Book of Abstracts

III International young researchers Conference on Invasive Species

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III International young researchers Conference on Invasive Species

IyrCIS – 2023 Proceedings

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and organized by

the Institute of Botany of the Czech Academy of Sciences and

the Department of Plant Biology and Soil Sciences – Universidade de Vigo.

Edited by

Marta Pérez Diz | Noa Núñez González | Luís González | Berea Rodríguez Addesso

ISBN: 978-84-09-51676-6

CONTACTS

Email: iyrcis.conference@gmail.com

Website: http://iyrcis.webs.uvigo.es

Twitter: https://twitter.com/home

Youtube channel: https://www.youtube.com/@iyrcisconference

Discord: https://discord.gg/4K4pWeBK

WELCOME

It is a great pleasure to welcome you to the International young researchers Conference on Invasive Species (IyrCIS – 2023). This conference serves as a unique and free platform specifically designed to foster collaboration, innovation, and knowledge exchange among young researchers in the field of invasive species.

The world faces numerous challenges regarding invasive species and their impacts on ecosystems, biodiversity, and human societies. It is crucial that you, as young researchers, come together to address these challenges head-on, exploring novel ideas, sharing your findings, and developing effective strategies for the management and mitigation of invasive species.

Throughout this conference, we will be able to delve into diverse topics, from the ecological and economic impacts of invasive species to the latest advancements in monitoring, prevention, and control methods. We will also be privileged to hear four presentations by young experts who will share their valuable insights and experiences.

Let this conference be a catalyst for inspiration, collaboration and impactful research. Let us board on this exciting journey together to explore the intricate world of invasive species and chart a path towards a sustainable future.

We have curated an enjoyable social program to complement the academic program. You can embark on virtual excursions to the breathtaking locations of Galicia in the Northwest of Spain and explore the beauty of the Cathedral of Santiago (Santiago de Compostela – Galicia, Spain). Furthermore, we also recommend two concerts inspired by traditional Galician music, featuring renowned musician Carlos Núñez and the talented music band Tanxugueiras.

- Visit Galicia (link)
- Visit to the Cathedral of Santiago de Compostela (link)
- Concert by Carlos Núñez (link)
- Concert by Tanxugueiras (link)

We sincerely hope that you have a wonderful experience at IyrCIS 2023! This is an excellent opportunity to enhance our education and enrich our lives. Your participation and the dedicated efforts of the organizing and scientific committees have made this event a reality.

Luís González,

on behalf of the Scientific and Organizing committee.

BIENVENIDOS

Es un gran placer darles la bienvenida a la *International young researchers Conference on Invasive Species* (IyrCIS – 2023). Esta conferencia sirve como una plataforma única y gratuita diseñada específicamente para fomentar la colaboración, la innovación y el intercambio de conocimientos entre jóvenes investigadores en el campo de las especies invasoras.

El mundo enfrenta numerosos desafíos en cuanto a las especies invasoras y sus impactos en los ecosistemas, la biodiversidad y las sociedades humanas. Es crucial que ustedes, como jóvenes investigadores, se unan para abordar estos desafíos de frente, explorando ideas novedosas, compartiendo sus hallazgos y desarrollando estrategias efectivas para la gestión y mitigación de las especies invasoras.

A lo largo de esta conferencia, podremos adentrarnos en diversos temas, desde los impactos ecológicos y económicos de las especies invasoras hasta los últimos avances en métodos de monitoreo, prevención y control. También tendremos el privilegio de escuchar cuatro presentaciones de jóvenes expertos que compartirán sus valiosas ideas y experiencias.

Permitamos que esta conferencia sea un catalizador de inspiración, colaboración e investigación de impacto. Emprendamos juntos este emocionante viaje para explorar el intrincado mundo de las especies invasoras y trazar un camino hacia un futuro sostenible.

Hemos diseñado un agradable programa social para complementar el programa académico. Podrán disfrutar de excursiones virtuales a los impresionantes lugares de Galicia, en el noroeste de España, y explorar la belleza de la Catedral de Santiago (Santiago de Compostela, Galicia, España). Además, también os recomendamos dos conciertos inspirados en la música tradicional gallega, con la destacada participación del reconocido músico Carlos Núñez y el talentoso grupo musical Tanxugueiras.

• Visita a Galicia (link)

• Visita a la Catedral de Santiago (link)

• Concierto de Carlos Núñez (link)

• Concierto de Tanxugueiras (link)

¡Esperamos sinceramente que tengan una maravillosa experiencia en IyrCIS 2023! Esta es una excelente oportunidad para mejorar nuestra educación y enriquecer nuestras vidas. Su participación y los esfuerzos dedicados de los comités organizador y científico han hecho posible este evento.

Luís González,

en nombre del Comité Científico y Organizador.

BENVIDOS

É un gran pracer darlles a benvida á *International Young Research Conference on Invasive Species* (IyrCIS - 2023). Esta conferencia serve como unha plataforma única e de balde deseñada especificamente para fomentar a colaboración, a innovación e o intercambio de coñecementos entre mozos investigadores no campo das especies invasoras.

O mundo enfronta numerosos desafíos en canto ás especies invasoras e aos seus impactos nos ecosistemas, a biodiversidade e as sociedades humanas. É crucial que vós, como mozos investigadores, vos unades para abordar estes desafíos de fronte, explorando ideas novidosas, compartindo os vosos achados e desenvolvendo estratexias efectivas para a xestión e mitigación das especies invasoras.

A través desta conferencia, poderemos mergullarnos en diversos temas, dende os impactos ecolóxicos e económicos das especies invasoras ata os últimos avances en métodos de monitorización, prevención e control. Tamén teremos o privilexio de escoitar catro presentacións de mozos e mozas expertas que compartirán as súas valiosas ideas e experiencias.

Permitamos que esta conferencia sexa un catalizador de inspiración, colaboración e investigación de impacto. Emprendamos xuntos esta emocionante viaxe para explorar o intrincado mundo das especies invasoras e trazar un camiño cara a un futuro sostible.

Deseñamos un programa social agradable para complementar o programa académico. Poderedes gozar de excursións virtuais aos impresionantes lugares de Galicia, no noroeste de España, e explorar a beleza da Catedral de Santiago (Santiago de Compostela, Galicia, España). Ademais, tamén vos recomendamos dous concertos inspirados na música tradicional galega, coa destacada participación do recoñecido músico Carlos Núñez e do talentoso grupo musical Tanxugueiras.

• Visita a Galicia (link)

• Visita á Catedral de Santiago (link)

• Concerto de Carlos Núñez (link)

• Concerto de Tanxugueiras (link)

Esperamos sinceramente que teñas unha marabillosa experiencia en IyrCIS 2023! Esta é unha excelente oportunidade para mellorar a nosa educación e enriquecer as nosas vidas. A túa participación e os esforzos dedicados dos comités organizador e científico fixeron posible este evento.

Luís González,

en nome do Comité Científico e Organizador.

Content – Contenido – Contido

Keynotes

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Plenarias

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Relatorios

Addressing invasive alien species and their impacts: the role of IUCN

Ana L. Nunes [1]

[1] Biodiversity Assessment and Knowledge Team, Science and Data Centre, International Union for Conservation of Nature (IUCN), Cambridge, UK
ana.nunes@iucn.org

Abstract: The International Union for Conservation of Nature (IUCN), together with the IUCN Invasive Species Specialist Group, has been producing extensive resources on invasive alien species (IAS) and developing tools to increase awareness and promote exchange of information worldwide, with the aim to reduce IAS threats to ecosystems. One of IUCN's current core activities on IAS consists in providing technical and scientific support to the European Commission for the implementation of EU Regulation 1143/2014 on the prevention and management of the introduction and spread of invasive alien species. Through this work, and with the support of a large network of scientific experts, IUCN has produced several freely available technical documents and decision-making support tools to assist National Authorities, researchers, environmental managers and conservation practitioners to obtain up to date information on IAS in order to more effectively identify, prevent and manage IAS across the EU. Additionally, IUCN has adopted a Standard which categorises the magnitude of impacts of alien species on the environment, the Environmental Impact Classification for Alien Taxa (EICAT). Possible EICAT uses consist in comparing the level of impact of alien taxa among regions and taxonomic groups, alerting relevant stakeholders to the possible consequences of the arrival of certain alien taxa, and assisting in the prioritisation of management actions. In this presentation, I will provide an overview of IUCN's work on IAS, both focusing on the wealth of resources produced for the European Commission throughout the years, as well as providing more detailed information about EICAT.

Keywords: EU IAS Regulation, EICAT, IAS of Union concern, policy support

Assessment of plant invasion status and prioritization at the ecoregion level

Adrián Lázaro-Lobo[1], Borja Jiménez-Alfaro[1]

[1] Biodiversity Research Institute IMIB (Univ. Oviedo - CSIC - Princ. Asturias), Mieres, Spain
adrianlalobo@gmail.com, jimenezalfaro@uniovi.es

Abstract: Understanding the invasion status of alien species in a territory and identifying priority species for management is pivotal to deal with biological invasions and the conservation of natural and semi-natural habitats. Despite significant progress in producing lists of invasive alien species for individual countries or continents, a standard methodology for the assessment of invasive alien species at the ecoregion level is lacking in the literature. Ecoregions refer to biogeographically homogeneous environmental units and provide a holistic framework for integrating research and management activities across large geographical areas. We present a systematic method that can be used to determine invasion status of invasive plant species and identify priority species for management within ecoregions. We applied the method to the Cantabrian mixed forest ecoregion, a biogeographical area highly affected by plant invasions, including the north-western parts of Spain and Portugal. We combine published data with expert knowledge to 1) create a comprehensive and updated list of invasive plant species for the ecoregion, 2) provide information on invasion status of each invasive species, 3) identify priority species based on their range size, local abundance, and environmental and socio-economic impacts, 4) detect the type of invaded habitats, and 5) make all the data open access for researchers and practitioners. The resulting information will help to delineate the biological impact of plant invasions at the biogeographical scale, setting a common framework for collaborative management and conservation beyond administrative boundaries.

Keywords: alien plants, Cantabrian mixed forest ecoregion, invasion status, management, priority species

Invasive alien plants in Mediterranean ecosystems: from ecology to management

Lorenzo Lazzaro [1]

[1] Department of Biology, University of Florence, via G. La Pira 4, I-50121 Florence, Italy
lorenzo.lazzaro@unifi.it

Abstract: Biological invasions represent one of major threats to biodiversity, inducing multiple environmental effects that change community composition, biotic interactions, and other ecosystem processes. Indeed, the study of the effects of invasive alien plants (IAPs) throughout a composite approach, including investigations on the effects on soil fauna and microbes and belowground processes revealed multi-level impacts. Particularly, the nitrogen-fixing tree *Acacia dealbata* invasion directly impacts the quantitative and qualitative properties of soils, soil microbial communities and understory plant communities of a typical Mediterranean sclerophyllous shrubland (Lazzaro et al. 2014). Another nitrogen-fixing tree, *Robinia pseudoacacia,* exerts similar impacts posing a severe threat to ecosystems, decreasing local biodiversity of microarthropods, nematodes and plant communities, as shown in areas where it becomes a dominant species, replacing nutrient-poor oak forests, which are habitats considered worthy of conservation in Europe (Lazzaro et al. 2018). Further evidence on the ecological impacts of these invasive nitrogen-fixing trees in Italy in a number of habitat types, showed variable effects on several biodiversity indices, including patterns of changes in the soil horizon stratification, mostly due to the altered condition of litter accumulation and degradation (Lazzaro et al. 2022). Managing IAPs is an important modern challenge for nature conservation. We'll finally see the main results from the control of *Carpobrotus* spp. conducted within the EU LIFE project RESTO CON LIFE, on the island of Giannutri (Lazzaro et al. 2023). The control has been implemented through the integration of two techniques of removal: manual removal and covering with mulching sheets. A similar approach has been undertaken to control *Carpobrotus* spp. within the LIFE project LETSGO GIGLIO. We will see the phases of mapping of *Carpobrotus* spp., planning and development of the executive project for the control actions, with clear impacts highlighted by the before-intervention monitoring (Mugnai et al. 2022).

