Status of bocaccio, *Sebastes paucispinis*, in the Conception, Monterey and Eureka INPFC areas as evaluated for 2011

John C. Field
Groundfish Analysis Team
Fisheries Ecology Division,
Southwest Fisheries Science Center
110 Shaffer Rd. Santa Cruz CA 95060
John.Field@noaa.gov

EXECUTIVE SUMMARY

Stock

This revised update of the 2009 stock assessment of the bocaccio rockfish (*Sebastes paucispinis*) reports the best estimate of bocaccio abundance and productivity off of the west coast of the United States, from the U.S.-Mexico border to Cape Blanco, Oregon (representing the Conception, Monterey and Eureka INPFC areas). Note that due to some of the key uncertainties encountered in this assessment, a small number of structural changes were made to the model, which no longer conforms to the strict definition of an "update" as defined by the PFMC terms of reference.

Catches

Bocaccio rockfish have long been one of the most important targets of both commercial and recreational fisheries in California waters, accounting for between 25 and 30% of the commercial rockfish (*Sebastes*) historical catch over the past century. However, this percentage has declined in recent years as a result of stock declines, management actions and the development of alternative fisheries. Since 2002 catches have generally been less than 200 tons per year, with the largest fraction of catches coming from the southern California recreational fishery.

Table E1. Recent catches (in metric tons) of bocaccio rockfish south of Cape Blanco

	trawl south of 38° N	trawl north of 38° N	hook and line	setnet	rec south of 34.5° N	rec north of 34.5° N	total (S. of 43 ° N)
1999	19.00	53.00	26.00	20.70	7.20	71.00	196.90
2000	13.50	60.00	6.60	7.00	0.70	52.00	139.80
2001	9.20	49.00	4.40	7.80	0.90	60.00	131.30
2002	28.04	20.67	0.13	0.01	35.88	4.93	89.66
2003	5.07	0.31	0.00	0.00	5.53	1.87	12.78
2004	13.86	3.52	1.84	0.21	63.43	2.27	85.13
2005	24.64	0.43	1.50	0.17	69.90	10.70	107.34
2006	16.09	0.31	2.25	0.25	29.00	11.80	59.70
2007	4.06	1.58	3.39	0.38	44.20	8.92	62.53
2008	0.42	1.98	2.02	0.08	31.50	3.33	39.33
2009	1.12	4.85	1.50	0.03	40.30	9.70	57.50
2010	2.90	10.97	1.45	0.05	52.60	7.40	75.36

Data and Assessment

The last full assessment of bocaccio rockfish was done in 2009 using the SS3 assessment model. This revised update extends the time series included in that model for the CalCOFI larval abundance survey, the NWFSC Southern California Bight hook and line survey, the NWFSC combined trawl survey, the SWFSC juvenile abundance survey, and the recreational pier fishery juvenile index. No new length frequency data are available for commercial fisheries, however new length frequency data are available and included for southern and central/northern California recreational fisheries.

The length composition data from the 2010 NWFSC trawl survey is dominated by small (Young-of-the-Year, YOY) individuals and had an overly strong influence on the model results in the initial (pre-review) models. As a result, a narrow range of analyses were recommended by the SSC to address how best to address the potential magnitude of this year class. Ultimately, the STAT proposed a model in which it is assumed that the bottom trawl survey does not provide an accurate index of age 0 abundance. The index and associated length composition data were revised to remove age 0 fish (fish smaller than 20 cm), and age selectivity was fixed to be non-selective for age 0 fish. Additionally, in order to account for what is in all likelihood one or several strong incoming year classes (2009, 2010), we also include the southern California power plant impingement survey for YOY bocaccio (which is updated from the index presented in the 2009 assessment but not included in the base model due to truncation of the time series). This index extends nearly 30 years, and was found to have a strong correlation with the model estimated recruitment time series.

Stock spawning output

For this update, trends in abundance and historical recruitment are only modestly changed from the 2009 model results. The final result is slightly more pessimistic of stock status relative to the 2009 model, with depletion in the year 2011 estimated at 26%, relative to the 30% projected from the 2009 model. Continued decline in the NWFSC combined trawl survey index and hook and line survey index were the primary drivers of this change, moreover the CalCOFI index suggests a flattening of what was previously an increasing trend over the last two years. With respect to overall model trends, the spawning output exhibits a very moderate decline until about 1950, with a steep decline from the early 1950s followed by a sharp increase in the early 1960s. Spawning output is estimated to have exceeded the mean unfished biomass level through the early 70s, when high fishing mortality rates again resulted in rapid declines. Fishing mortality declined towards the end of the 1990s, in response to management restrictions. Since the early 2000s, spawning output has been increasing steadily, largely as a result of reduced fishing mortality and a strong 1999 year class, although the rate of increase has slowed in the later half of the 2000s. Indications of strong 2009 and 2010 year classes should lead to additional increases in abundance.

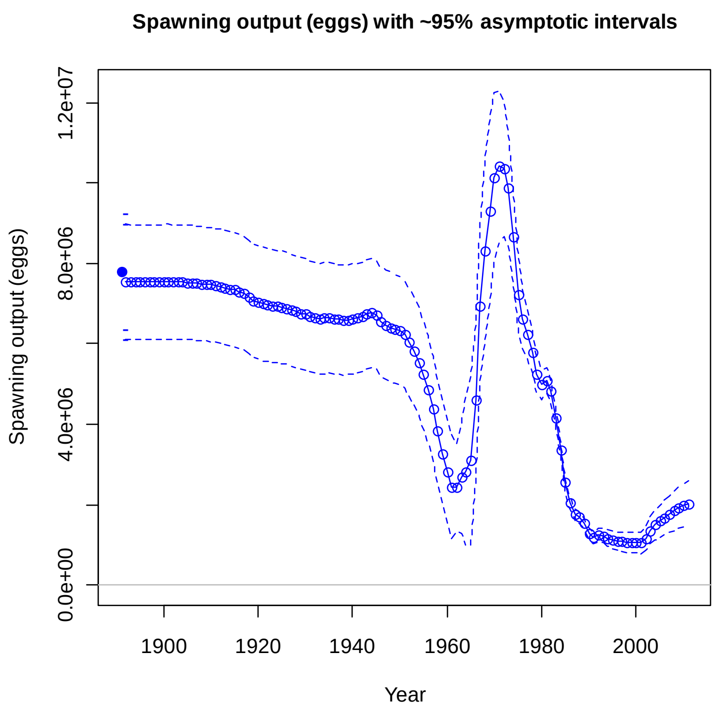


Figure E1. Estimated spawning output time series (1892-2011) for the base case, with approximate 95% confidence interval.

Table E2. Recent trends in estimated spawning output and relative depletion level

Year	Spawning Output (x 10^9)	CV spawning	Depletion	Confidence interval depletion (~95%)
1999	1067	0.123	0.137	(0.102 - 0.17)
2000	1055	0.126	0.135	(0.1 - 0.169)
2001	1052	0.129	0.135	(0.099 - 0.169)
2002	1161	0.129	0.149	(0.11 - 0.186)
2003	1357	0.129	0.174	(0.128 - 0.218)
2004	1505	0.129	0.193	(0.142 - 0.242)
2005	1588	0.131	0.203	(0.15 - 0.256)
2006	1672	0.132	0.214	(0.157 - 0.27)
2007	1764	0.133	0.226	(0.165 - 0.286)
2008	1850	0.135	0.237	(0.173 - 0.3)
2009	1932	0.136	0.247	(0.18 - 0.314)
2010	1987	0.137	0.254	(0.184 - 0.324)
2011	2029	0.138	0.260	(0.187 - 0.331)

Recruitment

Recruitment for bocaccio is highly variable, with a small number of year classes tending to dominate the catch in any given fishery or region. Recruitment appears to have been at very low levels throughout most of the 1990s, but several recent year classes (1999, 2003, 2005) have been relatively strong given the decline in spawner abundance, and have resulted in an increase in abundance and spawning output. Currently there is strong evidence for a relatively strong 2009 year class and a strong to very strong 2010 year class. The relative strength of this year class was considered by the STAT and the review panel to be a significant axis of uncertainty for future management decisions, and variability in the magnitude of this year class was used to develop the decision table for this update. The net effect from the 2009 and 2010 year classes in the base model is equates roughly to the net recruitment realized from the 1999 year class (the largest observed year class since 1989), resulting in the stock most likely being accelerated in rebuilding relative to the 2009 model estimate, but not tremendously so. Estimated recruitments and model derived confidence intervals for those values are shown in Table E3 and Figure E3.

Table E3. Estimated recruitment with 95% confidence interval, 1999-2010

	Recruits (1000s)	Recruit CV	Confidence interval recruits
1999	7216	0.14	(5230 - 9200)
2000	309	0.36	(85 - 533)
2001	267	0.35	(80 - 453)
2002	1023	0.20	(614 - 1431)
2003	3187	0.15	(2243 - 4130)
2004	405	0.29	(168 - 642)
2005	3090	0.15	(2137 - 4043)
2006	707	0.27	(325 - 1089)
2007	1542	0.19	(958 - 2125)
2008	1475	0.21	(864 - 2086)
2009	3750	0.21	(2187 - 5311)
2010	3433	0.46	(305 - 6559)

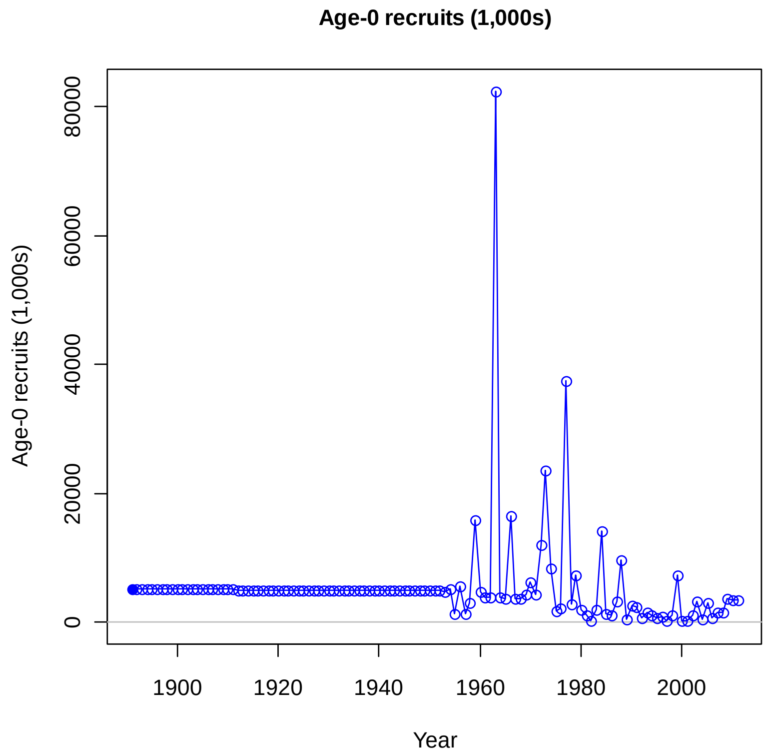


Figure E3. Estimated recruitment of bocaccio rockfish from 1892-2011

Reference Points

Reference points are presented in Table E4, which presents reference points for both the TOR and the STAT models, including the unfished summary biomass, unfished spawning output, mean unfished recruitment, the proxy estimates for MSY based on the $SPR_{50\%}$ rate, the fishing mortality rate associated with a spawning stock output of 40% of the unfished level, and MSY estimated based on the spawner/recruit relationship. The differences among point estimates of yield ranged from 1217 to 1234 tons, with the MSY estimated based on the spawner/recruit relationship leading to the higher value.

Table E4. Summary of reference points for bocaccio rockfish from the base model

		Approx Confidence	95% Limits
Unfished Stock	Estimate	Lower	Upper
Summary (1+) Biomass	44412	36148	52675
Spawning Output (x 109)	7812	6349	9275
Equilibrium recruitment	5112	4151	6073
	$SSB_{40\%}$	SPR proxy	MSY est.
SPR	0.502	0.500	0.445
Exploitation rate	0.065	0.065	0.078
Yield	1217	1218	1239
Spawning output (x 109)	3125	3107	2587
Summary biomass	18779	18682	15817
Recruits (x 103)	4070	4062	3802
SSB/SSB_0	0.400	0.398	0.331

Exploitation Status

The 2011 spawning output is estimated to be at 26% of the unfished spawning output, and exploitation rates are estimated to have ranged from 0.4 to 0.6% over the past five years, with corresponding SPR ratios of approximately 0.94 (ranging from 0.93 to 0.95) over that time (Table E5, Figures E5-E6).

Table E5. Base model estimated exploitation rate and spawning potential ratio (SPR)

Year	expl. rate	SPR rate
1999	0.035	0.681
2000	0.025	0.750
2001	0.019	0.822
2002	0.011	0.903
2003	0.001	0.987
2004	0.009	0.912
2005	0.011	0.891
2006	0.006	0.940
2007	0.006	0.939
2008	0.004	0.944
2009	0.005	0.944
2010	0.006	0.928

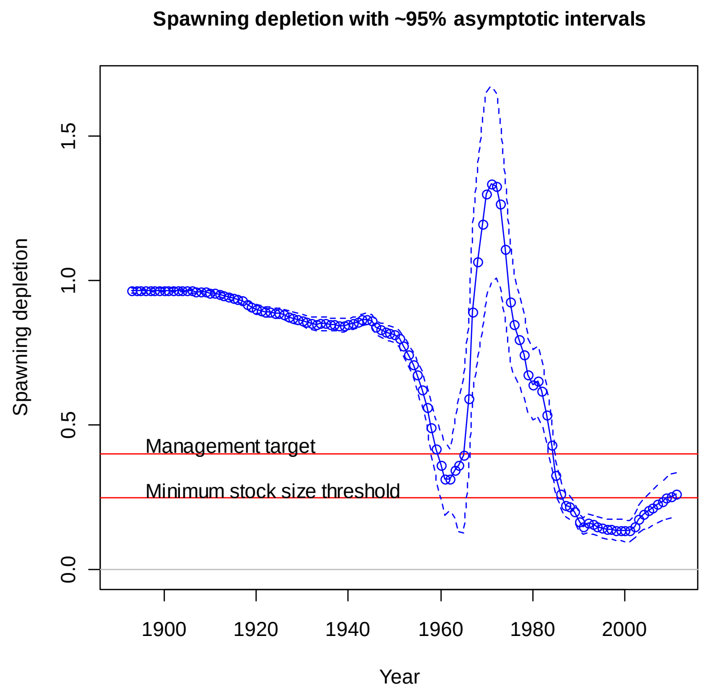


Figure E4. Time series of estimated depletion level of bocaccio from the STAT base model

Management Performance and forecast

Bocaccio rockfish were formally designated as overfished in March of 1999, and the OY has ranged from 218 and 307 tons since 2003 (Table E6), with actual catches (including discards) estimated to be less than half of that amount in most years. The current forecast is for an increasing abundance trend, with an expectation for sustained progress towards rebuilding as a result of the 2009 and 2010 year classes. Under the deterministic projection from the base model, the stock is not anticipated to rebuild until approximately 2020.

Table E6. Management performance

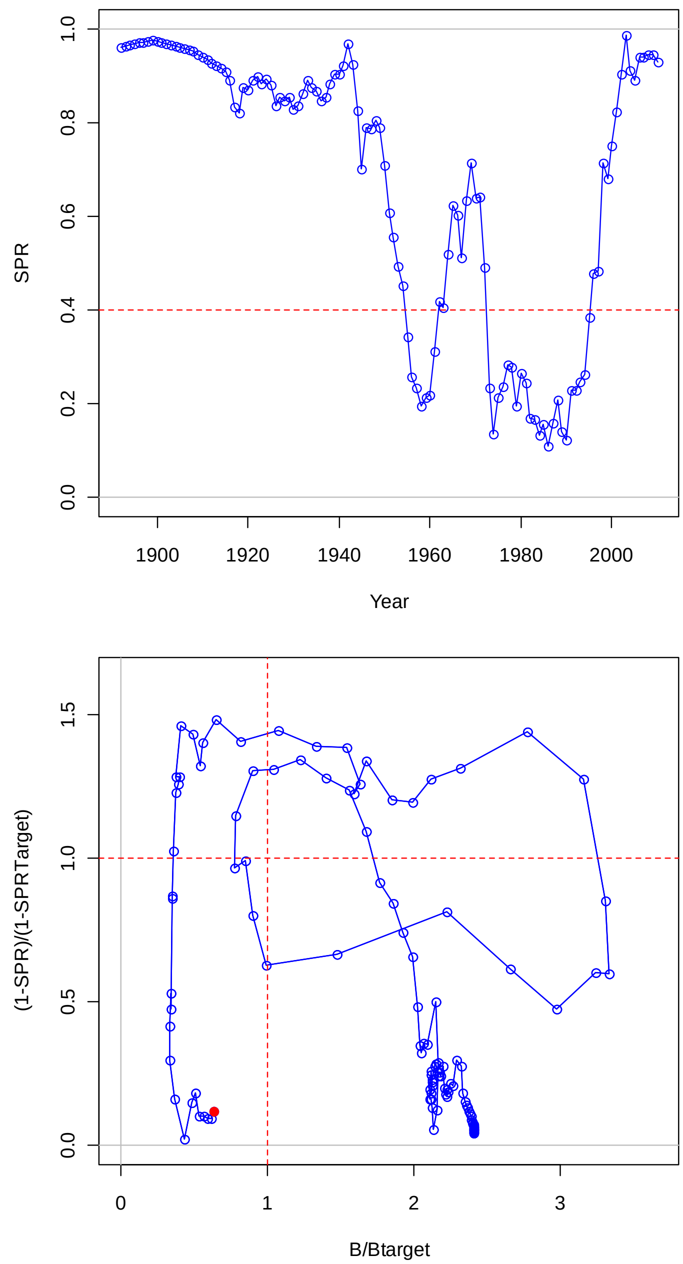
	Catch	OFL/ABC	ACL/OY
2001	131.30	122	100
2002	89.66	122	100
2003	12.78	244	20
2004	85.13	400	199
2005	107.34	566	307
2006	59.70	549	306
2007	62.53	602	218
2008	39.33	618	218
2009	57.50	793	288
2010	75.36	793	288
2011		737	263
2012		732	274

Table E7. Forecast of bocaccio ACL and OFL, spawning biomass and depletion (ACL based on the SPR= 0.777 fishing mortality target)

	STAT 0Y (SPR 0.777 after 2012)	STAT larvae $x10^{12}$	STAT depletion
2011	*263*	2.03	0.26
2012	*274*	2.07	0.26
2013	303	2.17	0.28
2014	340	2.31	0.29
2015	375	2.46	0.31
2016	406	2.62	0.33
2017	436	2.79	0.35
2018	463	2.95	0.37
2019	489	3.11	0.39
2020	506	3.27	0.41
2021	522	3.42	0.43
2022	537	3.56	0.45

Unresolved problems and major uncertainties

A major uncertainty for this update is the relative magnitude of the incoming 2010 year class. Virtually all sources of information that could be informative with respect to this recruitment year indicate strong to very strong recruitment for both 2009 and 2010. Thus, it is reasonable to expect that this year class will in fact result in increased abundance, as well as increased availability (or, inability for avoidance) for many fisheries, particularly in the Southern California Bight where most of the (recent) recruitment appears to have taken place. Although either an update or a full assessment will not be conducted until 2013, it is possible to do a tentative ("turn the crank" style) model evaluation with a limited set of information from 2011 that may help to evaluate and refine estimates of the magnitude of the 2010 year class in particular, based on length frequency information from recreational fisheries, the NWFSC bottom trawl survey and potentially the NWFSC hook and line survey.



Figures E5- E6. Spawner potential ratio (SPR) over time (top), with reference proxy for Sebastes (note reference should be 0.5) and phase plot of SPR rate plotted against SSB, against target levels (bottom).

Decision Table

As discussed earlier, currently what is likely the greatest source of uncertainty relevant to near term management decisions is the relative strength of the 2010 year class. In consultation with the September review panel, the decision table was structured to reflect this uncertainty, by bracketing what might be seen as highly optimistic and pessimistic results with respect to this year class. The rationale for this is that bocaccio are often encountered by fisheries, particularly the southern California recreational fishery, at high catch rates immediately following strong recruitment events, as young (and rapidly growing) bocaccio are often broadly dispersed over a range of habitats (see Figure 41 of main body of assessment). Consequently, despite the fact that recent catches have been substantially below target levels, there is some risk of reaching or exceeding adopted catch levels during periods of very high recruitment, particularly if this recruitment is underestimated in the model.

The bracketing of the magnitude of the 2010 year class was done by upweighting and downweighting the impingement survey dataset, leading alternatively to strong (comparable to 99 year class) or "weak" (comparable to average of the 2000s) estimates for the 2010 year class. This approach was considered reasonable as it is data-driven to a reasonable extent, and consistent with the weighting schemes used in the 2009 base model to determine states of nature (e.g., alternatively upweighting optimistic and pessimistic abundance indices).

In the resulting (deterministic) projections, assuming the maintenance of the current rebuilding SPR (0.777), the stock is anticipated to rebuild under both the base model and the "pessimistic" model by 2020, as these scenarios anticipate mean recruitment in years subsequent to 2010. Under the optimistic scenario, the stock could rebuild by 2016 for both the low and the baseline catch streams, with a slight delay (to 2017) if the catch streams corresponding to the high recruitment scenario are adopted. With respect to yield, the catch streams for the 2013-2014 management cycle under the rebuilding SPR are comparable (slightly greater) to 2011-2012 catches for the base model, nearly identical for the pessimistic model, and roughly 100 tons greater (per year) in the optimistic recruitment scenario. This reflects the potential for considerably greater abundance, encounter rates, and catches of smaller fish in particular if recruitment is indeed significantly greater than expected in the (current) base mode.

Table E8: Decision Table for the bocaccio update

Catch basis		low 2010 rec		STAT. Base		higher 2010 rec	
low 2010 rec		larvaex10^{12}	depletion	larvaex10^{12}	depletion	larvaex10^{12}	depletion
2011	*263*	2.07	0.26	2.03	0.26	2.01	0.26
2012	*274*	2.11	0.27	2.07	0.27	2.07	0.27
2013	276	2.19	0.28	2.17	0.28	2.28	0.29
2014	306	2.28	0.29	2.31	0.30	2.59	0.33
2015	338	2.40	0.31	2.47	0.32	2.88	0.37
2016	370	2.54	0.33	2.64	0.34	3.14	0.40
2017	400	2.69	0.34	2.81	0.36	3.38	0.43
2018	427	2.85	0.36	2.98	0.38	3.59	0.46
2019	453	3.01	0.39	3.15	0.40	3.78	0.48
2020	476	3.16	0.40	3.31	0.42	3.96	0.51
2021	491	3.31	0.42	3.47	0.44	4.12	0.53
2022	506	3.46	0.44	3.62	0.46	4.27	0.55
STAT base		larvaex10^{12}	depletion	larvaex10^{12}	depletion	larvaex10^{12}	depletion
2011	*263*	2.07	0.26	2.03	0.26	2.01	0.26
2012	*274*	2.11	0.27	2.07	0.26	2.07	0.27
2013	303	2.19	0.28	2.17	0.28	2.28	0.29
2014	340	2.28	0.29	2.31	0.29	2.58	0.33
2015	375	2.39	0.31	2.46	0.31	2.87	0.37
2016	406	2.53	0.32	2.62	0.33	3.13	0.40
2017	436	2.67	0.34	2.79	0.35	3.35	0.43
2018	463	2.82	0.36	2.95	0.37	3.56	0.46
2019	489	2.97	0.38	3.11	0.39	3.74	0.48
2020	506	3.12	0.40	3.27	0.41	3.91	0.50
2021	522	3.26	0.42	3.42	0.43	4.07	0.52
2022	537	3.41	0.44	3.56	0.45	4.21	0.54
higher 2010 rec		larvaex10^{12}	depletion	larvaex10^{12}	depletion	larvaex10^{12}	depletion
2011	*263*	2.07	0.26	2.03	0.26	2.01	0.26
2012	*274*	2.11	0.27	2.07	0.27	2.07	0.27
2013	385	2.19	0.28	2.17	0.28	2.28	0.29
2014	444	2.27	0.29	2.30	0.29	2.57	0.33
2015	478	2.36	0.30	2.43	0.31	2.84	0.36
2016	501	2.48	0.32	2.57	0.33	3.08	0.39
2017	513	2.61	0.33	2.72	0.35	3.29	0.42
2018	524	2.74	0.35	2.87	0.37	3.47	0.44
2019	536	2.88	0.37	3.02	0.39	3.65	0.47
2020	549	3.01	0.39	3.16	0.40	3.81	0.49
2021	562	3.15	0.40	3.30	0.42	3.95	0.51
2022	574	3.28	0.42	3.44	0.44	4.09	0.52

Research and Data Needs

Since large scale area closures and other management actions were initiated in 2001, the spatial distribution of fishing mortality has changed over both large and small spatial scales. Not only has this effectively truncated several abundance indices (recreational CPUE), this confounds the interpretation of survey indices for surveys that do not sample in the Cowcod Conservation Areas (CCAs), as insights from larval surveys suggest that there has been a change in the distribution of bocaccio in recent years such that the greatest abundance of bocaccio is found in that area. This, in turn, infers that fishing mortality is greater on the fraction of the stock currently outside of the CCAs, which may be undergoing localized depletion at a greater rate than the coastwide total stock due to the fact that the greatest catches of bocaccio are derived from these areas.

Stock structure for bocaccio rockfish on the West Coast remains an important issue to explore and consider. Although a reanalysis of the genetic evidence done for this assessment suggests no significant differentiation among the major oceanographic provinces in the California Current, the apparent differences in growth, maturity, and longevity, are indicative of moderate demographic isolation.

The potential to develop defensible aging criteria for bocaccio in the southern area should be evaluated further, particularly if such criteria could be developed in a coordinated effort among workers along the west coast.

The application of juvenile indices to inform future recruitment remains an area in need of additional research and development, including more extensive evaluation of two indices not included in the 2009 assessment (power plant impingement data and submersible observation data). A greater appreciation of the strengths and weaknesses of these indices is an important research priority.

INTRODUCTION

This revised assessment update responds to the comments and recommendations of the Pacific Fishery Management Council Scientific and Statistical Committee (PFMC SSC) following a review of an initial draft of the updated assessment in June 2011. That draft was found by the SSC not to meet the terms of reference for an update, as there were significant changes to the model structure and data done in order to avoid what the STAT found to be unrealistic results from the traditional update (PFMC 2010). The "unrealistic" result was an extremely strong 2010 year class inferred from the length frequency data of the NWFSC combined trawl survey. Although there are indeed signs of strong recruitment for bocaccio in 2009 and 2010 the magnitude of the 2010 recruitment estimate was essentially unprecedented (a "poorly informed" strong year class in the 1960s was as large or larger, but originated from a greater spawning stock biomass).

As this year class was essentially informed by a small number of length frequency observations and tows, the STAT considered the data unreliable for estimated the true magnitude of this year class, and excluded the 2010 length frequency data from the May draft of the model. The STAT then added a time series of pre-recruit (age 0) abundance data which had been used in past assessments, the power plant impingement dataset. This index was not included in the 2009 base model, however it was re-evaluated following the 2009 stock assessment when updated data became available, and subsequently found to have a strong correlation with the model estimates of recruitment. The STAT consequently considered this a more reliable indicator of impending year class strength than the NWFSC combined trawl dataset, and excluded the 2010 length frequency data from the latter dataset, and added the pre-recruit (age-0) abundance data from the impingement dataset. The STAT also reported the results from the model that adhered more closely to the terms of reference, but did not consider that model to be acceptable for providing management advice. That model projected that the bocaccio stock would rebuild by the year 2013, when the 2010 year class became mature, regardless of catch levels and only modestly sensitive to the assumed "states of nature" from the 2009 base model.

The SSC recognized that the model result under the strict interpretation of the terms of reference was questionable, but also concluded that because the model put forward by the STAT did not meet the terms of reference for an update, it could not be adopted for management without further review. The SSC recommended that a revised document be developed and reviewed at the Sept. 2011 "mop up" panel, at which time various alternative means of addressing the key uncertainty in the update could be investigated. The model reported here is the base model proposed by the STAT and recommended for adoption for management by that review panel. Although this assessment no longer meets the criteria for an "updated" assessment as defined in the terms of reference, the scope of the revisions are limited to deal with this specific issue. Consequently, this update does not include the background information provided in the full 2009 assessment, for which the 2009 assessment should be referred to (Field et al. 2009). Moreover, dataset descriptions, diagnostics and model fits are included only for time series that were extended in this update, as the model results and fits through the year 2009 change only modestly for these datasets.

DATA

Fishery Dependent Data

Commercial and Recreational catches

Commercial bocaccio catch estimates were updated from 2008 through 2010 based on the NWFSC total mortality reports, consistent with the means by which catches were estimated in the 2009 assessment (Tables 1-2). As no estimate was available for 2010, catches in this year were estimated by applying the discard rates inferred from the West Coast Groundfish Observer Program to catch estimates from CalCOM. Discard rates were approximately 85% for the trawl fishery in 2008-2009 (those rates were applied to 2010 estimates as preliminary 2010 bycatch rates were 100%). No discards were observed in fixed gear fisheries for any of these years, thus fixed gear landing estimates were based on fixed gear catches. A more rigorous evaluation of bycatch data and rates by gear type and region should be undertaken in the next full assessment. Recreational catch estimates for 2008-2010 were provided by John Budrick (CDFG) based on the CRFSS sampling system. Although recent efforts have been undertaken to improve species-specific estimates of historical catches in Oregon (Gertseva et al. in prep), this effort currently does not provide region-specific catch estimates, which is key to bocaccio where only the catches south of Cape Blanco are included in the model. Consequently, historical catch data were not revisited, but should be in the next full assessment.

Commercial Length Frequency Compositions

The number of length observations available from traditional (CalCOM) sources of length frequency data were inadequate (single digits each for 2009, 2010) to include as length composition information in this update. Consequently, no new commercial length frequency data are included in the update. Length frequency information is available from the bycatch monitoring program, but as this information was not incorporated in the 2009 assessment it is not included in this update. Revisiting an appropriate way to incorporate this data should be done in the next assessment.

Recreational Length Frequency Data

New recreational length frequency data area available from the CRFSS monitoring program (accessed from the RecFIN website) for 2009-2010. The total number of clusters, fish sampled, and initial effective sample sizes are presented as Table 3.

Fishery-Dependent Indices

None of the fishery-dependent indices (trawl or recreational CPUE) were updated for this assessment as all of the time series have been effectively truncated by management actions.

Fishery-Independent Data

CalCOFI larval abundance data

The CalCOFI larval abundance time series was updated with a small number of observations from (late) 2008, and new observations for all of 2009 and the January survey for 2010. The index was developed with the same approach adopted in the past assessment, a delta-GLM model with the main (fixed) effects of interest being year (adjusted to spawning season), month and line-station effects. These estimates and the associated standard errors estimated from a jackknife routine were used in the model as a relative index of population spawning output (Figures 2, Table 4). The year effects through 2008 were virtually identical from the most recent GLM results, the new estimates for 2009 and 2010 estimates were suggestive of a flattening, or potentially a decline, from the increasing trend observed through most of the 2000s.

Northwest Center Trawl Survey

The Northwest Fishery Science Center has conducted combined shelf and slope trawl surveys since 2003, based on a random-grid design from depths of 55 to 1280 meters. Additional details on this survey and design are available in the abundance and distribution reports by Keller et al. (2008). Bocaccio CPUE (kg/ha) and negative tows (in depths less than 350 m) pooled over all years are shown as Figure 3a and b; data for 2010 in the Southern California Bight only is shown in Figures 4a and b and discussed in greater detail momentarily. Additional data on the number of tows, number of positive tows, number of length measurements and mean CPUE rates by depth and INPFC area are provided in Tables 5.

The 2009 assessment used a GLMM approach for the development of a relative abundance index (using standard depth strata and area, as well as year, as factors), this index was updated with the latest catch data. The 2009 and the updated (2011) index are shown in Figure 5a. The 2011 index varies modestly from the 2009 index in the years 2005-2006, this is likely a result of changes to the definition of "standard" tows by the NWFSC between the 2009 data request and the 2011 data request, as tows that took place in recently closed (state MPA) areas were excluded from the 2011 data request (a document describing the rationale and results of this tuning is in preparation by the NWFSC). This resulted in a reduction of the number of acceptable hauls used to develop the index, particularly in 2005-2006 when 11 and 2 positive tows were removed respectively. Despite the modest difference between the 2009 and 2011 index, the general pattern is unchanged, with a peak in abundance in 2004 (likely reflecting a strong 2003 year class), a decline in 2005, and a smaller peak in 2006 with declining abundance since that time.

Length frequency data were based on the expanded length frequencies provided by Beth Horness (NWFSC), shown in Figure 5b through 2010. The length frequency data in most of the early years are dominated by the 1999 year class, with signs of the incoming 2003 and 2005 year classes in later survey years. Perhaps most importantly, the 2010 length frequency data are entirely dominated by small (16-20 cm) bocaccio, which represented over 85% of all of the fish encountered in the assessment region for that year (relative to just over 2% of all lengths encountered in the 2003-2009 time period). Although the majority of these fish came from a single haul, over 1 dozen hauls had age-0 fish in 2010, all of which were from hauls centered on the eastern half of the northern channel Islands (Figures 4a-b) and conducted during the second (fall) sweep of the survey. This has previously been described as a region that often has patchy, but highly abundant, numbers of YOY fish late in the year during years of successful recruitment (Love et al. 2005).

As this length composition data have tremendous influence on the model results, leading to what the STAT considered to be a likely unrealistic model projection, alternative means of dealing with these data were explored. Specifically, the STAT considered decoupling of the trawl survey young-of-the-year (YOY) from the age 1+ population, a reasonable approach for using the survey data. As the ageing of bocaccio in general is not feasible, we assumed that bocaccio smaller than 20 cm were young-of-the-year, and those 20 cm or larger were age 1+ (the base model assumes both males and females are 26 cm length at age 1.5). The length composition data from the survey were used to assign the relative CPUE for each tow to "YOY" or "Age 1+" biomass, in order to run separate GLMs of each index. However, due to the paucity of positive tows for age 0 bocaccio in most years (only 4 years had more than 1 positive tow in the region in which most positives were derived; see Tables 6-7) the resulting index could only be estimated for 6 of the 8 years of the survey. Moreover, a six year time series was only possible when the model was allowed to estimate year effects based on only a single positive observation in a single strata (which consequently precludes the estimation of a CV, as there were insufficient positive observations to conduct a jackknife). Thus this index was not considered reliable, and was not incorporated into the model. However, to the extent it does inform recruitment, the results are consistent with moderately strong recruitment events in 2003 and 2005 and the expectation of strong recruitment in 2009 and 2010. The revised index for age 1+, and the index for age 0 bocaccio are shown in Figure 5b. The index differed only modestly for the estimated age 1+ abundance relative to the index in which all catches were included in the estimation.

NWFSC Southern California Bight hook-and-line survey

A hook and line survey CPUE index developed by the NWFSC was developed by Harms et al. (2008, 2010) was used in the last assessment and updated in this assessment (J. Harms and J. Wallace, pers. com). The extended index (Figure 6a) and associated length frequency data (Figure 6b) are used in the model. The index suggested a slight decline from 2004-2008 in the last assessment, the most recent data points suggest a steeper decline from the early period into 2009- 2010, with the 2010 data point being less than 1/3rd the value of the 2004 data point. As the selectivity of this survey is strongly dome-shaped, and the length frequency data are not indicative of a strong incoming year class, this likely represents the continued decline and reduced selectivity of recent dominant year classes (1999, 2003, 2005) with some sign of a moderately strong year class in 2009. As with the trawl survey index, the hook and line survey index does not include sampling in the Cowcod Conservation Areas where much of the spawning biomass of bocaccio is thought to reside.

Recruitment Indices

Two young-of-the-year (YOY) recruitment indices were used in the 2009 bocaccio assessment: the coastwide midwater trawl survey index (2001-2008) and a recreational pier fishery CPUE index that included historical data from the 1950s and 60s. The coastwide midwater trawl survey index was updated by Ralston (2010) and show in Figure 7a and Table 8; the updated time series was included in the model. The 2010 estimated recruitment was the highest in the 10 year time series of this data set. The pier fishery index was also updated (Figure 7b), with several positive records of bocaccio in 2009, but only one positive record from currently available data for 2010. This record was for several fish, which would have led to a high 2010 value for this index if a minimum number of positive values was reduced to 1 (included as a dashed line on the figure), but this precludes the ability to estimate error with a jackknife routine, and thus was not done for the model (consistent with the original approach adopted in the 2009 assessment). The estimated 2009 value is among the highest in recent decades (Figure 7b; note that to evaluate the most recent data, the scale is truncated to exclude the 1950s and 1960s estimates).

A third juvenile index, based in power plant impingement data, was revisited (the data had been used or proposed in past assessments) and discussed in the 2009 assessment but not used due to the fact that the time series at that time only extended to 2001. However a connection to the data sources subsequently became available and an index was developed and evaluated in Field et al. (2010; attached as an appendix). The power plant impingement index represents data collected from coastal cooling water intakes at five Southern California electrical generating stations from 1972 to 2010 (and ongoing). These data have been previously described and published by Love et al. (1998) and Miller et al (2009) with respect to trends in abundance of *Sebastes* species and queenfish (*Seriphus politus*), respectively (See either of these manuscripts for additional information, and the precise location of the facilities). More recently, a manuscript describing abundance trends in sand basses (*Paralabrix spp*) in the southern California Bight was published using these (and other) data (Erisman et al. 2011).

The dataset includes observations on as many as 1.8 million fish encountered in three basic types of power plant impingement surveys (E. Miller unpublished data.). The three principle “types” of survey data include “normal operations” (fish sampled off of intake screens during normal operations, typically done every 24 hours although we aggregated these by month for any given plant to avoid excessive weighting of these data), “heat treatments” (periodic events in which a given volume of water is treated at high temperatures to kill off biofouling organisms, all fishes in that known volume of water are subsequently enumerated), and a third set (“fish chase”) data that are unique to the San Onofre power plant but were not used in this analysis due to the low frequency of occurrence of bocaccio in those data. Although the frequency of all of these sampling methods is irregular over the 28 year time series, as a result of changes in operating schedules, regulatory requirements and changes in ownership over time, the time series is uninterrupted at the annual scale from 1972-2008.

As with the pier recruitment index, the impingement index was developed using a Delta-GLM (generalized linear model) approach to combine a binomial model for presence/absence information with a model of catch per unit effort for positive observations. Akaike’s Information Criteria (AIC) was used to determine the appropriate error distributions and covariates. Year effects are independently estimated covariates which reflect a relative index of abundance for each year, error estimates for these parameters are developed with a jackknife routine. For the impingement data, the other covariates included month, the power plant (essentially “station” or spatial effects, five total), and survey type (“normal operations” or “heat treatments,” described above). The resulting recruitment indices from 1972-2008 were compared to the estimated recruitments from the 2009 stock assessment (which did not include this index), and the natural log of both the predictor (indices) and response (assessment recruits) values were used for the regression to best mimic the behavior of stock assessment model optimization routines. The power plant index compared very well (R^2 of 0.58) with the assessment estimated recruitments for the 1972-2008 period (Figures 8a-b). Although the data and index were not extensively reviewed by the 2009 STAR Panel, due to the short duration of the time series, the extended time series is included in this assessment due to the perceived or potential value of these data in assessing the relative strength of the 2010 year class.

A final juvenile index, based on a visual (Delta submersible) survey of Southern California Bight oil rigs and natural reefs was also developed and presented in Field et al. (2010) and updated for informative purposes only in this assessment (see Love et al. 2005 for more details regarding this survey). Data from this survey begin in 1995 and were reported through 2008 in the manuscript, for which the index was developed in a manner consistent with the other juvenile indices. The index was updated to include data from 2010, and the results are consistent with the expectation that 2010 should be among the highest recruitment years in recent history for bocaccio (Figure 9a-b). However, as this index was neither discussed nor included in the 2009 assessment, nor is the time series as long as the impingement index, it is not included in the model but referenced solely for informational purposes.

Model Description

Modeling software

The 2009 assessment used the Stock Synthesis 3 (SS-V3.03A) modeling framework developed by Dr. Richard Methot (Methot 2009a; Methot 2009b). While we originally (May 2011 draft) conducted the update with the SS3 version used in the 2009 assessment, other STAT teams did their updated assessments using more recent versions of SS3, which facilitated rapid viewing and comparison of model results by virtue of being able to use the most recent "R4SS" viewing and graphing code. As the model results and likelihood values changed only trivially (Figure 10, Table 9), we considered this a worthwhile upgrade. The 2009 model used uninformative priors on many of the selectivity parameters in early modeling efforts, as well as the Dorn (2002 and updated) beta prior distribution for steepness was used in the 2009 base model and is continued here.

Base model results

In the initial model that strictly followed the terms of reference for stock assessment updates, the length frequency data from the NWFSC 2010 bottom trawl survey had a very strong influence on the model behavior with respect to the estimation of the 2010 year class. Consequently, this revised update included the inquiries recommended by the SSC in May of 2011, and developed a revised model that is not strictly an update, but neither explored all of the questions and avenues that might have been investigated in a full assessment. In the current base model, the combined trawl survey was disaggregated into an age-0 and age 1+ index of relative abundance, with only the age 1+ index used in the model, and the impingement age-0 abundance index was added as a pre-recruit index. This model was the result of a suite of explorations, in which alternative selectivity forms (dome-shaped, time-varying), as well as alternative time periods for the recruitment bias correction phase-in were also explored, none of which made a substantive difference in the basic result or the relative magnitude of the 2010 year class when all of the length data were included. Although the impingement index was not a part of the 2009 assessment model, the index was reported in that assessment through 2001 (the year to which data were then available) and would have been included (or, at a minimum, explored further) had the more recent data been available at that time. Moreover, the methodology for the development of this index is entirely consistent with that of similar indices included in the 2009 assessment, as well as documented in a recent publication (Field et al. 2010 attached as an appendix) for which the impingement time series was demonstrated to be the best performing YOY abundance index for this species (out of four evaluated).

A summary of the available data by type and year is included as Figure 11. Selectivity curves for all surveys and fisheries are shown in Figure 12. Fits to the updated relative abundance indices (CalCOFI, the NWFSC hook and line index, the NWFSC trawl survey index, the juvenile trawl survey index, the pier fishery CPUE index and the impingement index) are shown in Figures 13-18, in both arithmetic and log space, including plots of the observed vs. predicted values. Fits to the truncated time series (trawl CPUE, triennial survey and the recreational CPUE indices) are not included as they are essentially unchanged from the 2009 assessment. Note that the fits to both the hook and line and the trawl survey index are very poor. These indices estimate a declining trend in abundance while the model (based on CalCOFI and other indices) estimates an increasing trend, these inconsistencies relate directly to what the STAT considers to be the greatest uncertainties and data needs; reconciliation of trend data from the areas solely outside of closed areas with those for the entire southern California Bight (e.g., CalCOFI). Fits to the length composition data, along with plots of residual values and input relative to effective sample sizes, for the recreational fisheries and updated surveys are presented as Figures 19-26 (note that fisheries for which no new data are available were not included as the fits have not changed significantly).

To track the influence of updating the various time series and data sources, we added updated data sequentially, and show basic model results as well as likelihood values and model trends for each addition leading up to what would have been the Terms of Reference (TOR) model and the final resulting base model (Table 9). Virtually all of the updated indices led to slightly more pessimistic estimates of stock status (with the exception of the YOY indices), although the influence was relatively modest for the recreational (length frequency) data and the CalCOFI data, and more substantial for the NWFSC SCB hook and line survey and the NWFSC combined bottom trawl survey, both of which exhibited particularly strong declines in recent years.

Point estimates of parameters (including the recruitment deviation point estimate values) for the base model are reported in Tables 10 and 11, along with the corresponding estimates from the 2009 model. With the exception of the selectivity parameters for the NWFSC combined trawl survey, the growth, recruitment and selectivity and parameter values changed very little. However, the recruitment deviation parameters changed modestly, and (with the exception of the poorly informed early period, which juggles among several years for the very strong early 1950s year class) generally had a bias towards lower recruitments, particularly in the last 20 or so years in the time series. This is presumably a consequence of the need to “balance” the recruitment deviations such that they sum to zero. The net effect is that the combination of the 2009 and 2010 year classes in the base model equate roughly (slightly less than) the net recruitment realized from the 1999 year class (the largest observed year class since 1989). By contrast, the 2010 year class estimated in the (unreported) TOR model was nearly 10 times the recruitment of the 1999 year class. Although such optimism may be overly exuberant, there is some possibility that the magnitude of this recruitment could be significantly greater than currently estimated.

The base model results are shown as Figures 27-33 (and in Table 12) for summary biomass, spawning output, depletion, age-0 recruits, recruitment deviation estimates, the spawner-recruit curve, the equilibrium yield curve, and the estimated SPR (including phase plot against B target). The resulting estimates of unfished summary (age 1+) biomass, spawning output and mean age 0 recruitment are only modestly changed from the 2009 results (approximately 44,000 mt, 7,800 x 10^9 larvae and 5.1 million recruits, respectively). Similarly, the estimated steepness was only modestly changed from the 2009 base model (0.60, relative to 0.58 in the 2009 model). General biomass trends were virtually identical to the 2009 model, although the current base is slightly more pessimistic than the 2009 model, with depletion estimated to be at 26% of the unfished level in 2011 (by contrast, the projected depletion level in 2011 for the 2009 model was 30% of the unfished level).

Uncertainty and sensitivity analysis

As discussed earlier, currently what is likely the greatest source of uncertainty relevant to near term management decisions is the relative strength of the 2010 year class. Greater analysis of some data streams precluded an update that strictly adhered to the PFMC terms of reference for stock assessment updates, as the magnitude of this year class was spectacularly optimistic (and, in the opinion of the STAT, unrealistically so). Moreover, although there are several indications of strong recruitment in 2010, this result was almost entirely due to the fact that over 85% of the individual fish encountered by the 2010 NWFSC combined trawl survey were YOY bocaccio (in contrast to just 2% for the preceding 7 years of the survey). As length composition data may be overemphasized relative to other index data in many models (Francis 2011), the influence of the survey length frequency data were overwhelming, resulting in an estimated 2010 recruitment value far above any observed in the historical time series and a recruitment deviation estimate far greater than any estimated by the model. This resulted in some dilemmas regarding the most appropriate way to parameterize this assessment. It should be pointed out that several sources of information point to this year class as being quite strong, including the juvenile trawl survey, the impingement data, the submersible survey index, the fact that there have been relatively cool and productive ocean conditions in the southern California Current in recent years. As the true strength of the 2010 year class will only be manifest in time, the very strong magnitude of the recruitment inferred by the trawl survey length frequency data were not considered entirely reliable by the STAT for the purposes of the update.

Specifically, the model that adhered to the terms of reference and included the 2010 length frequency data projects the stock will be rebuilt by 2013, and above the mean unfished level of spawning output by 2016. By contrast, under the STAT model, the stock is projected to rebuild steadily from the strong 2009 and 2010 year classes, reaching 40% of the unfished spawning potential between 2018 and 2021 (depending upon the catch stream). While this is earlier than projected with the 2009 model, it is consistent with the range of projections from that assessment and the subsequent rebuilding plan. Figures 34 and 35 shows a comparison of the 2009 model estimates and ten year projections for spawning biomass, relative depletion, recruitment and recruitment deviation values, along with that of the base model presented here and the model that would have strictly adhered to the terms of reference (TOR model). Although it is entirely possible that the 2010 recruitment for bocaccio will be considerably greater than projected in this base model, the STAT views the probability of recruitment at the level estimated by the terms of reference model to be very unlikely.

In consultation with the September review panel, the panel agreed with this determination, and accepted the revised model that included the impingement index as a reasonable base model to address this unique situation. Subsequently, the decision table (Table 13) was structured to reflect the uncertainty, by bracketing what might be seen as highly optimistic and pessimistic results with respect to this year class. A comparison of the resulting spawning output, depletion, recruitment and recruitment deviation time series are also shown in Figures 36-37. The rationale for this is that bocaccio are often encountered by fisheries, particularly the southern California recreational fishery, at high catch rates immediately following strong recruitment events (Figure 38), as young (and rapidly growing) bocaccio are often broadly dispersed over a range of habitats. Consequently, despite the fact that recent catches have been substantially below target levels, there is some risk of reaching or exceeding adopted catch levels during periods of very high recruitment, particularly if this recruitment is underestimated in the model.

The bracketing of the magnitude of the 2010 year class was done by upweighting and downweighting the impingement survey dataset, leading alternatively to strong (comparable to 99 year class; the total recruits is greater although the recruitment deviation parameter is slightly lower; difference reflects the increase in spawning biomass since 1999) or "weak" (essentially a recruitment deviation of 0, comparable to average of the 2000s) estimates for the 2010 year class. This approach was considered reasonable as it is data-driven to a reasonable extent, and consistent with the weighting schemes used in the 2009 base model to determine states of nature (e.g., alternatively upweighting optimistic and pessimistic abundance indices). Note that both the upweighting and the downweighting of the impingement index resulted in very slightly different recruitment time series and subsequent depletion levels in 2010 (due to the constraint that recruitment deviations must sum to, or very close to, zero). To minimize dramatic changes in the estimation of earlier recruitment and abundance trends, the CV on pre-2009 impingement data was doubled, essentially narrowing the focus of the upweighting to the most recent years of the impingement dataset. Subsequent to this change, differences in historical recruitments and biomass trends were negligible.

In the resulting (deterministic) projections, assuming the maintenance of the current rebuilding SPR (0.777), the stock is anticipated to rebuild under both the base model and the "pessimistic" model by 2020, as these scenarios anticipate mean recruitment in years subsequent to 2010. Under the optimistic scenario, the stock could rebuild by 2016 for both the low and the baseline catch streams, with a slight delay (to 2017) if the catch streams corresponding to the high recruitment scenario are adopted. With respect to yield, the catch streams for the 2013-2014 management cycle under the rebuilding SPR are comparable (slightly greater) to 2011-2012 catches for the base model, nearly identical for the pessimistic model, and roughly 100 tons greater (per year) in the optimistic recruitment scenario. This reflects the potential for considerably greater abundance, encounter rates, and catches of smaller fish in particular if recruitment is indeed significantly greater than expected in the (current) base mode. These catch streams are reported in the decision table, and in Figure 39.

There were no troubling or worrisome results from the retrospective analyses (Figures 40-41), although they too also illustrate the generally more pessimistic perception of relative spawning output as driven with the most recent data for various time series.

The STAT also notes that the poor fits to two of the more recent survey time series are considerably more pessimistic than the results of the base model. Although this 2011 assessment was not a typical "update" relative to the terms of reference, the narrow scope of new analysis did not provide an opportunity to take a more comprehensive look at these inconsistencies. However, as in the 2009 assessment, the STAT notes that there should be concerns over how these indices are interpreted, given that neither of these surveys cover the area that is currently the greatest region of bocaccio abundance, within the cowcod conservation areas (CCAs), as recently demonstrated by Ralston and MacFarlane (2010, see also Figure 42). These surveys may well capture the relative abundance trends in the coastal areas of the southern California Bight, where fishing mortality is also focused on a fraction of the total available habitat (and biomass) for bocaccio. Specifically, even relatively modest differences in abundance at the time of the cowcod area closures of 2001, if coupled with low or negligible movement of adult fish subsequent to that period, could result in an accumulation of biomass in the closed areas since that time which would not be captured by these surveys. Thus, relative declines may in fact be steep in the open areas (although see discussion on ontogenetic changes in habitat preferences with size/age in the 2009 assessment as well), but spawning potential may be stable or increasing as a whole throughout the range (as inferred by the CalCOFI larval abundance index) as a result of management measures. Resolving how best to measure and assess the actual biomass trends of bocaccio throughout the survey area, remains a key uncertainty and research need for assessment of this species.

Reference Points

Reference points are presented in Table 14, which report the unfished summary biomass, unfished spawning output, mean unfished recruitment and the proxy estimates for MSY based on the $SPR_{50\%}$ rate, the fishing mortality rate associated with a spawning stock output of 40% of the unfished level, and MSY estimated based on the spawner/recruit relationship. The corresponding yields for these three estimates varied by a relatively minor amount, ranging from 1217 to 1234 tons (by contrast, the 2009 model estimated a range of yield values from 1250 to 1270). Despite the minor difference in yield between the SPR proxy and the estimated MSY rate, there is a considerable range of spawning biomass levels associated with these alternatives, with the modestly greater OY under the estimated MSY rate associated with a considerably lower relative abundance.

Future Research Needs

Research needs are discussed comprehensively in the 2009 assessment and have changed little since that time. Particularly important is the observation that most of the fishing mortality on bocaccio rockfish takes place in the southern California recreational fishery, where a broad area of habitat is closed to fishing in the cowcod conservation areas (CCAs) and rockfish conservation areas (RCAs). As the NWFSC combined trawl survey and the NWFSC hook and line survey do not index abundance in the CCAs (they do survey within the RCAs), where larval distribution data suggest the greatest abundance of bocaccio is currently found, the time series derived from these indices in this region are likely to be biased, and inconsistent with the CalCOFI index that captures the entire region. Although this is not a problem limited to bocaccio, the problem is particularly acute to populations that have their greatest distribution in the Southern California Bight.

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Table 1. Total catches (metric tons) and PFMC adopted ABC/OY values for bocaccio rockfish.

	Catch	ABC	OY
1999	196.90	230	230
2000	139.80	164	100
2001	131.30	122	100
2002	89.66	122	100
2003	12.78	244	20
2004	85.13	400	199
2005	107.34	566	307
2006	59.70	549	306
2007	62.53	602	218
2008	39.33	618	218
2009	57.50	793	288
2010	75.36	793	288
2011		737	263
2012		732	274

Table 2. Estimated domestic commercial landings and discards of bocaccio rockfish south of Cape Blanco, by region and gear type, 1999-2010 (metric tons).

	trawl south of 38° N	trawl north of 38° N	hook and line	setnet	rec south of 34.5° N	rec north of 34.5° N
1999	19.00	53.00	26.00	20.70	7.20	71.00
2000	13.50	60.00	6.60	7.00	0.70	52.00
2001	9.20	49.00	4.40	7.80	0.90	60.00
2002	28.04	20.67	0.13	0.01	35.88	4.93
2003	5.07	0.31	0.00	0.00	5.53	1.87
2004	13.86	3.52	1.84	0.21	63.43	2.27
2005	24.64	0.43	1.50	0.17	69.90	10.70
2006	16.09	0.31	2.25	0.25	29.00	11.80
2007	4.06	1.58	3.39	0.38	44.20	8.92
2008	0.42	1.98	2.02	0.08	31.50	3.33
2009	1.12	4.85	1.50	0.03	40.30	9.70
2010	2.90	10.97	1.45	0.05	52.60	7.40

Table 3. Total number of length frequency observations, subsamples, and input effective sample size for recreational fisheries, 2008-2010 (see 2009 assessment for complete table).

