5. Summary Report

Stock Distribution and Identification

For this assessment, the SE US stock of mutton snapper was considered a single stock centered in South Florida and the Florida Keys.

Assessment Methods

A variety of models with different assumptions were used in this assessment including surplus production, a modified DeLury, catch curves, untuned virtual population analysis, stock reduction analysis, and a forward projecting statistical catch-at-age model (ASAP). The rationale for the different types of models was to examine the information content of catch and effort, the information in the catch-at-age, the influence of tuning, and the combination of all of these with the ideal of consistency across models. The assessment panel chose ASAP as the base model for determining the condition of the stock. The model was configured with five fleets, with discards being considered separately but linked to their appropriate fleet, and the model was tuned with 11 indices, six of which were fishery-independent indices and five were fishery-dependent. Two of the fishery-independent indices were associated with recruitment.

Assessment Data

Landings information and indices came from many sources. (Table 1 and Table 2)

Table 1. Fishery Dependent Assessment Data Availability

Fishery	Landings	Estimated Discards	Indices
Commercial Gears	1902 - 2006	2001 - 2006	1990 - 2006
Headboat (Survey)	1981 - 2006	2005 - 2006	1981-1991, 1995 - 2006
Recreational (MRFSS)	1981 - 2006	1981 - 2006	1981 - 2006

Table 2. Fishery Independent Assessment Data Availability

Survey	Indices
SEAMAP Video	1992 - 1997, 2002, 2004 - 2006
Florida Keys Visual	1999 - 2004, 2006
FWC Haul Seine	1999 - 2004, 2006
Riley's Hump Visual	2001 - 2006
NMFS/U Miami Reef Visual	1994 - 2005

Life history data are summarized in Table 3.

Table 3. Life History Data

Measure	Value
Natural Mortality (M)	0.11 per year
Maximum Age	40 years
Length at 50% Mature	402 mm Total Length
Age at 50% Mature	3.7 years
L_∞	874 mm Total Length
K	0.16
t_0	-1.32

Catch Trends

Recreational anglers land most of the mutton snapper, and anglers discard most of the mutton snapper that are discarded alive (Table 4, Fig. 1). The minimum size limit was raised to 16 inches (406 mm TL) from 12 inches in 1994, and the total landings decreased from an average of 490 mt to 330 mt. Commercial longline landings in recent years have offset the decrease in the other commercial gears. To estimate MRFSS landings in weight, the average weight by strata was used. For those strata lacking weight or length measurements because only Type B (unseen) fish were reported, a bootstrap procedure that drew from a pool of lengths from within the same mode and year was used. Commercial trips and headboat angler days have decreased over the time period while MRFSS effort has increased.

