

***REBUILDING FISHERIES: TAKING ACCOUNT OF SCIENCE,
NATURE, SOCIETY AND THE LAW***

WRITTEN TESTIMONY OF
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UNDER THE
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BEFORE THE
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SUBCOMMITTEE OF FISHERIES, WILDLIFE AND OCEANS

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Madam Chairwoman and members of the Subcommittee, I am Michael Sissenwine, Visiting Scholar, Woods Hole Oceanographic Institution. I was the Director of Scientific Programs and Chief Science Advisor of the National Marine Fisheries Service. I am also a former President of the International Council for Exploration of the Sea.

The letter inviting me to this hearing indicated that the Subcommittee is interested in progress toward achieving the Sustainable Fisheries Act's (SFA) goal of ending overfishing and rebuilding overfished fishery resources. The letter identifies several specific issues that interest the Subcommittee. Most of the issues are best addressed by the National Marine Fisheries Service as the Federal Agency with responsibility for implementing the Sustainable Fisheries Act. I understand that they are addressed in the testimony of the Agency's hearing witness, Dr. Steven Murawski. It seems to me that there are three general issues that concern fishery managers, the people who have a stake in fisheries management, and therefore the Subcommittee. They are (1) rebuilding targets, (2) rebuilding times, and (3) the appropriate response if rebuilding targets are not reached on time. In my testimony, I will address these three issues. I also want to close my testimony by putting US progress toward fulfilling the goal of the Sustainable Fisheries Act into a global perspective.

The Sustainable Fisheries Act (as amended by the 104th Congress in 2006) requires conservation and management measures to prevent overfishing (National Standard 1). This requirement is reinforced for overfished fisheries by requiring rebuilding plans to end overfishing immediately and rebuild stocks. There are many opinions about what these requirements mean, in terms of both the law and the science that underpins fisheries management. I emphasize that requirements and options for rebuilding fisheries must be addressed from both a legal and scientific perspective since Congress cannot legislate the

behavior of nature, nor are the public policy choices codified in law determined by science.

The Sustainable Fisheries Act and fisheries science seem to be reasonably in sync with respect to overfishing. The SFA relates overfishing to the failure to achieve optimum yield, which in turn is derived from Maximum Sustainable Yield (MSY). Scientists routinely define a fishing mortality rate (F) that exceed the fishing mortality rate associated with MSY (F_{msy}) as overfishing. This is consistent with the SFA.

Modern fisheries science is reasonably good at estimating the fishing mortality rate generated by fishing, and the rate that corresponds to overfishing. Ending overfishing immediately, as required by SFA rebuilding plans, may have serious implications for the fishing industry and fishery dependent communities, but it can be done by regulating fishing activity. There has been ample time to end overfishing since National Standard 1, which prohibits it, became law more than 30 years ago.

A key point to keep in mind is that fishing mortality (and therefore overfishing) is primarily a function of fishing activity that can be regulated by fisheries management. The size of a fish stock or its rate of change (either increasing or decreasing) is also influenced by fishing mortality. However, fish stocks are also affected by many natural factors such as climate and habitat quality. Thus, fishery management has the potential to exercise direct control to end overfishing, but it only has an indirect influence over rebuilding. This is a reality of nature that can not be changed by Congress or fishery managers.

While the SFA is clear about the need to rebuild overfished fish stocks, it gives little guidance on what rebuilt means, or when rebuilding is needed. According to the definitions section of the SFA, overfishing and overfished mean the same thing. They are both defined in terms of fishing mortality, not stock size. Does this mean that any time overfishing occurs, a stock is also overfished and needs to be rebuilt, even if stock size is considered “healthy” from a scientific perspective? This might be what’s required according to a strict interpretation of the language in the SFA, but it would be counterproductive, and the SFA has not been interpreted this way.

Since the 1996 Amendment of the SFA established the requirement to rebuild overfished fisheries, the National Marine Fisheries Service has interpreted the requirement in terms of the stock size associated with MSY (B_{msy}). In most cases, the target for rebuilding is B_{msy} , and fisheries have usually been classified as overfished (and thus requiring a rebuilding plan) when stock size is less than one half B_{msy} . This is a reasonable formulation from a scientific perspective. However, estimating B_{msy} is a scientific challenge, particularly for fisheries that have a long history of overfishing. For these fisheries, time series of scientific data, and the memory of participants in the fishery, may not extend far enough back in time to include a period when stock size was at or above B_{msy} . This means that scientists must use extrapolation to estimate B_{msy} , and the estimates may seem incredible to the fishing industry since they have never experience such a large stock size. However, their forefathers may have, and in most cases they probably did.

