

Exploratory Analysis

MIT2022-05 Large vessel trawl warp mitigation

AUTHOR

Kath Large - Dragonfly Data Science

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Project context

- Large vessels trawl fisheries have been identified as posing considerable bycatch risk to seabirds, particularly through warp strikes.
- Mandatory mitigation in large vessel trawl fisheries were introduced in the early 2000s, but mitigation requirements have remained largely unchanged for several years.
- Whilst substantial reductions in seabird bycatch estimates were documented in the 2000s, there has been little evidence for further bycatch rate reduction in more recent years.
- Since the introduction of mandatory mitigation, substantial new data on bycatch between vessels and across sectors of the fleet is available from relatively high levels of observer coverage.
- Of particular note, some mitigation used, i.e., bird bafflers, are not currently recognised as best practice globally.

Overall objective

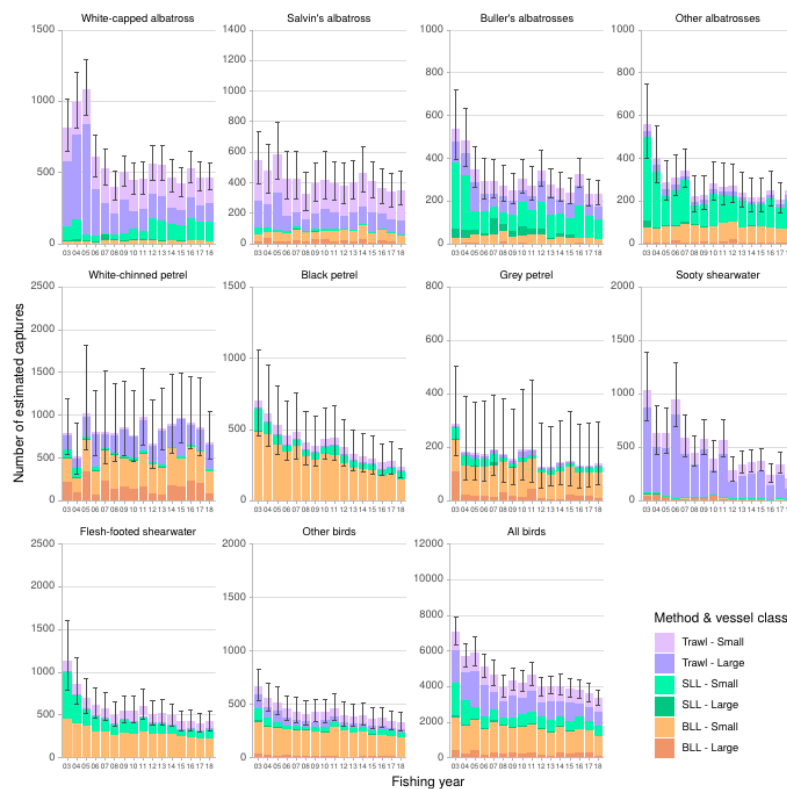
To assess the use and effectiveness of warp mitigation measures currently in use across New Zealand's commercial large-vessel trawl fisheries. The analysis will be based on:

- observer data;
- a systematic literature review; and,
- interviews with experts and stakeholders.

Objective 1

Primary exploration of observer data, relating estimated seabird capture rates to mitigation device use (as recorded in the Centralised Observer Database, COD).

- Using the current seabird bycatch estimation models (Abraham & Richard 2020) and observer data up to the 2019–20 fishing year; the observer data show some changes in capture rates, and take into account the effects that are unrelated to mitigation devices.
- Bycatch estimation models will be further expanded to include mitigation device covariates (baffler, warp-scarer and bird scaring lines) as an initial exploration of whether the use of a mitigation device affects the seabird capture rate.
- A-priori considerations include:
 - i. There is potential of a separate analysis for each species with sufficient observer records of warp captures in large-vessel trawl fisheries; e.g.; white-capped, Salvin's and Buller's albatrosses.
 - ii. Captures will need to be classified as warp or net, because this project will only apply to warp captures. Note, before the mandatory introduction of mitigation devices, the net-warp capture classification was not explicitly recorded; however, some classification information in the earlier period is available from observer comments.



(Figure 6 in Abraham and Richards (2020)): Time series of the number of estimated captures for the seabird species groups and for all birds for the 2002–03 to 2017–18 fishing years. Estimates are shown by fishing method and vessel size class. Cut-off lengths for small and large vessel size classes were 45 m, 34 m, and 28 m, for surface-longline (SLL), bottom-longline (BLL), and trawl fishing, respectively. Coloured bars indicate the mean number of captures, error bars are the 95% credible interval in the total number of estimated captures within each fishing year. (Note different y-axis scales.)

Objective 2

Investigate whether the recorded designs of the mitigation devices are impacting their effectiveness.

- Characterise and summarise the mitigation device data, which includes device measurements.
- Using the device data characterisation, liaise with stakeholders to determine:
 - i. ideal device design and deployment;
 - ii. whether device design details are evident in the data;
 - iii. whether modelling can identify optimal device combinations or configurations based on available data;
 - iv. how the data could best be summarised to inform mitigation effectiveness; and,
 - v. how the data collection and reporting can be improved to better inform mitigation effectiveness.

Objective 3

Present methods and preliminary results to a CSP Technical Working Group for review and critical feedback.

Objective 4

Use stakeholder review and feedback to refine data exploration and modelling approach (if applicable). Present final results, recommendations, and draft report to a second CSP Technical Working Group.