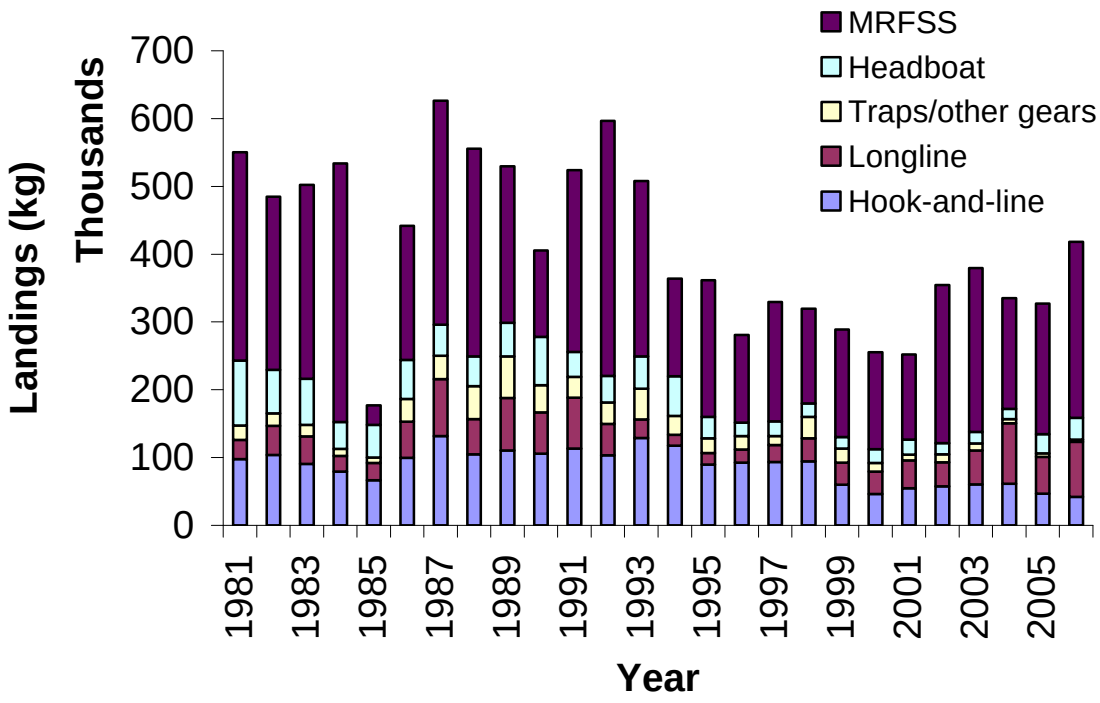


Figure 1. Landings by fishery sector.

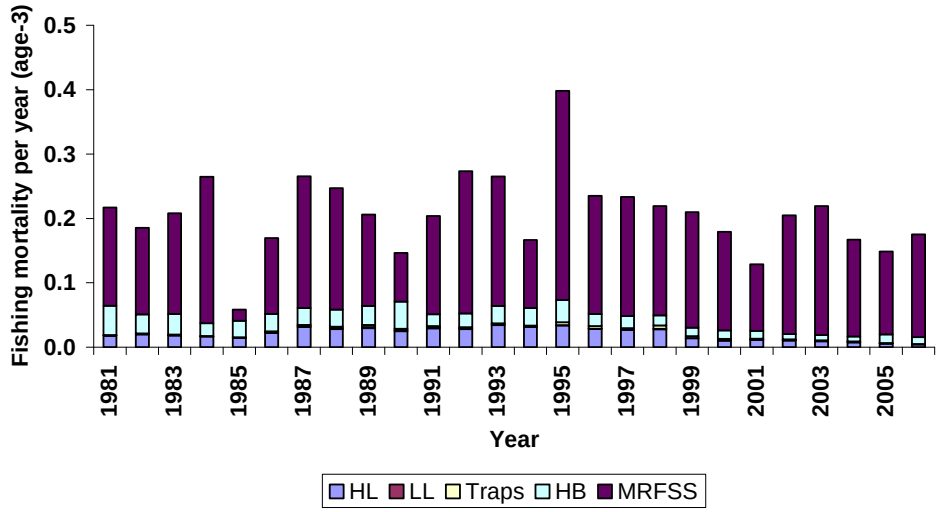
Fishing Mortality Trends

Since each fishery has a different selectivity, one cannot just compare the fishing mortality multipliers, but rather it is necessary to look at the breakdown of fishing mortality by fishery for a couple of ages. For example, when one looks at the mortality on age-3 fish, most of the mortality comes from MRFSS (average 77%), and if we look at age-7 fish, MRFSS still accounts for more of the fishing mortality, but the percentage is less (average 29%, Fig.2). Other than a spike in 1995, overall fishing mortality rates on age-3 fish averaged 0.20 per year while the fishing mortality rates on age-7 fish were slightly higher from 1987 through 1993 (0.23 per year) and then declined to 0.04 per year in 2005 and 2006.

Table 4. Landings and discards by fishery sector.

