APPENDIX H

FAO Expert Advisory Panel assessment report: spiny (picked) dogfish

Cop15 Proposal 18

SPECIES: *Squalus acanthias* Linnaeus, 1758 – FAO English name: Picked dogfish; other names also in use: Spiny dogfish, Spurdog, Piked dogfish)[1]

PROPOSAL: Inclusion of *Squalus acanthias* Linnaeus, 1758 in Appendix II in accordance with Article II 2(a) and (b)

Basis for proposal: The following is quoted from the Proposal

Annex 2a A: It is known, or can be inferred or projected, that the regulation of trade in the species is necessary to avoid it becoming eligible for inclusion in Appendix I in the near future.

With the possible exception of the Northeast Pacific (Alaska to California) coastal stock, all northern hemisphere stocks qualify under this criterion. Their marked decline in population size (to <10–30% of historic baseline) and/or rapid recent rates of decline meet CITES and FAO guidelines for the application of decline to commercially exploited aquatic species.

Annex 2a B: It is known, or can be inferred or projected, that regulation of trade in the species is required to ensure that the harvest of specimens from the wild is not reducing the wild population to a level at which its survival might be threatened by continued harvesting or other influences. Squalus acanthias fisheries are largely unmanaged and/or poorly monitored in several other parts of its range, where international trade demand for its high value meat is likely to increase as a result of the closure of the European Union fisheries. Based on the past fisheries' development it can be projected that stocks not meeting the criterion A may experience similar decreases within the next decade, unless trade regulation through CITES provides an incentive to introduce sustainable management or to improve existing monitoring and management measures in order to provide a basis for non-detriment findings and legal findings.

Annex 2b A: The specimens of the species in the form in which they are traded resemble specimens of a species included in Appendix II under the provisions of Article II, paragraph 2(a), or in Appendix I, such that enforcement officers who encounter specimens of CITES-listed species, are unlikely to be able to distinguish between them. Complex patterns of export, processing and re-export of meat make it difficult to distinguish readily products from different stocks, as only DNA analysis is available for identification of processed products. A split listing is not recommended as it “could facilitate IUU fishing for Spiny dogfish” stocks listed in Appendix II, “with catches laundered as taken from nonlisted stocks. Such an outcome would be clearly undesirable and had the potential to undermine the effectiveness of conservation and management efforts for Spiny dogfish globally” (FAO 2007). Stocks that do not qualify under Annex 2a (see Table 9) are proposed for listing under Annex 2b A.

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[1] To maintain consistency with the 2007 Panel report (FAO, 2007) of this species it was decided to continue using the common name spiny dogfish. FAO has developed a global list of English, French and Spanish names for exploited aquatic species (ASFIS list of species) and encourages the use of these FAO names to reduce ambiguity and uncertainty of fishery information.

ASSESSMENT SUMMARY

The FAO Expert Panel concluded that the available evidence does not support the proposal to include Spiny dogfish, *Squalus acanthias*, in CITES Appendix II.

The Panel agreed that this was a species of low productivity. When evaluated on a population by population basis, most of the Spiny dogfish populations did not meet the decline criteria.

A historically-fished population of Spiny dogfish in the Mediterranean and the large population in the Northeast Atlantic Ocean are considered to meet the extent of decline criterion. Directed fishing in the European Union was prohibited in 2007 and bycatch quotas have subsequently been reduced. In the Northwest Pacific, the decline may meet the Appendix II decline criterion.

The historical extent of decline in population abundance does not meet the Appendix II decline criterion for the following regions defined in the proposal: Northwest Atlantic (United States of America and Canada), Northeast Pacific (Alaska, Hecate Strait, Puget Sound, Georgia Strait) and the Black Sea. The Panel noted that certain stocks covered in the proposal had been inappropriately subdivided into additional units.

In the southern hemisphere, surveys in the Southwest Pacific indicate stable abundance, while those in the Southwest Atlantic show modest declines. No information on abundance trends is available for other populations in the southern hemisphere, such as those around Australia, South Africa and Chile.

Absolute abundance estimates are often difficult to evaluate in the context of CITES criteria, but in the case of Spiny dogfish, the global population estimate is in the order of one billion individuals, which mitigates risk of extinction.

International trade of *Squalus acanthias* is the key driver of exploitation in most areas, except the Northeast Atlantic where most of the catch is traded internally within the EU markets. There has been a serious fisheries management failure for the Northeast Atlantic Spiny dogfish population, which has led to the closure of the directed fishery. Catches from the Northeast Atlantic stock, both internally traded in the EU and imported, need to be further curtailed. In the event of a CITES listing, Spiny dogfish caught in the EU waters would likely be traded within the EU, and thus not be subject to CITES trade limitations. The Panel noted that the EU has adopted a Shark Action Plan and looks forward to its implementation.

In other areas, Spiny dogfish populations will benefit from improved management. Federal and state U.S. fishery management plans have been implemented for the Northwest Atlantic stock, but could benefit from better coordination internally and with Canada. All other areas in which *Squalus acanthias* is harvested need to be closely monitored to ensure that catches remain sustainable. Sustainable management requires that, where they have not done so, range States develop and implement National Plans of Action for sharks.

If *Squalus acanthias* is listed on Appendix II key implementation issues will include difficulties in differentiating *Squalus acanthias* products from other sharks in trade.

The proposal states that some populations of Spiny dogfish should be listed on Appendix II because of conservation concerns (in accordance with Article II paragraph 2(a)), while others should be listed because of inability to distinguish products from those listed for conservation reasons (in accordance with Article II paragraph 2(b)). While it is almost certainly true that differentiating products from different Spiny dogfish populations would be impossible by enforcement officers without specialized equipment or training, the approach of listing different populations of the same species under Article II, paragraphs 2(a) and 2(b) needs careful consideration. Ultimately the result of adoption of this approach could lead to a situation whereby one (perhaps relatively small) population was listed under paragraph 2(a) and the rest of the species under paragraph 2(b) even though the species as a whole is in a healthy state.

The Panel took note of the wording of CITES Resolution Conf. 9.24 (Rev. CoP14) indicating that Parties had resolved to adopt measures that are proportionate to the anticipated risks to the species when considering proposals to amend the Appendices. In this case, the Panel considered that listing some stocks (New Zealand, Argentina, and Alaska) in accordance with Article II paragraph 2(b) would be inconsistent with the proportionate risks to the species as a whole, since populations representing most of the historical abundance of the species globally were considered not to meet the criteria for listing in accordance with Article II paragraph 2(a).

In the 2007 deliberations of the Panel, the Panel concluded that the species did not meet the biological decline criteria for listing in CITES Appendix II. The additional information available to the current Panel included evidence of improved management actions in the Northeast Atlantic, updated stock assessments for the Northwest Atlantic, which indicated an improved prognosis due primarily to reduced fishing mortality and recovering recruitment, and additional information for the Northwest Pacific and Southwest Atlantic stocks. For the Northwest Pacific, in light of all the available information, it remains unclear whether the decline criterion is met. The additional information reinforces the previous conclusion of the Panel that the species as a whole does not warrant listing under Appendix II.

PANEL COMMENTS

Biological considerations

Population assessed

The proposal is to list the species *Squalus acanthias* Linnaeus, 1758, on Appendix II. This species is widely distributed on continental shelves in temperate and boreal waters of the northern and southern hemispheres, and is most common at depths 10-200 m. It is the most common of all shark species.

Although little work is available on structuring and relationships of populations within the species, populations within the distribution of the species have been identified, separated by deep ocean waters, tropical areas and polar areas. A few long-distance migrations, including across ocean basins, have been documented, but most tag recaptures show relatively short movements (McFarlane and King, 2003) and most individuals are assumed to remain within the identified populations.

Individuals in the Northeast Atlantic from the Barents Sea to northwestern Africa are considered to be a single population for fishery management purposes, based on recent tagging studies (ICES WGEF, 2006). Earlier studies had suggested at least two separate populations within this area. The relationship of individuals in the Mediterranean and Black Sea to this population and to each other is not known.

Individuals in the Northwest Atlantic have in the past been considered a single population for fisheries management purposes, based on tagging results (NMFS, 2006), but a recent study indicates that Spiny dogfish in this area should be considered a metapopulation with components in Canadian and US waters which mix to some extent (10-20%) (Campana *et al.*, 2007). The species is most common between Nova Scotia and Cape Hatteras but is found from Labrador to Florida.

For the north Pacific there does not appear to be an agreed picture of population structure, although the picture of western and eastern populations would be consistent with available tagging observations and with the north Atlantic situation. Of 71 000 individuals tagged over a 20-year period in British Columbia, most were recaptured near their release site, but 30 of 2940 recaptures were from near Japan (McFarlane and King, 2003).

Spiny dogfish occur off eastern South America, South Africa, Australia and New Zealand, but there appears to be little information on movements or population structure in these areas. Separate populations in these areas would be an assumption consistent with information from the north Atlantic and north Pacific.

Productivity level

Information available (Table 1) indicates that Spiny dogfish fit into the “low” productivity category. Intrinsic rate of increase for the Northeast Pacific was estimated as 0.017 at the MSY level, the lowest among 26 species of sharks for which estimates were made (Smith, Au and Show, 1998); an estimate of 0.034 for the Northwest Atlantic (Smith e1998) is also available. Aging of older individuals is imprecise but the natural lifespan is known to be well beyond the threshold for low productivity (25 years); 50 years is assumed in assessments in the Northwest Atlantic (NMFS, 2006). Natural mortality in the Northeast Atlantic assessment is assumed to be 0.1 for most ages (higher for young and old individuals) (ICES WGEF, 2006), and is estimated at 0.1 from the assumed lifespan for the Northwest Atlantic assessment (NMFS, 2006). Ages at 50% maturity and von Bertalanffy K are available from published studies of age, growth and maturation (Campana *et al.,* 2009). Fecundity increases with length of females and varies from 1-20 pups per litter; a range of 2-14 is used in Northeast Atlantic assessments (ICES WGEF, 2006). Females give birth on average every two years.

Life history parameters differ considerably for the Northeast Pacific population and for north Atlantic populations (Table 1), with the Northeast Pacific population showing much lower productivity. A recent study found that age at maturity in the Northeast Pacific had decreased from the 1940s to the 2000s, as a result either of environmental factors or of reduced population sizes due to fishing (Taylor and Gallucci, 2009).

Population status and trends

Small population size

FAO (2007) estimated global abundance of recruited Spiny dogfish at more than 1 billion recruited individuals (i.e. excluding small juveniles). Revised estimates of recruited biomass based on new information up to 2009 differ somewhat between regions, but give a similar total (Table 2). The abundance of mature females could presumably be as low as 5-10% of this number; i.e. 50 million to 100 million mature females, which still represents an extremely large number on a global basis.

Restricted distribution

Quantitative estimates of the distribution area are not available, but the species occurs over very wide areas on continental shelves in many parts of the world’s temperate oceans.

Decline

Abundance indices are available from many parts of the range (Table 3).

Northeast Atlantic

The most recent full assessment of Spiny dogfish in the Northeast Atlantic was in 2006 (ICES WGEF 2006), and its results were available to the FAO Panel meeting in 2007 (FAO 2007). Indices have not been updated subsequently, although updated landings and a summary of recent management measures is available (ICES WGEF, 2008).

The 2006 assessment (ICES WGEF, 2006) was based on a model which fit the data relatively well, and whose results were consistent with those from earlier analyses of this population by ICES using a variety of approaches. The “base case” of the model runs indicates that current total biomass level is 5% of that in 1905 (unexploited) and 7% of that in 1955 (lightly exploited) (Figure 1) (ICES WGEF, 2006). The only survey CPUE series considered valid, from a Scottish trawl survey (used in the population model), shows that recent values have been around 40% of those in the late 1980’s (ICES WGEF, 2006, Table 2.4, Figure 2.8).

Landings increased during the 1920s and early 1930s, dropped to low levels between 1940–1945, increased to very high levels during the 1950s and 1960s and subsequently declined. Recent landings have been well below 10% of values in the early 1950s, following imposition of a bycatch-only TAC in 2007 (Figure 2) (ICES WGEF, 2008).

Mediterranean and Black Sea

Results of a virtual population analysis of Spiny dogfish abundance in the Black Sea indicate that population biomass increased by about a factor of 3 between 1972 and 1982, and subsequently declined to 1992 by about the same extent (FAO, 1997; proposal Figures 18–19). Landings in the Mediterranean and Black Sea (Figure 3) show an increase from the 1950s to 1980, a period of high landings from 1980 to the mid-1990s, followed by a steep decline to levels similar to those of the 1950s.

Northwest Atlantic

The most recent full assessment of Northwest Atlantic dogfish, based on the assumption of a single population shared by Canada and the United States of America, was in 2006 (NMFS, 2006). These results were available to the FAO Panel in 2007. That assessment indicated that total biomass increased by a factor of 3 from the late 1960s to the early 1990s and then declined to about 60% of maximum values (Figure 4). The biomass of mature females declined to about 20% of the observed maximum between the late 1980s and the early 2000s. Although the time series for females is not as long as that for total biomass, an increase in female biomass was observed during the 1980s which may correspond to the end of the increase observed in total biomass.

An assessment update in 2008 (ASMFC, 2008) indicated that female spawning biomass has been increasing from low levels since 2004 and is currently above target and limit reference levels (Figure 5). The 2007 value of approximately 180 000 tonnes is similar to values in the early 1980s at the beginning of the time series, prior to the mid-1980s increase.

The 2008 assessment update projected a decline in abundance of the Northwest Atlantic population beginning in 2011 at the current fishing mortality rate of about 0.117., to a minimum level in 2017, as a result of low recruitment to this population (Figure6) (ASMFC, 2008). However, this minimum biomass level for $F_{rebuild}$ (0.11), which is close to the status quo F (0.117), is only marginally below the target female spawning biomass of 167,800 tonnes, and well above the rebuilding threshold (which is half of the target). A new survey conducted in the spring of 2009 shows that recruitment has been recovering since 2003 following a long period (1997–2003) of apparent recruitment failure (Figure 7). The 2007–09 estimates shows much larger numbers of juveniles less than 50 cm than have been observed in over a decade (Figure 6a) (MAFMC, 2009). The 2009 estimate of recruitment is one of the highest on record. The 2009 mean stochastic estimate of the female spawning biomass was slightly below the target of 167 800 tonnes. The swept area biomass estimate of Spiny dogfish in the 2009 spring bottom trawl survey was 557 900 tonnes.

New projections (MAFMC, 2009) predict that female spawning stock biomass in 2017 may be slightly lower than the estimates from the 2008 projections. However, the overall prognosis has improved substantially since the 2007 Panel report due to reductions in realized fishing mortality and evidence of recovering recruitment.

An assessment of Spiny dogfish in Canada was conducted in 2007 (DFO, 2007), which concluded that populations in Canada and theUnited States of America were partially distinct and could be considered to be part of a metapopulation. Trawl survey abundance indices from eastern Canada were superficially contradictory: the Scotian Shelf summer survey showed an increasing trend from 1970 to 2007 (Figure 8), while an eastern Scotian Shelf survey in spring (Figure 9) and a George’s Bank survey in February (Figure 10) showed major declines and almost complete disappearance of Spiny dogfish. The summer survey is not considered to track mature females well, while the winter and spring surveys may track these better (DFO, 2007).

Landings in the Northwest Atlantic show two peaks, in the early 1970s and the mid/late 1990s, both with maximum landings of over 25 000 tonnes/yr (Figure 11) (DFO, 2007). Recent landings are below 20% of these historical values, coincident with reduced TACs in the United States of America. Fisheries in theUnited States of America have targeted mature females which are preferred in markets, and which can be targeted (NMFS, 2006).

A joint US/Canada assessment meeting considering past, current and projected trends will be held in January 2010. The results of this assessment may be available for consideration by Parties at CoP15.

Northeast Pacific

New information on population status in this area cited in the proposal (King and McFarlane in press; Palsson in press) was not available for the Panel. The information presented in the FAO 2007 Panel report is therefore recapitulated here, supplemented by Wallace *et al.* (2009).

In the Gulf of Alaska, trawl survey biomass (Figure 12) and longline survey catches (Wright and Hulbert, 2000) have been increasing in recent years. On Canada's continental shelf, trawl survey CPUE (Figure 13) and longline survey CPUE (Figure 14) have varied without trend since the mid 1980s and early 1990s respectively, although both surveys show declines in the most recent period. Trawl survey numbers and biomass in waters in the area on both sides of the Canada-United States of America border have fluctuated without trend since 1980 (Figure 15). The population in Puget Sound is considered to be at a low level of abundance (Proposal Section 4.4.4).

Reported landings of spiny dogfish in the Northeast Pacific have generally been below 10 000 tonnes/yr since the late 1800s, with a large increase to 25 000–50 000 tonnes/yr from the mid-1940s to mid-1950s (Figure 16) (Taylor and Gallucci, 2009).

Northwest Pacific

Taniuchi (1990) provided information on Japanese catches of Spiny dogfish from 1951 to 1967, which declined from over 50 000 tonnes in the 1950s to less than 10 000 in the late 1960s.

Information on catches in the Sea of Japan and off the east coast of Japan was provided by Fisheries Agency, Government of Japan (2003). Catches off the east coast of Japan (Pacific North Area) declined from over 700 tonnes in 1974–79 to around 200 tonnes in the late 1990s and early 2000s. In the Sea of Japan catches were 7 500 to 11 250 tonnes in the late 1920s, accounting for 17–25% of Japan's overall catches.

In areas representative of traditional dogfish fishing, most CPUE indices declined. Off eastern Japan for the period 1972–2002 there was a long-term decline of about 90% and 81% for Danish seine in Shiriyazaki and Erimo, respectively (Figs 17, 18) (Fishery Agency 2003, 2004), although a change in the target fishery in the late 1980s complicated the interpretation of the extent of the decline (Fishery Agency 2005). Trawl CPUE in the Sea of Japan decreased by 74% from the early 1970s to the early 2000s (Fishery Agency, 2004) (Figure 18).

In Iwate, an area considered to be less representative of the fishery (since it is well south of the main fishing area), for the period 1972–2002, an early period of high catch rates followed by a long period of stability was observed for bull trawl, while CPUE fluctuated without trend for otter trawl and for Danish seine (Fishery Agency 2004) (Figure 17).

The proposal includes a series of CPUE graphs for the period 1970–2006 (Fishery Agency of Japan 2008 cited in the proposal), two of which show substantial declines to about 10% of values at the beginning of the series (Proposal Figure 23 a, d). Two other CPUE series are essentially without trend at low levels since 1970 (Proposal Figure 23 a, c) while a fifth series shows high values in the 1970s followed by no trend at a low level (Proposal Figure 23 b). Interpretation of these figures was difficult as the captions are in Japanese, but they appear to be consistent with the information summarized above.

Southern hemisphere

In New Zealand reported catches have increased since the early 1990s to about 2003 but this increase may be due to better reporting as well as to increased harvest (New Zealand Ministry of Fisheries 2009). Reported catches have declined since 2003 and have been well below the TAC (an average of 6 700 tonnes compared to a TAC of 12 660 tonnes). Trawl surveys indicate no overall trend in abundance between the early 1990s and the present, although an increase in abundance in the mid 1990s was observed (Table 7 in New Zealand Ministry of Fisheries, 2009).

Trawl surveys in the EEZ of Argentina indicate that there is no clear sign of decline in Spiny dogfish abundance over the last 30 years when the total distributional range (35°S–55°S) is considered (FAO, 2009). However declines of Spiny dogfish in some coastal areas, but not in others, over the last ten years have been reported (Massa *et al.*, 2007). In the Bonaerense region (Figure 19a) recent survey biomass has been about 20 percent of a single high value in 1994; this is a relatively small part of the distribution. In the central region (Figure 19b), recent biomass estimates are about 50 percent of those in the late 1990s. In the southern region comprising the largest part of the population there has been no trend in survey biomass estimates since the early 1990s (Figure 19c).

No information on abundance trends is available from other areas where Spiny dogfish are found in the southern hemisphere (Australia, South Africa and the Chilean coast of South America).

Assessment relative to quantitative criteria

Small population

The global population of spiny dogfish may be as high as 1 billion individuals (FAO, 2007 and revised numbers in Table 2). Even if mature females represent as little as 5–10% of this number; i.e. 50 million to 100 million individuals, this still represents a very large number on a global basis. Thus, although there may be concerns about abundance at the level of local populations or subpopulations, the species is not characterized by a small population size at the global level.

Restricted distribution

The species is widely distributed on continental shelves of northern and southern hemispheres, so cannot be characterized as having a restricted distribution.

Decline

For most populations, the information base has not changed substantially since the report of the FAO, 2007 Panel (FAO, 2007). Accordingly, the conclusions of the Panel are recapitulated here for those populations. The exception is the Northwest Atlantic, for which the most recent US assessment suggests a recent increase in abundance (ASMFC, 2008), and for which more information on abundance trends in Canada has recently been published (DFO, 2007). This report addresses the new information in assessing decline in the Northwest Atlantic.

For an Appendix II listing, assessment of whether the species is near Appendix I levels or likely to become so in the foreseeable future is required. For a low productivity species, a decline to less than 15–20% of the historical baseline would lead to consideration for Appendix I. To be near the Appendix I threshold, values 5–10% above this (i.e. 20–30% of the historical baseline) either now or in the foreseeable future may justify consideration for Appendix II.

Northeast Atlantic

In the Northeast Atlantic, the most recent peer-reviewed stock assessment indicates that recent total biomass has been ca 5–7% of historic values, within the 15–20% value which might qualify a species for Appendix II.

Mediterranean and Black Sea

The limited information available for the Mediterranean and Black Sea made it difficult to assess abundance trends against the decline criteria. If weight is given to the longer time series of reported landings, it is likely that the stock in the Mediterranean is currently within the decline threshold for a low productivity species. The available data for the Black Sea is somewhat contradictory.