	Southern California			Central/Northern California		
	obs	samples	Neff	obs	samples	Neff
2008	1811	484	400	163	88	110
2009	2085	444	400	215	89	119
2010	1869	368	400	184	87	112

Table 4. Total number of plankton tows, positive tows, and the mean cpue of positives for 2000-2010 (see 2009 assessment for complete table).

	Northern area (lines<77)			Southern area (lines>=77)		
	total tows	positive	ave cpue	total tows	positives	ave cpue
2000				96	8	0.8
2001				93	6	0.5
2002				118	10	1.0
2003	46	4	0.6	143	14	1.0
2004	46	3	1.3	99	11	4.9
2005				146	16	1.6
2006	28	4	1.6	149	13	0.7
2007	10	4	5.6	108	11	1.2
2008	***20***	***1***	***0.3***	176	13	1.8
2009	***24***	***1***	***0.2***	***170***	***10***	***0.7***
2010	***15***	***3***	***3.0***	***129***	***10***	***0.9***

Table 5. Summary of all bocaccio catch information for NWFSC combined shelf-slope bottom trawl survey, by latitude and inside of 350 meters depth, 2003-2010.

Total number of hauls, 50 to 350 m

lat	2003	2004	2005	2006	2007	2008	2000	2010
32	37	39	48	49	57	50	64	60
34.5	20	18	17	16	23	24	29	24
36	23	24	32	31	29	41	42	38
38	34	39	50	45	33	42	33	45
40.5	56	28	50	34	41	36	44	49
43	129	136	167	172	196	164	171	180

Number of positive tows

lat	2003	2004	2005	2006	2007	2008	2000	2010
32	9	9	13	11	12	2	8	16
34.5	7	4	2	2	6	3	6	10
36	6	7	12	9	6	8	4	6
38	8	10	8	12	1	8	5	3
40.5	4	0	3	1	2	1	1	0
43	5	0	2	3	3	4	0	1

Percent positive

lat	2003	2004	2005	2006	2007	2008	2000	2010
32	0.24	0.23	0.27	0.22	0.21	0.04	0.13	0.27
34.5	0.35	0.22	0.12	0.13	0.26	0.13	0.21	0.42
36	0.26	0.29	0.38	0.29	0.21	0.20	0.10	0.16
38	0.24	0.26	0.16	0.27	0.03	0.19	0.15	0.07
40.5	0.07	0.00	0.06	0.03	0.05	0.03	0.02	0.00
43	0.04	0.00	0.01	0.02	0.02	0.02	0.00	0.01

Mean CPUE (kg/ha) of positives

lat	2003	2004	2005	2006	2007	2008	2000	2010
32	2.0	3.0	1.7	1.8	6.1	2.3	0.8	1.1
34.5	1.0	5.8	1.7	29.0	3.7	1.7	4.7	2.2
36	2.1	66.0	14.3	2.1	4.7	11.4	3.2	1.2
38	3.5	4.0	3.2	3.4	1.9	4.8	2.5	1.8
40.5	2.7	0.0	2.7	0.3	2.7	0.0	4.5	0.0
43	5.0	0.0	1.4	27.1	6.8	5.1	0.0	0.7

Number of length measurements

lat	2003	2004	2005	2006	2007	2008	2000	2010
32	37	54	111	92	98	7	26	207
34.5	15	29	4	81	25	10	44	48
36	11	378	165	16	21	63	19	8
38	25	32	22	22	1	21	8	3
40.5	9	0	15	1	4	1	3	0
43	16	0	2	50	8	9	0	1

Table 6. Summary of presumed young-of-the-year (<20 cm) bocaccio catch data for NWFSC combined shelf-slope bottom trawl survey, 2003-2010.

Total number of hauls, 50 to 350 m

lat	2003	2004	2005	2006	2007	2008	2000	2010
32	37	39	48	49	57	50	64	60
34.5	20	18	17	16	23	24	29	24
36	23	24	32	31	29	41	42	38
38	34	39	50	45	33	42	33	45
40.5	56	28	50	34	41	36	44	49
43	129	136	167	172	196	164	171	180

Number of positive tows

lat	2003	2004	2005	2006	2007	2008	2000	2010
32	4	0	6	0	1	0	2	12
34.5	3	0	0	0	0	0	0	1
36	0	1	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0
40.5	0	0	0	0	0	1	0	0
43	0	0	0	0	0	1	0	0

Percent positive

lat	2003	2004	2005	2006	2007	2008	2000	2010
32	0.11	0	0.13	0	0.02	0	0.03	0.20
34.5	0.15	0	0	0	0	0	0	0.04
36	0	0.04	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0
40.5	0	0	0	0	0	0.03	0	0
43	0	0	0	0	0	0.01	0	0

Mean CPUE (kg/ha) of positives

lat	2003	2004	2005	2006	2007	2008	2000	2010
32	0.031	0	0.026	0	0.046	0	0.136	0.846
34.5	0.034	0	0	0	0	0	0	0.022
36	0	0.017	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0
40.5	0	0	0	0	0	0.012	0	0
43	0	0	0	0	0	0.013	0	0

Number of length measurements

lat	2003	2004	2005	2006	2007	2008	2000	2010
32	8	1	28	0	1	0	6	194
34.5	6		1	0	0	0	0	1
36	0	10	5	0	0	0	0	0
38	0	0	0	0	0	0	0	0
40.5	0	0	0	0	0	1	0	0
43	0	0	0	0	0	1	0	0

Table 7. Summary of age 1 plus (>=20 cm) bocaccio catch data for NWFSC combined shelf-slope bottom trawl survey, 2003-2010.

Total number of hauls, 50 to 350 m

lat	2003	2004	2005	2006	2007	2008	2000	2010
32	37	39	48	49	57	50	64	60
34.5	20	18	17	16	23	24	29	24
36	23	24	32	31	29	41	42	38
38	34	39	50	45	33	42	33	45
40.5	56	28	50	34	41	36	44	49
43	129	136	167	172	196	164	171	180

Number of positive tows

lat	2003	2004	2005	2006	2007	2008	2000	2010
32	5	9	7	11	12	2	7	5
34.5	4	4	2	2	6	3	6	9
36	6	7	12	9	6	8	4	6
38	8	10	8	12	1	8	5	3
40.5	4	0	3	1	2	0	1	0
43	5	0	2	3	3	3	0	1

Percent positive

lat	2003	2004	2005	2006	2007	2008	2000	2010
32	0.14	0.23	0.15	0.22	0.21	0.04	0.11	0.08
34.5	0.20	0.22	0.12	0.13	0.26	0.13	0.21	0.38
36	0.26	0.29	0.38	0.29	0.21	0.20	0.10	0.16
38	0.24	0.26	0.16	0.27	0.03	0.19	0.15	0.07
40.5	0.07	0.00	0.06	0.03	0.05	0.00	0.02	0.00
43	0.04	0.00	0.01	0.02	0.02	0.02	0.00	0.01

Mean CPUE (kg/ha) of positives

lat	2003	2004	2005	2006	2007	2008	2000	2010
32	0.530	0.682	0.533	0.411	1.288	0.093	0.079	0.140
34.5	0.414	1.298	0.200	3.630	0.961	0.216	0.972	0.970
36	0.555	18.757	5.348	0.598	0.965	2.217	0.308	0.187
38	0.832	1.024	0.509	0.918	0.058	0.916	0.374	0.121
40.5	0.195	0.000	0.165	0.010	0.132	0.000	0.101	0.000
43	0.195	0.000	0.017	0.472	0.105	0.124	0.000	0.004

Number of length measurements

lat	2003	2004	2005	2006	2007	2008	2000	2010
32	29	53	83	92	97	7	20	13
34.5	9	29	3	81	25	10	44	47
36	11	368	160	16	21	63	19	8
38	25	32	22	22	1	21	8	3
40.5	9	0	15	1	4	0	3	0
43	16	0	2	50	8	8	0	1

Table 8: Juvenile trawl survey young-of-the-year (YOY) index, 2001-2010

	09.Index	09.CV	11.Index	11.CV
2001	0.4	0.018	0.369	0.021
2002	0.59	0.018	0.583	0.021
2003	0.16	0.026	0.123	0.029
2004	0.39	0.017	0.353	0.021
2005	0.54	0.024	0.519	0.028
2006	0.09	0.017	0.115	0.017
2007	0.21	0.018	0.225	0.022
2008	0.23	0.018	0.243	0.021
2009			0.262	0.021
2010			0.625	0.033

Table 9: Key model outputs and likelihood values.

	2009 base model	2009 in SS3.21e	update CalCOFI, add 2011 catches, LFs	update H&L, trawl and pier pre-recruit	Update combo trawl survey (TOR base)	revise combo index (no age 0)	Revise combo, add impinge (STAT base)
R0	5060	5076	5161	5096	5158	5010	5106
SSB0	7861300	7906480	7960810	7802300	7880530	7663930	7812060
biomass0	44070	44225	44763	44028	44532	43271	44116
S2009/SSB0	0.281	0.281	0.272	0.257	0.251	0.244	0.247
S2011/SSB0			0.293	0.271	0.263	0.257	0.260
H. est	0.573	0.574	0.588	0.577	0.611	0.583	0.595
Likelihoods	3102.1	3098.0	3179.2	3237.8	3330.1	3279.0	3303.8
Survey	85.4	85.3	89.0	120.0	124.0	119.3	143.1
Length_comp	2982.4	2978.6	3056.8	3083.4	3166.2	3124.6	3126.5
Recruitment	32.9	32.7	32.0	32.8	37.4	33.6	32.7
Parm_priors	1.4	1.4	1.4	1.5	2.5	1.6	1.5
Survey							
Trawl_south	7.6	7.6	7.5	7.4	7.4	7.3	7.2
RecSouth	7.7	7.7	7.9	8.0	8.0	8.0	8.0
RecCentral	10.1	10.0	10.4	10.6	10.6	10.7	10.8
CalCOFI	21.3	21.3	22.3	21.5	21.6	21.2	21.7
Triennial	4.1	4.1	4.0	3.9	3.9	3.8	3.8
CPFV_index	6.0	6.0	5.9	5.7	5.7	5.6	5.6
SCB_hook	2.4	2.3	2.6	33.5	32.2	32.4	32.3
Combo	2.9	2.9	3.0	2.9	3.8	3.8	3.8
Juv_trawl	3.9	3.9	4.8	5.2	9.5	5.5	5.7
Pier_index	19.4	19.3	20.8	21.5	21.2	20.9	20.5
Impingement	0.0	0.0	0.0	0.0	0.0	86.3	23.6
Length							
Trawl_south	468.1	466.6	466.0	465.7	465.6	465.5	466.5
hook-line	363.0	363.2	362.9	363.0	363.4	363.2	363.3
setnet	356.2	355.9	354.6	354.0	354.2	354.0	354.3
RecSouth	375.4	375.0	416.5	419.9	440.1	422.5	422.8
RecCentral	365.2	364.8	399.4	397.5	401.6	396.0	396.7
Trawl_north	365.4	364.7	366.0	368.3	368.6	368.9	369.2
CalCOFI	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Triennial	151.0	150.9	150.3	148.8	148.1	148.5	148.4
CPFV_index	213.1	212.9	214.4	215.1	215.9	215.3	215.3
SCB_hook	60.9	60.8	57.9	81.0	79.7	81.3	81.0
Combo	137.3	137.1	139.0	139.5	199.7	177.9	177.7

Table 10. Fixed and estimated parameter values with standard deviations for the base model.

Parameter	est.	09.value	11 value	11 stdev
Natural mortality, both sexes	no	0.15		
Length@Amin, both sexes	no	26		
Length@Amax, females	yes	67.75	67.29	0.34
VonBert K females	yes	0.22	0.22	0.00
Length@Amax, males	yes	58.89	58.49	0.30
VonBert K males	yes	0.27	0.27	0.01
CV of size at Amin, both sexes	no	0.1		
CV of size at Amax, both sexes	no	0.08		
log R0	yes	8.53	8.54	0.09
Steepness (h)	yes	0.57	0.60	0.08
Sigma-R	no	1		
Initial F, hook and line fleet	yes	0.01	0.01	0.00
length@peak_trawlsou	yes	43.42	43.25	0.18
Width of top_trawlsou	no	-4.82	-4.82	
Ascending width_trawlsou	no	4.3	4.30	
Decending width_trawlsou	no	4.76	4.76	
Initial sel_trawlsou	no	-10.5	-10.50	
final sel_trawlsou	no	-0.77	-0.77	
length@peak_hook and line	yes	50.24	50.06	0.78
Width of top_hook and line	yes	-4.09	-4.12	2.52
Ascending width_hook and line	yes	4.33	4.32	0.13
Decending width_hook and line	yes	3.98	3.99	0.52
Initial sel_hook and line	yes	-9.41	-9.38	4.09
final sel_hook and line	yes	-0.67	-0.66	0.31
length@peak_setnet	yes	48.57	48.47	0.36
Width of top_setnet	yes	-7.41	-7.48	5.31
Ascending width_setnet	yes	3.45	3.44	0.10
Decending width_setnet	yes	4.15	4.14	0.18
Initial sel_setnet	yes	-6.07	-6.03	0.32
final sel_setnet	yes	-1.59	-1.58	0.21
length@peak_southern rec	yes	38.37	38.27	0.49
Width of top_southern rec	yes	-7.64	-7.84	5.05
Ascending width_southern rec	yes	4.66	4.58	0.11
Decending width_southern rec	yes	5.47	5.32	0.10
Initial sel_southern rec	yes	-4.47	-4.65	0.28
final sel_southern rec	yes	-3.23	-3.05	0.35
logistic, size infl_central rec	yes	34.44	33.70	0.44
logistic, width 95%_central rec	yes	11.7	11.03	0.54
logistic, size infl_northern trawl	yes	40.34	40.13	0.38
logistic, width 95%_northern trawl	yes	6.35	6.21	0.52
length@peak_triennial	no	24	24.00	
Width of top_triennial	no	-9.79	-9.79	
Ascending width_triennial	no	6.11	6.11	
Decending width_triennial	no	5.56	5.56	
Initial sel_triennial	no	-2.86	-2.86	
final sel_triennial	no	-1.25	-1.25	
length@peak_SCB hook line	yes	55.07	47.81	3.24
Width of top_SCB hook line	yes	-5.73	-1.46	0.52
Ascending width_SCB hook line	yes	6	5.28	0.39
Decending width_SCB hook line	yes	2.92	2.61	1.19
Initial sel_SCB hook line	yes	-7.76	-5.75	1.40
final sel_SCB hook line	yes	-1.12	-1.13	0.45
logistic, size inflection_NWFSC combo	yes	22.56	9.91	12.39
logistic, width 95% inflect_NWFSC combo	yes	15.19	15.86	9.17

Table 11. Fixed and estimated parameter values for recruitment deviations for the base model.

Parameter	09.value	11 value	11 stdev
RecrDev_1954	0.13	0.08	0.61
RecrDev_1955	-1.03	-1.29	0.67
RecrDev_1956	0.26	0.18	0.65
RecrDev_1957	-0.96	-1.23	0.68
RecrDev_1958	-0.31	-0.36	0.97
RecrDev_1959	0.36	1.35	1.10
RecrDev_1960	0.07	0.17	1.23
RecrDev_1961	0	0.07	1.12
RecrDev_1962	3.18	0.04	1.10
RecrDev_1963	0.04	3.06	0.32
RecrDev_1964	0.03	-0.03	1.05
RecrDev_1965	0	-0.08	1.02
RecrDev_1966	1.42	1.34	0.58
RecrDev_1967	-0.14	-0.19	0.96
RecrDev_1968	-0.13	-0.17	0.96
RecrDev_1969	0.02	-0.01	1.02
RecrDev_1970	0.42	0.39	0.98
RecrDev_1971	0.52	0.09	0.95
RecrDev_1972	1.02	1.16	0.26
RecrDev_1973	1.96	1.90	0.13
RecrDev_1974	0.95	0.92	0.16
RecrDev_1975	-0.87	-0.51	0.26
RecrDev_1976	-0.15	-0.28	0.24
RecrDev_1977	2.57	2.54	0.08
RecrDev_1978	-0.14	-0.03	0.32
RecrDev_1979	1.01	0.95	0.11
RecrDev_1980	-0.32	-0.36	0.18
RecrDev_1981	-0.97	-1.02	0.19
RecrDev_1982	-2.66	-2.69	0.35
RecrDev_1983	-0.22	-0.28	0.11
RecrDev_1984	1.77	1.72	0.06
RecrDev_1985	-0.58	-0.59	0.16
RecrDev_1986	-0.65	-0.71	0.15
RecrDev_1987	0.6	0.50	0.12
RecrDev_1988	1.67	1.61	0.10
RecrDev_1989	-1.31	-1.27	0.29
RecrDev_1990	0.56	0.43	0.15
RecrDev_1991	0.5	0.39	0.17
RecrDev_1992	-0.81	-0.86	0.29
RecrDev_1993	0.04	-0.08	0.17
RecrDev_1994	-0.25	-0.38	0.18
RecrDev_1995	-0.86	-0.95	0.23
RecrDev_1996	-0.27	-0.45	0.18
RecrDev_1997	-1.84	-1.87	0.33
RecrDev_1998	-0.13	-0.29	0.21
RecrDev_1999	1.73	1.57	0.15
RecrDev_2000	-1.67	-1.57	0.36
RecrDev_2001	-1.5	-1.71	0.34
RecrDev_2002	-0.2	-0.43	0.20
RecrDev_2003	0.85	0.62	0.13
RecrDev_2004	-1.15	-1.50	0.28
RecrDev_2005	0.68	0.51	0.13
RecrDev_2006	-1.48	-0.99	0.25
RecrDev_2007	-0.86	-0.24	0.16
RecrDev_2008	-0.87	-0.31	0.18
RecrDev_2009	n/a	0.61	0.18
RecrDev_2010	n/a	0.51	0.44

Table 12. Time series of key model outputs for 2011 base model.

Year	Total biomass	Summary biomass	Spawning output	CV spawning	Depletion	Recruits (x 103)	CV recruits	Total catch	Exploit. rate	SPR rate
Unfished	44183	44116	7812	0.094	1.000	5106	0.094	0	0.000	1.00
1893	42757	42691	7533	0.097	0.964	5074	0.093	157	0.004	0.96
1894	42746	42680	7532	0.097	0.964	5074	0.093	148	0.003	0.97
1895	42740	42674	7533	0.097	0.964	5074	0.093	139	0.003	0.97
1896	42739	42673	7533	0.097	0.964	5074	0.093	131	0.003	0.97
1897	42742	42676	7535	0.097	0.964	5075	0.093	123	0.003	0.97
1898	42751	42685	7537	0.097	0.965	5075	0.093	115	0.003	0.97
1899	42765	42698	7539	0.097	0.965	5075	0.093	108	0.003	0.97
1900	42784	42718	7543	0.097	0.966	5076	0.093	119	0.003	0.97
1901	42790	42724	7544	0.096	0.966	5076	0.093	131	0.003	0.97
1902	42783	42717	7543	0.096	0.966	5076	0.093	142	0.003	0.97
1903	42765	42698	7540	0.096	0.965	5075	0.093	154	0.004	0.96
1904	42735	42669	7535	0.096	0.965	5075	0.093	165	0.004	0.96
1905	42696	42630	7528	0.096	0.964	5074	0.093	176	0.004	0.96
1906	42649	42583	7520	0.096	0.963	5073	0.093	188	0.004	0.96
1907	42594	42527	7510	0.096	0.961	5072	0.093	199	0.005	0.95
1908	42531	42465	7499	0.097	0.960	5070	0.093	210	0.005	0.95
1909	42462	42396	7486	0.097	0.958	5069	0.093	237	0.006	0.95
1910	42373	42307	7470	0.097	0.956	5067	0.093	263	0.006	0.94
1911	42264	42198	7450	0.097	0.954	5065	0.093	289	0.007	0.93
1912	42137	42071	7427	0.097	0.951	5062	0.093	316	0.008	0.93
1913	41993	41927	7400	0.098	0.947	5059	0.093	342	0.008	0.92
1914	41835	41769	7371	0.098	0.944	5055	0.093	368	0.009	0.92
1915	41663	41597	7339	0.098	0.939	5051	0.093	395	0.009	0.91
1916	41479	41413	7305	0.099	0.935	5047	0.092	474	0.011	0.89
1917	41228	41162	7260	0.099	0.929	5041	0.092	747	0.018	0.83
1918	40721	40655	7171	0.100	0.918	5030	0.092	799	0.020	0.82
1919	40194	40129	7077	0.102	0.906	5018	0.092	529	0.013	0.88
1920	39976	39910	7032	0.102	0.900	5012	0.092	550	0.014	0.87
1921	39761	39695	6988	0.103	0.895	5006	0.092	463	0.012	0.89
1922	39655	39590	6963	0.103	0.891	5003	0.092	417	0.011	0.90
1923	39609	39544	6949	0.103	0.890	5001	0.091	489	0.012	0.88
1924	39500	39434	6926	0.103	0.887	4998	0.091	442	0.011	0.89
1925	39447	39382	6913	0.103	0.885	4996	0.091	505	0.013	0.88
1926	39338	39273	6891	0.103	0.882	4993	0.091	711	0.018	0.83
1927	39031	38966	6837	0.104	0.875	4986	0.091	610	0.016	0.85
1928	38841	38776	6802	0.104	0.871	4981	0.091	639	0.016	0.85
1929	38635	38570	6763	0.105	0.866	4975	0.091	597	0.015	0.85
1930	38487	38422	6733	0.105	0.862	4971	0.091	715	0.019	0.83
1931	38232	38167	6687	0.106	0.856	4964	0.091	689	0.018	0.84
1932	38024	37960	6645	0.106	0.851	4958	0.090	556	0.015	0.86
1933	37967	37903	6629	0.106	0.849	4956	0.090	429	0.011	0.89
1934	38046	37982	6638	0.106	0.850	4957	0.090	494	0.013	0.88
1935	38058	37993	6637	0.106	0.850	4957	0.090	534	0.014	0.87

Table 12 (continued)

Year	Total biomass	Summary biomass	Spawning output	CV spawning	Depletion	Recruits (x 103)	CV recruits	Total catch	Exploit. rate	SPR rate
1936	38029	37964	6630	0.106	0.849	4956	0.090	632	0.017	0.85
1937	37900	37836	6608	0.106	0.846	4953	0.090	589	0.016	0.85
1938	37821	37757	6593	0.106	0.844	4951	0.090	461	0.012	0.88
1939	37876	37812	6600	0.105	0.845	4952	0.090	373	0.010	0.90
1940	38021	37956	6621	0.105	0.848	4955	0.090	382	0.010	0.90
1941	38150	38085	6642	0.104	0.850	4958	0.090	308	0.008	0.92
1942	38346	38281	6675	0.104	0.854	4963	0.090	124	0.003	0.97
1943	38715	38650	6738	0.103	0.862	4972	0.090	292	0.008	0.92
1944	38901	38836	6768	0.102	0.866	4976	0.090	737	0.019	0.83
1945	38647	38582	6716	0.103	0.860	4969	0.090	1413	0.037	0.70
1946	37752	37687	6541	0.105	0.837	4943	0.090	880	0.023	0.79
1947	37417	37353	6473	0.106	0.829	4933	0.090	890	0.024	0.79
1948	37099	37035	6408	0.107	0.820	4923	0.089	766	0.021	0.81
1949	36910	36846	6374	0.108	0.816	4918	0.089	828	0.022	0.79
1950	36662	36598	6333	0.108	0.811	4912	0.089	1216	0.033	0.71
1951	36022	35958	6228	0.110	0.797	4895	0.089	1759	0.049	0.61
1952	34856	34792	6031	0.114	0.772	4863	0.089	1966	0.057	0.56
1953	33499	33436	5808	0.118	0.743	4824	0.088	2271	0.068	0.49
1954	31882	31815	5535	0.124	0.709	5185	0.599	2402	0.075	0.45
1955	30154	30137	5249	0.130	0.672	1304	0.675	3053	0.101	0.34
1956	27653	27581	4863	0.140	0.623	5536	0.645	3650	0.132	0.26
1957	24339	24322	4377	0.153	0.560	1318	0.690	3566	0.147	0.23
1958	21109	21070	3829	0.172	0.490	3013	0.978	3580	0.170	0.19
1959	17968	17761	3253	0.200	0.416	15886	1.050	2847	0.160	0.21
1960	16398	16337	2807	0.235	0.359	4664	1.268	2436	0.149	0.22
1961	16511	16459	2440	0.270	0.312	3981	1.159	1924	0.117	0.31
1962	17515	17464	2432	0.229	0.311	3879	1.128	1731	0.099	0.42
1963	19556	18479	2674	0.263	0.342	82499	0.230	2008	0.109	0.40
1964	25268	25218	2820	0.332	0.361	3805	1.077	1523	0.060	0.52
1965	37326	37277	3100	0.348	0.397	3734	1.040	1746	0.047	0.62
1966	49154	48938	4621	0.218	0.592	16595	0.572	3418	0.070	0.60
1967	57295	57246	6953	0.143	0.890	3741	0.958	5331	0.093	0.51
1968	60687	60637	8303	0.137	1.063	3763	0.961	3405	0.056	0.63
1969	62814	62758	9314	0.126	1.192	4264	1.017	2347	0.037	0.71
1970	63450	63370	10136	0.106	1.297	6138	0.969	2846	0.045	0.64
1971	61683	61626	10412	0.094	1.333	4343	0.946	2497	0.041	0.64
1972	59216	59060	10355	0.083	1.326	11959	0.240	3653	0.062	0.49
1973	55434	55125	9871	0.073	1.264	23622	0.088	7201	0.131	0.24
1974	49393	49285	8665	0.066	1.109	8306	0.134	9001	0.183	0.14
1975	43263	43239	7233	0.064	0.926	1839	0.247	6404	0.148	0.21
1976	39913	39884	6626	0.057	0.848	2264	0.226	6177	0.155	0.24
1977	36165	35676	6225	0.050	0.797	37479	0.035	4861	0.136	0.28
1978	34519	34482	5788	0.045	0.741	2839	0.317	4367	0.127	0.28
1979	35467	35370	5247	0.043	0.672	7376	0.084	6116	0.173	0.20

Table 12 (continued)

Year	Total biomass	Summary biomass	Spawning output	CV spawning	Depletion	Recruits (x 103)	CV recruits	Total catch	Exploit. rate	SPR rate
1980	34421	34396	4988	0.038	0.638	1981	0.176	5384	0.157	0.26
1981	33001	32988	5099	0.031	0.653	1028	0.184	5752	0.174	0.25
1982	29624	29622	4832	0.028	0.619	190	0.345	6599	0.223	0.17
1983	23902	23876	4175	0.027	0.534	2048	0.103	5598	0.234	0.17
1984	18527	18342	3374	0.028	0.432	14189	0.028	4676	0.255	0.13
1985	14514	14497	2560	0.033	0.328	1271	0.154	2864	0.198	0.16
1986	13344	13330	2047	0.037	0.262	1027	0.138	3121	0.234	0.11
1987	12023	11981	1750	0.040	0.224	3230	0.078	2649	0.221	0.16
1988	11120	10994	1686	0.040	0.216	9600	0.049	2304	0.210	0.21
1989	10653	10646	1552	0.043	0.199	516	0.287	2756	0.259	0.14
1990	9991	9957	1291	0.051	0.165	2569	0.107	2624	0.264	0.12
1991	9250	9220	1173	0.060	0.150	2343	0.121	1714	0.186	0.23
1992	9155	9146	1252	0.064	0.160	690	0.283	1832	0.200	0.23
1993	8575	8556	1221	0.073	0.156	1485	0.145	1593	0.186	0.25
1994	7856	7841	1171	0.084	0.150	1076	0.163	1294	0.165	0.26
1995	7174	7167	1121	0.096	0.143	592	0.216	818	0.114	0.38
1996	6796	6783	1090	0.106	0.140	961	0.166	547	0.081	0.48
1997	6540	6537	1086	0.112	0.139	232	0.328	498	0.076	0.48
1998	6227	6212	1063	0.120	0.136	1119	0.205	211	0.034	0.71
1999	6204	6110	1067	0.123	0.137	7216	0.138	213	0.035	0.68
2000	6514	6510	1055	0.126	0.135	309	0.363	160	0.025	0.75
2001	7347	7344	1052	0.129	0.135	267	0.349	139	0.019	0.82
2002	8142	8129	1161	0.129	0.149	1023	0.200	90	0.011	0.90
2003	8801	8760	1357	0.129	0.174	3187	0.148	13	0.001	0.99
2004	9433	9427	1505	0.129	0.193	405	0.293	85	0.009	0.91
2005	9962	9922	1588	0.131	0.203	3090	0.154	107	0.011	0.89
2006	10390	10381	1672	0.132	0.214	707	0.270	60	0.006	0.94
2007	10862	10842	1764	0.133	0.226	1542	0.189	63	0.006	0.94
2008	11210	11191	1850	0.135	0.237	1475	0.207	39	0.004	0.94
2009	11505	11456	1932	0.136	0.247	3750	0.208	58	0.005	0.94
2010	11879	11834	1987	0.137	0.254	3433	0.455	75	0.006	0.93
2011	12492	12447	2029	0.138	0.260	3441	1.007			

Table 13: Decision table for base model

Catch basis		low 2010 rec		STAT. Base		higher 2010 rec	
low 2010 rec		larvaex10^{12}	depletion	larvaex10^{12}	depletion	larvaex10^{12}	depletion
2011	*263*	2.07	0.26	2.03	0.26	2.01	0.26
2012	*274*	2.11	0.27	2.07	0.27	2.07	0.27
2013	276	2.19	0.28	2.17	0.28	2.28	0.29
2014	306	2.28	0.29	2.31	0.30	2.59	0.33
2015	338	2.40	0.31	2.47	0.32	2.88	0.37
2016	370	2.54	0.33	2.64	0.34	3.14	0.40
2017	400	2.69	0.34	2.81	0.36	3.38	0.43
2018	427	2.85	0.36	2.98	0.38	3.59	0.46
2019	453	3.01	0.39	3.15	0.40	3.78	0.48
2020	476	3.16	0.40	3.31	0.42	3.96	0.51
2021	491	3.31	0.42	3.47	0.44	4.12	0.53
2022	506	3.46	0.44	3.62	0.46	4.27	0.55
STAT base		larvaex10^{12}	depletion	larvaex10^{12}	depletion	larvaex10^{12}	depletion
2011	*263*	2.07	0.26	2.03	0.26	2.01	0.26
2012	*274*	2.11	0.27	2.07	0.26	2.07	0.27
2013	303	2.19	0.28	2.17	0.28	2.28	0.29
2014	340	2.28	0.29	2.31	0.29	2.58	0.33
2015	375	2.39	0.31	2.46	0.31	2.87	0.37
2016	406	2.53	0.32	2.62	0.33	3.13	0.40
2017	436	2.67	0.34	2.79	0.35	3.35	0.43
2018	463	2.82	0.36	2.95	0.37	3.56	0.46
2019	489	2.97	0.38	3.11	0.39	3.74	0.48
2020	506	3.12	0.40	3.27	0.41	3.91	0.50
2021	522	3.26	0.42	3.42	0.43	4.07	0.52
2022	537	3.41	0.44	3.56	0.45	4.21	0.54
higher 2010 rec		larvaex10^{12}	depletion	larvaex10^{12}	depletion	larvaex10^{12}	depletion
2011	*263*	2.07	0.26	2.03	0.26	2.01	0.26
2012	*274*	2.11	0.27	2.07	0.27	2.07	0.27
2013	385	2.19	0.28	2.17	0.28	2.28	0.29
2014	444	2.27	0.29	2.30	0.29	2.57	0.33
2015	478	2.36	0.30	2.43	0.31	2.84	0.36
2016	501	2.48	0.32	2.57	0.33	3.08	0.39
2017	513	2.61	0.33	2.72	0.35	3.29	0.42
2018	524	2.74	0.35	2.87	0.37	3.47	0.44
2019	536	2.88	0.37	3.02	0.39	3.65	0.47
2020	549	3.01	0.39	3.16	0.40	3.81	0.49
2021	562	3.15	0.40	3.30	0.42	3.95	0.51
2022	574	3.28	0.42	3.44	0.44	4.09	0.52

Table 14: Base model reference points

STAT model reference points

Unfished Stock	Estimate	95% Confidence Limits Lower	Upper
Summary (1+) Biomass	44412	36148	52675
Spawning Output (x 10^9)	7812	6349	9275
Equilibrium recruitment	5112	4151	6073

Yield reference Points

	$SSB_{40\%}$	SPR proxy	MSY est.
SPR	0.502	0.500	0.445
Exploitation rate	0.065	0.065	0.078
Yield	1217	1218	1239
Spawning output (x 109)	3125	3107	2587
Summary biomass	18779	18682	15817
Recruits (x 10^3)	4070	4062	3802
SSB/SSB_0	0.400	0.398	0.331

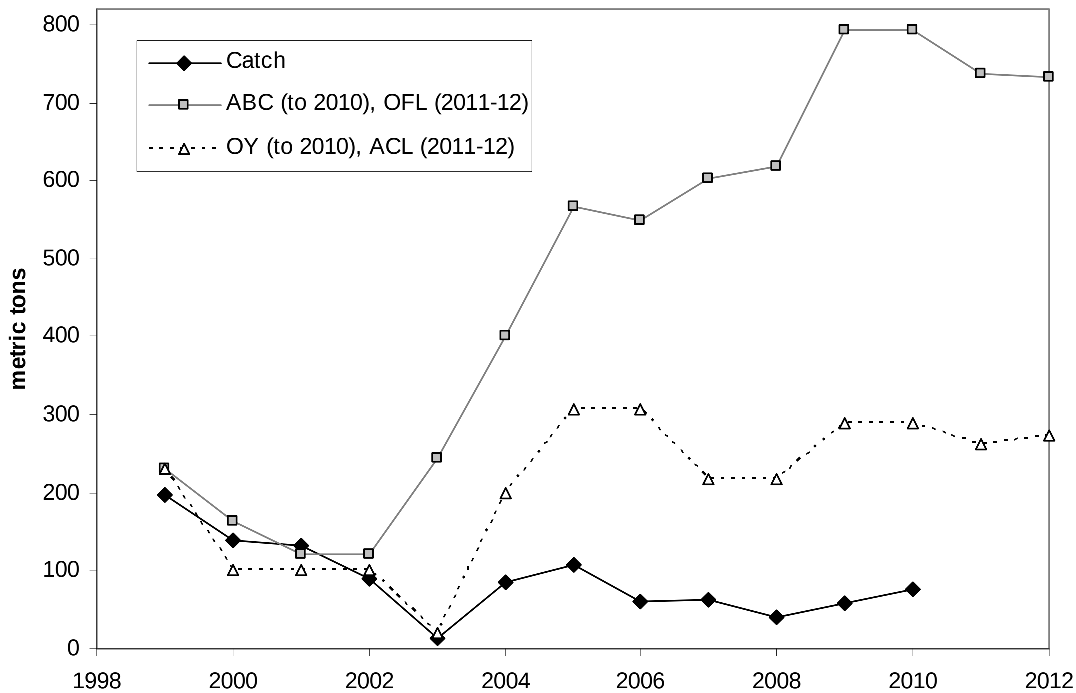
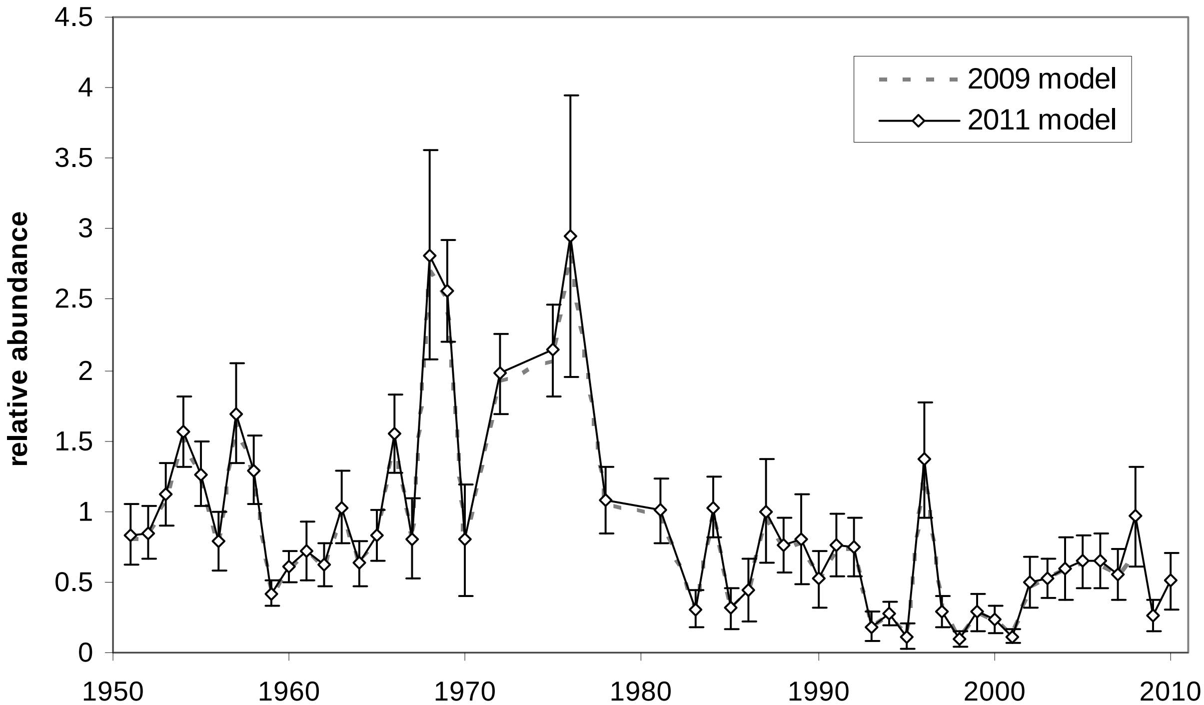


Figure 1: Management performance with PFMC adopted ABC and OY values (to 2010, OFL and ACL values for 2011-2012) relative to estimated catches from 1999-2012.



Figures 2. CalCOFI larval abundance indices for the coastwide bocaccio model updated through part of 2010 as compared to 2009 estimate.

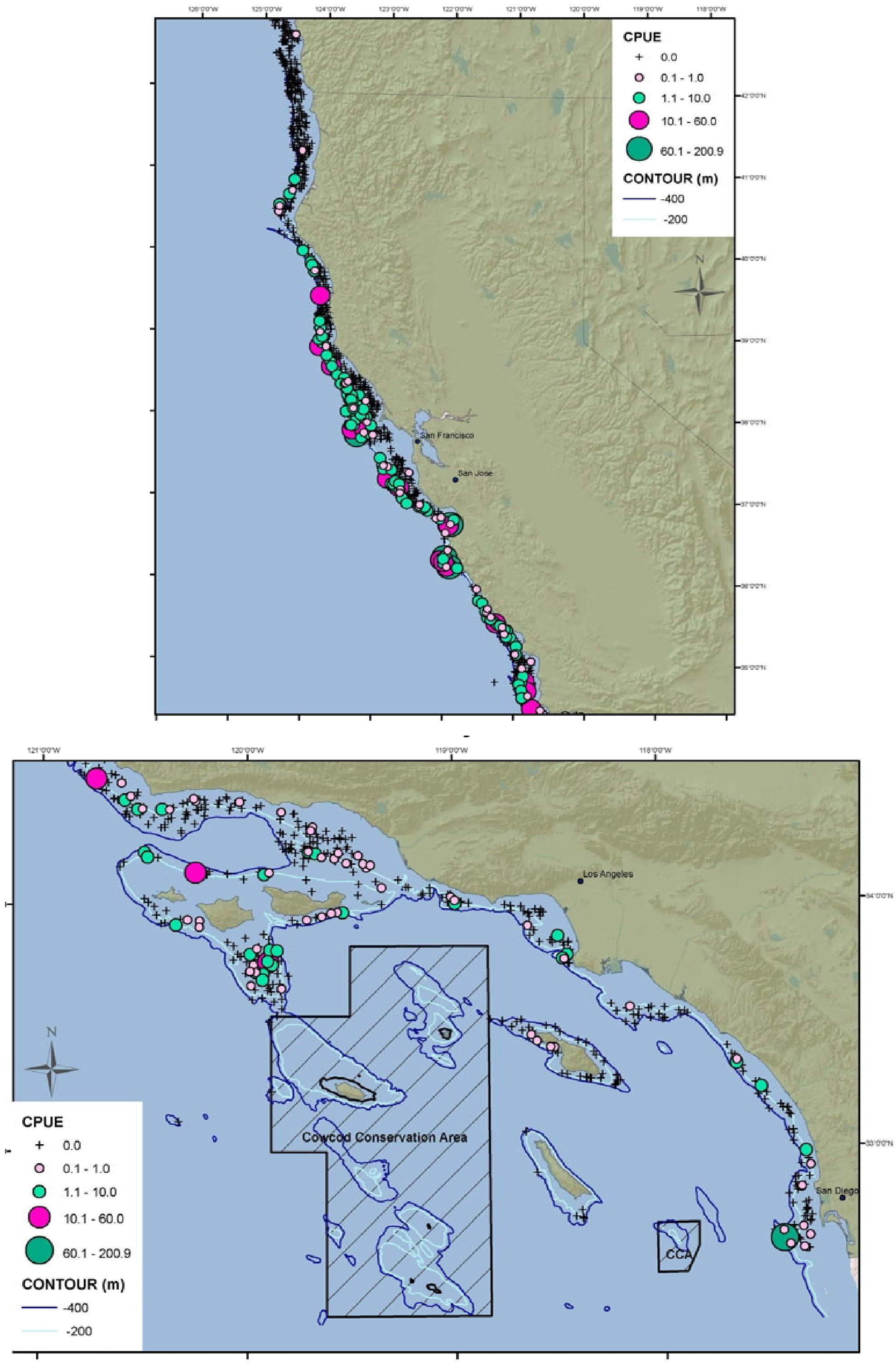
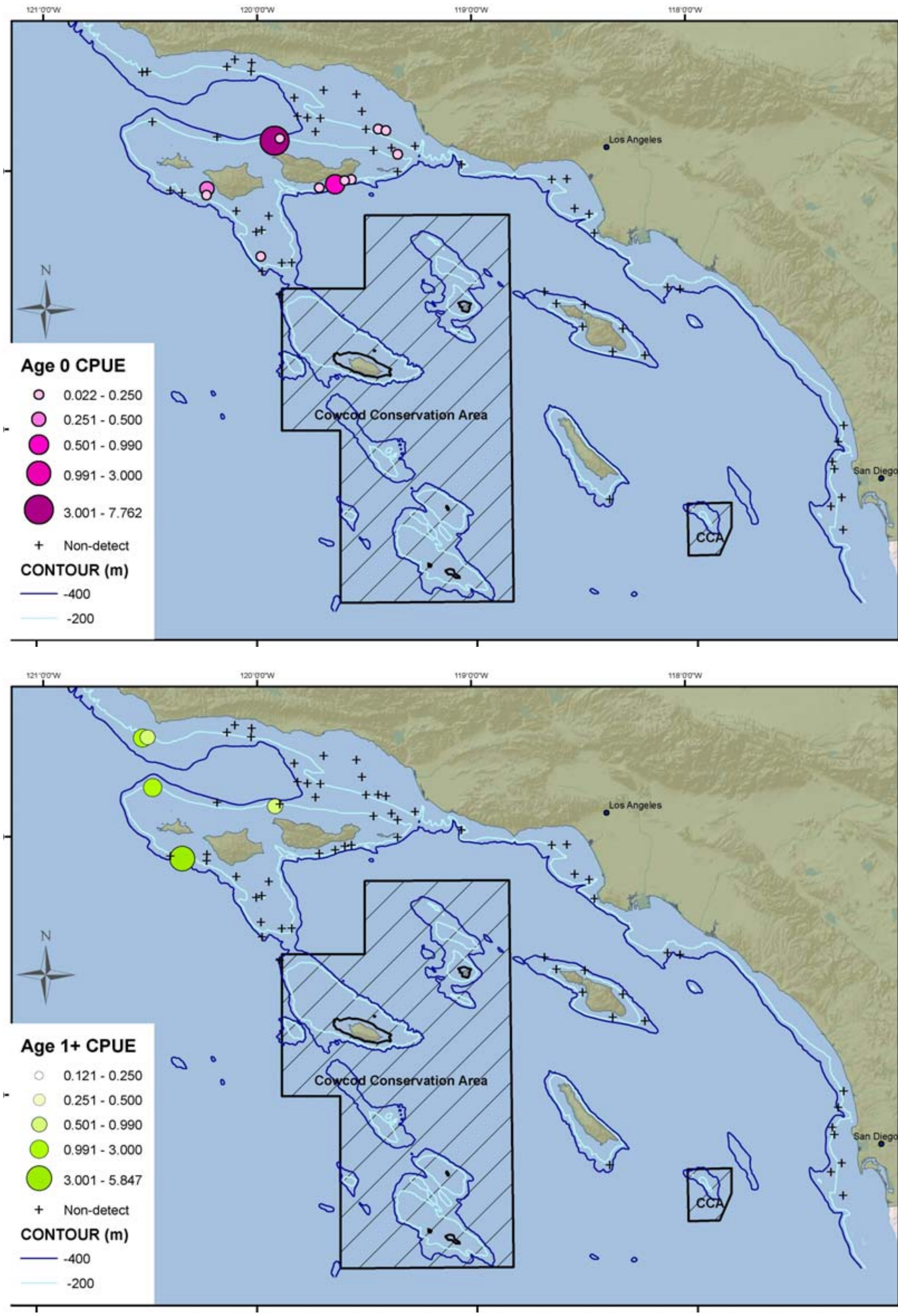
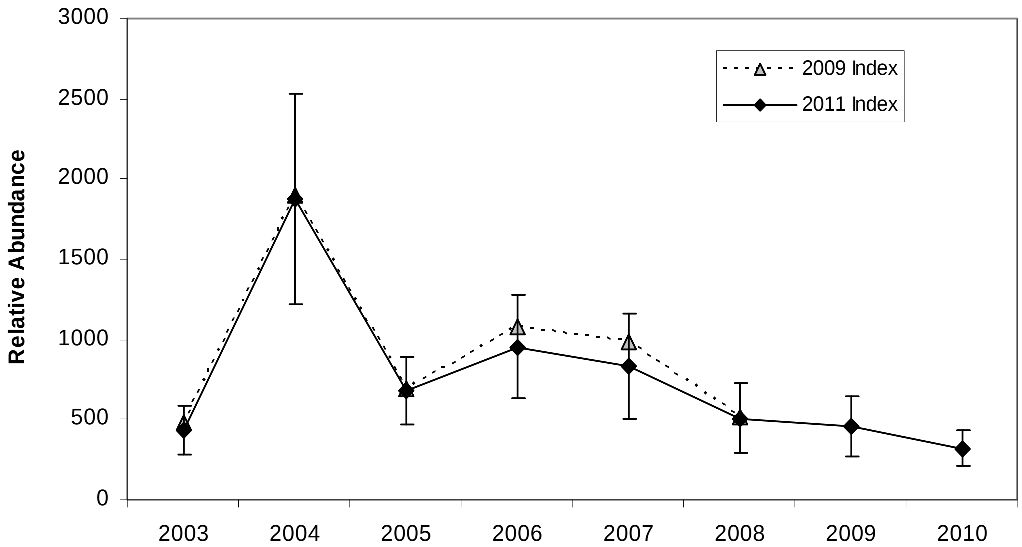
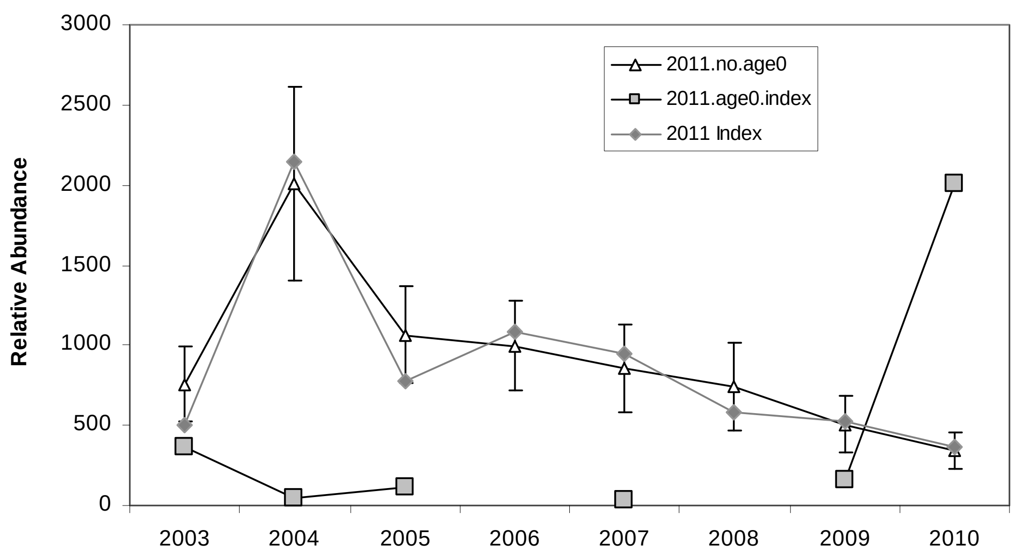


Figure 3a-b: NWFSC Combined shelf-slope survey CPUE for bocaccio rockfish, all years (2003-2010) combined.

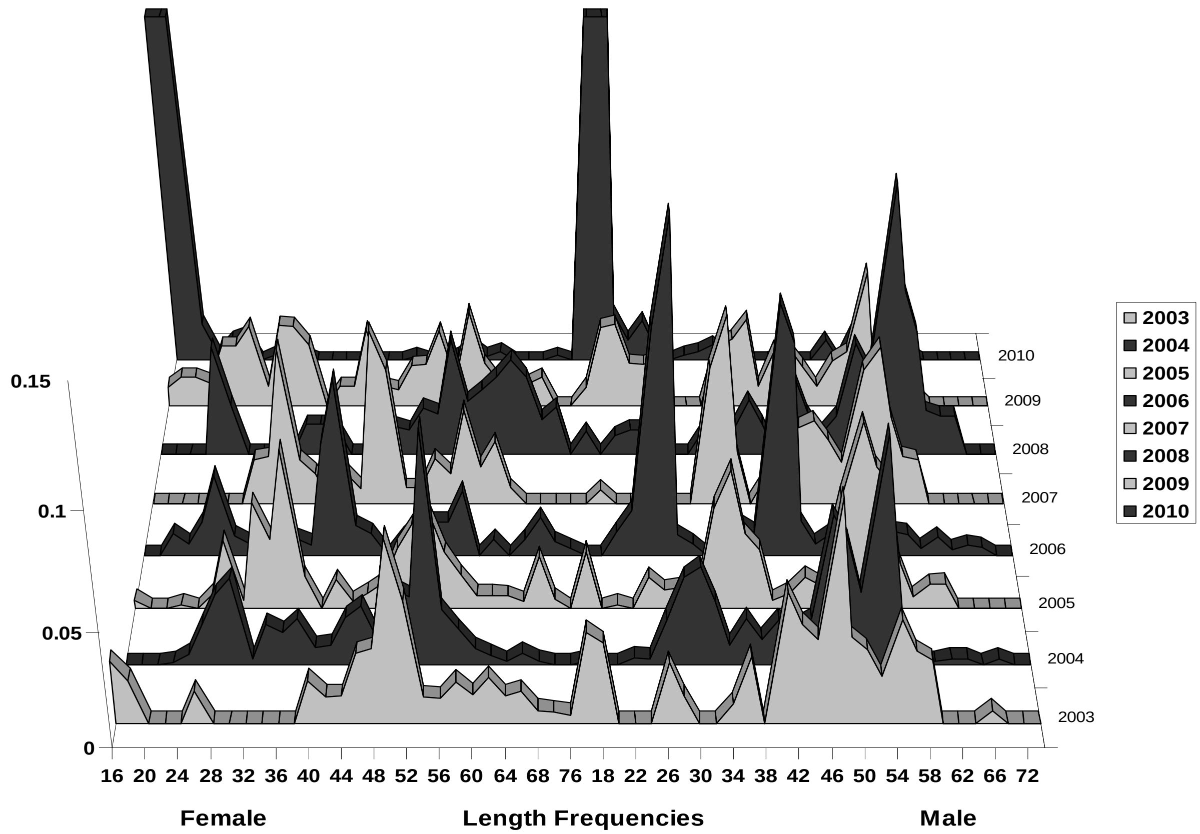


Figures 4a-b. Northwest Fisheries Science Center combined trawl survey catches of likely age-0 (<22 cm) bocaccio (top) and likely age 1+ (=>22 cm) bocaccio (bottom) in the Southern California Bight during 2010.

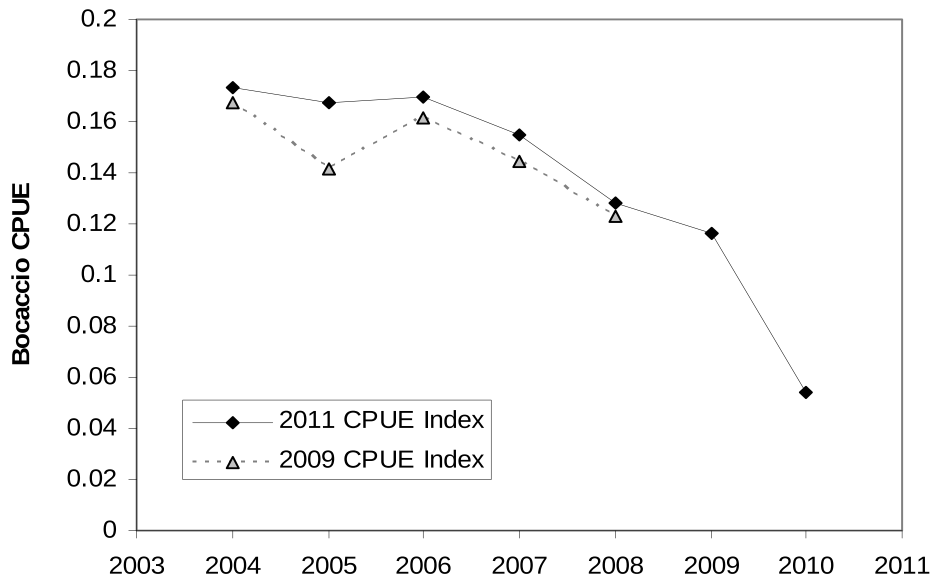




Figures 5a-b. 5a (top), Comparison 2009 and updated 2011 GLMM relative abundance estimates for bocaccio rockfish from the NWFSC Combined survey with all data. Error bars shown for 2011 only (comparable to 2009. 5b (bottom) the revised 2011 index as in 5a, and with all age 0 fish (<20 cm) removed, as well as an age 0 "index" based on CPUE data.



Figures 5c. Length frequency information for the 2003-2010 combined trawl survey.



