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SECOND TECHNICAL CONSULTATION ON THE SUITABILITY OF THE CITES CRITERIA FOR LISTING COMMERCIALLY-EXPLOITED AQUATIC SPECIES

Windhoek, Namibia, 22-25 October 2001

A BACKGROUND ANALYSIS AND FRAMEWORK FOR EVALUATING THE STATUS OF COMMERCIALLY-EXPLOITED AQUATIC SPECIES IN A CITES CONTEXT

Executive Summary

1. The FAO Secretariat analysed the appropriateness of the existing CITES listing criteria and guidelines for resources exploited by fisheries in marine and large freshwater bodies with particular emphasis on Appendix II. It concluded that several important improvements could be made and that, in particular, quantitative guidelines could and should be developed.

2. The Secretariat considers that the most important property of species and populations in relation to risk of extinction is their resilience and, based on current knowledge, this is best reflected by the productivity of the species, with more productive species generally being more resilient than less productive species. With reference to the existing Appendix I (Annex 1) criterion A, small population size, it **is recommended** that because there is no single absolute number that provides a good measure of risk of extinction for all exploited fish species, it is generally preferable to consider the size of a population in relation to a previous reference baseline; i.e. the historical-extent-of-decline. The existing Annex 5 guidelines for criterion B, area of distribution, are considered unlikely to be useful to protect species harvested for large scale fisheries, but may be applicable for certain reef fish and other completely or largely sessile species. Historical-extent-of-decline of the area of distribution should normally be used in preference to absolute measures for this criterion.

3. Criterion C, the decline criterion, was considered to be the one likely to be employed most frequently for exploited fish species. Decline can be expressed in two fundamentally different ways: (i) the overall long-term extent-of-decline and (ii) the recent-rate-of-decline. It is recommended that these two should be considered together. The greater the historical-extent-of-decline, the greater the concern associated with a given recent-rate-of-decline.

4. An historical-extent-of-decline to 5%-20% of the reference baseline, depending on the productivity of the species, **is recommended** as a general guideline for consideration for listing on Appendix I. Ranges of 5-10% should be used for species with high productivity, 10-15% for species with medium productivity, and 15-20% for species with low productivity.

Consideration could also be given to adding 5% to the Appendix I guideline to trigger consideration for Appendix II. In both cases the guidelines should be used in close conjunction with consideration of the relevant modifying factors and a rigorous and, whenever possible, quantitative scientific evaluation to refine the estimate of threat of extinction on a case-by-case basis.

5. A recent-rate-of-decline is important only if it is still occurring or may resume, otherwise the overall extent-of-decline is what is important. Given the more precautionary approach to Appendix I listing of the proposed 5% - 20% historical-extent-of-decline, compared to the existing guideline of 5 000 individuals, a separate Appendix I criterion for rate-of-decline is suggested to be unnecessary. However, rate-of-decline could be considered as a surrogate for historical-extent-of-decline when a baseline population size cannot be estimated. It may also be useful as an indicator of the urgency of the need for remedial action.

6. The rate-of-decline that would bring population size down from its current extent-of-decline to the Appendix I extent-of-decline guideline within 10 years **is recommended** as a guideline for consideration of listing on Appendix II.

7. The Secretariat emphasises that each proposal for a change to the Appendices needs to be evaluated on a case-by-case basis and that a balanced and objective scientific review process is an essential part of any evaluation.

1. Introduction

8. The 24th Session of COFI, 2001 requested that "The FAO Secretariat would prepare a background paper detailing as required the analysis of the CITES (Convention on the International Trade of Endangered Species of Wild Fauna and Flora) listing criteria, focusing on Appendix II, and proposing a scientific framework for evaluating the status of species for such listing." This document is the background paper requested.

9. This paper addresses all current and proposed criteria for listing on Appendix I, but only criteria in accordance with Article II paragraph 2(a) for listing on Appendix II. It does not address listing under Article II paragraph 2(b), including the `look-alike' clause, which will be dealt with in a separate process, referred to as "Developing a workplan for exploring CITES issues with respect to international fish trade", to be discussed at the next session of the Sub-Committee on Fish Trade, as instructed by COFI.

10. In preparation of this background paper, the Secretariat took note of the following conclusions and recommendations of the FAO Technical Consultation held in June 2000 (FAO 2000a [1]):

· "Refine the criteria and guidelines, as appropriate, considering the specific characteristics of commercially-exploited aquatic resources, and remove any possible ambiguities in the application of such criteria and guidelines which might lead to false alarms and misses. Once we have these criteria and guidelines, case studies should be conducted to ascertain their reliability. Among other things, attention should be given to life histories and taxonomic groups, and address the issue of using relative values and ratios instead of absolute figures when dealing with abundance (in criteria A and C) and area of distribution (in criterion B)."
· "Improve understanding of the listing of species in Appendix II; there were differences of opinion as to whether it relates to reducing the risk of extinction and/or promoting sustainable use."
· "Review the criteria for listing in Appendix II, particularly under Article II Paragraph 2a to ensure consistency, clarity and practicality."

11. The Secretariat took cognisance of the need for criteria and guidelines which minimise the probability of not identifying populations that are threatened with extinction (misses) or of incorrectly classifying species that are not threatened (false alarms). It recognised, however, that it is not possible to identify biological guidelines which will invariably be correct across all taxonomic groups and life history strategies. While it is desirable to establish criteria and guidelines that consistently indicate when populations are threatened, the Secretariat emphasises that each proposal for a change to the Appendices needs to be evaluated in terms of the criteria and guidelines on a case-by-case basis and that a balanced scientific review process is an essential part of any evaluation.

12. In accordance with the decisions of the Technical Consultation, this review deals with resources exploited by fisheries in marine and large freshwater bodies, with particular emphasis on fish and invertebrate species. These are referred to in this paper as "exploited fish species". The review focussed on species harvested in large scale commercial fisheries for which there is often considerable information, but the results are believed to be applicable to most cases where fewer data are available. Although in some cases there may not be sufficient data to quantitatively evaluate a population against the criteria and guidelines recommended here, it will almost always be possible to use at least qualitative information and analogies with other species.

2. The CITES Appendices, Criteria and Guidelines

2.1 Existing criteria

13. CITES makes allowance for listing plants and animals on three different Appendices, of which Appendix I and Appendix II are relevant to this review. The rationale for listing on these Appendices is given in Article II of the Convention text.

"1. Appendix I shall include all species threatened with extinction which are or may be affected by trade. Trade in specimens of these species must be subject to particularly strict regulation in order not to endanger further their survival and must only be authorised in exceptional circumstances."

CITES Appendix I currently lists 821 species (primarily plants, mammals and birds).

14. Paragraph 2(a) states:

"2. Appendix II shall include:
(a) all species which although not necessarily now threatened with extinction may become so unless trade in specimens of such species is subject to strict regulation in order to avoid utilization incompatible with their survival;"

Paragraph 2(b) of Article II deals with the so-called `look-alike clause' which is not considered in this review.

15. About 29,000 species are listed on Appendix II. Regulation of their trade is the responsibility of exporting countries (which may set quotas for export of listed species and must issue 'non-detriment' findings for such exports) and importing countries (which are required to ensure that imports are accompanied by the appropriate documentation). In exceptional cases, quotas can be established by a meeting of the Conference of the Parties (mainly for species transferred from Appendix I to Appendix II) or the Standing Committee [species reviewed under the provisions of Resolution Conf. 8.9 (rev.)] Trade records are submitted to CITES, thus ensuring that all international trade in listed species is monitored.

16. An issue of concern to some FAO members is the implication of the phrase "introduction from the sea" in the definition of "Trade" (Article I). This is not considered in this report and will be discussed by FAO at the next session of the Sub-Committee on Fish Trade.

17. The criteria for assessing the status of species or populations are provided in CITES Resolution 9.24 and its Annexes. Criteria for listing on Appendix I (Annex 1) can be summarised as:
1. small population size;
2. restricted area of distribution;
3. decline in numbers;
4. likely to satisfy one of 1-3 within the next 5 years.

Annex 5 provides guidelines for the first three of these criteria.

