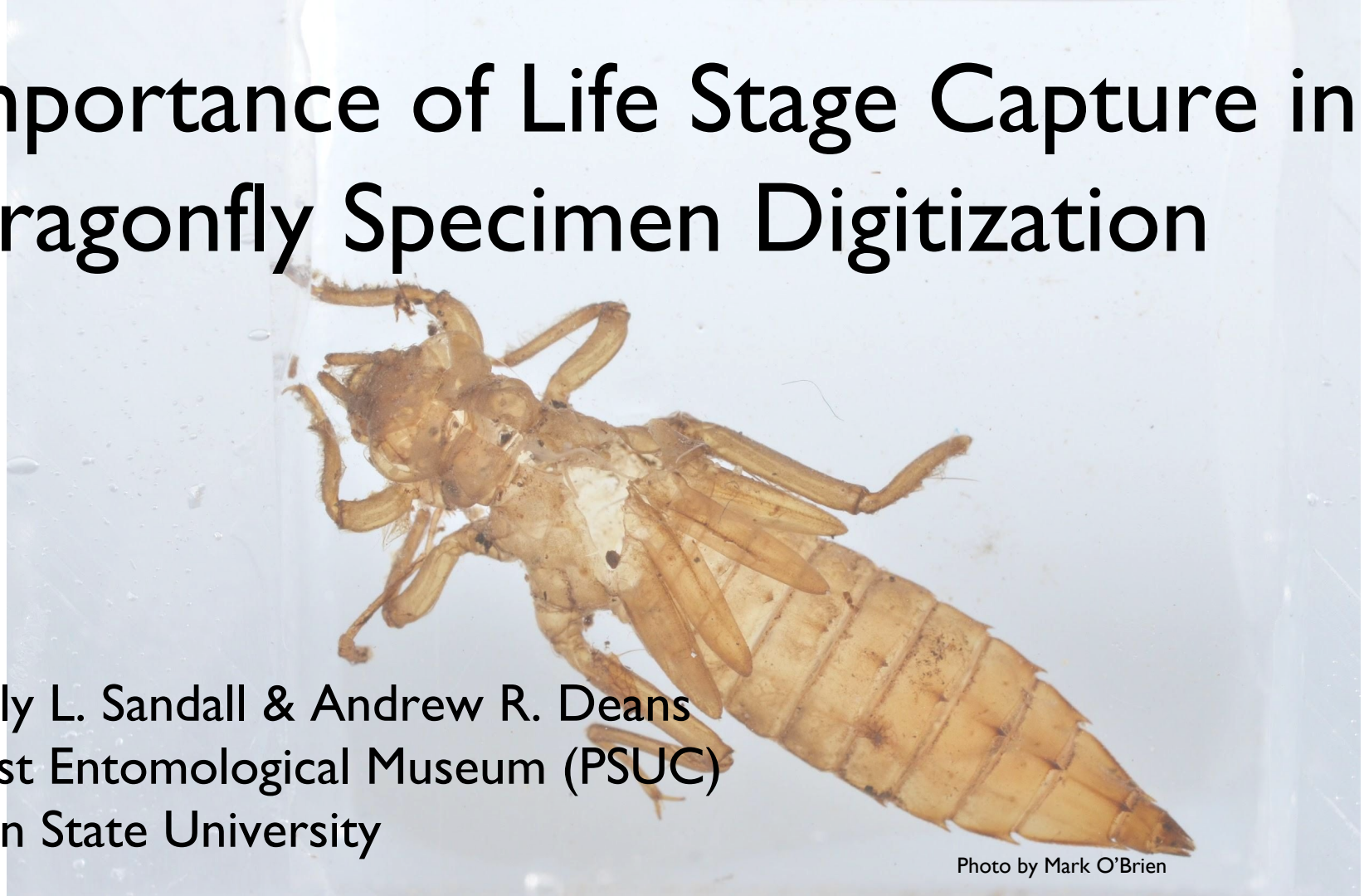
Importance of Life Stage Capture in Dragonfly Specimen Digitization



