THE DRAGONFLIES OF HUNTER'S LODGE, KENYA, 1981-1991

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Abstract — A report is given of the occurrence of Odonata at a site in Kenya comprising a stream which has been dammed to form a small reservoir. Observations have been made at the site on six occasions during the last ten years. Altogether 10 zygopteran and 35 anisopteran spp. have been observed at the site, and evidence of breeding by 8 zygopteran and 26 anisopteran spp. has been obtained. 17 spp. were reproductively active only at the stream and 9 spp. only at the reservoir. A further 7 spp. were active in both habitats. Patterns of daily activity of some of the commoner spp. have been analysed and evidence for temporal partitioning among some Zygoptera is described.

Introduction

While many reports exist on the odonate faunal composition of various African habitats (e.g. BALINSKY, 1961; CORBET, 1962; PINHEY, 1961, 1964, 1970, 1984; PINHEY & PINHEY, 1984; SAMWAYS, 1989; SILSBY, 1989), few have dealt with changes over time at one habitat. During the last decade we have had the opportunity to make six visits, each of from 4 to 35 days in duration, to an aquatic habitat in Kenya where we have observed altogether 45 species. This has allowed observations to be made on the stability of the populations of most species but also on changes in a few. We summarise the observations here and also report on the occurrence of temporal partitioning between some zygopteran species, a feature known in damselflies and dragonflies elsewhere (e.g. MIZUTA, 1974).

Habitat

The study site lies at just over 900 m above sea level in a region of Guinea savanna, 160 km south-east of Nairobi, close to the main road to Mombasa and near Makindu (37°32'E, 2°15'S) (MILLER, 1982a, 1982b). During April daily temperatures have a mean maximum of about 29°C. The main rains occur during April and May, with lesser amounts falling in November and December.

Two streams arise from springs which are fed by water falling on the Chyulu Hills situated about 20 km south-west of the site. The springs run throughout the year with little seasonal fluctuation. The smaller stream is used for irrigating adjacent farmland and the larger runs approximately north-east for about 40 km before it joins the Athi river. It has been dammed at several places along its length to form a series of small reservoirs. The water near the springs smells strongly sulphurous and the stream is said by local residents to be undrinkable but adequate for making tea or washing in. Observations have been made along the first 0.6 km of the larger stream in the vicinity of a small hotel, Hunter's Lodge.

Five zones were distinguished in this region as follows (Fig. 1):

(1) The springs which emerge amongst volcanic rubble in a densely shaded area under large trees, together with the first 10 m of the stream;

(2) A reservoir above the dam, which is about 300 m long and up to 80 m broad and through which the water flow is imperceptible. The bank in this region is partly exposed to sunlight and partly shaded by many trees and bushes, with dense clumps of *Typha domingensis* growing along its margins. There is little or no submerged

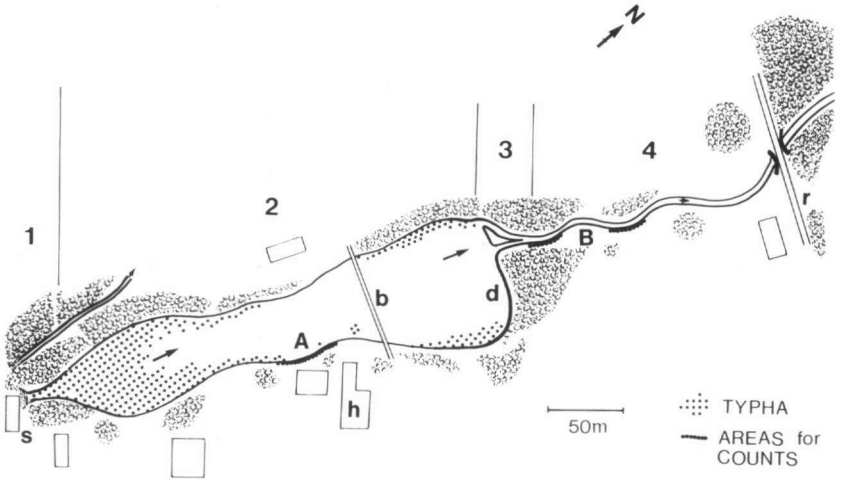

Fig. 1. A sketch map of the stream and reservoir where surveys were made. — [b: bridge; — d: dam; —h: hotel; — r: main road; — s: springs; — A & B: regions where counts were made; — N: North; —1-4: zones (see text)]

vegetation except in a small upper region of the reservoir. The reservoir which was probably formed 50-60 years ago supports large populations of cichlid and other fish;

