International Consultations on the Establishment of the

South Pacific Regional Fisheries Management Organisation

Report of the 9th Meeting of the Scientific Working Group

Viña del Mar, Chile, 21 – 29 October 2010



International Consultations on the Establishment of the
South Pacific Regional Fisheries Management Organisation

Meeting of the Deepwater Sub-Group

Bottom Fishery Impact Assessment Standard

- The previous draft of the SPRFMO Bottom Fishery Impact Assessment Standard, tabled at the 8th SWG meeting in November 2009, was further discussed.
- Discussions focused on requirements for new/exploratory fisheries, predictive modelling, detection of vulnerable marine ecosystems, the hierarchy of gear impacts, and the size of grid blocks for mapping the bottom-fishing footprint.
- The drafting group will continue to revise the BFIAS during the inter-sessional period, in cooperation with participants.

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Meeting of the Jack Mackerel Sub-Group

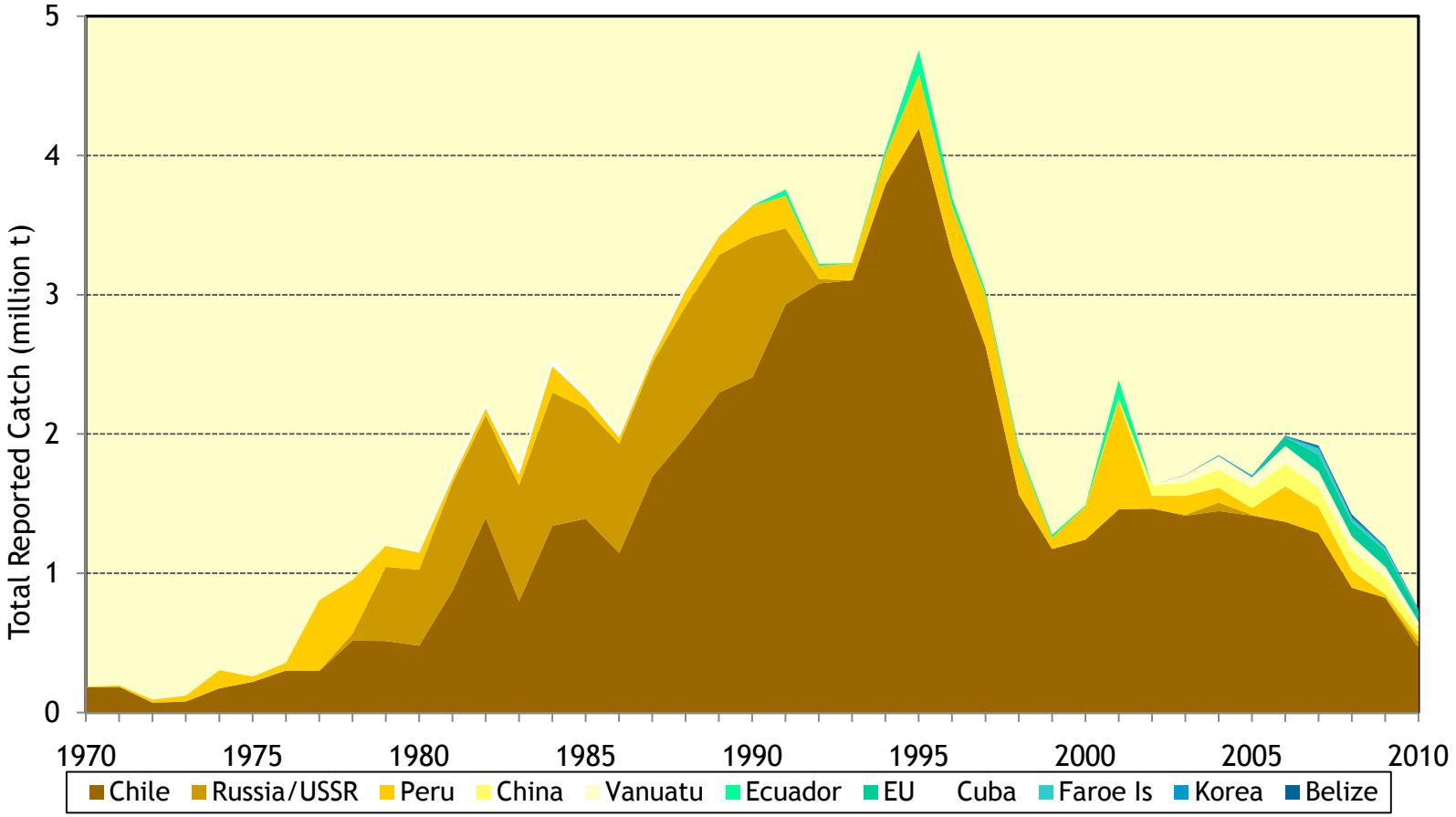
Jack Mackerel Sub-Group Tasks

The Jack Mackerel Sub-Group met prior to the SWG meeting:

- To conduct stock assessments using the Joint Jack Mackerel (JJM) statistical catch-at-age model, and a comparative assessment using a Triple Instantaneous Separable VPA model. The JJM model was developed and tested during two workshops of the Assessment Simulation Task Team in Lima, Peru in April 2010 and in Seattle, USA in August 2010.

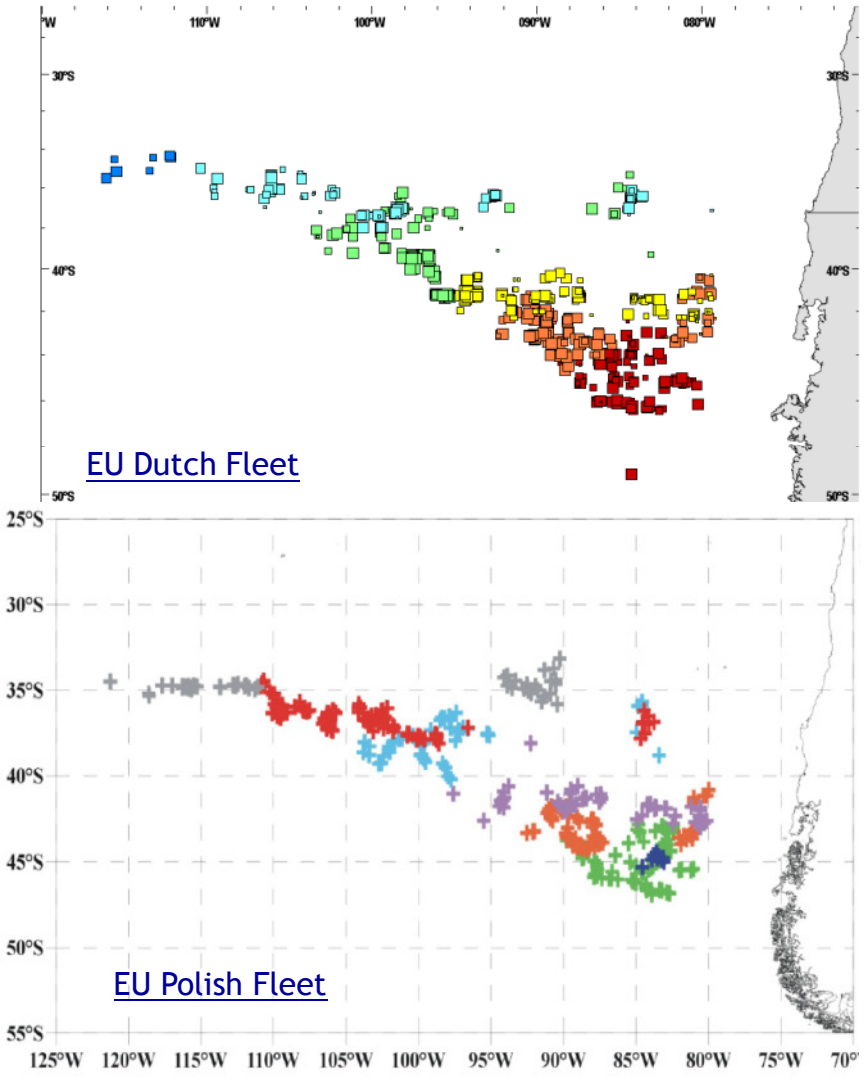
- To develop advice on the status of the Chilean jack mackerel resource in 2010 based on these assessments. Projections conducted using the JJM model under two alternative future recruitment scenarios, and five alternative future constant catch scenarios, were used to provide advice on probabilities of stock recovery under these scenarios.

