

**STATE OF WASHINGTON
DEPARTMENT OF FISH AND WILDLIFE**

April 30, 2024

TO: Puget Sound Dungeness Crab Fishery Managers

FROM: Aaron Dufault, Puget Sound Shellfish Manager
Katelyn Bosley, Puget Sound Crustacean Lead
Donald Velasquez, Fish and Wildlife Biologist
Blair Winnacott, Fish and Wildlife Biologist
Heidi Rutherford, IT Data Manager, Science Division

SUBJECT: Winter 2023 Dungeness Crab Recreational Catch Estimates

This memo summarizes the winter 2023 recreational Dungeness crab catch produced from the three data sources: Catch Record Cards (CRCs) returned through the mail, CRCs reported through the Internet, and catch from non-respondent CRC holders corrected for bias.

Catch is reported for Puget Sound Marine Areas 4 through 13. In 2023, Marine Areas 10, 11, 12 south of Ayock Point, and 13 were closed for the entire winter season (Table 1). Marine Area 7 opened September 5 to winter crabbing and was allowed Monday through Sunday, seven days a week. All remaining areas opened on October 1 and crabbing was allowed Monday through Sunday, seven days a week. The catch estimate for Marine Area 9 is further divided into two portions. The portion of Marine Area 9 north of the Hood Canal bridge and south of a line from Foulweather Bluff to Olele Point is combined with Marine Area 12 for management purposes (Crab Management Region 5) and is identified as area 25C in this document. Marine Area 9 (non-25C portion) refers to the remainder of Marine Area 9 including Port Townsend Bay and Admiralty Inlet. The percentage of Marine Area 9 catch taken from area 25C was estimated using a ratio calculator derived from a 2011 random survey of fishers who reported catch from Marine Area 9. Results of this survey show that 28% of crab harvested in Marine Area 9 comes from area 25C.

Each year separate summer and winter Dungeness crab catch record cards (CRC) are issued. CRCs are issued only to fishers who purchased a crab endorsement and are required only in Puget Sound marine areas. Each Dungeness crab CRC is independent from the CRC for all other species. Summer crab CRCs were valid for the period June 1 through September 4, 2023 (Labor Day). Fishers purchasing crab endorsements before August 15 were only issued a summer CRC. Winter CRCs were available at no charge at license vendors on or after August 15. Fishers who purchased or will purchase crab endorsements after August 15 can obtain both CRCs if they chose to. Fishers were required to return their winter CRCs to the Department by February 1, 2024. Each fisher has the option to mail their CRC back to the Department, drop their card off at a regional office, or report their catch online through a site developed by the Department. The Internet reporting option was only available from January 1, 2024, through February 1, 2024.

Fishers reporting on the Internet site were required to enter a document number unique to their CRC to verify they were reporting from their card rather than from memory.

Crab fishers were informed that they would be assessed a \$10.00 penalty in the form of an administrative fee on their next license purchase if they failed to report their summer or winter catch by the deadline. Three rounds of e-mail reminders were sent to crabbers with an e-mail address on file. The email reminders were sent on January 9, 23, and 30. Postcard reminders were mailed to those without e-mail addresses on January 2. Fishers were also reminded to return their card through social media ads and a WDFW blog post.

Census data from reported CRC's

A total of 32,975 fishers were issued winter Dungeness crab catch cards for the 2023 license year. A total of 15,204 fishers returned their cards by mail, dropping cards off at a regional office, or by reporting their catch online by February 1, 2024. Overall, 46.1% of fishers reported their winter CRCs (Table 2). Harvest from all the winter CRCs reported by mail and reported online were compiled into a single table and a harvest quantity was generated for each Marine Area from the reported CRCs (Table 3). These harvest data constitute a “census”, or known catch, assuming all catches were recorded on each harvester’s CRC and were correctly reported online. A weight conversion of 1.8 pounds per crab was used to convert number of crab to pounds harvested. The mean pounds per crab estimate is based on previous individual weight per crab data collected during dockside sampling of recreational catch.

Transitioning from phone survey estimates to non-response bias correction

A phone survey was conducted to complement both the summer and winter recreational CRC catches from 2007 to 2010, in order to estimate non-response bias.

The telephone surveys indicated that non-respondents caught fewer crabs per card than respondents. The average catch per card for the non-respondents was less than the returned card group because of the higher number of “zero catch cards” that exist in the non-responders and the angler’s perception that zero catch cards do not need to be returned. The bias correction model is then applied to reduce the estimate from the straight expansion.

Correlation of return rate to catch estimates determined from both the CRC returns and telephone surveys show that the bias correction factor differs with return rate. As the percentage of returns increases, the bias correction required decreases. At a 100% return rate, no correction is required. Using the data from eight reporting intervals from (2007-2010 summer and winter seasons), the regression relationship of bias correction factor with response rate is:

$$Y = -0.50(X)^2 + 1.39(X) + 0.097$$

where Y is the bias correction factor and X is the response rate.

Table 4 shows the calculated bias correction factors for response rates ranging from 11% to 52%. Figure 1 shows a plot of the overall bias correction rate model including proposed projections for higher return rates up to 100%. These corrections are made for the overall estimates, across all marine areas and for the combined returns from both mail and internet.

