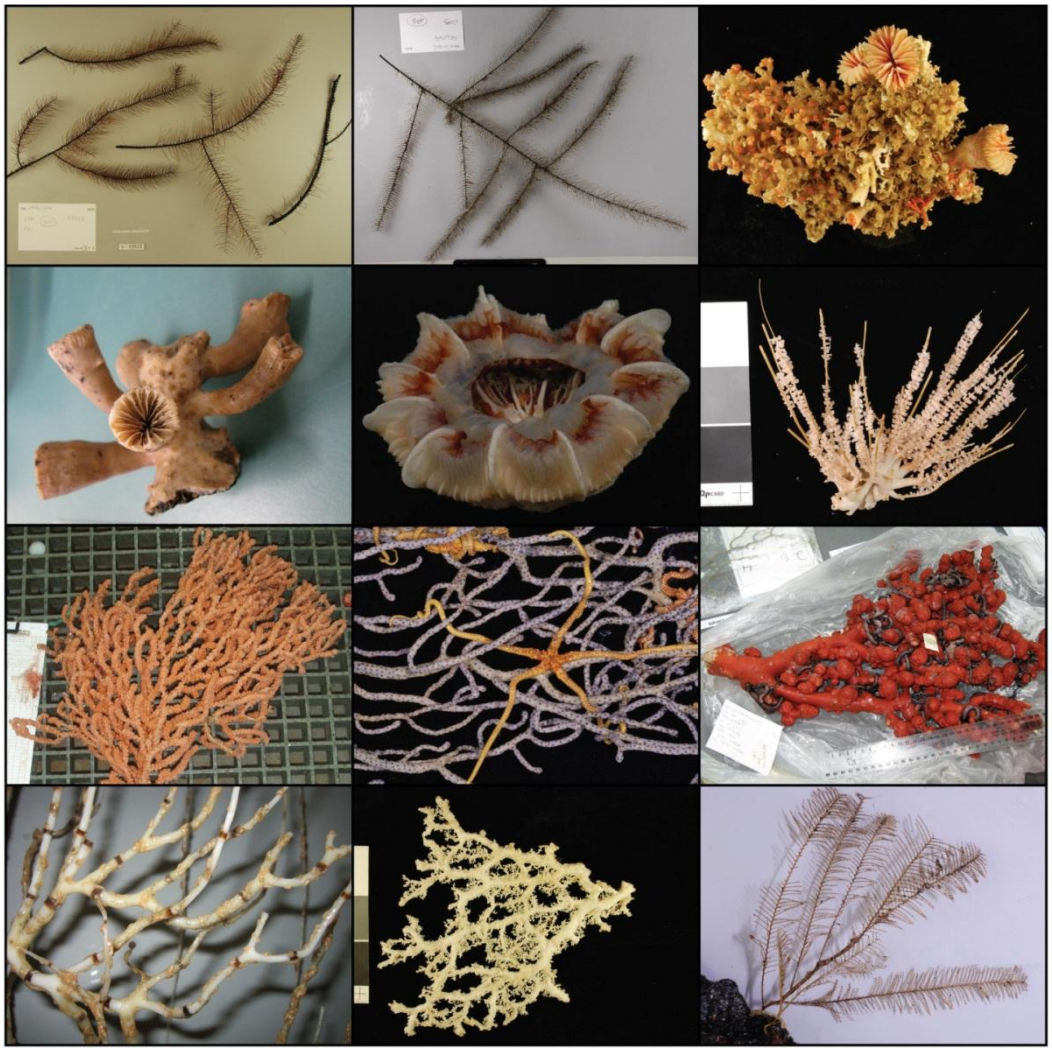
- **Scampi** (300-500 m): western edge of northern Chatham Rise + ECNI
  - None reported from major fisheries in Bay of Plenty; Auckland Islands Shelf
  - Coral catch belonging to only the 3 stony coral groups

- **Squid** (100-400 m): most from edge of Stewart-Snares shelf & Auckland Is Shelf (N + SE)
  - Very occasional catches of all groups except bubblegum, precious, and hydrocorals

