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# DIFFERENCES IN ODONATA ABUNDANCE AND DIVERSITY IN PESTICIDE-FISHED, TRADITIONALLY-FISHED AND PROTECTED AREAS IN LAKE VICTORIA, EASTERN AFRICA (ANISOPTERA)

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The growing use of pesticides for fishing is a current practice of concern for biodiversity in Eastern Africa. There is little information available, however, on the extent and effect of this practice on conspicuous indicator groups like dragonflies. Odon., especially during the larval stage, are particularly vulnerable to pesticides. This survey found significant differences in both dragonfly abundance and diversity in bays of Lake Victoria that had been fished using pesticides. Only 1-2 dragonfly spp. can be found in areas routinely pesticide-fished in contrast with > 20 spp. in protected areas. This survey highlights the detrimental effect of pesticide fishing on invertebrates.

## INTRODUCTION

Odonata have widely been viewed as useful indicators of water quality. They are particularly vulnerable to poor water quality in the larval stage both through direct poisoning, and as the larval stages are obligate predators, through the reduction of their prey which are also susceptible to poisons (CORBET, 1983). High concentrations of inorganic pollutants and pesticides have been shown to affect different life-stages of odonates and application of insecticides is known to produce a direct effect of decrease in odonate numbers from various studies as summarised by CORBET (1999).

As brightly coloured, diurnal and active insects they are also easy to track and identify and therefore a useful proxy for quality of a given aquatic habitat

(CLARK & SAMWAYS, 1996). This makes them a reliable indicator of the health, stability and integrity of a given wetland habitat (CHOVANEC & WARINGER, 2005). While differences in life-history strategies may result in uneven species' distributions, the diversity and abundance of most common species can be tied to the health of the habitat (WATSON et al. 1982).

Lake Victoria is the world's second largest fresh-water lake and an important area for a wide range of biodiversity taxa including cichlid fish and birds (BENNUN & NJOROGE, 1999). The lake has suffered from a number of ecological catastrophes including the introduction of the Nile Perch (PRINGLE, 2005), the

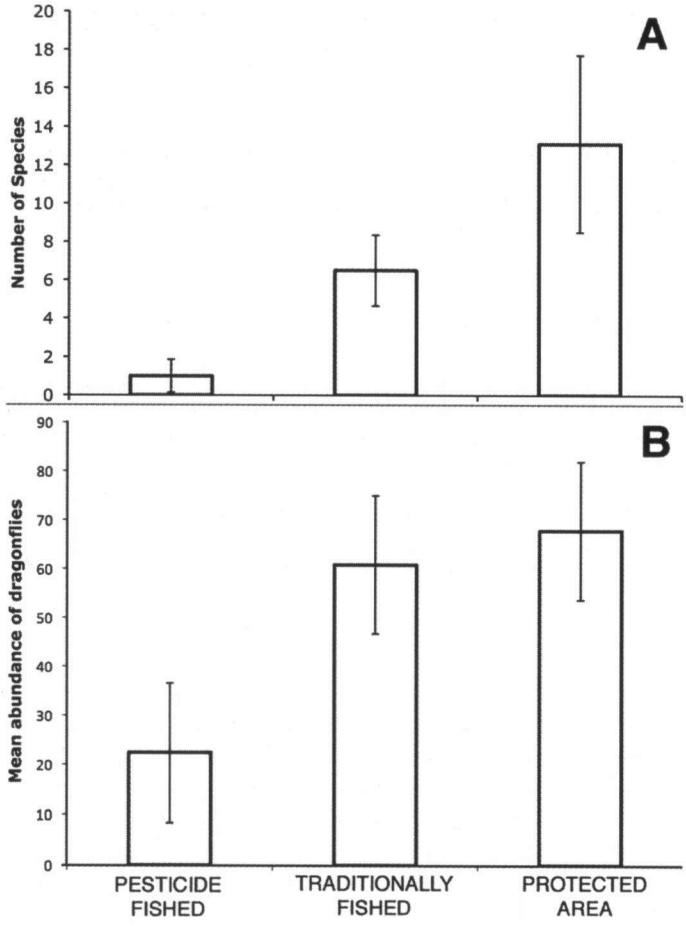


Fig. 1. (A): diversity of dragonflies at three categories of sites in Lake Victoria, N = 20 sites for each category; – (B): mean abundance of dragonflies at the three categories of sites studied in Lake Victoria. – [error bars are +/- 1 st. err.]

water hyacinth and more recently pollution (MARTINS, 2006). Use of pesticides for fishing is one growing area of concern and this study sought to conduct a preliminary investigation of the effect of pesticides on the diversity and abundance of odonates in Lake Victoria.

