Francisco (Paco) Barona-Gómez, Associate professor IBL (Full professor Cinvestav, Mexico)

Langebio, Cinvestav-IPN, Irapuato, Mexico. (2008 - 2022)

Institute of Biology Leiden University, the Netherlands. (2022 -)

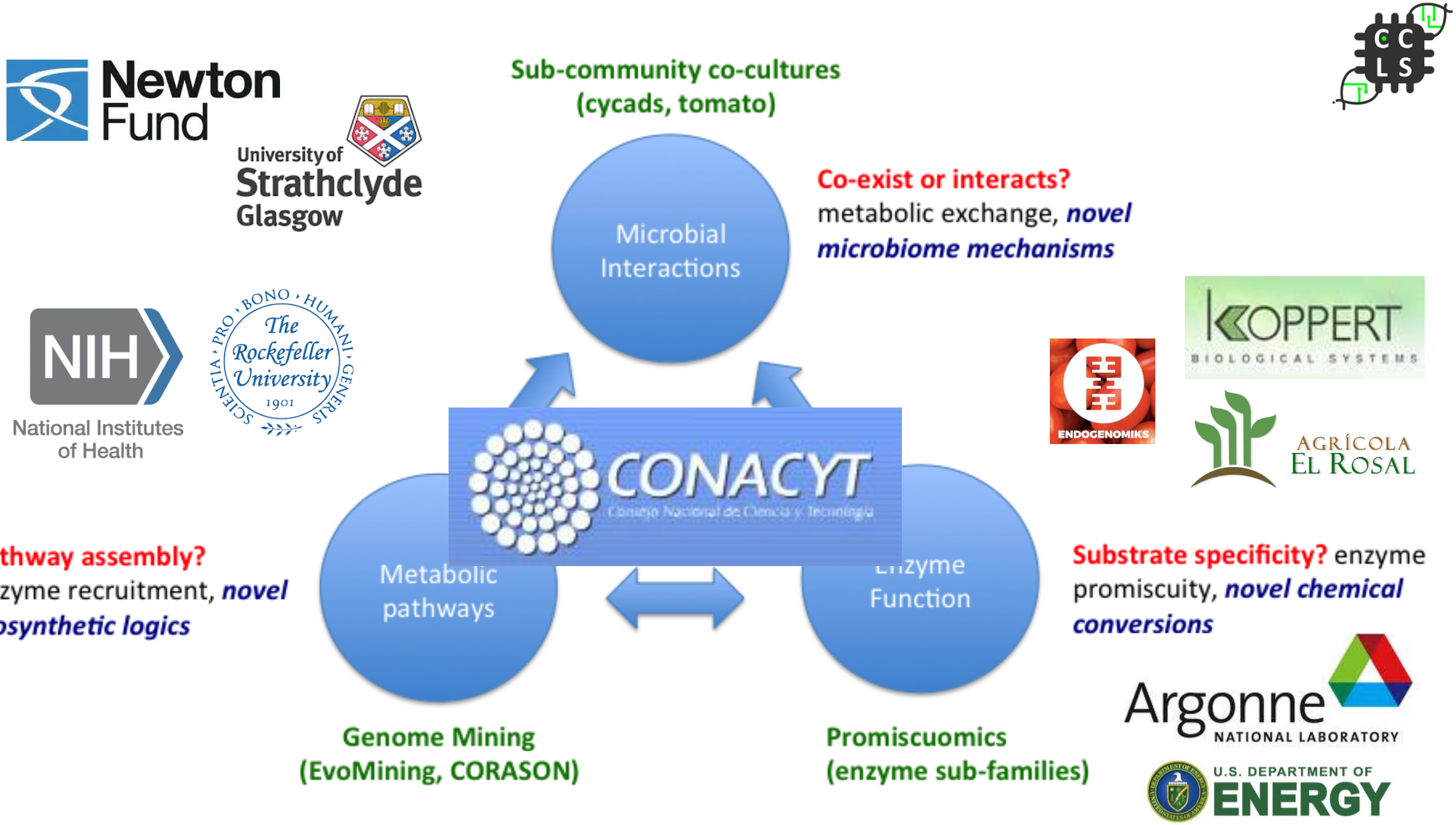
I am interested in deciphering the **evolutionary mechanisms**, at different scales (from atoms to microbial communities) underlying the evolution of **metabolism** during bacterial adaptation.

We investigate keystone bacterial taxa and their specialized metabolism emerging after ecological **host-microbiome interactions** studies, mainly in plants and insects.

We dissect the roles played by natural products in mediating **microbial interactions**, as well as deciphering novel **biosynthetic logics** leading to unprecedented **chemical scaffolds**.

Based in this basic knowledge, we develop **bioinformatics tools for genome mining** of natural products and **biotechnological applications**, mainly for agriculture.

