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Species composition and seasonal flight periodicity of stiletto flies (Diptera: Therevidae) occurring along the Kuiseb River, Gobabeb, Namibia

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Stiletto fly larvae are voracious predators of soil-dwelling arthropods and are relatively abundant in sandy, xeric habitats, but very little is known about them. This paper addresses the species composition, abundance and seasonal flight periodicity of stiletto flies caught by a Malaise trap set in the Namib Desert, Namibia, for one year. Four species were collected in very different numbers. It is speculated that the two most abundant species are confined to the riparian zone where the trap was situated, while one of the two less numerous species inhabits the gravel plain, and the other the dune hummocks adjacent to the riparian zone.

INTRODUCTION

Flies belonging to the family Therevidae (Diptera) are commonly known as 'stiletto flies', because adults possess slender, tapering, dagger-shaped abdomens. They form an integral part of the two-winged Order Diptera and hierarchically reside within the brachycerous superfamily Asiloidea.

Therevid larvae are voracious predators of subterranean phytophagous and saprophytic arthropods within sandy, vegetated substrates and leaf litter. Because of their abundance and ravenous feeding habits, these larvae likely play an important, though as yet not investigated, rôle in the suppression of root-feeding larvae in arid, semi-arid, and forested habitats, including agroecosystems and agroforestry systems and are, therefore, considered critical to the sound functioning of those environments (Irwin & Lyneborg 1981). Furthermore, because larvae are general predators of active, soil-dwelling insects, adult abundance is likely a reasonable, indirect measure of below-ground productivity. Moreover, because species appear to be tied closely to specific micro-environments, adult diversity may well provide a gauge of below-ground habitat heterogeneity.

Adult stiletto flies are often abundant during certain times of the year and, unlike their larvae, are quite vulnerable to attack by larger predaceous invertebrates and small vertebrates. Adults of a few species are known to feed on nectar and insect secretions; most, however, imbibe only water and, although the distances they travel have never been experimentally ascertained, they seemingly fly some distance along riverbeds, washes and flightways in search of water in xeric habitats. Even though water is rarely available in the Kuiseb River bed, where this study occurred, a few water seeps exist along the small washes higher to the east, where the writer observed many therevids congregating and actively drinking. Thus, populations can be readily monitored because adults are easily and quantitatively sampled by Malaise traps placed across flight pathways, particularly along ephemeral drainage channels.

The lone written account of adult abundance and seasonal periodicity of therevids chronicles ten species of the genus *Pherocera* Cole, 1923 (Phycinae), monitored by a Malaise trap set in the riparian zone of Deep Canyon, Riverside County, California, USA (Irwin 1971). Because stiletto flies seemingly play a critical rôle in ecosystem dynamics and the population regulation

