1. Introduction

In this paper, we attempted the preliminary stock assessment of swordfish (*Xiphias gladius*) (SWO in the Indian Ocean by A Stock-Production Model Incorporating Covariates (ASPIC) for two periods (27 years: 1980-2006 and 15 years: 1992-2006). The reasons to use these two periods are explained in the other papers submitted to this meeting (IOTC WPB6) by Nishida (2008).

2. Data

2.1 Catch

We used the nominal catch data from the IOTC database (as of July 2, 2008). We define three gears (fleets) as below (for longliners we defined two classes):

Table 1 Catch of three types of fleets (gear types) exploiting SWO in the Indian Ocean

	Targeting	Countries and other gear
Taiwan LL type	target and/or by-catch	● Taiwan and others (EC, Australia, Indonesia and Seychelles) ● other gears (nil catch)
Japan LL type	bycatch	● Japan and all others LL except Taiwan, EC, Australia, Indonesia and Seychelles ● Line (nil catch)
GILL	Target	● Taiwan and Sri Lanka

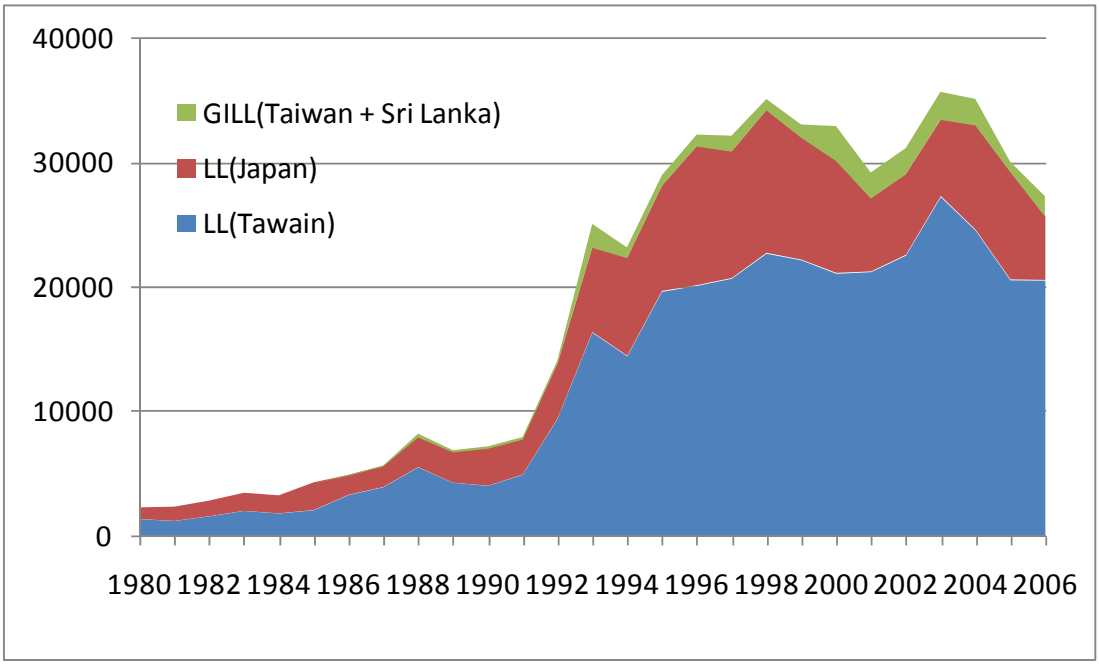

Fig 1 Nominal catch (tonnes) used for the ASPIC analyses for three types of fleets (gear types)

2.2 CPUE

(1) 1980-2006

For the standardized (STD) LL CPUE we used the Japanese one by Semba et al (IOTC-WPB6-2008-__) and the Taiwanese one by Wang et al (IOTC-WPB6-2008-__).

Longline

We did not use the Taiwan STD CPUE (case 1) (combined SWO catch compositions and NHBF for the correction factors for targeting) as this has the typical discrepancies between two CPUEs in the past which did not provide any realistic results. Similar observations are also realized for YFT and BET.

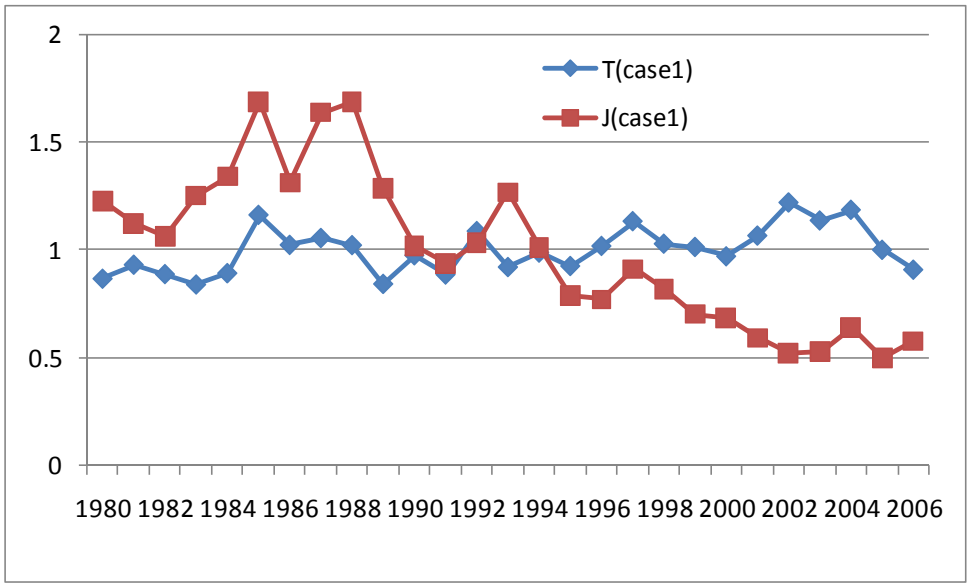

Fig 2 (not used)

However we used Japan STD CPUE (case1) and Taiwan STD CPUE (1995-2006) (case 3 and 4) as all three use the NFBF for the targeting correction factors for targeting.

