DAVIS EXPEDITION FUND

REPORT ON EXPEDITION / PROJECT

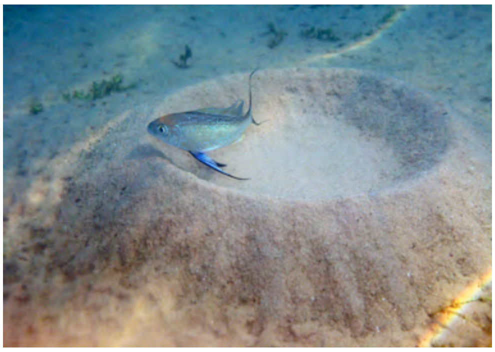
Expedition/Project Title:	Macroparasite communities of Lake Tanganyikan cichlids
Travel Dates:	22nd August 2012 – 20th September 2012
Location:	Kalambo Falls, Lake Tanganyika, Zambia
Group Members:	Alexander Hayward, Hanne Løvlie, Alexander Kotrschal, Masahito Tsuboi, Séverine Büchel, Josefina Zidar
Aims:	To sample macroparasites of cichlid fishes from across the Lake Tanganyikan radiation and investigate if certain ecological traits influence host susceptibility to parasite attack.

Outcome (not less than 300 words):- Please see attached

Macroparasite communities of Lake Tanganyikan cichlids





Project report for the Davis Expedition Fund

Alexander Hayward

Contact: zanderhayward@gmail.com

2013

Background

Despite their ubiquity in nature and the profound impact they impart upon their hosts, parasites are comparatively understudied. Thus, many basic questions remain regarding the true diversity, influence and evolutionary significance of parasites in natural systems. This expedition sought to sample the macroparasite communities of Lake Tanganyikan cichlid fishes to address some of these outstanding questions. The cichlid fishes of the East African Great Lakes constitute an explosive radiation of over 2000 species. Consequently, they are an important model system in evolutionary biology for the study of biological diversity and speciation. Given the wide range of differing ecologies and phylogenetic relatedness among these fishes, they also present a powerful model system with which to explore how differences in host traits can affect patterns in parasite distribution. Since ecologies may differ widely even among closely related individuals and there are many replicate species, the Tanganyikan cichlid system offers an opportunity to tease apart the relevance of host ecology (habitat, diet, social system, mating system, size, etc.) versus host phylogenetic similarity in determining the correlates of parasite attack.

Account of the expedition

In August 2012, the field assistants and myself flew to Lusaka, Zambia and undertook a long bus journey to Mpulungu on the southern shores of Lake Tanganyika. Mpulungu is a small town in the north east of Zambia on the southern shore of Lake Tanganyika, very close to the borders with the Democratic Republic of Congo and Tanzania. Once in Mpulungu, we visited the Department of fisheries to meet with local officials. Then, after an overnight and some topping up of supplies, we left by boat for the Kalambo Falls field station.

Although fairly remote, facilities at Kalambo Falls were ideal for our purposes, partially because the site had been used previously as a collection and holding center for fish for the cichlid aquarium trade (Kalambo Falls field station, Figure 1). Thus, we were quickly able to get organized and set up a field laboratory on one of the small piers at the waterfront (Field laboratory, Figure 2). After we had set up, we went for our first collecting trip into the lake.

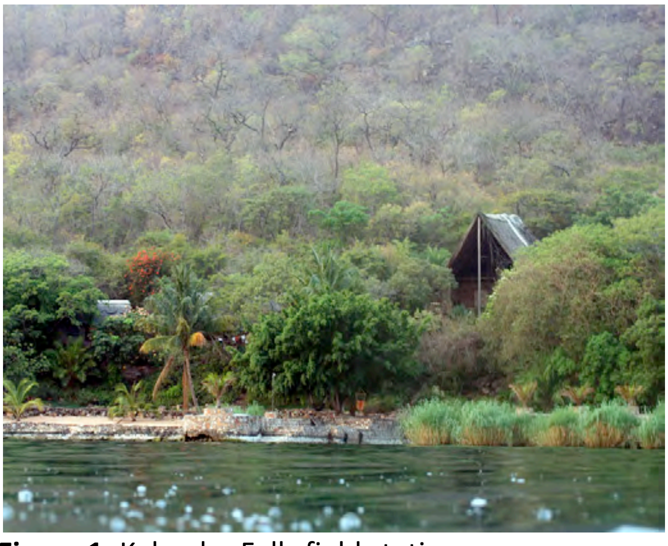


Figure 1. Kalambo Falls field station.

