



Le foreste del Parco e lo scoiattolo comune: uno studio multidisciplinare a lungo termine

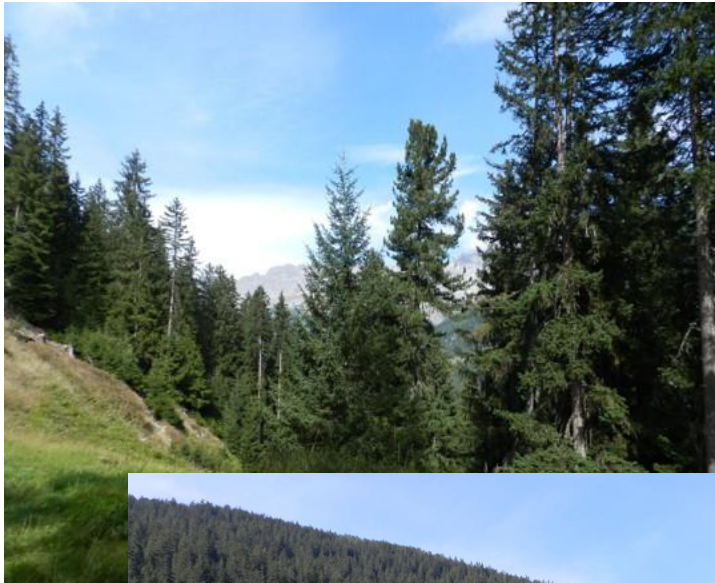
Santicchia F, Wauters LA, Molinari A, Preatoni DG, Martinoli A

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PARCO
NAZIONALE
DELLO
STELVIO

NATIONAL
PARK
STILFSEER
JOCH






Le foreste di conifere

- struttura forestale
- “masting” specie specifico
- altitudine
- pendenza

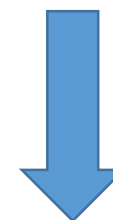
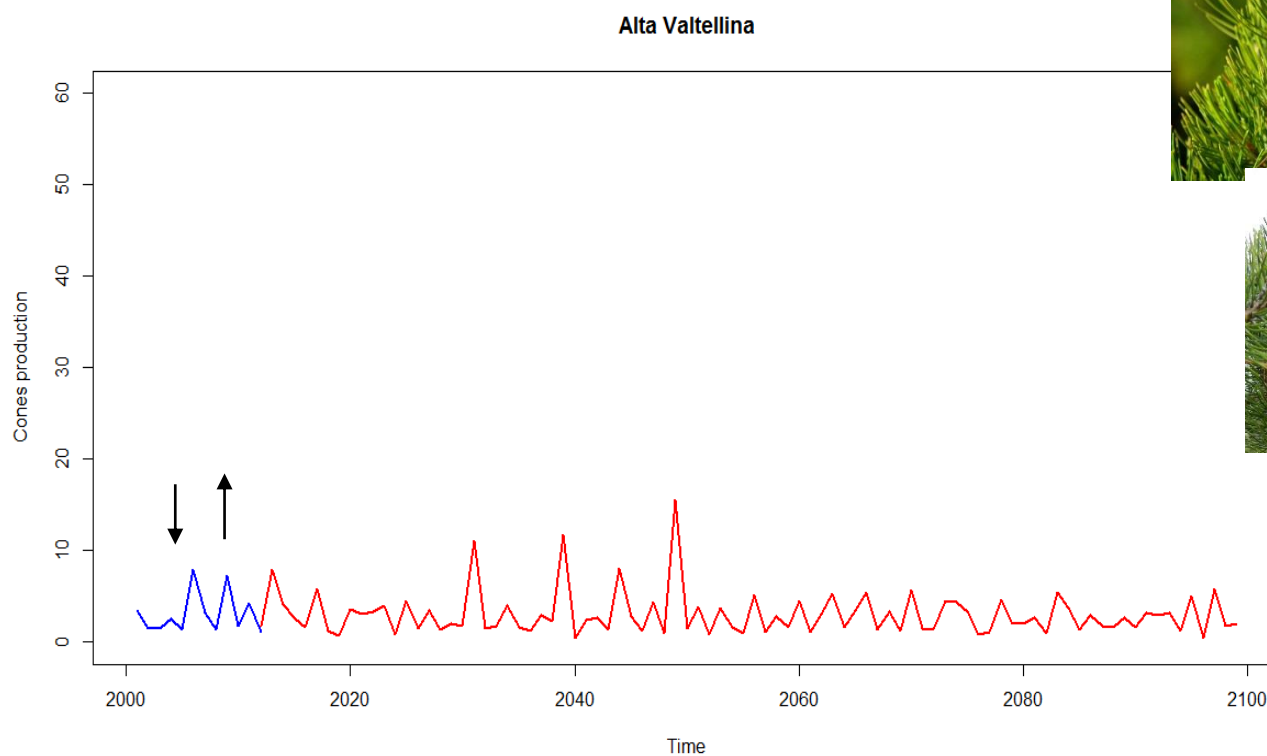
Abete rosso (*Picea abies*)
Pino cembro (*Pinus cembra*)
Larice (*Larix decidua*)
Pino mugo (*Pinus mugo*)
...

