

March 11, 2003

Dr. Ray Hilborn
School of Aquatic and Fisheries Sciences
University of Washington
1122 NE Boat Street
Seattle, Washington 98105

Dear Ray,

We write in response to your publicly released (November 27) "Comment" on our "Science of Marine Reserves" brochure and video. In your Comment, you made three points, all of which are inaccurate. We address each of these in turn.

(1) You said that although you provided comments to us on the original draft of the brochure, none your comments seemed to have any impact on the final draft. In fact, your comments had a major influence on the final brochure, and we were and are grateful to you for them. We sought reviews from 15 scientists with a range of perspectives and took great pains to address **every** comment we received. We listened carefully to the range of feedback we received and attempted to do an honest job of balancing the range of views and comments to produce a balanced and understandable summary of the current state of the science. You may not agree with every word in the document, but this does not mean your comments were ignored.

In case you are skeptical that we modified the brochure and video in response to your review, read through the next eight pages. In those pages you will find a clear documentation of the extent to which we responded to your review. We reprint your review of June 22 in its entirety (*in italics*) and following each point you made, we provide specific information (in regular type) to indicate how we changed the text in response to your comments or we provide the rationale for why we disagree with your interpretation. After reading the rest of this communiqué, anyone would be hard pressed to draw any conclusion other than that we responded to all of your concerns, and made modifications accordingly. We thank you again for helping us identify areas where the original text for the brochure and video needed alteration and for helping ensure the final product is balanced and accurate.

(2) You assert that the brochure and video are not an accurate summary of the state of scientific knowledge regarding marine reserves. The "Science of Marine Reserves" products have been widely recognized and praised as the most accurate and balanced summary of the science, for public audiences, as it stands today. That was our intent.

It is important to note that (contrary to your suggestion) our goal was to write a summary of scientific knowledge **for the public**, not a paper for publication in the scientific literature. A wealth of published scientific information about marine reserves already exists, but is not widely understood or communicated. Our intent was to summarize the existing, peer reviewed, information in an easy-to-understand format.

In seeking a wide range of reviews from a variety of qualified scientists across the nation, we tried to produce a summary of the scientific information that was broadly representative and accurate. We had no obligation to seek this outside review; we did so because we thought it would help make the documents more broadly representative and accurate. We incorporated the comments of each of the other reviewers just as we did yours, and the document benefited substantially from that review. We named each of the reviewers of the document to acknowledge their efforts and thank them publicly.

We certainly recognize the controversies (both scientific and social) that surround marine reserves, and indeed many of us, as you know, are actively engaged in doing experiments, studies or analyses to resolve these issues. Some of the issues you raise (e.g., appropriate levels of effort reduction following reserve implementation) have received little scientific attention, so are premature to summarize. Those and other topics are ripe for investigation. It is our hope that "The Science of Marine Reserves," as well as other scientific materials, will foster discussions regarding some of these difficult and important issues and spur additional scientific research. It was not our goal to flag all of the unresolved issues, but rather to summarize many of the new findings that have not been widely disseminated.

(3) You suggest that we misinterpreted some of the examples in the brochure or used examples selectively. In the detailed replies in the next few pages, we provide specific information to answer the points you raised. In most of these cases, we investigated a range of possible interpretations and satisfied ourselves that the information in the brochure represents the most likely explanation based on all of the available evidence. In doing so, we sought information directly from the authors of the other studies and based our information on those closest to the actual study.

In your 27 November Comment, you raise an additional point, criticizing our use of the Merritt Island information in the following fashion: "the Merritt Island and St. Lucia examples were both published in a paper by Roberts et al. in *Science*" and *Science* subsequently published several critiques of this work. In fact, the brochure text about Merritt Island (pages 8 and 10) is based entirely on a paper by Johnson et al. in the American Journal of Fisheries Management, and on the actual IGFA World Records for black drum in Florida. (One of us is a member of IGFA and thus has access to the database for the world records for black drum.) The reference to Roberts et al. was included at the end of the brochure only to provide readers with additional information. The St. Lucia example was not used at all in the booklet.

