GPT Sept 2022

Whale depredation estimate update

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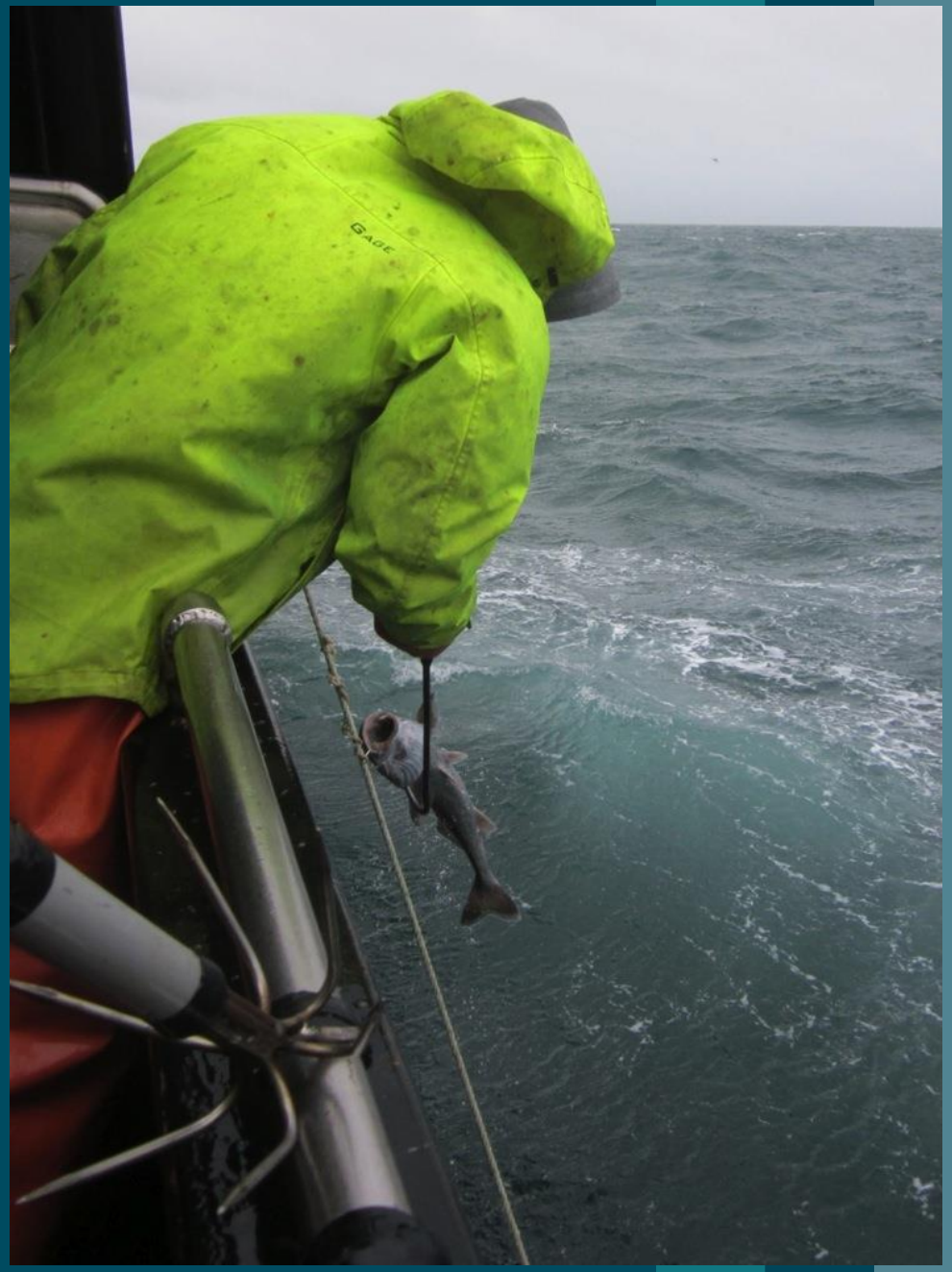
Whale depredation in the sablefish assessment

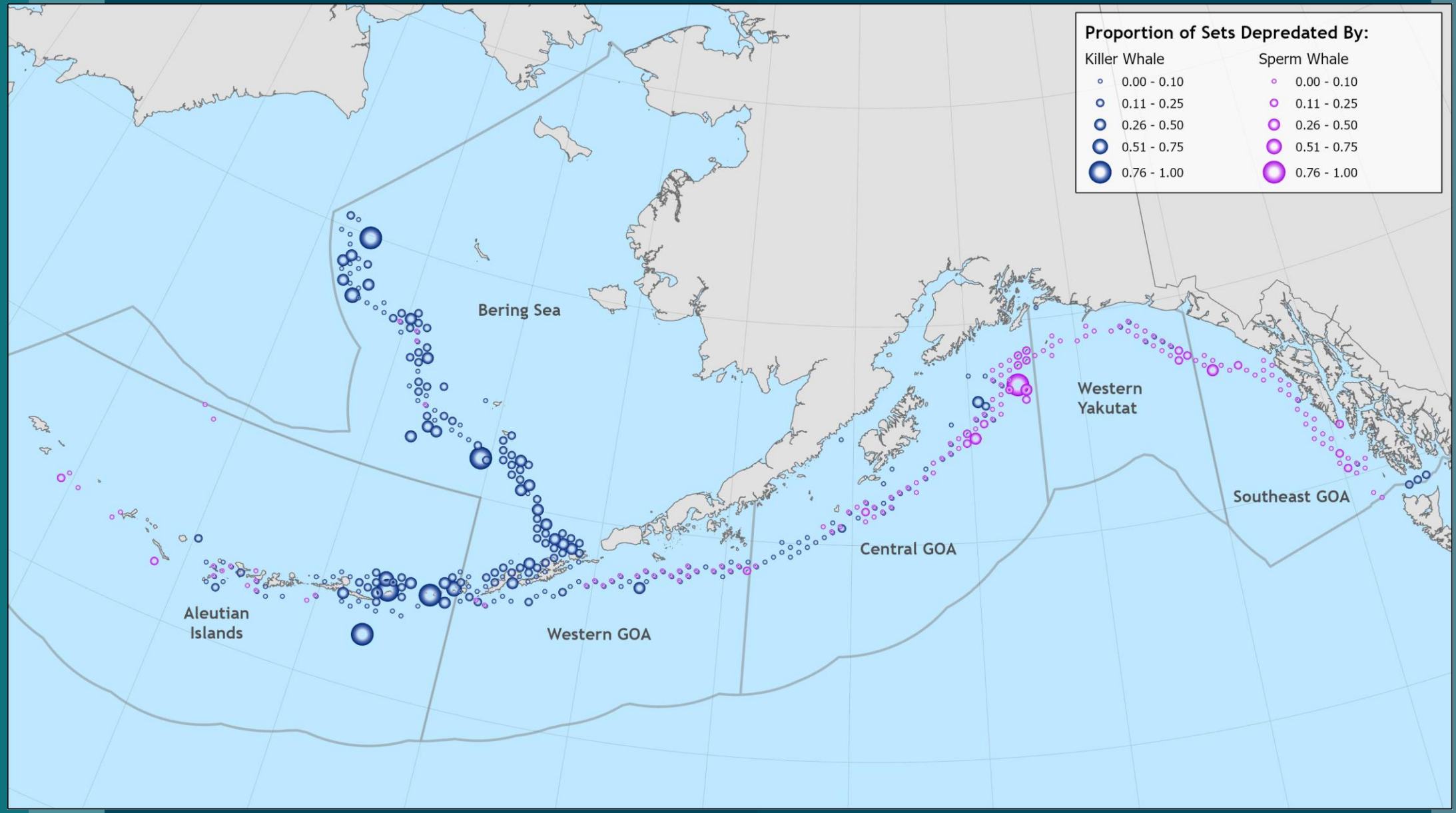
1. Longline survey
2. Commercial fishery
   a) Catch Per Unit Effort (CPUE) reductions
   b) Proportion of sets depredated based on fishery characteristics
   c) Sablefish mortality due to depredation on commercial fishery