Keywords: biodiversity, community ecology, conservation, Mediterranean islands, nitrogen-fixing tree

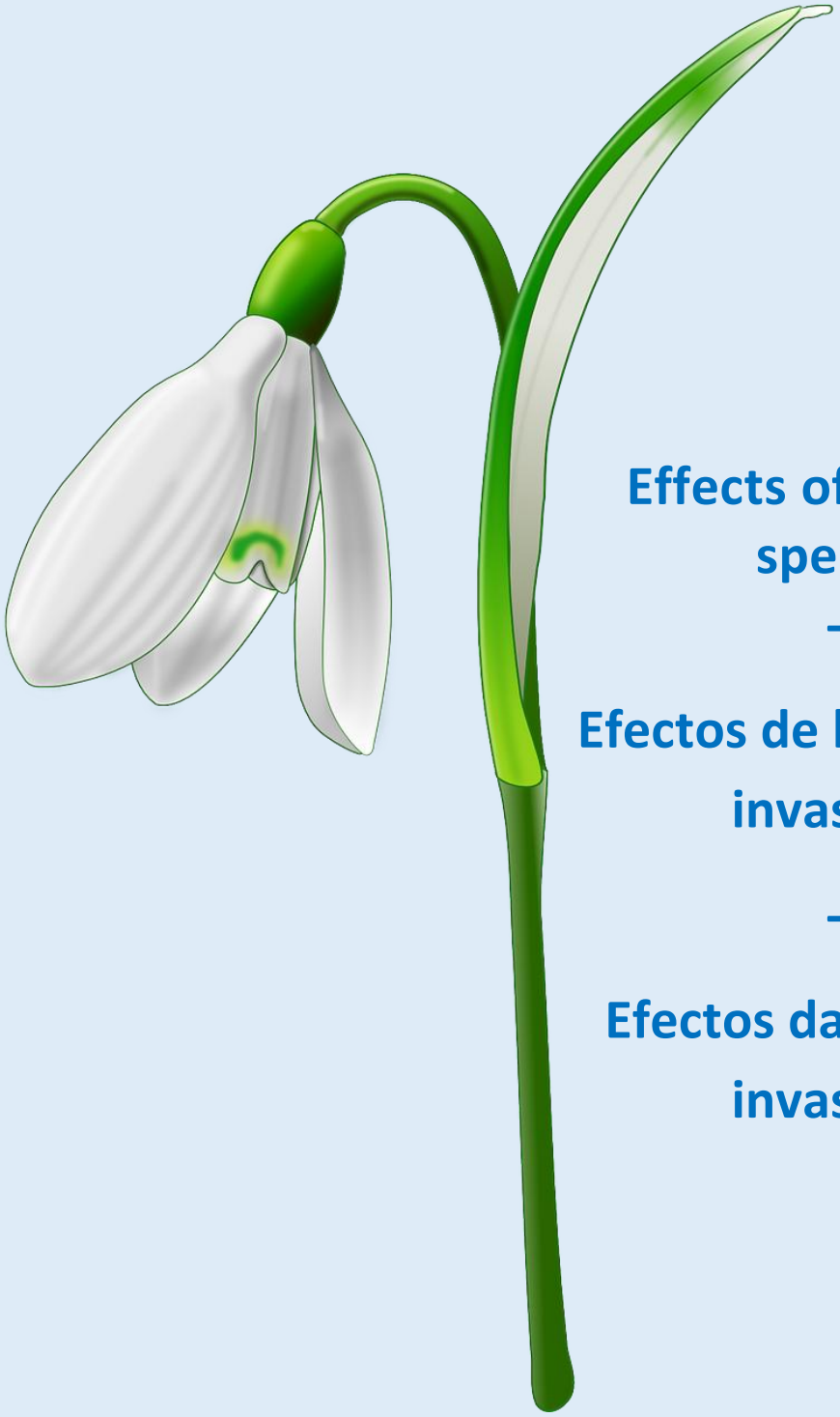
Invasive species in the Anthropocene: insights from plant populations dynamics

María Loreto Castillo [1]

[1] Institute of Botany, Czech Academy of Sciences. Zámek 1, 252 43 Průhonice, Czech Republic
mloretocastillo@gmail.com

Abstract: During the Anthropocene, the interest of using certain plant species have led to their intentional movement at global scale. In many cases, these introductions have led to the invasive spread of individuals. The success of invasive populations is shaped by factors related with different stages of invasion that can have important evolutionary consequences. These factors include the evolutionary history in the native range, stochastics events, artificial human selection, hybridisation between co-introduced congeners, polyploidy and post-introduced process, such as rapid evolution (Keller & Tailor, 2008; Castillo et al., 2021b; Le Roux, 2021). In addition, the uncertain taxonomic classification of many introduced species makes difficult to achieve accurate inferences about global introduction histories, identify new incursions, prevent or reduce the spread of new invaders and implement management option as biocontrol (Pyšek et al., 2013; Castillo et al., 2021a). Here, I give some examples of how molecular analyses have provided valuable insight into these issues, enhancing our understanding of plant population invasiveness, with a special emphasis on Eastern African invasions.

Keywords: eco-evolutionary dynamics, invasion genetics, plant invasions



Effects of invasive species

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Efectos de las especies invasoras

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Efectos das especies invasoras

Mapping the potential cumulative impact of invasive alien species on mountain systems from different biogeographic regions of the world

Joan Rabassa-Juvanteny [1], Bernat Claramunt-López [2]

[1, 2] CREAF (Center for Ecological Research and Forestry Applications), Bellaterra (Cerdanyola del Vallès), Catalonia

[2] Department of Animal Biology, Vegetal Biology and Ecology (Faculty of Biosciences), Bellaterra (Cerdanyola del Vallès), Catalonia

j.rabassa@creaf.uab.cat, bernat@creaf.uab.cat

Abstract: Research on invasive alien species has intensified in recent decades (Seebens et al., 2017; Turbelin et al., 2017; Pyšek et al., 2020). However, there is still a long way to go to understand their cumulative impact on mountain ecosystems. The purpose of this study was to assess and map the potential cumulative impact of invasive plant and animal species in mountainous regions worldwide. For this reason, we extracted data from scientific literature on the ecological impacts of invasive alien species in mountain ecosystems. We then estimated potential impact weights, using the magnitude of the reported ecological impacts and considering the strength of the supporting evidence (Katsanevakis et al., 2016). The mountains of the world were then grouped into broader mountain ranges, following Grêt-Regamey & Weibel (2020), and a matrix of potential impacts was created, in which the potential impact weights of each species were assigned to their corresponding habitats and mountain ranges. To apply the conservative additive model developed by Katsanevakis et al. (2016), we utilized (a) properly filtered GBIF presence data, (b) a standardized land cover raster (Latham et al., 2014), (c) the matrix of potential impacts, and (d) a grid layer with cells of 0.09x0.09 geographic degrees. The resulting maps show spatial heterogeneity in potential cumulative impact values, but several hotspots can be identified, especially in the Alps, the French Massif Central, the Appalachian Mountains, the Rocky Mountains, Taiwan, the Cape Ranges, the Great Dividing Ranges, and the Southern Alps. These findings underscore the critical threat posed by invasive alien species to mountain systems worldwide (Sala et al., 2000; Turbelin et al., 2017; Siniscalco & Barni, 2018).

Keywords: biological invasions, invasive alien species, mountain systems, potential cumulative impact, GIS

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Legacy effect of *Leucanthemum vulgare* on native soil seedbank: an experimental approach

Lone, S. [1], Ahmed, R. [1], Rashid, I. [2], Rasray, B. [1], Khuroo, A. [1]

[1] Centre for Biodiversity and Taxonomy, Department of Botany, University of Kashmir, Srinagar, India
[2] Biological Invasion Research Laboratory, Department of Botany, University of Kashmir, Srinagar, India
loneshowkeen@gmail.com, rameezkhuroo929@gmail.com, haiderbilal7006@gmail.com, anzarak@uok.edu.in, ecoirfan@yahoo.co.in

Abstract: For effective invasive plant management and restoration of the invaded ecosystems, understanding the legacy effects of plant invasions on recipient plant communities requires a thorough knowledge of changes occurring both on the aboveground vegetation and the belowground soil seed bank. The soil seed bank plays a major role in regulating the type of plant species that generally emerge following the removal of a plant invader and is therefore important to predict future community dynamics and the success of a restoration effort. Despite this, little is known about the impact of plant invasion on soil seed banks and the changes occurring following invasive plant removal. The present study using greenhouse germination trials aims to compare and quantify the seed bank from the soils collected from four sampling sites selected along an elevational gradient in the Kashmir Himalaya under three treatments or plots: (1) invaded plots with invasive *Leucanthemum vulgare* present and covering more than 50% area (2) removal plots with *L. vulgare* initially present but manually removed by ground clipping (3) spatially separated uninvaded or control plots within the vicinity with no history of *L. vulgare* invasion. Our study showed that the diversity of soil seed banks was relatively higher in the case of uninvaded plots, followed by removal and invaded plots for most of the sites. Furthermore, the composition of the soil seed bank community differed significantly between the three treatment plots, with uninvaded plots exhibiting a wide range of species pools among them. Overall, the findings of our study highlight that the soil seed bank of removal treatment plots showed a considerable difference from the seed bank of invaded treatments, with clear management implications.

Keywords: Kashmir Himalaya, legacy effect, *Leucanthemum vulgare*, plant invasion, seed bank

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How are pollination networks affected by an invasive plant? A case study with *Carpobrotus acinaciformis* and bees

Luiz Felipe Cordeiro Serigheli [1], Sofia Gabriele Marafon Bacca [2], Michele de Sá Dechoum [1]

[1] Programa de pós-graduação em Ecología, Universidade Federal de Santa Catarina, Florianópolis, Brazil

[2] Graduação Ciências Biológicas, Universidade Federal de Santa Catarina, Florianópolis, Brazil

luiz_serigheli@hotmail.com, sgmbacca@gmail.com, mdechoum@gmail.com

Abstract: Invasive non-native plants can cause changes in ecological interactions that can be represented as networks. *Carpobrotus acinaciformis* (Aizoaceae) is native to South Africa and invasive in several countries, including the southern coast of Brazil where it has been quickly spreading on frontal dunes. *Carpobrotus acinaciformis* provides abundant food resources for pollinators such as bees and beetles. This study aims to analyse the effects of the invasion by *C. acinaciformis* on pollination networks composed by bees. Between October 2021 and January 2022, active search and collection of bees were carried out in flowers of plants in two different sites (1,000m² each, 500 x 20m): an area with *C. acinaciformis* (Area A) and an area without (Area B). Sampling effort was approximately 100 h, 50 h for each area. Bees were collected for further identification to the lowest taxonomic level possible by experts. Abundance matrices (plants x bees) were built for comparison of nesting, connectance and modularity of the two networks (with and without the invader). Null models were generated to check if the results found were not random. We sampled 921 bees distributed in 26 morphotypes; 29 plant species were visited. Area A showed higher value for nesting and lower values for connectance and modularity in comparison to Area B, all values compared were significant. Thus, the area invaded by *C. acinaciformis* is more nested and with less connectance and modularity when compared to the area without the invader, pointing out the impacts that the invader generates in pollination networks, reducing its diversity and interactions.

Keywords: invasive species, pollinator, impact, coastal ecosystems, ecological network

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Scarification and allelochemical interaction between invasive fabaceans and the native fabacean *Vachellia caven* (Molina): scientific evidence to predict potential cohabitation scenarios

Vianca Fernández [1], Narciso Aguilera [1], Lubia Guedes [1]

[1] Laboratorio de Semioquímica Aplicada, Universidad de Concepción, Concepción, Chile

viankiss2015@gmail.com, naguileramarin@gmail.com, lubiamariaguedesg@gmail.com

Abstract: The Fabaceae family is considered one of the ones that include the largest number of invasive species, most of which originate from Australia. Plants use many strategies to ensure their survival. Some of these strategies involve the producing and releasing of compounds with high bioactivity. The study of the secondary metabolism of plants reveals that they produce various substances that perform physiological functions; they also allow intra- and interspecific interaction, which influences the cohabitation of populations and communities. These chemical substances called allelochemicals contribute to the adaptation of species and defense of many plant species against edaphoclimatic and biotic factors. In the present study, a scarification method was validated for the seeds of the native Fabaceae *Vachellia caven*; Species that grows naturally in the central zone of Chile. Subsequently, the phytotoxic effects induced by the invasive Fabaceae *Acacia dealbata*, *Teline monspessulana* and *Ulex europaeus* on the germination and initial growth of *V. caven* were determined. For this, an *in vitro* test was carried out with the seeds of the native species to evaluate the germinative dynamics and morphometric variables. In the same way, he developed an experiment in native and invaded soil, irrigating with different aqueous extracts from the invasive species, evaluating morphometric variables, as well as dry mass and content of photosynthetic pigments. The results indicated that scarification with sulfuric acid stimulated seed germination to values higher than 80%. Under *in vitro* conditions and the combination of substrates caused inhibition in the growth of *V. caven* plants. This study offers unpublished and relevant scientific information, which allows estimating the response that *V. caven* will have if its habitat is colonized by some of these invasive fabaceae.

Keywords: allelochemicals, fabaceae, biological invasions

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Invasive alien plants species (IAPs) and urban flora of Pokhara, Nepal

Ashish Poudel [1], Babulal Tiruwa [2]

[1] Institute of Forestry, Pokhara Campus P.O. Box 43, Hariyokharka, Pokhara, Nepal

[2] National Trust for Nature Conservation, P.O. Box 3712, Khumaltar, Lalitpur, Nepal

apoudel73@iofpc.edu.np, babulaltiruwa@gmail.com

Abstract: Urban ecosystem often serves as befitting suitable microhabitat for IAPs and the increased incidence of invasion around the world poses a major threat to native biodiversity in urban settings too. So, this study aims to find out diversity of IAPs and their impact on urban ecosystem of Pokhara Valley. For this work, urban ecosystem was divided into 4 different land categories based on characteristics and uses. 80 sample plots; 20 in each land category were randomly laid across the study area for the vegetation survey. Different variables like coverage, frequency, and density were measured in the field, and ecological parameters such as Margalef's index of richness (R'), Shannon-Weiner's diversity index (H'), and Pielou's Evenness Index (e') were calculated, additionally factor governing IAPs and its impacts were analyzed using linear regression. This study reported 19 species of IAPs belonging to 10 families, updating the checklist of invasive alien flora found in Pokhara Valley. Likewise, urban wetland category had the highest IAPs diversity (with H'= 2.31, R'= 2.84, e'= 0.55) while urban forest category had the least diversity. Additionally, the species richness of naturalized plant species was found to govern the invasion of IAPs with strong correlation and significant relationship ($r = 0.567$, $p < 0.001$). Moreover, species richness of native plants was found to be negatively affected by coverage of IAPS ($r = -0.130$, $p < 0.05$). Considering the results, this study recommends the utilization of combined control methods for widespread IAPs and containment and eradication of IAPs, which are in the early stage of invasion.

