The Threatened Plant Monitoring Scheme of the Valencian Community (Eastern Spain): a long-term project to assess the population trends of threatened species

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4th Mediterranean Plant Conservation Week
VALÈNCIA | 23-27 OCTOBER 2023

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Introduction

- Demographic monitoring of threatened species allows us to assess both population's trends and their conservation status. The Threatened Plant Monitoring Scheme of the Valencian Community (Eastern Spain) started formally in 2009 to achieve these goals, although previous population data were available for some emblematic plant species from a conservation point of view (*Cistus heterophyllus*, *Helianthemum caput-felis*, *Limonium perplexum*, *Medicago citrina*, *Silene* diclinis, *Teucrium lepicephalum*, etc.).

- The program includes 158 plant species located in 1054 monitoring plots (Fig. 1), called monitoring units (MU). These plots are mapped and population censuses are carried out every one to three years for each of the threatened flora species, according to its protection category in the *Valencian Catalogue of Threatened Plants* (VCTP)[1,2], population dynamics or biotype.

- Here we present the results of the analysis of populations trends of threatened plant species in the Valencian Community (Eastern Spain) using the *TRIM* statistical package.
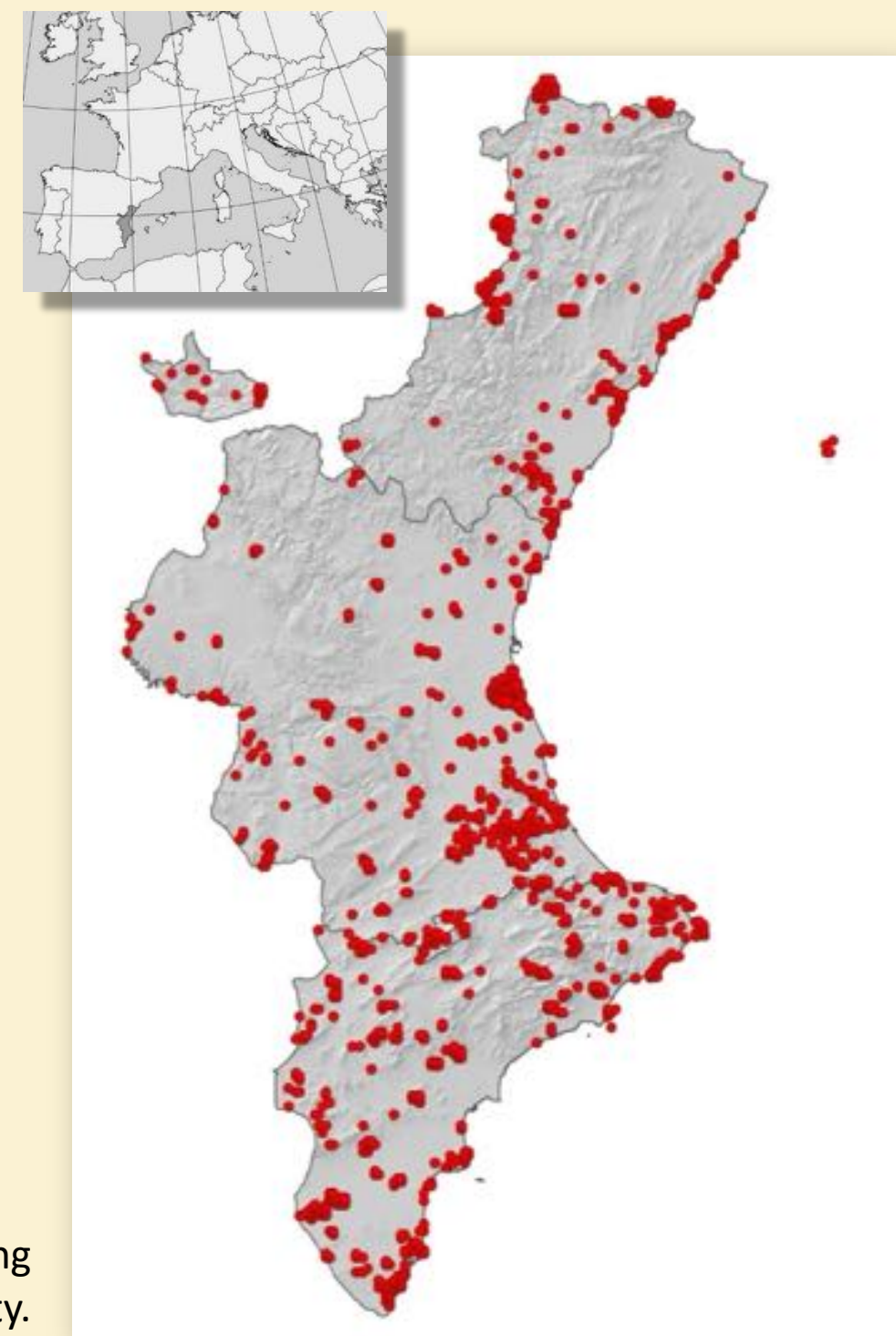
Fig. 1. Location of the Monitoring Units (MU) of the Threatened Plant Monitoring Scheme of the Valencian Community.

