

# Bahan Ajar: Plecoptera dan Ephemeroptera

**Hamdhani, S.P., M.Sc., Ph.D**

Avertebrata Air (SKS: 3)



**Recap.....**

# Holometabolous

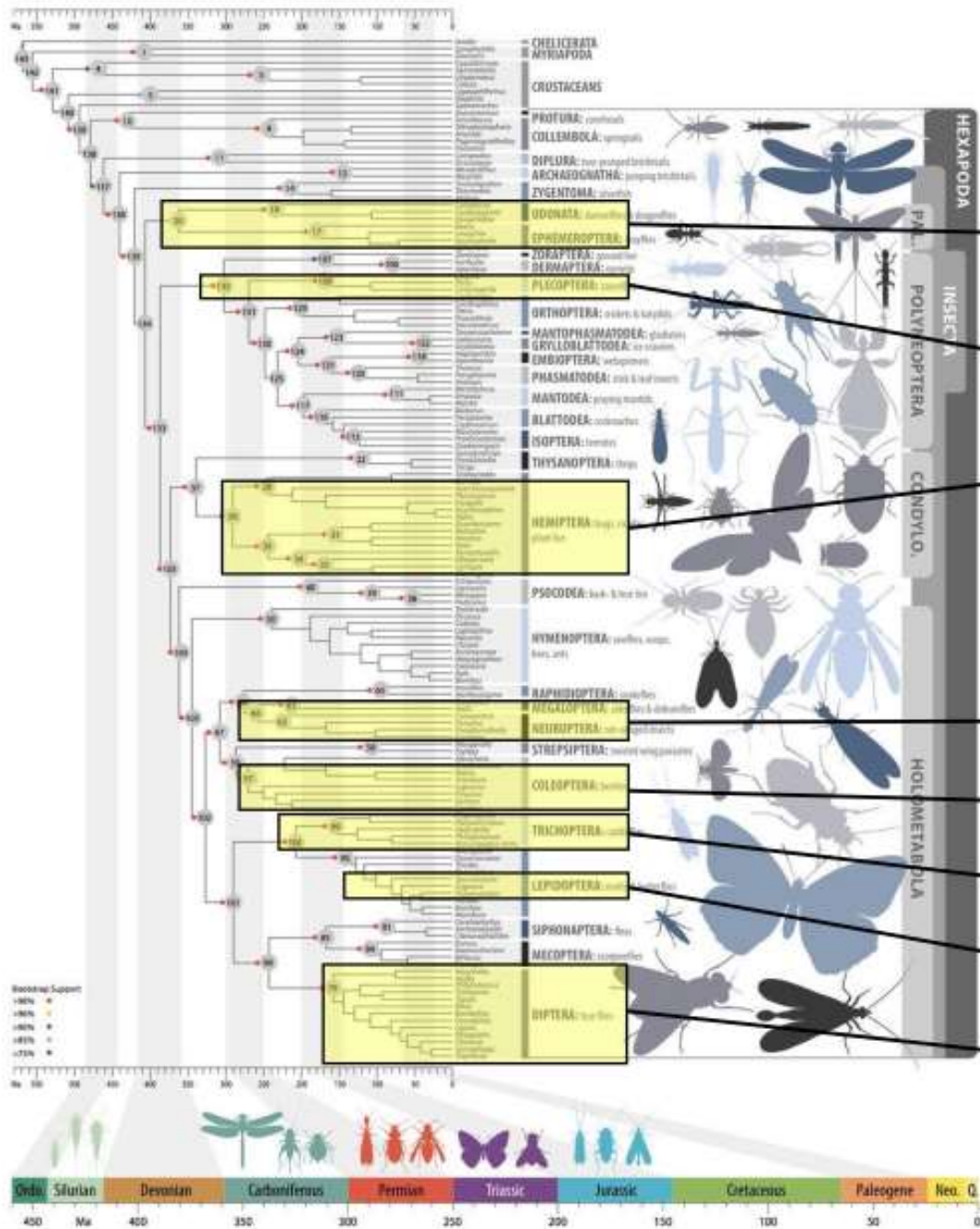


vs.

