Project Update: April 2018

Here, we summarize the field and lab measurements that have been done during the first year of the project (2017). We describe the activities and methods as well as present some preliminary results. Furthermore, we included descriptive field photographs in a supplementary material.

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Introduction

The colonial tuco-tuco is a group-living subterranean rodent whose geographic range is restricted to near 700 km2 in Nahuel Huapi National Park, Argentina. This endemic Patagonian rodent is categorized as critically endangered. Increasing grazing by livestock and emerging effects of climate change threaten the future of this species. The proposed project consists of a long-term monitoring program, in which, regular monitoring of tuco-tuco abundance, estimation of number of social groups, and habitat conditions will be used to quantify the effects of livestock and environmental change on *C. sociabilis*, to develop guidelines for the sustainable management of this species within the National Park.

Three habitat condition variables were identifying that the livestock might negatively modify at expenses of the tuco-tuco persistence: plant composition, plant biomass, and soil compaction. Livestock (primarily sheep) can alter plant species composition and biomass by reducing or even eliminating pasture cover that, with the time can be replaced by invasive herbs or even get desertificated as have occurred in extensive areas of Patagonia (Veblen et al. 1992; Perelman et al. 1997). Livestock (primarily cows) can also alter soil characteristics such as compaction, reducing the soil moisture retention, a key property affecting burrowing cost in subterranean rodents (Vleck 1979; Lovegrove 1989).

General activities

To test the impact of livestock on tuco-tuco colonies, during June-July of 2017, we established 1-ha enclosures in two paddock sites: Rincón Chico and Mallin Frisón at Estancia Fortín Chacabuco, where populations of the colonial tuco-tuco occurs (Fig. 1). Enclosures were constructed using conventional fence materials (hard wires and wooden poles) effectively use by local ranchers to exclude areas and manage livestock in the countryside's (see picture in supplementary material). Adjacent to each enclosure, a 1-ha control area was delimited with plastic stacks in the corners, in which the livestock (cow and sheep) can pasture freely. By comparing habitat variables (described below) in enclosures and control areas we will be able to assess the effect of livestock on the plant community, soil properties, and on the tuco-tuco population as well.

To assess the effectiveness of livestock exclusion in the 1-ha enclosure areas, a 1.5-m length pole provide with two camera traps was mounted in the center of each enclosure, and in the 1-ha control areas. Additionally, fences are periodically checked for possible breaks. In total 4 camera traps were settled per paddock sites (supplementary material). As fences are intended to prevent entrance of livestock into the 1-ha enclosure, we expect to capture only native mammals (guanaco, red-fox, edentates) as well as introduced species (hare, red-deer), which are capable of jumping or squeezing through the fence.

