

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 lake-side 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 Dragonflies are part of that diversity and have been catalogued.⁴ However, with recent unpublished taxonomic revisions, including DNA analysis,⁵ the national checklist now stands at 158 species, with an additional four subspecies, making 162 the total number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 database 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 List⁷. Of the threatened species, the Ceres stream damsel (*Metacnemis angusta*) may already be extinct, as it has not been seen, despite intensive searches, since 1920. The basking malachite (*Chlorolestes apricans*) 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.⁹ 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 (*Oncorhynchus mykiss*). The larvae of dragonfly species in the family Synlestidae (*Chlorolestes* and *Ecchlorolestes* 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.¹⁰

The influence of trout is, however, not conclusive, although strong circumstantial evidence comes from Bainskloof, where the marbled malachite (*Ecchlorolestes peringueyi*) occurs only above waterfalls and out of reach of the fish. Similarly, the yellow presba (*Syncordulia 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 (*Ecchlorolestes nylephtha*) 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 Umsingazi sprite (*Pseudagrion umsingaziense*), 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

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Table 1. Globally threatened Odonata species* in South Africa, their Red-List status, geographical distribution, and major threats to their survival.

Species	Distribution (provinces)	Red List status	Major threats
Basking malachite (<i>Chlorolestes apricans</i>)	Eastern Cape	Endangered	Invasive alien trees, particularly black wattle (<i>Acacia mearnsii</i>). Trampling of banks by cattle. Detergent input into one major habitat.
Marbled malachite (<i>Ecchlorolestes peringueyi</i>)	Western Cape	Vulnerable	Invasive alien trees, especially long-leaved wattle (<i>Acacia longifolia</i>). Habitat loss through planting of alien pines. Invasive alien trout. Trampling of banks by cattle.
Ceres stream damsel (<i>Metacnemis angusta</i>)	Western Cape	Critically endangered (possibly extinct)	Heavy invasion by alien wattles (<i>Acacia</i> species). Extraction of water for agriculture may also have contributed.
Kubusi stream damsel (<i>M. valida</i>)	Eastern Cape	Endangered	Invasive alien trees, particularly black wattle. Habitat loss (replaced by livestock grazing).
Balinsky's sprite (<i>Pseudagrion inopinatum</i>)	Mpumalanga	Vulnerable	Threats uncertain. Possible combination of alien trees and disturbance by cattle, or altered river dynamics and flood scouring.
Harlequin sprite (<i>P. newtoni</i>)	KwaZulu-Natal and Mpumalanga	Vulnerable	Trampling by cattle. Invasive alien trees, particularly black wattle.
Umsingazi sprite (<i>P. umsingaziense</i>)	KwaZulu-Natal	Vulnerable	Habitat loss as a result of agriculture and urbanization. Localized stands of alien broad-leaved trees. Mowing of lakeside margins.
Cape bluet (<i>Proischnura polychromaticum</i>)	Western Cape	Critically endangered	Invasive alien trees (black wattle?). Habitat conversion to agricultural land (?).
Cape thortail (<i>Ceratogromphus triceraticus</i>)	Western Cape	Vulnerable	Invasive alien trees (long-leaved wattle). Habitat conversion to agricultural land (?).
Yellow presba (<i>Syncordulia gracilis</i>)	KwaZulu-Natal and (formerly) Eastern and Western Cape	Vulnerable	Invasive alien trees (long-leaved and black wattles). Plantation forestry. Alien trout (?).
Mahogany presba (<i>S. venator</i>)	Western Cape	Vulnerable	Invasive alien trees (long-leaved wattle). Alien trout (?). Conversion to agricultural land.
Waxy-winged skimmer (<i>Orthetrum rubens</i>)	Western Cape	Endangered	Invasive alien trees (long-leaved wattle). Alien trout (?). Urbanization.

*All species are endemic to South Africa. Red-List status follows the standard IUCN categories¹⁷.

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 (especially 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 vegetal understorey. 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.^{11,12} 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 removal 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,¹³ as they are to some South African butterflies.¹⁴

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.¹⁵ However, migration from one stream catchment to another may be slow.¹⁶ 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.