Northwest Atlantic

Based on US assessments, decline can be assessed for different population components (mature females or total) and relative to different historical baselines (values in the late 1980s, following a population increase, or at earlier periods, representing the longest historical time series available). Using the mature females component would recognize the importance of this group to subsequent recruitment and would be a more cautious approach. Choice of historical baseline depends to some extent on the reason for the observed increase in abundance during the 1980s. If this was an increase toward a "normal" abundance level following exploitation in the 1970s, it would be appropriate to use the higher late 1980s level as best representing the historical population abundance. If this was an increase to "anomalous" levels as elasmobranchs replaced depleted groundfish stocks, the earlier, lower baseline population levels would be more appropriate.

Using mature females and the recent baseline (the most "cautious" scenario), current abundance is at 65% of historic. Relative to the earlier baseline, current mature female abundance is similar to the historic. No recent rate of decline is observed as abundance has been increasing in recent years. For total individuals, recent abundance is around 67% of the recent baseline (late 1980s), and twice the earlier baseline (late 1960s). None of these values is within the decline threshold for an Appendix II listing.

Since mature females are uncommon in the Canadian summer survey region, only total individuals are tracked by the survey with the longest time series, although two other surveys are considered to represent mature individuals better than the summer survey (DFO, 2007). Canadian indices show apparently contradictory trends. The summer Scotian Shelf index, considered to represent immature individuals, has increased 4-fold from 1970 to 2007. The spring index on the eastern Scotian Shelf and the February George's Bank index, which may represent mature individuals better, have shown severe declines of 99.3% and 98% respectively, from 1986–2007. Neither the eastern Scotian shelf survey nor the Georges Bank area include the area of greatest abundance of Spiny dogfish in Atlantic Canada (DFO, 2007), which may reduce the robustness of these indices as measures of population abundance. Trends in the latter indices would be consistent with the Appendix II guideline.

Northeast Pacific

There appear to be no indications of decline to or near levels consistent with the Appendix II guideline other than for Puget Sound, a small enclosed part of the distribution area. Details of abundance trends in Puget Sound were not available to the Panel. Indices from the Gulf of Alaska are increasing, while for Canadian waters and US waters near the Canadian southern border indices have been fluctuating without overall trend.

Northwest Pacific

Information quoted in the proposal (declines in CPUE of 80–90% in one fishery, 90% in another) would suggest that this population has declined to levels consistent with Appendix I, as would the observation that recent catches are less than 2% of those in the early 1950s. Decline in the Sea of Japan trawl CPUE to 26% of that in the early 1970s would also put this population "near" the Appendix I threshold. .

Since CPUE is most useful as an index of abundance when it is calculated for areas most representative of the fishery, the Panel concluded that the Shiriyazaki and Erimo CPUE indices were likely to be useful indicators of relative dogfish abundance in the area of the Japanese dogfish fishery. These indices suggest declines of 74–90%, although the extent of the decline may have been artificially exaggerated by the change in target fishery in the 1980s. As a result, the Panel could not assess if the Appendix II decline criteria had been met.

Southern hemisphere

Abundance indices appear to be stable or increasing in New Zealand. Off Argentina, in the period 1992–2006, a decline to 20% of a single historical value was observed in one relatively small area, a decline to 50% of historical in another, and no trend in a third area; overall this pattern does not show declines to levels at or near the Appendix II guideline.

Summary

In summary, the Panel concluded that the spiny dogfish in both the Northeast Atlantic Ocean and the Mediterranean were considered to meet the extent of decline criterion for inclusion in Appendix II. In the Northwest Pacific, the decline may meet the Appendix II decline criterion. The historical extent of decline in population abundance does not meet the Appendix II decline criterion for the following regions defined in the proposal: Northwest Atlantic (United States of America and Canada), Northeast Pacific (Hecate Strait, Puget Sound, Georgia Strait) and the Black Sea. The Panel noted that certain stocks covered in the proposal had been inappropriately subdivided into additional units. In the southern hemisphere, surveys in the Southwest Pacific indicate stable abundance, while those in the Southwest Atlantic show modest declines. No information on abundance trends is available for other populations in the southern hemisphere, such as those around Australia, South Africa and Chile.

Were trends due to natural fluctuations?

In the Northwest Atlantic population, observed trends could have been influenced by natural fluctuations as well as by exploitation. Observed increases in Spiny dogfish abundance from the 1960s to the 1980s are hypothesized by some to have resulted from replacement of depleted groundfish populations by elasmobranchs (e.g. Hall, 1999; Sinclair and Murawski, 1997), which would suggest that the population levels in the 1980s were anomalously high. This would mean that subsequent declines were greater than from a “typical” level of abundance. However this increase may also have been in response to a decline in dogfish harvests which were at maximum levels in the early 1970s and subsequently dropped to about 20% of the maximum levels (Figure 2). Arguing against the “replacement” hypothesis is the lack of recovery of teleost groundfish as Spiny dogfish have declined since the mid 1990s. Link *et al.* (2002) found no evidence that elasmobranch predation was removing enough groundfish biomass to account for low levels of groundfish biomass.

Taylor and Gallucci (2009) documented changes in life history parameters of the Northeast Pacific population between the 1940s and 2000s (mainly a decrease in age at maturity) and considered whether these changes might be due to environmental factors (extrinsic) or density-dependent population responses to reduced abundance as a result of fishing (intrinsic). While unable to clearly determine the principal reasons for the changes, they concluded that intrinsic factors were somewhat more likely to have been the cause.

Overall, there is no clear indication that observed changes in abundance were due to causes other than fishing. The observed changes are consistent with patterns of fishing in the areas for which information is available.

Risk factors and mitigating factors

Life history parameters of Spiny dogfish are such as to make them particularly vulnerable to the impacts of mortality from human activities (Table 1). Intrinsic rate of increase is low, even compared to other sharks (Smith *et al.*, 1998). Rate of reproduction is low and contributes to the low rate of increase; females give birth every two years and number of pups produced is typically 2–14 (ICES, 2006), although this may range from 1–20. Recent pup production in the Northwest Atlantic has averaged 4–9 (NMFS, 2006; Campana *et al.,* 2009).

Loss of large reproductive females and changes in sex ratio under exploitation may represent an additional risk factor for some populations of this species, particularly given the potential impact on recruitment. In the Northwest Atlantic, the ratio of mature males to females in survey catches increased 3-fold from 1993–2006 (Figure 20), and the mean length and weight of females taken in surveys declined substantially over the past two decades (Figure 21) (NMFS, 2006), consistent with targeting of large females in the fishery. In addition, the average size of pups has declined consistent with the reduction in average size of females (NMFS, 2006). The changes in size of females and in sex ratio might negatively affect reproductive potential of the population. A stock-recruitment relationship for this population indicates that recruitment success is influenced by maternal size, with the odds of poor recruitment 4.5 times greater when maternal size is less than 87cm; average maternal size in 2006 was less than 85 cm (NMFS, 2006). A skewed sex ratio such as observed here has been shown to have negative impacts on other elasmobranch populations although no information on Spiny dogfish is available (NMFS, 2006). Recruitment was very poor in 1997–2003, with recruit biomass near zero, compared with values of 1 000–10 000 tonnes in many previous years (NMFS, 2006), and individuals less than 60 cm in length have become very rare in survey catches since 1997 (NMFS, 2006). As a result of these developments, the population is projected to decline from 2009 to 2017, with the extent of the decline dependent on level of harvest (ASMFC, 2008). However trawl survey indices suggest that recruitment has improved since 2003 and the number of recruits in the most recent survey was among the highest on record (Figure 7).

Similar analysis of size and sex trends is not available in the ICES assessment (ICES WGEF, 2006) but inspection of size and sex frequency histograms from surveys over the past two decades indicates that most females have been less than 80 cm in length in the North Sea (ICES WGEF, 2006), while very few females have been greater than 80 cm off the Scottish west coast and in the Celtic Seas (ICES WGEF, 2006). In surveys in the Irish Sea there is a large proportion of individuals greater than 80 cm (ICES WGEF, 2006), although some concern is expressed about whether this information is biased by availability.

In Hecate Strait (Canada’s Pacific continental shelf) proportion of large mature individuals in trawl survey catches declined substantially during the 1980s and 1990s (Figure 21) (Wallace *et al.*, 2009). Fishing may have contributed to this change but is not considered the primary cause, which remains unknown (Wallace *et al.,* 2009).

Strengthened fishery management measures have been put in place in the Northeast Atlantic and Northwest Atlantic in the last several years which should act to mitigate risk to Spiny dogfish populations in these areas. In the Northeast Atlantic, small bycatch-only TACs were put in place in 2007 covering most of the fishery area, and Norway and Sweden have introduced additional restrictions on Spiny dogfish fisheries in their waters (ICES WGEF, 2008). In the Northwest Atlantic, TACs have been reduced in recent years in US waters and Canadian harvests have been consistent with TACs, resulting in reduced catches (Figure 11).

Fishery management measures in other areas are essentially as in the 2007 Panel report (FAO, 2007). While measures are essentially non-restrictive on catches, in some areas catches are below TACs (Northeast Pacific, New Zealand).

Trade considerations

Spiny dogfish meat is highly valued in markets. Products in trade include fillets, steaks, portions, backs, and belly flaps (smoked) (Vannuccini, 1999). Fins may also be in trade although their value is lower than from larger species, and derivatives (cartilage) may also be traded.

There is no species level customs code for Spiny dogfish in international trade, although “dogfish” are differentiated from other sharks under Harmonized System codes and in available information from States. Much of the international trade is probably Spiny dogfish (at least between North America and Europe), but other species are traded under the “dogfish” classification. Dogfish products are well known to marketers and consumers under a variety of names such as “rock salmon” and “saumonette”.

Spiny dogfish meat has high value in markets and substantial amounts have been traded internationally over the past decade. The EU is a significant importer (proposal Tables 5, 6), and consumed 65% of world production in 2001 (Fowler Fig. 2004). the EU countries took 77% of exports from the United States of America over the period 1999–2007 (proposal Table 7), confirming that the EU is indeed a major importer. Other countries taking US exports included Thailand, China, Mexico, Japan and Australia (proposal Table 7).

A number of countries have supplied Spiny dogfish meat to the EU in the past decade (proposal Table 5). As landings in the EU have declined, landings in theUnited States of America increased substantially in the 1990s, then declined, while Canadian landings increased in the late 1990s and early 2000s (Figure 9). The pattern in imports from these countries has followed that in landings (proposal Table 5). With the decline in landings in countries which formerly supplied the EU, imports from “new” areas such as Morocco and New Zealand are increasing (proposal Table 5).

With the strict limits on catches of Spiny dogfish in the EU waters, demand in the immediate future will have to be met primarily from imports. Imports to the EU have already declined substantially (proposal Table 6) and may decline further in future as a result of stricter limits on the fishery in the United States of America.

Although it appears that trade flows may be limited by stricter fishery management in future, there is no doubt that Spiny dogfish meat has been and is widely traded, and that there will be continued demand in importing markets as supplies decrease.

Implementation issues

Much of the material in this section is based on the 2007 FAO Panel report (FAO, 2007), whose conclusions generally continue to apply. Material has been updated where appropriate.

Introduction from the Sea

Spiny dogfish are associated with continental shelf habitats, most of which are within States’ EEZs. Catch of Spiny dogfish from waters outside EEZs is possible but it is likely to be a rare event.

The greatest potential for catches of Spiny dogfish to be taken from waters not under the jurisdiction of any State is in the Mediterranean Sea where few bordering countries have established EEZs.

Basis for findings: legally-obtained, non-detrimental

Scientific capacity, stock information, and management measures are in place with respect to populations in the Northeast Atlantic and Northwest Atlantic. In the Northeast Atlantic, TACs have been reduced to a very low level, for bycatch only, in the EU, and it is doubtful that there will be any exports requiring an NDF in the near future, given demand within the EU. In the Northwest Atlantic, where Canada and theUnited States of America have in the past conducted separate assessments and implemented separate management measures, a joint assessment of spiny dogfish is planned for early 2010, which should help to build a common picture of stock status. Should Canadian and US assessments be relied on as the basis for NDFs, domestic catch restrictions would need to be revised in line with scientific advice and take into account straddling stock and discard issues.

For other populations of Spiny dogfish there are apparently no biological assessments of population status which could serve as a basis for non-detriment findings. Information may exist which could serve as a basis for such assessments, particularly in areas where exploitation rates appear to be relatively low such as the Northeast Pacific and southern hemisphere.

Identification of products in trade

It is difficult to determine from available information the extent to which Spiny dogfish products might be distinguishable from other shark or fish products in trade, but this would probably be difficult. Identification guides and DNA testing could be used, and work is under way to develop DNA identification techniques (references in proposal, page 12). DNA techniques are not considered practical as initial screening tools, although they may be useful for secondary inspections or enforcement (CITES, 2006). The high value of Spiny dogfish meat should ensure that it is correctly labelled and differentiated in the marketplace (FAO 2007). Further, international markets appear to be reasonably narrow and focused in the EU. These factors, combined with the stricter domestic measures of the EU, which require the grant of an import permit for Appendix II specimens, would help facilitate identification of meat products were the species to be listed on Appendix II (FAO, 2007).

"Look-alike" issues

Listing for "look-alike" reasons (i.e., listing on Appendix II under Article II paragraph 2(b) of the Convention) is justified when enforcement officers who encounter specimens of CITES-listed species are unable to distinguish between them. Trade in Spiny dogfish product is predominantly as meat as belly flaps and backs, though the fins, cartilage and hides may also be traded.

The proposal states that some populations of Spiny dogfish should be listed on Appendix II because of conservation concerns (in accordance with Article II 2(a)), while others should be listed because of inability to distinguish products from those listed for conservation reasons (in accordance with Article II 2(b)). While it is almost certainly true that differentiating products from different Spiny dogfish populations would be impossible by enforcement officers without specialized equipment or training, the approach of listing different populations of the same species under Article II, paragraphs 2a and 2b needs careful consideration. Ultimately the result of adoption of this approach could lead to a situation whereby one (perhaps relatively small) population was listed under 2a and the rest of the species under 2b even though the species as a whole is in a healthy state.

If the trade in by-products was undermining the conservation effectiveness of a Spiny dogfish listing, and tools such as identification guides and DNA tests were not feasible, there would be potential justification for listing other species of shark on the basis that their products resemble those of Spiny dogfish in trade.

Likely effectiveness of a CITES Appendix II listing for species status

In evaluating the likely effectiveness of an Appendix II listing for the conservation of Spiny dogfish FAO (2007) concluded that the listing would be an inefficient management measure because it could impose unnecessary regulations on a number of populations that are under low fishing pressure. On the other hand, for the population that is of primary conservation concern (Northeast Atlantic), the requirement for non-detriment findings for trade in Appendix II species may assist in securing a closer alignment between scientific advice and management measures for the stocks. As noted by FAO (2007), management benefits of an Appendix II listing would be lower for the Northeast Atlantic population because most of the catch is traded internally within the EU markets.

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TABLES AND FIGURES

Table 1. Information for assessing productivity of Spiny dogfish.

Parameter	Information	Productivity	Source
Intrinsic rate of increase	a. NW Atlantic – $r_{2M} = 0.034$ b. NE Pacific - $r_{2M} = 0.017$	a. Low b. Low	a. Smith, Au and Show, 1998 b. Smith, Au and Show, 1998
Natural mortality	a. NE Atlantic – 0.1 b. NW Atlantic – 0.1 c. NE Pacific – 0.065	a. Low b. Low c. Low	a. ICES WGEF, 2006 b. NMFS, 2006 c. Smith, Au and Show, 1998
Age at maturity	a. NE Atlantic females – 11 yr b. NW Atlantic females – 12 yr; males – 6.5 yr c. NW Atlantic females – 16 yr; males – 10 yr d. NE Pacific females – 43 yr (1940s); 32 yr (2000s) e. SW Pacific females – 10 yr; males – 6 yr	Females a. Low b. Low c. Low d. Low e. Low	a. ICES, 2006a b. Nammack, Musick and Colvocoresses, 1985 c. DFO 2007 d. Taylor and Gallucci, 2009 e. NZ Ministry of Fisheries, 2006
Maximum age	NW Atlantic – 50 yr (assumed)	Low	NMFS 2006
von Bertalanffy K	a. NE Atlantic - 0.09 (female), 0.17 (male) b. NW Atlantic – 0.1057 (female), 0.1481 (male) c. NW Atlantic – 0.042 (female), 0.099 (male)	Females a. Low b. Low c. Low	a. ICES WGEF, 2006 b. Nammack, Musick and Colvocoresses, 1985 c. Campana *et al.*, 2007
Generation time	NW Atlantic – 19.9 yr	Low	Cortes, 2002

Table 2. Approximate global population estimate of recruited Spiny dogfish.

Area	Population assessment (million)	FAO landings (tonnes)	Source/method	Estimated population (million)
Northeast Atlantic	50	2 455	Population assessment: 100 000 tonnes, individual average weight 2 kg	50
Northwest Atlantic – United States of America (new survey data and analyses)	280	2 881	558 000 tonnes biomass, average weight 2 kg (new survey data and analyses)	280
Northwest Atlantic - Canada	200	2 328	Trawl survey numbers	200
Mediterranean (new information)	0.35	101	Population assessment: 6 700 tonnes biomass, individual average weight 2 kg	0.5
Black Sea (new information)	50	included in Mediterranean	Population assessment: 100 000 tonnes biomass, individual average weight 2 kg	50
Northeast Pacific (new information)		4 710	Whole BC coast: 450 000 tonnes[2] and 130 000 million individuals assuming average weight 3.5 kg; similar for Alaska	260
Northwest Pacific (new information)	50	-	Assumed the same as in the Northeast Atlantic	50
Southwest Pacific	50 for New Zealand	3 967	Note 1	100
Southwest Atlantic	50 for Argentina shelf	43	100 000 tonnes survey biomass, individual average weight 2 kg	50
Approximate global population		16 605		1 040

Note 1. New Zealand trawl survey biomass 100 000 tonnes; individual average weight 2 kg; therefore New Zealand numbers about 50 million. Since the New Zealand stock component represents a small part of the distribution area in Southwest Pacific, the total population size was estimated at twice the New Zealand estimate.

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[2] J. King, pers. comm. (DFO, Canada)

Table 3. Decline indices for Spiny dogfish

Area	**Index**	**Trend**	**Basis**	**Coverage**	**Reliability**	**Source**
Northeast Atlantic	Model estimate of biomass	Recent total biomass is ca 5% that in 1905	Analytical assessment	Northeast Atlantic stock, 1905-2005	Population model with multiple inputs (5)	ICES WGEF 2006
	Model estimate of biomass	Recent total biomass is ca. 7% of that in 1955	Analytical assessment	Northeast Atlantic stock, 1905-2005	Population model with multiple inputs (5)	ICES WGEF 2006
	CPUE	Recent values ca 40% of historic	Mean values of “year effect” 1985-1989 are 39% of 2001-2005	Scottish trawlers 1985-2005	Standardized CPUE (4)	ICES WGEF 2006 Table 2.4, Fig. 2.8
Mediterranean and Black Sea	Landings	Recent values ca. 30% of historical.	Decline by 70% between 1980-95 to 2000-07	Mediterranean and Black Sea	Reported landings FAO (2)	Proposal, FAO
	Model estimate of biomass	Increased 1972 (80 000 tonnes) to 1982 (220 000 tonnes), declined to 1992 (80 000 tonnes)	Virtual population analysis	Black Sea, 1972–1992	Population model, no details (1)	Proposal, FAO (1997)
Northwest Atlantic	Swept area biomass, females	Recent values ca 65% of those in late 1980s/early 1990s	Smoothed values 2006-7 ca 160 Kt, 1987-91 ca 250 Kt	Northwest Atlantic (US) 1980-2007	Survey CPUE (5)	NMFS 2006; ASMFC 2008; Figs. 4, 5 this report
	Swept area biomass, females	Recent values similar to those in early 1980s	Smoothed values 2006-7 ca 160 Kt, 1980-84 ca 150 Kt	Northwest Atlantic (US) 1980-2007	Survey CPUE (5)	NMFS 2006; ASMFC 2008; Figs 4, 5 this report
	Swept area biomass, total	Recent values ca 67% of those in late 1980s	Smoothed values 2001–2005 ca 400 Kt, 1986-93 ca 600 Kt	Northwest Atlantic (US) 1980-2006	Survey CPUE (5)	NMFS 2006; Fig. 5 this report

Table 3 (cont.)

Area	Index	Trend	Basis	Coverage	Reliability	Source
	Swept area biomass, total	Recent values ca 200% of those in late 1960s	Smoothed values 2001-5 ca 400 Kt, 1968-72 ca 200 Kt	Northwest Atlantic (US) 1980-2006	Survey CPUE (5)	NMFS 2006; Fig. 5 this report
	Average catch per tow	4-fold increase	Average values 2003-7 ca 50 kg, 1970-4 ca 12.4 kg	Scotian Shelf summer 1970-2007	Survey CPUE (5)	DFO 2007, Fig. 7 this report
	Average catch per tow	EOD 99.3%	Average values 2003-7 0.4 kg, 1986-90 55 kg	Eastern Scotian shelf spring 1986-2007	Survey CPUE (5)	DFO 2007, Fig. 8 this report
	Average catch per tow	EOD 98%	Average values 2003-7 3 kg, 1986-90 110 kg	George's Bank survey, February, 1986-2007	Survey CPUE (5)	DFO 2007, Fig. 9 this report
Northeast Pacific	Longline CPUE	Increases 1985-99	Inspection of graphs	Gulf of Alaska	IPHC Longline survey CPUE (5)	Wright and Hulbert 2000
	Trawl survey biomass	Increasing 1984-2003	Inspection of graph	Gulf of Alaska	Survey biomass (5)	Courtney Fig. 2004, Fig. 10 this report
	DFO Trawl survey, CPUE	No overall trend 1984-2003	Inspection of graph	Hecate Strait, Canada	Trawl survey CPUE (5)	Wallace Fig. in press, Fig. 11 this report
	IPHC Longline survey CPUE	No overall trend 1993-2004	Inspection of graph	Pacific continental shelf of Canada	Longline survey CPUE (5)	Wallace Fig. in press, Fig. 12 this report
	NMFS Trawl survey biomass and numbers	No overall trend 1980-2001	Inspection of graph	Vancouver Region, Canada-US	Survey biomass (5)	Wallace Fig. in press, Fig. 13 this report
Northwest Pacific	CPUE trawl	Extent of decline ca 74%	Average 42.6 kg/haul 1971-1975, average 11.2 kg/haul 1999-2003	Sea of Japan	Standardized (?) CPUE (4?)	Fisheries Agency of Japan 2004, Fig. 16 (right) this report

Table 3 (cont.)