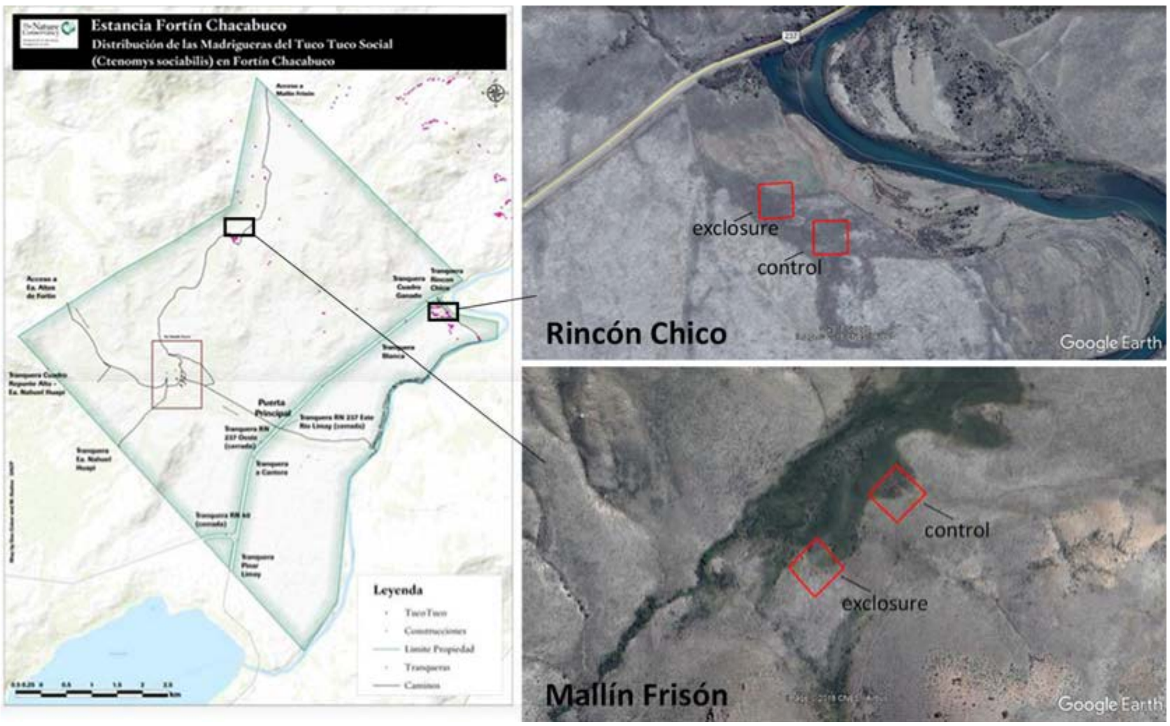

Figure 1: Map of studied sites in the Estancia Fortín Chacabuco. Location of enclosures and control areas are shown.

Specific methods

Habitat conditions baseline data

To confirm that habitat conditions did not differ a-priori in the selected areas where the enclosures and control areas were set, we conducted a baseline data collection, in May and September of 2017, before livestock was moved in each paddock sites. At each 1-ha enclosure and control area at both sites, we established nine 4-m square plots in which we measured vegetation cover, plant biomass and soil compaction. Additionally, we counted the number of non-native herbivore's feces (hares, deer, horse, cow and sheep) as an indicator of habitat use by these animals. Vegetation cover was visually estimated per plant species as percent cover following the classic Braun-Blanquet method (Wikum & Shanholtzer 1978; see Supplementary material). Plant biomass was estimated by cutting the aerial part of all plants present in a 50x50-cm plot situated adjacent to each vegetation cover plot (Catchpole & Wheeler 1992). Plant materials were then dried in a laboratory oven at 60 °C for 48hrs, and weight. Finally, soil compaction was estimated by extracting a 500-cm3 of soil near each biomass plot. Soil was immediately dried in a laboratory oven at 60 °C for 48hrs and then weighted and the compaction was estimated as the dry weight. In equal volume, compact soil will weigh more than loose soil.

Plant community was compared among enclosures and control areas using nonparametric multivariate analyses of similarity (ANOSIM; Clarke 1993), while plant biomass and soil compaction was compared with Mann-Witney *U*-test as implemented in computer package PAST 3.01 (Hammer et al. 2001). Nonmetric multidimensional scaling (NMDS) and box plots were used to graphically show the results. Throughout the text, means are reported ± 1 SD. unless otherwise indicated, $\alpha = 0.05$. When the same statistical test was used multiple times, α was adjusted using the Bonferroni correction procedure (Rice 1989).

Monitoring of tuco-tuco's populations

Due to the subterranean life of the tuco-tuco it is difficult to obtain the number of animals that are present in an area in other way than catching all the animals. But an estimation of animal abundance can be easily obtained taken advantage of the surface evidences as burrow entrances and mounds made by the animals. The number of burrow entrances is known to be positively related to the number of animals, thus providing a good indicator of animal abundances (E. Lacey comm. pers.).

Data collection will happen annually after the weaning of the pups that occurs during the austral spring in November, and the tuco-tucos activity in the surface is easy to detect (Lacey et al. 1997).

During November-December of 2017 tuco-tuco abundance was estimated by counting the number of active burrow entrances and fresh mounds in enclosures and control areas at each paddock sites.

Field work consisted of a 4-days consecutive monitoring of tuco-tuco activity per area (enclosure and control area) at each paddock site. Tuco-tuco activity was assessed by placing small twigs in the entrances of the burrows, which were marked with flags. The twigs would be displaced if an animal emerged (typically about one body length) from a burrow, thus indicating that the burrow entrance is active. The twigs were checked several times per day along the 4-days monitoring and every time a twig was displaced an extra flag was placed as well as the twig. From the beginning of the monitoring, all new tuco-tuco mounds were also marked with a flag. In addition, the 1-ha area was checked daily for evidence of new burrow entrances or mounds. The number of active burrows and fresh mounds were then estimated during the last monitoring day by counting all burrow entrances with more than two flags and a GPS waypoint was recorded at the burrows location.

