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SHORT COMMUNICATION



Rattus rattus, a potential threat to the endangered tree *Gomortega keule* in the Maulino forest of Chile

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ABSTRACT

Gomortega keule is an endangered tree species, the single extant species of a monotypic family. It is safeguarded only in one protected area. Its recruitment and germination are low, possibly in part because rodents prey on the seeds. However, it remains unknown if any rodent preys upon its large fruit and if so, to what extent. In this work we aimed to evaluate the interaction and possible predation of the invasive species *Rattus rattus* on *G. keule*. We recorded with camera traps the visits and behaviour of different animal species with the fruit of *G. keule*. We obtained a total of 90 records. The only animal species that interacted with the fruit during the 14-day observation period was *R. rattus*, eating and carrying away the fruit. This could constitute an additional threat to *G. keule*. Despite the evidence of seeds chewed by rodents, it would be useful to document the fates of seeds to confirm our conclusions and understand this interaction. However, in the meantime we recommend increasing propagation and protection of seedlings, and also taking actions against *R. rattus* in the only protected area where this endangered tree is present.

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Introduction

Gomortega keule, the single representative of the monotypic family Gomortegaceae, is an endangered tree species. Restricted to the Coast Range of central Chile from 35°47'S to, 37°41'S, with a total population of approx. 1000 mature individuals, its estimated area of occupancy is 300 km² (Echeverría and Campos 2019). Their scattered populations are threatened by land use changes, including forest replacement by forestry plantations, and risk of fires (Le Quesne and Stark 2006). Lack of seedling recruitment is an additional threat, due mostly to scant germination, and presumably some degree of seed predation by rodents (Le Quesne and Stark 2006; Muñoz-Concha and Davey 2011). However, it remains unknown if any rodent preys upon its large (2–5 cm diameter) fruit and if so, to what extent.

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Gomortega keule is currently safeguarded only in a 145 ha national reserve (Muñoz-Concha et al. 2015), and might be threatened within this protected area by the presence of the introduced black rat *Rattus rattus* (Saavedra and Simonetti 2005). Invasive species are well known to have negative impacts on native flora. In particular, invasive rodents like *R. rattus* reduce the recruitment of native species and may act as seed predators (Shaw et al. 2005; Meyer and Butaud 2009), thus being a menace to the survival of *G. keule* despite its protection from other threats.

Dispersion or predation by rodents can occur depending on many ecological factors. One factor is the size of the seed relative to the size of the rodent: small seeds tend to be dispersed while large seeds tend to experience higher predation pressure (Brewer 2001). The negative effects of invasive species such as the black rat (*R. rattus*) on seed survival and seedling recruitment in other native plant species tend to be higher than the effects of native species (Meyer and Butaud 2009; Morales et al. 2015).

Here we present for the first time evidence of the interaction of the invasive species *R. rattus* with the endemic and endangered *G. keule* through consumption of its fruit and the possible predation of its seeds.

Methods

Seeds of *G. keule* fall in aggregates near the base of the parental tree. In order to assess if *R. rattus*, or any other animal species, preys upon the fruit of *G. keule*, we recorded species visiting groups of seeds under four different trees of *G. keule*, between late November and early December, 2016. This work was conducted at Los Queules National Reserve (LQNR), a 145 ha protected area in the Maule region central Chile. We set camera traps (Bushnell Trophy Cam, Bushnell Corporation, USA) at 1.5 m from a group of 20 fruits. Camera traps were set to record a 25 s video and were active on average, for 14.5 (\pm 2.1 s.e.) days. Recording sites were at least 100 m apart. From recordings, we estimated the relative frequency of visits per species recorded and classified their behaviour toward the fruits as eating the fruit, carrying the fruit away from the parent tree, and no interaction with the fruit (e.g. passing across the site). Records of the same species were considered as independent when there was at least a 1 h interval between them (following Bowkett et al. 2008).

Results

A total of 90 records of eight vertebrate species that visited the fruit patches were gathered (Table 1). The relative frequency of visits was highest for *R. rattus* (0.55 ± 0.15 s.e.) followed by the Falkland thrush, *Turdus falcklandii* (0.38 ± 0.03 s.e.) and a lower rate for other species (Figure 1). *R. rattus* was also the only species that interacted with the fruit of *G. keule* (Figure 2A) either eating it (25% of records) or carrying it away (33% of records). Native birds and small mammals did not interact with the fruits (Table 1). All *G. keule* fruits had been removed or consumed by the time we removed the camera traps (Figure 2B,C).

Discussion

The invasive *R. rattus* prey upon the endangered *G. keule*, this being, to our knowledge, the first report of a small mammal interaction with fruit of *G. keule*. At places where it

Table 1. Behaviour of different species expressed as percentage of total records.

Species	Taxon	Origin	Number of records	% Eat the fruit	% Carry away the fruit	% Passing or observing
<i>Rattus rattus</i>	Mammal	Exotic	44	25%	32%	43%
<i>Abrothrix longipilis</i>	Mammal	Native	1	0%	0%	100%
<i>Pudu puda</i>	Mammal	Native	1	0%	0%	100%
<i>Turdus falcklandii</i>	Bird	Native	26	0%	0%	100%
<i>Pygarrhichas albogularis</i>	Bird	Native	1	0%	0%	100%
<i>Pteroptochos castaneus</i>	Bird	Native	3	0%	0%	100%
<i>Aphrastura spinicauda</i>	Bird	Native	1	0%	0%	100%
<i>Patagioenas araucana</i>	Bird	Native	13	0%	0%	100%

has been introduced, *R. rattus* is regarded as both a seed predator and disperser (e.g. Abe 2007; Shiels and Drake 2011). Their behaviour depends on many factors, such as the size of the fruit or the seed and the number of seeds. Small fruits/seeds tend to be dispersed by endozoochory while large fruits may be dispersed if rodents discard the seeds without eating them (Shiels and Drake 2011). Therefore, there is high variability in traits that can define the fate of the fruits/seeds (Abe 2007; Shiels and Drake 2011; Shiels and Drake 2015). Since the fruit of *G. keule* normally present one seed inside the endocarp, the probability that a seed would be discarded is low. Thus *G. keule* seeds likely face a greater risk of predation than do similar sized seeds of species with multi-seeded fruits (see Shiels and Drake 2011). Rodents that hoard fruits and seed are recognised as dispersers. To our knowledge, *R. rattus* are not hoarding rodents (Meyer and

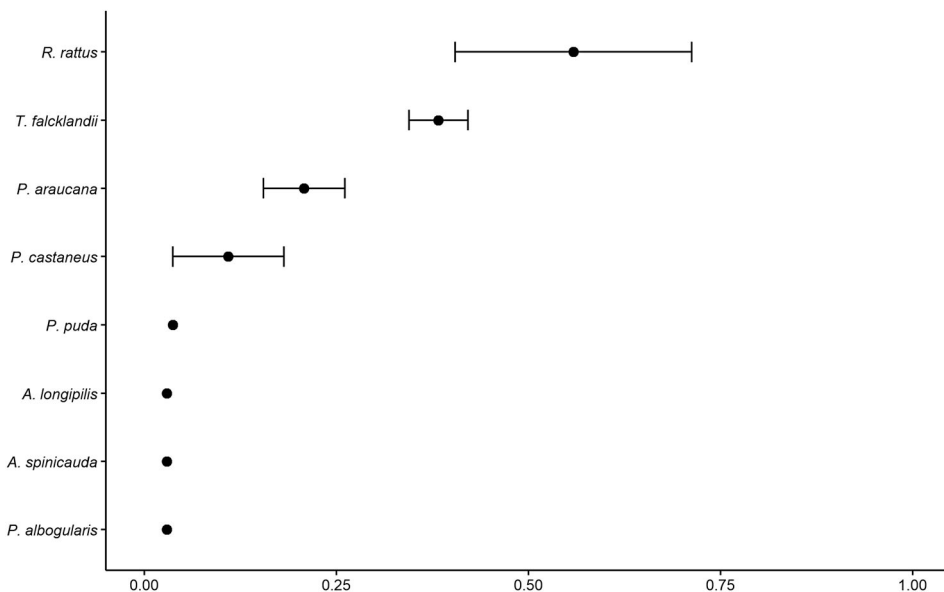
**Figure 1.** Relative frequency of visits of different species. Dot indicates the average frequency of the total visits. Bars indicate standard error.



Figure 2. Photos of camera trap. Letter **A**, shows the black rat carrying the fruit of *G. keule*. **B** and **C**, show the removal of fruits of *G. keule* at the beginning of records **B**, and the end of records **C**.

Butaud 2009), suggesting that it might account for a high fraction of seed mortality. *G. keule* seedlings were recorded only below parent trees in 2016, supporting the idea that *G. keule* cannot be dispersed by modern fauna. The absence of seedlings away from parent trees also suggests that removal of fruits does not lead to successful seed germination, perhaps due to seed predation.

The abundance of other rodents such as *Abrothrix longipilis* and *Oligoryzomys longicaudatus* is higher than *R. rattus* (Saavedra and Simonetti 2005). Although there are no studies of granivory on *G. keule*, these rodent species seem to consume other seeds like those of *Nothofagus obliqua* and *Gevuina avellana* (Murúa et al. 1980; Donoso et al. 2004). Lack of interest by these other rodent species could imply that chewed *G. keule*



Figure 3. Photograph of seeds of *G. keule* chewed by *R. rattus*. Photograph taken by Fundación Keule, city of Tomé, Chile.

seeds found by Le Quesne and Stark (2006) were preyed upon by *R. rattus*. New evidence of chewed seeds of *G. keule* by *R. rattus* (Figure 3) was reported south of the Los Queules National Reserve (personal observation of *Fundación Keule*). Nevertheless, further experimental studies (see Shiels and Drake 2015) are necessary to determine the fate of seeds of *G. keule* to understand this interaction.

Therefore, in addition to the threats of land use change, fires and exotic forestry plantations, *R. rattus* could be regarded as an additional threat for this endangered tree even within a protected area. In addition to the potential effect on *G. keule*, *R. rattus* could be affecting predation on other seeds (Donoso et al. 2004) as well as predation on bird nests (Vergara and Simonetti 2003). Our findings, along with the lack of seedling recruitment of *G. keule* (Muñoz-Concha and Davey 2011; Muñoz-Concha et al. 2015), are relevant to the conservation and fate of this endangered tree. Implementing a programme to control *R. rattus* in the Los Queules National Reserve seems mandatory, in parallel with greater efforts of propagation and protection of seedlings to increase the success of this species, which are required if the single representative species of the family Gomortegaceae is to be saved from extinction.

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Disclosure statement

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References

- Abe T. 2007. Predator or disperser? A test of indigenous fruit preference of alien rats (*Rattus rattus*) on Nishi-jima (Ogasawara Islands). *Pacific Conservation Biology*. 13:213–218.
- Bowkett AE, Rovero F, Marshall AR. 2008. The use of camera-trap data to model habitat use by antelope species in the Udzungwa Mountain forests, Tanzania. *African Journal of Ecology*. 46:479–487. doi:10.1111/j.1365-2028.2007.00881.x.
- Brewer SW. 2001. Predation and dispersal of large and small seeds of a tropical palm. *Oikos*. 92:245–255.
- Donoso DS, Grez AA, Simonetti JA. 2004. Effects of forest fragmentation on the granivory of differently sized seeds. *Biological Conservation*. 115:63–70. doi:10.1016/S0006-3207(03)00094-6.
- Echeverría C, Campos S. 2019. Gomortega keule. The IUCN Red List of Threatened Species 2019: e.T31357A2805379. doi:10.2305/IUCN.UK.2019-2.RLTS.T31357A2805379.en.
- Le Quesne C, Stark D. 2006. Gomortega keule (Mol.) Baillon. In: Donoso C, editor. *Las especies arbóreas de los bosques templados de Chile y Argentina, Autoecología*. Valdivia: Marisa Cuneo Ediciones; p. 277–284.
- Meyer JY, Butaud JF. 2009. The impacts of rats on the endangered native flora of French Polynesia (Pacific Islands): drivers of plant extinction or coup de grâce species? *Biological Invasions*. 11:1569–1585. doi:10.1007/s10530-008-9407-y.
- Morales NS, Becerra PI, Arellano EC, Gilabert HB. 2015. Efecto de herbívoros mamíferos pequeños y grandes sobre la sobrevivencia de semillas y plántulas en la restauración de *Beilschmiedia miersii* en Chile central. *Bosque*. 36:127–132. doi:10.4067/S0717-92002015000100014.
- Muñoz-Concha D, Davey MR. 2011. Gomortega keule, the neglected and endangered Chilean fruit tree. *European Journal of Forest Research*. 130:677–693. doi:10.1007/s10342-010-0465-1.
- Muñoz-Concha D, Farías C, Méndez J. 2015. Notes on a new population of the endangered Chilean tree *Gomortega keule*. *New Zealand Journal of Botany*. 53:224–230. doi:10.1080/0028825X.2015.1064974.
- Murúa R, González LA, Jofré C. 1980. Experimental food preferences of two southern Chilean rodents. *Journal of Mammalogy*. 61:138–140.
- Saavedra B, Simonetti JA. 2005. Small mammals of Maulino forest remnants, a vanishing ecosystem of south-central Chile. *Mammalia*. 69:337. doi:10.1515/mamm.2005.027.
- Shaw JD, Hovenden MJ, Bergstrom DM. 2005. The impact of introduced ship rats (*Rattus rattus*) on seedling recruitment and distribution of a subantarctic megaherb (*Pleurophyllum hookeri*). *Austral Ecology*. 30:118–125. doi:10.1111/j.1442-9993.2005.01430.x.
- Shiels AB, Drake DR. 2011. Are introduced rats (*Rattus rattus*) both seed predators and dispersers in Hawaii? *Biological Invasions*. 13:883–894. doi:10.1007/s10530-010-9876-7.
- Shiels AB, Drake DR. 2015. Barriers to seed and seedling survival of once-common Hawaiian palms: the role of invasive rats and ungulates. *AoB Plants*. 7. doi:10.1093/aobpla/plv057
- Vergara PM, Simonetti JA. 2003. Forest fragmentation and rhinocryptid nest predation in central Chile. *Acta Oecologica*. 24:285–288. doi:10.1016/j.actao.2003.09.006.