# Hemimetabolous



*Which of these is older, evolutionarily speaking?*



## Hemimetabolous

Dragonflies

Mayflies

Stoneflies

True bugs

## Holometabolous

Dobsonflies, lacewings

Beetles

Caddisflies

Aquatic moths

True flies

## *Hemimetabolous*

- Hemiptera
- Ephemeroptera
  - Odonata
- Plecoptera

## *Holometabolous*

- Trichoptera
- Lepidoptera
- Coleoptera
- Megaloptera
  - Diptera
- Neuroptera

Terminology varies but we'll use these

## **Holometabolous**

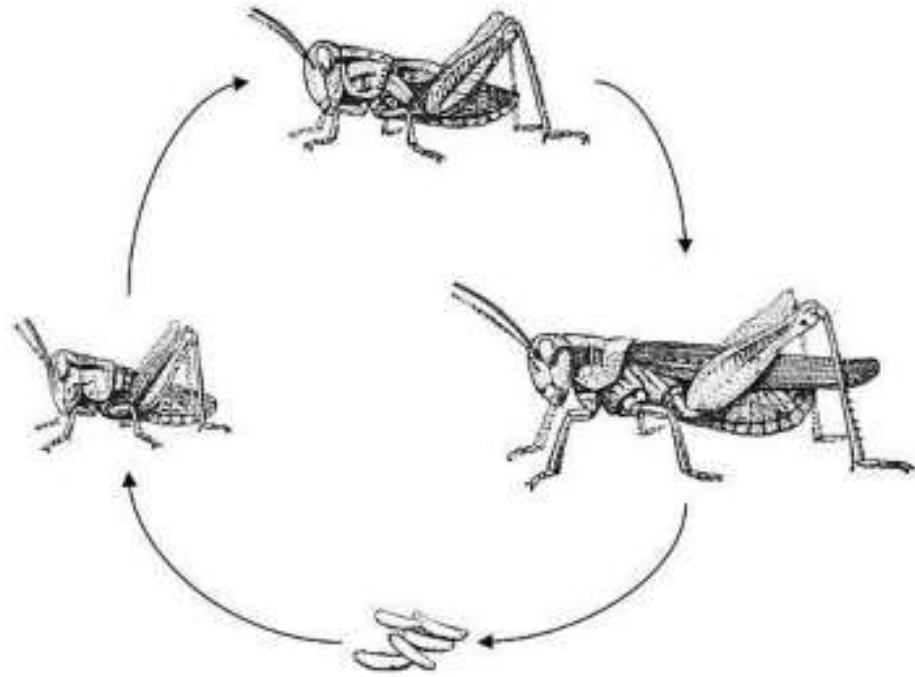
*egg* → *larva* → *pupa* → *adult*

## **Hemimetabolous**

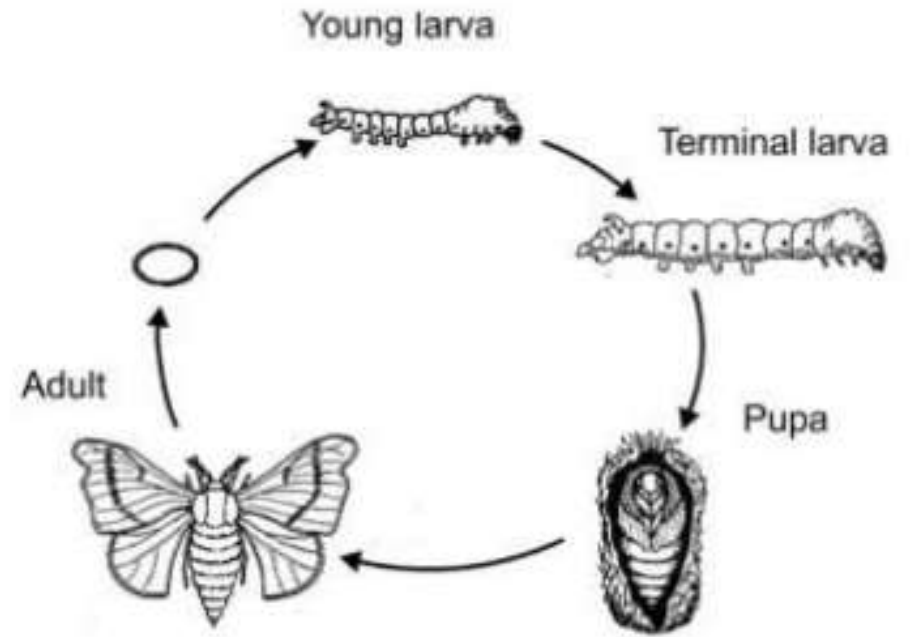
*egg* → *larva* → *adult*

*other terms: nymph, naiad, subimago, imago, etc*

# *Benefit of being holometabolous?*



*hemi*



*holo*



How do these cycles vary across orders?

