The Importance of Taxonomic Quality Control in Paleontological Digitization: Strategies for Increasing Fitness for Use and Trust in Aggregated Data

Katy Estes Smargiassi, Austin Hendy, Erica Krimmel, Jann Vendetti, and Lindsay Walker

Invertebrate Paleontology and Malacology

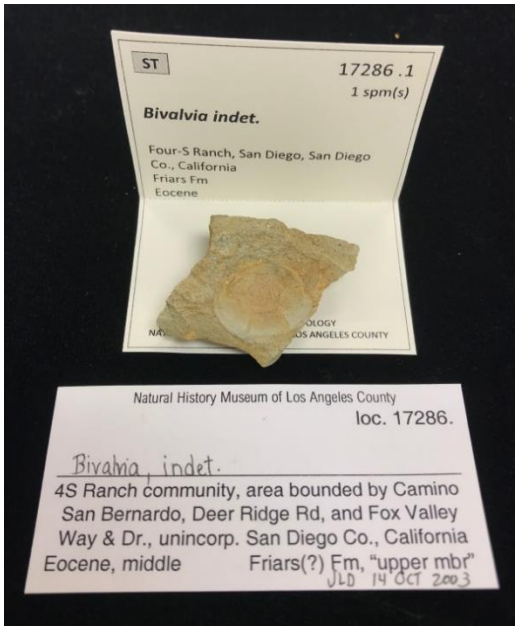
Natural History Museum of Los Angeles County

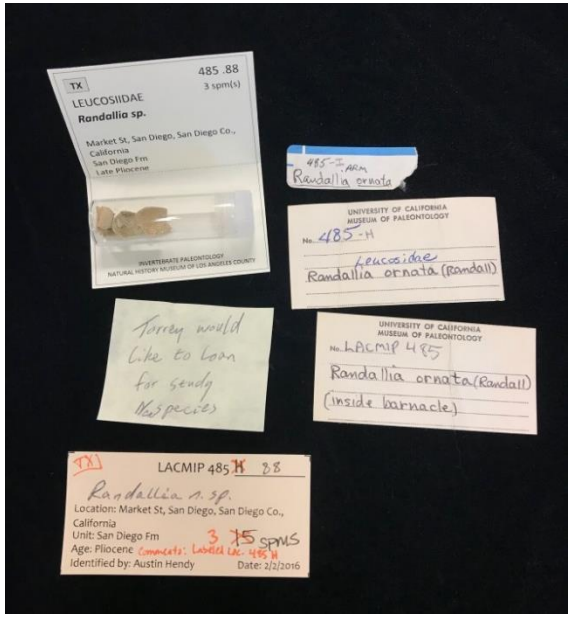
The Problem

- Responsibility for the quality of taxonomic data can be argued to belong to the
  - Data providers (who are responsible for identifications)
  - Data aggregators (who develop a unifying taxonomic backbone)
  - Downstream users (who analyze the data)

Taxonomic Quality over Quantity?

- Taxonomy of fossil specimens is fundamental to paleobiology research.
- Therefore, it is important that identifications of these specimens are as **accurate and precise as possible.**





Filling gaps in the LACMIP collection

Class	% indetermined*
Bivalvia	3.7
Echinoidea	33.6
Gastropoda	4.0
Malacostraca	91.3†
Polyplacophora	28.7
Scaphopoda	2.7

*Limited to data generated through the EPICC-TCN (Cenozoic only).

†Many reidentified by taxonomic expert, but awaiting updating of taxonomic dictionary

Filling gaps in the LACMIP collection

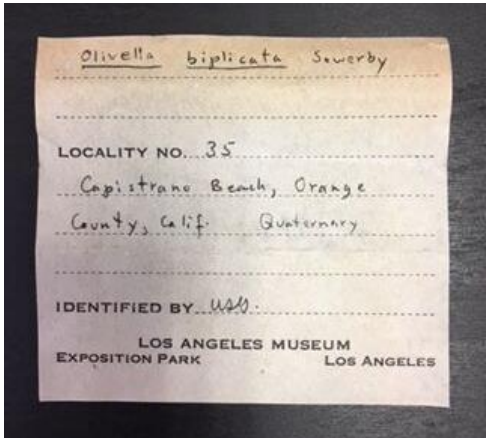
Age	% indetermined
Pleistocene	5
Pliocene	8.2
Miocene	9.2
Oligocene	8.8
Eocene	12.9
Paleocene	10.5

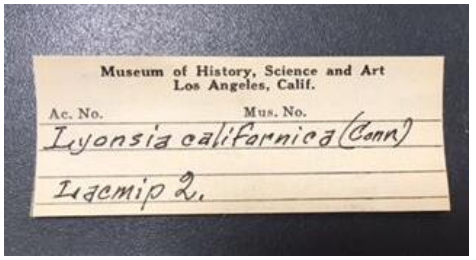
Where to Start?

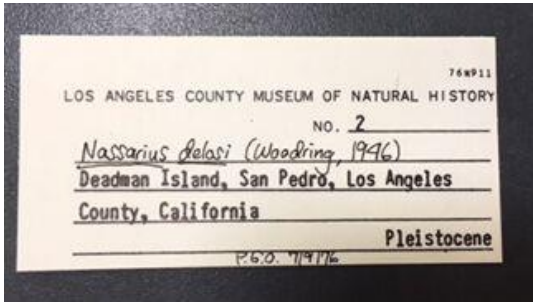
- Fossil invertebrate taxonomic groups lack the species-level compendia that aid classification of many neontological plant and animal groups.
- Existing databases provide an easy solution;
  - WoRMS: World Registry of Marine Species (taxon matching tools)
  - PBDB: Paleobiology Database
- These are being used in both the digitization process AND as the primary taxonomic backbones for data aggregators (e.g., GBIF, iDigBio).
- How well do these tools perform as a service to a major digitization effort (Eastern Pacific Invertebrate Communities of the Cenozoic-TCN)?