Estimating catch for non-reported CRCs

The 2023 winter recreational crab estimates were derived by expanding the reported catch by the proportion of issued cards to reported cards. The non-response bias correction factor was then calculated and applied based on the eight reporting intervals from 2007 through 2010 as described above. In general, catch is estimated using the following calculation:

N_R = number of cards reported
 N_T = total number of cards issued
 H_R = number of crab reported (from the Marine Area)
 H_T = estimated total crab harvest (from the Marine Area)
 B = non-response bias correction factor (0.63 for this period)

$$H_T = H_R \left(\frac{N_T}{N_R} \right) B$$

Total harvest data for the winter recreational crab fishery

Total harvest for the winter 2023 recreational season including catch from all reported CRCs (including out-of-season harvest) and non-reported CRCs is shown in Table 5. Harvest from Marine Area 9 is partitioned into the two portions described earlier with the 25C portion (28%) to be added to the Marine Area 12 catch estimate.

WDFW staff contacted people who reported catch from Marine Area 13, since the area was not open for harvest during this period. Based on that information, it was apparent that some fishers had recorded and reported the wrong marine area. Those records were corrected to reflect the proper Marine Area.

Any catch reported out of season, in a closed area, or with ‘unknown’ areas or dates was distributed between the Marine Areas and months based on catch proportions to generate the final estimates (Table 5).

Total harvest for the complete 2023 recreational season (summer and winter) is summarized in Table 6.

Table 1. Summary of recreational seasons by Puget Sound marine area for the winter 2023 Dungeness crab fishery.

Marine Area	Season	Weekdays Open	Open Days
4	October 1 - December 31	Monday - Sunday	92
5	October 1 - December 31	Monday - Sunday	92
6	October 1 - December 31	Monday - Sunday	92
7	September 5 - December 31	Monday - Sunday	118
8-1	October 1 - December 31	Monday - Sunday	92
8-2	October 1 - December 31	Monday - Sunday	92
9	October 1 - December 31	Monday - Sunday	92
10	None	None	0
11	None	None	0
12	October 1 - December 31	Monday - Sunday	92
13	None	None	0

* *The portion of Marine Area 12 south of Ayock Point was closed to recreational crabbing for winter 2023.*

Table 2. Fishers issued CRCs and percent that reported their CRC by season, 2007-2023.

Summer	CRCs Issued	CRCs Reported Mail	CRCs Reported Online	CRCs Reported	CRCs Unreported	Endorsements Entire Year
2007	210,327	34,400 (16%)	32,373 (15%)	66,773 (32%)	143,554 (58%)	226,063
2008	210,893	26,037 (12%)	43,919 (21%)	69,956 (33%)	140,937 (67%)	215,643
2009	236,665	37,128 (16%)	72,172 (30%)	107,300 (45%)	129,365 (55%)	241,226
2010	208,462	29,406 (14%)	77,472 (37%)	107,418 (52%)	101,044 (48%)	213,013
2011	230,355	31,222 (14%)	89,095 (39%)	120,317 (52%)	110,038 (48%)	237,129
2012	200,711	26,504 (13%)	79,895 (40%)	106,399 (53%)	94,312 (47%)	209,957
2013	214,692	26,236 (12%)	90,379 (42%)	116,615 (54%)	98,077 (46%)	222,050
2014	213,741	25,296 (12%)	91,270 (43%)	116,566 (55%)	97,175 (45%)	223,184
2015	232,621	25,685 (11%)	94,336 (41%)	120,021 (52%)	112,600 (48%)	243,934
2016	216,977	23,734 (11%)	90,262 (42%)	113,996 (53%)	102,981 (47%)	223,443
2017	215,929	33,252 (15%)	72,601 (34%)	105,853 (49%)	110,076 (51%)	222,222
2018	200,962	31,316 (16%)	72,790 (36%)	104,106 (52%)	96,856 (48%)	207,557
2019	192,798	29,006 (15%)	69,087 (36%)	97,571 (51%)	95,227 (49%)	200,113
2020	213,831	23,716 (11%)	53,029 (25%)	76,745 (36%)	137,086 (64%)	222,181
2021	225,282	27,534 (12%)	75,254 (33%)	102,788 (46%)	122,494 (54%)	233,108
2022	210,725	20,545 (10%)	68,164 (32%)	88,709 (42%)	122,016 (58%)	221,150
2023	185,455	22,847 (12%)	59,100 (32%)	81,947 (44%)	103,508 (56%)	194,652
Winter						
2007	157,905	10,281 (7%)	6,388 (4%)	16,669 (11%)	141,236 (89%)	226,063
2008	207,143	10,993 (5%)	10,871 (5%)	21,864 (11%)	185,279 (89%)	215,643
2009	89,259	11,909 (13%)	27,382 (31%)	39,291 (44%)	49,968 (56%)	241,226
2010	70,763	9,633 (14%)	27,346 (39%)	36,979 (52%)	33,784 (48%)	213,013
2011	28,514	4,675 (16%)	13,899 (49%)	18,574 (65%)	9,940 (35%)	237,129
2012	27,711	4,508 (16%)	13,357 (48%)	17,865 (65%)	9,846 (35%)	209,957
2013	29,638	4,419 (15%)	15,223 (51%)	19,642 (66%)	9,996 (34%)	222,050
2014	35,371	5,040 (14%)	17,401 (49%)	22,441 (63%)	12,930 (37%)	223,184
2015	36,398	5,039 (14%)	18,284 (50%)	23,323 (64%)	13,075 (36%)	243,934
2016	26,591	5,777 (22%)	10,577 (40%)	16,534 (62%)	10,057 (38%)	223,443
2017	23,277	4,431 (19%)	9,746 (42%)	14,177 (61%)	9,100 (39%)	222,222
2018	24,620	3,906 (16%)	9,896 (40%)	13,802 (56%)	10,818 (44%)	207,557
2019	23,578	4,178 (18%)	8,520(36%)	12,698 (54%)	10,880 (46%)	200,113
2020	36,459	5,015 (14%)	13,178 (36%)	18,193 (50%)	18,266 (50%)	222,181
2021	26,843	3,894 (15%)	9,591 (36%)	13,485 (50%)	13,358 (50%)	233,108
2022	37,900	5,173 (14%)	13,226 (35%)	18,399 (49%)	19,501 (51%)	221,150
2023	32,975	4,662 (14%)	10,542 (32%)	15,204 (46%)	17,771 (54%)	194,652

