Appendix A: Bycatch in the Groundfish Fisheries for the Tanner Crab Assessment

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Introduction

This appendix 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 1991-2016. Briefly, total bycatch estimates for 1991-2008 were obtained 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; via AKFIN). 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.

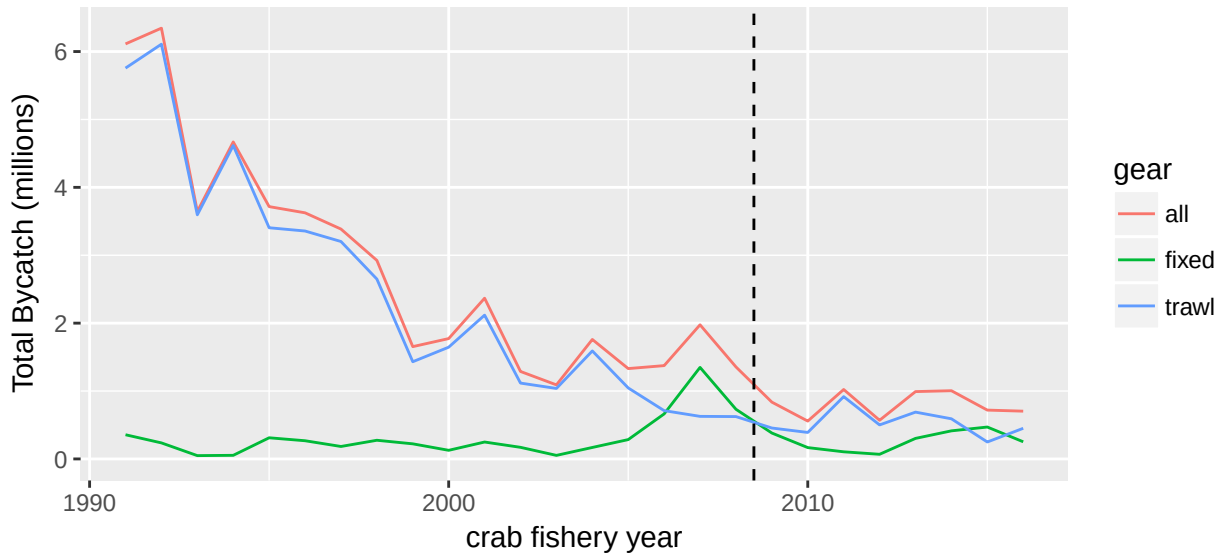

Figure 1: Figure

Estimated total bycatch by gear type

Figure 1. Estimated total bycatch abundance, by gear type, from the CAS/Blend and CIA databases for 1991-2016.

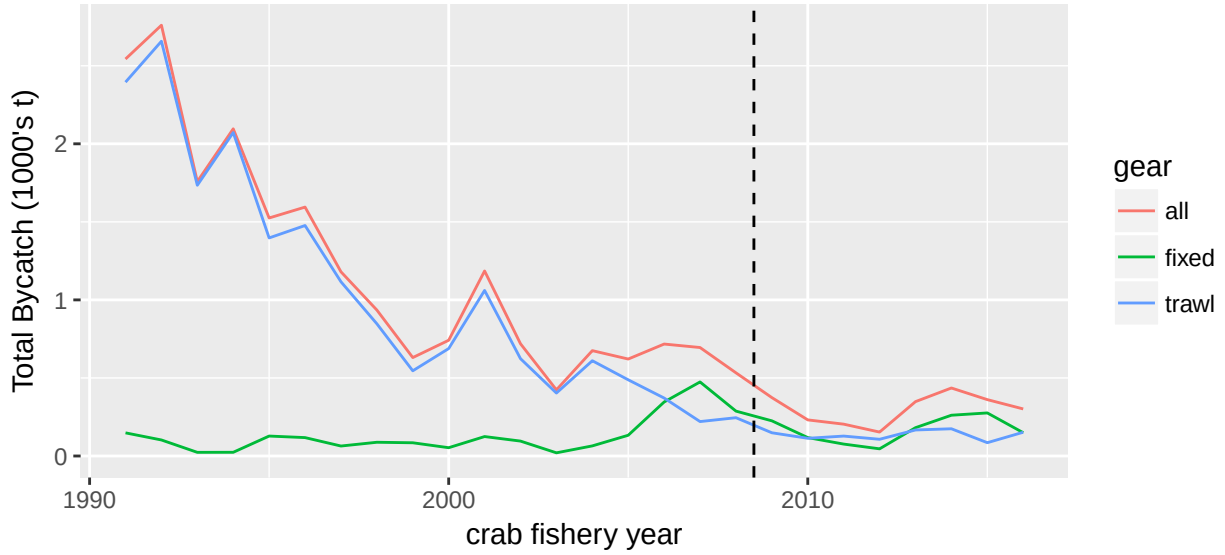

Figure 2: Figure

Figure 2. Estimated total bycatch biomass, by gear type, from the CAS/Blend and CIA databases for 1991-2016.

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

	all		fixed		trawl	
	num	wgt	num	wgt	num	wgt
year	millions	1000's t	millions	1000's t	millions	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	0.7036	0.3016	0.25266	0.14943	0.4509	0.15222

Estimated total catch by target type (2009/10-2016/17)

