Phytosanitäre Probleme, Forschung und Erkenntnisse am Vinschgauer Sonnenberg

Problemi fitosanitari, ricerca e risultati scientifici sul Sonnenberg in Val Venosta

Plant health issues, research and scientific results at Sonnenberg in the Venosta valley

Andrea Battisti – Università di Padova

UNIVERSITÀ DEGLI STUDI DI PADOVA
DAFNAE
Department of Agronomy Food Natural resources Animals and Environment

Outline

- Pine processionary moth/Kiefernprozessionspinner *Thaumetopoea pityocampa*
    1. Klaus Hellrigl, Stefano Minerbi and the diapause
    2. The earlier management approach
    3. The range expansion
    4. The take over of natural enemies
    5. The current management options
    6. The origin of the pine processionary moth in South Tyrol
    7. The wonderful things

- Drought and dieback by the shoot blight fungus *Diplodia (Sphaeropsis) sapinea*

- Drought and bark beetle spots

- Future perspectives in tree health

Forest@
Rivista di Selvicoltura ed Ecologia Forestale
Editoriale
doi: 10.3832/efor0051-018
vol. 18, pp. 72-73

In ricordo di Klaus Hellrigl

Stefano Minerbi [1],
Andrea Battisti [2]

Obituary: Klaus Hellrigl

Dr. Klausjörg Hellrigl (1935-2021) passed away few weeks ago. For decades Dr. Hellrigl was a reference for Italian and foreign entomologists. Among his many articles and investigations, Dr. Hellrigl was probably best known for his studies on xylophagous beetles (Coleoptera: *Buprestidae* and *Cerambycidae*). Here, two former pupils of Dr. Hellrigl remember his life and scientific works.

Keywords: Entomology, Coleoptera, Buprestidae, Cerambycidae

Ricordi personali di Stefano Minerbi

1 marzo 1982. Era il mio primo giorno in servizio presso l'Ispettorato Ripartimentale delle Foreste di Bolzano, quando l'allora dirigente Ing. Robert Preyer mi convocò per una riunione urgente in merito al forte attacco di *Lymantria monacha* nella zona di Merano, un evento straordinario per l'Alto Adige, mai soggetto in precedenza ad attacchi parassitari di tale gravità ed estensione. Fu così che conobbi Klaus. Questo incontro segnò *nolens volens* la mia successiva attività professionale. Ho quindi condiviso con Klaus una lunga esperienza ed acquisito innumerevoli conoscenze, in particolare l'approccio con la natura. Il ricordo del nostro rapporto professionale ed umano resterà per me indelebile.

Ricordi personali di Andrea Battisti

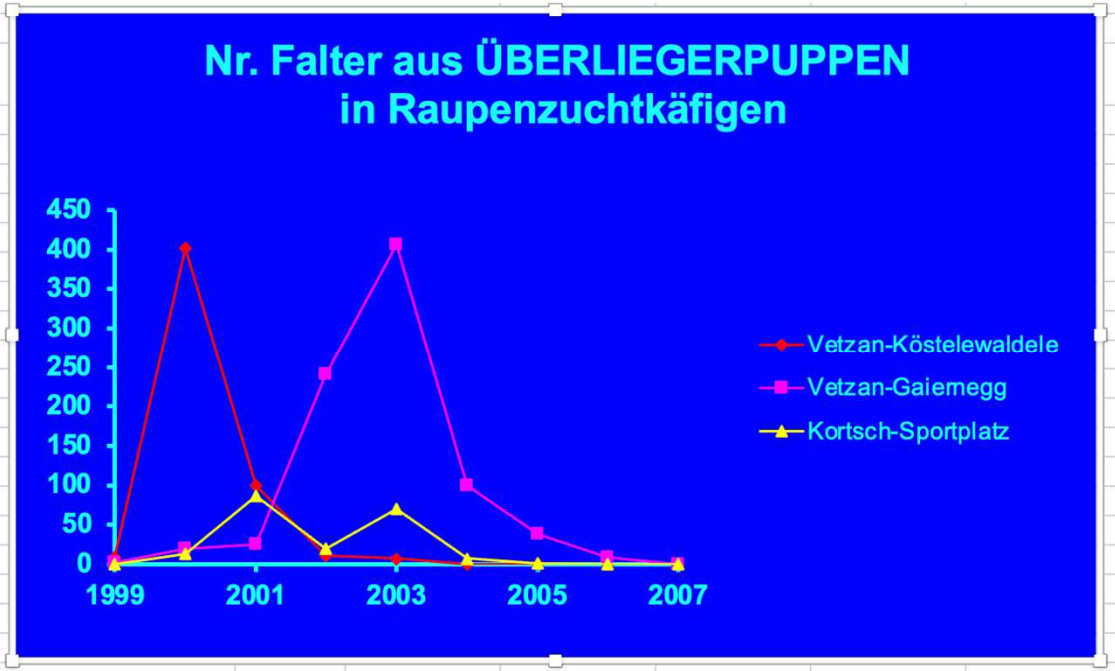
27 luglio 1982. Giorno della mia laurea in Scienze Forestali all'Università di Padova, quando ancora si facevano nella Sala dei Quaranta dove si trova la cattedra lignea di Galileo. Klaus, presente come correlatore di un altro studente, mi rivolse una serie di domande alla quali cercai di rispondere come meglio potei. Ricordo che la discussione andò avanti molto più del solito per la sua curiosità di conoscere il lavoro che avevo svolto in ogni dettaglio. Ebbi modo di tornare sull'argomento in varie occasioni successive, ma fu nel momento della grande espansione della processionaria del pino in Val Venosta verso la fine degli anni '90 che apprezzai il lavoro meticoloso che Klaus portava avanti da tempo. La documentazione precisa dei limiti dell'areale storico ci consentì, unita a prove sperimentali eseguite sul posto, di stabilire che gli attacchi dipendevano dall'aumento della temperatura invernale. Dati fondamentali, condivisi fraternamente e senza indugi, tra veri forestali.

Spring 1999: the first outbreak with total defoliation by the pine processionary moth *Thaumetopoea pityocampa* documented by Stefano Minerbi

Spring 1999: the start of the prolonged diapause experiment by Klaus Hellrigl

Klaus and Stefano wisdom: looking into the future 1999 - 2007

Year	Nr. of emergings (outcomings) of adults		
	1 VEZZANO Köschtenwaldele	2 VEZZANO Gaiernegg	3 CORCES Campo Sportivo
1999	9	2	0
2000	402	20	13
2001	100	25	87
2002	11	241	20
2003	7	406	70
2004	0	100	7
2005	0	38	1
2006	0	9	0
2007	0	0	0

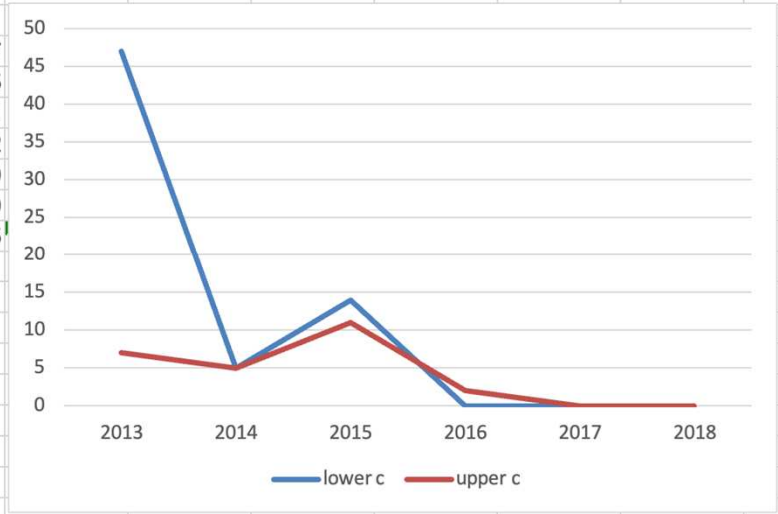


I would never stop to say THANKS to them and to the foresters who collected the data with great care

Cages repaired and the experiment restarted in 2013

Follow up by Andreas Klotz

wer c	upper c	year	lower c	upper c
0	3	2013	47	7
20	2	2014	5	5
24	1	2015	14	11
3	1	2016	0	2
5	4	2017	0	0
0	1	2018	0	0
13	3		66	25
1	8			
0	2			
0	0			
0	0			
66	25			



2013 – 2018: less intense and shorter diapause

Diapause in the pine processionary moth (*Thaumetopoea pityocampa*): ecological and applied significance

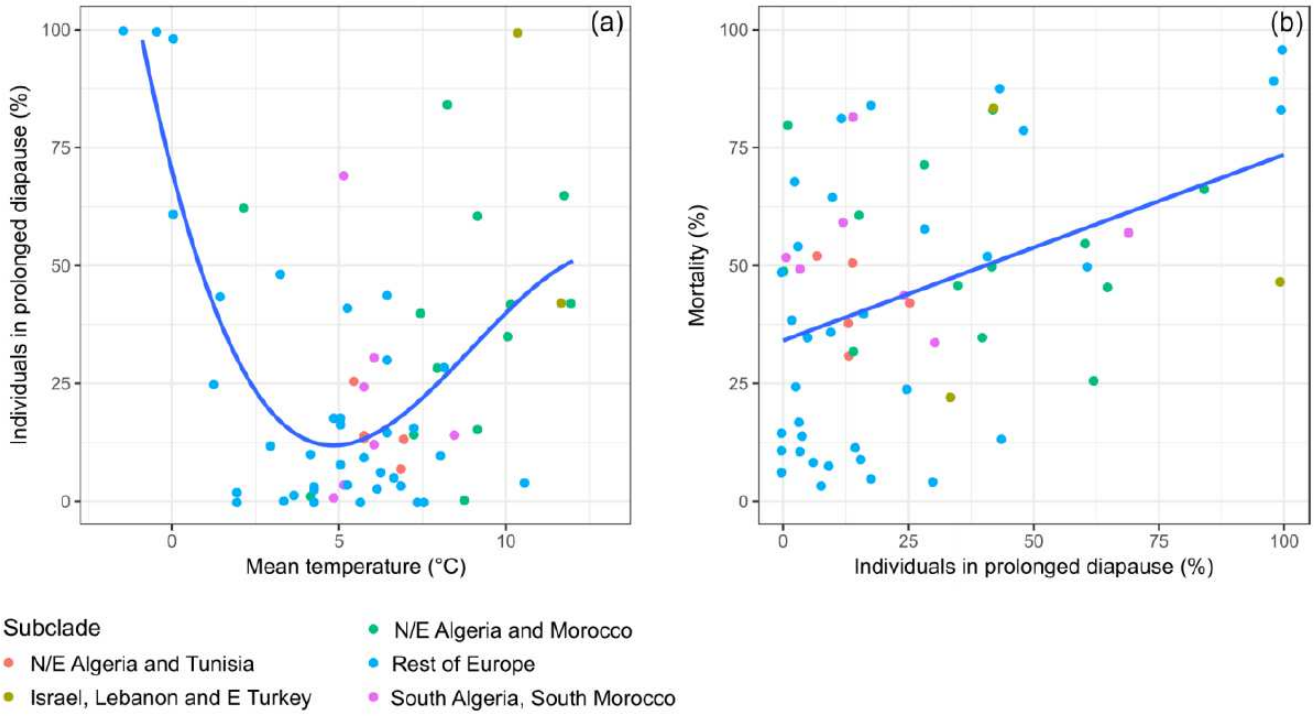
Salman MHR, University of Padova, Italy
Laparie M, INRA Orléans, France
Lehmann P, University of Stockholm, Sweden
Battisti A, University of Padova, Italy

