

Appendix D:

Bycatch in the Groundfish Fisheries for the Tanner Crab Assessment

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Contents

Introduction	2
Estimated total bycatch by gear type	3
Estimated total catch by target type (2009/10-2017/18)	6
Size frequencies from observer sampling	10
Sample sizes	10
Raw size frequencies	10
Expansion factors	15
Total bycatch size compositions	24
Size compositions aggregated over gear type	30
Spatial patterns of bycatch	35

List of Tables

1	Estimated total bycatch of Tanner crab by gear type from the combined CAS/Blend and CIA databases for 1991-2008.	5
2	Bycatch of Tanner crab in the groundfish fisheries, by target type. Biomass is in metric tons, numbers in 1000's of crab. Targets with less than 10 kg bycatch have been dropped.	7
3	Observed bycatch numbers, expanded numbers, and expansion factors from observed size frequencies to total bycatch, by gear type and reporting area.	17

List of Figures

1	Estimated total bycatch abundance, by gear type, from the CAS/Blend and CIA databases for 1991-2017.	3
2	Estimated total bycatch biomass, by gear type, from the CAS/Blend and CIA databases for 1991-2017.	4
3	Bycatch of Tanner crab in the groundfish fisheries, by target type.	6
4	Sample sizes from observer sampling for Tanner crab (> 24 mm CW) bycatch size frequencies in the groundfish fisheries.	10
5	Raw (unscaled) size frequencies by 1-mm size bin from observer sampling for Tanner crab bycatch in the groundfish fisheries.	11

6	Raw (unscaled) size frequencies by 1-mm size bin from observer sampling for Tanner crab bycatch in the groundfish fisheries.	12
7	Raw (unscaled) size frequencies by 1-mm size bin from observer sampling for Tanner crab bycatch in the groundfish fisheries.	13
8	Raw (unscaled) size frequencies by 1-mm size bin from observer sampling for Tanner crab bycatch in the groundfish fisheries.	14
9	Expansion factors from observed size frequencies to total bycatch, by gear type and reporting area.	16
10	Total bycatch size frequencies, by year, gear type and sex.	25
11	Total bycatch size frequencies, by year, gear type and sex.	26
12	Total bycatch size frequencies, by year, gear type and sex.	27
13	Total bycatch size frequencies, by year, gear type and sex.	28
14	Total bycatch size frequencies, by year, gear type and sex. Bubble area scales with catch abundance.	29
15	Total bycatch size frequencies, by year and sex, aggregated over gear type.	31
16	Total bycatch size frequencies, by year and sex, aggregated over gear type.	32
17	Total bycatch size frequencies, by year and sex, aggregated over gear type.	33
18	Total bycatch size frequencies, by year and sex, aggregated over gear type.	34
19	Bycatch of Tanner crab, by ADFG stat area, in the groundfish fisheries during 2009/10.	36
20	Bycatch of Tanner crab, by ADFG stat area, in the groundfish fisheries during 2010/11.	37
21	Bycatch of Tanner crab, by ADFG stat area, in the groundfish fisheries during 2011/12.	38
22	Bycatch of Tanner crab, by ADFG stat area, in the groundfish fisheries during 2012/13.	39
23	Bycatch of Tanner crab, by ADFG stat area, in the groundfish fisheries during 2013/14.	40
24	Bycatch of Tanner crab, by ADFG stat area, in the groundfish fisheries during 2014/15.	41
25	Bycatch of Tanner crab, by ADFG stat area, in the groundfish fisheries during 2015/16.	42
26	Bycatch of Tanner crab, by ADFG stat area, in the groundfish fisheries during 2016/17.	43
27	Bycatch of Tanner crab, by ADFG stat area, in the groundfish fisheries during 2017/18.	44

Introduction

This paper documents the calculations for the annual abundance and biomass time series and the sex-specific size compositions for Tanner crab bycatch in the groundfish fisheries used in the Tanner crab stock assessment model for 1991-2017. Briefly, total bycatch estimates were obtained from AKFIN for 1991-2008 from the NMFS Alaska Regional Office’s (AKRO) Catch Accounting System/Blend database (CAS; Cahalan et al., 2009) and for 2009 to the present from the AKRO’s Catch-in-Areas database (CIA). Annual sampling data for size frequencies of Tanner crab bycatch in the EBS groundfish fisheries was extracted from the NORPAC observer database (via AKFIN) by sex, gear (“trawl” and “fixed”), ADFG stat area and NMFS reporting area. These observed size frequency data were then scaled to total estimated bycatch size compositions using year/gear/area expansion factors based on the annual total bycatch estimates from the CAS and CIA database.

Sex-specific size compositions for Tanner crab bycatch in the groundfish fisheries during 1973-1990 are also incorporated in the assessment model. These size compositions are based on data from the former “joint venture” and foreign fishing fleets, and remain unchanged from the previous assessment.

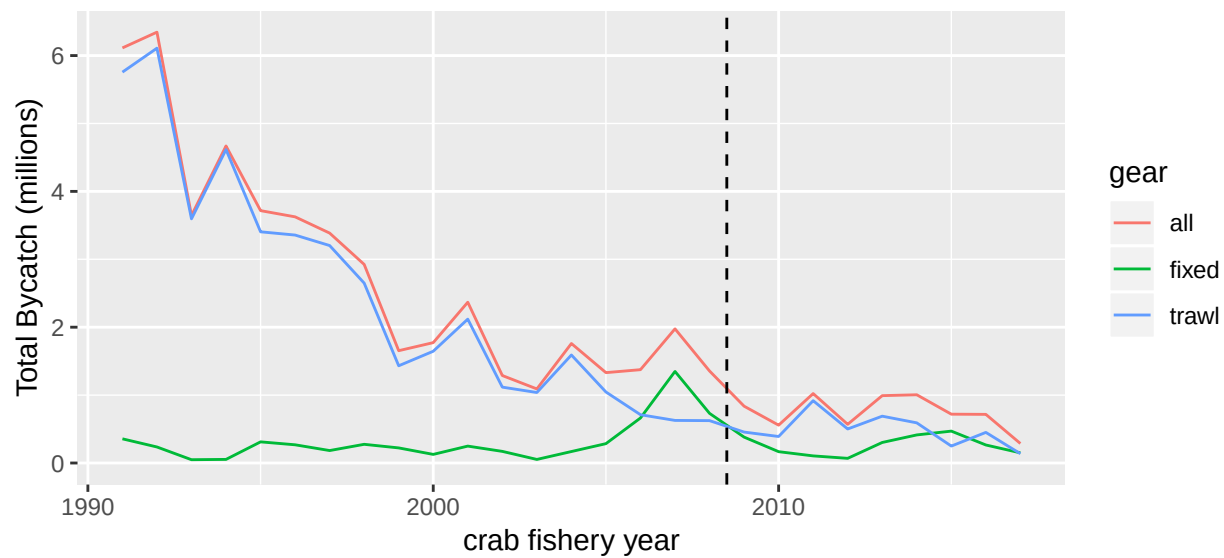


Figure 1: Estimated total bycatch abundance, by gear type, from the CAS/Blend and CIA databases for 1991-2017.

Estimated total bycatch by gear type

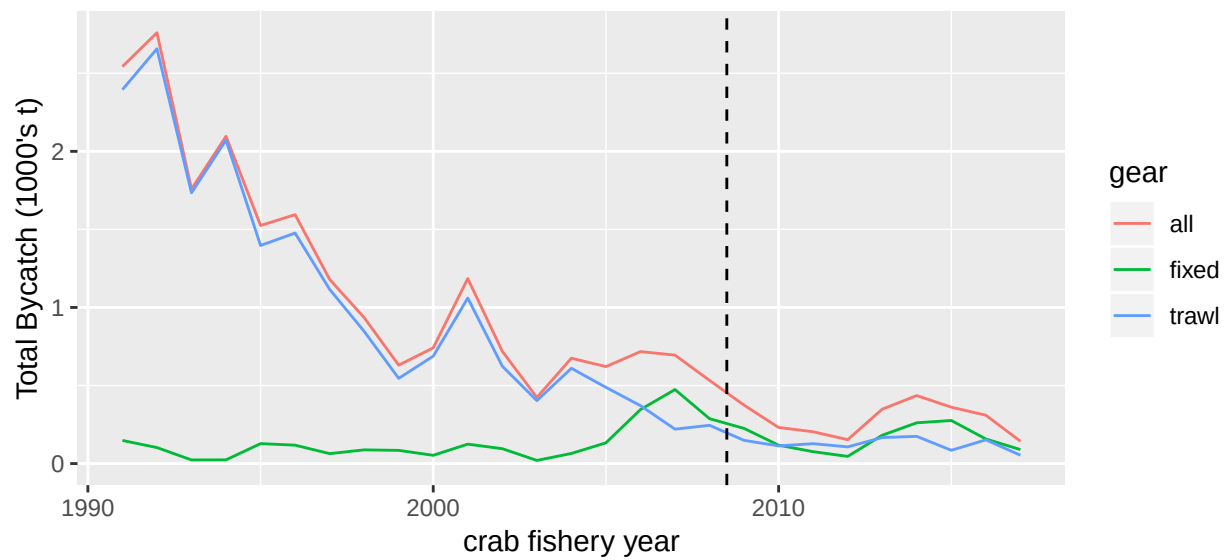


Figure 2: Estimated total bycatch biomass, by gear type, from the CAS/Blend and CIA databases for 1991-2017.

Table 1: Estimated total bycatch of Tanner crab by gear type from the combined CAS/Blend and CIA databases for 1991-2008.

year	all		fixed		trawl	
	num millions	wgt 1000's t	num millions	wgt 1000's t	num millions	wgt 1000's t
1991	6.1125	2.5432	0.35636	0.14827	5.7561	2.39491
1992	6.3447	2.7596	0.23614	0.10271	6.1086	2.65693
1993	3.6442	1.7580	0.04869	0.02349	3.5955	1.73451
1994	4.6688	2.0960	0.05320	0.02388	4.6156	2.07211
1995	3.7164	1.5249	0.31161	0.12786	3.4048	1.39702
1996	3.6250	1.5945	0.26818	0.11796	3.3568	1.47653
1997	3.3856	1.1800	0.18346	0.06394	3.2022	1.11602
1998	2.9243	0.9350	0.27512	0.08797	2.6491	0.84707
1999	1.6541	0.6306	0.22233	0.08476	1.4318	0.54585
2000	1.7727	0.7415	0.12702	0.05313	1.6457	0.68840
2001	2.3674	1.1852	0.24904	0.12467	2.1184	1.06052
2002	1.2882	0.7191	0.17112	0.09552	1.1171	0.62355
2003	1.0908	0.4238	0.05255	0.02042	1.0382	0.40339
2004	1.7598	0.6751	0.16907	0.06486	1.5907	0.61020
2005	1.3309	0.6212	0.28508	0.13306	1.0458	0.48812
2006	1.3743	0.7171	0.66295	0.34594	0.7114	0.37120
2007	1.9757	0.6949	1.34861	0.47437	0.6270	0.22056
2008	1.3552	0.5329	0.73133	0.28755	0.6239	0.24531
2009	0.8369	0.3742	0.38142	0.22535	0.4555	0.14884
2010	0.5573	0.2314	0.16702	0.11789	0.3903	0.11347
2011	1.0228	0.2040	0.10496	0.07636	0.9178	0.12762
2012	0.5698	0.1533	0.06867	0.04608	0.5011	0.10718
2013	0.9919	0.3484	0.30248	0.18155	0.6894	0.16682
2014	1.0050	0.4357	0.41362	0.26133	0.5914	0.17440
2015	0.7191	0.3612	0.46973	0.27596	0.2494	0.08526
2016	0.7162	0.3099	0.26532	0.15768	0.4509	0.15221
2017	0.2869	0.1433	0.14978	0.08964	0.1371	0.05361

Table 2: Bycatch of Tanner crab in the groundfish fisheries, by target type. Biomass is in metric tons, numbers in 1000's of crab. Targets with less than 10 kg bycatch have been dropped.

target	year	vessel count	haul count	biomass (t)	number (1000's)
Alaska Plaice - BSAI	2009	0	0	0.0	0.0
	2010	113	1563	0.6	3.2
	2011	35	563	0.1	0.2
	2012	181	2735	1.7	6.2
	2013	0	0	0.0	0.0
	2014	41	495	2.6	11.2
	2015	84	1452	0.6	2.1
	2016	16	148	1.1	1.8
	2017	293	4215	0.6	1.8
Arrowtooth Flounder	2009	246	9548	0.7	1.3
	2010	252	3555	2.2	3.5
	2011	998	15788	1.0	2.1
	2012	599	11571	0.8	3.4
	2013	1042	21590	1.0	5.0
	2014	734	15528	2.2	8.9
	2015	552	11491	1.7	8.7
	2016	372	6938	1.3	7.1
	2017	198	3430	0.6	2.8
Flathead Sole	2009	1133	23983	15.4	44.6
	2010	1191	22108	15.0	51.7
	2011	496	8408	6.1	41.8
	2012	833	14517	14.6	52.9
	2013	845	15216	19.6	64.2
	2014	865	16919	27.1	92.7
	2015	500	8984	5.9	19.0
	2016	871	18483	6.2	19.0
	2017	944	19757	10.4	26.4
Greenland Turbot - BSAI	2009	0	0	0.0	0.0
	2010	0	0	0.0	0.0
	2011	0	0	0.0	0.0
	2012	0	0	0.0	0.0
	2013	0	0	0.0	0.0
	2014	0	0	0.0	0.0
	2015	0	0	0.0	0.0
	2016	654	8410	0.6	3.6
	2017	393	4127	0.2	1.2
Other Flatfish - BSAI	2009	0	0	0.0	0.0
	2010	16	150	0.1	0.4
	2011	0	0	0.0	0.0
	2012	0	0	0.0	0.0
	2013	0	0	0.0	0.0
	2014	0	0	0.0	0.0
	2015	0	0	0.0	0.0

Pacific Cod	2016	89	791	0.1	0.5
	2017	0	0	0.0	0.0
	2009	10946	376241	243.8	414.2
	2010	11524	261032	129.0	178.8
	2011	14283	437602	84.0	117.6
	2012	14959	452023	50.9	80.7
	2013	19482	388896	186.9	318.9
	2014	18590	427599	270.1	431.1
	2015	17983	572272	282.8	483.0
	2016	16080	425908	161.6	273.7
Pollock - bottom	2017	13079	343706	90.5	151.3
	2009	1132	138860	2.9	5.5
	2010	1651	87126	5.9	14.7
	2011	1467	62223	0.9	4.8
	2012	1222	37912	1.5	7.5
	2013	791	16540	4.2	14.3
	2014	402	22662	2.9	11.3
	2015	364	19261	0.4	1.1
	2016	389	16764	1.5	7.5
	2017	240	21683	0.4	1.4
Pollock - midwater	2009	7520	249359	0.2	0.9
	2010	8297	252803	0.2	2.1
	2011	11584	306397	0.7	1.8
	2012	10130	262878	0.2	1.1
	2013	10399	272557	0.4	1.8
	2014	10554	278796	0.4	1.6
	2015	10074	276591	0.1	0.5
	2016	10818	275690	0.2	0.5
	2017	10306	251555	0.1	0.6
Rock Sole - BSAI	2009	2614	50187	34.8	73.8
	2010	3232	56049	32.0	85.8
	2011	2931	46400	26.4	91.1
	2012	2020	29627	14.7	39.8
	2013	3150	61903	36.5	108.1
	2014	3237	72179	20.8	55.1
	2015	4446	92725	8.9	21.9
	2016	2783	52700	24.0	74.8
	2017	2655	59563	4.7	10.6
Rockfish	2009	23	97	0.1	0.2
	2010	180	2586	0.1	0.5
	2011	0	0	0.0	0.0
	2012	0	0	0.0	0.0
	2013	197	3040	0.1	0.3
	2014	0	0	0.0	0.0
	2015	0	0	0.0	0.0
	2016	0	0	0.0	0.0
	2017	0	0	0.0	0.0
Sablefish	2009	76	128498	0.2	0.4

	2010	67	182129	0.4	0.8
	2011	0	0	0.0	0.0
	2012	0	0	0.0	0.0
	2013	58	61907	0.2	0.3
	2014	0	0	0.0	0.0
	2015	0	0	0.0	0.0
	2016	0	0	0.0	0.0
	2017	151	16875	0.4	0.7
Yellowfin Sole - BSAI	2009	6067	129005	76.0	295.9
	2010	6200	119756	45.8	215.8
	2011	6445	122233	84.8	762.8
	2012	7348	138839	68.9	378.0
	2013	7731	150735	99.3	478.8
	2014	6906	132814	109.6	392.7
	2015	8315	168488	60.5	182.4
	2016	9077	175809	113.2	327.7
	2017	9766	241335	35.2	89.6

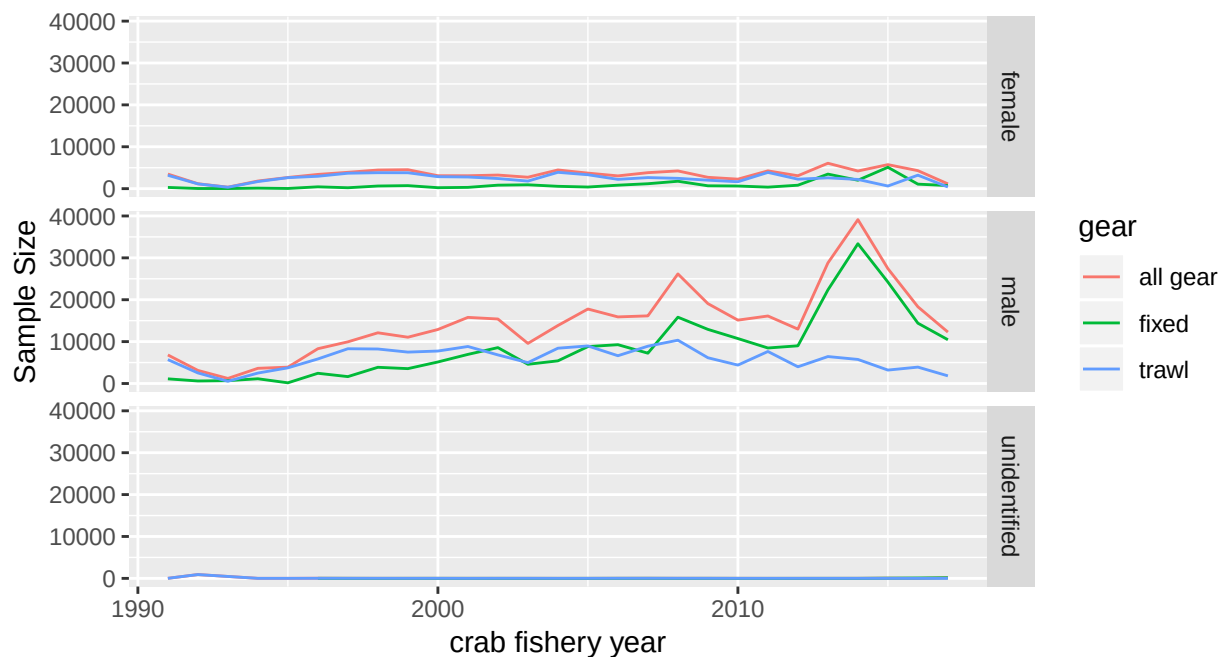


Figure 4: Sample sizes from observer sampling for Tanner crab (> 24 mm CW) bycatch size frequencies in the groundfish fisheries.

