

Latitudinal diversity gradient of ichneumonids / taxonomy of Amazonian ichneumonids

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- **Natural History Collections**
 - Zoology (4 million samples)
 - Botany (1.2 million samples)
 - Botanical Garden (5500 species)
 - Natural History Collections of the Åbo Akademi University
- **Field Stations**
 - Archipelago Research Institute (island of Seili)
 - Subarctic Research Institute (Kevo)
- **Aerobiology Unit** (pollen forecasts)
- **Science Centre**



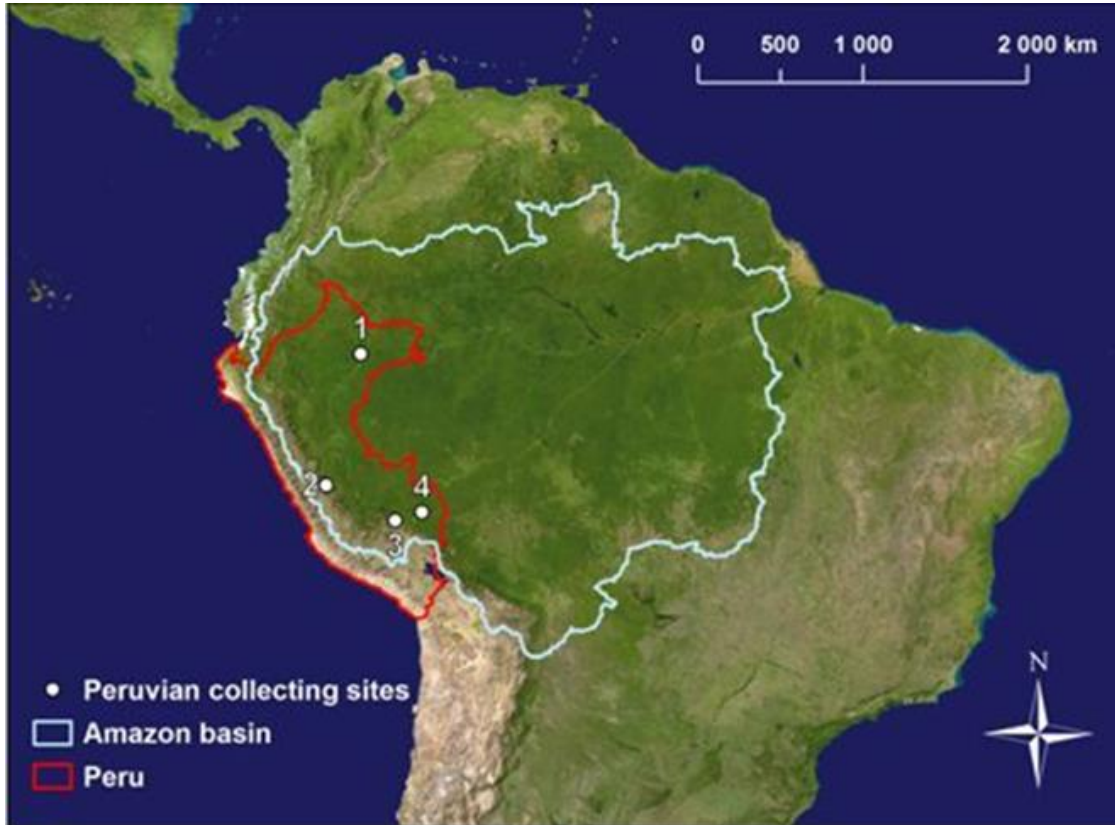


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Diversity of ichneumonids

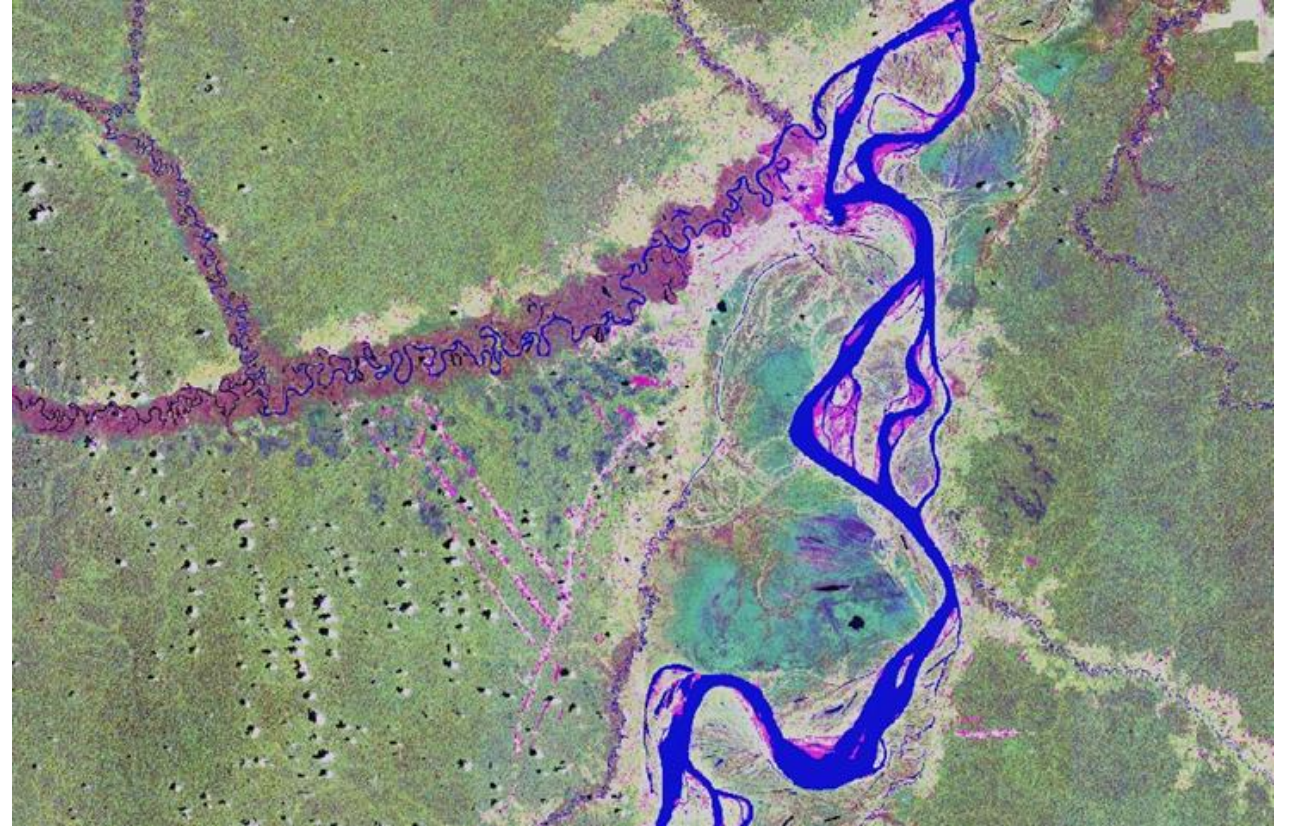
- Many studies (since Owen & Owen 1974) have shown that ichneumonids have an exceptional latitudinal species richness gradient that peaks at mid-latitudes.
- The gradient has been hypothesized to be dependent on the biology of the wasps / hosts, but questions on sampling and description biases have also been raised.
- Owen & Owen 1974: *“a quite extraordinary number of species was found once”*
- None of the early ichneumonid diversity gradient studies included South American data or long-term tropical data sets

Peruvian Amazonian study sites



Allpahuayo-Mishana

- Allpahuayo-Mishana is located close to the city of Iquitos (about 25 km southwest of it), in the Department of Loreto
- Rain forests near the city of Iquitos are famous for their habitat heterogeneity and extreme species richness
- Malaise trapping, sweeping, light trapping, yellow pan trapping, rearing host larvae...