ICE 2022 HELSINKI
Entomology for our planet
XXVI International Congress of Entomology
HELSINKI, FINLAND, JULY 17–22, 2022

Helsinki

U-shaped response to temperature

Mortality cost of prolonged diapause



Agricultural and Forest Entomology

Agricultural and Forest Entomology (2018), DOI: 10.1111/afe.12291

Prepupal diapause synchronizes adult emergence in the pine processionary moth *Thaumetopoea pityocampa* (Lepidoptera: Notodontidae)

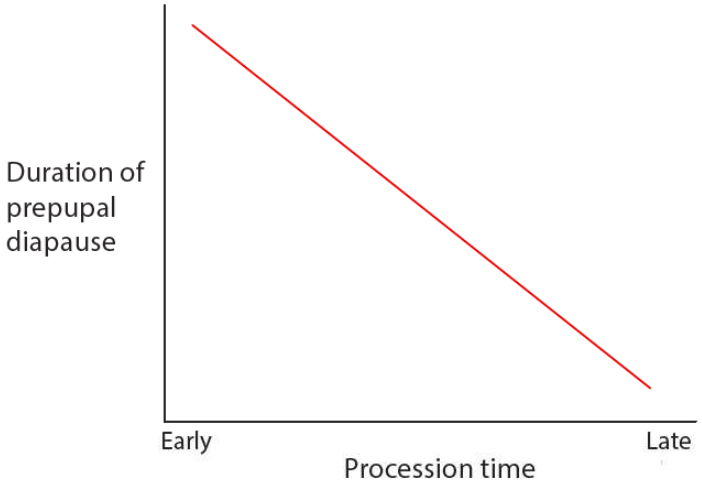
Md Habibur Rahman Salman*, Folco Giomi*, Mathieu Laparie†, Philipp Lehmann† and Andrea Battisti*

Vinschgau 2015-2018 – 30 trees

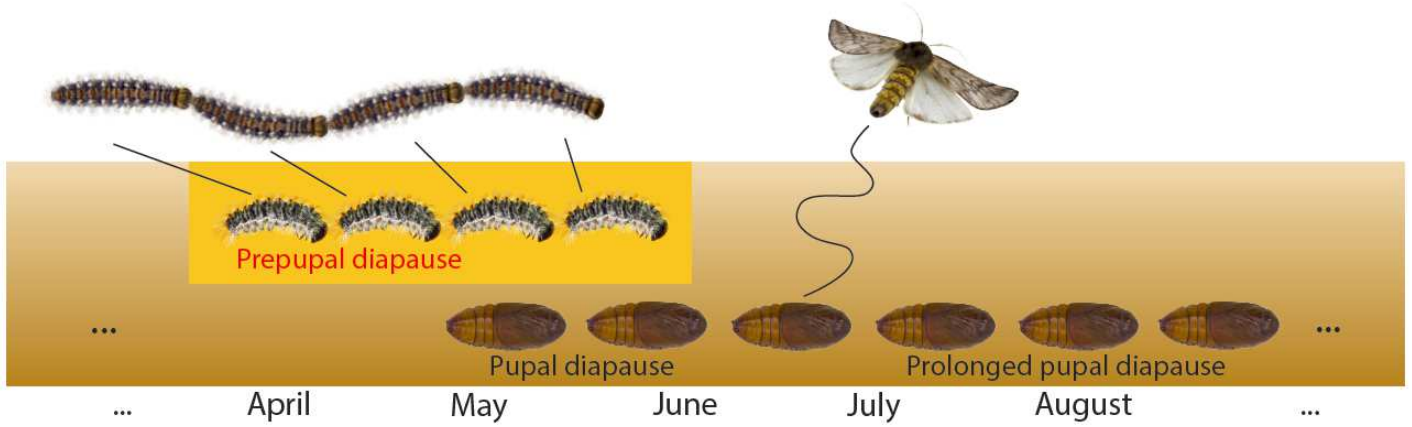
Weekly collection of processions with Ecopiège from March to May

Rearing under controlled conditions

Prepupal diapause buffers against winter and spring odds affecting individuals



But not against prolonged diapause ....



Physiological Entomology

Physiological Entomology (2019) **44**, 53–59 DOI: 10.1111/phen.12277

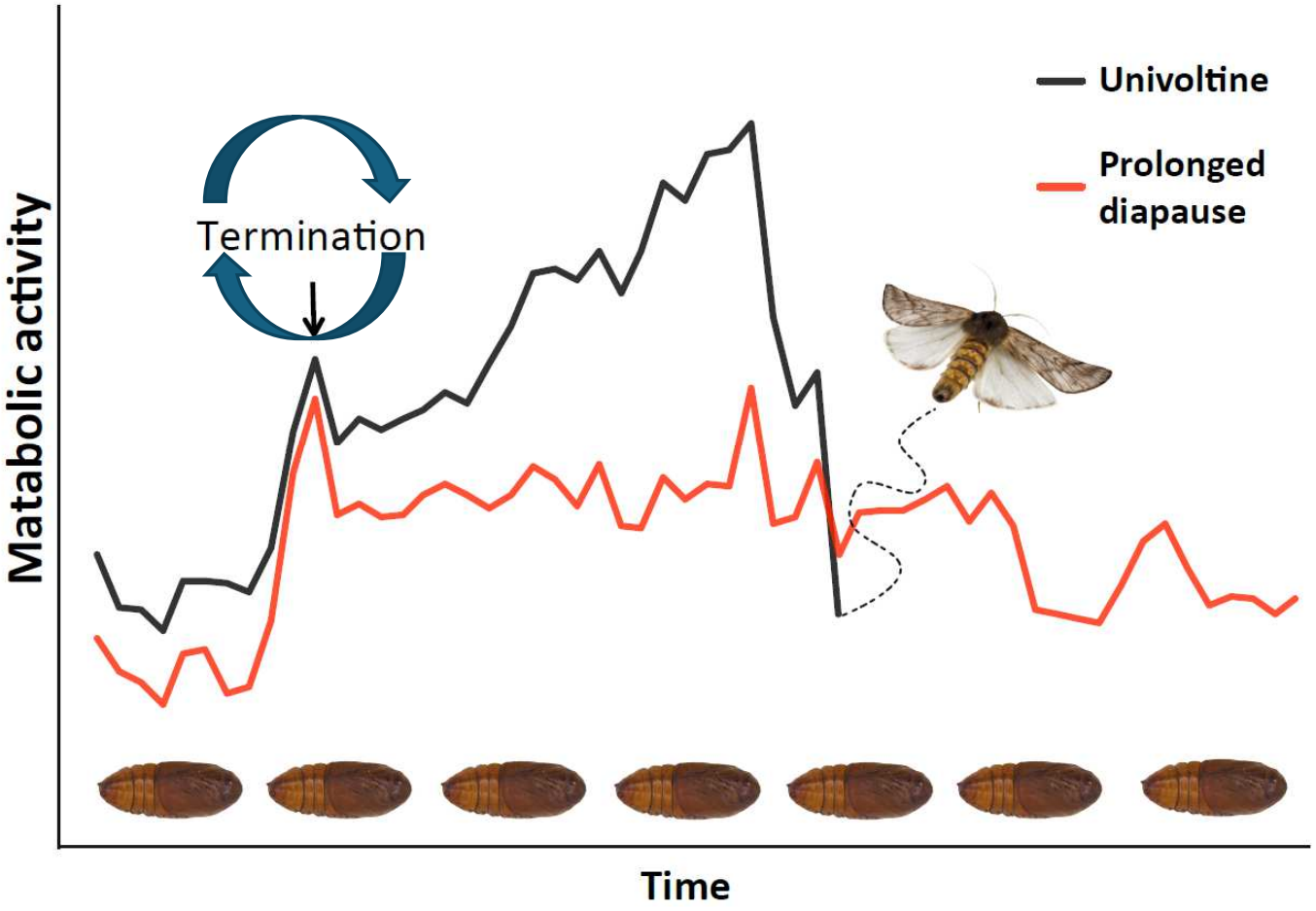
Termination of pupal diapause in the pine processionary moth *Thaumetopoea pityocampa*

MD HABIBUR R. SALMAN[1], FOLCO GIOMI[1], MATHIEU LAPARIE[2], PHILIPP LEHMANN[3], ANDREA PITACCO[1] and ANDREA BATTISTI[1]

Methods:

- Direct calorimetry by continuous temperature measurement with thermocouples
- Respirometry by discontinuous measurement of oxygen consumption in stop-flow