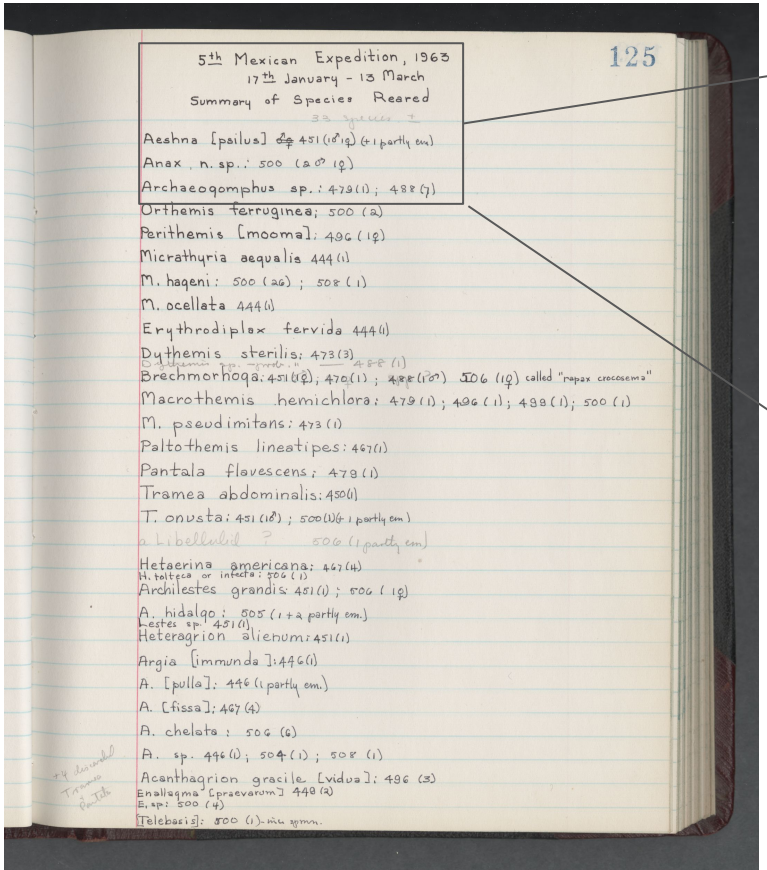
Emily L. Sandall & Andrew R. Deans
Frost Entomological Museum (PSUC)
Penn State University

Photo by Mark O'Brien

Clubtail Dragonflies (Odonata: Gomphidae)

The Beatty Collection

Collecting & Rearing



5th Mexican Expedition, 1963
17th January - 13 March
Summary of Species Reared

125

Aeshna [psilus] ♂♀ 451 (1♂1♀) (+1 partly em)
Anax n. sp.: 500 (2♂ 1♀)
Archaeogomphus sp.: 479 (1); 488 (?)
Orthemis ferruginea: 500 (2)
Perithemis [mooma]: 496 (1♀)
Micrathyria aequalis 444 (1)
M. haageni: 500 (2♂); 508 (1)
M. ocellata 444 (1)
Erythrodiplax fervida 444 (1)
Dythemis sterilis: 473 (3)
Brechmorhoga: 451 (1♀); 479 (1); 488 (1♂) 506 (1♀) called "rapax crocosema"
Macrothemis hemichlora: 479 (1); 496 (1); 498 (1); 500 (1)
M. pseudimitans: 473 (1)
Paltothemis lineatipes: 467 (1)
Pantala flavescens: 479 (1)
Tramea abdominalis: 450 (1)
T. onusta: 451 (1♂); 500 (1) (+1 partly em)
Hetaerina americana: 447 (4)
H. tolteca or infecta: 506 (1)
Archilestes grandis: 451 (1); 506 (1♀)
A. hidalgo: 505 (1+2 partly em.)
Heteragrion alienum: 451 (1)
Argia [immunda]: 446 (1)
A. [pulla]: 446 (1 partly em.)
A. [fissa]: 467 (4)
A. chelata: 506 (6)
A. sp. 446 (1); 504 (1); 508 (1)
Acanthagrion gracile [vidua]: 496 (3)
Enallagma [praevarum] 448 (2)
E. sp: 500 (4)
[Telebasis]: 500 (1) - nn gymn.