Food-availability around tuco-tuco's burrows

Tuco-tuco are herbivores animals that feed primarily on surface-growing vegetation by opening a burrow entrance and then cropping surface vegetation growing within roughly 1 body length of that entrance (Busch et al. 2000; Lacey & Wieczorek 2003). To evaluate for potential changes on tuco- tucos food items vegetation cover, we conducted a vegetation sampling during the annual monitoring of the tuco-tuco populations. Sampling consist of 10 1-m square plots to estimate food items cover. Locations of sampling plots were determined by random with the criteria that each plot contain ≥2 active burrows. Food-availability was visually estimated per plant species as percent cover as mentioned above, with emphasis on those plant species that tuco-tuco use to feed (E. Lacey and M. Manacorda comm. pers.).

Results and discussion

Habitat conditions baseline

The ANOSIM analysis shows that when the study began there were no differences in vegetation cover between enclosures and control areas in either paddock sites. This analyses compute an R statistic that provides a quantitative measure of the difference between data sets, with values ranging from 0 to 1; R-values approaching 1 indicate that the data sets are strongly differentiated. The R- value for Rincón Chico and Mallín Frisón were 0.02 ($p = 0.94$) and 0.23 ($p = 0.02$) respectively. The nonmetric multidimensional scaling (NMDS) ordination (based on the Bray–Curtis dissimilarity index) shows the similarity in plant species composition for enclosures and control areas (Fig. 2).

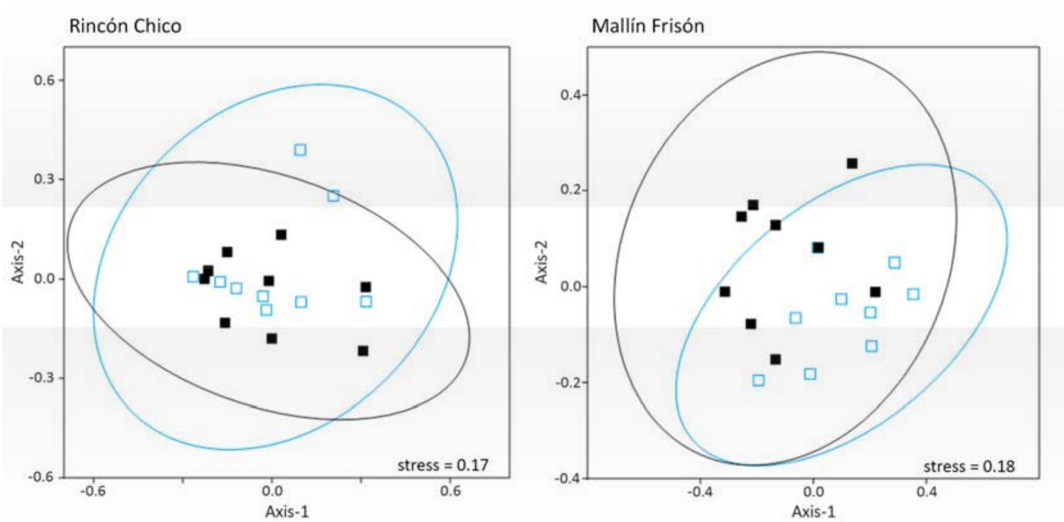

Figure 2: NMDS ordination plots for enclosures (fill square) and control area (square). 95% confidence interval ellipses are shown. The stress value denotes the fit between the data matrix and the 2-dimensional plane; a high stress value (> 0.3) indicates a poor fit and suggests that the NMDS representation distorts the underlying data.

Similarly, plant biomass and soil compaction did not differ between enclosures and control areas for either of the sites (Mann-Whitney U-test al p-values > 0.05, Fig. 3). This indicates no differences in plant biomass and soil compaction between studied areas prior to the livestock entrance.