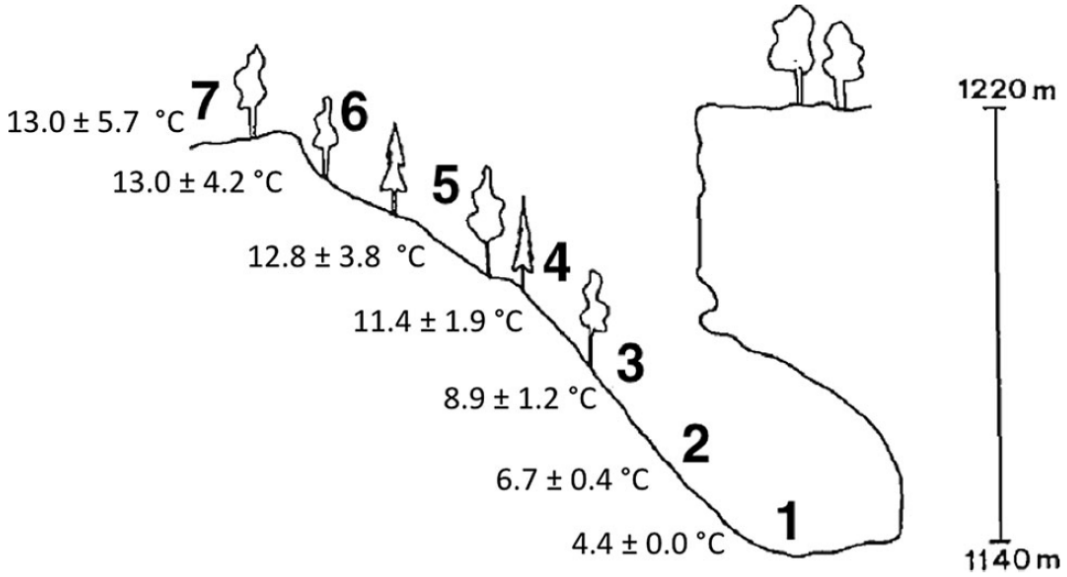
One individual pupa can go through several termination cycles until eclosion



Démolin hypothesis on the 'key period' is confirmed

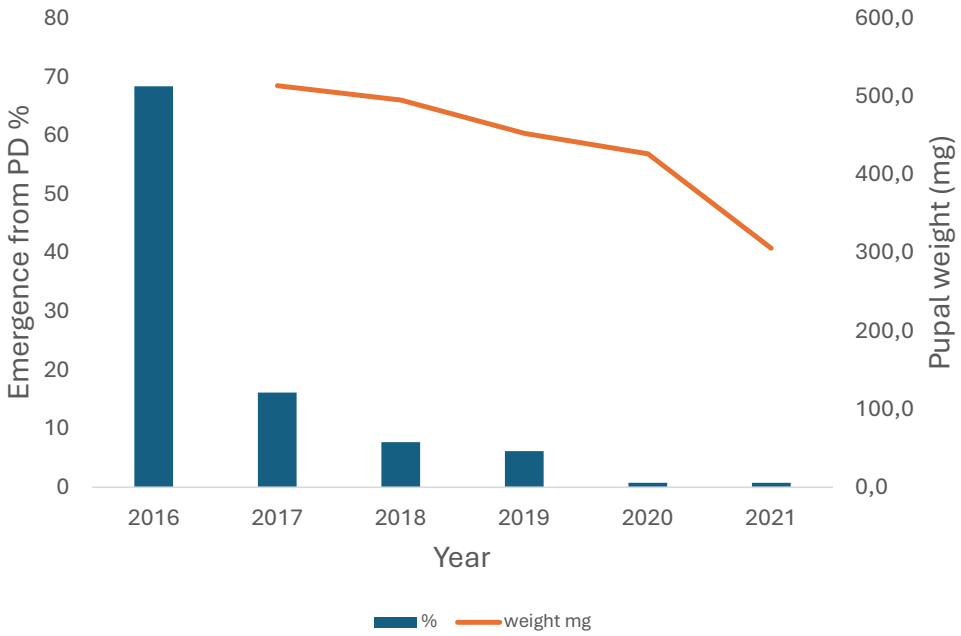
4. Follow up of pupal cohorts

Trade-off between body size, temperature, and prolonged diapause



Open-top cave reproducing natural fluctuating temperatures experienced by pupae of 7 populations in the soil 2015-2022

Emergence from prolonged diapause extended over 6 years



Pupal weight decreased about 40% - energy limitation

2. The earlier management approach (2001)

AVVERSITA'

LOTTA AUTUNNALE E INVERNALE ALLA PROCESSIONARIA DEL PINO CON *BACILLUS THURINGIENSIS* IN ALTO ADIGE

di S. Minerbi, K. Hellrigl e A. Battisti

NEGLI ULTIMI ANNI IN TALUNE AREE DELL'ALTO ADIGE – SPECIALMENTE NELLE PINETE DELLA VAL VENOSTA DOMINATE DA RIMBOSCHIMENTI DI *PINUS NIGRA* V. *AUSTRIACA* – SI SONO VERIFICATI ESTESI ED INTENSI ATTACCHI DI PROCESSIONARIA (*THAUMETOPOEA PITYOCAMPA* DEN. E SCHIFF.), TROMISURE TEMPESTIVE E DI SICURA EFFICACIA. PER IL FUTURO LE STRATEGIE DI LOT DEL PINO IN ALTO ADIGE PREVEDONO TUTTAVIA NEL MEDIO-LUNGO PERIODO I MIRATI ED INFORMATI A CRITERI DI RIEQUILIBRIO BIO-ECOLOGICO DEI POPOLAME LOTTA ATTIVA CON *BACILLUS THURINGIENSIS* SI CONFIGURA QUALE MISURA LIM ED AL CONTROLLO DEGLI ATTACCHI IN PARTICOLARI SITUAZIONI DI EMERGENZA S

The forcing associated with prolonged diapause
Andrea Aimi PhD 2008

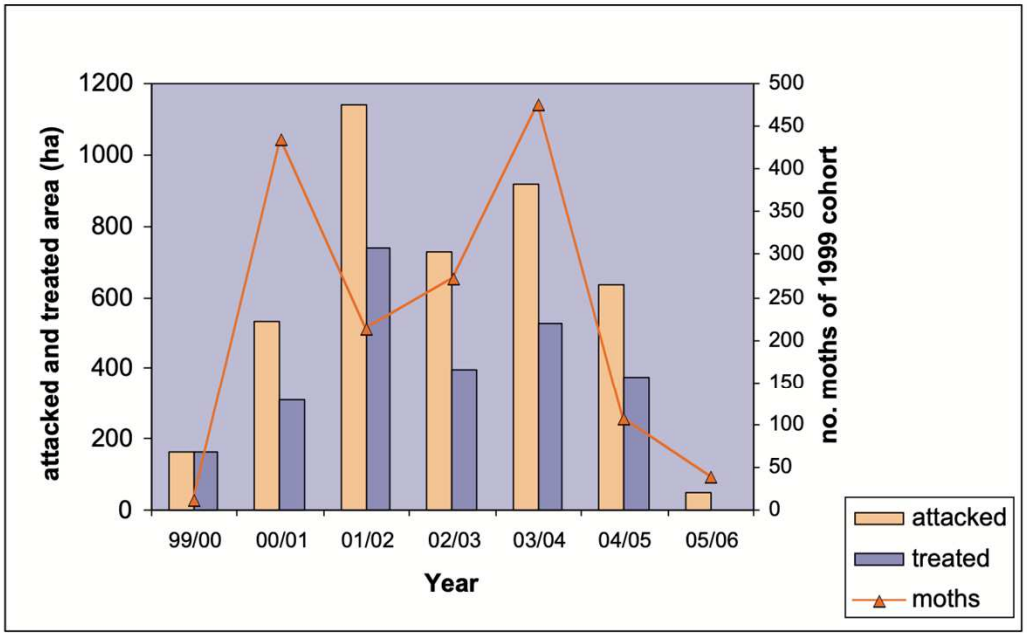


Fig. 2: Attacked and treated area in Venosta/Vinschgau during 1999-2006, compared with the total number of moths emerged from 3 cages where colonies of the 1998-99 cohort were allowed to pupate.

The costs and benefits of the integrated pest management
Paola Gatto UNIPD 2008

Tab. 2: Output of the Extended Economic Analysis 1 – EAA1, with additional items to FA.

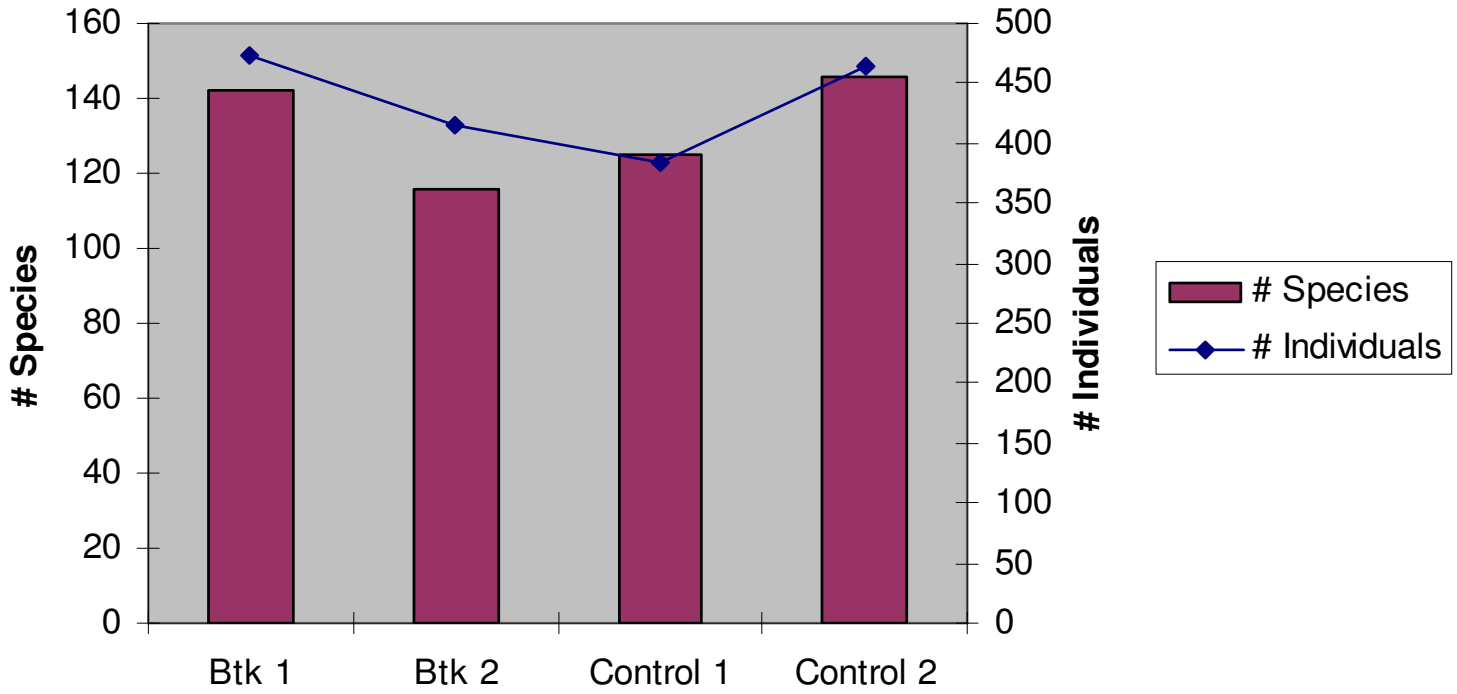
Step of CBA	Benefit + Cost -	Item being valued	Physical Indicator	Monetary indicator	Annual value for the case-study area (Euro)	
					with IPM	without IPM
EEA1	+	Soil protection from erosion		50-100 €/ha depending on forest functionality	93,800	50,300-78,800 depending on progressive expansion of the moth
	+	Carbon sequestration	Net C increment sequestered in forest biomass	Shadow price of Carbon : 13 €/tC	1,500-6,000 depending on forest growth	110-6,000 depending on forest growth
	-	Risk of dermatitis for visitors	Days of hospital treatment	Cost of daily hospital treatment	0	1,900-5,500 depending on progressive expansion of the moth

