Papel de los polinizadores asociados a los sistemas silvopastorales

Rocío Rosa García, Marta Ciordia, Rafael Celaya

SERIDA




LOS POLINIZADORES

Un **polinizador** es un vector que traslada polen de la antera al estigma. Permite unión del gameto masculino en el grano de polen con el gameto femenino del óvulo

FRONTIERS IN ECOLOGY *and the* ENVIRONMENT

Reviews

Global importance of vertebrate pollinators for plant reproductive success: a meta-analysis

Fabrizia Ratto, Benno I Simmons, Rebecca Spake, Veronica Zamora-Gutierrez, Michael A MacDonald, Jennifer C Merriman, Constance J Tremlett, Guy M Poppy, Kelvin S-H Peh, Lynn V Dicks

First published: 06 February 2018 | https://doi.org/10.1002/fee.1763 | Citations: 103

Meta-analysis 126 experiments on animal-pollinated plants: excluding vertebrate pollinators – but not insect pollinators – fruit and/or seed production reduced by 63% on average.

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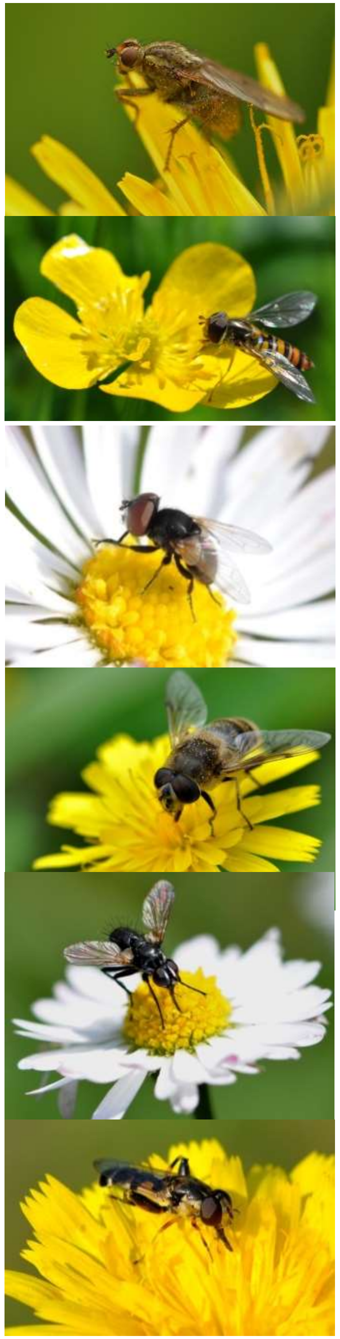
LOS INSECTOS POLINIZADORES

Dípteros (7.000)



Lepidópteros (5.000)

Coleópteros (+ 10.000)

Himenópteros, (9.500)

LAS ABEJAS

PAPEL DE LOS POLINIZADORES

- Necesarios para la reproducción de las plantas. El 85% plantas con flores dependen de animales -principalmente insectos- para su polinización (Ollerton et al. 2011).

- Importantes para las redes alimentarias de la fauna silvestre y humana. Ellos y los productos de las plantas que polinizan.

- 70% de los cultivos más comunes y 35% de la producción de cultivos (dependen o se benefician de la polinización animal), frutas, verduras, especias, frutos secos y semillas (Klein et al. 2007).
Plantas polinizadas por insectos (alfalfa, trébol) - alimento al ganado.

Otros servicios ecosistémicos cuya provisión dependen de comunidades saludables:
Reducción de la erosión del suelo,
Mejora de la infiltración del agua de lluvia, calidad del agua,
Reducción de la velocidad del viento,
Secuestro de carbono,
Espacios recreativos para los humanos,
Hábitat para una gran variedad de fauna silvestre, incluidos artrópodos depredadores y parasitoides que reducen las plagas de los cultivos.
Minerales, vitaminas y nutrientes (vitamina C, el calcioy el ácido fólico).

AMENAZAS Y CONSECUENCIAS

tivity.

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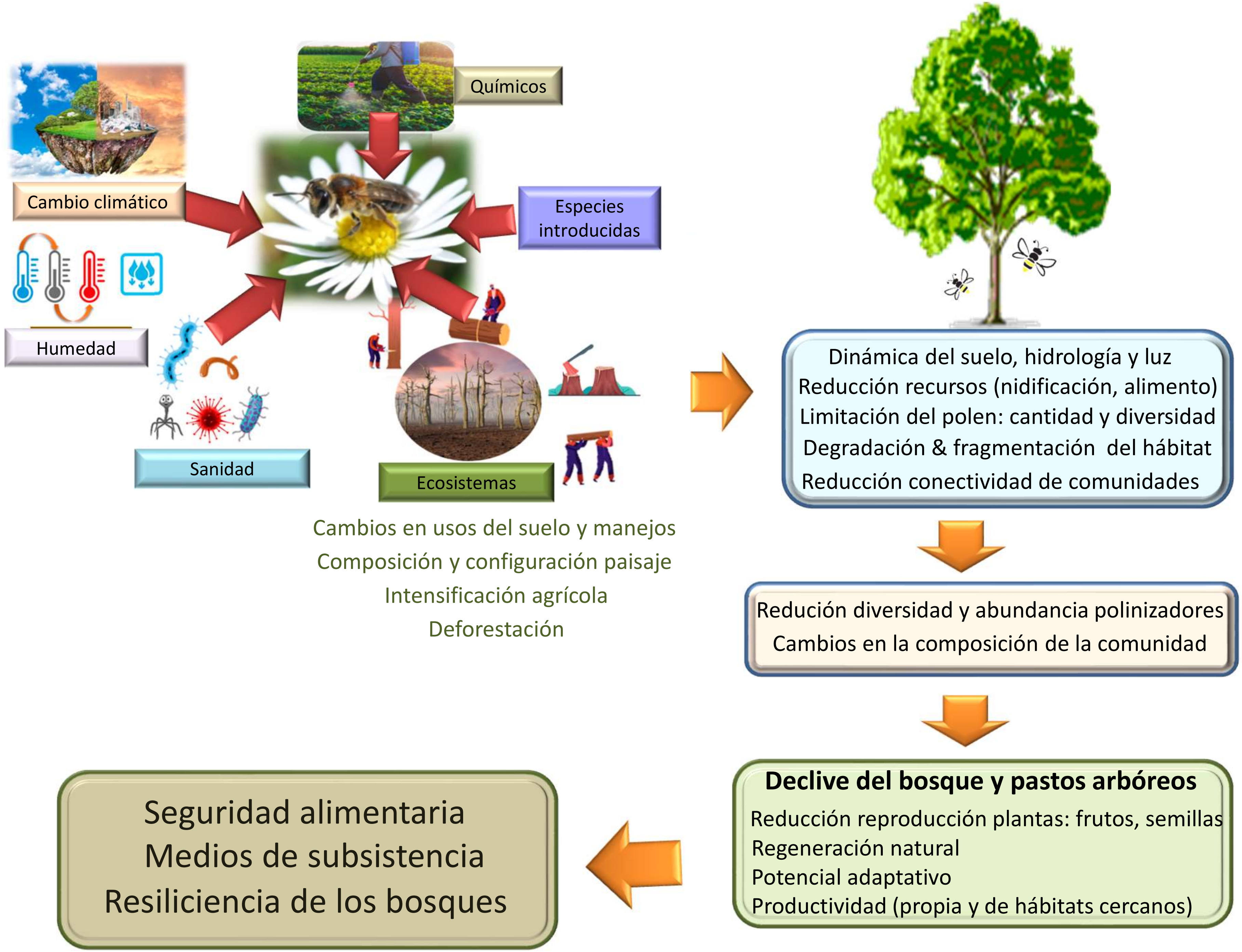

