A. Title page and list of preparers

The Status of California Scorpionfish (*Scorpaena guttata*) off Southern California in 2004

Mark N. Maunder[1], J. Thomas Barnes[2], Debbie Aseltine-Neilson[2], and Alec D. MacCall[3]

[1]Quantitative Resource Assessment LLC
8311 Bryn Glen Way
San Diego, CA, 92129

[2]California Department of Fish and Game
8604 La Jolla Shores Drive
La Jolla, CA 92037-1508

[3]National Marine Fisheries Service
Southwest Fisheries Science Center
Santa Cruz Laboratory
110 Shaffer Road
Santa Cruz, CA 95060

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FINAL PROJECT REPORT

Agreement No. P0470007 Subject: CA SCORPIONFISH STOCK ASSESSMENT

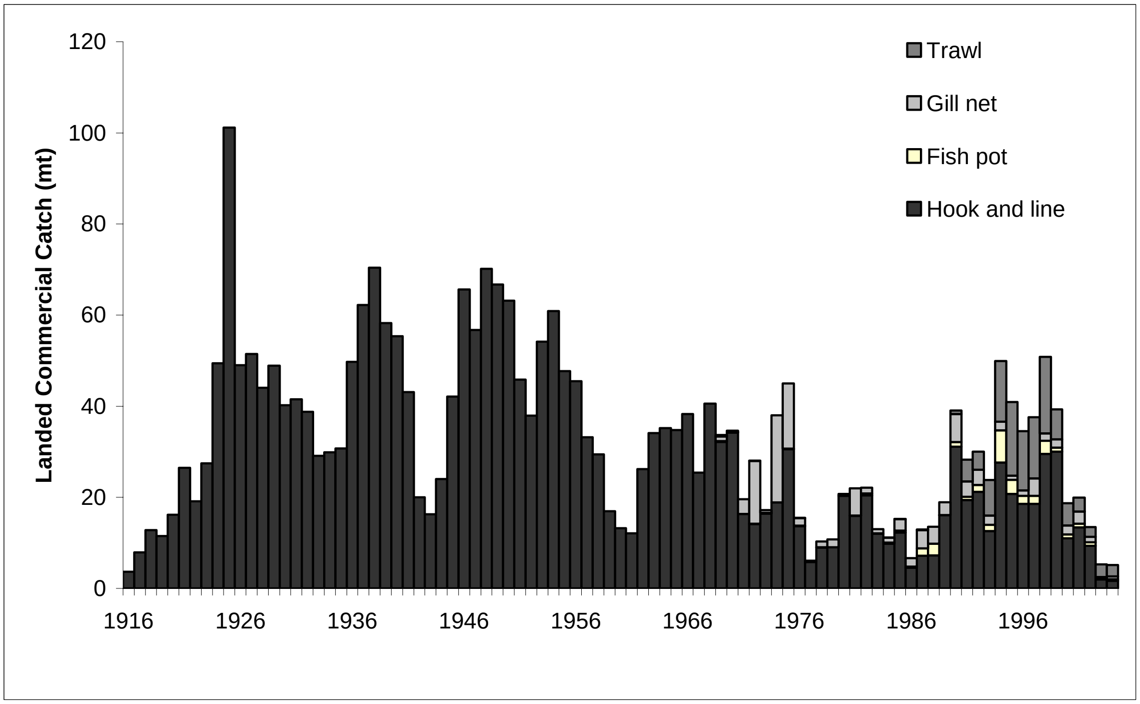
B. Executive Summary

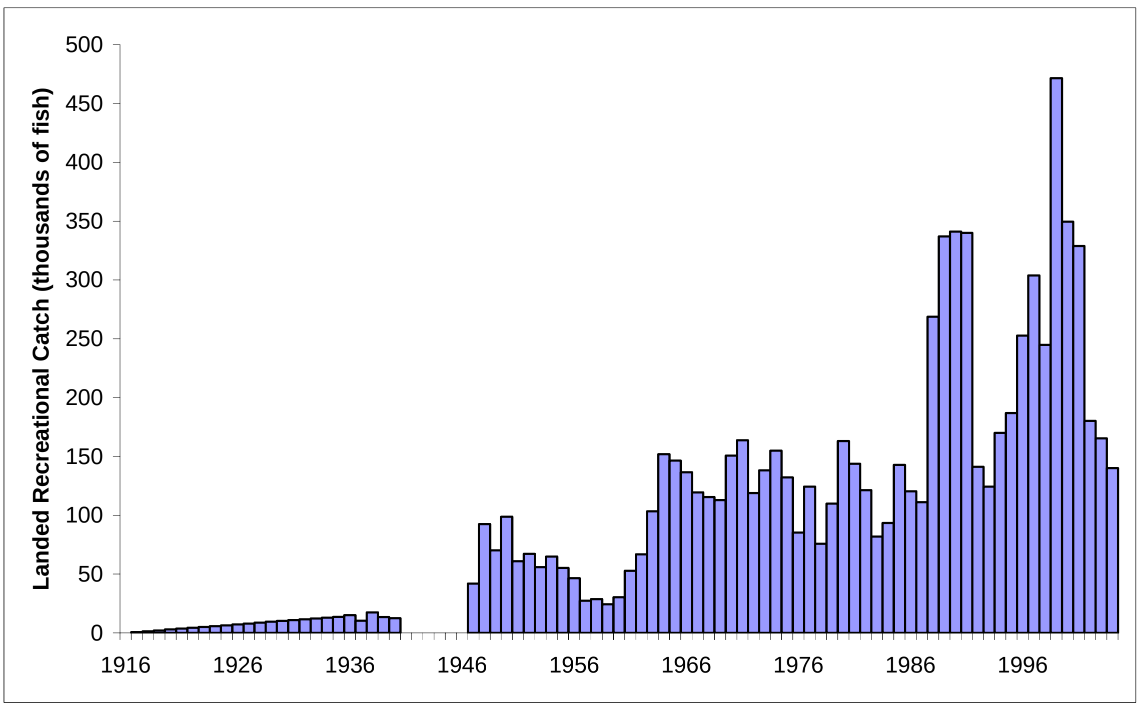
Stock: This stock assessment pertains to the population of California scorpionfish (*Scorpaena guttata*) off southern California (Point Conception to the Mexico border). A single stock was assumed for the whole of southern California due to the consistency of results from initial sub-stock analysis and paucity of data for some regions.

Catches: The fisheries for California scorpionfish were divided into one recreational fishery and four commercial fisheries (hook and line, trawl, gillnet, and fish pot). Catches were obtained from published information for the period 1916-2004. Recreational catch in numbers was calculated based on the CPFV logbooks and scaling up based on a 80% assumed reporting rate and the ratio of CPFV catch to the total recreational catch estimated from the RecFIN data base. The catch in 1935 is assumed equal to the average of the catch for the years 1936-1940 and a linear trend is assumed to a catch of zero in 1916. Commercial catch in weight by method for 1969 to 2004 was taken from CFIS. Catch for 1928 to 1968 was taken from PFEL and catch from 1916 to 1927 was taken from CDFG Fish Bulletins. All catch before 1969 was assumed to be taken by hook and line. Catch from Mexican waters landed in Californian ports was excluded from the analysis. It was assumed that there is no discard mortality for this species.

Recent California Scorpionfish Landings

year	Hook and line (mt)	Fish pot (mt)	Gill net (mt)	Trawl (mt)	recreational (thousands of fish)
1990	31.1	1.0	6.2	0.8	341.1
1991	19.4	0.8	3.3	4.8	339.9
1992	21.2	1.5	3.4	3.9	141.1
1993	12.6	1.4	2.0	7.8	124.3
1994	27.6	7.1	1.9	13.3	170.0
1995	20.8	3.1	0.9	16.2	186.9
1996	18.6	1.8	1.2	13.0	252.9
1997	18.6	1.8	3.8	13.4	303.7
1998	29.5	2.9	1.6	16.7	244.8
1999	30.0	0.9	1.8	6.6	471.6
2000	11.0	0.8	2.0	4.8	349.6
2001	13.4	0.8	2.7	3.1	328.8
2002	9.3	0.8	1.2	2.2	180.2
2003	2.0	0.2	0.4	2.8	165.4
2004	1.6	0.4	0.6	2.5	140.1





Data and assessment: This is the first fishery evaluation for California scorpionfish. The statistical assessment model (SS2 version 1.18) was configured to estimate population characteristics for the period 1916-2004, with the initial state determined in an unexploited equilibrium. Data used in the model included commercial landings by method in weight, recreational landings in numbers of fish, a fishery dependent CPUE statistic determined from analysis of CPFV logbook trip data from 1980-1999, a fishery independent index of abundance determined from trawl surveys carried out by the sanitation districts, and length-frequency data from the hook and line and trawl commercial fisheries, the recreational fishery, and the sanitation district trawl surveys. The model was sex-structured, used a Beverton-Holt stock-recruitment relationship with a steepness fixed at 0.7, estimated recruitment deviates for years 1966-2001, fixed M at 0.25 for both sexes, fixed the recruitment deviate standard deviation at 1.0, fixed the length at age coefficient of variation at 0.05 for both sexes, used sex specific growth curves and length-weight relationships from the literature, used maturity information from the literature, used fecundity information from available data, estimated logistic selectivity curves for the recreation and the hook and line and trawl commercial methods. The gillnet and fish pot selectivities were set equal to the hook and line selectivity. Two time blocks of selectivities were estimated to accommodate changes in management regulations: recreational 1916-1999 and 2000-2004; commercial 1916-1998 and 1999-2004. Iterative reweighting was used to determine the length-frequency sample size and the standard deviations of the two indices of abundance.

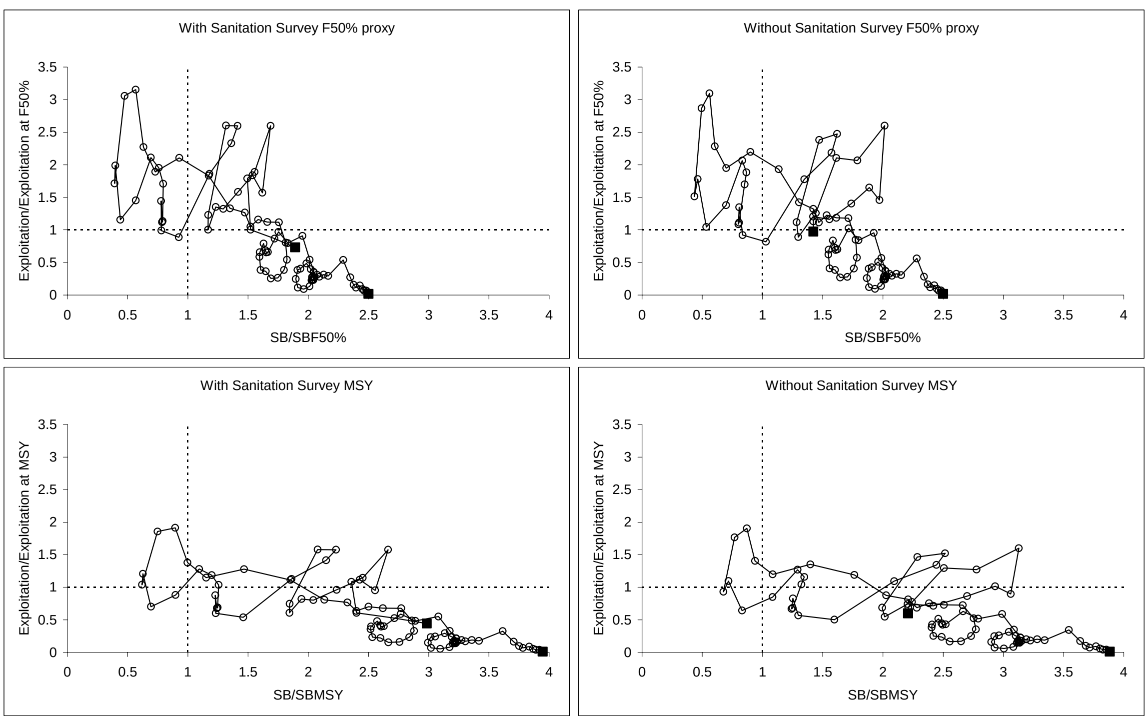
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Discards	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Landings (mt)	133	154	178	163	261	209	198	110	94	81	
ABC											
OY									84.9	84.9	
With sanitation survey											
SPR	0.482	0.455	0.435	0.471	0.383	0.418	0.420	0.530	0.587	0.656	
Exploitation rate	0.129	0.155	0.180	0.153	0.254	0.185	0.175	0.098	0.085	0.071	
Summary (age 2+) biomass	1444	1611	1687	1703	1688	1635	1743	1803	1848	1864	1866
Spawning stock biomass	530	580	629	663	691	636	612	623	704	774	816
(cv)	0.03	0.03	0.03	0.03	0.04	0.05	0.07	0.09	0.09	0.10	0.10
Recruitment	3025	2652	2223	3261	4660	3474	2103	1930	1968	1996	
Depletion level	0.518	0.567	0.615	0.648	0.675	0.622	0.598	0.608	0.688	0.756	0.798
(cv)										0.10	0.10
Without sanitation survey											
SPR	0.510	0.489	0.470	0.506	0.410	0.457	0.456	0.561	0.590	0.622	
Exploitation rate	0.114	0.138	0.163	0.144	0.256	0.204	0.207	0.124	0.111	0.096	
Summary (age 2+) biomass	1676	1801	1933	1894	1830	1646	1522	1405	1376	1358	1352
Spawning stock biomass	609	680	738	771	788	700	631	564	557	557	563
(cv)	0.05	0.04	0.05	0.05	0.06	0.08	0.09	0.10	0.10	0.09	0.09
Recruitment	3997	1984	1905	1915	1924	1893	1865	1831	1827	1827	
Depletion level	0.623	0.695	0.755	0.788	0.805	0.715	0.645	0.577	0.569	0.569	0.576
(cv)										0.08	0.07

Unresolved problems and major uncertainties: The current status is sensitive to the inclusion of the sanitation index in the stock assessment; removing the sanitation index reduces the current biomass level. To match information content in the data, annual recruitment deviates were not estimated after 1996 when the sanitation district trawl survey was excluded from the analysis. The STAR Panel and STAT Team gave relative probabilities to models including and excluding the sanitation index of 74% and 26%, respectively. There is a large amount of variation in recruitment levels and recent recruitments are estimated to be substantially higher than average. Predictions of future biomass will be dependent on what recruitment level is assumed in the future. Projections presented in this report use average recruitment based on the Beverton-Holt stock-recruitment relationship.

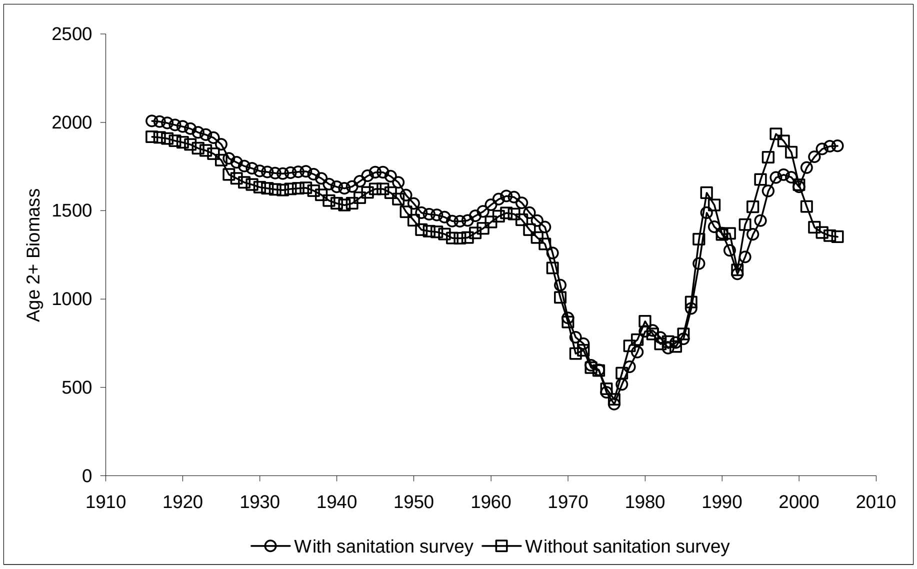
Reference points: The following reference points were obtained from the two models considered.

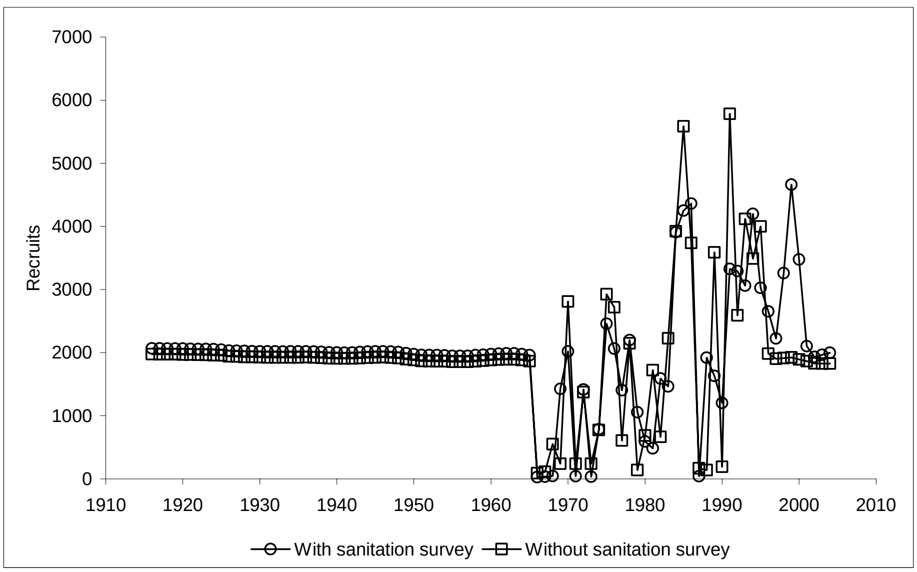
Biological Reference Points

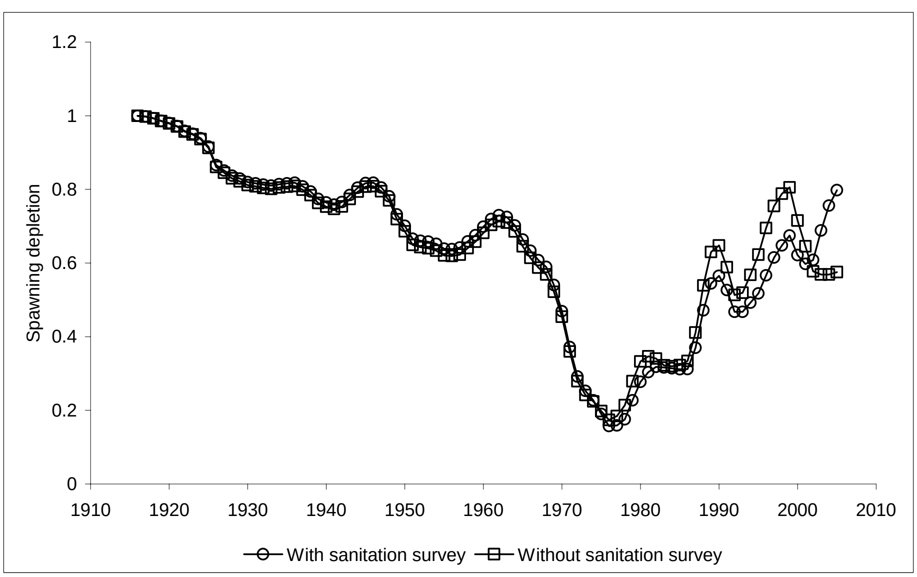
Quantity	Include sanitation index	Exclude sanitation index
Unfished spawning biomass (SB_0)	1024	978
Unfished summary (age 2+) biomass (B_0)	2007	1918
Unfished recruitment (R_0; age 0)	2067	1975
$SB_{40\%}$ (MSY proxy stock size = $0.4xSB_0$)	409	391
Exploitation rate at $F_{50\%}$ proxy	0.098	0.098
SB_{MSY}/SB_0	0.253	0.257
MSY	127	121
Exploitation rate at MSY	0.161	0.160



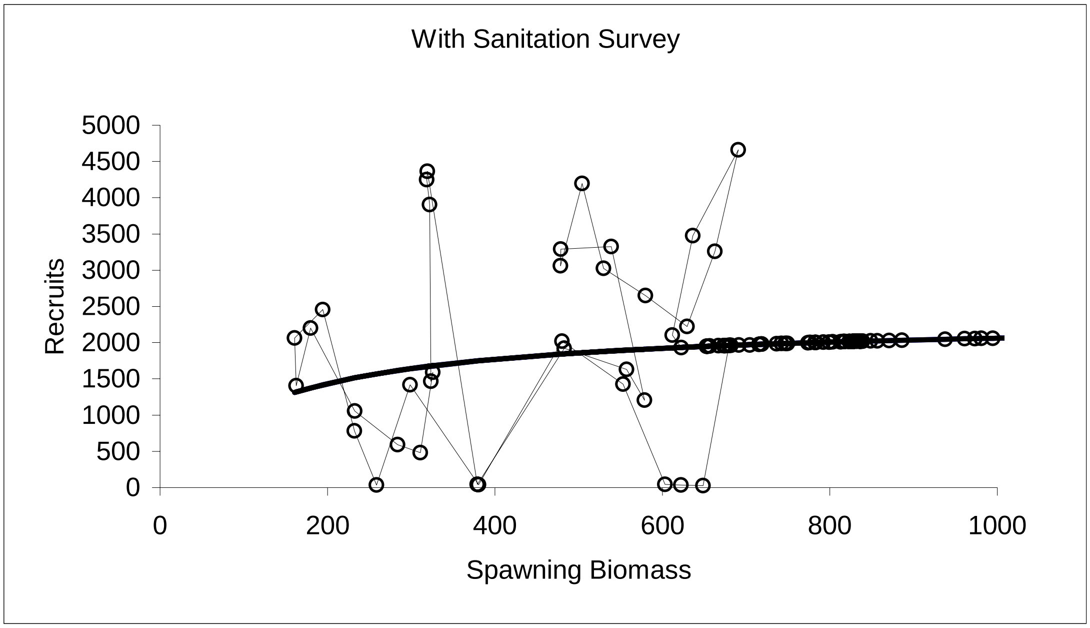
Stock biomass: Biomass time series (summary biomass (age 2+), recruitment, and spawning depletion) for the two models are shown below.

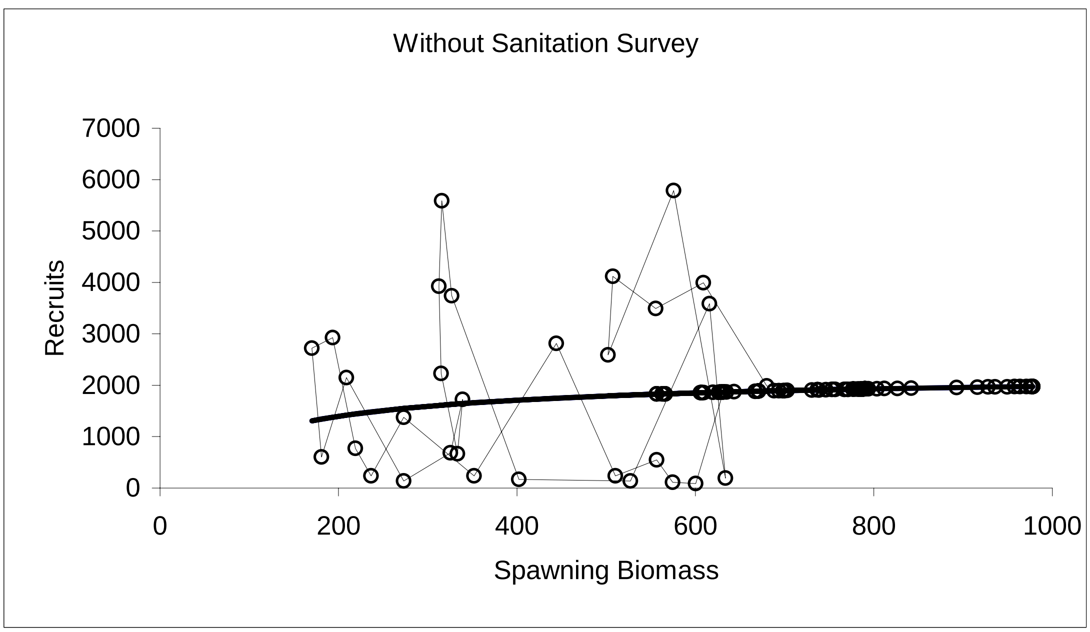

Age 2+ Biomass
2500
2000
1500
1000
500
0
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
With sanitation survey
Without sanitation survey


Recruits
7000
6000
5000
4000
3000
2000
1000
0
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
With sanitation survey
Without sanitation survey


Spawning depletion
1.2
1
0.8
0.6
0.4
0.2
0
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
With sanitation survey
Without sanitation survey

Recruitment: In the assessment, recruitment was modeled using a Beverton-Holt stock-recruitment relationship, with steepness (*h*) fixed at a value of 0.7 and recruitment variability (σ_r) fixed at 1.0. Recruitment deviations were estimated for the period 1966-2001. The virgin recruitment parameter (R_0) was the key estimated parameter. The assessments showed evidence of several strong recruitments starting in 1984.





Exploitation status: Both assessments estimate the stock to be above the MSY proxy. In addition, recent exploitation rates have been below or near the F_{msy} proxy (see phase-plots under Reference Points above). Recent landings have been less than the calculated ABC, based on harvesting at a $F_{50\%}$ rate.

Management performance: This is the first stock assessment of California scorpionfish off southern California.

Prior to the adoption of the Pacific Coast Groundfish Fishery Management Plan (FMP) in 1982, California scorpionfish (*Scorpaena guttata*) was managed through a regulatory process that included the California Department of Fish and Game (CDFG) along with either the California State Legislature or the Fish and Game Commission (FGC) depending on the sector (recreation or commercial) and fishery. With implementation of the Pacific Coast Groundfish FMP, California scorpionfish came under the management authority of the Pacific Fishery Management Council (PFMC), being incorporated, along with all genera and species of the family Scorpaenidae, into a federal rockfish classification and managed as part of "Remaining Rockfish" under the larger heading of "Other Rockfish" (PFMC 2004; PFMC 2002, Tables 31-39). California scorpionfish continued to be managed through federal regulations for "Remaining Rockfish" from 1983-1996, although the larger heading "Other Rockfish" was discontinued in 1992 and replaced with "*Sebastes* complex" (PFMC 2002, Tables 40-47; March 1, 1999, 64 FR 9936).

Under the Pacific Coast Groundfish FMP, groundfish species and species groups were managed using estimates of Allowable Biological Catch (ABC) (early documentation refers to Maximum Sustainable Yield, but now referenced as ABC). The ABCs provided by the PFMC's Groundfish Management Team (GMT) in the 1980's were based on an analysis of commercial landings from the 1960's and 1970's. For this analysis, most of the rockfishes were lumped into one large group. This analysis indicated that the landings for rockfish in the Monterey-Conception area were at or near ABC levels (PFMC 1993). In the 1990's, as bocaccio and other rockfish were assessed, the ABCs associated with these species were removed from this larger "*Sebastes* complex" group. Starting in 1992, some of the rockfish species and species groups began to be managed using harvest guidelines (in addition to ABCs) followed in 1999 by the use of Optimum Yields (OY).

To keep landings within these adopted harvest targets, the Pacific Coast Groundfish FMP provided the Council with a variety of management tools including area closures, season closures, gear restrictions, and, for the commercial sector, cumulative limits (generally for two-month periods). With the implementation of a federal groundfish restricted access program in 1994, allocations of total catch and cumulative limits began to be specifically set for open access (including most of California's commercial fisheries that target California scorpionfish in Southern California) and limited entry fisheries (PFMC 2002; 2004).

During most of this time frame, management also centered on the commercial groundfish sector primarily because harvest from the recreational sector was considerably smaller than that from the commercial sector. This approach began to change in the later 1990's as commercial landings decreased and recreational harvest became a greater proportion of the available harvest. For the "*Sebastes* complex", an estimate of the recreational harvest began to be included in the ABC tables starting in 1997 (PFMC 2002, Tables 48).

Also beginning in 1997, the "Remaining Rockfish" group was separated into two groups: "Other Rockfish" which contained those species, like California scorpionfish, with no quantifiable assessment (and whose OY was calculated as 0.5 of the ABC); and "Remaining Rockfish" which contained species that had been assessed with less rigorous methods than a stock assessment (and whose OY was calculated as 0.75 of the ABC) (PFMC 2002, Tables 48-53; March 1,1999, 64 FR 9935-9936). Therefore, beginning in 1997, California scorpionfish was managed as part of the *Sebastes* complex-south, "Other Rockfish" category. (*Sebastes* complex-south included the Eureka, Monterey, and Conception areas while *Sebastes* complex-north included the Vancouver and Columbia areas.)

The PFMC's rockfish management structure changed significantly in 2000 with the replacement of the *Sebastes* complex –north and –south areas with Minor Rockfish North (now covering the Vancouver, Columbia, and Eureka areas) and Minor Rockfish South (now Monterey and Conception areas only). The OY for these two groups (which continued to be calculated as 0.50 of the ABC) was further divided (between north and south of 40º10' N. Lat.) into nearshore, shelf, and slope rockfish categories with allocations set for Limited Entry and Open Access fisheries within each of these three categories (January 4, 2000, 65 FR 221; PFMC 2002, Tables 54-55). Species were parceled into these new categories depending on primary catch depths and geographical distribution. Because of its depth range and southern distribution, California scorpionfish was included within the Minor Rockfish South, "Other Rockfish" ABC and managed under the south of 40º10' N. Lat. nearshore rockfish OY and trip limits (PFMC 2002, Table 29).

Along with the above changes, a North/South management line at 40º10' N. Lat. was established in 2000 with separate management specifications adopted for the areas north and south of 40º10' N. Lat. and with the southern area divided into two separate management areas at Point Lopez, 36º00' N. Lat. This was followed in 2001 with the implementation of two distinct rockfish and lingcod management areas south of 40º10' N. Lat. (along with separate management specifications): the northern rockfish and lingcod management area between 40º10' N. Lat. and Point Conception (34º27' N. Lat.); and the southern rockfish and lingcod management area between Point Conception and the U.S.-Mexico border. These were later revised starting in 2004 with the northern rockfish and lingcod management area redefined as ocean waters from the Oregon – California border (42º00' N. Lat.) to 40º10' N. Lat., the central rockfish and lingcod management area defined as ocean waters from 40º10' N. Lat. to Point Conception, and the southern rockfish and management area continuing to be defined as ocean waters from Point Conception to the U.S.-Mexico border.

Cowcod Conservation Areas (CCAs) also were established in 2001 to reduce fishing effort for cowcod rockfish (PFMC 2002, Table 29). These areas were closed to all recreational and commercial fishing for groundfish except for recreational and commercial fishing for minor nearshore rockfish[1] (including California scorpionfish) within waters less than 20 fathoms. In addition, Rockfish Conservation Areas (RCAs) were established in 2003 to allow for the closure of specific area and depth ranges along the West Coast for the purpose of reducing fishing effort for shelf and slope rockfish. The California Rockfish Conservation Area (CRCA) was defined as those ocean waters south 40º10' N. Lat. to the U.S.-Mexico border with different depth zones specified for the areas north and south of Pt. Reyes (37º59'44''N. Lat.).

During the late 1990's and early 2000's, major changes also occurred in the way that California managed its nearshore fishery. The Marine Life Management Act (MLMA), which was passed in 1998 by the California Legislature and enacted in 1999, required that the FGC adopt an FMP for nearshore finfish. It also gave authority to the FGC to regulate commercial and recreational nearshore fisheries through FMPs and provided broad authority to adopt regulations for the nearshore fishery during the time prior to adoption of the nearshore finfish FMP. Within this legislation, the Legislature also included commercial size limits for nine nearshore species including California scorpionfish (10-inch minimum size) and a requirement that commercial fishermen landing these nine nearshore species possess a nearshore permit.

Following adoption of the Nearshore FMP and accompanying regulations by the FGC in fall of 2002, the FGC adopted regulations in November 2002 which established of a set of marine reserves around the Channel Islands in Southern California (which became effective April 2003) and adopted a nearshore restricted access program in December 2002 (which included the establishment of a Deeper Nearshore Permit) to be effective starting in the 2003 fishing year.

Although the Nearshore FMP provided for the management of the nearshore rockfish and California scorpionfish, management authority for these species continued to reside with the Council. Even so, for the 2003 and subsequent fishery seasons, the State provided recommendations to the Council specific to the nearshore species that followed the directives set out in the Nearshore FMP. These recommendations, which the Council incorporated into the 2003 management specifications, included a recalculated OY for Minor Rockfish South - Nearshore, division of the Minor Rockfish South - Nearshore into three groups (shallow nearshore rockfish; deeper nearshore rockfish; and California scorpionfish), and specific harvest targets and recreational and commercial allocations for each of these groups. This was followed in 2004 with the adoption of specific management measures for each of the three management areas: the California-Oregon border to 40º10' N. Lat.; 40º10' N. Lat. to Point Conception (34 º 27' N. Lat.); and Point Conception to the U.S.-Mexico border.

Also, since the enactment of the MLMA, the Council and State in a coordinated effort developed and adopted various management specifications in 1999-2004 to keep harvest within the harvest targets, including seasonal and area closures (e.g. the CCAs; a closure of Cordell Banks to specific fishing), depth restrictions, minimum size limits, and bag

[1] This exception also included the two state managed groundfish species, cabezon and kelp greenling.

limits to regulate the recreational fishery and license and permit regulations, finfish trap permits, gear restrictions, seasonal and area closures (e.g. the RCAs and CCAs; a closure of Cordell Banks to specific fishing), depth restrictions, trip limits, and minimum size limits to regulate the commercial fishery.

Summary of Federal and California Regulations for California Scorpionfish for the Area South of Point Conception (34° 27' N. lat.) from 1999-2004.

Recreational	
1999	Fishing open January – December at all depths.
2000	10" minimum size limit. January-February closure for rockfishes including California scorpionfish.
2001	January – February, November - December fishing in waters < 20 fathoms; March-October fishing open at all depths.
2002	January – February, November – December closure for rockfishes including California scorpionfish; March-June fishing open at all depths; July – October fishing in waters <20 fathoms.
2003	Bag limit changed from 10 fish to 5 fish. January – February fishing only in waters < 20 fathoms; March – June fishing open at all depths; July – August fishing in waters < 20 fathoms; September - November fishing in waters < 30 fathoms; December closure for rockfishes including California scorpionfish.
2004	January – February, May - October closure for rockfishes including California scorpionfish; March – April, November – December open in waters < 60 fathoms.
Commercial	
1999	10" minimum size limit with exemption for fish taken in trawl nets and landed dead. Fishermen landing California scorpionfish required to possess a Nearshore Permit. *Sebastes* Complex -South (which includes California scorpionfish) open January – December. Limits under Sebastes Complex –South provided in Federal Register (FR) for all open access gear (revised at 64 FR 54786, October 8, 1999). A limit of 300 pounds of groundfish per trip also set for open access exempted trawl gear engaged in fishing for pink shrimp, spot and ridgeback prawns, California halibut, and sea cucumbers; all limits and closures adopted for open access gear also apply and are counted toward the groundfish limit (PFMC 2002).
2000	For area south of 36° N. Lat., closed January – February; in area between 40° N. Lat. and 36° N. Lat., closed March – April. Limits under Minor Rockfish South – Nearshore provided in Table 5 for all open access gear (revised at 65 FR 66655, November 7, 2000) (also provided in PFMC 2002, Table 29.d). A limit of 300 pounds of groundfish per trip also set for open access exempted

	trawl gear engaged in fishing for spot and ridgeback prawns, California halibut, and sea cucumbers; all limits and closures adopted for open access gear (Table 29.d) also apply and are counted toward the groundfish limit; more specific limits set for exempted trawl gear engaged in fishing for pink shrimp (PFMC 2002).
2001	For area south of 34° 27', January – February fishing in waters < 20 fathoms; March – December open at all depths. Limits under Minor Rockfish South – Nearshore provided in Table 5 for all open access gear (revised at 66 FR 54721, October 5, 2001) (also provided in PFMC 2002, Table 29.h). A limit of 300 pounds of groundfish per trip also set for open access exempted trawl gear engaged in fishing for spot and ridgeback prawns, California halibut, and sea cucumbers; all limits and closures adopted for open access gear (Table 29.h) also apply and are counted toward the groundfish limit; more specific limits set for exempted trawl gear engaged in fishing for pink shrimp (PFMC 2002).
2002	For area south of 34° 27', closed January – February; March – June open at all depths; July – August open in waters < 20 fathoms; closed September – December. Limits under Minor Rockfish South – Nearshore provided in Table 5 for all open access gear (revised at 67 FR 70018, November 20, 2002). A limit of 300 pounds of groundfish per trip also set for open access exempted trawl gear engaged in fishing for spot and ridgeback prawns, California halibut, and sea cucumbers; all limits and closures adopted for open access gear (Table 5) also apply and are counted toward the groundfish limit; more specific limits set for exempted trawl gear engaged in fishing for pink shrimp (revised at 67 FR 10490, March 7, 2002).
2003	For California scorpionfish, closed January – April, September – December; open at all depths May – August. Limits under Minor Rockfish South – Nearshore, California scorpionfish provided in Table 5 (South) for all open access gears (revised at 68 FR 40187, July 7, 2003). Trip limits and RCAs for groundfish retained in the pink shrimp, ridgeback prawns, California halibut, and sea cucumber fisheries also provided in Table 5 (South). Fishermen using open access exempted trawl gear and taking nearshore species covered by the Nearshore Permit (including California scorpionfish) now required to have a Nearshore Fishery Bycatch Permit and now limited to 50 pounds per day of these select nearshore species. All limits and closures adopted for open access gear in Table (5) also apply.
2004	For California scorpionfish, closed January – February; open at all depths March – December. Limits under Minor Rockfish South – Nearshore, California scorpionfish provided in Table 5 (South) for all open access gears (revised at 69 FR 58916, October 6, 2004). Trip limits and RCAs for groundfish retained in the pink shrimp, ridgeback prawns, California halibut, and sea cucumber fisheries also provided in Table 5

	(South). Fishermen taking nearshore species covered by the Nearshore Permit (including California scorpionfish) under the Nearshore Fishery Bycatch Permit limited to 50 pounds per day of these select nearshore species. All limits and closures adopted for open access gear in Table (5) also apply.

ABCs, OYS, and Harvest Targets in Metric Tons for Nearshore Minor Rockfish South and California Scorpionfish for 1999-2006.

	1999			
Species Group	ABC	OY	Recreational[1]	Commercial[1]
Sebastes complex - south[2]	**4,731**	**2,705**	-----	**1,396**
Other Rockfish	**3,603**	-----	-----	-----

	2000				**2001**				**2002**			
Species Group	ABC	OY	Recreational[1]	Commercial[1]	ABC	OY	Rec.[1]	Comm.[1]	ABC	OY	Rec.[1]	Comm.[1]
Minor Rockfish South[3]	**3,457**	**1,899**	571	**1,328**	**3,556**	**2,040**	950	**1,090**	**3,506**	**2,015**	732	**1,283**
Other Rockfish	**2,702**	-----	-----	-----	**2,702**	-----	-----	-----	**2,652**	-----	-----	-----
Nearshore		**680**	379	**301**		**662**	550	**112**		**662**	532	**130**

		2003			**2004**				**2005/2006**			
Species Group	ABC	OY	Recreational[1]	Commercial[1]	ABC	OY[4]	Rec.[1]	Comm.[1]	ABC	OY[4]	Rec.[1]	Comm.[1]
Minor Rockfish South[3]	**3,506**	**1,894**	493	**1,401**	**3,412**	**1,968**	435	**1,390**	**3,412**	**1,968**	443	**1,390**
Other Rockfish	**2,652**	-----	-----	-----	**2,558**	-----	-----	-----	**2,558**	-----	-----	-----
Nearshore[4,5,6]		**541**	433	**108**		**615**	375	**97**		**615**	383	**97**
Shallow Nearshore		104.8	66	38.8		104.8	66	38.8		-----	-----	-----
Deeper Nearshore[6]		351.1	303.1	48		282.3	245.1	37.2		-----	-----	-----
California Scorpionfish		84.9	63.9	21		84.9	63.9	21		-----	-----	-----

Note:
1. Unbolded recreational values are either recreational estimates or harvest targets; unbolded commercial values are harvest targets while bolded values are OYs.
2. *Sebastes* complex -south covers the Eureka, Monterey, and Conception areas.
3. Minor Rockfish South covers only the Monterey and Conception areas with the boundary between Minor Rockfish North and Minor Rockfish South at 40° 30' N. lat.
4. The Nearshore Minor Rockfish South OY of 615 mt for 2004-2006 is currently under review.
5. The Nearshore Minor Rockfish South northern boundary is 40°10' N. lat.
6. Starting in 2004, Nearshore and Deeper Nearshore Rockfish OYs and harvest targets do not include black rockfish.

Commercial		Recreational
	1990	
Limits on set line length established Gill nets not allowed within 30 fm		Bag limit 10 fish, within the 15 fish bag limit No gear restrictions
	1994	
	Marine Resources Protection Act (MRPA) established four small reserves	
Sebastes complex split coastwide into limited entry (LE) and open access (OA) LE trip limits = 80,000 pounds per month OA trip limits = 40,000 pounds per month Gill nets not allowed within 3 miles of shore		
	1995	
Additional limitations for set lines established No set line fishing on weekends north of Santa Cruz Fishing restricted in Districts 12 & 13		
	1996	
Finfish trap permit required Limits on number of traps established Hook and line limited to 150 hooks within 1 mile of shore		
	1999	
Nearshore Fishery Permit (NFP) required NFP holders = 1,110 10-inch size limit established OA trip limits = 2,000 pounds per month south of 40º 10’ N. Latitude		
	2000	
	Sebastes complex split into nearshore, shelf, and slope CA scorpionfish included in nearshore	
Seasonal closures (2 months) first adopted for some areas		10-inch size limit established
	2001	
	Cowcod Conservation Area (CCA) established Depth restrictions adopted	
NFP moratorium established NFP holders = 750		
	2002	
	Nearshore Fishery Management Plan adopted	
100 pound renewal requirement for NFP NFP holders = 525 Commercial nearshore rockfish fishery closed early		Seasonal closures first adopted for CA scorpionfish south of Pt. Conception
	2003	
	California Rockfish Conservation Area (RCA) established south of 40º 10’ N. Latitude Groundfish fishing restricted by region, season, and depth Nearshore rockfish split into shallow, deeper, and California scorpionfish 50% of recent catches used to set harvest targets	
Formal restricted access program adopted NFP holders = 200 8-month closure as scheduled		Bag limit reduced to 5 fish No closure scheduled Recreational fishery closed early
	2004	
	2-month closures varied by region	

Forecasts: The population assessments were projected forward under the default PFMC and California harvest policies (i.e. F50% with 40:10 and 60:20 reductions, respectively). All scenarios assume that catch in 2005 and 2006 is equal to the catch in 2004. Projections for the commercial fishery are based on landed weights, while recreational projections are based on catch in numbers of fish converted to weight, resulting in slightly different trajectories for the two sectors due to variations in recent recruitment. Different allocation of catch among fisheries than presented below will produce somewhat different biomass trajectories because of different selectivities for the two sectors. Note: exploitation rates are in terms of the oldest aged fish in the model (Age 25 plus group) and not summary biomass.

