

Appendix C: Tanner Crab Bycatch in the Groundfish Fisheries

William Stockhausen

Introduction

This appendix documents the creation of the annual sex-specific size compositions for Tanner crab bycatch in the groundfish fisheries used in the Tanner crab stock assessment model. In summary, annual sampling data for size frequencies by sex, gear ("trawl" and "fixed"), and NMFS reporting area of Tanner crab bycatch in the EBS groundfish fisheries was extracted from the NORPAC observer database (via AKFIN). These observed size frequency data were then converted to crab year and scaled to total estimated bycatch size compositions using year/gear/area expansion factors developed from total bycatch estimates for 1991-2008 from the NMFS Alaska Regional Office's (AKRO) Catch Accounting System/Blend database (Cahalan et al., 2009) and for 2009 to the present from the AKRO's Catch-in-Areas database (via AKFIN).

Annual sex- and gear-specific size frequency data for Tanner crab bycatch in the ground fish fisheries was also available from the NORPAC observer database for 1986-1990. However, total bycatch estimates by gear and reporting area were not available to scale these frequencies to total bycatch size compositions, so the previously-developed all-gear size compositions for 1973-1990 will continue to be used in the assessment.

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 (Figure 1, Table 1), hence "raw" size frequencies (Figures 2-4) are not 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. These will first be converted to gear/area-specific size compositions that sum to 1 when aggregated over both sexes, then they will be scaled to total catch gear/area/sex-specific bycatch size frequencies, and finally they will be aggregated across area to obtain total catch gear/sex-specific bycatch size frequencies.

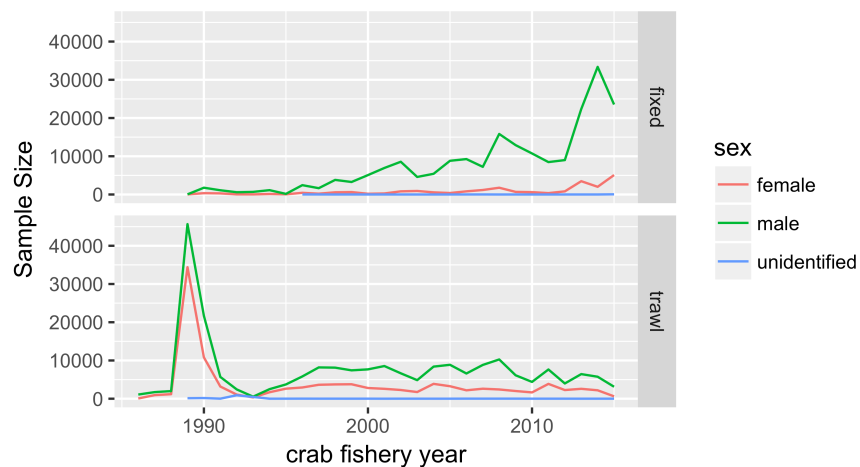


Figure 1. Sample sizes from observer sampling for Tanner crab (> 24 mm CW) bycatch size frequencies in the groundfish fisheries.

year	fixed gear			trawl gear		
	female	male	unidentified	female	male	unidentified
1986	0	0	0	62	1,091	0
1987	0	0	0	936	1,725	0
1988	0	0	0	1,185	1,990	0
1989	16	41	0	34,391	45,657	130
1990	345	1,773	0	10,810	21,668	173
1991	288	1,106	0	3,189	5,700	11
1992	31	597	0	1,078	2,430	904
1993	25	683	0	333	534	0
1994	126	1,133	0	1,694	2,495	4
1995	44	162	0	2,622	3,734	8
1996	439	2,442	13	2,936	5,822	17
1997	217	1,650	8	3,642	8,185	10
1998	571	3,814	2	3,739	8,123	12
1999	633	3,269	7	3,778	7,418	7
2000	193	5,074	3	2,795	7,672	11
2001	272	6,934	7	2,587	8,544	2
2002	821	8,563	0	2,278	6,645	11
2003	921	4,589	0	1,743	4,852	8
2004	559	5,412	1	3,882	8,393	5
2005	388	8,814	0	3,266	8,868	6
2006	821	9,263	0	2,195	6,592	17
2007	1,173	7,233	11	2,613	8,833	13
2008	1,769	15,828	1	2,416	10,267	16
2009	683	12,911	4	2,011	6,125	15
2010	615	10,730	2	1,645	4,392	8
2011	362	8,474	1	3,875	7,641	7
2012	817	8,997	0	2,263	3,986	7
2013	3,477	22,347	3	2,587	6,434	4
2014	2,012	33,373	3	2,200	5,746	6
2015	5,087	23,530	45	618	3,126	6

Table 1. Sample sizes from observer sampling for Tanner crab (> 24 mm CW) bycatch size frequencies in the groundfish fisheries.