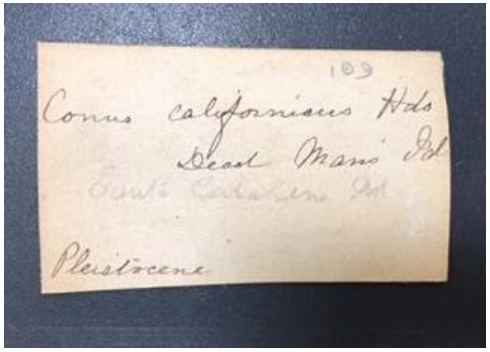
Expert identification

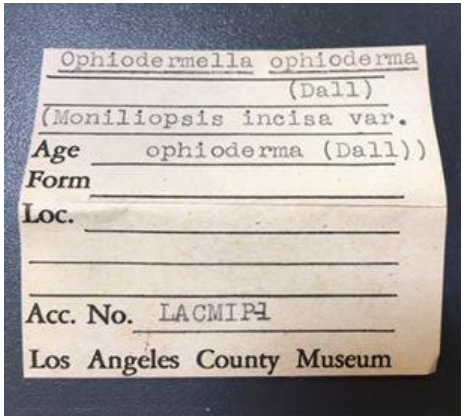
Analysis of historic labels



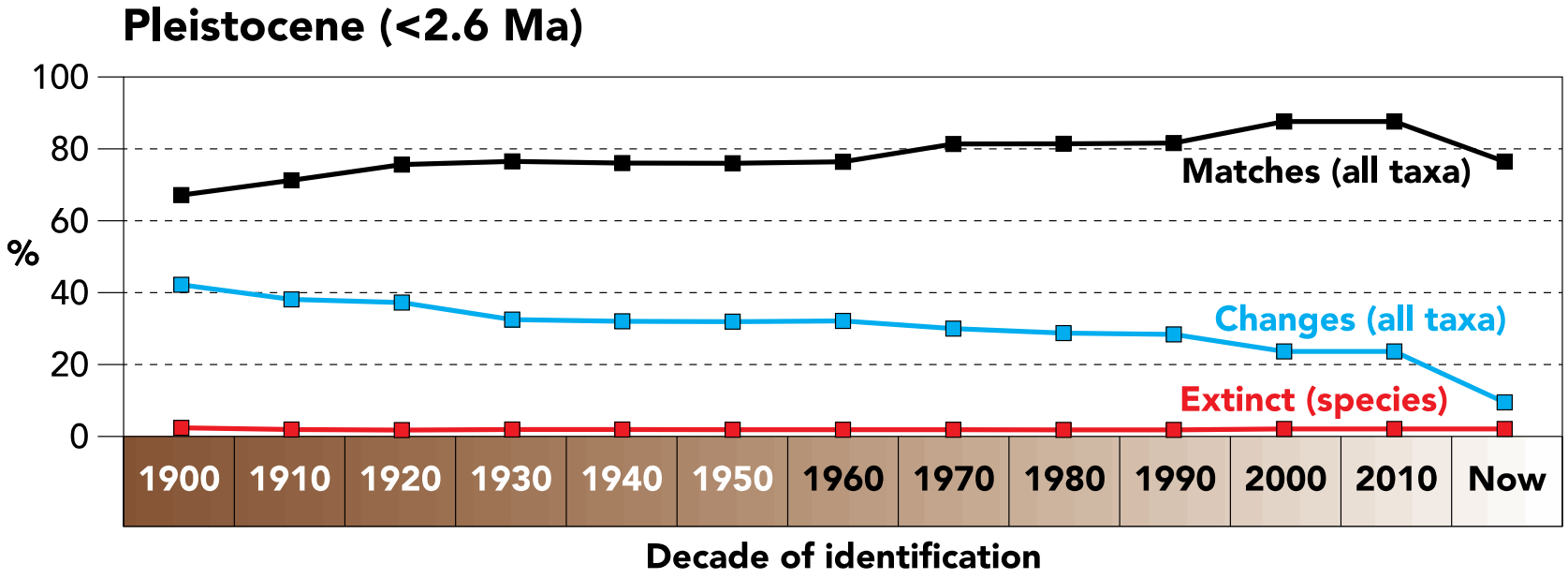






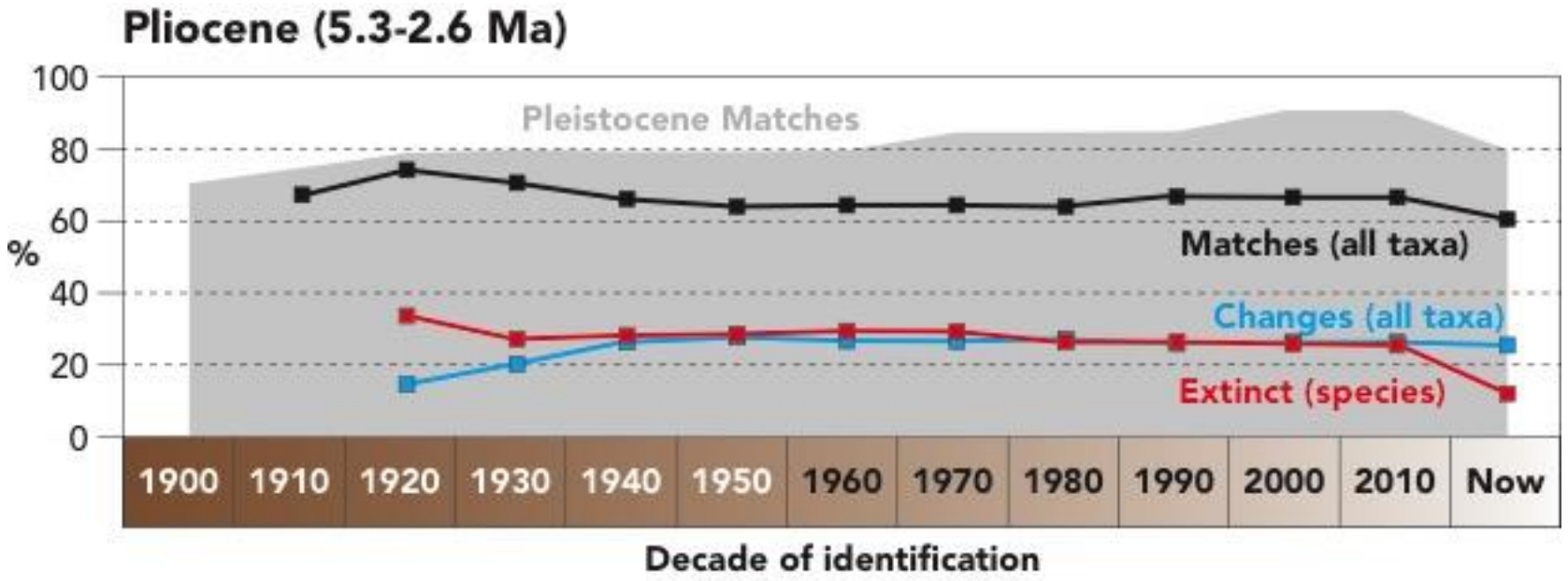


Historical trends in taxon matching



