GIS Mapping of Coral Capture in ORH3B NWCR and ESCR Fisheries

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BIBLIOGRAPHIC REFERENCE

Black J. 2018. GIS Mapping of Coral Capture in ORH3B NWCR and ESCR Fisheries. Lower Hutt (NZ): GNS Science. 40 p. (GNS Science consultancy report; 2018/150).

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EXECUTIVE SUMMARY

We undertake a spatial analysis of trawl tows that captured coral in two New Zealand fisheries. Analysis is carried out against two habitat types: Underwater Topographic Features (UTF) and 'slope' habitat. Statistics relating to catch of orange roughy and oreo associated with coral capture tows are calculated.

The study period is the most recent 5-year period for which data are available (01/10/12 to 30/09/17). The two fisheries are Marine Stewardship Council (MSC) certified OHR3B NWCR and ORH3B ESCR within the MSC Unit of Assessment (UoA) areas.

Coral capture and fish catch data were obtained from the Ministry for Primary Industries (MPI) by the Deepwater Group Ltd (DWG) in the form of fisher reports and MPI observer records. Tows were assigned to UTFs based on position information and the knowledge of fishing practice. Tows that were not assigned to specific UTFs were classed as slope tows. Statistics were calculated for fish species and coral catch. These were tabulated per UTF, and per fishery area.

A series of maps are provided, one for each UTF, or UTF group, and one for each of the two fisheries areas.

In summary, 100 tows were assigned to UTFs and the remaining 164 to the 'slope' habitat. The 38% of tows assigned to the UTF habitat contained 69% of the reported coral catch. The largest coral catch (1,637 kg) was reported on Possum Central in the ESCR fishery. This UTF also had the largest reported fish catch (77,778 kg).

When coral catch is considered as a percentage of total catch, tows assigned to Cotopaxi have the largest, with coral making up 30% of the catch, closely followed by Hartless at 29%. Less than 1% of the total catch is coral on 19 of the 31 UTFs studied here. Across all of the 31 UTFs, the coral catch is 1.27% of the total catch.

1.0 INTRODUCTION

The Deepwater Group Ltd (DWG) asked GNS Science to undertake spatial analysis of trawl tows that captured coral in two New Zealand fisheries. Analysis is carried out against two habitat types: Underwater Topographic Features (UTF) and 'slope' habitat. Statistics relating to catch of orange roughy (ORH) and oreo (BOE, SOR & SSO) associated with coral capture tows are calculated.

The goal is for the DWG to establish the feasibility (technically and economically) of reducing interactions with live coral by potentially not fishing in areas where evidence suggests there is a high-risk of encountering coral. The outcomes of this report will serve as a basis for discussion with quota owners and skippers around options to mitigating coral capture.

The study period is the most recent 5-year period for which data are available (01/10/12 to 30/09/17). The two fisheries are Marine Stewardship Council (MSC) certified OHR3B NWCR and ORH3B ESCR within the MSC Unit of Assessment (UoA) areas. For the purposes of this study, only the portion of ORH3B ESCR east of 179°30' W is considered.

Coral capture and fish catch data were obtained from the Ministry for Primary Industries (MPI) by the DWG in the form of fisher reports and MPI observer records. Bathymetry data were also provided by DWG.

2.0 METHOD

2.1 Bathymetry data

Single beam bathymetric data (raw and ungridded xyz points) collected within the fishery regions were provided by DWG. These single beam bathymetric data were collected by fishing vessels as they transit and fish between and within each fishery area. Bathymetric data for each UTF lie along vessel track lines rather than providing complete coverage, therefore the spatial data coverage for each UTF varies. Bathymetric data were interpolated and gridded in a rectangular region around each UTF.

In three cases (Mummy, Hartless and Headstone), the provided bathymetry was insufficient to define the UTF form, so their grids were supplemented by regional bathymetric data (Mitchell et al. 2012). This regional grid has a much lower resolution, so has been resampled to give a less blocky appearance.