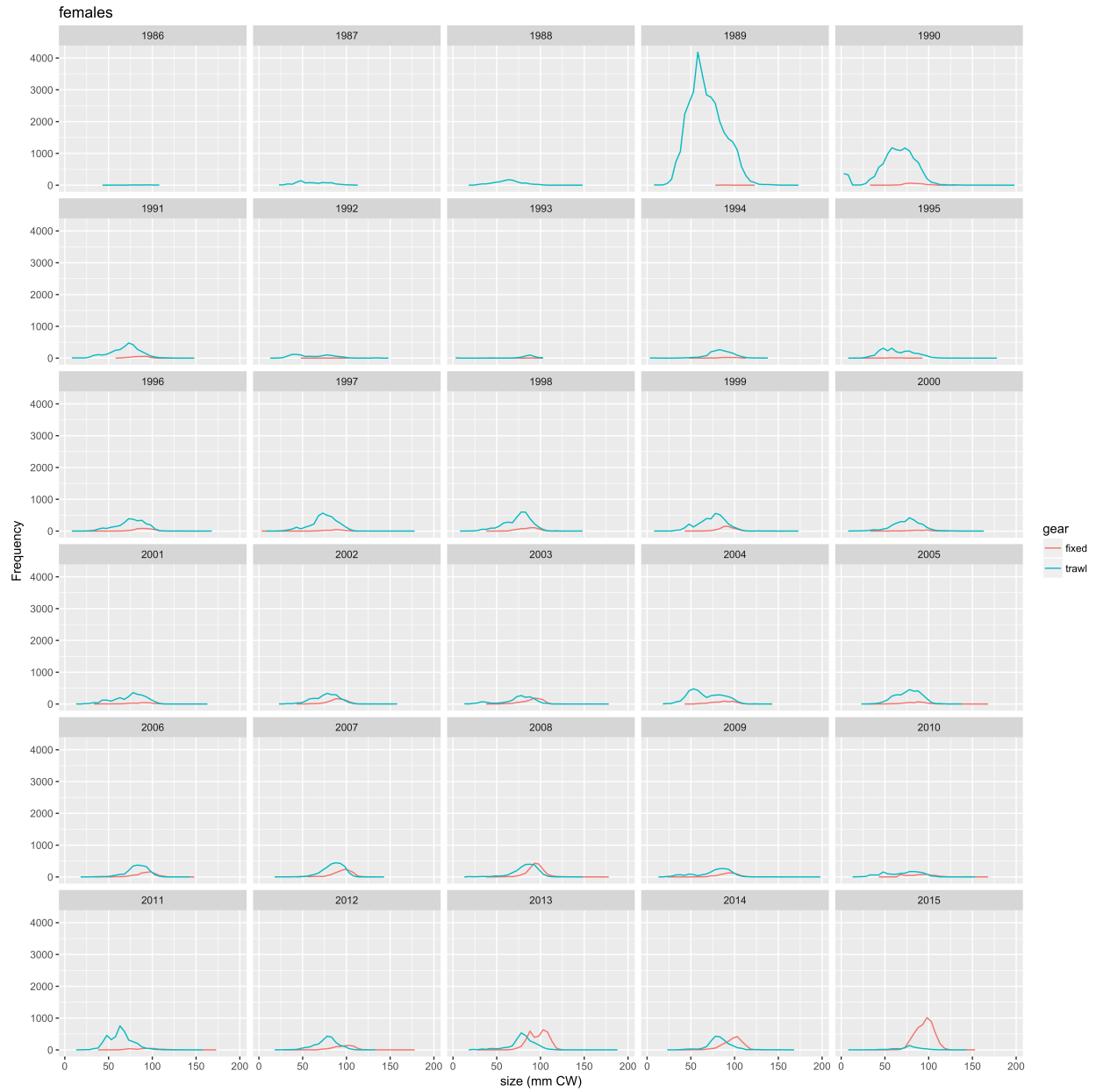


Figure 2. Raw (unscaled) size frequencies by 1-mm size bin from observer sampling for female Tanner crab bycatch in the groundfish fisheries.