SISTEMAS SILVOPASTORALES
ÁRBOLES, ANIMALES Y PASTOS

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Fostering pollination through agroforestry: A global review

Diego Centeno-Alvarado [a,*,1], Ariadna Valentina Lopes [b,2], Xavier Arnan [a,c,3]

[a] Programa de Pós-Graduação em Etnobiologia e Conservação da Natureza, Universidade Federal Rural de Pernambuco, Recife, Pernambuco, Brasil
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[c] Universidade de Pernambuco, Garanhuns, Pernambuco, Brasil

The Role of Temperate Agroforestry Practices in Supporting Pollinators

Gary Bentrup, Jennifer Hopwood, Nancy Lee Adamson, Rae Powers, and Mace Vaughan

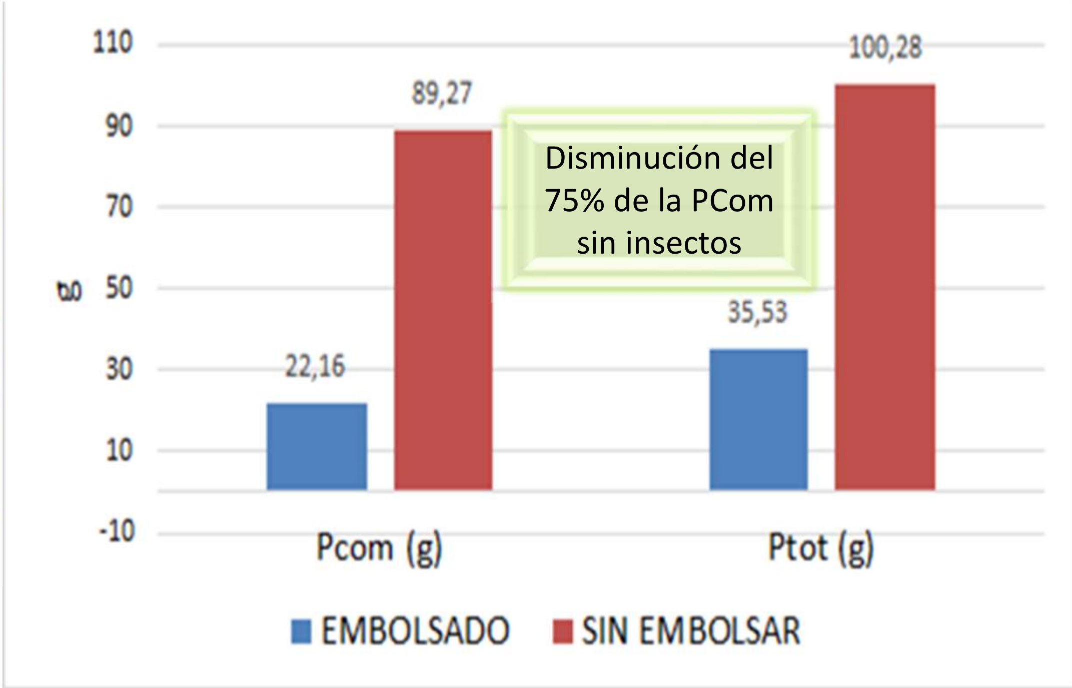
Dos enfoques polinizadores - sistemas silvopastorales:

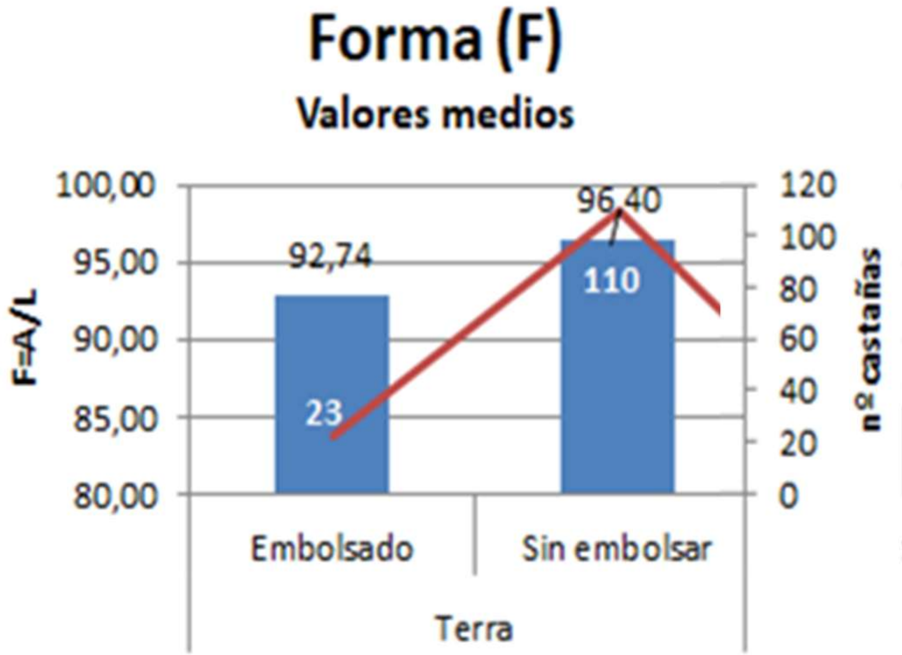
- Los polinizadores y castañicultura: resultados de SILFORE
- La ganadería, conservación de los polinizadores y servicios ecosistémicos