Keywords: urban ecosystem, invasive species, diversity indices, Nepal

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Impacts of an invasive fish species in Neotropical reservoirs

Aymar Orlandi Neto [1]

[1] São Paulo State University, Botucatu, Brazil
orlandi.aymar@gmail.com

Abstract: Alien or non-native species are defined as species living outside their natural distributional ranges (Gou & Ricklefs, 2010). In Neotropical reservoirs there are important knowledge gaps about the effects of invasions by non-native species, such as Acará/Porquinho (vernacular name of *Geophagus sveni*). Popular as aquarium fish, this cichlid is native from Amazon basin and have been introduced in several reservoirs in southeast Brazil, outside of their natural range. We tested the hypothesis that its invasion altered the structure of fish assemblages in Upper Paraná River reservoirs. We sampled the freshwater fish fauna in four southeast Brazil reservoirs over 15 years. We calculated and correlated the composition and taxonomic, functional and phylogenetic indices to the *G. sveni* abundance. There were no significant correlations between the indices and the *G. sveni* abundance. However, two common species (*G. brasiliensis* (native) and *Satonoperca pappaterra* (non-native)) were negatively correlated to the abundance of this invasive. Also, the Acará became dominant in most reservoir and explained ~3% of the variation of the fish fauna composition. Our results demonstrated that the Acará was successful in the invasion process at the basin and influenced the fish assemblages probably by competition mechanisms. For example, species phylogenetic and functional nearest related can lead to resource partitioning and overlapping in life history characteristics (Olden et al., 2006) which could explain the negative effect of *G. sveni* on *S. pappaterra* and *G. brasiliensis*. Also, this species is described as a small/medium fish, a bottom feeder with high plasticity range (trophic opportunism, adaptability and tolerance) and aggressive, which favoured its competition, dispersion and colonization in new environments, and consequently its invasion (Gois et al. 2015). These findings provide evidence that invasive *G. sveni* impact populations of native and non-native fishes in the southeast Brazil. Furthermore, it is evident the importance and need for long-term assessment to understand the process and dynamics of the invasion and its effect on the community.

Keywords: non-native, invasive, community ecology, impacts, Brazil

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Impact of *Prunus serotina* and *Robinia pseudoacacia* on temperate forests regeneration

Sebastian Bury [1], Marcin K. Dyderski [1]

[1] Department of Ecology, Institute of Dendrology of the Polish Academy of Sciences, Kórnik, Poland
sbury@man.poznan.pl, mdyderski@man.poznan.pl

Abstract: *Prunus serotina* and *Robinia pseudoacacia* are very common invasive tree species in Poland (Dyderski & Jagodziński, 2020). These species differ in biology and ecology, especially in nitrogen-fixing strategy (Rice et al. 2004; Aerts et al. 2017). Within the project "The impact of invasive tree species on ecosystem services: plants biodiversity, carbon and nitrogen cycling and climate regulation" funded by the National Science Centre (2019/35/B/NZ8/01381), we comprehensively study the impact of that two exotic trees on local forests, in particular forest ability to self-regeneration. The negative impact of their presence in native ecosystems is associated with biodiversity loss (Godefroid et al. 2005; Wohlgemuth et al. 2022). There are a lot of places in western and central Europe, where mentioned species hinder the natural and artificial regeneration of native tree and shrub species (Dyderski & Jagodziński, 2020). This forces the removal of disturbing individuals before or during regeneration, contributing to economic losses. Within 72 circular (500 m^2) plots in managed forests in Western Poland, varying in type of habitat (fertile and poor-nutrient), stand dominants (pine or oak), and age (medium and old) we assessed the effects of invader quantity (biomass) on natural regeneration. We hypothesize that invasive tree species will limit the regeneration of native tree species while studied neophytes will benefit from habitat transformation by alien species. According to the concept of invasional meltdown, invasive species can create favorable conditions for each other. This may intensify their negative impact on ecosystems. This interaction may concern, for example, a change in the chemical composition of the soil as a result of the presence of a given neophyte, which may favor other plants of foreign origin (Simberloff & Holle, 1999). We also assume that stand characteristics will also provide context-dependent responses of tree regeneration patterns (Halarewicz, 2011; Catford et al. 2022).

Keywords: exotic trees, *per capita* effect, context-dependent, biodiversity loss, invasional meltdown

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Effects of *Carpobrotus edulis* in the germination of native plant species

Miguel Alonso [1], Marta Pérez-Diz [1], Noa Núñez-González [1], Luís González [1]

[1] Department of Plant Biology and Soil Sciences, Faculty of Biology, Universidade de Vigo, 36310, Vigo, Spain

miguelalonsomendez2001@gmail.com, marta.perez.diz@uvigo.gal, noanunhez@gmail.com, luis@uvigo.gal

Abstract: *Carpobrotus edulis* (L.) N.E.Br. is an invasive species widely installed in the dune systems of the Atlantic coast, with many negative effects reported on native ecosystems. *C. edulis* has been shown to modify the soil structure, biotic interactions and physicochemical properties (Novoa et al. 2012; Vieites & González, 2018; Novoa et al. 2020; Rodríguez et al. 2020; Souza-Alonso et al. 2022). The release of organic material or chemicals in a sensitive ecosystem, such as coastal dunes, can drive allelopathic interactions with native vegetation (Novoa et al. 2012), impairing its establishment, altering their germination, distribution, and growth, even after the death of the invasive species (Campoy et al. 2018). Despite the above studies, the depth of the coastal dune is affected is unknown. This knowledge would have important implications for the dune restoration process. Therefore, this work aims to quantify the effect of soil transformation by *C. edulis* on the germination and growth of native species. For this purpose, dune sand was collected from three beaches on the Atlantic coast of the Iberian Peninsula: Rons (Spain), Moledo, and Forte do Cão (Portugal). In each, samples were obtained from the invaded dune and from the non-invaded dune at different depths: 0-10 cm and 10-20 cm. Germination of native species of the Atlantic dunes: *Malcolmia littorea*, *Cakile maritima*, *Plantago lanceolata, Scabiosa atropurpurea* and *Scolymus hispanicus*, was tested on Petri dishes with the different sand samples. Petri dishes were incubated in a germination chamber under suitable thermal, photoperiod, and water conditions. The ten replicates of all dishes of the same species were also checked for homogeneity under these conditions. A soil effect on the measured parameters has been shown to be dependent on the species tested and the soil depth.

Keywords: *Carpobrotus edulis*, allelopathic interactions, native plants

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Invasion process

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Proceso de invasión

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Proceso de invasión

Genetic structure of the invasive *Spartina alterniflora* and *Spartina anglica* and their unintentional introduction into South Korean coasts

Buhari Lawan Muhammad [1], Jang-Seu Ki [1]

[1] Department of Biotechnology, Sangmyung University, Seoul 03016, South Korea

buharilawan20@gmail.com, kijs@smu.ac.kr

Abstract: Marine aquatic plants pose serious threats to local biodiversity and ecosystem functions. For example, *Spartina alterniflora* and its allopolyploid hybrid, *Spartina anglica,* are aggressive alien aquatic plants that have invaded several salt marsh zones worldwide, causing detrimental ecological impacts. *Spartina alterniflora* Loisel. (Poaceae) is a smooth cordgrass native to the northeastern United States, while *Spartina anglica* arose in the late nineteenth century in southern England as a result of interspecific hybridization between the native *Spartina maritima* Fernald and the introduced *S. alterniflora.* The sterile F1 hybrid *Spartina* x *townsendii* gave rise to the new fertile allopolyploid species *S. anglica* after chromosome doubling. *S. alterniflora* and *S. anglica* were intentionally introduced into China for land reclamation; however, they have expanded rapidly and invaded other East Asian countries such as Taiwan, Japan, and South Korea. In South Korea, the species was first recorded in 2012, and since then, it has spread rapidly and devastated Korea's native ecosystems. However, to date, the molecular status, genetic structure, and introduction pathway of this species in Korea remain unknown. Information on the origin and invasion history of each invasive species is essential for preventing its further spread. In the present study, we used chloroplast DNA (cpDNA; *rps16* intron and *trnT-trnF*) to investigate the genetic structure and the introduction pathway of these invasive species on Korean coasts. Our results showed that the populations of these two species in Korea were differentiated based on geographical locations. *S. anglica* populations constituted only one haplotype, whereas *S. alterniflora* populations were highly differentiated based on geographic location and distinctly divided into two (C1 and C4) haplotypes, respectively. C4 haplotype was the only haplotype found in Japan and Taiwan and the most dominant in China. Our findings suggest that *S. anglica* and *S. alterniflora* might have been independently and introduced into Korean coasts multiple times from China, possibly through ocean currents or trade and transport. Therefore, it is essential to strengthen reliable detection and monitoring systems for *Spartina* introductions and other marine invaders. Moreover, it is important to continue monitoring areas where the *Spartina* species have already invaded to minimize their impacts in other regions.

Keywords: aquatic invasion, East Asian coasts, population genetics, *Spartina*

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Accidental biocontrol: human-mediated dispersal of insect parasitoids and predators

Gyda Fenn-Moltu [1], Andrew M. Liebhold [2,3], Donald C. Weber [4], Cleo Bertelsmeier [1]

[1] Department of Ecology and Evolution, University of Lausanne, Switzerland

[2] USDA Forest Service Northern Research Station, Morgantown, USA

[3] Faculty of Forestry and Wood Sciences, Czech University of Life Sciences Prague, Czech Republic

[4] USDA Agricultural Research Service, Maryland, USA

gyda.fenn-moltu@unil.ch, cleo.bertelsmeier@unil.ch, aliebhold@gmail.com, don.weber@usda.gov

Abstract: Globalization of human activities has increasingly facilitated the spread of non-native species. Insects are among the most numerous and damaging non-natives, causing widespread impacts on biodiversity, agriculture, and human health. The options to manage insect invasions include classical biological control, where species 'natural enemies' are introduced from their native range to control their population. Current selection processes for such biocontrol agents are rigorous, and generally based on host-specificity. However, parasitoid, and predatory species are also increasingly being introduced accidentally through human-mediated dispersal. These random introductions may favour generalists that establish more easily due to their broad host range, with considerable impacts for both non-native and native species. We used a large dataset of border interception records in the United States of America from 1913 to 2019 to assess the human-mediated transport of parasitoid and predatory insects. 94 families of 'natural enemies' were detected, and 175 species were identified. The insects largely arrived with various plant products, but introduction pathways differed between insect groups. Most of the species detected are generalists and are likely to have suitable prey or host species available on arrival. Several species that are not currently established in the USA have hosts or prey already established there, or also being detected at the border. Furthermore, ten of the 'natural enemy' species arriving in the USA are listed as invasive – spreading widely and causing negative impacts. The extensive transport of 'accidental biocontrol' insects stands in contrast to the rigorous and protracted processes for classical biological control. The insects detected at the US border could have significant ecological impacts, both positive and negative, if they eventually become established.

Keywords: insects, biocontrol, introductions, predators, parasitoids

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Wisdom of the crowd: evidence for density-dependent species fitness in *Hyptis suaveolens* (L.) Poit.

Kanhaiya Shah [1], Gyan Prakash Sharma [1]

[1] Department of Environmental Studies, University of Delhi, Delhi–110 007, India

kanhaiyashah111@gmail.com, gyanprakashsharma@gmail.com

Abstract: Biological invasions have been reported as one of the worst ecological threats (Richardson et al. 2011) and species' introductions are still increasing worldwide (Seebens et al. 2017). Once a novel species is introduced to natural areas, its spatial expansion depends on species' functional traits and population dynamics (Morel-Journel et al. 2016). Population size and density are important determinants of invasion success that can be estimated in terms of plant functional traits (PFTs) (Funk et al. 2016). However, inadequate information is available on how conspecific density affects PFTs and thereby species fitness. *Hyptis suaveolens* (L.) Poit. (Lamiaceae) is a native annual herb of tropical America. It is a major invader of disturbed area and wastelands across tropical regions (Sharma et al. 2009). A field study was conducted in *H. suaveolens* dominated degraded scrubland of Doon valley, Dehradun, India. It was observed that *H. suaveolens* exist in heterogeneous patch sizes. Different sizes of monospecific patches were identified, and population densities were estimated. Based on the sizes, these patches were classified into *small* (~4 m^2), *midsize* (~25 m^2), and *large* (>100 m^2). Interestingly, it was observed that *small, midsize,* and *large* patches were exhibiting low, medium, and high plant population densities, respectively. To assess the effects of population density on species fitness- vegetative and reproductive traits were estimated. Vegetative traits showed higher values for medium density. Contrastingly, plant individuals exhibited enhanced reproductive performance for high density. Results revealed population density based trait modulation ability of *H. suaveolens* potentially facilitates colonization and spread in heterogeneous patches of varying sizes. The current study calls for future investigations to understand how population density may affect *H. suaveolens*'s fitness and subsequently its colonization ability. The study also emphasizes that invasive species management plans must take into account the density-dependent facilitation of naturalizing populations.

