DISTRIBUTION OF SOCIAL WASPS IN VIETNAM (HYMENOPTERA: VESPIDAE)**Nguyen Thi Phuong Lien^{1*}, Junichi Kojima²**¹Institute of Ecology and Biological Resources, VAST, *phuonglientit@yahoo.com²Natural History Laboratory, Faculty of Science, Ibaraki University, Mito, 310-8512 Japan

ABSTRACT: Distribution records of social wasps in Vietnam are summarized and their distribution patterns are discussed. A total of 76 species in 11 genera of social wasps are recognized in Vietnam. They are 11 species belonging to four genera of the subfamily Stenogastrinae, 51 species in four genera of the Polistinae and 14 species belonging to three genera of the Vespinae. Distribution records of social wasps in Vietnam are given according to the three climatic conditions (Northern, Southern and Mountainous areas), showing that the numbers of species are higher in the mountainous areas and tend to decrease from north to south. Vietnam has a rich social wasp fauna, consisting of three major components: the northern element, of which the center of divergence might be on the eastern slope of Himalaya; the Sundaland species, which are distributed in the southern part of Vietnam; and species widely distributed in the Indo-Malayan region.

Keywords: Vespidae, climatic condition, distribution, social wasps, fauna, Vietnam.

INTRODUCTION

Social wasps, namely Stenogastrinae (hover wasps), Polistinae (paper wasps) and Vespinae (hornets and yellow-jackets) in the family Vespidae, consisting of about 1,000 described species worldwide, are beneficial insects in that they may attack many agricultural pests to feed their young [8, 11, 32], and thus they are, at least potentially, effective predators of insect pests in biological control programs [15, 10]. Also, because they are at the top-position in a food-web of terrestrial arthropods as well as pollinators of many plants [18, 7, 17], social wasps play important roles in an ecosystem where they occur, and thus they can be good bio-indicators for environmental conditions. Besides these subjects considered in relation to human life, the social wasps have provided us with enormous opportunities to study the origin and process of evolution of eusociality in hymenopterans and insects in general [16, 14, 1].

Vietnam's land is long and narrow, spreading from 8.5 to 23 degree north latitude and with the coastline of about 3,000 km long. As its geographical consequence Vietnam has a peninsula feature: The effect of the sea spreads over the area except in the northwestern part, where it has more or less continental inland climate [22]. Furthermore, although Vietnam is located south of the Tropics of Cancer, its

climate is not simply tropical but varies largely according to regions possibly because of presence of several mountain chains. All such geographical and climatic features of Vietnam allow us to expect that Vietnam harbors a rich biota. The social wasps should not be exceptional. Nevertheless taxonomic and faunal researches on Vietnamese social wasps had only recently been commenced by the first author with her colleagues [23-27, 30-32]. Through these works, a total of 49 species of social wasps have been recognized in Vietnam as summarized in this paper.

MATERIALS AND METHODS

The present study was based on the data given in several publications [23-33], specimens collected from 2000 to 2007 through out Vietnam, and those collected through the field trips to the northern parts and Tay Nguyen plateau of Vietnam from 2008 to 2013.

RESULTS AND DISCUSSION**Subfamily Stenogastrinae**

In the Stenogastrinae, 61 species in seven genera (five South Asian, two Papuan) have been recognized [5, 6, 33, 34]. In Vietnam, 11 species belonging to four South Asian genera are recognized [25, 30, 33, 35] (table 2).

Subfamily Polistinae

Polistinae, with about 980 extant species in 25 genera [3, 12, 13], are grouped into four monotypic tribes; the cosmopolitan tribe Polistini (= *Polistes*), the New World endemic Mischocyttarini (= *Mischocyttarus*) and Epiponini (19 genera), and the Old World endemic Ropalidiini (four genera). The genus

Polistes is divided into four subgenera [2]: the New World subgenus *Aphanilopterus*; *Polistes* s. str., primarily Palearctic and African, with a few species penetrating into the Oriental region; *Gyrostoma*, widely distributed in Asia, Pacific islands including New Guinea and Australia; and *Polistella*, occurring widely in the Old World other than Europe and Africa north of the Sahara.