18. The criteria for listing on Appendix II (Annex 2a) are:.

"A. It is known, inferred or projected that unless trade in the species is subject to strict regulation, it will meet at least one of the criteria listed in CITES Annex 1 in the near future.
B. It is known, inferred or projected that the harvesting of specimens from the wild for international trade has, or may have, a detrimental impact on the species by either:
i) exceeding, over an extended period, the level that can be continued in perpetuity; or
ii) reducing it to a population level at which its survival would be threatened by other influences."

2.2 The intention of Appendix II listings

19. The member States at the Technical Consultation were uncertain as to whether listing on Appendix II under Article II Paragraph 2(a) is intended to address reducing the risk of extinction and/or promoting sustainable use. CITES is also currently reviewing the listing criteria and guidelines including those for listing on Appendix II under Paragraph 2(a). CITES Notification to the Parties No 2001/037 of 31 May 2001 (hereafter referred to as the CITES Notification), proposes to change the criteria for listing of species in Appendix II in accordance with Article II, paragraph 2(a) to the following:

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

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 detrimental to the species concerned.

20. The FAO Secretariat did not find this suggested change resolved the uncertainty identified by FAO members. In particular, potential differences of opinion on the intended meaning of the word `detrimental' in the proposed new criterion B still give rise to considerable ambiguity regarding the intention of listing under Appendix II. Faced with this uncertainty, the FAO Secretariat considered first Article II, Paragraph 2(a) and concluded that the primary intention of Appendix II was to prevent a deterioration in population status that would lead to a listing, in due course, on Appendix I.

21. This interpretation is supported by the existing criteria Annex 2 (a) A and Annex 2 (a) B(i), both of which imply a decline in the population with time. Therefore, it was agreed that a primary consideration for listing on Appendix II under Article II 2(a) should be a declining trend (with trade contributing appreciably to the trend) which, if continued, would lead to a listing on Appendix I within a given time frame.

22. In addition, the existing criterion Annex 2 (a) B (ii) implies that listing should be considered if a population, while perhaps not still declining, is at a sufficiently low abundance that there is an unacceptably high risk of it being driven to extinction through influences other than exploitation. Such influences could include, for example, environmental or demographic variability, disease, habitat perturbation and other such factors.

23. Alternative criteria corresponding to these interpretations of the intention for listing on Appendix II are put forward below. Annex 2 (a) could be argued to imply that any species for which the exploitation rate is unsustainable should be listed on Appendix II, because such species must eventually become threatened with extinction. Such an interpretation is not considered practical, however, as it would result in an enormous number of false alarms (listings of species for which there is no short nor medium-term threat of extinction).

3. Analysis of the Existing Criteria and Guidelines

24. FAO (2000a and 2000b [2]) provide detailed information on the strengths and weaknesses of the existing CITES listing criteria and guidelines as they apply to exploited fish species and the concerns of FAO members, and these are not repeated here.

25. The existing criteria for Appendix II Article II 2(a) listings are very broad and represent principles more than biological criteria, in contrast to the criteria given for Appendix I, which are more specific. This review aims to provide a more biologically-based framework which includes, where feasible and practical, consideration of life histories and taxonomic groups. In doing so, use was made of the same basic categories currently used in the Appendix I criteria, i.e.:

· size of population;
· area of distribution;
· decline;
· projected future state.

26. This section draws on concepts suggested by the National Marine Fisheries Service of the United States of America (NMFS 2001)[3] and CITES (the CITES Notification). The approach proposed also explicitly includes consideration of a "quantitative analysis" criterion.

3.1 Relationship between resilience, productivity, and life history characteristics

27. In general, it is considered that taxonomic characteristics are less important to risk of extinction than life history characteristics (FAO 2000a). There is a widely supported view that the demographic variable of greatest relevance to the risk of extinction is probably population resilience (Musick 1999 [4], NMFS 2001), which can be defined as the `ability to rebound after perturbation' (Holling 1973[5]), and which is closely related to the allied concept of the `ability to sustain exploitation'. However, there is no reliable way of measuring the ability to rebound, except empirically, and there are insufficient case studies from which to develop robust, quantitative analyses.

28. Productivity is a complex function of fecundity, growth rates, natural mortality[6], age of maturity, and longevity. More productive species tend to have high fecundity, rapid individual growth rates, and high turnover of generations. They are likely to have greater ability to rebound from low numbers because they can quickly take advantage of conditions suitable for re-establishment or re-colonisation. But they will also have higher recruitment variability and fewer mature year classes in the spawning stock, therefore increasing the risk of fluctuating to low population sizes even in the absence of exploitation. In contrast, species with low productivity will tend to spend longer periods at low population sizes once they have been

depleted, and hence they will be exposed to greater risk of extinction arising from depensatory [7] factors. Further, there are several examples of long-lived marine species with high recruitment variability (e.g. sporadic exceptionally large year classes with most other year classes being insufficient for population replacement in some *Sebastes* species and northwest Atlantic ocean quahog).

29. Notwithstanding these opposing effects, and in the absence of an operational measure of resilience, this review assumes as a working hypothesis (pending further research on the relationship between productivity and extinction risk) that population productivity is a measurable surrogate for resilience.

30. The fishing mortality corresponding to the slope at the origin of a stock recruitment relationship (the extinction threshold, commonly called $F_{\_}$ or F_{crash}) is a widely-used indicator of the risk of extinction in fisheries. Based on a theoretical analysis, Mace (1994) [8] showed that F increases with increasing natural mortality and with individual growth rates. The analysis also showed it to increase substantially with increasing slope at the origin of the stock recruit relationship. These results imply that populations with higher productivity, as indexed by either high natural mortality, high growth rates, or high slope at the origin of a stock-recruitment relationship, can sustain higher harvest rates at relatively lower biomass[9], reinforcing the hypothesis that productivity is positively correlated to resilience.

31. Assuming that productivity can be considered a reasonable surrogate for resilience, it must be taken into account when attempting to define a `small' population or a `marked' decline. Musick (1999) proposed several indices of productivity and guideline ranges of values for these indices as a means of classifying species as having very low, low, medium or high productivity. The Secretariat supports the general concept of this classification scheme and agreed that "r", the intrinsic rate of increase of a species, is the best indicator of productivity amongst these and should be used as such whenever available. The Secretariat chose to use three categories, low, medium and high productivity rather than the four categories proposed by Musick (1999). The von Bertalanffy growth rate (K), age at maturity (t_{mat}) and maximum age (t_{max}) were also considered appropriate indices, but fecundity by itself was not. Natural mortality rate (M) and mean generation time (G) are additional parameters proposed by the Secretariat as potential indicators of productivity. The Secretariat **recommends** the productivity guidelines shown in Table 1. To ensure consistency across indices, the proposed guidelines were derived by first setting the productivity category for different values of M, and then extending this to the other indices using the theoretical relationships between parameters proposed by Jensen (1996)[10] and an r vs M relationship approximated from results in Beddington and Cooke (1983) [11]. With the exception of r, none of these parameters are satisfactory indicators of productivity by themselves. However, in data-poor situations, they may have to suffice. In general, the guidelines in Table 1 will result in species of fisheries interest being allocated to the same class or one more productive than would result from Musick's guidelines.

Table 1. Proposed guideline indices of productivity for exploited fish species (numbers in brackets are from Musick 1999).

Parameter	**Productivity**		
	Low	**Medium**	**High**
M	<0.2	0.2 - 0.5	>0.5
r	<0.14 (< 0.16)	0.14 - 0.35 (0.16 - 0.5)	>0.35 (> 0.5)

K	<0.15 (< 0.16)	0.15 - 0.33 (0.16 - 0.3)	> 0.33 (> 0.3)
t_{mat} (years)	> 8 (> 4)	3.3 - 8 ((2 - 4)	< 3.3 (< 1)
t_{max} (years) **(t_{max}=4.6/M)**[12]	>25 (> 10)	14 - 25 (4 - 10)	<14 (1 - 3)
G (years) **(G_t_{mat}+1/M)**	>10	5 - 10	< 5
Examples	orange roughy, many sharks	cod, hake	sardine, anchovy

3.2 Small population size

32. The existing Criterion A under Annex 1 states that a species should be considered as being threatened with extinction if the wild population is small and characterised by one of the following: a decline in the number of individuals, each sub-population being small, a majority of individuals being concentrated in one sub-population or large short-term fluctuations in the number of individuals. Further, under Annex 5, the guideline for what constitutes a small population is given as "a figure of less than 5 000 individuals", and "less than 500 individuals" for a very small sub-population.