			Landings (kg)					Discards (kg)		
Year	Hook-and-line	Longline	Traps/other	Headboat	MRFSS	Hook-and-line	Longline	Traps/other	Headboat	MRFSS
1981	97861	28399	20872	96003	307268	8	0	1	58	0
1982	103771	43172	18174	64175	255266	8	0	1	39	95
1983	90633	40620	16981	67791	286203	7	0	1	37	864
1984	79392	23237	10121	39835	381396	6	0	1	23	4091
1985	66695	25313	8238	48061	28754	5	0	1	27	1415
1986	99472	53511	33422	57455	198024	8	0	2	26	1153
1987	131827	83655	34804	45484	330609	10	0	2	26	6284
1988	104645	51834	48911	43757	306497	8	0	3	31	3021
1989	110382	77454	61565	49374	230830	9	0	4	32	756
1990	105742	60741	40105	71373	127284	8	0	2	49	589
1991	113161	75170	30657	36937	267922	9	0	2	24	5671
1992	103518	46265	31627	38997	376152	8	0	2	26	5675
1993	129032	27278	45092	47593	258790	10	0	3	32	7925
1994	117482	15908	28188	58449	143820	9	0	2	30	5124
1995	89479	17249	21848	31294	201928	355	0	68	636	6277
1996	92602	19267	19970	19694	129289	367	0	62	351	6694
1997	93632	25025	13031	21870	175687	371	0	40	387	13068
1998	94431	33791	31663	19953	139720	375	0	98	287	14937
1999	60126	32603	20755	16662	158891	239	0	64	299	5240
2000	46168	32901	12974	20221	143274	183	0	40	328	7683
2001	54731	41171	8619	22031	125292	217	0	27	411	4907
2002	57357	35715	11773	16330	233099	326	0	0	317	8220
2003	60214	50196	10512	16829	241542	160	0	19	291	6909
2004	61181	89300	6379	15162	162881	402	0	13	297	7088
2005	46665	54539	4930	28165	192639	137	0	70	699	15792
2006	41836	81202	3423	31985	259849	47	0	8	392	15437

a.



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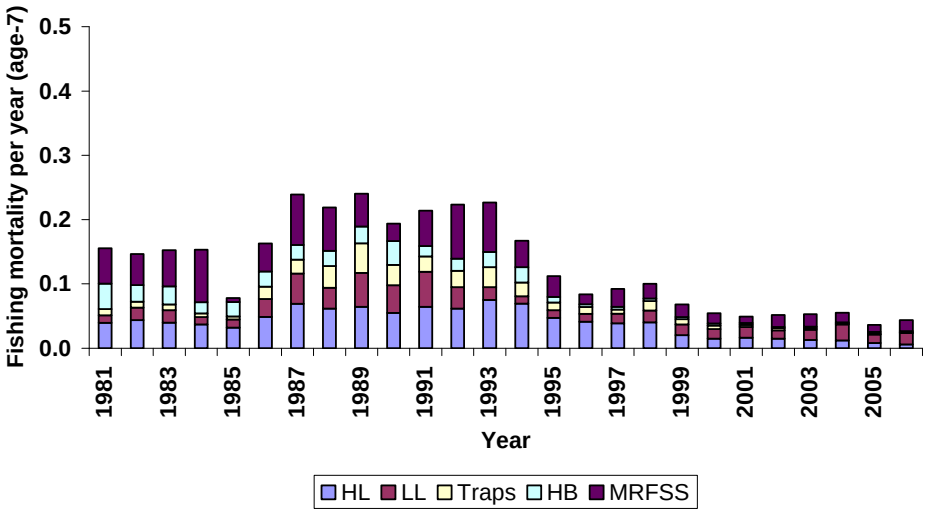

Figure 2. Fishing mortality rates by year and sectors for ages three (a) and seven (b) from the base run.

Stock Abundance and Biomass Trends

Population trends from the base run have been up in recent years (Table 5). The number of fish reached a low in 1985 and then has increased afterwards reaching 6.14 million fish in 2006. The biomass declined to a low in 1994 and then has increased to 9.57 million kg in 2006 (Fig. 3). Similarly, the spawning biomass reached a low in 1995 and has increased to 7.15 million kg in 2006. Recruitment was more variable, but the low was

462,000 fish in 1985, and the high was 2.40 million fish in 2005, reflecting the peak in the FWC FIM age 1+ recruitment index. Recruitment in 2006 was 1.58 million fish. The Beverton-Holt stock-recruit curve from the base run is shown in Fig. 4.

Table 5. Stock abundance, recruitment, biomass, and spawning stock biomass from base run.

