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Training a Generation of Avid Journal Manuscript Reviewers

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Peer review is an essential element of the scientific process. A good peer review acknowledges and appreciates the scientific advances made in a submitted manuscript (if any), identifies errors, gaps, or misinterpretations in the manuscript, either in the research itself or in its presentation, and conceives and articulates a clear set of steps (if possible) to revise and improve the quality and scope of the research. As such, the vast majority of published science, in *Fisheries Oceanography* or any other scientific journal, has benefited from and been improved by (often) anonymous reviewers who serve as the 'gatekeepers' of published science.

While individual scientists employ a wide range of styles in conducting peer review, a good review contains several common elements: (a) an understanding of the objectives, methods and key results of the research; (b)

familiarity with the broader context within which the research fits; (c) identification of both the strengths and weaknesses of the research, as conducted in the analyses and as organized and presented in the manuscript; and (d) well-articulated guidance on how to improve the manuscript, within the confines of feasibility and reasonableness. When done well, the review is both informative to the editor tasked with making a decision on publication and constructive to the authors in leading them to an improved manuscript.

Given the critical role that peer review plays in advancing science, it is concerning to note that the appreciation and skills required for good peer review are not generally taught in our graduate departments. While students receive significant experience in developing independent, critical thinking, and in participating in scientific publication as an author, it is much less common for them to receive guidance and experience serving as peers who must judge the quality of their fellow scientists' research.

At the University of Maine, we organized a peer review assignment in a graduate-level course in Fisheries Oceanography. At the beginning of the semester the professor (GZ) had a discussion with the graduate students about the important difference between writing a manuscript for submission to a journal (a task of most graduate students) and reading fully vetted and peer reviewed scientific literature. Most graduate students are not given the opportunity to see the steps between the first submission and what winds up in the literature. Yet we use the published literature and mentor them through writing papers with a committee, even though they are not usually formally walked through being a peer reviewer themselves. The students showed an interest in learning about that process, and since the course was Fisheries Oceanography the professor reached out to the *Fisheries Oceanography* editor-in-chief (SB) to see if there might be three submitted manuscripts that could be reviewed by the peer groups within the class. Three submitted manuscripts were provided with the usual timeline for peer review. Students chose one of the three papers based on their interest and expertise. Before we received the manuscripts we reviewed three papers reviewing the ethics and process of peer review along with the outlined review process for *Fisheries Oceanography*. Students worked out of classroom time to review the manuscripts and met with GZ over three weeks to complete the reviews. Students carefully considered the science and discussed details about the methodology in depth as they considered the manuscripts. They developed their thoughts and provided carefully worded comments in the form of a summary of the work as they understood it, a list of overall considerations for the authors, along with line-by-line instructions for consideration. Not only did they learn about the process of peer review but they were able to dive deeply into multiple theoretical and methodological aspects of fisheries oceanography. All groups shared their process with the larger class and most students provided feedback about it being a valuable process for them:

...The peer review project for Fisheries Oceanography was one of the most helpful from any graduate course I took. We were introduced to the other side of the peer review process and gained reviewer experience. This, in turn, prepared me to submit for publication and address comments and questions from experts reviewing my own work. Overall, I gained confidence in the submission process and believe this course project to be both informative and worthwhile.

Catherine Frederick, Maryland Sea Grant (PhD Marine Bioresources, U. Maine)

...That experience was really important for my learning experience because it allowed me to think critically about a publication, not just as a student but as a reviewer. Understanding the entirety of the review process helped me immensely later on when writing and reading literature, because I understood the pathway to publication from start to finish

Mattie Rodrigue, OceanX (Dual M.S. in Marine Biology and Marine Policy, U. Maine)

...Fisheries oceanography stood out from my other graduate courses at the University of Maine. I really enjoyed the interdisciplinary approach to the material, which spanned multiple fields to link the physical ocean environment with fish biology and behavior. This was also the only class I took that taught me to review scientific papers, stepping us through the entire process with actual submitted manuscripts related to course topics. Being able to write good, constructive reviews has greatly improved my ability to contribute to my field, and I think all science graduates should have this training

Haley Viehman, Fisheries Acoustician, Echoview (Interdisciplinary PhD in Engineering and the Natural Sciences, U. Maine)

The exercise described here involved a collaboration between a professor (GZ) and editor-in-chief (SB) to provide a real-world peer review experience for graduate students. It was mutually beneficial to all involved: the students gained experience in critically judging and recommending improvements to another scientist's research, and can use the end product as a template for reviews they will inevitably be called upon to make in their careers; the professor conveyed to her students the value of peer review to the scientific process, while providing them valuable experience in the skills of critical thinking and lucid scientific writing; and the editor received thorough and highly constructive reviews in a timely manner, and introduced a class of future fisheries oceanographers to our journal. We believe this process also greatly benefited the authors of these papers, whose submitted manuscripts were treated carefully and respectfully and were much improved in the process. As publishing output continues to increase and experts are over-saturated with review requests, it is valuable to get contributions from another pool of eager and skillful peer reviewers.

We personally found this to be a meaningful and rewarding experience and believe both the students and science more generally will benefit in the long run. We strongly encourage other educators to consider working with journal editors on peer review, and invite professors of oceanography and fisheries science to contact *Fisheries Oceanography* to organize their own course in peer review. As always, we thank all of our peer reviewers for their contributions to the journal.