Exploring the threatened aquatic insect biodiversity of the Canary Islands



Raúl Acosta

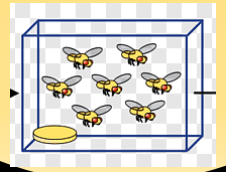
Núria Cid, Ian Criado, José María Fernández-Calero, Jérôme Latron, Francesc Gallart, Pilar Llorens, Pau Saa, Rosa Trobajo, Paula Arribas, Pau Fortuño, Marcos González, Nieves López-Rodríguez, Carles Alcaraz, Xavi Benito, Paula Mendoza, Miriam Salguero, Alba Garriga, Julie Crabot, David Mann, Brent Emerson, Maria Soria, Núria Bonada, Belinda Gallardo, Virgilio Hermoso & Miguel Cañedo-Argüelles.

STUDY AREA: KEY FACTORS

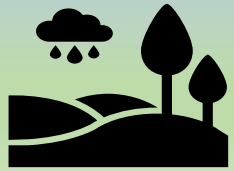
Origin: formed in the past 20 million years by volcanic eruptions: Permeable soils



Relative isolation: never in physical contact with the continents



Subtropical climate: warm temperatures and low seasonal variation





Relict Laurel forests: wet north-east wind circulation system forms “sea of clouds”



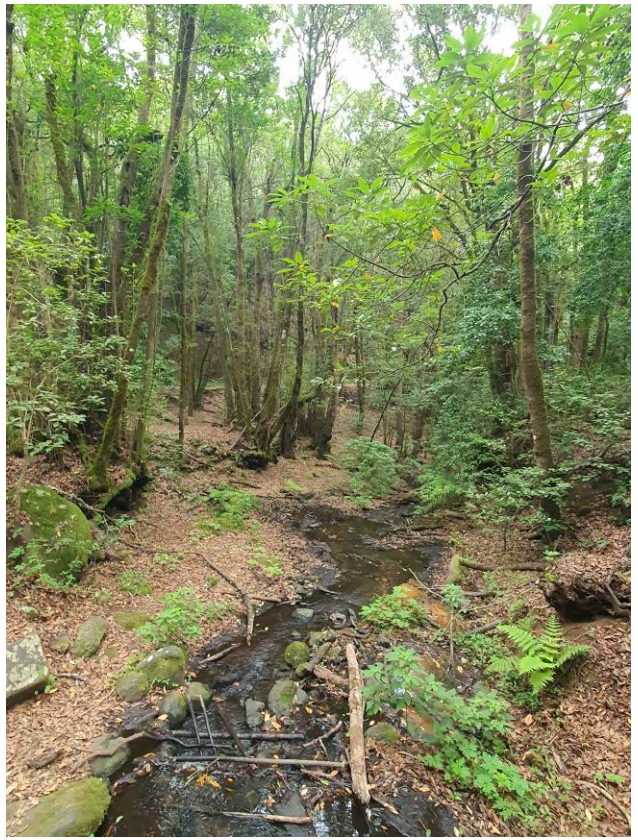
WHAT ABOUT FRESHWATER BODIES IN THE CANARY ISLANDS?



Barranco Juan Dana (Tenerife)



Barranco Igüeste (Tenerife)



Barranco el Cedro (La Gomera)



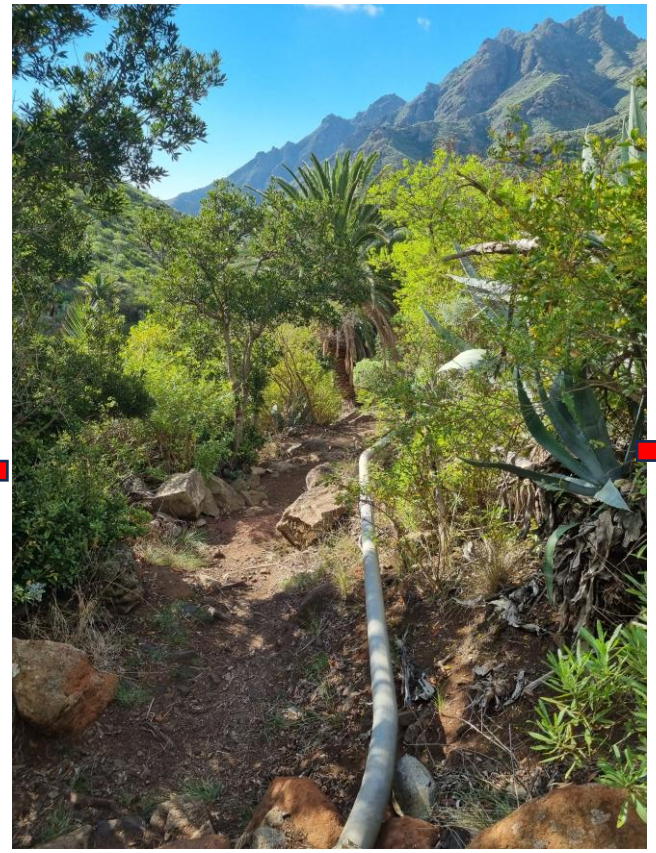
Barranco Verduras de Alfonso (La Palma)