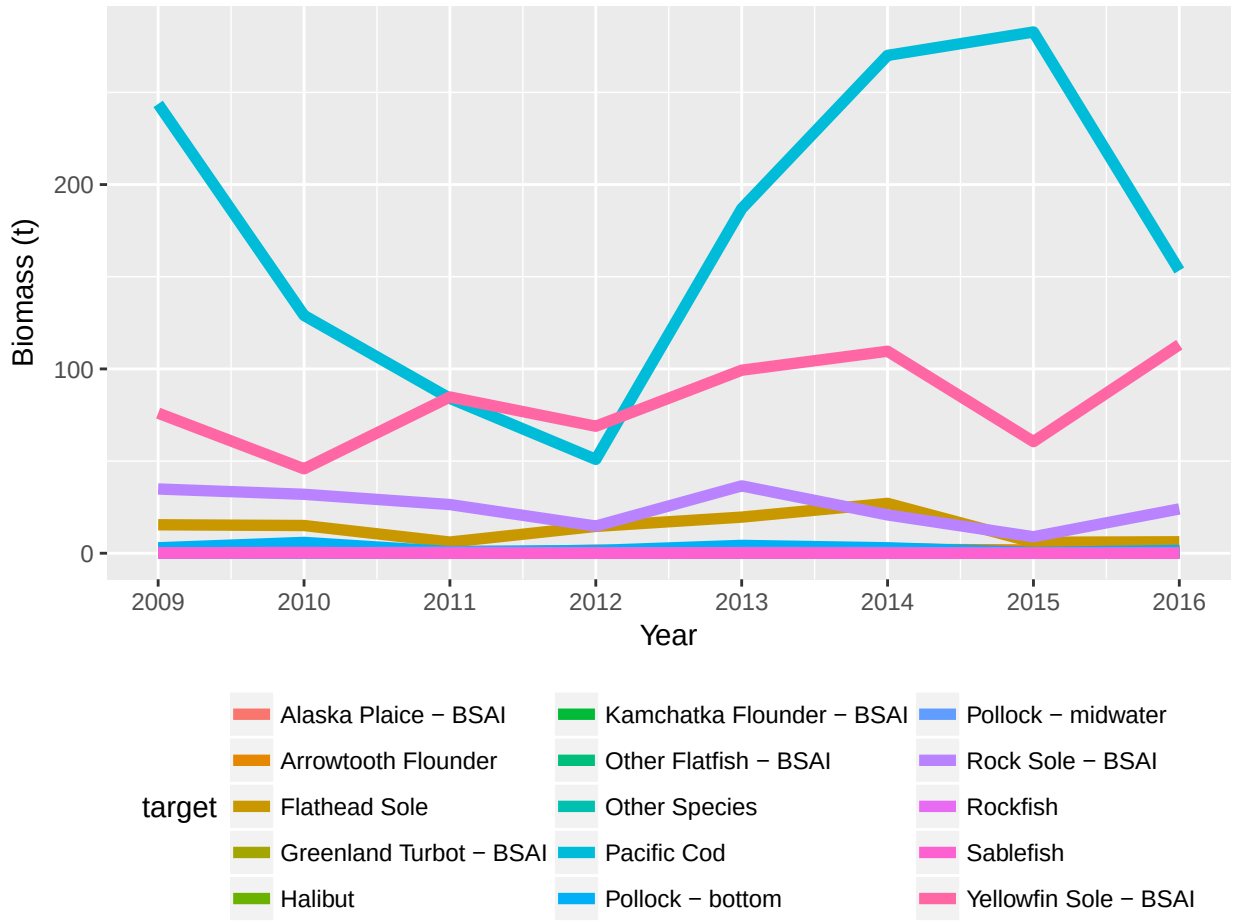

Figure 3. Bycatch of Tanner crab in the groundfish fisheries, by target type.

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
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
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
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
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
	2016	89	791	0.1	0.5
Pacific Cod	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	16127	351177	153.4	261.1
Pollock - bottom	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	15392	1.5	7.5
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	271640	0.2	0.5
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	2782	52699	24.0	74.8
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
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
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	9078	175812	113.1	327.6

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

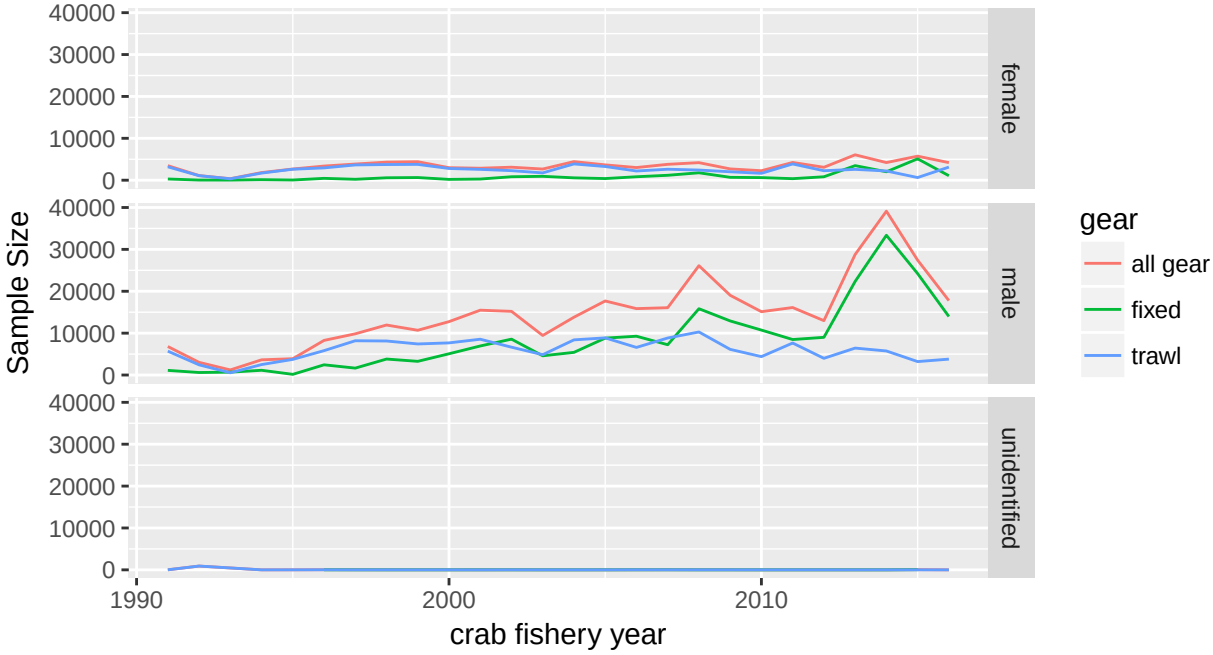

Figure 4. Sample sizes from observer sampling for Tanner crab (> 24 mm CW) bycatch size frequencies in the groundfish fisheries.

Table 3: Sample sizes from observer sampling for Tanner crab (> 24 mm CW) bycatch size frequencies in the groundfish fisheries

	all gear			fixed			trawl		
year	female	male	unidentified	female	male	unidentified	female	male	unidentified
1991	3477	6806	11	288	1106	0	3189	5700	11
1992	1109	3027	904	31	597	0	1078	2430	904
1993	358	1217	0	25	683	0	333	534	0
1994	1820	3628	4	126	1133	0	1694	2495	4
1995	2666	3896	8	44	162	0	2622	3734	8
1996	3375	8264	30	439	2442	13	2936	5822	17
1997	3859	9835	18	217	1650	8	3642	8185	10
1998	4310	11937	14	571	3814	2	3739	8123	12
1999	4411	10687	14	633	3269	7	3778	7418	7
2000	2988	12746	14	193	5074	3	2795	7672	11
2001	2859	15478	9	272	6934	7	2587	8544	2
2002	3099	15208	11	821	8563	0	2278	6645	11
2003	2664	9441	8	921	4589	0	1743	4852	8
2004	4441	13805	6	559	5412	1	3882	8393	5
2005	3654	17682	6	388	8814	0	3266	8868	6
2006	3016	15855	17	821	9263	0	2195	6592	17
2007	3788	16071	24	1173	7233	11	2615	8838	13
2008	4189	26108	17	1769	15828	1	2420	10280	16
2009	2694	19036	19	683	12911	4	2011	6125	15
2010	2260	15122	10	615	10730	2	1645	4392	8
2011	4237	16115	8	362	8474	1	3875	7641	7
2012	3080	12983	7	817	8997	0	2263	3986	7
2013	6064	28781	7	3477	22347	3	2587	6434	4
2014	4212	39119	9	2012	33373	3	2200	5746	6
2015	5734	27427	51	5106	24218	45	628	3209	6
2016	4193	17768	1	1067	13973	0	3126	3795	1

