#4

New England Fishery Management Council
50 WATER STREET | NEWBURYPORT, MASSACHUSETTS 01950 | PHONE 978 465 0492 | FAX 978 465 3116
John Pappalardo, *Chairman* | Paul J. Howard, *Executive Director*

MEMORANDUM

DATE: **January 14, 2008**

TO: Science and Statistical Committee

FROM: Skate PDT

SUBJECT: **Skate rebuilding catch limit re-analysis**

This analysis incorporates the new Data Poor Assessment Workshop[1] skate catch time series into the previous PDT evaluation of skate rebuilding potential. While total landings were updated and new methods to allocate unclassified skate landings to species were developed in the DPWS, new discard estimates were completely revised using observer data which had not previously been included. As a result, the re-assignment of catches to skate species were revised and total discard estimates are substantially different than previous data used in the Draft Amendment 3 analysis.

Like the previous assessment, the new analyses evaluate the relationship between catch, relative exploitation (catch/biomass) and changes in stratified mean biomass estimated by the surveys (spring for little skate, fall for the remaining six species). To smooth out noise from annual indices, a 3-year moving average for catch and biomass with no lags was evaluated[2]. Based on this type of analysis, the PDT recommended and the SSC approved using the median relative exploitation ratio (C/B) applied to the latest three year stratified mean biomass as an interim catch limit to initiate rebuilding of smooth, thorny, and winter skates.

The median values (2005-2007) for each species were summed and applied as an aggregate skate ABC/ACT, accounting for the partial effectiveness (assumed 90%) of barndoor, smooth, and thorny skate landings prohibitions. A value of 75% of the threshold catch limit was recommended to account for scientific and management uncertainty, approved for a management target, and applied as an ACT in the Draft Amendment 3 document. The average discard rate for 2004-2006 and two different historic landings splits between the skate wing and bait fisheries was then applied to estimate TALs for each fishery. The same procedure was applied in this analysis, except that the 2005-2007 discard rate was

---

[1] A Data Poor Assessment Workshop (DPWS) was conducted by the Northeast Fisheries Science Center during October 2008 to January 2009, focusing on exploratory assessment analyses of model-resistant species, including the seven managed skate stocks. While the survey time series is believed to be a good representation of changes in skate abundance and biomass, there has been considerable uncertainty in the skate species landings and in discard estimates. One of the important outcomes of the DPWS was two methods to allocate skate catches to species based on where the fishing activity occurred and the observed lengths of skate catches.

[2] Other lags and moving average durations were evaluated in the Draft Amendment 3 technical analyses and were not informative, i.e. correlations between catch or relative exploitation and biomass changes were worse.

applied, now that 2007 discard estimates have been calculated in the DPWS. A summary of comparative results are given in the table below.

Data source	Catch limit, mt (ABC/ACL)	Catch target, mt (ACT)	Discard rate	Total allowable landings, mt (TAL)	MSY (landings with biomass @ target)	Landings reduction from 2007 to achieve TAL	
						Wing	Bait
Draft Amendment 3	22,612	16,959	38%	10,484	53,731	-45%	-43%
DPWS Length composition method.	24,688	15,546	58%	7,786	64,196	-57%	-63%
DPWS selectivity ogive method	23,826	17,864	59%	7,328	63,240	-65%	-60%

Although they were initially different and derived independently, the two DPWS method catch series have become similar with refinement. As indicated above, there really is little difference between them in the context of the Amendment 3 rebuilding prospects at catch rates below and above the median values for the time series. Even the overall catch limit (landings and discards) are similar to the Draft Amendment 3 results, but the higher discard estimates result in a lower fraction (41-42%) of the total catch being allocated to landings (i.e. TAL).

Analysis of rebuilding potential, however, shows that the linkage between low exploitation rates and increases in biomass is either non-existent or not significant. None of the relationships are very strong and are probably not very predictive of rebuilding potential at lower catch levels. There is little or no relationship between the C/B ratio and changes in biomass for barndoor, clearnose, little, or thorny skates. The relationship for smooth and rosette seem entirely attributable to a few number of points which may be related to transient oceanographic events or sampling variability, while the relationship for winter seems to be related to serial autocorrelation.

Catch time series

For the Amendment 3 DEIS, the PDT estimated landings species composition by applying the survey biomass proportions for exploitable skates in each three-digit statistical area, as determined by a fitted logistic selectivity curve (fitting observed commercial kept skates to the survey in equivalent areas and seasons) of observed kept skate lengths on survey length frequencies in each region and season. Although known at the time, this procedure had a technical flaw and inconsistency with the survey design, but was not thought to significantly skew the species allocations. During the DEIS comment period, NMFS commented on this flaw in the analysis and it would be addressed in the DPWS[3]. Although the Council was slated to take final action at the November 2008 meeting, NMFS recommended that the Council wait to receive these results to determine whether to proceed with Amendment 3.

[3] Analyses were presented at the DPWS that the previous Amendment 3 assumption did not badly violate the survey statistical design and did not skew the biomass proportions or the calculated mean biomass of each species in a statistical area.

During the Amendment 3 development, the PDT also only had regional estimates (Georges Bank/Southern New England and Mid-Atlantic) of aggregate skate discards to use in the Amendment 3 analyses. These discard estimates used SAW44-reviewed procedures, but used the Groundfish Assessment Review Meeting (GARM) area allocation tables[4] to assign landings to statistical area and region. Because species composition of discards was not available at the time, the PDT used the regional skate discard estimates as a catch index for species by region (Georges Bank/Southern New England for thorny, smooth, winter, and little skates; Mid-Atlantic for clearnose and rosette skates).

The new catch series for this analysis allocate skate landings and discards to species based on surveyed biomass fractions using two different methods. These two methods were developed simultaneously, and independently arrived at similar results to one another. The details are described in the DPWS documents, but are summarized below. Each method has its pros and cons and both methods were accepted by the DPWS.

For the length composition method, the skate lengths of kept and discarded skates were binned into 5 cm intervals and applied to the survey biomass fractions by region. These biomass fractions were applied to total landings and total discard estimates by year, half-year, gear, and region (Gulf of Maine, Southern New England, and Mid-Atlantic). Discard to kept ratios were applied to total landings on all trips, also by year, half-year, gear, and region. The discard species composition was calculated in the same fashion as that for landings, using the length composition of discarded skates on observed trips. For both landings and discards, the species composition could only be determined since 1989, the first year of sea sampling data. Total discards were however hind-casted by applying the 1989-1991 DK ratio to dealer reported landings in earlier years.

For the selectivity ogive method of assigning species composition to skate landings and discards, the fraction of skate biomass for skate species were determined by estimating a selectivity ogive from kept skates on observed trips during 2004-2006 applied to surveyed skates in each three digit statistical area by year, gear, and season (spring, fall, and winter corresponding to the three trawl surveys). The survey biomass fractions were determined by applying the 2004-2006 selectivity ogive by year, season, sub-region, gear, and mesh (small, large, and extra-large for trawls and gillnets). Subsequent to the DPWS, these fractions were re-estimated by treating the fractions kept for vessels using gillnets separately for the skate wing and whole/bait fisheries[5]. This is the same procedure as the DPWS approved for trawls and recommended that it be used for the gillnet fishery as well.

Total discards were independently estimated for the DPWS by estimating the DK ratios[6] for each year, gear, sub-region, season, and mesh and applying them to total landings on every trip reported by dealers and included in the GARM area allocation tables. Trips in these tables with unknown area allocations were distributed to areas, based on fishing activity for assigned trips in each state, year, and gear combination. Skate species allocations were made using the same procedure that the DPWS accepted for landings, using the selectivity ogive method, except that for trips landing skates the species composition of discards were determined by A – B, where A is the selectivity ogive fitted for catch and B is the selectivity ogive fitted for kept skates. For trips with no skate landings in the dealer data, only the

[4] These area allocation tables use a peer-reviewed method to allocate dealer reported landings to statistical area level fishing locations.

[5] The DPWS estimates use a single selectivity ogive for all skate landings by vessels using gillnets and it was discovered during the review that a substantial fraction of gillnet landings are landed in whole form, presumably targeting little skates for bait.

[6] Skates discarded to total live weight of landings of all species on observed trips, which are then applied to total live weight of dealer reported landings of all species.

selectivity ogive for catch (A) was used to assign species composition to skate discards. Since the method uses the length distribution of skates in the survey to determine species composition, the species allocations could be assigned as far back as 1977.

This analysis of rebuilding potential described below uses the species composition of 1994-2007 landings and discards from each species allocation method independently to examine the effect of catch on changes in survey skate biomass. For 1977-1993, the total skate landings and both discard estimates were assigned the species composition determined by the selectivity ogive method (because there were no observed trips before 1989 and no GARM area allocation tables before 1994). Before the advent of the sea sampling program in 1989, both methods apply the 1989-1991 DK ratio to total landings. The data used in this analysis are shown in the following tables.

Table 1. Landings time series used in the rebuilding potential analysis and in estimating catch limits and targets associated with the median C/B exploitation ratio. Landings before 1994 were derived from the same time series of aggregate landings and species composition was assigned via the selectivity ogive method.

Length composition method
Landings Allocations

Year	barndoor	cleamose	little	rosette	smooth	thorny	winter
1964	**4.62**	**0.00**	**1.14**	**0.03**	**0.29**	**20.05**	**4.57**
1965	**5.78**	**0.00**	**1.87**	**0.02**	**0.44**	**25.03**	**5.46**
1966	**3.41**	**0.00**	**1.26**	**0.00**	**0.20**	**21.49**	**4.54**
1967	**3.68**	**1.23**	**5.48**	**0.12**	**0.56**	**42.38**	**18.24**
1968	**2.62**	**1.55**	**2.45**	**0.00**	**0.40**	**20.84**	**7.83**
1969	**2.62**	**1.30**	**3.54**	**0.01**	**0.48**	**32.43**	**11.21**
1970	**1.95**	**0.47**	**4.79**	**0.03**	**0.52**	**46.86**	**14.97**
1971	**0.78**	**0.64**	**5.24**	**0.05**	**0.90**	**37.77**	**17.92**
1972	**1.61**	**0.00**	**6.05**	**0.00**	**0.74**	**51.57**	**25.93**
1973	**1.43**	**0.71**	**6.82**	**0.03**	**0.77**	**47.47**	**29.67**
1974	**1.19**	**0.75**	**6.42**	**0.03**	**0.66**	**40.68**	**30.37**
1975	**1.51**	**1.20**	**9.34**	**0.04**	**0.87**	**53.56**	**47.58**
1976	**1.30**	**1.31**	**9.37**	**0.04**	**0.79**	**48.36**	**51.03**
1977	**1.47**	**1.91**	**12.64**	**0.05**	**0.96**	**58.22**	**73.05**
1978	**2.51**	**4.26**	**26.30**	**0.10**	**1.78**	**107.16**	**160.49**
1979	**3.27**	**7.52**	**43.61**	**0.15**	**2.60**	**155.39**	**279.66**
1980	**3.08**	**10.14**	**55.63**	**0.19**	**2.89**	**170.84**	**373.34**
1981	**1.10**	**5.80**	**30.21**	**0.09**	**1.34**	**78.44**	**211.42**
1982	**0.02**	**8.68**	**50.86**	**0.21**	**1.14**	**88.77**	**279.02**
1983	**0.00**	**11.38**	**76.64**	**0.01**	**3.42**	**124.33**	**666.91**
1984	**0.28**	**22.71**	**69.73**	**0.28**	**1.59**	**114.00**	**622.20**
1985	**0.06**	**12.71**	**51.44**	**0.08**	**2.32**	**72.72**	**623.98**
1986	**0.36**	**13.84**	**30.73**	**0.10**	**4.26**	**78.53**	**858.28**
1987	**0.32**	**40.34**	**84.38**	**0.26**	**4.52**	**107.37**	**1202.52**
1988	**0.01**	**63.95**	**99.07**	**0.51**	**10.73**	**163.98**	**1775.47**
1989	**1.03**	**112.20**	**550.87**	**0.70**	**27.51**	**692.92**	**5322.07**
1990	**14.39**	**322.67**	**830.97**	**1.07**	**65.07**	**859.75**	**9308.58**
1991	**16.47**	**983.65**	**1332.93**	**3.82**	**51.05**	**1173.66**	**7770.72**
1992	**471.60**	**746.18**	**1379.39**	**4.11**	**77.86**	**2089.16**	**7757.00**
1993	**70.90**	**1054.90**	**2915.57**	**2.20**	**117.38**	**1581.75**	**7161.30**
1994	**134.20**	**973.71**	**1794.69**	**6.62**	**89.09**	**1966.44**	**3818.55**
1995	83.11	348.48	1926.66	5.39	0.77	314.57	4453.48
1996	336.39	539.89	2399.89	11.01	0.37	759.51	10051.54
1997	281.04	748.73	3792.04	12.90	6.99	510.38	5353.70
1998	161.12	447.45	4028.73	27.33	7.83	628.19	8344.25
1999	452.37	324.36	3680.41	15.35	2.09	203.71	6866.57
2000	494.42	501.95	3336.02	19.96	7.67	466.39	8372.99
2001	1536.85	1860.07	1700.99	8.61	18.78	195.42	7655.28
2002	2123.66	640.20	2371.81	10.72	17.24	401.63	7094.18
2003	854.82	335.61	3302.87	5.82	8.55	302.94	9986.12
2004	844.52	344.54	1955.26	6.80	5.63	511.56	11787.82
2005	1976.34	168.47	3056.36	8.97	10.39	439.86	7650.58
2006	2632.83	384.49	2392.33	8.63	21.51	642.97	9256.81
2007	2011.46	361.73	3078.31	22.41	17.84	351.91	12860.80
1995-2007 proportions	7.9%	4.0%	21.3%	0.1%	0.1%	3.3%	63.2%

Selectivity ogive method
Landings Allocations

Year	barndoor	cleamose	little	rosette	smooth	thorny	winter
1964	**4.62**	**0.00**	**1.14**	**0.03**	**0.29**	**20.05**	**4.57**
1965	**5.78**	**0.00**	**1.87**	**0.02**	**0.44**	**25.03**	**5.46**
1966	**3.41**	**0.00**	**1.26**	**0.00**	**0.20**	**21.49**	**4.54**
1967	**3.68**	**1.23**	**5.48**	**0.12**	**0.56**	**42.38**	**18.24**
1968	**2.62**	**1.55**	**2.45**	**0.00**	**0.40**	**20.84**	**7.83**
1969	**2.62**	**1.30**	**3.54**	**0.01**	**0.48**	**32.43**	**11.21**
1970	**1.95**	**0.47**	**4.79**	**0.03**	**0.52**	**46.86**	**14.97**
1971	**0.78**	**0.64**	**5.24**	**0.05**	**0.90**	**37.77**	**17.92**
1972	**1.61**	**0.00**	**6.05**	**0.00**	**0.74**	**51.57**	**25.93**
1973	**1.43**	**0.71**	**6.82**	**0.03**	**0.77**	**47.47**	**29.67**
1974	**1.19**	**0.75**	**6.42**	**0.03**	**0.66**	**40.68**	**30.37**
1975	**1.51**	**1.20**	**9.34**	**0.04**	**0.87**	**53.56**	**47.58**
1976	**1.30**	**1.31**	**9.37**	**0.04**	**0.79**	**48.36**	**51.03**
1977	**1.47**	**1.91**	**12.64**	**0.05**	**0.96**	**58.22**	**73.05**
1978	**2.51**	**4.26**	**26.30**	**0.10**	**1.78**	**107.16**	**160.49**
1979	**3.27**	**7.52**	**43.61**	**0.15**	**2.60**	**155.39**	**279.66**
1980	**3.08**	**10.14**	**55.63**	**0.19**	**2.89**	**170.84**	**373.34**
1981	**1.10**	**5.80**	**30.21**	**0.09**	**1.34**	**78.44**	**211.42**
1982	**0.02**	**8.68**	**50.86**	**0.21**	**1.14**	**88.77**	**279.02**
1983	**0.00**	**11.38**	**76.64**	**0.01**	**3.42**	**124.33**	**666.91**
1984	**0.28**	**22.71**	**69.73**	**0.28**	**1.59**	**114.00**	**622.20**
1985	**0.06**	**12.71**	**51.44**	**0.08**	**2.32**	**72.72**	**623.98**
1986	**0.36**	**13.84**	**30.73**	**0.10**	**4.26**	**78.53**	**858.28**
1987	**0.32**	**40.34**	**84.38**	**0.26**	**4.52**	**107.37**	**1202.52**
1988	**0.01**	**63.95**	**99.07**	**0.51**	**10.73**	**163.98**	**1775.47**
1989	**1.03**	**112.20**	**550.87**	**0.70**	**27.51**	**692.92**	**5322.07**
1990	**14.39**	**322.67**	**830.97**	**1.07**	**65.07**	**859.75**	**9308.58**
1991	**16.47**	**983.65**	**1332.93**	**3.82**	**51.05**	**1173.66**	**7770.72**
1992	**471.60**	**746.18**	**1379.39**	**4.11**	**77.86**	**2089.16**	**7757.00**
1993	**70.90**	**1054.90**	**2915.57**	**2.20**	**117.38**	**1581.75**	**7161.30**
1994	112.38	10.09	717.39	0.00	29.39	2145.64	5309.57
1995	51.43	31.91	2109.72	0.80	27.59	1159.32	3051.41
1996	199.71	79.48	2436.66	0.18	71.95	1234.55	9877.93
1997	181.84	239.29	3748.39	0.12	68.67	1014.86	5195.41
1998	343.60	63.56	3084.12	0.27	67.25	2264.86	7233.26
1999	443.87	132.34	3482.30	0.93	67.71	888.61	6327.13
2000	514.35	268.18	3472.49	4.77	73.93	1847.52	6659.84
2001	540.10	193.70	2826.88	5.31	52.79	856.79	8184.23
2002	366.24	114.21	2663.35	1.00	60.25	1239.88	8521.89
2003	163.09	168.07	4685.24	1.50	18.09	298.09	10082.51
2004	111.30	51.86	2950.85	0.04	4.11	62.78	11017.90
2005	231.26	47.84	3277.84	0.12	28.78	63.84	8869.66
2006	668.31	55.51	3581.54	2.62	44.68	129.68	10571.61
2007	89.11	98.34	4019.34	2.96	8.03	207.92	13510.25
1995-2007 proportions	2.3%	0.9%	25.1%	0.0%	0.4%	6.7%	64.6%

