

Article

Biogeography of Timor and Surrounding Wallacean Islands: Endemism in Ants of the Genus *Polyrhachis* Fr. Smith

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Abstract: The Wallacean island of Timor is of particular biological interest due to its relatively large size and transitional location between the Indo-Malayan and Australasian biogeographic realms. However, the origins and levels of endemism of its invertebrate fauna are poorly known. A recent study of Timorese ants revealed a diverse fauna with predominantly Indo-Malayan affinities, but species-level taxonomy was considered to be too poorly understood for an analysis of levels of endemism. The highly diverse Old World tropical genus *Polyrhachis* represents a notable exception, and here we analyse levels of endemism in the *Polyrhachis* fauna of Timor and surrounding islands. We supplement the species listed in the previous study with additional collections to record a total of 35 species of *Polyrhachis* from Timor and surrounding islands. Only 14 (40%) of the 35 species could be named (*P. constricta*, *P. costulata*, *P. gab*, *P. sokolova*, *P. hera*, *P. illaudata*, *P. rixosa*, *P. acantha chrysophanes*, *P. saevissima*, *P. bicolor*, *P. cryptoceroides*, *P. dives*, *P. longipes* and *P. olybria*), and the large majority of the remaining species have not previously been collected. These are very likely to be endemic to Timor and surrounding islands, and point to remarkably high levels (>50%) of endemism in the regional ant fauna.

Keywords: ant fauna; Indo-Malaya; new species; Wallacea

1. Introduction

The Wallacean islands of the eastern Indonesian region are of exceptional biological interest because they are transitional between the strongly contrasting Indo-Malayan and Australasian biogeographic realms [1–3]. Most of these islands are oceanic and have never been connected to either the Indo-Malayan (Sunda) or Australasian (Sahul) continental plates [3]. Their biotas therefore have very mixed origins [4–7], and their isolation has resulted in high levels of endemism [8–10].

Timor (31,459 km²) is the second largest Wallacean island, lying 860 km east of Wallace's Line and 470 km north of north-western Australia. It was formed about four million years ago by the collision of the northwardly advancing Australasian plate with the Banda Volcanic Arc. Although it has never been in contact with either continental Australia or South-East Asia, during the last Ice Age distances to Australia were reduced to as little as 75 km and to South East Asia to even less via a range of stepping-stone Wallacean islands such as Atauro, Wetar and Alor, which currently lie from 30 km to the north [11]. Despite its size and location, Timor has attracted relatively little interest from biogeographers, and the origins and levels of endemism of its fauna have been poorly documented. This is especially the case for invertebrates.

A recent study of Timorese ants [12] revealed a diverse fauna with predominantly Indo-Malayan affinities, but species-level taxonomy was considered to be too poorly understood for an analysis of levels of endemism. However, the highly diverse Old World tropical genus *Polyrhachis* Fr. Smith represents a notable exception. One of us (RJK) has more than 30 years of experience undertaking taxonomic revisions of the genus from throughout the Indo-Malayan and Australian regions [13–19], is familiar with the available types of all described species, and has extensive holdings of undescribed species. *Polyrhachis* represents a particularly informative focal taxon for biogeographical analysis of the Timorese ant fauna because it includes numerous subgenera of both Indo-Malayan and Australian origin, and is extremely diverse ecologically, with different taxa nesting in the ground, within tree cavities, and inside woven leaves [20–22].

Here we analyse the *Polyrhachis* fauna of Timor and surrounding Lesser Sunder islands, describing its biogeographical affinities and, in particular, assessing apparent levels of endemism.

2. Methods

Our analysis is based primarily on the species of *Polyrhachis* recorded by [12] from Timor itself, Atauro and Wetar from the Timor group of islands to the north, and Alor, Lembata and Pantar from the Flores group of islands to the west. This was supplemented by subsequent collections from four other islands in the Timor group (Kisar, Romang, Sermata and Babar), from Flores, and from Tanimbar to the east (Figure 1, Table 1).

All species were identified by RJK, and the distribution of each species was assessed on the basis of published records combined with RJK's knowledge of specimens from publicly available collections. Voucher collections of species are deposited in the Queensland Museum and at CSIRO's Tropical Ecosystems Research Centre in Darwin.