Table 1. Natural occurrence of the Oriental social wasp genera in Vietnam and other zoogeographical regions

Genus	Vietnam	Australian	Palearctic	Ethiopian	Nearctic	Neotropical
<i>Cochlischnogaster</i> Dong and Otsuka	+	-	-	-	-	-
<i>Eustenogaster</i> van der Vecht	+	-	-	-	-	-
<i>Liostenogaster</i> van der Vecht	+	-	-	-	-	-
<i>Metischnogaster</i> van der Vecht	-	-	-	-	-	-
<i>Parischnogaster</i> von Schulthess	+	-	-	-	-	-
<i>Polistes</i> Latreille	+	+	+	+	+	+
<i>Belonogaster</i> de Saussure	-	-	-	+	-	-
<i>Ropalidia</i> (de Saussure)	+	+	-	+	-	-
<i>Parapolybia</i> de Saussure	+	+	+	-	-	-
<i>Polybioides</i> du Buysson	+	-	-	+	-	-
<i>Dolichovespula</i> Rohwer	-	-	+	-	+	-
<i>Provespa</i> Ashmead	+	-	-	-	-	-
<i>Vespa</i> Linnaeus	+	+	+	+	-	-
<i>Vespula</i> Thomson	+	-	+	-	+	-

In Ropalidiini, *Belonogaster* is predominantly African, with four species occurring in Arabian Peninsula and one in India [9]; in *Parapolybia*, six species are currently recognized, two in the Middle East, and four in the Oriental region; *Polybioides* show a disjunct distribution pattern, with two continental African species and four species distributed in Southeast Asia; *Ropalidia*, the largest genus in the tribe in term of the number of species, [19-21], is distributed in most of tropical and subtropical areas of the Old World. In Vietnam,

51 species in four Polistinae genera have so far been recorded [28, 29, this study]: 27 *Polistes* (5 *Gyrostoma* and 22 *Polistella*); 24 Ropalidiini species (20 *Ropalidia*, 3 *Parapolybia*, and 1 *Polybioides*) (table 2).

Subfamily Vespinae

Vespinae includes four extant genera (*Dolichovespula*, *Provespa*, *Vespa* and *Vespula*); all are found in Asia and the nocturnal genus, *Provespa*, is endemic to eastern Asian tropics [4].

In Vietnam, 14 species belonging to three genera (*Provespa*, *Vespa* and *Vespula*) are recognized [23] (table 2).

In total, 76 species of social wasps have been recorded in Vietnam as show in table 2.

Table 2. Climatic distribution of the Vietnamese social wasps

Taxon	Climatic area			Zoogeographical Region
	N	M	S	
Subfamily Stenogastrinae				
1. <i>Cochlischnogaster daduganensis</i> Dong and Otsuka	-	+	-	O
2. <i>Cochlischnogaster spatulata</i> (Carpenter and Starr)	+	+	-	O
3. <i>Cochlischnogaster</i> sp.	-	+	-	O
4. <i>Eustenogaster nigra</i> Saito and Nguyen	+	+	-	O
5. <i>Eustenogaster scitula</i> (Bingham)	+	+	+	O
6. <i>Eustenogaster vietnamensis</i> Saito	-	+	-	O
7. <i>Liostenogaster filicis</i> Turillazzi	+	+	+	O
8. <i>Liostenogaster nitidipennis</i> (de Saussure)	-	-	+	O
9. <i>Parischnogaster mellyi</i> (de Saussure)	+	+	+	O
10. <i>Parischnogaster striatula</i> (du Buysson)	-	-	+	O
11. <i>Parischnogaster</i> sp.	+	-	-	O
Subfamily Polistinae				
12. <i>Polistes gigas</i> (Kirby)	+	+	+	O
13. <i>Polistes olivaceus</i> (DeGeer)	+	-	+	O
14. <i>Polistes rothneyi</i> Cameron	+	+	-	O, P
15. <i>Polistes tenebrius</i> Lepeletier	+	+	+	O
16. <i>Polistes</i> sp. A	-	-	+	O
17. <i>Polistes affinis</i> Gusenleitner	-	+	-	O
18. <i>Polistes brunet</i> Nguyen & Kojima	+	+	-	O
19. <i>Polistes clandestinus</i> Nguyen, Kojima & Saito	-	+	-	O
20. <i>Polistes curcipunctum</i> Nguyen, Kojima & Saito	-	+	-	O
21. <i>Polistes dawnae</i> Dover and Rao	-	+	-	O
22. <i>Polistes delhiensis</i> Das and Gupta	+	-	-	O
23. <i>Polistes horrendus</i> Gusenleitner	-	+	-	O
24. <i>Polistes japonicus</i> de Saussure	+	+	+	O, P
25. <i>Polistes gilvus</i> Nguyen, Kojima & Saito	-	+	-	O
26. <i>Polistes khasianus</i> Cameron	-	+	-	O
27. <i>Polistes lepcha</i> Cameron	-	+	-	O
28. <i>Polistes mandarinus</i> de Saussure	-	+	-	O, P
29. <i>Polistes nigerrimus</i> Gusenleitner	-	+	-	O
30. <i>Polistes nigrirarsis</i> Cameron	-	+	-	O
31. <i>Polistes nipponensis</i> Pérez	+	+	-	O, P
32. <i>Polistes paco</i> Nguyen, Kojima & Saito	-	+	-	O
33. <i>Polistes relicinicypeus</i> Nguyen, Kojima & Saito	-	+	-	O
34. <i>Polistes sagittarius</i> de Saussure	+	+	+	O
35. <i>Polistes stigma</i> (Fabricius)	-	-	+	O, A
36. <i>Polistes strigosus</i> Bequaert	+	+	-	O