- **Jack mackerel** (80-140 m): south and north Taranaki Bight
  - Gorgonian, black, coral rubble

Objective 2

Assess value of carrying out IDs of protected corals



Methods

Data grooming
Categorise what data could be compared

Analysis
compare allocated MFish species codes (observers) with NIWA expert allocated code (follow method of (Parker et al., 2009; Tracey et al., 2010)
measure level of agreement & proportion of difficult-to-identify species

Comparison of observer & expert codes (n=852) & category code

Code 1 – 80 records (9%)

record unable to be used in the comparison analysis

code was clearly wrong (either a misuse of code or a database entry error unable to be addressed)

coral record is from an expert's identification of an attached sample on the "host" specimen

Code 2 – 227 records (27%)

correct coral identification and code provided but at a higher taxonomic level than the expert code

e.g., observer code SIA (scleractinian stony coral at Order level) expert code SVA (branching stony coral *Solenosmilia variabilis* at species level)

Code 3 – 545 records (64%)

able to be compared

codes either match or the observer has used an incorrect code

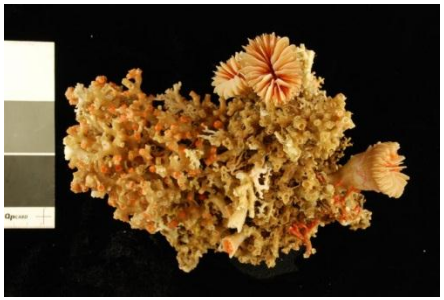
observer has identified the specimen to the lower taxonomic level for the coral, but the expert has gone to a higher level

Code categories

Proportion of data able to be used directly to measure accuracy good (545 records coded as category 3)

Limitations in the remaining dataset that restricted it's utilisation to measure accuracy, but important information provided e.g.,

- highlights mis-use of codes
- informs on labelling issues shows need for an improvement in data recording
- shows need for a method to accommodate recording corals associated with another coral, e.g., a stony cup coral attached to a stony branching coral



- code 2 (227 records), highlights the importance of having experts able to identify samples to a lower taxonomic level and so enhance the dataset available to provide distribution maps of deep-sea protected corals for the region

Level A: Analysis by accuracy by 3-letter MFish codes (App. 5)

Individual codes plot (n= 545 records)

- agreement between observer and NIWA expert identifications
- observer = row (A2 to A61)
- verified NIWA expert identification code = column headers
- numbers in each row = count of the no. times observer used a particular code

Summaries

- how often the observer's identiification was incorrect - (**% Wrg**)
- total no samples (**Total**)
- proportion of the total samples that were wrong (**Tot wrg**)

293 incorrect

Diagonal shows where there is agreement between observer and the expert

Level A: Analysis by accuracy by 3-letter MFish codes (App. 5), cont'd.

- Bamboo coral *Acanella* (ACN) is identified correctly twice and incorrectly 12x
- Incorrect identifications are instances where the corals are bamboo corals but were incorrectly called other genera in the same family (*Keratoisis* BOO and *Lepidisis* LLE)
- Stony branching coral mis-identified by the observers

  S. variabilis (SVA), percentage wrong high (89.8%), 88 of 98 samples labelled incorrectly

  G. dumosa (GDU), 6 observer identifications correct, 2 incorrect: mis-identified as either the stony branching coral SVA or (GOC)

- Two corals were coded as glass sponges (GLS)

Level B: Analysis of accuracy to higher taxonomic level grouping of coral codes into main groups (see Table 1)