Gillnet

We use the nominal CPUE obtained from catch & effort data available in the IOTC database (as of July 2 , 2008)

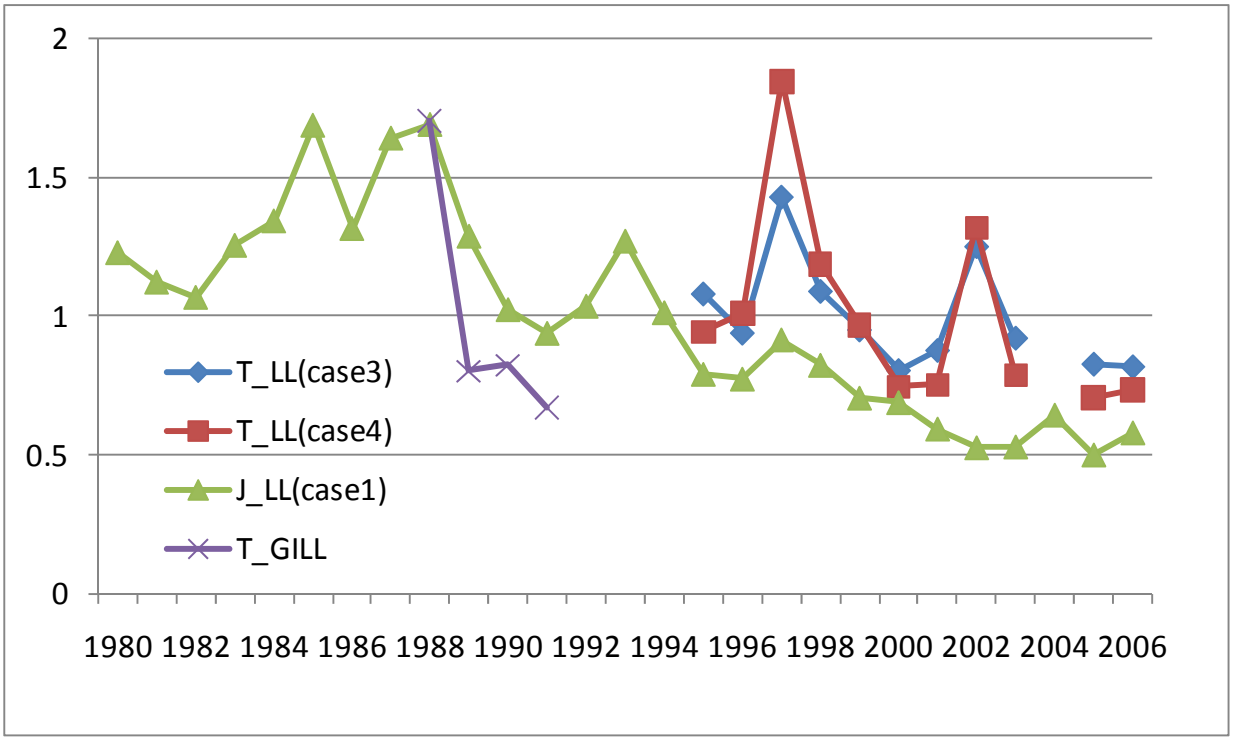

Fig. 3 Four types of CPUE series for the ASPIC (1980-2006) (scaled as average =1)

(2) 1992-2006

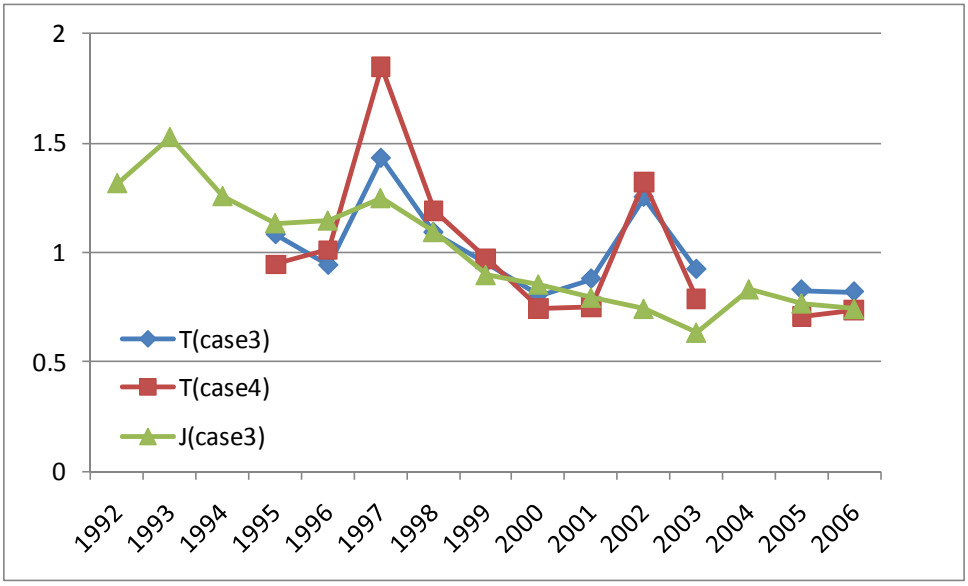

Fig. 4 Two types of CPUE series for the ASPIC (1992-2006) (scaled as average =1)

3. Preliminary ASPIC analyses

We used the ASPIC software (ver. 5.05) developed by Prager (2004). We attempt 8 scenarios combining among Japan & Taiwan STD LL CPUE and Taiwan GILL CPUE using the Schaefer option. Table 1 shows the results for 8 scenarios

Table 1 Eight scenarios and corresponding results of the ASPIC runs based on the Schaefer production model option.

(*) in 1,000 tones (**) NA not available

Period	no	Japan STD CPUE (case 1)	Taiwan STD CPUE (case 3) (1995-2006)	Taiwan STD CPUE (case 4) (1995-2006)	Taiwan GILL CPUE (1988-1991)	Catch 2006 (*)	MSY (*)	K (*)	B 2006 (*)	B (MSY) (*)	B06/B (MSY)	F 06	F (MSY)	F06/F (MSY)	R M S
A 1980-2006	A1	ON (1980-2006)	ON	OFF	ON	27	31	86	38	41	0.85	0.71	0.72	0.99	0.20
	A2				OFF		31	82	36	41	0.93	0.75	0.76	0.99	0.17
	A3		OFF	ON	ON		Unrealistic values (beyond common & realistic constraint values)								
	A4				OFF		30	102	42	51	0.85	0.65	0.80	1.09	0.20
	A5		OFF	OFF	OFF		30	121	49	61	0.81	0.56	0.49	1.14	0.17
B 1992-2006	B1	ON (1992-2006)	ON	OFF	NA (**)		29	120	107	105	1.03	0.26	0.28	0.92	0.15
	B2		OFF	ON			27	251	116	126	0.92	0.24	0.22	1.11	0.19
	B3		OFF	OFF			Unrealistic values (beyond common & realistic constraint values)								

Discussion

- For A1, A2 and A5, estimated biomass in 2006 (36-49,000 tones) are too low and too close to their MSY values (30-31,000 tones) which are unrealistic.
- For B1 and B2, based on RSM values, scenario B1 is likely the best among 8 scenarios.
- As predicted, it is likely that the period for 1980-2006 include the large uncertainty caused by biases from the regular LL (for details refer to Nishida, 2008 submitted to this meeting).
- Some resultant Figure are shown next page (Figs. 5-7).
- Based on the preliminary results, it is likely SWO stock is around the MSY level.