Draft Amendment 3
Landings Allocations

Year	barndoor	cleamose	little	rosette	smooth	thorny	winter
1964							
1965							
1966							
1967							
1968							
1969							
1970							
1971							
1972							
1973							
1974							
1975							
1976							
1977							
1978							
1979							
1980							
1981							
1982							
1983	7	4	397	0	1	60	387
1984	6	4	365	0	1	38	356
1985	8	5	472	0	1	28	459
1986	12	8	689	0	2	49	671
1987	17	11	1,011	0	3	34	985
1988	55	36	3,209	1	8	30	3,124
1989	94	61	5,456	2	14	15	5,311
1990	93	61	5,423	2	14	8	5,278
1991	103	67	5,993	2	15	14	5,834
1992	106	69	6,174	2	16	45	6,009
1993	72	47	4,200	1	11	124	4,088
1994	16.77	11.14	2670.78	0.24	14.20	125.25	4872.74
1995	20.77	26.26	3111.49	2.07	7.69	59.64	3278.95
1996	89.53	26.37	5992.46	1.38	23.97	37.76	7516.65
1997	175.97	153.33	6792.83	2.78	8.30	58.24	3635.79
1998	149.14	77.06	7706.28	1.37	13.45	121.04	6269.40
1999	154.25	89.01	6332.24	6.17	18.91	43.05	4622.77
2000	290.19	193.24	6984.79	1.95	9.16	39.53	5101.72
2001	336.13	91.00	6416.26	7.49	6.89	31.86	5767.17
2002	307.36	65.26	5704.98	1.59	9.87	27.33	6788.21
2003	52.19	30.63	6810.86	6.53	20.86	46.06	7892.06
2004	62.84	43.56	5422.44	2.91	6.27	23.77	9548.52
2005	63.69	54.31	6144.09	5.12	11.11	17.78	6948.28
2006	131.05	90.12	6854.99	9.72	28.64	24.22	8815.75
2007	152.35	104.76	7968.89	11.30	33.29	67.40	10248.26
1995-2007 proportions	1.2%	0.6%	47.7%	0.0%	0.1%	0.3%	50.1%

Table 2. Discard time series used in the rebuilding potential analysis and in estimating catch limits and targets associated with the median C/B exploitation ratio. Discards before 1993 were derived from the same source using DK ratios from the DPWS and the species composition using the selectivity ogive method.

Length composition method
Discards Allocations

Year	Barndoor	Clearnose	Little	Rosette	Smooth	Thorny	Winter
1964	13,820	-	9,422	169	1,551	61,225	17,508
1965	14,611	-	12,760	270	2,074	65,717	16,393
1966	10,627	-	11,229	-	1,113	70,109	16,502
1967	4,146	2,302	16,699	1,100	1,003	48,940	23,819
1968	5,752	3,702	16,402	80	1,525	49,761	19,941
1969	3,654	2,127	14,621	113	1,186	49,507	17,934
1970	1,704	720	11,916	129	816	44,796	14,752
1971	708	526	12,497	45	1,157	30,091	15,233
1972	845	-	9,328	-	732	29,592	16,374
1973	825	498	11,256	53	751	28,273	18,196
1974	739	555	11,467	53	698	26,139	19,910
1975	559	522	9,979	45	552	20,530	18,464
1976	529	619	11,031	48	551	20,357	21,615
1977	536	794	13,315	57	597	21,869	27,478
1978	553	1,062	16,834	71	673	24,380	36,423
1979	489	1,259	18,960	78	669	23,929	42,838
1980	375	1,372	19,726	80	607	21,374	46,381
1981	252	1,467	20,196	80	534	18,421	49,266
1982	6	1,914	27,399	151	365	17,074	52,965
1983	-	1,175	22,731	4	622	12,738	64,438
1984	27	2,400	20,160	124	259	11,205	63,077
1985	6	1,304	13,956	33	343	7,026	56,648
1986	32	1,231	7,755	37	540	6,826	65,596
1987	25	2,459	15,778	61	412	6,454	64,335
1988	2	2,841	11,538	118	732	6,856	67,492
1989	15	1,559	22,280	59	550	8,852	61,967
1990	129	3,595	26,349	47	1,016	9,050	85,647
1991	104	6,033	27,316	119	536	7,561	47,670
1992	1,766	3,371	18,290	90	577	9,299	34,270
1993	178	3,023	24,196	23	546	4,371	21,616
1994	871	6,956	40,319	204	1,037	14,161	31,239
1995	349	4,006	32,697	223	565	745	27,574
1996	108	5,315	33,937	407	350	482	21,953
1997	353	761	19,277	69	491	568	11,205
1998	265	3,218	34,173	218	755	1,134	25,728
1999	221	776	17,262	101	291	440	12,056
2000	1,392	1,581	18,272	176	342	582	13,392
2001	1,907	1,202	16,424	145	684	923	16,962
2002	2,398	1,411	17,266	77	582	852	17,523
2003	1,484	1,196	28,756	38	1,207	1,178	20,041
2004	1,450	1,521	17,493	48	1,590	721	24,138
2005	4,247	1,325	20,101	90	1,839	761	18,922
2006	4,254	738	13,486	46	1,126	595	15,890
2007	4,065	2,002	19,014	43	866	444	21,023
1995-2007 proportions	3.7%	4.1%	47.7%	0.3%	1.8%	1.6%	40.8%

Selectivity ogive method
Discards Allocations

Year	Barndoor	Clearnose	Little	Rosette	Smooth	Thorny	Winter
1964	13,820	-	9,422	169	1,551	61,225	17,508
1965	14,611	-	12,760	270	2,074	65,717	16,393
1966	10,627	-	11,229	-	1,113	70,109	16,502
1967	4,146	2,302	16,699	1,100	1,003	48,940	23,819
1968	5,752	3,702	16,402	80	1,525	49,761	19,941
1969	3,654	2,127	14,621	113	1,186	49,507	17,934
1970	1,704	720	11,916	129	816	44,796	14,752
1971	708	526	12,497	45	1,157	30,091	15,233
1972	845	-	9,328	-	732	29,592	16,374
1973	825	498	11,256	53	751	28,273	18,196
1974	739	555	11,467	53	698	26,139	19,910
1975	559	522	9,979	45	552	20,530	18,464
1976	529	619	11,031	48	551	20,357	21,615
1977	536	794	13,315	57	597	21,869	27,478
1978	553	1,062	16,834	71	673	24,380	36,423
1979	489	1,259	18,960	78	669	23,929	42,838
1980	375	1,372	19,726	80	607	21,374	46,381
1981	252	1,467	20,196	80	534	18,421	49,266
1982	6	1,914	27,399	151	365	17,074	52,965
1983	-	1,175	22,731	4	622	12,738	64,438
1984	27	2,400	20,160	124	259	11,205	63,077
1985	6	1,304	13,956	33	343	7,026	56,648
1986	32	1,231	7,755	37	540	6,826	65,596
1987	25	2,459	15,778	61	412	6,454	64,335
1988	2	2,841	11,538	118	732	6,856	67,492
1989	15	1,559	22,280	59	550	8,852	61,967
1990	129	3,595	26,349	47	1,016	9,050	85,647
1991	104	6,033	27,316	119	536	7,561	47,670
1992	1,766	3,371	18,290	90	577	9,299	34,270
1993	178	3,023	24,196	23	546	4,371	21,616
1994	374	13,349	52,307	715	543	5,121	22,379
1995	149	5,927	36,530	495	285	1,375	21,398
1996	184	3,796	36,009	141	243	1,423	20,754
1997	169	1,459	20,126	61	377	2,294	8,239
1998	752	5,477	36,308	297	893	4,301	17,462
1999	313	4,417	17,927	562	129	331	7,468
2000	730	2,721	21,407	79	198	785	9,818
2001	679	3,484	18,196	178	300	764	14,647
2002	574	2,872	21,077	236	227	860	14,261
2003	1,090	2,124	32,340	321	443	2,040	15,542
2004	1,784	2,571	22,535	121	493	1,284	18,173
2005	2,159	2,366	24,497	269	774	1,635	15,585
2006	2,730	1,577	18,271	106	516	942	11,991
2007	1,155	6,897	23,544	412	171	1,010	14,269
	2.1%	7.6%	54.4%	0.5%	0.8%	3.2%	31.4%

Draft Amendment 3
Discards Allocations

Year	Barndoor	Clearnose	Little	Rosette	Smooth	Thorny	Winter
1964							
1965							
1966							
1967							
1968							
1969							
1970							
1971							
1972							
1973							
1974							
1975							
1976							
1977							
1978							
1979							
1980							
1981							
1982							
1983	49,231	15,635	64,866	15,635	15,635	49,231	64,866
1984	49,231	15,635	64,866	15,635	15,635	49,231	64,866
1985	49,231	15,635	64,866	15,635	15,635	49,231	64,866
1986	49,231	15,635	64,866	15,635	15,635	49,231	64,866
1987	49,231	15,635	64,866	15,635	15,635	49,231	64,866
1988	49,231	15,635	64,866	15,635	15,635	49,231	64,866
1989	51,051	7,616	58,667	7,616	7,616	51,051	58,667
1990	71,832	11,161	82,993	11,161	11,161	71,832	82,993
1991	41,045	13,229	54,273	13,229	13,229	41,045	54,273
1992	48,876	29,345	78,221	29,345	29,345	48,876	78,221
1993	33,351	16,822	50,173	16,822	16,822	33,351	50,173
1994	32,212	30,651	62,863	30,651	30,651	32,212	62,863
1995	33,895	21,027	54,922	21,027	21,027	33,895	54,922
1996	27,517	17,937	45,454	17,937	17,937	27,517	45,454
1997	18,714	9,687	28,401	9,687	9,687	18,714	28,401
1998	34,513	13,800	48,314	13,800	13,800	34,513	48,314
1999	19,042	4,203	23,246	4,203	4,203	19,042	23,246
2000	29,204	8,215	37,419	8,215	8,215	29,204	37,419
2001	31,951	2,774	34,725	2,774	2,774	31,951	34,725
2002	34,086	9,828	43,914	9,828	9,828	34,086	43,914
2003	36,959	10,831	47,791	10,831	10,831	36,959	47,791
2004	28,132	3,984	32,116	3,984	3,984	28,132	32,116
2005	19,895	4,900	24,796	4,900	4,900	19,895	24,796
2006	11,001	3,581	14,582	3,581	3,581	11,001	14,582
2007	11,001	3,581	14,582	3,581	3,581	11,001	14,582
	17.5%	6.0%	23.5%	6.0%	6.0%	17.5%	23.5%

Table 3. Survey stratified mean biomass time series used in the rebuilding potential analysis and in estimating catch limits and targets associated with the median C/B exploitation ratio.

Change in Biomass

Year	Barndoor	Clearnose	Little	Rosette	Smooth	Thorny	Winter
1964					-34%		
1965	50%				46%		
1966	-55%				-32%		
1967	-46%				-53%		0%
1968	-35%			-84%	154%	63%	-14%
1969	-81%			-39%	-25%	29%	-29%
1970	23%			369%	-20%	29%	128%
1971	157%			-85%	-32%	-27%	-64%
1972	-44%			1094%	111%	-23%	174%
1973	-96%			-28%	-6%	11%	58%
1974	-100%			3%	-60%	-33%	-55%
1975				-66%	-39%	-19%	-37%
1976	181%	28%		478%	-49%	-30%	102%
1977	-100%	154%	3%	-17%	870%	87%	54%
1978		-80%	3%	-64%	20%	33%	22%
1979		168%	-53%	42%	-60%	-16%	3%
1980	-100%	64%	239%	766%	89%	27%	22%
1981		-75%	-32%	-12%	-65%	-27%	-9%
1982		25%	142%	-92%	-68%	-81%	47%
1983		-34%	58%	-83%	278%	273%	55%
1984		27%	-28%	2791%	36%	20%	4%
1985	-60%	72%	53%	-82%	6%	0%	-31%
1986	642%	78%	-56%	-50%	0%	-43%	72%
1987	-53%	-41%	68%	971%	-54%	-42%	-30%
1988	-46%	5%	10%	-25%	198%	58%	-32%
1989	-35%	-19%	31%	-17%	-55%	27%	-33%
1990	479%	47%	-25%	29%	51%	-10%	41%
1991	10%	130%	20%	-78%	-14%	-4%	-34%
1992	-92%	-63%	-12%	586%	-24%	-41%	-24%
1993	5698%	43%	42%	-38%	79%	72%	-47%
1994	-75%	90%	-52%	240%	-56%	-9%	11%
1995	220%	-65%	-21%	-46%	90%	-48%	-6%
1996	-62%	30%	164%	10%	-7%	4%	15%
1997	149%	43%	-64%	-70%	32%	4%	8%
1998	-15%	83%	176%	284%	-88%	-24%	53%
1999	237%	-6%	34%	34%	149%	-26%	36%
2000	-4%	-2%	-14%	-51%	118%	74%	-14%
2001	89%	56%	-20%	267%	86%	-60%	-11%
2002	43%	-45%	-6%	-57%	-61%	31%	44%
2003	-29%	-26%	1%	-36%	71%	70%	-40%
2004	134%	7%	11%	42%	13%	-4%	19%
2005	-20%	-26%	-55%	37%	-39%	-68%	-35%
2006	13%	1%	3%	-8%	61%	225%	-5%
2007	-32%	60%		17%	-58%	-56%	50%

Change in Biomass 3 year moving average

Year	Barndoor	Clearnose	Little	Rosette	Smooth	Thorny	Winter
1964							
1965							
1966							
1967							
1968					-34%	6%	
1969	-80%				-26%	-24%	
1970	-87%				-5%	15%	
1971	-81%				-21%	22%	
1972	-57%			9%	-13%	31%	32%
1973	-33%			111%	-12%	-20%	41%
1974	-66%			231%	13%	-36%	81%
1975	-94%			6%	-29%	-40%	15%
1976	-76%			37%	-70%	-48%	-30%
1977	-36%			20%	-36%	-37%	-17%
1978	129%			83%	70%	-8%	45%
1979	-86%			-7%	324%	54%	134%
1980	-86%	-4%		120%	99%	69%	103%
1981	-81%	4%	8%	246%	-26%	25%	45%
1982	-100%	-20%	116%	362%	-50%	-23%	42%
1983	-100%	-58%	155%	-20%	-69%	-49%	64%
1984	14%	-58%	208%	-80%	-40%	-49%	103%
1985		-41%	119%	-80%	11%	-5%	75%
1986		97%	21%	-57%	103%	16%	43%
1987	372%	120%	2%	0%	34%	-8%	5%
1988	263%	92%	-22%	46%	6%	-50%	-3%
1989	-40%	-10%	25%	80%	-18%	-42%	-38%
1990	-14%	-14%	22%	69%	18%	-7%	-45%
1991	27%	33%	41%	-13%	-17%	29%	-51%
1992	136%	80%	0%	-7%	-4%	0%	-35%
1993	328%	74%	13%	-1%	-14%	-16%	-48%
1994	175%	11%	-7%	185%	-8%	-21%	-55%
1995	362%	6%	-14%	114%	6%	-8%	-61%
1996	8%	-4%	-25%	155%	-11%	-27%	-38%
1997	45%	-23%	-20%	-26%	32%	-41%	-12%
1998	-18%	23%	27%	-20%	-15%	-41%	41%
1999	162%	64%	43%	-16%	-29%	-36%	77%
2000	162%	133%	98%	57%	-58%	-20%	97%
2001	379%	71%	43%	108%	17%	-29%	57%
2002	226%	27%	9%	58%	67%	-19%	23%
2003	177%	-1%	-24%	38%	133%	-23%	-3%
2004	132%	-39%	-21%	-40%	1%	15%	-3%
2005	79%	-46%	-23%	-29%	-3%	5%	-28%
2006	87%	-44%	-30%	-17%	-5%	10%	-29%
2007	14%	-16%		47%	-16%	-32%	-32%

Stratified mean biomass (kg/tow)

