

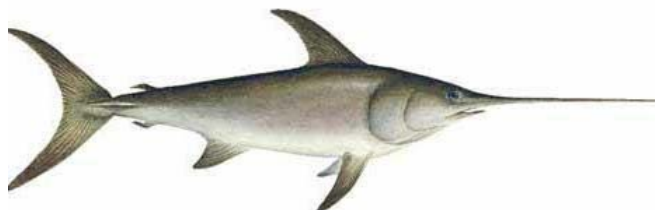
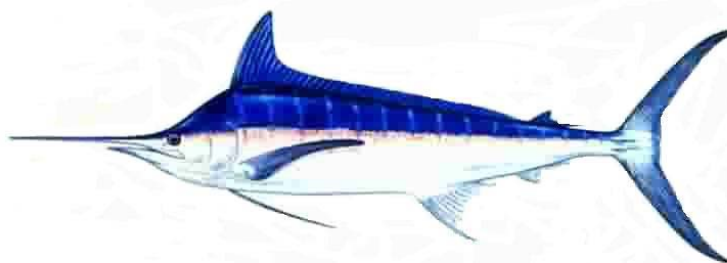


ISC/09/BILLWG-2/04

Input data for a North Pacific Swordfish Stock Assessment using Stock Synthesis

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Abstract

Time series of swordfish catch, catch per unit effort (CPUE), and length frequency from the North Pacific Ocean were compiled for input in Stock Synthesis models. Catch and CPUE were compiled by region under two stock scenarios. Stock Scenario-1 was a single stock north of the equator. Stock Scenario-2 was two stocks in the North Pacific Ocean. The BILL-WG requested that, if possible, catch, CPUE, and length for Stock Synthesis models be compiled using additional spatial stratification. Under Stock Scenario-1, there was one area with 6 regions. Under Stock Scenario-2, there were two sub-areas. Sub Area-1 had 5 regions. Sub Area-2 had one region. The rationale for regional stratification was that the smaller spatial scale may be more homogeneous in catch, length, and CPUE, and as a result may be more likely to accurately reflect the effect of fishery removals on the population in Stock Synthesis. In order to review the available time series of length composition for stock assessment, functions were developed in the R statistical package for plotting length frequency by year and quarter. Examples of R function output are provided. Due to time constraints, only length frequency data for Stock Scenario-1 were compiled for presentation here. Catch and CPUE for Bayesian Production models under the two stock structure scenarios were compiled separately.

Introduction

Time series of swordfish catch, catch per unit effort (CPUE), and length frequency from the North Pacific Ocean were compiled for input in Stock Synthesis models. Catch and catch per unit effort (CPUE) were compiled by region under two stock scenarios. Stock Scenario-1 was a single stock north of the equator. Stock Scenario-2 was two stocks in the North Pacific Ocean. Due to time constraints, only length frequency data for Stock Scenario-1 were compiled for presentation here. Catch and CPUE for Bayesian Production models under the two stock structure scenarios were compiled separately (Courtney and Wagatsuma 2009).

Spatial Stratification for Stock Synthesis

The BILL-WG requested that, if possible, catch, CPUE, and length for Stock Synthesis models be compiled using the spatial stratification identified in Sun et al. (2009) (BILL-WG, 2009) (Figures 1 and 2). Under Stock Scenario-1, there was one area with 6 regions (1, 2, 3, 4, 5, 6). Under Stock Scenario-2, there were two sub-areas. Sub Area-1 had 5

regions (1-1, 1-2, 1-3, 1-4, 1-5). Sub Area-2 had one region (2-1). The rationale for regional stratification was that the smaller spatial scale may be more homogeneous in catch, length, and CPUE, and as a result may be more likely to accurately reflect the effect of fishery removals on the population in Stock Synthesis. The potential downside is that some regions may lack data.

In order to review the available time series of length composition for stock assessment, a series of functions were developed in the R statistical package for plotting length frequency by year and quarter. Examples of R function output are provided for Japan offshore and distant water longline fisheries and for Hawaii longline fisheries (Appendix A). Additional plots at various resolutions under Stock Scenario-1 will be available for review by the BILLWG.

Methods

Catch (mt) and CPUE

A detailed description of catch and CPUE for Bayesian Production models under the two stock structure scenarios is provided by Courtney and Wagatsuma (2009). The same catch and CPUE were used for Stock Synthesis models with the following changes.

For Stock Synthesis, Japan catch data (including offshore plus distant-water longline catch, coastal longline, other longline, squid drift net, drift net, bait fishing, net fishing, trap net, and others-primarily harpoon) were provided stratified by stock scenario, region, and quarter (Figures 1 and 2) (Kimoto and Yokawa 2009a and 2009c). Japan offshore and distant-water longline standardized CPUE and 95% confidence intervals were provided stratified by region (Figures 1 and 2) (Kimoto and Yokawa 2009b and Ishimura et al. 2008). Approximate standard errors (SE) were estimated here for Japan offshore and distant-water longline standardized CPUE as the 95% confidence intervals divided by four.

For Stock Synthesis, Chinese Taipei distant water longline catch (in numbers), CPUE, and SE were provided annually stratified by stock scenario and region (Figures 1 and 2). The proportions of catch in numbers were used to apportion Chinese Taipei distant water longline catch (mt) among sub-areas (Sun et al. 2009, Sun and Yeh 2008, and Yeh and Sun 2008).

Korea catch was not provided by region. Instead, Korea catch was apportioned 10% to Region 4, 60% to Region 5 and 40% to Region 6 based upon information presented to the WG (Yoo et al. 2009).

Mexico catch was not provided by region. Instead, for Stock Scenario-1, Mexico catch was apportioned entirely to Region 3, and for Stock Scenario-2 Mexico catch was apportioned entirely to Region 2-1 (Courtney and Wagatsuma 2009).

California catch and CPUE were not provided by region. Instead, California catch and CPUE were apportioned entirely to Region 3 for Stock Scenario-1 and to Region 1-3 for Stock Scenario 2 (Courtney and Wagatsuma 2009, Ito and Childers 2008).

Hawaii longline catch and CPUE were not provided by region. Instead, Hawaii longline catch and CPUE were provided stratified by depth. Under Stock Scenario-1, shallow set catch occurred entirely in Region 2, and deep-set catch occurred equally in Region 2 and Region 5. Most shallow sets occurred north of 20° N Latitude, and west of 140° W Longitude (Figures 4-A and 4-B Courtney et al. 2009b). Roughly half of deep sets occurred north of 20° N Latitude, and most deep-sets occurred west of 150° W Longitude (Figures 4-A and 4-B Courtney et al. 2009b; Courtney and Wagatsuma 2009, Ito and Childers 2008).

Length

Time series of swordfish eye fork length (EFL cm) were provided from Japan offshore and distant-water longline fisheries using the regional stratification in Figures 1 and 2. Time series of swordfish EFL (cm) were also provided from Japan drift net and harpoon fisheries in Region 1 (Figure 1). Length was provided for males and females combined.

Time series of swordfish EFL (cm) were provided from Hawaii longline fisheries stratified by depth. Length frequency of swordfish in the Hawaii longline fishery differed significantly between males and females (Brodziak and Courtney 2009). As a result, swordfish length frequency was provided separately for males, females, and for males and females combined (Courtney et al. 2009).

Time series of swordfish EFL (cm) were provided from California driftnet fisheries for males and females combined (Piner 2009).

Results

Length

Due to time constraints, time series of swordfish EFL (cm) were only summarized for Stock Scenario-1.

Japan offshore and distant-water longline fishery swordfish length frequencies (EFL cm) were available for the years 1970 – 2007 (Tables 1 and 2). Quarterly mean length (EFL cm) in the Japan offshore and distant-water longline fishery remained relatively constant during the years 1970 – 2007 with CVs of around 20% (Table 2, Figure 3). Quarterly mean length (EFL cm) was somewhat larger in Region 6 than in the other regions (Tables 2.1 – 2.6, Figures 4.1 – 4.6). Very few swordfish lengths were available from Region 3 (Table 2.3, Figure 4.3). Length frequencies of swordfish EFL (cm) were provided for Japan drift net (2004 – 2006) and harpoon fisheries (2006, 2007) in Region 1 but were not presented here due to time constraints.

Hawaii longline fishery swordfish length frequencies (EFL cm) were available for the years 1994 – 2008 (Table 1). Three time series of Hawaii longline swordfish length frequency (EFL cm) were available from the shallow-set sector: Shallow-set combined sex, shallow-set females, and shallow-set males (Tables 3 and 4, Figure 5). An additional time series of swordfish length frequency from the deep-set sector was available: Deep-set combined sex (Tables 3 and 5, Figure 6). Deep-set sector sample sizes were very small prior to 2000 and very few lengths were available by sex (Tables 3 and 5). Deep-set sector mean length was consistently less than 100 cm (EFL) during every quarter except Q2 (Figure 6). Central North Pacific swordfish less than 100 cm (EFL) are probably less than 1 year old (DeMartini et al. 2007). As a result, Deep-set sector length frequency may be useful as a recruitment index (Courtney et al. 2009a)

California driftnet swordfish length frequencies (EFL cm) were available for the years 1981 – 2007 (Table 1). The time series was for males and females combined (Table 6, Figure 7). Length frequencies for the years 1981 – 1990 were from port samples of dressed weight converted to EFL cm (Figure 7, Panel A, maximum sample size (n) = 78). Length frequencies for the years 1990 – 2008 were from on board sampling of catch for EFL (cm) from NOAA Observers (Figure 7, Panel B, maximum sample size (n) = 29).

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Tables

Table 1. Time series of available swordfish length frequency in the North Pacific Ocean for use in Stock Synthesis.

Target Sector	Sex	Year Quarter	Excluding
Japanese Offshore and Distant Water Longline	Combined	1970 Q1 – 2007 Q4	2004 (incomplete)
Hawaii Longline Shallow-set	Combined	1994 Q1 – 2008 Q4	2001 Q2 – 2004 Q3 2006 Q2 – 2006 Q4 2008 (incomplete)
Hawaii Longline Shallow-set	Female	1994 Q1 – 2008 Q4	1995 Q4 1999 Q3 2001 Q2 – 2004 Q3 2006 Q2 – 2006 Q4 2008 (incomplete)
Hawaii Longline Shallow-set	Male	1994 Q1 – 2008 Q4	1995 Q4 1999 Q3 2001 Q2 – 2004 Q3 2006 Q2 – 2006 Q4 2008 (incomplete)
Hawaii Longline Deep-set	Combined	2000 Q4 – 2008 Q4	2007 Q1 2008 (incomplete) Exploratory purposes only
California Driftnet	Combined	1981 Q1 – 2007 Q4	2008 (incomplete)

Table 2. Number of swordfish lengths in the Japanese offshore and distant-water longline fishery by year and quarter during the years 1970 – 2007 under Stock Scenario-1, all regions combined.

Year	Q1	Q2	Q3	Q4	Grand Total
1970	25	82	137	554	798
1971	606	306	363	871	2,146
1972	272	280	956	1,236	2,744
1973	199	228	449	191	1,067
1974	524	594	1,694	909	3,721
1975	70	710	2,296	2,960	6,036
1976	404	864	1,886	1,139	4,293
1977	1,428	1,214	1,613	1,158	5,413
1978	1,782	859	1,890	2,376	6,907
1979	1,585	2,419	3,473	2,498	9,975
1980	501	3,012	915	2,194	6,622
1981	2,181	3,854	1,831	1,217	9,083
1982	1,884	4,512	2,707	1,630	10,733
1983	4,371	3,897	3,729	2,316	14,313
1984	4,846	4,770	4,236	4,900	18,752
1985	6,864	9,843	6,401	5,362	28,470
1986	8,533	15,495	8,449	14,657	47,134
1987	16,032	12,910	6,238	15,906	51,086
1988	20,271	14,038	6,804	13,511	54,624
1989	15,845	13,078	6,685	11,131	46,739
1990	17,104	11,597	5,589	7,902	42,192
1991	12,522	12,046	5,579	10,208	40,355
1992	17,640	15,594	8,130	12,132	53,496
1993	18,823	17,120	8,827	12,242	57,012
1994	18,467	15,299	4,771	10,573	49,110
1995	16,391	12,276	5,074	10,179	43,920
1996	15,738	13,625	4,425	7,624	41,412
1997	14,241	9,468	3,505	9,484	36,698
1998	27,583	19,903	5,226	14,622	67,334
1999	20,099	20,101	6,681	12,467	59,348
2000	24,966	14,027	6,011	13,223	58,227
2001	23,816	11,414	8,109	9,162	52,501
2002	19,975	11,703	9,187	15,583	56,448
2003	20,690	8,742	5,422	15,341	50,195
2004	1,700	75	5	4	1,784
2005	16,150	5,328	3,189	14,819	39,486
2006	24,487	11,430	12,185	34,124	82,226
2007	20,426	5,094	3,154	9,238	37,912
Grand Total	419,041	307,807	167,821	305,643	1,200,312

Table 2.1. Number of swordfish lengths in the Japanese offshore and distant-water longline fishery by year and quarter during the years 1970 – 2007 under Stock Scenario-1, Region 1.