Note

Progress to date:

- Literature review is underway.
- Initial discussions with experts about warp mitigation practices in New Zealand's deepwater fleet
 - met with Richard Wells and John Cleal in Nelson on 18th November.
- Today's presentation:
 - preliminary exploration of the observer data
 - seabird captures in the large vessel trawl fleet
 - warp captures
 - warp mitigation

Primary exploration of observer data

Captures

Restrict captures to:

- method = Trawl
- species = seabirds
- vessel class = L (vessel length > 28m)

Check capture method

Table 1: Number of capture events by capture method

	BB	M	N	NC	NI	NL	NW	O	OT	P	S	SG	SH	T	TO	U	X	Total	
1994	1																	1	
1995	14															3		17	
1996	13															1		14	
1997	46										5					3		54	
1998	72		8								9					5		94	
1999	145		30					1		3	92					2		273	
2000	76		13								51					16		156	
2001	511		39							3	140					17		710	
2002	173		16							4	92					23		308	
2003	2		131							3	58					67		261	
2004			126							1	70					51		248	
2005	3	1	219								130					77		430	
2006	7	4	240							1	46					39		337	
2007	13	1	143								9					12		178	
2008	1	5	183					7		2	19					8		225	
2009		2	323					2			41					6		374	
2010		1	185					1		9	27					18		241	
2011			278					5			13					19		315	
2012			162					8			52					4		226	
2013		1	606					7		1	63					22		700	
2014	7		384					8			56					17		472	
2015		2	556					6			19			1		12		596	
2016			365					15		1	45					10		436	
2017		2	368					6		1	23					4		404	
2018		5	419							1	34					11		470	
2019	36	1	388	2	1		2	43			59				2	8		542	
2020	10	2		43	205	101	135	2	15		33	1	9				3	559	
Total	1130	2	25	5182	45	206	101	137	111	15	30	1186	1	9	1	2	455	3	8641

Table 2: Number of observed captures by capture method

	BB	M	N	NC	NI	NL	NW	O	OT	P	S	SG	SH	T	TO	U	X	Total	
1994	2																	2	
1995	20															5		24	
1996	18															2		19	
1997	83										7					4		92	
1998	97		9								12					6		121	
1999	381		132					2		5	194					3		712	
2000	104		17								70					28		216	
2001	976		120							5	278					22		1397	
2002	320		22							5	233					45		621	
2003	3		391							4	120					110		624	
2004			188							2	97					66		350	
2005	5	2	313								202					111		629	
2006	9	5	818							2	100					61		990	
2007	17	2	944								37					29		1025	
2008	902	12	1343					65		4	177					31		2528	
2009		27	4016					4			244					11		4298	
2010		6	1484					10		28	163					110		1796	
2011			8716					40			82					143		8978	
2012			675					25			226					22		945	
2013		7	4697					37		2	7493					159		12390	
2014	34		3027					20			229					80		3386	
2015		37	6329					38			214			3		32		6648	
2016			2126					80		5	207					30		2444	
2017		6	7311					24		2	73					11		7422	
2018		15	3557							6	154					58		3786	
2019	445	10	2594	5	2		3	241			263				6	66		3626	
2020	32	31		493	1991	673	1921	29	86		212	17	76				7	5557	
Total	3432	31	119	48808	497	1992	673	1923	603	86	59	11064	17	76	3	6	1221	7	70600

