APPENDIX B EVALUATION REPORT DUNGENESS CRAB (REVISED)

Summary of Projected Entrainment, Adult Equivalent Loss, and Loss to Fishery. Lower Columbia River
WH Pearson and GD Williams

8.11

AEL LF

Variance Estimators (derived from June 2002 field sampling)

CV % 5.01 7.37

Z at 0.975

1.95996

Construction Dredging to 40 ft - Age 2+

Assumptions:

Projected Location Desdemona
Planned dredged volume (cy) 593,812

Results:			
	Projected		
Parameter	Value	SE	95% CI
E	132,790	6,653	13,039
AEL	20,078	1,480	2,900
AEL Male	12,052	888	1,741
AEL Female	8,026	592	1,159
Loss to Fishery	3,796	308	603

Construction Dredging to 40 ft - Age 3+
Assumptions:

Desdemona 593,812

	Projected		
Parameter	Value	SE	95% CI
E	132,790	6,653	13,039
AEL	9,035	666	1,305
AEL Male	5,423	400	783
AEL Female	3,612	266	522
Loss to Fishery	3,796	308	603

construction Dredging from 40 to 43 ft - Age 2+ Assumptions:

Posulte:

	Projected		
Parameter	Value	SE	95% CI
E	105,974	5,309	10,406
AEL	16,024	1,181	2,315
AEL Male	9,618	709	1,389
AEL Female	6,405	472	925
Loss to Fishery	3,030	246	482

onstruction Dredging from 40 to 43 ft - Age 3+

Assumptions:

Planned dredged volume (cy)

	Projected		
Parameter	Value	SE	95% CI
E	105,974	5,309	10,406
AEL	7,211	531	1,042
AEL Male	4,328	319	625
AEL Female	2,882	212	416
Loss to Fishery	3,030	246	482

ntenance Dredging 40' Year 1 - Age 2+

Assumptions:

Projected Location Desdemona
Planned dredged volume (cy) 40,000 Projected Location

Results:

Parameter	Projected Value	SE	95% CI
E	8,945	448	878
AEL	1,353	100	195
AEL Male	812	60	117
AEL Female	541	40	78
Loss to Fishery	256	21	41

nnual Maintenance Dredging 40' Year 1 - Age 3+

Assumptions:

Desdemona 40,000 Projected Location
Planned dredged volume (cy)

Parameter	Projected Value	SE	95% CI
E	8,945	448	878
AEL	609	45	88
AEL Male	365	27	53
AEL Female	243	18	35
Loss to Fishery	256	21	41

Annual Maintenance Dredging 40' Year 20 - Age 2+

Assumptions:

Results:

Parameter	Projected Value	SE	95% CI
E	8,945	448	878
AEL	1,353	100	195
AEL Male	812	60	117
AEL Female	541	40	78
Loss to Fishery	256	21	41

Annual Maintenance Dredging 40' Year 20 - Age 3+

Assumptions:

Projected Location
Planned dredged volume (cy)

Results:

	Projected		
Parameter	Value	SE	95% CI
E	8,945	448	878
AEL	609	45	88
AEL Male	365	27	53
AEL Female	243	18	35
Loss to Fishery	256	21	41

Annual Maintenance Dredging 43' Year 1 - Age 2+

Assumptions:

Projected Location Desdemona 60,00

Posults:

results.			
Parameter	Projected Value	SE	95% CI
E	13,417	672	1,318
AEL	2,029	150	293
AEL Male	1,218	90	176
AEL Female	811	60	117
Lose to Fishery	384	31	61

nnual Maintenance Dredging 43' Year 1 - Age 3+

Assumptions:

Desdemona 60,000

Parameter	Projected Value	SE	95% CI
E	13,417	672	1,318
AEL	913	67	132
AEL Male	548	40	79
AEL Female	365	27	53
Loss to Fishery	384	31	61

Annual Maintenance Dredging 43' Year 20 - Age 2+ Assumptions:

Projected Location	Desdemona
Planned dredged volume (cy)	40,000

Results:

Parameter	Projected Value	SE	95% CI
E	8,945	448	878
AEL	1,353	100	195
AEL Male	812	60	117
AEL Female	541	40	78
Loss to Fishery	256	21	41

Annual Maintenance Dredging 43' Year 20 - Age 3+

Projected Location	Desdemona
Planned dredged volume (cy)	40,000

Posulte:

Results.			
	Projected		
Parameter	Value	SE	95% CI
E	8,945	448	878
AEL	609	45	88
AEL Male	365	27	53
AEL Female	243	18	35
Loss to Fishery	256	21	41

- 1	Field Date	Field Location	Projection	Total Volume Dredged (cy)
			Construction Dredging to 40	
- 1	Projected	Desdemona June	ft	593812

VOLUME OF DREDGED MATERIALS - to 40 ft

Volu	ime to be Dredged	(cy)	
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 200
- 4	Lower Desdem.	222412	
5		353916	
6	Upper Desdem	0	
7		0	
8		8742	
9		8742	
10	Flavel Bar	49732	
11		298900	
12		121292	
13		72425	
14	Upper Sands	54585	
15		51945	
16		47557	
17		0	
18	Tongue Point	14775	
19		6976	
20		13283	
Total		1325282	

593812 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from June Data

ı	Age Class		Total		Propo		
ı	Age Class	Male	Female	Sexed	Male	Female	
ı	YOY	1	0	1	0.50	0.50	 binomial distributio
ı	1+	70	68	138			binomial distribution
ı	2+	12	4	16	0.75	0.25	binomial distribution
ı	3+	0	0	0	0.50	0.50	* low sample size - a

ion p>0.05; low sample size - assumed to be 1:1. n p=0.067 - not sign different from 1:1 n p<0.05 assumed to be 1:1.

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00517	3071.8		0.10	0.017	5.07		2.28	
1+	0.19327	114767.6		0.60	0.160	11017.69		4957.96	
2+	0.02429	14425.5		0.86	0.649	8051.43		3623.14	
3+	0.00088	525.5		0.86	2.222	1004.22		451.90	
All		132790.3				20078.41		9035.28	

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	2.53		0.50	2.53	
1+	0.50	5508.84		0.50	5508.84	
2+	0.25	2012.86		0.75	6038.57	
3+	0.50	502.11		0.50	502.11	
All		9026 24			12052.00	

R = Crab Entrainment Rate (crabe)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)
VAR(AEL) = AEL Variance

Age Class Distribution

Age Class	% of Total				
Age class	of Entrained	of AEL			
YOY	2.31	0.00			
1+	86.43	54.87			
2+	10.86	40.10			
3+	0.40	5.00			

	Proportion of Total AEL					
Age Class	Male	Female				
YOY	0.0001	0.0001				
1+	0.2744	0.2744				
2+	0.3007	0.1002				
3+	0.0250	0.0250				

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	Class Female			Male				
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)	
YOY	0.50	1.14		0.50	1.14		E = Crabs Entrained (number of Crabs)	
1+	0.50	2478.98		0.50	2478.98		M = Post-Entrainment Mortality (proportion)	
2+	0.25	905.79		0.75	2717.36		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)	
3+	0.50	225.95		0.50	225.95		AEL = Adult Equivalent Loss	
All		3611.86			5423.43		VAR(AEL) =AEL Variance	
					9035.283		=	

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL at 3+			
YOY	2.31	0.03			
1+	86.43	54.87			
2+	10.86	40.10			
3+	0.40	5.00			

	Proportion of T	otal AEL at 3+
Age Class	Male	Female
YOY	0.0001	0.0001
1+	0.2744	
2+	0.3007	0.1002
3+	0.0250	0.0250

SUMMARY VARIANCE DATA Fotrainment with Confidence Limits

rainment with Confidence Limits				
E Var(E) SE E Z at 0.975	132790.3			
Var(E)				
SE E				
Z at 0.975	1.95996			
95% C. I.				
CV E (%)				

	3+	0.0
	ALL	-
TOTAL AEL at 2	+ with Confidence	e Limits

TOTAL AEL 812	• with Confidenc	e Limit
AEL at 2+	20078.4	
Var(AEL2+)		
SE AEL		
Z at 0.975	1.95996	
95% C. I.		
CV AEL (%)		

AEL at 3+	9035.3
Var(AEL3+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

TOTAL AEL at 3+ with Confidence Limits

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+	5423.4
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

I EMALE ALL U	
AEL at 3+	3611
Var(AEL)	
SE AEL	
Z at 0.975	1.959
95% C. I.	
CV AEL (%)	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

		. ,,
Male Age 3+		Lost to Fishery
(number of	Harvest Rate	(number of
crab)	(proportion)	crab)
E422.4	0.70	2700 4

7796.4 Harvest rate of 0.70 is taken from Armstrong et al. (1987).

Loss to Fishery with Confidence Limits

Loss to Fishery	3796.4
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)
		Construction Dredging from	
Projected	Desdemona, June	40 to 43 ft	473893

VOLUME OF DREDGED MATERIALS - from 40 to 43 ft

Vol	ume to be Dredged	(cy)	
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 2002)
4	Lower Desdem.	94688	_
5		196724	
6	Upper Desdem	66193	
7		1039	
8		52398	
9		62851	
10	Flavel Bar	329296	
11		535074	
12		239608	
13		65743	
14	Upper Sands	171432	
15		271842	
16		306717	
17		108631	
18	Tongue Point	174113	
19		162864	
20		127219	
Total		2966432	

Dredged Yardage (cy)

473893 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from June Data

Age Class	Total			Propo	rtion	
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.50	0.50	* binomial distribution p>0.05; low sample size - assumed to
1+	70	68	138	0.51	0.49	binomial distribution p=0.067 - not sign different from 1:1
2+	12	4	16	0.75	0.25	binomial distribution p<0.05
3+	0	0	0	0.50	0.50	* low sample size - assumed to be 1:1.

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00517			0.10				1.82	
1+	0.19327	91590.5		0.60	0.160	8792.69		3956.71	
2+	0.02429	11512.3		0.86	0.649	6425.46		2891.46	
3+	0.00088	419.4		0.86	2.222	801.42		360.64	
All		105973.6				16023.62		7210.63	
	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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	2.02		0.50	2.02		E = Crabs Entrained (number of Crabs)
1+	0.50	4396.35		0.50	4396.35		M = Post-Entrainment Mortality (proportion)
2+	0.25	1606.37		0.75	4819.10		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	400.71		0.50	400.71		AEL = Adult Equivalent Loss
All		C40F 44			0040 47		MADIAEL Verience

Age Class Distribution

Age C	lace	% of Total		
Age C	1055	of Entrained	of AEL	
YC	Υ	2.31	0.00	
1-	+	86.43	54.87	
2	+	10.86	40.10	
3-	+	0.40	5.00	

	Proportion of Total AEL		
Age Class	Male	Female	
YOY	0.0001	0.0001	
1+	0.2744	0.2744	
2+	0.3007	0.1002	
3+	0.0250	0.0250	
ALL	0.60	0.40	

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

	Female			Male		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
′	0.50	0.91		0.50	0.91	
	0.25	722.86		0.75	2168.59	
	0.50	180.32		0.50	180.32	
		2882.45			4328.18	
					7210.628	
		7 0.50 0.50 0.25	Proportion AEL (0.50 0.91	Proportion AEL VAR(AEL)	Proportion AEL VAR(AEL) Proportion (0.50 0.91 0.50 0.95 0.50 0.95 0.50 0.50 0.50 0.50	Proportion AEL VAR(AEL) Proportion AEL 0.50 0.91 0.90 0.91 0.50 1978.36 0.59 0.91 0.50 1978.36 0.50 1978.36 0.25 722.26 0.75 2168.59 0.50 180.32 0.50 180.32 2882.45 4328.18 4328.18

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

Age Class Distribution

	Age Class	% of Total		
		of Entrained	of AEL at 3+	
	YOY	2.31		
	1+	86.43	54.87	
	2+	10.86	40.10	
	3+	0.40	5.00	

	Proportion of I	Otal AEL at 37
Age Class	Male	Female
YOY	0.0001	
1+	0.2744	0.2744
2+	0.3007	
3+	0.0250	0.0250
ALI	0.60	0.40

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

TOTAL AEL at 2+ with Confiden	
AEL at 2+	16023.6
Var(AEL2+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

AEL at 3+	7210.6
Var(AEL3+)	
SE AEL	
Z at 0.975	1.95996

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+	4328.2
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

FEMALE AEL at 3+ with Confidence Limits

AEL at 3+		2882.4
Var(AEL)		
SE AEL		
Z at 0.975		1.95996
95% C. I.		
CV AFL (%)		

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

Male Age 3+		Lost to Fishery
(number of	Harvest Rate	(number of
crab)	(proportion)	crab)
4220.2	0.70	2020 7

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

Loss to Fishery with Confidence Limits

Loss to Fishery	3029.7
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)
		Post	
		Construction	
		Maintenance, 40	
Projected	Desdemona, June	ft Yr 1	40000

VOLUME OF DREDGED MATERIALS - Maintenance 40' Yr 1

Г	Volu	ime to be Dredged		
	River Mile	Location Name	Volume (cy)	Data from Portland District (4)
	4 to 9	Desdemona	40,000	_
	10 to 13	Flavel Bar	400000	
ı	14 to 17	Upper Sands	50000	
	18 to 20	Tongue Point	270000	
_	Total		7(0000	

Dredged Yardage (cy)

40,000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from June Data

Age Class		Total		Proportion		
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.50	0.50	* binomial distribution p>0.05; low sample size - assumed to be 1:1
1+	70	68	138	0.51	0.49	binomial distribution p=0.067 - not sign different from 1:1
2+	12	4	16	0.75	0.25	binomial distribution p<0.05
3+	0	0	0	0.50	0.50	* low sample size - assumed to be 1:1

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00517	206.9		0.10	0.017	0.34		0.15	
1+	0.19327	7730.9		0.60	0.160	742.17		333.98	
2+	0.02429	971.7		0.86	0.649	542.36		244.06	
3+	0.00088	35.4		0.86	2.222	67.65		30.44	
All		9044.0				4252 54		CO0 C2	

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.17		0.50	0.17		E = Crabs Entrained (number of Crabs)
1+	0.50	371.08		0.50	371.08		M = Post-Entrainment Mortality (proportion)
2+	0.25	135.59		0.75	406.77		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 198'
3+	0.50	33.82		0.50	33.82		AEL = Adult Equivalent Loss
All		540.67			811.84		VAR(AEL) =AEL Variance

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL			
YOY	2.31	0.00			
1+	86.43				
2+	10.86	40.10			
3+	0.40	5.00			

	Proportion of Total AEL					
Age Class	Male	Female				
YOY	0.0001	0.0001				
1+	0.2744					
2+	0.3007	0.1002				
3+	0.0250	0.0250				
ALL	0.60	0.40				

AGE 3+ Calculation Contribution to Adu	s It Equivalent Loss (AEL at 3+) and Variance (AEL at 3+) by Sex (MALE/FEMALE) and Age Class
	Female	Male

Age Class		Female			Male		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.08		0.50	0.08		E = Crabs Entrained (number of Crabs)
1+	0.50	166.99		0.50	166.99		M = Post-Entrainment Mortality (proportion)
2+	0.25	61.02		0.75	183.05		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987
3+	0.50	15.22		0.50	15.22		AEL = Adult Equivalent Loss
All		243.30			365.33		VAR(AEL) =AEL Variance
					608.629		

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL at 3+			
YOY	2.31	0.03			
1+	86.43	54.87			
2+	10.86	40.10			
3+	0.40	5.00			

	Proportion of	Total AEL at 3+
Age Class	Male	Female
YOY	0.0001	0.0001
1+	0.2744	0.2744
2+	0.3007	0.1002
3+	0.0250	0.0250
ALL	0.60	0.40

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

E	8944.9
Var(E)	
SE E	
Z at 0.975	1.95996
95% C. I.	
CV E (%)	

TOTAL AEL at 2+	with Confidence Lin
AEL at 2+	1352.5
Var(AEI 2+)	

nt 2+	1352.5	AEL at 3+	608.6
EL2+)		Var(AEL3+)	
EL.		SE AEL	
975	1.95996	Z at 0.975	1.95996
i. I.		95% C. I.	
EL (%)		CV AEL (%)	

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+	365.3
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

FEMALE AEL at 3	8+ with Confidence Lim
AEL at 2±	243.3

AEL at 3+	243.
Var(AEL)	
SE AEL	
Z at 0.975	1.9599
95% C. I.	
CV AEL (%)	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

Male Age 3+		Lost to Fishery	
(number of	Harvest Rate	(number of	
crab)	(proportion)	crab)	
365.3	0.70	255.7	Harvest rate of 0.70 is taken from Armstrong et al. (19)

Loss to Fishery with Confidence Limits

Loss to Fishery	255.7
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)
		Post	
		Construction	
		Maintenance, 40	
Projected	Desdemona, June	ft Yr 20	40000

VOLUME OF DREDGED MATERIALS - Maintenance 40' Yr 20

ſ	Volu	ime to be Dredged		
ı	River Mile	Location Name	Volume (cy)	Data from Portland District (4 Dec 20
ı	4 to 9	Desdemona	40000	
I	10 to 13	Flavel Bar	210000	
ı	14 to 17	Upper Sands	50000	
- [18 to 20	Tongue Point	270000	
	Total		570000	='

Dredged Yardage (cy)

40000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from June Data

Age Class		Total		Propo	ortion	
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.50	0.50	* binomial distribution p>0.05; low sample size - assumed to
1+	70	68	138	0.51	0.49	binomial distribution p=0.067 - not sign different from 1:1
2+	12	4	16	0.75	0.25	binomial distribution p<0.05
3+	0	0	0	0.50	0.50	* low sample size - assumed to be 1:1.

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

Age Class	R	E	Var(E)	М	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00517	206.9		0.10	0.017	0.34		0.15	
1+	0.19327	7730.9		0.60	0.160	742.17		333.98	
2+	0.02429	971.7		0.86	0.649	542.36		244.06	
3+	0.00088	35.4		0.86	2.222	67.65		30.44	
All		9044.0				4252 54		C00 C2	

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			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.17		0.50	0.17		E = Crabs Entrained (number of Crabs)
1+	0.50	371.08		0.50	371.08		M = Post-Entrainment Mortality (proportion)
2+	0.25	135.59		0.75	406.77		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	33.82		0.50	33.82		AEL = Adult Equivalent Loss
All		540.67			811.84		VAR(AEL) =AEL Variance

Age Class Distribution

Age Class	% of Total			
Age Class	of Entrained of AE	of AEL		
YOY	2.31	0.00		
1+	86.43	54.87		
2+	10.86	40.10		
3+	0.40	5.00		

	Proportion of Total AEL			
Age Class	Male Female			
YOY	0.0001	0.0001		
1+	0.2744	0.2744		
2+	0.3007	0.1002		
3+	0.0250	0.0250		
ΔII	0.60	0.40		

AGE 3+ Calculations

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

Age Class		Female			Male		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.08		0.50	0.08		E = Crabs Entrained (number of Crabs)
1+	0.50	166.99		0.50	166.99		M = Post-Entrainment Mortality (proportion)
2+	0.25	61.02		0.75	183.05		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	15.22		0.50	15.22		AEL = Adult Equivalent Loss
All		243.30			365.33		VAR(AEL) =AEL Variance
					608.629		

Age Class Distribution

1	Age Class	% of Total			
	Age Class	of Entrained	of AEL at 3+		
	YOY	2.31	0.03		
ı	1+	86.43	54.87		
	2+	10.86	40.10		
	3+	0.40	5.00		

	Proportion of Total AEL at 3+		
Age Class	Male	Female	
YOY	0.0001	0.0001	
1+	0.2744		
2+	0.3007	0.1002	
3+	0.0250	0.0250	
ALL	0.60	0.40	

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

E	8944.9
Var(E)	
SE E	
Z at 0.975	1.95996
95% C. I.	
OV E (0/)	

TOTAL AEL at 2+ with Confidence Limits				
AEL at 2+	1352.5			
Var(AEL2+)				
SE AEL				
Z at 0.975	1.95996			
95% C. I.				
CV AEL (%)				

TOTAL AEL at 3+ v	with Confidence Limits
AEL at 3+	608.6
Var(AEL3+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	
	AEL at 3+ Var(AEL3+) SE AEL Z at 0.975 95% C. I.

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+	365.3
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

FEMAL	E AEI	_ at 3	+ with	Confide	ence Li

AEL at 3+	243.3
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

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

r of		
255.7	Hanvaet rate of 0.70 is taken from Armetrong et al. (1097	71

Loss to Fishery with Confidence Limits

Loss to Fishery	255.7
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LE (9/)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)
		Post	
		Construction	
		Maintenance, 43	
Projected	Desdemona, June	ft Yr 1	60000

VOLUME OF DREDGED MATERIALS - Maintenance 43' Yr 1

Vol	ame to be Dredged		
River Mile	Location Name	Volume (cy)	Data from Portland District (4 Dec 2002)
4 to 9	Desdemona	60000	
10 to 13	Flavel Bar	500000	
14 to 17	Upper Sands		
18 to 20	Tongue Point	330000	
Total		990000	='

Dredged Yardage (cy)

60000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from June Data

Age Class		Total		Propo	ortion	
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.50	0.50	* binomial distribution p>0.05; low sample size - assumed to be 1:1.
1+	70	68	138	0.51	0.49	binomial distribution p=0.067 - not sign different from 1:1
2+	12	4	16	0.75	0.25	binomial distribution p<0.05
3+	0	0	0	0.50	0.50	* low sample size - assumed to be 1:1.

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

Age Class	R	E	Var(E)	М	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00517	310.4		0.10	0.017	0.51		0.23	
1+	0.19327	11596.4		0.60	0.160	1113.25		500.96	
2+	0.02429	1457.6		0.86	0.649	813.53		366.09	
3+	0.00088	53.1		0.86	2.222	101.47		45.66	
All		40447.4				2020 70		042.04	

2028.76 912.94

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.26		0.50	0.26		E = Crabs Entrained (number of Crabs)
1+	0.50	556.63		0.50	556.63		M = Post-Entrainment Mortality (proportion)
2+	0.25	203.38		0.75	610.15		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	50.73		0.50	50.73		AEL = Adult Equivalent Loss
ΔII		911 00			1217 77		VAR(AFI) =AFI Variance

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL			
YOY	2.31	0.00			
1+	86.43	54.87			
2+	10.86	40.10			
3+	0.40	5.00			

	Proportion of Total AEL				
Age Class	Male	Female			
YOY	0.0001	0.0001			
1+	0.2744	0.2744			
2+	0.3007	0.1002			
3+	0.0250	0.0250			
ALL	0.60	0.40			

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	
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	0.12		0.50	0.12	
1+	0.50	250.48		0.50	250.48	
2+	0.25	91.52		0.75	274.57	
3+	0.50	22.83		0.50	22.83	

R = Crab Entrainment Rate (crabs/cy)
E = Crabs Entrained (number of Crabs)
M = Post-Entrainent Motality (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			
Age Class	of Entrained	of AEL at 3+		
YOY	2.31	0.03		
1+	86.43	54.87		
2+	10.86	40.10		
3+	0.40	5.00		

	Proportion of Total AEL at 3+	
Age Class	Male	Female
YOY	0.0001	0.0001
1+	0.2744	0.2744
2+	0.3007	0.1002
3+	0.0250	0.0250
ALL	0.60	0.40

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

E	13417.4
Var(E)	
SE E	
Z at 0.975	1.95996
95% C. I.	
CV E (%)	

TOTAL AEL at 2+ with Confidence Lin		
AEL at 2+	2028.8	
Var(AEL2+)		
SE AEL		
Z at 0.975	1.95996	

TOTAL AEL at 3+ with Confidence	
AEL at 3+	912.
Var(AEL3+)	
SE AEL	
Z at 0.975	1.9599
95% C. I.	
CV AEL (%)	

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

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

95% C. I. CV AEL (%)

MALE AEL at 3+ with Confidence Limits

AEL at 3+	548.0
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

FEMALE AEL at 3+ with Confidence Limit
--

AEL at 3+	364.9
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

Male Age 3+		Lost to Fishery
(number of	Harvest Rate	(number of
crab)	(proportion)	crab)
E49.0	0.70	202.0

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

Loss to Fishery with Confidence Limits

Loss to Fishery	383.
Var(AEL)	
SE LF	
Z at 0.975	1.9599
95% C. I.	
CV LF (%)	

	Field Date	Field Location	Projection	Total Volume Dredged (cy)
- [Post	
			Construction	
			Maintenance, 43	
	Projected	Desdemona, June	ft Yr 20	40000

VOLUME OF DREDGED MATERIALS - Maintenance 43' Yr 20

Г	Volu	ime to be Dredged	(cy)	
Γ	River Mile	Location Name	Volume (cy)	Data from Portland District (4 Dec 2002)
Γ	4 to 9	Desdemona	40000	
Γ	10 to 13	Flavel Bar	210000	
Γ	14 to 17	Upper Sands	100000	
E	18 to 20	Tongue Point	330000	
	Total		680000	-

Dredged Yardage (cy)

40000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from June Data

Age Class	Total		Prop	ortion		
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.50	0.50	* binomial distribution p>0.05; low sample size - assumed to be 1:1.
1+	70	68	138	0.51	0.49	binomial distribution p=0.067 - not sign different from 1:1
2+	12	4	16	0.75	0.25	binomial distribution p<0.05
3+	0	0	0	0.50	0.50	* low sample size - assumed to be 1:1

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

Age Class	R	E	Var(E)	М	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00517	206.9		0.10	0.017	0.34		0.15	
1+	0.19327	7730.9		0.60	0.160	742.17		333.98	
2+	0.02429	971.7		0.86	0.649	542.36		244.06	
3+	0.00088	35.4		0.86	2.222	67.65		30.44	
All		9044.0				4252 54		C00 C2	

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		Ī
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.17		0.50	0.17		E = Crabs Entrained (number of Crabs)
1+	0.50	371.08		0.50	371.08		M = Post-Entrainment Mortality (proportion)
2+	0.25	135.59		0.75	406.77		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	33.82		0.50	33.82		AEL = Adult Equivalent Loss
All		540.67			811.84		VAR(AEL) =AEL Variance

Age Class Distribution

Age Class	% of Total			
Age Class	of Entrained	of AEL		
YOY	2.31	0.00		
1+	86.43	54.87		
2+	10.86	40.10		
3+	0.40	5.00		

	Proportion of Total AEL			
Age Class	Male	Female		
YOY	0.0001	0.0001		
1+	0.2744	0.2744		
2+	0.3007	0.1002		
3+	0.0250	0.0250		
ΔII	0.60	0.40		

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.08		0.50	0.08		E = Crabs Entrained (number of Crabs)
1+	0.50	166.99		0.50	166.99		M = Post-Entrainment Mortality (proportion)
2+	0.25	61.02		0.75	183.05		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987
3+	0.50	15.22		0.50	15.22		AEL = Adult Equivalent Loss
All		243.30			365.33		VAR(AEL) =AEL Variance
					608.629		

Age Class Distribution

1	Age Class	% of Total			
	Age Class	of Entrained	of AEL at 3+		
	YOY	2.31	0.03		
ı	1+	86.43	54.87		
	2+	10.86	40.10		
	3+	0.40	5.00		

	Proportion of	Total AEL at 3+
Age Class	Male	Female
YOY	0.0001	0.0001
1+	0.2744	0.2744
2+	0.3007	0.1002
3+	0.0250	0.0250
ALL	0.60	0.40

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

E	8944.9
Var(E)	
SE E	
Z at 0.975	1.95996
95% C. I.	
OV E (0/)	

TOTAL AEL at 24	+ with Confidence
AEL at 2+	1352.5
Var(AEL2+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

L at 2+ v	with Confidence Limits	TOTAL AEL at 3+ v	with Confidence Limits
	1352.5	AEL at 3+	608.6
)		Var(AEL3+)	
		SE AEL	
	1.95996	Z at 0.975	1.95996
		95% C. I.	
.)		CV AEL (%)	

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+	365.3	
Var(AEL)		
SE AEL		
Z at 0.975	1.95996	
95% C. I.		
CV AFL (%)		

FEMALE	AEL	at 3+	with	Confidence	Limi

AEL at 3+		243.3
Var(AEL)		
SE AEL		
Z at 0.975	i	1.95996
95% C. I.		
CV AFL (%)	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

Male Age 3+		Lost to Fishery
(number of	Harvest Rate	(number of
crab)	(proportion)	crab)
200.2	0.70	255.7

Loss to Fishery with Confidence Limits

Loss to Fishery	255.
Var(AEL)	
SE LF	
Z at 0.975	1.9599
95% C. I.	
CV LF (%)	

Summary of Projected Entrainment, Adult Equivalent Loss, and Loss to Fishery Lower Columbia River
WH Pearson and GD Williams

Variance Estimators (derived from Sept 2002 field sampling)

CV % 29.43 20.25 Z at 0.975 1.95996 AEL LF 20.25

Construction Dredging	to 40 ft - Age 2+
-----------------------	-------------------

Assumptions:	
Projected Location	Desdemona

results.			
	Projected		
Parameter	Value	SE	95% CI
E	70,955	20,882	40,928
AEL	59,819	12,113	23,742
AEL Male	29,910	6,057	11,871
AEL Female	29,910	6,057	11,871
Loss to Fishery	9,422	1,908	3,739

Construction Dredging to 40 ft - Age 3+

Assumptions.	
Projected Location	Desdemona
Planned dredged volume (cy)	593,812

	Projected		
Parameter	Value	SE	95% CI
E	70,955	20,882	40,928
AEL	26,919	5,451	10,684
AEL Male	13,459	2,726	5,342
AEL Female	13,459	2,726	5,342
Loss to Fishery	9,422	1,908	3,739

Construction Dredging from 40 to 43 ft - Age 2+

	J
Assum	ptions:

Assumptions.	
Projected Location	Desdemona
Planned dredged volume (cv)	473 803

Results:

	Projected		
Parameter	Value	SE	95% CI
E	56,626	16,665	32,663
AEL	47,739	9,667	18,947
AEL Male	23,869	4,834	9,474
AEL Female	23,869	4,834	9,474
Loss to Fishery	7,519	1,523	2,984

Construction Dredging from 40 to 43 ft - Age 3+ Assumptions:

7 too ampaono.	
Projected Location	Desdemona
Planned dredged volume (cy)	473,893

Results:

	Projected		
Parameter	Value	SE	95% CI
E	56,626	16,665	32,663
AEL	21,482	4,350	8,526
AEL Male	10,741	2,175	4,263
AEL Female	10,741	2,175	4,263
Loss to Fishery	7,519	1,523	2,984

Annual Maintenance Dredging 40' Year 1 - Age 2+ Assumptions:

Projected Location	Desdemona
Planned dredged volume (cy)	40,000

Results:

	Projected		
Parameter	Value	SE	95% CI
E	4,780	1,407	2,757
AEL	4,030	816	1,599
AEL Male	2,015	408	800
AEL Female	2,015	408	800
Loss to Fishery	635	129	252

Annual Maintenance Dredging 40' Year 1 - Age 3+ Assumptions:

Projected Location	Desdemona
Planned dredged volume (cy)	40,000

Results:

Parameter	Projected Value	SE	95% CI
E	4,780	1,407	2,757
AEL	1,813	367	720
AEL Male	907	184	360
AEL Female	907	184	360
Loss to Fishery	635	129	252

Annual Maintenance Dredging 40' Year 20 - Age 2+

A۶	ssu	ımı	oti	io	ns:	

Projected Location	Desdemona
Planned dredged volume (cy)	40,000

Results:

	Projected		
Parameter	Value	SE	95% CI
E	4,780	1,407	2,757
AEL	4,030	816	1,599
AEL Male	2,015	408	800
AEL Female	2,015	408	800
Loss to Fishery	635	129	252

Annual Maintenance Dredging 40' Year 20 - Age 3+ Assumptions:

, rooumphono.	
Projected Location	Desdemona
Planned dredged volume (cv)	40 000

Parameter	Projected Value	SE	95% CI
E	4,780	1,407	2,757
AEL	1,813	367	720
AEL Male	907	184	360
AEL Female	907	184	360
Loss to Fishery	635	129	252

Annual Maintenance Dredging 43' Year 1 - Age 2+ <u>Assumptions</u>:

Projected Location	Desdemona
Name and Appellant Accelerate (as A	00.000

rojecteu Location	
lanned dredged volume (cy)	

Results:

	Projected		
Parameter	Value	SE	95% CI
E	7,169	2,110	4,135
AEL	6,044	1,224	2,399
AEL Male	3,022	612	1,199
AEL Female	3,022	612	1,199
Loss to Fishery	952	193	378

Annual Maintenance Dredging 43' Year 1 - Age 3+ Assumptions:

Projected Location	Desdemona
Planned dredged volume (cy)	60,000

Results:

Parameter	Projected Value	SE	95% CI
E	7,169	2,110	4,135
AEL	2,720	551	1,080
AEL Male	1,360	275	540
AEL Female	1,360	275	540
Loss to Fishery	952	193	378

Annual Maintenance Dredging 43' Year 20 - Age 2+ Assumptions:

i rojecteu Location	Desdelliona
Planned dredged volume (cy)	40,000

Results:

	Projected		
Parameter	Value	SE	95% CI
E	4,780	1,407	2,757
AEL	4,030	816	1,599
AEL Male	2,015	408	800
AEL Female	2,015	408	800
Loss to Fishery	635	129	252

Annual Maintenance Dredging 43' Year 20 - Age 3+ Assumptions:

Projected Location	Desdemona
Planned dredged volume (cy)	40,000

Results:			
Parameter	Projected Value	SE	95% CI
E	4,780	1,407	2,757
AEL	1,813	367	720
AEL Male	907	184	360
AEL Female	907	184	360
Loss to Fishery	635	129	252

Field Date	Field Location	Projection	Total Volume Dredged (cy)
		Construction Dredging to 40	
Projected	Desdemona, Sent	ft	593812

VOLUME OF DREDGED MATERIALS - to 40 ft

Volu	me to be Dredged	(cy)	
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 200)
4	Lower Desdem.	222412	· -
5		353916	
6	Upper Desdem	0	
7		0	
8		8742	
9		8742	
10	Flavel Bar	49732	
11		298900	
12		121292	
13		72425	
14	Upper Sands	54585	
15		51945	
16		47557	
17		0	
18	Tongue Point	14775	
19		6976	
20		13283	
Total		1325282	!