Size frequencies from observer sampling

Observers sampled Tanner crab bycatch in the groundfish fisheries to obtain sex and size information starting in 1985. Observer coverage varied by year across target fisheries and gear types, hence “raw” size frequencies are not necessarily directly comparable across these categories. Here, I assume it is valid to aggregate observations across target fisheries and to categorize gear types as “fixed” (longline and pot gear) and “trawl” (pelagic, non-pelagic, and unspecified trawl gear) to obtain annual sex- and gear-specific observed size frequencies by NMFS reporting area.

Sample sizes

Raw size frequencies

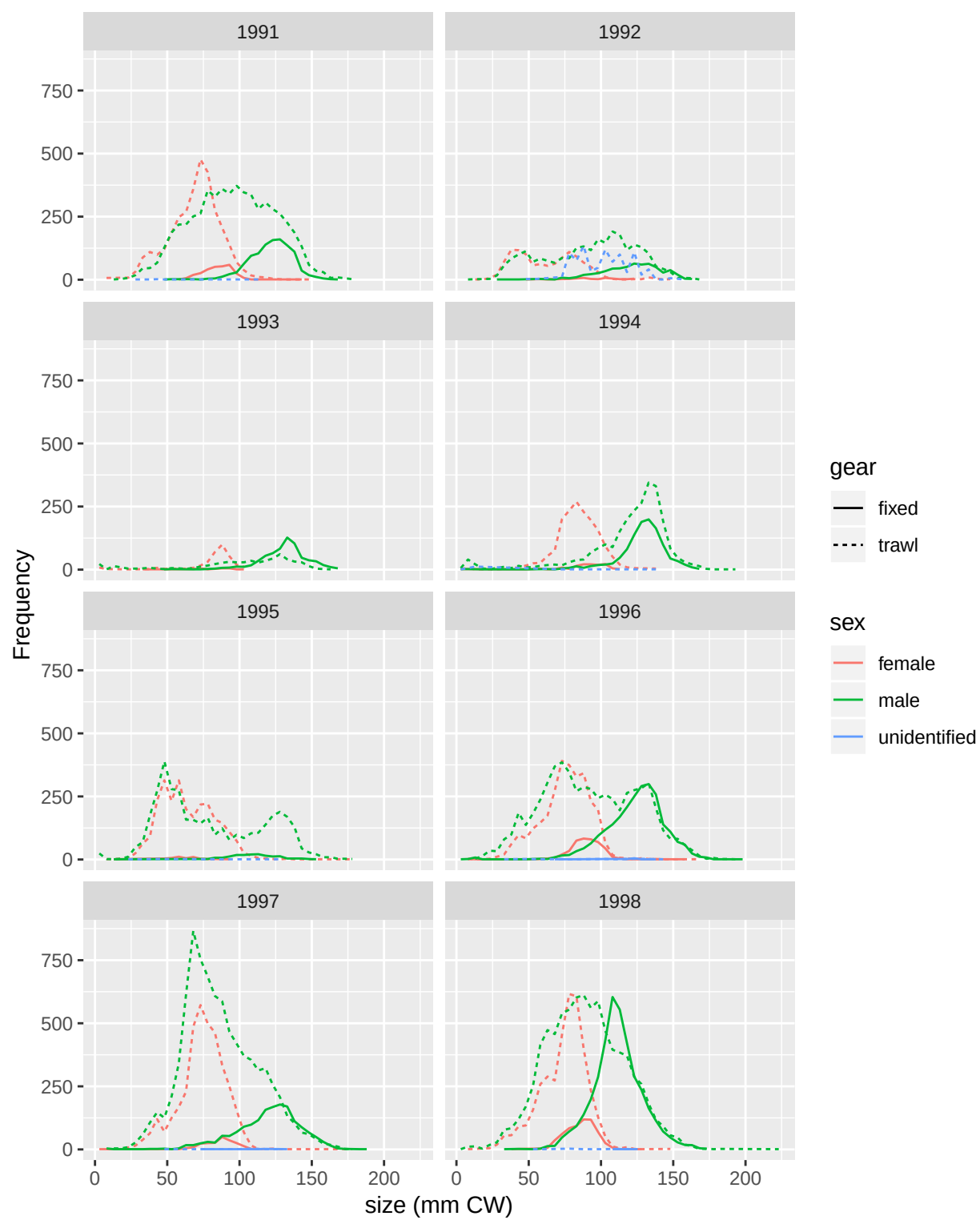


Figure 5: Raw (unscaled) size frequencies by 1-mm size bin from observer sampling for Tanner crab bycatch in the groundfish fisheries.

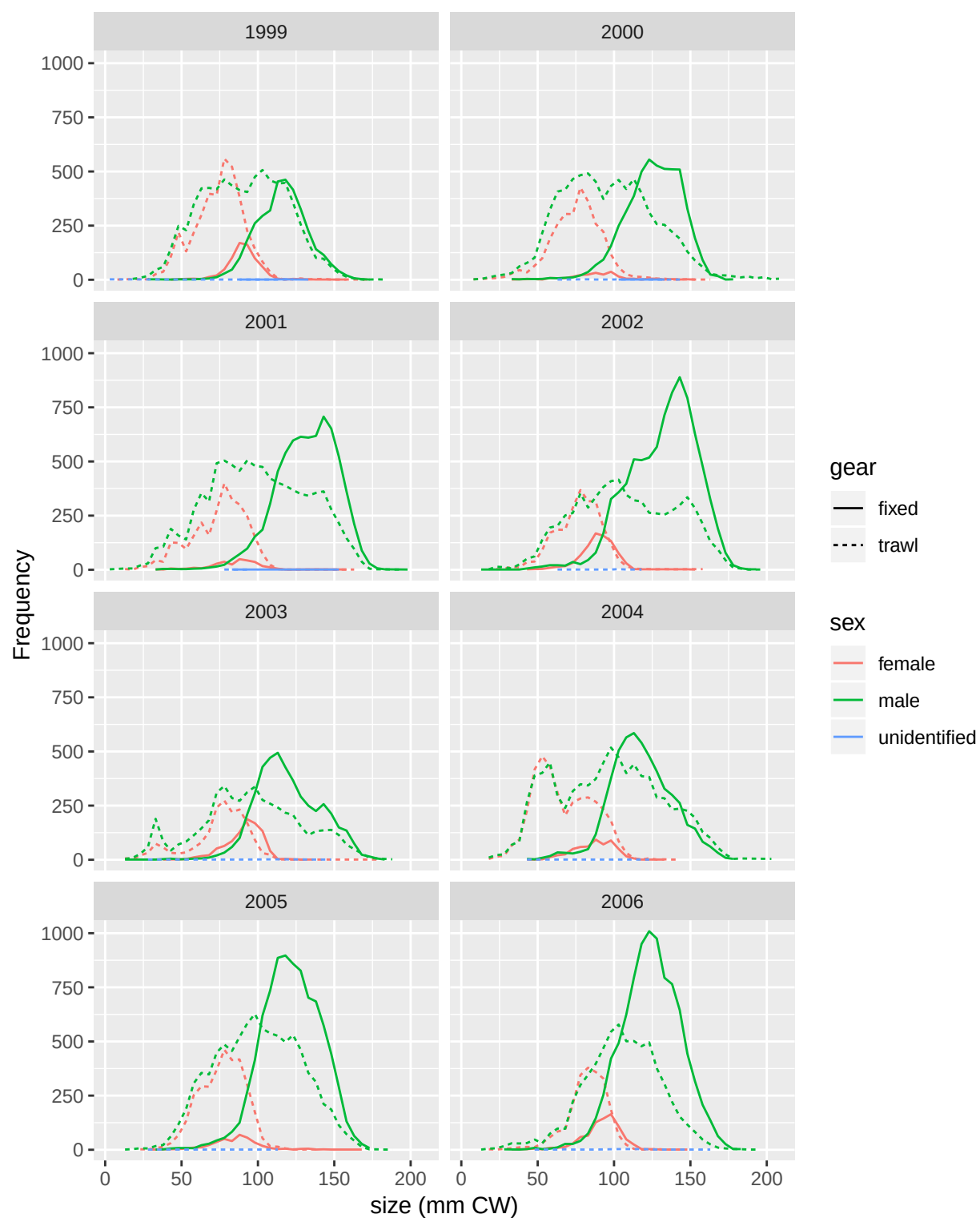


Figure 6: Raw (unscaled) size frequencies by 1-mm size bin from observer sampling for Tanner crab bycatch in the groundfish fisheries.

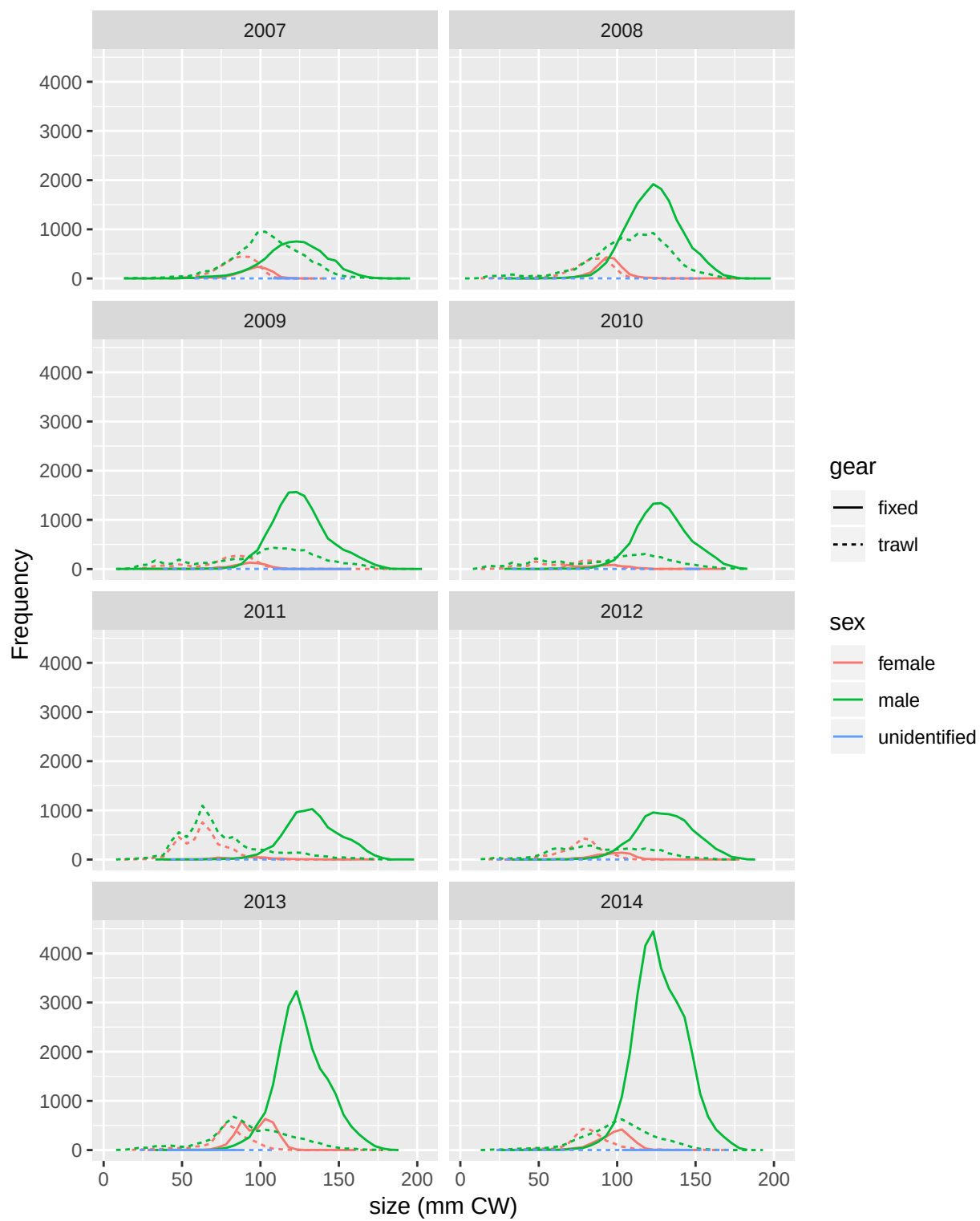


Figure 7: Raw (unscaled) size frequencies by 1-mm size bin from observer sampling for Tanner crab bycatch in the groundfish fisheries.

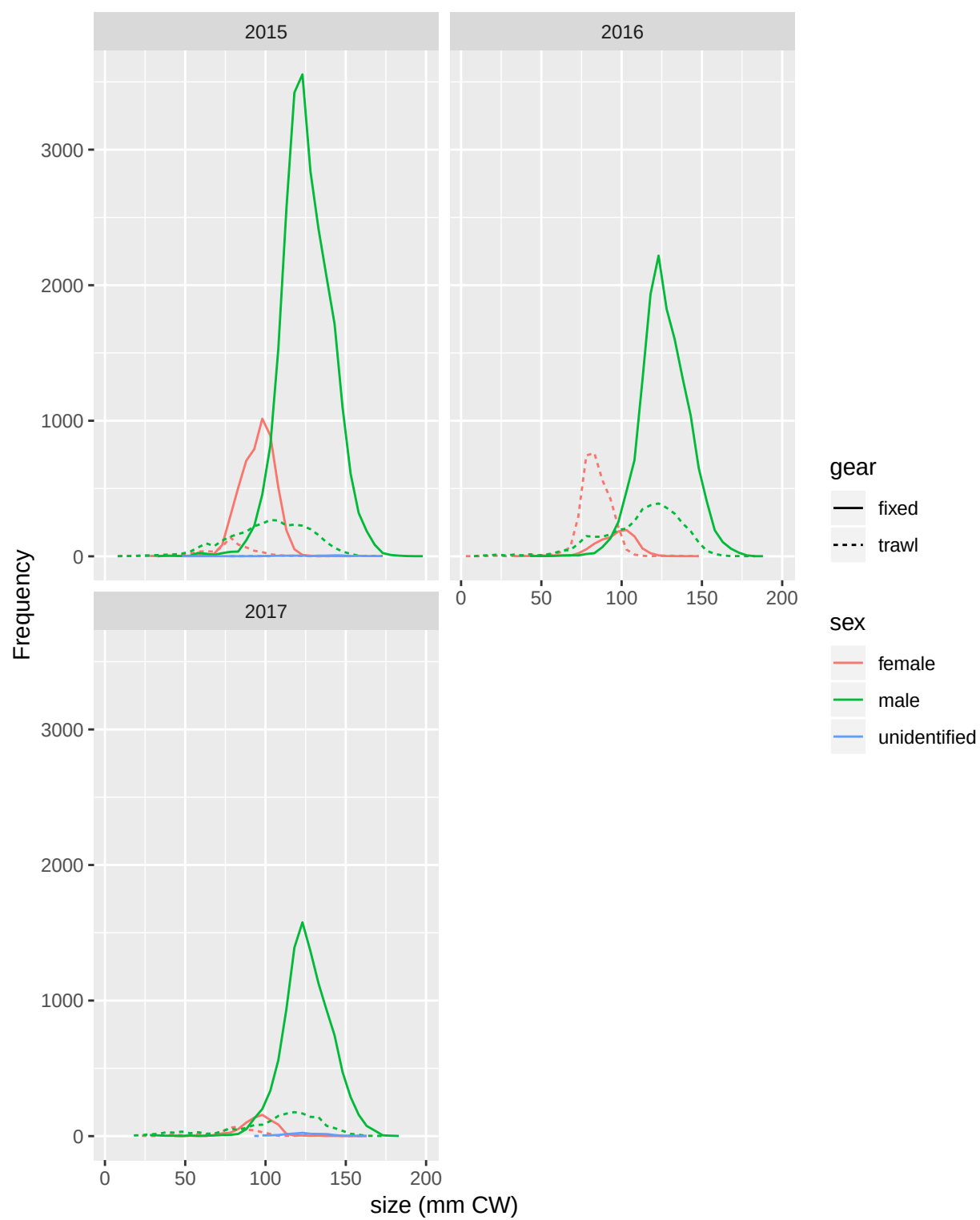


Figure 8: Raw (unscaled) size frequencies by 1-mm size bin from observer sampling for Tanner crab bycatch in the groundfish fisheries.