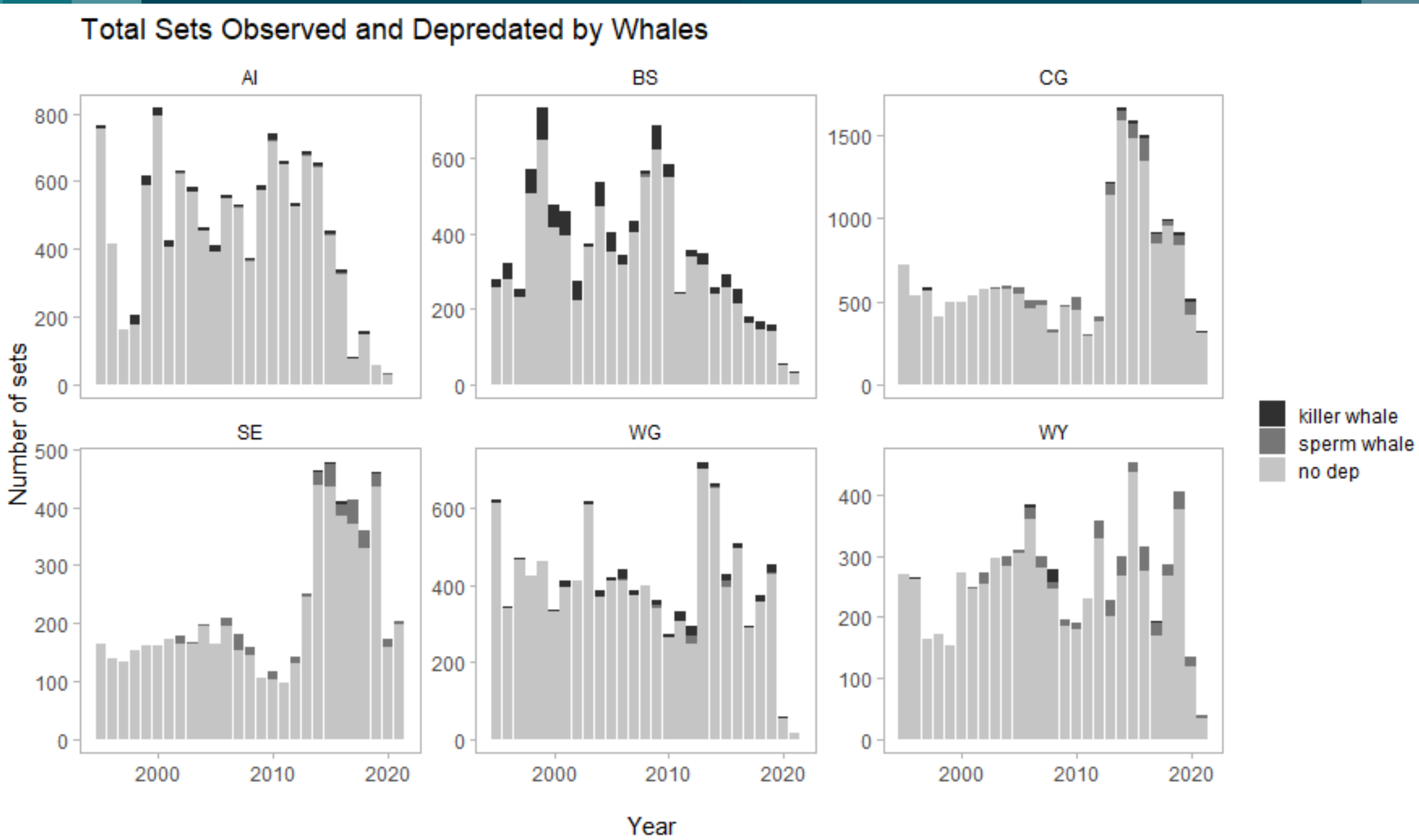


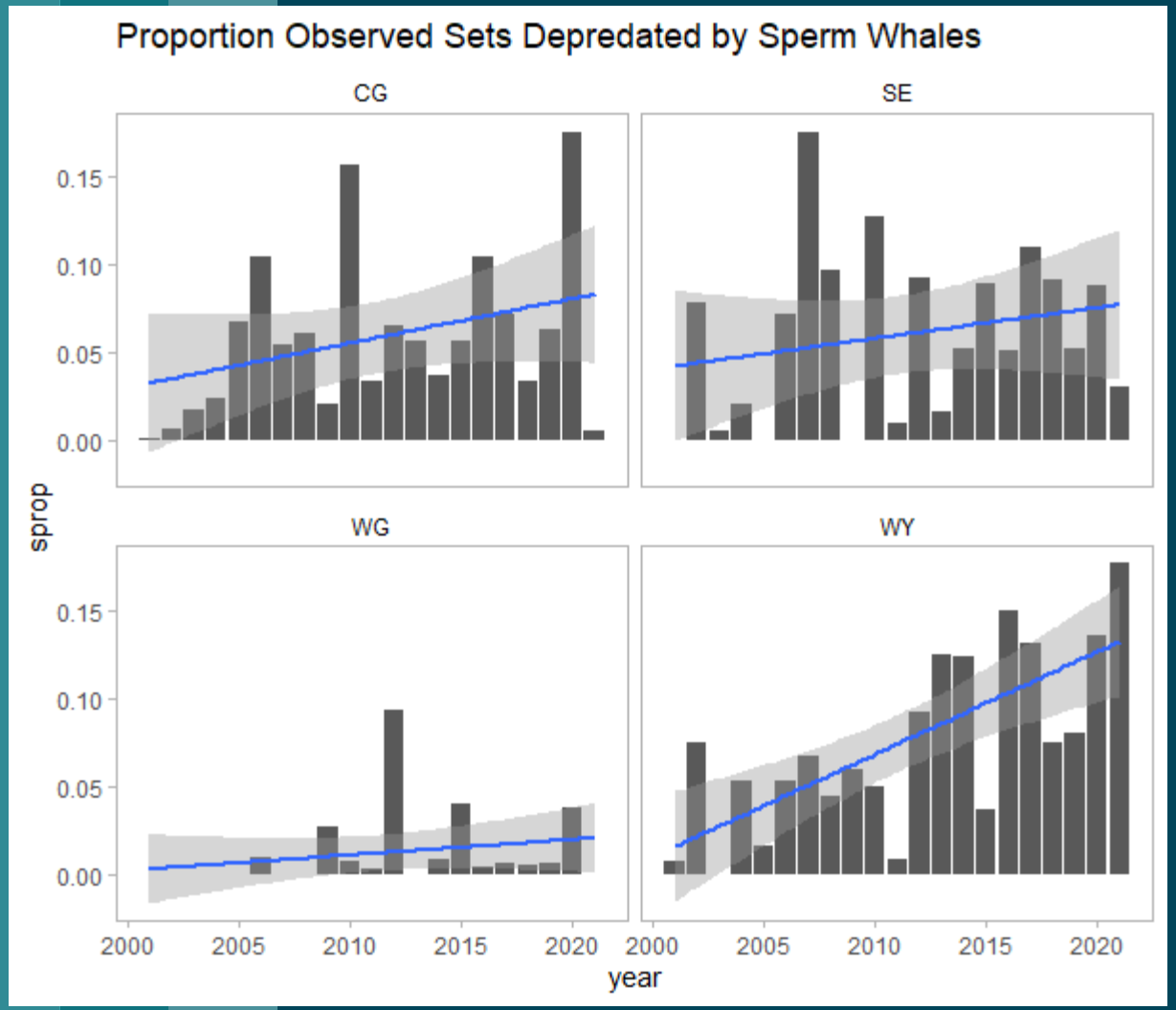
DATA

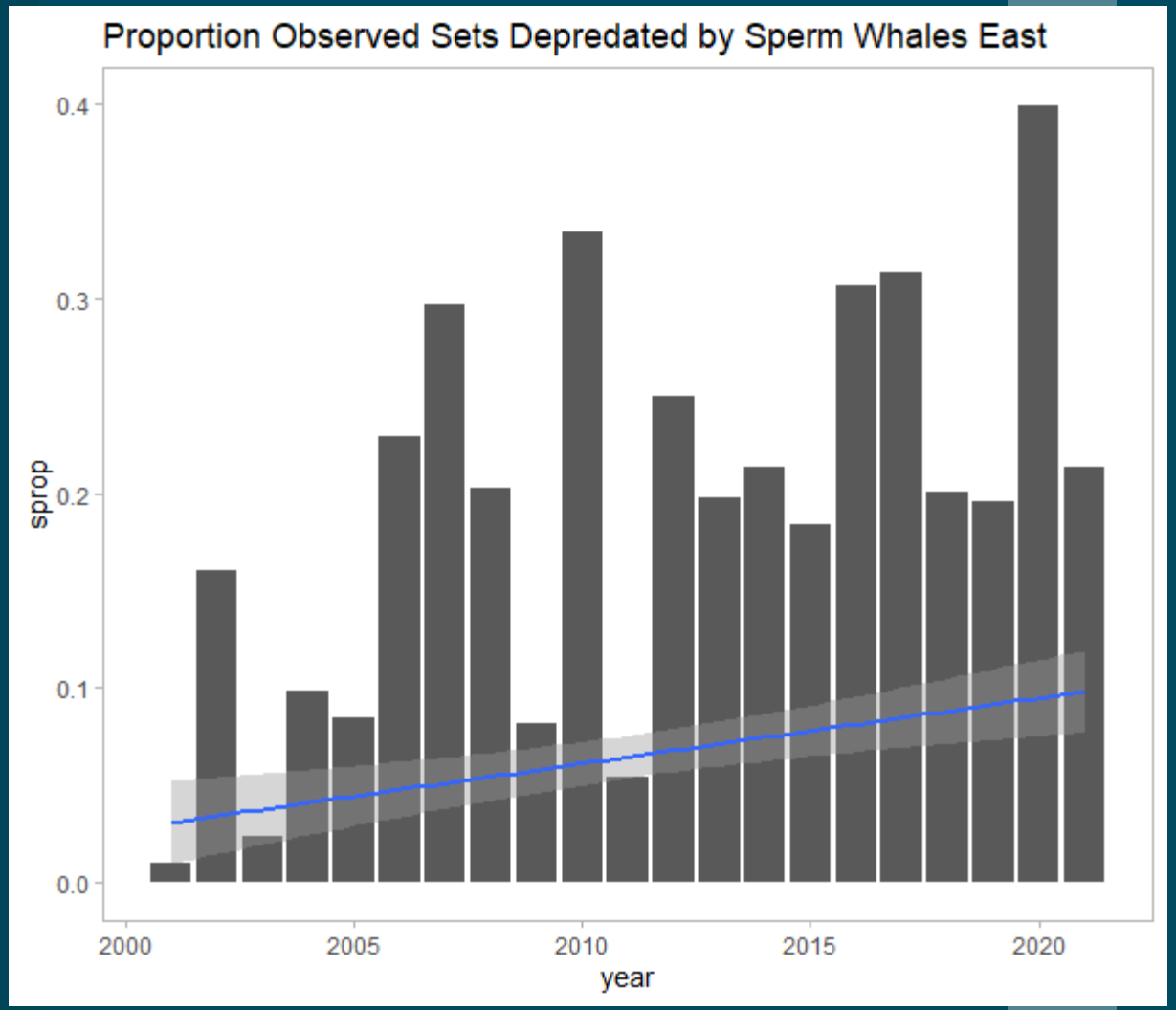
- **Observer data –** IFQ longline sablefish target, 1995-2021 (n=61,035 unique sets)
  - Marine mammal interactions documented (most of the time)
  - #Observed sets declined in all areas ~2017-2019
- **Catch in area data –**NMFS blended Catch in Areas database (based on processor system pre-2003, electronic logbook, observer and VMS data 2003 on; n=13,679 years/grids with catch data)