Methods

- We assess the population trends of threatened plant species using TRIM software (*Trend & Indices for Monitoring data,* TRIM 3.54). TRIM is statistical software developed for the analysis of long-term time series data from species monitoring programmes[3]. TRIM estimates annual population change indices. The TRIM index value at the first time point is 1.0 and it is taken as a reference for trends in subsequent years. The main advantages of TRIM are: (1) correction for both overdispersion and serial correlation; (2) incorporation of significant change points in trends; and (3) analyses of time series counts with missing observations[3]. The last of these is particularly advantageous when time series are incomplete due to lack of sampling, as occurred in some of our study areas.

- Trends were classified taking into account the slope imputed (i.e., multiplicative value) and the standard error provided by TRIM in six categories (Figure 2; modified from Pannekoek & van Strien 2005).

- In addition, the percentages of interannual change of the population of each species were integrated into multi-species change indices to assess the trend of sets of species grouped by a taxonomic, legislative or ecological link. Geometric average is used to avoid that the species with extreme values of the change indices produce a bias on the evaluated group.
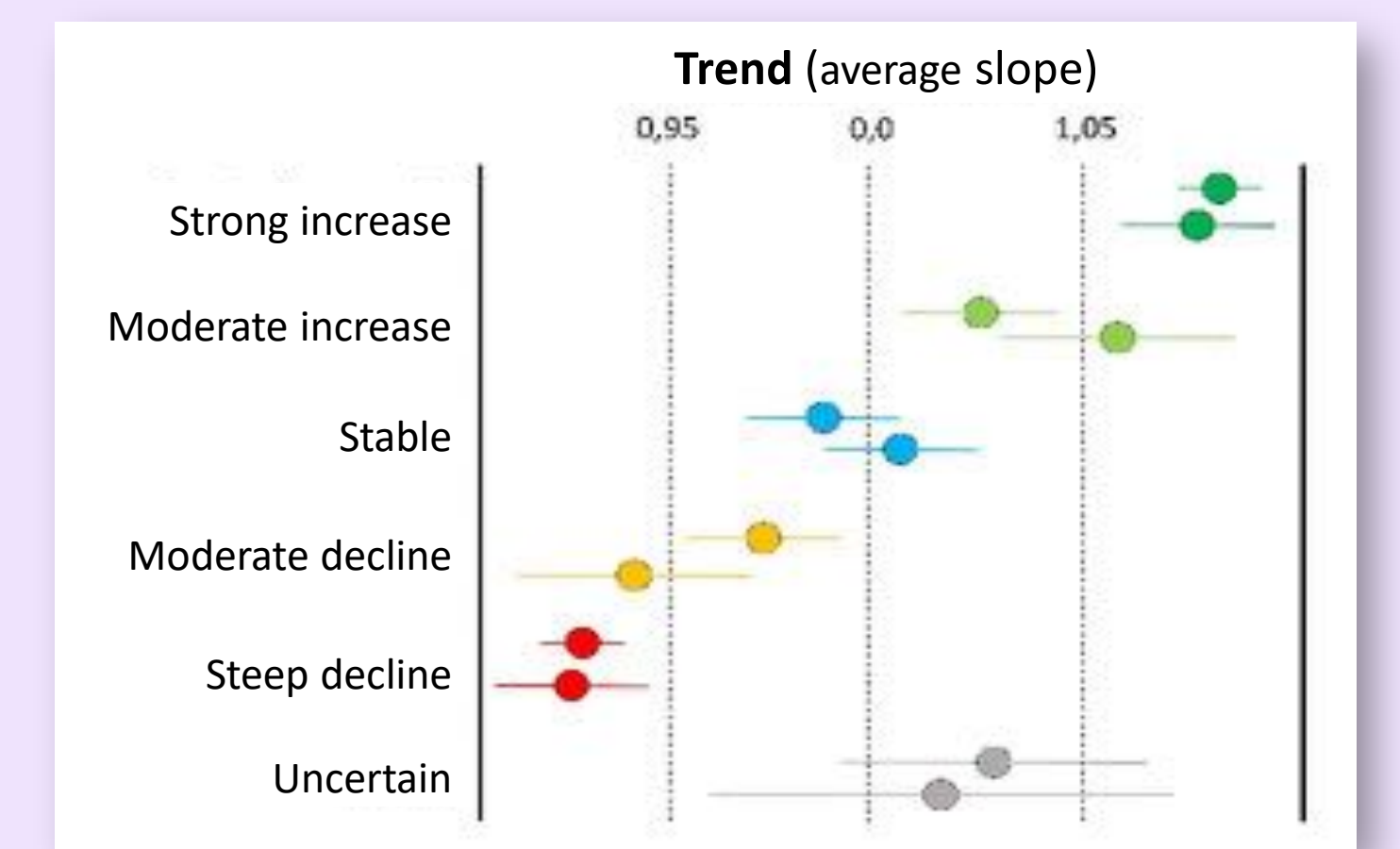
Trend (average slope)
0,95   0,0   1,05
Strong increase
Moderate increase
Stable
Moderate decline
Steep decline
Uncertain

Fig. 2. Estimation of trend categories in TRIM

Results and Discussion

Figure 3 shows the long-term population trend of the threatened flora species monitored in 2022. The percentage of species in decline (45.7%) was similar to that of species with a positive or stable trend (44.6%).
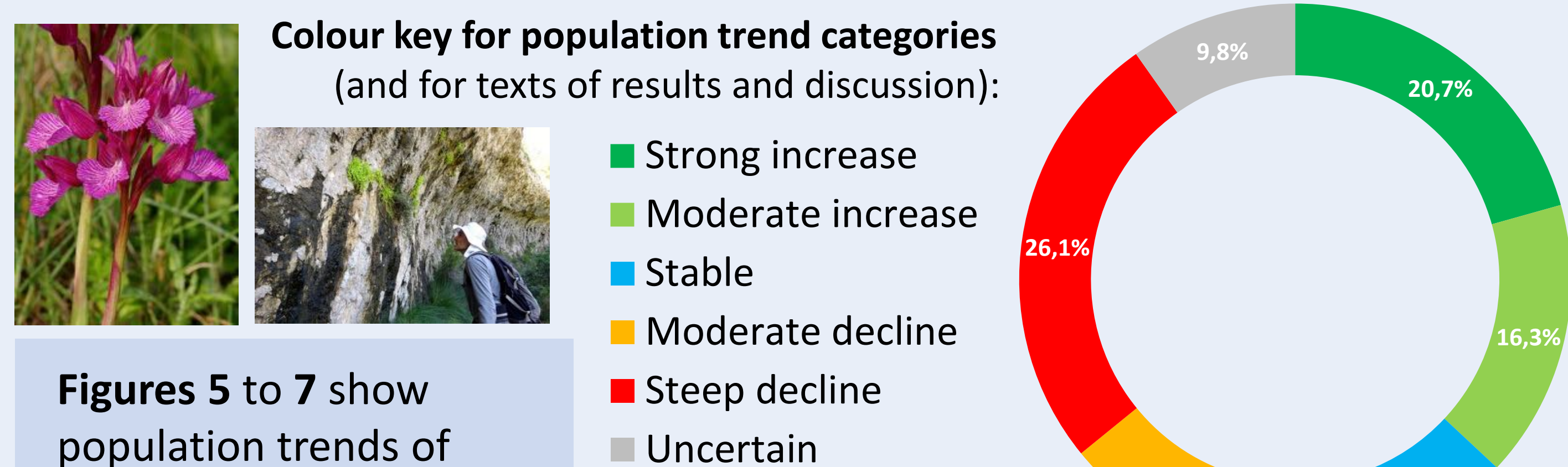
Colour key for population trend categories (and for texts of results and discussion):

