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# An Inventory of Invertebrates in an Agriculturally Impacted Floodplain in Semi-arid, Central Kenya

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ABSTRACT

Wetlands ecosystems are rich in invertebrates, where they are known to facilitate key ecosystem services such as pollination and nutrient recycling. Some invertebrates act as biological control agents for crop pests and parasites, while others are source of food for local communities. Despite their importance to the well-being of humans and ecosystem health, invertebrate diversity and abundance are reportedly declining in many temperate and tropical ecosystems. This is possibly due to habitat degradation and loss, but also direct effects of agrochemical uses. To understand the effects of human activities and agricultural land use on invertebrates, we monitored the seasonal abundance of invertebrates in the Ewaso Narok Swamp on the semi-arid Laikipia plateau in Central Kenya between 2015 and 2016. Sampling was done in 6 seasons, representing 3-wet and 3-dry periods, in four land use systems, representing different intensities of anthropogenic pressure (hemeroby) on the wetland ecosystem (pristine, grazed, fallow and cropland). We used pitfall traps for ground-dwelling and sweep net techniques for canopy-dwelling invertebrates. Due to their relative abundance, their importance as indicator species and our taxonomic expertise, the study focused on the classes Arachnida, Collembola and Insecta. Preliminary results indicate that the floodplain is rich in invertebrate fauna with 395 species 201 genera and 105 families recorded, mainly within the Arachnida, Collembola and Insecta. The class Insecta was the most abundant (51% of all the individuals) and most species rich (80% of the species), with a substantial share of potential biocontrol agents and some source of food by the local communities. The number of some genera for example *Omalium* was significantly lower in crop land ( less than 5%) than in grazing lands at (27%), while it was prevalent in undisturbed areas and previously cropped sites 35% and 37% respectively. Most sensitive to the practice of soil tillage were ground-dwelling species of the family Carabidae. Seasonal effects were not significantly different. We conclude that abundance and the diversity of some invertebrates strongly respond to anthropogenic disturbances. Their potential uses as indicators of wetland disturbance or the effects of land use on wetland integrity and health will be discussed.

***Keywords: Biodiversity, Ewaso Narok, Hemeroby, Indicator values, Land Use***

## Introduction

Invertebrates are dominant among multicellular organisms in terms of abundance, richness and often biomass. Approximately 80% of all described species are invertebrates. Beetles alone comprise at least 10 times the number of species of all vertebrates together and over 25% of all described species (Neves et al., 2009). Invertebrates occupy a wide range of habitats including wetlands and offer important provisioning, regulatory and supporting services, thus their conservation and that of their habitat is important. However, despite their high diversity and importance, invertebrates have largely been neglected in conservation studies and policies worldwide (Zamin et al., 2010). For instance in the World Conservation Union's (IUCN) Red List of Threatened Species (IUCN, 2010) lists less than 0.5% of all described arthropods and 4% of all described Molluscs worldwide, while most vertebrates have already been assessed. A similar trend has been observed in National Red Lists, with invertebrates being among the taxa with least comprehensive coverage in countries worldwide (Zamin et al., 2010). There is inadequate, taxonomic, distributional and abundance knowledge of diverse invertebrates groups. In addition complementary information, such as sensitivity to ecological change driven by anthropogenic pressure is known for a limited number of species (Kozlowski, 2008). Many invertebrates are sensitive to ecological change and could be used as indicators of ecosystem integrity and when sufficient data is available it is possible to infer on the past or future (Triantis et al., 2010) human caused extinctions. In view of the above, invertebrate inventories and the resulting checklist could provide valuable baseline information on species abundance, distribution and diversity. It is a first step towards a better understanding of the fauna of an area and a guide towards conservation planning. Efforts to manage and conserve such ecosystems are geared towards promoting innovative land use practices which sustain biological diversity without compromising food and income needs of the local community. Identification of such innovations requires knowledge of all taxa biodiversity contributing to sustainable ecosystem, including invertebrates (Buck *et* al., 2005). We limit our study to diurnal crawling and canopy-dwelling invertebrates in an agriculturally impacted floodplain and compare their abundance and diversity in the dry and rainy season along a land use gradient.