Figure 2. Hanne Løvlie and Alexander Kotrschal at work in our field laboratory at Kalambo Falls.

Lake Tanganyika is one of the Great Lakes of the African Rift valley, which together are estimated to hold more than one quarter of the world's freshwater supply. Tanganyika is the deepest of the three, descending to around 1.5km, and is the second largest freshwater lake in the world. The lake is very old and is one of the world's richest freshwater ecosystems. It is home to over 300 fish species and a great diversity of other organisms, some of which appear more marine than freshwater in character, for example the Lake Tanganyika jellyfish and crab.

Our first excursion into the lake was no disappointment and we soon observed a substantial diversity of cichlids present in the clear waters immediately in front of the field station (Figure 3). Over the following days we sampled cichlids using a range of techniques, and adopted a schedule whereby fish were caught and housed for one day at the field station prior to dissection. This allowed their gut contents to empty, so that dissection would be more accurate and efficient. We were helped greatly by the presence of local fish collectors who had previously worked in the aquarium trade and had excellent knowledge and fish catching abilities.

Figure 3. Cichlid fishes close to the shoreline at Kalambo Falls.

Results

Over the course of our fieldwork we were able to collect and dissect 626 specimens from 57 cichlid species of varying ecology and phylogenetic relatedness. This level of sampling was considerably higher than our initial target, and it is necessary to express our gratitude to the local fish catchers who were invaluable in helping us to achieve this total. Figure 4 illustrates the species we collected on a recently estimated evolutionary tree for Lake Tanganyikan cichlids (provided by Dr Niclas Kolm, Uppsala University), demonstrating the spread of sampling across phylogenetic diversity. No rare or endangered species were sampled for the purposes of the study, and our sample sizes will not have impacted on the large populations of cichlids present in the local area.

Our sampling represents 15/30 of our original target species, and reflects adjustments necessary given species availability at the Kalambo Falls field site. Alternative species to replace those we could not obtain were chosen to provide maximal sampling of host ecological and phylogenetic diversity. For 33/57 of the species collected we attained samples of 15 or more individuals, providing an excellent opportunity to investigate how macroparasite abundance and diversity vary among and within hosts. All fish were humanely euthanized and immediately photographed from the side and dorsal view, alongside a scale and a note of their specimen number to create an image database, of which several examples are provided in Figure 5. In addition, the weight, length, sex, sample date and location, and gut length were recorded for each fish. A tissue sample was also taken from each fishes tail to allow the possibility of obtaining host genetic data. Following this, each specimen was checked for ectoparasites and dissected.

Field dissections of the sampled fish proceeded well, despite the small body size of some of the species. To obtain gut helminth samples, a hot saline gut-wash technique was implemented with subsequent preservation of specimens in ethanol. This approach is well suited to field conditions where access to electricity and laboratory equipment is often limited, as in our case. Considerable gut helminth diversity was encountered, with specimens of the following helminth groups sampled: Cestoda (tapeworms), Nematoda (round worms), Digenea and Monogenea (flatworms), and Acanthocephala (spiny-headed worms). A surprising finding was the relative absence of macro-ectoparasites on the fish. Given the high densities of fish present close to the shoreline in Lake Tanganyika, a high abundance of ectoparasitic taxa was expected. However, we are confident this was not a consequence of our sampling procedure, and the observation was similar for fish examined whilst still in the lake.

Following the completion of sampling in Zambia, samples were exported to Uppsala University. Sorting of the samples is in progress, in order to provide counts of parasite species diversity and abundance for each cichlid specimen and species. Once complete, statistical analyses will be undertaken. To examine links among ecological traits and parasite attack, comparative analyses will be conducted within a multivariate framework controlling for shared ancestry among species. Findings will be written up as scientific papers for publication in international journals.