**Percentages shown are rounded to nearest full percent.*

Table 3. Recreational harvest from all reported CRCs for winter 2023. All out of season catch and catch reported in a closed area is included.

Marine Area	Region	Pre Labor-Day	September 5 th - 30 th	October	November	December	Unknown Month	Total Crabs	Total Pounds (lbs.)
4	3-3	0	14	44	31	28	0	117	211
5	3-3	7	8	209	126	117	0	467	841
6	3-1, 3-2	23	20	5,789	3,385	2,422	0	11,639	20,950
7	1	554	19,564	6,432	1,665	1,438	0	29,653	53,375
8	2E	0	0	34	9	9	0	52	94
8-1	2E	19	44	6,010	2,967	2,799	0	11,839	21,310
8-2	2E	202	18	7,091	3,971	4,461	0	15,743	28,337
9	2W	4	39	5,896	3,025	3,501	0	12,465	22,437
10	4	5	7	93	27	11	0	143	257
11	6	0	0	0	5	6	0	11	20
12	5	19	28	1,836	1,895	1,541	0	5,319	9,574
13	7	0	5	7	7	0	0	19	34
Unknown	--	0	0	0	5	0	0	5	9
Total	--	833	19,747	33,441	17,118	16,333	0	87,472	157,450

* Marine Area 10, Marine Area 11, the portion of Marine Area 12 south of Ayock Point, and Marine Area 13 were closed to recreational crabbing for winter 2023.

* Pre Labor-Day catch includes catch that occurred prior to the closing of the summer fishery but was reported on a winter card instead of a summer card.

Table 4. Response rate and overall estimated bias correction from telephone surveys for each reporting season, 2007 - 2010. These correction factors are calculated for catch across all marine areas and reporting types and were used to generate the current non-response bias correction factor model.

Year	Season	Response Rate	Estimated Correction Factor (B)
2007	Summer	0.32	0.50
	Winter	0.11	0.25
2008	Summer	0.33	0.53
	Winter	0.11	0.22
2009	Summer	0.45	0.53
	Winter	0.44	0.62
2010	Summer	0.52	0.66
	Winter	0.52	0.67

Table 5. Total winter 2023 recreational harvest estimates by area, including all reported CRCs and non-reported CRCs corrected for bias.

Marine Area	Region	September 5 th - 30 th	October	November	December	Total Crabs	Total Pounds (lbs.)
4	3-3	19	60	42	38	159	286
5	3-3	11	290	175	163	639	1,150
6	3-1, 3-2	27	7,946	4,646	3,325	15,944	28,699
7	1	27,313	8,979	2,325	2,008	40,625	73,125
8-1	2E	60	8,267	4,077	3,845	16,249	29,248
8-2	2E	25	9,866	5,518	6,199	21,608	38,894
9 (non-25C)	2W	38	5,818	2,985	3,453	12,294	22,129
9 (25C)	5	15	2,262	1,160	1,344	4,781	8,606
10	4	10	132	38	15	195	351
11	6	0	0	7	8	15	27
12	5	38	2,525	2,605	2,119	7,287	13,117
13	7	7	10	10	0	27	49
Total	--	27,563	46,155	23,588	22,517	119,823	215,681