5th Mexican Expedition, 1963
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Aeshna [psilus] ♂♀ 451 (1♂1♀) (+1 partly em)
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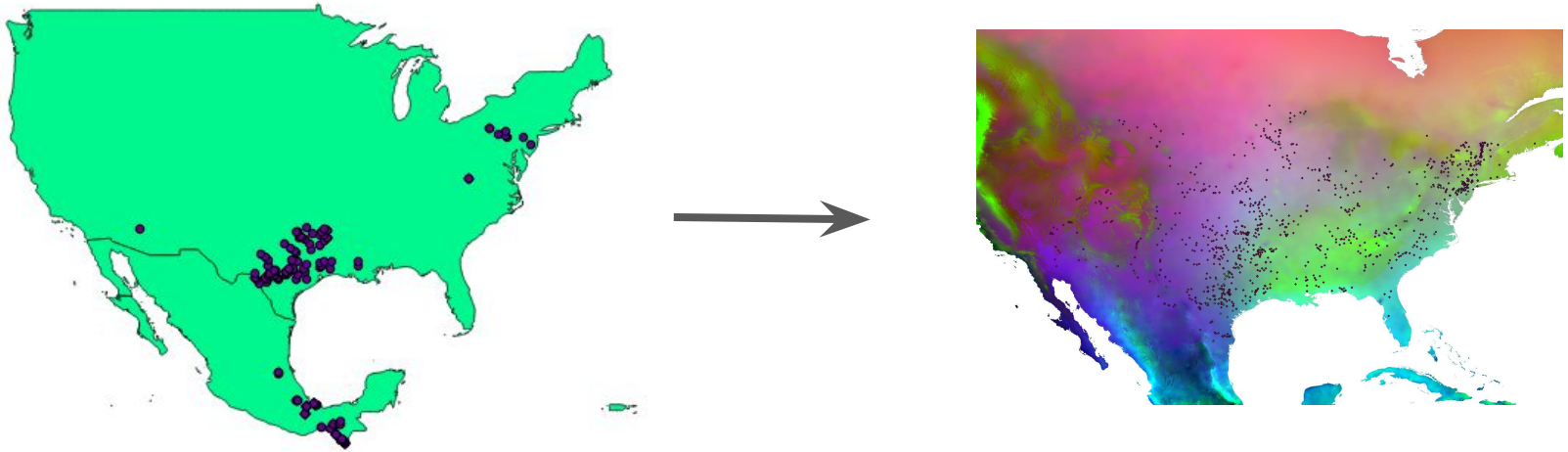
Species Distribution/Niche Modeling



Odonate Life Stages

Photo by Bob Hendricks (CC BY-NC 2.0).

Photo by Judy Gallagher (CC BY 2.0).

Photo by Vicki DeLoach (CC BY-NC-ND 2.0).

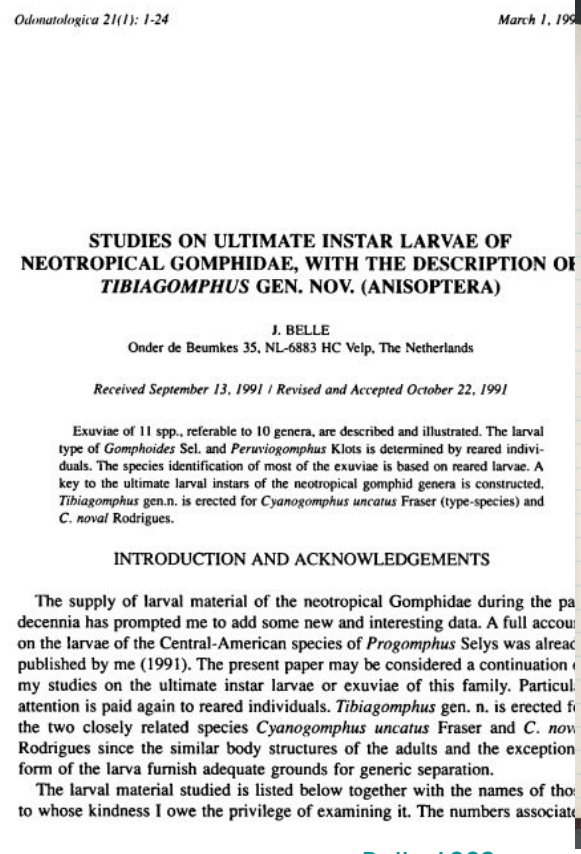
Original Hypotheses

1. Burrowing behavior of larvae present throughout Gomphidae phylogeny, but substrate increasing in size/complexity in younger taxa