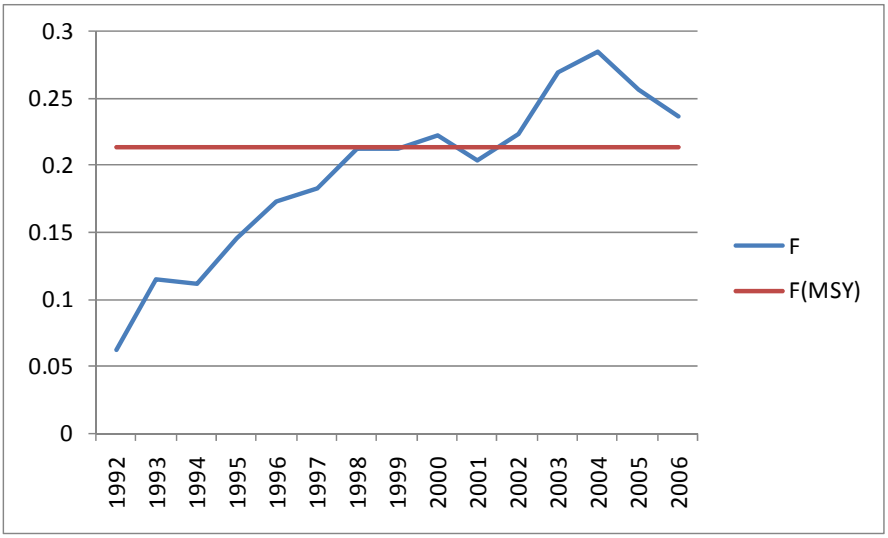

Fig 5. F vs. F(MSY)

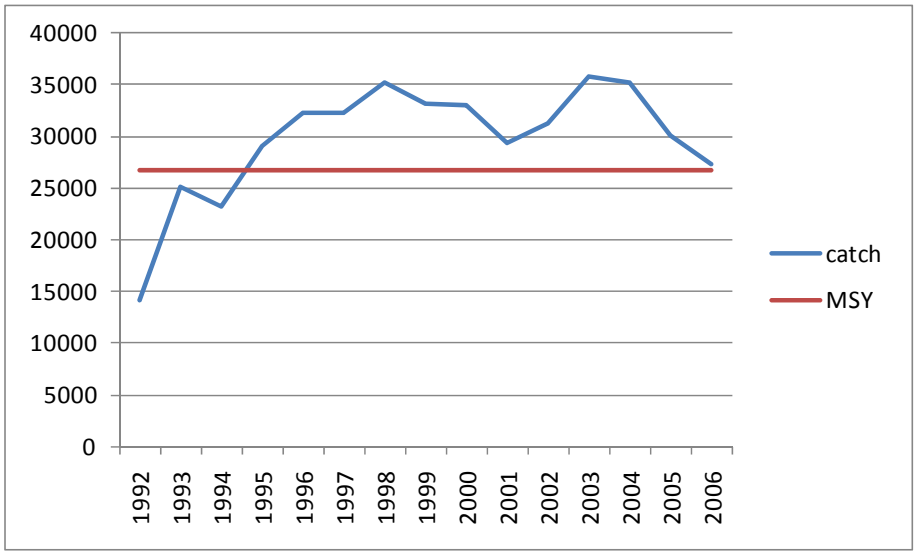

Fig 6. Catch vs. MSY

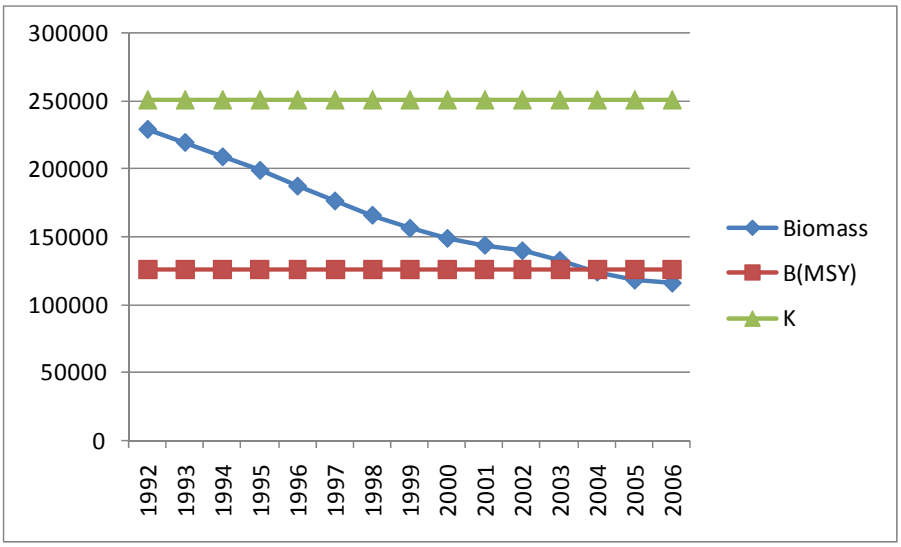

Fig. 7 Biomass vs B(MSY) and K

Acknowledgments

We thank Dr Mike Prager (developer of the ASPIC) (NMFS, NOAA, USA) who assisted our SWO analyses. Also many gracias for Mr. Miguel Herrera (IOTC) to provide the newest data set for our analyses.

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Prager, M. (2004) User's Manual for ASPIC: A Stock-Production Model Incorporating Covariates (ver. 5) and auxiliary programs, Population Dynamics Team, Center for Coastal Fisheries and Habitat Research, National Oceanic and Atmospheric Administration, 101 Pivers Island Road, Beaufort, North Carolina 28516 USA: National Marine Fisheries Service Beaufort Laboratory Document BL-2004-01

User's Manual for ASPIC: A Stock-Production Model

Incorporating Covariates (ver. 5)

And Auxiliary Programs

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Chang, Shui-Kai Chang and Wang, Shyh-Jiun Wang (2004) CPUE Standardization of Indian Ocean Swordfish from Taiwanese Longline Fishery for Data up to 2002 OTC-2004-WPB-09

Saito, H. and Yokawa, K. (2003): Update of standardization of swordfish CPUE of Japanese longliners In the Indian Ocean IOTC. Proceedings no. 6 (2003) pages 273-279 WPB-03-02, National Research Institute of Far Seas Fisheries, 5-7-1, Shimizu-Orido, Shizuoka, 424-9633, Japan

Other references are provided upon requested.

