WRITTEN TESTIMONY
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FOR AN OVERSIGHT HEARING ON IMPLEMENTATION OF THE MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

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COMMITTEE ON NATURAL RESOURCES
SUBCOMMITTEE ON INSULAR AFFAIRS, OCEANS AND WILDLIFE

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Madam Chairwoman and members of the subcommittee: Thank you for the opportunity to testify before you today concerning the implementation of the Magnuson-Stevens Fishery Conservation and Management Act. I am Andrew Cooper, Associate Professor in the School of Resource and Environmental Management at Simon Fraser University. For the past nine years, I have also been a member of the South Atlantic Fishery Management Council's Science and Statistical Committee, making me the longest-serving member currently on the committee.

Ending overfishing and rebuilding our depleted marine resources are important economic, ecological and social issues. Livelihoods, traditions, communities, and ecosystems all depend on healthy fish stocks and sustainable fisheries. The 2006 reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) included a number of new requirements that will help ensure that our fisheries are managed in a way that is best for the fish, the fisheries, and society. In particular, the MSA and the National Standard 1 (NS1) Guidelines require: the establishment of annual catch limits (ACLs); the explicit consideration of scientific uncertainty, as separate from management uncertainty; accountability measures to achieve compliance; specific timelines for rebuilding depleted stocks; as well as a program to improve the quality and accuracy of information collected from the recreational fishing community. Each of these requirements present challenges to both science and management, but significant progress is being made on all fronts. As per your request in the invitation to testify, I will gladly share my views on these points.

1) The process of establishing annual catch limits (ACLs) using the best scientific information available.

Much of our failure to rebuild depleted fish stocks has been due to our lack of willingness decrease fishing pressure despite clearly stated targets and limits (Rosenberg et al. 2006. Frontiers in Ecology and the Environment 4(6):303-308). The problem is not limited to just US fisheries; the dangers of not having and adhering to targets and limits has been demonstrated again and again throughout the world. The poor state of the European Union's fish stocks is largely due to the absence of reference points, and the current state of Atlantic bluefin tuna is entirely due to ICAAT's mixing of politics with the science in setting risk-prone reference points and then not even adhering to them. Excessive fishing pressure truncates a stock's size and age distribution (removing the larger and older individuals), lowers the genetic diversity (which may hamper the stock's ability to adapt to changing environments), and suppresses its reproductive capacity (thus slowing recovery).

Overfishing Limit and Allowable Biological Catch

The MSA, as interpreted by the NS1 Guidelines, helps prevent excessive fishing pressure by requiring each Council's Science and Statistical Committee (SSC) to define a level of catch that should not be surpassed (called the overfishing limit or OFL) as well as an allowable level of catch (called allowable biological catch or ABC) that is less than or equal to the overfishing limit. The Science and Statistical Committee is a group of academic and government scientists, selected and appointed by the Fishery Management Council, to review the science behind management options and advise the Council on their proposed management decisions. The amount by which the allowable biological catch should be set below the overfishing limit depends on both the scientific uncertainty in the overfishing limit and the Council's risk tolerance to overfishing. This amount is often referred to as the buffer between the overfishing limit and allowable biological catch. The estimate of the overfishing limit is based on two things: an estimate of the stock's current abundance; and an estimate of the fishing mortality rate that would produce the largest sustainable catch in perpetuity if the stock's abundance was at a healthy level (referred to as Fmsy). There is often significant uncertainty in one or both these estimates arising from the assessment's ability to precisely estimate these values given the data at hand, the level of complexity of the stock assessment model, the life history of the species, and the inherent uncertainty about the long-term dynamics of the stock.

Explaining the idea behind the Council's level of risk tolerance is a bit less straight-forward. There is a 50-50 chance that the true overfishing limit is lower than that estimated by science. If the allowable biological catch is set equal to the overfishing limit, and fishermen caught exactly the allowable biological catch, then there is a 50-50 chance that the catch would actually be too much relative to the productivity of the stock simply because of scientific uncertainty in the estimate of the overfishing limit. To obtain the Council's level of risk tolerance, the Science and Statistical Committee asks the Council, if fishermen were to catch exactly the allowable biological catch, what chance are you willing to live with that the resulting catch actually turned out to be in excess of what the stock could handle? In the case of the South Atlantic Fishery Management Council, they stated at their September 8, 2008 meeting that they were willing to accept a 1-in-4 chance (or a 25% probability). Once the scientists have this value, they can look at the uncertainty in the overfishing limit and determine where the allowable biological catch should be set such that if fishermen caught exactly the allowable biological catch, there would be a 1-in-4 chance that such a catch would actually be in excess of what the stock could handle.