Year	Q1	Q2	Q3	Q4	Grand Total
1970	0	3	28	150	181
1971	13	90	7	370	480
1972	16	7	792	359	1,174
1973	24	165	408	62	659
1974	356	518	200	180	1,254
1975	11	684	2,210	2,666	5,571
1976	288	210	1,545	644	2,687
1977	1,146	606	1,308	1,040	4,100
1978	933	396	1,156	2,056	4,541
1979	896	1,732	3,115	2,474	8,217
1980	420	2,327	876	2,166	5,789
1981	2,033	3,106	1,549	944	7,632
1982	1,675	3,184	2,551	1,283	8,693
1983	3,547	3,426	3,581	1,966	12,520
1984	4,261	1,063	3,874	4,124	13,322
1985	5,312	5,474	6,088	5,235	22,109
1986	6,658	9,114	7,373	9,277	32,422
1987	9,112	5,623	4,272	8,768	27,775
1988	10,372	4,832	4,645	5,957	25,806
1989	6,905	2,844	3,887	4,828	18,464
1990	8,751	6,215	3,809	2,910	21,685
1991	7,016	7,533	4,073	4,879	23,501
1992	10,863	11,167	5,642	5,597	33,269
1993	12,506	11,667	7,299	7,884	39,356
1994	14,125	11,903	3,928	6,355	36,311
1995	10,535	7,892	3,935	3,822	26,184
1996	10,748	9,232	3,399	2,921	26,300
1997	9,538	4,937	1,691	5,518	21,684
1998	22,592	7,651	2,655	3,133	36,031
1999	8,176	9,612	2,279	3,236	23,303
2000	18,206	10,255	2,560	3,760	34,781
2001	18,068	4,395	2,312	3,032	27,807
2002	9,026	501	1,307	4,472	15,306
2003	9,095	1,090	904	2,459	13,548
2004	705	0	0	0	705
2005	11,597	2,568	36	3,065	17,266
2006	18,720	1,557	312	6,668	27,257
2007	17,011	1,363	1,285	4,385	24,044
Grand Total	271,256	154,942	96,891	128,645	651,734

Table 2.2. Number of swordfish lengths in the Japanese offshore and distant-water longline fishery by year and quarter during the years 1970 – 2007 under Stock Scenario-1, Region 2.

Year	Q1	Q2	Q3	Q4	Grand Total
1970	2	0	0	216	218
1971	364	0	0	307	671
1972	44	0	26	847	917
1973	89	46	0	43	178
1974	0	0	924	712	1,636
1975	0	0	81	269	350
1976	115	597	320	335	1,367
1977	25	218	96	0	339
1978	506	109	282	91	988
1979	485	450	227	18	1,180
1980	25	583	0	5	613
1981	57	645	216	242	1,160
1982	142	1,221	110	343	1,816
1983	674	306	43	251	1,274
1984	127	3,025	27	510	3,689
1985	1,156	3,877	91	78	5,202
1986	1,593	5,583	737	5,085	12,998
1987	6,219	6,670	1,401	6,250	20,540
1988	9,525	8,585	1,591	7,251	26,952
1989	8,673	9,393	2,148	5,998	26,212
1990	8,105	4,832	1,324	4,692	18,953
1991	5,266	3,963	1,120	5,194	15,543
1992	6,414	3,842	1,837	6,314	18,407
1993	6,031	4,755	935	4,341	16,062
1994	4,003	2,707	403	4,143	11,256
1995	5,529	3,733	595	6,241	16,098
1996	4,786	3,819	685	4,646	13,936
1997	4,589	4,150	1,419	3,937	14,095
1998	4,719	11,785	2,300	11,407	30,211
1999	11,757	10,044	4,047	9,023	34,871
2000	6,569	3,283	3,068	9,383	22,303
2001	5,320	6,354	5,379	5,939	22,992
2002	10,747	10,341	7,572	11,044	39,704
2003	11,513	7,311	4,319	12,753	35,896
2004	922	0	0	0	922
2005	4,411	2,500	2,908	11,578	21,397
2006	5,555	9,516	11,615	27,382	54,068
2007	3,274	3,387	1,688	4,826	13,175
Grand Total	139,331	137,630	59,534	171,694	508,189

Table 2.3. Number of swordfish lengths in the Japanese offshore and distant-water longline fishery by year and quarter during the years 1970 – 2007 under Stock Scenario-1, Region 3.

Year	Q1	Q2	Q3	Q4	Grand Total
1970	0	0	21	40	61
1971	18	0	0	64	82
1972	37	0	67	16	120
1973	0	0	0	37	37
1974	0	0	0	6	6
1975	0	0	0	0	0
1976	0	0	3	31	34
1977	0	0	0	0	0
1978	1	0	0	0	1
1979	0	0	0	0	0
1980	0	4	0	0	4
1981	0	0	0	0	0
1982	56	0	0	0	56
1983	0	0	0	0	0
1984	52	0	0	0	52
1985	0	0	0	0	0
1986	0	0	0	76	76
1987	305	0	36	619	960
1988	151	0	0	0	151
1989	0	0	0	0	0
1990	0	0	0	0	0
1991	0	0	0	0	0
1992	180	0	0	1	181
1993	45	0	0	4	49
1994	0	0	0	3	3
1995	7	0	2	1	10
1996	2	0	0	0	2
1997	0	0	0	0	0
1998	2	0	0	5	7
1999	34	0	1	10	45
2000	0	0	0	0	0
2001	0	0	0	0	0
2002	0	0	0	0	0
2003	0	0	5	1	6
2004	0	0	0	0	0
2005	1	0	56	136	193
2006	23	0	0	0	23
2007	0	0	0	0	0
Grand Total	914	4	191	1,050	2,159

Table 2.4. Number of swordfish lengths in the Japanese offshore and distant-water longline fishery by year and quarter during the years 1970 – 2007 under Stock Scenario-1, Region 4.

Year	Q1	Q2	Q3	Q4	Grand Total
1970	1	11	0	7	19
1971	47	45	4	12	108
1972	5	17	8	12	42
1973	12	17	20	49	98
1974	34	19	0	7	60
1975	20	2	0	7	29
1976	0	28	17	117	162
1977	244	366	206	102	918
1978	280	354	359	229	1,222
1979	189	237	118	6	550
1980	18	98	39	23	178
1981	82	101	66	31	280
1982	11	37	46	0	94
1983	61	114	58	99	332
1984	368	475	214	262	1,319
1985	318	418	187	49	972
1986	131	320	79	202	732
1987	177	347	324	214	1,062
1988	98	466	517	210	1,291
1989	142	429	419	270	1,260
1990	159	379	341	252	1,131
1991	135	311	268	59	773
1992	123	329	597	185	1,234
1993	138	558	474	12	1,182
1994	190	481	238	62	971
1995	242	470	472	96	1,280
1996	98	376	249	38	761
1997	41	183	294	24	542
1998	109	226	256	69	660
1999	93	285	255	83	716
2000	118	350	218	78	764
2001	93	479	195	68	835
2002	131	273	85	54	543
2003	45	253	158	104	560
2004	1	0	0	0	1
2005	56	224	169	38	487
2006	67	264	125	39	495
2007	95	311	166	10	582
Grand Total	4,172	9,653	7,241	3,179	24,245

Table 2.5. Number of swordfish lengths in the Japanese offshore and distant-water longline fishery by year and quarter during the years 1970 – 2007 under Stock Scenario-1, Region 5.

Year	Q1	Q2	Q3	Q4	Grand Total
1970	22	0	80	25	127
1971	111	23	71	27	232
1972	138	119	16	2	275
1973	74	0	10	0	84
1974	76	0	567	4	647
1975	39	24	5	18	86
1976	1	29	0	11	41
1977	13	24	3	16	56
1978	62	0	93	0	155
1979	15	0	13	0	28
1980	38	0	0	0	38
1981	9	2	0	0	11
1982	0	62	0	4	66
1983	89	51	47	0	187
1984	36	207	121	4	368
1985	78	74	35	0	187
1986	132	429	227	17	805
1987	206	202	194	51	653
1988	124	141	44	91	400
1989	118	258	115	5	496
1990	61	81	13	14	169
1991	80	81	90	53	304
1992	56	179	26	35	296
1993	99	36	100	0	235
1994	126	202	200	10	538
1995	63	149	49	10	271
1996	67	142	79	8	296
1997	17	79	15	3	114
1998	47	22	15	6	90
1999	37	22	76	10	145
2000	20	34	61	0	115
2001	27	76	84	115	302
2002	28	422	43	0	493
2003	17	28	27	17	89
2004	25	19	2	0	46
2005	39	3	18	0	60
2006	31	43	74	9	157
2007	20	0	13	17	50
Grand Total	2,241	3,263	2,626	582	8,712

Table 2.6. Number of swordfish lengths in the Japanese offshore and distant-water longline fishery by year and quarter during the years 1970 – 2007 under Stock Scenario-1, Region 6.

Year	Q1	Q2	Q3	Q4	Grand Total
1970	0	68	8	116	192
1971	53	148	281	91	573
1972	32	137	47	0	216
1973	0	0	11	0	11
1974	58	57	3	0	118
1975	0	0	0	0	0
1976	0	0	1	1	2
1977	0	0	0	0	0
1978	0	0	0	0	0
1979	0	0	0	0	0
1980	0	0	0	0	0
1981	0	0	0	0	0
1982	0	8	0	0	8
1983	0	0	0	0	0
1984	2	0	0	0	2
1985	0	0	0	0	0
1986	19	49	33	0	101
1987	13	68	11	4	96
1988	1	14	7	2	24
1989	7	154	116	30	307
1990	28	90	102	34	254
1991	25	158	28	23	234
1992	4	77	28	0	109
1993	4	104	19	1	128
1994	23	6	2	0	31
1995	15	32	21	9	77
1996	37	56	13	11	117
1997	56	119	86	2	263
1998	114	219	0	2	335
1999	2	138	23	105	268
2000	53	105	104	2	264
2001	308	110	139	8	565
2002	43	166	180	13	402
2003	20	60	9	7	96
2004	47	56	3	4	110
2005	46	33	2	2	83
2006	91	50	59	26	226
2007	26	33	2	0	61
Grand Total	1,127	2,315	1,338	493	5,273

Table 3. Number of swordfish lengths in the Hawaii pelagic longline fishery by depth, year, and quarter during the years 1994 – 2008 under Stock Scenario-1.

