

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

December 5, 2023

TO: Puget Sound Dungeness Crab Fishery Managers

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SUBJECT: Summer 2023 Dungeness Crab Recreational Catch Estimates

This memo summarizes the summer 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, Area 13 and Area 12 south of Ayock Point were closed for the entire season (Table 1). Areas 10 and 11 opened July 2 and crabbing was only allowed on Sundays and Mondays. Area 7S opened July 15 and crabbing was allowed Thursday through Monday and Area 7N opened August 20 and crabbing was allowed Thursday through Monday. All remaining areas opened on July 1 and crabbing was allowed Thursday through Monday. 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 prior to 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 summer CRCs to the Department by October 1, 2023. 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 after Labor Day (September 4) through October 1,

2023. 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 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 September 14, 21, and 27. Postcard reminders were mailed to those without e-mail addresses on September 8. 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 185,455 fishers were issued summer Dungeness crab catch cards for the 2023 license year. 81,947 fishers returned their cards by mail, dropping it off at a regional office, or by reporting their catch online by October 1, 2023. Overall, 44.19% of fishers reported their summer CRCs (Table 2). Harvest from all the summer CRCs reported by mail and reported online were compiled into a single database 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 numbers 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 factors differ 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 summer 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 (0.6136 for this period)

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

Total harvest data for the summer recreational crab fishery

Total harvest for the summer 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 (January - June or after Labor Day [September 4, 2023]) 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 season will be available once recreational harvest is assessed after the winter reporting period which ends on February 1, 2024.

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

Marine Area	Season	Weekdays Open	Open Days
4	July 1 - September 4	Thursday - Monday	48
5	July 1 - September 4	Thursday - Monday	48
6	July 1 - September 4	Thursday - Monday	48
7 South	July 15 - September 4	Thursday - Monday	38
7 North	August 20 – September 4	Thursday - Monday	12
8-1	July 1- September 4	Thursday - Monday	48
8-2	July 1- September 4	Thursday - Monday	48
9	July 1- September 4	Thursday - Monday	48
10	July 2 – September 4	Sunday - Monday	20
11	July 2 – August 28	Sunday - Monday	18
12	July 1- September 4	Thursday - Monday	48
13	None	None	0

**The portion of Marine Area 12 south of Ayock Point was closed to recreational crabbing for summer 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%)	<i>Pending</i>
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

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

Table 3. Recreational harvest from all reported CRCs for summer 2023. All out of season harvest (January - June and post Labor Day catch) is included in the estimate.

Marine Area	Region	January - May	June	July	August	Sept. 1-4	Post-Labor Day	Unknown	Total Crab	Pounds (lbs.)
4	3-3	17	19	133	87	20	22	0	298	536
5	3-3	2	5	1,138	407	52	8	0	1,612	2,902
6	3-1, 3-2	14	135	26,024	9,509	2,307	173	0	38,162	68,692
7	1	16	280	56,226	76,280	20,324	12,170	0	165,296	297,533
8	2E	0	0	354	386	18	5	0	763	1,373
8-1	2E	18	180	46,331	27,465	7,065	405	0	81,464	146,635
8-2	2E	18	231	54,172	31,345	6,422	485	25	92,698	166,856
9	2W	0	267	31,680	13,872	3,072	415	20	49,326	88,787
10	4	9	138	13,697	8,075	1,892	97	4	23,912	43,042
11	6	5	27	12,557	7,785	129	117	5	20,625	37,125
12	5	5	43	8,554	4,415	1,157	72	0	14,246	25,643
13	7	0	6	19	11	0	0	0	36	65
Unknown	--	1	0	188	143	29	9	22	392	706
Total	--	105	1,331	251,073	179,780	42,487	13,978	76	488,830	879,894

