REPTILES & AMPHIBIANS

Habitat Modification by an Herbivorous Marsupial Benefits the Papuan Taipan, *Oxyuranus scutellatus canni* Slater 1956, in an Anthropogenic Environment in Central Province, Papua New Guinea

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Symbiotic relationships are described as long-term interspecies interactions that are beneficial to one or both of the symbionts, with driving factors including feeding, protection, and reduction of parasite loads (Dickman 1992). Three forms of symbiotic relationship — mutualism (in which the participants depend on the interaction), protocooperation (in which the benefits are facultative), and commensalism (in which one participant benefits and the other is not affected) — are widely reported in the animal kingdom. Interspecies interactions frequently have been observed among birds, mammals, fish, and invertebrates (e.g., Atwell 1966; Preston 1978; Poulin and Grutter 1996; Karplus 2014; Egerton 2015), but those involving amphibians and reptiles are less widely reported, with examples including associations between the Marsh Frog (*Pelophylax ridibundus*) and the Water Buffalo (*Bubalus bubalis*) (Zduniak et al. 2017), Nagao's Pug-snouted Frog (*Uperodon nagaoi*) and the Ornamental Tarantula (*Poecilotheriam* sp.) (Suranjan Karunarathna and Thasun Amarasinghe 2009), the Common Sandpiper (*Actitis hypoleucos*) and the Nile Crocodile (*Crocodylus niloticus*) (Cott 1961), and the Small Ground Finch (*Geospiza fuliginosa*) and the Galapagos Giant Tortoise (*Chelonoidis nigra*) (MacFarland and Reeder 1974).

A less-studied form of symbiosis occurs when a single species affects the structure and function of an entire commu-

Fig. 1. A Papuan Taipan (*Oxyuranus scutellatus canni*) found basking in a fully enclosed clearing of compacted and short-grazed vegetation in a Kunai Grass block. Photograph by Tom Charlton.

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nity through habitat modification that is of benefit to one or more other species (Stachowitcz 2001). Among reptiles, perhaps the most notable example of this is that of the Gopher Tortoise (*Gopherus polyphemus*), whose burrows are utilized by over 360 species of animals, including 13 species of snakes (Jackson and Milstrey 1989).

The Papuan Taipan (*Oxyuranus scutellatus canni*) (Fig. 1) is a large (>2 m total length), highly venomous elapid snake with a distribution encompassing the southern coastal provinces of Papua New Guinea and extending to the southwestern portion of Papua (Indonesian New Guinea). It occupies a wide range of habitats, including lowland savannah and dry woodlands, oil palm plantations, as well as human settlements and even larger towns and cities at elevations of 0–360 m asl (O'Shea 1996; O'Shea, pers. comm.). The Papuan Taipan is an alert and secretive species that routinely demonstrates its retiring nature (Slater 1956). However, its tolerance of disturbed environments increases the likelihood of human-snake conflict, and this species is responsible for the majority of serious snakebite envenomations in Central Province (Lalloo et al. 1995; Williams et al. 2005). Adult taipans have few natural predators in Papua New Guinea, yet remain vulnerable to injury or death through human persecution and from accidental encounters with motor vehicles and machinery (Fig. 2).

Herein, we describe observations of the Papuan Taipan benefiting from modifications to local Kunai Grass (*Imperata cylindrica*) habitat by the Agile Wallaby (*Macropus agilis*), an herbivorous marsupial, within a highly-disturbed anthropogenic environment in southern Central Province, Papua New Guinea.

Our observations were made on the grounds of an industrial site located near Lea Lea Village, Central Province, Papua New Guinea (9°17'34.76"S, 146°59'50.21"E). The site is comprised largely of hardstanding yards, bitumen and gravel roads, and short-mown grassland interspersed within blocks of Kunai grassland, salt marsh, and scattered Pandanus groves. It experiences a high level of human activity from the resident

Fig. 2. A road-killed Papuan Taipan (*Oxyuranus scutellatus canni*) found near the study site. Photograph by Tom Charlton.

Fig. 3. Papuan Taipans (*Oxyuranus scutellatus canni*) found basking in fully enclosed clearings of compacted and short-grazed vegetation in a Kunai Grass block. Photograph by Tom Charlton.

workforce, restricting much of the local terrestrial fauna to the small, isolated patches of remaining natural habitat. We routinely observed Agile Wallabies taking refuge in the dense growths of Kunai grassland during the day, either individually or in small groups.

Between December 2017 and February 2020, we made 14 observations of *O. s. canni* within a small and isolated block of unmanaged Kunai Grass between 0730 h and 1015 h local time. Kunai Grass is a densely growing perennial that reaches heights of over 2 m, limiting opportunities for basking by reptiles. On 11 occasions, taipans were encountered as they basked in fully enclosed clearings of compacted and short-grazed vegetation (Fig. 3). These clearings were readily identifiable as having been created by Agile Wallabies through the presence of short-grazed and compacted vegetation, scattered droppings, and the presence of individuals or small groups of wallabies (Fig. 4). We observed a further three taipans that were active in the same clearings, possibly disturbed by the observers' presence.

All taipans moved off rapidly when encountered. Six were captured and transported to the Charles Campbell Toxinology Centre (CCTC) located in Port Moresby for participation in the CCTC antivenom program. Although none of the specimens were accurately measured, they all were considered to be subadults or adults and ranged from an estimated 0.8 m to 1.5 m SVL.

Despite over 80 additional sightings or captures of Papuan Taipans in surrounding habitats during the same period, we observed no basking behavior outside of the Kunai grassland blocks. Furthermore, we encountered 12 taipans that had been killed by machinery or motor vehicles on roads and tracks within the surrounding area.

