

Insects of Medical and Veterinary Importance at the Hadejia-Nguru wetlands of Nigeria

N.B. MOLTA¹, H.H BDLIYA², O.A. AKINSOLA² AND G.K.A. BUAHIN¹

¹Department of Biological Sciences, University of Maiduguri,
P.M.B. 1069, Maiduguri, Nigeria.

²Hadeja - Nuguru Wetlands Conservation Project
P.O. Box 32, Niger Road, Kano, Nigeria

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ABSTRACT

Base-line data on the variety of insects of medical and veterinary importance was collected at various sites in the Hadejia-Nguru wetlands of Nigeria during November 1995 to March 1997. Entomological methods employed include use of Challier-Laveissiere (biconical) traps, aspirators (pooters), knock-down insecticide spraying, water-nets and laddle for sampling of aquatic bodies as well as visual examination. Ten Diptera, seven Hymenoptera and one Hemiptera were sampled with the biconical trap. Of common occurrence in the biconical trap catches were the housefly (*Musca domestica* L.) and the tabanid flies (*Tabanus gratus*, and *T. lineola* F). The housefly *Hippobosca variegatus* Megerle was common on cattle at various sites, but was only rarely collected in malaise trap catches or using sweep net. Insecticide spray catches included mosquitoes (*Culex pipiens quinquefasciatus* Say, *C. annulioris* and *Anopheles* species), housefly the calliphorid blowflies (*Lucilia cuprina* Wied. and *Cryomya albiceps* Wied.) and wasps (*Labus macrostylus* Kh. and *Polistes* sp). Eight species of mosquitoes, comprising two spp of *Culex* and seven spp of *Anopheles* were identified among the aspirator and insecticide spray catches. Only one tsetse fly (*Glossina* sp.) was collected with the malaise trap mounted at the river bank at Sara Dugum near Katagum, Bauchi State. Details of the findings and their implications for the health standard of living of the area are discussed.

INTRODUCTION

The Hadejia-Nguru Wetlands (HNW) area of north eastern Nigeria is an agriculturally fertile floodplain of roughly 3,500 km² largely watered by the Hadejia and Jama'are rivers that originate from the Jos Plateau (Hollis *et. al.*, 1993). This area is

inhabited by about 1.5 million people, including Hausa, Fulani, Badawa and Kanuri whose primary economic activities include livestock rearing. It is estimated that

506,500 heads of cattle, 437,000 sheep and 529,000 goats graze in the HNW, particularly during the critical dry season period (ANON., 1996). The estimated turnover from cattle trade alone is ₦416 million annually (ANON., 1993).

Thus the HNW area is significant for the provision of various livestock products, including meat, milk and milk products, hides and skin and manure. These, in addition to the production of fish, food and cash crops, and doum palm, are some of the economic activities of the HNW, which constitute a significant contribution to the national economy. Like in other national and international wetlands, these functions are only beginning to receive appreciation. For the HNW in particular, this realisation is a direct result of the establishment in 1987 of the HNW Conservation Project (HNWCP; now funded by IUCN).

Insects are among arthropods that exert negative influence on human and animal health as well as on economic development. Insects of medical and veterinary importance are known for one or more of the following: general nuisance, disease transmission by ectoparasites, myiasis by endoparasitic immature stages and for painful bites or stings that produce lesions (with or without allergic reactions). Some of the most deadly diseases e.g. malaria, yellow fever and trypanosomiasis are insect transmitted. Due to the specific nature of the problems caused by species of these category of insects, although with occasional overlap, it is important that insects belonging to this group be identified and documented in any given ecosystem.

This article reports on a study conducted on the diversity of insects of medical and veterinary importance in the HNW of North Eastern Nigeria at various times during 1995 to 1997 using a variety of collection methods. It examines the effectiveness of two biconical trap colour combinations for sampling the insects and discusses the implications of the findings for biodiversity surveys. The wider implications of the data for public health and livestock production in the wetlands are also discussed.

MATERIALS AND METHODS

(a) Study Sites

This study was conducted in the Hadejia-Nguru Wetlands (HNW) of north eastern Nigeria (Fig. 1), at various times during 1995 to 197. A detailed description of the study area is provided in Molta *et. al* (1997).

