



# Characterising and mitigating protected species interactions in inshore trawl

Presentation to the CSP Technical Working Group on  
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PARKER CONSERVATION

# Introduction

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Protected species interactions: extent and how they occur

Focus has been larger trawlers

Trawlers <28m mitigation not required

Inshore trawl: highest potential mortality in NZ fisheries (Richard et al. 2017)

*Thalassarche* albatrosses, *Procellaria* petrels

Observed shark, mammal captures

Observer coverage poor so estimate uncertain

Fleet highly variable (target, LOA, fishing practises, gear use, env conditions)

# Scope

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- Characterise subsets of the inshore trawl sector
- Explore protected species interactions
- Recommendations for future work to mitigate captures

Focus on fisheries observer data

# Methods: data sources

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Observer data - COD data tables

Refine by year and inshore classification

- Oct 2013 to Dec 2016
- CSP inshore trawl (39 spp)
- excl scampi, Cook Strait hoki

Observer trip information

- Trip reports, diaries, liaison info

Grey and published literature as support

# Data grooming

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## Data tables merged

- Non-fish bycatch → fishing event data
- Deck strikes retained

## Events removed if

- mitigation and discard data missing
- non-fish bycatch 'unobserved'

# Categories

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## Grouped mitigation device, target, FMA to main categories

None	GUR	AKE
bird baffler	TAR	AKW
tori line(s)	SNA	CEE
warp scarer	TRE	Other
baffler and tori	JDO	
Other	Other	

## Derived event-level code for discharge type, discharge stage

no discard	no discards
minced	Tow
whole fish	Haul
offal	Shot

# Analyses

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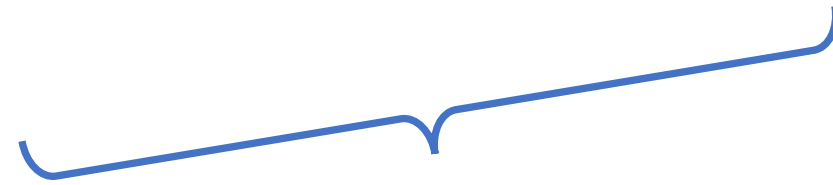
Exploratory:  
data adequate?



Association  
between captures  
and key covariate

→ flyers

→ swimmers



Qualitative  
What factors could  
influence captures?

Modeled capture rate by  
multiple explanatory variables

Neg binomial GLM  
Event-level data



# Results

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- COD observer data for 4,763 inshore trawl fishing events
  - 5,266 fishing events observed, 9.6% discarded
  - 34 vessels, LOA 13–82m
- Compared with trip reports for 77 inshore trawl trips
  - 89% of available reports reviewed
- Fisher discussions for areas without observer data