2.2 UTF data

UTF locations and summit depths were taken from Black et al. (2015). The basal boundary of each UTF is included on the UTF plots as constructed in Black et al. (2015). In that report, boundaries were not calculated for Headstone or Hartless, therefore they do not feature on the figures here.

2.3 Tow data

Fisher-reported coral and fish catch data were obtained from MPI by the DWG as a spreadsheet. MPI used data from the interpreted version of their database where available, meaning the data are of the best available quality. These data represent events where there was a catch of ORH, SSO, BOE or SOR that also reported taking a coral species by vessels operating under the permits that gave permission.

Observer-reported coral catch data were also obtained from MPI by the DWG as a spreadsheet. These data represent events where there was a catch of ORH, SSO, BOE or SOR that also reported taking a coral species by vessels operating under the permits that gave permission.

As well as recording catch data, the spreadsheets also contained start and end locations and depth for the tows. These points were loaded into a geographic information system (GIS) project. Tows were assumed to be linear and a straight line was created between the start and end positions in the GIS. This line was buffered to create a 150 m wide polygon (equivalent to the net door spread) and relocated by the warp length to represent the position of the net on the seabed. Warp is 1.8 x bottom depth at the tow start position and is assumed to angle down to the seabed.

Some tows have identical start and end locations, giving insufficient information to create a tow line, or a net polygon. In these cases, a circle centred on the start/end position is plotted. The circle has a diameter of 150 m, equivalent to the net door spread.

The tow data were provided in a spreadsheet format that shows multiple rows per tow because each fish species caught generates a separate 'event key'. For each tow, a row is present for each fish species caught and/or each coral type captured. Some duplication exists as fish catch and coral catch were recorded in different columns of the same row, and no cells were left empty. The GIS software was used to group these and ensure that each catch was counted exactly once.

Table 2.1 lists coral catch by species and has been categorised following Tracey et al. (2011).

Group Name	Group Code	Coral codes
Bamboo corals	ISI	BOO, ISI, LLE
Black corals	СОВ	COB, LSE, LIL
Bubblegum coral	PAB	PAB
Hydrocorals	COR	COR, ERR, LPT
Stony corals - branching	CBR	CBR, GDU, SVA, MOC
Stony corals - cup	CUP	COF, DDI, STP, CAY
Unspecified	COU	COU
Gorgonian corals	GOC	GOC, CHR, THO
Precious coral	CLL	CLL
Stony Corals	SIA	SIA

 Table 2.1
 Coral Grouping. See Appendix 1 for scientific names.

2.4 Tow assignment

Each tow is either assigned to a specific UTF or designated as a 'slope' tow. Assignment to a UTF is only made if the tow start position is within 2 nautical miles of the UTF summit position, and the tow start depth lies between the UTF summit depth and 100 meters deeper. If multiple UTFs qualify, a tow will be assigned to the closest UTF that meets the depth criteria. For example, if the tow start depth is >100 m deeper than the UTF's summit depth, the next nearest UTF will be considered. This process is repeated until the tow is either assigned or there are no further UTFs within the 2 nautical mile criteria, at which point it is classified as a 'slope' tow. It is assumed that all tows occurred in a downhill direction starting at or near the summit of the UTF. For the UTF tows, the start end of the net polygon is positioned at a location on the assigned UTF with the recorded tow start depth, such that the end point lies in a down slope direction. The azimuth and length of tows have not been altered (Figure 2.1). The 'slope' tows are not repositioned, in consequence, some of the 'slope' tows lie on or very close to UTFs. The tow start depth precludes them from being assigned to the UTF. There is insufficient information to accurately reposition the 'slope' tows, as there are many locations outside of the UTF habitat at the correct depth.

A small proportion of the observer tows have no start depth. If a similar trawl also occurs in the fisher database, then the start depth is assumed to be the same for the observer tow (for example, two trawls near Tomahawk). If no such similar tow exists, then depth information cannot be considered, and the tow is simply moved to the closest UTF (if one exists within the distance criteria).