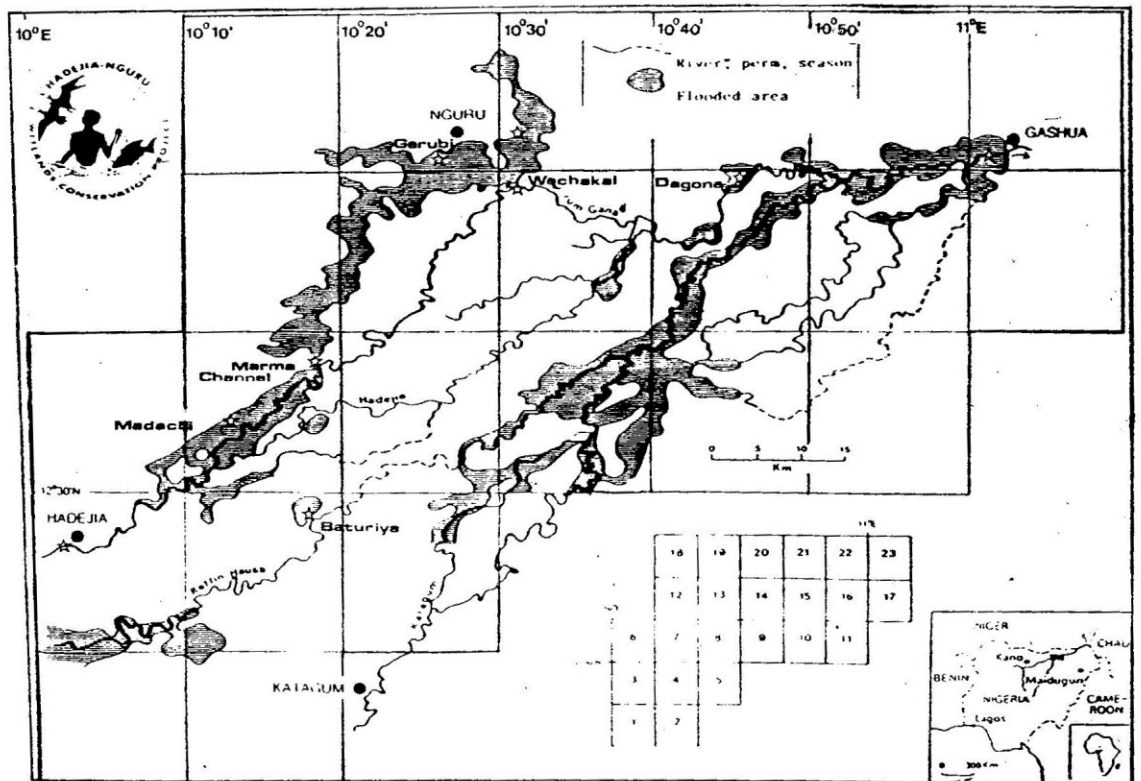


Fig. 1: Hadejia-Nuguru Wetlands of Nigeria with Sites Used in the Study of Insects of Medical and Veterinary Importance

At least, 16 sites scattered across the entire wetlands area were selected for this study (Table 1). The specific locations of some sites were determined using a GPS 45

Personal Navigotor to facilitate re-visit if and when necessary.

(b) Insect Collection Methods

Various methods of insect collection (Southwood, 1966; ANON., 1974; ANON., 1975; Chinery, 1976; Ryan and Molyneux, 1979; Service, 1990; ANON., 1986) were employed depending on appropriateness of the technique. These include:

- (1) Indoor spraying using pyrethroid-based aerosol ('Mobil' = Etramethrin, 0.20%; Phenothrin, 0.12%; Allethrin, 0.25%; Solvents/Propellants/Essential oils, 99.4%) for adult mosquitoes
- (2) Aspirator for collecting resting adult mosquitoes on wall surfaces.
- (3) Outdoor spraying, of flowering *Acacia senegal*, using 10% v/v Polythrin C440 EC, which is a broad spectrum rapid knock-down contact insecticide containing profenofos (400 g/l) and cypermethrin (40 g/l) (ANON., 1995). This compound was applied using a portable Hudson sprayer and the insects were collected on pre-laid sheets of cloth following knock-down.
- (4) Water net and laddle were used for collecting aquatic insects.
- (5) Sweep net was used for sampling flying insectts as well as those resting on animals.
- (6) Challier-Laveissiere (Biconical) (Ryan and Molyneux, 1979) traps were used at various locations. Initially, only one trap with a blue lower cone and white upper cone was used. Later, a second trap with blue lower cone and a black upper one was introduced. The two traps were always set-up 10 metres apart.