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

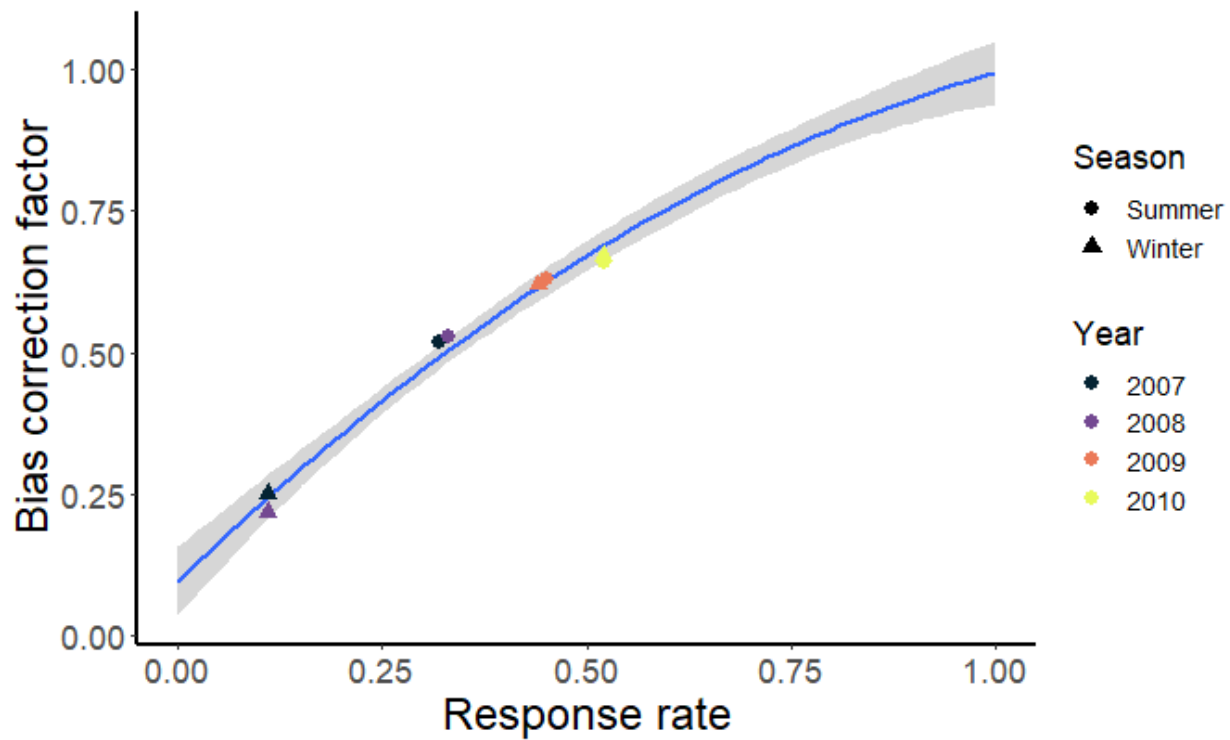
Table 5. Total recreational harvest estimates by area, including all reported CRCs and non-reported CRCs corrected for bias, summer 2023.

Marine Area	Region	July	August	September	Total Crab	Pounds (lbs.)
4	3-3	231	151	35	417	751
5	3-3	1,595	571	74	2,240	4,032
6	3-1, 3-2	36,452	13,319	3,231	53,002	95,404
7	1	84,605	114,781	30,582	229,968	413,942
8-1	2E	65,054	38,680	9,899	113,633	204,539
8-2	2E	76,126	44,182	9,005	129,313	232,763
9 (non-25C)	2W	32,142	14,073	3,116	49,331	88,796
9 (25C)	5	12,500	5,474	1,212	19,186	34,535
10	4	19,224	11,334	2,655	33,213	59,783
11	6	17,571	10,893	181	28,645	51,561
12	5	11,982	6,183	1,620	19,785	35,613
13	7	32	18	0	50	90
Total	--	357,514	259,659	61,610	678,783	1,221,809

* Catch reported from “unknown” areas and/or months and all out of season harvest (January- June and post-Labor Day) 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.

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 Summer CRC Data Summaries

Figure A1: Total Dungeness crab reported per angler as percentage of CRC respondents, Summer 2023.