2. Divergence of Libellulidae and Gomphidae proposed from larvae both being burrowers/sprawlers and occupying different niches
    a. What are the niches that Gomphidae larvae are filling?
    b. Are collected specimens reflecting these different habitats?

Capturing New Data

Finding Life Stage Records



Odonatologica 21(1): 1-24 March 1, 199

STUDIES ON ULTIMATE INSTAR LARVAE OF NEOTROPICAL GOMPHIDAE, WITH THE DESCRIPTION OF *TIBIAGOMPHUS* GEN. NOV. (ANISOPTERA)

J. BELLE
Onder de Beumkes 35, NL-6883 HC Velp, The Netherlands

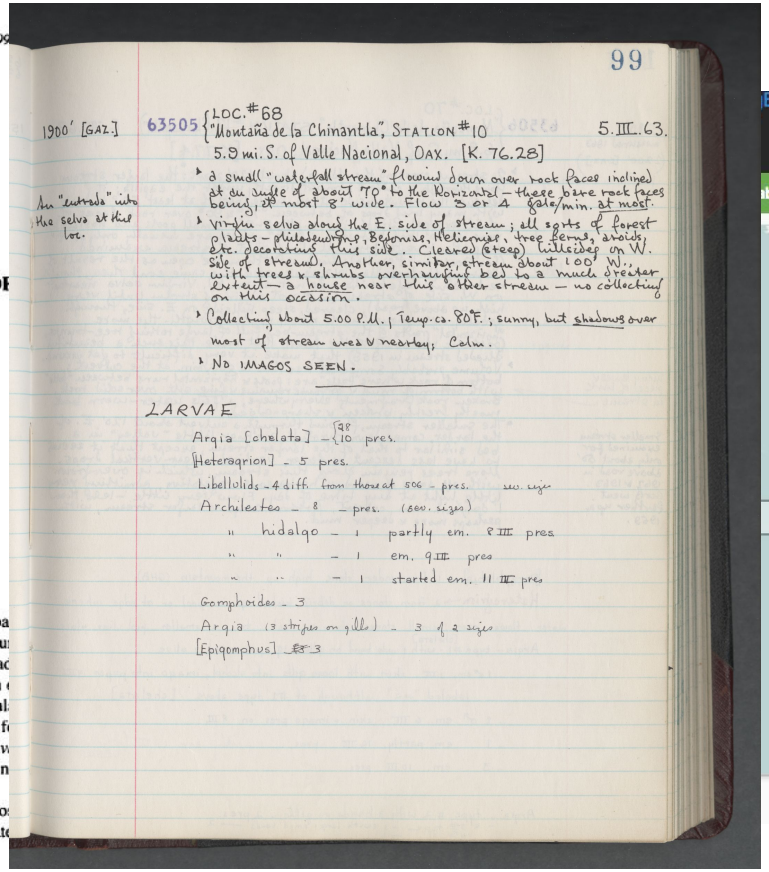
Received September 13, 1991 / Revised and Accepted October 22, 1991

Exuviae of 11 spp., referable to 10 genera, are described and illustrated. The larval type of *Gomphoides* Sel. and *Peruviogomphus* Klots is determined by reared individuals. The species identification of most of the exuviae is based on reared larvae. A key to the ultimate larval instars of the neotropical gomphid genera is constructed. *Tibiagomphus* gen.n. is erected for *Cyanogomphus uncatus* Fraser (type-species) and *C. noval* Rodrigues.