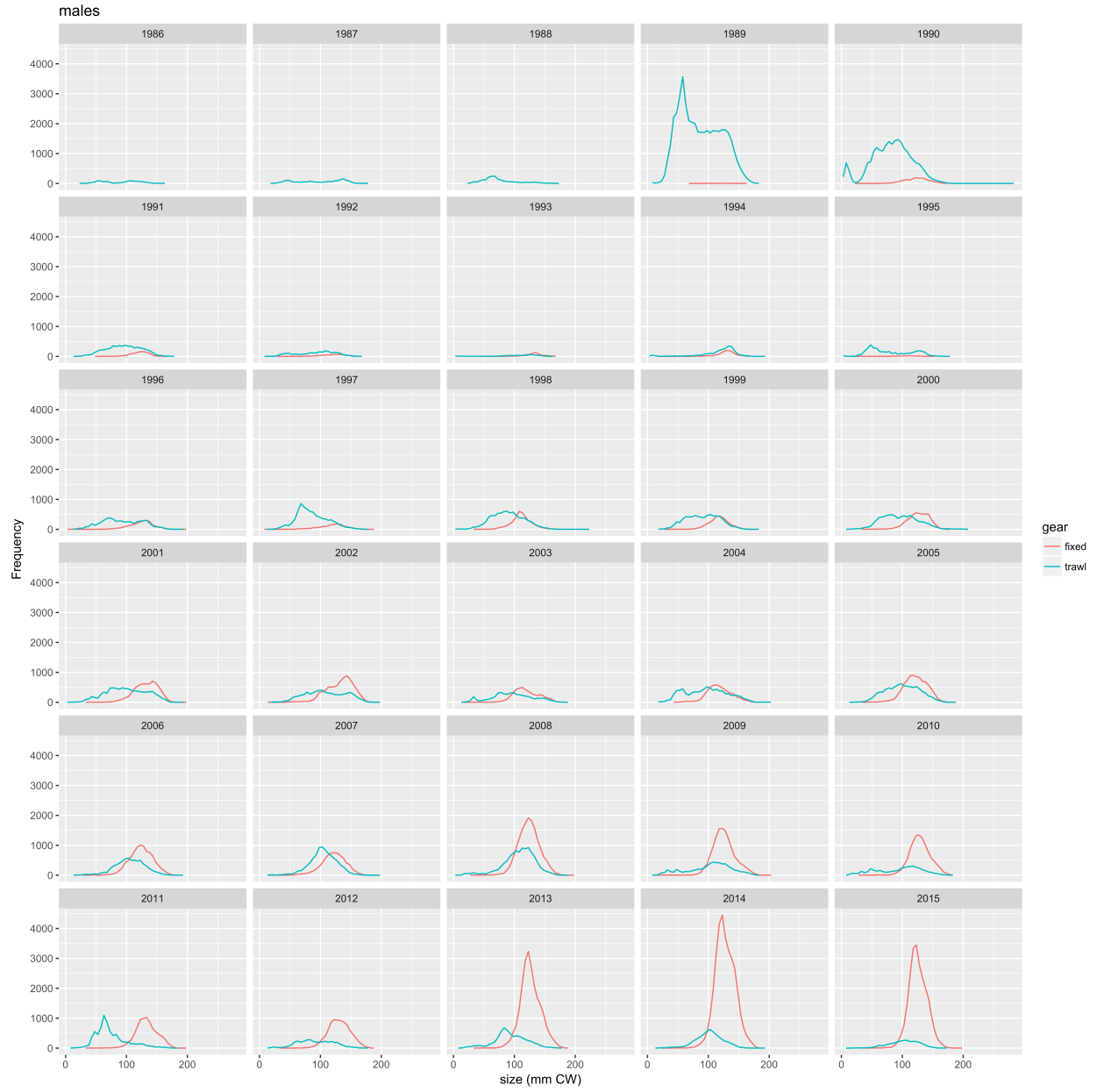


Figure 3. Raw (unscaled) size frequencies by 1-mm size bin from observer sampling for male Tanner crab bycatch in the groundfish fisheries.

