

THE BIODIVERSITY OF TERRESTRIAL FLATWORMS (TRICLADIDA: TERRICOLA) IN QUEENSLAND : A PRELIMINARY REPORT

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Abstract

Winsor, L., 1997. The biodiversity of terrestrial flatworms (Tricladida: Terricola) in Queensland: a preliminary report. *Memoirs of the Museum of Victoria* 56(2): 575-579.

Prior to this study of the Terricola in Queensland only nine species of terrestrial flatworms (land planarians) were reported from south and mid-east Queensland. Nothing was known of the flatworm taxa of the northern regions of the state. As a result of the study the known Queensland flatworm fauna has been increased over six fold. Eight genera and over 80% of the 62 species are new. Seven exotic species have been recorded from disturbed habitat. The flatworm fauna in the northern tropics exhibits high diversity and apparent endemicity in both the Rhynchodemidae and Geoplanidae, and shares some taxa with Indonesia and Irian-Jaya — Papua-New Guinea. It includes *Cotyloplana*, *Digonopyla* and *Dolichoplana* not previously recorded from the Australian mainland. The southern areas of the state are dominated by a less diverse geoplanid fauna with affinities with the south-eastern states and New Zealand. Threats to conservation include deforestation and destruction of remnant ground cover by humans and exotic animals.

Introduction

Terrestrial flatworms, also known as land planarians, are conspicuous carnivores of the Australian native forest cryptofauna. Generally regarded as having few moisture saving adaptations these animals frequent damp but not wet habitats under litter, bark and under rotting logs on the forest floor. Most taxa have low vagility and high endemicity. Terrestrial flatworms are generally not amenable to trapping, and are collected by handpicking. By the turn of the century some 90 Australian species and subspecies were described, presently accommodated in 12 genera within two principal families (Winsor, 1991a). On the basis of present investigations it is estimated that the total fauna is in excess of 400 species.

Taxonomy of the Terricola is based upon characters derived from the external morphology and internal microanatomy and histology of sexually mature specimens. The alpha taxonomy of the Australian Terricola is in a state of flux as the internal anatomy of many species has yet to be determined.

Whilst the Terricolan faunas of New South Wales, Victoria and Tasmania are relatively well documented, those of the remaining states are known only superficially. In Queensland only nine species of native terrestrial flatworms, all from sites below the Tropic of Capricorn, were

reported prior to this study. Terricola from this state are poorly represented in museum collections. Apart from the types of six species there are less than 20 specimen lots all from south-eastern Queensland held in museum collections. This study is part of an on-going taxonomic investigation of the Australian Terricola. It seeks to determine the composition and distribution of the Terricolan fauna of Queensland, with particular emphasis on the wet tropics, the preliminary results of which are presented here.

Materials and methods

The study is based upon specimens opportunistically collected by handpicking throughout eastern Queensland from Iron Range south to the border ranges, with particular attention to study sites in the Wet Tropics World Heritage Area (WHA), including the Paluma, Kirrama and Millaa Millaa areas. Whilst soil-dwelling and arboreal taxa are collected, there is a general bias towards handpicking species present beneath ground cover such as litter and rotting logs. Specimens are anaesthetised in 10% ethanol then fixed extended in 4% formaldehyde : 2% calcium acetate : 0.2% cobaltous nitrate aqueous solution (Winsor, 1991b). Following fixation specimens are sorted into recognisable taxonomic units (RTUs) and sexual examples

selected for anatomical study. Material for histological examination is processed to paraffin wax, serially sectioned transversely and sagittally at 8 μm , and stained using Heidenhain's AZAN technique (Gabe, 1976).

Results and discussion

Queensland has a rich, highly diverse terricolan fauna. As a result of this study, the number of taxa known from the state has been increased over six-fold to some 62 species (Table 1). Six genera and 80% of the species are new, and will be described elsewhere. A preliminary checklist of terrestrial flatworms from Queensland is provided in Table 2.

In north Queensland (above 20°S) there is high species diversity of both rhynchodemids (nine genera) and geoplanids (seven genera). The southern region of the state (below 20°S) both

Table 1. Summary of families, genera, and species of terrestrial flatworms in Queensland. The numbers of a particular taxon described prior to this study are given in parentheses, with totals indicated in bold.

