

SUMMARY OF CALCULATION OF ADULT EQUIVALENT LOSS BASED ON MODIFIED DREDGE IMPACT MODEL AND DIRECT MEASUREMENT OF ENTRAINMENT RATES at MCR from July through October 2002

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This calculation run is for

Location	Start Date	End Date	Total Volume Dredged (cy)
MCR	09-Jul-02	13-Oct-02	2763119

Overall Summary Statements

Adult Equivalent Loss of all age classes taken to 2+ is **108363** with 95% CI **10127**
We are 95% confident that the true value lies between **98236** and **118490**

Adult Equivalent Loss of all age classes taken to 3+ is **48763** with 95% CI **4557**
We are 95% confident that the true value lies between **44206** and **53320**

Number of MALE recruits lost to fishery is estimated to be **6285** with 95% CI **561**
We are 95% confident that the true value lies between **5724** and **6846**

Sex Ratios by Age Class Derived from Field Observations

Age Class	Total			Proportion		
	Male	Female	Sexed	Male	Female	
YOY	2	5	7	0.50	0.50	* binomial distribution p>0.05; low sample size - assumed to be 1:1.
1+	24	37	61	0.39	0.61	binomial distribution p=0.026; significantly different from 1:1
2+	25	113	138	0.18	0.82	binomial distribution p<0.001; significantly different from 1:1
3+	5	24	29	0.17	0.83	binomial distribution p<0.001; significantly different from 1:1

Estimates of Crab Entrainment Rate (R), Number of Crabs Entrained (E), Adult Equivalent Loss (AEL at 2+), and Variance (AEL at 2+)

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00335	9254.0	3037848.55	0.10	0.017	15.27	8.270542669	6.87	1.674784891
1+	0.01440	39788.7	9827747.85	0.60	0.160	3819.72	90572.52423	1718.87	18340.93616
2+	0.03218	88923.1	21326692.17	0.86	0.649	49631.56	6643696.682	22334.20	1345348.578
3+	0.01040	28727.6	5466902.33	0.86	2.222	54896.20	19963023.9	24703.29	4042512.339
All	0.0603	166693.5	39659190.90			108362.74	26697301.37	48763.23	5406203.53

Note: Entrained 3+ crab are back-calculated to provide AEL at 2+.

AGE 2+ Calculations

Contribution to Adult Equivalent Loss (AEL at 2+) and Variance (AEL at 2+) by Sex (MALE/FEMALE) and Age Class

Age Class	Female			Male		
	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	7.63	2.067635667	0.50	7.63	2.067635667
1+	0.61	2330.03	33702.03626	0.39	1489.69	13776.08093
2+	0.82	40640.33	4454597.927	0.18	8991.22	218037.7245
3+	0.83	45431.33	13672653.7	0.17	9464.86	593431.1503
All		88409.33	18160955.73		19953.41	825247.02
						18986202.76

R = Crab Entrainment Rate (crabs/cy)
E = Crabs Entrained (number of Crabs)
M = Post-Entrainment Mortality (proportion)
S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45%; Armstrong et al. 1987
AEL = Adult Equivalent Loss
VAR(AEL) = AEL Variance

Age Class Distribution

Age Class	% of Total		Proportion of Total AEL 2+	
	of Entrained	of AEL at 2+	Male	Female
YOY	5.55	0.01	0.0001	0.0001
1+	23.87	3.52	0.0137	0.0215
2+	53.35	45.80	0.0830	0.3750
3+	17.23	50.66	0.0873	0.4193
ALL			0.18	0.82

AGE 3+ Calculations

Contribution to Adult Equivalent Loss (AEL at 3+) and Variance (AEL at 3+) by Sex (MALE/FEMALE) and Age Class

Age Class	Female	Male

Appendix A
MCR Total AEL Summary

Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	3.44	0.418696223	0.50	3.44	0.418696223
1+	0.61	1048.51	6824.662344	0.39	670.36	2789.656389
2+	0.82	18288.15	902056.0803	0.18	4046.05	44152.63922
3+	0.83	20444.10	2768712.375	0.17	4259.19	120169.8079
All		39784.20	3677593.54		8979.03	167112.52
					48763.232	3844706.059

R = Crab Entrainment Rate (crabs/cy)
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M = Post-Entrainment Mortality (proportion)
S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45%; Armstrong et al. 1987
AEL = Adult Equivalent Loss
VAR(AEL) = AEL Variance

Age Class Distribution

Age Class	% of Total	
	of Entrained	of AEL at 3+
YOY	5.55	0.01
1+	23.87	3.52
2+	53.35	45.80
3+	17.23	50.66

Age Class	Proportion of Total AEL at 3+	
	Male	Female
YOY	0.0001	0.0001
1+	0.0137	0.0215
2+	0.0830	0.3750
3+	0.0873	0.4193
ALL	0.18	0.82

SUMMARY VARIANCE DATA

Entrainment with Confidence Limits

E	166693.5
Var(E)	39659190.9
SE E	6297.6
Z at 0.975	1.95996
95% C. I.	12343.0
CV E (%)	3.78

TOTAL AEL at 2+ with Confidence Limits

AEL at 2+	108362.7
Var(AEL2+)	26697301.4
SE AEL	5166.9
Z at 0.975	1.95996
95% C. I.	10127.0
CV AEL (%)	4.77

TOTAL AEL at 3+ with Confidence Limits

AEL at 3+	48763.2
Var(AEL3+)	5406203.5
SE AEL	2325.1
Z at 0.975	1.95996
95% C. I.	4557.2
CV AEL (%)	4.77

SE = Standard Error
Z = Value of Z from Normal Distribution

C.I. = Confidence Interval
CV = Coefficient of Variation in %

MALE AEL at 3+ with Confidence Limits

AEL at 3+	8979.0
Var(AEL)	167112.5
SE AEL	408.8
Z at 0.975	1.95996
95% C. I.	801.2
CV AEL (%)	4.55

FEMALE AEL at 3+ with Confidence Limits

AEL at 3+	39784.2
Var(AEL)	3677593.5
SE AEL	1917.7
Z at 0.975	1.95996
95% C. I.	3758.6
CV AEL (%)	4.82

TOTAL LOSS TO MALE FISHERY

(This total would be distributed over 3-4 years)

Male Age 3+ (number of crab)	Harvest Rate (proportion)	Lost to Fishery (number of crab)
8979.0	0.70	6285.3

Harvest rate of 0.70 is taken from Armstrong et al. (1987).

Loss to Fishery with Confidence Limits

Loss to Fishery	6285.3
Var(AEL)	81885.1359
SE LF	286.2
Z at 0.975	1.95996
95% C. I.	560.9
CV LF (%)	4.55

ADDITIONAL NOTES:

Mortality Rates (M) for crabs collected in June-September are from Armstrong et al. 1987 (Table 3.3, p. 61)
Survival rates (S) to age 2+ for crab collected from June-September are from Wainwright et al. 1992 (Table 6, p. 178), and thereafter survival rate from 2+ to age 3+ is 0.45 (Armstrong et al. 1987).
Sex ratios used were those observed or assumed to be 1:1 where sample size was low.