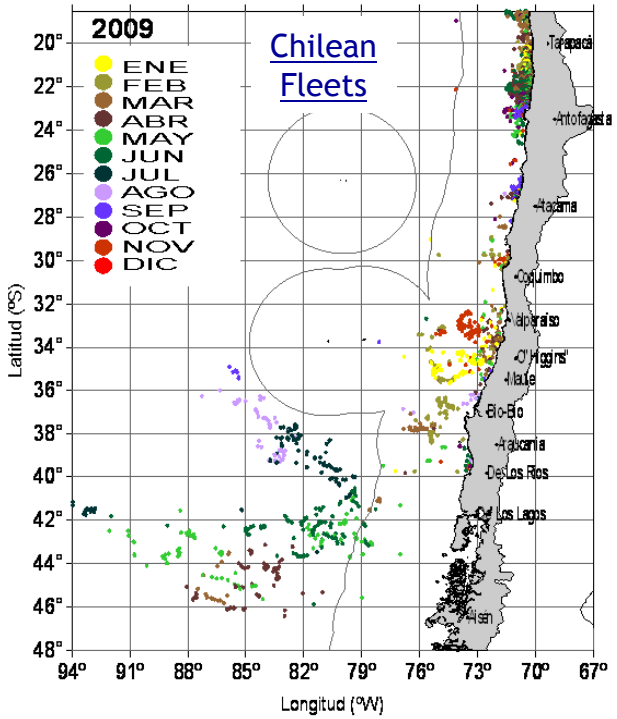
Jack Mackerel Catch Trends



Reported jack mackerel catches increased steadily from 1970 onwards, reaching a peak of 4.8 million t in 1995. Catches declined rapidly to 1.3 million t in 2000. Over the period 2000 - 2006 there was a slow increase to 2 million t. Despite increasing participation and fishing effort in the fishery since then, catches declined steadily from 2007 onwards to 1.2 million t in 2009, which was the lowest catch on record since 1980. Catches continued to decline in 2010, with reported total catches of 741,960 t (updated from 711,784 t reported to September 2010). (JMSG Report, Annex 2, Fig 1)

Jack Mackerel Stock Structure





Jack mackerel catches off the south-central Chilean coast show a continuous distribution from the coast out to the westwards extent of the current high-seas fishery, extending westwards past 120°W in 2009 and 2010.

In 2009 the SWG recommended that jack mackerel should be managed as one single management unit for the immediate future. Stock assessments were conducted under the assumption of a single stock.

(JMSG Report, Section 7.5)

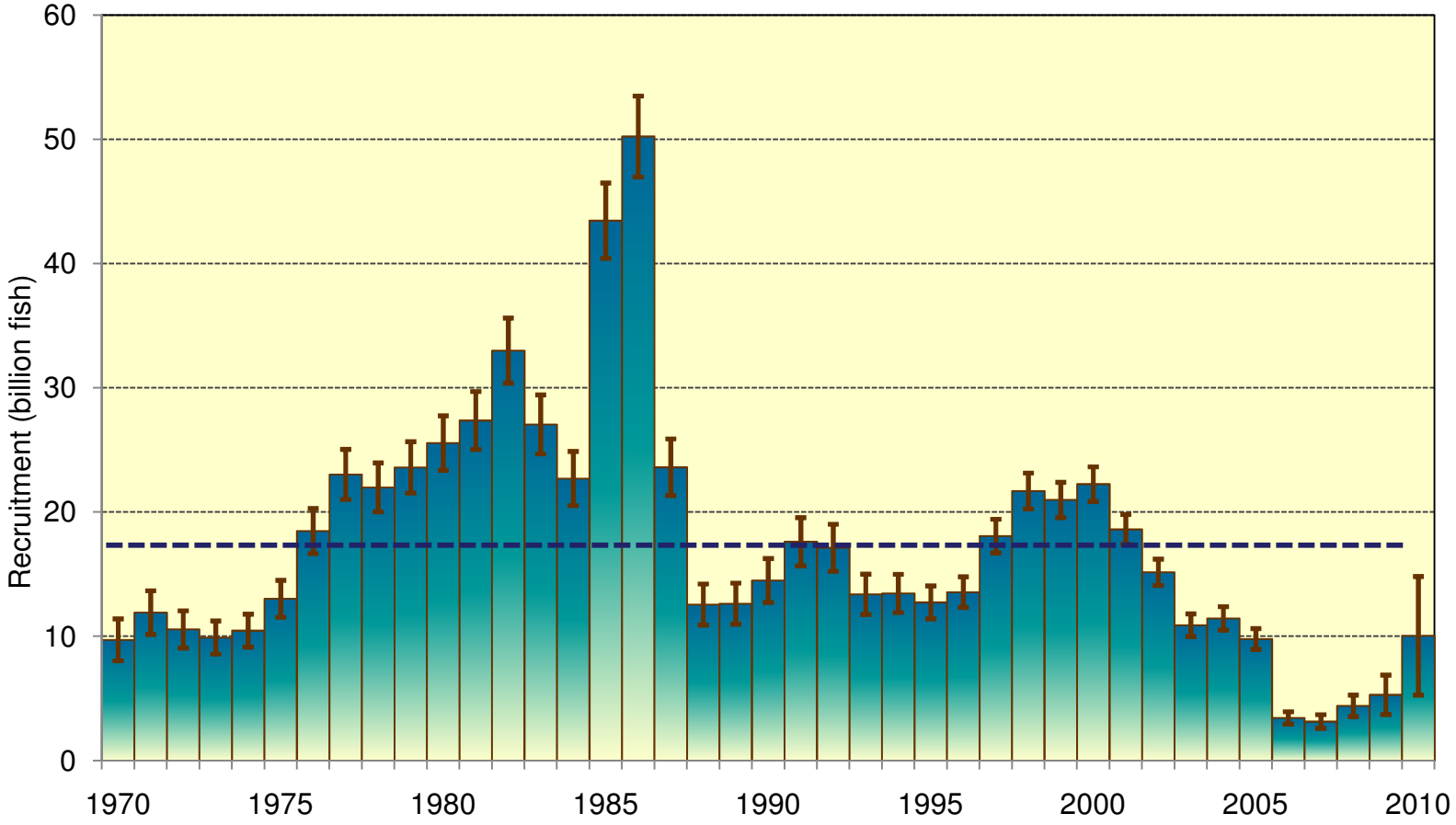
Jack Mackerel Assessment - Specifications

