Supplemental Paper.

Supplemental Paper: Skates
December 7, 2008

Skate Landings: Species Composition Estimates

Andy Applegate
November 5, 2008-12-07

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John Pappalardo, *Chairman* | Paul J. Howard, *Executive Director*

MEMORANDUM

DATE: **November 5, 2008**

TO: Data Poor Assessment Workshop (DPWS)

FROM: Andrew Applegate

SUBJECT: **Estimated proportional skate landings by species**

Earlier in 2008, the Skate PDT attempted to allocate skate landings by species based on the proportional survey weight per tow post-stratified by three-digit statistical area (see http://www.nefmc.org/tech/cte_mtg_docs/080414-15_mtg_docs.pdf). That analysis estimated that there were about 20% little skate in the wing fishery landings and 10-15% winter skate landings in the whole/bait fishery, contrary to earlier assumptions. These estimates were also consistent with a PDT analysis of sea sampling (http://www.nefmc.org/skates/tech%20docs/VTR%20vs%20observed%20skate%20identification.pdf), conducted in May 2007 and were used to estimate annual biomass changes with respect to various catch levels.

During the NEFMC review of Amendment 3, the NEFSC raised concerns that the PDT analysis had been inconsistent with the stratified random survey design. While this comment was technically correct, I showed at the last DPWS meeting that the PDT approach did not significantly violate the underlying statistical properties of the survey sampling design. Even with the post-hoc stratification along statistical area boundaries, larger areas received more tows than smaller areas, very similar to the statistical properties of the survey strata.

One problem that the last DPWS meeting discovered, however, was that the selectivity ogive for the skate wing fishery for vessels using trawls was probably too small. The PDT analysis assumed a knife-edge selectivity of 40 cm for the trawl wing fishery and 65 cm for the gillnet wing fishery, based on a previous (and incomplete) mesh selectivity analysis. It also assumed a maximum size ogive of 58 cm for the skate bait fishery, consistent with regulations.

This analysis attempts to correct both deficiencies. First, a selectivity ogive is estimated for observed hauls in each skate fishery compared to the applicable surveys during 2004-2007. The data were fit using a three parameter logistic curve via Millar's (1992) SELECT model. Results of these logistic model fits are given in Table 1 and in Figures 1-4. In most cases where the parameters could be estimated, the L50s for winter and little skates were similar to the overall fit for all skate species (with a notable exception of little skates observed in the retained fraction of gillnet catches). Also the ogives by region were very similar to one another within each fishery and gear type. As a result, pooled selectivity ogives for each gear and skate fishery were used to determine the exploitable species composition at size in each survey stratum. In the following table, the L50s for the newly estimated ogives are compared with the PDT's assumed knife edge selectivity ogive.

Fishery	L50 for selectivity ogive applied to survey weight per tow data	PDT assumed knife edge selectivity
Trawl wing	66.9 cm	> 40 cm
Trawl whole/bait	44.4 cm and < 59 cm	< 59 cm
Gillnet	54.9 cm	> 65 cm

Average proportional weight per tow by three digit statistical area was re-estimated by determining an average stratum weight per tow and then computing an area-weighted average for the sampled strata within each three digit statistical area. While this approach does not readily allow estimation of variance (like a domain estimator), the averages computed in this way satisfy the conditions of the stratified random survey design.

Applying these average proportions of survey catch by skate species to the VTR data by gear type, fishery (product form), and trimester (corresponding to the spring, fall, and winter surveys) gives the results shown in Table 2 and in Figure 5. These results represent the estimated amount and proportion of exploitable size skates captured on trips reporting skate landings on the VTR, not accounting for the regulations which prohibit landings of barndoor, smooth, and thorny skates. No attempt was yet made to reconcile these data with dealer reports, which could be done on the basis of state and month, if so desired for assessment needs. When the prohibited species are not considered as being landed, the proportions by legal species are shown in Figure 6.

Results from the PDT analysis are shown in Table 1 (bottom half) and in Figure 7 for comparison. The new analysis for the DPWS tended to reduce the amount of little skates assumed to be landed in the trawl wing fishery, reduced the amount of winter skates in the bait fishery, and increase the amount of little skates in the gillnet skate wing fishery. This last result is a bit surprising, but not when the difference in assumed selectivity ogives in the table above and in Table 1 are examined. In this analysis, there were considerable amount of skates less than 65 cm included in the gillnet fishery exploitable fraction, with an L50 of 54.9 cm. It is possible, however, that the gillnet boats are culling little skates from the exploitable size skates, but this is not apparent in the results given in Table 1 by species. In fact, there was some fraction of little skates retained with an estimated L50 of 44.2 cm in the Georges Bank region.

Even when these new exploitable species compositions are applied to the VTR landings, there still is a significant fraction of winter skate in the skate bait fishery landings and a significant fraction of little skate landings in the wing fishery. This analysis reduces these fractions compared to the PDT analysis, but these landings are still significant. Unlike the May 2007 PDT report that analyzed the species composition of observer data, this analysis does not rely on species identification by the dealer or by observers.

For assessment purposes, these estimated species compositions of exploitable skates could be applied to the dealer landings data, potentially stratified by state and month (or trimester). The unexploitable fraction of skates captured in the survey (which would presumably be discarded) could also be estimated using this approach by calculating a catch ogive from sea sampling data and subtracting the exploitable fractions at length estimated in this analysis. These fractions could thus be applied to the VMS data by estimating total discards with a discard/kept skate (or for all species where skates were not targeted) ratio.