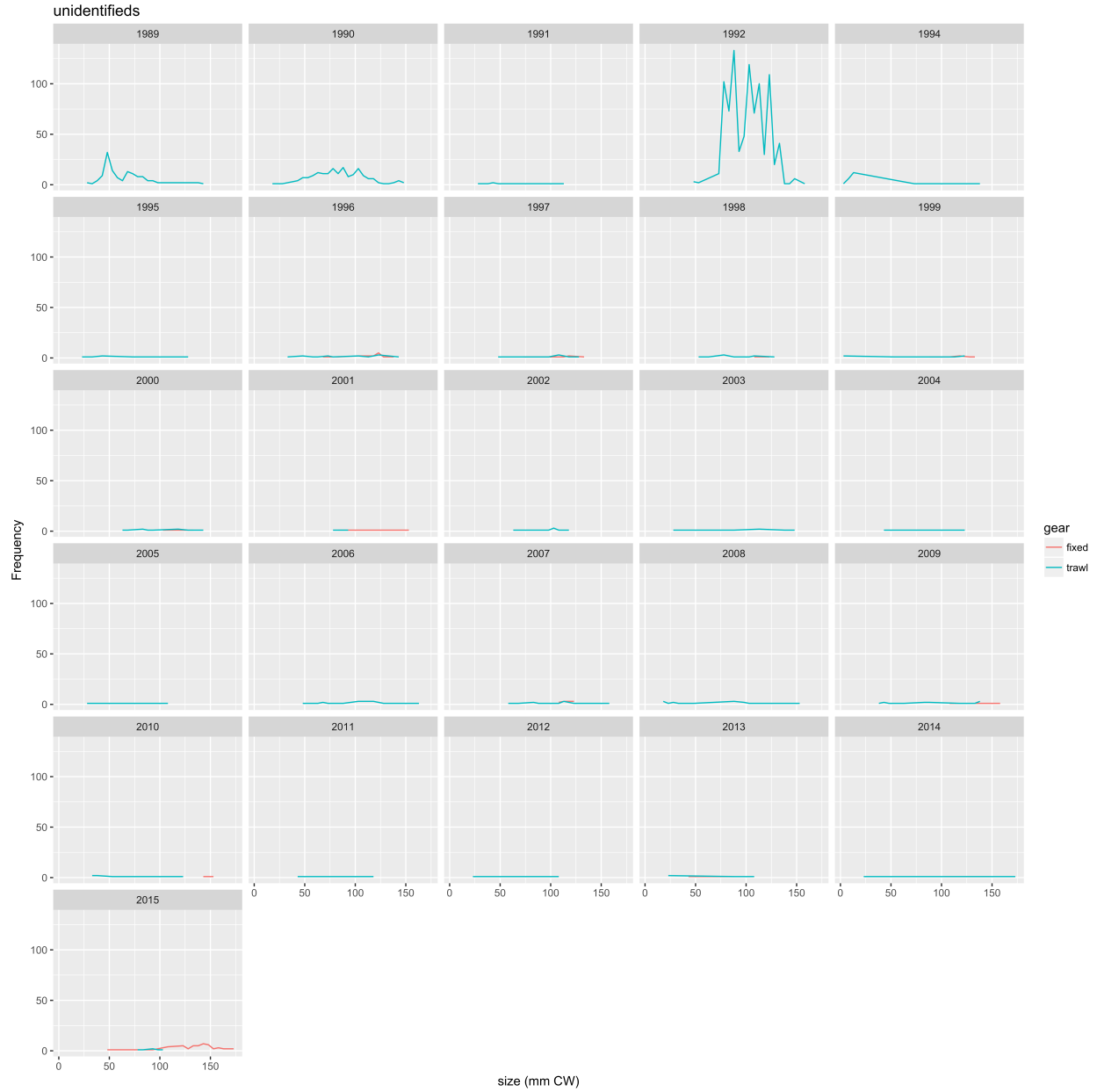


Figure 4. Raw (unscaled) size frequencies by 1-mm size bin from observer sampling for unidentified Tanner crab bycatch in the groundfish fisheries.