Tab. 3: Output of the Extended Economic Analysis 2 – EAA2, , with additional items to FA and EAA1.

Step of CBA	Benefit + Cost -	Item being valued	Physical Indicator	Monetary indicator	Annual Value/ha	
					with IPM	without IPM
EEA2	+	Recreation	150,000 day-visits per year in the with-situation, 120,000 in the without situation	Willingness to pay for 1 day-visit : 1.5 € in the with-situation, 1.0 € in the without situation	225,000 €	120,000 €
	+	Landscape	32,000 residents	Annual willingness to pay by each resident for an healthy forest: 0.5 €/year	16,000	0

Btk and the non-target Lepidoptera

No effects on the total number of species and individuals, Minerbi and Huemer 2000



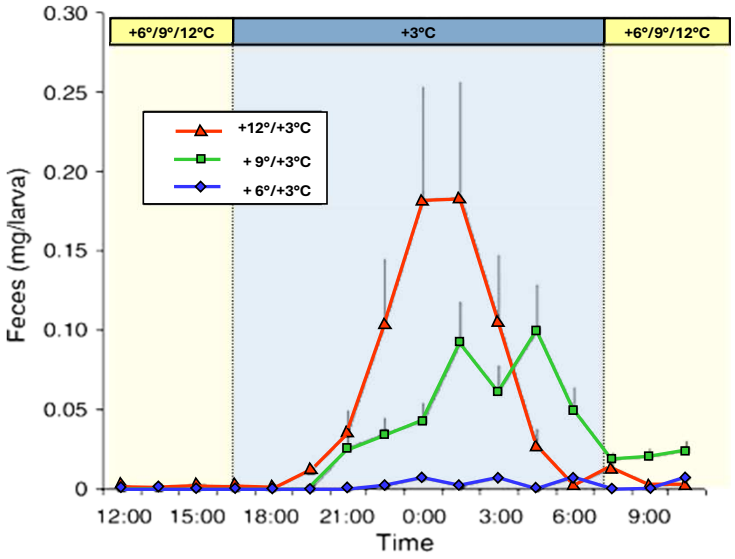
Vinschgau-/Venosta-Valley

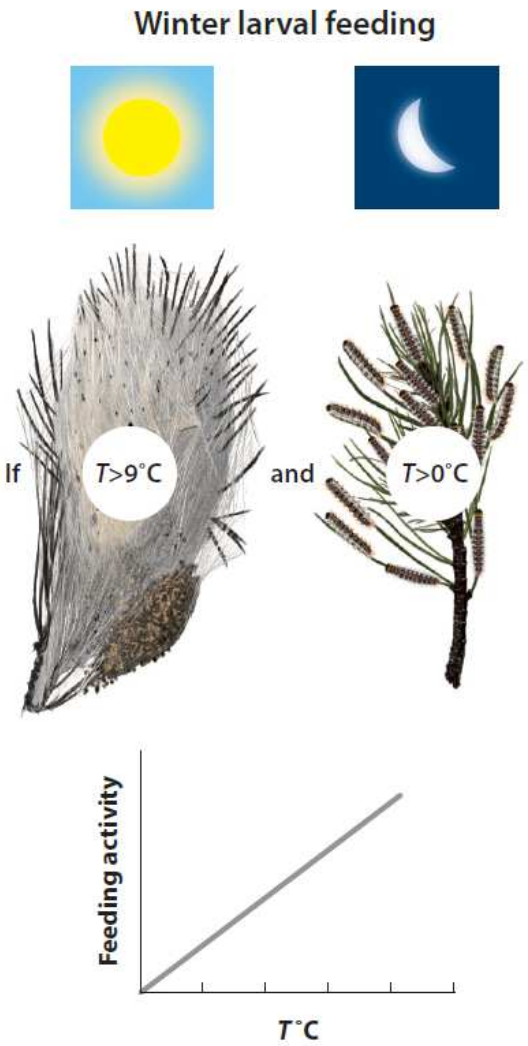
3. The range expansion

Gernot Hoch
Sigrid Netherer
Axel Schopf

BOKU laboratory
Vienna 2003-
2005

From data to model



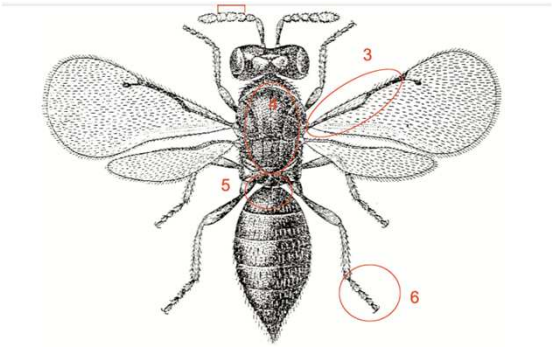


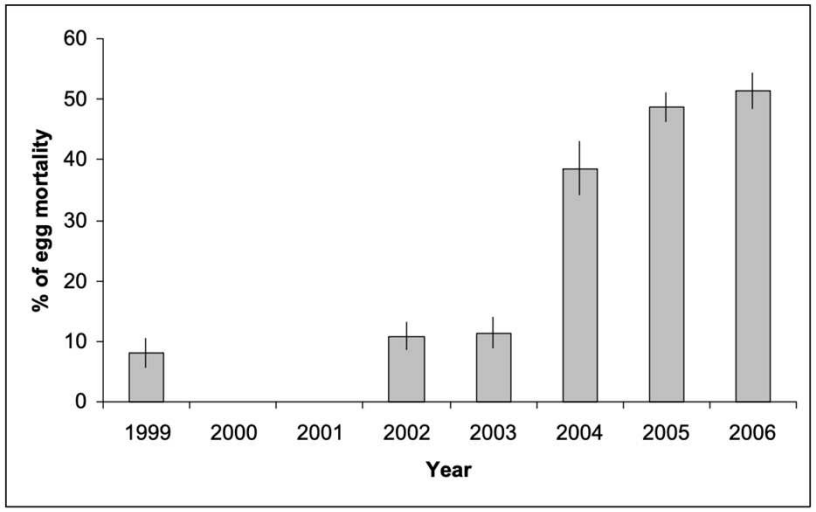
4. The take over of natural enemies

forest observer vol. 2/3 2006 81 - 88

Egg parasitoids of the pine processionary moth and their occurrence in Venosta/Vinschgau

Daniel Zovi[1], Andrea Battisti[1], Klaus Hellrigl[2], Stefano Minerbi[3]





The vertebrate predators

Alma De Angelis
PhD student

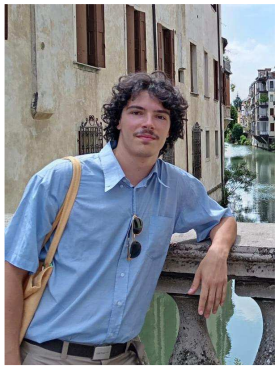
Collection of **fecal samples from wild birds** to assess pine processionary moth occurrence in the diet

urticating setae

head capsule fragments

proleg fragments

body setae



Davide Luigi Gilioli
Biology student

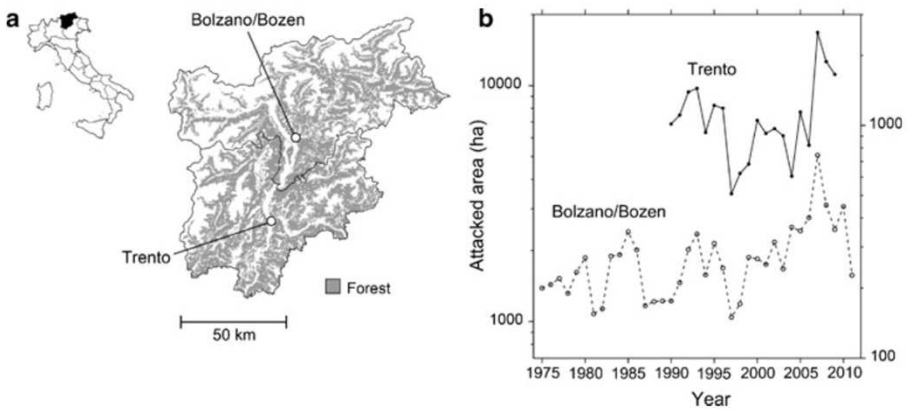
Pine processionary moth remains in bird fecal samples