Figure 1: Number of capture events by capture method

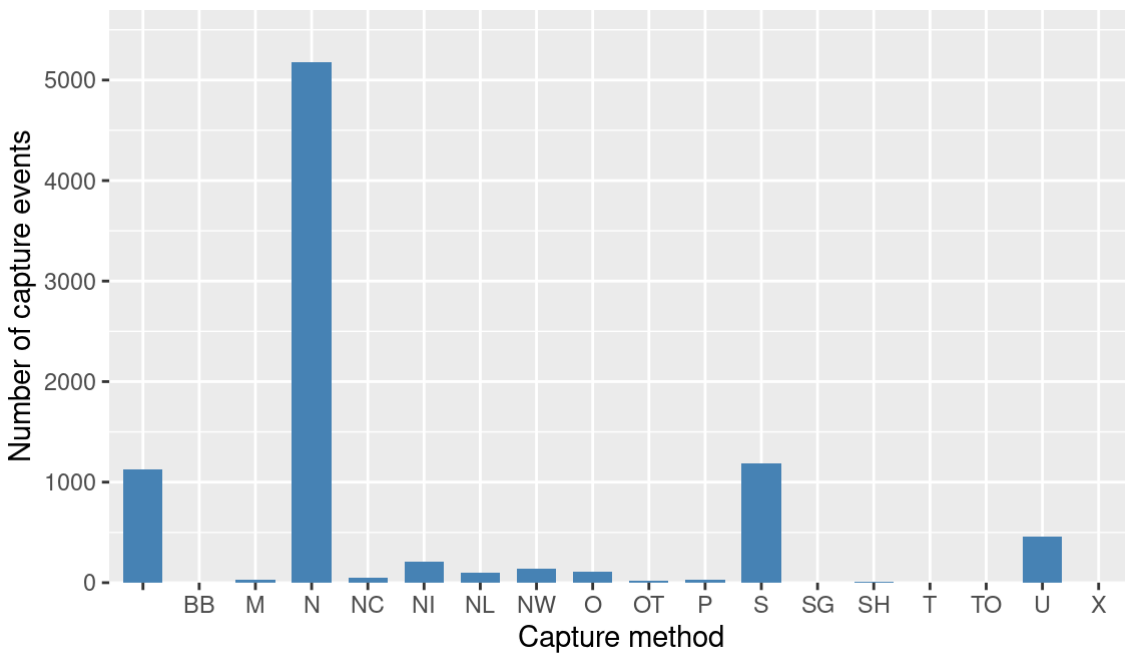


Table 3: Capture codes and descriptions

capture.code	
U	Unknown
T	Tangled
N	Net capture
M	Caught in seabird mitigation device (i.e. tori line or bird baffler)
S	Caught on warp or door
NI	Internal net capture (the animal was caught inside the trawl net/codend/pounds)
NC	External net capture (the animal was caught/tangled in mesh of the cod-end)
NL	External net capture (the animal was caught/tangled in the mesh of the lengthener/taper)
NW	External net capture (the animal was caught in the mesh of the net wings/body)
SH	Animal was caught/tangled in the hood of the SLED
SG	Animal was caught on the grid of the SLED
OT	Other capture location on a trawl vessel (describe in comments)
TO	Tangled in tori line
BB	Caught in bird baffler
P	Caught in fishing pot
O	Other location (only use this code if no others apply; describe in comments)
X	Unknown

Check extreme number of (< 1 or > 1000) specimens caught per capture event

Table 4: Number of observed captures by specimen counts per capture event, by capture method

	-1	0	1676	1677	1678	1857	2001	2002	2003	7001	7002	8360	9549	9550	9551	Total
M	0															0
N	-14	1	1677	1678	1679	1858	2002	2003	2004	7002		8361	9550	9551	9552	56891
O	0															0
S	0										7003					7002
Total	-17	1	1677	1678	1679	1858	2002	2003	2004	7002	7003	8361	9550	9551	9552	63890

Table 5: Number of observed captures by specimen counts per capture event, by fishing year

	-1	0	1676	1677	1678	1857	2001	2002	2003	7001	7002	8360	9549	9550	9551	Total
2007/2008	-6															-6

2008/2009	-6																-6
2009/2010	-2																-2
2010/2011	0						2002	2003	2004								6006
2012/2013			1677	1678	1679	1858				7002	7003	8361					29252
2013/2014		1											9550	9551	9552		28651
Total	-17	1	1677	1678	1679	1858	2002	2003	2004	7002	7003	8361	9550	9551	9552		63890

Warp captures

Restrict captures to:

- method = Trawl
- species = seabirds
- vessel class = L (vessel length > 28m)
- exclude extreme values for number of specimens caught per capture event
- capture method
 - M = caught in seabird mitigation device
 - S = caught on warp or door
 - TO = tangled in tori lone
 - BB = caught in bird baffler

Table 6: Number of observed capture events by capture method and fishing year

	BB	M	S	TO	Total
1997			5		5
1998			9		9
1999			92		92
2000			51		51
2001			140		140
2002			92		92
2003			58		58
2004			70		70
2005		1	130		131
2006		4	46		50
2007		1	9		10
2008		5	19		24
2009		1	40		41
2010		1	27		28
2011			13		13
2012			52		52
2013		1	62		63
2014			56		56
2015		2	19		21
2016			45		45
2017		2	23		25
2018		5	34		39
2019		1	59	2	62
2020	2		33		35

Total	2	24	1184	2	1212
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Table 7: Number of observed captures by capture method and fishing year

	BB	M	S	TO	Total
1997			7		7
1998			12		12
1999			194		194
2000			70		70
2001			278		278
2002			233		233
2003			120		120
2004			97		97
2005		2	202		203
2006		5	100		104
2007		2	37		38
2008		12	177		188
2009		28	245		272
2010		6	163		168
2011			82		82
2012			226		226
2013		7	491		497
2014			229		229
2015		37	214		250
2016			207		207
2017		6	73		78
2018		15	154		168
2019		10	263	6	277
2020	31		212		242
Total	31	120	4063	6	4217

Table 8: Number of observed captures by specimen counts per capture event, by fishing year

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	22	23	24	25
1997	5	3																						
1998	8	5																						
1999	57	29	28	17	16	7	8	9	10	11	12													
2000	42	11	10	5	6																			
2001	98	39	19	21	16	13	15	9	10	11	12	13	14											
2002	56	25	16	21	16	19	15	17	10	11	12	13	14											
2003	42	9	10	9	11	13	15	9	10															
2004	57	17	10	5	6	7																		
2005	99	41	13	13	11	7	8	9	10															
2006	36	11	10	5	6	7	8	9	10	11														
2007	7	5			6																	23		
2008	8	7	7	9	6	7						13	14	15				19	20	21				
2009	8	13	13	9	16	25	15	17	19	21	12	13	14		16							24	25	
2010	5	11	7	13	11	7	8	9	19	11	23	13	14	15	16									
2011	4	5	4	5	6	7		9							16	17	18							
2012	12	21	13	29	31	25	15	17	10	11	12	13	14		16									

2013	11	19	22	25	16	13	15	25		21	34	25	27	15	16	17		19	20	21		24	25	21
2014	12	17	40	37	21	7	22	9	10	11	12	13		15	16									
2015	3	7	4	5	6	7	8	17	10	11			14			17								
2016	12	13	13	21	26	13	22	25	19	11		13	14			17								
2017	7	17	13	9	6	19						13												
2018	10	17	10	21	21	25	15		10					15	16		18							
2019	13	21	22	33	21	25	43	33	37		23				16									
2020	8	17	13	5	11	7	22	9	10	11						17		19				24		21
Total	597	357	277	297	271	241	239	217	190	141	144	133	131	71	121	81	35	55	39	41	23	70	49	5