We fully appreciate the importance of open exchange of ideas and information and for highlighting areas that have not yet been addressed. We, too, hope for significant progress in resolving the remaining uncertainties. At the same time, we feel it is useful and important to communicate many of the areas in which there is strong consensus within the scientific community. The "Science of Marine Reserves" products were designed specifically to share new scientific information that is emerging with the broader world interested in those results, and especially in areas where there is strong consensus. We note that you state you are "broadly in favor of Marine Reserves and believe they are a valuable tool for protection of biodiversity, and in some cases may be an important tool in fisheries management." We think the brochure says the same thing.

Sincerely,

Jane Lubchenco, Oregon State University (OSU)

Steven Gaines, University of California at Santa Barbara (UCSB)

Robert Warner, University of California at Santa Barbara (UCSB)

Brooke Simler, Communication Partnership for Science and the Sea and OSU

Satie Airame, UCSB and NOAA

Encl: Seven pages that detail your June 22 2002 review of earlier drafts of the brochure and video and provide information about the ways in which we incorporated them into the final products or why we did not change the text.

Original comments from Ray Hilborn to Brooke Simler who coordinated the scientific review process for “The Science of Marine Reserves” brochure and video. Ray’s comments are presented here in their entirety, in italics.

Following each comment, we provide a description of how Ray’s comments were incorporated or addressed, or we explain why the concerns were not valid, in normal typeface.

From Ray Hilborn rayh@u.washington.edu

Date Saturday, June 22, 2002 10:42 am

To Brooke Simler simlerb@science.oregonstate.edu

Subject Re: Review: The Science of Marine Reserves

A few comments from a skeptic.

MPA’s promise you can have your cake (protected areas) and eat it to [sic] (improve fish yields). None of the pain of effort reduction, stock rebuilding plans, etc. It would be nice if this was true.

Some of the limitations of MPAs are emphasized in the booklet so that the reader will understand that MPAs may not be successful in the absence of other types of management. With specific reference to fisheries management we noted:

Page 20: “However, other types of management are still critical. Traditional practices, such as fishing quotas, seasons, and gear restrictions are important to achieve sustainable fisheries in surrounding waters. Scientists are developing fisheries management models that incorporate both marine reserves and more traditional methods of regulating fishing effort.”

In addition, we highlighted several other limitations that affect *both* conservation and fisheries goals:

Page 1: “Marine reserves are one tool for managing ocean ecosystems, but they cannot protect oceans from all human influences. Reserves alone may not address such pervasive problems as pollution and climate change, and they may have fewer direct benefits to some fishes and mammals that move long distances.”

Page 20: “Marine reserves cannot address all that ails the ocean. Problems such as pollution, invasive species, disease epidemics, and climate change affect whole regions and require complimentary solutions. However, by protecting critical habitats, reserves can contribute to the protections and restoration of healthy marine ecosystems.”

In a general description of potential effects of marine protected areas, it is not possible to predict the amount of effort reduction that will be necessary to restore sustainable fisheries in a specific location. However, the question “How will marine reserves affect commercial and recreational activities?” is presented on page 19 as part of the considerations for reserve design. Stock rebuilding plans were not mentioned specifically, however the question “What other management strategies will be needed to complement marine reserves?” is presented on page 19 as part of the considerations for reserve design.

Specific comments

Is it true that the oceans are supporting less abundant life, or just things that we harvest are less abundant? I don't know of any evidence that biomass has changed.

The original text that provoked this comment was: "Life in the ocean was once more plentiful than it is today."

After incorporating Dr. Hilborn's comment the new text is [Page 1] "Marine environments worldwide are in the midst of a transformation. There is increasing evidence that ocean ecosystems are being altered beyond the range of natural variability by the combination of human activities, including fishing, pollution, and coastal development."

Areas closed to fishing is a very old fisheries management technique, not in all fisheries, but certainly frequently used.

This comment refers to a line in the original script of "The Science of Marine" video that stated "The idea that you can't fish some place is something that's new — that's different..." Dr. Hilborn's comments, and other similar comments, pointed out that this was not a new idea. The line was removed from the narration.

Additionally, several sentences in the text indicate that marine reserves have been used in the past.

Page 2: "—At least 23 nations [which are listed] have established marine reserves to protect biodiversity, manage fisheries, and restore depleted populations of marine animals and plants. —More than 100 marine reserves have been established worldwide."

Page 4: "Scientists have studied the performance of more than 80 marine reserves of many different sizes in a variety of temperate and tropical habitats."

