~~Flexibility of interactions depends on habitat suitability~~

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E. Fernando Cagua[1] *(efc29@uclive.ac.nz)*
Audrey Lustig[2] *(audrey.lustig@canterbury.ac.nz)*
Jason M. Tylianakis[1] *(jason.tylianakis@canterbury.ac.nz)*
Daniel B. Stouffer[1] *(daniel.stouffer@canterbury.ac.nz)*

[1] Centre for Integrative Ecology, School of Biological Sciences, University of Canterbury, Private Bag 4800, Christchurch 8041, New Zealand

[2] Geospatial Research Institute, University of Canterbury, Private Bag 4800, Christchurch 8041, New Zealand

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Author for correspondence: E. Fernando Cagua (+64 20 4026 8153).

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Abstract

Evidence that the environment influences the interaction between species is rapidly accumulating. However, how it happens is currently unclear as environmental gradients appear to have contrasting or non-linear effects on the species' trophic niche breadth depending on the environmental variable. Here, we explore the relationship between the stresses imposed by the environment, instead of environmental gradients directly, and niche breadth using a global dataset of plant-pollinator interactions.We found that environmental stress plays a significant role in determining the number of partners a species interacts with, but this role is highly variable across species. In particular, when faced with environmental stress, species that have a large number of interactions are more likely to focus on a smaller number of, presumably higher-quality, interactions. Contrastingly, the specialists that can cope with increased stress are more likely to broaden their niche and engage in opportunistic interactions, effectively behaving as facultative generalists.

define this

Tiene sentido la historia?

Introduction

Species interactions are known to vary widely across space and time. There are multiple examples of species that interact tightly in an ecological community or a particular season but not in another. It is crucial to understand why and how this turnover of interactions occur because the network of interactions of an ecological community is known to underpin ecosystem function and stability. Despite much progress in the last decades, we are still unable to predict species interactions, partially because we still have not accurately identified the factors that drive species to interact under certain conditions and not under another.

define what is

There are two main processes involved in whether two species in a community interact or not. The first is an "Eltonian" niche process that is underpinned by the traits of the interacting species. Compared to other kinds of trophic interactions, mutualistic interactions, and plant-pollination interactions, in particular, are relatively generalised. While a large proportion of the interactions appear to be opportunistic, a fraction of interactions shows a strong signature of deep co-evolutionary history (Hutchinson, Cagua, and Stouffer 2017). In contrast to opportunistic interactions with low trait-matching, the more co-evolved interactions with optimally matched traits are more persistent (in time/space?) and presumably lead to a more substantial per-capita benefit for the interacting species. The second is a neutral process underpinned by the encounter rate of the interacting species. All else being equal, when the encounter rate of interacting species is high, there is a higher probability to interact than if the rate were lower, for example, due to species rarity.

Perhaps, because it operates at scales larger than those of the Eltonian niche concept, the abiotic environment is one of the factors that is commonly overlooked by community ecologists when explaining interaction turnover (but see Gravel et al. 2018). The most evident—and best-studied—way through

need to clarify this, b/c there are tons of studies looking at the eff. of e.g. habitat type on interactions identity.

not clear

which the environment can affect the structure of ecological networks is by way of patterns of community composition. At the heart of biogeography theory? is the idea that the abiotic environment can determine the "Grinellian" niche of a species, this is whether the species can have a positive growth-rate when rare in a particular location. For two species to interact, they first need to co-occur in the same community, which can only happen if the environmental conditions of the location ~~community~~ fall within the Grinellian niche of both species. Although less understood, the environment can also affect the interactions themselves, after community composition has been established (Tylianakis and Morris 2017). For instance, some studies show that trophic interactions, like predation (McKinnon et al. 2010; Vucic-Pestic et al. 2011) and herbivory (Baskett and Schemske 2018), can increase with temperature but might decrease with precipitation (Pires et al. 2016), and both plant-plant (Bertness and Callaway 1994) and plant-pollinator (Tur et al. 2016) interactions can switch from facilitative to competitive along an elevation/temperature gradient. Contrastingly, other studies have shown either no effect or non-linear effects of temperature or precipitation on plant-pollinator interactions (Devoto, Medan, and Montaldo 2005; Gravel et al. 2018). One way to summarise the seemingly contradictory evidence of whether the environment can influence whether two species interact or not is by moving from gradients of temperature or precipitation to gradients of environmental stress. Previous research is so far equivocal and, taken together, suggest that environmental stress can have two contrasting effects on species' Eltonian-niche (Tylianakis and Morris 2017). On the one hand, it is possible that when species are under environmental stress, they might be "pressured" to focus on partners with which they are best adapted to interact. For instance, Hoiss et al. (2012) found increased phylogenetic clustering between plants and pollinators at higher altitudes; while Peralta et al. (2015) found that parasitoids in plantation forest, where environmental stress was higher than in native forests, were constrained to interact with

what do you mean by this?

what freq?

refs conv?

here define it as it is the first time you mention this term

what do you mean by this?