Model	Description
Initial base case: Model 1	• All indices assumed proportional to biomass • Soviet age compositions based on Soviet age-length keys • Include all index data • Gili growth parameters to convert length frequencies from the far-north fishery to age compositions
Sensitivities	
Model 2	Peruvian growth parameters to convert length frequencies from the far-north fishery to age compositions
Model 3	Kochkin growth parameters to convert length frequencies from the far-north fishery to age compositions
Model 4	Soviet age compositions based on Chilean age-length keys
Model 5	Down-weight acoustic indices (double CV)
Model 6	Down-weight CPUE data (double CV)
Model 7	Natural mortality alternative: $M = 0.33$

Seven alternative specifications of the JJM model were run to explore the sensitivities to the main data inputs. Best fits were obtained with Model 4, which was chosen as the base case for further analyses. Models 5 and 6 were retained for robustness tests and projections. A comparative analysis was run using the TISVPA model.

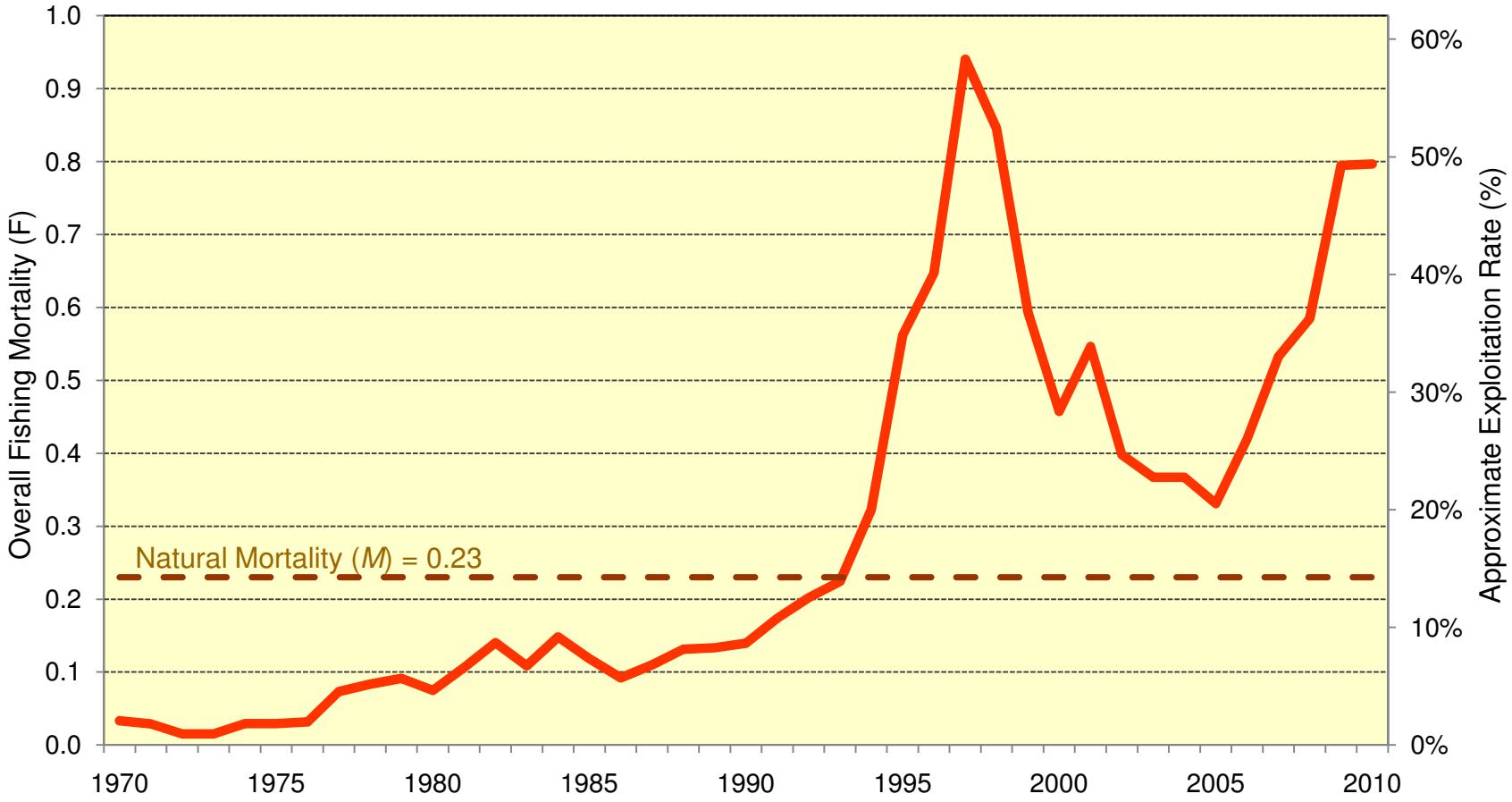
(JMSG Report, Annex 1, Tables 11 and 12)

Jack Mackerel Assessment - Recruitment



Results of the 2010 JJM assessment indicate that high catches in the 1990s resulted from steadily increasing recruitment (age 2) from 1970 to 1982, with two exceptionally strong recruitments in 1985 and 1986 (averaging 46.8 billion fish per year, more than two and a half times the long-term 1970 – 2010 average annual recruitment of 17.3 billion fish). Recruitment was somewhat below average from 1988 – 1996 and somewhat above average from 1997 – 2001. Recruitment has been below average since 2002 with four very weak year classes (30% of average) from 2006 – 2009. (JMSG Report, Annex 2, Fig 11b)

Jack Mackerel Assessment – Fishing Mortality

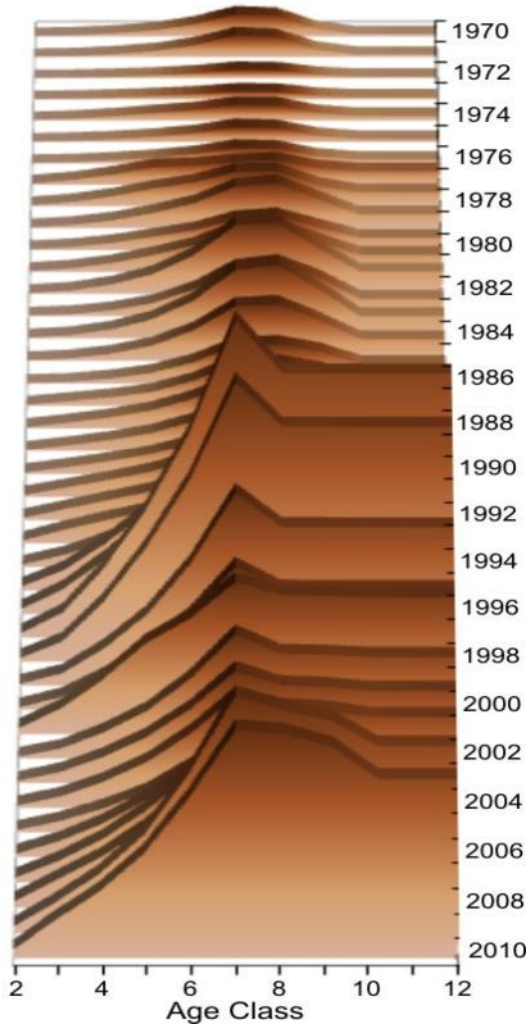


Fishing mortality (*F*) increased slowly from 1970 to reach about 0.22 in 1993, and then increased rapidly to 0.94, the highest level in the history of the fishery, in 1997. Estimated *F* declined back down to 1994 levels by 2005 partially as a result of effort reductions in the Chilean fleet, but has increased sharply again to about 0.8 in 2010, near the historically highest level.

