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Evaluating Global Regional Fisheries Management Organizations: Methodology and Scoring

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Evaluating global regional fisheries management organizations: methodology and scoring¹

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Abstract

Regional fisheries management organizations (RFMOs) collectively manage the largest distinct area of the world, the high seas, but their effectiveness in conserving the fish stocks therein has been questioned lately, as many stocks have declined. This study quantitatively assesses the effectiveness of the world's 18 RFMOs, based on a two-tiered approach, concentrating first on their performance 'on paper' and secondly, in practice. The former was determined by assessing how well RFMOs scored against 26 criteria that together reflect current RFMO best practices. The latter assessment referenced the current state of the stocks RFMOs manage, through biomass and fishing mortality reference points and biomass trends through time. Results show low performance of RFMOs for both assessments, i.e., average scores of 57% and 49%, respectively. The latter result is emphasized by findings that reflect two-thirds of stocks fished on the high seas and under RFMO management are either depleted or overexploited. Findings also indicate that there is no connection between the two sets of scores, suggesting a disparity between organization intent and action.

Keywords: Regional fisheries management organizations, global fisheries, theoretical performance, practical performance, fish stocks.

1. Introduction

Close to 60% of the oceans are outside national jurisdiction, i.e., beyond the 200 nm mile Exclusive Economic Zones (EEZs) of coastal countries, and thus, following the United Nations Convention on the Law of the Sea (United Nations, 1982), belong to the 'high seas' (Sumaila *et al.*, 2007). Despite covering the majority of oceans, the high seas have, until relatively recently, been inaccessible to fishers: vast, rough, and far from coasts, fishers did not have the vessels or gear to exploit these areas.

¹ This is a shortened version of the thesis, 'High seas, high risk: a global evaluation of the effectiveness of regional fisheries management organizations'; a version of this paper, titled 'Failing the high seas: a global evaluation of regional fisheries management organizations' has been submitted to *Marine Policy*. It is also a Revised Edition of the Working Paper 2009-12: the original Working Paper included the evaluation of 48 stocks to determine the 'Q' score in the second part of the assessment, which determines RFMO performance in practice. After input from Mr. Kjartan Hoydal, Secretary of NEAFC and the Chair of the RFB Secretariats Network, three of the stocks have since been removed. Results have not been affected.

Since the mid-20th century, however, progress in fishing technology (freezers, sonar, GPS) and cheap fossil fuel have allowed fishers to exploit the high seas, from which catches have thus increased (Pauly *et al.*, 2002, 2003). More dangerous and expensive than coastal fishing, fishing on the high seas is driven by its large rewards: tuna, toothfish, sharks, and certain billfish are all top predator fish of extremely high value (Riddle, 2006; Safina, 1993; Stevens *et al.*, 2000; Webster, 2006). In the 1950s, catch from the high seas amounted to under two million tonnes; in 2006, this had grown to over ten million tonnes (FAO, 2009). As a result, the fraction of the global marine catch originating from the high seas (as opposed to within EEZs) increased from 9% in 1950 to 15% in 2003 (see www.seararoundus.org; catch decreases within EEZs also contributed to this, but to a lesser extent).

But who manages the high seas? Steeped in the antiquated dogma of Hugo Grotius’ *‘The Free Sea’* from the early 17th century, fishers have long considered the high seas as open-access, meaning anyone and everyone had rights to fish there. This perception, however, is obsolete today: regional fisheries management organizations (RFMOs) are currently the only legally mandated fisheries management bodies on the high seas, and countries’ commercial fishing fleets must abide by RFMO regulations in order to fish in these areas, as decreed by the 1995 Straddling Fish Stocks Agreement (United Nations, 1995). In other words, *‘The Free Sea’* is no more (Rayfuse, 2007).

Almost all of the global high seas are now covered by at least one RFMO (Figure 1). While more RFMOs are slated to come into existence soon, the effectiveness of current RFMOs has never been comprehensively assessed, despite indications that the decline of many high seas fish stocks (Myers and Worm, 2003) may be attributed to weaknesses within RFMOs themselves (Gjerde, 2009). Indeed, the “ability of RFOs to be ‘vehicles of good governance’ to secure sustainable management has to be proven” (Sydnes, 2001). This contribution addresses these concerns.

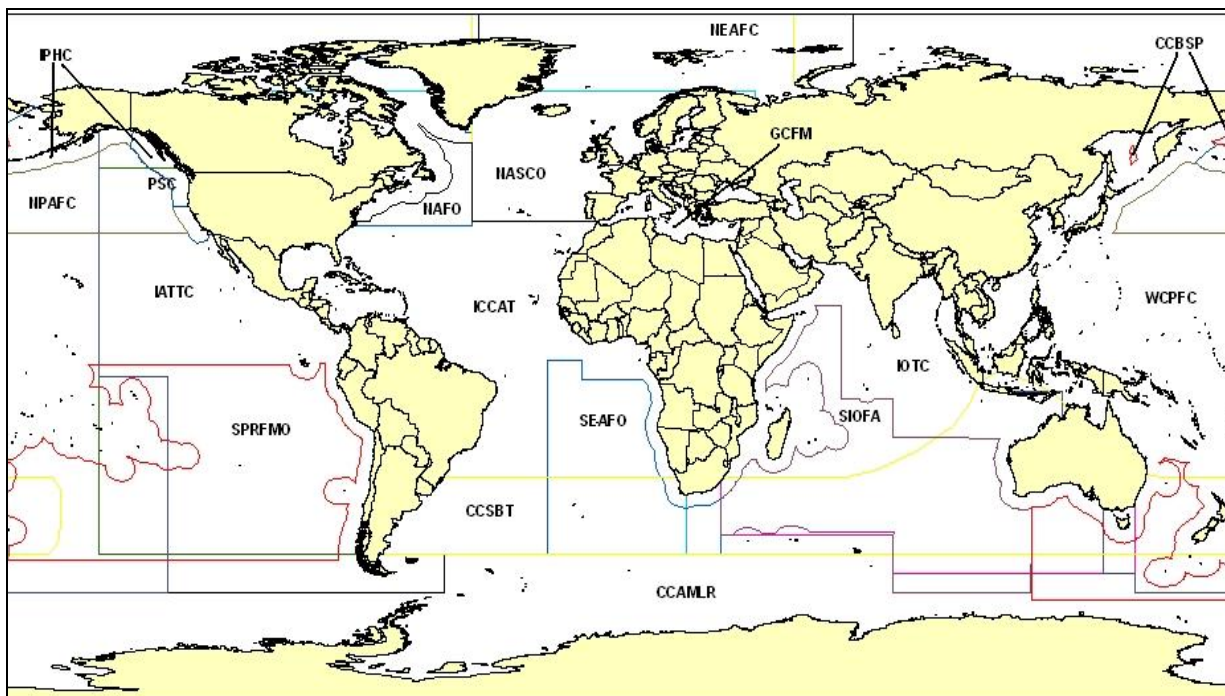


Figure 1 The global distribution of RFMOs. Note: IWC covers entire global ocean.

Here, the global evaluation on the effectiveness of RFMOs is based on a two-tiered system (Zino 2007): (1) in theory (or ‘on paper’), i.e., how well RFMOs meet standards as set by Lodge *et al.* (2007) and as measured by the comprehensiveness of available information; and (2) in practice, i.e., how well the stocks under RFMO management do, as measured by current abundance (biomass) trends of managed stocks, and supported by trends through time.

2. Materials and methods

2.1. Theoretical performance: ‘P’ scores

For this part of the study, we analyzed the 18 current global RFMOs, as characterized by FAO (see www.fao.org; and Zino, 2007), i.e., all current regional fisheries organizations with management power. We also included two ‘outgroups’ to test our scoring criteria: the National Marine Fisheries Service (NMFS), the national fisheries management agency of the USA, and the World Wildlife Fund (WWF), an international, environmental NGO involved in fisheries conservation issues (Table 1).

Table 1 The 20 organizations included in this study. All 18 RFMOs were included in theoretical performance assessment; ‘# of stocks’ refers to number of stocks assessed in practical performance assessment.

Acronym	Full name	# of stocks
CCAMLR	Commission for the Conserv. of Antarctic Marine Living Resources	1
CCBSP	Conv. on the Conserv. & Mgmt. of the Pollock Resources in the Centr. Bering Sea	1
CCSBT	Commission for the Conserv. of Southern Bluefin Tuna	1
GFCM	General Fisheries Commission for the Mediterranean	2
IATTC	Inter-American Tropical Tuna Commission	3
ICCAT	International Commission for the Conserv. of Atlantic Tunas	8
IOTC	Indian Ocean Tuna Commission	3
IPHC	International Pacific Halibut Commission	1
IWC	International Whaling Commission	9
NAFO	Northwest Atlantic Fisheries Organization	4
NASCO	North Atlantic Salmon Conserv. Organization	1
NEAFC	North East Atlantic Fisheries Commission	4
NMFS	National Marine Fisheries Service	Outgroup
NPAFC	North Pacific Anadromous Fish Commission	3
PSC*	Pacific Salmon Commission	-
SEAFO**	South East Atlantic Fisheries Organization	-
SIOFA**	South Indian Ocean Fisheries Agreement	-
SPRFMO**	South Pacific Regional Fisheries Management Organization	-
WCPFC	Western and Central Pacific Fisheries Commission	4
WWF	World Wildlife Fund	Outgroup

*Constraints on fish stock data: RFMO not assessed.

**Adequate fish stock data not yet available for these RFMOs.

Our methodology for evaluating RFMO performance was largely based on Alder *et al.* (2001), which focused on countries’ compliance to various fisheries and related instruments in the North Atlantic area. In that study, a scoring system was used to determine countries’ level of compliance with these instruments. In contrast, the goal here was to evaluate the effectiveness of RFMOs as determined by how their Conventions and other written texts scored against a set of criteria.

These criteria were based on the report ‘Recommended Best Practices for Regional Fisheries Management Organizations’ (Lodge *et al.*, 2007), from which 26 criteria were identified, jointly representing the core components of a competent RFMO.

Scoring was performed, as Sydnes (2001) describes, based on descriptions from RFMOs’ mandates, stock assessments, and other reports (available mainly from their websites). A score, which could range from 1 and 10, was given to each of the 20 organizations (i.e., including the outgroups) for each of the 26 criteria, creating a matrix of 520 data scores. While other studies assessing various aspects of RFMOs employ much smaller scoring ranges (see Alder *et al.*, 2001; Mooney-Seus and Rosenberg, 2007; Small, 2005), our larger range allowed more nuanced scoring. The scores were obtained by asking up to ten different questions for each criterion, each yielding a ‘yes’ or ‘no’ answer, and moving up (i.e., to the next question within the criterion) if the answer was ‘yes’, or allocating a corresponding score if the answer was ‘no’ (see Zino, 2007, for the rationale behind this ‘question’ methodology, and Appendix 1 for all questions under each criteria included in this assessment). Occasionally, when the questions did not necessarily ‘chain’ (e.g., when an RFMO could not meet the requirement expressed by a lower ranked question, but could meet that of a higher ranked question), a point system was implemented, where each question answered positively was given a ‘point’. Points were then added up to form a final ‘P’ score. Finally, if no information was available on a criterion, it was assumed to be ignored by the RFMO under evaluation, and a low score was allocated for that criterion (as in Alder *et al.*, 2001).

Scores were not weighted for this assessment, as the number of criteria would make such a process difficult. Furthermore, determining which criterion should be given more weight than others could be subjective, depending on the evaluator and the focus of the research. This was the same in other studies using a similar methodology (i.e., quantitatively answering questions by way of a scoring system), which also did not weight their scores (see Caddy, 1996; Pitcher *et al.*, 2008). After the final P scores were computed for each RFMO, an average score was computed, and the initial data matrix was then divided up into five general categories (see Appendix 1). These categories were based on the principal themes presented in Lodge *et al.* (2007), and describe RFMO performance in broad areas.

Ordination and correlation tests were then run, and a hierarchical cluster analysis was employed to detect patterns in data by grouping RFMOs according to their similarity; a dendrogram was then derived from the similarity matrix.

2.2 Performance in practice: ‘Q’ scores

For this second part of the study, a total of 45 stocks across 14 RFMOs were assessed (see Tables 1 and 2). We determined the Q scores of stocks managed by RFMOs by graphing, for each, F/F_{msy} against B/B_{msy} , where F is current fishing mortality rate, F_{msy} is the fishing mortality rate which maintains MSY, B is current biomass, and B_{msy} the biomass that produces MSY. Optimal fisheries management should maintain both ratios (i.e., F/F_{msy} and B/B_{msy}) near unity. On the other hand, if $F/F_{msy} > 1$, then the stock is overfished; similarly, if $B/B_{msy} < 1$, then biomass is depleted. Hence, a point falling within quadrant I of Figure 2 receives the lowest score of zero, quadrant IV, the highest score of three, and quadrants II and III receive scores of

one. The phase plot methodology is used in ICCAT stock assessment reports (see ICCAT, 2008), and is illustrated in Langley *et al.* (2009), and in Worm *et al.* (2009).

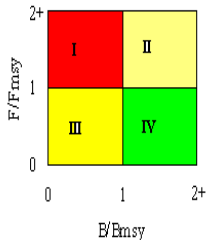


Figure 2 Example of a phase plot.

In addition, time series of abundance (biomass) of the (major) stocks managed by RFMOs were collected; such data were available for 15 of the 18 current RFMOs (see Appendix 2).

Table 2 Stocks used in determining Q score.

RFMO	Species
CCAMLR	Patagonian toothfish (South Georgia stock)
CCBSP	Pollock
CCSBT	Southern bluefin tuna
GFCM	Anchovy (northern Adriatic Sea stock), Sardine (northern Adriatic Sea stock)
IATTC	Bigeye tuna, Skipjack tuna, Yellowfin tuna
ICCAT	Bluefin tuna (west stock), Bluefin tuna (east stock), Yellowfin tuna, Skipjack tuna (east stock), Skipjack tuna (west stock), Bigeye, Albacore (south stock), Albacore (north stock).
IOTC	Bigeye, Albacore, Yellowfin.
IPHC	Pacific Halibut
IWC	Fin whale, Blue whale, Sperm whale, Right whale (Southern hemisphere), Sei whale, Bryde's whale, Humpback whale, Minke whale, Minke whale (Southern hemisphere).
NAFO	American plaice (Div3LNO stock), American plaice (Div 3M stock), Redfish (Div 3LN stock), Cod (Div 3M stock), cod (Div 3NO stock), Greenland halibut (Div 3KLMNO stock).
NASCO	Atlantic salmon (North American stock, large salmon only)
NEAFC	Blue whiting, Mackerel, Redfish, Herring (Norwegian-spawning stock).
NPAFC	Sockeye, Chum, Pink
WCPFC	Yellowfin tuna, Albacore tuna (south stock), Bigeye tuna, Skipjack tuna

2.3 Comparing P and Q scores

Unweighted and weighted regressions were both carried out to compare the results from the first assessment with the results from the second; a multiple regression analysis was also performed to test which criterion accounted for the highest between-score variance.

3. Results

3.1 Theoretical performance

Final P scores varied from 43% (PSC) to 74% (WCPFC), with an average score of 57% (0% being worst possible performance, and 100% being perfect performance; see Table 3 for data matrix of all results and Table 4 for final P scores).

Table 3 Results from theoretical performance assessment; see Appendix 1 for full list of 26 criteria.

Criterion	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
CCAMLR	10	9	7	9	10	1	6	6	5	1	4	10	7	9	7	7	9	9	6	1	1	2	4	3	2	5
CCBSP	6	9	7	4	9	3	1	2	2	6	6	5	9	6	5	7	2	8	5	1	4	2	1	1	3	1
CCSBT	2	5	10	8	7	3	6	6	2	4	3	2	5	4	1	6	5	8	4	1	1	2	5	5	4	5
GFCM	10	8	8	9	8	6	10	7	2	8	5	5	4	3	5	7	7	5	6	6	4	2	8	9	9	5
IATTC	8	6	8	9	9	7	8	6	4	5	2	7	6	9	1	6	6	8	2	5	6	7	8	3	7	4
ICCAT	9	10	9	8	2	2	10	2	1	5	3	3	7	7	4	8	8	7	6	5	2	2	7	5	9	7
IOTC	8	8	9	9	6	3	9	8	2	2	1	2	4	9	6	6	8	8	5	7	3	2	7	5	10	5
IPHC	10	8	8	8	8	2	5	2	1	6	4	3	9	6	8	8	1	8	1	2	2	10	5	2	6	2
IWC	10	10	7	8	10	5	6	4	2	8	4	8	8	8	8	7	2	8	4	8	5	5	5	5	9	1
NAFO	10	9	8	9	9	4	6	6	2	9	5	6	9	4	5	8	8	7	8	2	5	2	3	8	8	5
NASCO	6	4	6	8	6	2	6	6	2	2	3	9	1	3	10	9	4	7	3	1	4	2	6	9	6	3
NEAFC	8	6	9	9	7	4	6	6	4	8	6	5	7	2	4	5	9	6	9	1	7	2	7	9	9	10
NPAFC	8	8	7	10	6	3	6	6	4	6	8	1	1	3	9	8	9	9	3	1	2	4	7	7	6	1
PSC	8	8	6	9	8	1	8	5	1	1	1	3	1	3	9	9	1	8	1	2	1	5	1	1	8	2
SEAFO	10	8	8	5	10	7	7	6	5	4	5	6	5	5	5	9	7	7	5	5	6	2	4	9	8	5
SIOFA	8	3	7	4	4	4	3	8	6	5	3	5	3	2	3	6	2	6	7	5	5	6	4	8	4	1
SPRFMO	8	4	1	8	8	5	6	6	4	5	4	7	3	8	4	9	5	7	6	6	8	5	4	4	10	3
WCPFC	9	5	8	8	7	7	10	8	6	9	5	10	6	8	7	8	7	9	6	7	8	5	8	7	10	4
NMFS	5	1	1	4	4	5	8	1	1	1	6	1	5	1	1	7	7	4	1	1	2	1	10	1	1	1
WWF	1	1	1	1	1	1	5	1	1	1	1	1	1	1	5	1	1	4	1	1	1	1	4	8	1	1

Notes:

- Criterion 9 scores low overall: most RFMOs do not have adequate schemes to promote compliance.
- IPHC, Criterion 22: Unlike most RFMOs, full member participation is required in this organization because there are only two members. From the 1979 Protocol: "All decisions of the Commission shall be made by a concurring vote of at least two of the Commissioners of each Party."
- CCBSP, Criterion 24: No mention of working with other organizations, as is confirmed by CCBSP member, who says they do not collaborate with other organizations- they are a very small organization (P. Niemeier, pers.comm., NMFS, 2008).
- Outgroups (i.e., non-RFMOs), are bolded.

Table 4 Final P scores.

RFMO	P Score (%)	RFMO	P Score (%)
WCPFC	74	ICCAT	57
GFCM	64	SPRFMO	57
IWC	63	NPAFC	55
NAFO	63	IPHC	52
NEAFC	63	NASCO	52
SEAFO	63	SIOFA	47
IATTC	60	CCBSP	46
IOTC	58	CCSBT	44
CCAMLR	58	PSC	43
Average			57

The overall highest scoring category across all RFMOs was by far ‘General Information and Organization,’ with a 70% average score. The overall lowest scores across RFMOs were those in the ‘Allocation’ category, which had an average score of 43%. The overall highest single score in a category belonged to CCAMLR, which scored an 83% in the category of ‘Conservation and Management’ (Table 5). WCPFC was the most consistently high scoring RFMO across all categories, and thus received the highest overall score, too. The variance amongst scores was greatest for the ‘IUU fishing prevention’ criterion, and smallest for ‘Science’ (Table 6). From the correlation analysis, certain variables were highly significant (i.e., $p < 0.01$) and highly correlated (i.e., $r > 0.65$), and are shown in Table 7.

Table 5 Overall RFMO theoretical performance scores (in %) in five categories: GenInfo (General Information and Organization), Comp&Enforce (Compliance and Enforcement Measures), Cons&Manage (Conservation and Management), Allocation, Coop&Resol (Cooperation and Resolutions).

