**Bridging ecology and technology: Using citizen science and artificial intelligence to track fish health**

**Lead Supervisor Name**

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**Lead Supervisor Location/Student Home Institution**

Institution: Cardiff

School: School of Biological Sciences

**Full Project Description**

Crucial to conservation and management of wild fisheries are data on fish distribution and their disease status. Anglers have reported an increasing burden of welfare issues, particularly for those prominent skin pathogens which cause skin lesions, and are often a key indicator of general health. Oomycetes of Saprolegnia species are particularly problematic; increasing in prevalence as fish become more stressed and immunocompromised in the light of climate change, and the resulting fungal-like growths on the skin of the fish are visible by eye. In the UK, wild fisheries data are collected via government agencies, such as Natural Resources Wales (NRW) and the Environment Agency (EA) using methods that can be time-consuming, laborious, and expensive. Data on the distribution and extent of visible fish diseases are, as such, sparse, leading to large gaps in knowledge even for common species. There exists, however largely untapped sources of publicly contributed data via images shared on social media that could fill this knowledge gap by providing extensive spatial data on fish distribution and disease status. Social networks have a user base of over 2 billion, reflecting the observed reality of 25% of the human population. Using AI machine learning techniques from images submitted to social media we will develop an automatic monitoring systems (AMS) to identify, across the UK, fish species, their location and signs of disease. As an alternative to directed and structured surveys, we will explore the value of social media content in which members of the public photograph and describe wildlife ad hoc, and with no particular scientific intent. Such images, taken with smart phones are geo-tagged and so could provide a rich source of validated wildlife distribution data, constituting what we term ‘passive citizen science’. We will conduct a systematic evaluation of the quality of social media observations for wild freshwater fish mapping across the UK to predict species distribution data using the textual tags and image content of photos on online photo sharing sites, Flickr, Twitter, etc. Using machine learning and computer vision processes, we will identify fish species and quantify any visible disease on the fish (e.g. Saprolegnia). Such data will allow us to map the distribution of wild fish whilst simultaneously mapping their disease status, so allowing us to rapidly identify disease distribution. As a second objective we will initiate a dedicated citizen science project to map fish distribution and health intensively on Welsh rivers. Working with stakeholders ‘Wye and Usk Foundation’ we will use their ‘fishing passport’ to roll out a citizen science project. Anglers on the Wye and Usk are required to register for a day pass so providing an infrastructure via which we can provide instructions to angler on how to upload images to the photo-sharing website Flickr. From this very low citizen science effort we will extract location data and use the machine learning tools to identify both the species in the image and the presence and extent of any disease. We will evaluate this technique as a real-time reporter of disease on this catchment. Throughout the PhD the student will co-develop the reseach with their PhD committe, and benefit from the contrasting and complimentary experiences spending time with computer scientists (Cardiff and Exeter), disease ecologists (Cardiff), and engaging with the stakeholder. This broad skill set the studentt will acquire are highly sought after in the field of ecological and biomedical research and in private (e.g. ecological consultancies) and governmental (Defra, Fera, NRW) organisations, and more widely, making the student highly employable within diverse sectors.

**Real Life challenges this project will address**

Infectious diseases in fish account for 20% of all global losses in aquatic hatcheries and 1-10% of the harvest-size fish losses; this amounts to an annual economic loss of $6 billion and spill-over of infections into wild fish stocks. Here, we aim to monitor the extent and spread of infectious disease in real-time, so allowing disease control and management to be implemented.

**What you should know about this project**

A background in computer science and/or ecology is desirable, but all training will be given. Due to the ecology-technology interface of this PhD the supervisory team is highly interdisciplinary, consisting of disease ecologists, computer scientists and a wild freshwater fisheries stakeholder, who will form a PhD committee to guide the student. Disease ecologists Perkins and Cable both run highly successful UK-wide citizen science programs, and collaborate together on fish health. Computer scientists, Jones has worked on using AI methods to extract environmental data from social media with Perkins, while Dr. Jacqueline Christmas specialises in machine learning for intelligent image understanding.

**What expertise you will develop**

The student will receive training in a diverse range of skills including computer science, experimental design, statistical modelling and GIS using ‘R’. The student will also experience running a citizen science project, so providing high-level skills in communication and professionalism.

**Why this project is novel**

We will use artificial intelligence (AI) tools to determine fish species, location and health status using social media images across the UK. Secondly, we will create a citizen science project with a wild fisheries stakeholder to use AI to track fish distribution and health in real-time in a focused area. The project represents, to the best of our knowledge, the first application of real time monitoring of fish health using AI techniques, and bridges ecology and technology.

**Rest of Supervisory Team:**

**Stakeholder Organisation** The Wye and Usk Foundation

**Stakeholder Supervisor** Chris Gurney

**Co-Supervisor 1** Professor Joanne Cable

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