Another reason that it is difficult to estimate Bmsy is that the potential productivity of fish stocks is dynamic. It is affected by environmental conditions, including climate, habitat, and species interactions. Thus, estimates of Bmsy based on data from the past, may not reflect the potential of the stock over the period of time allowed for rebuilding. It may be possible to take account of some of the factors that affect stock productivity to improve the estimate of Bmsy applicable during the rebuilding period, but there will always be substantial uncertainty.

Note that uncertainty does not necessarily mean that Bmsy as a target for rebuilding is overestimated. In fact, it is common for Bmsy to be estimated using recruitment from a period when stock size was less than Bmsy. If recruitment increases as stock size increases toward Bmsy, this approach will result in an underestimate of Bmsy. Also, if Bmsy is overestimated because the environment is unfavorable for stock rebuilding, it will usually mean that fishing mortality (and thus catch) needs to be lower than when the environment is more favorable.

The SFA calls for a rebuilding period as short as possible taking account of several factors, such as the status and biology of the stock, needs of fishing communities, and ecosystem interactions. There is no way of knowing what the shortest possible time for rebuilding is because of the same natural variability that makes estimates of Bmsy uncertain. However, from a scientific perspective, rebuilding in the shortest possible time will virtually always mean prohibiting fishing. Taking account of the factors mentioned in the SFA, such as needs of fishing communities, may be a reason for lengthening the rebuilding time so that fishing does not have to be entirely prohibited, but it does not change what is possible. The SFA also says that the rebuilding period should not exceed 10 years, "...except in cases where the biology of the stock of fish, other environmental conditions, or management measures under an international agreement in which the United States participates dictate otherwise." Putting aside international agreements, the biology of the stock or other environmental conditions might dictate that a stock cannot be rebuilt in 10 years or less, but they do not change the conclusion that rebuilding as fast as possible means zero catch.

Thus, a strict interpretation of the language in the SFA from a scientific perspective means that rebuilding plans should prohibit fishing, which would be devastating for the recreational and commercial fisheries. In practice, rebuilding periods have usually been set as 10 years, unless it is expected to take more than 10 years to rebuild even with zero fishing. In such cases, the National Standard Guidelines issued by the National Marine Fisheries Service allow the rebuilding period to equal the time it is expected to take to rebuild with zero fishing (T_{min}) plus the mean generation time (T_{gen}) of the fishery resource being rebuilt. Mean generation time can be thought of as the average age at which fish reproduce.

From a scientific perspective, it makes sense to take account of mean generation time to determine the time period for rebuilding. However, the specific formulation for rebuilding time in the National Standard Guidelines does not make sense. It results in a "discontinuity" in rebuilding times such that small changes in stock status can result in rebuilding times changing by a large amount. This discontinuity can result in counter intuitive results such as when a small improvement in stock status means a shorter

rebuilding period, resulting in an even more restrictions on fishing, perhaps even requiring a virtual closure of the fishery. Good news in terms of stock status should not translate into bad news for the fishing industry.

The National Marine Fisheries Service is aware of the rebuilding time discontinuity problem, and it proposed a revision of the National Standard Guidelines (Federal Register/Vol. 70, No. 119, June 22, 2005) to address it. The proposal was to set rebuilding time at 10 years or 10 years plus one mean generation time ($10 + T_{gen}$), which ever is less. This formulation would eliminate the discontinuity problem, although other formulations might also have merit. The 2005 proposed revision of the National Standard Guidelines was not adopted.

With an estimate of B_{msy} and an agreed rebuilding time, a rebuilding plan can be constructed. Rebuilding within the allowed rebuilding period will usually require that management measures are sufficient to limit fishing mortality to the level associated with MSY (F_{msy}) or less. This requirement was made explicit by the 2006 Amendment of the SFA which requires that rebuilding plans end overfishing immediately. Many types of management measures are possible, such as catch limits, time and area closures, and gear restrictions, so long as they translate into a series of annual fishing mortality rates that are expected to rebuild the fishery.

Using an uncertain estimate of B_{msy} as a target for rebuilding need not be a problem unless the law is interpreted as requiring the rebuilding target to be reached during the rebuilding period with certainty. Simply put, certainty in fisheries management can not be legislated. If the law is interpreted as requiring that the risk of failing to reach the target must be as small as possible, it will usually mean that fishing must be prohibited, regardless of the period of time allowed for rebuilding.