In the initial discussion of areas protected from fishing have more fish—what happened to all that effort—how much did other areas get degraded?

This concern was raised again in the short piece Dr. Hilborn wrote for MPA News. Degradation of outside areas would show up as a decline in biological values (density, biomass, or maximum size) in outside areas in reserve studies with BACI designs. Of the 7 such studies we have been able to locate, density actually increased over time in control areas for five studies, there was no change in one, and an apparent decline in the single remaining study. In each case, densities increased faster within the reserve than in control areas. These findings are consistent with the explanation that the benefits of reserves beyond their borders (spillover of adults and export of larval production) commonly counter the potentially degrading effects of displaced effort.

Values inside reserves increased more than values outside. While we cannot ascribe causality for the overall increase to reserve effects, there is certainly no evidence of degradation in areas outside reserves.

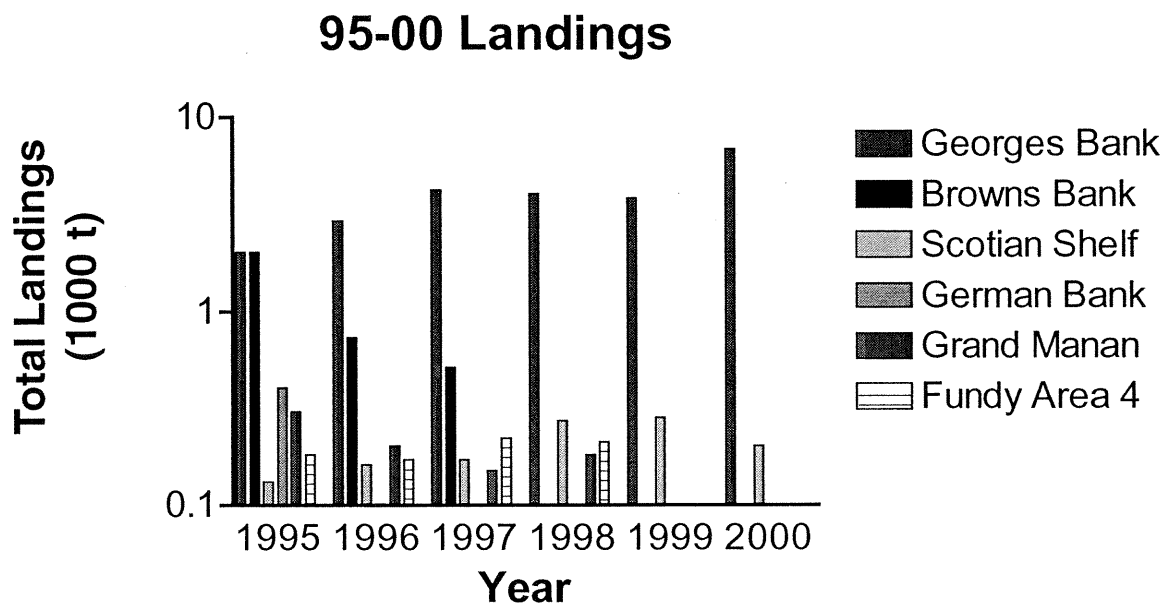
We performed this analysis after the brochure was published, so the results were not included. We do appreciate this as an important point. The goal of this section was to convey the biological responses observed within reserves. Based on the receipt of this, and related comments, the authors added the questions to the "Where Should Reserves Be Located" [Page 19] in order to acknowledge these concerns exist.

While I won't claim to be an expert on the New England scallop fishery, I would note that the scallop increased quite a bit in Canada at the same time where there were no protected areas, and in the 1990s lobsters and crabs did the same thing in most of eastern Canada (much more abundant than previously), with no MPAs.