INTRODUCTION AND ACKNOWLEDGEMENTS

The supply of larval material of the neotropical Gomphidae during the pa
decennia has prompted me to add some new and interesting data. A full accou
on the larvae of the Central-American species of *Progomphus* Selys was alread
published by me (1991). The present paper may be considered a continuation
my studies on the ultimate instar larvae or exuviae of this family. Particul
attention is paid again to reared individuals. *Tibiagomphus* gen. n. is erected f
the two closely related species *Cyanogomphus uncatus* Fraser and *C. nov*
Rodrigues since the similar body structures of the adults and the exception
form of the larva furnish adequate grounds for generic separation.

The larval material studied is listed below together with the names of tho
to whose kindness I owe the privilege of examining it. The numbers associat



99

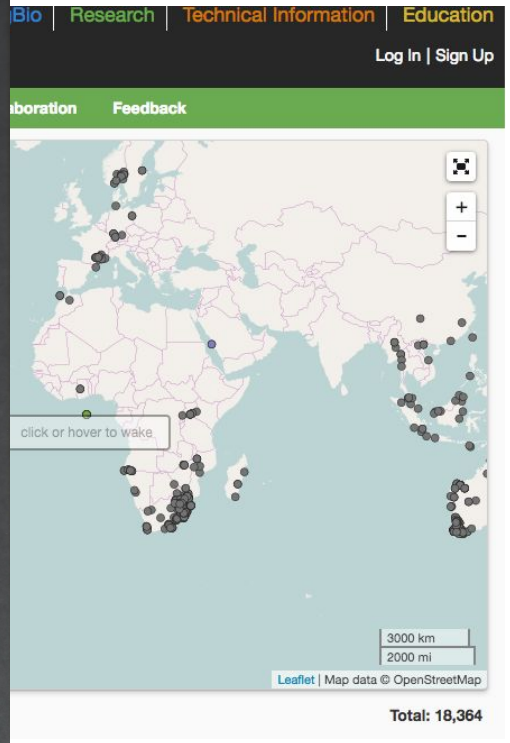
1900' [GAZ.] 63505 {LOC.#68 "Montaña de la Chinantla", STATION #10 5.III.63.
5.9 mi. S. of Valle Nacional, OAX. [K. 76.28]

An "entrada" into the selva at this loc.

- a small "waterfall stream" flowing down over rock faces inclined at an angle of about 70° to the horizontal — these bare rock faces being, at most 8' wide. Flow 3 or 4 gals/min. at most.
- Virgin selva along the E. side of stream; all sorts of forest plants — philodendrons, Begonias, Heliconias, tree ferns, aroids, etc. decorating this side. Cleared (steep) hillside on W. side of stream. Another, similar, stream about 100' W., with trees & shrubs overhanging bed to a much greater extent — a house near this other stream — no collecting on this occasion.
- Collecting about 5.00 P.M.; Temp. ca. 80°F.; sunny, but shadows over most of stream area & nearby; Calm.
- NO IMAGOS SEEN.

LARVAE

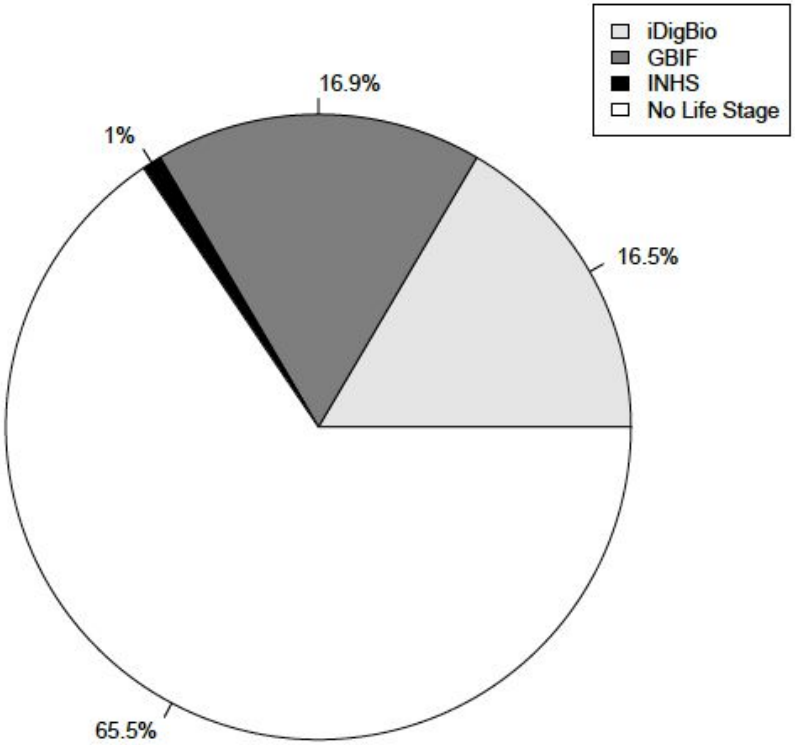
Argia [chelata] — {98 10 pres.
[Heteragrion] - 5 pres.
Libellulids - 4 diff. from thoracat 506 - pres. sev. sizes
Archilestes - 8 - pres. (sev. sizes)
" hidalgo - 1 partly em. 8.III pres.
" " - 1 em. 9.III pres.
" " - 1 started em. 11.III pres.
Gomphoides - 3
Argia (3 stripes on gills) - 3 of 2 sizes
[Epigomphus] ~~- 3~~