To date, the National Marine Fisheries Service has not required that rebuilding plans have the highest possible probability of reaching rebuilding targets in the allowed rebuilding period. Most rebuilding plans have been designed to have a 50% probability of reaching the rebuilding target stock size on time. Plans could be designed to have a higher probability, but this will mean a lower series of fishing mortalities, more restrictions, and lower catches. Given the long term benefits of rebuilding a fishery to produce MSY , it could be argued that rebuilding plans should have a higher probability of success than 50%. This argument is easier to make if B_{msy} is known. However, when the rebuilding target is a highly uncertain estimate of B_{msy} , the expected benefits of rebuilding to the estimate of B_{msy} may never be realized (when B_{msy} is overestimated).

Regardless of the level of risk used to construct a rebuilding plan, actual rebuilding will lag expectations some of the time for some fisheries. In some cases, stock size will be below the rebuilding target at the end of the rebuilding period. What should managers do?

Some will argue that the law requires fisheries to be rebuilt, and therefore managers should restrict fisheries even more, sometimes prohibiting fishing altogether. This may be appropriate in some situations, but it may also be a futile attempt to regulate nature.

There are three typical reasons that a fishery does not rebuild. They are discussed below:

1. Fishing mortality was higher than required by the rebuilding plan- Fishing mortality may exceed the level called for in a rebuilding plan for several reasons. One reason is that management measures were not strict enough. For example, a catch limit may have been set too high or time/area closures may not be long or large enough. This may occur because managers did not follow scientific advice, or because scientific advice was inaccurate. Another reason that fishing mortality might turn out to be too high is poor compliance with management measures or imperfect implementation.
2. Natural variability in productivity of the fish stock- Even if management controls fishing mortality as called for in the rebuilding plan, the stock may not rebuild as fast as expected because of natural variability in the productivity of the fishery resource. This shouldn't be a surprise since most rebuilding plans are designed to have a 50% probability of rebuilding within the allowed rebuilding period. This means that half the time they will not. Even if the rebuilding plan is designed with a higher probability of rebuilding, there will still be cases where the stock does not rebuild on schedule.
3. Bmsy is overestimated- Another reason that a stock may not rebuild to the estimate of Bmsy on time is that the estimate may be too high, at least for the period of time when the rebuilding plan applies. For example, environmental conditions may not be favorable for the stock. It will usually be difficult to distinguish between an overestimate of Bmsy and natural variability.

It seems to me that the response to a fishery not rebuilding on the schedule of a rebuilding plan should be different for reason 1 than for reasons 2 and 3. If fisheries management fails to achieve the fishing mortality level called for in the plan, then it makes sense to take remedial action to compensate for management's failure. This will usually mean more restrictive management and lower catches. However, if the level of fishing mortality called for in the rebuilding plan is achieved, then it makes sense to me to stick with the plan until the stock size has reached the rebuilding target, even if it takes longer than expected. If there is a sound scientific basis for reconsidering the rebuilding target, this should be done, and the rebuilding plan should be revised. If a stock does not rebuild to the estimate of Bmsy after an extended period of time with fishing mortality at or below Fmsy, it is also appropriate to reconsider the estimate of Bmsy and to revise the rebuilding plan.

Some may argue that the law does not allow the flexibility to extend the rebuilding period if a stock does not rebuild according to the schedule in the rebuilding plan. It seems to me, that if the law requires rebuilding with this degree of certainty, then the law should not allow the approval of a rebuilding plan with significantly less than 100% probability of rebuilding on schedule.

The National Marine Fisheries Service's 2005 proposed revision of the National Standard Guidelines also addressed the issue of fish stocks that do not rebuild according to a rebuilding plan schedule. The proposal is generally consistent with the approach I

outlined above. Many other formulations are reasonable and worth considering. What is not reasonable is to expect that rebuilding to an uncertain estimate of Bmsy can be achieved on schedule with a high degree of certainty. Attempting to do so will require far more restrictive fisheries management than we have seen to date, including closing some fisheries entirely. This is a public policy choice which science cannot decide.

The 2006 Amendment of the Sustainable Fisheries Act did not change the requirements for rebuilding plans significantly from the 1996 Amendment, except for requiring rebuilding plans to end overfishing immediately. My understanding is that the National Marine Fisheries Service did not act on its 2005 proposed revision of the National Standard Guidelines because Amendment of the SFA was pending. Now that Congress has amended the SFA, it is time for the National Marine Fisheries Service to reconsider its 2005 proposed revisions of the Guidelines, as well as additional revisions that may be appropriate in light of the 2006 Amendment.