Keywords: density-dependent, invasive species, species fitness, plant functional traits, trait modulation ability

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Exotic and invasive species of ships, harbours and marinas from the Cantabrian Sea

Ricardo López-Alonso [1], Esteban Pascual-Parra [1], Claudia González-Toral [2], Iris Carrera-Rodríguez [3], Sergio Villoria-Calvo [1], Natalia Vigil-Robles [1], Adriana Vaquero-Llera [1], Deva Menéndez-Teleña [3], Verónica Soto-López [3], Alejandro Fernández-Cudeiro [3], Jesús Ángel García-Maza [3], Candela Cuesta [4,5], Eduardo Cires [2,6], Andrés Arias [1]

[1] Department of Organisms and Systems Biology (Zoology), University of Oviedo, Oviedo 33071, Spain

2 Department of Organisms and Systems Biology (Botany), University of Oviedo, Oviedo 33071, Spain

3 Department of Nautical Science and Technology, University of Oviedo, Gijón 33203, Spain

4 Polytechnic School of Mieres, Mieres, Spain

5 Department of Organisms and Systems Biology (Plant Physiology), University of Oviedo, Oviedo 33071, Spain

6 Institute of Natural Resources and Territorial Planning (INDUROT), Mieres, Spain

UO250719@uniovi.es, UO265774@uniovi, UO270375@uniovi.es, UO273265@uniovi.es, UO296476@uniovi.es, ariasandres@uniovi.es, gonzaleztclaudia@uniovi.es, cireseduardo@uniovi.es, UO240328@uniovi.es, menendezdeva@uniovi.es, sotoveronica@uniovi.es, UO218306@uniovi.es, maza@uniovi.es, cuestacandela@uniovi.es

Abstract: Marine traffic (shipping) is one of the main introduction gates of exotic and invasive species worldwide (Sellheim et al., 2010; Pejovic et al., 2016). Thus, ships, ports/harbours and marinas constitute locations that are the object of study of the succession processes of the bioinvasions and other biological and ecological issues of exotic species (Fernández-Rodríguez et al., 2022). In the present work we analyse the different fouling fauna of three small ports and one commercial port. Also, we analyse the animal diversity that live attached to the ships, by collecting samples *in situ* on ships hulls. The preliminary results of the data collected from November 2022 to February 2023 revealed a total of 181 species in the studied ports, among them the invasive species represented the 7 % of the total with 14 species. Bryozoa and Chordata Phyla showed the highest number of invasive species, with five species in each Phylum, followed by Arthropoda, with two species, and the Mollusca and Nemertea Phyla, with one species each. Regarding the species on ships hulls, a total of 52 species were identified, being nine of them invasive (17%). Bryozoans appeared again as the Phyla with the highest number of exotics, followed by the arthropods and the tunicates, with two species in each Phyla.

Keywords: taxonomy, cryptogenic species, invasive species

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The non-native flora of Budapest (Hungary)

Attila Rigó [1,2], Ákos Malatinszky [3], Zoltán Barina [4]

[1] Doctoral School of Environmental Sciences, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary

[2] Institute of Ecology and Botany, Centre for Ecological Research, Vácrátót, Hungary

[3] Department of Nature Conservation and Landscape Management, Institute of Wildlife Management and Nature Conservation, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary

[4] H-1095 Budapest, Ipar utca 3., Hungary

rigo.attila@ecolres.hu, malatinszky.akos@uni-mate.hu, quercusbz@gmail.com

Abstract: Biological invasions are among the greatest challenges for nature conservation (Early et al., 2016). Cities can often be the starting point for plant invasions due to heavy traffic, the Urban Heat Island effect, and the presence of propagules of various non-native plants in large quantities (Padayachee et al., 2017). The research was carried out with street-level mapping in the urban habitats of Budapest (Hungary) between 2018 and 2022, where a complete species list was prepared for each different habitat on each street section visited (Rigó & Barina, 2020). So far, 1144 vascular plant species have been found in Budapest, of which 341 are non-native. Most of the non-native species are only casual adventives (e.g., *Talinum paniculatum*, *Lepidium didymum*). A smaller part of the species is recently spreading or is already widespread in Budapest and can be considered naturalised, but currently, they do not appear to be dangerous for the natural ecosystems (e.g., *Euphorbia serpens*, *Polycarpon tetraphyllum*). Some species were unknown in the area of Budapest until now, but there are large populations in several parts of the city. These species can be a threat to natural ecosystems (e.g., *Erigeron sumatrensis*). Finally, numerous nationally widespread and problematic invasive plants are also common in Budapest (e.g., *Ailanthus altissima*, *Erigeron canadensis*). Regarding the urban habitats of occurrences, the ratio of alien species is highest in urban hedges and flower beds, but the absolute number of alien species is highest in cracks and roadsides. Walls and are the most resistant urban habitats to alien species. The role of the urban road network in the spread of invasive species is well known (von der Lippe et al., 2005), while cracks often play an important role in the first establishment of some species.

Keywords: plant invasion, urban flora, casual aliens, introduction

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Black locust invasions facilitate invasions by its insect herbivores

Vladimír Medzihorský [1], Jiří Trombik [1], Richard Mally [1], Marek Turčáni [1], Michaela Skřivanová [1], Andrew M. Liebhold [1,2]

[1] Faculty of Forestry and Wood Sciences, Czech University of Life Sciences Prague, CZ 165 21 Praha 6-Suchdol, Czech Republic

[2] USDA Forest Service Northern Research Station, Morgantown, WV 26505, USA

medzihorsky.vladimir@gmail.com, jiri.trombik@gmail.com, mally@fld.czu.cz, turcani@fld.czu.cz, skrivanovam@fld.czu.cz, aliebhold@gmail.com

Abstract: Globalization tends to promote plant invasions. Plants often benefit in a new environment from absence of insect herbivores but over time native species may adapt to use them as hosts and specialists invade and re-establish their host associations. Black locust (*Robinia pseudoacacia*) is a good example of a tree species native to a relatively small part of North America, that has invaded large areas in virtually every temperate region of the world. Data acquired for this study consist of occurrence records (scientific literature, online databases) and leaf samples used to measure herbivory in 6 world regions. These data were used to i) explore spatial and taxonomic patterns of native and alien insect species utilizing black locust as a host worldwide, ii) evaluate environmental drivers of these insect invasions iii) compare how herbivory on black locust varies across intra- and inter-continental scales. A total of 454 herbivorous insect species are recorded feeding on *R. pseudoacacia* across the world, with 23 of these being specialized on this tree species. From this group, seven species have successfully expanded their range beyond North America. Within North America, richness of specialist species was explained by a combination of black locust density, distance from the native range, transportation corridors, human population, and climate. In North America black locust experiences the highest levels of herbivory which decreases with distance from its native range. The black locust specialists which have successfully established outside of North America are generally not common and cause little damage in the Nearctic region. However, one species, *Odontota dorsalis*, has become extremely common in invasive black locust stands in North America, causing extensive defoliation, but it has never invaded another continent.

Keywords: biological invasion, herbivory, insect community, *Robinia pseudoacacia*, spread

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Morphology and molecular identification of native, invasive and cryptogenic seaweed species

Claudia González-Toral [1], Ricardo López-Alonso [2], Esteban Pascual-Parra [2], Iris Carrera-Rodríguez [3], Sergio Villoria-Calvo [2], Deva Menéndez-Teleña [3], Verónica Soto-López [3], Alejandro Fernández-Cudeiro [3], Jesús Ángel García-Maza [3], Andrés Arias 2, Candela Cuesta [4,5], Eduardo Cires [1,6]

[1] Department of Organisms and Systems Biology (Botany), University of Oviedo, Oviedo, Spain.

[2] Department of Organisms and Systems Biology (Zoology), University of Oviedo, Oviedo, Spain.

[3] Department of Nautical Science and Technology, University of Oviedo, Gijón, Spain.

[4] Department of Organisms and Systems Biology (Plant Physiology), University of Oviedo, Oviedo, Spain.

[5] Polytechnic School of Mieres, Mieres, Spain.

[6] Institute of Natural Resources and Territorial Planning (INDUROT), Mieres, Spain.

gonzaleztclaudia@uniovi.es, cireseduardo@uniovi.es, UO250719@uniovi.es, UO265774@uniovi.es, UO270375@uniovi.es, ariasandres@uniovi.es, UO240328@uniovi.es, menendezdeva@uniovi.es, sotoveronica@uniovi.es, UO218306@uniovi.es, maza@uniovi.es, cuestacandela@uniovi.es, cireseduardo@uniovi.es

Abstract: Seaweeds play an important role in marine ecosystems by providing food, shelter, and habitat for a wide range of marine organisms (Hurd et al. 2014). Green, brown and red algae can be classified into three types: native, which have adapted and play an important role in maintaining the ecosystem balance, invasive and cryptogenic, which have an uncertain origin and an unclear native/invasive status (Carlton 1996; Glasby et al. 2007; Guiry & Guiry 2023). The introduction of alien seaweed species into new habitats has been related to human activities, as the main mechanisms of introduction include vessel boring and foulling, ballast water and semi-dry and dry ballast, mariculture, or tourism (Andreakis and Schaffelke 2012; Hewitt et al. 2007). Some of the introduced species, both intentionally and accidentally, have not had a negative impact on the local environment. However, other intentionally and accidentally introduced species have become invasive species (Pickering et al. 2007). Invasive seaweeds can have negative impacts on the invaded ecosystems by outcompeting native species for resources and altering the structure and function of the ecosystem, and therefore, should be managed (e. g. Hu and Lopez-Bautista 2014). Moreover, Cryptogenic seaweeds may have been introduced to an environment a long time ago, making it difficult to determine whether they are native or invasive. The present study aims to verify the taxonomic identity of seaweeds stuck to boats along the Cantabrian Sea (north of Spain) during discrete time periods, using morphological and molecular approaches. As the taxonomic identification of seaweeds can be notoriously difficult due to the intraspecific variability in morphological characteristics and high phenotypic plasticity, molecular methods can be a useful taxonomical tool. Therefore, here, we propose a roadmap using molecular approximation (i.e., DNA barcodes) to identify taxa morphologically indistinguishable.

Keywords: Molecular taxonomy, cryptogenic species, invasive species.

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The alienfish project: monitoring non-indigenous fish species along Italian coasts

Alessandro Nota [1,2], Daniele Tibullo [2,3], Fabio Crocetta [4], Sara Ignoto [2,5], Ernesto Azzurro [6], Francesco Tiralongo [2,5,6]

[1] Department of Biology and Biotechnology, University of Pavia, Pavia, Italy

[2] Ente Fauna Marina Mediterranea, Avola, Italy

[3] Department of Biomedical and Biotechnological Sciences, University of Catania, Catania, Italy

[4] Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, Napoli, Italy

[5] Department of Biological, Geological and Environmental Sciences, University of Catania, Catania, Italy

[6] National Research Council, Institute of Biological Resources and Marine Biotechnologies, Ancona, Italy

alessandro.nota01@universitadipavia.it, d.tibullo@unict.it, fabio.crocetta@szn.it, francesco.tiralongo@unict.it, sara.ignoto@phd.unict.it, ernesto.azzurro@cnr.it

Abstract: The Mediterranean Sea hosts a wide fish diversity, with around 700 species reported. Although most of these species are native and even endemic, such number also includes non-indigenous ones (Psomadakis et al., 2012), entering in the Mediterranean Sea through different vectors, including shipping, aquarium trade, aquaculture, and the opening and subsequent enlargement of the Suez Canal (Psomadakis et al., 2012; Azzurro et al., 2019; Tiralongo et al., 2020). Under this scenario, the continuous monitoring of non-indigenous, thermophilic, and uncommon fish species in our seas is critical to rapidly understand how they may expand or regress in national waters. To reach this goal, the citizen science approach is essential, as it allows volunteers to provide huge amounts of data otherwise unavailable to scientists. There is indeed a growing interest in involving citizen scientists in different projects, many of which focus on biodiversity monitoring (Azzurro et al., 2019; Tiralongo et al., 2019b; Tiralongo et al. 2020). The AlienFish project brings together more than twenty researchers from Italy. Our main aim is to study and monitor rare, thermophilic, and non-indigenous fish species along the Italian coasts. Most of the records come from volunteer citizens through social networks. In fact, divers, fishermen, and other sea-users often publish there many photos of unusual fish species; this particularly happens when they are not able to recognize the encountered specimens. By privately contacting authors of the above mentioned photos, data on presence, habits, and abundance of many species can be collected. The importance of this approach is progressively rising due to the increasing presence of warm-adapted species in the whole basin (Tiralongo et al., 2019a; Tiralongo et al., 2020; Tiralongo et al., 2022). Here we present new records of alien invaders in Italian waters, whose further expansion could threaten native biodiversity. In conclusion, we underline the usefulness of citizen science in monitoring presence and distribution of these species and in raising public awareness on ecological issues.