Table 1. Selectivity parameter estimates for observed skate landings fitted to survey length frequencies using the SELECT model (Millar 1992).

Winter skate

	Trawl, wings			Trawl, whole			Gillnet		
	GoM	GB	MA	GoM	GB	MA	GoM	GB	MA
a =	Insufficient data	1.278	Insufficient data	Insufficient data	4.401	-3.800	3.311	2.109	1.595
b =		0.1027			0.037	0.148	0.052	0.075	0.094
δ =		0.00042			0.00192	0.01032	0.00147	0.00102	0.00092
L50%		**66.911**			**60.817**	**59.030**	**68.626**	**68.381**	**61.597**
SE		34530.57			901.88	4817.01	689.32	2215.72	2709.99
Range		15.32			43.07	10.66	30.19	20.90	16.81
Log-likelihood		-11.74			-26.84	-14.49	-22.41	-18.90	-15.62
AIC		29.49			59.68	34.98	50.82	43.80	37.23

Little skate

	Trawl, wings			Trawl, whole			Gillnet		
	GoM	GB	MA	GoM	GB	MA	GoM	GB	MA
a =	Insufficient data	Insufficient data	Insufficient data	3.331	2.318	7.772	Insufficient data	-2.141	2.418
b =				0.114	0.126	-0.069		0.106	0.095
δ =				0.00037	0.00063	0.00710		0.10842	0.00154
L50%				**43.36**	**43.02**	**35.63**		**44.23**	**46.73**
SE				23931.22	5645.76	358.54		18.53	1967.88
Range				13.82	12.50	-22.83		15.39	16.62
Log-likelihood				-8.10	-5.05	-20.10		-7.42	-6.99
AIC				22.21	16.09	46.19		20.85	19.99

All landed skates

	Trawl, wings			Trawl, whole				Gillnet				
	GoM	GB	MA	All	GoM	GB	MA	All	GoM	GB	MA	All
a =	Insufficient data	Insufficient data	Insufficient data	-0.080	-1.120	2.768	2.616	4.161	1.030	-1.720	-1.670	-3.855
b =				0.112	0.151	0.096	0.011	0.0839	0.100	0.114	0.116	0.1098
δ =				0.002	0.003	0.001	0.053	0.00062	0.001	0.010	0.010	0.15670
L50%				**59.85**	**47.79**	**46.38**	**59.05**	**42.76**	**60.42**	**58.67**	**57.23**	**54.85**
SE				16247.71	1418.86	2781.13	41.41	1776.28	231.93	17.37	494.58	9.39
Range				14.05	10.43	16.47	142.17	18.74	15.77	13.84	13.60	15.13
Log-likelihood				-5.28	-5.91	-6.92	-16.04	-7.81	-18.79	-15.47	-10.43	-13.70
AIC				16.55	17.82	19.84	38.09	21.62	43.59	36.94	26.86	33.41

Richard equation:

$R(l) = [\exp(a+b*l)/(1+\exp(a+b*l))]^{1/\delta}$

Figure 1. Selectivity of observed winter skate landings by region, gear, and product type, 2004-2007, estimated with the SELECT model (Millar 1992).