Microbial Biodiversity and Specialized Metabolism Laboratory


Sub-community co-cultures
(cycads, tomato)
Microbial Interactions
Co-exist or interacts?
metabolic exchange, novel microbiome mechanisms
Pathway assembly?
enzyme recruitment, novel biosynthetic logics
Metabolic pathways
Enzyme Function
Substrate specificity? enzyme promiscuity, novel chemical conversions
Genome Mining
(EvoMining, CORASON)
Promiscuomics
(enzyme sub-families)
Newton Fund
University of Strathclyde Glasgow
NIH
National Institutes of Health
The Rockefeller University 1901
CONACYT
Consejo Nacional de Ciencia y Tecnología
ENDOGENOMIKS
KOPPERT BIOLOGICAL SYSTEMS
AGRÍCOLA EL ROSAL
Argonne NATIONAL LABORATORY
U.S. DEPARTMENT OF ENERGY

Natural Product Reports

REVIEW

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View Journal

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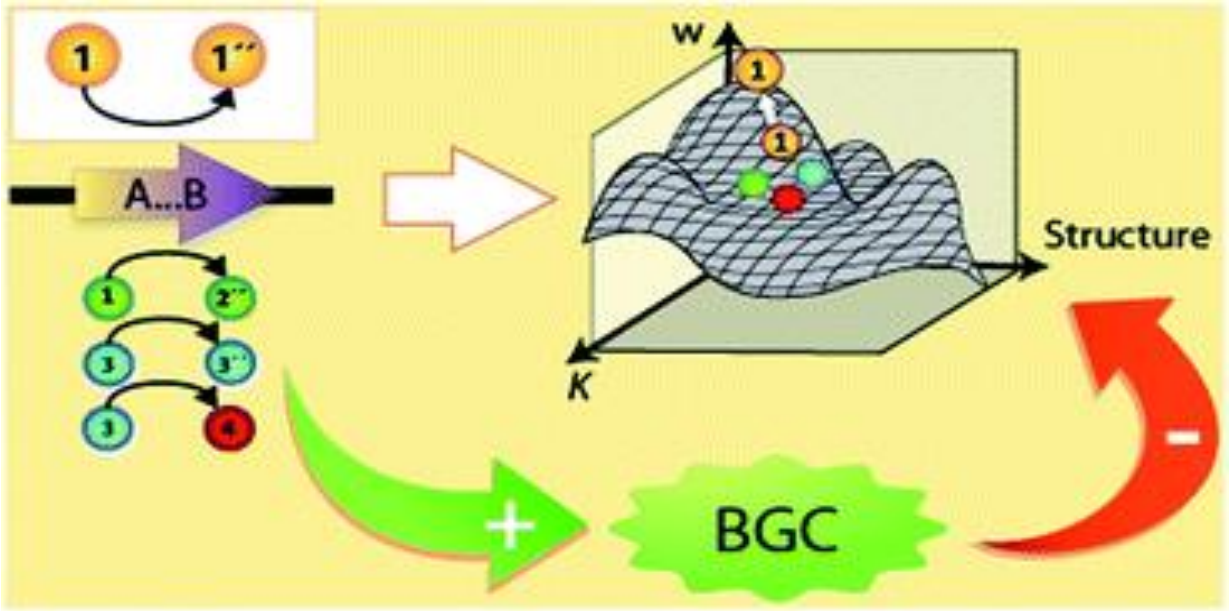
Cite this: DOI: 10.1039/c9np00048h

Evolutionary dynamics of natural product biosynthesis in bacteria

Marc G. Chevrette,[a] Karina Gutiérrez-García,[b] Nelly Selem-Mojica,[b] César Aguilar-Martínez,[b] Alan Yañez-Olvera,[b] Hilda E. Ramos-Aboites,[b] Paul A. Hoskisson[c] and Francisco Barona-Gómez*[b]



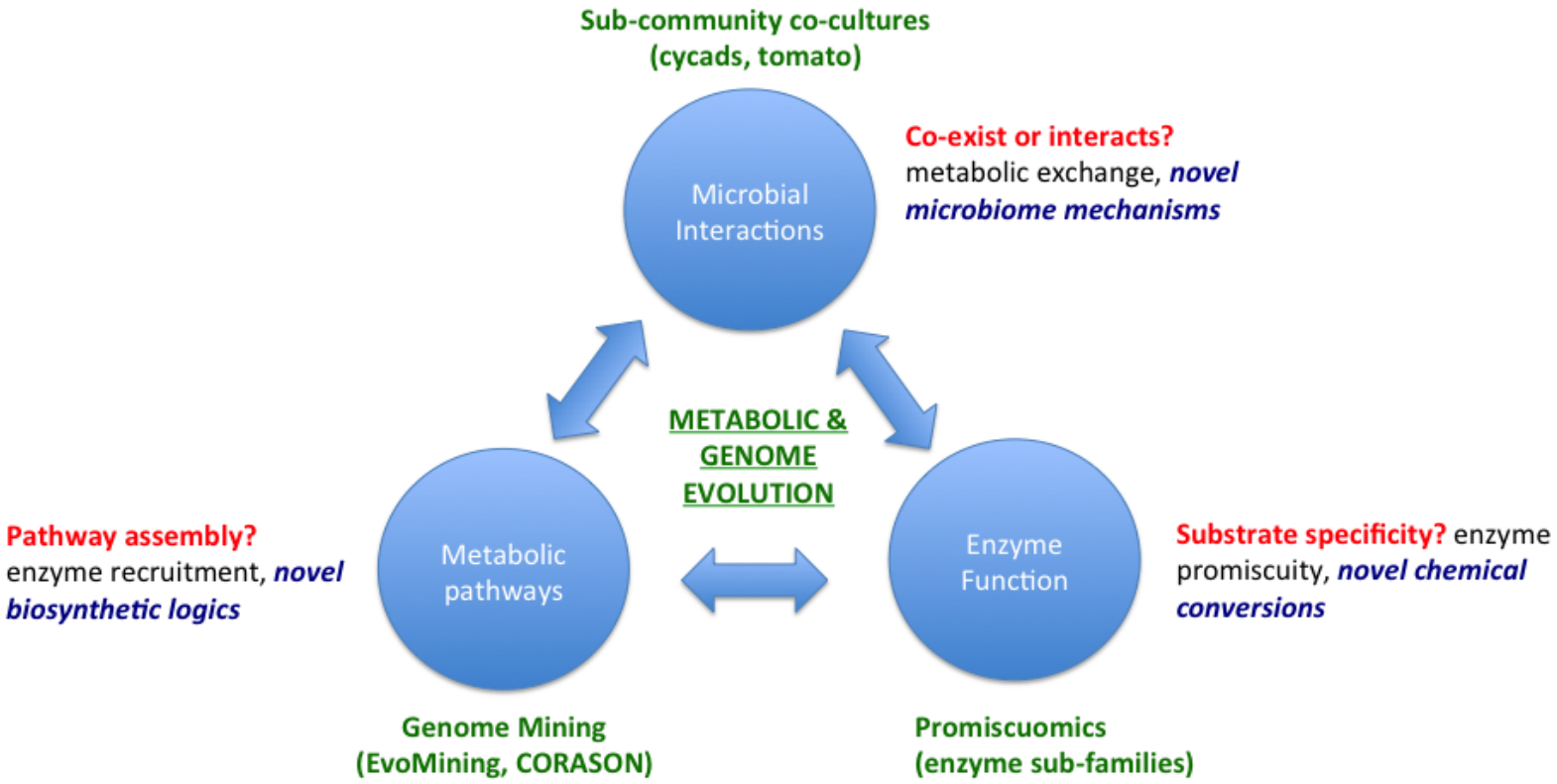
The Dynamic Chemical Matrix Evolutionary (DCME) hypothesis

