

Appendix B2: Sea scallop discard estimates.

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Discard estimates for Atlantic sea scallop (*Placopecten magellanicus*) were calculated using the method described with the Standardized Bycatch Reporting Methodology (SBRM) (Wigley et al. 2007). This approach differs from that used in the previous assessment for this stock.

This paper presents updated sea scallop discard estimates for nine fleets, followed by a comparison of these values with the estimates presented at the previous assessment as part of the SAW 45 (NEFSC 2007).

Methods

Estimates of Atlantic sea scallop discards (mt meats) were derived for nine fleets: Georges Bank open and closed scallop dredge, and Mid-Atlantic Bight open and closed scallop dredge for the 1994 to 2009 time period, and Mid-Atlantic Bight scallop trawl, Georges Bank and Mid-Atlantic Bight small-mesh otter trawl, and Georges Bank and Mid-Atlantic Bight large-mesh otter trawl for the 1989 to 2008 time period.

In the scallop dredge analysis, observer and Vessel Trip Report (VTR) trips were partitioned into fleets using four classification variables: calendar quarter, gear type, area fished, and access area. In the scallop trawl and otter trawl analysis, observer and dealer trips were partitioned into fleets using the following four classification variables: calendar quarter, gear type, area fished, and mesh. Trips were not partitioned by trip category ('limited' versus 'general', for scallop dredge and scallop trawl) due to small sample size over the time series. Calendar quarter was based on landed date and used to capture seasonal variations in fishing activity. Gear type was based on Northeast gear codes (scallop dredge: negear 132; scallop trawl: negear 052; otter trawl: negear 050). Trips for which gear was unknown were excluded. Two broad geographical regions are defined for area fished based on statistical area: areas 520-562 constituted the Georges Bank (GBK) area, and areas 600 and above constituted the Mid-Atlantic Bight (MAB) area. For scallop dredge, two access area categories were used: 'open' and 'closed', where 'closed' includes all trips fishing in one of the scallop access areas (Closed Area I, Closed Area II and Nantucket Lightship in the GBK region; Hudson Canyon, Virginia Beach, Elephant Trunk, and Delmarva in the MAB region). Observer trips were assigned to the access area category based on program code, and VTR trips were assigned based on latitude and longitude. Finally, two mesh size groups were formed for otter trawl: small (mesh less than 5.5 inches) and large (5.5 inch mesh and greater).

Discards were estimated using a combined d/k_{all} ratio estimator (Cochran 1963), where d is discarded pounds of sea scallops and k_{all} is kept pounds of all species, calculated from Northeast Fishery Observer Program (NEFOP) data. Discard weight was derived by multiplying the d/k_{all} ratio of each fleet by the corresponding VTR or commercial landings (Wigley et al. 2007). Coefficients of variation (CV) were calculated as the ratio of the standard error of the discards divided by the discards.

In cases where limited observer data were available (i.e. two or less observed trips in a calendar quarter), an imputation approach was used to 'fill in' the missing (or incomplete) information using data from adjoining strata. In this imputation procedure, the temporal stratification (i.e., calendar quarter) was relaxed to entire year, recognizing that seasonal variations may occur that will thus not be accounted for. Numbers of annual observed trips by fleet are summarized in Table 1.

Comparison with previous discard estimates

Estimates of Atlantic sea scallop discards presented at SAW 45 were calculated for trips stratified by target species using the ratio of pounds of scallops caught for every pound of the target species landed (NEFSC 2007). Because of the different estimation method and stratification scheme, a direct comparison between these estimates and the current discard estimates was not possible.

To perform a more general comparison, sea scallop discard estimates from SAW 45 and current estimates were separated into two groups: estimated discards from trips using scallop gear (scallop dredge and scallop trawl), and estimated discards from trips using otter trawl gear. In the first group, scallop gear discard estimates from SAW 45 included the total 'estimated discards on directed scallop trips' (NEFSC 2007) for 1992-2006, which are assumed to be discards from trips that used mostly scallop dredge and scallop trawl gear. Scallop gear discard estimates from the current assessment included the sum of scallop dredge discard estimates across areas for the period 1994-2003, and the sum of scallop dredge and scallop trawl discard estimates across areas and gear types for the time period 2004-2006. For the second group, otter trawl discard estimates from SAW 45 included the total 'estimated discards in non-scallop otter trawl fisheries' (NEFSC 2007) for 1994-2006. Otter trawl discard estimates from the current assessment included the sum of otter trawl discard estimates across areas and mesh sizes for the period 1994-2006. For each group, a plot of SAW 45 sea scallop discard estimates and current estimates over time were produced. In addition, a third plot containing the sum of the SAW 45 estimates and the sum of current estimates described above was produced for illustrative purposes.