Dry → Disconnected pools → Permanent flow

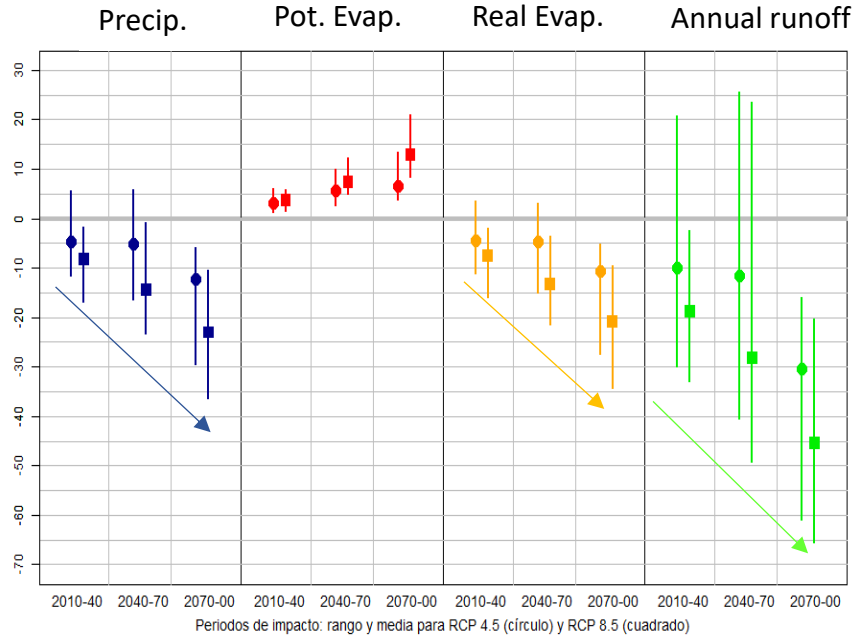
MAIN THREATS



Permeability of the volcanic soils



High pressure on water resources: Agriculture + Tourism + Urbanization



Climate change: decrease in precipitation and increment in temperature

Increased severity and duration of the dry period

Water Framework Directive (WFD) & Hydrological Plans (Canary Islands)

No Epicontinental waters of significant extension are identifed in Canary Islands !!!!

FRESHWATER BIODIVERSITY IN THE CANARY ISLANDS: CHARACTERISTICS

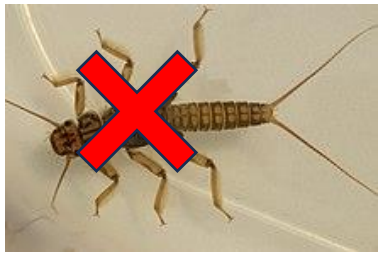
Low species richness



High endemicity



Disharmonic biota



Plecoptera



Elmidae (Coleoptera)

Restricted distributions



Gattolliat et al. 2018

Mixture of endemic and non-endemic species (with distributions in Mediterranean and African regions)

First general inventory at the community level (Malmqvist et al., 1993; 1995) = **171 species**

The most recent works (Luderitz et al 2016; Vidaña, 2020)= **78 species** (**without** considering the Diptera order) with approximately 30% endemic species

High level of endemisms in: Diptera (45 species), Coleoptera (18 species), Trichoptera (10 species)

Recorded genetic sequences of endemic species: Diptera:(3/45), Trichoptera: (1/10), Coleoptera: (12/18) Source: (Data base BIOCAN)

OBJECTIVES

Update basic information on the taxonomic, genetic diversity and distribution of aquatic insects in Canary Islands (Tenerife, La Palma y La Gomera)

Determine the vulnerability of species to global climate change in Canary Islands