Figure 2.1 Flintstone UTF with a tow path and net position

2.5 Plots and tables

Statistics were calculated for fish and coral catch, and itemised by fish species (ORH, BOE, SOR and SSO) and coral groupings (Table 2.1). These were tabulated per UTF and per fishery area (see Appendix 2).

A series of maps were produced, one for each UTF or UTF group, and one for each of the two fisheries areas (see Appendix 3).

3.0 **RESULTS AND CONCLUSIONS**

In total, 264 tows were analysed and assigned -100 to UTFs and 164 to 'slope' habitat. Trawling occurred on 31 UTFs -25 in the ESCR and six in the NWCR fishery. Eleven of the UTFs had only one tow assigned to them. Possum West had the most tows assigned to it, at 11. See Appendix 2 for full table.

3.1 Coral catch

Most (69%) of the coral catch was reported in the UTF habitat despite only 38% of the tows being assigned to UTFs. The largest coral catch (1,637 kg) was reported on Possum Central in the ESCR fishery, most of which were hydrocorals. Fourteen UTFs had a reported coral catch less than 10 kg, and a further seven UTFs less than 100 kg (Figure 3.1). The number of tows is not directly proportional to the coral catch, but in general the UTFs with a larger coral catch also have a greater number of tows.

The majority (63%) of the total coral catch is of unspecified (COU) type, all of which comes from fisher reported tows. The next highest coral catch, at 24%, is the hydrocorals group (COR), all of which were reported in the ESCR fishery.

3.2 Fish catch

The total fish catch in each habitat is directly related to the number of tows; 62% of the fish catch occurs in UTF habitat and 38% in slope habitat. However, when the UTFs are considered individually, there is not a direct relationship between the fish catch and the number of tows (Figure 3.2). The UTF with the largest reported fish catch was Possum Central (77,778 kg). Ten UTFs had a reported fish catch less than 1000 kg.



Figure 3.1 Total coral catch (left hand axis) and number of tows (right hand axis) by UTF. Total coral catch is coloured by fishery.



Figure 3.2 Total fish catch (left axis) and number of tows (right axis) by UTF. Total fish catch is coloured by fishery. UTFs are ordered by coral catch as on Figure 3.1.

3.3 Total Catch

When coral catch is considered as a percentage of total catch, Cotopaxi has the largest with coral making up 30% of the catch, closely followed by Hartless at 29% (Figure 3.3). It should be noted that both of these UTFs have a relatively small total catch, although there is a high percentage of coral caught, the weight is less than on other UTFs.

Less than 1% of the total catch is coral on 19 of the 31 UTFs studied here. Across all of the 31 UTFs, the coral catch is 1.27% of the total catch.



Figure 3.3 Line graph (right hand axis) showing percentage of coral in total catch, plotted with a stacked bar graph showing the weight (kg) of fish and coral catch on each UTF.

4.0 REFERENCES

- Black J, O'Brien G, Tilney R. 2015. Orange roughy and oreo-dory trawl footprints analysis of slope habitat and summary analysis of UTF habitat (Part 1). Lower Hutt (NZ): GNS Science. 22 p. (GNS Science consultancy report; 2015/58).
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- Tracey D, Baird, SJ, Sanders BM, Smith MH. 2011. Distribution of protected corals in relation to fishing effort and assessment of accuracy of observer identification. Wellington: National Institute of Water & Atmospheric Research. 74 p. NIWA Client Report No: WLG2011-33. Prepared for Department of Conservation, Wellington.

