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Austral rangelands: Challenges in Patagonian Ranching and a Behavioral Approach to Grazing Heterogeneity Inspired by New Zealand Hill- and High-country Livestock Systems



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Photo: Jon Hickford



Austral rangelands: Challenges in Patagonian Ranching and a Behavioral Approach to Grazing Heterogeneity Inspired by New Zealand Hill- and High-country Livestock Systems



Cristian Moreno Garcia



Pablo A. Cipriotti



Jon Hickford

Photo: Pablo Cipriotti



Outline

1. Patagonia
2. Patagonian Ranching
3. Patagonian environments
4. Challenges in Patagonian ranching
5. New Zealand Livestock Systems in hill- and high-country grasslands
6. A grazing distribution problem
7. A grazing behavior solution
8. Genetic associations with grazing behaviors
9. Shaping grazing by selecting more exploratory individuals

Photo: Pablo Cipriotti



1. Patagonia Region

- > 100M ha in Southern South America
- The Andes mountain chain
 - ~78M ha Eastern Patagonia, dry (Argentina)
 - ~24M ha Western Patagonia, humid (Chile)

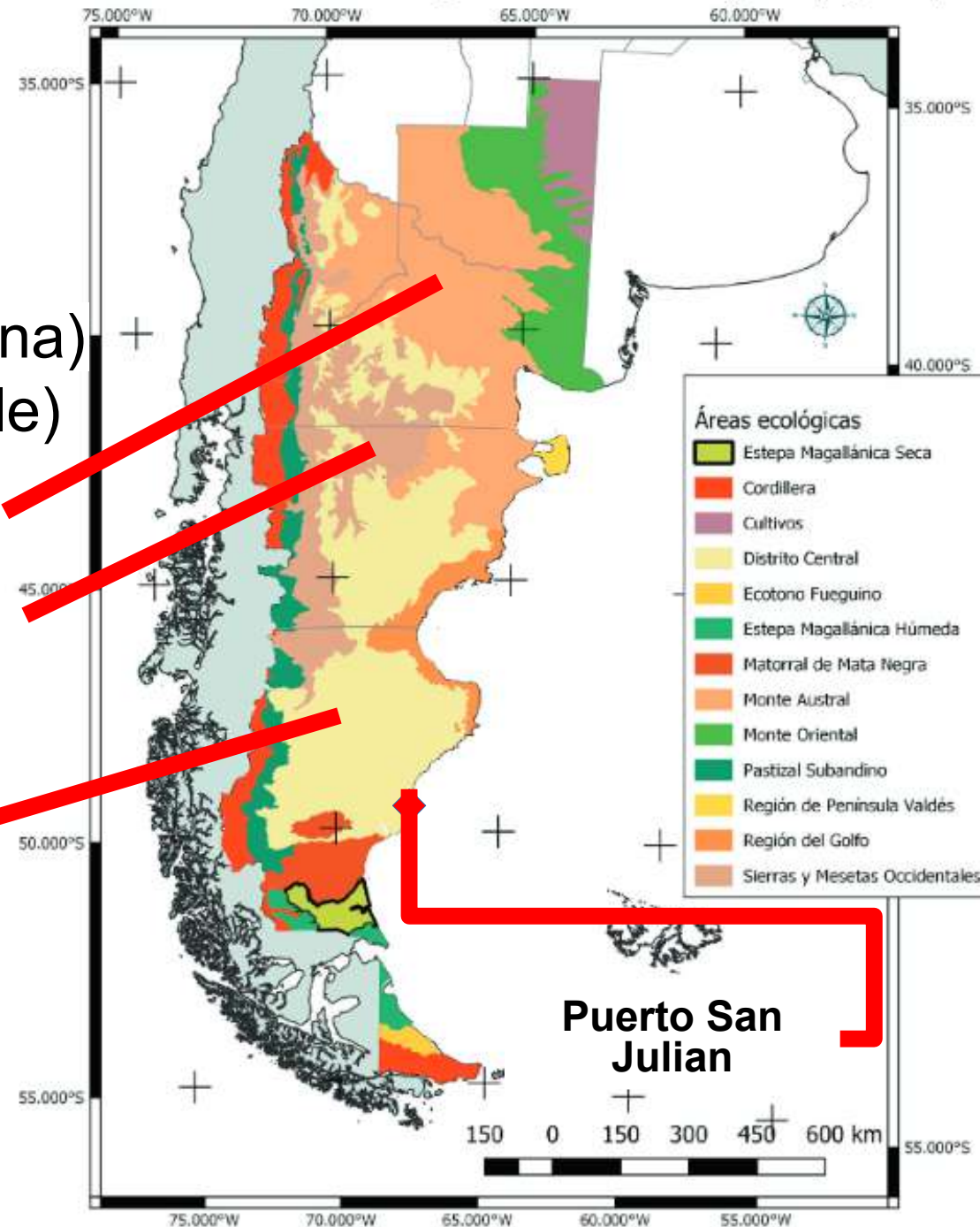


Austral woodland

Hills and plateaus

Central District

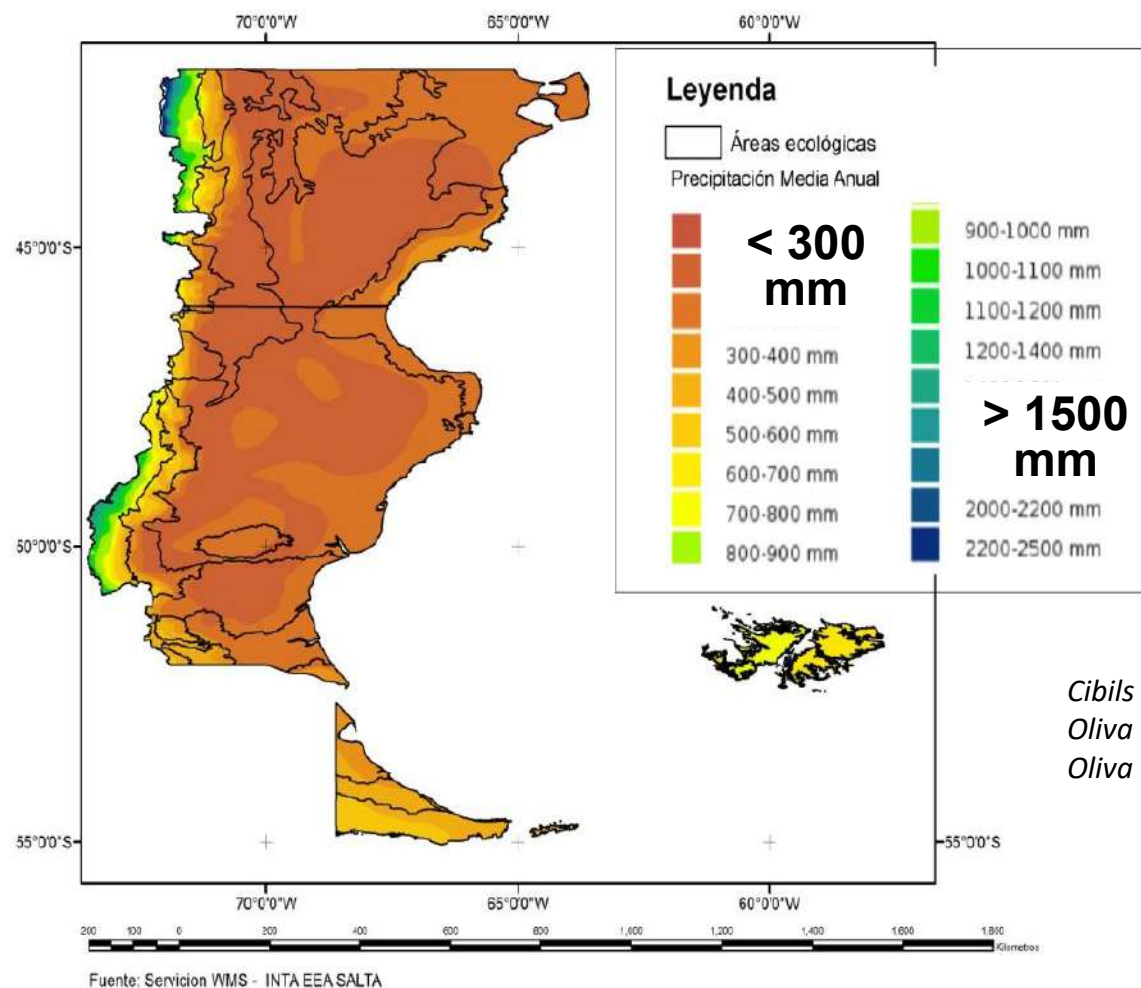
*Cibils & Borelli, FAO
Oliva et al. 2017
Oliva et al. 2019
Schenkel et al.
2021*



