

*Philoliche rostrata*

## Needles and pins

The exciting discovery of a new pollination system in the ribbon pincushion, *Leucospermum tottum*

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One of the noticeable features of many fynbos plants is the extravagant diversity of their flowers. This, quite apart from the sheer number of species, has ensured their fame among plant lovers and botanists alike. But why should their blooms be so diverse and, in many cases, so beautiful? Flowers are Nature's shop windows, dressing their sexual organs in colourful wrappings that advertise the presence of floral rewards like nectar or pollen. These energy-rich resources are eagerly sought by various animals and insects. The particular type of floral packaging present in each species serves to target a small sector of this greedy market, improving the chances that the visitor will act as a successful pollinator. The intricacies of these relationships among the fynbos flora are just beginning to emerge.

The Cape flora is unusually rich in pollination systems that are rare or relatively poorly developed elsewhere in southern Africa. This is thought to relate to the general paucity of insect species in the Cape, both in absolute terms and in relation to the extreme richness of the flora. In the absence of some of the more usual pollinators, fynbos flowers have become adapted to pollination by several less commonly employed animals and insects. Even bird-pollinated species are twice as common in the Cape flora as in the rest of the country. Among the more unusual pollinators exploited by Cape plants are rodents, oil-collecting bees, monkey beetles, the butterfly *Aeropetes tulbaghia* and a variety of long-proboscid flies (including the horsefly).

### Long-proboscid flies

Several families of flies specialize in feeding on the nectar of flowers. Some, like mosquitoes and gnats, are small and inconspicuous, except when they visit humans for a liquid meal of another sort! Others, especially horseflies (Tabanidae) and tangle-winged flies (Nemestrinidae), are large-bodied, often colourful insects. Equipped with ominous, needle-like mouthparts adapted to siphoning up liquid meals, they are collectively termed long-proboscid flies. Female horseflies, like mosquitoes, require a blood meal for their eggs to develop but adult tangle-winged flies of both sexes drink only nectar. Although well known to dipterists, these marvellous flies are rarely noticed by most people. This is a grave injustice to their importance in fynbos ecology. Cape botanist Rudolph Marloth first recorded them as pollinators in southern Africa in 1908 but an appreciation of the full significance of their role in the pollination of fynbos flowers is of very recent vintage. Some fifteen species of horseflies and tangle-winged flies with mouthparts between 15-70 mm long are known from southern Africa and it is estimated that they are the main or sole pollinators of around 200 species of wildflowers in the sub-region. Some 80% of these flowers are fynbos species.

Three species of long-proboscid fly are common in fynbos, the horseflies *Philoliche gulosa* and *P. rostrata*, and the tangle-winged fly *Moegistorhynchus longirostris*. All are on the wing in late spring and early summer, between September

and November. The flowers that they visit share several features: they are unscented and mostly two-lipped with a slender tube 20-75 mm long, creamy yellow to pink with red or maroon nectar guides and anthers, and they secrete small to moderate amounts (0.5-10 microlitres per flower) of moderately concentrated nectar (20-30% sucrose equivalents).

Species that share a particular aspect of their ecology are said to comprise a guild in relation to that aspect. This group of fynbos plants comprises a pollination guild, in this case the *Moegistorhynchus-Philoliche* guild in deference to its characteristic pollinators.

Flowers adapted to pollination by long-proboscid flies have been recorded from several plant families. Most are seasonal perennials and geophytes, plus some shrubs. No annuals or trees have so far been found with this pollination system. Pollination by long-proboscid flies is particularly well developed in Iridaceae (some 10% of southern African species) and Geraniaceae (up to 25% of southern African species). Among shrubby plants, pollination by long-proboscid flies has been recorded from several species of *Erica* and *Plectranthus* (Lamiaceae) and is anticipated to occur in several more, as well as in some Acanthaceae. It has not been recorded nor even predicted to occur in Proteaceae.