Estimated total bycatch

Estimated total bycatch abundance of Tanner crab in the groundfish trawl fisheries has declined since 1991 from a high of ~ 6 million crab to an average of about 500,000 since 2010, while bycatch in the fixed gear (longline + pot) fisheries has remained reasonably constant at approximately 250,000 (Figure 5, Table 2). Estimated total bycatch biomass of Tanner crab has followed similar trends (Figure 6, Table 2).

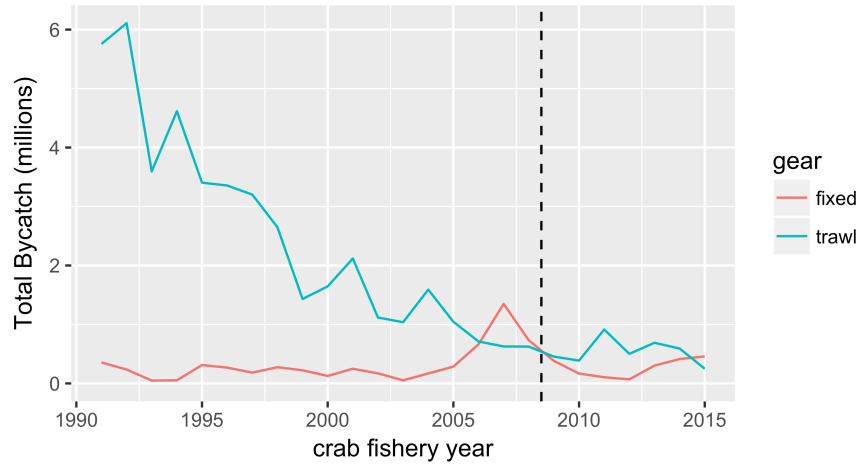


Figure 5. Estimated total bycatch (in millions of crab), by gear type, from the CAS/Blend database for 1991-2008 and the CIA database for 2009-2015.

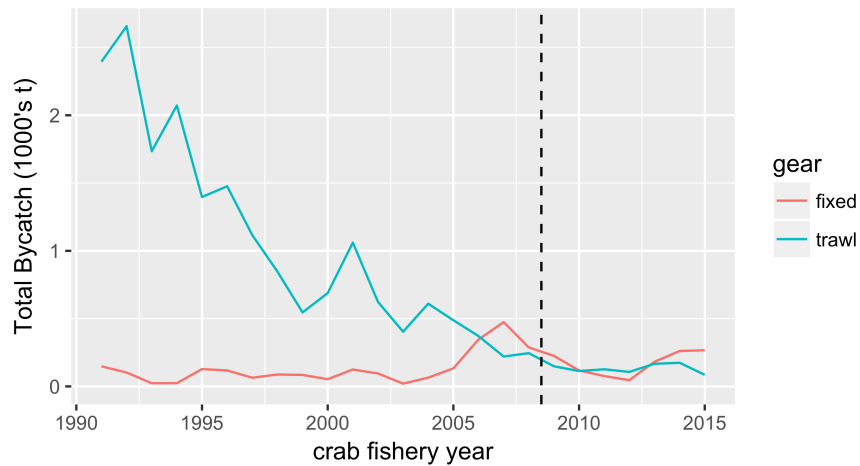


Figure 6. Estimated total bycatch (in 1000's t), by gear type, from the CAS/Blend database for 1991-2008 and the CIA database for 2009-2015.

Table 2. Estimated total bycatch by gear type from the CAS/Blend database for 1991-2008. Numbers in millions, biomass in 1000's t.