Villacondide (Coaña)-Asturias: con Gochu Asturcelta

- **GESTIÓN SILVOPASTORAL. Pastoreo rotacional** en **ecosistemas interconectados bosque-prados- frutales.**
- **ESPECIE: raza porcina autóctona, Gochu Asturcelta.**
- **SERVICIOS ECOSISTÉMICOS ADICIONALES para potenciar el uso múltiple del monte y favorecer la economía circular:** Valoración del apoyo de los insectos polinizadores en la productividad del bosque

Control de la producción y calidad de las castañas





INSECTOS VISITANDO LAS FLORES DEL CASTAÑO

BOTANY LETTERS
https://doi.org/10.1080/23818107.2021.1872041

Taylor & Francis
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Revisiting pollination mode in chestnut (*Castanea spp.*): an integrated approach

Clément Larue[a,b], Eva Austruy[a], Gaëlle Basset[a] and Rémy J. Petit[a]

[a]Univ. Bordeaux, INRAE, BIOGECO, Cestas, France; [b]INVENIO, Douville, France

4203 artrópodos 129 taxa

INSECT POLLINATION IN CHESTNUT

Clément Larue[1,2]

[1]Univ. Bordeaux, INRAE, BIOGECO, 33610 Cestas, France ; [2]INVENIO, Maison Jeannette, 24140 Douville, France

Are chestnuts pollinated by wind, insects, or both? For almost 150 years, this question has been in the air. To establish chestnut pollination mode on solid foundations, two types of experiences must be combined: pollinator exclusion, to test the dependence of chestnut pollination on insects, and insect monitoring during flowering, to identify the true pollinators of chestnut.

① Control

② Nets

①

②

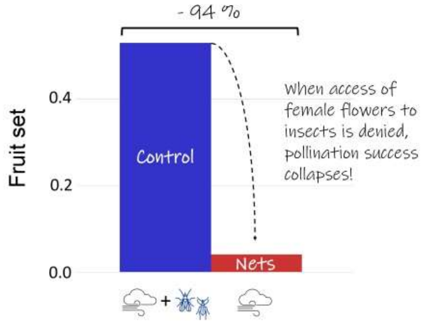
③

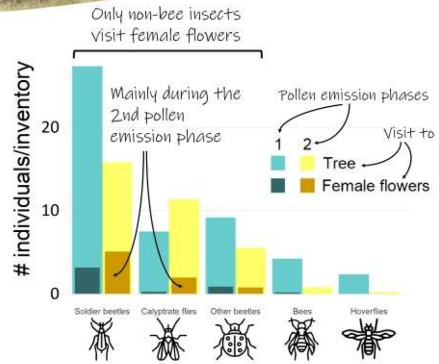
POLLINATOR EXCLUSION EXPERIMENTS

Larue et al. (2021) Petit & Larue (2022)

PHOTOGRAPHIC MONITORING OF INSECTS

Larue et al. (2021) Pauly et al. (2023)





✓ Chestnut is **strictly insect-pollinated**

✓ The main **pollinators** are **calyptrate flies** and beetles

Chestnut is neither entirely nor partly wind-pollinated. Instead, it is **entirely insect-pollinated**. The insects involved are **beetles** and especially **calyptrate flies**, **not bees**. We are starting to clarify the main mechanisms of chestnut pollination. Walking insects are attracted to rewardless female flowers by male catkins of bisexual inflorescences during the second pollen emission phase. They climb on the erect styles of female flowers and deposit pollen on the tiny stigmas. The preservation of non-bee pollinators is thus critical to the sustainable management of chestnut orchards.

Want to know more about my research?

POLINIZACIÓN – CONSERVACIÓN DE PASTOS

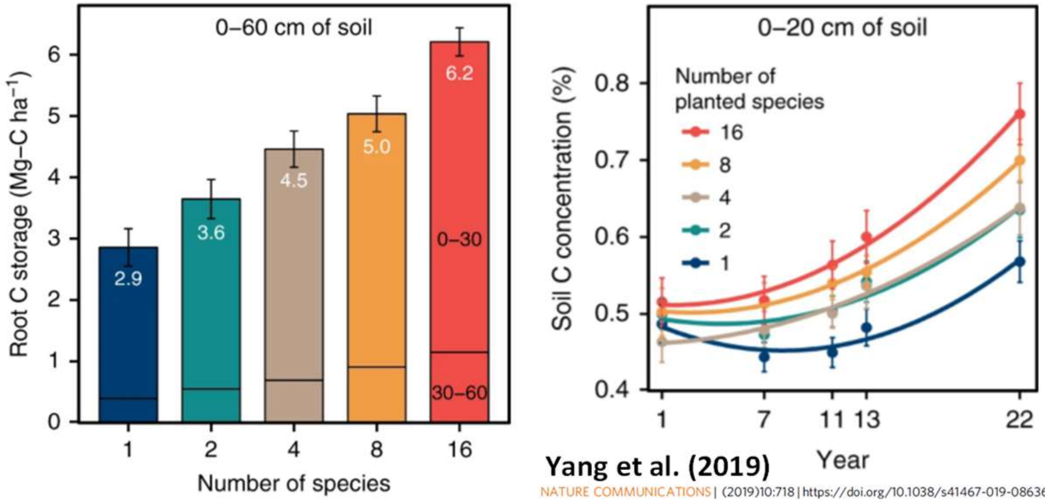
El sotobosque puede incluir gramíneas, otras herbáceas, arbustos y suelo desnudo, etc. Una gran parte tienen que ser polinizadas.

Algunas especies necesitan determinados polinizadores, otras pueden ser polinizadas por una mayor variedad de especies.

Necesaria variedad y cantidad de polinizadores en los pastizales.

Más visitas: + nº semillas + producción del pasto.