Expansion factors

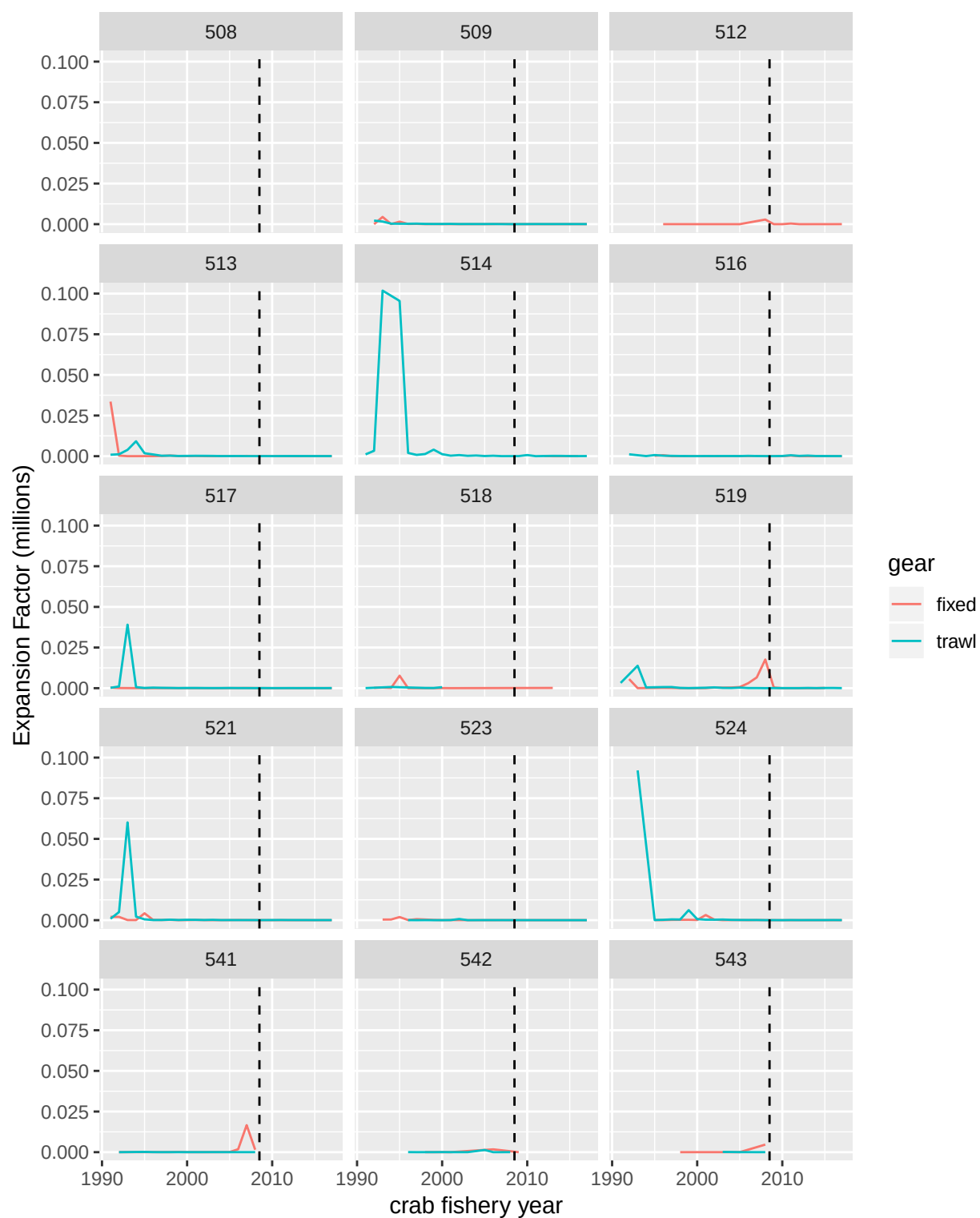


Figure 9: Expansion factors from observed size frequencies to total bycatch, by gear type and reporting area.

Table 3: Observed bycatch numbers, expanded numbers, and expansion factors from observed size frequencies to total bycatch, by gear type and reporting area.

area	year	obs N	fixed		obs N	trawl	
			est N	expansion		est N	expansion
508	1996	3	$3.996e-05$	$1.332e-05$	—	—	—
509	1992	305	$1.489e-03$	$4.882e-06$	436	$9.628e-01$	$2.208e-03$
	1993	2	$8.905e-03$	$4.453e-03$	409	$6.637e-01$	$1.623e-03$
	1994	180	$1.404e-02$	$7.801e-05$	2656	$8.653e-01$	$3.258e-04$
	1995	89	$1.372e-01$	$1.541e-03$	3063	$8.356e-01$	$2.728e-04$
	1996	1384	$1.701e-01$	$1.229e-04$	4759	$1.199e+00$	$2.520e-04$
	1997	504	$9.145e-02$	$1.815e-04$	2232	$7.367e-01$	$3.301e-04$
	1998	2660	$5.631e-02$	$2.117e-05$	4107	$6.712e-01$	$1.634e-04$
	1999	1357	$8.871e-02$	$6.537e-05$	3621	$4.511e-01$	$1.246e-04$
	2000	2536	$4.564e-02$	$1.800e-05$	2680	$3.682e-01$	$1.374e-04$
	2001	4481	$6.574e-02$	$1.467e-05$	3791	$6.565e-01$	$1.732e-04$
	2002	6173	$7.997e-02$	$1.295e-05$	3229	$2.797e-01$	$8.662e-05$
	2003	2483	$2.138e-02$	$8.609e-06$	1549	$1.547e-01$	$9.985e-05$
	2004	2445	$4.681e-02$	$1.915e-05$	2714	$2.417e-01$	$8.904e-05$
	2005	4950	$8.315e-02$	$1.680e-05$	2283	$1.988e-01$	$8.707e-05$
	2006	6097	$2.813e-01$	$4.614e-05$	1716	$1.902e-01$	$1.108e-04$
	2007	4471	$6.707e-01$	$1.500e-04$	2706	$1.210e-01$	$4.471e-05$
	2008	8151	$2.143e-01$	$2.629e-05$	3648	$1.742e-01$	$4.776e-05$
	2009	9320	$1.966e-01$	$2.109e-05$	3203	$1.483e-01$	$4.630e-05$
	2010	6995	$1.120e-01$	$1.601e-05$	2417	$1.526e-01$	$6.314e-05$
	2011	5717	$7.008e-02$	$1.226e-05$	4310	$3.421e-01$	$7.938e-05$
	2012	7647	$5.981e-02$	$7.822e-06$	1234	$8.571e-02$	$6.946e-05$
	2013	21534	$2.660e-01$	$1.235e-05$	4175	$2.828e-01$	$6.773e-05$
	2014	22377	$3.223e-01$	$1.440e-05$	2067	$1.360e-01$	$6.577e-05$
	2015	13162	$2.911e-01$	$2.211e-05$	509	$3.994e-02$	$7.847e-05$
	2016	8505	$2.147e-01$	$2.525e-05$	2389	$1.566e-01$	$6.553e-05$
	2017	4675	$1.086e-01$	$2.324e-05$	598	$3.534e-02$	$5.909e-05$
512	1996	32	$6.925e-04$	$2.164e-05$	—	—	—
	1998	7	$1.640e-04$	$2.343e-05$	—	—	—
	2000	2	$7.685e-06$	$3.843e-06$	—	—	—
	2001	48	$4.364e-04$	$9.092e-06$	—	—	—
	2002	8	$2.089e-05$	$2.611e-06$	—	—	—
	2003	5	$2.143e-05$	$4.286e-06$	—	—	—
	2004	106	$6.108e-04$	$5.762e-06$	—	—	—
	2005	1	$4.931e-07$	$4.931e-07$	—	—	—
	2008	4	$1.142e-02$	$2.855e-03$	—	—	—
	2009	13	$3.312e-05$	$2.547e-06$	—	—	—
	2010	2	$6.836e-06$	$3.418e-06$	—	—	—
	2011	2	$8.076e-04$	$4.038e-04$	—	—	—
	2012	2	$8.272e-06$	$4.136e-06$	—	—	—
	2013	440	$3.071e-03$	$6.980e-06$	—	—	—
	2014	279	$3.712e-03$	$1.331e-05$	—	—	—
	2015	2301	$2.952e-02$	$1.283e-05$	—	—	—

	2016	917	$1.559e-02$	$1.700e-05$	—	—	—
	2017	59	$1.746e-03$	$2.960e-05$	—	—	—
513	1991	1	$3.358e-02$	$3.358e-02$	1749	$1.556e+00$	$8.894e-04$
	1992	63	$2.162e-02$	$3.432e-04$	1694	$2.006e+00$	$1.184e-03$
	1993	161	$3.088e-03$	$1.918e-05$	494	$1.922e+00$	$3.892e-03$
	1994	314	$7.488e-03$	$2.385e-05$	321	$2.950e+00$	$9.191e-03$
	1995	—	—	—	1148	$2.066e+00$	$1.799e-03$
	1996	304	$1.658e-02$	$5.454e-05$	1353	$1.452e+00$	$1.073e-03$
	1997	147	$2.025e-02$	$1.377e-04$	6778	$1.860e+00$	$2.745e-04$
	1998	312	$1.270e-01$	$4.072e-04$	3928	$1.287e+00$	$3.275e-04$
	1999	479	$3.393e-02$	$7.084e-05$	3744	$4.898e-01$	$1.308e-04$
	2000	412	$1.733e-02$	$4.205e-05$	4043	$7.218e-01$	$1.785e-04$
	2001	547	$7.169e-02$	$1.311e-04$	2955	$6.856e-01$	$2.320e-04$
	2002	296	$9.485e-03$	$3.204e-05$	1779	$3.666e-01$	$2.061e-04$
	2003	2052	$1.156e-02$	$5.636e-06$	1197	$1.947e-01$	$1.627e-04$
	2004	2155	$5.926e-02$	$2.750e-05$	1513	$1.158e-01$	$7.652e-05$
	2005	1528	$6.635e-02$	$4.342e-05$	3277	$2.580e-01$	$7.873e-05$
	2006	1929	$8.681e-02$	$4.500e-05$	1377	$1.614e-01$	$1.172e-04$
	2007	1276	$1.765e-01$	$1.383e-04$	1933	$1.029e-01$	$5.323e-05$
	2008	1602	$6.240e-02$	$3.895e-05$	2726	$1.400e-01$	$5.134e-05$
	2009	1384	$9.890e-02$	$7.146e-05$	1979	$1.303e-01$	$6.584e-05$
	2010	1103	$2.936e-02$	$2.662e-05$	1333	$6.849e-02$	$5.138e-05$
	2011	385	$2.892e-03$	$7.511e-06$	6270	$4.828e-01$	$7.700e-05$
	2012	257	$9.284e-04$	$3.613e-06$	1900	$1.609e-01$	$8.466e-05$
	2013	809	$1.788e-03$	$2.211e-06$	2589	$2.131e-01$	$8.229e-05$
	2014	2534	$1.830e-02$	$7.223e-06$	3198	$2.376e-01$	$7.431e-05$
	2015	5213	$1.960e-02$	$3.761e-06$	1599	$9.455e-02$	$5.913e-05$
	2016	3368	$8.555e-03$	$2.540e-06$	2466	$1.671e-01$	$6.777e-05$
	2017	2234	$8.176e-03$	$3.660e-06$	966	$6.313e-02$	$6.535e-05$
514	1991	—	—	—	949	$1.056e+00$	$1.113e-03$
	1992	—	—	—	286	$9.474e-01$	$3.312e-03$
	1993	—	—	—	4	$4.074e-01$	$1.018e-01$
	1995	—	—	—	2	$1.910e-01$	$9.550e-02$
	1996	—	—	—	26	$5.177e-02$	$1.991e-03$
	1997	—	—	—	29	$2.299e-02$	$7.927e-04$
	1998	—	—	—	23	$3.045e-02$	$1.324e-03$
	1999	—	—	—	18	$7.241e-02$	$4.023e-03$
	2000	—	—	—	32	$3.995e-02$	$1.249e-03$
	2001	—	—	—	14	$4.325e-03$	$3.089e-04$
	2002	—	—	—	73	$4.944e-02$	$6.772e-04$
	2003	—	—	—	549	$1.172e-01$	$2.135e-04$
	2004	—	—	—	1470	$6.126e-01$	$4.167e-04$
	2005	—	—	—	321	$2.618e-02$	$8.157e-05$
	2006	—	—	—	4	$1.063e-03$	$2.658e-04$
	2007	—	—	—	921	$3.217e-02$	$3.493e-05$
	2008	—	—	—	233	$1.076e-02$	$4.619e-05$
	2009	—	—	—	10	$6.687e-04$	$6.687e-05$
	2010	—	—	—	2	$1.372e-03$	$6.860e-04$

	2011	—	—	—	5	$7.568e-05$	$1.514e-05$
	2012	1	$1.326e-04$	$1.326e-04$	51	$5.723e-03$	$1.122e-04$
	2013	2	$2.982e-05$	$1.491e-05$	24	$4.440e-03$	$1.850e-04$
	2014	39	$2.308e-04$	$5.919e-06$	260	$4.463e-02$	$1.717e-04$
	2015	156	$3.885e-04$	$2.491e-06$	1105	$8.002e-02$	$7.241e-05$
	2016	13	$9.698e-05$	$7.460e-06$	541	$2.912e-02$	$5.383e-05$
	2017	—	—	—	84	$7.489e-03$	$8.915e-05$
516	1992	—	—	—	54	$6.211e-02$	$1.150e-03$
	1994	—	—	—	317	$1.922e-02$	$6.062e-05$
	1995	76	$1.815e-02$	$2.388e-04$	36	$2.493e-02$	$6.925e-04$
	1996	2	$1.178e-03$	$5.891e-04$	32	$9.490e-03$	$2.966e-04$
	1997	259	$3.166e-03$	$1.222e-05$	288	$5.480e-02$	$1.903e-04$
	1998	81	$9.606e-04$	$1.186e-05$	709	$8.461e-02$	$1.193e-04$
	1999	29	$1.338e-04$	$4.612e-06$	1	$6.425e-05$	$6.425e-05$
	2000	42	$4.031e-04$	$9.599e-06$	284	$1.508e-02$	$5.310e-05$
	2001	263	$1.836e-03$	$6.979e-06$	389	$4.163e-02$	$1.070e-04$
	2002	119	$1.067e-03$	$8.969e-06$	551	$4.006e-02$	$7.270e-05$
	2003	16	$1.536e-04$	$9.602e-06$	333	$3.784e-02$	$1.136e-04$
	2004	87	$1.400e-03$	$1.609e-05$	309	$3.064e-02$	$9.916e-05$
	2005	43	$2.826e-04$	$6.572e-06$	102	$7.739e-03$	$7.587e-05$
	2006	74	$8.627e-03$	$1.166e-04$	54	$1.107e-02$	$2.050e-04$
	2007	21	$2.447e-03$	$1.165e-04$	125	$1.113e-02$	$8.905e-05$
	2008	383	$1.632e-03$	$4.262e-06$	121	$5.746e-03$	$4.749e-05$
	2009	126	$5.162e-04$	$4.097e-06$	382	$2.016e-02$	$5.278e-05$
	2010	12	$4.288e-04$	$3.573e-05$	90	$1.142e-02$	$1.269e-04$
	2011	8	$2.655e-03$	$3.318e-04$	20	$1.100e-02$	$5.501e-04$
	2012	219	$1.148e-03$	$5.240e-06$	17	$2.719e-03$	$1.599e-04$
	2013	728	$3.117e-03$	$4.281e-06$	155	$5.335e-02$	$3.442e-04$
	2014	4776	$3.205e-02$	$6.710e-06$	169	$1.679e-02$	$9.932e-05$
	2015	4330	$7.023e-02$	$1.622e-05$	133	$1.116e-02$	$8.395e-05$
	2016	143	$5.995e-04$	$4.192e-06$	78	$5.240e-03$	$6.718e-05$
	2017	1187	$3.711e-03$	$3.127e-06$	40	$1.936e-03$	$4.840e-05$
517	1991	340	$1.148e-01$	$3.377e-04$	1990	$4.821e-01$	$2.422e-04$
	1992	149	$1.070e-02$	$7.185e-05$	789	$8.216e-01$	$1.041e-03$
	1993	170	$7.590e-03$	$4.465e-05$	5	$1.953e-01$	$3.907e-02$
	1994	405	$1.003e-02$	$2.476e-05$	860	$5.595e-01$	$6.506e-04$
	1995	—	—	—	1462	$1.924e-01$	$1.316e-04$
	1996	628	$1.495e-02$	$2.381e-05$	1533	$5.283e-01$	$3.446e-04$
	1997	464	$1.562e-02$	$3.365e-05$	2189	$4.890e-01$	$2.234e-04$
	1998	345	$1.823e-02$	$5.284e-05$	2414	$3.692e-01$	$1.529e-04$
	1999	484	$1.286e-02$	$2.656e-05$	2802	$2.072e-01$	$7.395e-05$
	2000	1271	$1.603e-02$	$1.261e-05$	3152	$4.054e-01$	$1.286e-04$
	2001	1364	$3.384e-02$	$2.481e-05$	1505	$1.862e-01$	$1.237e-04$
	2002	1435	$1.856e-02$	$1.293e-05$	934	$8.565e-02$	$9.170e-05$
	2003	436	$2.494e-03$	$5.720e-06$	1087	$7.370e-02$	$6.780e-05$
	2004	673	$6.313e-03$	$9.380e-06$	2721	$2.131e-01$	$7.830e-05$
	2005	1725	$7.832e-02$	$4.540e-05$	1142	$1.335e-01$	$1.169e-04$
	2006	1200	$7.915e-02$	$6.596e-05$	1172	$8.737e-02$	$7.455e-05$