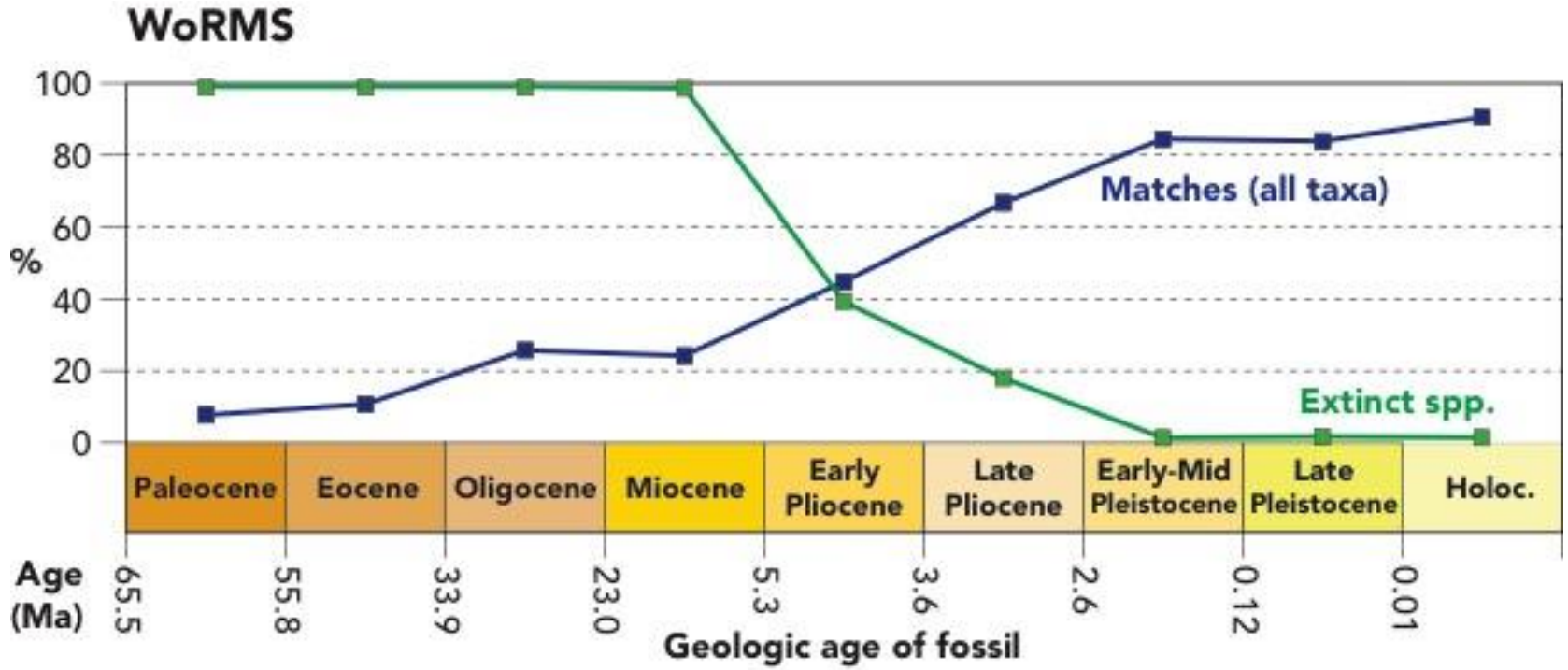
- For Pleistocene age fossils, a taxon-match with WoRMS will capture about 65-85% of specimen records
- This decreases with age of original identification
- Very few species are extinct!