+ producción pastos diversos = + secuestro C



Yang et al. (2019)
NATURE COMMUNICATIONS | (2019)10:718 | https://doi.org/10.1038/s41467-019-08636-w |

Las leguminosas :

a) ↑ cantidad y calidad de la alimentación del ganado

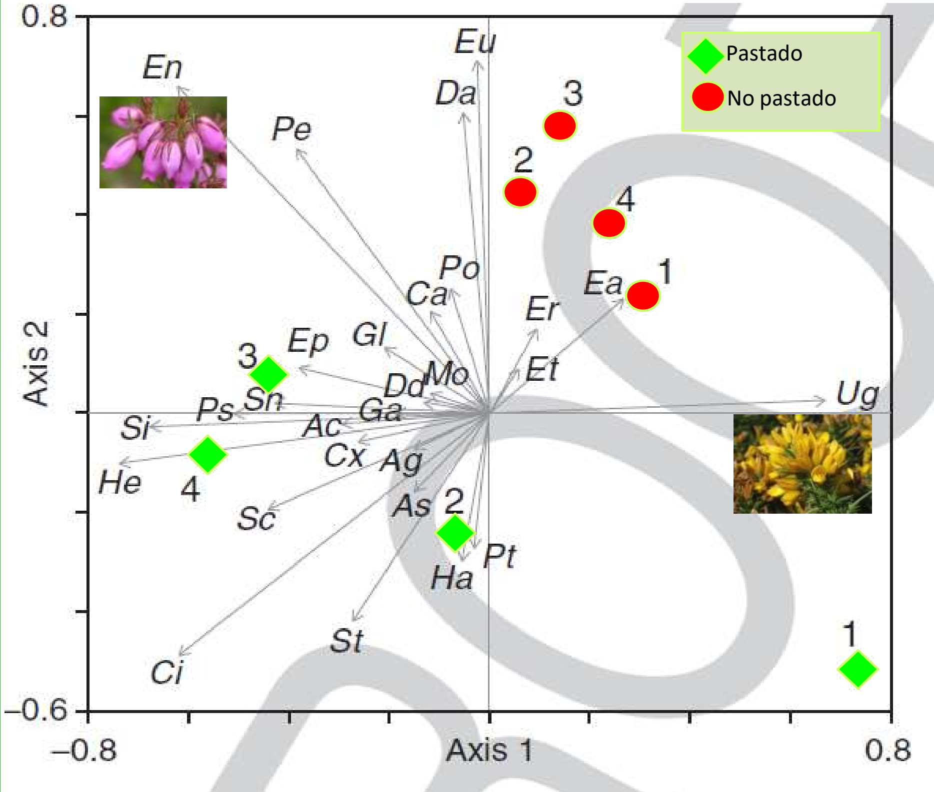
b) mejora del suelo - fijación N, la estabilización del suelo y el reciclaje de nutrientes (Schultze-Kraft et al., 2018).

PASTOREO CON EQUINO - BIODIVERSIDAD

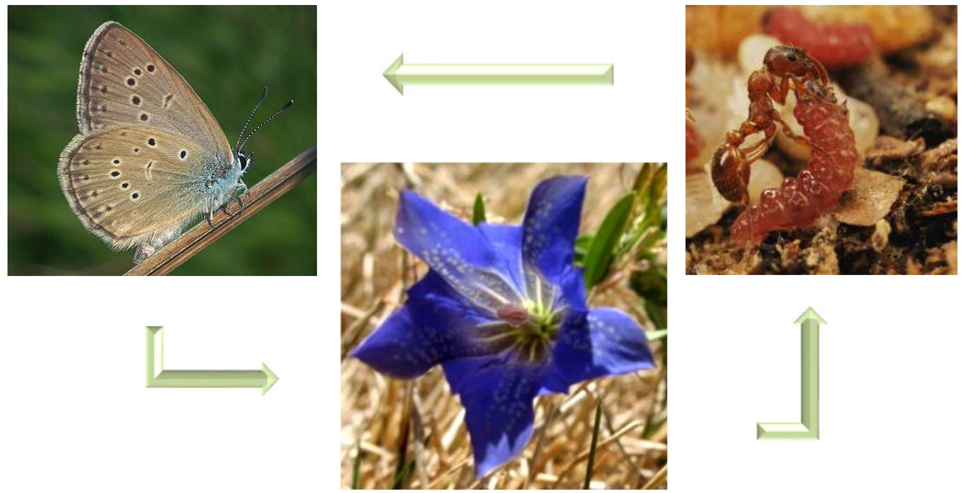
−216g/día

325 g/día

369 g/día



C. filipendulum, G. pneumonanthe, S. tinctoria and S. humilis



osa García R., et al. 2017. Impacts of horse grazing on botanical composition and diversity in different types of heathland. Rangeland Journal, 39. 375-385.

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EUROPEAN RESEARCH AREA ON SUSTAINABLE ANIMAL PRODUCTION

EcoLamb

EcoLamb
Holistic Production to Reduce the Ecological Footprint of Meat

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INSTITUTO TECNOLÓGICO AGRARIO