Caratteristiche semi e pigne



Seed type	Peso secco/semi (pigne)	Energia/semi (pigne)	Tempo per mangiare 1 seme/pigne	Energy intake/ora
Castagna	3700 ± 350 mg	66.2 ± 6.3 kJ	7.7 ± 1.5	514 ± 123
Nocciola	805 ± 15 mg	20.7 ± 2.7 kJ	4.9 ± 1.3	257 ± 83
 Pino cembro (<i>P. cembra</i>)	5100 ± 1100 mg	121 ± 40 kJ	28 ± 5	259 ± 30
 Abete rosso (<i>P. abies</i>)	1900 ± 230 mg	51 ± 11 kJ	14 ± 4	218 ± 50
 Pino mugo (<i>P. mugo</i>)	200 ± 30 mg	6.0 ± 1.2 kJ	3.0 ± 0.5	120 ± 20

Produzione pigne osservata e predetta



Pulsed resource system

Lo scoiattolo comune europeo (*Sciurus vulgaris*)

- roditore arboricolo
- habitat foreste planiziali di latifoglie decidue e montane di conifere
- specie solitaria
- territorialità intra e inter sessuale
- densità (0.2-1 ind/ha latifoglie; 0.1-0.6 ind/ha conifere)
- presenza fino 2200 m s.l.m.
- competizione con Scoiattolo grigio (*Sciurus carolinensis*) in pianura

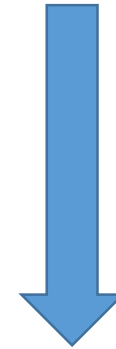


Il sistema produttori - consumatori

Variazione temporale nella produzione dei semi delle conifere
«Qualità» del seme specie-specifica



Dinamica di popolazione scoiattolo



Predazione pre-dispersione semi



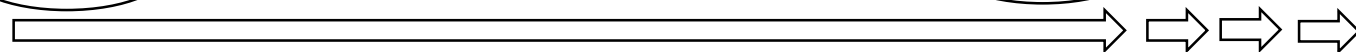
«Destino» dei semi
(sopravvivenza – germinazione)





2000

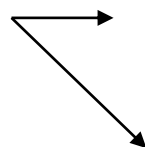
2018



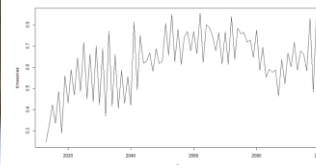
Alpine Squirrel Population Ecology Research (ASPER)