33. The Secretariat considered that these guidelines were not applicable for most exploited fish populations where the number of individuals associated with the risk of extinction could range from less than 1 000 (e.g. some low productivity species of reef fish) to at least 1 000 000 (e.g. some high productivity species of small pelagics), depending on the productivity and life history strategy of the species. The Secretariat agrees with the conclusions of FAO (2000b) that the existing guideline of 5 000 individuals "in some cases ... may allow dangerous misses. If the guidelines are applied so rigidly that it sets too high a minimum number of individuals for species which have highly vulnerable life-histories, it may prevent the listing of species which are at risk of extinction". The Secretariat considers that the extent-of-decline of the population from its estimated historical or potential carrying capacity is a more useful measure of what constitutes a small population, because populations that are low relative to the environmental carrying capacity may be susceptible to `depensation'. Depensation is defined as a negative effect on population growth that becomes proportionately greater as population size declines. Populations experiencing depensation are prone to further reductions in size, even in the absence of exploitation, and therefore have a greater risk of extinction. The CITES criteria and guidelines should be such that they identify species as being eligible for listing before they decline to an abundance at which there is a risk that depensatory effects would dominate. Guidelines to identify appropriate reference baselines are discussed in more detail under Section 3.4 Population Decline.

34. In populations for which there is no information from which to determine historical-extent-of-decline, the Secretariat supports the conclusions of FAO (2000b) that analyses should be undertaken through `a reasoned approach to individual listings ... conducted in a scientifically sound and transparent way..' as no guideline is universally applicable.

35. Recommendation

The current CITES guidelines for small absolute population size are appropriate for only a few exploited marine species, such as some sessile or semi-sessile species, some species with extremely low productivity, and some small endemics. Therefore in Annex 5 as applied to criterion A of Annex 1, the definition of small population size should be changed, at least where applied to exploited fish species, to place greatest emphasis on

historical-extent-of-decline. Guidelines for the historical-extent-of-decline which would trigger consideration for listing are discussed in Section 3.4.

3.3 Restricted area of distribution

36. The Annex 5 guideline of 10 000 km^2 for restricted area of distribution is unlikely to be useful to protect species harvested in large scale fisheries where much greater ranges of distribution will often apply. It may be applicable for certain reef fish, endemics, and other completely or largely sessile species, but it is too large to protect several small scale pelagic and invertebrate populations including corals. The Secretariat agrees with the conclusions of FAO (2000b) that with the existing criterion and related guidelines "there are concerns about the potential for misses" and "this criterion is not likely to lead to numerous false alarms".

37. Recommendation
The existing restricted area of distribution guideline of 10 000 km^2 is inappropriate (either too large or too small) for most exploited fish species. The historical-extent-of-decline in area of distribution should be used in preference (see Section 3.4). 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.

3.4 Population decline

38. This criterion is considered to be the most widely applicable for exploited fish given the nature of commonly available fisheries data (e.g. time series of research survey indices, or commercial catch and effort) and the potential for depensation. It has also generated the most concern amongst FAO member countries.

39. The recommendations under Annex 5 of the CITES Notification state that decline can be expressed in two fundamentally different ways: (i) the overall long-term extent-of-decline and (ii) the recent-rate-of-decline. The Secretariat considers that the historical-extent-of-decline and the recent-rate-of-decline should be considered in conjunction with one another. The greater the historical-extent-of-decline, the greater the concern associated with a given recent-rate-of-decline.

40. For listing purposes, the recent-rate-of-decline is important if a decline is still occurring or may resume; otherwise the overall extent-of-decline is what is important. However, the recent-rate-of-decline may also be important in several other respects: for example, it can be used as a surrogate for extent-of-decline when a baseline population size cannot be estimated or inferred; it may be indicative of a rapid change in environment, or a disease attack, or competition with an invasive species; and it may be a general indicator of the urgency of the need for remedial action.

41. Contrary to the current version of Annex 5, generation time is not suggested as a timeframe over which to assess decline. The Secretariat concluded that the timeframe for estimating or inferring the historical-extent-of-decline should be as long as possible: all relevant historical data and inferences should be considered, regardless of whether a species has low or high productivity, or long or short generation time [13], and the time frame for assessing recent-rate-of-decline should generally be shorter than 2-3 generations.

Historical-extent-of-decline

42. In the absence of adequate quantitative analyses to estimate extinction risk directly, the historical-extent-of-decline should be the primary criterion for considering species for listing on CITES Appendices. However, different reference baselines may be appropriate in different

situations. Depending on the species under consideration, the baseline may relate to the carrying capacity at some point in history, or to a reasonable or potential baseline given alterations to the environment that have affected current carrying capacity. Use of reasonable or potential baselines can reflect the reality that habitat changes have occurred in the past and the possibility that such changes may be reversible. However, if the potential baseline is very small due to substantial reductions in the carrying capacity of the habitat over time, it then becomes necessary to ask whether the current carrying capacity is adequate to ensure survival of the species and, if not, to consider appropriate remedial action.

43. The threshold historical-extent-of-decline should be a function of the productivity of the species. For a high productivity species, consideration for listing in CITES Appendices might not be triggered until the species has declined to a relatively low percentage of the baseline, while for a low productivity species, consideration for listing in CITES Appendices might be triggered at higher percentages of the baseline.

44. The recommendation under Annex 5 of the CITES Notification that `a general guideline for a marked historical-extent-of-decline is a decline to 5%-30% of the reference baseline, depending on the biology of the species', was considered at length. NMFS (2001) provided an extensive review of the fisheries literature supporting the 5-30% range as an indicator of population vulnerability. However, the present review concluded that, for the majority of exploited marine fish and invertebrates, a range of 5-20% would be more appropriate as a guideline for consideration for listing on Appendix I. Although some species may fall outside this range (e.g. a percentage of baseline less than 5% may be appropriate for some clupeoids, characterised by exceptionally high numbers and biomass; while a percentage of baseline greater than 20% may be appropriate for some exploited fish species characterised by extremely low productivity, for example certain sharks and deepwater species), these were considered to be the exception rather than the rule. In particular, the range of 20-30% was considered to be overly conservative for all but a few exploited fish species. For example, orange roughy are probably one of the least productive of marine teleosts, yet B_{MSY}[14] for one of the main stocks in New Zealand is estimated to be about 30% B_0[15], implying that extents-of-decline of the order of 30% of B_0 are unlikely to be associated with a high risk of extinction. There are estimates of B_{MSY} as a proportion of B_0 of similar magnitude for other marine fish populations.

45. Further support for the 5-20% guideline is provided by a preliminary analysis of 111 spawning stock-recruitment series of bony fish species extending over at least 16 years in the worldwide database developed by Dr R. Myers and colleagues. The averages of the four largest spawning biomass values in each series, together with their corresponding recruitments, were taken to define baselines. Nearly 70% of these series include spawning biomasses which drop below 30% of their baselines. These series indicate that generally spawning biomass must fall below a threshold no higher than about 15% of baseline before recruitment drops noticeably and consistently to very low values (four-year averages below some 20% of baseline). There was only one stock in the data set examined for which this rule definitely did not hold, and two further cases which might be so argued (all were gadoids).

46. Recommendation
The Secretariat recommends as an historical-extent-of-decline guideline the range of 5-20% of the reference baseline, depending on species productivity, be used for exploited fish species for consideration for listing on CITES Appendix I, noting that some species may fall outside this range. The range 5-10% should be used for species with high productivity, 10-15% for species with medium productivity and 15-20% for species with low productivity.

47. The following are considered to be relevant metrics or surrogates for the extent-of-decline:
· Number[16] of individual organisms in a population;
· Biomass;
· Area inhabited (area of distribution);
· Range (for migratory species);
· Percentage coverage (for sessile species);
· Current SPR[17], relative to unexploited SPR; and
· Numbers or biomass of new recruits (recruitment).

In general, only one or two of these metrics would be considered for any given species. The life history stage that is most relevant to measure will in most cases be the mature component.