Discard to landings

To evaluate the proportion of estimated sea scallop discards to landings, the sum of the current discard estimates for scallop dredge was compared to the sum of estimated landings from Georges Bank, Southern New England, and Mid-Atlantic Bight (SAW 50) for the 1994 to 2009 time period.

Results and Discussion

Annual Atlantic sea scallop discard estimates by fleet are presented in Table 1 and Table 2. This analysis indicates that during the 1994 to 2008 time period, sea scallops were primarily discarded in the scallop dredge fleets with higher discarding in the 'open' category fleets. For 2008, estimated discards from the Mid-Atlantic Bight open and closed scallop dredge fleets were 201 and 52 mt meats, respectively. Estimated discards from the Georges Bank open and closed scallop dredge fleets were 214 and 96 mt meats, respectively. Discard estimates for the other five fleets for the same year ranged from less than 1 mt meats (Georges Bank small-mesh otter trawl) to 45 mt meats (Mid-Atlantic Bight large-mesh otter trawl).

The discard estimation presented here used a broad stratification approach. In addition, limitations are inherent in the use of VTR data for trip assignment to the 'access area' category because of missing or inaccurate position data. Consequently, these results should be considered as preliminary.

Comparison with previous discard estimates

Figure 1 shows updated sea scallop discard estimates compared with estimates presented at SAW 45. Accounting for missing estimates in some years (i.e. 2000, 2001), trends of discards are generally similar between the two sets of estimates. Values of discard estimates from trips using scallop gear are comparable between the two sets, while current estimate values from trips using otter

trawl gear are lower than those presented at SAW 45 in most years. Both sets of sea scallop discard estimates indicate that a majority of discarding occurred in trips using scallop gear for the 1994 to 2006 time period.

Figure 2 indicates that trends in SAW 45 and current estimates are similar and resemble those observed with estimated sea scallop discards from trips using scallop gear (Figure 1A). This was expected, given the relatively small magnitude of the estimated discards from trips using otter trawl gear (Figure 1B).

These results provide an approximate comparison of current sea scallop discard estimates with those presented at SAW 45 and should be considered with caution given the different approaches used to obtain each set of estimates, as well as the missing estimates in some years. In particular, Figure 2 is meant to provide a general perspective of sea scallop discard estimates over the 1994 to 2006 time period, and exact values should not be used to convey total scallop discarding.

Discard to landings

Current estimates of discards and landings from 1994 to 2009 are presented in Figure 3. Total catch (discards plus landings) averaged 6,739 mt meats between 1994 and 1998. Catch increased in the following six years to peak at 31,348 mt meats in 2004, and averaged 26,490 mt meats from 2005 to 2009. Discards generally represent a small portion of total catch, with discard-to-landing ratios ranging from 0.006 in 1997 to 0.099 in 2003.

These results represent estimated sea scallop discards and landings in weight (mt meats). It is likely that discard-to-landing ratios of numbers would be higher because of the different size distribution of discarded scallops compared to that of landed scallops.

Acknowledgements

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References

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Appendix B2-Table 1A. Number of observed trips, sea scallop discards (mt meats) and coefficient of variation (CV) by the GBK open scallop dredge and GBK closed scallop dredge fleets, 1994-2009. Discards were not estimated for the GBK open scallop dredge fleet in 2000 and 2001 due to small sample size.