Scopi del progetto

Cambiamento climatico



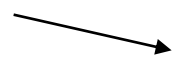
Dinamica popolazione
scoiattolo



Produttività conifere



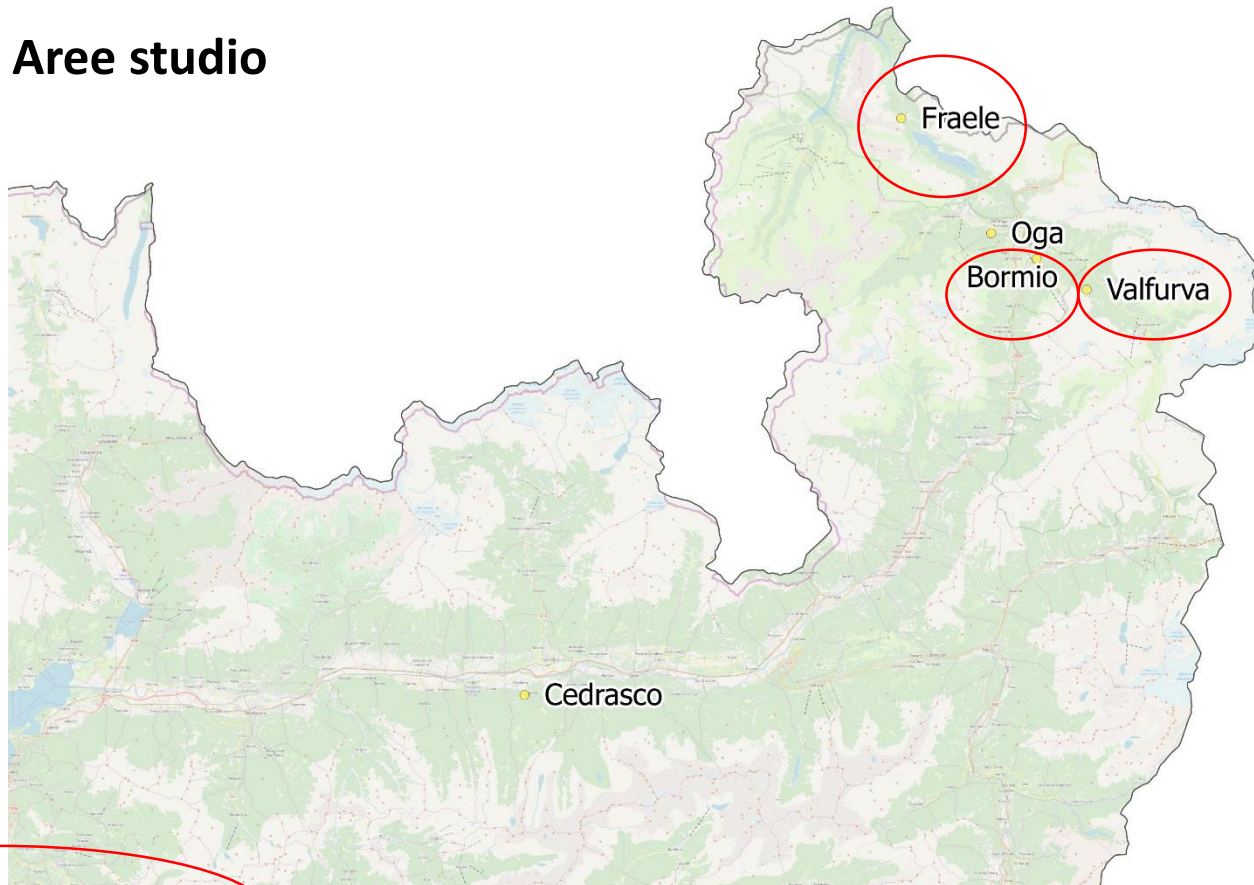
Aree controllo



Meccanismi competizione
interspecifica



Aree studio



Aree Parco Naz Stelvio

Censimento pigne



Variazione tra specie

Species	Mean	SD	min	max
<i>P. cembra</i>	21	23	0	86
<i>P. mugo</i>	25	17	3	54
<i>L. decidua</i>	268	381	0	2603
<i>P. abies</i>	103	116	0	518



Cattura – marcatura- ricattura (CMR)



Cattura mediante trappole a vivo

Determinazione del peso



Marcatura individuale

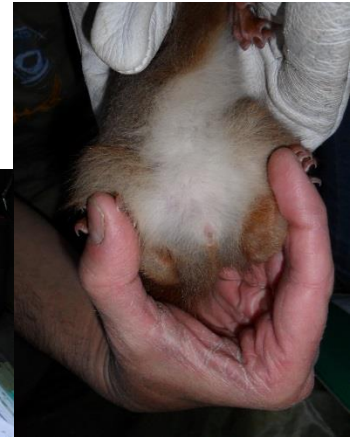


Cattura – marcatura- ricattura (CMR)