CTC centro tecnolóxico da carne

PORTUGAL

CIMO Centro de Investigação de Montanha

ITALIA

Università degli Studi di Torino Dipartimento di Scienze Veterinarie

ALEMANIA

Ganzheitliche Bilanzierung
Universität Stuttgart, Lehrstuhl für Bauphysik

ESLOVENIA

UNIVERZA V NOVI GORICI
SCIENTIA 1995 VINCES

TURQUÍA

ADNAN MENDERES ÜNIVERSITESİ AYDIN 1992









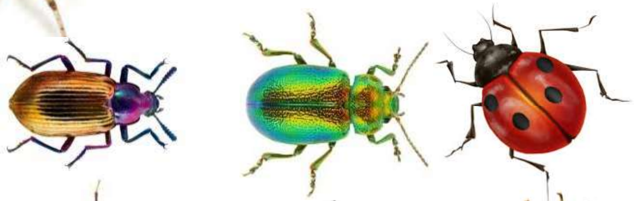
BIODIVERSIDAD EN LOS PASTOS

225.271 artrópodos de pastos durante años 2018 and 2019

4 clases, 22 órdenes y 118 taxa

16 familias arañas

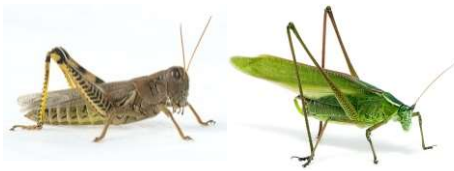
43 familias escarabajos



19 familias chinches

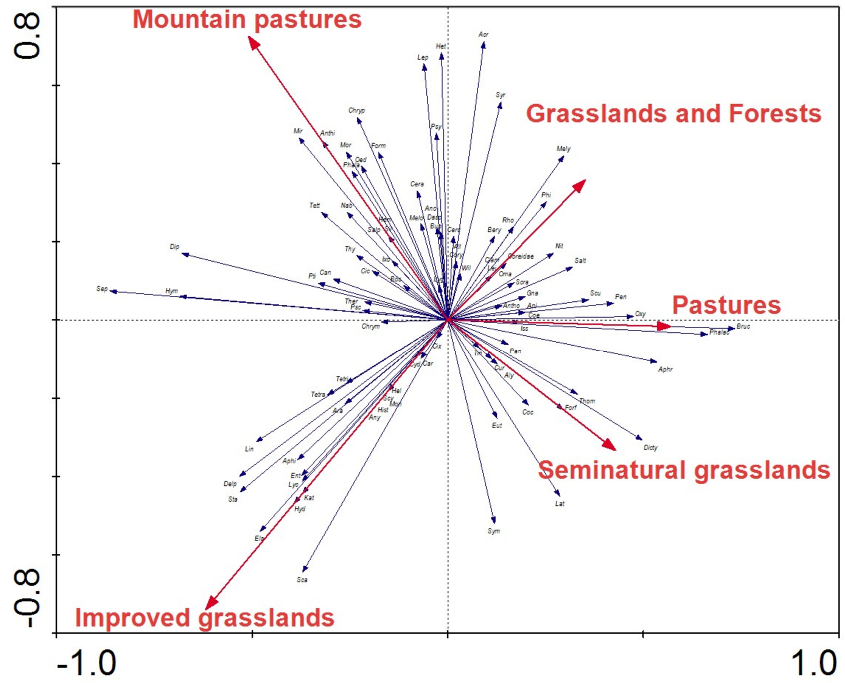
9 familias otros hemípteros

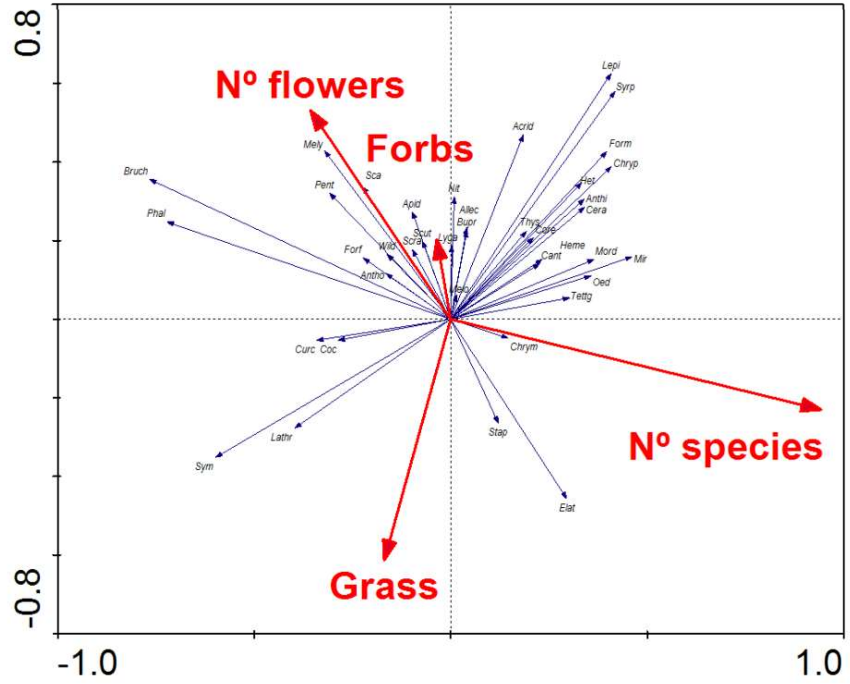
4 familias saltamontes y grillos de matorral.

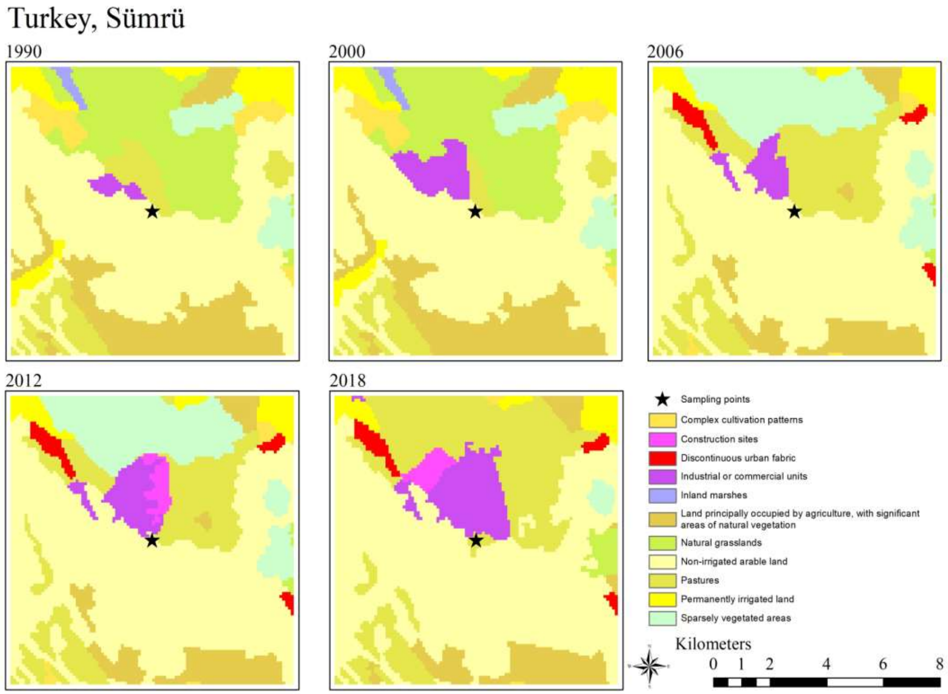


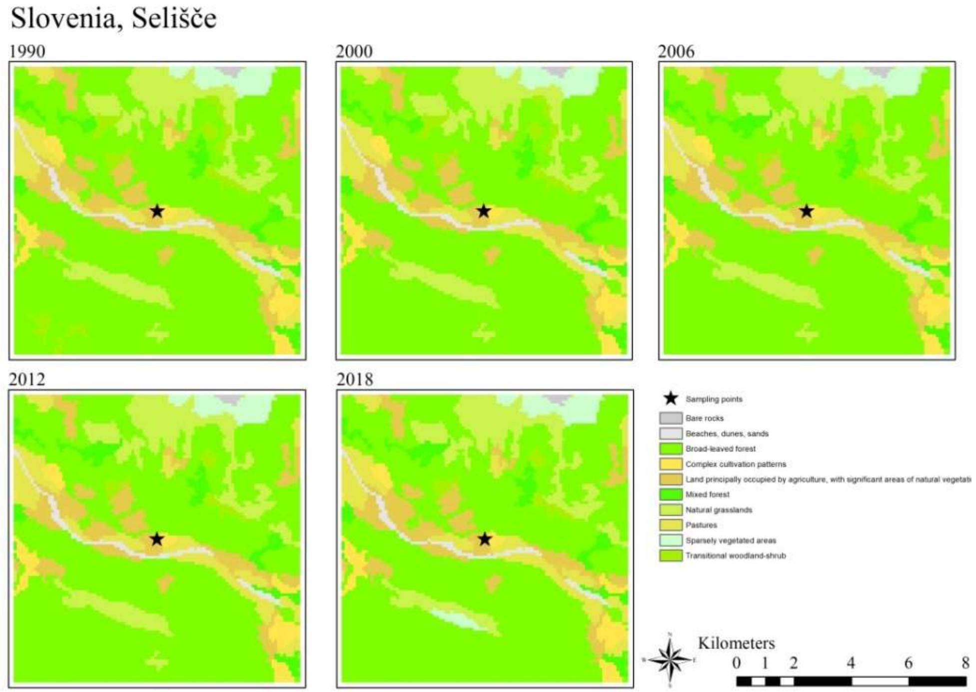
Pollinizadores: 76.856 artrópodos de 46 taxa

SISTEMAS PRODUCTIVOS – HÁBITATS - PAISAJES









!MUCHAS GRACIAS!