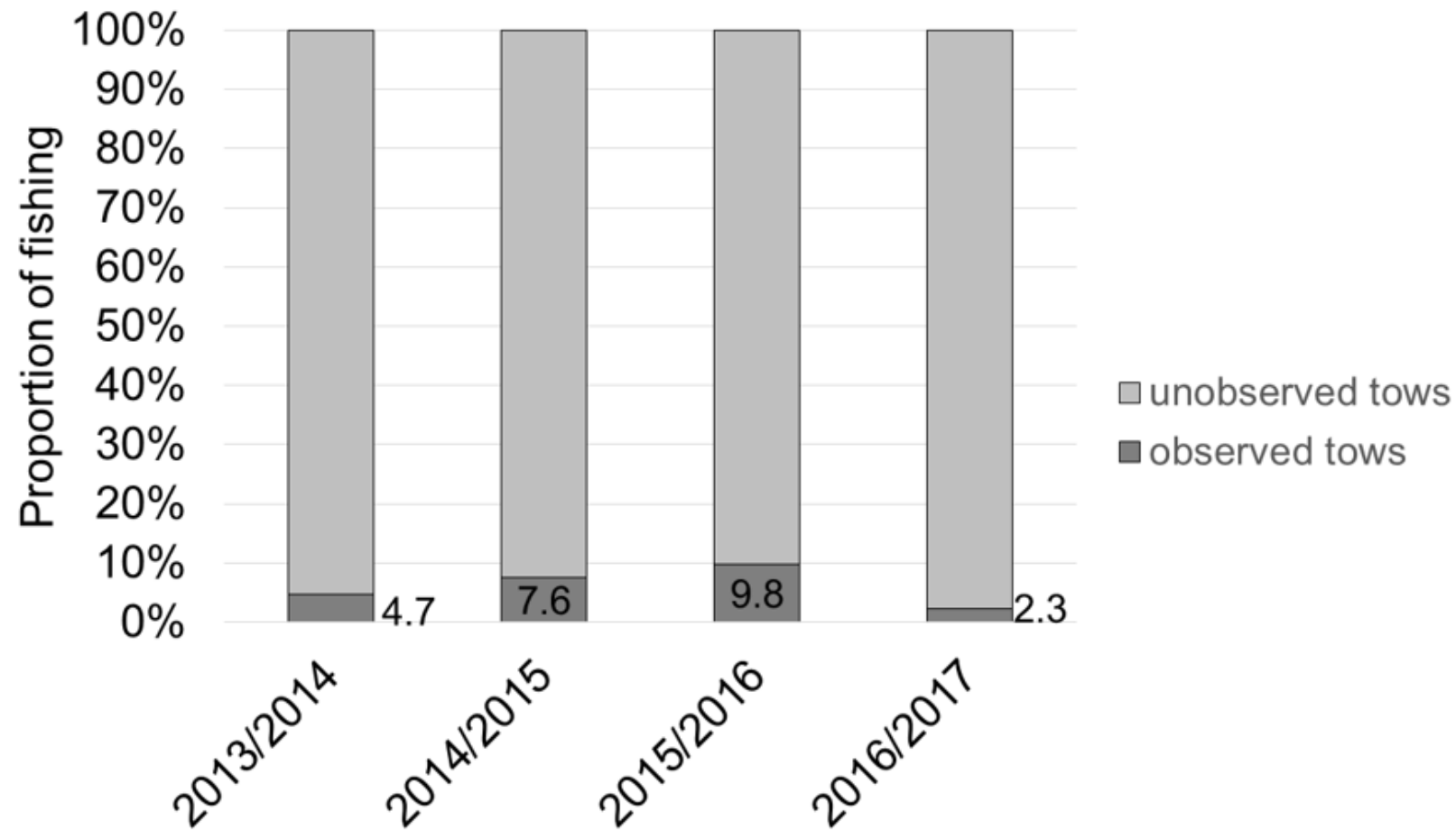


# Data coverage

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- 3.03% of inshore trawl fishing observed