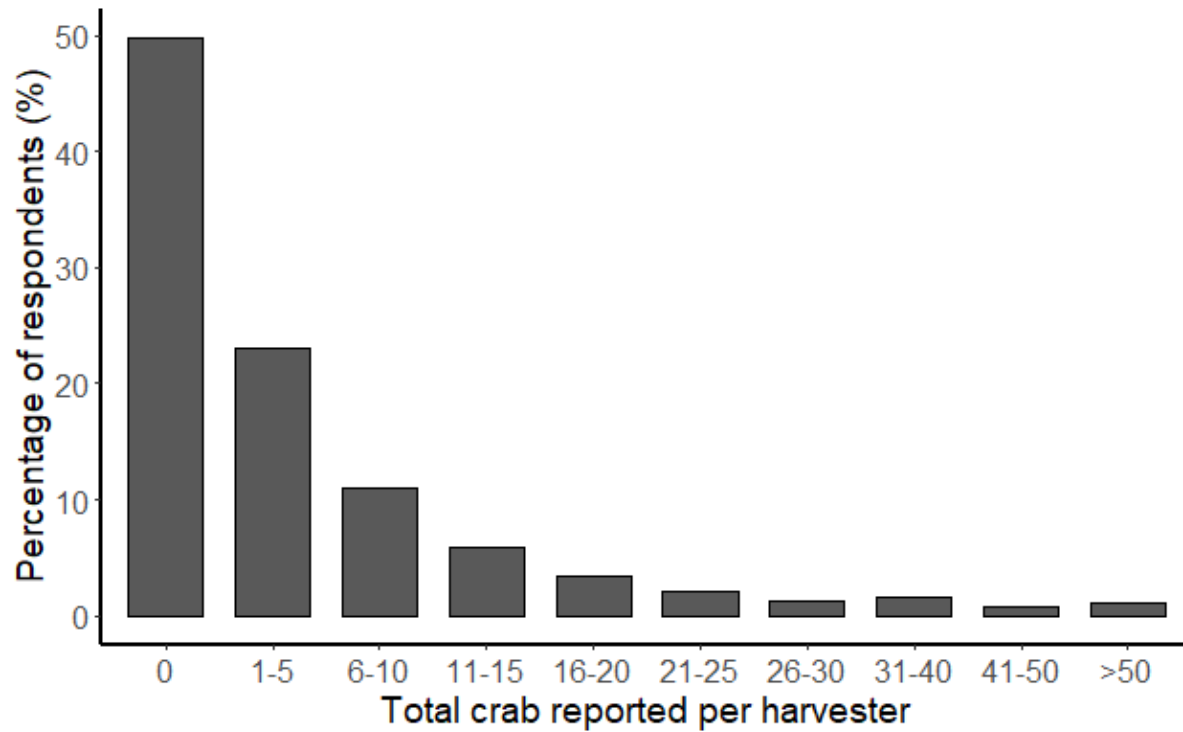


Figure A2: Total trips reported per angler as percentage of CRC respondents, Summer 2023.