Hacia la conservación y gestión de sistemas agroforestales resilientes a través del silvopastoralismo

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El BOSQUE Y LOS POLINIZADORES

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300–350 million people worldwide are highly dependent on forests for their survival (Chao, 2012).

Pollinators are key for maintaining the productivity of many NWFPs in the long term (Thomas *et al.*, 2009).

Advancing understanding of how pollination and pollinator availability affect non wood forest production, and vice versa, is crucial for sustaining national and international markets and for poverty alleviation (da Silva *et al.*, 2018).

NWFP forest produces leaves and fruits for medicinal and nutritional purposes, **bark and latex**

Canopy openness (such as that caused by logging of various intensities) increases light penetration and thus enhanced regeneration of herbs and shrubs. This may change the plant community structure and enhance forage and nesting resources for pollinators and change associated pollinator communities.

- Canopy gaps lead to warmer temperatures at ground level, which may assist beetle larval development.
- Canopy gaps offer additional food sources for adult beetles, which forage on herbs and shrubs.
- Cavity-nesting bees that prefer rotting wood are likely to predominate in mature forests, while ground-nesting species are more likely to prefer logged and edge sites. Ground-nesting pollinators may benefit from an increase in the availability of nesting sites in forest clearings.
- A combination of habitats with varying canopy coverage may be beneficial for pollinators.
- Fire (see also below) burns most of the leaf-litter layer and thus exposes the forest floor, which is preferred by ground-nesting bees. The opening up of the canopy due to tree deaths caused by fire is commonly followed by an increase in the herbaceous layer, increasing floral resources and thereby benefiting pollinators.

Forest structure

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Fire

- Pollen limitation in a fire-tolerant shrub in post-wildfire unlogged sites was shown to be related to the high floral densities of potential competitors that emerged after fire.
- Floral and bee density and species richness have been found to be higher in post-wildfire logged areas than in post-wildfire unlogged sites due to increased resource availability.
- The opening up of tree canopies by fire-caused tree deaths can lead to an increase in the herbaceous layer, providing forage for various pollinators. Repeated prescribed fire has been associated with high abundance and diversity of bees and other flower-visiting insects.
- Early successional habitats following fire may support a larger number of bee communities as a result of increased floral resources immediately after fire. The benefits of fire in terms of increased pollinator abundance and richness may decline over time, however.
- The responses of pollinators to fire may differ, depending on certain traits, and should be evaluated at lower taxonomic levels or according to traits. Fire could have detrimental effects if it occurs when pollinators are in a larval stage because of reduced mobility.
- Burning and mowing may reduce the presence of non-flowering forbs and thus increase the availability of ground-nesting sites, leading to higher bee abundance and richness.

Dead wood

- An increase in the volume of standing and lying dead wood can have a positive impact on pollinator diversity and abundance (e.g. on wood-nesting bees and beetles).

Disturbance and fragmentation

- Disturbances promote habitat diversity and hence pollinator diversity at the landscape scale.
- Habitat fragmentation and degradation may lead to pollen limitation by reducing tree density and altering habitat conditions for pollinators, increasing the risk of inbreeding depression, with negative consequences for population viability.
- Nesting resources (e.g. dead wood, bare ground and early successional plants such as grass) are important determinants of bee community composition.
- Up to a point, increasing tree mortality (from Douglas fir beetle) in a Douglas fir forest had a positive effect on bee abundance, species richness and diversity. Tree mortality was associated with more open canopies and increased herbaceous cover, which favoured bee abundance and diversity.

Understorey management

- The removal of ground debris that exposes bare soil may provide additional nesting sites for ground-nesting bees.
- Mowing, weed control and fertilizer application may reduce understorey plant diversity, with potential impacts on the diversity of pollinator species.
- Understorey mowing alters plant species composition, with potential impacts on pollinator diversity and abundance. Mowing can also affect the egg and larval stages of pollinators.
- Managers may reduce the impacts of mowing on pollinators by retaining unmown refuges and timing mowing to reduce impacts during heavy flowering events.
- In one study, bee species richness declined with increasing shrub cover and organic matter on the forest floor, which reduced the extent of herbs present and nesting sites for ground-nesting bees.
- Overlap in the diets of ungulates and bees in forests may supress pollinator populations, especially in the event of additional stressors such as drought that further reduce floral resources.

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Pathogens, nutritional shortages, climate change, and deforestation

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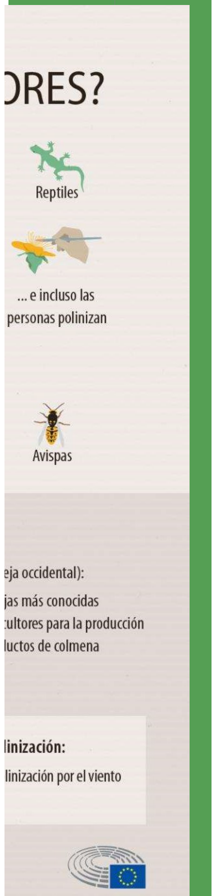
Extreme weather, shifts in season, rediuced forage, reduced genetic diversity