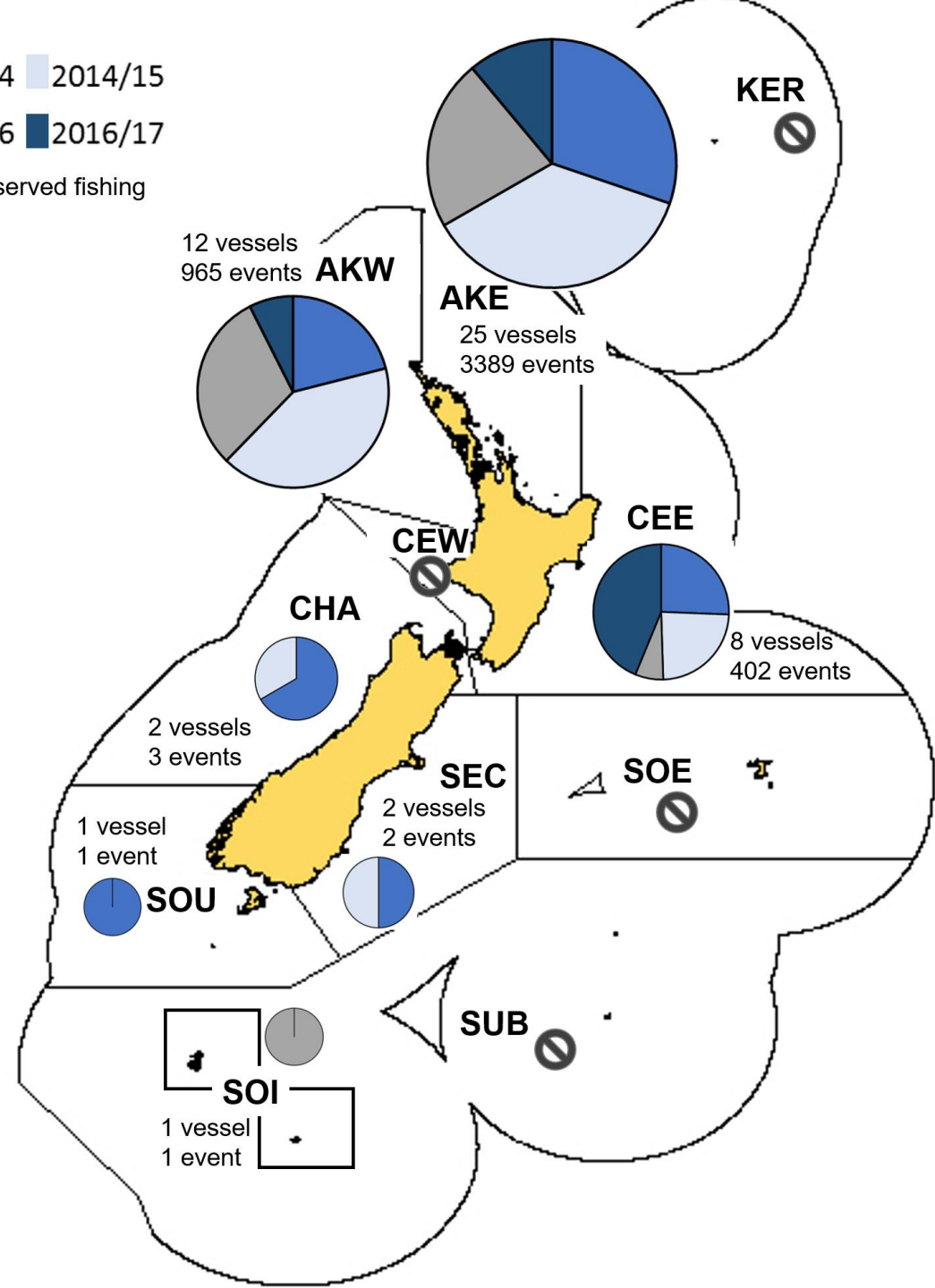


# Data coverage

2013/14 2014/15

2015/16 2016/17

No observed fishing



# Characterising inshore trawl - fishery



Most data for SNA, TAR fishing

Total observed peaked 2014

	2013/14	2014/15	2015/16	2016/17	Total
Snapper SNA	456	617	477	263	1813
Tarakihi TAR	374	391	160	198	1123
Trevally TRE	241	381	245	91	958
John Dory JDO	212	253	70	24	559
Gurnard GUR	40	89	104	31	264
Other	11	2	17	16	46
Total	1334	1733	1073	623	

# Protected species captures



	all years		2013/14		2014/15		2015/16		2016/17	
	n	rate	n	rate	n	rate	n	rate	n	rate
Flesh-footed and other shearwaters	23	0.437	8	0.595	11	0.617	4	0.318		
Black petrels and other <i>Procellaria</i> petrels	20	0.380	5	0.372	2	0.112	13	1.035		
Grey-faced and other <i>Pterodroma</i> petrels	10	0.190			6	0.337	3	0.239	1	0.113
Storm petrels	5	0.095					3	0.239	2	0.227
Common diving petrels	4	0.076	2	0.149	2	0.112				
White-capped albatross	3	0.057					3	0.239		
Unidentified seabird	1	0.019			1	0.056				
Dolphins	8	0.152	1	0.074	1	0.056	4	0.318	2	0.227
NZ fur seal	5	0.095	1	0.074	2	0.112			2	0.227
Green turtle	1	0.019			1	0.056				
White pointer shark	1	0.019					1	0.080		
<b>Total</b>	<b>82</b>	<b>1.557</b>	<b>17</b>	<b>1.264</b>	<b>26</b>	<b>1.459</b>	<b>32</b>	<b>2.548</b>	<b>7</b>	<b>0.793</b>