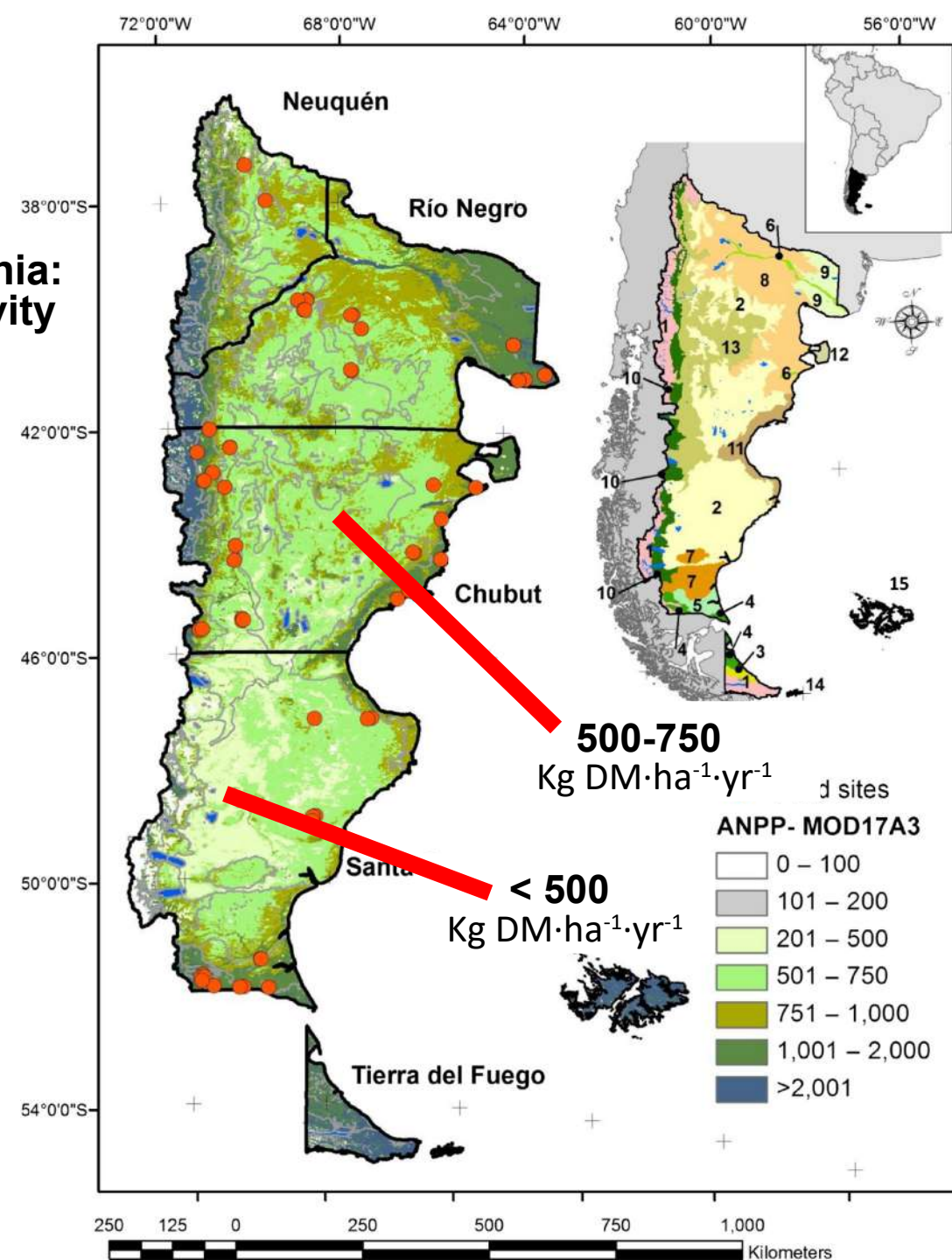


1. Patagonia Region

Southern Argentine Patagonia: rainfall



Argentine Patagonia: Primary productivity



Cibils & Borelli, FAO
Oliva et al. 2017
Oliva et al. 2019

2. Patagonian Ranching

- Ranching: extensive sheep farming
 - 50-100.000 ha (1st land division 1870')
 - 15-20.000 ha (2nd land division (1900')
- Domestic livestock (sheep)
 - Introduced ~ 1885
 - 22 M sheep (peak in 1952)
 - 8 Million sheep (2023)
- Unique stocking: ~ 2.5 ha per sheep
 - Commercial: > 5 000 sheep
 - Small-Medium: 1 000-5 000 sheep
 - Subsistence: < 1 000 sheep
- 78% continuous grazing
- 53% 1+ paddock > 5 000 ha
- 57% water distance 1.5-4 Km



2. Patagonian Ranching





2. Patagonian Ranching



Photo: Fco. de Larminat



2. Patagonian Ranching

- Native herbivores: Guanaco (camelid), huemul (South Andean deer), ñandú (South American ostrich)
- Native predators: Patagonian puma, fox



Photo: Ana Martelli



Photo: Ana Martelli



3. Patagonian environments

Wetland meadows



Grass steppes



Shrub steppes



Woodlands



Summer pastures



Winter pastures



3. Patagonian environments: different productivity & stocking



Environment	Area [%]	Productivity [kg DM·ha ⁻¹ ·yr ⁻¹]	Carrying capacity [sheep·ha ⁻¹]
Wetland meadows	0.2-3	1 000-6 000	3-8
Grass steppes	>90	600-1 800	0.4-0.8
Shrub steppes		200-800	0.1-0.3
Woodlands	1-5	400-1 200	0.2-0.4

Anchorena et al. 2001
 Borrelli y Oliva 2001
 Cipriotti et al. 2018
 Golluscio et al. 1998
 Irisarri et al. 2012
 Irisarri et al. 2022
 Ormaechea et al., 2019
 Paruelo et al. 1998





3. Patagonian environments: Wetland meadows



Photo: Pablo Cipriotti

Fence contrast in Wetland meadows

Productivity [kg DM·ha ⁻¹ ·yr ⁻¹]	Carrying capacity [sheep·ha ⁻¹]
1 000-6 000	3-8



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3. Patagonian environments: Grass steppes