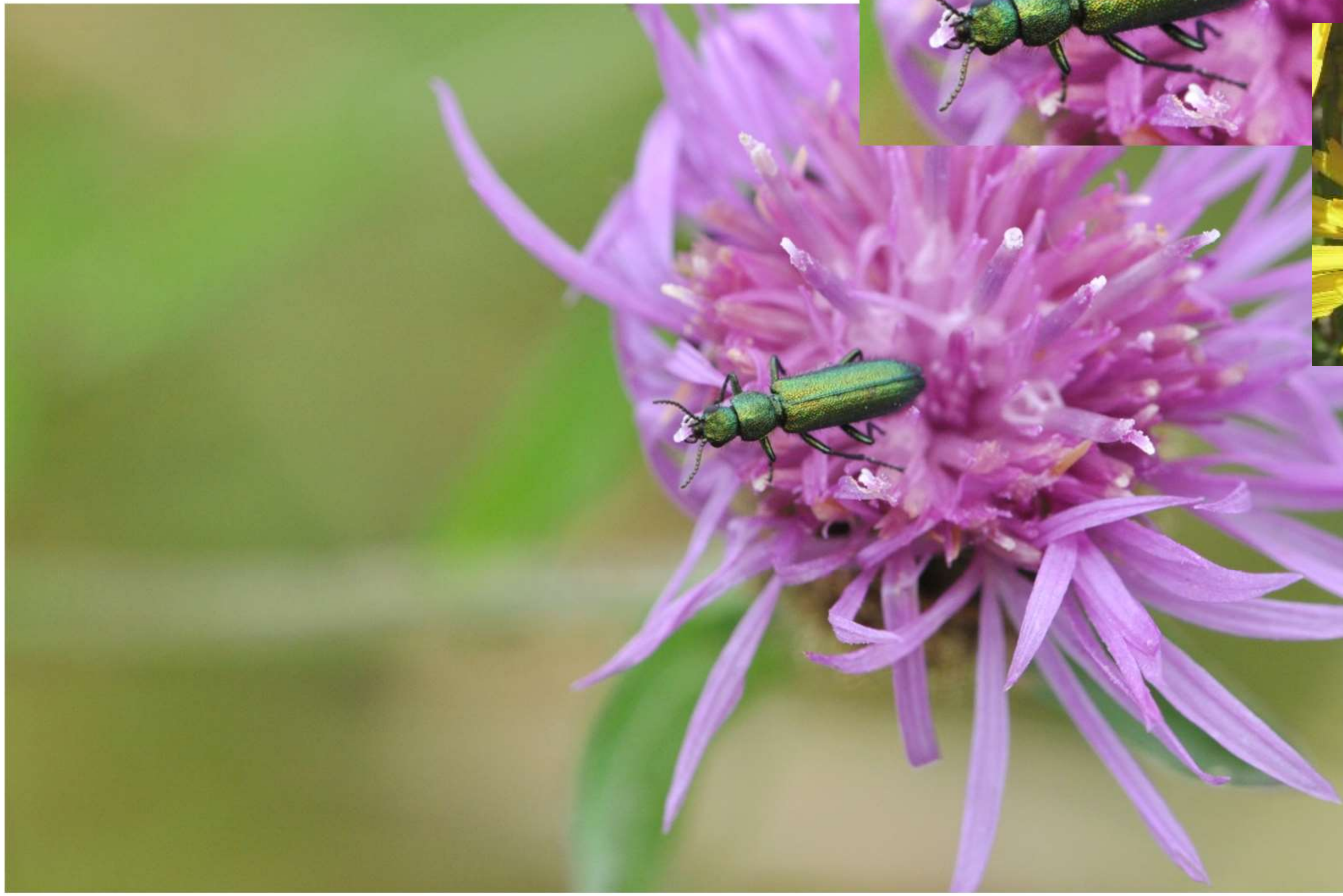
CAMBIO CLIMATICO Y POLINIZADORES



está afectando a los polinizadores provocando desplazamientos en las áreas de distribución de las especies y desajustes espaciales y temporales con las plantas que interactúan debido al aumento de las temperaturas.
Cambios en la distribución de los abejorros en la Cordillera Cantábrica - un patrón consistente con el cambio climático (Ploquin et al., 2013)

Fuerte pérdida de diversidad en la comunidad de abejorros en altitudes medias y altas, donde especies generalistas como Bombus terrestris se han vuelto particularmente abundantes en detrimento de especies más especialistas como es el caso de Bombus sylvarum. Además, existe una tendencia a la extinción de especies particularmente fuerte en altitudes bajas (0–900 m) y medias (900–1500 m).
En el caso de los Pirineos, con la excepción de unas pocas especies de abejorros, Ornosa et al. (2017) observaron una reducción de sus poblaciones y del rango altitudinal, con una tendencia de las poblaciones de abejorros hacia zonas altas mejor conservadas

Los polinizadores se pueden ver afectados además por otros efectos del cambio climático relacionados con la disponibilidad de agua. La sequía puede reducir tanto la producción de néctar (Wyatt et al. 1992; Halpern et al. 2010) como de polen (Waser y Price 2016), lo que probablemente provoque un incremento en la competencia entre especies por estos recursos. Por el contrario, en condiciones más húmedas, las flores pueden producir mayor volumen de néctar, aunque más diluido (Wyatt et al. 1992). Finalmente, el informe del Grupo Intergubernamental de Expertos sobre el Cambio Climático (IPCC 2104) prevé que eventos meteorológicos extremos como las fuertes precipitaciones e inundaciones aumentarán en frecuencia e intensidad, contribuyendo al declive de especies que anidan en el suelo, como los abejorros y numerosas especies de abejas



Up to half a trillion USD in global food supplies rely on pollination (Mekouar 2016) making this plant–animal relationship one of the world's most valued ecosystem services (Klein et al. 2007, Kremen et al. 2007). Insects pollinate more than 80% of the world's approximate 300 commercial crops (see Allsopp et al. 2008) and rangeland flowering plants (Ollerton et al. 2011), while bees (native and non-native) pollinate approximately 75% of the fruits, nuts, and vegetables grown in the United States (Moisset and Buchmann 2011). Worldwide declines in insect pollinator populations are the result of multiple stressors including habitat loss when native landscapes are converted to row crops, toxicity to pesticides associated with row crops, climate change, and disease (Cunningham 2000, Kremen et al. 2007, Winfree et al. 2009, Koh et al., 2016). The FAO (2016) suggests pollinator conservation as one of the most effective ways to boost food security and support sustainable agriculture.

