Research Application Summary

Diet and feeding habits of a small catfish, *Clarias liocephalus* in wetlands of western Uganda

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Abstract

Clarias liocephalus is an air-breathing catfish inhabiting wetlands of Uganda and widely distributed in East Africa. The species is in high demand for sale as live bait in the Nile perch fishery of Lake Victoria and equally important in the diet of the local community in the lake basin. The extensive and intensive wetland loss in the Lake Victoria basin and beyond and the increasing fishing pressure on its fishery are potential threats to the resilience of *C. liocephalus*. There is however, little information on the ecology of this species to permit evaluation of habitat threats. This study quantified dietary characteristics of *C. liocephalus* by analyzing 492 stomach samples collected monthly for one year from four wetlands in Western Uganda. Results show *C. liocephalus* as a generalist feeder whose diet was dominated by aquatic dipteran larvae and plant material. There was significant size differences ($P<0.01$) between the heavily and lightly fished wetland sites. The broad niche, gives *C. liocephalus* an ecological advantage to forage effectively on a wide selection of prey. The significant presence of plant material shows that the species may utilize plant protein and this is an important clue if the species was selected for aquaculture.

Key words: Aquaculture, catfish, *Clarias carsonii*, generalist feeder, wetlands

Résumé

Le *Clarias liocephalus* est un poisson-chat à qui respire de l'air, vivant dans les zones marécageuses de l'Ouganda. Il est largement distribué en Afrique orientale. L'espèce est en forte demande pour la vente comme appâts vivants pour la pêche de la perche du Nil du lac Victoria et tout aussi important dans le régime de la communauté locale dans le bassin du lac. La perte de terres marécageuse extensives et intensives dans le bassin du lac Victoria et au-delà, et la pression croissante de pêche

sur ses activités de pêche, sont des menaces potentielles à la résistance de *C. liocephalus*. Il y a, toutefois, peu d'information sur l'écologie de cette espèce afin de permettre l'évaluation des menaces pour l'habitat. Cette étude quantifie les caractéristiques alimentaires de *C. liocephalus* en analysant 492 échantillons d'estomacs, recueillies chaque mois pendant un an à partir de quatre zones humides en Ouganda occidental. Les résultats montrent que *C. liocephalus* est aliment généralisé dont le régime a été dominé par les larves de diptères aquatiques et de matériel végétal. Il y avait des différences de taille significative ($P < 0,01$) entre les sites humides où l'on produit plus et moins de poissons. Le créneau large donne au *C. liocephalus* un avantage écologique pour se nourrir efficacement sur une large sélection de proie. La présence importante de matériel végétal montre que les espèces peuvent utiliser des protéines végétales, ce qui est un indice important si l'espèce a été sélectionnée pour l'aquaculture.

Mots clés: aquaculture, silures, *Clariascarsonii*, aliment généralisé, les zones marécageuses (humides)

Background

Clarias liocephalus is an air-breathing catfish found in wetlands and streams of South Western Uganda and widely distributed in East African wetland systems (Chapman, 1995). *C. liocephalus* is a senior synonym of *C. carsonii* according to Teugels, 1986, although in Uganda, it is still commonly known by the latter name (Chapman, 1995). It is one of the 'small' fishes that constitute an integral part of the diets of many population groups and in Uganda, it has been for decades a favoured source of protein for rural communities who exploit the wetland fishery because of its proximity and free accessibility. However, the demand of this fish as bait to catch bigger fish especially the Nile Perch, has resulted into indiscriminate fishing to satisfy the market. The high fishing pressure and the current degradation of the wetland habitat may affect the resilience of this species. There is still little published information on the biology and ecology of most of the 'small' Clariids in general and *C. liocephalus* in particular. Defining the feeding habits and identifying food resources that sustain *C. liocephalus* in its natural habitat is important in understanding the species' place in the wetland food web and its influence on other organisms in the ecosystem (Amundsen *et al*., 1996). The findings provide benchmark information for sustainable utilization, conservation and management of *C. liocephalus* in wetland habitats.