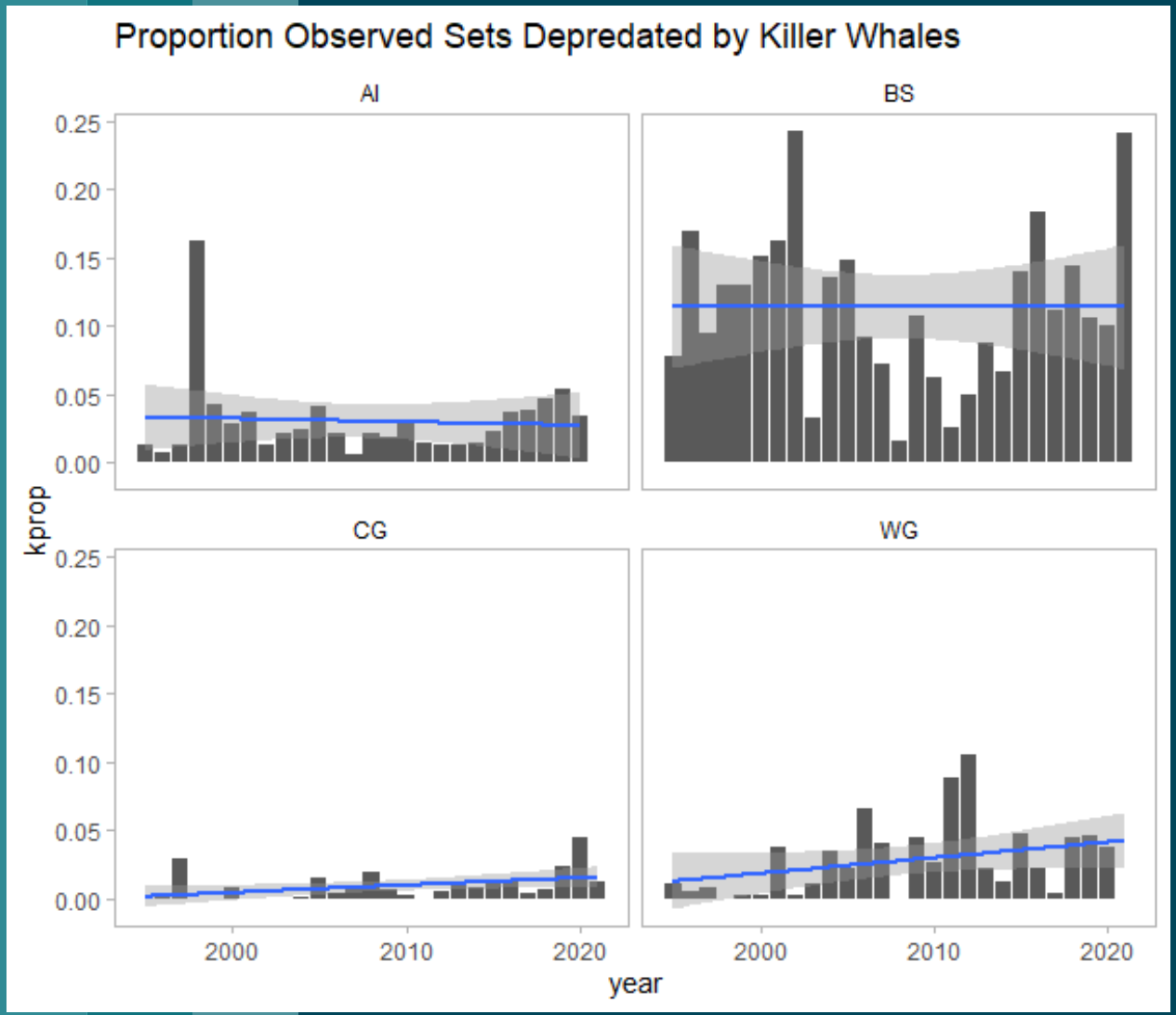
Sperm whale and killer whale depredation on the commercial longline sablefish fishery, 1995-2021