GenInfo		Comp&Enforce		Cons&Manage		Allocation		Coop&Resol	
GFCM	79	WCPFC	70	CCAMLR	83	WCPFC	65	NEAFC	73
IWC	79	NEAFC	66	IWC	80	GFCM	60	WCPFC	70
SEAFO	79	NPAFC	66	WCPFC	78	IOTC	60	GFCM	62
WCPFC	79	NAFO	60	NASCO	73	IWC	60	IATTC	58
NAFO	78	GFCM	58	IPHC	65	SIOFA	60	SEAFO	57
IATTC	77	SEAFO	54	CCBSP	63	SPRFMO	60	SPRFMO	57
CCAMLR	76	CCAMLR	50	NAFO	60	ICCAT	55	ICCAT	53
IOTC	73	SIOFA	48	IATTC	58	NAFO	50	IOTC	53
ICCAT	72	SPRFMO	48	SPRFMO	55	NEAFC	50	NAFO	52
IPHC	72	IATTC	46	ICCAT	53	SEAFO	50	IWC	50
NPAFC	72	IOTC	42	IOTC	53	CCAMLR	35	NASCO	50
PSC	72	CCSBT	40	SEAFO	53	IATTC	35	SIOFA	47
NEAFC	67	IWC	40	NEAFC	45	CCBSP	30	IPHC	45
SPRFMO	62	ICCAT	38	GFCM	43	CCSBT	25	NPAFC	45
CCSBT	61	CCBSP	36	PSC	40	NASCO	20	CCSBT	37
CCBSP	60	NASCO	34	NPAFC	35	NPAFC	20	PSC	30
NASCO	60	IPHC	28	SIOFA	33	IPHC	15	CCAMLR	28
SIOFA	50	PSC	18	CCSBT	30	PSC	15	CCBSP	27
Average	70		47		55		43		50

Table 6 Variation of theoretical performance scores between RFMOs by criterion.

Criterion	SD	Criterion	SD
IUU fishing prevention	2.89	New members	2.23
Precautionary approach	2.75	Working/cooperating with other RFMOs	2.21
Set targets	2.74	Species of concern	2.17
Rebuilding strategies	2.62	Conservation and management	2.12
Schemes to deter non-compliance	2.58	Area covered	2.02
Cooperation with other organizations	2.58	Commitment to Convention and Agreement	1.98
Bycatch, threatened spp., habitats, troph. rel.	2.57	Flag state duties	1.92
Provisions for developing states	2.54	Contracting parties	1.91
Strengthening mandate	2.52	Mechanisms for enforcement and surveillance	1.78
Assessments and reviews	2.38	Organization	1.75
Budget	2.35	Schemes to promote compliance	1.70
Transparency	2.32	Data collection, compilation and distribution	1.24
Full member participation	2.32	Science	1.10

Table 7 Results from theoretical performance correlation analysis.

Variable a	Variable b	r value
Transparency	Commitment to the Convention and the Agreement	0.76
Science	Bycatch, threatened species, habitats, trophic relationships	0.68
Species of concern	Area covered	0.68
Strengthening of mandate	Provisions for developing states	0.68
Flag state duties	Schemes to promote compliance	0.67
Assessments and reviews	IUU fishing	0.66

The results from the PRIMER 5 analysis are shown in dendrogram format in Figure 3, which depicts, as expected, that the outgroups (NMFS and WWF), fall outside the range for RFMOs. This confirmed that our questions, as hypothesized, served to characterize RFMOs. Beyond this, clusters, though small, do occur, and are identified in boxes in Figure 3. SIOFA appears the least similar to other RFMOs, while GFCM, NAFO and SEAFO are the most similar, and jointly form the tightest cluster.

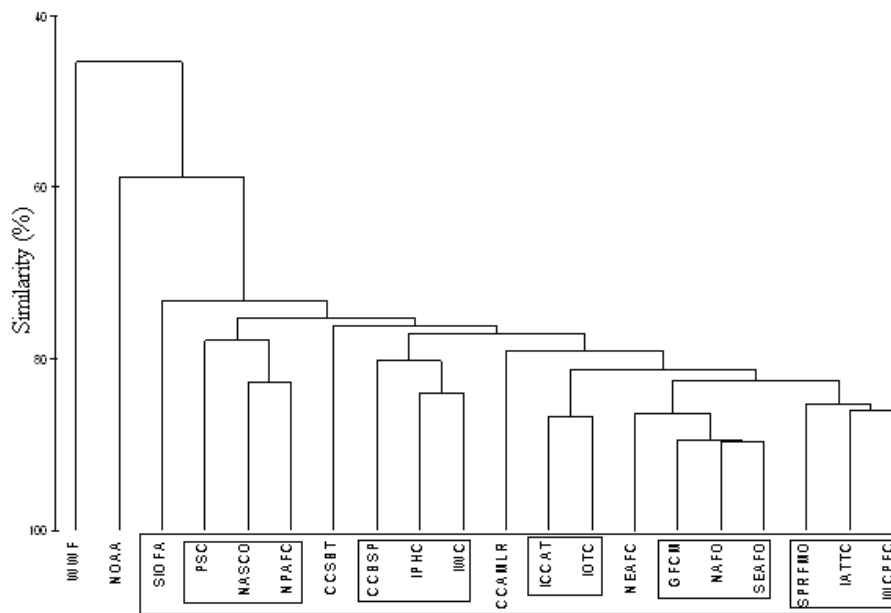


Figure 3 Dendrogram from SIMPER analysis, depicting the clustering of RFMOs and two outgroups. Boxes denote cluster groups.

3.2 Performance in practice

Final Q scores of RFMOs were all relatively low, averaging 48% across RFMOs. CCSBT had the lowest score at 0%, while CCAMLR had the highest at 100% (Table 8).

Table 8 Breakdown of Q scores, including number of stocks per quadrant. Q score = 100*(Total/Max. score)

RFMO	Total # stocks	Quad I	Quad II & III	Quad IV	Total (after weighting)	Max. score	Q score (%)
Weighting		0	1	3			
CCAMLR	1	0	0	1	3	3	100
CCBSP	1	0	1	0	1	3	33.3
CCSBT	1	1	0	0	0	3	0.00
GFCM	2	0	2	0	2	6	33.3
IATTC	3	2	0	1	3	9	33.3
ICCAT	8	3	3	2	9	24	37.5
IOTC	3	0	1	2	7	9	77.8
IPHC	1	0	1	0	1	3	33.3
IWC	9	0	9	0	9	27	33.3
NAFO	4	1	2	1	5	12	41.7
NASCO	1	0	1	0	1	3	33.3
NEAFC	4	1	0	3	9	12	75.0
NPAFC	3	0	1	2	7	9	77.8
WCPFC	4	0	2	2	8	12	66.7
Average							48.3

Of the 45 stocks assessed, 31 are currently depleted or being overfished, amounting to 69% of all stocks assessed.

The population sizes of certain stocks fluctuated widely through time, particularly for anadromous fishes (see Appendix 2). Yet the general trend in biomass for most species within management under RFMOs is one of decline, with one obvious exception being NEAFC's Norwegian-spawning herring. In relation to RFMO establishment, the majority of RFMOs did not seem to have a visible positive effect on stock biomass (see Figure 4 for ICCAT example; see Appendix 2 for all others).

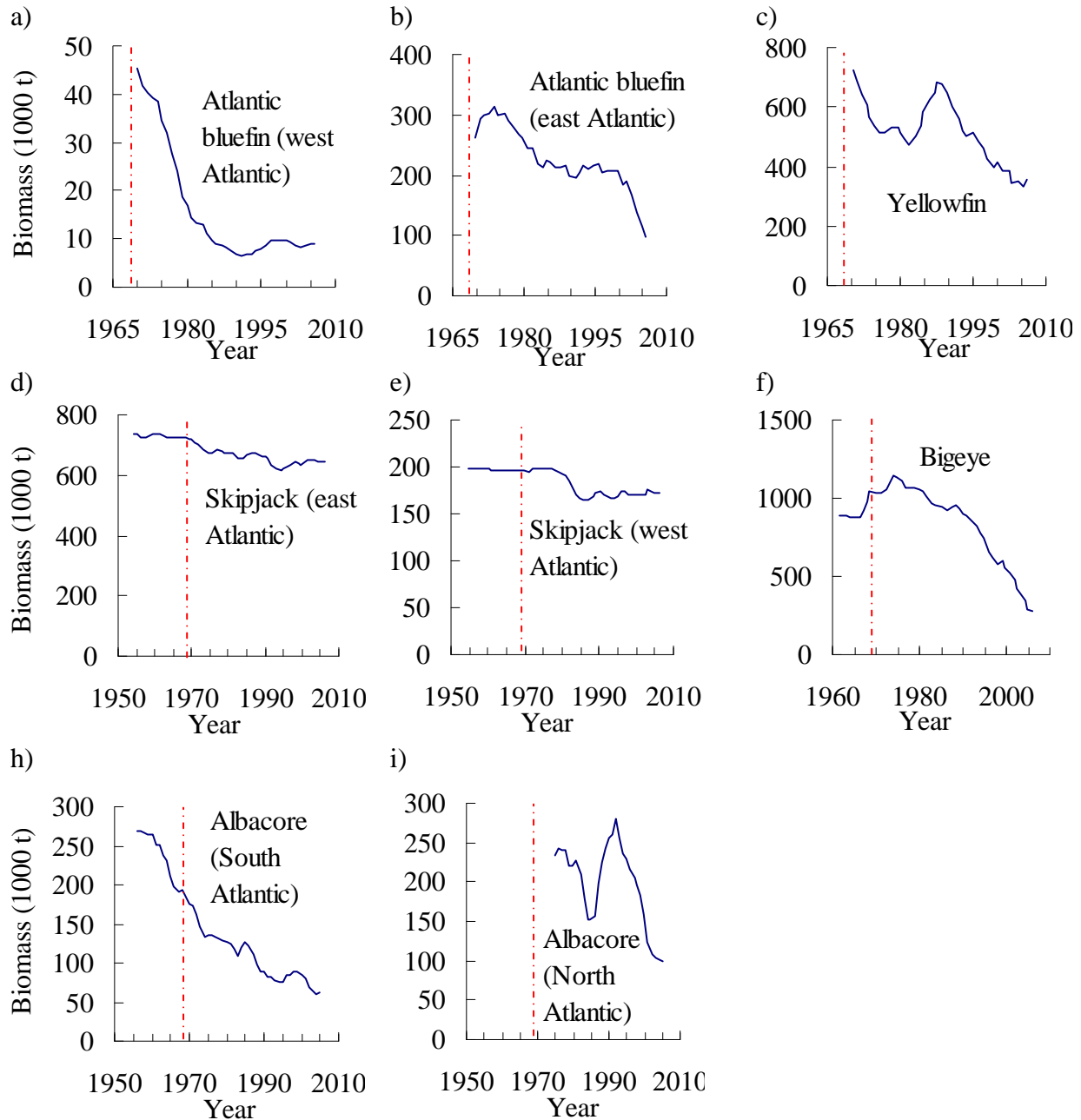


Figure 4 Example of historical biomass results for eight tuna stocks under ICCAT management; vertical line denotes year of RFMO establishment.

3.3 Comparing *P* and *Q* scores

While three RFMOs scored within 10% between assessments, others had prominently different *P* and *Q* scores, e.g., CCAMLR had the overall highest *Q* score at 100%, which differed markedly from its *P* score of 58%. The bivariate plot of *Q* versus *P* scores showed a positive correlation coefficient ($r = 0.43$), but was not significantly different from zero ($P > 0.05$).

4 Discussion

4.1 P scores

Of all RFMOs, PSC received the overall lowest score at 43%; as with IPHC (52%), it is limited to just two contracting parties, Canada and the USA. In addition, PSC and IPHC are also the only two RFMOs functioning primarily within national jurisdiction. These organizations probably scored poorly in part because they do not fit the typical RFMO framework.

The RFMO with the highest P score was WCPFC with 74%, 10% higher than the next most effective RFMO (GFCM, see Table 4). Established in 2004, WCPFC is currently the newest functioning RFMO. It suggests that newer RFMOs conform better to newer trends, particularly those pertaining to conservation measures, which have changed significantly through the years and which affected many of our criteria. Still, we note that SEAFO scored lower (63%), although it was established recently, in 2003.

CCAMLR had the highest category score (in ‘Conservation and Management’); this is unsurprising given that CCAMLR has been lauded as one of the better-managed RFMOs (Dunn *et al.*, 2007), with a good record in implementing conservation measures (Probert *et al.*, 2007; Small, 2005).

The ‘Allocation’ category generally yielded the lowest scores. This was attributable to both criteria therein, i.e., ‘New members’, and ‘Provisions for developing states’. The lack of framework for defining a legitimate membership process for countries to join an RFMO (termed the ‘new entrant problem’) has been criticized as a real impediment to successful fisheries management (Bjørndal *et al.*, 2000; Kaitala and Munro, 1993; Pintassilgo and Duarte, 2001); low scores in this category clearly reflect the absence of such a framework. In contrast, while a tentative framework does exist for supporting the participation and contributions of developing countries to the RFMO of which they are members (United Nations, 1995), many RFMOs did not even mention the subject of developing states, or if they did, only casually, despite the fact that all but two RFMOs have developing countries among their members. Exceptions were ICCAT and IWC, both by far the largest RFMOs in terms of number of member states (45 and 83, respectively). They are also the two organizations with the largest number of developing countries, likely explaining their well-documented framework and provisions on this subject.

The high variance amongst scores relating to the ‘IUU fishing prevention’ criterion reveals the lack of consistency among RFMOs in addressing the issue. In contrast, the low variance amongst scores relating to the ‘Science’ criterion is encouraging as the scores were mostly high. This suggests a widespread understanding of the importance of science in RFMO management, as well as a consistent scientific methodology across RFMOs.

Further, some of our correlations have implications for RFMO management. For example, the correlation between the two criteria ‘Schemes to promote compliance’ and ‘Flag state duties’ implies that if duties are well-defined, RFMO compliance may increase (the converse, while possible, is unlikely). Another example shows that if frequent assessments and performance reviews are carried out, approaches to deal with IUU fishing may emerge. Finally, strong

mandates could produce better provisions for developing states. Such results indicate that ‘influential’ criteria, i.e., criteria that potentially affect others, should be of primary interest in RFMO management.

Finally, the cluster analysis reveals that although these 18 RFMOs differ in size, organization and scope, they are mostly similar with regards to the core components of an operational RFMO. While certain individual criteria might differ markedly between RFMOs, no one RFMO is exceptionally different from the rest. Essentially, they all fall within one cluster, with an average similarity of about 78%, and the most dissimilar RFMO still having about 73% similarity (Figure 3). This is in contrast with WWF and NMFS, suggesting that, as a minimum, RFMOs have some fundamental, unifying structures in place, despite their seemingly differing backgrounds and mandates.

4.2. *Q scores*

The main conclusion based on these results is that RFMO management on the high seas is inadequate. Findings indicate that 69% of stocks under RFMO management either have low biomass, are overfished, or both (see Appendix 2). This is in line with FAO (2009), which states that: “In the case of straddling stocks and of other high seas fishery resources, nearly two-thirds of the stocks for which the state of exploitation can be determined were classified as overexploited or depleted. These high seas fishery resources constitute only a small fraction of the world fishery resources, but they can be considered key indicators of the state of a major part of the ocean ecosystem.”

The fishing mortality corresponding to MSY has been criticized as being too high a target reference point (Die and Caddy, 1997; Larkin, 1977; Mace, 2001), and indeed, “should be regarded as a minimum standard for limit reference points” (United Nations, 1995). Hence, had we employed a more precautionary (and likely, more appropriate) reference point such as Maximum Economic Yield (MEY), RFMO scores would be even lower (because MEY is achieved at a higher stock biomass and lower fishing mortality). However, only MSY-based estimates are available for most RFMOs.

In addition, while a stock that placed within quadrant I of the phase-plot is deemed to be in poor shape, it must be noted that a stock that scored within quadrants II and III also implies inadequate management. A score within quadrant II suggests that current high fishing pressure may lead to a low biomass in the future, while a score within quadrant III suggests overfishing has occurred in the past. While in the latter case, the potential to rebuild a depleted stock exists, decreases in fishing pressure rarely lead to actual biomass increases (Worm *et al.*, 2009). It is therefore not surprising that the historical global trend in high seas biomass across species is overwhelmingly one of decrease, one major exception being anadromous stocks, of which some exhibit very fluctuating biomasses (see Appendix 2). [It must also be noted that while CCAMLR scored 100% in this assessment, only one stock was evaluated for this RFMO, due to data availability].

Finally, as the establishment of some RFMOs preceded severe stock declines, this calls into question the very existence of these organizations. Equally worrying, is the lack of change in

species biomass trends after RFMO implementation: by far the main pattern across species, it implies that the effect of RFMO management on the stocks they control has, so far, been negligible.

4.3 Comparing P and Q scores

One way of identifying whether or not an organization is based on “dead letter provisions” – essentially terms that the organization supposedly abides by but are in fact, never put to use (Sydnes, 2001) – is to compare their written commitment with the state of the stocks they manage. The question is then: do they match up? Or: does the score of an RFMO in relation to best practices guidelines determine the state of their stocks?

Both the P and Q scores of RFMOs were relatively low, particularly the Q scores. While there was no significant correlation between the two scores (i.e., the P score of an RFMO does not necessarily determine its Q score), the difference between the final averages of these two scores was just over 8%, illustrating a gap between RFMO intent and practice. This is very close to the 9% difference in scores between stated intentions and actual compliance of countries regarding the UN Code of Conduct for Responsible Fisheries (Pitcher *et al.*, 2009).

5. Conclusion

In order to gauge the effectiveness of an RFMO, we must consider whether or not it has met its main goals. Objectives appear quite uniform across RFMOs (see Appendix 2), each emphasizing a commitment to the conservation of their stock(s) of interest, e.g., “...to contribute through consultation and cooperation to the optimum utilization, rational management and conservation of the fishery resources of the Convention Area” (NAFO, 2004). In this regard, RFMOs have failed. It is evident from our results that the priority of RFMOs – or at least of their member countries – has been first and foremost to guide the exploitation of fish stocks. While conservation is part of nearly all of their mandates, they have yet to demonstrate a genuine commitment to it on the water. Individual and organizational problems can account in part for the RFMOs’ low scores, but the larger concern is that most RFMOs score low overall. The focus therefore shifts from individual criteria or individual stocks to the bigger picture: taken as a whole, why have RFMOs failed?

A fundamental breakdown of fisheries management on the high seas lies in the principle, ‘*The Free Sea*’, for it exists no longer: “First, the principle of freedom of fishing could be retired from the pantheon of fundamental principles. Indeed, the continued articulation of the principle is both inaccurate and misleading, if not downright disingenuous” (Rayfuse, 2007). Still a global commons to most, the high seas undergo widespread and rampant illegal fishing with next to no consequence, a crisis further compounded by the immensity and unmonitored state of the area.

The management of historic coastal fisheries is widely seen as having failed throughout the world, with strong impacts on coastal ecosystems (Jackson *et al.*, 2001; Pauly *et al.*, 2002). The high seas, on the other hand, are still relatively pristine (Halpern *et al.*, 2008), and thus offer a momentary opportunity for RFMOs, if they reform themselves soon, to help turn around some

very worrying trends. However, this can only happen if RFMOs actually act as stewards of the high seas, and become accountable for their actions.

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Appendix 1

Table A. List of 26 criteria developed to assess theoretical effectiveness of RFMOs.

