



Diversity of Bees (Hymenoptera: Apoidea) in and around Namdapha National Park, with an Updated Checklist from Arunachal Pradesh, India

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Abstract

The present study documents a preliminary checklist of bee diversity from Arunachal Pradesh, India based on literature study and the surveys undertaken during October, 2016 to July, 2017. Altogether, 49 species have been recorded belonging to 12 genera under 03 families viz. Apidae, Halictidae, and Megachilidae. Family Megachilidae, Genus *Ceratina* and 13 species of bees are recorded first time from Arunachal Pradesh.

Keywords: Apidae, Bee diversity, Eastern Himalaya, Halictidae, Megachilidae

Introduction

Bees are considered to be the most effective insect in pollination service (Free, 1993; Torchio, 1990; Thakur and Dongarwar, 2012; Raj *et al.*, 2012). A sharp decline in bee population globally is been observed due to lack of quality food resources, anthropogenic effects like habitat fragmentation, degradation, climate change and application of pesticides in agricultural areas (Potts *et al.*, 2010; Biesmeijer *et al.*, 2006; Kremen *et al.*, 2002).

Bees belong to superfamily Apoidea, subdivided under 07 families namely, Colletidae Lepeletier, Andrenidae Latreille, Halictidae Thomson, Melittidae Schenck, Megachilidae Latreille, Stenotritidae Cockerell (found exclusively in Australian region) and Apidae Linnaeus (Michener, 2000). Gupta (2003) presented an overview of the diversity of bees in India, enlisting 06 families including 60 genera with 633 species. Gupta and Yanega (2003) gave a taxonomic overview of the carpenter bees of the Indian region. Knowledge of bee diversity from Arunachal Pradesh is scanty. Studies reporting bees from Arunachal Pradesh are of Roy and Kundu (1985), Rathor *et al.* (2013) from Namdapha National Park, Kundu *et al.* (2006) and Singh *et al.* (2010).

The paper presents an updated checklist of superfamily Apoidea of Arunachal Pradesh. Family Megachilidae with five species is recorded for the first time from Arunachal Pradesh. Genus *Ceratina* Latreille is also recorded for the first time from Arunachal Pradesh. To understand the distribution knowledge of bees of eastern Himalaya it is impeccable that more intensive studies are required from the region.

Study Site

Intensive collections for bee specimens were made from Changlang district during October 2016 to July 2017. The collection was done in Namdapha Tiger Reserve, inside the protected area in Changlang district and Miao, Arunachal Pradesh (Figure 1). This region is characterized by moist deciduous forest to a montane forest which holds alpine meadows.

Material and Methods

Survey and collection of the specimens were done on the selected study sites in different flowering seasons, which yielded a total of 297 specimens. The collection of bees was made by sweeping insect net

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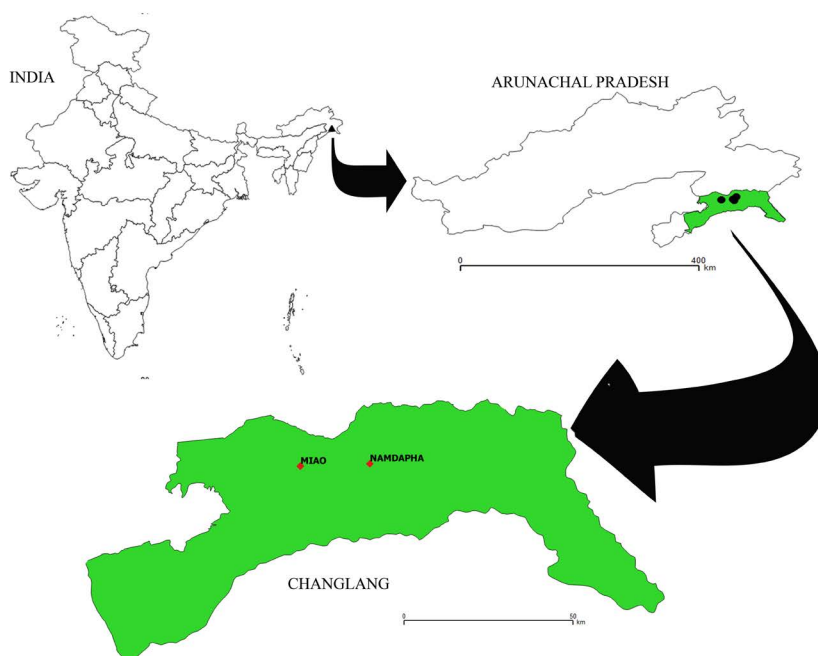