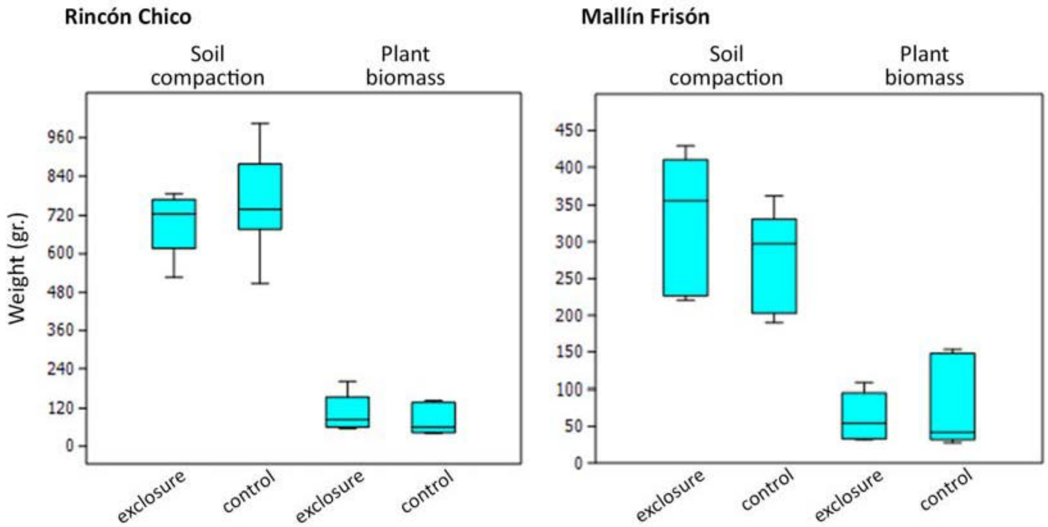

Figure 3: Box plots depicting soil compaction and plant biomass measures for enclosures and control areas. The 25-75 percent quartiles are drawn using a box. The median is shown with a horizontal line inside the box. The minimal and maximal values are shown using "whiskers".

Monitoring tuco-tuco populations

Data on the first monitoring of tuco-tuco activity and food availability around the burrows systems are under analysis but preliminary results suggest that the number of active burrows between enclosures and control areas were similar during the 2017 season. Total number of active burrows at Rincón Chico was 139 and 102 in enclosure and control area respectively, while at Mallín Frisón there were 189 and 168 active borrows, respectively (Fig.4). By exporting GPS´s records of active burrows to a Geographic Information System (GIS) and using some spatial algorithm will be able to have an estimation of the number of social units "colonies" at each area.

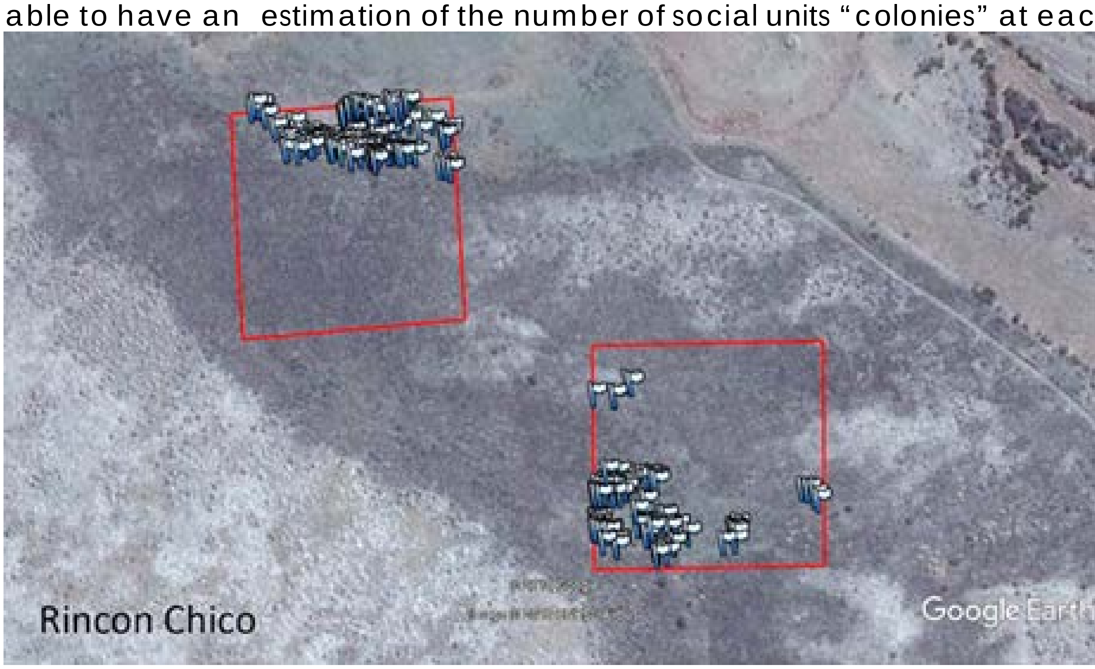

Figure 4: Distribution of active burrow systems identified during the 2017 monitoring.

Next steps

Effects of livestock on habitat condition
We plan to measure the effects of livestock on the plant community and soil compaction annually, immediately after the livestock is moved out of the paddocks. Sampling will consist in 25 fixed 4-m square plots that will be placed systematically at each 1-ha area.

We look forward to track-back the history -at least the last ten years- of pasture use by livestock in the Estancia by working with the current administration of Fotín Chacabuco as well as to know the current plan of management, animal movements and a number of heads of livestock at each paddock. By using this information, we will be able to track the livestock density at each paddock.

Monitoring tuco-tuco populations
We planned to carry out next the tuco-tuco´s monitoring during spring (2018).

