Notice of the Final Oral Examination
for the Degree of Doctor of Philosophy

of

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BSc (University of Calgary, 2014)

“Chondrichthyan conservation in marine protected areas:
Elucidating species associations in two chondrichthyan hotspots
using non-invasive techniques”

Department of Biology

Friday, May 8, 2020
3:00 P.M.
Remote Defence

Supervisory Committee:
Dr. Julia Baum, Department of Biology, University of Victoria (Supervisor)
Dr. Verena Tunnicliffe, Department of Biology, UVic (Member)
Dr. Francis Juanes, Department of Biology, UVic (Member)
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Dr. Christopher Eagle, Department of Mathematics and Statistics, Uvic

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Abstract

Chondrichthians—sharks, rays, skates, and chimaeras—influence top down control of food webs and connect disparate ecosystems, yet populations of many species around the world have experienced sharp declines in abundance. Marine protected areas (MPAs) have a long history of conserving marine biodiversity, but their effectiveness to protect representative and critical habitat for threatened species on a global scale is controversial and hindered by a lack of biological and ecological data for the majority of chondrichthyan species. In this thesis, I use non-invasive baited remote underwater video (BRUV) and citizen science diver data to explore diverse chondrichthyan communities in two developing countries, South Africa and Costa Rica, and their relationships to biotic and abiotic factors in their habitats in and around MPAs. First, through a literature review, I find substantial taxonomic and geographic biases in understanding of reef shark biology, ecology, and conservation, which impair ability to implement effective conservation measures for these species. After identifying these research gaps, I used BRUVs to explore the diversity of a chondrichthyan hotspot in South Africa, finding many poorly understood endemic chondrichthyans. I discovered strong associations of the chondricthyan community to different habitat types (sand versus reef and kelp habitat), which resulted in poor diversity within one of the region’s larger MPAs—a whale sanctuary whose focus on large charismatic whales left mostly poorer quality sand habitat protected. However, a high occurrence of chondrichthyans within a neighbouring MPA suggested even small MPAs can conserve at least small resident species. I then used the BRUV data to examine the relationships amongst these chondrichthyans and the community of other marine animals within the region, finding strong co-occurrence patterns that suggest chondrichthyans, particularly the endemic catsharks, could serve as effective ‘umbrella’ species for conservation in this region where little other information is available for conservation planning and monitoring. Finally, at Cocos Island, an MPA off Costa Rica, I discovered similarly strong, species-specific associations to another aspect of habitat: temperature. I found significant and species-specific reactions to the El Niño–Southern Oscillation (ENSO).
For example, the scalloped hammerhead *Sphryna lewini* counts declined by 225.4% during strong El Niños and by 14.6% with just a 1°C rise in SST, while the benthic whitetip reef shark *Triaenodon obesus* had a weaker response, dropping by only 7.8% and 4.5%, respectively. In general, strong El Niños reduced sightings with the MPA, providing some of the first indications of how a rising frequency and intensity of these events will impact the spatial distribution of both chondrichthyans and their habitat in the Eastern Tropical Pacific. Overall, this thesis provides insight into the factors influencing chondrichthyan abundance and diversity, demonstrating the importance of considering both biotic and abiotic factors during MPA design and the need to study these factors across diverse taxonomic groups and ecosystems.