Response to PEW factsheet on "The Best Available Science on Western Atlantic Bluefin Tuna"

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The factsheet implies that PEW is the arbiter of best available science rather than the ICCAT process for developing a scientific basis for fishery management. Atlantic bluefin tuna stock assessments are highly uncertain, primarily because of the highly migratory nature of tuna as well as the diverse, expansive and international fisheries for tuna. Accordingly, many aspects of Atlantic bluefin tuna biology are not known definitively, and alternative hypotheses should be considered by scientists and fishery managers. The PEW factsheet is an irresponsible distortion of the information available to justify reductions in fishing. Responsible fishery management should consider all the information provided by the ICCAT SCRS process.

Stock-recruitment relationship – Uncertainty in predicting future recruitment of Atlantic Bluefin tuna is best viewed as two possible states of nature, represented as the two stock-recruitment hypotheses. Contrary to the PEW factsheet, the low recruitment hypothesis is not an 'unsupported hypothesis.' Procedurally, the low recruitment hypothesis continues to be supported by the SCRS process. Scientifically, the low recruitment hypothesis recognizes changes in the North Atlantic ecosystem and the potential for associated changes in the productivity of bluefin tuna in the North Atlantic. Decadal variability of the North Atlantic marine ecosystem is well documented (e.g., ICES/NAFO symposium on the topic, ICES J. Marine Science 2012 vol. 69), and changes in bluefin tuna productivity are evidenced by the relative absence of bluefin tuna in the historically productive fishing grounds off Brazil and Norway in recent decades and changes in reproductive potential (Golet et al. 2007). Failure to recognize environmental changes and associated changes in fishery productivity can lead to ineffective fishery management.

The report of the Bluefin Tuna Stock Assessment Session (SCRS Doc. No. SCI-033 / 2012) states that, "*This year, the Group maintained the two alternative spawner-recruit hypotheses explored in several prior assessments: the two-line (low recruitment potential hypothesis) and the Beverton and Holt spawner-recruit formulation (high recruitment potential hypothesis)*." That conclusion reflects the consensus decision from a two-week meeting of 46 scientists from ICCAT member countries, seven scientists from ICCAT and 13 observers from various stakeholder groups.

The PEW factsheet cites a SCRS document (Rosenberg et al. 2012) that analyzed stock-recruitment estimates from the 2010 stock assessment to conclude that the information available supports the high recruitment hypothesis. However, when one of the co-authors of the Rosenberg et al. (2012) report updated the analysis with stock-recruitment estimates from the 2012 stock assessment, the revised results had nearly equal support for both the high recruitment and low recruitment hypotheses. The primary author of the PEW white paper on "Managing Atlantic Bluefin Tuna in the Midst of Uncertainty, History of the Stock-Recruit Relationship of the Western Stock at ICCAT" (Miller et al. 2013) was an observer at the 2012 stock assessment meeting, and was aware of the revised analysis, but failed to

report that important finding in either the factsheet or the white paper. The omission of the most recent results from the analysis reveals a subjective selection of information in the PEW white paper and factsheet.

Age to first maturity – The PEW factsheet on the information available on maturity of western Atlantic bluefin tuna is inaccurate and misleading. Contrary to the statement that the early maturity hypothesis is unproven, there is evidence of early maturity from macroscopic inspection and histological evaluation of gonads, and more recently from endocrine analysis (see SCRS/2012/161). Determining maturity through histology and endocrine analysis is the state-of-the-art for fisheries science. Life history modeling also predicts an energetics–based, sexual maturation schedule (Chapman et al., 2011). By contrast, the late maturity hypothesis is based on a relatively crude evaluation of the size frequency of tuna in the Gulf of Mexico spawning area (SCRS/2010/018) or is inferred from depth patterns alone. The biological implications of newly revised maturity schedules support the possibility of undetected western Atlantic spawning areas resulting from inadequate biological sampling (SCRS/2012/157). The report of the Bluefin Tuna Stock Assessment Session (SCRS Doc. No. SCI-033 / 2012) states that, "*there remains considerable uncertainty about the maturation of western bluefin tuna. For this reason the group decided to examine the sensitivity of the perception of stock status in the base case run to two alternative maturity schedules, one with the early maturation schedule used for the Eastern Atlantic and Mediterranean (50% maturity at age 4 and 100% maturity for age 5 and older) and one with later maturation (0% at age 8, increasing to 100% at age 16 as described in SCRS/2010/018)*." After further consideration of histological evidence, the 2013 Bluefin Meeting on Biological Parameters Review concluded that "*The Group recommends to revise the current maturity schedules assumed for stock assessment for both the eastern and western stocks, using the spawning ogives, and to determine a comprehensive maturity ogive for the western Atlantic*."

Contrary to the simplistic conclusion in the PEW factsheet, the implications of earlier maturity are complex. As shown in the sensitivity analysis, the earlier maturity assumption influences estimates of historical and recent spawning biomass, thereby changing stock-recruitment relationships and MSY reference points.

Strength of the 2003 yearclass – Movement of bluefin tuna between management areas and mixing of eastern and western spawning populations in North Atlantic fisheries continues to be a challenge for stock assessment and management. Information from tagging and otolith chemistry offer evidence of extensive movement and mixing among spawning populations. However, the implications of movement and mixing for fishery management are complex. The PEW factsheet suggests that catch in the western management area should not be increased, because the apparently strong 2003 yearclass is primarily of western origin, offering evidence that high recruitment is possible if the stock is rebuilt. However, the strength of the 2003 yearclass was revised downward in the 2012 stock assessment, which suggests the 2002 and 2003 yearclasses were of moderate abundance.

As documented in the Report of the 2013 Bluefin Meeting on Biological Parameters Review (ICCAT 2013), considerable investments have been made in electronic and conventional tagging, otolith research and population modeling to understand movement and mixing of Atlantic bluefin tuna, but

fundamental uncertainties remain in stock structure hypotheses and there are considerable challenges for incorporating movement and mixing in stock assessment and fishery management. Advancements in knowledge and methodology are expected to continue, but until stock assessments can account for movement and mixing, the 2012 stock assessments are the best available information for fishery management. The implications of mixing are complex and should not be considered in such a simplistic approach as proposed in the PEW factsheet.

Western bluefin tuna abundance in the 1970s – The PEW factsheet confounds the issue of historical and recent productivity of bluefin tuna in the western Atlantic. Fishery statistics demonstrate much greater catches of Bluefin tuna in the 1970s than in subsequent decades. The stock identity of historical catch in the western Atlantic is not well known. More importantly, there is considerable uncertainty on whether the resource can be rebuilt to achieve such productivity in the future. This uncertainty is communicated in the 2012 stock assessment as two stock-recruitment hypotheses, so that fishery managers can make decisions in the context of the uncertainty.

One vs. two stocks - As the PEW factsheet states, ICCAT has managed Atlantic bluefin tuna as two separate stocks since 1981. Although there are scientific initiatives to incorporate movement and mixing of spawning populations into stock assessment and fishery management, there is no agenda in ICCAT to manage Atlantic bluefin tuna as a single stock. This aspect of the PEW factsheet appears to be misinformed.

In summary, the PEW factsheet is a subjective selection of information, lacks scientific credibility and appears to be agenda driven. Fishery managers should be aware of the uncertainties involved in Atlantic bluefin tuna biology and stock assessment and should consider the alternative hypotheses identified by the SCRS process, the 2012 Bluefin Tuna Stock Assessment Session and the 2013 Bluefin Meeting on Biological Parameters Review.