CATEGORY	GENERAL INFORMATION AND ORGANIZATION
Criterion 1	Area covered
Question	Are clear boundaries stated?
1	No mention of Convention area at all?
2	Is there a vague mention?
3	Does the RFMO state which ocean is protected?
4	Are FAO statistical areas mentioned?
5	Are specific boundaries stated (without coordinates)?
6	Are exact coordinates stated?
7	6 + Is there a map?
8	7 + Is there a global map overlaid with designated Convention areas?
9	8+ Are priority areas mentioned?
10	9 + Is there a detailed description of areas?
CATEGORY	GENERAL INFORMATION AND ORGANIZATION
Criterion 2	Species of interest
Question	Which species are managed by the RFMO?
1	No mention of species at all?
2	Is there a vague mention?
3	Does the RFMO mention organism groups (e.g., whales)?
4	Are species mentioned by common name?
5	Are species mentioned by scientific name (including groups, ie, tuna-like species)?
6	Are all species named both scientifically and by common names?
7	6 + Are there management distinctions between stocks (if applicable)?
8	7 + Is there mention of other fish possibly affected?
9	8 + Are the scientific names/details of the other fish affected mentioned?
10	9 + Is there a description of bycatch?
CATEGORY	GENERAL INFORMATION AND ORGANIZATION
Criterion 3	Contracting parties
Question	Who is party to the RFMO?
1	No mention of contracting parties at all?
2	Does the RFMO mention the date the Convention was signed?
3	Does the RFMO mention the date the Convention was ratified?
4	Does the RFMO have only an outdated mention of countries?
5	Are the main contracting countries named?
6	Is each current, contracting party named?
7	Are contracting and cooperating parties named?
8	Are contracting parties presented with dates they signed Convention?
9	8 + Do they have notes on termination of membership?
10	7 + Are cooperating parties presented along with dates signed Convention?
CATEGORY	GENERAL INFORMATION AND ORGANIZATION
Criterion 4	Organization
Question	How is the organization of the Commission itself?
1	No mention of general information and Commission organization at all?
2	Is there a mandate available (downloadable/visible)?
3	Does the RFMO have annual meetings?
4	Is there a flow chart/other descriptive method showing organization of Commission?
5	Is there a description of general organization, Secretariat and mention of annual meetings?
6	5 + Does the RFMO have >1 meeting once/year?
7	5 + Does the RFMO mention having many meetings per year?
8	6 + Does the RFMO have specifics on at least one meeting?

9	8 + Does the RFMO have specifics on many meetings a year?
10	9 + Are the names of commissioners (heads, directors of each country) available? Other notes?
CATEGORY	GENERAL INFORMATION AND ORGANIZATION
Criterion 5	Stated commitment to the overriding objective of conservation and management
Question	Is the RFMO committed to conservation and management?
1	No mention at all?
2	Is conservation important inherently through their stated commitment to the Convention/the Agreement?
3	Is conservation mentioned (minimally) on their website?
4	Is there an appropriate commitment to conservation and management on their website?
5	Is there an appropriate commitment to conservation and management in their mandate?
6	Are there stated limits to their fish catch?
7	Do they have details of conservation and management criteria available?
8	Have they closed fishing or a small area for a short amount of time?
9	Do they employ the EBM Approach? Or is closing fisheries a viable option for dwindling stocks?
10	9 + Is the area closed to unsustainable fisheries (if applicable) or do they have MPAs?
CATEGORY	GENERAL INFORMATION AND ORGANIZATION
Criterion 6	Commitment to the Convention and the Agreement
Question	Is the RFMO committed to the Convention and the Agreement?
1	No mention at all?
2	Does the RFMO make reference to the Convention?
3	Does the RFMO mention that its mandate does not interfere with the Convention?
4	3 + Does the RFMO mention that it does not interfere with the Agreement?
5	Does the RFMO have a stated commitment to the Convention?
6	Does the RFMO describe how their mandate is in line with the Convention?
7	Does the RFMO have a stated commitment to the Convention and the Agreement?
8	5 + Does the RFMO mention which countries have signed on to the Convention?
9	Does the RFMO describe how their mandate incorporates the Agreement?
10	8 + Does the RFMO state which countries have signed on to both treaties?
CATEGORY	GENERAL INFORMATION AND ORGANIZATION
Criterion 7	Budget
Question	How is the budget allocated?
1	No mention at all?
2	Does the RFMO mention that they have a budget?
3	Does the RFMO mention some areas of funding (e.g., projects that need funding)?
4	Does the RFMO describe where the money comes from?
5	Is there a description of where money comes from and how it's divided up/allocated for different operations?
6	Is there a description of how the RFMO pays human resources (e.g., secretariat)?
7	5 + Does the RFMO mention developing states?
8	5 + Does the RFMO have detailed provisions for developing states?
9	Does the RFMO have a detailed plan for developing states?
10	6 + 8
CATEGORY	COMPLIANCE AND ENFORCEMENT MEASURES
Criterion 8	Flag state duties
Question	What are the duties of flag states?
1	No mention at all?
2	Does the RFMO allude to flag state duties (although none are available)?
3	Does the RFMO have a statement of duties that are simply those of the Convention or the Agreement?
4	Does the RFMO have a weak statement of general duties?
5	Does the RFMO have an appropriate statement of general duties?
6	Does the RFMO have a detailed list of general duties?
7	Does the RFMO have a detailed list of general and specific duties (e.g., for developed

	vs developing countries)?
8	Does the RFMO describe duties of specific sectors within the RFMO (e.g., port state, developing state, non-member state, etc.)?
9	Does the RFMO outline duties in detail, specific to each country?
10	Does the RFMO outline duties in detail specific to each country with clear repercussions if not followed?
CATEGORY	COMPLIANCE AND ENFORCEMENT MEASURES
Criterion 9	Schemes to promote compliance (ie: incentives)
Question	What does the RFMO do to promote compliance?
1	No mention at all?
2	Does the RFMO mention that RFMOs must comply?
3	Does the RFMO merely mention that there are incentives to join?
4	Are there implied incentives?
5	Is there a general list of appropriate incentives for member nations?
6	Is there a detailed list of appropriate incentives for member nations?
7	6 + Any additional elements?
8	Are the benefits distinguished between developed and developing nations?
9	Are appropriate incentives stated and are membership advantages presented?
10	Have the incentives to join the RFMO led to a cease in IUU fishing?
CATEGORY	COMPLIANCE AND ENFORCEMENT MEASURES
Criterion 10	Schemes to deter non-compliance (disincentives/penalties for violators)
Question	What schemes does the RFMO have in place to deter non-compliance?
1	No mention at all?
2	Is surveillance mentioned?
3	Does the RFMO state that non-compliance is not to be tolerated?
4	Does the RFMO mention that each party will take appropriate measures to deter non-compliance (without an extrapolation)?
5	Does the RFMO mention appropriate penalties resulting from non-compliance?
6	Does the RFMO detail a list of appropriate penalties?
7	6 + Is there an explanation of what constitutes as non-compliance?
8	7 + Is there an explanation of an appropriate monitoring system?
9	8 + Do they provide an example of a nation who has been caught violating before?
10	Are there severe and effective (clearly appropriate) penalties, with details on enforcing such measures?
CATEGORY	COMPLIANCE AND ENFORCEMENT MEASURES
Criterion 11	Mechanisms for enforcement and surveillance
Question	What mechanisms does the RFMO use to enforce its regulations?
1	No mention at all?
2	Is enforcement mentioned as important?
3	Are some weak enforcement measures mentioned?
4	Does the RFMO mention specific duties regarding surveillance and enforcement (e.g., observers)?
5	Is there a list of appropriate enforcement measures?
6	Are appropriate enforcement measures detailed to specific non-compliance acts?
7	6 + Are appropriate enforcement measures between different nations explained?
8	7 + Are appropriate, detailed enforcement measures differentiated between developed and developing states?
9	8 + Is there a VOI (a list of vessels of interest) to share info with other organizations?
10	Has the enforcement scheme led to the termination of illegal fishing?
CATEGORY	CONSERVATION AND MANAGEMENT MEASURES
Criterion 12	Precautionary Approach (PA) and acknowledgement of uncertainty
Question	Is the PA and the acknowledgment of uncertainty evident in their mandate?
1	No mention at all?
2	Is there an acknowledgement of uncertainty in the data?
3	Do they mention PA in their approach?

4	Do they mention the preventative measures the RFMO takes (but not PA explicitly)?
5	Do they mention implementation of PA in their mandate?
6	Do they explain the importance of PA in their mandate?
7	Does the RFMO have PA and does it outline uncertainty?
8	7 + Does the RFMO detail uncertain areas?
9	7 + Does the RFMO give examples and a detailed list of PA within their organization?
10	Is the RFMO a model for PA? (i.e., could it act as a template for other organizations?)
CATEGORY	CONSERVATION AND MANAGEMENT
Criterion 13	Set targets
Question	What are the TACs?
1	No targets at all?
2	No targets mentioned?
3	Does the RFMO state that they have targets but doesn't make them available?
4	Does the RFMO mention the main species targeted in outdated years?
5	Does the RFMO mention the main species targeted for present year?
6	Do the main species have stated catch limits, and do the other species have a mention (all for present year)?
7	Do the main species targeted have stated catch limits (from establishment of RFMO to present year)?
8	Do the main species and some other species targeted have stated limits (including the majority of years from establishment of RFMO to present year)?
9	Do the main and some other species targeted have stated limits (from establishment of RFMO to present year)?
10	Do all species harvested have a stated target (with data from establishment of RFMO, on)?
CATEGORY	CONSERVATION AND MANAGEMENT
Criterion 14	Bycatch, threatened species (TS), habitats, trophic relationships (TR)
Question	How does the RFMO deal with bycatch, threatened species and habitats and ecological interactions?
1	The RFMO has no relevant information on this topic?
2	Are one of the four topics mentioned?
3	Are all of the four topics mentioned save bycatch?
4	Does the RFMO admit to bycatch?
5	In the RFMO, is bycatch not concealed, do they mention main bycatch species involved?
6	Does the RFMO mention its most threatened species of bycatch?
7	5 + Does the RFMO mention trophic relationships?
8	6 + Does the RFMO mention the importance of a healthy habitat?
9	6 + Is there any elaboration/more detail?
10	Are the bycatch stats given, with an emphasis on TS, and the importance of habitat and TR?
CATEGORY	CONSERVATION AND MANAGEMENT
Criterion 15	Rebuilding strategies, new fisheries and adaptation to changing fishery dynamics
Question	How robust are their management and adaptation strategies?
1	The RFMO has no relevant information on this topic?
2	Does the RFMO acknowledge the importance of rebuilding?
3	Does the RFMO mention it will rebuild its stocks (but no details given)?
4	Is there a weak outline of a rebuilding plan?
5	Is there a detailed plan of a resource (of focus) being rebuilt?
6	5 + Does the RFMO mention adaptation to change?
7	6 + Is there any elaboration/more detail?
8	6 + Does the RFMO acknowledge climate change?
9	Does the RFMO have hatcheries or release fry, or other similar programs?

10	Does the RFMO have a detailed management plan (w/ heavy PA slant), a plan for adapting to potential changes in fishery (such as climate change), and an openness to new fisheries (or at least mention possibility of)?
CATEGORY	CONSERVATION AND MANAGEMENT
Criterion 16	Data collection, compilation and distribution
Question	How are their datum collected, compiled and distributed?
1	Do they mention anything about data collection?
2	Do they state where they get data from?
3	Is there a pattern/logic to their methods of data collection?
4	Is there a loose methodology to their data collection?
5	Is an adequate data collection described?
6	Is there a reputable datum collection described?
7	6 + Is data distributed to all those relevant (including public)?
8	7 + Is there a description of why this data collection was chosen?
9	8 + Is there a mention of data compilation procedures?
10	Is there a detailed, respectable data collection, and a description of person/committee who assembles data; distribute datum to all relevant; immediately available to public?
CATEGORY	CONSERVATION AND MANAGEMENT
Criterion 17	Illegal, Unreported and Unregulated (IUU) fishing prevention
Question	What is the RFMO doing to prevent IUU fishing?
1	The RFMO has no information on this topic?
2	Does the RFMO mention illegal fishing?
3	Does the RFMO acknowledge that IUU fishing is a concern to be addressed?
4	Does the RFMO have a weak plan to deal with IUU fishing?
5	Does the RFMO have an adequate plan to deal with IUU fishing?
6	Does the RFMO have a detailed plan to deal with IUU fishing?
7	6 + Is the RFMO in the process of compiling a list of IUU fishing boats/has a temporary list?
8	6 + Does the RFMO have a list of IUU fishing boats available to public and other RFMOs?
9	8 + Does the RFMO have the number of IUU fishing boats caught through the years on their website?
10	9 + Does the RFMO have a description of what each member country is doing to combat IUU?
CATEGORY	CONSERVATION AND MANAGEMENT
Criterion 18	Science
Question	Do they have scientific advice?
1	There is no information on this topic?
2	Does the RFMO offer only a mere mention of science?
3	Is science included in the RFMO?
4	3 + Are there any additional details?
5	Do scientific results dictate the catch of the RFMO?
6	5 + Does the RFMO have a scientific body/committee?
7	Does the RFMO state the importance of unbiased data, etc.?
8	Does the RFMO have catch trends available?
9	Is the RFMO's science thorough?
10	9 + Is there a list of all scientists that make up the scientific body?
CATEGORY	ALLOCATION
Criterion 19	New members
Question	How does the RFMO deal with new members?
1	No information on this topic?
2	Is there any mention of this topic?
3	Is there the mention of new members (but no details)?
4	Does the RFMO mention that new members are allowed, and provide some key details (i.e., who can apply for membership)?

5	Is the process of acquiring membership outlined?
6	5 + Is there any timeline reference regarding membership?
7	6 + Does the RFMO explicitly state how long it will take for membership to occur?
8	7 + Is a detailed process of acquiring membership described?
9	8 + Is there a strategy to deal with new members in relation to fluctuations in stock size?
10	9 + Does the RFMO acknowledge stock health in relation to new members (i.e., increased allocation increases pressure on the stock)?
CATEGORY ALLOCATION	
Criterion 20 Provisions for developing states	
Question	Does the RFMO acknowledge developing and developed states' disparity?
1	No information at all?
2	Is there no mention and the RFMO does not have developing states in the Commission?
3	Does the RFMO state they take developing states into account in any way?
4	Is there a noted difference in allocation or fees between developing and developed states?
5	Is there a process to aid developing states financially?
6	Is there a detailed process to deal with the financial disparity between developed and developing nations?
7	6 + Is there explicit criteria of what constitutes a developed nation?
8	6 + Do they have a fund for developing nations?
9	8 + Are roles and duties of developed states defined?
10	9 + Is there a special allocation for developing states?
CATEGORY COOPERATION AND RESOLUTIONS	
Criterion 21 Transparency (in all processes)	
Question	Is transparency practiced?
1	No mention at all?
2	Is transparency obvious? (But no mention of its importance).
3	Does the RFMO allude to transparency through the the Convention/the Agreement statements?
4	Does the RFMO offer an explanation of transparency?
5	Is there some acknowledgement of the importance of transparency or are the general areas of RFMO transparency outlined?
6	Is there a detailed list of transparent areas within the RFMO?
7	6 + Does the RFMO highlight the processes of greater transparency?
8	7 + Are there any additional details?
9	Is most information available to public?
10	Is there a striking effort to make all areas of RFMO transparent?
CATEGORY COOPERATION AND RESOLUTIONS	
Criterion 22 Full member participation	
Question	Is full member participation encouraged?
1	No mention at all?
2	Is there any mention of this topic?
3	Does the RFMO mention the importance of full member participation?
4	Does the RFMO mention the participation of major states?
5	Is full member participation stated and encouraged?
6	Is the importance of full member participation explained?
7	6 + Does the RFMO describe specific areas or events that need full member participation?
8	7 + Are there any additional details?
9	Does the RFMO express that states with more at stake have an appropriate say in the decision processes?
10	Is full member participation enforced?
CATEGORY COOPERATION AND RESOLUTIONS	
Criterion 23 Working/cooperating with other RFMOs	

Question	Does the RFMO work with other RFMOs?
1	No mention at all?
2	Does the RFMO mention other RFMOs?
3	Does the RFMO state the importance of working with other RFMOs?
4	Does the RFMO have stated plans to work with other RFMOs?
5	Has the RFMO had meetings with other RFMO(s) with similar interests?
6	5 + Are the details from those meetings available?
7	Has the RFMO worked with another RFMO(s)?
8	Does the RFMO collaborate often with other RFMO(s)?
9	Has the RFMO met with each RFMO of relevance to it (i.e., same area, species, etc.)?
10	Has the RFMO had meetings with all RFMOs?
CATEGORY	COOPERATION AND RESOLUTIONS
Criterion 24	Cooperation with other organizations/bodies (not RFMOs)
Question	Does the RFMO work with other organizations/bodies?
1	No mention at all?
2	Does the RFMO mention other organizations?
3	Does the RFMO state the importance of working with other appropriate organizations?
4	Does the RFMO have stated plans to work with other appropriate organizations?
5	Has the RFMO had meetings with appropriate organizations with similar interests?
6	5 + Are there details from the meeting(s) available?
7	Has the RFMO worked with an appropriate organization(s)?
8	Does the RFMO collaborate often with other appropriate organization(s)?
9	Is an appropriate organization a permanent part of this RFMO?
10	Is more than one appropriate organization an integral part of this RFMO?
CATEGORY	COOPERATION AND RESOLUTIONS
Criterion 25	Strengthening of mandate
Question	How does the RFMO strengthen its mandate?
1	No mention at all?
2	Is there any mention of this topic?
3	Does the RFMO state the importance of mandate strengthening?
4	Does the RFMO have plans to strengthen its mandate or does it provide a few strengtheners?
5	Does the RFMO have appropriate mandate strengthening?
6	Does the RFMO list the details of appropriate mandate strengthening?
7	Does the RFMO have an appropriate, current mandate?
8	7 + Does the RFMO have all mandate documents complete with updates/changes (previous and current)?
9	8 + Does the RFMO have any additional details?
10	Does the RFMO strengthen the mandate by making appropriate yearly changes?
CATEGORY	COOPERATION AND RESOLUTIONS
Criterion 26	Assessments and reviews (i.e., performance, etc.)
Question	Have performance reviews been created?
1	No mention at all?
2	Does the RFMO mention performance reviews as necessary?
3	Is the RFMO in the process of reviewing/planning on a review?
4	Has the RFMO had meetings with other RFMOs to discuss performance reviews?
5	Has a performance review been created (at least one)?
6	Has a performance review been executed?
7	Are the details of the review available?
8	7 + Does the RFMO guarantee implementation of relevant changes pending the results of the review?
9	Has the review led to any changes in the RFMO?
10	Has the review led to the implementation of tangible, positive changes in that RFMO?

Appendix 2

Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR)

Contracting parties: 26 total: Argentina, Australia, Belgium, Brazil, Chile, China, EU, France, Germany, India, Italy, Japan, Korea, Namibia, New Zealand, Norway, Poland, Russia, South Africa, Spain, Sweden, Ukraine, UK, USA, Uruguay.

Area: High Seas of Southern Ocean, around Antarctica.

Date entered into force: 1982

FAO association: No.

FAO statistical area: 88, 48, 58.

Objectives: "...to conserve marine life of the Southern Ocean. However this does not exclude harvesting carried out in a rational manner."

Primary species: Antarctic toothfish (*Dissostichus mawsoni*), Krill (*Euphausia superba*), Mackerel icefish (*Champsocephalus gunnari*), Patagonian toothfish (*Dissostichus eleginoides*).

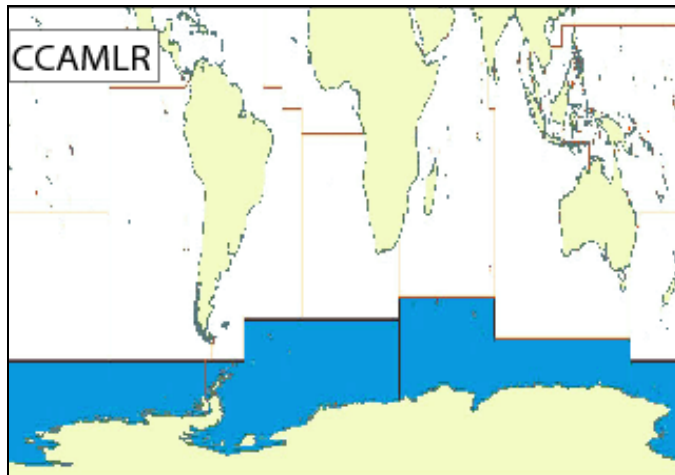


Figure A.1.1 CCAMLR convention area.