Historical trends in taxon matching



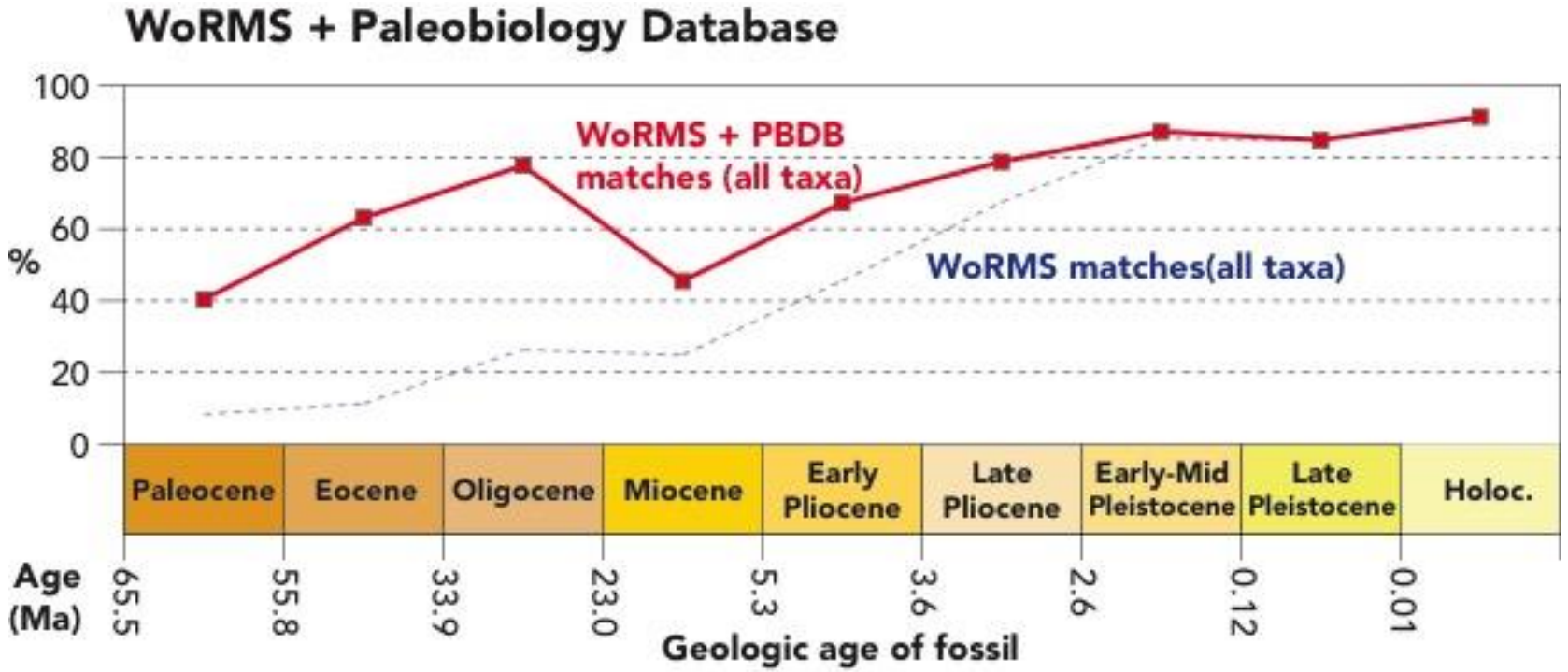
- For Pliocene-age fossils, a taxon-match with WoRMS will capture no more than 75% of v
- More species are extinct!