(JMSG Report, Annex 2, Fig 11c)

Jack Mackerel Assessment – *F* by Age Class

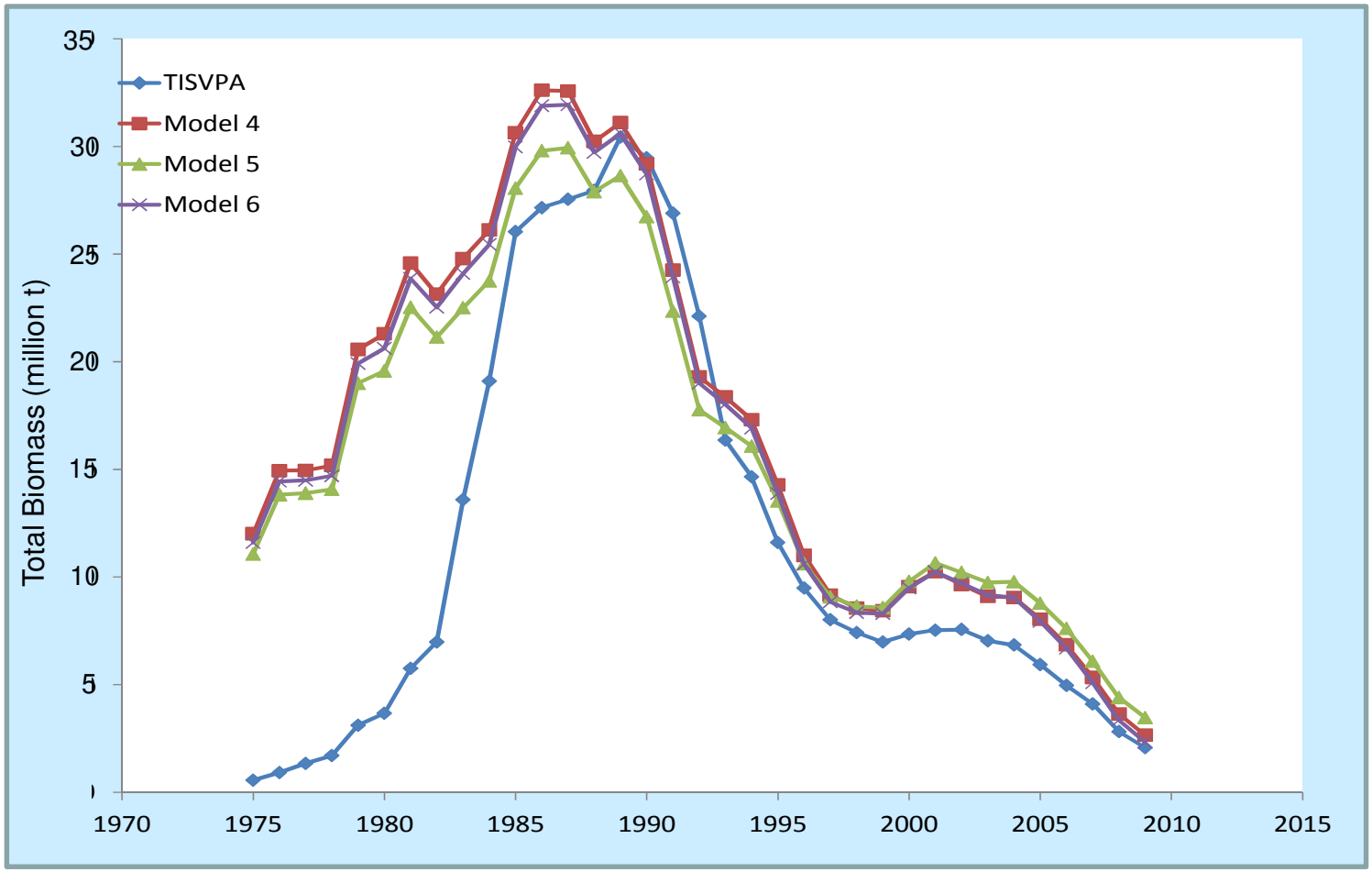
Age	2	3	4	5	6	7	8	9	10	11	12
1970	0.00	0.01	0.01	0.03	0.06	0.10	0.10	0.04	0.01	0.01	0.01
1971	0.00	0.01	0.01	0.03	0.06	0.10	0.10	0.04	0.01	0.01	0.01
1972	0.00	0.00	0.01	0.01	0.02	0.04	0.04	0.02	0.01	0.01	0.01
1973	0.00	0.00	0.01	0.02	0.02	0.04	0.04	0.02	0.01	0.01	0.01
1974	0.00	0.01	0.02	0.04	0.05	0.07	0.07	0.04	0.02	0.02	0.02
1975	0.00	0.01	0.01	0.02	0.04	0.07	0.07	0.03	0.01	0.01	0.01
1976	0.00	0.01	0.01	0.03	0.04	0.08	0.07	0.03	0.02	0.02	0.02
1977	0.01	0.02	0.05	0.09	0.09	0.11	0.12	0.08	0.07	0.07	0.07
1978	0.01	0.02	0.05	0.09	0.12	0.17	0.17	0.10	0.07	0.07	0.07
1979	0.00	0.02	0.04	0.07	0.12	0.20	0.22	0.14	0.07	0.07	0.07
1980	0.00	0.01	0.03	0.07	0.10	0.15	0.17	0.11	0.06	0.06	0.06
1981	0.01	0.02	0.04	0.08	0.13	0.21	0.22	0.15	0.09	0.09	0.09
1982	0.00	0.02	0.05	0.10	0.19	0.34	0.35	0.22	0.11	0.11	0.11
1983	0.00	0.01	0.03	0.07	0.13	0.24	0.26	0.19	0.09	0.09	0.09
1984	0.00	0.02	0.04	0.10	0.19	0.34	0.36	0.24	0.11	0.11	0.11
1985	0.00	0.01	0.04	0.08	0.15	0.27	0.28	0.20	0.11	0.11	0.11
1986	0.00	0.01	0.02	0.05	0.11	0.19	0.20	0.16	0.10	0.10	0.10
1987	0.01	0.02	0.04	0.07	0.13	0.21	0.22	0.18	0.11	0.11	0.11
1988	0.01	0.03	0.06	0.09	0.15	0.24	0.24	0.21	0.15	0.15	0.15
1989	0.01	0.03	0.06	0.09	0.15	0.24	0.24	0.21	0.15	0.15	0.15
1990	0.01	0.04	0.07	0.10	0.16	0.24	0.24	0.21	0.15	0.15	0.15
1991	0.01	0.05	0.09	0.13	0.20	0.29	0.26	0.24	0.21	0.21	0.21
1992	0.01	0.06	0.11	0.15	0.23	0.33	0.27	0.27	0.26	0.26	0.26
1993	0.02	0.07	0.13	0.17	0.25	0.36	0.30	0.29	0.29	0.29	0.29
1994	0.01	0.06	0.14	0.23	0.36	0.54	0.45	0.45	0.44	0.44	0.44
1995	0.02	0.11	0.25	0.42	0.63	0.91	0.78	0.77	0.77	0.77	0.77
1996	0.03	0.13	0.29	0.47	0.71	1.03	0.87	0.86	0.86	0.86	0.86
1997	0.03	0.14	0.37	0.66	1.03	1.54	1.31	1.31	1.31	1.31	1.31
1998	0.02	0.11	0.32	0.60	0.93	1.38	1.18	1.18	1.18	1.18	1.18
1999	0.01	0.07	0.21	0.38	0.64	0.99	0.82	0.82	0.82	0.82	0.82
2000	0.01	0.07	0.18	0.33	0.51	0.75	0.64	0.64	0.63	0.63	0.63
2001	0.03	0.14	0.30	0.49	0.62	0.80	0.74	0.73	0.73	0.73	0.73
2002	0.01	0.06	0.15	0.26	0.44	0.67	0.57	0.56	0.55	0.55	0.55
2003	0.01	0.06	0.15	0.26	0.41	0.61	0.53	0.52	0.50	0.50	0.50
2004	0.01	0.06	0.15	0.25	0.41	0.61	0.55	0.53	0.50	0.50	0.50
2005	0.01	0.07	0.14	0.23	0.37	0.54	0.48	0.47	0.44	0.44	0.44
2006	0.02	0.09	0.19	0.32	0.47	0.66	0.61	0.60	0.55	0.55	0.55
2007	0.03	0.12	0.24	0.40	0.60	0.84	0.79	0.77	0.70	0.70	0.70
2008	0.04	0.16	0.29	0.45	0.65	0.90	0.87	0.83	0.74	0.74	0.74
2009	0.04	0.18	0.34	0.56	0.88	1.28	1.21	1.15	1.02	1.02	1.02
2010	0.05	0.22	0.39	0.59	0.89	1.24	1.22	1.16	0.99	0.99	0.99