Misurazione lunghezza piede posteriore

Determinazione sesso e condizione riproduttiva



Prelievo campioni per altre analisi

Che tipo di studi?

population genetics
behavioral ecology
climate & productivity
space use
physiology
food & foraging
phenotypic variation
population dynamics
population management personality
host-parasite interactions



food & foraging

population dynamics

Energia e contenuto nutritivo semi
conifere



Metodo conteggio pigne e semi
(quantificare produttività e qualità
dei semi)

Misura disponibilità alimentare:
food-energy/unit area (kJ/ha)

Fluttuazioni produttività nel tempo
e energia disponibile tra diverse
specie conifere

food & foraging

Differenze in foraggiamento



Metodo ricerca segni di
foraggiamento su diverse specie
arboree

Misura caratteristiche morfologiche
dei coni e semi (lunghezza, peso,
spessore brattee....)

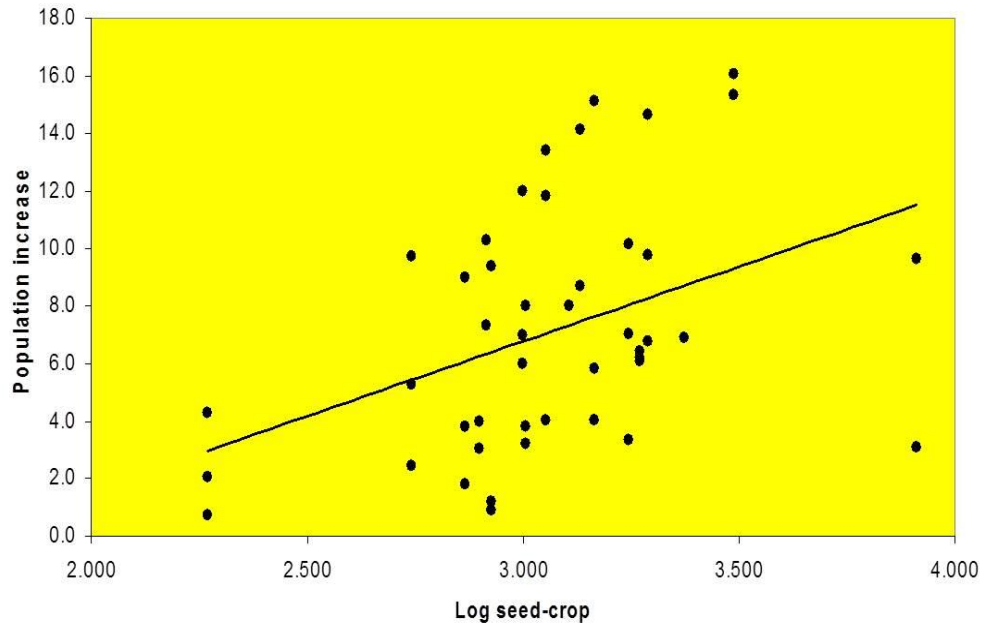
Gli scoiattoli scelgono gli alberi più
favorevoli al foraggiamento



P. cembra

population dynamics

Demografia e relazione con
 abbondanza cibo



In foreste montane di conifere:
 sincronia tra disponibilità di cibo e
 incremento della popolazione