Area	Index	Trend	Basis	Coverage	Reliability	Source
	CPUE Danish Seine	Extent of decline ca 90%	Inspection of figure	Shiriyazakai	Standardized (?) CPUE (3?)	Fishery Agency of Japan 2003, Fig. 17 this report
	CPUE Danish Seinc	Extent of decline ca 81%	Inspection of figure	Erimo	Standardized (?) CPUE (4?)	Fishery Agency of Japan 2004, Fig. 18 this report
	CPUE bull trawl	Early high to low and stable	Inspection of figure	Iwate	Standardized (?) CPUE (4?)	Fishery Agency of Japan 2003, Fig. 17 this report
	CPUE Otter trawl, Danish seine	No trend	Inspection of figure	Iwate	Standardized (?) CPUE (4?)	Fishery Agency of Japan 2003, Fig. 17 this report
Southwest Pacific	Trawl survey CPUE	No trend early 1990s to 2005/6	Description of results in assessment document	New Zealand waters	Survey CPUE (5)	NZ Ministry of Fisheries 2006
Southwest Atlantic	Trawl survey biomass	Decrease to 20% of historical	From 5 000 tonnes 1994 to appr 1 000 tonnes 1999-2005	Argentina – Bonaerense Region	Survey biomass (5)	Massa *et al.*, 2007; Fig. 16A this report
	Trawl survey biomass	Decrease to 50% of historical	From ca 80 000 tonnes 1997-99 to ca. 40 000 tonnes 2003-05	Argentina – Central Region	Survey biomass (5)	Massa *et al.*, 2007; Fig. 16B this report
	Trawl survey biomass	No trend	Fluctuating ca 40 000–100 000 tonnes 1992-2006	Argentina – southern region	Survey biomass (5)	Massa *et al.*, 2007; Fig. 16C this report

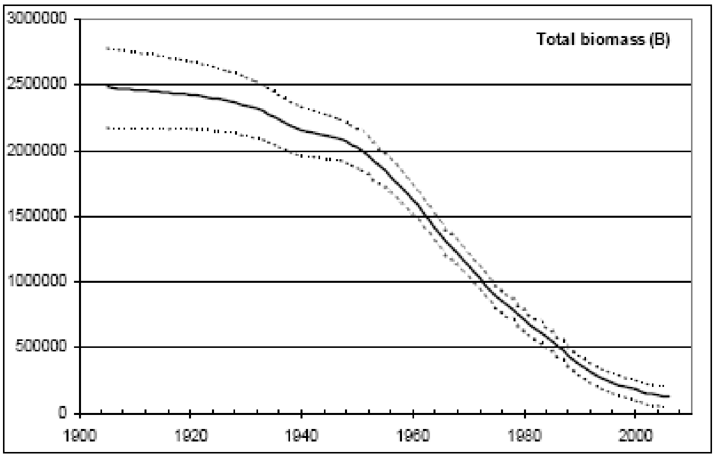


Figure 1. Total biomass, Northeast Atlantic spiny dogfish; model base case. Source: ICES WGEF, 2006; Figure 2.1.3.

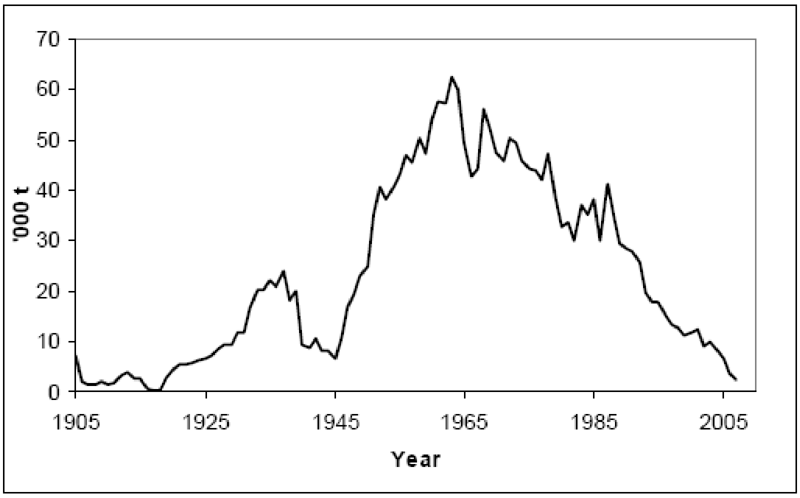


Figure 2. Landings of spiny dogfish, Northeast Atlantic. Source: ICES WGEF, 2008; Figure 2.1.

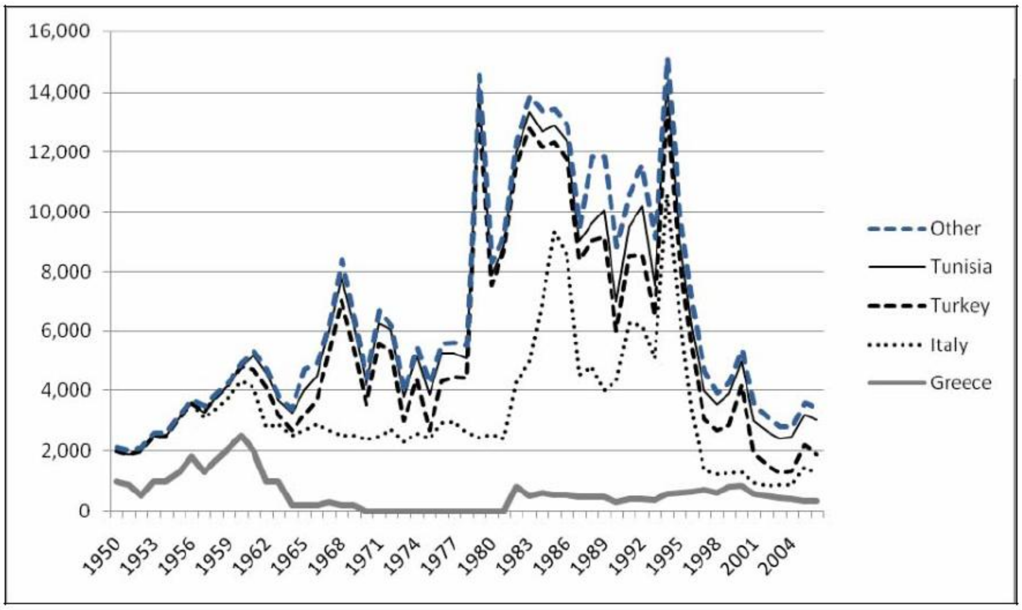
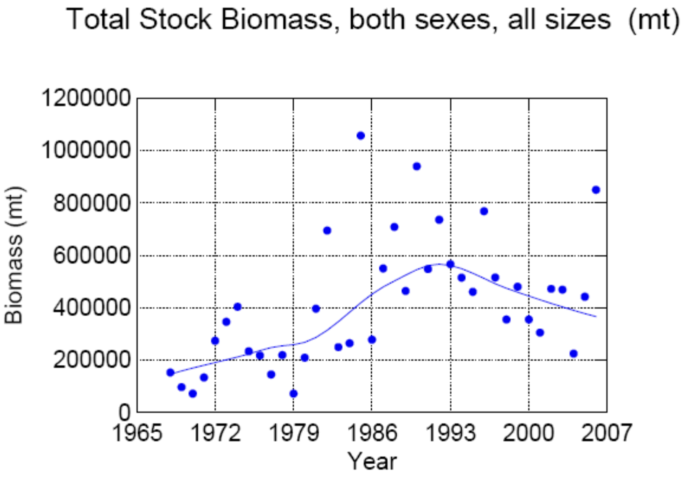


Figure 3. Reported landings by country (tonnes) of "dogfish sharks nei", "smooth-hounds nei" and *Squalus acanthias* from the Mediterranean and Black Sea, 1950–2007 (Source: FAO FishStat, proposal).



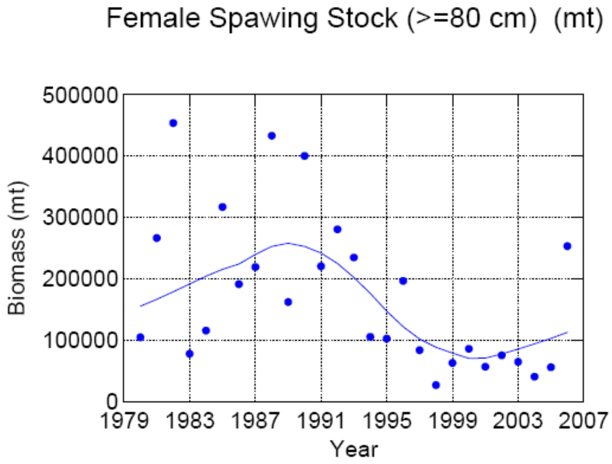


Figure 4. Swept area estimates of total dogfish biomass (tonnes), 1968–2006 (top), and for mature females only (bottom), 1980–2006, NEFSC spring R/V trawl surveys. Line represents Lowess smooth with tension factor 0.5. Source: NMFS, 2006.

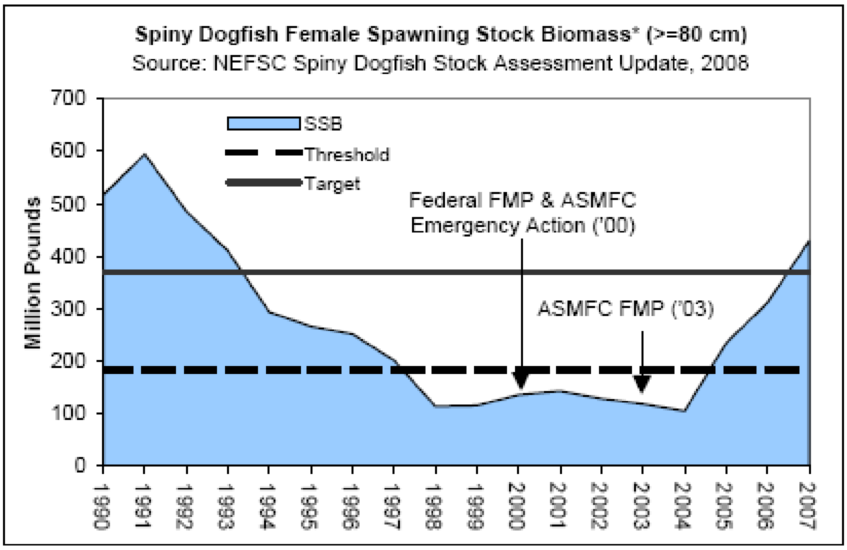


Figure 5. Female spawning stock biomass, US trawl survey. Source: ASMFC, 2008.

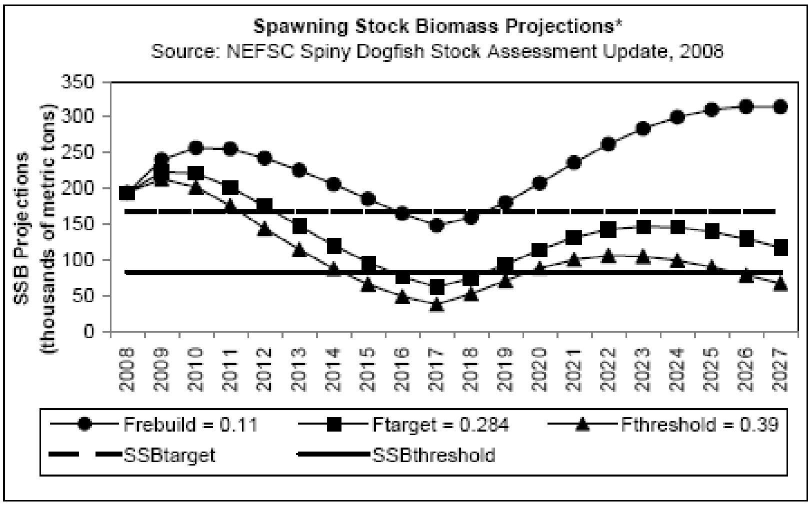


Figure 6. Spawning stock biomass projections, Northwest Atlantic spiny dogfish. Source: ASMFC, 2008.

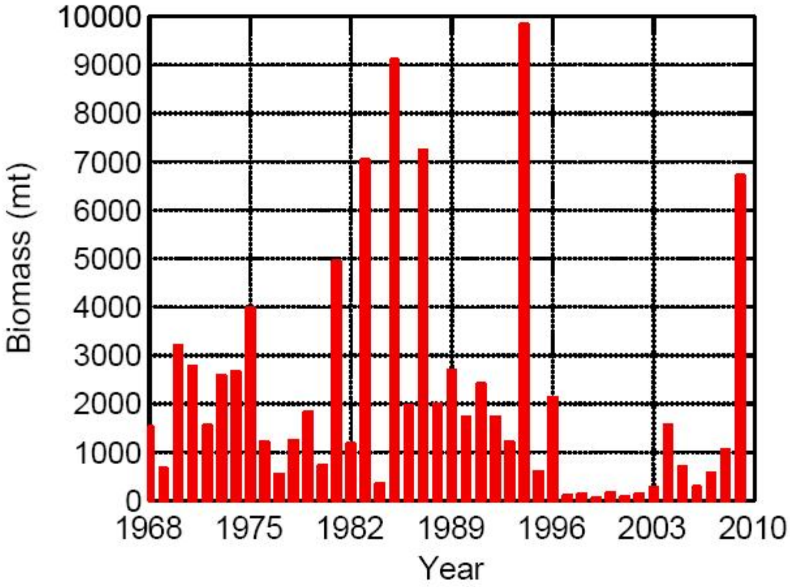


Figure 7. Swept area biomass of spiny dogfish recruits (< 1 yr old and < 36 cm TL), based on NEFSC spring bottom trawl survey, 1968-2009. Both sexes combined. Source: MAFMC, 2009.

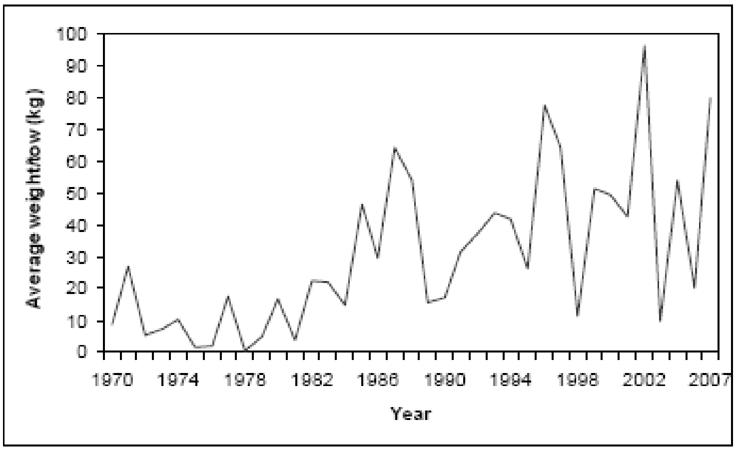


Figure 8. Relative biomass of spiny dogfish on Scotian Shelf, summer research vessel surveys. Source: DFO, 2007.

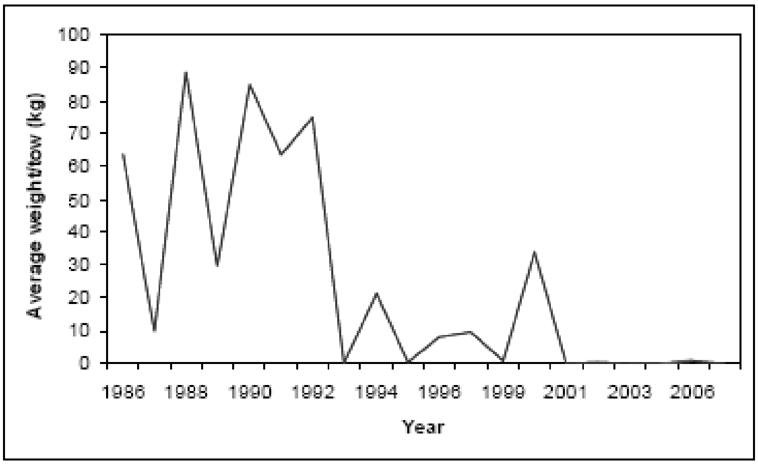


Figure 9. Relative biomass of spiny dogfish on eastern Scotian Shelf, spring research vessel surveys. Source: DFO, 2007.

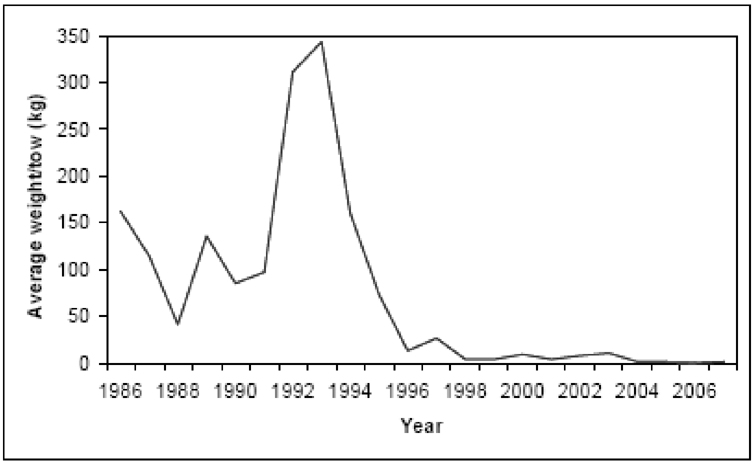


Figure 10. Relative biomass of spiny dogfish on George’s Bank, February research vessel surveys. Source: DFO, 2007.

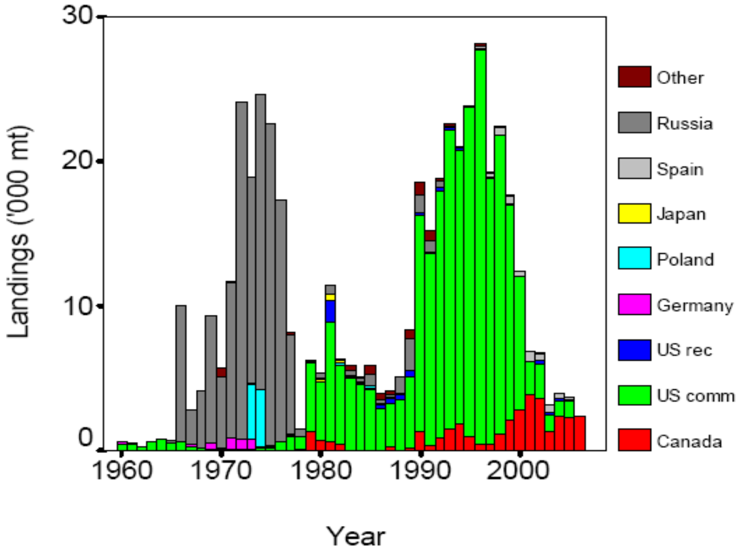


Figure 11. Reported landings, NAFO Areas 2-6 (Northwest Atlantic). Source: DFO, 2007.

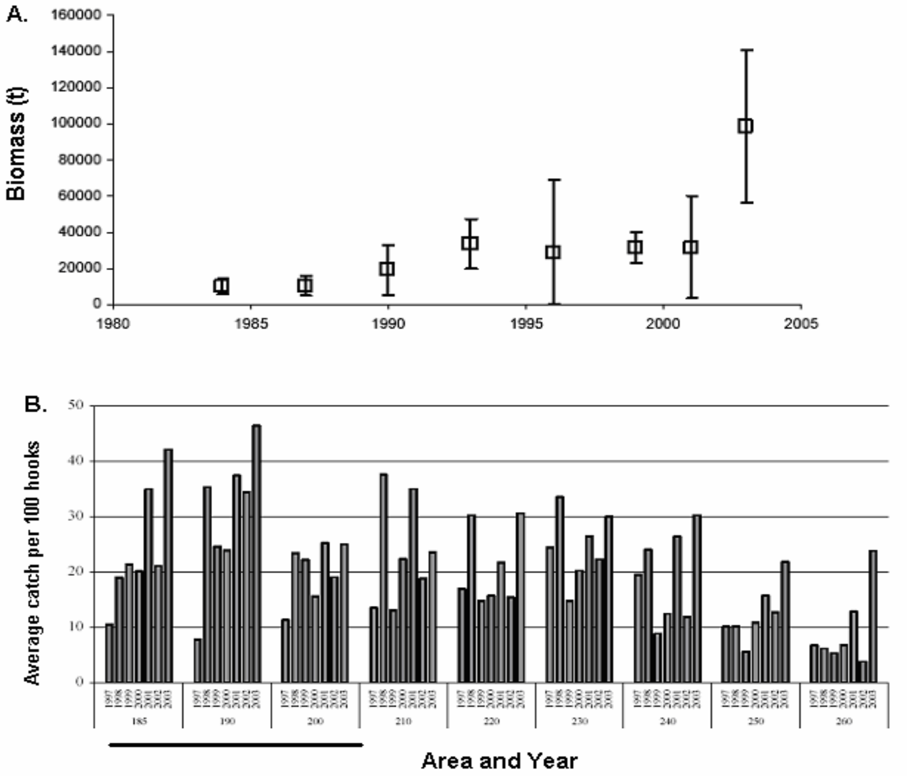


Figure 12. Trends in the abundance of spiny dogfish in the Gulf of Alaska from (A) biomass estimates (t) derived from the AFSC bottom trawl survey (error bars represent 95% confidence intervals); and (B) catch rates in the IPHC set survey. Waters adjacent to Canada off Southeast Alaska are represented by IPHC areas 185, 190, and 200. Figure modified from Courtney *et al.* (2004). Source: FAO 2007, Wallace *et al.*, 2009.