*egg* → *larva* → *pupa* → *adult*

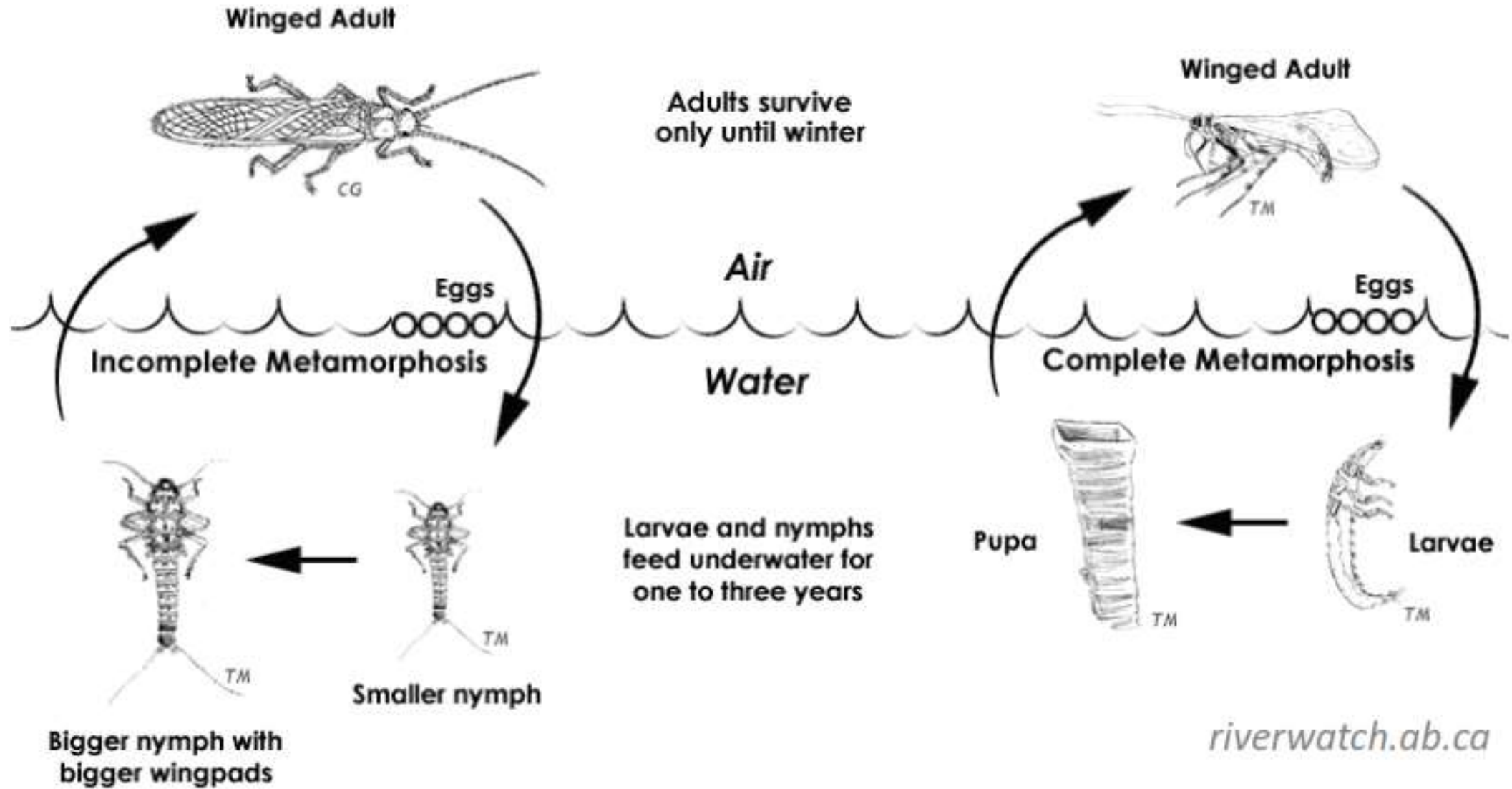
*egg* → *larva* → *adult*

*aquatic vs. terrestrial stages?*



# Hemimetabolous

# Holometabolous



*Anisoptera*

# ODONATA

*Zygoptera*

**Capung**



**Capung  
jarum**



Dragonflies

Damselflies

Anisoptera

# ODONATA

Zygoptera



no caudal appendages

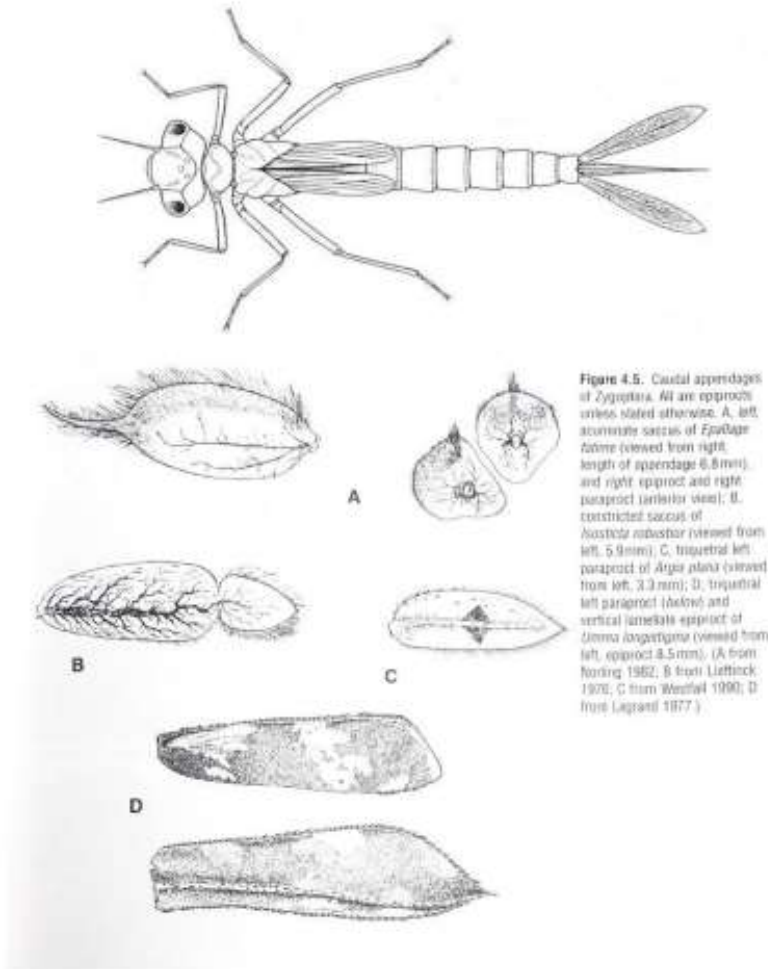


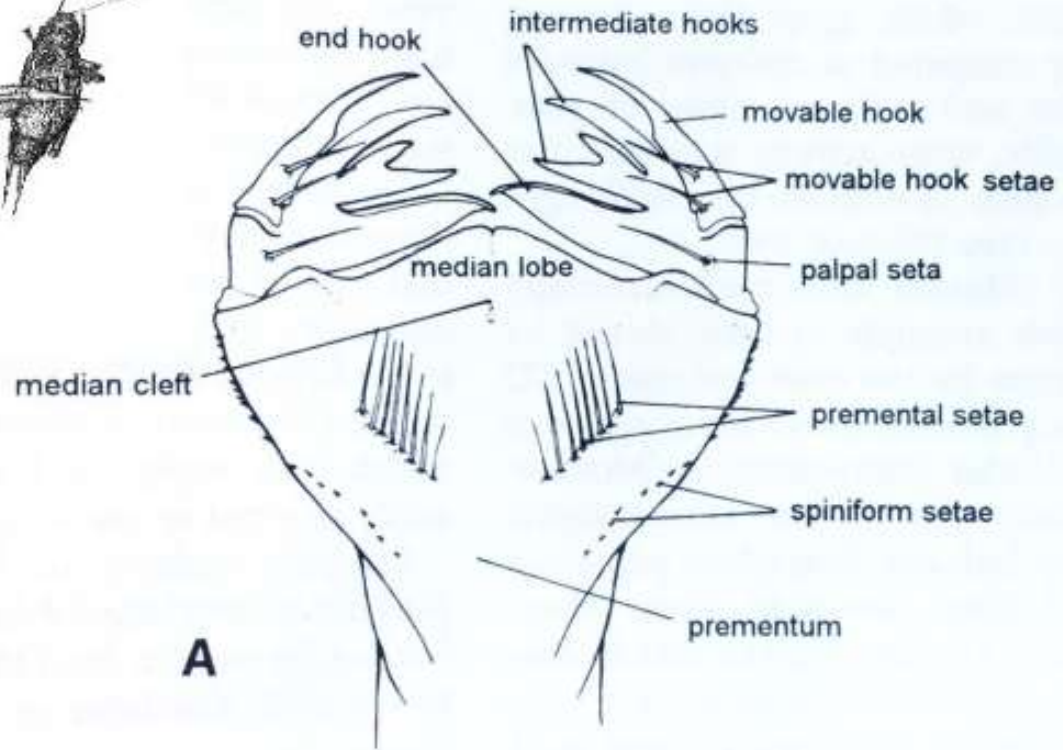
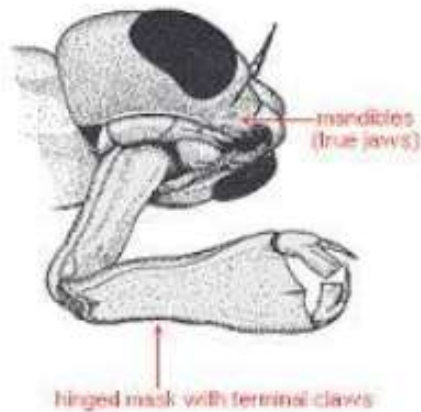
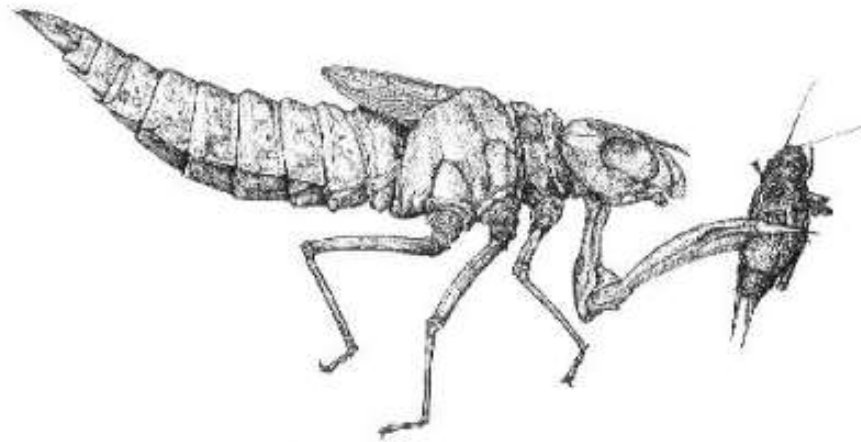
Figure 4.5. Caudal appendages of Zygoptera. All are epiprocts unless stated otherwise. A, left acuminate saccus of *Epiplatya latum* (viewed from right, length of appendage 6.8 mm), and right epiproct and right paraproct (anterior view); B, restricted saccus of *Anisotria robustior* (viewed from left, 5.9 mm); C, triangular left paraproct of *Arges platus* (viewed from left, 3.3 mm); D, triangular left paraproct (*Anisotria*) and vertical lamellate epiproct of *Limnaea longistigma* (viewed from left, epiproct 4.5 mm). (A from Harding 1962; B from Lieftinck 1976; C from Westfall 1990; D from Lagrand 1877.)

3 caudal appendages (“tails”, “gills”)