Identify the priority zones for the conservation of the biodiversity of aquatic insects

Fundación BBVA

BIOACUANA CONACAN

MINISTERIO PARA LA TRANSICIÓN ECOLÓGICA Y EL RETO DEMOGRÁFICO

ORGANISMO AUTÓNOMO PARQUES NACIONALES

METHODS



BIOACUANA CONACAN

38 sampling sites:

Tenerife: 14 **La Palma: 13** **La Gomera: 11**

3 samplings: November 2022, May 2023, November 2023

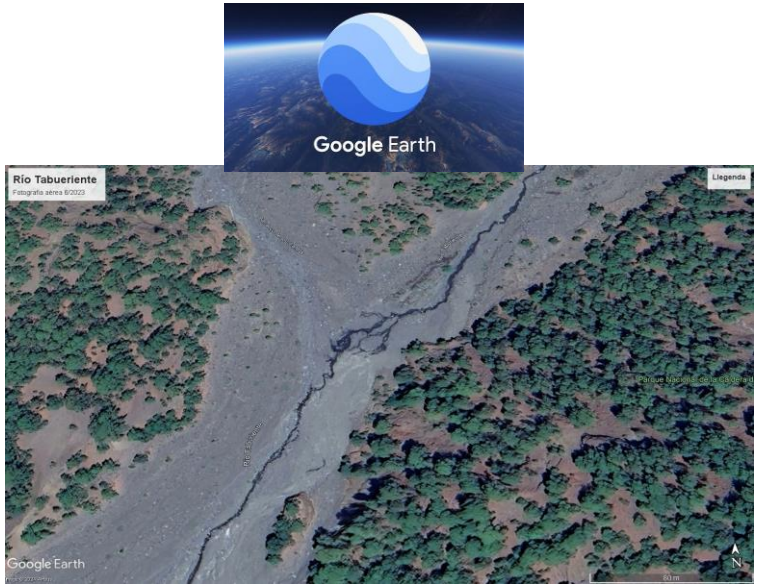
METHODS: HYDROLOGICAL CHARACTERIZATION





Conductivity and temperature **data loggers (HOBOs)**



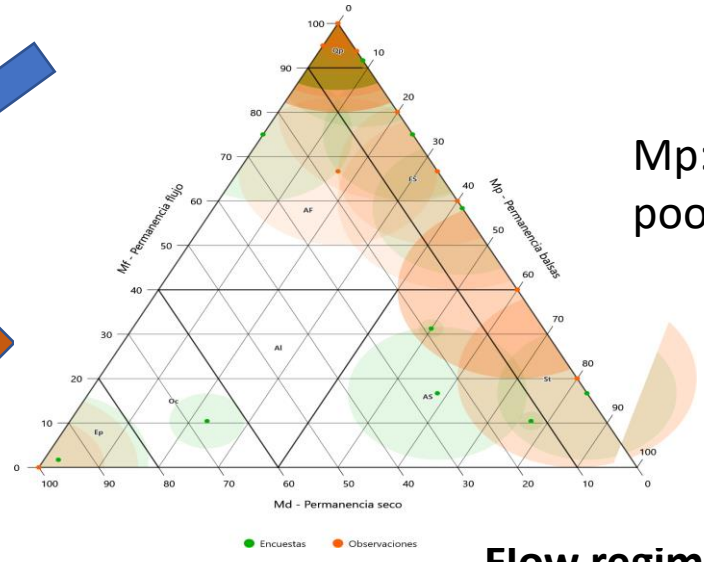


Online information: Wikiloc, Google Earth, Street View



Interviews to local people and stakeholders (National Park rangers)

TREHS



Flow regime classification

Permanence of:

Mf : flow

Mp: disconnected pools

Md: dry

METHODS: SAMPLING

SAMPLING OF AQUATIC STATES (LARVAE, PUPAE, SOME ADULTS)



Kick Net



Sorting and preservation of specimens

SAMPLING OF AERIAL ADULTS



Ultraviolet light trap



Emergence trap



Butterfly net

RESULTS: TAXONOMIC BIODIVERSITY

12 orders
58 families
119 genera
96 species
97 morphospecies



Chironomidae



Hydrachnidia



Atrichopogon sp.
(Ceratopogonidae)



Oxycera sp.
(Stratiomyidae)



Dicranomyia sp.
(Limoniidae)

Tanomically complex groups: …still working

Groups with undescribed larvae to species level:
Mainly endemic Diptera!!!