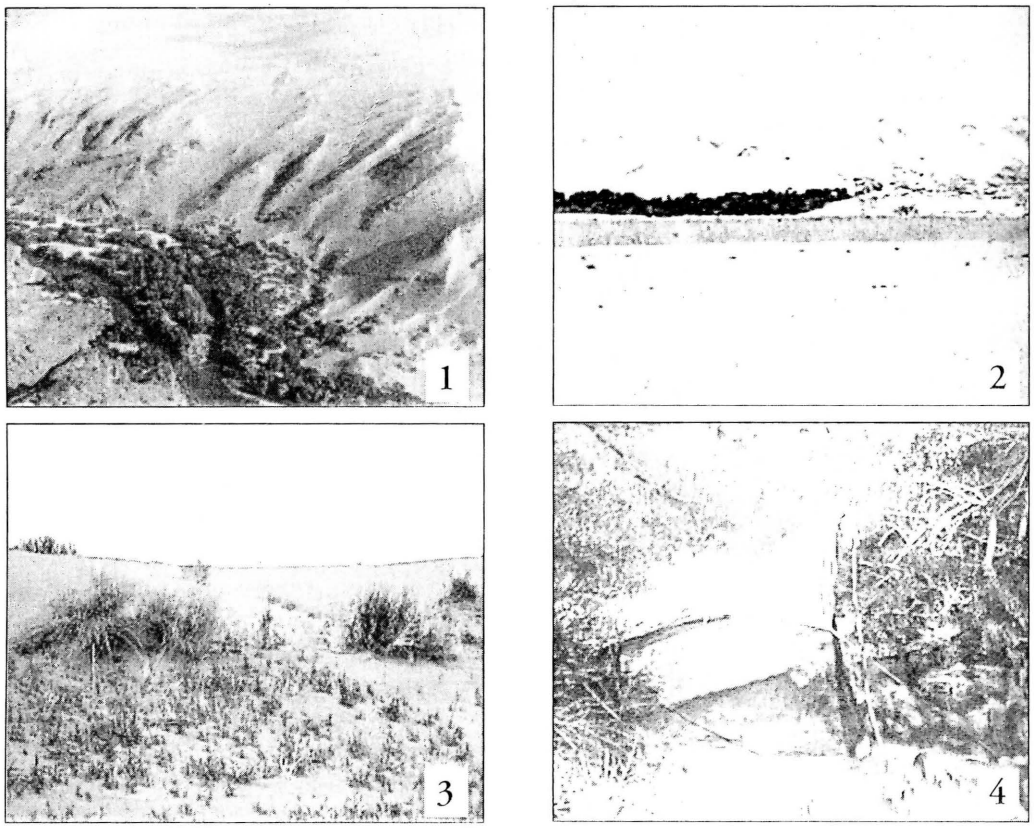

Figure 1-4. Photographs of the trap and the area where the trap was situated. 1. Aerial view of the Kuiseb River, showing the riparian vegetation, the sand dunes behind the river, and the rock and gravel plain in the foreground. Note the photo taken in 1974 after a major precipitation event; the Kuiseb flowed during that time; the next time it flowed was in 1997 during the study described herein. 2. Land-based view of the Kuiseb River study site, with the gravel plain in the foreground, the riparian vegetation in the middle ground and the dunes in the background. 3. The sparsely vegetated dune hummocks to the south and west of the Kuiseb River where immatures of *Orthactia gobabensis* can be found. 4. A Townes-style Malaise trap erected across a dry wash. This is the same style of trap that was used to monitor therevids in the study herein reported.

of soil-dwelling arthropods, the lack of information on their seasonal flight periodicity is lamentable. This paper adds to that written account by examining the species composition, seasonal flight periodicities and abundances of adult stiletto flies monitored over a single year by a Malaise trap set along a flight path within a desert riparian zone of southwestern Namibia. Because of seasonal weather anomalies, the specimen data presented here must be considered preliminary.

MATERIALS AND METHODS

A Townes-style Malaise trap (Figure 4) (Santé Inc., 739 Cooper Dr., Lexington, KY, USA 4 0502) was erected on a sand bench surrounded by low-growing perennial vegetation within the riparian zone of the Kuiseb River bed just south of the Namib Desert Research Station (Figures 1 & 2) at Gobabeb, Namibia <http://www.namibweb.com/gogabeb.htm>. The trap was

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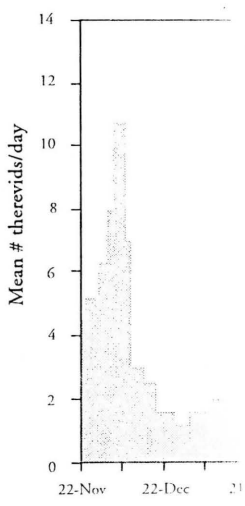

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RESULTS AND DISCUSSION

Species composition and relative abundances

Four species of Therevidae, represented by 1350 specimens, were captured by the single Malaise trap during the one-year study (Figure 5). All species belong within the subfamily Phycinae (Therevidae). *Stenogephyra torrida* Lyneborg (Lyneborg 1987), a small, slender species, was by far the most abundant species. Over 93% of all stiletto flies captured were of this species. The second most abundant species was *Phycus niger* Kröber (Kröber 1929; Lyneborg 1978), a larger, similarly slender species. This species made up slightly over 5% of the total stiletto fly catch. Two other species of Therevidae, *Ruppellia basalis* (Loew) (Loew 1858) and *Orthactia gobabebensis* Lyneborg (Lyneborg 1988), both of medium size and slightly more robust than the first two, were also collected, but in far fewer numbers. *Ruppellia basalis* represented 1% and *Orthactia gobabebensis* a mere 0.5% of the catch.

