

PhD Course in “MOLECULAR, CELLULAR AND ENVIRONMENTAL BIOLOGY ”

Competition on islands: evaluating the impact of *Podarcis siculus* on Mediterranean insular ecosystems

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Introduction

The islands

Hotspot of biodiversity

- Endemism
- Evolutionary patterns
- Insular adaptations



Introduction

The islands



Hotspot of biodiversity

- Endemism
- Evolutionary patterns
- Insular adaptations



Hotspot of biodiversity loss

- Human activities
- Introduction of predators
- Climate change
- Alien species

Introduction

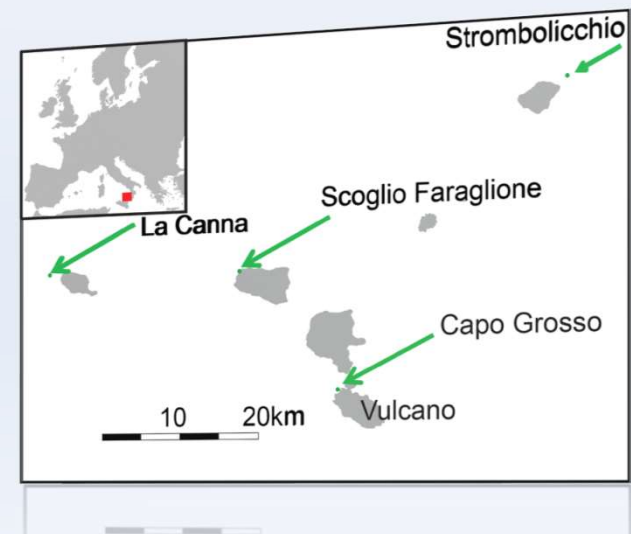
Alien species

One of the major drivers of extinction in reptiles

The case of *Podarcis siculus*



Its effect on *P. raffonei*



Introduction

Alien species

One of the major drivers of extinction in reptiles

The case of *Podarcis siculus*



Will other species also suffer the similar negative impacts?



Explore the impacts of *P. siculus* on other reptiles species

Objectivies

*Evaluating the effect of *P. siculus* on Mediterranean insular ecosystems*

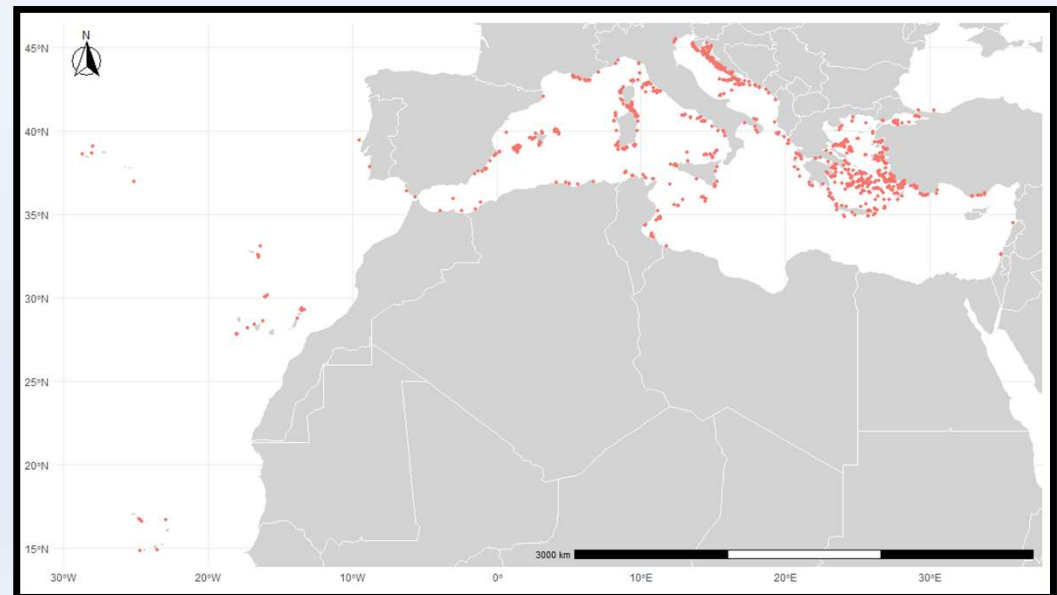
- **Mediterranean scale**: effects in shaping the distribution of insular reptiles
- **Island scale**: spatial competition and niche segregation between *P. siculus* and other lizards
- **Population scale**: potential impacts on abundance and physiological traits of sympatric lizards

Methods

1st year

Effects in shaping the distribution of insular reptiles

- **Co-occurrence analysis** of reptiles on islands
 - Dataset of Bonardi et al. (2022)
 - 152 species
 - 1311 islands