year	fixed gear		trawl gear	
	number	biomass	number	biomass
1991	0.356	0.148	5.756	2.395
1992	0.236	0.103	6.109	2.657
1993	0.049	0.023	3.596	1.735
1994	0.053	0.024	4.616	2.072
1995	0.312	0.128	3.405	1.397
1996	0.268	0.118	3.357	1.477
1997	0.183	0.064	3.202	1.116
1998	0.275	0.088	2.649	0.847
1999	0.222	0.085	1.432	0.546
2000	0.127	0.053	1.646	0.688
2001	0.249	0.125	2.118	1.061
2002	0.171	0.096	1.117	0.624
2003	0.053	0.020	1.038	0.403
2004	0.169	0.065	1.591	0.610
2005	0.285	0.133	1.046	0.488
2006	0.663	0.346	0.711	0.371
2007	1.349	0.474	0.627	0.221
2008	0.731	0.288	0.624	0.245
2009	0.382	0.225	0.455	0.149
2010	0.167	0.118	0.387	0.113
2011	0.105	0.076	0.914	0.126
2012	0.069	0.046	0.501	0.107
2013	0.302	0.182	0.689	0.167
2014	0.414	0.261	0.591	0.174
2015	0.458	0.267	0.249	0.085

Expansion factors

Expansion factors to convert from observed numbers of Tanner crab bycatch to total numbers were developed on an annual sex/gear/area basis by weighting the estimated total Tanner crab bycatch by gear/area by the sex/gear-specific fraction of crab observed for that gear/area combination (Figure 7).

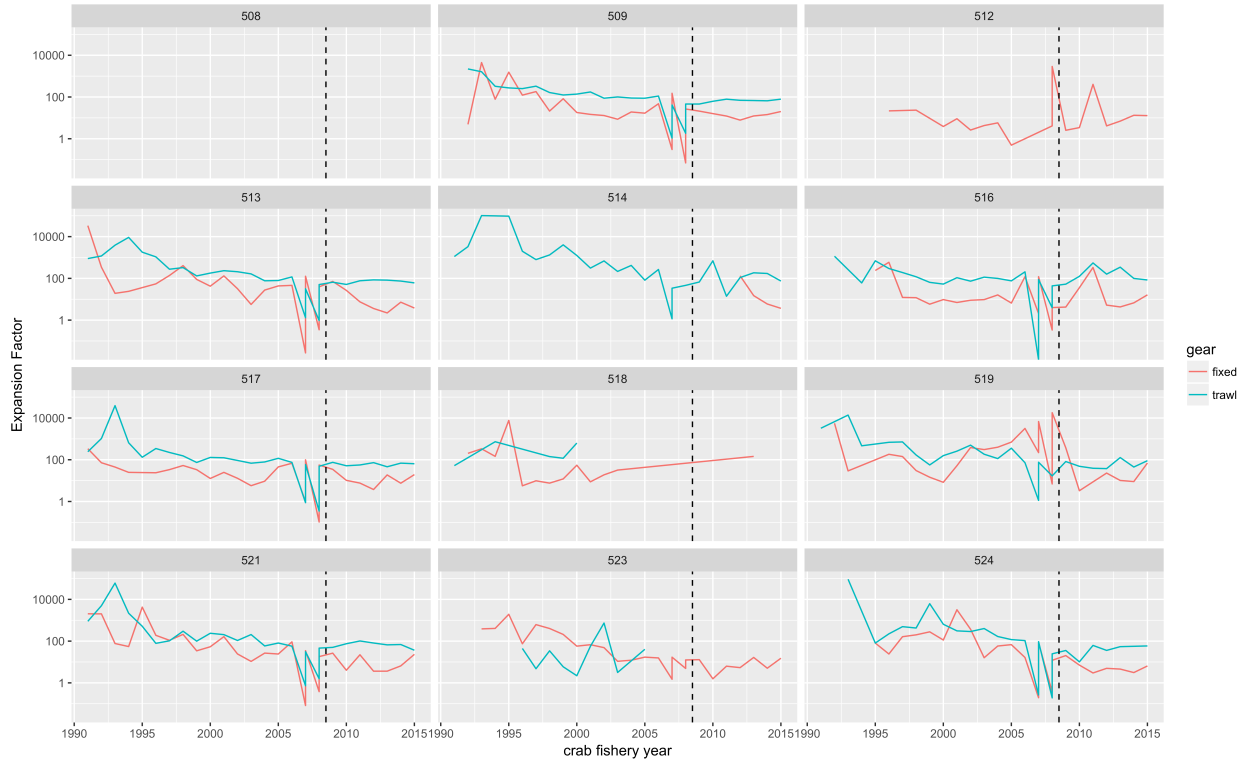


Figure 7. Expansion factors from observed size frequencies to total bycatch, by gear type and reporting area.