A. Number of lengths					
Year	Q1	Q2	Q3	Q4	Total
1994	618	670	130	559	1,977 *
1995	791	891	239	45	1,966
1996	589	804	334	843	2,570 *
1997	1,197	822	301	392	2,712
1998	615	300	508	1,222	2,645
1999	855	618	62	381	1,916
2000	1,146	1,262	270	1,278	3,956
2001	944	140	141	228	1,453
2002	487	257	204	277	1,225
2003	74	170	681	441	1,366
2004	224	486	294	1,159	2,163
2005	7,561	10,202	982	2,017	20,762 *
2006	11,261	144	90	109	11,604
2007	4,411	2,054	341	554	7,360
2008	3,529	1,846	387	660	6,422
Total	34,302	20,666	4,964	10,165	70,097

B. Number of lengths (shallow-sets).					
Year	Q1	Q2	Q3	Q4	Total
1994	617	660	116	498	1,891
1995	788	886	213	28	1,915
1996	567	775	331	840	2,513
1997	1,195	816	299	372	2,682
1998	606	292	481	1,163	2,542
1999	844	611	40	362	1,857
2000	1,139	1,245	229	1,119	3,732
2001	895	74	2	-	971
2002	13	-	-	-	13
2003	-	4	-	-	4
2004	33	14	6	775	828
2005	7,491	9,985	458	1,538	19,472
2006	11,161	-	-	-	11,161
2007	4,400	1,945	232	332	6,909
2008	3,486	1,632	298	605	6,021
Total	33,235	18,939	2,705	7,632	62,511

C. Number of lengths (deep-sets)					
Year	Q1	Q2	Q3	Q4	Total
1994	1	10	14	3	28
1995	3	5	26	17	51
1996	3	29	3	3	38
1997	2	6	2	20	30
1998	9	8	27	59	103
1999	11	7	22	19	59
2000	7	17	41	159	224
2001	49	66	139	228	482
2002	474	257	204	277	1,212
2003	74	166	681	441	1,362
2004	191	472	288	384	1,335
2005	70	216	524	479	1,289
2006	100	144	90	109	443
2007	11	109	109	222	451
2008	43	214	89	55	401
Total	1,048	1,726	2,259	2,475	7,508

*Totals do not add up due to missing predictor values for hooks per float.

Table 4. Number of swordfish lengths in the Hawaii pelagic longline fishery shallow-sets for males and females.

A. Number lengths (shallow-sets, female).					
Year	Q1	Q2	Q3	Q4	Total
1994	242	292	46	236	816
1995	334	387	35	10	766
1996	86	134	147	314	681
1997	635	312	134	179	1,260
1998	312	171	177	588	1,248
1999	424	333	15	77	849
2000	481	698	159	456	1,794
2001	320	7	2	-	329
2002	-	-	-	-	-
2003	-	-	-	-	-
2004	-	-	-	27	27
2005	151	1,860	179	354	2,544
2006	2,445	-	-	-	2,445
2007	988	541	65	123	1,717
2008	1,041	418	59	105	1,623
Total	7,459	5,153	1,018	2,469	16,099 *

B. Number of lengths (shallow-sets, male).					
Year	Q1	Q2	Q3	Q4	Total
1994	244	296	62	221	823
1995	347	330	90	5	772
1996	47	122	104	274	547
1997	425	235	159	176	995
1998	269	111	247	495	1,122
1999	352	229	19	88	688
2000	502	441	59	517	1,519
2001	206	23	-	-	229
2002	-	-	-	-	-
2003	-	-	-	-	-
2004	1	-	-	31	32
2005	241	2,005	200	287	2,733
2006	1,860	-	-	-	1,860
2007	743	446	58	89	1,336
2008	778	167	52	113	1,110
Total	6,015	4,405	1,050	2,296	13,766 *

*Totals do not add up due to missing predictor values for sex.

Table 5. Number of swordfish lengths in the Hawaii pelagic longline fishery deep-sets for males and females.

A. Number lengths (deep-sets, female).					
Year	Q1	Q2	Q3	Q4	Total
1994	-	2	-	2	4
1995	-	2	3	2	7
1996	1	10	1	2	14
1997	-	4	-	5	9
1998	1	2	7	11	21
1999	3	3	3	2	11
2000	1	5	1	9	16
2001	2	11	4	8	25
2002	40	27	5	5	77
2003	1	8	3	4	16
2004	2	12	9	4	27
2005	-	43	46	12	101
2006	10	19	2	9	40
2007	-	22	13	8	43
2008	3	53	10	2	68
Total	64	223	107	85	479 *

B. Number of lengths (deep-sets, male).					
Year	Q1	Q2	Q3	Q4	Total
1994	-	4	1	-	5
1995	2	1	6	3	12
1996	-	6	-	1	7
1997	1	1	-	7	9
1998	2	2	4	8	16
1999	4	2	-	1	7
2000	3	5	-	16	24
2001	6	17	7	9	39
2002	28	27	15	7	77
2003	1	8	7	3	19
2004	4	11	11	8	34
2005	4	29	34	19	86
2006	3	6	3	9	21
2007	1	10	11	15	37
2008	1	24	7	4	36
Total	60	153	106	110	429 *

*Totals do not add up due to missing predictor values for sex.

Table 6. Number of swordfish lengths in the California driftnet fishery by year and quarter during the years 1981 – 2008 under Stock Scenario-1.

A. Port sample dressed weight converted to EFL (cm).					
Year	Q1	Q2	Q3	Q4	Grand Total
81	0	1	34	242	277
82	0	1	422	440	863
83	8	4	375	1,778	2,165
84	428	21	597	2,028	3,074
85	199	12	1,280	1,805	3,296
86	14	11	1,215	3,800	5,040
87	401	14	309	1,462	2,186
88	38	13	773	2,381	3,205
89	121	0	543	1,912	2,576
90	354	36	184	456	1,030
Grand Total	1,563	113	5,732	16,304	23,712

B. On board measurements of EFL (cm).					
Year	Q1	Q2	Q3	Q4	Grand Total
1990	0	0	43	338	381
1991	2	0	67	465	534
1992	13	2	375	1059	1449
1993	86	0	337	1164	1587
1994	129	0	224	707	1060
1995	24	0	263	858	1145
1996	25	0	73	612	710
1997	76	0	99	1276	1451
1998	308	0	122	876	1306
1999	32	0	50	915	997
2000	68	0	86	797	951
2001	48	0	12	311	371
2002	11	0	11	468	490
2003	31	0	25	258	314
2004	6	0	1	469	476
2005	24	0	2	399	425
2006	31	0	38	806	875
2007	133	0	8	508	649
2008	0	0	0	0	0
Grand Total	1047	2	1836	12286	15171

Figures

Stock Scenario - 1

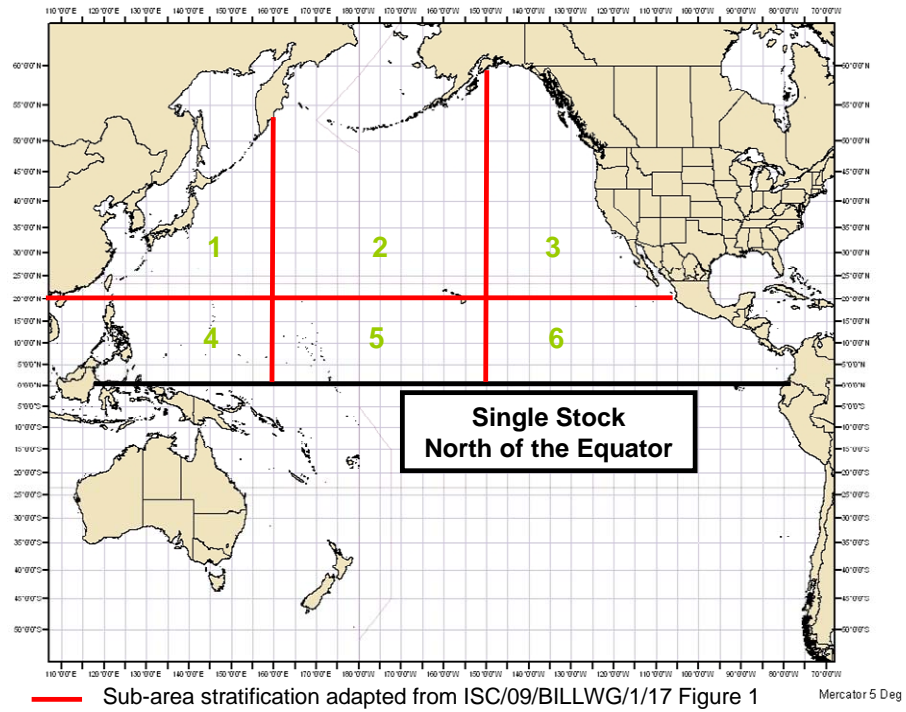


Figure 1. Additional area stratification into 6 regions for under Stock Scenario-1 (adapted from Sun et al. 2009, Figure 1).

Putative Boundary for Stock Scenario - 2

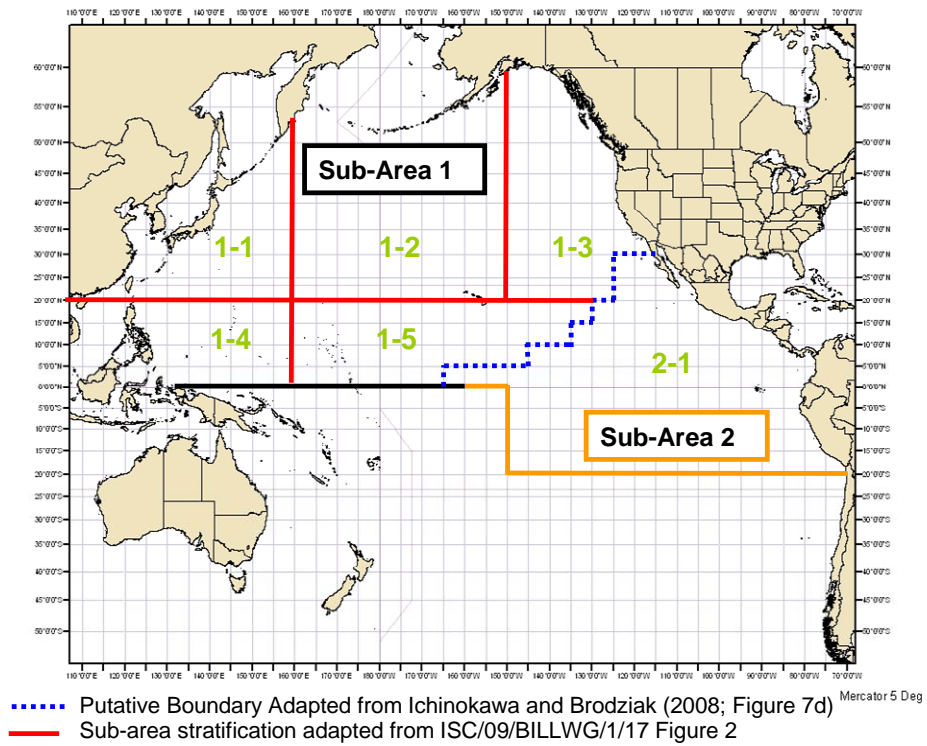


Figure 2. Additional area stratification under Stock Scenario-2 (adapted from Sun et al. 2009, Figure 2). Sub-Areas 2-1 and 2-2 are combined into one area 2-1.