# ODONATA

*extendable mouth parts*



*Anisoptera*

# ODONATA

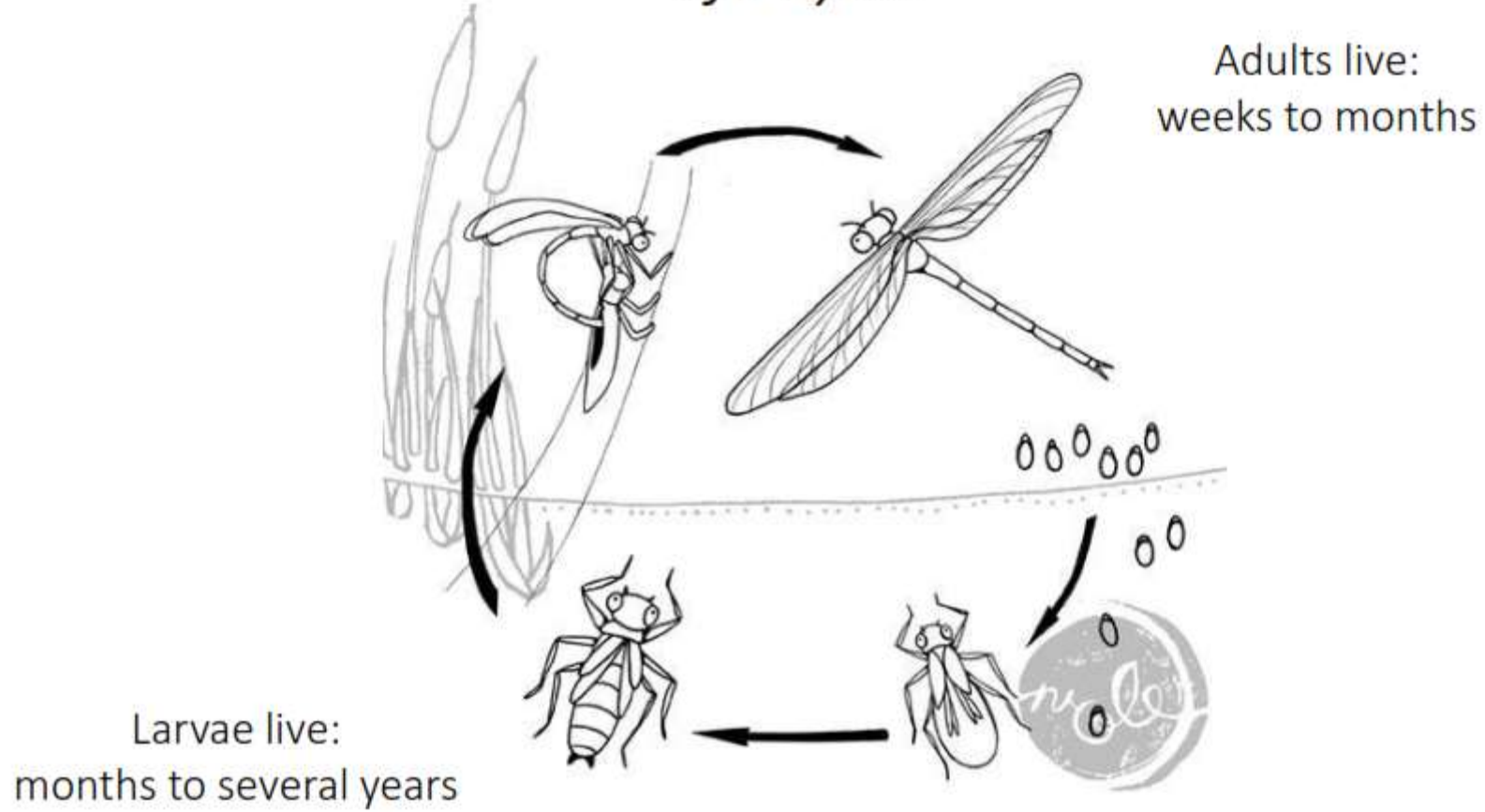
*Zygoptera*

*extendable mouth parts*



# ODONATA

## life cycle





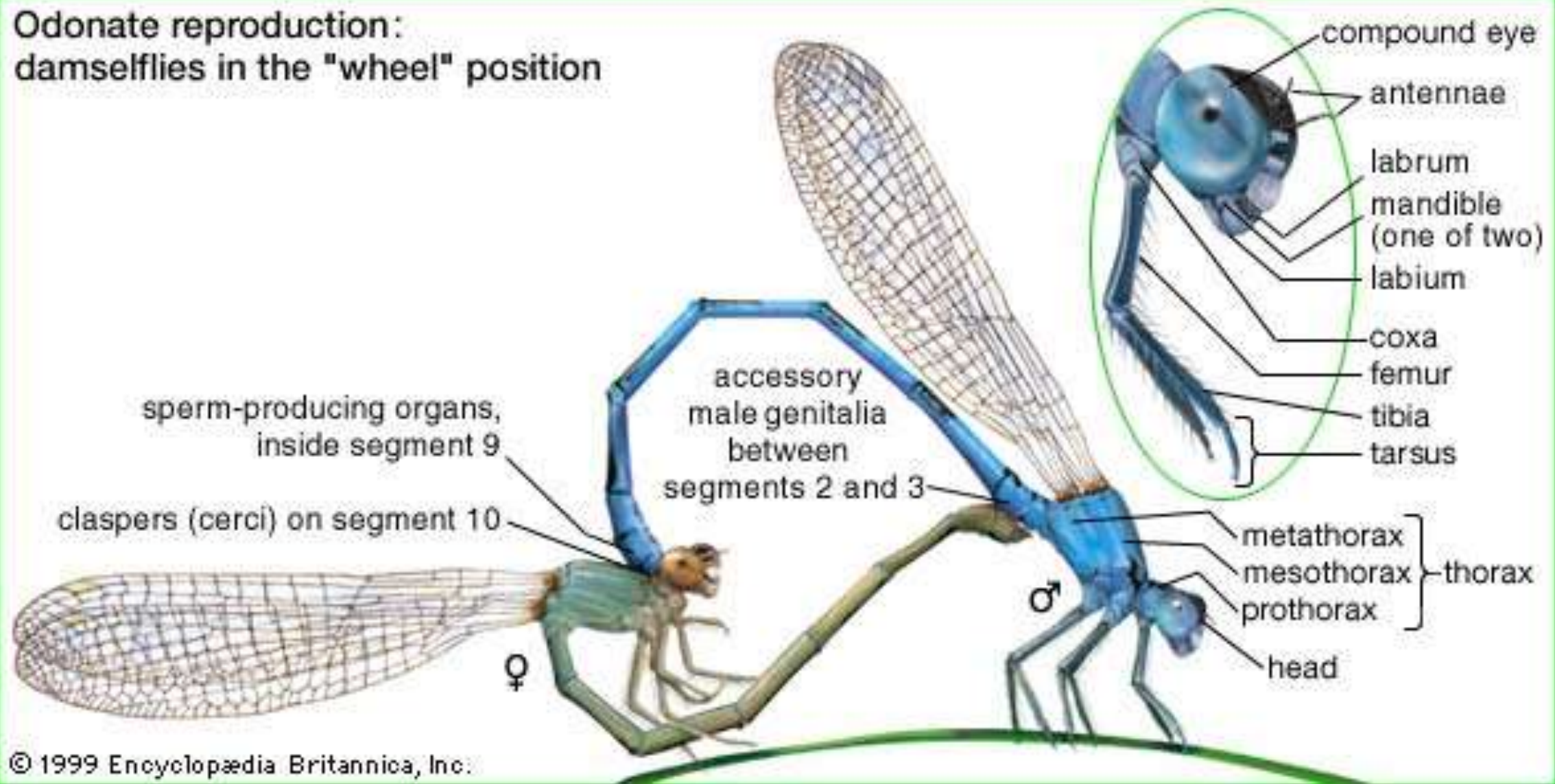
# ODONATA

*mating*





Odonate reproduction:  
damselflies in the "wheel" position



(a)

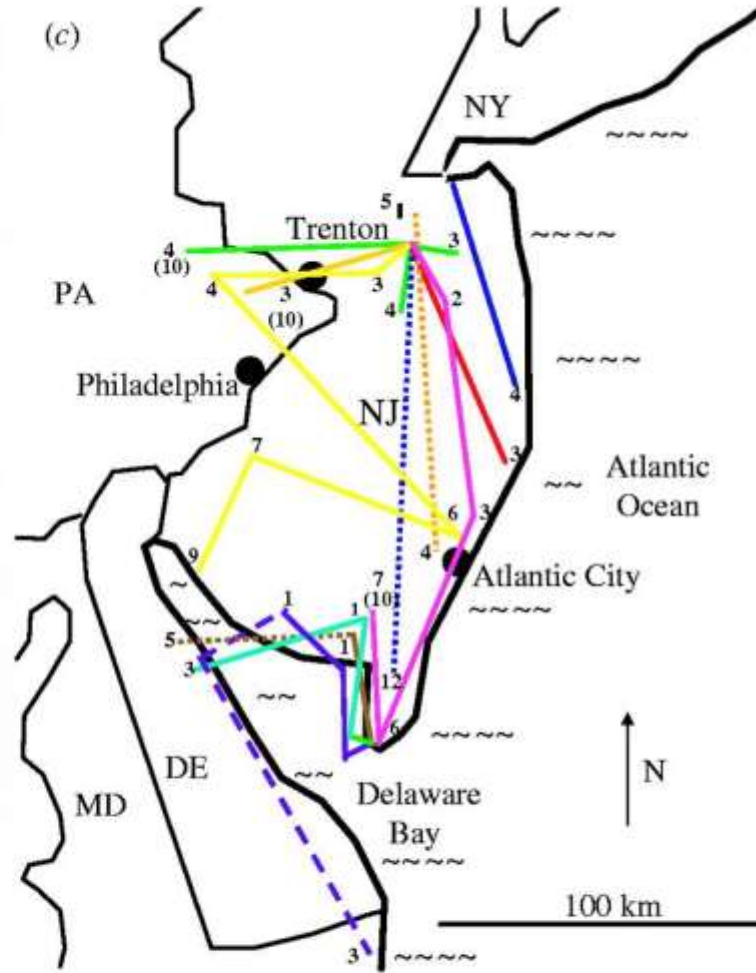


(b)



**BIOLOGY LETTERS**

(c)



## Simple rules guide dragonfly migration

Martin Wikelski, David Moskowitz, James S Adelman, Jim Cochran, David S Wilcove, Michael L May

Published 22 September 2006. DOI: 10.1098/rsbl.2006.0497

“The average distance covered over four generations may be **18,000 km** or even longer.