*"**The chemical matrix hypothesis** stems from the idea that secondary / specialized metabolism evolves from increased metabolic diversity driven by the concerted action of promiscuous enzymes.... BGCs are therefore evolutionary unstable and only the output of this process. Thus, **fitness landscapes**, defined by the relationship between relative fitness (W), chemical structure (S) and biomolecular activity (F)* are a more appropriate representation of the evolution of natural products biosynthesis"

https://jgi.doe.gov/natural-prodcast-episode-13-francisco-barona-gomez/

1. Expansion-and-recruitment of promiscuous enzymes is the raw (and constant) material for the evolution of NPs (**EvoMining**)

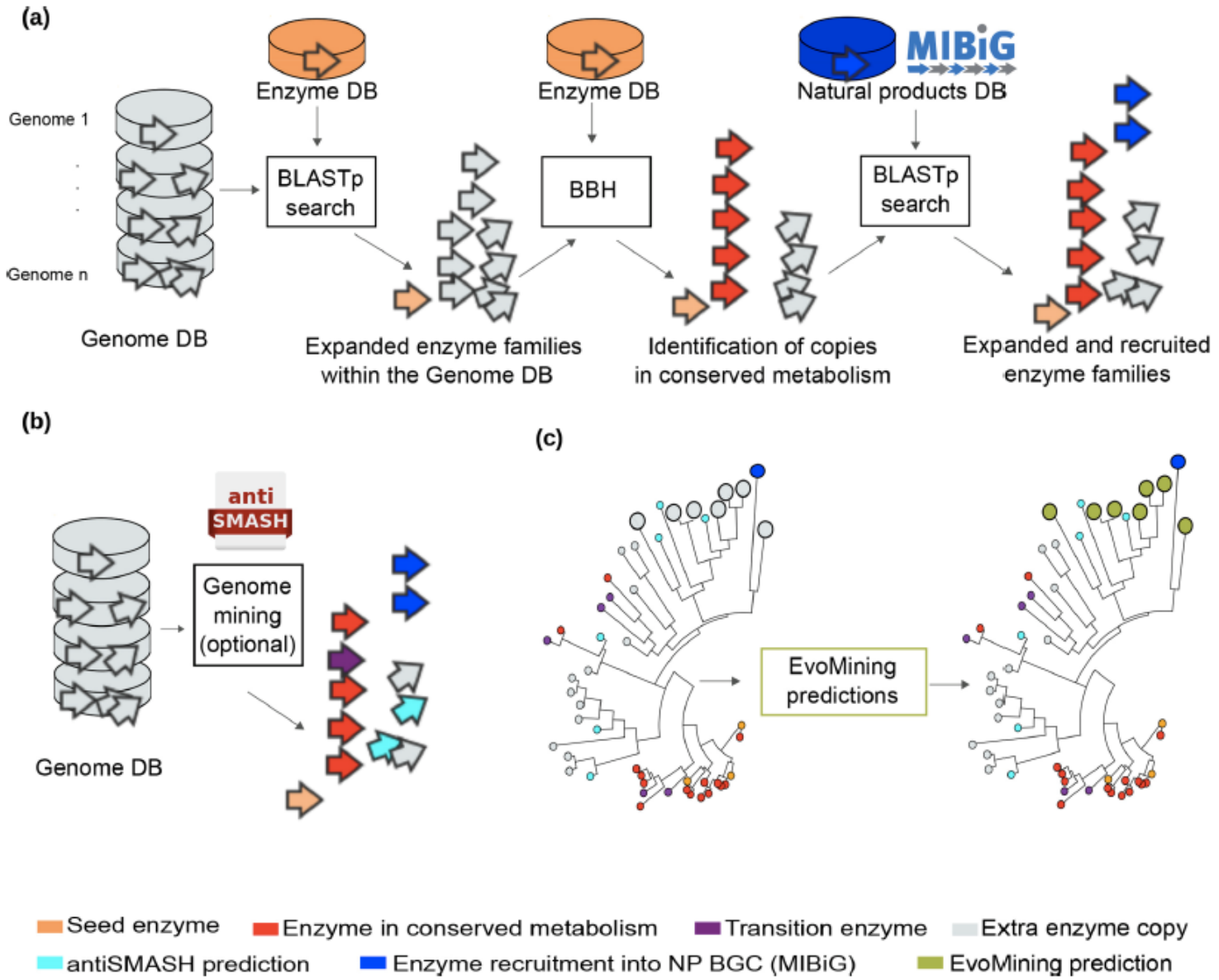
2. NPs evolve after a dynamic gene clustering that increases chemical diversity (**CORASON**)



