

# Imageomics(.org):

Images

as the Source of Information about Life



# Guiding questions

- ▶ How do you combine seemingly incompatible data sets to enable machine learning?
  - ▶ Still too much labor
- ▶ How do we promote reproducible research to our members and students?
  - ▶ Train domain scientists (Imageomics course), CV4Ecology
- ▶ **How do you impose scientific rules (inductive Bias) within your algorithms?**
  - ▶ **We are all about this!!! Knowledge-guided ML**
- ▶ The need for real world open data sets that are messy, but convey key concepts. How do you best deal with handling real world data?
  - ▶ We only have real world data. Lots of agreements, negotiations, domain conversations. But how do we design technology that promotes collaboration and data sharing and enables participation of non-scientists?
  - ▶ **Imagine All the People: Citizen Science, Artificial Intelligence, and Computational Research**

*A Computing Community Consortium (CCC) Quadrennial Paper*

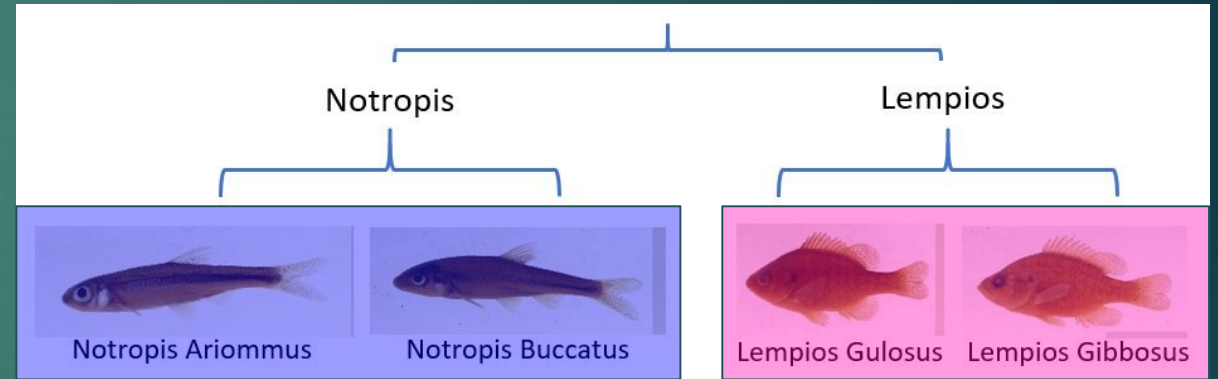
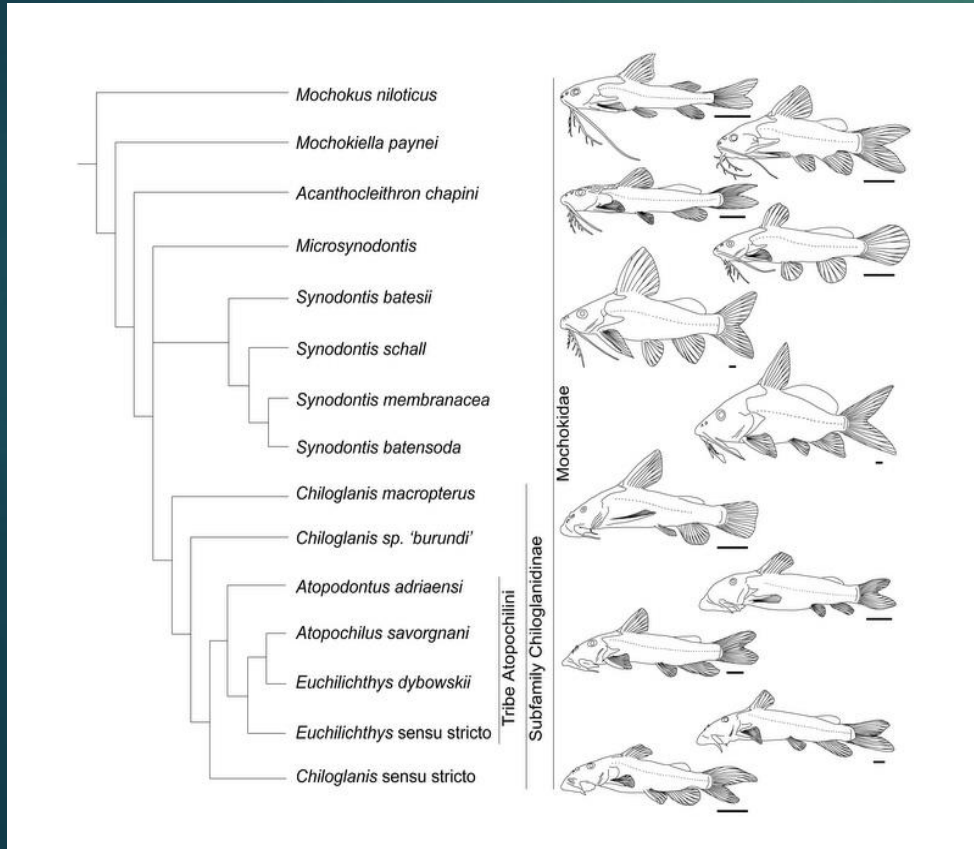
*Lea A. Shanley, Lucy Fortson, Tanya Berger-Wolf, Kevin Crowston, Pietro Michelucci*