Fishing mortality is highest on ages 5 to 12, substantially exceeding *M* on these ages since the early 1990s, particularly over 1995 – 2002 and from 2006 onwards.

(JMSG Report, Annex 2, Fig 12)

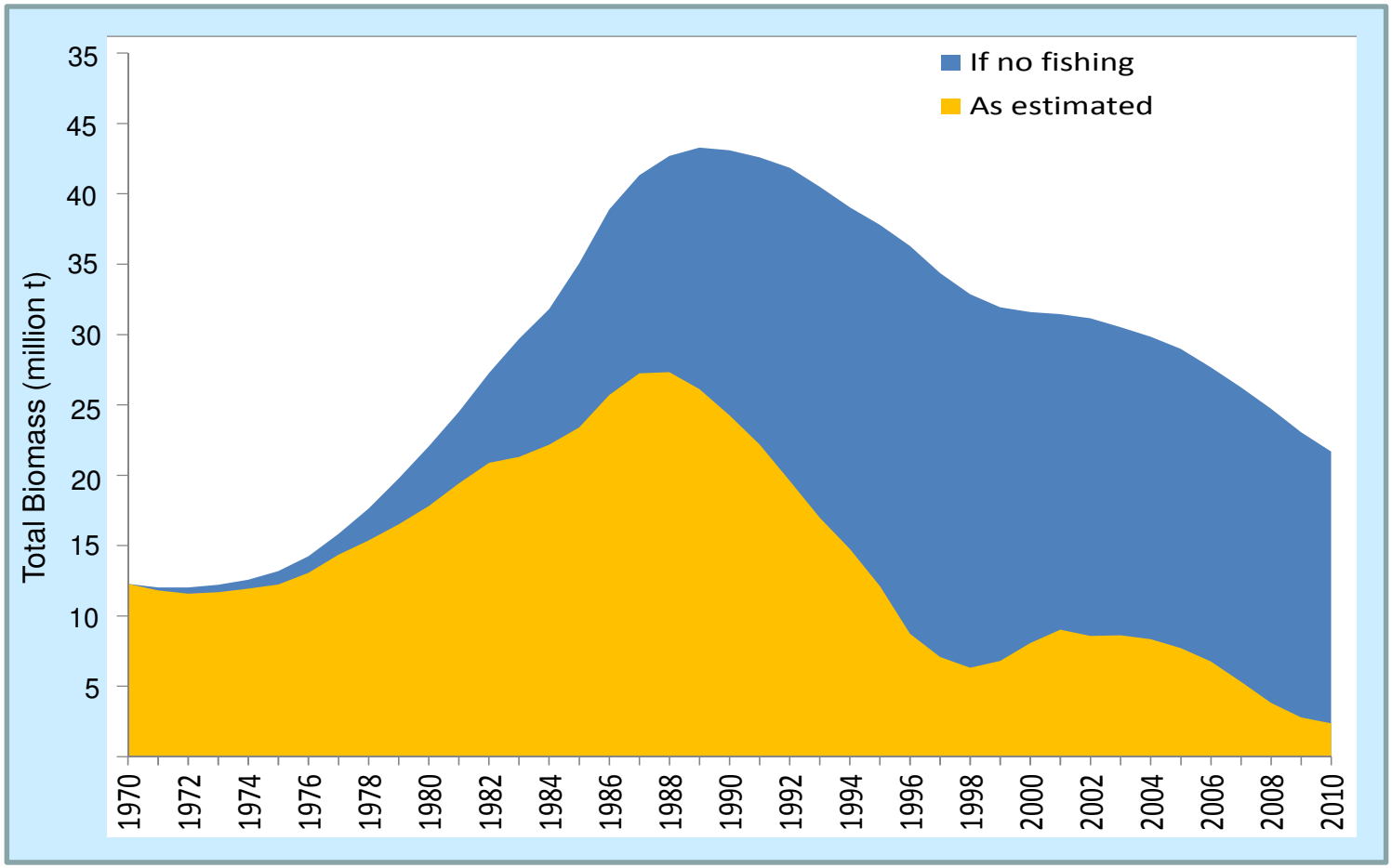
Jack Mackerel Assessment – Trend in Total Biomass



All assessment model and sensitivity runs produce highly similar historical trends in estimated total biomass, particularly over the period of decline from 1989 onwards. All models agree closely on relative and absolute estimates of current biomass.