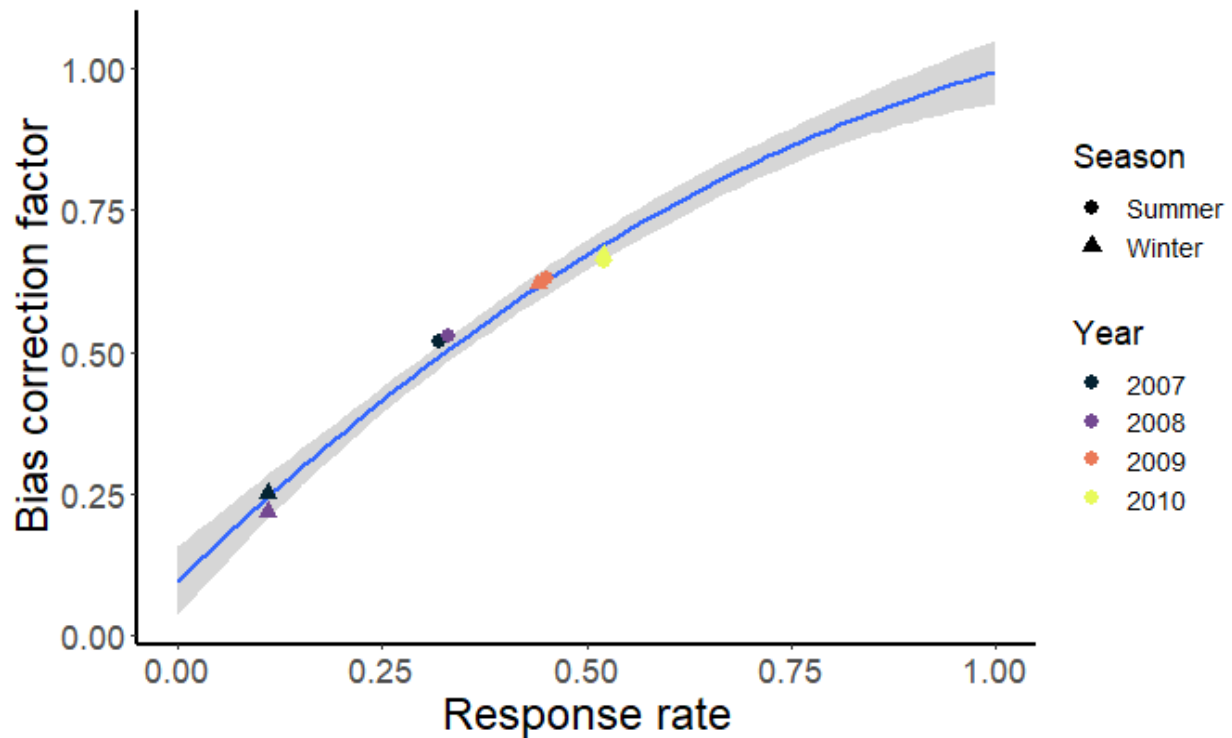
- * Marine Area 10, Marine Area 11, the portion of Marine Area 12 south of Ayock Point, and Marine Area 13 were closed to recreational crabbing for winter 2023.
- * Catch reported from “unknown” areas and/or months and all out of season harvest and harvest reported in a closed area was distributed between the areas and months in this table based on catch proportions.
- * Past phone survey information indicates that 28% of reported summer harvest within Marine Area 9 came from the 25C portion.

Table 6. Total recreational harvest estimates for 2023 by area, including all reported CRCs and non-reported CRCs corrected for bias.

Marine Area	Region	Summer total pounds (lbs.)	Winter total pounds (lbs.)	2023 total pounds (lbs.)
4	3-3	751	286	1,037
5	3-3	4,032	1,150	5,182
6	3-1, 3-2	95,404	28,699	124,103
7	1	413,942	73,125	487,067
8-1	2E	204,539	29,248	233,787
8-2	2E	232,763	38,894	271,657
9 (non-25C)	2W	88,796	22,129	110,925
9 (25C)	5	34,535	8,606	43,141
10	4	59,783	351	60,134
11	6	51,561	27	51,588
12	5	35,613	13,117	48,730
13	7	90	49	139
Total	--	1,221,809	215,681	1,437,490

* *Marine Area 12 south of Ayock Point and Marine Area 13 were closed to recreational crabbing for both summer and winter 2023. Marine Area 10 and Marine Area 11 were closed to recreational crabbing for only winter 2023.*

Figure 1. Overall bias correction by response rate based on data from returned cards and telephone surveys for eight reporting periods from 2007 through 2010.



References

Conrad, Robert, Marianna Alexandersdottir, and Northwest Indian Fisheries Commission (Wash.)., *Estimating the Harvest of Salmon by the Marine Sport Fishery in Puget Sound : Evaluation and Recommendations*. Olympia, WA (6730 Martin Way E., Olympia 98506): Northwest Indian Fisheries Commission, 1993. Print.

Appendix A: 2023 Winter CRC Data Summaries

Figure A1: Total Dungeness crab reported per harvester as percentage of winter 2023 CRC respondents.