Figure 1. Sampling location of bees in Arunachal Pradesh.

across the flowers. Bees were immediately killed using ethyl acetate fumes. They were properly mounted. Photographs were taken by Nikon digital camera (D-7000) and a digital camera attached to a Leica stereo-zoom Microscope (Leica M205A). Distribution data

of different bee species are documented from online catalogue of bees of Indian region by Gupta (2010), online World Checklist of Hymenoptera by Ascher and Pickering (2017) and Pauly (2009). Classification used after Michener (2000).



Figure 2. Landscape in and around Namdapha National Park.

Results

These extensive surveys resulted in yielding an identification of bee species from Arunachal Pradesh

with a total of 49 species under 12 genera belonging to 03 families (Table 1). Family Megachilidae is recorded for the first time from Arunachal Pradesh.

Table 1. Bee species so far known from Arunachal Pradesh

Family	Subfamily	Tribe	Genus	Species	Distribution
APIDAE	APINAE	ANTHOPHORINI	<i>Amegilla</i> Friese, 1897	<i>calceifera</i> (Cockerell, 1911)	UTR, AR & ASM
			<i>Amegilla</i> Friese, 1897	<i>cingulifera</i> (Cockerell, 1910)	UTR & AR
			<i>Amegilla</i> Friese, 1897	<i>himalajensis</i> (Radoszkowski, 1882)	HP, SKM & AR
			<i>Amegilla</i> Friese, 1897	<i>zonata</i> (Linnaeus, 1758)	Throughout India
		APINI	<i>Apis</i> Linnaeus, 1758	<i>cerana</i> Fabricius, 1793	Throughout India
			<i>Apis</i> Linnaeus, 1758	<i>dorsata</i> Fabricius, 1793	Throughout India
			<i>Apis</i> Linnaeus, 1758	<i>florea</i> Fabricius, 1787	Throughout India (except high altitudes in Himalaya)
			<i>Apis</i> Linnaeus, 1758	<i>laboriosa</i> Smith, 1871	J&K, HP, UTR, SKM, WB, AR & ASM
		BOMBINI	<i>Bombus</i> Latreille, 1802	<i>breviceps</i> Smith, 1852	HP, UTR SKM, WB, ME & AR
			<i>Bombus</i> Latreille, 1802	<i>eximius</i> Smith, 1852	SKM, WB, ME & AR
			<i>Bombus</i> Latreille, 1802	<i>festivus</i> Smith, 1861	HP, UTR, SKM, WB & AR
			<i>Bombus</i> Latreille, 1802	<i>flavescens</i> Smith, 1852	UTR, WB, SKM & AR
			<i>Bombus</i> Latreille, 1802	<i>funerarius</i> Smith, 1852	UTR, WB, SKM & AR
			<i>Bombus</i> Latreille, 1802	<i>genalis</i> Friese, 1918	SKM, ME, WB & AR
			<i>Bombus</i> Latreille, 1802	<i>haemorrhoidalis</i> Smith, 1852	J&K, HP, UTR, SKM, ME & AR
			<i>Bombus</i> Latreille, 1802	<i>hypnorum</i> (Linnaeus, 1758)	J&K, HP, UTR, SKM & AR
			<i>Bombus</i> Latreille, 1802	<i>kashmirensis</i> Friese, 1909	J&K, HP, UTR, SKM & AR
			<i>Bombus</i> Latreille, 1802	<i>keriensis</i> Morawitz, 1887	J&K, HP, UTR, SKM & AR