Dredged Yardage (cy)

593812 Amount (cy) dredged during dredging period

Sex Ratios by Age Class

Age Class		Total		Propo	rtion
Age Class	Male	Female	Sexed	Male	Female
YOY	0	0	0	0.5*	0.5*
1+	0	0	0	0.5*	0.5*
2+	2	0	2	0.5*	
3+	0	1	1	0.5*	0.5*

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00000	0.0		0.10		0.00		0.00	
1+	0.02173	12901.0		0.60	0.160	1238.49		557.32	
2+	0.06518	38702.9		0.86	0.649	21601.63		9720.73	
3+	0.03259	19351.4		0.86	2.222	36979.06		16640.58	
All		70955.3				59819.18		26918.63	
	Note: Entrangle And Annah and Andread								

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.00		0.50	0.00		E = Crabs Entrained (number of Crabs)
1+	0.50	619.25		0.50	619.25		M = Post-Entrainment Mortality (proportion)
2+	0.50	10800.81		0.50	10800.81		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	18489.53		0.50	18489.53		AEL = Adult Equivalent Loss
All		20000 50			20000 50		VAR(AEL) = AEL Variance

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL			
YOY	0.00	0.00			
1+	18.18	2.07			
2+	54.55	36.11			
3+	27.27	61.82			

	Proportion of Total AEL			
Age Class	Male	Female		
YOY	0.0000	0.0000		
1+	0.0104	0.0104		
2+	0.1806	0.1806		
3+	0.3091	0.3091		
ALL	0.50	0.50		

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R
YOY	0.50	0.00		0.50	0.00		Ε
1+	0.50			0.50	278.66		М
2+	0.50	4860.37		0.50	4860.37		s
3+	0.50	8320.29		0.50	8320.29		Αl
All		13459.32			13459.32		V

R = Crab Entrainment Rate (crabs/cy)
E = Crabs Entrained (number of Crabs)
M = Post-Entrainent Mortally (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				
Age Class	of Entrained	of AEL at 3+			
YOY	0.00	0.0			
1+	18.18	2.0			
2+	54.55	36.1			
3+	27.27	61.8			

	Proportion of I	Otal AEL at 3+
Age Class	Male	Female
YOY	0.0000	
1+	0.0104	0.0104
2+	0.1806	
3+	0.3091	0.3091
ALI	0.50	0.50

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

70955.3
1.95996

TOTAL AEL	at 2+	with	Confider	ice Li	mits

with Confidence Limits	TOTAL AEL at 3+ with Confidence			
59819.2	AEL at 3+	26918.6		
	Var(AEL3+)			
	SE AEL			
1.95996	Z at 0.975	1.95996		
	95% C. I.			
	CV AEL (%)			

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

MALE AEL at 3+ with Confidence Limits

AEL at 3+			134	59.3
Var(AEL)				
SE AEL				
Z at 0.975			1.95	996
95% C. I.				
CV AFI /%	١ -			

FEMALE AEL at 3+ with Confidence Limits

AEL at 3+	13459.3
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

		Lost to Fishery
Male Age 3+	Harvest Rate	(number of
(number of crab)	(proportion)	crab)
12450.2	0.70	0404 5

9421.5 Harvest rate of 0.70 is taken from Armstrong et al. (1987).

Loss to Fishery with Confidence Limits

Loss to Fishery	9421.
Var(AEL)	
SE LF	
Z at 0.975	1.9599
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)
		Construction Dredging to 40	
Projected	Desdemona, Sept	ft	473893

VOLUME OF DREDGED MATERIALS - from 40 to 43 ft

Volu	me to be Dredged (cy)	
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 200
4	Lower Desdem.	94688	
5		196724	
6	Upper Desdem	66193	
7		1039	
8		52398	
9		62851	
10	Flavel Bar	329296	
11		535074	
12		239608	
13		65743	
14	Upper Sands	171432	
15		271842	
16		306717	
17		108631	
18	Tongue Point	174113	
19		162864	
20		127219	
Total		2966432	!

Dredged Yardage (cy)

473893 Amount (cy) dredged during dredging period

Sex Ratios by Age Class

Age Class		Total		Propo	rtion	
Age Class	Male	Female	Sexed	Male	Female	
YOY	0	0	0	0.5*		* Sample sizes low; assumed to
1+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to
2+	2	0	2	0.5*	0.5*	* Sample sizes low; assumed to
3+	0	1	1	0.5*	0.5*	* Sample sizes low; assumed to

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00000			0.10				0.00	
1÷	0.02173	10295.6		0.60	0.160	988.38		444.77	
2+	0.06518	30886.9		0.86	0.649	17239.23		7757.65	
3+	0.03259	15443.5		0.86	2.222	29511.22		13280.05	
All		56626.0				47738.83		21482.47	
	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					
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.00		0.50	0.00		E = Crabs Entrained (number of Crabs)
1+	0.50	494.19		0.50	494.19		M = Post-Entrainment Mortality (proportion)
2+	0.50	8619.61		0.50	8619.61		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	14755.61		0.50	14755.61		AEL = Adult Equivalent Loss
All		22960 42			22960 42		VAR(AFI) = AFI Variance

Age Class Distribution

Age Class	% of	Total
Age Class	of Entrained	of AEL
YOY	0.00	0.00
1+	18.18	2.07
2+	54.55	36.11
3+	27 27	61 92

	Proportion of Total AEL				
Age Class	Male	Female			
YOY	0.0000				
1+	0.0104	0.0104			
2+	0.1806	0.1806			
3+	0.3091	0.3091			
ALL	0.50	0.50			

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			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	
YOY	0.50	0.00		0.50	0.00		
1+	0.50	222.39		0.50	222.39		
2+	0.50	3878.83		0.50	3878.83		
3+	0.50	6640.02		0.50	6640.02		
All		10741.24			10741.24		

R = Crab Entrainment Rate (crabs/cy)
E = Crabs Entrained (number of Crabs)
M = Post-Entrained (number of Crabs)
S = Natural Survivorship (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				
Age Class	of Entrained	of AEL at 3+			
YOY	0.00	0.0			
1+	18.18	2.0			
2+	54.55	36.1			
3+	27.27	61.8			

	Proportion of Total AEL at 3+			
Age Class	Male	Female		
YOY	0.0000	0.0000		
1+	0.0104	0.0104		
2+	0.1806	0.1806		
3+	0.3091	0.3091		
ALL	0.50	0.50		

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

TOTAL AEL at 2+	TOTAL AEL at 2+ with Confidence Limits				
AEL at 2+	47738.8				
Var(AEL2+)					
SE AEL					
Z at 0.975	1.95996				
95% C. I.					

TOTAL AEL at 3+	with Confidence Limits
AEL at 3+	21482.5
Var(AEL3+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	

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+			107	41.2
Var(AEL)				
SE AEL				
Z at 0.975			1.95	99
95% C. I.				
CV AFI /%	١			

FEMALE AEL at 3+ with Confidence Limits

AEL at 3+	10741.
Var(AEL)	
SE AEL	
Z at 0.975	1.9599
95% C. I.	
CV AEL (%)	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

		Lost to Fishery
Male Age 3+	Harvest Rate	(number of
(number of crab)	(proportion)	crab)
40744.0	0.70	

7518.9 Harvest rate of 0.70 is taken from Armstrong et al. (1991).

Loss to Fishery with Confidence Limits

Loss to Fishery	7518.9
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)
		Post	
		Construction	
		Maintenance, 40	
Projected	Desdemona, Sept	ft Yr 1	40000

VOLUME OF DREDGED MATERIALS - Maintenance 40' Yr 1

Volu	me to be Dredged	(cy)	1
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 200)
4 to 9	Desdemona	40,000	
10 to 13	Flavel Bar	400000	
14 to 17	Upper Sands	50000	
18 to 20	Tongue Point	270000	
Total		760000	

40,000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class

Age Class	Total			Prop	ortion	
Age Class	Male	Female	Sexed	Male	Female	
YOY	0	0	0	0.5*		* Sample
1+	0	0	0	0.5*	0.5*	* Sample
2+	2	0	2	0.5*		* Sample
3+	0	1	1	0.5*	0.5*	* Sample

e sizes low; assumed to be 1:1.

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00000	0.0		0.10	0.017	0.00		0.00	
1+	0.02173	869.0		0.60	0.160	83.43		37.54	
2+	0.06518	2607.1		0.86	0.649	1455.12		654.80	
3+	0.03259	1303.5		0.86	2.222	2490.96		1120.93	
All 4779.6 4029.50 1813.28									
	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	
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	0.00		0.50	0.00	
1+	0.50	41.71		0.50	41.71	
2+	0.50	727.56		0.50	727.56	
3+	0.50	1245.48		0.50	1245.48	
All		2014.75			2014.75	

R = Crab Entrainment Rate (crabs/cy)
E = Crabs Entrained (number of Crabs)
M = Post-Entrainment Morality (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			
Age Class	of Entrained	of AEL		
YOY	0.00	0.02		
1+	18.18	2.07		
2+	54.55	36.11		
3+	27.27	61.82		

	Proportion of Total AEL		
Age Class	Male	Female	
YOY	0.0000	0.0000	
1+	0.0104		
2+	0.1806	0.1806	
3+	0.3091	0.3091	
ALL	0.50	0.50	

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	0.00		0.50	0.00	•
1+	0.50	18.77		0.50	18.77	
2+	0.50	327.40		0.50	327.40	
3+	0.50	560.47		0.50	560.47	
All		906.64			906.64	
					1813,276	

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

VAR(AEL) =AEL Variance

Age Class Distribution

Age Class	% of Total		
Age Class	of Entrained	of AEL at 3+	
YOY	0.00	0.00	
1+	18.18	2.07	
2+	54.55	36.11	
3+	27.27	61.82	

	Proportion of Total AEL at 3+		
Age Class	Male	Female	
YOY	0.0000	0.0000	
1+	0.0104	0.0104	
2+	0.1806	0.1806	
3+	0.3091	0.3091	
ΔΠ	0.50	0.50	

SUMMARY VARIANCE DATA

4779.6	AEL at 2+
	Var(AEL2+)
	SE AEL
1.95996	Z at 0.975
	95% C. I.
	CV AEL (%)

TOTAL AEL at 2+ with Confidence		
AEL at 2+	4029.5	
Var(AEL2+)		
SE AEL		
Z at 0.975	1.95996	

TOTAL AEL at 3+ with Confidence Limits		
AEL at 3+	1813.3	
Var(AEL3+)		
SE AEL		
Z at 0.975	1.95996	
95% C. I.		
CV AEL (%)		

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

MALE AEL at 3+ with Confidence Limits

AEL at 3+	906.6
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

AEL at 3+	906.6
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

FEMALE AEL at 3+ with Confidence Limits

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

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

906.6 0.70 634.6 Harvest rate of 0.70 is taken from Armstrong et al. (1987).

Loss to Fishery with Confidence Limits

Loss to Fishery	634.6
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)
		Post	
		Construction	
		Maintenance, 40	
Projected	Desdemona, Sept	ft Yr 20	40000

VOLUME OF DREDGED MATERIALS - Maintenance 40' Yr 20

Volu	me to be Dredged	(cy)	
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 200)
4 to 9	Desdemona	40000	
10 to 13	Flavel Bar	210000	
14 to 17	Upper Sands	50000	
18 to 20	Tongue Point	270000	
Total		570000	•

40,000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class

Age Class		Total		Prope	ortion
Age Class	Male	Female	Sexed	Male	Female
YOY	0	0	0	0.5*	0.5*
1+	0	0	0	0.5*	0.5*
2+	2	0	2	0.5*	0.5*
3+	0	1	1	0.5*	0.5*

Sample sizes low; assumed to be 1:1. Sample sizes low; assumed to be 1:1. Sample sizes low; assumed to be 1:1. Sample sizes low; assumed to be 1:1.

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

Age Class	R	E	Var(E)	М	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00000	0.0		0.10	0.017	0.00		0.00	
1+	0.02173	869.0		0.60	0.160	83.43		37.54	
2+	0.06518	2607.1		0.86	0.649	1455.12		654.80	
3+	0.03259	1303.5		0.86	2.222	2490.96		1120.93	
All		4779.6				4029.50		1813.28	
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	
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	0.00		0.50	0.00	
1+	0.50	41.71		0.50	41.71	
2+	0.50	727.56		0.50	727.56	
3+	0.50	1245.48		0.50	1245.48	
All		2014.75			2014.75	

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

Age Class Distribution

Age Class	% of Total			
Age Class	of Entrained	of AEL		
YOY	0.00	0.02		
1+	18.18	2.07		
2+	54.55	36.11		
3+	27.27	61.82		

	Proportion of Total AEL		
Age Class	Male	Female	
YOY	0.0000	0.0000	
1+	0.0104	0.0104	
2+	0.1806	0.1806	
3+	0.3091	0.3091	
ALL	0.50	0.50	

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			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	
YOY	0.50	0.00		0.50	0.00	•	
1+	0.50	18.77		0.50	18.77		
2+	0.50	327.40		0.50	327.40		
3+	0.50	560.47		0.50	560.47		
All		906.64			906.64		
					1813,276		

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

VAR(AEL) =AEL Variance

1813.3

1.9599

Age Class Distribution

Age Class	% of Total			
Age Class	of Entrained	of AEL at 3+		
YOY	0.00	0.00		
1+	18.18	2.07		
2+	54.55	36.11		
3+	27.27	61.82		

	Proportion of Total AEL at 3+			
Age Class	Male	Female		
YOY	0.0000	0.0000		
1+	0.0104	0.0104		
2+	0.1806	0.1806		
3+	0.3091	0.3091		
ALI	0.50	0.50		

SUMMARY VARIANCE DATA

E	4779.6	
Var(E)		
SE E		
Z at 0.975	1.95996	
95% C. I.		
CV F (%)		

TOTAL AEL at 2+ with Confidence Limits

•	TOTAL AEL at 3	۰
	451	
	AEL at 3+	
	Var(AEL3+)	
	SE AEL	
	Z at 0.975	
	95% C. I.	1
	CV AEL (%)	

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

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

MALE AEL at 3+ with Confidence Limits

AEL at 3+	906.6
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

FEMALE AEL at 3+ with Confidence Limits

1.9599

AEL at 3+	906.6
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

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

		Lost to Fishery
Male Age 3+	Harvest Rate	(number of
(number of crab)	(proportion)	crab)
006.6	0.70	6246

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

Loss to Fishery with Confidence Limits

Loss to Fishery	634.6
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)
		Post	
		Construction	
		Maintenance, 43	
Projected	Desdemona, Sept	ft Yr 1	60000

VOLUME OF DREDGED MATERIALS - Maintenance 43' Yr 1

Volu	me to be Dredged	(cy)	
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 200)
4 to 9	Desdemona	60000	
10 to 13	Flavel Bar	500000	
14 to 17	Upper Sands	100000	
18 to 20	Tongue Point	330000	
Total		990000	•

Dredged Yardage (cy)

60,000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class

Age Class		Total	Proportion			
Age Class	Male	Female	Sexed	Male	Female	
YOY	0	0	0	0.5*	0.5*	* S
1+	0	0	0	0.5*	0.5*	* S
2+	2	0	2	0.5*	0.5*	* S
3+	0	1	1	0.5*	0.5*	* S

Sample sizes low; assumed to be 1:1. Sample sizes low; assumed to be 1:1. Sample sizes low; assumed to be 1:1. Sample sizes low; assumed to be 1:1.

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00000	0.0		0.10	0.017	0.00		0.00	
1+	0.02173	1303.5		0.60	0.160	125.14		56.31	
2+	0.06518	3910.6		0.86	0.649	2182.67		982.20	
3+	0.03259	1955.3		0.86	2.222	3736.44		1681.40	
All		7169.5				6044.25		2719.91	
	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	0.00		0.50	0.00	
1+	0.50	62.57		0.50	62.57	
2+	0.50	1091.34		0.50	1091.34	
3+	0.50	1868.22		0.50	1868.22	
All		3022.13			3022.13	

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

Age Class Distribution

Age Class	% of Total			
Age Class	of Entrained	of AEL		
YOY	0.00	0.01		
1+	18.18	2.07		
2+	54.55	36.11		
3+	27.27	61.82		

	Proportion (of Total AEL				
Age Class	Male Female					
YOY	0.0000	0.0000				
1+	0.0104	0.0104				
2+	0.1806	0.1806				
3+	0.3091	0.3091				
ALL	0.50	0.50				

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			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	
YOY	0.50	0.00	•	0.50	0.00		
1+	0.50	28.16		0.50	28.16		
2+	0.50	491.10		0.50	491.10		
3+	0.50	840.70		0.50	840.70		
All		1359.96			1359.96		
					2719.915		

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

VAR(AEL) =AEL Variance

Age Class Distribution

Age Class	% of Total	
Age Class	of Entrained	of AEL at 3+
YOY	0.00	0.00
1+	18.18	2.07
2+	54.55	36.11
3+	27.27	61.82

	Proportion of Total AEL at 3+	
Age Class	Male	Female
YOY	0.0000	0.0000
1+	0.0104	0.0104
2+	0.1806	0.1806
3+	0.3091	0.3091
ΔΠ	0.50	0.50

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

E	7169.5
Var(E)	
SE E	
Z at 0.975	1.95996
95% C. I.	
CV E (%)	

TOTAL AEL at 2+	with Confidence
AEL at 2+	6044.3
Var(AEL2+)	
SE AEL	
7 -4 0 075	4.05000

TOTAL AEL at 3+ with Confidence Limits		
AEL at 3+	2719.9	
Var(AEL3+)		
SE AEL		
Z at 0.975	1.95996	
95% C. I.		
CV AEL (%)		

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

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

MALE AEL at 2+ with Confiden

MALE ALL GOV W	iai comidence Ei
AEL at 3+	1360.0
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
ON (A.E.) (O()	

I EMALE ALE at 31 With Confident		
AEL at 3+	1360.0	
Var(AEL)		
SE AEL		
Z at 0.975	1.95996	
95% C. I.		
CV AEL (9/)		

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

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

		Lost to Fishery	
Male Age 3+	Harvest Rate	(number of	
(number of crab)	(proportion)	crab)	
1260.0	0.70	052.0	'n

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

Loss to Fishery with Confidence Limits

Loss to Fishery	952.0
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)
		Post	
		Construction	
		Maintenance, 43	
Projected	Desdemona, Sept	ft Yr 20	40000

VOLUME OF DREDGED MATERIALS - Maintenance 43' Yr 20

Volu	me to be Dredged	(cy)	
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 200)
4 to 9	Desdemona	40000	
10 to 13	Flavel Bar	210000	
14 to 17	Upper Sands	100000	
18 to 20	Tongue Point	330000	
Total		680000	•

Dredged Yardage (cy)

40000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class

Age Class	Total			Proportion		
Age Class	Male	Female	Sexed	Male	Female	
YOY	0	0	0	0.5*	0.5*	
1+	0	0	0	0.5*	0.5*	
2+	2	0	2	0.5*	0.5*	
3+	0	1	1	0.5*	0.5*	

ample sizes low; assumed to be 1:1. ample sizes low; assumed to be 1:1. ample sizes low; assumed to be 1:1. ample sizes low; assumed to be 1:1.

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

Age Class	R	Е	Var(E)	М	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00000	0.0		0.10	0.017	0.00		0.00	
1+	0.02173	869.0		0.60	0.160	83.43		37.54	
2+	0.06518	2607.1		0.86	0.649	1455.12		654.80	
3+	0.03259	1303.5		0.86	2.222	2490.96		1120.93	
All		4779.6				4029.50		1813.28	
Note: Entrained 3+ crab are back-calculated to provide AEL at									

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	
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	0.00		0.50	0.00	
1+	0.50	41.71		0.50	41.71	
2+	0.50	727.56		0.50	727.56	
3+	0.50	1245.48		0.50	1245.48	
All		2014.75			2014.75	

R = Crab Entrainment Rate (crabs/cy)
E = Crabs Entrained (number of Crabs)
M = Post-Entrainment Morality (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			
Age Class	of Entrained	of AEL		
YOY	0.00	0.02		
1+	18.18	2.07		
2+	54.55	36.11		
3+	27.27	61.82		

	Proportion of Total AEL		
Age Class	Male	Female	
YOY	0.0000	0.0000	
1+	0.0104	0.0104	
2+	0.1806	0.1806	
3+	0.3091	0.3091	
ALL	0.50	0.50	

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	0.00		0.50	0.00	•
1+	0.50	18.77		0.50	18.77	
2+	0.50	327.40		0.50	327.40	
3+	0.50	560.47		0.50	560.47	
All		906.64			906.64	
					1813,276	

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

VAR(AEL) =AEL Variance

Age Class Distribution

Age Class	% of Total			
Age Class	of Entrained	of AEL at 3+		
YOY	0.00	0.00		
1+	18.18	2.07		
2+	54.55	36.11		
3+	27.27	61.82		

	Proportion of Total AEL at 3+			
Age Class	Male	Female		
YOY	0.0000	0.0000		
1+	0.0104	0.0104		
2+	0.1806	0.1806		
3+	0.3091	0.3091		
ΔII	0.50	0.50		

SUMMARY VARIANCE DATA

AEL at 2+	4029.5
Var(AEL2+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AFL (%)	

TOTAL AEL at 34	with Confidence Limits
AEL at 3+	1813.3
Var(AEL3+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

C.I. = Confidence Interval

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

1.9599

MALE AEL at 3+ with Confidence Limits

CV = Coefficient of Variation in %
FEMALE AEL at 3+ with Confidence Limits

AEL at 3+	906.6
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

AEL at 3+	906.6
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

		Lost to Fishery
Male Age 3+	Harvest Rate	(number of

(number of crab) (proportion) 906.6 0.70

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

Loss to Fishery with Confidence Limits

Loss to Fishery	634.6
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Summary of Projected Entrainment, Adult Equivalent Loss, and Loss to Fishery. Lower Columbia River
WH Pearson and GD Williams

Variance Estimators (derived from June 2002 field sampling at Desdemona Shoals)

CV % 5.01 7.37

1.95996 Z at 0.975

AEL LF 8.11

Construction Dredging to 40 ft - Age 2+

Assumptions:	
Projected Location	Flavel Bar
Planned dredged volume (cy)	542,349

Posulte:

Results.			
	Projected		
Parameter	Value	SE	95% CI
E	121,282	6,076	11,909
AEL	18,338	1,352	2,649
AEL Male	11,008	811	1,590
AEL Female	7,331	540	1,059
Loss to Fishery	3,467	281	551

Construction Dredging to 40 ft - Age 3+
Assumptions:

	Projected		
Parameter	Value	SE	95% CI
E	121,282	6,076	11,909
AEL	8,252	608	1,192
AEL Male	4,953	365	716
AEL Female	3,299	243	477
Loss to Fishery	3,467	281	551

onstruction Dredging from 40 to 43 ft - Age 2+ Assumptions:

Posults:

	Projected		
Parameter	Value	SE	95% CI
E	261,577	13,105	25,685
AEL	39,551	2,915	5,713
AEL Male	23,741	1,750	3,429
AEL Female	15,811	1,165	2,284
Loss to Fishery	7,478	606	1,189

Construction Dredging from 40 to 43 ft - Age 3+

Assumptions:	
Projected Location	Flavel Bar
Planned dredged volume (cy)	1,169,721

Parameter	Projected Value	SE	95% CI
F	261.577	13,105	25.685
AEL	17,798	1,312	2,571
AEL Male	10,683	787	1,543
AEL Female	7,115	524	1,028
Loss to Fishery	7,478	606	1,189

Annual Maintenance Dredging 40' Year 1 - Age 2+

Assumptions:	
Projected Location	Flavel Bar
Planned dredged volume (cy)	400,000

Results:

Parameter	Projected Value	SE	95% CI
E	89,449	4,481	8,783
AEL	13,525	997	1,954
AEL Male	8,118	598	1,173
AEL Female	5,407	398	781
Loss to Fishery	2,557	207	406

Annual Maintenance Dredging 40' Year 1 - Age 3+

Assumptions:	
Projected Location	Flavel Bar
Planned dredged volume (cy)	400,000

Results:

	Projected		
Parameter	Value	SE	95% CI
E	89,449	4,481	8,783
AEL	6,086	449	879
AEL Male	3,653	269	528
AEL Female	2,433	179	351
Loss to Fishery	2,557	207	406

Annual Maintenance Dredging 40' Year 20 - Age 2+
Assumptions:

Projected Location	Flavel Bar
Planned dredged volume (cy)	210,000

Results:

D	Projected Value	SE	95% CI
Parameter	value	5E	95% CI
E	46,961	2,353	4,611
AEL	7,101	523	1,026
AEL Male	4,262	314	616
AEL Female	2,838	209	410
Loss to Fishery	1,343	109	213

nnual Maintenance Dredging 40' Year 20 - Age 3+

Assumptions: Projected Location
Planned dredged volume (cy)

Results:

Parameter	Projected Value	SE	95% CI
E	46,961	2,353	4,611
AEL	3,195	235	462
AEL Male	1,918	141	277
AEL Female	1,277	94	185
Loss to Fishery	1,343	109	213

Annual Maintenance Dredging 43' Year 1 - Age 2+

Assumptions: Flavel Bar 500,00

Results.				
	Projected			
Parameter	Value	SE	95% CI	
E	111,812	5,602	10,979	
AEL	16,906	1,246	2,442	
AEL Male	10,148	748	1,466	
AEL Female	6,758	498	976	
Loss to Fishery	3.197	259	508	

Annual Maintenance Dredging 43' Year 1 - Age 3+

Assumptions.	
Projected Location	Flavel Bar
Planned dredged volume (cy)	500,000

	Projected		
Parameter	Value	SE	95% CI
E	111,812	5,602	10,979
AEL	7,608	561	1,099
AEL Male	4,567	337	660
AEL Female	3,041	224	439
Loss to Fishery	3,197	259	508

Annual Maintenance Dredging 43' Year 20 - Age 2+
Assumptions:

Projected Location	Flavel Bar
Planned dredged volume (cy)	210,000

Results:

	Projected		
Parameter	Value	SE	95% CI
E	46,961	2,353	4,611
AEL	7,101	523	1,026
AEL Male	4,262	314	616
AEL Female	2,838	209	410
Loss to Fishery	1,343	109	213

Annual Maintenance Dredging 43' Year 20 - Age 3+

rojected Location	Flavel Bar	
anned dredged volume (cy)	210,000	

Results:			
Parameter	Projected Value	SE	95% CI
E	46,961	2,353	
AEL	3,195	235	462
AEL Male	1,918	141	277
AEL Female	1,277	94	185
Loss to Fishery	1,343	109	213

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona June crab entrainment data
		Construction		
		Dredging to 40		
Projected	Flavel Bar	ft	542349	

VOLUME OF DREDGED MATERIALS - to 40 ft

		me to be Dredged (e	
ata from Portland District (10 Sept 200	Volume (cy)	Location Name	River Mile
	222412	Lower Desdem.	4
	353916		5
	0	Upper Desdem	6
	0		7
	8742		8
	8742		9
	49732	Flavel Bar	10
	298900		11
	121292		12
	72425		13
	54585	Upper Sands	14
	51945		15
	47557		16
	0		17
	14775	Tongue Point	18
	6976		19
	13283		20
	1325282		Total

542349 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from June Data

Age Class	Total		Total Proportion			
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.50	0.50	* binomial distribution p>0.05; low sample size - assumed to b
1+	70	68	138			binomial distribution p=0.067 - not sign different from 1:1
2+	12	4	16	0.75	0.25	binomial distribution p<0.05
3+	0	0	0	0.50	0.50	* low sample size - assumed to be 1:1.