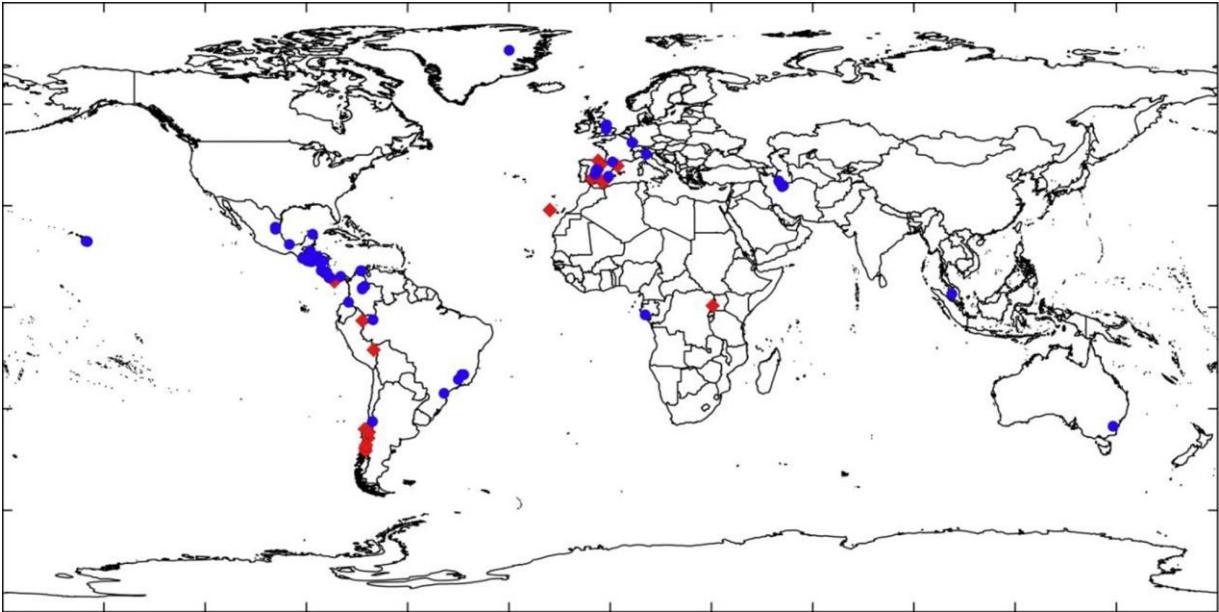
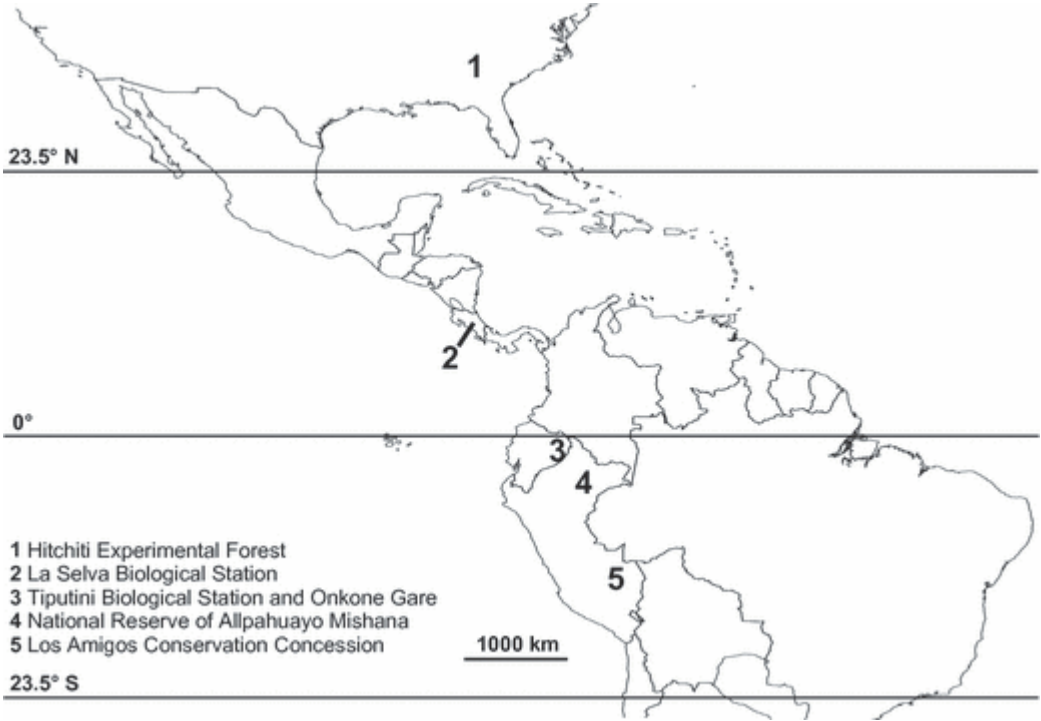