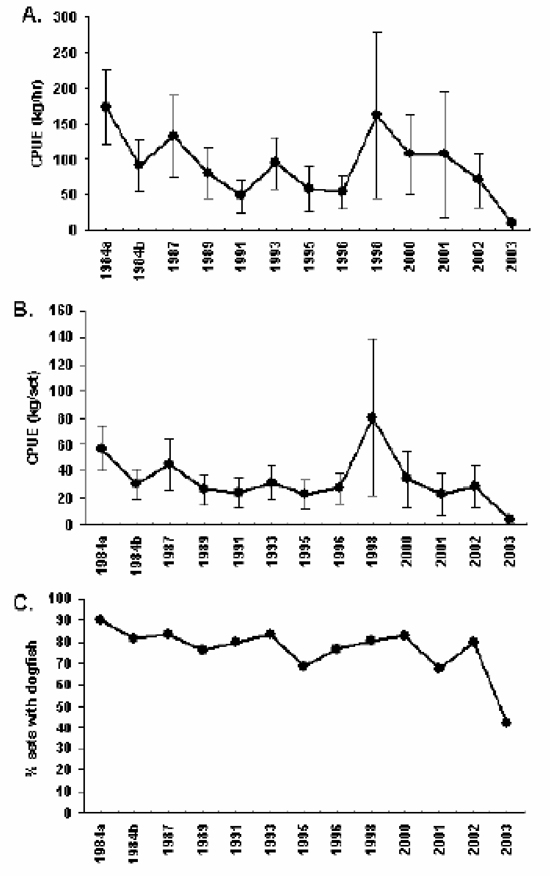


Figure 13. Trends in the abundance of Spiny dogfish from Hecate Strait trawl surveys between 1984–2003 using (A) mean CPUE (kg/hour); and (B) mean CPUE (kg/set); and (C) percentage of sets with Spiny dogfish. Error bars represent 95% confidence intervals around the mean. Source: FAO, 2007; Wallace *et al.*, (2009).

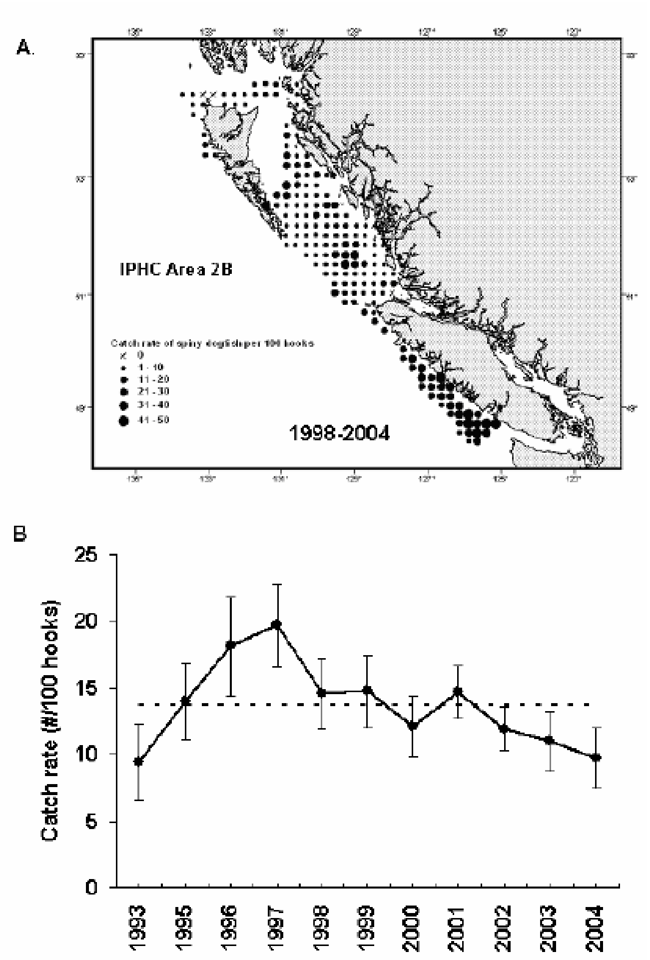


Figure 14. (A) Distribution of spiny dogfish in IPHC Area 2B shown by relative catch rates from 1998–2004 at IPHC survey stations; and (B) mean catch rate by year (error bars represent 95% confidence intervals around the mean). Dashed lined represents the series average. Data provided from the International Pacific Halibut Commission standardized stock assessment survey 1993– 2004. Note: no survey in 1994. Source: FAO, 2007; Wallace *et al.*, 2009.

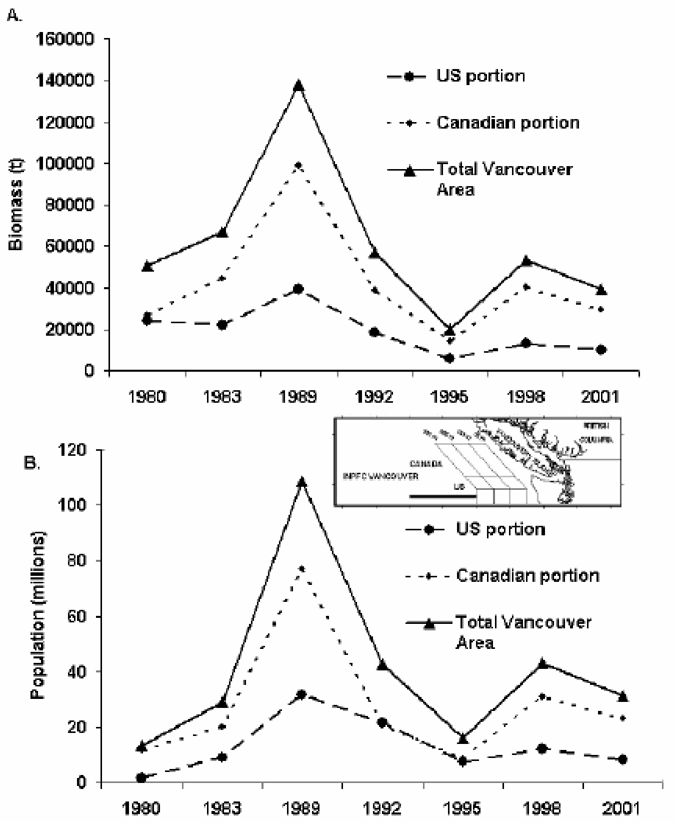


Figure 15. Swept area abundance estimates expressed as: (A) biomass; and (B) population in both the Canadian and US portions of the *INPFC Vancouver* region. Data from the National Marine Fisheries Service triennial trawl survey database. Source: FAO, 2007; Wallace *et al.*, 2009.

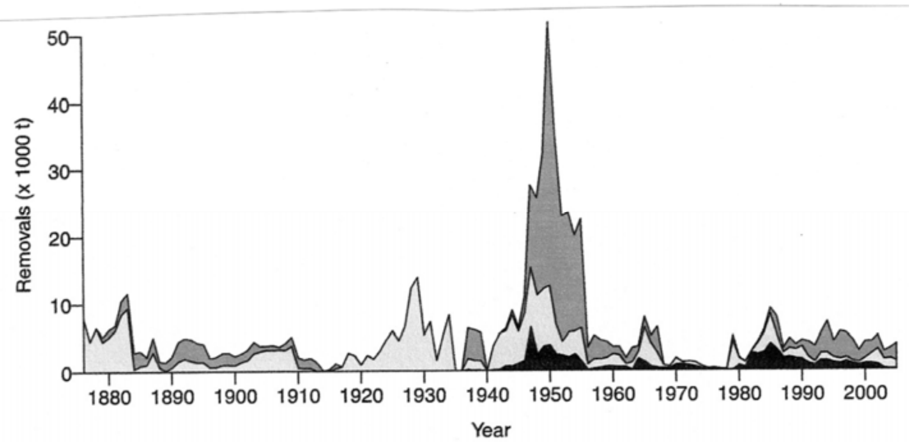


Figure 16. Reported landings of spiny dogfish in the Northeast Pacific. Solid areas: Puget Sound; lightly shaded areas: Strait of Georgia; darkly shaded areas: coastal waters between Alaska and Baja California. Source: Taylor and Gallucci, 2009.

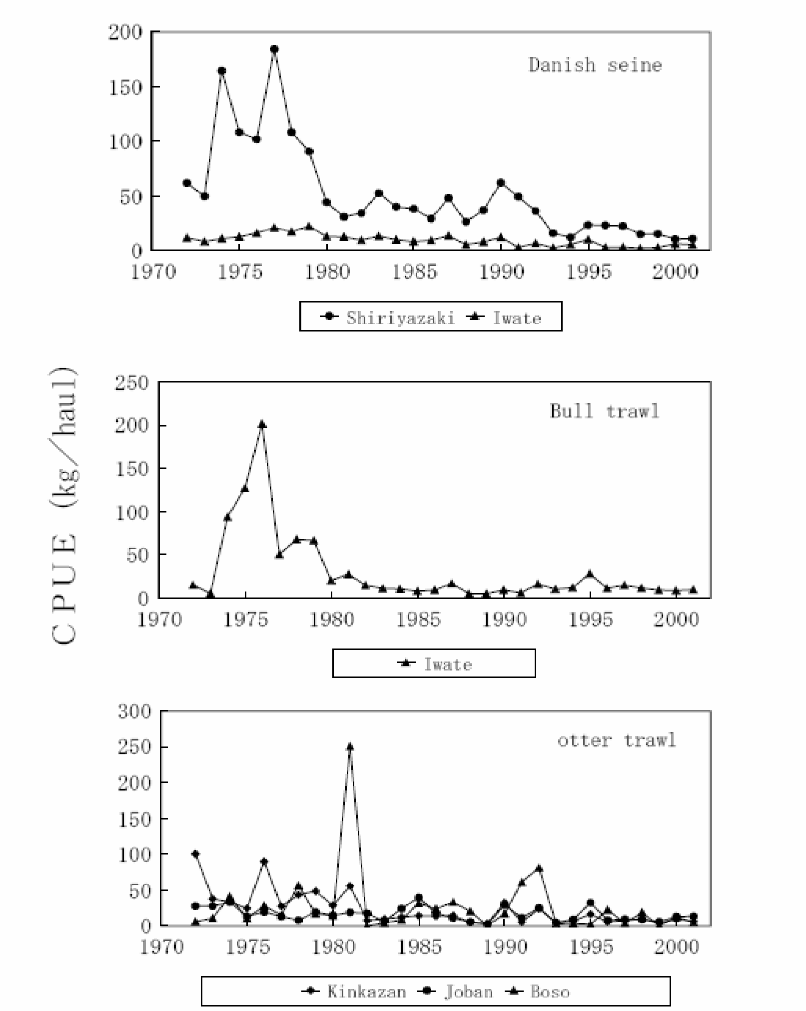


Figure 17. Eastern Japan CPUE series. Source: Fishery Agency 2003.

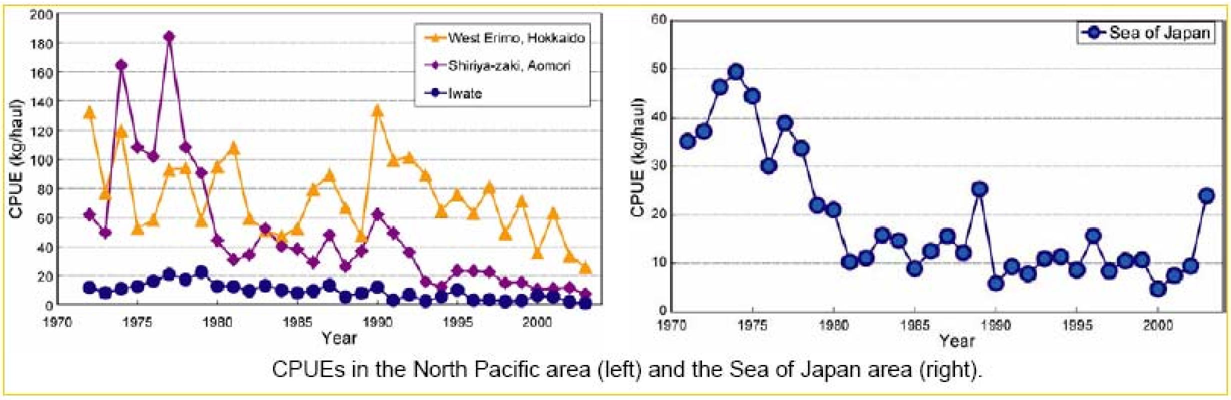


Figure 18. Catch per unit effort of spiny dogfish in several areas fished by Japan. Source: Fishery Agency 2004.

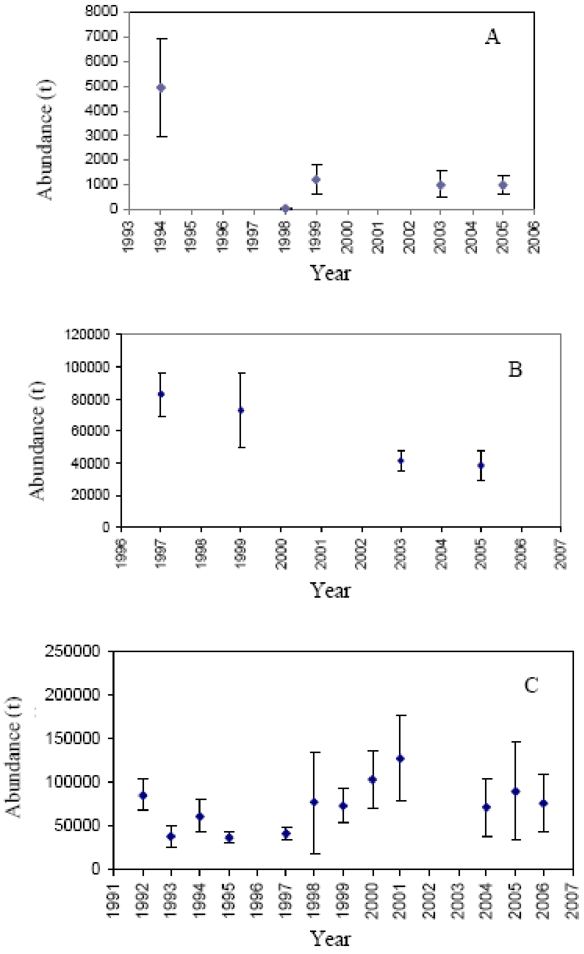


Figure 19. Swept area estimates of spiny dogfish biomass (tonnes) on the Argentinean shelf. (A) Bonaersense region; (B) central region; (C) southern Patagonian shelf. Source: Massa *et al.*, 2007.

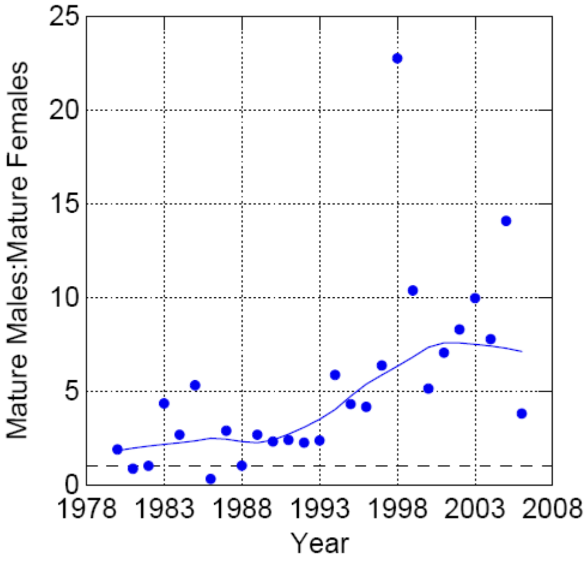


Figure 20. Ratio of number of spiny dogfish mature males (60 cm) to mature females (80 cm) per tow in NEFSC spring trawl surveys, 1980-2006. Line represents Lowess smooth with tension = 0.5. Source: NMFS, 2006.

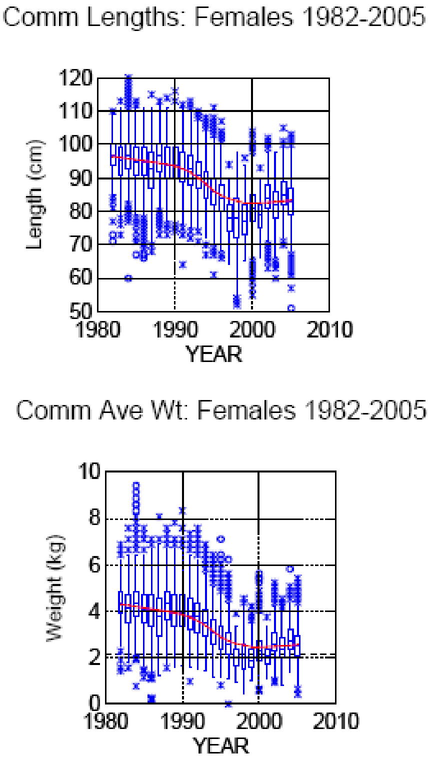


Figure 21. Length and weight of females in commercial fishery samples. Source: NMFS, 2006.

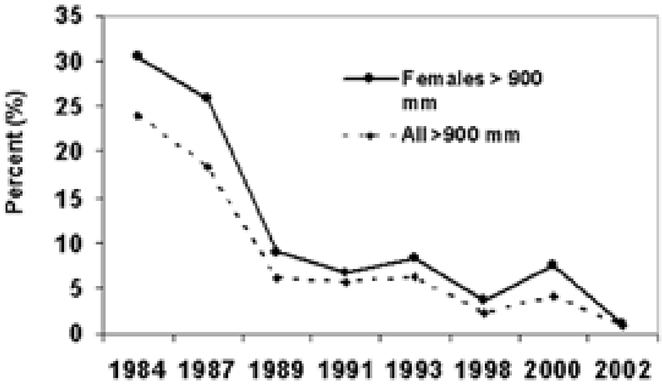


Figure 22. Proportion of spiny dogfish greater than 900 mm length in Hecate Strait trawl survey 1984–2002. Female length at maturity is 940 mm. Source: Wallace *et al.*, 2009.

APPENDIX I

FAO Expert Advisory Panel assessment report: Atlantic bluefin tuna

CoP15 Proposal 19

Species: *Thunnus thynnu*s – Atlantic bluefin tuna

Proposal: Inclusion of *Thunnus thynnus* (Linnaeus, 1758) in Appendix I in accordance with Article II paragraph 1.

Basis for proposal: The proposal states that the listing of Atlantic bluefin tuna on Appendix I is consistent with Annex 1A and 1C of Resolution Conf. 9.24 (Rev. CoP14):

Annex 1 A. The wild population is small, and is characterized by at least one of the following: iii) a majority of individuals being concentrated geographically during one or more life–history phases; or v) a high vulnerability to either intrinsic or extrinsic factors. Estimates of the genetically effective population size of subpopulations in the Mediterranean (400–700 individuals) is close to or below the minimum threshold related to the maintenance of genetic diversity and evolutionary potential in the long term. In addition the species displays strong aggregating behavior during feeding and spawning which makes it highly vulnerable to fishing.

Annex 1 C . A marked decline in the population size in the wild, which has been either: i) observed as ongoing or having occurred in the past (but with a potential to resume); ii) inferred or projected on the basis of any of the following: levels of patterns of exploitation; or a high vulnerability to either intrinsic or extrinsic factors; or a decreasing recruitment (only West stock). The East and West stocks of Atlantic bluefin have shown declines in standing stock biomass which meets the decline criteria for a low productivity species.

ASSESSMENT SUMMARY

A majority of the FAO Expert Advisory Panel considered that the available evidence supported the proposal to include Atlantic bluefin tuna, *Thunnus thynnus* (Linnaeus, 1758), in CITES Appendix I.

The Panel's deliberations were assisted especially by the Report of the Extension of the ICCAT Standing Committee on Research and Statistics (SCRS) Meeting to Consider the Status of Atlantic Bluefin Tuna Populations with respect to the CITES Biological Listing Criteria held in October 2009. The Panel concurred with the view of that meeting that the species did not meet the criterion that the wild population was sufficiently small to warrant listing under Appendix I.

In terms of the decline criterion for listing, the Panel again concurred with the view of that SCRS meeting that Atlantic bluefin tuna as a whole were near the borderline between a low and a medium productivity species, and consequently followed that meeting's approach of considering depletion to below 15% of a baseline (expressed in terms of spawning biomass as is customary for commercially–exploited aquatic species) level as the threshold guideline for an Appendix I listing.

The key consideration for the Panel was the choice of the baseline biomass level to use in computing the current extent of depletion. If the maximum spawning biomasses (B_{max}) in the period assessed (which commenced in 1970) are taken to be the baselines against which these depletions are evaluated, then both the Eastern (including Mediterranean) and Western populations are assessed to be above the 15% threshold. They are however sufficiently close to this threshold to meet the decline criterion for an Appendix II listing. Alternatively, if the estimated pre–exploitation spawning biomasses (B_0) are used for this baseline, both populations of Atlantic bluefin tuna are below this 15% threshold and meet the decline criterion for listing on Appendix I.

Some members of the Panel considered that B_{max} was an adequate proxy for pre–exploitation spawning biomass B_0 as in their view the two were unlikely to differ substantially. They considered that the alternative of estimating B_0 in the manner adopted by the ICCAT SCRS was highly sensitive to certain key assumptions, such as for the relationship between spawning stock and recruitment which has proven to be problematic to estimate for bluefin tuna. Estimates of B_0 obtained by the SCRS for the Eastern (including Mediterranean) population may be too high for various reasons. If the assessment is undertaken commencing in the early 1950s, it does not yield higher biomasses than the maximum obtained in the 1970+ assessment. As the annual catches prior to the 1950s are typically appreciably smaller than those that followed, the population was thus probably not greatly reduced by harvesting prior to the 1950s. Furthermore recruitment has shown systematic trends over recent decades, suggesting that B_0 also changes over time. Since recent recruitment has been above average levels, the values estimated for B_0 could be above the long–term average appropriate for a baseline.

However, the majority of members of the Panel considered that estimates of B_0 were preferable to use for the baseline because they took account of the reduction of the population by removals prior to the start of the assessment series, noting that the CITES Resolution Conf. 9.24 (Rev. CoP14) states that data used to estimate or infer a baseline for extent of decline of a commercially–exploited aquatic species should extend as far back into the past as possible. Furthermore, for the Western population any net bias in the estimate of B_0 is likely to be less than for the east. Catches off Brazil early in the fishery's history could well have belonged to the Western population and so should probably be taken into account in its assessment. Finally, the Western population likely has lower productivity than its eastern counterpart. Thus conclusions concerning this Western population meeting the Appendix I decline criteria are more strongly founded.