3. **NPs are responsive at the population level to environmental conditions and the composition of the community (EcoMining – Experimental. PopGenNP - computational)**

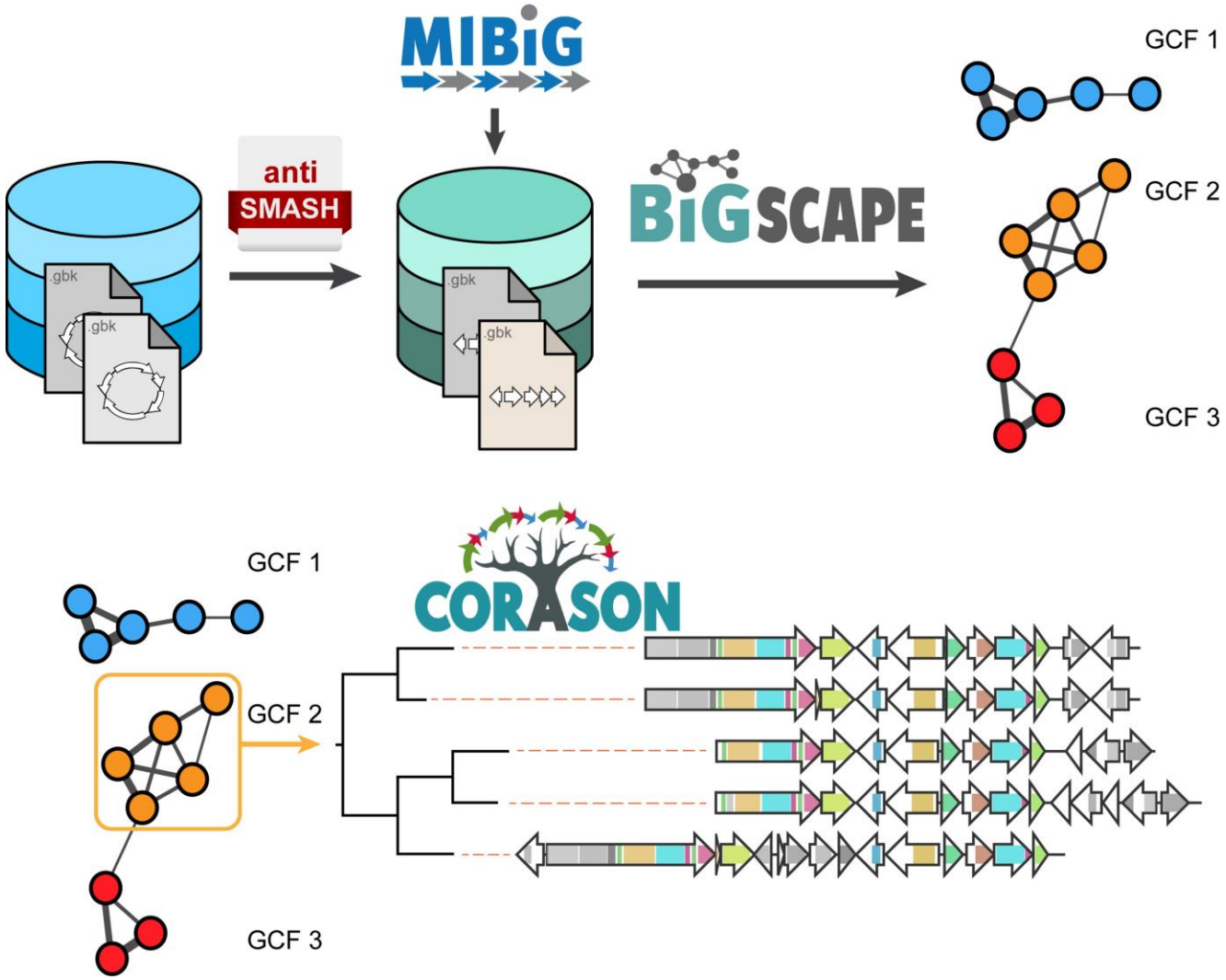
EvoMining 1.0: Cruz-Morales et al (2016) *Genome Biology & Evolution.*
EvoMining 2.0: Selem-Mojica et al (2019) *Microbial Genomics.*
EvoMining DB *(ActDES 1.0)* Schniete, Selem-Mojica et al (2021) *Microbial Genomics*

EvoMining
Evolution-inspired Genome Mining Tool



A computational framework for systematic exploration of biosynthetic diversity from large-scale genomic data

Jorge C. Navarro-Muñoz[1*], **Nelly Selem-Mojica[2*]**, Michael Mullowney[3*], (many other co-authors), Neil L. Kelleher[3#], **Francisco Barona-Gomez[2#]**, Marnix H. Medema[1#] (2020) *Nature Chemical Biology*



