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TRANSSAHARA AND TRANSMEDITERRANEAN MIGRATORY ACTIVITY OF *HEMIANAX EPHIPPIGER* (BURMEISTER) IN 1988 AND 1989 (ANISOPTERA: AESHNIDAE)

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Recent records of migratory *H. ephippiger* in Africa established a relation between the mass movements of this species and good monsoonal rains between the southern fringe of the Sahara and the Guinea Savannah. *H. ephippiger* thus offers an aquatic equivalent to the mass-migration of african locusts. Colonies fringing the sea are established in the western Mediterranean, but appear not to last inland. In the warmer eastern Mediterranean, permanent colonies are more frequent.

INTRODUCTION AND OBSERVATIONS

Between late November 1987 and mid-January 1988, specimens of *Hemianax ephippiger* (Burm.) were piling up against the southern foothills of the Atlas in central Algeria. In view of the time of their appearance, it was assumed that they were migrants from the South (DUMONT, 1988).

In April 1989, one of us (K.D.) made a trip into the Central Sahara, South of the Hoggar mountains. Between April 2-7, flocks of dragonflies, which were readily identified as *H. ephippiger,* were seen in the whole sector SSW of Tamanrasset (ca. 19-21°N, 3-5°E), and as far as the border of Niger, ca. 100 km W of In Guezzam. Large numbers of individuals ("hundreds could be seen at any point in time") were involved, which — typically of the species — were attracted to camp lights at night. Shortly thereafter (April and May), *Hemianax* was spotted in unusual numbers in the Rhone valley in southeastern France, as far North as Lyon. D.Grand (Saint-Romain au Mont d'Or, France, *in litt.*) describes their occurrence as an "invasion". Some specimens must have reached much further north, as illustrated by a male captured in the upper Rhone valley in

Switzerland on May 9th 1989 (MAIBACH et al., 1989). In France, records continued to be made until August, when *Hemianax* was even seen in the Département de la Nièvre. *H. ephippiger* was also observed in the first week of May in Corsica by STOBBE (1989), at a time when almost no local dragonfly species had begun emerging. Between 17 and 19 May 1989, one of us (H.D.) returned to the northern fringe of the Sahara at El Abiod Sidi Cheikh, where winter observations had been made one year earlier. No *Hemianax* was now seen there. However, flocks of the species were now hunting along two man-made reservoirs just south of Alger (lakes Hamiz and Kedara, 21-V.1989).

All these records point in the same direction: in winter 1988 and spring 1989, large numbers of this migrating species crossed the Sahara, and later the western Mediterranean Sea, to end up in continental western Europe. When this movement across the Sahara started is uncertain, but by early May, it had been completed, and only stray groups of individuals had been left behind on the fringes of the Mediterranean and on some of its islands. MAIBACH et al. (1989) made an analysis of the meteorological situation in the Mediterranean Basin in spring 1989, and found that 25 and 26 April were days when strong winds were blowing from Algeria and Tunesia across the sea in the direction of France and Italy. That the swarms observed in the Sahara early in April may have crossed the Mediterranean on these days is therefore more than a mere probability.

DISCUSSION: DOES *HEMIANAX* PERIODICALLY ESTABLISH BRIDGEHEADS IN WESTERN EUROPE?

In 1960, GAMBLES made the insightful observation that dragonfly species and genera common to the tropics-subtropics and the temperate climatic belts of Africa and Europe adapt to the environmental conditions of either area by reversing the amount of time allotted to their respective larval and imaginal instars. Thus, in temperate and continental Europe, most of the lifetime — which may amount to several years — is spent in the larval stage, while the adult phase is reduced to one or two months, at best. In the tropics, larval development is reduced to a few months, but adult lifespan may amount to a full year.

H. ephippiger is an example of the tropical type, but it is also a species typical of arid and semi-arid areas. It distinctly avoids woodlands in Africa and India (FRASER, 1936; PINHEY, 1961). Its range typically is from the Guinea Savannah to the desert, where it frequents river valleys, small lakes and pools (LINDLEY, 1974), many of which are only temporarily filled with water. Because this part of Africa is subject to a monsoonal precipitation regime, with rainfall concentrated in the five months' period from May to September, this is also the main period for oviposition and larval development.