Trichoptera: 15 recorded species
(db BIOCAN)

BIOACUANA/CONACAN: 13 species



Oecetis canariensis (?)
(Leptoceridae)



Lepidostoma tenerifensis
(Lepidostomatidae)



Polycentropus tenerifensis
(Polycentropodidae)



Wormaldia taganana
(Philopotamidae)

RESULTS: UPDATE DISTRIBUTION

First record to genera level for all Canary Islands

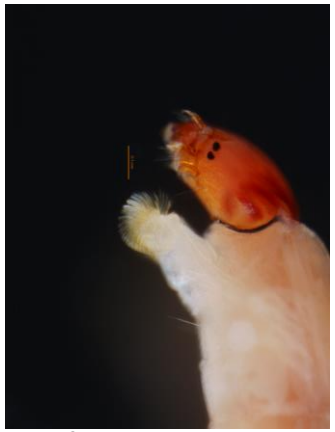
Also, other 15 genera (Chironomidae, Psychodidae and Dugesiidae) recorded for the first time in another different canary island.



Pelina sp. (Ephydridae) in Tenerife



Saetheria sp. (Chironomidae) in La Palma



Phaenopsectra sp. (Chironomidae) in La Palma

First record to species level



Agabus conspersus (Coleoptera: Dytiscidae) in La Gomera



Helobdella stagnalis (Hirudinea: Glossiphoniidae): in La Gomera



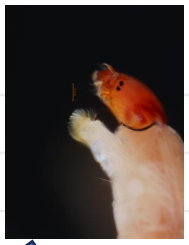
Macropelopia nebulosa (Diptera: Chironomidae): in La Palma and La Gomera

RESULTS: GENETIC BIODIVERSITY

901 specimens
(158 species/morphosps)

DNA EXTRACTION (BARCODING) cox1 fragment

Barcode sequences for:
784 specimens (**87%** success rate)
154 species/morphosps (**98%** success rate)









RESULTS: GENETIC BIODIVERSITY

(158 species/morphosps)

Molecular species delimitation

(178 molecular entities)

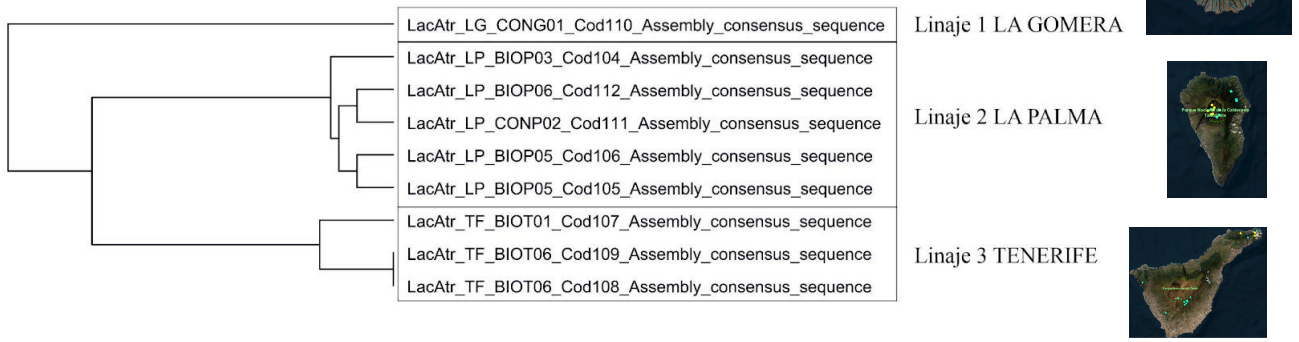
Cryptic species!!

Genetic divergence (3%)

Laccobius atroscephalus (Hydrophilidae)

