MORNING - Metacommunity Of freshwateR sNails IN Guadeloupe
Long-term monitoring of freshwater snails (2001-2020)

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This document briefly explains the scientific objectives and context in which the MORNING database was constituted, and what it contains.

Briefly, MORNING is the result of monitoring of a set of freshwater habitats (largely ponds, including small lakes) in the Guadeloupe archipelago (Grande-Terre, Marie-Galante, Terre de Haut and Désirade) over the 2001-2020 period by P. David, P. Jarne, J.-P. Pointier and colleagues. A core of 230 sites were surveyed annually, and the remaining set of sites less frequently. In each site, the density of those 23 species occupying Guadeloupe freshwaters were recorded as density class, and individuals from a subset of species were counted in a subset of sites. For the two parthenogenetic species *Melanoides tuberculata* and *Tarebia granifera*, determination was done at the clone level (6 and 2 respectively). In all sites, a set of environmental parameters were recorded.

1. The context and scientific objectives

Malacological surveys have been carried out in Guadeloupe since the early 1970's by J.-P. Pointier and co-workers in a context of the control of bilharziasis (a parasitic disease transmitted by schistosomes – flukes- for which a freshwater snail serves as intermediate host). See Pointier & Théron (1995) and Pointier & Augustin (1999) and references therein. A regular survey of ca. 30 sites was conducted over a decade in the 1980-1990's (Pointier & David 2004) which served as the basis for a more ambitious survey that led to MORNING. This survey (2001-2020) was conducted to study the population biology, population genetics and community ecology of freshwater snails in the context of communities experiencing both extensive environmental change and a flow of (snail) invaders. This work is detailed in Lamy et al. (2012a, 2012b, 2013a, 2013b, 2017), Chapuis et al. (2017), Dubart et al. (2019, 2022), Jarne et al. (2021) and Pantel et al. (2022).

2. Snails and environments in Guadeloupe

The Guadeloupe archipelago includes several islands (Figure 1) of more or less ancient volcanic origin. Our focus is here on Grande-Terre and Marie-Galante, with a few data from La Désirade and Les Saintes, which harbors natural and artificial ponds (for ex., ca. 2000 in Grande-Terre), but also a few small intermittent rivers and swamp grasslands connected to mangroves (referred to as back-mangroves in our publications. Guadeloupe experiences a sub-tropical climate, with the alternation of a dry season (December to June) and a wet season (July to November). During the dry season, the freshwater habitats can dry out for periods lasting for up to several months. During the wet season, flooding events can connect these habitats.

Mollusk species constitute the major part of the macrobenthos in ponds. The majority of species found in Guadeloupe belongs to the gastropods and one species to the bivalves (*Eupera viridans*). Gastropods are divided into two classes, the Pulmonates and the Caenogastropods. Around 70% of the species are considered as local, meaning they were already recorded in the prior to 1950, and the remaining ones have been introduced since then

(Figure 2), most probably through human activities (e.g., aquarist trade). Two gastropod species are parthenogenetic, and composed of clones that can be visually recognized – taxonomic determination therefore goes down to the clone level in these species.