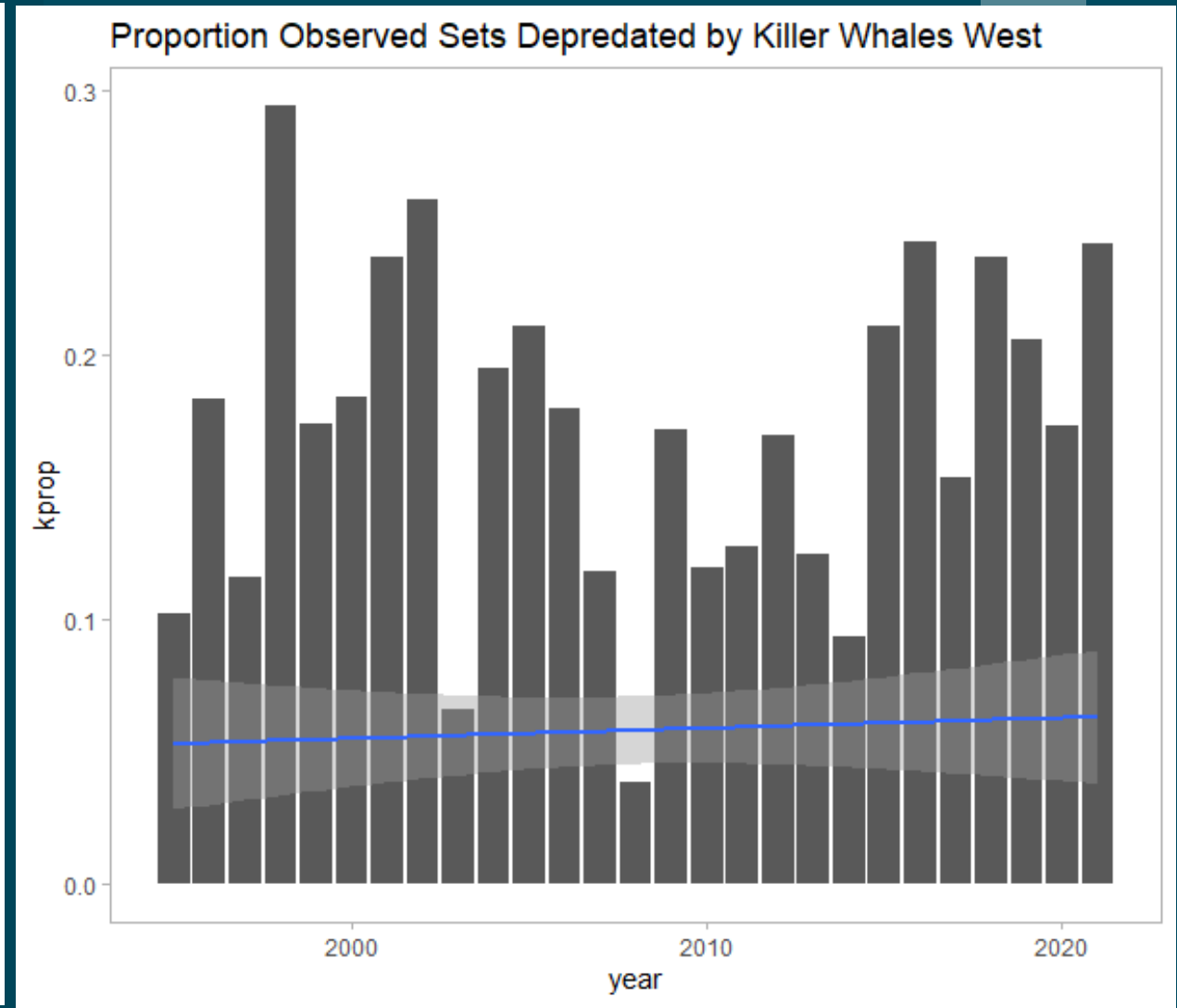


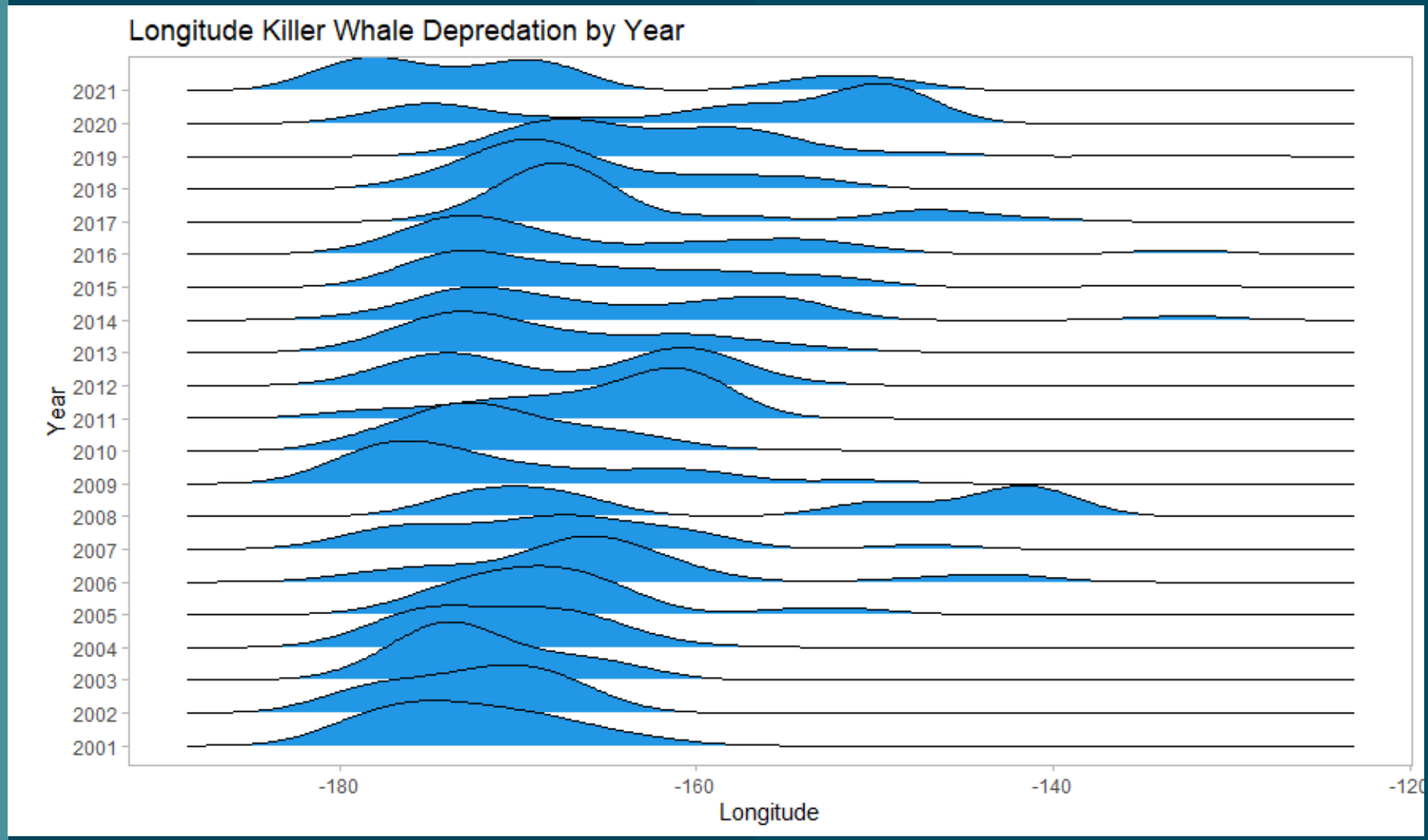

Total Sets Observed and Depredated by Whales
AI
BS
CG
SE
WG
WY
Number of sets
Year
killer whale
sperm whale
no dep


Proportion Observed Sets Depredated by Sperm Whales
CG
SE
WG
WY
sprop
0.15
0.10
0.05
0.00
2000
2005
2010
2015
2020
year


Proportion Observed Sets Depredated by Sperm Whales East
sprop
0.4
0.3
0.2
0.1
0.0
2000
2005
2010
2015
2020
year


Proportion Observed Sets Depredated by Killer Whales
AI
BS
CG
WG
kprop
0.25
0.20
0.15
0.10
0.05
0.00
2000
2010
2020
year


Proportion Observed Sets Depredated by Killer Whales West
kprop
0.3
0.2
0.1
0.0
2000
2010
2020
year


Longitude Killer Whale Depredation by Year
Year
2021
2020
2019
2018
2017
2016
2015
2014
2013
2012
2011
2010
2009
2008
2007
2006
2005
2004
2003
2002
2001
-180
-160
-140
-120
Longitude