82 captures during 34 trips, in 69 fishing events

# Capture location and state



SEABIRDS		Alive	Dead	all	Alive %
	Net capture	30	9 <sup>a</sup>	39	77
	Warp/door capture	1	5 <sup>b</sup>	6	17
	Deck strike	14		14	100
	other	4	1	5	80
	unknown	4		4	100
	all	53	13		
MAMMALS, SHARKS & TURTLES		Alive	Dead	all	Alive %
	Net capture <sup>c</sup>	4	11	15	27

A bird with 'unknown' life status included as dead because: <sup>a</sup> observer found bird unresponsive, unknown if alive or dead; and <sup>b</sup> bone and feathers were found in the warp splice.  
<sup>c</sup> One animal dead prior to capture excluded from summary.

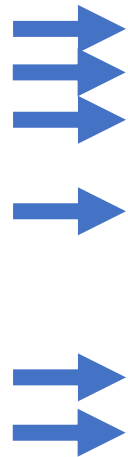
Net 59%  
 Warp 9%  
 Deck 21%

# Captures - fishery area and target spp



FMA	target	n captures	% of captures observed in FMA	% captures that were seabirds
AKE	TAR	33	57	91
	SNA	12	21	75
	JDO	11	19	82
	TRE	2	3	100
AKW	TAR	8	47	63
	TRE	6	35	67
	SNA	2	12	100
	GUR	1	6	100
CEE	TAR	6	86	50
	SNA	1	14	0
SOU	Other	2	100	100
CHA		0		
SEC		0		
SOI		0		

# PS captures fishery – area



FMA	target	n captures	Protected species caught
AKE	TAR	33	XSW,XSH,XPC,XGF,XFS,XBP,XPC,FUR,CDD
	SNA	12	XSW,XSH,XGF,XFS,XDP,XBP,WPS,FUR,BDO
	JDO	11	XSH,XFS,XBS,XBP,CDD
AKW	TRE	2	XDP,XBP
	TAR	8	XWM,XST,XPT,XPM,FUR,CDD
	TRE	6	XWM,XWF,XKP,XGP,UNF,GNT
	SNA	2	XWF,XFS
CEE	GUR	1	XWM
	TAR	6	XWF,XFS FUR
	SNA	1	CDD
SOU	Other	2	XSH
CHA		0	
SEC		0	
SOI		0	

BDO: bottlenose dolphin, *Tursiops truncatus*; CDD: common dolphin, *Delphinus delphis*; FUR: NZ fur seal, *Arctocephalus forsteri*; GNT: green turtle, *Chelonia mydas*; PIW: pilot whale long-finned, *Globicephala melas*; UNF: unidentified seabird; WPS: white pointer shark, *Carcharodon carcharias*; XBP: black petrel, *Procellaria parkinsoni*; XBS: bullers shearwater, *Puffinus bulleri*; XDP: common diving petrel, *Pelecanoides urinatrix*; XFS: flesh-footed shearwater, *Puffinus carneipes*; XGF: grey-faced petrel, *Pterodroma macroptera*; XGP: grey petrel, *Procellaria cinerea*; XKP: Cook's petrel, *Pterodroma cookii*; XPC: Procellaria petrels, *Procellaria* spp.; XPM: mid-sized petrels & shearwaters, *Pterodroma*, *Procellaria* & *Puffinus* spp.; XSH: sooty shearwater, *Puffinus griseus*; XST: storm petrel, Hydrobatidae; XSW: shearwaters, *Puffinus* spp.; XWF: white-faced storm petrel, *Pelagodroma marina*; XWM: white-capped albatross, *Thalassarche steadi*