Recent-rate-of-decline

48. The cumulative annual rate-of-decline that would drive a population down to the recommended Appendix I guideline for historical-extent-of-decline in the near future is suggested as a criterion for Appendix II listing. The period used to represent `near future' needs to be sufficiently long that a decline can be detected. The CITES Notification suggests defining near future as 5-10 years. For the purposes of this review, 10 years was used to represent the near future.

49. Calculations for the rate-of-decline necessary to reduce a population to the Appendix I "extent" guideline over a ten-year time horizon are summarised in Table 2. In general, the historical-extent-of-decline should be at less than 50% of baseline before considering a species for listing, because there would rarely be need for concern about exploited fish species at or above 50% of the baseline. Values of % baseline greater than 50% are included in the table because exploited fish species have been known to decline at rates sufficiently large to drive them from well above 50% to well below 50% over periods as short as 10 years. Values of average annual rates of decline are set to zero in the table once the population is at or below the extent-of-decline threshold because once a population has fallen to the suggested Appendix I guideline, a decline need not necessarily still be occurring for listing to be considered. In the table, low productivity is equated with an extent-of-decline guideline of 20% of the baseline, medium productivity with a guideline of 15% of the baseline, and high productivity with a guideline of 10% of the baseline; i.e. the upper bounds of the suggested ranges are used. Other percentages within the suggested ranges may be more appropriate for some species.

Table 2. Cumulative 10-year rate-of-decline (and corresponding average annual rate-of-decline) that would drive a population down from the current population level to the extent-of-decline threshold (as a percentage of the specified baseline) within 10 years. There should rarely be need for concern about exploited fish species at or above 50% of the baseline.

		Productivity	
Current population as % of baseline	**Low**	**Medium**	**High**
100%	80% (15%)	85% (17%)	90% (21%)
90%	78% (14%)	83% (16%)	89% (20%)
80%	75% (13%)	81% (15%)	88% (19%)
70%	71% (12%)	79% (14%)	86% (18%)
60%	67% (10%)	75% (13%)	83% (16%)
50%	60% (9%)	70% (11%)	80% (15%)
40%	50% (7%)	63% (9%)	75% (13%)

30%	33% (4%)	50% (7%)	67% (10%)
20%	0%	25% (3%)	50% (7%)
15%	0%	0%	33% (4%)
10%	0%	0%	0%
5%	0%	0%	0%

50. Recommendation
The Secretariat recommends that Table 2 be used to provide guidelines on recent-rates-of-decline which, if met or exceeded, would lead to consideration for an Appendix II listing. However, listing should not normally be considered if the present estimated historical-extent-of-decline is above 50% of baseline, since exploited fish species at such extent-of-decline would not usually constitute any cause for immediate concern. Table 2 is based on a 10-year time frame. If fewer than ten years of data are available, annual rates over a shorter period could be used to extrapolate beyond existing data where there is evidence that the decline is continuing and is not simply part of a short-term fluctuation. If there is evidence of a change in the direction in the trend, greater weight should be given to the more recent consistent trend.

51. The current CITES decline criterion for Appendix I (Annex 1) with its associated Annex 5 guidelines could lead to a listing on the basis of a decline of 50% or more over the longer of the last 5 years or two generations, or of 20% or more over the longer of 10 years or 3 generations if the population is small. The CITES Notification suggests changing this period to the last 10 years. The Secretariat considers that this guideline is generally not useful unless it is linked to extent-of-decline. Listing on the basis of rate-of-decline alone is seen as problematic because the seriousness of a given rate-of-decline in the context of threat of extinction depends on the overall extent-of-decline. However, in circumstances where other information to estimate extent-of-decline is limited, rate-of-decline over a recent period could itself still provide some information on extent-of-decline.

52. The Secretariat suggests that the combination of the extent-of-decline guidelines for consideration for Appendix I, together with the suggested linked extent/rate-of-decline guidelines for consideration for Appendix II described below will normally be sufficient to eliminate the need to include rate-of-decline considerations under Appendix I. However, a similar, linked extent/rate-of-decline guideline as has been recommended for Appendix II, but with a shorter time frame (e.g. the rate-of-decline that would drive a population down to the extent-of-decline threshold in 5 years instead of the 10 years used in Table 2), could be used for consideration for Appendix I, if considered necessary.

53. Using extent-of-decline for consideration for listing on Appendix I, and using a combination of extent-of-decline and rate-of-decline for consideration for listing on Appendix II as recommended above does not make explicit allowance for uncertainty in either the estimated rate or extent-of-decline, and it fails to specify criteria or guidelines under which a species transferred from Appendix I to Appendix II is later potentially removed from Appendix II listing. Two approaches are suggested which could alleviate these concerns. It **is recommended** that one of the two approaches be adopted.

54. The first approach would consider Appendix II listing when a population enters a buffer zone of 5% above the extent-of-decline guideline recommended above for consideration for Appendix I listing, independently of the recent-rate-of-decline (or increase). The suggested 5% range as a buffer is a trade-off between a buffer that is too small to provide a basis for discrimination and a buffer which is so large that it could result in many false alarms.

55. The second approach is intended for species that appear stable at an abundance slightly above the suggested Appendix I guidelines for extent-of-decline. In such cases, an Appendix II listing could be considered if associated uncertainties (for example, those arising from

typical recruitment fluctuations for that species) resulted in an unacceptably high risk of abundance dropping below the suggested Appendix I guidelines for extent-of-decline. De-listing from Appendix II would then require demonstrating, through quantitative analysis, that such a risk had become negligible. Application of such a prescription would make collection of appropriate data for the required quantitative analysis a prerequisite for de-listing from Appendix II.

56. The precautionary approach implies that transfer from Appendix I to Appendix II should occur only once the population has recovered to a higher extent-of-decline than that which initially led to the listing on Appendix I. Future adjustment of the CITES criteria to incorporate this concept should be considered. In the meantime, in order to be reasonably certain that an increase in population size is not simply due to short-term natural fluctuations, recovery above the extent-of-decline considered appropriate for transfer to Appendix II needs to be sustained for several years before transfer should occur.

3.5 Modifying Factors

57. NMFS (2001) suggested that the extent and rate-of-decline of populations must be considered in combination with the modifying factors that may be taxon or case specific. Such factors may increase or decrease the risks to the species, and may therefore necessitate appropriate modification to any percentages or rates suggested in these guidelines. The wide range of potential taxon-associated modifying factors supports the contention that there is no escaping the need to consider each population on a case-by-case basis.

58. A non-exhaustive list of modifying factors (adapted from NMFS 2001) that may be relevant to particular taxonomic groups is presented below. These modifying factors can be split into vulnerability factors that would increase concern for a population, and mitigating factors that would decrease concern. Some factors are purely unidirectional (i.e. either vulnerability or mitigating factors), but many could be either depending on the details. For simplicity the list below includes both, but could be further refined, and possibly split, in the future.

· Life history characteristics (e.g. fecundity, growth rate, age at first maturity);
· Absolute numbers or biomass;
· Selectivity of removals;
· Age, size or stage structure of a population;
· Social structure (e.g. sex ratio, social hierarchy, social dominance etc.);
· Density (particularly for sessile or semi-sessile species);
· Vulnerability at different life stages (e.g. during migration or spawning);
· Specialised niche requirements (e.g. diet and habitat);
· Species associations such as symbiosis and other forms of co-dependency;
· Aggregating behaviour (e.g. schooling);
· Fragmentation or concentration in one location;
· Genetic diversity;
· Trends in or extent of habitat loss or gain;
· Degree of endemism;
· Vulnerability to disease;
· Presence of invasive species;
· Rapid environmental change (e.g. shifts in ecological or climatic regimes);
· Existence of natural refugia;
· Adaptations to small population size;
· Degree of uncertainty.

59. Therefore, a species with estimated extent-of-decline below the guidelines proposed for consideration for Appendix I listings (5-20%) should not automatically be considered for listing as the modifying factors listed above could provide a sound biological basis not to list on Appendix I. Conversely, species with estimates above this range should not automatically be exempt from consideration for listing. However, in both instances, the burden should rest with the proponent to make a strong supporting case as to why the basic guidelines should be overridden. For example, large numbers by themselves are not a sufficient mitigating factor. It is necessary to demonstrate that, for example, reproductive success is not compromised and vulnerability factors such as schooling are not of overriding importance. The same principle should apply to other guideline rate and extent-of-decline provisions for Appendix I and II listings.