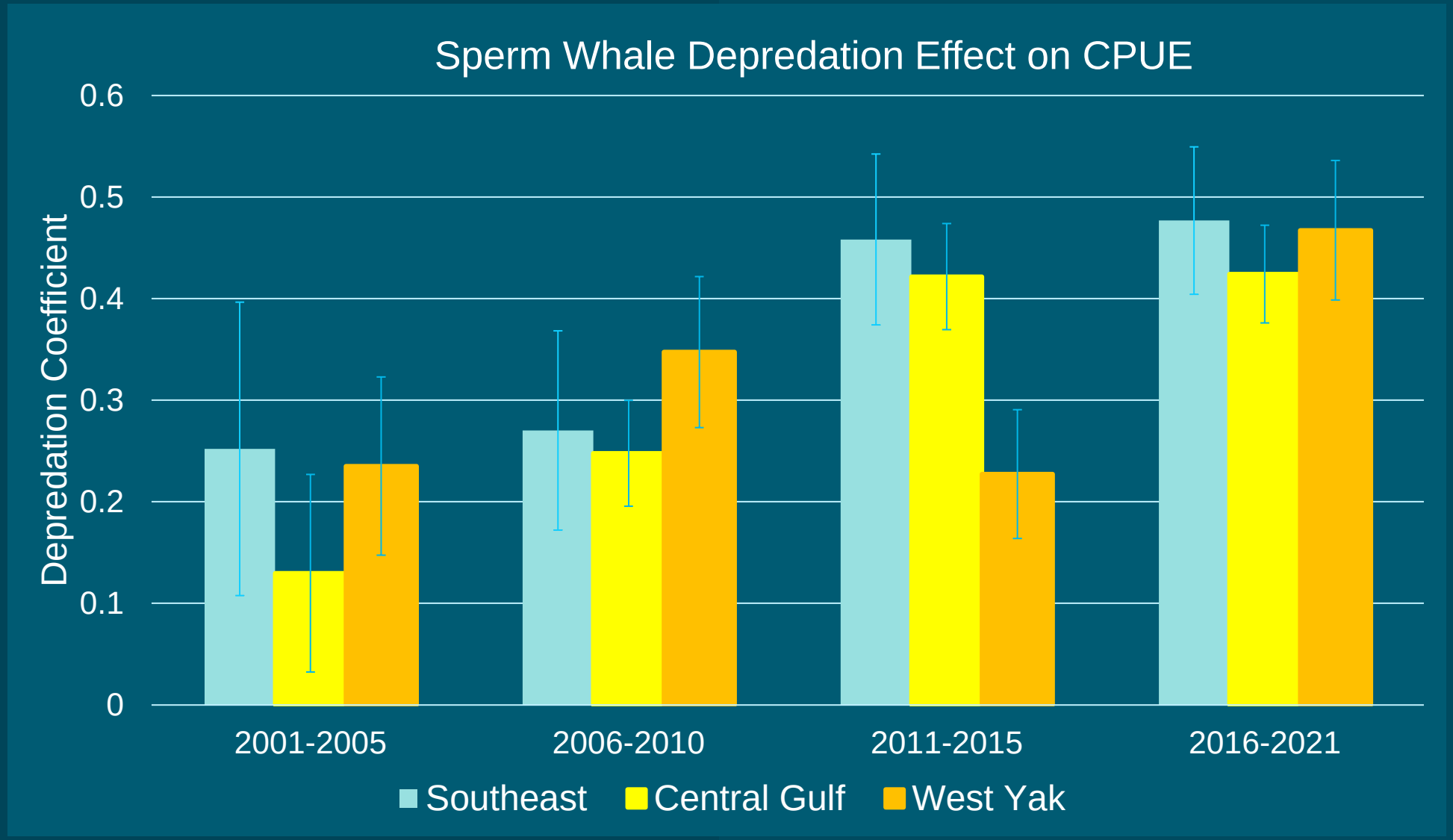
a) CPUE reductions

Sablefish CPUE

Considered explanatory terms	Input	Significant ($p < 0.05$)
Year	Factor random	Y
Vessel		Y
Depth (m)	Smoother fixed	Y
Julian day		Y
Vessel length (ft)		N
Grenadier CPUE		Y
Halibut CPUE		Y
Whale depredation		Y
% Haul Monitored		N
Lat/Long		Y

$$Log(sable_CPUE) = \beta_0 + whale_dep + depth + jul_day + (lat,long) + gren_CPUE + hal_CPUE + year + vessel + \varepsilon$$

	Previous Estimate	Updated Estimates		
	Depredation coefficient (CPUE Reduction) 2017	**Depredation coefficient (CPUE Reduction) 2022**	2 * SE	%Dev Explained
BS	0.457	**0.468**	0.09	44.3%
AI	0.577	**0.646**	0.12	34.5%
WG	0.694	**0.764**	0.10	34.9%
CG	0.238	**0.358**	0.06	47.4%
WY	0.263	**0.353**	0.07	56.9%
SE	0.294	**0.412**	0.09	50.8%


Sperm Whale Depredation Effect on CPUE
Depredation Coefficient
0.6
0.5
0.4
0.3
0.2
0.1
0
2001-2005
2006-2010
2011-2015
2016-2021
Southeast
Central Gulf
West Yak

b) Proportion sets depredated

- Data gridded into 1/3° by 1/3° (approx. 36 km by 25 km)
- Fishery characteristics averaged or summed per grid
- Zero Inflated Poisson (ziP) distribution GAM

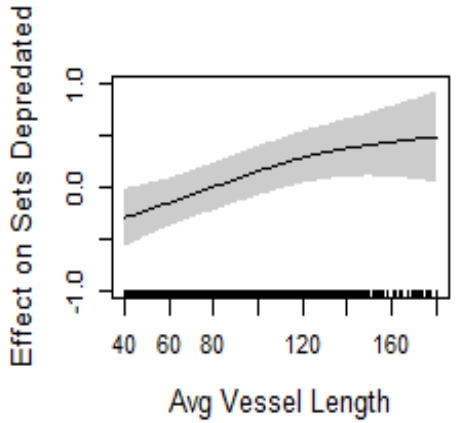
Total sets depredated

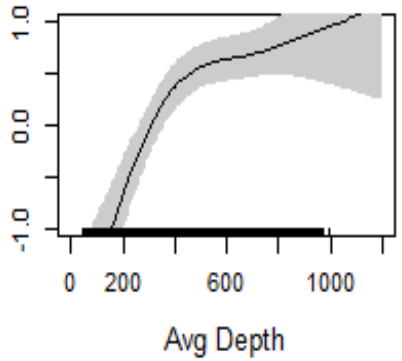
Considered explanatory terms
Average depth (m) per grid
Average # of hooks per grid – proxy for set length
Total # of hooks per grid – proxy for fishing effort per grid
Average sablefish CPUE non-depredated sets (kg/hook)
Total catch (t) – as estimated in NMFS blended Catch in Areas database- based on processor system pre-2003, and electronic logbook, observer and VMS data 2003 on
Average % haul monitored by onboard observers
Average vessel length (ft)
Whale cluster - killer whales in western AK only, as defined by Fearnbach et al. 2013