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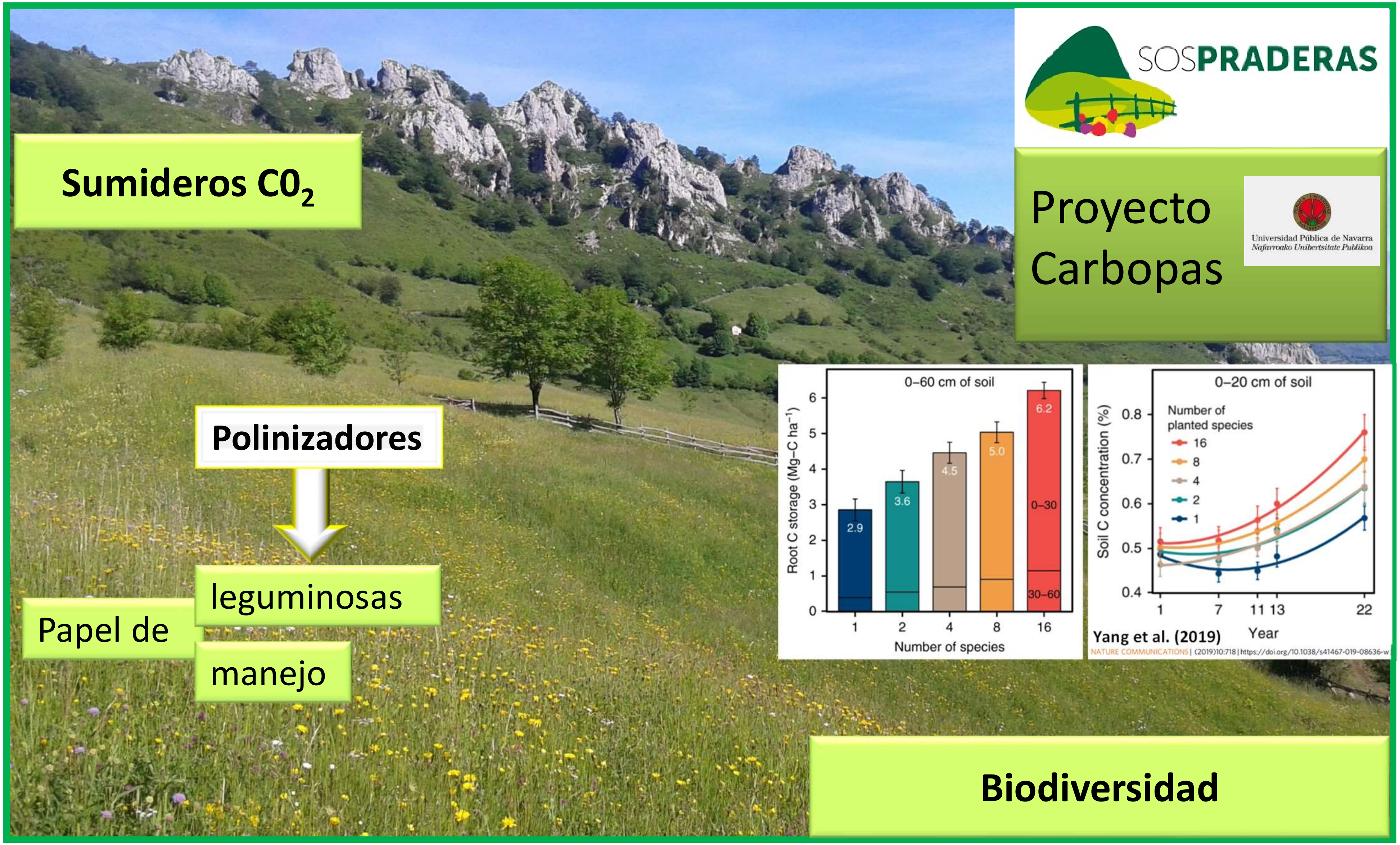
Mantenimiento pastos permanentes y mejora de praderas



Sumideros $C0_2$

Polinizadores

Papel de leguminosas

manejo

SOSPRADERAS

Proyecto Carbopas

Universidad Pública de Navarra
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Yang et al. (2019)
NATURE COMMUNICATIONS | (2019)10:718 | https://doi.org/10.1038/s41467-019-08636-w

Biodiversidad

En definitiva, al participar en la reproducción de las plantas y en la producción de frutos y semillas silvestres y cultivados, los polinizadores son un grupo biológico clave para la conservación de la biodiversidad, la preservación de la producción primaria sobre la cual se sustenta la vida y, por tanto, también para la alimentación humana. Es éste un servicio esencial, cuyo valor (únicamente referido a la producción de alimentos) se valora en 153.000 millones de euros a nivel mundial12, 22.000 millones de euros para la agricultura europea9 y más de 2.400 millones de euros para la agricultura española13 .

Measures for land and forest managers

At the **landscape scale**, such measures address, among other things, landscape-scale planning to maintain key landscape components on which pollinators depend; ensuring habitat connectivity, including through agroforestry, creating biological corridors or stepping stones, and retaining native vegetation; enhancing the density of floral resources; maintaining or increasing landscape heterogeneity and patchiness to increase the diversity and connectivity of floral and pollinator-nesting resources; maintaining large riverine buffers; and undertaking long-term studies to understand the impacts of natural disturbances on pollinator communities over time.

At the **forest management scale**,
Establishing baselines of pollinator diversity and abundance and monitoring these over time;
Maintaining a mosaic of burned and unburned pollinator habitat;
Field guides for pollinator management based on knowledge of the biological attributes of pollinator species in an area and floweri
phenology and synchrony;
Forest management practices such as selective logging, thinning, prescribed burning, mowing and coppicing in ways that increase t
heterogeneity of tree communities;
Allowing temporal (as well as spatial) habitat heterogeneity;
Retaining dead standing and lying wood in forests and ensuring sufficient bare ground for cavity-nesting and ground-nesting bees;
regulating the grazing of domestic and wild ungulates in forests to minimize competition for floral resources between those ungulat
wild pollinators; and,
Rrestoring degraded forests, establishing tree species at densities sufficient to enable their effective pollination.

Management practices should help maintain key landscape components, such as specific species and habitat types, on which pollinators depend. This requires knowledge of existing pollinator presence and the habitat requirements of individual pollinator species.

• Maintaining sufficient forest areas in landscapes, and diverse understoreys, may be important measures for maintaining pollinator diversity.

Restoration efforts should take into account the nesting needs of bees and address the management and conservation of primary-forest remnants that are sources of habitat.

PASTOREO Y POLINIZADORES

Grazing (by both domestic and wild animals) can lead to changes in floral abundance, plant architecture and community composition and in soil characteristics such as compaction, with potential implications for pollinators.

In some cases, such changes may benefit pollinators by increasing the availability of floral resources, nesting materials and habitat but in other cases the opposite effect may occur.

There may also be competition for food resources when there is a diet overlap between pollinators and herbivores (Wojcik *et al.*, 2018).

DeBano *et al.* (2016), for example, reported a 55 percent overlap in the diets of ungulates (domestic cattle as well as elk and mule deer) and bees in riparian vegetation in Oregon.

Stressors such as drought that – combined with grazing – supress wildflower blooms may exacerbate impacts on pollinators by further reducing resource access (Wojcik *et al.*, 2018).

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