The role of density-dependence

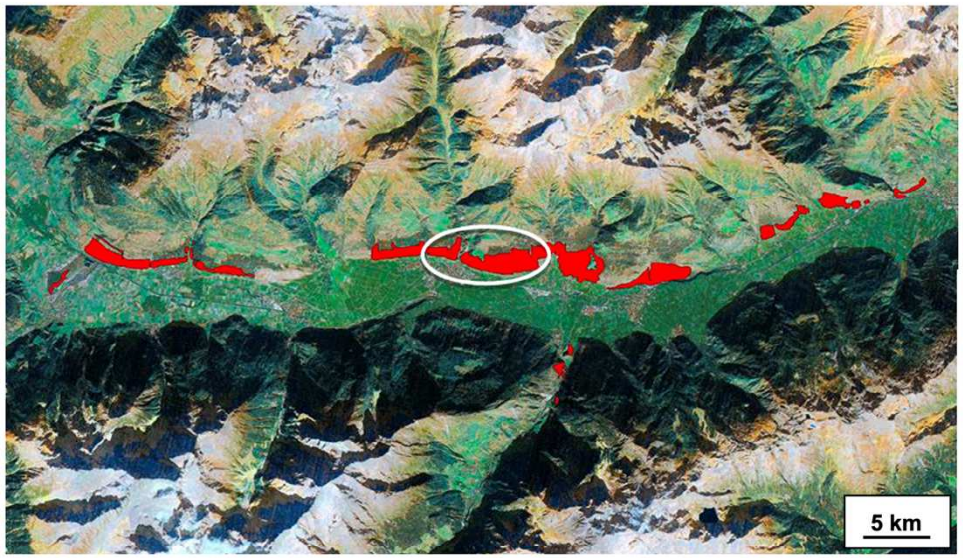
Climatic Change (2013) 121:701–712
DOI 10.1007/s10584-013-0966-2

Effects of climate and density-dependent factors on population dynamics of the pine processionary moth in the Southern Alps

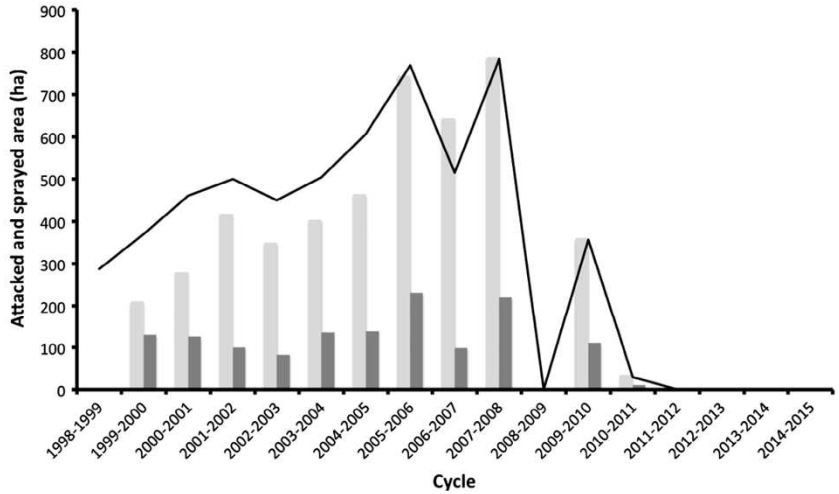
Giovanni Tamburini · Lorenzo Marini · Klaus Hellrigl · Cristina Salvadori · Andrea Battisti