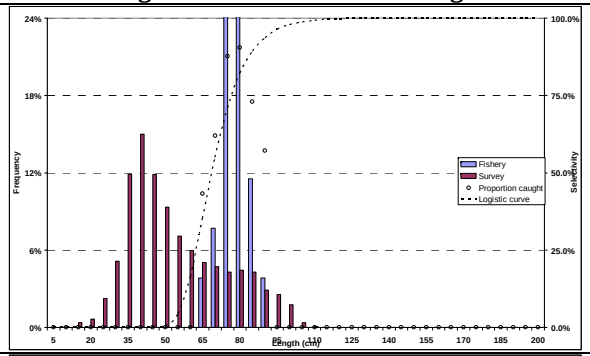
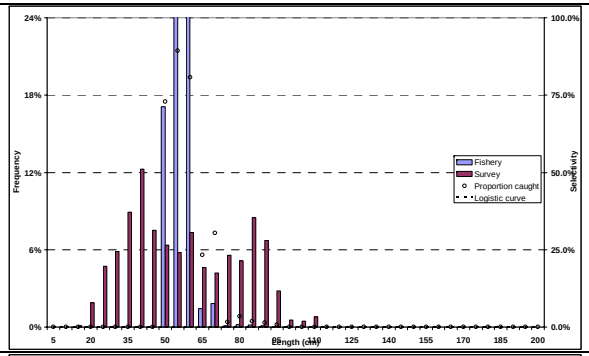
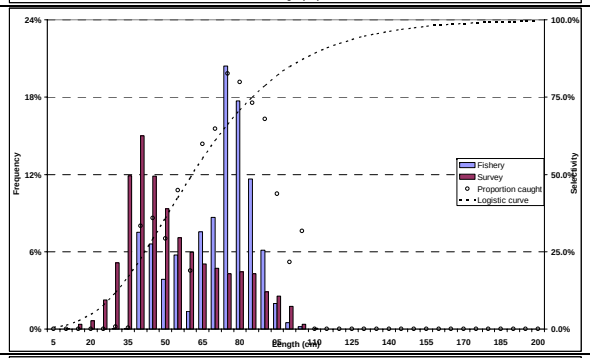
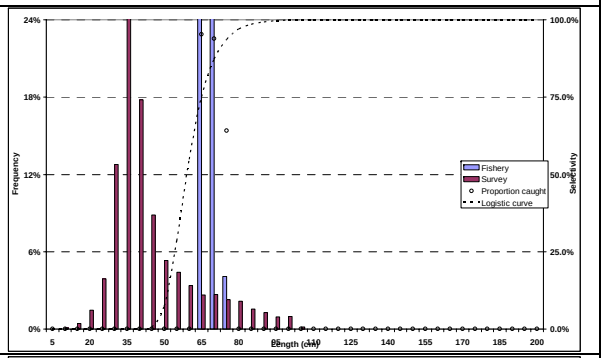
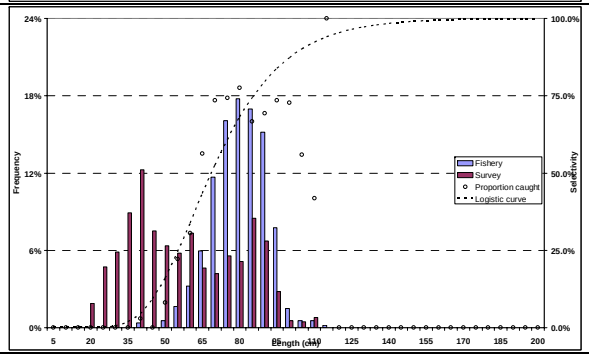
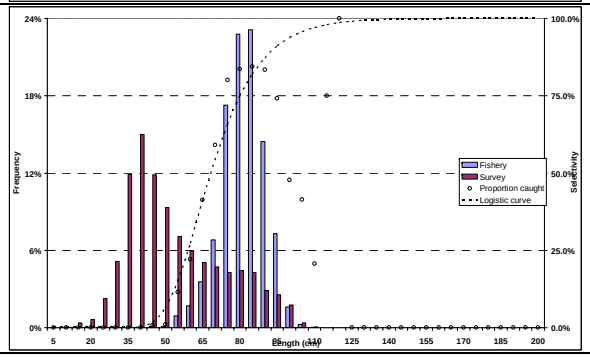
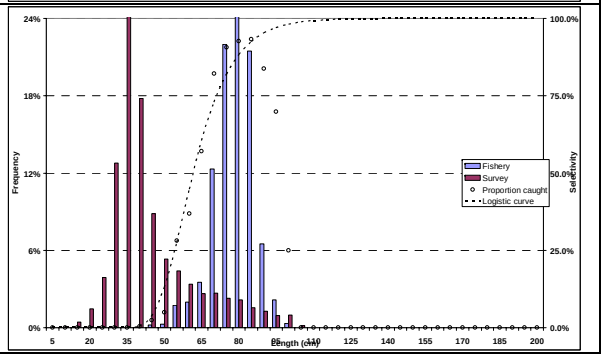
	Gulf of Maine	Georges Bank/Southern New England	Mid-Atlantic
Winter Trawl Wings	**Insufficient data**		**Insufficient data**
Winter Trawl Whole			
Winter Gillnet			

Figure 2. Selectivity of observed little skate landings by region, gear, and product type, 2004-2007, estimated with the SELECT model (Millar 1992).

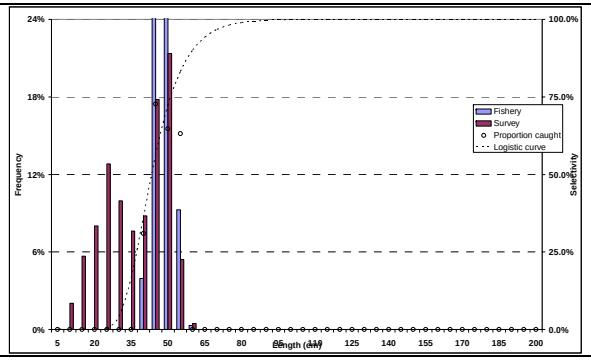
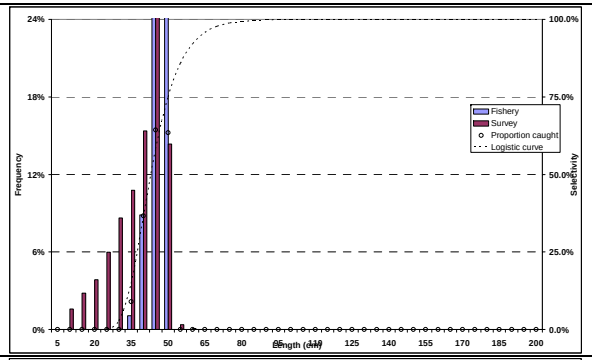
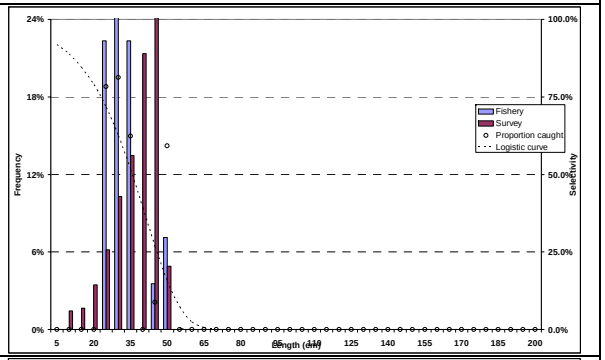
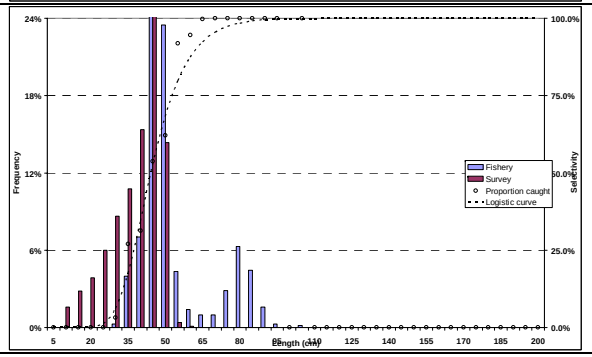
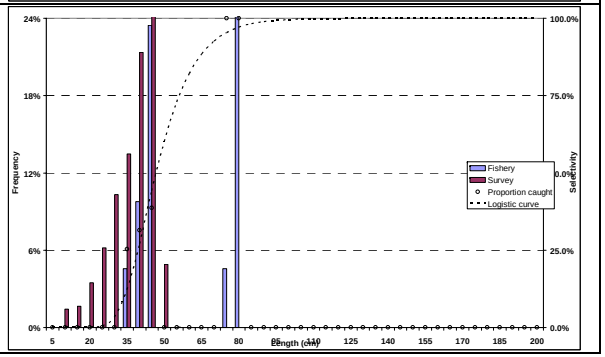
	Gulf of Maine	Georges Bank/Southern New England	Mid-Atlantic
Little Trawl Wings	**Insufficient data**	**Insufficient data**	**Insufficient data**
Little Trawl Whole			
Little Gillnet	**Insufficient data**		