With Sanitation Survey

Year	40:10	Biomass Age 2+	Spawning Biomass	Depletion	Commercial catch (mt)	Commercial harvest rate	Sport Catch (mt)	Sport Harvest Rate
2005	NA	1866	816	0.80	5.2	0.005	78.9	0.121
2006	NA	1846	827	0.81	5.2	0.005	82.6	0.113
2007	1	1811	818	0.80	13.4	0.013	222.2	0.291
2008	1	1633	703	0.69	11.5	0.013	191.0	0.291
2009	1	1503	623	0.61	10.0	0.013	164.9	0.291
2010	1	1412	572	0.56	9.0	0.013	145.7	0.291
2011	1	1348	541	0.53	8.3	0.013	132.6	0.291
2012	1	1303	520	0.51	7.9	0.013	124.0	0.291
2013	1	1271	505	0.49	7.6	0.013	118.4	0.291
2014	1	1246	494	0.48	7.4	0.013	114.6	0.291
2015	1	1226	485	0.47	7.2	0.013	111.8	0.291
2016	1	1210	478	0.47	7.1	0.013	109.5	0.291
2017		1198	472	0.46				

Year	60:20	Biomass Age 2+	Spawning Biomass	Depletion	Commercial catch (mt)	Commercial harvest rate	Sport Catch (mt)	Sport Harvest Rate
2005	NA	1866	816	0.80	5.2	0.005	78.9	0.121
2006	NA	1846	827	0.81	5.2	0.005	82.6	0.113
2007	1.00	1811	818	0.80	13.4	0.013	222.2	0.291
2008	1.00	1633	703	0.69	11.5	0.013	191.0	0.291
2009	1.00	1503	623	0.61	10.0	0.013	164.9	0.291
2010	0.96	1412	572	0.56	8.7	0.013	140.4	0.280
2011	0.94	1354	544	0.53	7.8	0.012	125.2	0.272
2012	0.92	1315	528	0.52	7.3	0.012	116.4	0.267
2013	0.91	1289	517	0.51	7.1	0.012	111.1	0.264
2014	0.90	1269	510	0.50	6.9	0.012	107.6	0.261
2015	0.89	1254	504	0.49	6.7	0.012	105.0	0.259
2016	0.88	1243	499	0.49	6.6	0.012	103.0	0.257
2017		1234	495	0.48				

Without Sanitation Survey

Year	40:10	Biomass Age 2+	Spawning Biomass	Depletion	Commercial catch (mt)	Commercial harvest rate	Sport Catch (mt)	Sport Harvest Rate
2005	NA	1352	563	0.58	5.2	0.007	82.0	0.151

2006	NA	1343	566	0.58	5.2	0.007	82.8	0.152
2007	1	1335	566	0.58	8.8	0.013	141.7	0.261
2008	1	1268	526	0.54	8.1	0.013	128.4	0.261
2009	1	1223	499	0.51	7.5	0.013	118.8	0.261
2010	1	1192	481	0.49	7.2	0.013	112.4	0.261
2011	1	1170	470	0.48	7.0	0.013	108.1	0.261
2012	1	1154	462	0.47	6.8	0.013	105.5	0.261
2013	1	1142	456	0.47	6.7	0.013	103.7	0.261
2014	1	1132	451	0.46	6.7	0.013	102.3	0.261
2015	1	1123	447	0.46	6.6	0.013	101.3	0.261
2016	1	1117	443	0.45	6.5	0.013	100.4	0.261
2017		1111	441	0.45				

Year	60:20	Biomass Age 2+	Spawning Biomass	Depletion	Commercial catch (mt)	Commercial harvest rate	Sport Catch (mt)	Sport Harvest Rate
2005	NA	1352	563	0.58	5.2	0.007	82.0	0.151
2006	NA	1343	566	0.58	5.2	0.007	82.8	0.152
2007	0.98	1335	566	0.58	8.6	0.013	139.1	0.256
2008	0.94	1271	528	0.54	7.6	0.012	121.8	0.246
2009	0.92	1232	505	0.52	7.0	0.012	110.9	0.240
2010	0.90	1208	492	0.50	6.7	0.012	104.5	0.236
2011	0.89	1192	484	0.50	6.5	0.011	100.7	0.233
2012	0.89	1181	479	0.49	6.3	0.011	98.6	0.232
2013	0.88	1173	476	0.49	6.3	0.011	97.2	0.231
2014	0.88	1167	473	0.48	6.2	0.011	96.1	0.230
2015	0.88	1162	471	0.48	6.1	0.011	95.3	0.229
2016	0.87	1158	469	0.48	6.1	0.011	94.7	0.228
2017		1155	468	0.48				

Decision table: Uncertainty in the analysis is represented by including and excluding the sanitation districts trawl survey. Management action alternatives considered were: (1) harvesting using the 40:20 rule based on the assessment including the sanitation districts trawl survey; (2) harvesting using the 60:20 rule based on the assessment including the sanitation districts trawl survey; and (3) harvesting using catch in 2004. All scenarios assume that catch in 2005 and 2006 is equal to the catch in 2004. Projections for the commercial fishery are based on landed weights, while recreational projections are based on catch in numbers of fish. Results are presented below.

				State of nature			
				With Sanitation More likely (p = 0.74)		Without Sanitation less likely (p = 0.26)	
Management Action	Year	Recreational catch (thousands of fish)	Commercial catch (mt)	Spawning Biomass	Depletion	Spawning Biomass	Depletion
40-10	2005	140	5	816	0.80	563	0.58
	2006	140	5	827	0.81	566	0.58
	2007	361	13	818	0.80	566	0.58
	2008	308	11	703	0.69	478	0.49
	2009	267	10	623	0.61	425	0.43
	2010	240	9	572	0.56	397	0.41
	2011	222	8	541	0.53	385	0.39
	2012	211	8	520	0.51	380	0.39

	2013	203	8	505	0.49	379	0.39
	2014	198	7	494	0.48	378	0.39
	2015	194	7	485	0.47	378	0.39
	2016	191	7	478	0.47	379	0.39
	2017			472	0.46	380	0.39
60-20	2005	140	5	816	0.80	563	0.58
	2006	140	5	827	0.81	566	0.58
	2007	361	13	818	0.80	566	0.58
	2008	308	11	703	0.69	478	0.49
	2009	267	10	623	0.61	425	0.43
	2010	231	9	572	0.56	397	0.41
	2011	209	8	544	0.53	388	0.40
	2012	197	7	528	0.52	387	0.40
	2013	189	7	517	0.51	389	0.40
	2014	184	7	510	0.50	392	0.40
	2015	180	7	504	0.49	395	0.40
	2016	177	7	499	0.49	398	0.41
	2017			495	0.48	401	0.41
Current catch	2005	140	5	816	0.80	563	0.58
	2006	140	5	827	0.81	566	0.58
	2007	140	5	818	0.80	566	0.58
	2008	140	5	785	0.78	565	0.58
	2009	140	5	762	0.76	563	0.58
	2010	140	5	739	0.74	561	0.57
	2011	140	5	717	0.71	559	0.57
	2012	140	5	697	0.69	557	0.57
	2013	140	5	679	0.68	555	0.57
	2014	140	5	663	0.66	553	0.57
	2015	140	5	649	0.65	551	0.56
	2016	140	5	637	0.63	549	0.56
	2017			626	0.62	548	0.56

Regional management: The range of California scorpionfish is restricted to southern California. A substantial, but unknown, proportion of the stock is in Mexican waters. Initial analysis conducted on individual sub-stocks showed that similar results are obtained for the nearshore stocks along the U.S. mainland coast. This is collaborated by the similarity in the CPUE and sanitation abundances indices for the nearshore stocks. The sum of the individual sub-stock assessments was similar to the single southern California assessment. However, the individual sub-stock assessments indicated that the exploitation rates are lower in the offshore areas. Unfortunately, there is limited data for the offshore areas. Regional management would require obtaining length-frequency data by CDFG block to allow stock assessments by region. In addition, more information on the site fidelity of California scorpionfish from tagging data would be needed to determine the appropriateness of regional management.

Research and data needs: Differences in growth rates between the sexes may imply that the fisheries have different impacts on the sexes. Sex-specific sampling of the data (e.g. length-frequencies) would help refine the model and identify the different impacts on the sexes. There is only limited information on the stock structure and a large proportion of the stock resides in Mexican waters. Extensive tagging studies would help define the stock structure, evaluate the need for local scale assessments, and determine the impact of the Mexican component of the stock. Catches from the Mexican fisheries would also be beneficial. The growth data are based on limited sampling and an updated aging study may improve the assessment.

C. Introduction

1. Description

California scorpionfish (*Scorpaena guttata*), also known locally as sculpin, is a generally benthic species found from central California to the Gulf of California between the inter-tidal and about 170 m (Eschmeyer et al., 1983; Love et al., 1987). It generally inhabits rocky reefs, but in certain areas and seasons it aggregates over sandy or muddy substrate (Frey, 1971; Love et al., 1987). Catch rate analysis and tagging studies show that most, but not all, California scorpionfish migrate to deeper water to spawn during May-September (Love et al., 1987). Tagging data suggest that they return to the same spawning site (Love et al. 1987), but information is not available on non-spawning season site fidelity. California scorpionfish are quite mobile and may not be permanently tied to a particular reef (Love et al. 1987). The species feeds on a wide variety of foods, including crabs, fishes, octopi, isopods and shrimp, but juvenile *Cancer* crabs are the most important prey (Limbaugh, 1955; Love et al., 1987).

2. Important life history characteristics

Love et al. (1987) provide a summary of the biology of California scorpionfish. California scorpionfish spawn from May through August, peaking in July (Love et al. 1987). The species is oviparous, producing floating, gelatinous egg masses in which the eggs are embedded in a single layer (Orton 1955). California scorpionfish utilize the “explosive breeding assemblage” reproductive mode in which fish migrate to, and aggregate at traditional spawning sites for brief periods (Love et al. 1987) and it is believed that spawning takes place just before, and perhaps after dawn, in the water column (Love et al. 1987). These spawning aggregations have been targeted by fishermen. Little is known about California scorpionfish larvae. Few larvae have been taken in ichthyoplankton surveys off southern California (Moser et al. 1993). Larvae are more abundant in surveys conducted off northern Baja California, Mexico (Moser et al. 1993). Few California scorpionfish are mature at 1 year of age, but over 50% are mature by age two and most are mature by age three (Love et al. 1987).

Males and females show different growth rates, with females growing to a larger size than males, and the sexes exhibit different length-weight relationships (Love et al. 1987).

Scorpionfish are very resistant to hooking mortality and have shown survival under extreme conditions. Therefore, for the purpose of this assessment, discard mortality is assumed to be negligible.

Like other species in the genus *Scorpaena*, California scorpionfish produce a toxin in their dorsal, anal, and pelvic spines, which produces intense, painful wounds (Love et al. 1987).

3. Fishery

California scorpionfish comprise a minor part of the Californian sport and commercial fisheries (Love et al., 1987). Some commercial passenger fishing vessels (CPFV) operators reportedly target California scorpionfish spawning aggregations during spring and summer (Love et al. 1987), and also target California scorpionfish in the winter when other species are not available. Historically, California scorpionfish were taken commercially by hook and line and, occasionally, by round haul nets (Daugherty, 1949). More recently, commercial bottom longlines have been used to target spawning aggregations offshore of Long Beach (Love et al. 1987). Since the early 1990s, trawl catch has been a substantial component of the commercial catch. Commercial landings have fluctuated substantially over time, which could, in part, be due to changes in targeting and El Niño events (Love et al. 1987). A high proportion of the catch landed in California during the 1960s and 1970s was taken from Mexican waters. In recent years, most of the catch has come from around the Los Angeles region. In general, the majority of the commercial catch has come from the Los Angeles region, except in the 1960s and 1970s when the majority of the catch came from the San Diego region and Mexican waters.

The CPFV effort has remained relatively constant over a long period (1959-1998; Dotson and Charter, 2003). However, there appears to be a shift in effort towards less utilized species, such as California scorpionfish, over the past decade (Dotson and Charter, 2003).

4. Management (and assessment)

No previous assessments have been carried out for California scorpionfish off southern California. Most previous work has focused on the biology and behavior of scorpionfish or the description and analysis of catch and catch rates (e.g. Love et al, 1987 and references therein).

Prior to the adoption of the Pacific Coast Groundfish Fishery Management Plan (FMP) in 1982, California scorpionfish (*Scorpaena guttata*) was managed through a regulatory process that included the California Department of Fish and Game (CDFG) along with either the California State Legislature or the Fish and Game Commission (FGC) depending on the sector (recreation or commercial) and fishery. With implementation of the Pacific Coast Groundfish FMP, California scorpionfish came under the management authority of the Pacific Fishery Management Council (PFMC), being incorporated, along with all genera and species of the family Scorpaenidae, into a federal rockfish classification and managed as part of "Remaining Rockfish" under the larger heading of "Other Rockfish" (PFMC 2004; PFMC 2002, Tables 31-39). California scorpionfish continued to be managed through federal regulations for "Remaining Rockfish" from 1983-1996, although the larger heading "Other Rockfish" was discontinued in 1992 and replaced with "*Sebastes* complex" (PFMC 2002, Tables 40-47; March 1, 1999, 64 FR 9936).

Under the Pacific Coast Groundfish FMP, groundfish species and species groups were managed using estimates of Allowable Biological Catch (ABC) (early documentation refers to Maximum Sustainable Yield, but now referenced as ABC). The ABCs provided by the PFMC's Groundfish Management Team (GMT) in the 1980's were based on an analysis of commercial landings from the 1960's and 1970's. For this analysis, most of the rockfishes were lumped into one large group. This analysis indicated that the landings for rockfish in the Monterey-Conception area were at or near ABC levels (PFMC 1993). In the 1990's, as bocaccio and other rockfish were assessed, the ABCs associated with these species were removed from this larger "*Sebastes* complex" group. Starting in 1992, some of the rockfish species and species groups began to be managed using harvest guidelines (in addition to ABCs) followed in 1999 by the use of Optimum Yields (OY).

To keep landings within these adopted harvest targets, the Pacific Coast Groundfish FMP provided the Council with a variety of management tools including area closures, season closures, gear restrictions, and, for the commercial sector, cumulative limits (generally for two-month periods). With the implementation of a federal groundfish restricted access program in 1994, allocations of total catch and cumulative limits began to be specifically set for open access (including most of California's commercial fisheries that target California scorpionfish in Southern California) and limited entry fisheries (PFMC 2002; 2004).

During most of this time frame, management also centered on the commercial groundfish sector primarily because harvest from the recreational sector was considerably smaller than that from the commercial sector. This approach began to change in the later 1990's as commercial landings decreased and recreational harvest became a greater proportion of the available harvest. For the "*Sebastes* complex", an estimate of the recreational harvest began to be included in the ABC tables starting in 1997 (PFMC 2002, Tables 48).

Also beginning in 1997, the "Remaining Rockfish" group was separated into two groups: "Other Rockfish" which contained those species, like California scorpionfish, with no quantifiable assessment (and whose OY was calculated as 0.5 of the ABC); and "Remaining Rockfish" which contained species that had been assessed with less rigorous methods than a stock assessment (and whose OY was calculated as 0.75 of the ABC) (PFMC 2002, Tables 48-53; March 1,1999, 64 FR 9935-9936). Therefore, beginning in 1997, California scorpionfish was managed as part of the *Sebastes* complex-south, "Other Rockfish" category. (*Sebastes* complex-south included the Eureka, Monterey, and Conception areas while *Sebastes* complex-north included the Vancouver and Columbia areas.)

The PFMC's rockfish management structure changed significantly in 2000 with the replacement of the *Sebastes* complex –north and –south areas with Minor Rockfish North (now covering the Vancouver, Columbia, and Eureka areas) and Minor Rockfish South (now Monterey and Conception areas only). The OY for these two groups (which continued to be calculated as 0.50 of the ABC) was further divided (between north and south of 40º10' N. Lat.) into nearshore, shelf, and slope rockfish categories with allocations set for Limited Entry and Open Access fisheries within each of these three categories (January 4, 2000, 65 FR 221; PFMC 2002, Tables 54-55). Species were parceled into these new categories depending on primary catch depths and geographical distribution. Because of its depth range and southern distribution, California scorpionfish was included within the Minor Rockfish South, "Other Rockfish" ABC and managed under the south of 40º10' N. Lat. nearshore rockfish OY and trip limits (PFMC 2002, Table 29).

Along with the above changes, a North/South management line at 40º10' N. Lat. was established in 2000 with separate management specifications adopted for the areas north and south of 40º10' N. Lat. and with the southern area divided into two separate management areas at Point Lopez, 36º00' N. Lat. This was followed in 2001 with the implementation of two distinct rockfish and lingcod management areas south of 40º10' N. Lat. (along with separate management specifications): the northern rockfish and lingcod management area between 40º10' N. Lat. and Point Conception (34º27' N. Lat.); and the southern rockfish and lingcod management area between Point Conception and the U.S.-Mexico border. These were later revised starting in 2004 with the northern rockfish and lingcod management area redefined as ocean waters from the

Oregon – California border (42º00’ N. Lat.) to 40º10’ N. Lat., the central rockfish and lingcod management area defined as ocean waters from 40º10’ N. Lat. to Point Conception, and the southern rockfish and management area continuing to be defined as ocean waters from Point Conception to the U.S.-Mexico border.

Cowcod Conservation Areas (CCAs) also were established in 2001 to reduce fishing effort for cowcod rockfish (PFMC 2002, Table 29). These areas were closed to all recreational and commercial fishing for groundfish except for recreational and commercial fishing for minor nearshore rockfish[2] (including California scorpionfish) within waters less than 20 fathoms. In addition, Rockfish Conservation Areas (RCAs) were established in 2003 to allow for the closure of specific area and depth ranges along the West Coast for the purpose of reducing fishing effort for shelf and slope rockfish. The California Rockfish Conservation Area (CRCA) was defined as those ocean waters south 40º10’ N. Lat. to the U.S.-Mexico border with different depth zones specified for the areas north and south of Pt. Reyes (37º59’44’’N. Lat.).

During the late 1990’s and early 2000’s, major changes also occurred in the way that California managed its nearshore fishery. The Marine Life Management Act (MLMA), which was passed in 1998 by the California Legislature and enacted in 1999, required that the FGC adopt an FMP for nearshore finfish. It also gave authority to the FGC to regulate commercial and recreational nearshore fisheries through FMPs and provided broad authority to adopt regulations for the nearshore fishery during the time prior to adoption of the nearshore finfish FMP. Within this legislation, the Legislature also included commercial size limits for nine nearshore species including California scorpionfish (10-inch minimum size) and a requirement that commercial fishermen landing these nine nearshore species possess a nearshore permit.

Following adoption of the Nearshore FMP and accompanying regulations by the FGC in fall of 2002, the FGC adopted regulations in November 2002 which established of a set of marine reserves around the Channel Islands in Southern California (which became effective April 2003) and adopted a nearshore restricted access program in December 2002 (which included the establishment of a Deeper Nearshore Permit) to be effective starting in the 2003 fishing year.

Although the Nearshore FMP provided for the management of the nearshore rockfish and California scorpionfish, management authority for these species continued to reside with the Council. Even so, for the 2003 and subsequent fishery seasons, the State provided recommendations to the Council specific to the nearshore species that followed the directives set out in the Nearshore FMP. These recommendations, which the Council incorporated into the 2003 management specifications, included a recalculated OY for Minor Rockfish South - Nearshore, division of the Minor Rockfish South - Nearshore into three groups (shallow nearshore rockfish; deeper nearshore rockfish; and California scorpionfish), and specific harvest targets and recreational and commercial allocations for each of these groups. This was followed in 2004 with the adoption of specific management measures for each of the three management areas: the California-Oregon border to 40º10’ N. Lat.; 40º10’ N. Lat. to Point Conception (34 º 27’ N. Lat.); and Point Conception to the U.S.-Mexico border.

Also, since the enactment of the MLMA, the Council and State in a coordinated effort developed and adopted various management specifications in 1999-2004 to keep harvest within the harvest targets, including seasonal and area closures (e.g. the CCAs; a closure of Cordell Banks to specific fishing), depth restrictions, minimum size limits, and bag limits to regulate the

[2] This exception also included the two state managed groundfish species, cabezon and kelp greenling.

recreational fishery and license and permit regulations, finfish trap permits, gear restrictions, seasonal and area closures (e.g. the RCAs and CCAs; a closure of Cordell Banks to specific fishing), depth restrictions, trip limits, and minimum size limits to regulate the commercial fishery.

A summary of the above regulations for 1999-2004, as they relate to California scorpionfish, is supplied in Table C4.1 and a regulation timeline for 1990-2004 is provided in Figure C4.1. In addition, OYs and harvest targets for the Minor Rockfish South - Nearshore and California scorpionfish for 1999-2006 are provided in Table C4.2.

Table C4.1. Summary of Federal and California Regulations for California Scorpionfish for the Area South of Point Conception (34° 27' N. lat.) from 1999-2004.

Recreational	
1999	Fishing open January – December at all depths.
2000	10" minimum size limit. January-February closure for rockfishes including California scorpionfish.
2001	January – February, November - December fishing in waters < 20 fathoms; March-October fishing open at all depths.
2002	January – February, November – December closure for rockfishes including California scorpionfish; March-June fishing open at all depths; July – October fishing in waters <20 fathoms.
2003	Bag limit changed from 10 fish to 5 fish. January – February fishing only in waters < 20 fathoms; March – June fishing open at all depths; July – August fishing in waters < 20 fathoms; September - November fishing in waters < 30 fathoms; December closure for rockfishes including California scorpionfish.
2004	January – February, May - October closure for rockfishes including California scorpionfish; March – April, November – December open in waters < 60 fathoms.
Commercial	
1999	10" minimum size limit with exemption for fish taken in trawl nets and landed dead. Fishermen landing California scorpionfish required to possess a Nearshore Permit. *Sebastes* Complex -South (which includes California scorpionfish) open January – December. Limits under Sebastes Complex –South provided in Federal Register (FR) for all open access gear (revised at 64 FR 54786, October 8, 1999). A limit of 300 pounds of groundfish per trip also set for open access exempted trawl gear engaged in fishing for pink shrimp, spot and ridgeback prawns, California halibut, and sea cucumbers; all limits and closures adopted for open access gear also apply and are counted toward the groundfish limit (PFMC 2002).
2000	For area south of 36° N. Lat., closed January – February; in area between 40° N. Lat. and 36° N. Lat., closed March – April. Limits under Minor Rockfish South – Nearshore provided in Table 5 for all open access gear (revised at 65 FR 66655, November 7, 2000) (also provided in PFMC 2002, Table 29.d). A limit of 300 pounds of groundfish per trip also set for open access exempted trawl gear engaged in fishing for spot and ridgeback prawns, California halibut, and sea cucumbers; all limits and closures adopted for open access gear (Table 29.d) also apply

	and are counted toward the groundfish limit; more specific limits set for exempted trawl gear engaged in fishing for pink shrimp (PFMC 2002).
2001	For area south of 34° 27’, January – February fishing in waters < 20 fathoms; March – December open at all depths. Limits under Minor Rockfish South – Nearshore provided in Table 5 for all open access gear (revised at 66 FR 54721, October 5, 2001) (also provided in PFMC 2002, Table 29.h). A limit of 300 pounds of groundfish per trip also set for open access exempted trawl gear engaged in fishing for spot and ridgeback prawns, California halibut, and sea cucumbers; all limits and closures adopted for open access gear (Table 29.h) also apply and are counted toward the groundfish limit; more specific limits set for exempted trawl gear engaged in fishing for pink shrimp (PFMC 2002).
2002	For area south of 34° 27’, closed January – February; March – June open at all depths; July – August open in waters < 20 fathoms; closed September – December. Limits under Minor Rockfish South – Nearshore provided in Table 5 for all open access gear (revised at 67 FR 70018, November 20, 2002). A limit of 300 pounds of groundfish per trip also set for open access exempted trawl gear engaged in fishing for spot and ridgeback prawns, California halibut, and sea cucumbers; all limits and closures adopted for open access gear (Table 5) also apply and are counted toward the groundfish limit; more specific limits set for exempted trawl gear engaged in fishing for pink shrimp (revised at 67 FR 10490, March 7, 2002).
2003	For California scorpionfish, closed January – April, September – December; open at all depths May – August. Limits under Minor Rockfish South – Nearshore, California scorpionfish provided in Table 5 (South) for all open access gears (revised at 68 FR 40187, July 7, 2003). Trip limits and RCAs for groundfish retained in the pink shrimp, ridgeback prawns, California halibut, and sea cucumber fisheries also provided in Table 5 (South). Fishermen using open access exempted trawl gear and taking nearshore species covered by the Nearshore Permit (including California scorpionfish) now required to have a Nearshore Fishery Bycatch Permit and now limited to 50 pounds per day of these select nearshore species. All limits and closures adopted for open access gear in Table (5) also apply.
2004	For California scorpionfish, closed January – February; open at all depths March – December. Limits under Minor Rockfish South – Nearshore, California scorpionfish provided in Table 5 (South) for all open access gears (revised at 69 FR 58916, October 6, 2004). Trip limits and RCAs for groundfish retained in the pink shrimp, ridgeback prawns, California halibut, and sea cucumber fisheries also provided in Table 5 (South). Fishermen taking nearshore species covered by the Nearshore Permit (including California scorpionfish) under the Nearshore Fishery Bycatch Permit limited to 50 pounds per day of these select nearshore species. All limits and closures adopted for open access gear in Table (5) also apply.

Table C4.2. ABCs, OYS, and Harvest Targets in Metric Tons for Nearshore Minor Rockfish South and California Scorpionfish for 1999-2006.
Table 2. ABCs, OYS, and Harvest Targets in Metric Tons for Nearshore Minor Rockfish South and California Scorpionfish for 1999-2006.

	1999			
Species Group	ABC	OY	Recreational[1]	Commercial[1]
Sebastes complex - south[2]	**4,731**	**2,705**	-----	**1,396**
Other Rockfish	**3,603**	-----	-----	-----

	2000				**2001**				**2002**			
Species Group	ABC	OY	Recreational[1]	Commercial[1]	ABC	OY	Rec.[1]	Comm.[1]	ABC	OY	Rec.[1]	Comm.[1]
Minor Rockfish South[3]	**3,457**	**1,899**	571	**1,328**	**3,556**	**2,040**	950	**1,090**	**3,506**	**2,015**	732	**1,283**
Other Rockfish	**2,702**	-----	-----	-----	**2,702**	-----	-----	-----	**2,652**	-----	-----	-----
Nearshore		**680**	379	**301**		**662**	550	**112**		**662**	532	**130**

		2003			**2004**				**2005/2006**			
Species Group	ABC	OY	Recreational[1]	Commercial[1]	ABC	OY[4]	Rec.[1]	Comm.[1]	ABC	OY[4]	Rec.[1]	Comm.[1]
Minor Rockfish South[3]	**3,506**	**1,894**	493	**1,401**	**3,412**	**1,968**	435	**1,390**	**3,412**	**1,968**	443	**1,390**
Other Rockfish	**2,652**	-----	-----	-----	**2,558**	-----	-----	-----	**2,558**	-----	-----	-----
Nearshore[4,5,6]		**541**	433	**108**		**615**	375	**97**		**615**	383	**97**
Shallow Nearshore		104.8	66	38.8		104.8	66	38.8		-----	-----	-----
Deeper Nearshore[6]		351.1	303.1	48		282.3	245.1	37.2		-----	-----	-----
California Scorpionfish		84.9	63.9	21		84.9	63.9	21		-----	-----	-----

Note:
1. Unbolded recreational values are either recreational estimates or harvest targets; unbolded commercial values are harvest targets while bolded values are OYs.
2. *Sebastes* complex -south covers the Eureka, Monterey, and Conception areas.
3. Minor Rockfish South covers only the Monterey and Conception areas with the boundary between Minor Rockfish North and Minor Rockfish South at 40° 30' N. lat.
4. The Nearshore Minor Rockfish South OY of 615 mt for 2004-2006 is currently under review.
5. The Nearshore Minor Rockfish South northern boundary is 40°10' N. lat.
6. Starting in 2004, Nearshore and Deeper Nearshore Rockfish OYs and harvest targets do not include black rockfish.

Figure C4.1. Commercial and recreational regulations for CA Scorpionfish, 1990-2004.

Commercial		Recreational
	1990	
Limits on set line length established Gill nets not allowed within 30 fm		Bag limit 10 fish, within the 15 fish bag limit No gear restrictions
	1994	
	Marine Resources Protection Act (MRPA) established four small reserves	
Sebastes complex split coastwide into limited entry (LE) and open access (OA) LE trip limits = 80,000 pounds per month OA trip limits = 40,000 pounds per month Gill nets not allowed within 3 miles of shore		
	1995	
Additional limitations for set lines established No set line fishing on weekends north of Santa Cruz Fishing restricted in Districts 12 & 13		
	1996	
Finfish trap permit required Limits on number of traps established Hook and line limited to 150 hooks within 1 mile of shore		
	1999	
Nearshore Fishery Permit (NFP) required NFP holders = 1,110 10-inch size limit established OA trip limits = 2,000 pounds per month south of 40º 10’ N. Latitude		
	2000	
	Sebastes complex split into nearshore, shelf, and slope CA scorpionfish included in nearshore	
Seasonal closures (2 months) first adopted for some areas		10-inch size limit established
	2001	
	Cowcod Conservation Area (CCA) established Depth restrictions adopted	
NFP moratorium established NFP holders = 750		
	2002	
	Nearshore Fishery Management Plan adopted	
100 pound renewal requirement for NFP NFP holders = 525 Commercial nearshore rockfish fishery closed early		Seasonal closures first adopted for CA scorpionfish south of Pt. Conception
	2003	
	California Rockfish Conservation Area (RCA) established south of 40º 10’ N. Latitude Groundfish fishing restricted by region, season, and depth Nearshore rockfish split into shallow, deeper, and California scorpionfish 50% of recent catches used to set harvest targets	
Formal restricted access program adopted NFP holders = 200 8-month closure as scheduled		Bag limit reduced to 5 fish No closure scheduled Recreational fishery closed early
	2004	
	2-month closures varied by region	

D. Assessment

1. Data

The data sources and dates are given in the acknowledgements section.

a. Distribution and stock structure

California scorpionfish is a generally benthic species found from central California to the Gulf of California between the intertidal and about 170 m (Eschmeyer et al., 1983; Love et al., 1987). A substantial, but unknown, portion of the stock resides in Mexican waters. It generally inhabits rocky reefs, but in certain areas and seasons it aggregates over sandy or muddy substrate (Frey, 1971; Love et al., 1987). Substantial numbers are found over soft substrate in the vicinity of Palos Verdes (Love et al. 1987). It is believed that its presence in this area is due to the large populations of ridgeback prawn (*Sicyonia ingentis*) that are linked to Whites Point sewer outfall (love et al. 1987). Catch rate analysis and tagging studies show that most, but not all, California scorpionfish migrate to deeper water to spawn during May-September (Love et al., 1987). Tagging studies on spawning aggregations over Dago Bank showed that individuals tend to return to the same spawning area (Love et al. 1987), but information is not available on non-spawning season site fidelity. Tags retuned from the non-spawning period ranged from El Segundo in the north to Long Beach in the south (Love et al. 1987). California scorpionfish are quite mobile and may not be permanently tied to a particular reef (Love et al. 1987). For example, several tagged California scorpionfish have been recorded to move from Santa Monica Bay to the Coronado Islands (Hartmann 1987).

Data from California Department of Fish and Game (CDFG) creel census showed lowest catch rates near Santa Barbara and generally increased to the south with greatest catches off Sand Diego around Catalina, San Clemente, and the Coronado Islands (Love et al. 1987). Catch rates were higher in 61-90 m and 121-150 m depth strata during the spawning season (May-September) and higher in 0-30 m and 31-60 m depth strata during the non-spawning season (October-April) (Love et al. 1987). However, not all fish migrate to deeper water at the same time during spawning season as mature and ripe individuals were also caught inshore (Love et al. 1987).

SCCWRP and Orange County Sanitation trawl data indicate large variations in population size (Love et al. 1987). Some of this variation may be due to El Niño events (Love et al. 1987). It is possible that the variation is due to movement of individuals rather than changes in population size because there is also an absence of other species from their normal areas at the same time (Love et al. 1987).

For stock assessment purposes the southern California population is assumed to be a single stock. This assumption is based on 1) similarities among CPUE indices and sanitation trawl surveys among sub-regions, 2) initial analyses using individual sub-stocks showed similar results among sub-stocks and the combined results were similar to a single stock analysis, and 3) paucity of data for some regions. The stock is truncated in the south at the international boarder. Catch from Mexican waters landed in Californian ports are excluded from the analysis.

b. Biological parameters

<u>Age and growth</u>
Love et al. (1987) used annuli on pterygiophore separately for each sex to estimate the parameters of the von Bertalanffy growth curve. The annuli were validated by observing seasonal development of the opaque zone on the sections' edges in fishes with 2-5 opaque zones. The von Bertalanffy parameters were estimated based on 182 females and 222 Males (Table D1.1). The parameters are in terms of total length.

$$L_t = L_\infty \left(1 - \exp\left[-k\left(t - t_0\right)\right]\right)$$

Table D1.1. Parameters of the von Bertalanffy growth curve for California scorpionfish off southern California estimated by Love et al. (1987).

Sex	L_∞	SE	k	SE	t_0	SE
Female	44.33	1.57	0.13	0.02	-1.90	0.42
Male	36.31	1.60	0.12	0.02	-3.86	0.68

No estimates of variation of length-at-age are available. The coefficient of variation of the length-at-age is assumed to be 0.05 for the assessment.

<u>Length weight</u>
Love et al. (1987) developed a length-weight relationship for California scorpionfish from 656 males and 371 females from southern California. They found a significant difference between males and females. The parameters are in terms of total length.

$W = aL^b$

where W is weight in grams, L is total length in centimeters.

a = 0.0196 and 0.0205, and b = 3.0102 and 3.0045 for females and males, respectively.

<u>Conversion factors</u>
California scorpionfish do not have a forked tail, therefore total length and fork length are equal. Love et al. (1987) provide conversion factors between standard length (SL) and total length (TL).

TL = 1.21SL + 1.02

SL = 0.82TL - 0.69

Maturity and fecundity

Few California scorpionfish are mature at age 1, but over 50% are mature at age 2 and most are mature at age 3 (Love at al. 1987). Gonad data collected from the bimonthly trawl survey conducted off Ventura and Santa Barbara from 1994 to 1995 (Steve Wertz, CDFG), shows a peak in May for females (Figure D1.1) indicating spawning occurs sometime between May and June. The proportion mature at length from the survey does not give a good indication of the size at maturity (Figure D1.2), but the GSI calculated as the gonad weight divided by the total weight suggests a linear function with length up to about 30 cm TL (Figure D1.3). For non-hydrated females assuming a maximum GSI of 0.02 at 30 cm TL, the GSI relationship with TL is

GSI = 0.0012TL - 0.0155

which can be used to generate a fecundity at size relationship

$$f_{TL} = \begin{cases} 0 & TL \le 13 \\ (0.0012TL - 0.0155)W_{TL} & 13 < TL < 30 \\ 0.2W_{TL} & TL \ge 30 \end{cases}$$

where TL is the total length and W_{TL} is the weight at that total length. This relationship is developed from females sampled throughout the year and therefore does not represent total eggs, but should provide a reasonable relative measure of fecundity if the size of individuals that were sampled does not change during the year and that the relative differences in GSI among lengths is consistent throughout the year.

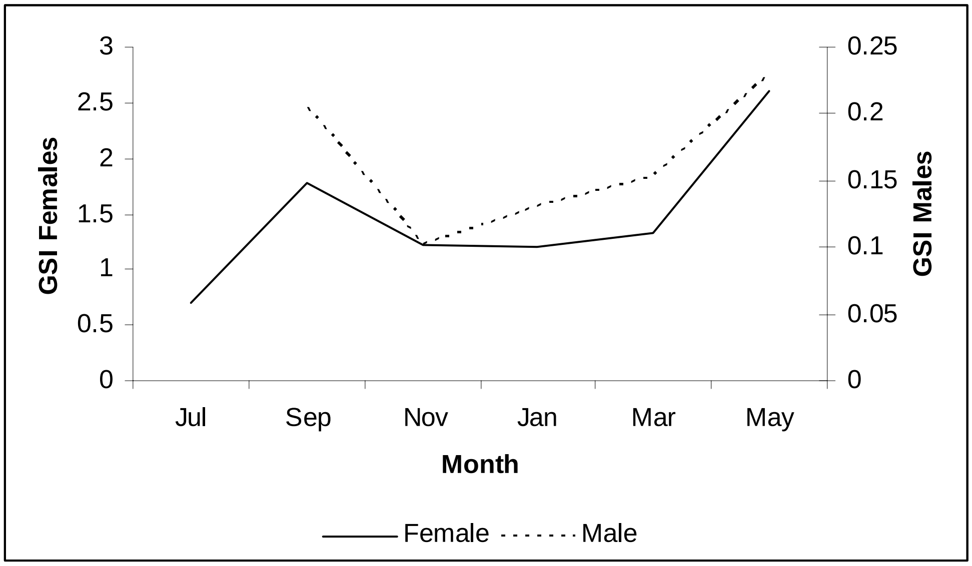


Figure D1.1. Seasonal Pattern in GSI index from the bimonthly trawl survey conducted off Ventura and Santa Barbara from 1994 to 1995 (Steve Wertz, CDFG).

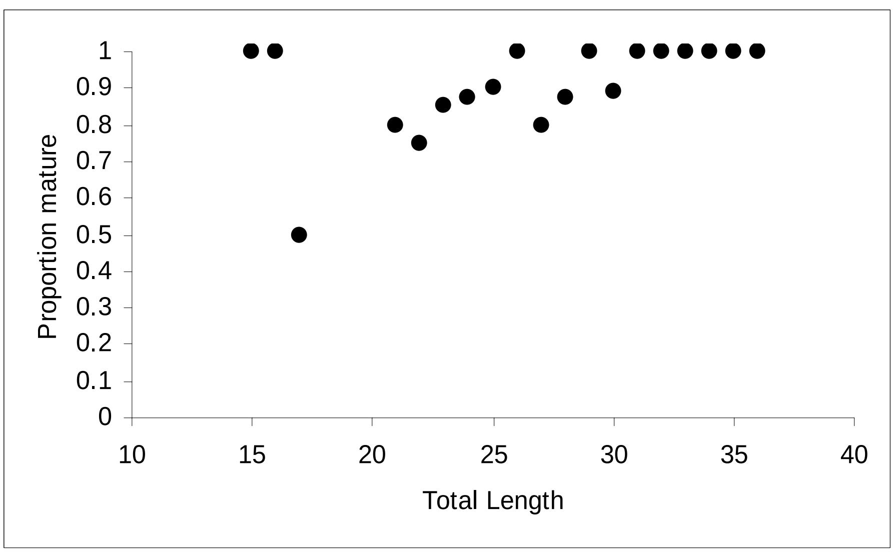


Figure D1.2. Proportion mature by length from the bimonthly trawl survey conducted off Ventura and Santa Barbara from 1994 to 1995 (Steve Wertz, CDFG).

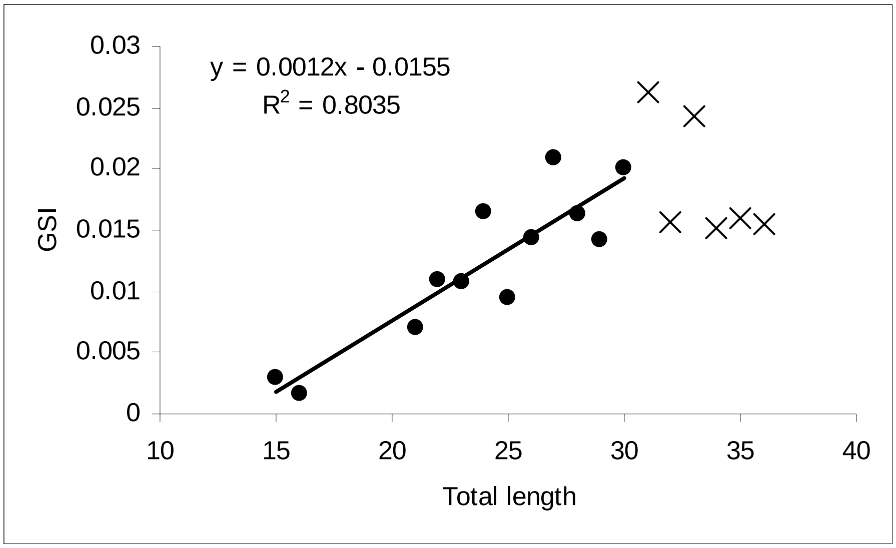


Figure D1.3. GSI (gonad weight/total weight) by total length for non-hydrated females assuming an asymptotic GSI at 0.02 at 30 cm TL using data from bimonthly trawl survey conducted off Ventura and Santa Barbara from 1994 to 1995 (Steve Wertz, CDFG). The data points marked with an X are not used in the regression.

Natural mortality

The maximum age observed by Love et al. (1987) was 21 and 15 years old for females and males, respectively. Approximately 20% of the fish were older than 11 years old (Table D1.2, Figure D1.4). Fish were sampled monthly from May 1981 to June 1982 and sporadically thereafter through May 1983. They used a 7.6 m or 4.9 m head rope otter trawl in 7-90 m of water, between Ventura and San Onofre. Thirty-four percent of the fish were not age-able due to malformed or poorly delineated annuli. The higher maximum age for females suggests that females have a lower total mortality rate than males. However, percent female decreases for the intermediate ages and then returns to about 50% for the older ages (Figure D1.5). The rapid decline in age-frequency and large age 12 plus group is inconsistent with standard catch-curve analysis.

Table D1.2. Frequency at age by sex from Love et al. (1987) Table 4. The numbers in the 12+ group represent all individuals aged 12 years and older and were calculated by subtracting the totals in Table 4 from Love et al. (1987) from the total number aged.

	count		Proportion of total		
age	Male	Female	Male	Female	Proportion female
2	7	3	0.03	0.02	0.30
3	31	31	0.14	0.17	0.50
4	62	43	0.28	0.24	0.41
5	40	31	0.18	0.17	0.44
6	15	24	0.07	0.13	0.62
7	4	11	0.02	0.06	0.73
8	9	3	0.04	0.02	0.25
9	5	1	0.02	0.01	0.17
10	7	2	0.03	0.01	0.22
11	4	1	0.02	0.01	0.20
12+	38	32	0.17	0.18	0.46
Total	222	182	1.00	1.00	0.45

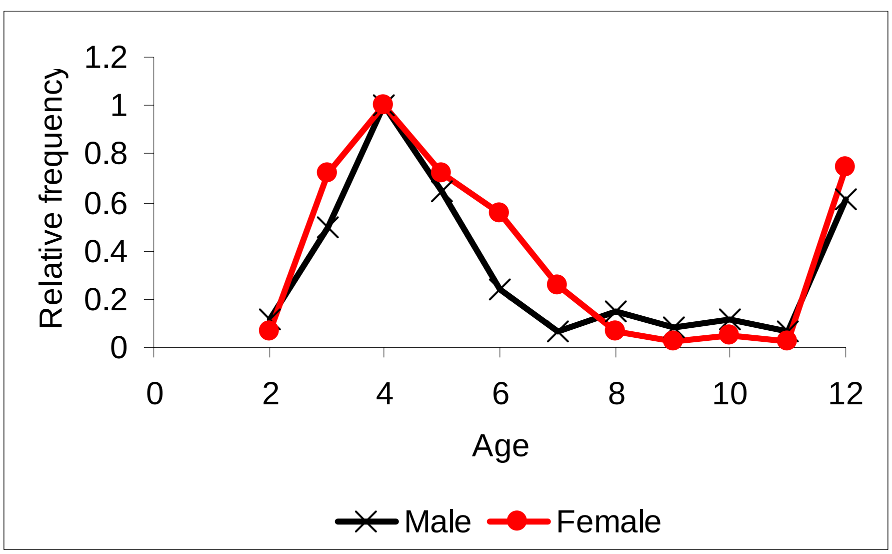


Figure D1.4. Relative age frequency by sex from Love et al. (1987). The data at age 12 is for all ages 12 and older.

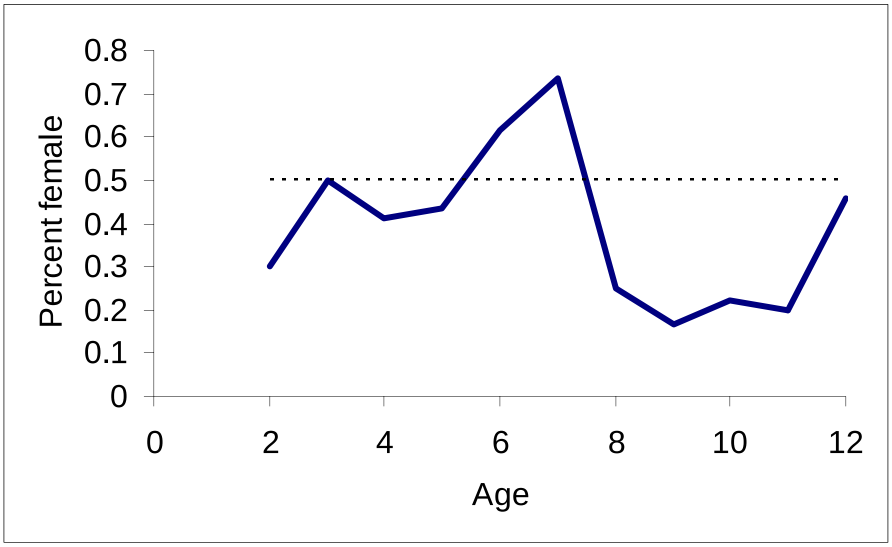


Figure D1.5. Proportion female from Love et al. (1987). The data at age 12 is for all ages 12 and older.

The age data collected by Love et al. (1987) contains about 20% of the individuals older than 11 years old. Females of this age would be greater than 35 cm TL. There are relatively few California scorpionfish caught greater than 35cm in the recreational, commercial, or sanitation surveys, except for the gillnet fishery. Therefore, the age data are inconsistent with the catch-at-length data unless the selectivity curves are dome shaped rather than asymptotic. In addition, the sex ratio from the age data shows a bias towards males for intermediate ages. A closer examination of the data shows that fish caught recreationally in the areas where the age data were collected tend to be larger than in other areas. This may indicate a bias in the sampling of the age data.