Assuming that oviposition by females surviving from the previous year runs in

parallel with rainfall, a peak in egg-laying activity should be expected around June. The ensuing rapid larval development takes ca. 100 days, such that no eclosions should be expected before September. Peak emergence is to be situated in October-November, which is the period when the majority of rain-fed, temporary lakes and pools begin to dry out. Most fall dry after December, but at that date the *Hemianax* emergence phase should normally be over. The feeding ecology of dragonfly larvae tuned to a fast development in an ephemeral habitat has not yet been studied, but it is known (e.g. DUMONT, 1979) that such environments in the Sahara, Sahel, and Guinea zones, are often devoid of fish, but extremely rich in macroplankton, including several species of Anostraca. Often, dragonflies and hemipterans are the only predators in such environments, where they easily find the abundance of food required to reach adulthood in a short time span. This population cycle is closely paralleled by that of a number of desert frogs and toads (LAMBERT, 1984).

The cyclicity of *Hemianax* spottings in Europe (cf. ASKEW, 1988), and their vast migratory movements across Northern Africa should, therefore, be related to a multiannual variation in precipitation in the Sahel and Guinea zones of Africa. The January 1977 migration along the Atlantic coast (DUMONT, 1977) came immediately after two years of relatively good rains in Mauretania, Mali, and Senegal, following the notorious drought of the early 1979ies. The records of 1988 and 1989 are also lagging one year behind the end of the 1980ies drought cycle. Good rains resumed in 1985, and 1988 and 1989 were particularly humid in the Central Sahel, where the Air mountains of Niger received especially good rains. Even some Saharan Oueds, like the Oued Tamanrasset and the Oued Taffassasset were running for several days to weeks, but such desert precipitation is always more local in nature than in the Sahel.

The results of these good rains are already reflected in a rejuvenation of the Sahelian vegetation, and in an increase in large faunal elements, such as gazellas (DUMONT & DESMET, 1989). The number of ostriches in the Air has increased to 600-800 specimens, up from a few dozens not more than a couple of years ago.

The migratory activity of *Hemianax* may thus safely be attributed to the abundance of monsoon rains South of the Sahara, and, as a system, is an aquatic equivalent to the great locust migrations. Swarms are believed to form as a result of mass emergence from rainfed lakes, between October and December. Coastal populations may easily be transported across the Atlantic, and indeed are known to reach the British Isles and even Iceland during late autumn or even winter, a paradoxical situation for a subtropical dragonfly (DUMONT, 1977). All that is needed is the incidence of air flows that carry the animals passively to their remote destinations (MIKKOLA, 1968).

However, animals that migrate across the western Sahara should find it difficult to overcome the Atlas mountain barrier in winter, as evidenced by the

1988 records (DUMONT, 1988). But their long lifespan permits them to cross it in the next spring, and to continue their northward course. *Hemianax ephippiger*, as far as the western Mediterranean basin is concerned, thus attempts to extend its range northwards, emigrating en masse from a temporarily crowded environment in the South. Successful reproduction in the Eastern Mediterranean basin, from the Levant, along the coastlands of Turkey and Greece to Montenegro, can hardly be doubted. In the slightly colder western Mediterranean basin, permanent bridgehead populations have only locally become established (e.g. in the South of Spain, in the Camargue, in some coastal wetlands of Sardegna, cf. ASKEW, 1988), where they probably revert to the long type of larval development, a suggestion which is in need of being verified. MAIBACH et al. (1989) find that the spring immigrants to Switzerland of 1989 successfully produced a second generation, emerging in August. These founding propagules thus maintained the "short type" of larval reproduction, no doubt because of the hot summer conditions of 1989. The fate of this second generation (successful oviposition; larval survival?) is not known. However, the intervening winter excludes a repetition of the short type larval development.

Note added in proof: More *Hemianax* migrations in the Sahara in 1990

On January 19th 1990, concentrations of *H. ephippiger* were again recorded in the Central Sahara (K.D.). They were observed in a sector N of the Hoggar mountains, extending between Mertoutek (24° N, 5° 40'E), and E of the mountain peak of Garet el Djenoun (25° 05'N, 5° 25'E). In most of this area, dragonflies were flying around in apparently random directions, but in the dry bed of the Oued Irharhar, a major intermittent river draining the North flank of the Hoggar, their behaviour shifted to an orderly, one-way migration pattern, directed South. A count was made near Garet el Djenoun, and revealed between 14 and 20 insects per minute passing across a transect of the Oued.

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