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Document de référence 2012/04

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Transboundary Resources Assessment Committee

Reference Document 2012/04

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An Alternative Stratification to Estimate Yellowtail Flounder Discards in the US Scallop Fishery

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ABSTRACT

Previous Transboundary Resources Assessment Committee (TRAC) assessments have estimated yellowtail flounder discards in the US sea scallop fishery by half year without using any spatial stratification. However, observer coverage and bycatch rates can differ substantially between general "open" areas and rotationally fished areas known as "access areas". We compared the non-spatial TRAC estimates of yellowtail discards to those obtained by spatially stratifying between open and access areas, but without temporal stratification. The estimates from the two approaches were similar with the exception of two years with relatively low sampling coverage (2000 and 2001). Differences in assessment model results between the two discard estimation methods were negligible. The non-spatially stratified method used by the TRAC is therefore adequate for assessment purposes, while the non-temporally but spatially stratified approach may be useful for quota monitoring. Fine spatio-temporal resolution of discard estimation requires high levels of observer coverage.

RÉSUMÉ

Dans les évaluations antérieures du Comité d'évaluation des ressources transfrontalières, on a estimé les rejets de limande à queue jaune découlant de la pêche au pétoncle géant aux États-Unis par périodes de demi-années sans avoir recours à la stratification spatiale. Cependant, la proportion d'observateurs présents et les taux de prises accidentelles peuvent varier grandement entre les zones « ouvertes » générales et les zones à pêche en rotation appelées « zones de pêche prescrites ». Nous avons comparé les estimations non spatiales de rejets de limande à queue jaune du Comité avec celles obtenues en procédant à la stratification spatiale entre les zones ouvertes et les zones de pêche prescrites, mais sans stratification temporelle. Les estimations des deux approches étaient semblables à l'exception de deux années où l'étendue d'échantillonnage était relativement faible (2000 et 2001). Les différences dans les résultats du modèle d'évaluation entre les deux méthodes d'estimation des rejets étaient négligeables. La méthode sans stratification spatiale utilisée par le Comité est donc adéquate aux fins d'évaluation, tandis que l'approche à stratification spatiale non temporelle pourrait s'avérer utile pour la surveillance des quotas. Une résolution spatio-temporelle faible de l'estimation des rejets exige une présence élevée d'observateurs.

INTRODUCTION

Discards of yellowtail flounder in the sea scallop fishery comprise a substantial fraction of total yellowtail catch in some years. In the past, estimates of discards in the US Georges Bank fishery were not stratified spatially, but were estimated for the whole stock in each half-year.

In December 1994, two large areas on Georges Bank (Closed Area I and Closed Area II) were closed to fishing for groundfish and sea scallops (Fig. 1). Sea scallops rapidly built up in these areas, and since 1999, portions of these areas have been reopened to limited scallop fishing on a rotational basis (Murawski et al. 2000, Hart and Rago 2006, Hart et al. 2012). Trips to the reopened areas (known as "access areas") were subject to individual trip limits for sea scallops (10,000 lbs meats in 1999-2000, 12,000 lbs meats in 2001, and 18,000 lbs meats since 2004), and a fleetwide yellowtail bycatch limit. Because of the importance of monitoring yellowtail bycatch, at-sea observer coverage rates in the access area fisheries have typically been higher than in the "open" areas, especially during 1999-2001. For this reason, yellowtail bycatch estimates that are not stratified between the access and open areas may be biased if bycatch rates differ among these areas. Typically, yellowtail bycatch in Closed Area I has been lower than in the open areas, whereas Closed Area II bycatch has often been higher than in the open areas. Possible bias that could be induced if there are changes in fishing practices when an observer is on board has the potential to overwhelm any stratification differences.

During last year's Transboundary Resources Assessment Committee (TRAC) meeting, the following recommendation was made: "Investigate whether estimates of yellowtail flounder discards in the US scallop dredge fishery can be improved using stratification schemes that account for the access area program." (Porter and O'Brien 2011). This document addresses this recommendation by computing the amount of yellowtail flounder discarded by the scallop fishery using a stratification scheme based on the access area programs and compares the estimates to the current ones (Legault et al. 2012).