Year	Barndoor	Clearnose	Little	Rosette	Smooth	Thorny	Winter
1964	1.21				0.33		
1965	1.82				0.48		
1966	0.81				0.32		
1967	0.44			0.02	0.15		2.16
1968	0.28			0.00	0.39	4.42	1.86
1969	0.05			0.00	0.29	5.71	1.32
1970	0.07			0.01	0.23	7.35	3.00
1971	0.17			0.00	0.16	5.36	1.08
1972	0.10			0.02	0.33	4.12	2.96
1973	0.00			0.01	0.31	4.56	4.69
1974	-			0.01	0.12	3.04	2.10
1975	0.02	0.24		0.00	0.08	2.47	1.31
1976	0.05	0.30		0.02	0.04	1.72	2.66
1977	-	0.77	1.35	0.02	0.38	3.22	4.10
1978	-	0.16	1.39	0.01	0.45	4.29	4.99
1979	0.01	0.42	0.65	0.01	0.18	3.61	5.12
1980	-	0.68	2.21	0.09	0.34	4.60	6.23
1981	-	0.17	1.50	0.08	0.12	3.34	5.67
1982	-	0.21	3.63	0.01	0.04	0.65	8.31
1983	-	0.14	5.72	0.00	0.15	2.41	12.85
1984	0.01	0.18	4.09	0.03	0.20	2.89	13.32
1985	0.00	0.31	6.26	0.01	0.21	2.88	9.18
1986	0.03	0.54	2.75	0.00	0.21	1.63	15.80
1987	0.01	0.32	4.63	0.03	0.10	0.94	11.06
1988	0.01	0.34	5.08	0.02	0.28	1.49	7.56
1989	0.00	0.27	6.63	0.02	0.13	1.88	5.08
1990	0.03	0.40	4.99	0.02	0.19	1.70	7.15
1991	0.03	0.92	5.99	0.01	0.17	1.63	4.72
1992	0.00	0.34	5.30	0.03	0.13	0.96	3.58
1993	0.14	0.49	7.52	0.02	0.23	1.66	1.91
1994	0.03	0.94	3.62	0.07	0.10	1.51	2.12
1995	0.11	0.33	2.87	0.04	0.19	0.78	1.99
1996	0.04	0.43	7.57	0.04	0.18	0.81	2.28
1997	0.10	0.61	2.71	0.01	0.23	0.85	2.46
1998	0.09	1.12	7.47	0.05	0.03	0.65	3.75
1999	0.30	1.05	9.98	0.07	0.07	0.48	5.09
2000	0.29	1.03	8.60	0.03	0.15	0.83	4.38
2001	0.54	1.61	6.84	0.12	0.29	0.33	3.89
2002	0.78	0.89	6.44	0.05	0.11	0.44	5.60
2003	0.55	0.66	6.49	0.03	0.19	0.74	3.39
2004	1.29	0.71	7.22	0.05	0.21	0.71	4.03
2005	1.04	0.52	3.24	0.06	0.13	0.22	2.61
2006	1.17	0.53	3.32	0.06	0.21	0.73	2.48
2007	0.80	0.85		0.07	0.09	0.32	3.71

Rebuilding prospects

For each managed skate species, the response of survey biomass to changes in catch was examined using the same procedures described in Document 5 of the DEIS Appendix I and the above three catch time series. The results are shown in Figure 1 to Figure 14. This analysis shows whether catch or the relative exploitation ratio (C/B) had any measurable effect on biomass. The top graphs of each panel show a linear least squares regression line and the median value. A negative slope is indicative that high catches lead to low biomass, and vice versa, as would be expected. Positive slopes or no slope are counterintuitive meaning among other things that other factors had more influence over changes in biomass than did the estimated catches.

As was recognized in Document 5 of Appendix I, the relationship between changes in biomass and the catch/biomass ratio are not completely independent, because biomass appears in the denominator of ordinate and the numerator of the abscissa. As a result, the null hypothesis that the slope is significantly different than zero is invalid. Instead, an alternative null hypothesis was developed using a randomization procedure to estimate a slope that resulted if the data were chosen on the basis of random choice alone, but are not truly independent variables.

A randomization test was performed where the change in the three year moving average of biomass and the three year moving average catch/biomass ratio were randomly chosen with replacement, over 1000 iterations in a 20 year artificial time series. The red dashed regression line in each time series represents a threshold where the null hypothesis should be rejected with 95% confidence when the realized slope is less (i.e. more negative). The red dot in each figure represents 2007.

In the Amendment 3 draft, smooth, thorny, and winter skates (all three overfished species) were thought to have a significant relationship between catches and changes in biomass, based on the preponderance of data that biomass increased more frequently when the C/B ratio was below the median value. Other skate species had no such relationship or the slope was counter intuitively positive. The lack of a relationship was attributed to uncertainty in the catch time series, or potentially lagged and poorly understood population dynamics.

The new catch time series and the randomizing test for a significant slope changes this perception. For both sets of winter skate catch estimates (Figure 1 and Figure 2), the C/B slope is not significantly different than no relationship (i.e. cannot reject the null hypothesis with 95% confidence), although the biomass increased 17 out of 19 times for an average of a 54% annual increase when the C/B ratio was below the median. This might have more to do with autocorrelations, because the years with high biomass in the mid-1980s are all clustered below the C/B median.

Thorny skate (Figure 3 and Figure 4) exhibits a flat slope and essentially no relationship between these values, for either catch time series. On the other hand, there does seem to be a significant relationship between C/B and changes in survey biomass for smooth skate (Figure 5 and Figure 6). This relationship appears to be driven by just five years of data, and for the rest of the time series there appears to be no difference in changes in biomass at high catch rates vs. low catch rates.

For rosette skate, the slope between the C/B ratio and changes in biomass are significant and negative, but again this appears to be driven by just two points, which may be related to transient oceanographic conditions in two survey years. Little, clearnose, and barndoor skate all exhibit a flat, non-significant slope.

Even though the relationship between the C/B ratio and changes in skate biomass appear in some cases to make sense and indicate that low catches are more likely than not to cause increases in biomass and rebuilding, none of the relationships are very strong and are probably not very predictive of rebuilding potential at lower catch levels.

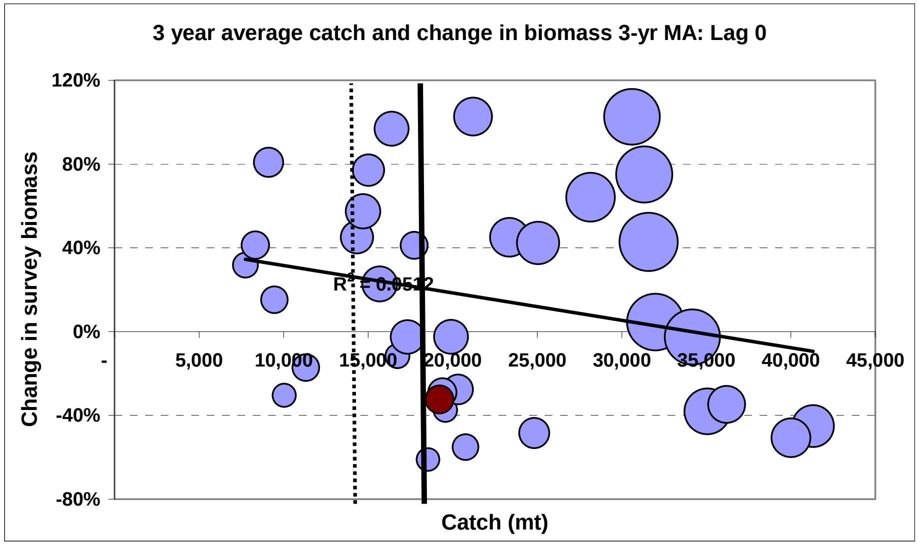
Calculation of catch limits

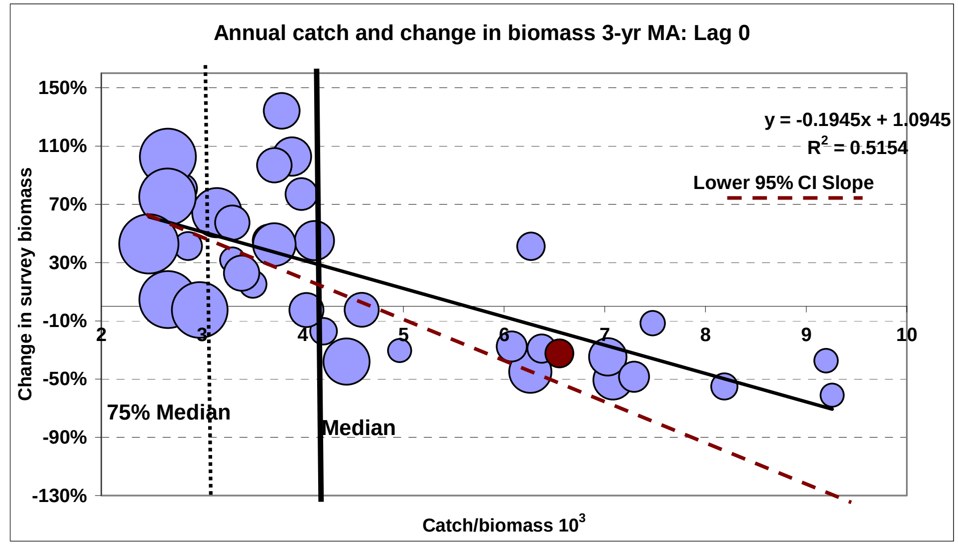
Catch limits and targets defined by the median catch/biomass ratio applied to the annual 3 year moving averages for survey biomass and aggregated over species are shown in Table 4 to Table 8. Using the Draft Amendment 3 catch time series, the perception was that in 2006, catch was close to the target (ACT) and landings were slightly above the TAL. Landings in 2007 had however exceeded the 2007 TAL (the TAL declined due to lower stratified mean biomass[7] values) and landings were approaching the catch target (which includes both landings and discards). It was anticipated that the discard rate in 2007 would be the same as that in 2006, or might have declined from the effects of Framework 42. Due to the increasing landings in 2007 it was however anticipated that the total catch would be above the ABC and that reductions in landings and catch were required. Amendment 3 proposed alternatives to reduce 2007 landings to the TAL. To meet the target, wing fishery landings would need to decline by 45% and bait fishery landings by 43%[8].

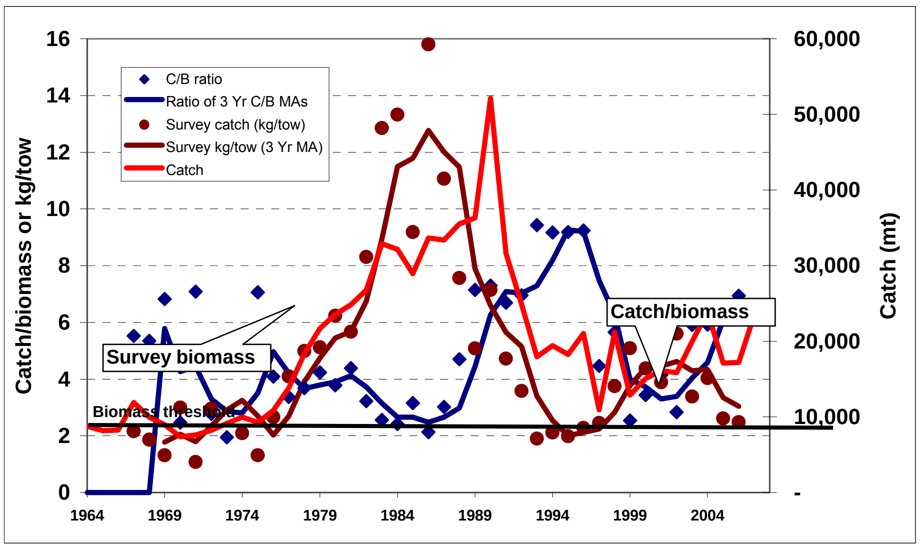
In contrast, the new discard estimates for 2004-2006 are substantially higher than previous estimates. As in the Amendment 3 DEIS, 2007 landings are near the catch target (or ACT). Instead of declining by 65%, the new discard estimates are flat or even increasing in recent years. Thus the fraction of total catch attributable to discards is much higher using these new estimates and results in a much lower TAL. Without action to reduce skate discards, the analyses using the new catch data (Figure 16 and Figure 17) indicate that it would take a 57-60% reduction in skate wing landings and a 63-65% reduction in skate bait landings to prevent the catch from exceeding the ACT.

[7] A considerable portion of the survey biomass decline arises from 2004 dropping out of the three year moving average.
[8] These re-estimated TALs are slightly

Figure 1. Relationship for winter skate between three year moving average of catch (length composition method) and biomass with no lag.







Catch thresholds and historic change in biomass

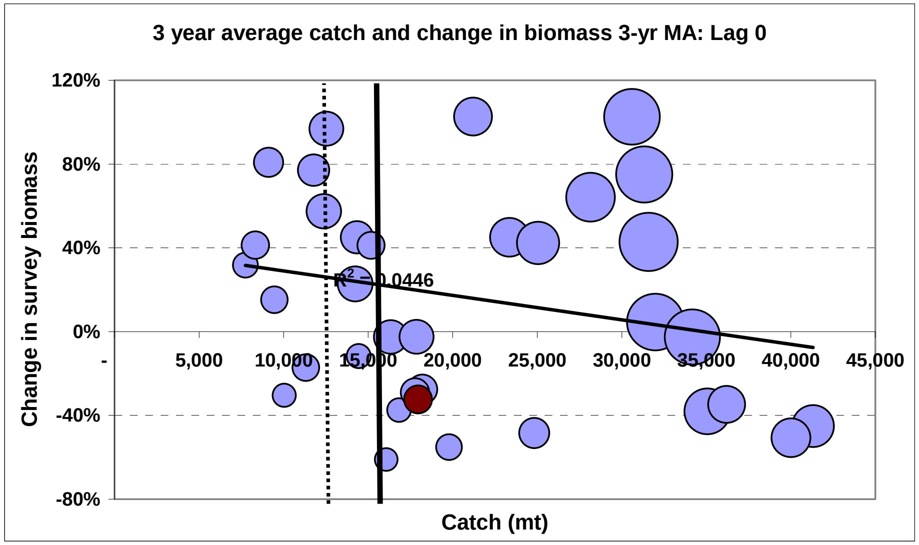
Catch

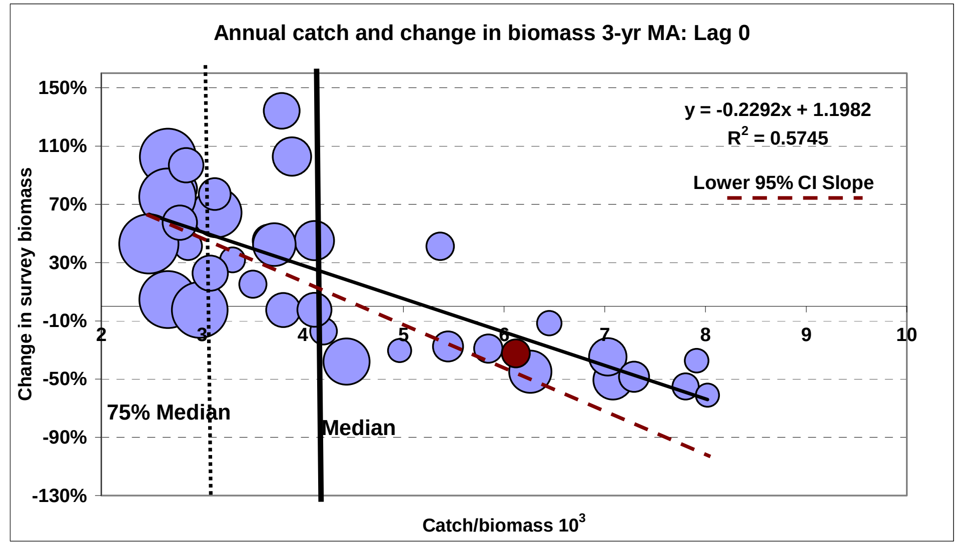
	Limit (mt)	Threshold	Biomass change Up	Down	Average	Δ2004-2006
		All	19	16	16.5%	
Maximum	41,320	Above median	8	12	0.7%	
Median	18,255	Below Median	11	4	42.9%	-6%
80% of media	14,604	Below 80%	5	2	30.5%	-25%
Percentile	31%					

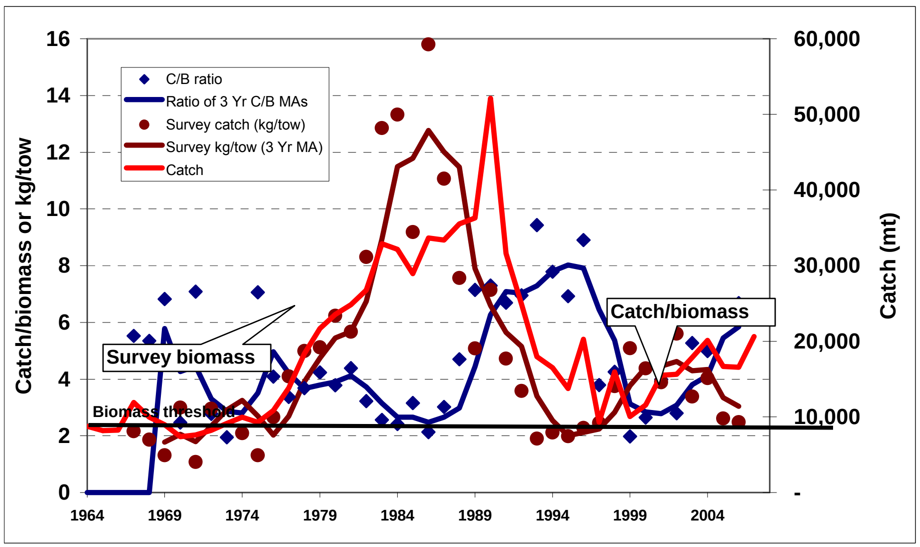
Catch/biomass ratio

	Limit	Threshold	Biomass change Up	Down	Average	Limit (mt)	Δ2004-2006
		All	19	16	16.5%		
Maximum	9.26	Above median	2	14	-27.2%		
Median	4.12	Below Median	17	2	54.5%	12,087	-38%
75% of media	3.09	Below 75%	6	1	49.5%	9,065	-53%
Percentile	17%						

Figure 2. Relationship for winter skate between three year moving average of catch (selectivity ogive method) and biomass with no lag.