## MATERIAL AND METHODS

All study sites were located in the Mwanza Gulf on Lake Victoria. Three different categories of sites were chosen: (i) areas that were fished using pesticides, (ii) areas that were fished traditionally (no pesticides, but using nets, lines and fish-traps) and (iii) protected areas that were neither fished nor had pesticides directly applied. Pesticide-fished areas were identified through interviews with local fishermen and direct observation of poisoned fish and odonate larvae. Vegetation and habitat structure around all sites was similar consisting of a rocky shore with aquatic grasses, *Sesbania* sp. and small patches of papyrus. Odonate diversity was quantified by identifying the species present at each 20 different sites in each category over ~1 month (July) in 2006 and 2008. This was done through direct observation and occasionally netting and checking with field guides (TARBOTON & TARBOTON, 2002; MILLER & MILLER, 2003). Abundance of odonates was measured by counting the total number of adults flying past a fixed point for 1 hr between 10-11 a.m. in the morning on five separate days at sites for each category. This was the general peak time for insect activity. Only adult dragonflies were identified and counted as they were easier to identify, damselflies were not included in the survey. Data were maintained in spreadsheets using Excel and analysed using STATA.

## RESULTS

Significant differences were found at all sites in both dragonfly diversity and abundance (Fig. 1A, B). Only 2 spp. were present in areas that were pesticide-fished in contrast with traditionally-fished (10 spp.) and protected areas (23 spp.) (Tab. I). Odonate diversity differed significantly between all sites (Fig. 1A, ANOVA $F_{2,57} = 86.6$ $p > 0.0001$). There were significant differences in odonate abundance between pesticide-fished and the two other categories of sites (Fig. 1A, ANOVA $F_{2,12} = 12.07$ $p > 0.0013$). Odonate abundance did not differ significantly between traditionally-fished sites and protected areas (Fig. 1B, Bonferroni post-hoc test $p > 1.0$), but diversity did ($p > 0.0001$)

## DISCUSSION

The results of this survey show that there are clear differences between areas that are pesticide-fished and areas that are not subject to direct application of pesticides on Lake Victoria. The two species that were observed in the pesticide--fished areas are *Pantala flavescens*, that is widely known to migrate both locally and regionally (TARBOTON & TARBOTON, 2002) and *Brachythemis leucostica*, which we observed to be the most common dragonfly in the region. *B. leucostica* was observed to lay many hundreds of eggs at the base of vegetation surrounding the bays and inlets of the lake. This reproductive strategy may be the reason why it is able to survive as it is both producing large numbers of offspring and

Table I
Diversity of dragonfly species observed at the different sites

| Species | Pesticide-fished | Traditionally-fished | Protected area |
|---|---|---|---|
| *Ictinogomphus ferox* | | | X |
| *Anax ephippiger* | | | X |
| *Anax speratus* | | | X |
| *Anax imperator* | | X | X |
| *Phyllomacromia picta* | | | X |
| *Brachythemis lacustris* | | | X |
| *Brachythemis leucostica* | X | X | X |
| *Palpopleura lucia* | | X | X |
| *Palpopleura portia* | | X | X |
| *Rhyothemis semihyalina* | | X | X |
| *Orthetrum caffrum* | | | X |
| *Orthetrum chrysostigma* | | | X |
| *Acisoma panorpoides* | | X | X |
| *Pantala flavescens* | X | X | X |
| *Philonomon luminans* | | X | X |
| *Sympetrum fonscolombii* | | | X |
| *Trithemis hecate* | | | X |
| *Trithemis kirbyi* | | | X |
| *Trithemis arteriosa* | | X | X |
| *Crocothemis erythraea* | | X | X |

utilising micro-habitats that may be more sheltered from the effects of pesticide application.

The use of pesticides in and around Lake Victoria needs to be addressed at a regional level. Pesticides are widely available in lake-side towns, such as Mwanza, and sometimes sold in shops that deal in fishing gear and tackle. It is apparent that it is a few unscrupulous fishermen who use this technique and not the majority. Several different pesticides are used and more work needs to be done on the different kinds of pesticides being used, including through both surveys of indicator groups such as dragonflies on Lake Victoria and more detailed analysis of water and aquatic habitats.

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