Figure 1. Map of Timor and surrounding Wallacean (Lesser Sunda) islands sampled for this study.



Table 1. Summary of supplementary sampling of *Polyrhachis* species, in addition to that described in [12].

Island	Survey dates	Survey effort (h)	Habitats sampled (elevation)
Flores	June/July 2011	6	Montane forest, secondary forest (625–1,625m)
Lembata	November 2011	8	Evergreen swamp forest (0–20 m)
Wetar	September–October 2010	30	Evergreen forest, <i>Eucalyptus</i> woodland (0–100 m)
Kisar	October 2010	20	<i>Eucalyptus</i> woodland, mangrove (0–150 m)
Romang	October 2010	30	Evergreen forest, <i>Eucalyptus</i> woodland (0–600 m)
Sermata	November 2010	20	Evergreen forest, mangrove (0–200 m)
Babar	August 2011	30	Evergreen forest, <i>Eucalyptus</i> woodland (0–600 m)
Tanimbar	August 2011	6	Evergreen forest (0–150 m)

3. Results and Discussion

Our analysis considered a total of 35 species of *Polyrhachis* from nine subgenera, with the richest subgenera being *Myrmhopla* Forel (13 species), *Chariomyrma* Forel (6), *Myrma* Billberg (6) and *Hedomyrma* Forel (4) (Table 2; revised identifications of the species recorded by [12] are provided in Appendix 1). Only 14 (40%) of the 35 species could be named, and they include species occurring primarily in Australia and New Guinea (e.g., *P. constricta*, *P. gab*, and *P. sokolova*), species restricted to the eastern Indonesian region (e.g., *P. acantha chrysophanes*, *P. hera*), widely distributed Indo-Malayan species (e.g., *P. rixosa*, *P. saevissima*), and species occurring in both Indo-Malaya and Australia (e.g., *P. bicolor*, *P. dives*) (Table 3).

Table 2. Cont.

	FLORES GROUP			TIMOR GROUP				
<i>P. rixosa</i> Fr. Smith			*		*			
<i>Polyrhachis</i> cf. <i>rixosa</i> Fr. Smith			*				*	
<i>Polyrhachis</i> cf. <i>villipes</i> Fr. Smith	*	*						
<i>Polyrhachis</i> cf. <i>zopyra</i> Fr. Smith	*	*	*	*	*	*	*	*
Myrmhopla								
<i>Polyrhachis acantha chrysophanes</i> Emery		*	*					
<i>Polyrhachis</i> cf. <i>acantha chrysophanes</i> Emery			*					
<i>Polyrhachis</i> (<i>mucronata</i> -gr.) sp			*					
<i>P. bicolor</i> Fr. Smith	*							
<i>Polyrhachis</i> cf. <i>bicolor</i> Fr. Smith			*					
<i>P. cryptoceroides</i> Emery		*						
<i>P. dives</i> Fr. Smith	*		*	*	*	*	*	
<i>P. longipes</i> Fr. Smith		*	*	*	*	*	*	
<i>Polyrhachis</i> cf. <i>moesta</i> Emery	*	*						
<i>Polyrhachis</i> cf. <i>mucronata</i> Fr. Smith		*	*	*				
<i>Polyrhachis</i> cf. <i>saevissima</i> Fr. Smith	*							
<i>Polyrhachis saevissima</i> Fr. Smith			*					
<i>Polyrhachis</i> cf. <i>tibialis</i> Fr. Smith			*		*	*	*	*
Myrmothrinax								
<i>Polyrhachis</i> cf. <i>thrinax</i> Roger								*
Polyrhachis								
<i>Polyrhachis olybria</i> Forel			*					

Table 3. Previously known distributions of named species from Timor and surrounding islands.