	2007	1097	$1.081e-01$	$9.856e-05$	2454	$1.484e-01$	$6.047e-05$
	2008	4229	$2.322e-01$	$5.491e-05$	3116	$1.521e-01$	$4.881e-05$
	2009	1467	$5.084e-02$	$3.466e-05$	890	$6.612e-02$	$7.429e-05$
	2010	1970	$2.030e-02$	$1.030e-05$	803	$4.123e-02$	$5.135e-05$
	2011	2105	$1.592e-02$	$7.562e-06$	351	$1.968e-02$	$5.606e-05$
	2012	966	$3.620e-03$	$3.748e-06$	642	$4.645e-02$	$7.236e-05$
	2013	1287	$2.410e-02$	$1.872e-05$	412	$1.897e-02$	$4.605e-05$
	2014	1973	$1.483e-02$	$7.518e-06$	674	$4.635e-02$	$6.877e-05$
	2015	2836	$5.141e-02$	$1.813e-05$	170	$1.072e-02$	$6.309e-05$
	2016	1039	$2.069e-02$	$1.991e-05$	694	$3.505e-02$	$5.050e-05$
	2017	475	$9.872e-03$	$2.078e-05$	189	$1.432e-02$	$7.576e-05$
518	1991	—	—	—	7	$3.656e-04$	$5.223e-05$
	1992	14	$2.840e-03$	$2.029e-04$	—	—	—
	1993	1	$3.340e-04$	$3.340e-04$	—	—	—
	1994	11	$1.595e-03$	$1.450e-04$	11	$8.027e-03$	$7.297e-04$
	1995	1	$7.681e-03$	$7.681e-03$	—	—	—
	1996	189	$1.069e-03$	$5.655e-06$	—	—	—
	1997	80	$7.847e-04$	$9.809e-06$	—	—	—
	1998	257	$1.947e-03$	$7.576e-06$	7	$9.907e-04$	$1.415e-04$
	1999	295	$2.825e-03$	$9.575e-06$	1	$1.178e-04$	$1.178e-04$
	2000	2	$1.086e-04$	$5.432e-05$	1	$6.279e-04$	$6.279e-04$
	2001	7	$6.124e-05$	$8.749e-06$	—	—	—
	2002	3	$5.678e-05$	$1.893e-05$	—	—	—
	2003	1	$3.198e-05$	$3.198e-05$	—	—	—
	2013	3	$4.346e-04$	$1.449e-04$	—	—	—
519	1991	—	—	—	1	$3.230e-03$	$3.230e-03$
	1992	1	$5.590e-03$	$5.590e-03$	—	—	—
	1993	11	$3.215e-04$	$2.922e-05$	1	$1.380e-02$	$1.380e-02$
	1994	—	—	—	11	$5.127e-03$	$4.661e-04$
	1996	7	$1.278e-03$	$1.826e-04$	4	$2.737e-03$	$6.842e-04$
	1997	157	$2.234e-02$	$1.423e-04$	3	$2.139e-03$	$7.131e-04$
	1998	457	$1.385e-02$	$3.030e-05$	112	$1.889e-02$	$1.686e-04$
	1999	314	$3.624e-03$	$1.154e-05$	516	$2.903e-02$	$5.627e-05$
	2000	150	$1.240e-03$	$8.269e-06$	15	$2.357e-03$	$1.572e-04$
	2001	130	$6.717e-03$	$5.167e-05$	45	$1.153e-02$	$2.563e-04$
	2002	44	$1.687e-02$	$3.835e-04$	20	$9.892e-03$	$4.946e-04$
	2003	37	$1.135e-02$	$3.069e-04$	81	$1.479e-02$	$1.826e-04$
	2004	99	$3.949e-02$	$3.989e-04$	175	$1.988e-02$	$1.136e-04$
	2005	47	$3.284e-02$	$6.988e-04$	21	$7.475e-03$	$3.559e-04$
	2006	41	$1.259e-01$	$3.071e-03$	20	$1.442e-03$	$7.210e-05$
	2007	39	$2.580e-01$	$6.616e-03$	39	$3.233e-03$	$8.290e-05$
	2008	8	$1.410e-01$	$1.763e-02$	27	$4.533e-04$	$1.679e-05$
	2009	5	$1.863e-03$	$3.727e-04$	4	$3.281e-04$	$8.202e-05$
	2010	201	$6.605e-04$	$3.286e-06$	10	$5.612e-04$	$5.612e-05$
	2011	—	—	—	10	$3.908e-04$	$3.908e-05$
	2012	18	$4.140e-04$	$2.300e-05$	5	$1.882e-04$	$3.764e-05$
	2013	11	$1.120e-04$	$1.018e-05$	3	$3.814e-04$	$1.271e-04$
	2014	83	$7.485e-04$	$9.018e-06$	2	$8.963e-05$	$4.481e-05$

521	2015	17	$2.520e-03$	$1.482e-04$	3	$3.649e-04$	$1.216e-04$
	2016	—	—	—	2	$2.520e-04$	$1.260e-04$
	2017	—	—	—	4	$1.615e-04$	$4.037e-05$
	1991	102	$2.080e-01$	$2.039e-03$	2985	$2.659e+00$	$8.908e-04$
	1992	96	$1.939e-01$	$2.020e-03$	263	$1.309e+00$	$4.977e-03$
	1993	361	$2.768e-02$	$7.669e-05$	5	$3.007e-01$	$6.014e-02$
	1994	348	$1.905e-02$	$5.475e-05$	96	$2.081e-01$	$2.167e-03$
	1995	34	$1.443e-01$	$4.243e-03$	86	$4.434e-02$	$5.155e-04$
	1996	323	$6.127e-02$	$1.897e-04$	942	$7.360e-02$	$7.814e-05$
	1997	257	$2.813e-02$	$1.095e-04$	306	$3.163e-02$	$1.034e-04$
523	1998	219	$4.598e-02$	$2.100e-04$	574	$1.712e-01$	$2.982e-04$
	1999	896	$2.442e-02$	$2.726e-05$	489	$4.863e-02$	$9.945e-05$
	2000	844	$4.507e-02$	$5.340e-05$	267	$6.328e-02$	$2.370e-04$
	2001	357	$5.847e-02$	$1.638e-04$	2335	$4.745e-01$	$2.032e-04$
	2002	1267	$3.077e-02$	$2.428e-05$	2222	$2.358e-01$	$1.061e-04$
	2003	401	$4.275e-03$	$1.066e-05$	1583	$3.241e-01$	$2.047e-04$
	2004	259	$6.905e-03$	$2.666e-05$	1990	$1.167e-01$	$5.864e-05$
	2005	840	$2.025e-02$	$2.411e-05$	4804	$3.875e-01$	$8.066e-05$
	2006	697	$6.237e-02$	$8.949e-05$	4410	$2.525e-01$	$5.726e-05$
	2007	1443	$6.147e-02$	$4.260e-05$	3186	$1.964e-01$	$6.164e-05$
	2008	3036	$5.529e-02$	$1.821e-05$	2900	$1.378e-01$	$4.751e-05$
	2009	1081	$2.863e-02$	$2.648e-05$	1770	$8.889e-02$	$5.022e-05$
	2010	1013	$4.063e-03$	$4.010e-06$	1510	$1.142e-01$	$7.564e-05$
	2011	558	$1.238e-02$	$2.218e-05$	603	$6.132e-02$	$1.017e-04$
	2012	671	$2.441e-03$	$3.638e-06$	2450	$1.987e-01$	$8.112e-05$
	2013	980	$3.562e-03$	$3.635e-06$	1741	$1.154e-01$	$6.628e-05$
	2014	3269	$2.126e-02$	$6.504e-06$	1599	$1.099e-01$	$6.875e-05$
	2015	1212	$4.567e-03$	$3.769e-06$	293	$1.016e-02$	$3.469e-05$
	2016	1383	$4.320e-03$	$3.123e-06$	969	$5.479e-02$	$5.654e-05$
	2017	2447	$1.689e-02$	$6.903e-06$	350	$1.451e-02$	$4.147e-05$
	1993	2	$7.714e-04$	$3.857e-04$	—	—	—
	1994	2	$8.094e-04$	$4.047e-04$	—	—	—
	1995	2	$3.853e-03$	$1.927e-03$	—	—	—
	1996	9	$6.724e-04$	$7.471e-05$	6	$2.666e-04$	$4.444e-05$
	1997	2	$1.235e-03$	$6.177e-04$	25	$1.190e-04$	$4.759e-06$
	1998	4	$1.608e-03$	$4.021e-04$	16	$5.474e-04$	$3.421e-05$
	1999	9	$1.496e-03$	$1.662e-04$	2	$1.177e-05$	$5.885e-06$
	2000	7	$4.005e-04$	$5.721e-05$	1	$2.190e-06$	$2.190e-06$
	2001	6	$4.033e-04$	$6.722e-05$	6	$3.365e-04$	$5.609e-05$
	2002	2	$9.749e-05$	$4.875e-05$	1	$7.258e-04$	$7.258e-04$
	2003	4	$4.311e-05$	$1.078e-05$	1	$3.132e-06$	$3.132e-06$
	2004	7	$8.509e-05$	$1.216e-05$	—	—	—
	2005	17	$2.906e-04$	$1.709e-05$	1	$4.040e-05$	$4.040e-05$
	2006	12	$1.826e-04$	$1.521e-05$	—	—	—
	2007	4	$1.026e-04$	$2.566e-05$	—	—	—
	2008	6	$1.031e-04$	$1.719e-05$	—	—	—
	2009	7	$9.055e-05$	$1.294e-05$	—	—	—
	2010	29	$4.350e-05$	$1.500e-06$	—	—	—

	2011	21	$1.275e-04$	$6.072e-06$	—	—	—
	2012	18	$9.006e-05$	$5.003e-06$	—	—	—
	2013	10	$1.651e-04$	$1.651e-05$	—	—	—
	2014	12	$6.043e-05$	$5.036e-06$	—	—	—
	2015	4	$6.020e-05$	$1.505e-05$	—	—	—
	2016	1	$1.999e-05$	$1.999e-05$	—	—	—
	2017	2	$1.227e-05$	$6.136e-06$	1	$9.721e-07$	$9.721e-07$
524	1993	—	—	—	1	$9.212e-02$	$9.212e-02$
	1995	6	$4.832e-04$	$8.053e-05$	605	$4.890e-02$	$8.082e-05$
	1996	15	$3.624e-04$	$2.416e-05$	162	$3.613e-02$	$2.230e-04$
	1997	3	$4.883e-04$	$1.628e-04$	5	$2.463e-03$	$4.926e-04$
	1998	43	$8.583e-03$	$1.996e-04$	25	$1.059e-02$	$4.235e-04$
	1999	39	$8.621e-03$	$2.211e-04$	21	$1.297e-01$	$6.179e-03$
	2000	1	$1.124e-04$	$1.124e-04$	38	$2.434e-02$	$6.404e-04$
	2001	3	$9.523e-03$	$3.174e-03$	142	$4.375e-02$	$3.081e-04$
	2002	38	$1.415e-02$	$3.723e-04$	132	$3.761e-02$	$2.849e-04$
	2003	76	$1.215e-03$	$1.599e-05$	285	$1.134e-01$	$3.977e-04$
	2004	140	$8.143e-03$	$5.816e-05$	1433	$2.379e-01$	$1.660e-04$
	2005	51	$3.458e-03$	$6.780e-05$	196	$2.312e-02$	$1.180e-04$
	2006	34	$5.444e-04$	$1.601e-05$	50	$5.294e-03$	$1.059e-04$
	2007	57	$4.737e-03$	$8.310e-05$	116	$1.088e-02$	$9.376e-05$
	2008	178	$2.180e-03$	$1.225e-05$	63	$1.560e-03$	$2.476e-05$
	2009	196	$3.977e-03$	$2.029e-05$	19	$6.764e-04$	$3.560e-05$
	2010	20	$1.420e-04$	$7.098e-06$	36	$3.655e-04$	$1.015e-05$
	2011	36	$1.072e-04$	$2.977e-06$	7	$4.352e-04$	$6.217e-05$
	2012	15	$7.533e-05$	$5.022e-06$	19	$6.833e-04$	$3.596e-05$
	2013	20	$9.159e-05$	$4.580e-06$	19	$1.031e-03$	$5.428e-05$
	2014	44	$1.371e-04$	$3.115e-06$	—	—	—
	2015	93	$3.482e-04$	$3.745e-06$	44	$2.470e-03$	$5.613e-05$
	2016	107	$7.355e-04$	$6.874e-06$	33	$2.758e-03$	$8.358e-05$
	2017	91	$7.223e-04$	$7.937e-06$	6	$2.290e-04$	$3.817e-05$
541	1992	12	$0.000e+00$	$0.000e+00$	155	$5.679e-06$	$3.664e-08$
	1994	6	$1.824e-04$	$3.040e-05$	—	—	—
	1995	—	—	—	11	$1.799e-03$	$1.635e-04$
	1996	—	—	—	66	$3.179e-03$	$4.817e-05$
	1997	—	—	—	127	$1.954e-03$	$1.539e-05$
	1998	21	$2.224e-04$	$1.059e-05$	182	$4.956e-03$	$2.723e-05$
	1999	367	$4.570e-02$	$1.245e-04$	101	$3.512e-03$	$3.477e-05$
	2000	16	$9.806e-05$	$6.129e-06$	135	$4.225e-03$	$3.129e-05$
	2001	41	$2.627e-04$	$6.407e-06$	483	$1.395e-02$	$2.888e-05$
	2002	18	$7.918e-05$	$4.399e-06$	326	$1.159e-02$	$3.556e-05$
	2003	2	$1.849e-05$	$9.247e-06$	193	$7.128e-03$	$3.693e-05$
	2004	2	$4.974e-05$	$2.487e-05$	47	$1.565e-03$	$3.330e-05$
	2005	2	$1.313e-04$	$6.563e-05$	127	$1.329e-03$	$1.046e-05$
	2006	9	$1.631e-02$	$1.812e-03$	53	$8.119e-04$	$1.532e-05$
	2007	4	$6.647e-02$	$1.662e-02$	89	$8.771e-04$	$9.854e-06$
	2008	4	$6.125e-03$	$1.531e-03$	92	$1.070e-03$	$1.163e-05$
542	1996	—	—	—	1	$4.647e-05$	$4.647e-05$

	1997	—	—	—	28	$2.042e-04$	$7.291e-06$
	1998	89	$2.007e-04$	$2.255e-06$	4	$4.094e-05$	$1.023e-05$
	1999	3	$1.928e-05$	$6.428e-06$	6	$9.961e-05$	$1.660e-05$
	2000	62	$1.927e-04$	$3.108e-06$	9	$4.938e-04$	$5.487e-05$
	2001	3	$2.447e-05$	$8.156e-06$	4	$5.519e-05$	$1.380e-05$
	2003	—	—	—	1	$1.878e-05$	$1.878e-05$
	2005	—	—	—	1	$1.349e-03$	$1.349e-03$
	2006	1	$1.732e-03$	$1.732e-03$	10	$5.294e-05$	$5.294e-06$
	2007	—	—	—	2	$8.540e-06$	$4.270e-06$
	2008	—	—	—	3	$1.040e-04$	$3.468e-05$
	2009	2	$3.968e-07$	$1.984e-07$	—	—	—
543	1998	2	$1.176e-05$	$5.881e-06$	—	—	—
	2000	26	$3.906e-04$	$1.502e-05$	—	—	—
	2001	3	$2.986e-05$	$9.952e-06$	—	—	—
	2003	—	—	—	4	$6.609e-04$	$1.652e-04$
	2004	—	—	—	10	$9.089e-04$	$9.089e-05$
	2005	1	$4.439e-06$	$4.439e-06$	27	$8.098e-04$	$2.999e-05$
	2006	—	—	—	6	$1.870e-04$	$3.117e-05$
	2007	—	—	—	13	$1.090e-04$	$8.387e-06$
	2008	1	$4.661e-03$	$4.661e-03$	12	$1.653e-04$	$1.377e-05$