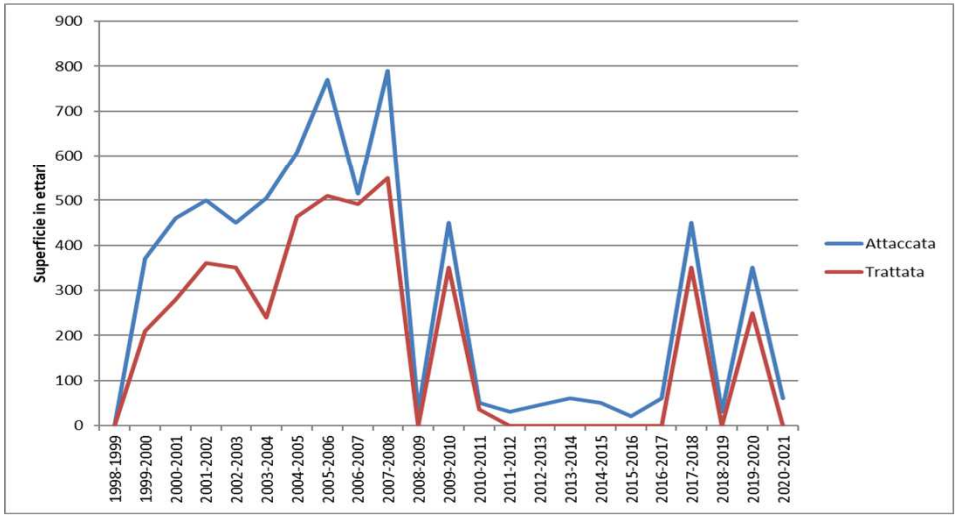


5. The current management options

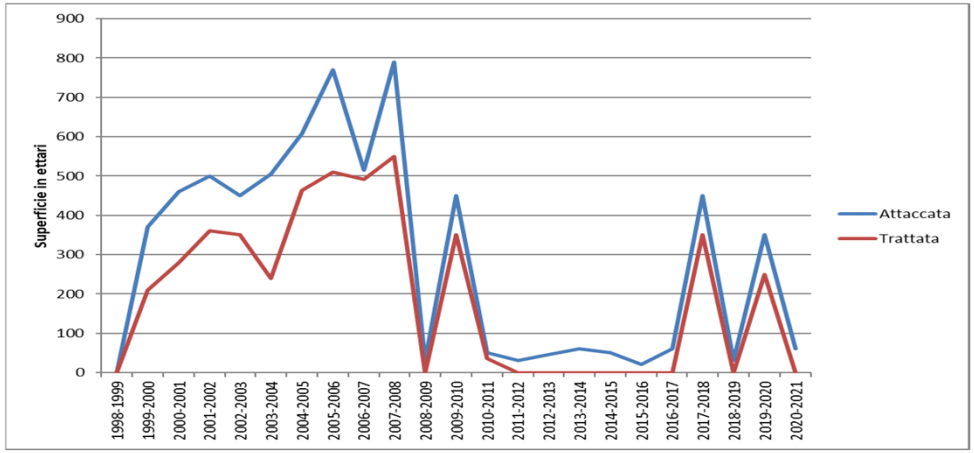


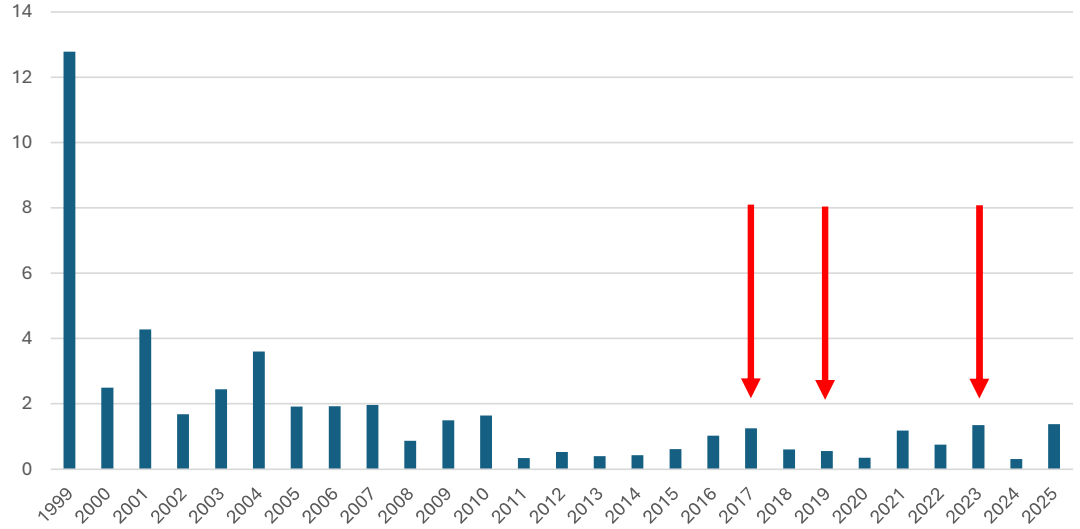
Alessandro
Andriolo



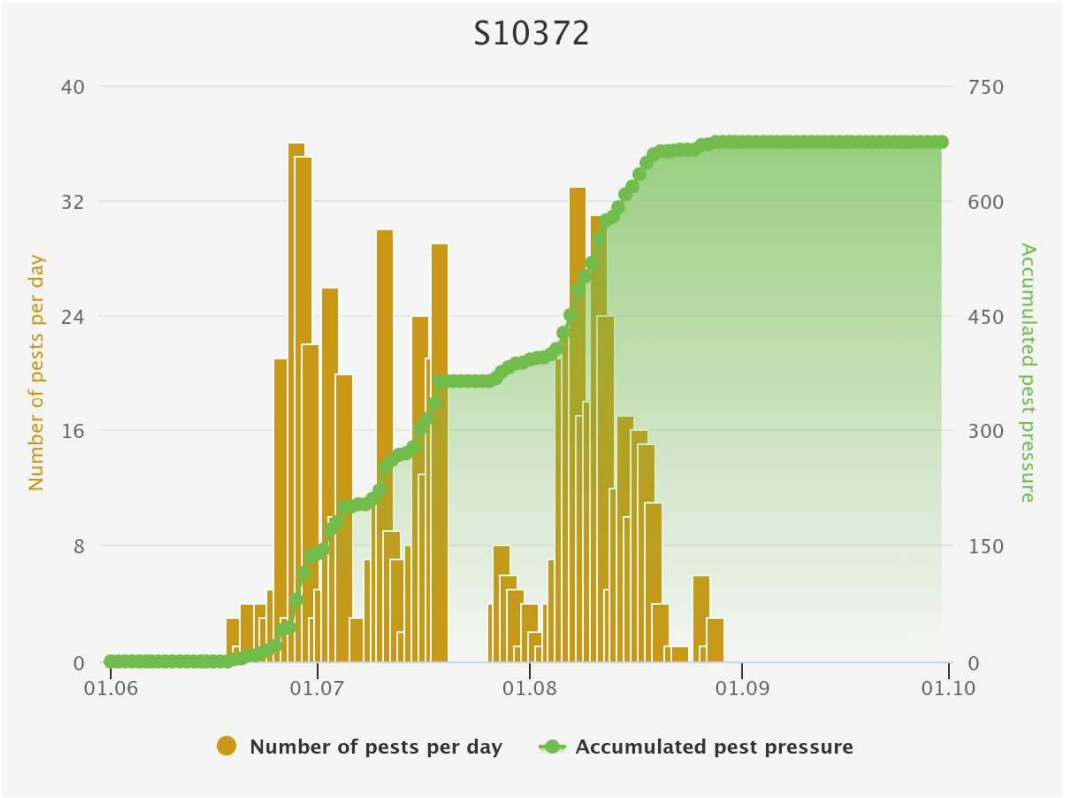


The pheromone trap catch 1999 – 2025 Latsch - Schlanders





The technological innovation for surveillance 2025



6. The origin of the pine processionary moth in South Tyrol

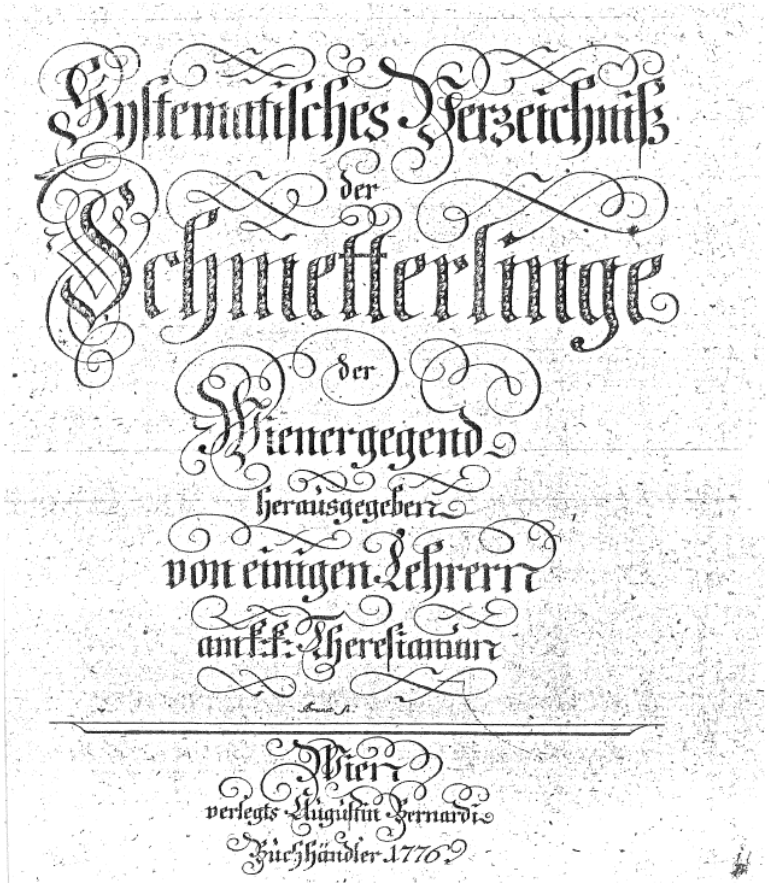
An old story

- Theophrastos of Eresos (314-313 BC) *Historia Plantarum*. Chiron's panacée (*Inula helenium*) used mixed with wine and oil "*against* … ***pityocampes*** …"

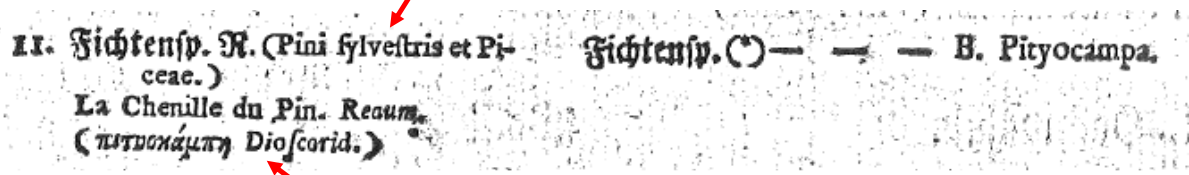
- Dioscoride II (53 AD) ***Pinorum erucae****: vis omnium communis erodere, ulcerare*

- Justinianus's law or Pandectes (534 AD) ***pityocampes***
in its Title VIII of the Cornelia law on murderers and poisoners

Denis & Schiffermüller 1776: Fichtenspinner *Bombyx pityocampa*


Systematisches Verzeichniß
der
Schmetterlinge
der
Wienergegend
herausgegeben
von einigen Lehrern
am k.k. Theresianum
Wien
verlegts Augustin Bernardi
Buchhändler 1776

Pini sylvestris et Piceae.


II. Fichtensp. R. (Pini sylvestris et Piceae.) Fichtensp. (*) — — — B. Pityocampa.
La Chenille du Pin. Reaum.
(πιτυοκάμπη Dioscorid.)

La Chenille du Pin. Reaum.
(pityocampa Discorid.)

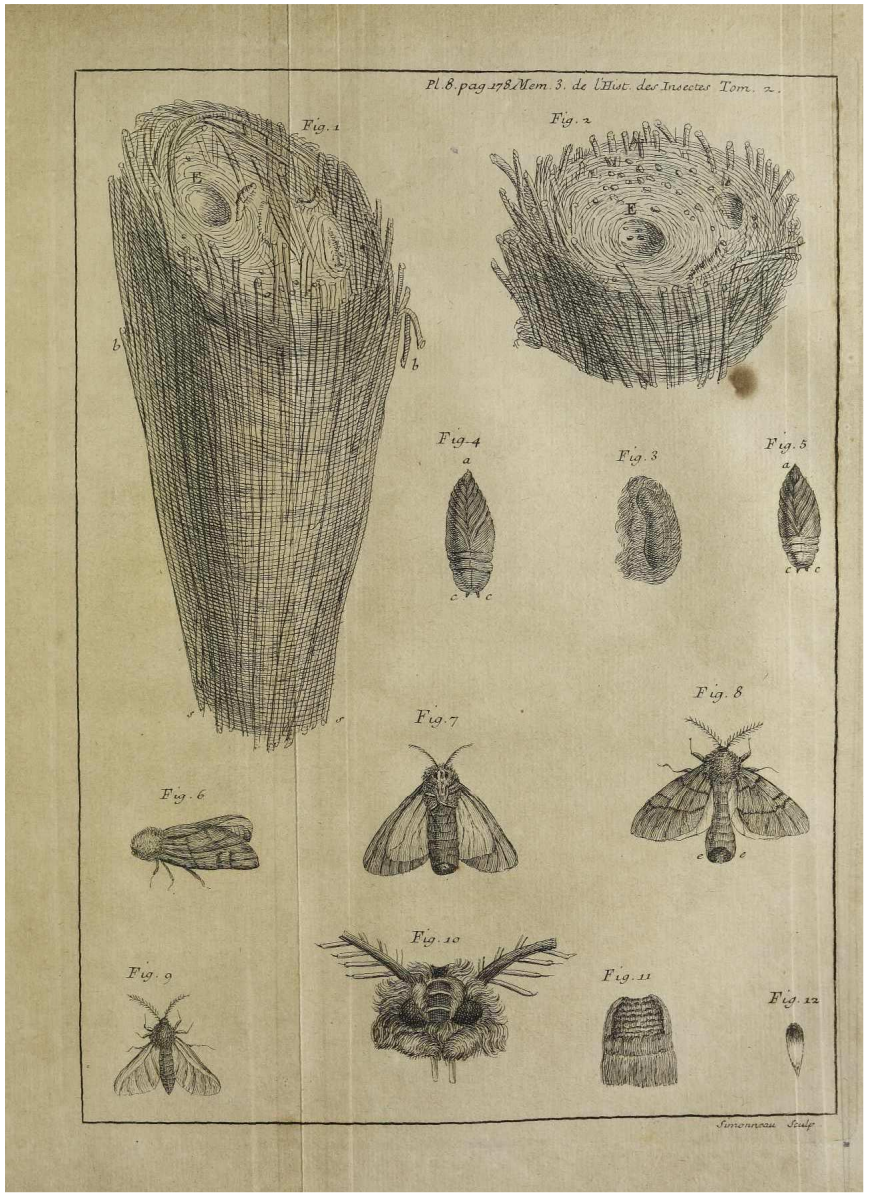
MEMOIRES
POUR SERVIR
A L'HISTOIRE
DES
INSECTES.

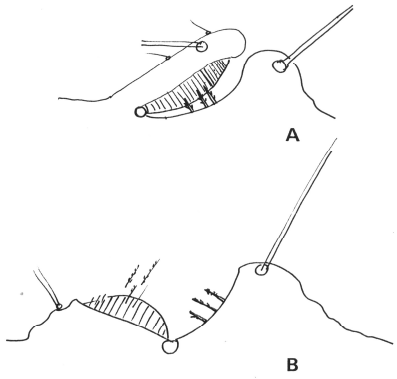
Par M. DE REAUMUR, de l'Académie Royale des Sciences.

TOME SECOND.