METHODS

The annual yellowtail flounder discards to scallop landings (D:K) ratio (metric tons of yellowtail flounder divided by metric tons of whole scallops) was estimated for Closed Area I, Closed Area II, and the remaining open areas using at-sea observer data (and referred to as the "Stratified" approach in the rest of the document). An annual time period was used because there were few or no observed trips in some areas when split into half-years, making accurate estimation difficult. Observers are assigned randomly to vessels fishing within an access area or the open areas, but coverage levels may be different among the areas. The observer database has a "program" code that indicates in which of the areas the vessel was fishing, so that observed trips can be separated among the areas with a high degree of certainty. There were no observed trips in 2001 in the open areas; the open area D:K ratio for this year was estimated as the mean of the 2000 and 2002 D:K ratios. Standard errors were computed as described in Wigley et al. (2008).

Total annual scallop landings (metric tons of scallop meats) for the Georges Bank yellowtail stock area were obtained using the Northeast US dealer database. This database does not indicate whether a trip was to an access area or an open area. However, the NMFS Northeast Regional Office monitors scallop landings and yellowtail catch from each access area, based on required call-ins by vessels prior to sailing to the access areas, linked to dealer and observer data. The final report for each access area program indicates the amount of scallop landings from that access area in a given fishing year. The western portion of Closed Area I does not lie in the Georges Bank yellowtail stock area (statistical areas 522, 525, 561, 562, 551, 552; Fig. 1). The proportion of Closed Area I scallop landings outside of the Georges Bank yellowtail stock area was estimated for each year using the statistical area reported in vessel trip reports; the reported Closed Area I landings were reduced by this proportion (typically between 10%-20%, depending on year) to obtain Closed Area I scallop landings from the Georges Bank yellowtail stock area. Open area scallop landings were obtained by subtracting Closed Area I and II landings from total Georges Bank landings.

Estimation of the total amount of yellowtail flounder caught as discards in the US scallop fishery is the product of the D:K ratio and scallop landings (multiplied by the standard meat weight to whole weight conversion factor of 8.33). However, this is just the start of the process for incorporating these values into the stock assessment. The sampled length distributions by the new stratification would need to be derived and expanded to the total amount caught within each stratum. Filling in missing or insufficiently sampled stratum would be required. The age-length keys by year would need to be applied to convert the estimated catch at length to catch at age. The catch weights at age would be derived.ing a length-weight equation appropriate for the whole year. These time series of catch and weights at age for the US scallop discards would then replace the current estimates for years 1999-2011. Due to time limitations, this was not possible. Instead, a simple change in the catch at age was made by first multiplying the US discards at age from all sources by [1 + (Stratified – TRAC) / US Discards] under the assumption that the scallop discards had the same age distribution as the US discards from all sources. These new US discards at age replaced the TRAC discards at age in the catch at age matrix, but the weights at age matrices were left unchanged. The new catch at age matrix was used as a sensitivity analysis in the Split Series model (Legault et al. 2012). The sensitivity run was compared to the Split Series model for the time series of fishing mortality rate, spawning stock biomass, and age-1 recruitment.

RESULTS AND DISCUSSION

Estimated yellowtail discards calculated by stratifying by area are similar in most years to those estimated from the non-spatial method used in previous TRAC assessments with no evidence of directional bias between the two estimation approaches (Table 1, Fig. 2). Major differences are seen only in 2000, and 2001. In the first two of these years, observer coverage rates in the access areas were much higher than those in the open areas, and D:K ratios in the access areas differed greatly from those in the open areas (Fig. 3). In 2000, open area scallop landings accounted for about one third of the total landings, but only 1 of the 176 observed trips was to the open areas. The mean D:K ratio in 2000 over all observed trips was higher than that observed on the one open area trip, so that ignoring the spatial stratification will induce a higher discard estimate. In 2001, scallop landings from Closed Area I accounted for about 20% of total landings, but the only observed trips that year were to this area. Since the Closed Area I D:K ratio was lower than that in the open areas (estimated from 2000 and 2002), ignoring the spatial effects results in a lower estimate of discards.