Seasonal flight periodicities

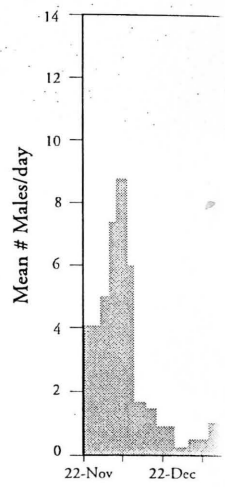
Malaise trap catches suggest that stiletto fly adults flew throughout the year except for a brief midwinter period (Figure 5). June and July were the months of least activity. Of the two therevid species caught in sufficient numbers to be analysed, males of *Stenogephyra torrida* began flight in mid July to early August and terminated flight activity in mid January, with a probable second generation emerging around the second week of February and terminating in mid May (Figure 6). Far fewer females of this species were captured; female flight activity began about a week after the first males began to fly (Figure 7). In contrast, *Phycus niger* appears to have a single generation, with males commencing flight in late October to mid November and terminating this behaviour in mid to late May (Figure 8). Although males were more abundantly captured than females, the same pattern was noted for both sexes, with a single female caught quite early, on September 18 (Figure 9). Only three males and 13 females of *Ruppellia basalis* were collected, between mid October and mid February, while four males and three females of *Orthactia gobabebensis* were taken between late August and late December.

Seasonal weather influences

In this yearlong study, a single measurable rain event occurred and that was during the week of May 20-26, 1997. The rain gauge at the Gobabeb station recorded 266 mm of precipitation over a short time period, sufficient to allow the Kuiseb River to flow for several weeks. Previous to this the Kuiseb flowed to the same extent following a similar precipitation event in early 1974 (Figure 2). Immediately following the 1997 rainfall event, stiletto flies ceased to be collected in the Malaise trap, even though the trap continued to operate. This absence of stiletto flies continued for several weeks. Three hypotheses might explain this phenomenon: 1). The rains coincided with the end of the flight activity period for the flies; fly numbers may have been extremely low as a normal winter event in June and July due to the seasonal low tempertures at that time. 2). The rainfall event was sufficiently strong to disable or kill the flies; i.e., they were no longer capable of flight. 3). Water was so abundant after the precipitation event that the flies did not have to move about in search of water, thus greatly decreasing their activity along flightways. It is impossible to state which of these competing hypotheses is correct. Because of the very unusual precipitation event in 1997, a second year of data would be required to discount one or more of the proposed hypotheses.

Resource partitioning by therevid species

Captured abundances among the four species differed dramatically, probably because some occurred in denser populations and flew more frequently and farther than others, but also because some lived within the riparian zone where the trap was located while others did not. Personal rearing records and observations on the four genera of Therevidae sampled attest to the fact that the immatures of *Stenogephyra torrida* are found below small perrenial shrubs on bars within sandy riverbeds. Immatures of *Phycus niger* have been reared from sandy substrates



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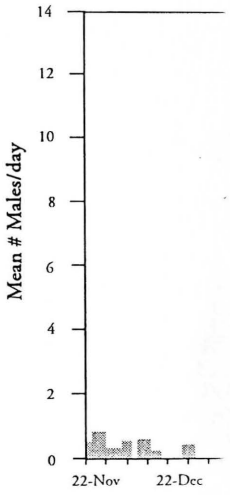

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positioned across a flight path leading from a higher sandy bench above the riverbed to a slightly lower one. This site is within the Namib-Naukluft National Park at about 450 meters above mean sea level. A global positioning system (GPS) fix of 23°33'45"S, 15°02'38"E was established for the site. The Kuiseb River and its riparian vegetation (Figures 1 & 2) provide a line of demarcation between two additional major habitats in the area: to the north and east lies a broad, sparsely vegetated gravel plain, and to the south and west lie high, shifting, sparsely vegetated sand dunes (Figure 3).

The Malaise trap was kindly maintained and the trap catch extracted about weekly between November 22, 1996 and November 10, 1997, by Immanuel Netumbo Kapofi (Desert Research Foundation of Namibia (DRFN)). The resulting insect material was packaged and sent to the writer in two separate shipments by Eugène Marais (National Museum of Namibia (NMNW)), where the stiletto flies were separated, sexed, counted, tabulated, and then stored in 95% ethanol. Pinned voucher material is to be deposited in NMNW, California Academy of Sciences, Natal Museum and Illinois Natural History Survey. A weather monitoring network maintained by Mary Seely (DRFN) recorded and made available rainfall readings taken during the time the Malaise trap was being monitored. The station maintains eight automatic weather stations throughout the central Namib Desert. Gobabeb has a forty year weather record <http://www.drfn.org/Gobabeb.html>. One of the recording stations is situated less than a kilometer to the south of the Malaise trap in the dunes near the riverbed; another is near the building complex on the grounds of the station and within 0.5 km of the trap.