3.6 Likely to satisfy one of 1-3 within the next 5 years.

60. The Secretariat suggests that this criterion is incorporated in the revised decline proposal (see 3.4).

3.7 Quantitative assessment

61. The principle of using the best scientific information available is fundamental to assessing the status of any population being considered for listing, transfer between Appendices or de-listing. This principle is affirmed in the UN Law of the Sea (Article 61) and the FAO Code of Conduct for Responsible Fisheries (Paragraph 6.4), which call for the use of the best scientific evidence available when making conservation and management decisions. In fisheries, as in any population assessment, quantitative methods will normally be used to integrate all available relevant data and analyses to obtain the best estimates of indicators such as population size over time, mortality rates and production rates. Therefore, typically, an assessment will generate estimates of relevance to more than one of the CITES criteria and guidelines (population size, extent-of-decline, rate-of-decline (or change) and impact of harvesting).

62. Many populations exploited by commercial fisheries are formally assessed on a regular basis through national, international, or intergovernmental scientific bodies, and the assessments are used to make fishery management decisions. For those populations, status in the CITES context should be evaluated using appropriate quantitative analyses, taking account of geographic differences in productivity .

63. Annex II of the UN Fish Stocks[18] agreement identifies a need for limit reference points to avoid and target reference points at which to aim, in terms of both fishing mortality and biomass. Several scientific fisheries bodies have identified fishing mortality and biomass limits and buffer zones adjacent to these limits where management action is required if the limits are to be avoided. The status of a population relative to these reference points may also be a useful index of threat of extinction and could be used as such. However, if the fishing mortality is estimated to be higher than the limit fishing mortality and/or if the biomass is estimated to be lower than the limit biomass, it does not necessarily mean that the population is at risk of extinction and the full results of the quantitative analysis need to be considered.

64. Recommendation
When sufficient data are available to allow reliable quantitative assessments to be conducted, the results from these should supersede simpler criteria or single indices for inferring threats of extinction. Even in data-poor situations, appropriate quantitative analyses should be used to the extent possible to ensure that indices of population status are as accurate and precise as possible. In cases where few or no quantitative data exist, qualitative information, analogies with other species and consideration of the modifying factors should be used

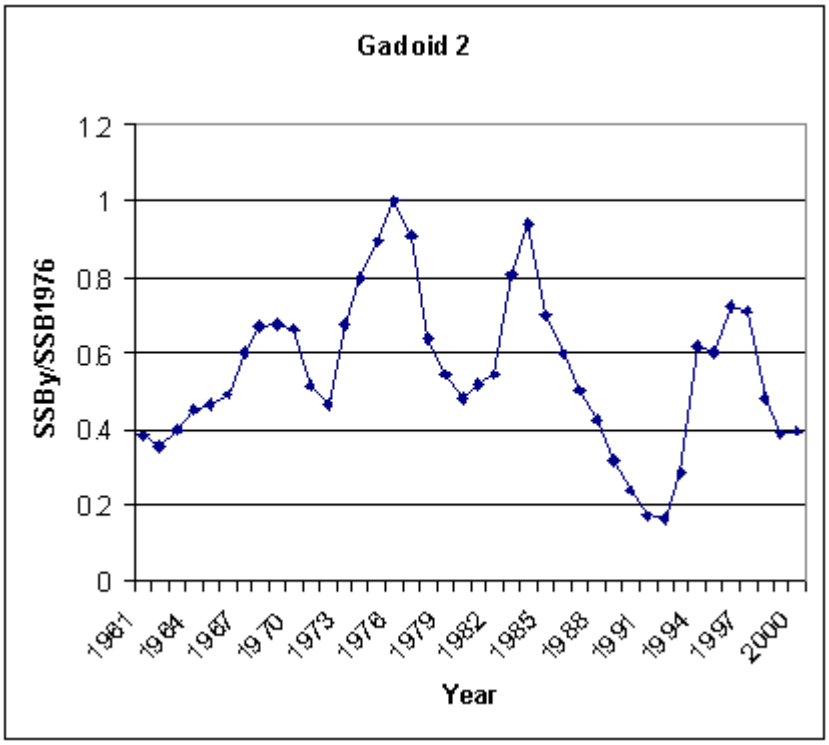
in combination to develop an informed judgement about the likely status of a population with respect to the suggested criteria and guidelines.

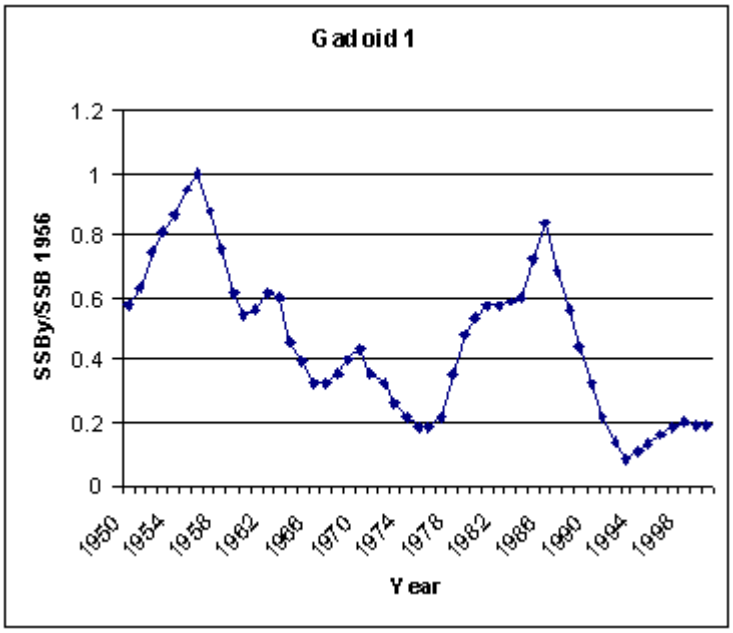
4. Case Studies

65. The Secretariat purposely selected cases studies that were anticipated to be within or close to the proposed guidelines for listing in Appendices I and II so as to be most useful in evaluating the guidelines. Quantitative assessments were available for most of the populations chosen, but only population trends and rates of declines were used and the evaluations presented here did not take into consideration the full results of any such quantitative analyses, and did not consider modifying factors. These case studies merely provide simple illustrations of the application of the guidelines recommended in this review.

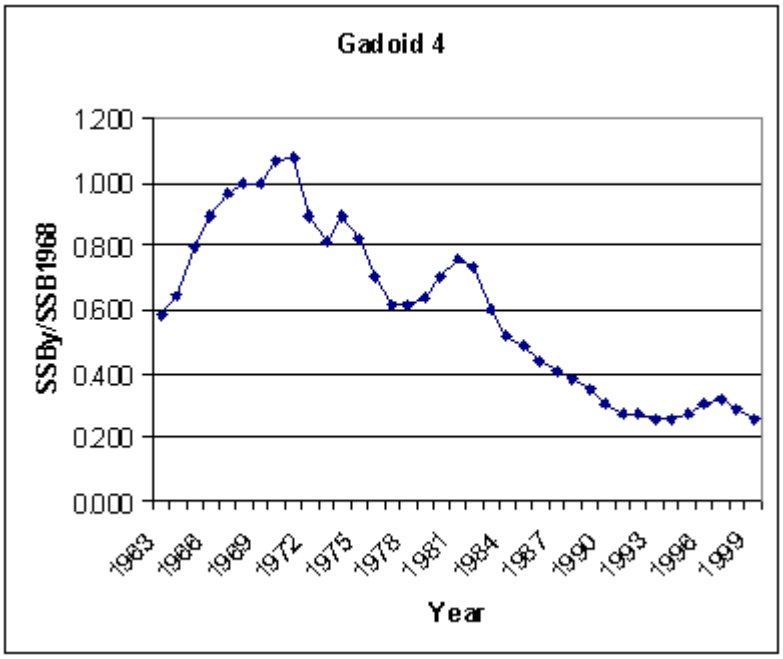
66. In addition to current extent-of-decline and rate-of-decline, the Secretariat examined what listing decisions might have been made in the past. The population estimates were scaled to an appropriate baseline, generally a biomass estimate early in the time series, so that extent-of-decline can be read directly from the graph.

