

# A hodgepodge of Hymenoptera: checklists of northern North America, ichneumonid natural history and a review of aquatic wasps

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Canadian National Collection of Insects, Arachnids and Nematodes



Agriculture and  
Agri-Food Canada

Agriculture et  
Agroalimentaire Canada

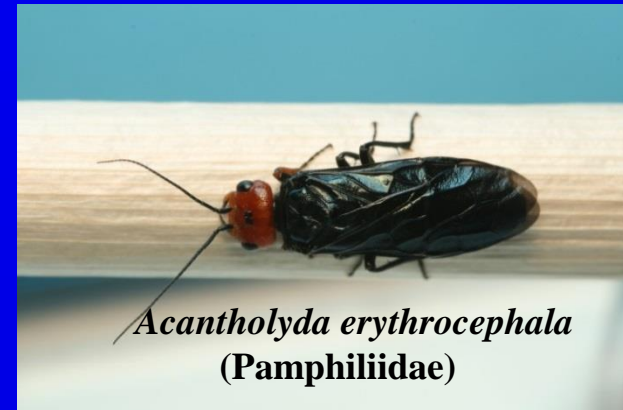


# 1. Checklists of the Hymenoptera of Canada, Alaska and Greenland



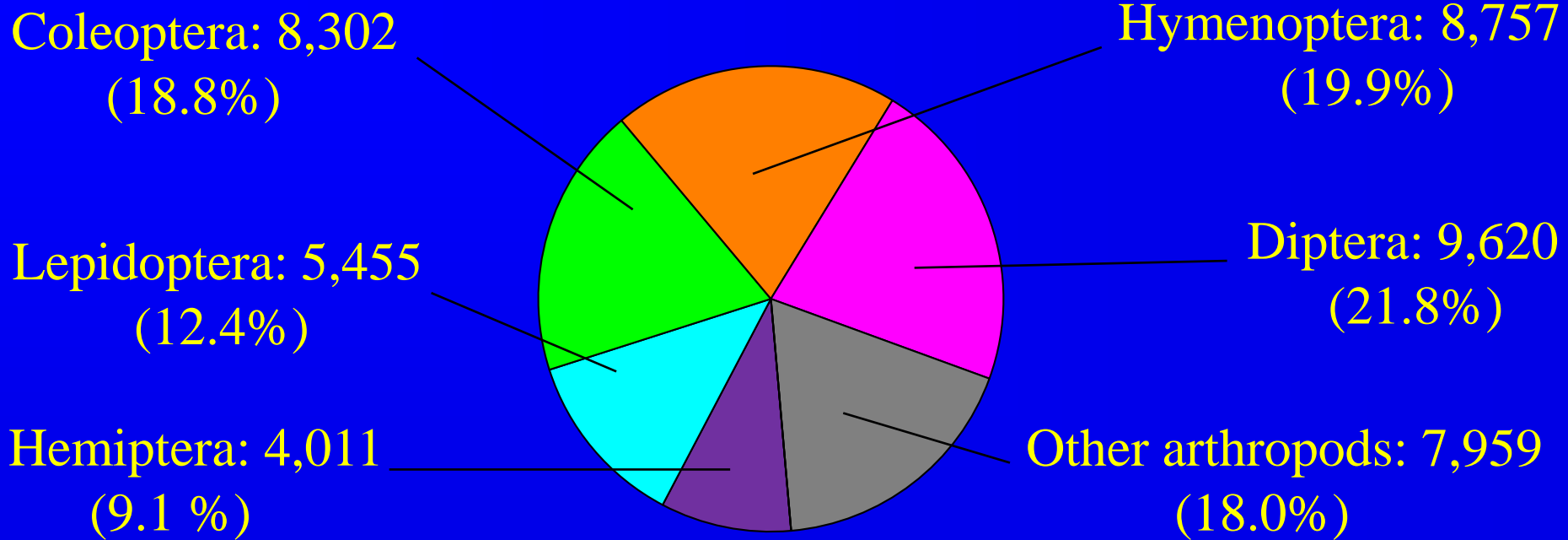
# Publications

- 1) Bennett, A.M.R., Sheffield, C.S. and deWaard, J.R. (2019) Hymenoptera of Canada, in Langor, D.W and Sheffield, C.S. (eds). The Biota of Canada – A Biodiversity Assessment. Part 1: The Terrestrial Arthropods. *ZooKeys* 819: 311-360.
- 2) Bennett, A.M.R. (in press) Checklists of the Hymenoptera of Canada, Alaska and Greenland – Introduction. *Journal of Hymenoptera Research* (Pensoft) (introduction to series of 11 papers)



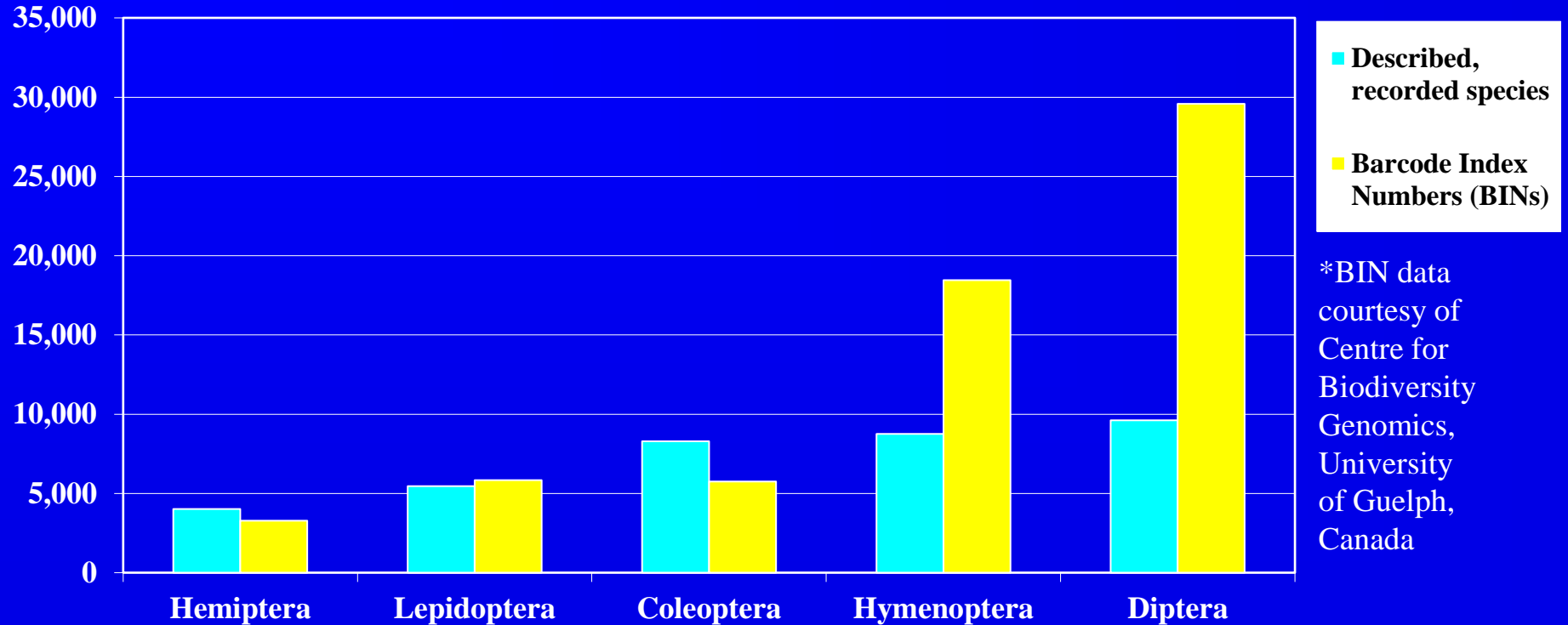
# Biota of Canada (Langor & Sheffield, 2019)