- Strong increase
- Moderate increase
- Stable
- Moderate decline
- Steep decline
- Uncertain

Figures 5 to **7** show population trends of flora species grouped by threatened categories, biotype or habitat.

9,8%
20,7%
16,3%
7,6%
19,6%
26,1%

2014 is an extraordinarily dry year, which begins a **period of aridity** with a marked lack of precipitation

Fig. 3. Relative percentage in each population trend categories of threatened flora species censuses in 2022 for the 92 species analyzed with TRIM.

Figure 4 shows two examples of population trend estimation for two threatened flora species. For some species, such as *Silene hifacensis*, long-term time series of population data are available.
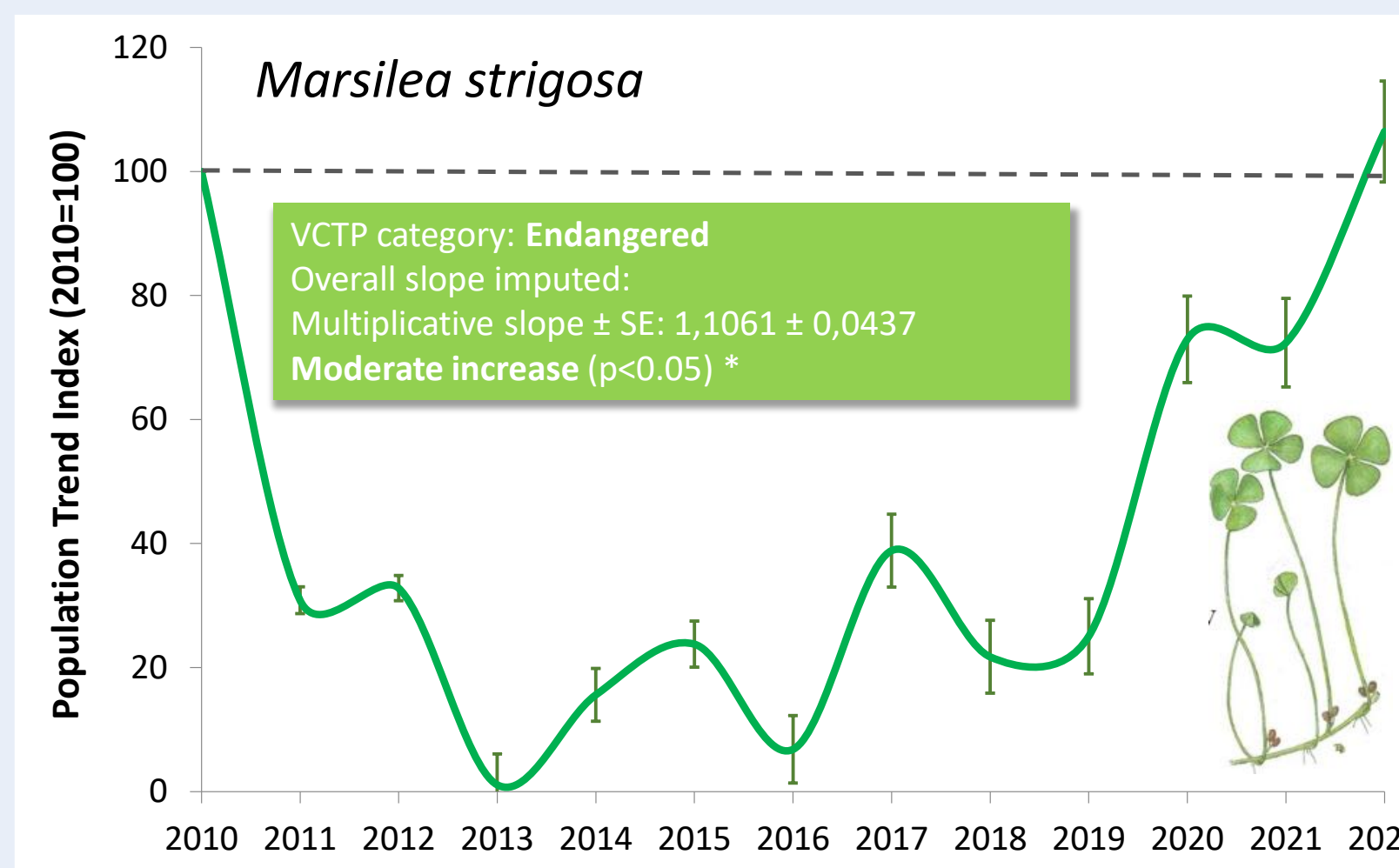
Marsilea strigosa
VCTP category: Endangered
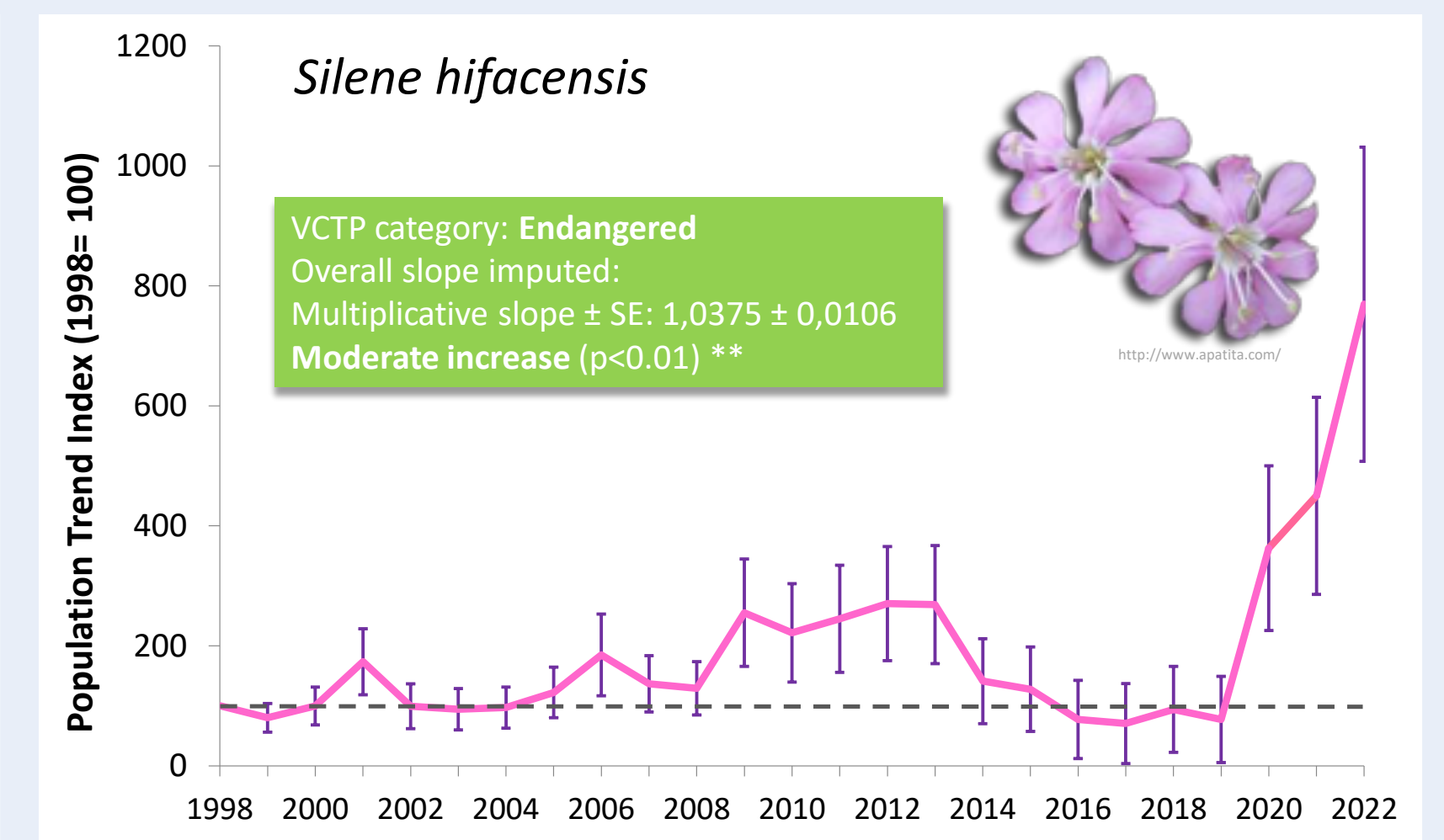Overall slope imputed:
Multiplicative slope ± SE: 1,1061 ± 0,0437
Moderate increase (p<0.05) *