Fully accounting for all the sources of uncertainty in a purely-data driven approach is, unfortunately, not possible. Essentially, we do not have enough data to determine whether uncertainty should be increased by, say, 10%, 20% or 30% when we our lack of data forces us to use a proxy for Fmsy rather than estimate it directly. Nor do we have data to, say, determine precisely how uncertainty should be increased when we attempt to apply a standard stock assessment model to species of fish that change sex as it grows in size. We know it increases, but not by how much. This is where expert judgment comes into play.

The treatment of expert judgment as "best available science" is nothing new to fisheries. Experts are typically defined as the government or Council scientists performing the analyses, those scientists brought into the formal review process for those analyses, and the members of the Science and Statistical Committees who make the final determination as to whether the analyses are based on the best available science. When we review a stock assessment or a the analysis of proposed management actions, we are not so much reviewing whether someone added two numbers correctly or whether their computer code is correct as we are reviewing how expert judgment was incorporated into the analysis and whether we agree with it. We are looking at the assumptions made by the analyst and reviewing the analyst's expert judgment based on our own expert judgment. As an example of expert judgment in the role of best available science, we rarely have data to directly estimate the natural mortality rate for a given stock. As such, we turn to other stocks for which we have data and then decide how those values may apply to our particular stock. As another example, when estimating the effect of recreational fishing regulations, we must often make an assumption about how effort will change in the future. We cannot know what the effort will truly be, but we can look at the rate of past changes in effort and make a judgment as to what future effort might be. Ideally, we would then also look at the potential consequence of us being wrong; this is called sensitivity analysis. The simple truth is that we will never have enough data so that the model, alone, without any input of expert judgment, will tell us everything we need to know. We will always have to make assumptions and therefore always have to rely on expert judgment to some extent. The key with using expert judgment as "best available science" is that it be applied in a consistent and transparent manner such that everyone can understand how the decisions were made. The debate can then focus on the validity of the underlying assumptions rather than on simply the outcome. This is true whether we are talking about how much below the overfishing limit to set the allowable biological catch to account for scientific uncertainty or about the effectiveness of specific fishing regulations.

The South Atlantic Fisheries Management Council's SSC has developed a system to formally incorporate expert judgment into the determination of the buffer between the overfishing limit and allowable biological catch called the ABC Control Rule. Generically, a control rule is a suite of rules or guidelines, agreed upon in advance, that determine how decisions will be made in the future depending on the data at hand and the situation being faced. In this particular ABC Control Rule, once the overfishing limit and its statistical uncertainty (which does not account for all sources of scientific uncertainty) have been estimated, the overfishing limit is evaluated according to four specific dimensions: assessment information, characterization of uncertainty, stock status, and the productivity and susceptibility of the stock. Each dimension has a set of tiers into which every assessment can be classified, and the statistical uncertainty is then adjusted in a systematic manner depending on which tiers it falls into. This approach is similar to the one developed by the North Pacific Fishery Management Council that has been in use since at least 2003. The advantage of such an approach is that not only are decisions for the buffer sizes transparent, but they are repeatable in that it will produce the same result each time when presented with the same information. More importantly, as information and certainty increases, the difference between the overfishing limit and allowable biological catch will be decreased in a systematic manner, consistent across all species. This ABC Control Rule has also been presented to the Gulf of Mexico Fishery Management Council and the Mid-Atlantic Fishery Management Council, and I believe it was quite well-received. In addition, this approach and others will be discussed at the upcoming National SSC Meeting in November 2009. For a full description of the ABC Control rule, please see the attached document that was presented to the South Atlantic Fishery Management Council at their September 2009 meeting and will be incorporated into their Comprehensive Annual Catch Limit Amendment.

This ABC Control Rule, however, requires an estimate of the overfishing limit and its statistical uncertainty. Work is currently underway to develop similar approaches for stocks which lack enough information to estimate the overfishing limit, a proxy for the overfishing limit, or the statistical uncertainty about the overfishing limit. These stocks are often referred to as "data-poor stocks". There are many excellent ideas being explored, but it unfortunately takes time to develop, analyze, and review the various methods. But, we’d rather take that time (still within the implementation timeline, though) to do it correctly than rush and get it wrong. I will discuss the situation for data-poor stocks in the next section.

To allay some potential fears, it should be noted that uncertainty in estimating a specific value for the overfishing limit does not necessarily translate into uncertainty about whether a stock is overfished (too small relative to its limit) or whether overfishing is occurring (catches in excess of the limit). For somewhat complicated statistical reasons, it is often much easier to estimate the relative size of a stock or the relative fishing pressure compared to a limit than it is to estimate any of those specific numbers directly.