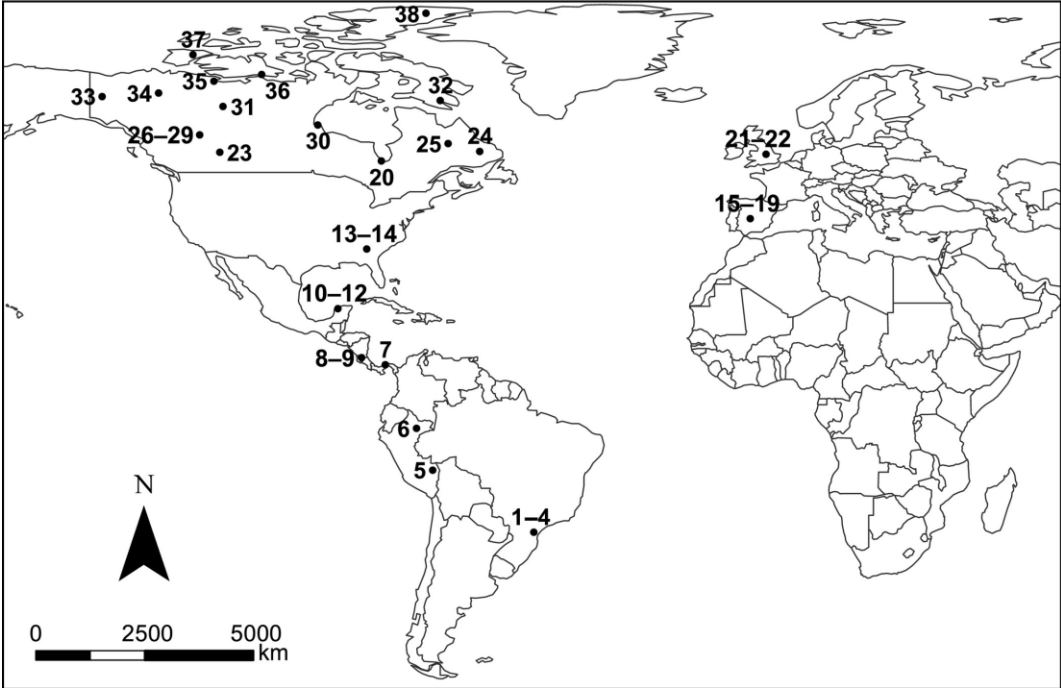