Described species of terrestrial arthropods recorded



Total described species of terrestrial arthropods: 44,104  
compared to 32,850 in 1979 (34.3% increase)

# Described, recorded species vs Barcode Index Numbers (BINs\*) in Canada



\*BIN data courtesy of Centre for Biodiversity Genomics, University of Guelph, Canada

# Comparisons in time

Danks (1979) *Canada and its Insect Fauna*

- Tabulation of described species of all terrestrial arthropods in Canada by class, order and family



*Chrysis* sp.  
(Chrysididae)



*Ammophila* sp.  
(Sphecidae)



*Pelecinus polyturator*  
(Pelecinidae)

# Comparisons in time

Rate of discovery of new Canadian records of described species

<b>Insect order</b>	<b>Danks (1979) Canada survey</b>	<b>Most recent survey/ checklist</b>	<b>Described, recorded species</b>	<b>Increase of new Canada records/ year</b>
<b>Hemiptera</b>	<b>3079</b>			
<b>Lepidoptera</b>	<b>4110</b>			
<b>Hymenoptera</b>	<b>6038</b>			
<b>Coleoptera</b>	<b>6748</b>			
<b>Diptera</b>	<b>7058</b>			

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<b>Hemiptera</b>	<b>3079</b>	<b>Maw et al. (2019)</b>	<b>4011</b>	
<b>Lepidoptera</b>	<b>4110</b>	<b>Pohl et al. (2019)</b>	<b>5455</b>	
<b>Hymenoptera</b>	<b>6038</b>	<b>Bennett (2021)</b>	<b>8933</b>	
<b>Coleoptera</b>	<b>6748</b>	<b>Brunke et al. (2019)</b>	<b>8302</b>	
<b>Diptera</b>	<b>7058</b>	<b>Savage et al. (2019)</b>	<b>9620</b>	

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<b>Hemiptera</b>	<b>3079</b>	<b>Maw et al. (2019)</b>	<b>4011</b>	<b>23.9</b>
<b>Lepidoptera</b>	<b>4110</b>	<b>Pohl et al. (2019)</b>	<b>5455</b>	<b>34.5</b>
<b>Hymenoptera</b>	<b>6038</b>	<b>Bennett (2021)</b>	<b>8933</b>	<b>70.6</b>
<b>Coleoptera</b>	<b>6748</b>	<b>Brunke et al. (2019)</b>	<b>8302</b>	<b>39.8</b>
<b>Diptera</b>	<b>7058</b>	<b>Savage et al. (2019)</b>	<b>9620</b>	<b>65.6</b>



*Alaptus* sp. (Mymaridae)  
Body length: 270  $\mu$ m

# Checklists of Canada Alaska and Greenland (up to Dec. 31, 2020)

- 9250 described species
- 8933 described species in Canada
- 84 (of about 100 extant families of Hymenoptera)



*Megarhyssa atrata*  
(Ichneumonidae)  
Body length: 4 cm  
(up to 19 cm including  
ovipositor)

# Checklist Format

- Following format for previous checklists of insects of Canada and Alaska
- Coleoptera (Bousquet, 1991; Bousquet *et al.*, 2013)
- Hemiptera (Maw *et al.*, 2000)
- Lepidoptera (Pohl *et al.*, 2018)



# Checklist format

from: Goulet & Bennett (in press) Checklist of the sawflies of Canada, Alaska and Greenland. *Journal of Hymenoptera Research*

AK YT NT NU BC AB SK MB ON QC NB PE NS LB NF GL REFERENCES/ DEPOSITORY

## Superfamily Anaxyeloidea

### Family Anaxyelidae

Genus *Syntexis* Rohwer, 1915

*S. libocedrii* Rohwer, 1915

– – – – BC – – – – – – – – – –

### Legend

Regular font: published, specimen examined

**Boldface:** new record, specimen examined

*Italics:* literature record (not examined)

## Superfamily Cephoidea

### Family Cephidae Nearctic revision: Ries (1937)

Genus *Caenocephus* Konow, 1896

*C. aldrichi* Bradley, 1905

– – – – BC – – – – – – – – – –

Genus *Calameuta* Konow, 1896 Key to Nearctic species: Smith & Schiff (2005)

*C. clavata* (Norton, 1869)

– – – – **BC** – – – – – – – – – –

Genus *Cephus* Latreille, 1802

*C. cinctus* Norton, 1872

– – – – BC AB SK MB ON **QC** – – – – – –

*C. pygmeus* (Linnaeus, 1767)

– – – – – – – – ON – – – *NS* – – – Goulet (1987)

Genus *Janus* Stephens, 1835 Key to Nearctic species: Smith & Solomon (1989)

*J. abbreviatus* (Say, 1824)

– – – – – AB SK MB ON QC – – NS – – – Emond & Wong (1987)

*J. bimaculatus* (Norton, 1869)

– – – – – – – – ON QC – – *NS* – – – BIOUG

*J. integer* (Norton, 1861)

– – – – **BC AB SK MB ON QC** – – – – *NF* – Smith (1979a)

# Comparisons in space

- Within Canada, Alaska and Greenland
- Versus rest of North America

*Trigoneura* sp. (Chalcididae)