Figure 2: Number of capture events by capture method

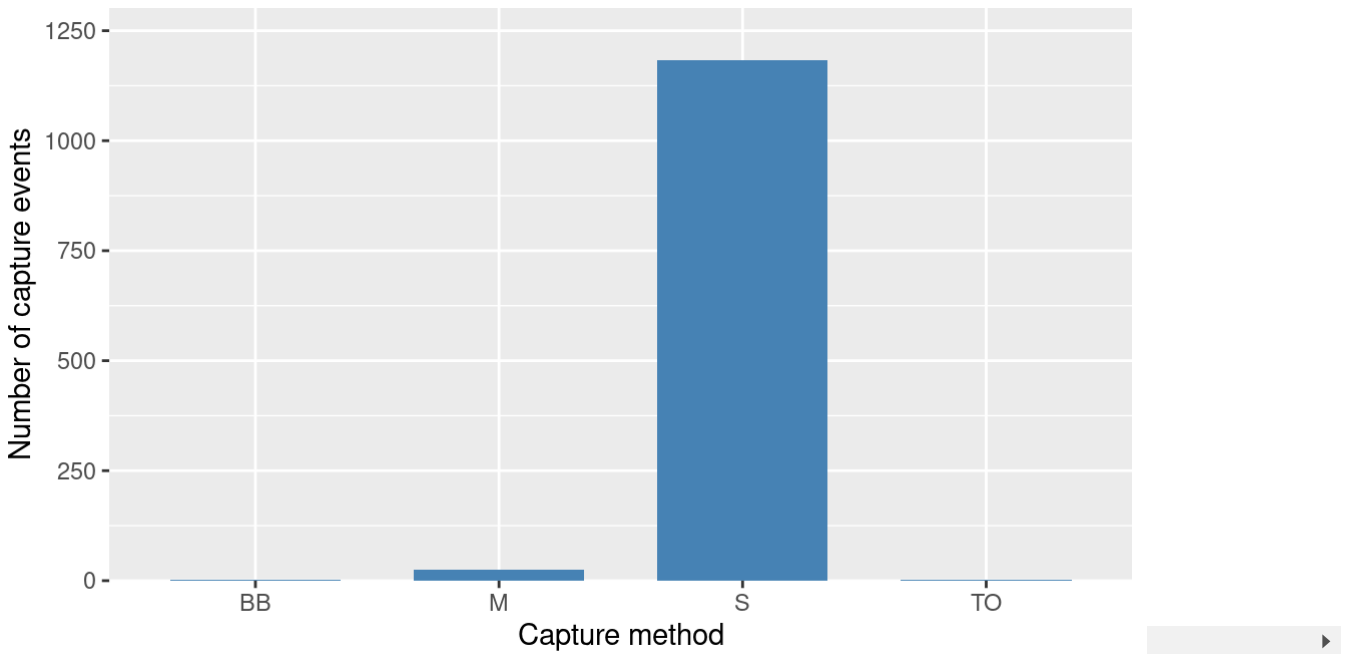


Figure 3: Number of capture events by fishery

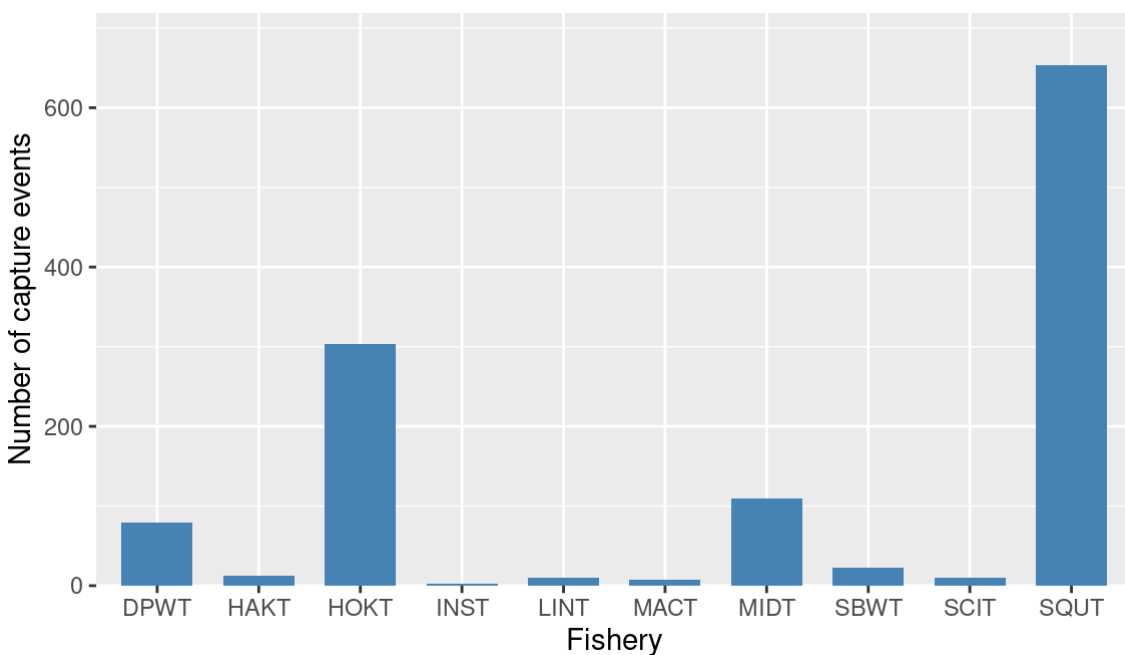


Figure 4: Number of capture events by area

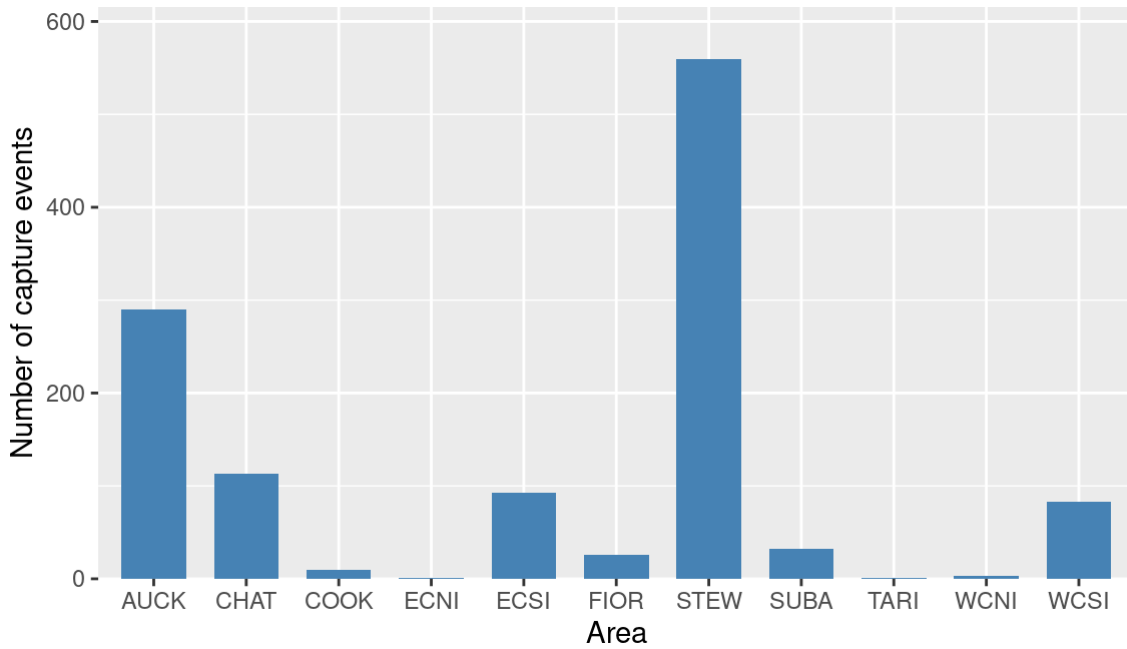


Figure 5: Number of capture events by target species