In a heavily-disturbed anthropogenic environment with limited remaining natural habitats, Kunai grassland blocks provide an ideal habitat for snakes to seek refuge. A close relative of the Papuan Taipan, the Coastal Taipan (*Oxyuranus scutellatus scutellatus*) of northern Queensland, Australia, is well known for utilizing sugarcane fields and windbreaks in a similar manner (Masci and Kendall 1995). The observations reported herein strongly suggest that the presence of Agile Wallaby-modified local grassland habitats enables the Papuan Taipan to exploit sheltered basking sites and avoid exposure in less hospitable areas within a highly-disturbed anthropogenic environment. We observed no interactions between taipans and wallabies. Although wallabies may occasionally be bitten and envenomated by taipans, inevitably resulting in

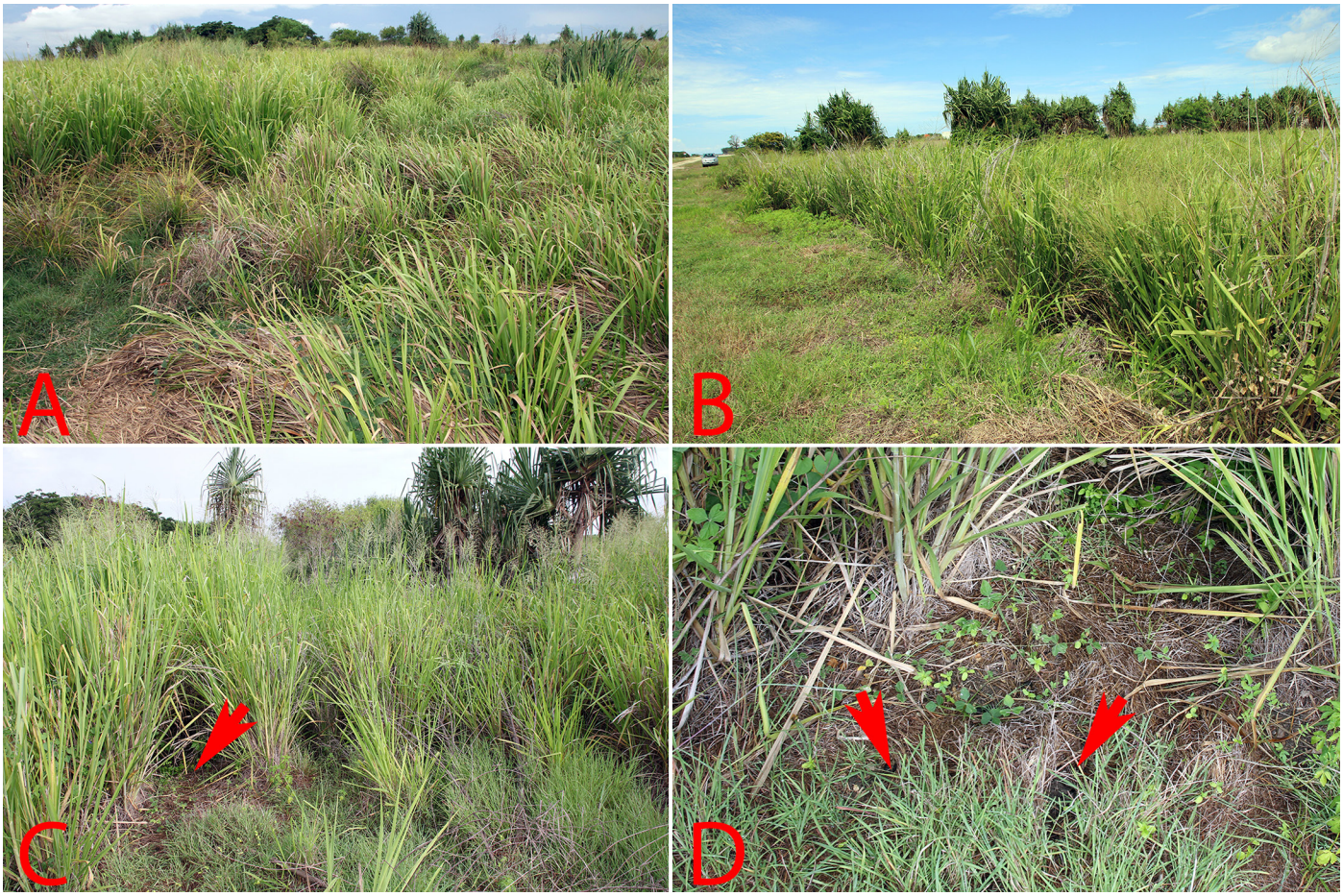

Fig. 4. Blocks of Kunai grassland (A, B); red arrows mark short-grazed and compacted vegetation (C), and Agile Wallaby (*Macropus agilis*) droppings (D), which are indicative of their presence. Photographs by Tom Charlton.

the death of the wallaby, we found no evidence of this during the period of our observations and we therefore consider the wallabies to be largely unaffected by the presence of taipans within the Kunai grassland.

Observations of symbiotic relationships involving snakes are rarely reported, possibly due in part to the difficulties of observing snakes in nature. We suspect that symbiotic relationships benefitting snakes are more widespread than the literature would indicate and hope that the observations documented here will encourage further research into this subject. Furthermore, because Papuan Taipans are responsible for a large number of serious snakebites and fatalities in Papua New Guinea, an improved knowledge of the ecology of this species remains a valuable part of mitigating the frequency of venomous snakebites in this region.

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