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00517	2805.5		0.10	0.017	4.63		2.08	
1+	0.19327	104821.2		0.60	0.160	10062.84		4528.28	
2+	0.02429	13175.3		0.86	0.649	7353.65		3309.14	
3+	0.00088	480.0		0.86	2.222	917.19		412.73	
All		121282.0				18338.30		8252.24	

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	
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	2.31		0.50	2.31	
1+	0.50	5031.42		0.50	5031.42	
2+	0.25	1838.41		0.75	5515.24	
3+	0.50	458.59		0.50	458.59	
ΔΙΙ		7330 74			11007 56	

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

Age Class Distribution

Age Class	% of	Total
Age Class	of Entrained	of AEL
YOY	2.31	0.0
1+	86.43	54.8
2+	10.86	40.1
3+	0.40	5.0

	Proportion of Total AEL			
Age Class	Male	Female		
YOY	0.0001	0.0001		
1+	0.2744	0.2744		
2+	0.3007	0.1002		
3+	0.0250	0.0250		

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	1.04		0.50	1.04		E = Crabs Entrained (number of Crabs)
1+	0.50	2264.14		0.50	2264.14		M = Post-Entrainment Mortality (proportion)
2+	0.25	827.29		0.75	2481.86		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	206.37		0.50	206.37		AEL = Adult Equivalent Loss
All		3298.83			4953.40		VAR(AEL) =AEL Variance
					8252.235		=

Age Class Distribution

A Cl	% of	Total
Age Class	of Entrained	of AEL at 3+
YOY	2.31	0.03
1+	86.43	54.87
2+	10.86	40.10
3+	0.40	5.00

	Proportion of Total AEL at 34		
Age Class	Male	Female	
YOY	0.0001	0.0001	
1+	0.2744		
2+	0.3007	0.1002	
3+	0.0250	0.0250	
ALL	0.60	0.40	

SUMMARY VARIANCE DATA

rainment with Confidence Limits		
E Var(E)	121282.0	
Var(E)		
SEE		
Z at 0.975	1.95996	
95% C. I.		
CV E (%)		

TOTAL AEL at 2	+ with Confidence L
AEL at 2+	18338.3
Var(AFI 2+)	

TOTAL AEL at 3	+ with Confidence
AEL at 3+	8252.2
Var(AEL3+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

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+	4953
Var(AEL)	
SE AEL	
Z at 0.975	1.9599
95% C. I.	
CV AEL (%)	

FEMALE AEL at 3+ with Confidence Limits

AEL at 3+	3298.8
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

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

4953.4 0.70 3467.4 Harvest rate of 0.70 is taken from Armstrong et al. (1987).

Loss to Fishery with Confidence Limits

Loss to Fishery	3467.4
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona June crab entrainment dat
		Construction		
Projected	Flavel Bar	Dredging from 40 to 43 ft	1160721	

VOLUME OF DREDGED MATERIALS - from 40 to 43 ft

nd	Surface Area to be	Dredged (ha)		
	River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 2002)
	4	Lower Desdem.	94688	
	5		196724	
	6	Upper Desdem	66193	
	7		1039	
	8		52398	
	9		62851	
	10	Flavel Bar	329296	
	11		535074	
	12		239608	
	13		65743	
	14	Upper Sands	171432	
	15		271842	
	16		306717	
	17		108631	
	18	Tongue Point	174113	
	19		162864	
	20		127219	
	Total		2966432	

Dredged Yardage (cy)

1169721 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from June Data

Age Class		Total		Propo	rtion	
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.50		* binomial distribution p>0.05; low sample size - assumed to be 1:1.
1+	70	68	138	0.51	0.49	binomial distribution p=0.067 - not sign different from 1:1
2+	12	4	16	0.75		binomial distribution p<0.05
3+	0	0	0	0.50	0.50	* low sample size - assumed to be 1:1.

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00517	6050.9		0.10	0.017	9.98		4.49	
1+	0.19327	226075.0		0.60	0.160	21703.20		9766.44	
2+	0.02429	28416.0		0.86	0.649	15860.12		7137.05	
3+	0.00088	1035.2		0.86	2.222	1978.16		890.17	
All		261577.1				39551.46		17798.16	
	Note: Estrained 2: such are heat; calculated to precide ACI 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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	Proportion AEL VAR(AEL) R		R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	4.99		0.50	4.99		E = Crabs Entrained (number of Crabs)
1+	0.50	10851.60		0.50	10851.60		M = Post-Entrainment Mortality (proportion)
2+	0.25	3965.03		0.75	11895.09		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	989.08		0.50	989.08		AEL = Adult Equivalent Loss
All		45040.70			22740.70		MAD(AEL) -AEL Meriones

Age Class Distribution

Age Class	% of 1	otal		Propo	
Age Class	of Entrained of AEL			Age Class	Male
YOY	2.31	0.00		YOY	-
1+	86.43	54.87		1+	-
2+	10.86	40.10		2+	-
3+	0.40	5.00		3+	-
			_	ALL	

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						
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	2.25		0.50	2.25		E = Crabs Entrained (number of Crabs)
1+	0.50	4883.22		0.50	4883.22		M = Post-Entrainment Mortality (proportion)
2+	0.25	1784.26		0.75	5352.79		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	445.09		0.50	445.09		AEL = Adult Equivalent Loss
All		7114.82			10683.34		VAR(AEL) =AEL Variance
					17709 169		

Age Class Distribution

Г	Age Class	% of Total				
L	Age Class	of Entrained	of AEL at 3+			
Г	YOY	2.31	0.03			
Г	1+	86.43	54.87			
Г	2+	10.86	40.10			
Г	3+	0.40	5.00			

	Proportion of I	Otal AEL at 37
Age Class	Male	Female
YOY	0.0001	
1+	0.2744	0.2744
2+	0.3007	
3+	0.0250	0.0250
ALL	0.60	0.40

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

261577.1	AEL at 2+	395
	Var(AEL2+)	
	SE AEL	
1.95996	Z at 0.975	1.95
	95% C. I.	
	CV AEL (9/)	

51.5	AEL at 3+	17798.2
	Var(AEL3+)	
	SE AEL	
5996	Z at 0.975	1.95996
	95% C. I.	
	CV AEL (%)	

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

MALE AEL at 3+ with Confidence Limits

AEL at 3+			106	83.3
Var(AEL)				
SE AEL				
Z at 0.975			1.95	599
95% C. I.				
CV AFI /%	١			

FEMALE AEL at	3+ with Confiden	ice Limits
AEL at 3+		
Var(AEL)		
SE AEL		
Z at 0.975	1.95996	
95% C. I.		
CV AFI (%)		

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

		Lost to Fishery	ı
Male Age 3+	Harvest Rate	(number of	ı
(number of crab)	(proportion)	crab)	ı
10683.3	0.70	7470 2	L

7478.3 Harvest rate of 0.70 is taken from Armstrong et al. (1987).

Loss to Fishery with Confidence Limits

Loss to Fishery	7478.3
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona June crab entrainment data
		Post		
		Construction		
		Maintenance, 40		
Projected	Flavel Bar	ft Yr 1	400000	

VOLUME OF DREDGED MATERIALS - Maintenance 40' Yr 1

ſ	Volu	me to be Dredged ((cy)	
ſ	River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept
ſ	4 to 9	Desdemona	40,000	
I	10 to 13	Flavel Bar	400000	
ſ	14 to 17	Upper Sands	50000	
I	18 to 20	Tongue Point	270000	
	Total		760000	

Dredged Yardage (cy)

400,000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from June Data

Age Class		Total			ortion	
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.50	0.50	* binomial distribution p>0.05; low sample size - assumed to be 1:
1+	70	68	138	0.51	0.49	binomial distribution p=0.067 - not sign different from 1:1
2+	12	4	16	0.75	0.25	binomial distribution p<0.05
3+	0	0	0	0.50	0.50	* low sample size - assumed to be 1:1

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

Age Class	R	E	Var(E)	М	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00517	2069.2		0.10	0.017	3.41		1.54	
1+	0.19327	77309.0		0.60	0.160	7421.67		3339.75	
2+	0.02429	9717.2		0.86	0.649	5423.56		2440.60	
3+	0.00088	354.0		0.86	2.222	676.45		304.40	
ΔII		90440.4				42525.00		C00C 20	

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	1.71		0.50	1.71		E = Crabs Entrained (number of Crabs)
1+	0.50	3710.83		0.50	3710.83		M = Post-Entrainment Mortality (proportion)
2+	0.25	1355.89		0.75	4067.67		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 19
3+	0.50	338.23		0.50	338.23		AEL = Adult Equivalent Loss
All		5406.66			8118.44		VAR(AEL) =AEL Variance

Age Class Distribution

Age Class	% of	Total
Age Class	of Entrained	of AEL
YOY	2.31	0.00
1+	86.43	54.87
2+	10.86	40.10
3+	0.40	5.00

	Proportion of	Total AEL
Age Class	Male	Female
YOY	0.0001	0.0001
1+	0.2744	0.2744
2+	0.3007	0.1002
3+	0.0250	0.0250
ALI	0.60	0.40

AGE 3+ Calculations

ontribution to Adult Equivalent L	oss (AEL at 3+) and Variance	(AEL at 3+) by Sex (MALE/FI	EMALE) and Age Class

Age Class		Female			Male		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.77		0.50	0.77		E = Crabs Entrained (number of Crabs)
1+	0.50	1669.88		0.50	1669.88		M = Post-Entrainment Mortality (proportion)
2+	0.25	610.15		0.75	1830.45		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 198
3+	0.50	152.20		0.50	152.20		AEL = Adult Equivalent Loss
All		2433.00			3653.30		VAR(AEL) =AEL Variance
					6086,292		

Age Class Distribution

Age Class	% of	Total
Age Class	of Entrained	of AEL at 3+
YOY	2.31	0.03
1+	86.43	54.87
2+	10.86	40.10
3+	0.40	5.00

	Proportion of Total AEL at 3+			
Age Class	Male	Female		
YOY	0.0001	0.0001		
1+	0.2744	0.2744		
2+	0.3007	0.1002		
3+	0.0250	0.0250		
ALL	0.60	0.40		

SUMMARY VARIANCE DATA

···	daniment with Confidence Limits		
	E	89449.4	
	Var(E)		
	SE E		
	Z at 0.975	1.95996	
	95% C. I.		
	CV F (%)		

OTAL	AEL	at 2+	with	Confidence	Limit

TOTAL AEL at 3+ with Confidence	
AEL at 3+	6086.3
Var(AEL3+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

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

AEL at 2+ Var(AEL2+) SE AEL Z at 0.975 95% C. I. CV AEL (%) C.I. = Confidence Interval CV = Coefficient of Variation in %

MALE AEL at 3+ with Confidence Limits

AEL at 3+	3653.3
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

FEMALE AEL at 3+ with Confidence Limits

2433.
1.9599

1.95996

TOTAL LOSS TO MALE FISHERY
(This total would be distributed over 3-4 years)

		Lost to Fishery	
Male Age 3+	Harvest Rate	(number of	
(number of crab)	(proportion)	crab)	
3653.3	0.70	2557.3	Harvest rate of 0.70 is taken from Armstrong et al. (

Loss to Fishery with Confidence Limits

Loss to Fishery	2557.3
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona June crab entrainment data
		Post		
		Construction		
		Maintenance, 40		
Projected	Flavel Bar	ft Yr 20	210000	

VOLUME OF DREDGED MATERIALS - Maintenance 40' Yr 20

Γ	Volu	me to be Dredged (1	
Г	River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 20
Γ	4 to 9	Desdemona	40000	
ſ	10 to 13	Flavel Bar	210000	
Г	14 to 17	Upper Sands	50000	
I	18 to 20	Tongue Point	270000	
	Total		570000	•

210000 Amount (cy) dredged during dredging period Dredged Yardage (cy)

Sex Ratios by Age Class, Derived from June Data

Age Class		Total		Proportion		
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.50	0.50	* binomial distribution p>0.05; low sample size - assumed to be 1:
1+	70	68	138	0.51	0.49	binomial distribution p=0.067 - not sign different from 1:1
2+	12	4	16	0.75	0.25	binomial distribution p<0.05
3+	0	0	0	0.50	0.50	* low sample size - assumed to be 1:1

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

Age Class	R	E	Var(E)	М	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00517	1086.3		0.10	0.017	1.79		0.81	
1+	0.19327	40587.2		0.60	0.160	3896.38		1753.37	
2+	0.02429	5101.5		0.86	0.649	2847.37		1281.32	
3+	0.00088	185.8		0.86	2.222	355.14		159.81	
All		10000 0				7400 07		0405.00	

7100.67 3195.30 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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.90		0.50	0.90		E = Crabs Entrained (number of Crabs)
1+	0.50	1948.19		0.50	1948.19		M = Post-Entrainment Mortality (proportion)
2+	0.25	711.84		0.75	2135.53		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	177.57		0.50	177.57		AEL = Adult Equivalent Loss
All		2838.50			4262.18		VAR(AEL) =AEL Variance

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL			
YOY	2.31	0.00			
1+	86.43	54.87			
2+	10.86	40.10			
3+	0.40	5.00			

	Proportion of Total AEL			
Age Class	Male	Female		
YOY	0.0001	0.0001		
1+	0.2744	0.2744		
2+	0.3007	0.1002		
3+	0.0250	0.0250		
ΔΠ	0.60	0.40		

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.40		0.50	0.40		E = Crabs Entrained (number of Crabs)
1+	0.50	876.68		0.50	876.68		M = Post-Entrainment Mortality (proportion)
2+	0.25	320.33		0.75	960.99		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987
3+	0.50	79.91		0.50	79.91		AEL = Adult Equivalent Loss
All		1277.32			1917.98		VAR(AEL) =AEL Variance
					3195,303		

Age Class Distribution

Age Class	% of	% of Total				
Age Class	of Entrained	of AEL at 3+				
YOY	2.31	0.03				
1+	86.43	54.87				
2+	10.86	40.10				
3+	0.40	5.00				

	Proportion of Total AEL at 3+					
Age Class	Male	Female				
YOY	0.0001	0.000				
1+	0.2744	0.2744				
2+	0.3007	0.1002				
3+	0.0250	0.0250				

SUMMARY VARIANCE DATA

E	46960.9
Var(E)	
SE E	
Z at 0.975	1.95996
95% C. I.	
CV E (%)	

AEL at 2+	7100.7
Var(AEL2+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

	TOTAL AEL at 3+ with Confidence				
1	AEL at 3+	3195.3			
	Var(AEL3+)				
	SE AEL				
1	Z at 0.975	1.95996			
9	95% C. I.				
-	CV AEL (%)				

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+	1918.0
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

FEMALE AEL at 3+ with Confidence Limits

AEL at 3+	1277.
Var(AEL)	
SE AEL	
Z at 0.975	1.9599
95% C. I.	
01/ 45/ (0/)	

TOTAL LOSS TO MALE FISHERY
(This total would be distributed over 3-4 years)

Male Age 3+	Harvest Rate	Lost to Fishery (number of	
(number of crab)	(proportion)	crab)	
1918.0	0.70	1342.6	Harvest rate of 0.70 is taken from Armstrong et al. (198

Loss to Fishery with Confidence Limits

Loss to Fishery	1342.6
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona June crab entrainment data
		Post		
		Construction		
		Maintenance, 43		
Projected	Flavel Bar	ft Yr 1	500000	

VOLUME OF DREDGED MATERIALS - Maintenance 43' Yr 1

				•
۱	Volu	me to be Dredged ((cy)	
ı	River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 2
ı	4 to 9	Desdemona	60000	· · ·
ı	10 to 13	Flavel Bar	500000	
ı	14 to 17	Upper Sands	100000	
ı	18 to 20	Tongue Point	330000	
	Total		000000	

500000 Amount (cy) dredged during dredging period Dredged Yardage (cy)

Sex Ratios by Age Class, Derived from June Data

Age Class		Total		Propo	ortion	
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.50	0.50	* binomial distribution p>0.05; low sample size - assumed to b
1+	70	68	138	0.51	0.49	binomial distribution p=0.067 - not sign different from 1:1
2+	12	4	16	0.75	0.25	binomial distribution p<0.05
3+	0	0	0	0.50	0.50	* low sample size - assumed to be 1:1.

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

Age Class	R	E	Var(E)	М	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00517	2586.5		0.10	0.017	4.27		1.92	
1+	0.19327	96636.3		0.60	0.160	9277.08		4174.69	
2+	0.02429	12146.5		0.86	0.649	6779.45		3050.75	
3+	0.00088	442.5		0.86	2.222	845.57		380.51	
All		111811.8				16906.37		7607.86	

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	2.13		0.50	2.13		E = Crabs Entrained (number of Crabs)
1+	0.50	4638.54		0.50	4638.54		M = Post-Entrainment Mortality (proportion)
2+	0.25	1694.86		0.75	5084.58		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987
3+	0.50	422.78		0.50	422.78		AEL = Adult Equivalent Loss
All		6758.32			10148.04		VAR(AEL) =AEL Variance

Age Class Distribution

Age Class	% of	Total
Age Class	of Entrained	of AEL
YOY	2.31	0.00
1+	86.43	54.87
2+	10.86	40.10
3+	0.40	5.00

	Proportion of Total AEL		
Age Class	Male	Female	
YOY	0.0001	0.0001	
1+	0.2744	0.2744	
2+	0.3007	0.1002	
3+	0.0250	0.0250	
ΔII	0.60	0.40	

Age Class	Ara Class Female			Male			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.96		0.50	0.96		E = Crabs Entrained (number of Crabs)
1+	0.50	2087.34		0.50	2087.34		M = Post-Entrainment Mortality (proportion)
2+	0.25	762.69		0.75	2288.06		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	190.25		0.50	190.25		AEL = Adult Equivalent Loss
All		3041.24			4566.62		VAR(AEL) =AEL Variance
					7607.865		- "

Age Class Distribution

Age Class	% of Total		
Age Class	of Entrained	of AEL at 3+	
YOY	2.31	0.03	
1+	86.43	54.87	
2+	10.86	40.10	
3+	0.40	5.00	

	Proportion of Total AEL at 3+			
Age Class	Male	Female		
YOY	0.0001	0.0001		
1+	0.2744	0.2744		
2+	0.3007	0.1002		
3+	0.0250	0.0250		

SUMMARY VARIANCE DATA

E	111811.8
Var(E)	
SE E	
Z at 0.975	1.95996
95% C. I.	
OM E (0/)	

AEL at 2+	16906.4
Var(AEL2+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

	TOTAL ALL at 3	with Confidence
1	AEL at 3+	7607.9
	Var(AEL3+)	
	SE AEL	
	Z at 0.975	1.95996
	95% C. I.	
	CV AFL (%)	

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

ALE AEL at 3+ wir	th Confidence Limits	FEMALE AEL at 3+	FEMALE AEL at 3+ with Confidence Limits		
EL at 3+	4566.6	AEL at 3+	3041.2		
ar(AEL)		Var(AEL)			
E AEL		SE AEL			
at 0.975	1.95996	Z at 0.975	1.95996		
5% C. I.		95% C. I.			
V AFL (%)		CV AFL (%)			

TOTAL LOSS TO MALE FISHERY
(This total would be distributed over 3-4 years)

		Lost to Fishery	
Male Age 3+	Harvest Rate	(number of	
(number of crab)	(proportion)	crab)	
4566.6	0.70	3196.6	Harvest rate of 0.70 is taken from Armstrong et al. (1987)

Loss to Fishery with Confidence Limits

Loss to Fishery	3196.6
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona June crab entrainment data
		Post		
		Construction		
		Maintenance, 43		
Projected	Flavel Bar	ft Yr 20	210000	

210000 Amount (cy) dredged during dredging period

VOLUME OF DREDGED MATERIALS - Maintenance 43' Yr 20

-				
Γ	Volu	me to be Dredged		
Γ	River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 2
Γ	4 to 9	Desdemona	40000	· · ·
Γ	10 to 13	Flavel Bar	210000	
Γ	14 to 17	Upper Sands	100000	
I	18 to 20	Tongue Point	330000	
	Total		680000	="

Sex Ratios by Age Class, Derived from June Data

Dredged Yardage (cy)

Age Class		Total	Proportion		
Age class	Male	Female	Sexed	Male	Female
YOY	1	0	1	0.50	0.50
1+	70	68	138	0.51	0.49
2+	12	4	16	0.75	0.25
3+	0	0	0	0.50	0.50

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00517	1086.3		0.10	0.017	1.79		0.81	
1+	0.19327	40587.2		0.60	0.160	3896.38		1753.37	
2+	0.02429	5101.5		0.86	0.649	2847.37		1281.32	
3+	0.00088	185.8		0.86	2.222	355.14		159.81	
AII		10000 0				7400 07		0405.00	

7100.67 3195.30 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			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.90		0.50	0.90		E = Crabs Entrained (number of Crabs)
1+	0.50	1948.19		0.50	1948.19		M = Post-Entrainment Mortality (proportion)
2+	0.25	711.84		0.75	2135.53		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 19
3+	0.50	177.57		0.50	177.57		AEL = Adult Equivalent Loss
All		2838.50			4262.18		VAR(AEL) =AEL Variance

Age Class Distribution

Age Class	% of	Total
Age Class	of Entrained	of AEL
YOY	2.31	0.00
1+	86.43	54.87
2+	10.86	40.10
3+	0.40	5.00

	Proportion of Total AEL			
Age Class	Male	Female		
YOY	0.0001	0.0001		
1+	0.2744			
2+	0.3007	0.1002		
3+	0.0250	0.0250		
ALL	0.60	0.40		

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			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.40		0.50	0.40		E = Crabs Entrained (number of Crabs)
1+	0.50	876.68		0.50	876.68		M = Post-Entrainment Mortality (proportion)
2+	0.25	320.33		0.75	960.99		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	79.91		0.50	79.91		AEL = Adult Equivalent Loss
All		1277.32			1917.98		VAR(AEL) =AEL Variance
					3195.303		-

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL at 3+			
YOY	2.31	0.03			
1+	86.43	54.87			
2+	10.86	40.10			
3+	0.40	5.00			

	Proportion of Total AEL at 3+				
Age Class	Male	Female			
YOY	0.0001	0.000			
1+	0.2744	0.2744			
2+	0.3007	0.1002			
3+	0.0250	0.0250			
***	0.00	0.46			

SUMMARY VARIANCE DATA

E	46960.9
Var(E)	
SE E	
Z at 0.975	1.95996
95% C. I.	
OV E (0/)	

ALL			
+ with Confidence Lim			
7100.7			
1.95996			

TOTAL AEL at 34	with Confidence
AEL at 3+	3195.3
Var(AEL3+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AFL (%)	

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+	1918.0
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AFL (%)	

FEMALE AEL at 3+ with Confidence Limits

AEL at 3+	1277.
Var(AEL)	
SE AEL	
Z at 0.975	1.9599
95% C. I.	
CV AEL (%)	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

Male Age 3+	Harvest Rate	Lost to Fishery (number of	
(number of crab)	(proportion)	crab)	
1918.0	0.70	1342.6	Harvest rate of 0.70 is taken from Armstrong et al. (1987).

Loss to Fishery with Confidence Limits

Loss to Fishery	1342.
Var(AEL)	
SE LF	
Z at 0.975	1.9599
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona June crab entrainment dat
		Construction		
Projected	Flavel Bar	Dredging to 40	542349	

VOLUME OF DREDGED MATERIALS - to 40 ft

	ey)	me to be Dredged (c	Volu
Data from Portland District (10 Sept 200	Volume (cy)	Location Name	River Mile
	222412	Lower Desdem.	4
	353916		5
	0	Upper Desdem	6
	0		7
	8742		8
	8742		9
	49732	Flavel Bar	10
	298900		11
	121292		12
	72425		13
	54585	Upper Sands	14
	51945		15
	47557		16
	0		17
	14775	Tongue Point	18
	6976		19
	13283		20
1	1325282		Total

542349 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from June Data

Age Class		Total		Propo	rtion	
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.50	0.50	* binomial distribution p>0.05; low sample size - assumed to be 1:1.
1+	70	68	138			binomial distribution p=0.067 - not sign different from 1:1
2+	12	4	16	0.75	0.25	binomial distribution p<0.05
3+	0	0	0	0.50	0.50	* low sample size - assumed to be 1:1.

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00517	2805.5		0.10	0.017	4.63		2.08	
1+	0.19327	104821.2		0.60	0.160	10062.84		4528.28	
2+	0.02429	13175.3		0.86	0.649	7353.65		3309.14	
3+	0.00088	480.0		0.86	2.222	917.19		412.73	
All		121282.0				18338.30		8252.24	

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			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	
YOY	0.50	2.31		0.50	2.31		
1+	0.50	5031.42		0.50	5031.42		
2+	0.25	1838.41		0.75	5515.24		
3+	0.50	458.59		0.50	458.59		
All		7220 74			44007.50		

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

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL			
YOY	2.31	0.0			
1+	86.43				
2+	10.86	40.1			
3+	0.40	5.0			

	Proportion of	of Total AEL
Age Class	Male	Female
YOY	0.0001	0.0001
1+	0.2744	0.2744
2+	0.3007	0.1002
3+	0.0250	0.0250

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	1.04		0.50	1.04		E = Crabs Entrained (number of Crabs)
1+	0.50	2264.14		0.50	2264.14		M = Post-Entrainment Mortality (proportion)
2+	0.25	827.29		0.75	2481.86		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	206.37		0.50	206.37		AEL = Adult Equivalent Loss
All		3298.83			4953.40		VAR(AEL) =AEL Variance
					8252.235		=

Age Class Distribution

Age Class	% of	Total
Age Class	of Entrained	of AEL at 3+
YOY	2.31	0.03
1+	86.43	54.87
2+	10.86	40.10
3+	0.40	5.00

	Proportion of Total AEL at 3+				
Age Class	Male	Female			
YOY	0.0001	0.0001			
1+	0.2744				
2+	0.3007	0.1002			
3+	0.0250	0.0250			
ALL	0.60	0.40			

SUMMARY VARIANCE DATA

rainment with Confidence Limits				
E	121282.0			
Var(E)				
SE E				
Z at 0.975	1.95996			
95% C. I.				
CV E (%)				

TOTAL AEL at 2+ with Confidence Lim

AEL at 3+	8252.
Var(AEL3+)	
SE AEL	
Z at 0.975	1.9599
95% C. I.	
CV AEL (%)	

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

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

Var(AEL2+)
SE AEL
Z at 0.975
95% C. I.
CV AEL (%)

MALE AEL at 3+ with Confidence Limits

AEL at 3+	4953.4
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

FEMALE AEL at 3+ with Confidence Limits

18338.3

AEL at 3+	3298.8
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

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

4953.4 0.70 3467.4 Harvest rate of 0.70 is taken from Armstrong et al. (1987).

Loss to Fishery with Confidence Limits

Loss to Fishery	3467.4
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona June crab entrainment dat
		Construction		
Projected	Flavel Bar	Dredging from 40 to 43 ft	1160721	

VOLUME OF DREDGED MATERIALS - from 40 to 43 ft

ıd	Surface Area to be	Dredged (ha)		
	River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 2002)
	4	Lower Desdem.	94688	
	5		196724	
	6	Upper Desdem	66193	
	7		1039	
	8		52398	
	9		62851	
	10	Flavel Bar	329296	
	11		535074	
	12		239608	
	13		65743	
	14	Upper Sands	171432	
	15		271842	
	16		306717	
	17		108631	
	18	Tongue Point	174113	
	19		162864	
	20		127219	
	Total		2966432	

Dredged Yardage (cy)

1169721 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from June Data

Age Class		Total		Proportion		
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.50		* binomial distribution p>0.05; low sample size - assumed to be 1:1.
1÷	70	68	138	0.51	0.49	binomial distribution p=0.067 - not sign different from 1:1
2+	12	4	16	0.75		binomial distribution p<0.05
3+	0	0	0	0.50	0.50	* low sample size - assumed to be 1:1.

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)	
YOY	0.00517	6050.9		0.10	0.017	9.98		4.49		
1+	0.19327	226075.0		0.60	0.160	21703.20		9766.44		
2+	0.02429	28416.0		0.86	0.649	15860.12		7137.05		
3+	0.00088	1035.2		0.86	2.222	1978.16		890.17		
All		261577.1				39551.46		17798.16		
	Note: Established 21 such are book excluded to provide AEI at 21									

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			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	4.99		0.50	4.99		E = Crabs Entrained (number of Crabs)
1+	0.50	10851.60		0.50	10851.60		M = Post-Entrainment Mortality (proportion)
2+	0.25	3965.03		0.75	11895.09		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	989.08		0.50	989.08		AEL = Adult Equivalent Loss
All		45040.70			22740.70		MAD(AEL) -AEL Meriones

Age Class Distribution

Age Class	% of Total			
Age Class	of Entrained	of AEL		
YOY	2.31	0.00		
1+	86.43	54.87		
2+	10.86	40.10		
3+	0.40	5.00		

	Proportion of	portion of Total AEL			
Age Class	Male	Female			
YOY	0.0001	0.0001			
1+	0.2744	0.2744			
2+	0.3007	0.1002			
3+	0.0250	0.0250			
ALL	0.60	0.40			

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	
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	2.25		0.50	2.25	E = Crabs Entrained (number of Crabs)
1+	0.50	4883.22		0.50	4883.22	M = Post-Entrainment Mortality (proportion)
2+	0.25	1784.26		0.75	5352.79	S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	445.09		0.50	445.09	AEL = Adult Equivalent Loss
All		7114.82			10683.34	VAR(AEL) =AEL Variance

Age Class Distribution

Age Class	% of Total			
Age Class	of Entrained	of AEL at 3+		
YOY	2.31	0.0		
1+	86.43	54.8		
2+	10.86	40.1		
3+	0.40	5.0		

	Proportion of I	Otal AEL at 37
Age Class	Male	Female
YOY	0.0001	
1+	0.2744	0.2744
2+	0.3007	
3+	0.0250	0.0250
ALL	0.60	0.40

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

	261577.1	Α
ar(E)		V
EE		S
at 0.975	1.95996	2
5% C. I.		9
		l 12

1	OTAL	AEL	at 2+	with	Conf	lider	ice	Limi	ts
_							_		

AEL at 3+	17798.
Var(AEL3+)	
SE AEL	
Z at 0.975	1.9599
95% C. I.	
CV AEL (0/)	

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

MALE AEL at 3+ with Confidence Limits

AEL at 3+			106	83.3
Var(AEL)				
SE AEL				
Z at 0.975			1.95	599
95% C. I.				
CV AFI /%	١			

FEMALE AEL at 3+ with Confidence Limits

AEL at 3+	
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

nı:	is total would be distributed over 3-4 years)					
	Male Age 3+ (number of crab)	Harvest Rate	Lost to Fishery (number of crah)			

10683.3 0.70 7478.3 Harvest rate of 0.70 is taken from Armstrong et al. (1987).

Loss to Fishery with Confidence Limits

Loss to Fishery	7478.3
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

ADDITIONAL NOTES:
Mortality Rates (M) for crabs collected in June-September are from Armstrong et al. 1987 (Table 3.3, p. 61)
Survival rates (5) to age 2+ for cnsb collected from June-September are from Warnwright et al. 1992 (Table 6, p. 178), and
Thereafter survival rate from 2+ to age 3+ is 0.45 (Armstrong et al. 1997).
Sec ratios used were those observed or assumed to be 11-where sample size was low.

Exhibit K-4, Evaluation Report Dungeness Crab (Revised)

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona June crab entrainment dat
		Post		
		Construction		
		Maintenance, 40		
Projected	Flavel Bar	ft Yr 1	400000	

400,000 Amount (cy) dredged during dredging period

VOLUME OF DREDGED MATERIALS - Maintenance 40' Yr 1

ı	Volu	me to be Dredged		
ı	River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 2
ı	4 to 9	Desdemona	40,000	· · ·
ı	10 to 13	Flavel Bar	400000	
ı	14 to 17	Upper Sands	50000	
-[18 to 20	Tongue Point	270000	
	Total		760000	

Sex Ratios by Age Class, Derived from June Data

Dredged Yardage (cy)

Age Class		Total		Prop	ortion	
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.50	0.50	* binomial distribution p>0.05; low sample size - assum
1+	70	68	138	0.51	0.49	binomial distribution p=0.067 - not sign different from 1:
2+	12	4	16	0.75	0.25	binomial distribution p<0.05
3+	0	0	0	0.50	0.50	* low sample size - assumed to be 1:1.

