The elephant in the room

Ecological and evolutionary implications of cryptic species

June 13th, 2016 | 9:00 – 14:00
Tøyen hovedgård (Monrads gate)
Natural History Museum, Oslo

Cryptic species refer to species groups with low (or even absent) morphological differentiation despite high genetic divergence. These species can be seen as taxonomic artifacts fueling the debate about species delimitation and ultimately highlighting the necessity for a taxonomical approach integrating morphological, behavioral, ecological, evolutionary and molecular data in the process of species delimitation.

On the other hand, cryptic species can also represent cases of extreme morphological conservationism between lineages (morphological stasis). Our understanding of the actual ecological and evolutionary processes maintaining cryptic species in the face of substantial genetic divergence is very limited. For instance: How can different lineages maintain morphological similarity for a few million years even when challenged by environmental changes? How can sympatric cryptic species share ecological spaces or niches (e.g., ecological redundancy)? What are the implications of cryptic species in community organization (e.g. phylogenetic community structure)?

In this symposium our invited speakers will address these topics with a special emphasis on ecological and evolutionary challenges imposed by species with a highly conserved morphology. We would like to invite you to the symposium providing a platform for discussions these interesting biological questions from a broader and interdisciplinary perspective beyond taxonomy.

Our key-note speakers include:

Dr. Eugene Hunt, Department of Paleobiology, National Museum of Natural History, Smithsonian Institution

Dr. Sarah Samadi, Department Systematique & Evolution, Museum National D'Histoire Naturelle

Dr. Jeffrey Feder, University of Notre Dame

After the talks we will have a casual lunch to meet and greet with the speakers. Pizza will be served outside the Botanical Museum (if there is bad weather, we move inside).

Form to sign up till June 6th:

https://nettskjema.uio.no/answer/72612.html

Schedule

Time	Speaker	Title
9:00 – 9:15	Torsten H. Struck (Naturistorisk Museum, Univ. of Oslo)	Welcome address: Introduction about cryptic species and the elephant in the room
9:15 – 10:15	Sarah Samadi (Muséum National d'Histoire Naturelle)	Defining Species and speciation in the conceptual framework of the Evolutionary Theory
10:15 – 10:45	Coffee break	
10:45 – 11:45	Gene Hunt (National Museum of Natural History, Smithsonian Inst.)	The fossil record of stasis and change: implications for cryptic species
11:45 – 12:00	Coffee break	
12:00 – 13:00	Jeffrey Feder (University of Notre Dame)	Sequential Divergence and the Origin of Cryptic Biodiversity across Trophic Levels
13:00 – 14:00	Lunch	

Venue - Tøyen hovedgård (Monrads gate)

(How to get there: https://goo.gl/maps/Rz7aLsbkfGR2)

Defining Species and speciation in the conceptual framework of the Evolutionary Theory

Sarah Samadi
Muséum National d'Histoire Naturelle, Institut de Systématique, Evolution, Biodiversité (ISyEB), Sorbonne 75005 Paris, France

The title of Darwin's book "on the origin of species" underlines the importance of the species category in the description the diversity of organisms and reminds us that the Evolutionary theory aims at providing scientific explanation to this diversity. Nevertheless, the definition of the species concept has often been treated as an unsolvable question. The development of the last decade showed that most of the debates result from the confusion between how the species category should be defined and how individual species are empirically recognized. In this presentation I will place the concepts of "species" and "speciation" in the formal framework of the Evolutionary Theory and I will discuss the consequences for empirical studies of species diversity and speciation processes. This framework should provide a basis for discussing the question of "cryptic species" using some examples.

The fossil record of stasis and change: implications for cryptic species

Gene Hunt

Department of Paleobiology, National Museum of Natural History, Smithsonian Institution, Washington DC 20013-7012;

The fossil record is the most direct source of information about how species' phenotypes evolve over significant periods of time. Here I review what the empirical fossil record reveals about typical patterns and magnitudes of phenotypic change within species-level lineages, and the bearing of these findings on understanding the phenomenon of cryptic species. Eldredge and Gould's punctuated equilibrium model has a complex relationship to this issue: the linkage of lineage splitting to bursts of phenotypic evolution would seem inconsistent with genetically distinct yet morphologically undifferentiated sister taxa, but the emphasis on morphological stasis is of direct relevance. I review analyses of compiled case studies that shows stasis to be commonly observed in fossil lineages, and discuss how the frequency and nature of stasis has implications for understanding the expected frequency and duration of cryptic status. Finally, I present initial results of a survey of a fossil ostracode fauna for which we can present fairly crude, but potentially useful, estimates of the proportion of fossil species that harbor cryptic diversity.

Sequential Divergence and the Origin of Cryptic Biodiversity across Trophic Levels

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Cryptic diversity is all around us, perhaps more than we can imagine. One system where this may be true involves plant-eating specialist insects and the parasitoid insects that attack them. Phytophagous insects and their parasites together represent the most speciose group of multi-cellular organisms, comprising an estimated 25-40% of the world's biodiversity. They are often small and difficult to distinguish. Moreover, phytophagous insects and their parasites may often be involved in multi-trophic, co-evolutionary arms races, and escape and radiate games of hide and seek, accelerating their rates of diversification. As a result, when a phytophagous insect divergences it can create new niche opportunities for the parasites that attack it to exploit, potentially leading to the genesis of many new parasitoid taxa in a process termed "sequential divergence." Here, my colleagues and I test for such a multiplicative effect of sequential divergence in a community of host-specific, cryptic parasitoid wasps, *Diachasma alloeum*, *Utetes canaliculatus* and *Diachasmimorpha mellea* (Hymenoptera: Braconidae), that attack sibling species of *Rhagoletis pomonella* fruit flies (Diptera: Tephritidae). Flies in the *R. pomonella* species complex radiated by sympatrically shifting and ecologically adapting to new host plants, the most recent example being the apple-infesting host race of *R. pomonella* formed from hawthorn-infesting flies within the last 160 years. Using population genetics, field-based behavioral observations, host fruit odor discrimination assays, and analyses of life history timing, we show that the same host-related ecological selection pressures that differentially adapt and reproductively isolate *Rhagoletis* to their respective host plants (host-associated differences in the timing of adult eclosion, host fruit odor preference and avoidance behaviors, and mating site fidelity) cascaded through the ecosystem and induce host-associated genetic divergence for each of the three members of the parasitoid community. Thus, divergent selection at lower trophic levels can potentially multiplicatively and rapidly amplify cryptic biodiversity at higher levels on an ecological time scale, which may sequentially contribute to the rich diversity of life. There may be many more species of plant-feeding specialist insects and their parasitoids in the world than we think.