Species	Distribution
<i>P. (Chariomyrma) constricta</i>	Australia, New Guinea
<i>P. (Chariomyrma) gab</i>	Australia
<i>P. (Chariomyrma) sokolova</i>	Australia, New Guinea, Aru, New Caledonia
<i>P. (Chariomyrma) costulata</i>	New Guinea
<i>Polyrhachis (Hedomyrma) hera</i>	Seram, Halmahera
<i>Polyrhachis (Hedomyrma) illaudata</i>	Sri Lanka, India, Thailand, Malaysia, Borneo, Sumatra, Java, Bali, Sumbawa, Philippines
<i>P. (Myrma) rixosa</i>	Sulawesi, Borneo
<i>P. (Myrmhopla) acantha chrysophanes</i>	Tanimbar, Flores
<i>P. (Myrmhopla) bicolor</i>	Throughout IndoMalaya, New Guinea, Australia
<i>P. (Myrmhopla) cryptoceroides</i>	Thailand, Malaysia, Borneo, Sulawesi, Java, Philippines
<i>P. (Myrmhopla) dives</i>	Throughout IndoMalaya, New Guinea, Australia
<i>P. (Myrmhopla) longipes</i>	Aru, New Guinea
<i>P. (Myrmhopla) saevissima</i>	Sulawesi, Sumatra, Seram
<i>P. (Polyrhachis) olybria</i>	Thailand, Malaysia, Borneo, Sumatra, Philippines

Twenty three (66%) of the 35 species belong to subgenera of Indo-Malayan origin (*Cyrtomyrma*, *Myrma*, *Myrmhopla*, *Myrmotherinx*, *Polyrhachis*), with 12 (34%) belonging to subgenera of Australian origin (*Campomyrma*, *Chariomyrma*, *Hagiomyrma*, *Hedomyrma*). These figures are similar to the overall ant fauna of Timor and surrounding islands, with 76% of total species considered to be of Indo-Malayan origin [12].

A small number of the 21 species that we were unable to name belong to unresolved complexes and so their taxonomic and distributional status remains unclear. However, most are clearly distinct from any previously collected species, and are very likely to be endemic to Timor and surrounding islands. The majority of these new species were recorded from Timor itself, but others are known only from surrounding islands. For example, *P. cf. thrinax* is known only from Wetar, *P. cf. rastellata* is known only from Romang, and *P. (Hedomyrma) sp. B (cf. cupreata)* is known only from Tanimbar. Several of the new species (*P. cf. murina*, *P. cf. villipes* and *P. cf. moesta*) are known only from the Flores group of islands. One of the described species, *P. acantha chrysophanes*, also appears to be endemic to the region; it was previously known only from Tanimbar and Flores, but we recorded it on Timor itself. We recorded *P. hera* from Tanimbar and it was previously known only from Seram and Halmahera [23], further north in the Banda Sea.

Apparent levels of endemism might even be higher because we have been conservative with our species identifications. For example, the species we have identified as *P. rixosa* has sparser and shorter hairs, and the petiole is narrower, than in the typical Sulawesi specimens. Detailed analyses of a range of vertebrate groups in the Timor region have shown that taxa previously considered to represent widespread and variable species are actually multiple, locally endemic species [24–28]. For example,

the ‘subspecies’ of the Rainbow Lorikeet (*Trichoglossus haematodus*) occurring on Timor, Wetar, Romang, Flores, Sumbawa and Sumba are now recognised as three distinct species [29].

4. Conclusion

Timor and surrounding islands support a remarkably diverse and notable *Polyrhachis* fauna. We recorded nine of the 13 recognised subgenera, with three of the other four subgenera (*Aulacomyrma* Emery, *Myrmatopa* Forel and *Hirtomyrma* Kohout) known from other islands of eastern Indonesia (e.g., Aru, Misool, Ambon, Seram; R. Kohout, unpublished data), and therefore very possibly also occurring on Timor and/or surrounding islands. Only one subgenus, *Hemioptica* Roger, which extends from Sri Lanka and India to Malaysia, Borneo and Sumatra, is unlikely to occur in the region. Our analysis reveals that the *Polyrhachis* fauna of Timor and surrounding islands has an extremely high level of endemism, with up to two-thirds of the species not known to occur elsewhere. Such a level of endemism is far higher than in vascular plants (about 10%; [30]) and birds (about 20%; [31]). Most of the native land mammal fauna of Timor was probably endemic [32], but the status of Timor’s herpetofauna remains poorly known [33]. We can think of no reason to suspect that levels of endemism are any higher in *Polyrhachis* than is typical for ants from the region, which suggests that more than half of all ant species occurring in Timor and surrounding islands are endemic. It also seems likely that many other invertebrate taxa show comparable levels of endemism.