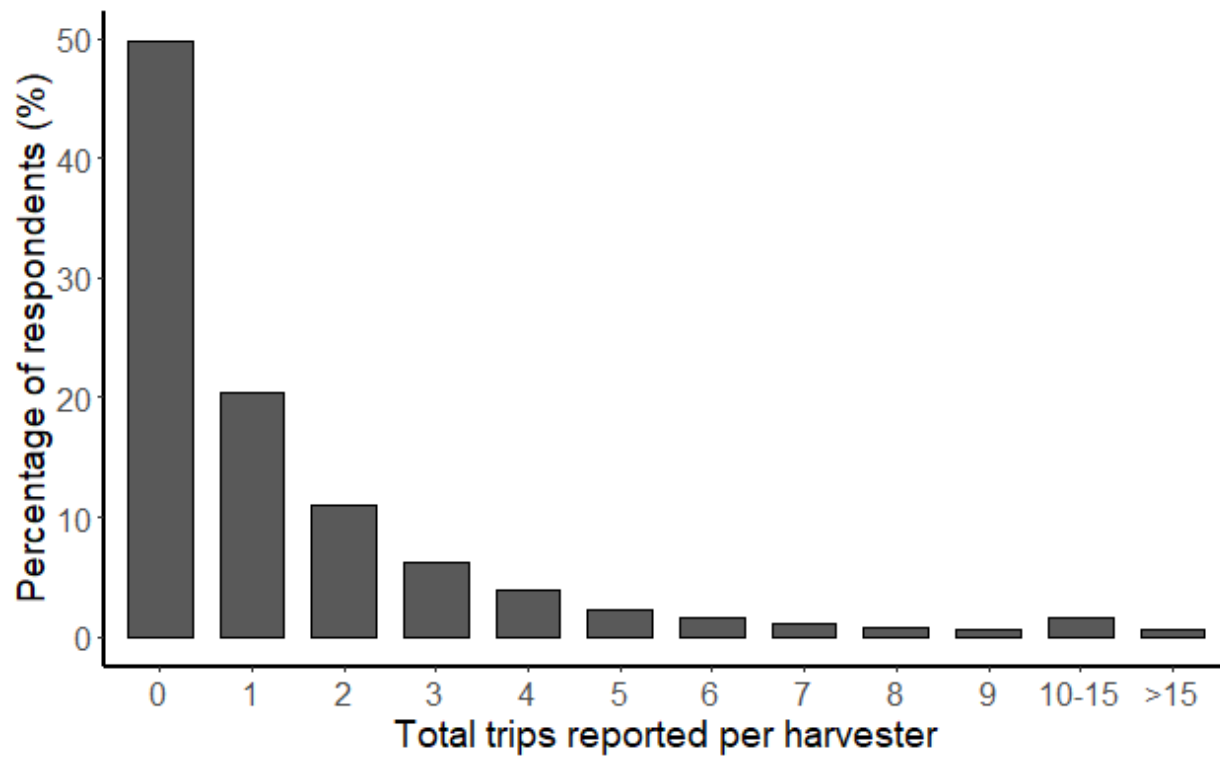


Figure A3: Histograms showing total catch reported on Summer 2023 CRCs by Marine Area. Trips with unknown Marine Areas are not shown.