The two estimates are within the approximate 95% confidence bounds of the other estimate in all cases where confidence bounds can be estimated, with the exception of the 2000 and 2001 Stratified estimates. The 2000 Stratified estimate is highly dependent on the single sample in the open area. If the same d:k had occurred in the open area as did in Closed Area II, similar to the previous year, then the Stratified discard estimate would be 805 mt, which is greater than the TRAC estimate for 2000 (694 mt). In 2001, the Stratified estimate is completely dependent on the assumed discard rate in the open area (mean of 2000 and 2002, as described above) because no observed trips occurred in the open area. This clearly demonstrates the difficulty of estimating discards with limited sample sizes, regardless of the stratification. The use of the full year time period for the stratified approach may also be contributing to the difference between the two estimates, as seen in years when no Closed Area trips were made by the scallop fleet (i.e. 2002, 2003, and 2010).

Replacing the TRAC estimates of US scallop discards with the Stratified estimates in the catch at age matrix resulted in minor changes, with the US discards multiplier ranging from 0.603 to 1.609 (Table 2), but the changes to the catch at age ranging from -20% to 12% (Table 3). The difference in fishing mortality rate, spawning stock biomass, and age-1 recruitment between the two sets of scallop discard estimates cannot be visually distinguished (Fig. 4). The differences between the two US scallop discard estimates are not significant in terms of the assessment results.

CONCLUSIONS

Discards of yellowtail flounder by the US scallop fishery are not sensitive to the stratification scheme used in their estimation in most but not all years. There is no indication of a directional change in estimated discards between the two stratification schemes. These differences have negligible effects on assessment results. Thus, it is not necessary to change the current TRAC approach. Spatial stratification may be a better method for use in quota monitoring because of the potential for bias when spatio-temporal strata with different discard rates are combined, provided some limitations in the data collection process are overcome. Specifically, all databases need to contain the necessary information to identify access area trips. Quota monitoring and assessment estimates of discards should continue to be compared annually to look for deviations between the two estimates. Fine spatio-temporal resolution of discard estimation requires high levels of observer coverage.

LITERATURE CITED

Hart, D.R., and P.J. Rago. 2006. Long-term dynamics of US sea scallop (*Placopecten magellanicus*) populations. N. Am. J. Fish. Manage. 26:490-501.

Hart, D.R., L.D. Jacobson, and J. Tang. 2012. To split or not to split: Assessment of Georges Bank sea scallops in the presence of marine protected areas. Fish. Res. (in press).

Legault, C.M., L. Alade, H.H. Stone, and W.E. Gross. 2012. Stock assessment of Georges Bank yellowtail flounder for 2012. TRAC Ref. Doc. 2012/02. 133 p. (available at http://www2.mar.dfo-mpo.gc.ca/science/TRAC/rd.html) (Accessed December 4, 2012)

Murawski S.A., R. Brown, H-L. Lai, P.J. Rago, and L. Hendrickson. 2000. Large-scale closed areas as a fishery management tool in temperate marine systems: The Georges Bank experience. Bull. Mar. Sci. 66:775-798.

Porter, J.M., and L. O'Brien. 2011. Proceedings of the Transboundary Resources Assessment Committee for eastern Georges Bank cod and haddock, and Georges Bank yellowtail Flounder. TRAC Proceed. Doc 2011/01. 33 p. (available at http://www2.mar.dfo-mpo.gc.ca/science/TRAC/proceedings.html) (Accessed December 4, 2012)

Wigley, S.E., M.C. Palmer, J. Blaylock, and P.J. Rago. 2008. A brief description of the discard estimation for the National Bycatch Report. NEFSC Ref. Doc. 08-02. (available at http://www.nefsc.noaa.gov/publications/crd/) (Accessed December 4, 2012).

Table 1. Derivation of yellowtail flounder discards in the US scallop fishery accounting for scallop access areas. DK denotes the ratio of discarded yellowtail flounder to kept scallops (whole weight), CV is the coefficient of variation of the associated DK estimate, NumTrips indicates the number of observed trips in the DK estimate, Landings denotes metric tons of scallop meats (meat weight is converted to whole weight by multiplying by 8.33), YTDiscards is the metric tons of yellowtail flounder discarded by the scallop fleet, SE is the standard error of the mean discard estimate computed as the product of the CV and YTDiscards, and the approximate 95% confidence interval is computed as the mean plus/minus 1.96 times the SE.