climate & productivity

Relazione tra fattori climatici e produttività



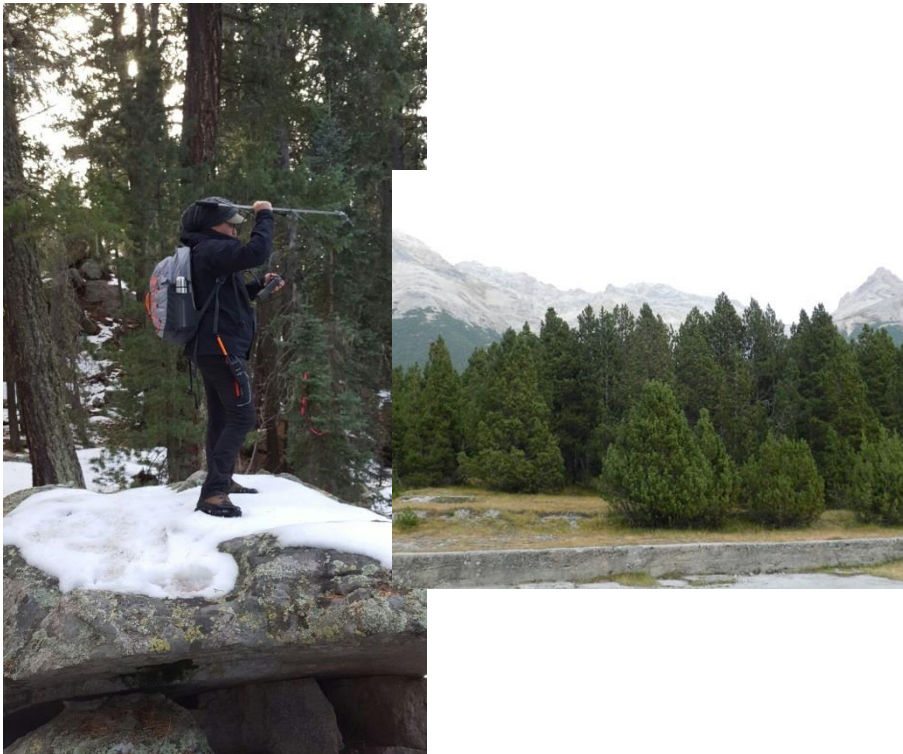
6 specie conifere (dal 1999- 2013)
Fattori: temperatura e precipitazioni

Temperatura stagionale e precipitazioni
di 1 o 2 anni precedenti

↓
maturazione dei semi

Scenario predittivo: specie resilienti

space use



Home-range in habitat marginali
varia in relazione abbondanza cibo

Radio-tracking

phenotypic variation

food & foraging



Microselezione locale per diverse grandezze in relazione alla disponibilità cibo



Peso importante per riproduzione e sopravvivenza

behavioral ecology

personality



Personalità:
misurazione con indici indiretti
(trappability e trap diversity)

Misure dirette (arena test)
Open field test
Mirror image stimulation test

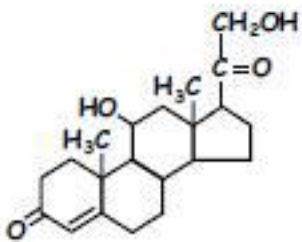
physiology



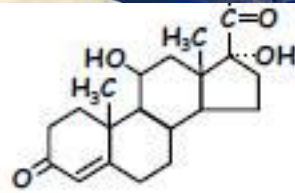
Utilizzo metaboliti glucocorticoidi fecali (FGM)

Validazione del metodo per la specie *Sciurus vulgaris*

Scoiattolo rosso livelli di stress più alti in presenza dello scoiattolo grigio (sp. invasiva)



Corticosterone



Cortisol

host-parasite interactions



Maggior abbondanza di parassiti (*T. sciuri*)
 nello scoiattolo comune:

-in aree frammentate (road-kill)

-in anni di bassa produttività (foreste
 montane conifere) (tape test)



