**PROJECT TITLE:** Polarization ecology of the rocky shore  
**DTP Research Theme(s):** Living World  
**Lead Institution:** University of Bristol  
**Lead Supervisor:** Dr Martin How, Ecology of Vision Group, School of Biological Sciences  
**Co-Supervisor:** Prof Martin Stevens, Exeter University, Penryn Campus  
**Project Enquiries:** m.how@bristol.ac.uk, www.ecologyofvision.com  
**Project keywords:** polarization, vision, rockpool, sensory ecology, marine

The shore crab *Carcinus maenas* can see the polarization of light across the whole visual field. Photo: Jim Galloway.  
Predators (herring gulls) viewed against the sky in intensity (left) and polarization (false-colour image right). From Smithers et al 2019.

**Project Background**  
We are used to seeing the world in colour and brightness, but the visual scene around us is full of information that is invisible to humans. A prime example of this is polarization, which refers to the orientation of light waves as they travel through space. Surprisingly, many animals make use of this property of light and some have sophisticated polarization vision systems used as a compass sense for navigation, as a beacon to find suitable habitats, and to enhance the detection of objects across the visual scene. Intertidal ecosystems are rich in polarization cues and many of the inhabitants exhibit remarkably sensitive polarization vision. However, the polarization ecology of rocky shore environments, both above and below water, remains poorly understood. Does polarized light play a role in the ecology of rocky shore inhabitants? Do these animals use polarization vision during social or predator-prey interactions? How do environmental conditions influence these polarization-based cues and signals?

**Project Aims and Methods**  
This project will use multiple approaches to uncover the ecological importance of polarization in rocky shore environments:  
A) *Measure the polarization of rocky shores.* State-of-the-art polarization cameras from the Ecology of Vision lab will be used to film rocky shores in the Southwest UK, both above water and within rockpools, to map the pattern of polarization across visual scenes and to understand how these cues vary with ecology, time, tide, and across different weather conditions. These data will be combined with animal vision models to approximate the information available to different rockpool inhabitants.  
B) *Lab-based behavioural experiments to test the sensitivity of rocky-shore inhabitants to the polarization of light.* Modified LCD monitors, used previously by the lead supervisor to test polarization vision in crustaceans and cephalopods (see reference 3 below), will play predator or prey-like visual stimuli to rockpool species housed in the lab to investigate their sensitivity to polarized contrasts.  
C) *Ecological function of polarization vision.* Manipulations of social and behavioural contexts of animals in the rocky shore will be used to test the ecological function of polarization in the field. This will include introducing dummy predators, prey or conspecifics with carefully controlled levels of polarization (reference 2 below) and by manipulating the levels of polarized light in the local environment.
Candidate Requirements
Preference will be given to candidates with a clear interest in animal sensory ecology and that can demonstrate an aptitude for field biology. Computer programming experience would also be beneficial.

Training
The Ecology of Vision Lab (www.ecologyofvision.com) at the University of Bristol and the Sensory Ecology Lab (www.sensoryecology.com) at Exeter University Penryn Campus have a long and rich history at the forefront of sensory and behavioural ecology. The student will interact with a wide range of researchers across the two groups, including 5 PIs, 5 postdocs, 2 PhDs and 15-16 graduate research students, and have access to leading researchers in the field via membership of the Bristol Vision Institute (www.bristol.ac.uk/vision-institute). The student will also have access to state-of-the-art lab and office space in the new Life Sciences Building, Bristol, and established intertidal field-sites within 1-3 miles of the Penryn campus near Falmouth, Cornwall. The student will have the opportunity to attend the globally-renowned Sensory Ecology postgraduate course at the Vision Group, Lund University, Sweden, a 2 week training course run by world-leaders in the field. In year 2, the student will be able to present their work at the International Congress of Neuroethology in Berlin and help with planning a UK-based Royal Society meeting on ‘Polarization Vision’. The University of Bristol provides a comprehensive postgraduate training program, with topics including statistics, presentation skills and time management.

References / Background reading list

Useful links
Links:

School of Biological Sciences http://www.bristol.ac.uk/biology/courses/postgraduate/

NERC GW4+ DTP Website:
For more information about the NERC GW4+ DTP, please visit http://nercgw4plus.ac.uk/

Bristol NERC GW4+ DTP Prospectus:
http://www.bristol.ac.uk/study/postgraduate/2020/docotoral/phd-great-western-four-dtp/

How to apply to the University of Bristol:
http://www.bristol.ac.uk/study/postgraduate/apply/

The application deadline is 1600 hours GMT Monday 6 January 2020 and interviews will take place between 10 and 21 February 2020

General Enquiries:
Bristol NERC GW4+ DTP Administrator
Email: bristol-nercgw4plusdtp-admin@bristol.ac.uk