Annual Catch Limits

With the overfishing limit and allowable biological catch now specified, annual catch limits (ACLs) and their associated accountability measures (AMs) can now be determined. The annual catch limit should be set less than or equal to allowable biological catch and serves as a triggering mechanism for corrective fishery management action as defined by the accountability measures. It is generally assumed that the Councils will set the annual catch limit equal to the allowable biological catch, essentially triggering the accountability measures when catch exceeds that which is based on their risk tolerance (namely, the allowable biological catch). It is important to note that the annual catch limit is a limit to be avoided and not a target to be aimed for. This is where management uncertainty (also called implementation uncertainty or outcome uncertainty) comes into play. When fisheries are managed by such measures as season timing, days at sea, bag limits (the number of fish a recreational fisherman may catch in a day or have in possession), trip limits, and the like, there is still uncertainty as to whether those measures will constrain actual catch near the target level of catch and below the annual catch limit. Fisheries with hard quotas and real-time monitoring are much less likely to exceed their annual catch limit. It has been shown that reducing management uncertainty (e.g. via better real-time monitoring of catch) may do more to ensure that targets are attained and limits are avoided than spending time and energy to improve upon sophisticated assessment models or forecasts (Holt and Peterman, 2008. Canadian Journal of Fisheries and Aquatic Sciences 65:1459–1474).

It is my opinion that managers should explicitly take management uncertainty into account so that fisheries that have a large amount of management uncertainty have targeted catch levels farther away from the annual catch limit than do better controlled fisheries. If, for example, a fishery tends to catch far more fish than is intended by the management measures, then there is a high chance that even if the overfishing limit, allowable biological catch, and annual catch limit are properly established, catches could exceed even the overfishing limit, thus violating the Council's own stated risk tolerance. That stated risk tolerance assumes that the fishery will catch only the allowable biological catch level. As management uncertainty decreases, the catch targets can be moved to a level closer to the annual catch limit. To help prevent catches exceeding the annual catch limit too often, the NS1 Guidelines state that if the annual catch limit is exceeded in one out of four years, then more restrictive management measures must be put in place. Personally, I would prefer to get it correct the first time rather than be forced to frequently change fishing regulations, making them more and more restrictive. This is also where the importance of accurate and timely data comes into play, and I will address this later.

2) Actions that can be taken to meet data collection and management needs in data-poor situations.

Establishing targets and limits for data-poor fisheries is a significant challenge, but progress is being made on multiple fronts and many creative solutions are being explored. For instance, Dr. Alec MacCall just published a method to estimate sustainable yields in data-poor situations (ICES Journal of Marine Science 2009. doi:10.1093/icesjms/fsp209). This technique, however, does require expert judgment on how small the stock is relative to its near-pristine condition as well as the relationship between Fmsy and the natural mortality rate. Another approach currently being explored by scientists in NMFS and in MRAG Americas (a consulting company with vast experience in fisheries management) adapts the Ecological Risk Assessment tool developed in Australia (Fletcher 2005. ICES Journal of Marine Science, 62: 1576–1587) to U.S. fisheries. This approach scores each fishery based on it level of productivity (defined by such attributes as maximum age or size, age at first reproduction, whether it produces few eggs or many eggs, etc.) and the stocks susceptibility to fishing (defined by such attributes as how much of the stock's range is covered by the fishery, are there places for the fish to hide, how much the species depends on particular habitats and how fragile those habitats might be, etc.). The scores from each category are tallied and used to create an over all score, with higher scores relating to stocks with greater risk and lower scores relating to stocks with lower risk. The idea is that the scores from data-rich stocks which have estimates of the overfishing limit and allowable biological catch could help scientists apply the scores from data-poor stocks to determine an overfishing limit and allowable biological catch for these data-poor stocks. This is similar to how we use natural mortality rates from well-studied stocks to inform the estimate of natural mortality for less-studied stocks. This type of analysis (called a Productivity-Susceptibility Analysis or PSA) is actually part of the SAFMC's proposed ABC Control Rule mentioned in the previous section. Along with these, the National Center for Ecological Analysis and Synthesis in Santa Barbara, California has an entire working group focusing on developing tools to manage fisheries with limited information. Will these approaches give us the same level of certainty in the status of stocks relative to their targets and limits as we get from our traditional stock assessment models? Of course not. But, they will help us manage wisely and adhere to both the intent and letter of MSA and the NS1 Guidelines.