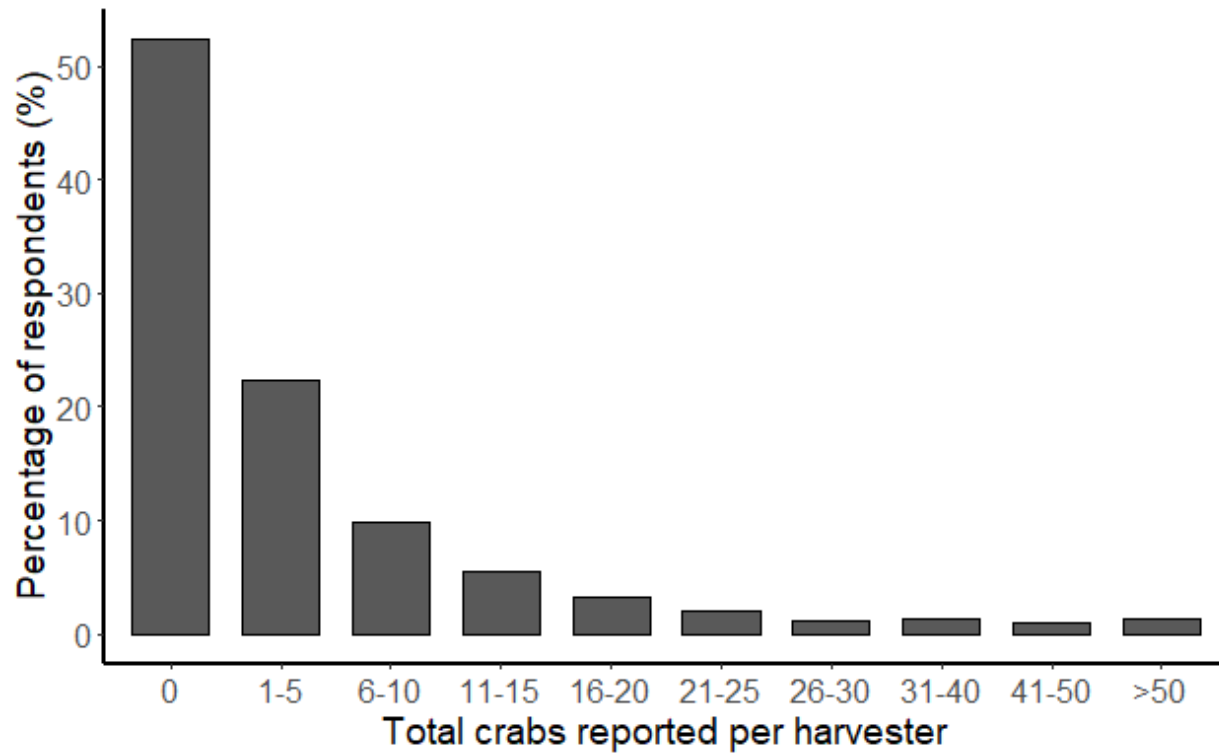


Figure A2: Total trips reported per harvester as percentage of winter 2023 CRC respondents.