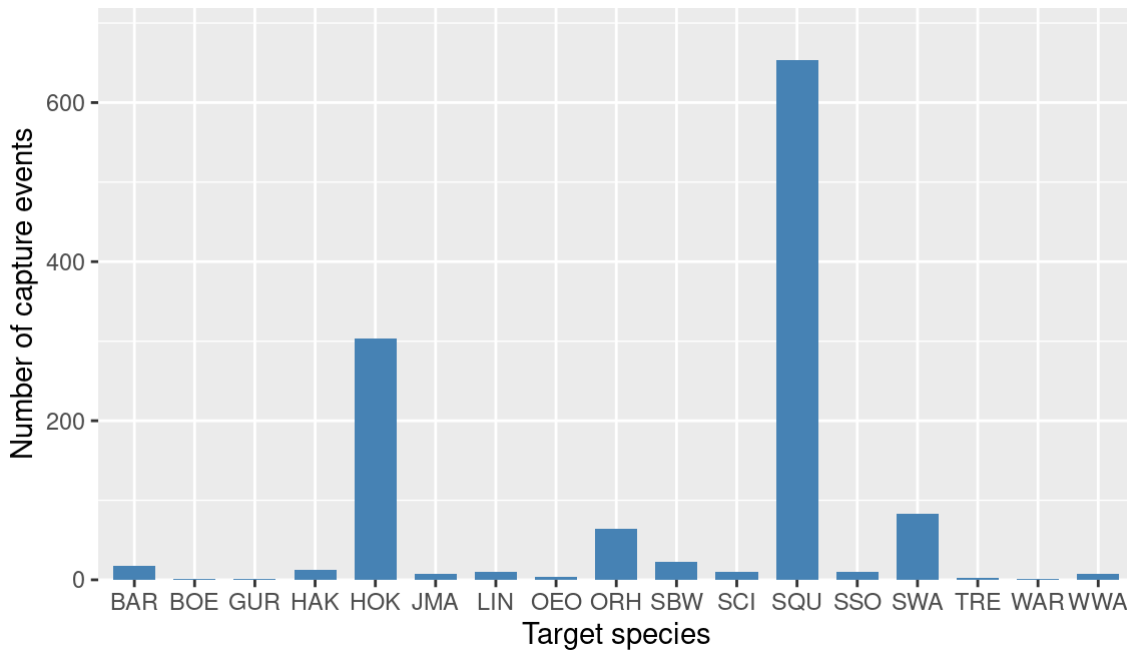


Table 9: Number of capture events by seabird species

species_code	common_name	n()
XAL	albatrosses	35
XBM	southern Buller’s albatross	133
XBP	black petrel	1
XCA	Snares Cape petrel	2
XCC	Cape petrel	6
XCI	Chatham Island albatross	13