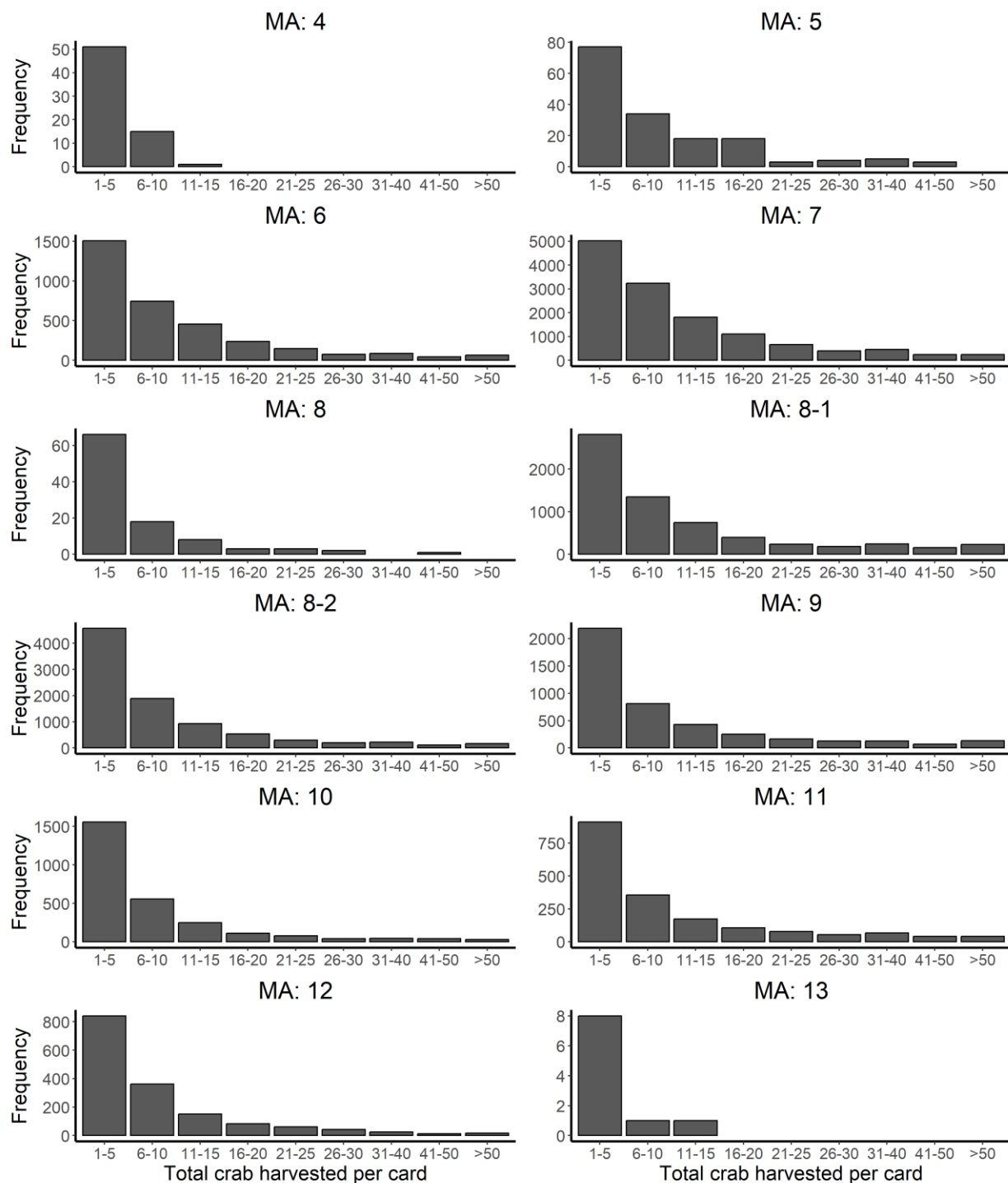


Figure A4: Average number of Dungeness crab reported for a successful trip by Marine Area. Error bars represent ± 1 standard deviation surrounding the mean crab per successful trip for each Marine Area. Only trips with at least 1 crab reported are used in the calculation. Trips with unknown Marine Areas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