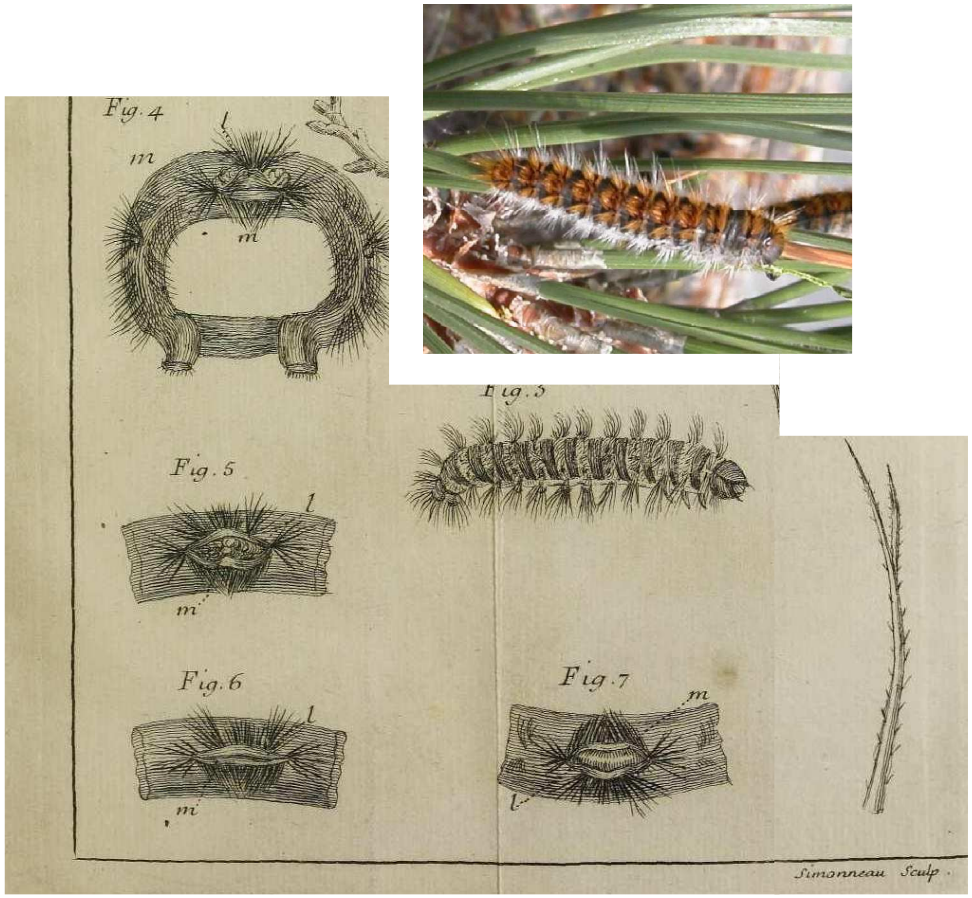
Suite de l'Hiſtoire des Chenilles & des Papillons ; Et l'Hiſtoire des Inſectes ennemis des Chenilles.

A PARIS,
DE L'IMPRIMERIE ROYALE
M. DCCXXXVI.

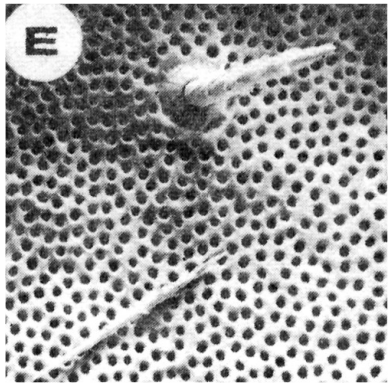




Démolin 1994



Reaumur 1733 La chenille du pin



Novak et al. 1987

(*) Den Spinner besitzen wir zwar noch nicht; es hat ihn aber schon Reaumür (*Memoires des Inf. Tom. 2. Mem. 13.*) genau beschrieben, und wir haben doch Hoffnung ihn bald zu sehen. Der gelehrte Naturkündige Hr. Popowitsch hat uns neulich einige Raupen dieser Art mitgetheilet, die er durch den Freyherrn von Sperges einen Mann, der alle nützlichen Kenntnisse mit patriotischem Eifer befördert, aus Tyrol erhalten hatte. Sie nähren sich sehr gut

Neotype:
Schlanders
South Tyrol

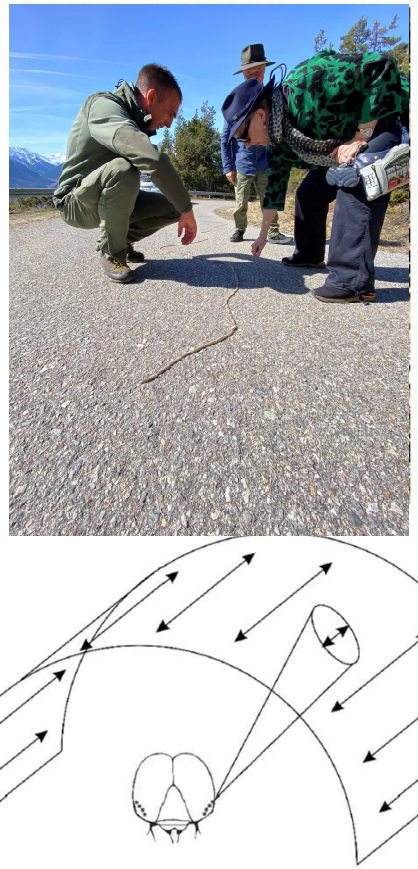
Joseph Freiherr von Sperges (1725-1791)
South Tyrol
http://worldcat.org/identities/lccn-n80040576/

Denis & Schiffermüller 1776

7. The wonderful things

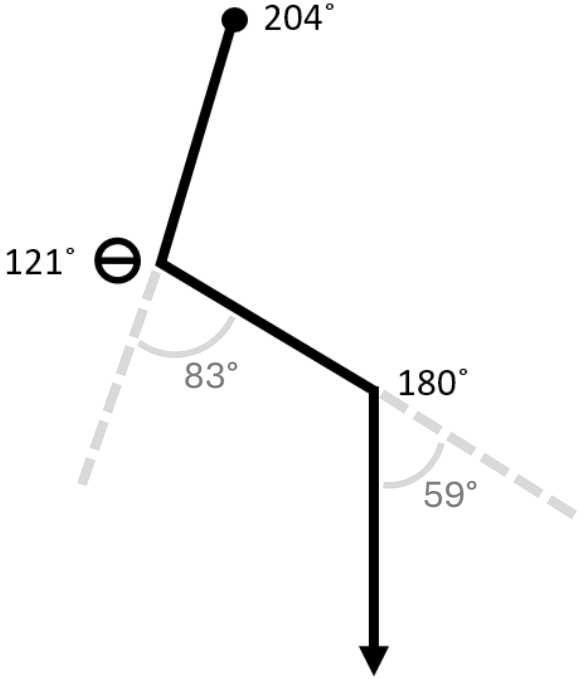
Thaumetopoea pityocampa: the caterpillar with the compass

(*a*)

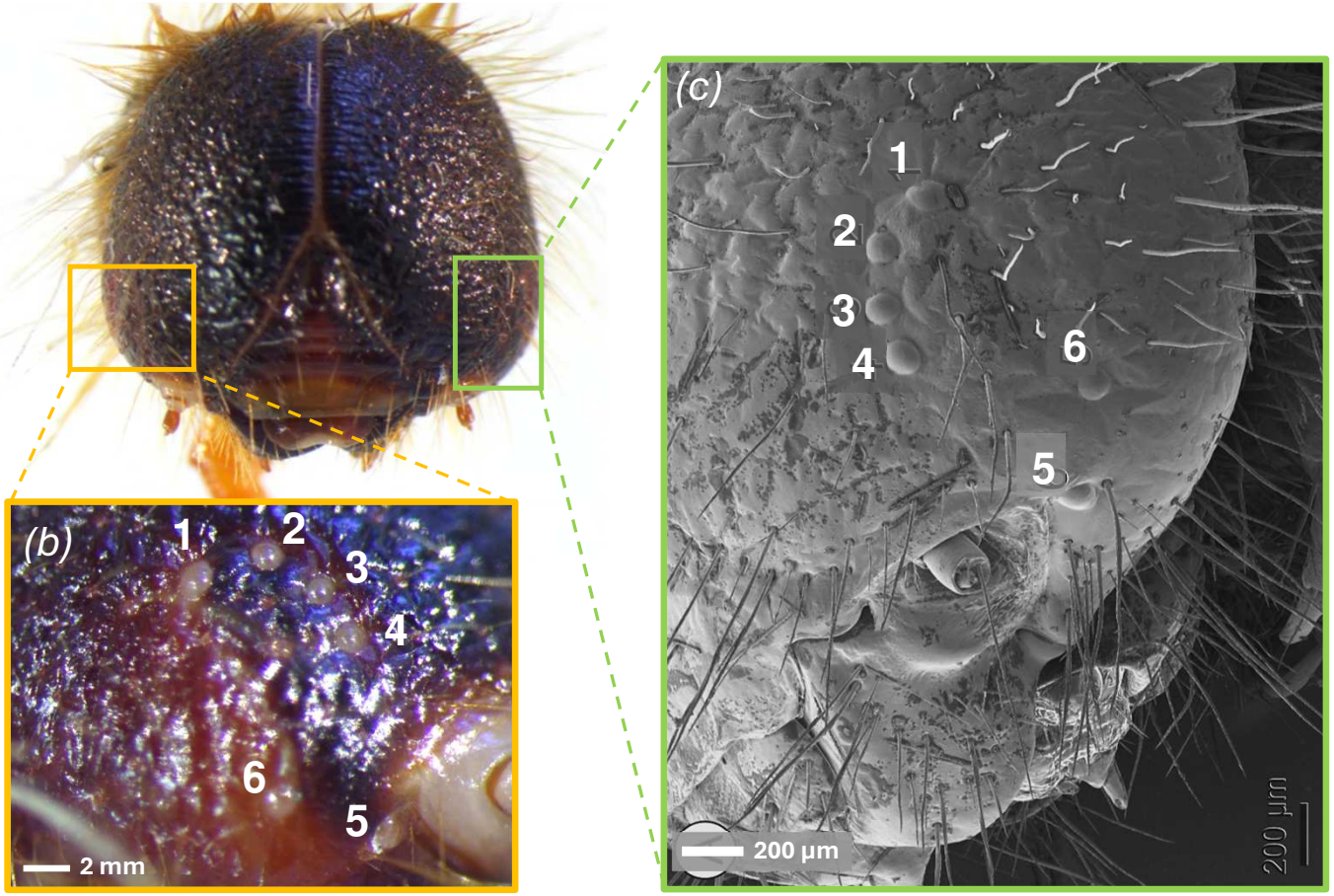


(*b*)

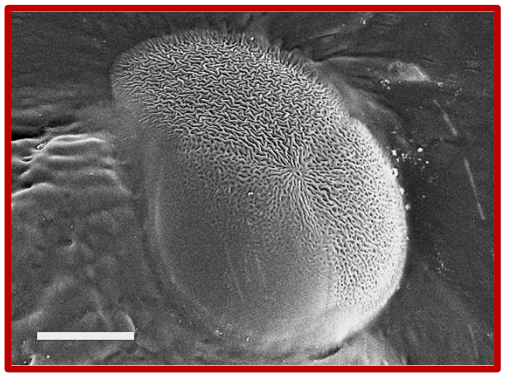
(*c*)