# Captures by fishery



rate  
increasing →

	2013/14		2014/15		2015/16		2016/17		Protected species caught <sup>a</sup>
	events	rate	events	rate	events	rate	events	rate	
MAMMALS, SHARKS & TURTLES									
Snapper	456	0	617	0.16	477	0.21	263	0.76	FUR, WPS, BDO, CDD
Tarakihi	374	0.53	391	0.51	160	1.88	198	1.01	CDD, FUR.
John Dory	212	0	253	0	70	x	24	x	CDD
Trevally	241	0	381	0.52	245	0	91	x	GNT
Gurnard	40	x	89	x	104	0	31	x	
Other	11	x	2	x	17	x	16	x	

# Captures by fishery



	2013/14		2014/15		2015/16		2016/17		Protected species caught <sup>a</sup>
	events	rate	events	rate	events	rate	events	rate	
SEABIRDS									
Snapper	456	0.66	617	0.81	477	0.63	263	0	XFS, XGF, XSW, XBP, XWF, XDP, XSH
Tarakihi	374	2.41	391	2.30	160	10.63	198	1.52	XBP, XFS, XSH, XSW, XBP, XPC, XWM, XPM, XST, XGF, XPT
John Dory	212	0.94	253	2.37	70	x	24	x	XFS, XSH, XBS, XBP
Trevally	241	0	381	0.52	245	1.63	91	x	XBP, XWM, XWF, XKP, XGF, XDP, UNF
Gurnard	40	x	89	x	104	0.96	31	x	XWM
Other	11	x	2	x	17	x	16	x	XSH

- 2015/16
- 65% of captures on a single vessel (7 TAR vessels observed)
  - 13 black petrels captured in 8 trawls in AKE

# Operational characteristics

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## Average fishing speed and depth

	events	speed (kn)	seabed depth (m)
Gurnard	264	2.8	45
John Dory	559	2.6	71
Snapper	1813	3.1	53
Tarakihi	1123	3.1	136
Trevally	958	3.2	50
Other	46	x	x

# Operational characteristics

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- Fishing speed 2.5 – 3 kn captures highest e.g. John Dory and gurnard
- And like depth appeared to decline at faster fishing speeds
- But five captures were recorded in 294 fishing events where no operational parameters were documented

# Operational characteristics - gear type

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- Standard codend 1.55 captures/100 events vs PSH 1.17
- PSH-20% of captures – XGF, XFS<sup>2</sup>, XBP, XDP, XWP, XCD<sup>4</sup>, XBD, XSW, XPM
- More time on surface, more captures
  - PSH 6 vs SBT 5 minutes (up to 188 and 164 minutes respectively)

# Mitigation use

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## Frequency of use

	2013/14		2014/15		2015/16		2016/17		all years	
	events	usage %	events	usage %	events	usage %	events	usage %	events	usage %
none	750	56	793	46	506	47	363	58	2412	51
baffler	314	24	651	38	487	45	259	42	1711	36
tori	267	20	225	13	1	x	1	x	494	10
other	3	x	64	x	79	x			146	3
Total	1334		1733		1073		623		4763	