Raw size frequencies

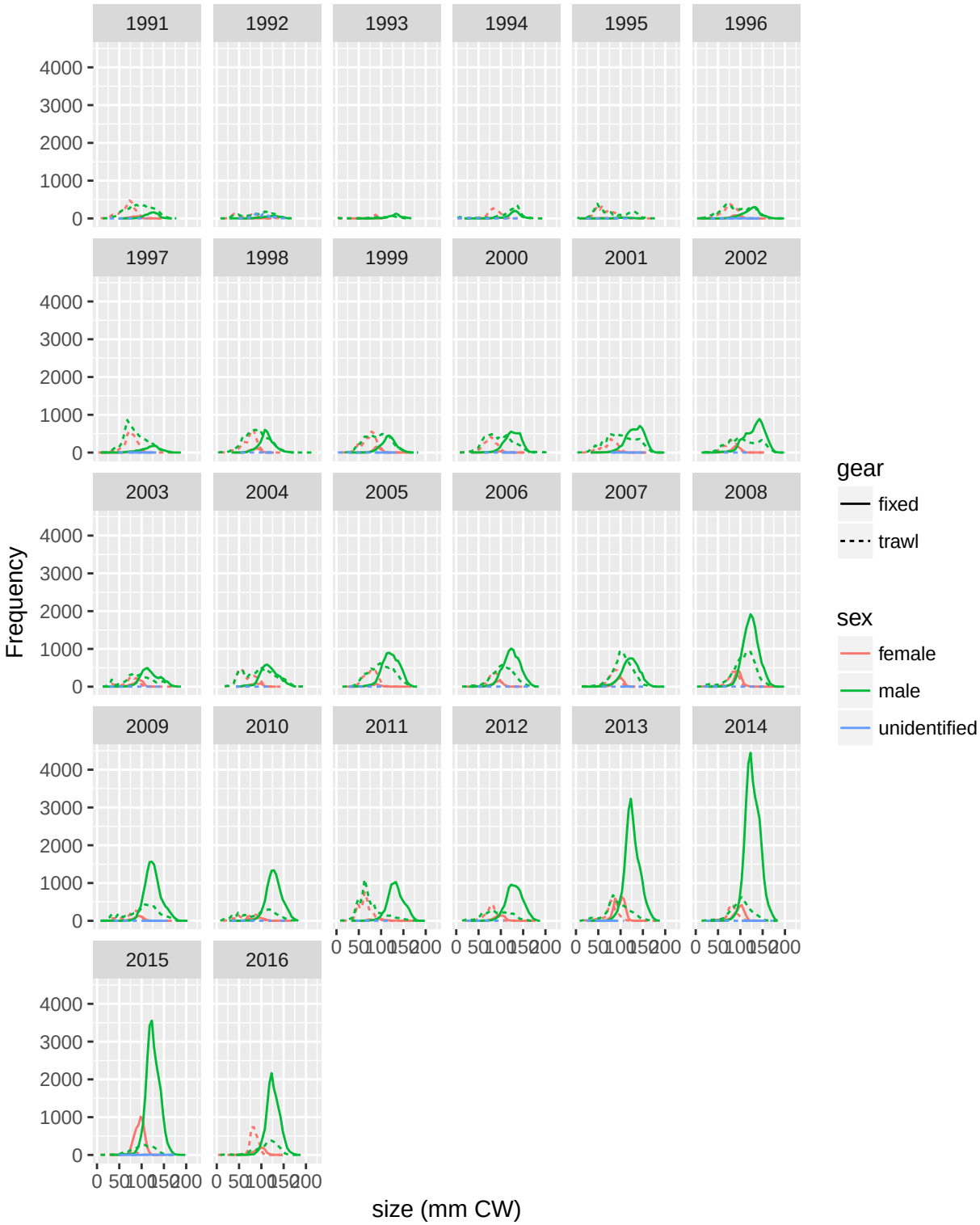

Figure 5. Raw (unscaled) size frequencies by 1-mm size bin from observer sampling for Tanner crab bycatch in the groundfish fisheries.

Expansion factors

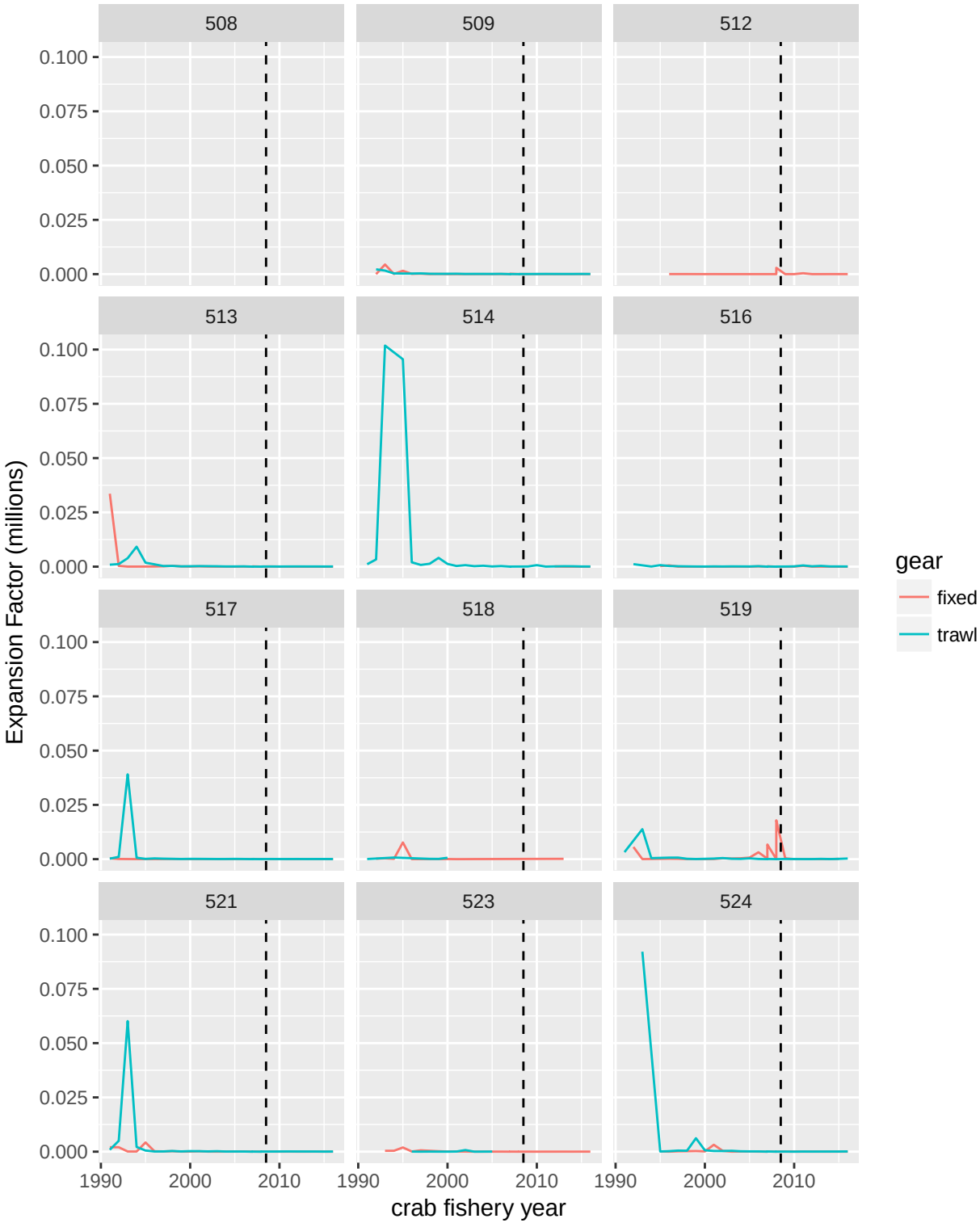

Figure 6. Expansion factors from observed size frequencies to total bycatch, by gear type and reporting area.

