Current ability to assess impacts of electromagnetic fields associated with marine and hydrokinetic technologies on marine fishes in Hawaii

Daniel J. Pondella II
145 Lyndon Street, Hermosa Beach, CA 90254-5108
Phone: (323) 533-3869 E-mail: pondella@oxy.edu

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LONG-TERM GOALS

To compile and analyze the existing information related to the potential effects and impacts of electromagnetic fields (EMF) associated with marine and hydrokinetic (MHK) technologies on the behaviors and movements of fishes with a focus on electro-sensitive species in the region around Hawaii.

OBJECTIVES

1. Conduct a review of relevant literature.
2. Assess the current ability to evaluate potential effects and impacts of EMF generated by subsea transmission cables associated with MHK and offshore wind developments on marine fishes in the Hawaii Region based on the available published information.
3. Develop recommendations for data collection to close any important knowledge gaps.

APPROACH AND WORK PLAN

The Vantuna Research Group (VRG) will compile the relevant available information to assess the current ability to evaluate potential effects and impacts of EMF generated by subsea transmission cables associated with MHK and offshore wind developments on marine fishes in the Hawaii Region. Then we will prioritize focal fish species as candidates for various paths of future research.

Dr. Dan Pondella and Dr. Jeremy Claisse are leading the project and developing the approach to rank and categorize focal species as candidates for future research. Jonathan Williams and Laurel Zahn are performing the literature search and participating in the literature review. Chelsea Williams is performing document management, budgeting, and accounting support

WORK COMPLETED

All objectives listed above for this project were completed as of 30 September 2015.

RESULTS

Marine and hydrokinetic energy (MHK) and offshore wind devices are being developed and deployed in U.S. and international waters. Electric current flowing through subsea transmission cables associated with these devices will generate electromagnetic fields (EMF), which may interact with, and potentially impact, marine fishes. Some marine fishes can detect electric and/or magnetic fields and use them to navigate, orientate, and sense prey, mates, and predators. Over the past five years there have been multiple comprehensive reviews and studies evaluating the potential vulnerability of marine fishes to EMF produced by MHK devices. Most documented

effects involve sub-lethal behavioral responses of individual fish when in close proximity to EMF (e.g., fish being repelled by or attracted to fields). These reviews reach conclusions that the current state of research on this topic is still in its infancy and evaluations of potential impacts are associated with great uncertainty. A variety of MHK technologies are likely to be considered for deployment offshore of the Hawaiian Islands, and there is a necessity to better predict and assess potential associated environmental impacts. To address this, we first developed a list of Hawaii Region Focal Species, which included fishes that are more likely to be sensitive to EMF. We then compiled species-specific information available in the literature on their sensitivity to EMF, as well as life history, movement and habitat use information that could inform an analysis of their likelihood of encountering EMF from subsea cables associated with MHK devices. Studies have only documented EMF sensitivity in 11 of the marine fish species in this region. There was also relatively little detailed information on fish movement and habitat use patterns for most of the focal species. Our last objective was to develop recommendations for research needs to close the important knowledge gaps. We described species-independent baseline research that primarily consists of *in situ* quantification of EMF generated by MHK devices and undersea cables that can occur as pilot and commercial scale MHK devices are deployed in Hawaii. Then we proposed a simple approach for prioritizing Hawaii Region Focal Species (ranked relative to each other) as candidates in multiple related research paths. The prioritization approach incorporates EMF sensitivity information with the likelihood of interacting with EMF generated undersea transmission cables associated with MHK devices. Finally, we discussed the types of research needed to help fill gaps in the scientific knowledge base for this region. These involve studies to better define species-specific EMF sensitivity thresholds under various environmental conditions, studies of life history, movement and habitat use patterns to improve our understanding of the likelihood and frequency fishes may be in the vicinity of EMF generated by subsea transmission cables, and studies of the potential for related population, community or ecosystem impacts. Many of these studies can and should occur opportunistically as pilot and commercial scale MHK devices are deployed in Hawaii.

IMPACT AND APPLICATIONS

1. **National Security**
   Development of renewable energy sources in the U.S. is key to energy security, which ultimately is a key component of U.S. National Security.

2. **Economic Development**
   This project will facilitate the deployment of new MHK and offshore wind energy generating technologies throughout U.S. waters, with an emphasis on the Hawaii region, while minimizing their impact on important fish species.

3. **Quality of Life**
   The results of our study will have broad applicability to MHK projects located throughout U.S. waters, with an emphasis on the Hawaii region.

4. **Science Education and Communication**
   This project will compile a set of resources so that researchers and managers can better assess the sensitivities of fishes in the Hawaii region to electromagnetic fields, the role

they play in navigation, migration and in other important behaviors during critical life stages.

TRANSMISSIONS

1. **National Security**
   N/A

2. **Economic Development**
   This project will facilitate the evaluation of potential impacts on fishes due to the deployment of new MHK and offshore wind energy generating technologies in U.S. waters.

3. **Quality of Life**
   This information will be used by managers to guide future research and minimize the impacts on fishes from new MHK and offshore wind energy generating technologies in U.S. waters.

4. **Science Education and Communication**
   The literature search results from this project will be incorporated into the U.S. Department of Energy's Tethys knowledge management system, a system that actively gathers, organizes, and disseminates information on the environmental effects of marine and wind energy development.