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A SURVEY OF AQUATIC INSECTS AT KWARE LAKE IN SOKOTO STATE

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Abstract
A survey was conducted to determine the diversity and abundance of aquatic insects in Kware Lake, Kware local government area of Sokoto State from October to December, 2003. During these months, aquatic insects are associated mostly with permanent water bodies in Sokoto. Samples were obtained twice a week from the lake which was proportioned into three units, A,B and C. Morphological observations of the insect caught were carried out in the laboratory and five different species were identified viz, *Calopteryx aequabilis* (Say.) (damselfly), *Haliplus solitarus* (Sharp) (water beetle), *Cordulegaster boltonii* (Don.) (dragonfly), *Libelullar quadrimaculata (*Linn.) (dragonfly) and *Coenagrion angulata* (Hagen) (damselfly). The results indicated that dragonfly *C. boltonii* had the highest abundance with density of 45.0% while the water beetle; *H. solitarus* recorded the lowest abundance with density of 5.7%. Significant differences (P<0.05) in the mean count of the insect caught also exist among the species in the sampling units, which may be due to some environmental conditions like the vegetation covers or competitive exclusion might have set in.

Keywords: survey, aquatic insects, density, abundance, lake

Introduction
As a group, insects have not been particularly successful in colonizing aquatic environment (Pennak, 1978), but those that succeeded spend at least part of their lives associated with water medium. Some insect orders such as Plecoptera (stoneflies), Ephemeroptera (mayflies), Odonata (dragonflies and damselflies), Trichoptera (caddisflies), Megaloptera (alderflies / fishflies), Heteroptera (true bugs), Coleoptera (beetles), Diptera (flies/midges), Lepidoptera (caterpillars) and Neuroptera (spongillaflies) consists of members that have aquatic stages (Ross, 1982; Roughley, 2001). Generally, eleven of the 30 – 35 orders of insect contain species that are regularly aquatic or semi aquatic, however, less than one percent (1%) of the total number of species occur in or on water (Pennak, 1978). Several species live only in particular habitats and their presence can be used to characterize healthy wetlands of all sorts (Bos, 2000). For example, some species of mayflies are sensitive to heavy metal contamination; many stoneflies cannot tolerate siltation or thermal pollution, whereas an overabundance of fly and midge larvae may indicate multiple stressors (Roughley, 2001). The warm water and rich aquatic vegetation attract most species (Nishida, 2002). The greatest numbers of species are however found at sites that offer a wide variety of microhabitats (Corbet, 1999). A good number are large, colorful and diurnal creatures with interesting behaviors and because the aquatic larvae can readily be kept in captivity for observation, they are excellent subjects for nature interpretation programs and public education about aquatic ecosystems in general (Cannings, 2002).

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Though the community of aquatic insects may be useful in assessing the water quality and its productive capacities, it also constitutes an integral part of fresh water biota and plays a significant role in energy transfer in the system (Westfall and May, 1996). The species have limited distribution range and their numbers fluctuate to a greater or lesser extent both in time and space. It is known that seasonal, cyclical and other variations of weather exert a profound influence on the rates of change in insect numbers (Clark *et al*., 1978). Aquatic insects are also threatened by habitat change or loss; degradation of habitat such as from water diversions or disturbance caused by feral ungulates and non-native invasive invertebrates, fish and frogs that prey on nymphs (Polhemus, 2004). It is true that in most cases the insect to be studied is usually determined by economic considerations which tend to support population work on pests rather than innocuous species, the need for the latter is also widely accepted, especially when it conforms to some investigators preference for natural unspoiled environment like Kware Lake in Sokoto. This survey determines the diversity and abundance of aquatic insects at Kware Lake.

Materials and methods

Study area

The study area represents a naturally occurring freshwater lake at Kware (Fig. 1), the head quarter of Kware local government area of Sokoto State; some 20kms north of Sokoto township. It is located on longitude 5°16′E and latitude 13°13′N. Kware is flanked by River Shella to the north east and River Rima to the east.

Sample collection

Insect samples were collected at intervals from three different areas of the lake designated as sampling units A, B, and C respectively. A pond net with long wooden handle was used, by way of swinging it horizontally for 2–3 minutes, depending on the insect catch. A killing jar containing a piece of cotton wool soaked with formalin to kill the insect caught after release into the jar was also used for each sampling unit and the contents were emptied into labeled (A, B, C) specimen bottles provided. All samples collected were counted and identified in the laboratory as described by Michael (1977). Analysis of variance (ANOVA) was used to determine the significant difference between means of insect caught in each sampling unit.