Table 4: Observed bycatch numbers, expanded numbers, ans expansion factors from observed size frequencies to total bycatch, by gear type and reporting area.

			fixed			trawl	
area	year	obs N	est N	expansion	obs N	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	$1.409e-02$	$7.828e-05$	2656	$8.653e-01$	$3.258e-04$
	1995	89	$1.372e-01$	$1.541e-03$	3063	$8.361e-01$	$2.730e-04$
	1996	1384	$1.701e-01$	$1.229e-04$	4759	$1.201e+00$	$2.523e-04$
	1997	504	$9.145e-02$	$1.815e-04$	2232	$7.372e-01$	$3.303e-04$
	1998	2660	$5.640e-02$	$2.120e-05$	4107	$6.725e-01$	$1.637e-04$
	1999	1357	$1.117e-01$	$8.229e-05$	3621	$4.522e-01$	$1.249e-04$
	2000	2536	$4.588e-02$	$1.809e-05$	2680	$3.692e-01$	$1.378e-04$
	2001	4481	$6.582e-02$	$1.469e-05$	3791	$6.609e-01$	$1.743e-04$
	2002	6173	$8.000e-02$	$1.296e-05$	3229	$2.826e-01$	$8.753e-05$
	2003	2483	$2.138e-02$	$8.612e-06$	1549	$1.558e-01$	$1.006e-04$
	2004	2445	$4.683e-02$	$1.915e-05$	2714	$2.420e-01$	$8.918e-05$
	2005	4950	$8.319e-02$	$1.681e-05$	2283	$1.994e-01$	$8.736e-05$
	2006	6097	$2.892e-01$	$4.743e-05$	1716	$1.905e-01$	$1.110e-04$
	2007	13413	$7.055e-01$	$1.578e-04$	8118	$1.212e-01$	$4.478e-05$
	2008	16302	$2.175e-01$	$2.668e-05$	7296	$1.746e-01$	$4.786e-05$
	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	8472	$2.091e-01$	$2.468e-05$	2312	$1.565e-01$	$6.769e-05$
512	1996	32	$6.925e-04$	$2.164e-05$	–	–	–
	1998	7	$1.642e-04$	$2.346e-05$	–	–	–
	2000	2	$7.727e-06$	$3.863e-06$	–	–	–
	2001	48	$4.370e-04$	$9.103e-06$	–	–	–
	2002	8	$2.090e-05$	$2.612e-06$	–	–	–
	2003	5	$2.144e-05$	$4.288e-06$	–	–	–
	2004	106	$6.110e-04$	$5.764e-06$	–	–	–
	2005	1	$4.933e-07$	$4.933e-07$	–	–	–
	2008	8	$1.159e-02$	$2.898e-03$	–	–	–
	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	$1.559e-02$	$1.701e-05$	–	–	–

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	$7.514e-03$	$2.393e-05$	321	$2.950e+00$	$9.191e-03$
	1995	–	–	–	1148	$2.067e+00$	$1.800e-03$
	1996	304	$1.658e-02$	$5.454e-05$	1353	$1.453e+00$	$1.074e-03$
	1997	147	$2.025e-02$	$1.377e-04$	6778	$1.862e+00$	$2.746e-04$
	1998	312	$1.273e-01$	$4.079e-04$	3928	$1.289e+00$	$3.281e-04$
	1999	479	$4.272e-02$	$8.918e-05$	3744	$4.910e-01$	$1.312e-04$
	2000	412	$1.742e-02$	$4.228e-05$	4043	$7.239e-01$	$1.790e-04$
	2001	547	$7.179e-02$	$1.312e-04$	2955	$6.902e-01$	$2.336e-04$
	2002	296	$9.489e-03$	$3.206e-05$	1779	$3.705e-01$	$2.082e-04$
	2003	2052	$1.157e-02$	$5.638e-06$	1197	$1.962e-01$	$1.639e-04$
	2004	2155	$5.928e-02$	$2.751e-05$	1513	$1.160e-01$	$7.664e-05$
	2005	1528	$6.638e-02$	$4.345e-05$	3277	$2.589e-01$	$7.900e-05$
	2006	1929	$8.923e-02$	$4.626e-05$	1377	$1.616e-01$	$1.174e-04$
	2007	3828	$1.857e-01$	$1.455e-04$	5799	$1.031e-01$	$5.332e-05$
	2008	3204	$6.333e-02$	$3.953e-05$	5452	$1.403e-01$	$5.145e-05$
	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	3135	$8.526e-03$	$2.720e-06$	2350	$1.671e-01$	$7.111e-05$
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	$1.911e-01$	$9.555e-02$
	1996	–	–	–	26	$5.182e-02$	$1.993e-03$
	1997	–	–	–	29	$2.300e-02$	$7.932e-04$
	1998	–	–	–	23	$3.050e-02$	$1.326e-03$
	1999	–	–	–	18	$7.260e-02$	$4.033e-03$
	2000	–	–	–	32	$4.007e-02$	$1.252e-03$
	2001	–	–	–	14	$4.354e-03$	$3.110e-04$
	2002	–	–	–	73	$4.995e-02$	$6.843e-04$
	2003	–	–	–	549	$1.181e-01$	$2.152e-04$
	2004	–	–	–	1470	$6.136e-01$	$4.174e-04$
	2005	–	–	–	321	$2.627e-02$	$8.184e-05$
	2006	–	–	–	4	$1.065e-03$	$2.662e-04$
	2007	–	–	–	1842	$3.222e-02$	$3.499e-05$
	2008	–	–	–	233	$1.078e-02$	$4.629e-05$
	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	$9.806e-05$	$7.543e-06$	541	$2.912e-02$	$5.383e-05$
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	$2.494e-02$	$6.929e-04$
	1996	2	$1.178e-03$	$5.891e-04$	32	$9.499e-03$	$2.968e-04$
	1997	259	$3.166e-03$	$1.222e-05$	288	$5.484e-02$	$1.904e-04$
	1998	81	$9.621e-04$	$1.188e-05$	709	$8.477e-02$	$1.196e-04$
	1999	29	$1.684e-04$	$5.806e-06$	1	$6.441e-05$	$6.441e-05$
	2000	42	$4.053e-04$	$9.650e-06$	284	$1.512e-02$	$5.326e-05$
	2001	263	$1.838e-03$	$6.988e-06$	389	$4.191e-02$	$1.077e-04$
	2002	119	$1.068e-03$	$8.973e-06$	551	$4.048e-02$	$7.346e-05$
	2003	16	$1.537e-04$	$9.606e-06$	333	$3.813e-02$	$1.145e-04$
	2004	87	$1.400e-03$	$1.610e-05$	309	$3.069e-02$	$9.931e-05$
	2005	43	$2.827e-04$	$6.575e-06$	102	$7.765e-03$	$7.613e-05$
	2006	74	$8.868e-03$	$1.198e-04$	54	$1.108e-02$	$2.053e-04$
	2007	42	$2.574e-03$	$1.225e-04$	375	$1.115e-02$	$8.919e-05$
	2008	766	$1.657e-03$	$4.326e-06$	242	$5.759e-03$	$4.759e-05$
	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	74	$5.686e-04$	$7.683e-06$	78	$5.240e-03$	$6.718e-05$
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	$1.006e-02$	$2.485e-05$	860	$5.595e-01$	$6.506e-04$
	1995	–	–	–	1462	$1.925e-01$	$1.317e-04$
	1996	628	$1.495e-02$	$2.381e-05$	1533	$5.288e-01$	$3.450e-04$
	1997	464	$1.562e-02$	$3.365e-05$	2189	$4.893e-01$	$2.235e-04$
	1998	345	$1.826e-02$	$5.292e-05$	2414	$3.699e-01$	$1.532e-04$
	1999	484	$1.618e-02$	$3.344e-05$	2802	$2.077e-01$	$7.414e-05$
	2000	1271	$1.612e-02$	$1.268e-05$	3152	$4.065e-01$	$1.290e-04$
	2001	1364	$3.388e-02$	$2.484e-05$	1505	$1.874e-01$	$1.245e-04$
	2002	1435	$1.857e-02$	$1.294e-05$	934	$8.655e-02$	$9.266e-05$
	2003	436	$2.495e-03$	$5.722e-06$	1087	$7.426e-02$	$6.832e-05$
	2004	673	$6.315e-03$	$9.383e-06$	2721	$2.134e-01$	$7.843e-05$
	2005	1725	$7.835e-02$	$4.542e-05$	1142	$1.339e-01$	$1.173e-04$
	2006	1200	$8.137e-02$	$6.781e-05$	1172	$8.750e-02$	$7.466e-05$
	2007	3291	$1.137e-01$	$1.037e-04$	7362	$1.486e-01$	$6.056e-05$
	2008	8458	$2.357e-01$	$5.573e-05$	6232	$1.524e-01$	$4.892e-05$
	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	1032	$1.372e-02$	$1.330e-05$	673	$3.511e-02$	$5.216e-05$
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	$1.600e-03$	$1.455e-04$	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	$1.950e-03$	$7.588e-06$	7	$9.926e-04$	$1.418e-04$
	1999	295	$3.556e-03$	$1.205e-05$	1	$1.181e-04$	$1.181e-04$
	2000	2	$1.092e-04$	$5.461e-05$	1	$6.297e-04$	$6.297e-04$
	2001	7	$6.132e-05$	$8.760e-06$	–	–	–
	2002	3	$5.681e-05$	$1.894e-05$	–	–	–
	2003	1	$3.199e-05$	$3.199e-05$	–	–	–
	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	$2.740e-03$	$6.849e-04$
	1997	157	$2.234e-02$	$1.423e-04$	3	$2.141e-03$	$7.136e-04$
	1998	457	$1.387e-02$	$3.035e-05$	112	$1.892e-02$	$1.690e-04$
	1999	314	$4.562e-03$	$1.453e-05$	516	$2.911e-02$	$5.641e-05$
	2000	150	$1.247e-03$	$8.313e-06$	15	$2.364e-03$	$1.576e-04$
	2001	130	$6.725e-03$	$5.173e-05$	45	$1.161e-02$	$2.580e-04$
	2002	44	$1.688e-02$	$3.837e-04$	20	$9.996e-03$	$4.998e-04$
	2003	37	$1.136e-02$	$3.070e-04$	81	$1.491e-02$	$1.840e-04$
	2004	99	$3.950e-02$	$3.990e-04$	175	$1.991e-02$	$1.138e-04$
	2005	47	$3.286e-02$	$6.991e-04$	21	$7.500e-03$	$3.571e-04$
	2006	41	$1.294e-01$	$3.157e-03$	20	$1.444e-03$	$7.221e-05$
	2007	78	$2.714e-01$	$6.959e-03$	117	$3.238e-03$	$8.304e-05$
	2008	16	$1.431e-01$	$1.789e-02$	27	$4.543e-04$	$1.682e-05$
	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	$8.963e-05$	$4.481e-05$
	2015	17	$2.520e-03$	$1.482e-04$	3	$3.649e-04$	$1.216e-04$
	2016	–	–	–	1	$2.919e-04$	$2.919e-04$
521	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	$1.912e-02$	$5.493e-05$	96	$2.081e-01$	$2.167e-03$