Catch thresholds and historic change in biomass

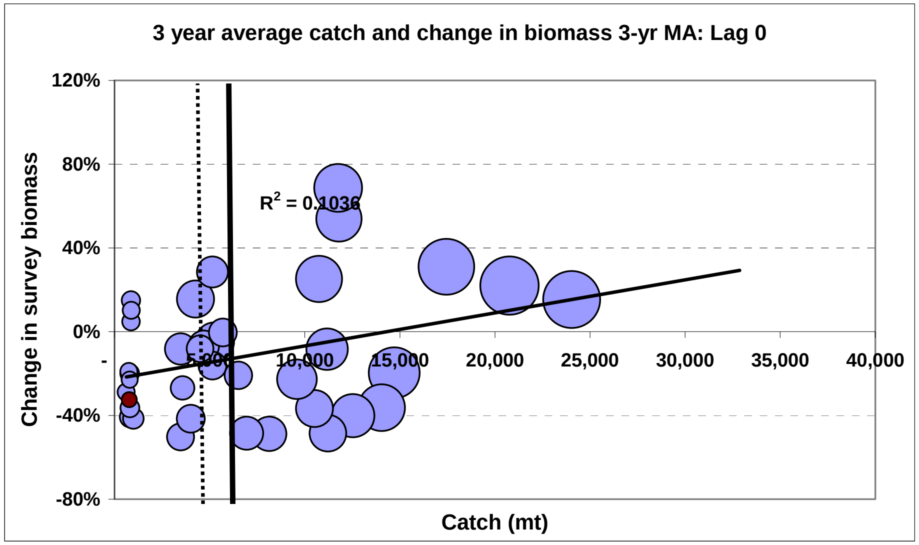
Catch

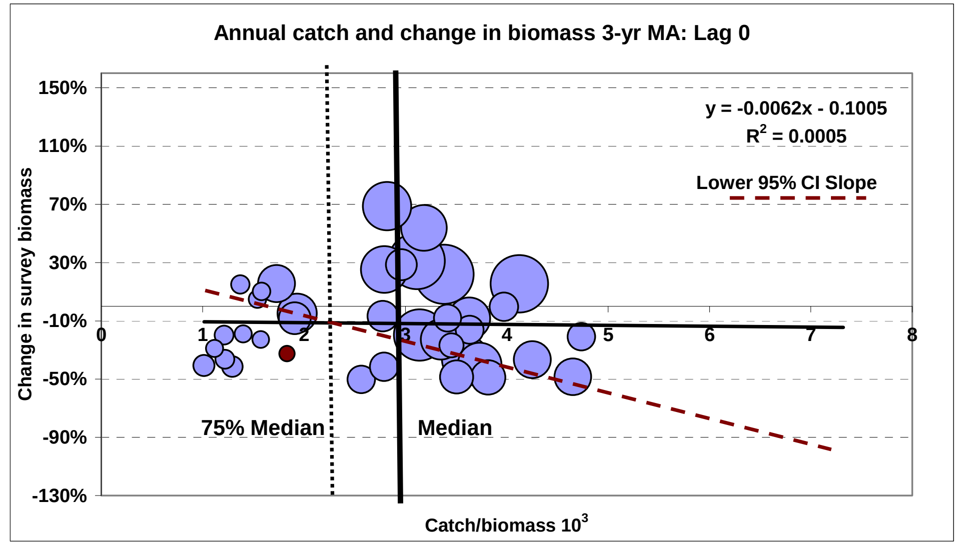
	Limit (mt)	Threshold	Biomass change Up	Down	Average	Δ2004-2006
		All	19	16	16.5%	
Maximum	41,320	Above median	9	11	10.4%	
Median	16,586	Below Median	10	5	33.9%	-7%
80% of media	13,269	Below 80%	7	2	44.5%	-25%
Percentile	35%					

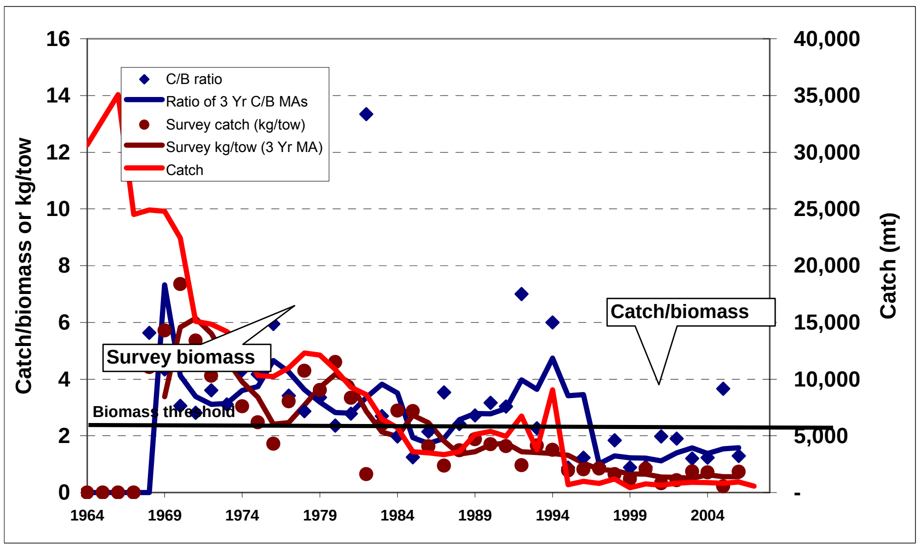
Catch/biomass ratio

		Threshold	Biomass change Up	Down	Average	Limit (mt)	Δ2004-2006
		All	19	16	16.5%		
Maximum	8.02	Above median	2	14	-27.2%		
Median	4.12	Below Median	17	2	54.5%	12,087	-32%
75% of media	3.09	Below 75%	9	1	52.4%	9,065	-49%
Percentile	24%						

Figure 3. Relationship for thorny skate between three year moving average of catch (length composition method) and biomass with no lag.







Catch thresholds and historic change in biomass

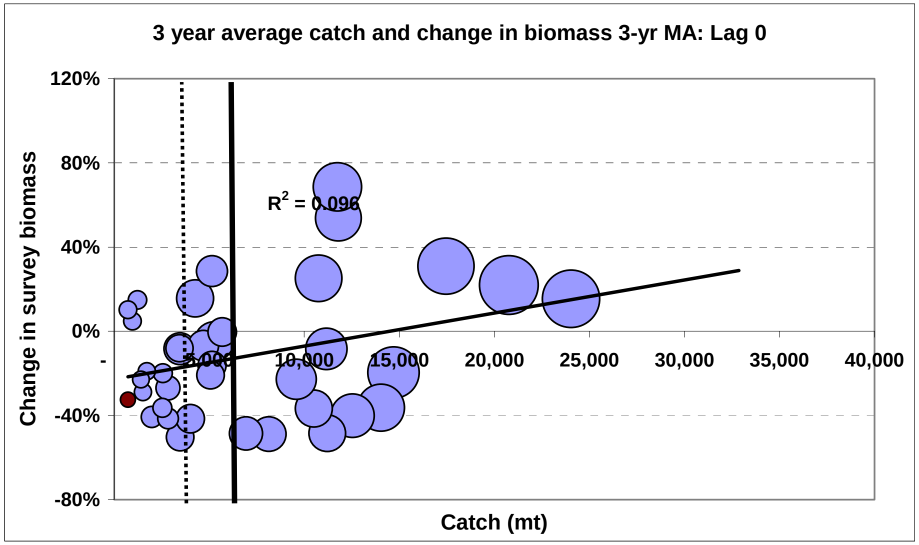
Catch

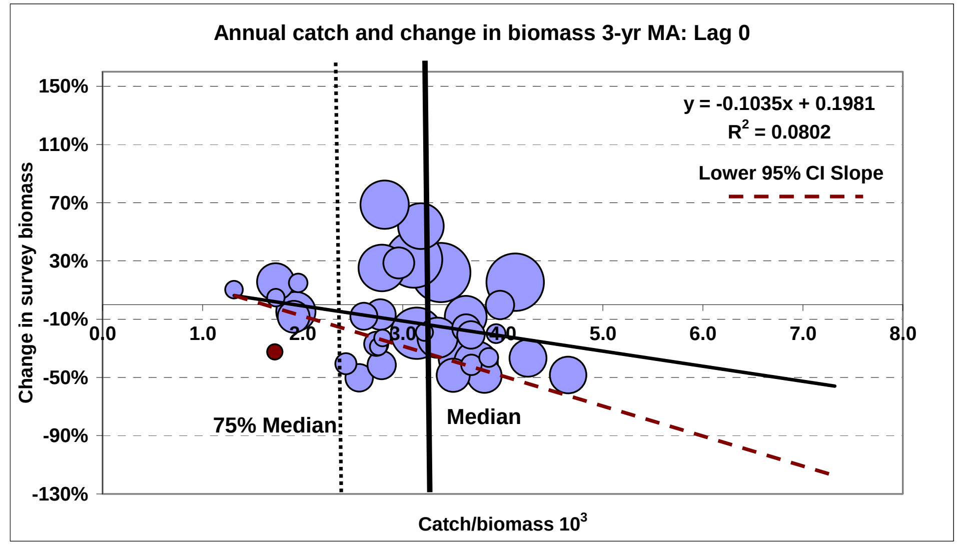
	Limit (mt)	Threshold	Biomass change Up	Down	Average	Δ2004-2006
		All	11	26	-11.8%	
Maximum	32,864	Above median	6	10	-9.5%	
Median	5,479	Below Median	5	16	3.5%	524%
80% of media	4,383	Below 80%	4	12	2.8%	399%
Percentile	38%					

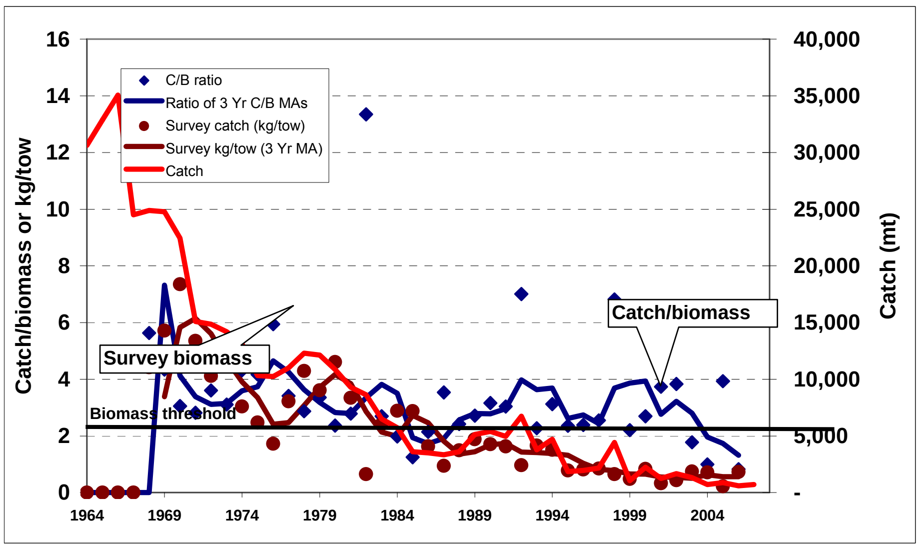
Catch/biomass ratio

		Threshold	Biomass change Up	Down	Average	Limit (mt)	Δ2004-2006
		All	11	26	-11.8%		
Maximum	7.32	Above median	5	13	-12.9%		
Median	2.96	Below Median	6	13	7.3%	1,258	43%
75% of media	2.22	Below 75%	4	10	3.2%	944	8%
Percentile	35%						

Figure 4. Relationship for thorny skate between three year moving average of catch (selectivity ogive method) and biomass with no lag.







Catch thresholds and historic change in biomass

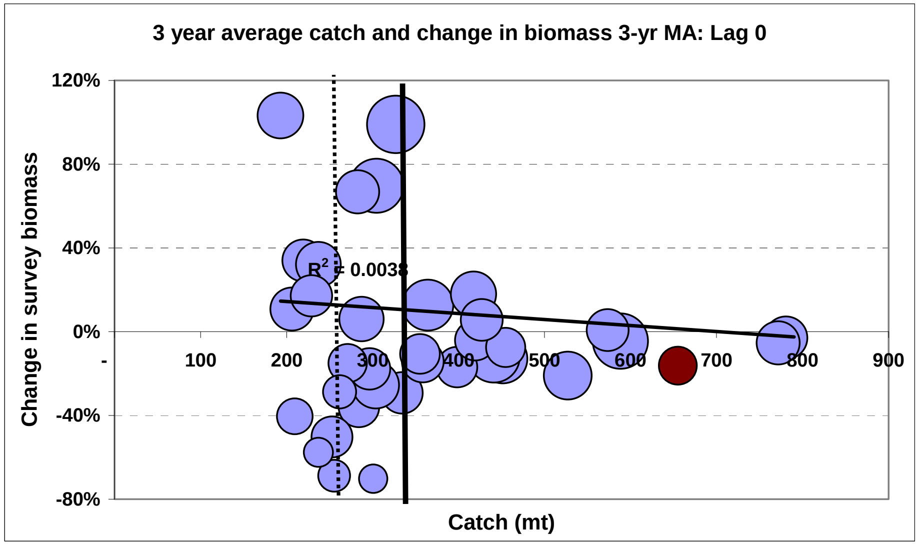
Catch

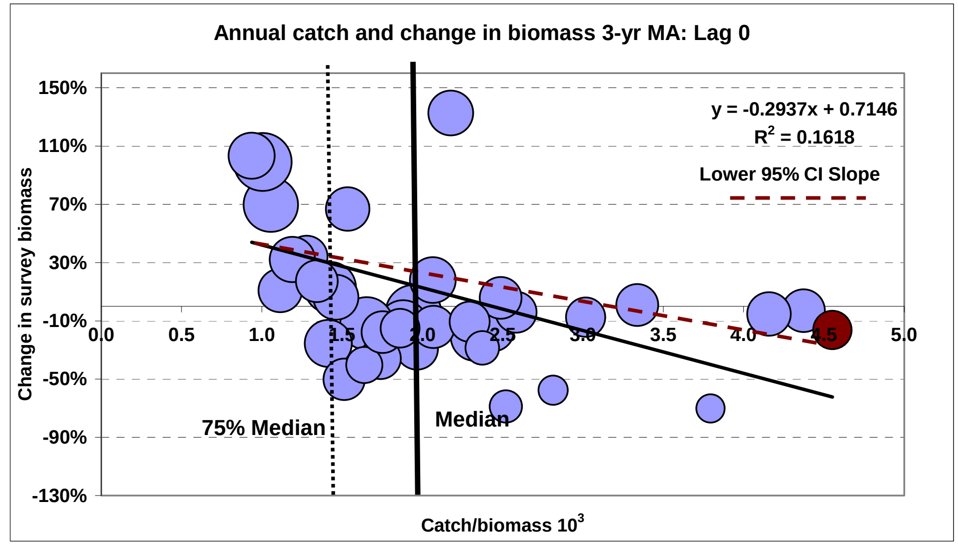
	Limit (mt)	Threshold	Biomass change Up	Down	Average	Δ2004-2006
		All	11	26	-11.8%	
Maximum	32,864	Above median	6	10	-8.5%	
Median	5,209	Below Median	5	16	3.5%	615%
80% of media	4,167	Below 80%	3	13	1.9%	472%
Percentile	38%					

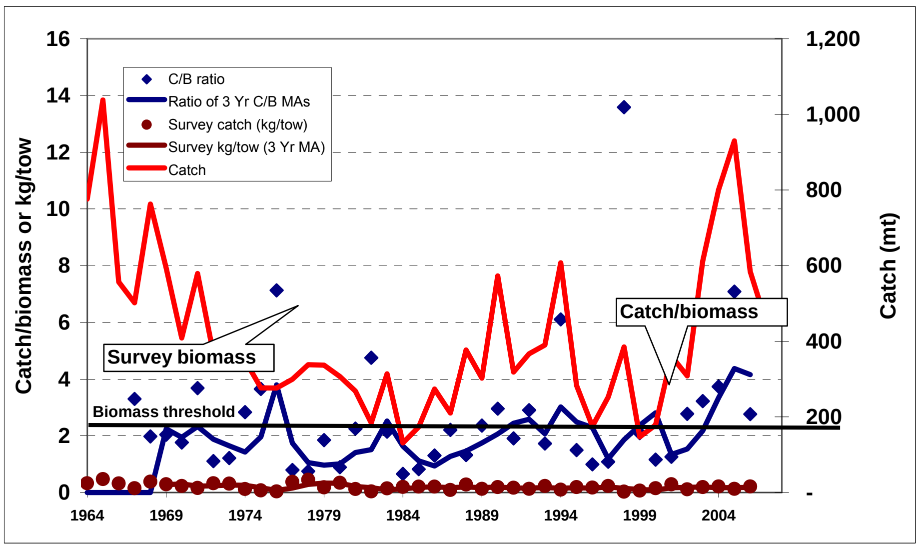
Catch/biomass ratio

		Threshold	Biomass change Up	Down	Average	Limit (mt)	Δ2004-2006
		All	11	26	-11.8%		
Maximum	7.32	Above median	3	15	-20.7%		
Median	3.14	Below Median	8	11	10.5%	1,335	83%
75% of media	2.36	Below 75%	4	3	6.5%	1,001	37%
Percentile	18%						

Figure 5. Relationship for smooth skate between three year moving average of catch (length composition method) and biomass with no lag.