Clearly, yields from fisheries can vary dramatically over time due to many factors. Regulatory changes and interannual variation in climatological and biological factors that affect recruitment of young, survival of juveniles or adults, and fecundity can all play significant roles. As a result, it is a challenge to evaluate the impact of any particular change. The data in *The Science of Marine Reserves* about scallop fisheries in New England, and its interpretation, were provided by fishery biologist Dr. Steve Murawski from the Northeast Fisheries Science Center. Maps were provided by Dr. Craig V. Lewis, who was a postdoctoral student at the Northeast Fisheries Science Center at the time he collected the data and now has a faculty position at the University of California at Berkeley. There are two important findings from these data relevant to reserves. First, scallop densities were dramatically higher inside the closed areas than nearby areas outside. The differences in density and age structure are striking. Second, scallop densities increased in areas adjacent to the closed areas where fishing was not eliminated. The key point here is not that the densities increased, but *where* they increased. The pattern of increase was consistent with model predictions of scallop larval dispersal from adults within the closed areas. The fact that scallops landings may have been increasing at the same time in other areas of Canada is largely irrelevant to both points. The crucial data on scallops we addressed both relied on the spatial patterns of increase (e.g., in versus out of closed area, and areas predicted to see high larval settlement), not simply that scallop densities or landings increased.

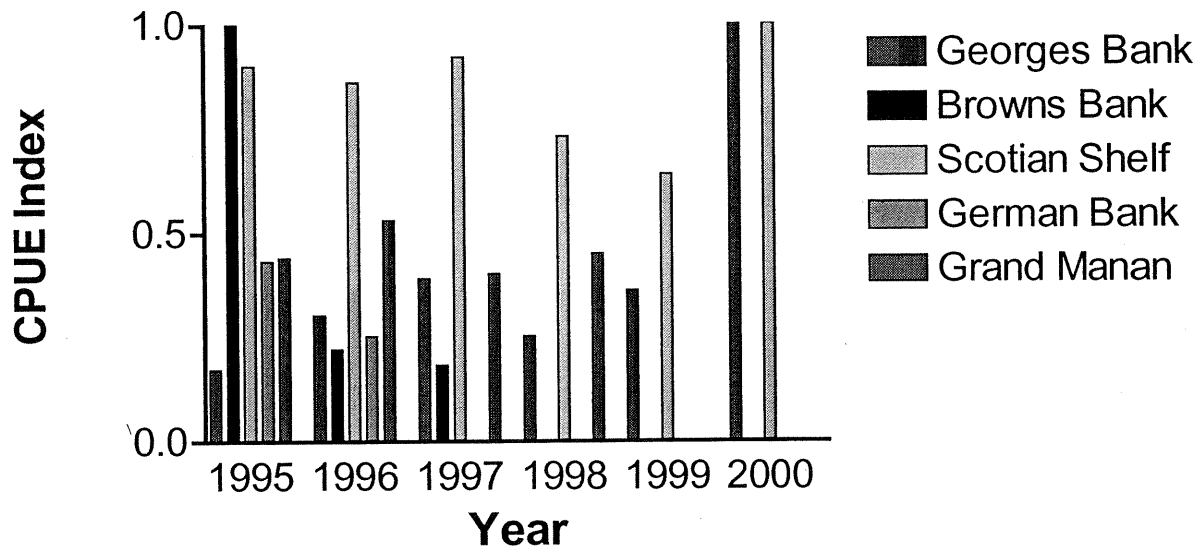
Although the scallop changes in Canada may not be relevant to these points, they are worth examining. We took a quick look at data from the Canadian DFO website to see how landings have changed since the closures. Overall scallop landings have indeed increased, but the spatial pattern of this increase is quite intriguing. If you break down the landings by region, the only area that shows a substantial increase during this period was Georges Bank, which increased more than three fold. Landings from all other managed areas either declined substantially or remained relatively constant. Since Georges Bank generates the largest yield, total Canadian scallop landings increased. These patterns are not consistent with some regional increases in scallops that could compromise interpretations. They are, however, completely consistent with the conclusions drawn in the *The Science of Marine Reserves*. The Canadian Georges Bank fishery is situated just to the east of Closed Area 1. The boundary of the closed area is the ICI line separating US and Canadian waters. The elevated adult abundances illustrated in the figure in *The Science of Marine Reserves* on page 17 can be clearly seen on the Canadian portion of

the bank. The ocean circulation models for this region suggest that larvae produced in the upper corner of Closed Area 1 should seed the Canadian part of the Georges Bank, which is consistent with the three fold increase in subsequent landings seen below. Ironically, the closed areas may be having some of their largest benefits on Canadian fisheries.