	1995	34	$1.443e-01$	$4.243e-03$	86	$4.436e-02$	$5.158e-04$
	1996	323	$6.127e-02$	$1.897e-04$	942	$7.368e-02$	$7.821e-05$
	1997	257	$2.813e-02$	$1.095e-04$	306	$3.165e-02$	$1.034e-04$
	1998	219	$4.606e-02$	$2.103e-04$	574	$1.715e-01$	$2.987e-04$
	1999	896	$3.074e-02$	$3.431e-05$	489	$4.875e-02$	$9.970e-05$
	2000	844	$4.531e-02$	$5.369e-05$	267	$6.346e-02$	$2.377e-04$
	2001	357	$5.854e-02$	$1.640e-04$	2335	$4.777e-01$	$2.046e-04$
	2002	1267	$3.078e-02$	$2.429e-05$	2222	$2.383e-01$	$1.072e-04$
	2003	401	$4.276e-03$	$1.066e-05$	1583	$3.265e-01$	$2.063e-04$
	2004	259	$6.907e-03$	$2.667e-05$	1990	$1.169e-01$	$5.873e-05$
	2005	840	$2.026e-02$	$2.412e-05$	4804	$3.888e-01$	$8.093e-05$
	2006	697	$6.412e-02$	$9.199e-05$	4410	$2.529e-01$	$5.734e-05$
	2007	4329	$6.466e-02$	$4.481e-05$	9558	$1.967e-01$	$6.173e-05$
	2008	6072	$5.612e-02$	$1.848e-05$	5800	$1.381e-01$	$4.761e-05$
	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	1302	$4.313e-03$	$3.313e-06$	968	$5.478e-02$	$5.660e-05$
523	1993	2	$7.714e-04$	$3.857e-04$	–	–	–
	1994	2	$8.122e-04$	$4.061e-04$	–	–	–
	1995	2	$3.853e-03$	$1.927e-03$	–	–	–
	1996	9	$6.724e-04$	$7.471e-05$	6	$2.669e-04$	$4.448e-05$
	1997	2	$1.235e-03$	$6.177e-04$	25	$1.191e-04$	$4.762e-06$
	1998	4	$1.611e-03$	$4.027e-04$	16	$5.484e-04$	$3.428e-05$
	1999	9	$1.883e-03$	$2.092e-04$	2	$1.180e-05$	$5.900e-06$
	2000	7	$4.027e-04$	$5.752e-05$	1	$2.196e-06$	$2.196e-06$
	2001	6	$4.038e-04$	$6.731e-05$	6	$3.388e-04$	$5.646e-05$
	2002	2	$9.754e-05$	$4.877e-05$	1	$7.334e-04$	$7.334e-04$
	2003	4	$4.313e-05$	$1.078e-05$	1	$3.156e-06$	$3.156e-06$
	2004	7	$8.512e-05$	$1.216e-05$	–	–	–
	2005	17	$2.907e-04$	$1.710e-05$	1	$4.054e-05$	$4.054e-05$
	2006	12	$1.877e-04$	$1.564e-05$	–	–	–
	2007	12	$1.079e-04$	$2.699e-05$	–	–	–
	2008	12	$1.047e-04$	$1.745e-05$	–	–	–
	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	$2.100e-05$	$2.100e-05$	–	–	–
524	1993	–	–	–	1	$9.212e-02$	$9.212e-02$
	1995	6	$4.832e-04$	$8.053e-05$	605	$4.892e-02$	$8.086e-05$

1996	15	$3.624e-04$	$2.416e-05$	162	$3.617e-02$	$2.233e-04$
1997	3	$4.883e-04$	$1.628e-04$	5	$2.465e-03$	$4.930e-04$
1998	43	$8.597e-03$	$1.999e-04$	25	$1.061e-02$	$4.243e-04$
1999	39	$1.085e-02$	$2.783e-04$	21	$1.301e-01$	$6.194e-03$
2000	1	$1.130e-04$	$1.130e-04$	38	$2.441e-02$	$6.422e-04$
2001	3	$9.535e-03$	$3.178e-03$	142	$4.404e-02$	$3.102e-04$
2002	38	$1.415e-02$	$3.725e-04$	132	$3.800e-02$	$2.879e-04$
2003	76	$1.216e-03$	$1.600e-05$	285	$1.142e-01$	$4.008e-04$
2004	140	$8.145e-03$	$5.818e-05$	1433	$2.383e-01$	$1.663e-04$
2005	51	$3.459e-03$	$6.783e-05$	196	$2.320e-02$	$1.184e-04$
2006	34	$5.597e-04$	$1.646e-05$	50	$5.302e-03$	$1.060e-04$
2007	171	$4.982e-03$	$8.741e-05$	232	$1.089e-02$	$9.391e-05$
2008	356	$2.213e-03$	$1.243e-05$	126	$1.563e-03$	$2.481e-05$
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	94	$7.162e-04$	$7.619e-06$	28	$2.758e-03$	$9.851e-05$