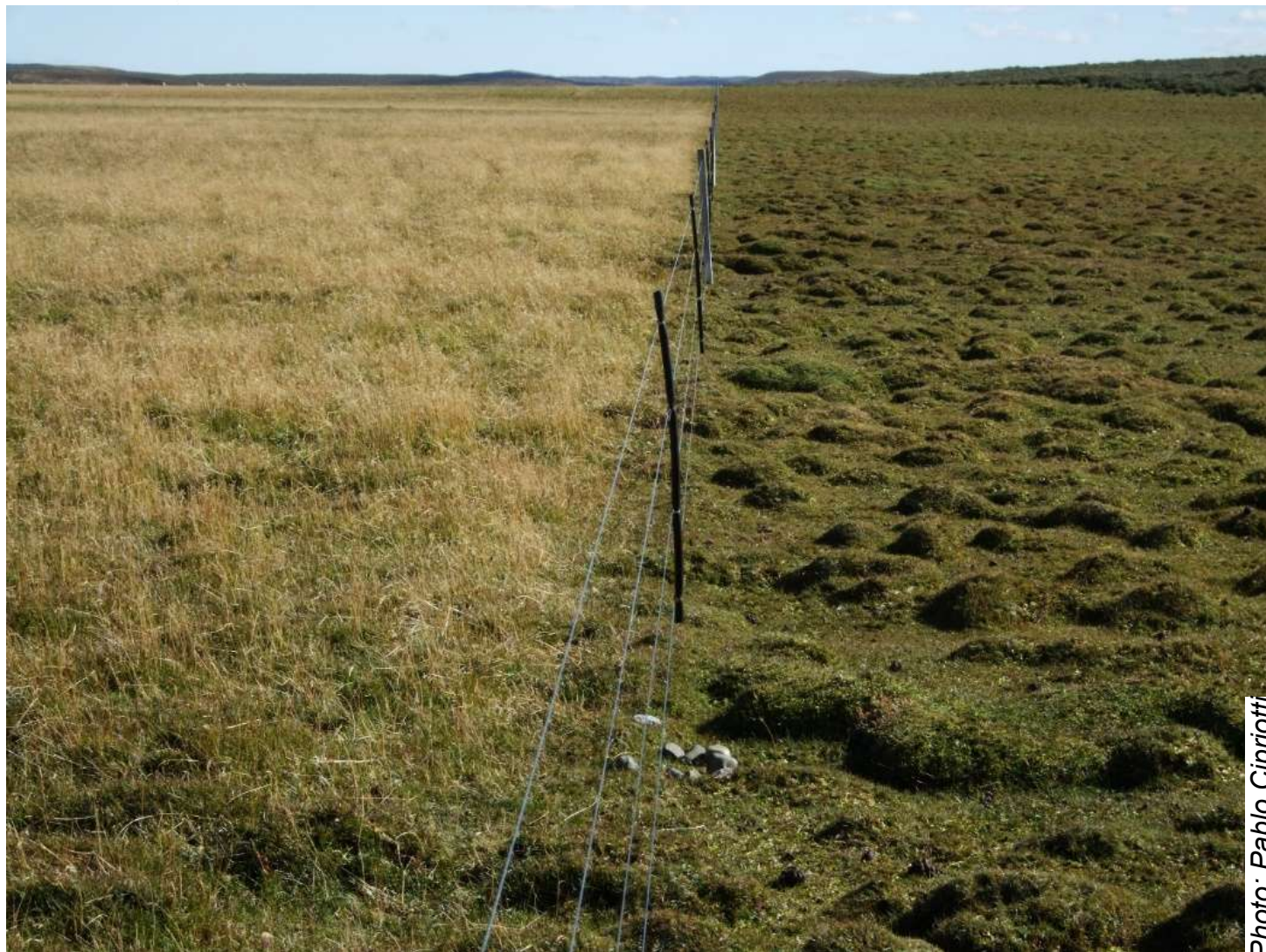


Photo: Pablo Cipriotti

Fence contrast in Grass steppes

Productivity [kg DM·ha ⁻¹ ·yr ⁻¹]	Carrying capacity [sheep·ha ⁻¹]
600-1 800	0.4-0.8



3. Patagonian environments: Shrub steppes

Fence contrast in Grass steppes

Productivity [kg DM·ha ⁻¹ ·yr ⁻¹]	Carrying capacity [sheep·ha ⁻¹]
200-800	0.1-0.3



Photo: Pablo Cipriotti



4. Challenges in Patagonian ranching

- Complex management
 - High heterogeneity
 - Limited infrastructure
- Extreme weather conditions
- Ranch abandonment
 - Decades of overstocking
 - Widespread degradation
 - Unfavorable wool market
- Limited adoption of range management
- Livestock movement
- Uneven grazing distribution