Using WoRMS for fossil invertebrates



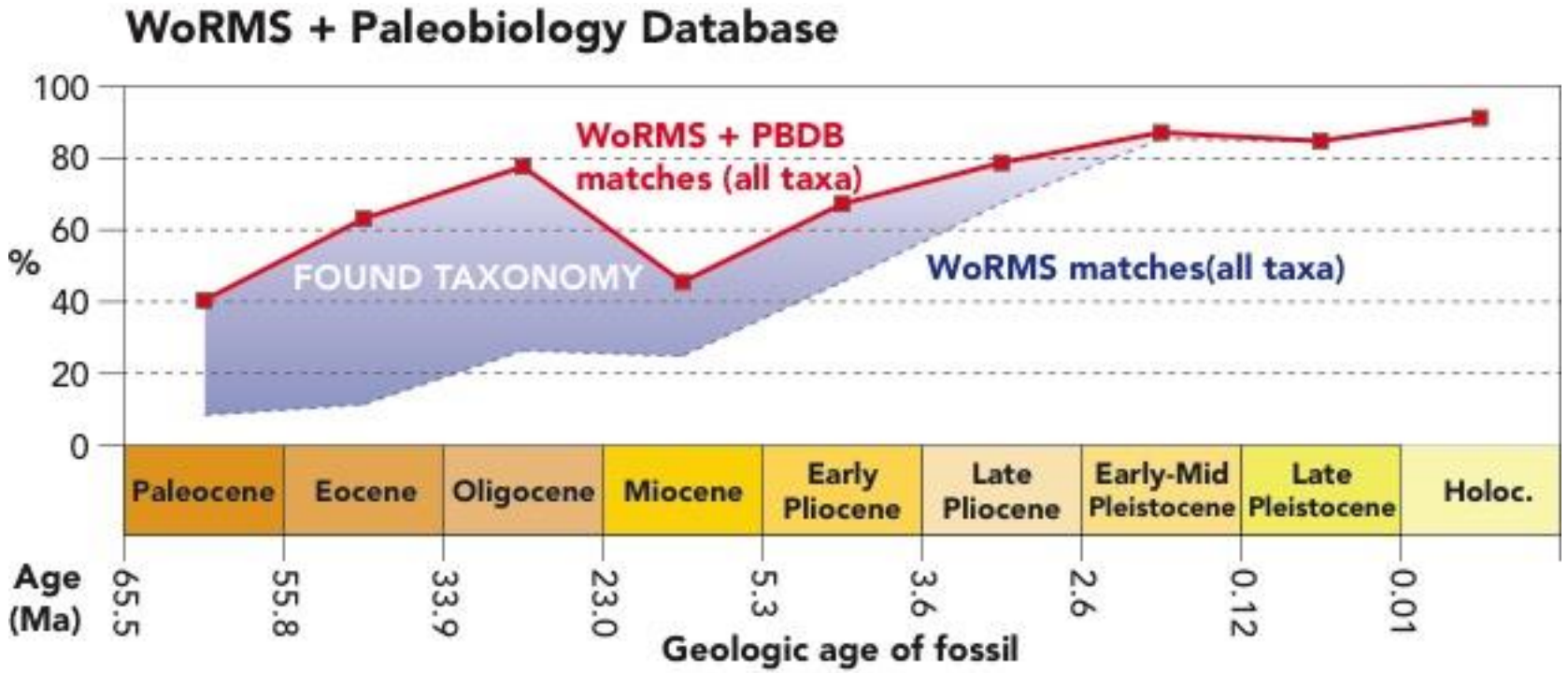
- Through geologic time the matches of specimen records increases as the number of extant species increase.
- Only really useful for Pliocene-age fossils onwards

Improving on a good taxonomic backbone



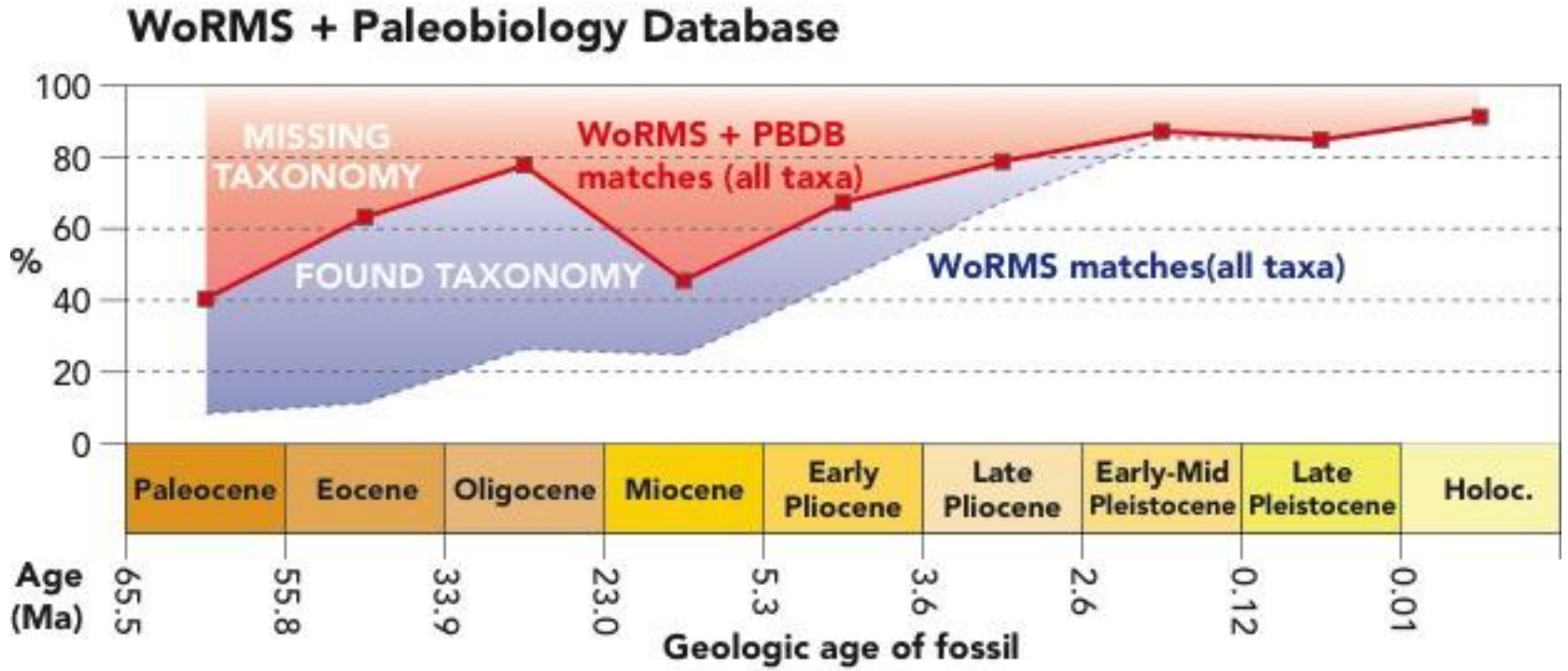
- Adding in the taxonomic opinons of the Paleobiology Database improves the % of matches with specimen records

Improving on a good taxonomic backbone



- Now about 40-80% of pre-Pliocene specimen records have matches with our two taxonomic resources