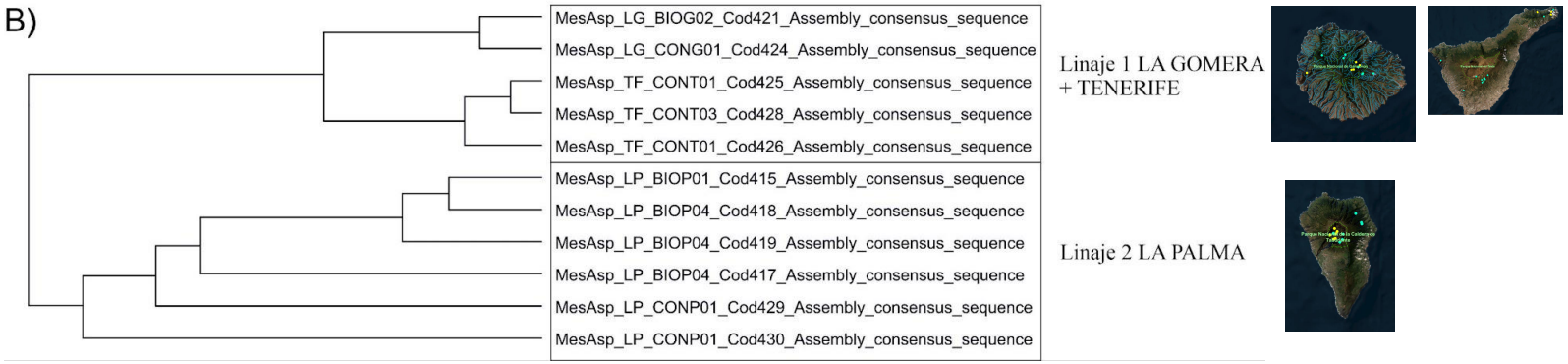


A)



Mesophylax aspersus (Limnephilidae)

B)





RESULTS: DIFFERENCES BETWEEN COMMUNTIES

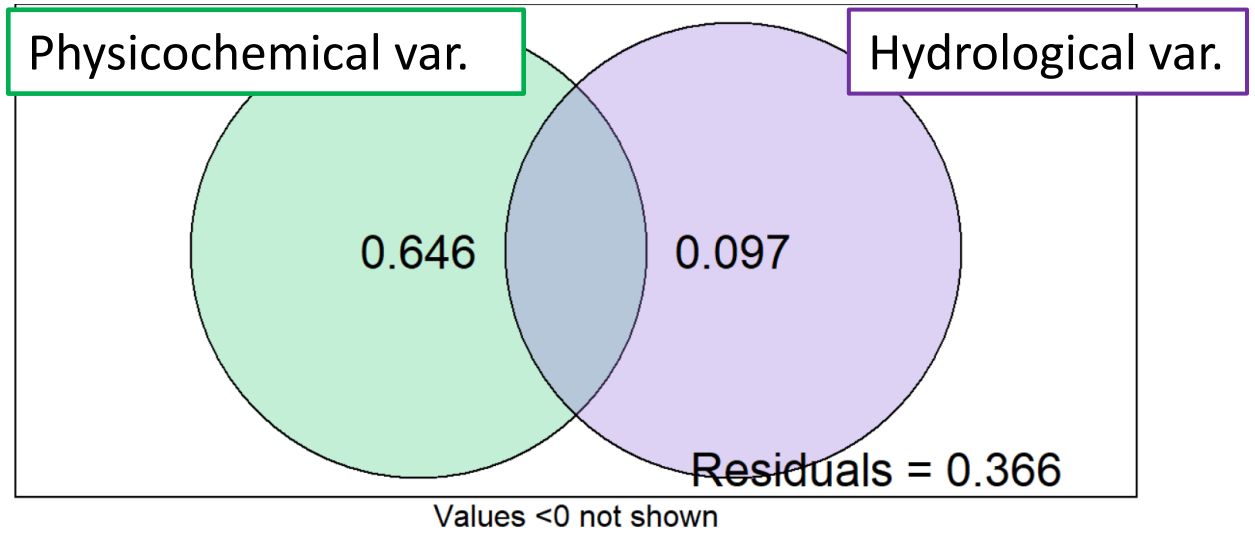
Spring Vs Autumn → ANOSIM → Spring = Autumn

ANOSIM: statistic R: 0.0009325

Tenerife Vs La Palma Vs La Gomera → ANOSIM → Tenerife ≠ La Palma ≠ La Gomera

ANOSIM: statistic R: 0.2956

Variation partitioning



Linear Mixed Model

Explained variance = **Fixed effects** + **Random effects**

Shannon Diversity 40.9% = Physicochemical var. 26.7% + Islands 14.2%

Shannon Diversity 52.3% = Hydrological var. 20.8% + Islands 31.5%

RESULTS: SPECIES VULNERABILITY

Insular Endemicity based Score

CATEGORY	SCORE
Non-endemic species from Macaronesia region	1
Endemic species of more than one Macaronesian archipelago (Canary, Azores, C. Verde)	2
Endemic species at least in 2 or 3 Canary Islands	3
Endemic species in 1 Canary Island	4