In addition to these methods, there is a relatively untapped source of information that may be especially helpful in data-poor situations, namely local ecological knowledge. Local ecological knowledge is knowledge about an environment gained through interaction with that environment. Speaking as a stock assessment scientist, we, as a group, are obsessed with catch data, effort data, and indices of abundance collected through traditional means such as surveys and reporting requirements. These are the centerpieces of high quality stock assessments, and should remain so. However, we have done a very poor job in figuring out how to effectively use local ecological knowledge in both our sophisticated stock assessment models and in data-poor situations. Subsistence fishermen know a lot about the fish they catch. They know how abundance has changed over their lifetime, at least in a relative sense. They may have heard stories passed down from relatives as to how things used to be. They know the seasonal patterns of the species composition. Commercial fishermen, recreational fishermen, and even scientists who have spent their lives interacting with the sea may also have local ecological knowledge. This knowledge, though, may not be perfect, and may actually be quite biased. The conditions in their fishing areas may not be representative of what is happening at the scale of the stock. As we are learning even in our data-rich fisheries, the state of the stock 40 years ago may grossly underestimate the potential productivity that the stocks could achieve. Social scientists have developed methods to tap into these knowledge systems, and we as fishery and stock assessment scientists must work harder to incorporate such information, when deemed reliable, into our assessments in a formal manner.

While far from ideal when compared to assessing stocks on an individual basis, it may be useful in data-poor situations to group stocks into complexes for management purposes. The NS1 Guidelines give crucial guidance for grouping stocks into complexes that will help avoid some of the common pitfalls of managing such complexes. It may be advantageous to group stocks into complexes when the fishery fishes on multiple species and is unable to target any one species specifically, when data are limited such that the stocks status relative to targets and limits can not be determined, or when fishermen are unable to distinguish between individual stocks in their catch. For most data-poor situations, more than one of these factors may be true. When stocks are grouped into complexes, they may either be managed as an aggregate (e.g., total catch from all stocks, rather than stock-specific catches) and / or an indicator stock may be tracked to determine the overall health of the complex. However, extreme care must be taken when grouping stocks into complexes. In particular, stocks must be grouped according to their life history (growth rates, age at first maturity, natural mortality rates, susceptibility to fishing gear, etc.) and indicator stocks must be representative of all the stocks in the complex. The Productivity – Susceptibility Analysis mentioned above is one tool to help accomplish this. If species with different life histories are grouped together, then we run the risk of severely depleting the less productive stocks (which are typically longer-lived and slower growing) while potentially fishing sustainably with respect to the more productive stocks. This would go against both the letter and intent of MSA and the NS1 Guidelines. If species with different life histories are grouped together, the MSA and NS1 Guidelines would require fishing at a level that could sustain the less productive stocks, which would mean forgoing the economic and social benefits that could be achieved if the more productive stocks could be fish harder. For both these reasons, if stocks are to be grouped into complexes, then they should be done so according to their life history traits so that all the stocks in the complex can be fished sustainably for the benefit of fishermen, communities, and the marine ecosystem.

Given the tools being developed for data-poor stocks, they will be able to be managed in accordance with MSA and the NS1 Guidelines, but society would be far better off if we could move them beyond the data-poor situation. The best path out of a data-poor situation is, quite simply, better data. New statistical approaches, local ecological knowledge, and, when necessary, grouping stocks into complexes will improve management; but to move out of a data-poor situation and into one that provides more accurate and precise estimates of the overfishing limit and allowable biological catch, we need more research surveys to produce reliable fishery-independent indices of abundance, improved collection of catch and effort data from all fishermen, and more basic research on fish ecology in particular and marine ecosystem ecology in general. Each of these will help us rely less on expert judgment and increase our certainty in the results. While this is especially important for improving the situation with data-poor stocks, this will also help decrease our scientific and management uncertainty for data-rich stocks. In addition to improved data there is also need for more personnel. In 2008, NMFS estimated that over the next decade universities will produce 20-180 fewer fisheries and stock assessment scientists than will be required in order to provide managers with the information they need, with the requirement tending closer to 180 (NOAA Technical Memorandum NMFS-F/SPO-91). The challenges put before managers and scientists with respect to data-poor stocks are large but manageable, but it is going to take money, personnel, and time to move stocks out of the data-poor situation.

3) The progress in improving the quality and accuracy of data collected to manage recreational fisheries.

In 2006, the National Research Council (NRC) of the National Academies published a review of recreational fisheries survey methods. This report listed numerous criticisms of the Marine Recreational Fisheries Statistics Survey (MRFSS) and provided a number of recommendations to improve MRFSS. One of the key recommendations was that a comprehensive, universal sampling frame with national coverage should be established – in other words, a national registry of all anglers without exception. Without knowing who actually went fishing, MRFSS had to resort to randomly calling households in coastal counties to ask if they had gone fishing and then, if so, collect information on their trips. As you can imagine, this is highly inefficient, and as the NRC pointed out, can produce biased results. The national registry of all fishermen would fix this problem and go a long way in improving the quality and accuracy of the data.