Total bycatch size frequencies

Sex/gear-specific annual total bycatch size frequencies were calculated by aggregating the sex/gear/area-specific size frequencies over area (Figures 8 and 9). One point to note is that, relatively speaking, fixed gear appears to capture more large crab while trawl gear captures smaller crab. This suggests that the selectivity functions for trawl gear bycatch may be dome-shaped in many years, whereas those for fixed gear may be more asymptotic at large sizes (i.e., more like an ascending logistic curve).

By gear type

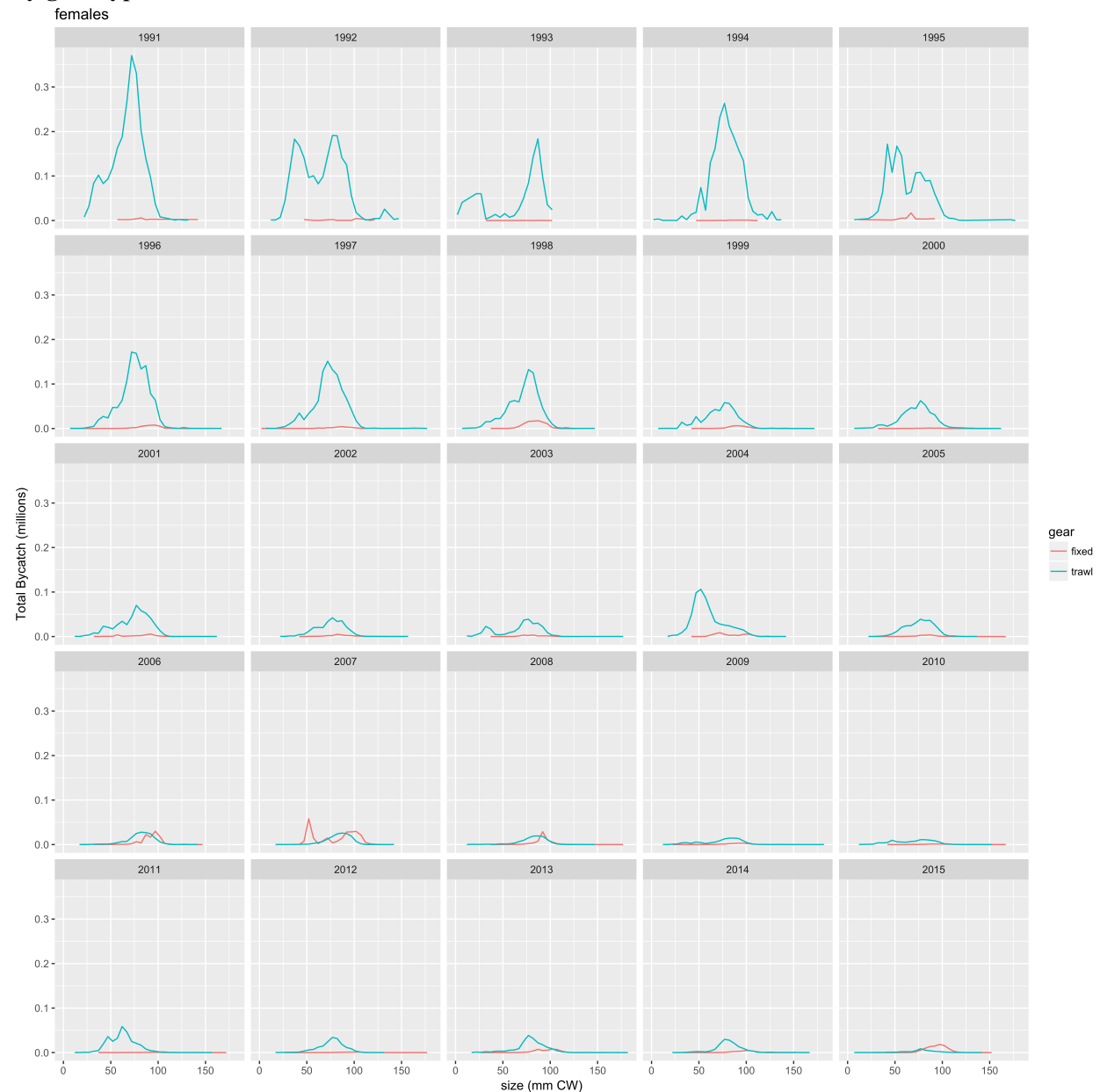


Figure 8. Total female bycatch size frequencies, by year, gear type and sex.