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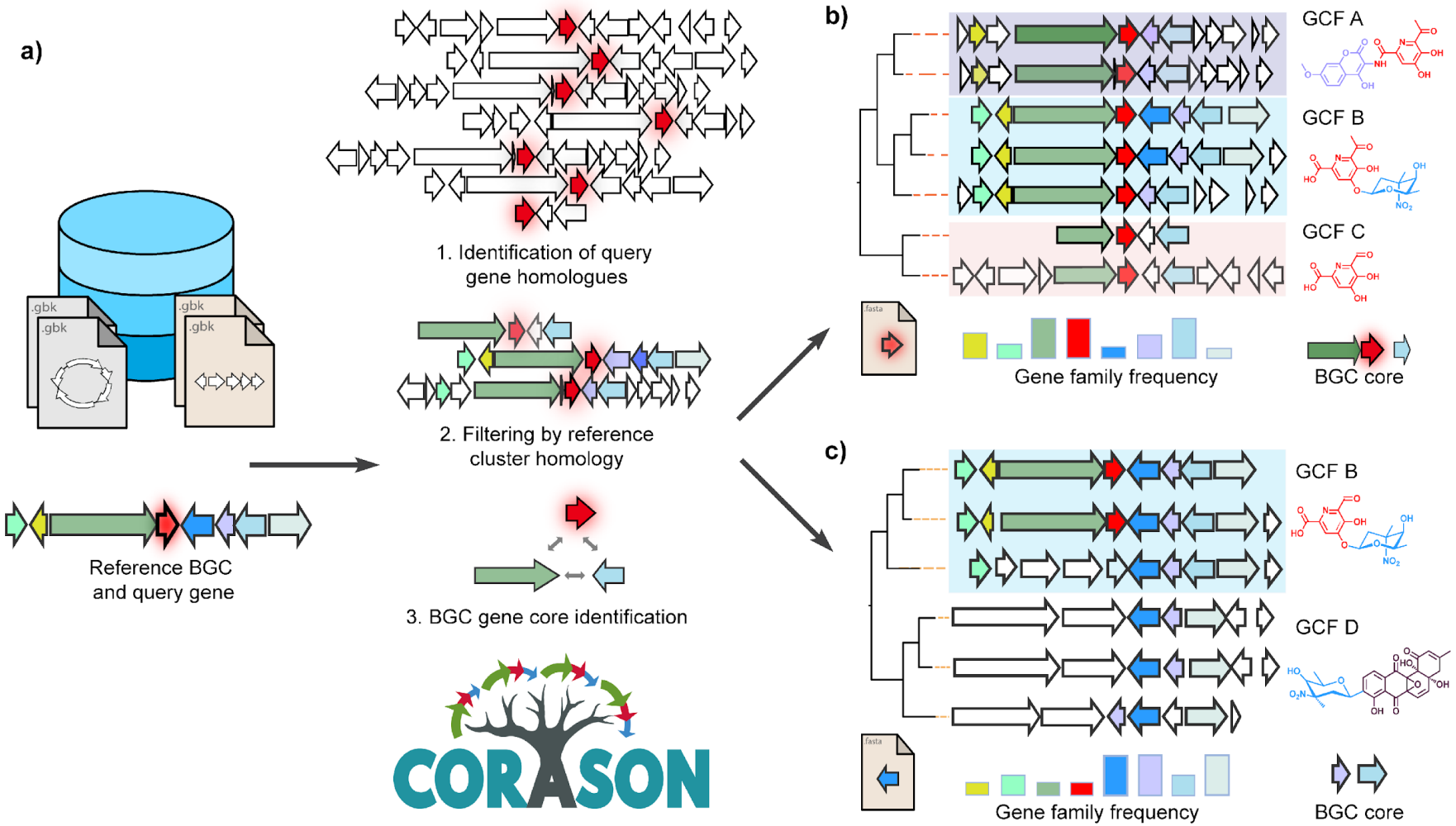