Literature Summary

C. liocephalus has significant economic, ecological and nutritional attributes, in part associated with its very high biomass in the dense interior of papyrus-dominated wetlands exclusively distributed in East Africa and the Nile Basin (Chapman, 1995). Its abundance in the wetlands of Uganda is an indication that *C. liocephalus* is well adapted to colonize the niche successfully. The high fishing pressure and the current degradation of the wetland habitat may affect the resilience of this species. It is important to understand the ecological needs of species and how changes in the biological and physical conditions of the habitat may affect their energy requirements and acquisition. Quantification of fish diets is also important in defining nutritional requirements of potential aquaculture species able to utilize food items available in the culture environments. General studies on the feeding ecology of *C. liocephalus* in rivers and lakes have been done, but no feeding ecological study has been done specifically for this species in a wetland habitat where it appears to have a very high biomass. Length and weight data provides a basis for estimating the production potential of a fishery in any given habitat. The length frequency data is used to assess fish populations and to monitor them over time in response to management strategies.

Study Description

The study was carried out in the Rwizi-rufuha wetland system, a chain of wetlands along River Rwizi, which stretches from Bushenyi and parts of Ntungamo districts, through Mbarara and Lake Mburo before entering Lake Victoria (Rwizi-Rufuha Wetland System Framework Management Plan, 2009). Four sites were selected according to their position along the river, level of fishing pressure and dominant vegetation cover. Live adult and juvenile *C. liocephalus* specimens were collected over a period of 12 months. The fish were euthanized with a lethal dose of clove oil and transported on ice to the laboratory, dissected and the stomachs excised following standard procedures (Gomiero and Braga, 2004; Blay-Jr and Agbeko, 2006). For each specimen, records were taken for site of capture, sex, total length and standard length (to the nearest 1mm), total weight and eviscerated weight (to the nearest 0.01 g), stomach weight (to the nearest 0.01g) and stomach fullness (coded as 0: empty; 1: less than ½ full; 2: ½ full; 3: full and 4: bursting). Stomachs with food were preserved in 10% formaldehyde for further analysis, empty stomachs were recorded as empty and discarded. Prey items in the stomach were sorted and identified to the lowest possible taxon under a stereo- microscope at 5X to 28X magnification, using published

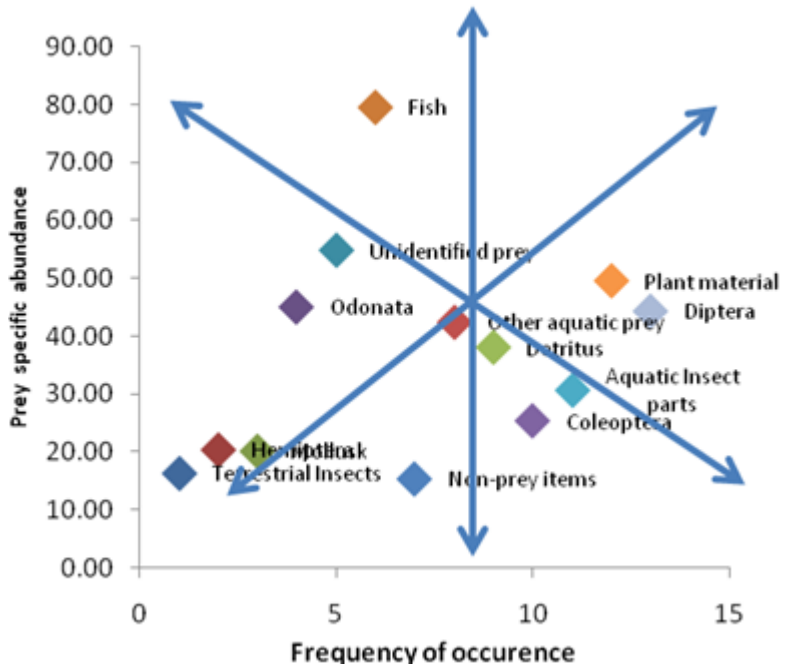
guides (Thorp and Covich, 2001; Bouchard, 2004; and Alberta Biodiversity Monitoring Program, 2007). The length weight relationships of fish from different sites were analysed using non-parametric tests (Kruskal Wallis test). A combination of numeric, occurrence and volumetric indexes were used to describe the diet of the species in terms of abundance, importance, feeding strategy, dietary shifts, and feeding intensity (Hyslop, 1980; Amundsen, 1996; Lima-Junior & Goitein, 2001).