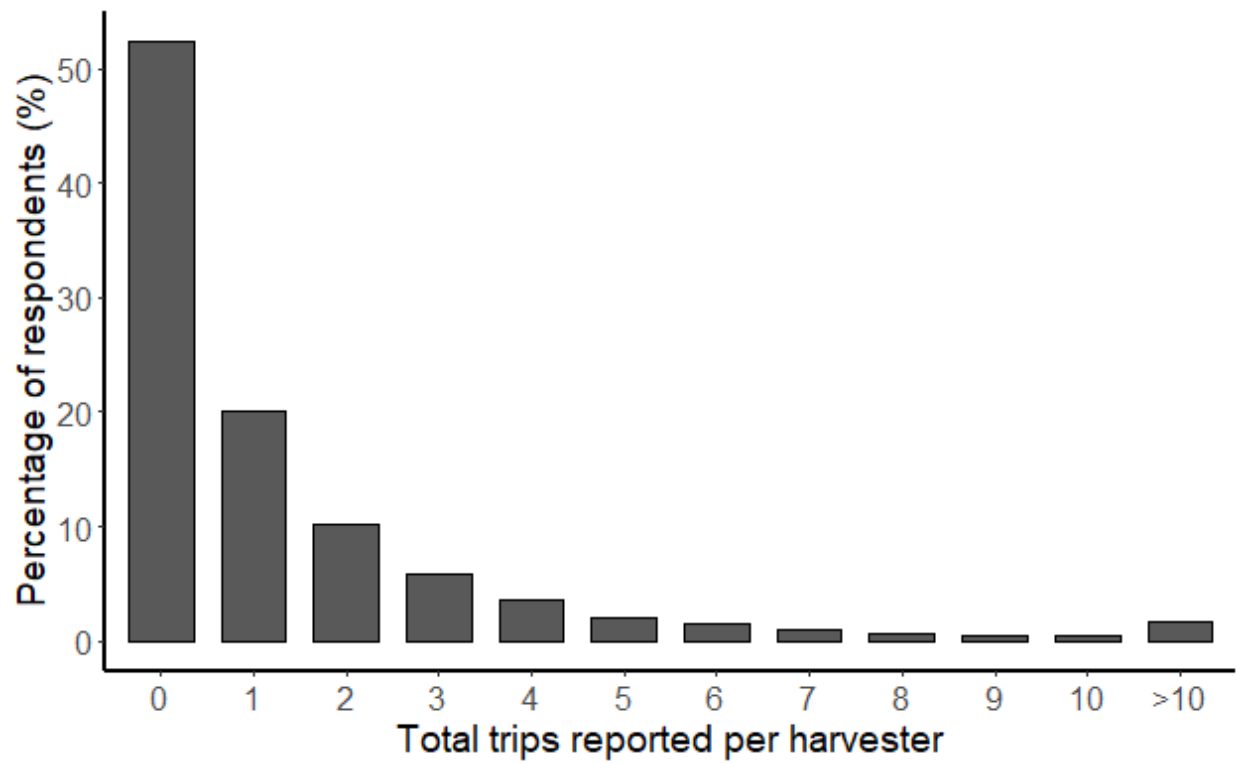
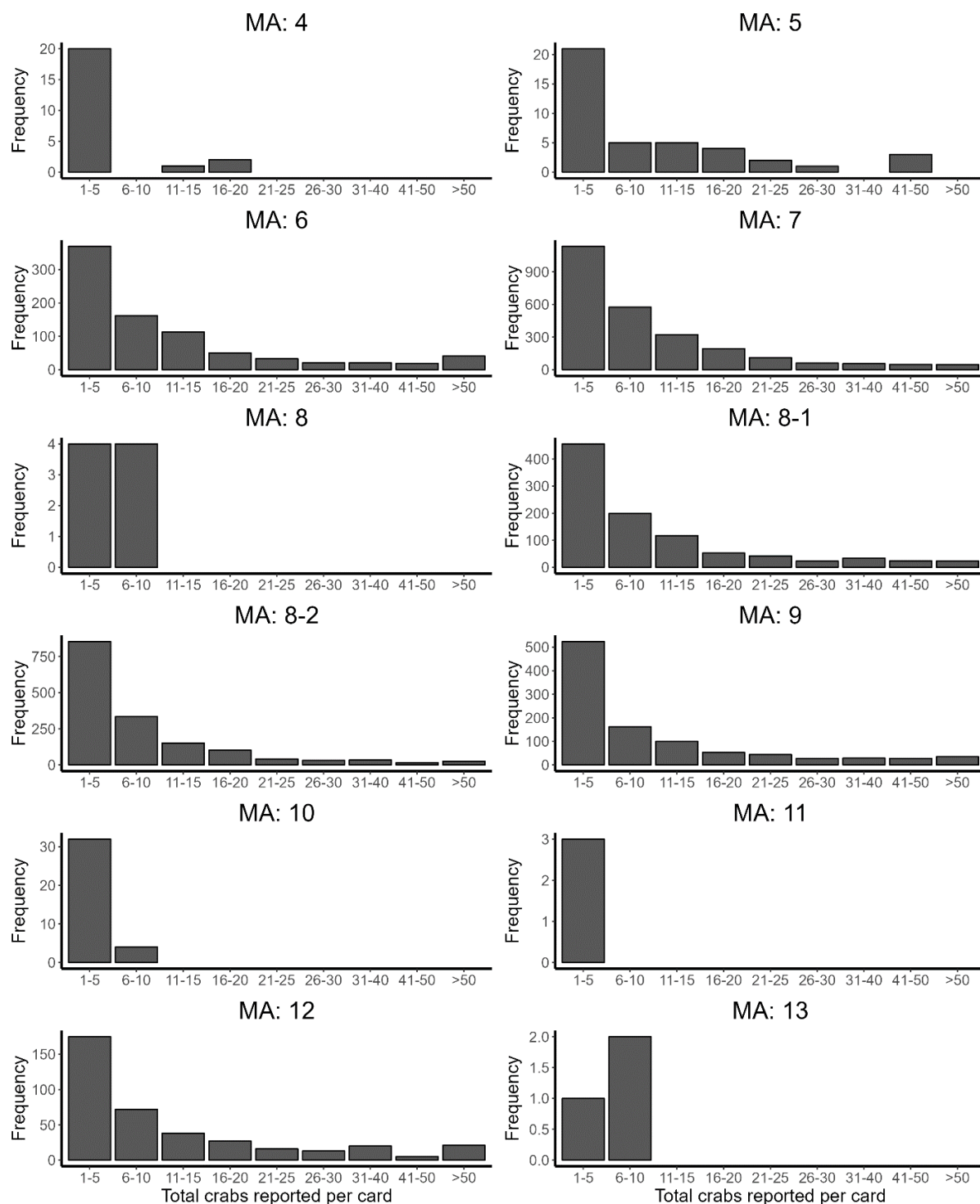


