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A mixed Butterfly Migration in West Africa
(Lepidoptera; Rhopalocera)

by
TORBEN B. LARSEN

Introduction

The main observations on which this paper is based were made on the 16th and 17th of April 1978 in and around the town of Natitingou (coordinates 10.18 N, 01.23 E), the capital city of Atacora province in the People's Republic of Benin (formerly Dahomey). Natitingou is situated among low mountains in the Guinea-savanna zone; in parts of the area the savanna reaches climax conditions and becomes quite dense. There has been much less environmental destruction in Benin than in most similar parts of Nigeria. Surprisingly the vegetation was well developed since normally the rainy season starts in May. However, in 1978 there had been significant rainfall since the end of March and the two days before my arrival had been punctuated by heavy thunderstorms. Local residents considered this rainfall pattern to be most unusual, and this could well have had a bearing on the genesis of the migration.

Magnitude of the migration

The morning of the 16th April in Natitingou was fine and sunny with a light breeze. By 10.00 hrs. random butterfly life in the area had crystallised into a thin but well defined migration towards the northeast. The flight was composed of the following species: *Graphium pylades* FABRICIUS, *Belenois creona* CRAMER, *Catopsilia florella* FABRICIUS, *Danaus chrysippus alcippus* FABRICIUS, *Byblia acheloia* WALLENGREN, *Precis hierta cebrene* TRIMEN, *Phalanta phalanta* DRURY*, and a skipper of the *Borbo*-group, probably *Borbo borbonica* BOISDUVAL but possibly *Pelopidas mathias* FABRICIUS, of which there was a sedentary population.

We left Natitingou just after 10.00 hrs. to go to Kotopounga (see map) and throughout the forty minute drive the migration was in evidence and presented the same general aspect in terms of density and species composition. During pauses for translation in our meetings in Kotopounga it was possible to make sixteen one-minute counts of the number of butterflies crossing a fifty metre front. Conditions did not allow for a species by species count although a general impression was obtained.

Unfortunately I did not catch this species and there remains the not very likely possibility that it was *P. columbina* CRAMER.

Table 1: Butterflies crossing a fifty metre front per minute at Kotopounga

Time	Number of butterflies	Time	Number of butterflies
11.15	7	11.50	13
11.17	9	11.54	8
11.20	10	11.59	10
11.25	8	12.04	13
11.33	14	12.09	11
11.42	11	12.12	3
11.45	6	12.16	17
11.47	6	12.20	8
	total for 16 minutes was 154 average per minute was 9.6		

This series of data supports the more general observation that the density of the migration was fairly stable. Confirmation was obtained at Natitingou later in the day (14.40 to 15.10 hrs.) where a count over a fifty metre front yielded an average of eight per minute during half an hour of continuous observation, although this count co-incided with the end of the movement for the day. After 15.30 hrs. little activity was observed.

The migration continued in what appeared to be the same density and composition on the following day, but my work schedule did not allow for more than cursory checking. However, at 14.40 hrs., while travelling southeast by road towards Parakou we were able to establish that the full force of the migration extended at least ten kilometres further southeast than the area shown on the map. By then the weather had become cloudy and yesterday's experience indicated that in any case the migration would have been coming to a spontaneous halt. Nonetheless, at about 16.00 hrs. at Djougou, some 70 km SE of Natitingou, there was still some evidence of migration, so the total expanse of the migration could well have been much larger than the twenty kilometres actually observed. On the morning of the 18th in Parakou (250 km SE of Natitingou) no migratory movement was observed whatsoever, nor was any observed on the coast at Cotonou at any time between 9th and 21st April.

A minimum estimate of the total migration, based on a front width of 20 km, nine butterflies crossing a fifty metre front per minute and two days of migration from 10.00 to 15.00 hrs., is 2.160.000 individuals. However, the front was certainly broader than 20 km and the migration may well have lasted more than two days.