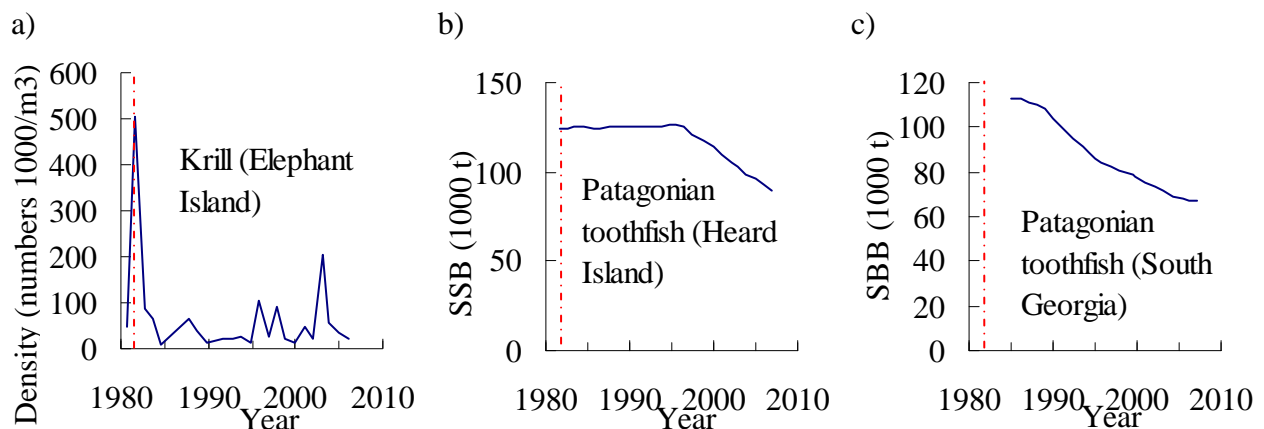


Figure A.1.2 Time series of biomass of three stocks under CCAMLR management; the red dashed lines denote the date CCAMLR was established (1982). Patagonian toothfish comprise the largest CCAMLR catch after krill. Data from Reiss *et al.* (2008), CCAMLR (2007a) and CCAMLR (2007b).

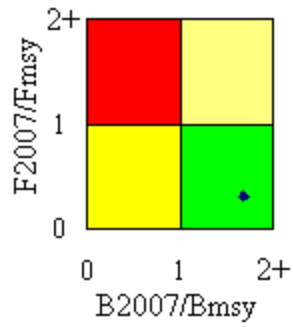


Figure A.1.3 Phase plot of South Georgia stock of Patagonian toothfish under CCAMLR management. The x-axis represents current biomass (B_{2007}) over biomass at maximum sustainable yield (B_{msy}). The y-axis represents current fishing mortality (F_{2007}) over fishing mortality that produces maximum sustainable yield (F_{msy}). Data from CCAMLR (2007b), FishBase (see www.fishbase.com), and Clark (1991).

Convention on the Conservation and Management of the Pollock Resources in the Central Bering Sea (CCBSP)

Contracting parties: 6 total: China, Japan, Republic of Korea, Republic of Poland, Russian Federation, USA.

Area: High seas of the Bering Sea.

Date entered into force: 1995

FAO association: No.

FAO statistical area: 61, 67.

Objectives: "...to establish an international regime for conservation, management, and optimum utilization of Pollock resources in the Convention area..."

Primary species: Pollock (*Theragra chalcogramma*).

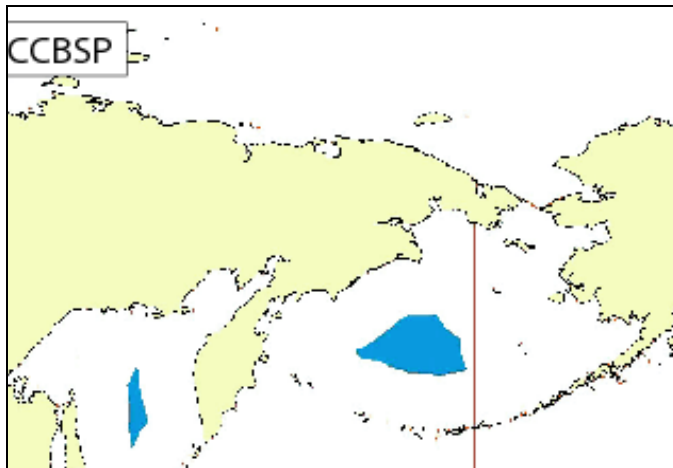


Figure A.2.1 CCBSP convention area.

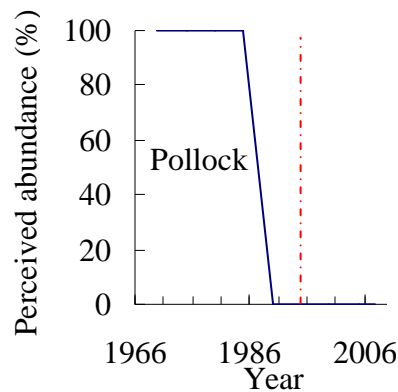


Figure A.2.2 Time series of biomass of Pollock, the primary species under CCBSP management, in the Donut Hole region; the red dashed line denotes establishment of CCBSP (1995). Data from qualitative information from L. Lee-Low, pers.comm., CCBSP, 2008, and from http://www.afsc.noaa.gov/refm/cbs/convention_description.htm.

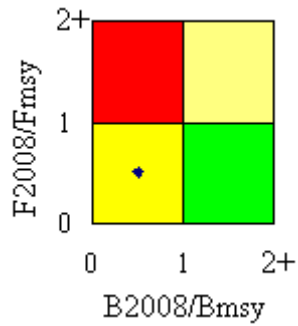


Figure A.2.3 Phase plot of pollock under CCBSP management. The x-axis represents current biomass (B2008) over biomass at maximum sustainable yield (Bmsy). The y-axis represents current fishing mortality (F2008) over fishing mortality that produces maximum sustainable yield (Fmsy). Data from qualitative information from L. Lee-Low, pers.comm., CCBSP, 2008, and from http://www.afsc.noaa.gov/refm/cbs/convention_description.htm.

Commission for the Conservation of Southern Bluefin Tuna (CCSBT):

Contracting parties: 6 total: Australia, Indonesia, Japan, Korea (Republic of), New Zealand, Taiwan.

Area: The entire geographical range of Southern bluefin tuna.

Date entered into force: 1994

FAO association: No.

FAO statistical area: 41, 47, 51, 57, 81.

Objectives: "...to ensure, through appropriate management, the conservation and optimum utilisation of the global SBT fishery. The Commission also provides an internationally recognised forum for other countries/entities to actively participate in SBT issues."

Primary species: Southern bluefin tuna (*Thunnus maccoyii*).

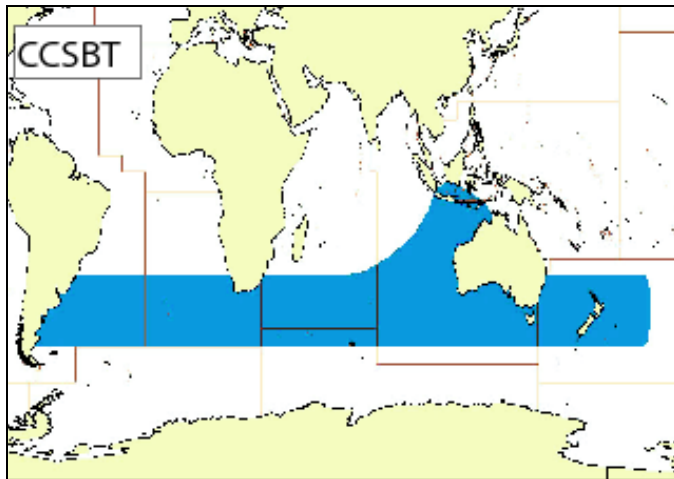


Figure A.3.1 CCSBT convention area.

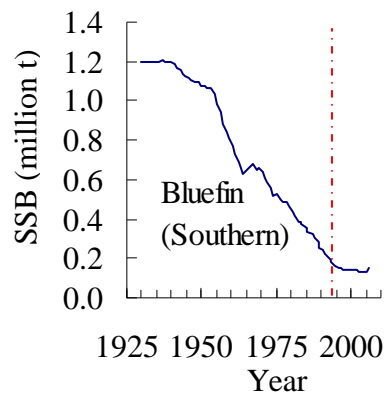


Figure A.3.2 Time series of biomass of Southern bluefin tuna, the primary species under CCSBT management; the red dashed line denotes the year of establishment of CCSBT (1994). Data from CCSBT (2006).

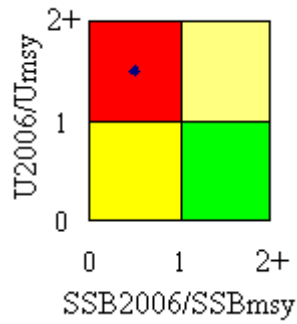


Figure A.3.3 Phase plot of Southern bluefin tuna under CCSBT management. The x-axis represents current spawning stock biomass (SB_{2006}) over spawning stock biomass at maximum sustainable yield (SSB_{msy}). The y-axis represents current exploitation rate (U_{2006}) over exploitation rate that produces maximum sustainable yield (U_{msy}). Data from CCSBT (2006) and CCSBT (2008).

General Fisheries Commission for the Mediterranean (GFCM):

Contracting parties: 24 total: Albania, Algeria, Bulgaria, Croatia, Cyprus, EU, Egypt, France, Greece, Israel, Italy, Japan, Lebanon, Libya, Malta, Monaco, Montenegro, Morocco, Romania, Slovenia, Spain, Syria, Tunisia, Turkey.

Area: The Mediterranean, Black Sea and connecting waters.

Date entered into force: 1952

FAO association: Yes.

FAO statistical area: 37.

Commission's objectives: "...to promote the development, conservation, rational management and best utilization of living marine resources, as well as the sustainable development of aquaculture in the Region."

Primary species: Albacore (*Thunnus alalunga*), Angler (*Lophius piscatorius*), Atlantic bluefin tuna (*Thunnus thynnus*), Atlantic mackerel (*Scomber scombrus*), Beluga (*Huso huso*), Blackbellied angler (*Lophius budegassa*), Blackspot seabream (*Pagellus bogaraveo*), Blue and red shrimp (*Aristeus antennatus*), Blue shark (*Prionace glauca*), Blue whiting (*Micromesistius poutassou*), Bluefish (*Pomatomus saltatrix*), Bogue (*Boops boops*), Common cuttlefish (*Sepia officinalis*), Common dolphinfish (*Coryphaena hippurus*), Common Pandora (*Pagellus erythrinus*), Common sole (*Solea solea*), Common spiny lobster (*Palinurus elephas*), Danube sturgeon (*Acipenser gueldenstaedtii*), Deepwater rose shrimp (*Parapenaeus longirostris*), European anchovy (*Engraulis encrasicolus*), European eel (*Anguilla anguilla*), European hake (*Merluccius merluccius*), European pilchard (Sardine) (*Sardina pilchardus*), European sprat (*Sprattus sprattus*), European squid (*Loligo vulgaris*), Giant red shrimp (*Aristaeomorpha foliacea*), Horned octopus (*Eledone cirrosa*), Mediterranean horse mackerel (*Trachurus mediterraneus*), Musky octopus (*Eledone moschata*), Norway lobster (*Nephrops norvegicus*), Pink spiny lobster (*Palinurus mauritanicus*), Porbeagle (*Lamna nasus*), Red mullet (*Mullus barbatus*), Round sardinella (*Sardinella aurita*), Shortfin mako (*Isurus oxyrinchus*), Starry sturgeon (*Acipenser stellatus*), Sturgeon (*Acipenser sturio*), Surmullet (*Mullus surmuletus*), Turbot (*Psetta maxima*), Whiting (*Merlangius merlangus*).

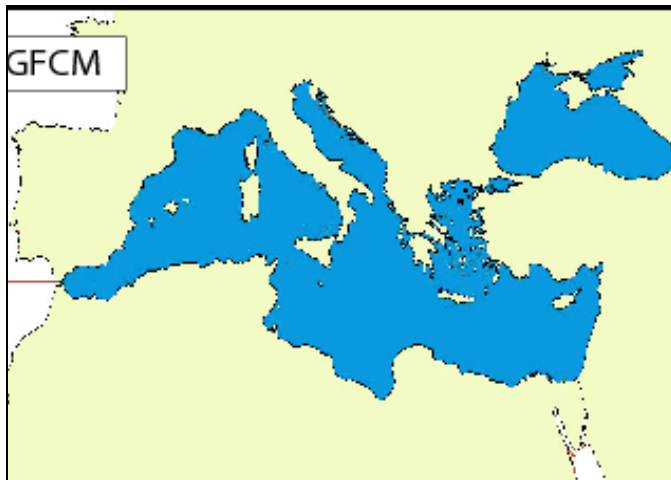
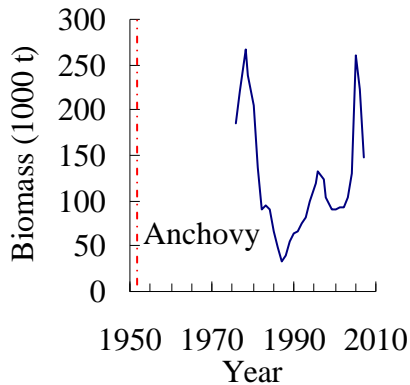


Figure A.4.1 GFCM convention area.

a)



b)

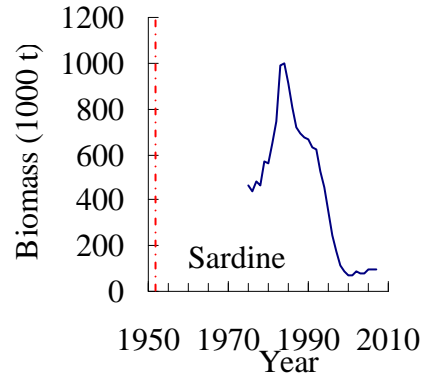


Figure A.4.2 Time series of the biomass of two main species under management of GFCM; both anchovy and sardine comprise a majority of GFCM's catch and had the most available data. The red dashed lines denote year of establishment of GFCM (1952). Data from GFCM (2008) and [http://151.1.154.86/meetingdocs/2008/SEP_\(Izmir\)%20SCSA%20WG%20on%20Small%20Pelagic%20Species%20including%20joint%20Stocks%20Assessments/Presentations/Anchovy%20and%20Sardine%20Stock%20Assessment%20in%20the%20GSA%2017%20\(1975-2007\).ppt#380,13,Slide 13](http://151.1.154.86/meetingdocs/2008/SEP_(Izmir)%20SCSA%20WG%20on%20Small%20Pelagic%20Species%20including%20joint%20Stocks%20Assessments/Presentations/Anchovy%20and%20Sardine%20Stock%20Assessment%20in%20the%20GSA%2017%20(1975-2007).ppt#380,13,Slide%2013).

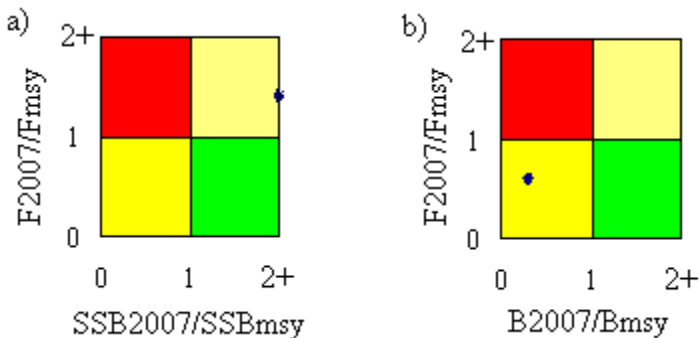


Figure A.4.3 Phase plot of two stocks under GFCM management: a) Anchovy (northern Adriatic Sea stock, GSA 17), and b) Sardine (northern Adriatic Sea stock, GSA 17). The x-axes represent either current spawning stock biomass (SSB2007) or current biomass (B2007) over either spawning stock biomass at maximum sustainable yield (SSBmsy) or biomass at maximum sustainable yield (Bmsy). The y-axes represent current fishing mortality (F2007) over fishing mortality that produces maximum sustainable yield (Fmsy). Data from GFCM (2006), GFCM (2008) and Clark (1991).

Inter-American Tropical Tuna Commission (IATTC):

Contracting parties: 16 total: Columbia, Costa Rica, Ecuador, El Salvador, France, Guatemala, Japan, Mexico, Nicaragua, Panama, Peru, Republic of Korea, Spain, USA, Vanuatu, Venezuela.

Area: Eastern Pacific Ocean

Date entered into force: 1950

FAO association: No.

FAO statistical area: 87, 77, 67.

Objectives: "...responsible for the conservation and management of fisheries for tunas and other species taken by tuna-fishing vessels in the eastern Pacific Ocean."

Primary species: Albacore (*Thunnus alalunga*), Bigeye tuna *Thunnus obesus*), Black skipjack (*Euthynnus lineatus*), Black marlin (*Makaira indica*), Blue marlin (*Makaira nigricans*), Bonitos (*Sarda* spp), Carangids (family: Carangidae), Dolphin fish (family: Coryphaenidae), Striped marlin (*Tetrapturus audax*), Pacific bluefin tuna (*Thunnus orientalis*), Indo-Pacific sailfish (*Istiophorus platypterus*), Skipjack tuna (*Katsuwonus pelamis*), Shortbill spearfish (*Tetrapturus angustirostris*), Swordfish (*Xiphias gladius*), Yellowfin tuna (*Thunnus albacares*).

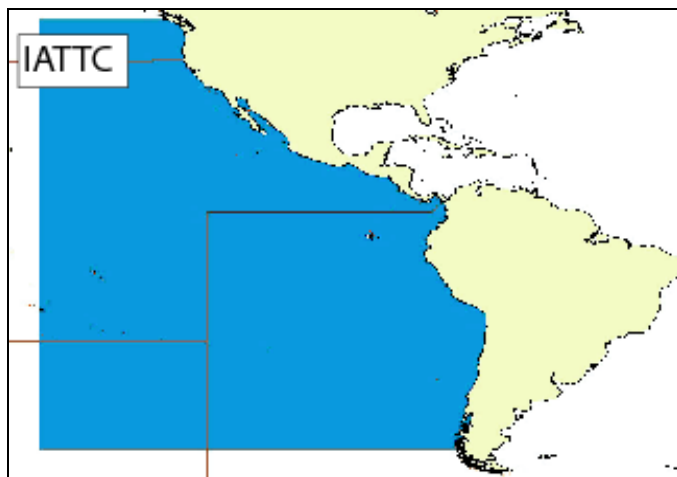


Figure A.5.1 IATTC convention area.

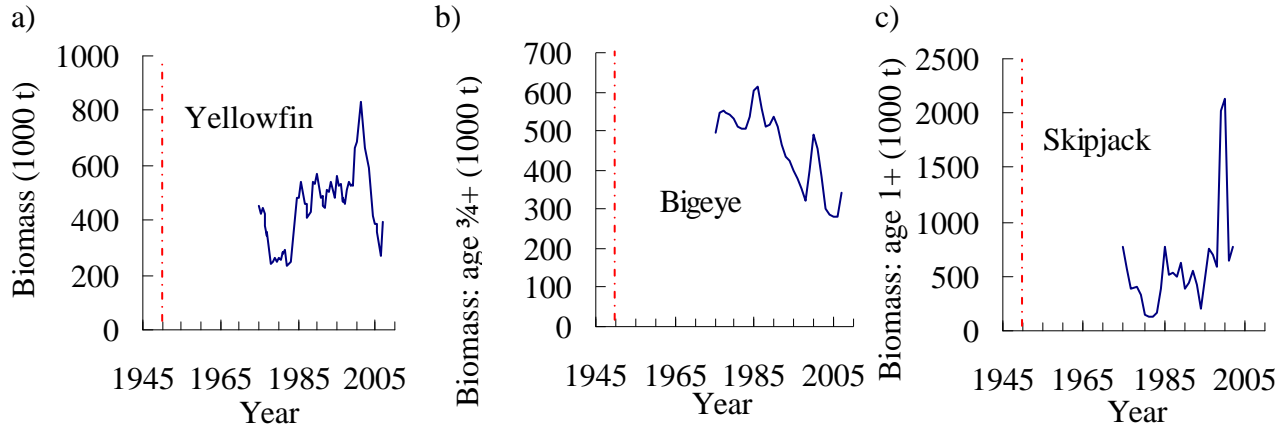


Figure A.5.2 Time series of the biomass of three main tuna species under IATTC management; the red dashed lines denote establishment of IATTC (1950). Data from Maunder (2007), Aires-da-Silva and Maunder (2007), and Maunder and Harley (2004).

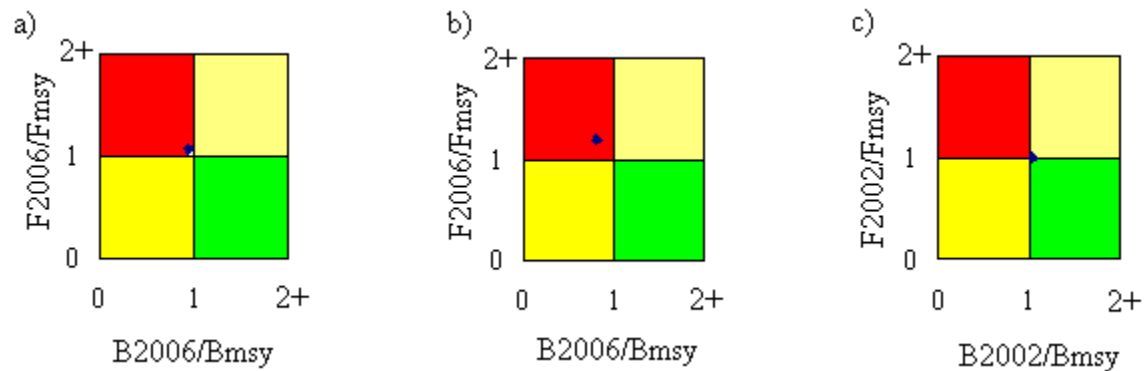


Figure A.5.3 Phase plots of three stocks under IATTC management: a) Yellowfin tuna (note: x-axis reflects stock size in relation to A_{msy} ; data point is running average of three years, 2004-2006); b) Bigeye tuna (note: x-axis reflects stock size in relation to A_{msy} ; data point is running average of three years, 2004-2006); c) Skipjack tuna. The x-axes represent current biomass (B_{2006} or B_{2002}) over biomass at maximum sustainable yield (B_{msy}). The y-axes represent current fishing mortality (F_{2006} or F_{2002}) over fishing mortality that produces maximum sustainable yield (F_{msy}). Data from Maunder (2007), Aires-da-Silva and Maunder (2007), Maunder and Harley (2004), FishBase (see www.fishbase.com) and Patterson (1992).

International Commission for the Conservation of Atlantic Tuna (ICCAT):

Contracting parties: 48 total: Albania, Algeria, Angola, Barbados, Belize, Brasil, Canada, Cap-Vert, China, Cote d'Ivoire, Croatia, Equatorial Guinea, Egypt, EU, France (St-Pierre et Miquelon), Gabon, Ghana, Guatemala, Guinee Rep, Honduras, Iceland, Japan, Korea (Republic of), Libya, Maroc, Mauritania, Mexico, Namibia, Nicaragua, Nigeria, Norway, Panama, Philippines, Russia, Sao Tome E Principe, Senegal, Sierra Leone, South Africa, Syria, St. Vincent & the Grenadines, Trinidad & Tobago, Tunisia, Turkey, UK, USA, Uruguay, Vanuatu, Venezuela.

Area: Atlantic Ocean and adjacent seas.

Date entered into force: 1969.

FAO association: No.

FAO statistical area: 41, 47, 48, 31, 34, 21, 27.

Objectives: "...conservation of tunas and tuna-like species in the Atlantic Ocean and adjacent seas."

Primary species: Albacore tuna (*Thunnus alalunga*), Atlantic bluefin tuna (*Thunnus thynnus t.*, *Thunnus maccoyii*), Bigeye tuna (*Thunnus obesus*), Billfishes- white marlin (*Tetrapturus albidus*), blue marlin (*Makaira nigricans*), sailfish (*Istiophorus albicans*) and spearfish (*Tetrapturus pfluegeri*), Mackerels- spotted Spanish mackerel (*Scomberomorus tritor*) and king mackerel (*Scomberomorus cavalla*), Skipjack tuna (*Katsuwonus pelamis*), Small tunas- Black skipjack tuna (*Euthynnus lineatus*), Frigate tuna (*Auxis thazard*), and Atlantic bonito (*Sarda sarda*), Swordfish (*Xiphias gladius*), Yellowfin tuna (*Thunnus albacares*).

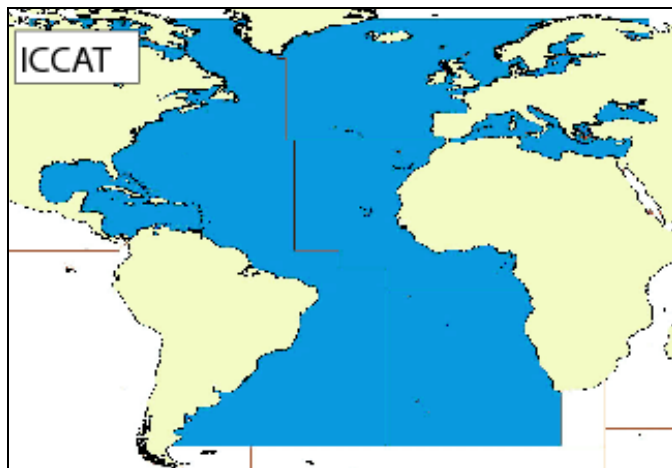


Figure A.6.1 ICCAT convention area.

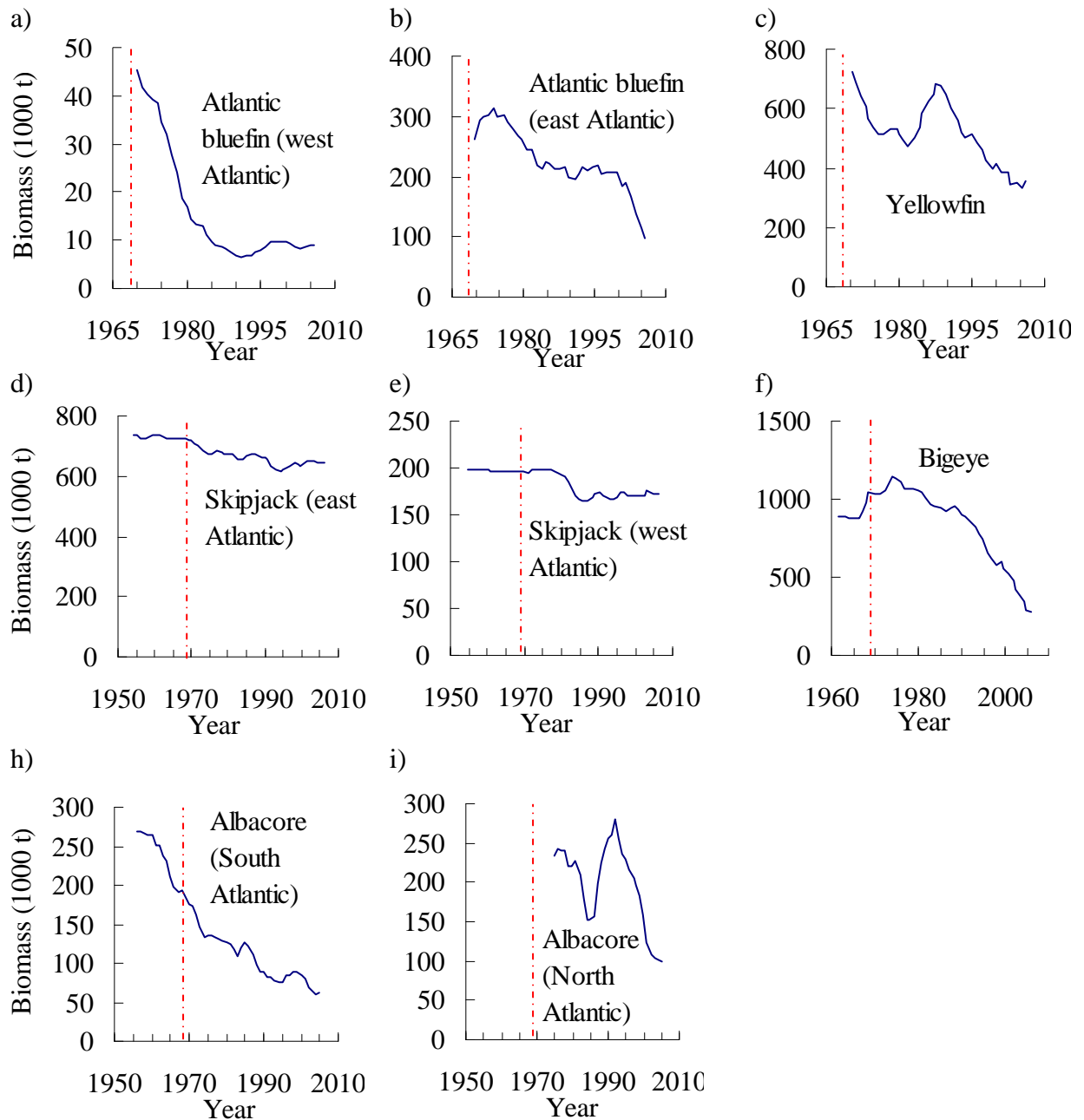


Figure A.6.2 Time series of biomass of the nine major tuna stocks under ICCAT management; the red dashed lines denote the date ICCAT was established (1969). Data from ICCAT (2008a), ICCAT (2008b), ICCAT (2008c), ICCAT (2008d), and ICCAT (2008e).

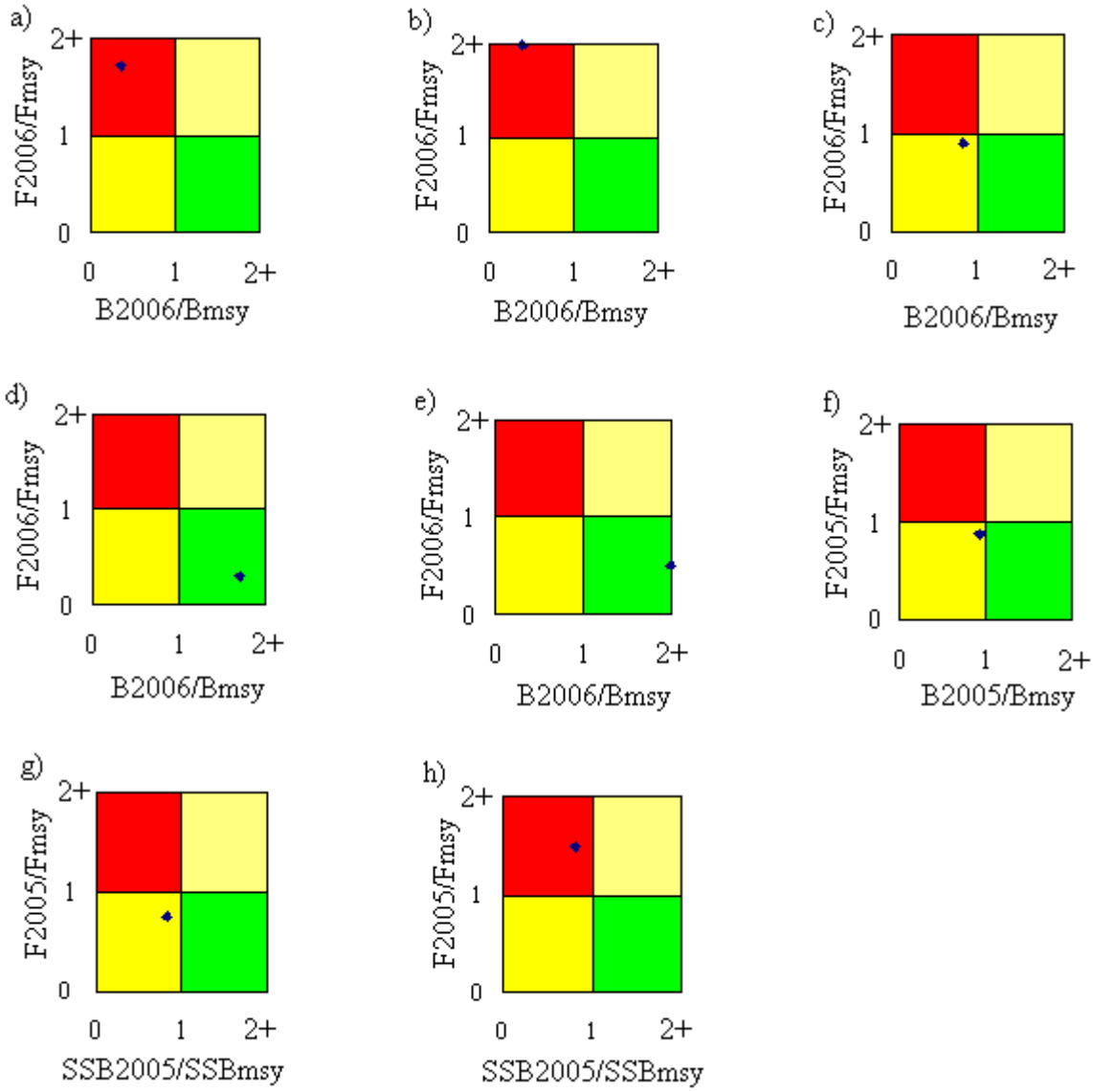


Figure A.6.3 Phase plots of eight stocks under ICCAT management: a) Bluefin tuna (west Atlantic stock); b) Bluefin tuna (east Atlantic stock); c) Yellowfin tuna; d) Skipjack tuna (east Atlantic stock); e) Skipjack tuna (west Atlantic stock); f) Bigeye tuna; g) Albacore tuna (south Atlantic stock); h) Albacore tuna (north Atlantic stock). The x-axes represent either current biomass (B2006 or B2005) or current spawning stock biomass (SSB2005) over either biomass at maximum sustainable yield (Bmsy) or spawning stock biomass at maximum sustainable yield (SSBmsy). The y-axes represent current fishing mortality (F2006 or F2005) over fishing mortality that produces maximum sustainable yield (Fmsy). Data from ICCAT (2008a), ICCAT (2008c), ICCAT (2008d), ICCAT (2008e).

Indian Ocean Tuna Commission (IOTC):

Contracting parties: 27 total: Australia, Belize, China, Comoros, Eritrea, EU, France, Guinea, India, Indonesia, Iran, Japan, Kenya, Republic of Korea, Madagascar, Malaysia, Mauritius, Oman, Pakistan, Philippines, Seychelles, Sri Lanka, Sudan, Tanzania, Thailand, UK, Vanuatu.

Area: The Indian Ocean (FAO statistical areas 51 & 57) and adjacent seas, north of the Antarctic Convergence.

Date entered into force: 1996

FAO association: Yes.

FAO statistical area: 51, 57.

Objectives: "...to promote cooperation among its Members with a view to ensuring, through appropriate management, the conservation and optimum utilisation of stocks and encouraging sustainable development of fisheries based on such stocks."

Primary species: Albacore tuna (*Thunnus alalunga*), Bigeye tuna (*Thunnus obesus*), Black marlin (*Makaira indica*), Bullet tuna (*Auxis rochei*), Frigate tuna (*Auxis thazard*), Kawakawa (*Euthynnus affinis*), Longtail tuna (*Thunnus tonggol*), Indo-Pacific blue marlin (*Makaira mazara*), Indo-Pacific king mackerel (*Scomberomorus guttatus*), Indo-Pacific sailfish (*Istiophorus platypterus*), Narrow barred Spanish mackerel (*Scomberomorus commersoni*), Skipjack (*Katsuwonus pelamis*), Southern bluefin tuna (*Thunnus maccoyii*), Swordfish (*Xiphias gladius*), Striped marlin (*Tetrapturus audax*), Yellowfin tuna (*Thunnus albacares*).

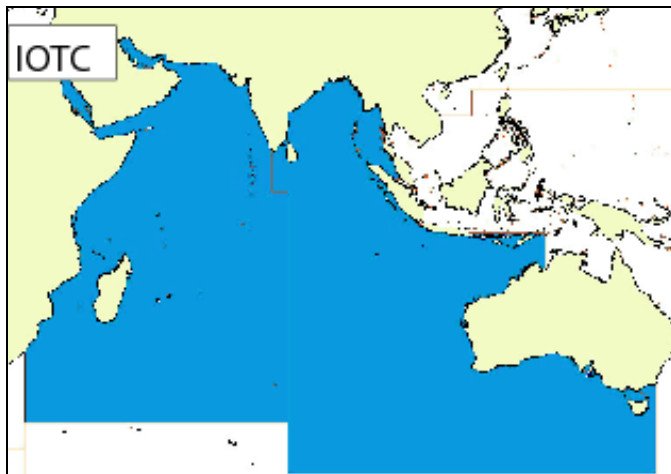


Figure A.7.1 IOTC convention area.

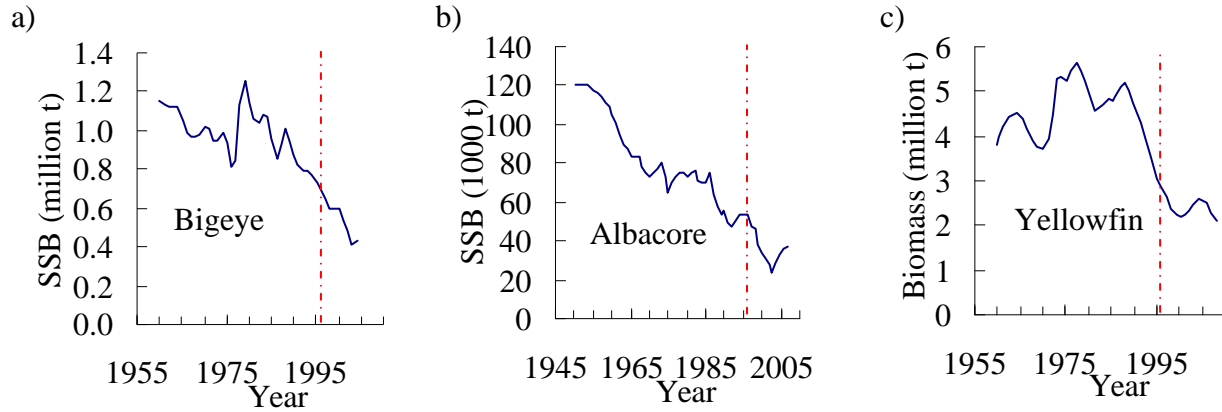


Figure A.7.2 Time series of biomass of the three main tuna stocks under IOTC management; the red dashed lines denote the date ICCAT was established (1996). Data from IOTC (2006), IOTC (2008a), and IOTC (2008b).

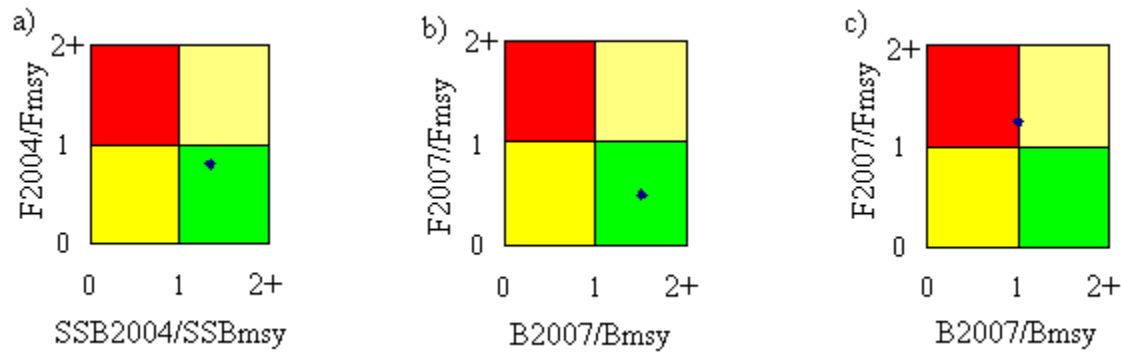


Figure A.7.3 Phase plots of three stocks under IOTC management: a) Bigeye tuna; b) Albacore tuna; c) Yellowfin tuna. The x-axes represent either current biomass (B2007) or current spawning stock biomass (SSB2004) over either biomass at maximum sustainable yield (Bmsy) or spawning stock biomass at maximum sustainable yield (SSBmsy). The y-axes represent current fishing mortality (F2007 or F2004) over fishing mortality that produces maximum sustainable yield (Fmsy). Data from IOTC (2006), IOTC (2008a), and IOTC (2008b).

International Pacific Halibut Commission (IPHC):

Contracting parties: 2 total: Canada, USA.

Area: Within EEZs of Canada and USA.

Date entered into force: 1923

FAO association: No.

FAO statistical area: 67.

Objectives: "...research on and management of the stocks of Pacific halibut (*Hippoglossus stenolepis*) within the Convention waters of both nations."

Primary species: Pacific halibut (*Hippoglossus stenolepis*).

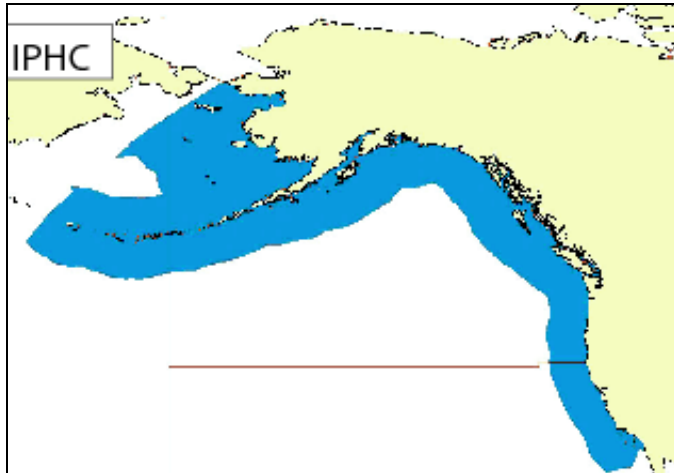


Figure A.8.1 IPHC convention area.

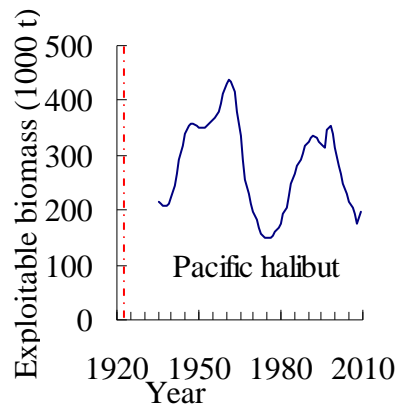


Figure A.8.2 Time series of exploitable biomass of Pacific halibut, the species under management of IPHC; the red dashed line denotes the date IPHC was established (1923). Data from S. Hare, unpublished data, IPHC, 2009, IPHC (2008), IPHC (1985), and <http://www.iphc.washington.edu/halcom/pubs/annmeet/1997/bluebook/PopulationAssessment1996.htm>.

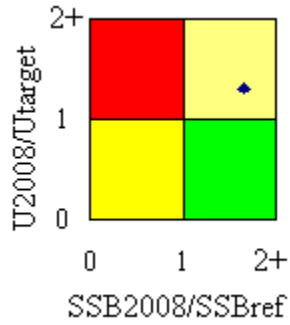


Figure A.8.3 Phase plot of Pacific halibut stock under IPHC management. The x-axis represents current spawning stock biomass (SSB2008) over IPHC's spawning stock biomass reference point for halibut (SSBref). The y-axis represents current exploitation rate (U2008) over exploitation target rate (Utarget). Data from IPHC (2008) and <http://www.iphc.washington.edu/halcom/pubs/annmeet/2009/presentations/sa08-public.pdf>.

International Whaling Commission (IWC):

Contracting parties: 86 total: Antigua & Barbuda, Argentina, Australia, Austria, Belgium, Belize, Benin, Brazil, Cambodia, Cameroon, Chile, China, Congo (Republic of), Costa Rica, Cote d'Ivoire, Croatia, Cyprus, Czech Republic, Denmark, Dominica, Ecuador, Eritrea, Estonia, Finland, France, Gabon, The Gambia, Germany, Ghana (Republic of), Greece, Grenada, Guatemala, Guinea (Republic of), Guinea-Bissau, Hungary, Iceland, India, Ireland, Israel, Italy, Japan, Kenya, Kiribati, Korea (Republic of), Laos, Lithuania, Luxemburg, Mali, Marshall Islands (Republic of), Mauritania, Mexico, Monaco, Mongolia, Morocco, Nauru, Netherlands, New Zealand, Nicaragua, Norway, Oman, Palau, Panama, Peru, Poland, Portugal, Romania, Russian Federation, San Marino, Senegal, Slovak Republic, Slovenia, Solomon Islands, South Africa, Spain, St. Kitts & Nevis, St. Lucia, St. Vincent & the Grenadines, Suriname, Sweden, Switzerland, Tanzania, Togo, Tuvalu, UK, USA, Uruguay.

Area: Global oceans.

Date entered into force: 1946

FAO association: No.

FAO statistical area: All areas.

Objectives: "...to provide for the proper conservation of whale stocks and thus make possible the orderly development of the whaling industry."

Primary species: All cetaceans.

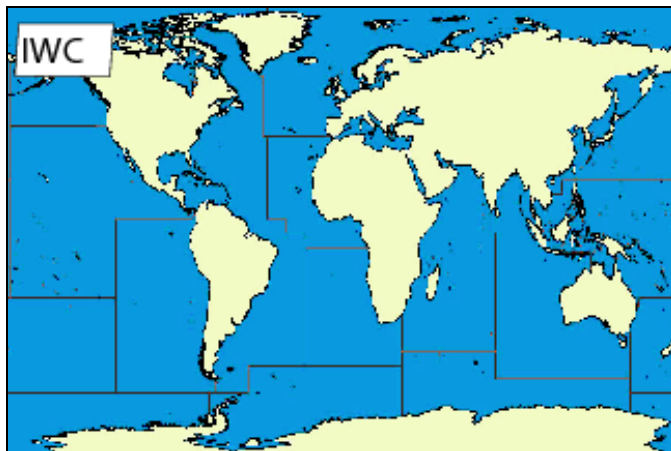


Figure A.9.1 IWC convention area.

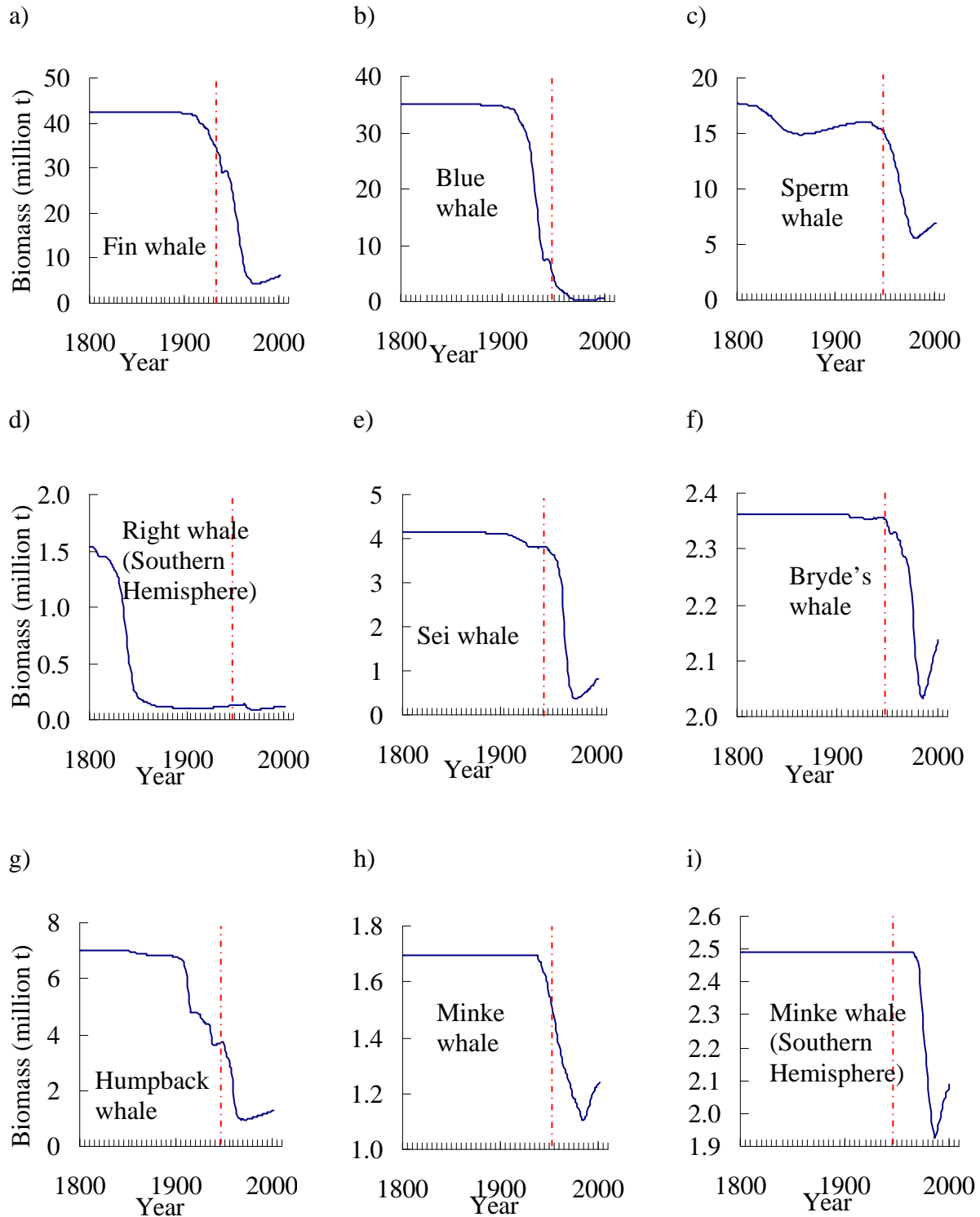


Figure A.9.2 Time series of biomass of the nine great whale stocks under IWC management; the red dashed lines denote the date IWC was established (1946). Data from L. Christensen, unpublished data, University of British Columbia, 2008.

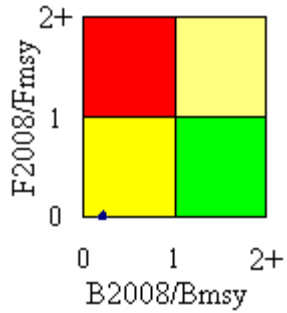


Figure A.9.3 Phase plot depicting nine great whale stocks (of greatest abundance) under IWC management, i.e., all nine stocks follow same example. The x-axis represents current biomass (B2008) over biomass at maximum sustainable yield (Bmsy). The y-axis represents current fishing mortality (F2008) over fishing mortality that produces maximum sustainable yield (Fmsy). Data from qualitative information from <http://www.iwcoffice.org/commission/iwcmain.htm#conservation> and http://www.iwcoffice.org/_documents/commission/scheduletables.pdf.

Northwest Atlantic Fisheries Organization (NAFO):

Contracting parties: 12 total: Canada, Cuba, Denmark (Faroe Islands & Greenland), EU, France (Saint Pierre et Miquelon), Iceland, Japan, Korea (Republic of), Norway, Russian Federation, Ukraine, USA.

Area: Northwest Atlantic.

Date entered into force: 1979

FAO association: No.

FAO statistical area: 21.

Objectives: "...to contribute through consultation and cooperation to the optimum utilization, rational management and conservation of the fishery resources of the Convention Area."

Primary species: American plaice (*Hippoglossoides platessoides*), Atlantic cod (*Gadus morhua*), Atlantic redfishes (*Sebastes spp.*), Capelin (*Mallotus villosus*), Greenland halibut (*Reinhardtius hippoglossoides*), Northern shrimp (*Pandalus spp.*), Shortfinned squid (*Illex illecebrosus*), Thorny skate (*Amblyraja radiata*), White hake (*Urophycis tenuis*), Witch flounder (*Glyptocephalus cynoglossus*), Yellowtail flounder (*Limanda ferruginea*).

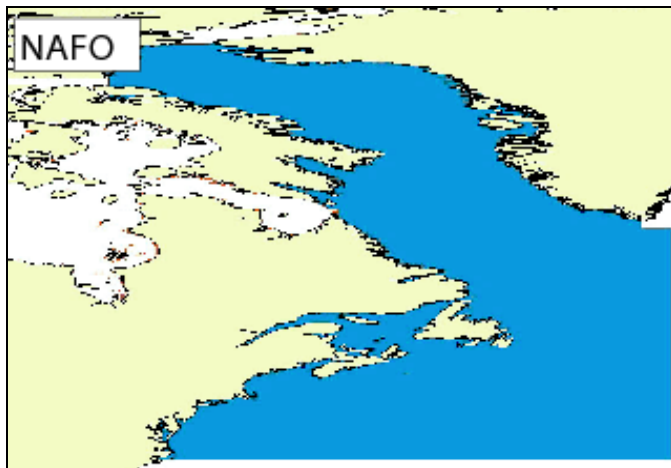


Figure A.10.1 NAFO convention area.

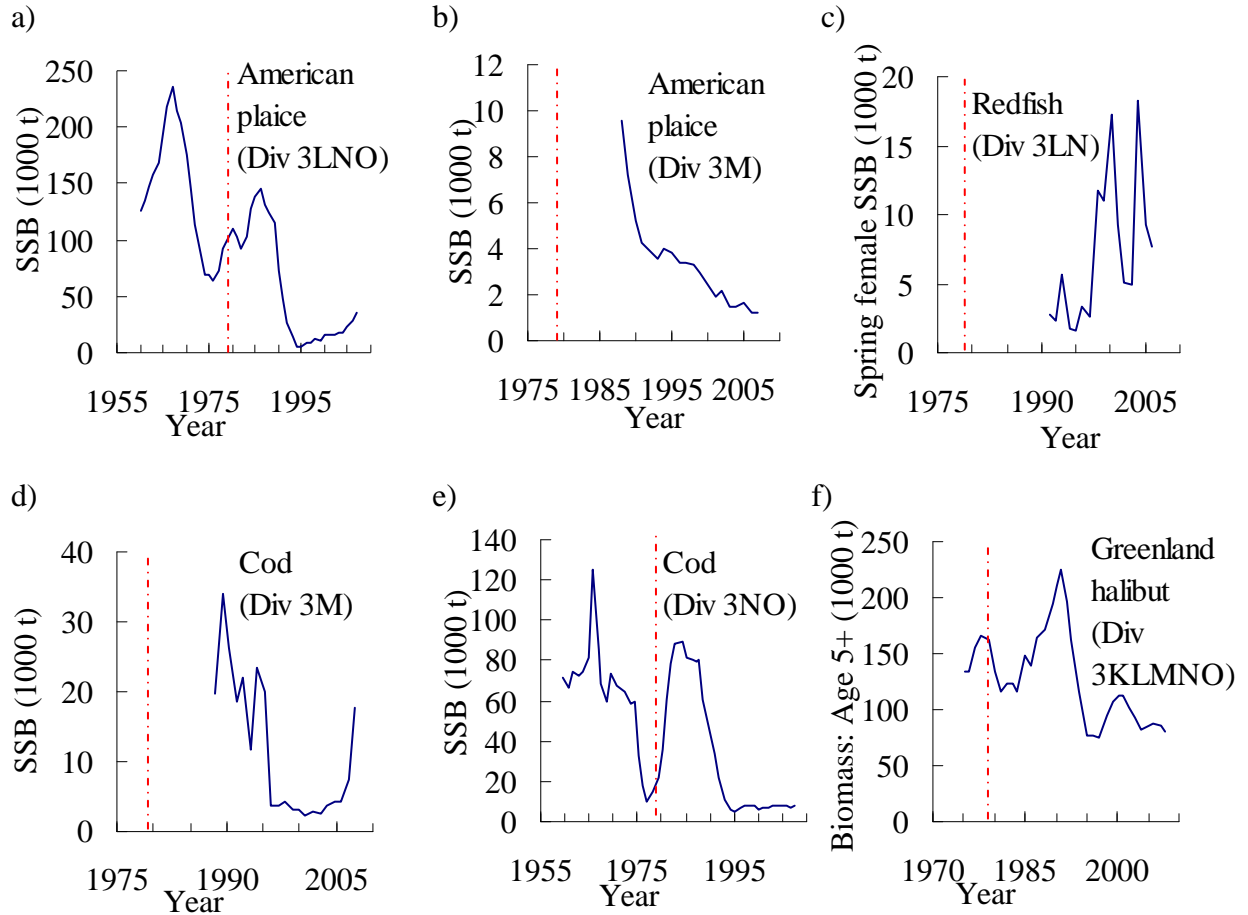


Figure A.10.2 Time series of biomass of the four main species (six stocks) under management of NAFO; the red dashed lines denote the date NAFO was established (1979). Data from NAFO (2008a) and <http://www.nafo.int/fisheries/frames/fishery.html>.

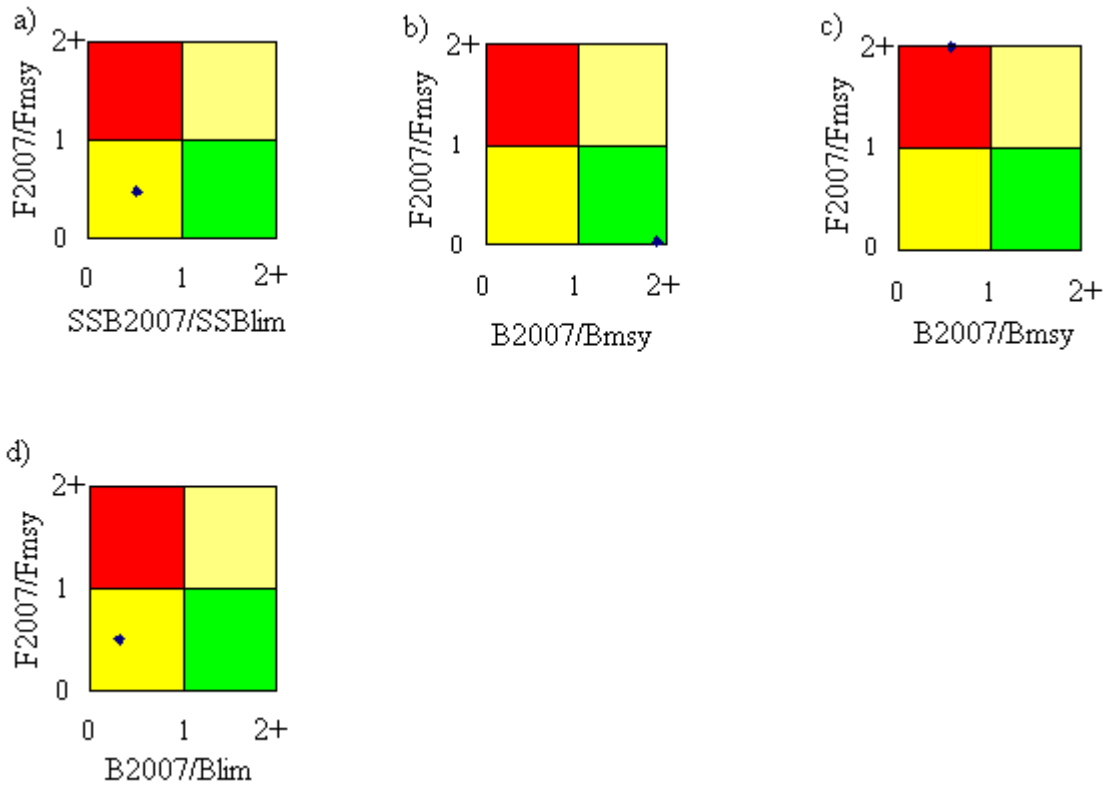


Figure A.10.3 Phase plots of four stocks under NAFO management: a) Cod (Div. 3M); b) Redfish (Div. 3M); c) Greenland Halibut (Div. 3KLMNO); d) American Plaice (Div. 3M). The x-axes represent either current biomass (B_{2007}) or current spawning stock biomass (SSB_{2007}) over either biomass at maximum sustainable yield (B_{msy}), biomass at ‘limit’ (B_{lim}), or spawning stock biomass at ‘limit’ (SSB_{lim}). The y-axes represent current fishing mortality (F_{2007}) over fishing mortality that produces maximum sustainable yield (F_{msy}). Data from NAFO (2008b) and Mooney-Seus & Rosenberg (2007).