Catch thresholds and historic change in biomass

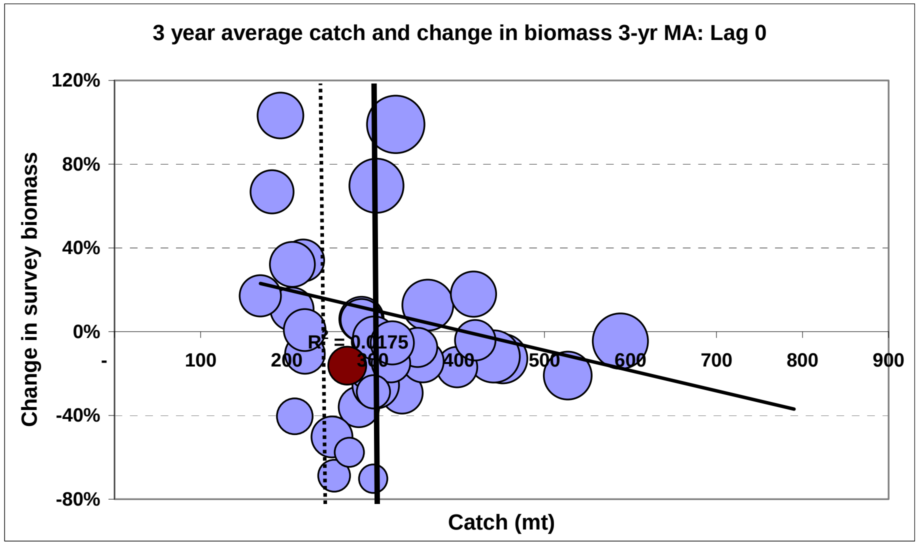
Catch

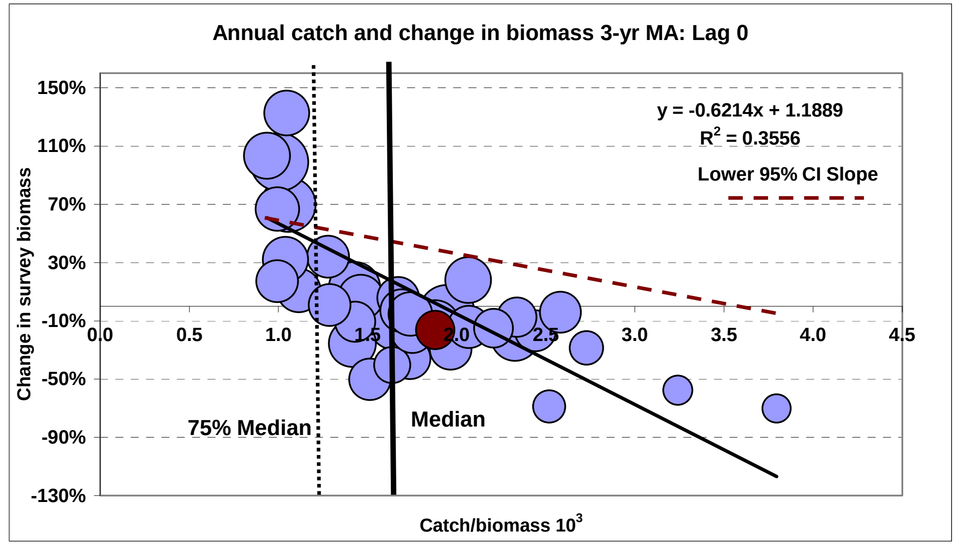
	Limit (mt)	Threshold	Biomass change Up	Down	Average	Δ2004-2006
		All	15	22	9.6%	
Maximum	790	Above median	5	11	4.2%	
Median	345	Below Median	10	11	36.3%	-55%
80% of media	276	Below 80%	5	6	17.9%	-64%
Percentile	25%					

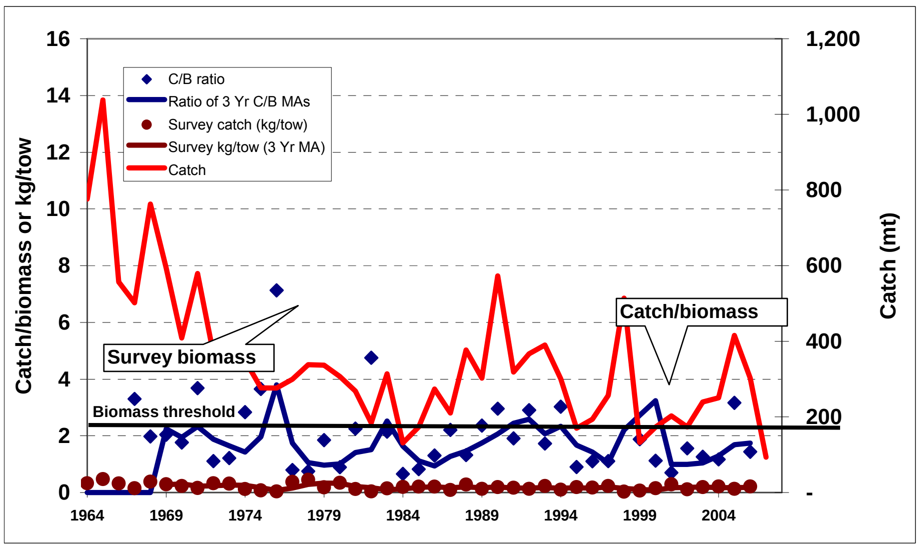
Catch/biomass ratio

			Biomass change Up	Down	Average	Limit (mt)	Δ2004-2006
		All	15	22	9.6%		
Maximum	4.55	Above median	4	14	-11.2%		
Median	1.95	Below Median	11	8	40.8%	280	-64%
75% of media	1.46	Below 75%	9	1	70.2%	210	-73%
Percentile	26%						

Figure 6. Relationship for smooth skate between three year moving average of catch (selectivity ogive method) and biomass with no lag.







Catch thresholds and historic change in biomass

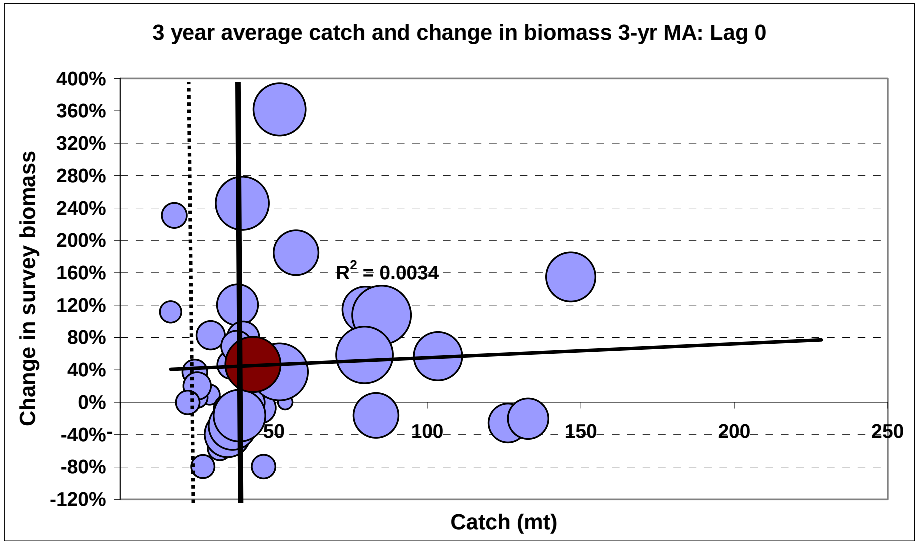
Catch

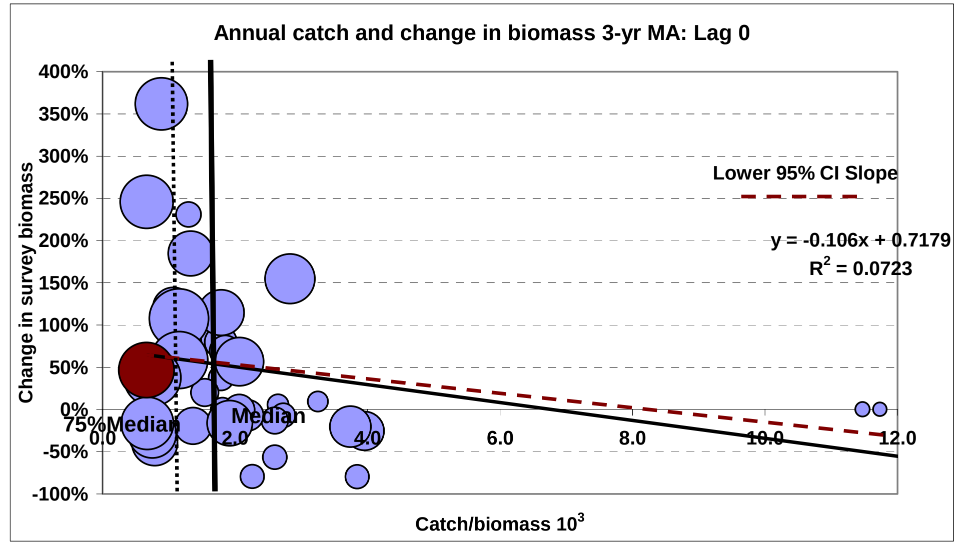
	Limit (mt)	Threshold	Biomass change Up	Down	Average	Δ2004-2006
		All	15	22	9.6%	
Maximum	790	Above median	5	11	23.8%	
Median	303	Below Median	10	11	19.5%	-6%
80% of media	242	Below 80%	8	2	39.7%	-25%
Percentile	24%					

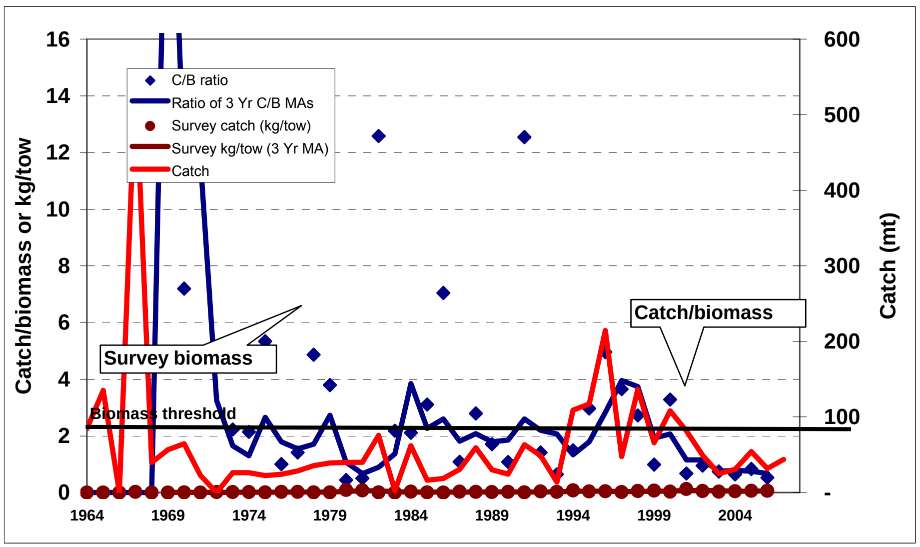
Catch/biomass ratio

		Threshold	Biomass change Up	Down	Average	Limit (mt)	Δ2004-2006
		All	15	22	9.6%		
Maximum	3.79	Above median	1	17	-22.9%		
Median	1.69	Below Median	14	5	48.1%	243	-25%
75% of media	1.27	Below 75%	9	0	95.0%	183	-43%
Percentile	24%						

Figure 7. Relationship for rosette skate between three year moving average of catch (length composition method) and biomass with no lag.







Catch thresholds and historic change in biomass

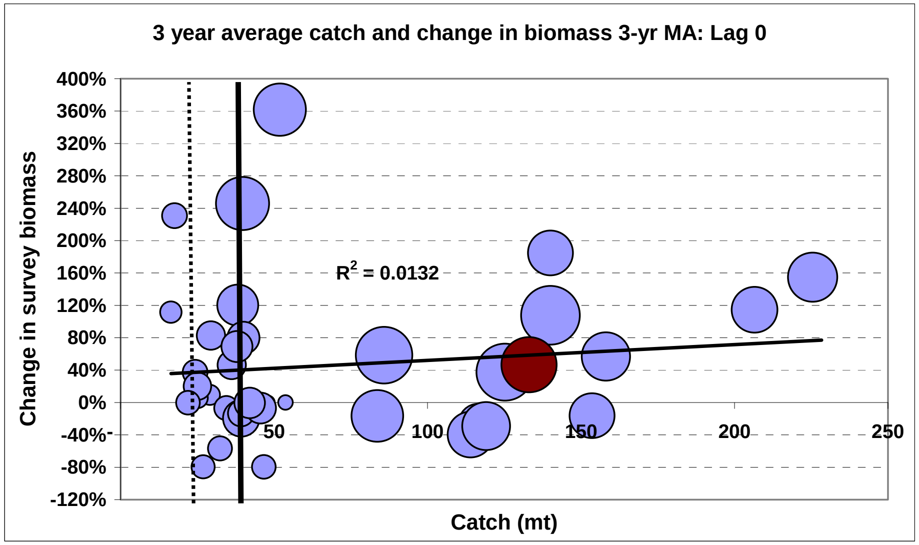
Catch

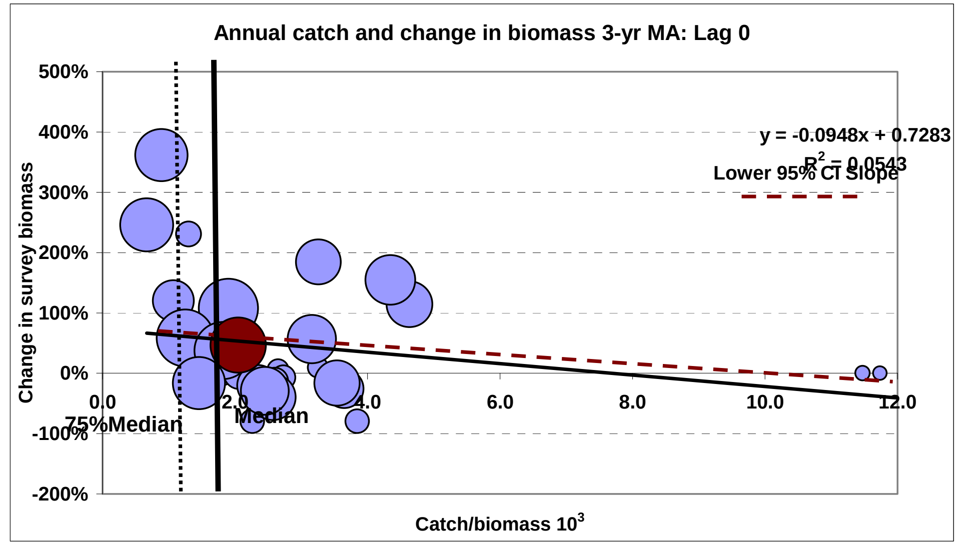
	Limit (mt)	Threshold	Biomass change Up	Down	Average	Δ2004-2006
		All	22	15	46.5%	
Maximum	228	Above median	10	6	60.8%	
Median	41	Below Median	12	9	50.4%	6%
80% of media	33	Below 80%	7	3	49.7%	-16%
Percentile	22%					

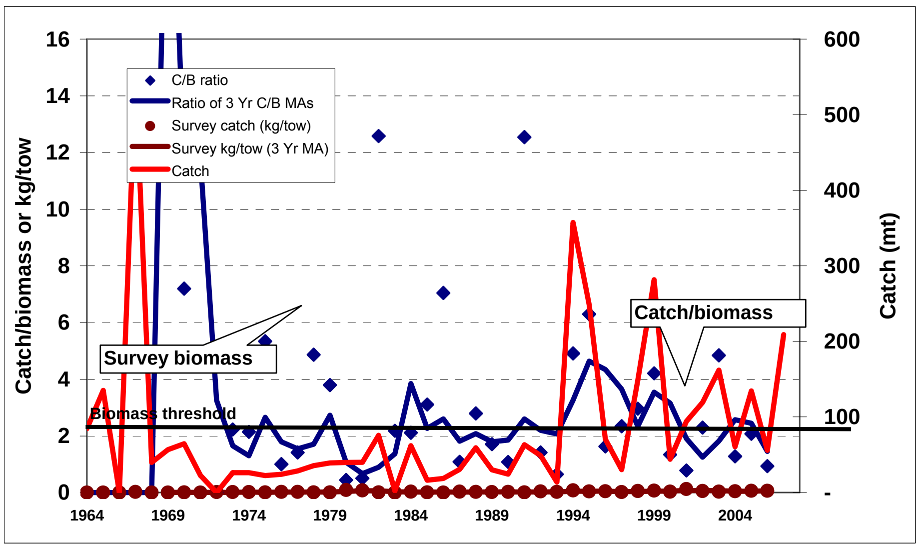
Catch/biomass ratio

			Biomass change Up	Down	Average	Limit (mt)	Δ2004-2006
		All	22	15	46.5%		
Maximum	26.36	Above median	7	11	2.0%		
Median	1.81	Below Median	15	4	96.8%	118	203%
75% of media	1.36	Below 75%	9	3	116.1%	88	128%
Percentile	31%						

Figure 8. Relationship for rosette skate between three year moving average of catch (selectivity ogive method) and biomass with no lag.