Due to unsuitability of catch-curve analyses and the violated assumptions of Hoenig's (1983) method, there is large uncertainty in the value of natural mortality for California scorpionfish. Cope et al. (2003) used a value of 0.25 for cabezon based on the maximum ages of 15 and 17 years for California and Washington, respectively. Cabezon is the most closely associated species with California scorpionfish in the recreational catch. A value of 0.25 was assumed for both sexes in the assessment.

<u>Stock-recruitment relationship</u>

There is no information about the stock-recruitment relationship for California scorpionfish. The species aggregates from multiple areas to spawn, uses "explosive" breeding assemblages, produces floating egg masses, and its larvae are found widely distributed off the coast of Baja California (Love et al. 1987, Moser 1993), indicating that recruitment is probably not locally driven and may be less related to stock size than for other species.

In a meta-analysis of stock-recruitment data for rockfish, Dorn (2002) estimated the mean steepness of the Beverton-Holt stock-recruitment relationship at approximately 0.65.

Steepness is the proportion of recruitment from an unexploited stock obtained when the population is at 20% of the unexploited stock size (Francis 1992). The estimate of mean steepness was lower when a Ricker stock recruitment model was used. These estimates were lower than those estimated by Myers et al. (2002) for the families Clupeidae (~0.7) and Gadidae (~0.8). Myers et al. (1999) provide estimates of steepness for three species in the family Scorpaenidae, which California scorpionfish is a member: chilipepper (*Sebastes goodei*), 0.35; Pacific ocean perch (*Sebastes alutus*) 0.43; and deepwater redfish (*Sebastes mentella*), 0.47. The estimate of steepness for the family was 0.48. Unfortunately, the data available for chilipepper is uninformative for steepness and Pacific Ocean perch covers many stocks much further north than the extent of California scorpionfish (Dorn 2002). The estimate of steepness for Pacific Ocean perch on the west coast of the United States from a highly informative data set is low, approximately 0.35 (Dorn 2002).

Unfortunately, information for steepness is not available for California scorpionfish and there is little information from related species that could be considered as a good proxy. A value of 0.7 was assumed for the assessment.

c. Landings

Scorpionfish are very hardy and have shown survival under extreme conditions. Therefore, for the purpose of this assessment, discard mortality is assumed to be negligible.

d. Historical catch

Recreational Landings

The recreational catch data comes from two sources, the RecFIN program and the Commercial Passenger Fishing Vessel (partyboat; CPFV) logbooks. RecFIN data are based on the Marine Recreational Fisheries Statistics Survey (MRFSS) catch estimates. The MRFSS was conducted from mid-1979 through 2003, with a hiatus from 1990 through 1992. MRFSS consists of an angler field survey paired with a randomized telephone survey. Total catch and effort are estimated for the whole southern California region in the MRFSS database, and the catch from smaller sub-areas is not provided. Since 1936, CPFV operators have been required to submit logbooks to CDFG for each fishing trip. Information is provided on the number of anglers, the number of hours fished, location of catch, and the type and quantity of fish caught. CPFV logbook data by trip is available since 1980; earlier data are only available in summarized form. Comparison of catch estimated by MRFSS for the CPFVs does not correspond well with the catch reported by the CPFV logbooks (Figure D1.6). The catches are similar in several years, but MRFSS estimates some substantial spikes in catch 1982, 1989, and 1996. These years have catch that is two to four times higher than for other years and for that reported in the logbooks. This variation is outside the 95% confidence intervals. Comparisons of the different modes of fishing from the MRFSS survey shows that CFPV (57%) and private/rental boats (42%) comprise most of the recreational catch (Figure D1.7).

However, the estimated proportion varies substantially from year to year. There does not appear to be any trend in the proportion taken by the two main modes (D1.8). There was no fishing during World War II. The LA Times data (http://swfscdata.nmfs.noaa.gov/LaTimes/) provides a poor representation of the catch for years before 1987, but has higher catch compared to the logbook data in the late 1980s early 1990s (Figure D1.9).

Catch for the stock assessment

The recreational catch for the assessment is calculated under the assumption that the CPFV logbook data are the most reliable estimate of annual recreational catches. It is assumed that approximately 80% of the CPFV trips were recorded on logbooks submitted to CDFG. For 1936 to 2004 the CPFV logbook catch data are first increased to account for the reporting level. The catch data are then expanded to include all modes of fishing based on the fraction of the total RecFIN catch taken by the CPFV fleet (0.5767). The catch in 1935 is assumed equal to the average of the catch for the 5 years before Would War II interrupted the fishery (1936-1940) and a linear trend is assumed to a catch of zero in 1916. The catch is given in Figure D1.10.

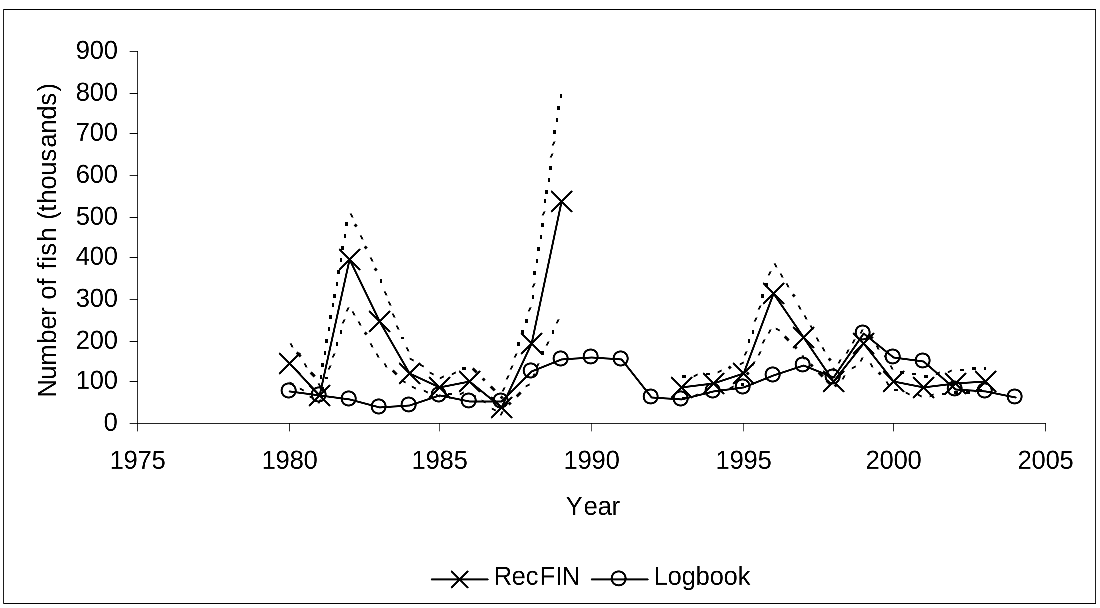
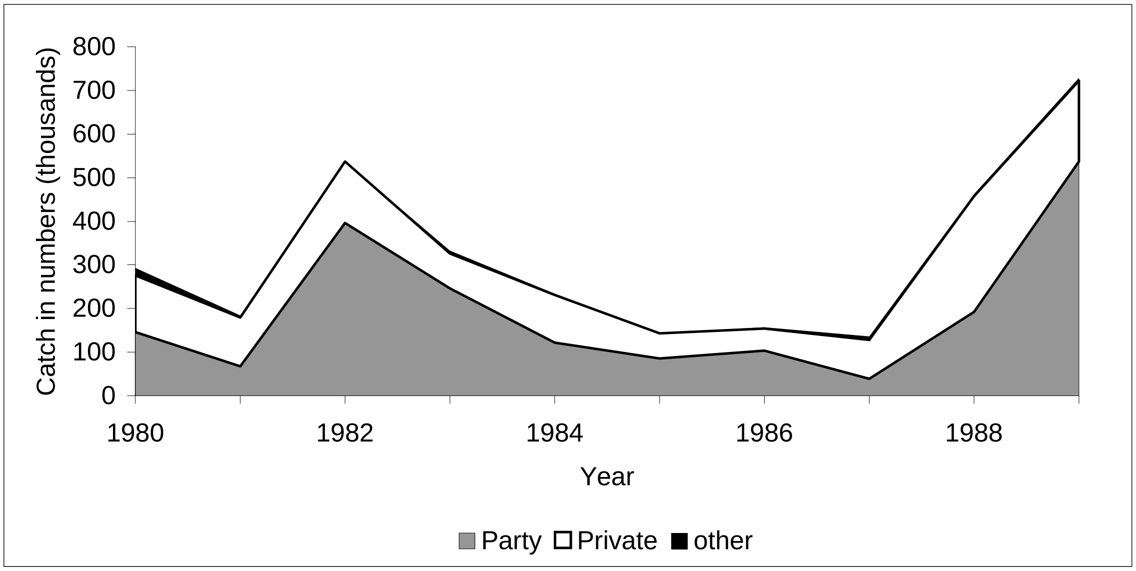


Figure D1.6. Comparison of catch estimated by MRFSS for the CPFVs with the catch reported on the CPFV logbooks. The dashed lines are the 95% confidence intervals for the MRFSS estimates



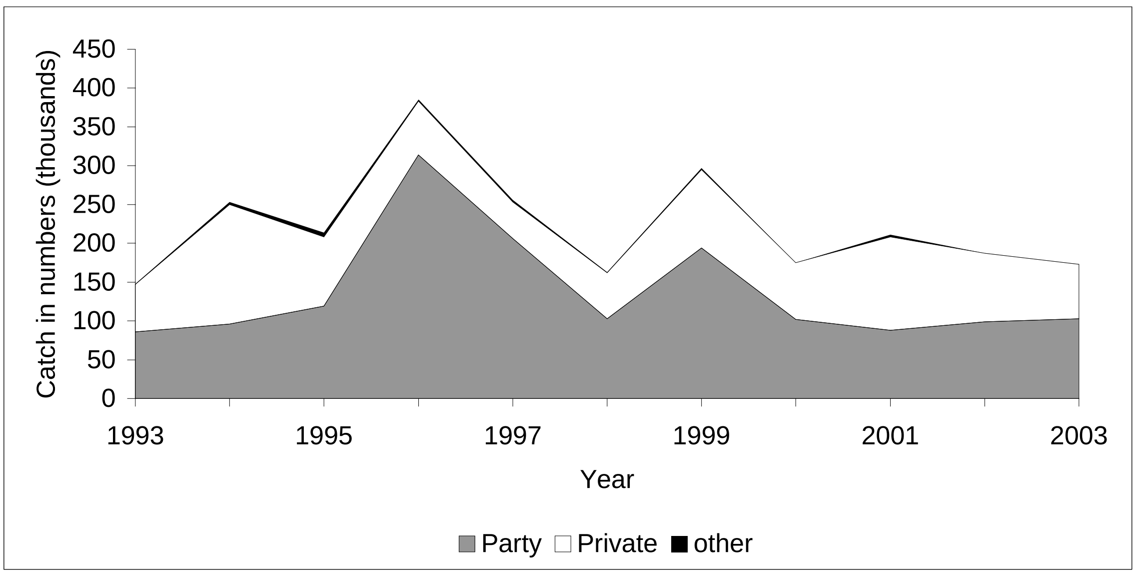


Figure D1.7. Recreational catch by modes of fishing from MRFSS

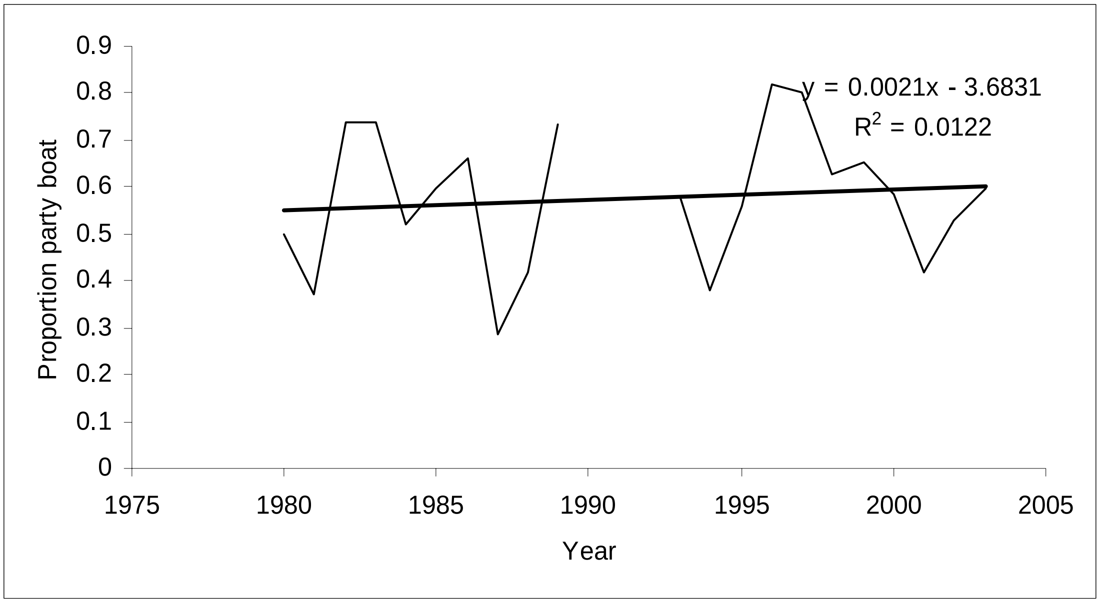


Figure D1.8. Proportion of the recreational catch taken by party boats calculated from MRFSS data.

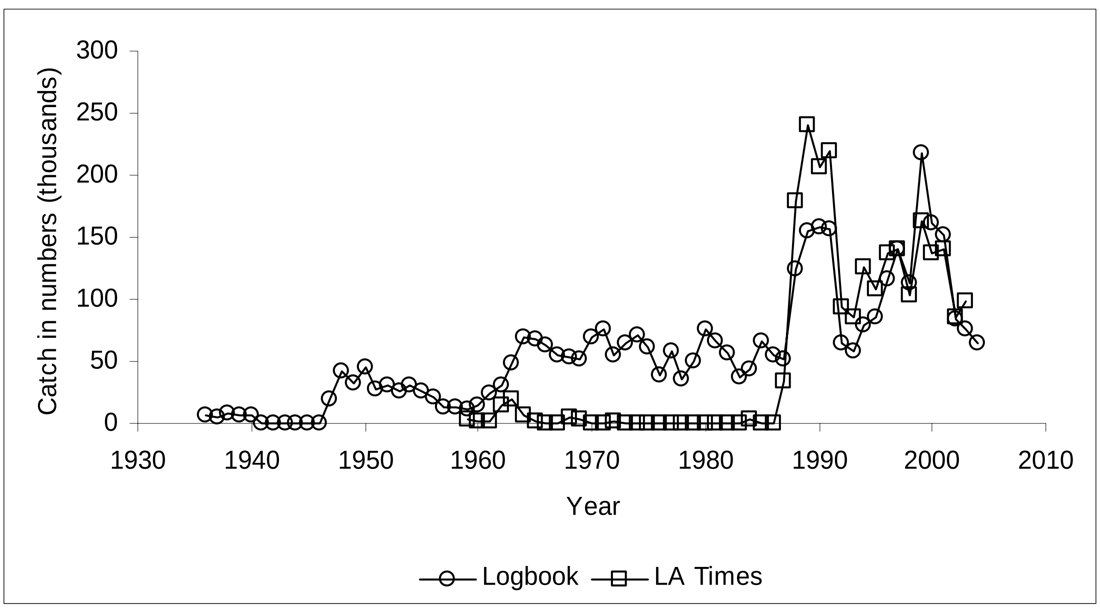
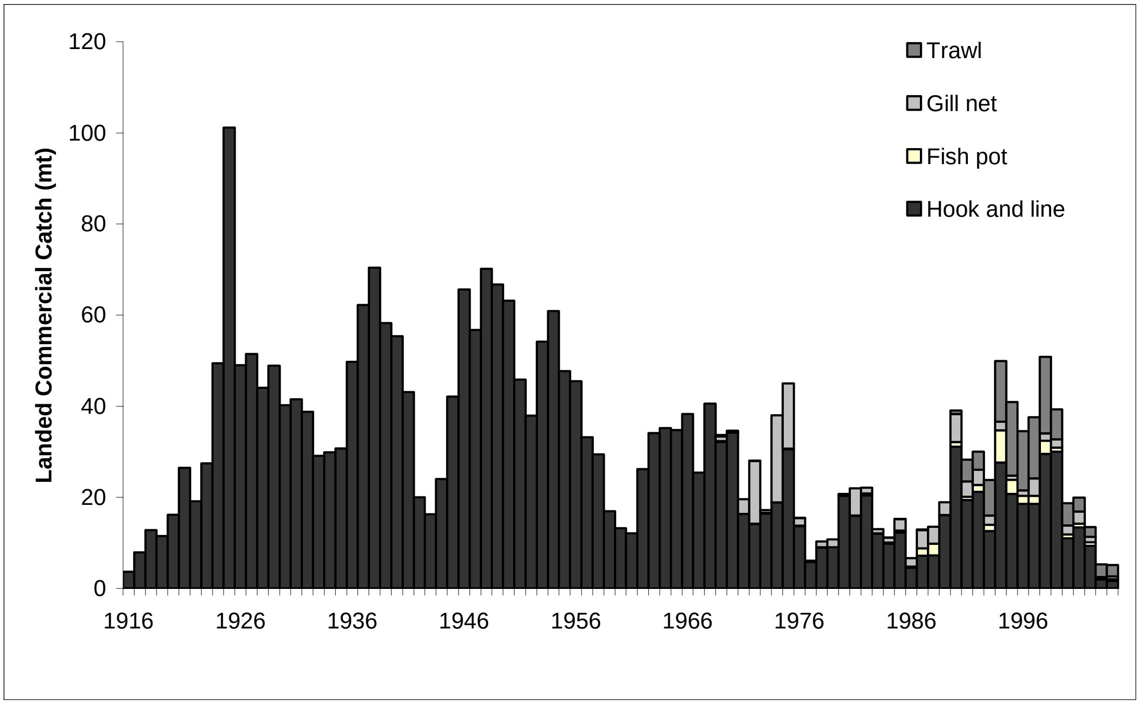


Figure D1.9. Comparison of catch from all ports from the logbook program and the LA Times data.



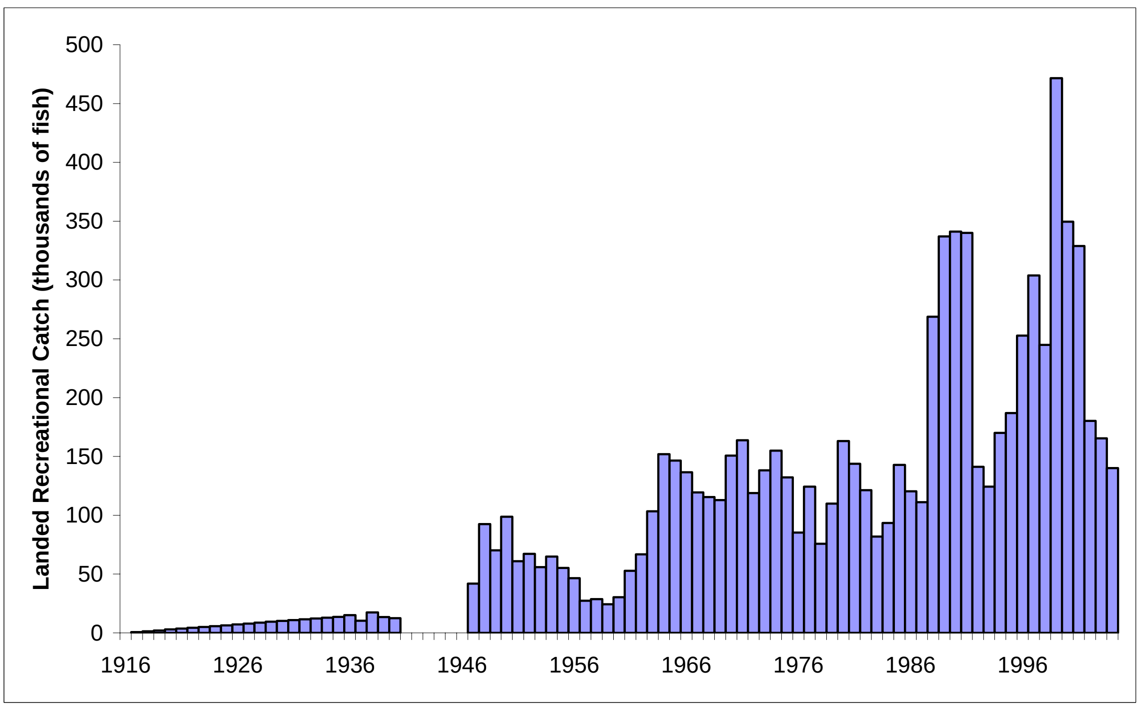


Figure D1.10. Catch used in the assessment.

Commercial Landings

There are several sources of commercial catch data available for California scorpionfish (often reported as "sculpin" in historical landing records). The earliest data starts in 1916 and data are available up to 2004. The data sets differ substantially in some years.

CalCom

The California Commercial Cooperative Groundfish Program (CalCom) landings database contains, among other information, catch in pounds by gear and port for 1978 to 2004.

CFIS

The Commercial Fisheries Information System (CFIS) also has catch in pounds by gear and port for 1969 to 2004 (Figures D1.11, D1.12). It also separates the data from that caught in California waters and that caught in Mexican waters. These data come from landing receipts or "fish tickets" filled out by the markets or fish buyers as required by the state for all commercial landings.

PFEL

The Pacific Fisheries Environmental Laboratory (PFEL) data (http://las.pfeg.noaa.gov:8080/las_fish1/servlets/dataset) includes California commercial landings data digitized from original tables published by the CDFG (D1.13). These data come from receipts or "fish-tickets" filled out by the markets and packing facilities as required by the state for all commercial landings. The landings for 1928 to 1976 were published by CDFG in their Fish Bulletin series. Landings from 1977 to 1980 were obtained from the CDFG Statistical Division and landings from 1981 to 2002 were obtained from Pacific Fisheries Information Network (PacFIN). The data only includes catches taken in California waters. A substantial amount of California scorpionfish landed in California were from Mexican waters and these are not included in the PFEL data set. We extracted data from PFEL using the scorpionfish market category.

California Explores the Ocean

California Explores the Ocean (CEO) provides several types of data taken from the CDFG Fish Bulletins in electronic form. One data set includes yearly landings in pounds for 1916 to 1947. Two other data sets include catch by area and month from 1926 to 1935 and from 1931 to 1976. Another data set provides the amount of catch caught north and south of the state borders from 1940 to 1976. (http://ceo.ucsd.edu/fishcatchtables/fish-catch-download.html)

CDFG Fish Bulletin

Landings from 1916 to 1935 are presented in CDFG Fish Bulletin No. 49 and bulletin No. 149 provides tabulated data from 1916 to 1968. Data by area and month are given in a series of bulletins, each bulletin usually providing information for a single year. Data by area and month is available for 1926 to 1986. The bulletins also provide information of the amount of catch landed in California caught north and south of the state boundaries. Electronic copies of the bulletin can be found at (http://ceo.ucsd.edu/fishbull/).

Comparison of Data Sets

The data sets generally rely on the CDFG Fish Bulletins for their data or similar sources used to generate the bulletins. However, the PFEL data set does not include data for fish caught outside the state boundaries and therefore differs substantially from the other data sets for the mid 1960s to the mid 1980s. The CEO data set duplicates the data from the bulletins for the data set that includes yearly landings in pounds for 1916 to 1947. However, the CEO data sets that include catch by area and month differ from the bulletins, particularly the data set for 1931 to 1976. The CEO data that gives the origin of the catch south of the state border for 1940 to 1976 are equal to the difference between the PFEL data and the bulletin data. For 1953 to 1960, the catch within the state is not equal to the PFEL data. The CalCOM data are within a few percent of the bulletin data. The CFIS data set is within a few percent of the CalCOM data except for the years 1992 and 1997 where the differences are larger. The CalCOM and CFIS data sets have catch by gear, the other data sources do not. All the data sets have catch by month, but this is not used in the analysis.

Data Sets Used in the Analysis

The assessment is of the southern California population of scorpionfish. In most years 99% or more of the landings occur in the southern California ports. Therefore, only landings in the Santa Barbara, Los Angeles, and San Diego areas are included. We also exclude catch taken in Mexican waters, but landed in California ports.

Data by gear (from CFIS) are only available starting in 1969. All catch before 1969 is assumed to be taken by hook and line. It is assumed that before 1928 there was no catch taken from Mexican waters landed in California. The catch is divided into four gear types: hook and line, fish pot, trawl, and gill net. Catch taken by other gears is added to the hook and line catch. Catch by gear for 1969 to 2004 is taken from CFIS. Catch for 1928 to 1968 is taken from PFEL. Catch for 1926 and 1927 is taken from the CDFG Fish Bulletins. Catch for 1916 to 1925 is taken from the CDFG Fish Bulletins. Commercial catch used in the assessment is given in Figure D1.10.

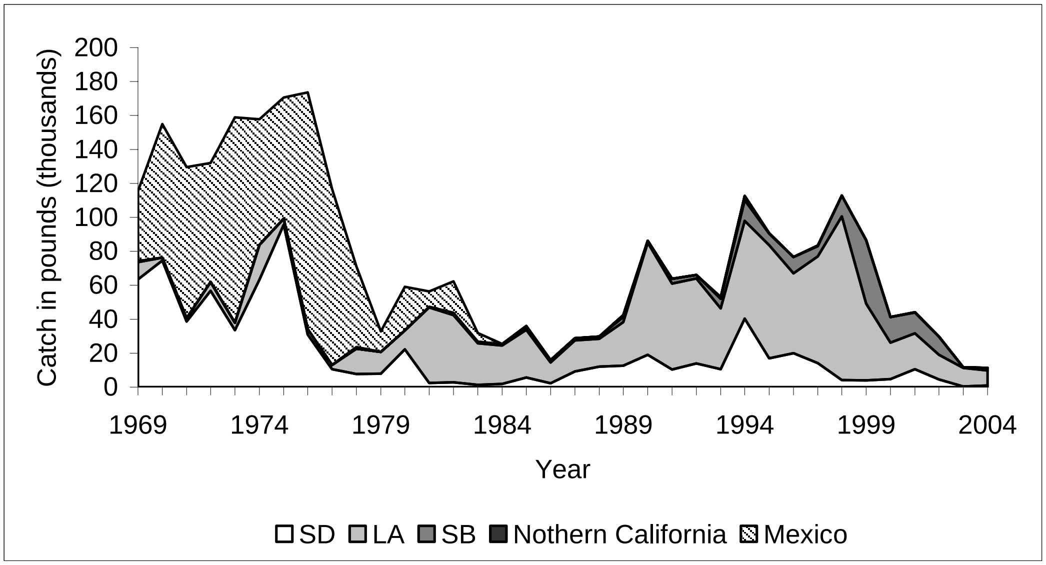


Figure D1.11. Commercial catch by region from the CFIS database.

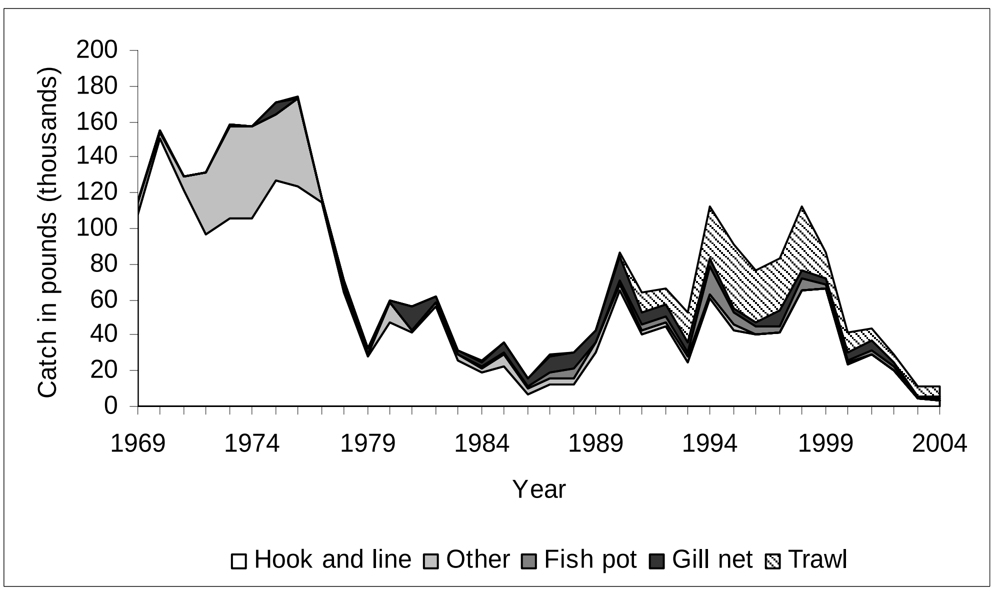


Figure D1.12. Commercial catch by fishing method from the CFIS database.

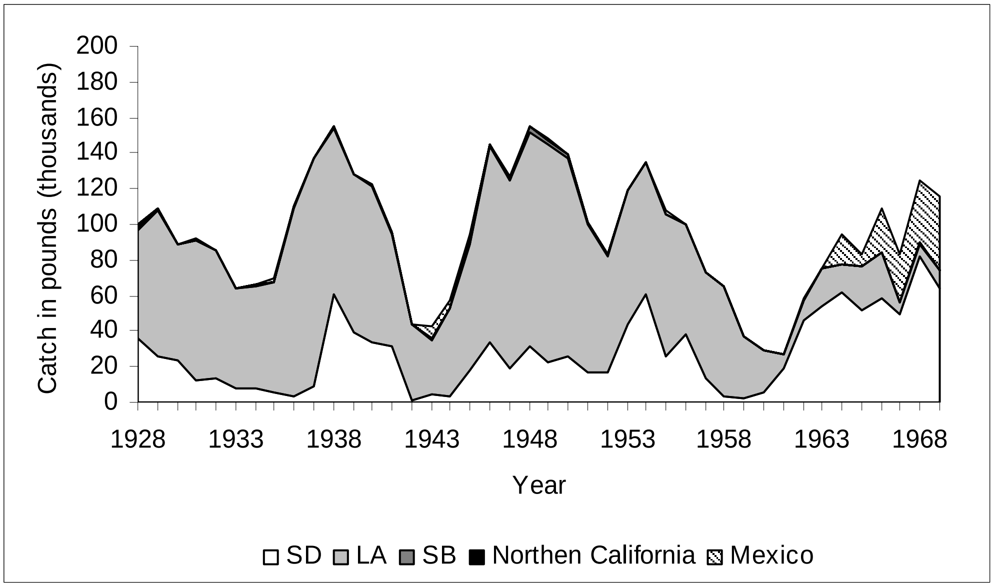


Figure D1.13. Commercial catch by region from the PFEL database.

e. Age and length compositions

RecFIN Length Frequency Data.
Size of fish (total length) in the recreational fishery is available from the RecFIN program (Table D1.4). Figure D1.14 shows the relative frequency of fish in 1 centimeter categories converted from total/fork length to standard length. The data represents measurements taken at interviews when the fish were landed, during the years 1980-2003 and includes all modes of recreational fishing.

Table D1.4. Sample sizes for length-frequency data.

Year	RecFIN	Observer	Trawl	Hook and line	Gillnet	Sanitation
1972						32
1973						29
1974						28
1975		935				21
1976		941				36
1977		1373				57
1978		1729				25
1979						262
1980	415					271
1981	387					324
1982	507					502
1983	422					106
1984	435					47
1985	365					83
1986	362	650				144
1987	133	1145				177
1988	652	2872				141
1989	653	3262				124
						203
						182
						183
1993	362					306
1994	362					322
1995	323					351
1996	808		237	25	27	463
1997	468		758	85	310	444
1998	802		352	197	13	358
1999	2444		591	202	21	456
2000	1048		110	24	11	476
2001	590		224	139	194	537
2002	1022		0	71	59	1573
2003	1207		70	6	51	409
2004			22	0	33	720

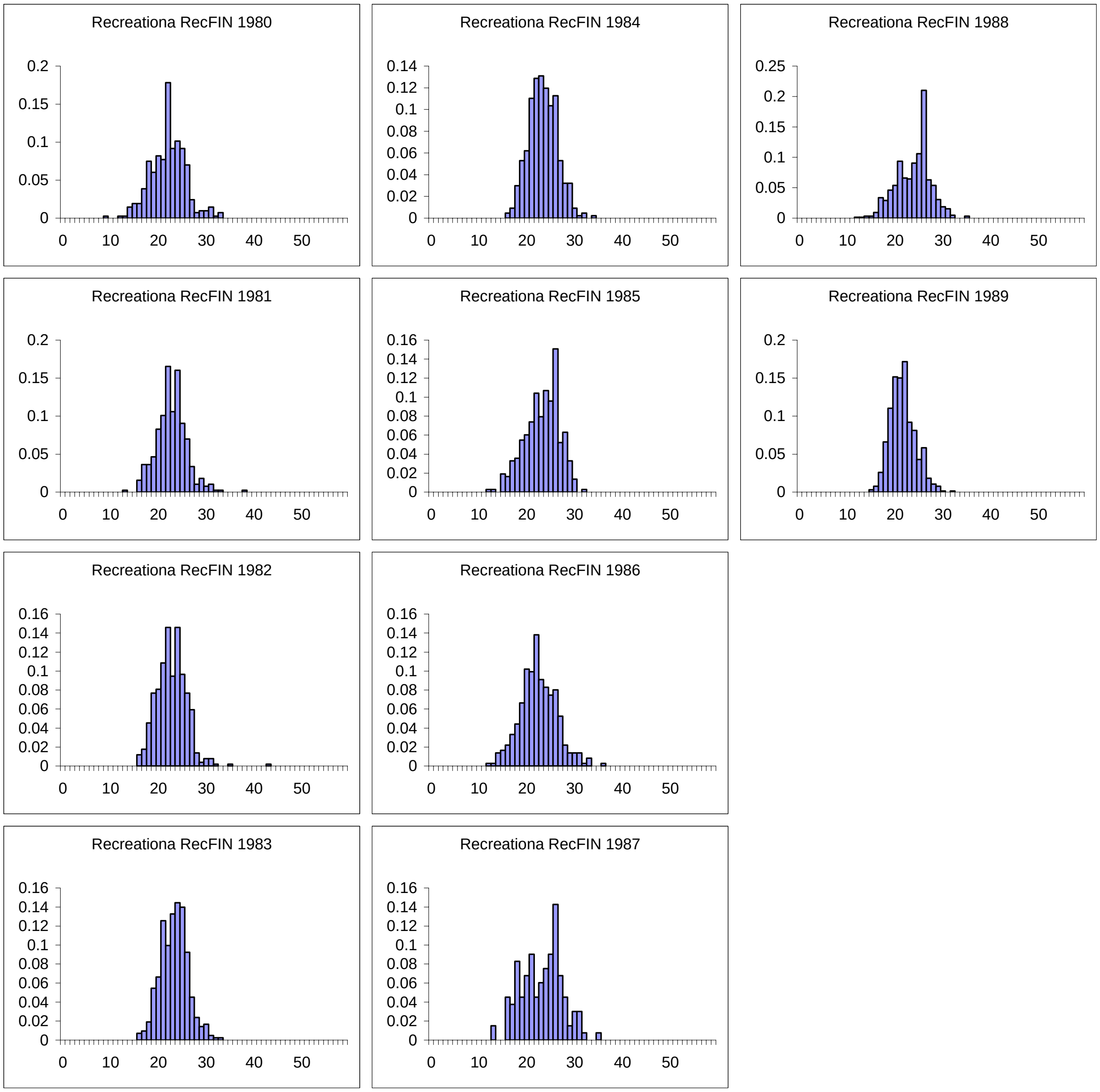


Figure D1.14. Length frequency distribution by year in standard length (cm) from the RecFIN database.

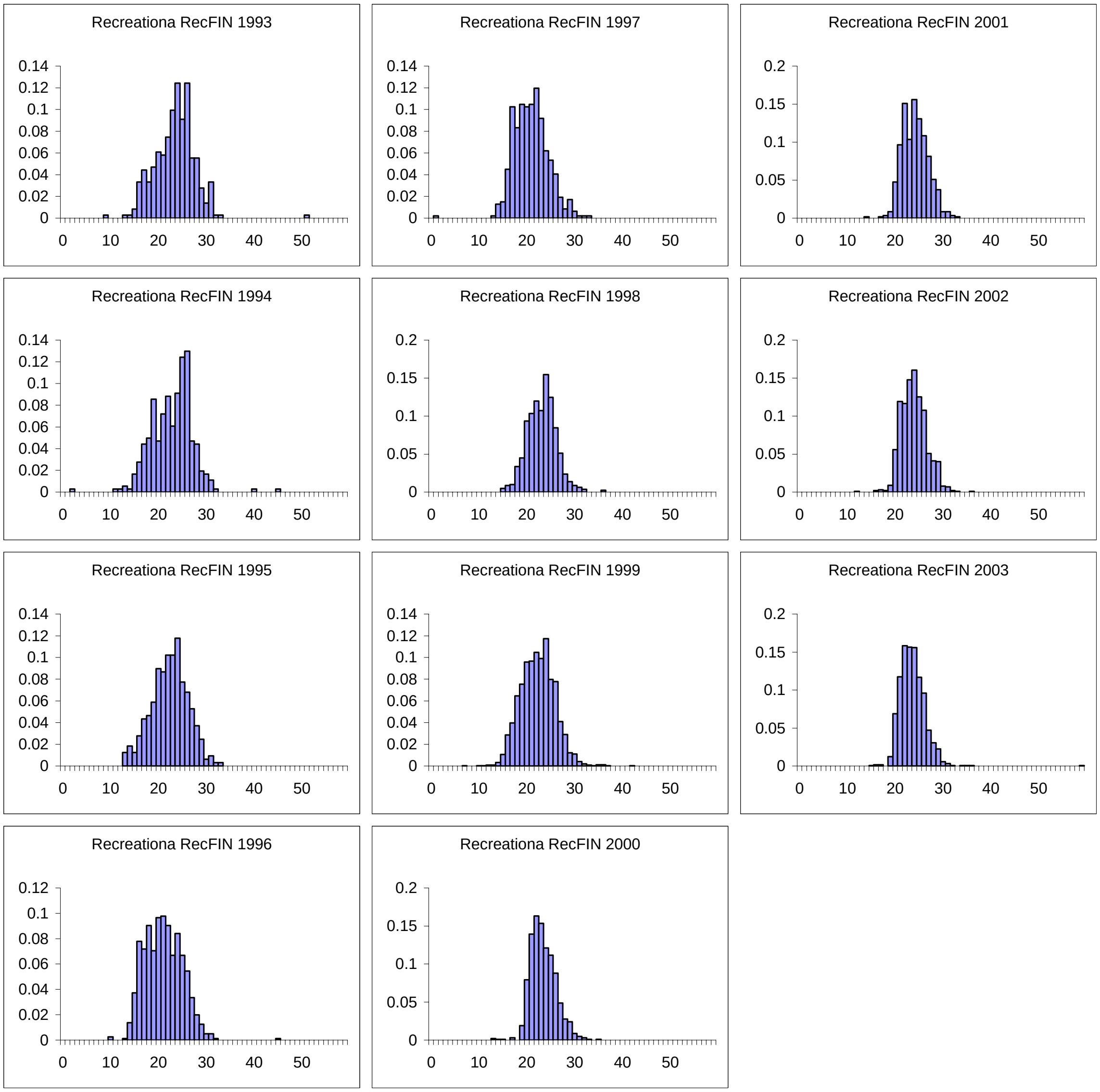


Figure D1.14 continued. Length frequency distribution by year in standard length (cm) from the RecFIN database.

CPFV Length Data

<u>CPFV Observer Programs</u>

The data were obtained from two CDFG partyboat observer programs, one in the late 1970s and another in the late 1980s, and represent measurements of total length taken on board the vessels by the observer (Table D1.4). Figure D1.15 shows the relative frequency of fish in 1 centimeter categories converted from total/fork length to standard length.

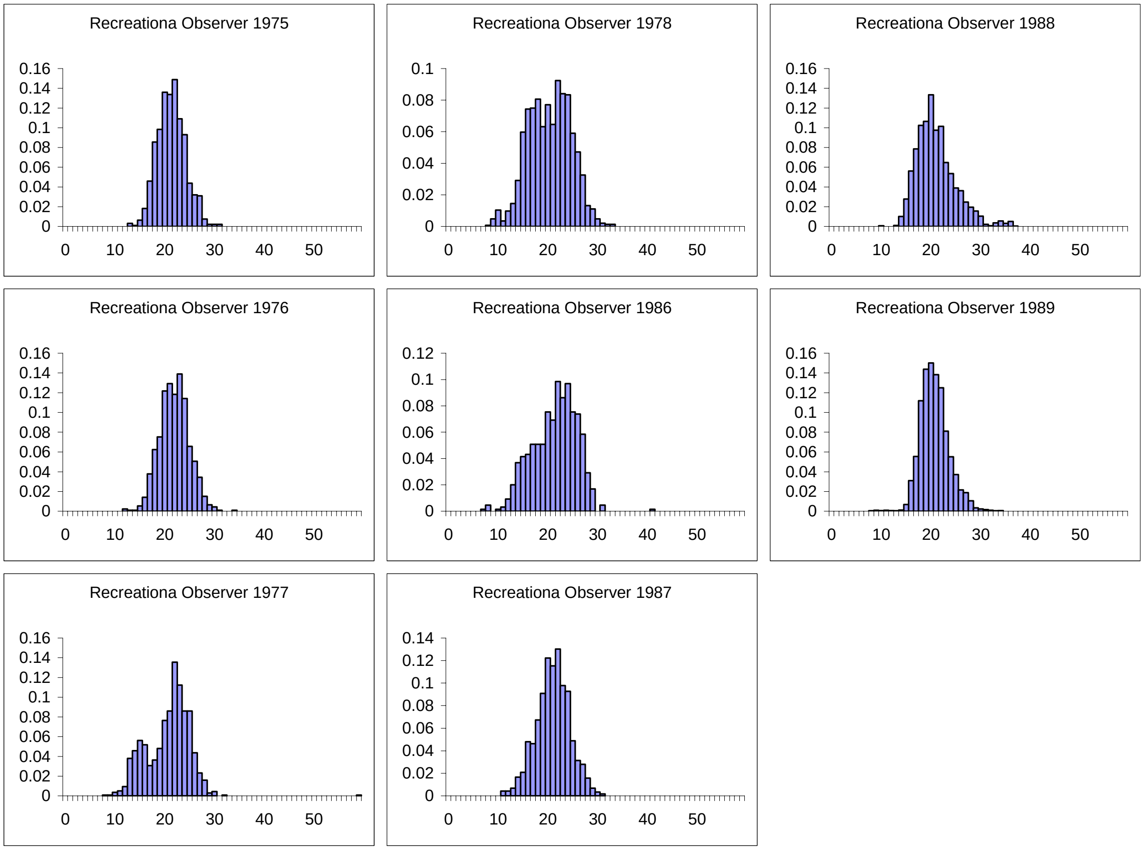


Figure D1.15. Length frequency distribution from the observer data by year in standard length (cm).

Commercial Length Data

<u>Commercial Length Frequency Data</u>
Commercial length data are available form CalCOM, PacFIN, and the CDFG sampling program. Only 79 fish were available from the PacFIN database and they were all from 1999. These contained 60 trawl caught length measurements from Ventura County and 19 hook and line caught length measurements from Santa Barbara County. Few fish were available from the CalCOM data base and all for 1999 and for the Santa Barbara County (some data for Los Angeles had borrowed length-frequencies from Santa Barbara). The CalCOM data contained both hook and line and trawl length frequencies, but the lengths were much greater than from PacFIN. More years of data are available from the CDFG sampling program (Table D1.4) and it appears that the PacFIN data are included.

Figure D1.16 shows the relative frequency of fish in 1 centimeter categories by gear converted from total/fork length to standard length. The data were obtained from the CDFG port sampling program data base and represent measurements taken when the fish were landed.