Fig. 4a. Population trend of *Marsilea strigosa*

Silene hifacensis
VCTP category: Endangered
Overall slope imputed:
Multiplicative slope ± SE: 1,0375 ± 0,0106
Moderate increase (p<0.01) **

Fig. 4b. Population trend of *Silene hifacensis*

Period of **population stability**

Beginning of a period of **moderate decline**

Beginning of a period of **steep decline**

Long-term population trends **below reference values**

Interannual fluctuations, but relative **long-term stability**

Interannual fluctuations, but **long-term increase**

Long-term population stability, but **short-term decline**

Climatic habitat species show **positive long-term trends**

Edaphic habitat species show **negative long-term trends**

Threatened species (n= 119)
Cataloged species (Endangered and Vulnerable; n= 78)
Protected but non-cataloqued species (n= 41)

Fig. 5. Population trend of the evaluated Threatened species

Therophytes
Hemicryptophytes
Geophytes
Chamaephytes and phanerophytes
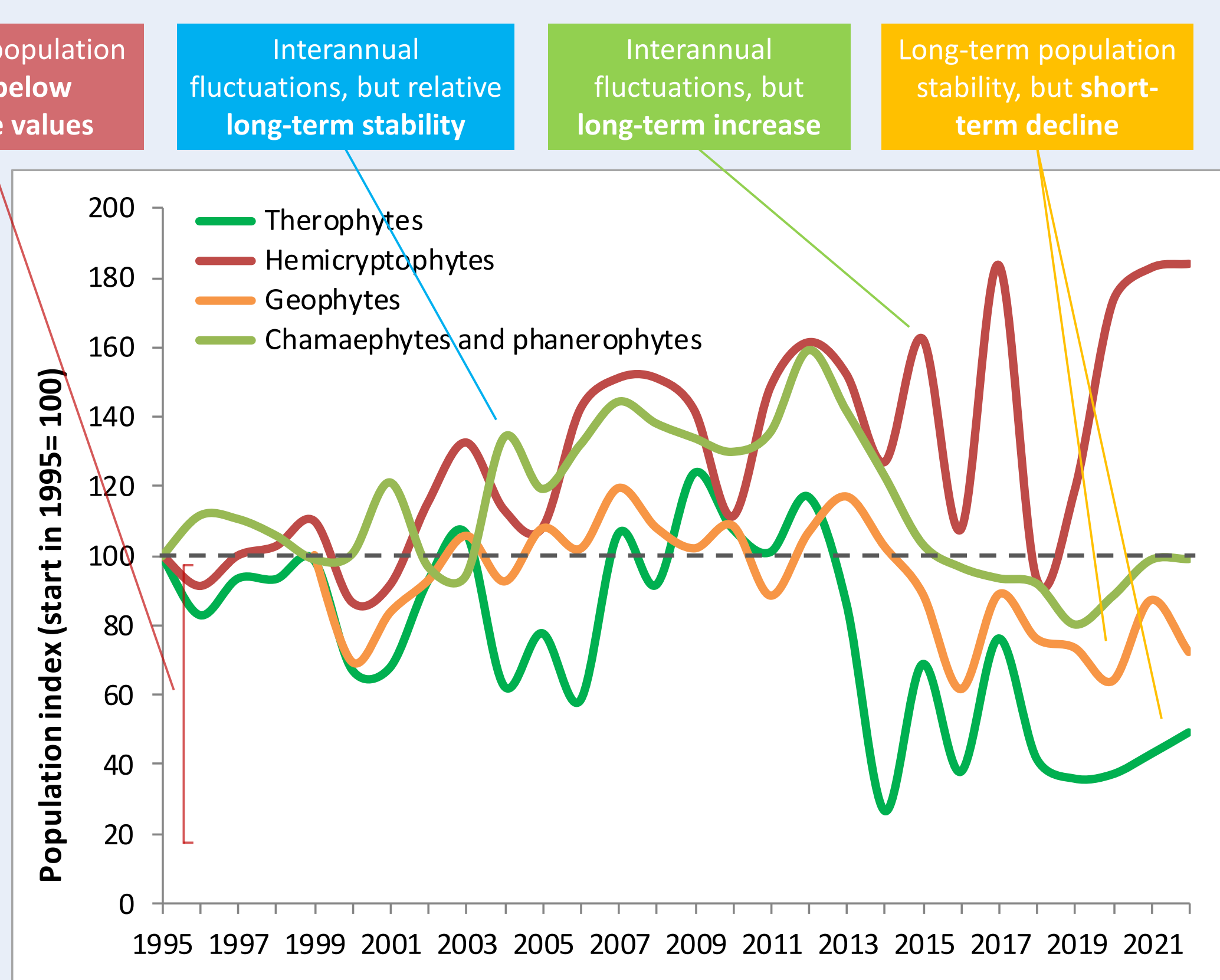
Fig. 6. Population trend of threatened species grouped by biotypes