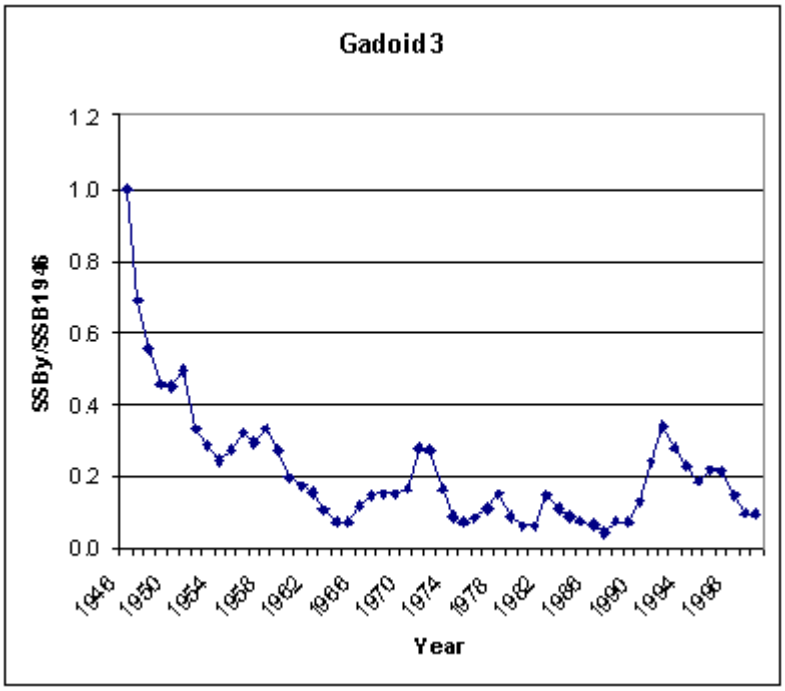
67. All the gadoids examined were of medium productivity (Table 1), although actual growth rates varied considerably between the various populations examined. Gadoid 1 could have been considered for listing on Appendix I in the mid 1990s when the population decreased to 9% of baseline (Table 2). It could have been considered for listing on Appendix II in 1989 when the population was less than 50% of baseline and decreasing at more than 20% per year. Over the last 10 years, the population increased by more than 50% from its minimum which would have been sufficient to de-list. The fishery for gadoid 1 was closed in 1994, and re-opened with considerably reduced catches in 1998.





68. Gadoid 2 demonstrates that even relatively long-lived demersal stocks can show marked natural fluctuations. It would not have qualified for listing on Appendix 1 because the lowest population was 16% of the baseline, but it could have been considered for listing on Appendix II in the mid 1980s when the population was less than 50% of the baseline and decreasing at 20% per year. The fishery for gadoid 2 was restricted in the early 1990s, but it remained open. Gadoid 2 shows that, given appropriate conditions, demersal stocks can rebuild very quickly.

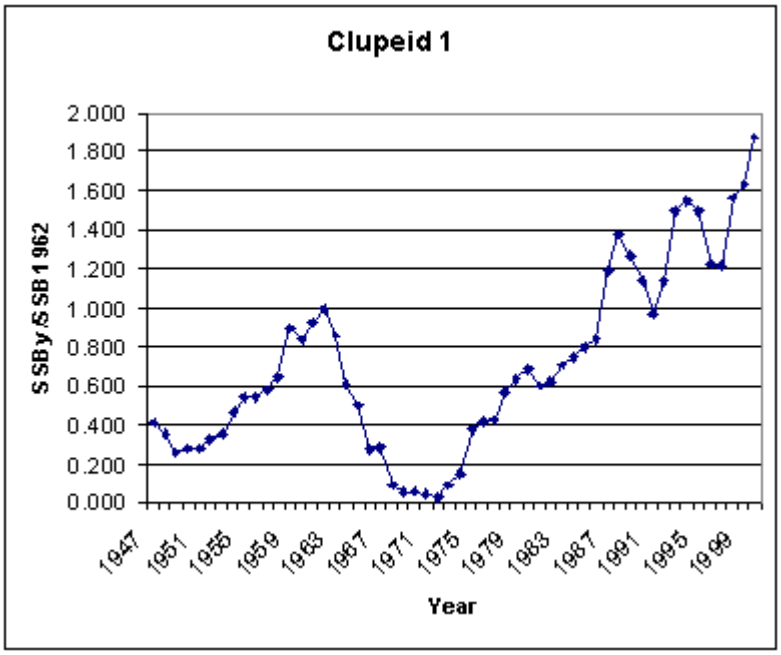


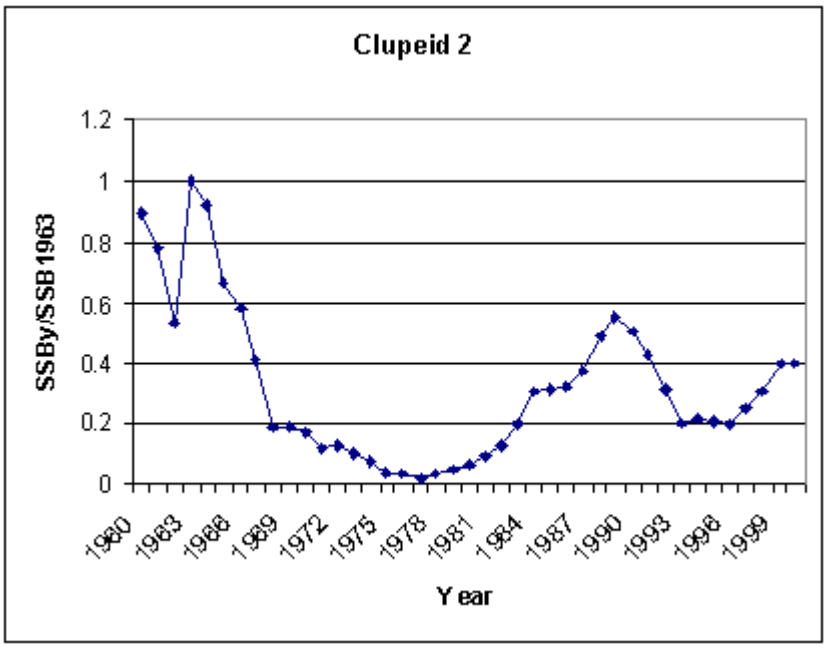


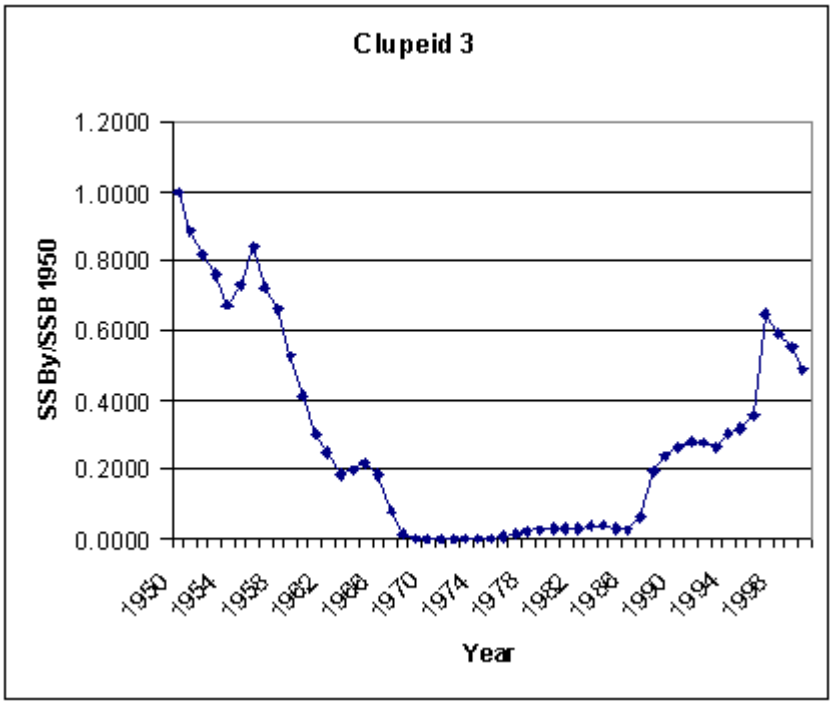
69. Gadoid 3 shows the importance of considering as long a time series of data as can be found. If, as is common for many exploited fish stocks, data were available only from the 1960s onward, gadoid 3 would not have given cause for concern. However, given the longer time series available, it could have been considered for listing on several occasions during its history, each time the population decreased below 10% of baseline, including 1999 and 2000. In fact, gadoid 3 could have been considered for either Appendix I or II for most of the 1980s and 1990s when the population was either less than 10% of baseline, or less than 50% and decreasing at a rapid rate. Fishing on gadoid 3 continues.