Species	Endemic (E) or marginal (M)	Threats
Elegant malachite (<i>Chlorolestes elegans</i>)	M	Invasive alien black wattle (<i>Acacia mearnsii</i>) (but not oak trees, <i>Quercus</i> spp.). Plantation forestry (<i>Pinus</i> species, <i>Eucalyptus</i> species). Habitat loss related to plantation forestry.
White malachite (<i>C. umbratus</i>)	E	Habitat loss, particularly conversion to agricultural land and pine plantations. Invasive alien trees, especially black wattle and long-leaved wattle (<i>A. longifolia</i>).
Queen malachite (<i>Ecchlorolestes nylephtha</i>)	E	Habitat loss (removal of indigenous forest).
Cryptic spreadwing (<i>Lestes dissimulans</i>)	M	Subject to El Niño drought/wet cycles. Cattle trampling of pool margins.
Tawny spreadwing (<i>L. ictericus</i>)	M	Subject to El Niño drought/wet cycles. Highly marginal in South Africa.
Brownish pond damsel (<i>Ceriagrion suave</i>)	M	Subject to El Niño drought/wet cycles. Highly marginal in South Africa.
Spear sprite (<i>Pseudagrion assegai</i>)	M	Subject to El Niño drought/wet cycles. Marginal in South Africa. Aggravated in times of drought by water extraction.
Catshead sprite (<i>P. coeleste</i>)	M	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.
Green-striped sprite (<i>P. makabusiense</i>)	M	Invasive alien trees (especially black wattle). Plantation forestry (principally <i>Eucalyptus</i> species).
Rufous-faced sprite (<i>P. sjoestedti</i>)	M	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.
Blue-spotted sprite (<i>P. sudanicum</i>)	M	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.
Opal slim (<i>Aciagrion congoense</i>)	M	Appeared and population grew to large numbers at Mfabeni Swamp, Cape Vidal after floods of February 2000. May actually not be threatened.
Emerald-striped slim (<i>A. pinheyi</i>)	M	Highly marginal in South Africa. Subject to El Niño drought/wet cycles.
Fork-tailed bluet (<i>Proischnura subfurcatum</i>)	M	Pollution at Zeekoevlei, Cape Town.
Gracious wisp (<i>Agriocnemis gratiosa</i>)	M	Urban expansion
Orange wisp (<i>A. ruberrima ruberrima</i>)	E	Habitat loss through industrialization and urban expansion. Another subspecies, <i>A. r. albifrons</i> , occurs in Botswana.
Southern red jewel (<i>Chlorocypha consueta</i>)	M	Invasive alien trees (especially black wattle). Agricultural disturbance of stream water (?).
Spined fairytail (<i>Lestinigomphus angustus</i>)	M	Appears to be multiple factors, including invasive alien trees, and impacts from urbanization (at Richards Bay). Probably only marginally threatened.
Quarre's fingertail (<i>Gomphidia quarrei quarrei</i>)	M	Subject to El Niño drought/wet cycles with apparently no anthropogenic impacts.
Zambezi siphontail (<i>Neurogomphus</i> sp. nov.)	M	Subject to El Niño drought/wet cycles with apparently no anthropogenic impacts. N.B.: taxon not yet clarified.
Horned talontail (<i>Crenigomphus cornutus</i>)	M	Subject to El Niño drought/wet cycles with apparently no anthropogenic impacts.
Highland hawkler (<i>Aeshna ellioti usambarica</i>)	M	Pine afforestation. Invasive alien trees (especially black wattle).
Hairy duskhawker (<i>Gynacantha villosa</i>)	M	Habitat loss through urbanization.
Unicorn cruiser (<i>Phyllomacromia monoceros</i>)	M	Probably a combination of alien invasive lowveld trees, mine effluent, agricultural run-off and alien fish. Has not been recorded in South Africa since 1911.
Little percher (<i>Diplacodes deminuta</i>)	M	Probably greatest threat is natural El Niño drought/wet cycles. <i>Eucalyptus</i> afforestation.
Slender bottletail (<i>Olpogastra lugubris</i>)	M	Subject to El Niño drought/wet cycles.
Banded duskdarter (<i>Parazyxomma flavicans</i>)	M	Habitat loss through industrialization and urban expansion, especially at Richards Bay.
St Lucia basker (<i>Urothemis luciana</i>) (formerly thought to be endemic but now known from Mozambique)	M	Habitat loss. Cattle trampling of pans. Urban sprawl.

*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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