APPENDICES

A1.0 APPENDIX 1: CORAL

Name	Group Code	Coral code	Common name	Scientific name	Family
Black corals	СОВ	СОВ	Black coral	Antipatharia (Order)	
Diddit Cordio		LSE	Leiopathes black coral	Leiopathes secunda	Leiopathidae
		LIL	Black coral	Lillipathes spp.	Schizopathidae
Stony corals -	CBR	CBR	Stony branching corals	Scleractinia	
branching		GDU	Bushy hard coral	Goniocorella dumosa	Caryophylliidae
		SVA	Deepwater branching coral	Solenosmilia variabilis	Caryophylliidae
		мос	Madrepora coral	Madrepora oculata	Oculinidae
Stony corals - cup	CUP	COF	Flabellum cup coral	Flabellum spp	Flabellidae
		DDI	Crested cup coral	Desmophyllum dianthus	Caryophylliidae
		STP	Solitary bowl coral	Stephanocyathus platypus	Caryophylliidae
		CAY	Carnation cup coral	Caryophyllia spp.	Caryophylliidae
Stony Corals	SIA	SIA	Stony corals	Scleractinia	
Gorgonian corals	GOC	GOC	Gorgonian coral	Gorgonacea (Order)	
		CHR	Golden coral	Chrysogorgia spp.	Chrysogorgiidae
		тно	Bottlebrush coral	Thouarella spp.	Primnoidae
Precious coral	CLL	CLL	Precious coral	Corallium spp.	Corallidae
Bamboo corals	ISI	BOO	Bamboo coral	Keratoisis spp.	Isididae
		ISI	Bamboo corals	Isididae	Isididae
		LLE	Bamboo coral	Lepidisis spp.	Isididae
Bubblegum coral	PAB	PAB	Bubblegum coral	Paragorgia arborea	Paragorgiidae
Hydrocorals	COR	COR	Hydrocorals	Stylasteridae (Family)	Stylasteridae
,		ERR	Red hydrocoral	Errina spp.	Stylasteridae
		LPT	Spiney lace coral	Lepidotheca spp.	Stylasteridae
unspecified	COU	COU	Coral (unspecified)	Alcyonacea	

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UTF	Fishery	No	Fish Cat	:ch (kg)					Coral	Catch (kg)				
	Area	of tows	BOE	ORH	SOR	SSO	other	Fish Total	ISI	СОВ	PAB	COR	CBR	cou	<u>่</u> 2
Deadringer	NWCR	4		2 455		42	88	2 585		-	US			37	<u>+</u>
Graveyard	NWCR			,				•							
Hartless	NWCR	-				50		50						20	2
Headstone	NWCR	σı	160	44,000		16,640	160	60,960						80	~
Morgue	NWCR	-	5	1,500		40	70	1,615						9	
Mummy	NWCR	2		1,800		420	285	2,505					400	11	4
Andes	ESCR	-			200	20	50	270						Ν	
Briscoes	ESCR	2		400		215	15	069						61	6
Camerons	ESCR							-							
Chuckys	ESCR	2				500		500		-				-	2
Coff Drop	ESCR														
Cotopaxi	ESCR	4	30	305		220	46	601		-			2	260	263
Crack	ESCR	з		9,002		10	715	9,727						53	53
Dickies	ESCR	1	100	80		300	80	560						4	4
Erebus	ESCR	-		350		10		360		2					2
Featherlite	ESCR														
Flintstone	ESCR														
Hideaway Hill	ESCR	-				7,000	105	7,105		-					-
Icecube	ESCR	4		5,550		800	625	6,975						6	6
Jimmy	ESCR	-		10		60	20	06						2	2
Ladies Night	ESCR	ω	1,050	2,580		1,600	70	5,300						700	700
Little Chief	ESCR	-	10	10		50	50	120						-	_
Lucky	ESCR	2	50	2,030		3,050	250	5,380						56	56
Not till Sunday	ESCR	-	20	450		550	20	1,040		-					_
Possum Central	ESCR	6	505	59,155		640	293	60,593		2		1,000		134	1,13
Possum East	ESCR	4	340	23,800		490	135	24,765					-	84	85
Possum West	ESCR	1	1,350	69,150	20	3,360	498	74,378		21			-	530	552
Ritchie Hill	ESCR														
Sir Michael	ESCR	2	40	220		700	80	1,040						135	135
Teepee	ESCR	8	1,911	6,772	50	12,882	873	22,488						667	667
Tomahawk	ESCR	ω	600	1,250		7,350	70	9,270		-				115	116
		2	6.171	230.869	270	56.999	4 598	298.907		ų	80	1.000	404	2.968	4 4R