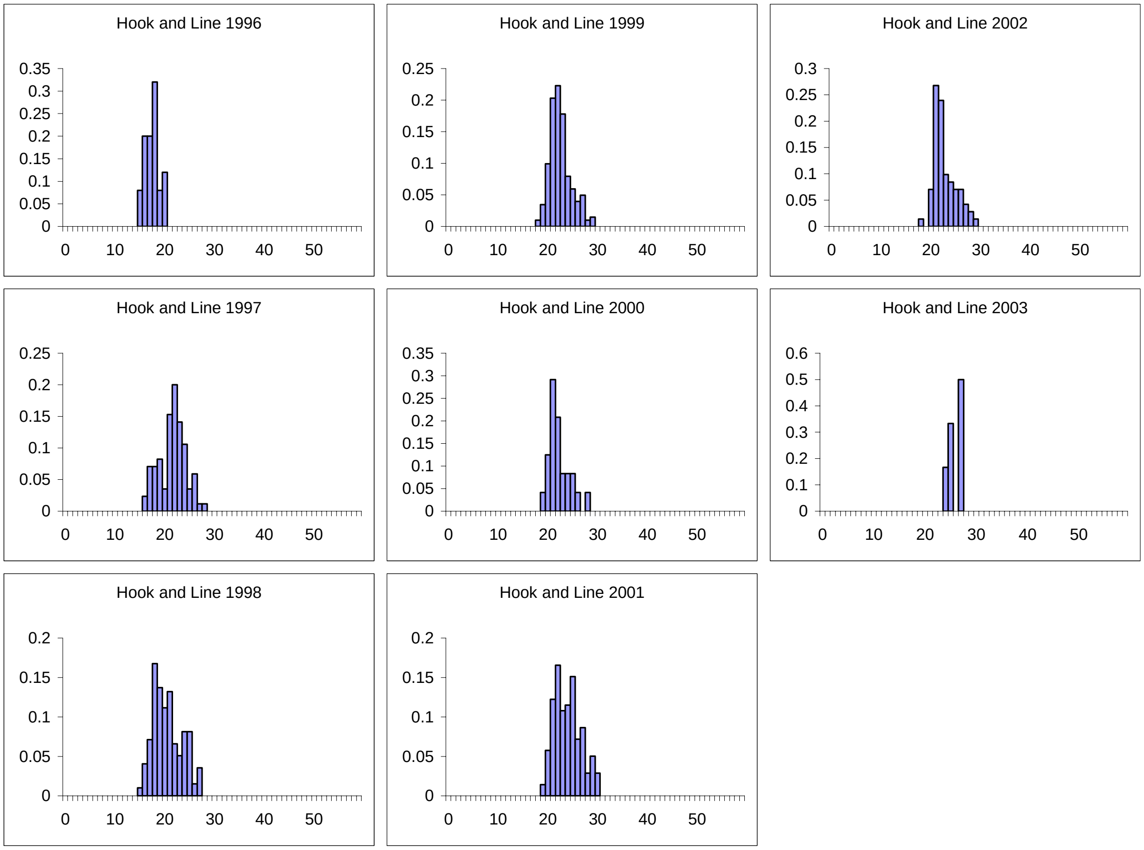


Figure D1.16a. Length frequency distribution from the hook and line commercial fisheries by year in standard length (cm).

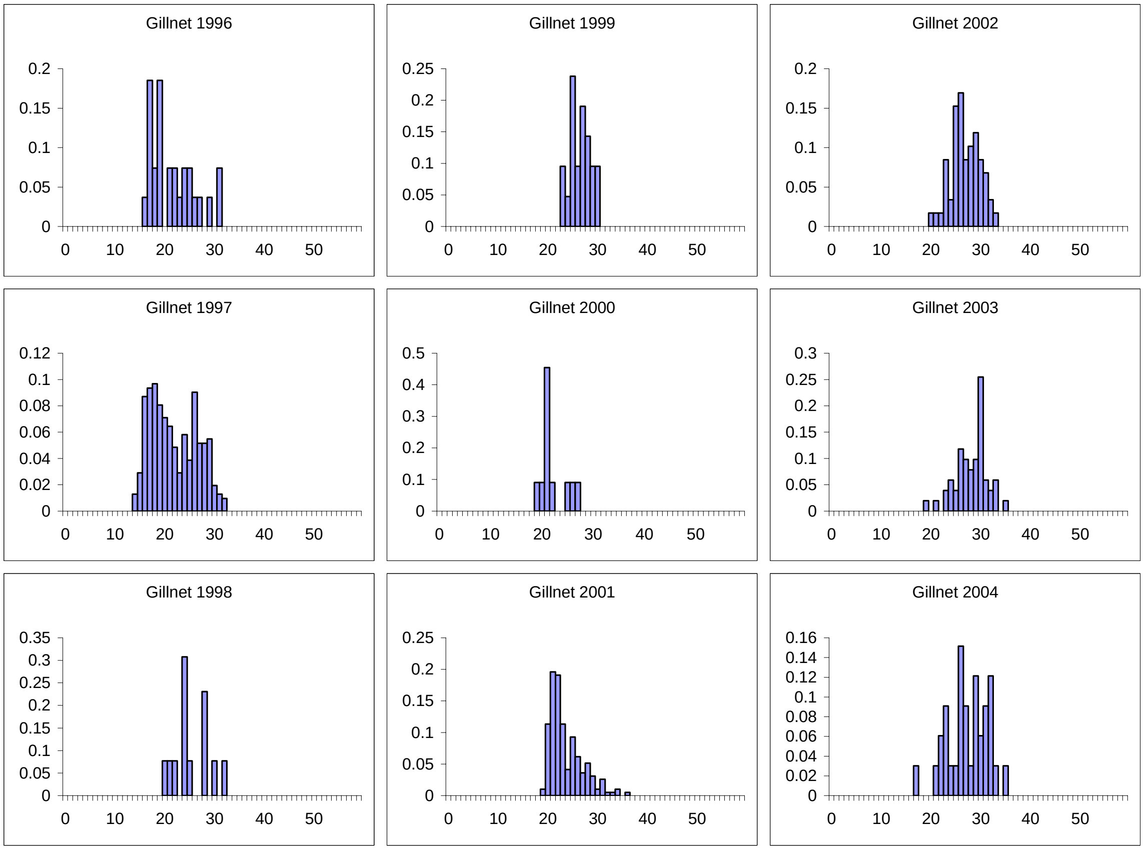


Figure D1.16b. Length frequency distribution from the gillnet commercial fisheries by year in standard length (cm).

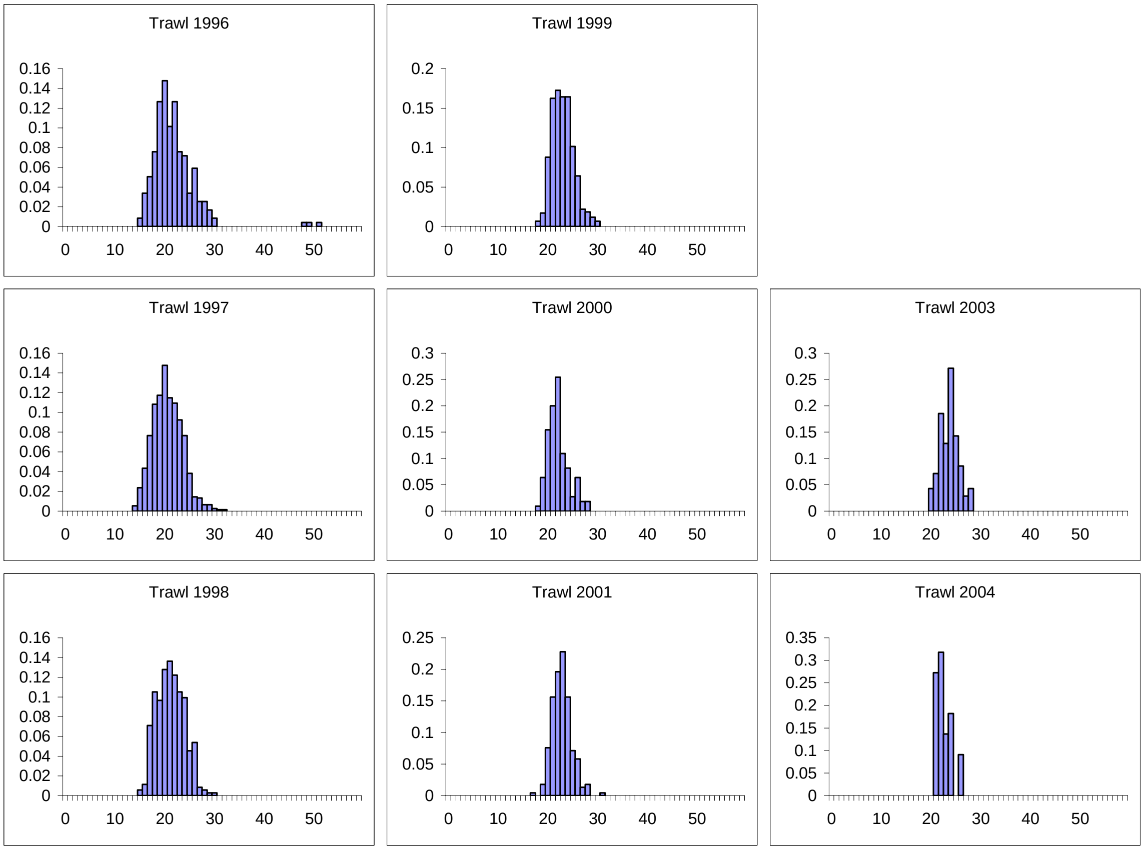


Figure D1.16c. Length frequency distribution from the trawl commercial fisheries by year in standard length (cm).

f. Indices of abundance

<u>CPFV Trip Data</u>
Trip level catch and effort data are available from the CPFV logbook data from 1980 to 2003. The analysis was conducted for 8 areas and restricted to CDFG blocks that were considered important California scorpionfish areas (Table D1.5, Figure D1.17). Of the 236 CFG blocks south of Pt. Conception, we considered only the CFG blocks with cumulative historical removals of 10,000 or more scorpionfish between 1980 and 2004. These 36 blocks accounted for 93% of the total California catch reported in the logbooks. These blocks were then grouped into eight relatively homogeneous geographic areas for purposes of calculating GLMs. A delta-gamma model is used to regress catch in numbers per angler hour versus the explanatory variables year, month and CDFG block. A binomial model is used to model the proportion positive and a gamma model is used to model the distribution of positive observations. The same explanatory variables are used in both the binomial and gamma components of the model. A combined year effect from the binomial and gamma models is used to represent the relative abundance (Table D1.6). A jackknife procedure is used to calculate standard errors for the year effects. The regression was run separately for each of the sub-areas. The analysis was carried out

using the R code provided by E.J. Dick. Based on the AIC criteria, all the explanatory variables were included in the analyses for all sub-areas.

A combined index for the southern California stock was created by summing the indices for all areas, excluding the Mexican area, weighted by the number of blocks used in each area.

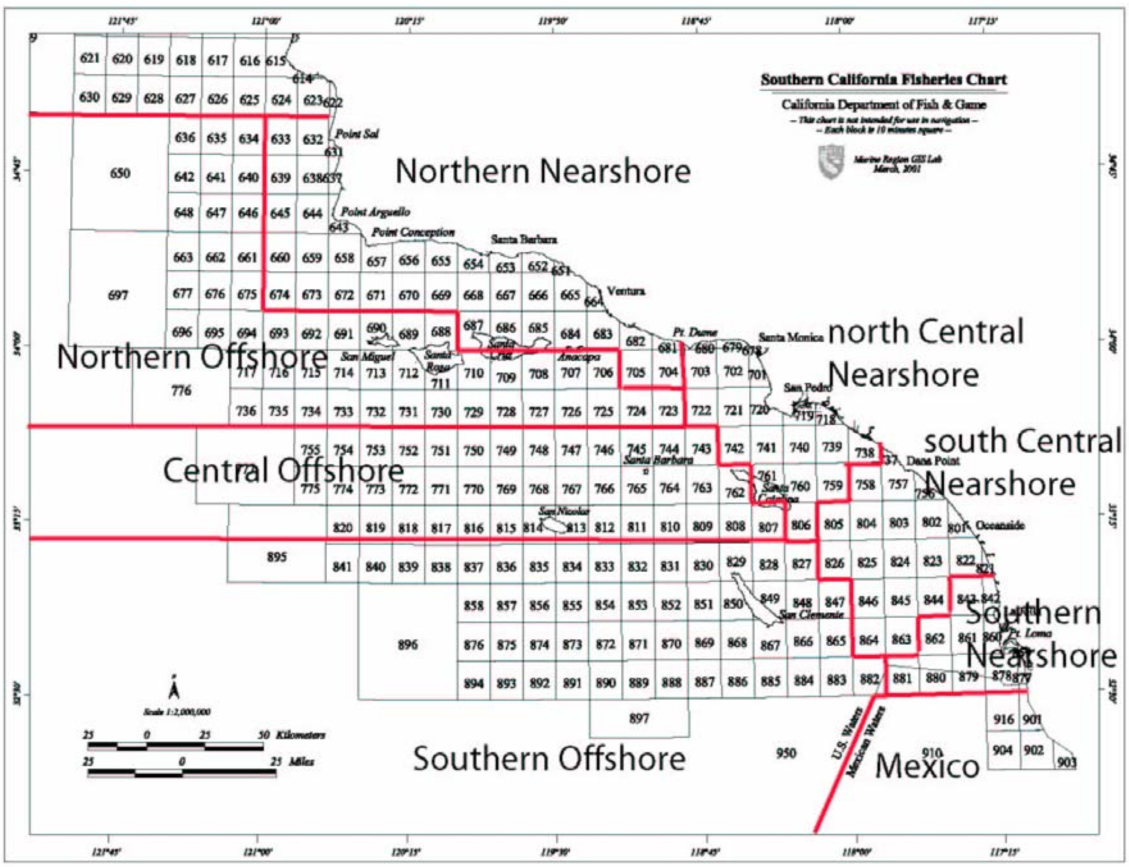


Figure D1.17. Definitions of sub-areas used in the CPUE analysis.

Table D1.5. Blocks used in the CPFV CPUE analysis (see Figure D1.17 for area definitions).

NN	NO	nCN	CO	sCN	SN	SO	MEX
652	689	678	762	737	842	829	901
653	690	679	765	756	843	849	902
665	706	680	807	757	860	850	916
666	707	701	808	801	861	867	
667	708	702	813	802	864	897	
681	709	703	814	803	877		
682	711	718		821	878		
683	729	719		822	879		
684	730	720		823			
685	734	721					
686		738					
687		739					
		740					
		741					
		742					
		759					
		760					
		761					
		806					

Table D1.6. Index and coefficient of variation for the trip level CPFV delta-gamma CPUE standardization.

	NoNear		NoOff		NoCenNear		CenOff		SoCenNear	
year	Index	cv	Index	cv	Index	cv	Index	cv	Index	cv
1980	0.0072	0.22	0.0139	0.75	0.0773	0.18	0.0121	0.2	0.028	0.24
1981	0.0059	0.15	0.0167	0.63	0.0596	0.15	0.0144	0.19	0.0176	0.13
1982	0.0074	0.15	0.0378	0.76	0.049	0.13	0.0347	0.5	0.0184	0.19
1983	0.0115	0.45	0.0068	0.48	0.0326	0.12	0.018	0.19	0.011	0.12
1984	0.0052	0.24	0.0017	0.33	0.0427	0.14	0.0497	0.43	0.0154	0.15
1985	0.0077	0.25	0.0075	0.49	0.0789	0.21	0.0224	0.27	0.032	0.21
1986	0.0136	0.22	0.0041	0.45	0.0677	0.14	0.0514	0.58	0.0222	0.12
1987	0.0114	0.16	0.0109	0.4	0.0598	0.2	0.0129	0.22	0.0401	0.43
1988	0.0176	0.1	0.0189	0.24	0.1168	0.11	0.0189	0.2	0.0544	0.11
1989	0.0247	0.27	0.0316	0.23	0.1737	0.11	0.0361	0.18	0.0408	0.17
1990	0.0206	0.15	0.0252	0.2	0.1104	0.1	0.042	0.27	0.0628	0.16
1991	0.0181	0.13	0.0438	0.41	0.1394	0.12	0.0578	0.16	0.0809	0.16
1992	0.0141	0.16	0.0311	0.24	0.0464	0.12	0.0334	0.18	0.0423	0.18
1993	0.0176	0.14	0.0263	0.25	0.0618	0.12	0.0435	0.22	0.0257	0.15
1994	0.0257	0.24	0.049	0.36	0.0788	0.09	0.0477	0.17	0.0543	0.2
1995	0.0218	0.18	0.0349	0.31	0.0874	0.13	0.0312	0.2	0.0656	0.16
1996	0.0316	0.17	0.0263	0.24	0.1126	0.11	0.0296	0.15	0.0755	0.15
1997	0.0268	0.09	0.0239	0.15	0.0739	0.1	0.0235	0.18	0.0611	0.15
1998	0.0296	0.13	0.0365	0.16	0.0913	0.14	0.0252	0.15	0.0379	0.15
1999	0.0345	0.14	0.0257	0.18	0.2058	0.13	0.0373	0.2	0.0612	0.17
2000	0.0356	0.39	0.0135	0.28	0.156	0.12	0.024	0.18	0.0691	0.21
2001	0.027	0.12	0.0385	0.27	0.1326	0.11	0.0398	0.26	0.0629	0.12
2002	0.0132	0.22	0.0294	0.34	0.069	0.18	0.0094	0.33	0.0373	0.18
2003	0.0075	0.27	0.0105	0.42	0.0631	0.2	0.0022	0.46	0.0315	0.27

SoNear		SoOff		Mex		Total	
Index	cv	Index	cv	Index	cv	Index	cv
0.0205	0.2	0.0404	0.22	0.0616	0.31	2.38	0.12
0.0198	0.12	0.0429	0.19	0.0271	0.33	1.99	0.10
0.0243	0.12	0.0502	0.14	0.04	0.37	2.22	0.15
0.0151	0.18	0.0344	0.14	0.0321	0.32	1.33	0.08
0.0162	0.15	0.0377	0.21	0.0198	0.46	1.65	0.11
0.0435	0.23	0.0355	0.16	0.0171	0.33	2.61	0.13
0.0292	0.1	0.029	0.36	0.071	0.37	2.38	0.11
0.0218	0.12	0.0424	0.22	0.0253	0.34	2.21	0.13
0.0329	0.16	0.0459	0.24	0.0203	0.27	3.72	0.07
0.0414	0.19	0.0317	0.21	0.0701	0.31	4.99	0.08
0.0556	0.12	0.0418	0.17	0.0638	0.36	4.07	0.06
0.1025	0.28	0.0522	0.15	0.1013	0.31	5.46	0.08
0.0276	0.1	0.0326	0.2	0.0574	0.36	2.33	0.07
0.0278	0.14	0.0381	0.13	0.0707	0.36	2.55	0.07
0.026	0.15	0.0383	0.29	0.0913	0.33	3.47	0.08
0.0398	0.14	0.0292	0.3	0.0363	0.6	3.51	0.08
0.0387	0.13	0.0169	0.19	0.0443	0.27	4.03	0.07

0.0679	0.24	0.0148	0.31	0.0414	0.3	3.27	0.07
0.0404	0.15	0.0095	0.23	0.041	0.36	3.32	0.08
0.0779	0.15	0.0109	0.27	0.053	0.29	6.03	0.09
0.0955	0.13	0.009	0.19	0.0319	0.33	5.10	0.08
0.1043	0.15	0.0221	0.2	0.0867	0.23	4.98	0.07
0.0466	0.22	0.0073	0.18	0.0571	0.29	2.57	0.11
0.0274	0.3	0.0058	0.29	0.0679	0.24	1.94	0.14

CPFV month and block summarized data

Month and CDFG block summarized catch and effort data are available from the CPFV logbook data from 1936 to 2004, with a hiatus from 1941 to 1946 due to WWII. Month information is not available for 1979 so this year is left out of the analysis. Data for 2004 is only preliminary. Only data from the same CDFG blocks identified in the analysis of the trip CPUE data as important California scorpionfish areas are used in the analysis. The data from 1980 to 2003 include catch and effort data that were also contained in the trip level CPUE analysis. A delta-gamma model is used to regress catch in numbers per angler hour versus the explanatory variables year, month and CDFG block. A binomial model is used to model the proportion positive and a gamma model is used to model the distribution of positive observations. The same explanatory variables are used in both the binomial and gamma components of the model. A combined year effect from the binomial and gamma models is used to represent the relative abundance (Table D1.7). The regression was run separately for each of the sub-areas. The analysis was carried out using the R code provided by E.J. Dick. The data were obtained from Dr Kevin Hill, NMFS SWFSC. Based on the AIC criteria, all the explanatory variables were included in the analyses for all sub-areas.

Table D1.7. Index for the month and CDFG block aggregated CPFV delta-gamma CPUE standardization (see Figure D1.17 for area definitions).

Year	nn	no	ncn	co	scn	sn	so	mex
1936	0.0080		0.0135		0.0280			
1937	0.0089		0.0072		0.0122			
1938	0.0632		0.0097		0.0081	0.0009		
1939	0.0410		0.0137		0.0157			
1940	0.1214		0.0083		0.0123	0.0024		
1941								
1942								
1943								
1944								
1945								
1946								
1947	0.0103		0.0318	0.0021	0.0047	0.0022	0.0021	0.0212
1948	0.0175	0.0043	0.0389	0.0128	0.0200	0.0034	0.0081	0.0363
1949	0.0156	0.0117	0.0254	0.0101	0.0138	0.0057	0.0064	0.0639
1950	0.0237	0.0206	0.0401	0.0178	0.0178	0.0021	0.0071	0.0472
1951	0.0178	0.0014	0.0230	0.0138	0.0313	0.0053	0.0140	0.0134
1952	0.0236	0.0677	0.0290	0.0219	0.0236	0.0047	0.0141	0.0166
1953	0.0239	0.0325	0.0332	0.0055	0.0282	0.0022	0.0118	0.0058
1954	0.0194	0.0231	0.0375	0.0146	0.0211	0.0023	0.0094	0.0063
1955	0.0047	0.0008	0.0330	0.0102	0.0615	0.0024	0.0556	0.0199
1956	0.0067	0.0023	0.0221	0.0296	0.0146	0.0010	0.0224	0.0168
1957	0.0040	0.0040	0.0154	0.0093	0.0068	0.0017	0.0081	0.0047
1958	0.0012	0.0010	0.0112	0.0017	0.0063	0.0012	0.0070	0.0005
1959	0.0010	0.0144	0.0101	0.0036	0.0049	0.0011	0.0066	0.0028
1960	0.0093	0.0077	0.0139	0.0051	0.0134	0.0010	0.0091	0.0050
1961	0.0040	0.0010	0.0609	0.0103	0.0213	0.0026	0.0126	0.0173
1962	0.0036	0.0021	0.0343	0.0076	0.0263	0.0074	0.0072	0.0123
1963	0.0042	0.0005	0.0443	0.0060	0.0405	0.0095	0.0088	0.0626
1964	0.0150	0.0052	0.0519	0.0125	0.0750	0.0141	0.0272	0.0391
1965	0.0152	0.0075	0.0490	0.0078	0.0560	0.0118	0.0240	0.0466
1966	0.0060	0.0070	0.0480	0.0089	0.0802	0.0083	0.0143	0.0448
1967	0.0118	0.0251	0.0410	0.0084	0.0650	0.0095	0.0108	0.0915
1968	0.0140	0.0078	0.0362	0.0074	0.0690	0.0137	0.0126	0.0613
1969	0.0078	0.0035	0.0338	0.0064	0.0597	0.0110	0.0083	0.1009
1970	0.0048	0.0030	0.0545	0.0043	0.0740	0.0268	0.0134	0.0479
1971	0.0058	0.0038	0.0783	0.0086	0.1174	0.0156	0.0149	0.0570
1972	0.0055	0.0039	0.0398	0.0099	0.1102	0.0080	0.0089	0.0224
1973	0.0076	0.0016	0.0730	0.0275	0.0859	0.0091	0.0125	0.0241
1974	0.0030	0.0013	0.0690	0.0248	0.1560	0.0040	0.0210	0.0677
1975	0.0025	0.0077	0.0625	0.0405	0.1091	0.0042	0.0357	0.0987
1976	0.0029	0.0002	0.0319	0.0646	0.0505	0.0049	0.0221	0.0403
1977	0.0020	0.0137	0.0849	0.0176	0.0379	0.0069	0.0243	0.0427
1978	0.0054	0.0039	0.0374	0.0075	0.0359	0.0147	0.0226	0.0434
1979								
1980	0.0081	0.0139	0.0643	0.0143	0.0235	0.0191	0.0463	0.0580
1981	0.0069	0.0196	0.0535	0.0151	0.0157	0.0198	0.0472	0.0306

1982	0.0080	0.0346	0.0418	0.0413	0.0188	0.0248	0.0556	0.0400
1983	0.0119	0.0074	0.0312	0.0192	0.0106	0.0153	0.0363	0.0357
1984	0.0051	0.0018	0.0403	0.0612	0.0152	0.0175	0.0435	0.0200
1985	0.0074	0.0077	0.0685	0.0257	0.0283	0.0456	0.0371	0.0164
1986	0.0155	0.0041	0.0686	0.0572	0.0212	0.0293	0.0306	0.0672
1987	0.0130	0.0110	0.0608	0.0143	0.0460	0.0236	0.0446	0.0300
1988	0.0195	0.0191	0.1204	0.0199	0.0607	0.0326	0.0469	0.0215
1989	0.0274	0.0333	0.1829	0.0420	0.0442	0.0430	0.0308	0.0616
1990	0.0217	0.0269	0.1271	0.0468	0.0630	0.0591	0.0429	0.0662
1991	0.0195	0.0398	0.1375	0.0649	0.0781	0.1039	0.0568	0.1221
1992	0.0148	0.0306	0.0472	0.0390	0.0448	0.0289	0.0370	0.0643
1993	0.0185	0.0265	0.0600	0.0479	0.0277	0.0283	0.0415	0.0865
1994	0.0303	0.0544	0.0834	0.0512	0.0612	0.0287	0.0403	0.1125
1995	0.0249	0.0352	0.0834	0.0319	0.0766	0.0418	0.0292	0.0870
1996	0.0332	0.0263	0.1143	0.0320	0.0844	0.0414	0.0167	0.0521
1997	0.0285	0.0254	0.0730	0.0263	0.0633	0.0755	0.0149	0.0478
1998	0.0299	0.0374	0.1082	0.0268	0.0421	0.0426	0.0094	0.0430
1999	0.0341	0.0270	0.2152	0.0382	0.0697	0.0840	0.0108	0.0658
2000	0.0366	0.0143	0.1734	0.0259	0.0699	0.0960	0.0103	0.0376
2001	0.0263	0.0367	0.1364	0.0461	0.0681	0.1045	0.0237	0.1012
2002	0.0145	0.0315	0.0720	0.0110	0.0433	0.0499	0.0082	0.0669
2003	0.0093	0.0148	0.0743	0.0027	0.0362	0.0346	0.0067	0.0851
2004	0.0035	0.0021	0.0427	0.0023	0.0304	0.0227	0.0028	0.0350

RecFIN CPFV species association

A major problem with CPUE analysis is determining if a data point should be included in the analysis. If a unit of effort has no chance of catching the species of interest, it should not be included in the analysis. For example, trips that focus solely on tuna will not catch California scorpionfish. However, it is often difficult to determine targeting of a trip. If the targeting changes over time this will bias the index of abundance derived from the CPUE analysis. We used a logistic regression method of Stephens and MacCall (2004) to determine the probability of catching California scorpionfish based on the presence of other species of fish in the catch. The association of other species is given in Figure D1.18.

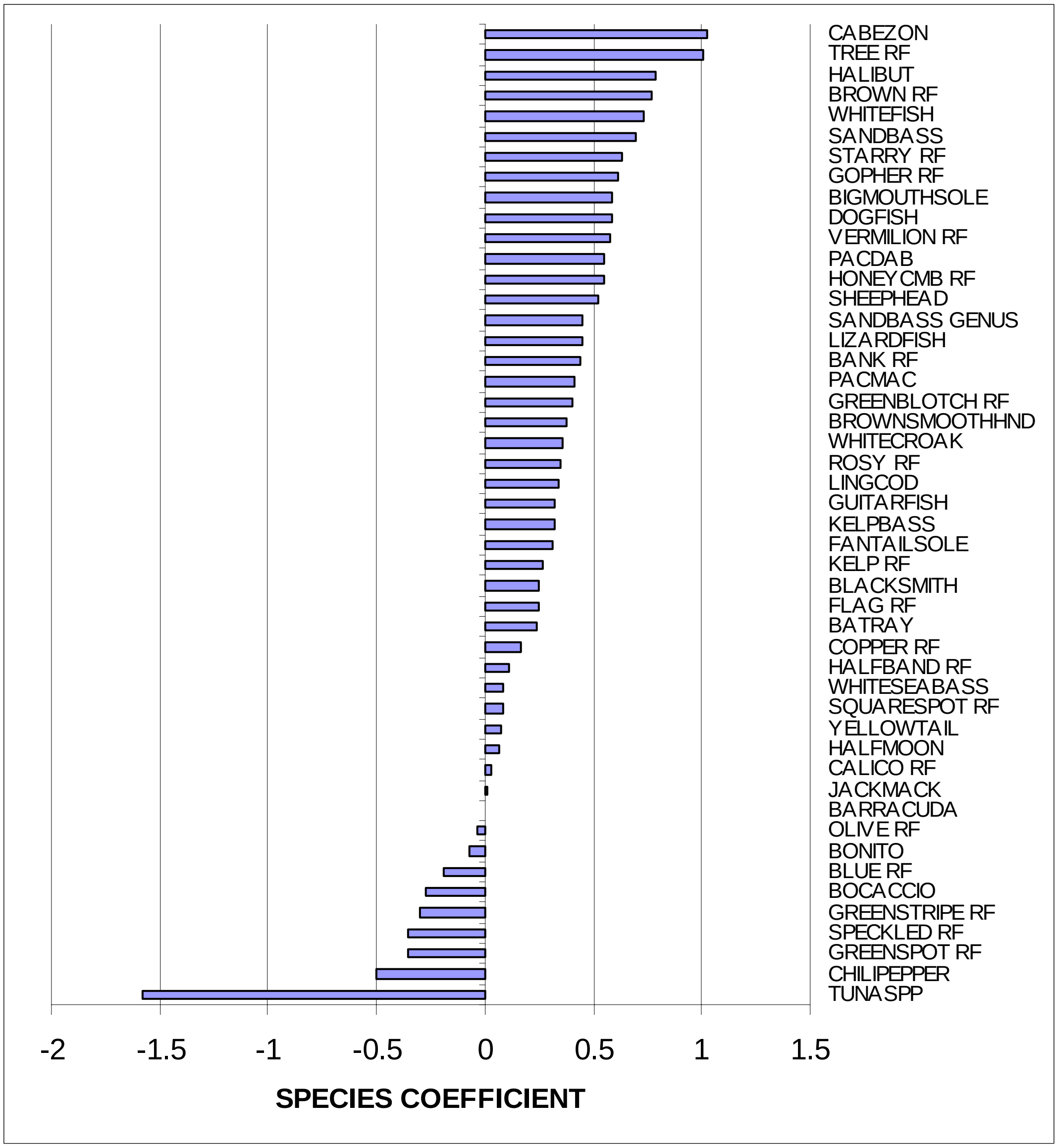


Figure D1.18. The association of species of fish with California scorpionfish in the CPFV catch from the RecFIN database.

We applied a delta-gamma regression to the data records that were determined to have at least a 31% probability of capturing a California scorpionfish. The cutoff was based on the logistic regression recommended threshold probability. Initial analyses suggested the results were not sensitive to this cutoff. Data are available from 1980-2003 with a hiatus in 1990-1992. The catch in numbers per angler hour fished was regressed against year, month, and a dummy variable indicating if the fishing was inside or outside the 3 mile line. Separate regressions were carried on for San Diego, Orange, and Los Angeles counties and for Santa Barbara and Ventura counties combined. Based on the AIC criteria, Los Angeles and San Diego counties included all explanatory variables; Orange County and Santa Barbara-Ventura counties did not include month. The indices are given in table D1.8.

Table D1.8. Index and coefficient of variation for the RecFIN CPFV species association delta-gamma CPUE standardization.

	SD		ORG		LA		SB-VEN	
Year	Index	CV	Index	CV	Index	CV	Index	CV
1980	0.0079	0.37	0.0246	0.73	0.0892	0.80	0.0028	0.62
1981	0.0082	0.38	0.0127	0.34	0.0111	0.42	0.0063	0.63
1982	0.0174	0.28	0.0072	0.37	0.0387	0.54	0.0048	1.07
1983	0.0127	0.19	0.0110	0.64	0.0124	0.37		
1984	0.0142	0.19	0.0109	0.35	0.0168	0.34	0.0017	0.57
1985	0.0182	0.27	0.0329	0.40	0.0306	0.35	0.0019	0.66
1986	0.0186	0.32	0.0367	0.38	0.0177	0.31	0.0037	0.63
1987	0.0678	0.87	0.0145	0.62	0.0304	0.54		
1988	0.0302	0.33	0.1276	0.54	0.0497	0.48	0.0054	0.69
1989	0.0256	0.41	0.0208	0.87	0.1821	0.54	0.0267	0.42
1993			0.0185	0.84	0.0082	0.75		
1994			0.0082	0.60				
1995	0.0344	0.27	0.0611	0.78	0.0247	0.31	0.0067	0.62
1996	0.0523	0.43	0.1098	0.49	0.0346	0.34	0.0076	0.47
1997	0.0955	0.49	0.0585	0.46	0.0508	0.71	0.0154	0.67
1998	0.0995	0.32	0.0124	0.48	0.0198	0.40	0.0171	0.61
1999	0.1380	0.49	0.1141	0.54	0.0674	0.31	0.0087	0.29
2000	0.0804	0.22	0.0514	0.34	0.0952	0.46	0.0200	0.45
2001	0.0748	0.25	0.0174	0.48	0.0714	0.33	0.0139	0.45
2002	0.0946	0.32	0.0670	0.47	0.0662	0.41	0.0107	0.39
2003	0.1091	0.37	0.0796	0.36	0.1199	0.33	0.0082	0.32

Trawl CPUE

Trip records are available from trawl logbooks for the Northern Nearshore and the north Central Nearshore sub-areas. We used a delta-gamma model to regress California scorpionfish catch against the explanatory variables year, month, CDFG block, vessel id, and tow hours as explanatory variables. For both sub-stocks all variables except vessel id were selected using the AIC criteria. The indices and CVs are given in table D1.9.

Table D1.9. Indices of abundance and CVs for the trawl CPUE data.

	Northern Nearshore		north Central Nearshore	
Year	Index	CV	Index	CV
1985	0.1171	0.73		
1993	0.5812	0.77		
1994	0.3920	0.35		
1995	2.1694	0.34		
1996	1.5926	0.35		
1997	1.4878	0.34	18.6150	0.18
1998	0.7517	0.33	11.6147	0.24
1999	1.6335	0.29	5.3210	0.29
2000	1.0703	0.31	6.4487	0.40
2001	0.2100	0.32	4.3816	0.37
2002	0.0920	0.41	6.7141	0.73
2003	0.0140	0.52	5.0424	0.63

Impingement data

We were unable to obtain the impingement data in time for the assessment.

Sanitation surveys

The sanitation districts of the counties in southern California carry out trawl surveys to monitor the effects of the sewer outfalls. These surveys record the number of California scorpionfish captured and, usually, measure the length of the fish. The lengths are measured in standard length. Data are available from Palos Verdes, Hyperion, Orange County, and San Diego. An index for the southern California stock was created by scaling the indices to have the same average for the overlapping period and then taking the average weighted by the inverse of the variance. Indices of abundance and CVs are given in Table D1.10.

Table D1.10. Index value and CV for the Sanitation District surveys.

	ORG		Hyperion		Palos Verdes		San Diego		Combined	
Year	Index	CV	Index	CV	Index	CV	Index	CV	Index	CV
1970	0.89	0.82							0.30	0.82
1971	0.6	0.52							0.20	0.52
1972	1.35	0.55			0.13	0.73			0.33	0.46
1973	2.49	0.54			0.22	0.61			0.54	0.42
1974	0.95	0.56			0.14	0.48			0.30	0.37
1975	1.15	0.36			0.1	0.77			0.31	0.34
1976	0.9	0.43			0.15	0.61			0.31	0.35
1977	1.21	0.32			0.35	0.36			0.47	0.24
1978	2.17	0.21			0.07	0.7			0.33	0.26
1979	2.73	0.28			0.85	0.22			1.19	0.18
1980	2.74	0.27			0.99	0.28			1.12	0.21
1981	2.14	0.3			1.64	0.26			0.88	0.24
1982	3.66	0.71			2.01	0.36			2.00	0.38
1983	0.42	0.4			0.71	0.34			0.16	0.35
1984	0.87	0.52			0.14	0.48			0.29	0.35
1985	1.07	0.33			0.4	0.32	0.13	0.86	0.19	0.31
1986	1.47	0.48			0.59	0.37	0.35	0.59	0.33	0.33
1987	3.48	0.39	2.86	0.77	0.73	0.25	0.37	0.90	0.64	0.26
1988	5.84	0.32	1.06	0.53	0.42	0.34	2.20	0.42	0.96	0.21
1989	2.51	0.41	1.32	0.39	0.22	0.36	2.26	0.31	0.65	0.20
1990	2.53	0.44	1.77	0.44	0.39	0.34	1.48	0.30	0.88	0.18
1991	2.38	0.47	0.39	0.53	0.16	0.39	0.73	0.52	0.33	0.25
1992	1.26	0.45	0.13	1.07	0.21	0.33	0.81	0.24	0.28	0.21
1993	1.6	0.31	1.37	0.41	0.18	0.38	1.22	0.20	0.56	0.15
1994	2.48	0.47	1.55	0.46	0.28	0.34	0.83	0.30	0.58	0.19
1995	1.21	0.52	1.79	0.3	0.46	0.28	1.45	0.21	0.78	0.15
1996	1.84	0.53	2.34	0.24	0.47	0.24	1.96	0.20	1.05	0.13
1997	4.55	0.46	2.01	0.29	0.76	0.25	1.21	0.24	0.97	0.15
1998	3.11	0.54	1.19	0.33	0.52	0.29	1.58	0.21	0.92	0.15
1999	2.54	0.38	2.08	0.27	0.33	0.31	3.13	0.16	1.07	0.13
2000	4.02	0.39	1.9	0.31	0.32	0.37	2.29	0.19	1.05	0.15
2001	3.15	0.33	2.14	0.24	0.67	0.42	2.20	0.17	1.29	0.12
2002	3.45	0.52	1.37	0.38	1.77	0.91	1.14	0.23	0.76	0.19
2003	4.05	0.82	1.78	0.36	0.5	0.48	2.88	0.31	1.25	0.21
2004			2.55	0.28	0.86	0.49	2.09	0.39	1.50	0.21

<u>Hyperion</u>

Only the stations with a reasonable time series and catches of scorpionfish were used in the analysis (stations A1, A3, C1-C6, C9, C9A, D1, D1T, HT10-HT11, Z2-Z3). A delta-gamma model is used to regress catch in numbers per tow versus the explanatory variables year, month and station. A binomial model is used to model the proportion positive and a gamma model is used to model the distribution of positive observations. The same explanatory variables are used in both the binomial and gamma components of the model. A combined year effect from the binomial and gamma models is used to represent the relative abundance. A jackknife procedure is used to calculate standard errors for the year effects. The analysis was carried out using the R code provided by E.J. Dick. The best model based on the AIC criterion included all explanatory variables. The index values and CVs are given in table D1.10.

<u>Orange County</u>
Only the stations with a long time series of years were used in the analysis (stations T0-T6 and T10-T11). A delta-gamma model is used to regress catch in numbers per tow versus the explanatory variables year, month and station. A binomial model is used to model the proportion positive and a gamma model is used to model the distribution of positive observations. The same explanatory variables are used in both the binomial and gamma components of the model. A combined year effect from the binomial and gamma models is used to represent the relative abundance. A jackknife procedure is used to calculate standard errors for the year effects. The analysis was carried out using the R code provided by E.J. Dick. The best model based on the AIC criterion included all explanatory variables. The index and CVs are given in table D1.10.

<u>Palos Verdes</u>
Most of the stations were sampled every year so all the stations were used in the analysis. A delta-gamma model is used to regress catch in numbers per tow versus the explanatory variables year, month and station. A binomial model is used to model the proportion positive and a gamma model is used to model the distribution of positive observations. The same explanatory variables are used in both the binomial and gamma components of the model. A combined year effect from the binomial and gamma models is used to represent the relative abundance. A jackknife procedure is used to calculate standard errors for the year effects. The analysis was carried out using the R code provided by E.J. Dick. The best model based on the AIC criterion included all explanatory variables. The index values and CVs are given in table D1.10.

<u>San Diego</u>
A delta-gamma model is used to regress catch in numbers per tow versus the explanatory variables year, quarter and station. A binomial model is used to model the proportion positive and a gamma model is used to model the distribution of positive observations. The same explanatory variables are used in both the binomial and gamma components of the model. A combined year effect from the binomial and gamma models is used to represent the relative abundance. A jackknife procedure is used to calculate standard errors for the year effects. The analysis was carried out using the R code provided by E.J. Dick. The best model based on the AIC criterion included all explanatory variables. The index values and CVs are given in table D1.10.

CalCOFI Surveys
UCSD Scripps Institution of Oceanography, CDFG, and the National Marine Fisheries Service have carried out a plankton survey on a regular basis since 1951 (Moser et al. 1993). Unfortunately, larvae for Scorpaena have not been identified to the species level. Dr William Watson of NMFS SWFSC looked at Scorpaena larvae from Mexican waters

on CalCOFI cruises 5707, 6608, and 8108. Based on these samples, *S. guttata* larvae occur at least as far south as Punta San Juanico (line 133), and other Scorpaena larvae occur as far north as Punta Abreojos (line 130). Adult *S. guttata* are reported to occur as far south as Punta Abreojos; other species in the south are *S. sonorae* that has been reported to occur as far north as the Bahia Magdalena/Punta Marquis vicinity on the outer coast (about CalCOFI line 147); S. histrio as far north as Cabo San Lucas vicinity; and S. mystes, which ranges north either to the Cabo San Lucas vicinity, or else to California, depending on the source (pers. com Dr William Watson of NMFS SWFSC). It appears that Scorpaena spp. larvae south to at least line 133 are mostly (> 95%) *S. guttata* or are consistent with *S. guttata* (pers. com Dr William Watson of NMFS SWFSC).

The CalCOFI bongo tows have 308 tows positive for Scorpaena, 8 of which were identified as *S. guttata*. Two hundred eighty-eight of these occur at line 133 or further north. The standardized count per tow has a large variation with the highest being 3416. This occurred at line 127 in August 1956. The CalCOFI manta tows have 10 tows positive for Scorpaena all of which were identified as *S. guttata* (1981 = 5, 1984 = 1, 1990 = 1, 1992 = 1, 1994 = 1). Only data from the bongo tows are used in this analysis. The CalCOFI cruses stopped covering Mexican waters in 1985 and we were unable to obtain the equivalent data from the Mexican survey in time for the assessment. Scorpaena were not identified in the survey before 1956. Therefore, we use data from 1956 to 1984 in this analysis. We use data including and north of line 133 and assume that this indicates the abundance of California scorpionfish.

The explanatory variables included year, month, latitude, latitude squared, station, and station squared. A binomial error was used for the proportion positive and a lognormal error structure was used to model the positive tows. Based on the AIC criteria, the best model included all the explanatory variables. The year 1968 only had one positive and this could not be used to generate jackknife estimates of uncertainty. The jackknife procedure was too computationally intensive to run, so confidence intervals were not calculated. The index is given in table D1.11.

This index is mainly for biomass that spawns off Mexico. It is possible that either adults from off the US coast migrate to Mexican waters to spawn or that the larvae are moved by the currents from off the coast of the US into Mexican waters.

Table D1.11. Abundance index from the CalCOFI survey.

Year	Index
1956	0.1337
1957	0.1750
1958	0.0133
1959	0.0351
1960	0.0628
1961	0.0955
1962	0.0948
1963	0.0786
1964	0.0412
1965	0.0552
1966	0.1325
1967	0.1122
1968	0.2806
1969	0.0821
1972	0.1192
1975	0.2001
1978	0.0415
1981	0.0898
1984	0.0000

Comparison of abundance indexes

The abundance indices from the CPFV trip data and the data summarized by month and CDFG bock are essentially the same for the years that overlap. The indices from the RecFIN species association data show the same trends (Figure D1.19), but have much more uncertainty than the other two indices. Therefore, they are not considered for the assessment. There is substantial variation in the targeting of the CPFV fleet (Figure D1.20). In the late 1950s the proportion of trips that caught highly migratory species greatly increased and then decline to the mid 1970s.

The CalCOFI index shows a similar trend to the CPFV CPUE index for the Mexican area except for the first two data points (Figure D1.21).

Due to the short period of the trawl CPUE indices and the management changes that occurred in the late 1990s and early 2000s, comparisons with the CPFV are not appropriate.

The inter-annual variation of the Hyperion sanitation index and the north Central Nearshore CPFV CPUE index has some similarities, but differs in more recent years where management regulations may have influenced the CPUE (Figure D1.22).

The Orange County Sanitation District survey index shows the same general upward trend as the CPFV CPUE index for the south Central Nearshore area over the period 1980 to 1999 (Figure D1.22). However, the inter-annual variations are different. The differences after 1999 could be due to management measures introduced at this time. There are large differences between the two indices before 1980.