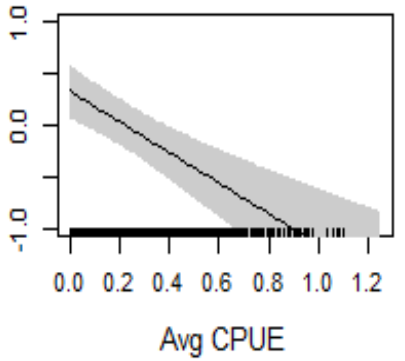
Fishery characteristics targeted by whales

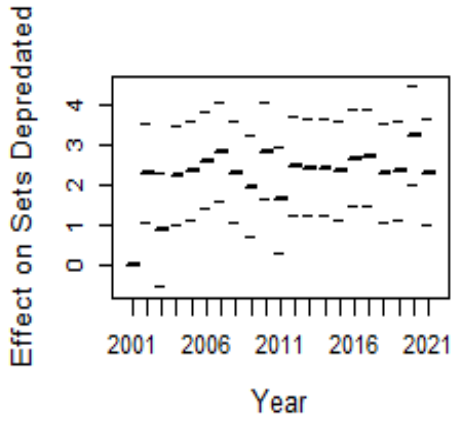
	Previous Estimates		Updated Estimates		
	Observed Proportion Sets Depredated	Model-Estimated Proportion Sets Depredated	**Observed Proportion Sets Depredated 2022**	**Model-Estimated Proportion Sets Depredated 2022**	%Dev Explained
AI	0.045	0.041	**0.046**	**0.039**	**40% n=3442**
BS	0.164	0.126	**0.170**	**0.141**	
WG	0.038	0.042	**0.037**	**0.041**	
CG	0.033	0.027	**0.029**	**0.025**	**64.4% n=2770**
WY	0.046	0.047	**0.052**	**0.054**	
SE	0.043	0.044	**0.060**	**0.048**	