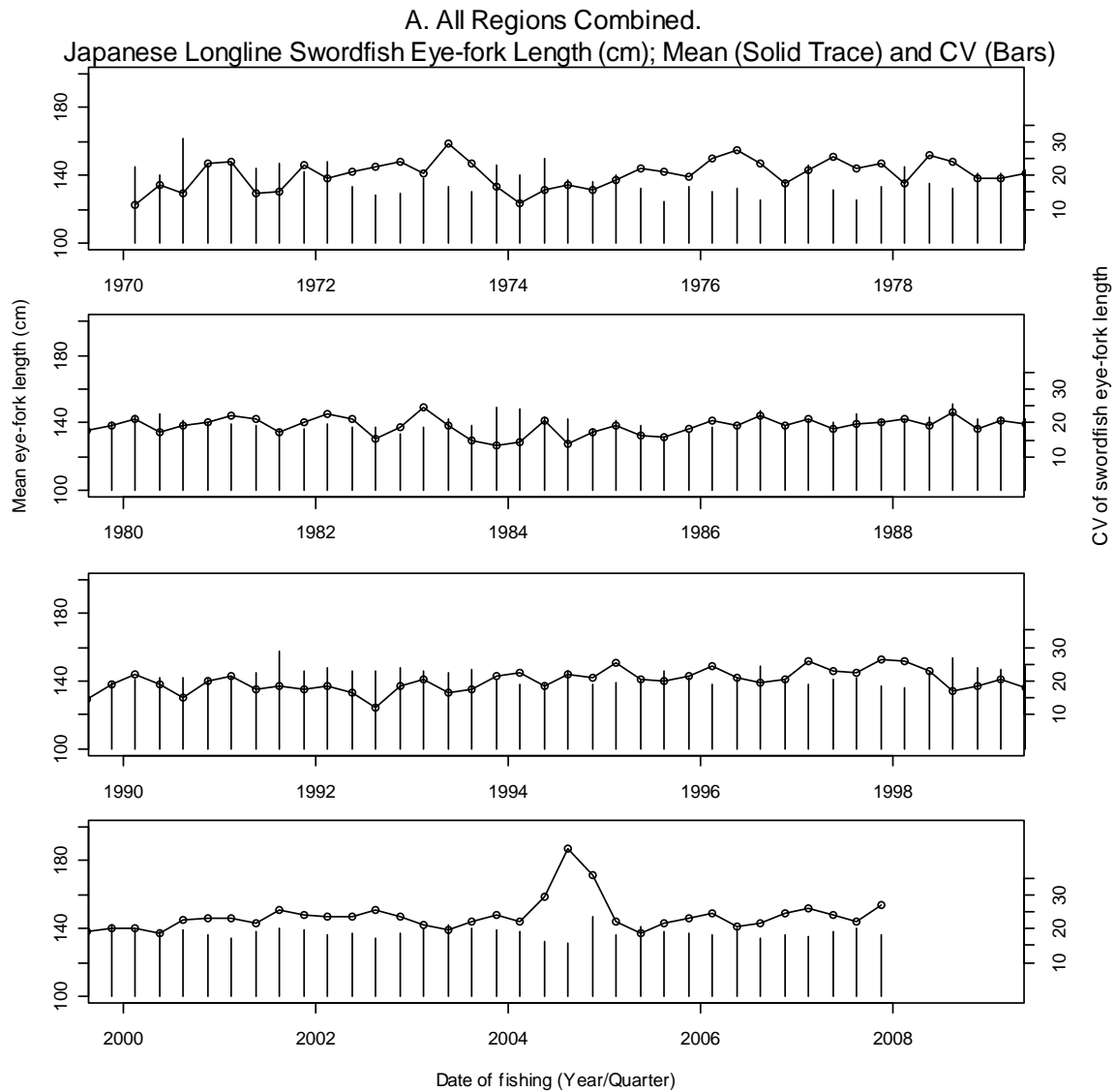


Figure 3. Swordfish mean eye fork length (cm) in the Japan offshore and distant-water longline fishery during the years 1970 – 2008 under Stock Scenario-1.

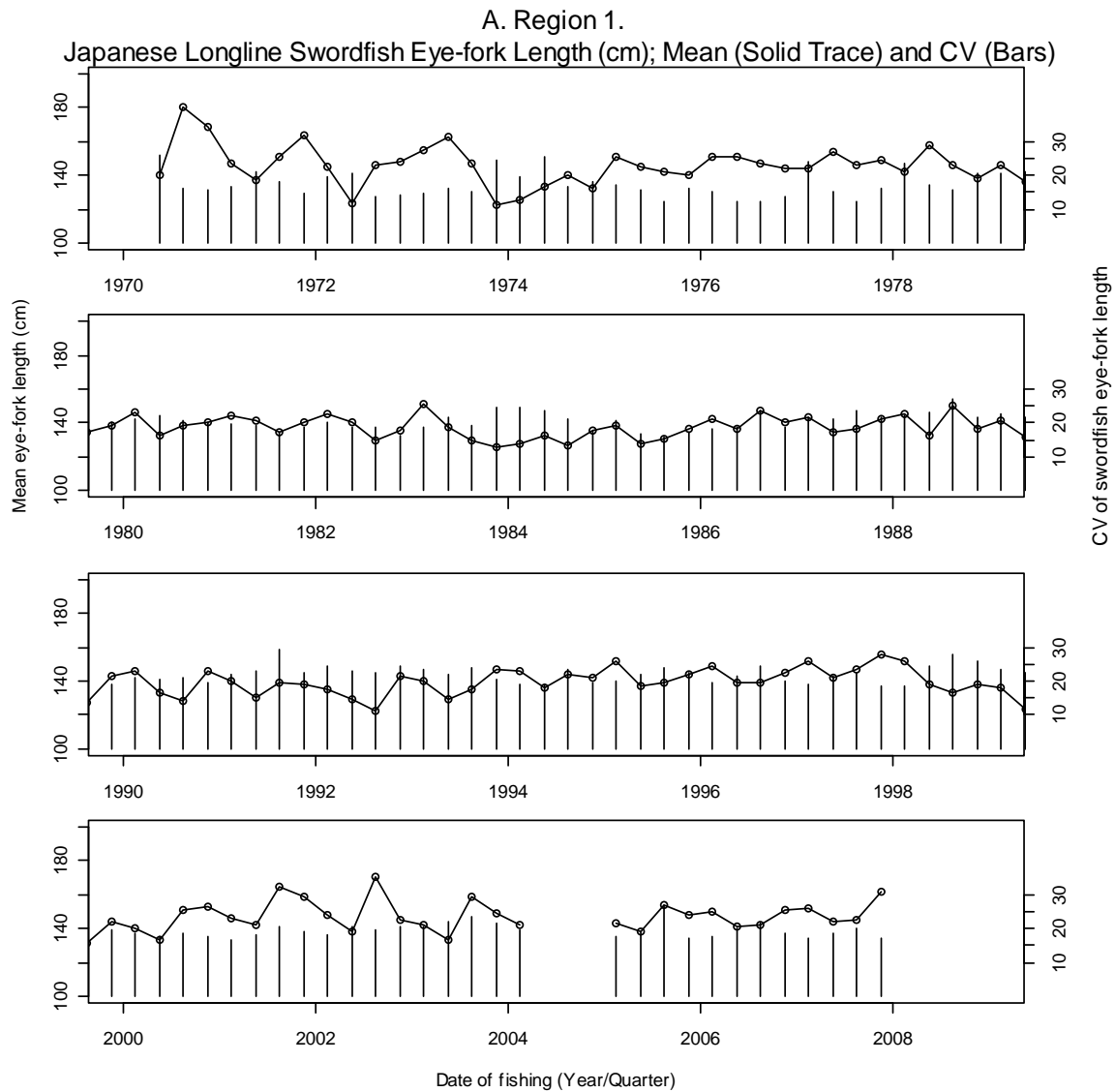


Figure 4.1. Swordfish mean eye fork length (cm) in the Japan offshore and distant-water longline fishery during the years 1970 – 2008 under Stock Scenario-1, Region 1.

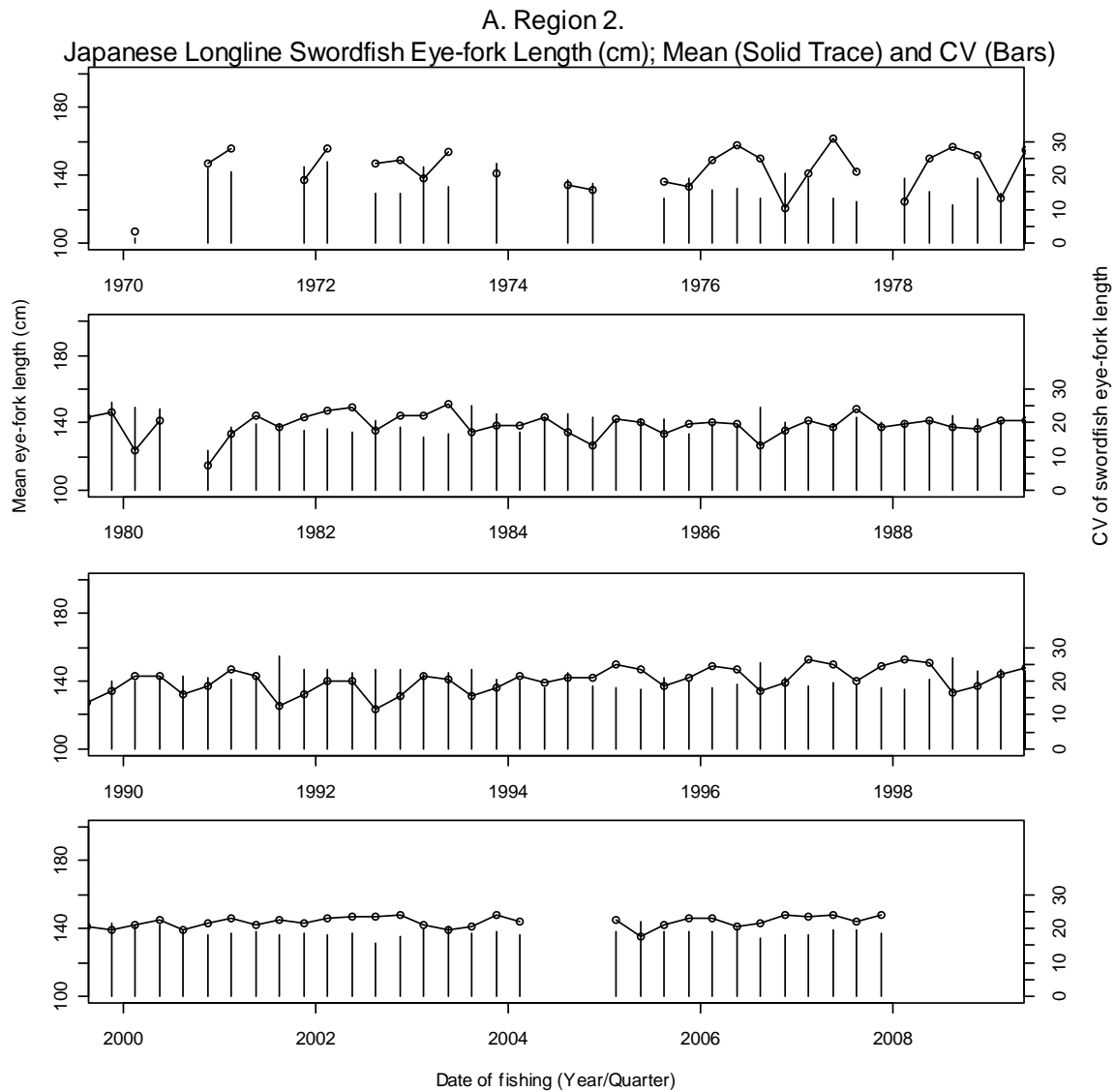


Figure 4.2. Swordfish mean eye fork length (cm) in the Japan offshore and distant-water longline fishery during the years 1970 – 2008 under Stock Scenario-1, Region 2.