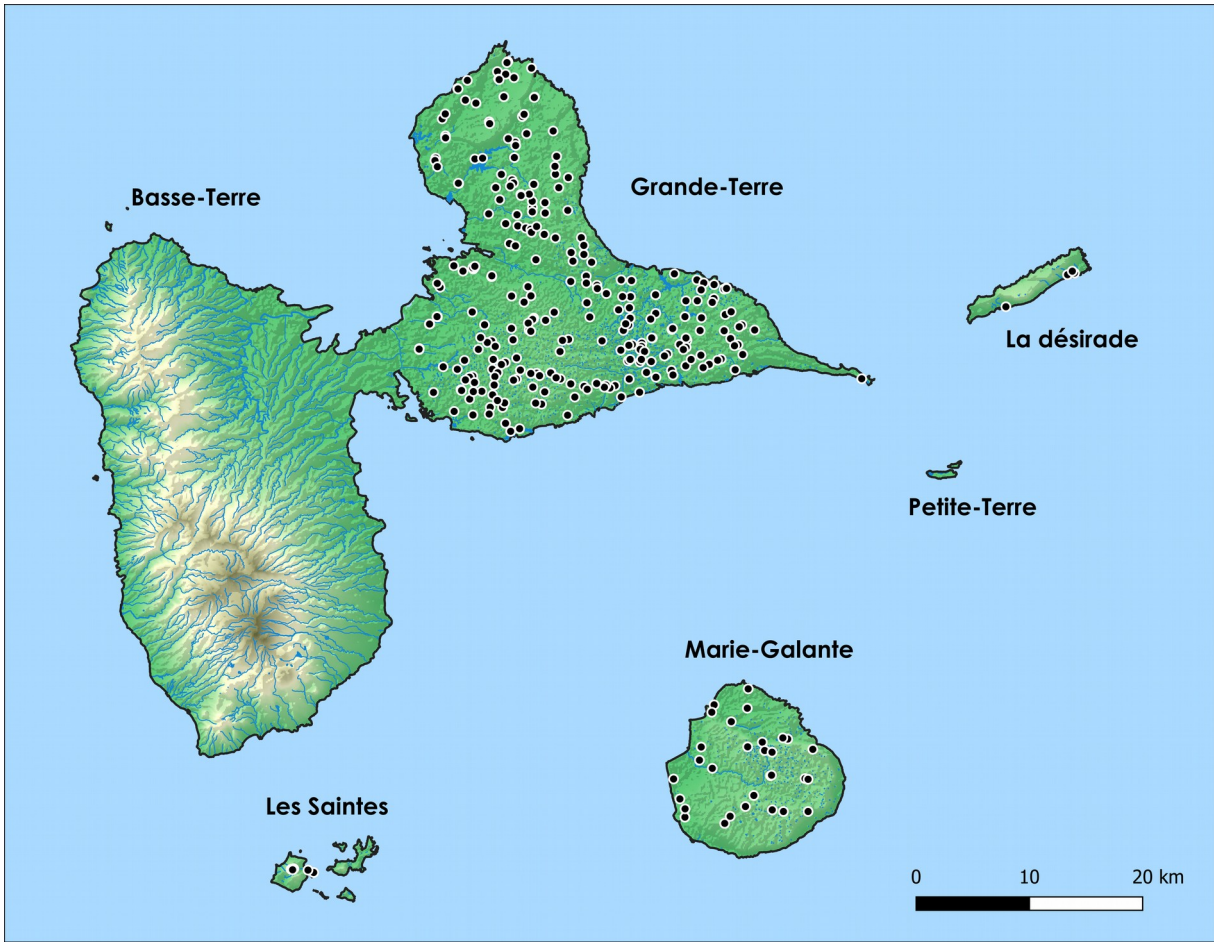

Figure 1. The Guadeloupe archipelago. Black dots represent locations sampled in the yearly survey initiated in 2001. Map realized with QGIS (Version 3.4.4), with data from https://www.data.gouv.fr/ (Open data from French government), and from the Shuttle Radar Topography Mission (SRTM, NASA) for topographic data (provided by the CGIAR - Consortium for Spatial Information, http://srtm.csi.cgiar.org/). Extracted from Dubart (2019).

3. Data in MORNING

MORNING has been constituted based on sampling carried out between 2001 and 2020 at the beginning of the dry season (generally January-February, sometimes December). The survey includes almost 300 sites (250 in Grande-Terre and 30 in Marie-Galante), 85% being ponds (or small lakes), and the remaining being shared between small intermittent rivers (water flows during the wet season) and back-mangroves (freshwater swamps that extend over a heterogeneous mosaic of interconnected meadows and inundated forest, including a few pools and small streams fed by permanent springs - these micro-habitats are intimately mixed and form continuous water bodies in the wet season, with a progressive transition to true, brackish and marine mangrove habitat, towards the sea side). A large fraction of sites was sampled over the whole period. Some were not, because they were destroyed, clogged by plants, or become inaccessible. New sites were therefore added to compensate for lost sites. Overall,

222.5 ± 30.5 sites were visited yearly over the 2001-2017 period, and each site was visited 14.9 times (± 3.14) (Dubart 2019).