GBK open scallop dredge				GBK closed scallop dredge			
YEAR	Trips	Discards (mt meats)	CV	YEAR	Trips	Discards (mt meats)	CV
1994*	7	1	0.78	1994	n/a		
1995*	6	43	0.58	1995	n/a		
1996	15	103	0.37	1996	n/a		
1997*	11	26	0.67	1997	n/a		
1998*	9	6	0.46	1998	n/a		
1999*	8	51	0.68	1999*	15	53	0.26
2000	2			2000	226	246	0.03
2001	2			2001	16	28	0.16
2002*	11	100	0.39	2002	n/a		
2003*	14	177	0.45	2003	n/a		
2004*	16	34	0.32	2004	30	25	0.19
2005	41	372	0.36	2005	66	40	0.27
2006*	56	796	0.16	2006	79	41	0.26
2007	53	193	0.30	2007	127	41	0.26
2008	73	201	0.23	2008	140	52	0.12
2009	58	265	0.33	2009	23	24	0.30

* Imputed data were used for discard estimation for these years.

n/a: not applicable

Appendix B2-Table 1B. Number of observed trips, sea scallop discards (mt meats) and coefficient of variation (CV) by the MAB open scallop dredge and MAB closed scallop dredge, 1994-2009. Discards were not estimated for the MAB open scallop dredge fleet in 2001 due to small sample size.

MAB open scallop dredge				MAB closed scallop dredge			
YEAR	Trips	Discards (mt meats)	CV	YEAR	Trips	Discards (mt meats)	CV
1994	16	276	0.59	1994		n/a	
1995*	20	341	0.28	1995		n/a	
1996	23	22	0.72	1996		n/a	
1997*	18	8	1.15	1997		n/a	
1998*	16	42	0.66	1998		n/a	
1999*	8	7	0.56	1999		n/a	
2000	28	749	0.33	2000		n/a	
2001	3			2001	85	301	0.09
2002*	13	1,446	0.19	2002	74	150	0.10
2003	62	2,206	0.14	2003	46	119	0.12
2004	143	1,856	0.13	2004	92	503	0.10
2005	166	367	0.29	2005	54	38	0.21
2006*	87	71	0.39	2006*	6	3	0.49
2007	85	66	0.40	2007	93	63	0.22
2008	89	214	0.54	2008	337	96	0.14
2009	118	549	0.16	2009	233	199	0.16

* Imputed data were used for discard estimation for these years.

n/a: not applicable

Appendix B2-Table 1C. Number of observed trips, sea scallop discards (mt meats) and coefficient of variation (CV) by the MAB scallop trawl fleet, 1989-2008. Discards were not estimated prior to 2004 due to small sample size.

MAB scallop trawl			
YEAR	Discards		CV
	Trips	(mt meats)	
1989			
1990			
1991			
1992			
1993			
1994			
1995			
1996			
1997			
1998			
1999			
2000			
2001	4		
2002	1		
2003			
2004*	44	99	0.25
2005	137	61	0.13
2006*	30	150	0.33
2007	34	15	0.58
2008*	38	7	0.61

* Imputed data were used for discard estimation for these years.

Appendix B2-Table 1D. Number of observed trips, sea scallop discards (mt meats) and coefficient of variation (CV) by the GBK small-mesh otter trawl, and MAB small-mesh otter trawl fleets, 1989-2008.

GBK small-mesh otter trawl				MAB small-mesh otter trawl			
YEAR	Trips	Discards (mt meats)	CV	YEAR	Trips	Discards (mt meats)	CV
1989	64	2	0.53	1989	34	213	0.39
1990	31	<1	1.22	1990	47	8	0.44
1991	68	<1	0.80	1991	78	11	2.05
1992	42	<1	0.69	1992	47	6	0.53
1993*	15	<1	0.79	1993*	7	14	1.12
1994*	10	23	0.80	1994*	11	41	1.03
1995*	10	<1	1.40	1995	63	71	0.23
1996*	11	0	0.00	1996	78	15	1.62
1997*	19	<1	0.88	1997*	49	1	2.83
1998*	5	<1	1.61	1998*	26	5	1.43
1999*	8	<1	2.62	1999	33	21	1.07
2000*	17	<1	0.49	2000	34	2	0.95
2001*	14	<1	0.64	2001	54	<1	8.88
2002*	33	<1	0.81	2002	32	68	0.34
2003	54	<1	1.10	2003	72	18	0.75
2004	107	2	0.99	2004	246	6	0.38
2005	191	<1	0.47	2005	166	4	0.33
2006	59	<1	0.55	2006	144	14	2.50
2007	62	<1	1.54	2007	216	5	0.55
2008	49	<1	0.48	2008	149	10	0.54

* Imputed data were used for discard estimation for these years.

Appendix B2-Table 1E. Number of observed trips, sea scallop discards (mt meats) and coefficient of variation (CV) by the GBK large-mesh otter trawl, and MAB large-mesh otter trawl fleets, 1989-2008. Discards were not estimated for MAB large-mesh otter trawl prior to 1992 due to small sample size.