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
DK													
Open	0.0184	0.0089	NA	0.0037	0.0152	0.0021	0.0053	0.0032	0.0053	0.0069	0.0010	0.0022	0.0039
CL1	NA	0.0017	0.0022	NA	NA	NA	0.0002	0.0001	0.0011	0.0016	NA	NA	0.00005
CL2	0.0177	0.0511	NA	NA	NA	0.0061	0.0066	0.0052	NA	NA	0.0113	NA	0.0074
CV													
Open	0.238	NA	NA	0.421	0.548	0.606	0.279	0.266	0.595	0.282	0.464	0.580	0.281
CL1	NA	0.173	0.268	NA	NA	NA	0.308	NA	0.149	0.346	NA	NA	0.279
CL2	0.139	0.113	NA	NA	NA	0.165	0.281	0.215	NA	NA	0.128	NA	0.210
TotalCV	**0.121**	**NA**	**NA**	**0.421**	**0.548**	**0.166**	**0.238**	**0.198**	**0.482**	**0.281**	**0.128**	**0.580**	**0.168**
TRAC	0.130	0.120	0.070	0.270	0.000	0.210	0.200	0.190	0.243	0.145	0.169	0.482	0.526
NumTrips													
Open	4	1	0	4	2	11	14	19	10	16	9	7	12
CL1	0	91	16	0	0	0	32	1	51	0	0	0	49
CL2	15	84	0	0	0	20	29	42	0	0	23	0	22
Total	19	176	16	4	2	31	75	62	61	16	32	7	83
Landings													
Open	1161	1098	1293	984	2361	665	622	945	1994	1996	2872	890	1593
CL1 (GB only)	0	908	451	0	0	0	2133	57	2252	38	0	0	2447
CL2	2720	763	0	0	0	1361	2874	6144	0	0	1547	0	1257
Total	3880	2769	1743	984	2361	2026	5629	7147	4246	2034	4419	890	5297
YTDiscards (mt)													
Open	178	81	67	30	300	12	28	25	88	114	23	17	52
CL1	0	13	8	0	0	0	3	0	21	0	0	0	1
CL2	400	325	0	0	0	69	158	264	0	0	145	0	78
Total	**578**	**419**	**76**	**30**	**300**	**81**	**189**	**290**	**108**	**115**	**168**	**17**	**131**
TRAC	566	694	28	29	293	81	186	251	120	128	170	8	104
SE													
Open	42.5	NA	NA	12.6	164.4	7.1	7.7	6.7	52.1	32.2	10.8	9.6	14.5
CL1	0.0	2.2	2.2	0.0	0.0	0.0	1.0	0.0	3.1	0.2	NA	NA	0.3
CL2	55.7	36.7	NA	0.0	0.0	11.4	44.4	56.8	NA	NA	18.6	NA	16.3
Total	70.1	NA	NA	12.6	164.4	13.4	45.0	57.2	52.2	32.2	21.5	9.6	21.9
Approx 95% Confidence Intervals for Discards (mt)													
Strat low	441			5	-22	54	101	177	6	52	126	-2	88
Strat high	715			55	622	107	277	402	211	178	210	35	173
TRAC low	422	531	24	14		48	113	158	63	91	114	0	-3
TRAC high	710	857	32	44		114	259	344	177	165	226	16	212

Table 2. US discards (thousands of fish) of Georges Bank yellowtail flounder estimated by the TRAC and Stratified methods. The column labeled Multiplier denotes the value which when multiplied by the TRAC estimates results in the Stratified values (see text for equation).