70. Gadoid 4 would not have been considered for Appendix I because the population never decreased to 10% or less of the baseline. It could have been considered for Appendix II in the mid 1990s when the population was 20-30% of baseline and decreasing at 5% per year. Gadoid 4 has been subjected to very high fishing mortality, considered to be unsustainable, since the early 1980s.

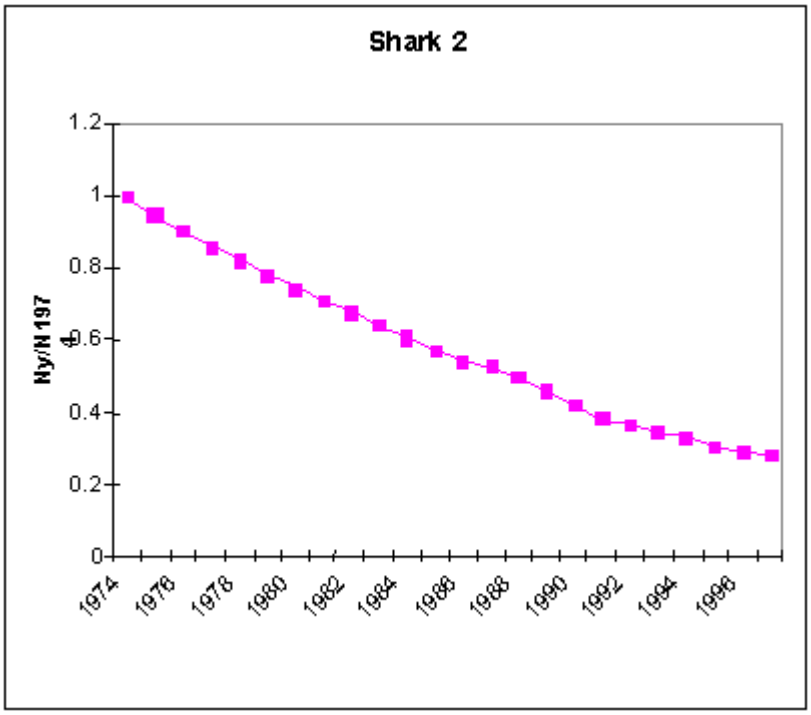
71. Clupeoids 1, 2 and 3 are also all of medium productivity. They demonstrate that exploited fish species can decrease to very small fractions of baseline (0.013% of baseline for clupeoid 3) and rebuild. However, the fact that a population has rebuilt once from a very low percentage of the reference baseline does not mean it will do so every time.

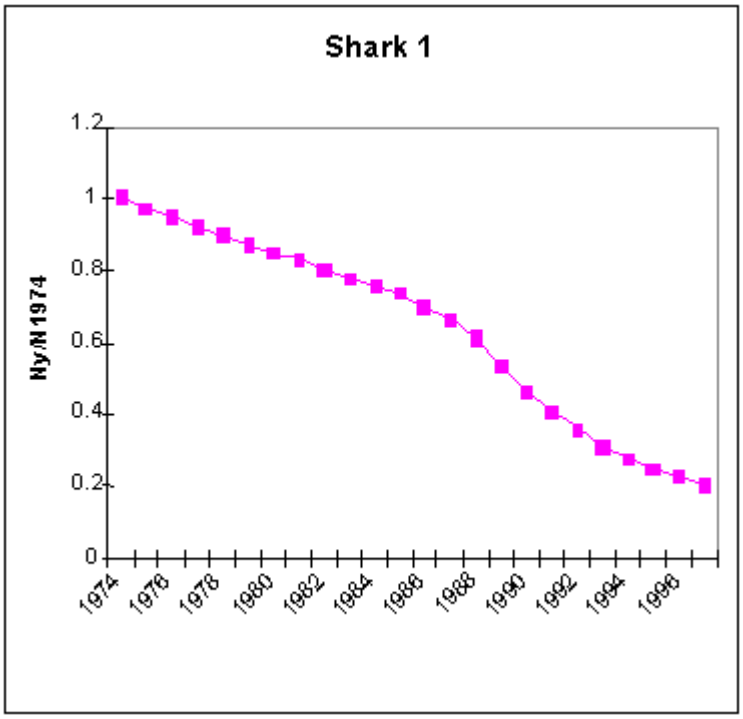






72. Sharks 1 and 2 are low productivity and they would not be considered for listing on Appendix I because current population sizes are greater than 20% of baseline. Shark 1 could have been considered for listing on Appendix II in the early 1990s because the population was less than 50% of baseline and the annual rate-of-decline of the order of 10%. Shark 2 could have been considered for Appendix II once its extent-of-decline had reached less than 40%, because the rate-of-decline was of the order of 5-6%.


Shark 2
Ny/N197
1.2
1
0.8
0.6
0.4
0.2
0
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996


Shark 1
Ny/N1974
1.2
1
0.8
0.6
0.4
0.2
0
1974
1976
1978
1980
1982
1984
1986
1988
1990
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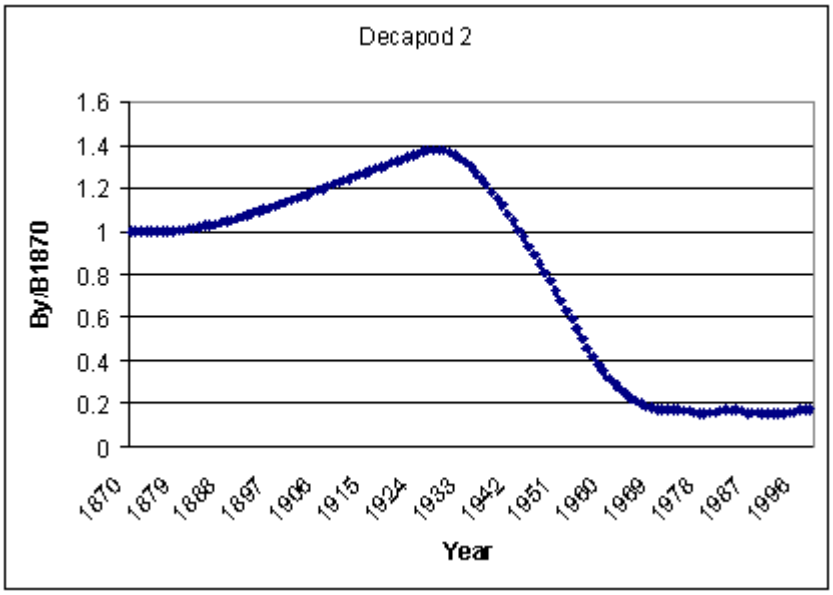
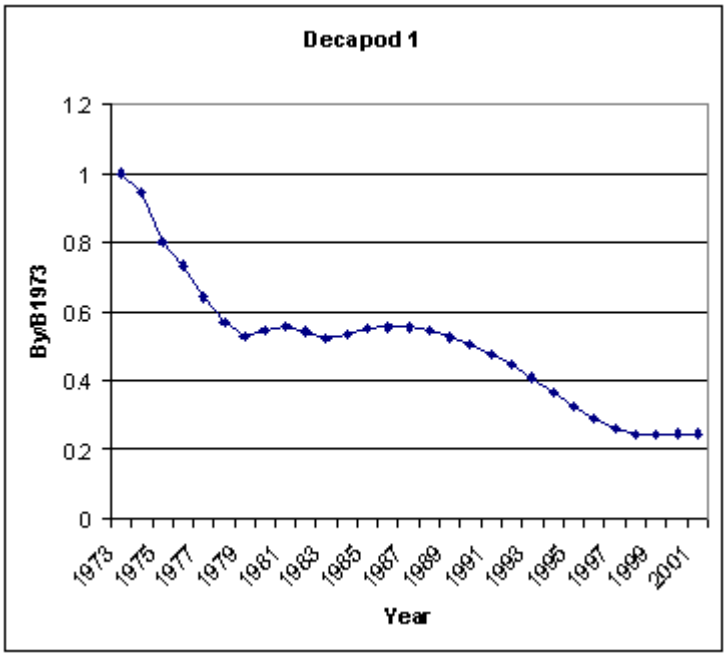
1996





73. Both decapods 1 and 2 are considered of low productivity. This means that decapod 1 would not have qualified for consideration on Appendix I, but decapod 2 would have been a candidate since the mid 1960s because the population was less than 20% of baseline. Decapod 1 could have been considered for listing on Appendix II in the early 1990s when the population was less than 40% of baseline and decreasing at 7% per year.