North Atlantic Salmon Conservation Organization (NASCO):

Contracting parties: 7 total: Canada, Denmark (Faroe Islands and Greenland), EU, Iceland, Norway, Russian Federation, USA.

Area: East coast EEZs of Canada & USA; EEZs West of Greenland, west of a line along 44°W longitude south to 59°N latitude, thence due east to 42°W longitude and thence due south; Maritime waters east of the line referred to in previous.

Date entered into force: 1983

FAO association: No.

FAO statistical area: 27, 21.

Objectives: "...to conserve, restore, enhance and rationally manage Atlantic salmon through international cooperation taking account of the best available scientific information."

Primary species: Atlantic salmon (*Salmo salar L.*).

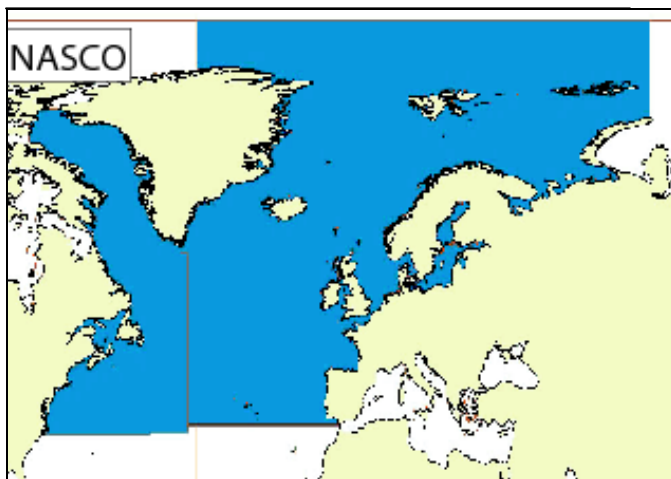


Figure A.11.1 NASCO convention area.

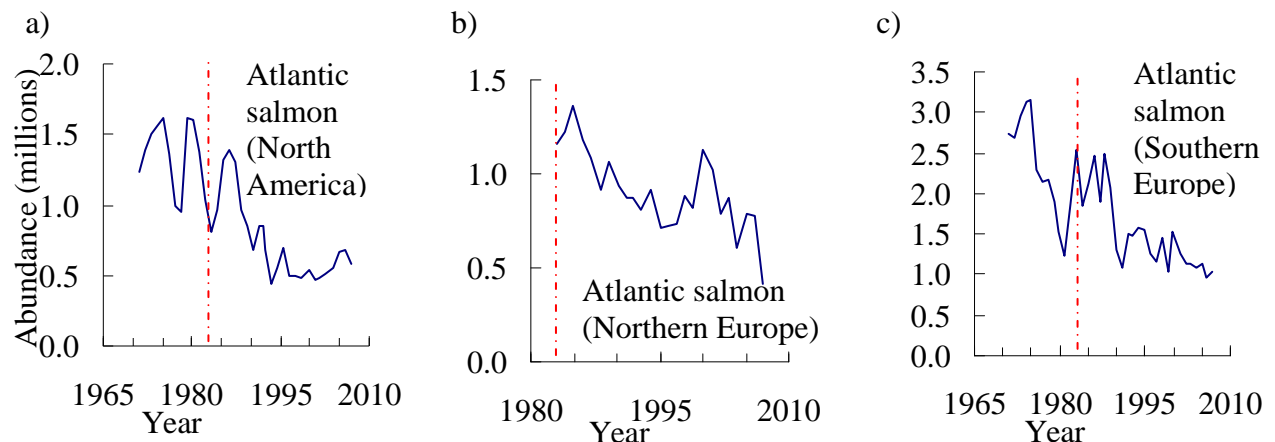


Figure A.11.2 Time series of abundance of the three stocks of Atlantic salmon under NASCO management; the red dashed lines denote the date NASCO was established (1983). Note: b) and c) depict pre-fishery abundance. Data from NASCO (2008).

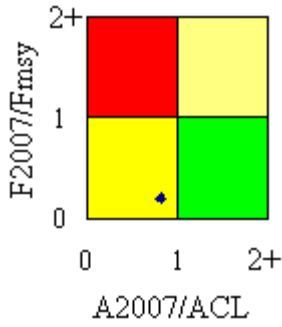


Figure A.11.3 Phase plot of North American Atlantic salmon (large salmon only) under NASCO management. The x-axis represents current abundance (A_{2007}) over abundance at conservation limit (ACL). The y-axis represents current fishing mortality (F_{2007}) over fishing mortality that produces maximum sustainable yield (F_{msy}). Data from ICES (2009) and NASCO (2008).

North East Atlantic Fisheries Commission (NEAFC):

Contracting parties: 5 total: Denmark (Faroe Islands & Greenland), EU, Iceland, Norway, Russian Federation.

Area: Atlantic and Arctic Oceans.

Date entered into force: 1982

FAO association: No.

FAO statistical area: 27.

Objectives: "...to recommend measures to maintain the rational exploitation of fish stocks in the Atlantic and Arctic Oceans."

Primary species: Blue whiting (*Micromesistius poutassou*), Deep-sea species, Haddock (*Melanogrammus aeglefinus*), Herring (*Clupea harengus*), Mackerel (*Scomber scombrus*), Redfish (*Sebastes mentella*).

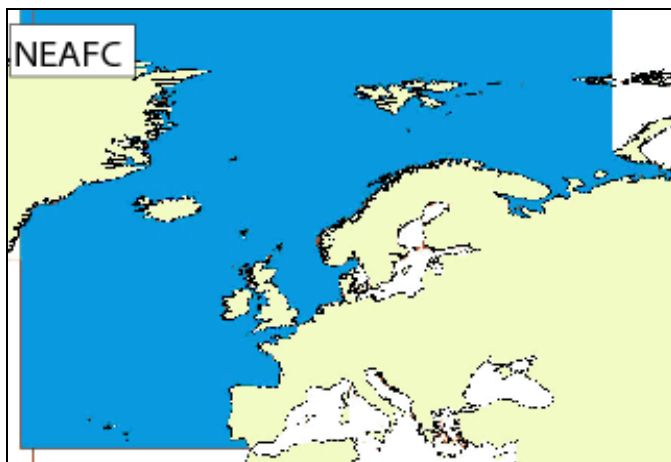


Figure A.12.1 NEAFC convention area.

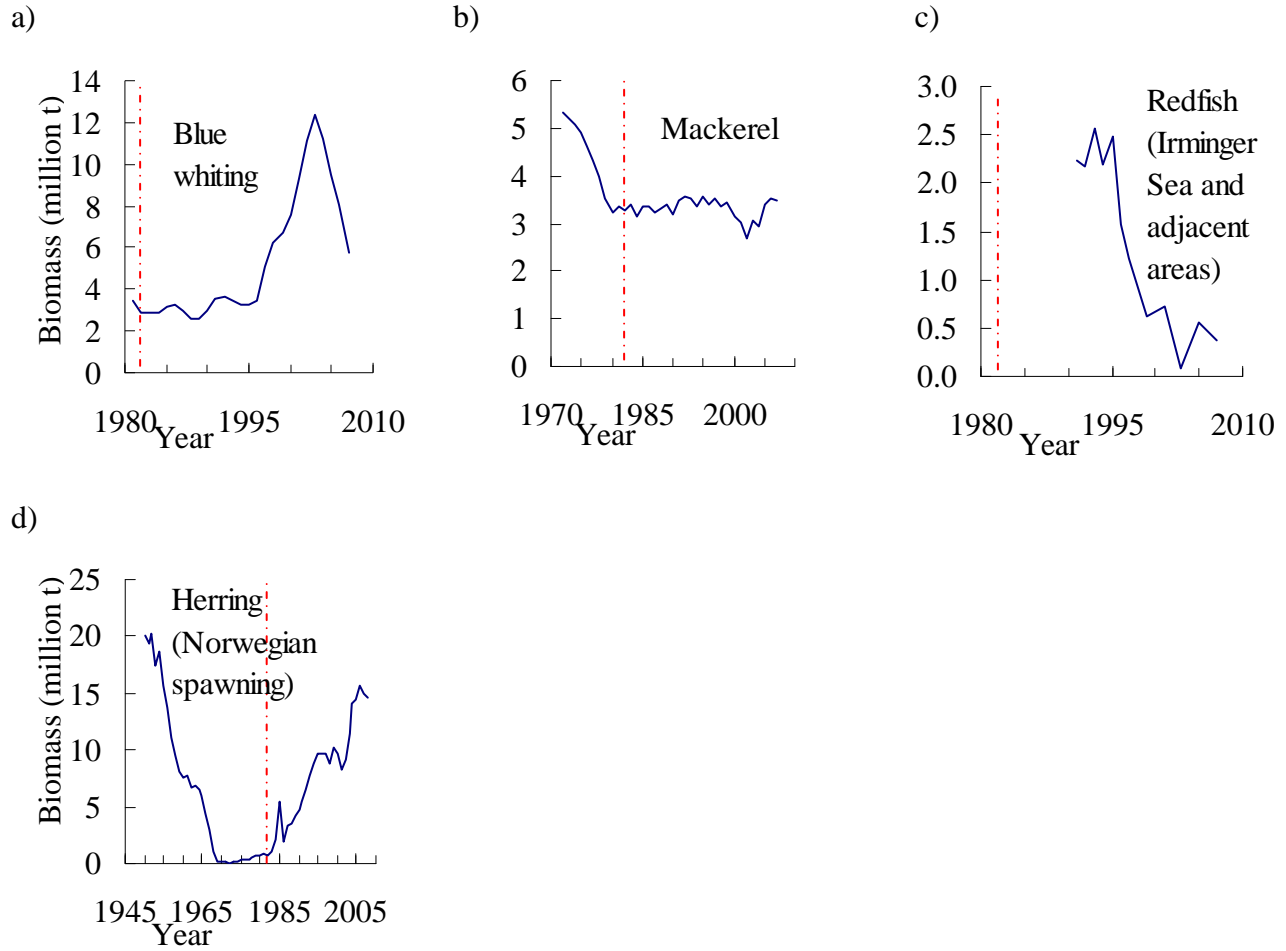


Figure A.12.2 Time series of biomass of the four main stocks under NEAFC management; the red dashed lines denote the date NEAFC was established (1982). Data from ICES database (see <http://www.ices.dk/datacentre/StdGraphDB.asp> and <http://www.ices.dk/reports/ACOM/2008/NWWG/Sec-19%20Pelagic%20Sebastes%20mentella.pdf>).

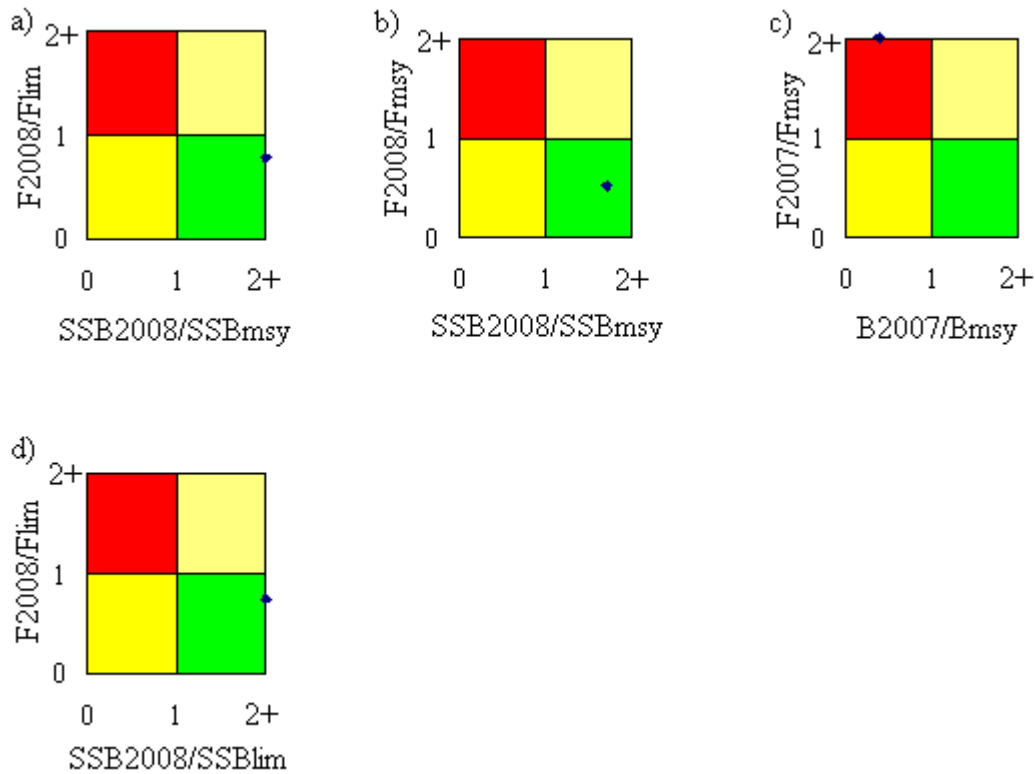


Figure A.12.3 Phase plots of four stocks under NEAFC management: a) Blue Whiting; b) Mackerel; c) Redfish; d) Herring, Norwegian-spawning. The x-axes represent either current biomass (B_{2007}) or current spawning stock biomass (SSB_{2008}) over either biomass at maximum sustainable yield (B_{msy}), spawning stock biomass at maximum sustainable yield (SSB_{msy}), or spawning stock biomass at “critical level” (SSB_{lim}). The y-axes represent current fishing mortality (F_{2008} or F_{2007}) over either fishing mortality that produces maximum sustainable yield (F_{msy}), or the fishing mortality limit (F_{lim}). Data from ICES (2008), Mooney-Seus and Rosenberg (2007), <http://www.ices.dk/reports/ACOM/2008/NWWG/Sec-19%20Pelagic%20Sebastes%20mentella.pdf>, NOAA (2007) and Clark (1991).

North Pacific Anadromous Fish Commission (NPAFC):

Contracting parties: 5 total: Canada, Japan, Korea (Republic of), Russian Federation, USA.

Area: High seas only of the North Pacific Ocean and its adjacent seas, north of 33 degrees North Latitude.

Date entered into force: 1993

FAO association: No.

FAO statistical area: 67, 61, 77.

Objectives: "...to promote the conservation of anadromous stocks in the Convention Area."

Primary species: Cheery salmon (*Oncorhynchus masou*), Chinook salmon (*Oncorhynchus tshawytscha*), Chum salmon (*Oncorhynchus keta*), Coho salmon (*Oncorhynchus kisutch*), Pink salmon (*Oncorhynchus gorbuscha*), Sockeye salmon (*Oncorhynchus nerka*), Steelhead trout (*Oncorhynchus mykiss*).

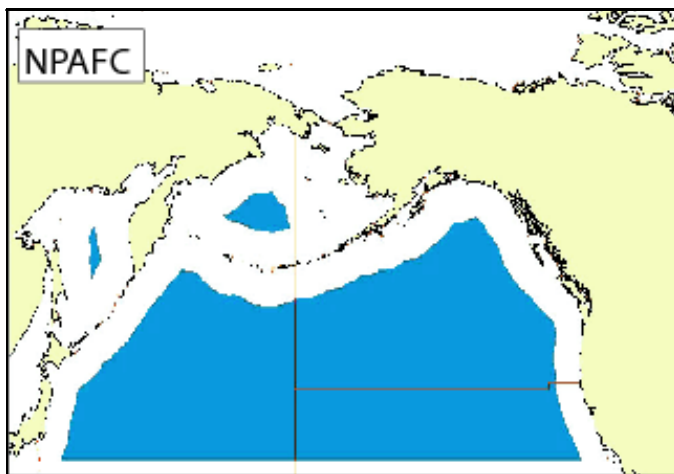


Figure A.13.1 NPAFC convention area.

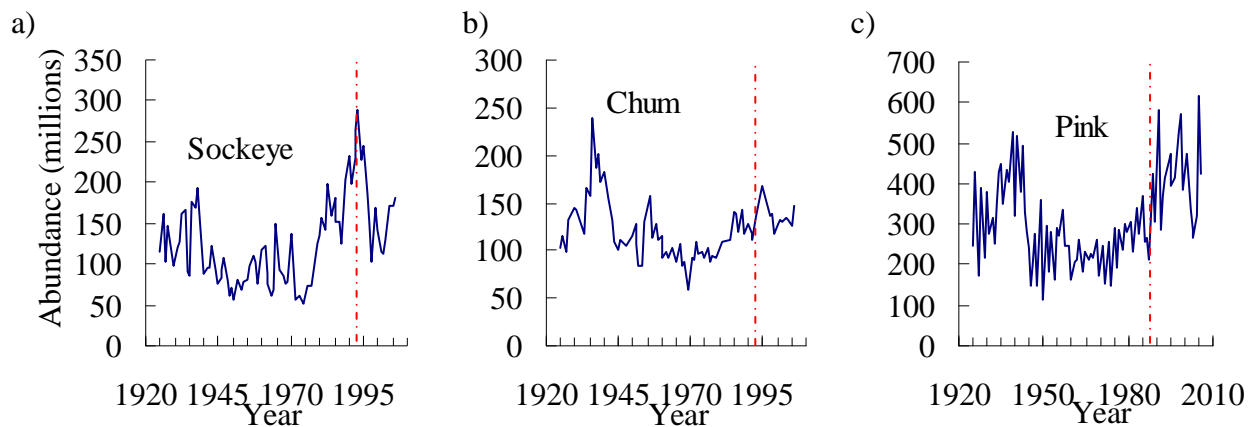


Figure A.13.2 Time series of biomass of the three main salmon stocks under NPAFC management; the red dashed lines denote the date NPAFC was established (1993). Data from [www.npafc.org/new/events/symposium/BASIS%202008/PPT/Keynote-4\(Kaeriyama\).pdf](http://www.npafc.org/new/events/symposium/BASIS%202008/PPT/Keynote-4(Kaeriyama).pdf).

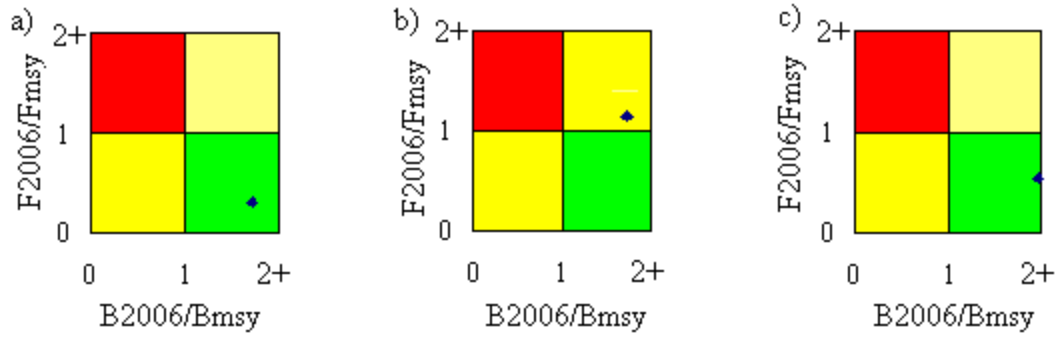


Figure A.13.3 Phase plots of three stocks under NPAFC management: a) Sockeye salmon; b) Chum salmon; c) Pink salmon. The x-axes represent current biomass (B_{2006}) over biomass at maximum sustainable yield (B_{msy}). The y-axes represent current fishing mortality (F_{2006}) over fishing mortality that produces maximum sustainable yield (F_{msy}). Data from www.npafc.org/new/publications/Annual%20Report/2007/15th%20Annual%20Meeting/CSRS.htm, and Clark (1991).

Pacific Salmon Commission (PSC):

Contracting parties: 2 total: Canada, USA.

Area: EEZs of Canada and USA.

Date entered into force: 1995

FAO association: No.

FAO statistical area: 67.

Objectives: "...to carry out their [Canada and USA] salmon fisheries and enhancement programs so as to: prevent over-fishing and provide for optimum production, and ensure that both countries receive benefits equal to the production of salmon originating in their waters."