Final Vulnerability Score

$\overline{X}$

BIOACUANA/CONACAN Distribution based Score

CATEGORY	SCORE
> 40 % Sampling Sites	1
> 20-40 % Sampling Sites	2
> 10-20 % Sampling Sites	3
<10 % Sampling Sites	4

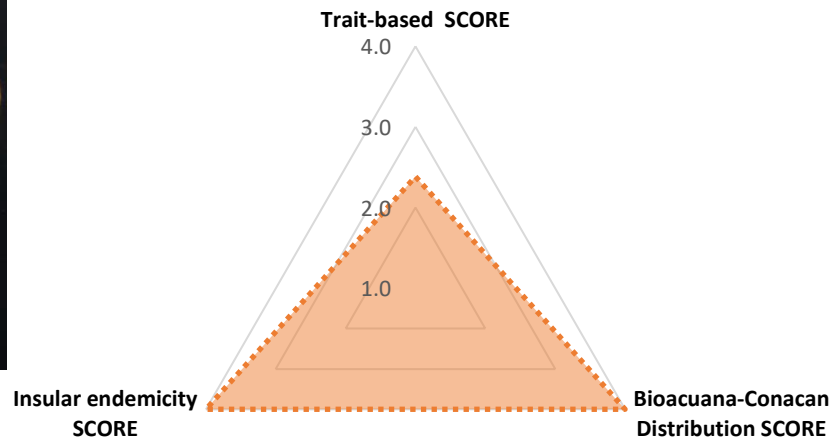
Ecological and Biological Traits based Score
13 Traits

Reproduction score	Reproductive cycles /year score
Resistance form score	Dispersal strategy score
Respiration score	Female wing length (mm) score
Feeding habits score	Fecundity score
Current velocity score	Altitude score
Temperature score	Microhabitat specialist score
Life cycle duration score	