I have heard, though, that while the new Marine Recreational Information Program (MRIP) is currently addressing many the concerns raised by the NRC panel, it may not improve the timeliness of the data. As such managers will have more accurate and precise information about recreational catches compared to what they have now, but only weeks after those catches took place. While this is not ideal, this should not prevent managers from using that information to predict when the recreational component of the annual catch limit might be exceeded. Improved timeliness of the data will decrease the uncertainty in these projections, but there will always be uncertainty. The existence of uncertainty should not be the cause for inaction. Rather, decisions must be made in a consistent and transparent manner in the face of such uncertainty.

4) Additional Issues: Rebuilding plans

In December 2007, the Subcommittee of Fisheries, Wildlife, and Oceans held an oversight hearing on rebuilding overfished fisheries under the MSA. However, given the recent bills that have come to my attention, it looks as though some wish to reopen this issue. As such, I would like to give you my opinion. Simply put, for the sake of our fishing communities and for the marine ecosystem upon which they depend, we need to rebuild stocks as quickly as possible. When stocks are depressed, they produce smaller catches than when they are healthy. Delaying rebuilding through excessive fishing pressure is trading long term benefits to society for short term gains. Research has shown that these short term gains are less than the long term benefits and that quicker rebuilding generally produces greater benefits for both the fishermen and the ecosystem than a delayed rebuilding schedule (Shertzer and Prager 2007. ICES Journal of Marine Science, 64: 149–159).

Beyond the fact that depleted stocks produce smaller catches, there are major issues that may arise due to stocks remaining in a depressed state. The first is that when stocks are small they are far more sensitive to the patterns of recruitment (birth), so that the stock abundance will swing wildly as large but rare birth pulses travel through the population.

It will appear as if the stock is suddenly recovering, when in fact, that recovery is entirely dependent upon the newly recruited fish, and this amount of fish is large relative to the total amount of fish already out there. If fishing pressure remains excessive, then the benefits of that birth pulse will be lost, and because such large birth pulses are rare, the stock will decrease almost as dramatically as it increased. These wild swings in abundance will frustrate fisherman who will see the stock's abundance rising and falling and wreak havoc on managers as they attempt to control fishing. A second major issue is that when a stock is depressed over long periods of time it has a greater chance of not being able to recover as the rest of the ecosystem adapts to the stock's low abundance. There is a hypothesis that this is precisely what happened to cod in the Gulf of Maine. Its depressed state allowed haddock stocks to expand, and now that haddock are relatively so much more abundant, there's no room for the cod stocks to grow. Such shifts have been demonstrated to occur in marine, freshwater, and even terrestrial systems.

I have heard it said that the 10-year rebuilding timeframe is arbitrary. But, in the writings of those who were involved in setting the precedent for this time frame, that is simply not the case (Safina et al. 2005. Science 309:707-708). The 10-year rebuilding time frame was chosen based on expert testimony of leading fisheries scientists that indicated the majority of depleted stocks could recover within 5 years if fishing ended. To prevent such Draconian measures as closing fisheries, a 10 year time frame was chosen. The lack of adhering to these timelines, though, has resulted in many of our stocks remaining in a depleted state, which in the long run decreases the benefits to society and increases the chance that the system may not be able to return to into original state.

In summary, I feel that the requirements of MSA will dramatically improve the management of our marine resources for the benefit of fishing communities, society at large, and the marine ecosystems, themselves. Preventing overfishing will help our depleted stocks recover and prevent our healthy stocks from becoming depleted. These healthier stocks not only produce greater catches, but also tend to be more stable and more robust to environmental changes. This, in turn, will translate not only into larger catches, but more reliable catches over time. The explicit accounting for scientific and management uncertainty will not only lead to better management, but will also help guide where resources should be spent by allowing us to identify those sources of uncertainty that have the greatest impact on management. Estimating overfishing limits, allowable biological catch, and annual catch limits present significant challenges, but they are challenges we are in the process of overcoming. The challenges for data poor stocks are even greater, but again, progress is being made. The Marine Recreational Information Program appears to be moving forward to correct many of the shortcomings identified by the NRC report. The new requirements of MSA, including the rebuilding timeframes, are moving both management and science in the right direction.

Madam Chair and members of the subcommittee, thank you for the opportunity to testify today. I would be pleased to respond to questions.