Figure 3. Selectivity of observed aggregate skate landings by region, gear, and product type, 2004-2007, estimated with the SELECT model (Millar 1992). Survey size frequency is for clearnose, little, rosette, and winter skates.

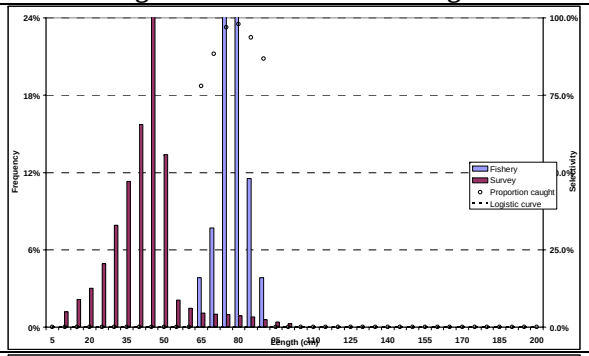
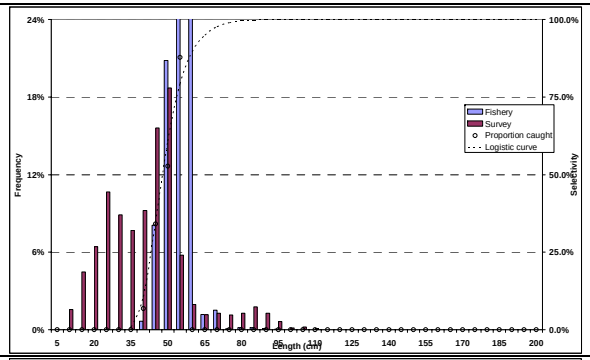
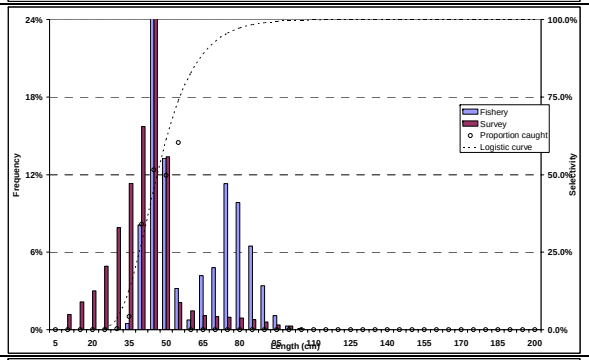
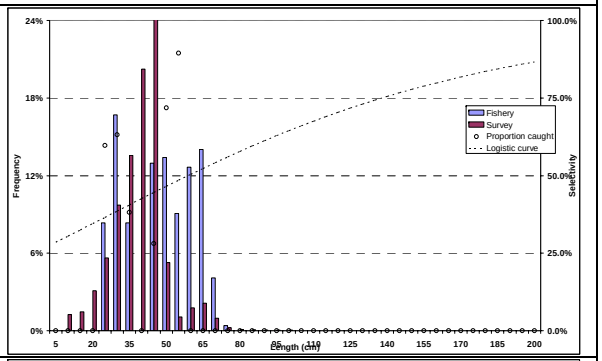
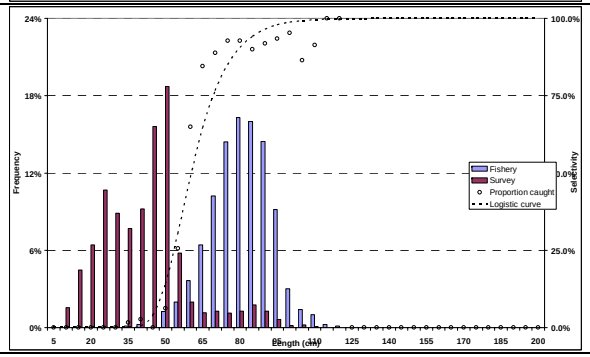
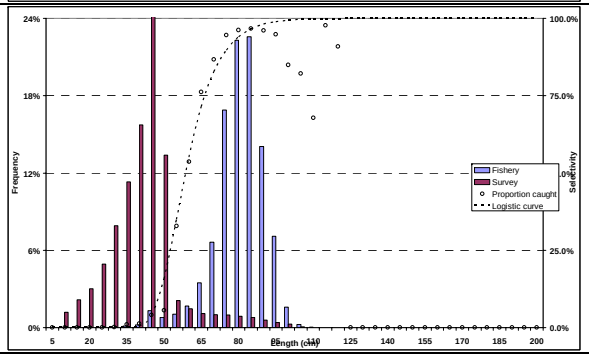
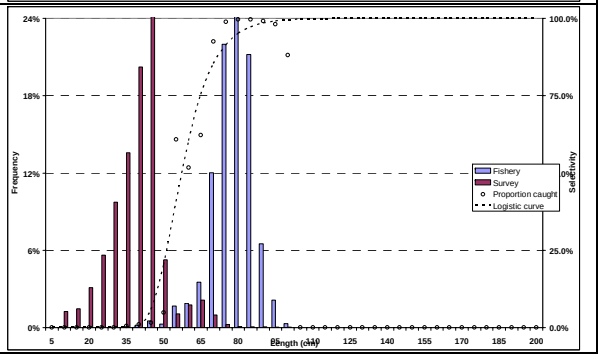
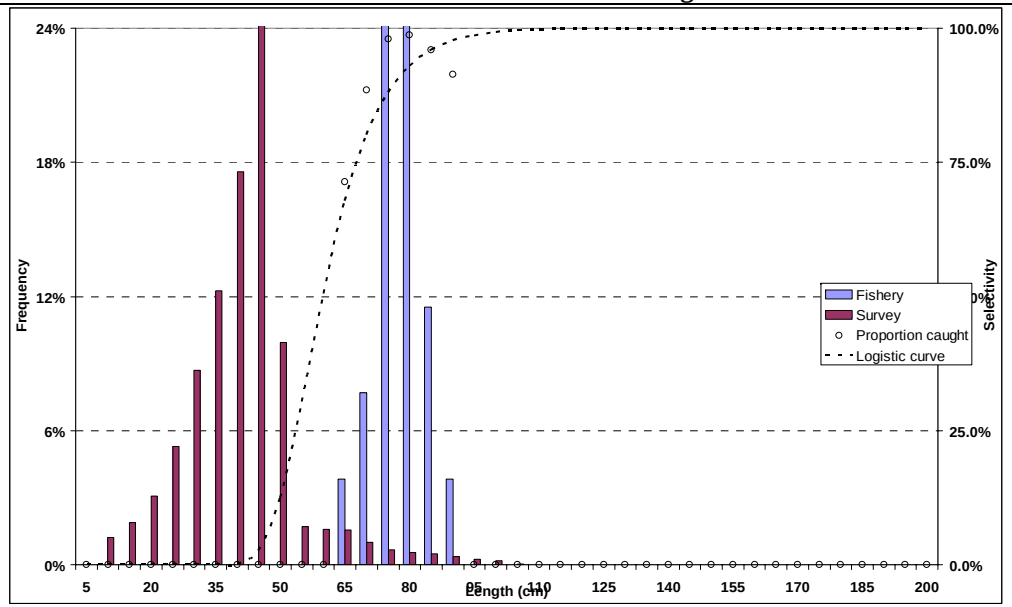