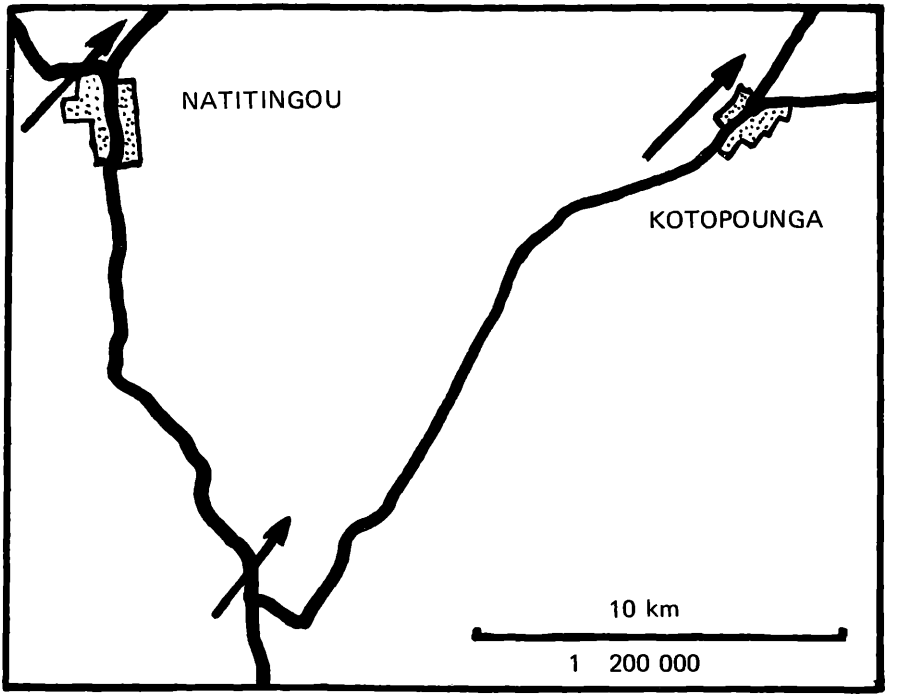

Fig. 1: Map of the area in which the observations were made. The most detailed observations were made at the points indicated by arrows, but the migration was in evidence at all points on the road between Natitingou and Kotopounga.

Composition of the migration

Table 2, which is derived from the general observations as well as on a detailed species by species count of half an hour in Natitinou, shows that the dominant species was *C. florella*, followed by *G. pylades* and *D. chrysippus*. As far as the less dominant species is concerned, the composition of the migration was not totally stable. *P. phalanta* was mostly seen before noon and the other species appeared to come in waves and often travelled in little groups of two or three.

Wind conditions and the migration

As far as could be determined with my very primitive compass wind conditions made little or no difference to the migration path as shown in figure 2 below, but it must be said that the wind was never very strong.

Table 2: Composition of the migration and imputed minimum number of specimens involved

Species	Percent of total	Number of individuals
Catopsilia florella	60 %	1.296.000
Graphium pylades	15 %	324.000
Danaus chrysippus	10 %	216.000
Phalanta phalanta)		
Precis hierta)		
Byblia acheloia)	15 %	324.000
Belenois creona)		
? Borbo)		
TOTAL	100 %	2.160.000

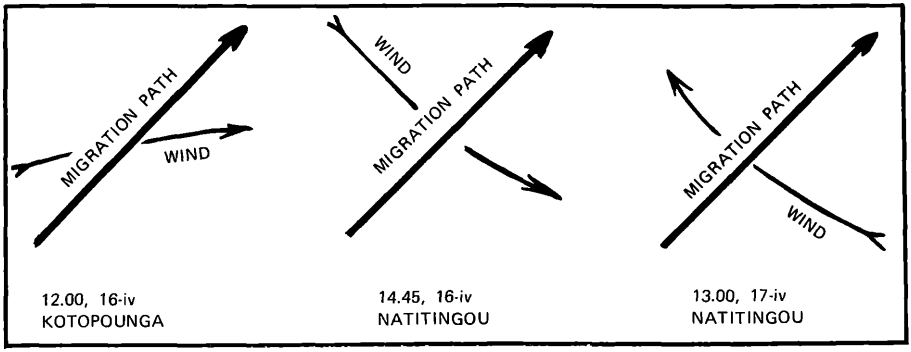

Fig. 2: Direction of the migration and wind conditions at three different times and/or places

The butterflies generally kept their course under differing wind conditions, though there may have been some differential drift. *D. chrysippus* seemed more subject to this than did the other species. At Natitingou *C. florella* flew on a path which was at a slight angle to that of the others, possibly because of its greater ability to compensate for drift.