Total bycatch size compositions

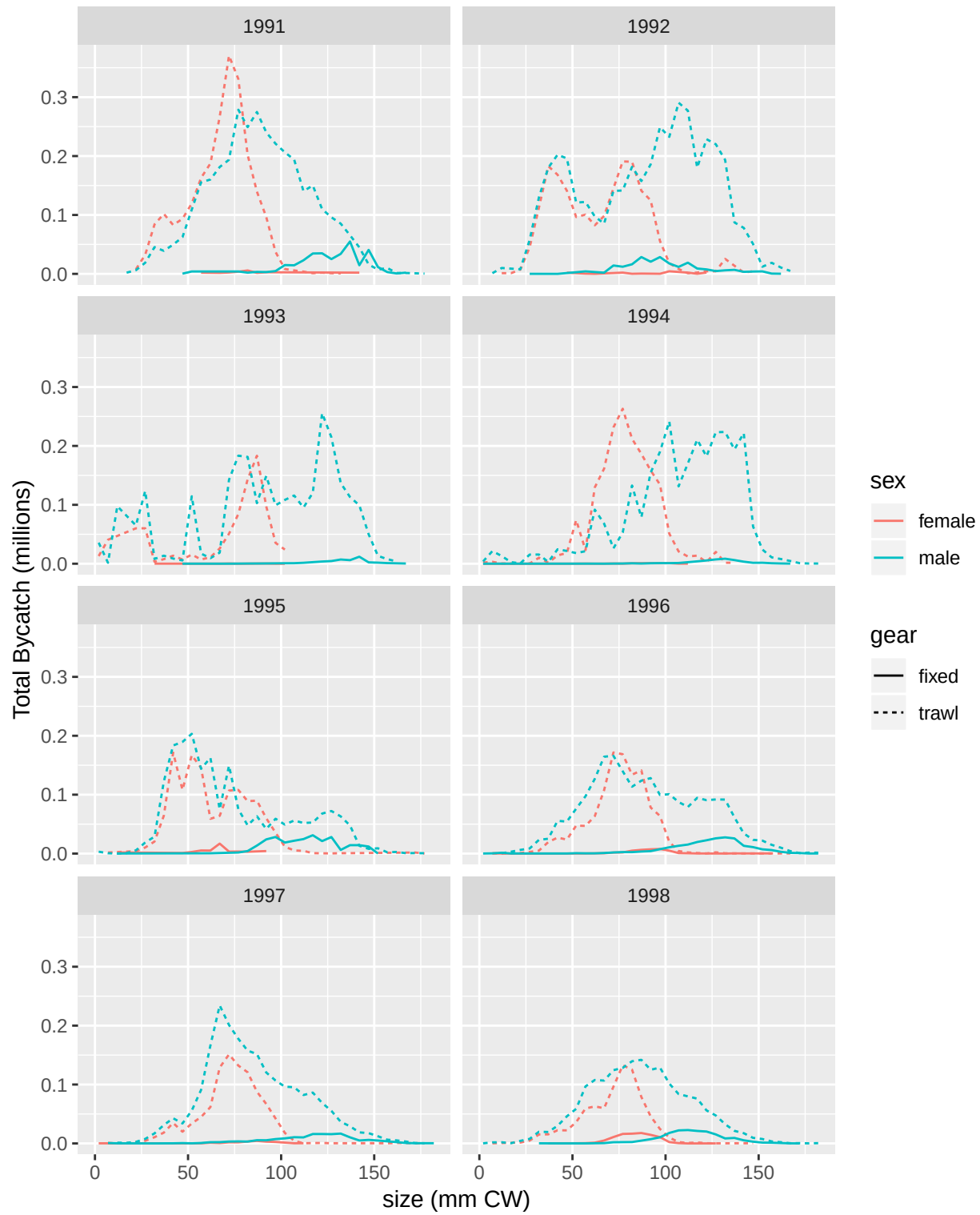


Figure 10: Total bycatch size frequencies, by year, gear type and sex.

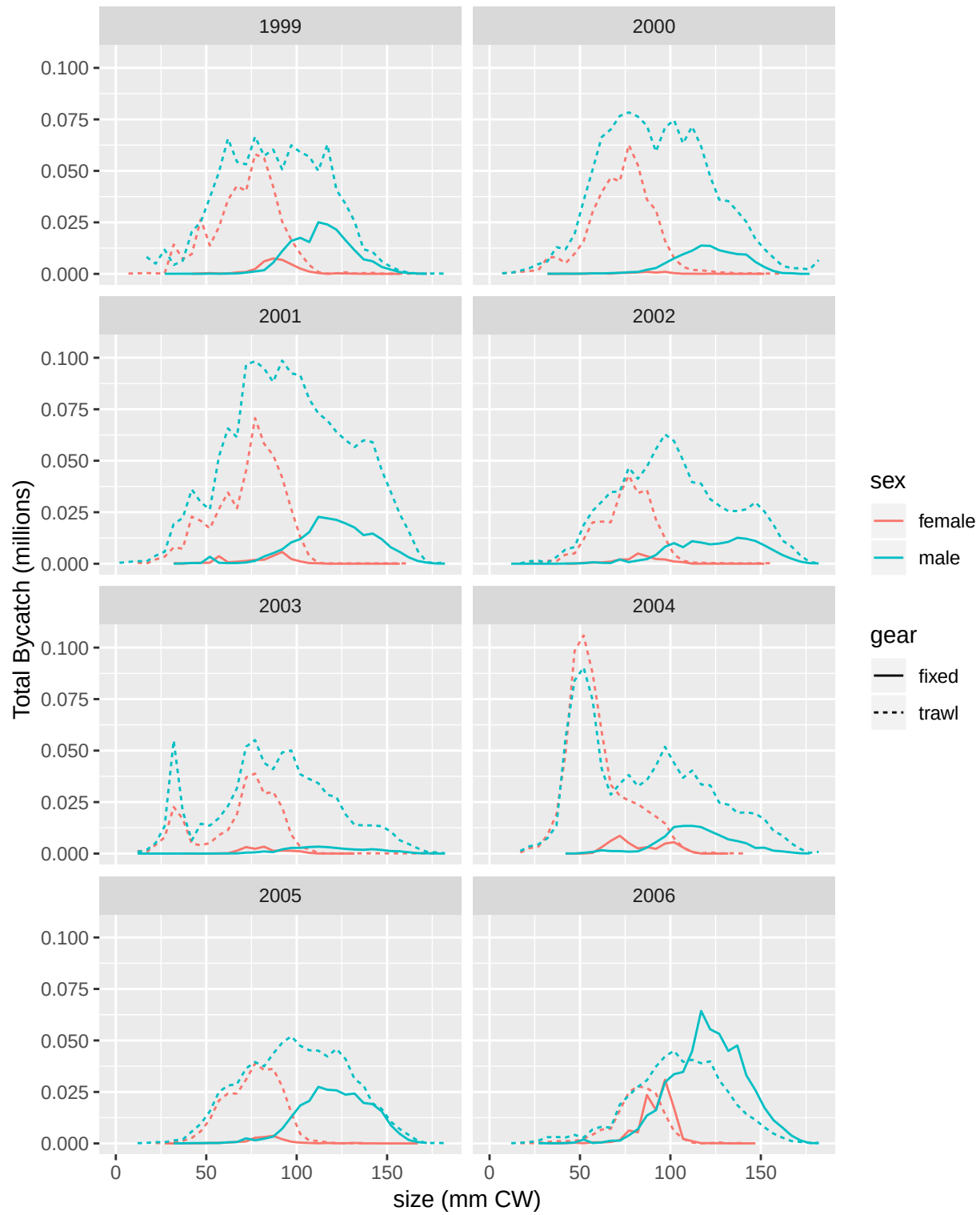


Figure 11: Total bycatch size frequencies, by year, gear type and sex.

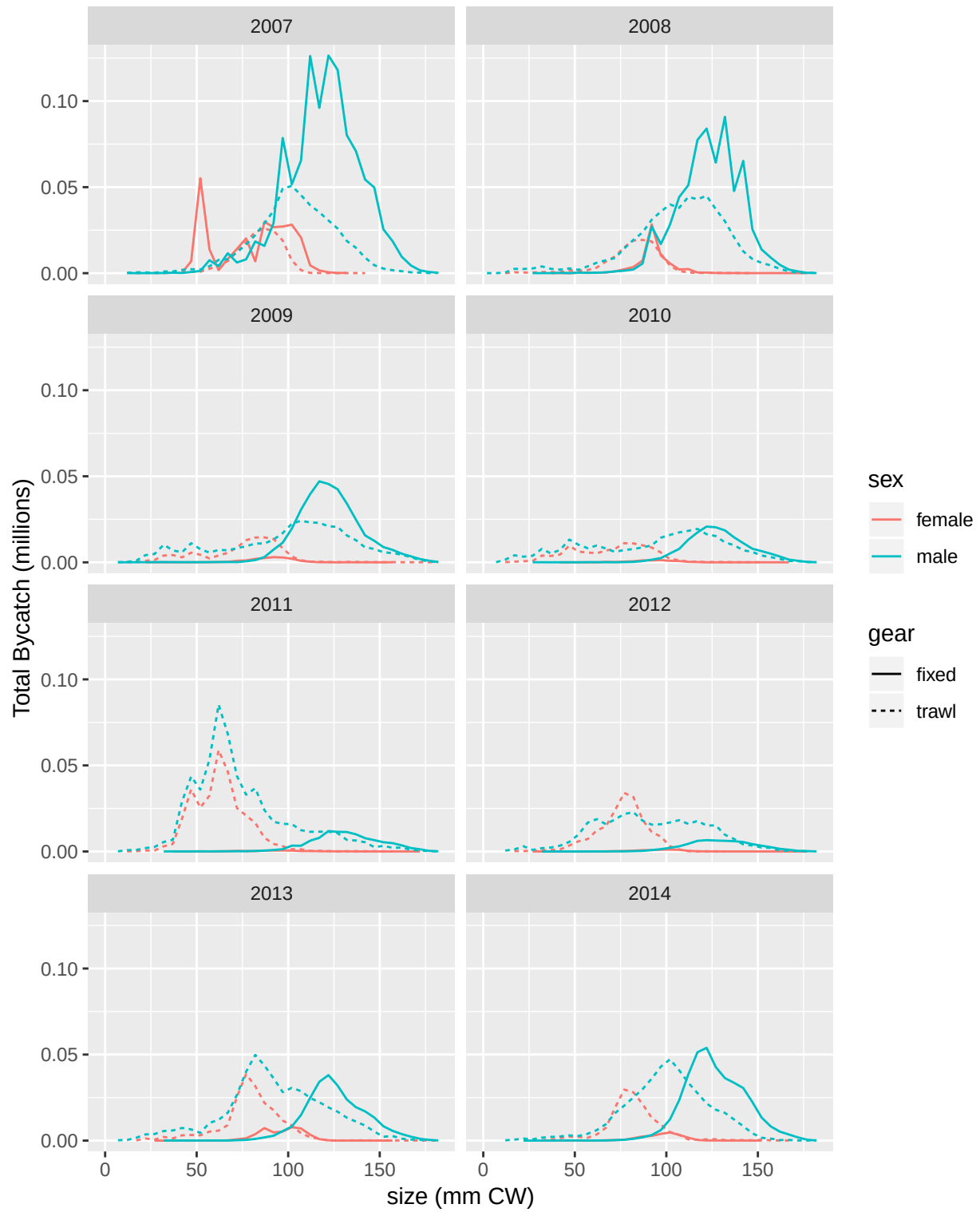


Figure 12: Total bycatch size frequencies, by year, gear type and sex.

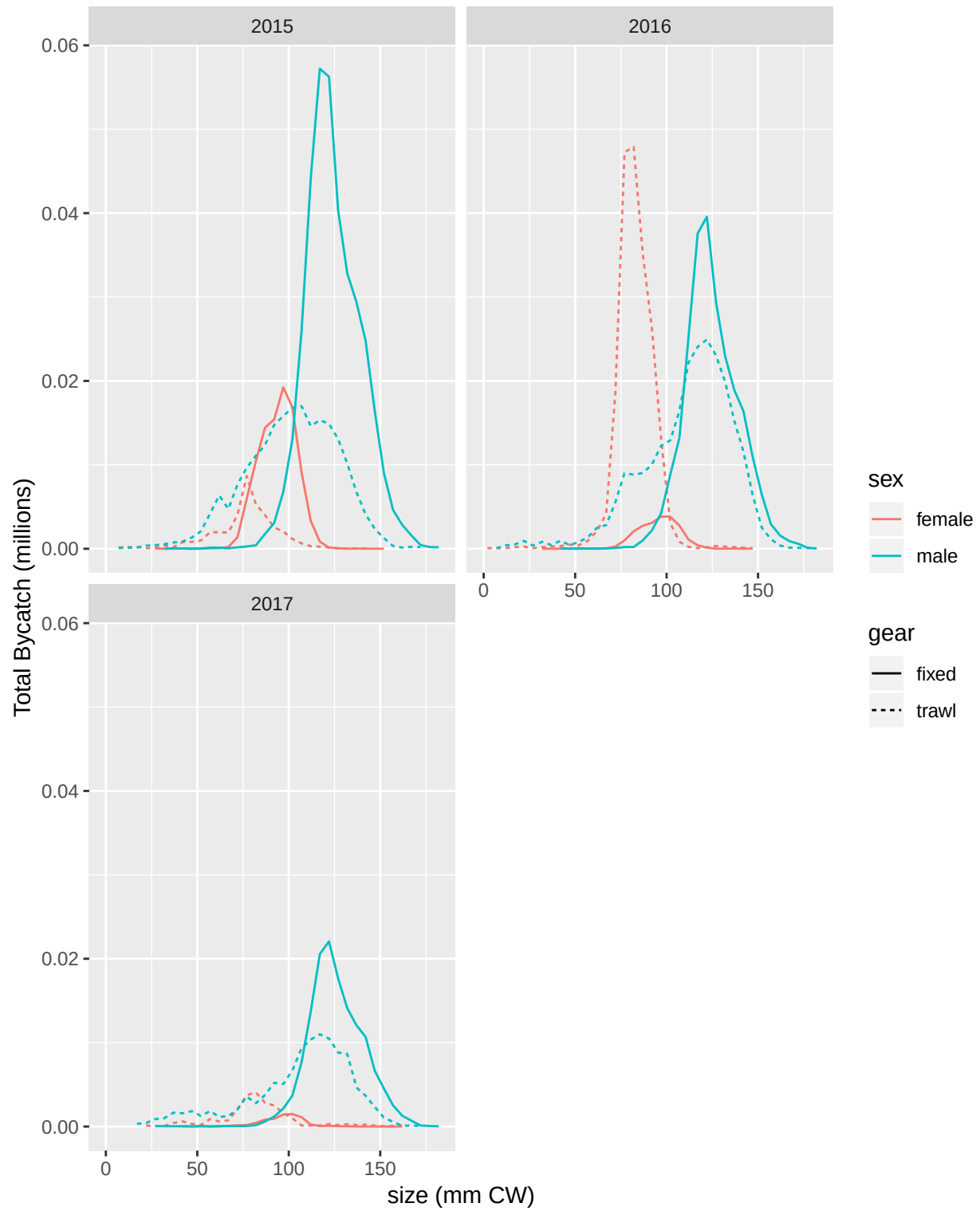


Figure 13: Total bycatch size frequencies, by year, gear type and sex.

