LONG-TERM PLANT COMMUNITY PATTERNS IN TEMPORARY FRESHWATER ROCKPOOLS

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Introduction

Context: the temporary freshwater rockpools (TFR) of the Maltese Islands have been studied from 1987 to 2018 at varying levels of detail. Data have appeared in different studies often relating to relatively short periods (1-3 years, maximum 7 years).

There has been no attempt to synthetise the data from the whole 30 year period to extract any trends that may be present in the data.

Data available

Species-level data for aquatic plants, amphibious plants, and terrestrial plants colonizing pools in several pool landscapes from 1987-2018.

Morphometric and landscape data for all pools (1987-2018).

Rainfall and temperature records (1987-2018); diurnal water temperature variation (2018).

Temporary freshwater rockpools

The habitat: relatively small pools in limestone bedrock with a seasonal hydrological and ecological cycle.

Size: generally less than 2m across, with water depths up to 1.5m.

Seasonality: flooded in September/October and may retain water, continuously or intermittently, up to April/May.

Biota: aquatic, amphibious, and terrestrial plants in different ecological zones. Several microcrustacean taxa also present.

Aims and Methods

We want to: collate all the data that was available between 1987-2018, analyse population cycles, and extract any trends.

Sample size: c.70 pools from 12 pool landscapes.

Data collection frequency: ranges from fortnightly visits to monthly/seasonal visits to the pools.

Data quality: ranges from detailed coverage of vegetation to binary presence/absence.

Taxa: all aquatic plants, amphibious plants, and terrestrial plants in the pool basins.

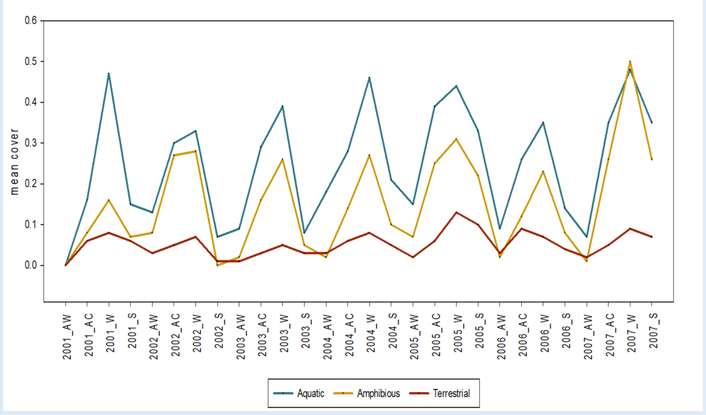
Environmental variables: rainfall (ranges from daily to seasonal), pool morphometry, surface geology, electrical conductivity, pH, diurnal temperature cycles.

Analyses: unconstrained multivariate analyses to explore general trends; constrained analyses to assess the effects of environmental factors on population cycles.

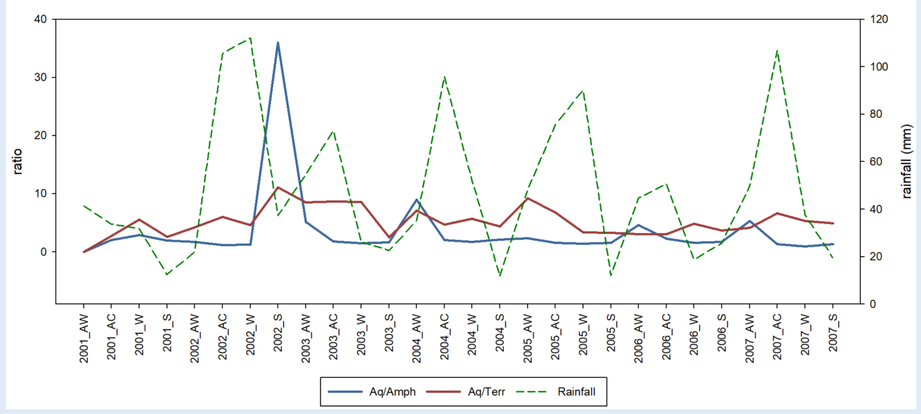
Quality of data

1987-1990		1991-1995	1996-1999	2000-2008	2008-2011	2012-2018
Low Quality: seasonal visits; presence-absence data; all taxa			Intermediate Quality: monthly visits, presence-absence data; all taxa			High Quality: fortnightly visits; detailed coverage; all taxa

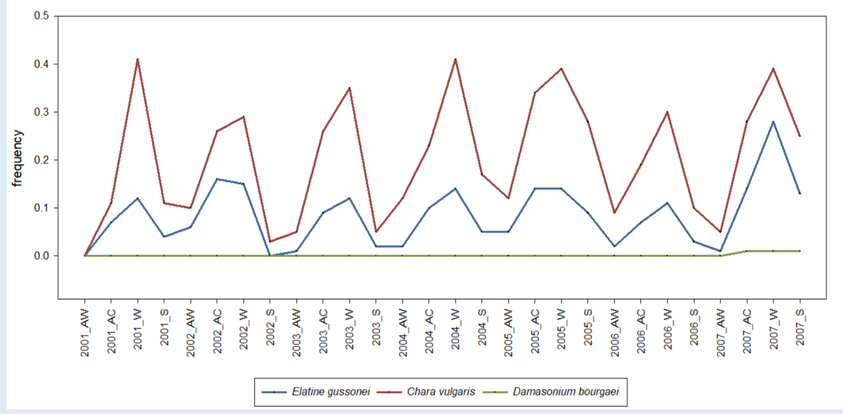
Sample Results (2001-2007)



Relative proportion of obligate aquatic plants, amphibious plants, and terrestrial plants in pools (2001-2007).