	Population	Recruitment	Biomass	Spawning Biomass
Year	Number	Number	kg	kg
1981	2497436	579944	6326937	5517080
1982	2282802	477960	6101939	5219000
1983	2307693	622232	5932115	4983390
1984	2139113	495077	5473088	4718770
1985	1961510	462157	5242415	4398880
1986	2179827	610405	5286702	4392860
1987	2352898	760588	5062145	4181160
1988	2430850	813322	4718758	3801290
1989	2363530	724539	4471582	3543410
1990	2325322	688157	4291270	3361510
1991	2517999	818275	4348125	3351360
1992	2358457	622552	4228111	3287490
1993	2113994	512925	3988699	3149060
1994	2206956	779861	3806676	3003850
1995	2408167	801129	3882778	2997360
1996	2508368	780928	4005868	3035870
1997	2510065	642766	4235895	3202970
1998	2624831	764695	4434340	3403010
1999	3268991	1316870	4769035	3604630
2000	3660472	1192850	5290474	3885080
2001	3843587	1035820	5881601	4271750
2002	3662143	675971	6443473	4857510
2003	4211581	1410270	7004040	5484490
2004	4487359	1254940	7584769	6017020
2005	5894154	2402660	8533002	6491510
2006	6137546	1582160	9573187	7145870

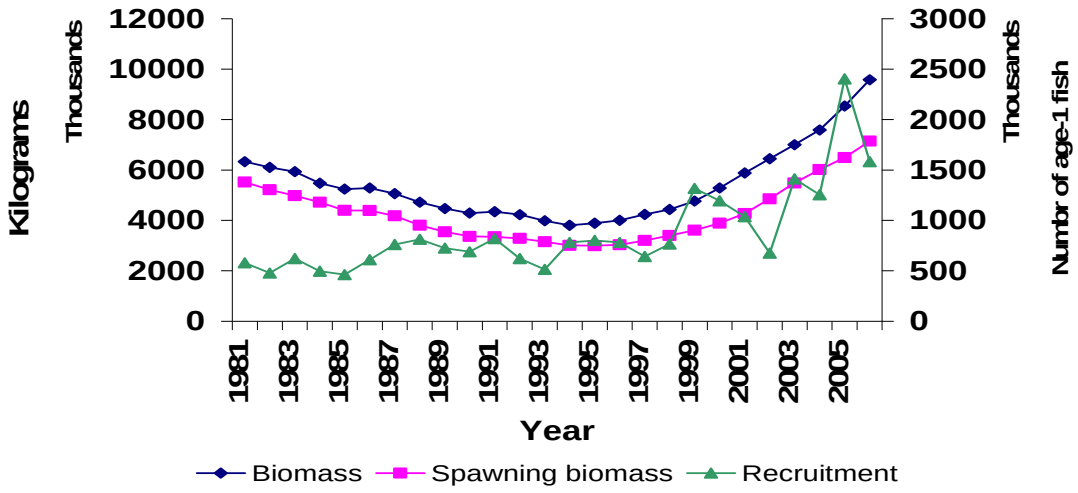

Figure 3. Stock biomass in kilograms showing both the immature portion and the spawning biomass by year from base run.

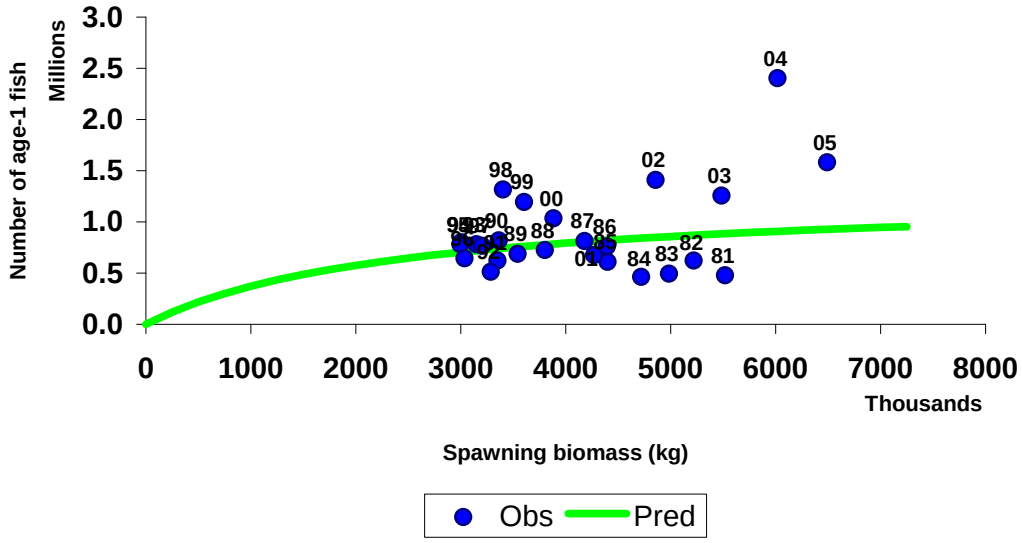

Figure 4. Spawning stock biomass and subsequent recruitment one year later. The steepness in the predicted curve was fixed at 0.75 in the base run.