(JMSG Report, Annex 2, Fig 14)

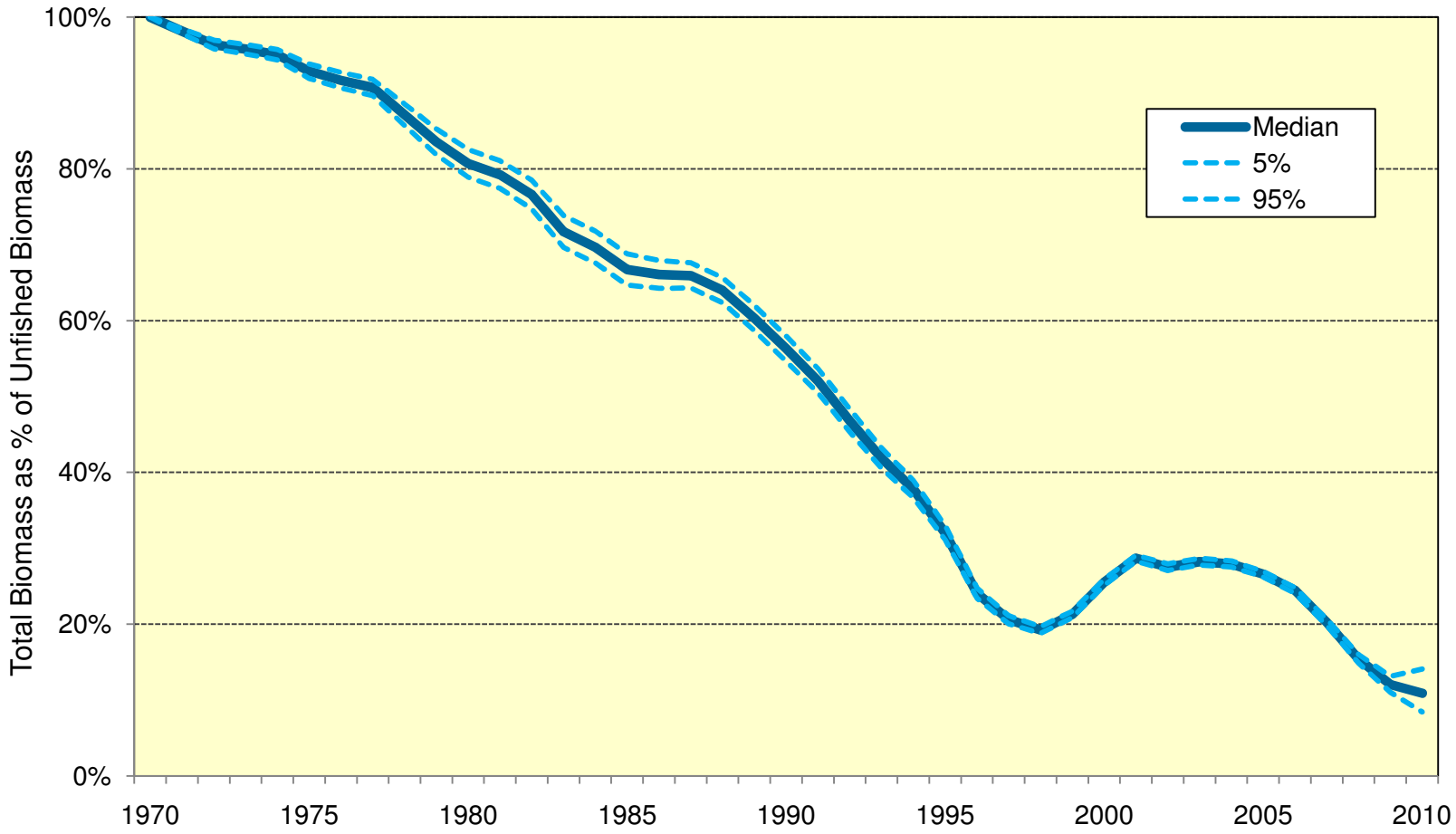
Jack Mackerel Assessment – Unfished Biomass



The ratio of estimated total biomass to the biomass which have existed had no fishing occurred has declined steadily throughout most of the history of this fishery. Under the JJM assessment model base case, the 2010 ratio of total biomass relative to the unfished biomass is estimated to be 11%, ranging from 9% (model 6) to 14% (model 5) in sensitivity analyses.

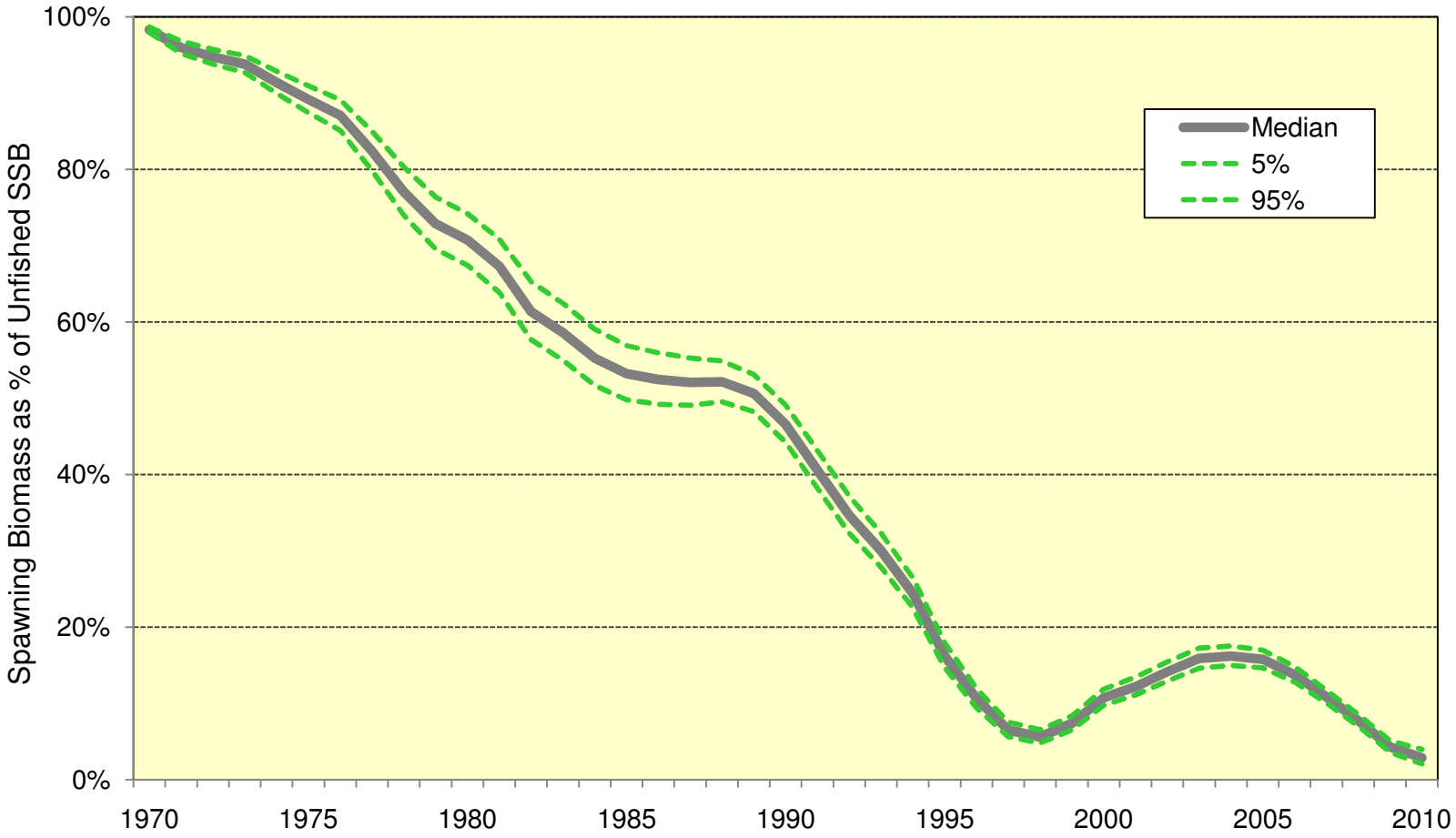
(JMSG Report, Annex 2, Fig 13)

Jack Mackerel Assessment – % of Unfished Total Biomass



Expressing current estimated biomass as a % of unfished biomass indicates that the stock dropped below 40% of the unfished level in 1994, dropping below 20% of unfished biomass in 1998. Estimated biomass recovered to almost 30% of unfished biomass over 2001 – 2004 before declining to the current level of 11%.