(3) Small waterfalls below the dam, where the drop is about 2 m, together with the first 10 m of the stream where it has a fast flow rate. This region is well shaded by large trees;

(4) The lower stream, partly shaded by trees (*Acacia xanthophloea, Ficus* spp.) but also with exposed clearings where the bank supports thick growths of *Mukia maderaspatana* (Cucurbitaceae), *Ipomoea tenuirostris* (Convolvulaceae), *Commelina benghalensis* (Commelinaceae), *Impatiens stuhlmanii* (Balsaminaceae) and *Dyschoriste radicans* (Acanthaceae) (identifications provisional);

(5) A disused swimming pool which usually contained water to a depth of ca 0.5 m.

Several changes in the habitat have taken place in the last few years:

(a) The upper 20% of the reservoir has become entirely grown over by *Typha domingensis* leaving no open water and causing the disappearance of the only area of submerged vegetation (1986-1991);

(b) After 1982 the smaller irrigation stream was dug out, straightened and lined with stones, destroying its vegetation;

(c) Considerable bush and tree clearance in the lower stream region has taken place since 1986 and there has been a marked increase in cultivation along the north side of the site together with an increased density of human settlements in the vicinity;

(d) Some of the water from the largest spring has been piped and led away to supply dwellings since 1984. The reservoir has become mildly eutrophic with periodic algal blooms, most noticeable in 1991, and probably resulting from a reduction in flow-rate together with increased agricultural activity and human settlement.

The dates when surveys were made are shown in Table I: additional brief visits were made in 1960, 1961 and 1973. On most days, observations continued for several hours. In addition counts of all individuals present were made at approximately 30-minute, or shorter, intervals on three successive days in 1991 in two selected

areas (Fig. 1). The first area (in zone 2) was a 63 m stretch of the reservoir bank which was well exposed to the sun and bordered by short grass and small emergent plants (*Canna, Juncus* spp.). The second (in zone 4) consisted of two stretches of the stream, totalling 65 m, partly shaded by trees and large stands of *Typha* and *Cyperus*. The counts were made by two observers independently at the times indicated in Figures 2 & 3 and Table II, each count taking 10-15 min.

Identifications have been carried out using PINHEY (1961, 1964, 1970), and with the kind assistance of S.J. Brooks of the Natural History Museum, London.

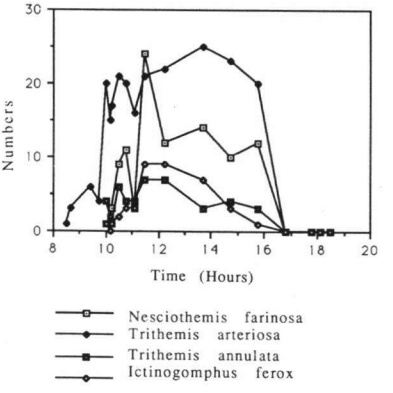

Fig. 2. Counts of 4 species of Anisoptera along 63 m of the reservoir bank at the times indicated, made on 14th April, 1991.

Results and Discussion

Table I shows the results of surveys carried out on six occasions between 1981 and 1991. It also indicates species for which proof of breeding was obtained (**) (i.e. presence of larvae, exuviae or teneral adults), or for which there was indirect evidence of breeding (*) (copulation and/or oviposition observed), together with the zones where reproductive activity was seen to occur. Estimates of numbers include those seen within ca 20 m of the water (e.g. many *Phaon iridipennis* were regularly observed feeding in the vicinity of a leaking sewage plant, 15 m from the stream). Altogether 45 species have been observed: 16 were found to be present during all visits, 26 in all but one, and 32 in all but two. Six species which were each seen only once may have been vagrants. However three of these were coenagrionids which were noted only cursorily in the earlier visits.