## Material and Methods

### Study Area

The study was conducted in Ewaso Narok swamp, a highland floodplain, formed by Ewaso Narok River in the semi-arid Laikipia plateau, Rumuruti in Central Kenya, (0 ° 17 'N 36°34' E, 1800m). The floodplain has been drained for crop cultivation, occasioned by unreliable rain-fed agriculture, and is a lifeline for livestock grazing by pastoralists. According to the classification of Köppen-Geiger, the Rumuruti is included in the transition between the bioclimates "Tropical Savanna" and "Temperate with Dry and Warm Summer" (Peel et al., 2007). The average annual temperature is 17 °C and the mean annual rainfall 714 mm.

### Estimating invertebrate availability

Surveillance and sampling plots were selected opportunistically to realize a uniform representation within each land use type for every season. Sampling locations were established in four different land uses of cropland (currently under cultivation), grazing land (areas under grazing by both domestic and wild herbivores), fallow (cropland that had been abandoned for at least three months) and pristine (mainly semi-aquatic vegetation representing long-term regeneration stage of natural vegetation. To investigate invertebrates' abundance and diversity, we used pitfall traps and sweep net to sample ground-active and canopy-dwelling invertebrates. For pitfall traps we used plastic cups of 300 mL volume and 26cm circumference buried level with the ground and filled with 200 mL of 30% ethanol solution mixed with 1 mL detergent to reduce surface tension (Greenslade, 1964). Within each of the plots per land use, we laid three pitfall traps diagonally and harvested after three nights, during which time we pooled them

together to make one pitfall sample. Similarly on the same plots where pitfall traps were laid, we made 50 sweeps around the plots using a sweep net (0.5m diameter and 1.5m long handle), to capture the canopy-dwelling invertebrates. In total we sampled six times three in the dry and three in the wet season in the year 2015-2016, each sampling time was 12 days. This made 3,000 pitfall traps and sweep net samples. In this study only the adult stage of the invertebrates were considered, since they are fully developed thus easier to recognize and identify. Collected specimens were morphologically identified using recognized taxonomic keys developed by, Gullan et al. (2010) and Adrian et al. (2008) and making reference to the Invertebrates Zoological Collection of the National Museums of Kenya. Specimens which could not be identified to the species level were handled as morpho-species and assigned to the next identified taxonomic rank

## Results and Discussion

### Overall invertebrate abundance and diversity

Out of 3,000 samples, we recorded 395 species and morphospecies, 201 genera, 105 families. The class Insecta was the most abundant and species rich at 51% and 80% respectively, with a substantial share of potential biocontrol agents and some source of food by the local communities. The number of some genera for example *Omalium* was significantly lower in crop land (less than 5%) than in grazing lands at (27%), while it was prevalent in undisturbed areas and previously cropped sites 35% and 37% respectively.

### Variation of invertebrates in seasons and along land use gradient

An independent sample t test showed there was no significance difference in mean species abundance of in the wet and dry season (t=- 0.51, df = 483, P< 0.61). Similarly, there was no significance difference in mean species abundance in the four land use regimes under different anthropogenic pressures based on the 1- way analysis of variance (F=1.23, df=3, P> 0.29). There was variation in the mean species abundance in the seasons and across the various land uses among the three groups of invertebrates (Figure 1).