Belle 1992

iDigBio 2017

Current Gomphidae Life Stage Capture Levels



Records of Larval Life Stage

GBIF: 99.1 % of records with life stage are adults; .9% of records larvae

- Terms: juvenile, **larva**, nymph, immature

iDigBio: 86.2 % of records with life stage are adults; 2.32 % of records are larvae

- Terms: larva, **juvenile**, nymph, immature

Illinois Natural History Survey: 64.0% of specimens with life stage are larvae

- Term: **immature**

Records of Exuviae

GBIF: 0 specimens labeled as exuviae

iDigBio: 2.45% of specimens with life stage

Terms: **exuviae**, exuvium, exoskeleton

Illinois Natural History Survey: 7.87% of specimens with life stage

Term: **exuvia**

Average Rate of Capture: 2.68% of records with life stage are exuviae

dwc:lifeStage

Life Stage: The age class or life stage of the biological individual(s) at the time the Occurrence was recorded. Recommended best practice is to use a controlled vocabulary.

Notes: The recommended controlled vocabulary includes:

zygote

embryo

larva

juvenile

adult

sporophyte

spore

gametophyte

gamete

pupa

Life Stage Vocabulary (or Lack Thereof)

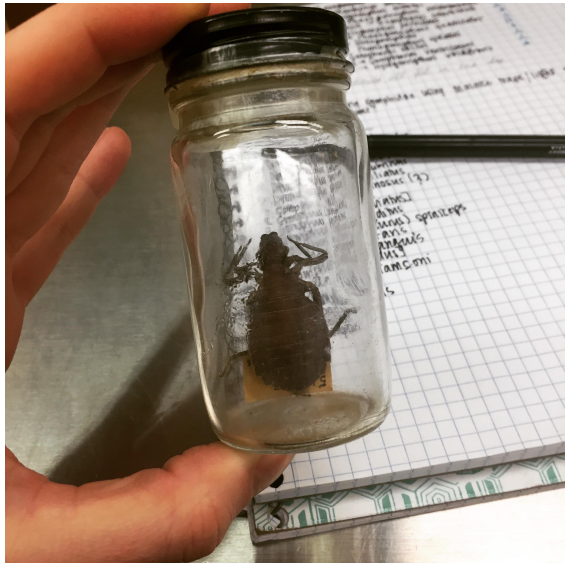
Top Ten ‘LifeStage’ Terms from GBIF

1. Quite rotten
2. Very little
3. Broken
4. A blob of red
5. All perfectly fresh
6. Smaller cuckoo red thread, Rest
7. Dull black plumage
8. >90% pneumatized
9. Some days
10. Quite bloody

Possible Causes for Low Levels of Life Stage Records

- Lack of use of Darwin Core term ‘lifeStage’
- Mismatch of term and data
- Lack of collection of juvenile life forms
  - Convenience?
  - Less knowledge of their natural history?
- Lack of identification of juvenile life forms
- Lack of digitization of juvenile life form-all assumed to be adults
  - Messy storage?
  - Lower priority?