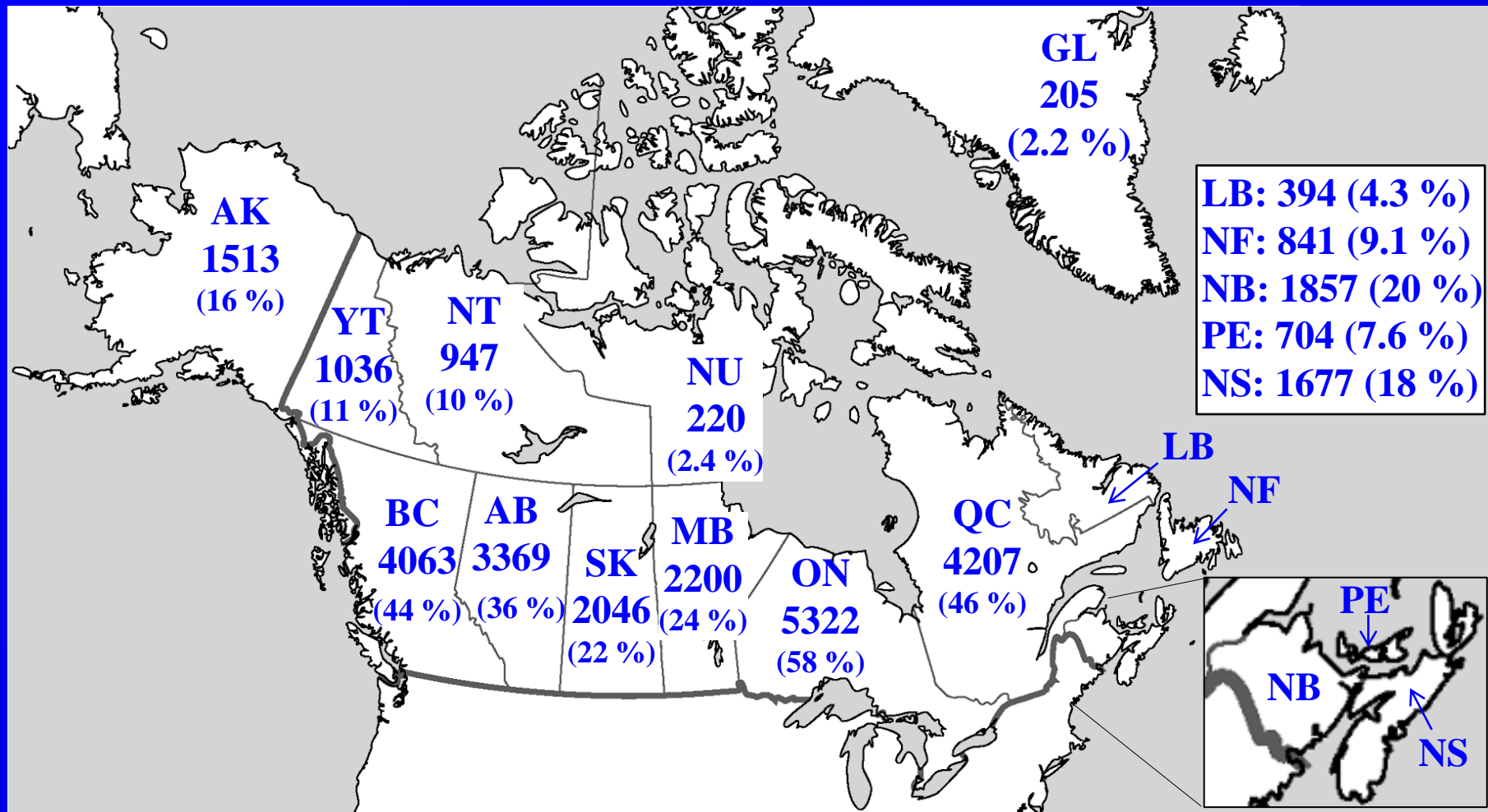


*Bombus impatiens* (Apidae)



*Schletterius cinctipes*  
(Stephanidae)





# Comparisons in space

- What percentage of Nearctic species are in Canada + AK + GL?

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<b>Taxon</b>	<b>CANADA + AK + GL (2021)</b>	<b>Nearctic (most recent counts)</b>	<b>Author of most recent Nearctic survey</b>	<b>Ratio of species #s: Canada+AK + GL/ Nearctic</b>
<b>Braconidae</b>	1237			
<b>Chalcidoidea</b>	1246			
<b>Ichneumonidae</b>	3201			

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<b>Braconidae</b>	1237	2589	Yu et al. (2016) Taxapad	
<b>Chalcidoidea</b>	1246	3567	Noyes (2019) Universal Chalcidoidea Database	
<b>Ichneumonidae</b>	3201	5058	Yu et al. (2016) Taxapad	

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<b>Braconidae</b>	1237	2589	Yu et al. (2016) Taxapad	0.48
<b>Chalcidoidea</b>	1246	3567	Noyes (2019) Universal Chalcidoidea Database	0.35
<b>Ichneumonidae</b>	3201	5058	Yu et al. (2016) Taxapad	0.63

# Comparisons in taxa

- What Hymenoptera taxa have the most species recorded in Canada, Alaska and Greenland?



*Spilopteron formosum*  
(Ichneumonidae)



*Perilampus hyalinus*  
(Perilampidae)



*Bracon cephi*  
(Braconidae)

# Total number of described, extant species: 9250

Braconidae: 1237 (13.4%)

Vespoidea *s.l.*: 518 (5.6%)

Sphecid wasps: 529 (5.7%)

Bees: 909 (9.8%)

Chalcidoidea: 1246 (13.5%)

Sawflies: 758 (8.2%)

Ichneumonidae: 3201  
(34.6%)

Ceraphronoidea: 52

Chrysoidea: 183

Cynipoidea: 149

Diaprioidea: 189

Evanoidea: 30

Mymarommatoidea: 2

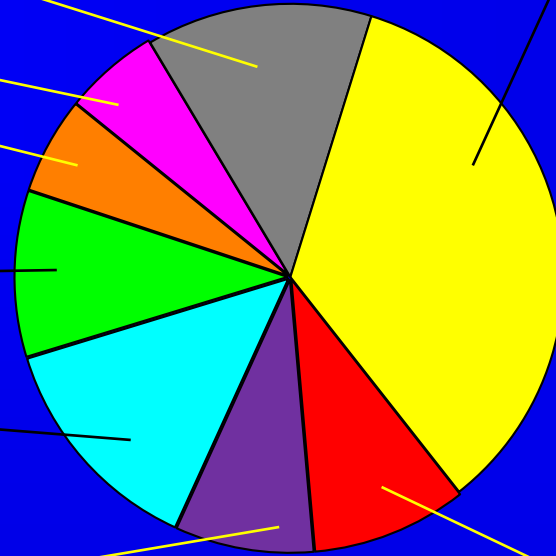
Platygastroidea: 168

Proctotrupeoidea: 73

Stephanoidea: 2

Trigonalyoidea: 4

Small superfamilies:  
852 (9.2%)



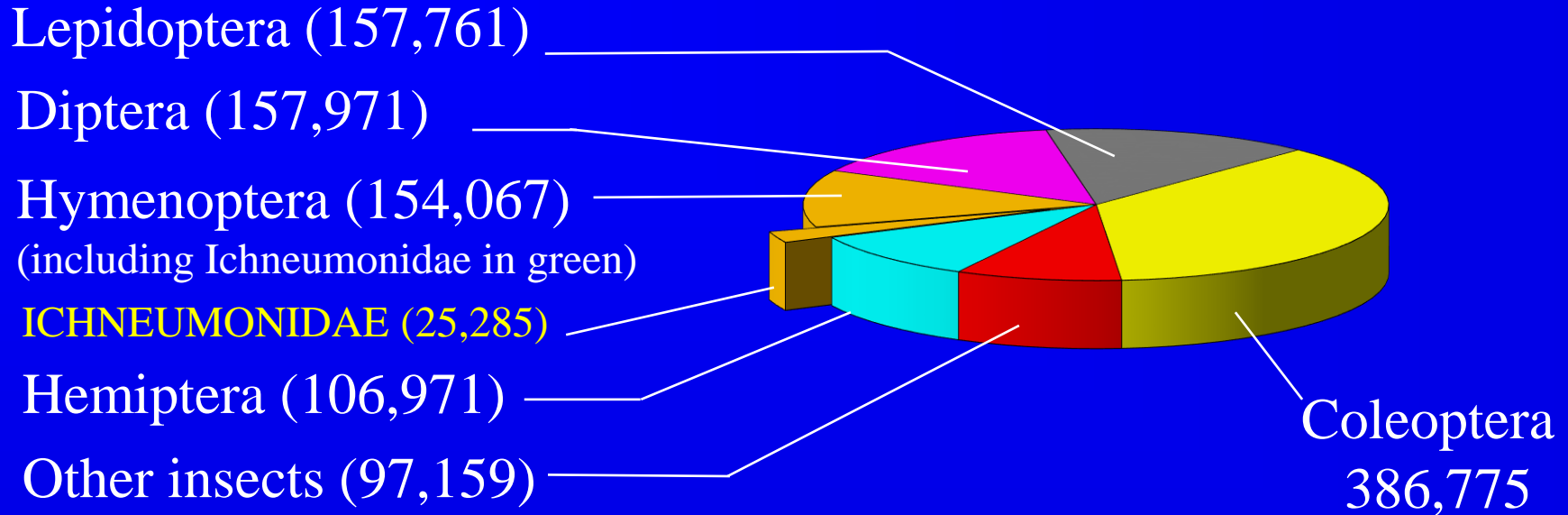
## 2. Diversity and natural history of ichneumonid wasps (Hymenoptera: Ichneumonidae)



# Major Insect Taxa

Data from Foottit and Adler (2017) *Insect Biodiversity: Science and Society* (2nd. ed.)