The populations of most of the commoner species remained fairly stable throughout the decade, but *Tholymis tillarga* is an exception in that it first appeared in 1984 and had almost totally disappeared by 1991. This may be explained by a chance invasion of the habitat followed by a gradual reduction of numbers resulting from competition with species better adapted to local conditions. The absence of *Brachythemis lacustris* in 1991 is puzzling since it had been reliably present on every previous visit although its numbers had declined in 1986. In contrast a small population of *B. leucosticta* was present in all visits. Thus by 1991, two of the three species with marked crepuscular periods of reproductive activity had declined or disappeared. The overall abundance of several species was estimated to be lower in 1991 than in previous years, possibly as a result of habitat changes.

Records were made in altogether six months of the year. Up to 25 species were represented in December but higher numbers of species and individuals were found during the main wet season, April and May. Several species, including *N. farinosa, T. arteriosa, T. annulata, I. ferox, O. chrysostigma* and several zygopterans are probably to be found throughout the year as adults, although in variable numbers. The considerable extension of *Typha* in shallower parts of the reservoir after 1984 with the consequent obliteration of open water at the upper end, together with the region of submerged vegetation, probably accounts for the reduction in numbers or disappearance of *Diplacodes lefebvrei, Urothemis assignata, U. edwardsi* and *Rhyothemis semihyalina,* most of whose reproductive activity took place close to the submerged vegetation. *Tetrathemis polleni* was observed only in shaded areas close to the springs (zone 1), although elsewhere in Kenya we have seen it to be active in exposed regions of ponds and streams. Three species, *Pantala flavescens, Crocothemis erythraea* and *Trithemis kirbyi*

Table I — The occurrence, estimated abundance and breeding activity of dragonflies at Hunter's Lodge [Estimated numbers seen: 0 = absent, — A = 1, — B = 2-5, — C = 5-10, — D = 10-50, — E = 50, — — = no record; Evidence of reprodn: * = species seen to be reproductively active; ** = species for which proof of breeding was obtained (observation of larvae, exuviae or tenerals); — Zone of reproductive activity: 1 = spring region, — 2 = reservoir, — 3 = water-fall region, — 4 = lower stream, — 5 = swimming pool]

Species	Occurrence 1981 29/4-2/6	1982 6-20/7	1984 7-25/4	1984 11-14/12	1986 28/3-11/4	1991 2-14/4	Evidence of reprodn	Zones where reprodn occurred
Zygoptera								
COENAGRIONIDAE								
+*Agriocnemis gratiosa* Gerst.	-	-	-	-	-	C	*	2
Agriocnemis sp.	-	-	-	-	-	B		
Ceriagrion glabrum (Burm.)	B	B	C	C	B	B	*	1, 4
P. commoniae nigerrimum Pinhey	C	C	C	-	C	D	*	2
Pseudagrion kersteni (Gerst.)	E	E	E	D	E	E	**	4
P. massaicum (Sjoestedt)	D	D	D	-	D	D	*	2 (1, 4)
P. pseudomassaicum Pinhey	-	-	-	-	-	B		4
PROTONEURIDAE								
Elattoneura glauca (Burm.)	E	E	E	E	E	E	*	2
CHLOROCYPHIDAE								
Platycypha caligata (Sel.)	D	D	D	C	D	E	**	1, 4
CALOPTERYGIDAE								
Phaon i. iridipennis (Burm.)	D	D	D	B	E	D	**	(1) 4
Anisoptera								
GOMPHIDAE								
Ictinogomphus ferox (Ramb.)	E	E	E	C	D	D	**	2 (4)
Phyllogomphus orientalis Fraser	O	O	O	O	O	A		
Gomphidia madi Pinhey	B	B	B	O	B	B	*	4
Paragomphus genei (Sel.)	B	B	B	O	B	B	**	4
+*P. elpidius* (Ris)	B	B	B	O	B	B	*	4
+*Crenigomphus hartmanni* (Foer.)	O	O	O	O	O	B	*	4
AESHNIDAE								
Anax imperator Leach	B	B	B	B	B	B	**	2
A. speratus Hag.	B	B	O	O	B	B	*	4 (1)
CORDULIIDAE								
Macromia reginae Le Roi	O	A	A	O	O	O		
+*M. pallidinervis* Foer.	B	B	B	O	B	B	*	4
LIBELLULIDAE								
Acisoma p. panorpoides Ramb.	O	O	O	A	O	A		
Brachythemis lacustris (Kirby)	E	E	E	D	D	O	*	2 (4)
B. leucosticta (Burm.)	B	A	B	C	C	C	*	2
Crocothemis erythraea (Brullé)	B	B	O	O	B	B	**	5
C. sanguinolenta (Burm.)	E	E	E	D	E	E	**	3, (4)
Diplacodes lefebvrei (Ramb.)	B	C	C	B	C	A	*	2
Nesciothemis farinosa (Foer.)	E	E	E	E	E	E	**	2, 4, (1)
Orthetrum brachiale P. de Beauv.	-	C	B	B	B	O		
O. chrysostigma (Burm.)	D	D	D	C	D	B	*	1, 4
O. trinacria (Sel.)	B	B	B	O	B	A	*	2
Palpopleura l. lucia (Dru.)	O	B	B	B	O	A	*	1
Pantala flavescens (Fabr.)	D	D	C	O	D	B	**	5
Rhyothemis semihyalina (Desj.)	B	B	B	O	O	O		
Tetrathemis polleni (Sel.)	B	O	B	B	O	B	*	1
Tholymis tillarga (Fabr.)	O	O	E	O	E	A	*	2 (4)
Tramea b. basilaris P. de Beauv.	O	O	A	O	O	O		
Trithemis annulata P. de Beuav.	D	D	E	D	E	E	**	2, 4
T. arteriosa (Burm.)	E	E	E	E	E	E	**	2, 4
T. furva Karsch	B	C	C	O	-	B		
T. kirbyi ardens (Gerst.)	O	B	A	B	O	B	**	5