Keywords: citizen science, alien fishes, marine bioinvasions, coastal monitoring

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Management

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Sensitive environmental DNA (eDNA) methods to detect invasive hemlock woolly adelgid and its biological control predators *Leucotaraxis* silver flies and a *Laricobius* beetle

Anish Kirtane [1,2], Nicholas J. Dietschler [2], Tonya D. Bittner [2], Marshall Bigler Lefebvre [2], Sabrina Celis [2], Katharine O'Connor [2], Nathan Havill [3], Mark C. Whitmore [2]

[1] Institute of Biogeochemistry and Pollutant Dynamics, Eidgenössische Technische Hochschule Zürich, Zürich, Switzerland

[2] New York State hemlock Initiative, Cornell University, Ithaca, New York, USA

dna.anish@gmail.com, nd283@cornell.edu, tdb68@cornell.edu, mbl233@cornell.edu, slc277@cornell.edu, ko@catskillmountainkeeper.org, mark.whitmore@cornell.edu

[3] USDA Forest Service, Northern Research Station, Hamden, Connecticut, USA

dna.anish@gmail.com, nd283@cornell.edu, tdb68@cornell.edu, mbl233@cornell.edu, slc277@cornell.edu, ko@catskillmountainkeeper.org, nathan.p.havill@usda.gov, mark.whitmore@cornell.edu

Abstract: Environmental DNA (eDNA) analysis can be a powerful tool for the early detection of invasive organisms. However, research on terrestrial eDNA detection from foliage surfaces has been limited. In this study, we developed methods to capture and detect eDNA using qPCR from an invasive forest pest, hemlock woolly adelgid (*Adelges tsugae*), and three of its biological control predators: *Leucotaraxis piniperda*, *Leucotaraxis argenticollis*, and *Laricobius nigrinus*. We designed four highly efficient qPCR assays with a low limit of detection (1–10 copies/reaction). The assay targeting *A. tsugae* was species-specific. The assays targeting *L. piniperda*, and *L. argenticollis* were biotype-specific in addition to being species-specific, demonstrating applications of eDNA analysis beyond species level detection. The *L. nigrinus* assay also detected DNA from closely related and hybridizing *Laricobius rubidus*. The eDNA methods were evaluated against traditional detection methods. We collected foliage samples from three strata (bottom, middle, and top) of eastern hemlock trees to detect the presence of *A. tsugae*. The detection of the biological control predators was evaluated using western hemlock foliage samples collected from the predators' native range in western Washington. The eDNA methods had significantly higher positive detection rates (2.8–4.5 times) than conventional methods of all target species. The strata of sampling were not significant in determining the presence of *A. tsugae* infestation. The eDNA concentration was positively correlated with the observed density for all species. This study demonstrates the efficacy of eDNA analysis as a more sensitive tool for early detection of *A. tsugae* and to track the establishment of its biological control predators.

Keywords: biological control, invasive species, Hemlock woolly adelgid, environmental DNA, qPCR

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Do plant-herbivore interactions recover after the invasive plant *Carpobrotus* spp. is removed?

Noa Núñez-González [1], Miguel Penas Boado [2], Luís González [1], Jonatan Rodríguez [3]

[1] Department of Plant Biology and Soil Sciences, Faculty of Biology, Universidade de Vigo, 36310, Vigo, Spain

[2] BioCost Group, Department of Biology, Faculty of Science, Universidade da Coruña, 15071 A Coruña, Spain

[3] Department of Functional Biology, Faculty of Biology, Universidade de Santiago de Compostela, 15782, Santiago de Compostela, Spain

noanunhez@gmail.com, miguel.penas.boado@udc.es, luis@uvigo.gal, jon.rodriguez.parra@gmail.com

Abstract: Invasive species are becoming increasingly widespread in all types of habitats. They drastically affect biodiversity and the functioning of the ecosystems in which they occur by competing with and displacing native flora and altering biotic interactions. One of the most problematic plant genera invading coastal habitats is *Carpobrotus*, a clonal succulent plant from South Africa that substantially affects these habitats, particularly in areas with a Mediterranean climate. To minimize its impacts, eradication programmes have recently been carried out in several locations on the northwest coast of the Iberian Peninsula. However, the consequences of these management actions on the recovery of plant-herbivore interaction networks are unknown. Therefore, we evaluated how the removal of *Carpobrotus* spp. affected the recovery of plant and invertebrate herbivore diversities and the successional dynamics of plant-herbivore interaction networks. To do so, at six locations, we collected data on observed plant and herbivore species, vegetation cover of native and invasive species, and abundance of herbivores and plants that they were feeding in ten quadrants of invaded, non-invaded and *Carpobrotus*-removed plots between 2018 and 2019 thanks to volunteer programmes. Our results showed a clear similarity between the non-invaded and the removed plots, while these results are very different from those of the invaded plots. In addition, removed and non-invaded plots showed greater species-level parameters, such as herbivore specialization, and network-level parameters, such as modularity, than invaded plots. Overall, our results suggest that removing *Carpobrotus* spp. from invaded areas may allow the recovery of plant-herbivore interactions after a few years of secondary succession, reaching levels similar to those in non-invaded areas. Based on our observations, to reduce the impact of *Carpobrotus* spp. on biodiversity and favour the conservation of native habitats, management strategies should be implemented in coastal areas invaded by this invasive plant.

Keywords: alien plant species, ecological networks, plant-herbivore interactions, plant diversity, invertebrate herbivore diversity

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Mapping and controlling invasive alien plants at Capraia Island (Italy)

Alice Misuri [1], Michele Mugnai [1], Michele Giunti [2], Lorenzo Lazzaro [3]

[1] Department of Biology, University of Florence, Italy; NBFC, National Biodiversity Future Center, Palermo, Italy

[2] Nature and Environment Management Operators s.r.l., Florence, Italy

[3] Department of Biology, University of Florence, Italy

alice.misuri@unifi.it, michele.mugnai@unifi.it, giunti@nemoambiente.com, lorenzo.lazzaro@unifi.it

Abstract: Island ecosystems are particularly threatened by biological invasion due to their peculiar biome (Celesti-Grapow et al. 2016, Russell et al. 2017). However, they represent the ideal target to obtain the best conservation results throughout the eradication of invasive alien plants (IAPs) (Simberloff et al. 2018). Toward the aim of informing the management options for the main IAPs at Capraia Island (Tuscan Archipelago, Central Italy) we investigated the current distribution and evaluated the control/eradication costs of the species *Chasmanthe floribunda*, *Nicotiana glauca*, *Opuntia ficus-indica*, *O. stricta*, *Senecio angulatus* and *Zantedeschia aethiopica*. Through field surveys, we mapped the current distribution of the six IAPs, also identifying the most impacted Natura 2000 habitats (Habitats Directive 92/43/EEC), merging the distribution of alien species with the habitat map. Finally, we evaluated the management options for these species and calculated the removal costs of the eradication techniques. Alien species are more widespread in the anthropized part of the island, with only *O. stricta* spreading also in natural contexts. In total, 71 ha (3.6% of the island's surface) are invaded by the six IAPs. *O. stricta* is by far the most widespread species with over 70 ha invaded. The habitats most affected by the invasion are the thermo-Mediterranean and pre-desert scrub, the low formations of *Euphorbia*, the vegetated sea cliffs of the Mediterranean coasts, and the pseudo-steppe with annual grasses, all invaded mainly by *O. Stricta*. We estimated the costs of *Opuntia* management according to two possible scenarios: total eradication from the island (about 480,000 €) and removal from priority areas (about 285,000 €). Instead, the costs for the management of the other species amounted to about 57,000 €. Therefore, thanks to this work we were able to quantify the invaded surface and the removal costs of these species.

Keywords: IAPs eradication, management, control costs

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Common hackberry (*Celtis occidentalis* L.): a warning from Hungary

Arnold Erdélyi [1], Mátyás Hugyecz [2], Márk Pálfi [2], Tamara Lerch [2], Judit Hartdégen [3], Ákos Malatinszky [4], Csaba Vadász [5]

[1] Doctoral School of Environmental Sciences, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary

[2] Nature Conservation BSc, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary

[3] MME BirdLife Hungary

[4] Institute for Wildlife Management and Nature Conservation, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary

[5] Kiskunság National Park Directorate

arnoldoooo@gmail.com, matyashugyecz221@gmail.com, palfilab2@gmail.com, lerchtamara2003@gmail.com, Malatinszky.Akos@uni-mate.hu, vadaszcs@knp.hu

Abstract: *Celtis occidentalis* is a North American deciduous tree species first introduced to Europe in 1636 (Goeze, 1916; Wein, 1930), then to Hungary in the late 18th century (Petri, 1798). It has been used in many sectors for nearly 200 years, e.g. as an ornamental tree or as a mix of species in forest plantations (Korda, 2018). Identified as invasive shortly before the turn of the millennium, *C. occidentalis* is now one of the leading species on the blacklist of Hungarian woody plants (Bartha, 2020) and is widely targeted in conservation projects (Csiszár & Korda 2015). Our study was carried out in the framework of the OAKEYLIFE project in a forest-steppe complex of high conservation value (Peszér Forest, Central Hungary). The pre-treatment conditions were recorded in 2018, and the post-treatment conditions in 2022. Data were collected in full spatial coverage in a 25x25 m grid (625 m^2 quadrats), including the number of seed-bearing individuals (S) and an estimated number of vital saplings (VS). Changes in individual numbers over four years were compared by treatment intensity and habitat type based on 6782 assessed quadrats in 420 ha. *C. occidentalis* showed huge average growth in control stands, with S increasing by 67% and VS by 253%. In once-treated (only S) stands, S decreased by 90%, but VS increased by 334%. Two treatments (S second time, VS) reduced S by 95% and SV by 46%, and combing treatments (S third time, VS second time and also seedling removal) reduced S by 99% and VS by 55%. *Celtis occidentalis* could regenerate and spread massively regardless of the forest habitat type. With our results, we would like to raise awareness of the threat posed by *C. occidentalis*, because it may still be possible to prevent its invasion in other countries in time.

Keywords: forest management, invasive tree species, OAKEYLIFE project, monitoring program

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Predicting the global spread of two aggressive Thiaridae invaders using ensemble models

Sive Kolisi [1], Samuel Motitsoe [1], Musa Mlambo [2], Tsungai Zengeya [3]

[1] Department of Zoology and Entomology, Rhodes University, Makhanda, South Africa

[2] Department Freshwater Inverterbrates, Albany Museum, Makhanda, South Africa

[3] Directorate of Biological Invasions, South African National Biodiversity Institute (SANBI), Pretoria

sivekolisi95@gmail.com, s.motitsoe@ru.ac.za, musa.mlambo@gmail.com, t.zengeya@sanbi.org.za

Abstract: The two notorious invasive gastropods *Tarebia granifera* and *Melanoides tuberculata,* originating from South-east Asia and Africa, respectively, are prolific spreaders that have invaded both freshwater and brackish systems in several regions of the world. These two Thiaridae snails have not only successfully invaded aquatic systems but co-occur with each other in multiple systems around the world. The occurrence of these snails has consequences on the economy and ecological functions of the invaded habitats. Our objective was to determine the potential range expansion of the two invasive snails globally using environmental variables. We build the Species Distribution Models for *Tarebia granifera and Melanoides tuberculata,* using the Biomod 2 package in R and Ensemble modelling technique, which utilises multiple methods to predict the future distribution of species. The study highlights the importance of temperature for the successful expansion of the two invaders worldwide. Our results can be used for early detection of these two problematic invasive gastropods, subsequently, can help identify areas that are at risk of invasion and prioritize management efforts in those areas. This could be a useful management tool in controlling the spread of these species on a global scale. Additionally, targeted surveillance efforts can be conducted in high-risk areas to detect invasive snails before they become established and spread further thus costing more for their control/management. Overall, managing invasive snails like *T. granifera* and *M. tuberculata* is essential for protecting the native biodiversity and ecological functions of freshwater and brackish ecosystems worldwide.

Keywords: invasion, distribution, snails

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Urgent action needed: combatting the menace of invasive *Pomacea canaliculata* and *Pomacea maculata* in Taiwan

Pritam Banerjee [1,2], Gobinda Dey [1,2], Raju Kumar Sharma [2,3], Jyoti Prokash Maity [4], Chen-Yen Chen [1]

[1] Department of Biomedical Sciences, Graduate Institute of Molecular Biology, National Chung Cheng University, 168 University Road, Min-Hsiung, Chiayi County 62102, Taiwan

[2] Department of Earth and Environmental Sciences, National Chung Cheng University, 168 University Road, Min-Hsiung, Chiayi County 62102, Taiwan

[3] Department of Chemistry and Biochemistry, National Chung Cheng University, 168 University Road, Min-Hsiung, Chiayi County, 62102, Taiwan

[4] Environmental Science Laboratory, Department of Chemistry, School of Applied Sciences, KIIT Deemed to be University, Bhubaneswar, Odisha, 751024, India

pritam8683@gmail.com, dgobinda1993@gmail.com, raju28212@gmail.com, jyoti_maity@yahoo.com chien-yen.chen@oriel.oxon.org

Abstract: Cryptic invasions are challenging to distinguish, thus easily bypassing traditional survey methods (e.g., morphological screening), creating false biodiversity information. Two species of Apple Snails, *Pomacea canaliculata*, and *P. maculata* are highly cryptic and are incredibly destructive worldwide (Carlsson et al., 2004). *Pomacea* spp, were introduced in Taiwan in the 1980s for commercial use. However, soon after their release into the wild, they became a serious pest of cultivated crops (Wu et al., 2011). Furthermore, they have a destructive effect on native species and natural ecosystems (e.g., wetlands). Making matters worse, *Pomacea* spp. was reported to transmit human angiostrongyliasis in Taiwan (Tsai et al., 2001). Thus, understanding their current distribution and possible impact is necessary, and further, we need to aim for the proper management and removal. The present study surveyed the distribution of *Pomacea* spp in Taiwan and its infection rate for *Angiostrongylus cantonensis*. Furthermore, we tried to develop a quick monitoring method to detect *Pomacea* spp from water samples (Banerjee, P., 2021). The detailed survey from 14 different locations in Taiwan, followed by the implementation of DNA barcoding, revealed the sympatric and heterogenous distribution of *P. canaliculata*, and *P. maculata*, where *P. canaliculata* was found to be the dominant species (Banerjee, P., 2022). In Taiwan, a high percentage of *Pomacea* spp were reported to be infected with *Angiostrongylus cantonensis*, suggesting a possible chance of disease emergence. Thus, removal action should be taken as soon as possible, depending on the current situation. Furthermore, the present study developed and applied environmental DNA-based method for quick and effective monitoring of *P. canaliculata*, and *P. maculata* from water samples.