Furthermore, individual *P. flavescens* migrating from the northern subcontinent to East Africa via the Maldives must be flying in excess of **6,000 km**, including a trans-oceanic crossing of **3,500 km**.

This is an extraordinary feat for a 5 cm long insect, and is, to the best of our knowledge, by far the longest regular single-generation migration documented for any insect.”

Troast D, Suhling F, Jinguji H, Sahlén G, Ware J (2016) A Global Population Genetic Study of *Pantala flavescens*. PLOS ONE 11(3): e0148949.  
doi:10.1371/journal.pone.0148949  
<http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0148949>

Kita menonton bersama

<https://www.youtube.com/watch?v=QRjJ5QkPauw>



# Now.. Plecoptera (Stonefly)





# Plecoptera

- Kebanyakan di air dingin (temp rendah), berbatu, dan berarus tenang
- Keragaman tinggi di sungai pegunungan
- Memerlukan DO tinggi dan kualitas air yang baik



**Tabel 3.** Kelimpahan serangga Ephemeroptera, Plecoptera, dan Tricoptera di Sungai Jangkok, Lombok, Nusa Tenggara Barat

Ordo	Famili	Genus	Lokasi pengamatan		
			Hulu	Tengah	Hilir
Ephemeroptera	Caenidae	<i>Caenis</i>	46	43	0
	Baetidae	<i>Baetis</i>	34	16	0
	Ephemerellidae	<i>Serratella</i>	35	0	0
Plecoptera	Perlidae	<i>Dinocras</i>	52	3	0
	Pteronarcyidae	<i>Pteronarcys</i>	19	8	0
Trichoptera	Psychomyiidae	<i>Psychomyia</i>	43	2	0
	Sericostomatidae	<i>Sericostoma</i>	95	1	0
	Goeridae	<i>Goera</i>	191	15	0
	Lepidostomatidae	<i>Lepidostoma</i>	30	0	0
	Rhyacophilidae	<i>Rhyacophila</i>	130	16	0
	Hydropsychidae	<i>Hydropsyche</i>	78	3	0
	Limnephilidae	<i>Limnephilus</i>	35	7	0
Total individu			788	114	0
Total keseluruhan			902		

**Tabel 4.** Kondisi fisik dan kimia perairan Sungai Jangkok, Lombok, Nusa Tenggara Barat

Parameter fisik dan kimia	Hulu	Tengah	Hilir
pH	7,37	7,46	7,09
Oksigen terlarut (DO) (mg/l)	7,33	6,80	6,90
Suhu air (°C)	23,3	25,7	28,1
Suhu udara (°C)	27,4	28,6	29,1
Kecerahan (%)	100	75,2	58,8
Kecepatan arus (m/s)	0,70	0,60	0,12
Kedalaman (cm)	44,7	68	130,4
Tipe substrat	Batu, kerikil, pasir	Batu, kerikil, pasir	Lumpur, sampah

Diantari et al., 2017





## **Keanekaragaman serangga Ephemeroptera, Plecoptera, dan Trichoptera sebagai bioindikator kualitas perairan di Sungai Jangkok, Nusa Tenggara Barat**

Diversity of Ephemeroptera, Plecoptera, and Trichoptera as bioindicator of water quality in Jangkok River, West Nusa Tenggara

**Ni Putu Reny Diantari, Hilman Ahyadi, Immy Suci Rohyani, I Wayan Suana\***

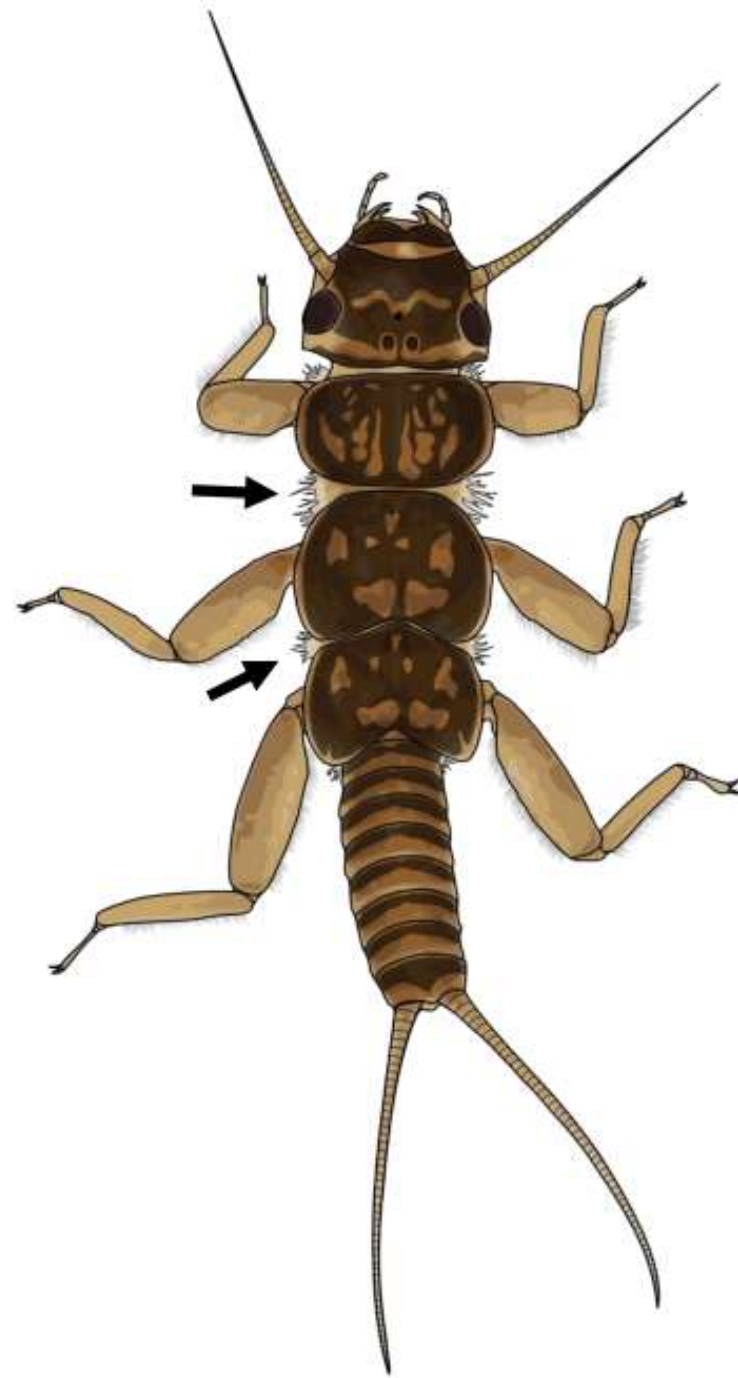
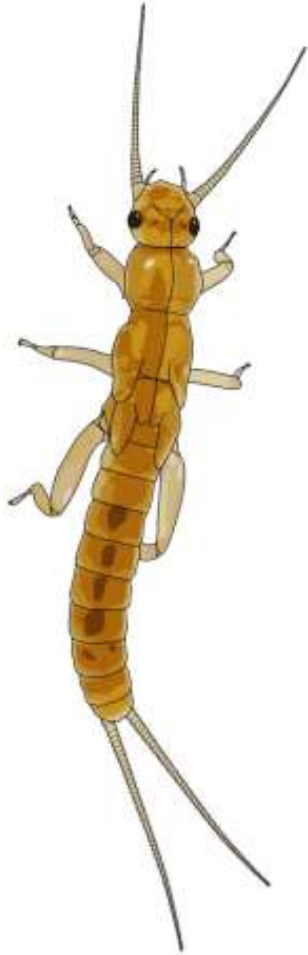
Program Studi Biologi, Fakultas Matematika dan Ilmu Pengetahuan Alam, Universitas Mataram, Jalan Majapahit 62 Mataram, Lombok, Nusa Tenggara Barat 83125