A2.0 APPENDIX 2: STATISTICS

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Total	Tomahawk	Teepee	Sir Michael	Ritchie Hill	Possum West	Possum East	Possum Central	Not till Sunday	Lucky	Little Chief	Ladies Night	Jimmy	Icecube	Hideaway Hill	Flintstone	Featherlite	Erebus	Dickies	Crack	Cotopaxi	Coff Drop	Chuckys	Camerons	Briscoes	Andes	Mummy	Morgue	Headstone	Hartless	Graveyard	Deadringer			UTF
	ESCR	ESCR	ESCR	ESCR	ESCR	ESCR	ESCR	ESCR	ESCR	ESCR	ESCR	ESCR	ESCR	ESCR	ESCR	ESCR	ESCR	ESCR	ESCR	ESCR	ESCR	ESCR	ESCR	ESCR	ESCR	NWCR	NWCR	NWCR	NWCR	NWCR	NWCR		Area	Fishery
26	-			-		-	2	2			3		2		-	-	ω		1		-		2	1		-	1	1		1			tows	No of
1,271	100			65		300	160				70		20			9	-				504		ъ			10	6	20					BOE	
84,481	250			1,196		9,310	16,855	1,930			23		7,310		150	10	1,700		38,000		2		4,742	130		σı	1,707	12		1,149			ORH	Fis
69													65		1											ω							SOR	sh Catch (
14,555	100			180		300	170	40			725		1,000		35	4,831	721		100		409		88	15		2,440	68	3,328		5			SSO	kg)
100,376	450			1,441		9,910	17,185	1,970			818		8,395		187	4,850	2,422		38,100		915		4,835	145		2,458	1,781	3,360		1,154			Fish Total	
-													1.0											0.2									ISI	
15	1.0					0.8	0.8	1.2					6.0				2.0						3.3										СОВ	
•																																	PAB	
501				0.5			500.0																										COR	
134											83.0					3.0	1.2		0.2								9.0	35.0		3.0			CBR	Cor
•																																	COU	al Catch (
-															1.0																		CLL	kg)
																																	CUP	-
0																					0.2												GOC	-
10																										10.0							SIA	
662				-		-	501	-			83		7			ω	ω		0		0		ы	0		10	9	35		3			Coral Total	
0.66%	0.22%	N/A	N/A	0.03%	N/A	0.01%	2.83%	0.06%	N/A	N/A	9.21%	N/A	0.08%	N/A	0.53%	0.06%	0.13%	N/A	0.00%	N/A	0.02%	N/A	0.07%	0.14%	N/A	0.41%	0.50%	1.03%	N/A	0.26%	N/A	catch	coral in	%

UTF	Fishery Area	Total fish catch kg	Total coral catch kg	% coral in catch			
Deadringer	NWCR	2,585	118	4.37%			
Graveyard	NWCR	1,154	3	0.26%			
Hartless	NWCR	50	20	28.57%			
Headstone	NWCR	64,320	115	0.18%			
Morgue	NWCR	3,396	18	0.53%			
Mummy	NWCR	4,963	421	7.82%			
Andes	ESCR	270	2	0.74%			
Briscoes	ESCR	775	61	7.32%			
Camerons	ESCR	4,835	3	0.07%			
Chuckys	ESCR	500	2	0.40%			
Coff Drop	ESCR	915	0	0.02%			
Cotopaxi	ESCR	601	263	30.44%			
Crack	ESCR	47,827	53	0.11%			
Dickies	ESCR	560	4	0.71%			
Erebus	ESCR	2,782	5	0.19%			
Featherlite	ESCR	4,850	3	0.06%			
Flintstone	ESCR	187	1	0.53%			
Hideaway Hill	ESCR	7,105	1	0.01%			
Icecube	ESCR	15,370	13	0.08%			
Jimmy	ESCR	90	2	2.17%			
Ladies Night	ESCR	6,118	783	11.35%			
Little Chief	ESCR	120	1	0.83%			
Lucky	ESCR	5,380	56	1.03%			
Not till Sunday	ESCR	3,010	2	0.07%			
Possum Central	ESCR	77,778	1,637	2.06%			
Possum East	ESCR	34,675	86	0.25%			
Possum West	ESCR	74,378	552	0.74%			
Ritchie Hill	ESCR	1,441	1	0.03%			
Sir Michael	ESCR	1,040	135	11.49%			
Теерее	ESCR	22,488	667	2.88%			
Tomahawk	ESCR	9,720	117	1.19%			
Total		399,283	5,145	1.27%			