species_code	common_name	n()
XCM	Campbell black-browed albatross	11
XCP	Cape petrels	12
XDPA	common diving petrel	1
XGA	great albatrosses	3
XGP	grey petrel	4
XKM	black-browed albatrosses	17
XMA	smaller albatrosses	2
XNB	northern Buller's albatross	2
XNP	northern giant petrel	7
XNR	northern royal albatross	2
XPB	Buller's albatross	1
XPC	Procellaria petrels	2
XPE	fulmars, petrels, prions and shearwaters	2
XRA	southern royal albatross	9
XRU	royal albatrosses	2
XSA	Salvin's albatross	139
XSB	seabirds	3
XSH	sooty shearwater	11
XSL	large seabirds	9
XSM	black-browed albatross	4
XSP	southern giant petrel	2
XST	storm petrels	1
XSY	Tasmanian albatross	9
XWC	white-chinned petrel	48
XWF	New Zealand white-faced storm petrel	1
XWM	New Zealand white-capped albatross	715

species_code	common_name	n()
XWP	Westland petrel	2
XXP	petrels, prions, and shearwaters	1

Table 10: Number of observed capture events by seabird species groups

speciesGroup	n()
NZ white-capped albatross	715
Other albatross	110
Other petrel	43
Other seabirds	24
Salvin’s albatross	139
southern Buller’s albatross	133
white-chinned petrel	48