GBK large-mesh otter trawl				MAB large-mesh otter trawl			
YEAR	Trips	Discards (mt meats)	CV	YEAR	Trips	Discards (mt meats)	CV
1989	27	1	0.88	1989	1		
1990	33	1	0.72	1990			
1991	34	4	0.54	1991	4		
1992	35	<1	1.10	1992*	14	4	0.40
1993*	22	3	0.60	1993*	7	0	0.00
1994	27	<1	1.24	1994*	13	230	0.57
1995	60	<1	0.42	1995	52	107	0.80
1996	33	<1	0.78	1996*	16	<1	0.57
1997*	21	<1	1.00	1997*	5	0	0.00
1998*	7	<1	0.67	1998*	13	3	1.79
1999*	11	<1	1.36	1999*	5	0	0.00
2000	26	<1	0.54	2000	27	9	1.54
2001	51	<1	0.45	2001*	44	10	1.02
2002	77	2	0.60	2002*	37	8	2.37
2003	161	3	0.76	2003*	11	42	0.92
2004	314	42	0.35	2004	91	19	0.32
2005	952	10	0.18	2005	87	2	0.80
2006	457	30	0.37	2006	63	16	0.72
2007	463	5	0.25	2007	160	13	0.54
2008	562	6	0.21	2008	127	45	1.02

* Imputed data were used for discard estimation for these years.

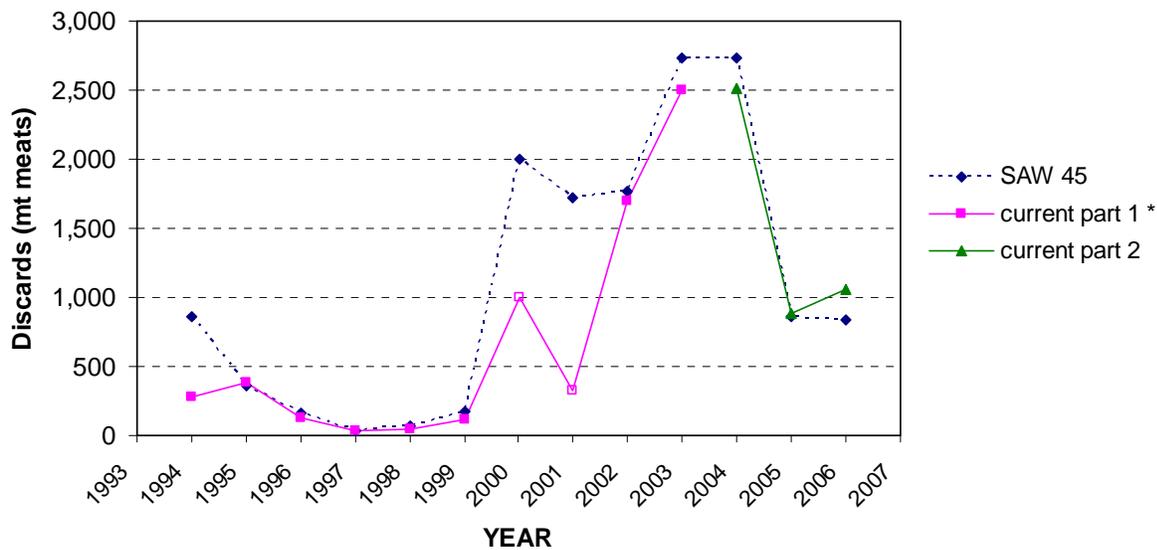
Appendix B2-Table 2. Summary of sea scallop discard estimates (mt meats) from Table 1 by region, 1994-2009.