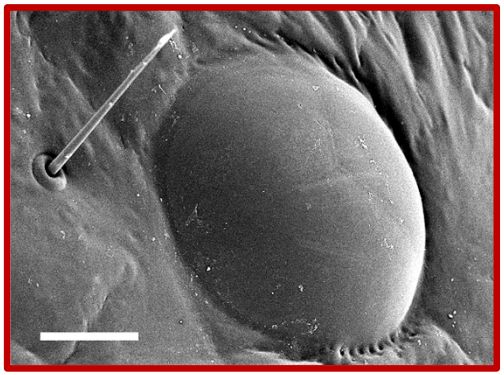
Thaumetopoea pityocampa: the caterpillar with the compass



Stemma 1

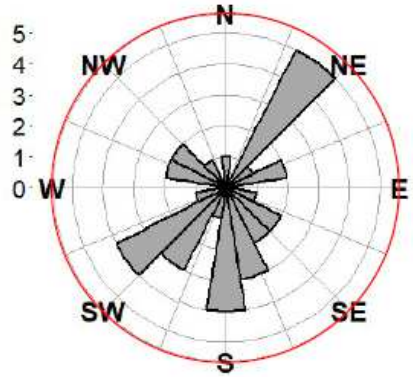


Stemmata 2-6

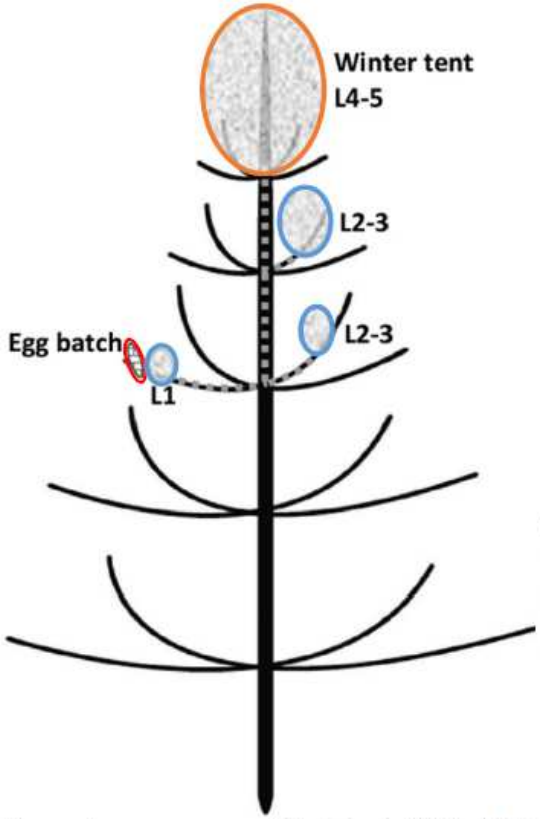


Biol Lett 2021

Thaumetopoea pityocampa social architect

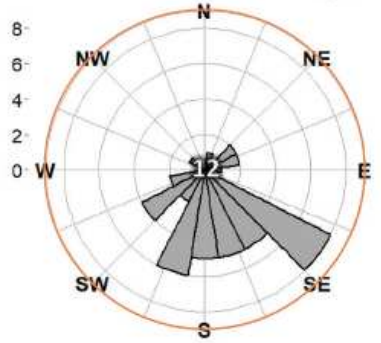


K = 1.48, N= 35, P > 0.15

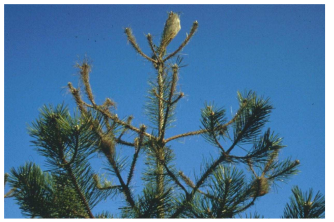


Colonies that survived until final instar (L5), made an average of 3.6 tents (SE ± 0.25, *N* = 44).

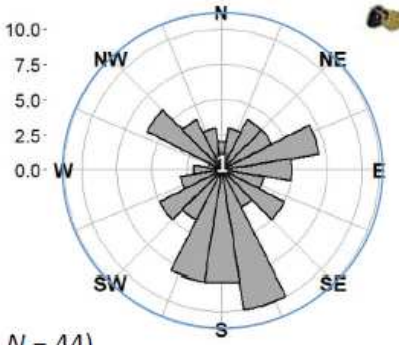
Older (L3-4)



K = 3.13, N = 44, P < 0.01



Younger (L1-2)

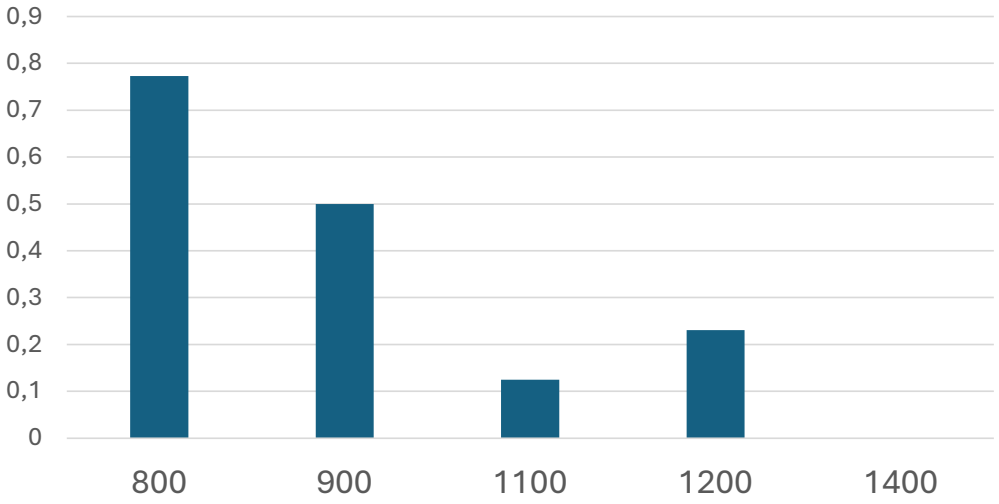


K = 1.83, N = 90, P < 0.05

Entomol Gen 2021

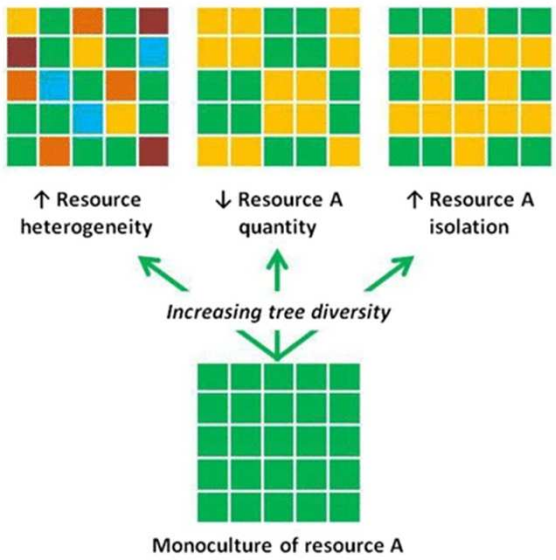
- Drought and dieback by the shoot blight fungus *Diplodia (Sphaeropsis) sapinea*

Frequency of Diplodia across elevation as proxy of drought, exercise done with Forest Sciences international students on May 12th 2026 from Schlanders to Patsch



- Drought and bark beetle spots (*Ips acuminatus, Ips sexdentatus, Tomicus spp.*)

- Future perspectives in tree health



Higher forest diversity → **associational resistance**

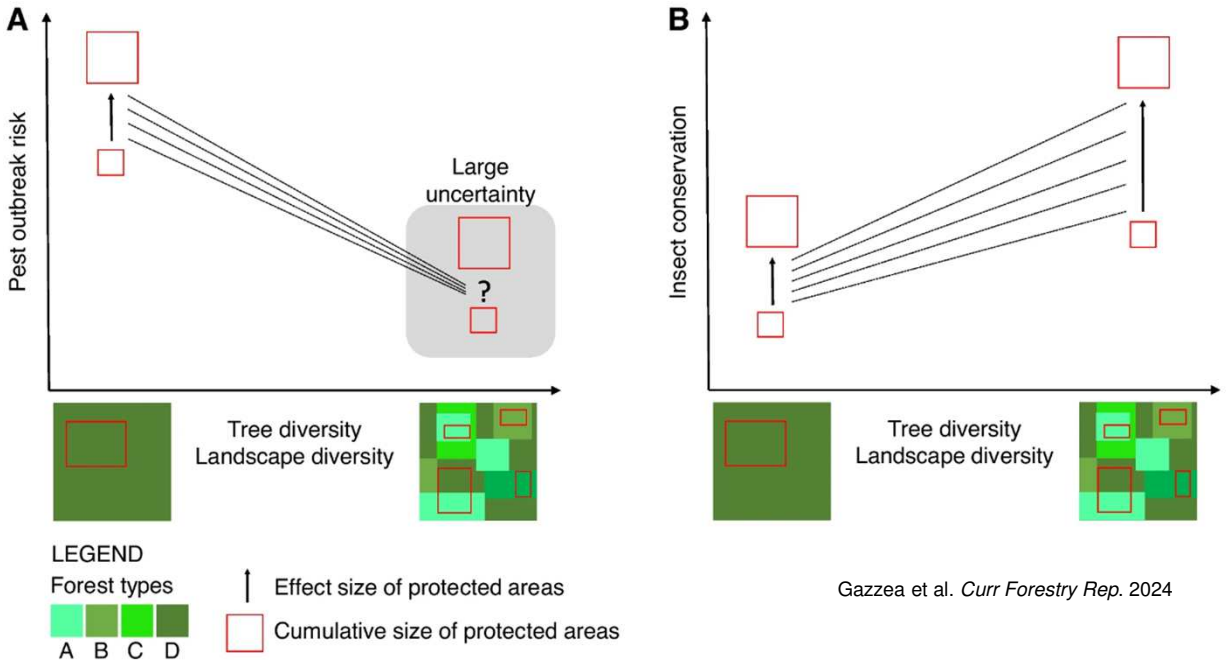
heterospecific neighbours reduce the risk of a focal tree being attacked by herbivores

Pest management objective concurs with insect conservation

Higher forest diversity → **increase in species diversity**

Jactel et al. *Curr Forestry Rep.* 2017

Design protected areas targeting insects



Gazzea et al. *Curr Forestry Rep.* 2024