Catch thresholds and historic change in biomass

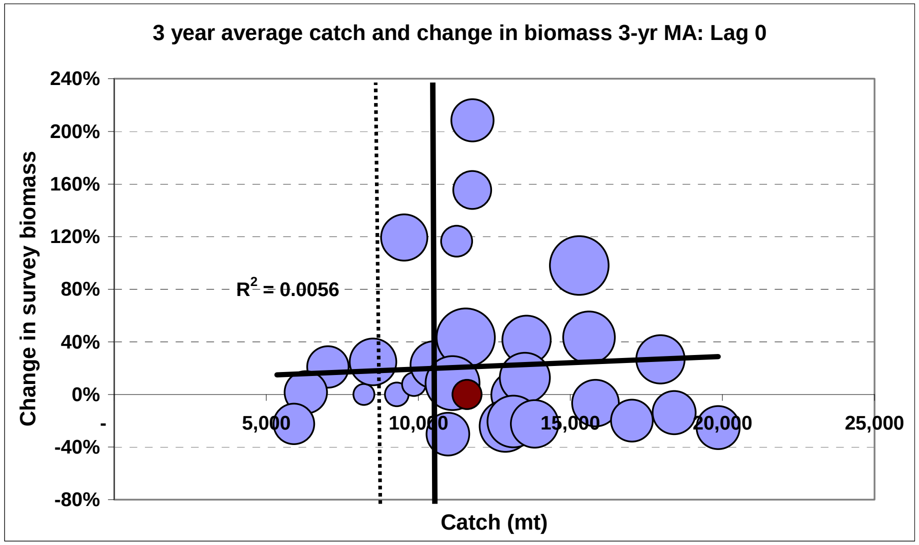
Catch

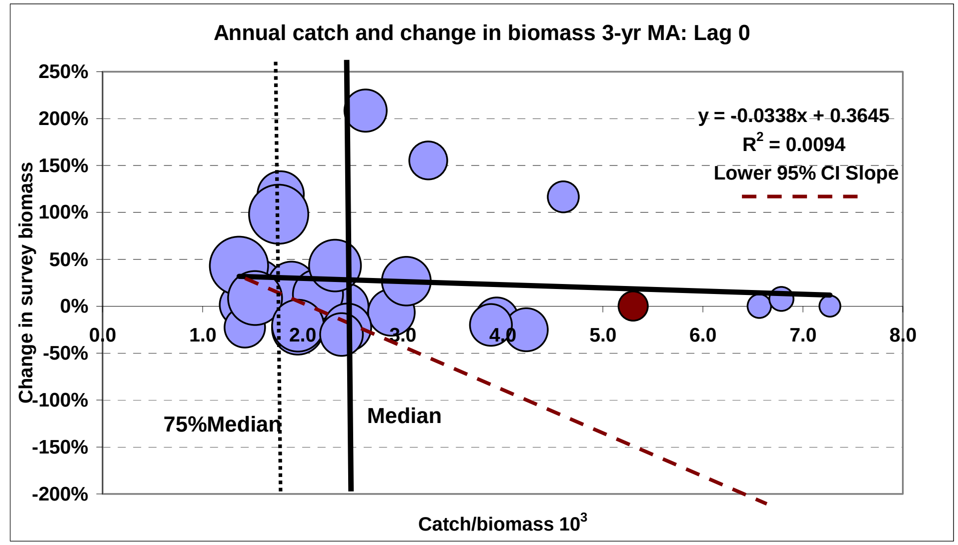
	Limit (mt)	Threshold	Biomass change Up	Down	Average	Δ2004-2006
		All	22	15	46.5%	
Maximum	228	Above median	10	6	60.9%	
Median	47	Below Median	12	9	50.4%	-43%
80% of media	38	Below 80%	8	4	45.3%	-55%
Percentile	29%					

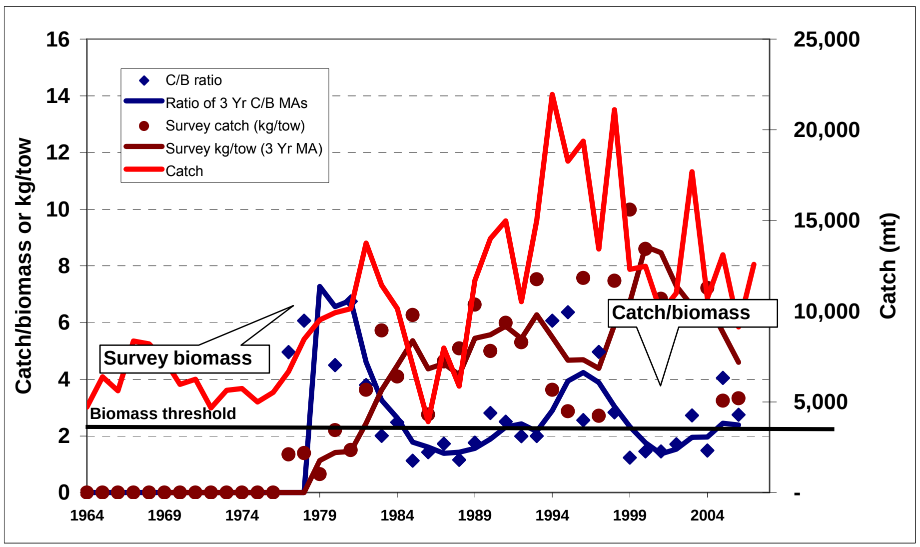
Catch/biomass ratio

		Threshold	Biomass change Up	Down	Average	Limit (mt)	Δ2004-2006
		All	22	15	46.5%		
Maximum	26.36	Above median	7	11	8.4%		
Median	2.19	Below Median	15	4	87.1%	143	70%
75% of media	1.65	Below 75%	6	2	129.6%	107	28%
Percentile	21%						

Figure 9. Relationship for little skate between three year moving average of catch (length composition method) and biomass with no lag.







Catch thresholds and historic change in biomass

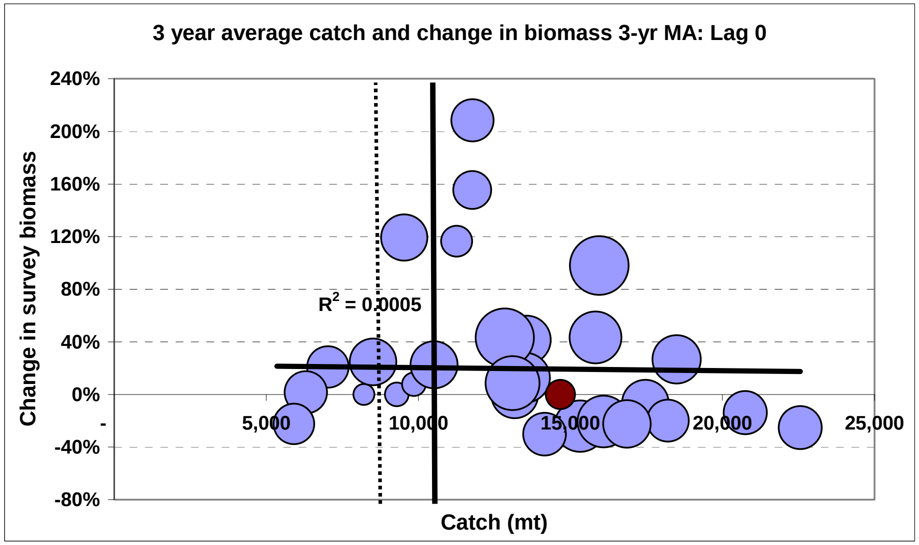
Catch

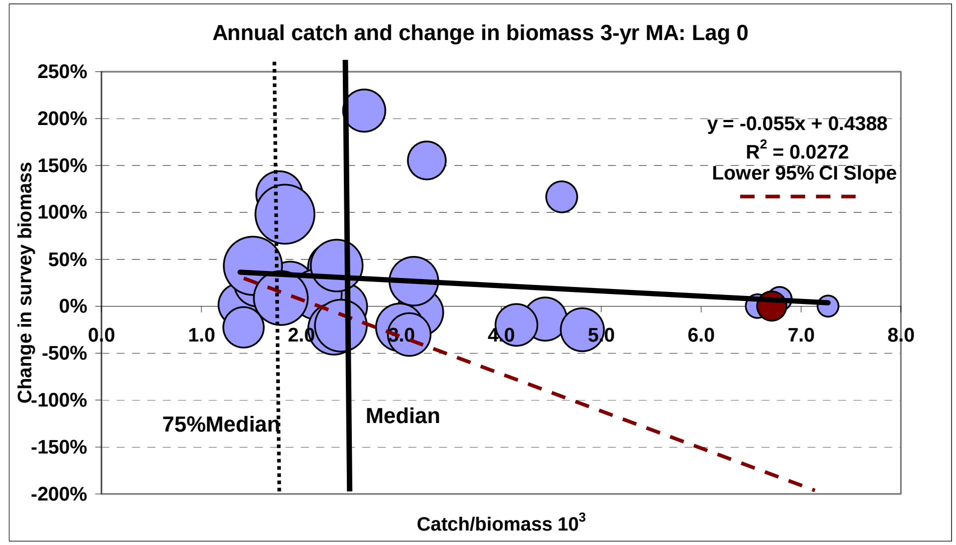
	Limit (mt)	Threshold	Biomass change Up	Down	Average	Δ2004-2006
		All	27	10	20.1%	
Maximum	19,866	Above median	22	9	19.8%	
Median	10,189	Below Median	5	1	29.0%	-7%
80% of media	8,151	Below 80%	2	1	7.5%	-26%
Percentile	38%					

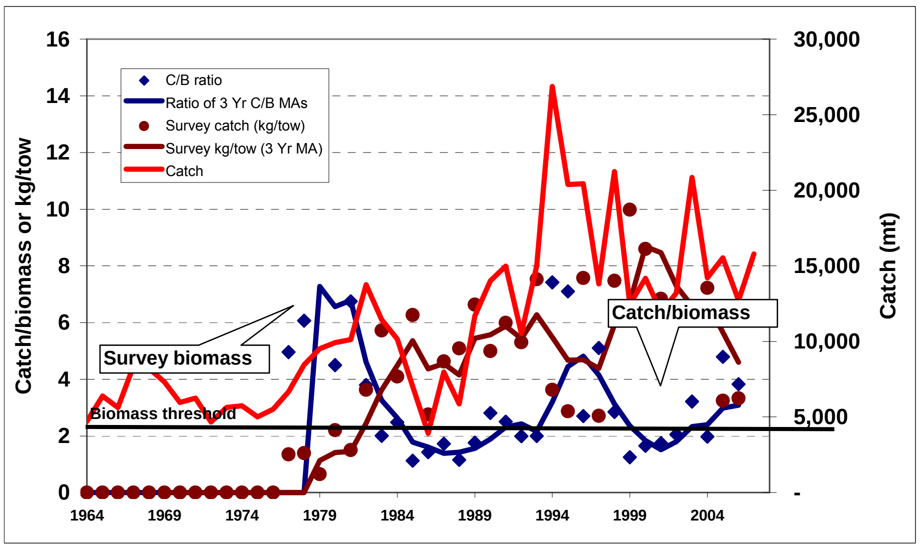
Catch/biomass ratio

			Biomass change Up	Down	Average	Limit (mt)	Δ2004-2006
		All	27	10	20.1%		
Maximum	7.27	Above median	16	7	17.2%		
Median	2.39	Below Median	11	3	31.1%	5,230	-52%
75% of media	1.79	Below 75%	7	1	39.5%	3,922	-64%
Percentile	25%						

Figure 10. Relationship for little skate between three year moving average of catch (selectivity ogive method) and biomass with no lag.







Catch thresholds and historic change in biomass

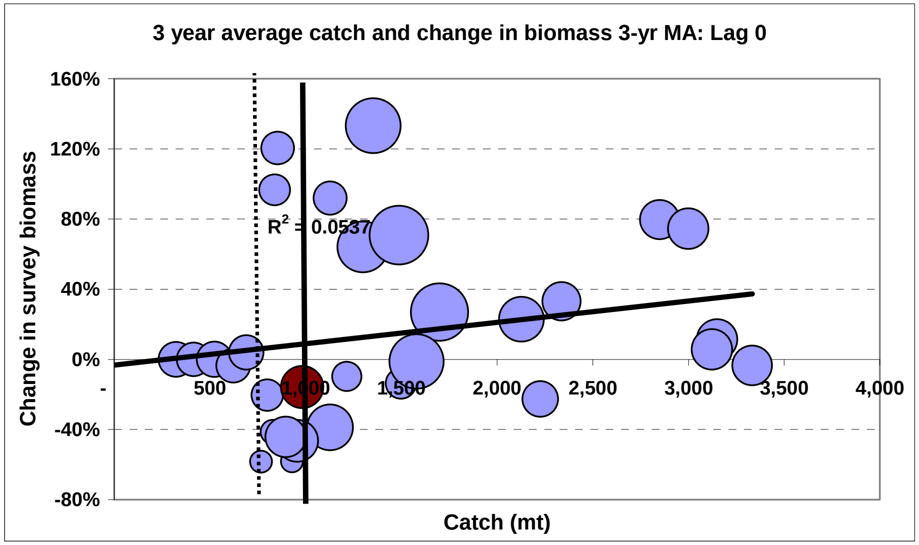
Catch

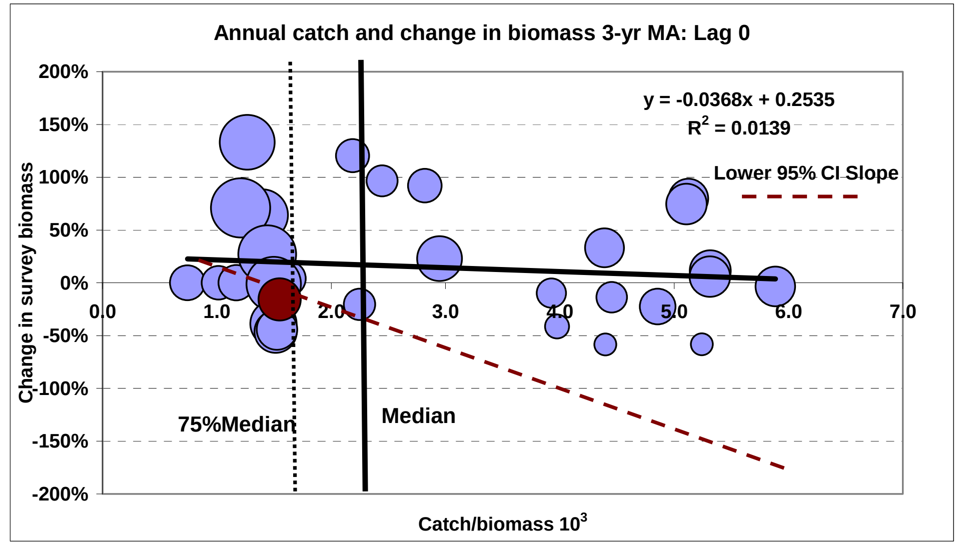
	Limit (mt)	Threshold	Biomass change Up	Down	Average	Δ2004-2006
		All	27	10	20.1%	
Maximum	22,562	Above median	22	9	19.8%	
Median	10,189	Below Median	5	1	29.0%	-28%
80% of media	8,151	Below 80%	2	1	7.5%	-42%
Percentile	38%					

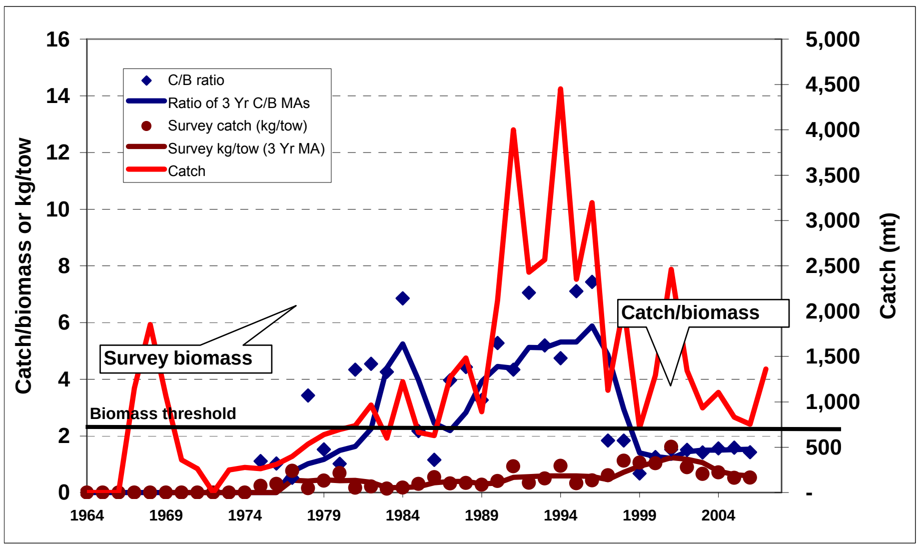
Catch/biomass ratio

			Biomass change Up	Down	Average	Limit (mt)	Δ2004-2006
		All	27	10	20.1%		
Maximum	7.27	Above median	16	7	17.2%		
Median	2.43	Below Median	11	3	31.1%	5,312	-62%
75% of media	1.82	Below 75%	6	1	31.1%	3,984	-72%
Percentile	24%						

Figure 11. Relationship for clearnose skate between three year moving average of catch (length composition method) and biomass with no lag.