● Ranchers' perception (Ormaechea et al., 2019)

- Droughts
- Wild herbivores
- Predators
- Subdivision: 53% wants to increase
- 75% there is uneven grazing
- 60% said is not a major problem
- 33% not targeted management
- 8% strategic management



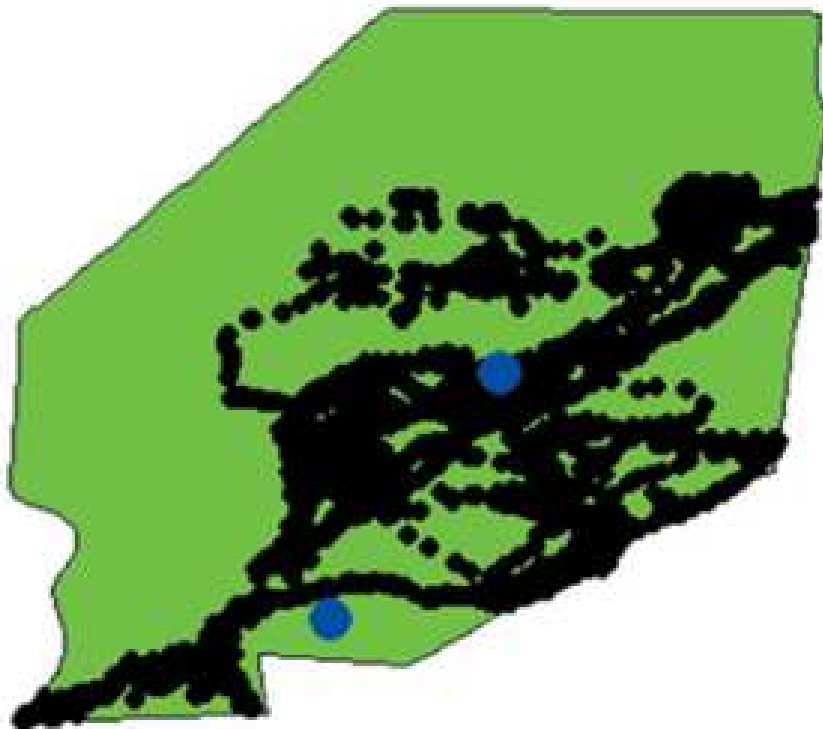
4. Challenges in Patagonian ranching: UNEVEN GRAZING