<https://cra.org/ccc/wp-content/uploads/sites/2/2021/03/CCC-TransitionPaperImagine-All-the-People.pdf>



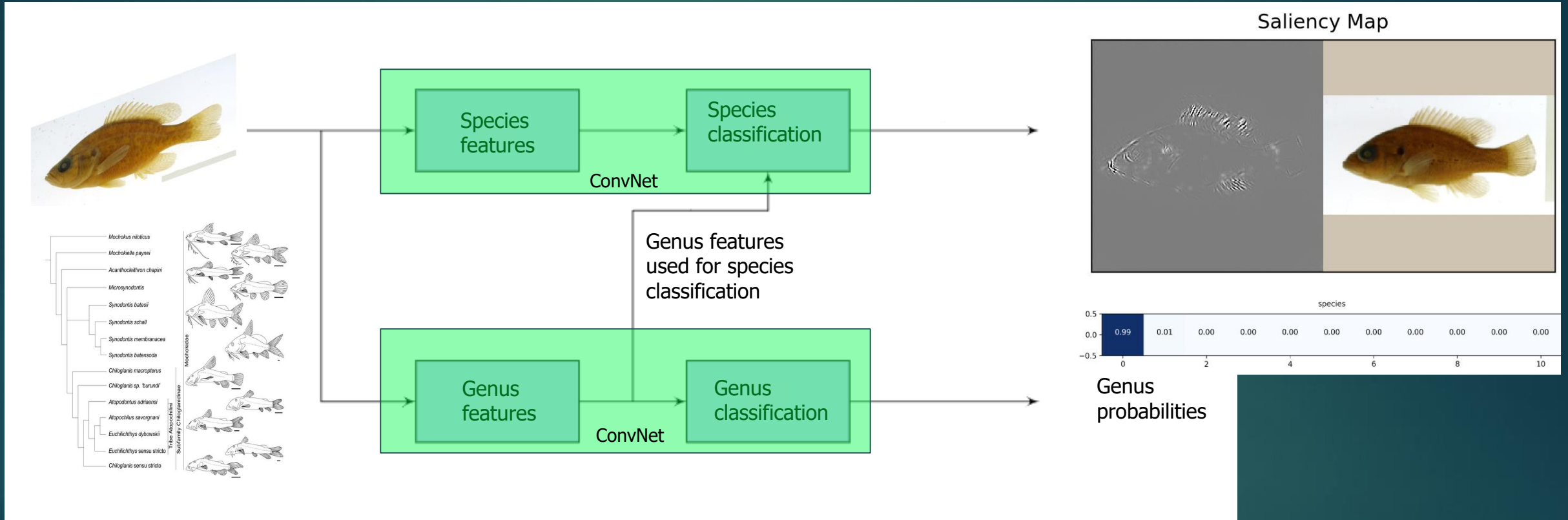
# BGNN for Species Classification using Species-Species Knowledge

- ▶ Species that share taxonomic concepts (e.g., common genus) have similar traits, and hence **must express similar features at the neural network layers**



**Goal:** Bridge the hierarchy of deep learning features with known hierarchies in biology (e.g., taxonomic groupings and phylogenies)