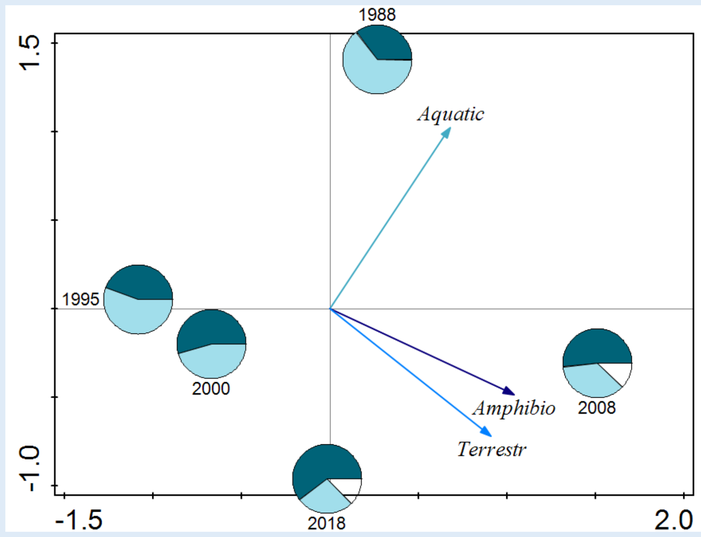


Ratio of obligate aquatic plants to amphibious plants, and ratio of obligate aquatic plants to terrestrial plants (2001-2007). Rainfall data also shown.

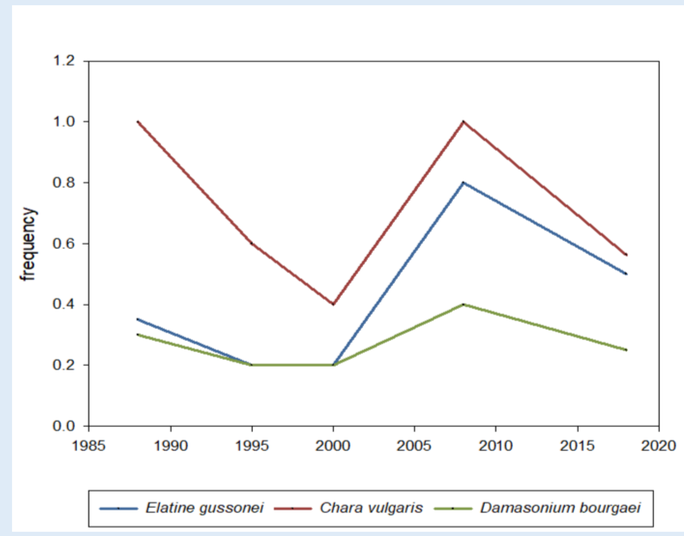


Frequency of *Elatine gussonei* (amphibious), *Chara vulgaris* (aquatic) and *Damasonium bourgaei* (amphibious) 2001-2007.

Longer term patterns (1988-2018)



PCA plot of community composition in all pools in 1988, 1995, 2000, 2018. Axis 1 and 2 explain 99.7% of the variability in the data. Legend: light blue—aquatic plants; dark blue—amphibious plants; white—terrestrial plants.



Frequency of *Elatine gussonei* (amphibious), *Chara vulgaris* (aquatic) and *Damasonium bourgaei* (amphibious) in 1988, 1995, 2000, 2008, and 2018. This cycle shows a consistent dip in frequency from 1988-2000.

Conclusions

General trends: 30-year reduction in the frequency of aquatic species and, since 2008, considerable infiltration of terrestrial species into pool basins. Frequency of amphibious species also increasing.

Community cycles: The TFR community undergoes periods of relative stasis, often lasting for several years, followed by abrupt shifts in community composition. The periods of stasis may be attributable to reduced immigration rates of competing resident species, to the filtering effects of hydroperiod duration and water depth, and to the oxidising effects of the summer drought which prevents gradual infill by sediment.

Stochastic meteorological events: unseasonal rainfall episodes or occasional deluges can play a key role in causing abrupt shifts. Unseasonal rain can trigger germination at unfavourable times of year, leading to reproductive failure over a whole population, whilst heavy deluges can wash out sediment and seed banks from pools.

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