GPS tracks of 5 sheep in 1859 ha grass steppe

Ormaechea, Cipriotti et Peri, 2021

North
paddock

Year 2015



North
paddock

Year
2016



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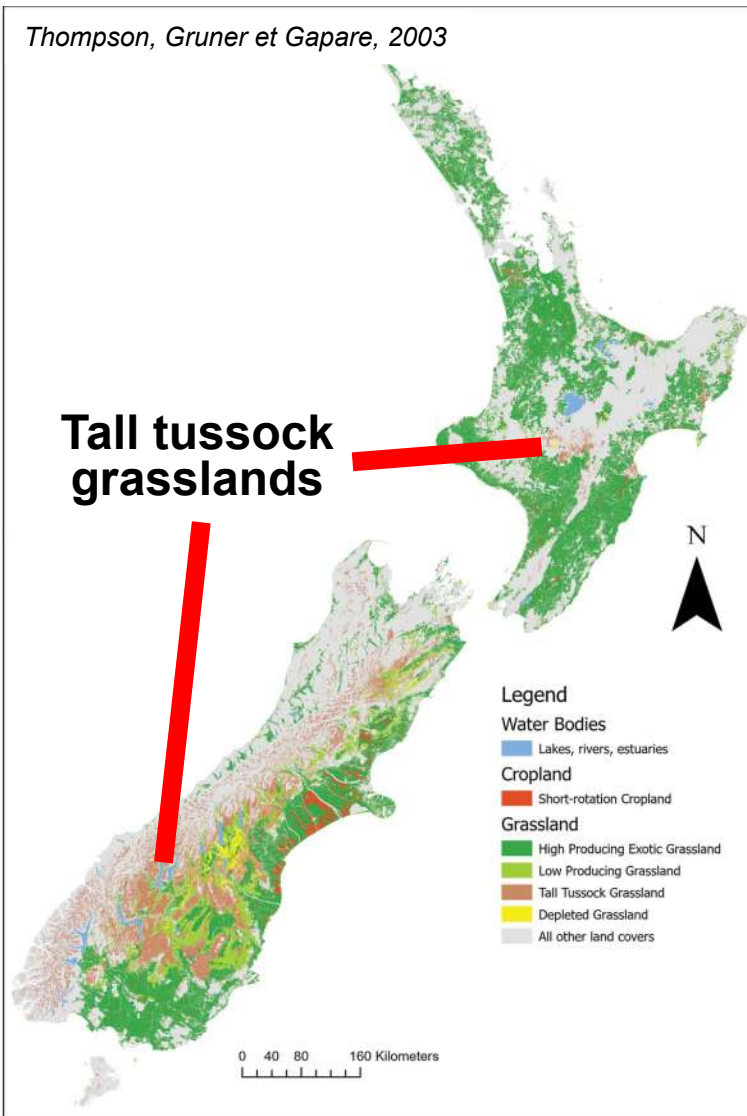
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5. New Zealand Livestock Systems in hill- and high-country grasslands



Photo: Jon Hickford



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6. A grazing distribution problem





7. A grazing behavior solution: GRAZING PERSONALITY MODEL

REVIEW article

Front. Vet. Sci., 25 February 2020

Sec. Animal Behavior and Welfare

Volume 7 - 2020 | <https://doi.org/10.3389/fvets.2020.00074>

On the Search for Grazing Personalities: From Individual to Collective Behaviors



Cristian A. Moreno García *



Thomas M. R. Maxwell



Jonathan Hickford



Pablo Gregorini *

GRAZING PERSONALITY MODEL

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7. A grazing behavior solution: GRAZING PERSONALITY MODEL

Given the same access, are they grazing all the same?





7. A grazing behavior solution: GRAZING PERSONALITY MODEL

Repeated sets of grazing behaviors are different

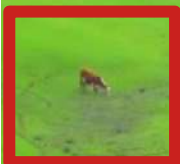
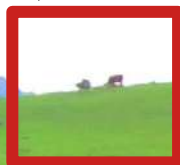


Grazing personalities are “suites of traits of different nature (e.g., behavioral [...]), which are correlated and often concatenated, to result in specific grazing patterns displayed consistently across contexts and over time.”



7. A grazing behavior solution: GRAZING PERSONALITY MODEL

Grazing personalities are determined by grazing genes, but...



...the expression of grazing genes is modulated by the social and biophysical environments.