Figure 6: Number of observed capture events by seabird species groups

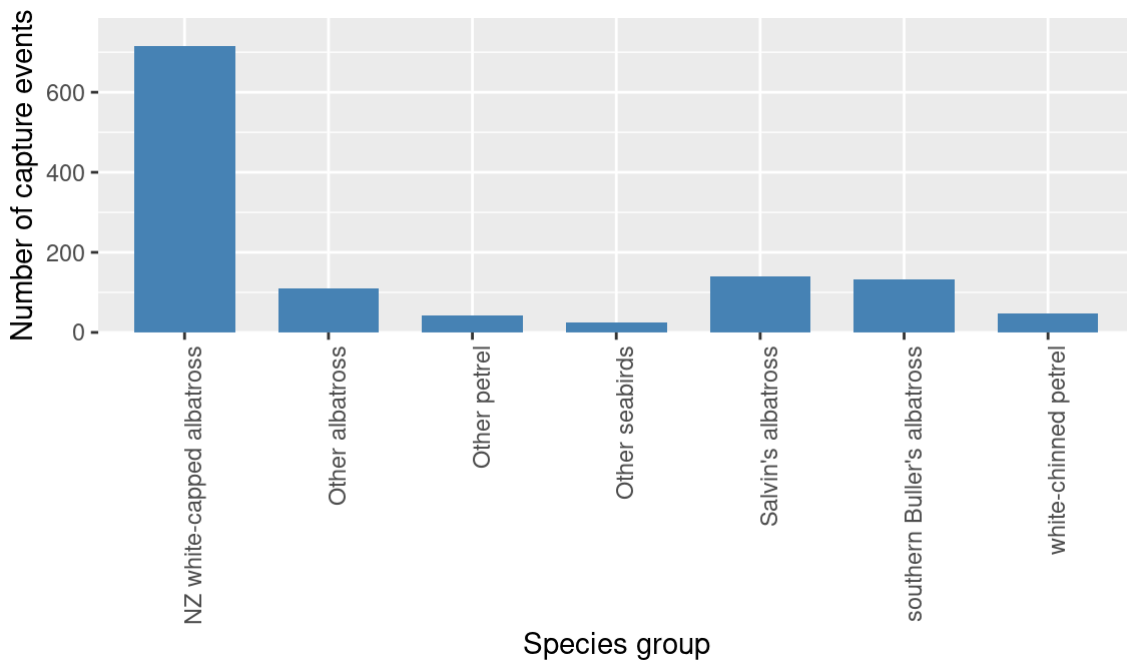


Figure 7: Number of observed capture events by fishing year

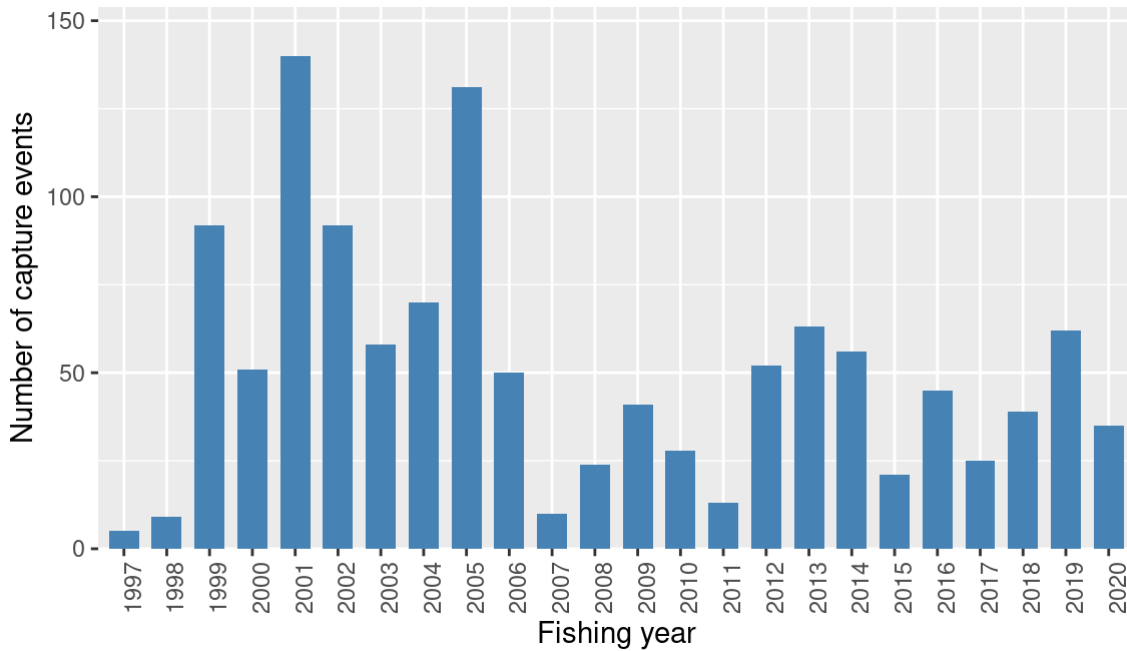


Figure 8: Number of observed captures by fishing year

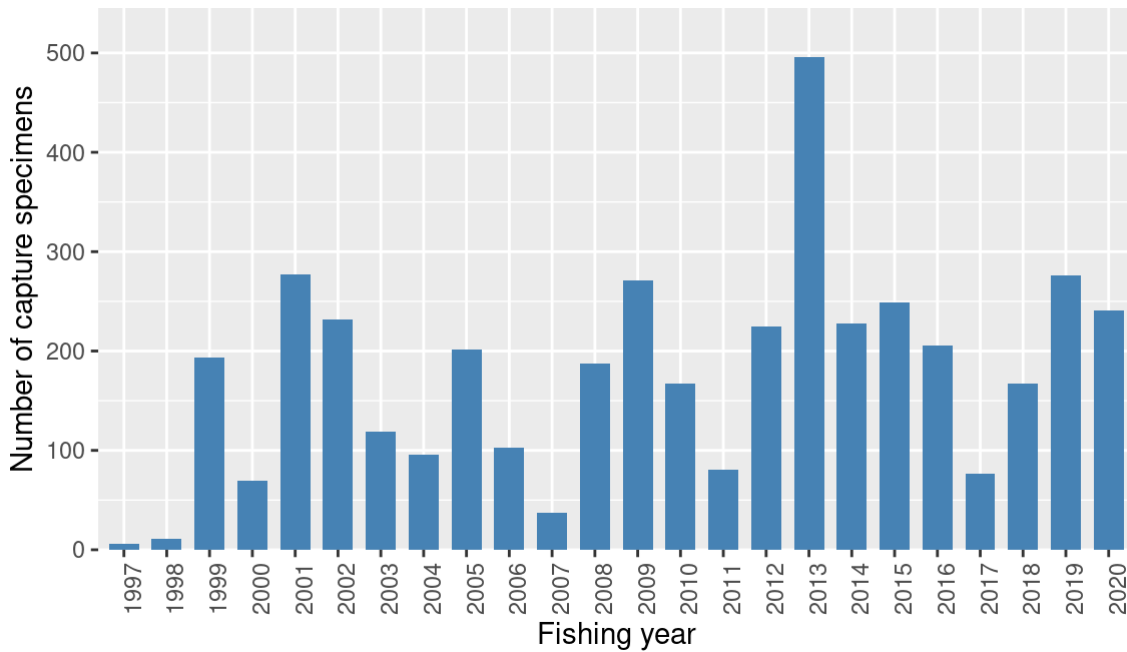


Table 11: Number of observed capture events by seabird species groups and fishing year

	NZ white-capped albatross	Other albatross	Other petrel	Other seabirds	Salvin's albatross	southern Buller's albatross	white-chinned petrel	Total
1997	5							5
1998	6	2		1				9
1999	33	15	2	2	13		1	92
2000	25	8	2	2	8		5	51
2001	107	14	4	2	6		4	140
2002	78	7			1		4	92
2003	35	4	1	1	15		2	58
2004	54	3	1	1	3		6	70
2005	84	9	7	4	15		8	131
2006	34	2	3	2	3		4	50
2007	5		2	1			2	10

2008	13	2	2	2	1	4		24
2009	19	4	2	1	2	13		41
2010	8	7	1	1	8	3		28
2011	9			1	1	2		13
2012	24	3	4		6	15		52
2013	38	6	1	1	7	9	1	63
2014	22	4	2		18	10		56
2015	9	1			9	2		21
2016	25	1	1		3	15		45
2017	17	4	2		1	1		25
2018	19	3	2		6	5	4	39
2019	31	6	3	1	6	12	3	62
2020	15	5	1	1	7	6		35
Total	715	110	43	24	139	133	48	1212