Coastal habitats (n=13)
Saline habitats (n=13)
Rocky habitats (n=9)
Aquatic habitats (n=22)
Thermomediterranean shrublands/grasslands (n=39)
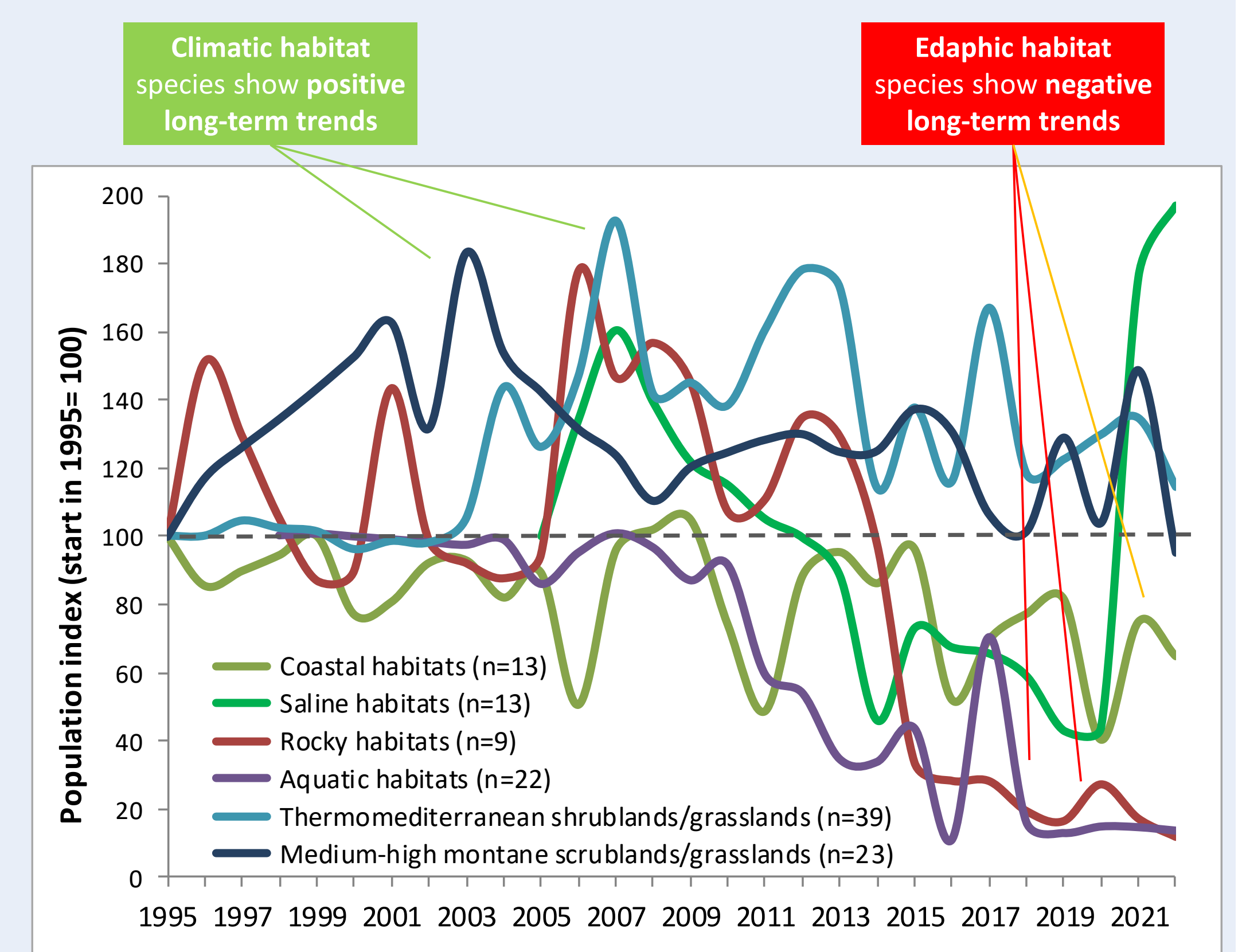Medium-high montane scrublands/grasslands (n=23)

Fig. 7. Population trend of threatened species grouped by habitats

References

1 Decreto 70/2009, de 22 de mayo, del Consell, por el que se crea y regula el Catálogo Valenciano de Especies de Flora Amenazadas y se regulan medidas adicionales para su conservación. Diari Oficial de la Comunitat Valenciana 6.021: 20143-20162.

2 Orden 2/2022, de 16 de febrero, de la Conselleria de Agricultura, Desarrollo Rural, Emergencia Climática y Transición Ecológica, por la que se actualizan los listados valencianos de especies protegidas de flora y fauna. Diari Oficial de la Comunitat Valenciana, 9285: 12677-12687.

3 Pannekoek, J. & Van Strien, A.J. (2005). TRIM 3 Manual (TRends & Indices for Monitoring data). Voorburg: Statistics Netherlands.