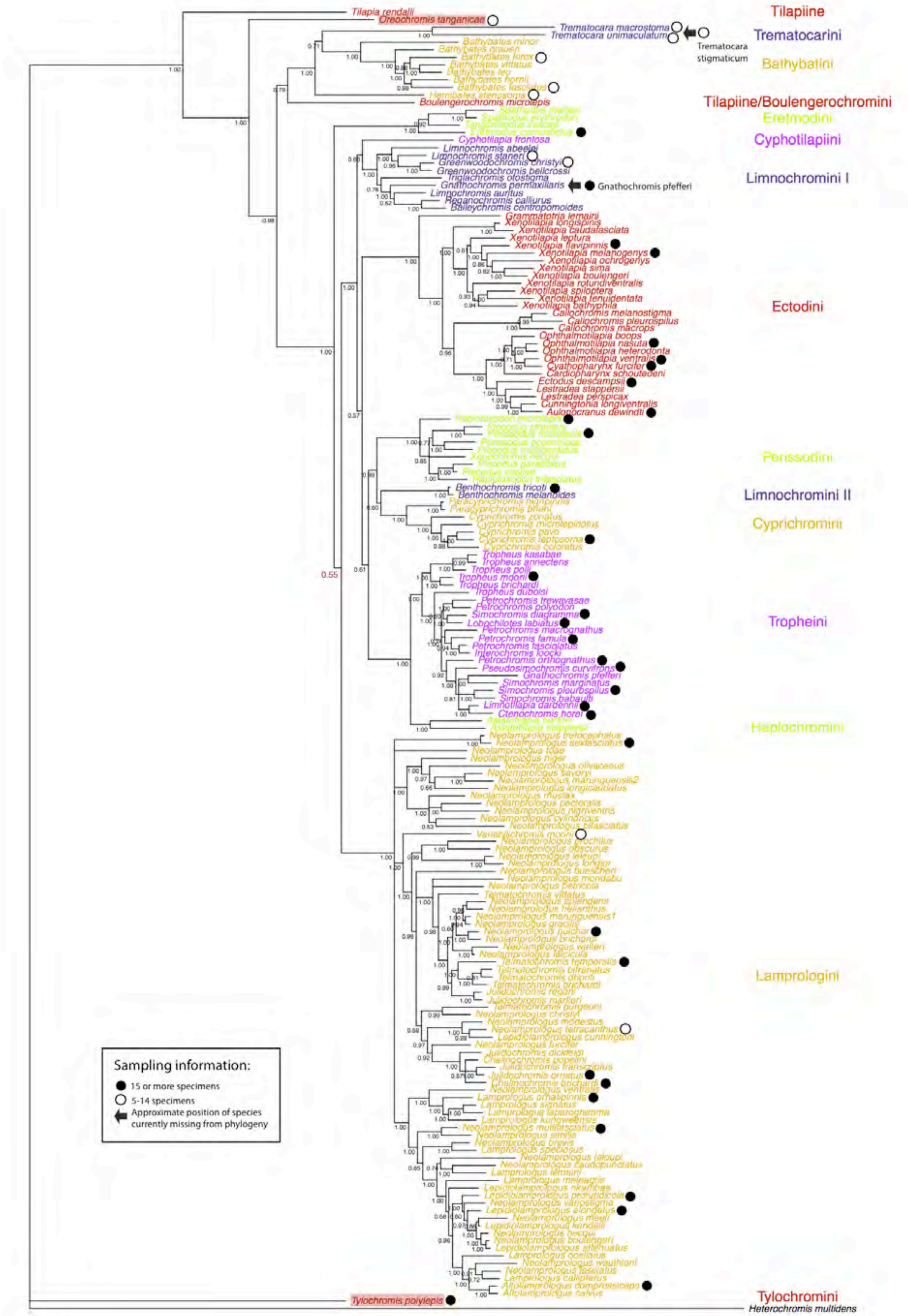


Figure 4. Evolutionary tree of Lake Tanganyikan cichlids, showing the species sampled in this study (closed circles ≥ 15 individuals sampled, open circles 5-14 individuals sampled).

Pseudosimochromis curvifrons

Bathybates fasciatus

Trematocara stigmaticum

Aulonocranus dewindti

Julidochromis ornatus

Cyathopharynx furcifer

Figure 5. Six species of cichlid fishes sampled from Lake Tanganyika, illustrating just a small proportion of cichlid phenotypic diversity present in the Lake.

Summary

Improved understanding of the factors that affect the transmission and prevalence of parasites and pathogens is of considerable applied significance. This is the case with regards both to human health and agriculture, and the management of natural ecosystems more generally. Over 10 million local people depend upon Lake Tanganyika for their livelihoods, and it acts as a vital source of food and especially protein throughout the region. Given the increasing level of human impact upon the lake, the ecosystem is changing rapidly in some locations. Under such circumstances the balance between hosts and parasites can become altered, and important conservation decisions can by influenced by a thorough understanding of parasitic and pathogenic organisms. It is hoped that this study may provide some clues into the key ecological traits of importance in determining host susceptibility to parasite attack.

I wish to end this report by thanking the Davis Expedition Fund for their support, without which it would not have been possible to undertake this expedition.

Figure 6. Local fishermen fishing for Tanganyika sardines or '*kapenta*', which are distant freshwater relatives of the herring.