### Pollinators on pincushions

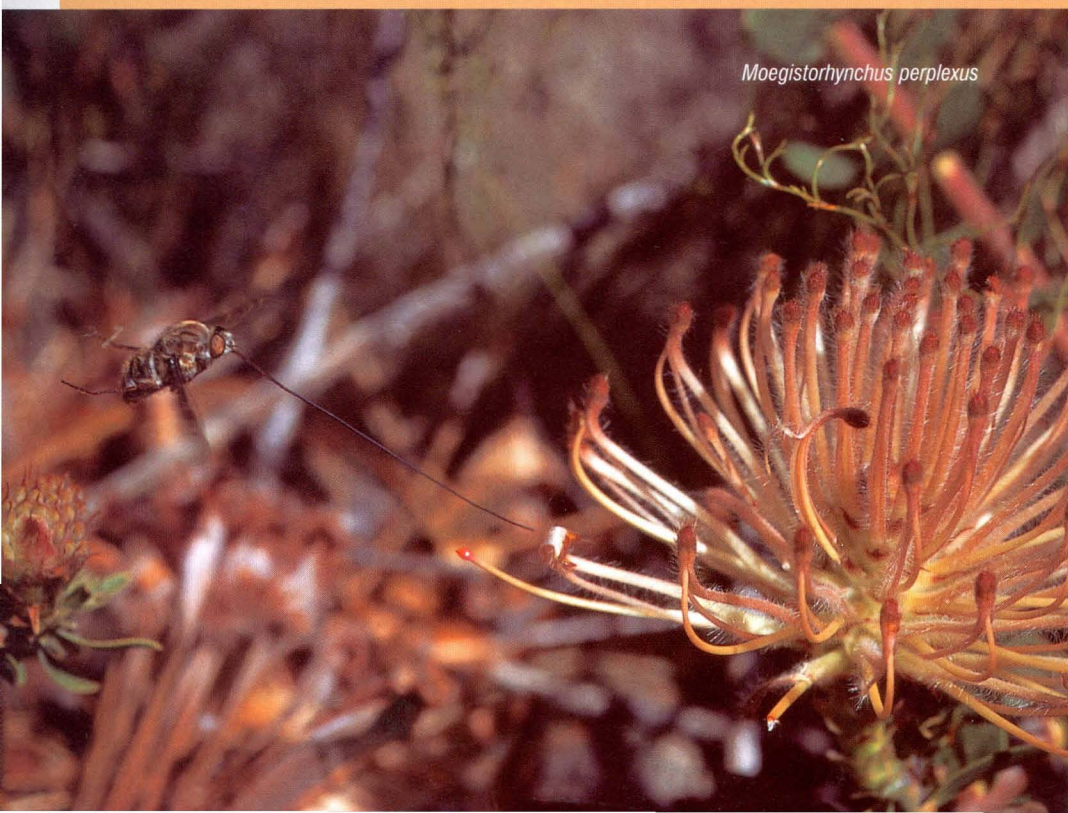
Walking on Middelberg Pass (near Citrusdal) on a warm still morning in mid-October 2003, our party came across a small colony of the ribbon pincushion, *Leucospermum tottum* var. *tottum* in full flower. Within moments of stopping to admire the pink flower heads we noticed that they were being visited by long-proboscid flies. We sat entranced for an hour watching four or five individuals of *Moegistorhynchus* and a couple of horseflies (*Philoliche rostrata*) extracting nectar from the flowers. The flies visited each open floret in an inflorescence in turn before moving on to another. As they probed deeply into each floret their bodies came into contact with the pollen-presenter at the tip of the long styles, either picking up pollen or depositing it. We noticed three other plants adapted to pollination by these two flies in the area, *Geissorhiza confusa* and *Geissorhiza cedarmontana* in the immediate vicinity and, a little way off, *Ixia paniculata* (all Iridaceae). The *Moegistorhynchus* visiting the pincushion is almost certainly the rarely seen *M. perplexus*, described from a specimen caught near Clanwilliam in September 1928 and hardly collected since then. *Moegistorhynchus perplexus* appears to be a montane vicariant (or geographical relative) of *M. longirostris*, a more widespread lowland species that is (or was) distributed all

along the coastal forelands and near interior of the Northern and Western Cape, from northern Namaqualand to the Cape Peninsula.

The pincushion is a highly rewarding source of nectar for these active, large-bodied flies. Each newly opened flower contains 2-4 microlitres of moderately concentrated nectar (25-40% sucrose equivalents). Older flowers do not seem to continue to secrete nectar but with around a dozen fresh flowers available in each head, the total daily nectar volume per head is around 24-48 microlitres. Each flower head thus contains three or four times as much nectar as is available from a plant of *Geissorhiza confusa* or *Ixia paniculata* and the total per shrub is dozens of times this.

*Leucospermum tottum* var. *tottum* is widespread in the western mountains of the south-western Cape, from the Cederberg southwards through the Koue Bokkeveld and Hex River mountains to the Du Toit's Kloof mountains, Villiersdorp. It grows on rocky sandstone slopes above 300 m and flowers between September and January.

The flowers are pale pink with dull maroon tips and the horizontally spreading styles are 50 mm long. Small amounts of moderately concentrated nectar are secreted. All of these features are consistent with pollination by long-proboscid flies. The straight, spreading styles of the flowers, in par-



*Moegistorhynchus perplexus*

The nectar-feeding horsefly *Philoliche rostrata* (opposite page) and the tangle-winged fly *Moegistorhynchus perplexus* (left) visit a range of flowers including the ribbon pincushion, *Leucospermum tottum* var. *tottum*. Their slender siphon-like mouthparts are ideal for reaching into elongated floral tubes for the nectar inside.

Photos: John Manning

ticular, are ideally arranged to contact hovering, rather than perching visitors. Bird-pollinated pincushions typically have erect, often curved styles that form a cage around the flower head on which the birds can perch. This can be seen in species like *Leucospermum cordifolium* as well as in *L. tottum* var. *glabrum*, a localized form of the species that is restricted to a single kloof in the Hex River mountains. Its erect, bright yellow styles tipped with red are consistent with bird-pollination and not pollination by long-proboscid flies and suggest that its status in relation to the typical variety is worth reconsidering.

This is the first time that long-proboscid fly-pollination has been recorded in the family Proteaceae. The larger-flowered pincushions are typically adapted to pollination by sunbirds and sugarbirds, while insect pollination is important in several smaller-flowered species, and rodent pollination is pre-

dicted to occur in a few more. Some thirty species of pincushions are bird-pollinated, and most of them have large flower heads in which the individual flowers are longer than 35 mm. The flower heads are typically yellow to red or bicoloured. *Leucospermum tottum* var. *tottum* is among this group. Although Cape sugarbirds have been seen visiting this species in Kirstenbosch and on Du Toit's Kloof, the fleshy-pink colouring of the flowers has always struck me as unusual among the bird-pollinated species. It is only now that its significance is clear: it is an exact match for the coloration that predominates in the fynbos species belonging to the *Moegistorhynchus-Philoliche* pollination guild. It is now evident that at Middelberg Pass, at least, the long-proboscid flies *Moegistorhynchus perplexus* and *Philoliche rostrata* are important pollinators of *Leucospermum*

*tottum* var. *tottum*, either alone or in combination with birds. Elsewhere in its range, the horsefly *Philoliche gulosa* can be predicted to visit it as well.

These observations mean that *Leucospermum tottum* qualifies for membership to the *Moegistorhynchus-Philoliche* pollination guild. Until now ten species of *Pelargonium*, twenty-three species of Iridaceae in eight genera, two species of *Disa* and one of *Lobelia* were identified as part of this pollination system, and another forty-four inferred to belong to it on the basis of their morphology, geography and phenology. To this impressive list we can now add the first Proteaceae known to be adapted to fly pollination, and concurrently one of just a handful of truly shrubby species identified with this guild. The pollination of Cape flowers is clearly far from completely understood and many surprises await the observant student in the field.

#### Acknowledgements

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#### Further reading

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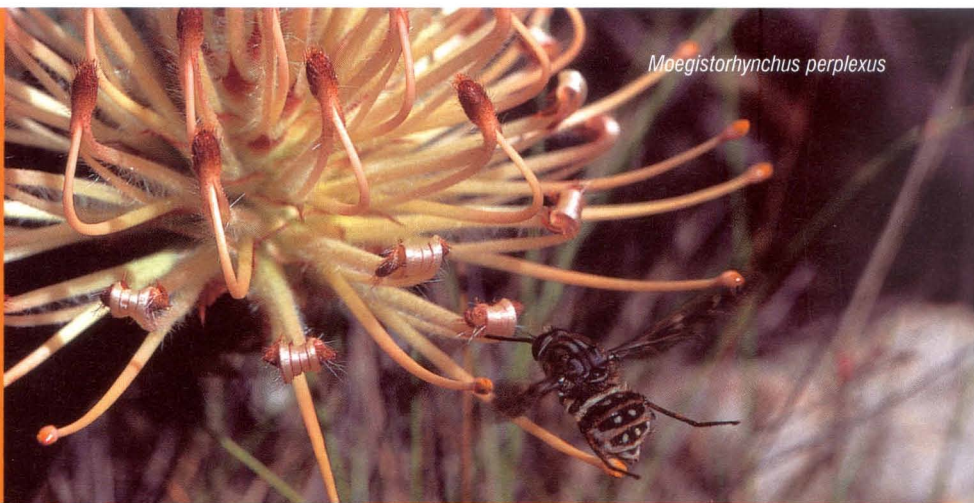
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*Moegistorhynchus perplexus*

*Philoliche rostrata*



The styles of the ribbon pincushion *Leucospermum tottum* var. *tottum* are the perfect length for depositing pollen, carried on a special pollen-presenter located at their tips, onto the bodies and legs of the nectar-feeding flies *Philoliche rostrata* (left) and *Moegistorhynchus perplexus* (above) as they probe the flowers for nectar.

Photos: John Manning.