Afrotropical study site (Uganda, Kibale)



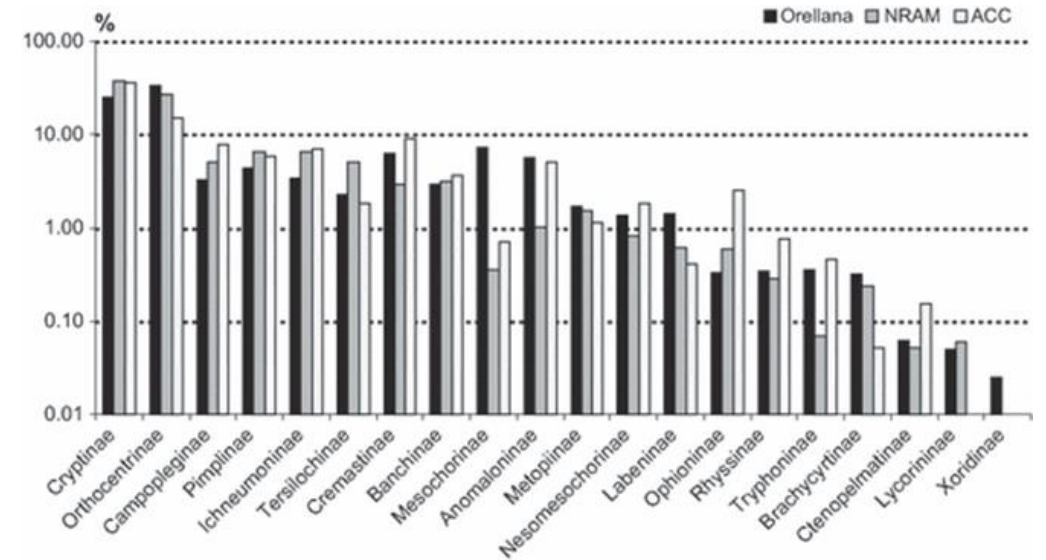
Photos: Tapani Hopkins

Global data sets: Timms et al. 2016, Veijalainen et al. 2013, Gómez et al. 2017



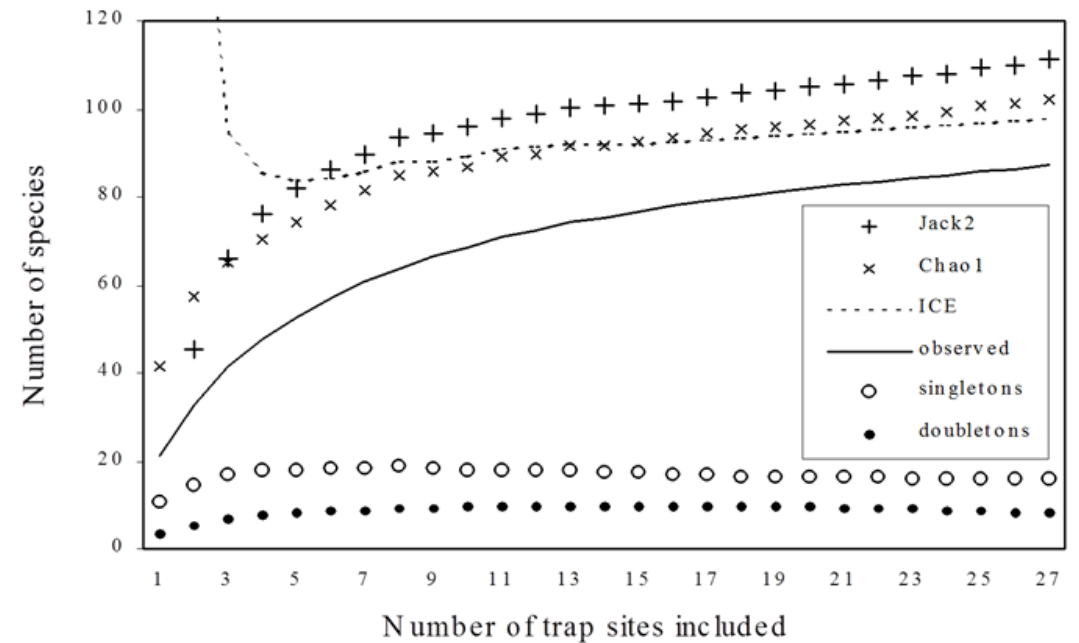
Amazonian ichneumonids

- In total, approx. 30 000 Amazonian ichneumonid individuals have been collected belonging to 22 subfamilies (two of them reported as new from South America / Peru)
 - **257 MTM's**; canopy fogging etc.
 - all samples with supporting botanical data (botanical transects in trap sites)
 - Cryptinae (24.7–38.0%) and Orthocentrinae (15.2–34.1%) are clearly the two most abundant subfamilies in all data sets, followed by the rest in a gradually declining order (Veijalainen et al. 2013)
- Subfamily abundance seems to be a good indicator of subfamily species richness (Timms et al. 2016)