Yu et al. (2016): Taxapad (Ichneumonidea database)



Total number of described species of insects = 1,060,704

# Ichneumonidae

- 25,285 described species  
(estimated 100,000+ total species)
- 1,900,000 described organisms (Chapman, 2009)  
ichneumonids = 1.6% of total or 1 out of every 75 species!
- Most speciose family in Hymenoptera
- Most speciose family in North America: 5058 described spp.
  - Staphylinidae (4059 spp.)
  - Noctuidae (2990 spp.)
  - Cicadellidae (3195 spp.)

# Ichneumonoidea

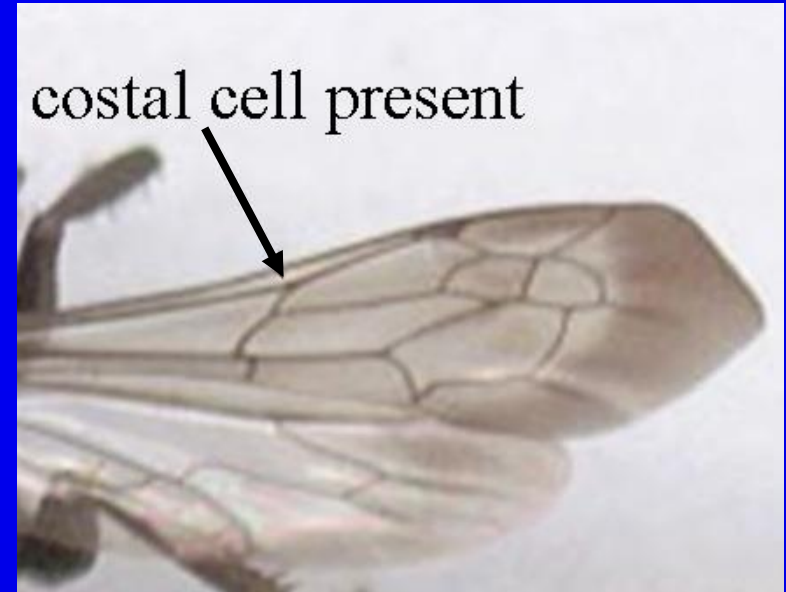
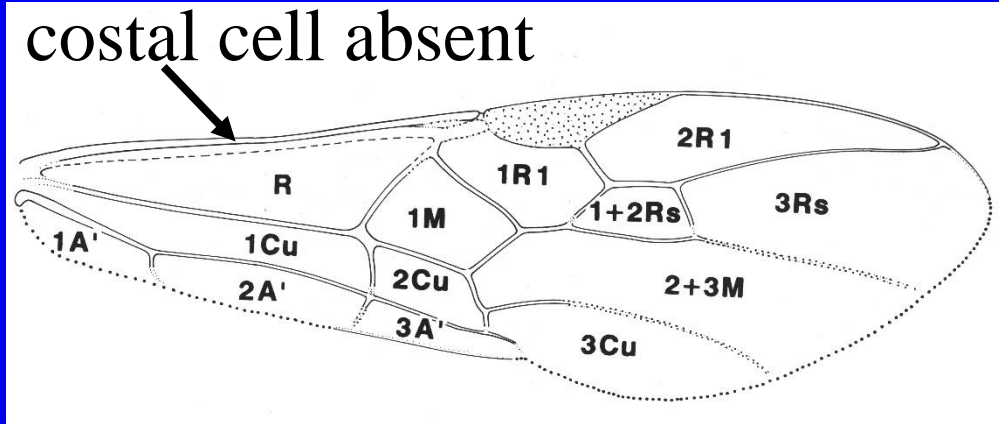
## (Ichneumonidae and Braconidae)

- Antenna with (many) more than 13 segments
- Forewing lacking costal cell
- Abdominal sternites small/ weakly sclerotized

# Ichneumonoidea

(Ichneumonidae and Braconidae)

- Forewing lacking costal cell



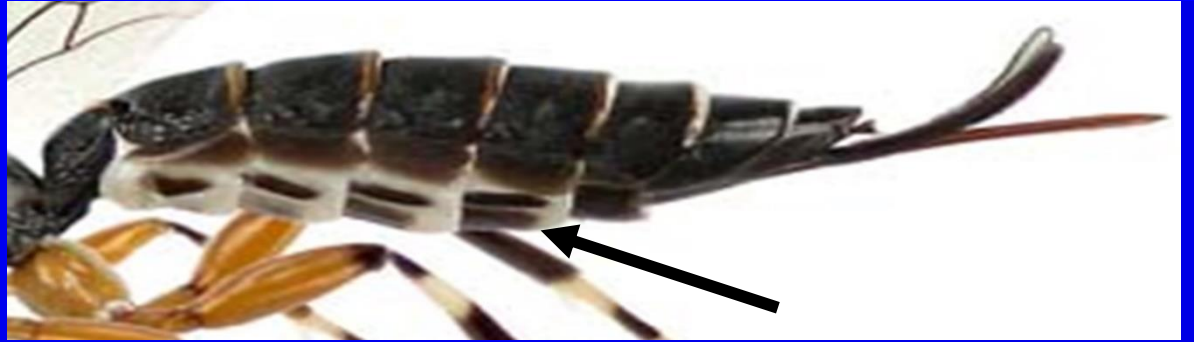
Ichneumonoidea (Braconidae) Aculeata (Pompilidae)

# Ichneumonoidea

(Ichneumonidae and Braconidae)

- Abdominal sternites small/ weakly sclerotized

Ichneumonoidea  
(Ichneumonidae)



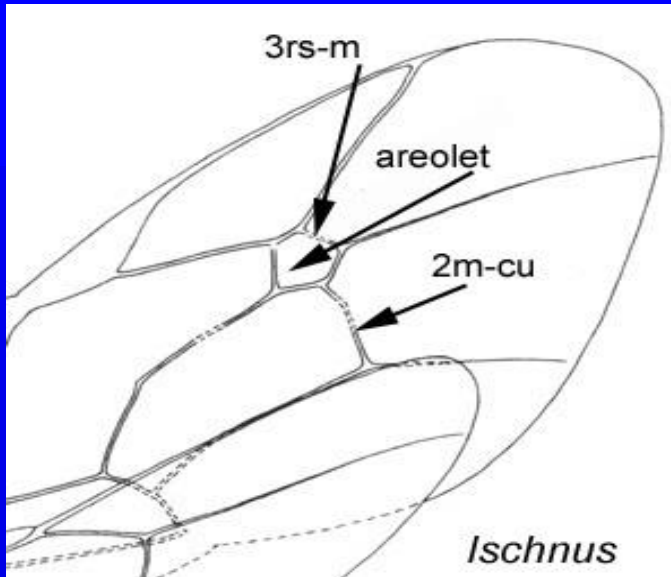
Aculeata  
(Vespidae)