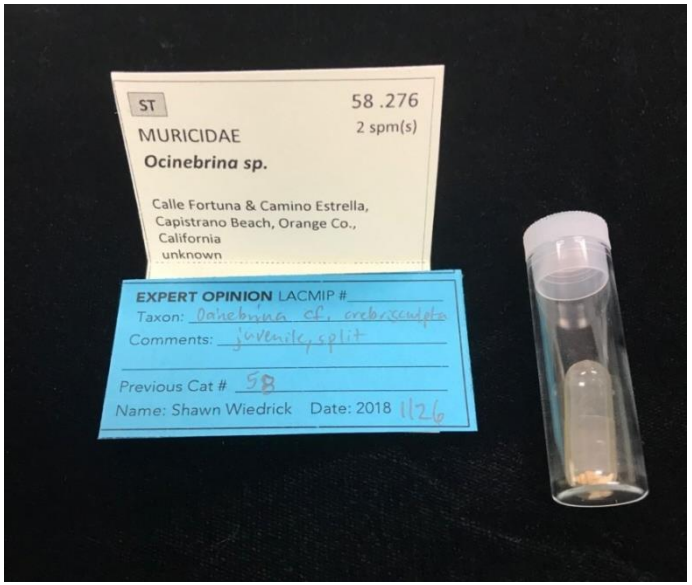
Improving on a good taxonomic backbone



- But, what about the gap?
- We (paleontology community) need to resolve this

Strategies for success

- Involvement of experts
  - identification of specimens
  - building taxonomic dictionaries
  - project design
- Develop taxonomic dictionaries with internal consistency
- Implement internally consistent taxonomic dictionaries when migrating to a new database or when starting fresh
- Work together to identify and ENHANCE taxonomic resources