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

Age Class	R	Е	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00517	2069.2		0.10	0.017	3.41		1.54	
1+	0.19327	77309.0		0.60	0.160	7421.67		3339.75	
2+	0.02429	9717.2		0.86	0.649	5423.56		2440.60	
3+	0.00088	354.0		0.86	2.222	676.45		304.40	
All		90440.4				42525.00		cooc 20	

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

	ı	Female Male		1			
Age Class							
	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	1.71		0.50	1.71		E = Crabs Entrained (number of Crabs)
1+	0.50	3710.83		0.50	3710.83		M = Post-Entrainment Mortality (proportion)
2+	0.25	1355.89		0.75	4067.67		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	338.23		0.50	338.23		AEL = Adult Equivalent Loss
All		5406.66			8118.44		VAR(AEL) =AEL Variance

Age Class Distribution

Age Class	% of Total			
Age Class	of Entrained	of AEL		
YOY	2.31	0.00		
1+	86.43	54.87		
2+	10.86	40.10		
3+	0.40	5.00		

	Proportion of Total AEL			
Age Class	Male	Female		
YOY	0.0001	0.0001		
1+	0.2744			
2+	0.3007	0.1002		
3+	0.0250	0.0250		
ALL	0.60	0.40		

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	
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	0.77		0.50	0.77	
1+	0.50	1669.88		0.50	1669.88	
2+	0.25	610.15		0.75	1830.45	
3+	0.50	152.20		0.50	152.20	
All		2433.00			3653.30	

R = Crab Entrainment Rate (crabs/cy)
E = Crabs Entrained (number of Crabs)
H = Post-Entrained (number of Crabs)
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			
Age Class	of Entrained	of AEL at 3+		
YOY	2.31	0.03		
1+	86.43	54.87		
2+	10.86	40.10		
3+	0.40	5.00		

	Proportion of Total AEL at 3+			
Age Class	Male	Female		
YOY	0.0001	0.0001		
1+	0.2744	0.2744		
2+	0.3007	0.1002		
3+	0.0250	0.0250		
ALL	0.60	0.40		

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

89449.4 E Var(E) SE E Z at 0.975 95% C. I. CV E (%) 1.95996

	ALL	
TOTAL AEL at 2+	with Confidence	Limits
AEL at 2+	13525.1	
Var(AEL2+)		
SE AEL		

TOTAL AEL at 3+	with Confidence
AEL at 3+	6086.3
Var(AEL3+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

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

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

MALE AEL at 3+ v	vith Confidence Limits
AEL at 3+	3653.3
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AFL (%)	

AEL at 3+	2433.0
Var(AEL)	
SE AEL	
Z at 0.975	1.9599
95% C. I.	
CV AEL (%)	

TOTAL LOSS TO MALE FISHERY
(This total would be distributed over 3-4 years)

Г			Lost to Fishery	
	Male Age 3+	Harvest Rate	(number of	
(n	umber of crab)	(proportion)	crab)	
Г	3653.3	0.70	2557.3	Harvest rate of 0.70 is taken

Loss to Fishery with Confidence Limits

Loss to Fishery	2557.3
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona June crab entrainment data
		Post		
		Construction		
		Maintenance, 40		
Projected	Flavel Bar	ft Yr 20	210000	

VOLUME OF DREDGED MATERIALS - Maintenance 40' Yr 20

ı	Volu	me to be Dredged ((cy)	
ı	River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 20
ı	4 to 9	Desdemona	40000	· · ·
ı	10 to 13	Flavel Bar	210000	
ı	14 to 17	Upper Sands	50000	
-[18 to 20	Tongue Point	270000	
	Total		570000	•

Dredged Yardage (cy)

210000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from June Data

Г	Age Class	Total			Propo	ortion	
Age class		Male	Female	Sexed	Male	Female	
Γ	YOY	1	0	1	0.50	0.50	* binomial distribution p>0.05; low sample size - assumed to be 1:
Г	1+	70	68	138	0.51	0.49	binomial distribution p=0.067 - not sign different from 1:1
Γ	2+	12	4	16	0.75	0.25	binomial distribution p<0.05
Г	3+	0	0	0	0.50	0.50	* low sample size - assumed to be 1:1

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

Age Class	R	E	Var(E)	М	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00517	1086.3		0.10	0.017	1.79		0.81	
1+	0.19327	40587.2		0.60	0.160	3896.38		1753.37	
2+	0.02429	5101.5		0.86	0.649	2847.37		1281.32	
3+	0.00088	185.8		0.86	2.222	355.14		159.81	
All		10000 0				7400 07		0405.00	

7100.67 3195.30 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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	Proportion AEL VAR(AEL)		R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.90		0.50	0.90		E = Crabs Entrained (number of Crabs)
1+	0.50	1948.19		0.50	1948.19		M = Post-Entrainment Mortality (proportion)
2+	0.25	711.84		0.75	2135.53		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	177.57		0.50	177.57		AEL = Adult Equivalent Loss
All		2838.50			4262.18		VAR(AEL) =AEL Variance

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL			
YOY	2.31	0.00			
1+	86.43	54.87			
2+	10.86	40.10			
3+	0.40	5.00			

	Proportion of Total AEL		
Age Class	Male	Female	
YOY	0.0001	0.0001	
1+	0.2744	0.2744	
2+	0.3007	0.1002	
3+	0.0250	0.0250	
ALL	0.60	0.40	

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.40		0.50	0.40		E = Crabs Entrained (number of Crabs)
1+	0.50	876.68		0.50	876.68		M = Post-Entrainment Mortality (proportion)
2+	0.25	320.33		0.75	960.99		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	79.91		0.50	79.91		AEL = Adult Equivalent Loss
All		1277.32			1917.98		VAR(AEL) =AEL Variance
					3195.303		

Age Class Distribution

Age Class	% of Total		
Age Class	of Entrained	of AEL at 3+	
YOY	2.31	0.03	
1+	86.43	54.87	
2+	10.86	40.10	
3+	0.40	5.00	

	Proportion of	Total AEL at 3+
Age Class	Male	Female
YOY	0.0001	0.0001
1+	0.2744	0.2744
2+	0.3007	0.1002
3+	0.0250	0.0250

SUMMARY VARIANCE DATA

ntı	trainment with Confidence Limits		
	E	46960.9	
	E Var(E)		
	SE E		
	Z at 0.975	1.95996	
	95% C. I.		
	CV E (%)		

TOTAL AEL at 2+ v	ith Confidence
AEL at 2+	7100.7
Var(AEL2+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

TOTAL ALL BUS	with Confidence L
AEL at 3+	3195.3
Var(AEL3+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

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+	1918.0
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AFL (%)

FEMALE AEL at 3+ with Confidence Lim	nit
--------------------------------------	-----

AEL at 3+	1277.
Var(AEL)	
SE AEL	
Z at 0.975	1.9599
95% C. I.	
CV AEL (%)	

TOTAL LOSS TO MALE FISHERY
(This total would be distributed over 3-4 years)

		Lost to Fishery	
Male Age 3+	Harvest Rate	(number of	
(number of crab)	(proportion)	crab)	
1918.0	0.70	1342.6	Harvest rate of 0.70 is taken from Armstrong et al. (1987).

Loss to Fishery with Confidence Limits

Loss to Fishery	1342.
Var(AEL)	
SE LF	
Z at 0.975	1.9599
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona June crab entrainment data
		Post		
		Construction		
		Maintenance, 43		
Projected	Flavel Bar	ft Yr 1	500000	

VOLUME OF DREDGED MATERIALS - Maintenance 43' Yr 1

				•
۱	Volu	me to be Dredged (
ı	River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 2
ı	4 to 9	Desdemona	60000	· · ·
ı	10 to 13	Flavel Bar	500000	
ı	14 to 17	Upper Sands	100000	
ı	18 to 20	Tongue Point	330000	
	Total		000000	

Dredged Yardage (cy)

500000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from June Data

Age Class	Total			Proportion		
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.50	0.50	* binomial distribution p>0.05; low sample size - assumed to be 1:
1+	70	68	138	0.51	0.49	binomial distribution p=0.067 - not sign different from 1:1
2+	12	4	16	0.75	0.25	binomial distribution p<0.05
3+	0	0	0	0.50	0.50	* low sample size - assumed to be 1:1

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

	Age Class	R	E	Var(E)	М	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
	YOY	0.00517	2586.5		0.10	0.017	4.27		1.92	
	1+	0.19327	96636.3		0.60	0.160	9277.08		4174.69	
	2+	0.02429	12146.5		0.86	0.649	6779.45		3050.75	
	3+	0.00088	442.5		0.86	2.222	845.57		380.51	
г	All		111811.8				16906.37		7607.86	

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				
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	2.13		0.50	2.13		E = Crabs Entrained (number of Crabs)
1+	0.50	4638.54		0.50	4638.54		M = Post-Entrainment Mortality (proportion)
2+	0.25	1694.86		0.75	5084.58		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	422.78		0.50	422.78		AEL = Adult Equivalent Loss
All		6758.32			10148.04		VAR(AEL) =AEL Variance

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL			
YOY	2.31	0.00			
1+	86.43	54.87			
2+	10.86	40.10			
3+	0.40	5.00			

	Proportion of Total AEL		
Age Class	Male	Female	
YOY	0.0001	0.0001	
1+	0.2744	0.2744	
2+	0.3007	0.1002	
3+	0.0250	0.0250	
ALI	0.60	0.40	

AGE 3+ Calculations Contribution to Adult Equivalent Loss (AEL at 3+) and Variance (AEL at 3+) by Sey (MALE/FEMALE) and Age Cla

Contribution to Adult	Equivalent Loss (A	EL at 3+) and Varian	ice (AEL at 3+) by Sex (MALE/FEMALE) and Age Class

Age Class	Female				Male		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.96		0.50	0.96		E = Crabs Entrained (number of Crabs)
1+	0.50	2087.34		0.50	2087.34		M = Post-Entrainment Mortality (proportion)
2+	0.25	762.69		0.75	2288.06		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987
3+	0.50	190.25		0.50	190.25		AEL = Adult Equivalent Loss
All		3041.24			4566.62		VAR(AEL) =AEL Variance
					7607.865		

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL at 3+			
YOY	2.31	0.03			
1+	86.43	54.87			
2+	10.86	40.10			
3+	0.40	5.00			

	Proportion of	Total AEL at 3+
Age Class	Male	Female
YOY	0.0001	0.0001
1+	0.2744	0.2744
2+	0.3007	0.1002
3+	0.0250	0.0250
ALL	0.60	0.40

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

E	111811.8
Var(E)	
SE E	
Z at 0.975	1.95996
95% C. I.	
CV E (%)	

AEL at 2+	16906.4
Var(AEL2+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

TOTAL AEL at 34	with Confidence	Limits
AEL at 3+	7607.9	
Var(AEL3+)		
SE AEL		
Z at 0.975	1.95996	
95% C. I.		
CV AEL (9/)		

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+			4	566.6
Var(AEL)				
SE AEL				
Z at 0.975			1.9	5996
95% C. I.				
CV AFL (S	%)			

FEMALE AEL at 3+ with Confidence Limits

AEL at 3+	3041.2
Var(AEL)	
SE AEL	
Z at 0.975	1.9599
95% C. I.	
CV AEL (%)	

TOTAL LOSS TO MALE FISHERY
(This total would be distributed over 3-4 years)

Γ			Lost to Fishery	
	Male Age 3+	Harvest Rate	(number of	
	(number of crab)	(proportion)	crab)	
Γ	4566.6	0.70	3196.6	Harvest rate of 0.70 is taken from Armstrong et al. (19)

Loss to Fishery with Confidence Limits

Loss to Fishery	3196.6
Var(AEL)	
SE LF	
Z at 0.975	1.9599
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona June crab entrainment data
		Post		
		Construction		
		Maintenance, 43		
Projected	Flavel Bar	ft Yr 20	210000	

VOLUME OF DREDGED MATERIALS - Maintenance 43' Yr 20

ſ	Volu	me to be Dredged	(ev)	1
İ	River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 2
ı	4 to 9	Desdemona	40000	
ı	10 to 13	Flavel Bar	210000	
-[14 to 17	Upper Sands	100000	
ı	18 to 20	Tongue Point	330000	
	Total		600000	

210000 Amount (cy) dredged during dredging period Dredged Yardage (cy)

Sex Ratios by Age Class, Derived from June Data

Age Class	Total			Propo	ortion	
Age Class	Male	Male Female Sexed		Male	Female	
YOY	1	0	1	0.50	0.50	* binomial distribution p>0.05; low sample size - assumed to b
1+	70	68	138	0.51	0.49	binomial distribution p=0.067 - not sign different from 1:1
2+	12	4	16	0.75	0.25	binomial distribution p<0.05
3+	0	0	0	0.50	0.50	* low sample size - assumed to be 1:1.

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

Age Class	R	Е	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00517	1086.3		0.10	0.017	1.79		0.81	
1+	0.19327	40587.2		0.60	0.160	3896.38		1753.37	
2+	0.02429	5101.5		0.86	0.649	2847.37		1281.32	
3+	0.00088	185.8		0.86	2.222	355.14		159.81	
ΔII		40000				7400 67		2405 20	

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.90		0.50	0.90		E = Crabs Entrained (number of Crabs)
1+	0.50	1948.19		0.50	1948.19		M = Post-Entrainment Mortality (proportion)
2+	0.25	711.84		0.75	2135.53		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	177.57		0.50	177.57		AEL = Adult Equivalent Loss
All		2838.50			4262.18		VAR(AEL) =AEL Variance

Age Class Distribution

_	Age Class	% of	Total		
_ ′	Age Class	of Entrained	of AEL	Age Class	
	YOY	2.31	0.00	YOY	
	1+	86.43	54.87	1+	
	2+	10.86	40.10	2+	
	3+	0.40	5.00	3+	

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			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.40		0.50	0.40		E = Crabs Entrained (number of Crabs)
1+	0.50	876.68		0.50	876.68		M = Post-Entrainment Mortality (proportion)
2+	0.25	320.33		0.75	960.99		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987
3+	0.50	79.91		0.50	79.91		AEL = Adult Equivalent Loss
All		1277.32			1917.98		VAR(AEL) =AEL Variance
					3195,303		

Age Class Distribution

Age Class	% of Total			
Age Class	of Entrained	of AEL at 3+		
YOY	2.31	0.03		
1+	86.43	54.87		
2+	10.86	40.10		
3+	0.40	5.00		

	Proportion of Total AEL at 3+			
Age Class	Male	Female		
YOY	0.0001	0.000		
1+	0.2744	0.2744		
2+	0.3007	0.1002		
3+	0.0250	0.0250		

SUMMARY VARIANCE DATA

E	46960.9
Var(E)	
SE E	
Z at 0.975	1.95996
95% C. I.	
CV E (%)	

ALL	
TOTAL AEL at 2+ with Confidence	Limits

TOTAL ALL BU	3. With Confidence
AEL at 3+	3195.3
Var(AEL3+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

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

AEL at 2+ Var(AEL2+) SE AEL Z at 0.975 95% C. I. CV AEL (%) C.I. = Confidence Interval CV = Coefficient of Variation in %

MALE AEL at 3+ with Confidence Limits

MALL ALL UIO. WI	ui Goilliachte Ei
AEL at 3+	1918.0
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

FEMALE AEL at 3+ with Confidence Limits

AEL at 3+	1277.
Var(AEL)	
SE AEL	
Z at 0.975	1.9599
95% C. I.	
CV AEL (%)	

1.95996

TOTAL LOSS TO MALE FISHERY
(This total would be distributed over 3-4 years)

		Lost to Fishery	
Male Age 3+	Harvest Rate	(number of	
(number of crab)	(proportion)	crab)	
1918.0	0.70	1342.6	Harvest rate of 0.70 is taken from Armstrong et al. (1987

Loss to Fishery with Confidence Limits

Loss to Fishery	1342.6
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Summary of Projected Entrainment, Adult Equivalent Loss, and Lost Recruits Lower Columbia River
WH Pearson and GD Williams

Variance Estimators (derived from Sept 2002 field sampling at Desdemona Shoals)

	CV %		
E	29.43	Z at 0.975	1.95996
AEL	20.25		
LE	20.25		

Construction	Dredging	to 40 ft -	Age 2+

Assumptions:	
Projected Location	Flavel Bar
Diagnosi dradaad valuma (av)	E42 240

results.			
	Projected		
Parameter	Value	SE	95% CI
E	64,806	19,072	37,381
AEL	54,635	11,064	21,684
AEL Male	27,317	5,532	10,842
AEL Female	27,317	5,532	10,842
Loss to Fishery	8,605	1,743	3,415

Construction Dredging to 40 ft - Age 3+

Assumptions.	
Projected Location	Flavel Bar
Planned dredged volume (cy)	542,349

Results:

	Projected		
Parameter	Value	SE	95% CI
E	64,806	19,072	37,381
AEL	24,586	4,979	9,758
AEL Male	12,293	2,489	4,879
AEL Female	12,293	2,489	4,879
Loss to Fishery	8,605	1,743	3,415

Construction Dredging from 40 to 43 ft - Age 2+

Assumptions:

Assumptions.	
Projected Location	Flavel Bar
Planned dredged volume (cv)	1 160 721

Results:

	Projected		
Parameter	Value	SE	95% CI
E	139,771	41,135	80,622
AEL	117,835	23,862	46,768
AEL Male	58,917	11,931	23,384
AEL Female	58,917	11,931	23,384
Loss to Fishery	18,559	3,758	7,366

Construction Dredging from 40 to 43 ft - Age 3+

Assumptions.	
Projected Location	Flavel Bar
Planned dredged volume (cy)	1,169,721

Results:

	Projected		
Parameter	Value	SE	95% CI
E	139,771	41,135	80,622
AEL	53,026	10,738	21,045
AEL Male	26,513	5,369	10,523
AEL Female	26,513	5,369	10,523
Loss to Fishery	18,559	3,758	7,366

Annual Maintenance Dredging 40' Year 1 - Age 2+ Assumptions:

Projected Location	Flavel Bar
Planned dredged volume (cy)	400,000

Results:

	Projected		
Parameter	Value	SE	95% CI
E	47,796	14,067	27,570
AEL	40,295	8,160	15,993
AEL Male	20,148	4,080	7,996
AEL Female	20,148	4,080	7,996
Loss to Fishery	6,346	1,285	2,519

Annual Maintenance Dredging 40' Year 1 - Age 3+ Assumptions:

Projected Location	Flavel Bar
Planned dredged volume (cy)	400,000

Results:

Parameter	Projected Value	SE	95% CI
E	47,796	14,067	27,570
AEL	18,133	3,672	7,197
AEL Male	9,066	1,836	3,598
AEL Female	9,066	1,836	3,598
Loss to Fishery	6,346	1,285	2,519

Annual Maintenance Dredging 40' Year 20 - Age 2+ Assumptions:

Projected Location	Flavel Bar
Planned dredged volume (cy)	210,000

Results:

	Projected		
Parameter	Value	SE	95% CI
E	25,093	7,385	14,474
AEL	21,155	4,284	8,396
AEL Male	10,577	2,142	4,198
AEL Female	10,577	2,142	4,198
Loss to Fishery	3,332	675	1,322

Annual Maintenance Dredging 40' Year 20 - Age 3+

Assumptions.		
Projected Location	Flavel Bar	
Planned dredged volume (cv)	210.000	

Parameter	Projected Value	SE	95% CI
E	25,093	7,385	14,474
AEL	9,520	1,928	3,778
AEL Male	4,760	964	1,889
AEL Female	4,760	964	1,889
Loss to Fishery	3,332	675	1,322

Annual Maintenance Dredging 43' Year 1 - Age 2+ Assumptions:

Projected Location	Flavel Bar
Name and Appellant Accelerate (as A	E00 000

Results:

	Projected		
Parameter	Value	SE	95% CI
E	59,746	17,583	34,462
AEL	50,369	10,200	19,991
AEL Male	25,184	5,100	9,995
AEL Female	25,184	5,100	9,995
Loss to Fishery	7,933	1,606	3,149

Annual Maintenance Dredging 43' Year 1 - Age 3+

Assumptions.		
	Projected Location	Flavel Bar

Projected Location	Flavel Bar
Planned dredged volume (cy)	500,000

Results:

	Projected		
Parameter	Value	SE	95% CI
E	59,746	17,583	34,462
AEL	22,666	4,590	8,996
AEL Male	11,333	2,295	4,498
AEL Female	11,333	2,295	4,498
Loss to Fishery	7,933	1,606	3,149

Annual Maintenance Dredging 43' Year 20 - Age 2+ Assumptions:

Projected Location	Flavel Bar
Planned dredged volume (cv)	210.000

Results:

	Projected		
Parameter	Value	SE	95% CI
E	25,093	7,385	14,474
AEL	21,155	4,284	8,396
AEL Male	10,577	2,142	4,198
AEL Female	10,577	2,142	4,198
Loss to Fishery	3,332	675	1,322

Annual Maintenance Dredging 43' Year 20 - Age 3+ Assumptions:

7100umptiono.	
Projected Location	Flavel Bar
Planned dredged volume (cy)	210,000

Results:			
	Projected		
Parameter	Value	SE	95% CI
E	25,093	7,385	14,474
AEL	9,520	1,928	3,778
AEL Male	4,760	964	1,889
AEL Female	4,760	964	1,889
Loss to Fishery	3,332	675	1,322

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona September crab entrainment da
		Construction		
		Dredging to 40		
Drojected				

VOLUME OF DREDGED MATERIALS - to 40 ft

Volu	ime to be Dredged	(cy)	
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 2002
4	Lower Desdem.	222412	
5		353916	
6	Upper Desdem	0	
7		0	
8		8742	
9		8742	
10	Flavel Bar	49732	
11		298900	
12		121292	
13		72425	
14	Upper Sands	54585	
15		51945	
16		47557	
17		0	
18	Tongue Point	14775	
19		6976	
20		13283	
Total		1325282	

Dredged Yardage (cy)

542349 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from Desdemona Sept Data

-	Age Class	Total		Propo	rtion		
-	Age Class	Male	Female	Sexed	Male	Female	
-	YOY	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.
-	1+	0	0	0	0.5*	0.5*	 Sample sizes low; assumed to be 1:1.
-	2+	2	0	2	0.5*		* Sample sizes low; assumed to be 1:1.
	3+	0	1	1	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00000	0.0		0.10				0.00	
1+	0.02173	11782.9		0.60	0.160	1131.16		509.02	
2+	0.06518	35348.7		0.86	0.649	19729.51		8878.28	
3+	0.03259	17674.3		0.86	2.222	33774.25		15198.41	
All		64805.9				54634.92		24585.72	
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				
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.00		0.50	0.00		E = Crabs Entrained (number of Crabs)
1+	0.50	565.58		0.50	565.58		M = Post-Entrainment Mortality (proportion)
2+	0.50	9864.76		0.50	9864.76		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	16887.13		0.50	16887.13		AEL = Adult Equivalent Loss
All		27247.40			27247.46		VAR(AEL) - AEL Variance

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL			
YOY	0.00	0.00			
1+	18.18	2.07			
2+	54.55	36.11			
3+	27.27	61.82			

	Proportion of Total AEL				
Age Class	Male	Female			
YOY	0.0000	0.0000			
1+	0.0104	0.0104			
2+	0.1806	0.1806			
3+	0.3091	0.3091			
ALL	0.50	0.50			

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		1	
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.00		0.50	0.00		E = Crabs Entrained (number of Crabs)
1+	0.50	254.51		0.50	254.51		M = Post-Entrainment Mortality (proportion)
2+	0.50	4439.14		0.50	4439.14		S = Natural Survivorship (proportion); survi
3+	0.50	7599.21		0.50	7599.21		AEL = Adult Equivalent Loss
All		12292.86			12292.86		VAR(AEL) =AEL Variance
					24585.715		

Age Class Distribution

Age Class	% of Total				
Age class	of Entrained	of AEL at 3+			
YOY	0.00	0.00			
1+	18.18	2.07			
2+	54.55	36.11			
3+	27.27	61.82			

	Proportion of I	otal AEL at 3+
Age Class	Male	Female
YOY	0.0000	
1+	0.0104	0.010
2+	0.1806	
3+	0.3091	0.309
ALL	0.50	0.50

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

AEL at 2	+	54634.
Var(AEL	2+)	
SE AEL		
Z at 0.97	5	1.9599

AEL at 3+	24585.
Var(AEL3+)	
SE AEL	
Z at 0.975	1.9599
95% C. I.	
CN/ AFL (9/)	

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+	12292.9
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

FEMALE AEL a	at 3+ with Confider
AEL at 3+	12292.9
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

Male Age 3+		Lost to Fishery
(number of	Harvest Rate	(number of
crab)	(proportion)	crab)
12202.0	0.70	9605.0

3605.0 Harvest rate of 0.70 is taken from Armstrong et al. (1987).

Loss to Fishery with Confidence Limits

Loss to Fishery	8605.0
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV F (0/)	

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) age 2- for crab collected from June-September are from Warnwright et al. 1992 (Table 6, p. 178), and
thereafter survival rate from 2- to age 3-1 is 0.45 (Armstrong et al. 1997).
Rear ratios used were those observed or assumed to be 1: where sample size was low.

rival to 3+ is assumed to be 45% (Armstrong et al. 1987)

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona September crab entrainment dat
		Construction		
		Dredging from		
Brolosted	Elavol Par	40 to 43 ft	1160721	

VOLUME OF DREDGED MATERIALS - from 40 to 43 ft

	ime to be Dredged		
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 2002)
4	Lower Desdem.	94688	-
5		196724	
6	Upper Desdem	66193	
7		1039	
8		52398	
9		62851	
10	Flavel Bar	329296	
11		535074	
12		239608	
13		65743	
14	Upper Sands	171432	
15		271842	
16		306717	
17		108631	
18	Tongue Point	174113	
19		162864	
20		127219	
Total		2966432	

Dredged Yardage (cy)

1169721 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from June Data

Age Class	Total			Propo	rtion	
Age Class	Male	Female	Sexed	Male	Female	
YOY	0	0	0	0.5*		* Sample sizes low; assumed to be 1:1.
1+	0	0	0	0.5*	0.5*	 Sample sizes low; assumed to be 1:1.
2+	2	0	2	0.5*		* Sample sizes low; assumed to be 1:1.
3+	0	1	1	0.5*	0.5*	 Sample sizes low; assumed to be 1:1.

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00000	0.0		0.10		0.00		0.00	
1+	0.02173	25413.0		0.60	0.160	2439.65		1097.84	
2+	0.06518	76238.9		0.86	0.649	42551.98		19148.39	
3+	0.03259	38119.5		0.86	2.222	72843.23		32779.45	
All		139771.3				117834.86		53025.69	
	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				
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.00		0.50	0.00		E = Crabs Entrained (number of Crabs)
1+	0.50	1219.82		0.50	1219.82		M = Post-Entrainment Mortality (proportion)
2+	0.50	21275.99		0.50	21275.99		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	36421.61		0.50	36421.61		AEL = Adult Equivalent Loss
All		F0047 43			50047.40		MADIAEL Verience

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL			
YOY	0.00	0.00			
1+	18.18	2.07			
2+	54.55	36.11			
3+	27.27	61.82			

г		Proportion of Total AEL		
	Age Class	Male	Female	
	YOY	0.0000	0.0000	
	1+	0.0104	0.0104	
	2+	0.1806	0.1806	
	3+	0.3091	0.3091	
_	ALL	0.50	0.50	

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	remale			wate			ı
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	E
YOY	0.50	0.00		0.50	0.00		E
1+	0.50	548.92		0.50	548.92		١
2+	0.50	9574.20		0.50	9574.20		٤
3+	0.50	16389.73		0.50	16389.73		Α
All		26512.84			26512.84		١
					53025.686		•

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

Age Class Distribution

Age Class	% of	Total
Age Class	of Entrained	of AEL at 3+
YOY	0.00	0.00
1+	18.18	2.07
2+	54.55	36.11
3+	27.27	61.82

	Proportion of I	Otal AEL at 37
Age Class	Male	Female
YOY	0.0000	
1+	0.0104	0.0104
2+	0.1806	
3+	0.3091	0.3091
ALI	0.50	0.50

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

TOTAL AEL	at 2+ with	Confidence	Lim

OTAL	AEL	at 3+	with	Confidence	Limits

E	139771.3
Var(E)	
SEE	
Z at 0.975	1.95996
95% C. I.	
CV E (%)	

117834.9
1.95996

AEL at 3+	53025.7
Var(AEL3+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

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

MALE AEL at 3+ with Confidence Limits

AEL at 3+	26512.8
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV/ AEL (0/)	

3+ With Confider
26512.8
1.95996

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

 ils total would be distributed over 3-4 years)						
Male Age 3+		Lost to Fishery				
(number of	Harvest Rate	(number of				
crab)	(proportion)	crab)				
26512.8	0.70	18559.0				
26512.8						

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

Loss to Fishery with Confidence Limits

Loss to Fishery	18559.0
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona September crab entrainment data
		Construction		
		Dredging to 40		
Projected	Flavel Rer	ft	542349	

VOLUME OF DREDGED MATERIALS - to 40 ft

Volu	ime to be Dredged	(cy)	
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 200)
4	Lower Desdem.	222412	
5		353916	
6	Upper Desdem	0	
7		0	
8		8742	
9		8742	
10	Flavel Bar	49732	
11		298900	
12		121292	
13		72425	
14	Upper Sands	54585	
15		51945	
16		47557	
17		0	
18	Tongue Point	14775	
19		6976	
20		13283	
Total		1325282	

Dredged Yardage (cy)

542349 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from Desdemona Sept Data

ı	Age Class	Total			Propo	rtion	
ı	Age class	Male	Female	Sexed	Male	Female	
ı	YOY	0	0	0	0.5*		 Sample sizes low; assumed to be 1:1.
ı	1+	0	0	0	0.5*	0.5*	 Sample sizes low; assumed to be 1:1.
ı	2+	2	0	2	0.5*		 Sample sizes low; assumed to be 1:1.
[3+	0	1	1	0.5*	0.5*	 Sample sizes low; assumed to be 1:1.

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00000			0.10				0.00	
1+	0.02173	11782.9		0.60	0.160	1131.16		509.02	
2+	0.06518	35348.7		0.86	0.649	19729.51		8878.28	
3+	0.03259	17674.3		0.86	2.222	33774.25		15198.41	
All		64805.9				54634.92		24585.72	
	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			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.00		0.50	0.00		E = Crabs Entrained (number of Crabs)
1+	0.50	565.58		0.50	565.58		M = Post-Entrainment Mortality (proportion)
2+	0.50	9864.76		0.50	9864.76		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	16887.13		0.50	16887.13		AEL = Adult Equivalent Loss
All		07047.40			27247.40		MADIAEL Verience

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL			
YOY	0.00	0.00			
1+	18.18	2.07			
2+	54.55	36.11			
3+	27.27	61.82			

	Proportion of Total AEL			
Age Class	Male	Female		
YOY	0.0000	0.0000		
1+	0.0104	0.0104		
2+	0.1806	0.1806		
3+	0.3091	0.3091		
ALL	0.50	0.50		

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		remaie		Male			
•	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R
YOY	0.50	0.00		0.50	0.00		Ε
1+	0.50	254.51		0.50			М
2+	0.50	4439.14		0.50	4439.14		s
3+	0.50	7599.21		0.50	7599.21		Α
All		12292.86			12292.86		V.
					24585.715		

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

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL at 3+			
YOY	0.00				
1+	18.18	2.07			
2+	54.55	36.1			
3+	27.27	61.82			

	Proportion of i	Otal AEL at 37
Age Class	Male	Female
YOY	0.0000	
1+	0.0104	0.0104
2+	0.1806	
3+	0.3091	0.3091
ALL	0.50	0.50

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

TOTAL AFL at 2+ v	TOTAL AFL at 2+ with Confidence Limits		
AEL at 2+	54634.9		
Var(AEL2+)	54654.8		
SE AEL Z at 0.975	4.05000		
95% C. I.	1.93990		
CV AEL (%)			

TOTAL AEL at	5+ With Confidence
AEL at 3+	24585.7
Var(AEL3+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AFL (%)	

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+	12292.9
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

FEMALE AEL at 3+ with Confidence Limits 12292.9

1.9599

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

HIE	is total would be distributed over 3-4 years)							
1	Male Age 3+		Lost to Fishery					
-	(number of	Harvest Rate	(number of					
-	crab)	(proportion)	crab)					
-	12292.9	0.70	8605.0					

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

95% C. I. CV AEL (%)

Loss to Fishery with Confidence Limits

Loss to Fishery	8605.0
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

ADDITIONAL NOTES:
Mortality Rates (M) for crabs collected in June-September are from Armstrong et al. 1987 (Table 3.3, p. 61)
Savive Intels (5) to age 2+ for crab collected from June-September are from Warnwright et al. 1992 (Table 6, p. 176), and
Sex ratios used were those observed or assumed to be 1-1 where sample size was low.