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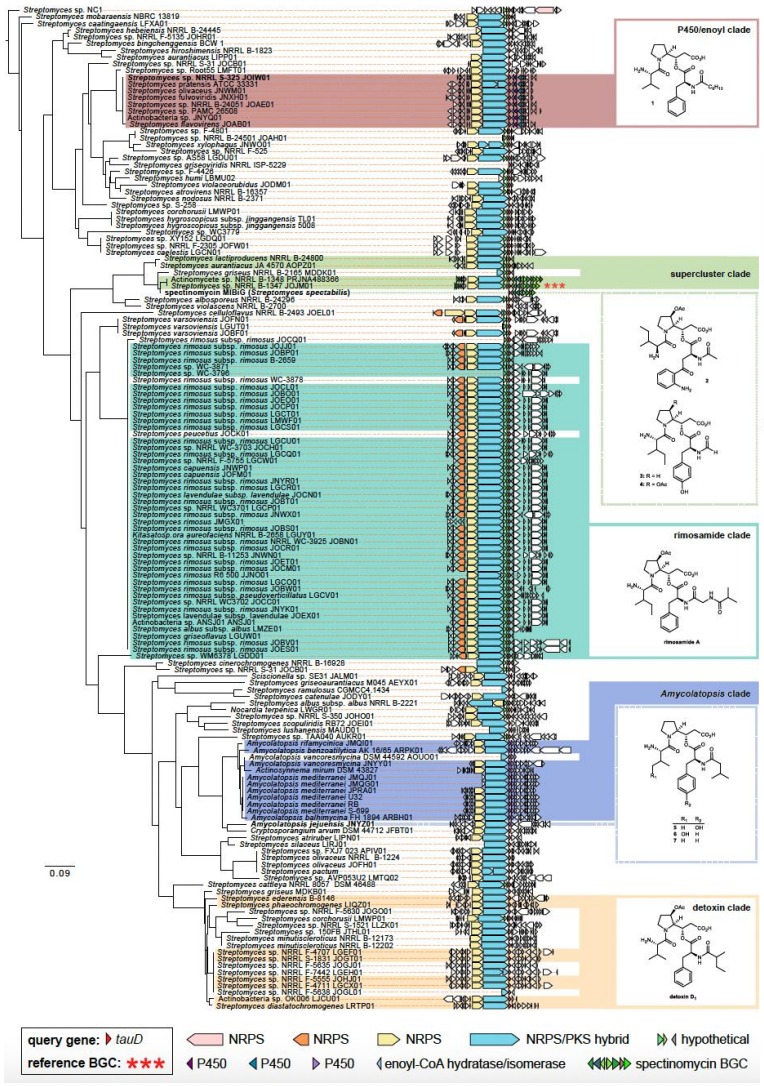
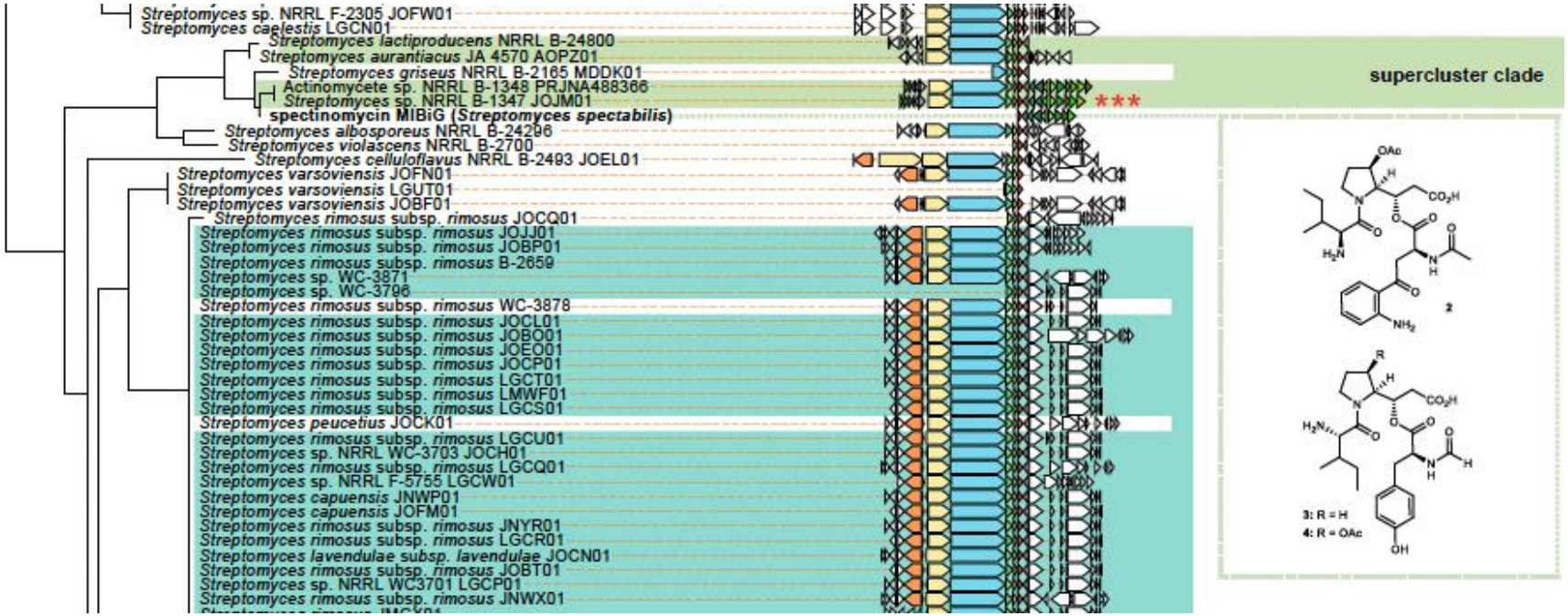