37. <i>Polistes santoshae</i> Das and Gupta	+	-	-	O
38. <i>Polistes</i> sp. B	+	+	-	O
39. <i>Ropalidia artifex</i> (de Saussure)	+	+	+	O
40. <i>Ropalidia bicolorata</i> van der Vecht	+	+	+	O
41. <i>Ropalidia birmanica</i> van der Vecht	-	+	-	O
42. <i>Ropalidia cyathiformis</i> (Fabricius)	+	+	-	O
43. <i>Ropalidia fasciata</i> (Fabricius)	+	+	+	O
44. <i>Ropalidia flavopicta</i> (Smith)	+	-	+	O
45. <i>Ropalidia hongkongensis</i> (de Saussure)	+	+	-	O
46. <i>Ropalidia magnanima</i> van der Vecht	-	-	+	O
47. <i>Ropalidia malayana</i> Cameron	-	+	-	O
48. <i>Ropalidia marginata</i> (Lepeletier)	+	-	+	O, A
49. <i>Ropalidia mathematica</i> (Smith)	+	-	-	O
50. <i>Ropalidia modesta</i> (Smith)	-	-	+	O
51. <i>Ropalidia nigrita</i> Das and Gupta	-	+	-	O
52. <i>Ropalidia ornaticeps</i> (Cameron)	+	+	+	O
53. <i>Ropalidia rufocollaris</i> (Cameron)	+	-	-	O
54. <i>Ropalidia rufoplagiata</i> (Cameron)	+	-	-	O
55. <i>Ropalidia stigma</i> (Smith)	+	+	+	O
56. <i>Ropalidia taiwana</i> Sonan	-	+	-	O
57. <i>Ropalidia thailandia</i> Gusenleitner	-	+	-	O
58. <i>Ropalidia vietnama</i> Gusenleitner	-	-	+	O
59. <i>Parapolybia indica</i> (de Saussure)	+	+	-	O, P
60. <i>Parapolybia nodosa</i> van der Vecht	-	+	-	O
61. <i>Parapolybia varia</i> (Fabricius)	+	+	+	O, A, P
62. <i>Polybioides gracilis</i> van der Vecht	-	-	+	O
Subfamily Vespinae				
63. <i>Provespa barthelemyi</i> (du Buysson)	+	+	-	O
64. <i>Provespa nocturna</i> van der Vecht	+	-	+	O
65. <i>Vespa affinis</i> (Linnaeus)	+	+	+	O, A
66. <i>Vespa analis</i> Fabricius	+	+	+	O, P
67. <i>Vespa basalis</i> Smith	+	+	+	O
68. <i>Vespa bicolor</i> Fabricius	+	+	+	O
69. <i>Vespa ducalis</i> Smith	+	+	-	O, P
70. <i>Vespa mandarinia</i> Smith	+	+	-	O, P
71. <i>Vespa mocsaryana</i> du Buysson	+	+	+	O, P
72. <i>Vespa soror</i> du Buysson	+	+	+	O
73. <i>Vespa tropica</i> (Linnaeus)	+	+	+	O
74. <i>Vespa velutina</i> Lepeletier	+	+	+	O
75. <i>Vespula koreensis</i> (Radoszkowski)	+	+	-	O, P
76. <i>Vespula orbata</i> (du Buysson)	+	+	-	O

(+). Present; (-). Absent; O: Oriental; P: Palearctic; A: Australian.