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona September crab entrainment da
		Post		
		Construction		
		Maintenance, 40		
Projected	Flavel Bar	ft Yr 1	400000	

VOLUME OF DREDGED MATERIALS - Maintenance 40' Yr 1

Γ	Volu	ime to be Dredged		
Г	River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 20
Г	4 to 9	Desdemona	40,000	
Г	10 to 13	Flavel Bar	400000	
Г	14 to 17	Upper Sands	50000	
	18 to 20	Tongue Point	270000	
	T - t - 1		7(0000	

400,000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from Desdemona Sept Data

Age Class		Total		Prop	ortion	
Age Class	Male	Female	Sexed	Male	Female	
YOY	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be
1+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be
2+	2	0	2	0.5*	0.5*	* Sample sizes low; assumed to be
3+	0	1	1	0.5*	0.5*	* Sample sizes low; assumed to be

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

Age Class	R	E	Var(E)	М	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00000	0.0		0.10	0.017	0.00		0.00	
1+	0.02173	8690.3		0.60	0.160	834.27		375.42	
2+	0.06518	26070.8		0.86	0.649	14551.16		6548.02	
3+	0.03259	13035.4		0.86	2.222	24909.61		11209.32	
All		47796.5				40295.03		18132.76	
Note: Entrained 3+ crab are back-calculated to provide AEI 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	
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	0.00		0.50	0.00	
1+	0.50	417.13		0.50	417.13	
2+	0.50	7275.58		0.50	7275.58	
3+	0.50	12454.80		0.50	12454.80	
All		20147.52			20147.52	

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

Age Class Distribution

	Age Class	% of Total				
		of Entrained	of AEL			
	YOY	0.00	0.00			
	1+	18.18	2.07			
	2+	54.55	36.11			
	3+	27.27	61.82			

	Proportion of Total AEL				
Age Class	Male	Female			
YOY	0.0000	0.0000			
1+	0.0104	0.0104			
2+	0.1806	0.1806			
3+	0.3091	0.3091			
ALL	0.50	0.50			

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			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	
YOY	0.50	0.00		0.50	0.00		
1+	0.50	187.71		0.50	187.71		
2+	0.50	3274.01		0.50	3274.01		
3+	0.50	5604.66		0.50	5604.66		
All		9066.38			9066.38		
18132.764							

R = Crab Entrainment Rate (crabs/cy)
E = Crabs Entrainment Mortality (croportion)
M = Post-Entrainment Mortality (croportion)
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
Age Class	of Entrained	of AEL at 3+
YOY	0.00	0.00
1+	18.18	2.07
2+	54.55	36.11
3+	27.27	61.82

	Proportion of Total AEL at 3+					
Age Class	Male	Female				
YOY	0.0000	0.0000				
1+	0.0104	0.0104				
2+	0.1806	0.1806				
3+	0.3091	0.3091				
ALL	0.50	0.50				

SUMMARY VARIANCE DATA

1.9599

TOTAL AEL at 2+ with Confidence Limits AEL at 2+ Var(AEL2+) SE AEL Z at 0.975 95% C. I. 1.9599

AEL at 3+	18132.8
Var(AEL3+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

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

MALL ALL at 3	- with Confidence Li
AEL at 3+	9066.4
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV/ AEL (9/)	

FEMALE AEL at 3+ with Confidence Lim				
AEL at 3+	9066.4			
Var(AEL)				

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

ı	Male Age 3+		Lost to Fishery	
	(number of	Harvest Rate	(number of	
	crab)	(proportion)	crab)	
	9066.4	0.70	6346.5	Harvest rate

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

Loss to Fishery with Confidence Limits

Loss to Fishery	6346.5
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona September crab entrainment dat
		Post		
		Construction		
		Maintenance, 40		
Projected	Flavel Bar	ft Yr 20	210000	

VOLUME OF DREDGED MATERIALS - Maintenance 40' Yr 20

Г	Voli	ime to be Dredged	(cv)	Ī
ı	River Mile	Location Name		Data from Portland District (10 Sept 200
ı	4 to 9	Desdemona	40000	
ı	10 to 13	Flavel Bar	210000	
ſ	14 to 17	Upper Sands	50000	
ı	18 to 20	Tongue Point	270000	
	Total		570000	-

210000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from Desdemona Sept Data

Age Class	Total			Total Proportion				
Age Class	Male	Female	Sexed	Male	Female			
YOY	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:		
1+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:		
2+	2	0	2	0.5*	0.5*	* Sample sizes low; assumed to be 1:		
3+	0	1	1	0.5*	0.5*	* Sample sizes low; assumed to be 1:		

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00000	0.0		0.10	0.017	0.00		0.00	
1+	0.02173	4562.4		0.60	0.160	437.99		197.10	
2+	0.06518	13687.2		0.86	0.649	7639.36		3437.71	
3+	0.03259	6843.6		0.86	2.222	13077.54		5884.89	
All		25093.1				21154.89		9519.70	

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

Ann Class		Female		Male		
Age Class	Proportion AEL		VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	0.00		0.50	0.00	
1+	0.50	218.99		0.50	218.99	
2+	0.50	3819.68		0.50	3819.68	
3+	0.50	6538.77		0.50	6538.77	
All		10577.45			10577.45	

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

Age Class Distribution

Age Class	% of Total		
Age Class	of Entrained	of AEL	
YOY	0.00	0.00	
1+	18.18	2.07	
2+	54.55	36.11	
3+	27.27	61.82	

	Proportion of Total AEL		
Age Class	Male	Female	
YOY	0.0000	0.0000	
1+	0.0104	0.0104	
2+	0.1806	0.1806	
3+	0.3091	0.3091	
ALI	0.50	0.50	

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			
ı	Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
	YOY	0.50	0.00		0.50	0.00	
	1+	0.50	98.55		0.50	98.55	
	2+	0.50	1718.86		0.50	1718.86	
	3+	0.50	2942.45		0.50	2942.45	
	All		4759.85			4759.85	
						9519,701	

R = Crab Entrainment Rate (crabs/cy)
E = Crabs Entrainment (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 Lost

VAR(AEL) =AEL Variance

Age Class Distribution

Age Class	% of Total		
Age Class	of Entrained	of AEL at 3+	
YOY	0.00	0.00	
1+	18.18	2.07	
2+	54.55	36.11	
3+	27.27	61.82	

	Proportion of Total AEL at 3+	
Age Class	Male	Female
YOY	0.0000	0.0000
1+	0.0104	0.0104
2+	0.1806	0.1806
3+	0.3091	0.3091
ALL	0.50	0.50

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

1.9599

AEL at 2+	21154.9
Var(AEL2+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

TOTAL AEL at 3-	with Confidence Lin	nits
AEL at 3+	9519.7	
Var(AEL3+)		
SE AEL		
Z at 0.975	1.95996	
95% C. I.		
CV AEL (%)		

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

MALE ALE OF WILL COMMUNICO E		
AEL at 3+	4759.9	
Var(AEL)		
SE AEL		
Z at 0.975	1.95996	
95% C. I.		
CV/ AEL (9/)		

TEMPLE ALE GO WILL COMMONIC		
AEL at 3+	4759.9	
Var(AEL)		
SE AEL		
Z at 0.975	1.95996	
95% C. I.		
01/ 451 (0/)		

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

Male Age 3+		Lost to Fishery	
(number of	Harvest Rate	(number of	
crab)	(proportion)	crab)	
4759 9	0.70	3331.9	Harves

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

Loss to Fishery with Confidence Limits

Loss to Fishery	3331.9
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona September crab entrainment dat
		Post		
		Construction		
		Maintenance, 43		
Projected	Flavel Bar	ft Yr 1	500000	

VOLUME OF DREDGED MATERIALS - Maintenance 43' Yr 1

	Volu	ime to be Dredged	(cy)	
	River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 200)
	4 to 9	Desdemona		
	10 to 13	Flavel Bar	500000	
	14 to 17	Upper Sands	100000	
	18 to 20	Tongue Point	330000	
-	Tetal		000000	

500000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from Desdemona Sept Data

Age Class		Total		Prop	ortion	
Age Class	Male	Female	Sexed	Male	Female	
YOY	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:
1+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:
2+	2	0	2	0.5*	0.5*	* Sample sizes low; assumed to be 1:
3+	0	1	1	0.5*	0.5*	* Sample sizes low; assumed to be 1:

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00000	0.0		0.10	0.017	0.00		0.00	
1+	0.02173	10862.8		0.60	0.160	1042.83		469.27	
2+	0.06518			0.86	0.649			8185.03	
3+	0.03259	16294.3		0.86	2.222	31137.01		14011.65	
All		59745.6				50368.79		22665.95	
						Note: Entrained	3+ crab are bac	k-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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.00		0.50	0.00		E = Crabs Entrained (number of Crabs)
1+	0.50	521.42		0.50	521.42		M = Post-Entrainment Mortality (proportion)
2+	0.50	9094.47		0.50	9094.47		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	15568.50		0.50	15568.50		AEL = Adult Equivalent Loss
All		25184.39			25184.39		VAR(AEL) =AEL Variance

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL			
YOY	0.00	0.00			
1+	18.18	2.07			
2+	54.55	36.11			
3+	27 27	61.82			

	Proportion of Total AEL		
Age Class	Male	Female	
YOY	0.0000	0.0000	
1+	0.0104		
2+	0.1806	0.1806	
3+	0.3091	0.3091	
ALL	0.50	0.50	

Age Class	Female				Male		
Age class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.00		0.50	0.00		E = Crabs Entrained (number of Crabs)
1+	0.50	234.64		0.50	234.64		M = Post-Entrainment Mortality (proportion)
2+	0.50	4092.51		0.50	4092.51		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1983
3+	0.50	7005.83		0.50	7005.83		AEL = Adult Equivalent Loss
All		11332.98			11332.98		VAR(AEL) =AEL Variance
					22665.954		- "

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL at 3+			
YOY	0.00	0.00			
1+	18.18	2.07			
2+	54.55	36.11			
3+	27 27	61.82			

	Proportion of	Total AEL at 3+
Age Class	Male	Female
YOY	0.0000	0.0000
1+	0.0104	0.0104
2+	0.1806	0.1806
3+	0.3091	0.3091
ALL	0.50	0.50

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

E	59745.6
Var(E)	
SE E	
Z at 0.975	1.95996
95% C. I.	
CV E (%)	

TOTAL AEL at 2+ with Confidence Limits AEL at 2+ Var(AEL2+) SE AEL Z at 0.975 95% C. I. CV AEL (%)

Var(AEL3+) SE AEL	L	AEL at 3+	22666
	975 1.95	/ar(AEL3+)	
		SE AEL	
Z at 0.975		Z at 0.975	1.959

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

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

MALE AEL at 3+ with Confidence Limits 11333.0

FEMALE AEL at 3+ with Confidence Limits				
AEL at 3+	11333.0			
Var(AEL)				
SE AEL				
Z at 0.975	1.95996			
95% C. I.				
CV AEL (%)				

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

1.9599

ı	Male Age 3+		Lost to Fishery	
ı	(number of	Harvest Rate	(number of	
ı	crab)	(proportion)	crab)	
ı	11333.0	0.70	7933.1	Harvest rate of 0.70 is taken from Armstrong et al. (198

Loss to Fishery with Confidence Limits

Loss to Fishery	7933.1
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona September crab entrainment data
		Construction		
		Dredging to 40		
Projected	Flavel Rer	ft	542349	

VOLUME OF DREDGED MATERIALS - to 40 ft

Volu	ime to be Dredged	(cy)	
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 200)
4	Lower Desdem.	222412	
5		353916	
6	Upper Desdem	0	
7		0	
8		8742	
9		8742	
10	Flavel Bar	49732	
11		298900	
12		121292	
13		72425	
14	Upper Sands	54585	
15		51945	
16		47557	
17		0	
18	Tongue Point	14775	
19		6976	
20		13283	
Total		1325282	

Dredged Yardage (cy)

542349 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from Desdemona Sept Data

ı	Age Class	Total			Propo	rtion	
ı	Age Class	Male	Female	Sexed	Male	Female	
ı	YOY	0	0	0	0.5*		 Sample sizes low; assumed to be 1:1.
ı	1+	0	0	0	0.5*	0.5*	 Sample sizes low; assumed to be 1:1.
ı	2+	2	0	2	0.5*		 Sample sizes low; assumed to be 1:1.
[3+	0	1	1	0.5*	0.5*	 Sample sizes low; assumed to be 1:1.

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00000	0.0		0.10		0.00		0.00	
1+	0.02173	11782.9		0.60	0.160	1131.16		509.02	
2+	0.06518	35348.7		0.86	0.649	19729.51		8878.28	
3+	0.03259	17674.3		0.86	2.222	33774.25		15198.41	
All		64805.9				54634.92		24585.72	
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						
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.00		0.50	0.00		E = Crabs Entrained (number of Crabs)
1+	0.50	565.58		0.50	565.58		M = Post-Entrainment Mortality (proportion)
2+	0.50	9864.76		0.50	9864.76		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	16887.13		0.50	16887.13		AEL = Adult Equivalent Loss
All		07047.40			27247.40		MADIAEL Verience

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL			
YOY	0.00	0.00			
1+	18.18	2.07			
2+	54.55	36.11			
3+	27.27	61.82			

	Proportion of Total AEL		
Age Class	Male	Female	
YOY	0.0000	0.0000	
1+	0.0104	0.0104	
2+	0.1806	0.1806	
3+	0.3091	0.3091	
ALL	0.50	0.50	

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	0.00		0.50	0.00	
1+	0.50	254.51		0.50	254.51	
2+	0.50	4439.14		0.50	4439.14	
3+	0.50	7599.21		0.50	7599.21	
All		12292.86			12292.86	

R = Crab Entrainment Rate (crabs/cy)
E = Crabs Entrained (number of Crabs)
M = Post-Entrainment Mortality (proportion)
S = Natural Survivorship (proportion); sun
AEL = Adult Equivalent Loss
VAR(AEL) = AEL Variance

rival to 3+ is assumed to be 45% (Armstrong et al. 1987)

24585.715 Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL at 3+			
YOY	0.00	0.00			
1+	18.18	2.07			
2+	54.55	36.11			

	Proportion of I	otal AEL at 3+
Age Class	Male	Female
YOY	0.0000	
1+	0.0104	0.010
2+	0.1806	
3+	0.3091	0.309
ALL	0.50	0.5

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

TOTAL AEL St 2	TOTAL AEL at 2+ with Confident	
AEL at 2+	54634.9	
Var(AEL2+)		
SE AEL		
Z at 0.975	1.9599	
95% C. I.		
CV AEL (%)		

•	TOTAL AEL at 3+ with Confident	
	AEL at 3+	24585.7
	Var(AEL3+)	
	SE AEL	
	Z at 0.975	1.95996
	95% C. I.	
	CV AFL (%)	

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+	12292.9
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

FEMALE AEL at 3+ with Confiden	
AEL at 3+	12292.9
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

Male Age 3+		Lost to Fishery
(number of	Harvest Rate	(number of
crab)	(proportion)	crab)
12202.0	0.70	9605.0

ber of			
ab)			
0005.0		-4 -1	(4007

Loss to Fishery with Confidence Limits

Loss to Fishery	8605.0
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

ADDITIONAL NOTES:
Mortality Rates (M) for crabs collected in June-September are from Armstrong et al. 1987 (Table 3.3, p. 61)
Savive Intels (5) to age 2+ for crab collected from June-September are from Warnwright et al. 1992 (Table 6, p. 176), and
Sex ratios used were those observed or assumed to be 1-1 where sample size was low.

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona September crab entrainment dat
		Post		
		Construction		
		Maintenance, 43		
Projected	Flavel Bar	ft Yr 20	210000	

VOLUME OF DREDGED MATERIALS - Maintenance 43' Yr 20

ı	Volu	ame to be Dredged		
ı	River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 200
ı	4 to 9	Desdemona	40000	
ı	10 to 13	Flavel Bar	210000	
ı	14 to 17	Upper Sands	100000	
	18 to 20	Tongue Point	330000	
_	T-1-1		600000	

210000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from Desdemona Sept Data

Age Class		Total Proportion		Proportion		
Age Class	Male	Female	Sexed	Male	Female	
YOY	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:
1+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:
2+	2	0	2	0.5*	0.5*	* Sample sizes low; assumed to be 1:
3+	0	1	1	0.5*	0.5*	* Sample sizes low; assumed to be 1:

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

Age Class	R	E	Var(E)	М	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00000	0.0		0.10	0.017	0.00		0.00	
1+	0.02173	4562.4		0.60	0.160	437.99		197.10	
2+	0.06518	13687.2		0.86	0.649	7639.36		3437.71	
3+	0.03259	6843.6		0.86	2.222	13077.54		5884.89	
All		25093.1				21154.89		9519.70	
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	
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	0.00		0.50	0.00	
1+	0.50	218.99		0.50	218.99	
2+	0.50	3819.68		0.50	3819.68	
3+	0.50	6538.77		0.50	6538.77	
All		10577.45			10577.45	

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

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL			
YOY	0.00	0.00			
1+	18.18	2.07			
2+	54.55	36.11			
3+	27.27	61.82			

	Proportion of Total AEL		
Age Class	Male	Female	
YOY	0.0000	0.0000	
1+	0.0104	0.0104	
2+	0.1806	0.1806	
3+	0.3091	0.3091	
ALI	0.50	0.50	

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			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)		
YOY	0.50	0.00	•	0.50	0.00			
1+	0.50	98.55		0.50	98.55			
2+	0.50	1718.86		0.50	1718.86			
3+	0.50	2942.45		0.50	2942.45			
All		4759.85			4759.85			
					9519.701			

R = Crab Entrainment Rate (crabs/cy)
E = Crabs Entrained (number of Crabs)
M = Post-Entrained (number of Crabs)
3 = 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				
Age Class	of Entrained	of AEL at 3+			
YOY	0.00	0.00			
1+	18.18	2.07			
2+	54.55	36.11			
3+	27.27	61.82			

	Proportion of Total AEL at 3+			
Age Class	Male	Female		
YOY	0.0000	0.0000		
1+	0.0104	0.010		
2+	0.1806	0.1806		
3+	0.3091	0.309		
ALI	0.50	0.50		

SUMMARY VARIANCE DATA

AEL at 2+	21154.9
Var(AEL2+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AFL (%)	

TOTAL AEL at 3+ with Confidence Limits		
AEL at 3+	9519.7	
Var(AEL3+)		
SE AEL		
Z at 0.975	1.95996	
95% C. I.		
CV AEL (%)		

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

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

1.9599

MALE AEL at 3+	with Confidence L	imits
AEL at 3+	4759.9	
Var(AEL)		
SE AEL		
Z at 0.975	1.95996	

FEMALE AEL at	3+ with Confidence Limits
AEL at 3+	4759.9
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

Male Age 3+		Lost to Fishery	
(number of	Harvest Rate	(number of	
crab)	(proportion)	crab)	
4759.9	0.70	3331.9	Harvest rate of 0.70 is taken from Armstrong et al. (

Loss to Fishery with Confidence Limits

Loss to Fishery	3331.9
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona September crab entrainment data
		Construction		
		Dredging from		
Projected	Elavol Par	40 to 43 ft	1160721	

VOLUME OF DREDGED MATERIALS - from 40 to 43 ft

	ime to be Dredged		
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 2002)
4	Lower Desdem.	94688	-
5		196724	
6	Upper Desdem	66193	
7		1039	
8		52398	
9		62851	
10	Flavel Bar	329296	
11		535074	
12		239608	
13		65743	
14	Upper Sands	171432	
15		271842	
16		306717	
17		108631	
18	Tongue Point	174113	
19		162864	
20		127219	
Total		2966432	

Dredged Yardage (cy)

1169721 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from June Data

Age Class		Total		Propo	rtion	
Age Class	Male	Female	Sexed	Male	Female	
YOY	0	0	0	0.5*		 Sample sizes low; assumed to be 1:1.
1+	0	0	0	0.5*	0.5*	 Sample sizes low; assumed to be 1:1.
2+	2	0	2	0.5*		 Sample sizes low; assumed to be 1:1.
3+	0	1	1	0.5*	0.5*	 Sample sizes low; assumed to be 1:1.

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)	
YOY	0.00000	0.0		0.10				0.00		
1+	0.02173	25413.0		0.60	0.160	2439.65		1097.84		
2+	0.06518	76238.9		0.86	0.649	42551.98		19148.39		
3+	0.03259	38119.5		0.86	2.222	72843.23		32779.45		
All		139771.3				117834.86		53025.69		
	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		Female Male				
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.00		0.50	0.00		E = Crabs Entrained (number of Crabs)
1+	0.50	1219.82		0.50	1219.82		M = Post-Entrainment Mortality (proportion)
2+	0.50	21275.99		0.50	21275.99		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	36421.61		0.50	36421.61		AEL = Adult Equivalent Loss
All		F0047 43			50047.40		MADIAEL Verience

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL			
YOY	0.00	0.00			
1+	18.18	2.07			
2+	54.55	36.11			
3+	27 27	61.82			

Г		Proportion of	f Total AEL
ı	Age Class	Male	Female
Γ	YOY	0.0000	
Г	1+	0.0104	0.0104
Г	2+	0.1806	
Г	3+	0.3091	0.3091
	ALL	0.50	0.50

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		remale		Male			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = (
YOY	0.50	0.00		0.50	0.00		E = 0
1+	0.50	548.92		0.50	548.92		M = F
2+	0.50	9574.20		0.50	9574.20		S = 1
3+	0.50	16389.73		0.50	16389.73		AEL
All		26512.84			26512.84		VAR
					53025.686		-

Crab Entrainment Rate (crabs/cy)
Crabs Entrained (number of Crabs)
Post-Entrainment Motality (proportion)
Natural Survivorship (proportion); sur
L = Adult Equivalent Loss
R(AEL) = AEL Variance rival to 3+ is assumed to be 45% (Armstrong et al. 1987)

Age Class Distribution

Age Class	% of Total		
Age Class	of Entrained	of AEL at 3+	
YOY	0.00		
1+	18.18	2.07	
2+	54.55	36.1	
3+	27.27	61.82	

Age Class	Male	Female
YOY	0.0000	
1+	0.0104	0.0104
2+	0.1806	
3+	0.3091	0.3091
ΔΠ	0.50	0.50

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

TOTALALLUT	E. Willi Goilliache
AEL at 2+	117834.9
Var(AEL2+)	
SE AEL	

TOTAL AEL at 3+ with Confidence Limits

E	139771.3
Var(E)	
SEE	
Z at 0.975	1.95996
95% C. I.	
CV E (%)	

117834.9
1.95996

AEL at 3+	53025.7
Var(AEL3+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

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

MALE AEL at 3+ with Confidence Limits

AEL at 3+	26512.8
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CM AFL (0/)	

FEMALE AEL at 3+ with Confide		
AEL at 3+	26512.8	
Var(AEL)		
SE AEL		
Z at 0.975	1.95996	
95% C. I.		
CV AEL (%)		

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

Male Age 3+		Lost to Fishery
(number of	Harvest Rate	(number of
crab)	(proportion)	crab)
26612.0	0.70	10550.0

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

Loss to Fishery with Confidence Limits

Loss to Fishery	18559.0
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

ADDITIONAL NOTES:
Mortality Rates (M) for crabs collected in June-September are from Armstrong et al. 1987 (Table 3.3, p. 61)
Savive Intels (5) to age 2+ for crab collected from June-September are from Warnwright et al. 1992 (Table 6, p. 176), and
Sex ratios used were those observed or assumed to be 1-1 where sample size was low.

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona September crab entrainment data
		Construction		
		Dredging from		
Projected	Elavol Par	40 to 43 ft	1160721	

VOLUME OF DREDGED MATERIALS - from 40 to 43 ft

	ime to be Dredged		
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 2002)
4	Lower Desdem.	94688	-
5		196724	
6	Upper Desdem	66193	
7		1039	
8		52398	
9		62851	
10	Flavel Bar	329296	
11		535074	
12		239608	
13		65743	
14	Upper Sands	171432	
15		271842	
16		306717	
17		108631	
18	Tongue Point	174113	
19		162864	
20		127219	
Total		2966432	

Dredged Yardage (cy)

1169721 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from June Data

Age Class	Total			Propo	rtion	
Age Class	Male	Female	Sexed	Male	Female	
YOY	0	0	0	0.5*		 Sample sizes low; assumed to be 1:1.
1+	0	0	0	0.5*	0.5*	 Sample sizes low; assumed to be 1:1.
2+	2	0	2	0.5*		 Sample sizes low; assumed to be 1:1.
3+	0	1	1	0.5*	0.5*	 Sample sizes low; assumed to be 1:1.

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00000	0.0		0.10				0.00	
1+	0.02173	25413.0		0.60	0.160	2439.65		1097.84	
2+	0.06518	76238.9		0.86	0.649	42551.98		19148.39	
3+	0.03259	38119.5		0.86	2.222	72843.23		32779.45	
All		139771.3				117834.86		53025.69	
	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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.00		0.50	0.00		E = Crabs Entrained (number of Crabs)
1+	0.50	1219.82		0.50	1219.82		M = Post-Entrainment Mortality (proportion)
2+	0.50	21275.99		0.50	21275.99		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	36421.61		0.50	36421.61		AEL = Adult Equivalent Loss
All		F0047 43			50047.40		MADIAEL Verience

Age Class Distribution

Age Class	% of Total		
Age Class	of Entrained	of AEL	
YOY	0.00	0.00	
1+	18.18	2.07	
2+	54.55	36.11	
3+	27 27	61.82	

Г		Proportion of Total AEL		
ı	Age Class	Male	Female	
Γ	YOY	0.0000		
Г	1+	0.0104	0.0104	
Г	2+	0.1806		
Г	3+	0.3091	0.3091	
	ALL	0.50	0.50	

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	remaie			Male			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = (
YOY	0.50	0.00		0.50	0.00		E = 0
1+	0.50	548.92		0.50	548.92		M = F
2+	0.50	9574.20		0.50	9574.20		S = 1
3+	0.50	16389.73		0.50	16389.73		AEL
All		26512.84			26512.84		VAR
					53025.686		-

Crab Entrainment Rate (crabs/cy)
Crabs Entrained (number of Crabs)
Post-Entrainment Motality (proportion)
Natural Survivorship (proportion); sur
L = Adult Equivalent Loss
R(AEL) = AEL Variance rival to 3+ is assumed to be 45% (Armstrong et al. 1987)

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL at 3+			
YOY	0.00				
1+	18.18	2.07			
2+	54.55	36.1			
3+	27.27	61.82			

Age Class	Male	Female
YOY	0.0000	
1+	0.0104	0.0104
2+	0.1806	
3+	0.3091	0.3091
ΔΠ	0.50	0.50

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

TOTALALLUT	E. Willi Goilliache
AEL at 2+	117834.9
Var(AEL2+)	
SE AEL	

TOTAL AEL at 3+ with Confidence Limits

E	139771.3
Var(E)	
SEE	
Z at 0.975	1.95996
95% C. I.	
CV E (%)	

117834.9
1.95996

AEL at 3+	53025.7
Var(AEL3+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

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

MALE AEL at 3+ with Confidence Limits

AEL at 3+	26512.8
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CM AFL (0/)	

FEMALE AEL at	3+ with Confide
AEL at 3+	26512.8
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

Male Age 3+		Lost to Fishery
(number of	Harvest Rate	(number of
crab)	(proportion)	crab)
26612.0	0.70	10550.0

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

Loss to Fishery with Confidence Limits

Loss to Fishery	18559.0
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

ADDITIONAL NOTES:
Mortality Rates (M) for crabs collected in June-September are from Armstrong et al. 1987 (Table 3.3, p. 61)
Savive Intels (5) to age 2+ for crab collected from June-September are from Warnwright et al. 1992 (Table 6, p. 176), and
Sex ratios used were those observed or assumed to be 1-1 where sample size was low.