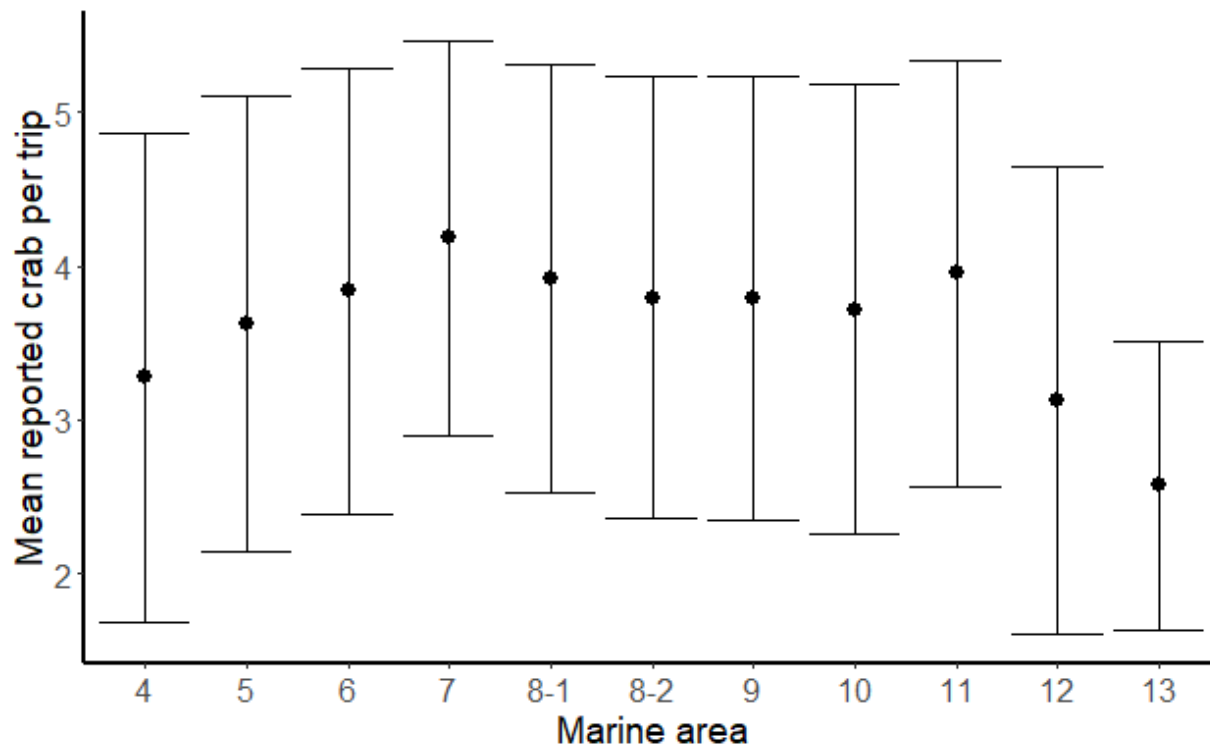


Figure A5: Average number of Dungeness crab reported per fisher for the summer 2023 season by Marine Area. Error bars represent ± 1 standard deviation surrounding the mean reported crab per fisher for each Marine Area. Trips with unknown Marine Areas are not shown.

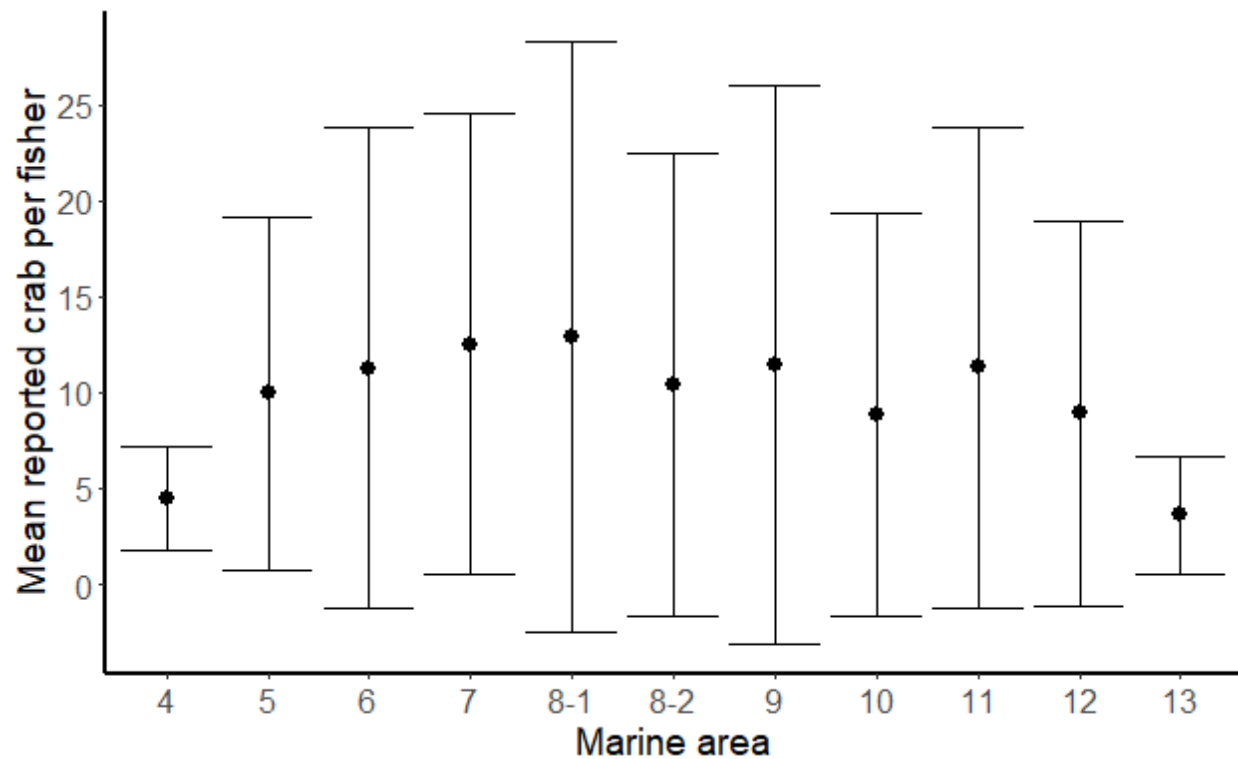


Figure A6: Total number of successful trips by Marine Area during the summer 2023 recreational season. Only trips with at least one crab reported are included. Trips with unknown Marine Areas are not shown.