There was consensus in the Panel that the evidence available supported the inclusion of Atlantic bluefin on Appendix II.

An Appendix I listing would be likely to reduce the bluefin catches from both component populations. This would assist to ensure that recent unsustainable catches in the East Atlantic and Mediterranean are reduced.

Although reported catches from the Western population have not exceeded the total allowable catch (TAC) over the past 2–3 decades, there have been serious flaws in the recent management of the eastern component, including TACs set above scientific recommendations at unsustainable levels, and a large illegal component of the fishery making appreciable catches. However, in 2009 there have been important improvements in ICCAT's Eastern management approach, with the TAC for 2010 being reduced to 13 500 tonnes, a commitment to tie future TACs to SCRS advice, and a rebuilding plan based upon projections of reaching B_{MSY} in 2023 with 60% probability (assuming perfect implementation). The 2009 report of the ICCAT SCRS also comments that the appreciable differences between reported and estimated catches noted for 2007 had declined considerably for 2008, which could reflect improved implementation of regulatory and control mechanisms in the Mediterranean.

The proponent argued that the listing proposal included provision for downlisting to Appendix II, should stock status improve. It should be noted that implementation of a listing on Appendix I would impact many of the indices and the associated catch at size/age from the various bluefin fisheries, with unknown impacts on ability to monitor stock trends.

PANEL COMMENTS

Biological considerations

Population assessed

The Atlantic bluefin tuna, *Thunnus thynnus* is a highly migratory species found throughout the North Atlantic Ocean and adjacent seas, particularly the Mediterranean Sea. The species is managed by the International Commission for the Conservation of Atlantic Tunas (ICCAT) as two separate stocks: the Eastern and Western stocks. The separation of the two stocks was established based on evidences of

1) two separate spawning grounds (in the Mediterranean Sea on the Eastern side and in the Gulf of Mexico on the Western side); 2) differences in age at sexual maturity; 3) presence of juveniles and adults on both sides of the Atlantic; and 4) no spawning activity in the middle of the North Atlantic (Fromentin, 2008).

The hypothesis of only two stocks in the North Atlantic has been challenged by recent studies. On the one hand tagging and chemical signature studies have showed the mixing of bluefin tuna of different origins throughout the east coast of North America and the North Atlantic Ocean (Block *et al.*, 2005). On the other hand recent mitochondrial DNA studies revealed significant population subdivision among the Gulf of Mexico, the Western Mediterranean and Eastern Mediterranean (Boustany, Reeb and Block, 2008). These results suggest that despite the mixing of individuals from different origins in the North Atlantic, individuals show strong natal homing to their spawning grounds in the Gulf of Mexico, west Mediterranean and east Mediterranean. In addition to the studies above, the proposal refers to the work of Riccioni *et al.*, (2009) which suggests that Atlantic bluefin tuna population in the Mediterranean is composed of genetically differentiated subpopulations of small size.

Despite the uncertainties on the structure of the population, the separation of Western and Eastern North Atlantic stocks is strongly supported by the available information and remains the most accepted and utilized hypothesis for management purposes today.

Productivity level

According to the information provided in the proposal, the Atlantic bluefin tuna falls into the category of low productivity species for all parameters, with the exception of age at maturity (Table 1; ages 4–6 for the Eastern stock and 8–12 for the Western). The former suggests a medium productivity level for the Eastern stock, whereas the latter suggests low productivity for the Western stock. Therefore, following SCRS (2009), in this evaluation of the proposal the Atlantic bluefin tuna was considered a “low–medium” productivity species.

Population status and trends

Small population size

The most recent stock assessment of Atlantic bluefin tuna estimated that the Eastern stock included about 5 million individuals in 2007, of which about 1million were spawners (SCRS, 2008; 2009). The estimated number of individuals in the Western stock was about 225 000 in the same year.

Riccioni *et al.* (2009) estimated effective genetic population sizes in the Mediterranean in the order of 400–700 individuals. According to SCRS (2009) these estimates would translate into abundances of reproductive units in the order of 10^6 to 10^7 individuals.

Restricted distribution

Atlantic bluefin tuna is widely distributed throughout the North Atlantic and Mediterranean Sea. Important changes in the spatial and temporal patterns of distribution of the species have been observed since the early part of the 20th century (proposal). For instance, the species is now absent or rare from areas formerly occupied, such as the North Sea and Black Sea. On the other hand areas such as Eastern Mediterranean and the central North Atlantic have been supporting large catches in recent years. The reasons for the changes are unclear but these seem to result from interactions between biological, environmental, trophic and fishing processes (proposal, SCRS 2008). As noted by SCRS (2009), despite the fact that the population is managed as two stocks separated by the 45 W meridian, there are many uncertainties about the population structure. Complex spatial genetic structuring of the population in the Mediterranean suggests for instance the existence different isolated subpopulations in the region. However the area occupied by the distinct populations is probably wide, considering that individuals from different populations migrate and mix in the North Atlantic, as demonstrated by tagging studies (Block *et al.*, 2005).

Decline

The main source of information about the extent of decline of the Atlantic bluefin tuna population used in the proposal is the outcome of the stock assessment of Eastern and Western stocks conducted by the Standing Committee on Research and Statistics (SCRS) of ICCAT in 2008 (SCRS, 2008).

Results from the same assessment were used by the SCRS in 2009 to evaluate the status of Atlantic bluefin tuna in relation to CITES listing criteria (SCRS, 2009). The methods and results reported in SCRS (2009) are described below for the Western and Eastern stocks. Additional sources reported in the proposal are also included.

The calculation of the extent of decline of both stocks conducted by SCRS (2009) was based on two approaches:

1. From a historical perspective, by comparing current population size (as measured by the spawning stock biomass, SSB) against the (a) unexploited population size (SSB_0), and (b) the maximum historical population size (SSB_{max}) estimated in the stock assessment.
2. From a future perspective, by comparing future (2019) population size (as measured by SSB) against either (a) unexploited population size or (b) the maximum historical population size estimated in the stock assessment, and by comparing population size in 2019 against the current population size (2009).

Both stocks were assessed using Virtual Population Analysis (VPA). Results are expressed in terms of the probability of the spawning stock biomass being less than 10%, 15% or 20% of the baseline (SSB0 or SSBmax) in 2009 and 2019.

Western stock

The proposal states that spawning stock biomass of the Western stock declined from 49 482 tonnes in 1970 to 8 693 tonnes in 2007. That represents an extent of decline of 82.4% since the start of the time series. Using the data reported in SCRS (2008; Figure 1), the extent of extent of decline was recalculated comparing the 5–year average biomass at the beginning (1970–74) and end (2003–07) of the time series. The average spawning stock biomass declined from 44 798 tonnes in 1970–74 to 8 440 in 2003–07, representing a decline of 81.1% between the two periods.

Most of the decline occurred between 1970 and 1985. Since then the spawning stock biomass has remained relatively stable, varying from 18% to 27% of the 1975 level (SCRS, 2008). The stock has been under a rebuilding plan since 1998.

It should be noted that the numbers reported in the proposal are from one of the sensitivity runs of the assessment model. Results from 13 sensitivity runs of the model to the various indexes of abundance used in the assessment are reported in SCRS (2008). The extent of decline of the spawning stock biomass between 1970 and 2007 estimated in these runs varied from 65% to 90%, with an average extent of decline of 80%.

One limitation of the results reported above is that the estimated biomass in the early 1970s is used as baseline to calculate the extent of decline, while it is known that the peak catches from the west stock occurred in the mid–1960s (Figure 2). Therefore the calculated historical extent of decline is likely to be an underestimate of the level of depletion of the stock.

There are two studies that provide estimates of extent of decline going back to the earlier phases of the fishery. The study by Taylor *et al.* (2009), referred to in the proposal, uses a spatial age–structured model to assess the Eastern and Western stocks of Atlantic bluefin tunas simultaneously by accounting for movement of fish between the two stocks. The results, considered preliminary by the authors since the model has not been adequately tested yet, suggest that the total biomass of the west stock has declined substantially since 1950, probably by more than 80%.

The other study, more recent, was undertaken by SCRS (2009). In this study two recruitment scenarios were used for calculating the unexploited population size (SSB_0) as baseline for evaluating extent of decline: a “high recruitment” scenario reflecting a hypothesis that the potential productivity of the stock has shown no trend over the assessment period; and a “low recruitment” scenario reflecting the hypothesis that productivity potential has shifted to a lower level after the late 1970s. The other baseline used by SCRS (2009) was the maximum spawning stock biomass (SSB_{max}) estimated in the period 1970–2007. The estimated SSB_{max} is not affected by the assumptions made about recruitment.

SCRS (2009) also used two management scenarios to simulate future trends in the status of the stock: 1) following the recommended TACs in SCRS Rec. [08–04], i.e., 1 900 tonnes in 2009, 1 800 tonnes in 2010 with 1 800 tonnes carried forward until 2019; and 2) a projection of zero catch allowed after 2009.

Results of the evaluations undertaken by SCRS (2009) are shown in Table 2. If the maximum spawning stock biomass (SSB_{max}) is used as baseline, the probability that the current population size is below 10%, 15% and 20% of the baseline is 8.8%, 30% and 54.2% respectively, independent of the recruitment scenario used (Table 2A). If the unexploited population size (SSB_0) is used as baseline, the probabilities associated with the three decline thresholds are 30.2%, 92.6% and 99.6% for a low recruitment scenario, and 99.6%, 100% and 100% for the high recruitment scenario (Table 2A).

The projected trends for the next ten years are summarized in Table 2B. Assuming full compliance with the established TAC in Rec [08–04], the probability that SSB in 2019 will remain below 20% of SSB_{max} is less than 9%. If SSB_0 is used as baseline, there is a 15% probability that the stock will be below the 20% decline threshold for the low recruitment scenario and a 95% probability if a high recruitment scenario is used. The potential to recover to levels above 20% of the baseline is near 100% if no catches are allowed after 2009, the only exception being under the high recruitment scenario, where there is a probability of 62.6% that the stock will be below 20% of SSB_0 (SCRS, 2009).

Eastern stock

The proposal indicates that, according to the VPA analysis conducted by SCRS (2008) using data from 1955 to 2007, the spawning stock biomass of the Eastern stock declined from 305 136 tonnes in 1958 to 78 724 tonnes in 2007, representing a decline of 74,2 % . The proposal also notes that the bulk of the decline occurred since 1997, when the spawning stock biomass was estimated at 201 479 tonnes.

Of the model runs evaluated by SCRS (2008), four were considered satisfactory in fitting historical data: runs 6 and 7, based on catch at age data from 1970 to 2007; and runs 13 and 14, based on a longer time–series of data starting in 1955. While runs 6 and 13 were based only on reported catches, runs 7 and 14 accounted for unreported catches of 50 000 tonnes between 1998 and 2006 and of 60 000 tonnes in 2007. The results reported in the proposal are from run 14 (Figure 3).

Using the results from the two longer time series (runs 13 and 14), the extent of decline was recalculated comparing the average estimated biomass in 1955–59 and in 2003–07. In run 13, the spawning stock biomass declined from 293 176 tonnes in 1955–59 to 110 803 in 2003–07, representing a decline of 62,2% between the two periods. In run 14, the spawning stock biomass declined from 297 318 tonnes in 1955–59 to 117 443 in 2003–07, representing a decline of 60.5% between the two periods.

Since 2000 there has been a rapid increase in fishing mortality especially for large (ages 8+) fish and a rapid decline in spawning stock biomass (SCRS, 2008). The 2008 assessment results indicate that the spawning stock biomass continues to decline while fishing mortality is increasing rapidly, especially for large bluefin. As noted by SCRS (2008) the increase in mortality for large bluefin is consistent with a shift in targeting towards larger individuals destined for farming.

Therefore, in contrast to the Western stock, where biomass seems to have stabilized in recent years, the recent rate of decline of the Eastern stock is of concern. Based on the 2000–2007 spawning stock biomass estimates (run 13), the recent rate of decline would be approximately 3.2% /year. Projecting the SSB forward from 2008 to 2017 (10 years) would bring a decline to 51 201 tonnes, which is equivalent to 17.4% of the average spawning stock biomass in 1955–59.

Mackenzie, Moseegard and Rosenberg (2009) used an age–structured stochastic modeling approach based on SCRS 2008 for predicting future trends in the Eastern stock under the full implementation of ICCAT’s 2006 recovery plan, which includes the application of decreasing TACs between 2007 and 2010. Their conclusions were that “even if a near-complete ban on all bluefin tuna fishing in the

Northeast Atlantic and Mediterranean were implemented immediately in 2008 and enforced until 2022, the population will probably fall to record lows in the next few years, unless environmental conditions promote exceptionally high recruitment”. One of the reasons for the projected trends is the decrease of the proportion of older fish in the population observed in recent years, which according to the authors causes a reduction of the buffering capacity of the stock to unfavorable environmental conditions affecting reproductive success.

Two additional studies evaluated the historical extent of decline of the eastern stock. Taylor *et al.* (2009), cited in the proposal (and considered in the 2008 SCRS assessment), used a spatial age-structured model to assess the eastern and western stocks of Atlantic bluefin tuna simultaneously by accounting for movement of fish between the two stocks. Preliminary results indicated that total biomass of the Eastern stock has probably declined by more than 80% since 1950. SCRS (2009) evaluated historical extent of declines and projected future declines of the Eastern stock according to different scenarios, described as follows (SCRS, 2009):

> “Thirty–six projections were made for the following combinations, assuming that catches in 2009 and thereafter would follow the TACs in Rec. [08–05]:
>
> - 3 steepness levels (0.5, 0.75, 0.99)
> - 2 recent catch levels in the VPA (reported or adjusted)
> - 3 periods of SSB–R observations for the SRR (1970–1980, 1970–2002, and 1990–2002)
> - 2 implementation levels (perfect, and 20% overages, as was assumed in 2008)”.
>
> “In addition, the Committee agreed that it would be useful to provide ICCAT with additional advice that reflects the management recommendations made by SCRS in 2009. For this reason, additional scenarios were considered with 2010–2019 catches of 15 000 tonnes (approximating an F_{max} strategy), 8 500 tonnest (approximating an $F_{0.1}$ strategy), and zero catches, with the "base case" steepness and the three recruitment levels, and perfect implementation”.

The results of the simulations indicated that (SCRS, 2009):

> “The probability of SSB_{2009} being lower than 15% of the maximum SSB were about 0.19 for the case of reported catches and approximately 0.23 for the adjusted catches. In both cases, these results were the same for the three recruitment scenarios (low, medium, and high). The probabilities with respect to $SSB_{2009} < 0.15SSB_0$ were between approximately 0.88 and 1.00 depending on the recruitment scenario. In the case of projections, the probability of $SSB_{2019} <$ 15% of the maximum SSB ranged from 0.27 to 0.43 while the probability of $SSB_{2019} < 0.15 SSB_0$ ranged from 0.67 to 1.00” (SCRS, 2009; Figure 4).

Assessment relative to quantitative criteria

Small population

The estimate of total population size for the Eastern and Western stocks (5 million and 225 000 individuals, respectively) are well above the general guideline (5000) for small population size provided in the CITES definitions (CITES Conf. Res. 9.24 Rev CoP14). Riccioni *et al.* (2009) estimated effective genetic population sizes in the Mediterranean in the order of 400–700 individuals. These estimates would translate into abundances of reproductive units in the order of 10^6 to 10^7 individuals, which are also above the general CITES guidelines (framed in terms of number of individuals) for small population size,

As noted by FAO (2001), the CITES guideline for small population is considered generally inappropriate for populations of commercially–exploited marine species, except for a few species such as some sessile or semi–sessile species, some species with extremely low productivity, and some small endemics. The Atlantic bluefin tuna does not fit in any of these typologies of species.

Restricted distribution

No guidelines for restricted area of distribution are provided in the CITES Criteria, which indicate that thresholds should be taxon–specific (Conf Res 9.24 Rev CoP14). FAO (2001) recommended that historical extent of decline in area of distribution would be a better measure of extinction risk than absolute value of distributional area, but that if no other suitable information is available and absolute area of distribution has to be used for an exploited fish population, analyses should be on a case–by–case basis as no numeric guideline is universally applicable.

The Atlantic bluefin tuna is widely distributed in the North Atlantic and is not characterized by restricted distribution.

Decline

Under the CITES criteria for commercially–exploited aquatic species (Conf Res 9.24 Rev CoP14), a decline to 15–20% of the historical baseline for a low productivity species and to 10–15% for a medium productivity species might justify consideration for Appendix I. While there seems to be supporting evidence that the western stock could be considered of low productivity, the situation is less clear for the eastern stock, for which the age at maturity characterizes a medium productivity species. Therefore a decline threshold of 10–20% of the historical baseline, corresponding to a low–medium productivity species, was considered below in the evaluation of bluefin population decline.

According to the evaluation undertaken by SCRS (2009) the probabilities that the current spawning biomass is below 10%, 15% and 20% of the maximum estimated spawning biomass are 8.8%, 30% and 54,2% respectively. According to the same study, if the estimated pre–exploitation population size is used as the baseline, the probabilities associated with the 10%, 15% and 20% decline thresholds vary from 30.2–99.6%, 92.6–100% and 99.6–100%, respectively. On this basis, the Western stock of bluefin tuna meets the decline level criterion for listing a low–medium productivity species in Appendix I.

The evaluation of the status of the eastern stock against the CITES decline criteria undertaken by SCRS (2009) concluded that "there is a 96% probability that SSB in 2009 is less than 15% of long term potential (i.e. the probability that SSB_{2009} is less than 0.15 times SSB_0 is greater than 96%). The probability that SSB_{2009} is less than 15% of the maximum SSB estimated since 1970 is about 21%".

The recent of rate of decline of the eastern stock is also of concern. The 2008 assessment results indicate that the spawning stock biomass continues to decline while fishing mortality is increasing rapidly, especially for large bluefin which are targeted for farming. According to the stock projections conducted by SCRS (2009), even with the perfect implementation of ICCAT's then recommended TACs through 2019, there is more than 85% chance that spawning stock biomass in 2019 will be less than 15% of long term potential (SSB_0). The same study concluded that there is a 35% chance that the spawning stock biomass in 2019 will be less than 15% of the maximum spawning biomass estimated since 1970.

The key consideration for the Panel was the choice of the baseline biomass level to use in computing the current extent of depletion. If the maximum spawning biomasses (B_{max}) in the period assessed (which commenced in 1970) are taken to be the baselines against which these depletions are evaluated, then both the eastern and western populations are assessed to be above the 15% threshold. They are however sufficiently close to this threshold to meet the decline criterion for an Appendix II listing. Alternatively, if the estimated pre–exploitation spawning biomasses (B_0) are used for this baseline, both populations of Atlantic bluefin tuna are below this 15% threshold and meet the decline criterion for listing on Appendix I.

Some members of the Panel considered that B_{max} was an adequate proxy for pre–exploitation spawning biomass B_0 as in their view the two were unlikely to differ substantially. They considered that the alternative of estimating B_0 in the manner adopted by the ICCAT SCRS was highly sensitive to certain key assumptions, such as for the relationship between spawning stock and recruitment which has proven to be problematic to estimate for bluefin tuna. Estimates of B_0 obtained by the SCRS for the Eastern population may be too high for various reasons. If the assessment is undertaken commencing in the early 1950s, it does not yield higher biomasses than the maximum obtained in the 1970 assessment. As the annual catches prior to the 1950s are typically appreciably smaller than those that followed, the population was thus probably not greatly reduced by harvesting prior to the 1950s. Furthermore recruitment has shown systematic trends over recent decades, suggesting that B_0 also changes over time. Since recent recruitment has been above average levels, the values estimated for B_0 could be above the long–term average appropriate for a baseline.

However, the majority of members of the Panel considered that estimates of B_0 were preferable to use for the baseline because they took account of the reduction of the population by removals prior to the start of the assessment series, noting that the CITES Resolution Conf. 9.24 (Rev. CoP14) states that data used to estimate or infer a baseline for extent of decline should extend as far back into the past as possible. Furthermore, for the western population any net bias in the estimate of B_0 is likely to be less than for the eastern. Catches off Brazil early in the fishery's history could well have belonged to the Western population and so should probably be taken into account in its assessment. Finally, the Western population likely has lower productivity than its eastern counterpart. Thus conclusions concerning this Western component of the population meeting the Appendix I decline criteria are more strongly founded.

There was consensus in the Panel that the evidence available supported the inclusion of Atlantic bluefin on Appendix II.

Were trends due to fluctuations or management action?

Long term fluctuations in bluefin catches in the Mediterranean have been associated with fluctuations in the environmental conditions. Analyzing long–term time series of bluefin tuna catches from traditional Mediterranean and Atlantic trap fisheries, Ravier and Fromentin (2001) showed that the Eastern Atlantic bluefin population displays fluctuations with a period of 100–120 years and also cyclic variations of about 20 years. The long–term fluctuations were strongly and negatively correlated to trends in temperature. Ravier and Fromentin (2004) concluded that the relationship between catches and temperature seemed to be best explained by changes in the migration patterns of bluefin tunas, and consequently changes in their availability to the fixed gears, imposed by modifications in oceanographic conditions of spawning areas. The role played by these natural fluctuations in the observed decline of the stock since the second half of the 20th century is unknown but probably minor compared to effect of biomass removals from fisheries. There seems to be wide recognition that management actions adopted by ICCAT have failed to maintain the eastern stock at sustainable levels of exploitation.

Risk factors and mitigating factors

Several factors increase the risk to the population. Changes in the age structure of the population, with the decrease in abundance of older year classes, is expected to decrease the resilience of the stock to fluctuations in environmental conditions controlling recruitment. Bluefin displays strong schooling behavior during feeding and spawning which increases the catchability of stocks and consequently the risk of continued stock decline due to overfishing. The latter factor is applicable for the eastern stock in particular, where most of the landings are currently made by purse seine operations.