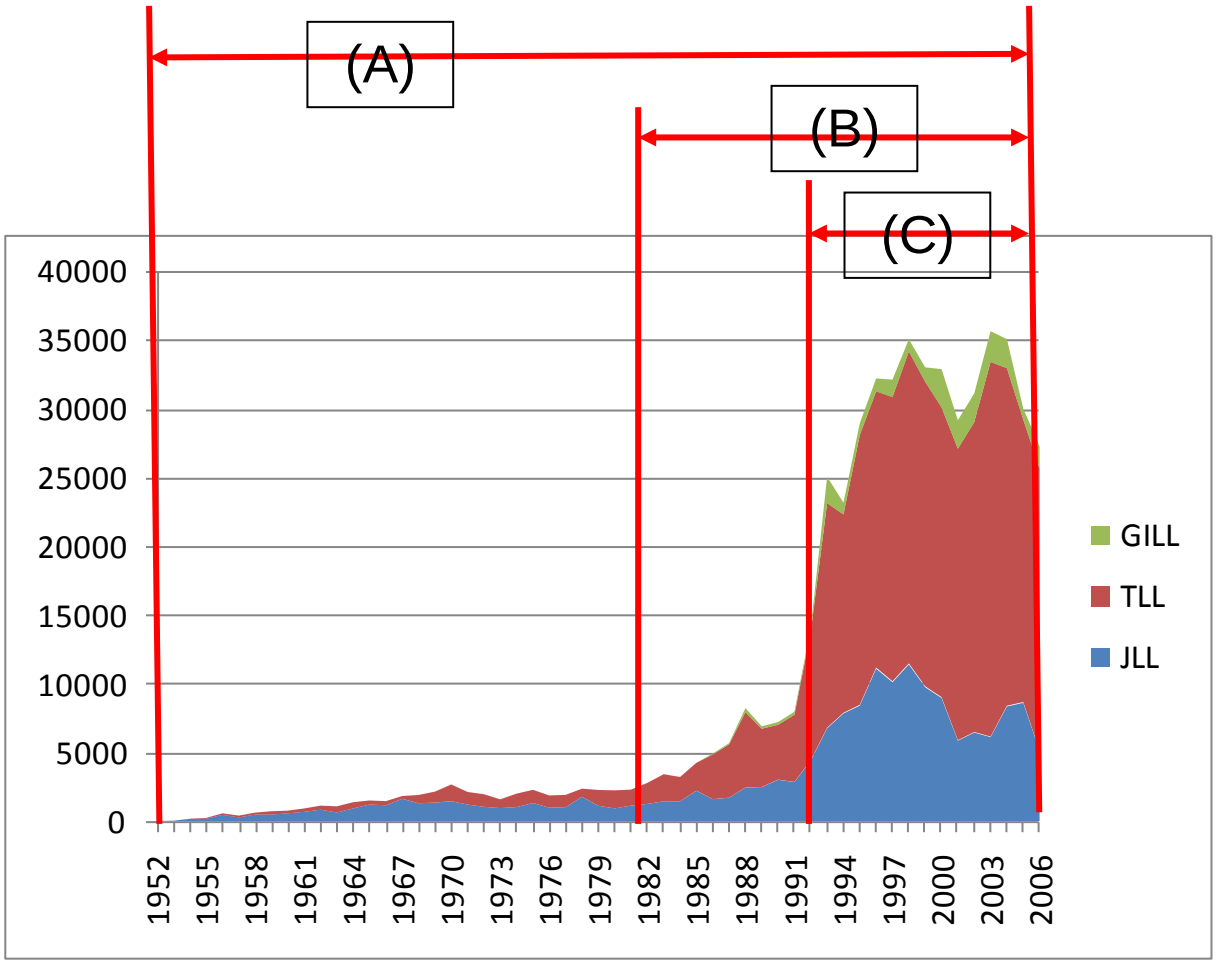
Addendum

Preliminary stock assessment of swordfish (*Xiphias gladius*) in the Indian Ocean by A Stock-Production Model Incorporating Covariates (ASPIC)

Nishida and Semba

- **Three Periods**

(A) ALL	**1952-2006**	**All stage (virgin stock to now)**
(B) After 1980	**1980-2006**	**Developmental stage to now**
(C) After 1992	**1992-2006**	**Full exploitation stage**

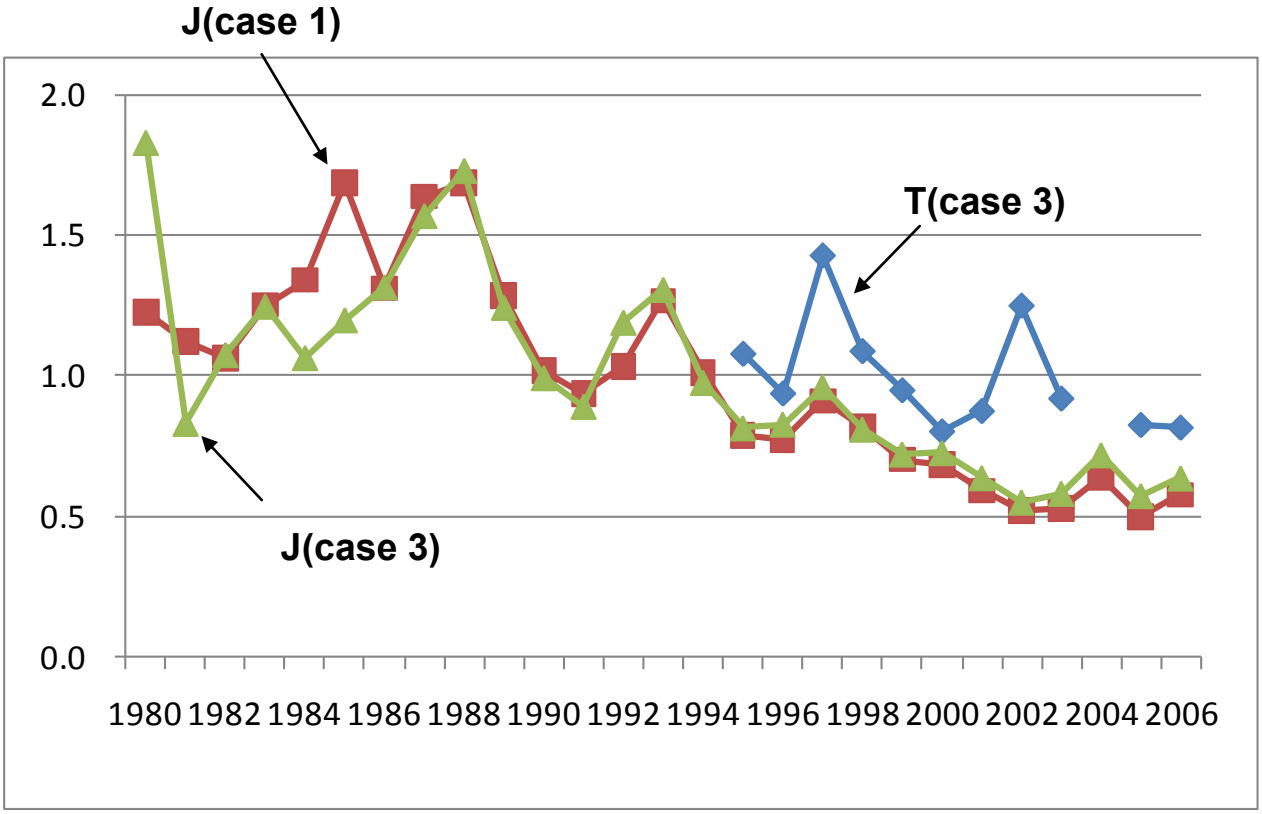


Catch (three fleets) in three periods

CPUE

Period A (1952-2006)
Period B (1980-2006)