A2.1.3 Fisher & Observer Reported Tows

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A2.2 Habitat Statistics

A2.2.1 Fisher Reported Tows

		No	Fish Cato	:h (kg)					Coral Cat	tch (kg)						% coral
		of tows	BOE	ORH	SOR	SSO	other	Total	ISI	СОВ	PAB	COR	CBR	COU	Total	in catch
NWCR	slope	6		3,255		2,550	2,520	9,785						71	71	0.72%
	UTF	13	165	49,755		17,192	603	67,715		1	80		400	157	638	0.93%
	total	19	165	53,010	-	19,742	2,545	77,500	-	1	80	-	400	228	709	0.91%
ESCR	slope	72	23,345	226,133	530	70,634	209,340	354,757	2	6	5	305		1,621	1,939	0.54%
	UTF	61	6,006	181,114	270	39,807	3,995	231,192		30		1,000	4	2,811	3,845	1.64%
	total	133	29,351	407,247	800	110,441	222,361	585,949	2	36	5	1,305	4	4,432	5,784	0.98%
	Total	152	29,516	460,257	800	130,183	224,906	663,449	2	37	85	1,305	404	4,660	6,493	0.97%

A2.2.2 Observed Reported Tows

		No.	Fish catcl	h (kg)				Coral ca	tch (kg)									% coral
		of tows	BOE	ORH	SOR	SSO	Total	ISI	СОВ	PAB	COR	CBR	CLL	CUP	GOC	SIA	Total	in catch
NWCR	Slope	22	1,180	2,170	216	257	3,823		1			17		11			29.01	0.75%
	UTF	4	36	2,873	3	5,836	8,748					47				10	57	0.65%
	Total	26	1,216	5,043	219	6,093	12,571	-	1	-	-	64	-	11	-	10	86.01	0.68%
ESCR	Slope	64	55,148	188,124	3,258	43,812	290,342	6	0	51	0	19	1	139	1	2	219.4	0.08%
	UTF	22	1,235	81,608	66	8,714	91,623	1	15		501	87	1		0		605.4	0.66%
	Total	86	56,383	269,732	3,324	52,526	381,965	8	15	51	501	106	2	139	1	2	824.8	0.22%
	Total	112	57,599	274,775	3,543	58,619	394,536	8	16	51	501	170	2	150	1	12	910.8	0.23%

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808: Hideaway Hill

Legend Tows with coral catch UTF tow (net position) ☆ UTF position

- Slope tow (net position)
 vessel start position
 vessel end position

Vessel path (% coral in catch) -- $\leq 1 \%$

Coral catch: 1 kg % Coral in catch: 0.01%

0 0.1 0.2 nm 0 0.25 0.5 km





648: Little Chief

Legend

- ☆ UTF position
- Tows with coral catch Slope tow (net position)
- UTF tow (net position)
- vessel start position vessel end position
- Vessel path (% coral in catch) $-- \leq 1 \%$
- Coral catch: 1 kg % Coral in catch: 0.83%
- 0.2 0.4 nm 0 0.5

1 km



642: Lucky

Legend ☆ UTF position

- Tows with coral catch
- Slope tow (net position)
- UTF tow (net position)
- vessel start position
- vessel end position

- Coral catch: 56 kg % Coral in catch: 1.03%











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-44°39′



0

-44°38′

-44°40′