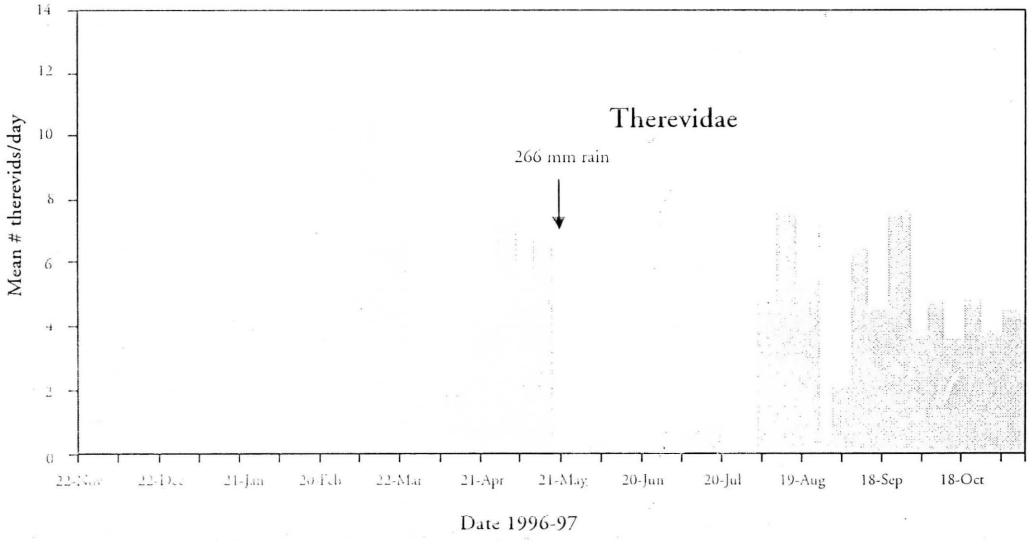

Figure 5. Seasonal periodicity and abundance of all therevid specimens captured by the Malaise trap placed within the riparian vegetation zone of the Kuiseb River, Gobabeb, Namibia (November 1996 - November 1997).

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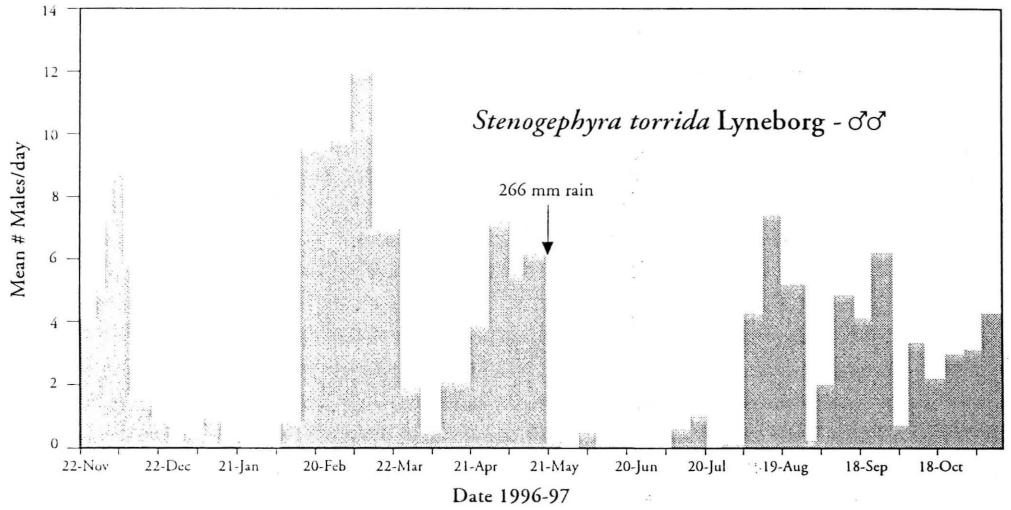

Figure 6. Seasonal periodicity and abundance of *Stenogephyra torrida* Lyneborg ♂♂ captured by a Malaise trap placed along the Kuiseb River, Gobabeb, Namibia (November 1996 - November 1997).