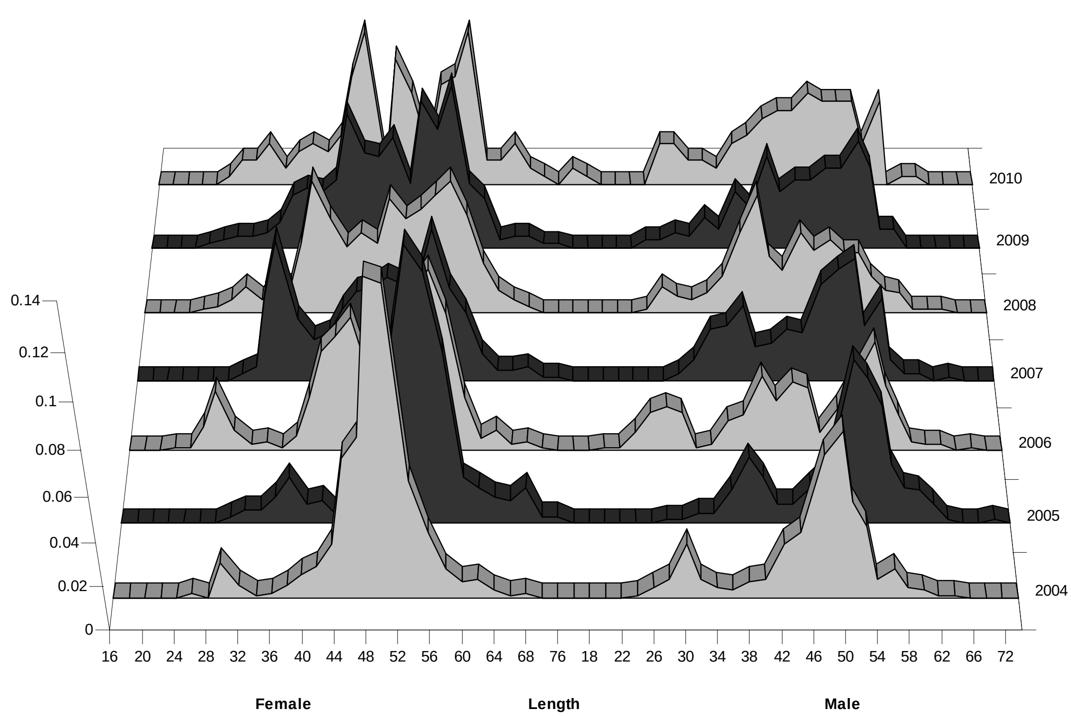
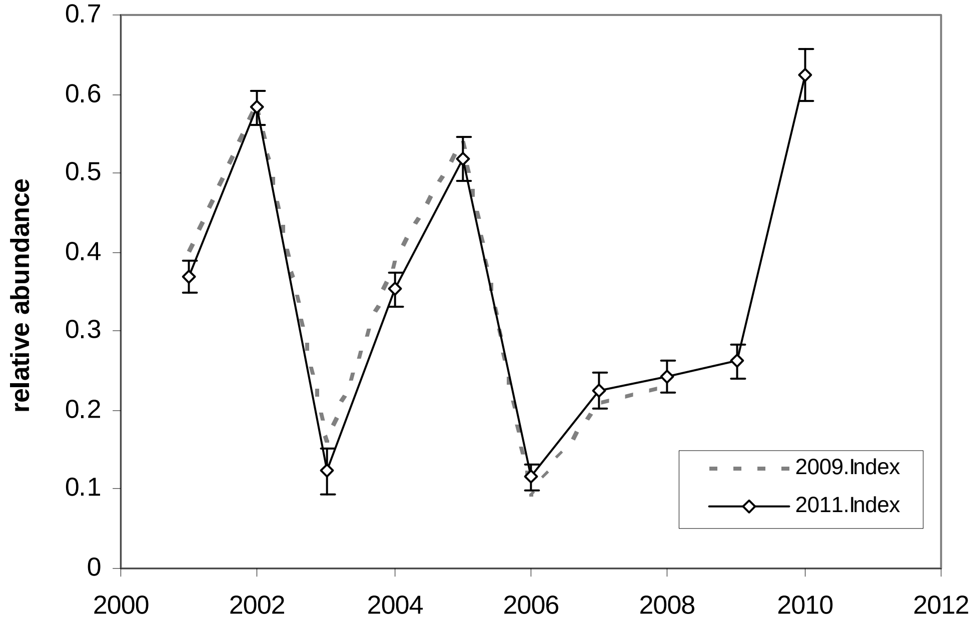
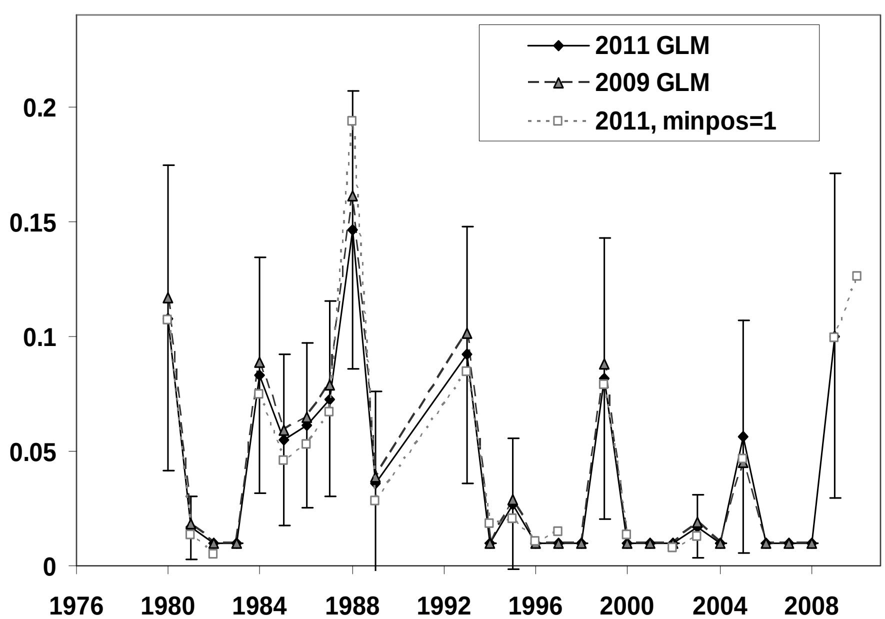


Figure 6a-b. Figure 6a (top) Catch rate indices of bocaccio abundance for the NWFSC hook-and-line survey in the Southern California Bight, 2004-2010 and Figure 6b (bottom), length frequency distribution for all bocaccio rockfish measured in the same survey.





Figures 7a-b. Figure 7a (top), 2009 and current index for the coastwide pelagic juvenile trawl survey index of bocaccio YOY abundance; 7b (bottom), 2009 and current index for the 1980-2010 pier fishery index.

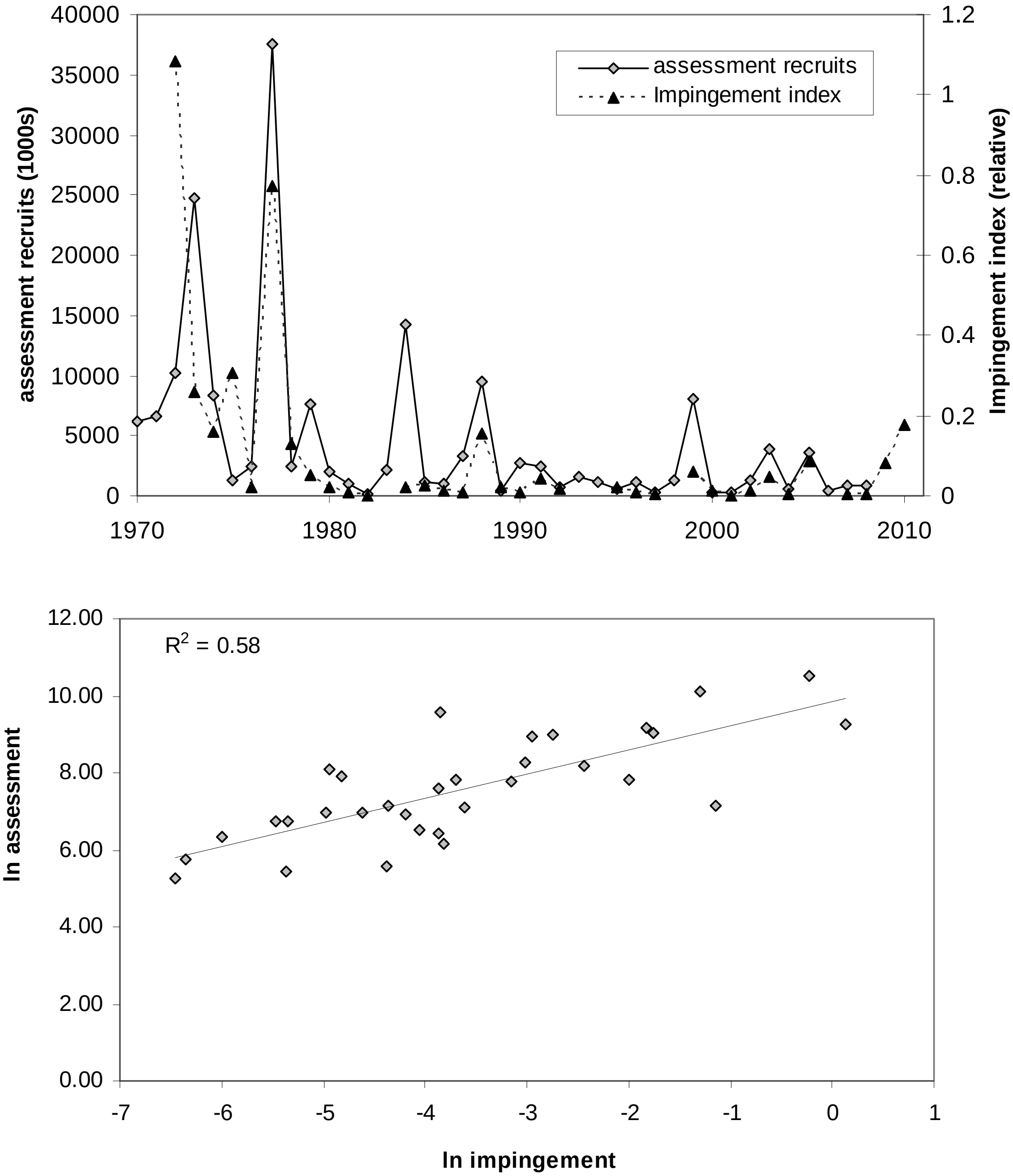


Figure 8a-b. Recruitment estimates from the 2009 model (run with zero emphasis on the recruitment indices) compared to an index of age-0 abundance developed from the Power plant impingement dataset provided by Eric Miller (MBC Applied Environmental Sciences).

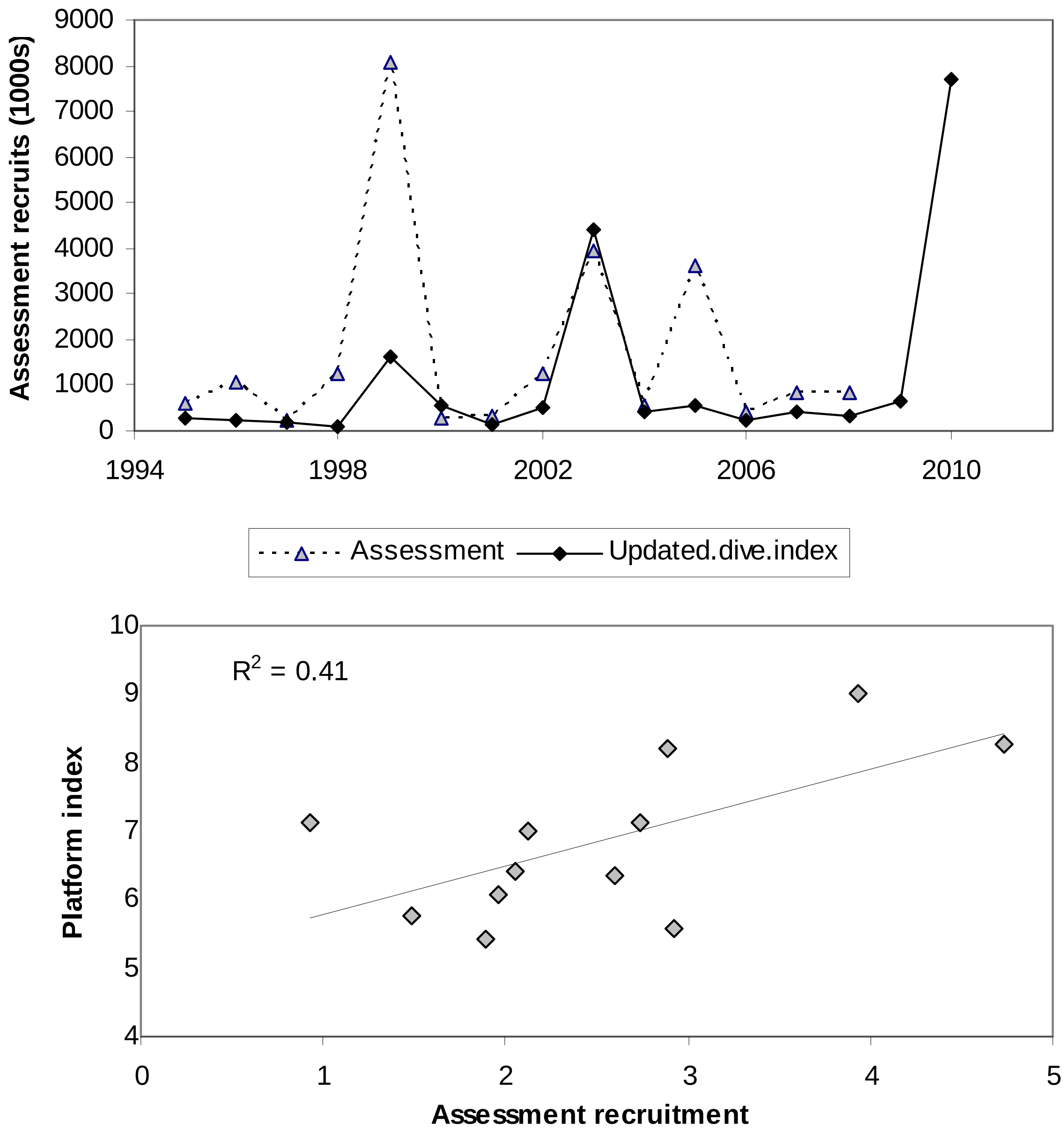


Figure 9a-b: Recruitment estimates from the 2009 model (run with zero emphasis on the recruitment indices) compared to an index of age-0 abundance developed from the delta submersible dive survey conducted by M. Love (USCB, Pers. Com).

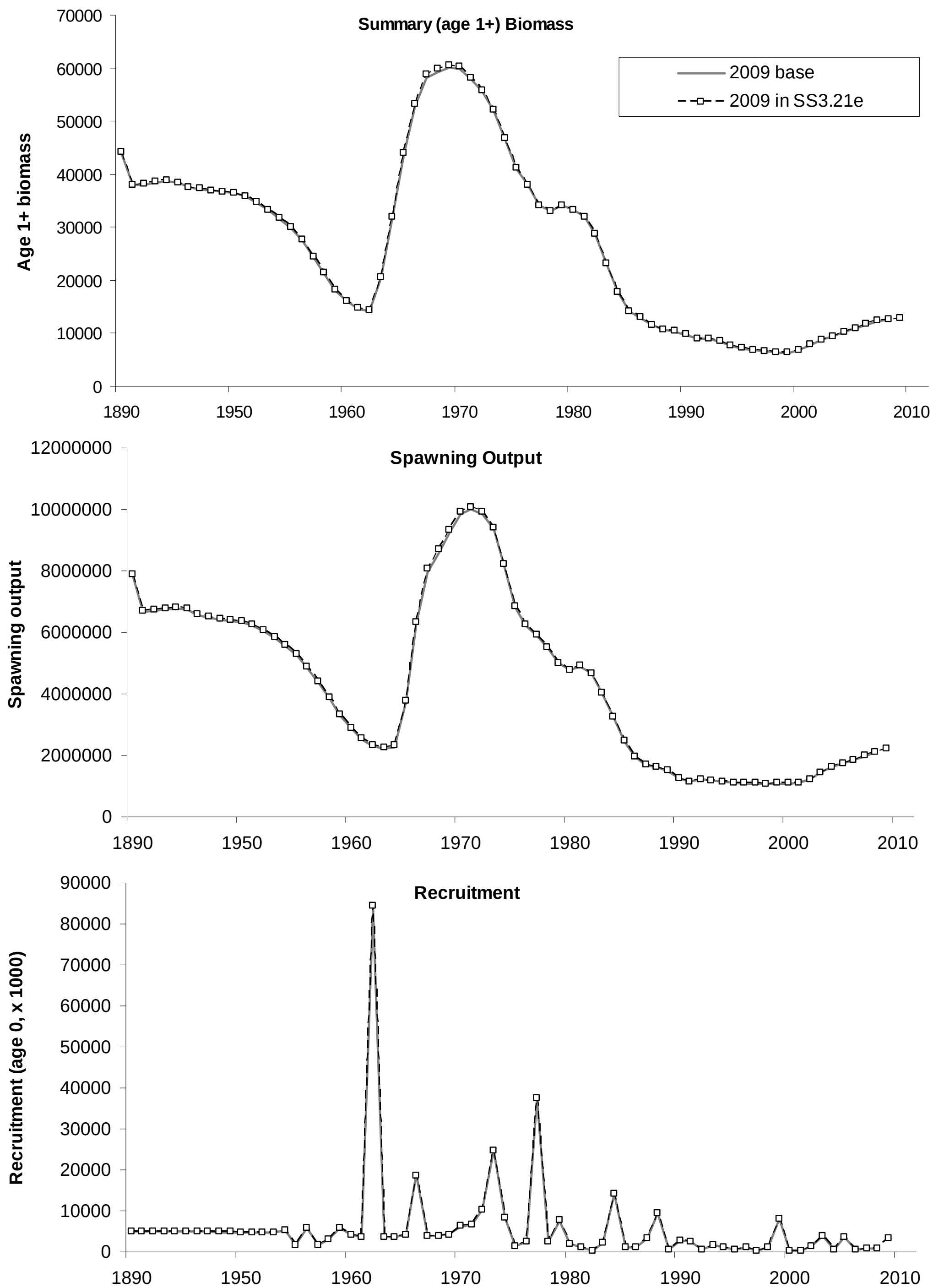


Figure 10: Comparison of the 2009 base model with in both the 2009 SS3 version and SS3 version 3.21e (used for this assessment).

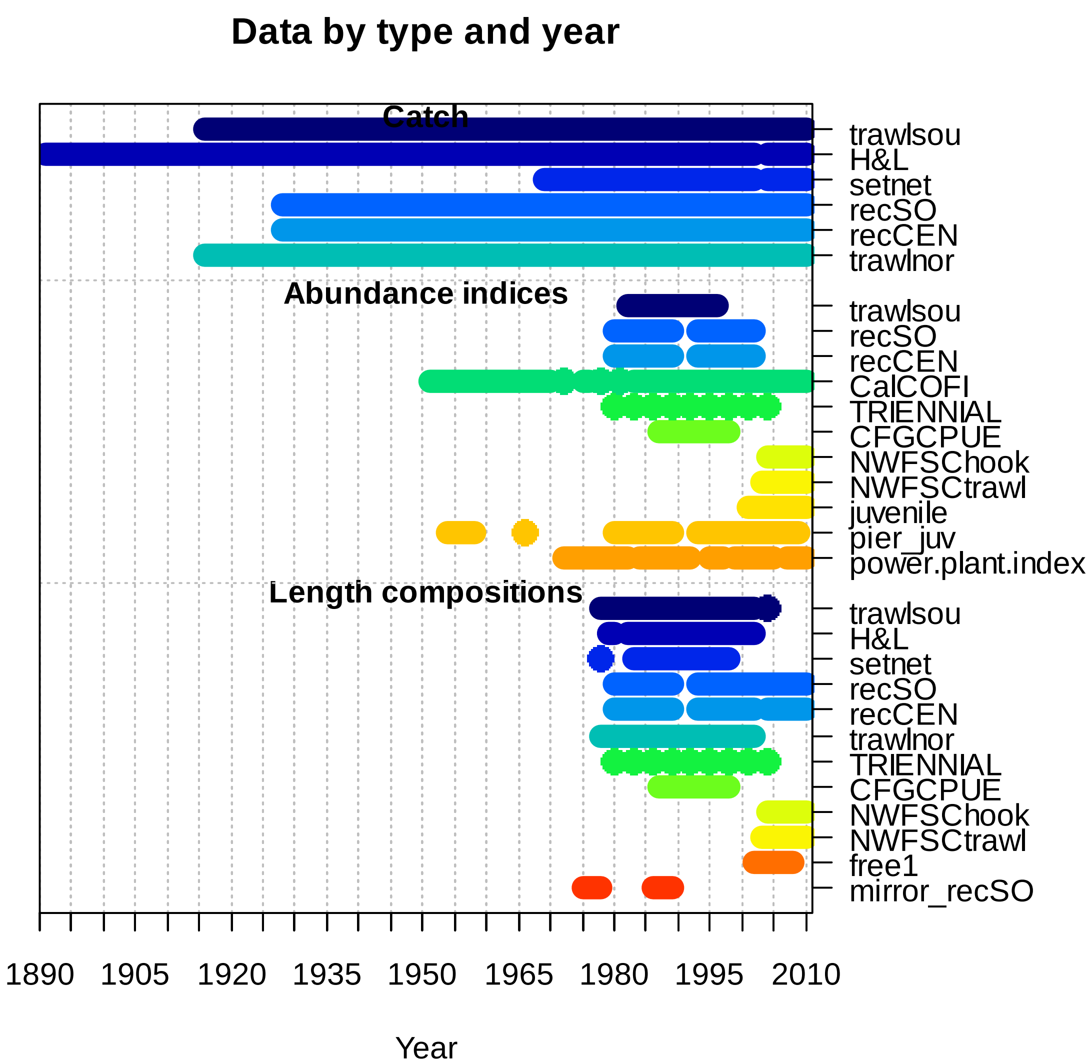
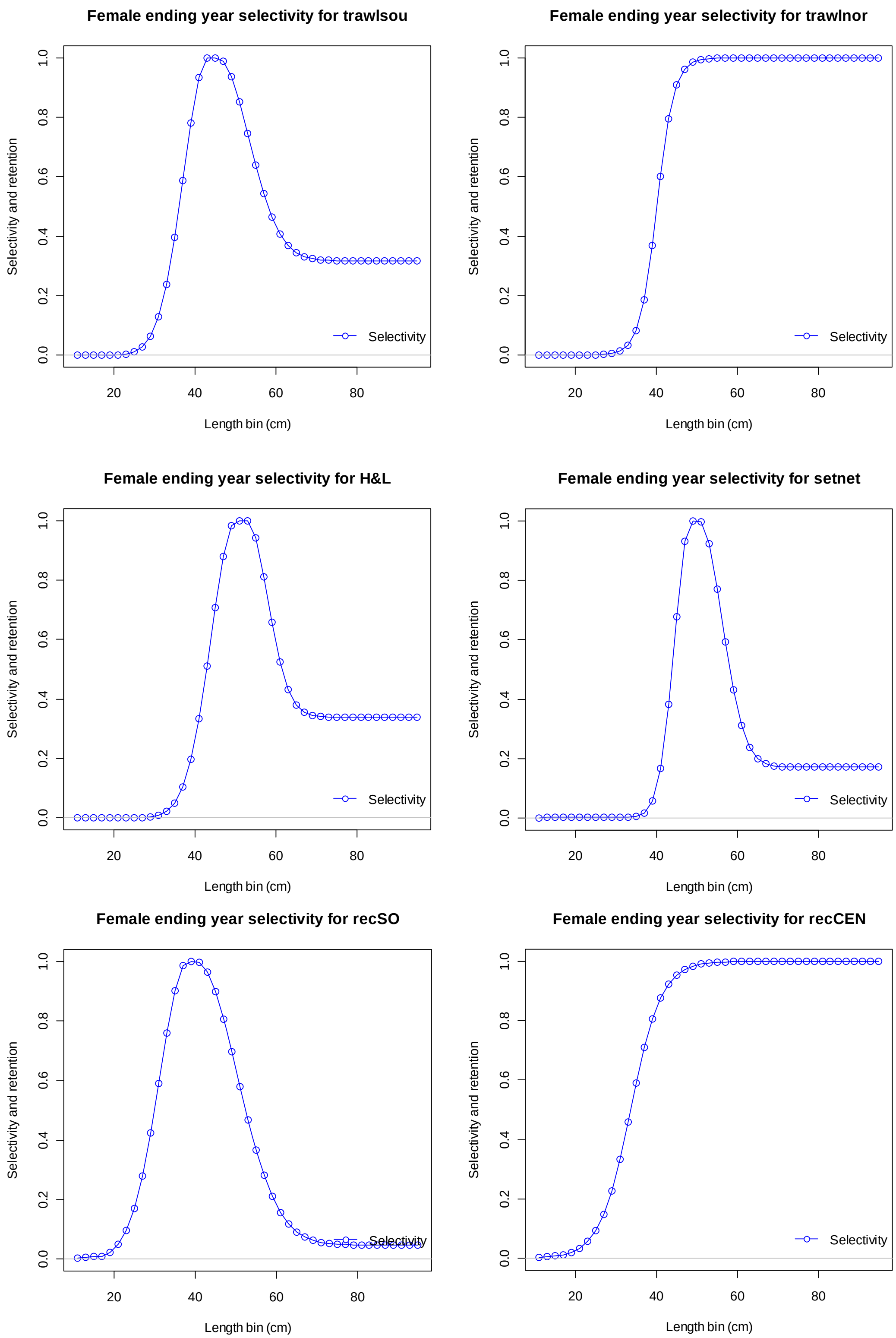
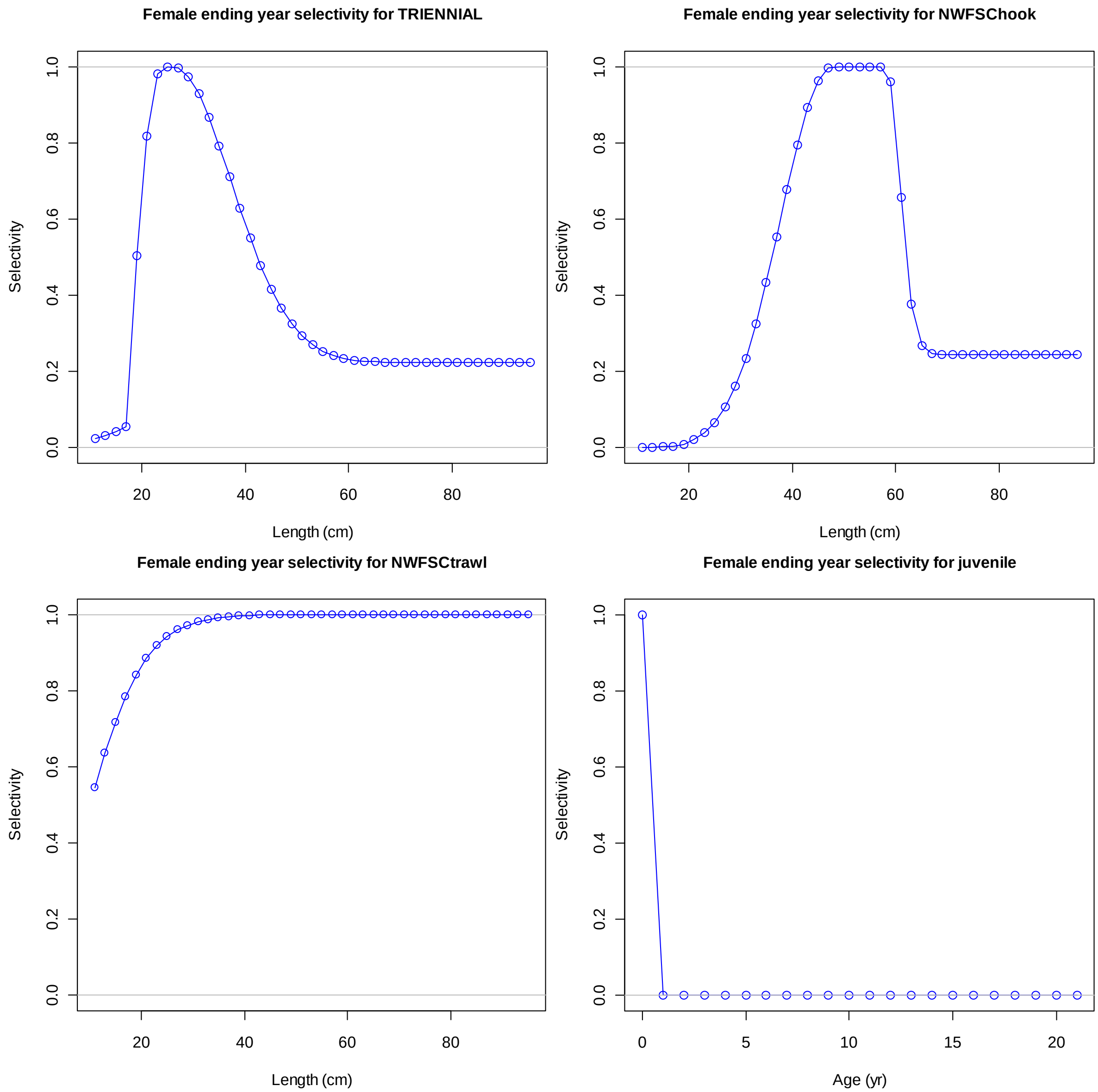


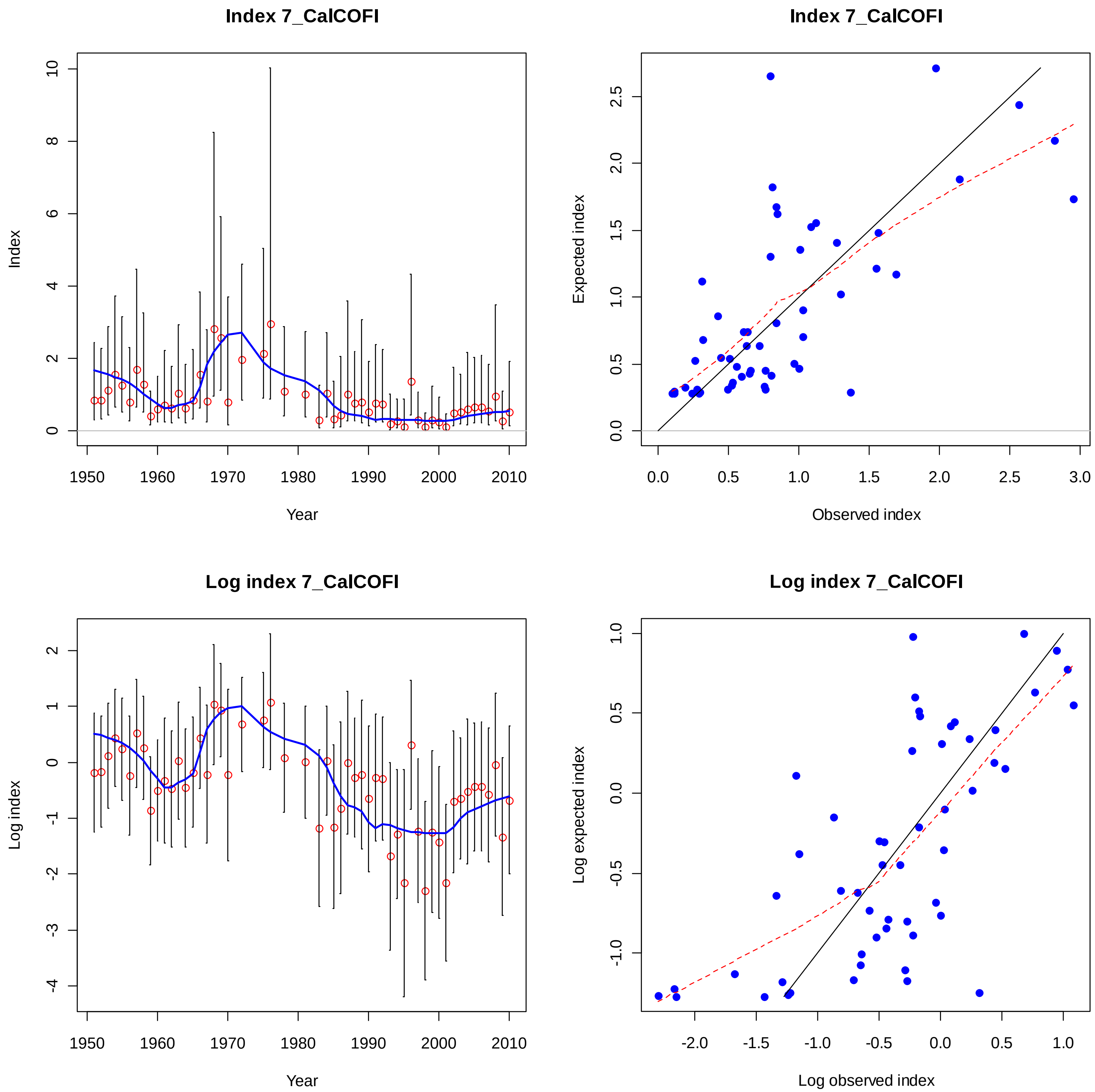
Figure 11: Summary of major sources of data used in the bocaccio model (only fits to updated data or time series are shown in the update).



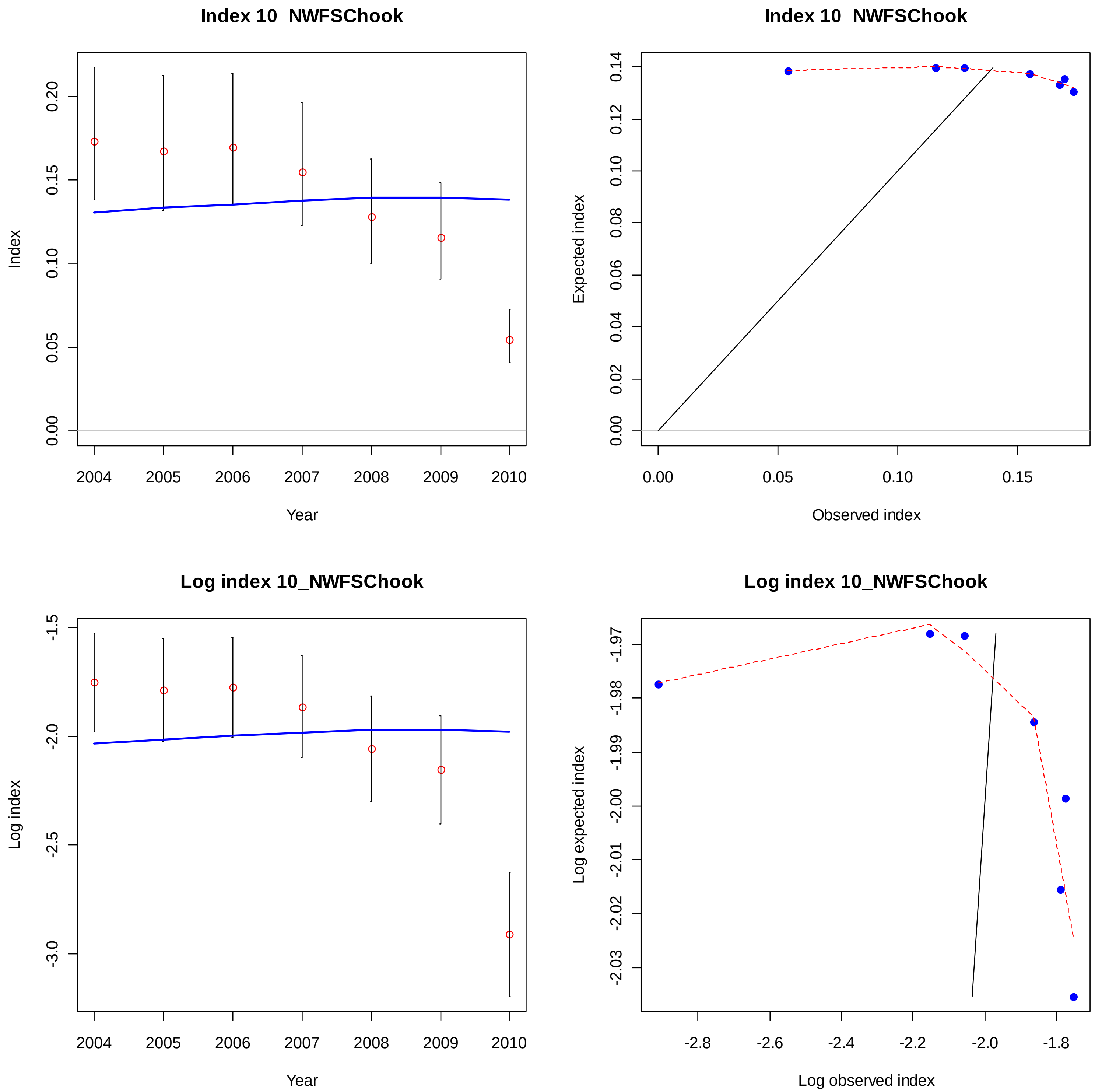
Figures 12a-f. Estimated selectivity curves for the bocaccio base model for commercial fisheries, trawl (north and south of 38° N latitude), hook-and-line, set net, and southern and central California recreational fisheries.



Figures 12g-j. Selectivity curves for bocaccio in the triennial survey (fixed), the NWFSC Southern California Bight hook-and-line survey, the NWFSC combined shelf and slope survey, and age selectivity for the pelagic juvenile age-0 survey.



Figures 13a-d. Arithmetic and log fits, with corresponding observed and predicted values, to the CalCOFI larval abundance time series of bocaccio abundance.



Figures 14a-d. Arithmetic and log fits, with corresponding observed and predicted values, to the NWFSC hook and line survey GLMM index of bocaccio abundance.

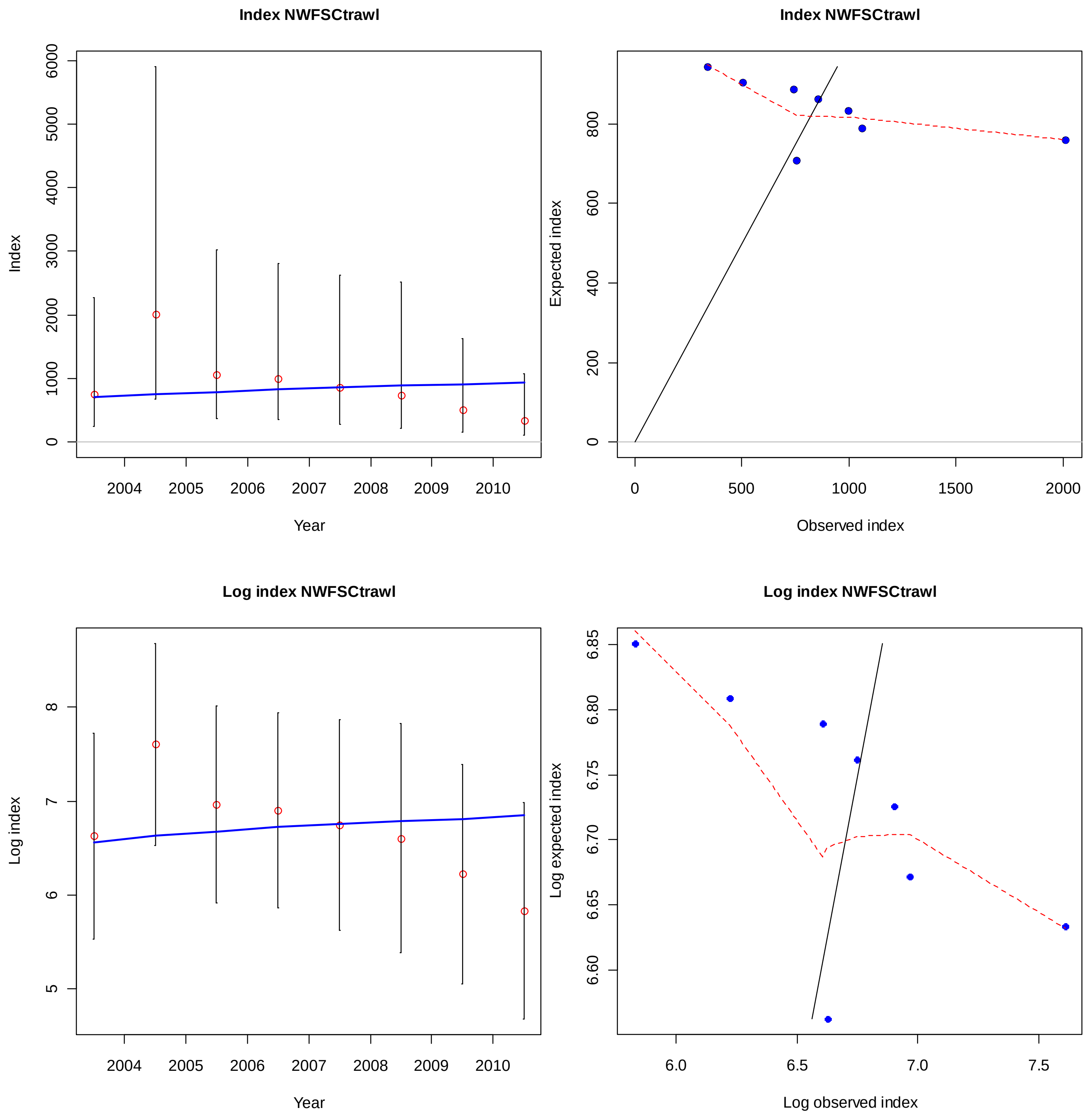


Figure 15a-d: Arithmetic and log fits, with corresponding observed and predicted values, to the NWFSC combined trawl survey index (revised to exclude age 0 fish).

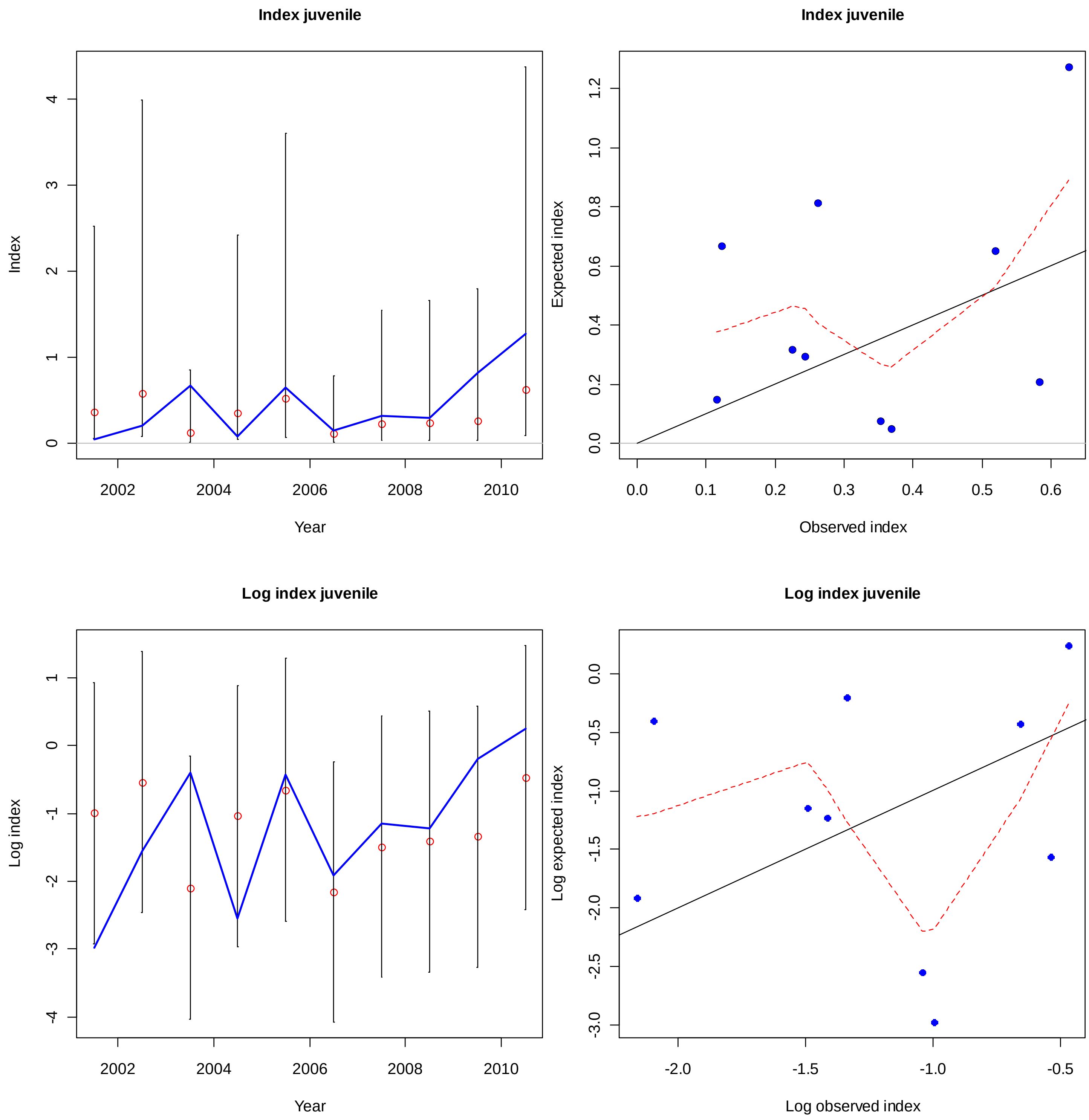


Figure 16a-d: Arithmetic and log fits, with corresponding observed and predicted values, to the SWFSC juvenile trawl survey index.

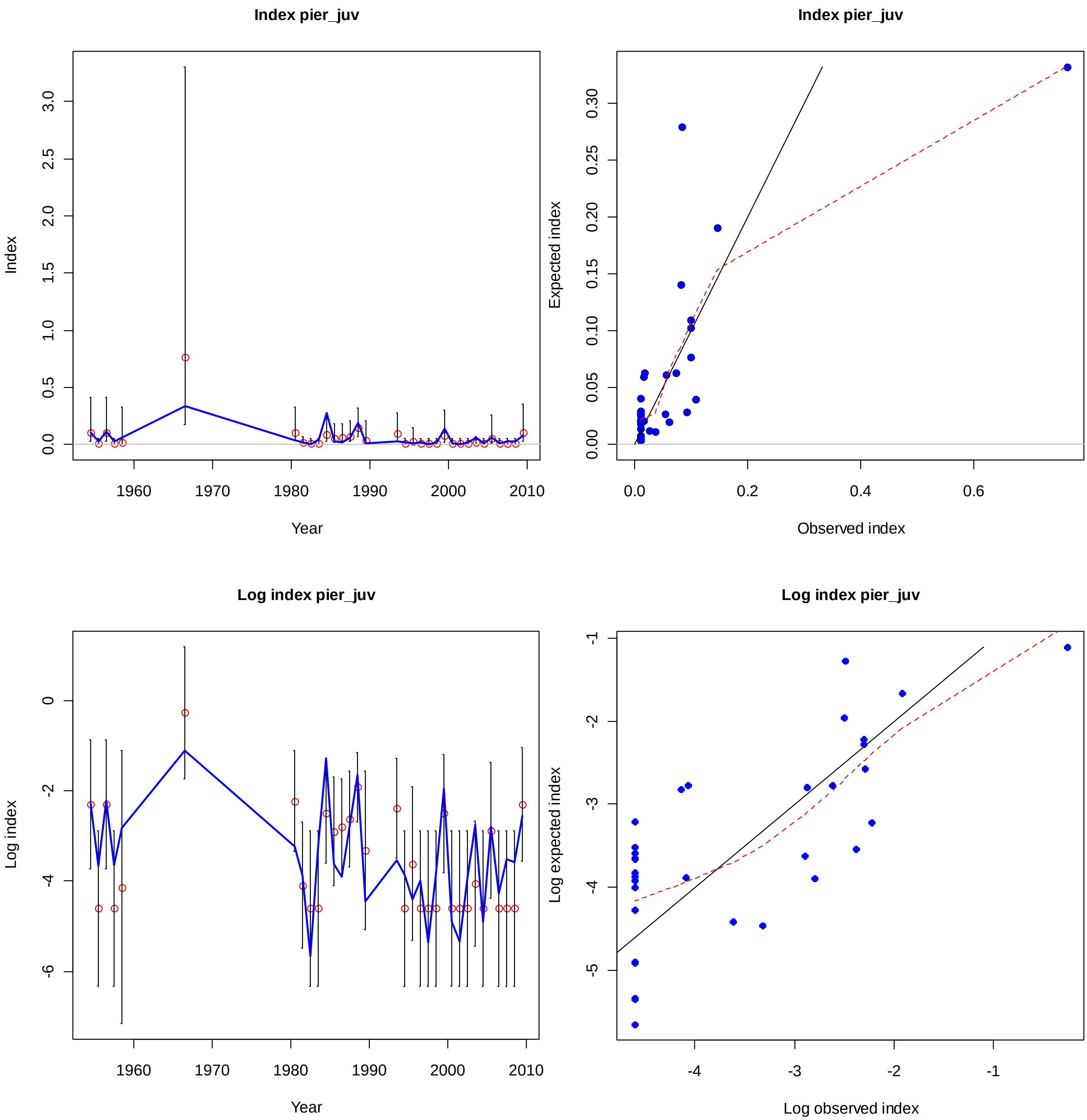


Figure 17a-d: Arithmetic and log fits, with corresponding observed and predicted values, to the Pier fishery index of age 0 (YOY) bocaccio.

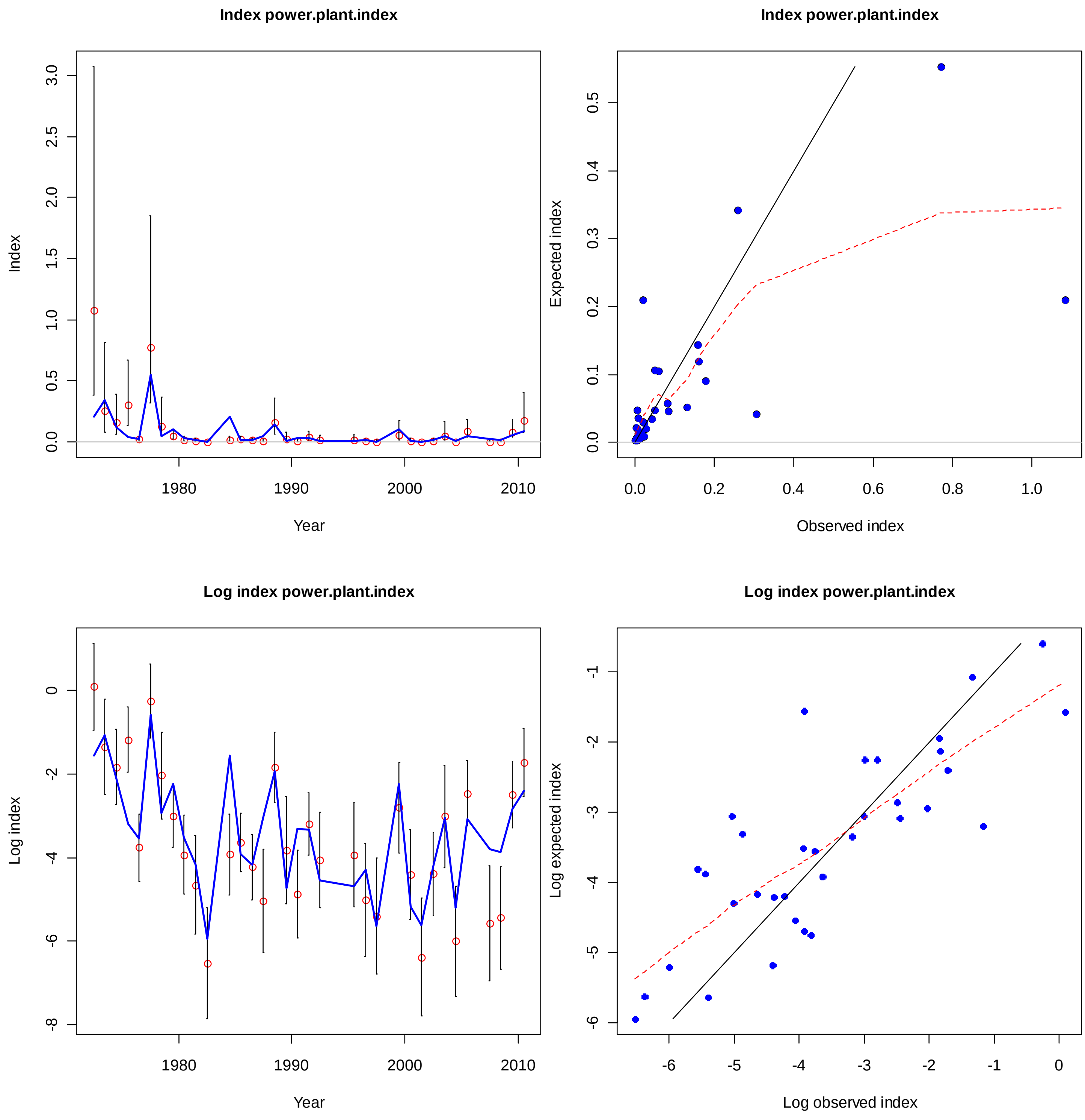


Figure 18: Arithmetic and log fits, with corresponding observed and predicted values, to the power plant impingement index.