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona September crab entrainment da
		Post		
		Construction		
		Maintenance, 40		
Projected	Flavel Bar	ft Yr 1	400000	

VOLUME OF DREDGED MATERIALS - Maintenance 40' Yr 1

Γ	Volu	ime to be Dredged	1	
Г	River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 20
Γ	4 to 9	Desdemona	40,000	1
Г	10 to 13	Flavel Bar	400000	
Г	14 to 17	Upper Sands	50000	
Г	18 to 20	Tongue Point	270000	
	Total		760000	='

400,000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from Desdemona Sept Data

Age Class		Total		Prop	ortion	1
Age Class	Male	Female	Sexed	Male	Female	
YOY	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to
1+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to
2+	2	0	2	0.5*	0.5*	* Sample sizes low; assumed to
3+	0	1	1	0.5*	0.5*	* Sample sizes low; assumed to

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)	
YOY	0.00000	0.0		0.10	0.017	0.00		0.00		
1+	0.02173	8690.3		0.60	0.160	834.27		375.42		
2+	0.06518	26070.8		0.86	0.649	14551.16		6548.02		
3+	0.03259	13035.4		0.86	2.222	24909.61		11209.32		
All		47796.5				40295.03		18132.76		
	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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.00		0.50	0.00		E = Crabs Entrained (number of Crabs)
1+	0.50	417.13		0.50	417.13		M = Post-Entrainment Mortality (proportion)
2+	0.50	7275.58		0.50	7275.58		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	12454.80		0.50	12454.80		AEL = Adult Equivalent Loss
All		00447.50			00447.50		1/4B/4EL) -4EL)/

Age Class Distribution

	Age Class	% of Total				
L		of Entrained	of AEL			
	YOY	0.00	0.00			
	1+	18.18	2.07			
	2+	54.55	36.11			
	3+	27.27	61.82			

	Proportion	of Total AEL
Age Class	Male	Female
YOY	0.0000	0.0000
1+	0.0104	
2+	0.1806	0.1806
3+	0.3091	0.3091
ALL	0.50	0.50

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	0.00		0.50	0.00	
1+	0.50	187.71		0.50	187.71	
2+	0.50	3274.01		0.50	3274.01	
3+	0.50	5604.66		0.50	5604.66	
All		9066.38			9066.38	
18132.764						

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

Age Class Distribution

Age Class	% of Total		
Age Class	of Entrained	of AEL at 3+	
YOY	0.00	0.00	
1+	18.18	2.07	
2+	54.55	36.11	
3+	27.27	61.82	

	Proportion of Total AEL at 3+		
Age Class	Male	Female	
YOY	0.0000	0.0000	
1+	0.0104	0.0104	
2+	0.1806	0.1806	
3+	0.3091	0.3091	
ALL	0.50	0.50	

SUMMARY VARIANCE DATA

E	47796.5
Var(E)	
SE E	
Z at 0.975	1.95996
95% C. I.	
CV E (%)	

TOTAL AEL at 2+ with Confidence Limits AEL at 2+ Var(AEL2+) SE AEL Z at 0.975 95% C. I. CV AEL (%)

TOTAL AEL at 3	+ with Confidence Limits
AEL at 3+	18132.8
Var(AEL3+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

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

9066.4
1.95996

FEMALE AEL at 3+ with Confidence Limits				
AEL at 3+	9066.4			
Var(AEL)				
SE AEL				
Z at 0.975	1.95996			
95% C. I.				
CV AEL (%)				

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

Male Age 3+		Lost to Fishery	
(number of	Harvest Rate	(number of	
crab)	(proportion)	crab)	
9066.4	0.70	6346.5	Ha

of		
46 5	Hanvest rate of 0.70 is taken from Armstrong et al. (1097)	

Loss to Fishery with Confidence Limits

Loss to Fishery	6346.5
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona September crab entrainment da
		Post		
		Construction		
		Maintenance, 40		
Projected	Flavel Bar	ft Yr 20	210000	

VOLUME OF DREDGED MATERIALS - Maintenance 40' Yr 20

ſ	Volume to be Dredged (cy)			
Γ	River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 20
Ι	4 to 9	Desdemona		
	10 to 13	Flavel Bar	210000	
	14 to 17	Upper Sands	50000	
I	18 to 20	Tongue Point	270000	
	Total		570000	-

210000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from Desdemona Sept Data

Age Class	Total		Prop	ortion		
Age Class	Male	Female	Sexed	Male	Female	
YOY	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:
1+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:
2+	2	0	2	0.5*	0.5*	* Sample sizes low; assumed to be 1:
3+	0	1	1	0.5*	0.5*	* Sample sizes low; assumed to be 1:

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00000	0.0		0.10	0.017	0.00		0.00	
1+	0.02173	4562.4		0.60	0.160	437.99		197.10	
2+	0.06518	13687.2		0.86	0.649	7639.36		3437.71	
3+	0.03259	6843.6		0.86	2.222	13077.54		5884.89	
All		25093.1				21154.89		9519.70	
	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

Ann Class		Female		Male		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	0.00		0.50	0.00	
1+	0.50	218.99		0.50	218.99	
2+	0.50	3819.68		0.50	3819.68	
3+	0.50	6538.77		0.50	6538.77	
All		10577.45			10577.45	

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

Age Class Distribution

Age Class	% of Total			
Age Class	of Entrained	of AEL		
YOY	0.00	0.00		
1+	18.18	2.07		
2+	54.55	36.11		
3+	27.27	61.82		

	Proportion of Total AEL		
Age Class	Male	Female	
YOY	0.0000	0.0000	
1+	0.0104		
2+	0.1806	0.1806	
3+	0.3091	0.3091	
ALL	0.50	0.50	

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		
	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	0.00		0.50	0.00	
1+	0.50	98.55		0.50	98.55	
2+	0.50	1718.86		0.50	1718.86	
3+	0.50	2942.45		0.50	2942.45	
All		4759.85			4759.85	
					9519.701	

R = Crab Entrainment Rate (crabs/cy)
E = Crabs Entrained (number of Crabs)
M = Post-Entrained (number of Crabs)
3 = 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		
Age Class	of Entrained	of AEL at 3+	
YOY	0.00	0.00	
1+	18.18	2.07	
2+	54.55	36.11	
3+	27.27	61.82	

	Proportion of Total AEL at 3+			
Age Class	Male	Female		
YOY	0.0000	0.0000		
1+	0.0104	0.0104		
2+	0.1806	0.1806		
3+	0.3091	0.3091		
ALL	0.50	0.50		

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

E	25093.1
Var(E)	
SE E	
Z at 0.975	1.95996
95% C. I.	
CV E (%)	

TOTAL AEL at 2+ with Confidence Limits

TOTAL AEL at 3-	TOTAL AEL at 3+ with Confidence Limits				
AEL at 3+	9519.7				
Var(AEL3+)					
SE AEL					
Z at 0.975	1.95996				
95% C. I.					
CV AEL (%)					

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

AEL at 2+ Var(AEL2+) SE AEL Z at 0.975 95% C. I. CV AEL (%)

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

MALE AEL at 3+ with Confidence Limits 4759.9 1.9599

FEMALE AEL at 3+ with Confidence Limits

AEL at 3+	4759.9
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

Male Age 3+		Lost to Fishery
(number of	Harvest Rate	(number of

(number of	Harvest Rate	(number of	
crab)	(proportion)	crab)	
4759.9	0.70	3331.9	Harvest rate of 0.70 is taken from Armstrong et al. (1987).

Loss to Fishery with Confidence Limits

Loss to Fishery	3331.9
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona September crab entrainment dat
		Post		
		Construction		
		Maintenance, 43		
Projected	Flavel Bar	ft Yr 1	500000	

VOLUME OF DREDGED MATERIALS - Maintenance 43' Yr 1

Γ	Volu	ime to be Dredged		
ſ	River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 200
Γ	4 to 9	Desdemona	60000	
Г	10 to 13	Flavel Bar	500000	
ſ	14 to 17	Upper Sands	100000	
	18 to 20	Tongue Point	330000	
_	T - t - 1		000000	

500000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from Desdemona Sept Data

Age Class	Total			Total Proportion		
Age Class	Male	Female	Sexed	Male	Female	
YOY	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:1
1+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:1
2+	2	0	2	0.5*	0.5*	* Sample sizes low; assumed to be 1:1
3+	0	1	1	0.5*	0.5*	* Sample sizes low; assumed to be 1:1

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

Age Class	R	E	Var(E)	М	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00000	0.0		0.10	0.017	0.00		0.00	
1+	0.02173	10862.8		0.60	0.160	1042.83		469.27	
2+	0.06518	32588.5		0.86	0.649	18188.95		8185.03	
3+	0.03259	16294.3		0.86	2.222	31137.01		14011.65	
All		59745.6				50368.79		22665.95	
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			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R
YOY	0.50	0.00		0.50	0.00		ĪΕ
1+	0.50	521.42		0.50	521.42		М
2+	0.50	9094.47		0.50	9094.47		s
3+	0.50	15568.50		0.50	15568.50		Α
All		25184.39			25184.39		T٧

Drab Entrainment Rate (crabs/cy)

Arabs Entrained (number of Crabs)

Social Charles (proportion)

Socia

Age Class Distribution

Age Class	% of Total			
Age Class	of Entrained	of AEL		
YOY	0.00	0.00		
1+	18.18	2.07		
2+	54.55	36.11		
3+	27.27	61.82		

	Proportion	of Total AEL
Age Class	Male	Female
YOY	0.0000	0.0000
1+	0.0104	
2+	0.1806	0.1806
3+	0.3091	0.3091
ALL	0.50	0.50

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		
	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	0.00		0.50	0.00	
1+	0.50	234.64		0.50	234.64	
2+	0.50	4092.51		0.50	4092.51	
3+	0.50	7005.83		0.50	7005.83	
All		11332.98			11332.98	
					22665.954	

R = Crab Entrainment Rate (crabs/cy)
E = Crabs Entrainment Mortality (croportion)
M = Post-Entrainment Mortality (croportion)
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			
Age Class	of Entrained	of AEL at 3+		
YOY	0.00	0.00		
1+	18.18	2.07		
2+	54.55	36.11		
3+	27.27	61.82		

	Proportion of	Total AEL at 3+
Age Class	Male	Female
YOY	0.0000	0.0000
1+	0.0104	0.0104
2+	0.1806	0.1806
3+	0.3091	0.3091
ALL	0.50	0.50

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

E	59745.6
Var(E)	
SE E	
Z at 0.975	1.95996
95% C. I.	
CV E (%)	

1	TOTAL AEL at 2+ with Confidence Limits					
7	AEL at 2+	50368.8				
١	Var(AEL2+)					
1	SE AEL					

TOTAL AEL at 3+ with Confidence Limits				
AEL at 3+	22666.0			
Var(AEL3+)				
SE AEL				
Z at 0.975	1.95996			
95% C. I.				
CV AEL (%)				

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 11333.0 1.9599

FEMALE AEL	at 3+ with	Confidence Limits

1.95996

AEL at 3+	11333.0
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

1	Male Age 3+		Lost to Fishery	
ı	(number of	Harvest Rate	(number of	
ı	crab)	(proportion)	crab)	
ı	11333.0	0.70	7933 1	Harveet r

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

Loss to Fishery with Confidence Limits

Loss to Fishery	7933.1
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Desdemona September crab entrainment dat
		Post		
		Construction		
		Maintenance, 43		
Projected	Flavel Bar	ft Yr 20	210000	

VOLUME OF DREDGED MATERIALS - Maintenance 43' Yr 20

Volu	ame to be Dredged		
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 200
4 to 9	Desdemona	40000	
10 to 13	Flavel Bar	210000	
14 to 17	Upper Sands	100000	
18 to 20	Tongue Point	330000	

210000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class, Derived from Desdemona Sept Data

Age Class		Total		Prop	ortion	
Age Class	Male	Female	Sexed	Male	Female	
YOY	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:
1+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:
2+	2	0	2	0.5*	0.5*	* Sample sizes low; assumed to be 1:
3+	0	1	1	0.5*	0.5*	* Sample sizes low; assumed to be 1:

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

Age Class	R	E	Var(E)	М	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.00000	0.0		0.10	0.017	0.00		0.00	
1+	0.02173	4562.4		0.60	0.160	437.99		197.10	
2+	0.06518	13687.2		0.86	0.649	7639.36		3437.71	
3+	0.03259	6843.6		0.86	2.222	13077.54		5884.89	
All		25093.1				21154.89		9519.70	
Note: Entrained 3+ crab are back-calculated to provide AEI 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	
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	0.00		0.50	0.00	
1+	0.50	218.99		0.50	218.99	
2+	0.50	3819.68		0.50	3819.68	
3+	0.50	6538.77		0.50	6538.77	
All		10577.45			10577.45	

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

Age Class Distribution

Age Class	% of	Total	
Age Class	of Entrained	of AEL	
YOY	0.00	0.00	
1+	18.18	2.0	
2+	54.55	36.1	
3+	27.27	61.8	

	Proportion of Total AEL		
Age Class	Male Female		
YOY	0.0000	0.0000	
1+	0.0104	0.0104	
2+	0.1806	0.1806	
3+	0.3091	0.3091	
ALL	0.50	0.50	

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			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	0.00		0.50	0.00	
1+	0.50	98.55		0.50	98.55	
2+	0.50	1718.86		0.50	1718.86	
3+	0.50	2942.45		0.50	2942.45	
All		4759.85			4759.85	
9519.701						

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		
Age Class	of Entrained	of AEL at 3+	
YOY	0.00	0.00	
1+	18.18	2.07	
2+	54.55	36.11	
3+	27.27	61.82	

	Proportion of Total AEL at 3+		
Age Class	Male	Female	
YOY	0.0000	0.0000	
1+	0.0104	0.0104	
2+	0.1806	0.1806	
3+	0.3091	0.3091	
ALL	0.50	0.50	

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

1.9599

AEL at 2+	21154.9
Var(AEL2+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AFL (%)	

TOTAL AEL at 3+ with Confidence Limits				
AEL at 3+	9519.7			
Var(AEL3+)				
SE AEL				
Z at 0.975	1.95996			
95% C. I.				
CV AEL (%)				

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+	4759.9
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

FEMALE AEL at 3+ with Confidence Limits				
AEL at 3+	4759.9			
Var(AEL)				
SE AEL				
Z at 0.975	1.95996			
95% C. I.				
CV AEL (%)				

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

ı	4759.9	0.70	3331.9	Harvest rate of 0.70 is
ı	crab)	(proportion)	crab)	
ı	(number of	Harvest Rate	(number of	
ı	wate Age 5+		Lost to Fishery	

s taken from Armstrong et al. (1987).

Loss to Fishery with Confidence Limits

Loss to Fishery	3331.9
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Summary of Projected Entrainment, Adult Equivalent Loss, and Loss to Fishery. Lower Columbia River WH Pearson and GD Williams

Variance Estimators (derived from Sept 2002 field sampling at Upper Sands)

	CV %		
E	70.70	Z at 0.975	1.95996
AEL	98.30		
1 F	98.30		

Construction	Dredgin	g to 40	ft -	Age	2+

Assumptions:	
Projected Location	Flavel Bar
Diagnosi dradaad valuma (av)	542 340

Results:			
	Projected		
Parameter	Value	SE	95% CI
E	11,136	7,873	15,431
AEL	539	530	1,039
AEL Male	270	265	519
AEL Female	270	265	519
Loss to Fishery	85	83	164

Construction Dredging to 40 ft - Age 3+

Assumptions.	
Projected Location	Flavel Bar
Planned dredged volume (cy)	542,349

	Projected		
Parameter	Value	SE	95% CI
E	11,136	7,873	15,431
AEL	243	238	467
AEL Male	121	119	234
AEL Female	121	119	234
Loss to Fishery	85	83	164

Construction Dredging from 40 to 43 ft - Age 2+ Assumptions:

	J
Assum	ptions:

Projected Location	Flavel Bar
Planned dredged volume (cy)	1,169,721

Results:

	Projected		
Parameter	Value	SE	95% CI
E	24,017	16,980	33,280
AEL	1,163	1,143	2,240
AEL Male	581	571	1,120
AEL Female	581	571	1,120
Loss to Fishery	183	180	353

Construction Dredging from 40 to 43 ft - Age 3+

Assumptions.	
Projected Location	Flavel Bar
Planned dredged volume (cy)	1,169,721

Results:

	Projected		0=0/ 01
Parameter	Value	SE	95% CI
E	24,017	16,980	33,280
AEL	523	514	1,008
AEL Male	262	257	504
AEL Female	262	257	504
Loss to Fishery	183	180	353

Annual Maintenance Dredging 40' Year 1 - Age 2+ Assumptions:

Projected Location	Flavel Bar
Planned dredged volume (cy)	400,000

Results:

	Projected		
Parameter	Value	SE	95% CI
E	8,213	5,807	11,381
AEL	398	391	766
AEL Male	199	195	383
AEL Female	199	195	383
Loss to Fishery	63	62	121

Annual Maintenance Dredging 40' Year 1 - Age 3+ Assumptions:

Projected Location	Flavel Bar
Planned dredged volume (cy)	400,000

Results:

	Projected		
Parameter	Value	SE	95% CI
E	8,213	5,807	11,381
AEL	179	176	345
AEL Male	89	88	172
AEL Female	89	88	172
Loss to Fishery	63	62	121

Annual Maintenance Dredging 40' Year 20 - Age 2+ Assumptions:

Projected Location	Flavel Bar
Planned dredged volume (cy)	210,000

Results:

Parameter	Projected Value	SE	95% CI
E	4,312	3,048	5,975
AEL	209	205	402
AEL Male	104	103	201
AEL Female	104	103	201
Loss to Fishery	33	32	63

Annual Maintenance Dredging 40' Year 20 - Age 3+ Assumptions:

Projected Location	Flavel Bar
Planned dredged volume (cy)	210,000

Results:

Parameter	Projected Value	SE	95% CI
E	4,312	3,048	5,975
AEL	94	92	181
AEL Male	47	46	90
AEL Female	47	46	90
Loss to Fishery	33	32	63

Annual Maintenance Dredging 43' Year 1 - Age 2+ <u>Assumptions:</u>

Projected Location	Flavel Bar
Name and designed conference (ac.)	E00 000

Results:

	Projected		
Parameter	Value	SE	95% CI
E	10,266	7,258	14,226
AEL	497	489	958
AEL Male	248	244	479
AEL Female	248	244	479
Loss to Fishery	78	77	151

nnual Maintenance	Dredging 43' Year 1	- Age 3+

Assumptions:

Projected Location	Flavel Bar
Planned dredged volume (cy)	500,000

Results:

	Projected		
Parameter	Value	SE	95% CI
E	10,266	7,258	14,226
AEL	224	220	431
AEL Male	112	110	215
AEL Female	112	110	215
Loss to Fishery	78	77	151

Annual Maintenance Dredging 43' Year 20 - Age 2+ Assumptions:

Projected Location	Flavel Bar
Planned dredged volume (cv)	210.000

Results:

	Projected		
Parameter	Value	SE	95% CI
E	4,312	3,048	5,975
AEL	209	205	402
AEL Male	104	103	201
AEL Female	104	103	201
Loss to Fishery	33	32	63

Annual Maintenance Dredging 43' Year 20 - Age 3+ Assumptions:

Projected Location	Flavel Bar
Planned dredged volume (cy)	210,000

Results:			
	Projected		
Parameter	Value	SE	95% CI
E	4,312	3,048	5,975
AEL	94	92	181
AEL Male	47	46	90
AEL Female	47	46	90
Loss to Fishery	33	32	63

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Upper Sands crab entrainment data
		Construction Dredging to 40		
Projected	Flavel Bar	ft	542349	

VOLUME OF DREDGED MATERIALS - to 40 ft

Volu	ime to be Dredged	(cy)	
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 200)
4	Lower Desdem.	222412	
5		353916	
6	Upper Desdem	0	
7		0	
8		8742	
9		8742	
10	Flavel Bar	49732	
11		298900	
12		121292	
13		72425	
14	Upper Sands	54585	
15		51945	
16		47557	
17		0	
18	Tongue Point	14775	
19		6976	
20		13283	
Total		1325282	

Dredged Yardage (cy)

542349 Amount (cy) dredged during dredging period

Sex Ratios by Age Class

ı	Age Class	Total			Total Proportion		
ı	Age Class	Male	Female	Sexed	Male	Female	
ı	YOY	1	0	1	0.5*		 Sample sizes low; assumed to be 1:1.
ı	1+	0	1	1	0.5*	0.5*	 Sample sizes low; assumed to be 1:1.
ı	2+	0	0	0	0.5*		 Sample sizes low; assumed to be 1:1.
[3+	0	0	0	0.5*	0.5*	 Sample sizes low; assumed to be 1:1.

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.01036	5616.7		0.10		9.27		4.17	
1+	0.01018	5519.0		0.60	0.160	529.83		238.42	
2+	0.00000	0.0		0.86	0.649	0.00		0.00	
3+	0.00000	0.0		0.86	2.222	0.00		0.00	
All		11135.7				539.09		242.59	
	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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	4.63		0.50	4.63		E = Crabs Entrained (number of Crabs)
1+	0.50	264.91		0.50	264.91		M = Post-Entrainment Mortality (proportion)
2+	0.50	0.00		0.50	0.00		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	0.00		0.50	0.00		AEL = Adult Equivalent Loss
All		200 55			200 55		VAR/AEL) - AEL Variance

Age Class Distribution

Age Class	% of Total		
Age Class	of Entrained	of AEL	
YOY	50.44	0.00	
1+	49.56	98.28	
2+	0.00	0.00	
3+	0.00	0.00	

	Proportion of Total AEL						
Age Class	Male	Female					
YOY	0.0086	0.0086					
1+	0.4914	0.4914					
2+	0.0000	0.0000					
3+	0.0000	0.0000					

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	
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	2.09		0.50	2.09	
1+	0.50	119.21		0.50	119.21	
2+	0.50	0.00		0.50	0.00	
3+	0.50	0.00		0.50	0.00	
All		121.30			121.30	

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

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL at 3+			
YOY	50.44	1.72			
1+	49.56	98.28			
2+	0.00	0.00			
3+	0.00	0.00			

	Proportion of Total AEL at 3+				
Age Class	Male	Female			
YOY	0.0086				
1+	0.4914	0.491			
2+	0.0000				
3+	0.0000	0.000			

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

TOTAL AEL at 2	* with Confidence
AEL at 2+	539.1
Var(AEL2+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

AEL at 3+	242.
Var(AEL3+)	
SE AEL	
Z at 0.975	1.9599
95% C. I.	

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+	121.3
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

FEMALE AEL at 3+ with Confidence Limits

AEL at 3+		1:	21.3
Var(AEL)			
SE AEL			
Z at 0.975		1.95	996
95% C. I.			
CV AFI (%)			

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

Male Age 3+		Lost to Fishery
(number of	Harvest Rate	(number of
crab)	(proportion)	crab)
404.0	0.70	

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

Loss to Fishery with Confidence Limits

Loss to Fishery	84.9
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Upper Sands crab entrainment data
		Construction		
		Dredging from		
Projected	Flavel Bar	40 to 43 ft	1169721	

VOLUME OF DREDGED MATERIALS - from 40 to 43 ft

Volu	ime to be Dredged	(cy)	
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 2002)
4	Lower Desdem.	94688	-
5		196724	
6	Upper Desdem	66193	
7		1039	
8		52398	
9		62851	
10	Flavel Bar	329296	
11		535074	
12		239608	
13		65743	
14	Upper Sands	171432	
15		271842	
16		306717	
17		108631	
18	Tongue Point	174113	
19		162864	
20		127219	
Total		2966432	

Dredged Yardage (cy)

1169721 Amount (cy) dredged during dredging period

Sex Ratios by Age Class

Age Class	Total			Propo	ortion
Age Class	Male	Female	Sexed	Male	Female
YOY	1	0	1	0.5*	
1+	0	1	1	0.5*	0.5*
2+	0	0	0	0.5*	
3+	0	0	0	0.5*	0.5*

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.01036			0.10				8.99	
1+	0.01018	11903.3		0.60	0.160	1142.71		514.22	
2+	0.00000	0.0		0.86	0.649	0.00		0.00	
3+	0.00000	0.0		0.86	2.222	0.00		0.00	
All		24017.2				1162.70		523.22	
	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			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	9.99		0.50	9.99		E = Crabs Entrained (number of Crabs)
1+	0.50	571.36		0.50	571.36		M = Post-Entrainment Mortality (proportion)
2+	0.50	0.00		0.50	0.00		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	0.00		0.50	0.00		AEL = Adult Equivalent Loss
All		F04 3F			504.35		MADIAEL Verience

Age Class Distribution

Age Class	% of Total			
Age Class	of Entrained	of AEL		
YOY	50.44	0.00		
1+	49.56	98.28		
2+	0.00	0.00		
3+	0.00	0.00		

	Proportion of Total AEL		
Age Class	Male	Female	
YOY	0.0086	0.0086	
1+	0.4914	0.4914	
2+	0.0000	0.0000	
3+	0.0000	0.0000	
ALL	0.50	0.50	

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			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = C
YOY	0.50	4.50		0.50	4.50		E = C
1+	0.50	257.11		0.50	257.11		M = P
2+	0.50	0.00		0.50	0.00		S = N
3+	0.50	0.00		0.50	0.00		AEL =
All		261.61			261.61		VAR(

orab Entrainment Rate (crabs/cy)
rabs Entrained (number of Crabs)
ost-Entrainment Mortality (proportion)
taltural Survivorship (proportion); sun
= Adult Equivalent Loss
AEL) = AEL Variance rival to 3+ is assumed to be 45% (Armstrong et al. 1987)

Age Class Distribution

	Age Class	% of Total		
Age Class		of Entrained	of AEL at 3+	
	YOY	50.44	1.72	
	1+	49.56	98.28	
	2+	0.00	0.00	
	3+	0.00	0.00	

Age Class	Male	Female
YOY	0.0086	
1+	0.4914	0.4914
2+	0.0000	
3+	0.0000	0.0000
ALL	0.50	0.50

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

TOTAL AEL at 2+ with Confidence Limits				
AEL at 2+	1162.7			
Var(AEL2+)				
SE AEL				
Z at 0.975	1.95996			
95% C. I.				
CV AEL (%)				

AEL at 3+	
Var(AEL3+)	
SE AEL	
Z at 0.975	_
95% C. I.	
CV AEL (%)	

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+	261.6
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

FEMALE AEL at 3+ with Confidence Limits

AEL at 3+	261.6
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

Male Age 3+		Lost to Fishery
(number of	Harvest Rate	(number of
crab)	(proportion)	crab)
261.6	0.70	102 1

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

Loss to Fishery with Confidence Limits

Loss to Fishery	183.1
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Upper Sands crab entrainment da
		Post		
		Construction		
		Maintenance, 40		
Projected	Flavel Bar	ft Yr 1	400000	

VOLUME OF DREDGED MATERIALS - Maintenance 40' Yr 1

Г	Volu	ime to be Dredged	(cy)	1
ı	River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 20
Γ	4 to 9	Desdemona	40,000	1
Г	10 to 13	Flavel Bar	400000	
Г	14 to 17	Upper Sands	50000	
Г	18 to 20	Tongue Point	270000	
	Total		760000	='

Dredged Yardage (cy)

400,000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class

Age Class	Total			Propo	ortion	
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.5*	0.5*	* Sample sizes low; assumed to be 1:1
1+	0	1	1	0.5*	0.5*	* Sample sizes low; assumed to be 1:1
2+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:1
3+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:1

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.01036	4142.5		0.10	0.017	6.84		3.08	
1+	0.01018	4070.5		0.60	0.160	390.76		175.84	
2+	0.00000	0.0		0.86	0.649	0.00		0.00	
3+	0.00000	0.0		0.86	2.222	0.00		0.00	
All		8213.0				397.60		178.92	
Note: Entrained 3+ crab are back-calculated to provide AEL at 2									

+ Calculations						Note: Entra
	Equivalent Loss (AE	L at 2+) and Var	iance (AEL at 2+	by Sex (MALE/FE	MALE) and Age C	lass
Age Class	Proportion	Female AEL	VAR(AEL)	Proportion	Male AEL	VAR(AE
YOY	0.50	3.42	· · · · · ·	0.50	3.42	
1+	0.50	195.38		0.50	195.38	
2+	0.50	0.00		0.50	0.00	
3+	0.50	0.00		0.50	0.00	

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

Age Class Distribution

Age Class	% of Total			
Age Class	of Entrained	of AEL		
YOY	50.44	0.00		
1+	49.56	98.28		
2+	0.00	0.00		
3+	0.00	0.00		

	Proportion of Total AEL		
Age Class	Male	Female	
YOY	0.0086	0.0086	
1+	0.4914	0.4914	
2+	0.0000	0.0000	
3+	0.0000	0.0000	
ΔII	0.50	0.50	

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	1.54		0.50	1.54	
1+	0.50	87.92		0.50	87.92	
2+	0.50	0.00		0.50	0.00	
3+	0.50	0.00		0.50	0.00	
All		89.46			89.46	
					178,920	

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

Age Class Distribution

Age Class	% of Total		
Age Class	of Entrained	of AEL at 3+	
YOY	50.44	1.72	
1+	49.56	98.28	
2+	0.00	0.00	
3+	0.00	0.00	

	Proportion of	Total AEL at 3+
Age Class	Male	Female
YOY	0.0086	0.0086
1+	0.4914	0.4914
2+	0.0000	0.0000
3+	0.0000	0.0000
ALL	0.50	0.50

SUMMARY VARIANCE DATA

E	8213.0
Var(E)	
SE E	
Z at 0.975	1.95996
95% C. I.	
01/ 5 (0/)	

TOTAL AEL at 2+ with Confidence Limits

1.9599

TOTAL AEL at 3	with Confidence	Limits
AEL at 3+	178.9	
Var(AEL3+)		
SE AEL		
Z at 0.975	1.95996	
95% C. I.		
CV AEL (%)		

AEL at 2+ Var(AEL2+) SE AEL Z at 0.975 95% C. I.