Methods

1st year

Effects in shaping the distribution of insular reptiles

- **Co-occurrence analysis** of reptiles on islands
 - Dataset of Bonardi et al. (2022)
 - 152 species
 - 1311 islands
- Explore association between species pairs
 - Probabilistic approach (Veech, 2013)
 - Observed **VS** expected co-occurrence
 - **Negative**, **positive** or random associations

	obs_cooccur	prob_cooccur	exp_cooccur	p_lt	p_gt	sp1_name	sp2_name
3165	0	0.000	0.0	1.00000	1.00000	Podarcis milensis	Stellagama stellio
3172	4	0.207	15.3	0.00000	1.00000	Podarcis muralis	Podarcis siculus
3177	0	0.040	0.2	0.80000	1.00000	Podarcis muralis	Psammodromus algirus
3179	1	0.004	0.1	1.00000	0.12121	Podarcis muralis	Pseudopus apodus
3182	0	0.000	0.0	1.00000	1.00000	Podarcis muralis	Stellagama stellio
3184	4	0.124	3.2	1.00000	0.40033	Podarcis muralis	Timon lepidus
3186	0	0.000	0.0	1.00000	1.00000	Podarcis peloponnesiacus	Podarcis pityusensis
3188	0	0.000	0.0	1.00000	1.00000	Podarcis peloponnesiacus	Podarcis siculus
3195	0	0.000	0.0	1.00000	1.00000	Podarcis peloponnesiacus	Pseudopus apodus
3198	0	0.008	0.1	0.90909	1.00000	Podarcis peloponnesiacus	Stellagama stellio
3203	1	0.026	1.7	0.41565	0.91750	Podarcis pityusensis	Podarcis siculus
3208	0	0.000	0.0	1.00000	1.00000	Podarcis pityusensis	Psammodromus algirus
3215	0	0.000	0.0	1.00000	1.00000	Podarcis pityusensis	Timon lepidus
3217	1	0.166	3.2	0.01574	0.99974	Podarcis raffonei	Podarcis siculus
3232	10	0.099	13.7	0.03388	0.99092	Podarcis siculus	Podarcis tiliguerta
3234	7	0.790	7.1	0.88889	1.00000	Podarcis siculus	Podarcis waglerianus

Methods

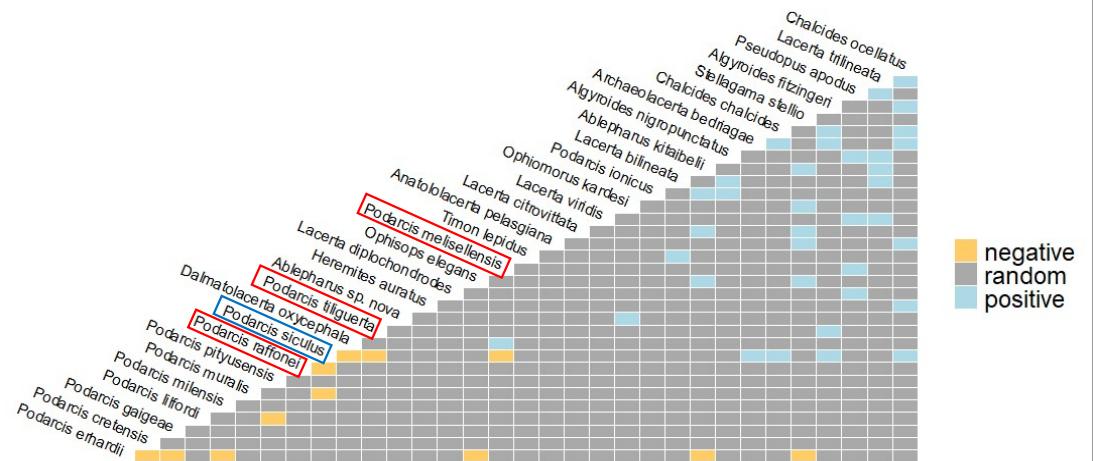
1st year

Target species and sampling sites

Target species

- *Podarcis tiliguerta*
- *Podarcis raffonei*
- *Podarcis melisellensis*

Species Co-occurrence Matrix



Methods

1st year

Target species and sampling sites

Target species

- *Podarcis tiliguerta*
- *Podarcis raffonei*
- *Podarcis melisellensis*

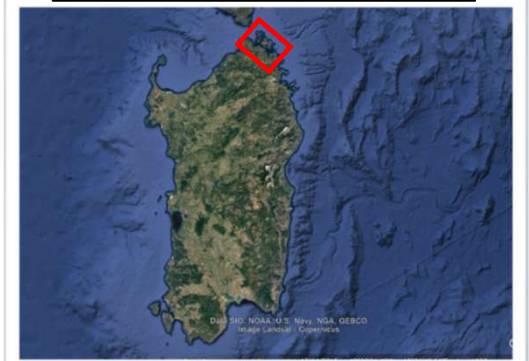
Sampling sites

- Selection of islands where species coexist
- Different types of habitat in the selected islands