Keywords: invasive species, DNA barcoding, environmental DNA, molecular ecology, human angiostrongyliasis

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Control of *Ailanthus altissima* using different chemical techniques

Soler J [1], Izquierdo J [1], Vilamú J [2]

[1] Departament d'Enginyeria Agroalimentària i Biotecnologia, UPC. Campus Baix Llobregat. Ed. D4. 08860 Castelldefels, Spain

[2] Servei de Medi Natural. Parc Natural de la Serra de Collserola. Ctra. de l'Església, 92, 08017 Barcelona, Spain

soleraaa@hotmail.com, jordi.izquierdo@upc.edu, jvilamu@parccollserola.net

Abstract: *Ailanthus altissima* is considered an invasive weed in natural ecosystems in Europe (Europe, R 2019/1262). Its invasion alters the ecosystem functioning, modifying native plant communities and wildlife habitat and threatening biodiversity. The Conservation Park of Serra de Collserola in Barcelona (Catalonia, Spain) has an area of 8,300 ha of which 40 ha have been invaded by *A. altissima*. Glyphosate is a known effective herbicide for this specie, but because of a ban for its use in many cities in Barcelona region, other active ingredients had to be tested. The use of herbicides is known as an effective method (Burch and Zedaker 2003), and the use of biological agents it is suggested as a promising method (Moragrega et al 2021). Different herbicides were applied diluted in water using three technics (stem injection, cut stump and basal bark) during October 2021. Every product was applied to a group of 10 trees with 3 replications plus a control, in trees with diameters less than 10 cm. In stem injection, four holes were done with a drill on the basal part of the uncut trunks. The same procedure was made for cut stump applications, but trees were cut just above the holes. For basal bark, herbicides were applied using a brush, painting the first 100 cm of the stem. The same amount of broth was applied for each technique. Survival of the trees was monitored during April, June, and September 2022. Trees from stem injection and cut stump, using Triclopyr + aminopyralid (1,2 + 0,2 mg a.i./tree), fluroxipir (1,35 mg a.i./tree) and triclopyr + clopyralid (0,5 + 2,1 mg a.i./tree) died. No resprouts or alive branches were observed. Trees with the basal bark technique died, except those treated with fluroxipir, that controlled 53% of trees. For no treated trees, only those with the cut stump technique showed a significant mortality (41%).

Keywords: *Ailanthus altissima,* invasive weed, stem injection, cut stump, basal bark, herbicide

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REGLAMENTO DE EJECUCIÓN (UE) 2019/1262 de la Comisión, de 25 de julio de 2019, por el que se modifica el Reglamento de Ejecución (UE) 2016/1141 con el fin de actualizar la lista de especies exóticas invasoras preocupantes para la Unión (2019), OJ L199, 1–4.

A framework to declare alien species absent from a country: South Africa as a case study

Chelsey Matthys [1], Sjirk Geerts [1], John Wilson [2]

[1] Department of Conservation and Marine Sciences, Cape Peninsula University of Technology, Cape Town, South Africa

[2] Department of Botany & Zoology, University of Stellenbosch, Stellenbosch, South Africa

chelseykmatthys@gmail.com, geertss@cput.ac.za, jrwilson@sun.ac.za

Abstract: Reliable lists of alien species are vital foundations for managing biological invasions, when an alien species is absent, conservation resources can be diverted to manage and control other alien species that are present and problematic. However, declaring an alien species as absent cannot be done with perfect certainty and if an alien species is incorrectly declared as absent the opportunity to achieve eradication or significantly reduce spread might be lost. We developed a framework to evaluate if an alien species should be declared absent from a country based on the probability that the species was present in the past and, if it had been present, the probability that it is still present. Data on the nature and timing of records of presence, the likelihood that observed populations have been extirpated since they were observed, the effort expended to find remaining individuals, and the likelihood of new (or re-) introductions are all required for the assessment. Based on a methodology developed to evaluate the likelihood that a species has gone extinct, we propose the use of argument maps to identify reasons, evidence, and sources to support a claim that a species is absent (or still present). We demonstrate the approach using the example of the Chilean black urchin [*Tetrapygus niger* (Molina, 1782)] in South Africa, a taxon that is regulated as an invasive species in the country but that has not been seen for over a decade. By setting out the arguments for and against the presence of *T. niger*, the argument map approach allowed us to clearly motivate that *T. niger* be removed from regulatory lists on the basis that it is absent from South Africa.

Keywords: alien species lists, biological invasions, *Tetrapygus niger*, South Africa, framework

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Feral horses in natural grasslands of the Argentinian Pampas

Franco Bostal [1]

[1] GEKKO (Grupo de Estudios en Conservación y Manejo), Departamento de Biología, Bioquímica y Farmacia, Universidad Nacional de Sur, Bahía Blanca, Argentina

franco.bostal@uns.edu.ar

Abstract: Populations of feral horses occur in several countries, including Argentina (Novillo and Ojeda 2008; MAyDS 2021), where they inhabit many protected areas, such as the Ernesto Tornquist Provincial Park (ETPP) in the Southern Pampas (Scorolli and Lopez Cazorla 2010). In this reserve, they affect the structure and composition of plant communities (de Villalobos and Zalba 2010), promote the arrival and spread of alien woody plants (Loydi and Zalba 2009; Loydi et al. 2012) and reduce the abundance and breeding success of grassland birds (Zalba and Cozzani 2004). Simultaneously, horses can be considered a cultural keystone species, adding an additional dimension to any management policy aimed at minimizing their impact. In April 2022, I started my doctorate project with the main goal of developing a comprehensive management plan for feral horses at ETPP, based on demographic tools and the analysis of social representations, applicable to other conflicts involving invasive wild mammals. The project will quantify the demographic response of feral horses of different sexes and ages and of their body condition at high population densities and compare them with the theoretical paradigm proposed for ungulates; to develop and validate population models to simulate the effects of different management interventions; and to assess key stakeholders' perceptions about the presence of feral horses. During the first year of the study, I performed monthly samplings to identify harem-bands and the individuals that compose them with the objective of estimating the size of the population, and I assigned a seasonal body condition score for adult females. These initial results are similar to those reported by Scorolli and Lopez Cazorla (2010) when the population approached carrying capacity (24 adult horses/km^2), foreseeing density-dependence responses in demographic parameters in the coming years, but also severe environmental impacts highlighting the need for population management.

Keywords: feral horses, demography, body condition, perception, management

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Effect of aqueous extracts of *Ulex europaeus*, *Teline monspessulana* and *Acacia dealbata* on weed species of agricultural importance

Francisca Montero [1], Narciso Aguilera [1], Lubia Guedes [1]

[1] Laboratorio de Semioquímica Aplicada, Universidad de Concepción, Concepción, Chile

francisca.montero0@gmail.com, naguileramarin@gmail.com, lubiamariaguedesg@gmail.com

Abstract: Weeds reduce agricultural yields between 20% and 80% around the world. They are managed using synthetic chemical herbicides, which in turn cause contamination of soil, water, and food. That is why bioherbicides are a good alternative to solve this issue. In this context, the study of allelochemicals released by invasive Fabaceae on different types of dicotyledonous and monocotyledonous weeds has been focused. These Fabaceae are also a threat to agroforestry and forest ecosystems. However, they are highly bioactive, which could induce damage in receiving weeds. For this reason, this research explores the morphometric and anatomical effects that the invasive Fabaceae *Teline monspessulana*, *Ulex europaeus* and *Acacia dealbata* cause to weeds *Sorghum halepense*, *Setaria pumila* and *Portulaca oleracea* during their initial growth, which are included among the 28 weed species with the greatest economic impact due to the losses caused in agricultural crops. Experiments were established with the mentioned weed species, in substrate and under controlled conditions. Plants were irrigated with aqueous extracts of the Fabaceae. The variables plant length, root length, number of secondary roots, dry mass, number of true leaves and number of shoots were evaluated. The results show that allelochemicals in *T. monspessulana*, *U. europaeus, A. dealbata* extracts and their combinations affect growth and development of weed species, especially *P. oleracea*, which growth decreased by 47.20% with *T. monspessulana* extract and 56.26% with *U. europaeus* extract. Also *T. monspessulana* and *U. europaeus* extracts reduced root length by 69.57% and 60.8% respectively. In *S. halepense*, *U. europaeus* induced a 29.60% decrease in plant length and a 75.60% increase in root length. The morphometric and morphological damage registered in most of the weeds, indicate that the extracts of the invasive Fabaceae can exert potential herbicidal action, with emphasis on dicotyledonous species.

Keywords: allelopathy, chemical stress, biological invasions, Facabeae

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Tradescantia fluminensis invading the Tins River: a threat to the conservation of native flora

Felipe González-Outeiriño [1], Rubén Retuerto [1], Jonatan Rodríguez [2]

[1] Department of Functional Biology, Faculty of Biology, Universidade de Santiago de Compostela, 15782, Universidade de Santiago de Compostela, Spain

[2] CRETUS, Department of Functional Biology, Faculty of Biology, Universidade de Santiago de Compostela, 15782, Universidade de Santiago de Compostela, Spain

felipe.gonzalez.outeirino@rai.usc.es, ruben.retuerto@usc.es, jon.rodriguez.parra@gmail.com

Abstract: *Tradescantia fluminensis* is a plant member of the Commelinaceae family native to southeastearn South America. It is a perennial clonal plant that rarely produces viable seeds and is therefore mainly spread by human, water or animals that redistribute vegetative propagules (Kelly and Skipworth, 1984; Dugdale et al., 2015). It is considered a problematic invasive species in Spain and its first record was in 1949 near the Miño River in Tui (Galicia, NW Spain) (Rodríguez, 1951). Here, our aim was to know how *T. fluminensis* affects the plant community by evaluating the species composition and plant diversity on the terrace of the Tins River in Outes (Galicia, Spain). To achieve this, we evaluated its impact by monitoring 35 plots of standard quadrats of 1 m^2 with and without *T. fluminensis*. We also tested whether native plants showed signs of early recovery after removal of the invasive plant from some of these plots using two types of mechanical methods (cutting and uprooting). Our results show a negative effect of *T. fluminensis* on both native plant diversity and species richness, likely due to competition from monospecific patches (Standish et al., 2001; O'Loughlin et al., 2021) and inhibition of native seedling development by creating a dense leaf cover on the ground (Eminağaoğlu et al., 2012). We also found promising results with uprooting, which removes all plant material rather than cutting the plant and leaving the vegetal material on the ground. The latter is a common approach to mowing in the area by local authorities and it is important to test its effect on the native plant communities and the spread of *T. fuminensis.* This information may be useful in helping practitioners and land managers to understand the impact on the native flora and how to manage this plant in a riparian area.

Keywords: Invasive alien species, invasive species management, mechanical control, mowing, plant community ecology, riparian vegetation

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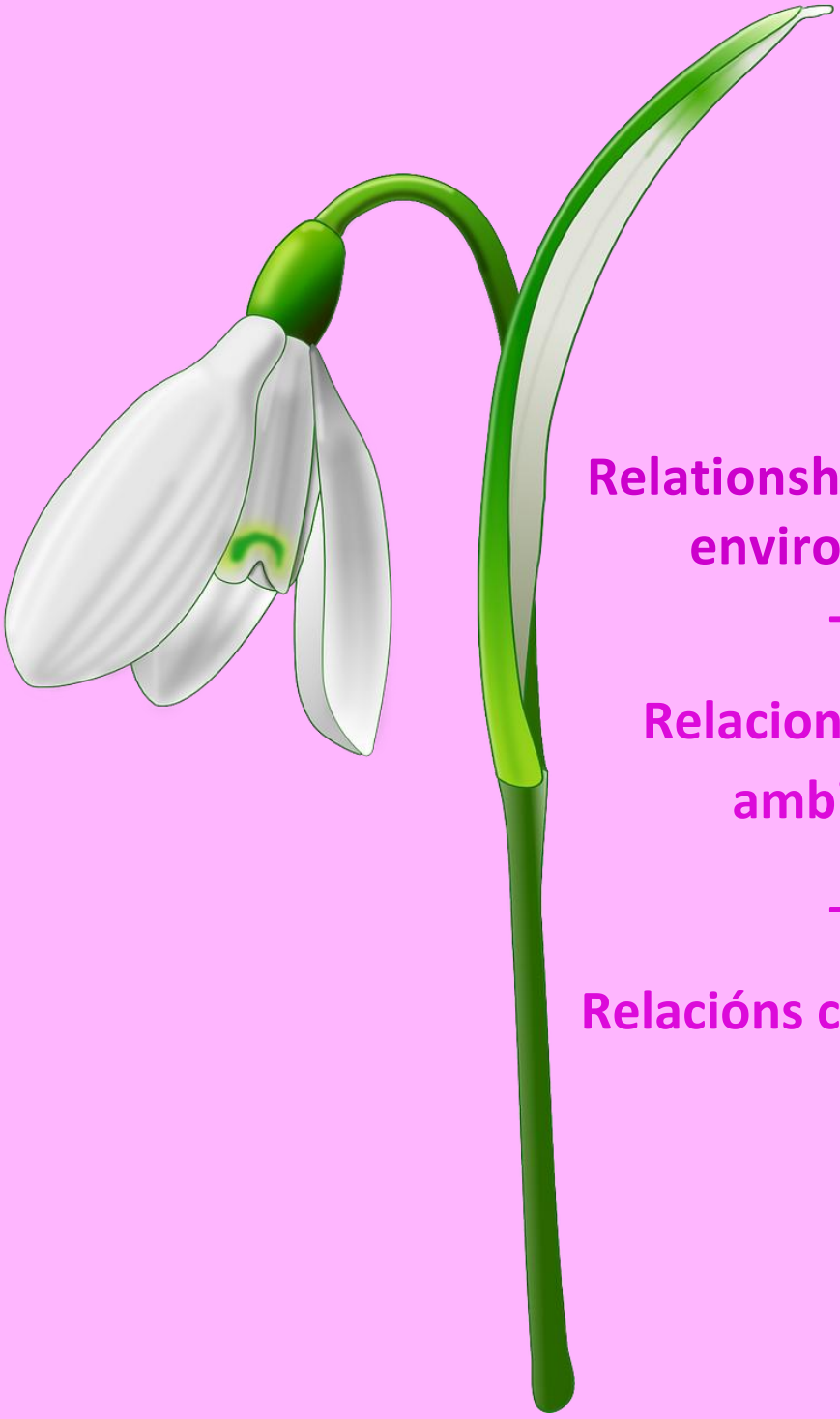