What about focusing only on plant-pol int throughout the intro? I say this because parasitoids are generally more specialized than other groups, so it could be argued that even specialized groups could increase their specialization (contrary to what your hypothesis is).

hosts they were best adapted to attack. Similarly, Lavandero and Tylianakis (2013) found that environmental stress due to higher temperature reduced the breadth of the Eltonian niche of parasitoids. On the other, it is also possible that when species are under environmental stress, they are forced to be more flexible in their interactions as higher environmental stress is likely to be reflected in greater energetic or reproductive costs and therefore they might not be able to sustain encounter rates with their preferred partners at sufficient levels. In line with this hypothesis, Hoiss, Krauss, and Steffan-Dewenter (2015) found that the specialisation of plant-pollinator networks decreased both with elevation and after extreme drought events. Likewise, Pellissier et al. (2010) found a positive relationship between niche breadth and environmental stress: disk- or bowl-shaped blossoms (which allow a large number of potential pollinator species to access pollen and nectar rewards) dominated at high altitude flower communities.

and this would be env. stress??

Separados OK.

We analyse data on plant-pollinator interactions globally and calculate the environmental suitability of all species present at two or more communities to. Our main aim is to leverage that information to test the two competing hypotheses that relate environmental stress and Eltionian niche breadth and whether there is a pattern within and across species. Specialist species can become "facultative" generalists to reduce their vulnerability to the absence of preferred partners (for example, when variations in climate de-couple phenologies; Benadi et al. 2014). We therefore also expect that as environmental stress increases species with a relatively small number of partners are more likely to broaden their range Eltonian niche. Species with a large number of partners, on the other hand, should have a larger pool of available partners and might, therefore, be more likely to narrow their niche under environmental stress. Importantly, when testing these hypotheses, we control for the potential effects of the environment in community composition and the size of the species fundamental niche, both from an Eltonian

for what?

revisa

any pattern.

not clear, become more generalists you mean?

Acá repetiría la idea de que esta reducción de nicho sería el concentrarse en partners que traen más beneficios.

Does this mean that you control for the fact that the hosts (or interacting partners) are present or not? And their abundances??

(interactions) and Grinellian (environment) perspective.

Methods

We retrieved plant-pollinator networks from the Web of Life database (Fortuna, Ortega, and Bascompte 2014). This database contains datasets originating from 57 studies published in the primary literature between 106 and 2016 (Kaiser-Bunbury et al. 2010; Bartomeus, Vilà, and Santamaría 2008; Arroyo, Primack, and Armesto 1982; Hattersley-Smith 1985; Barrett and Helenurm 1987; Dicks, Corbet, and Pywell 2002; Dupont, Hansen, and Olesen 2003; Elberling and Olesen 1999; Herrera 1988; Hocking 1968; Inouye and Pyke 1988; Kato et al. 1990; Medan et al. 2002; Memmott 1999; Motten 1986; Olesen, Eskildsen, and Venkatasamy 2002; Ollerton 2003; Petanidou and Vokou 1993; McMullen 106AD; Mosquin 1967; Clements and Long 1923; Kevan 1970; Small 1976; Montero 2005; Stald, Valido, and Olesen 2003; Ingversen 2006; Bundgaard 2003; Bek 2006; KATo 2000; Dupont and Olesen 2009; Lundgren and Olesen 2005; Percival 1974; Philipp et al. 2006; Primack 1983; Ramirez 1989; Ramirez and Brito 1992; Schemske et al. 1978; Smith-Ramírez et al. 2005; Vázquez 2002; Robertson 1929; Ferreira Canela 2006; Kohler 2011; Lasprilla and others 2003; Sabatino 2010; Lara 2006; Las-Casas, Azevedo Júnior, and Dias Filho 2012; del Coro Arizmendi and Ornelas 1990; Abreu and Vieira 2004; Vizentin-Bugoni et al. 2016; Kaiser-Bunbury et al. 2014; Bezerra, Machado, and Mello 2009; INouE et al. 1990; KATo, Matsumoto, and Kato 1993; Yamazaki and Kato 2003; Gutierrez Z, Rojas-Nossa, and Stiles 2004; Kato and Miura 1993; Kakutani et al. 1990). Calculating the environmental stress of species in their community and their Eltonian niche breadth requires that the scientific names used to identify them are valid and unambiguous. This is because valid scientific names are necessary to both accurately match species across studies and to obtain other information from biological databases. However, a significant proportion