RESULTS: SPECIES VULNERABILITY

Lepidostoma tenerifensis

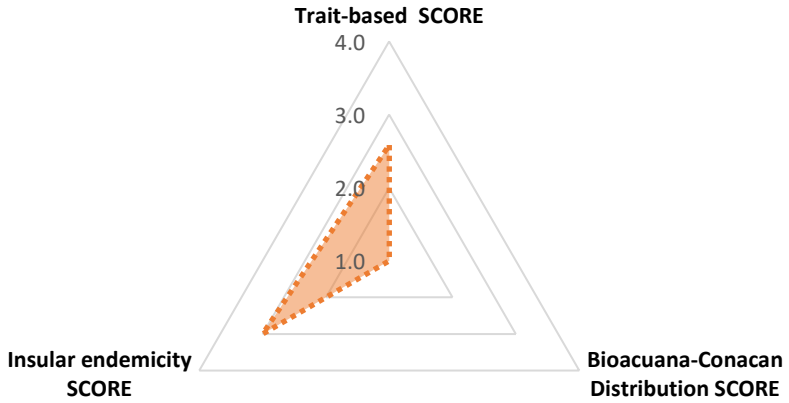




FINAL SCORE: 3.5

Mesophylax aspersus canariensis

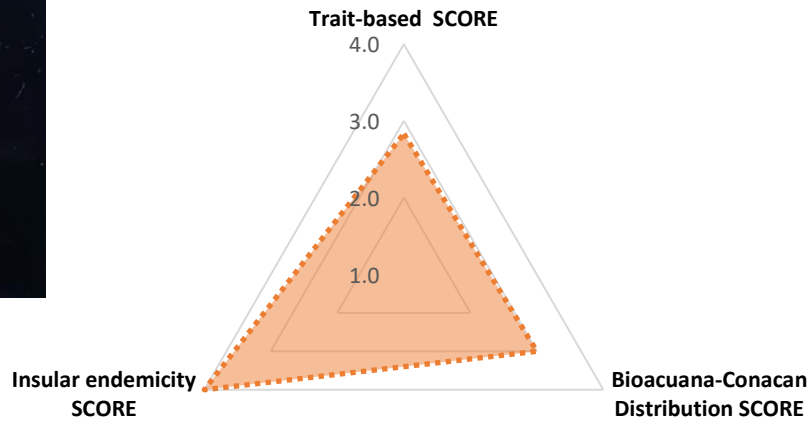




FINAL SCORE: 2.2

Rhipidogammarus gomeranus

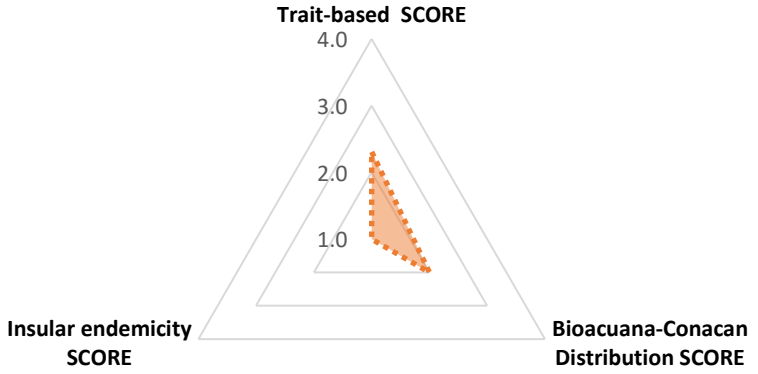




FINAL SCORE: 3.3

Hydropsyche maroccana



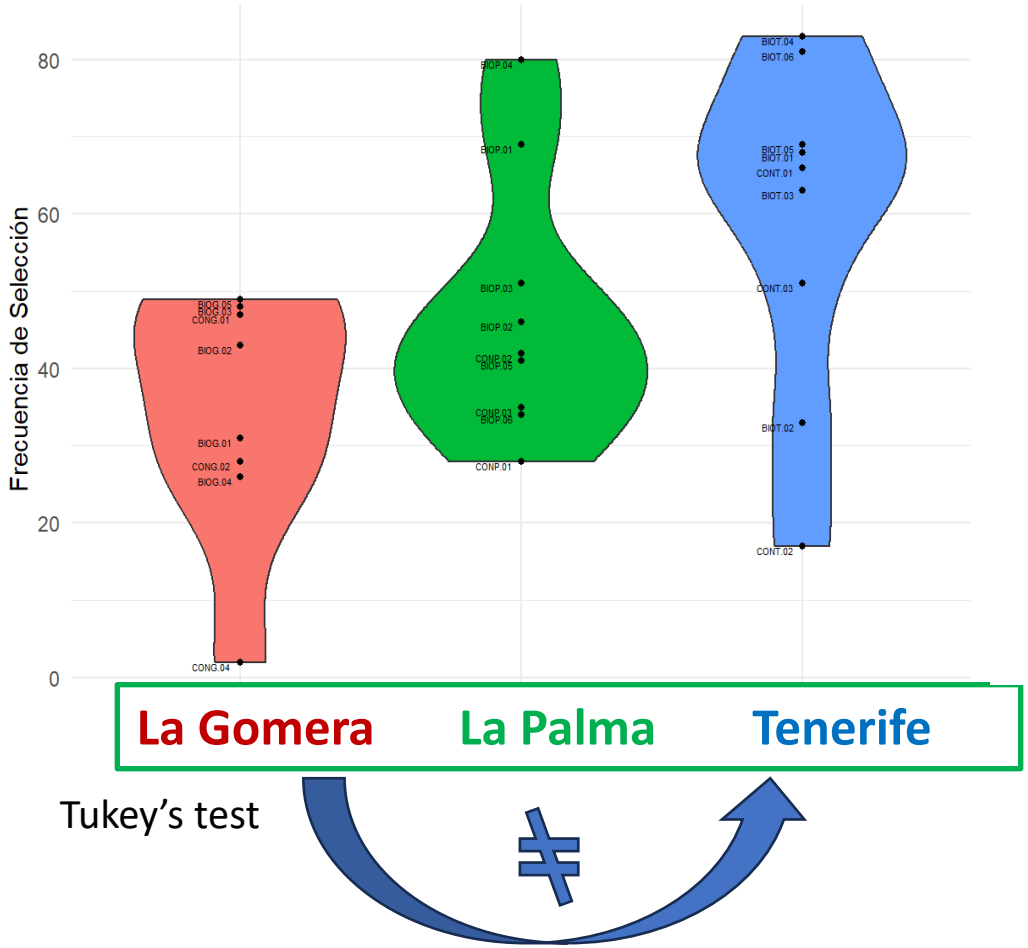


FINAL SCORE: 1.8

RESULTS: CONSERVATION

MARXAN
conservation solutions

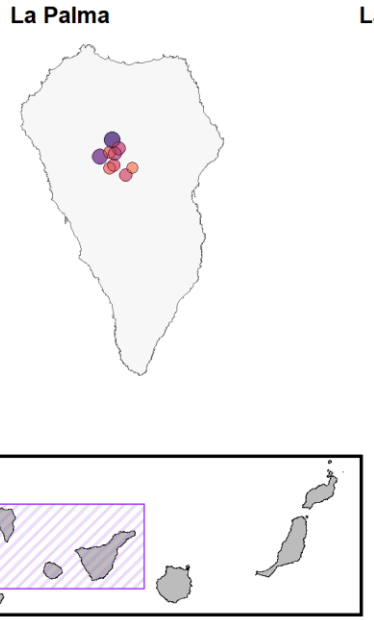