In addition to these sampling methods, visual observation was made, particularly for insects on animals.

Insects collected from various sites using techniques described above were then sorted and identified using various keys. The numbers were recorded according to site, sampling method, date and time of collection. Confirmation of species identification was later made using the reference collection of the Entomology Museum of the Department of Crop Protection of the Institute of Agricultural Research, Ahmadu Bello University, Zaria.

(c) Data Analysis

Data analysis involved comparison between catches of different sexes, sites, time of sampling and sampling tools. Where appropriate, the student t-test and analysis of variance (ANOVA) are employed to compare the data.

RESULTS

At least 30 species of insects of known veterinary and medical importance were recorded in HNW during this study (Table 1). These include mainly members of the Diptera (6 families) and to a much lesser extent, Hymenoptera (3 families), Dictyoptera (1 family). Species not included in the list include *Apis mellifera* L. (Hymenoptera:Apidae), *Camponotus perrisi* (Hymenoptera:Formicidae) and bed bugs (Hemiptera:Cimicidae).

The most widely occurring species in the wetlands is the common housefly, *Musca domestica*. It was found in spray catches from flowering *Acacia* trees as well as in biconical trap collections from all sites. Closely following *M. domestica* in abundance was the tabanid flies, *Tabanus* spp. (including *T. gratus* and *T. taeniola*). The tsetse fly, *Glossina* sp. was the most rare medical/veterinary insect, collected only at the bank of the Jama'are River at Sara Dugum near Katagum.

Biconical trap catches from near the Fulani Camp at Wachakal during March/April (dry season) consisted of 3 genera: *Tabanus*, *Musca* and *Phytomia* (Table 2). Consistently higher numbers of the tabanids (56.8 - 84.0%) than muscids (16.0 - 42.9%) were found in the daily catches with a corresponding abundance ratio of 2.2:1. Afternoon catches of *Tabanus* species at Wachakal always exceeded the morning catches.

Table 3 summarises the data on insects sampled using two biconical trap cone colour combinations (Black/Blue=BB and White/Blue-WB) at five sites. The lowest number of species caught by either trap was two spp (at Wachakal and Bonigal for BB and at Bonigal and Gashua for WB), while the highest of seven spp was caught by the WB trap at Hadejia. There consistently was an overlap of two spp caught with the two trap colour combinations at all sites, except at Dagona where the overlap involved three spp.

Table 1: Some insects of medical and veterinary importance at the Hadejia-Nguru Wetlands of Nigeria.

| ORDER/FAMILY | SPECIES | SITE OF COLLECTION |
|---|---|--|
| DICTYOPTERA Cockroach | Unidentified sp. | 1,8,10, |
| DIPTERA Calliphoridae | <i>Chrysomya albiceps</i> (Wied.) <i>Lucilia cuprina</i> (Wied.) | 7 3,11 |
| Culicidae | <i>Anopheles gambiae</i> Giles <i>A. maculipalpis</i> <i>A. pharoensis</i> Theo. <i>A. rufips</i> <i>A. squamosis</i> Theo. <i>A. ziemanni</i> Grunb. <i>A. funestus</i> Giles <i>Culex pipiens quinquefasciatus</i> (Say) (= <i>C.p. fatigans</i> Wied) <i>C. annulirostris</i> Skuse | 10 10 10 10 10 10 10 10 10 10 |
| Glossinidae | <i>Glossina</i> sp. | 10 |
| Hippoboscidae | <i>Hippobosca variegatus</i> Megerle | 2 5,6,7,8 |
| Muscidae | <i>Coenosia albicoxa</i> (Stein.) <i>C. pachypoda</i> Bigot. <i>Musca domestica</i> L. <i>Dichaetomyia luteiventris</i> (Rondani.) <i>Dichaetomyia</i> sp. | 1-16 5,10,12 |
| Tabanidae | <i>Ancala fasciata</i> (Fab.) <i>Atylotus agretis</i> <i>Tabanus gratus</i> <i>T. lineola</i> F. | 5,10 7 5,7 1-16 3,5,10,13,14 |
| COLEOPTERA Meloidea (Blister beetles) | <i>Coryna argentata</i> <i>Cyaneolytta maindroni</i> (Pic.) <i>Cylindrothorax dusaulti</i> (Duf.) <i>Mylabris bifasciata</i> (Deg.) <i>M. tristigmata</i> (Gerst.) | 6,8,9,11 6,7,8 7 7,12 8,13,15 |
| HYMENOPTERA Formicidae | <i>Camponotus perrisi</i> (For.) | 1-16 |
| Vespidae | <i>Labus macrostylus</i> (Khl.) <i>Polistes</i> sp. | 3,15,16 3,10,15,16 |