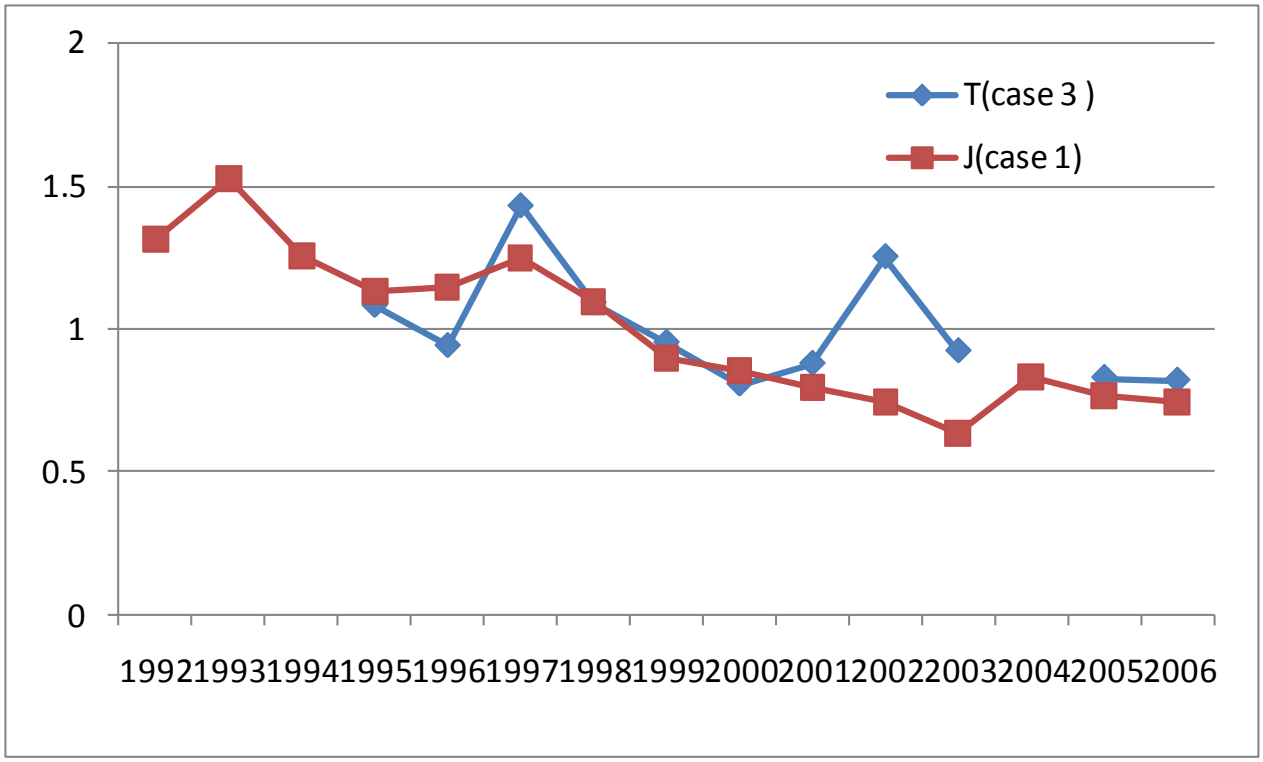
Case	GLM type	Scale	ENV
J(case 1)	Wang	coarse (5x5/Mo)	FULL
J(case 3)	Semba		
T(case 3)	Wang	Fine scale	Partial (no NCEP)



CPUE

Period C (1992-2006)

Case	GLM type	Scale	ENV
J(case 1)	Wang	coarse (5x5/Mo)	FULL
T(case 3)	Wang	Fine	Partial (no NCEP)



ASPIC runs (9 scenarios)

no	Period	CPUE		Catch 2006	MSY	K	Biomass			Biomass ratio		F (***)		F ratio	RMS
		J	T3				Virgin	2006	MSY (*)	2006 /1980 (**)	2006 /MSY	2006	MSY	2006 /MSY	
				in 1,000 tonnes											
A1	(A) 1952 - 2006	J1	ON	27	32	135	60	60	50	1.00	1.23	0.46	0.64	0.72	0.17
A2			OFF		30	167	127	68	61	0.54	1.13	0.40	0.49	0.82	0.17
A3		J3	ON		33	178	102	88	66	0.86	1.36	0.31	0.50	0.63	0.19
A4			OFF		31	204	157	96	75	0.61	1.29	0.29	0.41	0.69	0.20
B1	(B) 1980 - 2006	J1	ON		32	126	108	55	46	0.50	1.22	0.50	0.68	0.73	0.17
B2			OFF		30	148	124	59	54	0.48	1.11	0.46	0.56	0.83	0.16
B3		J3	ON		33	172	181	86	63	0.48	1.38	0.32	0.52	0.61	0.19
B4			OFF		31	201	205	95	74	0.46	1.31	0.29	0.43	0.67	0.20
C1	(C)1992-2006	J1	ON		31	262	242	131	96	0.54	1.37	0.21	0.32	0.85	0.15