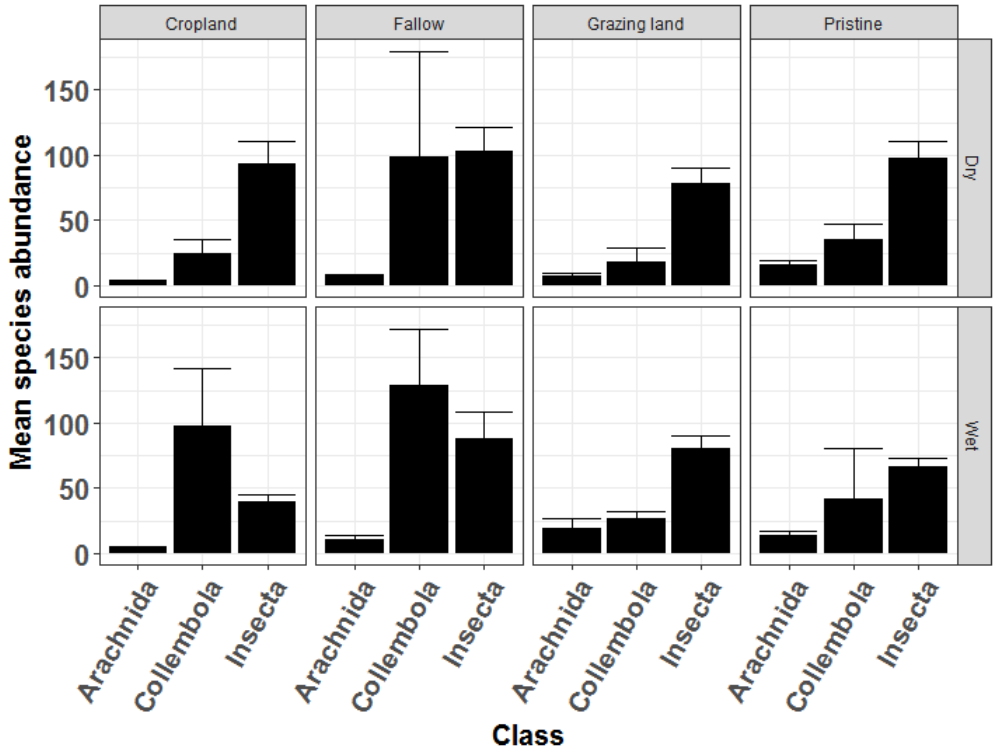


Figure 1. Mean species abundance in the different land use regimes in the wet and the dry season

Invertebrates play significant ecosystem role such as pollination, nutrient cycling, bio-control and are of great economic importance in terms of pests and disease vectors. (Coleman and Hendrix, 2000). Some of the groups found in Ewaso Narok, such as members of the family Apidae (Bees) are important pollinators, species in the family Formicidae, are key actors in nutrient recycling, while Hemiptera (Bugs) are important crop pests. Two families (Histeridae and Anthicidae) of the order Coleoptera which were represented in this study have successfully been used as bio-control agents. Thus the presence of the various groups of invertebrates is relevant to the productivity of Ewaso Narok due to the provision of the various ecosystem services and functions.

**Conclusions and Outlook**

In conclusion this first inventory has demonstrated that Ewaso Narok floodplain though agriculturally impacted has high diversity of invertebrates. The ecosystem could be a conservation hotspot for some of the species. The occurrence of some species at specific land use regimes and seasons could make good candidates for development of indicator species. However, there is a high risk of losing some taxa that could be important indicators of anthropogenic activities even before they are documented.

**References**

Buck, W.R., Cox, C.J., Shaw, A.J. and Gaffinet, B. (2005). Ordinal relationship of pleurocarpous mosses, with special emphasis on the Hookeriales. *Systematics and Biodiversity* 2 (2), 26 Jan. 2005: 121-145.

Coleman, D.C. and P. Hendrix (eds), 2000. Invertebrates as *Webmasters in Ecosystems*. CABI Publishing. Oxford, United Kingdom. 336pp.

Greenslade, P.J.M. (1964). Pitfall trapping as a method for studying populations of Carabidae (Coleoptera). *Journal of Animal Ecology* 33: 301–310.

Gullan, P.J. and P.S. Cranston (2010). *The insects: An outline of Entomology (ed.).* Oxford: Wiley, John & Sons, Incorporated.

1UCN, 2010. IUCN Red List of Threatened Species. Version 2010.4. <http:// www.iucnredlist.org> (downloaded 01.04.11).

Kozlowski, G., 2008. Is the global conservation status assessment of a threatened taxon a Utopia? *Biodiversity and Conservation* 17: 445-448.

Neves, R.C., Sorensen, K.J.K., Kristensen, R.M. and Wanninger, A. 2009. Cycliophoran dwarf males break the rule: high complexity with low cell numbers. *Biological Bulletin* 217: 2-5.

Peel, M.C., Finlayson, B.L. and McMahon, T.A. 2007. Updated world map of the Köppen-Geiger climate classification. *Hydrology and. Earth Systems*. Sciences. 11: 1633–1644.

Triantis, K.A., Borges, P.A.V., Ladle, R.J., Hortal, J., Cardoso, P., Caspar, C, Dinis, F., Mendonca, E., Silveira, L.M.A., Gabriel, R., Melo, C, Santos, A.M.C., Amorim, I.R., Ribeiro, S.P., Serrano, A.R.M., Quartau, J.A. and Whittaker, R.J., 2010. Extinction debt on oceanic islands. *Ecography* 33: 285-294.

Zamin, T.J., Baillie, J.E.M., Miller, R.M., Rodriguez, J.P., Ardid, A. and Collen, B. 2010. National red listing beyond the 2010 target. *Conservation Biology* 24: 1012-1020.