Sites: 1=Baturiya, 2=Sara Dugum, 3=Hadejia, 4=Bonigal 5=Wachakal, 6=Dagona, 7=Gashua, 8=Gorgoram, 0=Gwayo 10=Nguru, 11=Zungun Baderi, 12=Wachakal Nguroji, 13=Margadu, 14=Likori, 15=Adiani, 16=Birniwa.

An exceptionally high number of *Dichaetomyia* spp (including *D. luteiventris* and *Dichaetomyia* sp.) was caught by the BB trap (296), while the WB caught only three at Wachakal on one sampling occasion (Table 4). Otherwise, the total individuals of all species caught by both BB and WB traps were closely similar ($T=0.98$, $df=17$; $p>0.05$). However, three species of insects (including *Chrysis* sp) were only sampled by the WB trap.

Table 2: Challier-Laveissiere (Biconical) trap catches of insects near Fulani settlement camp at Wachakal during March and April, 1996 (NB: Only White/Blue trap used).

| Date | <i>Tabanus</i> spp | <i>Musca</i> sp. | Others | Total |
|-------|--------------------|------------------|---------|-------|
| 29/03 | 41 (75.9) | 13 (24.1) | 0 | 54 |
| 30/03 | 37 (80.4) | 9 (19.6) | 0 | 46 |
| 31/03 | 28 (57.1) | 21 (42.9) | 0 | 49 |
| 01/04 | 21 (84.0) | 4 (16.0) | 0 | 25 |
| 02/04 | 31 (73.8) | 11 (26.2) | 0 | 42 |
| 03/04 | 39 (59.1) | 27 (40.9) | 0 | 66 |
| 04/04 | 25 (56.8) | 18 (40.9) | 1 (2.3) | 44 |
| 05/04 | 73 (69.5) | 32 (30.5) | 0 | 105 |
| Total | 295(68.4) | 135 (31.3) | 1 (0.2) | 431 |

Footnote: Numbers in parentheses are percentages.

Table 3: Insects captured using Black/Blue (BB) and White/Blue (WB) coloured biconical traps at various sites in the Hadejia Nguru Wetlands.

| Study Site | Number of Species | | | | Number of Insects | | |
|------------|-------------------|----|----|----|-------------------|----|-----|
| | BB | WB | TT | OL | BB | WB | TT |
| Wachakal | 2 | 4 | 4 | 2 | 298 | 13 | 311 |
| Bonigaral | 2 | 2 | 2 | 2 | 9 | 7 | 16 |
| Hadejia | 4 | 7 | 9 | 2 | 7 | 20 | 27 |
| Gashua | 3 | 2 | 3 | 2 | 12 | 4 | 16 |
| Dagona | 3 | 4 | 4 | 3 | 20 | 20 | 40 |
| Total | | | | | 346 | 64 | 410 |

Footnote: TT=Total number captured at individual site

OL=Number of species common to both BB and WB trap catches.

Anophiline mosquitoes recorded in the wetlands (Table 1) include, in decreasing order of abundance, *A. gambiae* (30.4%), *A. squamosis* (27.5%), *A. rufipes* (12.3%),

A. pharoensis (11.9%), *A. ziemanni* (9.6%), *A. maculipalpis* (6.3%) and *A. funestus* (2.0%). Other mosquitoes of the area are *C.P. quinquefasciatus* and *C. annulioris*. The surveys of indoor mosquitoes in both 1996 and 1997 yielded higher proportions of *Anopheles* species (61.1% and 60.0%, in 1996 and 1997, respectively) than *Culex* species (38.9% and 40.0%). The numbers of both species recorded from the same collection site were generally higher in 1997 than in 1996 (Table 5). But, both genera showed a predominance of females over males within human habitation.