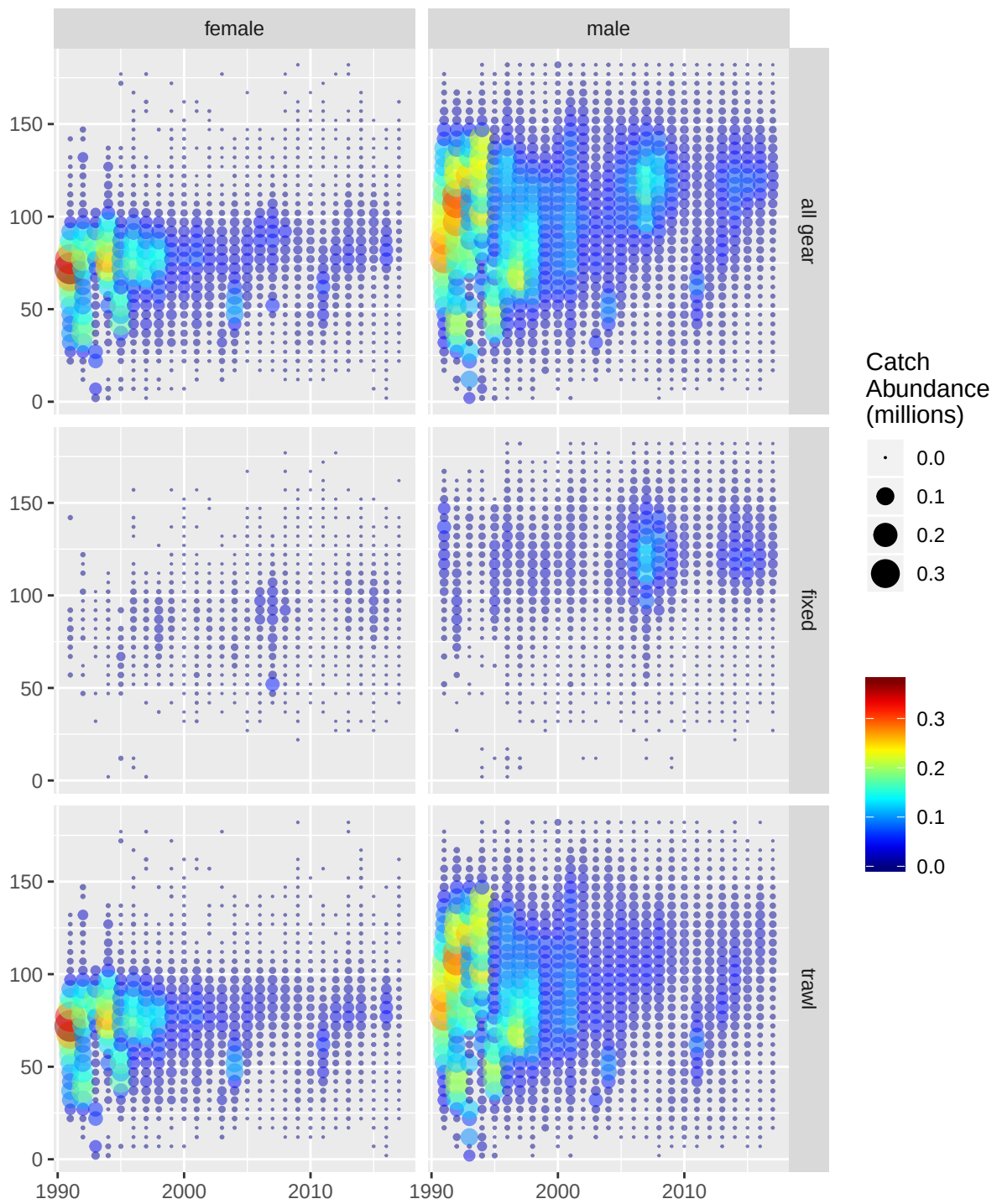


Figure 14: Total bycatch size frequencies, by year, gear type and sex. Bubble area scales with catch abundance.

Size compositions aggregated over gear type



Figure 15: Total bycatch size frequencies, by year and sex, aggregated over gear type.

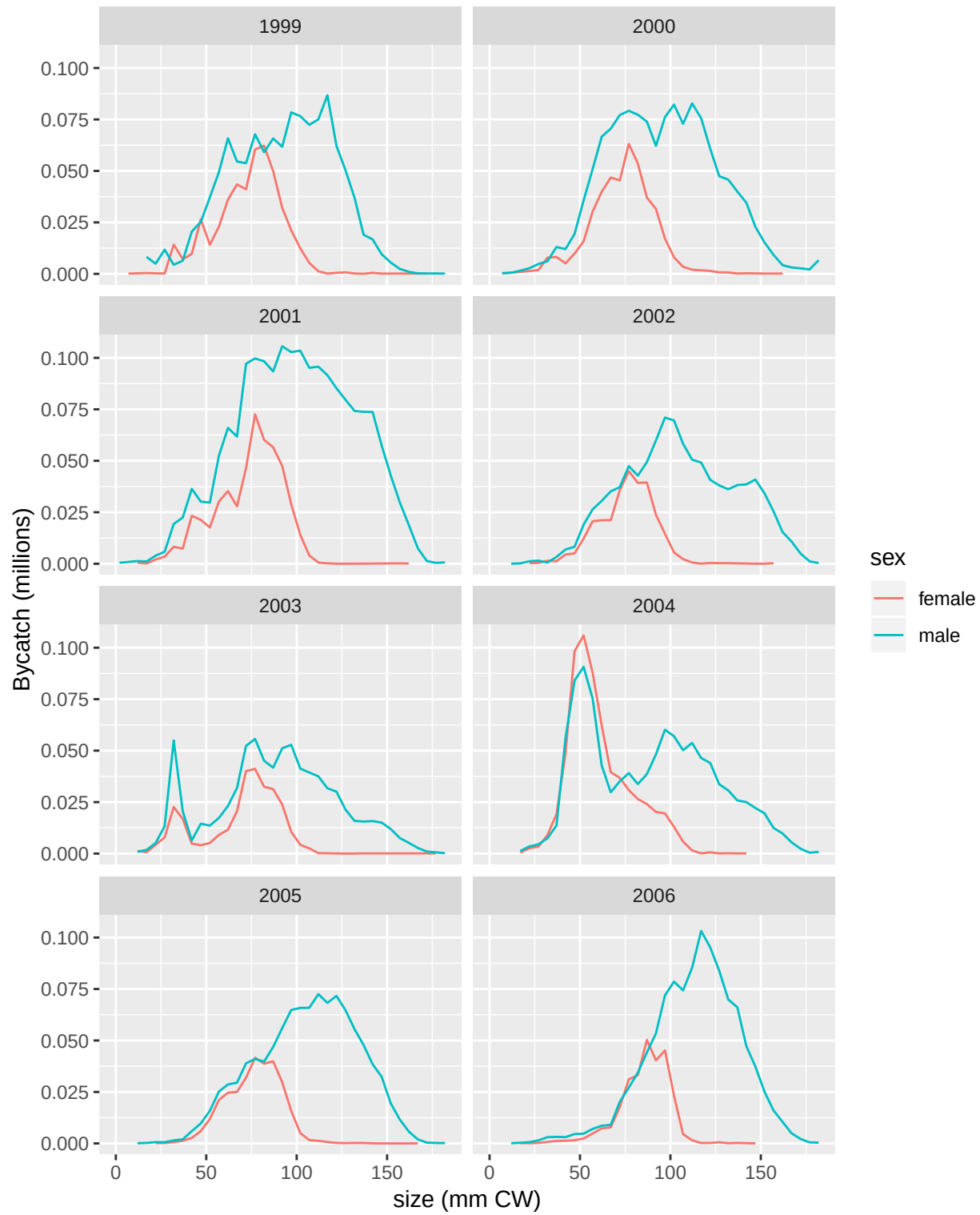


Figure 16: Total bycatch size frequencies, by year and sex, aggregated over gear type.

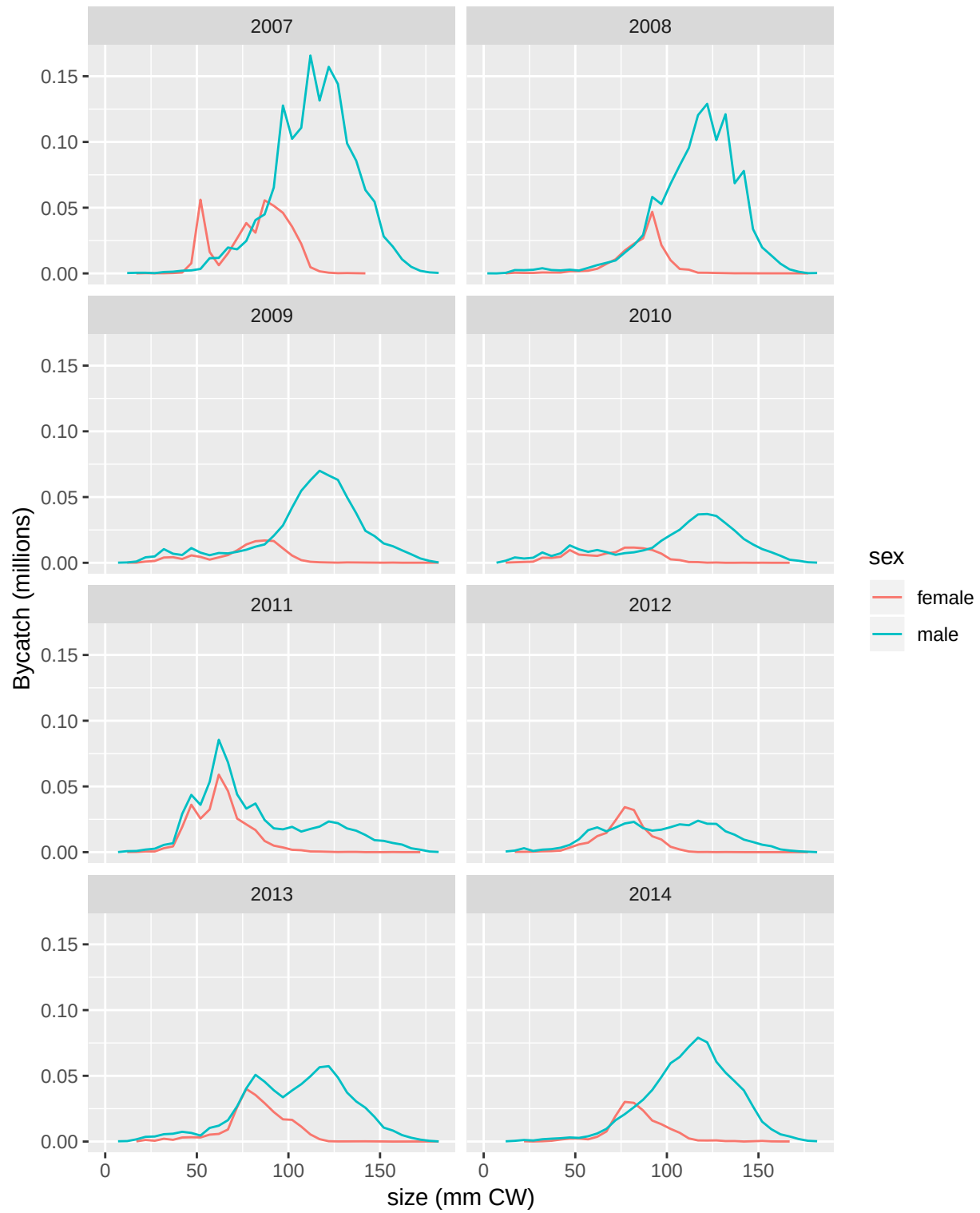


Figure 17: Total bycatch size frequencies, by year and sex, aggregated over gear type.

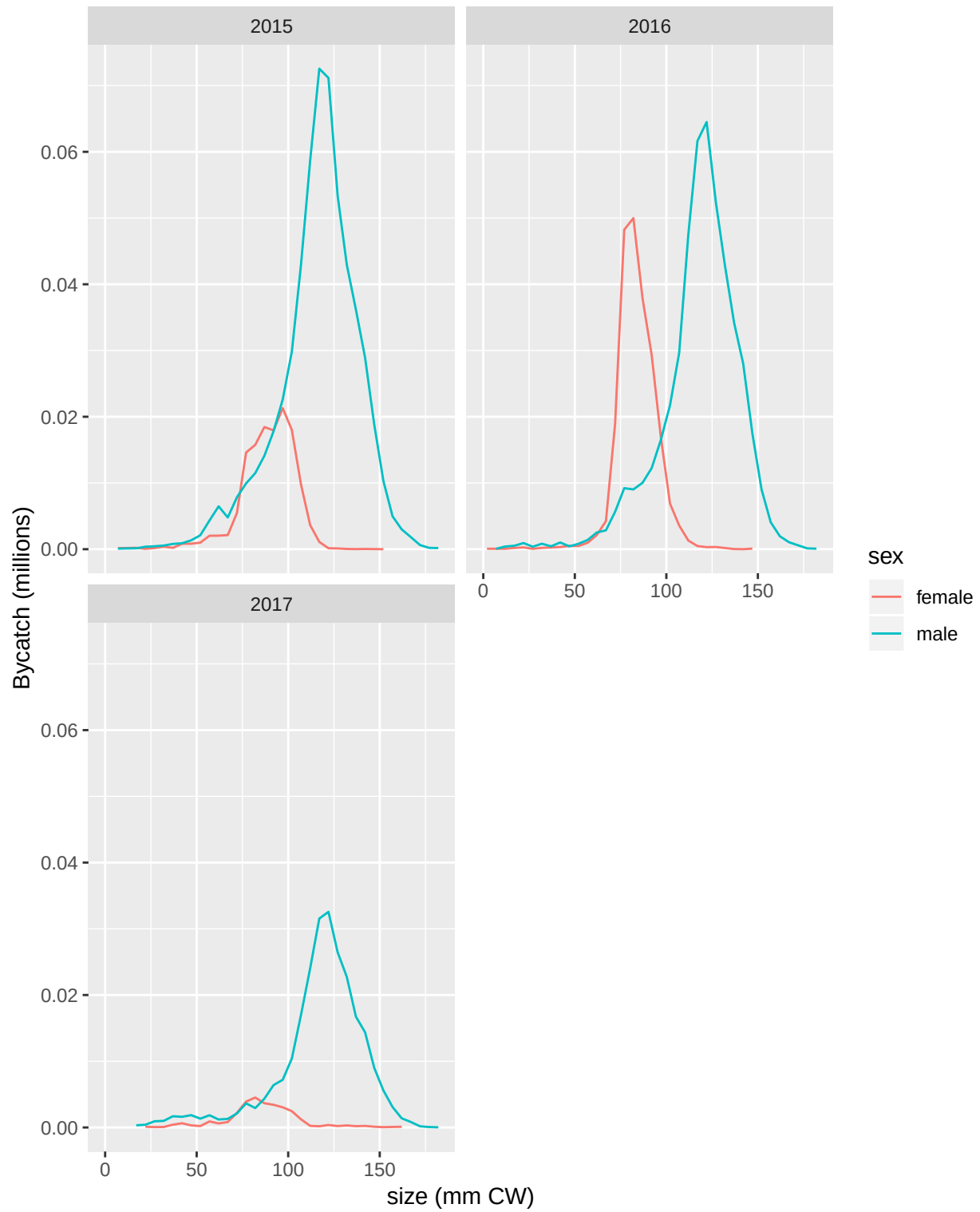
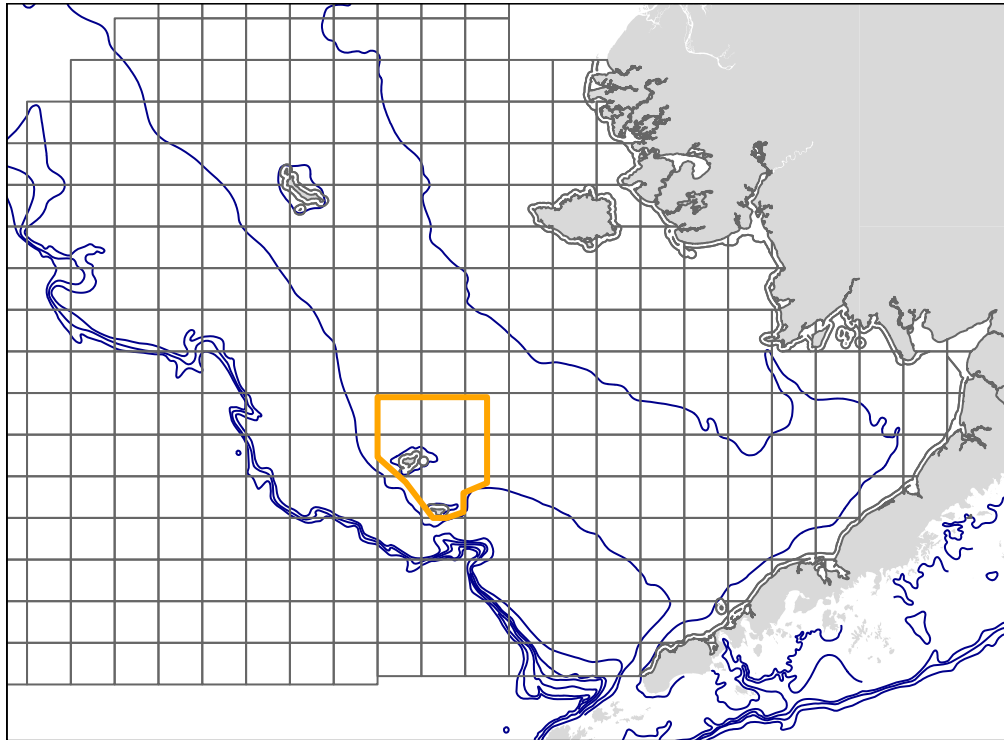


Figure 18: Total bycatch size frequencies, by year and sex, aggregated over gear type.

Spatial patterns of bycatch

Spatial patterns of Tanner crab bycatch in the groundfish fisheries, by ADFG stat area for 2009-2017, are illustrated by gear type in Figures 20-21 below. Bycatch less than 0.1 t in a stat area is not shown.