Research Application

The size of *C. liocephalus* ranged between 5.3 – 29.6 cm total length and 1.24 -138.6 g total weight. There was a significant variation in TL (Kruskal Wallis test $p<0.01$) between LMCA and the rest of the sites (Fig. 1). The outstanding disparity in fish size distribution across the sites may be attributed to fishing pressure. The largest fish were got from the LMCA site which is located in a national park where fishing is regulated, while the smallest sizes came from the open access wetlands where fishing is indiscriminate and uncontrolled. Although modern catfishes are generally known to be benthic feeders, (Bruton 1979), the presence of benthic (e.g. chironomids) and non-benthic (e.g. cucilidae) prey taxa in the diet shows that *C. liocephalus* in wetland habitats has capacity to effectively forage at different levels.

The wide food spectrum of the species and the significant presence of plant material in its diet revealed by this study point to the possibility of having *C. liocephalus* as a candidate for aquaculture since it would not require expensive animal protein in its feed. The feeding strategy plot suggests that *C. liocephalus* is unspecialized in its feeding habit. It has a high within phenotype contribution to niche breadth since many individuals utilized most prey items simultaneously. This behavior is an optimal strategy especially in habitats that are prone to change. Occurrence of major prey categories across all sizes also points to a possibility of intra-specific competition in *C. liocephalus*. Competition becomes likely when prey occurrence is above 25% in two or more size classes (Hyslop, 1980). Accordingly, there is competition for all prey taxa whose occurrence exceeds 25 %. The presence of *C. liocephalus* juveniles in some stomach samples pointed to possible cannibalistic feeding habit in this species. However, the low level of occurrence for *C. liocephalus* prey (2.8%) and the generally low occurrence of fish prey (9.4%) suggests that cannibalism and the use of fish in *C. liocephalus* diet is not as

(a)



(b)

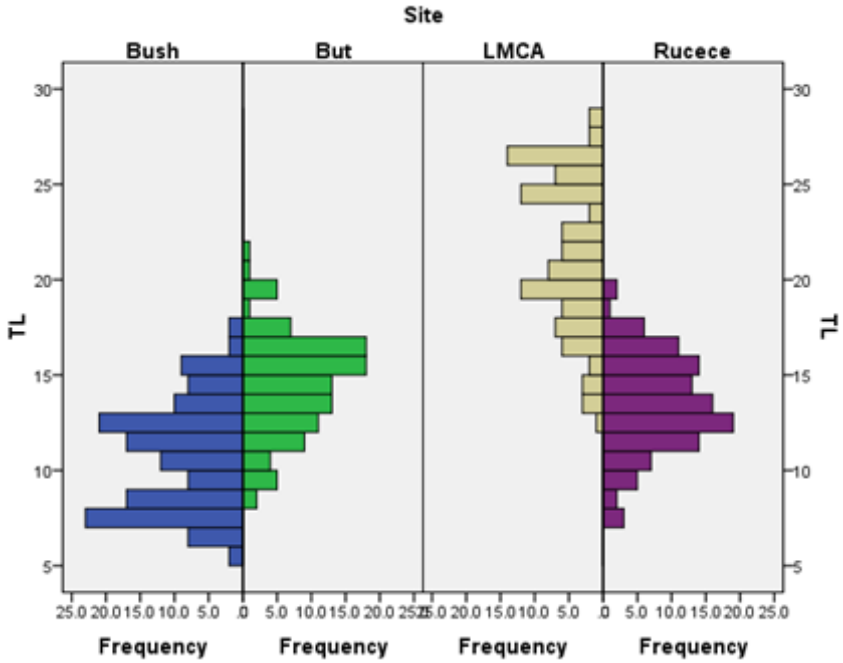


Figure 1. (a) Feeding strategy plot for *C. liocephalus* (b) Size distribution of *C. liocephalus* in the 4 study sites.

pronounced as it is in the large and medium sized clariids like *C. gariepinus* and *C. ngamensis* (Bruton, 1979)

We conclude that *C. liocephalus* is a generalist feeder that draws prey from several trophic levels depending on the availability. The major prey taxa in its diet are aquatic dipterans and plant material. It does not fall in the piscivorous catfishes because fish does not contribute much to its diet. The size distribution is strongly related to fishing pressure and this may affect the life history of this fish in the future.

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