Rhynchodemidae	34 (2)
Rhynchodeminae	
<i>Cotyloplana</i>	2
<i>Digonopyla</i>	1
<i>Dolichoplana</i>	9
<i>Dolichoplana</i> ?	1
<i>Platydemus</i>	6
<i>Rhynchodemus</i>	3 (2)
rhynchodemids	8
new genera-new species	3
Microplaninae ?	
new genus	1
Geoplanidae	27 (7)
Caenoplaninae	
<i>Artioposthia</i>	1 (1)
<i>Australopacifica</i>	2 (2)
<i>Australoplana</i>	3 (1)
<i>Caenoplana</i>	8 (2)
<i>Flethamnia</i>	1 (1)
<i>Kontikia</i>	2
<i>Parakontikia</i>	3
geoplanid	1
new genera-new species	5
Pelmatoplaninae	
<i>Pelmatoplana</i> ?	1
Bipaliidae	1(1)
<i>Bipalium</i>	1
Total number of species	62 (10)

rhynchodemid (two genera) and geoplanid (six genera) diversity is less, and geoplanid taxa dominate. In the Wet Tropics World Heritage Area (Tables 2 and 3) the Rhynchodeminae have their highest generic diversity in the sclerophyll forest with five genera and six species. Four genera including *Cotyloplana* and nine species are found in rainforest. A slightly different picture emerges for the Caenoplaninae with higher generic diversity in the rainforest. Here six genera and ten species are present in rainforest, with only four genera containing five species occurring in sclerophyll forest.

The only widespread morphospecies is a *Caenoplana* sp. which occurs in tall open forest and rainforest from Iron Range south to over the southern Queensland border. Histological and other analyses of this *Caenoplana* may reveal a species complex. The majority of taxa in northern Queensland appear to be highly restricted or endemic in distribution.

The rhynchodemid genera *Digonopyla*, *Dolichoplana*, and *Cotyloplana* have not previously been recorded from the Australian mainland. Two *Cotyloplana* species are now reported from the wet tropics. *Cotyloplana* species have previously been described from Lord Howe Island, and others from Indonesia. Eleven species of *Dolichoplana* are presently recognised worldwide. The genus exhibits its greatest diversity in north Queensland where at least nine undescribed species have been found. *Digonopyla* is poorly known. Two species are reported from Wallacea and an undescribed species has now been found at Iron Range on Cape York. Of particular interest is an arboreal rhynchodemid. A single translucent green specimen was found on a native rainforest grape vine (Vitaceae) in the Eungella area. Arboreal flatworms are rare, and only two species from bromeliads in Costa Rica have previously been reported (Beauchamp, 1912).

Southern Queensland represents the northern limit of the range of *Parakontikia* and *Flethamnia*. The geoplanid *Artioposthia regina* exhibits a disjunct distribution pattern. Originally found at Gympie, it has now been recorded from the Windsor Tablelands in far north Queensland.

There has been an increase in the number of introduced Terricola found in the state (Table 2). The cosmopolitan flatworm *Bipalium kewense* was reported from Gympie in 1892. Since then it has become common in urban areas of Brisbane, Townsville and country areas (Winsor, 1983, 1985). Other introduced species

Table 2. A checklist of terrestrial flatworms from Queensland. Taxa present in Wet Tropics World Heritage Area are indicated with an asterisk, and introduced species with a cross.

Rhynehodemidae**Rhynehodeminae***Cotyloplana* sp. 1 Millaa Millaa S/Lake Eacham**Cotyloplana* sp. 2 Millaa Millaa S**Digonopyla* sp. Iron Range*Dolichoplana* sp. 1 Kirrama**Dolichoplana* sp. 2 Townsville/Charters Towers†*Dolichoplana* sp. 3 Iron Range*Dolichoplana* sp. 4 Atherton Tablelands**Dolichoplana* sp. 5 Paluma**Dolichoplana* sp. 6 Eungella*Dolichoplana* sp. 6 Bowen*Dolichoplana* sp. 7 Millaa Millaa S**Dolichoplana* sp. 8 Cooroy, Gin Gin*Dolichoplana* sp. 9 Paluma*? *Dolichoplana* sp. Mt Finnigan**Platydemus manokwari* Beauchamp, 1962†*Platydemus* sp. 1 Malanda**Platydemus* sp. 2 Millaa Millaa S (neck band)**Platydemus* sp. 3 Millaa Millaa**Platydemus* sp. 4 Millaa Millaa (white blotched)**Platydemus* sp. 5 Paluma**Rhynchodemus obscurus* Fletcher & Hamilton, 1888*Rhynchodemus putzei* Graff, 1899*Rhynchodemus* sp. Eungella (arboreal)