Georges Bank (GBK)						Mid-Atlantic Bight (MAB)						
YEAR	open scallop dredge	closed scallop dredge	small-mesh otter trawl	large-mesh otter trawl	Total	YEAR	open scallop dredge	closed scallop dredge	scallop trawl	small-mesh otter trawl	large-mesh otter trawl	Total
1994	1	n/a	23	1	24	1994	276	n/a	*	41	230	547
1995	43	n/a	0	0	43	1995	341	n/a	*	71	107	519
1996	103	n/a	0	0	103	1996	22	n/a	*	15	1	38
1997	26	n/a	0	0	26	1997	8	n/a	*	1	0	9
1998	6	n/a	0	0	6	1998	42	n/a	*	5	3	50
1999	51	53	0	0	104	1999	7	n/a	*	21	0	28
2000	*	246	0	1	247	2000	749	n/a	*	2	9	760
2001	*	28	1	0	29	2001	*	301	*	1	10	312
2002	100	n/a	0	2	103	2002	1,446	150	*	68	8	1,673
2003	177	n/a	0	3	181	2003	2,206	119	*	18	42	2,386
2004	34	25	2	42	103	2004	1,856	503	99	6	19	2,482
2005	372	40	0	10	421	2005	367	38	61	4	2	473
2006	796	41	1	30	868	2006	71	3	150	14	16	254
2007	193	41	0	5	240	2007	66	63	15	5	13	162
2008	201	52	0	6	259	2008	214	96	7	10	45	372
2009	265	24	+	+	289	2009	549	199	+	+	+	748

* No discard estimate due to small sample size.

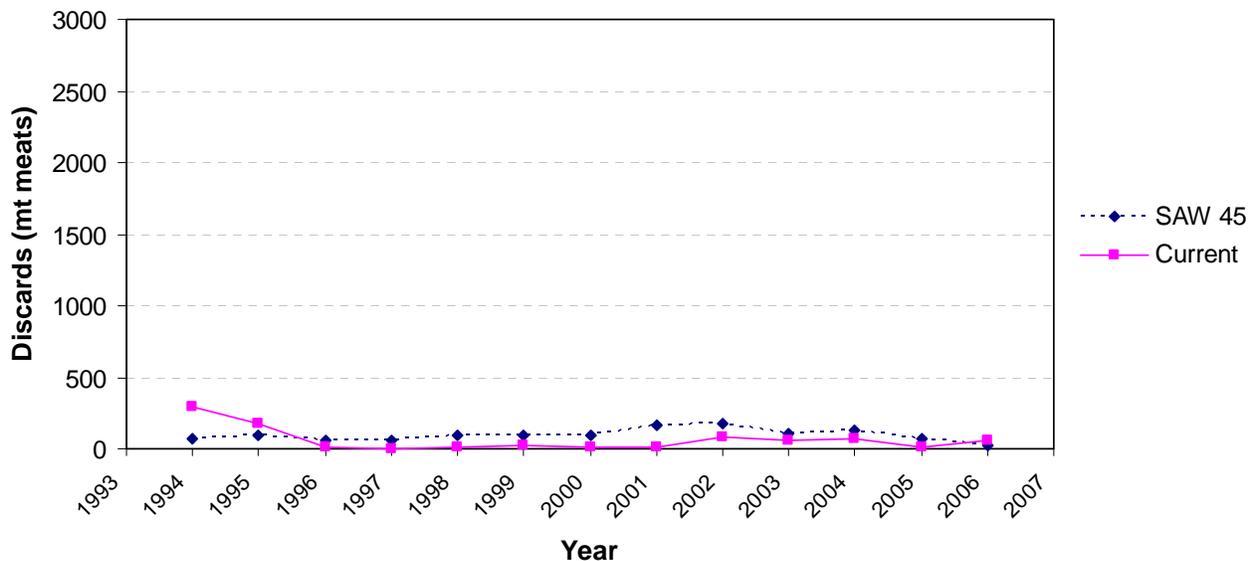
+ No discard estimate because 2009 data not yet available.