We recorded the density of the 25 species (and clones in parthenogenetic gastropods; Figure 2) in each site by searching for *ca*. 15 minutes (sometimes far less when sites were very small) by usually three persons exploring all sub-habitats. A random subset of sites (ca. 30) was re-sampled each year from 2007 on in order to estimate species detection probabilities (Dubart et al. 2022, Pantel et al. 2022). We also counted individuals to get more accurate data (and to account for wide variation in density among species) in groups including species of similar shape and size – we considered four groups:

- Group A: all small Planorbids (*Drepanotrema* spp.);
- Group B: small Pulmonates with acute shell (*Physa acuta, Aplexa marmorata, Pseudosuccinea columella, Galba cubensis, Pleisiophysa granulata*);
- Group C: larger Planorbids (*Biomphalaria spp., Indoplanorbis exustus* and *Helisoma duryi*);
- Group D: all Thiarids.

Importantly, these numbers allow to estimate relative frequency WITHIN groups, and cannot be compared among groups. Other species were not counted.

Several environmental characteristics were also recorded in each site, and includes for example vegetation cover, site size and maximum depth, water quality, and quantity of organic debris (i.e., dead leaves, branches or fruits). The environmental characteristics also include an index reflecting the frequency with which a site is connected to others depending on the local topography and proximity to other ponds. Dry sites (ca. 5% per year on average) were not sampled. More details are provided in the various publications mentioned above.

MORNING entries are detailed in the joint CSV file.

4. Acknowledgements

The surveys leading to MORNING were initiated by J.-P. Pointier (EPHE, now retired) in the 1970's, and he contributed to fed it all the way along to today. He therefore deserves special thanks. Thanks are also due to the many colleagues and students who participated to field sampling (in alphabetical order): N. Bargié, K. Béthunes, N. Bonel, V. Calcagno, E. Chapuis, S. Coulon, M. Dubard, M.-P. Dubois, G. Epinat, J. Escobar, F. Laroche, F. Massol, E. Noel, J. Pantel and A. Segard. Field sampling was funded by grants from the French National Research Agency (ANR JCJC-0202, AFFAIRS 12SV005 and ANR17-CE32-0011-05), the French Fondation for Research on Biodiversity (Cesab COREIDS), the French Ministry of Environment (ECOFOR, Ecosystèmes Tropicaux and INVABIO programs), the Occitanie Region (Chercheurs d'Avenir, P. David), the OSU OREME and the Ecology-Environment institute of CNRS, as well as by PhD fellowships from the French Ministry for Research (T. Lamy and M. Dubart) and for Agriculture (F. Massol and F. Laroche), and a post-doctoral fellowship AXA fondation (E. Chapuis).