The combination of high fishing mortality, low stock biomass and overcapacity of the fleet increased the risk of continued declines in the eastern and western stocks. According to SCRS (2008) the potential catch of the active fleet in the East Atlantic and Mediterranean (ca. 73 000 tonnes) was at least 3 times the level needed to fish at a level consistent with the Convention objective. Likewise, the estimated capacity of the tuna farms in the Mediterranean represented as much as twice the agreed TAC for 2008 (SCRS, 2008).

Substantial illegal catches, above the recommended catch levels by ICCAT, increased fishing mortality above sustainable levels. Also fishing for bluefin tuna to supply capture-based farming activities in the Mediterranean have exacerbated the fishing pressure in recent years, particularly on older age classes.

The high value of the Atlantic bluefin meat in international markets, particularly in the Japanese sashimi market, constitutes another risk factor for supporting the maintenance of high fishing pressure on the stock. Bluefin products are easily and rapidly transported with current technology which facilitates their movement in trade.

Among factors mitigating risk, in 2009 there have been important improvements in ICCAT's Eastern stock management approach, with the TAC for 2010 being reduced to 13 500 tonnes (the short–term sustainable yield at F_{max} was estimated by the ICCAT SCRS to be 15 000 tonnes), a commitment to tie future TACs to the SCRS advice, a scheme to reduce fleet capacity, and a rebuilding plan with the objective of reaching B_{MSY} in 2023 with 60% probability (assuming perfect implementation). The 2009 report of the ICCAT SCRS also notes that the appreciable differences between reported and estimated catches noted in 2007 had declined considerably in 2008, which could reflect improved implementation of regulatory and control mechanisms in the Mediterranean.

The Western stock has been under formal rebuilding plans since 1998. This represents an important mitigation measure. However recent assessments indicate that the stock is not rebuilding as rapidly as was projected under the plan initially. In response, ICCAT adopted harvest plans in 2008 that included a higher probability of reaching the rebuilding target (which implies lower future yields).

Trade considerations

Catches of bluefin tuna supply both domestic and international markets, with the bulk of the catches exported to Japan where they fetch high prices. The main types of products in trade are belly meat, dressed fish, fillets, loins and gilled and gutted fish.

According to the proposal, the large Japanese market has been responsible for the growth of the tuna farming activities in the Mediterranean in recent years. Domestic markets in the EU involve mainly the principal fishing nations, including Spain, France and Italy. However, statistics of the volume traded domestically are likely to be underestimated (proposal). According to the Eurostat data on exports of Atlantic bluefin tuna from the Eastern population (data reported in the proposal), about 77% of the total processed bluefin tuna reported in 2007 were exported to countries outside the EU, while 49% of the live bluefin were traded internally in the EU.

In the Mediterranean the bulk of the catches are made by purse seiners and transferred as live fish to tuna fattening farms. This transfer of live tuna may also be considered international trade, since vessels are not necessarily from the same countries as those in which the farms are located. The level of illegal catches in trade is considered substantial. According to the information presented in the proposal, Japan reported to ICCAT the import of 32 356 tonnes of processed Atlantic bluefin tuna in 2007, when the legal quota for the same year was 29 500 tonnes. The estimated total catches (including from IUU sources) for the same year was about 61 000 tonnes (SCRS, 2008).

No information is reported in the proposal about the importance of international trade for the Western stock. Information available to the Panel suggests that some varying level of domestic consumption in Canada and USA exists, but the bulk of the revenues are derived from the catches traded internationally.

Implementation Issues

Introduction from the sea

Under the CITES Convention, specimens captured in international waters (outside the jurisdiction of any State) and brought into the jurisdiction of a State, are considered to be undergoing a process analogous to international trade.

Since under an Appendix I listing, international trade is only permitted in exceptional circumstances, introduction from the sea is not expected to be a major problem for Atlantic bluefin tuna if an Appendix I listing is accepted. No commercial harvesting of Atlantic bluefin on the high seas, either for direct use or for supplying tuna farms, would be allowed. Any Atlantic bluefin introduced from the sea for non–commercial purposes would require a certificate from the State of introduction that the introduction would not be detrimental to the survival of the species.

Non–detriment findings

An Appendix I listing places strict restrictions on international trade. Both an export and an import permit are required for any shipment and a number of conditions must be met before any shipment is made. The principal condition for permits is that shipments not be for primarily commercial purposes, implying that shipments would only be made rarely, and for scientific or display purposes. Once this condition is met, a non–detriment finding and a finding that the specimen was legally–obtained are required as part of the permitting process.

The basis for non–detriment findings (NDF) for the Atlantic bluefin tuna should be straightforward considering that the species is regularly assessed by the SCRS of ICCAT. The assessment conducted by SCRS leads to recommendations on the optimal levels catch levels to achieve management objectives and target reference points, which could be easily translated into non–detriment findings.

Findings that specimens were legally obtained

The management of the Atlantic bluefin tuna is under the competence of ICCAT. ICCAT adopts at its annual meeting specific legislation with management measures that are binding for its 48 contracting Parties. All bluefin tuna fishing and farming nations are contracting Parties of ICCAT and are thus obliged to comply with its legislation. Management measures elaborated by ICCAT are also adopted by the GFCM (General Fisheries Commission for the Mediterranean) and by member countries of the European Union. Therefore the basis for establishing if exports of bluefin tuna are from legal harvesting is well established. Compliance with the rules has been however a problem, particularly in the east Atlantic and Mediterranean where the levels of unreported catches have been high.

Identification of products in trade and “look–alike” issues

The identification of processed Atlantic bluefin tuna (e.g. loins and belly meat) and differentiation among other bluefin tuna species (Pacific and Southern bluefin) and some tropical tunas (Yellowfin and Bigeye) may pose difficulties to customs officers. Morphologically the 3 bluefin species are very similar and once processed it may be very difficult to distinguish among these species or Yellowfin and Bigeye. The use of genetic techniques is a solution for the accurate identification of specimens or products in trade. However the cost of such techniques can be an issue for some countries.

The Convention allows for listing species for “look–alike” reasons when enforcement officers who encounter specimens of CITES–listed species are unable to distinguish between them and closely–related, non–listed species. If the trade in by–products under the guise of non–listed related species was undermining the conservation effectiveness of a bluefin listing, and tools such as identification guides and DNA tests were not adequate to bring the illegal trade under control, there could be a basis for listing other tuna species on the grounds that their products resemble those of Atlantic bluefin in trade.

Monitoring future stock status

The proponent argued that the listing proposal included provision for downlisting to Appendix II, should stock status improve. It should be noted that implementation of a listing on Appendix I would impact many of the indices and the associated catch at size/age from the various bluefin fisheries, with unknown impacts on ability to monitor stock trends.

Likely effectiveness of a CITES Appendix I listing for species status

The impact of a CITES Appendix I listing on species status depends on several factors including the extent to which trade (as opposed to exploitation for national utilization) is driving exploitation; the relative importance of directed harvest for trade and of other sources of mortality including incidental catch; and the actual effects of the listing.

An Appendix I listing would essentially eliminate legal commercial international trade in Atlantic bluefin products. Currently a large proportion of the catches of the Eastern stock supplies, either directly or through tuna farming activities, the Japanese market. It is expected that without the international demand for bluefin products, harvesting would be conducted only to supply domestic markets in the EU. With a reduced demand it could be expected that harvest levels are more likely to be commensurate with or lower than the recommended TACs for allowing stock recovery.

It is important to note, however, that a substantial part of the catches in the East Atlantic and Mediterranean are made in international waters, and these catches when introduced from the sea would also be considered international trade and therefore would not be allowed under an Appendix I listing. As a result it is very likely that legal harvesting from the Eastern stock of Atlantic bluefin tuna will be substantially reduced, thus benefiting the conservation of species.

It is unclear whether the listing would benefit the Western stock. There is no trade information related to the Western population of Atlantic bluefin tuna in the proposal, but most if not all of the product harvested in Canada would be exported. US catches may supply mainly the North American domestic market. The Western stock is also already under a rebuilding plan with reduced TACs. With the listing, the proportion of catches taken in the high seas would be eliminated, benefiting the rebuilding of the stock. Considering the hypothesis that Eastern and Western stocks are mixing, the reduced pressure on the Eastern stock would also benefit the Western stock and *vice versa*.

Illegal fishing constitutes one important threat to the effectiveness of the listing. As noted above, the recent level of illegal catches in trade was substantial (the estimated volume traded illegally in 2007 being higher than the TACs for the Eastern population of Atlantic bluefin in the same year). It is expected that a CITES listing would add some tools to combat illegal trade. Enforcement by customs would be facilitated because any specimen or product in trade would probably be illegal. Identification of products in trade could be assisted by DNA tests.

Mortality caused by incidental catch in other fisheries does not seem to be a concern for the Eastern stock but can be important for the Western stock because it is taken as bycatch in other Gulf of Mexico fisheries.

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TABLES AND FIGURES

Table 1. Information for assessing productivity level of the Atlantic bluefin tuna. Unless otherwise indicated, information is from the proposal. Productivity levels refer to guidelines in FAO (2001).

Parameter	**Information**	**Productivity**	**Source**
Intrinsic rate of increase	0.03 – 0.06	Low	Proposal; McAllister and Carruthers (2007)
Natural mortality	Eastern stock: 0.18 (mean of all age classes), 0.16 (mean of sexually mature age classes). Western stock: 0.14 (all ages)	Low Low	Proposal; SCRS (2008) Proposal, SCRS (2008)
Age at maturity	Eastern stock: 4 – 6 years Western stock: 8 – 12 years	Medium Low	Proposal; Fromentin (2006), SCRS (2008)
Maximum age	27 years Eastern stock: > 20 years Western stock: 32 years	Low Low? Low	Proposal; Nichy and Berry (1975) SCRS (2008) SCRS (2008)
K	0.003 – 0.120 Eastern stock: 0.079 Western stock: 0.093	Low Low Low	Proposal; Restrepo *et al.* (2007) SCRS (2008) SCRS (2008)
Generation time	11 – 17 years (6 to 9 generations per 100 years)	Low	Proposal

Table 2. Calculated probabilities that the spawning stock biomass of the Western stock is below decline thresholds (A) and is projected to be below decline thresholds in 10 years time (B). Source (SCRS, 2009).

A)

Recruitment scenario	**Probability that SSB2009 is below historical decline threshold**		
	<10% SSBmax	*<15% SSBmax*	*<20% SSBmax*
Low	0.088	0.298	0.542
High	0.088	0.300	0.542
	<10% SSB0	*<15% SSB0*	*<20% SSB0*
Low	0.302	0.926	0.996
High	0.996	1.000	1.000

B)

TAC	**Recruitment scenario**	**Probability that SSB2019 will be below historical decline threshold**		
Rec [08–04]		*<10% SSBmax*	*<15% SSBmax*	*<20% SSBmax*
	Low	0.004	0.016	0.056
	High	0.012	0.038	0.090
0 t				
	Low	0.000	0.000	0.000
	High	0.000	0.000	0.000
Rec [08–04]		*<10% SSB0*	*<15% SSB0*	*<20% SSB0*
	Low	0.006	0.036	0.152
	High	0.544	0.848	0.952
0 t				
	Low	0.000	0.000	0.000
	High	0.096	0.298	0.626

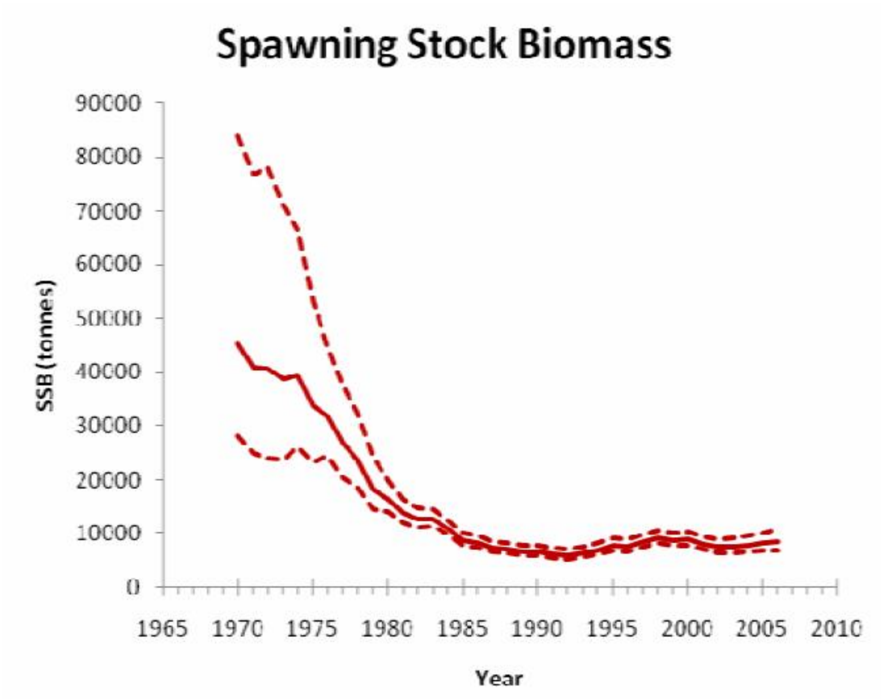

Figure 1. Annual median estimates of spawning stock biomass of the western stock. Dashed lines indicate the 80% confidence interval. Source: SCRS, 2008.

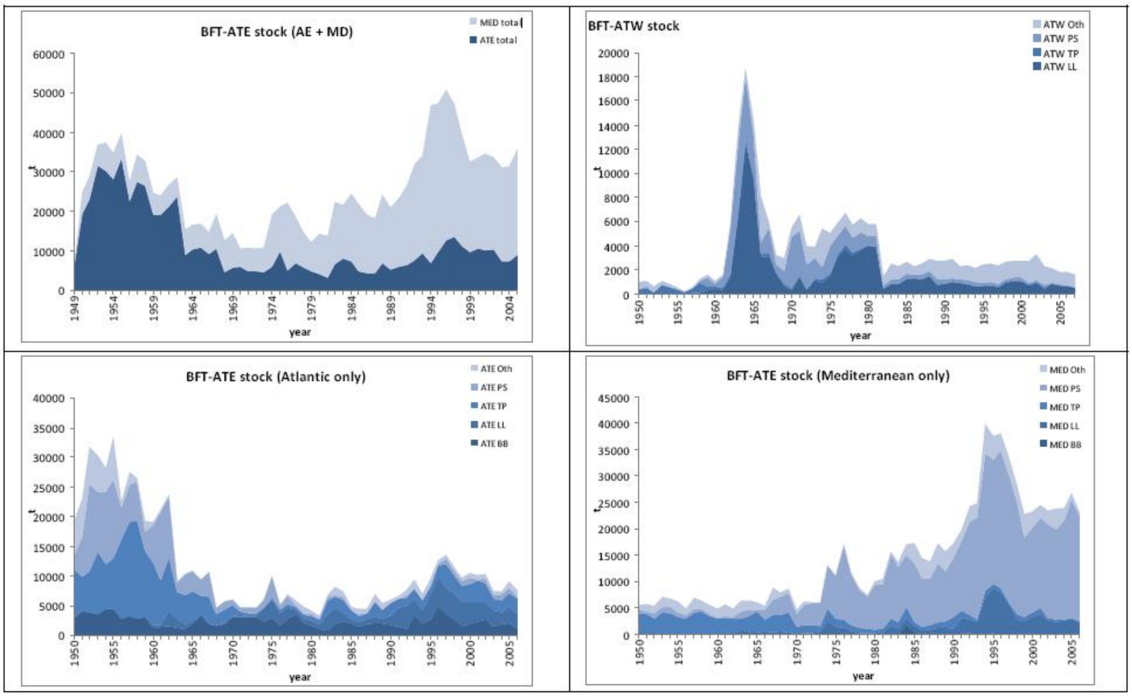

Figure 2. Bluefin reported annual catches by area and gear. BFT–ATE: eastern stock; BFT–ATW: western stock. TP: tuna trap; PS: purse seine; LL: longline; BB: bait boat. Source : SCRS 2008.

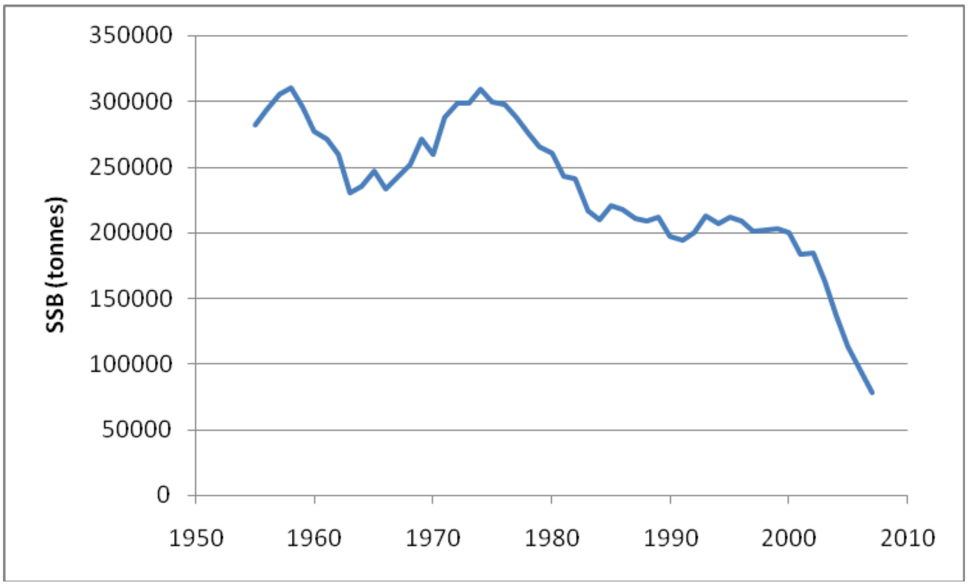

Figure 3. Estimated spawning stock biomass of the eastern stock (results from run 14; SCRS 2008).

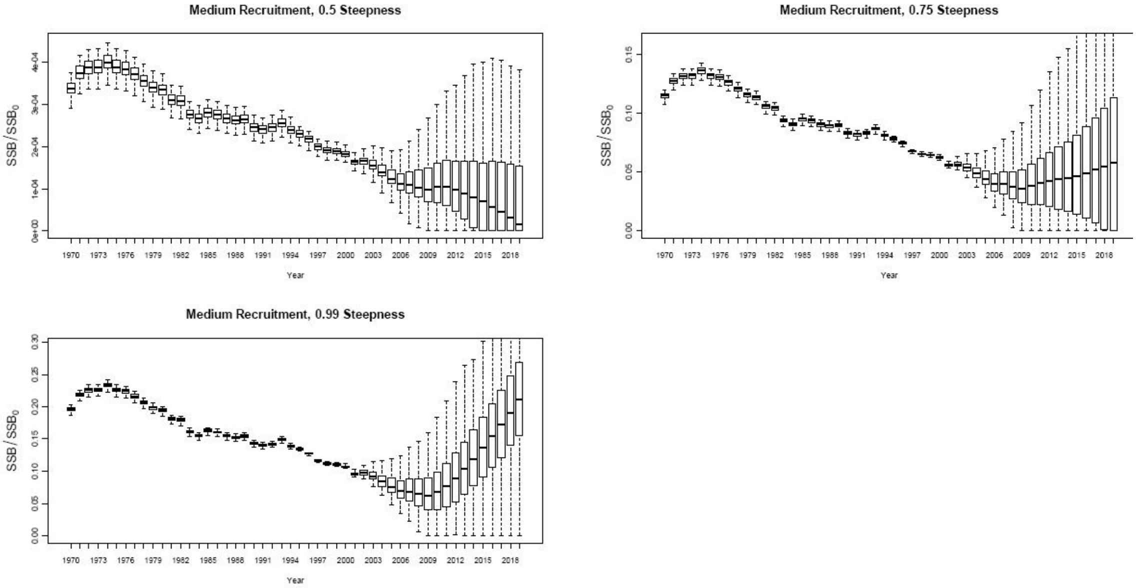

Figure 4. Trends in spawning biomass for the Eastern stock relative to the baseline biomass estimated with different assumptions (note that the Y–axis scale differs between the various panels). The baseline is SSB_0 estimated with assumed steepness values of 0.5, 0.75 and 0.99, and using all of the SSB–R observations. The boxes contain the central 50% of the observations and the whiskers 95%. Source: SCRS, 2009.

APPENDIX J

FAO Expert Advisory Panel assessment report: family Coralliidae

CoP15 Proposal 21

SPECIES: All species in the family Coralliidae.

PROPOSAL: Inclusion of all species in the family Coralliidae in Appendix II of CITES in accordance with Article II paragraph 2(a) and 2(b).

Basis for proposal: According to the proposal seven species of Coralliidae (*Corallium rubrum, C. secundum, C. lauuense [C. regale], P. japonicum, C. elatius, C. konojoi,* and *Corallium* sp.nov*)* qualify for listing in Appendix II in accordance with Article II, paragraph 2 (a) of the Convention. These species are intensively harvested to supply international demand for jewelery and other products and have life-history characteristics that make them vulnerable to over-exploitation. Therefore regulation in trade in these species is required to "ensure that the harvest of specimens from the wild is not reducing the wild population to a level at which its survival might be threatened by continued harvesting or other influences" (Annex 2a, Criterion B). The other 24 species of Coralliidae qualify for listing in Appendix II in accordance with Article II, paragraph 2 (b) of the Convention, because they resemble the seven species proposed to be listed under Article II paragraph 2(a). Their listing is therefore justified to avoid implementation problems caused by the difficult identification of specimens or products of the listed species by enforcement officers.

ASSESSMENT SUMMARY

The FAO Expert Panel concluded that the available evidence does not support the proposal to include all species in the family Coralliidae (*Corallium* spp. and *Paracorallium* spp.) in CITES Appendix II.

The Panel considered that populations representing a large proportion of the abundance of the seven species proposed for listing under Article II paragraph 2(a) (*Corallium rubrum*, *C. japonicum*, *C. secondum*, *C. elatius*, *C. konojoi, Corallium* sp. nov., *C. lauuense* [*C. regale*]) globally did not meet the decline criteria for Appendix II.

The Panel considers *Corallium rubrum* to be a low productivity species. Little is known about the life-history characteristics of the other 6 species under consideration but it is highly likely that they are also low productivity species.