# Captures with mitigation

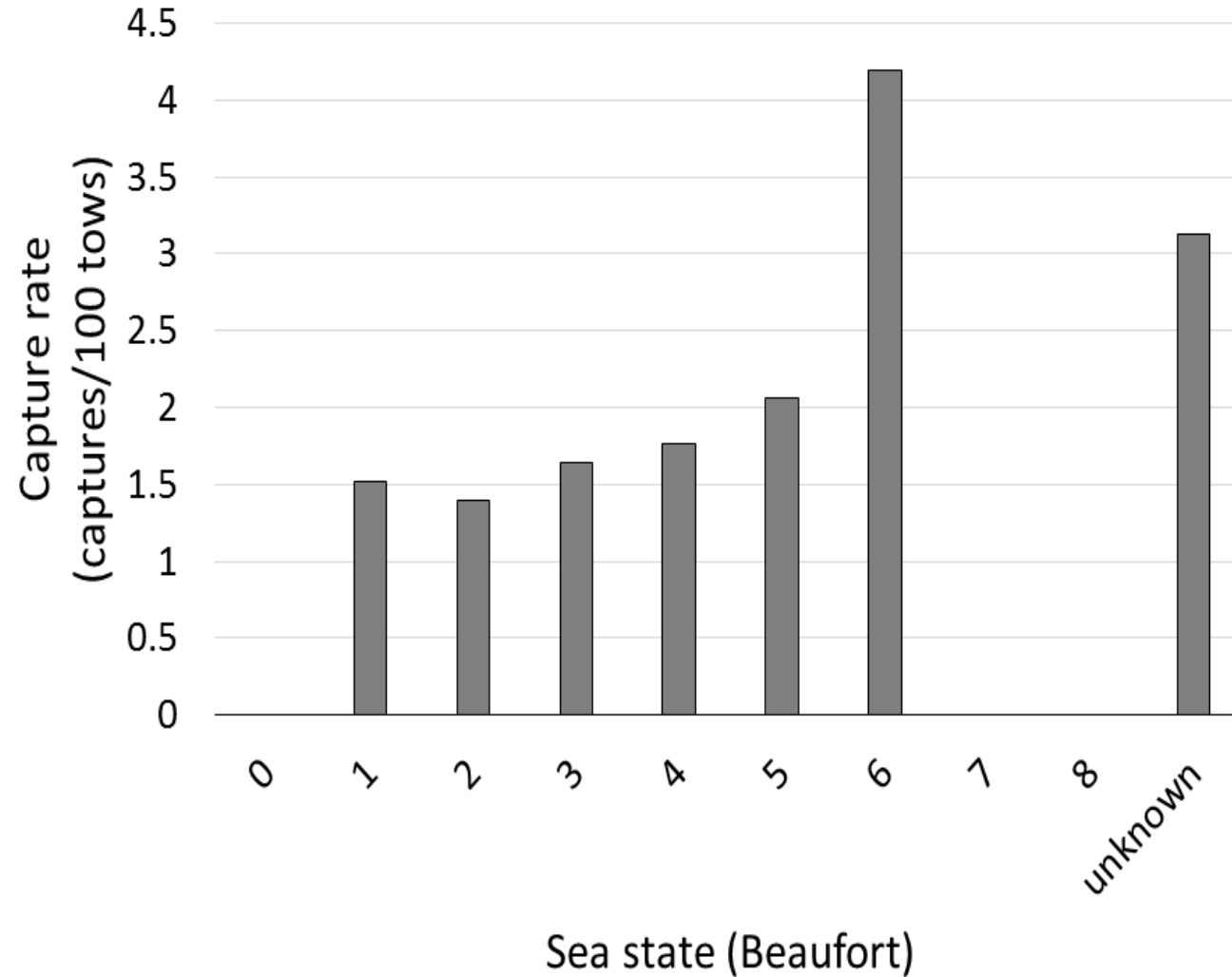


	2013/14		2014/15		2015/16		2016/17		all years	
	events	capture rate	events	capture rate	events	capture rate	events	capture rate	events	capture rate
none	750	0.80	793	1.39	506	4.35	363	0.83	2412	1.74
baffler	314	2.23	651	0.77	487	0.62	259	0	1711	0.88
tori	267	0.37	225	2.67	1	x	1	x	494	1.42
other	3	x	64	x	79	x			146	2.05



# Sea state and captures

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# Discarding



- What and when

	2013/14		2014/15		2015/16		2016/17	
	events	%	events	%	events	%	events	%
Discard type								
none	1098	82	1173	68	739	69	425	68
fish	128	10	250	14	121	11	42	7
offal	108	8	310	18	213	20	156	25
Discard stage								
not during fishing	1098	82	1173	68	739	69	425	68
tow	140	10	341	20	158	15	71	11
haul	3	<1	1	<1	4	<1		
shot	93	7	218	13	172	16	127	20

# Discarding – capture rates



	No material		Fish		Offal		All	Protected species captured <sup>a</sup>
	events	capture rate	events	capture rate	events	capture rate		
<b>Seabirds</b>								
No discards during fishing tow haul	3435	1.57	314	0.32	396	1.01	0.66	XBP, XDP, XFS, XGF, XKP, XPC, XPM, XSH, XSW, XWF, XWM
shot			223	1.79	387	1.03	1.41	XBS, XST, XWF, XWM
All		1.57		1.06		1.02		
<b>Mammals sharks and turtles</b>								
No discards during fishing tow haul	3435	0.23	314	0.32	396	0.51	0.41	CDD, FUR
shot			223	0.45	387	1.29	0.87	CDD, FUR, WPS
All		0.23		0.38		0.90		BDO, CDD, FUR, GNT, UNF

