Niche segregation between guanacos and cattle in grasslands and *Nothofagus* forests under silvopastoral use estimated using camera traps

Nothofagus antarctica (ñire) forests are managed through silvopastoral proposals, combining forestry and cattle breeding purposes.

Nothofagus pumilio (lenga) are managed for timber, and cattle also foraging there, as well as in grasslands.
Those management proposals greatly affect the availability of limited natural resources due to the modification of the forest structure, which greatly impacted over biodiversity. Negative synergies also occurred among herbivore species, e.g. natural populations of guanaco \( (Lama guanicoe) \) and cattle \( (Bos taurus) \) compete for habitat and food.

Great landscape heterogeneity.
The objective was to determine the existence of niche segregation between guanacos and cattle in natural grasslands, as well as ñire and lenga forests under silvopastoral uses, and to identify different temporal patterns in the landscape use.
BCÑ = ñire forests with close canopy

BL = unharvested lenga forests

CFL = heavy harvesting in lenga forests

P = grasslands

CSL = light harvesting in lenga forests

BAÑ = ñire forests with open canopy
We used digital camera traps at 1.5 m height (origin China, 55U$S) with solar panels and gel batteries located underground (n = 4 per treatment, N = 24 in total) along 1 year and 10 months (1 full growing season and 2 winters).

Cameras were set with 5 minutes delay between photos, with medium sensibility and a capacity of 3000 shots. We recollect the data every 2 months.

Forest structure was characterized, as well as the regeneration and the effective area of each photo in the ground.

Finally, we characterize and quantify (growing season and time-day) the macro-fauna in each photo, and calculated a relative density index (IDR) for the most abundant species (IDR, obs.día⁻¹.ha⁻¹).
Forest structure significantly changed with treatments, while forest regeneration presented different patterns according to closure and forest type.
Bos taurus

Ovis aries

Lama guanicoe
Pseudalopex culpaeus & P. griseus

Canis lupus familiaris

Feral dogs
Theristicus caudatus
Campephilus magellanicus
The gaucho, his horse and the good dogs
Vultur gryphus
Buteo polyosoma
Polyborus plancus
We collected thousand of photos, and among them we found 6.892 useful pictures with 13.345 animals: 46% guanacos, 36% cattle, 14% buff-necked ibis, 2% foxes, 1% sheeps, and 1% others (crested caracara, dogs, condor, woodpecker, pygmy-owl and red-backed hawk), with bigger defferences among environment types (P = 77%, CFL = 15%, BL = 4%, BAÑ = 2%, CSL = 1% and BCÑ = 1%).

The camera traps detected other species that was not included due to their small size, e.g. insects (Cerambicidae), bats, mice, several Passeriform species and other raptor birds.

The same number of camera traps resulting in an unbalanced effective sampling among treatments.
BCN = nire forests with close canopy

100.9 m²

BAN = nire forests with open canopy

127.9 m²

BL = unharvested lenga forests

359.4 m²

CFL = heavy harvesting in lenga forests

455.2 m²

CSL = light harvesting in lenga forests

1,382.6 m²

P = grasslands

10,409.6 m²
It was observed differences among the observed species along the day, being the environments with greater forest cover those selected for shelter during the night or during days of extreme climate.
Cattle was observed in the study area between November and March, being more frequent in P (IDR 0.08 to 2.87 obs.day$^{-1}$.ha$^{-1}$) than in ñire forests (IDR 0.05 to 0.13 obs.day$^{-1}$.ha$^{-1}$), while guanacos using both environments along the round year, with differences between winter and summer (IDR 0.15-0.53 obs.day$^{-1}$.ha$^{-1}$ in P and 0.69-0.51 obs.day$^{-1}$.ha$^{-1}$ in ñire forests, respectively).
Cattle was observed in the study area between November and March in P (IDR 0.08 to 2.87 obs.day⁻¹.ha⁻¹) but also used the harvested lenga forests (IDR 1.40 to 16.27 obs.day⁻¹.ha⁻¹), while guanacos using both environments along the round year, with differences between winter and summer (IDR 0.15-0.53 obs.day⁻¹.ha⁻¹ in P and 0.67-3.60 obs.day⁻¹.ha⁻¹ in harvested lenga forests, respectively).
It was observed a different use along the seasons, being maximum between December and January, and more frequent during the diurnal hours. This species only was recorded in P, avoiding close or open forests, however, they use the tallest trees for nesting or as refuge during night hours.
The arriving of the cattle generated a local displacement of natural guanaco populations in P, which recover the expected values when the cattle were removed. This over use of P increase the use of other environments, e.g. harvested forests.

Our results indicate that management activities impacted over the forest macro-fauna, but the co-occurrence between species is possible considering certain thresholds of conservation, and it is possible that some undesirable trade-offs were observed (e.g. cattle browsing vs. forest regeneration).

This kind of research gives tools to develop new proposals to improve the management practices of agro-silvopastoral alternatives at different landscape scale.
Thanks!