One of the more striking patterns in the Canadian fisheries statistics is that the increases in yield on Georges Bank were achieved while fishing effort declined dramatically. DFO calculates a CPUE index, which scales CPUE to its highest value for a particular region during recent years with catch and effort data. Note that Georges Bank is the only Canadian region where the trend in CPUE is increasing during this interval. Total fishing effort was half as high in 2000 as in 1995 on Georges Bank, yet landings increased three fold. As a result, CPUE increased more than five fold.

95-00 CPUE Index



I would be careful in drawing an analogy between reserves and hatcheries—there is little evidence that hatcheries actually work!

The original text that provoked Dr. Hilborn's comment was: "Scientific studies show that these processes, known respectively as spillover and export, enable marine reserves to act as natural hatcheries that supply adults and young to replenish nearby populations."

After incorporating Dr. Hilborn's comment the new text is: [Page 7] "Spillover and export may enable marine reserves to replenish nearby populations." The term "hatcheries" was deleted.

Overall you mention that reserves are controversial but you don't present any of the issues about why they might

1—have negative impacts on biodiversity

We incorporated several paragraphs that describe the possible declines of organisms due to establishment of marine reserves.

Please note page 5: "Will reserves increase the abundance of all species? Although many animals and plants become more plentiful within newly established marine reserves, some decline. For example, a fished animal, such as lobster, may increase in number and size in marine reserves and consequently reduce the number of its prey, such as sea urchins (see illustration). In addition, some species that were absent may not become reestablished in a reserve if no viable populations remain nearby."

Although it is difficult to predict the exact changes for any particular species or location, the data from existing reserves show that, on average, increases in abundance, body size, biomass, and the number of species are common outcomes after marine reserves are established.”

Please note page 6: “Lessons Learned: —Inside the reserve, kelp forests flourish because lobsters and sheephead, which are predators, reduce populations of kelp-eating purple urchins. —As a result, the kelp forest ecosystem in the reserve is more productive and stable over time than kelp forests outside. —Similar effects through the food web are likely to occur in other reserves because marine animals and plants often strongly affect one another.”

Please note page 6: “Lobster and California sheephead protected inside this reserve feed on sea urchins, thereby keeping the urchin numbers in check. Reduced numbers of urchins allow stands of kelp to flourish, which in turn support many other species inside the reserve.”

Caption on page 6: “When one species in the food web is fished, other species are affected. For example, when lobsters are fished, sea urchins become abundant and kelp declines. In a reserve, lobsters grow larger and more abundant, keeping the urchin population down and allowing kelp to grow.”

2—reduce fisheries yields

To address this comment and other comments about economic and social concerns, we completely revised pages 19 and 20. The new text does not answer these important questions, because very little information exists about potential reduction in fisheries yields following establishment of MPAs. We are unaware of documented declines in fisheries yields due to the establishment of reserves.

However, the text of the “Science of Marine Reserves” does emphasize the importance of economic and social considerations.

Page 19: “A variety of questions must be considered before reserve design can satisfy the goals of diverse communities. —How will marine reserves affect commercial and recreational activities?... The breadth of knowledge and values in each community can help to answer some of these questions. Personal knowledge can fill some gaps in scientific data. Economic modeling, based on data from landing records and logbooks, can be used to evaluate the potential short-and long-term economic impacts of reserves. Societal values can influence the design of reserves so that our traditional relationships with the ocean are protected and sustained.”

On the other hand, you don't mention how MPAs could be used in the complex multispecies fisheries like the West Coast US to protect species like bocaccio that are now driving fisheries management for other species. That is where I think MPAs could really improve fisheries yields!

Ray Hilborn

Although complex multispecies fisheries are not specifically named, the booklet emphasizes the use of MPAs as a tool to manage whole systems, rather than single species. Several statements in the booklet indicate that MPAs could be appropriate management tools for multispecies fisheries.

Page 1: "Reserves protect marine habitats in a particular place and the diversity of animals and plants that live in those habitats. Consequently, many animals and plants in reserves tend to live in greater numbers, grow larger, and reproduce more than their counterparts outside reserves."

Page 20: "By eliminating extractive and other destructive activities in particular locations, reserves can protect significant portions of entire ecosystems at once. Traditional approaches tend to focus on single species independent of other elements of the ecosystem. The most effective protection for even a single species requires an ecosystem approach, because every species interacts with numerous other species and the environment."