<sup>a</sup> Protected species codes are defined in Table 5

# Captures by vessel



	Vessel length	Fishery	events	Mitigation	%mit	Capture rate
1	15	TAR	30	N	0	50.0
2	15	JDO	117	N	0	4.27
3	25	TAR	146	N	0	3.42
4	20	TRE	160	B	100	3.13
5	15	JDO	98	N	0	3.06
6	15	SNA	190	N	0	2.63
7	15	TAR	152	N	0	2.63
8	20	TAR	258	T	100	1.94
9	20	SNA	53	O	8	1.89
10	25	SNA	502	T	99	1.59
11	20	JDO	529	B	100	1.32
12	20	TAR	98	N	0	1.02
13	25	TAR	596	N	0	1.01
14	20	TAR	328	N	0	0.91
15	15	SNA	124	N	0	0.81
16	20	SNA	792	B	100	0.63
17	15	SNA	235	N	0	0.43
18	15	TAR	80	N	0	0
19	30	TRE	62	B	100	0
20	30	SNA	40	B	100	0
21	20	TAR	39	N	0	0
22	20	GUR	31	N	0	0

# Modelled captures

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		Estimate	Std. Error	Significance
Intercept		-5.53	0.43	***
Target	tarakihi	2.00	0.40	***
	trevally	-0.01	0.55	
	John Dory	1.09	0.50	*
	gurnard	-0.61	1.11	
	Other	-1.27	3.03	
Fishing year	2014–15	0.31	0.39	
	2015–16	1.09	0.41	**
	2016–17	-0.51	0.72	
Area (FMA)	AKW	-0.08	0.39	
	CEE	-1.17	0.68	.
	Other	5.49	3.03	.

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Significance: \*\*\* p<0.001, \*\* p<0.01, \* p<0.05, . p<0.1

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# Discussion

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- Protected species captures
  - Diverse range of species
  - Varying conservation classifications
  - Birds
  - Mammals
  - Sharks

# Discussion

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- Spatial coverage
  - North Island skewed
  - Quantitative vs qualitative
  - Vessel differences
  - Differences in vulnerable species distribution
  - Difference in average sea conditions



# Discussion

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- Target species
  - Tarakihi higher PS bycatch
  - Snapper lowest
  - Mixed bag fishing

# Discussion

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- Location in gear of capture
  - Net – majority of captures
  - Warp – 7% of seabirds
  - Deck-strikes – 17% of all protected species – all seabirds

# Discussion

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- Mitigation – net
  - Net cleaning
  - Net surface time
  - Operational, e.g. turning to close net mouth

# Discussion

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- Mitigation – warp
  - Bafflers
  - Tori-lines
  - Other

# Discussion

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- Mitigation – discarding
  - Holding all waste 68-82% of fishing
  - Batching?
  - Zero-discarding yet still captures

# Risk exacerbators

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- No mitigation
- Discarding, and discarding during shoot
- Net stickers, but many birds caught at haul
- Net surface time

# Recommendations

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- Future work
  - Larger data set
  - Improved spatial coverage
  - Warp captures may be underestimated
  - Accurate ID of storm and diving petrels
  - Sticker removal better measured
  - Time net on surface not clear – just to doors up

# Recommendations

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- Refining capture data collection
  - Spatial coverage
  - Null entry versus confirmed negative
  - Fishing stage capture occurred
  - Deck-strike location and time
  - Indications of animals lost during fishing
  - Quality of observers view of warp
  - Captures of wildlife outside of fishing



# Capture summary

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Most animals trawl caught in the net

- Captures seabirds mostly alive (suggests caught haul)
- marine mammals, sharks and a turtle dead (fishing stage unknown)

Warp captures almost always dead

Net mitigation very important, but better quantification of warp captures needed

Mitigation needs empirical testing



# Acknowledgements

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