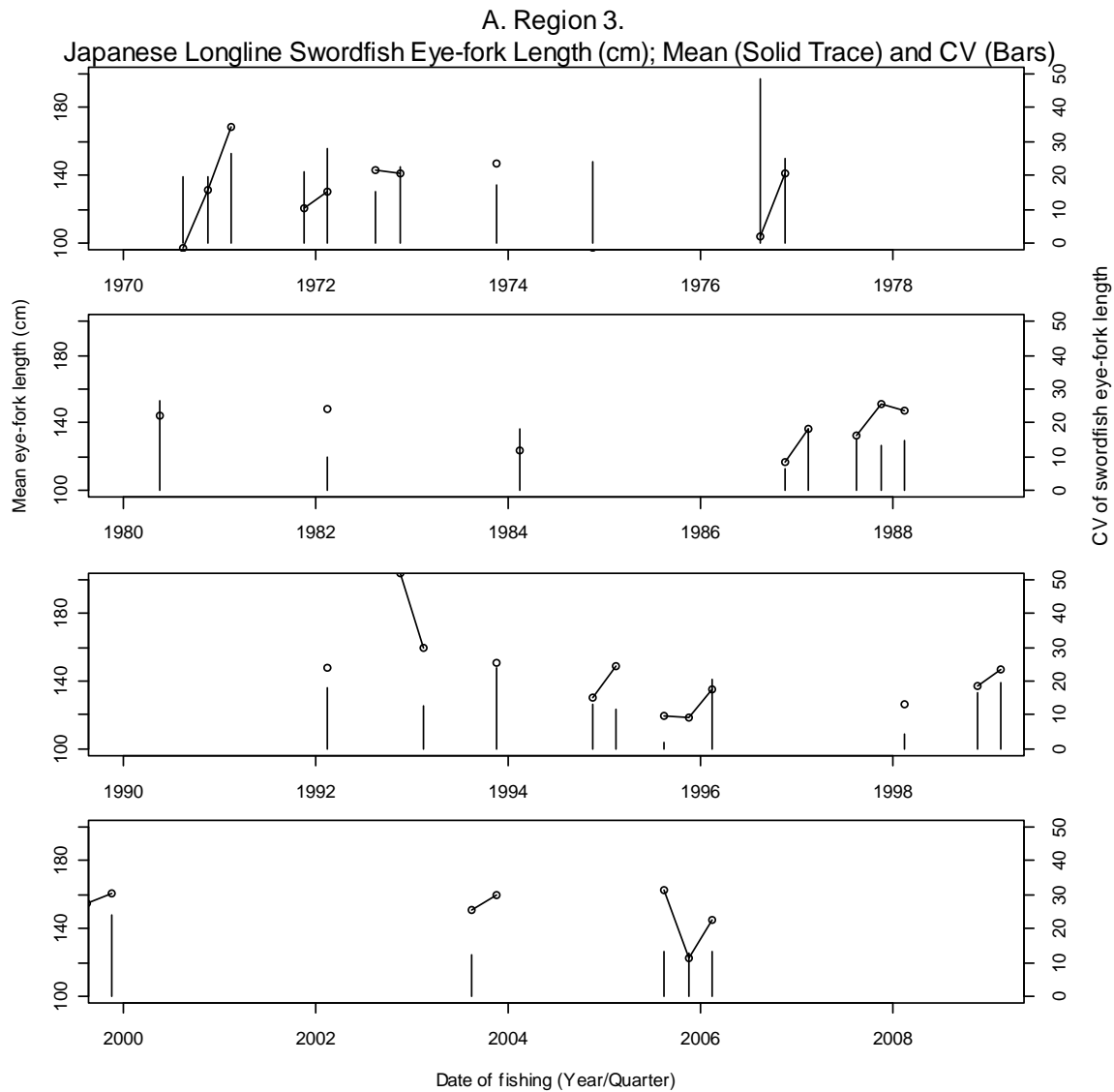


Figure 4.3. Swordfish mean eye fork length (cm) in the Japan offshore and distant-water longline fishery during the years 1970 – 2008 under Stock Scenario-1, Region 3.

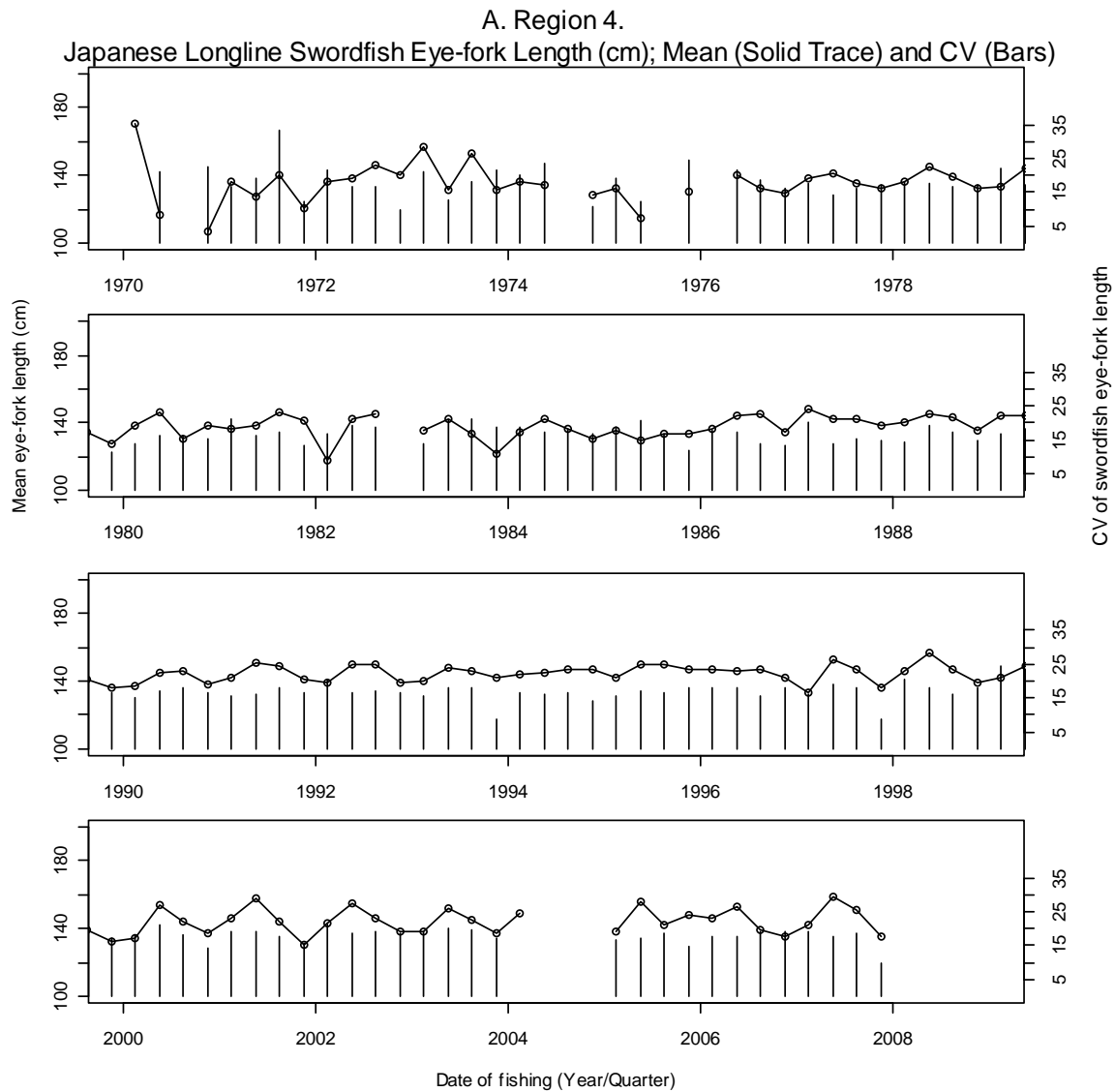


Figure 4.4. Swordfish mean eye fork length (cm) in the Japan offshore and distant-water longline fishery during the years 1970 – 2008 under Stock Scenario-1, Region 4.

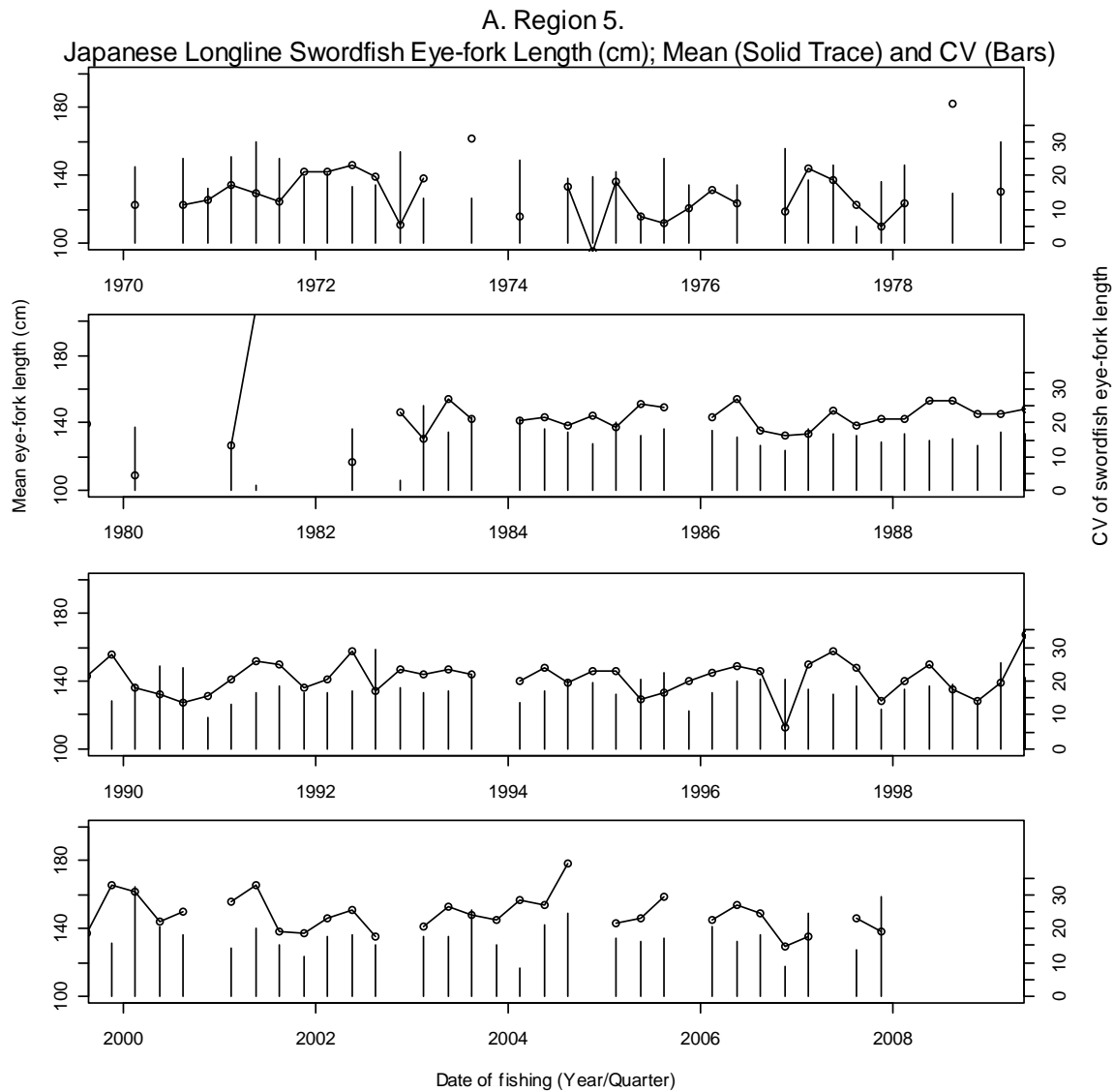


Figure 4.5. Swordfish mean eye fork length (cm) in the Japan offshore and distant-water longline fishery during the years 1970 – 2008 under Stock Scenario-1, Region 5.

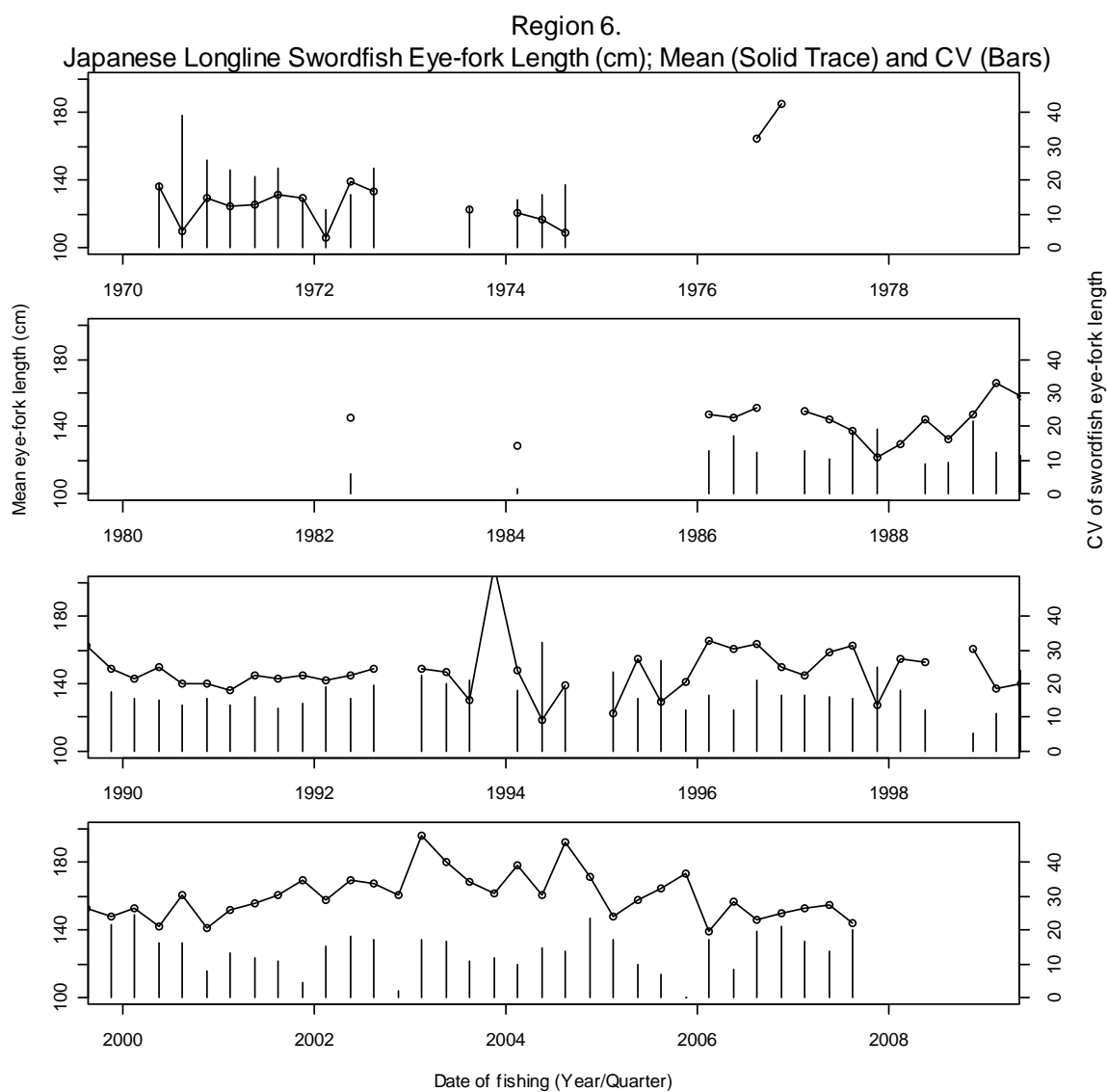


Figure 4.6. Swordfish mean eye fork length (cm) in the Japan offshore and distant-water longline fishery during the years 1970 – 2008 under Stock Scenario-1, Region 6.