# Ichneumonidae vs Braconidae

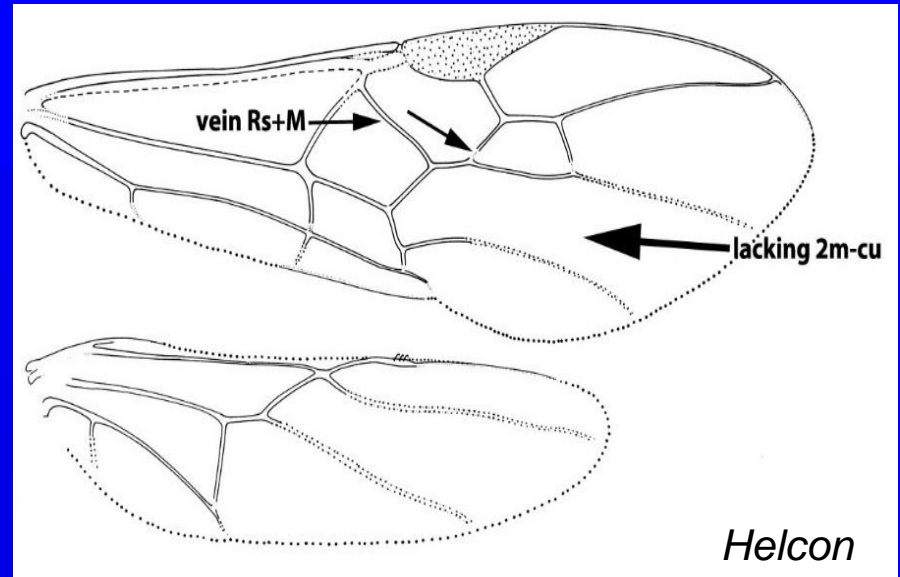
## Ichneumonidae

- Forewing with vein 2m-cu usually present
- Forewing lacking complete vein Rs+M



## Braconidae

- Forewing with vein 2m-cu absent
- Forewing often with complete vein Rs+M



# Ichneumonid diversity and biology

- 43 subfamilies
- almost all are parasitoids (mostly of larvae)
- parasitoids of holometabolous insects + spiders
- ectoparasitoids, endoparasitoids,  
hyperparasitoids
- idiobionts and koinobionts

# Ichneumonid diversity and biology

- Idiobiont: Parasitoid larva hatches and immediately begins to feed (and kill) host (30% of species)
- Koinobiont: Parasitoid larva hatches but does not continue development until later. Host develops (typically to pre-pupa) at which time parasitoid begins feeding and kills host (70% of species)

Most ectoparasitoids are idiobionts

Most endoparasitoids are koinobionts

# Some examples of Ichneumonidae

Ichneumoninae (4355 species in 437 genera)

- endoparasitoids of Lepidoptera (e.g., *Trogus*)



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*Trogus pennator* (Fabricius)  
parasitoid of swallowtails!

# Some examples of Ichneumonidae

Rhyssinae (259 species in 8 genera)

- idiobiont ectoparasitoids of wood-boring sawfly larvae



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Rhyssinae (259 species in 8 genera)

- idiobiont ectoparasitoids of wood-boring sawfly larvae



*Megarhyssa macrurus*  
(Linnaeus)



*Megarhyssa atrata*  
(Fabricius)

# Some examples of Ichneumonidae

Pimplinae (1737 species in 77 genera)

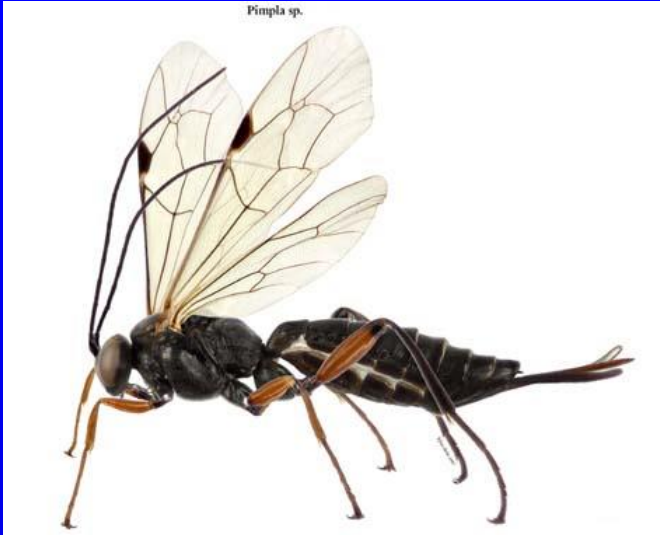
- wide host biology (most are idio/ ecto)



# Some examples of Ichneumonidae

Pimplinae (1737 species in 77 genera)

- wide host biology (most are idio/ ecto)



*Pimpla disparis* Viereck  
- idiobiont endo in pupae



*Polysphincta* group of genera  
- koinobiont ecto on spiders

# Some examples of Ichneumonidae

Ophioninae (1109 species in 32 genera)

- koino, endo on Lepidoptera (one species on Coleoptera)



# Some examples of Ichneumonidae

Ophioninae (1109 species in 32 genera)

- koino, endo on Lepidoptera (one species on Coleoptera)
- most species are nocturnal
- attracted to lights
- can sting painfully

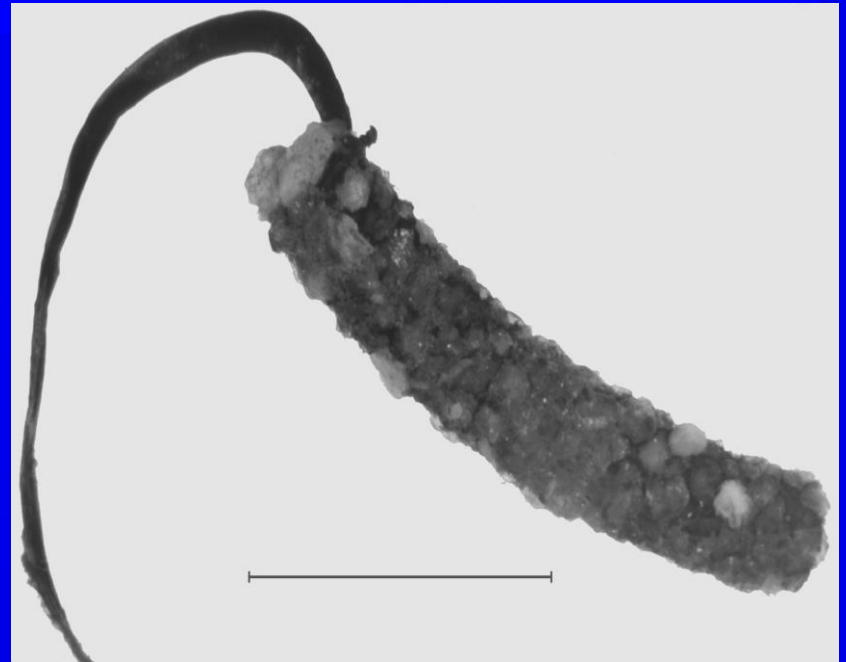
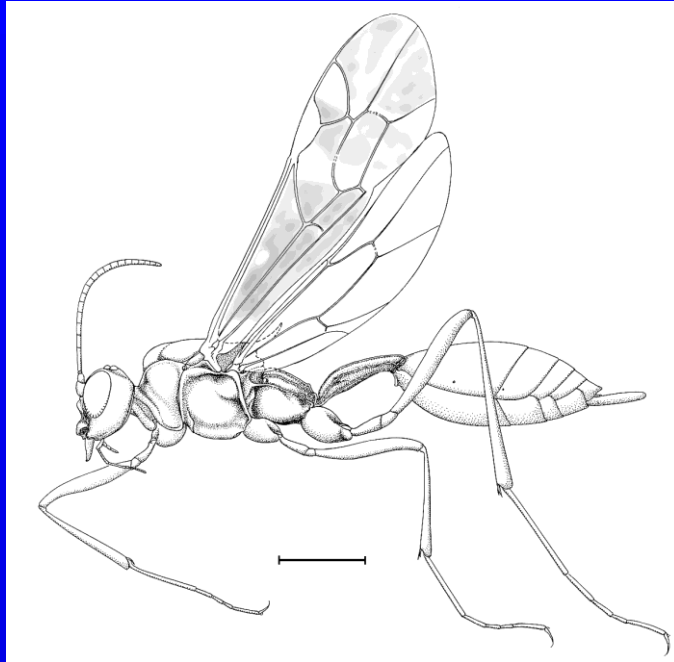


*Ophion* sp.