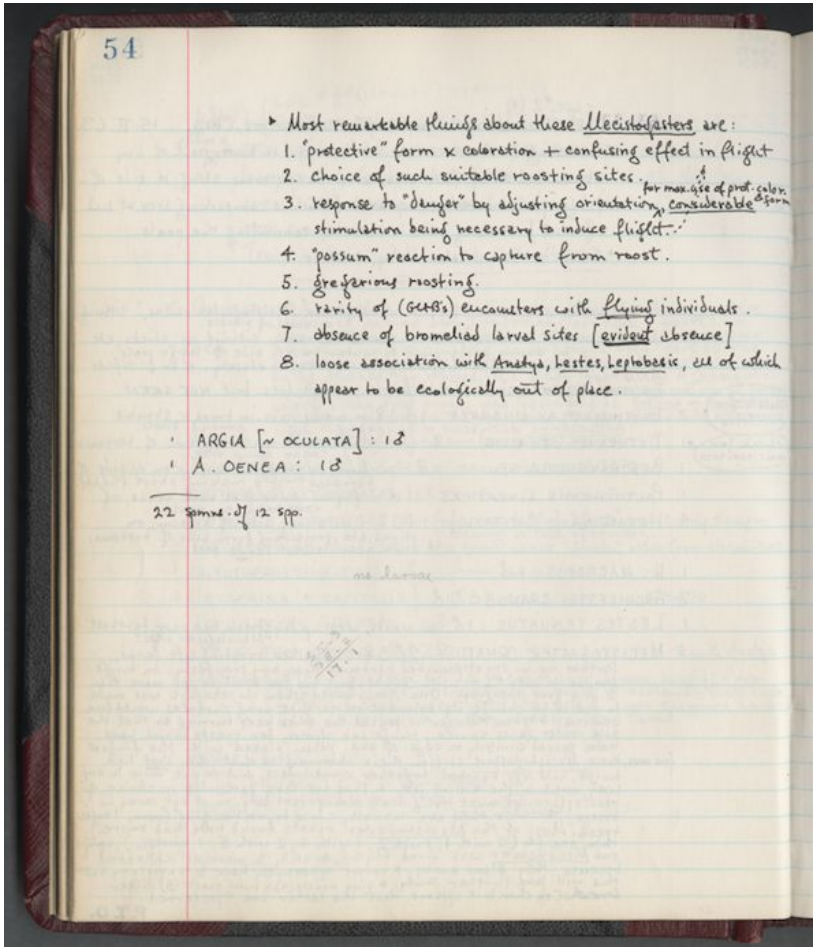
Preservation & Digitization



Possible Effects of Low Levels of Life Stage Records

- Natural history of larvae and exuviae at times poorly understood
- Collecting efforts not maximized
  - Adults can be harder to collect
  - Can collect multiple larvae per pass
- Misleading occurrence recorded
  - Larvae reliably recorded from site of collection
  - Adults patrol, but may have come from elsewhere
  - Exuviae indicative of successful occurrence/emergence
- Less emphasis on larvae, exuviae diagnostics, digitization