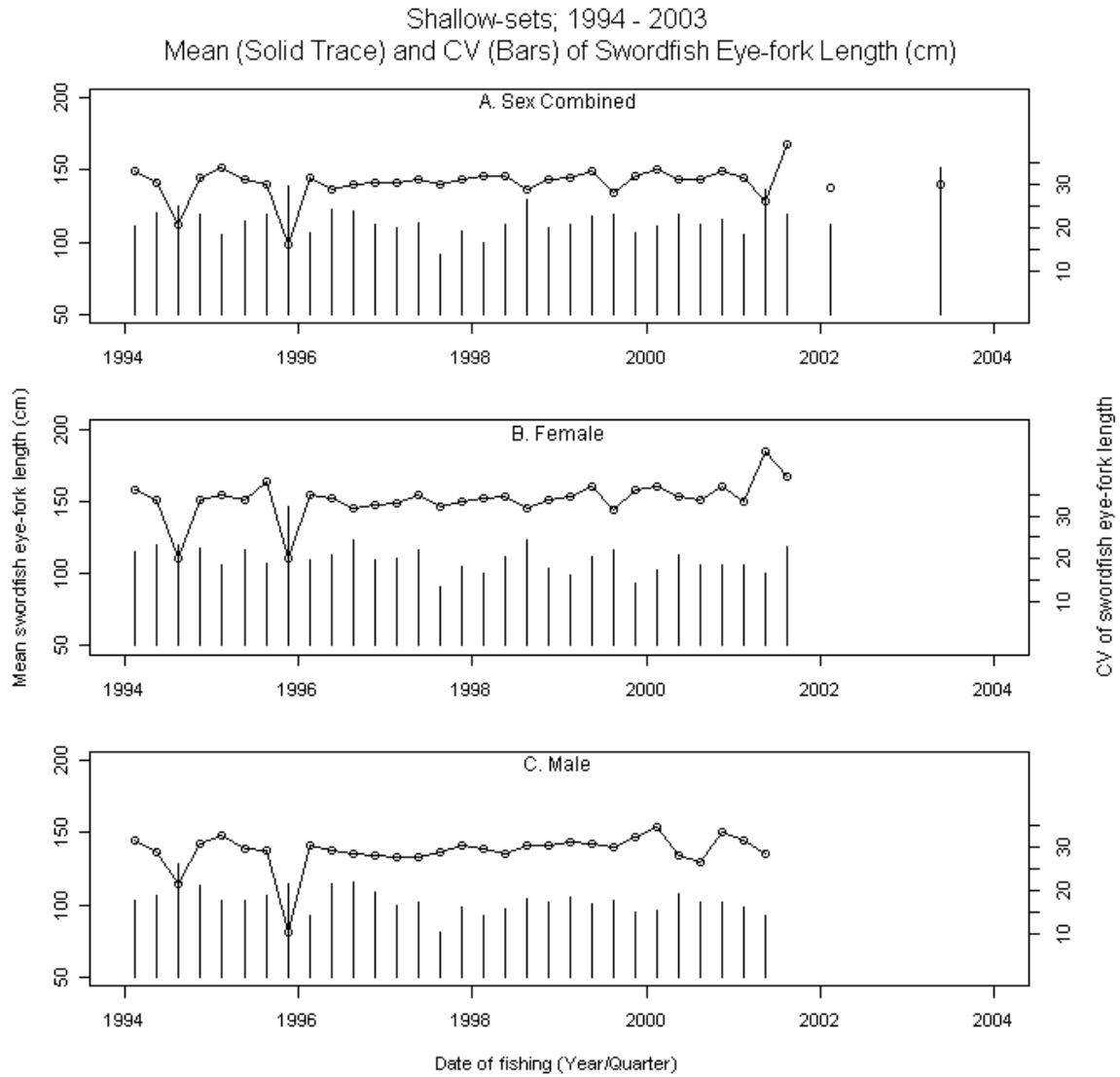


Figure 5.1. Mean and coefficient of variation (CV) of swordfish length frequency for the years 1994 – 2003 (mid-eye to fork, EF) to the nearest centimeter (cm) from shallow-sets (< 15 hooks per float) in the Hawaii longline fishery.

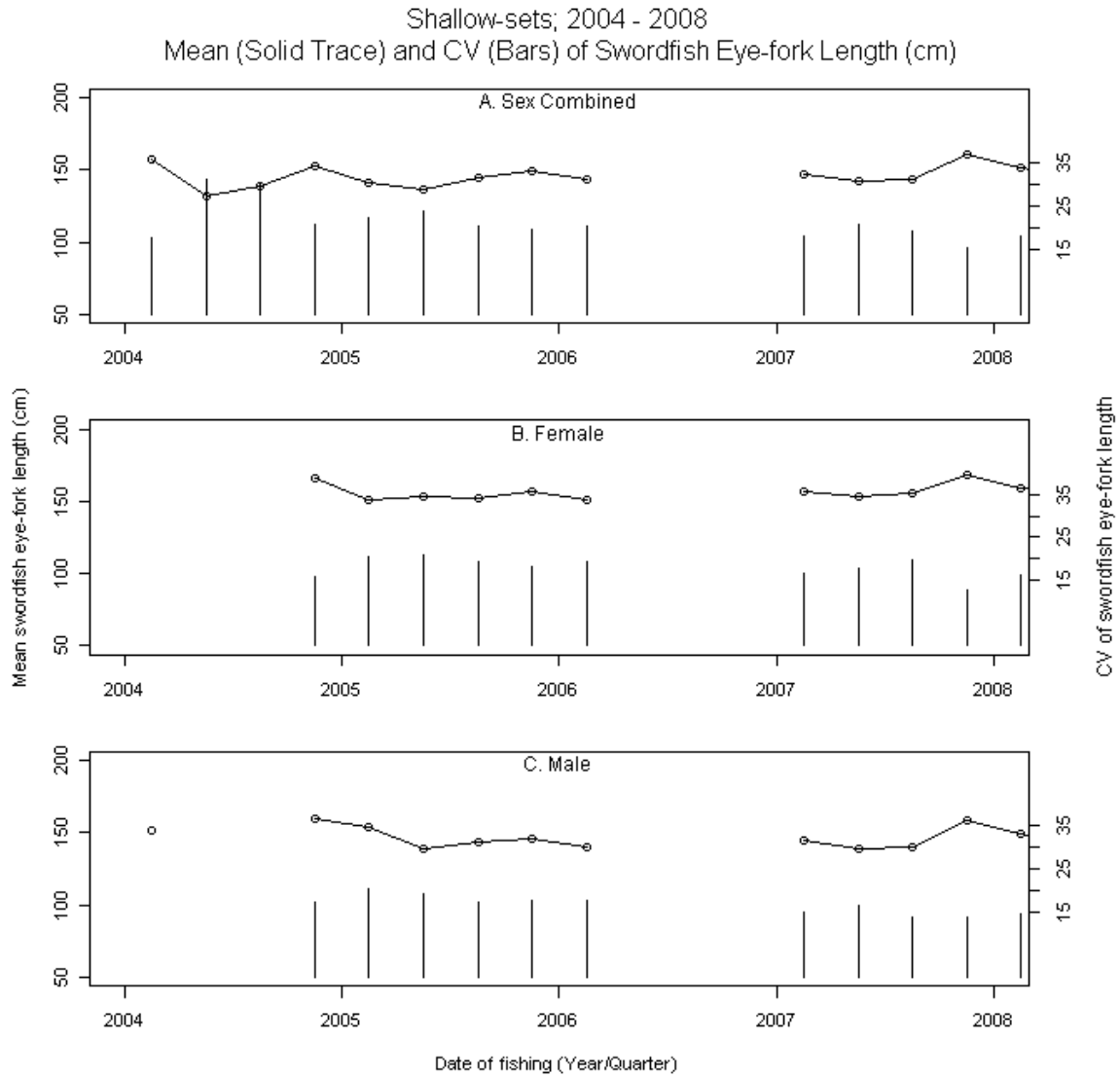


Figure 5.2. Mean and coefficient of variation (CV) of swordfish length frequency for the years 2004 – 2008 (mid-eye to fork, EF) to the nearest centimeter (cm) from shallow-sets (< 15 hooks per float) in the Hawaii longline fishery.

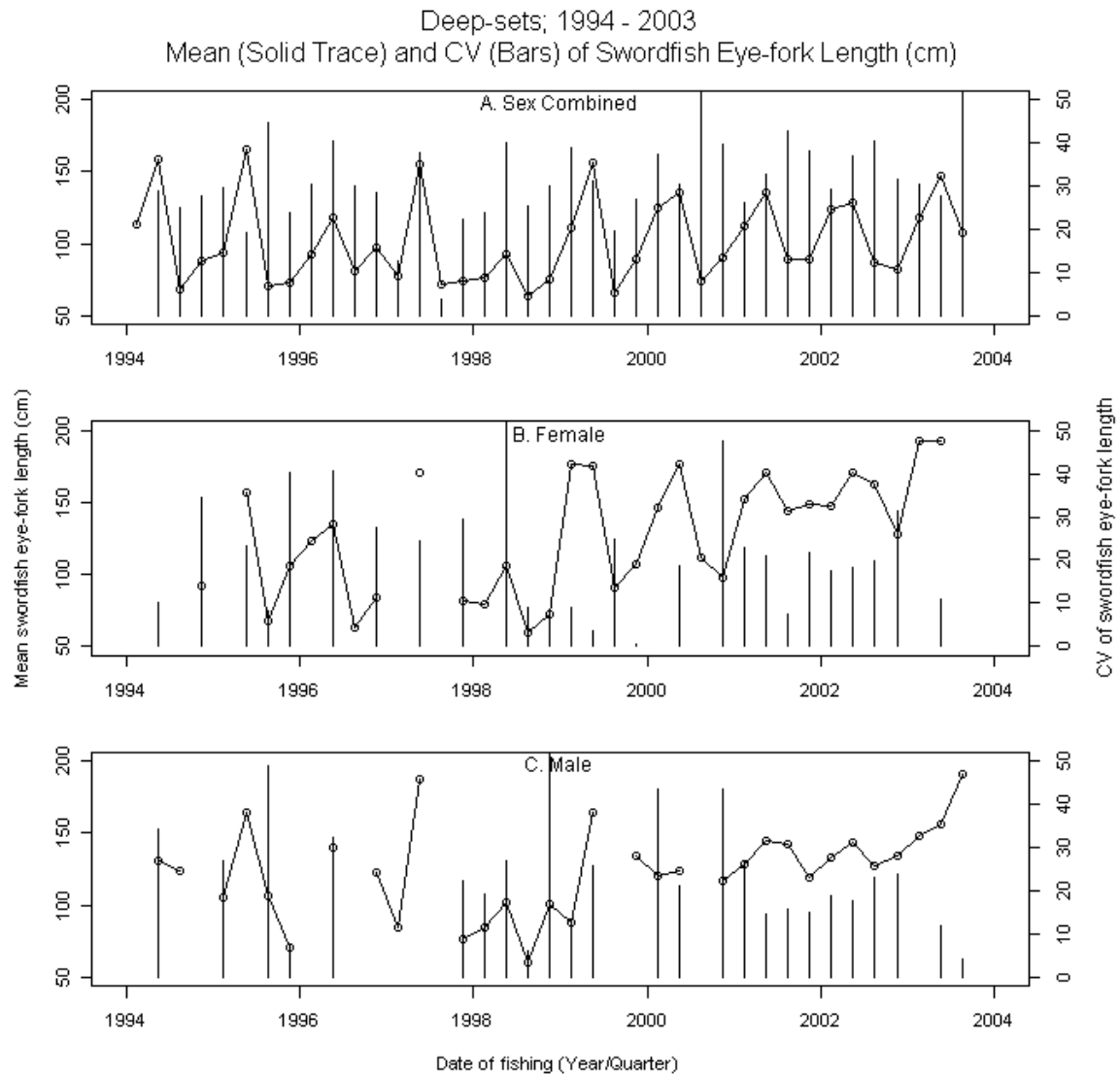


Figure 6.1. Mean and coefficient of variation (CV) of swordfish length frequency for the years 1994 – 2003 (mid-eye to fork, EF) to the nearest centimeter (cm) from deep-sets (≥ 15 hooks per float) in the Hawaii longline fishery.