rhynehodemid sp. 1 Lake Eacham*

rhynehodemid sp. 2 Kirrama (pink)*

rhynehodemid sp. 3 Windsor Tablelands*

rhynehodemid sp. 4 Condon

rhynehodemid sp. 5 Eprapah

rhynehodemid sp. 6 Mt Stuart

rhynehodemid sp. 7 Charters Towers

rhynehodemid sp. 8 Cooroy

gen. nov. A sp. nov. Charters Towers

gen. nov. B sp. nov. Paluma*

gen. nov. D sp. nov. Red Falls

Geoplanidae**Caenoplaninae***Artioposthia regina* (Dendy, 1892b)*Australopacifica pava* (Steel, 1897)*Australopacifica scaphoidea* (Steel, 1900)*Australopacifica minor* Dendy, 1892b*Australopacifica* sp. Border Ranges*Australopacifica* sp. Eungella*Caenoplana coerulea coerulea* Moseley, 1877*Caenoplana bicolor* (Graff, 1899)*Caenoplana* sp. 1 (widespread)**Caenoplana* sp. 2 Atherton Tablelands**Caenoplana* sp. 3 Eungella*Caenoplana* sp. 4 Magnetic Island†*Caenoplana* sp. 5 Paluma**Caenoplana* sp. 6 Lake Barrine**Fletchamia quinquelineata accentuata* (Steel, 1897)*Kontikia circularis* (Fyfe, 1956)†*Kontikia orana* Froehlich, 1955†*Parakontikia atrata* (Steel, 1897)*Parakontikia ventrolineata* (Dendy, 1892a)*Parakontikia* sp. Miriam Vale

geoplanid sp. Paluma (maculate)*

gen. nov. 1 sp. nov. Paluma*

gen. nov. 2 sp. nov. Lake Barrine*

gen. nov. 3 sp. nov. Millaa Millaa S*

gen. nov. 4 sp. nov. 1 Paluma*

gen. nov. 4 sp. nov. 2 Russell River*

Pelmatoplaninae*Pelmatoplana* sp. Roberston†**Bipaliidae***Bipalium kewense* Moseley, 1878†**Microplaninae ?**

gen. nov. C sp. nov. Paluma*

Table 3. Terricola genera of the Wet Tropics World Heritage Area. Number of species present in sclerophyll forest and rainforest.

Taxon	sclerophyll rainforest forest	
Rhynchodeminae		
<i>Cotyloplana</i>		2
<i>Dolichoplana</i>	5	1
<i>Platydemus</i>	2	2
rhynchodemimid spp.	1	2
new genus B	1	
new genus C	1	
Caenoplaninae		
<i>Artioposthia</i>	1	1
<i>Caenoplana</i>	2	3
new genus 1	1	1
new genus 2		1
new genus 3		1
new genus 4	1	2
Totals	15	16

in northern Queensland include *Kontikia orana* (Winsor, 1986), *Platydemus manokwari*, used elsewhere for the control of the Giant African snail *Achatina fulica*, and a *Caenoplana* species. The latter two species are probably introduced from Papua-New Guinea.

Compared to many other groups of terrestrial invertebrates, terrestrial flatworms are under-represented in museum collections. In part this is possibly because they are extremely delicate, moisture and heat sensitive. Unless special precautions such as cooling are taken during collection and transport, the flatworms die and rapidly decompose. Recommended fixatives such as ethanol and simple formalin solutions (Steel, 1897, 1900) have failed to preserve the colour and pattern; most museum specimens are a featureless brown colour. For taxonomic purposes flatworms require careful anaesthesia, and good histological fixation which also maintains external morphology, colour and pattern (Winsor, 1991b).