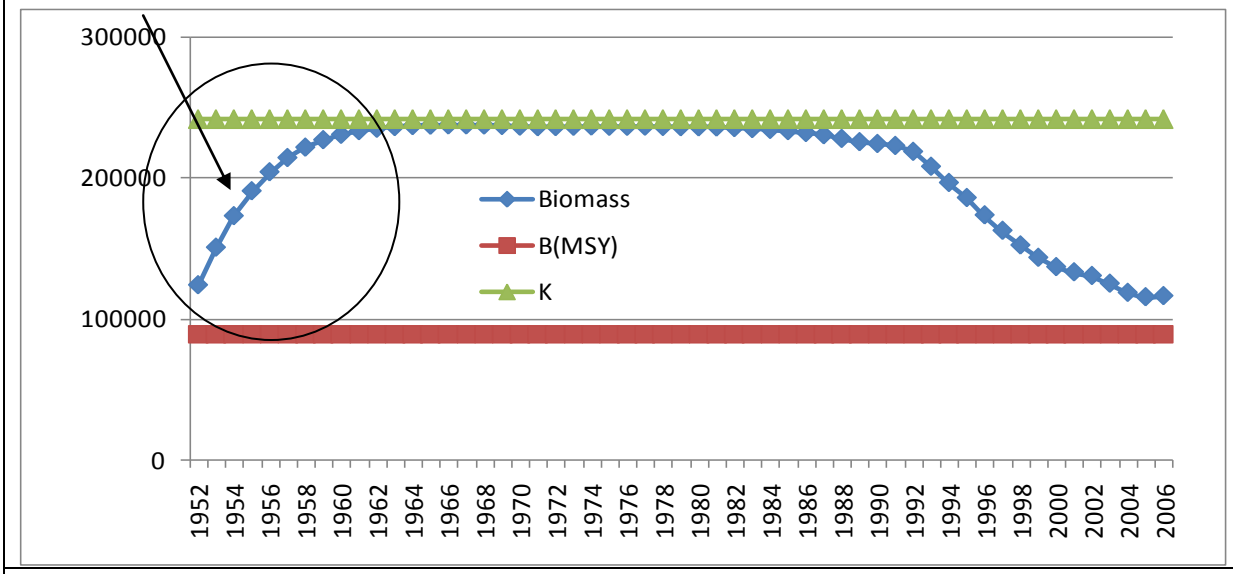
Criteria for the screening

(*)	B(MSY)	less than 2.*MSY
(**)	Depletion	more than 1.00
(***)	F	more than 0.5

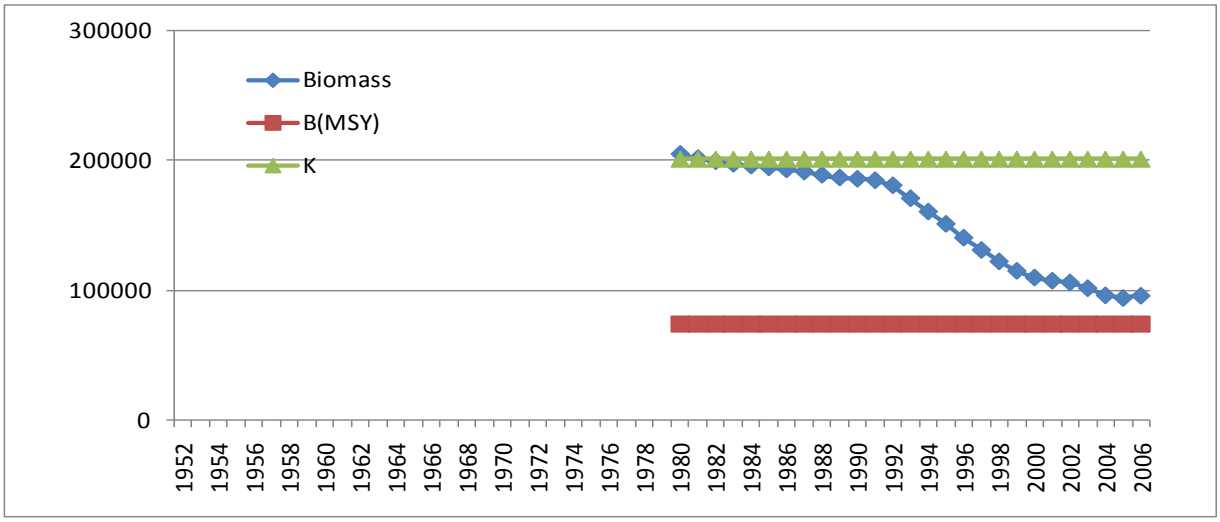
Finalists: A4, B4 and C1

BIOMASS、B(MSY) and K

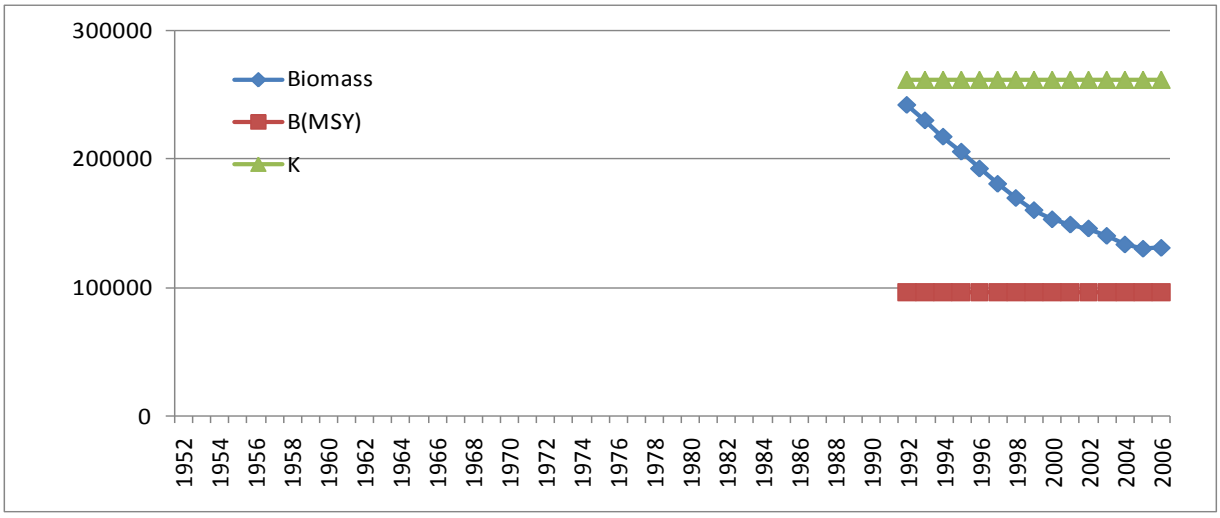
A4 ?