TRAC Estimates of US Discards							
Year	age-1	age-2	age-3	age-4	age-5	age-6+	
1999	27	755	437	104	48	22	
2000	66	346	474	319	84	104	
2001	35	114	88	12	2	1	
2002	21	76	54	8	2	1	
2003	62	549	416	85	23	10	
2004	56	656	400	152	53	35	
2005	56	447	406	122	35	20	
2006	136	550	357	91	24	15	
2007	48	1073	451	72	9	5	
2008	4	287	521	181	34	10	
2009	15	207	702	532	156	28	
2010	1	70	217	215	98	27	
2011	4	94	205	134	30	5	
Stratified Estimates of US Discards							
Year	age-1	age-2	age-3	age-4	age-5	age-6+	Multiplier
1999	28	771	446	107	49	22	1.021
2000	40	209	286	192	50	63	0.603
2001	56	184	142	20	4	2	1.609
2002	22	77	55	9	2	1	1.018
2003	63	558	423	86	24	10	1.016
2004	56	656	400	152	53	35	0.999
2005	57	450	409	123	36	20	1.007
2006	149	605	392	100	26	17	1.100
2007	47	1048	441	71	9	5	0.976
2008	3	277	504	175	33	10	0.968
2009	15	207	700	531	156	28	0.998
2010	1	72	223	221	101	28	1.030
2011	5	107	232	153	34	6	1.136

Table 3. Total catch at age (CAA; thousands of fish) of Georges Bank yellowtail flounder estimated by the TRAC and Stratified methods, along with the relative change.

Year	age-1	age-2	age-3	age-4	age-5	age-6+
	Total CAA from TRAC					
1999	60	2753	4195	1548	794	301
2000	132	3864	5714	3173	826	528
2001	176	2884	6956	2893	1004	525
2002	212	4169	3446	1916	683	485
2003	160	3919	4710	2320	782	693
2004	61	1152	3184	3824	1970	1470
2005	60	1579	4031	1707	392	185
2006	152	1293	1626	947	364	214
2007	51	1491	1705	662	136	55
2008	29	493	1903	855	125	24
2009	17	284	1266	1361	516	74
2010	2	139	644	890	445	99
2011	11	161	763	908	312	76
	Total CAA from Stratified					
1999	61	2769	4204	1550	795	302
2000	106	3726	5526	3046	793	487
2001	197	2953	7010	2901	1005	526
2002	212	4170	3447	1916	683	485
2003	161	3928	4717	2321	783	694
2004	61	1152	3183	3824	1970	1470
2005	60	1582	4034	1708	392	185
2006	166	1348	1662	956	366	216
2007	50	1466	1694	661	136	55
2008	29	484	1886	849	124	24
2009	17	283	1265	1360	516	73
2010	2	141	650	896	448	100
2011	11	174	791	927	316	76
	Relative Change (Stratified - TRAC)/TRAC					
1999	1%	1%	0%	0%	0%	0%
2000	-20%	-4%	-3%	-4%	-4%	-8%
2001	12%	2%	1%	0%	0%	0%
2002	0%	0%	0%	0%	0%	0%
2003	1%	0%	0%	0%	0%	0%
2004	0%	0%	0%	0%	0%	0%
2005	1%	0%	0%	0%	0%	0%
2006	9%	4%	2%	1%	1%	1%
2007	-2%	-2%	-1%	0%	0%	0%
2008	0%	-2%	-1%	-1%	-1%	-1%
2009	0%	0%	0%	0%	0%	0%
2010	2%	1%	1%	1%	1%	1%
2011	5%	8%	4%	2%	1%	1%