		<i>Bombus</i> Latreille, 1802	<i>ladakhensis</i> Richard, 1928	J&K, HP, UTR, SKM & AR
		<i>Bombus</i> Latreille, 1802	<i>lemniscatus</i> Skorikov, 1912	J&K, HP, UTR, SKM & AR
		<i>Bombus</i> Latreille, 1802	<i>lepidus</i> Skorikov, 1912	J&K, HP, UTR, SKM & AR
		<i>Bombus</i> Latreille, 1802	<i>lucorum</i> (Linnaeus, 1761)	J&K, HP, UTR, SKM & AR
		<i>Bombus</i> Latreille, 1802	<i>luteipes</i> Richards, 1934	SKM, WB & AR
		<i>Bombus</i> Latreille, 1802	<i>nobilis</i> Friese, 1905	HP, UTR, SKM & AR
		<i>Bombus</i> Latreille, 1802	<i>rotundiceps</i> Friese, 1916	HP, UTR, WB, SKM, ME & AR
		<i>Bombus</i> Latreille, 1802	<i>rufofasciatus</i> Smith, 1852	J&K, HP, UTR, SKM & AR
		<i>Bombus</i> Latreille, 1802	<i>trifasciatus</i> Smith, 1852	J&K, HP, UTR, WB, SKM, AR, MAN & ME
		<i>Bombus</i> Latreille, 1802	<i>turneri</i> (Richards, 1929)	SKM & AR
		<i>Bombus</i> Latreille, 1802	<i>haemorrhoidalis</i> Smith, 1852	J&K, HP, UTR, WB, SKM, AR, ME
	CERATININI	<i>Ceratina</i> Latreille, 1802	<i>binghami</i> Cockerell, 1908	WB, MH, N. W. India. & AR
		<i>Ceratina</i> Latreille, 1802	<i>propinqua</i> Cameron, 1897	Northern India & AR
	MELIPONINI	<i>Lepidotrigona</i> Schwartz, 1939	<i>arcifera</i> (Cockerell, 1929)	WB, NL, SKM & AR
		<i>Tetragonula</i> , Moure, 1961	<i>laeviceps</i> (Smith, 1857)	AR
		<i>Tetragonula</i> , Moure, 1961	<i>gressitti</i> (Sakagami, 1978)	AR
	XYLOCOPINI	<i>Xylocopa</i> Latreille, 1802	<i>fenestrata</i> (Fabricius, 1798)	AR, HP, UP, OD, WB, J&K, ASM, UTR, MH, TN, JHK, RJN, GOA & GUJ
		<i>Xylocopa</i> Latreille, 1802	<i>dejeanii</i> Lepeletier, 1841	UTR, UP, SKM & AR
		<i>Xylocopa</i> Latreille, 1802	<i>latipes</i> (Drury, 1773)	WB, ME, SKM, ASM & AR
		<i>Xylocopa</i> Latreille, 1802	<i>pubescens</i> (Spinola, 1838)	AR, GOA, KAR, MP, MH, PUN & ANP
	MELECTINI	<i>Thyreus</i> Panzer, 1806	<i>smithii</i> (Dalla Torre, 1896)	AR

HALICTIDAE	NOMIINAE		<i>Nomia</i> Latreille, 1804	<i>crassipes</i> (Fabricius, 1798)	AR, DL, MH, TN & KR
			<i>Nomia</i> Latreille, 1804	<i>incerta</i> Gribodo, 1894	AR & ME
			<i>Nomia</i> Latreille, 1804	<i>nitidata</i> Strand, 1913	SKM & AR
			<i>Nomia</i> Latreille, 1804	<i>thoracica</i> Smith, 1875	WB, AR, TN & KR
			<i>Lipotriches</i> Gerstaecker, 1858	<i>fulvinerva</i> (Cameron, 1907)	GUJ
MEGACHILIDAE	MEGACHILINAE	MEGACHILINI	<i>Megachile</i> Latreille, 1802	<i>binghami</i> Meade-Waldo, 1912	AR, UTR, WB, MH & KAR
			<i>Megachile</i> Latreille, 1802	<i>faceta</i> Bingham, 1897	ME & AR
			<i>Megachile</i> Latreille, 1802	<i>hera</i> Bingham, 1897	PUN, GUJ & AR
			<i>Megachile</i> Latreille, 1802	<i>stulta</i> Bingham, 1897	SKM, KAR & AR
			<i>Megachile</i> Latreille, 1802	<i>umbripennis</i> Smith, 1853	PUN, SKM, TN, MAH & AR

Abbreviations: AR- Arunachal Pradesh, HP- Himachal Pradesh, WB- West Bengal, ME- Meghalaya, UP- Uttar Pradesh, J&K- Jammu and Kashmir, SKM- Sikkim, OD- Odisha, RJN- Rajasthan, MAN- Manipur, ASM- Assam, MH- Maharashtra, TN- Tamil Nadu, UTR- Uttarakhand, JHK- Jharkhand, GOA-Goa, GUJ- Gujarat, KAR, Karnataka, PUN- Punjab, KR- Kerala, Delhi- DL, NL- Nagaland, MP- Madhya Pradesh. AP- Andhra Pradesh.