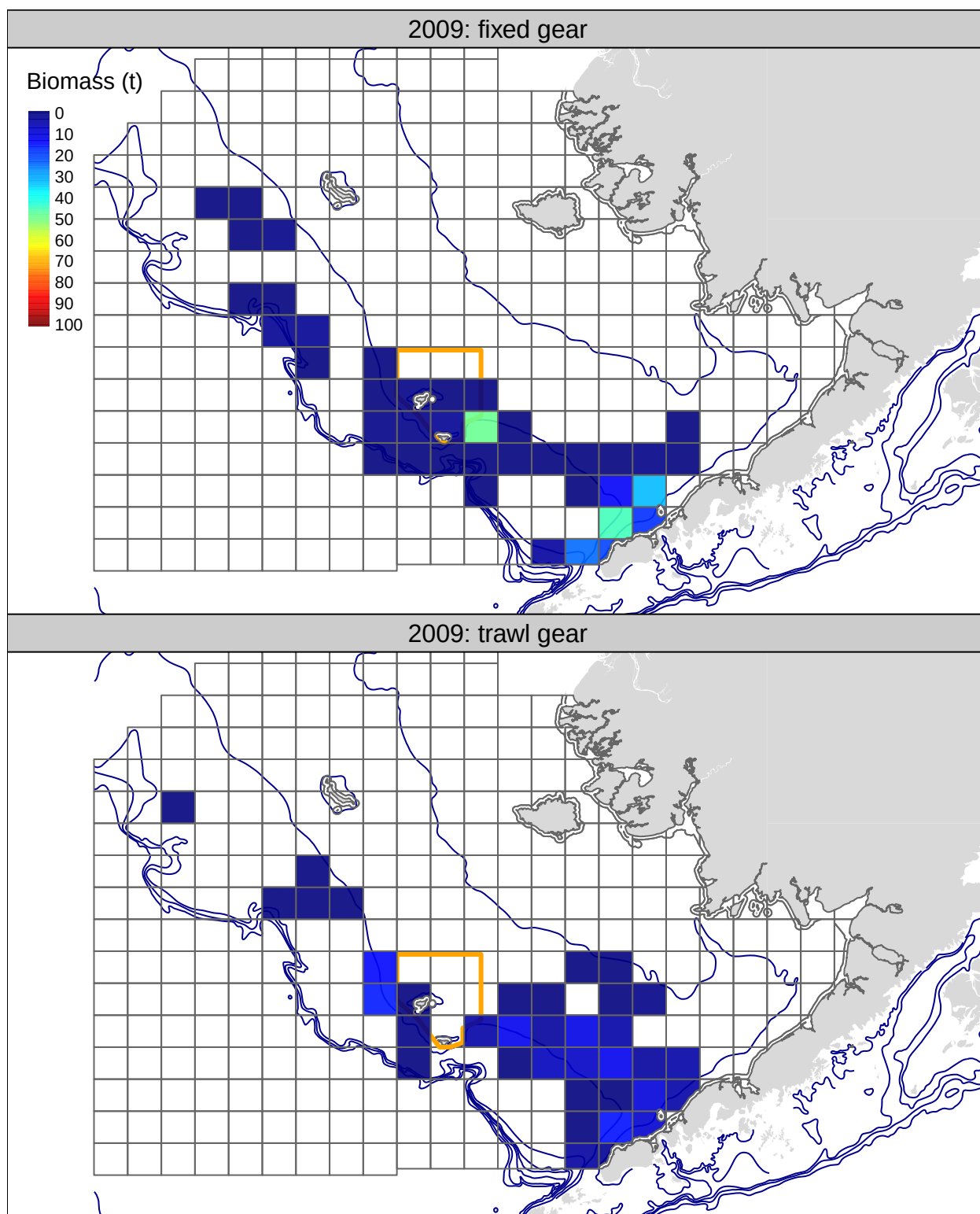


Figure 19: Bycatch of Tanner crab, by ADFG stat area, in the groundfish fisheries during 2009/10.

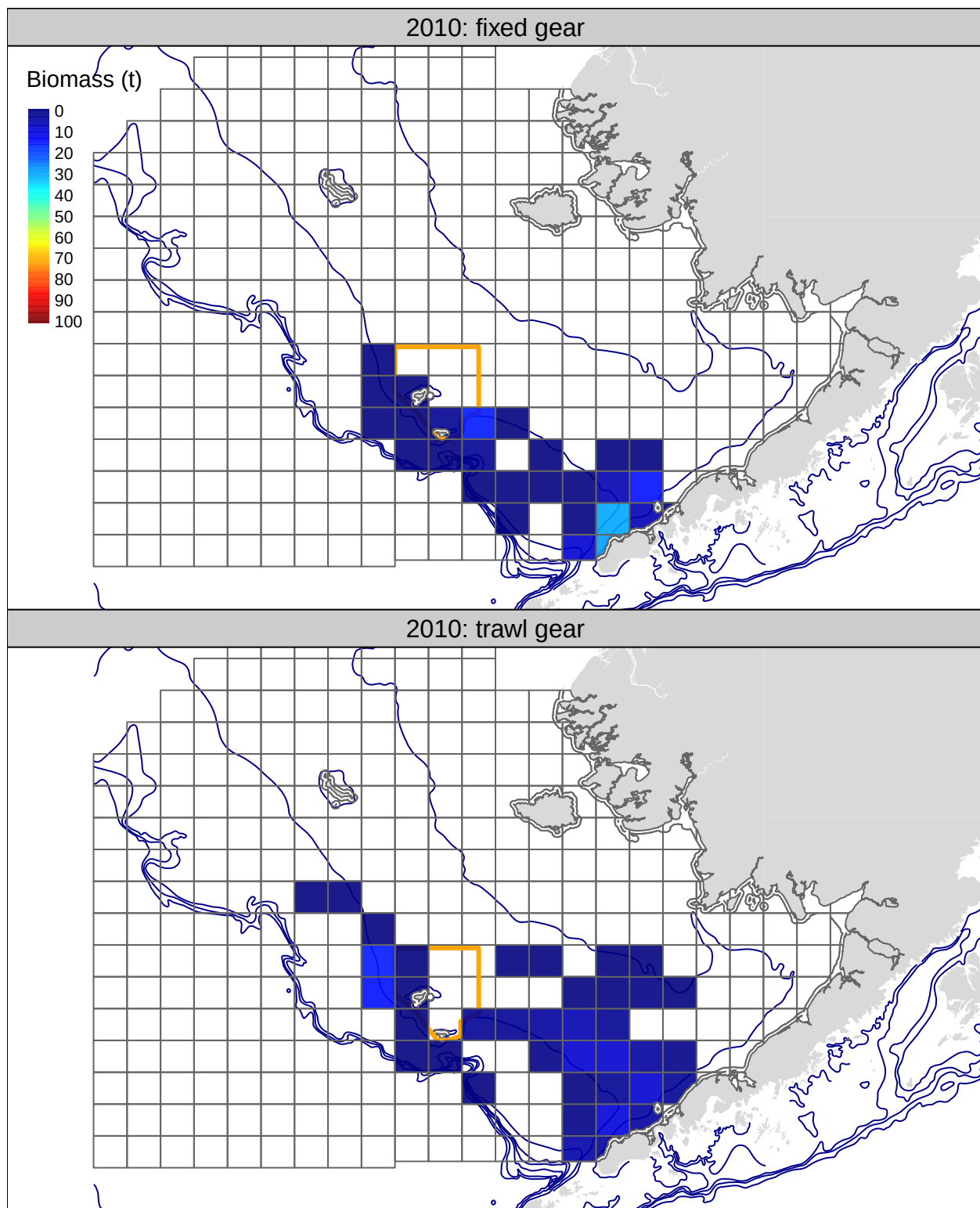


Figure 20: Bycatch of Tanner crab, by ADFG stat area, in the groundfish fisheries during 2010/11.

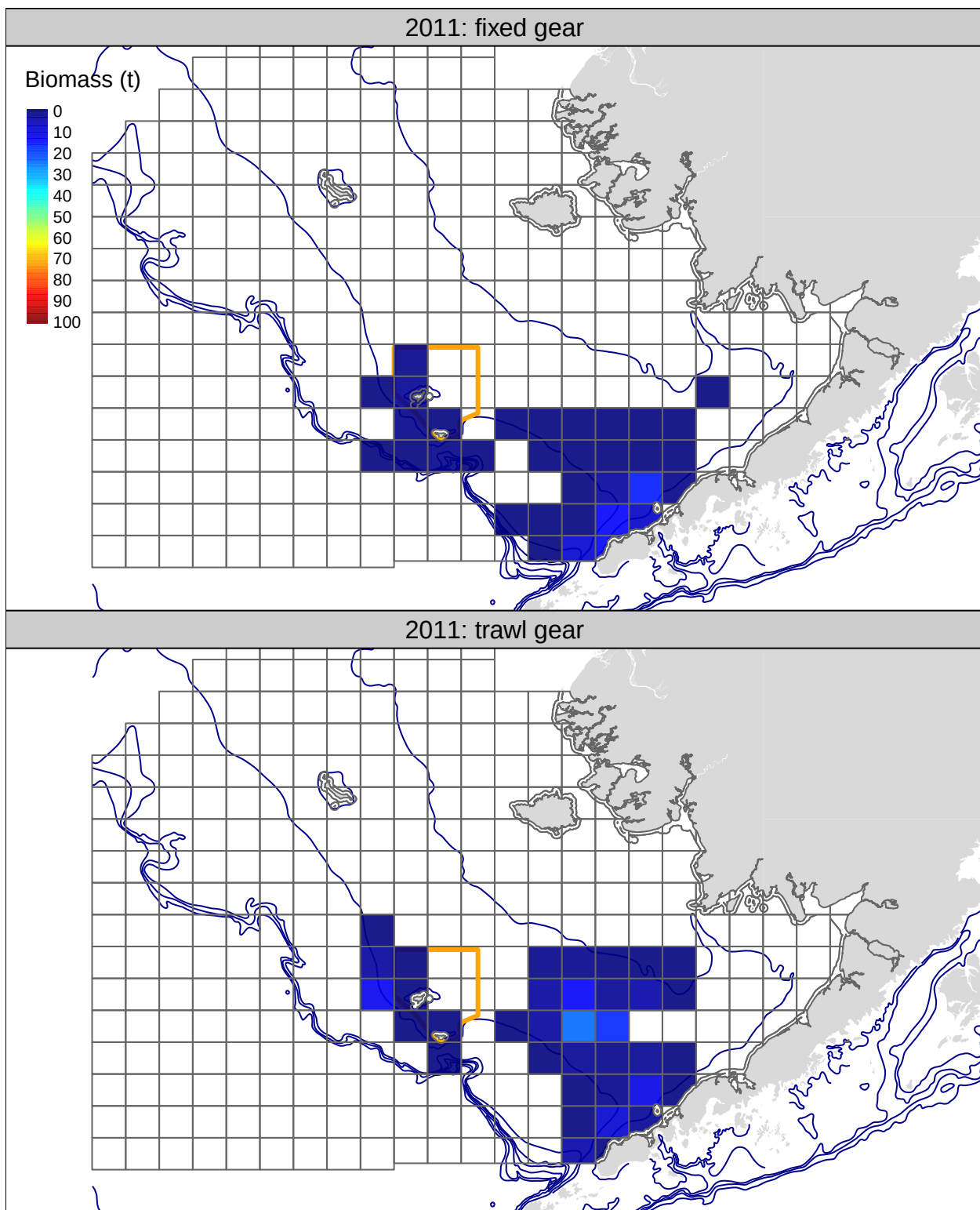


Figure 21: Bycatch of Tanner crab, by ADFG stat area, in the groundfish fisheries during 2011/12.

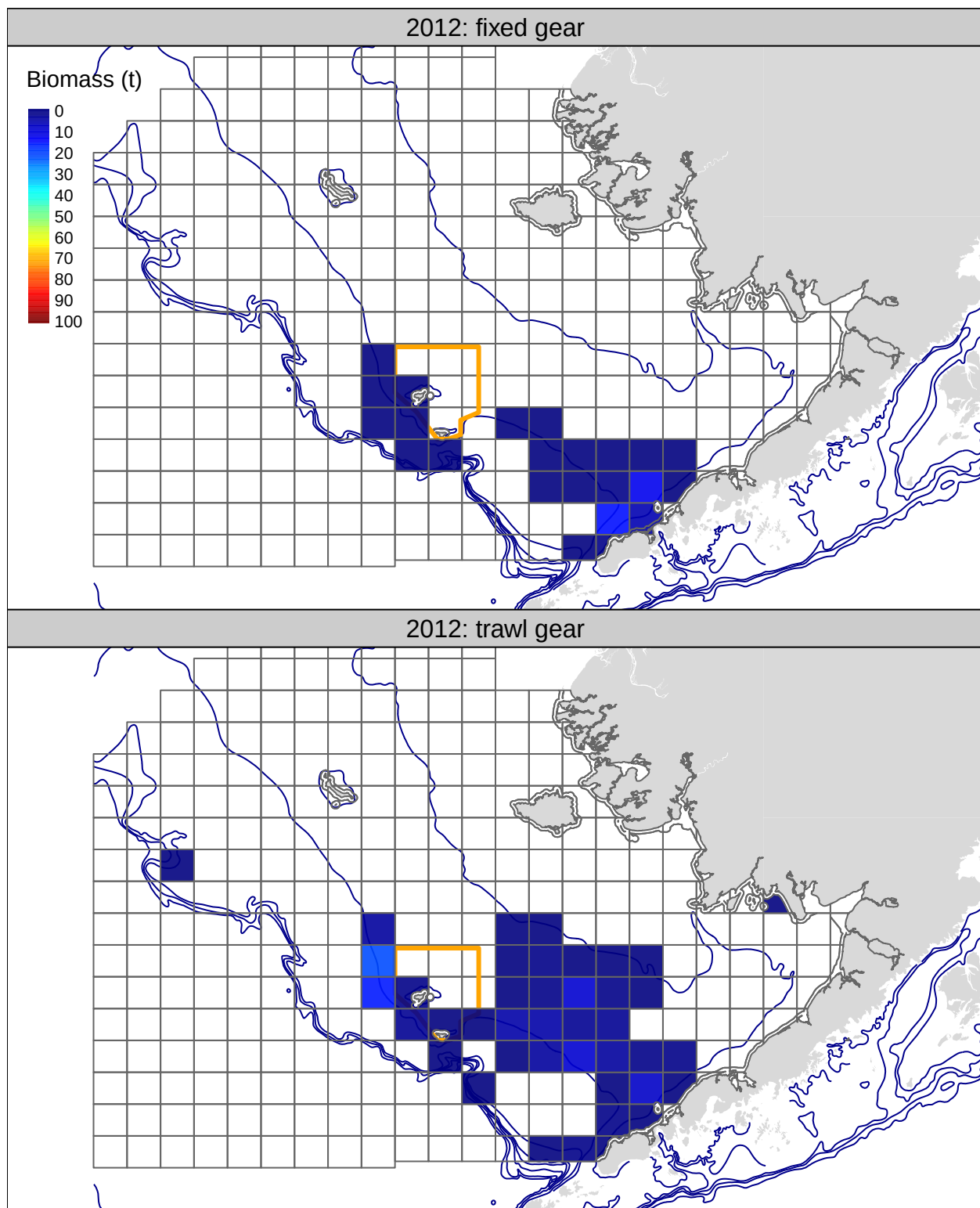


Figure 22: Bycatch of Tanner crab, by ADFG stat area, in the groundfish fisheries during 2012/13.

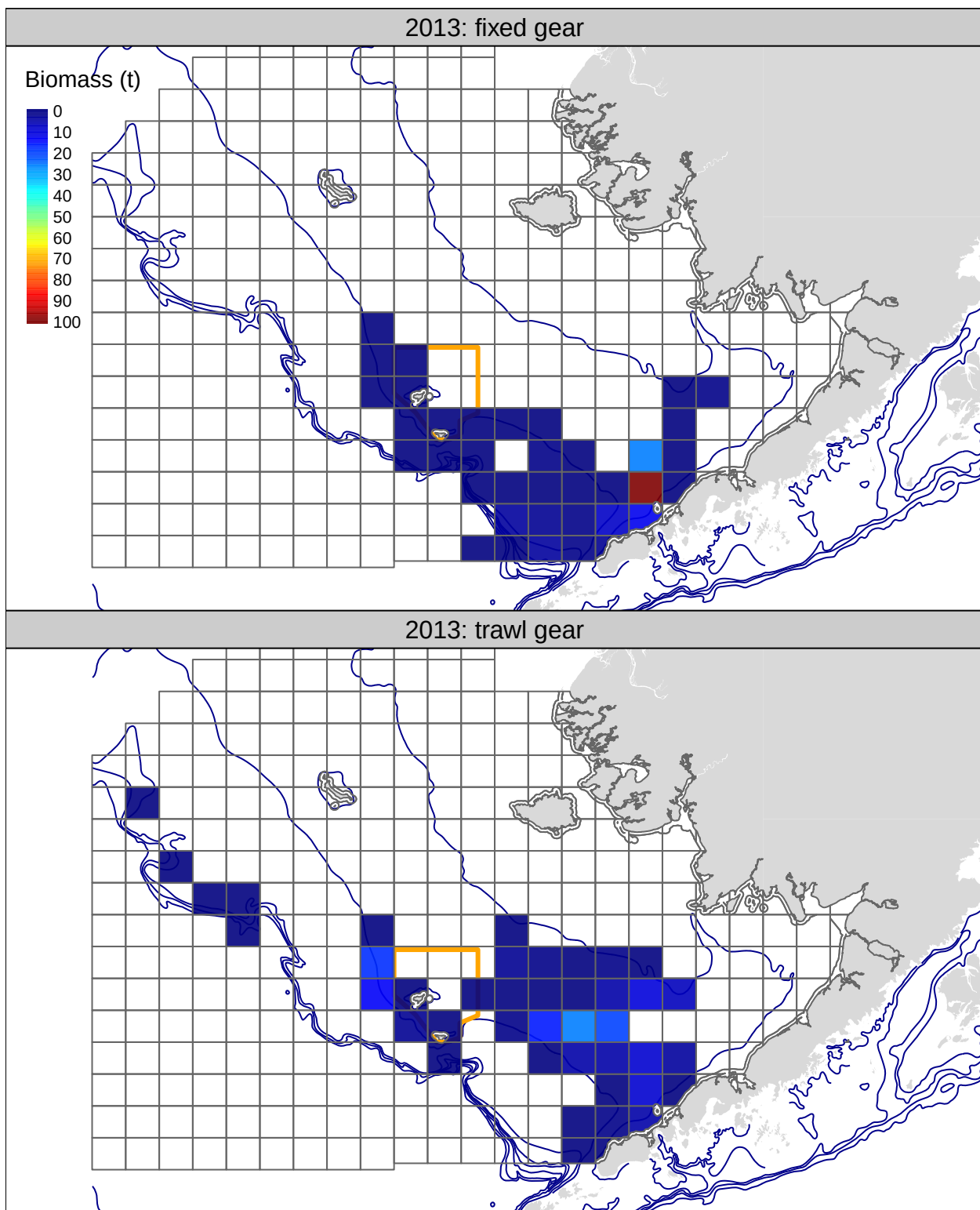


Figure 23: Bycatch of Tanner crab, by ADFG stat area, in the groundfish fisheries during 2013/14.