Table I — Continued

Species	Occurrence 1981 29/4-2/6	1982 6-20/7	1983 7-25/4	1984 11-14/12	1986 28/3-11/4	1991 2-14/4	Evidence of reprodn	Zones where reprodn occurred
T. stictica (Burm.)	O	B	O	B	O	B		
Urothemis assignata (Sel.)	O	B	B	B	O	O	*	2
U. edwardsi (Sel.)	B	B	B	O	B	A	*	2
Zygonyx natalensis (Martin)	D	D	D	D	D	D	**	3 (1)
Z. torrida (Kirby)	C	C	C	C	C	C	**	3
Totals	31	36	36	24	30	38		

+ = identification provisional.

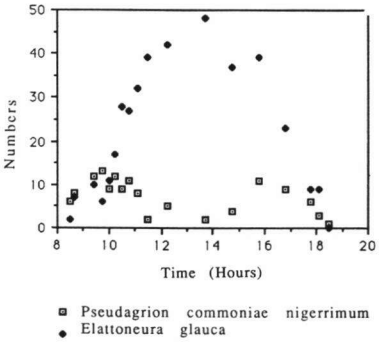

Fig. 3. Counts of 2 species of Zygoptera along 63 m of reservoir bank at the times indicated, made on 14th April, 1991.

ardens, were active and bred only in the swimming pool (zone 5).

Comparing the reservoir and stream as sites of reproductive activity, 9 species were confined to the stream, never being active at the reservoir, and 17 species were active only at the stream, never at the reservoir. For example *Anax imperator* was entirely confined to the reservoir whereas *A. speratus* was seen only at the stream. A further 7 species were reproductively active at both the stream and the reservoir although all were more numerous at the reservoir. For example *I. ferox, N. farinosa, T. arteriosa* and *T. annulata* were regularly reproductively active at the stream as well as at the reservoir, and this was also true, but less commonly so, for *B. lacustris* and *T. tillarga.* Except for *N. farinosa,* all these species were observed only in regions of the stream which were less than 100 m from the reservoir and it is likely that their principal breeding ground was the reservoir. *N. farinosa* remained active on the stream until shortly before sunset (ca. 18.30 h) although it had usually left the reservoir by about 16.00 h. Considering only the commoner species, it can be postulated that 17 species would have been present on the original stream before it was dammed to form reservoirs and that a further 16 species appeared after the formation of reservoirs, thereby doubling the odonate fauna of the locality.