Systematic Account and identification key to the Bees known from Namdapha National Park

Superfamily APOIDEA

Family HALICTIDAE

Genus *Nomia* Latreille, 1804

Key to the species of *Nomia*

1. Tergites with yellow, blue, or green tegumentary apical stripes..... 2
 - Tergites without tegumentary stripes, sometimes with pubescence band present 3
2. Metanotum with double projections; tegumentary stripes blue *N. incerta* Gribodo, 1894
 - Metanotum without double projections; tegumentary stripes yellow *N. crassipes* (Fabricius, 1798)

3. Mandibles with a tooth on inner edge.....
..... *N. thoracica* Strand, 1913
- Mandibles without a tooth on inner edge.....
..... *N. nitidata* Strand, 1913

1. *Nomia crassipes* (Fabricius, 1798)* *Eucera crassipes* Fabricius 1798: 278.

Material examined: Miao (27.4901° N, 96.20713° E), 03.vii.2017, 4 females, Coll. J. Saini.

Distribution: India: Arunachal Pradesh Delhi, Maharashtra, Tamil Nadu, and Kerala. *Elsewhere:* Sri Lanka, Bhutan, Thailand, China, Taiwan.

2. *Nomia incerta* Gribodo, 1894* *Nomia incerta* Gribodo, 1894: 129.

Material examined: Deban (27.49715° N, 96.39111° E), 25-26.vi.2017, 2 Males, Coll. J. Saini.

Distribution: India: Arunachal Pradesh and Meghalaya. *Elsewhere:* Java, China, Taiwan, Malaysia.

3. *Nomia nitidata* Strand, 1913

Nomia megasoma var *nitidata* Strand, 1913: 105.

Material examined: Deban (27.49715° N, 96.39111° E), 26.vi.2017, 3 Males, 1 Female, Coll. J. Saini.

Distribution: India: Arunachal Pradesh and Sikkim. *Elsewhere:* China, Singapore.

4. *Nomia thoracica* Smith, 1875

Nomia thoracica Smith 1875: 45.

Material Examined: Deban (27.49715° N, 96.39111°E), 24.vi.2017, 2 Males, Coll. J. Saini.

Distribution: India: Arunachal Pradesh, Kerala, West Bengal and Tamil Nadu. *Elsewhere:* Java, China, Philippines.

Family APIDAE

Genus *Amegilla* Friese, 1897

Key to the species of *Amegilla*

1. Hair of metasomal terga metallic blue..... 2
 - Hair of metasomal terga not metallic blue, basal two segments with fulvous pubescence
..... *A. himalajensis* (Radoszkowski, 1882)
2. Pubescence on thorax above bluish grey.....
..... *A. cingulifera* (Cockerell, 1910)
 - Pubescence on thorax dull yellow brown
..... *A. calceifera* (Cockerell, 1911)

5. *Amegilla calceifera* (Cockerell, 1911)*

Anthophora calceifera Cockerell, 1911: 491.

Material examined: 19 mile (27.47775° N, 96.4012° E), 29.vi.2017, 2 Males, 03.vii.2017, 6 Females, Coll. J. Saini.

Distribution: India: Arunachal Pradesh, Assam and Uttarakhand. *Elsewhere:* China, Malaysia, Java, North Korea.

6. *Amegilla cingulifera* (Cockerell, 1910)*

Anthophora cingulifera Cockerell, 1910: 410

Material Examined: Deban (27.49715° N, 96.39111° E), 24.vi.2017, 2 Males, 26.06.2017, 5 Females, Coll. J. Saini.

Distribution: India: Arunachal Pradesh and Uttarakhand. *Elsewhere:* Sri Lanka.

7. *Amegilla himalajensis* (Radoszkowski, 1882)*

Anthophora himalajensis Radoszkowski, 1882: 74

Material examined: 19 mile (27.47775° N, 96.4012° E), 26.vi.2017, 1 Male, 24.vi.2017, 3 Females, Coll. J. Saini.

Distribution: India: Arunachal Pradesh, Himachal Pradesh and Sikkim. *Elsewhere:* Nepal, Myanmar.