Eolian archipelago



La Maddalena archipelago



Dalmatian archipelago

Methods

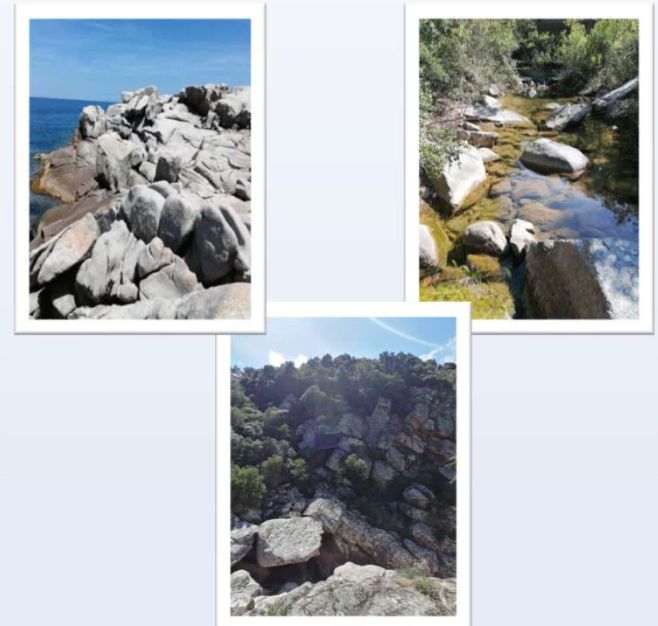
Spatial competition between P. siculus and other lizards

Data collection

- Multiple visits to sampling sites
 - 20-30 sampling sites for each pair of target species
 - 5-10 visits for each site
 - Presence - absence matrix for each species

Data analysis

- Site occupancy analysis (MacKenzie et al., 2003)
 - Estimation of occupancy (ψ) and detectability (p)



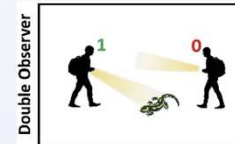
Methods

1° - 2° year

Potential impacts on abundance of sympatric lizards

Data collection

- Multiple counts to sites
 - Subset of sampling sites for each species pair
 - Sites where only species A occur, where only species B is present, where species coexist



Data analysis

- Demographic estimation methods
 - N -mixture models (Royle, 2004)
 - Distance sampling (Buckland et al., 2015)

Estimation of abundance (N) and detectability (p)

A	B	C	D	E	F	G	H	I	J	K
Transetto	1	2	3	4	5	6	7	8	9	10
BO1	8	4	3	3	8	16	9	5	1	1
BO2	6	5	4	4	14	7	10	4	5	3
LB1	12	5	13	9	12	6	22	11	16	12
LB2	17	3	5	12	9	4	12	11	19	15
LB3	15	14	10	16	17	6	11	12	28	22
LB4	3	8	6	15	9	1	4	7	26	9
LB5	3	3	2	7	6	3	4	5	29	7
PA1	9	7	6	5	1	2	6	5	8	10
PA10	4	3	5	5	3	5	8	4	2	4
PA2	4	3	1	8	5	1	5	1	3	3
PA3	1	3	2	1	5	4	1	5	1	6
PA4	5	3	6	2	1	1	3	12	3	1
PA5	9	13	15	6	13	9	1	8	3	13
PA6	9	8	9	10	13	7	4	6	9	8
PA7	14	2	16	18	22	17	9	10	12	26
PA8	4	6	8	12	12	9	8	11	9	10
PA9	3	5	6	7	2	10	4	1	11	4

Methods

2°- 3° year

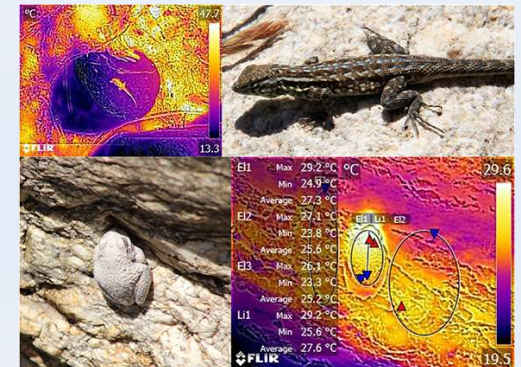
Niche segregation and impacts on physiological traits of sympatric lizards

Data collection

- Selection of target populations for each species
- Individual measurements (T_{body} , length, and mass)
- Environmental variables at macro- and micro-habitat scale (e.g., temperature, humidity, vegetation)

Data analysis

- Thermoregulation Effectiveness (Hertz et al., 1993 protocol)
- Body Condition Index
- Thermal niche characterization



Blais et al., 2023

CNR IRET
Istituto di Ricerca sugli Ecosistemi Terrestri

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References

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Thank you!