Status Determination Criteria

In the management of mutton snapper in the Southeast US, the two Councils have adopted $F_{30\%}$ as a proxy for F_{MSY} and $F_{40\%}$ as a proxy for the fishing mortality rate at optimum yield, F_{OY} (Amendment 11, Snapper Grouper FMP, SAMFC 1998). Therefore, the MFMT would be $F_{30\%}$ or 0.34 per year, MSY would be the yield associated with $F_{30\%}$

or 688,000 kg, and SSB_{MSY} would be the spawning biomass at $F_{30\%}$ or 6.30 million kg. The MSST would be (1- constant) times the spawning biomass at $F_{30\%,}$ and the constant usually is the natural mortality. In the case of mutton snapper, the constant would be 0.11, and MSST would be 5.96 million kg (Table 6). The control rule is shown in Fig. 5. The AW panel did not recommend changing any of the management criteria for mutton snapper.

Table 6. Stock status criteria

Parameter	Value	Units
Maximum sustainable yield (MSY, $Yield_{F30\%}$)	688000	Kg
Spawning biomass at MSY ($SSB_{MSY,}$ $SSB_{F30\%}$)	6296000	Kg
Maximum Fishing Mortality Threshold (MFMT, $F_{30\%}$)	0.34	Per year
Minimum Spawning Stock Threshold (MSST, (1-0.11)*$SSB_{F30\%}$)	5603000	Kg
Fishing mortality at optimum yield ($F_{40\%}$)	0.26	Per year
Optimum yield (OY, $Yield_{F40\%}$)	524000	Kg
F_{2006}	0.18	Per year
$F_{2006}/F_{30\%}$	0.51	--
SSB_{2006}	7146000	Kg
$SSB_{2006}/SSB_{F30\%}$	1.14	--

Stock Status

The stock status ratios from the base run were $F_{2006}/F_{30\%}$ = 0.51 and $SSB_{2006}/SSB_{F30\%}$ = 1.14. Using the current status criteria, the base run indicates the stock was neither undergoing overfishing nor was the stock overfished in 2006, but sensitivity runs indicate that there is a moderate probability that the stock could be overfished. The general increase in the recreational fishing mortality rate adds to the concern.

Uncertainty

There were two aspects to uncertainty. The first estimated the standard errors of the parameters, and the second was explored through the use of different models and through sensitivity runs (Fig. 5). The standard errors of some key parameters such as virgin stock size were very narrow (on the order of CV = 0.2% or 0.4%) while their associated parameter estimates differed by 240%. While the sensitivity runs were not exhaustive,

they were chosen to represent a range of plausible conditions. The sensitivity runs show that over many alternative configurations of steepness and natural mortality, the stock was not undergoing overfishing but the stock could be overfished. The uncertainty in virgin stock size complicates determining whether mutton snapper were overfished in 2006. The base run results indicate that the stock is in a healthy condition being neither over-fished nor undergoing overfishing. However, there is concern that, given the uncertainty in the results, the stock was overfished in 2006 and that the recreational fishing mortality rate could increase such that the stock could become overfished. The Review Panel thought that the way to address the uncertainty as to whether mutton snapper were overfished would be to have the stock re-assessed in a short time (3 years) using a different assessment method.