Relationship with the environment

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Relaciones con el ambiente

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Relacións co ambiente

Introduction pathways shape the success of non-native plants along landscape gradients

Marc Riera [1,2], Joan Pino [1,2], Llorenç Sáez [3], Pere Aymerich [4], Yolanda Melero [1,5]

[1] CREAF (Center for Ecological Research and Forestry Applications), Bellaterra (Cerdanyola del Vallès), Catalonia, Spain

[2] Universitat Autònoma de Barcelona, Bellaterra (Cerdanyola del Vallès), Catalonia, Spain

[3] Departament of Animal Biology, Plant Biology and Ecology, Universitat Autònoma de Barcelona, Bellaterra (Cerdanyola del Vallès), Catalonia, Spain

[4] C/ Barcelona 29, Barcelona, Catalonia, Spain.

[5] Department of Evolutionary Biology, Ecology and Environmental Sciences, and Biodiversity Research Institute (IRBio), Universitat de Barcelona, 08028, Barcelona, Catalonia, Spain

m.riera@creaf.uab.cat, joan.pino@uab.cat, gymnesicum@yahoo.es, pere_aymerich@yahoo.es, y.melero@creaf.uab.cat

Abstract: Plant invasions are triggered by their transport through introduction pathways (Hulme et al., 2008), which include gardening, agriculture and unintentional introductions (e.g. sowing of contaminated seeds, trade). Introduction pathways change in importance over time, and shape invasion success in combination with other causal factors like landscape gradients and plant traits (Pyšek et al., 2020). Here, we explore temporal trends in pathway importance, and the interplay between introduction pathways and other causal factors, using the non-native flora of Catalonia (NE Spain) as our study system (Aymerich & Sáez, 2019; Clotet et al., 2016). We explored temporal trends in pathway importance with contingency tables (N = 1025 species, including archaeophytes); related the presence of non-native plants introduced through the gardening and unintentional pathways to landscape gradients by fitting GLMs (N = 632 plots); and related habitat range and frequency to introduction pathways, minimum residence time and plant traits, fitting phylogenetically informed GLMs (N = 77 species). Over time, the main motivation for introducing plants changed from agriculture to gardening, while unintentional introductions occurred at an approximately constant rate. Gardening plants invaded mostly in urban areas, while unintentionally introduced plants invaded urban areas and croplands. Plants introduced a long time ago, and those introduced unintentionally, achieved the greatest frequency and habitat range, although with considerable overlap with gardening plants. Unintentionally introduced plants had large native ranges and were mostly annuals. Our results suggest that unintentional introductions might have decoupled partially from agricultural activity. The invasion success of unintentionally plants could be related to trait covariation with wide ecological tolerance and fast life cycles, and the possession of a greater diversity of introduction epicentres. The ability of unintentionally introduced plants to invade the highest number of habitats challenges the idea that economic use is necessary for invasion success.

Keywords: habitat range, introduction pathways, introduction epicentres, invasion success, landscape gradients

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A wellbeing perspective on biological invasions: Impact of *Lantana camara* on forest dependent communities in India

Varnika Walvekar [1]

[1] The University of Trans-Disciplinary Health Sciences and Technology and Ashoka Trust for Research in Ecology and the Environment, Bangalore, Karnataka, India

varnika.walvekar@atree.org

Abstract: The ecological impacts of invasive species, in terms of biodiversity loss, effects on forest composition and structure, and native vegetation have been widely studied. Whereas, there is not much emphasis placed on the impacts of invasive species on livelihoods and human well-being (Shackleton et al., 2019). Recently, studies on ecosystem services and disservices related to invasive species have taken an impetus (Pejchar & Mooney, 2009; Walsh et al., 2016). However, these provide us with little understanding of the regional or local implications, especially the impacts on communities dependent on natural resources for their lives and livelihoods (Shackleton et al., 2019). A recent framework has been proposed by Bacher et al. (2018), termed as SEICAT (Socio-Economic Impact Classification of Alien Taxa) to assess the well-being aspect of invasive species, complementary to the EICAT (Environmental Impact Classification for Alien Taxa) framework adopted by the IUCN. The current research draws from this framework to study the impacts of an invasive alien plant species *Lantana camara* on the well-being of forest-dependent communities in Baiga Chak region, Madhya Pradesh, India. It aims to conduct a comparative study in high and low lantana villages to assess whether differential lantana infestation leads to differences in livelihood and well-being outcomes. The presence of lantana and its density will be mapped using remote sensing and the socio-economic impacts will be studied by conducting household surveys, semi-structured interviews and transect walks in the forests surrounding the villages. The research will primarily focus on impacts on the following: income derived from forest, availability of grasses for forage, plant species of local importance and time taken by people to access the forest resources. The research is currently in the data collection stage, which will be concluded by May.

Keywords: *Lantana camara*, forest-dependence, well-being, socio-economic impacts

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Contrasting effects of predictor collinearity on the transferability of invasive species distribution models

Sergio Luna [1], Roberto Mendoza [1], Alexander Peña-Peniche [2]

[1] Laboratory of Ecophysiology, Autonomous University of Nuevo León, San Nicolás de los Garza, Mexico.

[2] Laboratory of Ecology, Autonomous University of Nuevo León, San Nicolás de los Garza, Mexico.

sergio.lunap@gmail.com, roberto.mendoza@yahoo.com, lpenap@uanl.edu.mx

Abstract: Biological invasions are the second leading cause of biodiversity loss worldwide, with aquatic environments being especially vulnerable. So, it is crucial to identify areas with the highest probability of establishment for invasive species. Ecological niche modeling (ENM) represents an essential tool to estimate the potential distribution of these species, but the modeling process can become very complex (Liu et al., 2020). Virtual species, for which their occurrence-environment relationship is accurately known, are increasingly used to understand the influence of various factors on the selection of the best predictive models (Meinard et al., 2019; Warren et al., 2019). This project is focused on an evaluation of the importance of various factors involved in the generation and selection of ENM. Models were made using the Maxent algorithm through the dismo package in R and presence records generated by virtual species simulations. The probability of presence was defined as a logistic transformation of the actual environmental suitability, with parameters α and β randomly selected from bioclimatic variables and dispersal capacity to define native and invasive ranges. The influence of six factors was evaluated: spatial filtering of occurrences, calibration area extent, predictor variables and collinearity, background sampling, and the Maxent regularization parameter. The predictive capacity was evaluated with the functional accuracy in the native and invasive simulated range. A total of 3,840 models were evaluated, which showed that the calibration area had the greatest effect on functional accuracy in the native area, followed by the reduction of collinearity and the combination of environmental variables. In the invasive range, model performance was primarily influenced by reduction of collinearity, followed by the calibration area extent. The data so far suggest reducing the number of predictor variables when the interest is to project the models in areas with different environmental conditions, to reduce the risk of extrapolation and its potential associated error, thereby increasing model transferability.

Keywords: species distribution models, virtual species, biological invasions, model extrapolation, model transferability

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Isotopic compositions shed new light on the plasticity of *Carpobrotus* species

Marta Pérez-Diz [1], Berea Rodríguez-Addesso [1,2], Muhammad Iftikhar Hussain [1], Jonatan Rodríguez [3,4], Ana Novoa [4], Luís González [1]

[1] Department of Plant Biology and Soil Sciences, Faculty of Biology, Universidade de Vigo, 36310, Vigo, Spain.

[2] Swedish University of Agricultural Sciences, Almas Allé 8, 750 07, Uppsala, Sweeden.

[3] CRETUS, Department of Functional Biology, Faculty of Biology, Universidade de Santiago de Compostela, 15782, Santiago de Compostela, Spain.

[4] Czech Academy of Sciences, Institute of Botany, Department of Invasion Ecology, 25243 Průhonice, Czech.

marta.perez.diz@uvigo.gal, berea13.98@gmail.com, mih786@gmail.com, jon.rodriguez.parra@gmail.com, novoa.perez.ana@gmail.com, luis@uvigo.gal

Abstract: Several aggressive invasive species which represent a danger to biodiversity in coastal areas around the world belong to the genus *Carpobrotus* N.E.Br. In the north-western part of the Iberian Peninsula, in four coastal habitats (coastal cliffs, disturbed areas, dunes and coastal forests), we investigated the ecophysiological plasticity of *Carpobrotus* spp. Different individuals obtained from each habitat were examined for morphological characteristics and their stable isotope compositions of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$). According to our findings, mixed forests had lower dry shoot weight and higher leaf carbon content (%C) than cliffs. On the other hand, mixed forests had higher leaf moisture levels than cliffs. The presence of *Acacia longifolia*, an alien species that accumulates nitrogen in the soil through symbiotic relationships with N-fixing bacteria, may have contributed to the greater leaf nitrogen content (%N) found in forests. Different N sources were used in each habitat, as evidenced by variations in $\delta^{15}N$. Values were lower on cliffs and in forests and higher in disturbed areas with more human activity. $\delta^{13}C$ was higher in the cliffs and dunes, indicating CAM activity in areas of greater salinity and dryness. Water use efficiency (iWUE) and $\delta^{13}C$ were higher on cliffs and dunes, indicating that *Carpobrotus* spp. has a high tolerance for adverse conditions like salinity or drought in the invaded areas.

Keywords: abiotic stress tolerance, stable isotopes, coastal ecosystems, ecophysiological plasticity

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Cities as landscape shapers: exotic plants contribution to local flora in South America through the lens of big data

González, M. V [1], Araoz, E [1,3], Jimenez, Y.G [1], Montti, L [2], Powell, P [1], Grau, H.R [1,3], Ferro Franco Sosa [1], A; Foguet, J [1], Fernandez, R[1], Aragon, R [1]

[1] Instituto de Ecología Regional (IER), Consejo Nacional de Investigaciones Científicas y Técnicas(CONICET) - Universidad Nacional de Tucumán (UNT), Tucumán, Argentina

[2] Instituto de Investigaciones Marinas y Costeras-CONICET, Instituto de Geología de Costas y del Cuaternario Facultad de Ciencias Exactas y Naturales, Universidad Nacional de Mar del Plata, Mar del Plata, Argentina

[3] Universidad Nacional de Tucumán, Instituto de Ecología Regional (IER), CC 34, Yerba Buena, Tucumán, Argentina, tel.: 54 (381) 4255174,

virginiagonzalez782@gmail.com, ezequielaraoz@gmail.com, yohanajimenez2406@gmail.com, liamontti@gmail.com, priscilaapowell@gmail.com, chilograu@gmail.com, ffsagostina@gmail.com, jjfoguet@gmail.com, romi.d.fernandez@gmail.com, roxaragon@gmail.com

Abstract: Modeling exotic species with socioeconomic drivers is a relatively unexplored area, especially in South America. Cities are anthropic ecosystems built around humans, where humans shape the surrounding vegetation's composition, creating new ecosystems and vegetation distribution patterns. The ecological patterns generated by urban areas vary with different factors (e.g., scale, land use and amount of impervious surface, population size, climate conditions, etc. Gaertner et al., 2017). The general goal of this study was to understand the socio-environmental drivers of exotic species abundance along an urbanization gradient in the American southern cone. First, we collected biodiversity big data, extracting total occurrences of vascular plants from the Global Biodiversity Information Facility: a worldwide portal with records from different taxonomic groups. From these total occurrences we selected those species that appeared in introduced and invasive species listings from the Global Register of Introduced and Invasive Species (GRIIS) for each country of the southern cone, then we estimated the proportion of exotic plants. We compared these exotic plants abundance patterns with socio-environmental patterns using climate databases, land use, city age, fire events, livestock density, percentage of agricultural coverage, and richness of native plants. This association was tested using mixed regressive models that consider the differences within and between groups (urbanization typologies). We obtained a total of 2,171,015 occurrences with1.5% were exotic plants. Cities are landscape shapers that determine the introduction and establishment of exotic plants. Some characteristics of these cities such as low natives' richness and land use diversity favor novel species composition; these cities with high native richness may have greater resistance to introduction, minimizing the influence of cities as hubs of human activity. Understanding how cities influence exotic plant pools is critical for urban management, in this study we take a step further concluding that urbanization increases the pool of exotic plants.