Behaviour of the migrants

Generally speaking all the migrants behaved with the normal single-mindedness of migrants, but behaviour did vary from species to species. The most obvious differences were in terms of speed; based on a couple sprints along the flight path, I made the following estimates of ground speed.

Table 3: Estimates of ground speed of the migrants species at Natitingou

Species	Ground speed km/h
C. florella, P. hierta	15–20
G. pylades, B. creona	12–16
P. phalanta, B. acheloia	8–12
D. chrysippus	6–10

C. florella and *P. phalanta* usually flew at two to five metres above the ground, though occasionally as high at ten. The remaining species flew at the more usual one to one and a half metres. *C. florella* and *P. hierta* were especially persistent in maintaining a bee-line course while *G. pylades* and *D. chrysippus* allowed themselves to wander on occasion.

Resident populations of *C. florella* and *P. phalanta* were not noted. There was no difficulty in distinguishing between resident and migrant populations of the other species. The differences were especially noticeable in *P. hierta* and *B. acheloia*, resident populations of which were feeding on rotten mangoes in the company of *Charaxes jasius epijasius* REICHE, *Precis oenone* LINNÉ and *Hamanumida daedulus* FABRICIUS. The behaviour of *G. pylades* and *D. chrysippus* indicated that the resident populations might have been starting to join the migration.

Three known migrant species were seen in Natitingou, but displayed no tendency towards joining in the flight. *Papilio demodocus* ESPER was abundant and active, while *Hypolimnas misippus* LINNÉ and *Lampides boeticus* LINNÉ were less common. All three behaved in a completely sedentary fashion.

It deserves to be underlined that conditions in the area must have been almost ideal for breeding populations of all the species in question, so the reason for continued migration does not seem to lie in local ecological insufficiencies. I obviously did not have the time to search systematically for early stages, nor am I sufficiently familiar with them to do so well. Still, it may be worthwhile mentioning that examination of several promising clumps of *Cassia* yielded no eggs of *C. florella*, though I found lots in Parakou the following day. I thoroughly searched about score of *Calotropis procera* for early stages of *D. chrysippus* without success, despite the fact that there were resident popula-

tions and it is the preferred food plant. By chance, since the food plant was unknown to me, I found two larvae of *G. pylades* of which there were also resident populations.

Physiology of the migrants

Time did not allow me to catch more than eleven specimens from the migration, all of which were found to be in perfect or near perfect condition. This was generally true of the specimens observed as well. Migrants would not normally be damaged in the course of the actual migration, but their good condition might be indicative that the migration started fairly soon after eclosion in the area of origin.

The specimens captured were dissected (admittedly under somewhat crude conditions and without the aid of a microscope). The results of this dessection is given in table 4.

Table 4: Sexual development of the migrant specimens captured

Species	Comments
C. florella	4 ♂, 2 ♀: Male testicles of normal size and morphology. Females with very slender abdomens, apparently with little fat reserves and with no fully formed eggs.
D. chrysippus	1 ♂, 3 ♀: Male testicles of normal size and morphology. Females with strongly swollen abdomens and many fully developed eggs.
B. creona	1 ♂: Testicle normal.
G. pylades	1 ♂: Testicle normal.

It is interesting that the *C. florella* females should be with arrested ovarian development while the *D. chrysippus* should have them strongly developed. The sample, in conjunction with the general observations, is not inconsistent with a hypothesis of a normal sex ratio in the migration, but the species involved have slight sexual dimorphism only, so a larger sample of specimens caught would have been desirable. It may or may not be significant that all females of *C. florella* seen were of the andromorph type. No yellow or heavily marked females were seen, though they were present in resident populations at Cotonou.

General comments

In terms of density the observed migration must be classified as thin, although it was clearly recognisable as a migration even to the uninitiated observer. But with more than two million individuals involved it was certainly large enough to have a significant impact in the area where the migrants eventually settle.