Genus *Apis* Linnaeus, 1758

8. *Apis cerana* Fabricius, 1793

Apis cerana Fabricius, 1793: 327.

Material examined: 19 mile (27.47775° N, 96.4012° E), 24.vi.2017, Deban (27.49715° N 96.39111° E), 29.vi.2017, 3 Females, Coll. J. Saini.

Distribution: India: Throughout India. *Elsewhere:* China, Indonesia, Sri Lanka, Pakistan, Nepal.

9. *Apis dorsata* Fabricius, 1793

Apis dorsata Fabricius, 1793: 328.

Material examined: Deban (27.49715°, 96.39111° E), 26.vi.2017, 4 Females, Coll. J. Saini.

Distribution: Throughout India and in the east up to Malaysia.

10. *Apis florea* Fabricius, 1787

Apis florea Fabricius, 1787: 305.

Material examined: Deban (27.49715° N, 96.39111° E), 26.vi.2017, 1 Female, Coll. J. Saini.

Distribution: Throughout southern Asia (except high altitudes in Himalaya, Afghanistan, northern Pakistan, and Bhutan)

Genus *Ceratina* Latreille, 1802

11. *Ceratina binghami* Cockerell, 1908*
Ceratina binghami Cockerell, 1908: 340.

Material examined: Anamika fall, (27.49338° N, 96.37806° E), 14.iii.2017, 1 Female, Coll. J. Saini.

Distribution: India: Arunachal Pradesh, Uttarakhand, West Bengal, Maharashtra and Karnataka. *Elsewhere:* Sri Lanka, Myanmar.

12. *Ceratina propinqua* Cameron, 1897*
Ceratina propinqua Cameron, 1897: 137

Material examined: Anamika fall (27.49338° N 96.37806° E), 14.iii.2017, 3 Females, Coll. J. Saini.

Distribution: India: Arunachal Pradesh and entire Northern India.

Genus *Lepidotrigona* Schwarz 1939

13. *Lepidotrigona arcifera* (Cockerell, 1929)
Trigona arcifera Cockerell 1929: 591-592

Material Examined: Anamika fall (27.49338° N, 96.37806° E), 13.iii.2017, 15 Females. Coll. J. Saini.

Distribution: India: West Bengal, Nagaland and Sikkim.

Genus *Xylocopa* Latreille, 1802

Keys to the species of *Xylocopa*

- 1 Thorax with yellow pubescence
..... *X. pubescens* Spinola, 1838
- Thorax without yellow or with white pubescence 2
- 2 Third abdominal segment with a minute spiracular lateral impression *X. fenestrata* (Fabricius, 1798)
- Spiracular impression absent, pronotum with white pubescence *X. dejeanii* Lepeletier, 1841

14. *Xylocopa fenestrata* (Fabricius, 1798)*
Apis fenestrata, Fabricius, 1798: 273.

Material examined: Miao (27.4901° N, 96.20713° E), 3.vii.2017, 2 Females; Deban (27.49715° N, 96.39111° E), 3.vii. 2017, 4 Males, Coll. J. Saini.

Distribution: India: Assam, Jammu & Kashmir, Delhi, Rajasthan, Uttarakhand, Uttar Pradesh, Odisha, Delhi, West Bengal, Maharashtra, Karnataka, Jharkhand, and Tamil Nadu. *Elsewhere:* Nepal, Myanmar, Sri Lanka, Pakistan, Iran.

15. *Xylocopa dejeanii* Lepeletier, 1841
Xylocopa dejeanii Lepeletier, 1841: 209.

Material examined: 19 mile (27.47775° N, 96.4012°E), 29.vi.2017, 1 Female; Miao (27.4901° N, 96.20713° E), 3.vii.2017, 1 Female, Coll. J. Saini.

Distribution: India: Himachal Pradesh, Uttar Pradesh, Sikkim, Uttarakhand, Assam and West Bengal. *Elsewhere:* Cambodia, Malaysia, Sulawesi, Taiwan, Vietnam.

16. *Xylocopa pubescens* Spinola, 1838
Xylocopa pubescens Spinola, 1838: 518–519.

Material examined: Miao (27.4901° N, 96.20713° E), 3.vii.2017, 1 Female, Coll. J. Saini.