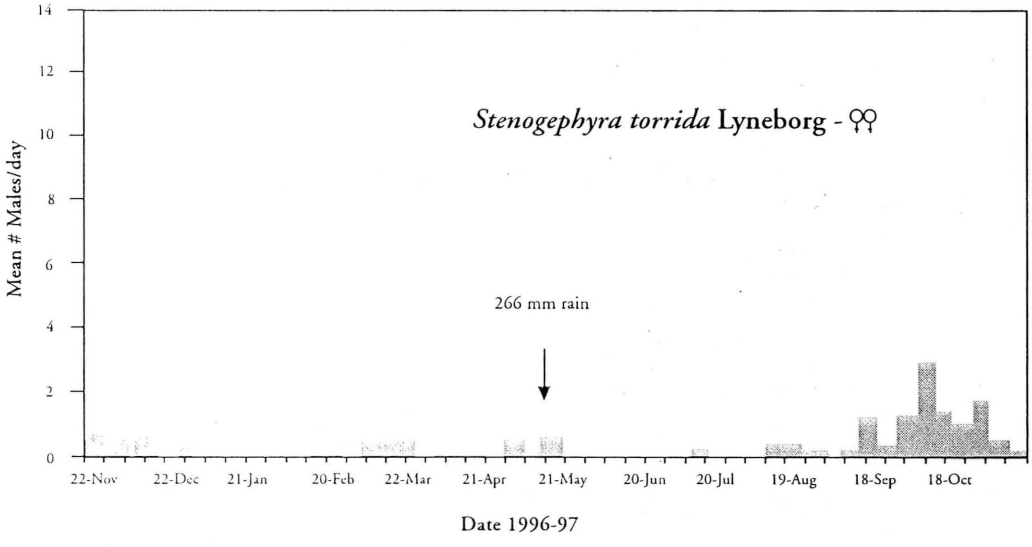

Figure 7. Seasonal periodicity and abundance of *Stenogephyra torrida* Lyneborg ♀♀ captured by a Malaise trap placed along the Kuiseb River, Gobabeb, Namibia (November 1996 - November 1997).

beneath and surrounding large *Acacia* (Fabaceae) trees within the riparian zone. Immatures of *Ruppellia basalis* and *Orthactia gobabensis* are not true riparian denizens; indeed, immatures of *Orthactia gobabebensis* are closely associated with the root zones of small perennial shrubs growing in the dune hummocks to the south and west of the river (Figure 3), while immatures of *Ruppellia basalis* are in the loose soil and litter under perennial vegetation in the gravel plain to the north and rocky hillsides to the east of the riparian site.

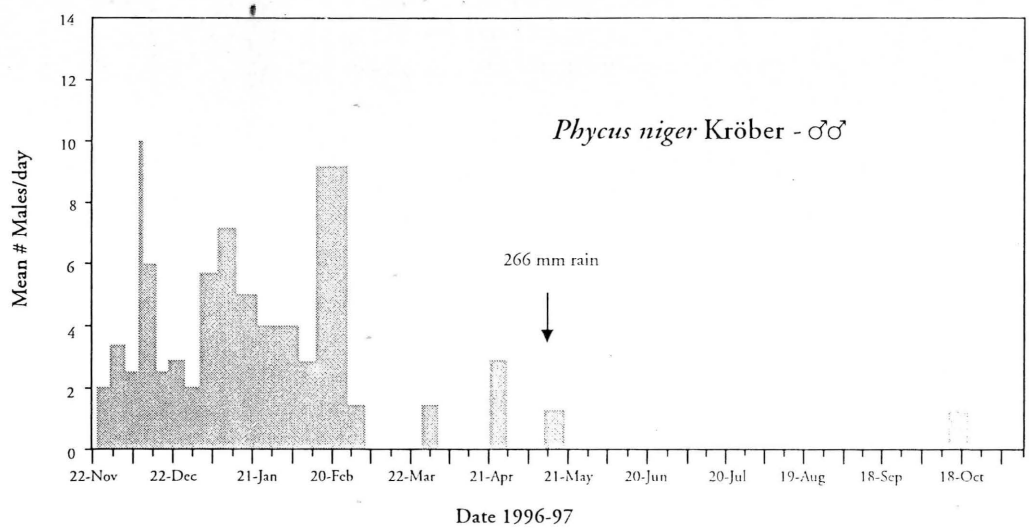

Figure 8. Seasonal periodicity and abundance of *Phycus niger* Kröber ♂♂ captured by a Malaise trap placed along the Kuiseb River, Gobabeb, Namibia (November 1996 - November 1997).