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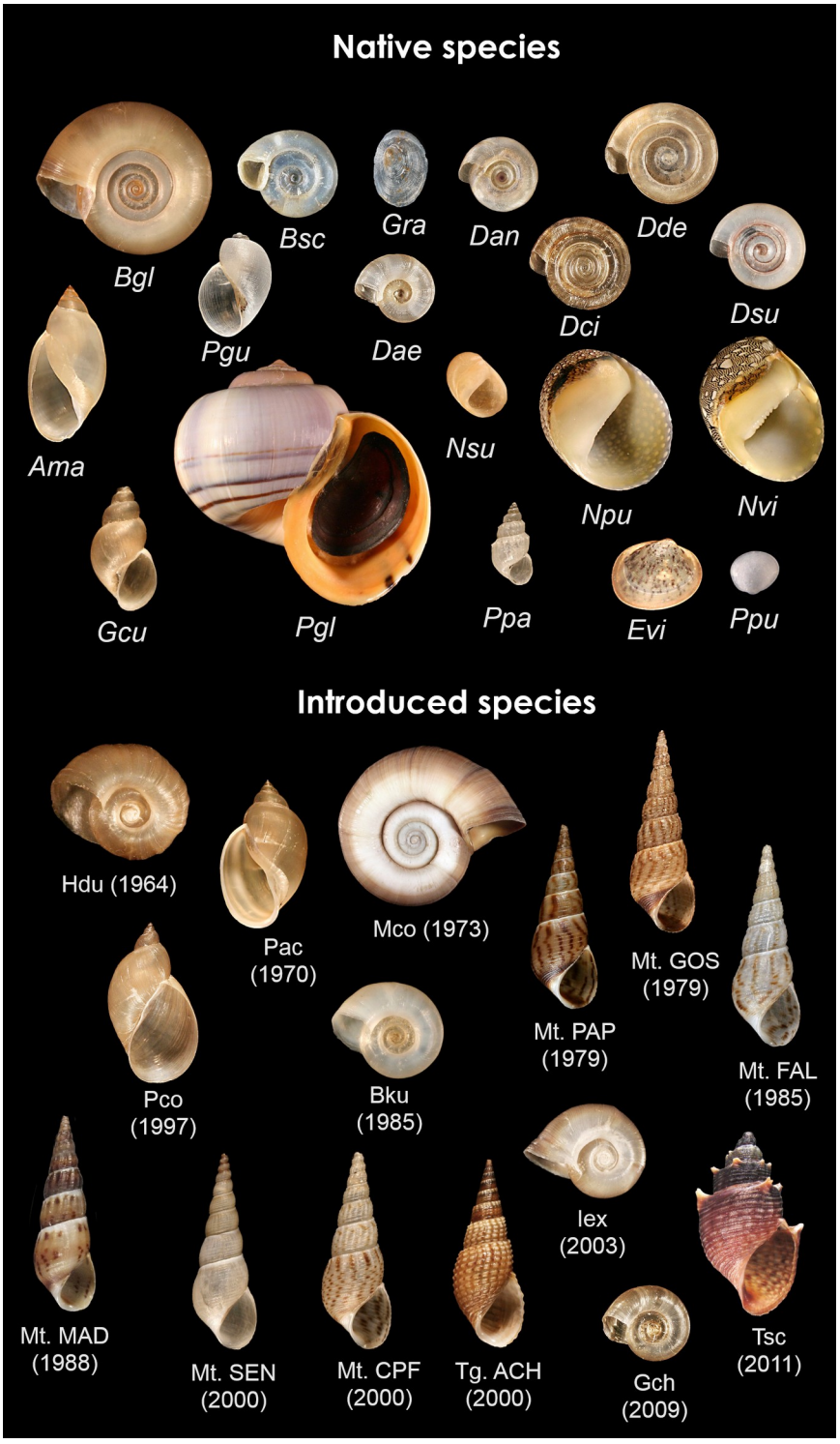

Figure 2. Native and introduced species in the Guadeloupe archipelago (with dates of first sampling for the introduced species). Abbreviations: Ama: *Aplexa marmorata*, Bgl: *Biomphalaria glabrata*, Bku: *Biomphalaria kuhniana*, Bsc: *Biomphalaria schrammi*, Dae: *Drepanotrema aeruginosum*, Dan: *Drepanotrema anatinum*, Dci: *Drepanotrema cimex*, Dde: *Drepanotrema depressissimum*, Dsu: *Drepanotrema surinamense*, Evi: *Eupera viridans*, Gch: *Gyraulus chinensis*, Gcu: *Galba cubensis*, Gra: *Gundlachia radiata*, Hdu: *Helisoma duryi*, Iex: *Indoplanorbis exustus*, Mco: *Marisa cornuarietis*, Mt. X: *Melanoides tuberculata*, morph X, Npu: *Neritina punctulata*, Nsu: *Neritilia succinea*:, Nvi: *Neritina virginea*, Pac: *Physa acuta*, Pco: *Pseudosuccinea columella*, Pgl: *Pomacea glauca*, Pgu: *Plesiophysa guadeloupensis*, Ppu: *Pisidium punctifera*, Tg. ACH: *Tarebia granifera*, morph ACH,

Tsc: *Thiara scabra*. Pictures are not to scale. Photographic credit: J.-P. Pointier. Extracted from Dubart (2019).