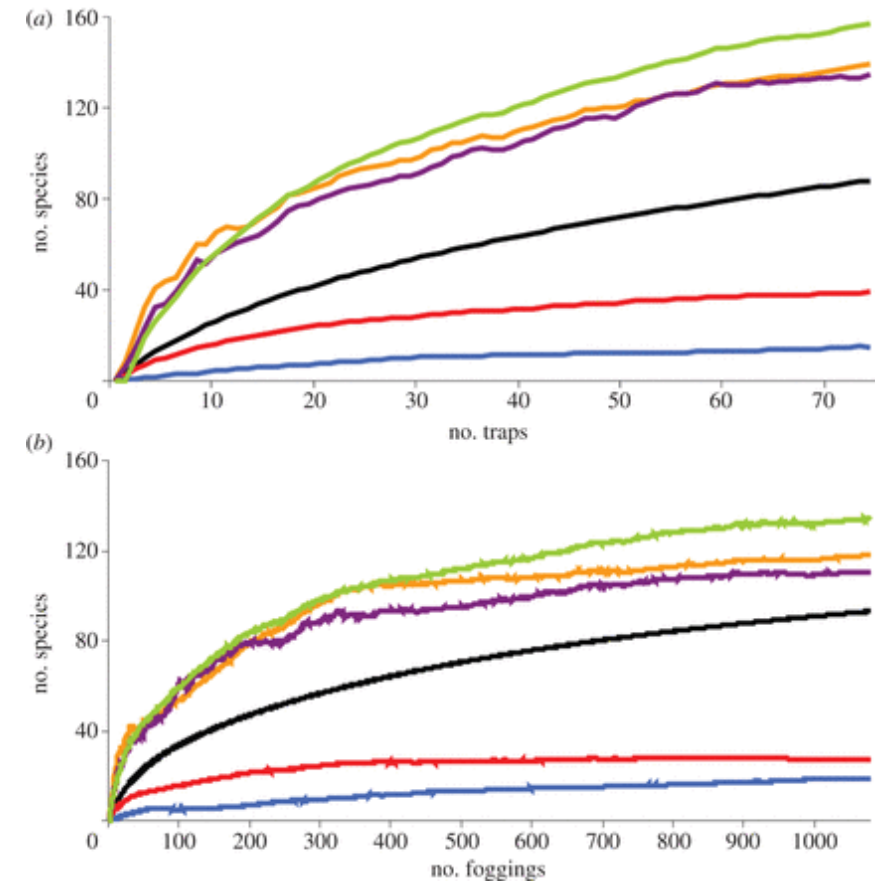
Amazonian idiobionts

- Certain ichneumonid subfamilies and tribes (for example Pimplinae, Rhyssinae, Ophioninae and Cryptini) have been observed to be at their richest in tropical regions
- A comparison with results from Mesoamerica revealed that at equal numbers of individuals sampled, the number of Pimplinae and Rhyssinae species in Peruvian Amazonia is at least twofold compared with lowland locations in Mesoamerica (Costa Rica)
- **The highest observed species richness in any locality for pimelines and rhyssines, 105 species**
 - Even higher richness in certain tropical Andean valleys (in prep.)
 - 2 new genera of pimelines in prep.
- Sääksjärvi et al. 2004, Gómez et al. 2017