CV AEL (%)

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

89.5
1.95996

FEMALE AEL at 3	3+ with Confidence L
AEL at 3+	89.5
Var(AEL)	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

Male Age 3+		Lost to Fishery	
(number of	Harvest Rate	(number of	
crab)	(proportion)	crab)	
89.5	0.70	62.6	Harve

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

Loss to Fishery with Confidence Limits

Loss to Fishery	62.6
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Upper Sands crab entrainment dat
		Post		
		Construction		
		Maintenance, 40		
Projected	Flavel Bar	ft Yr 20	210000	

VOLUME OF DREDGED MATERIALS - Maintenance 40' Yr 20

Volume to be Dredged (cy)			
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 200
4 to 9	Desdemona	40000	
10 to 13	Flavel Bar	210000	
14 to 17	Upper Sands	50000	
18 to 20	Tongue Point	270000	
T - t - 1		570000	

Dredged Yardage (cy)

210000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class

Age Class	Total			al Proportion		
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.
1+	0	1	1	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.
2+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.
3+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.01036	2174.8		0.10	0.017	3.59		1.61	
1+	0.01018	2137.0		0.60	0.160	205.15		92.32	
2+	0.00000	0.0		0.86	0.649	0.00		0.00	
3+	0.00000	0.0		0.86	2.222	0.00		0.00	
All		4311.8				208.74		93.93	
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	no Class			male			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainm
YOY	0.50	1.79		0.50	1.79		E = Crabs Entraine
1+	0.50	102.58		0.50	102.58		M = Post-Entrainmen
2+	0.50	0.00		0.50	0.00		S = Natural Survivo
3+	0.50	0.00		0.50	0.00		AEL = Adult Equiva
All		104.37			104.37		VAR(AEL) =AEL V

ument Rate (crabs/cy)
nned (number of Crabs)
nned (number of Number of

Age Class Distribution

Age Class	% of Total			
Age Class	of Entrained	of AEL		
YOY	50.44	0.00		
1+	49.56	98.28		
2+	0.00	0.00		
3+	0.00	0.00		

	Proportion of Total AEL			
Age Class	Male	Female		
YOY	0.0086	0.0086		
1+	0.4914	0.4914		
2+	0.0000	0.0000		
3+	0.0000	0.0000		
ALI	0.50	0.50		

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	0.81		0.50	0.81	
1+	0.50	46.16		0.50	46.16	
2+	0.50	0.00		0.50	0.00	
3+	0.50	0.00		0.50	0.00	
All		46.97			46.97	
					93.933	

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			
Age Class	of Entrained	of AEL at 3+		
YOY	50.44	1.72		
1+	49.56	98.28		
2+	0.00	0.00		
3+	0.00	0.00		

	Proportion of Total AEL at 3+			
Age Class	Male	Female		
YOY	0.0086	0.0086		
1+	0.4914	0.4914		
2+	0.0000	0.0000		
3+	0.0000	0.0000		
ALI	0.50	0.50		

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

1.9599

TOTAL AEL at 24	with Confidence L
AEL at 2+	208.7
Var(AEL2+)	
SE AEL	

TOTAL AEL at 3-	with Confidence Limits
AEL at 3+	93.9
Var(AEL3+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

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+	47.0
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

AEL at 3+	47.0
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

FEMALE AEL at 3+ with Confidence Limits

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

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

у	Lost to Fishery		Male Age 3+
	(number of	Harvest Rate	(number of
	crab)	(proportion)	crab)
.9 Har	32.9	0.70	47.0

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

Loss to Fishery with Confidence Limits

Loss to Fishery	32.9
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Upper Sands crab entrainment da
		Post		
		Construction		
		Maintenance, 43		
Projected	Flavel Bar	ft Yr 1	500000	

VOLUME OF DREDGED MATERIALS - Maintenance 43' Yr 1

Γ	Volu	ime to be Dredged	(cy)	
ı	River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 2002
Γ	4 to 9	Desdemona	60000	
П	10 to 13	Flavel Bar	500000	
ſ	14 to 17	Upper Sands	100000	
	18 to 20	Tongue Point	330000	
_	T - t - 1		000000	

Dredged Yardage (cy)

500000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class

Age Class		Total	Proportion			
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.5*	0.5*	* Sample sizes low; assumed to be 1:1
1+	0	1	1	0.5*	0.5*	* Sample sizes low; assumed to be 1:1
2+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:1
3+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:1

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.01036	5178.1		0.10	0.017	8.54		3.84	
1+	0.01018	5088.1		0.60	0.160	488.46		219.80	
2+	0.00000	0.0		0.86	0.649	0.00		0.00	
3+	0.00000	0.0		0.86	2.222	0.00		0.00	
ΔII		10266.2				497.00		223 65	

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	4.27		0.50	4.27	
1+	0.50	244.23		0.50	244.23	
2+	0.50	0.00		0.50	0.00	
3+	0.50	0.00		0.50	0.00	
All		248,50			248.50	

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

Age Class Distribution

	Age Class	% of Total		
		of Entrained	of AEL	
	YOY	50.44	0.00	
	1+	49.56	98.28	
	2+	0.00	0.00	
	3+	0.00	0.00	

	Proportion of Total AEL			
Age Class	Male	Female		
YOY	0.0086	0.0086		
1+	0.4914	0.4914		
2+	0.0000	0.0000		
3+	0.0000	0.0000		
ALL	0.50	0.50		

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			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	1.92		0.50	1.92	
1+	0.50	109.90		0.50	109.90	
2+	0.50	0.00		0.50	0.00	
3+	0.50	0.00		0.50	0.00	
All		111.82			111.82	
					223,650	

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		
Age Class	of Entrained	of AEL at 3+	
YOY	50.44	1.72	
1+	49.56	98.28	
2+	0.00	0.00	
3+	0.00	0.00	

	Proportion of Total AEL at 3+		
Age Class	Male	Female	
YOY	0.0086	0.0086	
1+	0.4914	0.4914	
2+	0.0000	0.0000	
3+	0.0000	0.0000	
ALL	0.50	0.50	

111.8

SUMMARY VARIANCE DATA

E	10266.2
Var(E)	
SE E	
Z at 0.975	1.95996
95% C. I.	
CV E (%)	

TOTAL AEL at 2+ with Confidence Limits AEL at 2+ Var(AEL2+) SE AEL Z at 0.975 95% C. I. CV AEL (%)

TOTAL AEL at 3+ with Confidence Limits

SE = Standard Error Z = Value of Z from Normal Distribution MALE AEL at 3+ with Confidence Limits

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

FEMALE AEL at 3+ with Confidence Limits

AEL at 3+	111.8
Var(AEL)	
SE AEL	

AEL at 3+	111.8
Var(AEL)	
SE AEL	
Z at 0.975	1.9599
95% C. I.	
CV AEL (%)	

1.9599

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

Male Age 3+		Lost to Fishery	ĺ
(number of	Harvest Rate	(number of	
crab)	(proportion)	crab)	
111.8	0.70	78.3	Han

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

Loss to Fishery with Confidence Limits

Loss to Fishery	78.3
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Upper Sands crab entrainment data
		Post		
		Construction		
		Maintenance, 43		
Projected	Flavel Bar	ft Yr 20	210000	

VOLUME OF DREDGED MATERIALS - Maintenance 43' Yr 20

ı	Volu	ime to be Dredged		
River Mile Location Name Volume (cy)		Data from Portland District (10 Sept 200		
ı	4 to 9	Desdemona	40000	
ı	10 to 13	Flavel Bar	210000	
ı	14 to 17	Upper Sands	100000	
ı	18 to 20	Tongue Point	330000	
	T + 1		600000	

Dredged Yardage (cy)

210000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class

Age Class Total		Prop	ortion			
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.
1+	0	1	1	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.
2+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.
3+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.01036	2174.8		0.10	0.017	3.59		1.61	
1+	0.01018	2137.0		0.60	0.160	205.15		92.32	
2+	0.00000	0.0		0.86	0.649	0.00		0.00	
3+	0.00000	0.0		0.86	2.222	0.00		0.00	
All		4311.8				208.74		93.93	
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	
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	1.79		0.50	1.79	
1+	0.50	102.58		0.50	102.58	
2+	0.50	0.00		0.50	0.00	
3+	0.50	0.00		0.50	0.00	
All		104.37			104.37	

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

Age Class Distribution

Age Class	% of Total			
Age Class	of Entrained	of AEL		
YOY	50.44	0.00		
1+	49.56	98.28		
2+	0.00	0.00		
3+	0.00	0.00		

	Proportion of Total AEL		
Age Class	Male	Female	
YOY	0.0086		
1+	0.4914	0.4914	
2+	0.0000	0.0000	
3+	0.0000	0.0000	
ALL	0.50	0.50	

AGE 3+ Calculations

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

1	Age Class	Female			Male		
	Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
Г	YOY	0.50	0.81		0.50	0.81	
Г	1+	0.50	46.16		0.50	46.16	
Г	2+	0.50	0.00		0.50	0.00	
	3+	0.50	0.00		0.50	0.00	
	All		46.97			46.97	
						93.933	

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		
Age Class	of Entrained	of AEL at 3+	
YOY	50.44	1.72	
1+	49.56	98.28	
2+	0.00	0.00	
3+	0.00	0.00	

	Proportion of Total AEL at 3+		
Age Class	Male	Female	
YOY	0.0086	0.0086	
1+	0.4914	0.4914	
2+	0.0000	0.0000	
3+	0.0000	0.0000	
ALL	0.50	0.50	

SUMMARY VARIANCE DATA

1.9599

AEL at 2+	208.7
Var(AEL2+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

AEL at 3+	93.9
Var(AEL3+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

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

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

FEMALE AEL at 3+ with Confidence Limits

MALE AEL at 3+ with Confidence Limits

AEL at 3+	47.0
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

AEL at 3+	47.0
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

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

Male Age 3+		Lost to Fishery	
(number of	Harvest Rate	(number of	
crab)	(proportion)	crab)	
47.0	0.70	32.9	H

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

Loss to Fishery with Confidence Limits

Loss to Fishery	32.9
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Summary of Projected Entrainment, Adult Equivalent Loss, and Loss to Fishery. Lower Columbia River WH Pearson and GD Williams

Variance Estimators (derived from Sept 2002 field sampling)

	CV %	
E	70.70	Z at 0.975
AEL	98.30	
1.5	08.30	

Construction Dredging to 40 ft - Age 2+

Assumptions:	
Projected Location	Upper Sands
Planned dredged volume (cv)	154.087

Results:			
	Projected		
Parameter	Value	SE	95% CI
E	3,164	2,237	4,384
AEL	153	151	295
AEL Male	77	75	148
AEL Female	77	75	148
Loss to Fishery	24	24	46

1.95996

Construction Dredging to 40 ft - Age 3+
Assumptions:

Projected Location	Upper Sands
Planned dredged volume (cy)	154,087

	Projected		
Parameter	Value	SE	95% CI
E	3,164	2,237	4,384
AEL	69	68	133
AEL Male	34	34	66
AEL Female	34	34	66
Loss to Fishery	24	24	46

Construction Dredging from 40 to 43 ft - Age 2+

Assumptions:	
Projected Location	Upper Sands
Planned dredged volume (cv)	858.622

Results:

	Projected		
Parameter	Value	SE	95% CI
E	17,630	12,464	24,429
AEL	853	839	1,644
AEL Male	427	419	822
AEL Female	427	419	822
Loss to Fishery	134	132	259

Construction Dredging from 40 to 43 ft - Age 3+

Assumptions:	
Projected Location	Upper Sands
Planned dredged volume (cy)	858,622

Results:

	Projected		
Parameter	Value	SE	95% CI
E	17,630	12,464	24,429
AEL	384	378	740
AEL Male	192	189	370
AEL Female	192	189	370
Loss to Fishery	134	132	259

Annual Maintenance Dredging 40' Year 1 - Age 2+
Assumptions:

Projected Location	Upper Sands
Planned dredged volume (cy)	50,000

Results:

	Projected		
Parameter	Value	SE	95% CI
E	1,027	726	1,423
AEL	50	49	96
AEL Male	25	24	48
AEL Female	25	24	48
Loss to Fishery	8	8	15

Annual Maintenance Dredging 40' Year 1 - Age 3+

Assumptions.	
Projected Location	Upper Sands
Planned dredged volume (cy)	50,000

Results:

D	Projected Value	0.5	95% CI
Parameter	value	SE	95% CI
E	1,027	726	1,423
AEL	22	22	43
AEL Male	11	11	22
AEL Female	11	11	22
Loss to Fishery	8	8	15

Annual Maintenance Dredging 40' Year 20 - Age 2+

Assumptions:	
Projected Location	Upper Sands
Planned dredged volume (cy)	50,000

Parameter	Projected Value	SE	95% CI
E	1,027	726	1,423
AEL	50	49	96
AEL Male	25	24	48
AEL Female	25	24	48
Loss to Fishery	8	8	15

Annual Maintenance Dredging 40' Year 20 - Age 3+

Assumptions:	
Projected Location	Upper Sands
Planned dredged volume (cy)	50,000

Parameter	Projected Value	SE	95% CI
E	1,027	726	1,423
AEL	22	22	43
AEL Male	11	11	22
AEL Female	11	11	22
Loss to Fishery	8	8	15

Annual Maintenance Dredging 43' Year 1 - Age 2+

Projected Location	Upper Sands
Planned dredged volume (cv)	100.000

Results:

	Projected		
Parameter	Value	SE	95% CI
E	2,053	1,452	2,845
AEL	99	98	192
AEL Male	50	49	96
AEL Female	50	49	96
Loss to Fishery	16	15	30

Annual Maintenance Dredging 43' Year 1 - Age 3+

Addunptions.	
Projected Location	Upper Sands
Planned dredged volume (cy)	100,000

Results:

Parameter	Projected Value	SE	95% CI
E	2,053	1,452	2,845
AEL	45	44	86
AEL Male	22	22	43
AEL Female	22	22	43
Loss to Fishery	16	15	30

Annual Maintenance Dredging 43' Year 20 - Age 2+
Assumptions:

Projected Location
Planned dredged volume (cy)

Results:

	Projected		
Parameter	Value	SE	95% CI
E	2,053	1,452	2,845
AEL	99	98	192
AEL Male	50	49	96
AEL Female	50	49	96
Loss to Fishery	16	15	30

Annual Maintenance Dredging 43' Year 20 - Age 3+
Assumptions:

7100umptiono.	
Projected Location	Upper Sands
Planned dredged volume (cy)	100,000

Results:			
	Projected		
Parameter	Value	SE	95% CI
E	2,053	1,452	2,845
AEL	45	44	86
AEL Male	22	22	43
AEL Female	22	22	43
Loss to Fishery	16	15	30

Field Date	Field Location	Projection	Total Volume Dredged (cy)
		Construction Dredging to 40	
Projected	Upper Sands	ft	154087

VOLUME OF DREDGED MATERIALS - to 40 ft

Vol	ume to be Dredged	(cy)	
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 2002)
4	Lower Desdem.	222412	_
5		353916	
6	Upper Desdem	0	
7		0	
8		8742	
9		8742	
10	Flavel Bar	49732	
11		298900	
12		121292	
13		72425	
14	Upper Sands	54585	
15		51945	
16		47557	
17		0	
18	Tongue Point	14775	
19		6976	
20		13283	
Total		1325282	

Dredged Yardage (cy)

154087 Amount (cy) dredged during dredging period

Sex Ratios by Age Class

Age Class	Total			Total Proportion				
Age Class	Male	Female	Sexed	Male	Female			
YOY	1	0	1	0.5*		 Sample sizes low; assumed to b 		
1+	0	1	1	0.5*	0.5*	 Sample sizes low; assumed to b 		
2+	0	0	0	0.5*	0.5*	 Sample sizes low; assumed to b 		
3+	0	0	0	0.5*	0.5*	 Sample sizes low; assumed to b 		

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

	Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
Г	YOY	0.01036			0.10	0.017	2.63		1.18	
Г	1+	0.01018	1568.0		0.60	0.160	150.53		67.74	
Г	2+	0.00000	0.0		0.86	0.649	0.00		0.00	
Г	3+	0.00000	0.0		0.86	2.222	0.00		0.00	
Г	All		3163.8				153.16		68.92	

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			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	1.32		0.50	1.32		E = Crabs Entrained (number of Crabs)
1+	0.50	75.26		0.50	75.26		M = Post-Entrainment Mortality (proportion)
2+	0.50	0.00		0.50	0.00		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	0.00		0.50	0.00		AEL = Adult Equivalent Loss
All		70.50			70.50		MADIAEL Verience

Age Class Distribution

Age Class	% of	Total	
Age Class	of Entrained	of AEL	
YOY	50.44	0.00	
1+	49.56	98.28	
2+	0.00	0.00	
3+	0.00	0.00	

	Proportion of Total AEL					
Age Class	Male	Female				
YOY	0.0086					
1+	0.4914	0.4914				
2+	0.0000	0.0000				
3+	0.0000	0.0000				
ALL	0.50	0.50				

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			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.59		0.50	0.59		E = Crabs Entrained (number of Crabs)
1+	0.50	33.87		0.50	33.87		M = Post-Entrainment Mortality (proportion)
2+	0.50	0.00		0.50	0.00		S = Natural Survivorship (proportion); survi
3+	0.50	0.00		0.50	0.00		AEL = Adult Equivalent Loss
All		34.46			34.46		VAR(AEL) =AEL Variance
					68.923		_

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL at 3+			
YOY	50.44	1.7			
1+	49.56	98.2			
2+	0.00	0.0			
3+	0.00	0.0			

	Proportion of Total AEL at 3+				
Age Class	Male	Female			
YOY	0.0086	0.0086			
1+	0.4914	0.4914			
2+	0.0000	0.0000			
3+	0.0000	0.0000			

SUMMARY VARIANCE DATA Entrainment with Co-ff

ainment with Con	fidence Limits	TOTAL AEL at 2	+ with Confidence
E	3163.8	AEL at 2+	153.2
Var(E)		Var(AEL2+)	
SEE		SE AEL	
Z at 0.975	1.95996	Z at 0.975	1.95996
95% C. I.		95% C. I.	
CV E (%)		CV AEL (%)	

TOTAL AEL at 3+ with Confidence		
AEL at 3+	68.9	
Var(AEL3+)		
SE AEL		
Z at 0.975	1.95996	
95% C. I.		
CV AEL (%)		

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

MALE AEL at 3+ with Confidence Limits

AEL at 3+	34.5
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV/ AFL (0/)	

AEL at 3+	34.5
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

Male Age 3+		Lost to Fishery
(number of	Harvest Rate	(number of
crab)	(proportion)	crab)
34.5	0.70	24.1

Loss to Fishery with Confidence Limits

-	
Loss to Fishery	24.1
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	

ADDITIONAL NOTES:
Mortality Rates (M) for crabs collected in June-September are from Armstrong et al. 1987 (Table 3.3, p. 61)
Survival rates (5) to age 2+ for cnab collected from June-September are from Warnwright et al. 1992 (Table 6, p. 178), and
Thereafter survival rate from 2+ to age 3+ is 0.45 (Armstrong et al. 1997).
Sec ratios used were those observed or assumed to be 11-where sample size was low.

rival to 3+ is assumed to be 45% (Armstrong et al. 1987)

Field Date	Field Location	Projection	Total Volume Dredged (cy)
		Construction Dredging from	
Projected	Upper Sands	40 to 43 ft	858622

VOLUME OF DREDGED MATERIALS - from 40 to 43 ft

Volu	ime to be Dredged	(cy)	
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 2002
4	Lower Desdem.	94688	
5		196724	
6	Upper Desdem	66193	
7		1039	
8		52398	
9		62851	
10	Flavel Bar	329296	
11		535074	
12		239608	
13		65743	
14	Upper Sands	171432	
15		271842	
16		306717	
17		108631	
18	Tongue Point	174113	
19		162864	
20		127219	
Total		2966432	

Dredged Yardage (cy)

858622 Amount (cy) dredged during dredging period

Sex Ratios by Age Class

Age Class	Total			Propo	rtion	
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.5*		 Sample sizes low; assumed to be
1+	0	1	1	0.5*	0.5*	 Sample sizes low; assumed to be
2+	0	0	0	0.5*	0.5*	 Sample sizes low; assumed to be
3+	0	0	0	0.5*	0.5*	 Sample sizes low; assumed to be

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.01036	8892.1		0.10		14.67		6.60	
1+	0.01018	8737.5		0.60	0.160	838.80		377.46	
2+	0.00000	0.0		0.86	0.649	0.00		0.00	
3+	0.00000	0.0		0.86	2.222	0.00		0.00	
All		17629.6				853.47		384.06	
						Note: Entrained	3+ crab are bac	k-calculated to p	rovide 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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	7.34		0.50	7.34		E = Crabs Entrained (number of Crabs)
1+	0.50	419.40		0.50	419.40		M = Post-Entrainment Mortality (proportion)
2+	0.50	0.00		0.50	0.00		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	0.00		0.50	0.00		AEL = Adult Equivalent Loss
All		400 70			400 70		VAR(AEL) - AEL Variance

Age Class Distribution

Age Class	% of Total	
Age Class	of Entrained	of AEL
YOY	50.44	0.00
1+	49.56	98.28
2+	0.00	0.00
3+	0.00	0.00

	Proportion of Total AEL		
Age Class	Male	Female	
YOY	0.0086	0.0086	
1+	0.4914	0.4914	
2+	0.0000	0.0000	
3+	0.0000	0.0000	

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		remaie		Maie		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	3.30		0.50	3.30	
1+	0.50	188.73		0.50	188.73	
2+	0.50	0.00		0.50	0.00	
3+	0.50	0.00		0.50	0.00	
All		192.03			192.03	

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

Age Class Distribution

Age Class	% of Total	
Age Class	of Entrained	of AEL at 3+
YOY	50.44	1.72
1+	49.56	98.2
2+	0.00	0.00
3+	0.00	0.00

	Proportion of Total AEL at 3+		
Age Class	Male	Female	
YOY	0.0086		
1+	0.4914	0.4914	
2+	0.0000		
3+	0.0000	0.000	
ALL	0.50	0.50	

SUMMARY VARIANCE DATA Entrainment with Confidence

nfidence Limits	TOTAL AEL at 2+	with Confidence
17629.6	AEL at 2+	853.5
	Var(AEL2+)	
	SE AEL	
1.95996	Z at 0.975	1.95996
	95% C. I.	

TOTAL ALL BUS	· with confidence
AEL at 3+	384.1
Var(AEL3+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AFL (%)	

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+	192.0
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (9/)	

3+ with Confidence L
192.0

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

nı	nis total would be distributed over 3-4 years)						
	Male Age 3+ Lost to Fishery (number of Harvest Rate (number of						
	crab)	(proportion)	crab)				

192.0 0.70 134.4 Harvest rate of 0.70 is taken from Armstrong et al. (1987).

Loss to Fishery with Confidence Limits

Loss to Fishery	134.4
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

ADDITIONAL NOTES:
Mortality Rates (M) for crabs collected in June-September are from Armstrong et al. 1987 (Table 3.3, p. 61)
Savive Intels (5) to age 2+ for crab collected from June-September are from Warnwright et al. 1992 (Table 6, p. 176), and
Sex ratios used were those observed or assumed to be 1-1 where sample size was low.

Field Date	Field Location	Projection	Total Volume Dredged (cy)
		Post	
		Construction	
		Maintenance, 40	
Projected	Upper Sands	ft Yr 1	50000

VOLUME OF DREDGED MATERIALS - Maintenance 40' Yr 1

Volt	ime to be Dredged	(cy)	
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 2002
4 to 9	Desdemona	40,000	
10 to 13	Flavel Bar		
14 to 17	Upper Sands	50000	
18 to 20	Tongue Point	270000	
Total		760000	

Dredged Yardage (cy)

50000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class

Age Class	Total			Prop	ortion	
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.
1+	0	1	1	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.
2+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.
3+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.

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

Age Class	R	E	Var(E)	М	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.01036	517.8		0.10	0.017	0.85		0.38	
1+	0.01018	508.8		0.60	0.160	48.85		21.98	
2+	0.00000	0.0		0.86	0.649	0.00		0.00	
3+	0.00000	0.0		0.86	2.222	0.00		0.00	
All		1026.6				49.70		22.36	
	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	
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	0.43		0.50	0.43	
1+	0.50	24.42		0.50	24.42	
2+	0.50	0.00		0.50	0.00	
3+	0.50	0.00		0.50	0.00	
All		24.85			24.85	

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

Age Class Distribution

A Class	% of	Total
Age Class	of Entrained	of AEL
YOY	50.44	0.00
1+	49.56	98.2
2+	0.00	0.00
3+	0.00	0.00
	YOY 1+ 2+ 3+	YOY 50.44 1+ 49.56

	Proportion of Total AEL				
Age Class	Male	Female			
YOY	0.0086	0.0086			
1+	0.4914	0.4914			
2+	0.0000	0.0000			
3+	0.0000	0.0000			
ALI	0.50	0.50			

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	0.19		0.50	0.19	
1+	0.50	10.99		0.50	10.99	
2+	0.50	0.00		0.50	0.00	
3+	0.50	0.00		0.50	0.00	
All		11.18			11.18	
					22.365	

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				
Age class	of Entrained	of AEL at 3+			
YOY	50.44	1.72			
1+	49.56	98.28			
2+	0.00	0.00			
3+	0.00	0.00			

	Proportion of Total AEL at 3+			
Age Class	Male	Female		
YOY	0.0086	0.0086		
1+	0.4914	0.4914		
2+	0.0000	0.0000		
3+	0.0000	0.0000		
ALL	0.50	0.50		

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

E		1026.6
Var(E)		
SE E		
Z at 0.975		1.95996
95% C. I.		
CV E (%)		

TOTAL AEL at 2+ with Confidence Limits

1.9599

TOTAL AEL at 34	with Confidence Limits
AEL at 3+	22.4
Var(AEL3+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

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

AEL at 2+ Var(AEL2+) SE AEL Z at 0.975 95% C. I. CV AEL (%)

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

MALE AEL at 3+ with Confidence Limits

AEL at 3+	11.2
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

I LINALL ALL UI	. with confidence E
AEL at 3+	11.2
Var(AFI)	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

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

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

Loss to Fishery with Confidence Limits

Loss to Fishery	7.8
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)
		Post	
		Construction	
		Maintenance, 40	
Projected	Upper Sands	ft Yr 20	50000

VOLUME OF DREDGED MATERIALS - Maintenance 40' Yr 20

Volu	ame to be Dredged		
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 2002
4 to 9	Desdemona		
10 to 13	Flavel Bar		
14 to 17	Upper Sands	50000	
18 to 20	Tongue Point	270000	
Total		570000	

Dredged Yardage (cy)

50000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class

Age Class		Total		Propo	ortion	
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.
1+	0	1	1	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.
2+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.
3+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)	
YOY	0.01036	517.8		0.10	0.017	0.85		0.38		
1+	0.01018	508.8		0.60	0.160	48.85		21.98		
2+	0.00000	0.0		0.86	0.649	0.00		0.00		
3+	0.00000	0.0		0.86	2.222	0.00		0.00		
All		1026.6				49.70		22.36		
	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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	0.43		0.50	0.43	
1+	0.50	24.42		0.50	24.42	
2+	0.50	0.00		0.50	0.00	
3+	0.50	0.00		0.50	0.00	
ΔII		04.05			04.05	

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

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL			
YOY	50.44	0.00			
1+	49.56	98.28			
2+	0.00	0.00			
3+	0.00	0.00			

	Proportion	of Total AEL
Age Class	Male	Female
YOY	0.0086	0.0086
1+	0.4914	0.4914
2+	0.0000	0.0000
3+	0.0000	0.0000
ALL	0.50	0.50

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			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	
YOY	0.50	0.19		0.50	0.19		
1+	0.50	10.99		0.50	10.99		
2+	0.50	0.00		0.50	0.00		
3+	0.50	0.00		0.50	0.00		
All		11.18			11.18		
					22.365		

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

Ago Class	% of	Total
Age Class YOY	of Entrained	of AEL at 3+
YOY	50.44	1.72
1+	49.56	98.28
2+	0.00	0.00
3+	0.00	0.00

	Proportion of Total AEL at 3+			
Age Class	Male	Female		
YOY	0.0086	0.0086		
1+	0.4914	0.4914		
2+	0.0000	0.0000		
3+	0.0000	0.0000		
ALL	0.50	0.50		

SUMMARY VARIANCE DATA

E	1026.6
Var(E)	
SE E	
Z at 0.975	1.95996
95% C. I.	
CV F (%)	

TOTAL AEL at 2+ with Confidence Limits

TOTAL AEL at 3+ with Confidence Limits 1.9599 CV AEL (%

SE = Standard Error Z = Value of Z from Normal Distribution C.I. = Confidence Interval CV = Coefficient of Variation in %

AEL at 2+ Var(AEL2+) SE AEL Z at 0.975 95% C. I.

CV AEL (%)

MALE AEL at 3+ with Confidence Limits

AEL at 3+	11.2
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

FEMALE AEL	at 3+ with	Confidence	Limits

1.9599

AEL at 3+	11.2
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

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

11.2 0.70

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

Loss to Fishery with Confidence Limits

Loss to Fishery	7.8
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)
		Post	
		Construction	
		Maintenance, 43	
Projected	Upper Sands	ft Yr 1	100000

VOLUME OF DREDGED MATERIALS - Maintenance 43' Yr 1

Γ	Volt	ime to be Dredged		
Ī	River Mile	Location Name	Volume (cy)	Data from Portland District (10 Se
Γ	4 to 9	Desdemona	60000	
	10 to 13	Flavel Bar	500000	
	14 to 17	Upper Sands	100000	
	18 to 20	Tongue Point	330000	
	Total		990000	='

Dredged Yardage (cy)

100000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class

Age Class	Total			Prop	ortion	
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.5*	0.5*	* Sample sizes low; assumed to b
1+	0	1	1	0.5*	0.5*	* Sample sizes low; assumed to b
2+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to b
3+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to b

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

Age Class	R	E	Var(E)	М	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.01036	1035.6		0.10	0.017	1.71		0.77	
1+	0.01018	1017.6		0.60	0.160	97.69		43.96	
2+	0.00000	0.0		0.86	0.649	0.00		0.00	
3+	0.00000	0.0		0.86	2.222	0.00		0.00	
All		2053.2				99.40		44.73	
	Note: Entrained 3+ crab are back-calculated to provide AEL at 2								

- Calculations						vote. Entra
	Equivalent Loss (AE	1 at 2+) and Var	iance (AFI at 2+	by Soy (MAI F/FF	MALE) and Are C	lace
oution to Addit	Equivalent 2000 (A2	e at 2-, and van	iunoc (ALL ut 2	, by oux (mineral c	.m.z.e., una zige o	
Age Class		Female			Male	
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEI
YOY	0.50	0.85		0.50	0.85	
1+	0.50	48.85		0.50	48.85	
2+	0.50	0.00		0.50	0.00	
3+	0.50	0.00		0.50	0.00	

R = Crab Entrainment Rate (crabs/cy)
E = Crabs Entrained (number of Crabs)
M = Post-Entrained (number of Crabs)
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

Ago Class	% of Total		
Age Class	of Entrained	of AEL	
YOY	50.44	0.00	
1+	49.56	98.2	
2+	0.00	0.00	
3+	0.00	0.00	
	YOY 1+ 2+ 3+	YOY 50.44 1+ 49.56	

	Proportion of Total AEL		
Age Class	Male Female		
YOY	0.0086	0.0086	
1+	0.4914	0.4914	
2+	0.0000	0.0000	
3+	0.0000	0.0000	
ALL	0.50	0.50	

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	0.38		0.50	0.38	
1+	0.50	21.98		0.50	21.98	
2+	0.50	0.00		0.50	0.00	
3+	0.50	0.00		0.50	0.00	
All		22.36			22.36	
					44,730	

R = Crab Entrainment Rate (crabs/cy)
E = Crabs Entrainment (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	% of Total		
Age Class	of Entrained	of AEL at 3+		
YOY	50.44	1.72		
1+	49.56	98.28		
2+	0.00	0.00		
3+	0.00	0.00		

	Proportion of	Total AEL at 3+
Age Class	Male	Female
YOY	0.0086	0.0086
1+	0.4914	0.4914
2+	0.0000	0.0000
3+	0.0000	0.0000
ALL	0.50	0.50

SUMMARY VARIANCE DATA

1.9599

TOTAL AEL at 2+ with Confidence Limits

1.9599

TOTAL AEL at 3	with Confidence	Limits
AEL at 3+	44.7	
Var(AEL3+)		
SE AEL		
Z at 0.975	1.95996	
95% C. I.		
CV AEL (%)		

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

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

AEL at 2+ Var(AEL2+) SE AEL Z at 0.975 95% C. I.

MALE AEL at 3+ with Confidence Limits

AEL at 3+	22.4
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

FEMALE AEL at 3	8+ with	Confidence	Lim
AEL at 3+		22.4	

1.9599

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

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

ale Age 3+		Lost to Fishery		
number of	Harvest Rate	(number of		
crab)	(proportion)	crab)		
22.4	0.70	15.7	Harvest rate of 0.70 is taken from Armstrong et al.	11

Loss to Fishery with Confidence Limits

Loss to Fishery	15.7
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)
		Post	
		Construction	
		Maintenance, 43	
Projected	Upper Sands	ft Yr 20	100000

VOLUME OF DREDGED MATERIALS - Maintenance 43' Yr 20

Volu	ime to be Dredged		
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 2
4 to 9	Desdemona	40000	
10 to 13	Flavel Bar	210000	
14 to 17	Upper Sands	100000	
18 to 20	Tongue Point	330000	
Total		680000	-

Dredged Yardage (cy)

100000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class

Age Class Male		Total	Total		Proportion		
		Female	Sexed	Male	Female		
YOY	1	0	1	0.5*	0.5*	* Sample sizes low	
1+	0	1	1	0.5*	0.5*	* Sample sizes low	
2+	0	0	0	0.5*	0.5*	* Sample sizes low	
3+	0	0	0	0.5*	0.5*	* Sample sizes low	

v; assumed to be 1:1. v; assumed to be 1:1. v; assumed to be 1:1. v; assumed to be 1:1.

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.01036	1035.6		0.10	0.017	1.71		0.77	
1+	0.01018	1017.6		0.60	0.160	97.69		43.96	
2+	0.00000	0.0		0.86	0.649	0.00		0.00	
3+	0.00000	0.0		0.86	2.222	0.00		0.00	
All		2053.2				99.40		44.73	
Note: Entrained 3+ crab are back-calculated to provide AEL at 2+.									