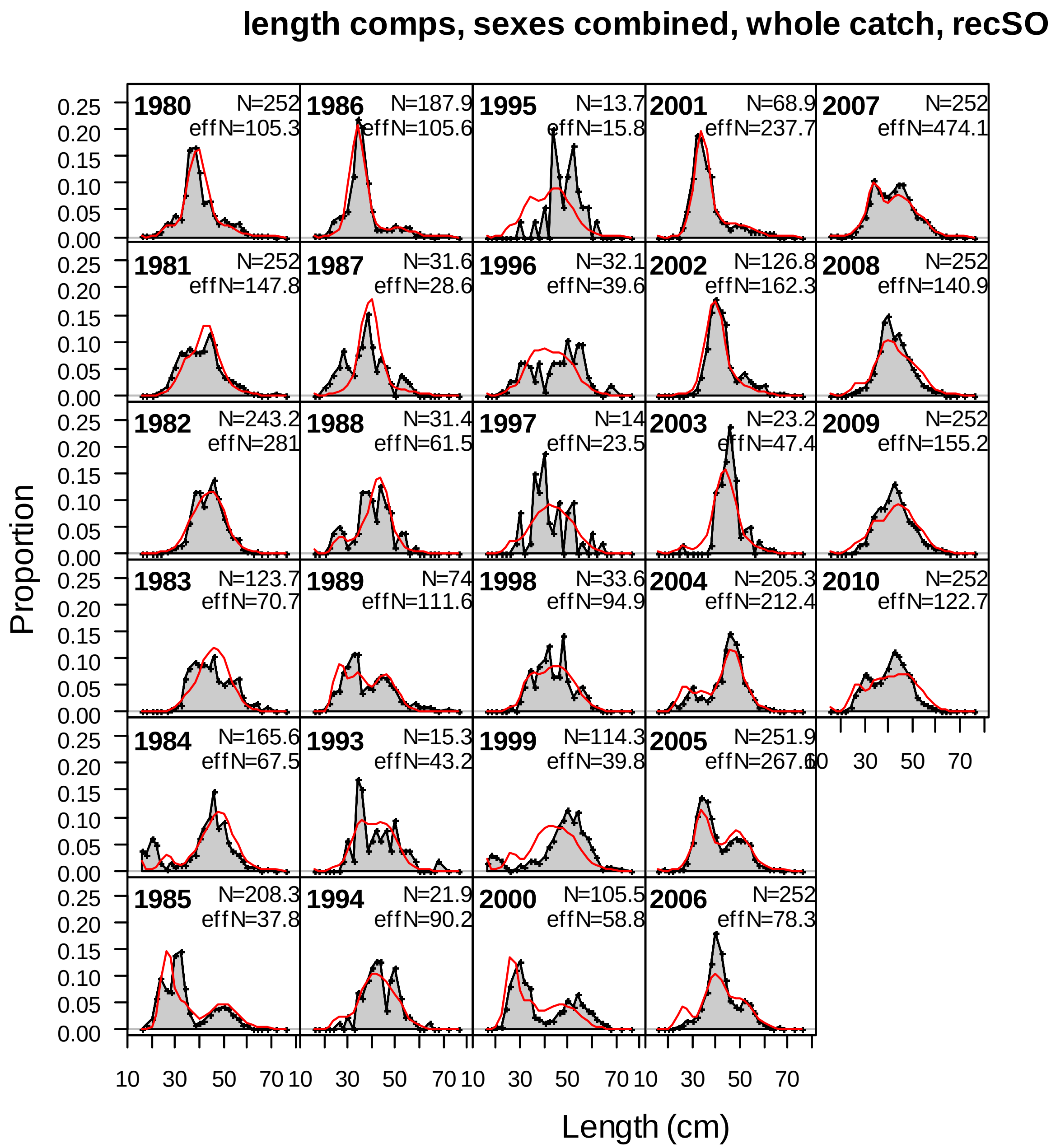
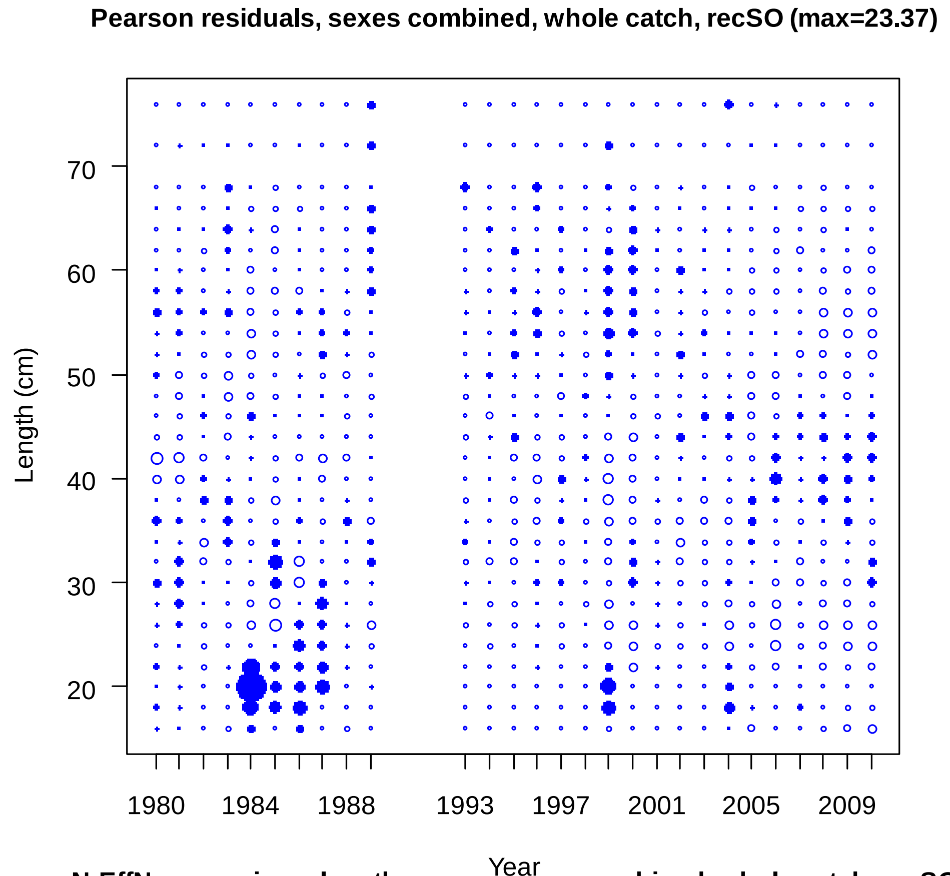


Figure 19: Fits to length frequency data (sexes combined) for the southern recreational fishery (2009 and 2010 data are new to update).



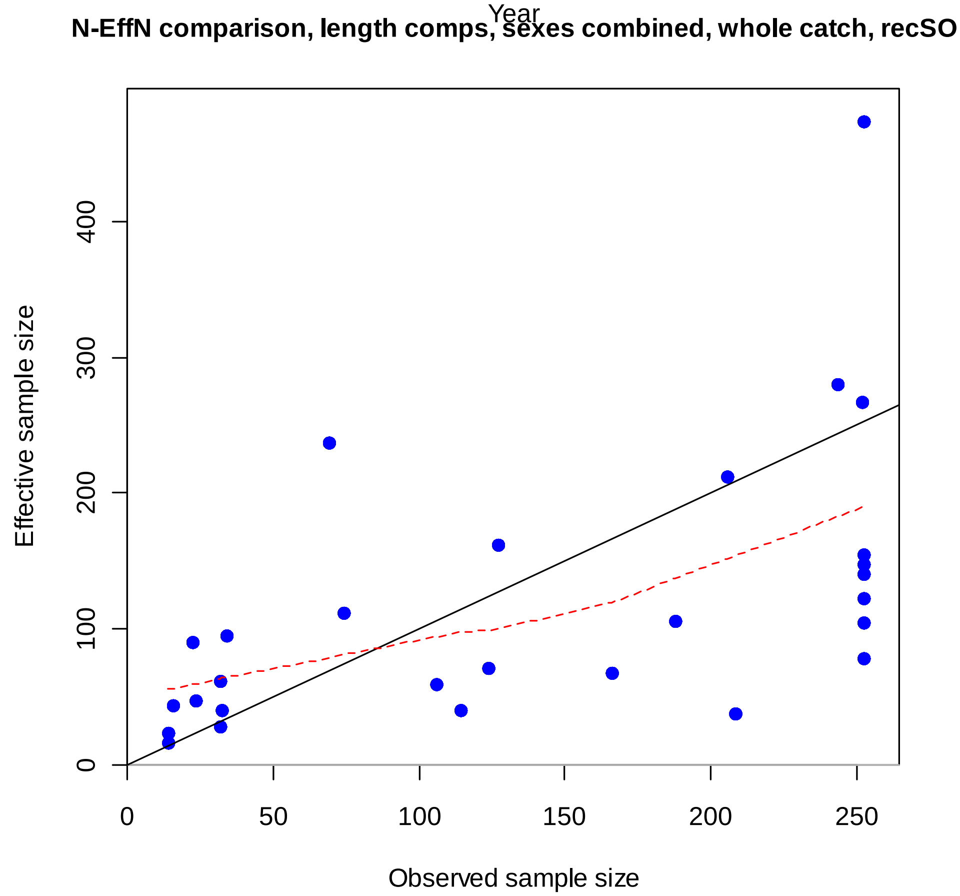


Figure 20: Residuals to length frequency fits and observed vs. effective sample sizes for the southern recreational fishery.

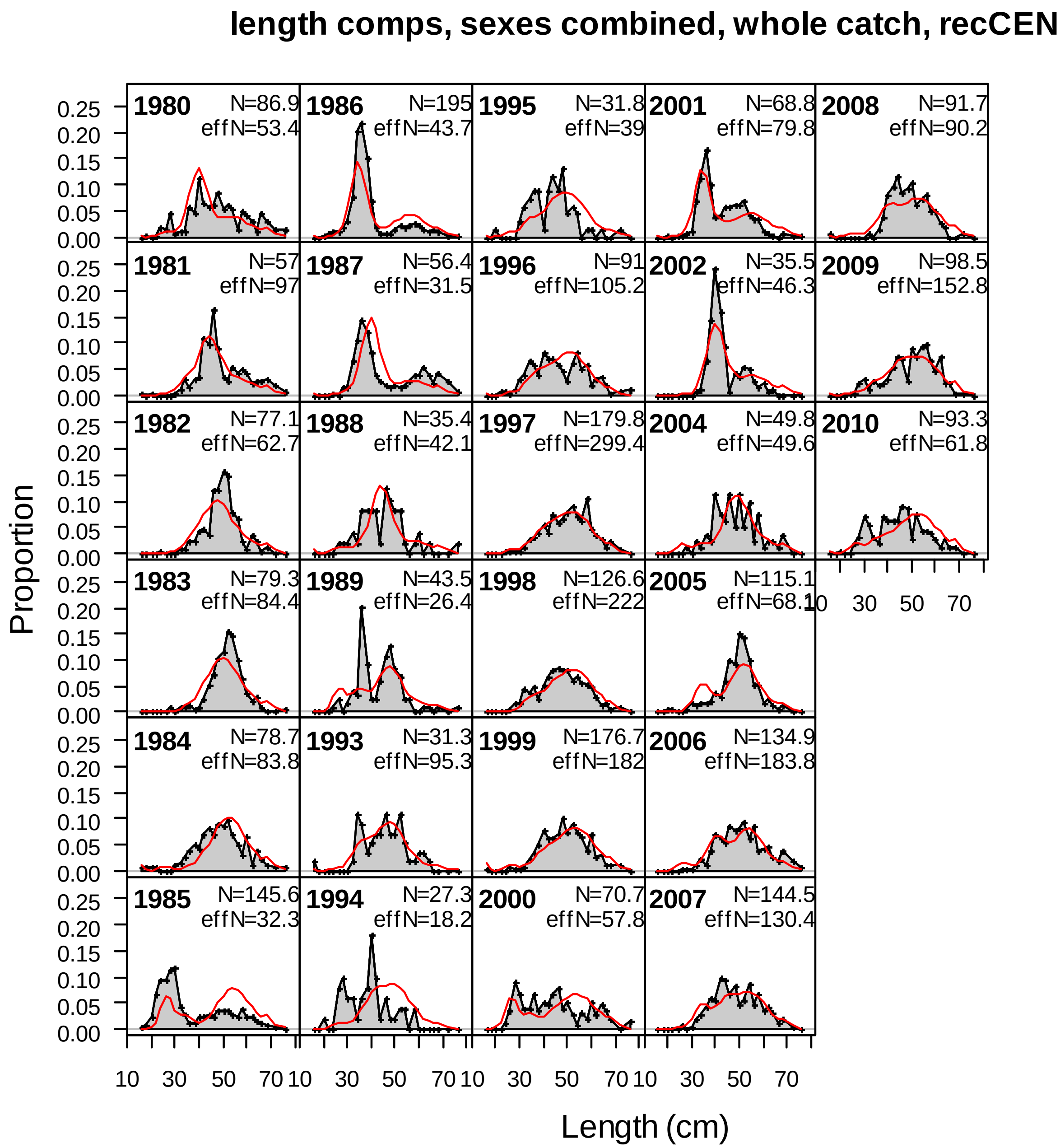


Figure 21: Fits to length frequency data (sexes combined) for the central California recreational fishery (2009 and 2010 data are new to update).

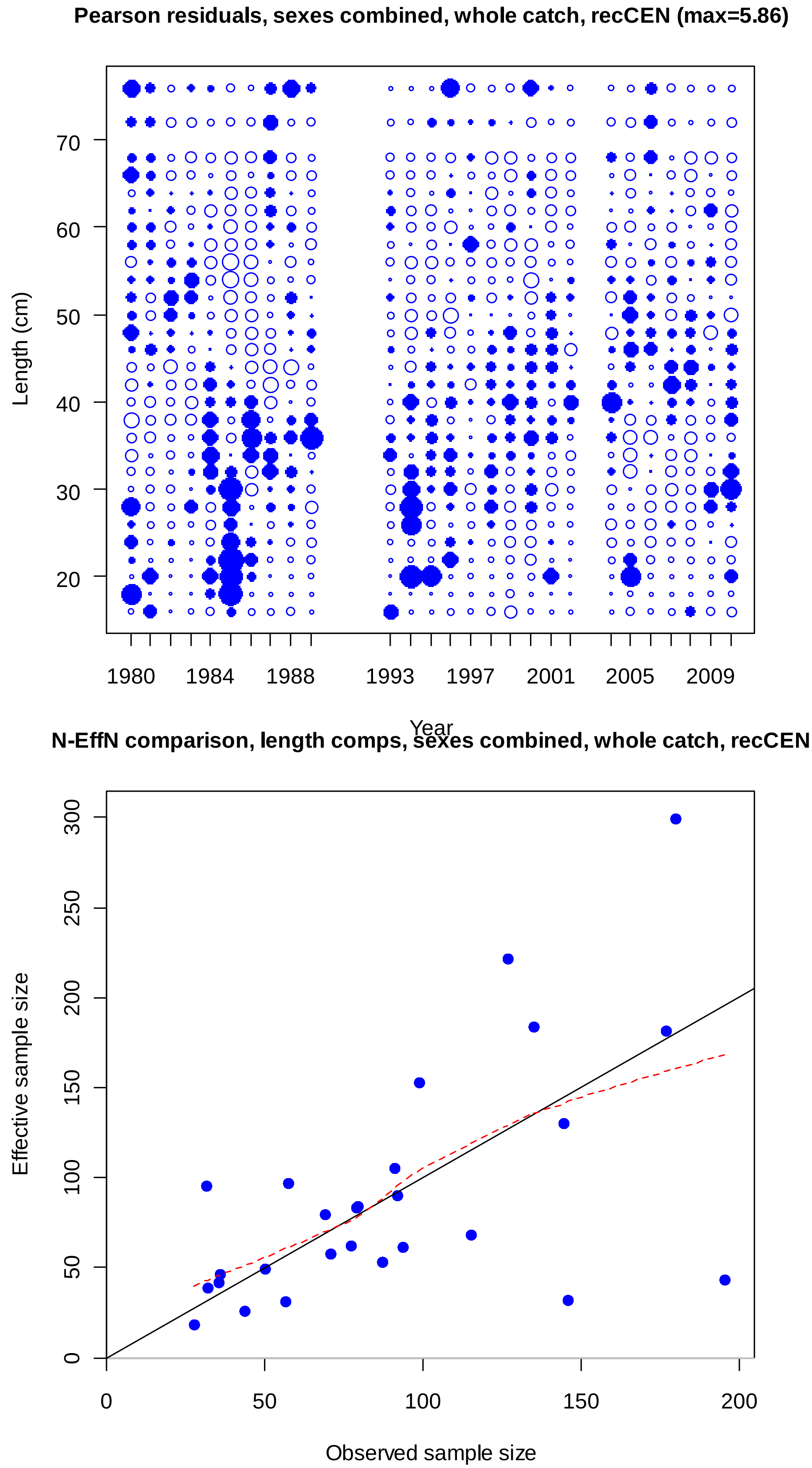


Figure 22: Residuals to length frequency fits and observed vs. effective sample sizes for the southern recreational fishery.

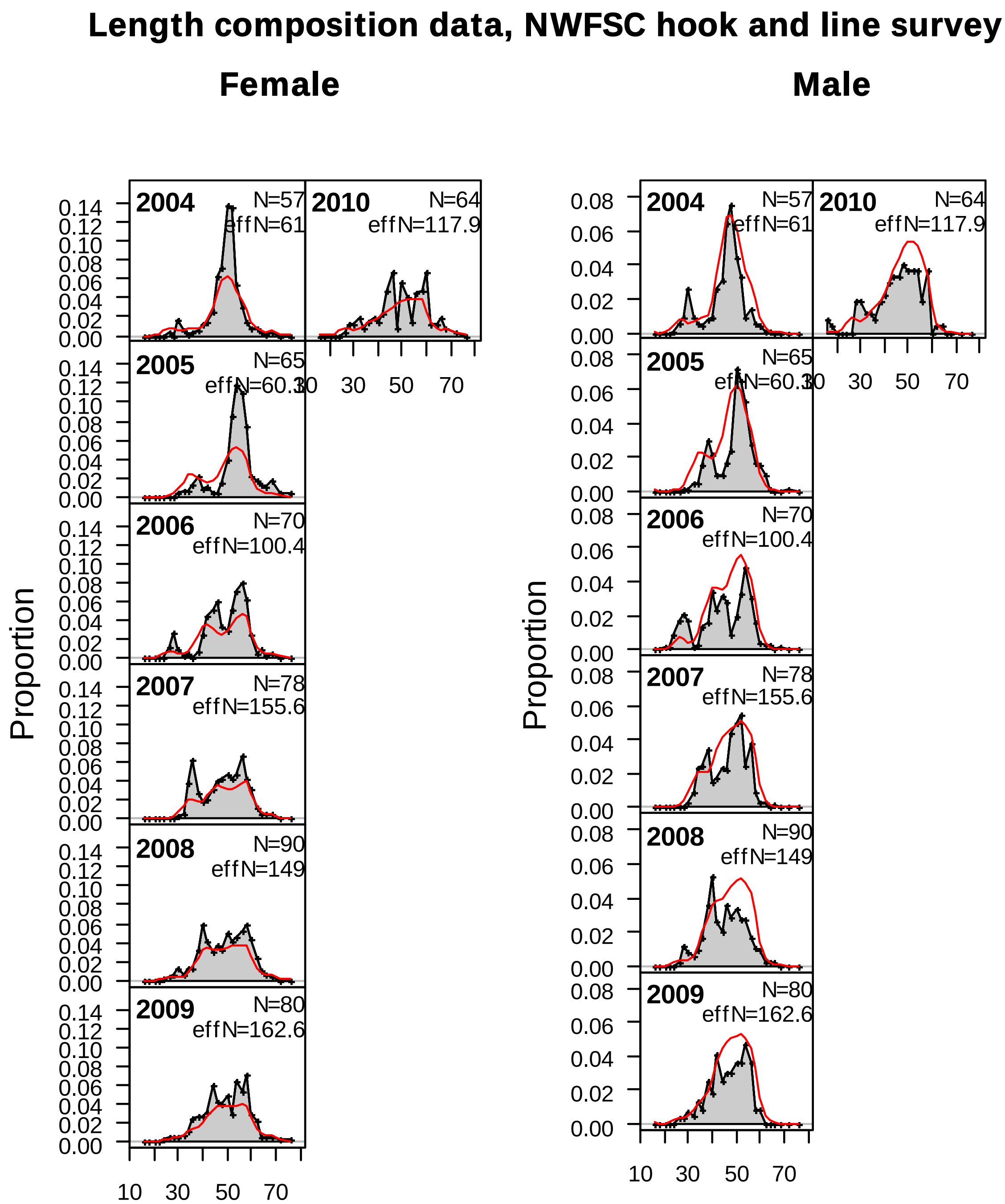


Figure 23: Fits to the NWFSC hook and line survey length frequency data.

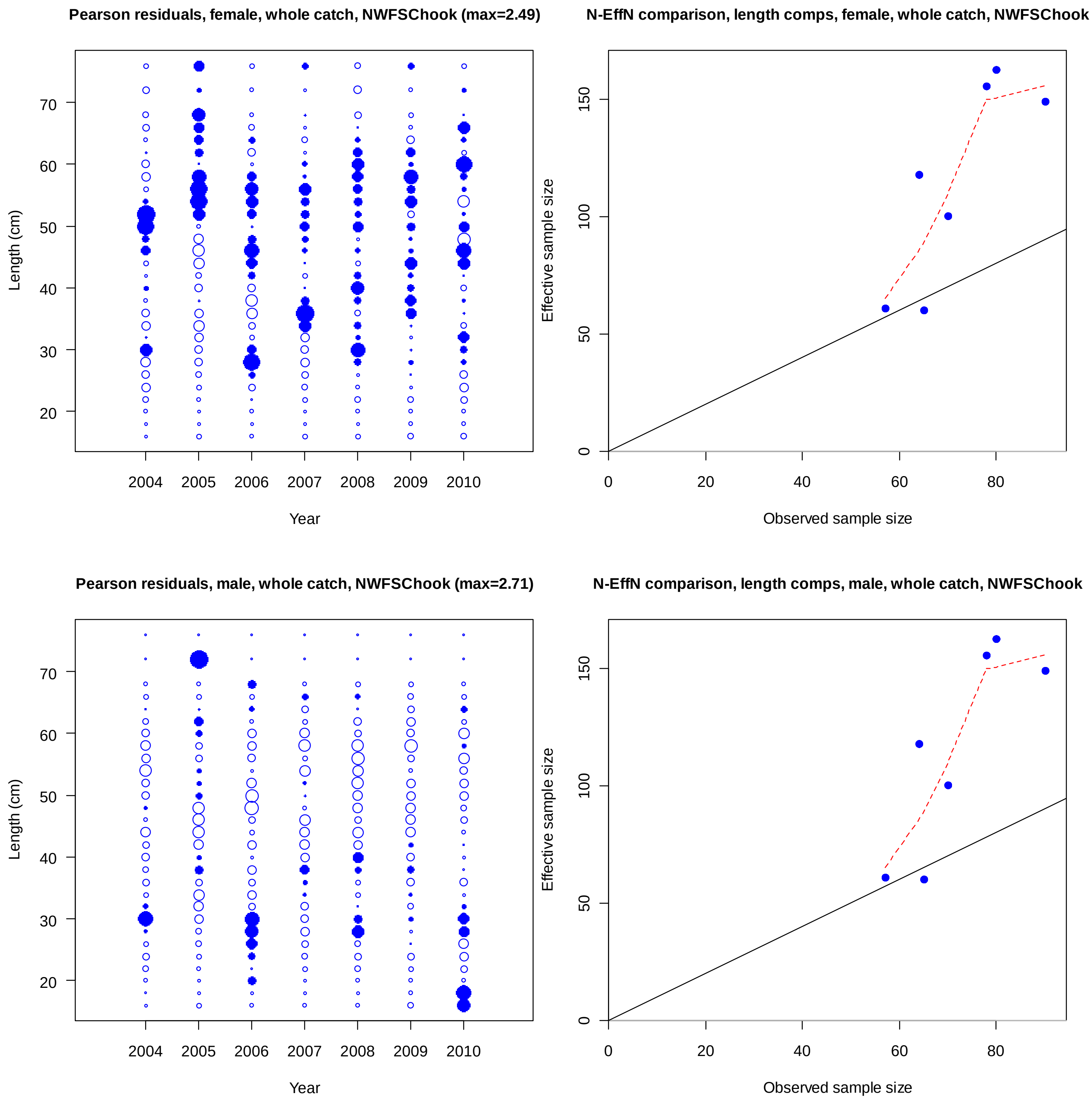


Figure 24: Residuals to length frequency fits and observed vs. predicted sample sizes for NWFSC hook and line survey data.

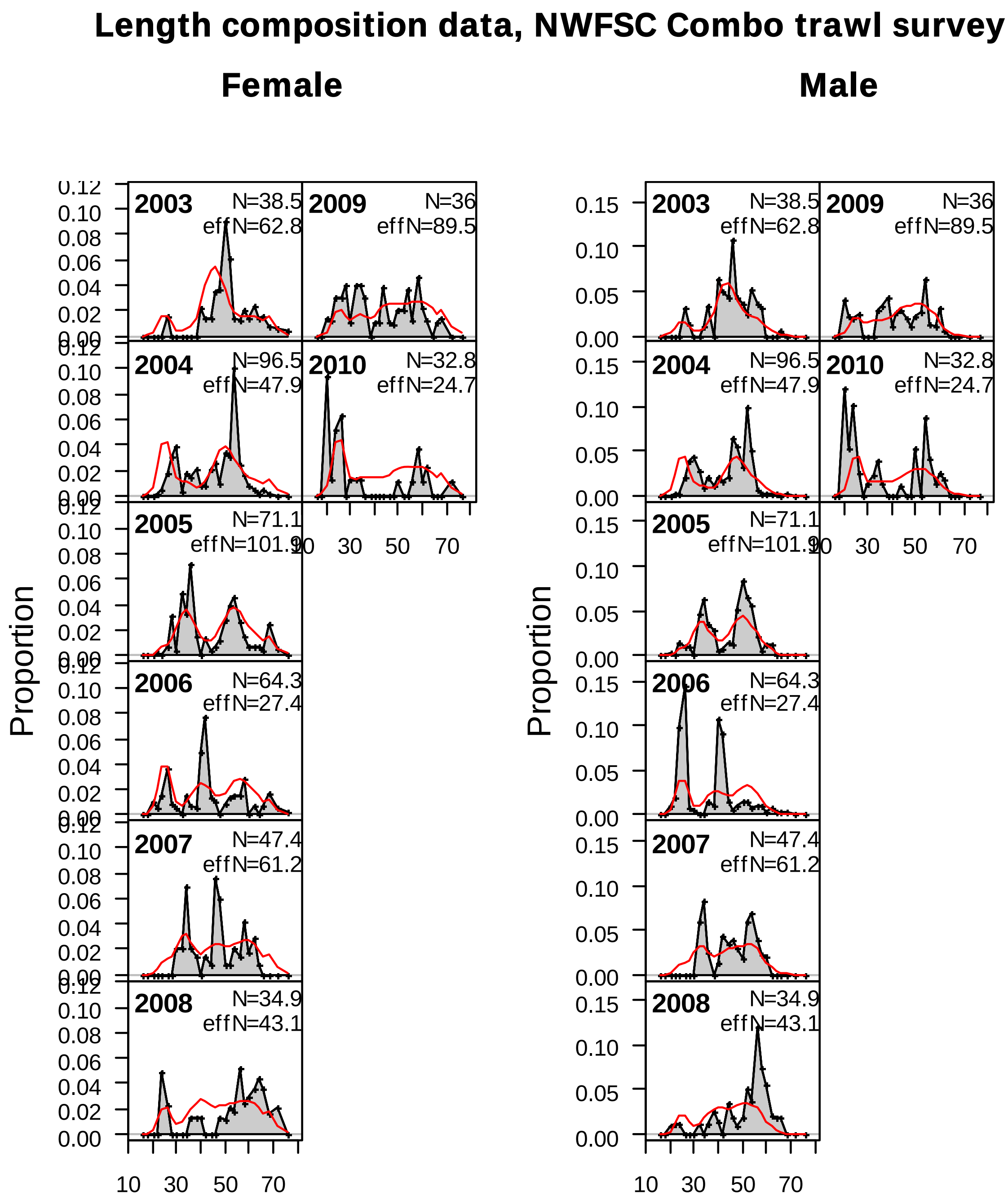


Figure 25: Fits to the NWFSC combined shelf-slope trawl survey length frequency data (for base model, sizes <20 cm removed, selectivity unselected for age-0 fish).

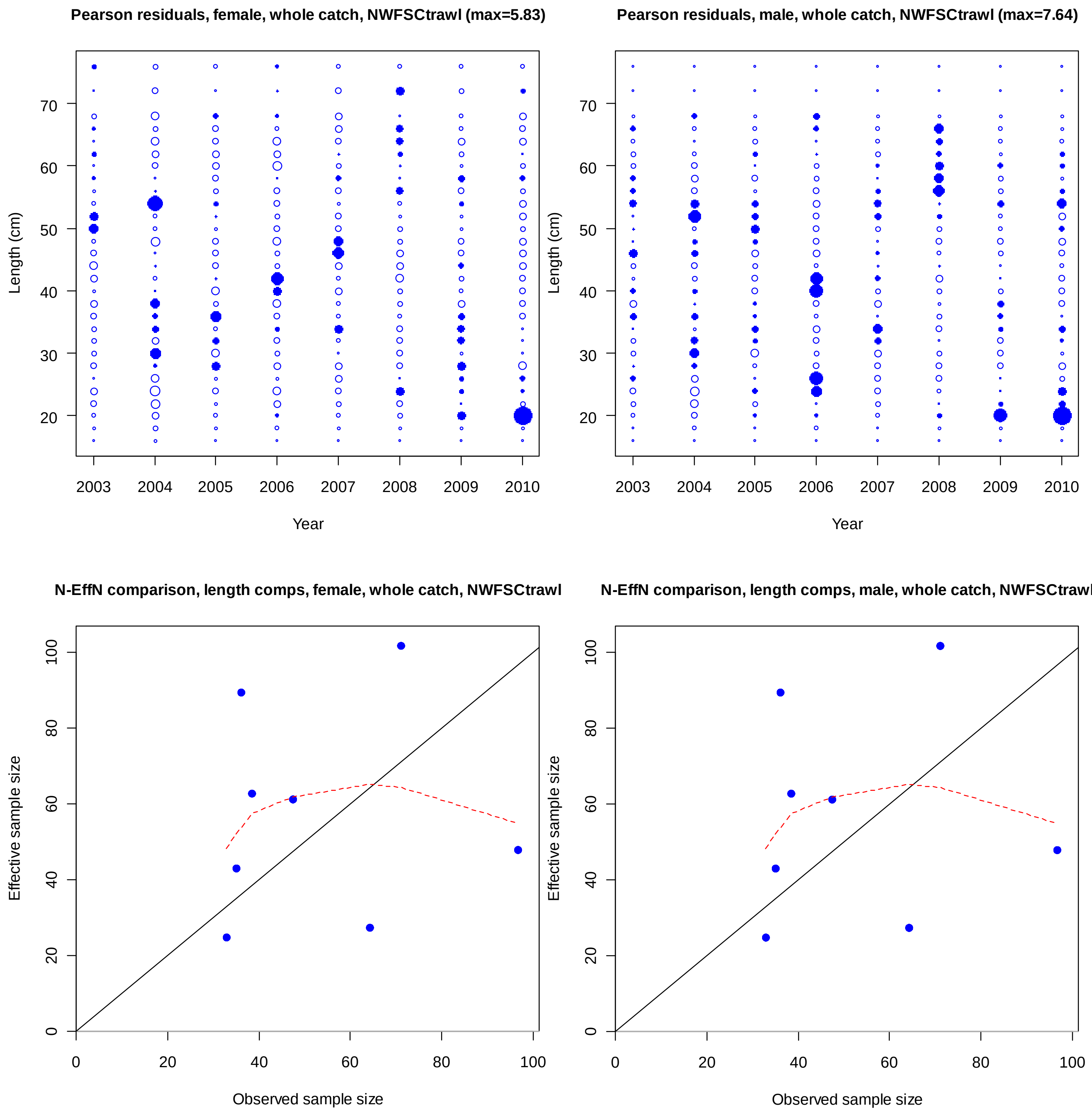


Figure 26: Residuals to length frequency fits and observed vs. predicted sample sizes for NWFSC shelf-slope bottom trawl survey data

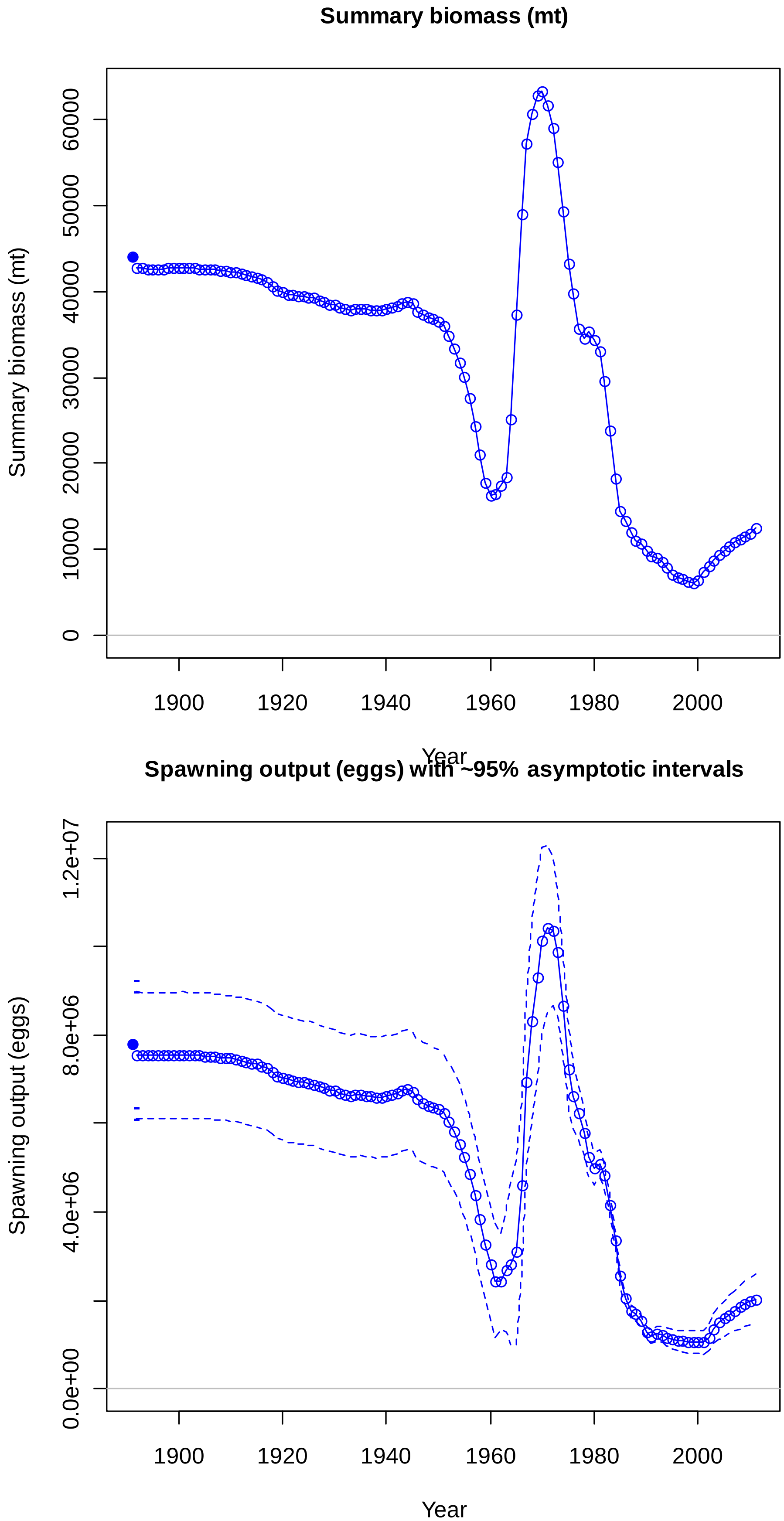


Figure 27: Summary biomass and spawning output for 2011 base model.

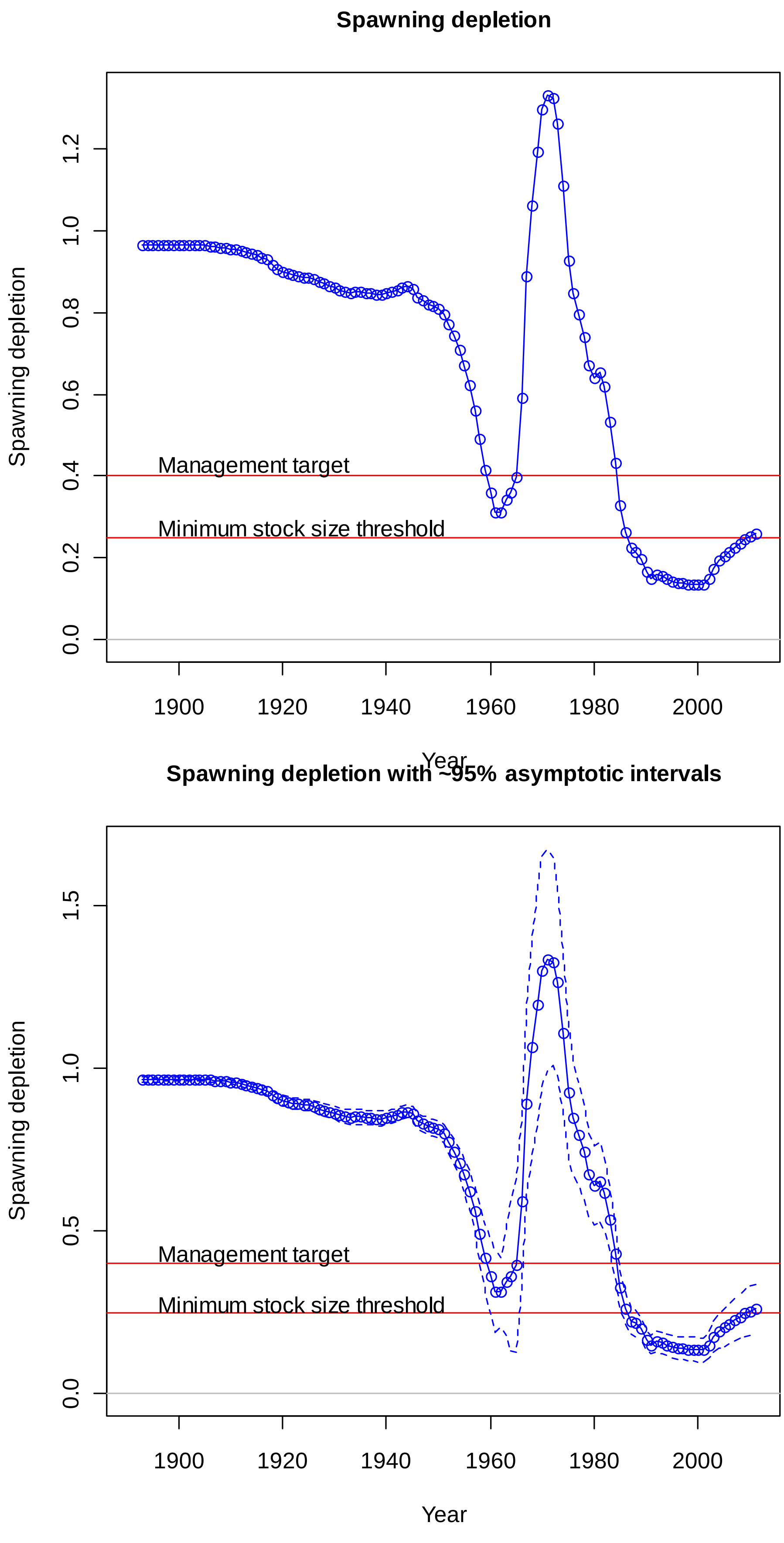


Figure 28: Relative depletion (top) with ~ 95% confidence limits (bottom) for 2011base model.

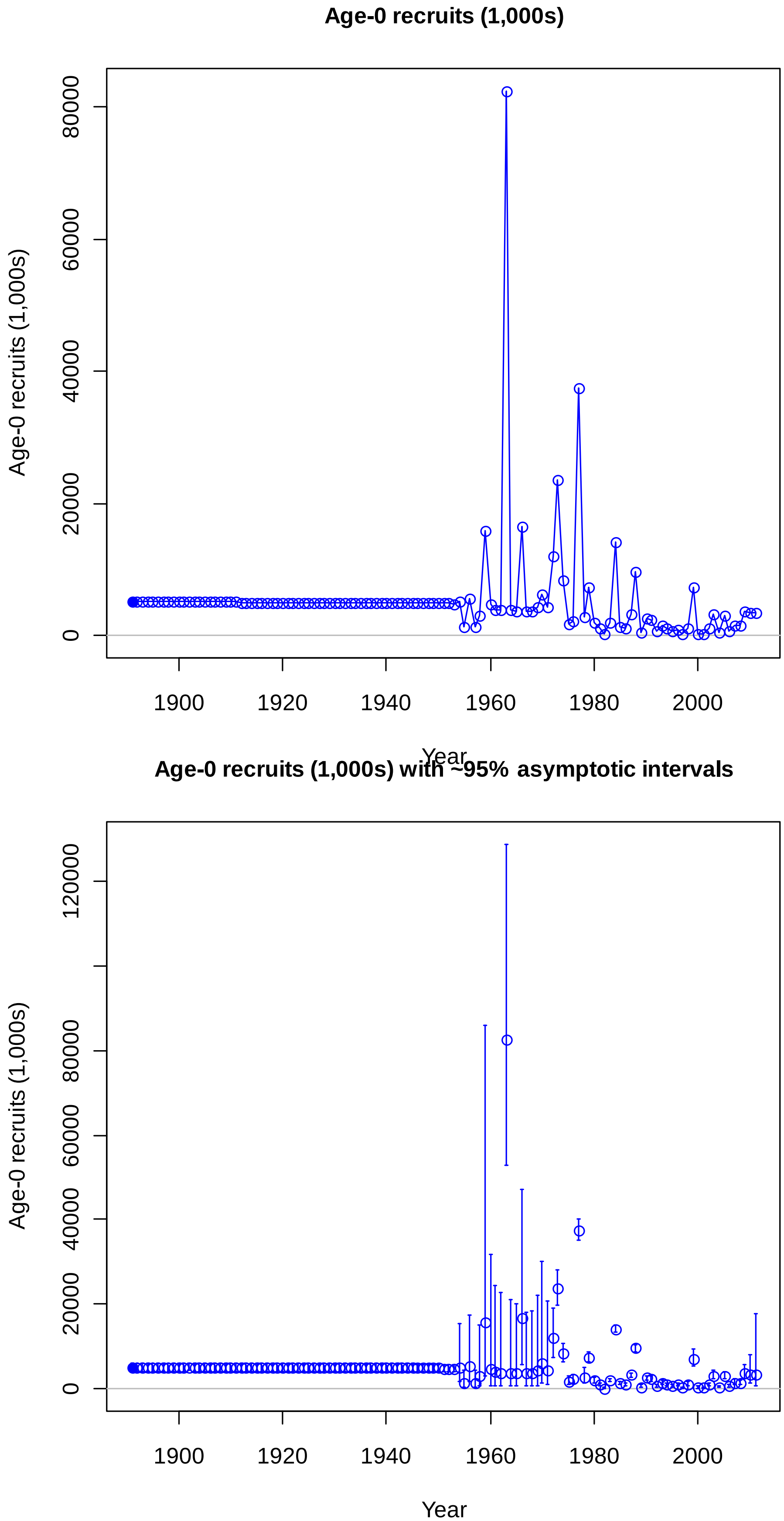


Figure 29: Estimated age 0 recruitments (top) and with ~95% confidence intervals (bottom) for 2011 base model.

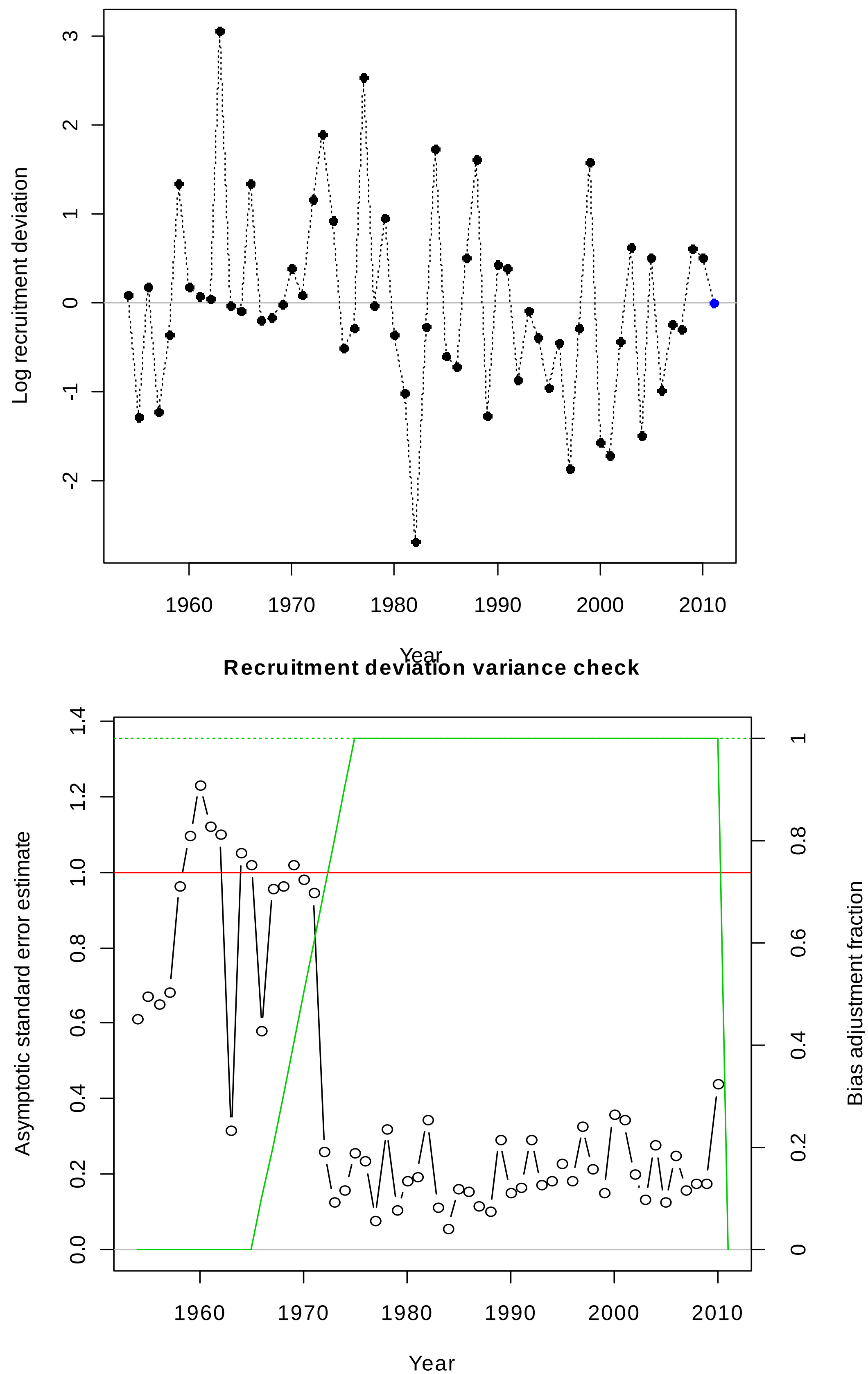


Figure 30: Estimated recruitment deviation parameter values (top) with approximate standard error estimates (bottom).

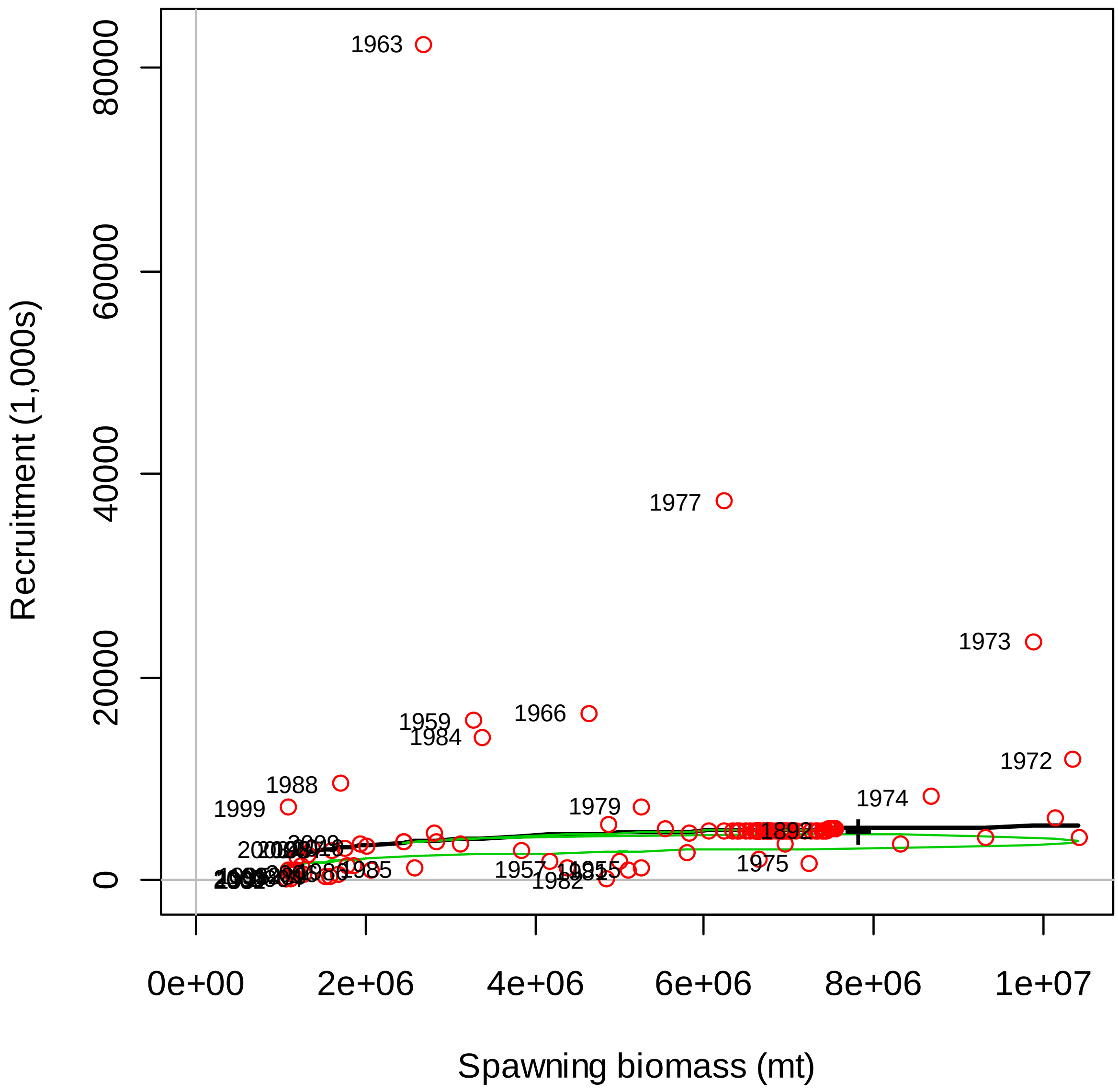
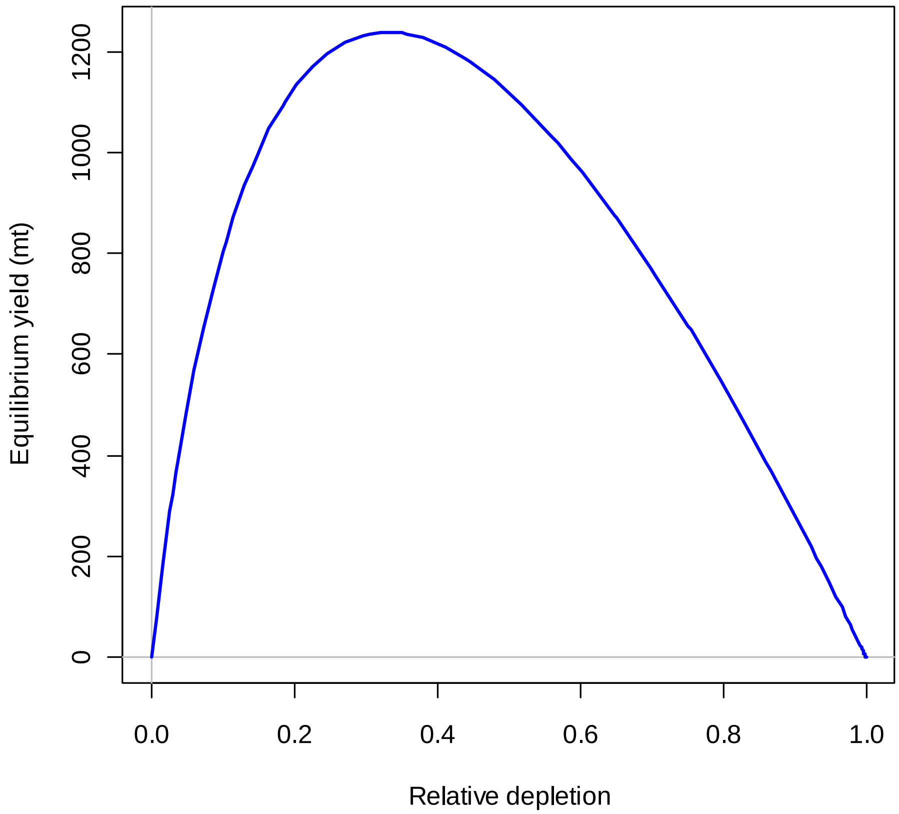


Figure 31: Estimated spawner-recruit relationship, with observed recruitments, for the STAT base model



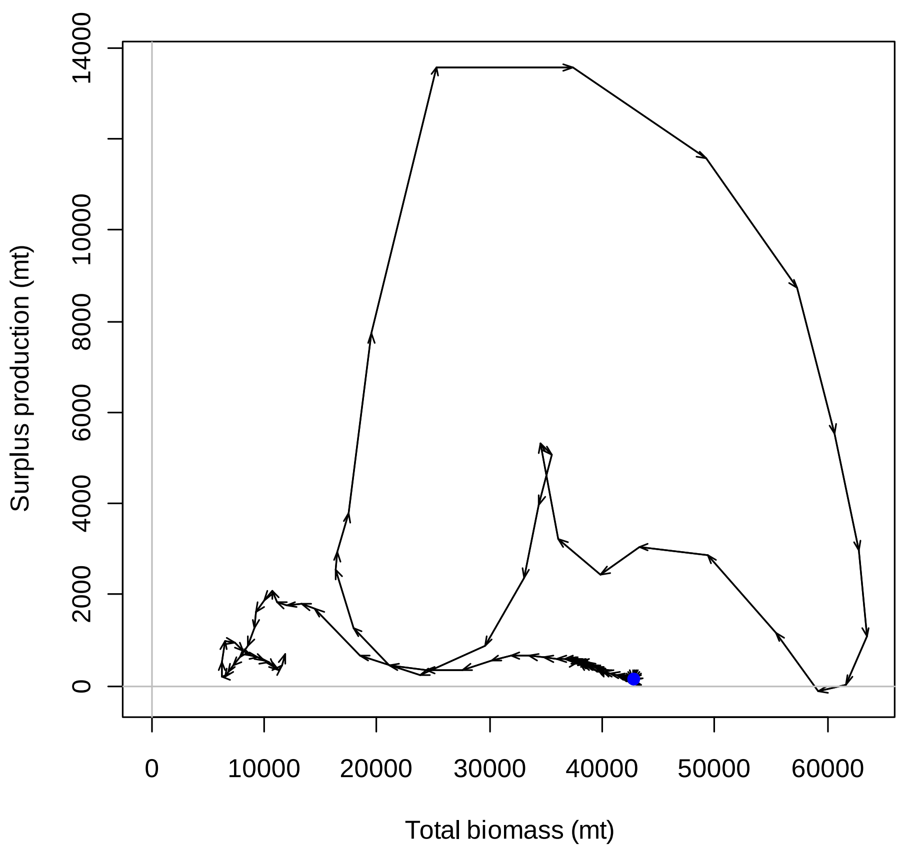
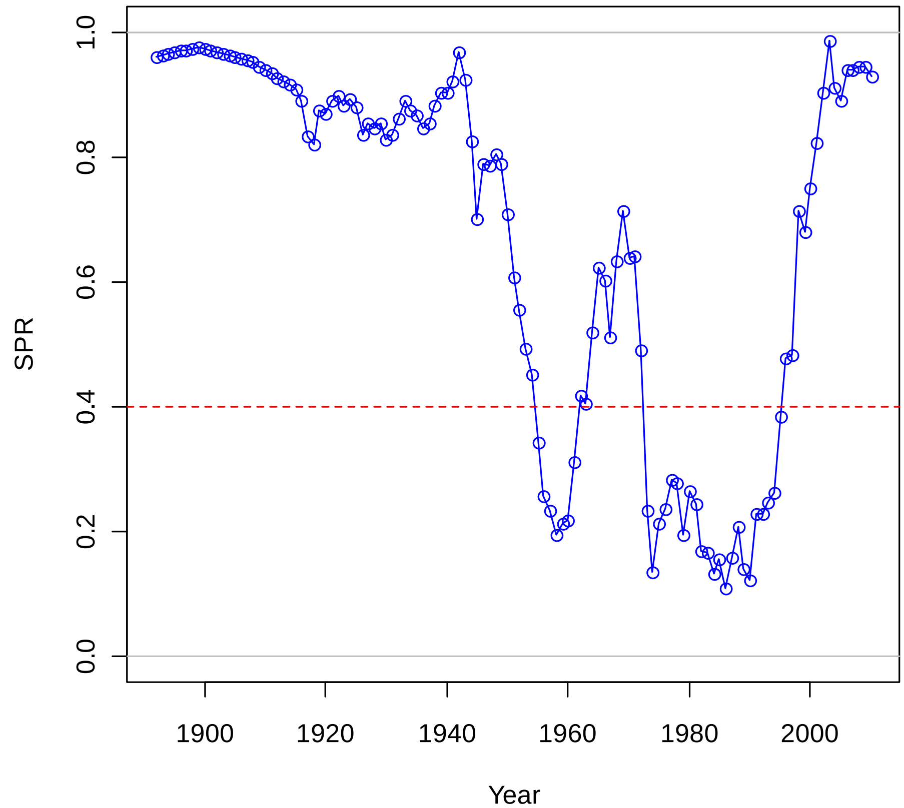


Figure 32: Estimated equilibrium yield curve (top) and phase plot of total biomass against surplus production (bottom) for STAT base model



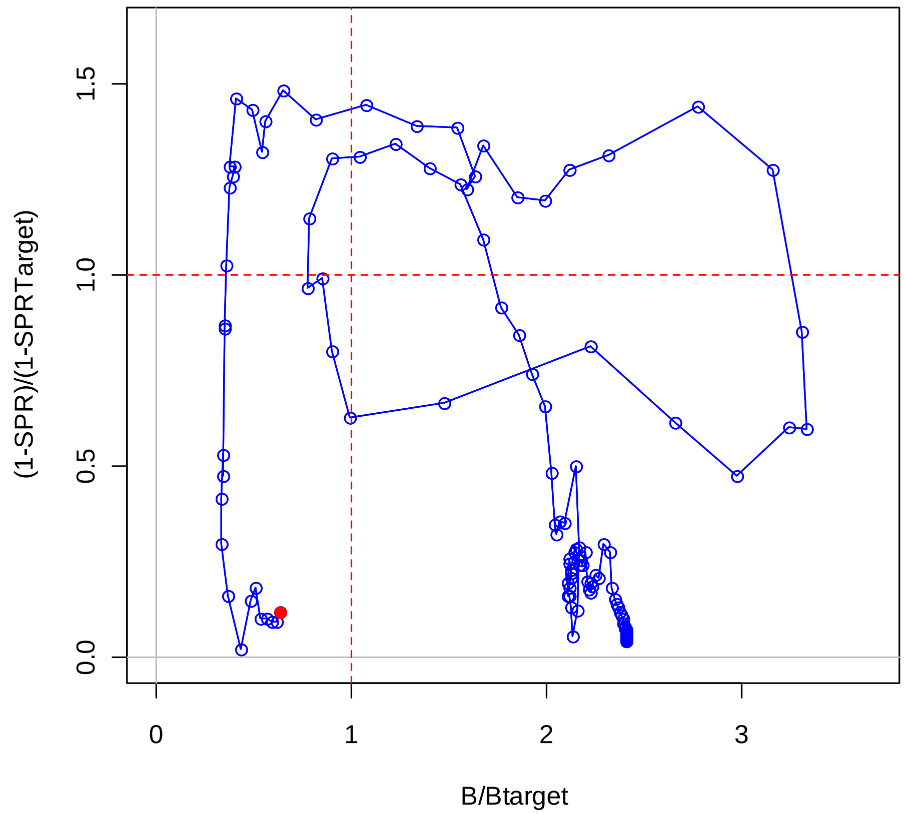


Figure 33: Base model estimates of SPR and relative SPR against biomass (relative to target)- NOTE SPR target incorrectly listed here as 0.4, should be 0.5.