Table 12: Number of observed captures by seabird species groups and fishing year

	NZ white-capped albatross	Other albatross	Other petrel	Other seabirds	Salvin's albatross	southern Buller's albatross	white-chinned petrel	Total
1997	7							7
1998	9	3		2				12
1999	50	32	3	3	16	2	94	194
2000	37	9	3	3	15	7	2	70
2001	244	16	5	3	7	5	4	278
2002	218	8			2	6	3	233
2003	58	5	2	2	55	3		120
2004	78	4	2	2	4	7	6	97
2005	151	11	9	5	19	9	5	203
2006	88	3	4	3	4	5	3	104
2007	27		7	2		5		38
2008	164	6	4	4	4	11		188
2009	85	34	13	7	4	134		272
2010	28	46	6	12	74	7		168
2011	53			18	9	5		82
2012	90	6	15		19	100		226
2013	404	23	2	5	47	18	4	497
2014	133	12	7		58	23		229
2015	85	29			129	10		250
2016	122	3	5		18	63		207
2017	57	8	9		5	3		78
2018	83	5	12		19	26	28	168
2019	138	31	6	4	32	52	20	277
2020	136	41	2	3	26	39		242
Total	2522	315	98	63	546	519	160	4217

Warp mitigation

Add observer effort and catch effort mitigation fields to captures data

Query mitigation fields

Table 13: Mitigation fields available in COD

names.mitigation_fields.
mitigation_sled
mitigation_none
mitigation_tori
mitigation_baffler
mitigation_warp_scarer
mitigation_other
shot_offal_discharge
shot_offal_lookup_key
shot_fish_discharge
shot_fish_lookup_key
tow_offal_discharge
tow_offal_lookup_key
tow_fish_discharge
tow_fish_lookup_key
haul_offal_discharge
haul_offal_lookup_key
haul_fish_discharge
haul_fish_lookup_key
mitigation_equipment
mitigation_events
mitigation_event_lookup_key
nonfish_bycatch

Table 14: Mitigation fields available in COD: mitigation_tori

	f	t	Total
1996/1997	5		5
1997/1998	9		9
1998/1999	92		92
1999/2000	51		51
2000/2001	140		140
2001/2002	92		92
2002/2003	58		58
2003/2004	70		70

2004/2005	131			131
2005/2006	50			50
2006/2007	5	4	1	10
2007/2008		11	13	24
2008/2009		36	5	41
2009/2010		26	2	28
2010/2011		1	12	13
2011/2012	1	35	16	52
2012/2013		55	8	63
2013/2014		40	16	56
2014/2015		12	9	21
2015/2016		20	25	45
2016/2017		12	13	25
2017/2018		27	12	39
2018/2019		23	39	62
2019/2020		24	11	35
Total	704	326	182	1212

Table 15: Mitigation fields available in COD: mitigation_baffler

		f	t	Total
1996/1997	5			5
1997/1998	9			9
1998/1999	92			92
1999/2000	51			51
2000/2001	140			140
2001/2002	92			92
2002/2003	58			58
2003/2004	70			70
2004/2005	131			131
2005/2006	50			50
2006/2007	5	1	4	10
2007/2008		6	18	24
2008/2009		5	36	41
2009/2010			28	28
2010/2011		3	10	13
2011/2012	1	2	49	52
2012/2013		1	62	63
2013/2014		5	51	56
2014/2015		1	20	21
2015/2016		4	41	45
2016/2017		5	20	25
2017/2018		2	37	39
2018/2019			62	62
2019/2020		2	33	35
Total	704	37	471	1212

Table 16: Mitigation fields available in COD: mitigation_warp_scarer

	f	t	Total	
1996/1997	5		5	
1997/1998	9		9	
1998/1999	92		92	
1999/2000	51		51	
2000/2001	140		140	
2001/2002	92		92	
2002/2003	58		58	
2003/2004	70		70	
2004/2005	131		131	
2005/2006	50		50	
2006/2007	5	5	10	
2007/2008		24	24	
2008/2009		40	1	41
2009/2010		28	28	
2010/2011		13	13	
2011/2012	1	51	52	
2012/2013		63	63	
2013/2014		56	56	
2014/2015		21	21	
2015/2016		45	45	
2016/2017		25	25	
2017/2018		39	39	
2018/2019		62	62	
2019/2020		35	35	
Total	704	507	1	1212

Table 17: Number of observed capture events by mitigation_equipment and fishing year

	B1	B1B2	B1B2S2	B1B2T1	B1C3C4	B1O1S1	B1O1S3	B1O1T1T2	B1S1	B1S1T3T4	B1S2	B1T1	B1T1S1	B1T1T2
1997	5													
1998	9													
1999	92													
2000	51													
2001	140													
2002	92													
2003	58													
2004	70													
2005	131													
2006	50													
2007	5	4												
2008		5		1									6	
2009		31									1			1
2010		23												2
2011		1										2		6
2012	1	30							2		1			6

2013		38	11											1		4
2014		37				1				1				1		6
2015		11											1			8
2016		18			1					1			1			20
2017		10														7
2018		18								1				2		7
2019		20	3									1		2		25
2020		18					1	1	1	3	1					4
Total	704	264	14		1	1	1	1	1	1	8	2	4	8	6	96

Table 18: Number of observed capture events by mitigation_equipment and vessel_size category

		B1	B1B2	B1B2S2	B1B2T1	B1C3C4	B1O1S1	B1O1S3	B1O1T1T2	B1S1	B1S1T3T4	B1S2	B1T1	B1T1S1	B1T1T2	
28-43	34	34	1		1								2			5
43+	670	230	13	1		1	1	1	1	8	2	4	6	6		91
Total	704	264	14	1	1	1	1	1	1	8	2	4	8	6		96

Note

Project plan:

End of January

- Complete literature review
- Complete mitigation methods data characterisation
- Complete modelling design and run initial models
- Circulate progress report to stakeholders for review and feedback

15 February 2023

- Present final results and recommendations to the CSP TWG

28 February 2023

- Draft final report

24 March 2023

- Final report