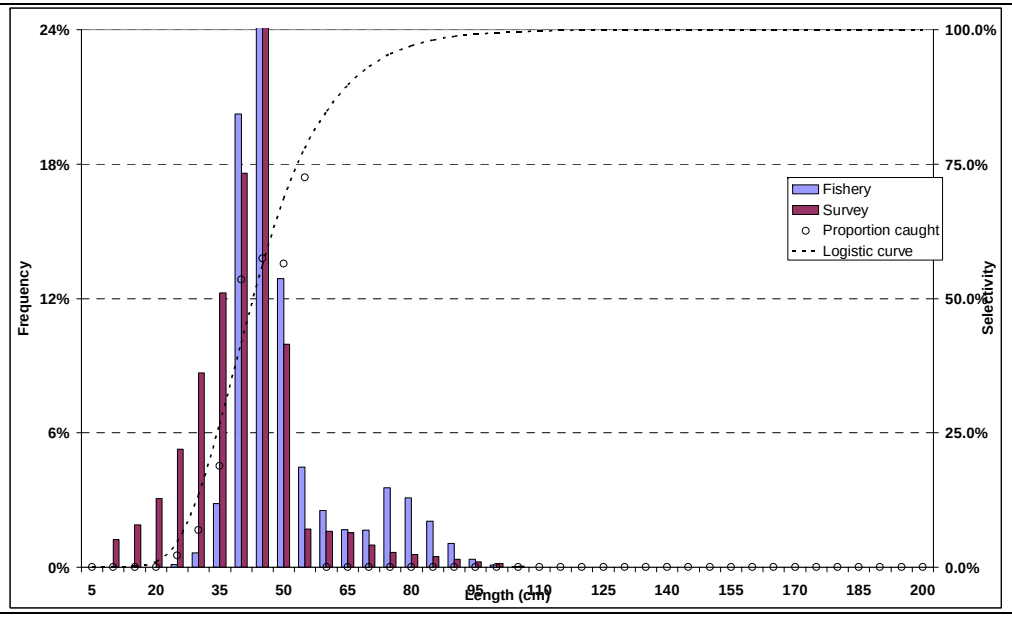
	Gulf of Maine	Georges Bank/Southern New England	Mid-Atlantic
Clearnose, Little, Rosette, & Winter Trawl Wings	**Insufficient data**		**Insufficient data**
Clearnose, Little, Rosette, & Winter Trawl Whole			
Clearnose, Little, Rosette, & Winter Gillnet			

Figure 4. Selectivity of observed aggregate skate landings by gear and product type, 2004-2007, estimated with the SELECT model (Millar 1992). Survey size frequency is for clearnose, little, rosette, and winter skates.