The Palos Verdes sanitation index differs substantially from the north Central Nearshore CPFV CPUE index (Figure D1.22).

The San Diego sanitation index is similar to the Southern Nearshore CPFV index (Figure D1.22).

The sanitation indices all show similar trends, with an increase since the early 1990s (Figure D1.23).

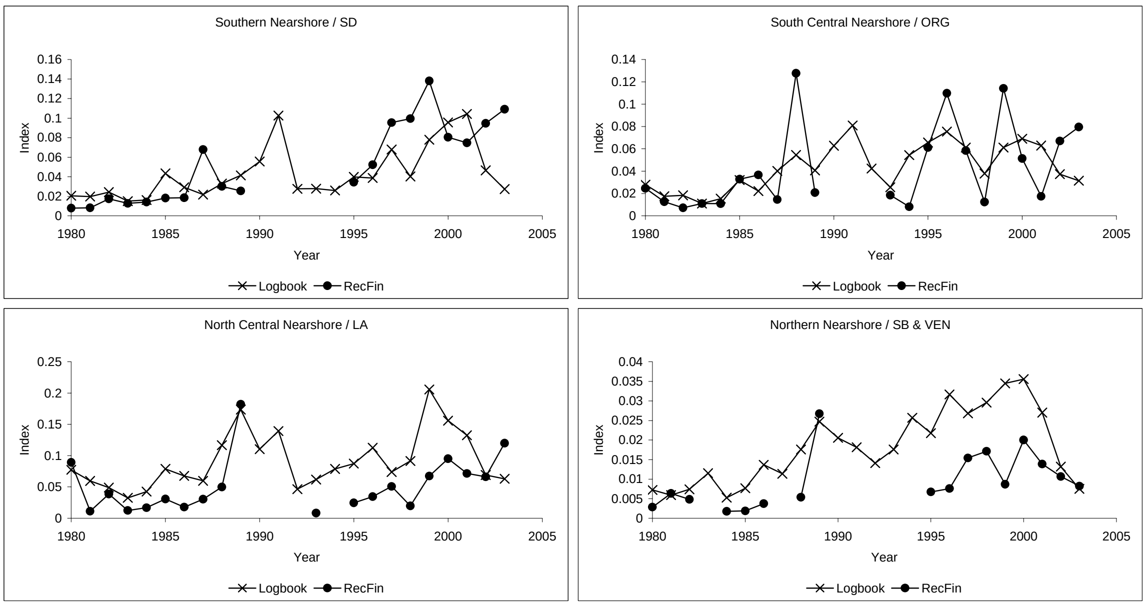


Figure D1.19. Comparison of species composition RecFIN CFPV CPUE indices with CPFV logbook CPUE indices.

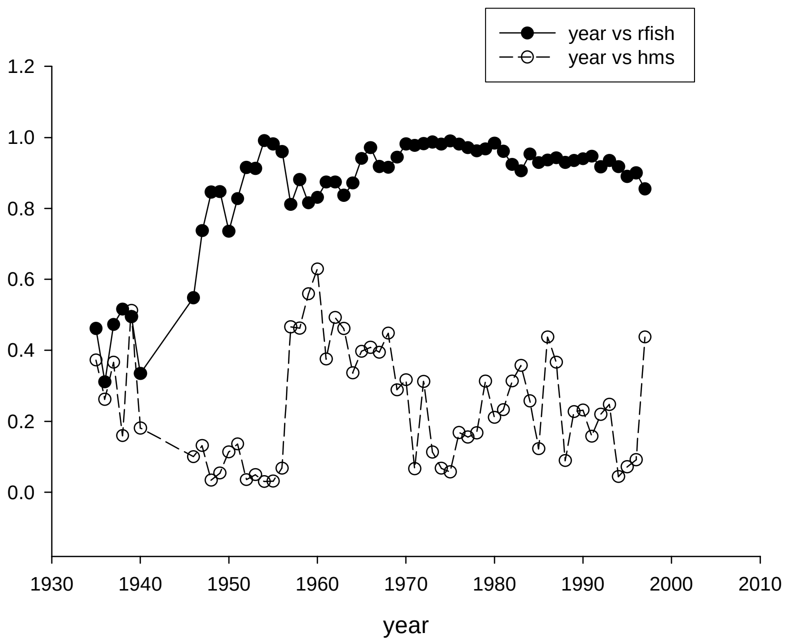


Figure D1.20. Proportion of trips that had positive catches of rockfish (rfish) and highly migratory species (hms).

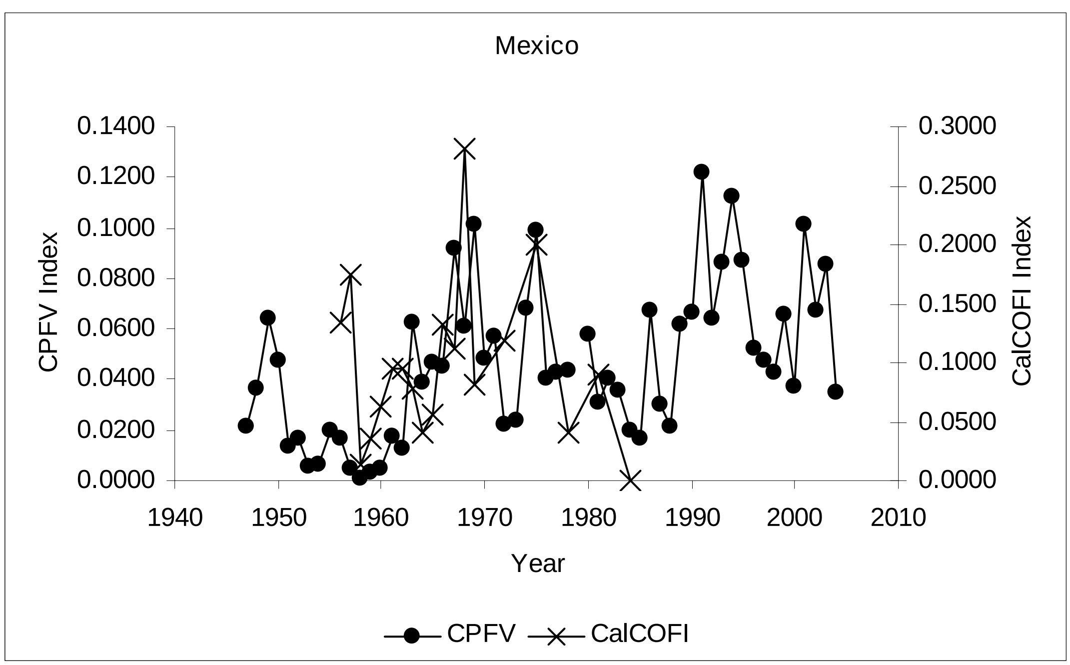


Figure D1.21. Comparison of the CPFV CPUE index from the Mexican area with the CalCOFI survey index.

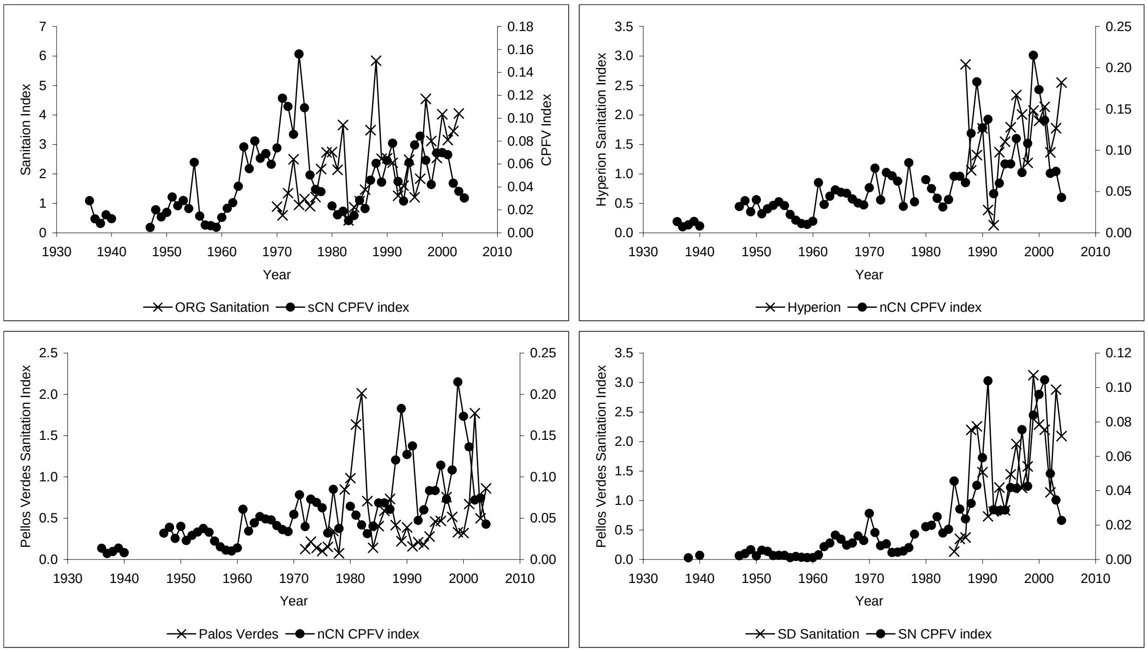


Figure D1.22. Comparison of the CPFV CPUE indices with the sanitation survey indices.

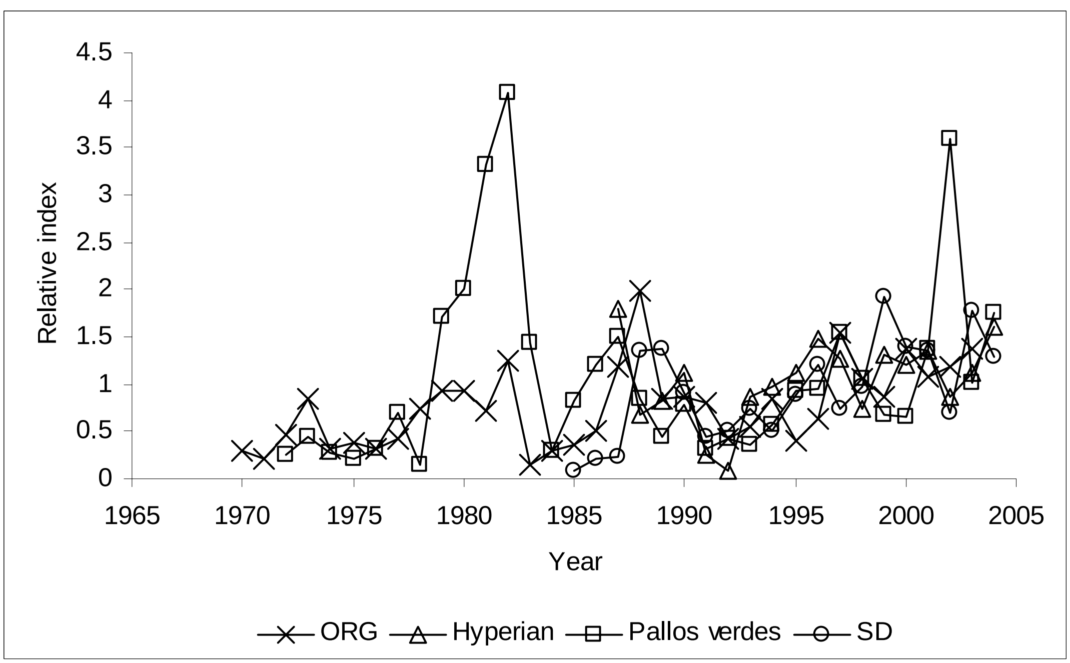


Figure D1.23. Comparison of the sanitation survey indices.

2. History of modeling approaches

This is the first time that California scorpionfish has been assessed. No previous stock assessment models are available for this species.

3. Model Description

The stock assessment is carried out using Stock Synthesis II version 1.18 (SS2; Methot 2005 [SS2 version 1.19 was used to update the MSY quantities]). SS2 is an age-structured statistical stock assessment model programmed in AD Model Builder (http://otter-rsch.com/admodel.htm). SS2 is general, fits to multiple data types, and allows for a range of assumptions about the dynamics of the population and the fisheries. We chose to use a sex-structured model to allow for the differences in the growth rates between males and females (love et al. 1987). Age 25 is used as a plus group to accumulate all older fish and the biological characteristics for all fish in this group are assumed to be the same. In general, the model is fit to catch-at-length data and abundance indices. The stock is modeled from a virgin (unexploited) population in 1916. There is no catch-at-length data for the fish pot fishery and we assume that the selectivity for this gear is the same as the hook and line fishery. The gillnet fishery catches larger fish than all the other fisheries, but comes from a limited spatial area. Therefore, we set the selectivity of the gillnet fishery to that of the hook and line fishery and excluded the gillnet length-frequency data from the analysis. All the selectivities are length-based and it is assumed that this length based selectivity is the same for males and females. However, because males and females have different mean lengths at age, males and females will have different age-specific selectivities. Due to changes in the minimum legal size, two time blocks are used for the commercial and recreational fisheries. For the recreational fisheries they are 1916-1999 and 2000-2004. For the commercial fisheries they are 1916-1998 and 1999-2004. Length data are recorded as total length (TL, or equivalently fork length) to the nearest millimeter for all the fisheries. The sanitation survey data are measured in standard length (SL) and often to the nearest centimeter. Conversion from centimeter SL bins to TL causes problems with clumping of data, therefore we convert all data and parameters into SL and use SL as the basis for the analysis. One centimeter bins from 1 to 59 (lower bounds of bins) are used to represent the catch-at-length data. Selectivity curves for all fisheries are assumed to be asymptotic and modeled using the SS2 double logistic. The selectivity for the lowest length bin is set close to zero, the peak is set to the largest length bin, the selectivity for the oldest length bin is set close to 1, and the slope and inflection point of the left hand limb are the only parameters estimated. Catch and catch-at-length data from the CPFV and private recreational boats are combined into a single fishery. The commercial catch is included in the model in tons and the recreational catch is included in the model in thousands of fish. Mean length at age is taken from the growth equation estimated by Love et al. (1987) converted into standard length and the coefficient of variation for length at age is assumed as 0.05.

The biological parameters used in the SS2 assessments were converted to SL from TL (Table D3.1). SS2 uses a logistic function to represent maturity at length and a linear regression for eggs per kilogram. This does not correspond to the maturity and fecundity data for scorpionfish (see above). Therefore, we combine the GSI (grams of eggs/grams of weight) and the maturity schedule into a single maturity schedule by fitting the logistic function (Figure D3.1).

Table D3.1. Biological parameters used in SS2 based on SL.

Parameter	Female	Male
SL(1)	10.727	12.467
SL(25)	34.560	28.151
K	0.130	0.120
SL_a	0.053	0.056
SL_b	2.911	2.902
Mat_slope	-0.466	
Mat_int	17.188	

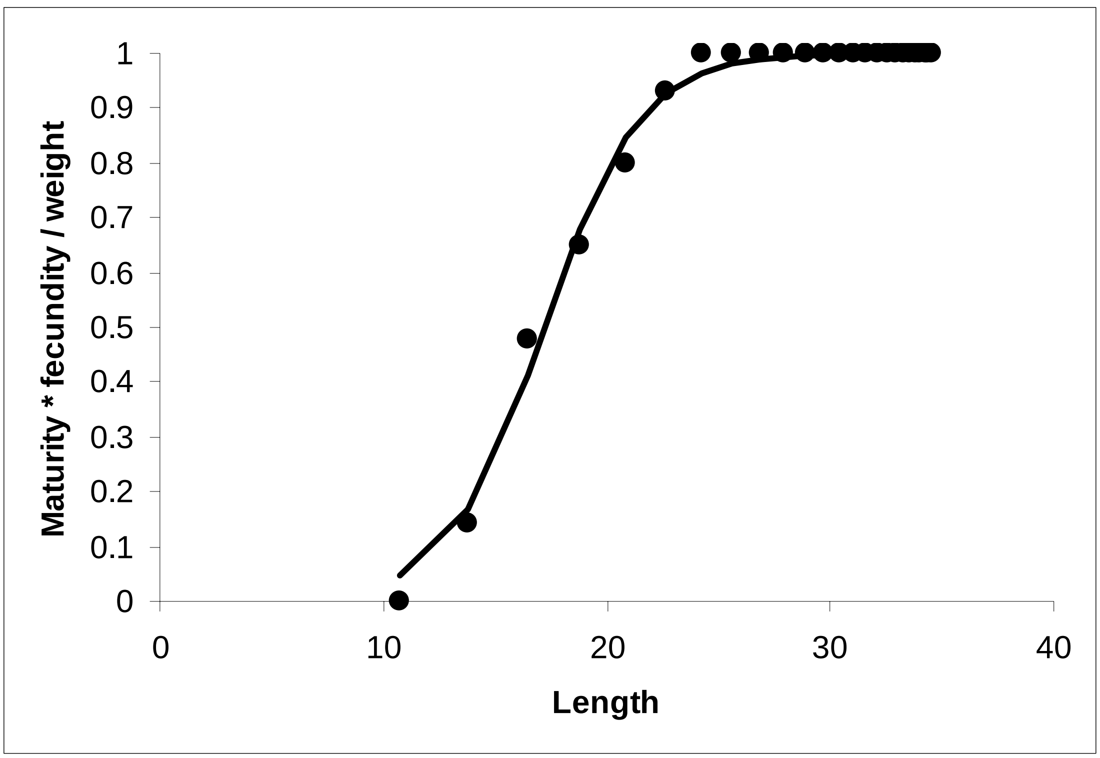


Figure D3.1. The maturity schedule used in SS2 developed by fitting the logistic function to the GSI*maturity at length.

There are six candidate indices of abundance, but only the trip based CPFV CPUE and the sanitation indices are used.

1) Trawl CPUE. Due to management restrictions on the commercial fishery that were initiated in 1999, the trawl survey CPUE index is not considered a reliable index of abundance and is not use in the analysis.

2) CPFV CPUE based on trip records, 1980-2003. This index is considered a reasonable representation of the abundance for years prior to the implementation of management restrictions in 2000, and these years are used in the analysis. The index was included in the model as an index of number of fish.

3) CPFV CPUE based on month and CDFG block summarized data 1936-2004. The years 1980 – 2003 are duplicates of the CPFV CPUE based on trip records and it is thought that earlier data may be influenced by changes in technology and targeting. Therefore, this index is not included in the analysis.

4) CPFV CPUE based on RecFIN data and species association selection of records. These data were not used because it shows similar trends to the trip based CPUE, but has much larger CVs.

5) The sanitation surveys. These fishery independent surveys are thought to be a reasonable representation of the abundance and used in the analysis. The four indices were combined to form a single index. The index was included in the model as a an index of number of fish.

Catch-at-length data are available from the commercial, recreational, and sanitation surveys.

Catch-at-age data are available from the biological studies of Love et al. (1987). These data are from trawls around the Palos Verdes area. Due to the limited spatial coverage and the opportunistic sampling, the data are assumed to be inappropriate to include in the analysis.

The steepness of the Beverton-Holt stock-recruitment relationship is assumed equal to 0.7, the natural mortality is assumed equal to 0.25 for both sexes, and the coefficient of variation of length at age is assumed equal to 0.05. The model estimates the virgin recruitment, the catchability coefficients for the CPFV trip CPUE index and the sanitation survey indices, annual recruitment deviates for 1966 to 2001,and the slope and inflection point of the logistic selectivity curve for the hook and line, gillnet, trawl, recreational, and sanitation survey logistic selectivity curves (two time periods of selectivities for the fisheries).

4. Model selection and evaluation

5. Base run results

The model provides a reasonable fit to both the indices of abundance used in the model (Figure D5.1). The model generally fits the length-frequency data well, except for the gillnet data which is not included in the objective function and the selectivity for this gear is assumed to be the same as the hook and line fishery (Figure D5.2). There are some outliers in the length-frequency data.

The spawning biomass is estimated to be 80% of the average unexploited population level (Figure D5.3, Table D5.1). Recruitment has been generally higher than average since the mid 1980s. The estimated selectivity curves are given in Figure D5.4 and show that the increase in minimum legal size has reduced the selectivity of small fish as expected.

The spawning biomass is reasonably well estimated (Figure D5.5) and there is no clear relationship between recruitment and the spawning stock size (Figure D5.6).

Table D5.1. Estimated quantities from the assessment.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Discards	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Landings (mt)	133	154	178	163	261	209	198	110	94	81	
ABC											
OY									84.9	84.9	
With sanitation survey											
SPR	0.482	0.455	0.435	0.471	0.383	0.418	0.420	0.530	0.587	0.656	
Exploitation rate	0.129	0.155	0.180	0.153	0.254	0.185	0.175	0.098	0.085	0.071	
Summary (age 2+) biomass	1444	1611	1687	1703	1688	1635	1743	1803	1848	1864	1866
Spawning stock biomass	530	580	629	663	691	636	612	623	704	774	816
(cv)	0.03	0.03	0.03	0.03	0.04	0.05	0.07	0.09	0.09	0.10	0.10
Recruitment	3025	2652	2223	3261	4660	3474	2103	1930	1968	1996	
Depletion level	0.518	0.567	0.615	0.648	0.675	0.622	0.598	0.608	0.688	0.756	0.798
(cv)										0.10	0.10
Without sanitation survey											
SPR	0.510	0.489	0.470	0.506	0.410	0.457	0.456	0.561	0.590	0.622	
Exploitation rate	0.114	0.138	0.163	0.144	0.256	0.204	0.207	0.124	0.111	0.096	
Summary (age 2+) biomass	1676	1801	1933	1894	1830	1646	1522	1405	1376	1358	1352
Spawning stock biomass	609	680	738	771	788	700	631	564	557	557	563
(cv)	0.05	0.04	0.05	0.05	0.06	0.08	0.09	0.10	0.10	0.09	0.09
Recruitment	3997	1984	1905	1915	1924	1893	1865	1831	1827	1827	
Depletion level	0.623	0.695	0.755	0.788	0.805	0.715	0.645	0.577	0.569	0.569	0.576
(cv)										0.08	0.07

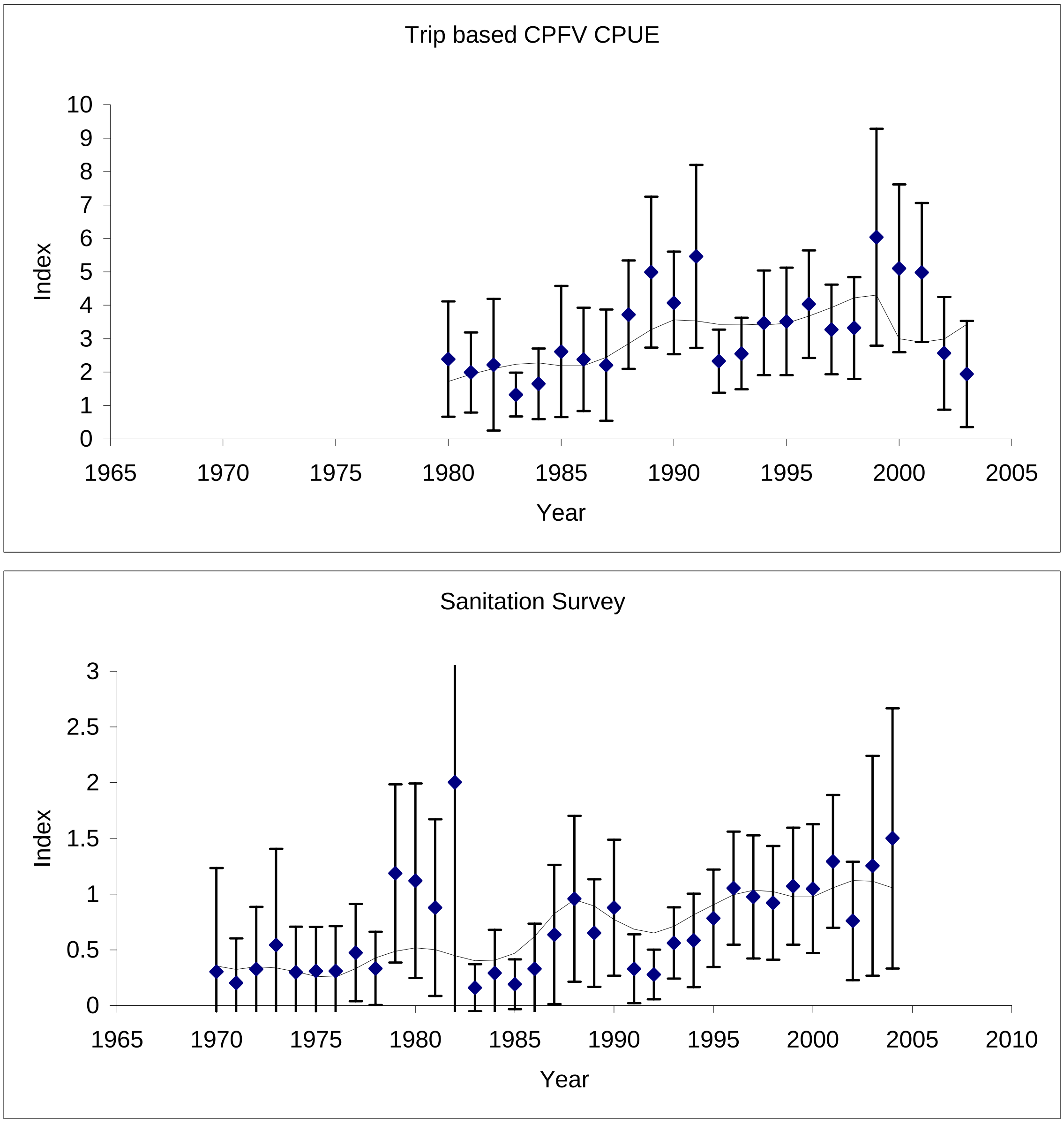


Figure D5.1a. Fit of the model to the indices of abundance.

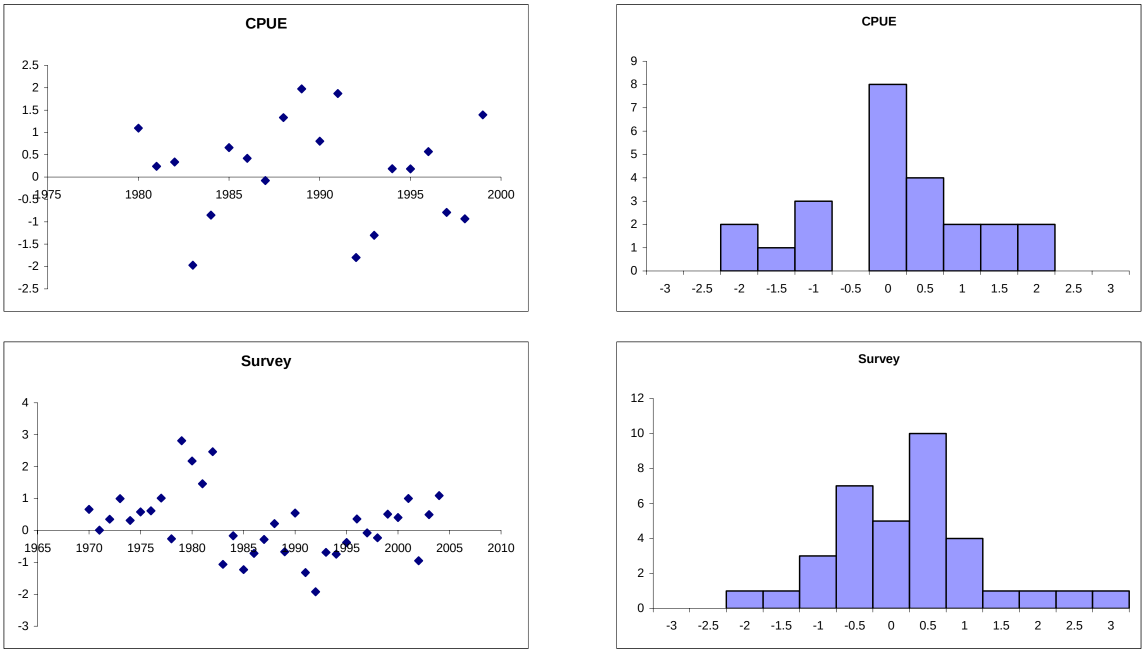
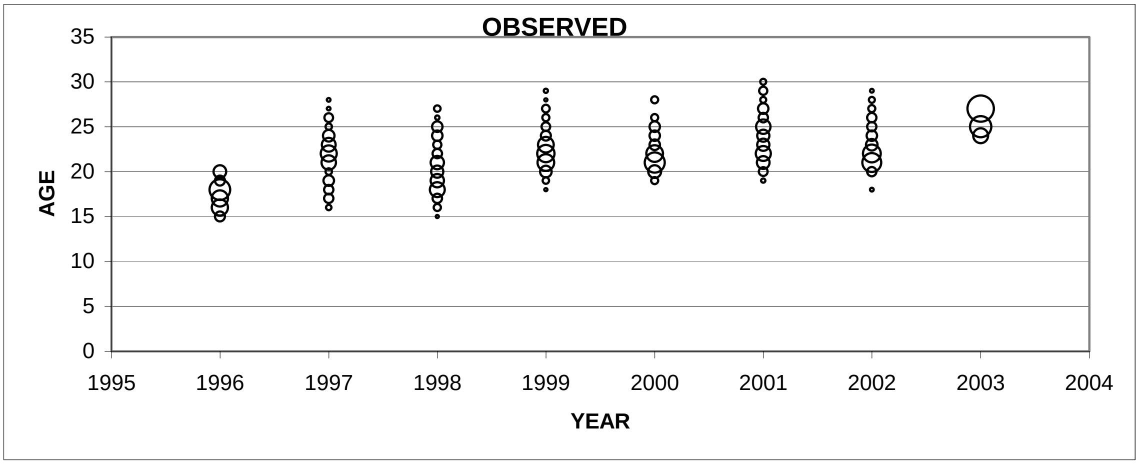
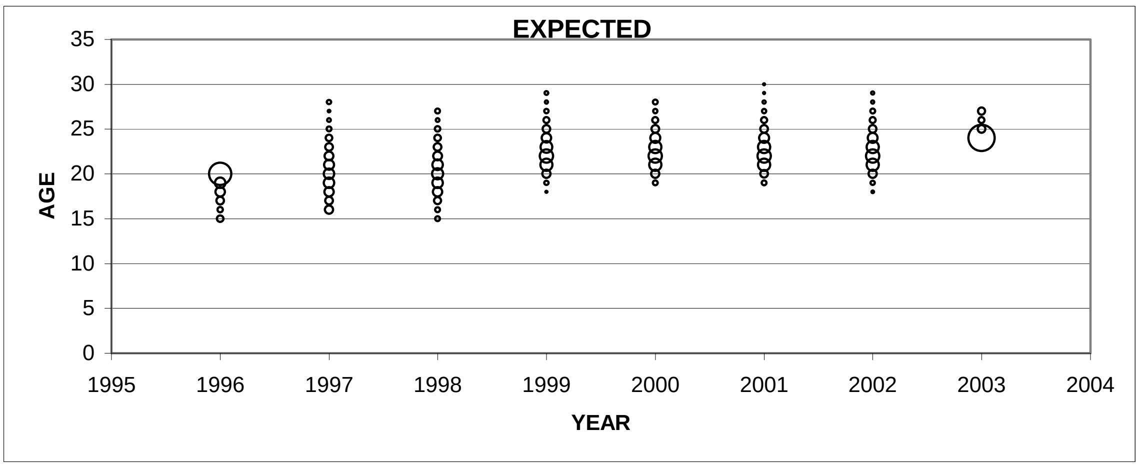


Figure D5.1b. Bias adjusted standardized residuals from the fit of the model to the indices of abundance.





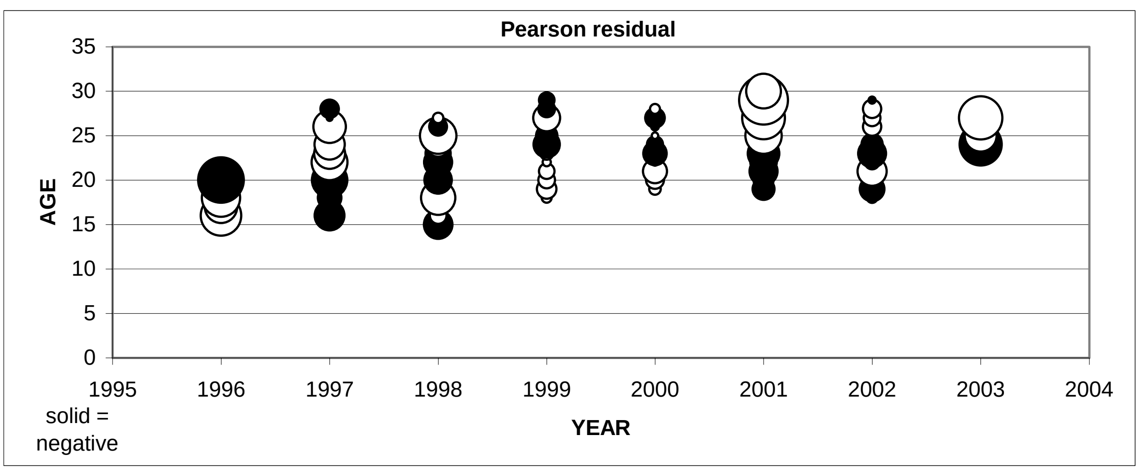


Figure D5.2a. Fit to the Hook and Line commercial length frequency data.

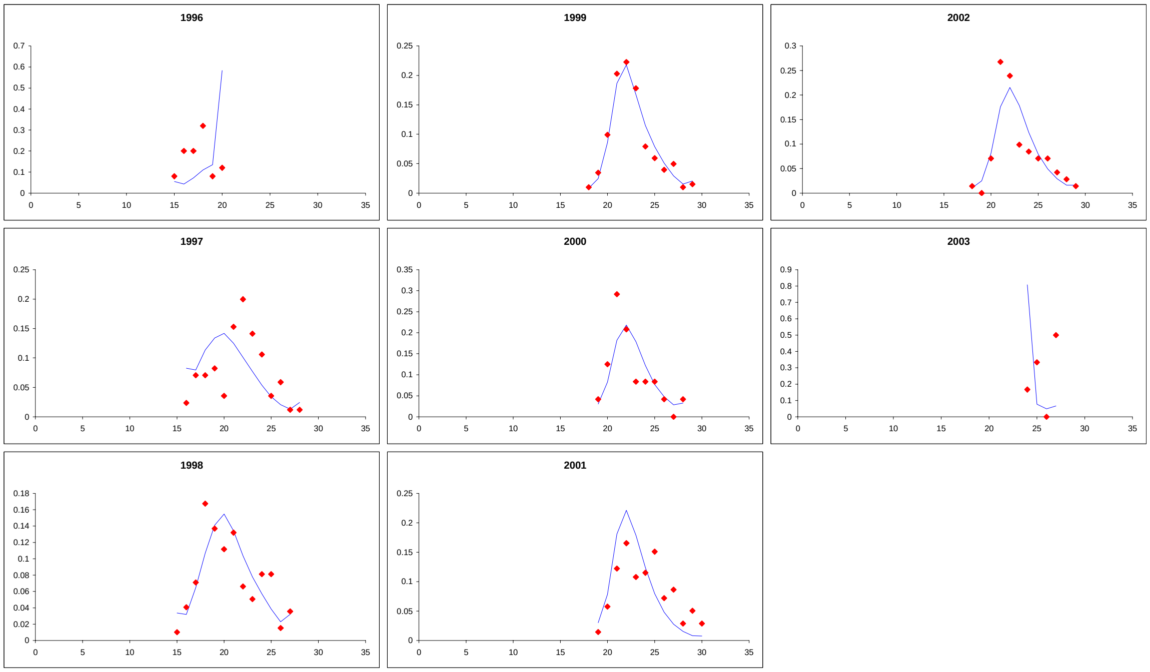


Figure D5.2a continued. Fit to the Hook and Line commercial length frequency data.

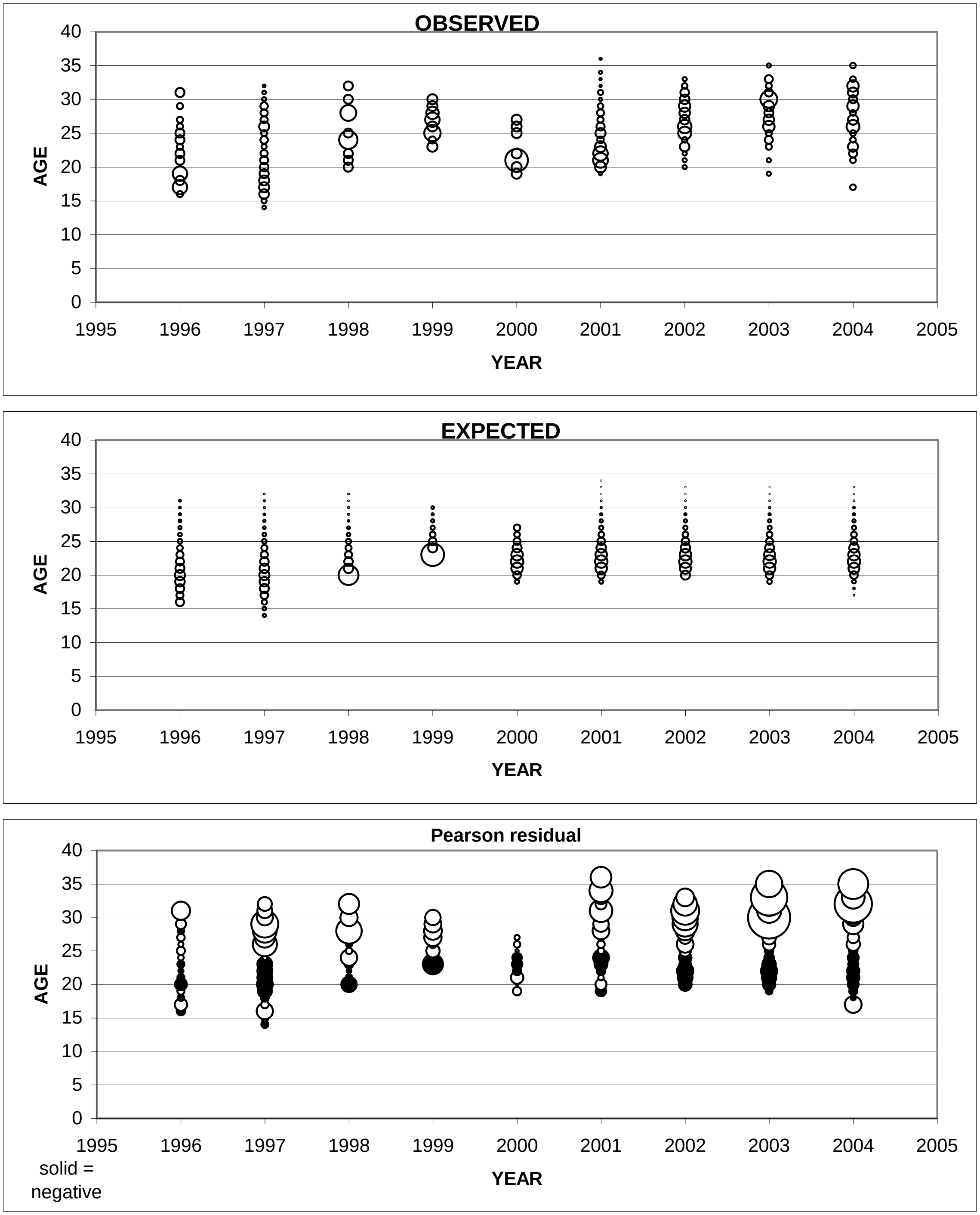


Figure D5.2b. Fit to the set net commercial length frequency data. Note that these data were not included in the objective function.

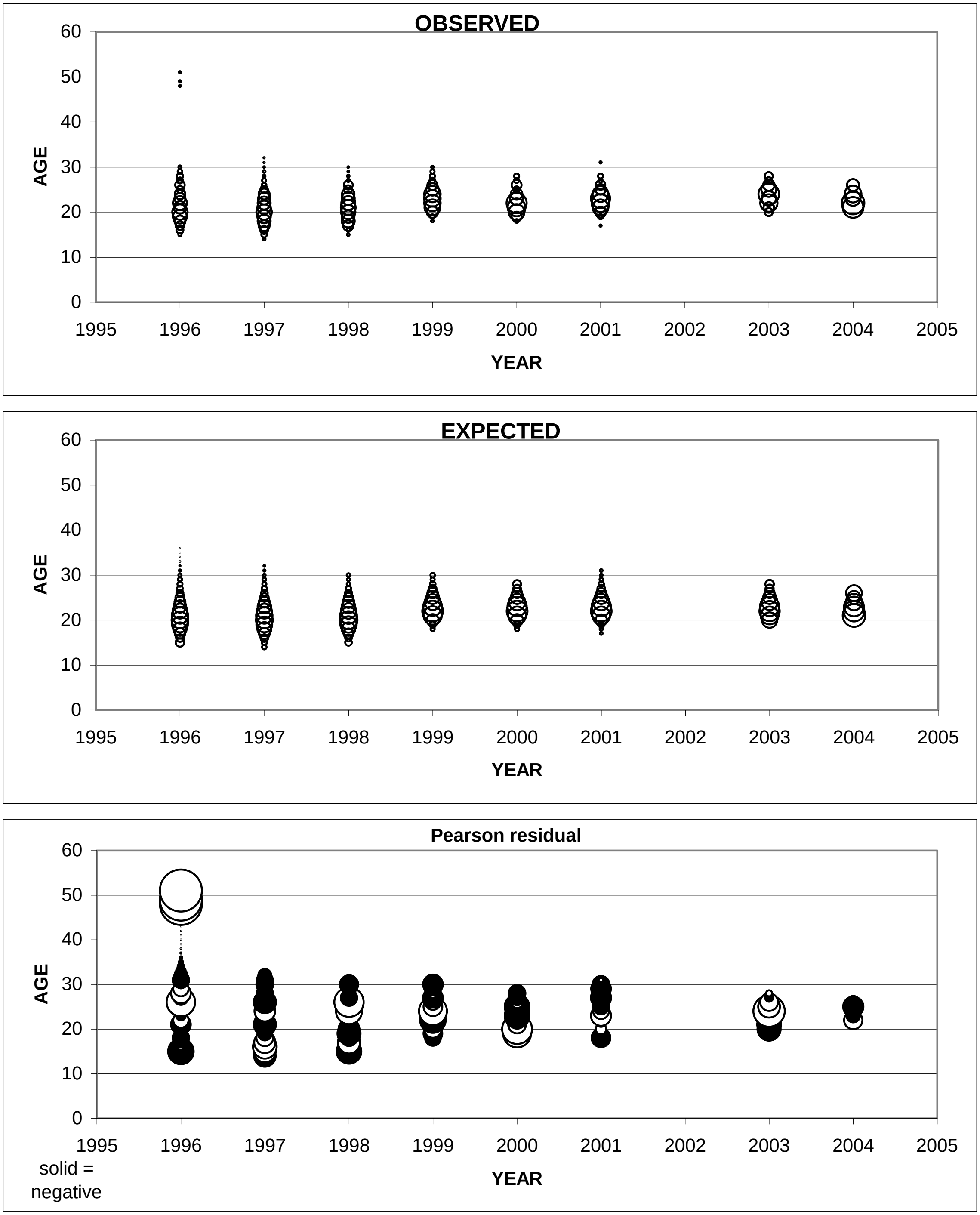


Figure D5.2c. Fit to the trawl commercial length frequency data.

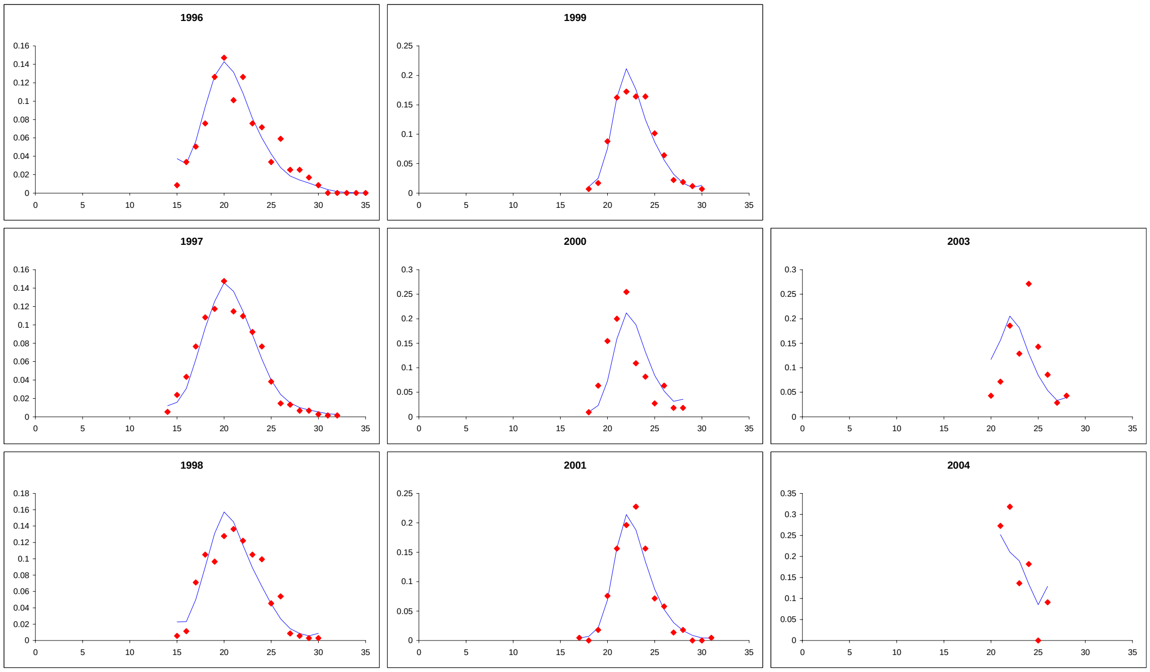


Figure D5.2c continued. Fit to the trawl commercial length frequency data.