(diterima Januari 2017, disetujui Mei 2017)

### **ABSTRAK**

Keberadaan serangga Ephemeroptera, Plecoptera, dan Trichoptera (EPT) di suatu perairan dapat dijadikan indikator kualitas perairan tersebut. Tujuan penelitian ini adalah untuk 1) mengetahui keanekaragaman serangga EPT di Sungai Jangkok, Lombok, Nusa Tenggara Barat, 2) menentukan kualitas perairan Sungai Jangkok berdasarkan *family biotic index* (FBI), dan 3) mengetahui pengaruh parameter fisik, kimia, dan biologi lingkungan terhadap keberadaan serangga EPT. Pengambilan sampel serangga dilakukan pada bulan Juli 2016 menggunakan *eckman grab* dan jaring air secara acak sistematis pada 22 titik yang tersebar di bagian hulu, tengah, dan hilir Sungai Jangkok. Selain itu, dilakukan juga pengukuran data fisik, kimia, dan biologi lingkungan perairan. Kualitas perairan ditentukan dengan nilai FBI, serta analisis korelasi berganda untuk mengetahui hubungan antara faktor fisik dan kimia lingkungan perairan dengan keberadaan serangga EPT. Penelitian menemukan 902 individu serangga EPT yang tergolong dalam 12 famili dan 12 genus. Di bagian hulu ditemukan 788 individu (12 famili dan 12 genus), di bagian tengah 114 individu (10 famili dan 10 genus), sedangkan di bagian hilir tidak ditemukan serangga EPT. Dari hasil penelitian fisik

# Plecoptera

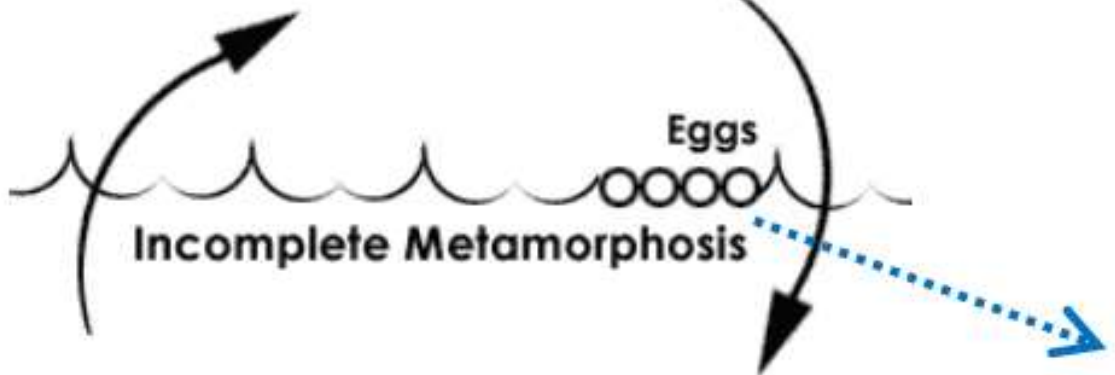
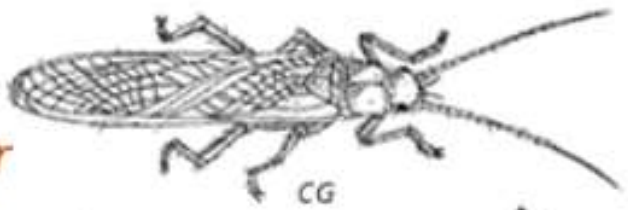


Illustrations: Pau Fortuño

# Plecoptera

*Emergence usually in spring / early summer*

**Winged Adult**



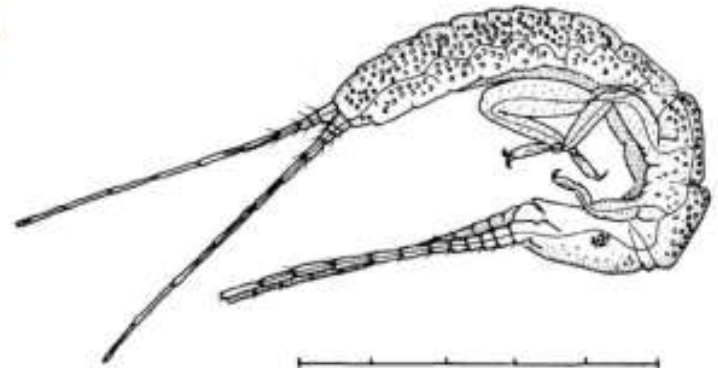
*Often have egg or larval diapause*



**Bigger nymph with bigger wingpads**



**Smaller nymph**



0.5 mm



# Plecoptera *dispersal*

- Hanyut (Drift) – pada larva muda (instars)
- Merayap (Crawling) – puluhan hingga ratusan meter
- Terbang (Flight) – tetap dekat daerah sungai, biasanya < 1km



# *Lednia tumana*



## RESEARCH ARTICLE

### Loss of Genetic Diversity and Increased Subdivision in an Endemic Alpine Stonefly Threatened by Climate Change

Steve Jordan<sup>1\*</sup>, J. Joseph Giersch<sup>2</sup>, Clint C. Muhlfeld<sup>2,3</sup>, Scott Hotaling<sup>4</sup>, Liz Fanning<sup>1</sup>, Tyler H. Tappenbeck<sup>2</sup>, Gordon Luikart<sup>2</sup>

**1** Department of Biology, Bucknell University, Lewisburg, Pennsylvania, United States of America, **2** U.S. Geological Survey, Northern Rocky Mountain Science Center, Glacier National Park, West Glacier, Montana, United States of America, **3** Flathead Lake Biological Station, Montana Conservation Genomics Laboratory, Division of Biological Sciences, University of Montana, Polson, Montana, United States of America, **4** University of Kentucky, Department of Biology, Lexington, Kentucky, United States of America

\* [steve.jordan@bucknell.edu](mailto:steve.jordan@bucknell.edu)



“The loss of glaciers and perennial snowfields is projected to reduce suitable habitat for *L. tumana* by >80%”



# Lednia tumana



NEWS & FEATURES | SPORTS | OUTDOORS | ARTS & ENTERTAINMENT | OPINION

## Feds Say Glacier Stoneflies Threatened by Climate Change

Wildlife agency says greater protections needed for obscure alpine insects dependent on glacial streams

BY TRISTAN SCOTT // OCT 4, 2016 // OUTDOORS

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U.S. Fish & Wildlife Service  
**ECOS** Environmental Conservation Online System  
Conserving the Nature of America

Species Profile for Meltwater Ledian stonefly (*Lednia tumana*)

### Meltwater Ledian stonefly (*Lednia tumana*)

[Candidate Info](#) | [Federal Register](#) | [Conservation Plans](#) | [Factors](#) | [Life History](#)

Taxonomy: [View taxonomy in ITIS](#)