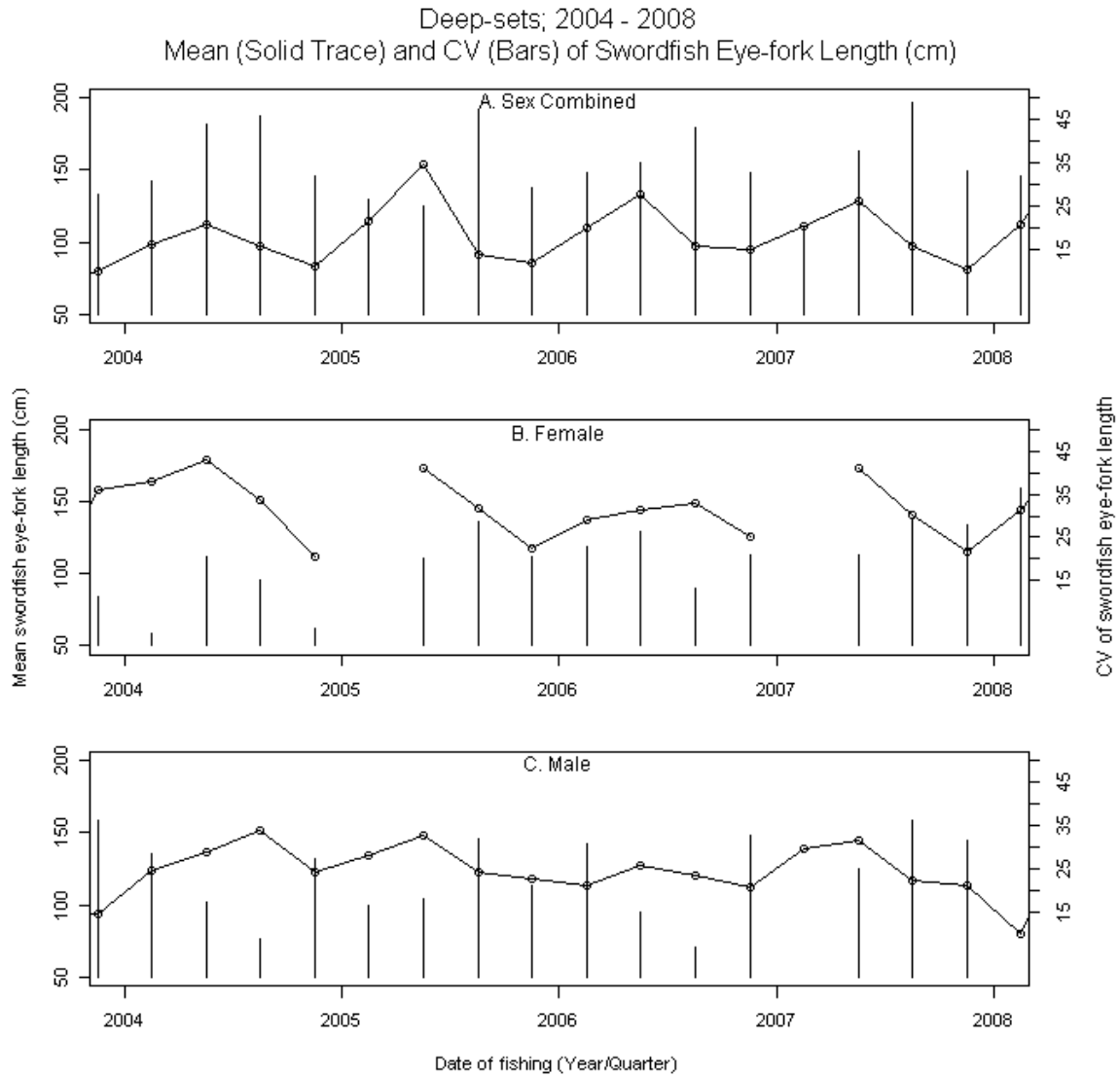


Figure 6.2. Mean and coefficient of variation (CV) of swordfish length frequency for the years 2004 – 2008 (mid-eye to fork, EF) to the nearest centimeter (cm) from deep-sets (≥ 15 hooks per float) in the Hawaii longline fishery.

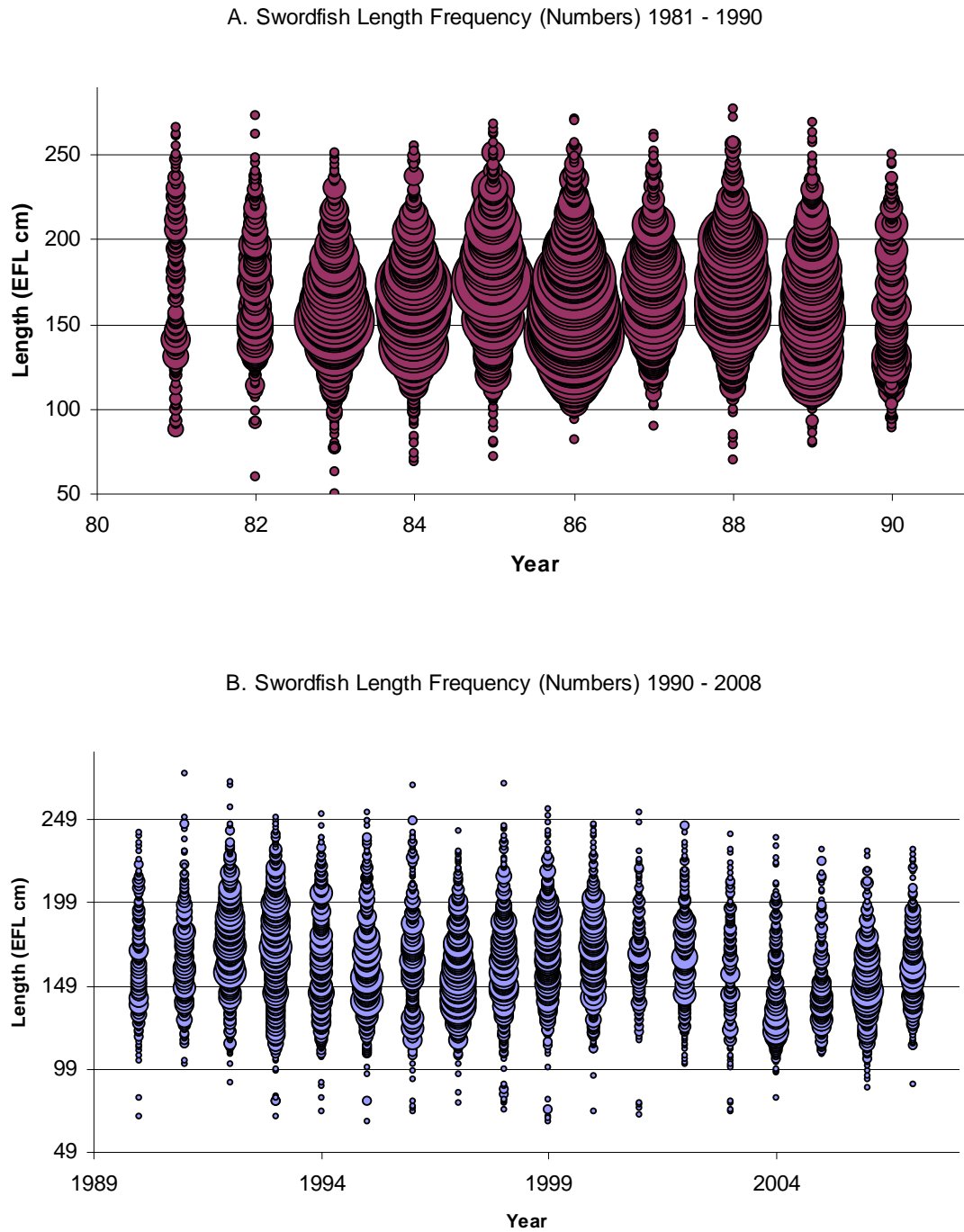
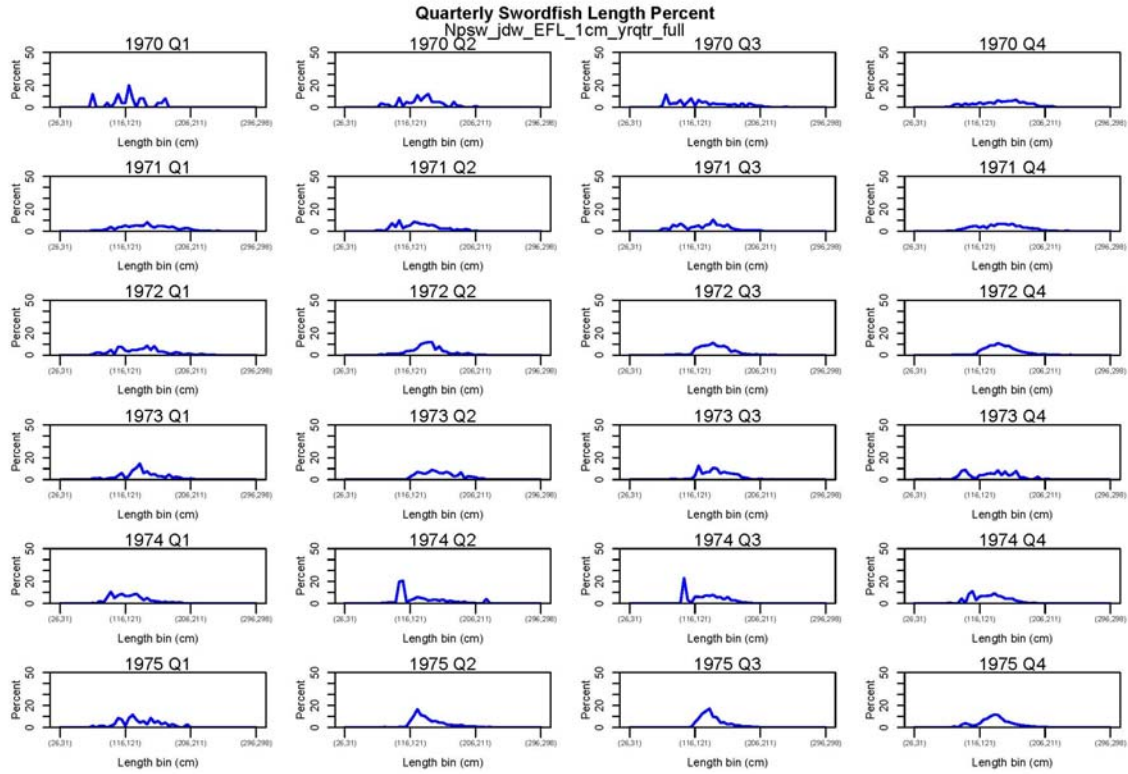
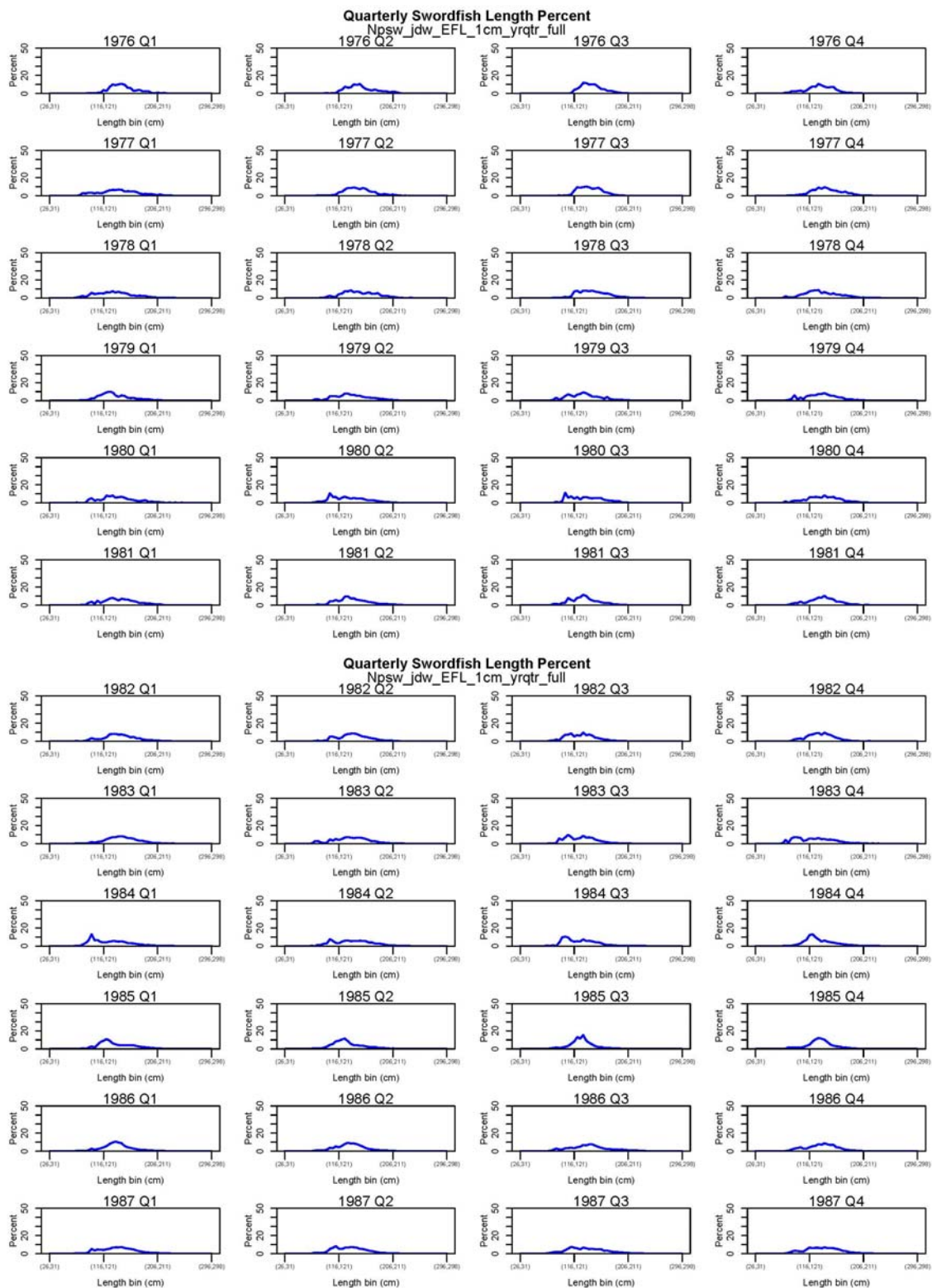


