

Is There a Shortage of Fisheries Stock Assessment Scientists?



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INTRODUCTION

Stock assessments are critical to the management of marine fish stocks and fisheries. Stock assessment scientists develop the tools used to evaluate the status of fish stocks and fisheries, estimate the likely effects of alternative management policies, and contribute in the design of monitoring and research programs that provide the input necessary for assessments. Quantitative skills are essential; implementation of legislation, including the Magnuson-Stevens Fishery Conservation and Management Act (hereafter referred to as the Magnuson-Stevens Act), Marine Mammal Protection Act, and Endangered Species Act, requires the continual involvement of individuals with such skills. Stock assessment scientists are employed by many organizations, including state, federal, and tribal agencies; resource users, such as commercial and recreational fishing groups; non-governmental organizations (NGOs); and environmental consulting firms.

For years, anecdotal accounts have circulated of organizations, including the National Marine Fisheries Service (NMFS), facing difficulties in recruiting a sufficient quantity and quality of stock assessment scientists. University professors have also expressed concern in attracting incoming graduate students to work on stock assessment research projects.

As a result of these concerns, NMFS asked the National Research Council (NRC) to convene a workshop in 2000 to review NMFS plans for meeting its anticipated staff needs in stock assessment and social sciences. The NRC panel concluded, "For stock assessment scientists, NMFS is the primary employer and demand is already large relative to the total

supply. NMFS' anticipated expansion in this area exceeds the present capacity of university programs." (NRC 2000). Over time, programs were designed and implemented to increase the number of stock assessment scientists (DOC and DOE 2008), but concerns about a shortage still persisted.

As a result, Congress, in its 2007 reauthorization of the Magnuson-Stevens Act (MSRA), directed that a study be conducted to determine if a shortage exists in the number of individuals with post-baccalaureate degrees who have the ability to conduct high quality scientific research in fishery stock assessment, fishery population dynamics, and related fields for government, non-profit, and private sector entities (P.L. 109-479, sec. 217). This essay is a synopsis of the studies that we conducted in response to the directive by Congress; the complete Congressional Report (DOC and DOE 2008) is available at the following website: www.st.nmfs.noaa.gov/report_congress/.

Based on the results of two studies, one investigating the anticipated demand and one estimating the current supply, the Congressional Report concludes that a shortage likely does exist. Numerical estimates of the shortage were calculated, albeit with a number of well-defined limitations and assumptions, as one would expect from broad-based surveys. In this essay, however, we take a slightly different approach in the hopes of eliciting further discussion as to whether a shortage exists, and if so, what the likely causes are and what the solutions may be. To do this, we draw evidence from the studies within the Congressional Report and pose the question, "Is the likelihood of a shortage sufficient to require the development

and implementation of a strategy to increase the supply? If so, what should be the strategy's components?"

For the purpose of this article, the term "stock assessment" will be used to represent "stock assessment, fishery population dynamics, and related fields." The term "stock assessment scientist" will be used to represent "individuals who have the ability to conduct high quality scientific research in stock assessment, fishery population dynamics, and related fields."

DEMAND

Over time, fisheries management has required increased involvement of stock assessment scientists. Further, legislation has given science, scientists, and stock assessment scientists a larger role in the management process. Increased data availability and computing power have allowed more complex questions to be addressed.

The MSRA increased the responsibilities of stock assessment scientists by requiring the establishment of annual catch limits and associated accountability measures on all stocks addressed in fishery management plans (Section 104 (a) (15)). Addressing this critical new requirement, along with additional requirements in other parts of the MSRA, created substantial new responsibilities for stock assessment scientists.

For the Congressional Report, we asked NMFS science centers about their current number of stock assessment scientists and their anticipated future needs (DOC and DOE 2008). They reported the following:

- NMFS currently employs about 90 stock assessment scientists.
- Approximately 40–44 retirements are anticipated over the next 10 years.
- To meet its growing responsibilities, NMFS would need to create 95-102 new stock assessment scientist positions within the next 10 years.
- Combining the number of retiring stock assessment scientist positions to be replaced with the number of new positions required summed to a total of 135-146 new hires within the next 10 years.
- The minimum number of new hires within the next 10 years amounts to 150% of the current number employed.
- Approximately one-half of the new hires are needed within the next 5 years.