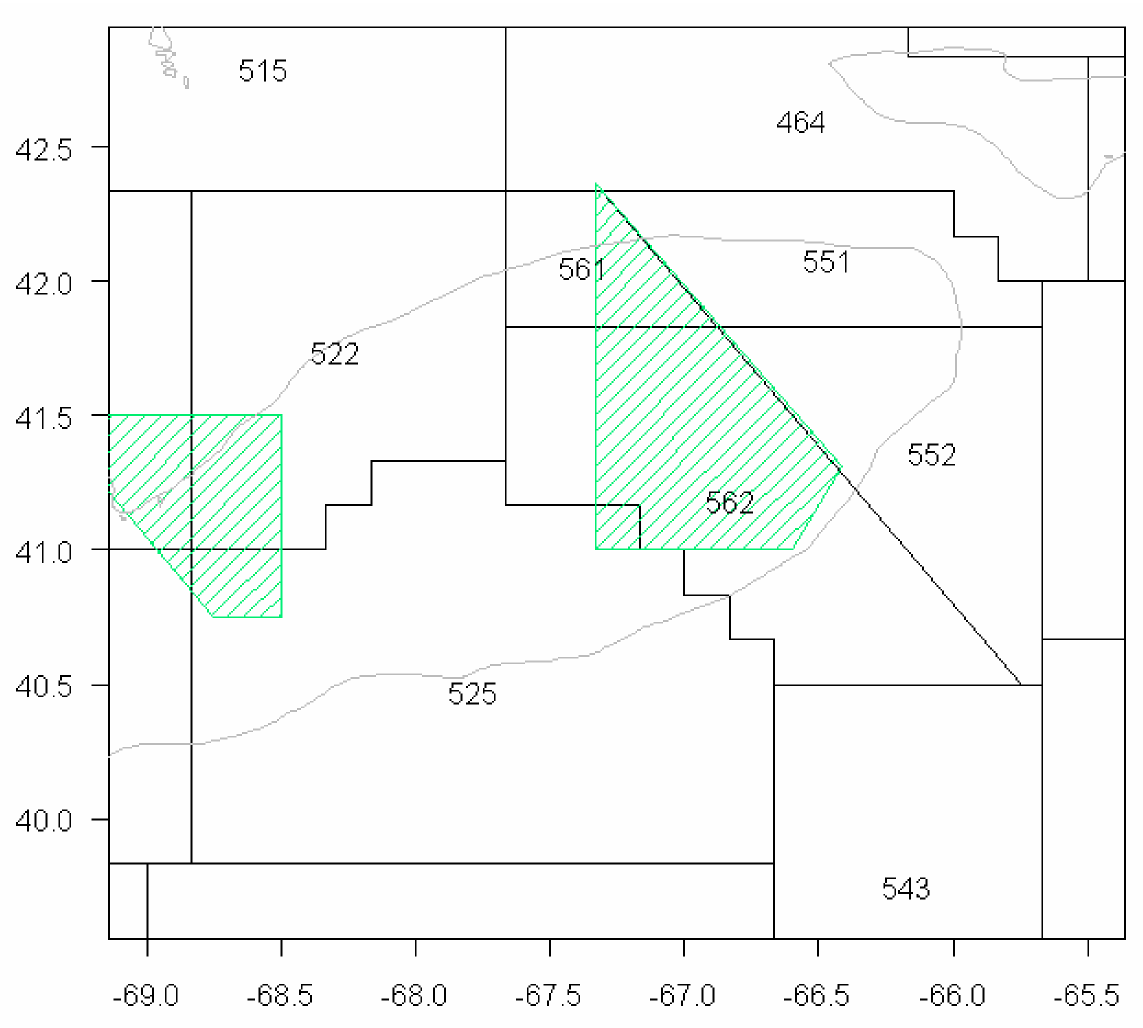

Figure 1. US commercial statistical areas used in the Georges Bank yellowtail flounder stock assessment (522, 525, 561, 562, 551, 552). The green shaded polygons are Closed Areas I (on the left) and Closed Area II (on the right). The grey line denotes the 100 m depth contour.