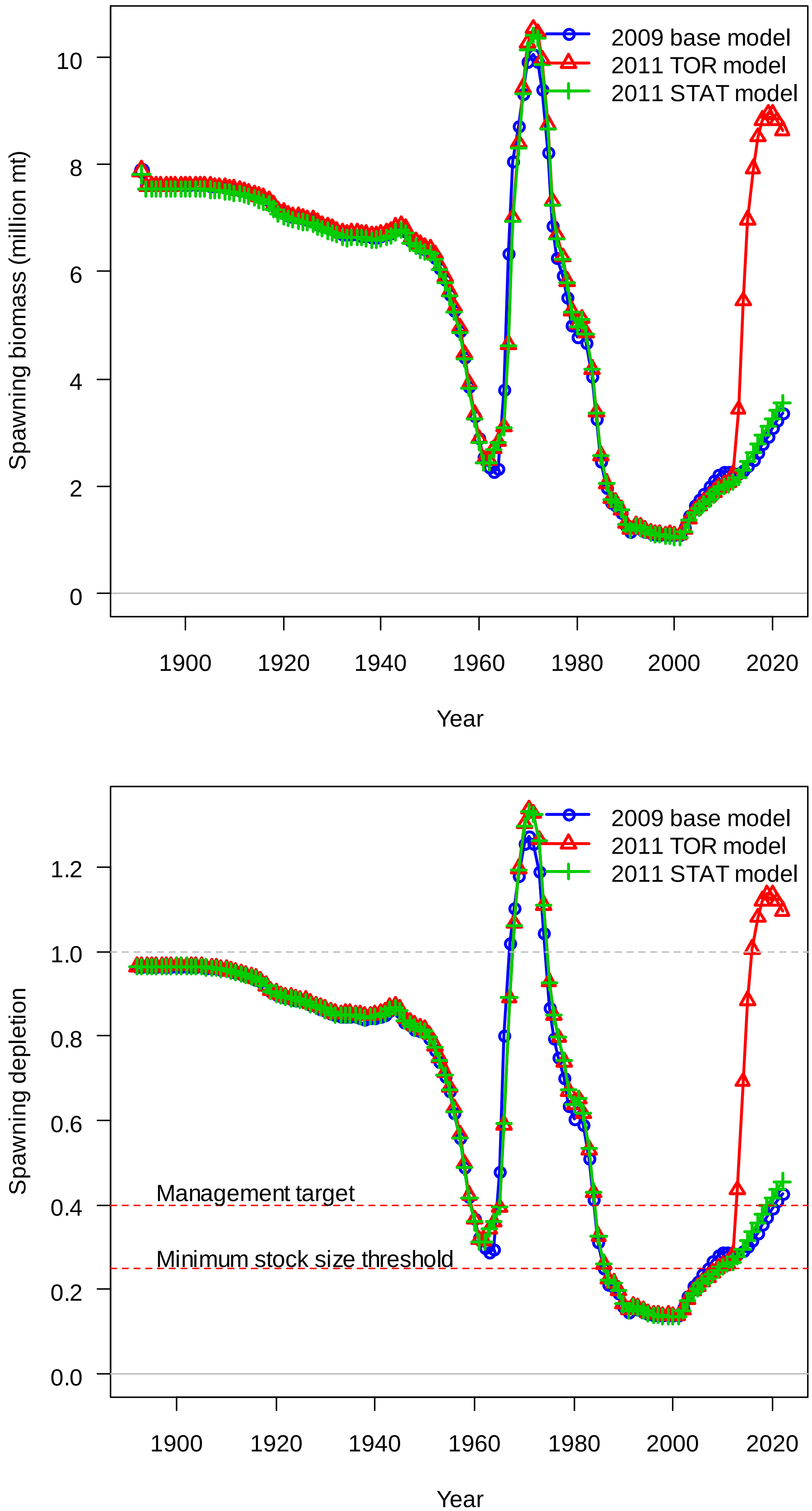


Figure 34: Comparison of 2009, 2011 base model, and Terms of Reference ("TOR") 2011 model (for sensitivity) spawning output and depletion trends.

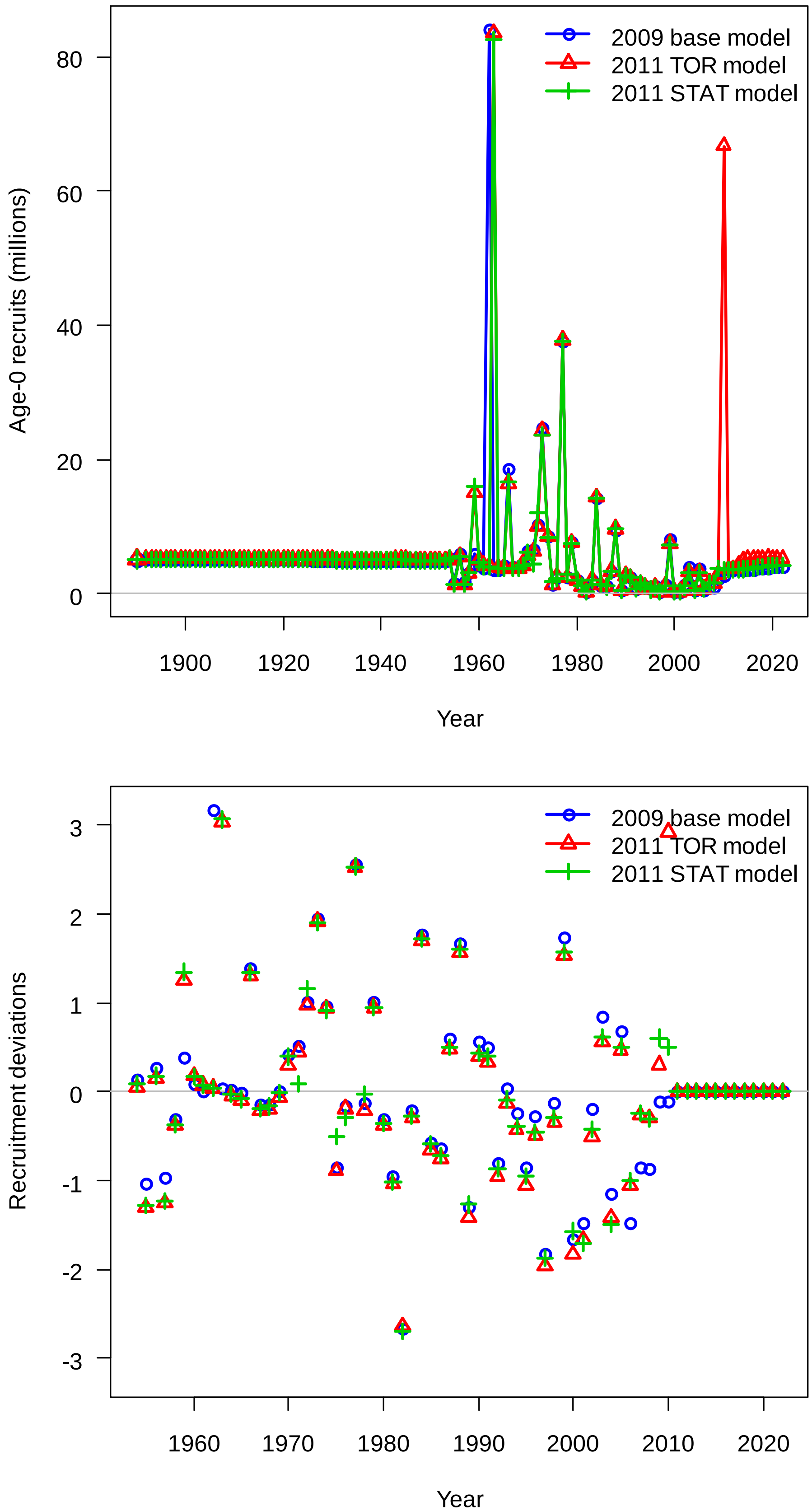


Figure 35: Comparison of 2009, 2011 base model, and Terms of Reference ("TOR") 2011 model (for sensitivity) recruitment and recruitment deviation values.

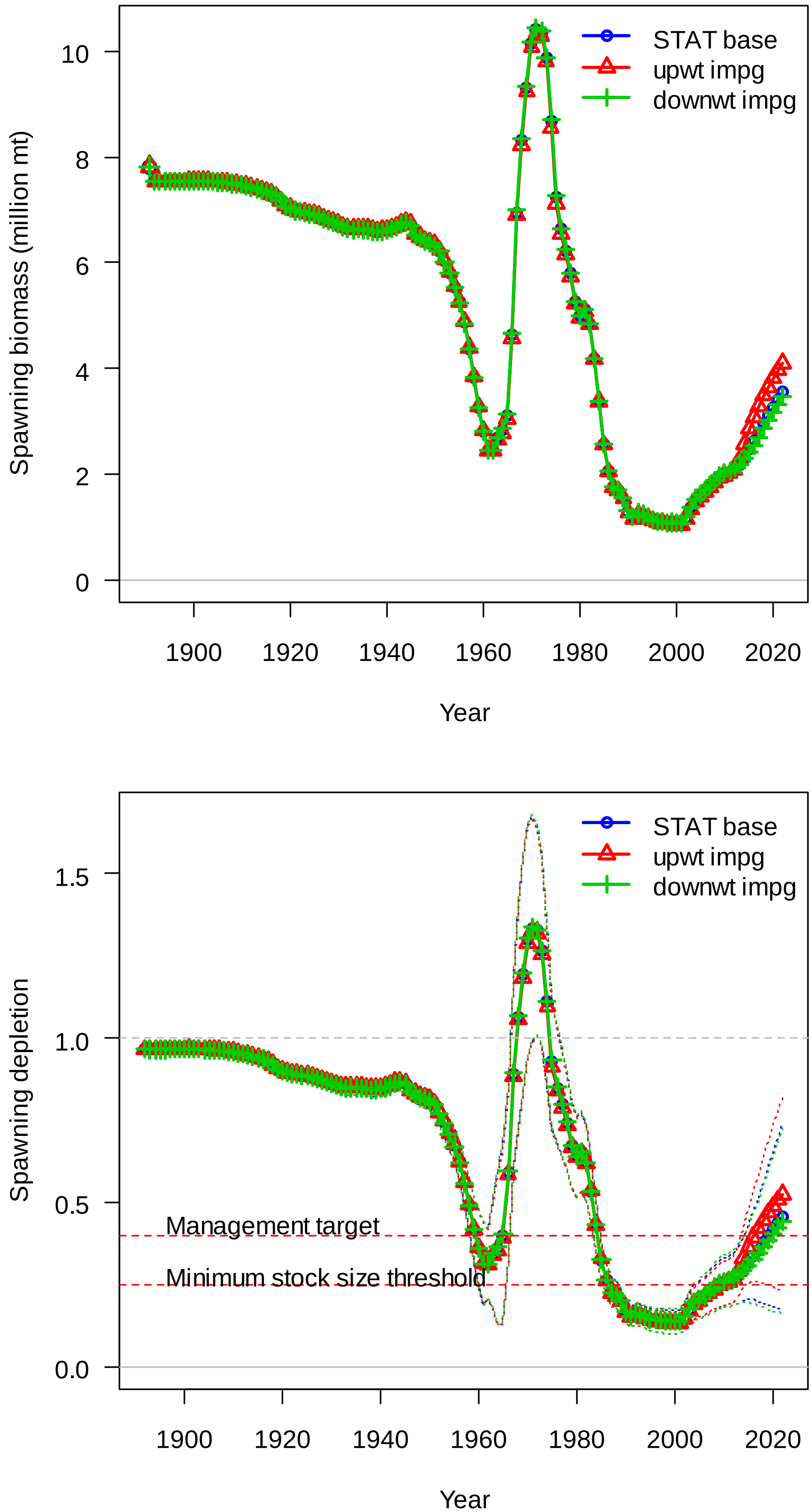


Figure 36: Comparison of the 2011 base model, with upweighted and downweighted impingement data, base model spawning output and depletion trends.

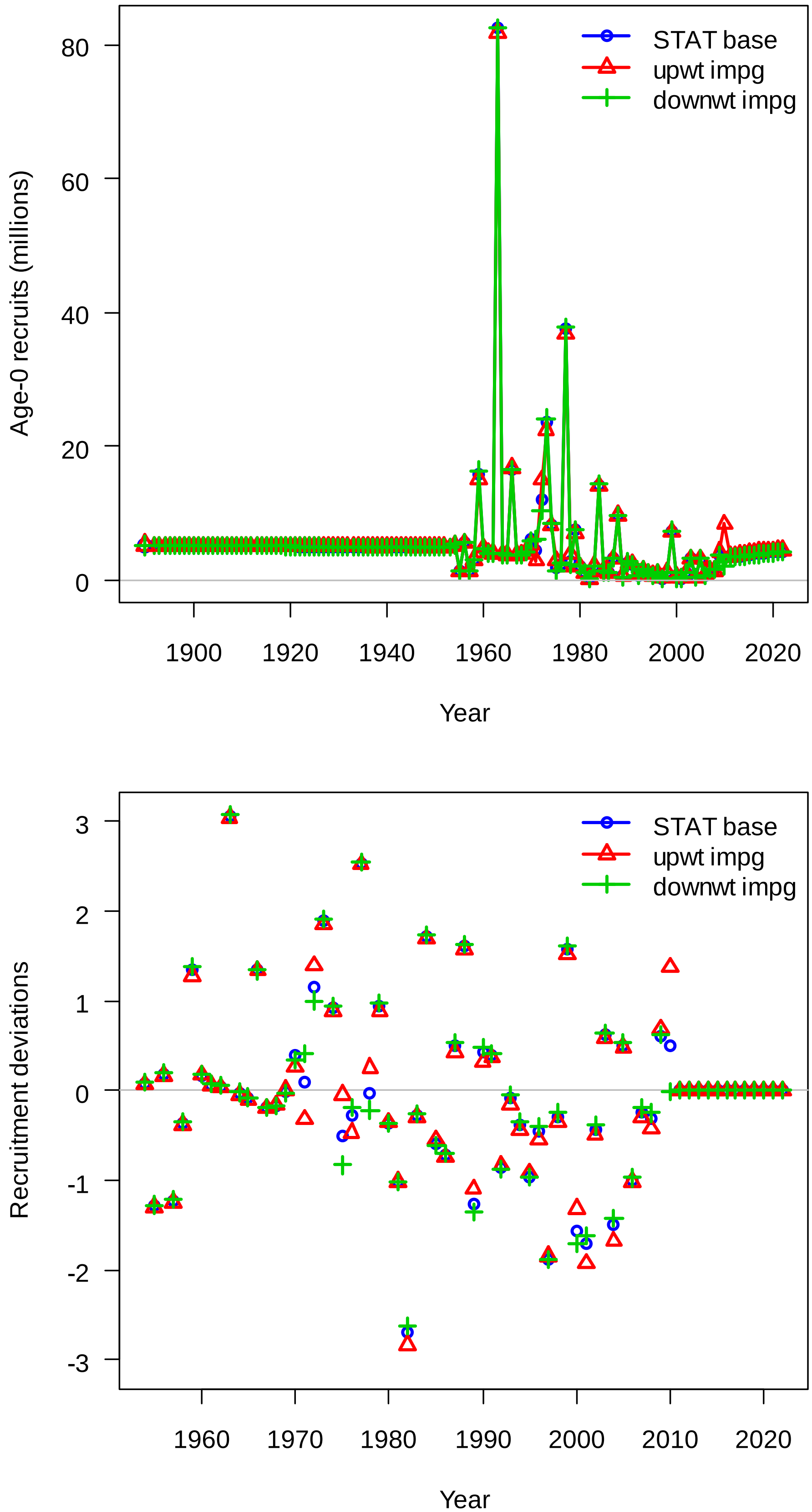


Figure 37: Comparison of the 2011 base model, with upweighted and downweighted impingement data, recruitment and recruitment deviation values.

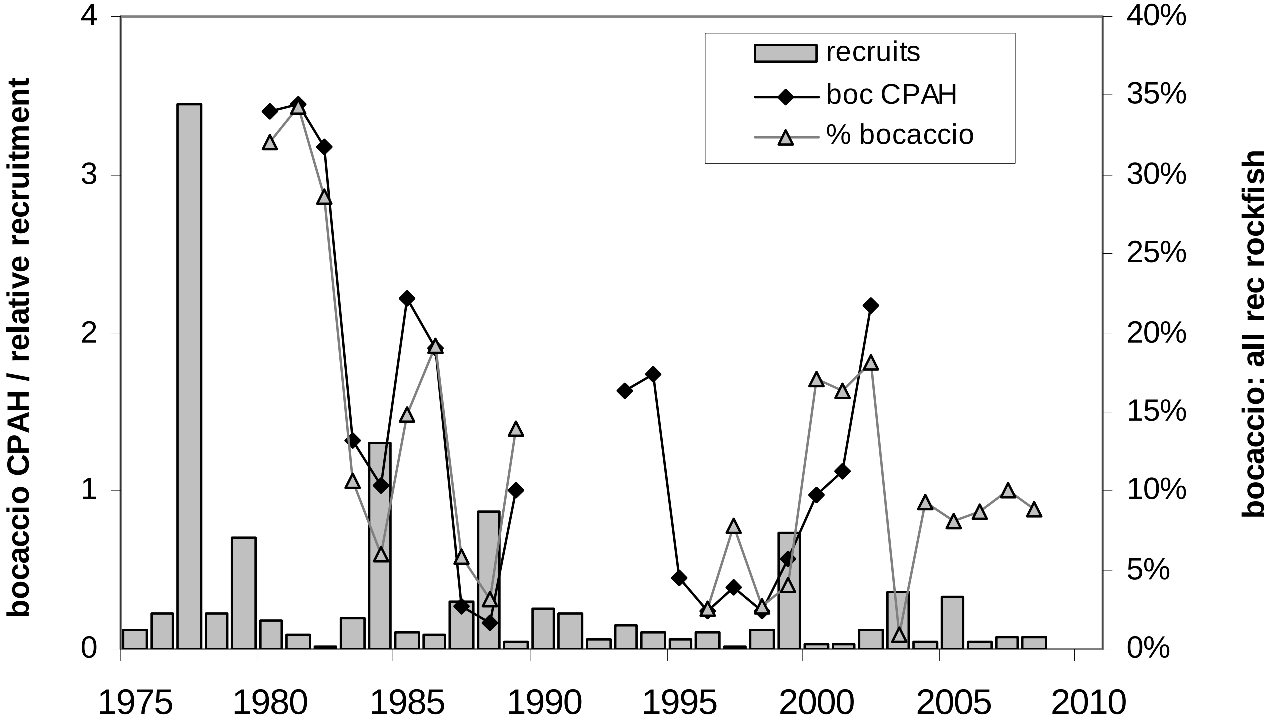


Figure 38: Estimated annual recruitment (grey bars) relative to Southern California recreational fishery catch rates (black line) and the percentage of the total southern California recreational catch represented by bocaccio (grey line).

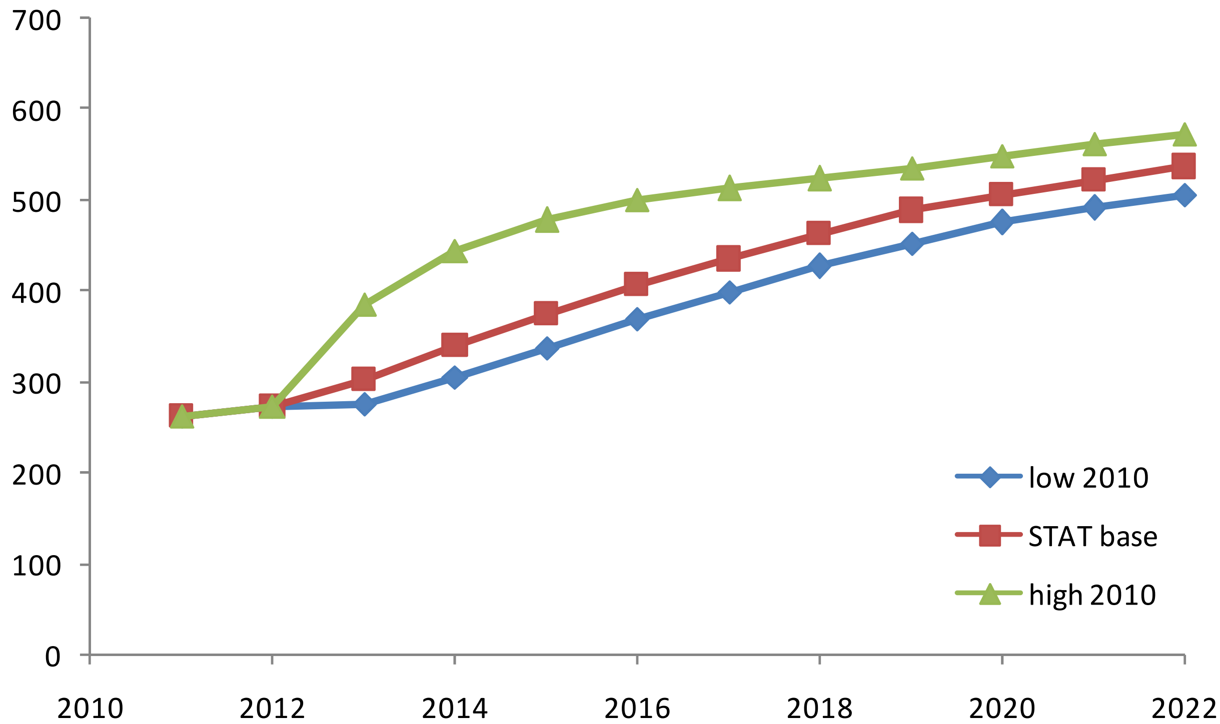


Figure 39: Catch streams associated with the 0.777 SPR rate as applied to projections from the base, low and high 2010 recruitment scenarios

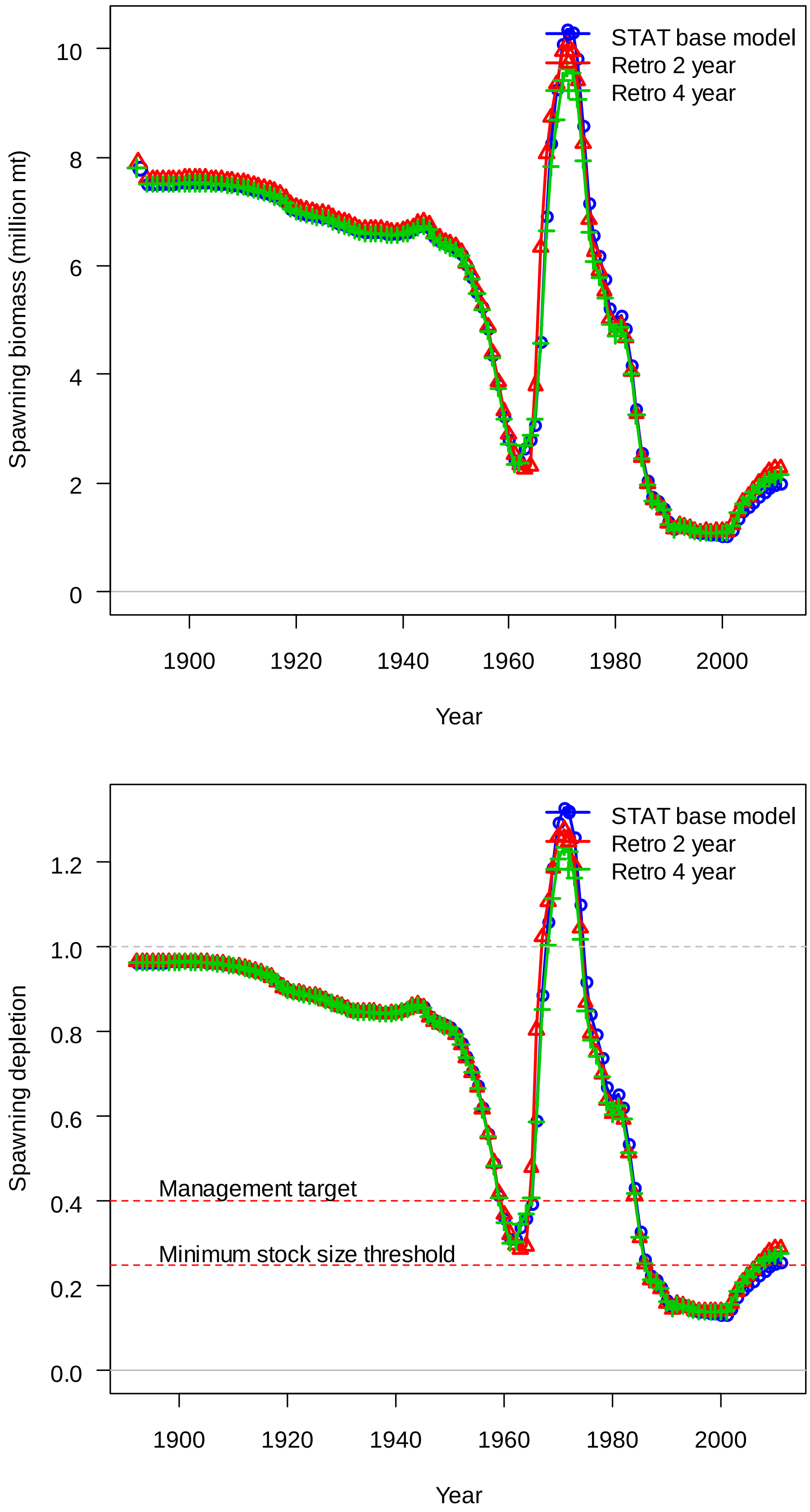


Figure 40: Retrospective analysis of STAT base model spawning output and depletion trends.

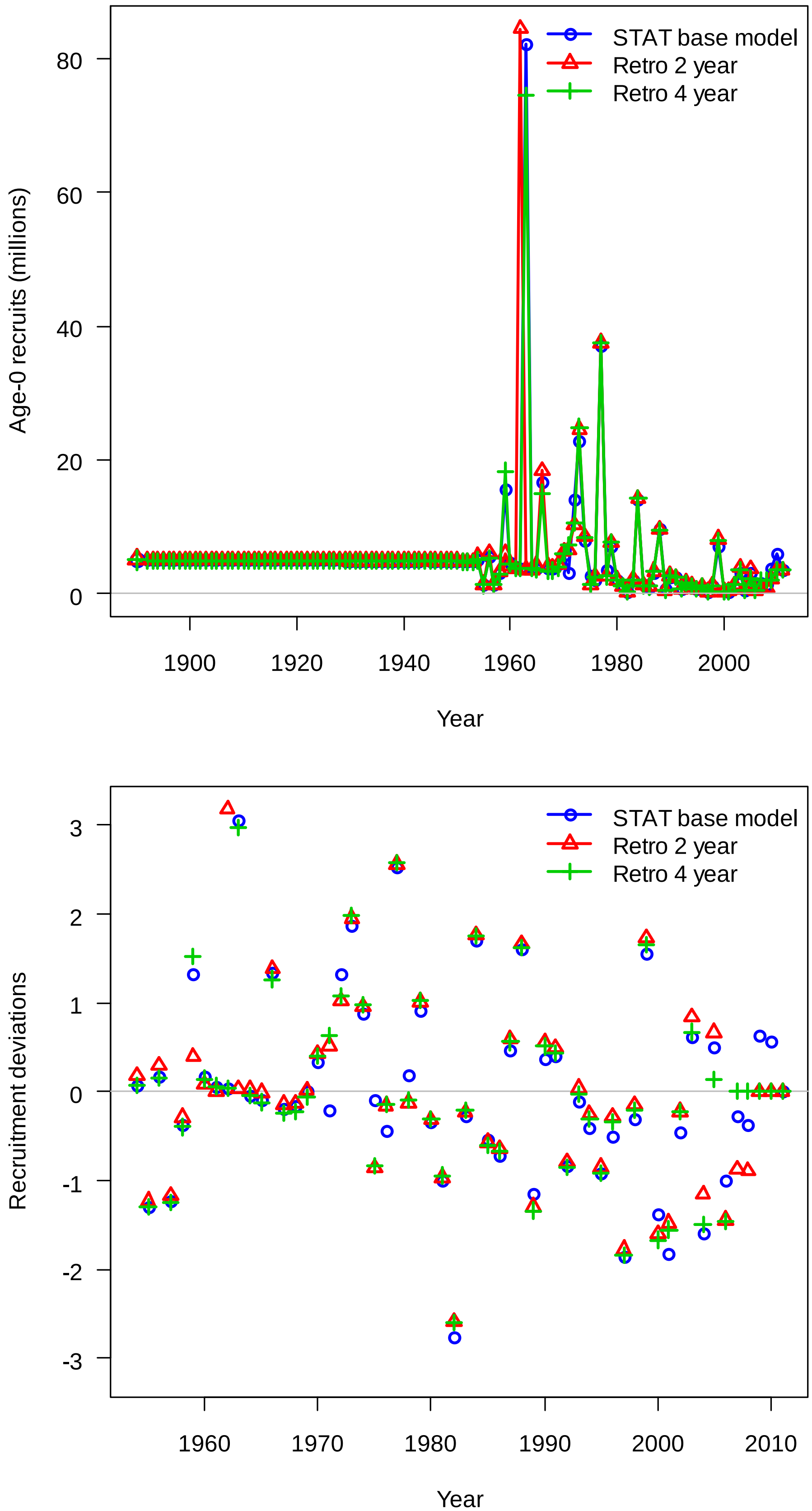


Figure 41: Retrospective analysis of STAT base model recruitment and recruitment deviations.

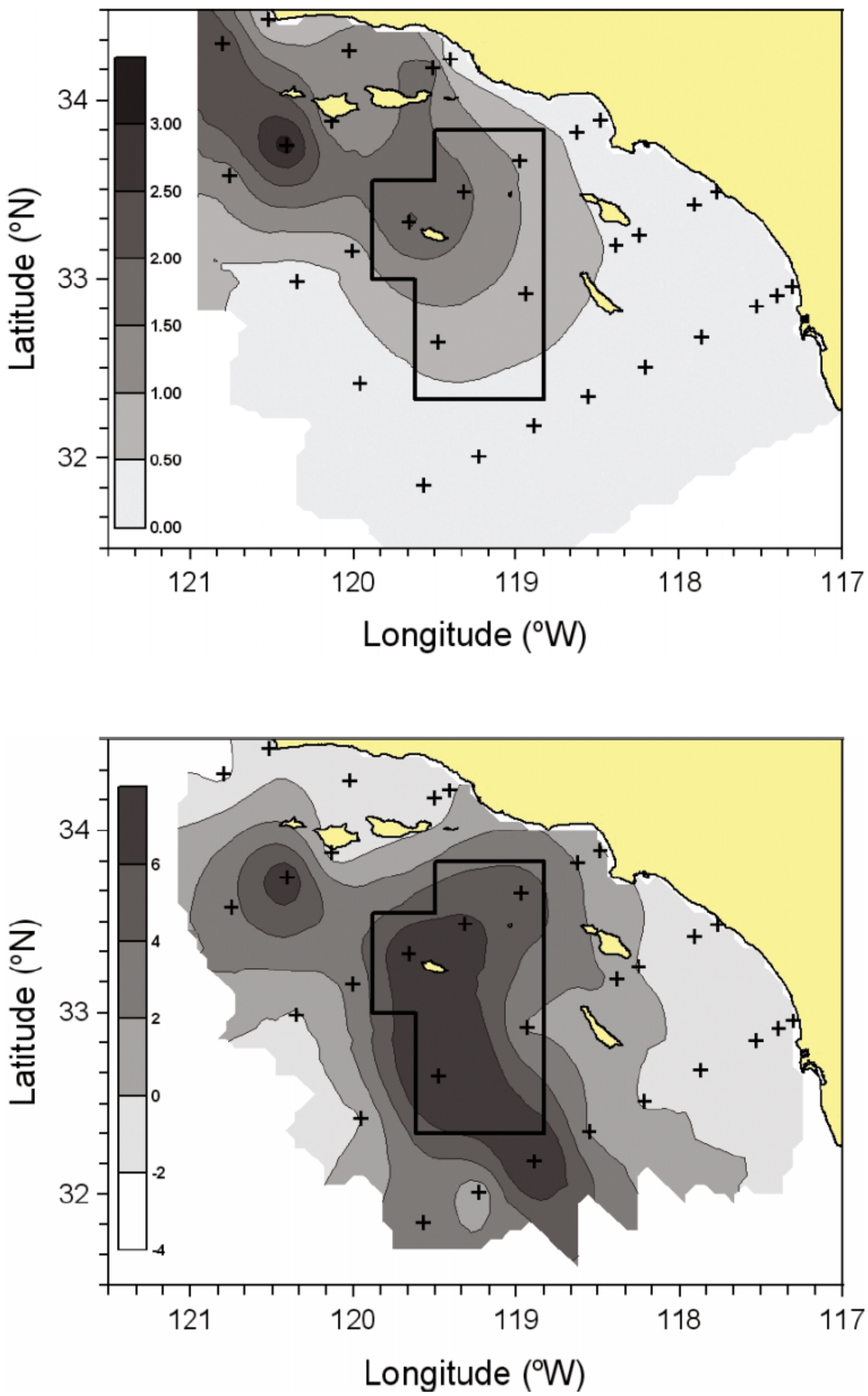


Figure 42: Figures 32a-b. Spatial distribution of bocaccio larvae (number per 10 m2) based on long-term mean of station effects (top) and as 2002-2003 anomalies from the long-term mean distribution (bottom).

Appendix A: Data, control, starter and forecast files for 2011 bocaccio update

Starter file

```
#V3.20b
#C starter comment here
boc8.dat
boc4f.ctl
0 # 0=use init values in control file; 1=use ss3.par
0 # run display detail (0,1,2)
1 # detailed age-structured reports in REPORT.SSO (0,1)
0 # write detailed checkup.sso file (0,1)
0 # write parm values to ParmTrace.sso (0=no,1=good,active; 2=good,all; 3=every_iter,all_parms; 4=every,active)
1 # write to cumreport.sso (0=no,1=like&timeseries; 2=add survey fits)
0 # Include prior_like for non-estimated parameters (0,1)
1 # Use Soft Boundaries to aid convergence (0,1) (recommended)
3 # Number of datafiles to produce: 1st is input, 2nd is estimates, 3rd and higher are bootstrap
7 # Turn off estimation for parameters entering after this phase
10 # MCeval burn interval
2 # MCeval thin interval
0 # jitter initial parm value by this fraction
1890 # min yr for sdreport outputs (-1 for styr)
2022 # max yr for sdreport outputs (-1 for endyr; -2 for endyr+Nforecastyrs
0 # N individual STD years
#vector of year values
0.0001 # final convergence criteria (e.g. 1.0e-04)
0 # retrospective year relative to end year (e.g. -4)
1 # min age for calc of summary biomass
1 # Depletion basis: denom is: 0=skip; 1=rel X*B0; 2=rel X*Bmsy; 3=rel X*B_styr
1 # Fraction (X) for Depletion denominator (e.g. 0.4)
3 # SPR_report_basis: 0=skip; 1=(1-SPR)/(1-SPR_tgt); 2=(1-SPR)/(1-SPR_MSY); 3=(1-SPR)/(1-SPR_Btarget); 4=rawSPR
1 # F_report_units: 0=skip; 1=exploitation(Bio); 2=exploitation(Num); 3=sum(Frates); 4=true F for range of ages
#COND 10 15 #_min and max age over which average F will be calculated with F_reporting=4
3 # F_report_basis: 0=raw; 1=F/Fspr; 2=F/Fmsy ; 3=F/Fbtgt
999 # check value for end of file
```

Forecast file

for all year entries except rebuilder; enter either: actual year, -999 for styr, 0 for endyr, neg number for rel. endyr
1 # Benchmarks: 0=skip; 1=calc F_spr,F_btgt,F_msy
2 # MSY: 1= set to F(SPR); 2=calc F(MSY); 3=set to F(Btgt); 4=set to F(endyr)
0.77 # SPR target (e.g. 0.40)
0.4 # Biomass target (e.g. 0.40)
#_Bmark_years: beg_bio, end_bio, beg_selex, end_selex, beg_relF, end_relF (enter actual year, or values of 0 el. endyr)
0 0 0 0 0 0
2010 2010 2010 2010 2010 2010 # after processing
1 #Bmark_relF_Basis: 1 = use year range; 2 = set relF same as forecast below
1 # Forecast: 0=none; 1=F(SPR); 2=F(MSY) 3=F(Btgt); 4=Ave F (uses first-last relF yrs); 5=input annual F scalar
12 # N forecast years
1 # F scalar (only used for Do_Forecast==5)
#_Fcast_years: beg_selex, end_selex, beg_relF, end_relF (enter actual year, or values of 0 or -integer to be rel. endyr)
0 0 -3 0
2010 2010 2007 2010 # after processing
1 # Control rule method (1=catch=f(SSB) west coast; 2=F=f(SSB))
0.4 # Control rule Biomass level for constant F (as frac of Bzero, e.g. 0.40)
0.1 # Control rule Biomass level for no F (as frac of Bzero, e.g. 0.10)
1 # Control rule target as fraction of Flimit (e.g. 0.75)
3 #_N forecast loops (1-3) (fixed at 3 for now)
3 #_First forecast loop with stochastic recruitment
0 #_Forecast loop control #3 (reserved for future bells&whistles)
0 #_Forecast loop control #4 (reserved for future bells&whistles)
0 #_Forecast loop control #5 (reserved for future bells&whistles)
2023 #FirstYear for caps and allocations (should be after years with fixed inputs)
0 # stddev of log(realized catch/target catch) in forecast (set value>0.0 to cause active impl_error)
0 # Do West Coast gfish rebuilder output (0/1)
2000 # Rebuilder: first year catch could have been set to zero (Ydecl)(-1 to set to 1999)
2011 # Rebuilder: year for current age structure (Yinit) (-1 to set to endyear+1)
1 # fleet relative F: 1=use first-last alloc year; 2=read seas(row) x fleet(col) below
Note that fleet allocation is used directly as average F if Do_Forecast=4
2 # basis for fcast catch tuning and for fcast catch caps and allocation (2=deadbio; 3=retainbio; 5=deadnum; 6=retainnum)
Conditional input if relative F choice = 2
Fleet relative F: rows are seasons, columns are fleets
0.0934707 0.0262569 0.00218684 0.777667 0.0598171 0.0406017
max totalcatch by fleet (-1 to have no max) must enter value for each fleet
-1 -1 -1 -1 -1 -1
max totalcatch by area (-1 to have no max); must enter value for each fleet
-1
fleet assignment to allocation group (enter group ID# for each fleet, 0 for not included in an alloc group)
0 0 0 0 0 0
#_Conditional on >1 allocation group
allocation fraction for each of: 0 allocation groups
0 # Number of forecast catch levels to input (else calc catch from forecast F)
2 # basis for input Fcast catch: 2=dead catch; 3=retained catch; 99=input Hrate(F) (units are from fleetunits; note new
Input
fixed catch values
#Year Seas Fleet Catch(or_F)
#
999 # verify end of input

Control File

```
#C growth parameters are estimated
#_3.21 version
1  #_N_Growth_Patterns
1 #_N_Morphs_Within_GrowthPattern
#_Cond 1 #_Morph_between/within_stdev_ratio (no read if N_morphs=1)
#_Cond  1 #vector_Morphdist_(-1_in_first_val_gives_normal_approx)

#_Cond 0  #  N recruitment designs goes here if N_GP*nseas*area>1
#_Cond 0  #  placeholder for recruitment interaction request
#_Cond 1 1 1  # example recruitment design element for GP=1, seas=1, area=1

#_Cond 0 # N_movement_definitions goes here if N_areas > 1
#_Cond 1.0 # first age that moves (real age at begin of season, not integer) also cond on do_migration>0
#_Cond 1 1 1 2 4 10 # example move definition for seas=1, morph=1, source=1 dest=2, age1=4, age2=10

3 #_Nblock_Patterns
11 6 18 #_blocks_per_pattern
# begin and end years of blocks
1975 1977
1978 1980
1981 1983
1984 1986
1987 1989
1990 1992
1993 1995
1996 1998
1999 2001
2002 2004
2005 2008

1970 1979
1980 1988
1989 1991
1992 1998
1999 2003
2004 2008

1973	1974
1975	1976
1977	1978
1979	1980
1981	1982
1983	1984
1985	1986
1987	1988
1989	1990
1991	1992
1993	1994
1995	1996
1997	1998
1999	2000
2001	2002
2003	2004
2005	2006
2007	2008


0.5 #_fracfemale
1 #_natM_type:_0=1Parm; 1=N_breakpoints;_2=Lorenzen;_3=agespecific;_4=agespec_withseasinterpolate
2 #_N_breakpoints
```

1 5 # age(real) at M breakpoints
1 # GrowthModel: 1=vonBert with L1&L2; 2=Richards with L1&L2; 3=not implemented; 4=not implemented
1.5 #_Growth_Age_for_L1
25 #_Growth_Age_for_L2 (999 to use as Linf)
0 #_SD_add_to_LAA (set to 0.1 for SS2 V1.x compatibility)
0 #_CV_Growth_Pattern: 0 CV=f(LAA); 1 CV=F(A); 2 SD=F(LAA); 3 SD=F(A)
1 #_maturity_option: 1=length logistic; 2=age logistic; 3=read age-maturity matrix by growth_pattern; 4=read age-fecundity
#_placeholder for empirical age-maturity by growth pattern
1 #_First_Mature_Age
1 #_fecundity option:(1)eggs=Wt*(a+b*Wt);(2)eggs=a*L^b;(3)eggs=a*Wt^b
0
1 #_parameter_offset_approach (1=none, 2= M, G, CV_G as offset from female-GP1, 3=like SS2 V1.x)
2 #_env/block/dev_adjust_method (1=standard; 2=with logistic trans to keep within base parm bounds)

#_growth_parms

#_LO	HI	INIT	PRIOR	PR_type	SD	PHASE	env-var	use_dev	dev_min	dev_max	dev_std	Block	Blk_Fxn	
0.05	0.25	0.15	0.16	0	0.8	-3	0	0	0	0	0.5	0	0	# NatM_p_1_Fem_GP:1
0.05	0.25	0.15	0.16	0	0.8	-3	0	0	0	0	0.5	0	0	# NatM_p_2_Fem_GP:1
1	45	26	27	0	10	-4	0	0	0	0	0.5	0	0	# L_at_Amin_Fem_GP_1
60	80	67.738	69	0	10	3	0	0	0	0	0.5	0	0	# L_at_Amax_Fem_GP_1
0.15	0.25	0.21958	0.21	0	0.8	3	0	0	1970	2008	0.5	3	1	# VonBert_K_Fem_GP_1
0.05	0.25	0.1	0.1	0	0.8	-6	0	0	0	0	0.5	0	0	# CV_young_Fem_GP_1
0.05	0.25	0.08	0.1	0	0.8	-3	0	0	0	0	0.5	0	0	# CV_old_Fem_GP_1
0.05	0.25	0.15	0.16	0	0.8	-3	0	0	0	0	0.5	0	0	# NatM_p_1_Mal_GP:1
0.05	0.25	0.15	0.16	0	0.8	-3	0	0	0	0	0.5	0	0	# NatM_p_2_Mal_GP:1
1	45	26	27	0	10	-4	0	0	0	0	0.5	0	0	# L_at_Amin_Mal_GP_1
50	70	58.9149	61	0	10	3	0	0	0	0	0.5	0	0	# L_at_Amax_Mal_GP_1
0.2	0.3	0.26418	0.2	0	0.8	3	0	0	1970	2008	0.5	3	1	# VonBert_K_Mal_GP_1
0.05	0.25	0.1	0.1	0	0.8	-6	0	0	0	0	0.5	0	0	# CV_young_Mal_GP_1
0.05	0.25	0.08	0.1	0	0.8	-3	0	0	0	0	0.5	0	0	# CV_old_Mal_GP_1
-3	3	7.355E-06	2.44E-06	0	0.8	-3	0	0	0	0	0.5	0	0	# Wtlen_1_Mal
-3	4	3.11359	3.34694	0	0.8	-3	0	0	0	0	0.5	0	0	# Wtlen_2_Mal
30	60	39.9	37.7	0	0.8	-3	0	0	0	0	0.5	0	0	# Mat50%_Fem
-3	3	-0.359	-0.2876	0	0.8	-3	0	0	0	0	0.5	0	0	# Mat_slope_Fem
#-3	3	0.22475	0.25	0	0.8	-3	0	0	0	0	0.5	0	0	# Eg/gm_inter_Fem
#-3	3	0.03657	0	0	0.8	-3	0	0	0	0	0.5	0	0	# Eg/gm_slope_wt_Fem
-3	3	192.5	190	0	0.8	-3	0	0	0	0	0.5	0	0	# Eg/gm_inter_Fem
-3	3	49.3	36.57	0	0.8	-3	0	0	0	0	0.5	0	0	# Eg/gm_slope_wt_Fem

```
-3	3	7.355E-06	2.44E-06 0	0.8	-3	0	0	0	0
	0.5	0	0	#	Wtlen_1_Mal
-3	4	3.11359	3.34694	0	0.8	-3	0	0	0	0	0.5
	0	0	#	Wtlen_2_Mal
0	0	0	0	-1	0	-4	0	0	0	0	0
	0	0	#	RecrDist_GP_1
0	0	0	0	-1	0	-4	0	0	0	0	0
	0	0	#	RecrDist_Area_1
0	0	0	0	-1	0	-4	0	0	0	0	0
	0	0	#	RecrDist_Seas_1
0	0	0	0	-1	0	-4	0	0	0	0	0
	0	0	#	CohortGrowDev


#_Cond 0  #custom_MG-env_setup (0/1)
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no MG-environ parameters

1 #_Cond 0  #custom_MG-block_setup (0/1)
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no MG-block parameters
#_LO	HI	INIT	PRIOR	PR_type SD	PHASE
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4


#_seasonal_effects_on_biology_parms
 0 0 0 0 0 0 0 0 0 0 #_femwtlen1,femwtlen2,mat1,mat2,fec1,fec2,Malewtlen1,malewtlen2,L1,K
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no seasonal MG parameters
```

#_Cond -4 #_MGparm_Dev_Phase

#_Spawner-Recruitment
3 #_SR_function
#_LO HI INIT PRIOR PR_type SD PHASE
6 15 9.5 9 0 10 1 # SR_R0
0.2 1 0.736 0.73 0 0.186 5 # SR_steep
0 2 1 0.95 0 0.8 -4 # SR_sigmaR
-5 5 0 0 0 1 -3 # SR_envlink
-5 5 0 0 0 1 -4 # SR_R1_offset
0 0 0 0 -1 0 -99 # SR_autocorr
0 #_SR_env_link
0 #_SR_env_target_0=none;1=devs;_2=R0;_3=steepness

1 #do_recdev: 0=none; 1=devvector; 2=simple deviations
1954 # first year of main recr_devs; early devs can preceed this era
2010 # last year of main recr_devs; forecast devs start in following year
2 #_recdev phase

1 # (0/1) to read 11 advanced options
0 #_recdev_early_start (0=none; neg value makes relative to recdev_start)
-4 #_recdev_early_phase
0 #_forecast_recruitment phase (incl. late recr) (0 value resets to maxphase+1)
1 #_lambda for prior_fore_recr occurring before endyr+1
1965 #_last_early_yr_nobias_adj_in_MPD
1975 #_first_yr_fullbias_adj_in_MPD
2010 #_last_yr_fullbias_adj_in_MPD
2011 #_first_recent_yr_nobias_adj_in_MPD
1.
0
-5 #min rec_dev
5 #max rec_dev
0 #_read_recdevs
#_end of advanced SR options
read specified recr devs
#_Yr Input_value

#Fishing Mortality info
0.26 # F ballpark for tuning early phases
1980 # F ballpark year (neg value to disable)
3 # F_Method: 1=Pope; 2=instan. F; 3=hybrid (hybrid is recommended)
2.9 # max F or harvest rate, depends on F_Method

#need these three lines when doing option 2
#0.1 # start F
#1   # overall phase
#0   # N detailed inputs
#5 # need this for Fmethod 3, number if tuning iterations in hybrid F, 4 or 5 usually good
5

no additional F input needed for Fmethod 1
read overall start F value; overall phase; N detailed inputs to read for Fmethod 2
read N iterations for tuning for Fmethod 3 (recommend 3 to 7)
#Fleet Year Seas F_value se phase (for detailed setup of F_Method=2)

#_initial_F_parms
#_LO HI INIT PRIOR PR_type SD PHASE
0 0.1 0 0.01 1 99 -2 # InitF_1FISHERY1
0.0001 0.05 0.007 0.007 0 99 2 # InitF_1FISHERY2
0 0.1 0 0.01 1 99 -2 # InitF_1FISHERY3
0 0.1 0 0.01 1 99 -2 # InitF_1FISHERY4

```
0 0.1 0 0.01 1 99 -2 # InitF_1FISHERY5
0 0.1 0 0.01 1 99 -2 # InitF_1FISHERY6


#_Q_setup
# A=do power, B=env-var, C=extra SD, D=devtype(<0=mirror, 0/1=none, 2=cons, 3=rand, 4=randwalk);
E=0=num/1=bio, F=err_type
#A B C D
0 0 0 0 # fleet (fishery or survey) # 1
0 0 0 0 # fleet (fishery or survey) # 2
0 0 0 0 # fleet (fishery or survey) # 3
0 0 0 0 # fleet (fishery or survey) # 4
0 0 0 0 # fleet (fishery or survey) # 5
0 0 0 0 # fleet (fishery or survey) # 6
0 0 0 0 # fleet (fishery or survey) # 7
0 0 0 0 # fleet (fishery or survey) # 8
0 0 0 0 # fleet (fishery or survey) # 9
0 0 0 0 # fleet (fishery or survey) # 10
0 0 0 0 # fleet (fishery or survey) # 11
0 0 0 0 # fleet (fishery or survey) # 12
0 0 0 0 # fleet (fishery or survey) # 13
0 0 0 0 # fleet (fishery or survey) # 14
0 0 0 0 # fleet (fishery or survey) # 15
0 0 0 0 # fleet (fishery or survey) # 16

#_Cond 0 #_If q has random component, then 0=read one parm for each fleet with random q; 1=read a parm for each
year of index
#_Q_parms(if_any)
# LO HI INIT PRIOR PR_type SD PHASE

#_size_selex_types
#_Pattern Discard Male Special
24 0 0 0 #  FISHERY1 trawl
24 0 0 0 #  FISHERY2 hookline
24 0 0 0 #  FISHERY3 gillnet
24 0 0 0 #  FISHERY4 southrec
1 0 0 0  #  FISHERY5 cenrec
1 0 0 0  #  Fishery6 trawlnorth
30 0 0 0 #  SURVEY1 calcofi
24 0 0 0 #  SURVEY2 triennial
5 0 0 5  #  SURVEY3 deb w-v
24 0 0 0 #  SURVE4 hookline
1 0 0 0  #  SURVEY5 nwc combo
33 0 0 0 #  SURVEY6 juvenile survey
0 0 0 0  #  SURVEY7 pier index
0 0 0 0  #  SURVEY8 60s MBay rec LFs
5 0 0 1  #  SURVEY9 mirror southern trawl to look at LFs from observer fleet
5 0 0 4  #  SURVEY10 - mirror southern rec (for CPFV obs. LFs)


#_age_selex_types
#_Pattern ___ Male Special
11 0 0 0 # 1 FISHERY1
11 0 0 0 # 1 FISHERY2
11 0 0 0 # 1 FISHERY3
11 0 0 0 # 1 FISHERY4
11 0 0 0 # 1 FISHERY5
11 0 0 0 # 1 FISHERY6
11 0 0 0 # 2 SURVEY1
11 0 0 0 # 3 SURVEY2
11 0 0 0 # 3 SURVEY3
11 0 0 0 # 3 SURVEY4
```

```
11 0 0 0 # 3 SURVEY5
11 0 0 0 # 3 SURVEY6
11 0 0 0 # 3 SURVEY7
11 0 0 0 # 3 SURVEY8
11 0 0 0 # 3 SURVEY9
11 0 0 0 # 3 SURVEY10

#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev dev_minyr dev_maxyr dev_stddev Block Block_Fxn
#_size_sel: trawl - try logistic-

15      60      45.5    46      0       20      3       0       0       0       0       0.5
        0       0       #       PEAK    value
-10     10      -4.822  5       0       10      -4      0       0       0       0       0.5
        0       0       #       TOP     logistic
1       15      4.296   3.5     0       10      -4      0       0       0       0       0.5
        0       0       #       WIDTH   exp
-1      9       4.76    2       0       10      -4      0       0       0       0       0.5
        0       0       #       WIDTH   exp
-15     9       -10.5   -4.5    0       10      -4      0       0       0       0       0.5
        0       0       #       INIT    logistic
-5      9       -0.766  2       0       10      -4      0       0       0       0       0.5
        0       0       #       FINAL   logistic

# size_se1: 1- male offsets- 4 lines
#1      60      16      20      0       100     -5      0       0       0       0       0.5
        0       0       #       size@dogleg
#-10    0       0       0       0       10      -5      0       0       0       0       0.5
        0       0       #       log(relmalesel)at minL
#-10    0       0       0       0       10      -5      0       0       0       0       0.5
        0       0       #       log(relmalesel)at dogleg
#-10    0       0       0       0       10      -5      0       0       0       0       0.5
        0       0       #       log(relmalesel) at maxL
# size_se1: 1- male offsets- 4 lines
# fishery 2
15      60      52.459  55      0       20      3       0       0       0       0       0.5
        0       0       #       PEAK    value
-10     10      -10     5       0       10      3       0       0       0       0       0.5
        0       0       #       TOP     logistic
1       15      4.096   3.5     0       10      3       0       0       0       0       0.5
        0       0       #       WIDTH   exp
-1      9       4.744   2       0       10      3       0       0       0       0       0.5
        0       0       #       WIDTH   exp
-15     9       -11.22  -4.5    0       10      3       0       0       0       0       0.5
        0       0       #       INIT    logistic
-5      9       -1      2       0       10      3       0       0       0       0       0.5
        0       0       #       FINAL   logistic
# fishery 3
15      60      50.713  55      0       20      3       0       0       0       0       0.5
        0       0       #       PEAK    value
-10     10      -9.8    -5      0       10      3       0       0       0       0       0.5
        0       0       #       TOP     logistic
1       15      3.008   3.5     0       10      3       0       0       0       0       0.5
        0       0       #       WIDTH   exp
-1      9       4.408   2       0       10      3       0       0       0       0       0.5
        0       0       #       WIDTH   exp
-15     9       -11.22  -6      0       10      3       0       0       0       0       0.5
        0       0       #       INIT    logistic
-5      9       -1.76   2       0       10      3       0       0       0       0       0.5
        0       0       #       FINAL   logistic
#_size_sel: 4 double logistic-
15      60      36      40      0       20      3       0       0       0       0       0.5
        0       0       #       PEAK    value
```

```
-10	10	-7	-5	0	10	3	0	0	0	0	0.5
	0	0	#	TOP	logistic
1	15	4	3.5	0	10	3	0	0	0	0	0.5
	0	0	#	WIDTH	exp
-1	9	5.2	5	0	10	3	0	0	0	0	0.5
	0	0	#	WIDTH	exp
-15	9	-4	-4.5	0	10	3	0	0	0	0	0.5
	0	0	#	INIT	logistic
-5	9	-3.28	-4	0	10	3	0	0	0	0	0.5
	0	0	#	FINAL	logistic
# size_sel fishery 5 cenrec double logistic
#15	80	54.68	55	0	20	3	0	0	0	0	0.5
	0	0	#	PEAK	value
#-10	10	5.1	5	0	10	3	0	0	0	0	0.5
	0	0	#	TOP	logistic
#1	15	6.1	3.5	0	10	3	0	0	0	0	0.5
	0	0	#	WIDTH	exp
#-1	9	2.5	2	0	10	3	0	0	0	0	0.5
	0	0	#	WIDTH	exp
#-15	9	-2.86	-4.5	0	10	3	0	0	0	0	0.5
	0	0	#	INIT	logistic
#-5	9	1.25	2	0	10	3	0	0	0	0	0.5
	0	0	#	FINAL	logistic
#_size_sel: cenRec - try logistic-
5	50	40	35	0	50	3	0	0	0	0	0
	0	0 #
0.0001	35	10	15	0	10	3	0	0	0	0	0
	0	0 #

# size_sel fishery 6 trawlnorth double logistic
#13	80	54.68	55	0	20	3	0	0	0	0	0.5
	0	0	#	PEAK	value
#-10	10	-9.792	5	0	10	3	0	0	0	0	0.5
	0	0	#	TOP	logistic
#1	15	6.112	3.5	0	10	3	0	0	0	0	0.5
	0	0	#	WIDTH	exp
#-1	9	5.56	2	0	10	3	0	0	0	0	0.5
	0	0	#	WIDTH	exp
#-15	9	-2.86	-4.5	0	10	3	0	0	0	0	0.5
	0	0	#	INIT	logistic
#-5	9	-1.25	2	0	10	3	0	0	0	0	0.5
	0	0	#	FINAL	logistic

# size sel for fishery 6- northern trawl
5	50	40	35	0	50	3	0	0	0	0	0
	0	0 #
0.0001	35	10	5	0	10	3	0	0	0	0	0
	0	0 #
#-1 20 -1 -1 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_1P_1_SURVEY3 - min and max bins
#-1 20 -1 -1 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_1P_2_SURVEY3 - min and max bins# sel survey 8 triennial
# size selectivity survey 8 - triennial
#5	50	40	20	0	50	3	0	0	0	0	0
	0	0 #
#0.0001	35	10	5	0	10	3	0	0	0	0	0
	0	0 #

# sel survey 8 - triennial double logistic
15	80	24	25	0	20	-3	0	0	0	0	0.5
	0	0	#	PEAK	value
-10	10	-9.792	5	0	10	-3	0	0	0	0	0.5
	0	0	#	TOP	logistic3
```

```
1       15      6.112   3.5     0       10      -3      0       0       0       0       0.5
        0       0       #       WIDTH   exp
-1      9       5.56    2       0       10      -3      0       0       0       0       0.5
        0       0       #       WIDTH   exp
-15     9       -2.86   -4.5    0       10      -3      0       0       0       0       0.5
        0       0       #       INIT    logistic
-5      9       -1.25   2       0       10      -3      0       0       0       0       0.5
        0       0       #       FINAL   logistic
# size sel 9 cpfv, set to mirror northrec
-1 20 -1 -1 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_1P_1_SURVEY3 - min and max bins
-1 20 -1 -1 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_1P_2_SURVEY3 - min and max bins# sel survey 8 triennial


#_size_sel: 10 SCB hook line double logistic-
15      60      54      55      0       20      3       0       0       0       0       0.5
        0       0       #       PEAK    value
-10     10      -3.9    -5      0       10      3       0       0       0       0       0.5
        0       0       #       TOP     logistic
1       15      12.2    3.5     0       10      3       0       0       0       0       0.5
        0       0       #       WIDTH   exp
-1      9       5.2     2       0       10      3       0       0       0       0       0.5
        0       0       #       WIDTH   exp
-15     9       -1.7    -4.5    0       10      3       0       0       0       0       0.5
        0       0       #       INIT    logistic
-5      9       -3.3    2       0       10      3       0       0       0       0       0.5
        0       0       #       FINAL   logistic

# size sel. 11 - combo survey - mirror triennial
#-1 20 -1 -1 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_1P_1_SURVEY3 - min and max bins
#-1 20 -1 -1 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_1P_2_SURVEY3 - min and max bins# sel survey 8 triennial
5       50      30      25      0       50      3       0       0       0       0       0
        0       0 #
0.0001  35      10      15      0       10      3       0       0       0       0       0
        0       0 #
# size selectivity survey 11 - NWFSC combo survey
#13     60      28.52   55      0       20      3       0       0       0       0       0.5
        0       0       #       PEAK    value
#-10    10      -1.23   5       0       10      3       0       0       0       0       0.5
        0       0       #       TOP     logistic
#1      15      4.43    3.5     0       10      3       0       0       0       0       0.5
        0       0       #       WIDTH   exp
#-2     9       -1.5    2       0       10      3       0       0       0       0       0.5
        0       0       #       WIDTH   exp
#-15    9       -0.58   -4.5    0       10      3       0       0       0       0       0.5
        0       0       #       INIT    logistic
#-5     9       -0.03   2       0       10      3       0       0       0       0       0.5
        0       0       #       FINAL   logistic

# size selectivity survey 14 - 60s LFs from CenCal Rec fishery- mirror cen/north rec
#-1 20 -1 -1 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_1P_1_SURVEY
#-1 20 -1 -1 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_1P_2_SURVEY
# size sel. 15 bycatch LF data from observer program, link to southern trawl fishery
-1 20 -1 -1 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_1P_1_SURVEY
-1 20 -1 -1 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_1P_2_SURVEY
# size sel. 16 mirror southern rec for LF data from CPFV observer program
-1 20 -1 -1 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_1P_1_SURVEY
-1 20 -1 -1 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_1P_2_SURVEY


0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_1_FISHERY1
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_2_FISHERY1
0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_1_FISHERY2
```

```
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_2_FISHERY2
0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_1_FISHERY3
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_2_FISHERY3
0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_1_FISHERY4
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_2_FISHERY4
0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_1_FISHERY5
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_2_FISHERY5
0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_1_FISHERY6
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_2_FISHERY6
0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_2P_1_SURVEY1
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_2P_2_SURVEY1
0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_2P_1_SURVEY2
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_2P_2_SURVEY2
0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_3P_1_SURVEY3
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_2P_2_SURVEY3
0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_3P_1_SURVEY4
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_2P_2_SURVEY4

# make NWFSC combo survey unselected for age 0 fish (don't mess with size selectivity)
0 21 1 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_3P_1_SURVEY5
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_2P_2_SURVEY5

0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_3P_1_SURVEY6
0 21 0 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_3P_2_SURVEY6
0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_3P_1_SURVEY7
0 21 0 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_3P_2_SURVEY7

0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_3P_1_SURVEY8
0 21 0 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_3P_2_SURVEY8

0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_3P_1_SURVEY9
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_2P_2_SURVEY9
0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_3P_1_SURVEY10
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_2P_2_SURVEY10



#_Cond 0 #_custom_sel-env_setup (0/1)
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no enviro fxns


# Tag loss and Tag reporting parameters go next
0  # TG_custom:  0=no read; 1=read if tags exist
#_Cond -6 6 1 1 2 0.01 -4 0 0 0 0 0 0 0  #_placeholder if no parameters

1 #_Variance_adjustments_to_input_values
#_1 2 3
  0.06 0 0 0.59 0.6 0 0.285 0.5 0.22 -0.06 0.25 0.96 0 0.37 0 0#_add_to_survey_CV
#  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 #_add_to_survey_cv
  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 #_add_to_discard_stddev
  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 #_add_to_bodywt_CV
  0.76 1 0.81 0.63 0.83 0.485 1 0.32 1 1 1 1 1 1 1 0.63 #_mult_by_lencomp_N
#  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 #_mult_by_length comp_N
  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 #_mult_by_agecomp_N
  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 #_mult_by_size-at-age_N
# removed for SSv3.20: 30 #_DF_for_discard_like
# removed for SSv3.20: 30 #_DF_for_meanbodywt_like

4 #_maxlambdaphase
0 #_sd_offset
```

```
6 # number of changes to make to default Lambdas (default value is 1.0)
# Like_comp codes:  1=surv; 2=disc; 3=mnwt; 4=length; 5=age; 6=SizeFreq; 7=sizeage; 8=catch;
# 9=init_equ_catch; 10=recrdev; 11=parm_prior; 12=parm_dev; 13=CrashPen; 14=Morphcomp; 15=Tag-comp;
16=Tag-negbin
#like_comp fleet/survey  phase  value  sizefreq_method

1 1 1 1 1
1 8 1 1 1
1 14 1 1 1
4 15 1 0 1
6 4 1 0 1
6 5 1 0 1


# lambdas (for info only; columns are phases)
0 # (0/1) read specs for more stddev reporting
# runfaster using ss3 bat -nohess nox
# R output viewer commands- after loading routines
#myreplist <- SSv3_output(dir='c:\\SS3ver3\\bocstar\\', covar=F)
#SSv3_plots(replist=myreplist,plot=1:7)
#
999
```

Data file

```
#_bootstrap file: 1
1892 #_styr
2010 #_endyr
1 #_nseas
12 #_months/season
1 #_spawn_seas
6 #_Nfleet
10 #_Nsurveys
1 #_N_areas
trawlsou%H&L%setnet%recSO%recCEN%trawlnor%CalCOFI%TRIENNIAL%CFGCPUE%NWFSChook%NWFSCt
rawl%juvenile%pier_juv%power.plant.index%free1%mirror_recSO
0.5 0.5 0.5 0.5 0.5 0.5 0.1 0.5 0.5 0.78 0.66 0.5 0.75 0.5 0.5 0.5 #_surveytiming_in_season
# SCB hook and line, and NWFSC combo based on Julian days
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 #_area_assignments_for_each_fishery_and_survey
1 1 1 1 1 1 #_units of catch:  1=bio; 2=num
0.01 0.01 0.01 0.01 0.01 0.01 #_se of log(catch) only used for init_eq_catch and for Fmethod 2 and 3
2 #_Ngenders
21 #_Nages
0	152.72	0	0	0	0	#_init_equil_catch_for_each_fishery
119 #_N_lines_of_catch_to_read
#_catch_biomass(mtons):_columns_are_fisheries,year,season
```

#TWL	HKL	NET	RecSou	RecNor	ORWA_all	year	season
0	166.77	0	0	0	0	1892	1
0	157.4	0	0	0	0	1893	1
0	148.03	0	0	0	0	1894	1
0	138.66	0	0	0	0	1895	1
0	130.93	0	0	0	0	1896	1
0	123.2	0	0	0	0	1897	1
0	115.47	0	0	0	0	1898	1
0	107.73	0	0	0	0	1899	1
0	119.2	0	0	0	0	1900	1
0	130.66	0	0	0	0	1901	1
0	142.12	0	0	0	0	1902	1
0	153.59	0	0	0	0	1903	1
0	165.05	0	0	0	0	1904	1
0	176.36	0	0	0	0	1905	1
0	187.68	0	0	0	0	1906	1
0	198.99	0	0	0	0	1907	1
0	210.3	0	0	0	0	1908	1
0	236.64	0	0	0	0	1909	1
0	262.98	0	0	0	0	1910	1
0	289.32	0	0	0	0	1911	1
0	315.66	0	0	0	0	1912	1
0	342	0	0	0	0	1913	1
0	368.34	0	0	0	0	1914	1
0	394.68	0	0	0	0	1915	1
54.77	418.96	0	0	0	0.160	1916	1
85.57	661.43	0	0	0	0.320	1917	1
96.66	701.13	0	0	0	0.720	1918	1
66	463.1	0	0	0	0.160	1919	1
67.82	482.28	0	0	0	0.220	1920	1
56.38	406.03	0	0	0	0.330	1921	1
49.37	367.12	0	0	0	0.250	1922	1
55.07	434.14	0	0	0	0.080	1923	1
36.97	405.15	0	0	0	0.270	1924	1
29.85	474.63	0	0	0	0.870	1925	1
83.2	627.09	0	0	0	0.810	1926	1
111.29	497.26	0	0	0	1.500	1927	1
150.62	482.9	0	1.99	2.39	1.210	1928	1

119.43	441.16	0	3.99	4.79	28.040	1929	1
135.62	551	0	5.99	5.51	16.700	1930	1
45.59	578.08	0	7.99	7.34	49.580	1931	1
68.87	430.61	0	9.99	9.18	37.280	1932	1
89.53	257.34	0	11.98	11.02	59.260	1933	1
108.88	316.57	0	13.98	12.85	41.380	1934	1
90.51	369.17	0	15.98	14.69	43.190	1935	1
107.86	473.58	0	15.98	16.53	17.690	1936	1
91.98	408.44	0	27.51	19.59	41.130	1937	1
76.46	295.45	0	22.18	19.27	47.540	1938	1
49.95	200.11	0	19.63	16.85	86.170	1939	1
45.57	238.49	0	14.07	24.27	59.720	1940	1
32.44	187.35	0	13	22.43	53.070	1941	1
7.9	72.1	0	6.91	11.91	25.550	1942	1
7.56	70.44	0	6.6	11.39	196.130	1943	1
2.94	83.63	0	5.42	9.35	635.220	1944	1
55.17	127.08	0	7.23	12.47	1211.050	1945	1
111.53	122.33	0	12.45	21.47	611.940	1946	1
5.57	198.21	0	37.32	16.99	631.600	1947	1
81.94	150.23	0	102.08	33.9	397.440	1948	1
94	176.56	0	132.83	43.94	380.480	1949	1
303.66	327.61	0	156.82	53.55	374.730	1950	1
765.29	262.44	0	135.78	63.17	532.060	1951	1
1310.96	180.88	0	151.62	54.97	268.000	1952	1
1678.25	70.2	0	171.23	46.81	304.510	1953	1
1597.98	89.11	0	410.71	58.19	245.780	1954	1
1764.99	122.87	0	760.57	69.38	334.950	1955	1
2006.22	299.57	0	917.14	77.46	349.930	1956	1
2219.46	271.26	0	529.88	76.8	468.870	1957	1
2459.84	213.5	0	301.14	123.49	482.050	1958	1
2062.66	125.38	0	177.61	102.75	378.690	1959	1
1731.86	92.91	0	185.13	81.26	344.610	1960	1
1297.35	80.89	0	211.89	68.5	265.670	1961	1
1147.09	68.25	0	204.46	80.38	230.360	1962	1
1314.09	85.06	0	194.38	88.71	326.220	1963	1
942.79	70.17	0	244.36	74.98	190.470	1964	1
965.94	81.03	0	319.14	106.55	273.070	1965	1
2410.23	129.52	0	564.3	118.21	196.070	1966	1
4036.28	117.9	0	770.19	111.44	294.710	1967	1
1996.47	80.71	0	832.18	103.9	391.890	1968	1
1132.64	78.02	17.41	785	110.52	223.000	1969	1
1341.14	82.39	15.06	1039.41	117.87	250.090	1970	1
961.36	81.56	58.73	966.96	104.45	323.740	1971	1
1648.11	122.56	70.95	1308.7	123.08	379.600	1972	1
4537.05	151.53	167.3	1510.62	186.09	648.420	1973	1
5956.32	164.1	261.65	1892.59	200.89	525.550	1974	1
3316.02	158.13	285.36	1865.23	200.29	578.560	1975	1
3424.73	218.88	123.1	1489.03	215.7	705.480	1976	1
2381.4	188.75	158.08	1265.09	193.57	673.610	1977	1
1878.87	247.93	124.75	1174.03	195.63	745.440	1978	1
3299.31	351.15	235.32	1713.94	230.22	286.170	1979	1
3054.87	320.49	215.88	942.92	264.04	586.080	1980	1
1779.75	312.34	353.03	908.12	234.52	2164.520	1981	1
2323.84	392.92	387.01	1225.49	371.85	1897.440	1982	1
1914.02	238.56	588.49	265.96	310.65	2280.140	1983	1
1891.75	367.29	547.07	181.6	67.14	1621.380	1984	1
582.41	143.01	1091.66	324.48	67.93	654.150	1985	1
789.66	258.99	1085.78	433.75	175.84	376.540	1986	1
650.4	277.14	967.86	91.7	106.14	555.370	1987	1
590	496.55	371.48	106.54	44.32	695.430	1988	1
594.21	362.92	981.88	182.16	81.71	553.310	1989	1
681.56	458.67	793.27	160.27	68.02	462.620	1990	1

498.36	266.28	457.6	160.27	68.02	263.310	1991	1
362.09	468.03	640.31	160.27	68.02	133.250	1992	1
358.87	417.33	430.18	115.71	68.02	202.860	1993	1
377.01	193.06	262.64	243.9	68.02	149.530	1994	1
215.41	56.74	281.15	34.24	68.02	162.450	1995	1
225.84	66.23	91.83	68.36	32.22	62.910	1996	1
136.26	53.37	34.94	68.71	111.26	93.850	1997	1
41.16	39.38	39.21	33.53	25.87	31.970	1998	1
19.01	20.68	7.18	80.06	60.21	25.980	1999	1
13.48	7.01	0.73	58.24	74.42	6.570	2000	1
9.21	7.82	0.88	62.68	53.84	4.440	2001	1

total mortality reports- NWFSC total mort report for com fisheries 2002-2007
based on J. Budrick data for rec. fisheries 2004-2007, and scorecard estimates for all 2008 fisheries

#trl_s	hk_ln	setnet	Rec_S	Rec_N	trawl north		
28.04	0.13	0.01	35.88	4.93	20.67	2002	1
5.07	0	0	5.53	1.87	0.31	2003	1
13.86	1.84	0.21	63.43	2.27	3.52	2004	1
24.64	1.5	0.17	69.9	10.7	0.43	2005	1
16.09	2.25	0.25	29	11.8	0.31	2006	1
4.06	3.39	0.38	44.2	8.92	1.58	2007	1
20.42	2.02	0.08	31.50	3.33	1.98	2008	1
1.12	1.50	0.03	40.30	9.70	4.85	2009	1
2.90	1.45	0.05	52.60	7.40	10.97	2010	1

221 #_N_cpue_and_surveyabundance_observations
#_Units: 0=numbers; 1=biomass; 2=F
#_Errtype: -1=normal; 0=lognormal; >0=T
#_Fleet Units Errtype
1 1 0 # fleet (fishery or survey) # 1
2 1 0 # fleet (fishery or survey) # 2
3 1 0 # fleet (fishery or survey) # 3
4 1 0 # fleet (fishery or survey) # 4
5 1 0 # fleet (fishery or survey) # 5
6 1 0 # fleet (fishery or survey) # 6
7 1 0 # fleet (fishery or survey) # 7
8 1 0 # fleet (fishery or survey) # 8
9 1 0 # fleet (fishery or survey) # 9
10 1 0 # fleet (fishery or survey) # 10
11 1 0 # fleet (fishery or survey) # 11
12 1 0 # fleet (fishery or survey) # 12
13 1 0 # fleet (fishery or survey) # 13
14 1 0 # fleet (fishery or survey) # 14
15 1 0 # fleet (fishery or survey) # 15
16 1 0 # fleet (fishery or survey) # 16
#_year seas index obs se(log)

1982	1	1	166.4	0.32	#areaweightedCPUEfromRalston
1983	1	1	73.1	0.32	#areaweightedCPUEfromRalston
1984	1	1	72.3	0.32	#areaweightedCPUEfromRalston
1985	1	1	30.7	0.32	#areaweightedCPUEfromRalston
1986	1	1	31.2	0.32	#areaweightedCPUEfromRalston
1987	1	1	44.4	0.32	#areaweightedCPUEfromRalston
1988	1	1	51.6	0.32	#areaweightedCPUEfromRalston
1989	1	1	35.8	0.32	#areaweightedCPUEfromRalston
1990	1	1	37.1	0.32	#areaweightedCPUEfromRalston
1991	1	1	26.9	0.32	#areaweightedCPUEfromRalston
1992	1	1	20.4	0.32	#areaweightedCPUEfromRalston
1993	1	1	19.7	0.32	#areaweightedCPUEfromRalston
1994	1	1	23.9	0.32	#areaweightedCPUEfromRalston
1995	1	1	15.2	0.32	#areaweightedCPUEfromRalston
1996	1	1	8.7	0.32	#areaweightedCPUEfromRalston

1980	1	4	3.401	0.071906949	#MRFsoCAL
1981	1	4	3.447	0.059646908	#MRFsoCAL
1982	1	4	3.173	0.073301426	#MRFsoCAL
1983	1	4	1.318	0.081365149	#MRFsoCAL
1984	1	4	1.034	0.084548676	#MRFsoCAL
1985	1	4	2.224	0.091706845	#MRFsoCAL
1986	1	4	1.91	0.105307369	#MRFsoCAL
1987	1	4	0.275	0.448819689	#MRFsoCAL
1988	1	4	0.169	0.387042386	#MRFsoCAL
1989	1	4	0.997	0.137842628	#MRFsoCAL
1993	1	4	1.631	0.255474245	#MRFsoCAL
1994	1	4	1.732	0.142670896	#MRFsoCAL
1995	1	4	0.448	0.358378941	#MRFsoCAL
1996	1	4	0.246	0.203184778	#MRFsoCAL
1997	1	4	0.395	0.38023361	#MRFsoCAL
1998	1	4	0.234	0.202021118	#MRFsoCAL
1999	1	4	0.566	0.091309348	#MRFsoCAL
2000	1	4	1.098	0.086438291	#MRFsoCAL
2001	1	4	1.28	0.113037949	#MRFsoCAL
2002	1	4	2.01	0.08355396	#MRFsoCAL

1980	1	5	0.917	0.118186092	#MRFnorth
1981	1	5	1.28	0.170552193	#MRFnorth
1982	1	5	1.326	0.131232941	#MRFnorth
1983	1	5	1.377	0.143163299	#MRFnorth
1984	1	5	0.388	0.126294711	#MRFnorth
1985	1	5	0.75	0.081166137	#MRFnorth
1986	1	5	1.39	0.07061189	#MRFnorth
1987	1	5	0.914	0.154768554	#MRFnorth
1988	1	5	0.294	0.1734864	#MRFnorth
1989	1	5	0.457	0.157321533	#MRFnorth
1993	1	5	0.202	0.345617372	#MRFnorth
1994	1	5	0.351	0.236456026	#MRFnorth
1995	1	5	0.482	0.197847986	#MRFnorth
1996	1	5	0.535	0.099354307	#MRFnorth
1997	1	5	0.42	0.125405334	#MRFnorth
1998	1	5	0.432	0.14513239	#MRFnorth
1999	1	5	0.802	0.066825326	#MRFnorth
2000	1	5	1.961	0.089420947	#MRFnorth
2001	1	5	2.022	0.115414586	#MRFnorth
2002	1	5	2.618	0.162618942	#MRFnorth

1951	1	7	0.8356082	0.2600304	#CalCOFIindex
1952	1	7	0.8477566	0.2198659	#CalCOFIindex
1953	1	7	1.1203115	0.1946184	#CalCOFIindex
1954	1	7	1.5595068	0.1593167	#CalCOFIindex
1955	1	7	1.2647899	0.1813438	#CalCOFIindex
1956	1	7	0.7930313	0.2586213	#CalCOFIindex
1957	1	7	1.6910182	0.209057	#CalCOFIindex
1958	1	7	1.2934664	0.187288	#CalCOFIindex
1959	1	7	0.4205862	0.2053309	#CalCOFIindex
1960	1	7	0.6059711	0.1798713	#CalCOFIindex
1961	1	7	0.7215946	0.2842966	#CalCOFIindex
1962	1	7	0.6241535	0.2465393	#CalCOFIindex
1963	1	7	1.0273862	0.2474056	#CalCOFIindex
1964	1	7	0.6319091	0.2547808	#CalCOFIindex
1965	1	7	0.8358392	0.2157732	#CalCOFIindex
1966	1	7	1.550326	0.1764235	#CalCOFIindex
1967	1	7	0.808292	0.347014	#CalCOFIindex
1968	1	7	2.8134619	0.26283	#CalCOFIindex
1969	1	7	2.5614508	0.1417053	#CalCOFIindex
1970	1	7	0.7970022	0.4980813	#CalCOFIindex

1972	1	7	1.9745682	0.1459947	#CalCOFIindex
1975	1	7	2.1435162	0.1515554	#CalCOFIindex
1976	1	7	2.9527088	0.3385088	#CalCOFIindex
1978	1	7	1.0812648	0.2139001	#CalCOFIindex
1981	1	7	1.0067293	0.2256607	#CalCOFIindex
1983	1	7	0.3079739	0.4329301	#CalCOFIindex
1984	1	7	1.0295769	0.2097524	#CalCOFIindex
1985	1	7	0.3150882	0.4627654	#CalCOFIindex
1986	1	7	0.4419074	0.4968653	#CalCOFIindex
1987	1	7	0.9991566	0.3677525	#CalCOFIindex
1988	1	7	0.758646	0.2576719	#CalCOFIindex
1989	1	7	0.8016189	0.3971494	#CalCOFIindex
1990	1	7	0.5212969	0.3795327	#CalCOFIindex
1991	1	7	0.762163	0.2951539	#CalCOFIindex
1992	1	7	0.7505338	0.2754136	#CalCOFIindex
1993	1	7	0.1866505	0.5711888	#CalCOFIindex
1994	1	7	0.2767606	0.3024538	#CalCOFIindex
1995	1	7	0.1149556	0.7522513	#CalCOFIindex
1996	1	7	1.3652737	0.3017633	#CalCOFIindex
1997	1	7	0.2939504	0.3710218	#CalCOFIindex
1998	1	7	0.1007829	0.5326119	#CalCOFIindex
1999	1	7	0.2891032	0.4504429	#CalCOFIindex
2000	1	7	0.2381801	0.4086741	#CalCOFIindex
2001	1	7	0.1161277	0.4280781	#CalCOFIindex
2002	1	7	0.4933842	0.3644697	#CalCOFIindex
2003	1	7	0.5258488	0.26999	#CalCOFIindex
2004	1	7	0.5947927	0.3758298	#CalCOFIindex
2005	1	7	0.6444137	0.2998567	#CalCOFIindex
2006	1	7	0.6522035	0.3031658	#CalCOFIindex
2007	1	7	0.5582143	0.3251469	#CalCOFIindex
2008	1	7	0.9627358	0.3697702	#CalCOFIindex
2009	1	7	0.2627943	0.4361989	#CalCOFIindex
2010	1	7	0.5093906	0.3887055	#CalCOFIindex

1980	1	8	2227.932433	0.149683111	#TRIENNIAL
1983	1	8	1849.416128	0.176692006	#TRIENNIAL
1986	1	8	723.6568073	0.159390796	#TRIENNIAL
1989	1	8	529.7149835	0.143672021	#TRIENNIAL
1992	1	8	319.1654707	0.228586262	#TRIENNIAL
1995	1	8	192.9998349	0.194757645	#TRIENNIAL
1998	1	8	56.92735471	0.301249017	#TRIENNIAL
2001	1	8	121.4857726	0.261983439	#TRIENNIAL
2004	1	8	439.3928644	0.214285691	#TRIENNIAL

1987	1	9	3.545	0.161148115	#VandenbergCPUE
1988	1	9	2.349	0.140405176	#VandenbergCPUE
1989	1	9	3.001	0.121154053	#VandenbergCPUE
1990	1	9	6.009	0.14611662	#VandenbergCPUE
1991	1	9	4.637	0.172508578	#VandenbergCPUE
1992	1	9	3.543	0.12570181	#VandenbergCPUE
1993	1	9	2.319	0.131726504	#VandenbergCPUE
1994	1	9	1.46	0.168399042	#VandenbergCPUE
1995	1	9	1.721	0.15083795	#VandenbergCPUE
1996	1	9	1.457	0.169280019	#VandenbergCPUE
1997	1	9	1.823	0.157419694	#VandenbergCPUE
1998	1	9	1.646	0.215088204	#VandenbergCPUE

2004	1	10	0.1735	0.1749	#S_Cal_Hook_line

2005	1	10	0.1674	0.1821	#S_Cal_Hook_line	
2006	1	10	0.1697	0.1775	#S_Cal_Hook_line	
2007	1	10	0.1551	0.1801	#S_Cal_Hook_line	
2008	1	10	0.1279	0.1832	#S_Cal_Hook_line	
2009	1	10	0.116	0.1865	#S_Cal_Hook_line	
2010	1	10	0.0544	0.2057	#S_Cal_Hook_line	

2003	1	11	756.00	0.3099737	#	NWFSC
2004	1	11	2009.26	0.3003482	#	NWFSC
2005	1	11	1061.88	0.2844723	#	NWFSC
2006	1	11	995.03	0.2800638	#	NWFSC
2007	1	11	853.49	0.3239426	#	NWFSC
2008	1	11	739.19	0.3744739	#	NWFSC
2009	1	11	504.57	0.3481183	#	NWFSC
2010	1	11	340.89	0.3388633	#	NWFSC

2001	1	12	0.369	0.021	#	pre-recruit index
2002	1	12	0.583	0.021	#	pre-recruit index
2003	1	12	0.123	0.029	#	pre-recruit index
2004	1	12	0.353	0.021	#	pre-recruit index
2005	1	12	0.519	0.028	#	pre-recruit index
2006	1	12	0.115	0.017	#	pre-recruit index
2007	1	12	0.225	0.022	#	pre-recruit index
2008	1	12	0.243	0.021	#	pre-recruit index
2009	1	12	0.262	0.021	#	pre-recruit index
2010	1	12	0.625	0.033	#	pre-recruit index

Pier Index

1954	1	13	0.1	0.72528
1955	1	13	0.01	0.88207
1956	1	13	0.1	0.72528
1957	1	13	0.01	0.88207
1958	1	13	0.01593	1.54141
1966	1	13	0.76471	0.74688
1980	1	13	0.1078	0.5675
1981	1	13	0.01668	0.71192
1982	1	13	0.01	0.88207
1983	1	13	0.01	0.88207
1984	1	13	0.08304	0.56998
1985	1	13	0.05492	0.61209
1986	1	13	0.06104	0.54481
1987	1	13	0.07279	0.54011
1988	1	13	0.14651	0.39676
1989	1	13	0.03599	0.8973
1993	1	13	0.09198	0.56186
1994	1	13	0.01	0.88207
1995	1	13	0.02682	0.8694
1996	1	13	0.01	0.88207
1997	1	13	0.01	0.88207
1998	1	13	0.01	0.88207
1999	1	13	0.08153	0.66772
2000	1	13	0.01	0.88207
2001	1	13	0.01	0.88207
2002	1	13	0.01	0.88207
2003	1	13	0.01713	0.70799
2004	1	13	0.01	0.88207
2005	1	13	0.05629	0.77327
2006	1	13	0.01	0.88207
2007	1	13	0.01	0.88207
2008	1	13	0.01	0.88207

2009	1	13	0.10024	0.63688

#impingement

1972	1	14	1.081498823	0.53295
1973	1	14	0.259325532	0.5834
1974	1	14	0.159835516	0.45561
1975	1	14	0.306401577	0.39862
1976	1	14	0.023219121	0.41032
1977	1	14	0.771328406	0.44772
1978	1	14	0.130167483	0.52614
1979	1	14	0.049954159	0.38914
1980	1	14	0.019524608	0.48278
1981	1	14	0.009536932	0.59967
1982	1	14	0.001457321	0.67585
1984	1	14	0.01972994	0.48843
1985	1	14	0.026307506	0.35308
1986	1	14	0.014595918	0.40102
1987	1	14	0.006518048	0.63352
1988	1	14	0.156822144	0.42722
1989	1	14	0.02186896	0.65176
1990	1	14	0.007665479	0.53995
1991	1	14	0.041142176	0.3786
1992	1	14	0.017166439	0.58308
1995	1	14	0.019559837	0.63674
1996	1	14	0.006634418	0.69229
1997	1	14	0.004508517	0.70812
1999	1	14	0.06060139	0.55093
2000	1	14	0.012255996	0.54458
2001	1	14	0.001699715	0.72195
2002	1	14	0.012410641	0.50146
2003	1	14	0.048994218	0.62496
2004	1	14	0.002481634	0.67372
2005	1	14	0.085269324	0.40251
2007	1	14	0.00381591	0.70406
2008	1	14	0.004342091	0.62414
2009	1	14	0.082489813	0.40111
2010	1	14	0.178638522	0.41895

0 #_N_fleets_with_discard
#_discard_units (1=same_as_catchunits(bio/num); 2=fraction; 3=numbers)
#_discard_errtype: >0 for DF of T-dist(read CV below); 0 for normal with CV; -1 for normal with se; -2 for lognormal
#_Fleet units errtype
1   2   30 # FISHERY1
0 #_N_discard_obs

0 #_N_meanbodywt_obs
30 #_DF_meanwt

2 # length bin method: 1=use databins; 2=generate from binwidth,min,max below; 3=read vector
2 # binwidth for population size comp
10 # minimum size in the population (lower edge of first bin and size at age 0.00)
94 # maximum size in the population (lower edge of last bin)

-1 #_comp_tail_compression
1e-007 #_add_to_comp
0 #_combine males into females at or below this bin number
29 #_N_LengthBins
16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 72 76

208 #_N_Length_obs

trawl fishery south of 38 26 currently#fish Female

Male

#Yr	Seas	Flt/Svy	Gender	Part	Stewart, max400		16	18	20	22	24
	26	28	30	32	34	36	38	40	42	44	46
	48	50	52	54	56	58	60	62	64	66	68
	72	76	16	18	20	22	24	26	28	30	32
	34	36	38	40	42	44	46	48	50	52	54
	56	58	60	62	64	66	68	72	76		
1978	1	1	3	0	196.8	0	0	0	0	0	4
	20	40	26	15	8	13	19	20	47	67	54
	32	30	19	26	17	15	12	8	10	6	3
	1	0	0	0	0	0	2	14	13	10	4
	10	19	27	48	80	60	60	23	22	23	17
	10	3	4	0	0	1	0	1			
1979	1	1	3	0	211.7	0	1	0	0	0	3
	31	55	64	75	66	42	27	20	17	29	41
	48	52	36	15	18	15	11	7	3	7	4
	2	0	0	1	0	0	1	4	3	16	26
	19	18	12	17	39	55	70	33	21	24	16
	13	5	2	0	0	1	0	0			
1980	1	1	3	0	244.8	0	0	0	0	0	0
	0	3	2	5	10	33	115	111	65	14	6
	16	24	30	20	17	13	10	11	9	15	6
	5	0	0	0	0	0	1	0	0	1	7
	20	63	101	68	23	23	33	24	27	20	16
	7	9	7	1	0	1	0	0			
1981	1	1	3	0	165	0	0	0	0	0	0
	1	6	7	2	2	4	9	35	87	80	32
	8	4	8	9	12	5	7	4	2	1	2
	0	0	0	0	0	0	0	0	3	3	4
	8	6	26	79	73	27	11	20	14	11	10
	5	2	1	1	0	0	0	0			
1982	1	1	3	0	342	0	0	0	0	0	0
	1	2	6	2	11	37	62	56	52	55	75
	91	83	47	19	18	27	26	20	18	7	5
	9	0	0	0	0	0	0	1	1	8	10
	20	49	59	62	91	162	116	58	40	42	27
	20	12	4	4	0	0	0	0			
1983	1	1	3	0	349	0	0	0	0	0	0
	0	0	1	1	6	11	16	33	70	74	71
	73	142	100	41	25	29	14	22	16	10	6
	11	0	0	0	0	0	0	1	2	1	3
	9	11	25	66	111	132	148	94	68	60	25
	16	9	3	2	0	0	0	0			
1984	1	1	3	0	400	0	0	0	0	0	0
	0	0	0	1	0	8	11	26	45	48	60
	78	93	97	110	71	47	26	27	20	16	12
	13	0	0	0	0	0	0	0	0	1	1
	5	10	31	57	94	134	155	165	133	100	53
	23	16	9	3	2	0	0	0			
1985	1	1	3	0	340.8	0	0	0	0	1	3
	18	22	35	15	1	5	8	8	15	31	43
	40	58	31	43	49	37	22	9	11	15	10
	7	0	0	0	0	0	6	9	12	21	7
	3	3	11	33	43	63	77	96	94	62	35
	24	7	2	3	3	0	0	0			
1986	1	1	3	0	369	0	0	0	0	0	0
	1	36	88	157	231	191	120	37	13	7	9

	18	26	28	16	24	24	15	8	4	2	3
	0	0	0	0	0	0	3	2	19	82	155
	184	150	69	16	11	13	20	35	23	22	18
	6	3	1	1	0	0	1	0			
1987	1	1	3	0	342.9	0	0	0	0	0	0
	0	0	5	30	53	83	173	227	173	64	6
	11	9	9	16	11	9	7	3	2	0	1
	0	0	0	0	0	0	0	1	5	17	42
	59	124	215	203	101	15	10	22	20	28	10
	2	2	0	0	0	0	0	0			
1988	1	1	3	0	258.3	0	0	0	0	0	1
	1	7	13	15	19	24	46	82	97	117	82
	41	18	10	8	7	9	5	7	3	2	1
	0	0	0	0	0	0	0	1	3	8	9
	25	40	72	102	152	83	36	9	15	18	5
	2	1	0	0	1	1	0	0			
1989	1	1	3	0	189.4	0	0	0	0	0	0
	4	13	15	27	43	27	16	15	22	28	25
	42	28	15	4	6	2	2	2	4	3	0
	1	0	0	0	0	0	2	4	11	22	27
	29	28	29	28	45	64	47	17	9	4	6
	3	1	0	1	0	0	0	0			
1990	1	1	3	0	314.4	0	0	0	0	0	0
	2	18	65	141	121	124	90	22	32	10	17
	11	11	24	13	8	7	2	0	4	2	1
	0	0	0	0	0	0	0	4	38	87	138
	147	131	65	29	23	22	31	19	15	10	6
	5	1	0	0	0	0	0	0			
1991	1	1	3	0	361.7	0	0	0	0	0	0
	4	8	5	7	24	95	194	211	133	71	40
	20	16	23	21	25	15	3	7	2	4	3
	3	0	0	0	0	0	2	6	10	5	10
	49	156	259	181	106	51	35	33	24	24	10
	8	0	6	1	0	1	0	0			
1992	1	1	3	0	260	0	0	0	0	0	1
	2	8	32	28	33	18	15	39	107	150	85
	39	24	14	22	20	22	15	10	6	2	3
	2	0	0	0	0	0	0	1	7	17	25
	29	21	54	113	149	89	49	46	19	20	10
	13	4	5	2	0	0	0	0			
1993	1	1	3	0	219.6	0	0	0	0	0	0
	2	15	30	19	17	53	57	43	51	55	56
	48	28	20	20	12	7	4	3	2	1	0
	0	0	0	0	0	0	0	1	8	22	19
	31	46	60	71	93	63	36	21	22	14	7
	5	1	0	0	0	0	0	0			
1994	1	1	3	0	94.1	0	0	0	0	0	0
	0	0	0	1	6	13	9	12	11	15	12
	16	15	8	4	0	4	1	2	1	0	1
	1	0	0	0	0	0	0	0	0	1	4
	5	9	11	26	29	43	22	9	9	8	0
	2	1	1	1	0	0	0	0			
1995	1	1	3	0	76.1	0	0	0	0	0	0
	0	0	0	0	0	0	2	4	5	13	13
	8	27	8	6	4	3	4	3	3	1	1
	0	0	0	0	0	0	0	0	0	0	1
	1	1	4	9	21	42	23	19	9	3	0
	1	0	1	0	0	0	0	0			
1996	1	1	3	0	82.1	0	0	0	0	0	0
	0	0	1	0	2	1	2	16	8	2	16
	22	29	18	17	14	10	5	1	0	1	0
	0	0	0	0	1	0	0	0	1	0	0

	3	1	10	12	19	30	59	21	9	11	4
	2	1	0	0	0	0	0	0			
1997	1	1	3	0	103.7	0	0	0	0	0	1
	0	0	0	0	2	2	3	3	8	12	13
	20	31	16	15	14	14	5	6	7	1	5
	4	0	0	0	0	0	0	0	0	0	1
	1	7	8	14	12	31	23	29	16	15	7
	12	5	2	1	2	0	0	0			
1998	1	1	3	0	59.7	0	0	0	0	0	0
	0	0	2	6	6	6	2	6	8	7	10
	16	9	10	13	9	8	3	2	8	1	0
	0	0	0	0	0	0	0	0	1	3	9
	5	5	6	8	9	19	23	27	10	13	8
	0	2	0	0	1	0	0	0			
1999	1	1	3	0	78.5	0	0	0	0	0	0
	0	0	0	0	4	17	27	16	10	8	13
	15	15	11	14	8	7	5	7	2	0	0
	1	0	0	0	0	0	0	0	1	1	5
	4	22	17	16	16	21	27	44	38	16	5
	3	1	0	0	0	0	0	0			
2000	1	1	3	0	25.2	0	0	0	0	0	0
	0	4	6	3	1	3	1	6	4	8	7
	6	3	1	0	3	0	1	1	0	0	0
	0	0	0	0	0	0	0	0	6	4	3
	5	2	5	1	7	6	4	1	1	0	0
	0	0	0	0	0	0	0	0			
2001	1	1	3	0	92.2	0	0	0	0	0	0
	3	10	39	31	17	34	15	9	2	9	15
	12	17	7	7	2	6	1	5	1	1	0
	0	0	0	0	0	0	0	2	15	42	23
	21	19	6	7	7	17	22	14	7	3	1
	1	1	0	0	0	0	0	0			
2002	1	1	3	0	38	0	0	0	0	0	0
	0	0	0	0	1	6	9	13	10	5	1
	1	7	7	6	3	3	6	6	0	0	0
	1	0	0	0	0	0	0	0	0	1	2
	2	10	14	15	5	6	4	8	5	2	1
	0	0	0	0	0	0	0	0			
#2003	1	1	3	0	1.2	0	0	0	0	0	0
	0	0	0	0	0	1	0	0	0	0	0
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2004	1	1	3	0	33.2	0	0	0	0	0	0
	1	0	0	1	1	0	0	1	3	2	5
	8	17	18	13	1	6	2	4	0	1	0
	0	0	0	0	0	0	0	0	1	0	0
	0	1	2	1	3	3	9	8	5	1	0
	0	0	0	0	0	0	0	0			
#2005	1	1	3	0	1.5	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	1	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	1	1	1	0	0
	0	0	0	0	0	0	0	0			
#2007	1	1	3	0	5.3	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	0	0	1
	0	0	1	0	2	1	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	2	1	0
	0	0	0	0	0	0	0	0			

#2008	1	1	3	0	2.2	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
#											

#Yr	Seas	Flt/Svy	Gender	Part	Stewart, max400		16	18	20	22	24
	26	28	30	32	34	36	38	40	42	44	46
	48	50	52	54	56	58	60	62	64	66	68
	72	76	16	18	20	22	24	26	28	30	32
	34	36	38	40	42	44	46	48	50	52	54
	56	58	60	62	64	66	68	72	76		
1979	1	2	3	0	5.3	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	1
	1	1	1	0	0	0	0	1	1	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	1	0	1	1	4	0	1	1
	1	1	0	0	0	0	0	0			
1980	1	2	3	0	18.9	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	0	1	0
	0	0	1	3	1	1	4	4	3	2	1
	6	0	0	0	0	0	0	0	0	0	0
	0	1	0	0	0	0	0	1	1	1	4
	6	4	3	1	0	0	0	0			
1982	1	2	3	0	17.7	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	1	0
	3	1	0	2	2	1	2	1	0	0	1
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	1	0	0	0	0	0	1
	0	2	0	0	0	0	1	0			
1983	1	2	3	0	18.5	0	0	0	0	0	0
	0	0	0	0	0	0	2	0	1	3	1
	2	5	2	3	5	0	1	1	1	1	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	1	3	1	2	1	3	5	4	3
	3	0	1	0	0	0	0	0			
1984	1	2	3	0	22.4	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	1	0	0
	0	1	2	3	3	0	3	2	2	1	2
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	1	2	5	7	5	4
	0	2	0	0	0	0	0	0			
1985	1	2	3	0	34.9	0	0	0	0	0	0
	0	0	0	1	0	3	2	2	6	9	4
	5	9	4	3	2	1	0	0	1	0	1
	0	0	0	0	0	0	0	0	0	0	0
	0	1	2	11	2	5	3	5	7	3	2
	0	0	0	0	0	0	0	0			
1986	1	2	3	0	72.7	0	0	0	0	0	0
	1	0	0	2	1	4	6	4	2	3	17
	9	14	17	14	13	16	5	5	0	0	0
	0	0	0	0	0	0	0	0	1	3	4
	3	2	3	3	2	4	17	23	25	20	11
	2	3	0	0	0	0	0	0			
1987	1	2	3	0	56.3	0	0	0	0	0	0
	0	1	0	1	6	7	11	8	15	9	6

	6	5	11	5	6	3	1	2	0	0	0
	0	0	0	0	0	0	0	0	0	3	4
	12	13	10	10	13	6	16	12	6	6	3
	4	3	0	1	1	1	0	0			
1988	1	2	3	0	23.3	0	0	0	0	0	0
	0	0	0	0	0	2	1	1	8	5	9
	9	4	1	4	2	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	2	0	10	7	5	3	5	2	1	0
	1	0	0	0	0	0	0	0			
1989	1	2	3	0	44.4	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	5	5	9
	7	7	10	4	7	1	3	0	1	0	0
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	2	7	7	6	12	7	1	5
	2	2	0	0	1	0	0	0			
1990	1	2	3	0	23.3	0	0	0	0	0	0
	0	0	0	0	0	4	2	0	3	2	6
	1	2	7	0	2	0	0	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0
	3	4	4	3	5	2	7	5	3	2	0
	0	0	0	0	0	0	0	0			
1991	1	2	3	0	49.8	0	0	0	0	0	0
	0	0	0	1	0	0	4	6	6	3	4
	3	4	3	6	7	4	5	1	0	2	0
	1	0	0	0	0	0	0	1	0	0	0
	1	2	10	10	4	8	1	3	8	6	3
	1	1	0	2	1	0	0	0			
1992	1	2	3	0	111.4	0	0	0	0	0	0
	0	0	0	5	8	8	2	10	25	46	37
	15	5	9	2	4	6	4	3	0	2	1
	1	0	0	0	0	0	0	0	0	0	1
	9	2	4	16	37	25	10	13	5	7	4
	0	2	0	1	0	0	0	0			
1993	1	2	3	0	109.9	0	0	0	0	0	0
	0	0	0	2	0	2	4	14	16	48	25
	15	11	5	3	4	1	2	2	0	0	0
	0	0	0	0	0	0	0	0	1	1	2
	2	2	7	17	19	11	10	8	3	0	2
	0	0	0	0	0	0	0	0			
1994	1	2	3	0	86.2	0	0	0	0	0	0
	0	0	0	0	0	0	4	2	10	13	8
	21	28	22	12	6	4	6	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	1	1	3	3	9	14	19	8	10	4	1
	2	0	0	0	0	0	0	0			
1995	1	2	3	0	39.4	0	0	0	0	0	0
	0	0	0	0	0	0	0	3	5	1	3
	11	10	10	9	5	2	0	0	0	1	0
	0	0	0	0	0	0	0	0	0	1	0
	0	0	1	5	2	10	5	2	1	0	0
	2	1	0	0	0	0	0	0			
1996	1	2	3	0	105.8	0	0	0	0	0	0
	0	0	0	1	1	0	7	10	10	15	24
	33	26	21	23	12	4	1	3	0	1	0
	2	0	0	0	0	0	0	0	0	0	2
	4	2	9	12	21	20	28	12	7	3	3
	1	0	0	0	0	0	0	0			
1997	1	2	3	0	76.5	0	0	0	0	0	0
	0	0	0	0	0	0	1	2	5	10	17
	21	38	44	25	17	10	5	2	2	3	1
	0	0	0	0	0	0	0	0	0	0	0

	1	0	1	5	4	12	12	14	5	5	2
	1	0	0	0	0	0	0	0			
1998	1	2	3	0	58.3	0	0	0	0	0	0
	0	0	0	0	1	1	1	5	8	13	16
	14	17	17	10	11	3	1	0	2	0	0
	1	0	0	0	0	0	0	0	0	0	0
	0	1	3	5	11	10	12	8	8	5	3
	0	1	0	3	0	0	0	0			
1999	1	2	3	0	23.5	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	2	2	6
	8	6	9	11	4	2	2	2	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	1	0	0	1	2	4	10	3	7	4
	3	5	1	1	1	0	0	0			
2000	1	2	3	0	16	0	0	0	0	0	0
	0	1	0	0	0	0	0	0	1	1	1
	2	2	3	2	2	0	0	0	0	1	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	1	0	6	1	3	2	3	1	1
	3	2	3	1	1	0	0	0			
2001	1	2	3	0	40.9	0	0	0	0	0	0
	0	0	1	3	10	5	0	3	1	4	3
	5	6	11	5	8	4	5	3	2	0	2
	0	0	0	0	0	0	0	0	1	2	2
	8	3	2	1	3	7	3	6	6	7	5
	5	7	3	0	0	0	0	0			
2002	1	2	3	0	6.9	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	1	0	1
	3	3	2	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	3	0	0
	0	0	0	0	0	0	0	0			
#											

#Yr	Seas	Flt/Svy	Gender	Part	Stewart, max400		16	18	20	22	24
	26	28	30	32	34	36	38	40	42	44	46
	48	50	52	54	56	58	60	62	64	66	68
	72	76	16	18	20	22	24	26	28	30	32
	34	36	38	40	42	44	46	48	50	52	54
	56	58	60	62	64	66	68	72	76		
1978	1	3	3	0	19	0	0	0	0	0	0
	0	0	0	0	0	3	3	3	3	2	7
	4	2	2	2	1	1	1	1	1	1	2
	1	0	0	0	0	0	0	0	0	0	0
	0	0	3	1	4	9	5	4	1	2	1
	1	0	0	1	0	0	0	1			
#1979	1	3	3	0	3.7	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	2	0	0
	0	0	1	0	2	1	3	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	1	2	2	3	1	0	1	0
	0	0	0	0	0	0	0	0			
#1982	1	3	3	0	2.2	0	0	0	0	0	0
	0	0	0	0	0	0	1	0	0	0	0
	1	0	0	1	0	0	1	0	2	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	1	0	0	1	0	0	0	0	0
	0	1	0	0	0	0	0	0			

1983	1	3	3	0	41.2	0	0	0	0	0	0
	0	0	0	0	0	1	0	2	3	2	5
	3	3	5	3	1	0	0	3	2	1	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	1	1	4	5	1	4	2	5	1
	2	0	0	0	0	0	0	0			
1984	1	3	3	0	88.3	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	1
	2	4	2	2	1	1	3	1	0	0	1
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	1	2	4	7	2	5	5
	0	1	0	0	0	0	0	0			
1985	1	3	3	0	348.5	1	1	2	2	1	0
	0	1	0	0	1	4	8	14	38	35	47
	38	32	22	28	25	17	12	14	7	3	3
	5	0	2	3	0	5	0	0	1	0	0
	1	3	4	23	63	88	103	60	42	32	24
	15	11	3	7	1	0	0	0			
1986	1	3	3	0	338.8	0	0	0	0	0	0
	0	0	2	1	0	2	7	7	4	8	28
	56	67	80	99	67	37	21	14	7	8	2
	9	0	0	0	0	0	0	0	0	0	0
	1	9	3	8	10	24	91	133	158	159	84
	30	12	7	4	0	0	1	0			
1987	1	3	3	0	263.7	0	0	0	0	0	0
	0	0	0	0	0	4	16	42	65	45	20
	20	28	57	44	48	35	17	11	5	4	2
	3	0	0	0	0	0	0	0	0	0	0
	5	7	35	63	42	36	45	67	107	93	43
	26	7	3	3	1	0	0	0			
1988	1	3	3	0	225.4	1	0	0	0	0	0
	0	0	1	1	0	2	5	24	61	105	111
	62	38	20	16	10	14	8	7	4	4	1
	1	0	0	0	0	0	0	0	0	1	0
	2	2	13	34	104	113	72	34	31	19	10
	12	8	5	2	0	2	0	0			
1989	1	3	3	0	323.3	0	0	0	0	0	0
	0	2	0	4	3	4	4	12	43	89	130
	120	117	84	45	30	6	8	9	5	4	3
	1	0	0	0	0	0	0	0	1	1	0
	0	1	13	28	90	165	155	100	50	26	21
	12	8	5	0	1	0	1	0			
1990	1	3	3	0	232.4	0	0	0	0	0	0
	0	0	1	2	7	33	49	24	45	60	41
	58	53	60	35	25	11	11	4	4	3	1
	0	0	0	0	0	0	1	0	0	0	1
	12	16	28	23	46	61	76	60	39	15	5
	5	1	0	0	0	0	0	0			
1991	1	3	3	0	89.9	0	0	0	0	0	0
	0	0	0	1	2	5	21	51	51	34	21
	10	8	6	5	4	4	2	0	1	2	0
	1	0	0	0	0	0	0	0	0	0	4
	1	8	26	28	24	16	14	15	11	4	3
	0	1	0	0	0	0	0	0			
1992	1	3	3	0	234.6	0	0	0	0	0	0
	0	0	0	3	6	8	7	20	83	151	164
	106	50	20	12	16	6	11	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	3
	3	8	15	64	147	145	66	29	22	13	4
	2	1	0	0	0	0	0	0			
1993	1	3	3	0	111.6	0	0	0	0	0	0
	0	3	5	0	7	3	8	9	41	69	51

	29	12	19	11	15	3	5	0	1	0	0
	0	0	0	0	0	0	0	0	0	3	1
	1	3	6	33	37	31	13	10	11	6	1
	0	0	0	0	0	0	0	0			
1994	1	3	3	0	80	0	0	0	0	0	0
	0	0	0	0	0	0	1	2	7	14	29
	24	20	10	0	1	2	2	1	1	0	0
	0	0	0	0	0	0	0	0	0	0	0
	1	0	2	5	19	21	15	11	4	3	1
	0	0	0	0	0	0	0	0			
1995	1	3	3	0	70.1	0	0	0	0	0	0
	0	0	0	0	0	0	1	1	6	3	12
	16	31	17	8	2	9	1	4	1	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	1	6	16	27	24	8	6	2	2
	0	0	0	0	0	0	0	0			
1996	1	3	3	0	43.6	0	0	0	0	0	0
	0	0	0	1	0	0	0	0	0	3	10
	12	19	10	4	0	2	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	4	17	21	10	5	2	0
	1	0	0	0	0	0	0	0			
1997	1	3	3	0	24.5	0	0	0	0	0	0
	0	0	0	0	0	0	1	0	2	0	7
	6	8	8	6	1	4	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	1	1	3	10	12	7	3	2	2
	0	0	0	0	0	0	0	0			
1998	1	3	3	0	33.5	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	1	6	4
	16	16	10	9	3	5	1	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	2	1	5	6	13	16	6	4	0
	0	0	1	0	0	0	0	0			
#1999	1	3	3	0	4.5	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	1	1
	4	5	7	5	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	2	1	0	0	0
	0	0	0	0	0	0	0	0			
#2002	1	3	3	0	4.4	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	1
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	2	0	7	11	4	0
	0	0	0	0	0	0	0	0			
#2004	1	3	3	0	4.3	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	1	0	2	0	4	2	3	3	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	1	1	0
	0	0	0	0	0	0	0	0			

#Yr	Seas	Flt/Svy	Gender	Part	Neff	16	18	20	22	24	26
	28	30	32	34	36	38	40	42	44	46	48
	50	52	54	56	58	60	62	64	66	68	72
	76	16	18	20	22	24	26	28	30	32	34
	36	38	40	42	44	46	48	50	52	54	56
	58	60	62	64	66	68	72	76			
1980	1	4	0	0	400	4	2	3	20	30	63
	64	101	87	208	427	435	312	169	173	104	68
	89	68	52	64	33	15	5	4	5	1	0

	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1981	1	4	0	0	400	1	1	2	7	13	31
	74	116	181	172	197	177	176	187	256	210	118
	76	67	60	45	31	18	6	6	1	1	3
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1982	1	4	0	0	386	0	0	0	0	3	5
	16	25	27	44	108	207	208	164	213	253	190
	121	83	59	51	18	11	4	5	1	2	1
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1983	1	4	0	0	196.4	0	0	0	1	0	0
	3	7	8	45	59	66	61	62	59	73	42
	35	42	38	45	19	10	9	12	2	7	1
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1984	1	4	0	0	262.9	23	17	35	29	9	2
	8	4	6	6	14	17	35	48	59	87	46
	53	30	23	17	11	4	4	5	0	2	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1985	1	4	0	0	330.6	1	10	27	74	126	96
	94	185	194	104	42	11	17	22	35	53	49
	57	49	35	26	11	12	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1986	1	4	0	0	298.2	5	5	5	13	36	47
	52	60	145	284	264	133	63	16	18	19	20
	27	19	21	25	3	9	5	3	0	1	1
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1987	1	4	0	0	50.2	0	0	2	3	5	7
	11	7	5	10	12	20	12	6	9	7	3
	0	5	4	3	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1988	1	4	0	0	49.9	0	0	0	1	3	4
	3	1	2	3	9	9	8	5	10	7	6
	1	3	3	0	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1989	1	4	0	0	117.4	0	0	3	8	18	19
	37	42	53	54	18	24	22	29	32	30	25
	21	11	9	5	9	5	4	4	3	1	2
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1993	1	4	0	0	24.3	0	0	0	0	0	0
	1	3	1	9	8	2	3	4	3	4	2
	5	2	2	2	1	0	0	0	0	1	0
	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1994	1	4	0	0	34.8	0	0	0	0	0	1
	0	2	0	6	5	8	10	11	11	3	8
	10	5	2	2	1	0	0	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1995	1	4	0	0	21.8	0	0	0	0	0	0
	0	1	0	0	1	0	2	0	7	4	2
	4	6	3	2	2	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1996	1	4	0	0	51	0	0	0	1	1	3
	3	7	7	6	3	7	1	5	7	7	7
	12	7	11	11	4	2	1	0	1	2	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1997	1	4	0	0	22.3	0	0	0	0	0	0
	1	4	0	1	8	6	10	3	2	5	0
	4	5	0	1	0	2	0	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1998	1	4	0	0	53.4	0	0	0	0	0	1
	0	2	5	8	5	9	10	13	7	7	15
	6	3	4	5	3	1	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1999	1	4	0	0	181.4	7	13	11	8	3	0
	2	5	3	9	8	7	11	21	25	38	44
	53	41	50	33	28	19	12	1	3	3	2
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2000	1	4	0	0	167.5	0	0	2	2	20	43
	58	66	46	41	12	11	7	8	8	16	19
	29	22	35	24	19	16	11	7	4	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2001	1	4	0	0	109.4	0	0	0	1	0	6
	18	42	72	69	49	43	18	11	9	5	8
	8	6	3	3	3	2	2	2	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2002	1	4	0	0	201.3	0	0	0	0	0	0
	3	3	7	23	62	112	129	113	95	37	20
	25	31	18	12	11	13	2	1	1	2	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2003	1	4	0	0	36.8	0	0	0	0	0	2
	0	0	0	0	0	2	14	16	21	29	17
	4	5	6	0	3	1	1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			

2004	1	4	0	0	325.8	1	3	5	14	8	17
	27	44	24	27	20	25	48	55	105	135	116
	97	52	37	21	8	8	5	4	2	2	0
	2	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2005	1	4	0	0	399.9	0	2	0	0	3	6
	20	77	148	195	185	143	91	54	58	74	86
	84	83	68	34	17	8	6	3	3	0	1
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2006	1	4	0	0	400	1	0	1	2	8	17
	28	29	46	69	128	224	334	263	169	96	80
	72	98	82	56	28	13	6	2	4	2	1
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2007	1	4	0	0	400	2	3	0	5	5	18
	44	74	133	228	173	167	158	184	208	209	148
	107	74	68	58	38	24	3	6	0	2	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2008	1	4	0	0	400	0	0	0	0	7	15
	23	27	51	74	151	247	267	193	209	171	120
	88	65	31	25	20	12	11	2	1	1	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2009	1	4	0	0	400	0	0	1	4	5	12
	33	43	94	148	177	173	209	273	238	190	127
	109	95	51	30	30	14	14	10	1	4	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2010	1	4	0	0	400	0	0	2	6	20	62
	83	129	118	93	101	126	154	208	198	170	135
	111	54	35	23	17	12	4	6	0	2	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			

#

#"year	Seas	Flt/Svy	Gender	Part	Stewart, max400		16	18	20	22	24
	26	28	30	32	34	36	38	40	42	44	46
	48	50	52	54	56	58	60	62	64	66	68
	72	76	16	18	20	22	24	26	28	30	32
	34	36	38	40	42	44	46	48	50	52	54
	56	58	60	62	64	66	68	72	76		
1978	1	5	3	0	-98	0	0	0	0	2	4
	2	4	0	3	5	8	7	9	28	32	15
	14	7	3	9	13	10	4	8	11	20	9
	2	1	0	0	0	0	3	1	1	3	1
	5	5	11	7	19	18	20	16	22	19	17
	14	12	12	13	3	0	1	1			
1979	1	5	3	0	-22	0	0	0	0	0	3
	1	7	25	44	26	7	0	4	7	20	14

	11	11	7	9	11	17	18	12	23	32	13
	12	0	0	0	0	0	0	2	4	2	4
	4	3	7	4	14	10	22	14	16	17	26
	34	34	35	16	13	4	3	1			
1980	1	5	3	0	-86.7	0	0	0	0	0	0
	1	0	1	4	2	15	33	23	9	5	4
	4	3	8	6	3	7	5	2	8	7	6
	0	0	0	0	0	0	2	1	0	1	0
	12	15	20	6	6	3	8	4	4	5	8
	5	4	8	4	3	2	0	0			
1981	1	5	3	0	-59.3	0	0	0	0	0	0
	1	0	11	13	2	1	4	8	9	15	19
	5	4	6	4	6	2	2	3	5	3	2
	1	0	0	0	0	0	0	2	0	6	8
	5	3	4	6	17	11	8	7	8	4	9
	6	7	1	3	1	2	0	0			
1982	1	5	3	0	-63	0	0	0	0	0	1
	0	0	0	1	5	3	3	8	7	5	14
	16	15	9	6	6	10	3	3	2	7	2
	2	0	0	0	0	0	2	0	0	0	0
	0	2	4	3	5	14	20	8	7	7	5
	7	6	2	1	2	1	0	0			
1983	1	5	3	0	-40.7	0	0	0	0	0	0
	0	0	0	0	0	1	3	6	3	10	4
	3	10	7	8	4	2	2	4	4	1	0
	1	0	0	0	0	0	0	1	0	2	0
	1	0	4	5	5	11	9	3	12	7	8
	4	2	1	5	1	0	0	0			
1984	1	5	3	0	-20.7	0	0	0	0	0	0
	0	0	0	0	1	0	1	2	4	0	1
	7	2	3	2	10	4	2	1	3	2	0
	1	0	0	0	0	0	0	0	0	0	3
	0	0	4	4	2	3	3	3	4	5	2
	4	3	2	0	1	0	0	0			

#YEAR

1980	1	5	0	0	104.7	0	1	0	1	5	4
	11	2	3	3	14	11	28	16	14	15	21
	13	15	13	4	12	10	7	3	11	7	4
	4	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1981	1	5	0	0	68.7	1	0	1	0	0	0
	0	1	3	8	4	8	9	28	25	41	23
	9	7	14	11	13	11	6	7	7	8	5
	2	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1982	1	5	0	0	92.9	0	0	0	0	1	0
	0	0	3	3	7	7	14	15	11	38	38
	49	46	24	21	8	3	11	7	1	4	0
	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1983	1	5	0	0	95.5	0	0	0	0	0	0
	3	1	4	3	5	2	4	9	19	26	37
	42	55	53	36	23	13	8	10	3	1	0
	2	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1984	1	5	0	0	94.8	1	1	1	1	0	0
	0	2	3	5	7	9	8	13	15	13	17
	16	18	13	9	6	12	2	7	4	2	1
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1985	1	5	0	0	175.4	2	5	12	38	52	53
	63	65	24	15	7	7	13	13	15	13	20
	19	19	15	13	21	14	14	8	7	4	3
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1986	1	5	0	0	234.9	0	0	1	5	8	8
	18	29	72	190	204	142	66	18	4	5	7
	13	21	17	19	24	19	15	11	14	8	3
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1987	1	5	0	0	68	0	0	0	0	1	0
	3	3	15	24	33	27	18	9	6	4	3
	4	3	4	6	9	9	12	9	5	10	6
	2	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1988	1	5	0	0	42.6	0	0	0	0	0	1
	1	1	2	1	4	4	4	4	1	6	5
	4	4	1	0	1	2	0	1	0	0	0
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1989	1	5	0	0	52.4	0	0	0	0	1	3
	0	2	5	4	24	11	3	3	7	13	15
	10	8	3	3	0	0	1	1	0	1	0
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
#YEAR	16	18	20	22	168	26	28	30	32	34	36
	38	40	42	44	46	48	50	52	54	56	58
	60	62	64	66	68	72	76	16	18	20	22
	24	26	28	30	32	34	36	38	40	42	44
	46	48	50	52	54	56	58	60	62	64	66
	68	72	76								
1993	1	5	0	0	37.7	1	0	0	0	0	0
	0	0	1	6	5	2	3	4	4	6	4
	4	6	3	1	1	2	2	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1994	1	5	0	0	32.9	0	0	1	0	0	4
	5	3	3	1	3	4	9	5	1	3	1
	1	2	2	0	2	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			

1995	1	5	0	0	38.3	0	0	1	0	0	0
	0	2	4	5	6	6	1	6	8	6	9
	3	4	3	0	1	1	0	1	0	0	1
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1996	1	5	0	0	109.6	0	0	0	2	2	1
	3	7	9	15	13	9	19	16	16	13	11
	6	14	19	12	13	4	7	8	4	1	2
	3	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1997	1	5	0	0	216.6	0	0	0	1	5	4
	4	2	10	21	25	32	44	31	60	48	53
	63	71	55	49	84	37	29	22	11	20	6
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1998	1	5	0	0	152.5	0	0	0	0	0	3
	8	9	22	18	24	13	26	35	40	43	41
	41	31	35	29	27	24	14	6	8	2	5
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1999	1	5	0	0	212.9	2	0	0	0	0	3
	1	2	3	14	22	30	49	38	39	43	63
	47	55	47	40	25	44	17	20	6	7	6
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2000	1	5	0	0	85.2	0	0	0	0	3	10
	25	18	11	11	18	10	14	13	19	22	11
	14	8	2	9	5	14	8	13	10	5	0
	4	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2001	1	5	0	0	82.9	0	0	1	0	1	1
	2	3	23	36	55	33	12	14	18	19	20
	20	22	14	11	11	3	2	1	0	2	1
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2002	1	5	0	0	42.8	0	0	0	0	0	0
	0	0	1	2	12	26	44	29	17	1	8
	6	10	9	5	3	4	1	2	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2004	1	5	0	0	60	0	0	0	0	0	0
	1	0	2	1	3	2	9	6	5	9	4
	9	4	8	2	6	1	2	2	1	3	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2005	1	5	0	0	138.7	0	0	1	1	0	0
	1	5	3	5	4	6	10	8	16	26	24
	39	37	26	14	14	5	7	3	1	3	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2006	1	5	0	0	162.5	0	0	0	0	0	1
	1	1	3	6	3	11	19	17	15	24	22

	23	26	17	24	11	12	13	7	5	11	5
	2	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2007	1	5	0	0	174.1	0	0	0	0	0	2
	0	1	5	7	11	15	14	26	25	18	22
	12	14	23	12	18	9	11	8	3	5	1
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2008	1	5	0	0	110.494	1	0	0	0	0	0
	0	0	1	0	2	6	13	16	19	14	15
	17	10	12	13	8	8	4	3	0	0	1
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2009	1	5	0	0	118.67	0	0	0	0	1	1
	5	7	2	6	4	5	7	12	16	15	6
	19	16	20	21	14	10	16	5	5	1	1
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2010	1	5	0	0	112.392	0	0	1	0	0	4
	6	13	10	6	4	13	12	12	12	17	16
	5	14	8	8	7	5	2	5	2	2	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			

#

#year	Seas	Flt/Svy	Gender	Part	Stewart, max400		16	18	20	22	24
	26	28	30	32	34	36	38	40	42	44	46
	48	50	52	54	56	58	60	62	64	66	68
	72	76	16	18	20	22	24	26	28	30	32
	34	36	38	40	42	44	46	48	50	52	54
	56	58	60	62	64	66	68	72	76		
1978	1	6	3	0	179.5	0	0	0	0	1	1
	0	0	0	0	0	0	3	5	27	52	42
	16	8	4	15	15	16	9	17	18	19	12
	5	0	0	0	0	0	0	0	0	0	0
	0	1	7	18	51	53	19	12	24	23	37
	27	14	9	3	1	0	0	0			
1979	1	6	3	0	67.4	0	0	0	0	0	0
	0	1	2	5	1	0	1	0	1	1	7
	8	11	4	3	2	6	3	5	4	5	2
	3	0	0	0	0	0	0	0	1	2	4
	2	0	1	0	2	7	13	6	5	8	14
	9	11	4	1	1	0	2	2			
1980	1	6	3	0	220.9	0	0	0	0	0	0
	0	0	0	8	17	61	96	55	44	10	3
	7	8	11	10	6	2	2	6	4	1	4
	5	0	0	0	0	0	0	0	0	0	7
	28	77	71	39	14	4	9	9	13	12	4
	4	12	0	3	0	0	0	0			
1981	1	6	3	0	195.2	0	0	0	0	0	0
	0	0	1	0	0	4	12	35	83	104	65
	24	2	0	3	0	2	2	4	2	4	6

	5	0	0	0	0	0	0	0	0	0	0
	7	12	24	73	111	65	15	2	6	6	11
	7	10	5	3	2	2	0	0			
1982	1	6	3	0	243.8	0	0	0	0	0	0
	0	0	0	1	3	19	19	38	13	36	67
	94	90	49	15	2	4	6	4	1	2	5
	9	0	0	0	0	0	0	0	0	0	2
	9	19	21	19	38	98	97	39	18	8	8
	19	20	6	5	2	0	0	0			
1983	1	6	3	0	365.8	0	0	0	0	0	0
	0	0	0	0	2	9	16	39	36	46	41
	50	54	110	79	31	11	7	11	11	11	11
	28	0	0	0	0	0	0	0	0	1	0
	1	4	16	36	50	51	111	126	64	25	20
	17	28	21	10	2	1	0	0			
1984	1	6	3	0	245.7	0	0	0	0	0	0
	0	0	0	0	1	0	0	2	10	14	21
	28	37	34	78	68	33	13	9	12	10	6
	36	0	0	0	0	0	0	0	0	0	0
	1	0	4	9	16	28	64	105	108	54	23
	16	26	22	6	3	0	0	0			
1985	1	6	3	0	196.1	0	0	0	0	0	0
	0	0	0	0	1	0	3	0	1	6	2
	18	23	23	28	43	55	20	9	3	3	3
	9	0	0	0	0	0	0	0	0	0	0
	0	2	0	3	9	11	23	55	85	78	31
	17	17	8	6	0	0	0	0			
1986	1	6	3	0	167.2	0	0	0	0	0	0
	0	0	0	4	14	13	9	5	0	1	0
	4	7	11	20	20	38	29	26	9	4	4
	3	0	0	0	0	0	0	0	1	4	9
	32	21	15	4	0	0	5	22	36	78	50
	19	11	9	6	1	1	0	0			
1987	1	6	3	0	255.6	0	0	0	0	0	0
	0	0	0	2	7	27	64	118	101	50	16
	2	2	3	4	9	17	22	26	25	9	2
	7	0	0	0	0	0	0	0	1	1	1
	12	65	113	112	58	14	5	4	21	43	36
	26	12	6	3	2	0	0	0			
1988	1	6	3	0	178.3	0	0	0	0	0	0
	0	0	0	0	0	10	6	21	37	54	63
	30	15	3	1	1	3	8	10	10	3	3
	3	0	0	0	0	0	0	0	0	0	1
	0	10	20	39	89	101	26	13	6	11	31
	17	6	7	3	1	0	0	0			
1989	1	6	3	0	129.2	0	0	0	0	0	0
	1	1	2	3	1	0	1	1	6	15	27
	26	25	20	13	3	2	3	3	5	4	0
	1	0	0	0	0	0	0	0	0	2	3
	2	3	1	5	17	45	68	34	16	6	25
	24	6	5	2	2	0	0	0			
1990	1	6	3	0	160.1	0	0	0	0	0	0
	0	0	6	10	8	14	18	13	10	15	9
	6	15	14	21	13	5	1	1	5	10	4
	4	0	0	0	0	0	0	2	6	14	17
	18	20	24	20	16	21	20	44	36	26	21
	20	10	8	5	2	0	0	0			
1991	1	6	3	0	124	0	0	0	0	0	0
	0	0	0	4	1	5	28	39	45	21	22
	8	4	9	20	18	9	7	2	2	2	1
	2	0	0	0	0	0	0	1	0	0	3

	2	22	49	68	36	20	13	17	25	21	13
	14	18	8	1	0	0	0	0			
1992	1	6	3	0	45.9	0	0	0	0	0	0
	0	0	0	1	1	1	0	0	6	17	18
	13	9	13	1	4	9	5	3	2	2	2
	3	0	0	0	0	0	0	0	0	0	0
	0	1	0	7	8	19	18	6	5	10	9
	5	8	2	1	1	0	0	0			
1993	1	6	3	0	43.7	0	0	0	0	0	0
	0	0	0	0	0	0	1	1	2	3	10
	10	19	10	2	4	6	6	2	1	2	2
	0	0	0	0	0	0	0	0	0	0	0
	1	0	3	5	7	24	31	17	29	12	3
	7	3	6	1	0	0	0	0			
1994	1	6	3	0	53.5	0	0	0	0	0	0
	0	0	0	0	0	1	2	1	6	3	6
	6	5	10	14	8	7	4	4	6	1	4
	1	0	0	0	0	0	0	0	0	0	0
	0	3	2	11	18	11	22	35	29	14	10
	11	7	5	4	1	0	0	0			
1995	1	6	3	0	40.2	0	0	0	0	0	0
	0	0	1	0	0	0	1	1	1	1	2
	2	2	1	1	6	3	5	5	9	4	0
	4	0	0	0	0	0	0	1	0	1	1
	1	0	0	3	2	0	1	10	14	9	7
	13	12	16	8	2	4	0	0			
1996	1	6	3	0	18.1	0	0	0	0	0	0
	0	0	0	0	0	0	1	1	0	1	0
	3	2	3	3	4	4	0	0	2	3	1
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	2	1	0	2	3	8	5
	4	2	1	1	1	0	0	0			
1997	1	6	3	0	17.6	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	1	0	0
	0	0	0	1	0	3	4	3	2	0	3
	7	0	0	0	0	0	0	0	0	0	0
	0	0	1	0	0	0	0	2	3	8	9
	5	6	4	4	3	1	0	0			
1998	1	6	3	0	21.6	0	0	0	0	0	0
	0	0	0	0	0	0	1	1	2	3	9
	9	5	2	0	0	2	7	8	5	5	2
	3	0	0	0	0	0	0	0	0	0	0
	0	0	0	1	3	1	1	1	3	3	8
	12	5	1	2	1	0	0	0			
1999	1	6	3	0	7.8	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	2	1	1	0	0	1	1
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	1	0	0	0	0	2	1
	4	2	4	1	0	0	0	0			
2000	1	6	3	0	13.9	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	3	0
	1	0	0	1	3	2	0	10	5	5	1
	4	0	0	0	0	0	0	0	0	0	0
	0	0	1	0	1	5	5	3	0	2	4
	3	1	1	3	1	0	0	0			
2001	1	6	3	0	7.2	0	0	0	0	0	0
	0	0	0	0	1	0	0	0	0	0	0
	0	0	0	0	1	0	0	0	1	1	0
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	1	0	0	0	1
	3	3	1	1	0	1	0	0			

2002	1	6	3	0	23.7	0	0	0	0	0	0
	0	1	0	0	0	6	21	11	6	5	0
	1	0	1	0	0	0	1	0	3	3	1
	1	0	0	0	0	0	0	0	0	0	1
	2	15	10	7	2	1	1	2	0	0	0
	0	3	1	1	0	0	0	0			
#2005	1	6	3	0	1.2	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	1	0	0	0	0			
#2007	1	6	3	0	2.2	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	1	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
#2008	1	6	3	0	9.8	0	0	0	0	0	0
	0	0	0	0	0	0	0	2	3	4	1
	0	0	1	0	0	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	1	2	0	1	0	2	1	1
	0	0	0	1	0	0	0	0			

#Yr	Seas	Flt/Svy	Gender	Part	Nsamp	16	18	20	22	24	26
	28	30	32	34	36	38	40	42	44	46	48
	50	52	54	56	58	60	62	64	66	68	72
	76	16	18	20	22	24	26	28	30	32	34
	36	38	40	42	44	46	48	50	52	54	56
	58	60	62	64	66	68	72	76			
#1977	1	8	3	0	163	0	0	0	0.001	0.001	0
	0.001	0.001	0.004	0.0071	0.0071	0.0307	0.0501	0.047	0.0409	0.0317	0.0358
	0.0153	0.0143	0.0266	0.0153	0.0225	0.0184	0.0255	0.0194	0.0174	0.0276	0.003
	0.001	0	0	0	0	0.002	0.001	0.004	0.002	0.0051	0.0081
	0.0112	0.0225	0.0603	0.0552	0.044	0.0327	0.0276	0.0358	0.0327	0.045	0.0307
	0.045	0.0245	0.0276	0.0092	0.003	0.004	0	0			
1980	1	8	3	0	81	0	0	0	0	0.0078	0.0216
	0.0078	0	0	0	0.0078	0.0451	0.1119	0.1375	0.1041	0.0176	0
	0.0039	0.0039	0.0058	0	0.0019	0.0019	0.0019	0	0	0	0
	0	0	0	0	0	0.0078	0.0353	0.0137	0.0019	0	0
	0.0098	0.0648	0.1611	0.1335	0.053	0.0039	0.0019	0.0019	0.0039	0.0019	0.0039
	0.0078	0.0039	0.0039	0.0019	0	0.0019	0	0			
1983	1	8	3	0	75	0	0	0	0	0	0
	0	0	0	0.002	0	0.002	0.0041	0.0062	0.0062	0.0083	0.0188
	0.0167	0.0439	0.0899	0.1087	0.0313	0.0062	0.0083	0.0083	0	0.0083	0.0062
	0	0	0	0	0	0	0	0	0	0	0
	0.0041	0	0	0.0083	0.0271	0.0271	0.0585	0.1778	0.1485	0.0606	0.0439
	0.0376	0.0167	0.0083	0.0041	0	0	0	0			
1986	1	8	3	0	39	0	0	0	0	0.019	0.0095
	0.0047	0.0047	0.019	0.0428	0.0523	0.0476	0.0238	0	0	0	0
	0	0.0047	0.0047	0	0.0095	0.0142	0.0333	0.0476	0.0285	0.0285	0
	0.0047	0	0	0	0	0.0047	0.038	0.0238	0	0.038	0.0761
	0.1523	0.0761	0.0142	0	0	0	0.0047	0	0.0238	0.0238	0.038
	0.0238	0.0238	0.019	0.0142	0	0.0047	0	0			
1989	1	8	3	0	400	0.0014	0	0	0.0044	0.0404	0.1596
	0.1456	0.0147	0.0066	0.0132	0.0206	0.0066	0.0007	0.0022	0.0007	0	0.0044
	0.0103	0.0036	0.0117	0.0036	0.0022	0.0014	0	0.0022	0.0014	0.0014	0
	0	0.008	0.0007	0	0.0103	0.0699	0.2008	0.142	0.0117	0.0044	0.011
	0.0125	0.0044	0	0.0007	0.0014	0.0095	0.0125	0.0183	0.0073	0.0014	0.0029
	0.0051	0.0029	0.0007	0	0	0.0007	0	0			

1992	1	8	3	0	78	0	0	0	0	0.0076	0.0329
	0.0482	0.0228	0.0228	0.0304	0.0203	0.0228	0.0101	0.0279	0.0609	0.0532	0.0507
	0.0101	0	0.005	0.0025	0.0076	0	0	0.0025	0.0025	0	0
	0	0	0	0.0025	0	0.0126	0.0532	0.0507	0.0152	0.0279	0.038
	0.0964	0.0304	0.0406	0.0482	0.0583	0.0304	0.0126	0.0203	0.0025	0.0076	0.0025
	0	0	0.0025	0.0025	0	0	0.0025	0			
1995	1	8	3	0	63	0	0	0.0178	0.0773	0.0952	0.0119
	0.0178	0.0238	0.0178	0.0178	0.0238	0	0	0	0.0059	0.0178	0.0178
	0.0059	0.0119	0.0059	0.0119	0.0297	0.0178	0.0119	0.0178	0	0.0178	0.0119
	0	0	0.0178	0.0476	0.0714	0.0535	0.0178	0.0178	0.0119	0.0357	0.0297
	0.0119	0.0059	0	0.0059	0.0059	0.0059	0.0357	0.0119	0.0357	0.0178	0.0297
	0.0119	0.0178	0.0119	0	0	0	0	0			
1998	1	8	3	0	31	0	0	0	0	0.0169	0
	0	0.0677	0.1525	0.1186	0.0508	0.0508	0	0	0	0.0338	0
	0	0.0169	0	0	0.0169	0	0.0169	0.0169	0	0.0169	0
	0	0	0	0.0169	0.0169	0	0	0.0338	0.0338	0.0677	0.0338
	0.0169	0	0	0	0	0.0169	0.0169	0.0847	0.0169	0	0.0169
	0.0338	0	0.0169	0	0	0	0	0			
2001	1	8	3	0	34	0	0.014	0.014	0.0281	0	0
	0	0.014	0.1267	0.0704	0.1267	0.014	0.014	0.014	0.014	0	0
	0	0.014	0	0	0.014	0	0	0	0	0.0281	0.014
	0	0	0	0	0	0	0	0	0.014	0.0563	0.0845
	0.1408	0.014	0.0281	0	0	0	0	0.0422	0.014	0.0281	0.014
	0	0.014	0.014	0.014	0	0	0	0			
2004	1	8	3	0	65	0.0045	0	0	0.0045	0.0273	0.0593
	0.0045	0	0	0	0	0	0	0.0091	0.0045	0.0182	0.0319
	0.0228	0.0456	0.073	0.0456	0.0273	0.0182	0.0182	0.0182	0.0136	0.0228	0.0091
	0.0045	0	0	0.0045	0.0182	0.0273	0.0547	0.0091	0.0045	0	0
	0.0045	0	0	0.0091	0.0091	0.0136	0.0136	0.073	0.0593	0.0319	0.0547
	0.0182	0.0273	0.0228	0.0273	0.0182	0.0136	0	0			

#CPFV observer LFs

#Year	Seas	Flt/Svy	Gender	Part	NSamp	16	18	20	22	24	26
	28	30	32	34	36	38	40	42	44	46	48
	50	52	54	56	58	60	62	64	66	68	72
	76	16	18	20	22	24	26	28	30	32	34
	36	38	40	42	44	46	48	50	52	54	56
	58	60	62	64	66	68	72	76			
1987	1	9	0	0	197.5	3	1	2	0	0	4
	6	6	16	33	69	107	101	101	111	76	65
	29	26	29	29	26	20	21	19	2	14	1
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1988	1	9	0	0	300.3	1	4	10	2	7	6
	9	16	30	22	54	78	92	140	198	129	130
	80	44	22	18	26	20	15	22	18	28	5
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1989	1	9	0	0	361	1	0	1	13	24	24
	49	57	63	55	55	59	45	65	114	133	186
	126	111	95	55	19	26	15	10	12	12	9
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1990	1	9	0	0	192.6	0	1	2	1	8	18
	25	83	157	124	58	58	80	53	31	44	42
	55	47	36	24	12	7	2	2	1	5	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			

1991	1	9	0	0	179.1	0	0	1	3	1	4
	8	1	3	6	18	24	54	103	123	75	66
	57	57	64	50	42	37	28	16	8	15	6
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1992	1	9	0	0	395.8	0	0	4	2	4	9
	21	34	59	50	41	49	78	109	191	196	181
	132	122	73	58	86	77	56	23	15	17	12
	3	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1993	1	9	0	0	296.9	1	0	0	2	0	1
	8	21	25	25	28	41	43	45	66	72	143
	113	122	78	57	49	66	60	30	21	29	12
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1994	1	9	0	0	210.4	0	0	0	1	3	10
	12	6	8	13	25	57	50	48	66	58	63
	63	49	51	36	25	17	21	14	8	11	5
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1995	1	9	0	0	224.5	0	0	2	3	3	12
	9	22	18	32	33	41	32	42	60	72	84
	73	50	36	30	34	17	17	7	8	8	5
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1996	1	9	0	0	185	1	0	0	0	1	4
	5	7	18	22	24	26	24	41	43	53	51
	53	45	32	38	25	22	17	13	5	10	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1997	1	9	0	0	257.5	0	0	0	1	5	4
	9	3	12	24	29	33	49	35	75	63	63
	86	83	82	76	67	52	47	29	16	28	11
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1998	1	9	0	0	124.7	0	0	0	0	0	1
	5	7	15	15	8	10	18	30	33	39	37
	36	32	33	29	27	21	10	10	6	3	7
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			

#Year	Seas	Flt/Svy	Gender	Part	NSamp	16	18	20	22	24	26
	28	30	32	34	36	38	40	42	44	46	48
	50	52	54	56	58	60	62	64	66	68	72
	76	16	18	20	22	24	26	28	30	32	34
	36	38	40	42	44	46	48	50	52	54	56
	58	60	62	64	66	68	72	76			
2004	1	10	3	0	57	0	0	0	0	0	2
	0	13	5	1	2	5	9	12	20	50	57
	108	106	42	24	11	6	7	3	1	2	0
	0	0	0	0	0	1	4	7	20	7	4
	3	6	7	20	24	51	59	35	26	7	11
	4	3	1	1	0	0	0	0			

2005	1	10	3	0	65	0	0	0	0	0	0
	0	2	4	4	8	14	6	7	2	2	10
	26	56	79	72	50	14	11	8	7	11	2
	2	0	0	0	0	0	0	1	1	3	3
	10	20	14	6	6	11	16	48	43	35	18
	11	10	6	1	0	0	1	0			
2006	1	10	3	0	70	0	0	0	1	1	8
	20	7	2	3	1	5	18	33	38	44	25
	22	37	52	59	45	18	4	7	2	3	1
	0	0	0	1	1	6	13	15	13	1	2
	10	12	25	17	23	21	6	14	24	36	22
	12	3	2	2	0	1	0	0			
2007	1	10	3	0	78	0	0	0	0	0	0
	0	2	4	25	40	18	12	14	21	26	27
	30	28	30	43	27	20	8	3	3	4	1
	1	0	0	0	0	0	0	0	2	6	15
	16	22	10	11	15	14	28	32	35	16	24
	6	2	2	0	1	0	0	0			
2008	1	10	3	0	90	0	0	0	0	1	2
	4	8	4	9	8	21	39	28	20	24	21
	34	28	31	35	39	29	15	7	4	2	0
	0	0	0	0	0	0	1	8	5	4	6
	11	24	35	17	13	24	19	22	18	18	11
	7	6	1	1	1	0	0	0			
2009	1	10	3	0	80	0	0	0	0	1	2
	3	3	4	7	14	16	15	18	35	25	24
	29	17	38	31	42	17	13	2	3	3	1
	1	0	0	0	0	0	2	2	4	3	8
	5	15	11	24	15	18	18	21	21	28	21
	5	5	0	0	0	0	0	0			
2010	1	10	3	0	64	0	0	0	0	0	1
	3	3	5	2	4	5	4	6	13	18	2
	15	11	4	12	13	18	3	3	5	2	1
	0	2	1	0	0	0	0	5	5	3	3
	2	5	6	8	9	9	11	10	10	10	5
	10	0	1	1	0	0	0	0			

#year	Seas	Flt/Svy	Gender	Part	Nsamp	16	18	20	22	24	26
	28	30	32	34	36	38	40	42	44	46	48
	50	52	54	56	58	60	62	64	66	68	72
	76	16	18	20	22	24	26	28	30	32	34
	36	38	40	42	44	46	48	50	52	54	56
	58	60	62	64	66	68	72	76			
2003	1	11	3	0	38.454	0	0	0	0	0	14677
	0	0	0	0	0	0	19773	12373	12590	31816	33936
	82649	55254	12159	11412	19250.5	13105	20986	12487	14788	6029	5077
	3832	0	0	0	0	0	27911	12487	0	0	9024
	30739	0	59320	45082	38462	99249	39067	33419	21508	47151	33186
	28779.5	0	0	0	6029	0	0	0			
2004	1	11	3	0	96.516	0	0	0	9015	38855	151044
	257610	316953	22193	150585	119209	169096	63290	71791	176752	217938	83366
	279525	250018	840875	204934	131428	58799	34468	11301	44503	12658	0
	0	0	0	0	25368	23409	165924	320652	358702	232678	74084
	171619	96158	168656	135720	169682	542970	452187	266385	820258	429010	52210
	12013	11301	21430	22378	0	20332	0	0			
2005	1	11	3	0	71.054	0	0	0	6099	0	19905
	93519	11484	143365	95153	213206	44473	0	39619	10022	21842	36056
	82164	114577	135087	77615	46055	18435	18435	17562	10022	70913	13884
	0	0	0	6099	0	43348	26004	28896	0	137041	186601
	103421	80779	11389	21363	44058	32670	150622	248487	191348	167876	62870
	16232	33745	34131	0	0	0	0	0			

2006	1	11	3	0	64.256	0	0	22460	11717	34763	82996
	20114	11369	0	35756	18325	11150	114592	178976	30919	22877	0
	18668	33384	34315	34315	66592	0	16465	0	16465	39661	13721
	6462	0	0	23434	46601	229159	335595	20963	12159	0	0
	33647	23597	252133	213932	35560	11438	22877	33620	35036	20395	25396
	22068	7259	18957	5235	10342	8442	0	0			
2007	1	11	3	0	47.424	0	0	0	0	0	0
	0	32757	34745	112013	32559	22146	0	23370	11375	124584	97164
	11685	11685	33342	22115	68650	27640	45602	11682	0	0	0
	0	0	0	0	0	0	0	0	0	98696	135710
	38700	0	20002	70111	56177	61278	46741	30433	97274	113547	63830
	35380	32807	0	0	0	0	0	0			
2008	1	11	3	0	34.938	0	0	0	0	44005	20487
	0	0	0	0	12235	12235	12235	0	0	0	11621
	9830	19264	16848	46848	22030	26727	32181	39130	31938	14466	19560
	0	0	0	7464	10244	10244	0	0	0	10244	0
	10244	22479	12235	0	31800	17194	7944	15887	45376	34191	108031
	66513	49869	18143	15887	15887	0	0	0			
2009	1	11	3	0	35.972	0	0	11385	9159	23220	23285
	30916	7935	31479	31018	24075	0	7783	7783	29543	7783	6592
	15878	16203	28984	9897	36217	16717	9785	0	8606	11416	0
	0	0	0	31929	16726	16139	18415	0	0	0	23069
	25929	33705	7783	21902	22597	15566	7783	17568	21313	51157	9785
	9159	24354	5301	0	0	0	0	0			
2010	1	11	3	0	32.798	0	0	64452.5	9072	36288	43555
	0	9072	9057	9057	0	0	0	0	0	0	0
	7267	0	0	7267	25618	7267	15878	0	0	0	8101
	0	0	0	82932.5	36287	70194	17082	0	9072	15408	27171
	9072	0	0	0	7615	0	0	36403	0	60028	29069
	9874	16723	12059	0	0	0	0	0			

this is the Gotshall and Miller LF data from Central California sampling programs

#year	Seas	Flt/Svy	Gender	Part	#_samp	16	18	20	22	24	26
	28	30	32	34	36	38	40	42	44	46	48
	50	52	54	56	58	60	62	64	66	68	72
	76	16	18	20	22	24	26	28	30	32	34
	36	38	40	42	44	46	48	50	52	54	56
	58	60	62	64	66	68	72	76			
1959	1	14	0	0	-10	9	0	0	0	0	0
	0	0	0	3	3	4	5	12	19	28	24
	40	24	24	15	14	5	4	6	3	1	0
	3	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1960	1	14	0	0	-95	0	1	2	1	0	0
	0	0	1	5	4	5	25	42	121	123	166
	122	103	105	58	26	20	14	5	5	2	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1961	1	14	0	0	-25	0	0	0	0	0	0
	0	0	6	2	2	2	1	5	22	44	51
	57	25	10	13	2	6	3	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1966	1	14	0	0	-30	140	3	2	1	1	3
	5	2	10	28	40	35	14	6	1	10	12
	28	30	25	15	13	21	3	4	3	3	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			

this is the observer LF data

#Yr	Seas	Flt/Svy	Gender	Part	Neff	16	18	20	22	24	26
	28	30	32	34	36	38	40	42	44	46	48
	50	52	54	56	58	60	62	64	66	68	72
	76	16	18	20	22	24	26	28	30	32	34
	36	38	40	42	44	46	48	50	52	54	56
	58	60	62	64	66	68	72	76			
2002	1	15	0	0	24.38	0	0	0	0	0	0
	0	0	0	0	1	1	8	19	10	16	9
	15	11	11	7	7	3	3	1	0	3	1
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2003	1	15	0	0	8.83	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	3	5
	6	4	6	2	4	0	0	0	0	5	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2004	1	15	0	0	60.36	0	0	12	4	7	0
	2	0	0	0	0	0	2	3	7	9	24
	28	45	40	21	26	24	18	14	11	9	1
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2005	1	15	0	0	123.2	0	0	0	0	0	2
	1	0	0	2	6	8	5	8	21	34	49
	66	85	88	88	56	50	35	32	16	22	8
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2006	1	15	0	0	38.80	0	0	0	0	0	0
	0	0	0	0	1	2	5	11	20	19	13
	10	14	27	14	11	13	9	7	4	5	2
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2007	1	15	0	0	44.46	0	1	0	0	1	1
	0	1	0	1	2	1	1	0	3	2	8
	23	13	17	21	15	14	12	12	10	8	1
	2	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2008	1	15	0	0	2.828	0	0	0	0	1	2
	0	0	0	0	0	0	0	0	0	0	0
	0	0	1	0	0	0	1	0	0	1	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			

#Yr	Seas	Flt/Svy	Gender	Part	Neff	16	18	20	22	24	26
	28	30	32	34	36	38	40	42	44	46	48
	50	52	54	56	58	60	62	64	66	68	72
	76	16	18	20	22	24	26	28	30	32	34
	36	38	40	42	44	46	48	50	52	54	56
	58	60	62	64	66	68	72	76			
1975	1	16	0	0	400	3	8	18	22	124	435
	1059	2645	3183	2660	2729	2587	1969	910	662	705	717
	495	354	236	129	69	57	41	19	10	12	7
	1	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1976	1	16	0	0	400	7	5	9	35	91	160
	381	1136	2293	2505	2364	3574	3567	2634	1841	1329	1140
	895	687	463	292	154	131	87	43	31	31	14
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1977	1	16	0	0	400	35	86	114	66	36	48
	126	252	276	290	438	1081	1428	1372	1514	1256	815
	587	485	389	279	162	96	77	49	41	25	8
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1978	1	16	0	0	400	24	26	293	978	1346	1444
	1622	1729	1059	343	261	389	669	863	1218	1390	1348
	1042	752	625	464	295	189	106	41	34	21	6
	2	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1986	1	16	0	0	400	3	1	17	23	25	60
	139	373	629	701	610	497	335	133	68	58	86
	91	79	72	47	38	13	8	2	1	1	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1987	1	16	0	0	400	1	0	0	1	3	15
	36	100	134	171	305	548	596	382	191	110	66
	57	54	48	45	31	29	13	6	3	3	0
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1988	1	16	0	0	341	7	6	7	14	1	17
	38	89	106	80	49	103	137	186	260	239	178
	93	69	73	26	22	30	12	11	7	8	1
	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1989	1	16	0	0	400	9	11	33	167	289	286
	390	715	679	318	117	120	134	183	260	340	290
	207	190	113	65	33	33	16	16	7	4	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			

21 #_N_age_bins
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
0 #_N_ageerror_definitions
0 #_N_Agecomp_obs
1 #_Lbin_method: 1=poplenbins; 2=datalenbins; 3=lengths
1 #_combine males into females at or below this bin number
#Yr Seas Flt/Svy Gender Part Ageerr Lbin_lo Lbin_hi Nsamp datavector(female-male)

0 #_N_MeanSize-at-Age_obs
#Yr Seas Flt/Svy Gender Part Ageerr Ignore datavector(female-male)

1 #_N_environ_variables
0 #_N_environ_obs
1 # N sizefreq methods to read

```
25 #Sizefreq N bins per method
1 #Sizetfreq units(bio/num) per method
1 #Sizefreq scale(kg/lbs/cm/inches) per method
1e-005 #Sizefreq mincomp per method
20 #Sizefreq N obs per method
#_Sizefreq bins
0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4
	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.5	5	5.5
	6	6.5
#_Year season Fleet Partition Gender SampleSize <data>
# southern California RecFIN
#	#Yr	Seas	Flt/Svy	Gender	Part	Nsamp	0.2	0.4	0.6	0.8	1
	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2
	3.4	3.6	3.8	4	4.5	5	5.5	6	6.5	0.2	0.4
	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6
	2.8	3	3.2	3.4	3.6	3.8	4	4.5	5	5.5	6
	6.5
1	1980	1	4	0	0	-176	253	258	821	536	209
	121	81	81	66	55	41	35	21	10	5	4
	4	2	0	3	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0
1	1981	1	4	0	0	-148	211	395	367	302	316
	240	110	72	58	60	31	33	16	8	3	3
	4	0	0	0	2	2	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0
1	1982	1	4	0	0	-135	40	82	313	320	268
	306	174	115	71	54	39	19	9	6	1	4
	3	0	1	2	0	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0
1	1983	1	4	0	0	-99	8	58	123	103	79
	80	41	39	36	42	33	17	7	12	3	9
	8	0	1	4	2	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0
1	1984	1	4	0	0	-181	127	13	30	63	79
	102	47	45	30	19	8	14	4	3	2	3
	3	0	0	2	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0
1	1985	1	4	0	0	-147	669	281	30	29	49
	63	55	50	42	26	21	8	13	1	1	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0
1	1986	1	4	0	0	-119	253	567	266	41	24
	20	32	16	18	20	21	2	7	2	5	2
	1	0	1	0	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0
1	1987	1	4	0	0	-32	37	20	33	10	12
	6	1	4	1	5	2	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
```

	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
1	1988	1	4	0	0	-39	12	12	13	11	12
	8	4	2	3	1	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
1	1989	1	4	0	0	-50	139	105	42	41	49
	28	26	14	7	6	4	8	5	1	4	1
	4	2	0	1	0	2	0	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										

Northern California RecFIN

#use	YEAR	Seas	Flt/Svy	Gender	Part	Nsamp	0.2	0.4	0.6	0.8	1
	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2
	3.4	3.6	3.8	4	4.5	5	5.5	6	6.5	0.2	0.4
	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6
	2.8	3	3.2	3.4	3.6	3.8	4	4.5	5	5.5	6
	6.5										
1	1980	1	5	0	0	-70	24	4	27	42	16
	16	22	14	11	14	3	6	9	6	3	3
	5	1	3	12	2	5	0	1	3	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
1	1981	1	5	0	0	-34	2	12	12	16	46
	48	21	6	6	13	10	12	6	8	5	3
	4	6	1	4	7	2	1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
1	1982	1	5	0	0	-50	1	7	13	22	18
	48	44	50	31	26	15	7	4	5	7	4
	4	1	0	4	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
1	1983	1	5	0	0	-46	3	9	6	11	21
	33	47	44	46	48	29	17	13	8	7	6
	5	1	2	1	0	0	1	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
1	1984	1	5	0	0	-69	6	8	16	15	21
	17	18	17	16	9	8	5	6	9	1	5
	2	1	4	1	0	1	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
1	1985	1	5	0	0	-99	301	37	13	21	21
	20	17	18	17	11	12	16	9	13	10	8
	2	4	1	3	3	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
1	1986	1	5	0	0	-105	84	365	266	45	5
	10	12	14	16	18	14	19	16	17	6	6
	10	7	3	6	3	1	0	1	0	0	0

	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
1	1987	1	5	0	0	-37	9	55	50	19	8
	5	2	2	5	4	4	7	5	11	7	8
	2	3	5	6	4	2	0	0	2	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
1	1988	1	5	0	0	-36	3	10	10	7	4
	8	5	3	1	1	0	1	2	0	0	1
	0	0	0	0	0	0	0	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
1	1989	1	5	0	0	-36	8	17	27	3	11
	14	16	8	8	2	1	0	0	0	1	0
	1	0	0	1	0	0	0	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										

0 # no tag data
0 # no morphcomp data

999

ENDDATA

BOCACCIONOMICS: THE EFFECTIVENESS OF PRE-RECRUIT INDICES FOR ASSESSMENT AND MANAGEMENT OF BOCACCIO

JOHN C. FIELD, ALEC D. MACCALL, STEPHEN RALSTON
Fisheries Ecology Division
Southwest Fishery Science Center
National Marine Fisheries Service

MILTON S. LOVE
University of California, Santa Barbara

ERIC F. MILLER
MBC Applied Environmental Sciences

ABSTRACT

Bocaccio (*Sebastes paucispinis*) has been one of the most important species of rockfish to both commercial and recreational fisheries in California Current waters over the last century. Actions taken to rebuild the stock of bocaccio residing off of California have been responsible for dramatic changes on both commercial and recreational groundfish management and total allowable yields of most groundfish species in California waters over the last decade, including a virtual cessation of commercial and recreational fishing in 2003. In retrospect, it was determined that a strong 1999 year class was moving through the fishery at that time, resulting in high catch rates during a period in which management sought to drastically reduce catch. This results in a paradox, in which rebuilding requires strong year classes, which requires further constraints on fishing during periods in which the condition of the stock seems to be improving. Although this paradox exists for all stocks undergoing rebuilding, it is particularly pronounced for bocaccio as they have among the greatest variability in recruitment observed in any species of West Coast rockfish, as well as very rapid growth and very young age at recruitment to the recreational fishery. Consequently, accurate indices of the strength of incoming year classes both improve stock assessment estimates of future (near term) abundance trends, as well as aid regulators in making management decisions during those infrequent periods of high abundance of young fish. We discuss several indices of recruitment strength based on data on young bocaccio, evaluate their relative performance in the early detection of strong year classes, and consider both the oceanographic factors that may drive recruitment variability, as well as the spatial patterns of recruitment events which may aid in interpreting these indices.

INTRODUCTION

Bocaccio (*Sebastes paucispinis*) have long been one of the most important targets of both commercial and recreational fisheries in California waters, accounting for between 25 and 30% of the commercial and recreational rockfish (*Sebastes* spp.) catch over the past century. However, this percentage has declined in recent years as a result of stock declines, restrictive management actions and the development of alternative fisheries. Catches and abundance began to fall during the 1980s and declined rapidly in the 1990s, due to a combination of high harvest rates and poor ocean conditions (MacCall 2003; Field et al. 2009). More recently, since the southern sub-stock of bocaccio (currently representing the population of bocaccio south of Cape Blanco, OR)[1] was declared overfished by the Pacific Fishery Management Council (PFMC) in 1999,[2] management measures have been responsible for even more significant reductions of both commercial and recreational catches. Management measures included a virtual cessation of most commercial and recreational fishing in 2003, following a very pessimistic assessment of stock status in 2002 (MacCall et al. 2002).

The landings limitations and area closures that followed the 2002 assessment led to considerable economic hardships during a period in which many fishermen complained bitterly that bocaccio were "more abundant than ever before." Management constraints implemented to rebuild bocaccio, as well as six other species of rockfishes that were declared overfished, have substantially reduced rockfish landings coastwide since then (Berkeley et al. 2004, Punt and Ralston 2007). Although the stock is still estimated to have been in an overfished condition throughout the 1990s, the most recent assessment indicates that the population was not as depleted as estimated in the 2002 assessment (MacCall 2003, Field et al. 2009). Additionally, it is now clear that a relatively strong (relative to parental biomass) 1999 year class had indeed been moving through the fishery at that time, following a decade of record-low recruitment

[1]This paper investigates the recruitment and abundance trends of the southern sub-stock of bocaccio only, currently defined as waters south of Cape Blanco, Oregon to the U.S./Mexico border (Field et al. 2009). Bocaccio in U.S. waters north of Cape Blanco are likely to be more connected from a population perspective to bocaccio off of British Columbia, Canada, for which abundance has also been estimated to be at very low levels (Stanley et al. 2009).

[2]The PFMC is the management body charged with implementing the requirements of federal law for west coast groundfish fisheries, and defines a stock or population as being "overfished" if the stock is at or below the minimum stock size threshold (MSST). The MSST for West Coast rockfish is currently defined as 25% of the estimated spawning biomass or spawning potential that would occur in an unfished condition.

levels that began in 1990. Thus, the fishermen's complaints had validity, in that the bocaccio population was undergoing a significant increase in abundance during a period in which management sought to drastically reduce catch.

Consequently, management of bocaccio in recent years has been complicated by both changes in management regimes and objectives, and variable population trajectories driven (to a large extent) by highly variable recruitment. Despite the significant socio-economic hardships, management actions have been effective at reducing mortality. This combined with several recent strong year classes (1999, 2003, 2005), have resulted in an increase in abundance and spawning output over the past decade. Although the current estimate of abundance is substantially higher than those of the 1990s, the population will remain in "rebuilding" status until it has recovered to the target level of abundance, currently set to 40% of the unfished abundance for West Coast groundfish (Punt and Ralston 2007; Field and He 2009). In an analysis of the likely time to rebuild to this target level, recruitment variability remains among the most significant factors contributing to rebuilding success or failure by the currently adopted management target of 2026 (Field and He 2009). Rebuilding plans and targets are developed by simulating forward projections of the population under a variety of harvest rates to determine the probability of recovering to target abundance levels (40% of the unfished spawning potential) by target years that are defined by law (Punt 2003; Punt and Ralston 2007). For bocaccio, the current target is the year 2026, and while the most recent assessment projects that this rebuilding target has a greater than 75% probability of being met (at current harvest rates), this leaves an approximately 25% probability of not achieving this target. Most of the uncertainty regarding the probability of rebuilding is a consequence of recruitment stochasticity and the inability to accurately forecast future recruitment events.

Information regarding the magnitude and the determinants of impending year class strength can be of utility for tactical management actions, such as short-term catch projections and consideration of seasonal and area closures, particularly with respect to avoiding the mismatch between stock trends and management actions that took place following the 1999 year class and the overfishing declaration. In this manuscript, we will first briefly describe the early life history of bocaccio and introduce four fishery-independent sources of information regarding recruitment success as indexed by the abundance of young-of-the-year (YOY) bocaccio, and describe the methods typically used to develop recruitment indices from these data. Next we will provide a short overview of the structure and results of the most recent bocaccio assessment, including biomass trends and exploitation rates, but with a focus on the estimation of recruitment in either the most recent or in past stock assessments. Then we will evaluate the relative performance of the recruitment indices in predicting impending strong year classes (assuming that the stock assessment estimates of recruitment based on length composition data represent "true" recruitment). Finally, we will consider the performance of recruitment indices, including the spatial patterns of recruitment events and how these indices may relate to climate variables, and discuss how these indices could or should be used in future assessments and management.

DATA AND METHODS

Life history

Like all rockfish, bocaccio are primitively viviparous and bear live young at parturition. Copulation typically takes place during September–October, although fertilization is often delayed, and parturition occurs during the winter months (Moser 1967; Wyllie Echeverria, 1987). Figure 1 provides a conceptual overview of early life history stages of bocaccio following parturition. Early stage larvae (pre-flexion, approximately 0 to 20 days) are weak swimmers, however post-flexion late-stage larvae do have some swimming capabilities. Bocaccio are one of a very few number of *Sebastes* species for which data on larval abundance and distribution are available from 1951 to the present from California Cooperative Oceanic Fisheries Investigation research collections, as the larvae of most *Sebastes* species cannot be distinguished using morphological characteristics (Moser et al. 1977). These data have long been used as an indicator of population abundance in stock assessments (MacCall 2003; Field et al. 2009), under the assumption that larval abundance is a reflection of the female reproductive effort and thus spawning biomass. More recently, Ralston and MacFarlane 2010 have used these data to estimate total (rather than relative) spawning biomass. However, as year class strength for most California Current fish populations is thought to be set following parturition (Lasker 1977, Hollowed 1992), larval abundance data are not considered a reliable indicator of recruitment.

Both larval and juvenile stages are typically found in the mixed layer from 10 to 100 meters depth, (Ahlstrom 1959; Ross and Larson 2003). Pelagic juveniles are capable swimmers, and there is some evidence that both larval and juvenile stages of bocaccio tend to occur in the shallower sections of the water column (Ross and Larson 2003), which would imply greater dispersal relative to more deeply oriented larval and juvenile rockfish based on the propagule dispersal models

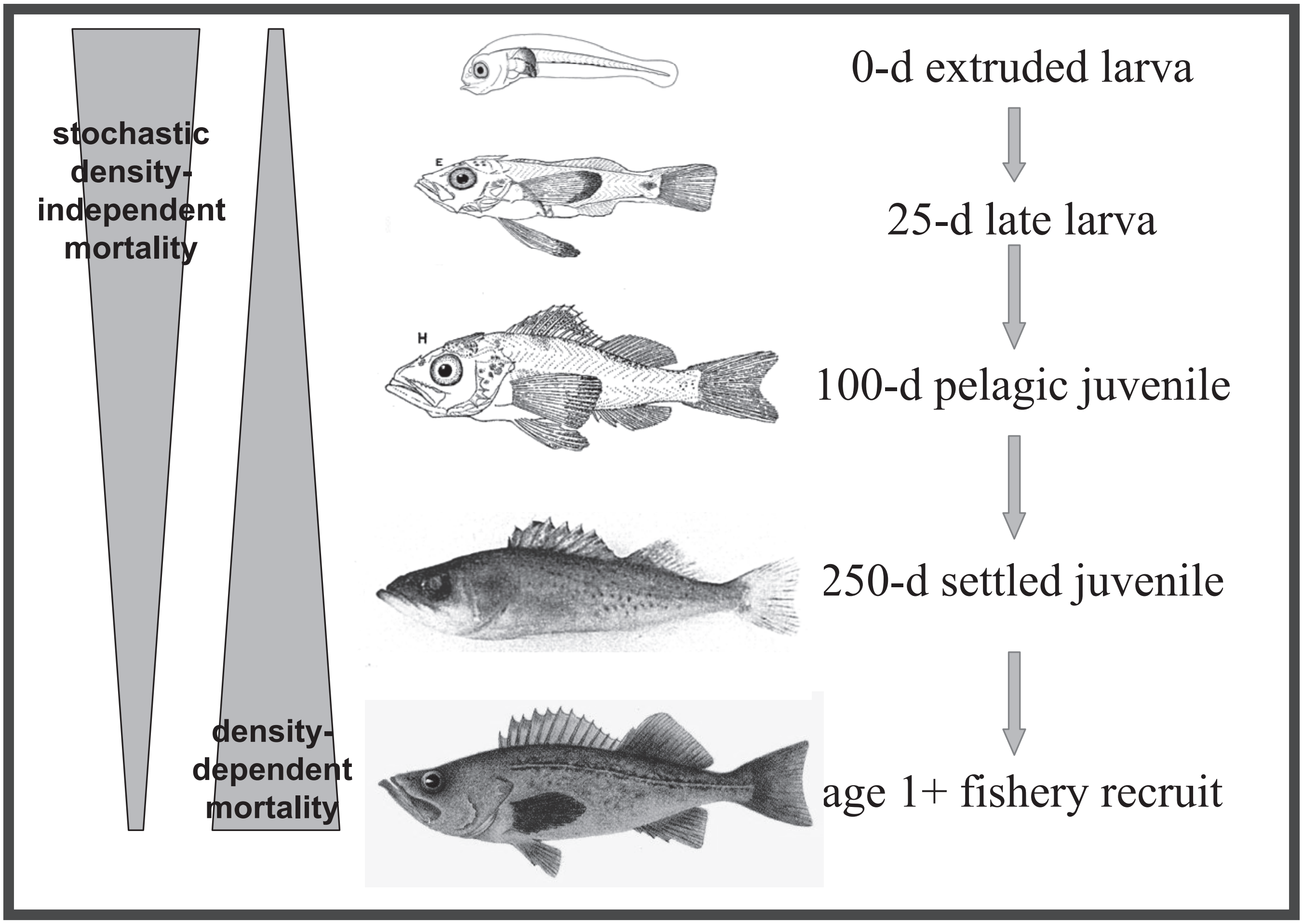


Figure 1. Ontogenetic sequence of bocaccio life history stages, as related to a conceptual model of the nature of density dependent and density independent mortality sources for each stage.

of Peterson et al. (2010). This may also lead to relatively greater dispersal to nearshore habitats immediately prior to settlement to benthic habitats, as bocaccio are entrained in surface waters that are pushed closer to the coastline than waters at depth. Settlement to nearshore and demersal habitats begins in late spring and extends throughout the summer months. Pelagic YOY typically recruit to shallow habitats, and subadult bocaccio are more common in shallower water than adults, with an apparent ontogenetic movement of adults to deeper water with size and/or age. Adult bocaccio occur in a broad range of habitats and depths, including midwater, although high densities tend to be more associated with more complex (e.g., rocky, high relief) substrates.

The rapid growth of bocaccio is also initiated at the juvenile stage; Woodbury and Ralston (1991) describe linear species-specific growth rates (and interannual variability in the same) for juvenile rockfish in approximately the first 50 to 150 days of life. Bocaccio growth rates ranged from 0.56 to 0.97 mm/day, the highest rate amongst the *Sebastes* species. This rapid growth continues into the settled juvenile and young adult stages, with fish growing to a mean size of 27 and 36 cm (fork length) by ages 1.5 and 2.5 respectively, the most rapid growth of any West Coast *Sebastes*. As bocaccio have been proven to be very difficult to age (Andrews et al. 2005; Piner et al. 2006), and age data are consequently not routinely developed or used in assessments, this rapid growth provides the primary means of estimating recruitment variability and year-class (cohort) strength from length frequency data (Ralston and Ianelli 1998). Such rapid growth is fueled by almost exclusive piscivory; Phillips (1964) reported that recently settled YOY typically preyed on other YOY rockfishes, surfperches (Embiotocidae), jack mackerel (*Trachurus symetricus*) and other small inshore species, and that such patterns of piscivory are retained throughout their life.[3]

[3]Juvenile rockfish appear to dominate the prey spectrum of juvenile bocaccio, as the original food habits notes of Phillips report that *Sebastes jordani, S. goodei, S. mystinus* and other species represented more than 60% of all prey, while the *Sebastes* genus, primarily *S. jordani*, represented 40% of the prey of adult *S. paucispinis.* Access to Phillip's original notes was graciously provided by Tim Thomas of the Monterey Maritime Museum.

Stock assessment results

The most recent bocaccio assessment was adopted as the scientific basis for management actions by the PFMC in September 2009 (Field et al. 2009). The resulting abundance trends and recruitment estimates were highly consistent with previous assessments (MacCall 2003; MacCall 2007), although changes in the estimated catch history resulted in a generally more optimistic perception of the stock status and productivity. The modeling framework used in this assessment (and most other West Coast groundfish assessments) is the age structured model Stock Synthesis III (Methot 2009a, 2009b). The model treats a cohort, or year class, as a collection of fish whose size-at-age is characterized by a mean and a variance, such that the numbers at age are distributed across defined length bins. Several sources of both fishery-dependent (catch per unit effort data) and fishery independent (surveys of larval abundance, trawl surveys, and juvenile abundance indices) information are available for this species, and there are hundreds of thousands of length observations across various fisheries and surveys which inform population structure and estimates of recruitment. In order to evaluate the performance of the recruitment indices independently from their effect in the assessment model, the adopted stock assessment model was re-run with the recruitment indices removed. This is done to avoid contaminating the estimated "true" recruitment time series,[4] based exclusively on fishery and survey abundance and length frequency data, to recruitment indices derived solely from the suite of juvenile (age-0) abundance data explored in this manuscript.

Juvenile abundance data

We evaluate four sources of juvenile abundance data for consideration as indices of impending recruitment for bocaccio assessment and management. The first is an index of pelagic juvenile abundance based on data from a standardized midwater trawl survey specifically designed to estimate the abundance of pelagic juvenile rockfishes, and to develop indices of year-class strength for use in groundfish stock assessments (Ralston and Howard 1995). The remaining three indices reflect a slightly later life history stage for YOY rockfish, as settling or recently settled juveniles from power plant impingement studies, recreational pier fisheries, and submersible (*in situ*) surveys of fish abundance at both oil platforms and natural reef habitats in the Southern California Bight. We develop these data sources into relative recruitment indices, and subsequently contrast them with the recruitment estimates from the statistical catch-at-age model in order evaluate their performance in early detection of recruitment events. Each of these four datasets represents a different region of the range of the population of bocaccio subpopulation (fig. 2), although most of the data overlap spatially. Although the southern subpopulation is currently considered to range from the U.S./Mexico border to Cape Blanco, Oregon, recruitment of YOY bocaccio is rarely observed north of 38°N, the approximate northern boundary of the midwater trawl survey. Recruits are rarely observed between this region and the apparent center of the northern subpopulation off of Vancouver Island, Canada.

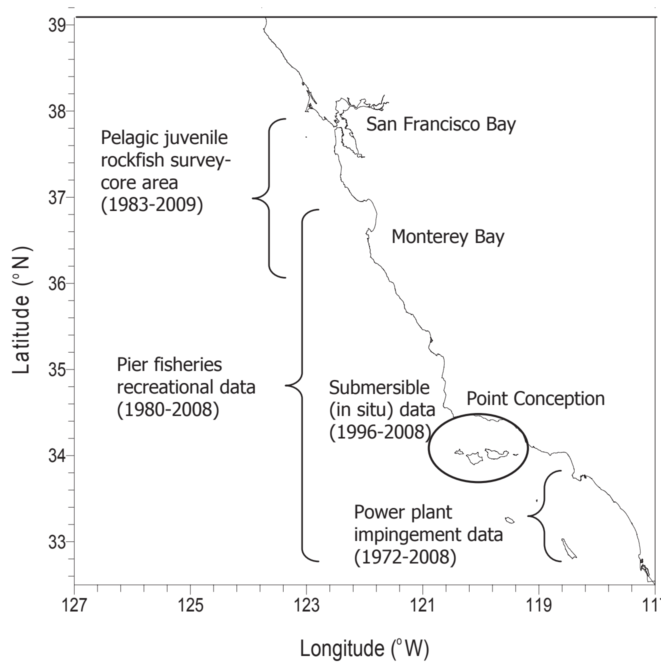


Figure 2. Spatial distribution of the four sources of data on juvenile abundance used to develop recruitment indices.

The midwater trawl survey samples YOY rockfish when they are ~100 days old, an ontogenetic stage that occurs after year-class strength is established from the larval stage, but well before cohorts recruit to commercial and recreational fisheries. This survey has encountered strong interannual variability in the abundance of the rockfishes that are routinely indexed, as well as high apparent synchrony in abundance among the ten most frequently encountered species. This synchronicity appears to be related to physical climate indicators (S. Ralston and J. Field, unpublished data). Several past assessments have used this survey as an index of year-class strength, including assessments for widow rockfish (*Sebastes entomelas*, He et al. 2005), Pacific hake (*Mer-*

[4]In most age structured stock assessment models, annual recruitment estimates are estimated with parameters that represent lognormally distributed deviations around the "expected" recruitment based on the spawner recruit relationship (Maunder and Deriso 2003, Methot 2009). The standard deviation of these parameters, σ_R, defines the magnitude of recruitment variability. For bocaccio this value is fixed at 1 and estimated to be (effectively) slightly greater (1.1).

luccius productus, Helser et al. 2006[5]), shortbelly rockfish (*S. jordani*, Field et al. 2007) and chilipepper rockfish (*S. goodei*, Field 2008). The midwater trawl survey has taken place during May–June every year since 1983, with a historical range (1983–2003) between 36˚30' to 38˚20' N latitude (approximately Carmel to just north of Point Reyes, CA). Beginning in 2004, the spatial coverage expanded to effectively cover a broader range of the California Current, from Cape Mendocino in the north to the U.S./Mexico border in the south (Sakuma et al. 2006). Although the expanded survey frame is considered to be a more appropriate index for use in stock assessments[6], the time series of the expanded survey is thus far insufficient to accurately assess performance relative to the time series from the core area. Consequently, we focus on the long-term data for this evaluation, in order to address the long-term performance of the index. The survey index is calculated after the raw catch data are adjusted to a common age of 100 days to account for interannual differences in age structure (Ralston and Howard 1995).

The power plant impingement index represents data collected from coastal cooling water intakes at five Southern California electrical generating stations from 1972 to 2008 (and ongoing). These data have been previously described and published by Love et al. (1998) and Miller et al. (2009) with respect to trends in abundance of *Sebastes* species and queenfish (*Seriphus politus*), respectively (See either of these manuscripts for additional information, and the precise location of the facilities). The dataset includes observations on over 13 million fish encountered in three basic types of power plant impingement surveys (E. Miller unpublished data). The three principle "types" of survey data include fish sampled off of intake screens during normal operations (typically over a 24 hour period, however we aggregated normal operations data by month for any given plant), fish abundances estimated during heat treatments (a periodic event in which a given volume of water is treated at high temperatures to kill off biofouling organisms [mussels, barnacles, etc.; Graham et al. 1977], and all fishes are subsequently enumerated), and a third set of impingement survey data that are unique to the San Onofre power plant but were not used in this analysis due to the low frequency of occurrence of bocaccio in those data (Miller et al. 2009). Fish are identified to the lowest possible taxon, and standardized length measurements are obtained for all species. The frequency of all of these sampling methods is irregular, as a result of changes in operating schedules, regulatory requirements and changes in ownership over time, however the time series is uninterrupted at the annual scale from 1972–2008.

Recreational fisheries catch, and often target, bocaccio of all sizes throughout their range, including high catches of YOY bocaccio in pier fisheries in central and southern California during good recruitment years. Since 1980 (but excluding 1990–1992), these pier fisheries have been sampled, first by the Marine Recreational Fisheries Statistics Survey (MRFSS) and then by the California Recreational Fisheries Survey (CRFS), with data analyzed and made available on the RecFIN internet site. The stock assessment also incorporated data from studies in the 1950s and 1960s that were insightful with respect to several large historical recruitment events.[7] Catches of bocaccio typically take place during infrequent strong recruitment years from San Mateo county (south of the entrance to San Francisco Bay) through Ventura county (somewhat north of Palos Verdes peninsula in the Southern California Bight), with the highest catch rates being observed in San Luis Obispo county. Juveniles were rarely observed at piers south of Los Angeles County, and in analyzing spatial patterns of recruitment, MacCall (2003) concluded that there was no evidence of separate recruitment events north and south of Point Conception in these data. For this analysis, RecFIN records of bocaccio catch per angler hour were summarized by years, 2-month sampling periods ("waves," using only waves 3, 4 and 5, corresponding to data from May through October, as bocaccio catches in other waves were very infrequent), and counties, such that each combination constitutes a single record.

In southern California, settling juvenile bocaccio recruit to a variety of habitats, including both natural reefs and oil platforms, often in large numbers during strong recruitment years. Observational data collected from submersible (*in situ*) surveys have been used to assess the abundance of rockfish and other species on both natural reefs and oil platforms to develop absolute abundance indices for other species of rockfishes (e.g., Love et al. 2005; Yoklavich et al. 2007) and to characterize assemblages of rockfish communities (Love et al. 2009); details of the survey methods and results can be found in those publications. Over the course of these

[5]The index evolved to a coastwide index following the 2006 assessment, but has not been used on the most recent assessment (Hamel and Stewart 2009), although it continues to be reported in the assessment documentation.

[6]See discussion in J. Hastie and S. Ralston, 2006, "Summary Report of Pre-Recruit Survey Workshop, September 13-15, 2006, Southwest Fisheries Science Center Santa Cruz, California," prepared for the PFMC (reported in April 2007 in the NWFSC Supplemental Science Report, Agenda Item E.1.b) and available online at http://www.pcouncil.org/bb/2007/0407/E1b_NWFSC3_sup.pdf.

[7]URL for recfin: http://www.recfin.org/data.htm. Historical data are from Miller and Gotschall (1965), who reported large numbers of YOY bocaccio in piers throughout central California in 1956 and 1957; an event also observed by one of the coauthors (M. Love). Large numbers of bocaccio were also observed in pier fisheries in the Central California region during the fall of 1966, for which bocaccio accounted for 26% of the 1.3 million fish estimated to have been caught in pier fisheries in that year (Miller and Odemar 1968).

surveys, bocaccio catches have been shown to be very patchily distributed, with the highest catch (observation) rates at oil platforms relative to natural reef habitats (Love et al. 2006). For all of the submersible data, we obtained dive-specific "catch" (observation) rates, which were standardized to reflect observations per 100 square meters. Only bocaccio smaller than 30 cm were included in developing the catch rate index.

All of the recruitment indices were developed using a Delta-GLM (generalized linear model) approach, consistent with the approach used in past assessments (MacCall 2003; Field et al. 2009). The Delta-GLM approach combines a binomial model for presence/absence information with a model of catch per unit effort for positive observations (Stefansson 1996, Maunder and Punt 2004). Akaike's Information Criterion (AIC) was used to determine the appropriate error distributions and to assess the most parsimonious model with respect to the number of covariates (Dick 2004). Year effects are independently estimated covariates which reflect a relative index of abundance for each year, error estimates for these parameters are developed with a jackknife routine. Seasonal (or temporal) effects are estimated using month, two-month periods, or season as covariates depending upon the resolution of the original data. For the midwater trawl survey, which takes place over an approximate 50 day period in May and June, bins of 10 Julian day periods are used, while two month periods ("waves") were used for the recreational pier fisheries data, one month periods were used for the impingement data, and no temporal effects were used for the submersible data (which only takes place during weather windows in late fall). Similarly, spatial effects are described by spatial covariates, represented by individual trawl stations for the midwater trawl survey data, counties for the recreational pier fishery data, individual power plants for the impingement data, and habitat types (oil rig base, oil rig midwater, and natural reef) as well as depth for the submersible data. For the impingement data, "survey type" was also included as a factor, with only two types estimated, these being the "normal operations" and "heat treatment" types described previously.

The resulting recruitment indices were compared to the estimated recruitments from the stock assessment. The natural logarithm of both the predictor (indices) and response (assessment recruits) values were used for the regression, to best mimic the behavior of stock assessment models which perform maximum likelihood parameter estimations (Maunder and Punt 2004, Methot 2009). In addition to comparing the results of the recruitment indices to the results of the assessment, we evaluate the extent to which the recruitment indices improve the predictive ability of the stock assessment model. This is done by retrospectively estimating the magnitude and confidence in estimates of one of the strongest recruitment events in recent years, the 1999 year class, when data are sequentially removed from the model going backwards in time. By sequentially removing entire years of data for two models with and without the recruitment indices we can compare both the absolute recruitment estimates and the confidence in those estimates. The estimated precision of the absolute values of annual recruitment are provided by the asymptotic approximation used in the stock synthesis model (Methot 2009a, b). This allows us to better evaluate how well the recruitment indices may, or may not, perform with respect to predicting strong incoming year classes of bocaccio.

RESULTS

The bocaccio stock assessment model that was re-run without the recruitment indices suggested a biomass trend and recruitment estimates nearly identical to those from the adopted assessment model (fig. 3). As with bocaccio assessments done over the past 10 years, the results indicate that the spawning output (a reflection of the spawning biomass, accounting for the greater fecundity of larger fish) fluctuated significantly through the 1960s and 1970s, peaking near 1970 and declined rapidly through the rest of the 1980s and 1990s. These declines were primarily a result of high exploitation rates, although a period of anomalously poor recruitment appears to have taken place throughout most of the 1990s. The estimated recruitment time series illustrates that recruitment has a high degree of interannual variability, but that the relative size of the strong recruitment events have declined in concert with the decline of spawning output through the year 2000. Since that time, fishing mortality has declined markedly due to severe management restrictions, and the stock has been increasing at a fairly rapid rate coincident with a series of several relatively strong year classes (1999, 2003, 2005). Note that the differences in the magnitude of recruitment events in the late 1950s and early 1960s, shown in Figure 3, results from exclusion of the recreational pier fishery time series in the model used for evaluating the performance of recruitment indices, as there were a mix of qualitative and quantitative data used in the full assessment.

For all of the models, several alternative model structures were explored and evaluated using AIC, and the most parsimonious model (explaining the greatest amount of relative variance with the lowest number of parameters) was used. Similarly, for each of the recruitment data sources, the year effects from the delta-GLM models led to an improvement in the AIC, indicating that the year effects provided information potentially usable as a recruitment index. We provide a summary

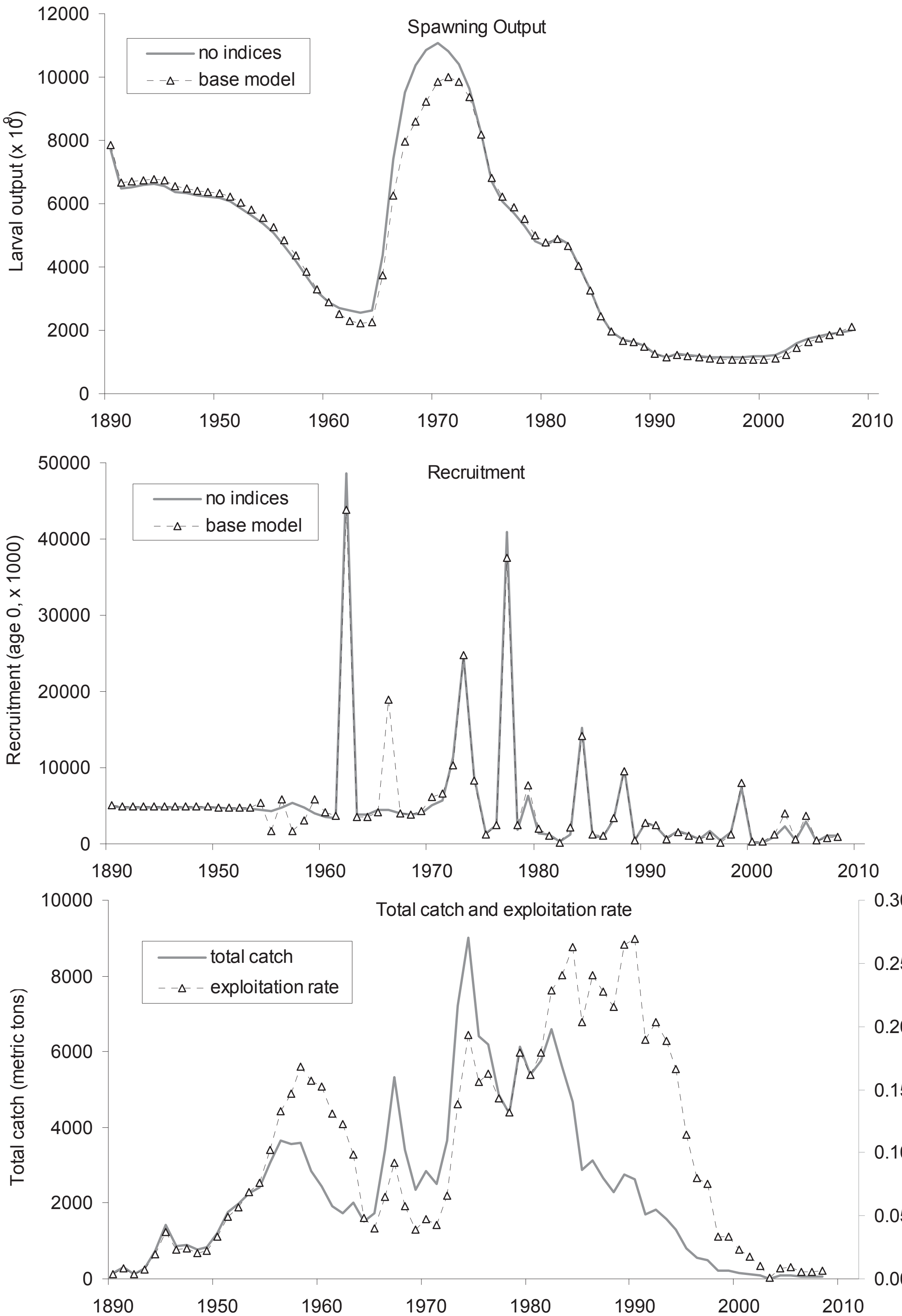


Figure 3. Estimated reproductive potential (spawning output) and recruitment of bocaccio from the base 2009 model (dashed lines) relative to the same model in which all juvenile indices are removed (solid lines), to avoid confounding the performance of the various indices.

TABLE 1
Summary of data availability, the number of parameter estimated, and GLM model performance for the four recruitment indices.

	Pelagic trawl	Recreational Pier	Power Plant Impingement	Delta Submersible
Time period	1983–2008	1980–2008	1972–2008	1995–2008
Number of years*	17	19	31	13
Temporal parameters	6	0	12	0
Spatial parameters	34	6	6	7
Data points	2225	312	2628	914
Coefficients of variation				
average	0.56	0.73	0.60	0.41
maximum	0.87	1.11	0.83	0.63
minimum	0.34	0.40	0.37	0.30
Change to AIC				
Remove year				
binomial	123.3	0.2	36.7	6.4
positive	75.4	3.9	78.2	5.0
Remove spatial				
binomial	18.9	45.6	25.5	41.3
positive	–9.0	66.2	–5.7	87.6
Remove temporal				
binomial	0.5	n/a	5.8	n/a
positive	7.6	n/a	14.3	n/a
Null model				
binomial	142.7	66.2	71.6	51.3
positive	93.1	49.6	167.4	92.8

of available data for each index, listing the time period for which data are available, the number of observations, the number of covariates used in the GLM, and both the null and final model AIC (tab. 1). The mean, and range, of the estimated coefficients of variation that result from the jackknife routine are also reported in this table. We focus subsequent discussion on the year effects (covariates) for each model, although the intra-annual (seasonal) and spatial covariates are also relevant.

All four of the resulting indices tracked most of the strong recruitment events estimated from the assessment model (fig. 4a-d). All of the indices were significantly correlated to the assessment estimates of recruitment (at the $p<0.05$ level), with coefficients of determination (R^2) values ranging from 0.28 for the pier fishery index to 0.58 for the power plant impingement data, with the juvenile trawl survey and submersible survey having coefficients of 0.35 and 0.41 respectively. One particular challenge with this type of model is how to deal with missing data. Many indices have years with insufficient numbers of positive observations to estimate a year effect (generally speaking, two positive observations in a given year are necessary), despite having fairly comprehensive sampling coverage (and data) overall. For the correlations shown here, those years have been dropped, although one approach to including that information is to use some fraction of the minimum estimated value for years with insufficient numbers of positive observations (for example, half). This is consistent with the practice frequently used in stock assessments. Although admittedly ad-hoc, this approach recognizes that there is information in the data regarding the relative strength of a given year class when data are collected and no juveniles are observed (the year class is presumably weak in such circumstances, although differences in sampling intensity are also relevant). The juvenile trawl survey index, the pier fishery index and the impingement survey index have eight, ten, and five years that meet this criteria respectively (there are no years of submersible data with this problem); if half of the minimum estimated values are used for these years and added to the regressions, the resulting R^2 values are 0.21, 0.45 and 0.46 respectively. Thus, the information content of the juvenile survey and the impingement survey are slightly degraded, that of the pier fishery is slightly improved, if this approach is adopted.

Another challenge is how to address the problem of errors in variables (EIV). In ordinary regression models, the independent variables are assumed to be measured without error, such that all error is a function of the dependent variable. This issue has a deep history in fisheries science and in the fisheries literature (Ricker 1975, Hilborn and Walters 1992), a comprehensive review of which is beyond the scope of this manuscript, but it is worth noting that the issue remains generally unresolved (Kimura 2000). We explored several approaches to addressing the issue, ultimately settling upon reporting both the "standard" linear regression relationship and the geometric mean estimate of the functional regression (GM regression; Ricker 1975), both of which are presented in Figure 4. Note that the coefficients of variation are unchanged among the two models, it is

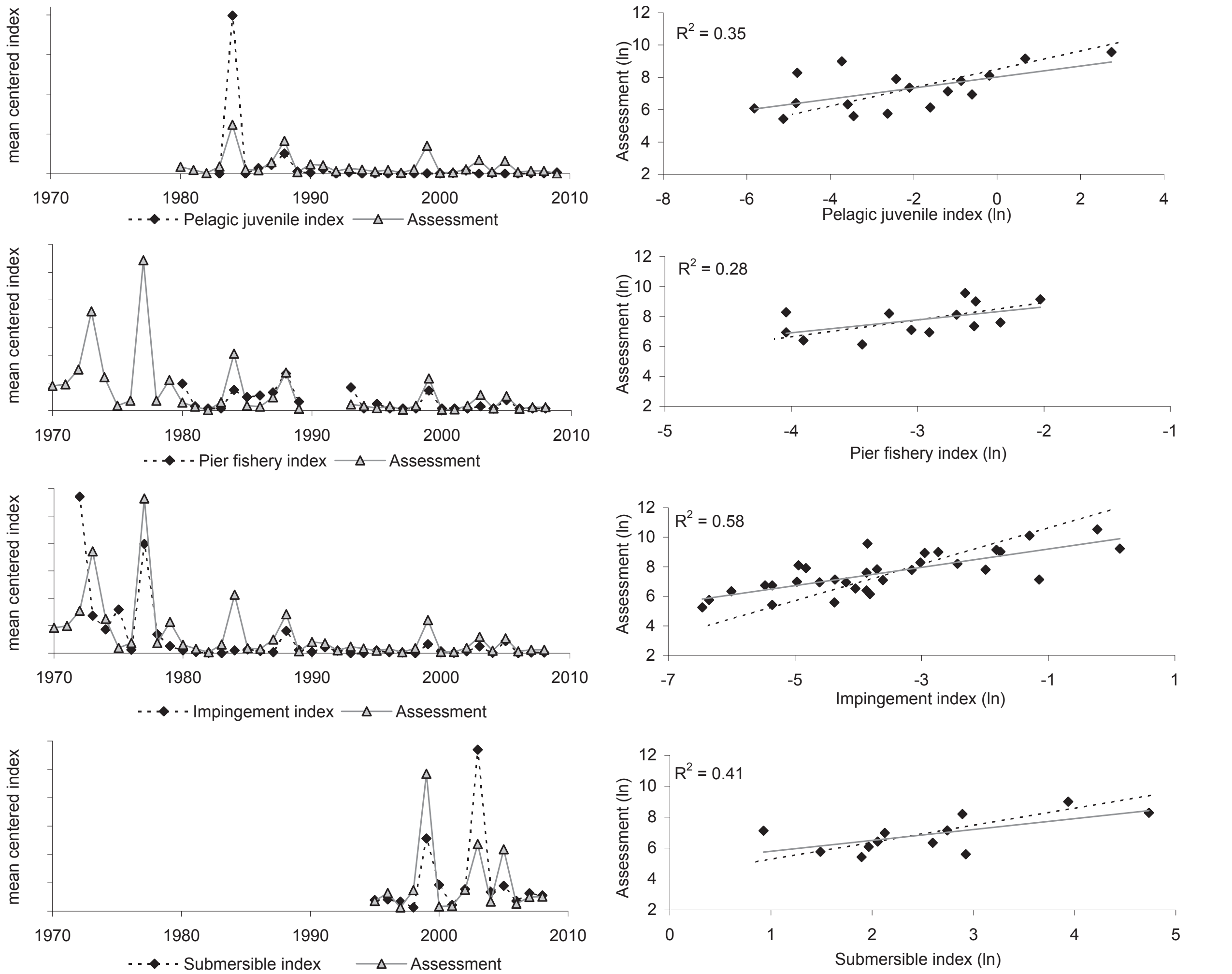
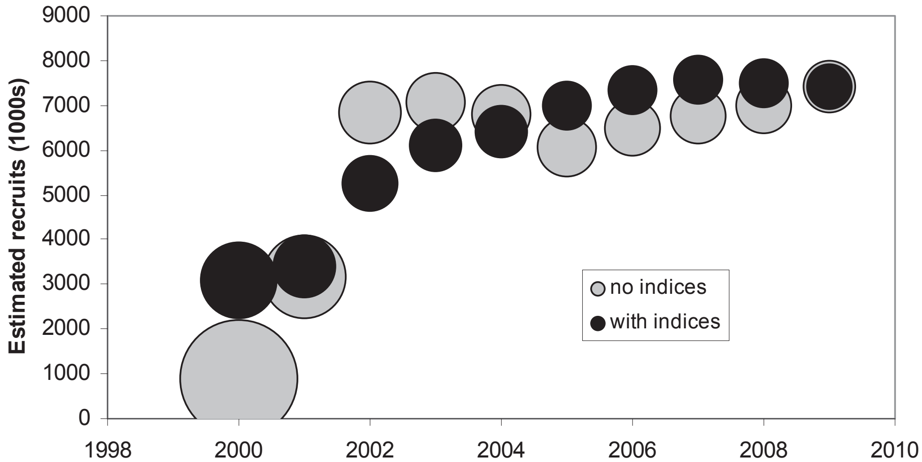


Figure 4. Mean-centered estimates of recruitment from the base stock assessment model (absent recruitment index data) relative to mean-centered indices of juvenile abundance from the data sources reported here (left panels). Corresponding regression results for each index (right panels), with both ordinary least squares regression (solid grey line) and geometric mean regression (dotted black line).

only the slope and intercept parameters that differ, and neither of these parameters are utilized further for the purposes of this manuscript.

While the recreational pier fishery index has a relatively modest correlation to assessment estimates of recruitment, this index does capture the magnitude of the 1984, 1988 and importantly the 1999 year class. The midwater trawl survey was among the noisier of indices ($R^2 = 0.35$), although this index captured the magnitude of the 1984 and (perhaps to a lesser extent) the 1988 year classes, there have been very few bocaccio juveniles observed in the catches since that time. Consequently, this index did not detect the strong year classes observed in 1999, 2003 and 2005, which may be an artifact of changes in the relative distribution of spawning biomass (and subsequent recruitment) over recent years. In fact, the failure of the juvenile survey to capture the magnitude of the 1999 year class for bocaccio or any other species contributed to the decision to expand the geographic range of the juvenile rockfish survey, under the assumption that expanding the survey accross space would lead to more effective predictions of coastwide recruitment events (Sakuma et al. 2006). The power plant impingement index also compares favorably with the stock assessment estimates of recruitment ($R^2 = 0.58$), and as the only index that precedes the 1980s it is reassuring to observe that the index does particularly well with respect to capturing the magnitude of the 1973, 1977 and 1988 year classes. This index also captures apparently strong recruitment in 2005 and 2007, which are now showing up in fishery data. Interestingly, this index appears to miss the magnitude of the 1984 and 1999 year classes, although it does recognize some recruitment in both of those years. Finally, although it is the shortest of the time series evaluated here, the submersible index also performs fairly



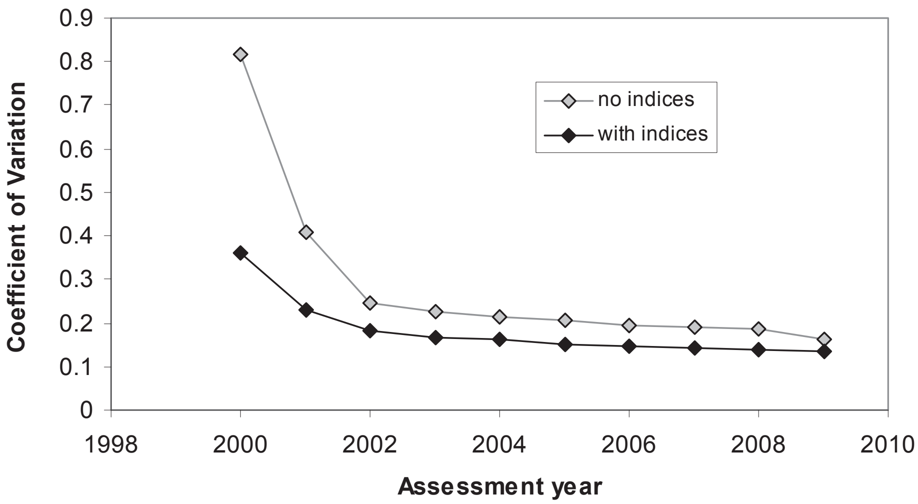


Figure 5a (top). Relative information content of the 1999 recruitment from retrospective bocaccio assessment models with (black) and without (grey) the juvenile indices developed in this manuscruipt. Size of bubbles corresponds to the CV of the estimates, which are also shown in Figure 5b (bottom).

well in capturing the magnitude of large year classes (R^2 = 0.41), although it overestimates the 2003 and underestimates the 1999 year class.

The comparison of estimates of the magnitude of the 1999 year class with retrospective model runs with and without all of the recruitment indices is shown (fig. 5a), along with the estimates of the CV of that recruitment point estimate in subsequent years. Here, we can see that the information content of informative indices is limited to the first 1–2 years before fish show up in fishery and survey data. For example, an assessment done in 2000 using data through 1999 would predict considerably greater recruitment with the recruitment indices than without them, due to the limited information available on that cohort available in length frequency data and the statistical "penalties" imposed on data with low information content in the model (thus the first two years represent primarily a recruitment estimation drawn from the spawner recruit curve), with considerably greater confidence (CV of 0.38 versus 0.85). However, by 2001 fishery-based length frequency data for bocaccio have already demonstrated the presence of the 1999 year class, and although the recruitment indices lead to a smaller variance estimate of that year class strength, the magnitude is generally well established based on simply the recreational fishery length composition data alone. As this example includes all of the recruitment indices in the model simultaneously, which would not necessarily be an optimal approach in a typical assessment, the difference among the estimated recruitments after the second year is negligible. That these recruitment events appear so strongly defined so early in the fishery reflects the unique life history of bocaccio, which grow very rapidly and are encountered by sport fisheries in particular at very young ages, whereas other *Sebastes* species are typically not vulner-

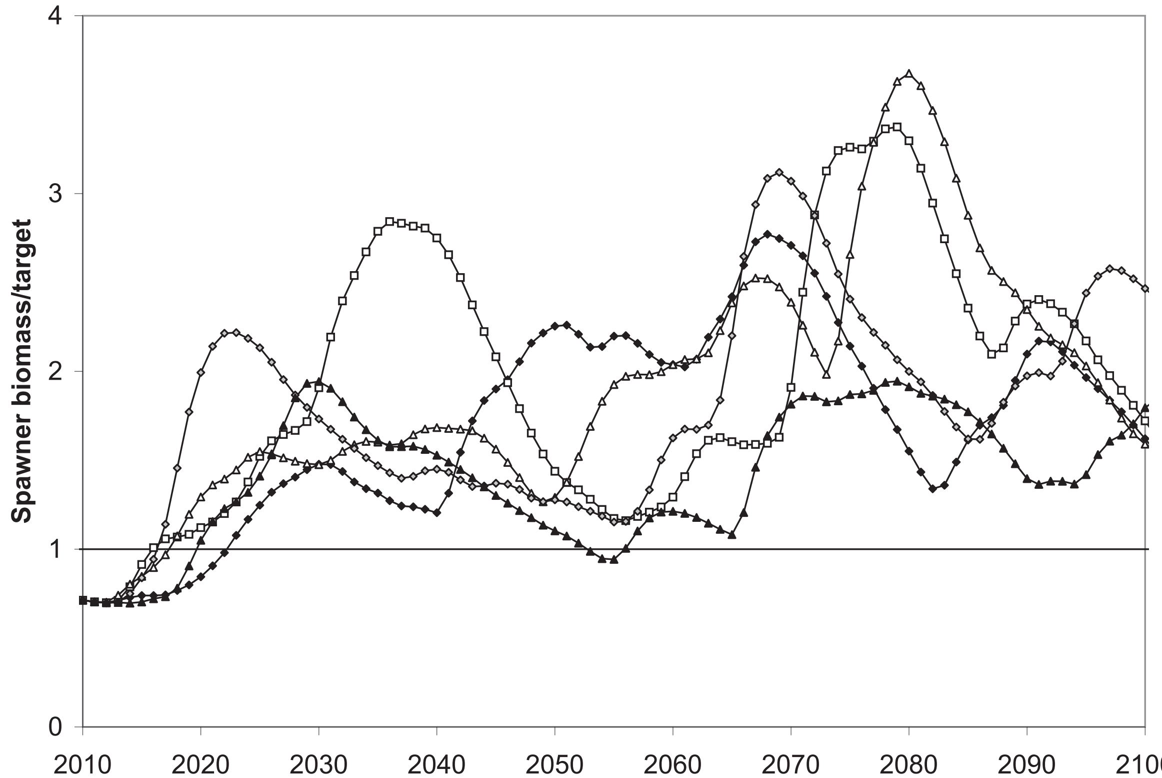


Figure 6. Five example trajectories, of the thousands simulated in the rebuilding analysis for bocaccio rockfish, illustrating the significance of highly variable recruitment events on population trends (harvest rates are constant set to current level in all scenarios). These individual trajectories are used to assess the probability of rebuilding by management targets.

able to fisheries until individuals reach ages of 3–10 years. For such slower-growing species, recruitment indices would be more useful in assessing abundance and productivity in the long term. For bocaccio, the period in which recruitment indices are useful in forecasting productivity is relatively brief (one to two years), although given the significance of changing bocaccio bycatch rates on other fisheries, improved forecasting of such recruitment events is still of great importance to resource management activities.

DISCUSSION

The southern bocaccio population is fortunate to have multiple sources of informative data that can provide estimates of the magnitude of recruitment events. As such, bocaccio are a good case study for evaluating the effectiveness of pre-recruit indices for West Coast groundfish, particularly as the correlation coefficients from this evaluation are comparable to or considerably greater than the correlations between the spawner recruit curve and subsequent recruitments. Currently, only two of these indices (the midwater trawl survey, albeit an index based on greater spatial resolution and shorter duration, and the recreational pier fishery index) are used are used in the stock assessment. Both of the other indices described here hold considerable potential for future assessments, and should be evaluated accordingly in the future. Moreover, the performance of most these indices is consistent with what DeOliveira and Butterworth (2005) describe as a reasonable threshold for the application of indicators (albeit, environmental indicators in their case) for improving stock assessment models, for which indicators should be able to explain approximately 50% or more of the total variation in recruitment.

Moreover, the data from these recruitment indices could provide insights into the physical and biological conditions that either enable or repress strong recruitment events. The high recruitment variability exhibited by this species leads to considerable uncertainty with respect to the estimated time to rebuild to target levels for this stock, as illustrated by five equally plausible trajectories of stock biomass developed as a part of a comprehensive rebuilding analysis (fig. 6, from Field and He 2009). Essentially, thousands of these individual trajectories are used to assess the probability of rebuilding by management targets, using the methods developed in Punt (2003). The rebuilding analysis also indicates that upon rebuilding to target biomass levels, the chance of returning to an overfished condition in the future remains significant if the default harvest policies are followed, simply due to the highly variable nature of recruitment for this stock. Comparable results have been described for Pacific hake (*Merluccius productus*), another species with highly variable recruitment and population trajectories (Haltuch et al. 2008). Consequently, for stocks with such high variability in recruitment, such that harvest policies based on constant harvest rates may not be optimal for either ecological or socio-economic stability.

The potential for bocaccio recruitment indices to provide insights beyond just the bocaccio stock should also be explored. Several other commercially and ecologically important species have recruitment trends that covary with bocaccio rockfish, including chilipepper and Pacific hake. There is also some synchrony in recruitment variability of other species, for example nearly all of the assessed groundfish stocks on the U.S. west coast experienced good to excellent recruitment in 1999, and most also experienced strong recruitment in 1980 and 1984. Similarly, there tends to be poor recruitment during strong El Niño events, such as those 1982–83, 1986–87 and 1997–98 El Niño events (it is noteworthy to consider that many of the strongest recruitment events for West Coast groundfish have taken place in years that immediately followed these El Niño events). However, thus far the degree of synchrony in groundfish recruitment has been relatively modest; the leading principal components explain 25–45% of the variance for groundfish recruitment deviations for well-informed stocks (range reflects the subset of stocks evaluated), which is comparable to results for other regions (Mueter et al. 2007). While suggestive of some generalized response to ocean conditions, this fraction of the total variance is relatively modest in comparison to the high amount of synchrony observed in juvenile rockfish abundance in the pelagic stage, where the leading principle component explains 85% of the variance for the ten most abundant rockfish species (J. Field and S. Ralston, unpublished data). The spatial component of recruitment for shelf rockfish has also been shown to be strongly coherent over broad spatial scales (Field and Ralston 2005), although this reflects post-settlement and recruitment based primarily on fishery data and may not reflect the patchy nature of recruitment prior to dispersal. All of these observations suggest that many of the processes contributing to variable year class strength for rockfish, and perhaps other groundfish, occur at the post settlement stage, and vary considerably among species, again consistent with expectations for most marine species more generally (Ralston and Howard 1995, Houde 2008). For bocaccio, a closer evaluation of both the synchrony and the spatial structure of strong recruitment events using the different indices could lead to insights regarding the nature of the physical and biological ocean conditions that lead to strong year classes.

The geographic frame of the various indices also appears to be informative with respect to stock structure trends. The data used in the most recent assessment suggest that the stock biomass south of Point Conception appears to be rebuilding at a more rapid rate than to the north, based on the relative influence of data from these respective regions. The patterns observed in the recruitment index time series are consistent with this, in that the strong recruitment in 1984 seemed to be a "northern" recruitment event. This recruitment event was strongest in the central California data, including both the midwater trawl survey and the recreational pier fishery index (particularly Santa Cruz and San Luis Obispo counties). Since the 1990s however, the signal from the pier survey index has been dominated by San Luis Obispo and Santa Barbara Counties, and both the impingement index and the visual survey index suggest that recruitment south of Point Conception is strongly correlated with the model estimates of recruitment for the entire stock. This too is consistent with the abundance indices that suggest greater population increases in the southern part of the stock range relative to the central portion (Field et al. 2009), indicating that both recruitment and rebuilding may have a regional component.

With respect to further utility of these recruitment indicators, it may be that they are also useful for managers contemplating the duration of fishing seasons and seasonal depth restrictions. As one of several rebuilding species of rockfish on the West Coast, bocaccio is a constraining species for fisheries on healthy populations, and regulations focus on minimizing the catch of bocaccio while allowing opportunities to exploit more productive stocks. Thus, effective forecasting catches of this constraining species is key for maintaining fishing opportunities, while avoiding the chance of exceeding the allowable catch of bocaccio. Given the dramatic spikes in both catch rates and the percentage of the total southern California rockfish catch that is bocaccio following strong recruitment events (fig. 7)[8], improved predictions of future catch rates of constraining species could be of considerable value not only in assessments that include future year projections, but in year-to-year management activities as well. The latter point may be particularly true in a management regime in which the bocaccio stock assessment is performed every two years at most, and with a greater lag between the data and the time period in which the results are applied to management, making "fine tuning" of management measures

[8]There are statistically significant relationships among these variables, the R^2 between the assessment recruitment and a one-year lagged change in the percentage of all southern California rockfish (with an arcsine transform to account for proportionality) is 0.34, while the R^2 between recruits and one year lagged catch per angler hour is 0.35. However, a linear regression may be too simplistic, as both relationships show signs of non-linearity.

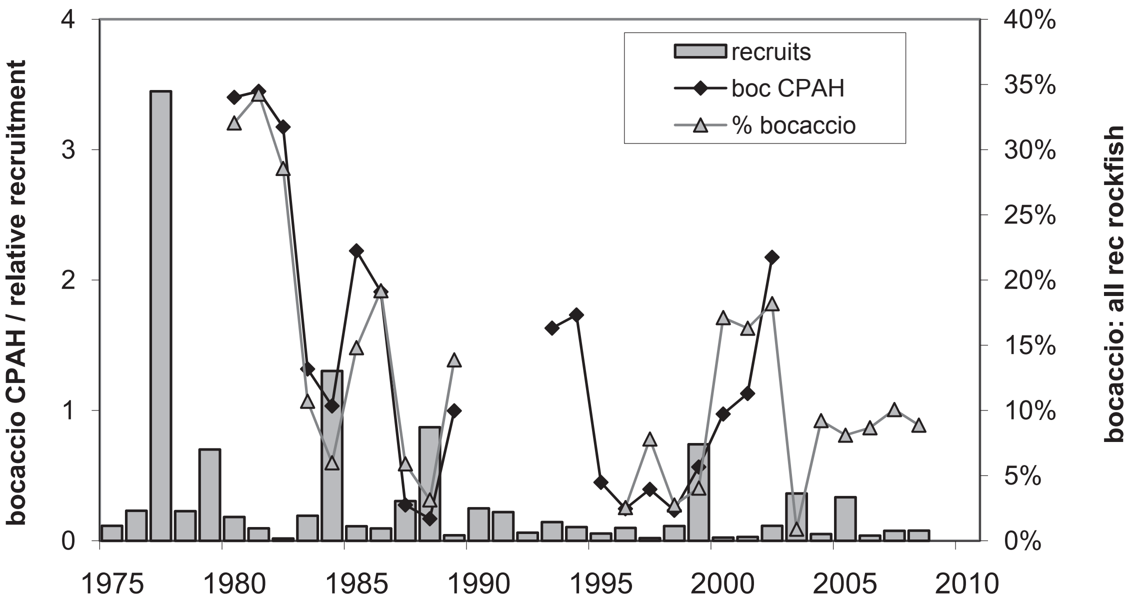


Figure 7. Estimated annual recruitment (grey bars) relative to Southern California recreational fishery catch rates (catch per angler hour, black line) and to the percentage of the total recreational catch represented by bocaccio (grey line).

in response to changing conditions even more important. In such a scenario, integrating all of the indices into a single indicator of impending recruitment, using principle components analysis or comparable means, might be more useful for management with respect to predicting spikes in bocaccio catches in recreational fisheries.

We have shown that there are several sources of information that could improve the prediction of strong year classes in stock assessment of bocaccio. Such information is useful to assessing stock status and productivity, to tracking rebuilding success, and likely to improving real time management of commercial and recreational fisheries that routinely encounter large numbers of young bocaccio during strong recruitment events. Additionally, these data could be informative with respect to recruitment trends for species of groundfish that tend to covary with bocaccio, and could ultimately lead to an improved understanding of the oceanographic processes that drive variable recruitment. In the long term, such information should aid both scientists and managers, by improving the ability to monitor and respond to the variable abundance and catch rates of bocaccio, as well as by leading to a greater appreciation for the connectivity between environmental changes in coastal ecosystems and fisheries productivity.

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