Phylogeny and evolution of large body size in the rove beetle genus *Phlaeopterus* Motschulsky, 1853

(Coleoptera: Staphylinidae: Omaliinae: Anthophagini)

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Alaska Entomological Society – 15 minute talk
(online), 30 January 2021

Outline

1. History & Background
2. Goals & Questions
   Do the large bodied species form a monophyletic group?
3. Phylogenetic Methods
4. Results - Phylogeny

History & Background

Coleoptera: Staphylinidae

Omaliinae - 6 tribes, 117 genera, 1,500+ species

Anthophagini ~ 40 genera

Phlaeopterus Motschulsky, 1853

History & Background

Phlaeopterus Motschulsky, 1853 *the first 148 years**

MOTSCHULSKY (1853)	+ 1 species
FAUVEL (1878)	+ 1 species
CASEY (1885, 1886, 1893)	+ 3 species
HATCH (1957)	+ 4 species
SHAVRIN (2001)	+ 1 species (Siberia)
	=10 species

* Not all named in *Phlaeopterus*, does not include now invalid names or species moved out

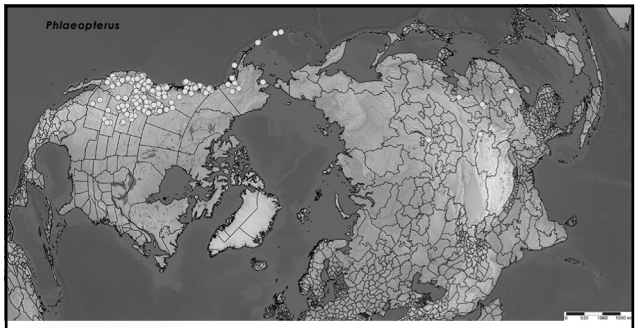
History & Background

Phlaeopterus Motschulsky, 1853

MULLEN, CAMPBELL, SIKES (2018) – revision, key
8 new species, 2 removed, synonymies

SHAVRIN (2020) – added 4 species from China
1 new species, 3 added from *Lesteva* Latreille, 1797

= 22 species currently

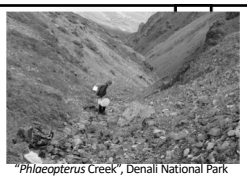


mountainous regions NW North America (17 spp) eastern Asia (5 spp)

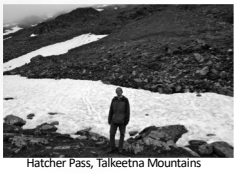
Ecology

Alpine snowfields, cold, cascading streams, waterfalls

Feed on arthropod fallout on snowfields



"*Phlaeopterus* Creek", Denali National Park



Hatcher Pass, Talkeetna Mountains

Phlaeopterus feeding on arthropod fallout

Extinctions?

Two new (2018) species
not collected in over 36 years

Phlaeopterus bakerensis - 1979
Phlaeopterus olympicus - 1984

Known only from Washington state

- *P. bakerensis* = 10 mm max (giant)
- sites have been visited

Scalzitti, J., Strong, C. and Kochanski, A., (2016) Climate change impact on the roles of temperature and precipitation in western US snowpack variability. Geophysical Research Letters, 43(10): 5361-5369.

Nature of Southeast Alaska: A Guide to Plants, Animals, and Habitats

Goals & Questions

1) Estimate the phylogeny
2) Do morphology-based species demarcations correspond to discrete mtDNA lineages?
3) Test prior hypotheses of species relationships

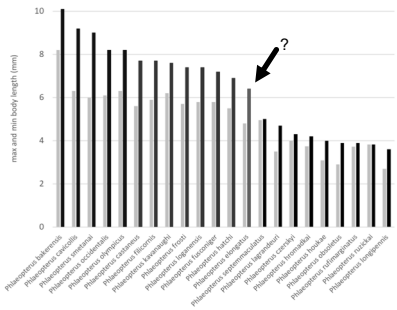
Do the large bodied species form a monophyletic group? – as proposed by Campbell

Body lengths of *Phlaeopterus* species

grey columns – min.

colored columns – max.

Data from
MULLEN et al. (2018)
SHAVRIN (2020).



***Phlaeopterus* species size variation**

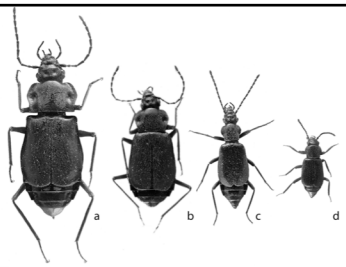
Maximum size: 2 states

(0) less than 5.0 mm;

(1) greater than 6.0 mm

represents Milt Campbell's hypothesis that the large-bodied species form a monophyletic group.