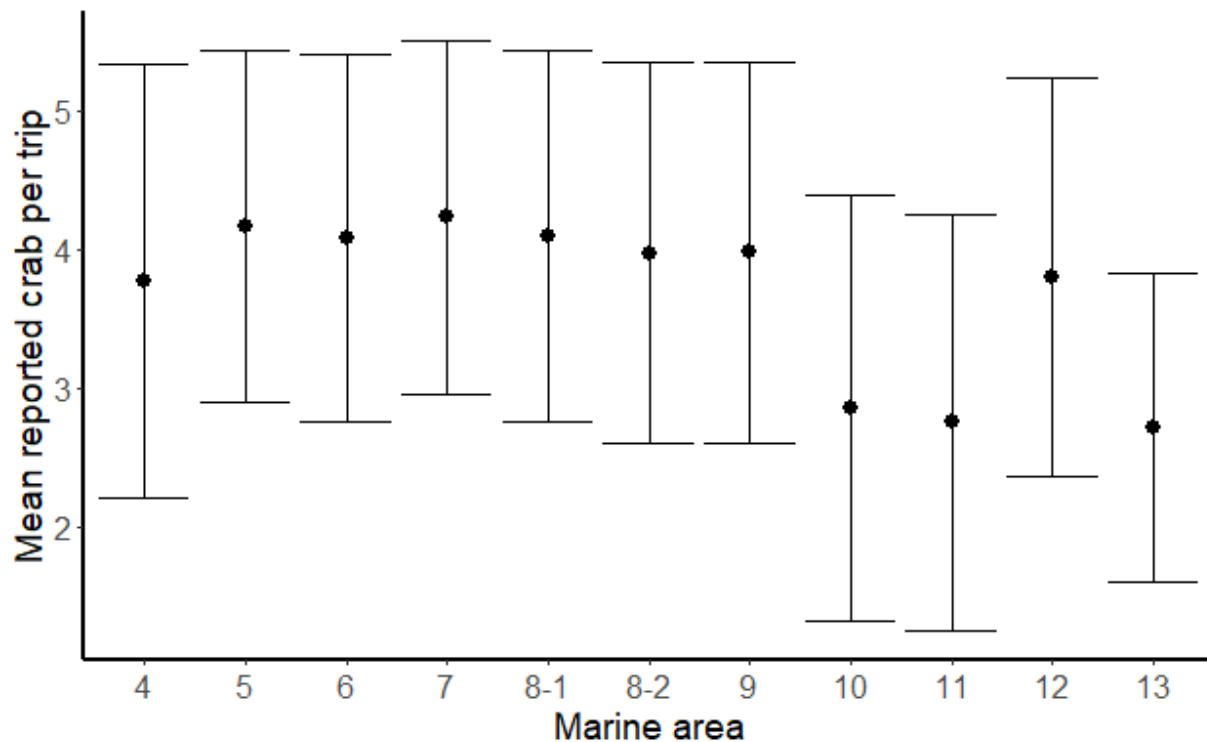
Figure A3: Histograms binned by total crab reported by an individual harvester on a winter 2023 CRC by Marine Area. Trips with unknown Marine Areas are not shown.



* Marine Area 10, Marine Area 11, the portion of Marine Area 12 south of Ayock Point, and Marine Area 13 were closed to recreational crabbing for winter 2023.

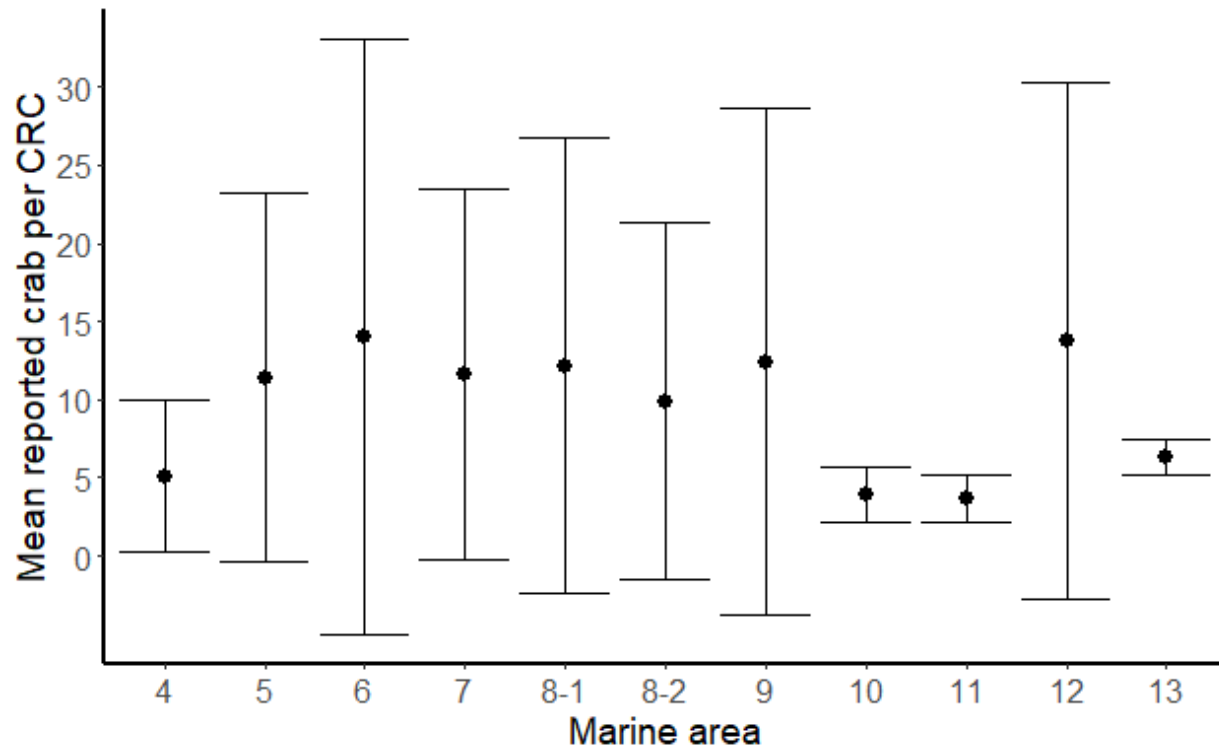
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Figure A4: Average number of Dungeness crab reported per successful trip by Marine Area. Error bars represent ± 1 standard deviation surrounding the mean crab per successful trip for each Marine Area. Only trips with at least 1 crab reported are used in the calculation. Trips with unknown Marine Areas are not shown.