Results

Of the five different species of aquatic insects identified at Kware Lake, *C. boltonii* (in unit A) had the highest abundance of 41.0% followed by *C. eaquabilis* having 25.6%. The remaining species caught in the same unit such as *L. quadrimaculata, H. solitarus* and *C. angulata*, showed abundance of 12.8% or less (Table 1). All the species were however, at par significantly in the mean number of insect count except *C. boltonii* (5.3) which had a higher but similar significant value when compared with *C. aequabilis* (2.7). Almost exact pattern of results were observed in sampling units B and C to those obtained in respect of sampling unit A not minding slight fluctuations with regard to percentage abundance (Table 1). Nonetheless, cumulative results of the three sampling units revealed that *C. boltonii* maintained the highest of abundance with 42.9% (Table 2) while *H. solitarus* showed the least with 7.8% abundance. The level of significance in the cumulative mean number of insect count remained the same as aforementioned, with *C. boltonii* (5.4) and *C. aequabilis* (3.2) showing similar significant values, though the latter did not differ significantly with neither of the other species.

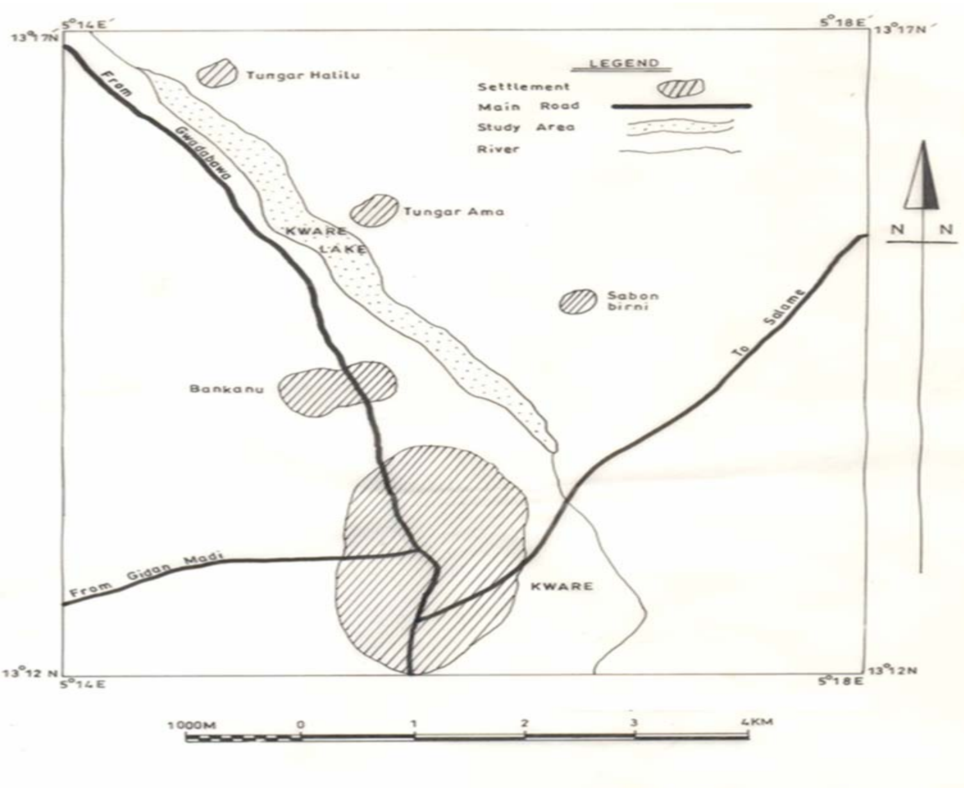

Fig. 1: Map of the study area (Kware Lake) Drawn from Sokoto Topo sheet 10.