Table 4: Distribution of various insects species captured using Black/Blue (BB) and White/Blue (WB) coloured biconical traps at various sites in the Hadejia-Nguru wetlands.

| INSECT SPECIES | SITE | NUMBERS BB | COLLECTED WB | TOTAL |
|--|------|---------------|-----------------|-------|
| <i>Musca domestica</i> L. | 1 | 2 | 8 | 10 |
| | 2 | 8 | 5 | 13 |
| | 3 | 3 | 7 | 10 |
| | 4 | 6 | 3 | 9 |
| | 5 | 11 | 8 | 19 |
| | | 30(49.2) | 31(50.8) | 61 |
| <i>Tabanus</i> spp. | 1 | 0 | 1 | 1 |
| | 2 | 1 | 2 | 3 |
| | 3 | 1 | 5 | 6 |
| | 4 | 2 | 3 | 5 |
| | 5 | 6 | 11 | 17 |
| | | 10(31.3) | 22(68.8) | 32 |
| <i>Dichaetomyia</i> spp | 1 | 296 | 3 | 299 |
| | 3 | 0 | 3 | 3 |
| | 4 | 4 | 1 | 5 |
| | | 300(97.7) | 7(2.3) | 307 |
| <i>Ancala fasciata</i> (Fab.) | 3 | 1 | 0 | 1 |
| | 5 | 3 | 1 | 4 |
| | | 4 | 1 | 5 |
| <i>Phytomyia natalensis</i> (Macq.) | 4 | 2 | 0 | 2 |
| | 5 | 3 | 1 | 4 |
| | | 5 | 1 | 6 |
| <i>Consanguina pusilla</i> (Macq.) | 4 | 2 | 0 | 2 |
| <i>Allograpta nasuta</i> | 4 | 4 | 1 | 5 |
| Total | | 355(84.9) | 63(15.1) | 418 |

Sites: 1=Wachakal; 2=Bonigara; 3=Hadejia; 4=Gashua; 5=Dagona. Numbers in parentheses are percentages.

Unlike the adult mosquitoes, larval sampling at various sites showed a predominance of *Culex* species over *Anopheles*. But, no *Aedes* larvae were recorded

in any of the samples. The water samples, particularly those from the Nguru Lake at Gerubi and ponds on the Gashua Road at Nguru, also contained *Cybister africana* (Coleoptera:Dytiscidae) (predaceous beetle that can be harmful to man) and cyclopoid intermediate hosts of guineaworm.

Table 5: Mosquitoes collected at Nguru using aspirator and insecticide spraying during Auguts/September, 1996, and June, 1997.

| Date | <i>Culex</i> species | | | <i>Anopheles</i> species | | | Total mosquitoes |
|--------------|----------------------|-----------|-----------|--------------------------|-----------|------------|------------------|
| | Fm | M1 | Total | Fm | M1 | Total | |
| 28.8.96 | 2 | 1 | 3 | 7 | 4 | 11 | 14 |
| 28.8.96 | 2 | 2 | 4 | 4 | 3 | 7 | 11 |
| | 3 | 2 | 5 | 3 | 1 | 4 | 9 |
| 30.8.96 | 3 | 0 | 3 | 3 | 1 | 4 | 7 |
| | 0 | 1 | 1 | 7 | 1 | 8 | 11 |
| 31.8.96 | 3 | 1 | 4 | 5 | 2 | 7 | 11 |
| | 6 | 0 | 6 | 4 | 1 | 5 | 18 |
| 01.9.96 | 8 | 1 | 9 | 9 | 0 | 9 | 51 |
| 17.6.97 | 17 | 5 | 23 | 21 | 7 | 28 | 39 |
| 18.6.97 | 12 | 4 | 16 | 18 | 5 | 23 | 32 |
| 19.6.97 | 7 | 3 | 10 | 17 | 5 | 22 | |
| Total | 63 | 20 | 84 | 98 | 30 | 128 | 212 |

DISCUSSION

The data presented in a significant contribution towards the production of an inventory of species in this category of insects of the wetlands. With increasing desertification, particularly in the sahelian (North East) sub-region, the Hadejia-Nguru Wetlands is certain to attract a larger human and domestic animal population. Therefore, the importance of the species listed for human and animal health, as well as for economic activities of the area is bound to increase. This trend is only reversible using effective control strategies.