n/a: not applicable

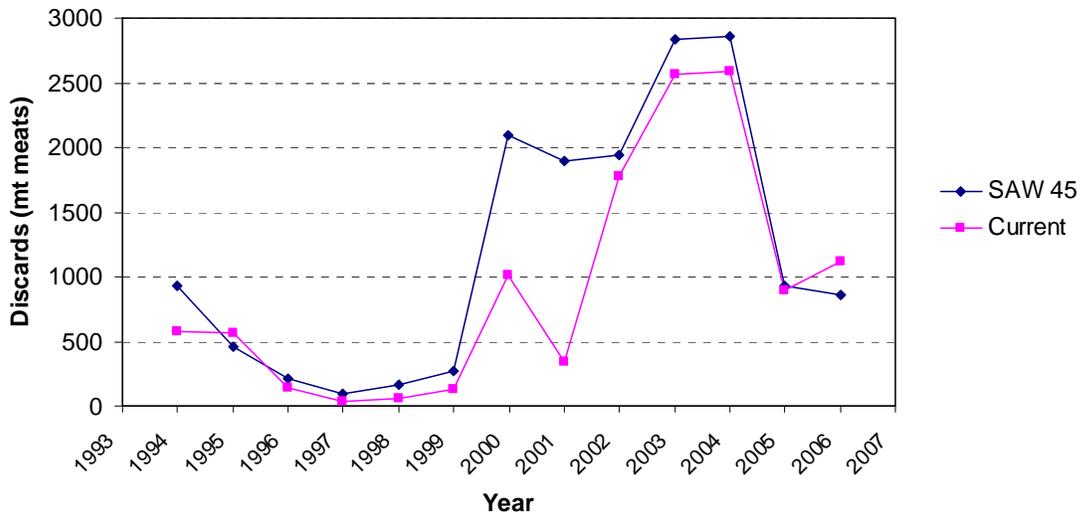


* Discards in 2000 and 2001 are underestimates because no discards were estimated for GBK open scallop dredge in 2000 and 2001, and MAB open scallop dredge in 20001 due to small sample size.

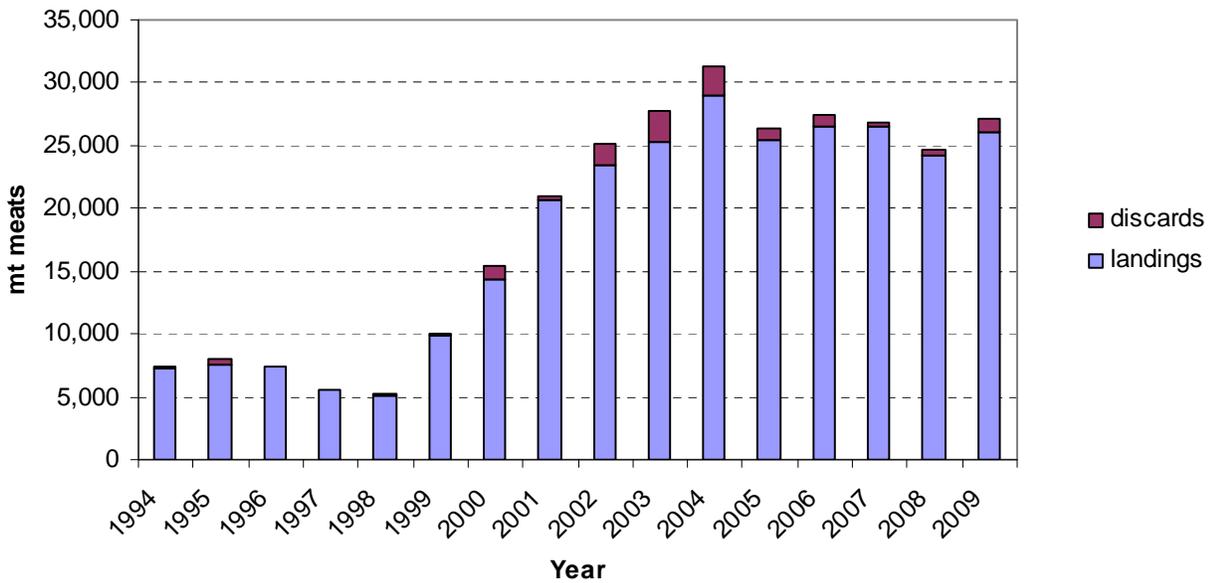
Appendix B2-Figure 1A. SAW 45 and current estimated sea scallop discards from trips using scallop gear (mt meats), 1994-2006. Current part 1 includes estimates from scallop dredge trips only, while part 2 includes estimates from scallop dredge and scallop trawl.



Appendix B2-Figure 1B. Estimated sea scallop discards from trips using otter trawl gear (mt meats), 1994-2006.



Appendix B2-Figure 2. Sum of the SAW 45 and current estimated sea scallop discards (mt meats) presented in Figure 1 (estimated discards from trips using scallop gear, and estimated discards from trips using other trawl gear), 1994-2006. This figure is for illustration purposes only and is not meant to convey exact total sea scallop discard estimates.



Appendix B2-Figure 3. Estimated scallop landings (SAW 50) and current estimated sea scallop discards from scallop dredge fleets (mt meats), 1994-2009.