Total bycatch size compositions

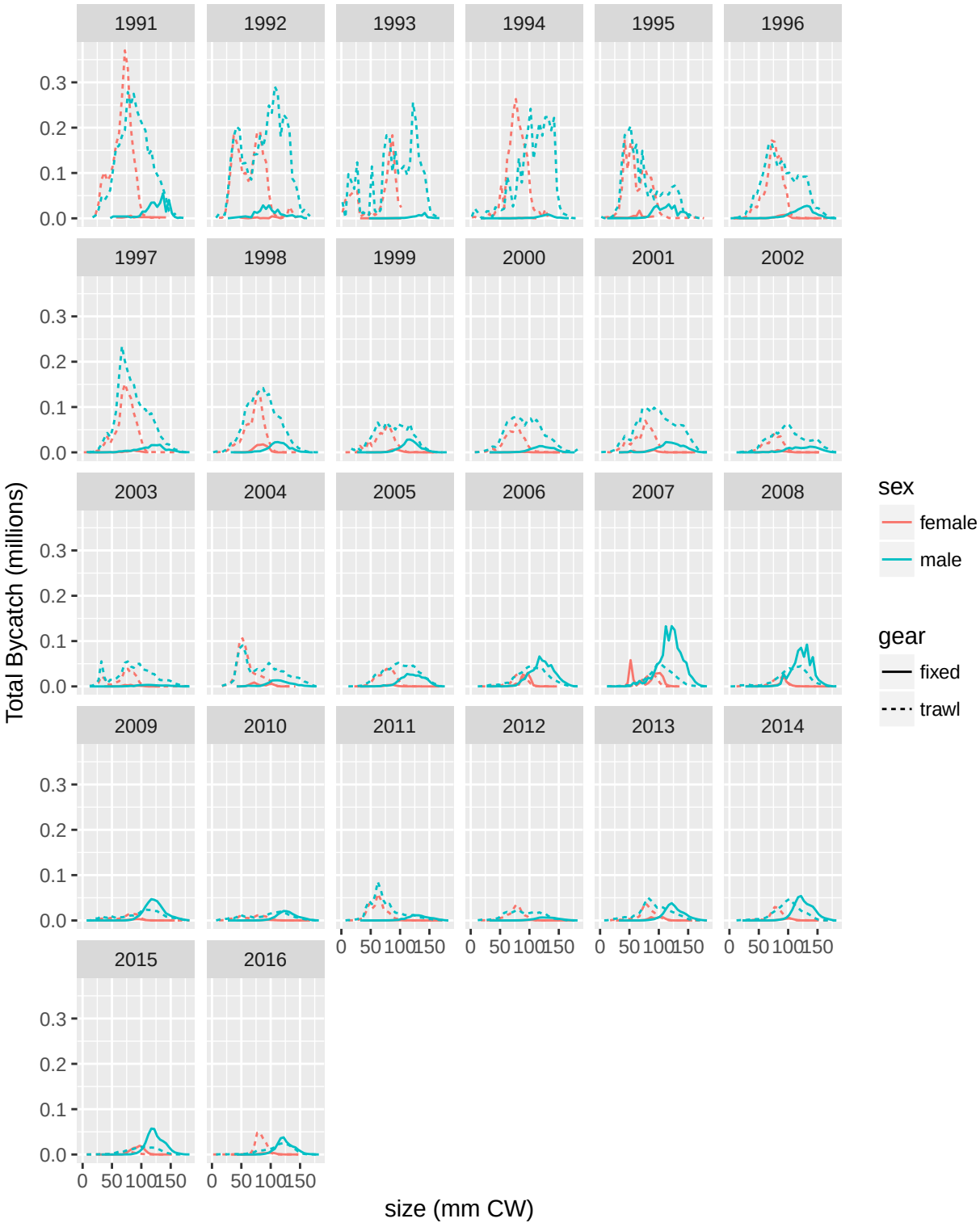

Figure 7. Total bycatch size frequencies, by year, gear type and sex.

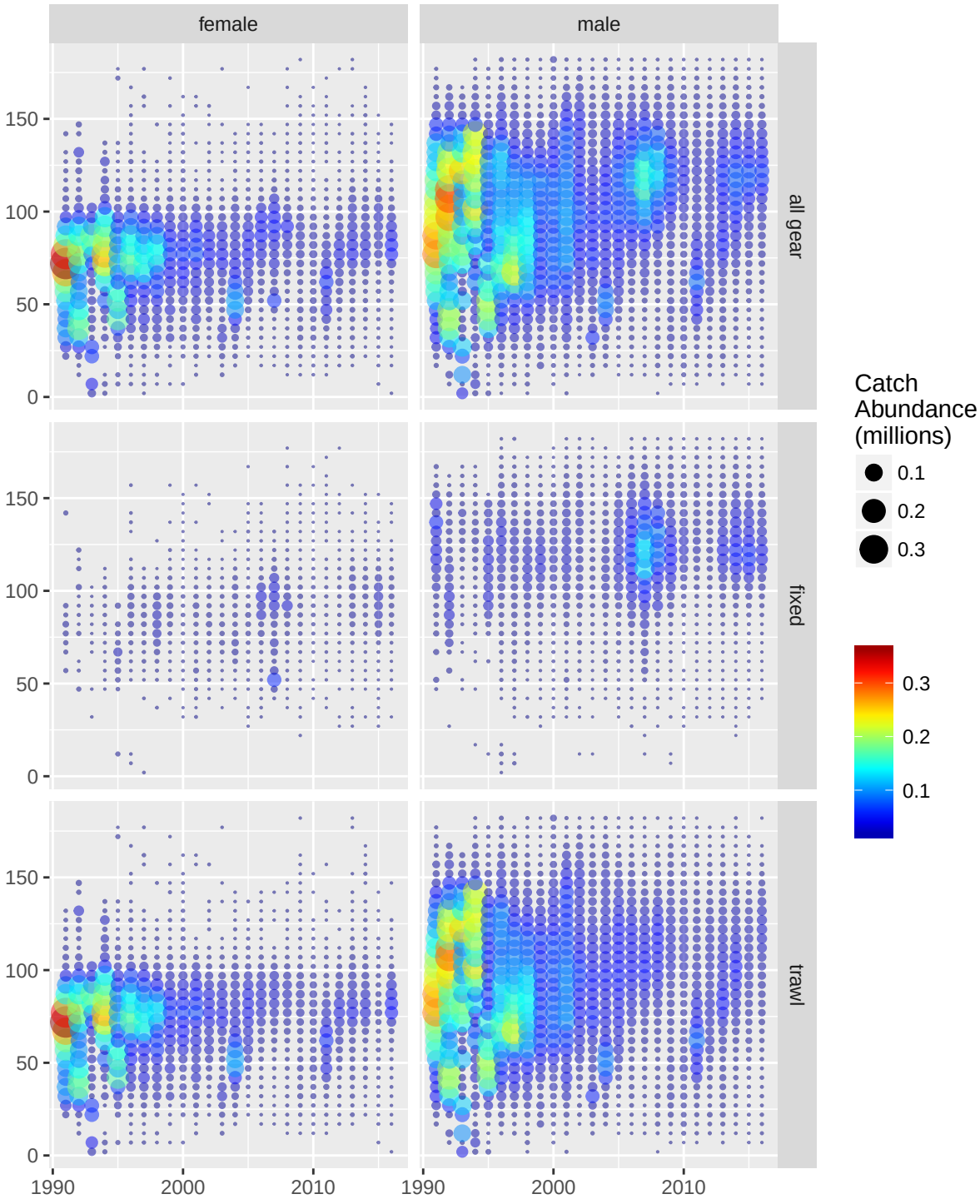

Figure 8. Total bycatch size frequencies, by year, gear type and sex. Bubble area scales with catch abundance.