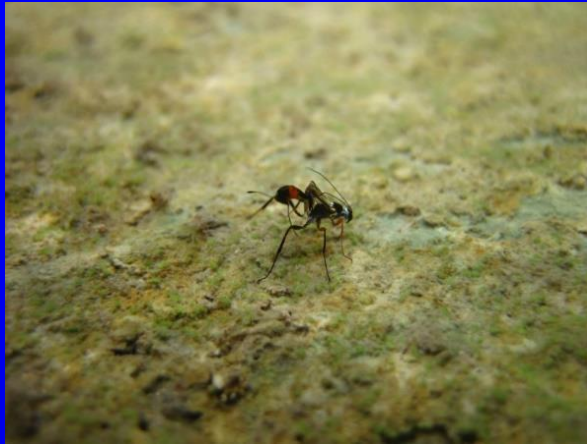
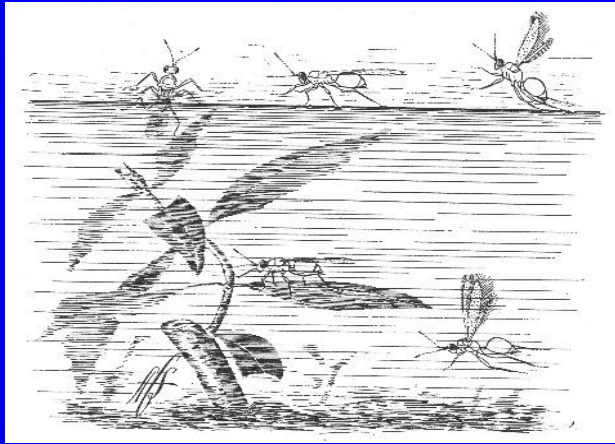
# Some examples of Ichneumonidae

Agriotypinae (16 species in one genus)

- idiobiont ectoparasitoids on Trichoptera pupae and pre-pupae



# 3. A review of the aquatic Hymenoptera of the world



How prevalent is aquatic behaviour in  
Hymenoptera?

# How prevalent is aquatic behaviour in Hymenoptera?

- depends on definition
- VAST majority of DESCRIBED species have no behavioural or ecological information

# Definition of “aquatic” for this talk

Species considered aquatic if there is “unequivocal evidence that they spend some of their life in water”

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Direct observation:

- females entering water to oviposit
- freshly eclosed adults exiting water
- larvae dissected from aquatic stages of hosts

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Phylogenetic inference:

- species with unknown biology that belong to genera that:
  - a) are demonstrably monophyletic **AND**
  - b) have known host range that is entirely aquatic

Species omitted

# Species omitted:

- 1) Undescribed species
- 2) Species that develop on terrestrial stages of aquatic insects (e.g., parasitoids that oviposit in pupae of gyrenids)

# Species omitted:

- 1) Undescribed species
- 2) Species that develop on terrestrial stages of aquatic insects (e.g., parasitoids that oviposit in pupae of gyrids)
- 3) Marine species

Data on following page updated to 2021 from:

**Bennett, A.M.R.** (2008) Aquatic Hymenoptera. In: Balian, E.V., C. Lévêque, C.H. Segers, K. Martens (eds). 2008. Freshwater Animal Diversity Assessment. *Hydrobiologia* **595**: 529-534. (150 species)

## Number of species of aquatic Hymenoptera by biogeographic region

<b>Taxon</b>	<b>TOTAL</b>	<b>PA</b>	<b>NA</b>	<b>AT</b>	<b>NT</b>	<b>OL</b>	<b>AU</b>	<b>PAC</b>	<b>ANT</b>
<b>Order HYMENOPTERA</b>	<b>204</b>	<b>74</b>	<b>60</b>	<b>5</b>	<b>28</b>	<b>44</b>	<b>12</b>	<b>9</b>	<b>-</b>
<b>Superfamily CHALCIDOIDEA</b>	<b>55</b>	<b>24</b>	<b>23</b>	<b>-</b>	<b>10</b>	<b>10</b>	<b>7</b>	<b>2</b>	<b>-</b>
Family CHALCIDIDAE	6	3	3	-	-	-	-	-	-
Family EULOPHIDAE	12	8	4	-	1	-	-	-	-
Family MYMARIDAE	7	4	4	-	3	1	1	-	-
Family PTEROMALIDAE	4	3	3	-	-	-	-	1	-
Family TRICHOGRAMMATIDAE	26	5	8	-	6	9	6	1	-
<b>Superfamily CYNIPOIDEA</b>	<b>11</b>	<b>3</b>	<b>2</b>	<b>-</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>7</b>	<b>-</b>
Family FIGITIDAE	11	3	3	-	1	-	-	7	-
<b>Superfamily DIAPRIOIDEA</b>	<b>7</b>	<b>2</b>	<b>3</b>	<b>-</b>	<b>2</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
Family DIAPRIIDAE	7	2	3	-	2	-	-	-	-
<b>Superfamily ICHNEUMONOIDEA</b>	<b>100</b>	<b>41</b>	<b>27</b>	<b>5</b>	<b>8</b>	<b>20</b>	<b>5</b>	<b>-</b>	<b>-</b>
Family BRACONIDAE	60	27	16	5	6	6	4	-	-
Family ICHNEUMONIDAE	40	14	11	-	2	14	1	-	-
<b>Superfamily PLATYGASTROIDEA</b>	<b>28</b>	<b>3</b>	<b>5</b>	<b>-</b>	<b>7</b>	<b>14</b>	<b>-</b>	<b>-</b>	<b>-</b>
Family SCELIONIDAE	28	3	5	-	7	14	-	-	-
<b>Superfamily POMPILOIDEA</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
Family POMPIIIDAE	3	2	1	-	-	-	-	-	-

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Family MYMARIDAE	7	4	4	-	3	1	1	-	-
Family PTEROMALIDAE	4	3	3	-	-	-	-	1	-
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Family BRACONIDAE	60	27	16	5	6	6	4	-	-
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Family SCELIONIDAE	28	3	5	-	7	14	-	-	-
<b>Superfamily POMPILOIDEA</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
Family POMPILOIDAE	3	2	1	-	-	-	-	-	-