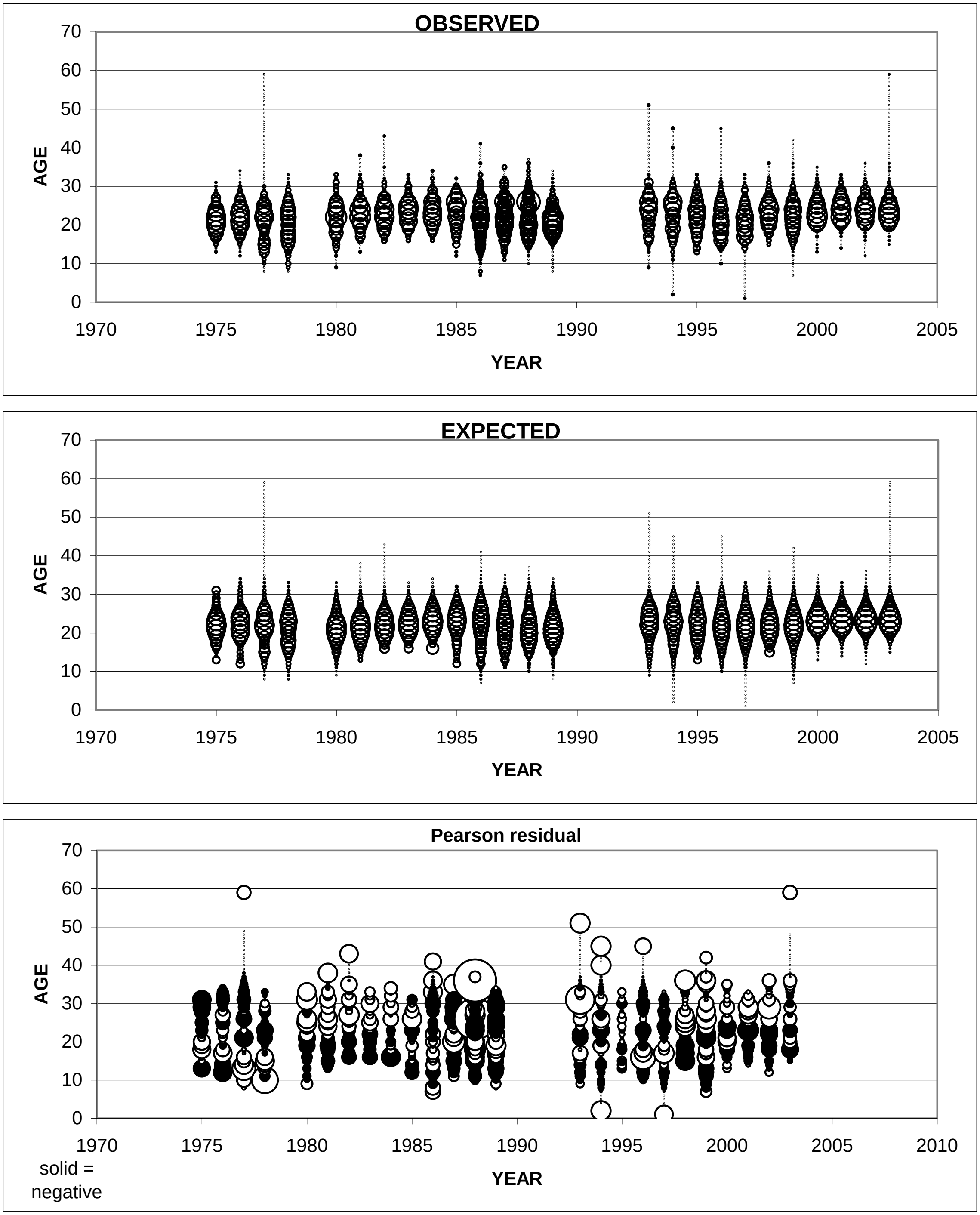


Figure D5.2d. Fit to the recreational length frequency data.

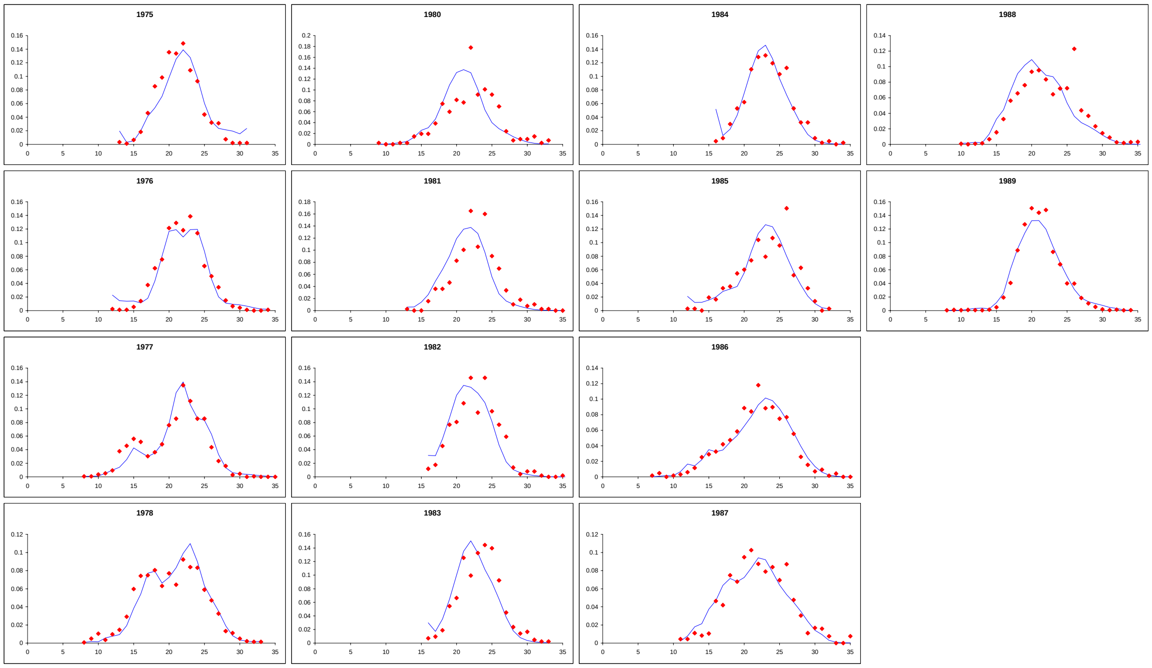


Figure D5.2d continued. Fit to the recreational length frequency data.

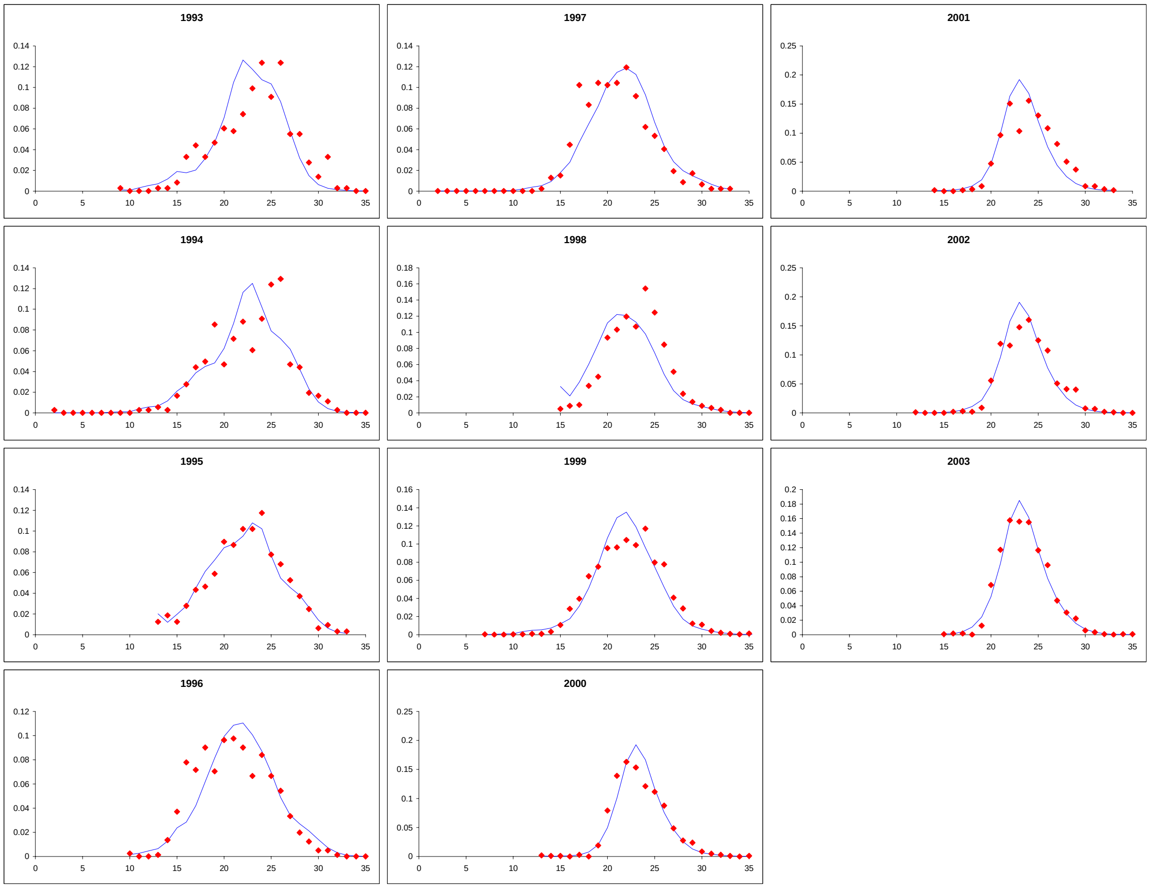


Figure D5.2d continued. Fit to the recreational length frequency data.

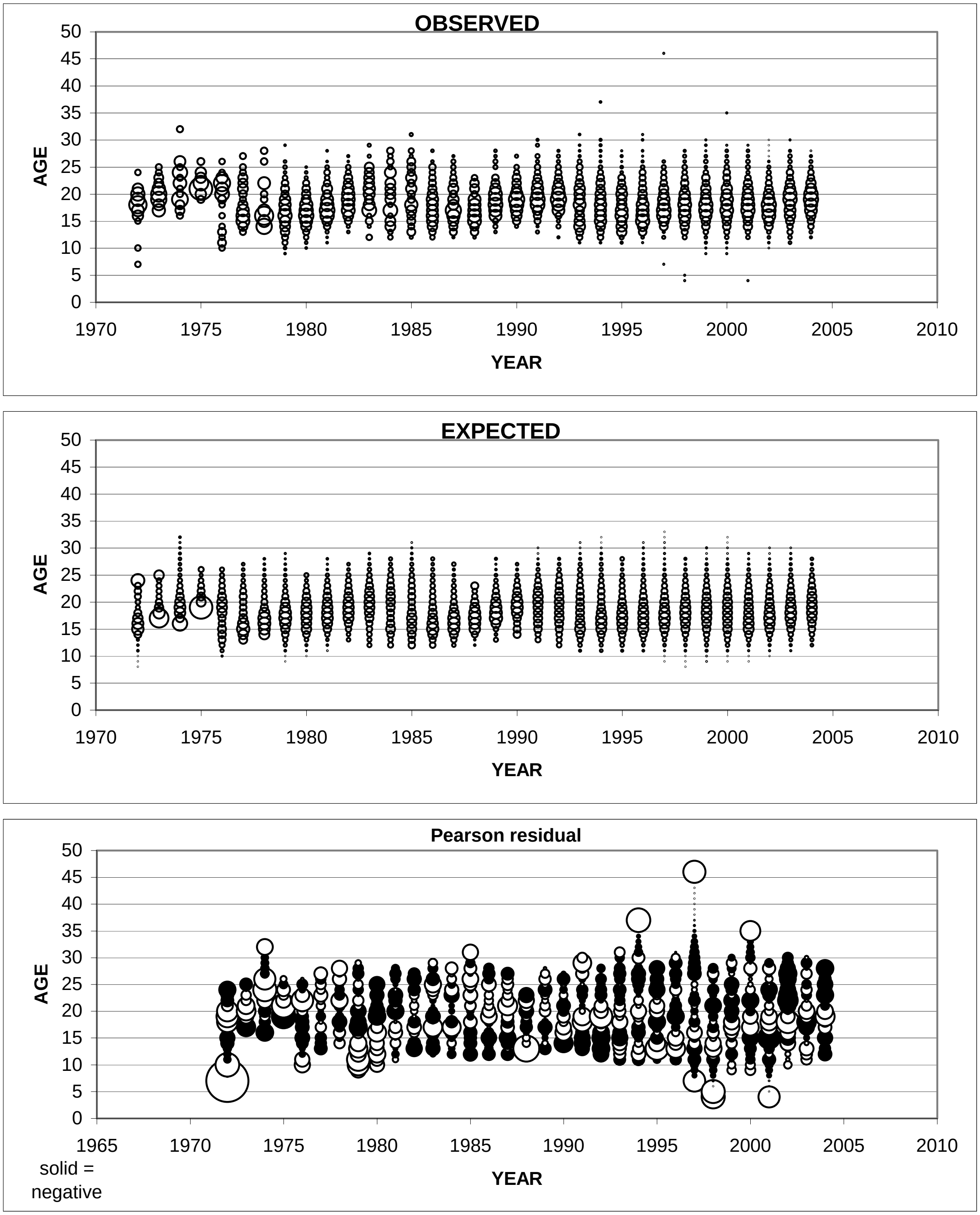


Figure D5.2e. Fit to the sanitation survey length frequency.

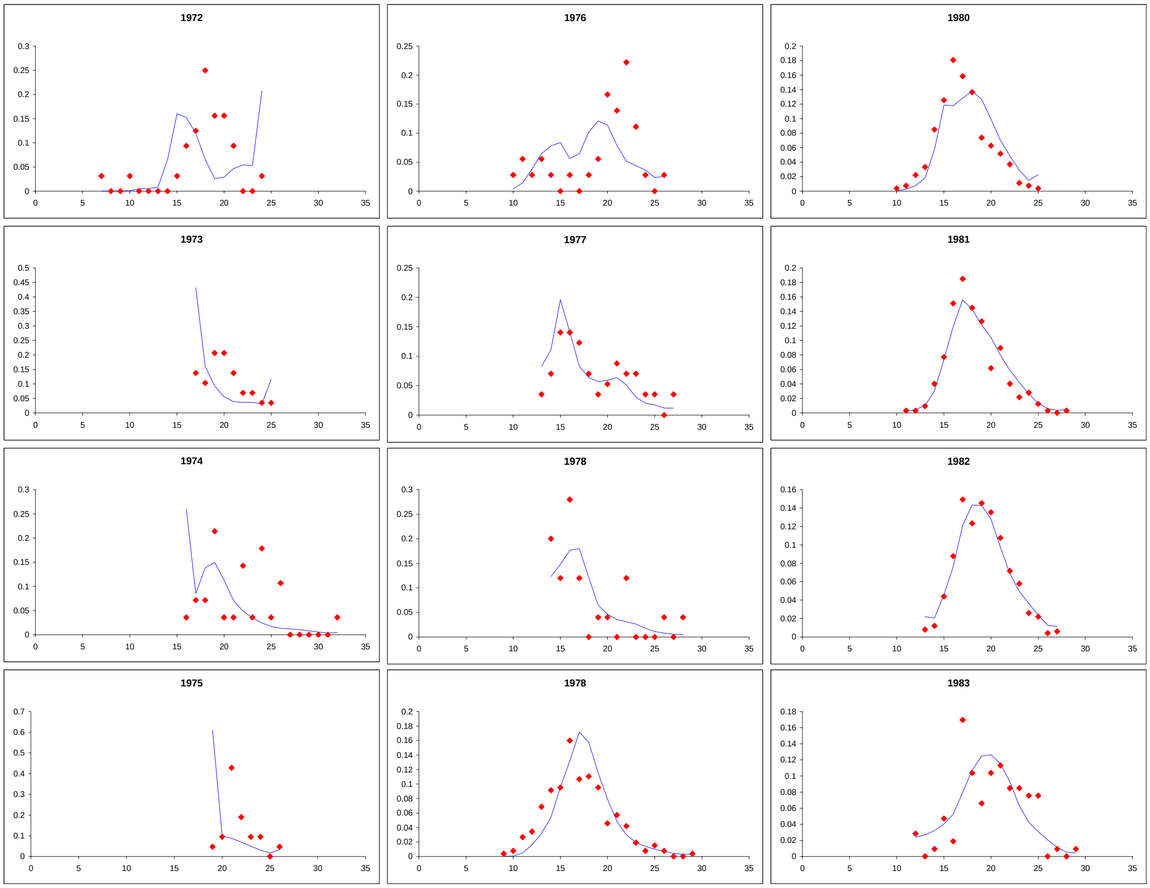


Figure D5.2e continued. Fit to the sanitation survey length frequency.

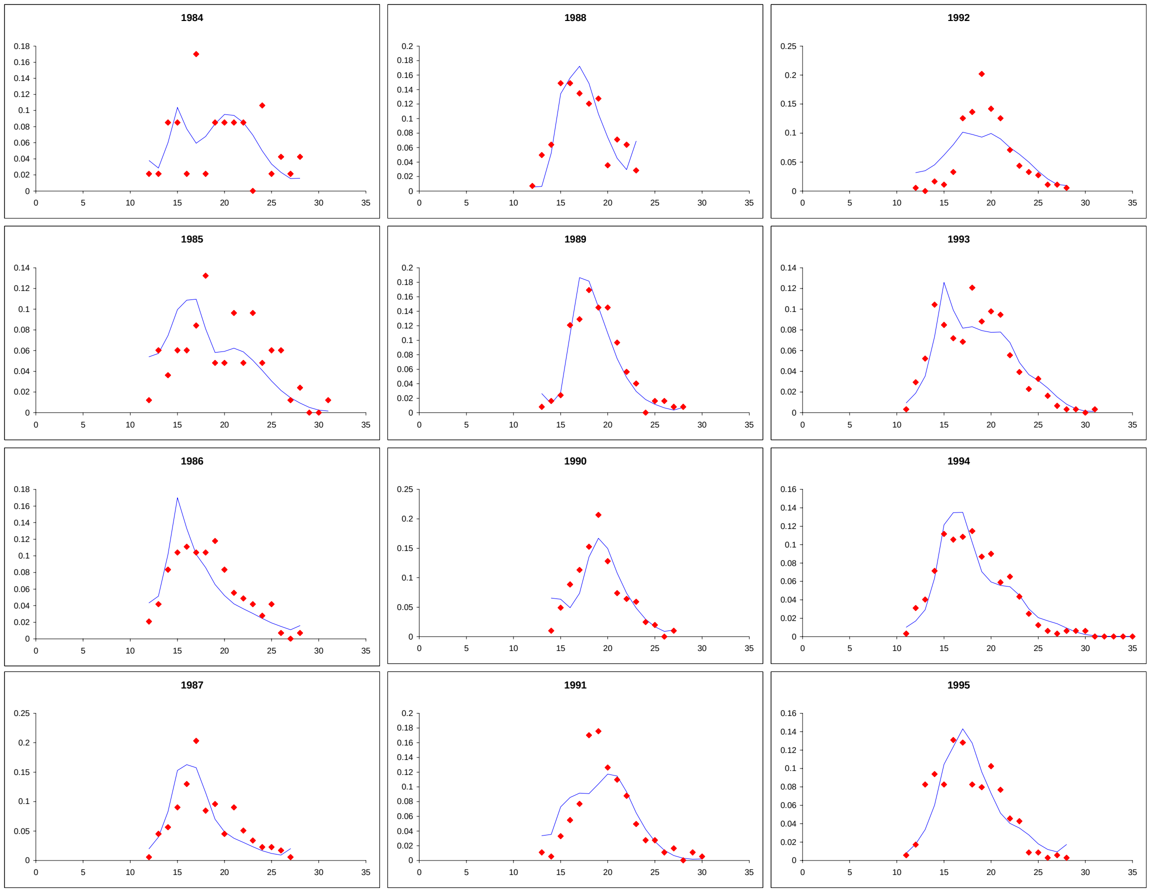


Figure D5.2e continued. Fit to the sanitation survey length frequency.

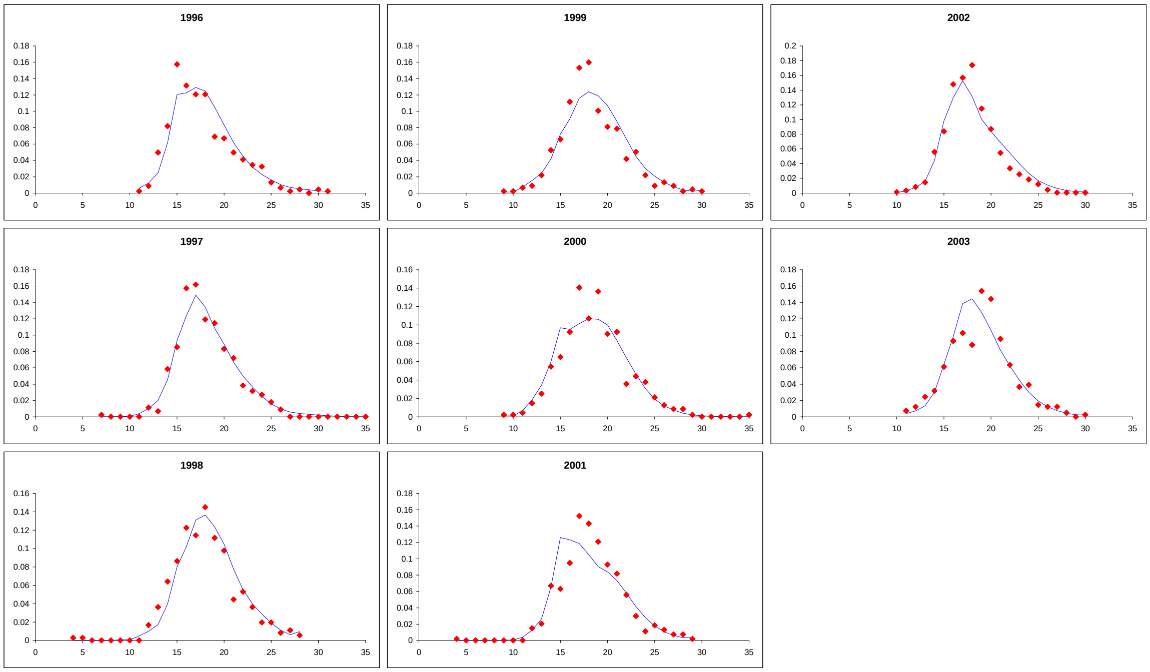
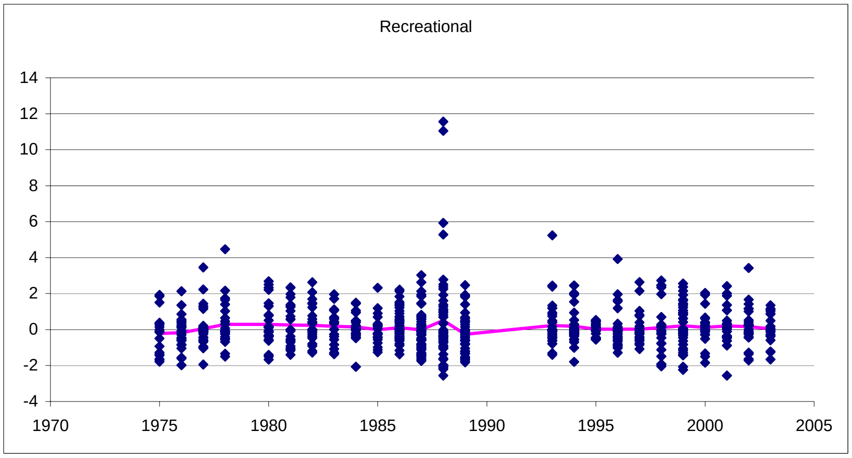
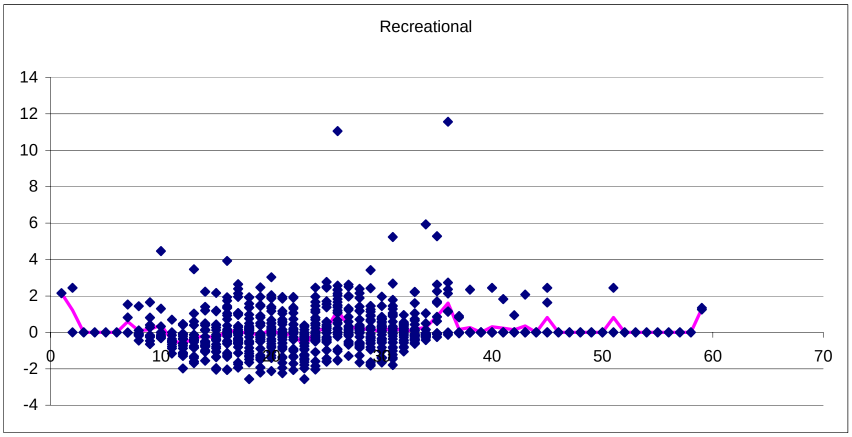


Figure D5.2e continued. Fit to the sanitation survey length frequency.





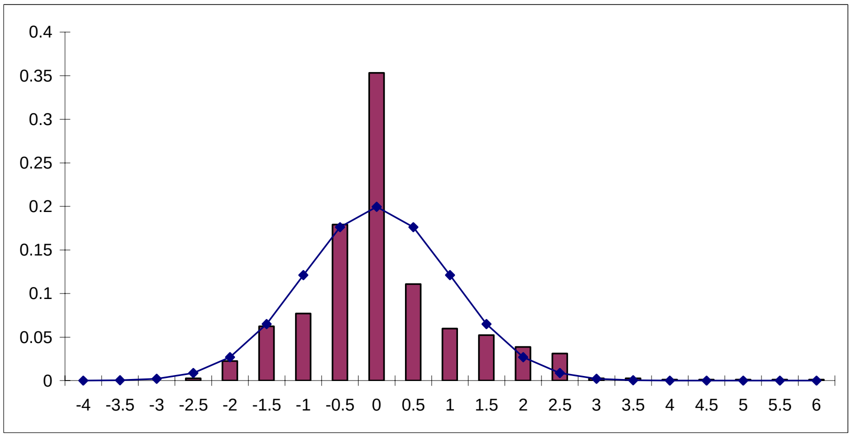


Figure D5.2f. Standardized residuals from the fit to the recreational length frequency. Top – by year, Middle – by length. The large numbers of zeros is due to the method of choosing the length-frequency bins to use in the likelihood. This method includes many bins with zero observed individuals, which are also predicted to have zero individuals.

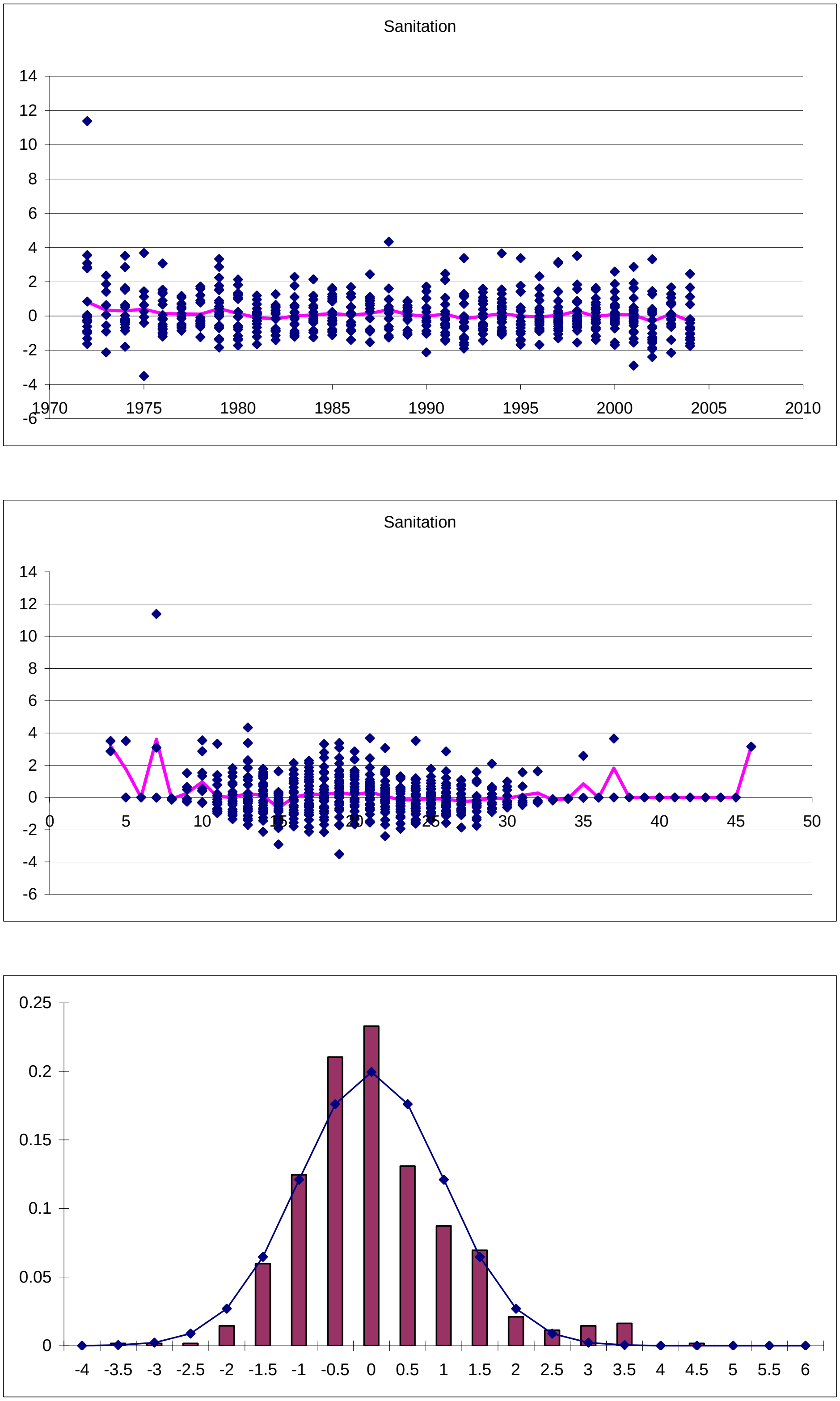


Figure D5.2g. Standardized residuals from the fit to the sanitation survey length frequency. Top – by year, Middle – by length.

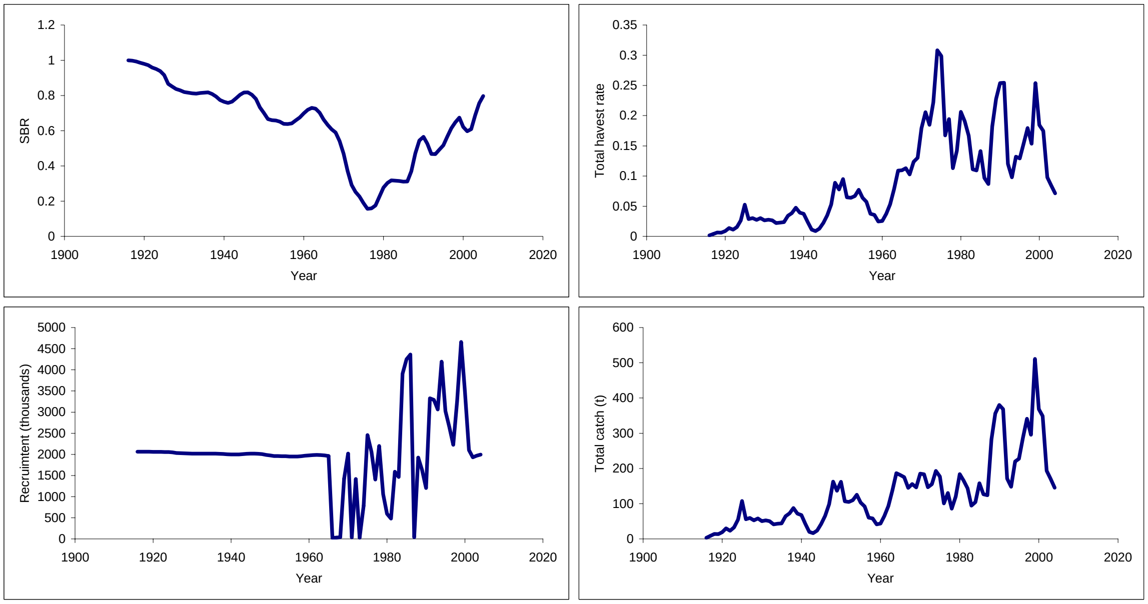


Figure D5.3. Spawning biomass ratio, exploitation rate, recruitment, and total catch estimated for by the model.

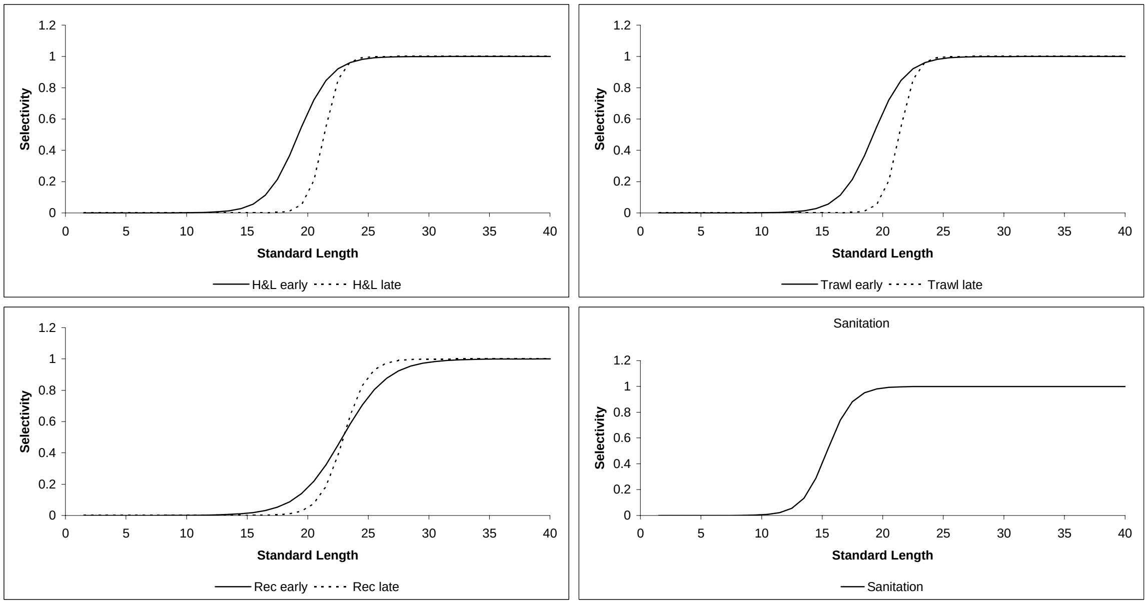


Figure D5.4. Estimated size specific selectivity curves for fisheries and sanitation survey.

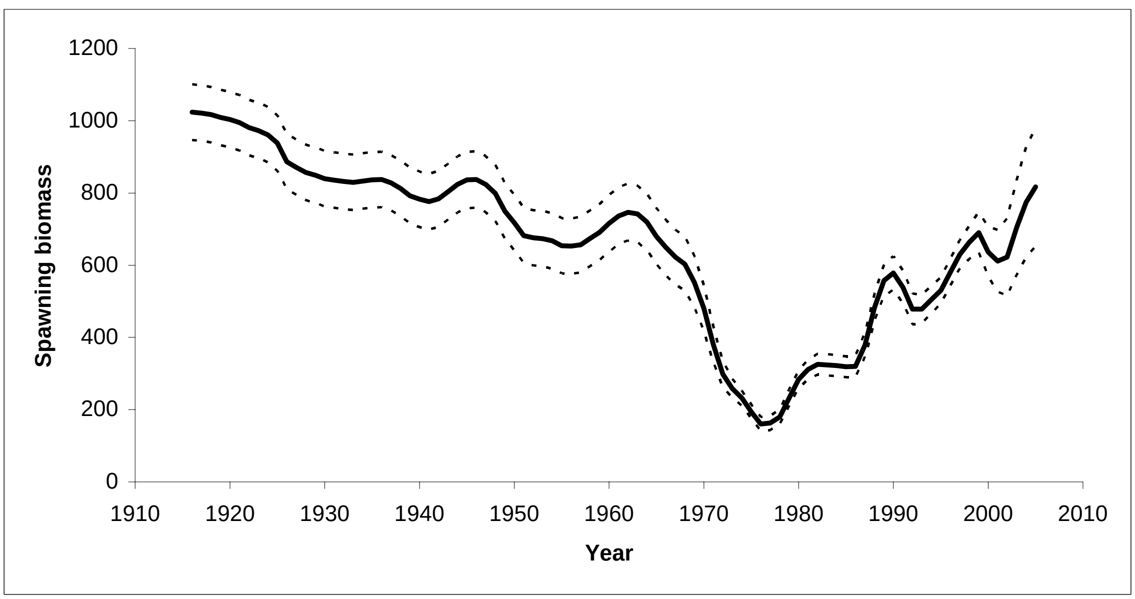


Figure D5.5. Spawning biomass and approximate 95% confidence intervals.

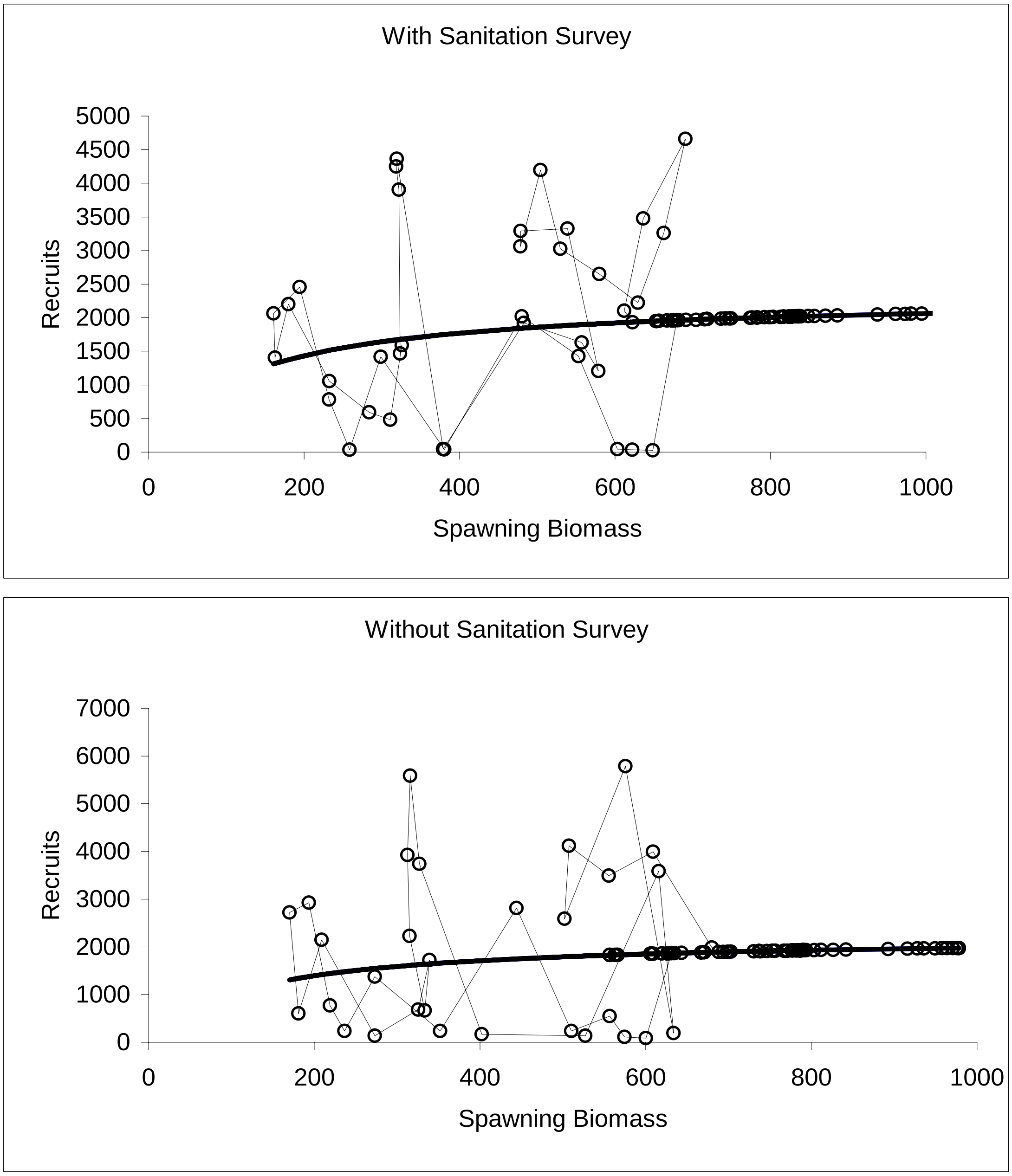


Figure D5.6 Spawner-recruit plots for the basecase and the sensitivity that excludes the sanitation survey.

6. Uncertainty and sensitivity analyses

The current status is sensitive to the inclusion of the sanitation index in the stock assessment; removing the sanitation index reduces the current biomass level. To match information content in the data, annual recruitment deviates were not estimated after 1996 when the sanitation district trawl survey was excluded from the analysis. The STAR Panel and STAT Team gave relative probabilities to models including and excluding the sanitation index of 74% and 26%, respectively. The results of the sensitivity analysis are shown in Figure D6.1.

Other sensitivity analyses were carried out to investigate natural mortality (M) steepness of the Beverton-Holt stock-recruitment relationship (h) and the coefficient of variation of the length-at-age (Lcv). The overall management implications of the results were not very sensitive to the values investigated (Table D6.1). The data supported higher values of all three parameters. When Lcv was estimated, it became unrealistically high and the exploitation rates become higher than 1, which is not plausible. This is the basis for *a priori* choosing a reasonable value for Lcv.

The model results were slightly (a few percent) sensitive to the initial parameter starting values due to local minima, including 2005 and 2006 catch based on the 2004 catch in the estimation period, and including the forward projections in the estimation model. However, this does not change the conclusions of the analysis.

There is a large amount of variation in recruitment levels and recent recruitments are estimated to be substantially higher than average. Predictions of future biomass will be dependent on what recruitment level is assumed in the future. Projections presented in this report use average recruitment based on the Beverton-Holt stock-recruitment relationship.

