

Project Update: July 2011

This study began in January 2010. The main aim was to assess the distribution patterns of indigenous fish in relation to the presence and absence of non native sharptooth catfish, *Clarias gariepinus*, within the Great Fish and Sundays Rivers in the Eastern Cape. The first part of the study was conducted by assessing the habitat associations of indigenous minnows within headwater streams that were not invaded the catfish. The second part of the study assessed the feeding habits of the sharptooth catfish within the mainstream sections of the two rivers where the catfish is abundant. The findings of these studies are summarised below.

Inter-seasonal persistence and size-structuring of two minnow species within headwater streams

Understanding the relationship between fish and habitat relationships is crucial for conserving stream fishes. Two indigenous species of cyprinid minnows, Eastern Cape redbfin, *Pseudobarbus afer*, which is listed on the IUCN Red List as endangered, and chubbyhead barb, *Barbus anoplus*, are the most widespread in the headwater streams of the Sundays and Great Fish Rivers respectively. This study examined temporal variation in population dynamics and size structuring of these two cyprinid minnows in relation to their proximate physical habitats. The two minnows are threatened by alien invasive species, especially sharptooth catfish, *Clarias gariepinus*, which have established in the mainstream sections of the two rivers where these minnows have generally disappeared. Continuous monitoring of distribution and density, and an evaluation of the critical habitats for the indigenous minnows is therefore essential. *Pseudobarbus afer* was collected in the tributaries of the Sundays River in the Zuurberg Mountains within Addo Elephant National Park (AENP). Three other species, *Barbus pallidus*, *Glossogobius callidus* and *Anguilla mossambica*, co-occurred with *P. afer* in the Zuurberg. *Barbus anoplus* was collected in the headwaters of the Koonap River, a tributary of the Great Fish River, in the Winterberg Mountains. *Anguilla mossambica* was also present in the Winterberg. Three-pass depletion electric fishing was conducted at 21 sites for *P. afer* and 19 sites for *B. anoplus* to estimate population parameters. Sites were sampled in both summer (February-May 2010) and winter (July-September 2010). The habitats were characterised by seasonal variation in all physico-chemical conditions and spatial variation in substrata compositions. Whereas significant differences in population size were noted between seasons for *B. anoplus*, no differences were found between seasons for density and capture probability for either species. An increase in boulders was associated with increase in population size and density for *P. afer*, whereas for *B. anoplus*, increase percentage bedrock and bank vegetation were associated with increase in population size and probability of capture, respectively. There was no evidence that the seasonal per capita loss was dependent on summer abundance. This suggests that population dynamics were density-independent and largely driven by extrinsic factors. These factors could be inferred from the substantial seasonal differences in environmental variables, notably substrate in the Zuurberg for *P. afer* and physicochemical variables in the Winterberg for *B. anoplus*. During winter, percentage boulder increased in the Zuurberg whereas turbidity decreased substantially as the habitats receded into isolated pool compared to summer when there was high flow. According to Canonical Correspondence Analysis, size structuring in *P. afer* was explained predominantly by seasonality, with smaller

length classes associated with seasonal variable, summer, while larger length classes were associated with pH that was higher in winter. By comparison, for *B. anoplus*, the habitat variables - bank vegetation and bedrock, accounted for much of the explained variance for size structuring. Recruitment appeared to be the major driver of size structuring for the two species whereas refugia, especially boulders and bank vegetation, respectively, also appeared to be important. Overall, the two species were adapted to the headwater streams that were generally variable in environmental conditions. Efforts should continue to protect these minnows from potential stressors such as the alien invasive catfish that threaten their upstream habitats. This can be achieved by constructing barriers that limit the upstream migration of the catfish from the mainstream sections.

Assessment of the feeding habits of non-native sharptooth catfish

This study investigated its trophic impact of sharptooth catfish, *Clarias gariepinus*, by examining its feeding habits by comparing stomach content and stable isotope analyses from three localities - the Great Fish River, Sundays River and Glen Melville Dam. Stomach content analysis indicated a catholic diet dominated by fish particularly in relatively more turbid Glen Melville Dam (60%) and the Great Fish River (44%) than in the relatively more transparent Sundays River (35%). Among the fish prey were three indigenous species the Goldie barb *Barbus pallidus* in the Sundays River, Mozambique tilapia *Oreochromis mossambicus* in the Great Fish River and moggel *Labeo umbratus* from Glen Melville Dam. The Goldie barb, which has a restricted distribution in most Eastern Cape Rivers, including the Sundays, is reported to be threatened by the presence of catfish. The results from this study provide evidence for the potential threat to this species in the Sundays River. While the conservation status of the other identified two fish prey is considered to be in the category of least concern, these species may be preyed more in habitats that are less structured and where the catfish grow to bigger sizes such as in dams and wider and deeper riverine habitats especially of the Great Fish River. Aquatic invertebrate consumption was higher in the transparent Sundays River (31%) than the turbid Great Fish River (21%). An ontogenetic shift in diet was evident, with small fish predominantly consuming aquatic invertebrates and shifting towards fish with increasing size. Stable isotope analyses also showed a wide variation in prey isotopic signatures. Catfish stable isotope signatures were slightly depleted in $\delta^{15}\text{N}$ compared to indigenous fish prey in the rivers. This indicated that the catfish may occupy trophic positions that differ from its functional role as a predator, suggesting a complex role for the catfish in the food webs. Isotopic mixing models indicated that fish contributed less to catfish's diet in the Great Fish River and Glen Melville Dam and more in the Sundays Rivers than was observed using stomach contents. In addition, comparison of the two methods suggested an under-estimation of some prey, especially algae, aquatic invertebrates and zooplankton by stomach content analysis. The two methods were nevertheless complementary in the assessment of feeding habits and potential impact of the non-native catfish.

On-going research

Work on acoustic telemetry to determine the patterns of habitat use is currently being undertaken in the Glen Melville Dam. Ten fish were tagged in February 2011, and are currently being tracked manually to determine their movement patterns.

Contribution of this study to policy and management

The finding of this study will contribute towards the conservation efforts, especially of the endangered minnows within the headwater streams. Reports from this study have been prepared for SANParks, the responsible authority for the management and conservation of this species. The current policy on invasive fish such as the catfish is to encourage its eradication in areas where they have established. Formal and informal reports are part of the process to increase public awareness, especially farmers along the mainstream section and fishermen, to encourage the eradication of the catfish.

Publications

Two publications are currently in preparation from this study:

Wilbert T Kadye & Anthony J Booth (in prep) Inter-seasonal persistence and size-structuring of two minnow species within headwater streams in the Eastern Cape, South Africa.

Wilbert T. Kadye and Anthony J. Booth (submitted) Integrating stomach content and stable isotope analyses to elucidate the feeding habits of non-native sharptooth catfish *Clarias gariepinus*.