5. Process for Scientific Evaluation

74. At the 24th Session of COFI, it was agreed that "decisions concerning listing and de-listing of species should be based on the best possible scientific evidence and an effective scientific evaluation process." The call for a scientific evaluation process arose from concerns about the current procedure for making decisions in CITES on listing, transfer between lists and de-listing. The existing process for considering amendments at meetings of the Conference of the Parties (COP) is (from paragraph 1 of Article XV of the Convention):
(a) Any Party may propose an amendment to Appendix I or II for consideration at the next meeting. The text of the proposed amendment shall be communicated to the Secretariat at least 150 days before the meeting. The Secretariat shall consult the other Parties and interested bodies on the amendment in accordance with the provisions of sub-paragraphs (b) and (c) of paragraph 2 of this Article and shall communicate the response to all Parties not later than 30

days before the meeting.
(b) Amendments shall be adopted by a two-thirds majority of Parties present and voting. For these purposes "Parties present and voting" means Parties present and casting an affirmative or negative vote. Parties abstaining from voting shall not be counted among the two-thirds required for adopting an amendment.

75. Sub-paragraph (b) of paragraph 2 applies to marine species and states: "the Secretariat shall..... also consult inter-governmental bodies having a function in relation to those species especially with a view to obtaining scientific data these bodies may be able to provide and to ensuring co-ordination with any conservation measures enforced by such bodies. The Secretariat shall communicate the views expressed and data provided by these bodies and its own findings and recommendations to the Parties as soon as possible."

76. IUCN-the World Conservation Union is an inter-governmental organisation which operates as a scientific and technical advisor to CITES under a co-operative agreement with the CITES Secretariat. The intention of the agreement is for IUCN to provide an objective, critical and impartial analysis of the information presented in the supporting statement for each CITES proposal, and the extent to which the proposal fulfils the criteria adopted by the Parties for amending the Appendices. In order to achieve this, shortly before each CITES Conference of the Parties, IUCN consults experts and produces the *IUCN Analyses*, which evaluate the biological and trade components of all CITES listing proposals.

77. The existing process for scientific evaluation relies on the contents of each listing proposal, its presentation to the CITES Secretariat and their appraisal, the consultation with Parties and relevant inter-governmental bodies, and the IUCN consultation. The latter aims to provide an independent, objective evaluation of the proposals, but is time-limited (three months) and undertaken by correspondence only. Therefore, unlike many fisheries management bodies, CITES does not have a Scientific Committee meeting shortly before COP to provide in-depth scientific appraisals of proposals. This means that there is little scope to resolve any conflicting views should a scientific evaluation be contested, and there is a risk that Parties will not receive a coherent and balanced scientific analysis of a proposal on which to base their decision. At the Second Meeting of FAO and Non-FAO Regional Fishery Bodies or Arrangements (20 and 21 February 2001) it was suggested that an effective scientific evaluation process is required. This suggestion needs to be addressed and the FAO Secretariat **recommends** that means of improving the existing process be explored.

78. The first step in a balanced scientific process would be the early identification of proposals that are contested on the basis of the biological criteria or guidelines. These contested proposals and any data and views on them received in accordance with Article XV paragraph 2(b), should undergo objective scientific evaluation of:
· the accuracy, relevance and suitability of any data and information used in the proposal;
· the appropriateness of the methods of analysis used and whether or not they have been correctly applied;
· modifying factors and the levels of uncertainty in the data and analyses, and whether these have been appropriately considered in the conclusions of the proposal; and
· the validity of the results and conclusions, and hence of the recommendation in the proposal.

79. The review, for which a mechanism by correspondence alone would generally not be sufficient, would generate a balanced and agreed report which may or may not present a common consensus view, but would include all defensible views and interpretations.

80. There are several possible mechanisms which could be considered by CITES to evaluate and report to COP on contested proposals including:
· the appointment by CITES of a panel of specialists, probably including representatives from

IUCN and the relevant Fishery Management Organisation, as well as impartial experts in population assessment and conservation biology;
· special scientific reviews organised by CITES prior to each COP where all CITES Parties (and observer NGOs and IGOs) may participate if they wish and should include primarily technical experts on their delegations so as to be able to contribute to the scientific review;
· delegation by CITES of the scientific evaluation to the relevant Fishery Management Organisation or Organisations;
· provision by CITES of greater support to IUCN to ensure they have the resources to undertake and/or coordinate the required review and provide the balanced and agreed report.

81. Article XV of CITES effectively limits the time available for a process of scientific evaluation of proposals to 120 days (150 less 30). This limitation could have important implications for the type of review process and mechanism which is possible, and the effectiveness of that process, and needs to be carefully considered.

82. Recommendation.
CITES should strengthen and improve its existing process for scientific evaluation of proposals to ensure that decisions on amendments to the Appendices are informed by objective and transparent evaluations of the status of each population in relation to the biological criteria and guidelines.

6. Acknowledgements

83. This review was prepared by the FAO Secretariat with assistance from four consultants: Prof. D. Butterworth (University of Cape Town, South Africa); Ms Sarah Fowler (IUCN Species Survival Commission); Dr Pamela Mace (National Marine Fisheries Service, United States of America); and Mr J.-J. Maguire (Halieutikos Inc., Canada). The assistance of Billy Ernst (University of Washington, United States of America); Jim Ianelli (NMFS, United States of America); E.J. Milner-Gulland (Imperial College, London, United Kingdom) and Alison Rosser (IUCN/SSC, United Kingdom) on specific topics, and the provision of information for case studies from a number of individuals is also gratefully acknowledged. The Government of Japan is thanked for their financial contribution which made this study possible.

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2 FAO. 2000b. An appraisal of the suitability of the CITES criteria for listing commercially-exploited aquatic species. FAO Fisheries Circular 954.
3 NMFS. 2001. Report of the NMFS CITES Criteria Working Group. Preliminary Draft 16 May 2001. NMFS, Woods Hole, USA.
4 Musick, J.A. 1999. Criteria to define extinction risk in marine fishes. Fisheries 24(12): 6-14.
5 Holling, C. S. 1973. Resilience and stability of ecological systems. Annual Rev. Ecol. Systematics 4: 1-23.
6 Mortality from causes other than fishing.
7 Depensation makes populations more prone to further reductions in size even in the absence of exploitation (see also section 3.2).
8 Mace, P.M. 1994. Relationships between common biological reference points used as thresholds and targets of fisheries management strategies. Can. J. Fish. Aquat. Sci. 51: 110-122.
9 Biomass is the total weight of the fish population, i.e. numbers of fish multiplied by their individual weights.
10 Jensen, A.L. 1996. Beverton and Holt life history invariants result from optimal trade-off of reproduction and survival. Can. J. Fish. Aquat. Sci. 53: 820-822.
11 Beddington, J.R. and Cooke, J.G. 1983. The potential yield of fish stocks. FAO Fisheries Tech. Pap. 242.
12 The formula for calculating t_{max} equates to the age at which a cohort drops to 1% of its original number.
13 See NMFS (2001) Appendix III for further considerations on the importance of an historical perspective.
14 The average biomass at which the maximum sustainable yield (MSY) can be produced.
15 B_0 is the average unexploited biomass .
16 Absolute estimates of total numbers and/or total biomass may not be available and relative indices of these metrics, such as catch per unit effort (cpue), will often need to be used.
17 SPR = Spawning-biomass-per-recruit.
18 Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks.