Impacts of invasive alien plants on Red-Listed South African dragonflies (Odonata)

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This paper gives an overview of the threats to dragonflies (including damselflies) (Odonata), globally and nationally Red-Listed by the IUCN, in South Africa. All the globally Red-Listed species are endemic to South Africa. Invasive alien plants, especially Australian Acacia trees along water-courses, are by far the most important threat to these endemic species. Removal of the invasive alien trees is likely to increase considerably the prospects for the long-term survival of these species. In contrast, the nationally Red-Listed species that are not globally Red-Listed are threatened overall more by natural vagaries of weather than by invasive alien plants.

Introduction

Dragonflies (including damselflies) (Insecta: Odonata) are conspicuous as adults, being major aerial predators of small, flying insects. The larvae are aquatic, and predators of invertebrates in the water system. Evidence is accumulating that dragonflies are being increasingly threatened. Many of the species are confined within the borders of South Africa (endemic species) and are threatened by invasive alien trees in particular.

The global magnitude of the invasive alien plant problem is highlighted by the fact that 23% of the plant species in the United States1 and 47% in New Zealand2 are aliens. In South Africa, the situation is not any better, with some species dominating entire ecosystems to the effect that hydrology has been adversely affected.3 Our knowledge of how riverine and lakeside invasive alien plant species affect insect assemblages and their conservation is very limited, despite the fact that insects play a pivotal role in compositional and functional diversity. Dragonflies are part of that diversity and have been catalogued.4 However, with recent unpublished taxonomic revisions, including DNA analysis,5 the national checklist now stands at 158 species, with an additional four subspecies, making 162 the total number of taxa.

For most dragonfly species, we have a reasonably clear picture of their geographical distributions, and these are being updated and mapped on a database maintained at the universities of Stellenbosch and Natal. This database has enabled the compilation of a Red List of the endemic species that are threatened on a global scale.6 By definition, if these species were lost in South Africa, they would also be lost to the rest of the world. The data-base has also been used to compile a list of nationally threatened South African taxa,7 that is, those species and subspecies that are threatened in South Africa but not necessarily threatened elsewhere.

The global Red List is significant, because South Africa has a relatively high proportion of endemic taxa (species and subspecies). There are 31 endemic taxa in all, representing 19.1% of the South African odonate fauna. Globally Red-Listed South African species

The South African species that are globally Red-Listed represent 7.4% of the Odonata (Table 1). Threats are to the endemic species, while none of the endemic subspecies is currently globally Red-Listed as threatened. However, a recommendation has been made also to include the endemic subspecies of the red wisp (Agriocnemis ruberrima ruberrima) on the global Red List.8 Of the threatened species, the Ceres stream damsel (Mecansemis angusta) may already be extinct, as it has not been seen, despite intensive searches, since 1920. The basking malachite (Chlorolestes africans) is known only from two sites, having disappeared from at least six of its formerly listed sites.8 The Kubusi stream damsel (M. valida) is also currently known only from two sites, although dispersal in good years and discovery of new sites may increase this number. Balinsky’s sprite (Pseudagrion inopinatum) and the harlequin sprite (P. newtoni) have both disappeared from their type localities, although one population of each has been rediscovered at other locations. However, the last four of these species are highly threatened and their conservation should be given immediate attention.

Riverine alien trees, especially black wattle (Acacia mearnsii) in northern parts of the country and the long-leaved wattle (A. longifolia) in the southwest, are the principal threat to the globally Red-Listed species (Table 1). These invasives have dense canopies that effectively shade out the habitat.2 Synergistic impacts include habitat disturbance by cattle that use invasive alien trees for shade. In some cases, there may be possible predation by trout, especially rainbow trout (Oncorhyncus mykiss). The larvae of dragonfly species in the family Synlestidae (Chlorolestes and Ecolhestes species) appear to be highly susceptible, as they perch conspicuously on the surface of submerged objects, and trout are voracious, visual feeders that can capture dragonflies perched above the water.2

The influence of trout is, however, not conclusive, although strong circumstantial evidence comes from Bainskloof, where the marbled malachite (Ecolhestes peringueyi) occurs only above waterfalls and out of reach of the fish. Similarly, the yellow presba (Sycordulia gracilis), which was formerly known from Mitchell’s Pass, has not been recorded there in recent times. If trout are involved, then it would almost certainly be a synergistic impact with the effect of alien trees. While trees shade out the habitat, sunny (as well as shady) reaches of the stream suitable for dragonfly larvae would then become focal areas for feeding by trout.

Nationally Red-Listed species

Species that are nationally Red-Listed, in addition to those that are globally Red-Listed, are given in Table 2. Only three of these (two species and one subspecies) are endemic to South Africa and only the white malachite (Chlorolestes umbratus) is threatened by alien trees. All three are threatened by habitat loss, with both C. umbratus and the queen malachite (Ecolhestes nylontha) tolerant to some degree of shading by alien tree canopy with sun shafts.

There is a striking difference between the globally Red-Listed species (Table 1) and the South African nationally Red-Listed species (Table 2). Riverine invasive alien trees (and lakeside alien trees in the case of one species, the Umnsingazi sprite (Pseudagrion umnsingaziene), are a major threat to the globally Red-Listed endemic fauna. However, it is natural drought (for some species) and flood (for other species) conditions that are by far the most important threat to these tropical African species whose range extends just into South Africa. This is particularly true under the extreme conditions associated with
El Niño events (Table 2) and current global climatic stress. Habitat loss exacerbates these threats in the case of some species, although this is rarely synergistic with invasive alien trees. The reason for this is that the water bodies (essentially the fast-flowing rivers of the Kruger National Park, and pans and swamps in the northern areas) are largely free of invasive alien plants.

### Discussion

Of the total of 31 endemic species of South African Odonata, 12 are globally Red-Listed, and, of these, 11 are threatened by encroachment by alien riverine trees and one by lakeside alien trees. These threatened species are mostly Western Cape montane species. For the nationally Red-Listed species (excluding the globally Red-Listed ones), the situation is rather different. Only six of the 28 nationally Red-Listed species have invasive alien trees as a threat. The reason for this difference in proportions (100% of the globally Red-Listed species and 21% of the additional nationally Red-Listed species threatened, at least in part, by alien plant species) is that many of the nationally Red-Listed species are geographically marginal. As such, they are generally much more susceptible to the vagaries of wet/drought cycles along the northern regions of South Africa’s borders than they are to invasive trees along perennial water courses. Also, they are not under threat within their wider geographical ranges.

The important point regarding the globally Red-Listed species is that it is the invasive alien riparian trees, particularly black and long-leaved wattles, that are posing the greatest threat, and not low-growing invasive alien plants. These trees shade out the vegetation understory. As a result, grasses which are perching sites for these species, and bushes, which are oviposition sites for *Chlorolestes* and *Ecchlorolestes* species, are disappearing.

Dragonflies are particularly sensitive to conditions of light and shade. The invasive alien trees destroy their habitats both through shading out the subcanopy vegetation and by making conditions too dark for them. It is of interest that the elegant malachite (*Chlorolestes elegans*), *C. umbratus* and *E. nylephtha* are fairly shade tolerant and, except for *C. umbratus*, invasive alien trees are not a major threat. Indeed, *C. elegans* can even live under an oak canopy. The biggest threat to these species is simply habitat loss, which is largely removed of indigenous trees, with or without replacement by alien trees, particularly pine.

These findings have clear management implications. First, to ensure long-term survival of the irreplaceable endemic South African dragonflies, the prime management option is to remove dense-canopy invasive alien trees, particularly black and long-leaved wattles. But as perching and oviposition sites are essential, regrowth from alien seedlings must then be suppressed, and indigenous grasses and/or bushes re-established. Furthermore, evidence from a European species, *Lestes barbarus* (Fabricius, 1798), suggests that alien trees may be a barrier to local movement, as they are to some South African butterflies.

Alien trees are not the sole factor adversely affecting these endemic and rare dragonflies, and it is essential to reduce any other synergies. The stream (for most species) or pond (in a few species) must also be free of pollution, including chemical input from alien leaf litter. Streams must also be hydrologically sound, without scouring that may occur when alien trees are removed too rapidly. A further consideration is that there must not be overstocking and excessive damage from domestic livestock, which trample the vegetation, break down the banks and silt the streams.

Recovery of the fauna also depends on the presence of a source population along the river. Preliminary evidence suggests that recovery is likely to be fast, as the adult dragonflies are relatively vagile. Also, evidence from storm impacts suggests that population recovery could occur within a year or so along the same water course. However, migration from one stream catchment to another may be slow. Finally, population recovery following the removal of alien vegetation needs baseline and follow-up studies to evaluate the speed and extent of natural recovery. Most other aquatic insects are also likely to be similarly affected by the various contributions of alien waterside vegetation, and may not necessarily recover in a similar way.
Table 2. Threats to nationally Red-Listed Odonata species* in South Africa.

<table>
<thead>
<tr>
<th>Species</th>
<th>Endemic (E) or marginal (M)</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elegant malachite (Chlorolestes elegans)</td>
<td>M</td>
<td>Invasive alien black wattle (Acacia mearnsii) (but not oak trees, Quercus spp.). Plantation forestry (Pinus species, Eucalyptus species). Habitat loss related to plantation forestry.</td>
</tr>
<tr>
<td>White malachite (C. unbratus)</td>
<td>E</td>
<td>Habitat loss, particularly conversion to agricultural land and pine plantations. Invasive alien trees, especially black wattle and long-leaved wattle (A. longifolia).</td>
</tr>
<tr>
<td>Queen malachite (Ecclorolastes nylephtha)</td>
<td>E</td>
<td>Habitat loss (removal of indigenous forest).</td>
</tr>
<tr>
<td>Cryptic spreading (Lestes dissimulatus)</td>
<td>M</td>
<td>Subject to El Niño drought/wet cycles. Cattle trampling of pool margins.</td>
</tr>
<tr>
<td>Tawny spreading (L. ictericus)</td>
<td>M</td>
<td>Subject to El Niño drought/wet cycles. Highly marginal in South Africa.</td>
</tr>
<tr>
<td>Brownish pond damsel (Ceriargion suave)</td>
<td>M</td>
<td>Subject to El Niño drought/wet cycles. Highly marginal in South Africa.</td>
</tr>
<tr>
<td>Spear sprite (Pseudagriornis assegi)</td>
<td>M</td>
<td>Subject to El Niño drought/wet cycles. Marginal in South Africa. Aggravated in times of drought by water extraction.</td>
</tr>
<tr>
<td>Catshead sprite (P. coeleste)</td>
<td>M</td>
<td>Subject to El Niño drought/wet cycles. Highly marginal in South Africa. Formerly known only from Sabie River, but habitat and species washed away in floods of February 2000.</td>
</tr>
<tr>
<td>Rufous-faced sprite (P. sjoestedti)</td>
<td>M</td>
<td>Subject to El Niño drought/wet cycles. Highly marginal in South Africa. Formerly known only from Sabie Wier but habitat and species washed away in floods of February 2000.</td>
</tr>
<tr>
<td>Blue-spotted sprite (P. s. sudanicum)</td>
<td>M</td>
<td>Subject to El Niño drought/wet cycles. Highly marginal in South Africa. Much less common now at Sabie Wier than prior to floods of February 2000, although continues to survive upstream, and in Limpopo province.</td>
</tr>
<tr>
<td>Opal slim (Aciagrion congoense)</td>
<td>M</td>
<td>Appeared and population grew to large numbers at Mtbeni Swamp, Cape Vidal after floods of February 2000. May actually not be threatened.</td>
</tr>
<tr>
<td>Emerald-striped slim (A. pinheyi)</td>
<td>M</td>
<td>Highly marginal in South Africa. Subject to El Niño drought/wet cycles.</td>
</tr>
<tr>
<td>Fork-tailed blue (Pseudochroa subfasciata)</td>
<td>M</td>
<td>Pollution at Zeekoevlei, Cape Town.</td>
</tr>
<tr>
<td>Gracious wasp (Agrionomus crassipes)</td>
<td>M</td>
<td>Urban expansion.</td>
</tr>
<tr>
<td>Orange wasp (A. rubinera rubinera)</td>
<td>E</td>
<td>Habitat loss through industrialization and urban expansion. Another subspecies, A. r. aforinos, occurs in Botswana.</td>
</tr>
<tr>
<td>Southern red jewel (Chlorocypha consueta)</td>
<td>M</td>
<td>Invasive alien trees (especially black wattle). Agricultural disturbance of stream water (?).</td>
</tr>
<tr>
<td>Spined fairytail (Lestenogomphus angustus)</td>
<td>M</td>
<td>Appears to be multiple factors, including invasive alien trees, and impacts from urbanization (at Richards Bay). Probably only marginally threatened.</td>
</tr>
<tr>
<td>Quare’s fingertail (Gomphidia quaere quaeret)</td>
<td>M</td>
<td>Subject to El Niño drought/wet cycles with apparently no anthropogenic impacts.</td>
</tr>
<tr>
<td>Zambezi siphonthal (Neuroglossum sp. nov.)</td>
<td>M</td>
<td>Subject to El Niño drought/wet cycles with apparently no anthropogenic impacts. N.B.: taxon not yet clarified.</td>
</tr>
<tr>
<td>Horned tailnot (Crenigomphus cornutus)</td>
<td>M</td>
<td>Subject to El Niño drought/wet cycles with apparently no anthropogenic impacts.</td>
</tr>
<tr>
<td>Hairy dushkewar (Gynacantha vilosa)</td>
<td>M</td>
<td>Habitat loss through urbanization.</td>
</tr>
<tr>
<td>Unicorn cruiser (Phyllocomama monoceros)</td>
<td>M</td>
<td>Probably a combination of alien invasive lowweld trees, mine effluent, agricultural run-off and alien fish. Has not been recorded in South Africa since 1911.</td>
</tr>
<tr>
<td>Little percher (Diplacodes deminuta)</td>
<td>M</td>
<td>Probably greatest threat is natural El Niño drought/wet cycles. Eucalyptus afforestation.</td>
</tr>
<tr>
<td>Slender bottletail (Iphogomphus lugubris)</td>
<td>M</td>
<td>Subject to El Niño drought/wet cycles.</td>
</tr>
<tr>
<td>Banded dushkarter (Parazygomphus flavicans)</td>
<td>M</td>
<td>Habitat loss through industrialization and urban expansion, especially at Richards Bay.</td>
</tr>
<tr>
<td>St Lucia basket (Urothemis luciana)</td>
<td>M</td>
<td>Habitat loss. Cattle trampling of pans. Urban sprawl.</td>
</tr>
</tbody>
</table>

*The species are in addition to the globally Red-Listed species in Table 1. Marginal species are geographically widespread in Africa, with their southern geographical ranges reaching over the South African border.

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