Calaulatiana					r	Note: Entra
E Calculations	Equivalent Loss (AE	1 at 2+) and Var	ance (AFI at 2+	by Soy (MALE/FE	MALE) and Age C	lace
ration to readit	Equivalent 2000 (A2	e at 2-, and van	unce (ALL ut 2	, by oux (mineral c	mace, and ago o	
Age Class		Female			Male	
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL
YOY	0.50	0.85		0.50	0.85	
1+	0.50	48.85		0.50	48.85	
2+	0.50	0.00		0.50	0.00	
3+	0.50	0.00		0.50	0.00	

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

Age Class Distribution

Age Class	% of Total			
Age Class	of Entrained	of AEL		
YOY	50.44	0.00		
1+	49.56	98.28		
2+	0.00	0.00		
3+	0.00	0.00		

	Proportion of Total AEL			
Age Class	Male	Female		
YOY	0.0086	0.0086		
1+	0.4914	0.4914		
2+	0.0000	0.0000		
3+	0.0000	0.0000		
ALL	0.50	0.50		

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	
YOY	0.50	0.38		0.50	0.38		
1+	0.50	21.98		0.50	21.98		
2+	0.50	0.00		0.50	0.00		
3+	0.50	0.00		0.50	0.00		
ΔII		22 36			22 36		

R = Crab Entrainment Rate (crabs/cy)
E = Crabs Entrainment (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			
Age Class	of Entrained	of AEL at 3+		
YOY	50.44	1.72		
1+	49.56	98.28		
2+	0.00	0.00		
3+	0.00	0.00		

	Proportion of Total AEL at 3+			
Age Class	Male	Female		
YOY	0.0086	0.0086		
1+	0.4914	0.4914		
2+	0.0000	0.0000		
3+	0.0000	0.0000		
ALL	0.50	0.50		

SUMMARY VARIANCE DATA

1.9599

TOTAL AEL at 2+ with Confidence Limits AEL at 2+ Var(AEL2+) SE AEL Z at 0.975 95% C. I. 1.9599

TOTAL AEL at 3+ with Confidence Limits				
AEL at 3+	44.7			
Var(AEL3+)				
SE AEL				
Z at 0.975	1.95996			
95% C. I.				
CV AEL (%)				

95% C. I. CV AEL (%)

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

MALE AEL at 3+ with Confidence Limits

CV =	Coefficient of Variation	in

FEMALE AEL at 3+ with Confidence Limits

AEL at 3+	22.4
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

AEL at 3+	22.4
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

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

Male Age 3+		Lost to Fishery	
(number of	Harvest Rate	(number of	
crab)	(proportion)	crab)	
22.4	0.70	15.7	Harvest rate of 0.70 is taken from Armstrong et a

Loss to Fishery with Confidence Limits

Loss to Fishery	15.7
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Summary of Projected Entrainment, Adult Equivalent Loss, and Loss to Fishery. Lower Columbia River WH Pearson and GD Williams

Variance Estimators (derived from Sept 2002 field sampling at Upper Sands)

	CV %		
E	70.70	Z at 0.975	1.95996
AEL	98.30		
I.F.	98.30		

Construction	Dredging	to 40 ft -	Age 2+

Assumptions:	
Projected Location	Tongue Pt
Dianned dredged volume (cv)	35 034

Results:			
Parameter	Projected Value	SE	95% CI
E	719	509	997
AEL	35	34	67
AEL Male	17	17	34
AEL Female	17	17	34
Loss to Fishery	5	5	11

Construction Dredging to 40 ft - Age 3+

Assumptions.	
Projected Location	Tongue Pt
Planned dredged volume (cy)	35,034

	Projected		
Parameter	Value	SE	95% CI
E	719	509	997
AEL	16	15	30
AEL Male	8	8	15
AEL Female	8	8	15
Loss to Fishery	5	5	11

Construction Dredging from 40 to 43 ft - Age 2+ Assumptions:

ssumptions:	
rojected Location	Т

Projected Location	Tongue Pt
Planned dredged volume (cy)	464,196

Results:

	Projected		
Parameter	Value	SE	95% CI
E	9,531	6,738	13,207
AEL	461	454	889
AEL Male	231	227	444
AEL Female	231	227	444
Loss to Fishery	73	71	140

Construction Dredging from 40 to 43 ft - Age 3+

Assumptions.	
Projected Location	Tongue Pt
Planned dredged volume (cy)	464,196

Results:

	Projected		
Parameter	Value	SE	95% CI
E	9,531	6,738	13,207
AEL	208	204	400
AEL Male	104	102	200
AEL Female	104	102	200
Loss to Fishery	73	71	140

Annual Maintenance Dredging 40' Year 1 - Age 2+ Assumptions:

Projected Location	Tongue Pt
Planned dredged volume (cy)	270,000

Results:

Parameter	Projected Value	SE	95% CI
E	5,544	3,919	7,682
AEL	268	264	517
AEL Male	134	132	259
AEL Female	134	132	259
Loss to Fishery	42	42	81

Annual Maintenance Dredging 40' Year 1 - Age 3+ Assumptions:

Projected Location	Tongue Pt
Planned dredged volume (cy)	270,000

Results:

Parameter	Projected Value	SE	95% CI
E	5,544	3,919	7,682
AEL	121	119	233
AEL Male	60	59	116
AEL Female	60	59	116
Loss to Fishery	42	42	81

Annual Maintenance Dredging 40' Year 20 - Age 2+ Assumptions:

Projected Location	Tongue Pt
Planned dredged volume (cy)	270,000

Parameter	Projected Value	SE	95% CI
E	5,544	3,919	7,682
AEL	268	264	517
AEL Male	134	132	259
AEL Female	134	132	259
Loss to Fishery	42	42	81

Annual Maintenance Dredging 40' Year 20 - Age 3+

Assumptions.	
Projected Location	Tongue Pt
Planned dredged volume (cv)	270.000

Parameter	Projected Value	SE	95% CI
E	5,544	3,919	7,682
AEL	121	119	233
AEL Male	60	59	116
AEL Female	60	59	116
Loss to Fishery	42	42	81

Annual Maintenance Dredging 43' Year 1 - Age 2+ Assumptions:

Projected Location	Tongue Pt
	000 000

Results:

	Projected		
Parameter	Value	SE	95% CI
E	6,776	4,790	9,389
AEL	328	322	632
AEL Male	164	161	316
AEL Female	164	161	316
Loss to Fishery	52	51	100

Annual Maintenance Dredging 43' Year 1 - Age 3+ Assumptions:

Projected Location	Tongue Pt
Discussed decidered continues (e.c.)	220.00

Projected Location	Tongue Pt
Planned dredged volume (cy)	330,000

Results:

	Projected		
Parameter	Value	SE	95% CI
E	6,776	4,790	9,389
AEL	148	145	284
AEL Male	74	73	142
AEL Female	74	73	142
Loss to Fishery	52	51	100

Annual Maintenance Dredging 43' Year 20 - Age 2+ Assumptions:

Projected Location	Tongue Pt
Planned dredged volume (cy)	330,000

Results:

	Projected		
Parameter	Value	SE	95% CI
E	6,776	4,790	9,389
AEL	328	322	632
AEL Male	164	161	316
AEL Female	164	161	316
Loss to Fishery	52	51	100

Annual Maintenance Dredging 43' Year 20 - Age 3+ Assumptions:

7 too ampaono.	
Projected Location	Tongue Pt
Planned dredged volume (cy)	330,000

Results:							
	Projected						
Parameter	Value	SE	95% CI				
E	6,776	4,790	9,389				
AEL	148	145	284				
AEL Male	74	73	142				
AEL Female	74	73	142				
Loss to Fishery	52	51	100				

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Upper Sands crab entrainment data
		Construction		
		Dredging to 40		
Projected	Tongue Pt		35034	

VOLUME OF DREDGED MATERIALS - to 40 ft

Volu	ime to be Dredged	(cy)	
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 200)
4	Lower Desdem.	222412	
5		353916	
6	Upper Desdem	0	
7		0	
8		8742	
9		8742	
10	Flavel Bar	49732	
11		298900	
12		121292	
13		72425	
14	Upper Sands	54585	
15		51945	
16		47557	
17		0	
18	Tongue Point	14775	
19		6976	
20		13283	
Total		1325282	

Dredged Yardage (cy)

35034 Amount (cy) dredged during dredging period

Sex Ratios by Age Class

ı	Age Class	Total		Total Proportion	rtion		
ı	Age Class	Male	Female	Sexed	Male	Female	
ı	YOY	1	0	1	0.5*		 Sample sizes low; assumed to be 1:1.
ı	1+	0	1	1	0.5*	0.5*	 Sample sizes low; assumed to be 1:1.
ı	2+	0	0	0	0.5*		 Sample sizes low; assumed to be 1:1.
[3+	0	0	0	0.5*	0.5*	 Sample sizes low; assumed to be 1:1.

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.01036			0.10	0.017	0.60		0.27	
1+	0.01018	356.5		0.60	0.160	34.23		15.40	
2+	0.00000	0.0		0.86	0.649	0.00		0.00	
3+	0.00000	0.0		0.86	2.222	0.00		0.00	
All		719.3				34.82		15.67	

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	0.30		0.50	0.30		E = Crabs Entrained (number of Crabs)
1+	0.50	17.11		0.50	17.11		M = Post-Entrainment Mortality (proportion)
2+	0.50	0.00		0.50	0.00		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	0.00		0.50	0.00		AEL = Adult Equivalent Loss
All		17.41			17.41		VAR(AEL) =AEL Variance
						0.00	7

Age Class Distribution

	Age Class	% of Total			
Α,	Age class	of Entrained	of AEL		
	YOY	50.44	0.00		
	1+	49.56	98.28		
	2+	0.00	0.00		
	3+	0.00	0.00		

	Proportion of Total AEL				
Age Class	Male	Female			
YOY	0.0086				
1+	0.4914	0.4914			
2+	0.0000	0.0000			
3+	0.0000	0.0000			
ALL	0.50	0.50			

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						
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Er
YOY	0.50	0.13		0.50	0.13		E = Crabs E
1+	0.50	7.70		0.50	7.70		M = Post-Ent
2+	0.50	0.00		0.50	0.00		S = Natural
3+	0.50	0.00		0.50	0.00		AEL = Adult
All		7.84			7.84		VAR(AEL) =

val to 3+ is assumed to be 45% (Armstrong et al. 1987)

Age Class Distribution

1	Age Class	% of Total			
	Age class	of Entrained	of AEL at 3+		
	YOY	50.44	1.73		
	1+	49.56	98.2		
	2+	0.00	0.0		
	3+	0.00	0.0		

	Proportion of Total AEL at 3+				
Age Class	Male	Female			
YOY	0.0086				
1+	0.4914	0.4914			
2+	0.0000				
3+	0.0000	0.0000			
ALL	0.50	0.50			

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

TOTAL AEL at 2+	with Confiden
AEL at 2+	34.
Var(AEL2+)	
SE AEL	
Z at 0.975	1.9599
OFFI C I	

TOTAL ALL at 3	· with confidence i
AEL at 3+	15.7
Var(AEL3+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AFL (%)	

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

MALE AEL at 3+ with Confidence Limits

AEL at 3+	7.8
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	

PEMALE AEL 81 3	+ with Confider
AEL at 3+	7.8
Var(AEL)	0.0
SE AEL	0.0
Z at 0.975	1.95996
95% C. I.	0.0
CV AEL (%)	0.00

TOTAL LOSS TO MALE FISHERY

(number of Harvest Rate (number of	his t	is total would be distributed over 3-4 years)							
			Harvest Rate (proportion)	Lost to Fishery (number of crah)					

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

Loss to Fishery with Confidence Limits

Loss to Fishery	5.5
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Upper Sands crab entrainment data
		Construction		
		Dredging from		
Projected	Tongue Pt	40 to 43 ft	464196	

VOLUME OF DREDGED MATERIALS - from 40 to 43 ft

	ime to be Dredged		
River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 2002)
4	Lower Desdem.	94688	-
5		196724	
6	Upper Desdem	66193	
7		1039	
8		52398	
9		62851	
10	Flavel Bar	329296	
11		535074	
12		239608	
13		65743	
14	Upper Sands	171432	
15		271842	
16		306717	
17		108631	
18	Tongue Point	174113	
19		162864	
20		127219	
Total		2966432	

Dredged Yardage (cy)

464196 Amount (cy) dredged during dredging period

Sex Ratios by Age Class

Age Class	Total			Propo	rtion	
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.5*	0.5*	* Sample sizes low; assumed to be
1+	0	1	1	0.5*	0.5*	* Sample sizes low; assumed to be
2+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be
3+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be

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

- [Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
ı	YOY	0.01036			0.10	0.017	7.93		3.57	
ı	1+	0.01018	4723.7		0.60	0.160	453.48		204.07	
ı	2+	0.00000	0.0		0.86	0.649	0.00		0.00	
ı	3+	0.00000	0.0		0.86	2.222	0.00		0.00	
ı	All		9531.1				461.41		207.63	

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			
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	3.97		0.50	3.97		E = Crabs Entrained (number of Crabs)
1+	0.50	226.74		0.50	226.74		M = Post-Entrainment Mortality (proportion)
2+	0.50	0.00		0.50	0.00		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	0.00		0.50	0.00		AEL = Adult Equivalent Loss
All		230.70			230.70		VAR(AEL) =AEL Variance

Age Class Distribution

Age Class	% of Total				
Age class	of Entrained	of AEL			
YOY	50.44	0.00			
1+	49.56	98.28			
2+	0.00	0.00			
3+	0.00	0.00			

	Proportion of Total AEL					
Age Class	Male	Female				
YOY	0.0086	0.0086				
1+	0.4914	0.4914				
2+	0.0000	0.0000				
3+	0.0000	0.0000				
ALL	0.50	0.50				

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

	Male			Female			Age Class
R = Crab Entra	VAR(AEL)	AEL	Proportion	VAR(AEL)	AEL	Proportion	Age Class
E = Crabs Enti		1.78	0.50		1.78	0.50	YOY
M = Post-Entrai		102.03	0.50		102.03	0.50	1+
S = Natural Su		0.00	0.50		0.00	0.50	2+
AEL = Adult E		0.00	0.50		0.00	0.50	3+
VAR(AEL) =AE		103.82			103.82		All

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL at 3+			
YOY	50.44	1.72			
1+	49.56	98.28			
2+	0.00	0.00			
3+	0.00	0.00			

	Proportion of I	Otal AEL at 37
Age Class	Male	Female
YOY	0.0086	
1+	0.4914	0.4914
2+	0.0000	
3+	0.0000	0.0000
ALL	0.50	0.50

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

it with Confidence Limits					
	9531.1				
		1			
75	1.95996				

TOTAL AE	L at 2+	with	Confidence	Limits
TOTAL AE	L at 24	with	Confidence	Limit

ience Limits	TOTAL AEL at 3+ with Confider			
61.4	AEL at 3+	207		
	Var(AEL3+)			
	SE AEL			
996	Z at 0.975	1.9599		
	95% C. I.			
	CV AEL (%)			

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

MALE AEL at 3+ with Confidence Limits

AEL at 3+	103.8
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

AEL at 3+		103.8
Var(AEL)		
SE AEL		
Z at 0.975		1.95996
95% C. I.		
CV AFL (%)		

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

Male Age 3+		Lost to Fishery
(number of	Harvest Rate	(number of
crab)	(proportion)	crab)
102.0	0.70	70.7

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

Loss to Fishery with Confidence Limits

Loss to Fishery	72.7
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

ADDITIONAL NOTES:
Mortality Rates (M) for crabs collected in June-September are from Armstrong et al. 1987 (Table 3.3, p. 61)
Savival rates (5) to age 2+ for crab collected from June-September are from Warnwright et al. 1992 (Table 6, p. 176), and
Securities autwind rate from 2+ to age 2+ is 0.45 (Americang et al. 1997).

When the control used were those observed or essemble to be 11-th where sample size was low.

ral to 3+ is assumed to be 45% (Armstrong et al. 1987)

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Upper Sands crab entrainment da
		Post		
		Construction		
		Maintenance, 40		
Projected	Tongue Pt	ft Yr 1	270000	

VOLUME OF DREDGED MATERIALS - Maintenance 40' Yr 1

Г	Volu	ime to be Dredged		
	River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 2002)
	4 to 9	Desdemona	40,000	
	10 to 13	Flavel Bar	400000	
	14 to 17	Upper Sands	50000	
	18 to 20	Tongue Point	270000	
	Total		760000	

Dredged Yardage (cy)

270000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class

Age Class	Total		Prop			
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.5*	0.5*	* Sample sizes low;
1+	0	1	1	0.5*	0.5*	* Sample sizes low;
2+	0	0	0	0.5*	0.5*	* Sample sizes low;
3+	0	0	0	0.5*	0.5*	* Sample sizes low;

assumed to be 1:1. assumed to be 1:1. assumed to be 1:1. assumed to be 1:1.

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

Age Class	R	E	Var(E)	М	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.01036	2796.2		0.10	0.017	4.61		2.08	
1+	0.01018	2747.6		0.60	0.160	263.77		118.69	
2+	0.00000	0.0		0.86	0.649	0.00		0.00	
3+	0.00000	0.0		0.86	2.222	0.00		0.00	
All		5543.7				268.38		120.77	
	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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	2.31		0.50	2.31	
1+	0.50	131.88		0.50	131.88	
2+	0.50	0.00		0.50	0.00	
3+	0.50	0.00		0.50	0.00	
All		134.19			134.19	

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

Or AR(AEL) = AEL Variance

Age Class Distribution

Age Class	% of Total			
Age Class	of Entrained	of AEL		
YOY	50.44	0.00		
1+	49.56	98.28		
2+	0.00	0.00		
3+	0.00	0.00		

	Proportion of Total AEL		
Age Class	Male	Female	
YOY	0.0086	0.0086	
1+	0.4914	0.4914	
2+	0.0000	0.0000	
3+	0.0000	0.0000	
ALL	0.50	0.50	

AGE 3+ Calculations

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

Ago Class	Age Class		Female		Male		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	
YOY	0.50	1.04		0.50	1.04		
1+	0.50	59.35		0.50	59.35		
2+	0.50	0.00		0.50	0.00		
3+	0.50	0.00		0.50	0.00		
All		60.39	•		60.39		
					120,771		

R = Crab Entrainment Rate (crabs/cy)
E = Crabs Entrained (number of Crabs)
M = Post-Entrained (number of Crabs)
3 = 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	50.44	1.72	
1+	49.56	98.28	
2+	0.00	0.00	
3+	0.00	0.00	

	Proportion of Total AEL at 3+		
Age Class	Male	Female	
YOY	0.0086	0.0086	
1+	0.4914	0.4914	
2+	0.0000	0.0000	
3+	0.0000	0.0000	
ALL	0.50	0.50	

SUMMARY VARIANCE DATA

E	5543.7
Var(E)	
SE E	
Z at 0.975	1.95996
95% C. I.	
OV E (0/)	

TOTAL AEL at 2+ with Confidence Limits

TOTAL AEL at 3+ with Confidence Limits		
AEL at 3+	120.8	
Var(AEL3+)		
SE AEL		
Z at 0.975	1.95996	
95% C. I.		
CV AEL (%)		

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

AEL at 2+ Var(AEL2+) SE AEL Z at 0.975 95% C. I.

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

MALE AEL at 3+ with Confidence Limits 1.9599

1.9599

AEL at 3+	60.4
Var(AEL)	0.0
SE AEL	0.0
Z at 0.975	1.95996
95% C. I.	0.0
CV AEL (%)	0.00

TOTAL LOSS TO MALE FISHERY
(This total would be distributed over 3-4 years)

Male Age 3+		Lost to Fishery	
(number of	Harvest Rate	(number of	
crab)	(proportion)	crab)	
60.4	0.70	42.3	Harvest rate of 0.

0.70 is taken from Armstrong et al. (1987).

Loss to Fishery with Confidence Limits

Loss to Fishery	42.3
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Upper Sands crab entrainment da
		Post		
		Construction		
		Maintenance, 40		
Projected	Tongue Pt	ft Yr 20	270000	

VOLUME OF DREDGED MATERIALS - Maintenance 40' Yr 20

Г	Volu	ime to be Dredged	(cy)	
	River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 200
	4 to 9	Desdemona		
	10 to 13	Flavel Bar	210000	
	14 to 17	Upper Sands	50000	
	18 to 20	Tongue Point	270000	
	Total		570000	•

Dredged Yardage (cy)

270000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class

ſ	Age Class	Total			Prop	ortion	
ı	Age Class	Male	Female	Sexed	Male	Female	
Γ	YOY	1	0	1	0.5*	0.5*	* Sample sizes low; assumed to b
Г	1+	0	1	1	0.5*	0.5*	* Sample sizes low; assumed to b
ı	2+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to b
Г	3+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to b

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.01036	2796.2		0.10	0.017	4.61		2.08	
1+	0.01018	2747.6		0.60	0.160	263.77		118.69	
2+	0.00000	0.0		0.86	0.649	0.00		0.00	
3+	0.00000	0.0		0.86	2.222	0.00		0.00	
All		5543.7				268.38		120.77	

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

г			Female			Male		Ţ
	Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
ŀ	YOY	0.50	2.31		0.50			E = Crabs Entrained (number of Crabs)
ı	1+	0.50	131.88		0.50	131.88		M = Post-Entrainment Mortality (proportion)
ı	2+	0.50	0.00		0.50	0.00		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
	3+	0.50	0.00		0.50	0.00		AEL = Adult Equivalent Loss
	All		134.19			134.19		VAR(AEL) =AEL Variance

Age Class Distribution

Age Class		% of Total				
Age Class	0	f Entrained	of AEL			
YOY		50.44	0.00			
1+		49.56	98.28			
2+		0.00	0.00			
3+		0.00	0.00			

	Proportion of Total AEL				
Age Class	Male	Female			
YOY	0.0086	0.0086			
1+	0.4914	0.4914			
2+	0.0000	0.0000			
3+	0.0000	0.0000			
ALL	0.50	0.50			

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			ĺ	
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	1.04		0.50	1.04	
1+	0.50	59.35		0.50	59.35	
2+	0.50	0.00		0.50	0.00	
3+	0.50	0.00		0.50	0.00	
All		60.39			60.39	
					120,771	

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 Los

VAR(AEL) =AEL Variance

Age Class Distribution

Age Class	% of Total				
Age Class	of Entrained	of AEL at 3+			
YOY	50.44	1.72			
1+	49.56	98.28			
2+	0.00	0.00			
3+	0.00	0.00			

	Proportion of Total AEL at 3+				
Age Class	Male	Female			
YOY	0.0086	0.0086			
1+	0.4914	0.4914			
2+	0.0000	0.0000			
3+	0.0000	0.0000			
ALL	0.50	0.50			

SUMMARY VARIANCE DATA

E	5543.7
Var(E)	
SE E	
Z at 0.975	1.95996
95% C. I.	
CV E (%)	

TOTAL AEL at 2+ with Confidence Limits AEL at 2+ Var(AEL2+) SE AEL Z at 0.975 95% C. I. CV AEL (%)

TOTAL AEL at 34	with Confidence Limits
AEL at 3+	120.8
Var(AEL3+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

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

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

MALE AEL at 3+ with Confidence Limits						
AEL at 3+	60.4					
Var(AEL)						
SE AEL						
Z at 0.975	1.95996					
95% C. I.						
CV AEL (%)						

AEL at 3+	60.4
Var(AEL)	0.0
SE AEL	0.0
Z at 0.975	1.95996
95% C. I.	0.0
CV AEL (%)	0.00

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

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

Male Age 3+		Lost to Fishery	
(number of	Harvest Rate	(number of	
crab)	(proportion)	crab)	
60.4	0.70	42.3	H

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

Loss to Fishery with Confidence Limits

Loss to Fishery	42.3
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Upper Sands crab entrainment da
		Post		
		Construction		
		Maintenance, 43		
Projected	Tongue Pt	ft Yr 1	330000	

VOLUME OF DREDGED MATERIALS - Maintenance 43' Yr 1

Г	Volu	ime to be Dredged		
ı	River Mile	Location Name	Volume (cy)	Data from Portland District (10 Sept 200
	4 to 9	Desdemona	60000	
L	10 to 13	Flavel Bar		
- 1	14 to 17	Upper Sands	100000	
	18 to 20	Tongue Point	330000	
	Total		990000	-

330000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class

Age Class	Total Proportion			ortion		
Age Class	Male Female Sexed		Male	Female		
YOY	1	0	1	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.
1+	0	1	1	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.
2+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.
3+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)	
YOY	0.01036	3417.6		0.10	0.017	5.64		2.54		
1+	0.01018	3358.1		0.60	0.160	322.38		145.07		
2+	0.00000	0.0		0.86	0.649	0.00		0.00		
3+	0.00000	0.0		0.86	2.222	0.00		0.00		
All		6775.7				328.02		147.61		
	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

	Female			Male			
Age Class	Proportion AEL VAR(AEL)		Proportion	AEL	VAR(AEL)	R = 0	
YOY	0.50	2.82		0.50	2.82		E = 0
1+	0.50	161.19		0.50	161.19		M = P
2+	0.50	0.00		0.50	0.00		S = N
3+	0.50	0.00		0.50	0.00		AEL :
All		164.01			164.01		VAR(

Crab Entrainment Rate (crabs/cy)
Crabs Entrained (number of Crabs)
Crabs Entrained (number of Crabs)
Author (Sease-Entrainment Moratilly (proportion))
Altural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
- Adult Equivalent Loss
(AEL.) = AEL Variance

Age Class Distribution

Age Class	% of Total			
Age Class	of Entrained	of AEL		
YOY	50.44	0.00		
1+	49.56	98.28		
2+	0.00	0.00		
3+	0.00	0.00		

	Proportion of Total AEL						
Age Class	Male	Female					
YOY	0.0086	0.0086					
1+	0.4914	0.4914					
2+	0.0000	0.0000					
3+	0.0000	0.0000					
ALI	0.50	0.50					

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	1.27		0.50	1.27	
1+	0.50	72.54		0.50	72.54	
2+	0.50	0.00		0.50	0.00	
3+	0.50	0.00		0.50	0.00	
All		73.80			73.80	
					147.609	

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				
Age Class	of Entrained	of AEL at 3+			
YOY	50.44	1.72			
1+	49.56	98.28			
2+	0.00	0.00			
3+	0.00	0.00			

	Proportion of Total AEL at 3+				
Age Class	Male	Female			
YOY	0.0086	0.0086			
1+	0.4914	0.4914			
2+	0.0000	0.0000			
3+	0.0000	0.0000			
ALL	0.50	0.50			

SUMMARY VARIANCE DATA

1.9599

AEL at 2+ Var(AEL2+) SE AEL Z at 0.975 95% C. I. CV AEL (%)

AEL at 3+	147.6
Var(AEL3+)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AFL (%)	

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+	73.8
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

FEMALE AEL at	3+ with Confidence Limits
AEL at 3+	73.8
Var(AEL)	0.0
SE AEL	0.0
Z at 0.975	1.95996
95% C. I.	0.0
CV AEL (%)	0.00

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

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

(number of	Harvest Rate	(number of	
crab)	(proportion)	crab)	
73.8	0.70	51.7	Harvest rate of 0.70 is taken from Armstrong et al. (1987).

Loss to Fishery with Confidence Limits

Loss to Fishery	51.7
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	

Field Date	Field Location	Projection	Total Volume Dredged (cy)	**Based on Upper Sands crab entrainment dat
		Post		
		Construction		
		Maintenance, 43		
Projected	Tongue Pt	ft Yr 20	330000	

VOLUME OF DREDGED MATERIALS - Maintenance 43' Yr 20

	(cy)	Volum		
Data from Portland District (10 Sept 20	Volume (cy)	Location Name	River Mile	
	40000	Desdemona	4 to 9	
	210000	Flavel Bar	10 to 13	
	100000	Upper Sands	14 to 17	
	330000	Tongue Point	18 to 20	

Dredged Yardage (cy)

330000 Amount (cy) dredged during dredging period

Sex Ratios by Age Class

Age Class		Total		Propo	ortion	
Age Class	Male	Female	Sexed	Male	Female	
YOY	1	0	1	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.
1+	0	1	1	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.
2+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.
3+	0	0	0	0.5*	0.5*	* Sample sizes low; assumed to be 1:1.

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

Age Class	R	E	Var(E)	M	S to 2+	AEL at 2+	VAR(AEL 2+)	AEL at 3+	VAR(AEL 3+)
YOY	0.01036	3417.6		0.10	0.017	5.64		2.54	
1+	0.01018	3358.1		0.60	0.160	322.38		145.07	
2+	0.00000	0.0		0.86	0.649	0.00		0.00	
3+	0.00000	0.0		0.86	2.222	0.00		0.00	
All		6775.7				328.02		147.61	

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)	R = Crab Entrainment Rate (crabs/cy)
YOY	0.50	2.82		0.50	2.82		E = Crabs Entrained (number of Crabs)
1+	0.50	161.19		0.50	161.19		M = Post-Entrainment Mortality (proportion)
2+	0.50	0.00		0.50	0.00		S = Natural Survivorship (proportion); survival to 3+ is assumed to be 45% (Armstrong et al. 1987)
3+	0.50	0.00		0.50	0.00		AEL = Adult Equivalent Loss
All		164.01			164.01		VAR(AEL) =AEL Variance

Age Class Distribution

Age Class	% of Total			
Age Class	of Entrained	of AEL		
YOY	50.44	0.00		
1+	49.56	98.28		
2+	0.00	0.00		
3+	0.00	0.00		

	Proportion of Total AEL		
Age Class	Male	Female	
YOY	0.0086	0.0086	
1+	0.4914	0.4914	
2+	0.0000	0.0000	
3+	0.0000	0.0000	
ALL	0.50	0.50	

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		
Age Class	Proportion	AEL	VAR(AEL)	Proportion	AEL	VAR(AEL)
YOY	0.50	1.27		0.50	1.27	
1+	0.50	72.54		0.50	72.54	
2+	0.50	0.00		0.50	0.00	
3+	0.50	0.00		0.50	0.00	
All		73.80			73.80	
					147.609	

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

Age Class Distribution

Age Class	% of Total			
Age Class	of Entrained	of AEL at 3+		
YOY	50.44	1.72		
1+	49.56	98.28		
2+	0.00	0.00		
3+	0.00	0.00		

	Proportion of Total AEL at 3+			
Age Class	Male	Female		
YOY	0.0086	0.0086		
1+	0.4914	0.4914		
2+	0.0000	0.0000		
3+	0.0000	0.0000		
ALL	0.50	0.50		

SUMMARY VARIANCE DATA Entrainment with Confidence Limits

E	6775.7
Var(E)	
SE E	
Z at 0.975	1.95996
95% C. I.	
CV F (%)	

TOTAL AEL at 2+ with Confidence Limits AEL at 2+ Var(AEL2+) SE AEL Z at 0.975 95% C. I. CV AEL (%) 1.9599

TOTAL AEL at 3-	+ with Confidence Limit	s
AEL at 3+	147.6	
Var(AEL3+)		
SE AEL		
Z at 0.975	1.95996	
95% C. I.		
CV AEL (%)		

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

SE = Standard Error Z = Value of Z from Normal Distribution MALE AEL at 3+ with Confidence Limits

AEL at 3+	73.8
Var(AEL)	
SE AEL	
Z at 0.975	1.95996
95% C. I.	
CV AEL (%)	

EMALE	AEL	at 3+	with	Confidence	Limit

73.8
0.0
0.0
1.95996
0.0
0.00

TOTAL LOSS TO MALE FISHERY (This total would be distributed over 3-4 years)

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

73.8		,	Harvest rate of 0.70 is taken from Armstrong et al. (1987).
(number of crab)	(proportion)	(number of crab)	
Wale Age 3+		LUST TO FISHERY	

Loss to Fishery with Confidence Limits

Loss to Fishery	51.7
Var(AEL)	
SE LF	
Z at 0.975	1.95996
95% C. I.	
CV LF (%)	