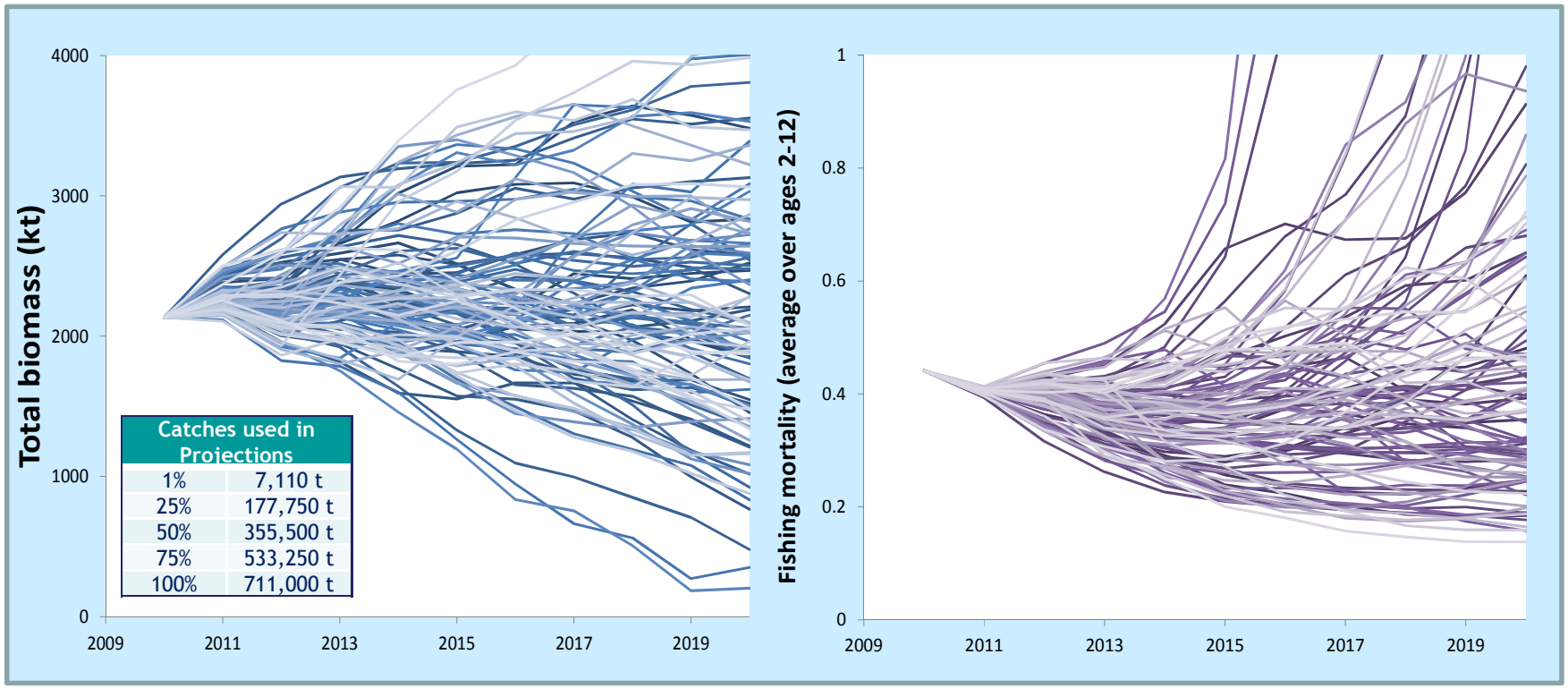
Jack Mackerel Assessment – % of Unfished Spawning Biomass



A comparison of estimated spawning biomass as a % of unfished biomass indicates that spawning biomass dropped below 20% of the unfished level in 1995, and has remained below 20% since then. After a period of recovery, estimated spawning biomass declined from 2005 onwards to 3% of unfished (for model 4; 5.9% for model 5; 1.4% for model 6).

Jack Mackerel Assessment - Projections

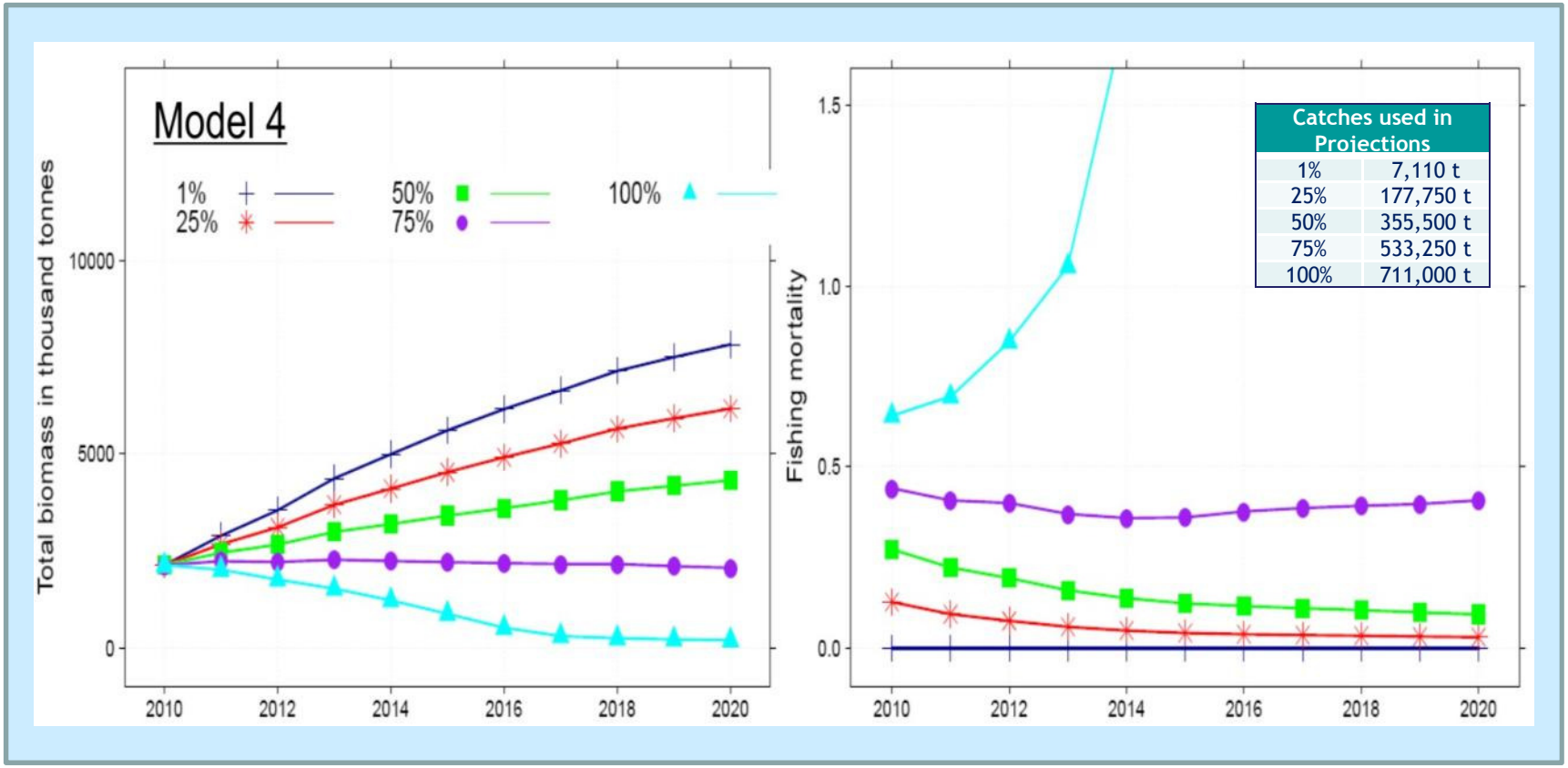
Projections of future total biomass (*B*) and fishing mortality (*F*) to 2020 were conducted under two alternative future recruitments scenarios: 1) Average recruitment from 2005-2009 (30% of the long-term average); and 2) Average recruitment from 2000-2009 (60% of the long term average). Four constant catch scenarios were explored: 'current' levels (711,000 t) and at 75%, 50%, 25%, and 1% of 'current' levels.