Size compositions aggregated over gear type

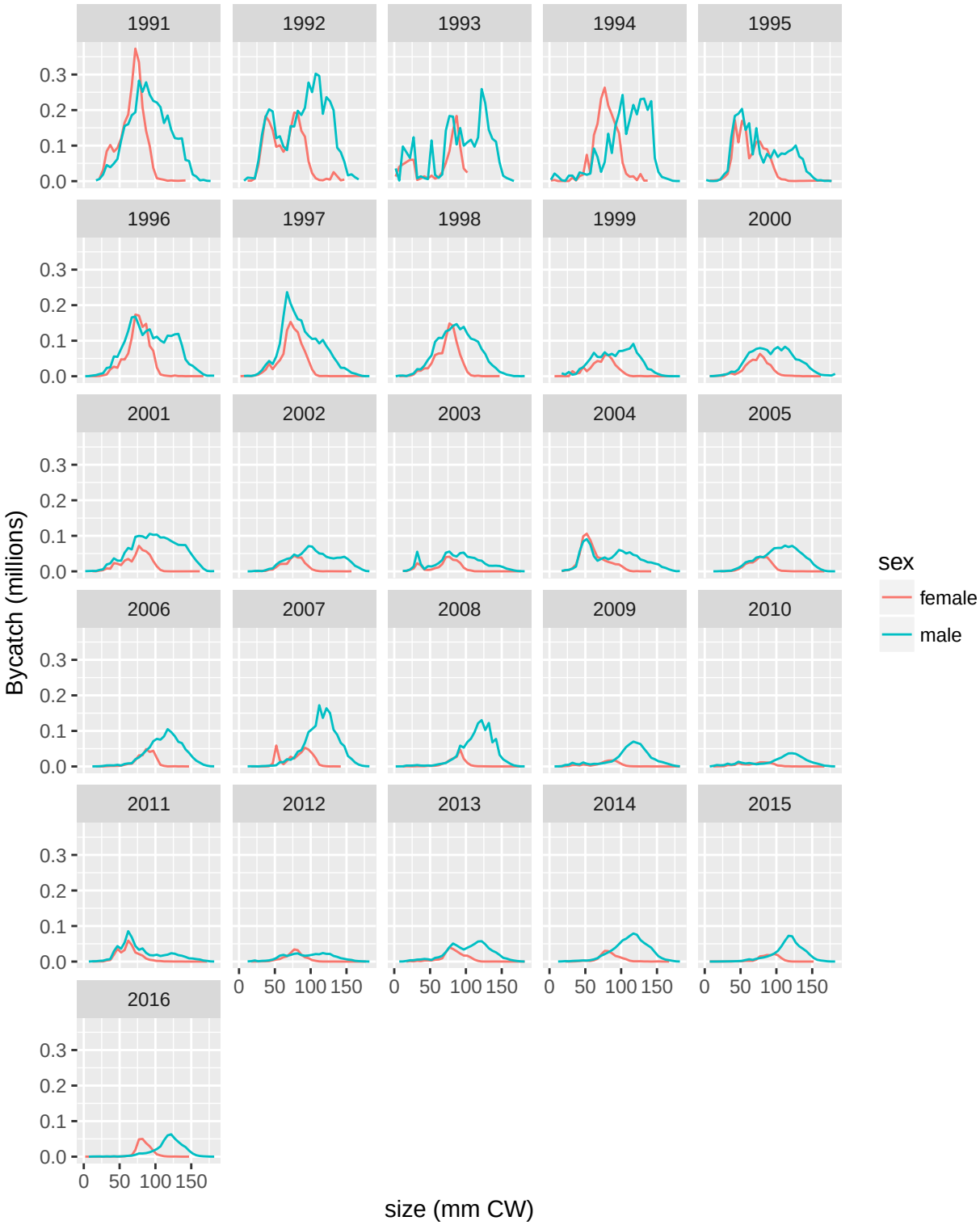

Figure 9. Total bycatch size frequencies, by year and sex, aggregated over gear type.

Spatial patterns of bycatch

Spatial patterns of Tanner crab bycatch in the groundfish fisheries, by ADFG stat area for 2009-2016, are illustrated by gear type in Figures 11-12 below. Bycatch less than 0.1 t in a stat area is not shown.

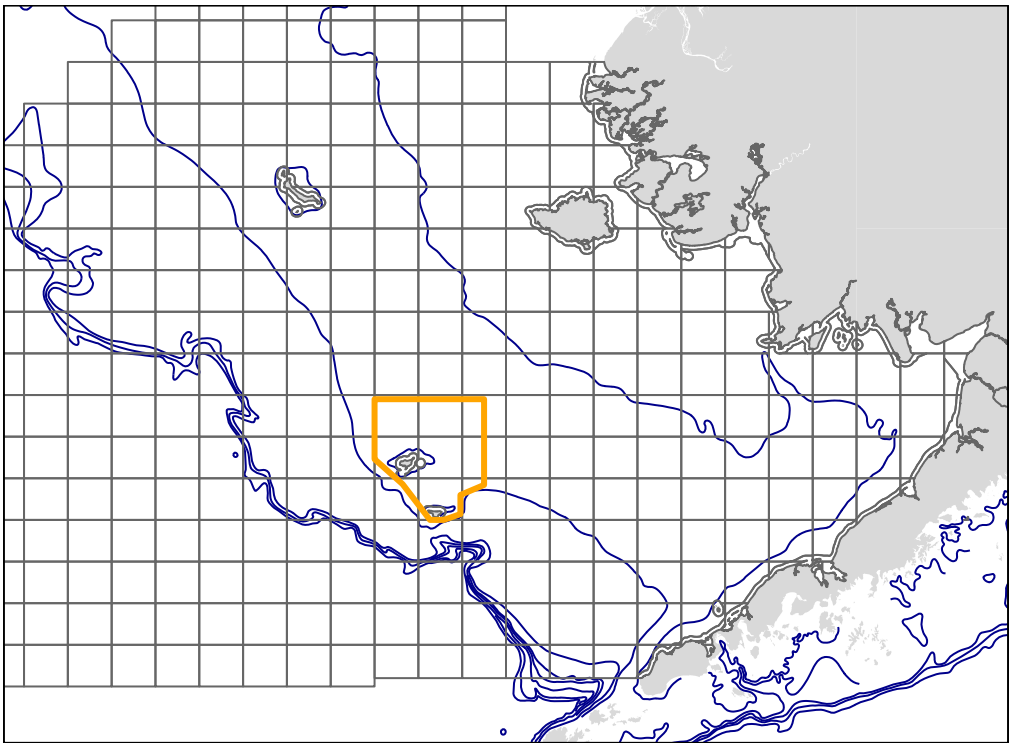

Figure 10. Basemap for subsequent maps, with EBS bathymetry (blue lines), ADFG stat areas (black rectangles), and the Pribilof Islands Habitat Conservation Area (orange outline).