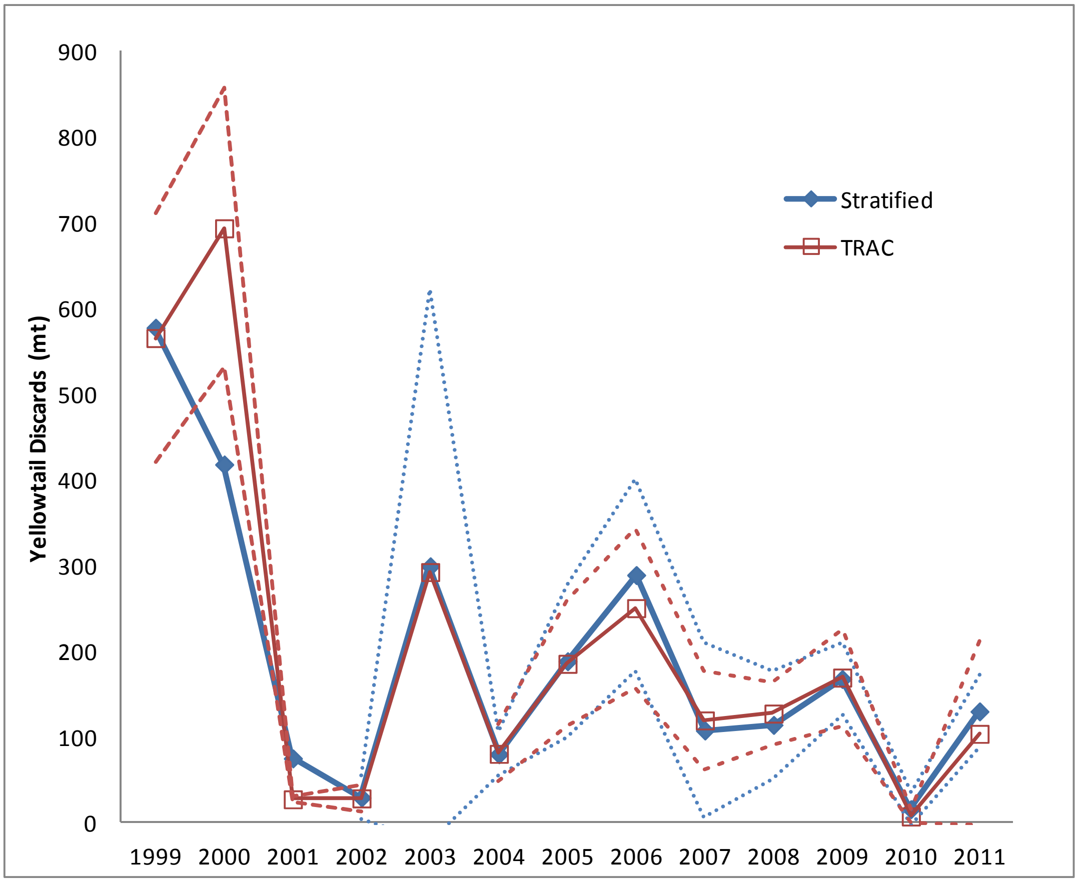

Figure 2. Yellowtail flounder discards (mt) in the US scallop fishery based on two estimation approaches: one which stratifies for the access areas (Stratified) and one which does not (TRAC). The approximate 95% confidence intervals for the two methods are shown as dashed lines in the same color as the point estimates. Note that confidence intervals are not available for all years (see Table 1).

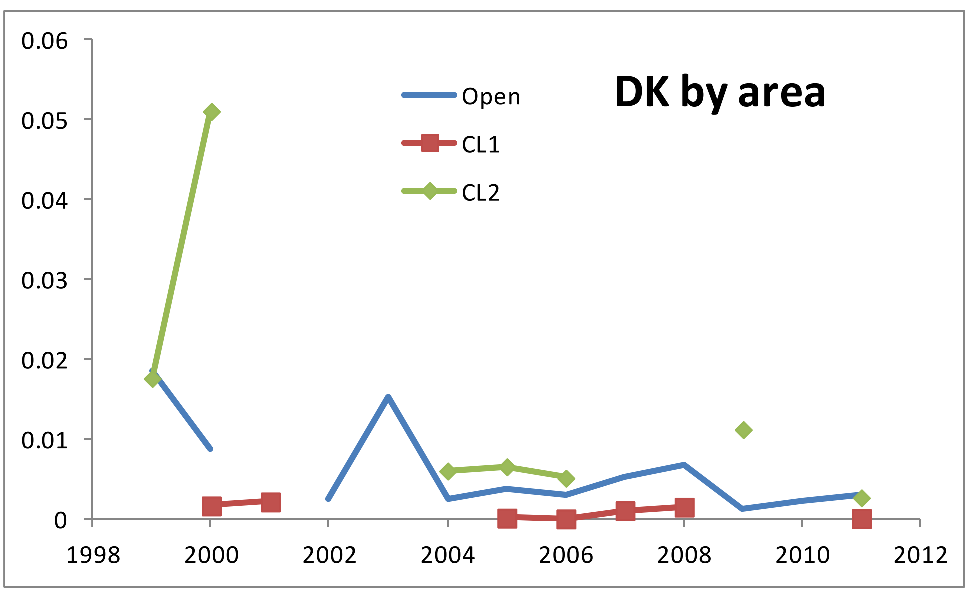

Figure 3. Yellowtail discards:scallop landings D:K ratio by area.