Distribution pattern of Vietnamese social wasps

Zoogeographical distribution of Vietnamese social wasps

Of the 14 genera so far recorded from the Oriental region, 11 occur in Vietnam (table 1). Among these 11 genera, *Polistes* occurs in all the zoogeographical regions, three

(*Parapolybia*, *Vespa* and *Vespula*) also occur in the Palaearctic Region, three (*Ropalidia*, *Polybioides* and *Vespa*) in the Ethiopian Region, two (*Ropalidia* and *Vespa*) in the Australian Region, and *Vespula* in the Nearctic Region.

In the 11 genera occurring in Vietnam, 76 species (including four undescribed) have been recognized. Of the 72 described species, 25 are restricted to Southeast Asia (17 recorded only in the continent), eleven and four occur also respectively in the Palaearctic and Australian region, and *Parapolybia varia* is widely distributed in the Oriental, Palaearctic regions and New Guinea (table 2).

Distribution pattern of Vietnamese social wasps in term of climate and altitude

Fig. 1. Map showing climatic areas in Vietnam

Vietnam is often divided into the following three climatic zones: “North Climate” characterized by the monsoon climate with a cool or even cold season is the northern part of Vietnam to Ngang Pass in the south; “South

Climate”, monsoon climate without distinct seasonality in temperature, is the southern part of Vietnam from western part of Truong Son, extending southward to eastern part of Nam Bo and Mekong Delta; and “East Truong Son Climate” is the transitional zone between the North and South Climate [22]. On the other hand, the climatic zones in Vietnam in relation to distribution patterns of insects could be categorized in a different way. They could be the Northern area (N) and the Southern area (S), bordered by the Hai Van Mountains (fig. 1); the Northern area has a more or less defined winter, while in the Southern area it is warm or hot throughout the year. Another climatic zone could be a Mountainous area (M), namely areas above 500 m altitude in the northern part and 700 m altitude in the southern part. These areas have a cool or even cold season.

Of the 76 social wasp species in 11 genera so far known in Vietnam, the highest number of species (58 species in ten genera) has been recorded in the Mountainous area; 46 species in ten genera were recorded in the Northern area; and the Southern area had the lowest number of social wasps recorded, 33 species in nine genera.

A total of 21 species in seven genera (*Eustenogaster*, *Liostenogaster*, *Paraschnogaster*, *Polistes*, *Ropalidia*, *Parapolybia* and *Vespa*) have been recorded in all the three climatic areas. Six species belonging to three genera (*Paraschnogaster*, *Polistes* and *Ropalidia*) have been recorded only in the Northern area, 22 species belonging to four genera (*Cochlischnogaster*, *Eustenogaster*, *Polistes* and *Ropalidia*) only in the Mountainous area, and seven species belonging to three genera (*Eustenogaster*, *Polistes* and *Ropalidia*) only in the Southern area. The species known only in the Southern area (table 2) are those so far recorded in the southern parts of Southeast Asia or are widely distributed in equatorial or subequatorial areas.

In the Northern area, the highest number of species recorded is in the subfamily Polistinae (27 species in three genera), and 14 species of three genera in the Vespinae and six species in four genera in the Stenogastrinae.

Fig. 2. Map showing the known distribution records of *Eustenogaster* species

Fig. 3. Map showing the known distribution records of some *Polistes* species

Fig. 4. Map showing the known distribution records of three species of the *Ropalidia stigma* group

Fig. 5. Map showing the known distribution records of three *Vespa* species

Fig. 6. Map showing the known distribution records of two *Vespa* species

Fig. 7. Map showing the known distribution records of four *Ropalidia* species occurring in Vietnam

Fig. 8. Map showing the known distribution records of *Parischnogaster* species

Fig. 9. Map showing the known distribution records of three *Vespa* species with wide distribution ranges

In the Southern area, the Polistinae had the highest number of recorded species (18 species in four genera); 9 species in two genera (*Provespa* and *Vespa*) in the Vespinae, and 6 species in three genera in the Stenogastrinae.