# Hierarchy-guided Neural Networks (HGNNs)



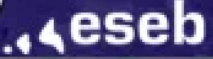
Elhamod et al., Hierarchy-guided neural networks for species classification. *Methods in Ecology and Evolution* (accepted), 2021. <https://www.biorxiv.org/content/10.1101/2021.01.17.427006v1.full>

Elhamod et al., Biology-guided neural network for species classification. *SICB*, v 61, E228–E229, 2021





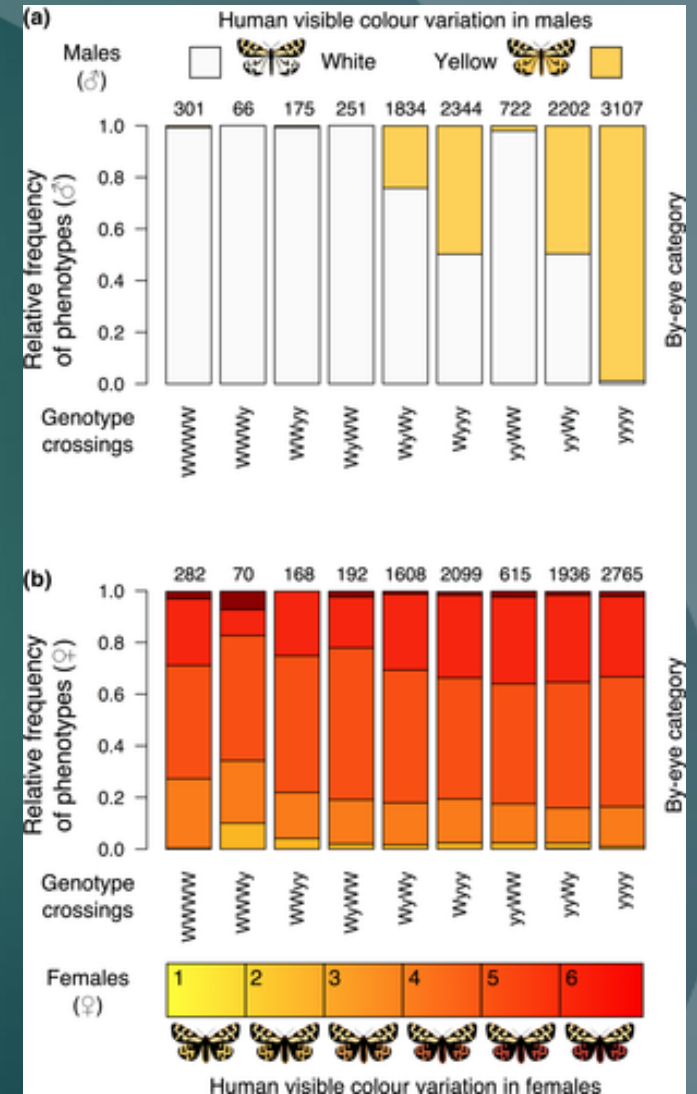
# What do humans and machines see? (And don't)