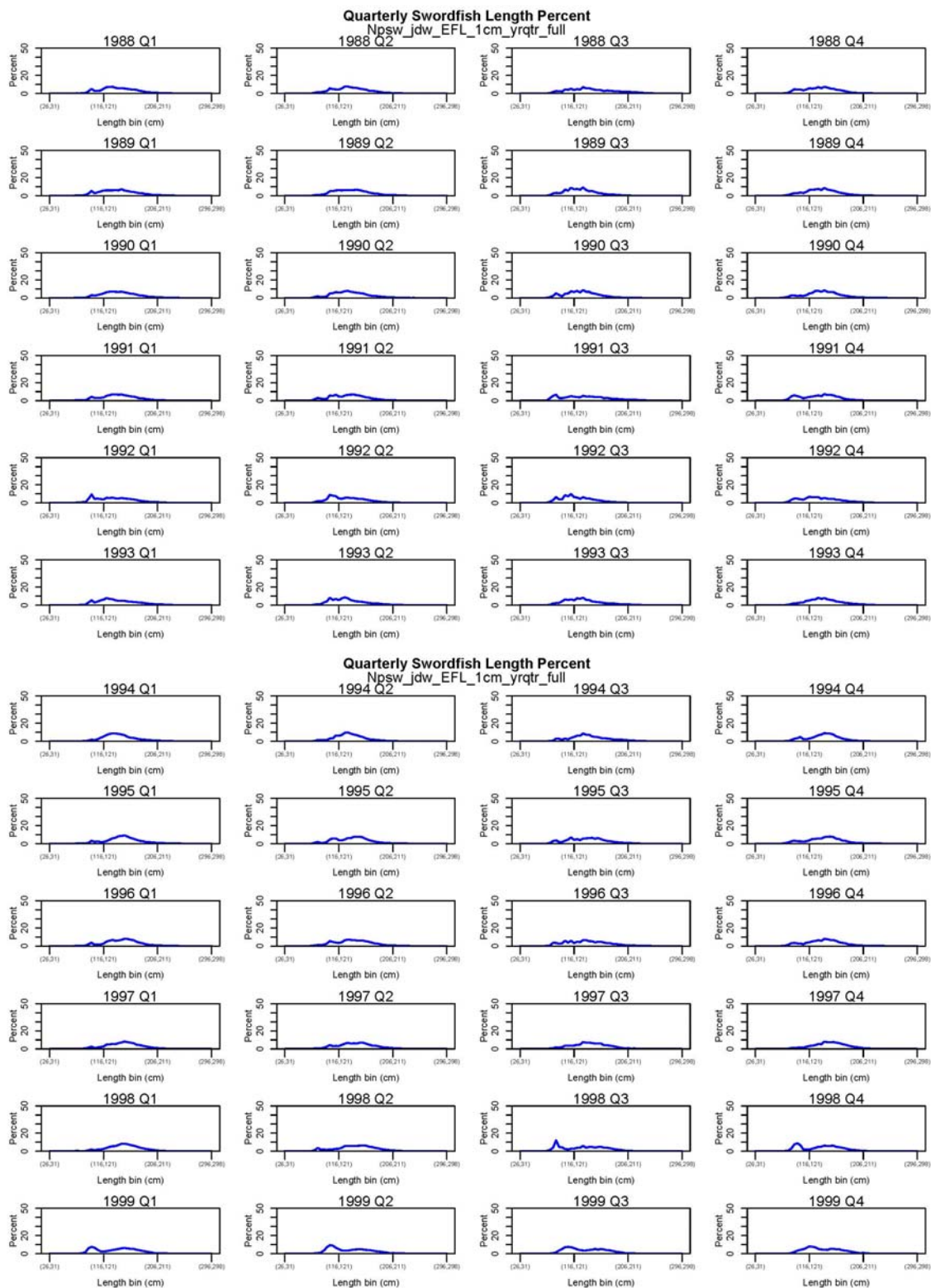
Figure 7. California driftnet swordfish length frequency (numbers) 1981 – 1990 (Panel A, max. 78), 1990 – 2008 (Panel B, max. 29).

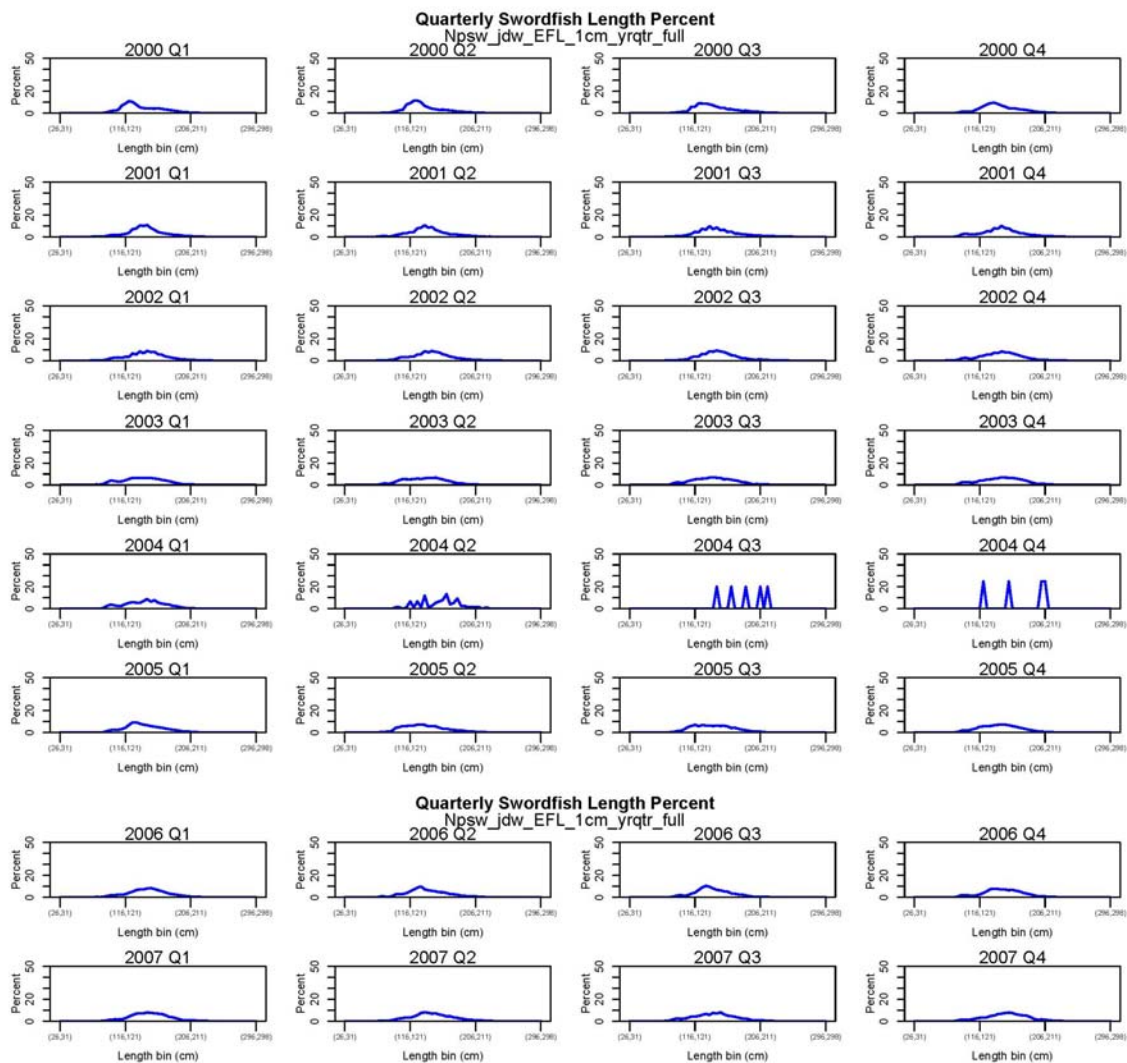
Appendix A

Examples of R function output plots of swordfish length frequency (EFL cm) by year and quarter for Japanese offshore and distant water longline fisheries (Figures with title “Npsw_jdw_EFL_1cm_yrqr_full”)









Examples of R function output plots of swordfish length frequency (EFL cm) by year and quarter for Hawaii longline fisheries (Figures with title “1994_2003_EF_1cm_all_full”).