Discussion

Although detailed species-level phylogenetic analyses and historical geography in Southeast Asia are necessary to have a robust scenario for the formation of the present-day social wasp fauna in Vietnam, the Vietnamese social wasp fauna may be considered to include the following three components with respect to their current distribution patterns and their relationships expected from morphological similarities. The first is comprised of northern and/or mountainous species, of which the center of divergence might be in the eastern slope of Himalaya including the northern part of Vietnam. The second includes species which may be the Sundaland origin or which may have originated from Sundaland species. The third consists of the species that are or of which closely related species are widely distributed in South Asia or even to Papuan region.

The species included in the first component would be *Cochlischnogaster* species, *Eustenogaster scitula* and *E. nigra* (fig. 2) in the Stenogastrinae, *Polistes* species with a basally strongly swollen second metasomal sternum such as *P. affinis*, *P. dawnae*, *P. lepcha* (fig. 3),

P. mandarinus, and *P. nigerrimus* (see Nguyen et al., 2011), *Ropalidia birmanica*, *R. taiwana*, *R. nigrita* (fig. 4), *R. rufocollaris*, and *Parapolybia* species in the Polistinae, *Vespa basalis*, *V. ducalis*, *V. soror* (fig. 5) and *Vespula* species (fig. 6) in the Vespinae.

The second component could include *Ropalidia malayana*, *R. modesta*, *R. vietnama* and *R. thailandia* (fig. 7) in the Polistinae.

The species included in the third component could be *Parischnogaster* species (fig. 8) in the Stenogastrinae, *Polistes* (*Gyrostoma*) species (except *Polistes gigas*) and *Polistes* (*Polistella*) *sagittarius* in the Polistinae, and *Vespa affinis*, *V. analis* and *V. velutina* (fig. 9) in the Vespinae.

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NGHIÊN CỨU VỀ CÁC LOÀI ONG BẮT MỒI (HYMENOPTERA: VESPIDAE) Ở VIỆT NAM VÀ PHÂN BỐ CỦA CHÚNG

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TÓM TẮT

Bài báo là kết quả tổng kết nghiên cứu về các loài ong bắt mồi thuộc họ Ong vàng (Vespidae) ở Việt Nam và đưa ra kiểu phân bố của chúng. Tổng số có 76 loài thuộc 11 giống được ghi nhận ở Việt Nam, bao gồm 11 loài thuộc bốn giống của phân họ Stenogastrinae, 51 loài thuộc bốn giống của phân họ Polistinae và 14 loài thuộc ba giống của phân họ Vespidae. Ghi nhận về phân bố của tất cả các loài ong bắt mồi ở ba điều kiện khí hậu (phía Bắc, phía Nam và khu vực miền núi) của Việt Nam được đưa ra, cho thấy số lượng các loài có xu hướng giảm từ Bắc xuống Nam và khu vực miền núi là nơi có số lượng loài được ghi nhận nhiều nhất.

Khu hệ các loài ong bắt mồi của Việt Nam rất phong phú và bao gồm ba yếu tố chính. Thứ nhất là yếu tố phía Bắc mà trong đó trung tâm của sự phát sinh có thể là ở sườn đông của dãy Himalaya bao gồm phía Bắc của Việt Nam. Một lượng lớn các loài ong bắt mồi của Việt Nam chịu ảnh hưởng của yếu tố này. Yếu tố thứ hai có thể là yếu tố Sundaland, bao gồm những loài có phân bố ở phía Nam của Việt Nam. Yếu tố thứ ba gồm những loài có phân bố rộng khắp từ Ấn Độ đến Ôxtrâyliá, và thậm chí ở cả khu vực Papuan. Việt Nam có khu hệ các loài ong bắt mồi phong phú không chỉ vì vị trí địa lý rất đặc thù của nó, mà còn vì các vùng của đất nước có các điều kiện khí hậu khác nhau, là nơi trú ẩn cho các loài ong thích nghi với các điều kiện môi trường sống khác nhau.

Từ khóa: Vespidae, điều kiện khí hậu, ong bắt mồi, khu hệ, phân bố, Việt Nam.

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