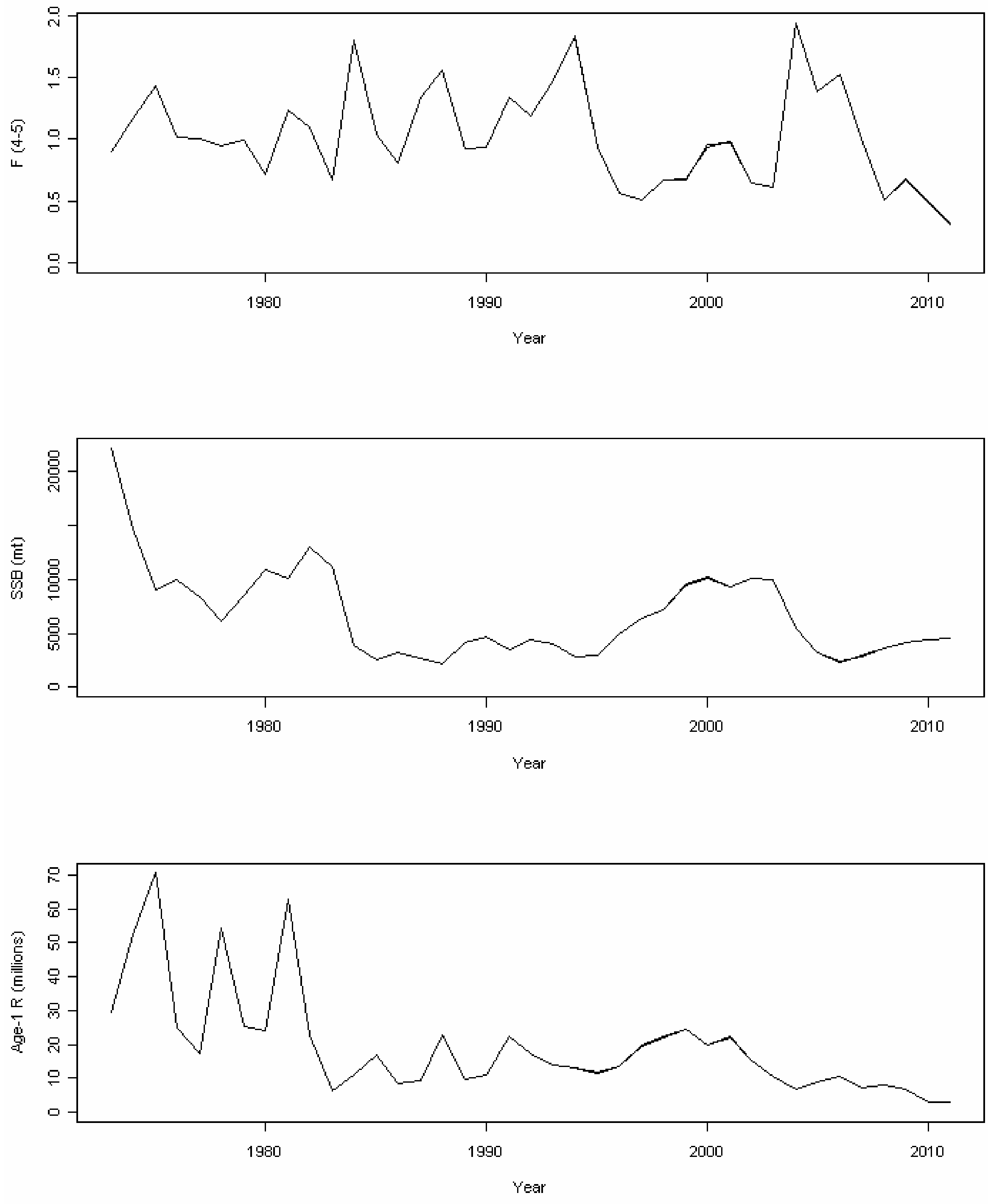

Figure 4. Fishing mortality rate (ages 4-5), spawning stock biomass (mt), and age-1 recruitment (millions of fish) for the Split Series model and the sensitivity analysis using the Stratified estimates for the US scallop fishery. Note the two lines cannot be visually distinguished in these plots.