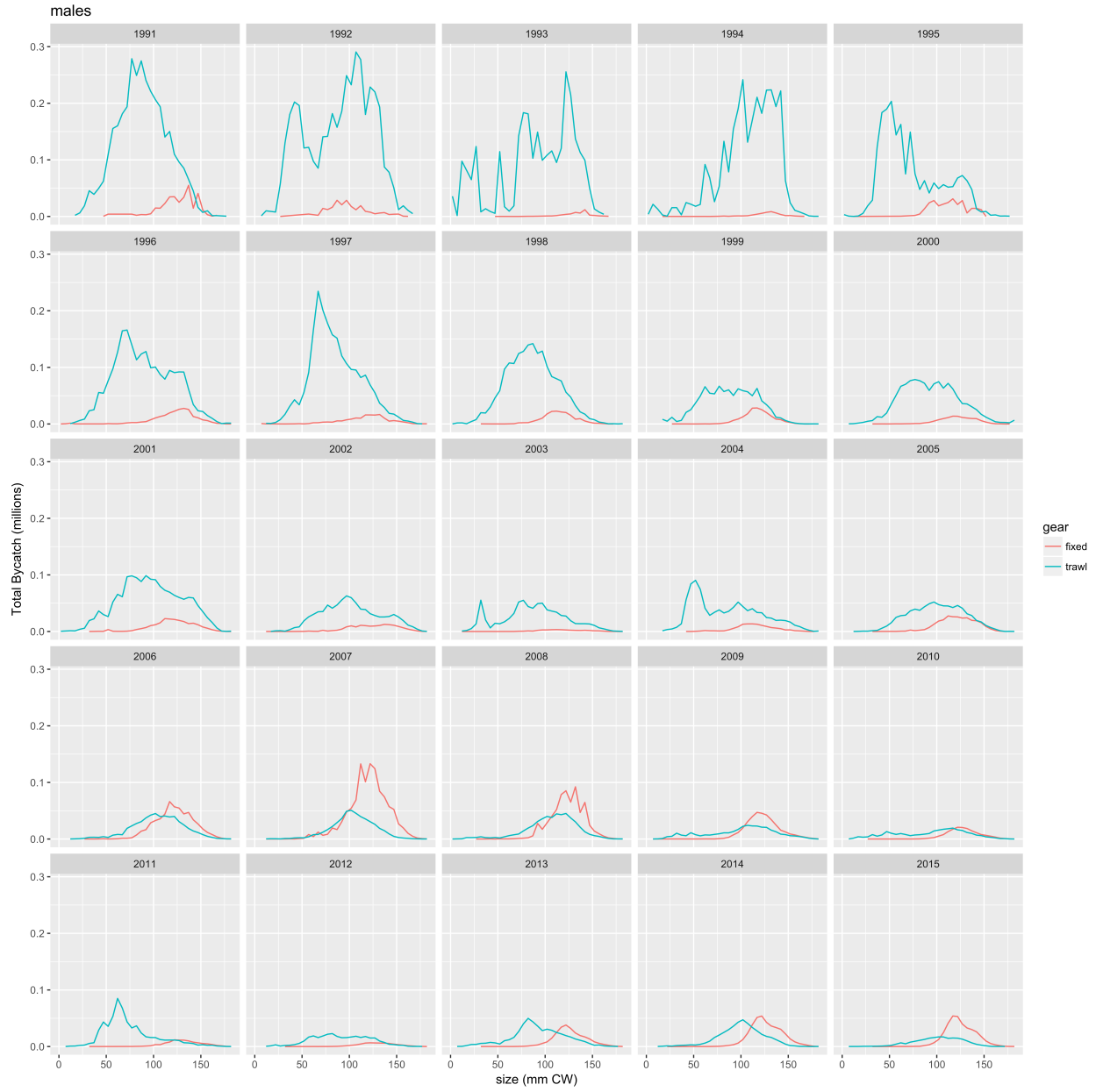


Figure 9. Total male bycatch size frequencies, by year, gear type and sex.