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Appendix

Appendix 1. Revised identifications of *Polyrhachis* species recorded in Trainor and Andersen (2010).

Identification in Trainor and Andersen (2010)	Revised identification
<i>Polyrhachis</i> (<i>Campomyrma</i>) sp. A	<i>Polyrhachis</i> cf. <i>insularis</i> Emery
<i>Polyrhachis</i> (<i>Chariomyrma</i>) sp. F (<i>arcuata</i> gp.)	<i>Polyrhachis</i> cf. <i>arcuata acutinota</i> Forel
<i>Polyrhachis</i> (<i>Cyrtomyrma</i>) sp. P	<i>Polyrhachis</i> cf. <i>gibba</i> Emery
<i>Polyrhachis</i> (<i>Hedomyrma</i>) sp. O (<i>euterpe</i> gp.)	<i>Polyrhachis</i> cf. <i>machaon</i> Santschi
<i>Polyrhachis</i> (<i>Myrma</i>) <i>mayri</i>	<i>P. illaudata</i> Walker
<i>Polyrhachis</i> (<i>Myrma</i>) sp. nr. <i>villipes</i>	<i>Polyrhachis</i> cf. <i>villipes</i> Fr. Smith
<i>Polyrhachis</i> (<i>Myrmhopla</i>) <i>acantha</i>	<i>Polyrhachis acantha chrysophanes</i> Emery
<i>Polyrhachis</i> (<i>Myrmhopla</i>) <i>argentea</i>	<i>Polyrhachis</i> cf. <i>tibialis</i> Fr. Smith
<i>Polyrhachis</i> sp. nr. <i>bicolor</i>	<i>Polyrhachis</i> cf. <i>bicolor</i> Fr. Smith
<i>Polyrhachis</i> (<i>Myrmhopla</i>) <i>bicolor</i>	<i>P. bicolor</i> Fr. Smith
<i>Polyrhachis</i> (<i>Myrmhopla</i>) <i>concolor</i>	<i>P. longipes</i> Fr. Smith
<i>Polyrhachis</i> (<i>Myrmhopla</i>) <i>cryptoceroides</i>	<i>P. cryptoceroides</i> Emery
<i>Polyrhachis</i> (<i>Myrmhopla</i>) <i>dives</i>	<i>P. dives</i> Fr. Smith
<i>Polyrhachis gab</i>	<i>P. gab</i> Forel
<i>Polyrhachis</i> sp.nr. <i>inconspicua</i>	<i>Polyrhachis</i> cf. <i>insularis</i> Emery
<i>Polyrhachis mucronata</i>	<i>Polyrhachis</i> cf. <i>mucronata</i> Fr. Smith
<i>Polyrhachis</i> sp. nr. <i>mucronata</i>	<i>Polyrhachis</i> (<i>mucronata</i> -group) sp.

Appendix 1. Cont.

Identification in Trainor and Andersen (2010)	Revised identification
<i>Polyrhachis</i> sp. B (<i>bellicosa</i> gp.)	<i>P. olybria</i> Forel
<i>Polyrhachis</i> sp. J (<i>cupreata</i> gp.)	<i>Polyrhachis</i> (<i>Hedomyrma</i>) sp. A (cf. <i>cupreata</i> Emery)
<i>Polyrhachis</i> sp. K (<i>zopyra</i> gp.)	<i>Polyrhachis</i> cf. <i>murina</i> Emery
<i>Polyrhachis</i> sp. L (<i>tibialis</i> gp.)	<i>Polyrhachis</i> cf. <i>moesta</i> Emery
<i>Polyrhachis</i> sp. L (<i>zopyra</i> gp.)	<i>Polyrhachis</i> cf. <i>zopyra</i> Fr. Smith
<i>Polyrhachis</i> sp. nr. <i>obtusa</i>	<i>Polyrhachis costulata</i> Emery
<i>Polyrhachis rixosa</i>	<i>P. rixosa</i> Fr. Smith

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