	All regions
Clearnose, Little, Rosette, & Winter Trawl Wings	
Clearnose, Little, Rosette, & Winter Trawl Whole	

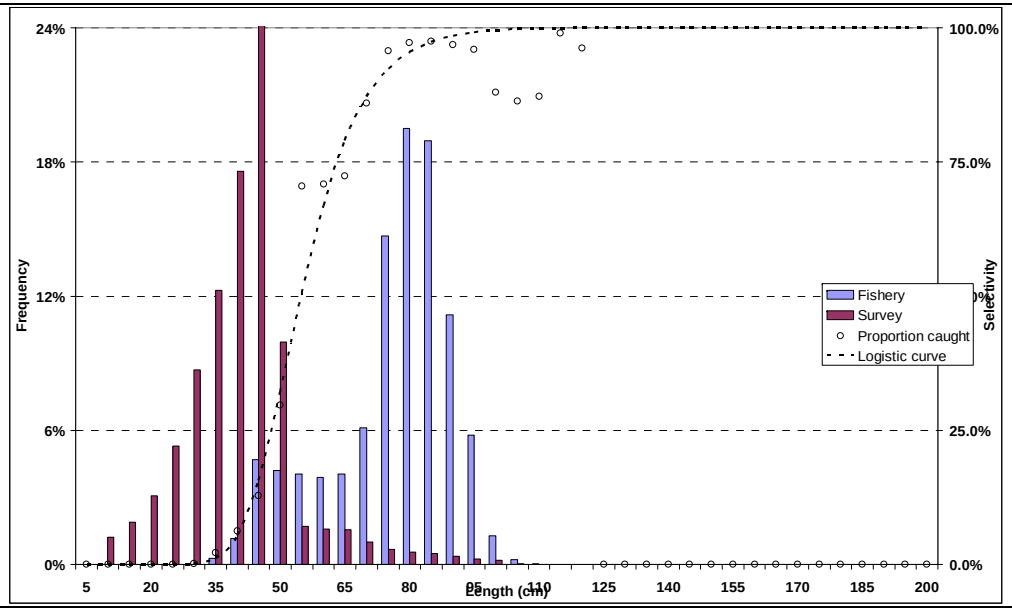
Clearnose, Little, Rosette, & Winter Gillnet	

Table 2. Comparison of estimated landings by species reported via VTR data.

Stratified area allocation

		Data						
YEAR	MARKET_CATEGORY	Winter_survey	Little_survey	Clearnose_survey	Rosette_survey	Barndoor_survey	Smooth_survey	Thorny_survey
1994	Whole	127,376	735,569	1,930	20	199	1,952	5,653
	Wings	9,806,069	1,552,534	19,095	37	178,089	69,967	4,546,653
1995	Whole	1,198,024	4,580,935	11,273	2,287	2,986	1,461	14,389
	Wings	4,439,210	1,216,547	38,553	170	95,787	60,313	2,534,702
1996	Whole	2,334,952	6,066,523	12,261	408	54	821	14,152
	Wings	17,012,833	1,857,173	86,285	91	425,711	159,794	2,674,321
1997	Whole	1,454,161	10,193,302	94,737	271	2,496	3,349	14,691
	Wings	6,943,124	1,550,375	253,281	40	320,243	117,002	2,240,666
1998	Whole	2,049,928	8,852,516	19,034	726	10,175	6,073	2,899
	Wings	9,911,233	2,116,832	85,505	409	644,877	152,669	4,932,717
1999	Whole	2,029,784	8,629,229	11,279	2,364	8,096	7,204	4,001
	Wings	9,768,974	1,657,669	153,955	2,866	644,245	161,916	1,930,410
2000	Whole	676,715	8,919,903	141,463	13,369	4,790	3,550	1,736
	Wings	11,075,785	2,104,651	320,105	2,085	991,345	159,473	3,930,806
2001	Whole	1,111,776	7,950,090	61,841	12,044	7,268	29,753	36,608
	Wings	13,254,016	2,436,815	150,707	793	1,090,653	124,618	1,831,959
2002	Whole	1,279,018	8,346,161	18,933	2,644	42,213	34,054	12,520
	Wings	13,234,716	2,088,690	75,627	565	716,932	127,890	2,625,682
2003	Whole	984,297	8,964,572	2,190	1,953	37,705	50,766	73,219
	Wings	15,817,519	3,194,556	153,464	118	1,515,097	86,786	2,163,595
2004	Whole	1,476,861	6,297,778	6,002	91	37,479	17,138	701
	Wings	20,713,238	1,321,658	65,334	693	1,932,636	109,075	816,836
2005	Whole	1,164,766	6,705,841	8,132	315	20,504	8,338	14,367
	Wings	14,156,572	2,403,206	57,236	334	2,767,871	338,169	374,512
2006	Whole	2,164,413	7,469,003	53,599	5,780	59,181	64,436	30,748
	Wings	14,566,459	2,271,174	44,532	274	6,210,223	634,678	664,068
2007	Whole	1,659,612	8,430,648	70,564	6,544	54,429	12,103	17,469
	Wings	23,717,145	3,434,679	115,340	1,072	998,173	61,265	1,416,545