JOURNAL OF Evolutionary Biology 

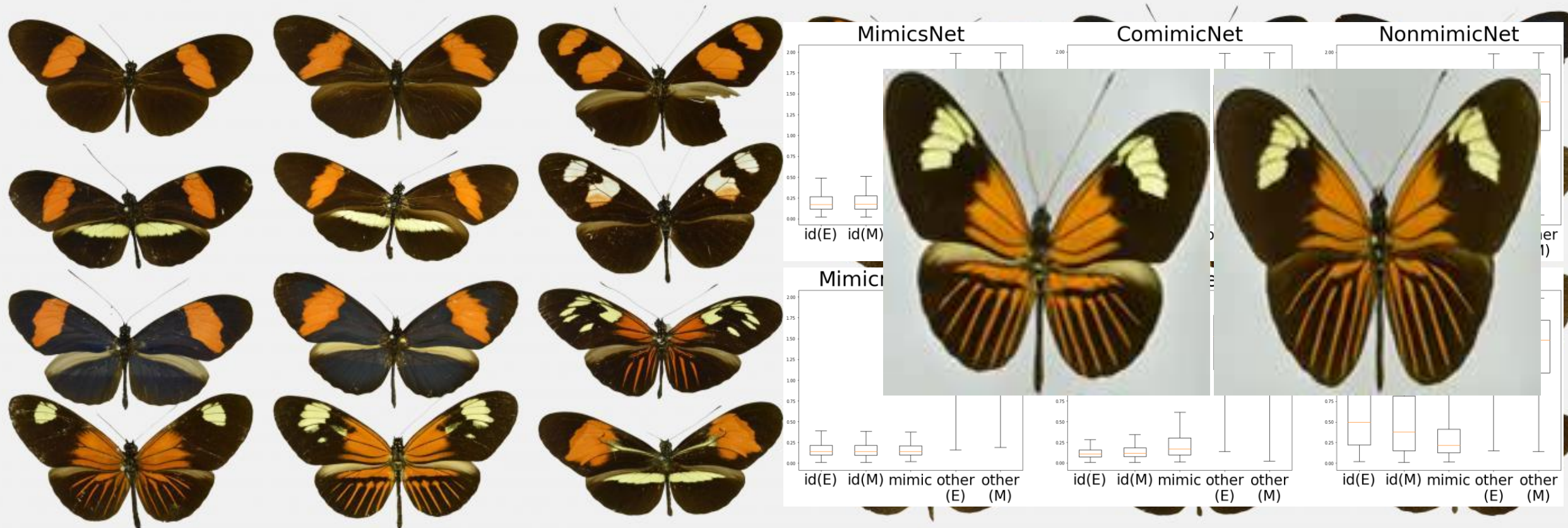
RESEARCH ARTICLE |  Open Access |  

## Genetic colour variation visible for predators and conspecifics is concealed from humans in a polymorphic moth

Ossi Nokelainen , Juan A. Galarza, Jimi Kirvesoja, Kaisa Suisto, Johanna Mappes



# Mimicry in the right light (Species Traits)



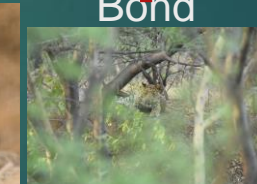
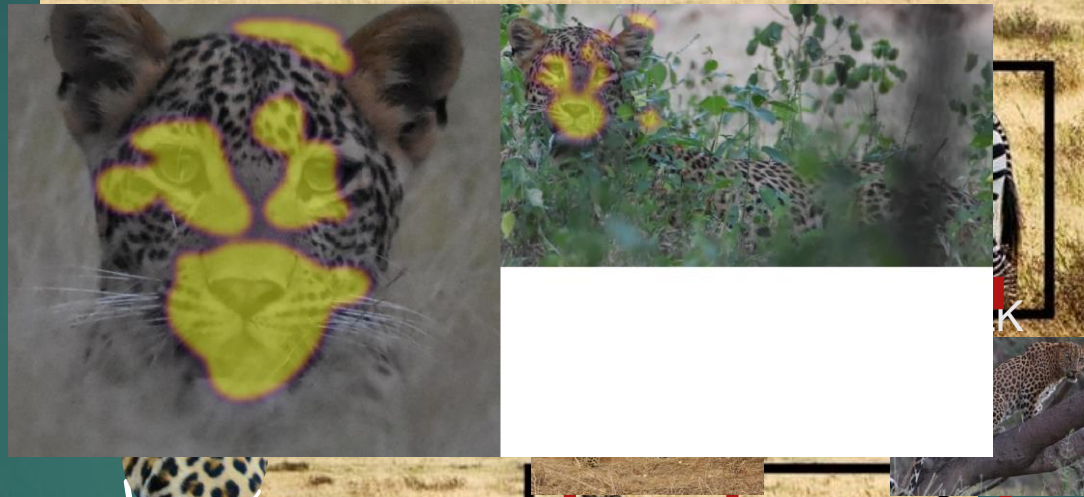
Reshma Ramesh Babu, Christopher Lawerence, Harry Chao, David Carly, Mo ElHamod, Anuj Karpatne, Jihung Kil, Owen McMillan, Dan Rubenstein, Yu Su, Luke Song, Sam Stevens, Chuck Stewart, Yael Stochel, TBW  
CV4Animals@CVPR 2022





# Patterns vs Genetics (Population Traits)

Tessa Cotron, Swapnil Kumbhojkar, Reuven Yosef, Tanya Berger-Wolf, Chuck Stewart



Bond