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<b>Taxon</b>	<b>TOTAL</b>	<b>PA</b>	<b>NA</b>	<b>AT</b>	<b>NT</b>	<b>OL</b>	<b>AU</b>	<b>PAC</b>	<b>ANT</b>
<b>Order HYMENOPTERA</b>	204	74	60	5	28	44	12	9	-
<b>Superfamily CHALCIDOIDEA</b>	55	24	23	-	10	10	7	2	-
Family CHALCIDIDAE	6	3	3	-	-	-	-	-	-
Family EULOPHIDAE	12	8	4	-	1	-	-	-	-
Family MYMARIDAE	7	4	4	-	3	1	1	-	-
Family PTEROMALIDAE	4	3	3	-	-	-	-	1	-
Family TRICHOGRAMMATIDAE	26	5	8	-	6	9	6	1	-
<b>Superfamily CYNIPOIDEA</b>	11	3	2	-	1	-	-	7	-
Family FIGITIDAE	11	3	3	-	1	-	-	7	-
<b>Superfamily DIAPRIOIDEA</b>	7	2	3	-	2	-	-	-	-
Family DIAPRIIDAE	7	2	3	-	2	-	-	-	-
<b>Superfamily ICHNEUMONOIDEA</b>	100	41	27	5	8	20	5	-	-
Family BRACONIDAE	60	27	16	5	6	6	4	-	-
Family ICHNEUMONIDAE	40	14	11	-	2	14	1	-	-
<b>Superfamily PLATYGASTROIDEA</b>	28	3	5	-	7	14	-	-	-
Family SCELIONIDAE	28	3	5	-	7	14	-	-	-
<b>Superfamily POMPILOIDEA</b>	3	2	1	-	-	-	-	-	-
Family POMPILOIDAE	3	2	1	-	-	-	-	-	-

## Number of species of aquatic Hymenoptera by biogeographic region

<b>Taxon</b>	<b>TOTAL</b>	<b>PA</b>	<b>NA</b>	<b>AT</b>	<b>NT</b>	<b>OL</b>	<b>AU</b>	<b>PAC</b>	<b>ANT</b>
<b>Order HYMENOPTERA</b>	<b>204</b>	<b>74</b>	<b>60</b>	<b>5</b>	<b>28</b>	<b>44</b>	<b>12</b>	<b>9</b>	<b>-</b>
<b>Superfamily CHALCIDOIDEA</b>	<b>55</b>	<b>24</b>	<b>23</b>	<b>-</b>	<b>10</b>	<b>10</b>	<b>7</b>	<b>2</b>	<b>-</b>
Family CHALCIDIDAE	6	3	3	-	-	-	-	-	-
Family EULOPHIDAE	12	8	4	-	1	-	-	-	-
Family MYMARIDAE	7	4	4	-	3	1	1	-	-
Family PTEROMALIDAE	4	3	3	-	-	-	-	1	-
Family TRICHOGRAMMATIDAE	26	5	8	-	6	9	6	1	-
<b>Superfamily CYNIPOIDEA</b>	<b>11</b>	<b>3</b>	<b>2</b>	<b>-</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>7</b>	<b>-</b>
Family FIGITIDAE	11	3	3	-	1	-	-	7	-
<b>Superfamily DIAPRIOIDEA</b>	<b>7</b>	<b>2</b>	<b>3</b>	<b>-</b>	<b>2</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
Family DIAPRIIDAE	7	2	3	-	2	-	-	-	-
<b>Superfamily ICHNEUMONOIDEA</b>	<b>100</b>	<b>41</b>	<b>27</b>	<b>5</b>	<b>8</b>	<b>20</b>	<b>5</b>	<b>-</b>	<b>-</b>
Family BRACONIDAE	60	27	16	5	6	6	4	-	-
Family ICHNEUMONIDAE	40	14	11	-	2	14	1	-	-
<b>Superfamily PLATYGASTROIDEA</b>	<b>28</b>	<b>3</b>	<b>5</b>	<b>-</b>	<b>7</b>	<b>14</b>	<b>-</b>	<b>-</b>	<b>-</b>
Family SCELIONIDAE	28	3	5	-	7	14	-	-	-
<b>Superfamily POMPILOIDEA</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
Family POMPILOIDAE	3	2	1	-	-	-	-	-	-

## Examples of Aquatic Hymenoptera

Chalcidoidea: *Eustochus (Caraphractus) cinctus* (Walker)

Proctotrupoidea: *Psychopria hoguei* Masner and García

Platygastroidea: *Tiphodytes gerriphagus* Marchal

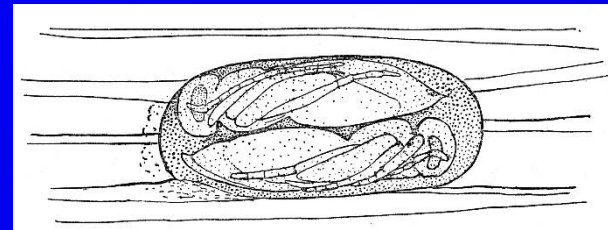
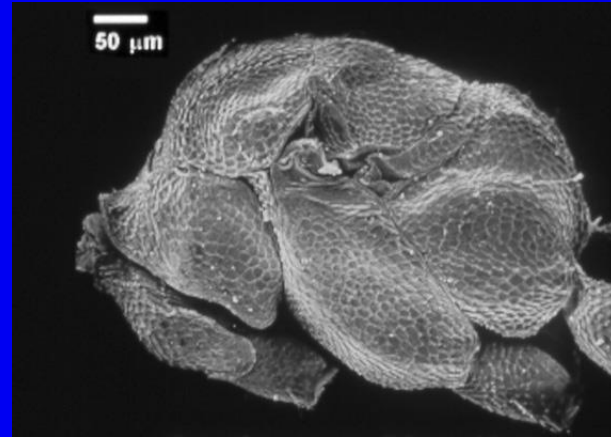
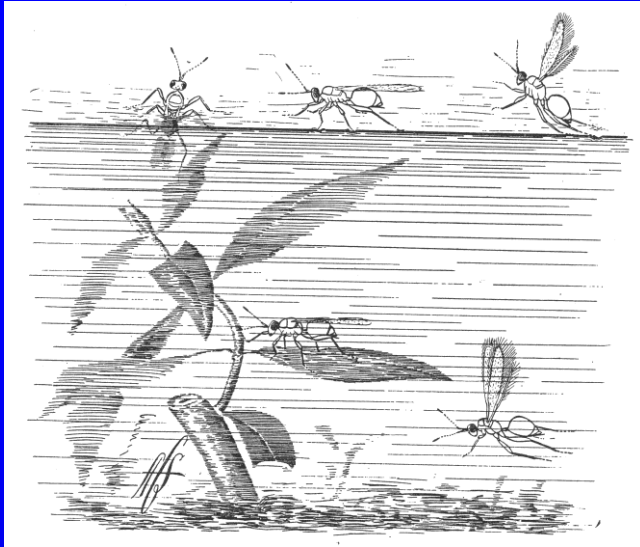
Ichneumonoidea: *Agriotypus chaoi* Bennett

*Tanychela pilosa* Dasch

Cynipoidea: *Aspidogyrus* spp.

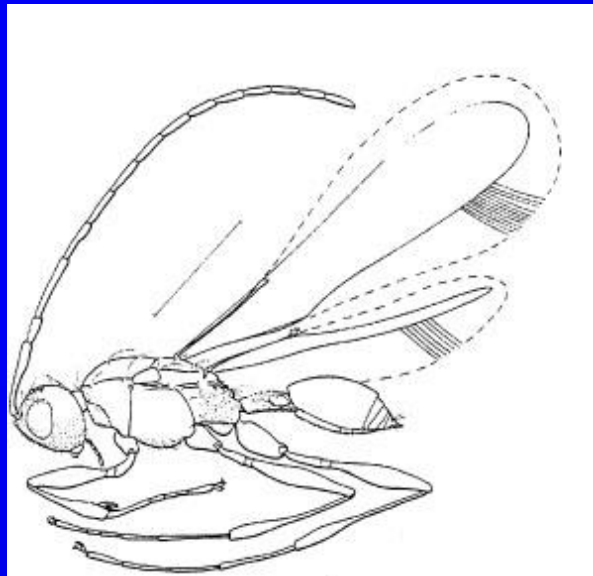
Pompiloidea: *Anoplius depressipes* Banks