All large bodied species are snowfield associated



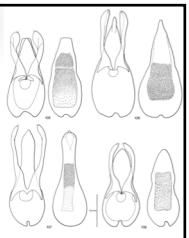
a)	*Phlaeopterus bakerensis*	~ 10 mm	very large & wide
b)	*Phlaeopterus kavanaughi*	~ 7.6 mm	large & wide
c)	*Phlaeopterus elongatus*	~ 6.4 mm	large & narrow
d)	*Phlaeopterus obsoletus*	~ 3.9 mm	small

Methods

<u>Morphological data</u>

18 of 22 species (type specimens if possible)
Outgroup - 4 *Lesteva, 1 Unamis*
40 characters, (MULLEN et al. 2018)
Mesquite v3.6
Mkv model
Specimens from

University of Alaska Museum
California Academy of Sciences
Canadian National Collection of Insects



Methods

Molecular data

164 DNA barcode sequences, 403–654 bp each
9 of 22 *Phlaeopterus* species
Outgroups: 6 *Lesteva* spp. 1 *Unamis* sp.
Specimens from

- University of Alaska Museum
- Canadian National Collection of Insects
- California Academy of Sciences
- Santa Barbara Museum of Natural History
- Field Museum of Natural History
- Smithsonian Museum of Natural History
- University of Idaho William F. Barr Entomological Museum
- Brigham Young University Monte L. Bean Life Science Museum

Methods

Molecular data

Mesquite v3.6
PartitionFinder 2.1.1 - CIPRES Science Gateway
Partition by codon position

- 1st TRN+G
- 2nd TIM+I
- 3rd GTR+G

(MrBayes 1st & 3rd GTR+G, 2nd GTR+I+G)

Methods

Analyses

Concatenated, COI, Morphology

Garli 2.01 & MrBayes 3.2.7a

Partition COI by codon position, morphology as 4th

CIPRES Science Gateway

Combined analysis

Bayesian MJ contree

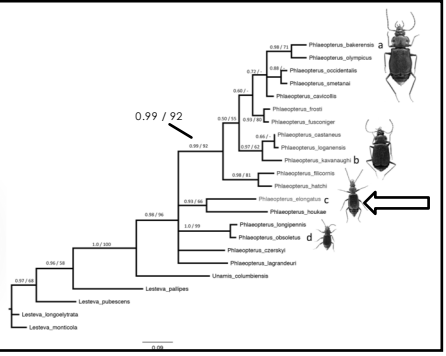
Posterior probabilities

ML Bootstrap values

Large bodied species (blue, red, green)

NOT monophyletic

due to *P. elongatus*



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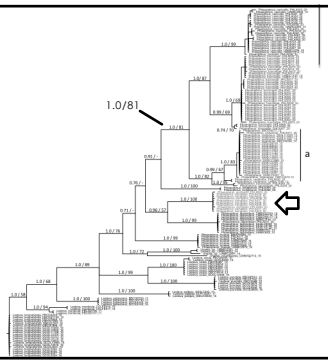

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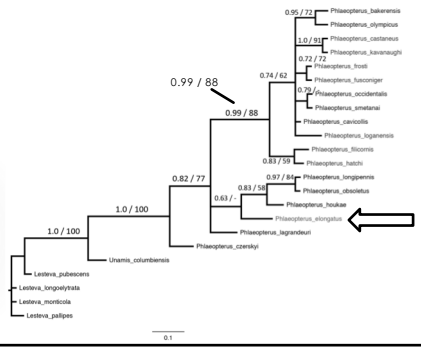

Bayes Factors (KASS & RAFTERY 1995) were used to compare two Stepping-stone MrBayes analyses, with partial topological constraints enforced that tested the monophyly of the large bodied species.

Data	Marginal Likelihood Mean with *P. elongatus*	Marginal Likelihood Mean without *P. elongatus*	Bayes Factor
Concatenated	-3171	-3168	6.14**
COI	-4956	-4950	13.34***

** Strong evidence
*** Very strong evidence

Large body size (5 mm+) in *Phlaeopterus* evolved twice

Conclusions

1) Large body size (5 mm+) evolved twice in *Phlaeopterus* (due to *P. elongatus*)
2) Large, wide bodied species form a clade
3) Ancestor was small-bodied

Expect publication in next few months

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