Primary species: Chinook salmon (*Oncorhynchus tshawytscha*), Chum salmon (*Oncorhynchus keta*), Coho salmon (*Oncorhynchus kisutch*), Pink salmon (*Oncorhynchus gorbuscha*), Sockeye salmon (*Oncorhynchus nerka*).

Note: current stock status data for PSC is not available.

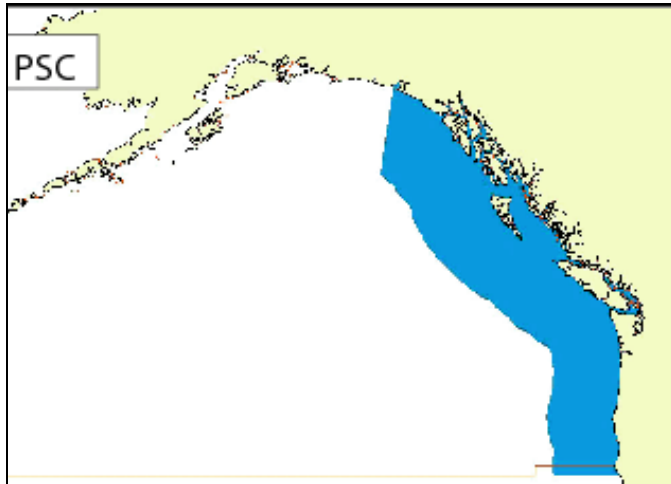


Figure A.14.1 PSC convention area.

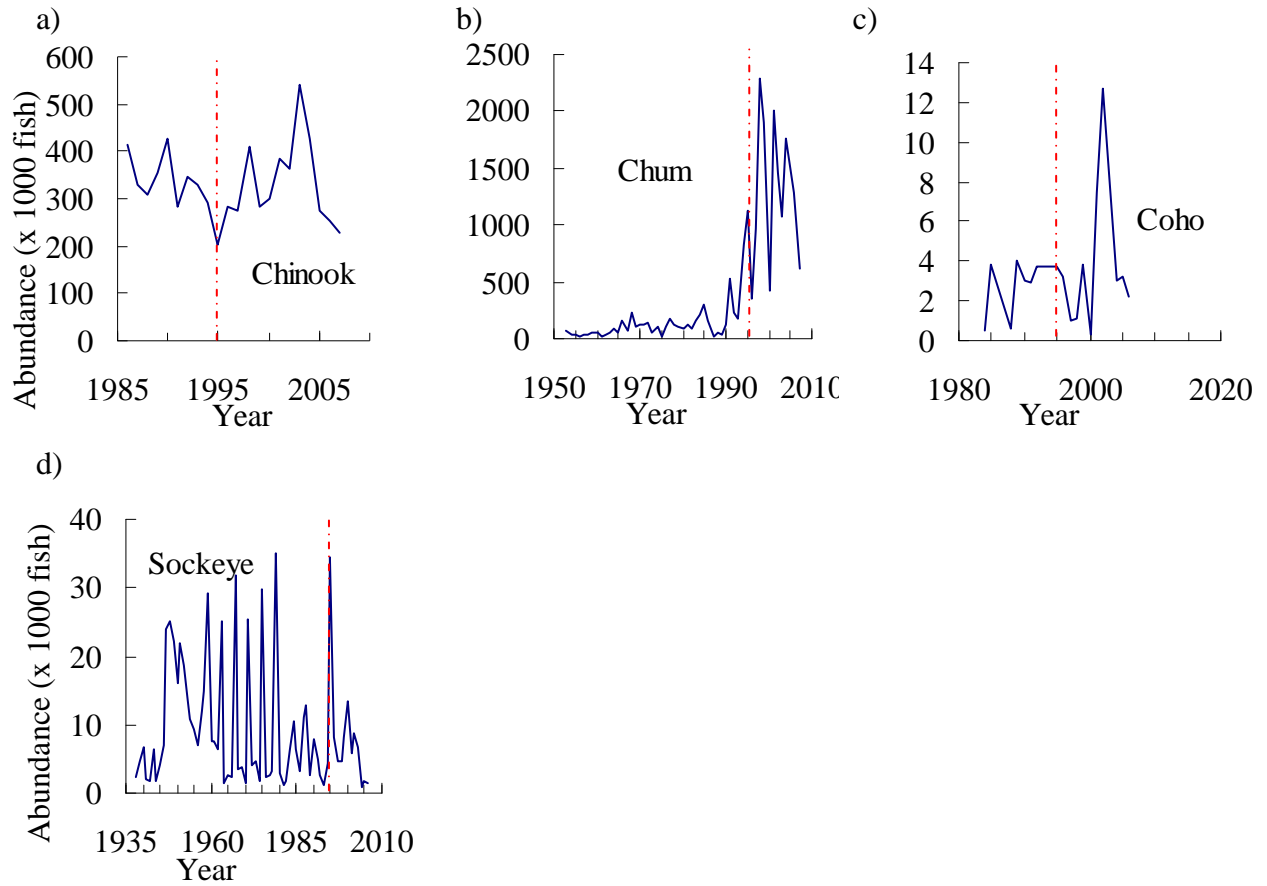


Figure A.14.2 Time series of biomass of four main salmon stocks under PSC management; the red dashed lines denote the date PSC was established (1995). Data from PSC (2008a), A. Rushton, unpublished data, PSC, 2009, PSC (2008b), and C. Michielsens, unpublished data, PSC, 2009.

South East Atlantic Fisheries Organization (SEAFO):

Contracting parties: 5 total: Angola, EU, Namibia, Norway, South Africa.

Area: Southeast Atlantic high seas.

Date entered into force: 2003

FAO association: No.

FAO statistical area: 47, 34.

Objectives: "...to ensure the long-term conservation and sustainable use of the fishery resources in the Convention Area through the effective implementation of the Convention."

Primary species: Alfonsino (Family *Berycidae*), Armourhead (*Pseudopentaceros spp.*), Cardinal fish (*Epigonus spp.*), Chub mackerel (*Scomber japonicus*), Deepsea crab (*Chaceon maritae*), Deepwater hake (*Merluccius paradoxus*), Horse mackerel (*Trachurus spp.*), Octopus (Family *Octopodidae*), Orange roughy (*Hoplostethus spp.*), Oreodories (Family *Oreosomatidae*), Patagonian toothfish (*Dissostichus eleginoides*), Skates (Family *Rajidae*), Squid (Family *Loliginidae*), Wreckfish (*Polyprion americanus*).

Note: at time of research, SEAFO did not yet have species biomass information available.

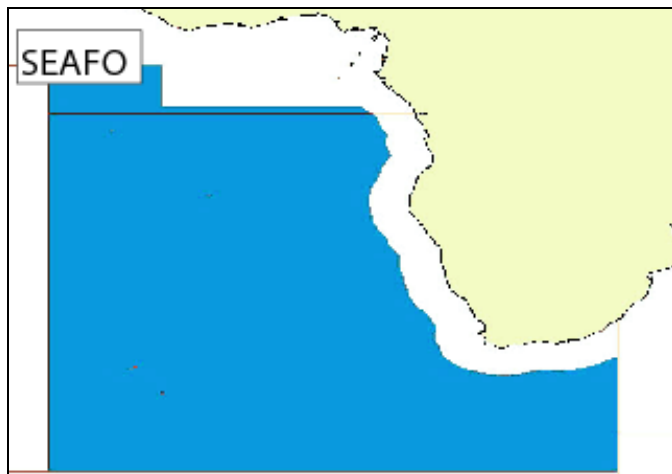


Figure A.15.1 SEAFO convention area.

South Indian Ocean Fisheries Agreement (SIOFA):

Contracting parties: 23 total: Australia, China, Comoros, Cook Islands, EU, France, Iran, Japan, Kenya, Korea (Republic of), Madagascar, Maldives, Mauritius, Mozambique, Namibia, New Zealand, Russia, Seychelles, Somalia, South Africa, Tanzania, UK, Yemen.

Area: South Indian Ocean, outside national jurisdictions.

Date entered into force: Still waiting.

FAO association: Yes.

FAO statistical area: 51.

Objectives: "...at ensuring the long-term conservation and sustainable use of fishery resources other than tuna in areas that fall outside national jurisdictions."

Primary species: Fishery resources other than tuna in areas that fall outside national jurisdictions in South Indian Ocean.

Note: at time of research, SIOFA did not yet have species biomass information available.

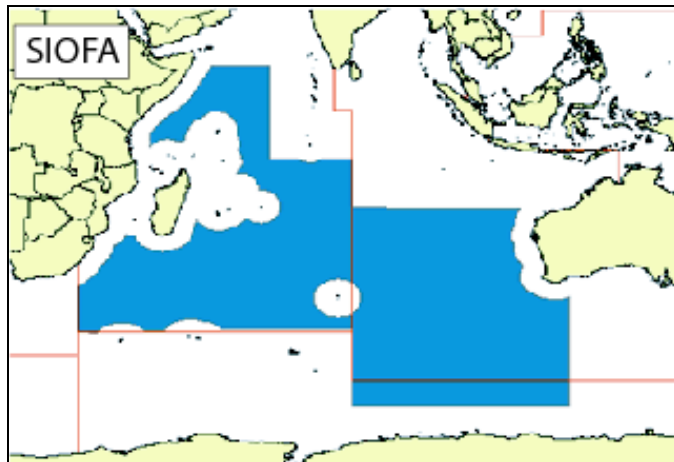


Figure A.16.1 SIOFA convention area.

South Pacific Regional Fisheries Management Organization (SPRFMO):

Contracting parties: 4 total: Australia, Chile, EU, New Zealand.

Area: High seas of South Pacific Ocean (from the most eastern part of the South Indian Ocean through the Pacific towards the EEZs of South America).

Date entered into force: Still waiting.

FAO association: No.

FAO statistical area: 81, 71, 57.

Objectives: "...to ensure the long-term conservation and sustainable use of fish stocks and to protect biodiversity in the marine environment."

Primary species: Discreet high seas stocks and straddling stocks.

Note: at time of research, SPRFMO did not yet have species biomass information available.

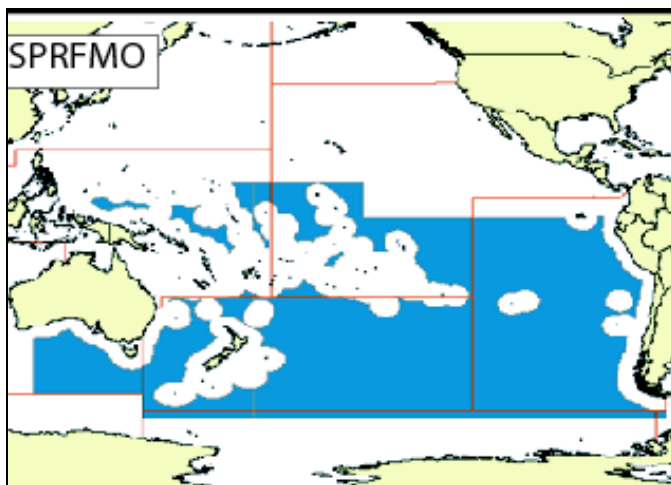


Figure A.17.1 SPRFMO convention area.

Western and Central Pacific Fisheries Commission (WCPFC):

Contracting parties: 25 total: Australia, Canada, China, Cook Islands, European Community, Federated States of Micronesia, Fiji, France, Japan, Kiribati, Korea, Marshall Islands (Republic of), Nauru, New Zealand, Niue, Palau, Papua New Guinea, Philippines, Samoa, Solomon Islands, Chinese Taipei, Tonga, Tuvalu, USA, Vanuatu.

Area: Western and Central Pacific Ocean.

Date entered into force: 2004

FAO association: No.

FAO statistical area: 81, 71, 61, 67, 77.

Objectives: "...to ensure, through effective management, the long-term conservation and sustainable use of highly migratory fish stocks in the western and central Pacific Ocean in accordance with the 1982 United Nations Convention on the Law of the Sea and the 1995 UN Fish Stocks Agreement."

Primary species: All species of highly migratory fish stocks within the Convention Area, except sauries.

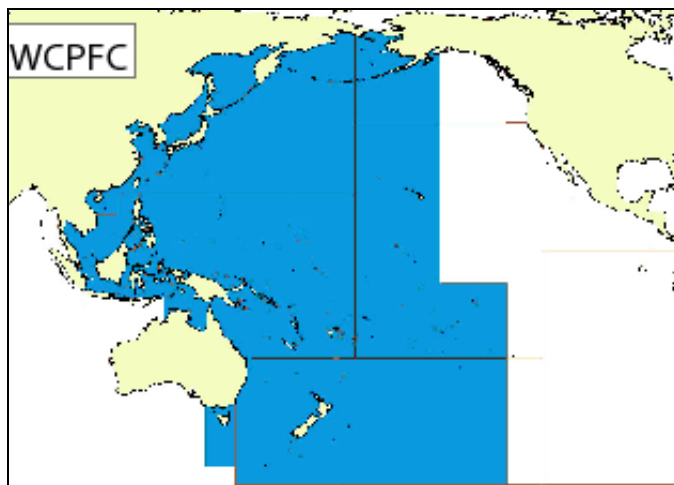


Figure A.18.1 WCPFC convention area.

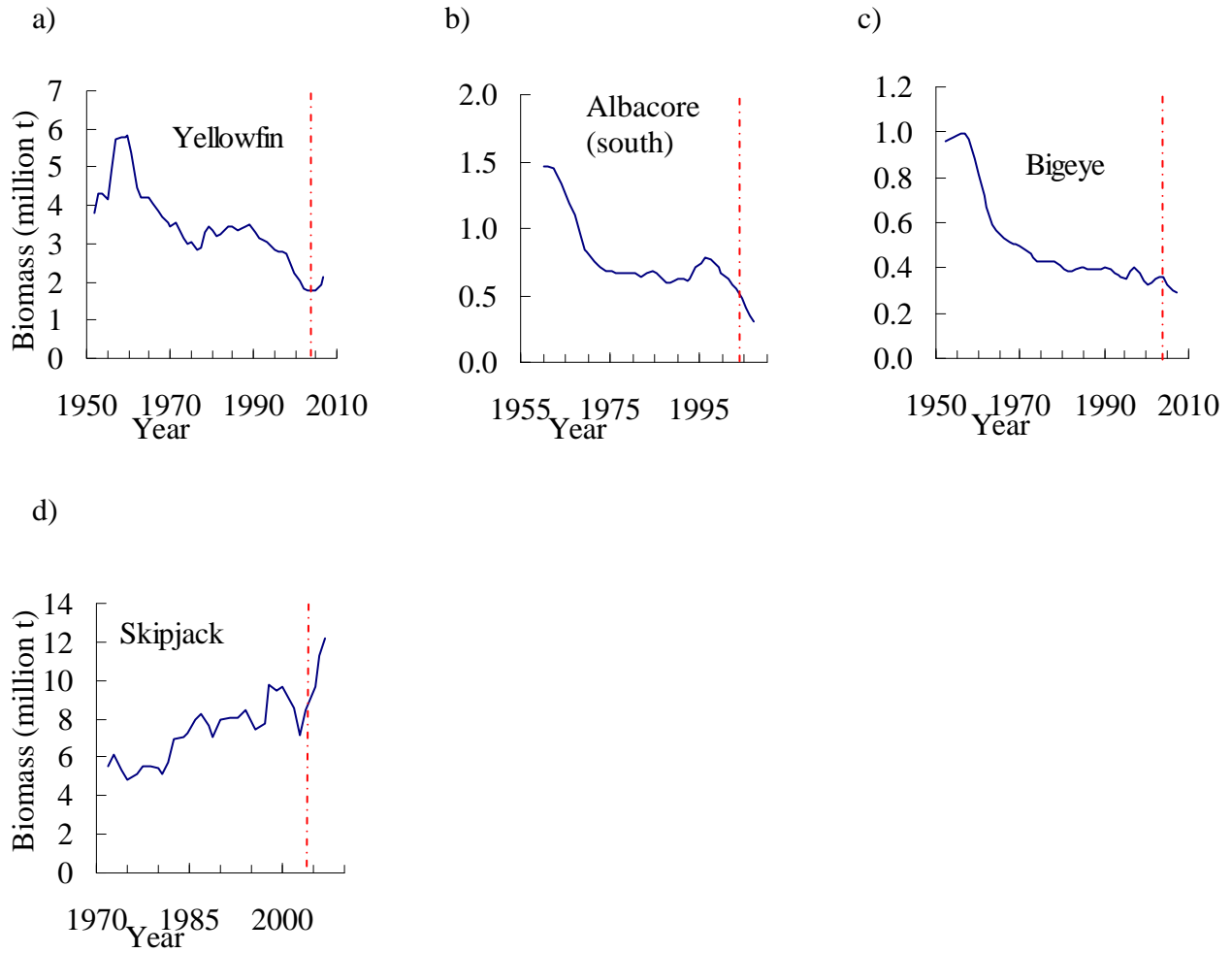


Figure A.18.2 Time series of biomass of the four main tuna stocks under WCPFC management; the red dashed lines denote the date WCPFC was established (2004). Data from WCPFC (2007), WCPFC (2008a), WCPFC (2008b), and WCPFC (2008c).

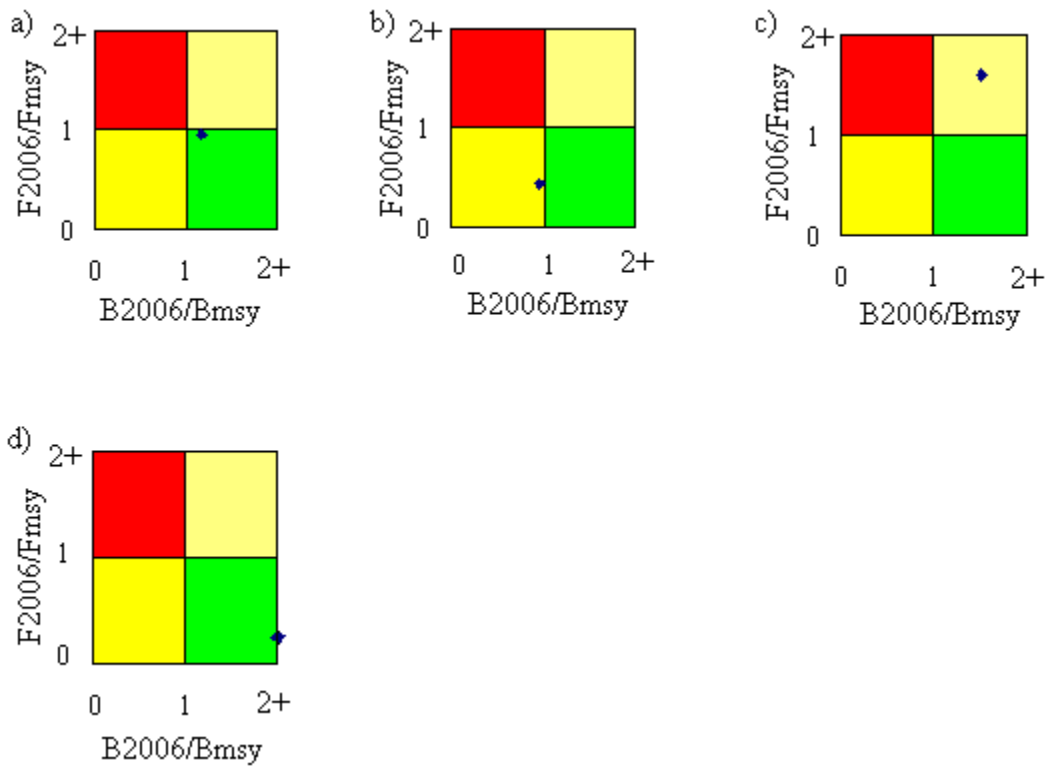


Figure A.18.3 Phase plots of four stocks under WCPFC management: a) Yellowfin tuna; b) Albacore tuna, south; c) Bigeye tuna; d) Skipjack tuna. The x-axes represent current biomass (B_{2006}) over biomass at maximum sustainable yield (B_{msy}). The y-axes represent current fishing mortality (F_{2006}) over fishing mortality that produces maximum sustainable yield (F_{msy}). Data from WCPFC (2007), WCPFC (2008a), WCPFC (2008b), and WCPFC (2008c).

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