## *Eustochus cinctus* (Walker) (Chalcidoidea: Mymaridae)



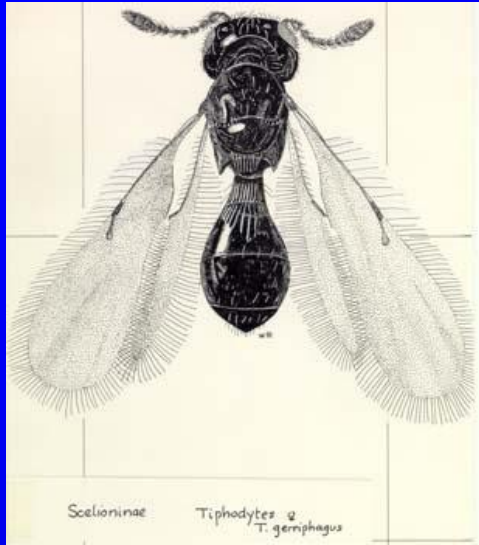
- Egg parasitoid of Dytiscidae
- Holarctic in still water
- swims with wings (1-2 mm long)
- females can remain under water for over fifteen days in lab
- mating can occur in water or out of water (Jackson 1958, 1961, 1966)
- within Mymaridae – six aquatic species in four genera
- within Chalcidoidea – 55 aquatic species in 18 genera in five families

# *Psychopria hoguei* Masner and García (Diaprioidea: Diapriidae)



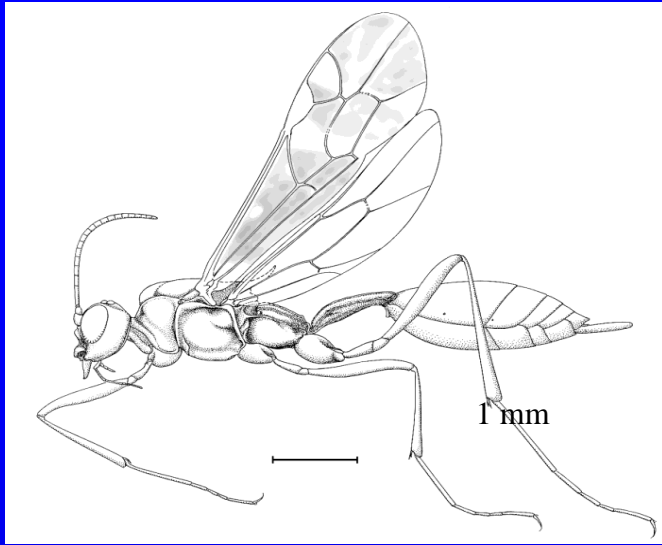
- reared from pupa of *Maruina* (Diptera: Psychodidae)  
Masner and García (2002) Bull. Am. Mus. Nat. Hist. 268: 1-138.
- Neotropical (Costa Rica) in running water
- only described species in genus, but many undescribed
- within Diaprioidea – 7 aquatic species in three genera in one family

# *Tiphodytes gerriphagus* Marchal (Platygastroidea: Scelionidae)

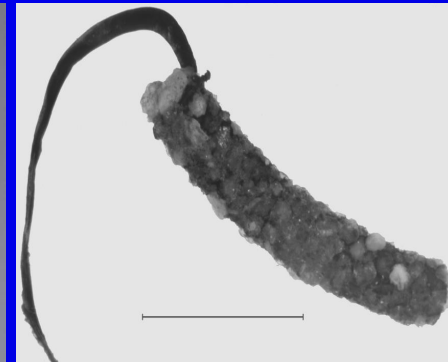


- egg parasitoid of Gerridae (Hemiptera) (Spence, 1986: *Can. J. Zool.* 64:2728-2738)
- Holarctic in still or slowly moving water
- genus found throughout the world – 16 described species but many more undescribed
- 28 species of Scelionidae in five genera aquatic but family may have highest number of aquatic species based on collections in yellow pan traps around water

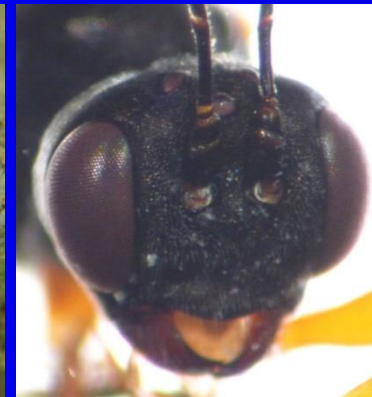
## *Agriotypus chaoi* Bennett (Ichneumonoidea: Ichneumonidae)



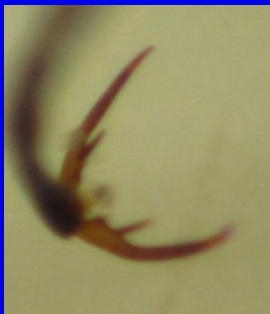
- ectoparasitoid of pre-pupal and pupal Trichoptera
- Palearctic and Oriental in fast-running streams
- 16 described species in genus (subfamily)
- unique pupal respiratory filament
- covered by dense setae and has elongate claws
- **Ichneumonoidea: 100 species in 22 genera**



*Tanychela pilosa* Dasch (Ichneumonoidea: Ichneumonidae)



- endoparasitoid of larval and pupal aquatic Crambidae (Lepidoptera)
- Nearctic and Neotropical in streams (2 described species in genus (1 from WA, ID, CA, MT, TX and N. Mexico) (+ Arizona?))



<https://www.youtube.com/watch?v=-vQj2cDPBJY>

*Aspidogyris* spp. (Cynipoidea: Figitidae)



- reared from pupae of beach flies: *Procanace* (Diptera: Canacidae)
- witnessed walking along stones on bottom of fast-running streams
- four described species in genus endemic to Hawaii (one species on each of Kauai, Oahu, Maui and Hawaii)
- two aquatic species in large genus *Kleidotoma* are also endemic to Hawaii
- within Cynipoidea: 11 aquatic species in four genera in one family

## *Anoplius depressipes* Banks (Pompiloidea: Pompilidae)



- ectoparasitoid of adult *Dolomedes* spp. (Araneae: Pisauridae)

Roble (1985): J. Arachn. 13: 391-392

- Nearctic (East) in still water

- dives into water to chase and sting host, drags paralyzed spider to water's surface and then along surface film to shore where it lays eggs on spider in burrow

- only aquatic Aculeata

- within Pompiloidea: **three species in one genus in one family aquatic.**

# Summary of aquatic Hymenoptera habitats and types of parasitism (among 204 species)

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Freshwater  
habitat

Lentic  
 $\approx 86\%$

Lotic  
 $\approx 14\%$

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 $\approx 14\%$

Location of  
development

Endoparasitoids  
 $> 85\%$

Ectoparasitoids  
 $< 15\%$

---

## Summary of aquatic Hymenoptera habitats and types of parasitism (among 204 species)

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Freshwater habitat	Lentic ≈86%	Lotic ≈14%	
Location of development	Endoparasitoids > 85%	Ectoparasitoids < 15%	
Host stage parasitized	Egg 38%	Larval/pupal 61%	Adult 1%

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## Host used by aquatic Hymenoptera

Host	% of total spp.
Diptera	44
Hemiptera	16
Lepidoptera	13
Odonata	10
Trichoptera	9
Coleoptera	3
Araneae	1

How prevalent is aquatic behaviour in  
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- 204 aquatic species known

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- about 0.1%

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(**Philanthidae**)



*Dolichovespula maculata*  
(Vespidae)



*Diprion similis*  
(Diprionidae)



*Tremex columba* (Siricidae)