Catch thresholds and historic change in biomass

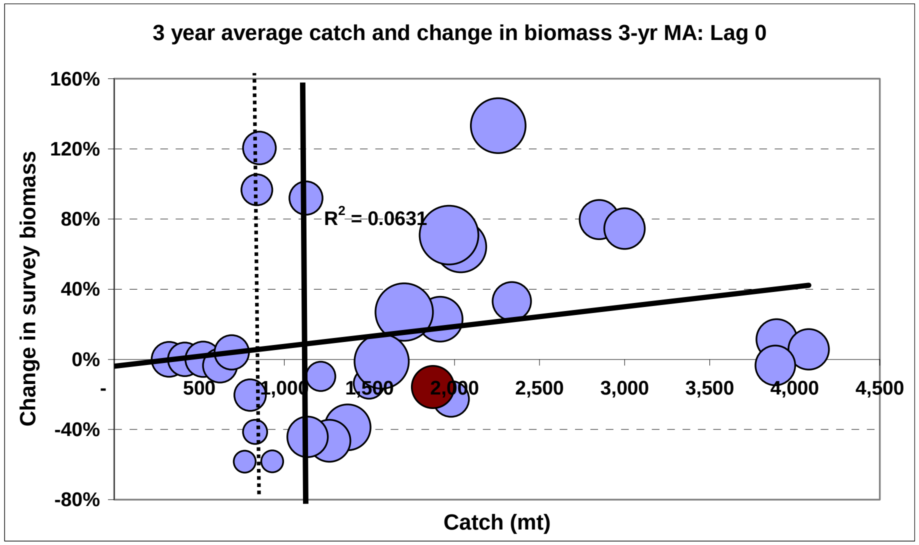
Catch

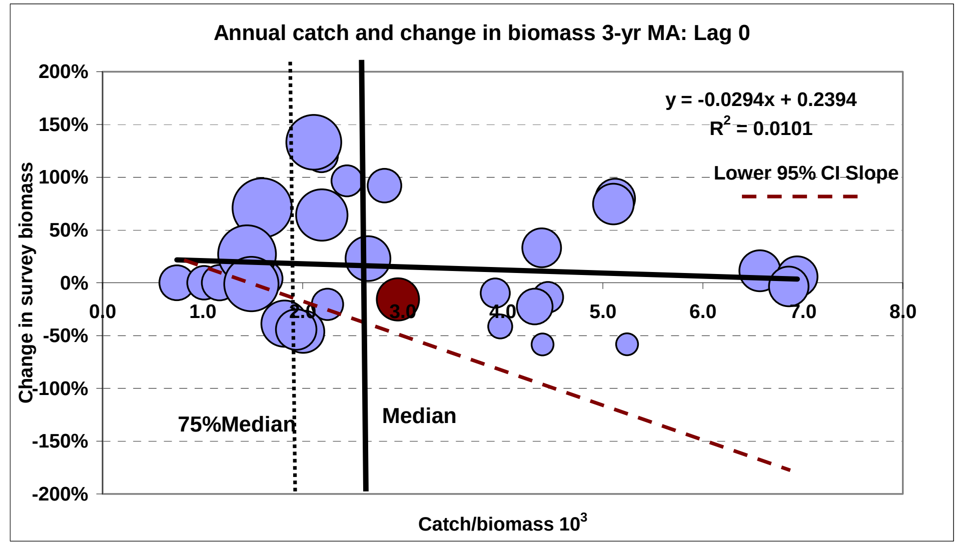
	Limit (mt)	Threshold	Biomass change Up	Down	Average	Δ2004-2006
		All	24	13	12.0%	
Maximum	3,334	Above median	21	6	18.8%	
Median	969	Below Median	3	7	22.1%	8%
80% of medi	776	Below 80%	1	2	1.3%	-13%
Percentile	32%					

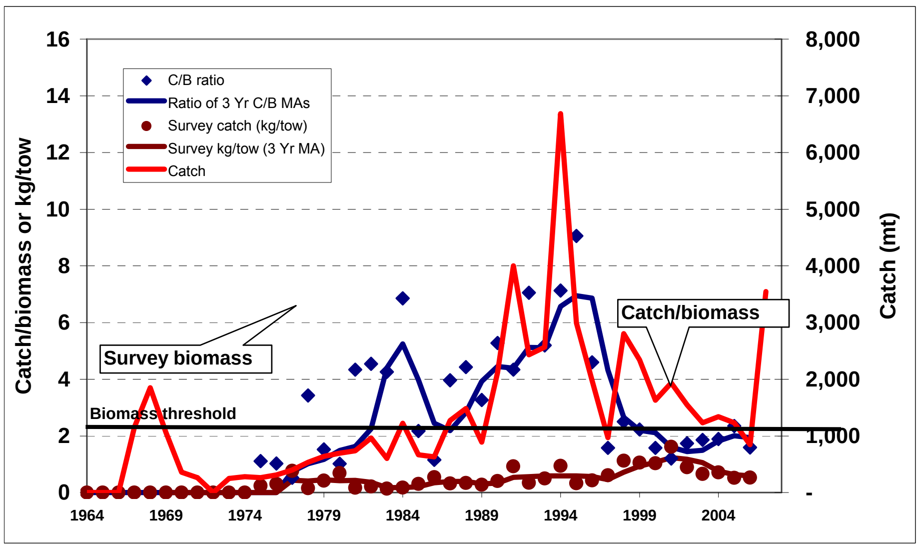
Catch/biomass ratio

		Threshold	Biomass change Up	Down	Average	Limit (mt)	Δ2004-2006
		All	24	13	12.0%		
Maximum	5.89	Above median	18	7	7.5%		
Median	2.25	Below Median	6	6	34.9%	1,427	59%
75% of medi	1.69	Below 75%	5	6	27.2%	1,070	19%
Percentile	44%						

Figure 12. Relationship for clearnose skate between three year moving average of catch (selectivity ogive method) and biomass with no lag.







Catch thresholds and historic change in biomass

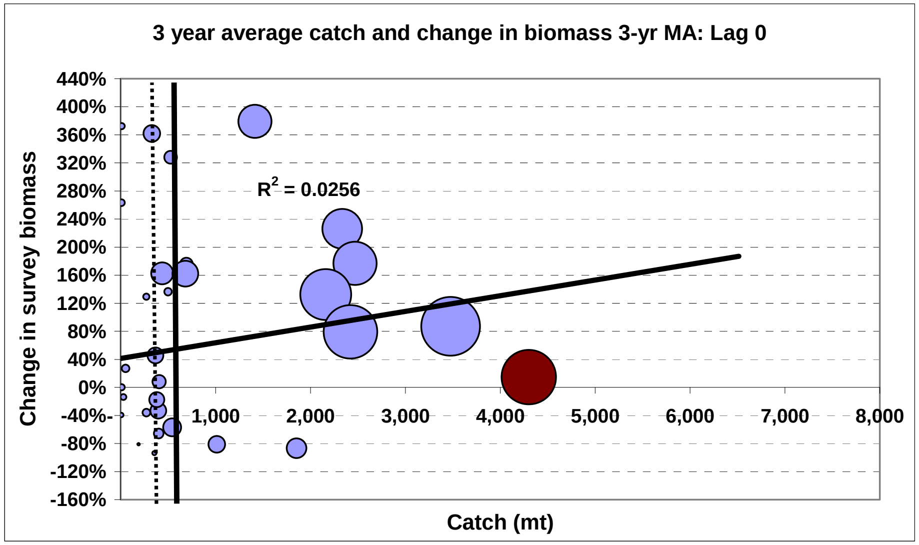
Catch

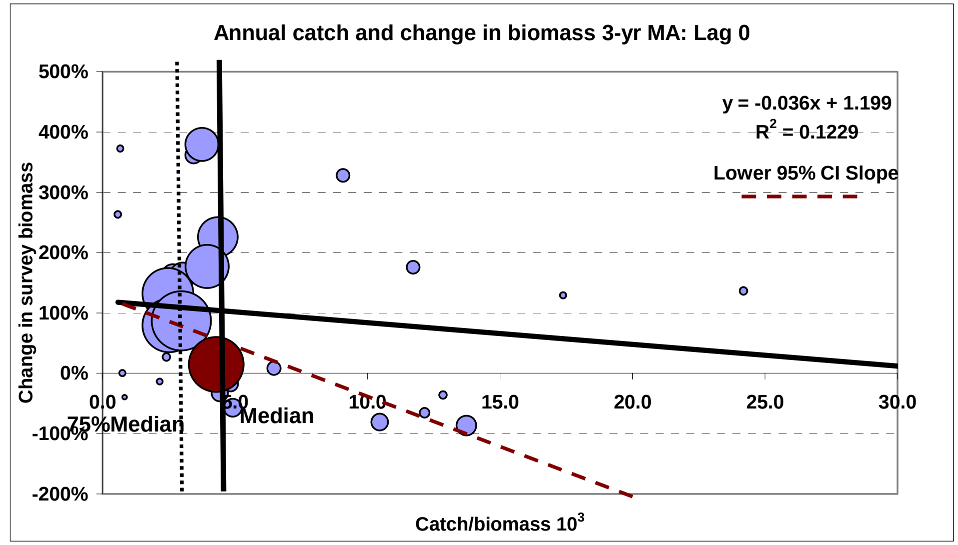
	Limit (mt)	Threshold	Biomass change Up	Down	Average	Δ2004-2006
		All	24	13	12.0%	
Maximum	4,082	Above median	21	8	14.4%	
Median	1,110	Below Median	3	5	27.6%	-2%
80% of media	888	Below 80%	3	4	31.5%	-22%
Percentile	43%					

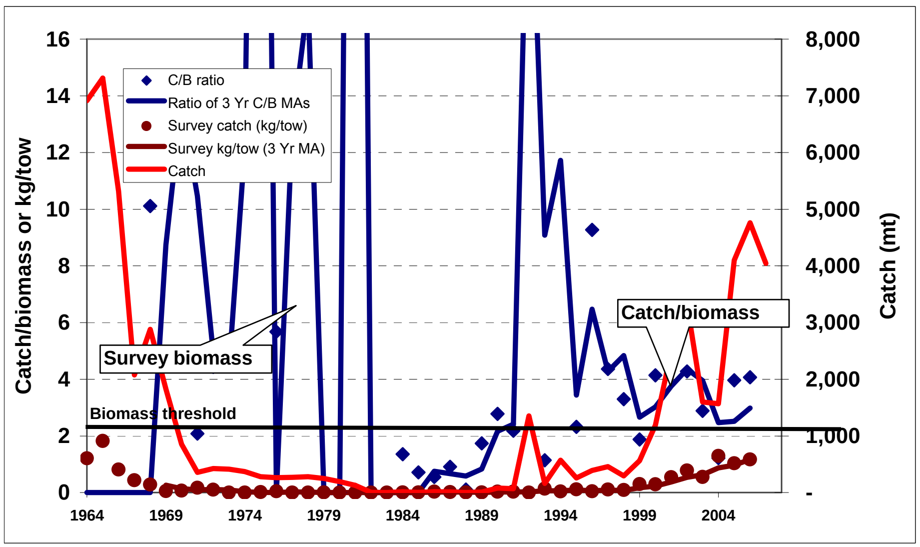
Catch/biomass ratio

	Limit	Threshold	Biomass change Up	Down	Average	Limit (mt)	Δ2004-2006
		All	24	13	12.0%		
Maximum	6.94	Above median	18	7	7.7%		
Median	2.44	Below Median	6	6	34.9%	1,551	36%
75% of media	1.83	Below 75%	3	3	16.9%	1,164	2%
Percentile	27%						

Figure 13. Relationship for barndoor skate between three year moving average of catch (length composition method) and biomass with no lag.







Catch thresholds and historic change in biomass

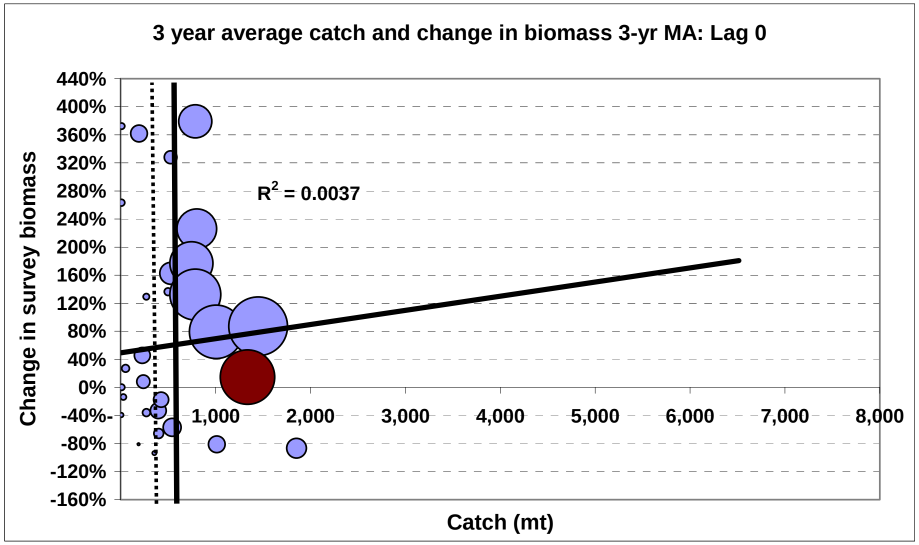
Catch

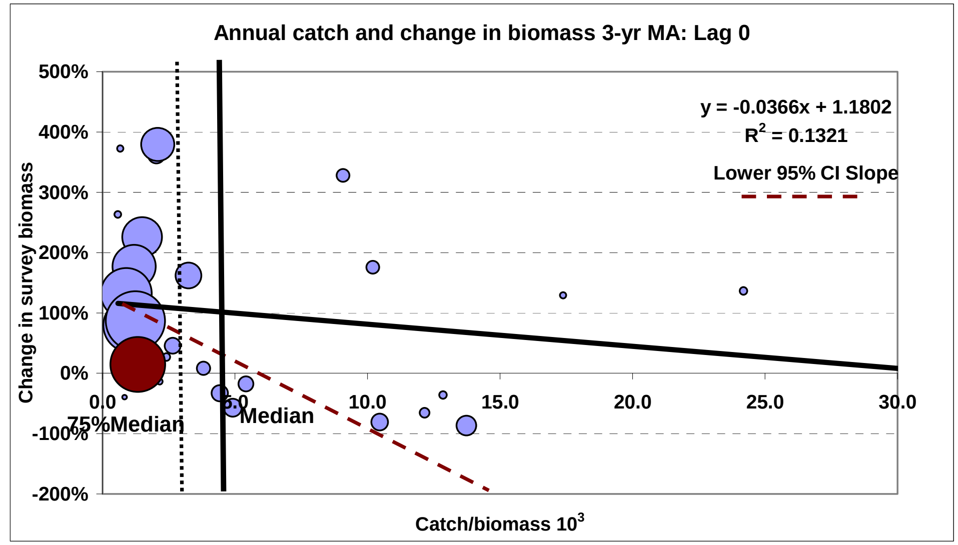
	Limit (mt)	Threshold	Biomass change Up	Down	Average	Δ2004-2006
		All	21	16	58.5%	
Maximum	6,514	Above median	14	4	108.0%	
Median	400	Below Median	7	12	63.9%	-88%
80% of medi	320	Below 80%	5	9	57.6%	-91%
Percentile	38%					

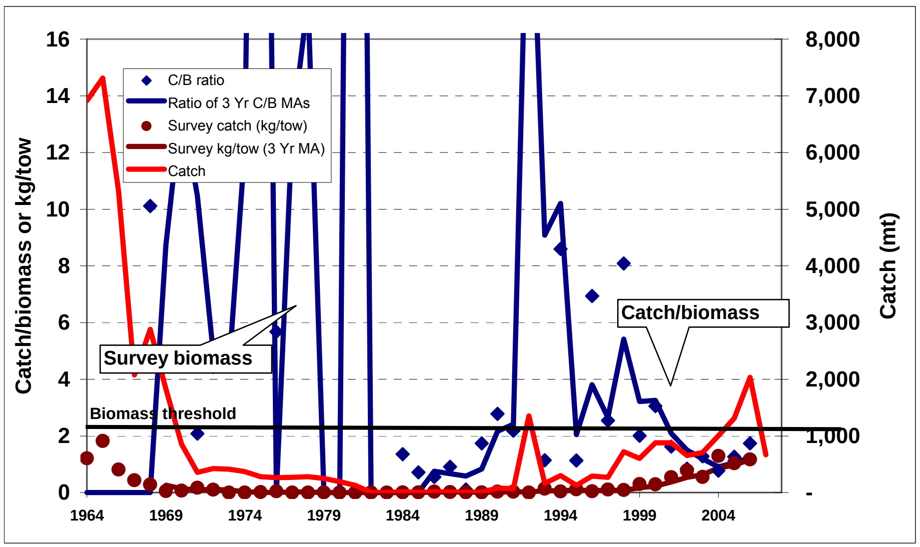
Catch/biomass ratio

		Threshold	Biomass change Up	Down	Average	Limit (mt)	Δ2004-2006
		All	21	16	58.5%		
Maximum	64.47	Above median	8	14	0.7%		
Median	4.32	Below Median	13	2	150.9%	4,332	25%
75% of medi	3.24	Below 75%	8	2	128.5%	3,249	-7%
Percentile	34%						

Figure 14. Relationship for barndoor skate between three year moving average of catch (selectivity ogive method) and biomass with no lag.