7. A grazing behavior solution: GRAZING PERSONALITY MODEL

GPS-tracking

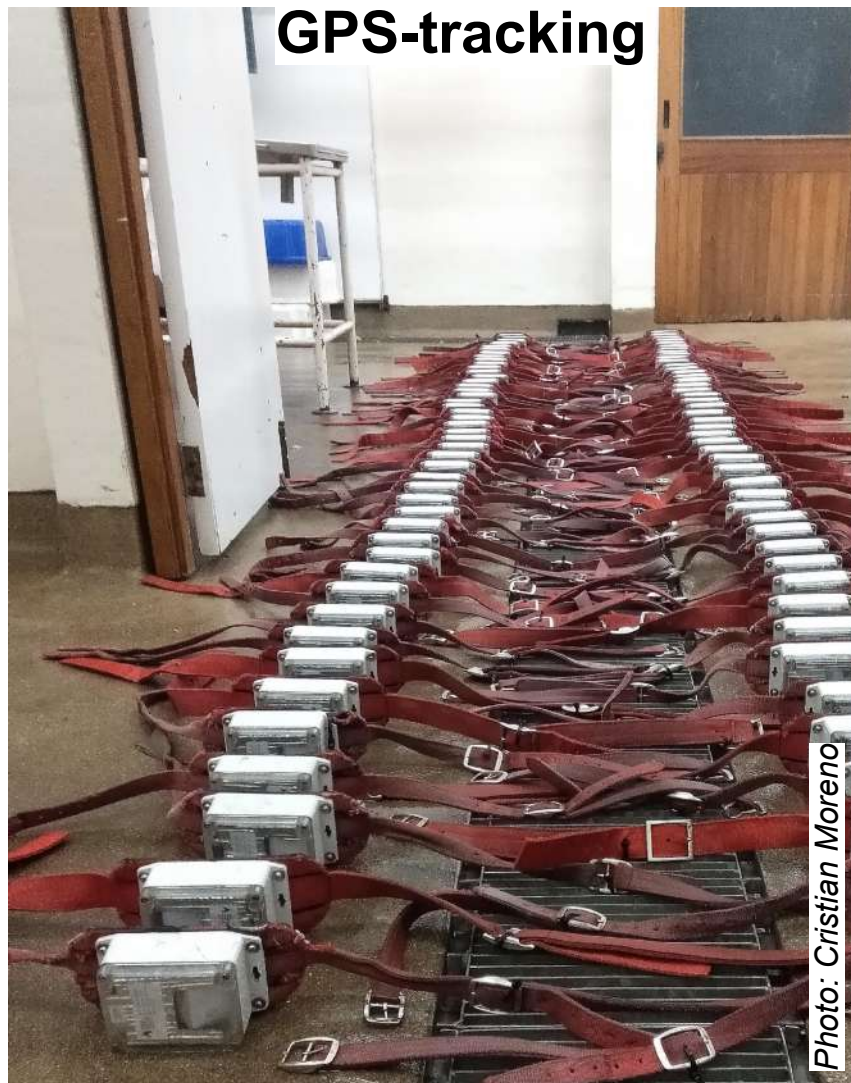


Photo: Cristian Moreno

Grazing behavior



Photo: Cristian Moreno

Genotyping



Photo: Cristian Moreno



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8. A grazing behavior solution: GRAZING PERSONALITY MODEL





9. Genetic associations with grazing behaviors

 **BMC** Part of Springer Nature



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The glutamate metabotropic receptor 5 (*GRM5*) gene is associated with beef cattle home range and movement tortuosity

[Cristian A. Moreno García](#) , [Huitong Zhou](#), [David Altimira](#), [Robyn Dynes](#), [Pablo Gregorini](#), [Sadeepa Jayathunga](#), [Thomas M. R. Maxwell](#) & [Jonathan Hickford](#)

- ~20% differences in daily grazing behaviors between cows
- Genetic associations: home range and movement tortuosity
- Trends towards associations: elevation range and horizontal distance traveled



9. Genetic associations with grazing behaviors

- 16% of the herd had two genotypes (*AB*, *AC*) associated with the largest home ranges
- 72% of the herd held two *GRM5* genotypes (*BC*, *CC*) associated with medium-sized home ranges
- 12% of the herd held the genotype (*BB*) with the smallest home range



9. Genetic associations with grazing behaviors

Since *GRM5* genotypes seems to be asymmetrically represented in beef cattle herds, increasing the proportion of *AB/AC* genotypes associated with largest home ranges may lead to spreading out the grazing in the landscape

- Decreasing grazing frequency of vegetation patches
- Reducing the grazing intensity
- More homogeneous grazing



10. Shaping grazing by selecting more exploratory individuals

Selecting animals with more exploratory grazing...

...has the potential of improving the grazing distribution in heterogeneous rangelands such as those found in Patagonia.

...in doing so, may enable productive and more sustainable pastoral grazing systems.



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Thank you!



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