Keywords: urban systems, southern cone, exotic plants, historical background

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Predicted range shifts of invasive Giant Hogweed (*Heracleum mantegazzianum*) in Europe

Quadri A. Anibaba [1], Marcin K. Dyderski [1], Andrzej M. Jagodziński [1]

[1] Department of Ecology, Institute of Dendrology, Polish Academy of Sciences, Kórnik, Poland

qanibaba@man.poznan.pl, mdyderski@man.poznan.pl, amj@man.poznan.pl

Abstract: *Heracleum mantegazzianum* Sommier & Levier (Giant hogweed) has spread across Europe after its introduction as an ornamental from its native range in the Western Greater Caucasus. In the invaded areas, *H. mantegazzianum* reduces the alpha diversity of plant species and can cause second degree burns to humans when its phytotoxic sap contacts the skin upon exposure to sunlight. Previous studies on the distribution of *H. mantegazzianum* focused on individual countries, therefore we know little about the potential range shift of the species distribution under changing climate at the continental scale. To fill this gap here, we aimed to (i) assess the climatic factors influencing the distribution of *H. mantegazzianum* in Europe, (ii) identify suitable and unsuitable areas for the establishment of *H. mantegazzianum* for future climate scenarios to prioritize management action. We used published observations of *H. mantegazzianum* evenly distributed within a 0.25° raster grid and bioclimatic variables to develop a MaxEnt model of the species potential Distribution. Then, we used climate change scenarios from IPCC 6th Assessment Report to predict *H. mantegazzianum* distribution probability in the future. Our study showed that the mean temperature of the coldest quarter (bio11) and temperature annual range (bio7) were the most important bioclimatic variables predicting the suitable habitat of the species in Europe. For all scenarios, we found that the majority of the range changes expected by 2100 will occur as early as 2041. We predicted an overall decrease in climatically suitable area for *H. mantegazzianum* under climate change with over three quarters (i.e., 94%) of the suitable area reduced under the Shared Socioeconomic Pathway (SSP) 585 in 2100. However, under the same scenario, climate conditions will likely favour the expansion (i.e., 20%) of *H. mantegazzianum* in northern Europe. The results from the present study will help in developing a climate change-integrated management strategy, most especially in northern Europe where range expansion is predicted.

Keywords: biological invasions, range shifts, species distribution models, bioclimatic modelling, Europe

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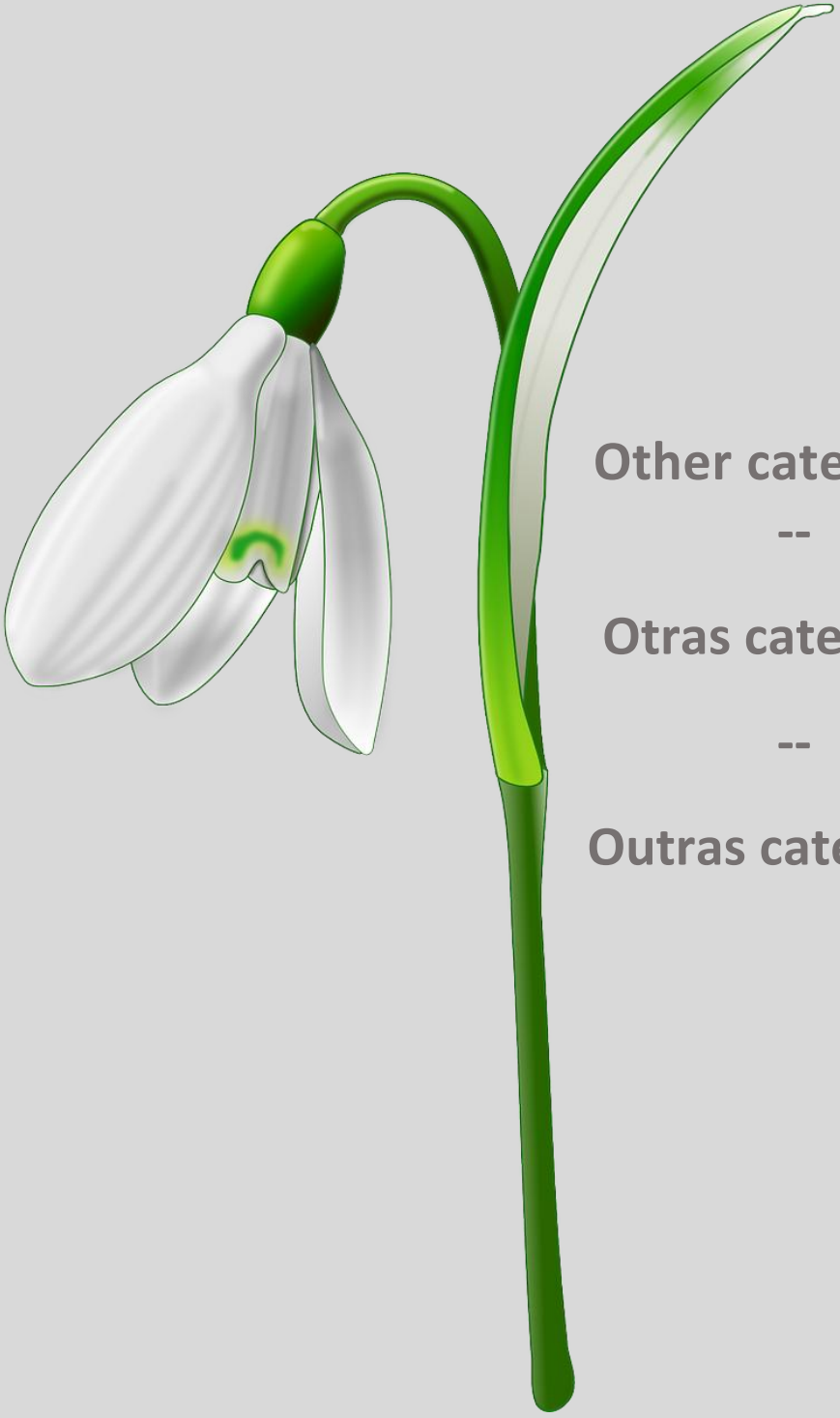

Other categories

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Otras categorías

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Outras categorías

Ecological plasticity of four invasive populations of the topmouth gudgeon *Pseudorasbora parva*

Paride Balzani [1], Giuseppe La Sala [2], Thomas Busatto [2], Giacomo Santini [2], Annamaria Nocita [3]

[1] Faculty of Fisheries and Protection of Waters, University of South Bohemia in České Budějovice, Vodňany, Czech Republic
[2] Department of Biology, University of Florence, Sesto Fiorentino, Italy
[3] Natural History Museum, University of Florence, Firenze, Italy

balzani@frov.jcu.cz, giuseppe.lasala@stud.unifi.it, thomas.busatto@unifi.it, giacomo.santini@unifi.it, annamaria.nocita@unifi.it

Abstract: The topmouth gudgeon *Pseudorasbora parva* is a small cyprinid native to East Asia that was accidentally translocated with the voluntary introduction of Asian carp species for fish farming, and consequently spread (Gozlan et al. 2010). Due to its great environmental adaptability (Britton et al. 2008) and life-history traits favouring its invasiveness (Gozlan et al. 2010), this species is now one of the most widespread invasive species in Eurasia (Gozlan et al. 2010), being considered one of the most impactful invasive species worldwide. Nonetheless, there are only few studies on its ecology in Italy and information on its seasonal dietary variations are scanty. To fill these gaps, we studied four populations of *P. parva*, across the four seasons within one year, within the Arno River basin (Central Italy). To analyse the population structure in terms of age classes and reproductive maturity, for each population we counted the annuli of the scales, and for each population and season, we measured the gonadosomatic index. Moreover, to investigate phenotypic differences among the four populations, we counted their meristic traits. Finally, we investigated the dietary seasonal differences of the four population, using stomach content analyses. The gonadosomatic index showed a similar pattern across all populations, with higher values in spring and summer, indicating a long reproductive period. We found significant differences in the morphology of the studied populations, suggesting a different origin or multiple introductions, or adaptation to different environmental conditions. The diet considerably varied across populations and seasons, suggesting a high degree of spatio-temporal trophic plasticity. The diet breadth also varied among seasons, being more specialized in spring and summer, and more opportunistic during autumn and winter. Our results highlight a high ecological plasticity in the invasive populations of *P. parva*, favouring its high invasiveness and potential to impact multiple native taxa.

Keywords: invasive alien species, diet, plasticity, spatio-temporal variability, aquatic environment

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Spatiotemporal patterns of public attention to alien species across an invasion front: a case study from the Mediterranean Sea

Lara Fazzari [1], Reut Vardi [2], Ivan Jaric´ [3,4], Ricardo A. Correia [5,6,7], Valerio Sbragaglia [1]

[1] Department of Marine Renewable Resources, Institute of Marine Sciences (ICM-CSIC), Barcelona, Spain

[2] School of Zoology, Faculty of Life Sciences, Tel Aviv University, Tel Aviv 6997801, Israel

[3] Université Paris-Saclay, CNRS, AgroParisTech, Ecologie Systématique Evolution, Orsay, France

[4] Institute of Hydrobiology, Biology Centre of the Czech Academy of Sciences, České Budějovice, Czech Republic

[5] Biodiversity Unit, University of Turku, 20014 Turku, Finland

[6] Helsinki Lab of Interdisciplinary Conservation Science (HELICS), Department of Geosciences and Geography, University of Helsinki, Helsinki, Finland

[7] Department of Geosciences and Geography, Helsinki Institute for Sustainability Science (HELSUS), University of Helsinki, Helsinki, Finland

larafazzari94@gmail.com, sbragaglia@cmima.csic.es, reutvardi@gmail.com, ivan.jaric@universite-paris-saclay.fr, raheco@utu.fi

Abstract: Biological invasions are one of the major threats to biodiversity, causing ecological as well as socio-economic impacts (Pejchar & Mooney, 2009). Understanding the interactions between humans and invasive species is crucial for achieving effective conservation action. However, monitoring invasive species is limited by insufficient resources, and by logistical and technological challenges to cover large-scale, spatiotemporal dynamics (Hussey et al., 2015). In addition, biological invasions frequently occur at a rate that is hard to track with traditional methodologies, and near real-time monitoring is needed to develop effective conservation strategies (Pergl et al., 2020). Moreover, the severity of the consequences caused by biological invasions tends to be underestimated by the public (Courchamp et al., 2017), with implications reflected in their management. The digital revolution has opened up new opportunities to advance research and management, using the vast amount of data that is available with limited associated costs, and almost in near real-time (Jarić et al., 2021). In this study, we focus on the arrival of the devil firefish or lionfish *Pterois miles* in the Mediterranean Sea (where it is an alien species) and investigate spatiotemporal patterns of public attention to the species along the invasion gradients. Google search volumes were downloaded from 2013 to 2023 for all Mediterranean countries. Our results show that public attention is higher in countries which have already experienced *P. miles* invasion rather than the ones in which the species has not arrived yet, likely indicating a greater public awareness and interest in the problem. Moreover, the analysis of Google search volumes over time enables us to identify a possible transience of societal attention, highlighting the complex dynamics of public awareness and attitudes towards this invasive alien species, key elements to engage in management actions. Overall, this study provides an overview of societal response to *P. miles* invasion across the Mediterranean Sea, paving the way for a further implementation of digital data in alien invasive species research.

Keywords: digital data, invasion culturomics, public attention, *Pterois miles*

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Species list -- Lista de especies -- Lista de especies

Acacia dealbata
Acacia longifolia
Adelges tsugae
Ailanthus altissima
Angiostrongylus cantonensis
Cakile maritima
Carpobrotus spp.
Celtis occidentalis
Chasmanthe floribunda
Dactylis glomerata
Erigeron canadensis
Erigeron sumatrensis
Euphorbia serpens
Geophagus brasiliensis
Geophagus sveni
Heracleum mantegazzianum
Hyptis suaveolens
Lantana camara
Laricobius nigrinus
Laricobius rubidus
Lepidium didymium
Leucanthemum vulgare
Leucotaraxis argenticollis
Leucotaraxis piniperda
Malcolmia littorea
Melanoides tuberculata
Nicotiana glauca
Odontota dorsalis
Opuntia ficus-indica
Opuntia stricta
Plantago lanceolata
Polycarpon tetraphyllum
Pomacea canaliculata
Pomacea maculata
Portulaca oleracea
Prunus serotina
Pseudorasbora parva
Pterois miles
Robinia pseudoacacia
Satonoperca pappaterra
Scabiosa atropurpurea
Scolymus hispanicus
Senecio angulatus
Setaria pumila
Sorghum halepense
Spartina alterniflora
Spartina anglica
Spartina x townsendii
Talinum paniculatum
Tarebia granifera
Teline monspessulana
Tetrapygus niger
Tradescantia fluminensis
Ulex europaeus
Vachellia caven
Zantedeschia aethiopica

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