The proposal depends heavily on catch statistics to support inclusion of the seven species for listing under the Appendix II decline criterion. The Panel considered that these data were not very reliable, as landings are influenced by economics (such as price of coral, price of fish, price of fuel), management practices (such as size limits, area closures), difference in spatial coverage, mixing of live and dead coral weights (Japan targets dead coral in some fisheries), differences in collection methods (SCUBA, submersibles, drags), and other factors. Nevertheless, these data can be useful to observe the extreme "boom and bust" cycles characteristic of this fishery when new beds are discovered.

The Panel observed that some fished areas in the Mediterranean demonstrate a historical extent of decline in a few metrics (trends in number of polyps per colony and population fecundity) commensurate with the Annex 5 guidelines on extent of decline for low productivity species. Decline to a lesser extent was found in the catches, maximum size of colonies, mean height and proportion of older colonies per stock. There has been a clear over-exploitation of shallow water beds which has led to a shift in harvesting to deeper water colonies. In some areas in the Mediterranean (for example the Costa Brava) only 9% of the colonies are sexually mature. However, in other areas (for example Sardinia) management measures have been implemented and recruitment appears strong.

In the Pacific including Hawaii, Japan, Taiwan Province of China, and in international waters there is no evidence to show extents of decline that meet the criteria for inclusion in Appendix II. In Hawaii, harvest of the family Coralliidae is under a management scheme and there has been an increase in population density since 1971. In Japan only three out of twenty-eight known areas with coral beds have been assigned for harvest. Little quantitative analysis has occurred of population dynamics in Japan or Taiwan Province of China. In the Philippines all areas with coral beds are closed to fishing (at least 11) and have never been exploited. Pacific seamounts have been overexploited, with catches exhibiting classic boom and bust dynamics. No fisheries occur on international sea mounts at present. The Panel concluded that the recent fisheries (last 20 years) in the Pacific appear to be small-scale and managed. The Panel noted that of the seven species proposed for listing under the Appendix II decline criterion, no data are presented for *C. lauuense* (*C. regale*) to support its listing. *C. lauuense* is described by Baco and Hank (2005) as one of the more common deep-sea octocorals on the seamounts and islands of the Hawaiian Archipelago.

The data from all areas indicate that uncontrolled fisheries have depleted coral beds in the past. Some populations rely on refugia in inaccessible areas that might become accessible to the fisheries through new technology (ROVs, mixed gas diving, etc.). These exploited long-lived corals require effective local management to prevent unsustainable harvesting and this is not occurring across their full geographic distribution. Recovery of these low productivity species may take several decades. There is a risk that new fishing activities could be initiated in international waters leading to over-exploitation of coral on sea mounts.

The Panel considered the difficulty of identifying products in trade and the substantial administrative burden of issuing CITES trade documents and of recording for the large number of individual specimens in trade as key issues affecting the effective implementation of CITES regulations for these species. It recognises efforts by the proposing parties to address these issues.

The Panel considered that, despite a lack of reliable statistics, it seems probable that a substantial fraction of the production of *Corallium* spp. and *Paracorallium* spp. is in international trade and that international trade was an important driver of the harvest of these species.

In the 2007 deliberations of the Panel, the Panel concluded that the genus *Coralllium* did not meet the biological decline criteria for listing in CITES Appendix II. The additional information available to the current Panel included a consideration about decline in number of polyps and a shift in depths of harvesting in the Mediterranean. The current proposal also increased the requested listing to the family Coralliidae. The additional information and scope of the proposal did not lead the Panel to change its previous conclusion related to the genus *Corallium*.

PANEL COMMENTS

Biological considerations

Population assessed

The proposal is to include all species of the family Coralliidae in Appendix II of CITES, including 24 species of the genus *Corallium* and 7 species of the genus *Paracorallium*. The family Coralliidae (Octocorallia) has a broad distribution extending throughout the world in tropical, subtropical and temperate oceans, including the Mediterranean Sea and the Atlantic, Indian and Pacific Oceans (Figure 1). They are found from shallow subtidal waters to depths of 1500 m.

Corallium rubrum is endemic to the Mediterranean Sea (primarily central and western basins) with smaller populations in the eastern Atlantic off the coast of Morocco. The other six species proposed for listing in accordance with Article II paragraph 2(a) are found in the Pacific. *P. japonicum, C. elatius*, and *C. konojoi* are found in Japan, Taiwan Province of China, Philippines, Viet Nam, Indonesia, Palau and Vanuatu and are the most commercially valuable of the Pacific species. *C. secundum* and *Corallium* sp. nov. are found in Hawaii and on Pacific seamounts in international waters (e.g., Emperor). *C. lauuense* has so far only been identified in Hawaii. All are or have been commercially exploited with the possible exception of *C. lauuense*. This species does not appear in the catch data but does appear in trade documents.

Productivity level

The life-history characteristics of *C. rubrum* are very well studied and associated with low productivity. It has a long life-expectancy, slow growth rate, limited larval dispersal, lacks asexual reproduction through fragmentation (unlike most other corals), prolonged oogenesis (~12 months) and a low number of oocytes per polyps (2-3). Despite the relatively early age of first reproduction (year 2-10) (Torrents *et al.* 2005), only one third of the population reproduce per year. Little is known about the life-history characteristics of the other six species under consideration. *C. secundum* is known to reproduce at age 12 to 13 years and is considered to be a broadcast spawner (Grigg, 1993).

Available life history information suggests that the species in the family would fit into the low productivity category (Tables 1, 2). This is different from the considerations of FAO (2007) who considered it low-medium. The Panel considered the extremely low production of eggs per polyp in *C. rubrum* to be important. The interaction between size and fecundity is particularly important for smaller, younger colonies of this species. There is little information on the other species but we do know that at least one of them has a later age at first reproduction.

Population status and trends

When considering the CITES criteria, the Panel clarified that the coral colony is equivalent to an individual, that colony size is an important indicator of reproductive potential, and that colonies are found in coral beds which themselves are found in larger "areas". Coral growth is three dimensional and the reproductive unit is the polyp; these are distributed along the branches (Figure 2). Therefore colony height is a linear measure of a three-dimensional metric. Reproductive potential therefore increases exponentially with colony size.

Small population size

The total number of colonies of all species in the family Coralliidae is unknown. The number of colonies in three of the largest Coralliidae beds off Hawaii (United States of America) were 120 000 (Makapu'u), 7 000 (Keahole Point) and 2 500 (Cross Seamount) (Grigg, 2002) for a total of 129 500 colonies. The proposal reports estimates of the density of colonies in different parts of the species distribution, but the actual number of colonies is not reported.

Restricted distribution

No estimates of distribution area were available in the proposal. The Family Coralliidae (Octocorallia) has a broad distribution extending throughout the world in tropical, subtropical and temperate oceans, including the Mediterranean Sea and the Atlantic, Indian and Pacific Oceans (Figure 1). The Panel determined that in Japan there are 28 known areas with coral beds and in the Philippines at least 11 areas with coral beds have been documented. In Hawaii Coralliidae are distributed throughout the Hawaiian archipelago. In the Mediterranean, *C. rubrum* is more common in the central and western basins.

Decline

Although density estimates are provided for some areas, no time trends in densities (which might be useful as indices of abundance) are provided in the proposal to evaluate decline in population abundance.

Surveys conducted in the Makapu'u Bed off Oahu, Hawaii (the largest known population of *Corallium* in the U.S. Pacific [Bruckner and Roberts, 2009]), estimated that the density of *C. secundum* increased from 0.02 colonies m^{-2} in 1971 to 0.022 colonies m^{-2} in 1983/1985 to 0.3 colonies m^{-2} in 2001 (Grigg, 2002). The recovery of the population from harvesting in the 1970s was also demonstrated by the increase in frequency of older year classes in 2001 compared to 1971, 1983 and 1985 (Figure 3).

The proposal depends heavily on catch statistics as a proxy for decline to support inclusion of the 7 species for listing under the decline criterion. The Panel considered that these data were not very reliable as landings are influenced by economics (for example price of coral, price of fish, price of fuel), management practices (for example size limits, area closures), difference in spatial coverage, mixing of live and dead coral weights (Japan targets dead coral in some fisheries), differences in collection methods (SCUBA, submersibles, drags), and other factors. Nevertheless, these data can be useful to observe the extreme "boom and bust" cycles characteristic of this fishery when new beds are discovered.

In the Pacific, these pooled catch data incorporate the dynamics of two different kinds of harvesting. One is the exploitation of newly discovered seamounts, and a second, regional fisheries that are moving towards management and thus restricting catch and avoiding over-harvesting. Grigg (1984) highlighted the interaction of price and catch of *Corallium* in the Pacific. As stated above these factors will influence any detailed interpretation of Pacific catch data and figures.

Overall, pooled regional catch statistics are the only information in the proposal available to describe historical declines in the different parts of the Coralliidae range (Table 3). Total harvesting of *Corallium* in the Emperor Seamounts, western Pacific, by Japan and Taiwan Province of China declined to small fractions of their maximum values between 1979-81 and 1989-91 – 4% and 1% respectively (Table 2 in proposal). Total reported landings of Coralliidae in the Pacific declined to about 3% of the historical peak of 350 tonnes between 1984-86 and 2004-07 (Figure 4).

In the Mediterranean the reported landings of *C. rubrum* have similar issues surrounding the data as are detailed for the Pacific (for example, new areas were exploited in Algeria and Morocco within the time series), with the addition of the phasing out of dredging and the shift of SCUBA harvesting to deeper water being major factors.

C. rubrum declined to about 40% of the historical maximum of 88 tonnes between 1978-80 and 2004-07 (Figure 4). As noted by Santangelo *et al.* (2009) catch figures from the Mediterranean are probably underestimated because they are reported by coral wholesalers, while illegal fishing and trade are known to be common.

Trends in catches were also used as an indicator of decline in population abundance when the listing of the genus *Corallium* in Appendix II was proposed to CITES CoP14. In evaluating that proposal for listing *Corallium* in Appendix II, FAO (2007) considered that catch data alone are unlikely to represent abundance trends precisely since changes in fishing intensity will change catch values. The same conclusion is valid for the current proposal.

Other indices

Other indices examined by the Panel have only been estimated for *C. rubrum* in the western Mediterranean. The proposal states that colony size in a population is a more important indicator of population status for these colonial animals than abundance. The Panel concluded, however, that colony size should be considered in addition to abundance. This is justified, for instance, by the exponential increase in larval production with the increase in colony size and complexity (more branches).

Some local estimates of changes in the size of colonies are reported in the proposal. In Spain the mean height of colonies exploited above 60 m depth decreased from 61.8 mm to 27 mm from 1986 to 2003 (Table 3) (Tsounis *et al*., 2006). This would represent a decrease of at least 56% in the reproductive potential of colonies (Bruckner and Roberts 2009 indicate a loss of 80-90% of reproductive modules in a colony with a decrease in height from 20-50 cm to 5 cm). In France colony height decreased to 10% of the maximum height in historical records (Bruckner 2009 cited in the proposal). For the Pacific, Grigg (2002) demonstrated an increase in the frequency of older age classes in the population of *C. secundum* off Hawaii, which also reflects an increase in colony size, between 1971 and 2001 (Figure 3).

Bruckner and Roberts (2009) reported results of drop camera surveys conducted in areas formerly targeted by coral drag fisheries off Koko Seamount, in international waters of the North Pacific. Although no data from these surveys are provided, it is stated that “out of 44 drop camera surveys conducted during these surveys, *Corallium* was only identified in one area”. The authors noted that this area is now proposed as a closed area for trawl fisheries.

Table 3 shows other indices that were calculated with new information available to the Panel. The Panel observed that some fished areas in the Mediterranean demonstrate an historical extent of decline in a few metrics (trends in number of polyps per colony and population fecundity) commensurate with the Resolution Conf 9.24 (Rev. CoP14) Annex 5 decline criterion for low productivity species. Decline to a lesser extent was found in the catches, maximal size of colonies, mean height and proportion of older colonies per stock.

Assessment relative to quantitative criteria

Small population

In relation to absolute population size, there are estimates of density from different parts of the Coralliidae distribution, as provided in the proposal, but no estimates of total population size are available. The family is widely distributed and probably occurs in relatively large numbers worldwide.

Restricted distribution

The family is distributed widely across tropical, sub-tropical and temperate regions. Notwithstanding some local extirpations, there is no reason to suspect a decline in area of distribution has taken place and distribution is relatively wide in large areas of the ocean. Certain of the seven species are limited geographically, such as *C. rubrum* which is endemic to the Mediterranean.

Decline

For an Appendix II listing, assessment of whether the species is near Appendix I levels or likely to become so in the foreseeable future is required. For a low productivity species, a decline to less than 15–20% of the historical baseline might justify consideration for Appendix I. For a medium productivity species decline to 10–15% would be of concern. To be near the Appendix I threshold, values 5–10% above these (i.e. 15–30% of the historical baseline) either now or in the foreseeable future might justify consideration for Appendix II.

With the exception of the time series of *C. secundum* densities estimated for Hawaii (Grigg, 2002), there are no abundance data available to infer the trend of Coralliidae populations in other parts of their range.

The increase in the frequency of older age classes in the Hawaii population also supports the finding that the population is recovering from harvesting during the 1970s (Grigg, 2002).

Overall, the only data used in the proposal to infer declines in Coralliidae populations are changes in pooled catches over wide areas. As noted before, catch information is not an adequate measure of population abundance because it responds also to changes in fishing intensity. In the Mediterranean the decline as indicated by catches has been to about 40 percent which is not within the Appendix II levels. However, the decreases of the number of polyps per colony in *C. rubrum* in the western Mediterranean fit the Appendix II decline criterion. Reported declines to 1–4% of the maximum catches in the Pacific are unlikely to represent declines in population abundance.

In terms of declines in colony size, the only trend data reported in the proposal are from local studies in the Mediterranean. It is difficult to judge if these declines are representative of the whole population in the Mediterranean or of global populations. It seems for instance that colonies in deeper waters are larger due to less intensive harvesting (Rossi *et al*,. 2008).

In summary available information does not demonstrate global levels of decline in Coralliidae populations consistent with listing under the CITES decline criterion.

Were trends due to fluctuations or management action?

There is no evidence available that observed negative trends in population abundance were due to environmental fluctuations. Mass mortality events of *C. rubrum* observed since the late 1990s have been linked to elevated temperature anomalies (Garrabou *et al.* 2001; 2003). However these events cannot explain the observed longer term declines in catches, which are consistent with harvesting.

Risk and mitigating factors

Life history (long lifetime, low natural mortality rate) and ecological characteristics (isolated subpopulations, limited dispersal potential) of Coralliidae species contribute to risk of severe declines. Small colony size and local depletions associated with intensive harvesting could add to these risks. Overfished populations would be more susceptible to natural impacts associated with climate change, such as increased temperatures, which have been linked to population die-offs, and ocean acidification that is expected to affect calcification of skeletons and colony growth.

The Panel considers that the available information on the life history and population genetic structure of *Corallium* species is highly relevant while assessing the proposal. It is well established that in the Mediterranean Sea *C. rubrum* is a brooder which releases planulae to the water (Vighi, 1972; Weinberg, 1979), whereas the other species (*C. secundum, C. lauuense*) of the family studied so far are broadcaster spawners, that is the gametes are externally fertilized (Grigg, 1993; Baco and Shank, 2005). Early genetic studies have shown that *C. rubrum* planulae exhibit limited dispersal that promotes population differentiation (Abbiati, Santangelo and Novell, 1993). Recent microsatellite studies have provided evidence for significant heterozygote deficiencies in *C. rubrum* and chaotic genetic structuring at spatial scales of 1 m and thus occurrence of genetically distinct pools of colonies at meter distances (Costantini and Abbiati, 2006). Further studies that have quantified levels of genetic divergence among coastal populations and estimated numbers of migrants among populations suggested that the planulae of *C. rubrum* have short-range dispersal. Geographic distances greater than 100 km can be considered as the threshold for genetic divergence between populations.

For the broadcast spawner *C. lauuense* in Hawaii heterozygote deficiency was noted in every studied population at least within one locus thus indicating that the population is suffering from inbreeding depression (Baco and Shank, 2005).

Destructive fishing methods, such as dredges and trawls are still in use in Japan and Taiwan Province of China. Poor fishing practices, such as the scraping of basal plates, occur in the Mediterranean, and prevent the regeneration of colonies, thus contributing to the risk of population decline (FAO, 2007).

The high value of products from some Coralliidae species is also a factor increasing risk for the species. IUU harvesting seems to be an issue of concern in the Mediterranean (proposal). Other secondary risk factors include pollution, sedimentation, recreational diving and incidental takes associated with bottom fishing gear (longline and trawl).

Different management measures have been put in place in different parts of the species range. If effectively implemented, these measures can mitigate risks to localized populations. In the USA, a Precious Corals Fisheries Management Plan, in place since 1983, sets the norms for the exploitation of Coralliidae in Hawaii and other USA territories in the western Pacific. In the Philippines all coral harvesting is prohibited. In Japan and in Taiwan Province of China harvesting is regulated by licensing, harvest zones, maximum harvest days per year and maximum harvest. Fishing gear restrictions are in effect in the EU and in Japan. Marine protected areas and depth and other refugia exist in the Mediterranean, around the northwestern Hawaiian Islands, Japan and Taiwan Province of China. Other measures (e.g. minimum size limits, licenses and fishing seasons, rotational closed areas) are also adopted in some countries. However, in large parts of the range, particularly in international waters in the Pacific, this species group is essentially unmanaged.

Since 2008, China has listed four species of Coralliidae on Appendix III of CITES (*P. japonicum*, *C. elatius*, *C. konojoi*, and *C. secundum* [which does not occur in China]). Although the listing is too recent to evaluate its effectiveness, the main intention of an Appendix III listing is to curtail the illegal trade of specimens and products. This is achieved by means of export permits issued by the country of origin certifying that the species in trade were legally obtained.

The species of Coralliidae in international waters should be considered by the appropriate regional fishery management organizations in their response to UN General Assembly Resolution 95 by 2012. This non-binding resolution that prohibits destructive fishing practices that have adverse impacts on vulnerable marine ecosystems is expected to benefit the protection of Coralliidae species in international waters against, for instance, bottom trawling (proposal).

Trade considerations

The family Coralliidae includes species highly valued for jewelry and art objects. The most valuable species, making up the bulk of landings, are *C. rubrum*, *C. secundum*, *P. japonicum*, *C. elatius*, *C. konojoi* and *Corallium* sp. nov. (Cairns, 2007; FAO, 2007).

Products in trade include whole dried colonies, branches and fragments, beads and polished stones, manufactured jewelry, and powder (pills, granules, ointment and liquid) (proposal; FAO, 2007). There are no customs codes specific to Coralliidae species under the Harmonized System; a single code applies to all unworked coral and shell (Green and Shirley, 1999).

Although international trade is recognized as a significant factor in driving fisheries for precious corals (FAO, 2007), relatively little information is provided in the proposal. All quantitative information deals with imports to the United States of America.

According to the proposal the main centers for processing Coralliidae includes Italy, India, China, Japan, and the United States. The Italian industry imports around 70% of its raw Coralliidae material from Pacific sources, particularly Japan and Taiwan Province of China (FAO, 2007). Japan imports from Taiwan Province of China, France, Italy, Spain and Tunisia. The United States of America are the main consumer of all precious corals. According to the information presented in the proposal, between 2001 to 2008, the United States of America imported Coralliidae specimens and products from 55 countries, mostly from China, Taiwan Province of China and Italy. About 90% of all precious corals produced by Italy and China are exported to the United States of America (proposal). In 2008 the United States of America imported 22 tonnes of unprocessed *C. rubrum* (Figure 5). This represents more than half of the total reported catches of *C. rubrum* in the Mediterranean from 2004-07 (37 tonnes) (FAO data). In the last few years China has taken an increasing amount of Coralliidae production.

FAO (2007) noted that re-export may be a significant factor for this species given the widely dispersed nature of the trade. For instance it is mentioned that 70% of trade from Italy is re-exported. Considering that existing international trade figures do not account for re-export, there could potentially be some double counting in existing trade statistics (FAO, 2007).

Implementation issues

Introduction from the sea

Species in the family Coralliidae are harvested in waters both within State jurisdiction and outside the jurisdiction of any State. Harvest in the Mediterranean may be primarily within national jurisdiction, since continental shelves are narrow in this area. In the western Pacific, harvesting in areas between Japan and the Philippines and in waters under US jurisdiction from the Hawaiian Islands northwest along the Emperor Seamount chain would be within national jurisdiction. Harvesting in international waters has occurred around the Emperor Seamounts and near Midway Island, apparently primarily by Japan and Taiwan Province of China (proposal). According to the proposal, the two largest peaks in Coralliidae landings from the Pacific (1960s and 1980s) were from international waters.

Should the family Coralliidae be listed on CITES Appendix II, certificates for introduction from the sea (supported by non-detriment findings) would be necessary for specimens harvested in international waters.

Basis for findings: legally-obtained, not detrimental

Non-detriment findings

Non-detriment findings are the responsibility of the exporting state and must show that exports are not detrimental to survival of the species, that is, that they are consistent with sustainable harvesting. Development of an NDF requires appropriate scientific capacity, biological information on the species, and an approach to demonstrating that exports are based on sustainable harvest.

If the species of Coralliidae were listed on CITES Appendix II, a finding that export and introduction from the sea are not detrimental to species status would be required to support both export permits and certificates of introduction from the sea. The making of NDFs for exports of species harvested in international waters would require some form of international co-ordination, including mechanisms for assessment and management which currently do not exist.

Findings that specimens were legally obtained

In countries of the Mediterranean and in waters under national jurisdiction in the Pacific, specimens harvested consistent with management measures in place could be certified as legally obtained. In international waters and in national jurisdictions where no restrictions on harvesting are in place, there would also be a basis for certifying that specimens were legally obtained but this would be of little value in terms of ensuring sustainable use. In all cases some form of demonstration of the place of origin of the harvested coral would be necessary to support the finding.

However, as noted by FAO (2007) the high prices of Coralliidae products might encourage illegal harvest and trade. Illegal harvesting has been a problem in the past and continues in some areas (proposal). Certifying harvest as originating from international waters when it had been illegally harvested within a national jurisdiction would appear to be a potential problem, especially in the western Pacific (FAO, 2007). In addition, because some of the products in trade may be highly processed (for example, worked into beads or based on specimens ground into powder), it is possible that legally and illegally obtained specimens are included in the same product. Detecting illegally obtained specimens at the time of shipment of such products would be difficult (FAO, 2007).

