STATEMENT OF GRANT PURPOSE

Easton R. White, Canada, Biology

“Assessing predator-prey relationships in global fisheries”

I seek Fulbright funding to spend the academic year in Canada working with Professor Julia Baum at the University of Victoria, applying the skills I have developed in mathematics and statistics, in an effort to understand better how different species and populations of marine organisms interact at varying temporal and spatial scales. My research will attempt to answer questions about how populations of different animals affect each other in complex food webs and how humans impact marine ecosystems through fishing and resource harvesting. Large data sets to answer these questions have been collected from around the world already, but the challenge is how to probe and recognize meaningful patterns in the data. My project will use statistical modeling and develop new computational algorithms to do precisely this.

Over the past fifty years, large marine vertebrate populations have been declining at an alarming rate because of targeted fisheries and from fisheries bycatch. However, there is a dearth of knowledge regarding exact estimates of declines, consequences of species removal from the food chain, and the extent of population recovery on a global scale. In fisheries and conservation biology, stock assessments evaluate the health of a specific population, but the people doing these evaluations commonly base their conclusions on a single species or population in a particular location in the world. However, drawing conclusions from these types of studies can be misleading. Species of marine organisms do not act independently; they are part of a complex food web of multiple trophic levels, which includes humans, on a global, not local scale.

An online database called the RAM Legacy Stock Assessment Database has assembled and organized data from fisheries around the world. Although the database is a work-in-progress, it has already been instrumental in addressing issues related to the difference in management success across different countries and geographic areas of the globe, how specific life history traits relate to potential population collapse, the future of global fish stocks, sustainability of seafood, and explaining the similarities and differences between conservation and fisheries perspectives. Professor Julia Baum of the University of Victoria is one of the persons who built this database; she has been a pioneer in answering questions about how species interact, specifically focusing on how they do so on large spatial scales. Importantly, she has also been addressing specific questions related to anthropogenic impacts on marine ecosystems. She is able to tackle these problems because of her background in statistical modeling, which allows a quantitative approach to these biological questions. My background in computational modeling and statistics complements her lab research goals (see attached letter from Professor Baum).

I will arrive in Canada in September 2013. For the first month, I will study the RAM database to familiarize myself with it, after which I will spend approximately one month extracting data of interest from the database, focusing on data representative of many marine taxa across large spatial scales. Specifically though, I want to examine the role large predators (i.e. sharks, tunas and billfishes) have in marine ecosystems and how humans can affect this role through fishing. For the next five months, I will analyze the data using already proven statistical modeling methods as well as developing new techniques to analyze relationships between marine species and impacts of humans. In particular, I will use the large datasets and statistical modeling techniques to test two predictions. The first prediction, that large predators can have a dramatic effect on prey populations. The second, and perhaps more interesting component of my project will be to see how fishing of different prey and predator populations can disturb natural

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processes and potentially drive populations to extinction. I would hypothesize that overfishing can dramatically affect marine fish populations and will have differing effects when I examine overfishing of specific predators, their prey or both. The final two months I will be working on drawing conclusions based on our analyses, which will provide information that will be able to better inform policy and management decisions of global fisheries stocks.

Over the past three years I have been working on a variety of research projects, all involving mathematical and computational ecology. I have studied a number of different systems with focused questions related to what drives animal populations to fluctuate, how different species interact with one another, and how spatial and temporal components affect animal populations. To answer these questions, I constructed mathematical simulation models of the different populations to test different predictions and hypotheses. In the case of wolves and moose population dynamics we found that the wolves have very little effect on driving the fluctuations we see in the moose population size. Our work on pika evolution has already yielded results not seen in the current literature. Specifically, we found that behavioral traits, like dispersal, can evolve simply as a consequence to the spatial distribution of where pikas live. We are currently finalizing our results in two publications; one explores basic population dynamics of pikas and the other explores the evolutionary questions we addressed. Finally, I am finishing up a publication based on my findings for conservation strategies of a lemon shark population in the Bahamas. In particular, I found that certain demographic parameters are much more important than others in predicting population size and how dramatically that population can fluctuate on a year-to-year basis. In addition, I found that changes in the environment might be the most important consideration in making predictions for the population. My background and research experience will be instrumental in helping me answer the research questions I am posing for my project in Canada.

The fisheries I will be studying are important, as approximately twenty percent of the world’s animal protein comes from the sea. In addition, given that different countries can disturb marine ecosystems in regions even far away from their own, nations, particularly developing nations, may be detrimentally affected because they rely heavily on the availability of oceanic food. Therefore, it is more critical than ever to understand how intricate marine ecosystems operate and the effect we have on the ocean. Understanding these processes on the global scale is the only way to draw real conclusions and make informed suggestions to policy makers and resource managers.

British Columbia has become a central hub for fisheries and marine conservation research. Professor Julia Baum collaborates with a number of scientists not only from Canada but also from around the world. Working with Professor Baum and learning new statistical tools will be significant for me when I begin a PhD program mathematical ecology in fall 2014. My PhD will again be addressing marine ecological problems through mathematical and statistical modeling.

Studying in Canada will also allow me to conduct public outreach about my research, as the University of Victoria already has an established organization called the UVic Speakers Bureau that will provide me the framework to speak with local schools and clubs about my research. I am very excited at the opportunity to do so.