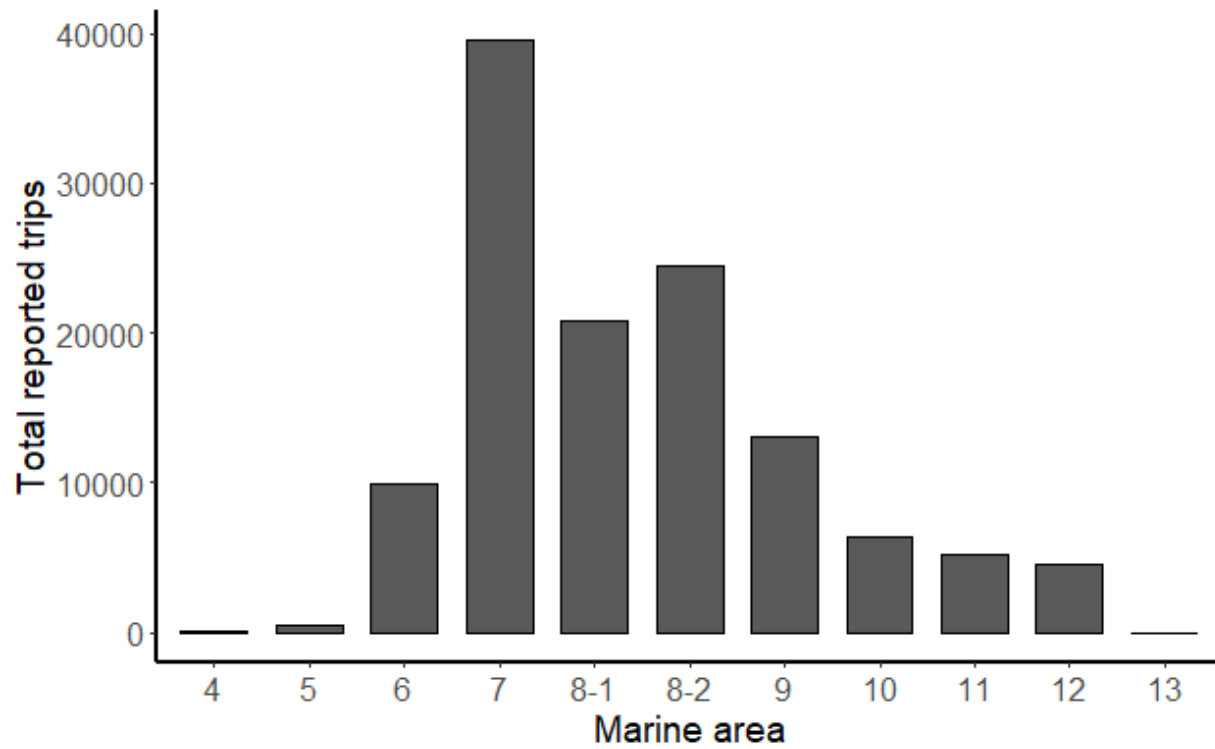


Table A1: Total number successful trips reported on CRCs by month and Marine Area for summer 2023. Catch data reported on CRCs include trips reported outside the open fishery period (January – June and post-Labor Day).

Marine Area	January - June	July	August	Sept. 1-4	Sept. 5-30	October
4	11	41	25	8	6	0
5	3	303	123	14	2	0
6	42	6,669	2,585	609	46	0
7	78	13,693	18,112	4,744	2,903	4
8	0	91	97	6	1	0
8-1	64	12,002	6,875	1,739	106	0
8-2	70	14,104	8,365	1,755	131	0
9	70	8,165	3,845	834	117	3
10	33	3,630	2,218	524	26	1
11	11	3,146	1,994	34	30	0
12	24	2,719	1,435	353	23	0
13	2	7	5	0	0	0