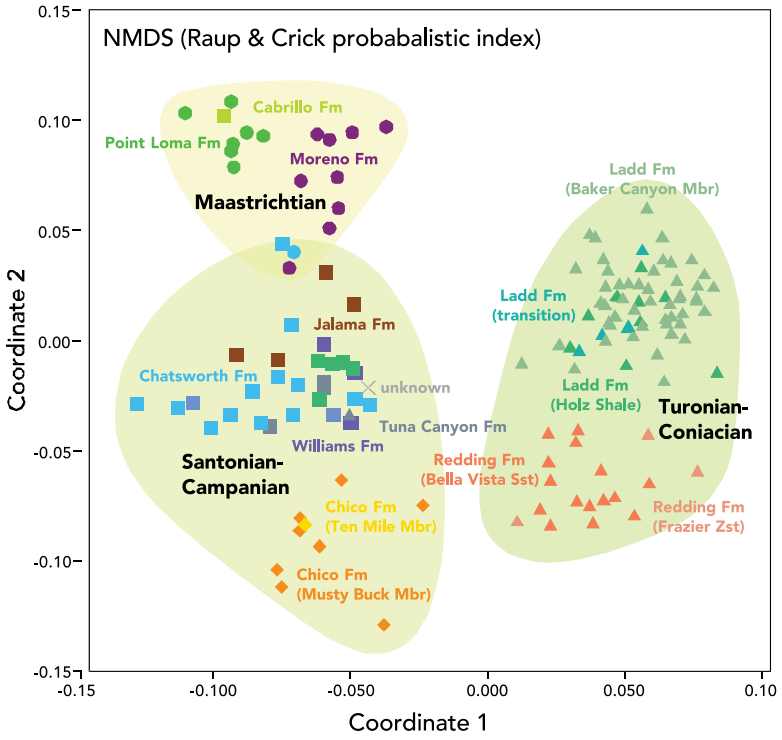


Putting the dead to work:
Late Cretaceous biogeography

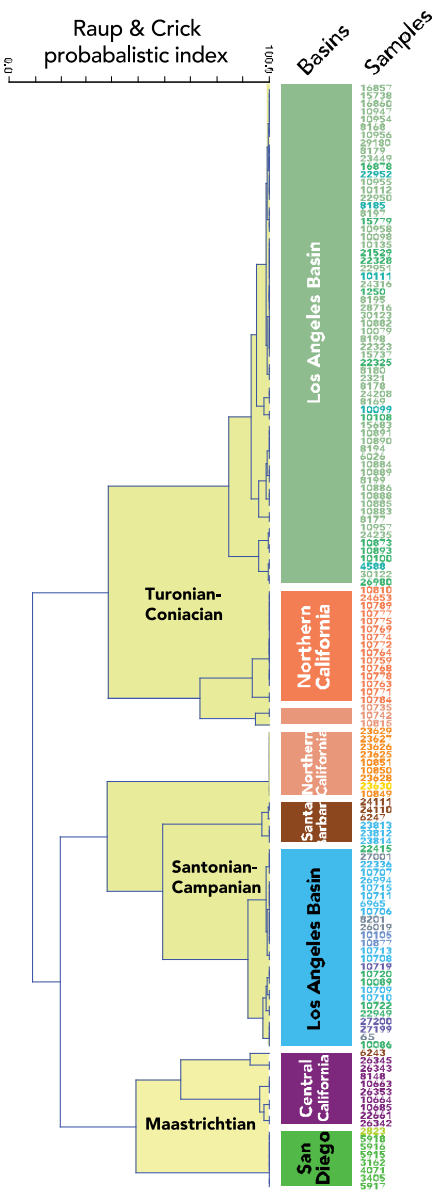
Taxonomic checklists

Mollusca
Gastropoda
Neogastropoda
Volutidae
Drilluta
Drilluta jacksonensis (Anderson, 1958)
Konista
Konistra biconica (Anderson, 1958)
Longoconcha
Longoconcha eumeka Saul & Squires, 2008
Retipirula
Retipirula calidula Saul & Squires, 2008
Retipirula crassitesta (Gabb, 1869)
Retipirula pinguis Saul & Squires, 2008
Varens
Varens anae Saul & Popenoe, 1993
Varens formosus Saul & Popenoe, 1993
Volutoderma
Volutoderma angelica Saul & Squires, 2008
Volutoderma averillii (Gabb, 1864)
Volutoderma elderi Saul & Squires, 2008
Volutoderma magna Packard, 1922
Volutoderma perissa Saul & Squires, 2008
Volutoderma blakei Saul & Squires, 2008
Volutoderma californica Dall, 1903
Volutoderma gabbi White, 1889
Volutoderma jalama Saul & Squires, 2008
Volutoderma querna Saul & Squires, 2008
Volutoderma santana Packard, 1922
Volutoderma suciana Dall, 1907
Volutoderma ynezae Saul & Squires, 2008
Volutoderma? antherena Saul & Squires, 2008

Gradient analysis



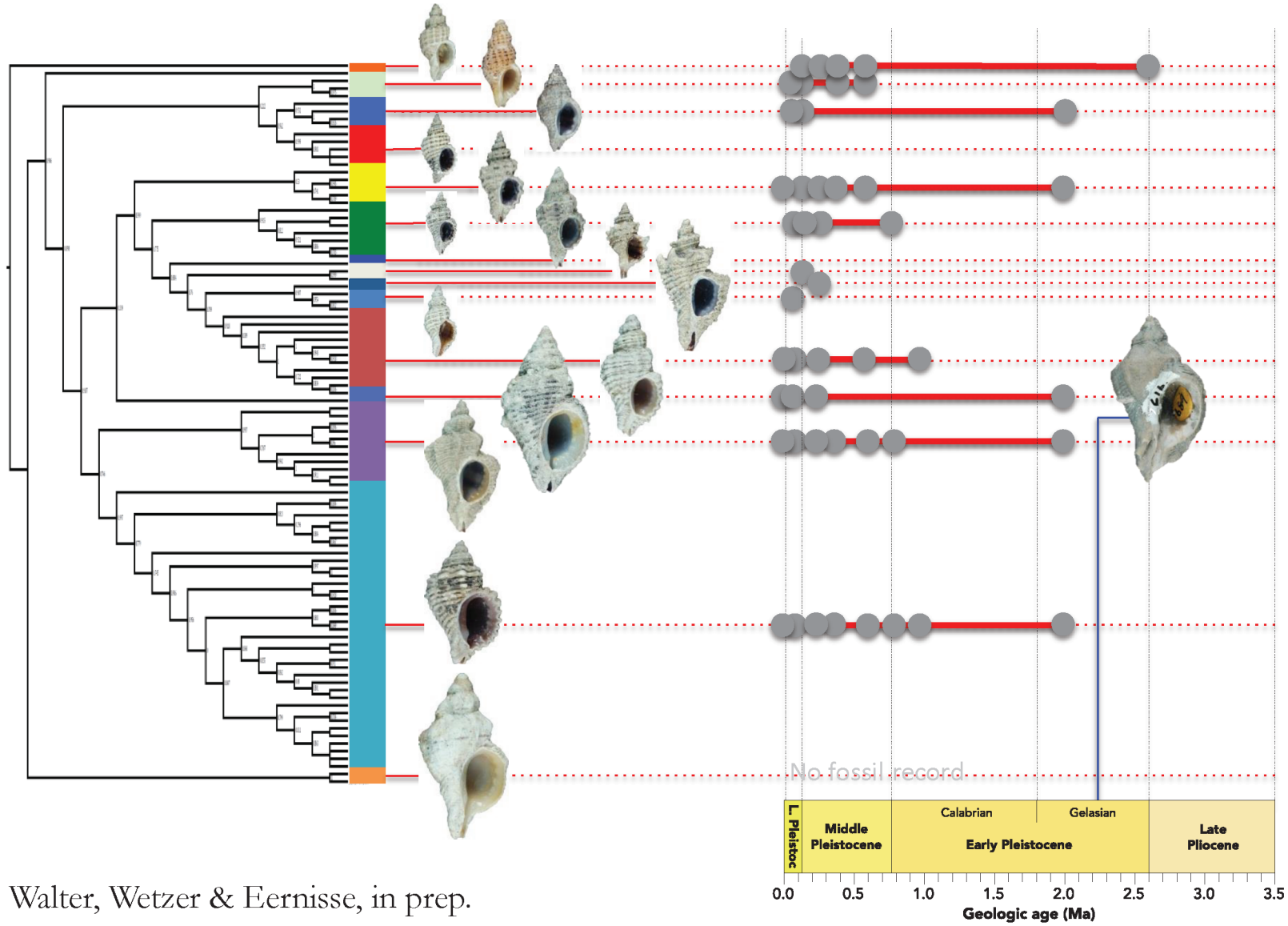
Cluster analysis



Walker et al. (this meeting) – Revitalizing the Cretaceous Seas of California (CSBR)