Catch thresholds and historic change in biomass

Catch

	Limit (mt)	Threshold	Biomass change Up	Down	Average	Δ2004-2006
		All	21	16	58.5%	
Maximum	6,514	Above median	13	5	106.6%	
Median	400	Below Median	8	11	64.3%	-72%
80% of media	320	Below 80%	8	9	71.8%	-78%
Percentile	45%					

Catch/biomass ratio

		Threshold	Biomass change Up	Down	Average	Limit (mt)	Δ2004-2006
		All	21	16	58.5%		
Maximum	64.47	Above median	8	14	-2.2%		
Median	3.23	Below Median	13	2	155.1%	3,237	123%
75% of media	2.42	Below 75%	11	2	163.0%	2,428	68%
Percentile	42%						

Table 4. Calculation of alternative skate catch limits using catch and catch/biomass medians from Draft Amendment 3, using corrected discards.

	Catch		C/B derived catch limits	
Species	Median	80% of medi	Median	75% of medi
Barndoor	290	232	2,685	2,014
Clearnose	521	417	614	460
Little	17,524	14,019	7,649	5,737
Rosette	26	21	56	42
Smooth	33	26	27	20
Thorny	155	124	50	38
Winter	17,422	13,938	11,530	8,648
Total	35,971	28,777	22,612	16,959
Discards	13,734	10,987	8,634	6,475
Prohibited species	430	344	2,486	1,865
Legal species	13,305	10,644	6,147	4,611
Discard rate legal sp	37%	37%	31%	31%
Allowable landings	22,237	17,789	13,978	10,484
Prohibited species	48	38	276	207
Legal species	22,189	17,751	13,702	10,277
Wing fishery TAL	15,502	12,402	10,351	7,763
Change from 2007	10%	-12%	-26%	-45%
Bait fishery TAL	6,735	5,388	3,627	2,721
Change from 2007	41%	13%	-24%	-43%
TAL	22,237	17,789	13,978	10,484
Discards	13,734	10,987	8,634	6,475
TAC	35,971	28,777	22,612	16,959
Change from 2007	39%	11%	-13%	-34%

Figure 15. Trend in annual ABC, ACT, and TALs derived from applying the median catch/biomass ratio from Draft Amendment 3 catches to historic stratified mean biomass by skate species.

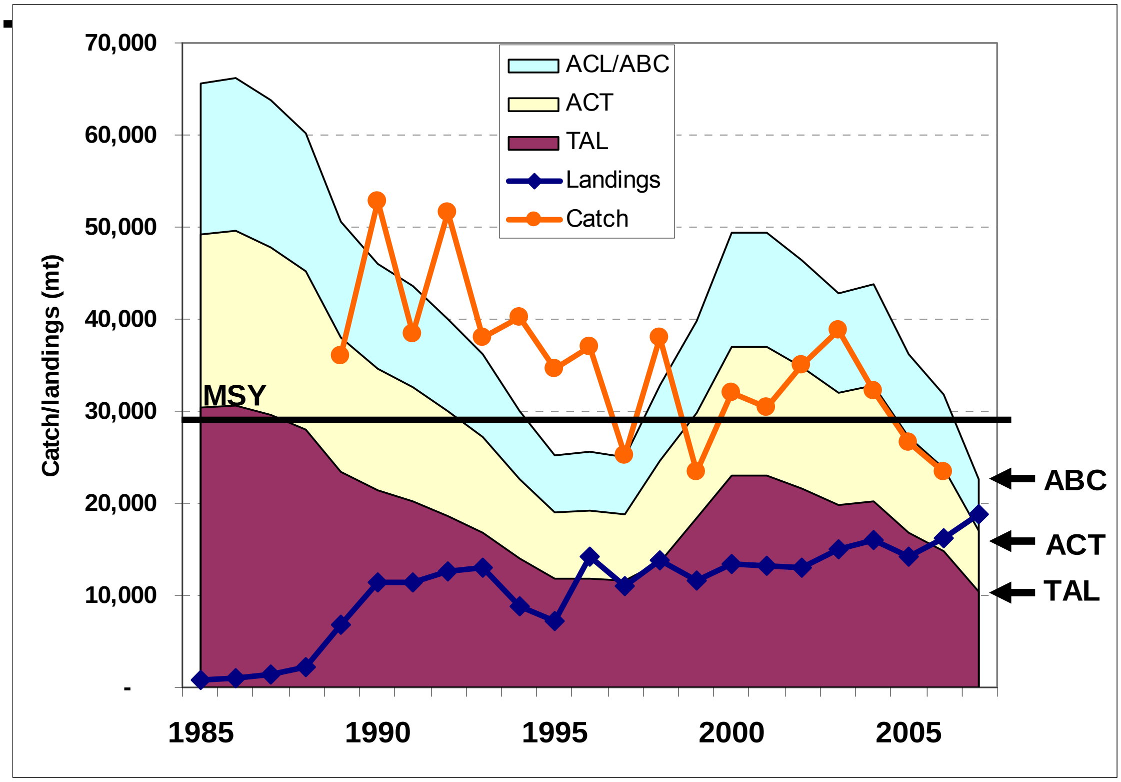


Table 5. Input variables and results application of catch/biomass ratios derived from Draft Amendment 3 catches and applied to stratified mean survey biomass.

Species	Catch/biomass index (thousand mt catch/kg per tow) Median	75% of median	Stratified mean survey weight (kg/tow) 2004-2006	2005-2007	Target
Barndoor	2.68	2.01	1.17	1.00	1.62
Clearnose	0.97	0.73	0.59	0.63	0.56
Little	3.50	2.62	4.59	3.67	6.54
Rosette	0.86	0.65	0.06	0.06	0.03
Smooth	0.19	0.14	0.19	0.14	0.31
Thorny	0.12	0.09	0.55	0.42	4.41
Winter	3.93	2.95	3.04	2.93	6.46
Annual catch limit (ACL/ABC)			31,858	22,612	53,731
Annual catch target (ACT)			23,893	16,959	40,298
Total allowable landings (TAL)			14,770	10,484	29,912

Table 6. Calculation of alternative skate catch limits using catch and catch/biomass medians from the Data Poor Assessment Workshop length composition method.

	Catch		C/B derived catch limits	
Species	Median	80% of medi	Median	75% of medi
Barndoor	400	320	4,328	3,246
Clearnose	969	776	1,428	1,072
Little	10,189	8,151	5,230	3,917
Rosette	41	33	77	88
Smooth	345	276	281	210
Thorny	5,479	4,383	1,257	943
Winter	18,255	14,604	12,092	9,069
Total	35,678	28,543	24,692	18,546
Discards	20,699	16,559	14,325	10,759
Prohibited species	5,602	4,481	5,280	3,959
Legal species	15,097	12,078	9,046	6,800
Discard rate legal sp	51%	51%	48%	48%
Allowable landings	14,979	11,984	10,367	7,786
Prohibited species	622	498	587	440
Legal species	14,357	11,486	9,780	7,346
Wing fishery TAL	11,399	9,120	8,022	6,027
Change from 2007	-19%	-35%	-43%	-57%
Bait fishery TAL	3,580	2,864	2,341	1,759
Change from 2007	-25%	-40%	-51%	-63%
TAL	14,979	11,984	10,363	7,786
Discards	20,699	16,559	14,325	10,759
TAC	35,678	28,543	24,688	18,546
Change from 2007	-16%	-33%	-42%	-56%

Figure 16. Trend in annual ABC, ACT, and TALs derived from applying the median catch/biomass ratio from catches using the length composition method to assign catches and apply them to historic stratified mean biomass by skate species.

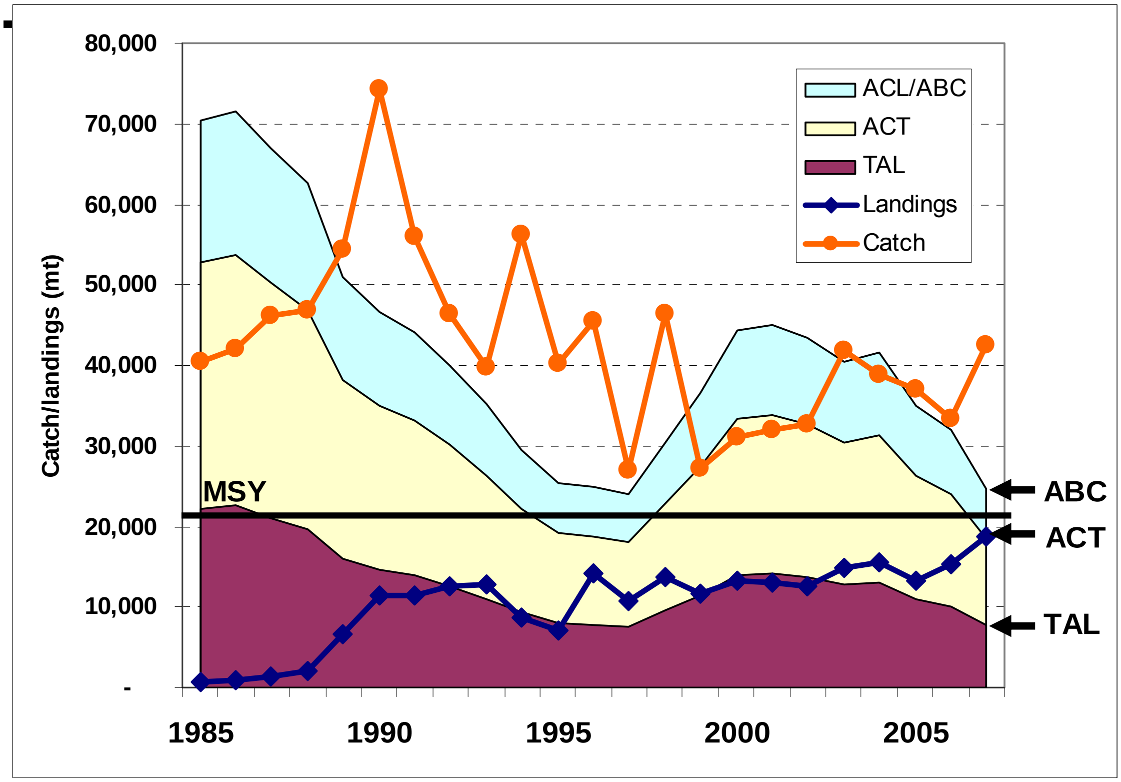


Table 7. Input variables and results application of catch/biomass ratios derived from length composition method catches and applied to stratified mean survey biomass.

Species	Catch/biomass index (thousand mt catch/kg per tow) Median	75% of median	Stratified mean survey weight (kg/tow) 2004-2006	2005-2007	Target
Barndoor	4.32	3.24	1.17	1.00	1.62
Clearnose	2.25	1.69	0.59	0.63	0.56
Little	2.39	1.79	4.59	3.67	6.54
Rosette	1.18	1.36	0.06	0.06	0.03
Smooth	1.95	1.46	0.19	0.14	0.31
Thorny	2.96	2.22	0.55	0.42	4.41
Winter	4.12	3.09	3.04	2.93	6.46
Annual catch limit (ACL/ABC)			31,945	24,688	64,196
Annual catch target (ACT)			23,977	18,546	48,145
Total allowable landings (TAL)			10,067	7,786	20,213

Table 8. Calculation of alternative skate catch limits using catch and catch/biomass medians from the Data Poor Assessment Workshop selectivity ogive method.

	Catch		C/B derived catch limits	
Species	Median	80% of medi	Median	75% of medi
Barndoor	400	320	3,236	2,425
Clearnose	1,110	888	1,548	1,161
Little	10,189	8,151	5,230	3,917
Rosette	47	38	142	107
Smooth	303	242	243	183
Thorny	5,209	4,167	1,334	1,002
Winter	16,586	13,269	12,092	9,069
Total	33,844	27,075	23,825	17,864
Discards	19,962	15,969	14,052	10,536
Prohibited species	5,321	4,256	4,332	3,249
Legal species	14,641	11,713	9,720	7,287
Discard rate legal sp	52%	52%	51%	51%
Allowable landings	13,882	11,106	9,773	7,328
Prohibited species	591	473	481	361
Legal species	13,291	10,633	9,292	6,967
Wing fishery TAL	10,419	8,336	7,532	5,648
Change from 2007	-26%	-41%	-47%	-60%
Bait fishery TAL	3,463	2,770	2,241	1,679
Change from 2007	-27%	-42%	-53%	-65%
TAL	13,882	11,106	9,773	7,328
Discards	19,962	15,969	14,052	10,536
TAC	33,844	27,075	23,826	17,864
Change from 2007	-19%	-35%	-43%	-57%

Figure 17. Trend in annual ABC, ACT, and TALs derived from applying the median catch/biomass ratio from catches using the selectivity ogive method to assign catches and apply them to historic stratified mean biomass by skate species.

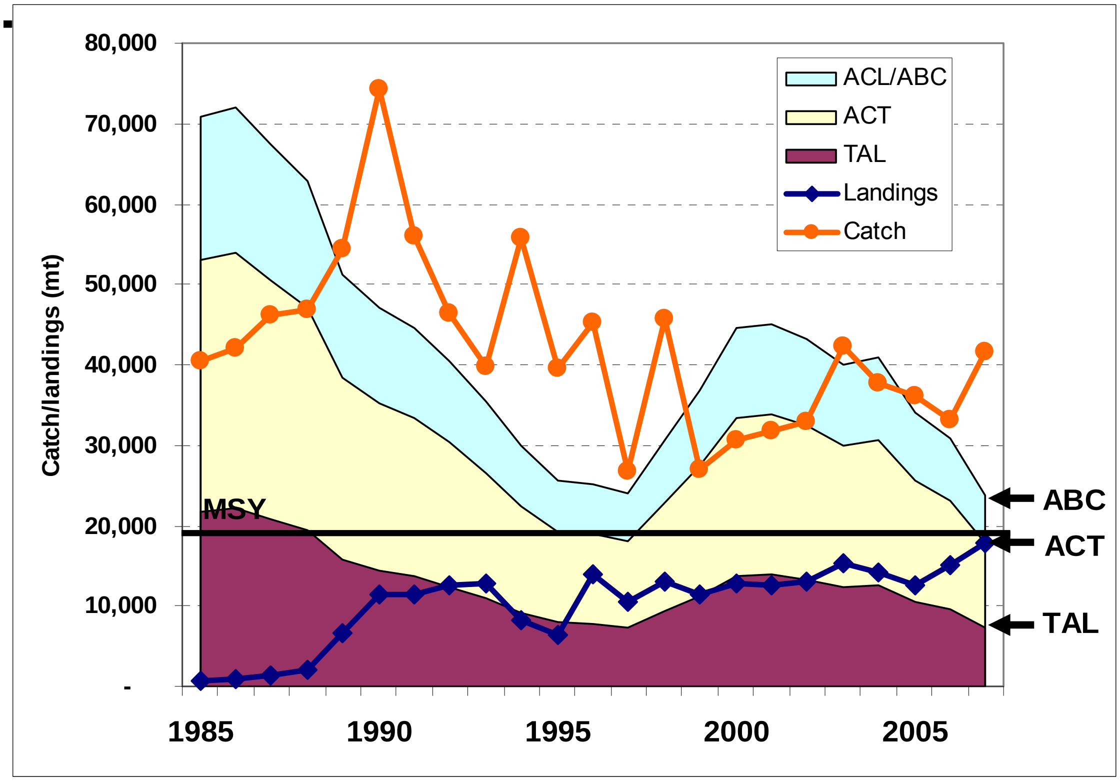


Table 9. Input variables and results application of catch/biomass ratios derived from selectivity ogive method catches and applied to stratified mean survey biomass.

Species	Catch/biomass index (thousand mt catch/kg per tow) Median	75% of median	Stratified mean survey weight (kg/tow) 2004-2006	2005-2007	Target
Barndoor	3.23	2.42	1.17	1.00	1.62
Clearnose	2.44	1.83	0.59	0.63	0.56
Little	2.39	1.79	4.59	3.67	6.54
Rosette	2.19	1.65	0.06	0.06	0.03
Smooth	1.69	1.27	0.19	0.14	0.31
Thorny	3.14	2.36	0.55	0.42	4.41
Winter	4.12	3.09	3.04	2.93	6.46
Annual catch limit (ACL/ABC)			30,898	23,826	63,240
Annual catch target (ACT)			23,162	17,864	47,462
Total allowable landings (TAL)			9,501	7,328	19,469