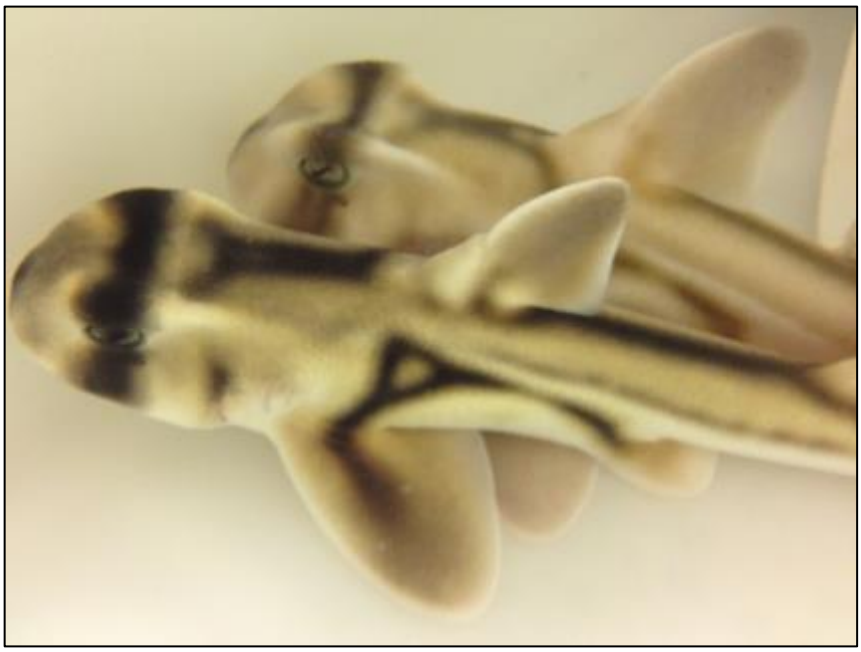
EARLY LIFE BEHAVIOUR & SENSORY ECOLOGY OF PREDATORY FISH UNDER CLIMATE CHANGE AND OCEAN ACIDIFICATION



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Cover Image: *Heterodontus portusjacksoni*. Photo credit: Jennifer C.A. Pistevos

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CONTENTS

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ABSTRACT

The early life cycle of a fish species is presumed to be the most vulnerable to abiotic change. Their successful development and growth is key to sustaining and connecting existing populations and dispersal to new habitats. Larvae and juvenile fish have to progressively develop and fine tune their behavioural and sensory capabilities in order to successfully hunt and or forage for prey, avoid larger predators and find suitable habitat to reach maturity and reproduce. Their sensory capabilities typically involve multiple senses including, vision, olfaction and audition. Ocean warming and acidification alter the physiological performance and behaviour of many small bodied fish, however, the potential interactive effects of these stressors on large predatory fish has not been explored fully and may act synergistically or antagonistically. Predatory fish can have large effects on trophically-structured systems. The potential for altered predatory function through alterations in their metabolism as a result of temperature and behaviour from ocean acidification may not only affect their hunting ability but also the communities in which their prey live. In this thesis, I show that the combination of ocean warming with acidification can alter the metabolic function and hunting behaviour of a predatory shark leading to considerable reductions in growth rates. Laboratory experiments revealed faster embryonic development under elevated temperature, however elevated temperature and CO_2 had detrimental impacts on sharks by increasing energetic demands. Subsequent mesocosm experiments showed reductions in growth rates under elevated CO_2 either alone or in combination with elevated temperatures, where their metabolic efficiency was decreased and their ability to locate food through olfaction was reduced. Additionally, while elevated temperature increased the motivational drive to locate prey, elevated CO_2 negated chemical and visual behavioural responses that enable effective hunting. I also found that ocean acidification alone altered the physicochemical sensing in a

predatory teleost fish (Barramundi) such that cues for temperature and salinity were inhibited by reduced pH. This thesis reveals a more complex reality for predators where the combination of elevated temperature and CO_2 reduces their ability to hunt effectively leading to smaller sharks, ultimately reduces their ability to exert strong top-down control over food webs. Furthermore, alterations to their perception and evaluation of environmental cues during the critical phase of dispersal have implications for ensuing recruitment and population replenishment. Alterations such as the ones brought about by ocean acidification and increased temperature far reaching consequences, not just for the individual predator population's sustainability, but also the ecosystem food webs which they inhabit.