Statistical area allocation

		Data						
YEAR	MARKET_CATEGORY	Winter_survey	Little_survey	Clearnose_survey	Rosette_survey	Barndoor_survey	Smooth_survey	Thorny_survey
1994	Whole	136,459	737,063	3,987	46	192	1,939	6,464
	Wings	8,786,564	4,203,983	20,141	476	36,786	311,113	2,754,906
1995	Whole	2,199,316	4,241,389	34,224	3,170	4,904	761	10,576
	Wings	4,276,214	2,037,108	22,264	1,278	40,896	168,855	1,304,247
1996	Whole	1,985,876	6,475,728	8,584	657	2	1,108	17,500
	Wings	13,760,090	6,336,546	49,017	2,351	197,389	527,421	814,865
1997	Whole	1,299,391	10,342,527	116,031	4,790	7,580	2,533	17,934
	Wings	5,914,328	4,118,346	218,360	1,280	380,361	180,379	1,266,130
1998	Whole	1,816,005	9,130,752	80,249	560	3,809	504	1,663
	Wings	10,636,454	6,560,637	88,376	2,439	324,988	295,970	2,666,890
1999	Whole	1,880,767	8,781,709	48,189	11,764	1,849	2,737	2,378
	Wings	7,722,376	4,537,483	147,975	1,835	338,223	414,159	946,733
2000	Whole	874,488	8,757,692	152,576	1,819	5,041	3,054	4,040
	Wings	9,736,835	6,311,234	273,297	2,484	634,712	198,912	867,429
2001	Whole	997,136	8,097,713	66,558	11,052	6,764	14,031	8,136
	Wings	11,298,351	5,699,003	133,250	5,220	734,266	137,789	694,160
2002	Whole	1,360,454	8,267,238	37,649	671	19,007	15,022	22,159
	Wings	13,103,743	4,073,780	105,686	2,817	658,603	202,504	580,411
2003	Whole	1,108,799	8,890,938	8,317	9,399	37,987	19,637	75,404
	Wings	14,761,979	5,290,559	58,628	4,327	1,112,630	440,236	940,068
2004	Whole	1,801,634	6,002,746	25,928	207	12,278	10,320	357
	Wings	17,827,537	5,531,821	69,598	5,522	1,373,056	127,872	523,633
2005	Whole	1,016,025	6,992,222	24,566	1,953	25,016	5,094	6,524
	Wings	13,134,860	5,884,882	94,603	8,608	1,379,014	239,928	385,565
2006	Whole	2,123,434	7,427,629	164,330	8,798	111,295	59,706	43,801
	Wings	14,876,441	6,473,821	33,185	11,493	2,777,929	571,610	490,132

Figure 5. Estimated proportion of exploitable size skates, survey area weighted stratified mean weight per tow proportions applied to VTR reported landings by trimester, gear, and statistical area.