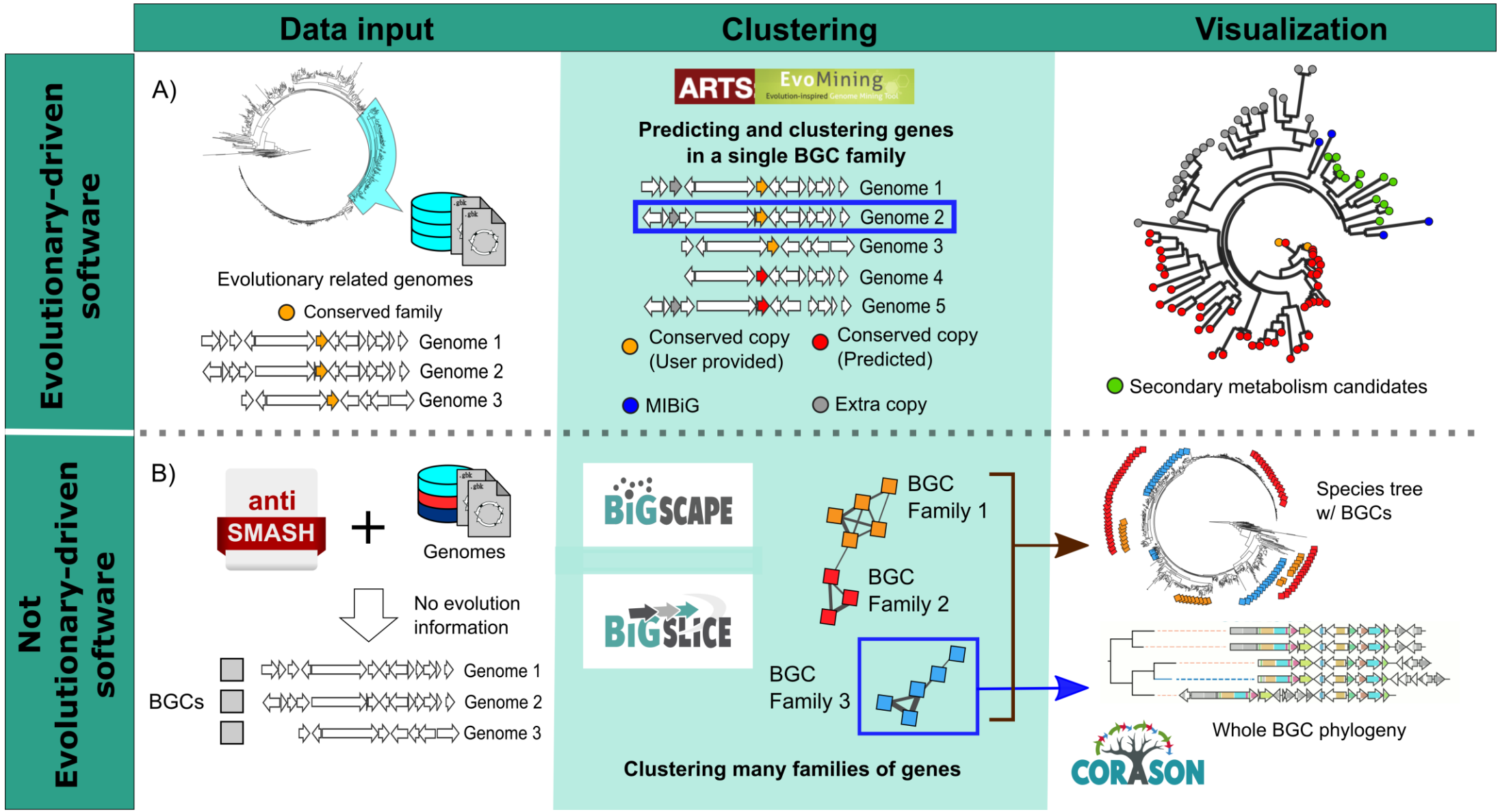
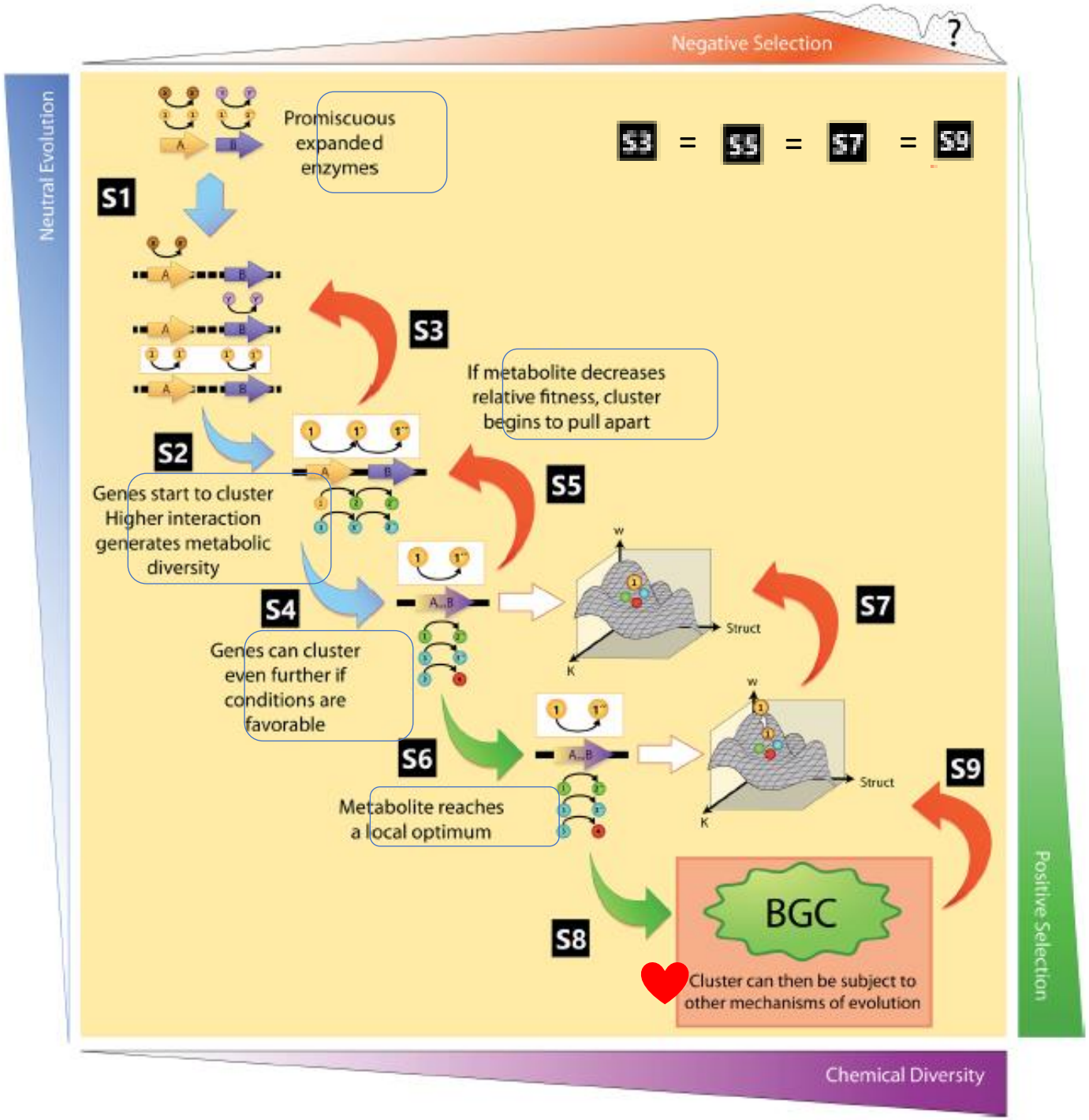
Supplementary Figure 9. CORASON phylogeny of detoxin/rimosamide-related BGCs.