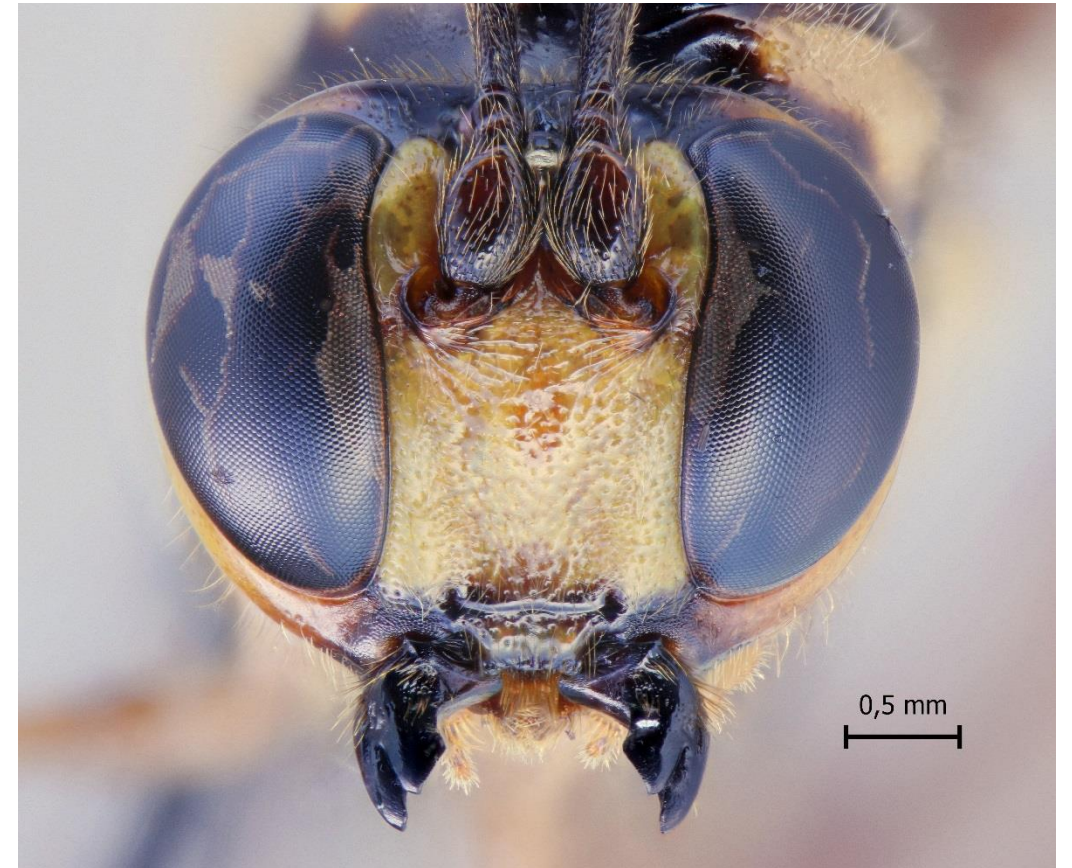
Amazonian koinobionts

- Recent evidence suggest that especially the small-bodied koinobiont species might be overlooked or undersampled in the tropics.
- We examined 1549 individuals of Orthocentrinae (1078 from Ecuador and 471 from Central America) that included a minimum of 177 morphospecies which is over three times the number of currently described tropical orthocentrine species
- Banchinae data set in prep.
- Veijalainen et al. 2012



Afrotropical ichneumonids

- 382 MTM's, 100 000 ichneumonids (but less species in comparison with Amazonia... 😊)
- Hopkins, T., Roininen, H. & Sääksjärvi, I.E. 2018: Assessing the species richness of Afrotropical ichneumonid wasps with randomly placed traps provides ecologically informative data. *African Entomology* 26(2): 350-358.
- Hopkins, T., Roininen, H. & Sääksjärvi, I.E. 2019: Extensive sampling reveals the phenology and habitat use of Afrotropical parasitoid wasps (Hymenoptera: Ichneumonidae: Rhyssinae). *Royal Society Open Science* 6: 190913.
- Hopkins, T., Roininen, H., van Noort, S., Broad, R.G., Kaunisto, K. & Sääksjärvi, I.E. In press: Extensive sampling of Afrotropical Rhyssinae (Hymenoptera: Ichneumonidae) reveals two new species and demonstrates the limitations of previous sampling efforts. *ZooKeys*.
- Amazonian-African comparison (in prep.)



Conclusions and our goal

- Sampling and description of tropical ichneumonids has been inadequate to draw clear conclusions about the large-scale species richness patterns in Ichneumonidae.
- **Studying tropical ichneumonids requires long-term sampling programmes.**
- Collaboration?
 - Our samples are available for all of you
 - New application: Tropical ichneumonids and large-scale changes in Amazonia...Going back to Amazonia! 😊