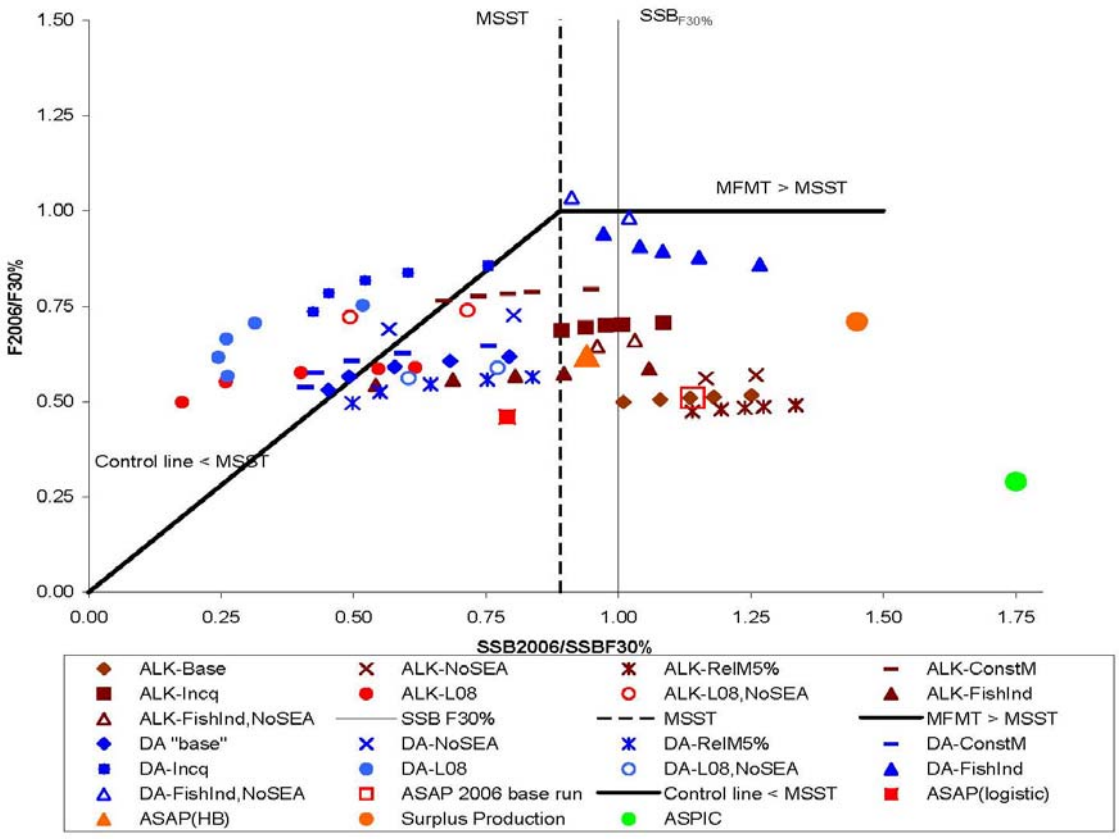

Figure 5. Control rule and results from ASAP sensitivity runs including two runs requested at the review and the surplus production model. The base run results are indicated by the square with the diamond in the center.

Projections

ASAP's projections were run using the base run, with natural mortality averaging 0.11 per year, and similar runs using the lower natural mortality averaging 0.08 per year. The fishing mortality options were: (a) F=0, (b) the Councils' OY fishing rate of $F_{40\%}$, (c) the Councils' MSY fishing rate of $F_{30\%}$, and (d) using the total harvest fishing mortality rate in 2006. Because of the longevity of mutton snapper, the projections were run out 50 years, 2007-2056 with the harvest in 2007 set equal to that in 2006 because any regulations could not be implemented prior to 2008. Projections using the base run of directed harvest through 2017 are shown in Table 7. The situation with mutton snapper is a bit unusual because the fishing mortality rate for the past several years has been less than either the MSY proxy or OY. Thus, if either of these benchmark fishing mortality rates is adopted, the harvest would be expected to increase which would reduce the spawning stock biomass. Another set of projections using the Lorezen natural mortality rates that averaged 0.08 per year also showed the spawning biomass increasing with fishing at $F_{30\%}$,$F_{40\%}$, or F_{2006}. Given a new assessment in three years, a better determination of stock status and whether stocks are continuing to increase can be made.

Table 7. Projected directed harvest from ASAP base run with age-specific natural mortality rates averaging 0.11 per year for three different fishing mortality rates.

Year	Directed Harvest (kg)		
	MSY($F_{30\%}$)	OY ($F_{40\%}$)	F_{2006}
2007	432600	432600	432600
2008	928851	708863	492672
2009	824689	646123	460589
2010	803414	643036	467920
2011	783622	639389	474006
2012	757327	629411	475015
2013	727479	614579	471269
2014	703190	602548	468454
2015	683254	592949	466694
2016	665965	584518	465103
2017	650941	577132	463696

Special Comments

No special comments are made.

Sources of Information

The source of results contained in summary report came from the Data Workshop and Stock Assessment Workshop reports and adjustments or corrections found after the reports were submitted.