Listing Status: **Proposed Threatened**

- **States/US Territories** in which the Meltwater Ledian stonefly, Wherever found is known to or is believed to occur: [Montana](#)
- **US Counties** in which the Meltwater Ledian stonefly, Wherever found is known to or is believed to occur: [View All](#)
- **USFWS Refuges** in which the Meltwater Ledian stonefly, Wherever found is known to occur: Banton Lake Wetland Management District

Current Listing Status Summary

Status	Date Listed	Lead Region	Where Listed
<b>Proposed Threatened</b>		<a href="#">Mountain-Plains Region (Region II)</a>	Wherever found

Species Occurrence

Population(s)  
Wherever found

# Ephemeroptera (Mayfly)





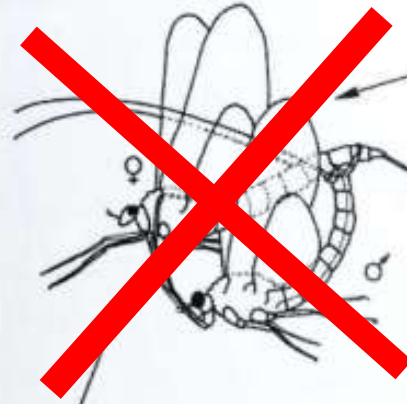
# Ephemeroptera

- Sekitar 40 family, 440 genus, 3500 species
- Beatidae alone has 1000 species
- Lotik dan lentik system, sebagian kecil di air payau.



# Ephemeroptera

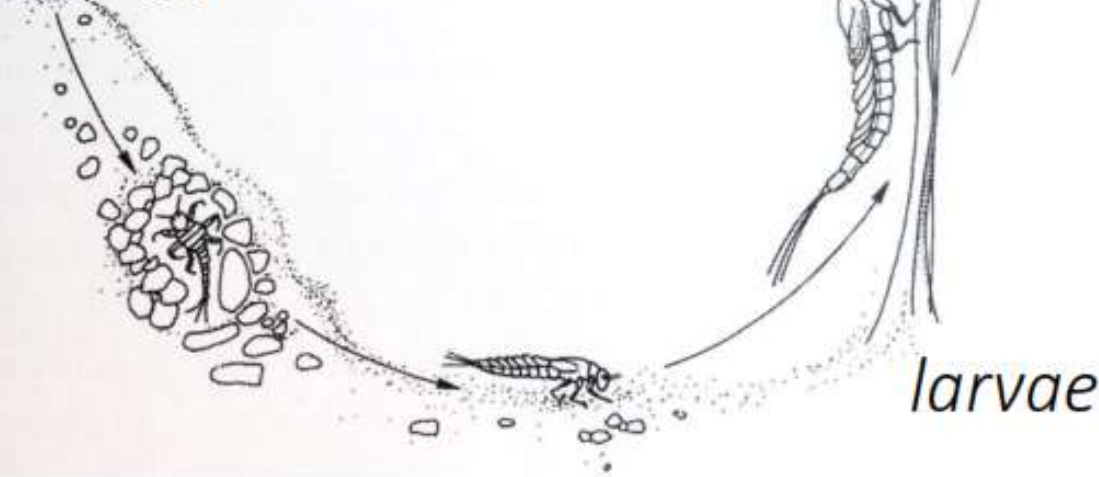
*imago*  
(mature  
adult)



**Parthenogenesis**  
**Pada beberapa species**

*subimago*  
(immature  
adult)

eggs



larvae

# Peran dalam lingkungan

- Scrapers, filterers collector-gatherers, predators, dan kombinasi
- Mangsa (prey) dari hewan lain: Ikan bisa menghabiskan >40% produksi mayfly di suatu habitat (+burung dan kelelawar)

# Ephemeroptera

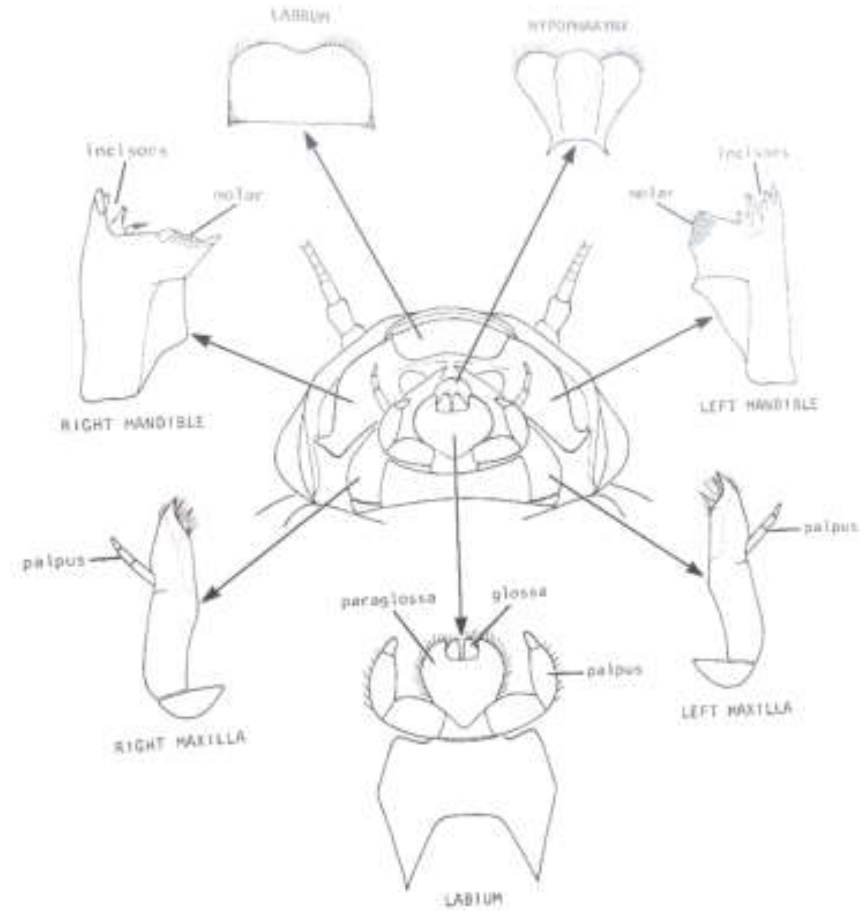
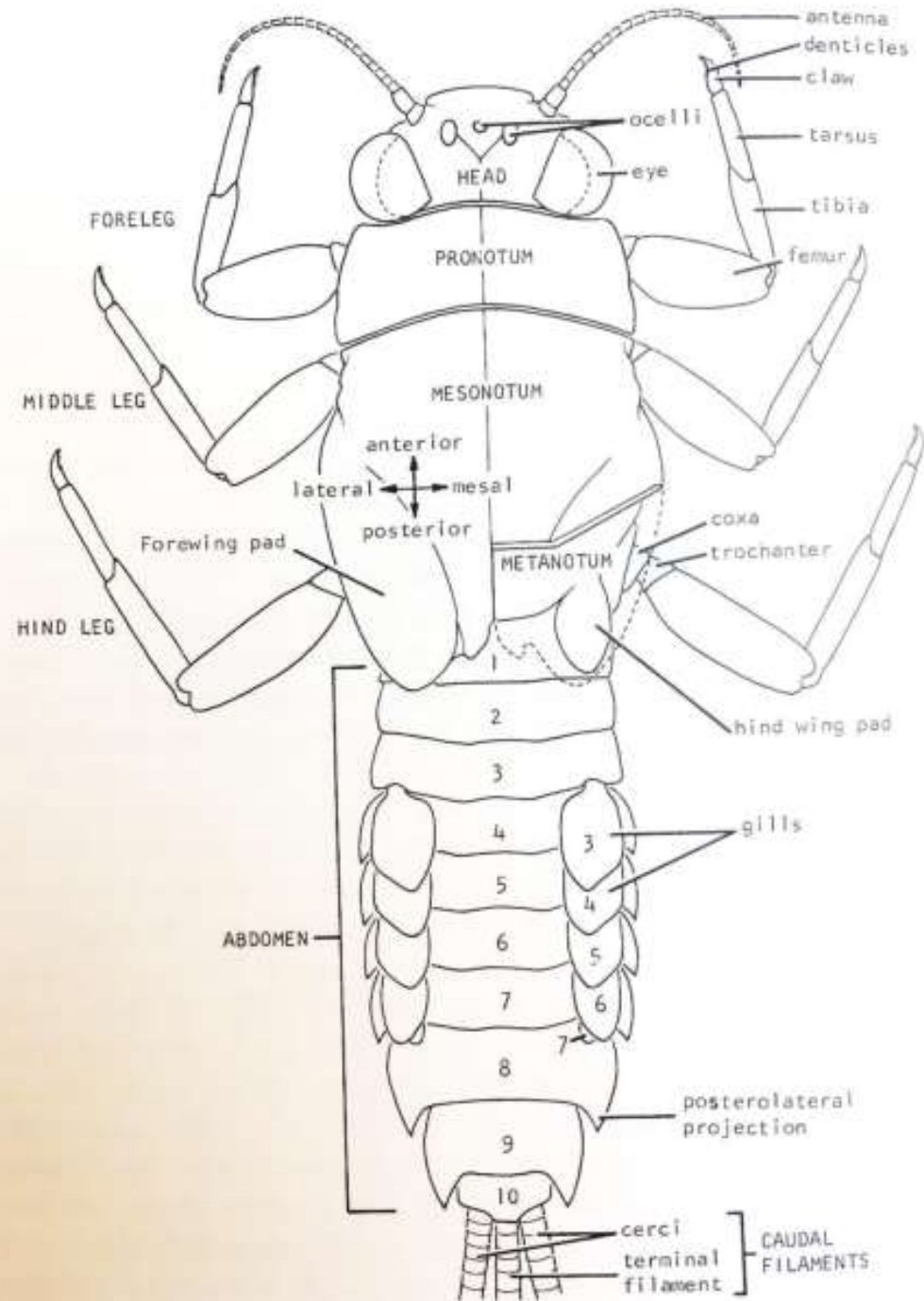
## Dispersal capacity