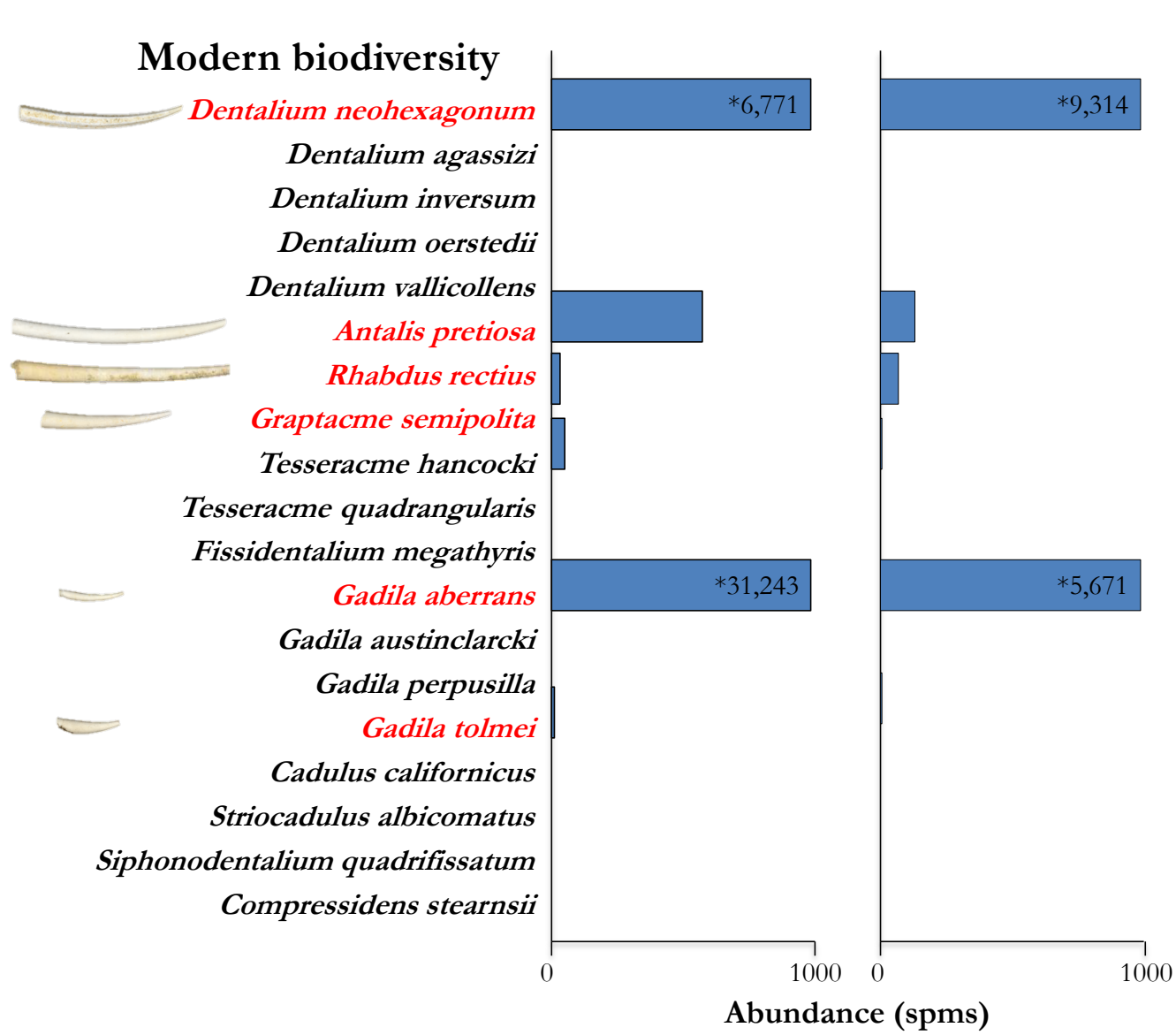
Putting the dead to work:

Plio-Pleistocene *Ocinebrina* among the collections

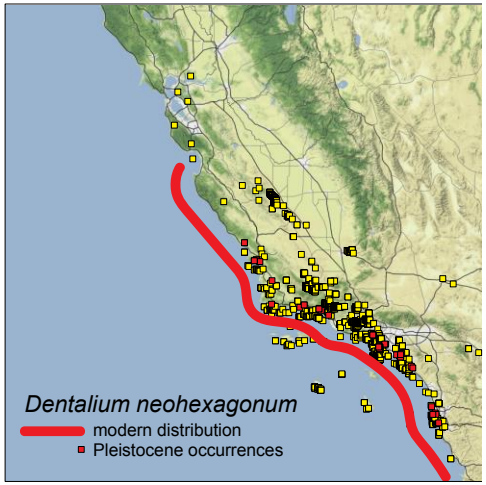


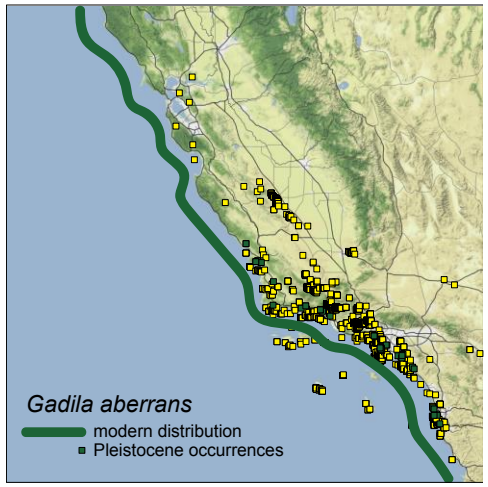
Wiedrick, Walter, Wetzer & Eernisse, in prep.

Putting the dead to work:
Plio-Pleistocene scaphopods



Species distribuion (past & present)





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Integrated Digitized Biocollections