The numbers above do not account for state marine fisheries agencies, regional fishery management councils, or interstate commissions, all of which are included in the Congressional Report. Neither the numbers above nor the Congressional Report account for tribal fishery management agencies, non-governmental organizations, environmental consulting firms, state and federal freshwater fisheries agencies, or the many other organizations that rely on individuals with the skills required of stock assessment scientists. Given the increasing role of stock assessment scientists in fisheries management, demand is likely to grow in all of these professional sectors.

SUPPLY

While the demand for stock assessment scientists has been increasing, the supply has not kept pace. As part of the

Congressional Report addressing the supply of stock assessment scientists, we surveyed college and university department heads with fisheries-related programs (DOC and DOE 2008). Several of the survey components indicated a trend towards academia supplying insufficient numbers of graduates with training that would allow them to enter into a stock assessment position with a skill set advocated by NMFS. In particular, faculty expertise, graduate education, and quantitative training of undergraduates were viewed as major concerns in the supply issue.

Faculty Expertise

Faculty are at the center of the supply issue, as faculty teach courses and supervise research and training of students entering the discipline and job market. Department heads provided the following responses concerning faculty:

- Retiring population dynamics faculty will be replaced at a lower rate than fisheries faculty in general (77% vs. 91%).
- Assuming new faculty positions were available, only 12% of the hires would be in the field of population dynamics.
- Nearly one-third of fisheries programs reported that they do not have the resources necessary to train students to conduct research in population dynamics.

Graduate Education

As part of the supply survey, we created a list of graduate-level courses potentially available to fisheries students at most institutions with fisheries-related programs (DOC and DOE 2008). From that list, the NMFS science centers were polled to devise an "essential curriculum" that would prepare graduates for employment as stock assessment scientists for the federal government. Nine of the 32 courses identified were deemed essential by the NMFS science centers: *population dynamics*, *fish ecology*, *multivariate statistics*, *sampling theory*, *fisheries or natural resources modeling*, *Bayesian statistics*, *stock assessment*, *risk and decision analysis*, and *fisheries or natural resources computer programming*. Department heads were asked whether or not their universities offered each course and, if so, the percentage of their fisheries students who took each course. Results indicated that:

- Only 7% of the universities offered all 9 essential courses, while more than one-half of the universities offered 4 or fewer.
- Less than 12% of graduate students took a stock assessment course.
- A relatively small percentage of fisheries graduate students took courses in fisheries or natural resource modeling (18%), Bayesian statistics (13%), risk and decision analysis (6.2%), and fisheries or natural resources computer programming (3.5%).

Quantitative Undergraduate Education

Problems on the supply side are not limited to faculty expertise and graduate education. The lack of undergraduate students with strong quantitative skills translates into a lack

of adequately-trained incoming graduate students. Based on our survey:

- Department heads ranked the strength of recent first semester M.S. students in 12 skill areas in the following order: verbal communication, fishery biology, fishery ecology, critical thinking, information synthesis, fishery management, fishery science, written communication, mathematics, statistics, population dynamics, and modeling.
- They were also asked to compare these strengths for recent incoming M.S. students to students in the past decade. Not only were mathematics and population dynamics the two lowest ranking skill areas overall, but population dynamics was the only skill area where recent students were perceived to be weaker than students a decade ago.
- Department heads were less successful at recruiting M.S. students capable of conducting population dynamics research than M.S. students in general.

DISCUSSION

The discipline of stock assessment is neither the first nor the only discipline to notice a decline in the quality of quantitative education in U.S. institutions of higher learning. There has been an ongoing multidisciplinary call to improve undergraduate science, technology, engineering, and mathematics (STEM) education nationally (NRC 1996; NSF 1996). Stock assessment is only one of many disciplines feeling the effects of decreased performance from incoming graduate students in quantitative fields.

Demand for stock assessment scientists is increasing at a time when faculty are not being added or replaced in the same proportion as currently employed. As a result, limited graduate course offerings

are likely to be further reduced, and quantitative skills of incoming graduate students will likely continue to decline.

As the leading employer of stock assessment scientists, the burden of reducing the shortage of stock assessment scientists, if one truly exists, largely lies with NMFS. Producing additional stock assessment scientists requires time: time to find promising students and time to train them adequately. The new mandates under the MSRA do not allow for delays, which means that efforts to increase the supply need to begin immediately. Such efforts would need to incorporate mechanisms to increase faculty with expertise in stock assessment, graduate course offerings, and the number of incoming graduate students with strong quantitative backgrounds. NMFS has created and implemented programs aimed at accomplishing each of these goals, but their current scale is likely to be insufficient to solve this potential shortage (DOC and DOE 2008).

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