Figures 2-4 and Table II show the results of counts of the commoner species at the reservoir and stream sites made at intervals on each of 3 days in 1991. Many species were most abundant at the water between 10.00 and 16.00 h (Fig. 2), whereas counts of *Pseudagrion commoniae*

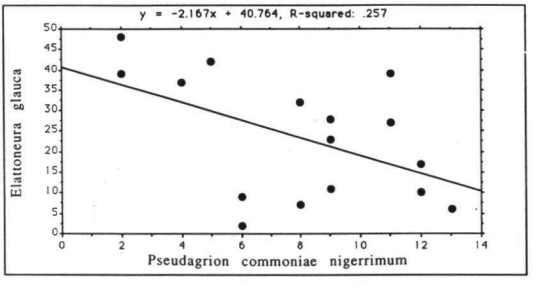

Fig. 4. Counts of *Elattoneura glauca* plotted against those of *Pseudagrion commoniae nigerrimum* made at the reservoir at intervals between 08.30 and 18.00 h on 14th April, 1991, showing a negative correlation ($P < 0.05$).

Table II — Comparison of numbers of species present at ca 14.00 h in zones 2 and 4 (reservoir and lower stream), and at other times in zone 4, on 3 days in April, 1991

Species	Reservoir (Zone 2)			Stream (Zone 4)					
	Day 12 4	13/4	14 4	12/4	12/4	12/4	13/4	13/4	14/4
	Time 14.00	13.40	13.40	09.30	14.15	17.15	09.55	14.00	14.15
Agriocnemis gratiosa	2	1	1	0	0	0	0	0	0
Ceriagrion glabrum	1	0	1	0	0	0	0	0	0
Pseudagrion kersteni	0	2	0	17	12	34	28	18	12
P. commoniae nigerrimum	5	8	2	0	0	0	0	0	0
P. massaicum	2	2	1	0	0	0	0	2	0
P. pseudomassaicum	0	0	0	0	2	0	0	1	2
Elattoneura glauca	35	35	48	0	12	2	4	1	1
Platycypha caligata	0	0	0	0	4	6	7	7	12
Phaon iridipennis	0	0	0	0	1	2	2	2	2
Ictinogomphus ferox	5	2	7	0	3	0	2	3	2
Paragomphus hageni	0	0	0	0	0	0	0	1	2
Anax imperator	1	0	0	0	0	0	0	0	0
A. speratus	0	0	0	0	0	0	2	2	1
Macromia pallidinervis	0	0	0	0	1	0	0	0	2
Crocothemis sanguinolenta	0	0	0	0	15	1	1	17	16
Nesciothemis farinosa	18	9	14	0	17	13	5	15	14
Orthetrum chrysostigma	0	0	0	0	0	0	1	0	2
Trithemis annulata	9	12	3	0	3	1	1	1	1
T. arteriosa	29	23	25	0	3	4	1	2	1
Zygonyx natalensis	0	0	0	0	2	0	1	2	0
Z. torrida	0	0	0	0	4	0	2	2	4

nigerrimum showed two peaks to occur, one at ca. 10.00 and the other at ca. 16.00 h. In contrast, the numbers of the commonest zygopteran in the same region, *Elattoneura glauca,* were highest in the middle hours of the day (Fig. 3). Plotting the abundance of *P. c. nigerrimum* against that of *E. glauca* at the same times between 08.30 and 18.00 h gave a significant negative correlation of their numbers on 14th April ($R^2 = 0.257$; $P < 0.05$) (Fig. 4). On 12 and 13th April, however, the results were not significant, although they suggest a similar trend. The markedly black head and thoracic dorsum of *P. c. nigerrimum* may function in thermoregulation by absorbing radiation and promoting activity at lower temperatures, but with a risk of overheating in the middle of the day. In contrast the light blue thoracic dorsum of *E. glauca* may reflect more of the radiation. These two species also divided the habitat vertically between them, with *P. c. nigerrimum* always perching and flying very close to the water surface whereas *E. glauca* normally perched > 0.5 m above the water surface. PINHEY (1984) describes the former species as being found more commonly at streams than at "quiet grassy pools" and always flying low. Comparable temporal partitioning of a habitat has been described for other Zygoptera by MIZUTA (1974).

Conclusion

The considerable odonatological interest of Hunter's Lodge deserves to be more widely known, not least because the water is readily accessible and comfortable accommodation is to hand. However the habitat, which is rightly popular for bird-watching, is fragile and is currently under some threat from increasing agricultural development and human settlement. Already commercial, agricultural and tourist interests are in conflict. Although we actually saw more species in 1991 than on any previous visit, the abundance of many of the commonest species had declined and this trend will continue if the habitat is not safeguarded.

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