The data has, also highlighted major areas of crucial investigations on insect vectors of this wetland area. Initial interest was stimulated by the observation that the area only became inhabited by properly settled human population (and their domestic animals) round about the time that malaria control drugs, including chloroquine and quinine, became available (Henry Thompson, pers.comm., 1987). This observation brought to the force the significance of anopheline vectors of malaria in the wetlands.

It is of interest that the study has revealed the presence of at least six *Anopheles*

species. Unfortunately, the identification procedure of using keys employed in this work is tedious and does not differentiate between closely related species like the sibling species of *A. gambiae* Giles complex (e.g. *A. gambiae* s.s. and *A. arabiensis*). Studies in Kaduna area by Service (1963) showed various proportions of the A and B forms. The two species can and often are sympatric (Coluzzi, 1970), and are the main vectors of malaria in West Africa (Lemasson *et. al.*, 1997). But, *A. arabiensis* appears more adapted to the sahelian environment (Lemasson *et. al.*, 1997) and persists longer after the dry season than *A. gambiae* (White, 1972). Both species have same nocturnal biting cycles and endophagic rates (Lemasson *et. al.*, 1997) and are established vectors of malaria and filariasis.

A. funestus, with the lowest abundance (2%) among *Anopheles* species of the wetlands has been shown to sustain malaria transmission during dry season periods in Kisumu area of Kenya before *A. gambiae* appears during the rainy season (White, 1972). On the other hand, *A. gambiae* prevails all-year-round where suitable water persists perennially (White and Rosen, 1973). This may be the case for the HNW area. *A. funestus* appears to have wide distribution in Sahel (Gadzama, 1983).

Besides mosquitoes, other potential vectors of human and animal diseases are the muscids, tabanids, calliphorids (including the agent of blowfly strike) and hippoboscids. This is not surprising since the immature stages develop in moist soil or mud (Chinery, 1976) that is readily available in the wetlands. Among these groups, the muscid houseflies and the tabanid, *Tabanus* spp. are the most widely occurring in the wetlands. Interestingly, some of these species were found on flowering *Acacia* trees, presumably attracted to nectar (main diet of males) on the plants. This finding is important from the pest control point of view. These plants, among others, clearly are potential sources of re-infestation of insecticide-treated areas (human habitation, animal sheds, etc.).

Vector analysis is a pre-requisite for disease epidemiology and for development, planning, execution/implementation and evaluation of antivector measures (Coluzzi, 1992). It is, therefore crucially important that further studies take advantage of new emerging molecular tools (polymerase chain reaction, PCR; enzyme-linked immunosorbent assay, ELISA; etc.) to characterise various vector populations of the area.

Higher proportions of male mosquitoes (both *Anopheles* and *Culex* species) than females were recorded in the samples. This is considered to be a function of feeding behaviour as well as of proximity to major breeding sites. However, the larval sampling gave more *Culex* larvae than *Anopheles* whereas more adult *Anopheles* than *Culex* were found in the indoor samples. Another unexpected observation is the total

absence of *Aedes* mosquitoes from both larval and adult catches. The reasons for these observations are not clear, but may not be unconnected with breeding requirements. Further studies are required to provide acceptable explanation.

Studies with the biconical traps show that the two colour combinations are almost equally effective in surveys to produce an inventory of species. However, the occurrence of three species only in the White/Blue trap and not in the Black/Blue indicates that using both traps can improve both quantitative and qualitative information. This is of particular importance for rare species.

A comparison of the present data with data generated by Reid (1989) from the Oban District of Cross River State, Nigeria reveals considerable differences in species composition of the two ecological settings. For instance, two *Tabanus* species were recorded in the HNW while six were found in the Oban District, but there is no species common to both ecosystems. Similar differences have been reported by Molta *et. al* (1997) for other insects, indicating the influence of climate on species distribution. This has obvious consequences for disease epidemiology and transmission among other ecological functions.

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