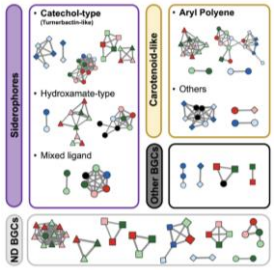


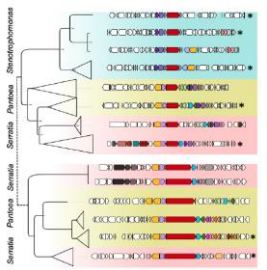
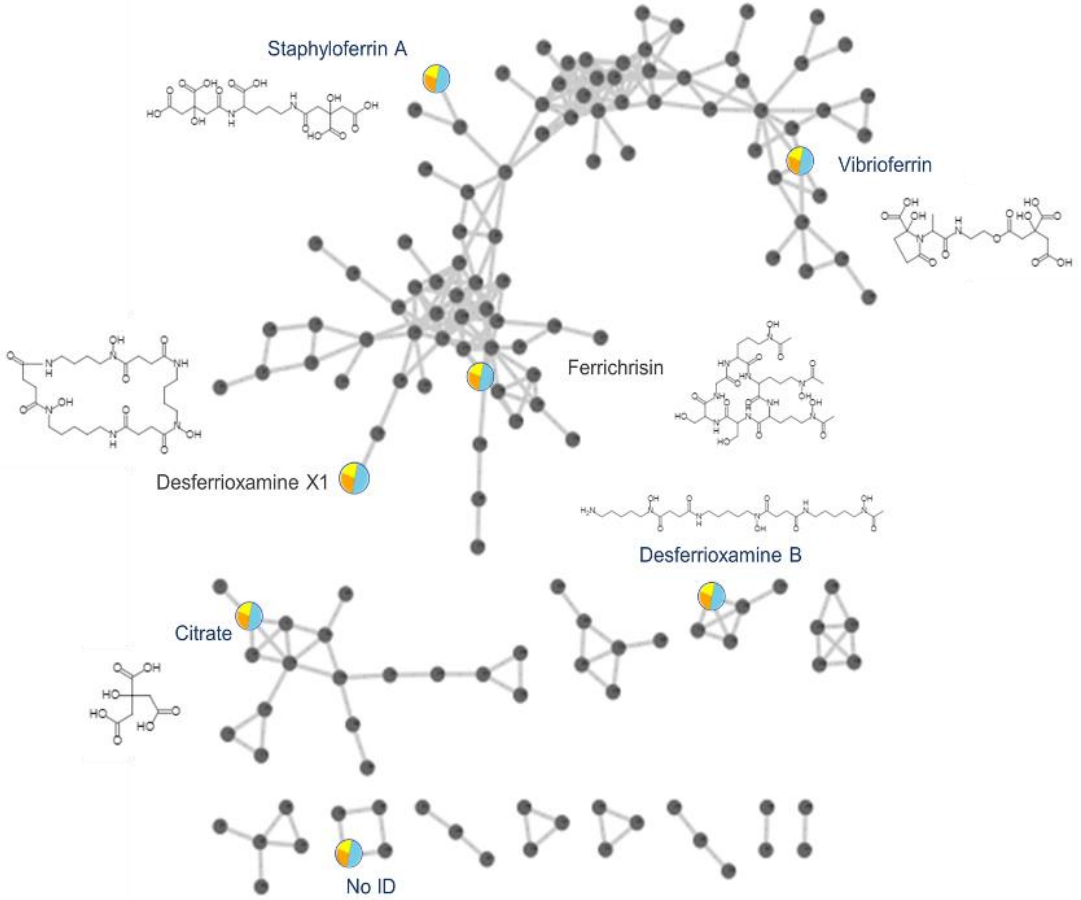


Chevrette et al (2021) **The confluence of Big Data and evolutionary genome mining for the dscoviery of natural products**. *Natural Product Reports.* 2024-2040.
Chevrette et al (2022) **Evolutionary Genome Mining for the Discovery and Engineering of Natural Product Biosynthesis**. In *Engineering Natural Product Biosynthesis*. 129-155









PopGenNP – computational?