Stochastic 10-year projections of biomass (kt; left panel) and fishing mortality (average ages 2-12; right panel) for the base case model (Model 4) under the assumption that future recruitment has the same mean and variance as the **5-year** period 2005-2009 (30% of average) and assuming constant catch of 533,250 t (75% of 711,000 t, ~2010 catch to Sep).

(JMSG Report, Annex 2, Fig 15)

Jack Mackerel Assessment – Median Projections



Projections of median total biomass (kt, left panel) and fishing mortality (over ages 2-12; right panel) for the base case model (model 4) under five alternative future harvest levels, and under the assumption that future recruitment will have the same mean and variance as the 5-year period 2005-2009.

(JMSG Report, Annex 2, Fig 17)

Jack Mackerel Assessment – Projection Results

- For the base case (model 4), future constant catches held at 533,250 t (75% of 711,000t) for the 5-year average recruitment scenario are predicted to result in slight decline in projected biomass, with little change in fishing mortality.
- Under the sensitivity analyses explored, for model 6, there is an increased likelihood that biomass will decline under catches at 75% of 'current' catches; under model 5 biomass is predicted to remain stable or increase slightly at 75% of 'current' catch.
- For the 5-year average recruitment scenario, under all assessment models, catches would need to be reduced to less than 75% of 'current' catch for there to be a greater than 50% probability of stock increase.

Model 4 Projection Results (for constant catch %'s of 711,000 t)

Probability (B2020 < B2010)

Recr	1%	25%	50%	75%	100%
5yr	0.00	0.00	0.00	0.54	1.00
10yr	0.00	0.00	0.00	0.01	0.17

Ratio (B2020 / B2010)

Recr	1%	25%	50%	75%	100%
5yr	3.67	2.89	2.02	0.97	0.10
10yr	6.04	5.22	4.32	3.29	2.01

2009 Advice on Status of Jack Mackerel

In November 2009, based on a comprehensive review of fishery and stock status indicators for the Chilean jack mackerel resource, the 8th meeting of the Scientific Working Group advised that:

- *Fishing mortality (F) is likely to have exceeded sustainable levels since at least 2002, and continues to do so. Current biomass levels are substantially below levels at the peak of the fishery in the 1990s and, as a result of recent poor recruitment, are highly likely to be still declining.*
- *Low recruitment, low and declining spawning and total biomass, low and declining SBR and landings in excess of surplus production all indicate that further declines in stock status are likely unless fishing mortality is reduced, particularly if recruitment remains poor.*

(SWG8 Report, November 2009)

2010 Advice on Status of Jack Mackerel

Advice on stock status was based on assessments conducted using the Joint Jack Mackerel statistical catch-at-age model. Results from a Triple Instantaneous Separable Virtual Population Analysis are closely consistent with the results of the JJM assessments:

- *Jack mackerel catches have declined steadily since 2006, and continued to decline in 2010, with … 2010 catches being at the lowest level since 1976. There is close agreement on current biomass levels between all of the assessment models used. Assessment results indicate that total biomass has declined by 79% since 2001 to 2.1 million t, the lowest level in the history of the fishery. Current total biomass levels are estimated to be 9% - 14% of the biomass which would have existed if there had been no fishing.*

2010 Advice on Status of Jack Mackerel

- *Estimated average recruitment over 2005 – 2009 has only been 30% of long-term average recruitment. There has been an appearance of small (20 cm) fish in 2010 catches in a number of regions and fisheries. However, these have been patchily distributed and have contributed small catches. Appearance of these small fish is an encouraging sign that recruitment may be improving, but is not yet persuasive evidence of appearance of a strong year class.*
- *It is possible that appearance of small fish signals the start of a period of increase in recruitment back towards higher average levels. However, past recruitment histories and auto-correlation between annual recruitment indicate that recruitment increase will be gradual. It is therefore likely that recruitment in 2011 will be closer to the recent 5-year average recruitment, than to higher 10-year average recruitment.*

2010 Advice on Status of Jack Mackerel

- *Under 5-year average recruitment, for the base case assessment, there is a 100% probability that biomass will continue to decline at current (2010) catch levels (711,784 t), with projected biomass in 2020 of 10% of current biomass. At 75% of current catches, there is a 54% chance that biomass will continue to decline, with projected biomass in 2020 of 97% of current biomass. At 50% of current catches, all models indicate that biomass will increase to about double current biomass.*

- *Given the current low biomass, and the high likelihood of rapid further declines at current catch levels, immediate catch reductions will be required to prevent further biomass decline and provide some possibility of rebuilding.*

Jack Mackerel Sub-Group Work Programme

The following were identified as the most important jack mackerel research activities to conduct over the next year:

- Stock assessment: Implement the recommended improvements to jack mackerel stock assessments and conduct an updated jack mackerel assessment in 2011.
- Jack Mackerel Research Programme:
  - Collaborative collection and contribution of samples from different fleets and regions for the Chilean multidisciplinary project on jack mackerel stock structure.
  - Preparation for, and conducting of, an otolith interpretation and ageing workshop in Peru during 2011.
  - Development of schedules of maturity by length and age for different regions.
- Investigate opportunities for increased collaboration between SPRFMO participants with acoustic surveys work for pelagic species.

Approval and Actions Required

The SWG is seeking approval and support for the following inter-sessional work:

- Stock assessment: Implement the recommended improvements to jack mackerel stock assessments and conduct an updated jack mackerel assessment in 2011.
- Jack Mackerel Research Programme: Preparation for, and conducting of, an otolith interpretation and ageing workshop in Peru during 2011.

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Questions ?