In particular, the revised National Standard Guidelines need to address the new requirement of the SFA to "...establish a mechanism for specifying annual catch limits in the plan (including a multiyear plan), implementing regulations, **or** (emphasis added) annual specifications, at a level such that overfishing does not occur in the fishery, including measures to ensure accountability." The Guidelines need to clarify if and when annual catch limits (ACLs) are required. There seems to be a perception in fishery management circles, including Fishery Management Councils, that ACLs are required. I'm not a lawyer, but the use of "or" instead of "and" in the SFA seems to mean otherwise. The requirement to including measures to ensure accountability also requires guidance. Fisheries management has much more direct control over overfishing than over rebuilding (for the reasons discussed above). Therefore, it is feasible, and it makes sense, to design measures to ensure accountability, although not with absolute certainty.

My bottom line is that the important public policy embodied in the SFA to end overfishing and rebuild overfished fisheries, is clear and achievable, but not with a high degree of certainty according to a rigid schedule when it comes to rebuilding. Fisheries management has direct control over overfishing such that management measures can be designed to end overfishing with reasonable confidence. However, fisheries management has only an indirect influence over rebuilding. The design and implementation of plans to rebuild fisheries need to take account of the law, science, nature and society. This is best achieved by allowing a degree of flexibility to reflect uncertainty in general, and specific fishery situations. Unfortunately, the past is full of examples of flexibility being abused such that overfishing is still occurring more than 30 years since the law prohibited it. As a result, fisheries management is very polarized and distrust abounds. This is understandable, but it is unfortunate. Finding reasonable solutions will require leadership and a new spirit of cooperation.

In closing, I would like to briefly put US efforts to end overfishing and rebuild overfished fisheries into a global perspective. Most countries have laws that prohibit overfishing, and they generally interpret overfishing in an MSY context like the USA. Effort to rebuild fisheries have spread since the World Summit on Sustainable Development (WSSD) in Johannesburg, South Africa, 2002, committed to rebuild fisheries by 2012.

The USA is fortunate to have nearly a decade head start on the Johannesburg commitment, but much more needs to be done.

In terms of fisheries management, the European Union is a reasonable example of a peer of the USA. Their fisheries are similar in size and complexity, as are their economies, social conditions and governance principles. There are also Regional Advisory Committees (RACs) that have some similarities with US Fishery Management Councils, although they have much less authority. The Europe Union's Common Fisheries Policy (CFP) is their equivalent of the SFA. It calls for fisheries management plans, and rebuilding plans for overfished fisheries. Recently, I had the opportunity to review the CFP and its performance. My conclusion is that the European Union (EU) is far behind the USA in preparing and implementing rigorous fishery management plans and rebuilding plans with a realistic chance of success based on objective scientific analyses. The EU has only recently issued a policy for rebuilding fisheries according to the Johannesburg 2002 WSSD commitment, but it does not actually aim to rebuild fisheries by 2012. Its goal is limited to ending overfishing. In general, fisheries management in the USA is much more transparent and the linkage to science is clearer, even though USA management does not always follow scientific advice. In general, I characterize USA efforts to end overfishing and rebuild overfished fisheries as more conservation oriented and more intense than Europe's.

However, there are other countries that are even more conservation oriented than the USA. For example, Australia recently adopted a "Harvest Strategy Policy" that sets the target stock size for fisheries management 20% above Bmsy, and it calls for rebuilding when the stock size is less than Bmsy. At one half Bmsy (the point at which most USA fisheries are considered overfished), Australian fishery resource species are considered a candidate for listing as an endangered species under Australian law, and fisheries may be closed.

It is informative to consider the actual performance of US fisheries management relative to the rest of the world. The percentage of stocks subject to overfishing or overfished is a useful performance indicator. Such information is uncertain and it is not strictly comparable from one country to another, but it does give a rough indication of the performance of fisheries management. The following statistics were extracted from government websites or scientific publications:

COUNTRY	OVERFISHING/OVERFISHED (%)
USA	25%
European Union	81%
Australia	40%
New Zealand	15%
Worldwide	25%

The USA has a lot more to do to end overfishing and rebuild overfished stocks, but it is not alone.

I want to thank the Subcommittee for the opportunity to testify. I hope my testimony is helpful. It solely represents my own professional judgments based on more than 30 years of experience working at the interface between fisheries science and fisheries management. I would be please to answer questions from the Subcommittee.