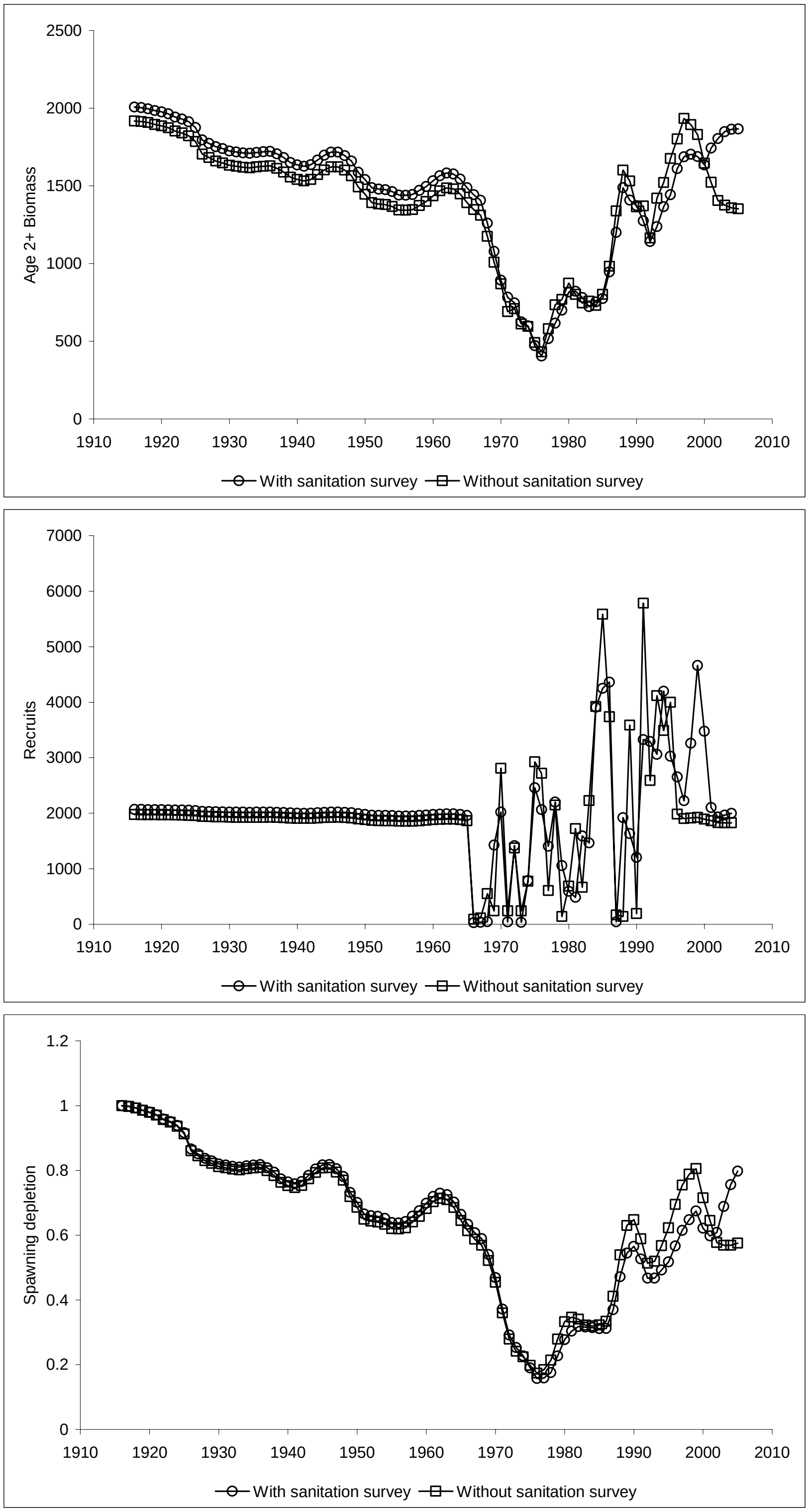


Figure D6.1. Comparison of age 2+ biomass, recruitment and depletion level from the sensitivity analysis excluding the sanitation survey and the base model that includes the sanitation survey.

Table D6.1. Results from the sensitivity analyses. Lcv is the coefficient of variation for the length-at-age.

	basecase	No sanitation	M = 0.2	M = 0.3	h = 0.5	h = 1.0	Lcv = 0.0.25	Lcv = 0.075	Lcv = 0.1
Unfished recruitment (R0; age 0)	2067	1975	1175	3339	2035	1944	2262	1841	1712
Unfished spawning biomass (SB0)	1024	978	973	1056	1008	963	1112	922	872
Depletion 2005	0.80	0.58	0.75	0.87	0.79	0.86	0.74	0.75	0.63
-LN(Likelihood)	836	NA	862	819	853	820	1014	761	723

E. Rebuilding parameters

The status of the stock does not require rebuilding.

F. Reference points (biomass and exploitation rate)

Table F1. Reference points estimated from the basecase analysis and the sensitivity excluding the sanitation survey index.

Biological Reference Points

Quantity	Include sanitation index	Exclude sanitation index
Unfished spawning biomass (SB_0)	1024	978
Unfished summary (age 2+) biomass (B_0)	2007	1918
Unfished recruitment (R_0; age 0)	2067	1975
$SB_{40\%}$ (MSY proxy stock size = 0.4xSB_0)	409	391
Exploitation rate at $F_{50\%}$ proxy	0.098	0.098
SB_{MSY}/SB_0	0.253	0.257
MSY	127	121
Exploitation rate at MSY	0.161	0.160

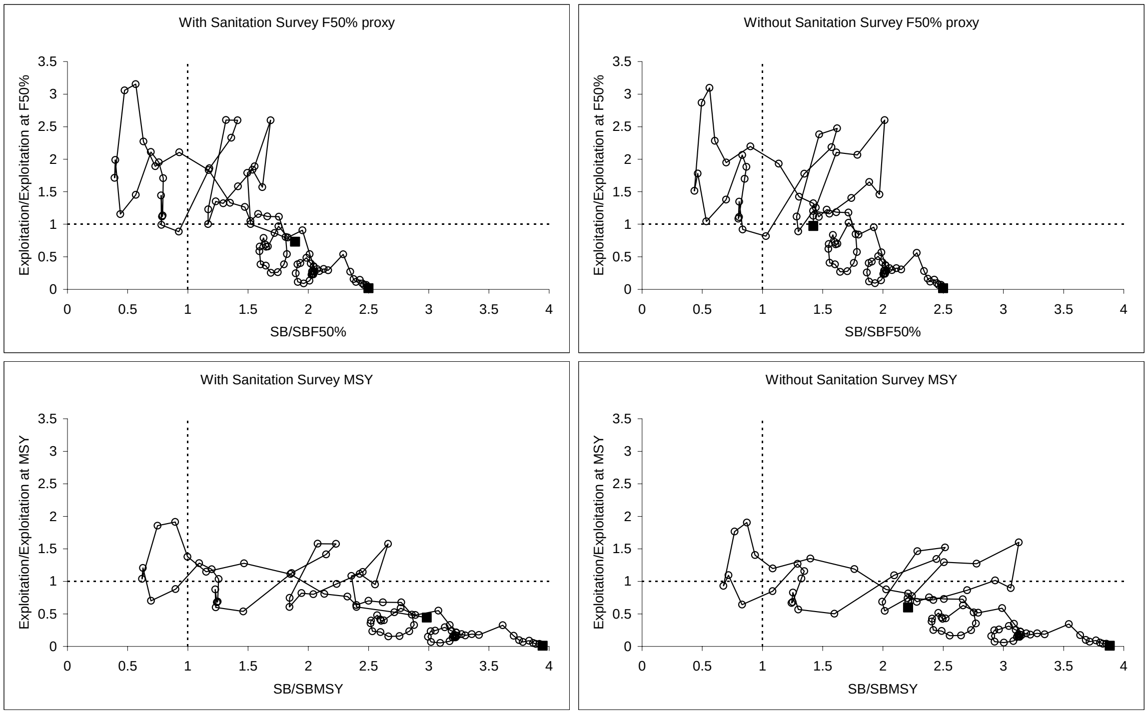


Figure F1. Exploitation rates versus spawning biomass plots from the basecase analysis and the sensitivity excluding the sanitation survey index.

G. Harvest projections and decision tables

The population assessments were projected forward under the default PFMC and California NFMP harvest policies (i.e. F50% with 40:10 and 60:20 reduction, respectively). All scenarios assume that catch in 2005 and 2006 is equal to the catch in 2004. Results are presented in Table G1.

A decision table was created with two states of nature and three management options. Uncertainty in the analysis (the states of nature) is represented by including and excluding the sanitation districts trawl survey. Management action alternatives considered were: (1) harvesting using the 40:20 rule based on the assessment including the sanitation districts trawl survey; (2) harvesting using the 60:20 rule based on the assessment including the sanitation districts trawl survey; and (3) harvesting using catch in 2004. All scenarios assume that catch in 2005 and 2006 is equal to the catch in 2004. Results are presented in Table G2.

Table G1. Forward projections under the default PFMC and California NFMP harvest policies (i.e. F50% with 40:10 and 60:20 reduction, respectively). All scenarios assume that catch in 2005 and 2006 is equal to the catch in 2004. Exploitation rates are in terms of the oldest aged fish in the model (Age 25 plus group) and not summary biomass.

With Sanitation Survey

Year	40:10	Biomass Age 2+	Spawning Biomass	Depletion	Commercial catch (mt)	Commercial harvest rate	Sport Catch (mt)	Sport Harvest Rate
2005	NA	1866	816	0.80	5.2	0.005	78.9	0.121
2006	NA	1846	827	0.81	5.2	0.005	82.6	0.113
2007	1	1811	818	0.80	13.4	0.013	222.2	0.291
2008	1	1633	703	0.69	11.5	0.013	191.0	0.291
2009	1	1503	623	0.61	10.0	0.013	164.9	0.291
2010	1	1412	572	0.56	9.0	0.013	145.7	0.291
2011	1	1348	541	0.53	8.3	0.013	132.6	0.291
2012	1	1303	520	0.51	7.9	0.013	124.0	0.291
2013	1	1271	505	0.49	7.6	0.013	118.4	0.291
2014	1	1246	494	0.48	7.4	0.013	114.6	0.291
2015	1	1226	485	0.47	7.2	0.013	111.8	0.291
2016	1	1210	478	0.47	7.1	0.013	109.5	0.291
2017		1198	472	0.46				

Year	60:20	Biomass Age 2+	Spawning Biomass	Depletion	Commercial catch (mt)	Commercial harvest rate	Sport Catch (mt)	Sport Harvest Rate
2005	NA	1866	816	0.80	5.2	0.005	78.9	0.121
2006	NA	1846	827	0.81	5.2	0.005	82.6	0.113
2007	1.00	1811	818	0.80	13.4	0.013	222.2	0.291
2008	1.00	1633	703	0.69	11.5	0.013	191.0	0.291
2009	1.00	1503	623	0.61	10.0	0.013	164.9	0.291
2010	0.96	1412	572	0.56	8.7	0.013	140.4	0.280
2011	0.94	1354	544	0.53	7.8	0.012	125.2	0.272
2012	0.92	1315	528	0.52	7.3	0.012	116.4	0.267
2013	0.91	1289	517	0.51	7.1	0.012	111.1	0.264
2014	0.90	1269	510	0.50	6.9	0.012	107.6	0.261
2015	0.89	1254	504	0.49	6.7	0.012	105.0	0.259
2016	0.88	1243	499	0.49	6.6	0.012	103.0	0.257
2017		1234	495	0.48				

Without Sanitation Survey

Year	40:10	Biomass Age 2+	Spawning Biomass	Depletion	Commercial catch (mt)	Commercial harvest rate	Sport Catch (mt)	Sport Harvest Rate
2005	NA	1352	563	0.58	5.2	0.007	82.0	0.151
2006	NA	1343	566	0.58	5.2	0.007	82.8	0.152
2007	1	1335	566	0.58	8.8	0.013	141.7	0.261
2008	1	1268	526	0.54	8.1	0.013	128.4	0.261
2009	1	1223	499	0.51	7.5	0.013	118.8	0.261
2010	1	1192	481	0.49	7.2	0.013	112.4	0.261
2011	1	1170	470	0.48	7.0	0.013	108.1	0.261
2012	1	1154	462	0.47	6.8	0.013	105.5	0.261

2013	1	1142	456	0.47	6.7	0.013	103.7	0.261
2014	1	1132	451	0.46	6.7	0.013	102.3	0.261
2015	1	1123	447	0.46	6.6	0.013	101.3	0.261
2016	1	1117	443	0.45	6.5	0.013	100.4	0.261
2017		1111	441	0.45				

Year	60:20	Biomass Age 2+	Spawning Biomass	Depletion	Commercial catch (mt)	Commercial harvest rate	Sport Catch (mt)	Sport Harvest Rate
2005	NA	1352	563	0.58	5.2	0.007	82.0	0.151
2006	NA	1343	566	0.58	5.2	0.007	82.8	0.152
2007	0.98	1335	566	0.58	8.6	0.013	139.1	0.256
2008	0.94	1271	528	0.54	7.6	0.012	121.8	0.246
2009	0.92	1232	505	0.52	7.0	0.012	110.9	0.240
2010	0.90	1208	492	0.50	6.7	0.012	104.5	0.236
2011	0.89	1192	484	0.50	6.5	0.011	100.7	0.233
2012	0.89	1181	479	0.49	6.3	0.011	98.6	0.232
2013	0.88	1173	476	0.49	6.3	0.011	97.2	0.231
2014	0.88	1167	473	0.48	6.2	0.011	96.1	0.230
2015	0.88	1162	471	0.48	6.1	0.011	95.3	0.229
2016	0.87	1158	469	0.48	6.1	0.011	94.7	0.228
2017		1155	468	0.48				

Table G2. Decision table.

				State of nature			
				With Sanitation		Without Sanitation	
				More likely (p = 0.74)		less likely (p = 0.26)	
Management Action	Year	Recreational catch (thousands of fish)	Commercial catch (mt)	Spawning Biomass	Depletion	Spawning Biomass	Depletion
40-10	2005	140	5	816	0.80	563	0.58
	2006	140	5	827	0.81	566	0.58
	2007	361	13	818	0.80	566	0.58
	2008	308	11	703	0.69	478	0.49
	2009	267	10	623	0.61	425	0.43
	2010	240	9	572	0.56	397	0.41
	2011	222	8	541	0.53	385	0.39
	2012	211	8	520	0.51	380	0.39
	2013	203	8	505	0.49	379	0.39
	2014	198	7	494	0.48	378	0.39
	2015	194	7	485	0.47	378	0.39
	2016	191	7	478	0.47	379	0.39
	2017			472	0.46	380	0.39
60-20	2005	140	5	816	0.80	563	0.58
	2006	140	5	827	0.81	566	0.58
	2007	361	13	818	0.80	566	0.58
	2008	308	11	703	0.69	478	0.49
	2009	267	10	623	0.61	425	0.43
	2010	231	9	572	0.56	397	0.41
	2011	209	8	544	0.53	388	0.40
	2012	197	7	528	0.52	387	0.40
	2013	189	7	517	0.51	389	0.40
	2014	184	7	510	0.50	392	0.40
	2015	180	7	504	0.49	395	0.40
	2016	177	7	499	0.49	398	0.41
	2017			495	0.48	401	0.41
Current catch	2005	140	5	816	0.80	563	0.58
	2006	140	5	827	0.81	566	0.58
	2007	140	5	818	0.80	566	0.58
	2008	140	5	785	0.78	565	0.58
	2009	140	5	762	0.76	563	0.58
	2010	140	5	739	0.74	561	0.57
	2011	140	5	717	0.71	559	0.57
	2012	140	5	697	0.69	557	0.57
	2013	140	5	679	0.68	555	0.57
	2014	140	5	663	0.66	553	0.57
	2015	140	5	649	0.65	551	0.56
	2016	140	5	637	0.63	549	0.56
	2017			626	0.62	548	0.56

H. Regional management

The range of California scorpionfish is restricted to southern California. A substantial, but unknown, proportion of the stock is in Mexican waters. Initial analysis conducted on individual sub-stocks showed that similar results are obtained for the nearshore stocks. This is collaborated by the similarity in the CPUE and sanitation abundances indices for the nearshore stocks. The sum of the individual sub-stock assessments was similar to the single southern California assessment. However, the individual sub-stock assessments indicated that the exploitation rates are lower in the offshore areas. Unfortunately, there are limited data for the offshore areas. Regional management would require obtaining length-frequency data by CDFG block to allow stock assessments by region. In addition, more information on the site fidelity of California scorpionfish from tagging data would be needed to determine the appropriateness of regional management.

I. Research needs

Differences in growth rates between the sexes may imply that the fisheries have different impacts on the sexes. Sex-specific sampling of the data (e.g. length-frequencies) would help refine the model and identify the different impacts on the sexes. There is only limited information on the stock structure and a large proportion of the stock resides in Mexican waters. Extensive tagging studies would help define the stock structure, evaluate the need for local scale assessments, and determine the impact of the Mexican component of the stock. Catches from the Mexican fisheries would also be beneficial. The growth data are based on limited sampling and an updated aging study may improve the assessment.

J. Acknowledgements

This report would not have been possible without the cooperation of many people who provide data and advice.

Rick Methot developed SS2 and provided advice on using SS2

Kevin Piner provided advice on modeling, data, and the use of SS2

Meisha Key provided advice on data

EJ Dick provided R code for the delta GLM

Milton Love provided advice on the biology of California scorpionfish

Richard Charter and William Watson provided advice on the CalCOFI data.

Richard Cosgrove NMFS La Jolla provided habitat and bathymetry maps of southern California to aid in determining population structure.

We are grateful to the many people that provided us with the necessary data to carryout the assessment.

Data Sources

The CPFV southern California observer data from two independent surveys (1975-1978 and 1985-1989) conduct by the CDFG were provided by Paulo Serpa, Pacific States Marine Fisheries Commission (PSMFC), and received on 1/11/2005.

The trip level CPFV data were provided by from Wade Van Buskirk (PSMFC), and received on 11/24/2004

Landings data from CALCOM and CFIS, and trawl logs were provided by Gerry Kobylinsky, California PacFIN Coordinator (CDFG/PSMFC) and received on 3/03/2005

Commercial length-frequency data from the California port sampling program was provided by Valerie Taylor, CDFG, and received on 1/27/05

RecFIN data were extracted on 2/18/05

The month and block aggregated CPFV logbook data were provided by Kevin Hill, NMFS, and received on 2/25/05

The CalCOFI survey data were provided by Susie Jacobson, NMFS, and was received on 3/04/05.

Gonad index data from bimonthly trawl survey conducted off Ventura and Santa Barbara Counties from 1994 to 1995 were provided by Stephen Wertz, CDFG, and received on 2/25/05.

Los Angeles County Sanitation Districts (Palos Verdes) were provided by Dave Montagne and Shelly Walther, Los Angeles County Sanitation Districts, and received on 3/17/05

Hyperion Sanitation survey data were provided Curtis Cash, City of Los Angeles, Dept. of Public Works, Bureau of Sanitation, and received on 03/21/05.

Orange County Sanitation District survey data were provided Hai Nguyen, Orange County Sanitation District, and received on 03/24/05.

San Diego County Sanitation District survey data were provided Timothy Stebbins, City of San Diego Ocean Monitoring Program Environmental Monitoring & Technical Services Division, Metropolitan Wastewater Department, and received on 04/26/05.

K. Literature cited

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L. Complete parameter and data in the native code of the stock assessment

<u>SS2NAMES.NAM</u>

```
#### Scorpionfish base names file ####
#This file must be named:  SS2NAMES.NAM
#Filename of data file
US.DAT
#Filename of control file
US.CTL
#Run number:  simply an identifier used in ss2-report.txt cumulative output file
1
#Read SS2.PAR (0=no, 1=yes)
0
#Verbosity of console display during run(0/1/2)
1
#Produce_detailed_.rep_file_(0/1)
1
#Number of bootstrap datafiles to create in nudata.dat
0
#Phases greater than this value are set to -1; good for debugging input by letting you can view rep file after just phase 1
100
#String containing prefix for output of version number e.g. Code_version_:_
Code_version_:_
#Burn in for mcmc chain
10
#Thinning interval for mcmc
```

2
#Jitter initial parm values; be careful, jitter is scaled by parameter's max-min, so could be very large
#.0001
0
#Push initial parm values away from max-min bounds
0.01
#Min year for spbio sd report (negative value sets to styr-2; the virgin level)
-1
#Max year for spbio sd_report (negative value sets to endyr+1)
-1

forecast.ss2

```
#### Scorpionfish base forecast file
#This file must be named forecast.ss2
# Summary Age; compute biomass for this age and older
2
# 0=skip forecast; 1=normal; 2=force
1
# target SPR
0.50
# number of forecast years
12
# number of forecast years with stddev
12
# emphasis for the forecast recrutment devs that occur prior to endyyr+1 (NEW)
1000
# fraction of bias adjustment to use with forecast_recruitment_devs before endyr+1
0
# fraction of bias adjustment to use with forecast_recruitment_devs after endyr
0
# top end of 40:10 option; set to 0.0 for no 40:10
.6
# bottom end of 40:10 option
.2
# OY scalar relative to ABC   (NEW)
1.0
# for forecast:  1=set relative F from endyr; 2=use relative F read below
1
# relative F used for Fspr, Fmsy, and forecast if option=2;
#rows are seasons; columns are fleets;
#If forecast option =0 or 1, then only one value is read and then ignored.
.2 .2 .2 .2 .2
#
# verification read for end of the correct number of relative F reads
999
#
# time series of future landed catch beginning in endyr+1; negative values indicate that catch will be calculated from Fspr
-500          # year 1 season 1 fleet 1 for forecast years  (NEW)
-500          # year 2 season 1 fleet 1 for forecast years
-500          # year 3 season 1 fleet 1 for forecast years
-500          # year 4 season 1 fleet 1 for forecast years
-500          # year 5 season 1 fleet 1 for forecast years
-500          # year 6 season 1 fleet 1 for forecast years
-500          # year 7 season 1 fleet 1 for forecast years
-500          # year 8 season 1 fleet 1 for forecast years
-500          # year 9 season 1 fleet 1 for forecast years
-500          # year 10 season 1 fleet 1 for forecast years
-500          # year 11 season 1 fleet 1 for forecast years
-500          # year 12 season 1 fleet 1 for forecast years
-500          # year 1 season 1 fleet 1 for forecast years  (NEW)
-500          # year 2 season 1 fleet 1 for forecast years
-500          # year 3 season 1 fleet 1 for forecast years
-500          # year 4 season 1 fleet 1 for forecast years
-500          # year 5 season 1 fleet 1 for forecast years
-500          # year 6 season 1 fleet 1 for forecast years
-500          # year 7 season 1 fleet 1 for forecast years
-500          # year 8 season 1 fleet 1 for forecast years
```

-500 # year 9 season 1 fleet 1 for forecast years
-500 # year 10 season 1 fleet 1 for forecast years
-500 # year 11 season 1 fleet 1 for forecast years
-500 # year 12 season 1 fleet 1 for forecast years
-500 # year 1 season 1 fleet 1 for forecast years (NEW)
-500 # year 2 season 1 fleet 1 for forecast years
-500 # year 3 season 1 fleet 1 for forecast years
-500 # year 4 season 1 fleet 1 for forecast years
-500 # year 5 season 1 fleet 1 for forecast years
-500 # year 6 season 1 fleet 1 for forecast years
-500 # year 7 season 1 fleet 1 for forecast years
-500 # year 8 season 1 fleet 1 for forecast years
-500 # year 9 season 1 fleet 1 for forecast years
-500 # year 10 season 1 fleet 1 for forecast years
-500 # year 11 season 1 fleet 1 for forecast years
-500 # year 12 season 1 fleet 1 for forecast years
-500 # year 1 season 1 fleet 1 for forecast years (NEW)
-500 # year 2 season 1 fleet 1 for forecast years
-500 # year 3 season 1 fleet 1 for forecast years
-500 # year 4 season 1 fleet 1 for forecast years
-500 # year 5 season 1 fleet 1 for forecast years
-500 # year 6 season 1 fleet 1 for forecast years
-500 # year 7 season 1 fleet 1 for forecast years
-500 # year 8 season 1 fleet 1 for forecast years
-500 # year 9 season 1 fleet 1 for forecast years
-500 # year 10 season 1 fleet 1 for forecast years
-500 # year 11 season 1 fleet 1 for forecast years
-500 # year 12 season 1 fleet 1 for forecast years
-500 # year 1 season 1 fleet 1 for forecast years (NEW)
-500 # year 2 season 1 fleet 1 for forecast years
-500 # year 3 season 1 fleet 1 for forecast years
-500 # year 4 season 1 fleet 1 for forecast years
-500 # year 5 season 1 fleet 1 for forecast years
-500 # year 6 season 1 fleet 1 for forecast years
-500 # year 7 season 1 fleet 1 for forecast years
-500 # year 8 season 1 fleet 1 for forecast years
-500 # year 9 season 1 fleet 1 for forecast years
-500 # year 10 season 1 fleet 1 for forecast years
-500 # year 11 season 1 fleet 1 for forecast years
-500 # year 12 season 1 fleet 1 for forecast years

US.DAT

Scorpionfish base data file
#
#
Model Dimensions
#
1916 # start year
2006 # end year
1 # N seasons per year
12 # vector with N months in each season
1 # spawning season; spawning occus at beginning of this season
5 # N fishing fleets
1 # N surveys; data type ID below is sequential with the fisheries
#string containing names for each fishery and survey, delimited by the "%" character
Hook&line%Pot%Net%Trawl%Rec%Sanitation
0.5 0.5 0.5 0.5 0.5 0.5 # vector containing the timing of each fishery CPUE and each survey. A value must exist for each type, starting with the fisheries and then the surveys. Values are the fraction of the season elapsed before the CPUE is measured or the survey conducted. Values have no impact on the fishery timing, which removes the catch after e-M*0.5*seasdur has occurred. Beware: if there is a multiple season setup and a CPUE or survey occurs in more than one season, then this timing fraction is the same in each season.
2 # number of genders (1/2); females are gender 1
25 # accumulator age; model always starts with age 0. Make this a reasonably large value so that fish at this age will be a very large (say 99%) of Linfinity. Make this larger than the largest bin age so that the misaging of old fish can be handled well. SS2 does not have the SS1 factor called "old fish discount" that was applied to try to account for dynamics within the accumulator age
#
#

Catch Data
#
catch (units are mt for commercial and thousands of fish for recreational)
0.001 0.0000 0.0000 0.0000 0.0000 # initial equil catch for each fishery (Enter annual init. eq. values even if model has >1 season)
fishery-1 fishery-2.. fishery-N for year season
catch for each fishery in first year/season, catch is the RETAINED catch, not the total catch

3.6352	0.0000	0.0000	0.0000	0.0000
7.9040	0.0000	0.0000	0.0000	0.7252
12.8083	0.0000	0.0000	0.0000	1.4504
11.5360	0.0000	0.0000	0.0000	2.1756
16.1817	0.0000	0.0000	0.0000	2.9007
26.4812	0.0000	0.0000	0.0000	3.6259
19.1061	0.0000	0.0000	0.0000	4.3511
27.4274	0.0000	0.0000	0.0000	5.0763
49.4742	0.0000	0.0000	0.0000	5.8015
101.2000	0.0000	0.0000	0.0000	6.5267
49.0196	0.0000	0.0000	0.0000	7.2519
51.4641	0.0000	0.0000	0.0000	7.9770
44.0368	0.0000	0.0000	0.0000	8.7022
48.8967	0.0000	0.0000	0.0000	9.4274
40.1935	0.0000	0.0000	0.0000	10.1526
41.5375	0.0000	0.0000	0.0000	10.8778
38.7842	0.0000	0.0000	0.0000	11.6030
29.1030	0.0000	0.0000	0.0000	12.3281
29.9099	0.0000	0.0000	0.0000	13.0533
30.7577	0.0000	0.0000	0.0000	13.7785
49.7468	0.0000	0.0000	0.0000	14.9694
62.1949	0.0000	0.0000	0.0000	10.4153
70.4350	0.0000	0.0000	0.0000	17.5033
58.2876	0.0000	0.0000	0.0000	13.4954
55.3714	0.0000	0.0000	0.0000	12.5092
43.0739	0.0000	0.0000	0.0000	0.0000
20.0001	0.0000	0.0000	0.0000	0.0000
16.3219	0.0000	0.0000	0.0000	0.0000
24.0326	0.0000	0.0000	0.0000	0.0000
42.1263	0.0000	0.0000	0.0000	0.0000
65.6318	0.0000	0.0000	0.0000	0.0000
56.7925	0.0000	0.0000	0.0000	41.8974
70.1660	0.0000	0.0000	0.0000	92.5280
66.7168	0.0000	0.0000	0.0000	70.2625
63.1629	0.0000	0.0000	0.0000	98.8812
45.8531	0.0000	0.0000	0.0000	61.0286
37.9255	0.0000	0.0000	0.0000	67.1390
54.1680	0.0000	0.0000	0.0000	55.8480
60.9171	0.0000	0.0000	0.0000	64.8739
47.7069	0.0000	0.0000	0.0000	55.2563
45.4652	0.0000	0.0000	0.0000	46.6769
33.2344	0.0000	0.0000	0.0000	27.3550
29.4259	0.0000	0.0000	0.0000	28.7401
16.9383	0.0000	0.0000	0.0000	24.3139
13.2465	0.0000	0.0000	0.0000	30.2661
12.1193	0.0000	0.0000	0.0000	52.9044
26.1759	0.0000	0.0000	0.0000	66.8225
34.1148	0.0000	0.0000	0.0000	103.3660
35.1926	0.0000	0.0000	0.0000	151.8529
34.7811	0.0000	0.0000	0.0000	146.6246
38.3133	0.0000	0.0000	0.0000	136.7079
25.4220	0.0000	0.0000	0.0000	119.3542
40.6026	0.0000	0.0000	0.0000	115.5392
32.1875	0.1837	1.0129	0.2758	112.8557
34.2264	0.1415	0.2477	0.0000	150.7279
16.3577	0.0027	3.2500	0.0000	163.6684
14.1718	0.0186	13.7826	0.1030	119.0637
16.4013	0.2204	0.5851	0.0000	138.3293
18.8530	0.0549	19.0929	0.0000	154.9417
30.5853	0.1048	14.3102	0.0082	132.2990
13.6910	0.0780	1.6806	0.0635	85.2384
5.7916	0.0381	0.2576	0.0000	124.3266
8.9618	0.0880	1.2601	0.0027	75.8397

9.0330	0.0231	1.7355	0.0027	109.8168
20.3004	0.0290	0.3865	0.0000	163.1070
15.9731	0.0435	5.9857	0.0000	143.8913
20.4447	0.4214	1.2787	0.0000	121.3397
12.0036	0.1338	0.8441	0.0000	81.8548
9.8123	0.2436	1.0719	0.0739	93.4016
12.2681	0.4672	2.4966	0.0240	142.8400
4.5342	0.2359	1.8657	0.0236	120.3708
7.1882	1.6135	4.0379	0.1125	111.1520
7.2277	2.6096	3.6801	0.0027	268.7945
16.0847	0.0422	2.8137	0.0213	337.0282
31.1147	1.0233	6.1830	0.7816	341.1488
19.3964	0.7552	3.3281	4.8172	339.8655
21.2049	1.5273	3.3512	3.9427	141.1233
12.6137	1.3653	2.0417	7.7715	124.2854
27.6261	7.0993	1.8888	13.3059	170.0195
20.7517	3.1276	0.8977	16.1727	186.9375
18.5536	1.7690	1.1993	12.9793	252.8584
18.5876	1.7559	3.8284	13.4080	303.7426
29.5416	2.9148	1.6044	16.7433	244.8188
30.0134	0.9081	1.7981	6.5926	471.5750
11.0198	0.8428	1.9963	4.8431	349.5568
13.4216	0.8011	2.6563	3.0963	328.8477
9.3355	0.7847	1.1912	2.1818	180.1811
1.9863	0.1624	0.3570	2.7511	165.3678
1.6488	0.3620	0.6110	2.5370	140.1024
1.6488	0.3620	0.6110	2.5370	140.1024
1.6488	0.3620	0.6110	2.5370	140.1024

#
#
Abundance Indices##
59

#Year	Seas	Type	Value	s
#standard error is after reweighting has been applied				
1980	1	5	2.384081718	0.361933756
1981	1	5	1.987982504	0.301202814
1982	1	5	2.217100239	0.443988738
1983	1	5	1.325277927	0.248233548
1984	1	5	1.64569334	0.320519947
1985	1	5	2.61367413	0.374883685
1986	1	5	2.377306134	0.325759844
1987	1	5	2.206209217	0.377802043
1988	1	5	3.716148994	0.218116907
1989	1	5	4.985871137	0.226182473
1990	1	5	4.067075461	0.18905006
1991	1	5	5.461579732	0.250508029
1992	1	5	2.325831824	0.203102078
1993	1	5	2.553496459	0.209397623
1994	1	5	3.470267676	0.225965874
1995	1	5	3.513004892	0.228919572
1996	1	5	4.031785529	0.199582696
1997	1	5	3.273476189	0.204847554
1998	1	5	3.317663841	0.230221409
1999	1	5	6.033173175	0.269103378
2000	1	5	-5.100000779	0.246257458
2001	1	5	-4.978672179	0.208902555
2002	1	5	-2.565449881	0.328821906
2003	1	5	-1.938007014	0.409262943
1970	1	6	0.303369703	1.533826735
1971	1	6	0.202435817	0.985666516
1972	1	6	0.326386567	0.857701341
1973	1	6	0.543221074	0.795237241
1974	1	6	0.298642584	0.687513837
1975	1	6	0.308516301	0.645269649
1976	1	6	0.308040277	0.65714423
1977	1	6	0.474692866	0.459861977
1978	1	6	0.333199357	0.491968232
1979	1	6	1.186993144	0.336749901
1980	1	6	1.119839503	0.389968714
1981	1	6	0.878555802	0.451760521

1982	1	6	2.00222562	0.708891507
1983	1	6	0.159677421	0.662008228
1984	1	6	0.291769627	0.667086438
1985	1	6	0.190254182	0.591284894
1986	1	6	0.32855107	0.617164404
1987	1	6	0.637265163	0.490374088
1988	1	6	0.958550523	0.388296816
1989	1	6	0.650448894	0.371765644
1990	1	6	0.878033612	0.346924019
1991	1	6	0.329528487	0.469960272
1992	1	6	0.279356042	0.398180688
1993	1	6	0.562247205	0.28379826
1994	1	6	0.583664767	0.359413101
1995	1	6	0.783308701	0.279235152
1996	1	6	1.052378894	0.241166969
1997	1	6	0.974807046	0.283081833
1998	1	6	0.922783366	0.276148605
1999	1	6	1.072249199	0.244960244
2000	1	6	1.04925516	0.275758776
2001	1	6	1.293797805	0.230177573
2002	1	6	0.758475193	0.350747543
2003	1	6	1.2538916 0.393144897	
2004	1	6	1.500154948	0.389210367

#
#
Discard Biomass
2
0
#
Mean BodyWt
#
0 # N observations
Composition conditioners
0.0001
0.0001
#
#
Length Composition
#
59 # N length bins
vector containing lower edge of length bins. Example bins:
#this is mid of bin so probably need to change it

1	2	3	4	5	6	7	8	9	10	11	12
	13	14	15	16	17	18	19	20	21	22	23
	24	25	26	27	28	29	30	31	32	33	34
	35	36	37	38	39	40	41	42	43	44	45
	46	47	48	49	50	51	52	53	54	55	56
	57	58	59								

#N Length comp observations
87
#Yr Seas Flt/Svy Gender Part Nsamp datavector(female-male)
#note, even if using a combined sex, you need to have a second dummy set of proportions
#sample size is after reweighting has been applied
#hook and line

1996	1	1	0	2	17.07588785		0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0.08	0.2
	0.2	0.32	0.08	0.12	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

	0 0 0 0 0 0 0 0 0 0 0
	0 0 0.08 0.2 0.2 0.32 0.08 0.12 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 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 1 0 2 58.05801869 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0
	0.023529412 0.070588235 0.070588235 0.082352941 0.035294118
	0.152941176 0.2 0.141176471 0.105882353 0.035294118 0.058823529
	0.011764706 0.011764706 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0.023529412 0.070588235
	0.070588235 0.082352941 0.035294118 0.152941176 0.2 0.141176471
	0.105882353 0.035294118 0.058823529 0.011764706 0.011764706 0
	0 0 0 0 0 0 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 1 0 2 134.5579963 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0.010152284
	0.040609137 0.07106599 0.16751269 0.137055838 0.111675127
	0.131979695 0.065989848 0.050761421 0.081218274 0.081218274
	0.015228426 0.035532995 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0.010152284 0.040609137
	0.07106599 0.16751269 0.137055838 0.111675127 0.131979695
	0.065989848 0.050761421 0.081218274 0.081218274 0.015228426
	0.035532995 0 0 0 0 0 0 0 0 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 1 0 2 137.9731739 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0.00990099 0.034653465 0.099009901 0.202970297 0.222772277
	0.178217822 0.079207921 0.059405941 0.03960396 0.04950495
	0.00990099 0.014851485 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0.00990099 0.034653465
	0.099009901 0.202970297 0.222772277 0.178217822 0.079207921
	0.059405941 0.03960396 0.04950495 0.00990099 0.014851485 0
	0 0 0 0 0 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 1 0 2 16.39285233 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0.041666667 0.125 0.291666667 0.208333333 0.083333333
	0.083333333 0.083333333 0.041666667 0 0.041666667 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0.041666667 0.125 0.291666667 0.208333333
	0.083333333 0.083333333 0.083333333 0.041666667 0 0.041666667
	0 0 0 0 0 0 0 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 1 0 2 94.94193645 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0.014388489 0.057553957 0.122302158 0.165467626
	0.107913669 0.115107914 0.151079137 0.071942446 0.086330935
	0.028776978 0.050359712 0.028776978 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0

	0	0	0	0	0	0	0	0	0	0.014388489	
	0.057553957		0.122302158		0.165467626		0.107913669		0.115107914		
	0.151079137		0.071942446		0.086330935		0.028776978		0.050359712		
	0.028776978		0	0	0	0	0	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	1	0	2	48.4955215		0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0.014084507		0	0.070422535		0.267605634		0.23943662		
	0.098591549		0.084507042		0.070422535		0.070422535		0.042253521		
	0.028169014		0.014084507		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0.014084507		0	
	0.070422535		0.267605634		0.23943662		0.098591549		0.084507042		
	0.070422535		0.070422535		0.042253521		0.028169014		0.014084507		0
	0	0	0	0	0	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	1	0	2	4.098213084		0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0.166666667		0.333333333	
	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
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0.166666667		0.333333333		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	0				

#

#Net

1996	1	3	0	2	4.672054566		0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	
	0.037037037		0.185185185		0.074074074		0.185185185		0	0.074074074	
	0.074074074		0.037037037		0.074074074		0.074074074		0.037037037		
	0.037037037		0	0.037037037		0	0.074074074		0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0.037037037		0.185185185	
	0.074074074		0.185185185		0	0.074074074		0.074074074		0.037037037	
	0.074074074		0.074074074		0.037037037		0.037037037		0	0.037037037	
	0	0.074074074	0	0	0	0	0	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	3	0	2	53.64210797		0	0	0	0	0
	0	0	0	0	0	0	0	0	0.012903226		

0.029032258 0.087096774 0.093548387 0.096774194 0.080645161
0.070967742 0.064516129 0.048387097 0.029032258 0.058064516
0.038709677 0.090322581 0.051612903 0.051612903 0.05483871
0.019354839 0.012903226 0.009677419 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0.012903226 0.029032258 0.087096774 0.093548387
0.096774194 0.080645161 0.070967742 0.064516129 0.048387097
0.029032258 0.058064516 0.038709677 0.090322581 0.051612903
0.051612903 0.05483871 0.019354839 0.012903226 0.009677419 0
0 0 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 3 0 2 2.249507754 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0.076923077 0.076923077 0.076923077 0
0.307692308 0.076923077 0 0 0.230769231 0 0.076923077
0 0.076923077 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0.076923077 0.076923077 0.076923077
0 0.307692308 0.076923077 0 0 0.230769231 0
0.076923077 0 0.076923077 0 0 0 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 3 0 2 3.633820218 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0.095238095 0.047619048
0.238095238 0.095238095 0.19047619 0.142857143 0.095238095
0.095238095 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0.095238095
0.047619048 0.238095238 0.095238095 0.19047619 0.142857143
0.095238095 0.095238095 0 0 0 0 0 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 3 0 2 1.903429638 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0.090909091 0.090909091 0.454545455 0.090909091 0
0 0.090909091 0.090909091 0.090909091 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0.090909091 0.090909091 0.454545455 0.090909091 0
0 0.090909091 0.090909091 0.090909091 0 0 0 0
0 0 0 0 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 3 0 2 33.56957725 0 0 0 0 0
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0.113402062 0.041237113 0.092783505 0.06185567 0.036082474
0.051546392 0.030927835 0.010309278 0.025773196 0.005154639
0.005154639 0.010309278 0 0.005154639 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
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0 0 0 0 0 0 0 0 0 0
2002 1 3 0 2 10.20930442 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0

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0.033898305 0.152542373 0.169491525 0.084745763 0.101694915
0.118644068 0.084745763 0.06779661 0.033898305 0.016949153 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0.016949153 0.016949153 0.016949153 0.084745763 0.033898305
0.152542373 0.169491525 0.084745763 0.101694915 0.118644068
0.084745763 0.06779661 0.033898305 0.016949153 0 0 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 3 0 2 8.824991957 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0.019607843 0 0.019607843 0 0.039215686
0.058823529 0.039215686 0.117647059 0.098039216 0.078431373
0.098039216 0.254901961 0.058823529 0.039215686 0.058823529 0
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0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0.019607843 0 0.019607843 0 0.039215686 0.058823529
0.039215686 0.117647059 0.098039216 0.078431373 0.098039216
0.254901961 0.058823529 0.039215686 0.058823529 0 0.019607843
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 3 0 2 5.710288913 0 0 0 0 0
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0.03030303 0.03030303 0.151515152 0.090909091 0.03030303
0.121212121 0.060606061 0.090909091 0.121212121 0.03030303 0
0.03030303 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0.03030303
0 0 0 0.03030303 0.060606061 0.090909091 0.03030303
0.03030303 0.151515152 0.090909091 0.03030303 0.121212121
0.060606061 0.090909091 0.121212121 0.03030303 0 0.03030303
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0
#

#trawl

1996 1 4 0 2 157.1450356 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0.008438819
0.033755274 0.050632911 0.075949367 0.126582278 0.147679325
0.101265823 0.126582278 0.075949367 0.071729958 0.033755274
0.05907173 0.025316456 0.025316456 0.016877637 0.008438819 0

	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0.004219409 0.004219409 0
	0.004219409 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0.008438819 0.033755274 0.050632911 0.075949367
	0.126582278 0.147679325 0.101265823 0.126582278 0.075949367
	0.071729958 0.033755274 0.05907173 0.025316456 0.025316456
	0.016877637 0.008438819 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0
	0.004219409 0.004219409 0 0.004219409 0 0 0 0
	0 0 0 0
1997	1 4 0 2 502.5988901 0 0 0 0 0
	0 0 0 0 0 0 0 0 0.005277045
	0.023746702 0.04353562 0.07651715 0.10817942 0.117414248
	0.147757256 0.114775726 0.109498681 0.092348285 0.07651715
	0.038258575 0.014511873 0.013192612 0.006596306 0.006596306
	0.002638522 0.001319261 0.001319261 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0.005277045 0.023746702 0.04353562 0.07651715
	0.10817942 0.117414248 0.147757256 0.114775726 0.109498681
	0.092348285 0.07651715 0.038258575 0.014511873 0.013192612
	0.006596306 0.006596306 0.002638522 0.001319261 0.001319261 0
	0 0 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 2 233.3968461 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0.005681818
	0.011363636 0.071022727 0.105113636 0.096590909 0.127840909
	0.136363636 0.122159091 0.105113636 0.099431818 0.045454545
	0.053977273 0.008522727 0.005681818 0.002840909 0.002840909 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0.005681818
	0.011363636 0.071022727 0.105113636 0.096590909 0.127840909
	0.136363636 0.122159091 0.105113636 0.099431818 0.045454545
	0.053977273 0.008522727 0.005681818 0.002840909 0.002840909 0
	0 0 0 0 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 2 391.868 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0.00676819 0.016920474 0.087986464 0.162436548 0.172588832
	0.164128596 0.164128596 0.101522843 0.0642978 0.021996616 0.018612521
	0.011844332 0.00676819 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0.00676819 0.016920474
	0.087986464 0.162436548 0.172588832 0.164128596 0.164128596
	0.101522843 0.0642978 0.021996616 0.018612521 0.011844332 0.00676819
	0 0 0 0 0 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 2 72.93651439 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0.009090909 0.063636364 0.154545455 0.2 0.254545455
	0.109090909 0.081818182 0.027272727 0.063636364 0.018181818
	0.018181818 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0 0 0 0 0
	0 0 0 0 0 0 0.009090909 0.063636364
	0.154545455 0.2 0.254545455 0.109090909 0.081818182 0.027272727
	0.063636364 0.018181818 0.018181818 0 0 0 0 0
	0 0 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	2	148.5252656	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0.004464286	0	0.017857143	0.075892857	0.15625	0.196428571
	0.227678571	0.15625	0.071428571	0.058035714	0.013392857	0.017857143
	0	0	0.004464286	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0.004464286	0	0.017857143	0.075892857
	0.15625	0.196428571	0.227678571	0.15625	0.071428571	0.058035714
	0.013392857	0.017857143	0	0	0.004464286	0	0	0
	0	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	2	46.41414552	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0.042857143	0.071428571	0.185714286	0.128571429
	0.271428571	0.142857143	0.085714286	0.028571429	0.042857143	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0.042857143	0.071428571	0.185714286
	0.128571429	0.271428571	0.142857143	0.085714286	0.028571429
	0.042857143	0	0	0	0	0	0	0	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	2	14.58730288	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0.272727273	0.318181818	0.136363636
	0.181818182	0	0.090909091	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0.272727273	0.318181818	0.136363636	0.181818182
	0	0.090909091	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0
#Observer
```

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1975	1	5	0	2	203.9236491	0	0	0	0	0
	0	0	0	0	0	0	0	0.003208556	0.001069519
	0.006417112	0.018181818	0.045989305	0.085561497	0.098395722
	0.135828877	0.13368984	0.148663102	0.109090909	0.093048128
	0.043850267	0.032085561	0.031016043	0.007486631	0.002139037
	0.002139037	0.002139037	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0.003208556	0.001069519	0.006417112	0.018181818	0.045989305
	0.085561497	0.098395722	0.135828877	0.13368984	0.148663102
	0.109090909	0.093048128	0.043850267	0.032085561	0.031016043
	0.007486631	0.002139037	0.002139037	0.002139037	0	0	0
	0	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	5	0	2	205.2322501	0	0	0	0	0
	0	0	0	0	0	0	0.002152853	0.001076426
	0.001076426	0.005382131	0.013993541	0.037674919	0.062432723
```