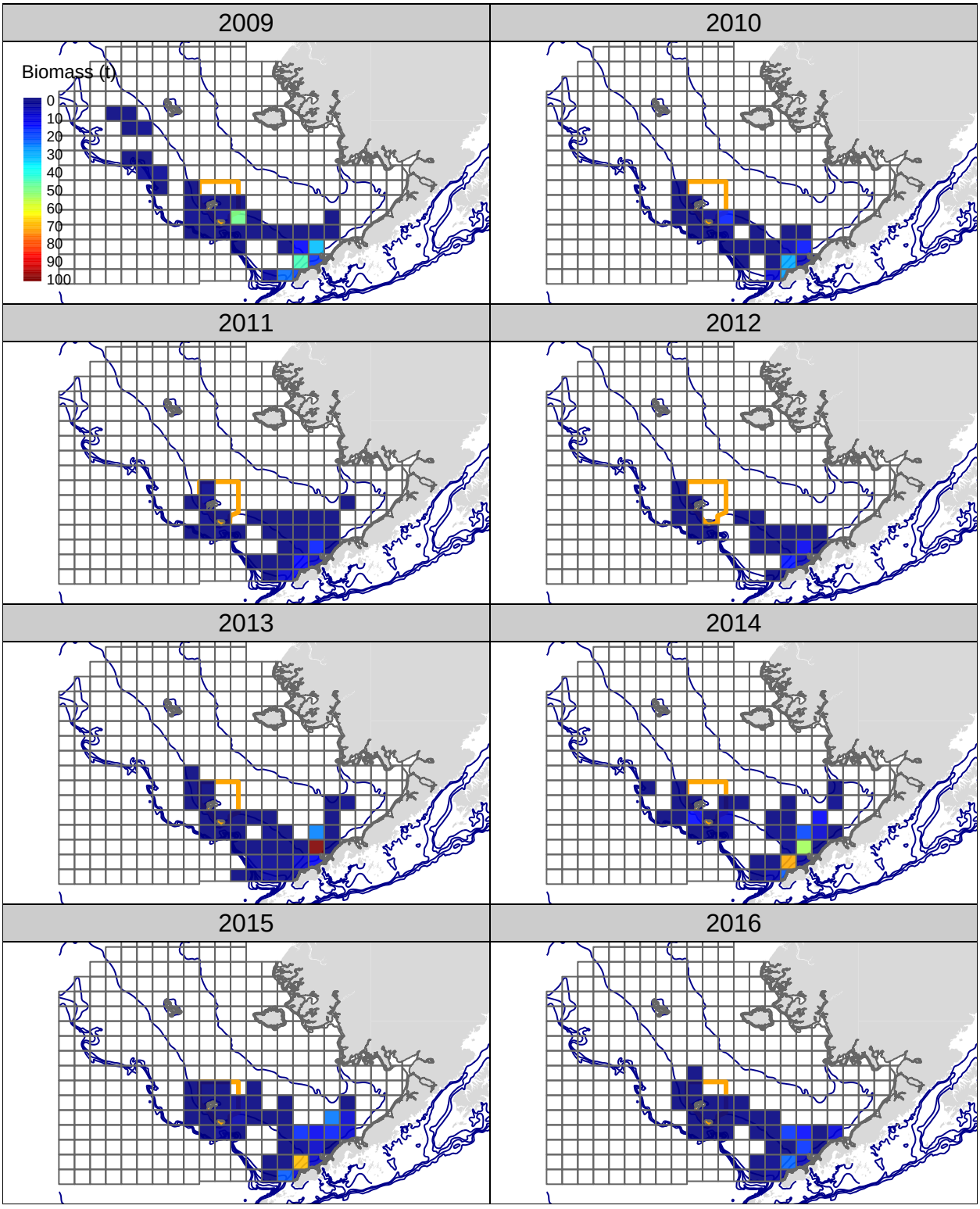

Figure 11 (1of 1). Bycatch of Tanner crab, by ADFG stat area, in the fixed gear groundfish fisheries.

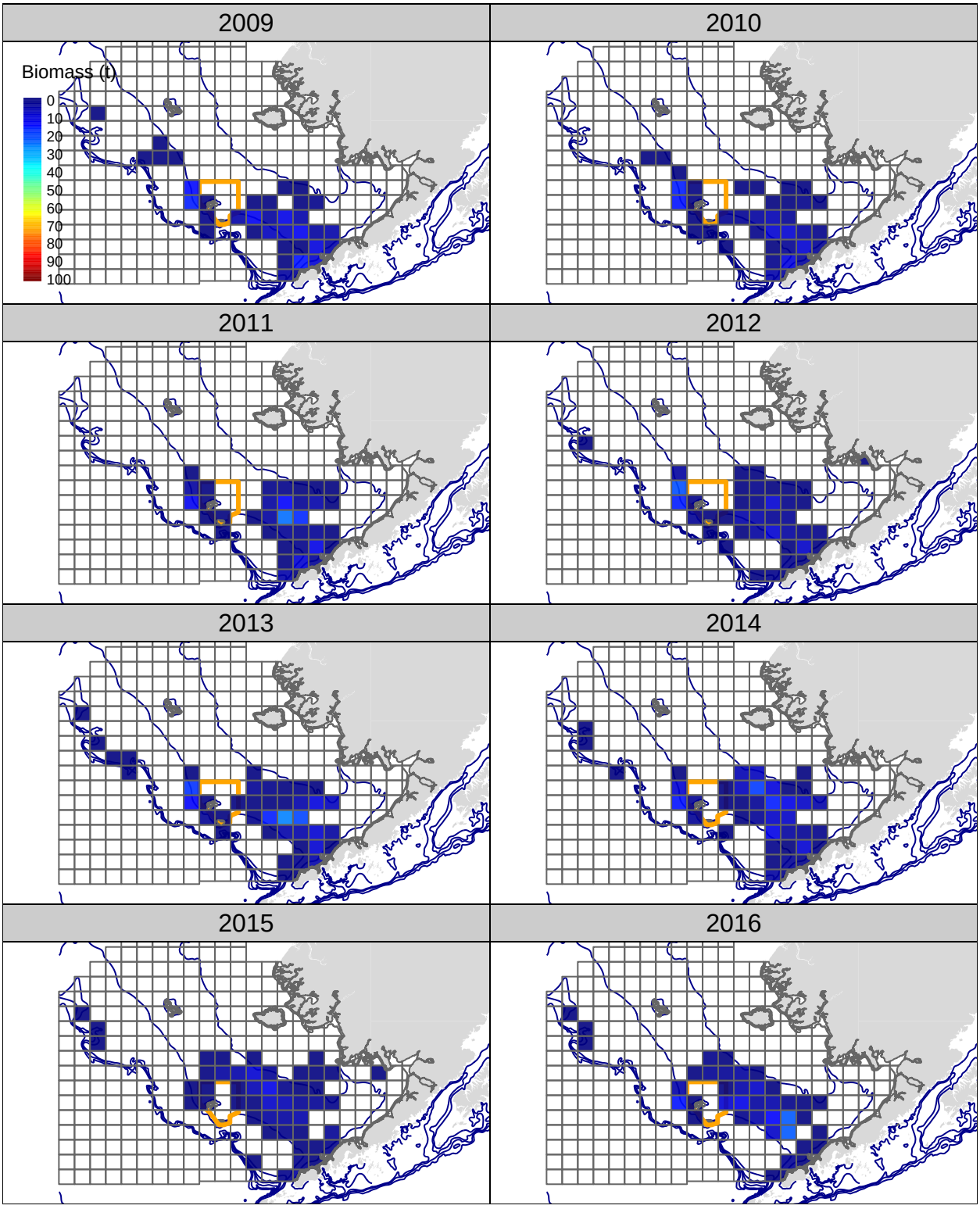

Figure 12 (1of 1). Bycatch of Tanner crab, by ADFG stat area, in the trawl gear groundfish fisheries.