Grazie per l'attenzione

Publicazioni

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2. Wauters LA, Zaninetti M, Tosi G, Bertolino S (2004) Is coat-clour polymorphism in Eurasian red squirrels (*Sciurus vulgaris* L.) adaptive? *Mammalia* 68: 37-48. **PHENOTYPIC VARIATION**
3. Bertolino S, Vizzini A, Wauters LA, Tosi G (2004) Consumption of hypogeous and epigeous fungi by the red squirrel (*Sciurus vulgaris*) in subalpine conifer forests. *For Ecol Manage* 202: 227-233. **FOOD AND FORAGING**
4. Trizio I, Crestanello B, Galbusera P, Wauters LA, Tosi G, Matthysen E, Hauffe HC (2005) Geographical distance and physical barriers shape the genetic structure of Eurasian red squirrels (*Sciurus vulgaris*) in the Italian Alps. *Mol Ecol* 14: 469-481. **POPULATION GENETICS**
5. Wauters LA, Bertolino S, Adamo M, Van Dongen S, Tosi G (2005) Food shortage disrupts social organization: the case of red squirrels in conifer forests. *Evol Ecol* 19: 375-404. **SPACE USE; FOOD AND FORAGING; BEHAVIORAL ECOLOGY**
6. Tattoni C, Preatoni DG, Lurz PWW, Rushton SP, Tosi G, Bertolino S, Martinoli A, Wauters LA (2006) Modelling the expansion of a grey squirrel population: implications for squirrel control. *Biol Invasions* 8: 1605-1619. **POPULATION MANAGEMENT**
7. Molinari A, Wauters LA, Airoldi G, Cerinotti F, Martinoli A, Tosi G (2006) Cone selection by Eurasian red squirrels in mixed conifer forests in the Italian Alps. *Acta Oecol* 30: 1-10. **FOOD AND FORAGING**
8. Wauters LA, Preatoni DG, Molinari A, Tosi G (2007) Radio-tracking squirrels: performance of home range density and linkage estimators with small range and sample size. *Ecol Modelling* 202: 333-344. **SPACE USE**

9. Wauters LA, Vermeulen M, Van Dongen S, Bertolino S, Molinari A, Tosi G, Matthysen E (2007) Effects of spatio-temporal variation in food supply on red squirrel *Sciurus vulgaris* body size and body mass and its consequences for some fitness components. *Ecography* 30: 51-65.

PHENOTYPIC VARIATION; FOOD AND FORAGING

10. Di Pierro E, Molinari A, Tosi G, Wauters LA (2008) Exclusive core areas and intrasexual territoriality in Eurasian red squirrels (*Sciurus vulgaris*) revealed by incremental cluster polygon analysis. *Ecol Res* 23: 529-542. DOI 10.1007/s11284-007-0401-0 **SPACE USE; BEHAVIORAL ECOLOGY**

11. Wauters LA, Githiru M, Bertolino S, Molinari A, Tosi G, Lens L (2008) Demography of alpine red squirrel populations in relation to fluctuations in seed crop size. *Ecography* 31: 104-114. (doi: 10.1111/j.2007.0906-7590.05251.x). **POPULATION DYNAMICS**

12. Mari V, Martini S, Romeo C, Molinari A, Martinoli A, Tosi G, Wauters LA (2008) Record litter size in the Eurasian red squirrel (*Sciurus vulgaris*). *Hystrix* 19: 61-65. **POPULATION DYNAMICS**

13. Kváč M, Hofmannová L, Bertolino S, Wauters LA, Modrý D (2008) Natural infection with two genotypes of *Cryptosporidium* in red squirrels (*Sciurus vulgaris*) in Italy. *Folia Parasitol* 55: 95-99. **HOST-PARASITE INTERACTIONS**

14. Salmaso F, Molinari A, Di Pierro E, Ghisla A, Martinoli A, Preatoni D, Cerabolini B, Tosi G, Bertolino S, Wauters LA (2009) Estimating and comparing food availability for tree-seed predators in typical pulsed-resource systems: alpine conifer forests. *Plant Biosystems* 143: 258-267. **FOOD AND FORAGING; POPULATION DYNAMICS**