SITES SELECTION FREQUENCY



La Gomera La Palma Tenerife

Tukey's test

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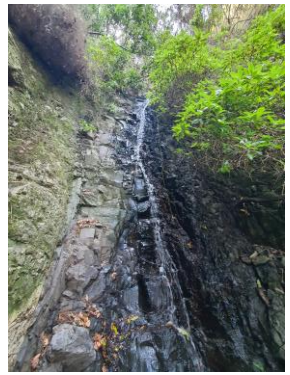


Frecuencia de selección
0 25 50 75 100









RESULTS: CONSERVATION

HYDROLOGICAL VARIABLES → **SITES SELECTION FREQUENCY** ← **PHYSICOCHEMICAL VARIABLES**

Mf : Flow

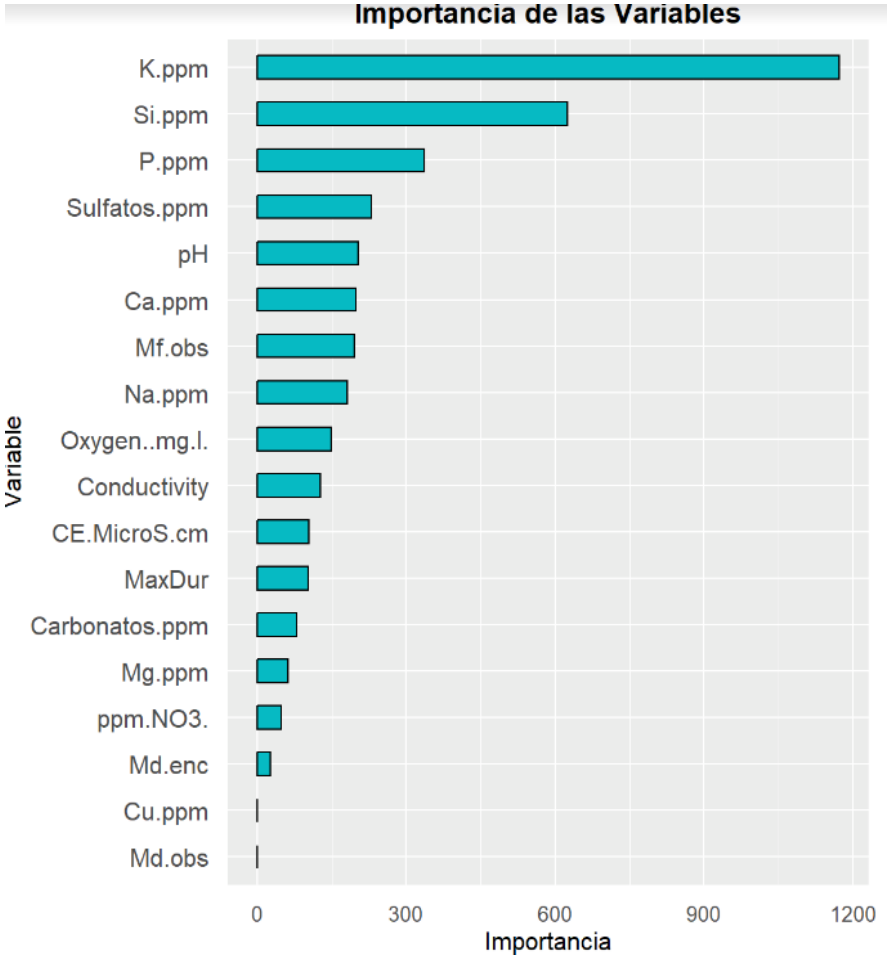


Mp: pools



Md: dry













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