Distribution: India: Andhra Pradesh, Arunachal Pradesh, Goa, Karnataka, Madhya Pradesh, Maharashtra, and Punjab. *Elsewhere:* Africa, United Arab Emirates, Iran, Pakistan and Afghanistan.

Family MEGACHILIDAE*
Subfamily MEGACHILINAE
Tribe **Megachilini**
Genus ***Megachile*** Latreille, 1802

Key to the species of *Megachile*

- 1. Abdomen with fulvous or ferruginous-red pubescence above 2
- Abdomen with white pubescence above or on lateral side 4
- 2. Only first terga with red ferruginous-red pubescence, wings dark fuscous with rich purple effulgence, base hyaline..... *M. umbripennis* Smith, 1853
- 1-6 tergites with fulvous or ferruginous-red pubescence 3
- 3. Body small (length 8-9 mm), scutum, scutellum joint with thin white hairs *M. stulta* Bingham, 1897
- Body large, scutum (length 12-14 mm), scutellum joint without white hairs.... *M. binghami* Meade-Waldo, 1912

4. Head and thorax with fulvous pubescence, thorax puncture run into longitudinal striae
..... *M. faceta* Bingham, 1897

– Head and thorax without fulvous pubescence, thorax minutely punctured *M. hera* Bingham, 1897

17. *Megachile binghami* Meade-Waldo, 1912*

Megachile binghami Meade-Waldo, 1912: 465.

Material examined: Miao (27.4901° N, 96.20713° E), 3.vii.2017, 2 Females. Coll. J. Saini.

Distribution: India: Sikkim. *Elsewhere:* Myanmar.

18. *Megachile faceta* Bingham, 1897*

Megachile faceta Bingham, 1897: 486.

Material examined: Miao (27.4901° N, 96.20713° E), 3.Vii.2017, 7 Females. Coll. J. Saini.

Distribution: India: Meghalaya. *Elsewhere:* Myanmar.

19. *Megachile hera* Bingham, 1897*

Megachile hera Bingham, 1897: 489.

Material examined: Deban (27.49715° N, 96.39111 E°), 3.vii.2017, 1 Female, Coll. J. Saini.

Distribution: India: Punjab, Gujarat. *Elsewhere:* Sri Lanka, Thailand, Myanmar.

20. *Megachile stulta* Bingham, 1897*

Megachile stulta Bingham, 1897: 476.

Material examined: Miao (27.4901° N, 96.20713° E), 3.vii.2017, 1 Female. Coll. J. Saini.

Distribution: India: Sikkim, Karnataka. *Elsewhere:* Malaysia, Singapore, Indonesia.

21. *Megachile umbripennis* Smith, 1853*

Megachile umbripennis Smith, 1853: 175.

Material examined: Miao (27.4901° N, 96.20713° E), 3.vii.2017, 4 Females, Coll. J. Saini.

Distribution: India: Chandigarh, Sikkim, Tamil Nadu, Maharashtra. *Elsewhere:* Malaysia, China, Myanmar.

*** New records from Arunachal Pradesh.**

Remarks: Roy and Kundu (1985) reported 10 bee species from Namdapha National Park in which 4 species are not included in our collection viz., *Lipotriches fulvinerva* (Cameron, 1907), *Thyreus smithii* (Dalla Torre, 1896), *Anthophora zonata* (Linnaeus), and *Bombus orientalis* Smith.

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Plate 1



Nomia crassipes (Fabricius, 1798)



Nomia incerta Gribodo, 1894



Nomia nitidata Strand, 1913



Nomia thoracica Smith, 1875



Amegilla calceifera (Cockerell, 1911)



Amegilla cingulifera (Cockerell, 1910)

Plate 2



Amegilla himalajensis (Radoszkowski, 1882)



Apis cerana Fabricius, 1793



Apis dorsata Fabricius, 1793



Apis florea Fabricius, 1787



Ceratina binghami Cockerell, 1908



Ceratina propinqua Cameron, 1897

Plate 3



Lepidotrigona arcifera (Cockerell, 1929)



Xylocopa fenestrata (Fabricius, 1798)



Xylocopa dejeanii Lepeletier, 1841



Xylocopa pubescens Spinola, 1838



Megachile binghami Meade-Waldo, 1912



Megachile faceta Bingham, 1897

Plate 4



Megachile hera Bingham, 1897



Megachile stulta Bingham, 1897



Megachile umbripennis Smith, 1853