Climate variables
We recently got 4 Hobos data logger to start taking information on temperature and relative humidity in the sampling areas. Data Loggers will be placed in the field during 2018.

Literature cited

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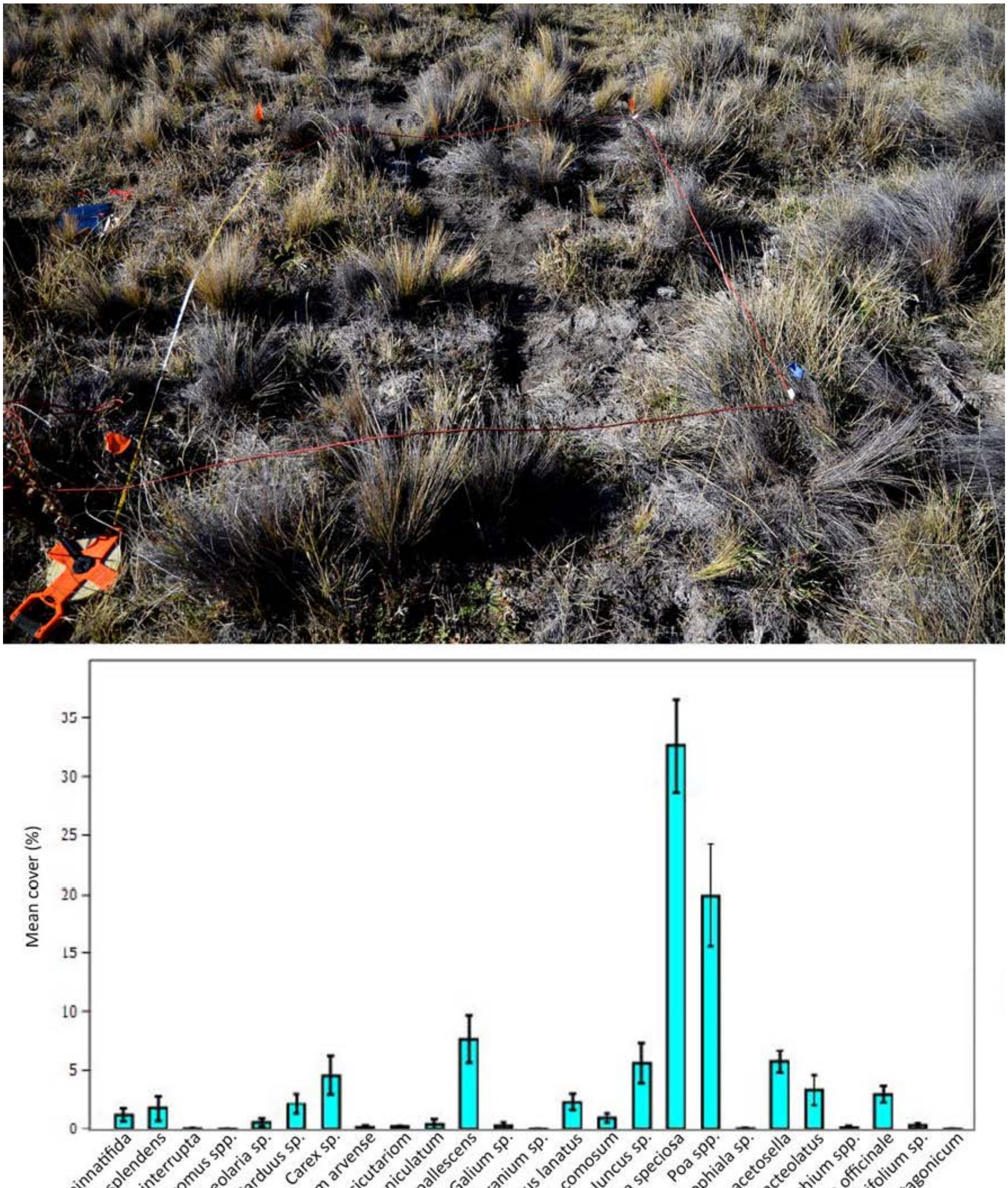
Supplementary material

Supp.1: Depiction of enclosures at Rincón Chico and Mallín Frisón and camera traps.

Supp.2: Wire flags and plastic mark used to monitoring tuco-tuco's activity. Burrow entrance with a twig, and a burrow entrance plugged with displaced twig. Also shown, sampling of vegetation at Rincón Chico.



Supp.3: 4-m square plot used to measure vegetation cover. Mean cover of plant species at studied tuco-tuco populations in Estancia Fortin Chacabuco.