0.075349839 0.121636168 0.129171152 0.118406889 0.138858988
0.114101184 0.065662002 0.050592034 0.03444564 0.015069968
0.006458558 0.004305705 0.001076426 0 0 0.001076426 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0.002152853 0.001076426 0.001076426 0.005382131
0.013993541 0.037674919 0.062432723 0.075349839 0.121636168
0.129171152 0.118406889 0.138858988 0.114101184 0.065662002
0.050592034 0.03444564 0.015069968 0.006458558 0.004305705
0.001076426 0 0 0.001076426 0 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 5 0 2 299.451519 0 0 0 0 0
0 0 0.000728332 0.000728332 0.003641661 0.005098325
0.009468318 0.03787327 0.045884924 0.056081573 0.05171158
0.030589949 0.036416606 0.04806992 0.076474873 0.08594319
0.135469774 0.112163146 0.08594319 0.08594319 0.043699927
0.023306628 0.016023307 0.002913328 0.004369993 0 0.000728332
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0.000728332 0 0 0 0 0
0 0 0.000728332 0.000728332 0.003641661 0.005098325
0.009468318 0.03787327 0.045884924 0.056081573 0.05171158
0.030589949 0.036416606 0.04806992 0.076474873 0.08594319
0.135469774 0.112163146 0.08594319 0.08594319 0.043699927
0.023306628 0.016023307 0.002913328 0.004369993 0 0.000728332
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0.000728332
1978 1 5 0 2 377.0951758 0 0 0 0 0
0 0 0.000694444 0.004861111 0.010416667 0.003472222
0.009722222 0.014583333 0.029166667 0.059722222 0.074305556 0.075
0.080555556 0.063194444 0.077083333 0.064583333 0.092361111
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0.001388889 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0.000694444 0.004861111 0.010416667 0.003472222
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0.080555556 0.063194444 0.077083333 0.064583333 0.092361111
0.084027778 0.083333333 0.059027778 0.047222222 0.032638889
0.013194444 0.011111111 0.004861111 0.002083333 0.001388889
0.001388889 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0
#RecFIN

1980 1 5 0 2 90.51156616 0 0 0 0 0
0 0 0 0.002409639 0 0 0.002409639 0.002409639
0.014457831 0.019277108 0.019277108 0.038554217 0.074698795
0.060240964 0.081927711 0.077108434 0.178313253 0.091566265
0.101204819 0.091566265 0.069879518 0.024096386 0.007228916
0.009638554 0.009638554 0.014457831 0.002409639 0.007228916 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0.002409639 0 0 0.002409639 0.002409639 0.014457831
0.019277108 0.019277108 0.038554217 0.074698795 0.060240964
0.081927711 0.077108434 0.178313253 0.091566265 0.101204819

0.091566265 0.069879518 0.024096386 0.007228916 0.009638554
0.009638554 0.014457831 0.002409639 0.007228916 0 0 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 2 84.4047617 0 0 0 0 0
0 0 0 0 0 0 0 0.002583979 0 0
0.015503876 0.036175711 0.036175711 0.046511628 0.082687339
0.100775194 0.165374677 0.105943152 0.160206718 0.090439276
0.069767442 0.033591731 0.010335917 0.018087855 0.007751938
0.010335917 0.002583979 0.002583979 0 0 0 0
0.002583979 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0.002583979 0 0 0.015503876 0.036175711
0.036175711 0.046511628 0.082687339 0.100775194 0.165374677
0.105943152 0.160206718 0.090439276 0.069767442 0.033591731
0.010335917 0.018087855 0.007751938 0.010335917 0.002583979
0.002583979 0 0 0 0 0.002583979 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 2 110.5767809 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0.01183432 0.017751479 0.045364892 0.076923077 0.08086785
0.108481262 0.145956607 0.094674556 0.145956607 0.096646943
0.076923077 0.059171598 0.013806706 0.003944773 0.007889546
0.007889546 0.001972387 0 0 0.001972387 0 0 0
0 0 0 0 0.001972387 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0.01183432 0.017751479 0.045364892
0.076923077 0.08086785 0.108481262 0.145956607 0.094674556
0.145956607 0.096646943 0.076923077 0.059171598 0.013806706
0.003944773 0.007889546 0.007889546 0.001972387 0 0
0.001972387 0 0 0 0 0 0 0 0.001972387
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0
1983 1 5 0 2 92.03826733 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0.007109005 0.009478673 0.018957346 0.05450237 0.066350711
0.125592417 0.099526066 0.132701422 0.144549763 0.139810427
0.092417062 0.045023697 0.023696682 0.014218009 0.016587678
0.004739336 0.002369668 0.002369668 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0.007109005 0.009478673 0.018957346 0.05450237
0.066350711 0.125592417 0.099526066 0.132701422 0.144549763
0.139810427 0.092417062 0.045023697 0.023696682 0.014218009
0.016587678 0.004739336 0.002369668 0.002369668 0 0 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 2 94.87356936 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0.004597701 0.009195402 0.029885057 0.052873563 0.062068966
0.110344828 0.128735632 0.131034483 0.11954023 0.103448276
0.112643678 0.052873563 0.032183908 0.032183908 0.009195402
0.002298851 0.004597701 0 0.002298851 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0.004597701 0.009195402 0.029885057 0.052873563
0.062068966 0.110344828 0.128735632 0.131034483 0.11954023
0.103448276 0.112643678 0.052873563 0.032183908 0.032183908
0.009195402 0.002298851 0.004597701 0 0.002298851 0 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 2 79.60655819 0 0 0 0 0
0 0 0 0 0 0 0.002739726 0.002739726 0
0.019178082 0.016438356 0.032876712 0.035616438 0.054794521
0.060273973 0.073972603 0.104109589 0.079452055 0.106849315
0.095890411 0.150684932 0.052054795 0.063013699 0.032876712
0.01369863 0 0.002739726 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0.002739726 0.002739726 0 0.019178082 0.016438356 0.032876712
0.035616438 0.054794521 0.060273973 0.073972603 0.104109589
0.079452055 0.106849315 0.095890411 0.150684932 0.052054795
0.063013699 0.032876712 0.01369863 0 0.002739726 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0

#Observer

1986 1 5 0 2 141.7651036 0 0 0 0 0
0 0.001538462 0.004615385 0 0.001538462 0.003076923
0.009230769 0.02 0.036923077 0.041538462 0.043076923 0.050769231
0.050769231 0.050769231 0.075384615 0.069230769 0.098461538
0.086153846 0.096923077 0.075384615 0.073846154 0.058461538
0.029230769 0.016923077 0 0.004615385 0 0 0 0
0 0 0 0 0 0.001538462 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0.001538462
0.004615385 0 0.001538462 0.003076923 0.009230769 0.02
0.036923077 0.041538462 0.043076923 0.050769231 0.050769231
0.050769231 0.075384615 0.069230769 0.098461538 0.086153846
0.096923077 0.075384615 0.073846154 0.058461538 0.029230769
0.016923077 0 0.004615385 0 0 0 0 0 0
0 0 0 0.001538462 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0

#RecFIN

1986 1 5 0 2 78.95225772 0 0 0 0 0
0 0 0 0 0 0 0.002762431 0.002762431
0.013812155 0.016574586 0.022099448 0.033149171 0.044198895
0.066298343 0.102209945 0.099447514 0.138121547 0.091160221
0.082872928 0.074585635 0.080110497 0.052486188 0.022099448
0.013812155 0.013812155 0.013812155 0.002762431 0.008287293 0
0 0.002762431 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0.002762431 0.002762431 0.013812155
0.016574586 0.022099448 0.033149171 0.044198895 0.066298343
0.102209945 0.099447514 0.138121547 0.091160221 0.082872928
0.074585635 0.080110497 0.052486188 0.022099448 0.013812155
0.013812155 0.013812155 0.002762431 0.008287293 0 0
0.002762431 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0
0 0 0
#Observer

1987 1 5 0 2 249.7246826 0 0 0 0 0
0 0 0 0 0 0.004366812 0.004366812 0.0069869
0.016593886 0.020960699 0.048034934 0.04628821 0.067248908
0.090829694 0.122270742 0.115283843 0.130131004 0.097816594
0.092576419 0.048908297 0.031441048 0.027947598 0.015720524 0.0069869
0.00349345 0.001746725 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0.004366812
0.004366812 0.0069869 0.016593886 0.020960699 0.048034934 0.04628821
0.067248908 0.090829694 0.122270742 0.115283843 0.130131004
0.097816594 0.092576419 0.048908297 0.031441048 0.027947598
0.015720524 0.0069869 0.00349345 0.001746725 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0
#RecFIN

1987 1 5 0 2 29.00732122 0 0 0 0 0
0 0 0 0 0 0 0 0.015037594 0 0
0.045112782 0.037593985 0.082706767 0.045112782 0.067669173
0.090225564 0.045112782 0.060150376 0.07518797 0.090225564
0.142857143 0.067669173 0.045112782 0.015037594 0.030075188
0.030075188 0.007518797 0 0 0.007518797 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0.015037594 0 0 0.045112782 0.037593985 0.082706767
0.045112782 0.067669173 0.090225564 0.045112782 0.060150376
0.07518797 0.090225564 0.142857143 0.067669173 0.045112782
0.015037594 0.030075188 0.030075188 0.007518797 0 0
0.007518797 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0
#Observer

1988 1 5 0 2 626.3836581 0 0 0 0 0
0 0 0 0 0.000696379 0 0 0.001044568
0.010097493 0.027855153 0.056058496 0.078690808 0.102367688

0.106545961 0.133356546 0.097493036 0.10132312 0.064763231
0.05362117 0.038997214 0.036211699 0.024721448 0.019498607
0.015668524 0.010445682 0.002089136 0.000696379 0.003481894
0.005571031 0.003133705 0.005222841 0.000348189 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0.000696379 0 0
0.001044568 0.010097493 0.027855153 0.056058496 0.078690808
0.102367688 0.106545961 0.133356546 0.097493036 0.10132312
0.064763231 0.05362117 0.038997214 0.036211699 0.024721448
0.019498607 0.015668524 0.010445682 0.002089136 0.000696379
0.003481894 0.005571031 0.003133705 0.005222841 0.000348189 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0

#RecFIN

1988 1 5 0 2 142.2013039 0 0 0 0 0
0 0 0 0 0 0 0.001533742 0.001533742
0.003067485 0.003067485 0.009202454 0.033742331 0.029141104
0.04601227 0.053680982 0.093558282 0.06595092 0.064417178
0.090490798 0.105828221 0.210122699 0.062883436 0.053680982
0.030674847 0.018404908 0.015337423 0.004601227 0 0
0.003067485 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0.001533742 0.001533742 0.003067485
0.003067485 0.009202454 0.033742331 0.029141104 0.04601227
0.053680982 0.093558282 0.06595092 0.064417178 0.090490798
0.105828221 0.210122699 0.062883436 0.053680982 0.030674847
0.018404908 0.015337423 0.004601227 0 0 0.003067485 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0

#Observer

1989 1 5 0 2 711.4427202 0 0 0 0 0
0 0 0.00030656 0.000919681 0.000613121 0.000919681
0.000613121 0.00030656 0.001226242 0.006744329 0.0309626 0.055487431
0.111894543 0.143776824 0.150214592 0.138258737 0.12507664
0.080931944 0.055180871 0.037093807 0.021459227 0.018700184
0.010423053 0.003372164 0.002145923 0.001532802 0.000919681
0.00030656 0.000613121 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0.00030656 0.000919681 0.000613121 0.000919681
0.000613121 0.00030656 0.001226242 0.006744329 0.0309626 0.055487431
0.111894543 0.143776824 0.150214592 0.138258737 0.12507664
0.080931944 0.055180871 0.037093807 0.021459227 0.018700184
0.010423053 0.003372164 0.002145923 0.001532802 0.000919681
0.00030656 0.000613121 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0

#RecFIN

1989 1 5 0 2 142.4194041 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0.003062787
0.007656968 0.026033691 0.065849923 0.110260337 0.151607963
0.15007657 0.17151608 0.091883614 0.081163859 0.04287902
0.058192956 0.018376723 0.010719755 0.007656968 0.001531394 0
0.001531394 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0.003062787 0.007656968 0.026033691 0.065849923 0.110260337
0.151607963 0.15007657 0.17151608 0.091883614 0.081163859
0.04287902 0.058192956 0.018376723 0.010719755 0.007656968
0.001531394 0 0.001531394 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
#

#RecFIN

1993 1 5 0 2 78.95225772 0 0 0 0 0
0 0 0 0.002762431 0 0 0 0.002762431
0.002762431 0.008287293 0.033149171 0.044198895 0.033149171
0.046961326 0.060773481 0.05801105 0.074585635 0.099447514
0.124309392 0.091160221 0.124309392 0.055248619 0.055248619
0.027624309 0.013812155 0.033149171 0.002762431 0.002762431 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0.002762431 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0.002762431 0 0 0 0.002762431 0.002762431
0.008287293 0.033149171 0.044198895 0.033149171 0.046961326
0.060773481 0.05801105 0.074585635 0.099447514 0.124309392
0.091160221 0.124309392 0.055248619 0.055248619 0.027624309
0.013812155 0.033149171 0.002762431 0.002762431 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0.002762431 0 0 0 0 0 0
0 0
1994 1 5 0 2 78.95225772 0 0.002762431 0 0
0 0 0 0 0 0 0.002762431 0.002762431
0.005524862 0.002762431 0.016574586 0.027624309 0.044198895
0.049723757 0.085635359 0.046961326 0.071823204 0.08839779
0.060773481 0.091160221 0.124309392 0.129834254 0.046961326

0.044198895 0.019337017 0.016574586 0.011049724 0.002762431 0
0 0 0 0 0 0 0.002762431 0 0 0
0 0.002762431 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0.002762431 0 0
0 0 0 0 0 0 0.002762431 0.002762431
0.005524862 0.002762431 0.016574586 0.027624309 0.044198895
0.049723757 0.085635359 0.046961326 0.071823204 0.08839779
0.060773481 0.091160221 0.124309392 0.129834254 0.046961326
0.044198895 0.019337017 0.016574586 0.011049724 0.002762431 0
0 0 0 0 0 0 0.002762431 0 0 0
0 0.002762431 0 0 0 0 0 0 0 0
0 0 0 0 0 0
1995 1 5 0 2 70.44635152 0 0 0 0 0
0 0 0 0 0 0 0 0.012383901 0.018575851
0.012383901 0.027863777 0.043343653 0.046439628 0.058823529
0.089783282 0.086687307 0.102167183 0.102167183 0.117647059
0.077399381 0.068111455 0.052631579 0.037151703 0.024767802
0.00619195 0.009287926 0.003095975 0.003095975 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0.012383901 0.018575851 0.012383901 0.027863777
0.043343653 0.046439628 0.058823529 0.089783282 0.086687307
0.102167183 0.102167183 0.117647059 0.077399381 0.068111455
0.052631579 0.037151703 0.024767802 0.00619195 0.009287926
0.003095975 0.003095975 0 0 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 2 176.2249289 0 0 0 0 0
0 0 0 0 0.002475248 0 0 0.001237624
0.013613861 0.037128713 0.077970297 0.071782178 0.090346535
0.070544554 0.096534653 0.097772277 0.090346535 0.066831683
0.084158416 0.066831683 0.054455446 0.033415842 0.01980198
0.012376238 0.004950495 0.004950495 0.001237624 0 0 0
0 0 0 0 0 0 0 0 0 0.001237624
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0.002475248 0 0 0.001237624 0.013613861 0.037128713
0.077970297 0.071782178 0.090346535 0.070544554 0.096534653
0.097772277 0.090346535 0.066831683 0.084158416 0.066831683
0.054455446 0.033415842 0.01980198 0.012376238 0.004950495
0.004950495 0.001237624 0 0 0 0 0 0 0
0 0 0 0 0 0.001237624 0 0 0 0
0 0 0 0 0 0 0 0 0 0
1997 1 5 0 2 102.0708746 0.002136752 0 0 0
0 0 0 0 0 0 0 0 0.002136752
0.012820513 0.014957265 0.044871795 0.102564103 0.083333333
0.104700855 0.102564103 0.104700855 0.11965812 0.091880342
0.061965812 0.053418803 0.040598291 0.019230769 0.008547009
0.017094017 0.006410256 0.002136752 0.002136752 0.002136752 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0.002136752 0 0 0 0 0 0
0 0 0 0 0 0.002136752 0.012820513 0.014957265
0.044871795 0.102564103 0.083333333 0.104700855 0.102564103
0.104700855 0.11965812 0.091880342 0.061965812 0.053418803
0.040598291 0.019230769 0.008547009 0.017094017 0.006410256
0.002136752 0.002136752 0.002136752 0 0 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 2 174.9163279 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0.004987531
0.00872818 0.009975062 0.033665835 0.044887781 0.093516209
0.103491272 0.119700748 0.10723192 0.154613466 0.124688279
0.08478803 0.051122195 0.023690773 0.013715711 0.00872818
0.006234414 0.003740648 0 0 0 0.002493766 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0.004987531 0.00872818 0.009975062 0.033665835

0.044887781 0.093516209 0.103491272 0.119700748 0.10723192
0.154613466 0.124688279 0.08478803 0.051122195 0.023690773
0.013715711 0.00872818 0.006234414 0.003740648 0 0 0
0.002493766 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 2 533.0367898 0 0 0 0 0
0 0.000409165 0 0 0.000409165 0.000409165 0.000818331
0.000818331 0.003273322 0.010638298 0.028641571 0.039689034
0.064648118 0.075286416 0.095744681 0.096563011 0.104746318
0.099018003 0.117430442 0.079787234 0.077741408 0.04091653
0.029050736 0.012274959 0.011047463 0.004091653 0.002045827
0.000818331 0.000409165 0.001227496 0.001227496 0.000409165 0
0 0 0 0.000409165 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0.000409165 0 0
0.000409165 0.000409165 0.000818331 0.000818331 0.003273322
0.010638298 0.028641571 0.039689034 0.064648118 0.075286416
0.095744681 0.096563011 0.104746318 0.099018003 0.117430442
0.079787234 0.077741408 0.04091653 0.029050736 0.012274959
0.011047463 0.004091653 0.002045827 0.000818331 0.000409165
0.001227496 0.001227496 0.000409165 0 0 0 0
0.000409165 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
2000 1 5 0 2 228.5689672 0 0 0 0 0
0 0 0 0 0 0 0 0.001908397 0.000954198
0.000954198 0 0.002862595 0 0.019083969 0.079198473
0.139312977 0.163167939 0.153625954 0.121183206 0.111641221
0.08778626 0.048664122 0.027671756 0.023854962 0.008587786
0.004770992 0.002862595 0.000954198 0 0.000954198 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0.001908397 0.000954198 0.000954198 0 0.002862595 0
0.019083969 0.079198473 0.139312977 0.163167939 0.153625954
0.121183206 0.111641221 0.08778626 0.048664122 0.027671756
0.023854962 0.008587786 0.004770992 0.002862595 0.000954198 0
0.000954198 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 2 128.6790942 0 0 0 0 0
0 0 0 0 0 0 0 0 0.001694915 0
0 0.001694915 0.003389831 0.008474576 0.047457627 0.096610169
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#Sanitation

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0.069114471 0.066954644 0.049676026 0.041036717 0.034557235
0.032397408 0.012958963 0.006479482 0.002159827 0.004319654 0
0.004319654 0.002159827 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0.002159827
0.008639309 0.049676026 0.082073434 0.157667387 0.13174946
0.120950324 0.120950324 0.069114471 0.066954644 0.049676026
0.041036717 0.034557235 0.032397408 0.012958963 0.006479482
0.002159827 0.004319654 0 0.004319654 0.002159827 0 0
0 0 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 6 0 2 196.011103 0 0 0 0 0
0 0.002252252 0 0 0 0 0.011261261 0.006756757

0.058558559 0.085585586 0.157657658 0.162162162 0.11936937
0.114864865 0.083333333 0.072072072 0.038288288 0.031531531
0.027027027 0.018018018 0.009009009 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0.002252252 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0.002252252 0 0 0 0 0.011261261
0.006756757 0.058558559 0.085585586 0.157657658 0.162162162
0.11936937 0.114864865 0.083333333 0.072072072 0.038288288
0.031531531 0.027027027 0.018018018 0.009009009 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0.002252252 0 0 0 0
0 0 0 0 0 0 0 0 0
1998 1 6 0 2 158.0449882 0 0 0 0.002793296
0.002793296 0 0 0 0 0 0 0.016759777
0.036312849 0.06424581 0.086592179 0.122905028 0.11452514
0.145251397 0.111731844 0.097765363 0.044692737 0.053072626
0.036312849 0.019553073 0.019553072 0.008379888 0.011173184
0.005586592 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0.002793296 0.002793296 0 0 0 0
0 0 0.016759777 0.036312849 0.06424581 0.086592179
0.122905028 0.11452514 0.145251397 0.111731844 0.097765363
0.044692737 0.053072626 0.036312849 0.019553073 0.019553072
0.008379888 0.011173184 0.005586592 0 0 0 0 0
0 0 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 6 0 2 201.3087004 0 0 0 0 0
0 0 0 0.002192983 0.002192983 0.006578947 0.00877193
0.021929825 0.052631579 0.065789473 0.111842105 0.153508772
0.160087719 0.100877193 0.081140351 0.078947369 0.041666667
0.050438596 0.021929825 0.00877193 0.013157895 0.00877193
0.002192983 0.004385965 0.002192983 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0.002192983 0.002192983 0.006578947 0.00877193 0.021929825
0.052631579 0.065789473 0.111842105 0.153508772 0.160087719
0.100877193 0.081140351 0.078947369 0.041666667 0.050438596
0.021929825 0.00877193 0.013157895 0.00877193 0.002192983
0.004385965 0.002192983 0 0 0 0 0 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 6 0 2 210.1380294 0 0 0 0 0
0 0 0 0.00210084 0.00210084 0.004201681 0.014705882
0.025210084 0.054621849 0.06512605 0.092436975 0.140756302
0.107142857 0.136554622 0.090336134 0.092436975 0.035714286
0.044117647 0.037815126 0.021008403 0.012605042 0.008403361
0.008403361 0.00210084 0 0 0 0 0 0.00210084
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0.00210084 0.00210084 0.004201681 0.014705882 0.025210084
0.054621849 0.06512605 0.092436975 0.140756302 0.107142857
0.136554622 0.090336134 0.092436975 0.035714286 0.044117647
0.037815126 0.021008403 0.012605042 0.008403361 0.008403361
0.00210084 0 0 0 0 0 0.00210084 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 6 0 2 237.0674829 0 0 0 0.001862197
0 0 0 0 0 0 0 0.014897579 0.020484171
0.067039106 0.063314711 0.094972067 0.152700186 0.143389199
0.12104283 0.09310987 0.081936685 0.055865922 0.029795158
0.011173184 0.018621974 0.013035382 0.007448789 0.00744879
0.001862197 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0.001862197 0 0 0 0 0 0 0

```
	0.014897579	0.020484171	0.067039106	0.063314711	0.094972067
	0.152700186	0.143389199	0.12104283	0.09310987	0.081936685
	0.055865922	0.029795158	0.011173184	0.018621974	0.013035382
	0.007448789	0.00744879	0.001862197	0	0	0	0	0
	0	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	6	0	2	694.4267224	0	0	0	0	0
	0	0	0	0	0.001271456	0.00317864	0.008264463
	0.014621742	0.055944056	0.083916084	0.148124602	0.157024793
	0.174189447	0.115066751	0.087094723	0.0546726 0.033693579	0.025429116
	0.01843611	0.012078831	0.004450095	0.000635728	0.000635728
	0.000635728	0.000635728	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0.001271456
	0.00317864	0.008264463	0.014621742	0.055944056	0.083916084
	0.148124602	0.157024793	0.174189447	0.115066751	0.087094723	0.0546726
	0.033693579	0.025429116	0.01843611	0.012078831	0.004450095
	0.000635728	0.000635728	0.000635728	0.000635728	0	0	0
	0	0	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	6	0	2	180.5597774	0	0	0	0	0
	0	0	0	0	0	0.007334963	0.012224939	0.024449878
	0.031784841	0.061124694	0.092909536	0.102689486	0.08801956
	0.15403423	0.144254279	0.095354523	0.063569682	0.036674816
	0.039119804	0.014669927	0.012224939	0.012224939	0.004889976	0
	0.002444988	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0.007334963
	0.012224939	0.024449878	0.031784841	0.061124694	0.092909536
	0.102689486	0.08801956	0.15403423	0.144254279	0.095354523
	0.063569682	0.036674816	0.039119804	0.014669927	0.012224939
	0.012224939	0.004889976	0	0.002444988	0	0	0	0
	0	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	6	0	2	317.8558429	0	0	0	0	0
	0	0	0	0	0	0	0.005555556	0.009722222
	0.027777778	0.040277778	0.069444444	0.120833333	0.136111111
	0.176388889	0.15	0.093055556	0.076388889	0.0375	0.027777778	0.0125
	0.009722222	0.005555556	0.001388889	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0.005555556	0.009722222	0.027777778
	0.040277778	0.069444444	0.120833333	0.136111111	0.176388889	0.15
	0.093055556	0.076388889	0.0375	0.027777778	0.0125	0.009722222
	0.005555556	0.001388889	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0
#
## Age Composition ##
#
0	# N age' bins
0	# number of unique ageing error matrices to generate
0	# N age observations (need to count and enter value here)
0	# N size@age' observations
## Environmental data ##
#
# Parameter values can be a function of an environmental data series
0	#N environmental variables
0	#	N environmental observations
#
999	#end of data file marker
```

US.CTL

```
#### Scorpionfish base control file
#
#
## Define Morphs ##
#
2                   #_N growthmorphs
1  2                #_assign gender to each morph (1=female; 2=male)
#
#
## Areas and Migration ##
#
1                        # Number of areas (sub-populations).  Note that the code for moving fish between areas is not yet operational,
but array dimensioning for areas is defined and in use.
1 1 1 1 1 1         #Assign each fleet and survey to an area.  Each operates in only one area.
0                   # do migration between areas.  Keep this value = 0 for now
#
#
## Time blocks for time-varying parameters ##
#
2                   #_Number of time block definitions.  If zero, then do not include the following lines in this section
#
1 1                 #_Number of time blocks in each definition this is an extra block to the block before this
1999  2006    #_  begin and end year for each block in definition 1
2000  2006    #_  begin and end year for each block in definition 2
##
#
## Natural_mortality_and_growth ##
#
4                   # NMyoung is the last age for natmort young, same for all morphs
15                  # NMold is the first age for natmort old
1                   # AFIX is the age for growth Lmin
25                  # AFIX2 is the age for growth Lmax
-4                  # phase in which any MGparm devs begin
#
#
#*** FEMALES ***
#
# Read 7 parameter lines for first morph.
#The elements read from each line are:
#LO, HI, INIT, PRIOR, Prior_type, SD, PHASE, env-variable, use_dev, dev_minyr, dev_maxyr, dev_stddev, block, block_type
#NMmin              Natural mortality for ages <= NMyoung (units are per year)
0.075 1 0.25 0.25 0 1000 -1 0 0 0 0 0 0 0
#NMmax              Natural mortality for ages >= NMold (units are exponential offset from young fish).  For intermediate ages, do a
linear interpolation of NM on age.
-3                  3    0      0      0      0.8    -3     0      0      0      0      0.5
                    0    0
#Lmin               Body length at Amin (units in cm)
10 30 10.72713916 10.72713916 0 1000 -1 0 0 0 0 0 0 0
#Lmax               Body length at Amax (units in cm)
30 50 34.55960897 34.55960897 0 1000 -1 0 0 0 0 0 0 0
#VBK                Von Bertalanffy growth coefficient (units are per year)
0.05 0.3 0.13 0.13 0 1000 -1 0 0 0 0 0 0 0
#CV-young           Coefficient of variation for size at age at age<=AFIX (units are fraction).  Note that CV cannot vary over time, so do
not set up an env-link or a dev vector.
0.02 0.3 0.05 0.1 0 1000 -3 0 0 0 0 0 0 0
#CV-old             Coefficient of variation for size at age at age>=AFIX2 (units are exponential offset from young fish).  For
intermediate ages, do a linear interpolation of CV on mean size-at-age (note that prior to version 1.13, the interpolation was on age).
-3                  3    0      0      0      1000   -3     0      0      0      0      0.5
                    0    0
#
#
#*** MALES ***
#
# Read 7 parameter lines for second morph.
-3                  3    0      0      0      0.8    -3     0      0      0      0      0.5
                    0    0      #M2_natM_young_as_exponential_offset(rel_morph_1)
```

```
-3	3	0	0	0	0.8	-3	0	0	0	0	0.5
	0	0	#M2_natM_old_as_exponential_offset(rel_young)
-3	3	0.150302997	0.150302997	0	0.8	-3	0	0	0
	0	0.5	0	0	#M2_Lmin_as_exponential_offset
-3	3	-0.205088765	-0.205088765	0	0.8	-2	0	0	0
	0	0.5	0	0	#M2_Lmax_as_exponential_offset
-3	3	-0.080042708	-0.080042708	0	0.8	-3	0	0	0
	0	0.5	0	0	#M2_VBK_as_exponential_offset
-3	3	0.	0.	0	0.8	-3	0	0	0	0	0.5
	0	0	#M2_CV-young_as_exponential_offset(rel_CV-young_for_morph_1)
-3	3	0.	0.	0	0.8	-3	0	0	0	0	0.5
	0	0	#M2_CV-old_as_exponential_offset(rel_CV-young)
#
#
## Biological parameters ##
#
#The elements read from each line are:
#LO, HI, INIT, PRIOR, Prior_type, SD, PHASE, env-variable, use_dev, dev_minyr, dev_maxyr, dev_stddev, block, block_type
#
#Read 2 parameter lines for female weight-length coefficients
#Female_scale	coefficient to convert L in cm to Wt in kg
0.01	0.03	5.34695E-05	5.34695E-05	0	1000	-3	0	0	0
	0	0.5	0	0
#Female_exp	exponent in female L-W conversion
2	4	2.911161894	2.911161894	0	1000	-3	0	0	0
	0	0.5	0	0
#Read 2 parameter lines for female maturation.
#Female Maturity-at-length is a logistic function: mat_len(z)=1/(1 + mfexp(slope*(len_bins_m(z)-inflection)))
#mat-inflect	maturity logistic inflection (in cm)
1	3	17.18820023	17.18820023	0	1000	-3	0	0	0
	0	0.5	0	0
#mat-slope	maturity logistic slope
0.01	1	-0.46563644	-0.46563644	0	1000	-3	0	0	0
	0	0.5	0	0
#Read 2 parameter lines for eggs/kilogram
#Alpha	intercept for linear relationship
0.01	2	1	1	0	1000	-3	0	0	0	0	0.5
	0	0
#Beta	slope; so Alpha=1 and Beta=0 causes fecundity to be the same as spawning biomass.
-1	1	0	0	0	1000	-3	0	0	0	0	0.5
	0	0
#If gender=2, then read 2 parameter lines for male weight-length coefficients
#male_scale	coefficient to convert L in cm to Wt in kg
0.01	0.03	5.34695E-05	5.34695E-05	0	1000	-3	0	0	0
	0	0.5	0	0
#male_exp	exponent in male L-W conversion
2	4	2.901828706	2.901828706	0	1000	-3	0	0	0
	0	0.5	0	0
#
#
## Recruitment distribution among areas and morphs
#
# pop*gmorph lines For the proportion of each morph in each area
0	1	0.5000	0.5	0	1000	-3	0	0	0	0	0.5
	0	0	#frac to morph 1 in area 1
0	1	0.5000	0.5	0	1000	-3	0	0	0	0	0.5
	0	0	#frac to morph 2 in area 1
# pop lines For the proportion assigned to each area
0	1	1	1	0	1000	-3	0	0	0	0	0.5
	0	0	#frac to area 1
#
#
## Custom read parameters ##
#
# if used has this format	LO	HI	INIT	PRIOR	Pr_type	SD	PHASE

#
#_custom-env_read
```

0 #_ 0=read_one_setup_and_apply_to_all_env_fxns; 1=read_a_setup_line_for_each_MGparm_with_Env-var>0
#_custom-block_read
0 #_ 0=read_one_setup_and_apply_to_all_MG-blocks; 1=read_a_setup_line_for_each_block x MGparm_with_block>0
#
#
Spawner recruit
#
1 # SR_fxn: 1=Beverton-Holt

#LO	HI	INIT	PRIOR	Pr_type	SD	PHASE	
0	31	10.8	9.3	0	1000	2	#Ln(R0)
0.2	1	0.7	0.7	0	0.2	-3	#steepness of S-R; bound by 0.2 and 1.0 for Beverton-Holt
0	10	1.0	1.0	0	1000	-2	#sigma-r std.dev. of log recruitment; used to define offset of S-R curve
-5	5	0	0	0	1	-3	#Env_link coefficient
-5	5	0	0	0	1	-4	#init_equalibrium recruitment: log(R1) offset, value of zero sets initial equil recruitment equal to virgin recruitment.

0 #env-var_for_link

#	recruitment_residuals					
#	start_rec_year	end_rec_year		Lower_limit	Upper_limit	phase
1966	2001	-15	15	1		

#
#
Initial Fishing Mortality
#
#Read a short parameter setup line for each fishery. The parameters are the fishing mortalities for the initial equilibrium. Do not try to estimate parameters for fisheries with zero initial equilibrium catch. If there is catch, then best to estimate the parameter in phase 1. If there is catch, then give a starting value greater than zero.

#	LO	HI	INIT	PRIOR	PR_type	SD	PHASE
	0	1	.000001	0.01	0	1000	-1
	0	1	.00	0.01	0	1000	-2
	0	1	.00	0.01	0	1000	-2
	0	1	.00	0.01	0	1000	-2
	0	1	.00	0.01	0	1000	-2

#
#
catchability
#_Qsetup for each fishery and survey

#_add_parm_row_for_each_positive_entry_below(row_then_column)

#-Float(0/1) #Do-power(0/1) #Do-env(0/1) #Do-dev(0/1) #env-Var #Num/Bio(0/1) for each fleet and survey

0	0	0	0	0	1
0	0	0	0	0	1
0	0	0	0	0	1
0	0	0	0	0	1
0	0	0	0	0	0
0	0	0	0	0	0

#parameters from above most log(q)

#	LO	HI	INIT	PRIOR	PR_type	SD	PHASE	env-variable

#
#
Selectivity and Retention
#
#Selex_type Do_retention(0/1) Do_male Mirrored_selex_number

#Size selex

```
#mirror is a bit of a problem for gear 2 using type 7

7	0	0	0
5	0	0	1
5	0	0	1
7	0	0	0
7	0	0	0
7	0	0	0
#_Age	selex

10	0	0	0
10	0	0	0
10	0	0	0
10	0	0	0
10	0	0	0
10	0	0	0
#	LO	HI	INIT	PRIOR	PR_type	SD	PHASE	env-variable	use_dev	dev_minyr	dev_maxyr	dev_stddev	Block_Pattern
#logistic using double logistic
#	LO	HI	INIT	PRIOR	PR_type	SD	PHASE	env-variable	use_dev	dev_minyr	dev_maxyr	dev_stddev	Block_Pattern
#Hook and line
	10	70	59.5	59.5	0	1000	-6	0	0	0	0	0.5	0	0	#p1 - PEAK:  size (age) for peak.  Should be an integer and should be at bin boundary and not estimated.  But options 7 and 18 may allow estimation
	0	0.2	0.0001	0.05	0	1000	-4	0	0	0	0	0.5	0	0	#p2 - INIT:  selectivity at lengthbin=1 (minL) or age=0
	-20	70	-0.135303	0	0	1000	2	0	0	0	0	0.5	1	0	#p3 - INFL1:  size (age) at which selectivity is halfway between INIT and 1.  A logit transform (1/(1+exp(-x)) is used so that the transformed value will be between 0 and 1.  So a p1 value of -1.1 will be transformed to 0.25 and used to set the selectivity equal to 0.5 at a size (age) equal to 0.25 of the way between minL and PEAK.  (see SS2-selex.xls).
	0.01	60	0.426551	10	0	1000	3	0	0	0	0	0.5	1	0	#p4 - SLOPE1:  slope of left side (ascending) selectivity
	-100	10000	1000	20	0	1000	-3	0	0	0	0	0.5	0	0	#p5 - FINAL:  logit transform for selectivity at maxL (or maxage)
	0.01	60	0	10	0	1000	-2	0	0	0	0	0.5	0	0	#p6 - INFL2:  logit transform for size(age) at right side selectivity equal to half way between PEAK+PEAKWIDTH and maxL (or max age)
	0	70	.3	20	0	1000	-2	0	0	0	0	0.5	0	0	#p7 - SLOPE2:  slope of right side (descending) selex
	0.01	60	1	1	0	1000	-3	0	0	0	0	0.5	0	0	#p8 - PEAKWIDTH:  in width of flattop
#pot
	0	80	1	1	0	1000	-2	0	0	0	0	0.5	0	0	#min
	0	80	59	59	0	1000	-3	0	0	0	0	0.5	0	0	#max
#net
	0	80	1	1	0	1000	-2	0	0	0	0	0.5	0	0	#min
	0	80	59	59	0	1000	-3	0	0	0	0	0.5	0	0	#max
##Trawl
	10	70	59.5	59.5	0	1000	-6	0	0	0	0	0.5	0	0	#p1 - PEAK:  size (age) for peak.  Should be an integer and should be at bin boundary and not estimated.  But options 7 and 18 may allow estimation
	0	0.2	0.0001	0.05	0	1000	-4	0	0	0	0	0.5	0	0	#p2 - INIT:  selectivity at lengthbin=1 (minL) or age=0
	-20	70	-0.135303	0	0	1000	2	0	0	0	0	0.5	1	0	#p3 - INFL1:  size (age) at which selectivity is halfway between INIT and 1.  A logit transform (1/(1+exp(-x)) is used so that the transformed value will be between 0 and 1.  So a p1 value of -1.1 will be transformed to 0.25 and used to set the selectivity equal to 0.5 at a size (age) equal to 0.25 of the way between minL and PEAK.  (see SS2-selex.xls).
	0.01	60	0.426551	10	0	1000	3	0	0	0	0	0.5	1	0	#p4 - SLOPE1:  slope of left side (ascending) selectivity
	-100	10000	1000	20	0	1000	-3	0	0	0	0	0.5	0	0	#p5 - FINAL:  logit transform for selectivity at maxL (or maxage)
	0.01	60	0	10	0	1000	-2	0	0	0	0	0.5	0	0	#p6 - INFL2:  logit transform for size(age) at right side selectivity equal to half way between PEAK+PEAKWIDTH and maxL (or max age)
```

```
	0	70	.3	20	0	1000	-2	0	0	0	0
	0.5	0	0	#p7 - SLOPE2:  slope of right side (descending) selex
	0.01	60	1	1	0	1000	-3	0	0	0	0
	0.5	0	0	#p8 - PEAKWIDTH:  in width of flattop
#rec
	10	70	59.5	59.5	0	1000	-6	0	0	0	0
	0.5	0	0	#p1 - PEAK:  size (age) for peak.  Should be an integer and should be at bin boundary
and not estimated.  But options 7 and 18 may allow estimation
	0	0.2	0.0001	0.05	0	1000	-4	0	0	0	0
	0.5	0	0	#p2 - INIT:  selectivity at lengthbin=1 (minL) or age=0
	-20	70	-0.135303	0	0	1000	2	0	0	0	0
	0.5	2	0	#p3 - INFL1:  size (age) at which selectivity is halfway between INIT and 1.  A logit
transform (1/(1+exp(-x)) is used so that the transformed value will be between 0 and 1.  So a p1 value of -1.1 will be transformed to
0.25 and used to set the selectivity equal to 0.5 at a size (age) equal to 0.25 of the way between minL and PEAK.  (see SS2-selex.xls).
	0.01	60	0.426551	10	0	1000	3	0	0	0	0
	0.5	2	0	#p4 - SLOPE1:  slope of left side (ascending) selectivity
	-100	10000	1000	20	0	1000	-3	0	0	0	0
	0.5	0	0	#p5 - FINAL:  logit transform for selectivity at maxL (or maxage)
	0.01	60	0	10	0	1000	-2	0	0	0	0
	0.5	0	0	#p6 - INFL2:  logit transform for size(age) at right side selectivity equal to half way
between PEAK+PEAKWIDTH and maxL (or max age)
	0	70	.3	20	0	1000	-2	0	0	0	0
	0.5	0	0	#p7 - SLOPE2:  slope of right side (descending) selex
	0.01	60	1	1	0	1000	-3	0	0	0	0
	0.5	0	0	#p8 - PEAKWIDTH:  in width of flattop
#Sanitation
	10	70	59.5	59.5	0	1000	-6	0	0	0	0
	0.5	0	0	#p1 - PEAK:  size (age) for peak.  Should be an integer and should be at bin boundary
and not estimated.  But options 7 and 18 may allow estimation
	0	0.2	0.0001	0.05	0	1000	-4	0	0	0	0
	0.5	0	0	#p2 - INIT:  selectivity at lengthbin=1 (minL) or age=0
	-20	70	-0.135303	0	0	1000	2	0	0	0	0
	0.5	0	0	#p3 - INFL1:  size (age) at which selectivity is halfway between INIT and 1.  A logit
transform (1/(1+exp(-x)) is used so that the transformed value will be between 0 and 1.  So a p1 value of -1.1 will be transformed to
0.25 and used to set the selectivity equal to 0.5 at a size (age) equal to 0.25 of the way between minL and PEAK.  (see SS2-selex.xls).
	0.01	60	0.426551	10	0	1000	3	0	0	0	0
	0.5	0	0	#p4 - SLOPE1:  slope of left side (ascending) selectivity
	-100	10000	1000	20	0	1000	-3	0	0	0	0
	0.5	0	0	#p5 - FINAL:  logit transform for selectivity at maxL (or maxage)
	0.01	60	0	10	0	1000	-2	0	0	0	0
	0.5	0	0	#p6 - INFL2:  logit transform for size(age) at right side selectivity equal to half way
between PEAK+PEAKWIDTH and maxL (or max age)
	0	70	.3	20	0	1000	-2	0	0	0	0
	0.5	0	0	#p7 - SLOPE2:  slope of right side (descending) selex
	0.01	60	1	1	0	1000	-3	0	0	0	0
	0.5	0	0	#p8 - PEAKWIDTH:  in width of flattop
#
#
#retention no parameters
#no male selectivity
#these would be entwined with the above see instructions
#_custom-env_read

0	#_	0=read_one_setup_and_apply_to_all;_1=Custom_so_read_1_each;

#_custom-block_read

0	#_	0=read_one_setup_and_apply_to_all;_1=Custom_so_see_detailed_instructions_for_N_rows_in_Custom_setup

#	LO	HI	INIT	PRIOR	PR_type	SD	PHASE

-10	10	0	0	0	1000	4
-4	#_phase_for_selex_parm_devs
#
#
## Lambdas (emphesis factors) ##
#
```

1 #Max_lambda_phase: read this number of lambda values for each element below. The last lambda value is used for all higher numbered phases

1 #sd_offset; value=0 causes log(like) to omit the +log(s) term; value=1 causes log(like) to include the log(s) term for CPUE, discard, meanbodywt, recruitment deviations.

```
#_survey_lambdas
0	0	0	0	1	1
#_discard_lambdas
0	0	0	0	0	0
#
#ss2 -nohess -cbs 100000000 -gbs 1000000000
#
#
#_meanbodywt
0
#_lenfreq_lambdas
1	0	0	1	1	1
#_age_freq_lambdas
0	0	0	0	0	0
#_size@age_lambdas
0	0	0	0	0	0
#_initial_equil_catch
0
#_recruitment_lambda
1
#_parm_prior_lambda
0
#_parm_dev_timeseries_lambda
1
#
# crashpen lambda
100
#max F
0.9
#
## End of file control ##
#
999	#_end-of-file
```