Table 4. Occurrence of genera in south eastern Australia, southern Queensland, in north and far north Queensland above 20 degrees latitude, and in Papua New Guinea, Irian Jaya and Indonesia.

Family/Genus	SE Aust	S Qld	N Qld	FN Qld	PNG-IJ Indonesia
Geoplanidae					
<i>Artioposthia</i>	+	+	+	+	
<i>Australoplana</i>	+	+	+	+	
<i>Caenoplana</i>	+	+	+	+	
<i>Australopacifica</i>	+	+			+
<i>Parakontikia</i>	+	+			
<i>Fletchamia</i>	+	+			
new genus 1			+	+	
new genus 2			+	+	
new genus 3			+	+	
new genus 4			+	+	
Rhynchodemidae					
<i>Rhynchodemus</i>	+	+	+	+	+
<i>Platydemus</i>	+	?	+	+	+
<i>Dolichoplana</i>		+	+	+	+
<i>Cotyloplana</i>				+	+
<i>Digonopyla</i>				+	+
new genus A			+		
new genus B			+		
new genus C			+		
new genus D			+		
Totals	6	14	12	6	

Taxonomy and systematics of the Terricola are based principally upon microanatomical characters revealed by histological investigations. Biogeographical and phylogenetic analyses of the Queensland taxa are presently precluded at this early stage of investigations because of incomplete data. Terrestrial flatworms do not appear to be as numerically abundant in Queensland as they are in the south-eastern states, though this observation has not been substantiated by quantitative studies. Despite these limitations, two broad elements can be clearly recognised in the Queensland terrestrial flatworm fauna (Table 4). A southern group which is comprised largely of caenoplaninid genera dominant in southern Queensland which includes taxa present in south-eastern Australia. The other element is the northern group composed chiefly of rhynchodemid genera including taxa present in Indonesia, Irian Jaya and Papua-New Guinea. The affinities of the new caenoplaninid genera in this group have not yet been determined.

Conservation threats to terrestrial flatworms include loss of habitat through deforestation and high-frequency fuel reduction burning. Destruction of rotting logs and habitat in rainforest by feral pigs may also be significant in certain areas of the Wet Tropics WHA. Throughout Australia, small pockets of remnant forest along roadsides and on farms are often significant cryptofaunal refugia, vital for reconstructing the historic biogeography of the Terricola, and for the conservation of flatworms. Clearing and burning fallen timber on agricultural land, and the removal of fallen timber by the public for firewood are significant threats to the conservation of cryptofauna. Maintenance and augmentation of these important areas should be encouraged and included in all regional rural conservation education and management schemes.

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References

- Beauchamp, P. de., 1912. Planaires terrestres des Broméliacées de Costa-Rica recueillis par M.C. Picado. *Archives de Zoologie expérimentale et générale* 50: 1-10.
- Gabe, M., 1976. *Histological techniques*. Masson: Paris.
- Steel, T., 1897. Australian land planarians: descriptions of new species and notes on collecting and preserving. *Proceedings of the Linnean Society of New South Wales* 22: 104-119.
- Steel, T., 1900. Australian land planarians. descriptions of new species and notes on collecting and preserving. No.2. *Proceedings of the Linnean Society of New South Wales* 25: 563-580.
- Winsor, L., 1983. A revision of the cosmopolitan land planarian *Bipalium kewense* Moseley, 1878 (Turbellaria: Tricladida: Terricola). *Zoological Journal of the Linnean Society* 79: 61-100.
- Winsor, L., 1985. Land planarians (Turbellaria: Tricladida: Terricola) introduced into Australia — 1. *Bipalium kewense* Moseley, 1877. *Victorian Naturalist* 103: 102 — 105.
- Winsor, L., 1986. Land planarians (Turbellaria: Tricladida: Terricola) introduced into Australia — 2. *Kontikia orana* Froehlich, 1955. *Victorian Naturalist* 103: 9-11.
- Winsor, L., 1991a. A provisional classification of Australian terrestrial geoplanid flatworms (Tricladida: Terricola: Geoplanidae). *Victorian Naturalist* 108: 42-49.
- Winsor, L., 1991b. Methods for taxonomic and distributional studies of terrestrial flatworms (Tricladida: Terricola). In: S. Tyler (ed), *Turbellarian biology*. *Hydrobiologia* 227: 349-352.