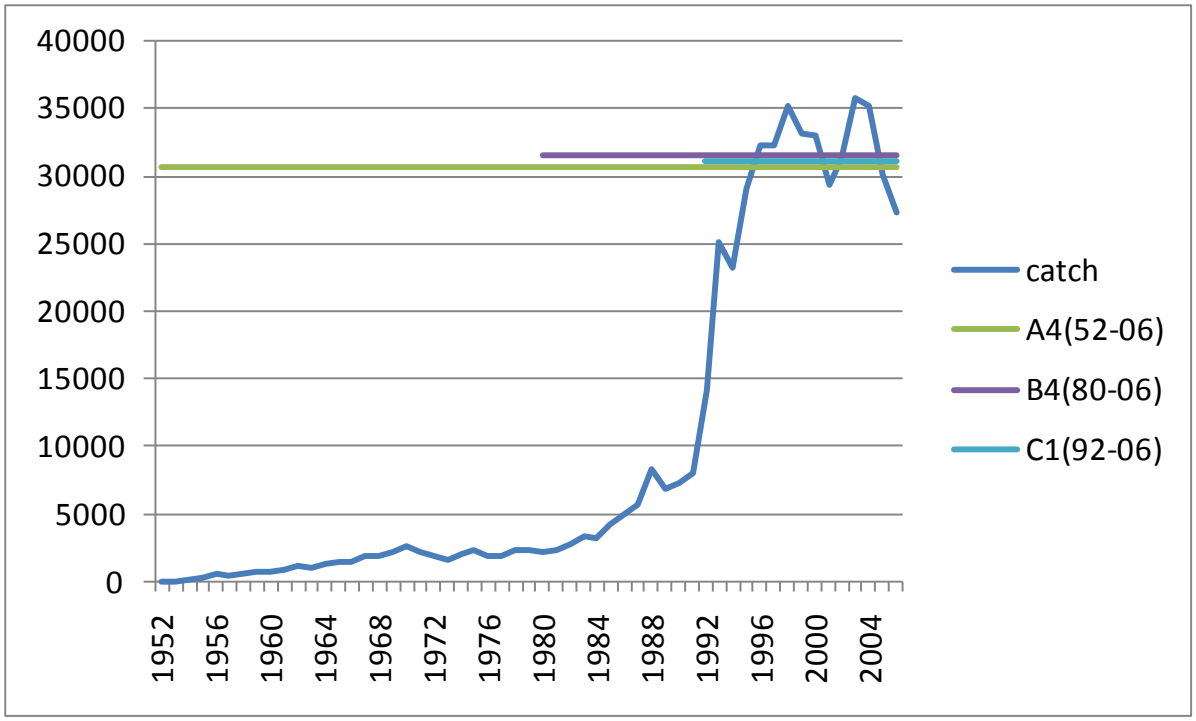
B4



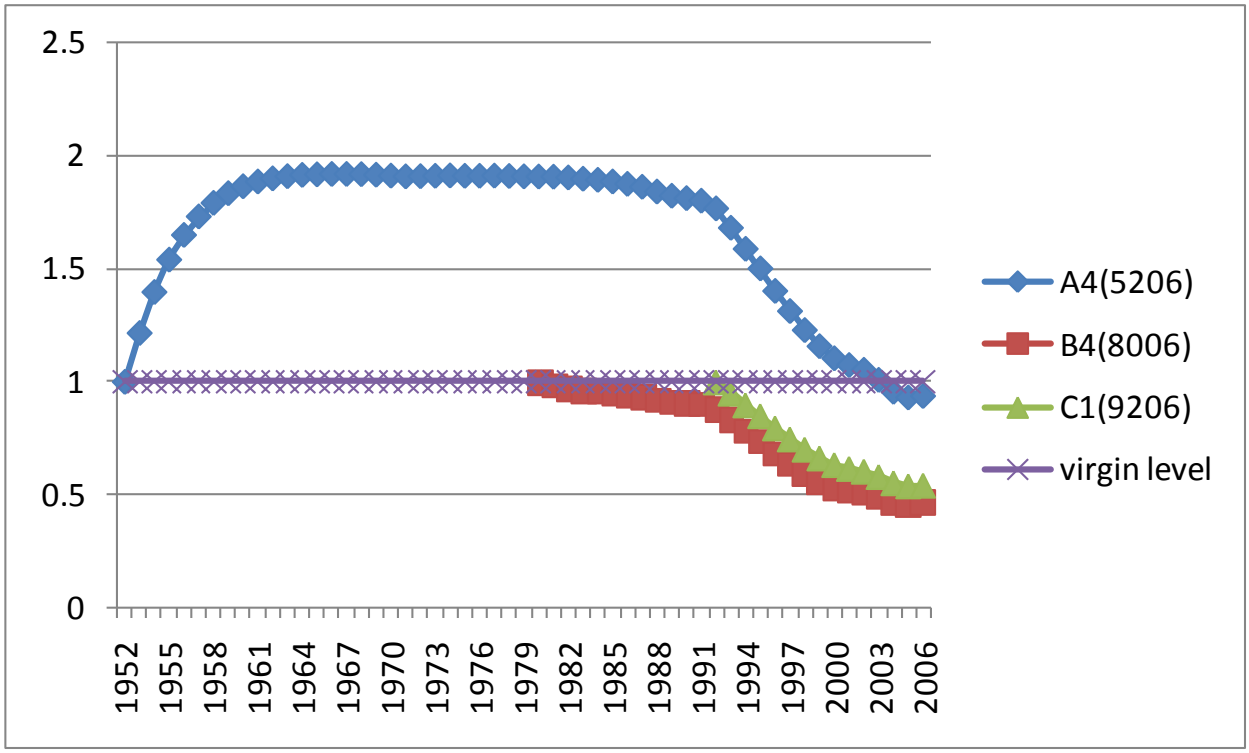
C1



CATCH vs MSY

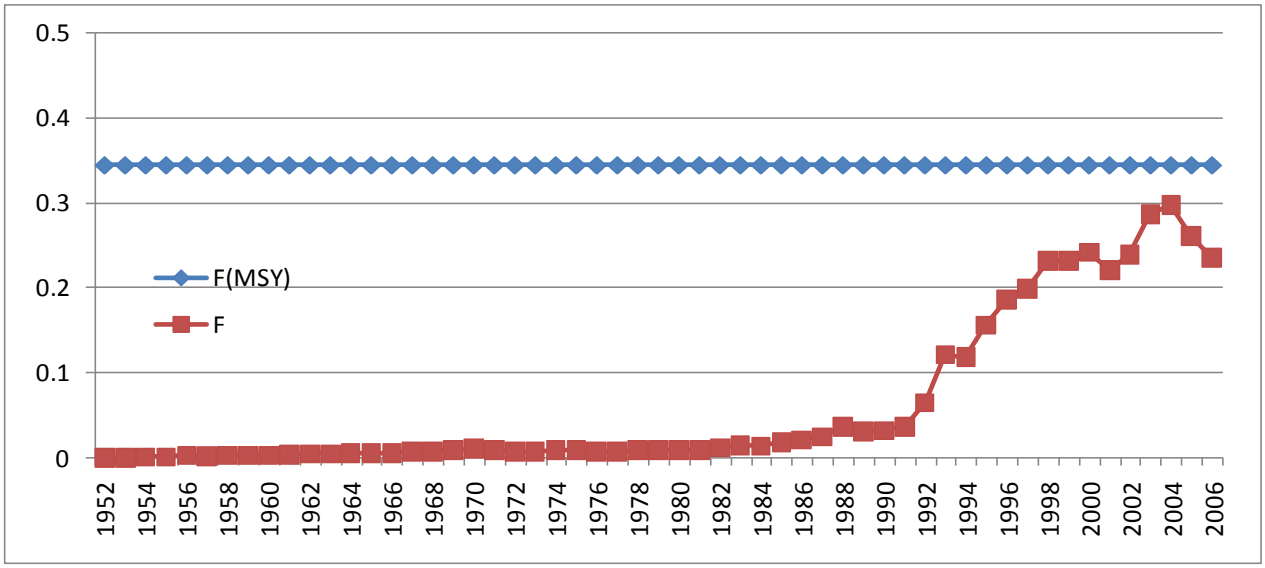


Depletion levels

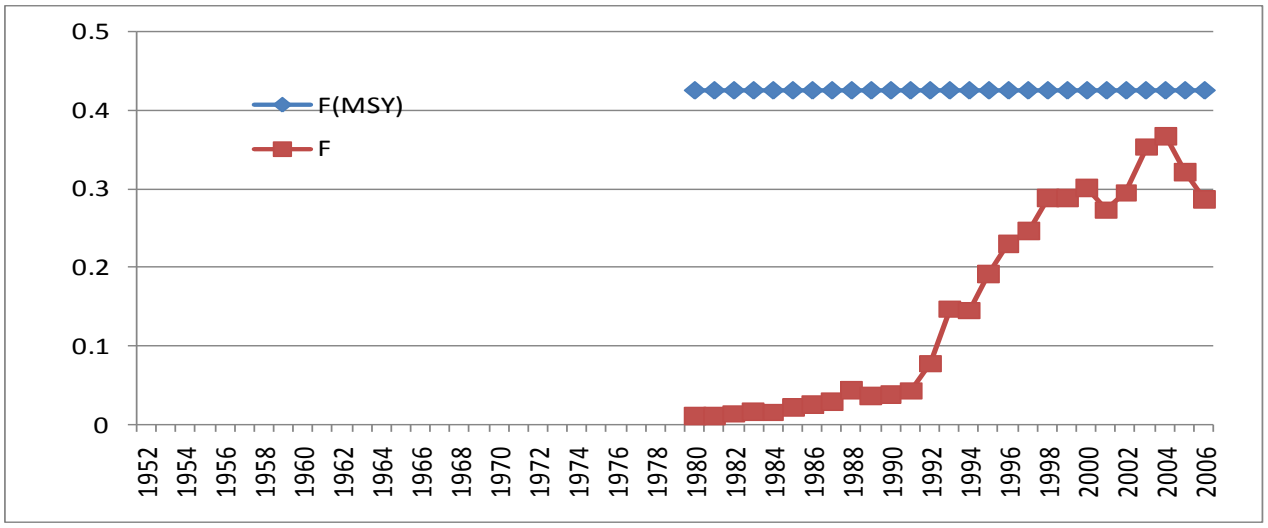


F vs. F(MSY)

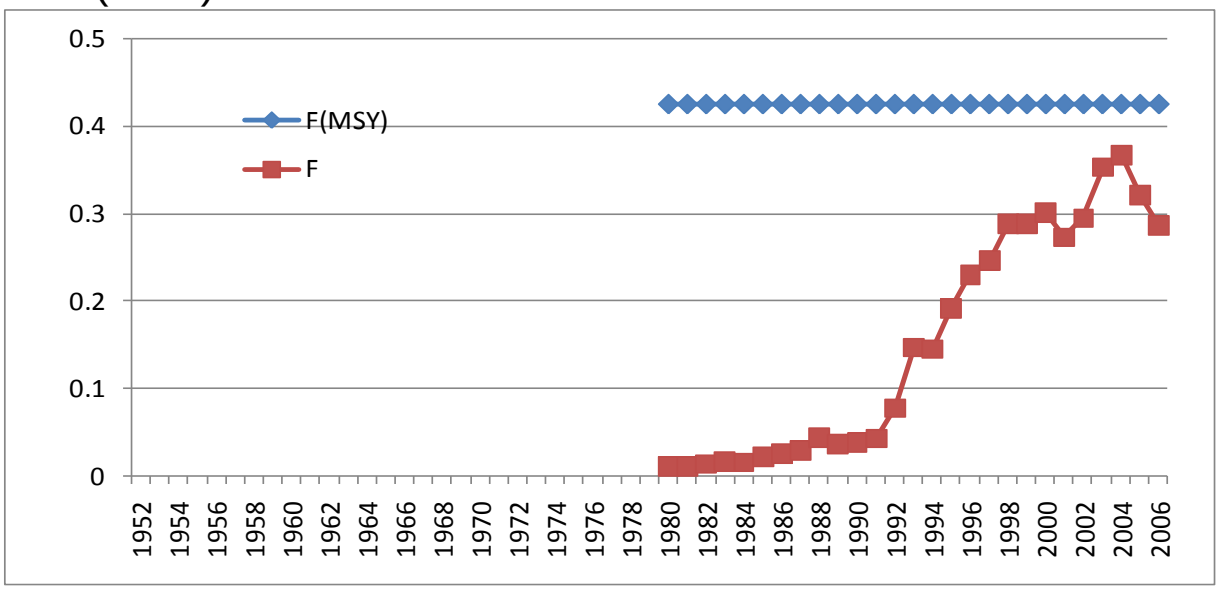
A4



B4



C1 F(MSY)



Summary

	BIOMASS trends	F and F(MSY)	MSY	B and B(MSY)	Depletion	Conclusion	MSY with 95% CI (1000 Tonnes)
A4	Abnormal behavior in 1950's	OK	OK	OK	Abnormal trends		
B4	OK	OK	OK	OK	OK	Best	( )-31-( )
C1	OK	OK	OK	OK	OK	2nd best	( )-31-( )

Important note

In 2006 F ratio seems to be low which imply the SWO stock status seems to be good. But this is due to the sudden decrease of the catch in 2005-2006.

For the recent F ratio and B ration for B4 and C1 are as below:

	B4	C1
2003	0.83	0.79
2004	0.86	0.82
2005	0.76	0.72
2006	0.67	0.65

Conclusion (ASPIC analyses)

Although the current assessment shows that the SWO stock status indicators (F ratio, B ratio etc) seems to be a good but this is due to the sudden drops of 2004-2005 catch.

Considering this factor, results of the assessments and the fact that the catch have been above MSY level (31,000 tones) in recent 12 years (1993-2004), SWO stock is likely around the MSY level and the stock status is likely improving if the catch level less than MSY level continues.