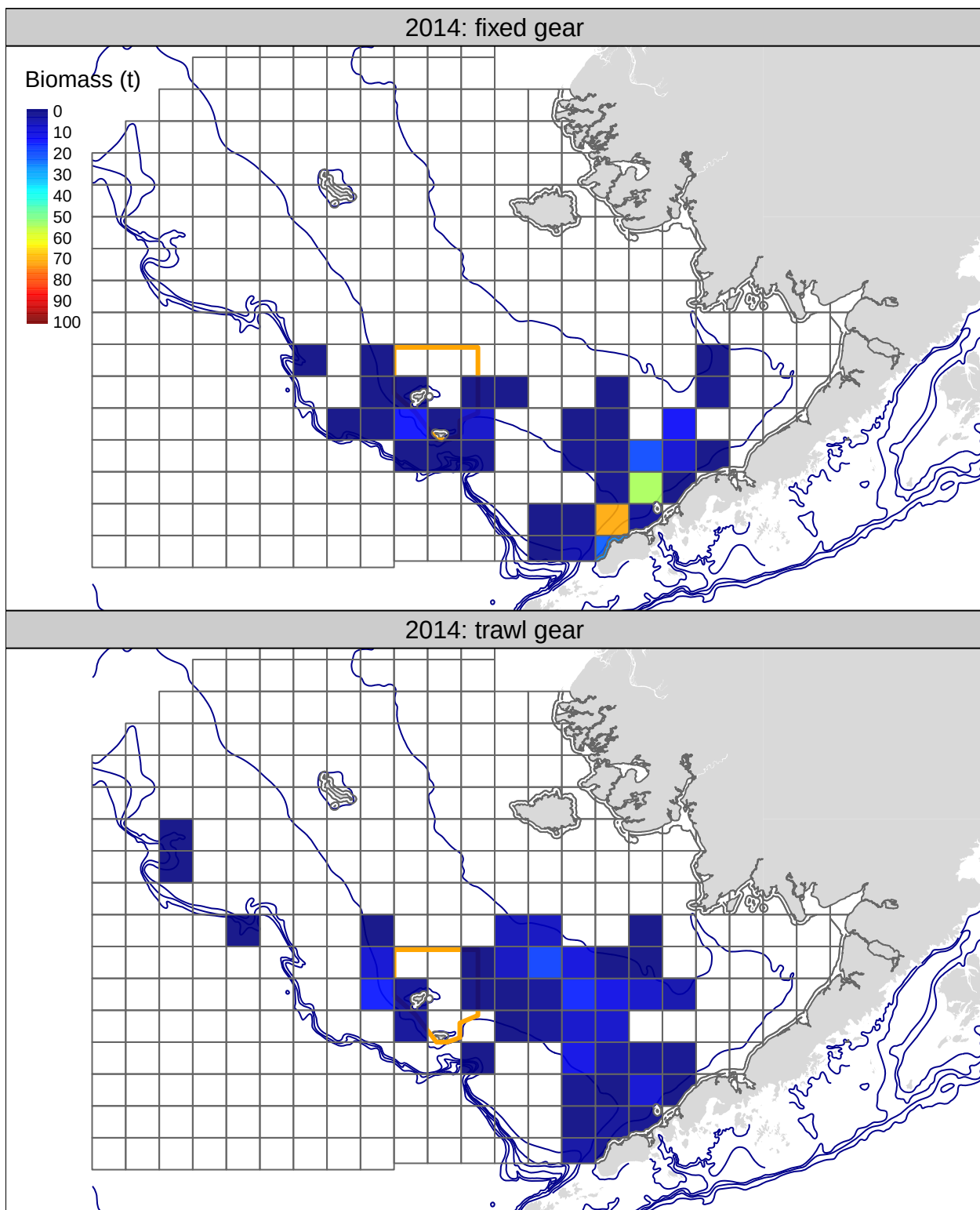


Figure 24: Bycatch of Tanner crab, by ADFG stat area, in the groundfish fisheries during 2014/15.

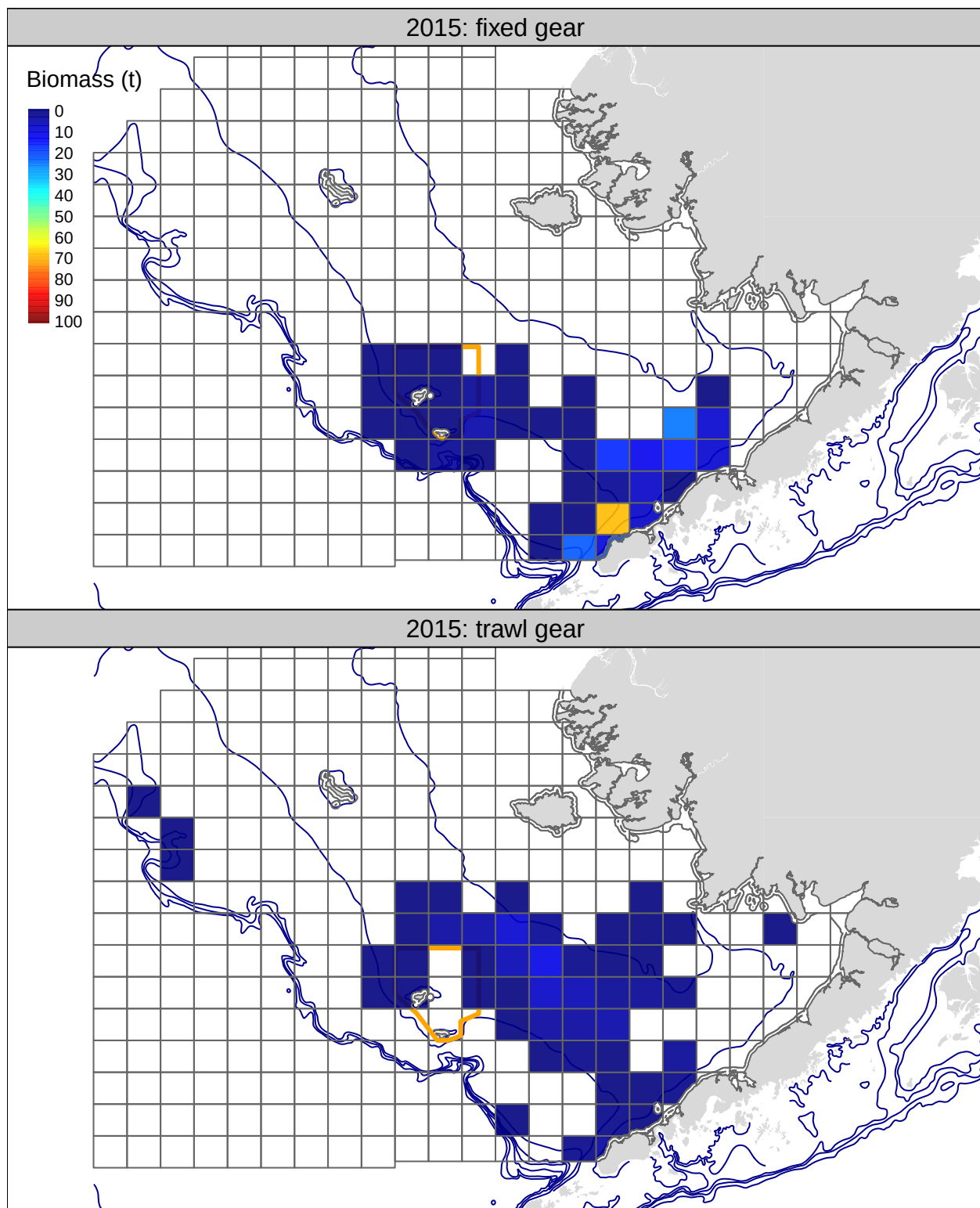


Figure 25: Bycatch of Tanner crab, by ADFG stat area, in the groundfish fisheries during 2015/16.

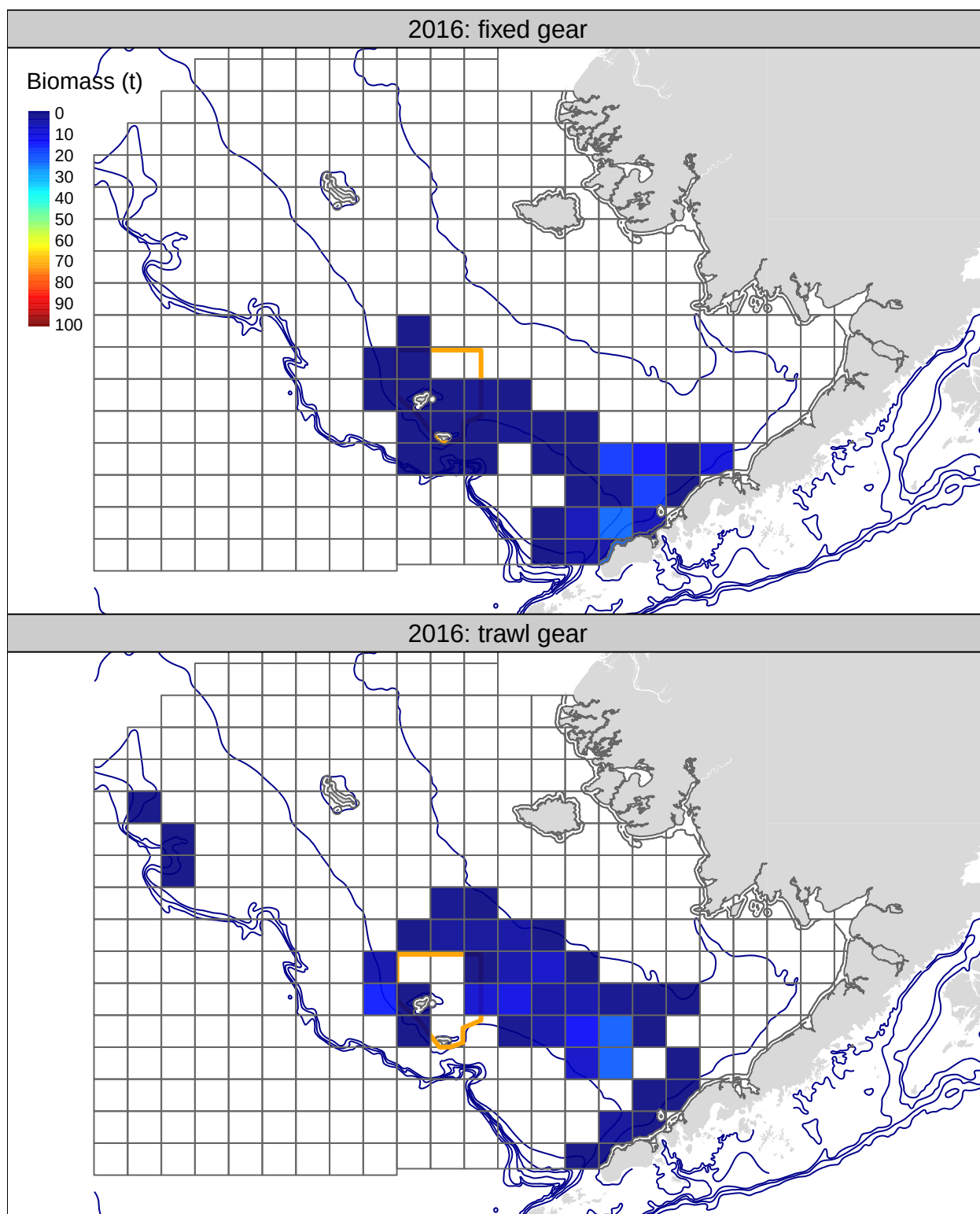


Figure 26: Bycatch of Tanner crab, by ADFG stat area, in the groundfish fisheries during 2016/17.

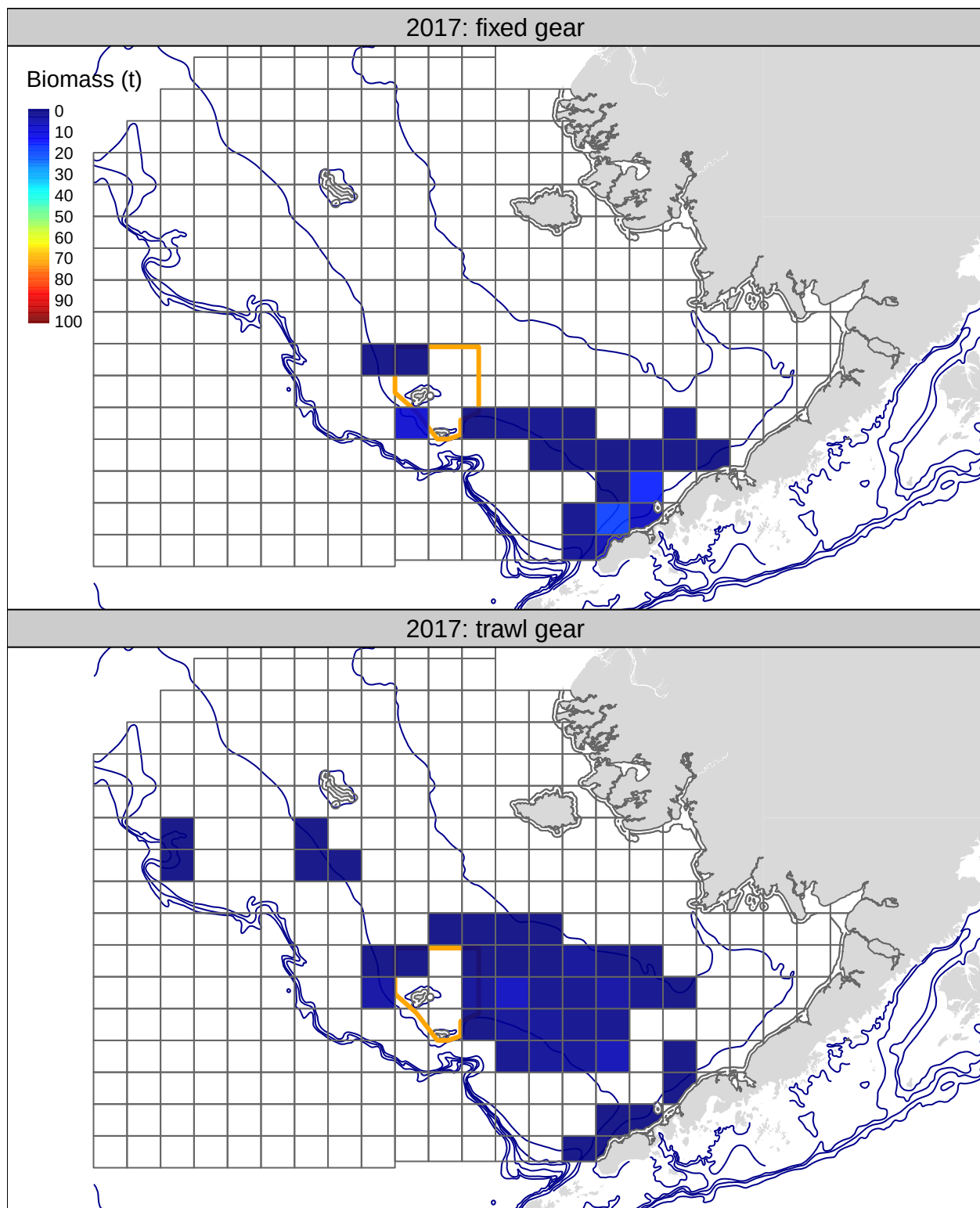


Figure 27: Bycatch of Tanner crab, by ADFG stat area, in the groundfish fisheries during 2017/18.