Nee Soon Swamp Forest Under Threat? – Distribution of Introduced Cichlid *Acarichthys heckelii* (Müller and Troschel, 1849) in Singapore’s only Remaining Freshwater Swamp Habitat

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**Abstract:**

With the increasing loss of biodiversity, especially in the tropics, biological invasion has become an important factor to consider in conservation efforts. This is especially true in Singapore where the other drivers of extinction, namely, the exploitation of natural resources and habitat degradation have been largely halted in recent years. The introduced cichlid, *Acarichthys heckelii* has recently been reported to be present in one of the streams at Nee Soon Swamp forest, arguably the most important freshwater habitat in Singapore, to the alarm of biologist. Therefore, this study was launched to investigate if the fish had established a naturally reproducing population in the swamp forest, chart out its distribution in connected water bodies and assess the threat that it poses on the swamp habitat. The results of the study indicate that *A. heckelii* had not been successful in invading Nee Soon as a result of unsuitable abiotic parameters, although a feral population was found in the connected stream at Sungei Seletar, along with several other introduced species. This finding, coupled with the high accessibility of the streams at Nee Soon from Sungei Seletar points to the fact that Singapore’s last freshwater swamp habitat remains at risk of invasion by exotic species.

**Introduction:**

The last few decades have seen biodiversity loss is occurring around the globe at a rate faster than ever recorded leading some to believe that a mass extinction event unprecedented since the Permian extinction is taking place (Sodhi *et al.*, 2007; Benton, 2005). One of the chief drivers of extinction is Biological Invasion although its gravity is very often underestimated. Recent studies have reports have indicated the presence of an introduced cichlid, *Acarichthys heckelii* in Nee Soon Swamp forest, arguably the most important primary freshwater habitat in Singapore to the alarm of Biologists (Tan & Lim, 2008). Therefore, this study determine if the *Acarichthys heckelii* has indeed established a naturally breeding feral population in the Nee Soon Swamp Forest as well as to chart the distribution of the cichlid in the connected water bodies. By achieving such, the study hopes to assess the threat that the introduced fish poses on Singapore’s only remaining freshwater swamp habitat.

**Materials and Methods:**

Surveys were conducted at several sites along the stream running through Nee Soon Swamp Forest, the stream at Lorong Banir, and along Sungei Seletar. All three

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locales are connected water bodies with the former being furthest upstream, and the latter the furthest downstream. Sampling was conducted with the use of large and small bottle traps as well as cast nets where the width of the river is permitting. *A. heckelii* specimens obtained were euthanised on ice and deposited at the Raffle’s Museum of Biodiversity Research at the National University of Singapore where the Standard Length (SL) was recorded. Abiotic parameters at the sampling locales were measured with the use of the Multi-Parameter PCSTestr™ 35 probe.

**Results:**

**Distribution Survey:**

Upon the completion of the survey at all three locales, a total of forty-four specimens were obtained, all from Sungei Seletar. The fishes acquired ranged from juveniles measuring an SL of 49.9mm to adults measuring at 105mm SL. No *Acarichthys heckelii* fishes were caught at any of the sampling sites at the Nee Soon Swamp forest and the stream at Lorong Banir. The presence of the fish was also confirmed via *in situ* observation at Sungei Seletar but not at the other two survey locations.

**Survey of Abiotic Factors:**

The sampling sites at Nee Soon Swamp forests were most acidic of the three survey locations while the sites at Sungei Seletar measured to be least acidic. In addition to that, of the three survey locations, only Sungei Seletar recorded a mean pH value that falls within the pH range of the *Acarichthys heckelii*’s native habitat (Liebel, 1984). While other abiotic parameters, namely, water temperature (°C), salinity (ppt) and conductivity (μS/cm) were similar at sites located at both Lorong Banir and Nee Soon Swamp Forest, the measurements were significantly higher at Sungei Seletar.

**Species Richness of the Survey locations:**

Of the three locations, Nee Soon Swamp Forest recorded the highest species richness (12 species), consisting mainly of species listed as being endangered, while Sungei Seletar has the lowest species richness (3 species) and Lorong Banir recorded an intermediate value (4 species). Also, no introduced fish species were recorded at Nee Soon Swamp Forest or Lorong Banir while in Sungei Seletar, almost all the fish species caught were non-native with the exception of the indigenous *Dermogenys pusillus*.

**Discussions:**

Examining the distribution of *Acarichthys heckelii* and the presence of established feral populations:

Although *A. heckelii* have been found in Nee Soon Swamp Forest and Lorong Banir in the past, this study shows that the fish were unable to establish themselves at the two said locations. However, a naturally reproducing feral population was present downstream at Sungei Seletar. One of the possible explanations of the inability of *A. heckelii* to successfully invade Nee Soon is the presence of abiotic barriers in the form of acidic waters and the lack of suitable substrate.
Status of the freshwater habitat at Nee Soon Swamp Forest:
The study has shown that the status of the freshwater habitat at Nee Soon Swamp forest is currently satisfactory and rather encouraging due to the presence of many fish species listed as being endangered coupled with the absence of introduced species (Nparks, 2006). However, the lack of substantial barriers to a biological invasion from a connected habitat which is occupied mainly by introduced species, under circumstances of close proximity and high accessibility means that Nee Soon Swamp Forest remains in a precarious situation and is still very much at risk of a biological invasion from connected waterways consisting mainly of disturbed freshwater habitats.

The future of freshwater biodiversity conservation at Nee Soon Swamp Forest:
With more support from the public, it is hopes that a stricter enforcement of laws against the release of animals into the wild by Nparks and AVA could help safeguard Nee Soon Swamp Forest from biological invasion. In addition to that, instalment of physical barrier at Lorong Banir to prevent the migration of introduced species from Sungei Seletar upstream without interfering with the flow of the river is also a matter of importance should the upstream migration of introduced species at Sungei Seletar be avoided. A possible invasive threat to Nee Soon in the near future was observed at Sungei Seletar in the form of the Cyprinus carpio, a species that has already formed feral population damaging to native fauna in other parts of the world.

Conclusion:
Due to the high accessibility of the streams of Nee Soon Swamp Forest from Sungei Seletar where several potential invasive species are found, it is a matter of considerable importance that quick preventive measures are taken in order to avert damaging biological invasion events in the last stronghold of most of the endangered freshwater fish species in Singapore (Tan & Lim, 2008).

References:


