

Responses of an island endemic invertebrate to rodent invasion and eradication

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Abstract

Invertebrates dominate many terrestrial ecosystems in terms of biomass, and they also structure ecosystems through their roles as pollinators, detritivores, primary consumers, predators and prey. Invasive rodents (rats and mice) are known to have detrimental effects on many island invertebrates, although these effects are seldom quantified or ecologically understood. Here we provide evidence of the effects of invasive rats (*Rattus* spp.) on island invertebrate populations using a large-scale natural experiment. We investigated the effects of invasive rats on Falkland camel crickets (*Parudenus* spp.) in the Falkland Islands (South Atlantic) by comparing an index of camel cricket relative abundance between 18 rat-infested islands, six rat-eradicated islands and 13 naturally rat-free islands (in total, 37 islands). Our study provided two key results. First, camel crickets were up to an order of magnitude more abundant on rat-free islands than on rat-infested or rat-eradicated islands. This difference was larger in native tussock grass *Poa flabellata* than in other vegetation types. Second, camel cricket populations recovered after rat eradication, because the relative abundance of camel crickets on rat-eradicated islands was intermediate between those of naturally rat-free and rat-infested islands, and among rat-eradicated islands relative abundance was lowest where rats had been cleared most recently. Our results demonstrate severe suppression of a superabundant and large-bodied island endemic invertebrate by invasive rodents, and its prompt recovery after rodent eradication.

Introduction

A wave of vertebrate extinctions often follows the arrival of invasive rats (*Rattus* spp.) on remote islands (Townes, Atkinson & Daugherty, 2006). As humans have introduced rats to over 82% of the world's island groups, this effect has been a major driver of global biodiversity loss (Atkinson, 1985). In addition to the well-known impacts on vertebrates, a number of studies indicate that predation by introduced rats and mice can severely affect island invertebrate populations, resulting in local suppression or extinction (Townes *et al.*, 2006; Gibbs, 2009). The majority of these studies come from New Zealand, although a handful from other regions suggest that rodent impacts on island invertebrates may be geographically widespread (e.g. Palmer & Pons, 1996; Pridel *et al.*, 2003; Hadfield & Sauffer, 2009). Furthermore, such impacts may be ecologically important – not only do island invertebrate species often exhibit a high degree of endemism and thus have inherent conservation value, but they can also be vital for ecosystem functioning, with key roles as pollinators, detritivores, primary consumers, pre-

dators and prey (Seastedt & Crossley, 1984). Despite this, island invertebrates are frequently overlooked in conservation research and management, with a disproportionate bias in attention and effort towards the conservation of charismatic vertebrate species (Clark & May, 2002).

In the Falkland Islands, a South Atlantic archipelago of several hundred islands, which contains no native land mammals, relatively little is known about the ecological impact of invasive rodents. One study has shown that most native songbird species are more likely to be absent on islands where rats are present, and these detrimental effects (and putative impacts on seabirds) have motivated a programme of rat eradications (Hall *et al.*, 2002; Hilton & Cuthbert, 2010). However, the effects of invasive rats (and their eradication) on the invertebrate fauna of the Falkland Islands has never been studied.

We investigated the effects of rat invasion and eradication on the Falkland Islands' endemic *Parudenus* camel crickets (Orthoptera: Rhaphidophoridae), which are among the largest terrestrial invertebrates to occur there, having a body length of over 20 mm (Jones, 2004). As well as being

large-bodied, camel crickets are both widespread and remarkably abundant in the Islands and are thus likely to be important to native ecosystem processes (Gaston & Fuller, 2008). Likely functions within the ecosystem include nutrient cycling and acting as a major prey group for vertebrate predators, roles which the Orthoptera are known to fulfil in other systems (e.g. Samways, 1997).

We anticipated rat impacts on Falklands camel crickets for several reasons. Firstly, a negative association between the presence of invasive rodents and the abundance of camel crickets has been anecdotally noted (Alex Jones, pers. comm.). Secondly, studies elsewhere suggest that population-level impacts of rats may be most severe for large-bodied invertebrates, particularly those with a rodent-free evolutionary history (Gibbs, 2009). Thirdly, the New Zealand case study suggests that the Orthoptera – which includes weta and giant weta (Orthoptera: Anostostomatidae) – are particularly vulnerable to predation by introduced rats (Meads, 1990).

To investigate the apparent association between rats and camel crickets we used a cross-island quasi-experimental approach, by installing standardized grids of pitfall traps on islands which were rat infested, naturally rat free or recently cleared of rats. By incorporating islands on which rats once occurred but have since been eradicated into the natural experimental design, factors such as anthropogenic disturbance which might simultaneously favour, for example, rat presence and camel cricket absence can be more confidently discounted. The design also allowed us to investigate whether, if camel crickets are adversely

affected by rat presence, the effect can be reversed by rat eradication. The reversal of the detrimental effects of invasive species is a key objective of eradication programmes, and of restoration ecology in general, but this reversibility is often assumed rather than explicitly tested (Simberloff, 1990).

Methods

Study sites

The Falkland Islands are an archipelago of two principal islands (East and West Falkland) and over 750 smaller islands in the South Atlantic Ocean, located *c.* 500 km east of continental South America. The anthropogenic introduction of exotic rodents (Norway rats *Rattus norvegicus*, ship rats *Rattus rattus*, and house mice *Mus musculus*) to many of the Falkland Islands has created a natural experiment; furthermore, since 2001 *R. norvegicus* populations have been successfully eradicated from ~25 islands (Hilton & Cuthbert, 2010). During the Austral summer of 2008/09, we visited 37 islands across the Falkland Islands archipelago (Fig. 1). Of these, 13 were naturally rat free, 18 contained extant rat populations, and rat eradication had taken place on six. These eradications were achieved using brodifacoum poison bait, and took place between one and seven years before data collection for the current study. Rats have been present on the Falkland Islands for at least 175 years, although the exact dates of colonization are unknown (Woods & Woods, 1997). Sampled islands ranged from 1 to

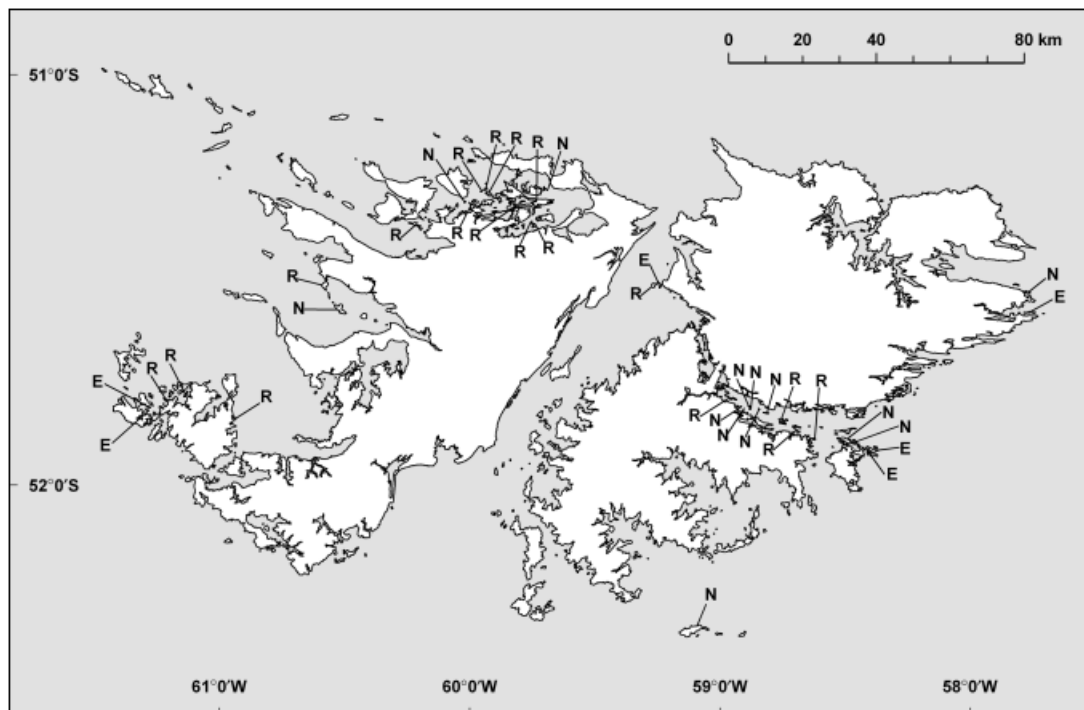


Figure 1 The Falkland Islands, showing distribution of study islands. R, rat-infested islands; N, naturally rat-free islands; E, rat-eradicated islands.

905 ha, with a median size of 16 ha. Sampling took place over a 2-month period, from 7th October to 12th December 2008. Data on rat presence were confirmed in all cases by searching for sign including burrows, droppings and tracks. In the Falkland Islands, these signs are usually very obvious and it is possible to categorize an island as rat free or rat infested within a few minutes of arrival.

Study species

The Falklands camel crickets *Parudenus* spp. comprise a genus endemic to the Falkland Islands, and are the only Orthoptera to occur there (Jones, 2004). The taxonomy of the genus has not yet been resolved (Eades & Otte, 2010), and as it may prove monotypic we use the term ‘camel crickets’ for the taxon throughout this paper.

No attempt was made to identify the species of rat at each island, but within the Falkland Islands *R. rattus* is only known to occur on New Island (Woods & Woods, 1997), which was not sampled; thus it is probable that the rat-infested islands in our study harboured only *R. norvegicus*. The distribution of *M. musculus* in the Falkland Islands is relatively unknown, with mice being confirmed as present on only seven islands in the archipelago (Falklands Conservation, unpublished database), and while none of these were included in our study we cannot discount the possibility that mice were present but undetected on some of our study islands.

Data collection

At each island, we installed a grid of pitfall traps consisting of eight lines of five traps, each line perpendicular to the coast. In each line, the five traps were placed at 0, 5, 20, 50 and 100 m distant from the first permanent vegetation above the high tide line. On very small or narrow islands (<200 m wide) the final trap was omitted, giving a line of four traps at 0, 5, 20 and 50 m inland. The spacing of traps within traplines was coastally biased because in the Falkland Islands the distributions of both rats and tussac grass (a key native habitat) are also coastally biased. Trap lines were placed 200 m apart, and on smaller islands (<1600 m circumference) this spacing was reduced as necessary to accommodate all eight lines of traps. In statistical models we used island area as an explanatory variable to control for the reduction of the study area on the smallest islands, and for potential effects of island area on camel cricket density.

Each pitfall trap consisted of a plastic cup, 8.5 cm depth and 6.5 cm diameter at the lip (volume 215 mL), countersunk to soil level and containing water to a depth of ~3 cm. The water contained a drop of washing-up detergent to reduce surface tension. Each trap had a mesh cover, fixed with wire 2 cm above the trap to deter interference by birds or rodents. At each trap, we recorded the distance from the shore (in metres), and the dominant vegetation type within a 1 m radius of the trap. Five vegetation classes were included; tussac grass *Poa flabellata* (41% of traps); diddle-dee *Empetrum rubrum* (21%); bare soil (8%); and finally, all remaining plant cover types –

generally a mixture of grasses, sedges and herbaceous perennials – were divided into two sward categories, short (<15 cm; 26%) and long (>15 cm; 4%). As vegetation might also affect camel cricket populations at larger spatial scales than our ‘vegetation type’ factor could detect, two further explanatory variables were created and scored for each island; a two-level ‘grazing status’ factor (island currently grazed or ungrazed), and a continuous explanatory variable comprising the proportion of pitfall traps (arcsine transformed) on each island that were located in tussac grass, which is regarded as the natural climax vegetation for coastal regions in the Falkland Islands (Woods & Woods, 1997). We left each trap for two nights, although in some cases we were unable to collect traps until three ($n =$ three islands) or four ($n =$ two islands) nights had passed. We used this extremely short trapping duration to reduce possible effects by which early captures affect the probability of later captures, and the ‘digging-in’ effect by which, over time, pitfall traps deplete invertebrate populations in their immediate vicinity (Digweed *et al.*, 1995). Because ambient temperature can affect pitfall capture probabilities (Southwood & Henderson, 2000), we obtained minimum and maximum night-time temperatures ($^{\circ}\text{C}$) from a meteorological station on East Falkland for the period for which each grid of pitfall traps was active. After collection, all traps were scored as present or absent with respect to camel crickets.

Because of a spatial bias in the distribution of sampled islands – with 72% of sampled rat-infested islands located around West Falkland, and 70% of sampled rat-free islands located around East Falkland (Fig. 1) it was necessary to control for any potential pre-existing geographical bias in camel cricket distribution. To this end a two-level ‘island location’ factor was created, to which islands were assigned according to their location off East or West Falkland.

Data analysis

Presence/absence of camel crickets in pitfall traps formed the response variable. Binary data were used for two reasons; firstly, such data are free from any bias introduced by potential conspecific attraction – in which, individuals may be more likely to enter a trap which has already captured one or more crickets (Southwood & Henderson, 2000) – and secondly, the approach is highly conservative, giving equal weight to traps containing one or many camel crickets and requiring fewer assumptions about data structure (Crawley, 2007). Data were analysed using generalized linear mixed models with binomial errors, fit using maximum likelihood in the lme4 package of Program R version 2.6.2 (R core development team, 2010).

Model 1 – camel cricket capture success

Camel cricket presence/absence at the level of the pitfall trap was modelled as a function of the continuous variables ‘ n trap-nights’, ‘minimum temperature’, ‘maximum temperature’, ‘island area’ (log10 transformed), ‘proportion of traps in tussac grass’ (arcsine transformed) and ‘trap distance from shore’ (square-root transformed), and of the

categorical variables 'rat status', 'observer ID', 'vegetation type', 'grazing status' and 'island location'. First-order interactions between 'trap distance from shore', 'rat status' and 'vegetation type' were also included (as these were judged biologically feasible *a priori*), with 'island ID' retained as a random factor in all models. Initially, 'trap line ID' was included as a random factor nested within 'island ID', but the nested term had a variance of zero and was excluded from subsequent analysis following Bates (2010).

Model 2 – camel cricket capture success, 'rat-eradicated' subset

A second set of models were specified to investigate the effect of time since rat eradication on camel cricket capture success, using only the subset of islands from which rats have been eradicated ($n = 217$ traps on six islands), and incorporating a new explanatory variable ' n years since (rat) eradication'. To avoid over-parameterizing the initial model, terms that had been identified as unimportant using the full dataset in the first (model 1) simplification were excluded *a priori*, and the same pooled factor levels were used. The 'rat status' term was also omitted, as within the rat-eradicated data subset it contained no variation. Finally, ' n years since eradication' and its first-order interaction with 'vegetation type' were included. In the full model, camel cricket presence/absence at the level of the pitfall trap was thus considered as a function of ' n years since rat eradication', 'vegetation type', 'trap distance from shore', and first-order interaction between 'vegetation type' and ' n years since eradication', with 'island ID' retained as a random factor.

Model simplification

To specify minimum adequate models (henceforth MAMs) the data structure was first simplified by pooling redundant factor levels; factor levels were combined when doing so caused no significant increase in model deviance according to χ^2 deletion tests (Crawley, 2007). The resulting (henceforth 'full') model thus contained all terms but no redundant factor levels. Model simplification then followed the suggestion of Crawley (2007) for non-orthogonal study designs: each individual term was deleted from the full model, and a χ^2 deletion test was used to compare the full model with the reduced version: term deletions were rejected if they caused significant increases in model deviance. Terms, which were retained in the MAM are presented with the results of the χ^2 deletion test and the associated change in Akaike Information Criterion (Δ AIC).

Results

Eight hundred and nine camel crickets were captured during 2970 trap-nights on 37 different islands. Of 1365 traps retrieved, 269 captured at least one camel cricket. On seven islands, no camel crickets were captured in any trap; of

these, five were classed as rat-present, two had rat-eradicated status, and none were classed as naturally rat absent.

Model 1 camel cricket capture success, all islands

Full model and simplification

Pooling of factor levels indicated that only one vegetation type ('tussac grass') improved explanatory power relative to the others; all other vegetation types were therefore pooled, forming a two-level vegetation-type factor ('tussac grass' and 'other types'). Similarly, pooling of the rat-status levels 'naturally rat-absent' and 'rat-eradicated' did not reduce explanatory power, and these two factor levels were combined to form a single 'rat-absent' factor level. Removal of the terms 'observer ID'; ' n trap-nights'; 'minimum temperature'; 'maximum temperature'; 'proportion of traps in tussac grass'; 'island area'; 'island location'; 'grazing status'; 'rat status \times trap distance from shore' and 'vegetation type \times trap distance from shore' from the full model did not significantly reduce explanatory power as determined by χ^2 deletion tests and Δ AIC, and so these terms were excluded from the MAM. The MAM thus contained a single continuous term (trap distance from shore), two two-level factors ('rat status' and 'vegetation type') and the interaction between 'rat status' and 'vegetation type'.

MAM

The MAM indicated that camel crickets were less likely to be captured where rats were present than when they were absent, and more likely to be captured in Tussac grass than in other vegetation types (Table 1; Fig. 2). The significant interaction between vegetation type and rat status shows that the negative effect of rat presence was greater in Tussac grass than in other vegetation types. In both vegetation types, camel cricket capture success was lower when rats had been eradicated than when rats had always been absent (Fig. 2), although the difference was not statistically significant and the two factor levels were pooled in the MAM. Finally, there was a weak but highly significant effect of distance from the shore, with camel crickets more likely to occur away from the coast than adjacent to it after other variables were statistically held constant.

Model 2 camel cricket capture success, 'rat-eradicated' subset

Full model and simplification

Removal of the term 'trap distance from shore' and the interaction 'vegetation type \times n years since eradication' did not significantly reduce explanatory power and so they were excluded from the MAM, which thus contained one continuous variable (years since rat eradication) and one two-level factor (vegetation type).

Table 1 Minimum adequate models of the effects of environmental variables on camel cricket pitfall capture success (a) across islands with different rat status and (b) within the subset of rat-eradicated islands

Variable and Levels	Coefficient \pm SE	Δ AIC	χ^2 (d.f.)	P
<i>(a) Full dataset</i>				
Intercept	-2.416 \pm 0.366	-	-	-
Trap distance from shore	+0.076 \pm 0.027	3.39	9.392 (3)	0.0245
Rat status				
Absent	-	10.88	16.889 (3)	0.0007
Present	-1.494 \pm 0.508			
Vegetation				
Other types	-	49.78	55.785 (3)	<0.0001
Tussac grass	+2.104 \pm 0.283			
Rat status \times vegetation				
Absent, other types	-	3.19	5.199 (1)	0.0226
Present, tussac grass	-1.360 \pm 0.568			
<i>(b) Rat-eradicated subset</i>				
Intercept	-11.018 \pm 3.600	-	-	-
Years since rat eradication	+1.431 \pm 0.611	6.56	10.566 (2)	0.0051
Vegetation				
Other types	-	5.18	9.1918 (2)	0.0101
Tussac grass	+2.652 \pm 1.163			

Tables show coefficients (in logits) and associated standard errors. Δ AIC shows the increase that occurred when the variable (and associated interactions) were removed from the full model; χ^2 statistic; degrees of freedom and *P*-values are for comparisons between full and reduced (variable-removed) models.

MAM

The number of years since rat eradication was a strong predictor of camel cricket capture success (Table 1b; Fig 3). This indicates that when other variables such as vegetation type are controlled for, capture success increases during the years following rat eradication. It should be noted that sites were not evenly distributed along the *x*-axis (more islands were cleared five to seven years ago than in the last 4 years) and the single site at which rats were eradicated one year prior to sampling was clearly influential; however, when this site was excluded from the analysis, time since rat eradication remained a significant predictor of capture success ($P = 0.034$).

Discussion

We found that pitfall capture success of *Parudenus* camel crickets in the Falkland Islands was lower on rat-infested islands than on naturally rat-free islands, with the probability of capturing at least one camel cricket in a given trap estimated at over ten times higher for traps on rat-free islands in tussac grass, and over four times higher in other vegetation types. Furthermore, the capture success on islands from which rats had been eradicated was intermediate between those of rat-infested and naturally rat-free islands, strongly suggesting a causal link between rat presence and camel cricket capture success. Consistent with this finding, capture success on rat-eradicated islands increased with the amount of time since the eradication took place.

The higher capture success in tussac grass habitat, regardless of rat status, suggests that this is the favoured habitat of camel crickets as reported by other workers (Woods, 1970; Jones, 2004), and the interaction between rat presence and

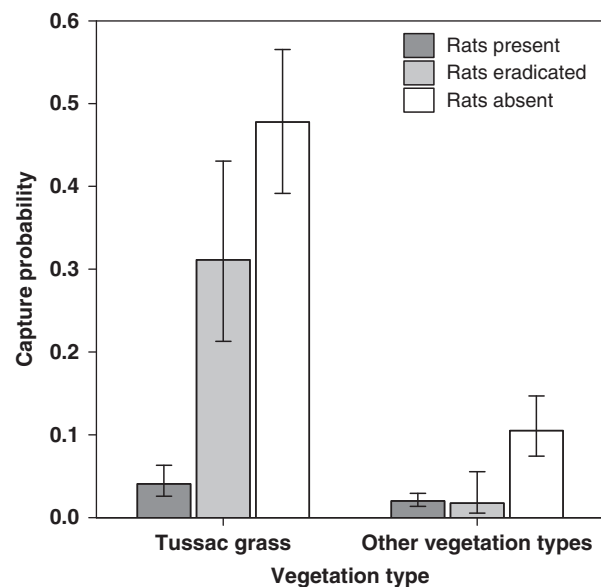


Figure 2 Effect of rat status and vegetation type on the probability (\pm SE) that pitfall traps contained one or more camel crickets; fits from a model identical to the MAM, but with 'rat-eradicated' and 'rat-absent' not pooled to form a single level as in the MAM. In calculating the model fits 'trap distance from shore' was set to zero. Pairwise comparisons within vegetation types were all highly significant ($P < 0.0006$) apart from 'rats absent' vs 'rats eradicated' (both vegetation types) and 'rats eradicated' and 'rats present' (non-tussac traps only).

vegetation type in their effects on capture success is consistent with the finding that rat densities are also highest in tussac grass habitat (Darren Christie, pers. comm.). The

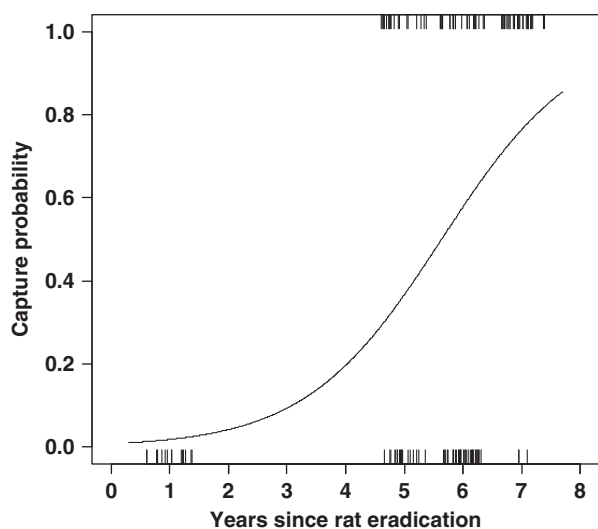


Figure 3 Binomial logistic regression of cricket capture success against number of years since rodent eradication occurred, for traps in Tussac grass only; plot shows fitted line, with position of actual presence/absence data indicated by rugs (with jitter) on the x-axes.

weak positive relationship between capture success and the distance from the shoreline may indicate an aversion to the elevated salinity (due to sea-spray) of near-shore habitats, or possibly an effect of predation, as rats and most insectivorous songbirds occur at their highest density adjacent to the shore (Darren Christie, pers. comm., Woods, 1970).

Interpretation of pitfall capture success data

Here we interpret pitfall capture success of camel crickets – within vegetation types – as an index of relative abundance. Several assumptions are implicit in this interpretation, which arise from the fact that the probability of pitfall capture is a function of both the abundance and activity level of the focal species; thus, the relationship between relative abundance and capture success may be confounded by factors that affect activity levels. Potential confounds include relationships between early captures and the probability of subsequent captures, differences in vegetation structure between islands of different rat status and behavioural responses to increased predation risk.

We are confident that the extremely short trapping duration and use of presence/absence data ensure that associations between early and late captures can be discounted as major sources of variation. We are also confident that the use of three vegetation-based explanatory variables ('vegetation type', 'proportion of traps in tussac grass' and 'grazing status') has adequately controlled for any potentially confounding differences in the vegetation of rat-infested, rat-eradicated and naturally rat-free islands; in fact, once vegetation type around the pitfall trap was accounted for, neither the proportion of tussac grass in the study area nor the grazing status of the island had explanatory power.

Finally, changes in prey activity levels may arise in response to differences in predator communities, as has been recorded in other Orthopteran taxa (Pitt, 1999; Rufaut & Gibbs, 2003). Although we cannot discount the possibility that rat presence causes reduced activity in *Parudenus* camel crickets, it seems improbable that such an effect would account for the order-of-magnitude differences in capture success between rat-infested and rat-free sites.

The impact of rats on camel crickets

The difference in pitfall capture success between rat-infested and rat-free islands strongly indicates a severe reduction in camel cricket abundance when rats are present, and is likely to reflect top-down regulation of camel cricket populations by invasive rats via predation. This population suppression may serve to increase the risk of local extinction, particularly on small islands where absolute population size may be relatively small and the impacts of stochastic disturbance (e.g. climate, inundation, fire) correspondingly large. The capture of at least one camel cricket (with a moderate effort of ~80 trap-nights per island) on 13 of the 18 rat-infested islands we surveyed suggests that camel cricket populations are usually not driven to extinction by rat introduction, although our results are consistent with occasional local extinctions.

The high capture success on rat-free islands, particularly in tussac grass (where approximately half of traps contained at least one camel cricket after only 2 days), suggests that camel crickets are remarkably abundant in these habitats. Invertebrate communities in the Falkland Islands are highly depauperate, and there is likely to be little redundancy within functional groups (Rosenfeld, 2002) – in fact, fewer than 300 insect species are known from the whole archipelago (Jones, 2004). On the basis of their abundance, large body size and phylogenetic and morphological uniqueness, it is probable that camel crickets have functional importance in terrestrial Falkland Islands ecosystems, and that their suppression by invasive rats is likely to indirectly affect other ecosystem properties. The functional roles of camel crickets remain to be investigated, but may include the decomposition of dead vegetation and other detritus, predation on smaller invertebrates, and forming a prey-base for native insectivorous birds such as the endemic Cobb's Wren *Troglodytes cobbi* (Cawkell & Hamilton, 1961; Jones, 2004). We note that the majority of Falkland Islands songbirds are negatively associated with rat presence, in particular Cobb's Wren which does not occur on islands with rats (Hall *et al.*, 2002). Disjunct distributions of birds and rats are usually attributed to predation by rats of individual birds or nests, but evidence for a direct interaction is lacking in most cases and our results highlight another candidate mechanism, that of competition between native birds and invasive rodents for invertebrate prey.

Recovery after rat eradication

Crucially, our results suggest that rat eradication has quick and measurable benefits for camel cricket populations, with capture success on islands from which rats have been

eradicated resembling that on naturally rat-free islands more than that on rat-infested islands after less than a decade.

Given their likely roles as detritivores, predators and prey, the recovery of camel cricket populations after rat eradication may facilitate the recovery of other taxa and of whole-island ecosystems. Our data strongly suggest a prompt recovery of camel cricket populations following rat eradication, taking a few years at most. It should be noted, however, that on two islands from which rats had been eradicated no camel crickets were captured during our study. Although it is probable that the taxon does exist at relatively low abundances on these islands, its apparent absence raises a perennial caveat of restoration ecology; once a species has been extirpated from an island, it must first recolonize before recovery can begin (Townes, 2009). The recolonization ability of camel crickets is unknown, but they are wingless, and natural recolonization over long distances may well be an infrequent event, although certainly feasible via rafting, hitch-hiking on birds, or very high winds. If it is ever confirmed that rats have extinguished a camel cricket population, translocation of new founders from nearby populations (following rat eradication) would be a straightforward solution.

Conclusions and future directions

Very little is known about Falkland Islands terrestrial ecosystems in general, or *Parudenus* camel crickets in particular, and our results highlight some potentially productive research avenues. The number and distribution of *Parudenus* species, and whether each is affected equally by rat presence, have not yet been determined but should any distinct taxon prove to have a restricted or single-island range it would clearly be a priority for conservation management. The effects of mice remain unknown, and the potentially differing effects of the two *Rattus* species on camel crickets could not be distinguished with the data available, but such knowledge may prove useful in the prioritization of rodent eradications. We did not attempt to determine the mechanism by which rats affect camel crickets, and although direct predation is the strongest candidate, quantitative dietary studies of rats – for preference in both early and late stages of rat invasion – are required to confirm the predation hypothesis.

We suggest that investigation of the functional roles of rodent-vulnerable island invertebrates would be rewarded by a deeper understanding of the indirect consequences of rat invasion, both for individual species and for ecosystem properties. In the Falkland Islands the role of *Parudenus* camel crickets in soil processes could be easily investigated experimentally, while their importance as a food for native birds would be straightforward to establish with quantitative diet studies.

Finally, our results suggest that the relatively well-documented suppression of many of New Zealand's endemic invertebrates following rodent invasion is not necessarily exceptional, and that comparable impacts of rodents on

island invertebrates in other regions may be more common and widespread than is usually appreciated. We suggest that practitioners of island conservation and restoration around the world should routinely consider the potential for rodent-invertebrate interactions, to complement the ongoing focus on vulnerable vertebrate species.

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