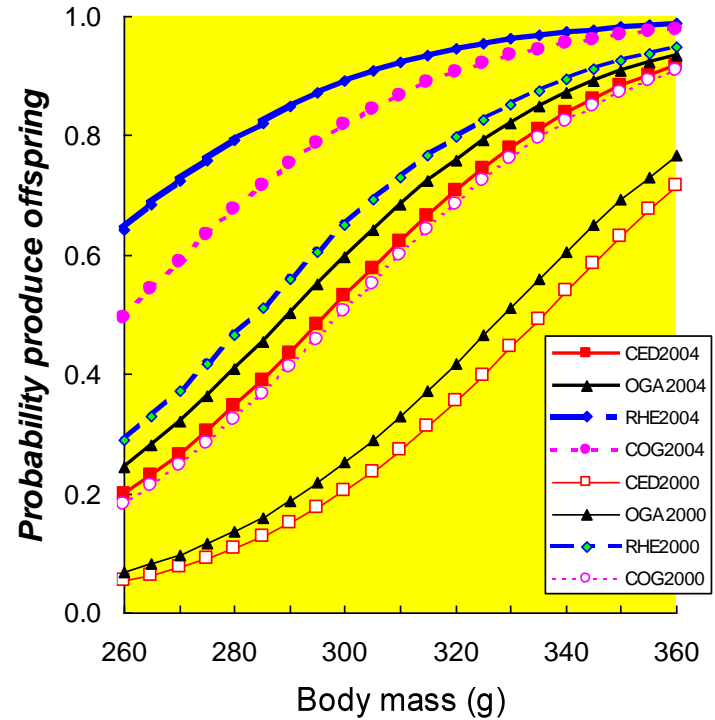
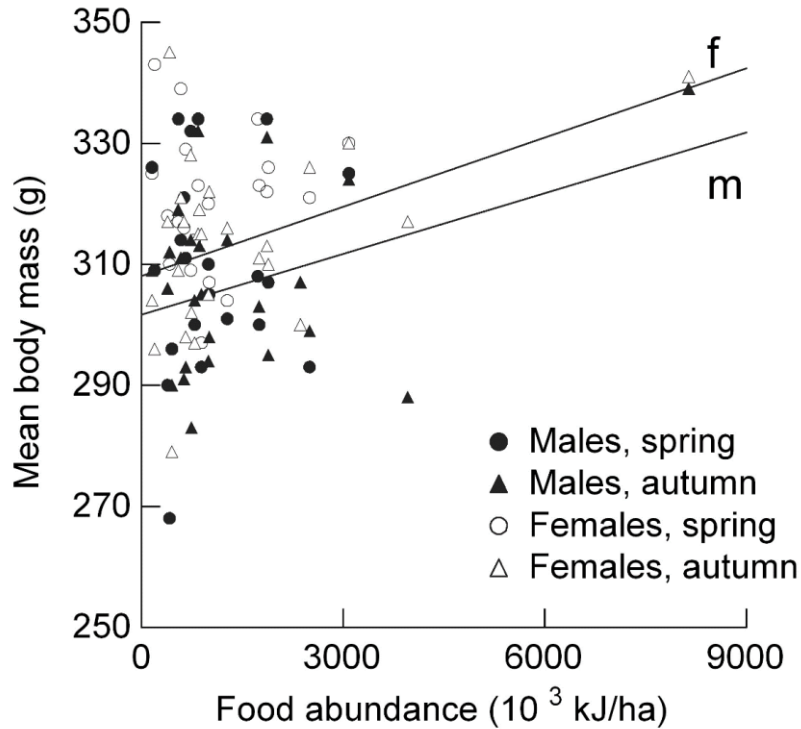
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19. Zong C, Wauters LA, Van Dongen S, Mari V, Romeo C, Martinoli A, Preatoni D, Tosi G (2010) Annual variation in predation and dispersal of Arolla pine (*Pinus cembra* L.) seeds by Eurasian red squirrels and other seed-eaters. *For Ecol Manage* 260: 587-594. **FOOD AND FORAGING; POPULATION DYNAMICS**
20. Romeo C, Wauters LA, Preatoni D, Tosi G, Martinoli A (2010) Living on the edge: Space use of Eurasian red squirrels in marginal high-elevation habitat. *Acta Oecol* 36: 604-610. **SPACE USE; BEHAVIORAL ECOLOGY**
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23. Zong C, Wauters LA, Rong K, Martinoli A, Preatoni DG, Tosi G (2012) Nutcrackers become choosy seed harvesters in a mast-crop year. *Ethol Ecol Evol* 24: 54-61. **FOOD AND FORAGING**
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Influenza dell'habitat sullo scoiattolo rosso



Fluttuazioni in semi/pigne



peso scoiattolo



effetti sulla riproduzione