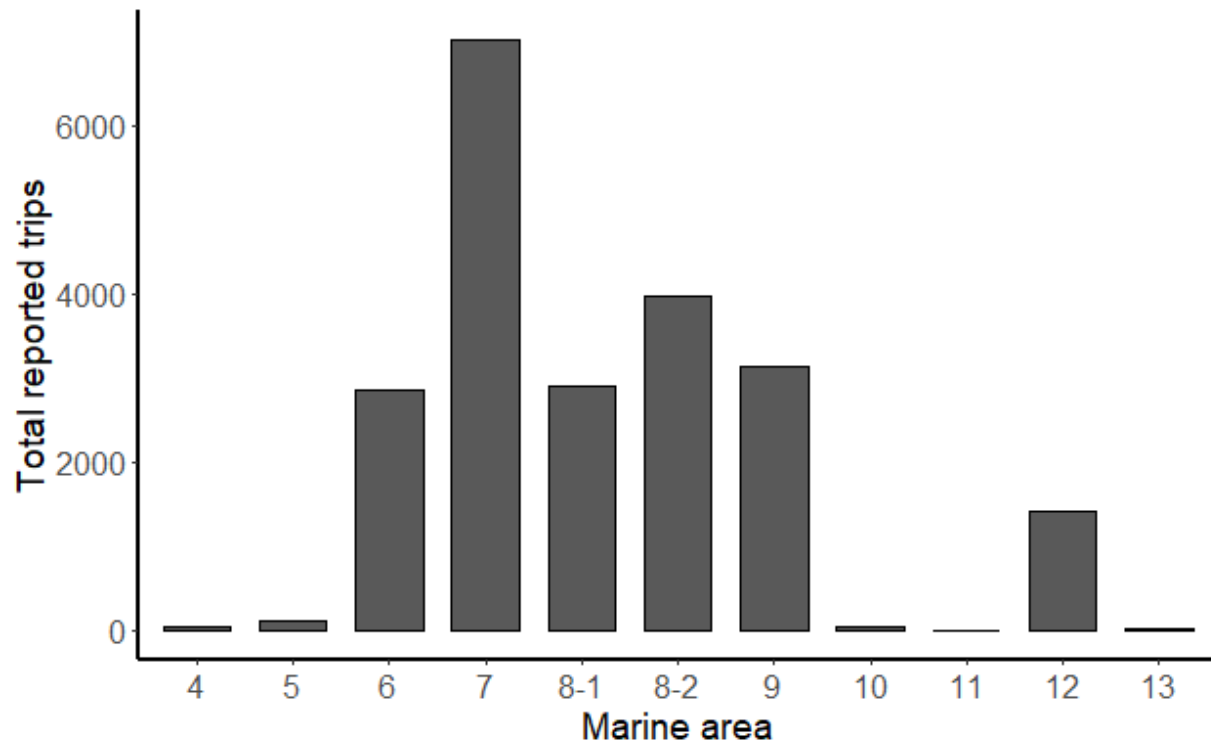
* *Marine Area 10, Marine Area 11, the portion of Marine Area 12 south of Ayock Point, and Marine Area 13 were closed to recreational crabbing for winter 2023.*

Figure A5: Average number of Dungeness crab reported per fisher for the winter 2023 season by Marine Area. Error bars represent ± 1 standard deviation surrounding the mean reported crab per fisher for each Marine Area. Trips with unknown Marine Areas are not shown.



* *Marine Area 10, Marine Area 11, the portion of Marine Area 12 south of Ayock Point, and Marine Area 13 were closed to recreational crabbing for winter 2023.*

Figure A6: Total number of successful trips reported on CRCs by Marine Area during the winter 2023 recreational season. Only trips with at least one crab reported are included. Trips with unknown Marine Areas are not shown.



* *Marine Area 10, Marine Area 11, the portion of Marine Area 12 south of Ayock Point, and Marine Area 13 were closed to recreational crabbing for winter 2023.*

Table A1: Total number of successful trips reported on winter 2023 CRCs by month and Marine Area.

Marine Area	January - August	September	October	November	December
4	0	4	12	8	7
5	0	4	50	29	29
6	4	6	1,357	824	657
7	47	4,453	1,551	498	459
8	0	0	8	3	4
8-1	4	13	1,418	733	724
8-2	53	13	1,756	983	1,158
9	0	14	1,429	771	917
10	1	3	31	11	4
11	0	0	0	1	3
12	7	8	493	476	416
13	0	1	3	3	0

- * *Marine Area 10, Marine Area 11, the portion of Marine Area 12 south of Ayock Point, and Marine Area 13 were closed to recreational crabbing for winter 2023.*
- * *January - August trips include successful trips that occurred during the summer fishery but was reported on a winter card instead of a summer card.*