	Corals	Black corals	Stony corals	Stony branching corals	Stony cup corals	Gorgonian corals	Corallium precious coral	Bamboo corals	Bubblegum coral	Hydrocorals	Hydroids	Soft corals	Sea pens	Anemones	Epizoanthid	Crustacean	Sponge	Seaweed	Rock
Corals																	3		
Black corals		36		2		5		1			2								
Stony corals			2	1		2		1		2									
Stony branching corals				133	1	2		3		1									
Stony cup corals				3	54							1			1				
Gorgonian corals		1		10		45			1		3								
Corallium precious coral				1						2									
Bamboo corals		2				20		58					1						
Bubblegum coral						10		4	37										
Hydrocorals				3		2				5	3								
Hydroids				1				1			6								
Soft corals						12						3							
Sea pens		1											9						
Anemones			1									1	1	19					
Epizoanthid															6				
Crustacean															1				
Sponge	1					1						3							
Seaweed						3					6		1						
Rock	1			1		1													
Barnacle														1					
Percent wrong	**100.0**	**10.0**	**33.3**	**14.2**	**1.8**	**56.3**		**14.7**	**2.6**	**50.0**	**70.0**	**62.5**	**25.0**	**5.0**	**25.0**		**100.0**		
Total	2	40	3	155	55	103		68	38	10	20	8	12	20	8		3		
Tot wrong	2	4	1	22	1	58		10	1	5	14	5	3	1	2		3		
Diagonal		36	2	133	54	45		58	37	5	6	3	9	19	6				

Columns = grouped verified coral codes

Rows = grouped observer coral codes

Diagonal = agreement

Level B: Analysis of accuracy to higher taxonomic level, cont'd

- good agreement (<15% error) between expert and observers for black corals, branching stony corals, bamboo and bubblegum corals

- not good agreement between the gorgonian and hydrocoral identifications

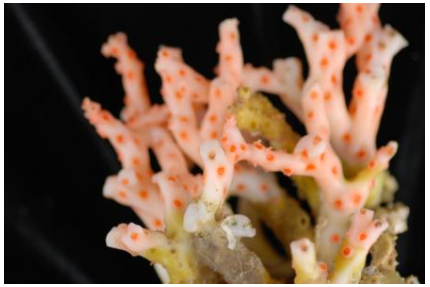
Note: observers identified some of the gorgonian corals as bamboo and bubblegum coral, the overall result to level gorgonian is reasonable

- hydroids confused with black corals, gorgonian corals, or soft corals

- some gorgonian corals are being confused with stony branching corals

- good identification for the non-protected anemones and sea pens

Conclusion from results



Observers provide a excellent data source – EEZ / High Seas, nevertheless the numbers of misclassifications at species level for some coral groups highlight specific needs

Level A – poor accuracy for some species particularly stony branching corals, often going to too low level of ID

Level B – better ID for some species, COB, SIA, ISI, PAB, but 70% wrong for other GOC (confused with soft corals or black corals). Of the few hydrocorals compared (n=10), ID error 50%. (also a problem in distinguishing hydrocorals in Ross Sea)

Caution regarding data extracts if using unconfirmed IDs – collection to verify IDs important, ground-truthing improves accuracy

Recommendations

Assessing the interaction between the fishery and protected deepwater corals

- Combine observer coral bycatch data with earlier observer data, including samples verified by Sanchez (Tracey 2010c), & with scientific research data from biodiversity and research trawl surveys. (Draft MCS Annual Plan 2011/12)

  Published distribution data for certain protected coral species highlight the benefits of using various sources to describe their geographic and depth distributions. Using a single database and subsequent plots of combined data will provide a more complete understanding of the spatial distribution of protected coral fauna to species level

Recommendations cont'd

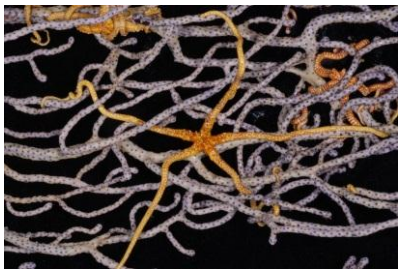
Improving identification accuracy by observers

- Update Coral Identification Guide (Tracey et al. 2008) to better assist observer's in making accurate identifications

- More expert participation in the briefings given to observers
  - sample identification and collection
  - clearer instructions on specimen identification, what to retain, to record on the benthic forms and labels, sub-sampling methods (could address the identification of all invertebrates, not just the protected corals)

- Continue to return samples
  - proportion of mis-identifications highlights the need for expert identifications & for molecular verification of morphological ID's

- Record fauna associated with
  - protected coral



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