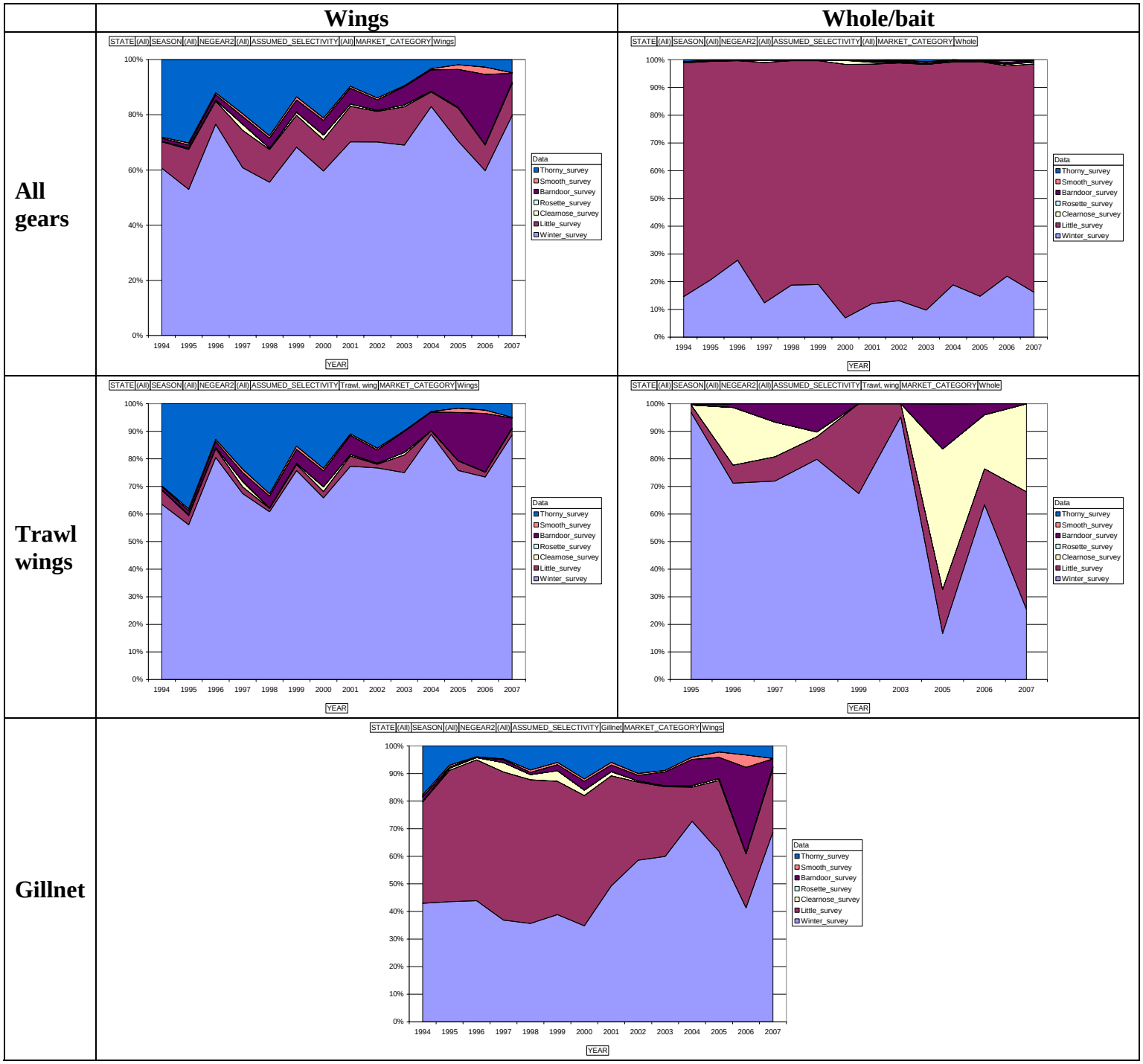


Figure 6. Estimated proportion of exploitable size legal skates (clearnose, rosette, little, and winter), survey area weighted stratified mean weight per tow proportions applied to VTR reported landings by trimester, gear, and statistical area.

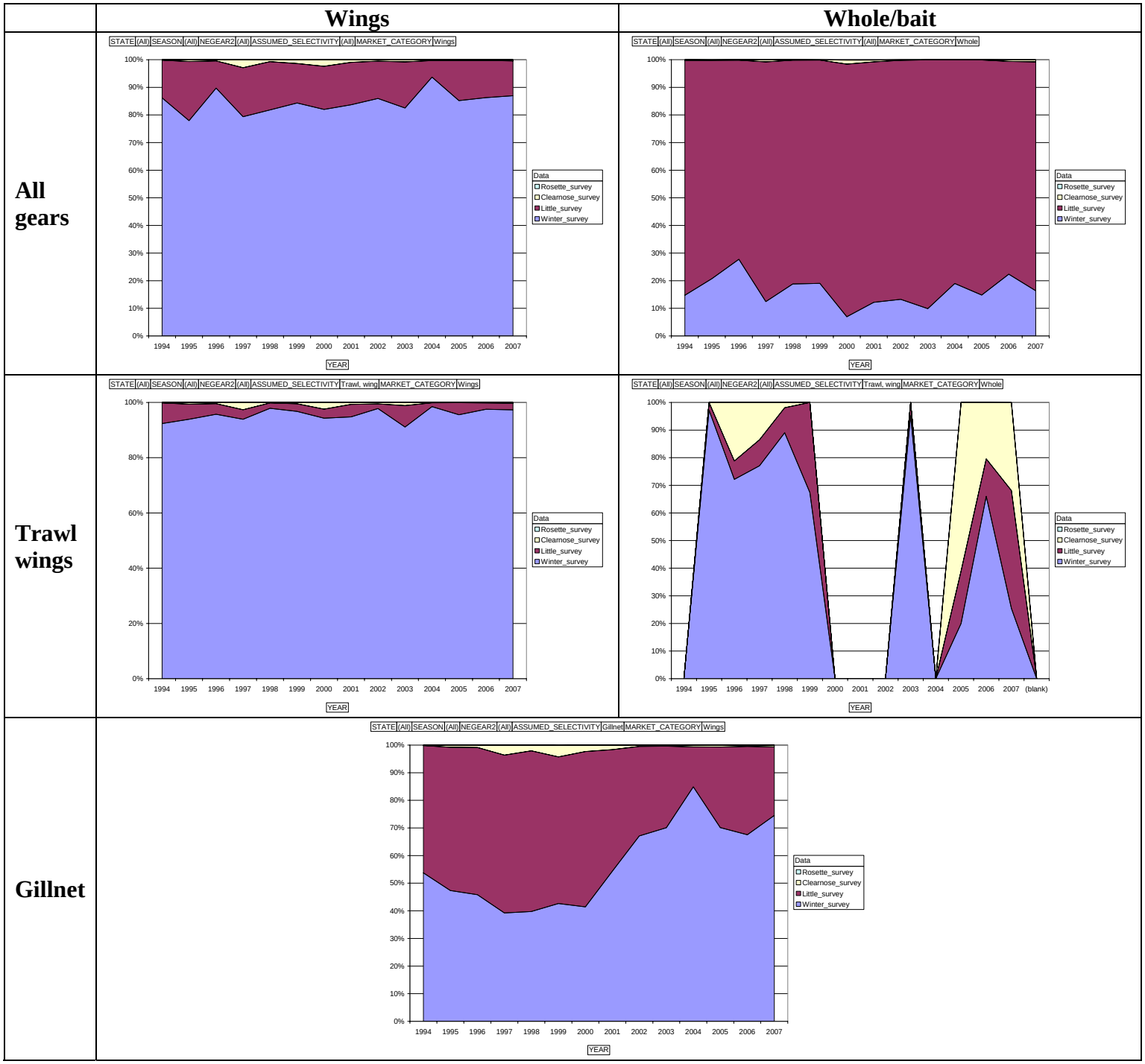


Figure 7. Estimated proportion of exploitable size skates, survey tow proportions by statistical area applied to VTR reported landings by trimester and gear.