larvae: frequently drift, good swimmers

adults: weak fliers, but found 5km inland,  
some colonize oceanic islands (800km)



# Ephemeroptera





## Two new genera of Baetidae (Ephemeroptera) from Borneo (East Kalimantan, Indonesia)

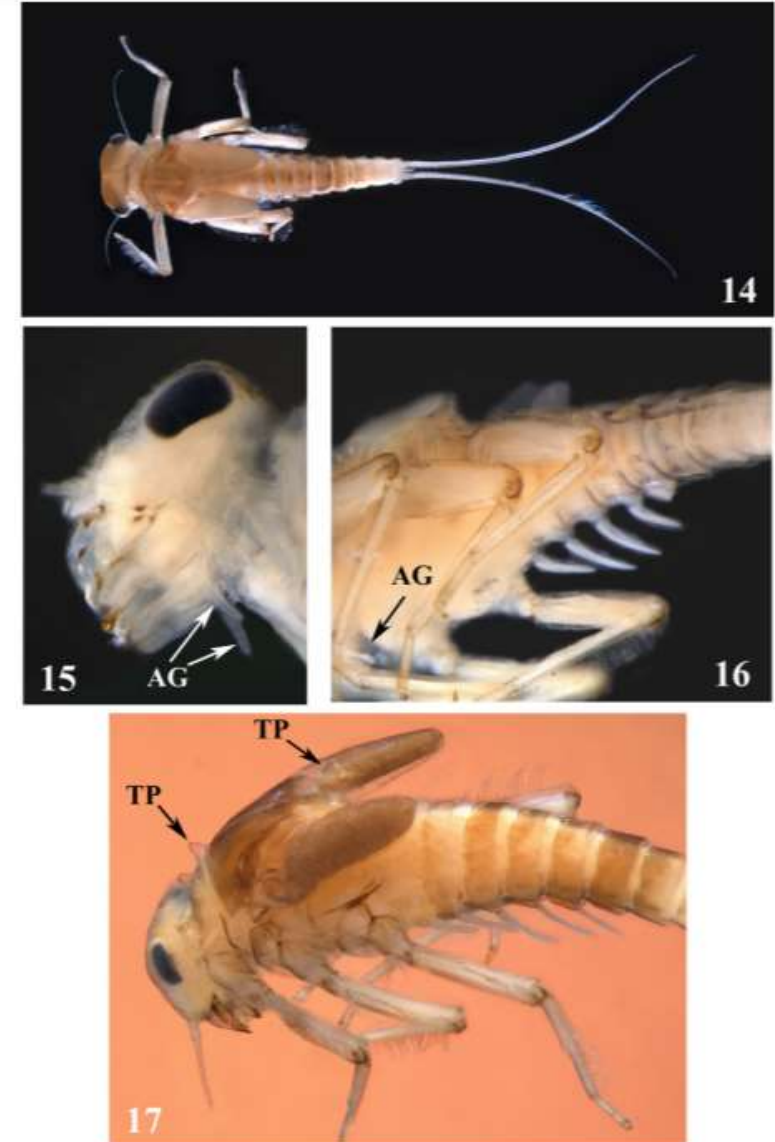
Jean-Luc Gattolliat\*

Museum of Zoology, Palais de Rumine, Place Riponne 6, CH-1014 Lausanne, Switzerland

Received 30 June 2011; Accepted 16 November 2011

**Abstract** – Two new genera of Baetidae are described from East Kalimantan (Borneo): *Asiobaetodes* n.gen. and *Acerobiella* n.gen. Both genera are monospecific and only known from a very restricted area. They are highly adapted to fast flow and are closely related to Oriental genera *Liebebiella* Waltz & McCafferty, 1987 and *Platybaetis* Müller-Liebenau, 1980. *Asiobaetodes* is characterized by five pairs of ventrally orientated gills and tubular accessory gills at the bases of mouthparts and forelegs; these characters are also present in the Panamerican genus *Baetodes* Needham and Murphy, 1924 and the African genus *Afrobaetodes* Demoulin, 1970. The study of the mouthparts clearly indicates that the similarities must be considered as homoplasies. *Acerobiella* is characterised by its dorsal armature, especially the spike tubercles turned upwards on tergum II, which constitutes a unique character among the Baetidae.

**Key words:** Ephemeroptera / Baetidae / *Asiobaetodes* / *Acerobiella* / new genera / Borneo



**Figs. 14–17.** Larval structures of *Asiobaetodes eloi* sp.n.: (14) Dorsal view of male larva. (15) Head (ventro-lateral view; AG = accessory gills). (16) Thorax and abdomen (ventral view; AG = accessory gill). (17) Head, thorax and abdomen (dorso-lateral view; TP = triangular process).

# Tugas menonton

- <https://www.youtube.com/watch?v=E4Al8cwkb4I>



- Diantari, N. P. R., Ahyadi, H., Rohyani, I. S., & Suana, I. W. (2017). Keanekaragaman serangga Ephemeroptera, Plecoptera, dan Trichoptera sebagai bioindikator kualitas perairan di Sungai Jangkok, Nusa Tenggara Barat. *Indonesian Journal of Entomology*, 14(3), 238-243.
- Lillehamnur, A., Brittain, J. E., Saltveit, S. J., & Nielsen, P. S. (1989). Egg development, nymphal growth and life cycle strategies in Plecoptera. *Ecography*, 12(2), 173-186.