Identification of products in trade and “look-alike” issues

The conclusions reached by FAO (2007) with respect to *Corallium* are also relevant for the current Coralliidae proposal. “Whole dried specimens of *Corallium* can be identified relatively easily to the genus level by specialists but taxonomic characteristics necessary for identification of *Corallium* are lost when the coral is processed into jewellery or when coral fragments are ground into powder for powder-based products. Moreover given the range in color of *Corallium* spp. and the appearance on the market of other species dyed to resemble *Corallium* … identification by nonspecialists at customs posts might be a problem”. “In addition, specimens in jewellery may include coral from more than one species and from various origins, as well as pre-convention corals. This would seriously complicate the issuance of CITES trade documents and trade recording”.

The Panel considered that identification to species level of raw coral by specialists is possible.

Recognizing such difficulties, it is mentioned in the proposal that proponents will submit a document to CoP 15 requesting Parties to amend Resolution Conf. 12.3 (Rev. CoP14) to allow worked specimens of Coralliidae to be identified on CITES permits and certificates at the genus or family level.

Likely effectiveness of a CITES Appendix II listing for species status

The panel reiterated the view of the FAO (2007) assessment. The Panel does not recommend a CITES Appendix II listing for Coralliidae species. Nevertheless, since international trade is a driver of their harvesting, if such a listing resulted in a tightening of their management, it could lead to an improvement in their status. However, this improved status would be bought at the cost of a considerable administrative overhead and Government efforts would be better employed in enacting and enforcing appropriate local management regimes.

The Panel cautions that if Coralliidae were included in Appendix II, aspects of the implementation would be problematic, particularly the identification at the species level of processed products and providing a suitable protocol for pre-convention specimens. The Panel noted that a very large number (many thousands) of small, individual specimens is in trade, meaning that a significant amount of paperwork would be required to track all items in trade.

The Panel is convinced that the Coralliidae do require to be managed within EEZs and in areas beyond national jurisdiction in a fashion which takes account of their long life and their ecological role. The Panel considered that these long-lived species require appropriate and effective local management such as harvest restrictions and rotational closures and protected areas to facilitate their sustainable harvest.

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TABLES AND FIGURES

Table 1. Information for assessing productivity of Coralliidae. Reference levels in "productivity" column are from FAO (2001). Note corrections from proposal.

Parameter	**Information**	**Productivity**	**Source**
Natural mortality	0.04-0.07 (4-7% per year) 0.027 - 0.048 (2.7 – 4.8% per year) 0.06 (*C. secundum*)	Low (<0.2)	FAO (2007), Grigg (1976, 1984, 1993) , Santangelo *et al*. (2009)
Age at maturity	7-13 years (*C. rubrum* 2-10 yr; *C. secundum* 12- 13 yr)	Low/medium (Low >8 yr) (Med 3.3-8 yr)	Grigg (1993) and Marschal *et al*. (2004), Santangelo *et al*. (2009)
Maximum age	75-100 years	Low (>25 yr)	Proposal

Table 2: Biology of precious coral species. Different values cited are from different published sources. Source: Table 1 in Tsounis *et al.* (in press).

Species	**Zoogeographic distribution**	**Max. height**	**Growth rate (height)**	**Growth rate (diam.) mm y^{-1}**	**Max. age**
Corallium rubrum	Mediterranean and neighbouring Atlantic shores	50 cm	1.78 + 0.7 mm year^{-1}	0.24 ± 0.05 0.34 ± 0.15 0.62 ± 0.15	ca. 100 yr
Corallium secundum	Hawaiian Archipelago	75 cm	0.9 cm yr-1	0.17	45 > 90
Corallium sp. nov.	Midway Island to Emperor Seamounts (W. Pacific)	-	-		
Corallium japonicum (Paracorallium japonicum)	Japan, Okinawa and Bonin Islands	30 cm		0.3 ± 0.14	
Corallium konojoi	Japan to northern Philipine Islands	30 cm	-	0.58	
Corallium elatius	Northern Phillipines to Japan	110 cm		0.19 ± 0.15 0.15	
Corallium lauuense (C. regale)	Hawaii	-	0.58		

Table 3. Decline indices for red/pink corals (Coralliidae).

Area	**Index**	**Trend**	**Basis**	**Coverage**	**Reliability**	**Source**
Pacific	Population density	Increase	1971, 1983/85, 2001,	Hawaii Makapu'u Bed, managed fishery	Fishery independent survey (5)	Grigg, 2002
Pacific	Catches	Decline to 15%	1979-1989, kg, 3 year average	Western Pacific, pooled species	Combines species and areas. Includes live and dead coral (2)	Grigg, 1993
Pacific	Catches	Decline to <2%	1979-1989, kg, 3 year average	Midway grounds, pooled species	Combines species and areas. Includes live and dead coral (2)	Grigg, 1993
Pacific	Catches	Increase	1979-1991, kg, 3 year average	Japan/ Hawaii Submersible	Combines species and areas. Includes live and dead coral (2)	Grigg, 1993
Pacific	Catches	Decline to 1%	Average 1979-81 to 1989-91	Taiwan Province of China fisheries, 1979-1991	Anecdotal information (1)	Grigg, 1993
Pacific	Proportion Live:Dead in Catch 1. *C. japonicum*; 2. *C. elatius*; 3. *C. konojoi*	1. no trend 10-16% live; 2. no trend 0-5% live; 3. Decline from 44 to 5% live	1989-2008	Japan Tosa Bay, Kochi Prefecture, (4 areas combined)	Commercial catches with observers (3)	Kosuge, Int. Forum Precious Coral, 2009, Comm.
Pacific	Catches	Increase	1989-2008, kg, pooled species	Japan, Tosa Bay, Kochi Prefecture (area A)	Observed catches, same small area fished over 20 years (3)	Kosuge Int. Forum Precious Coral, 2009, Comm.
Pacific	Catches	Increase	1989-2008, kg, pooled species	Japan, Tosa Bay, Kochi Prefecture, (area B)	Observed catches, same small area fished over 20 years (3)	Kosuge Int. Forum Precious Coral, 2009, Comm.

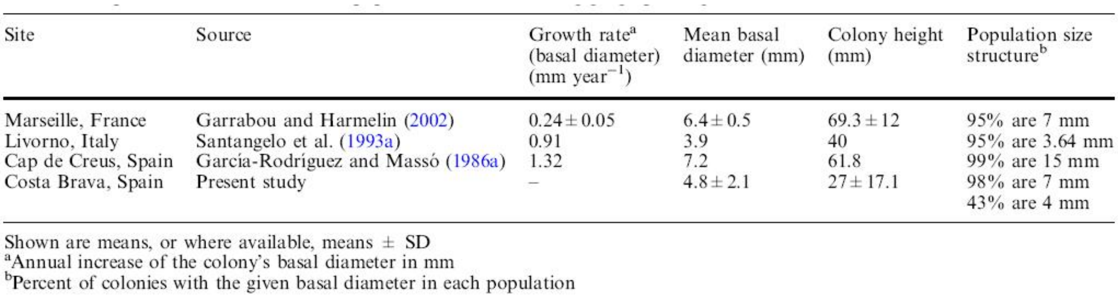
Table 3 (cont.)

Area	**Index**	**Trend**	**Basis**	**Coverage**	**Reliability**	**Source**
Pacific	Catches	Increase	1989-2008, kg, pooled species	Japan, Tosa Bay, Kochi Prefecture, (area C)	Observed catches, same small area fished over 20 years (3)	Kosuge Int. Forum Precious Coral 2009, Comm.
Pacific	Proportion of Areas Fished	Decline; 28 to 3 coral beds (all viable)	1989-2008	Japanese Waters	Reports from harvesters (3)	Sukumo Coral Assoc., Kochi Pref., Japan
Pacific	Catches	Decline to 3%	1984-6-2004-07 Pooled species t	Pacific fisheries	Catches (2)	FAO
Mediterranean	Catches *C. rubrum*	Declined to ca. 40% of 1978 level	Average 1978-80 88 t, 2004-07 34 t	Mediterranean Fisheries pooled areas	Catches (2)	FAO
Mediterranean	Frequency of large colonies in populations *C. rubrum*	Decline to 30-50%	1950s - 2004	Mediterranean Fisheries	Surveys and catch (2)	Tsounis *et al.*, in press
Mediterranean	Mean colony height *C. rubrum*	Decline to 35% (from 86.4 mm to 30 mm)	1986 – 2004	Spain	Surveys designed for the species (5)	Tsounis *et al.*, 2007; Garcia-Rodriguez and Masso, 1986
Mediterranean	Mean colony height *C. rubrum*	Decline to 30%	1980s–2006	Mediterranean Fisheries	Historical data and surveys (3)	Liverino, 1983; Garrabou and Harmelin, 2002
Mediterranean	Mean number of polyps per colony *C. rubrum*	Decline to 10%	Historical to 2004	Shallow water Mediterranean Fisheries	Surveys (4) and anecdotal information (2)	Bruckner, 2009

Table 3 (cont.

Area	**Index**	**Trend**	**Basis**	**Coverage**	**Reliability**	**Source**
Mediterranean	Proportion >7 mm diam in population *C. rubrum*	Decline to 31%	From 35% in 1986 to 11% in 2004	Spain	Catch with observers (3)	Tsounis *et al.*, 2006; Rodriguez and Masso, 1986
Mediterranean	Area available to SCUBA harvesting *C. rubrum*	Decline to 60%	Shift from 30-45 m in the 1950s to 90-130 m in the 1980s	Italy	Estimate from dive surveys (3)	Unpublished data Liverino, 1983

Table 4. Comparison of *Corallium rubrum* population structure among geographic regions (source Tsounis *et al.*, 2006, Table 6).



Site	Source	Growth rate[a] (basal diameter) (mm year^{-1})	Mean basal diameter (mm)	Colony height (mm)	Population size structure[b]
Marseille, France	Garrabou and Harmelin (2002)	0.24 ± 0.05	6.4 ± 0.5	69.3 ± 12	95% are 7 mm
Livorno, Italy	Santangelo et al. (1993a)	0.91	3.9	40	95% are 3.64 mm
Cap de Creus, Spain	García-Rodríguez and Massó (1986a)	1.32	7.2	61.8	99% are 15 mm
Costa Brava, Spain	Present study	–	4.8 ± 2.1	27 ± 17.1	98% are 7 mm 43% are 4 mm

Shown are means, or where available, means ± SD

[a] Annual increase of the colony's basal diameter in mm

[b] Percent of colonies with the given basal diameter in each population

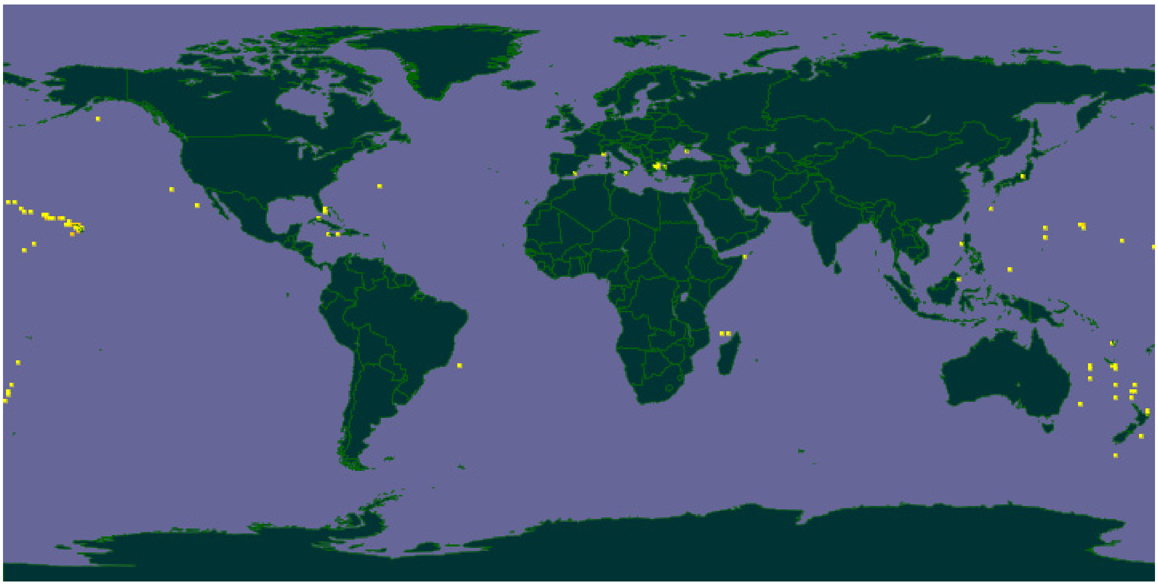


Figure 1. Distribution of Coralliidae species as extracted from the Global Biodiversity Information Facility (GBIF) data portal (http://data.gbif.org) accessed on December 11, 2009.

Figure 2. Drawing of Coralliidae to show three-dimensional structure. Source: FAO.

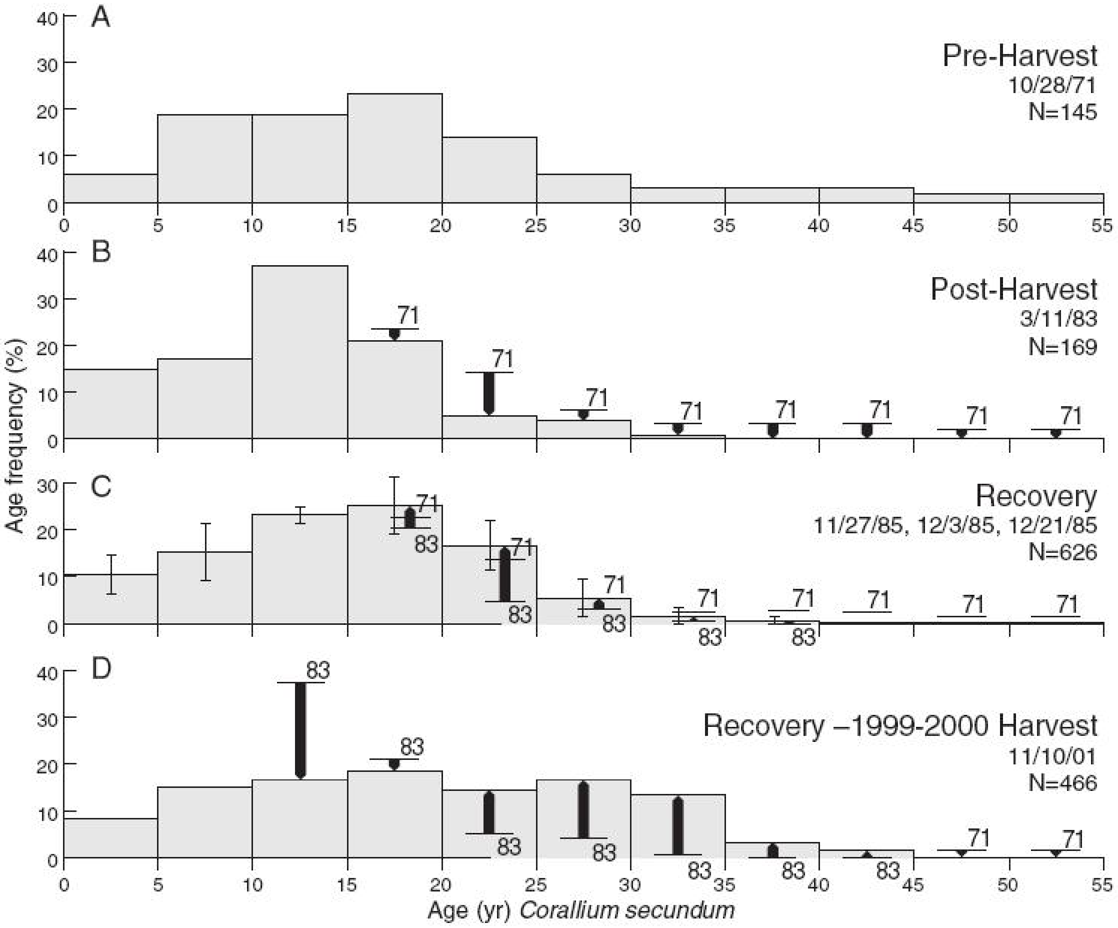


Figure 3. Age structure (frequency distribution) of pink coral in the Makapu'u Bed, Oahu, in 1971, 1983, 1985 and 2001. (Source Grigg 2002).

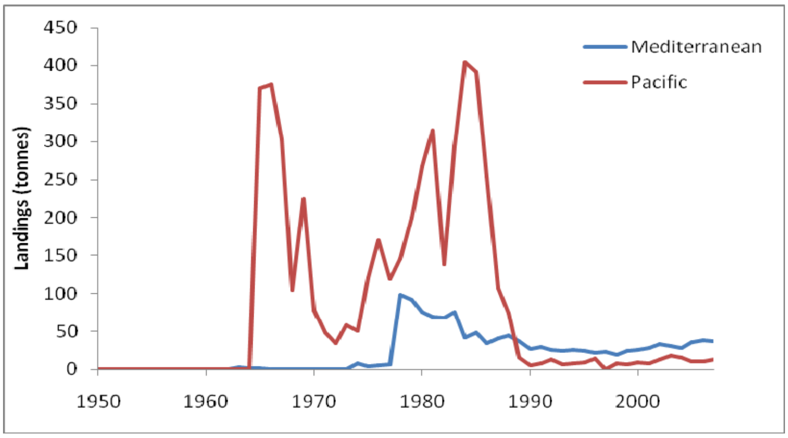


Figure 4. Reported landings of all species of Corallidade from the Pacific Ocean and Mediterranean Sea. (Source FAO).

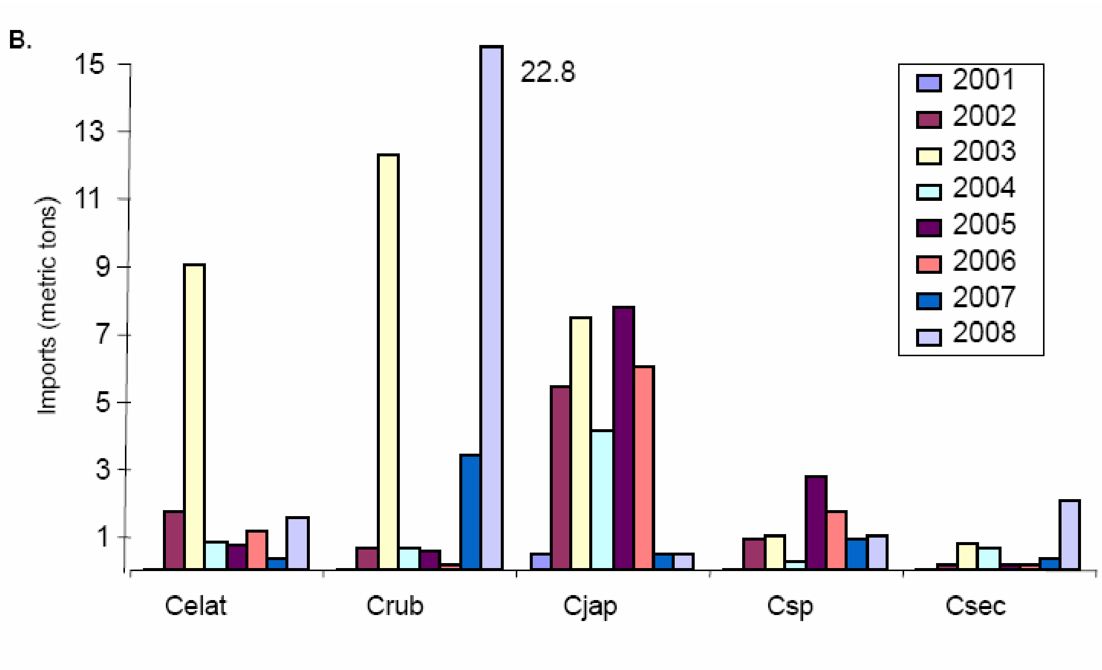


Figure 5. Total imports of unprocessed skeletons of five species of *Corallium* into the United States of America from 2001 to 2008. *C. elatius* = Celat, *C. rubrum* = Crub, *C. japonicum* = Cjap, *Corallium* sp. nov. = Csp, *C. secundum* = Csec. Source: US Fish and Wildlife Service import data (proposal).

The third FAO Expert Advisory Panel for the Assessment of Proposals to Amend Appendices I and II of CITES Concerning Commercially-exploited Aquatic Species was held at FAO headquarters from 7 to 12 December 2009. The Panel was convened in response to the agreement by the twenty-fifth session of the FAO Committee on Fisheries (COFI) on the terms of reference for an expert advisory panel for assessment of proposals to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and to the endorsement of the twenty-sixth session of COFI to convene the Panel for relevant proposals to future CITES Conference of the Parties. The objectives of the Panel were to: i) assess each proposal from a scientific perspective in accordance with the CITES biological listing criteria (Resolution Conf. 9.24 [Rev. CoP13]); ii) comment, as appropriate, on technical aspects of the proposal in relation to biology, ecology, trade and management issues, as well as, to the extent possible, the likely effectiveness for conservation. Six proposals were evaluated by the Panel: (i) CoP15 Proposal 15. Proposal to include *Sphyrna lewini* (scalloped hammerhead) on CITES Appendix II; (2) CoP15 Proposal 16. Proposal to include *Carcharhinus longimanus* (Oceanic whitetip shark) on CITES Appendix II; (3) CoP15 Proposal 17. Proposal to include *Lamna nasus* (porbeagle) on CITES Appendix II; (4) CoP15 Proposal 18. Proposal to include *Squalus acanthias* (spiny dogfish) on CITES Appendix II; (5) CoP15 Proposal 19. Proposal to include *Thunnus thynnus* (Atlantic bluefin tuna) on CITES Appendix I; CoP15 Proposal 21. Proposal to include all species in the family Coralliidae (red and pink corals) on CITES Appendix II. This report includes the assessment of each of the six proposals by the Panel.

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