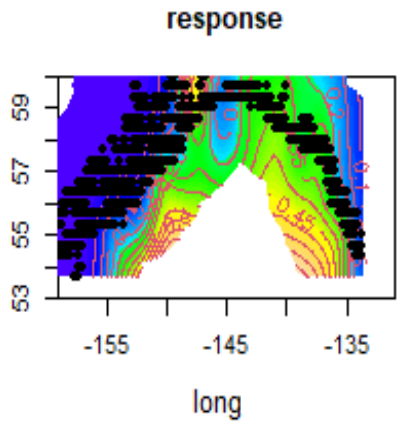
Gulf of Alaska Sperm Whale Depredation



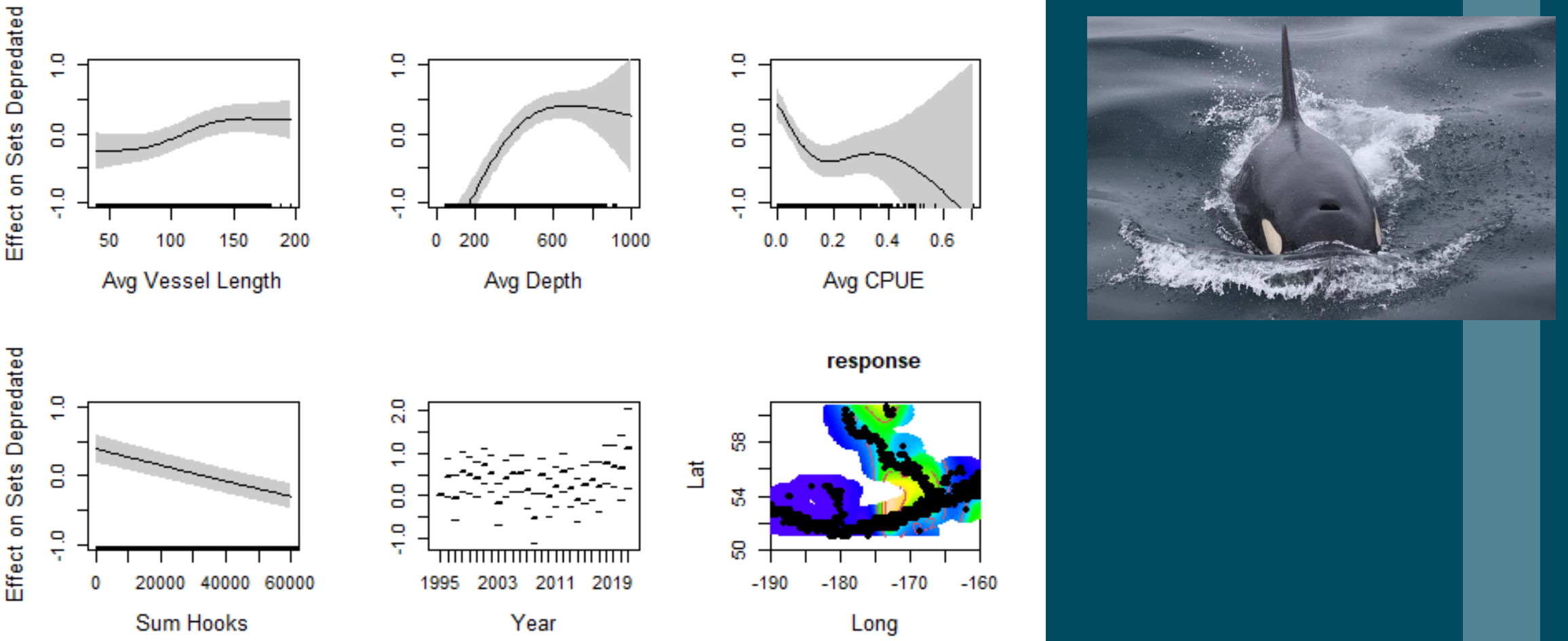






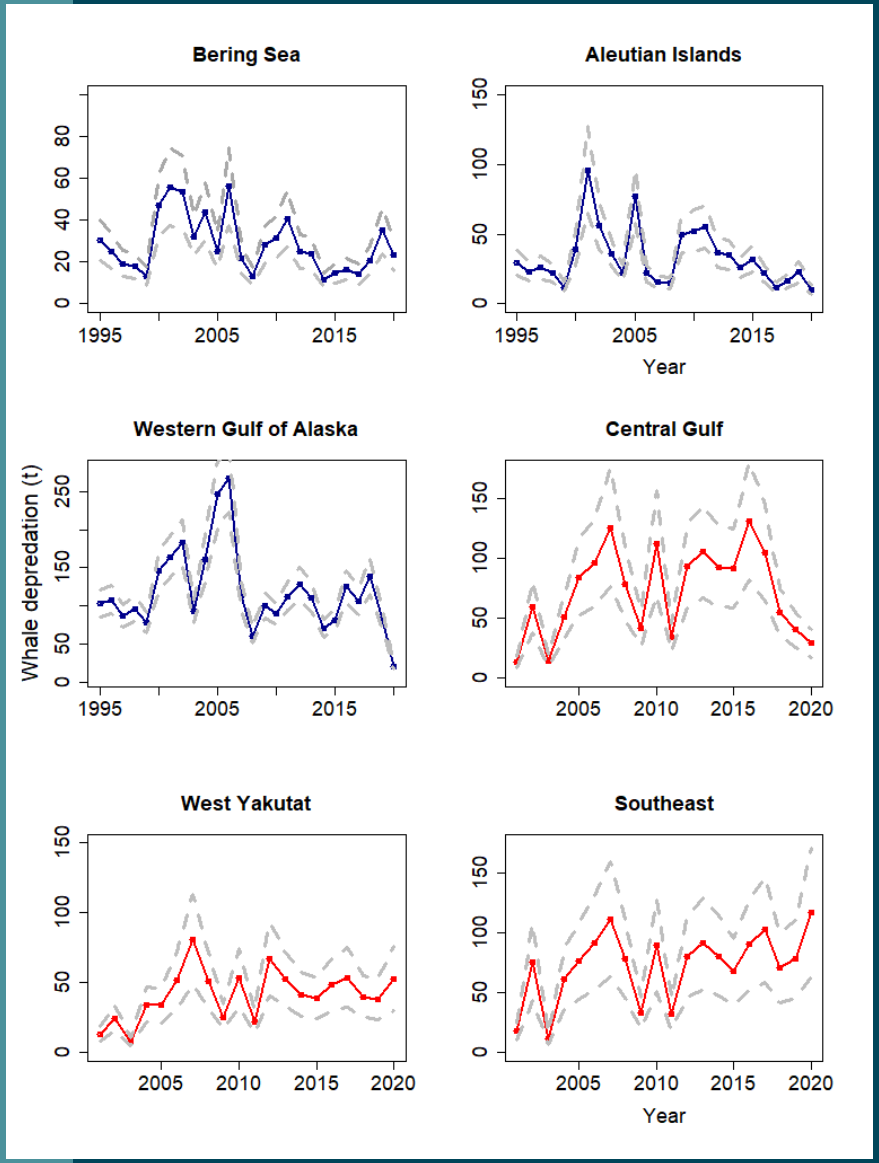


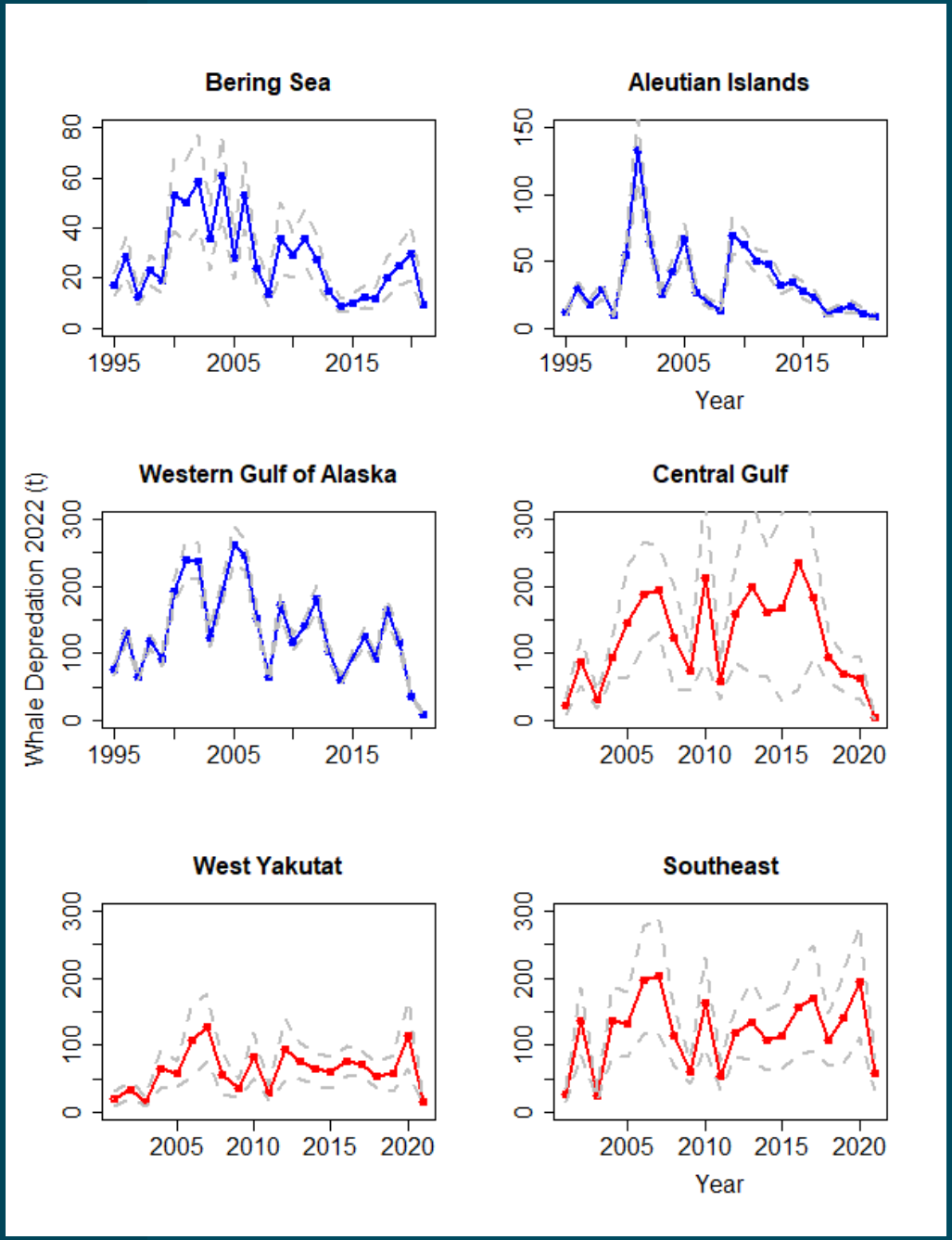
Western Alaska Killer Whale Depredation



c) Sablefish mortality (t) due to whales

2021 SAFE





2022 Updated

SUMMARY

- Updated depredation estimates similar
- Sperm whale depredation coefficient (effect on CPUE) generally increasing over time
- Overall whale effect on sablefish mortality (and stock assessment) remains small
- Limited observer coverage
- Future work: Logbooks? Pot covariate?

Thanks for your time!

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