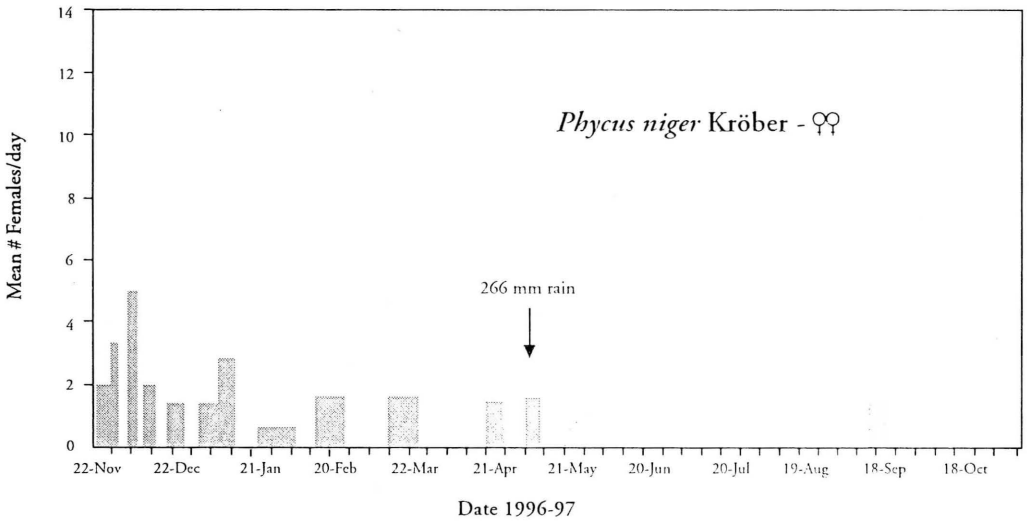

Figure 9. Seasonal periodicity and abundance of *Phycus niger* Kröber ♀♀ captured by a Malaise trap placed along the Kuiseb River, Gobabeb, Namibia (November 1996 - November 1997).

Because habitat preferences for the four species differ markedly, it could be argued that population densities alone account for the very different numbers of adults captured. The sandy substrate under the perennial riparian vegetation where the trap was located and where *Stenogephyra torrida* and *Phycus niger* larvae live contains a large amount of organic debris. Such a substrate is capable of supporting large populations of diverse decomposers and their predators. The substrates in the dune hummock and gravel plain habitats probably contain less organic matter, fewer species of decomposers and, therefore, fewer predators, including therevid

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I am grateful to Eugène Marais a
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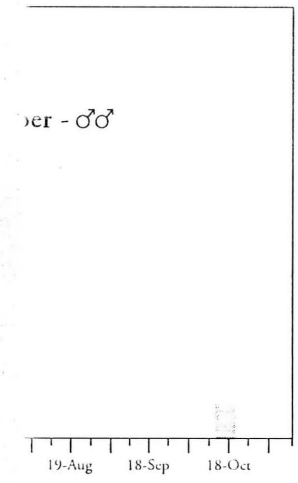

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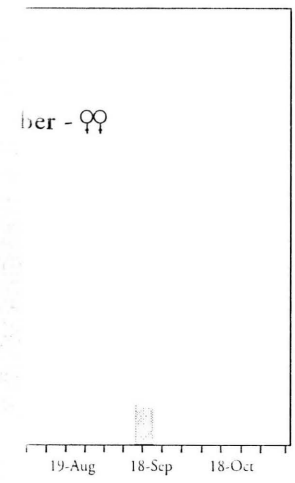

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larvae. From the perspective of densities of therevid species, one could argue that those in the riparian zone would be caught more abundantly. This does not explain the fact that considerably more land is occupied by dunes and gravel plains than by the riparian zone. Overall area-wide abundances might not reflect the densities in specific habitats described above.

It seems reasonable to also speculate that adults of *Stenogephyra torrida* were collected most abundantly because their immatures occurred beneath small, perennial shrubs of the riparian habitat adjacent to the trap; post eclosion adults, particularly males, probably flew along nearby pathways in search of females and water, while females of that species flew less frequently along pathways and more often close to shrubs and across open spaces in search of oviposition sites. Adults of *Phycus niger* were relatively abundant in the traps, but much less so than *Stenogephyra torrida*, possibly because their immatures also existed in the riparian zone but not in the immediate vicinity of the trap. While I suggest that the males fly along pathways in search of both water and mates, I have observed that females spend considerable time walking back and forth along fallen *Acacia* tree trunks. This would explain why the species was relatively abundant in the trap, but the catch was predominantly male. The other two species occupied very different habitats and probably flew into and through the riparian zone infrequently.

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