Table 1. Average number of insect caught at Kware Lake in three sampling units (each observation based on three replicates)

Common name	Specific name	X no caught (%) at the units		
		Unit A	Unit B	Unit C
Damselfly	*Calopteryx aequabilis*	3.3[ab] (25.6)	2.7[ab] (20.0)	3.7[ab] (31.4)
Water beetle	*Haliplus solitarus*	1.3[b] (10.3)	1.0[b] (7.5)	0.7[c] (5.7)
Dragonfly	*Cordulegaster boltonii*	5.3[a] (41.0)	6.0[a] (45.0)	5.0[a] (42.9)
Dragonfly	*Libellular quadrimaculata*	1.7[b] (12.8)	1.0[b] (7.5)	1.3[bc] (11.4)
Damselfly	*Coenagrion angulata*	1.3[b] (10.3)	2.7[ab] (20.0)	1.0[c] (8.6)
LSD		2.9	3.5	2.5

Means followed by the same latter are not significantly different ($p<0.05$)

Table 2. Average number of insect caught from the three sampling units at Kware Lake

Sampling unit	*Calopteryx aequabilis*	*Haliplus solitarus*	*Cordulegaster boltonii*	*Libellular quadrimaculata*	*Coenagrion angulata*
A	3.3	1.3	5.3	1.7	1.3
B	2.7	1.0	6.0	1.0	2.7
C	3.7	0.7	5.0	1.3	1.0
Means	3.2[ab]	1.0[a]	5.4[b]	1.3[a]	1.7[a]
% Abundance	25.7%	7.8%	42.9%	10.6%	13.0%
LSD			2.2		

Means followed by the same latter are not significantly different ($p<0.05$)

Discussion

It is obvious from the results obtained in this study that, five species of aquatic insects reside at Kware Lake. Among the species *C. boltonii* (dragonfly) and *C. aequabilis* (damselfly) were prominently higher in abundance than *C. angulata* (damselfly), *L. quadrimaculata* (dragonfly) and *H. solitarus* (water beetle). The observations made here may not be surprising since manifestation of competitive exclusion could be easily enhanced as most of the species have closely similar requirements and that dragonflies proved to be stronger competitors as also observed by Williams and Blair (1994). An additional advantage to dragonflies is the ability to regulate their body temperature primarily through changes in body posture and degree of exposure to the sun, and this permit them to begin to hunt very early in the morning before the other species are fully functional (Ross and Rand, 1997). Apart from Water beetle (*H. solitarus*), all the other species belong to the same order; Odonata (Greek for "toothed jaws''). A small order of insects, of about 5,500 named species and 33 families worldwide, but predominantly tropical in distribution and is not as diverse at higher latitudes (Cannings, 2002). The two suborders, Anisoptera ("unequal wings'') and Zygoptera ("jointed wings'') housing dragonflies and damselflies respectively, consist of members with large heads and very large compound eyes relative to the rest of their body. Each compound eye is composed of nearly 28,000 individual units (ommatidia) and more than 80% of their brain is devoted to analyzing visual information (Michael, 1997). By contrast, their antennae are tiny and mouths have been adapted for biting, making them efficient hunters (Bos, 2000). Dragonflies do not hunt in cold weather but damselflies are not as limited by temperature and have been observed hunting during cold spells (Corbet, 1999). However, dragonflies have many adaptations enabling them to avoid predation. They have exceptional visual responses and truly agile flight (Michael, 1997), can fly forward at about 100 body-lengths per second and backwards at about 3 body-lengths per second (Olberg *et al*., 2000). They are also capable of hovering in the air for about a minute, since longer periods of stagnant flight would interfere with thermoregulation (Polhemus, 2004). Oftentimes, they hunt in groups where large numbers of termites or ants are flying, or near swarms of mayflies, caddisflies or gnats (Olberg *et al*., 2000). Among the dragonflies the prey is subdued while on flight but damselflies tend to capture while the prey is resting (Williams and Blair, 1994). The adult feeds on every possible type of flying insect including each other (Westfall and May, 1996) and this is done to satisfy the daily requirements of 600 insects per day (Manning, 1997).

Some environmental factors may also play roles in species abundance and distribution, but for aquatic life the three most common are temperature, moisture and food (Frost, 1954). These are relatively stable at the lake, but abundance is also proportional to the length of the shoreline (Cole, 1921). The lake though, not quite long can still be said to be productive, since these insects are believed to act as biological indicators of productivity as well as environmental quality. A report by the U.S Environmental Protection Agency indicated that nearly every state water quality agency in the U.S uses aquatic insects to some degree in evaluating surface water quality (Roughley, 2001). The lake would also serve as a readily available larvae reservoir of many of the aquatic insects if properly managed in order to provide agents of biological control against mosquito larvae. Even the adult mosquitoes can be chiefly controlled by using "Mosquito hawk"; another name for the adult dragonflies. This in no small measure can alleviate environmental pollution, toxic residue in food, pest resurgence and development of pest resistance all resulting from pesticide application. Focus should thus be placed on not only protecting current populations and key breeding habitats, but also to establish additional populations, thereby reducing the risk of extinction.

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