Into the Field Notes

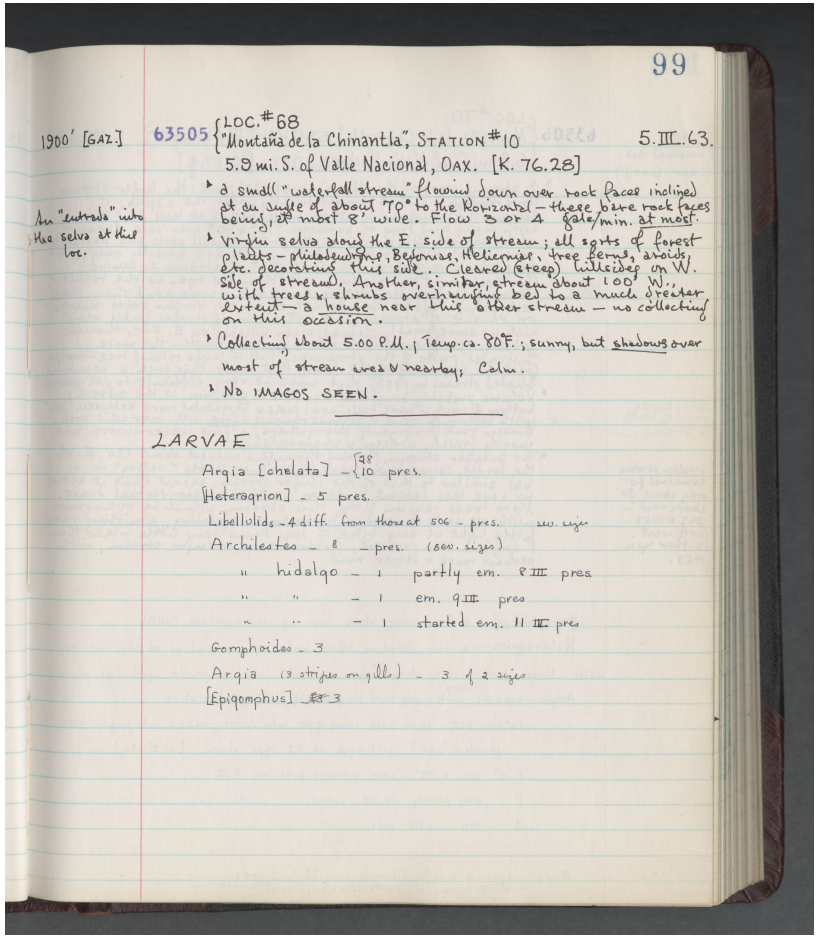


54

▸ Most remarkable things about these Mecistogasters are:
1. "protective" form x coloration + confusing effect in flight
2. choice of such suitable roosting sites. for max. size of prot. color. considerable form
3. response to "danger" by adjusting orientation, stimulation being necessary to induce flight.
4. "possum" reaction to capture from roost.
5. gregarious roosting.
6. rarity of (Getts) encounters with flying individuals.
7. absence of bromeliad larval sites [evident absence]
8. loose association with Anadyas, Hestes, Lestobasis, all of which appear to be ecologically out of place.

· ARGIA [v OCULATA] : 1♂
· A. OENEA : 1♂

22 spms. of 12 spp.



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[Epigomphus] ~~2~~ 3

What Can We Gain From Recording Life Stages?

- Successful emergence (Lubertazzi & Ginsberg 2009)
  - What triggers this emergence?
  - Start of reproductive period
- Accurate occurrence records (Raebel et al 2010)
- Designated types (Gloyd 1936)
  - Original description often for adult stage, but sometimes larval stage is included-important to have a type of each stage described
- Rearing information/possibility (Rice 2008)
- Water body information (Samways & Steytler 1996)
- Changes in populations in an area following disturbance (Dolný et al 2011)
- More immature stages to analyze
  - Useful for separating species in some genera (ie Gomphus)

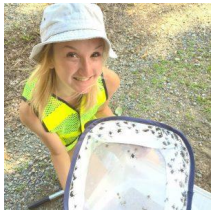
Suggestions Moving Forward

1. Record life stage when digitizing records
2. Establish a controlled vocabulary for digitization projects
3. Ensure that that appropriate field is being used
4. Link field note data to specimen data

Acknowledgments

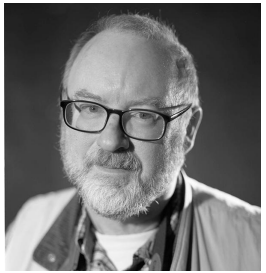
FROST ENTOMOLOGICAL MUSEUM





Rachel Davis, Kelsey VanHorn, Lindsay Erndwein

PennState University Libraries



Mark O'Brien

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ODONATA CENTRAL

Survey on the Conference Wiki

Please take the survey about biodiversity data in publications on the conference wiki page! You can find it here at https://docs.google.com/forms/d/1Ji5oHAJ2KvqDsFkH0RsINDOMLIIj6oAfsZT089gYnDk/edit.

Thank you!