The direction of the flight led towards the drier types of savanna prevailing in the Borgou province of Benin or in Niger and Haute Volta.

The fact that the migration was traversing an area which in all respects was ecologically suitable for permanent colonisation and with a plentiful supply of food plants deserves underlining. I have earlier (LARSEN, 1976) subscribed to the view of SOUTHWOOD (1962) that most migratory activity in butterflies is of a somewhat randomised nature, designed to ensure dispersal to all areas of potential suitability, especially in parts of the world where the vagaries of the climate could conceivably kill off entire resident populations. Invasions of the Sahel (if indeed the migrants were to reach that far) as observed at Natitingou would be consistent with this theory. It seems almost certain that the extreme drought in the Sahel during the early part of this decade resulted in depletion or extinction of many butterfly populations.

All the species observed in the flight are known, active migrants, with the possible exception of *B. acheloia*. It is certainly not by chance that all the species involved have a vast distribution in and even beyond Africa. *G. pylades* and *B. creona* are found throughout dry Africa, and the latter when migrating even penetrates the forest zone (LARSEN, 1968). *C. florella* is found all over Africa, Arabia and the Indian subcontinent, from where it invades the temperate zone in Egypt, Lebanon, Palestine, Jordan and the Canary Islands (LARSEN, 1976). *P. hierta cebrene* is common throughout dry Africa and in southwestern Arabia, penetrating to lower Egypt and even on occasion to Lebanon (LARSEN, 1974). *P. phalanta* is found in both India and Africa, but oddly enough apparently not in Arabia. *D. chrysippus* has a vast area of distribution (PIERRE, 1974), but as subspecies are maintained, interregional migration must be slight. West African populations are exclusively of f. *alcippus*, which occasionally migrate into Morocco and Tunisia (CHNEOUR, 1954). However, the resident populations of the Canary Islands, which are all nominate *chrysippus*, cannot be of West African origin. Arabian material resembles that of East Africa in having large proportions of f. *dorippus* KLUG (LARSEN, 1977).

Acknowledgements

It was unfortunate that a tight official programme did not allow a more detailed study of the migration, but this brief note should still be useful. I would like to thank my colleagues, Camerades L. OUENDO, E. ADJOVI, E. PEMA and T. KUMEKPOR for their indulgence in small departures from the programme which I had to make. I would be remiss indeed if I did not take the opportunity of thanking Camerade A. BIGA, Chef du District de Natitingou, for making our visit both professionally and personally so worthwhile.

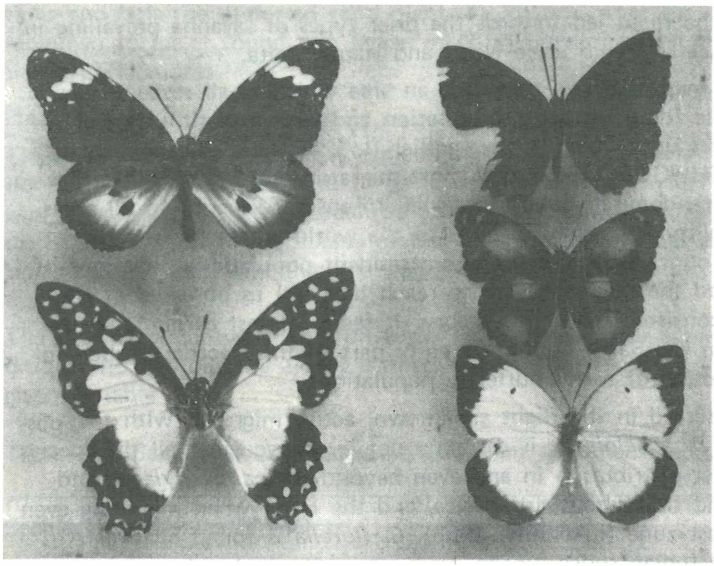

Fig. 1:
Left row:
Danaus chrysippus,
Graphium pylades.
Right row:
Byblia ilithyia,
Precis hierta,
Belenois creona.
All specimens from the actual migration at Natitingou except the *Danaus chrysippus* which is from Arabia.

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Authors address: TORBEN B. LARSEN
23 Jackson's Lane
London N 6