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Quality, safety and sustainability of agroforestry productions (processes and products)

Livestock productions

Feeding preferences of Highland cattle reveal their attitude to exploit woody vegetation in mountain environments

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PROGETTO Ager AGROALIMENTARE E RICERCA | FONDAZIONI IN RETE PER LA RICERCA AGROALIMENTARE

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INTRODUCTION

Increase of woody species dominated-habitats in the Alps in the last decades due to agro-pastoral abandonment

The exploitation of these habitats by livestock is **challenging**:

- Poor forage quality
- Difficult accessibility
- Difficult management of the animals (e.g., fencing)

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These habitats could be managed with livestock hardy breeds, such as the **Highland cattle breed**

Highland cattle:

- Has low maintenance energy requirements
- Can feed on poor quality vegetation (Pauler et al. 2020)
- Consume woody plant more than other cattle breeds (Pauler et al. 2020)
- Has great agility on steep terrain (Svenks et al. 2020)
- Can easily move within shrub-encroached areas using the long horns

Objectives of the study:

Study Highland cattle **feeding behavior** in different mountain environments in terms of:

1. Percent consumption of woody and herbaceous plants;
2. Preference indices for different plant species, particularly woody species;
3. Relations between amount of consumption and abundance of species.

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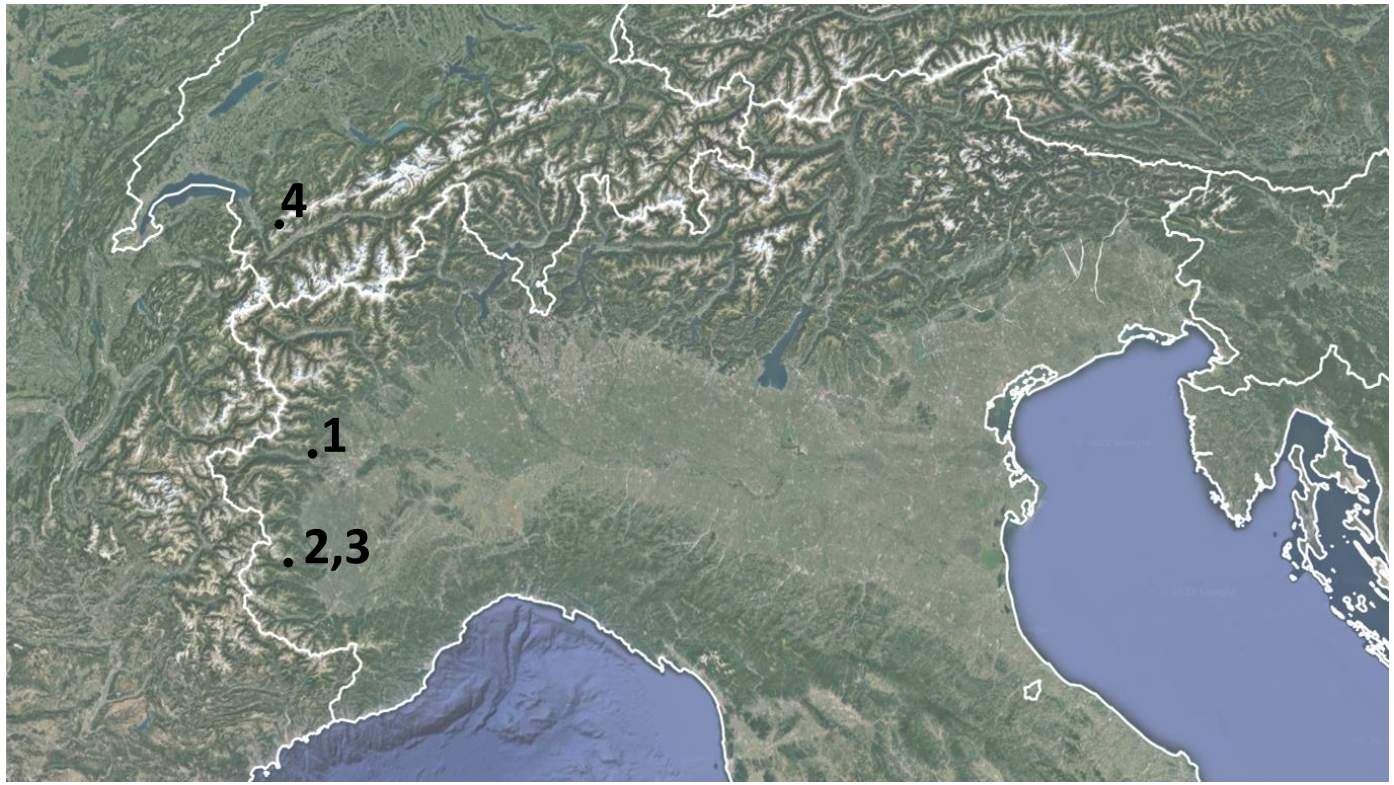
MATERIALS AND METHODS

Four Study areas in 2020, in the Western Alps, along an elevation gradient and with contrasting vegetation:



1. **Almese** (Italy) – 450 m a.s.l., shrub-encroached dry grasslands
2. **Casteldelfino A** (Italy) – 1350 m a.s.l., shrub-encroached dry grasslands
3. **Casteldelfino B** (Italy) – 1250 m a.s.l., mixed forest with shrub-encroached clearings
4. **Bovonne** (Switzerland) – 1750 m a.s.l., shrub-encroached mesophilous grasslands

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MATERIALS AND METHODS

Overview of the study areas:

	Livestock Units	Grazing period	Paddock size	Dominant woody species
1 **Almese** (Italy) – 450 m a.s.l.	18 LU	May	17.4 ha	*Rubus* sp., *Prunus spinosa*
2 **Casteldelfino A** (Italy) – 1350 m a.s.l.	14.2 LU	June-August	19.2 ha	*Prunus spinosa*, *Rosa* sp.
3 **Casteldelfino B** (Italy) – 1250 m a.s.l.	6 LU	August-Sept	11.4 ha	*Acer pseudoplatanus, Fraxinus excelsior, Rubus idaeus*
4 **Bovonne** (Switzerland) – 1750 m a.s.l.	20 LU	July	8.3 ha	*Alnus viridis*

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Methodology: Direct Observations

- Each observer chose a focal cow

- The observer recorded the grazing behavior for 15 seconds at regular intervals (15 sec observation + 20 sec rest, and so on)

- At each observation, two parameters were recorded:
  1. **Plant species consumption**, in terms of relative consumption (scale 0-1)
  2. **Plant species abundance**, in terms of relative abundance (scale 0-1) in a 1-m buffer area around the head of the cow

All woody plants were identified at the species level, while herbaceous species were joined in a broad category (except for easy-to-identify tall herbs)

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Data analysis

Percent consumption of woody and herbaceous plants

$$\%\ \text{Consumption}_i = \frac{\sum \text{Consumption}_i}{\sum \text{Consumption}_{i\text{-}n}}$$

Jacob's Selection Index

$$\text{JSI}_i = \frac{(\text{Consumption}_i - \text{Abundance}_i)}{(\text{Consumption}_i + \text{Abundance}_i - 2 * \text{Consumption}_i * \text{Abundance}_i)}$$

$\text{JSI}_i > 0$: Preferred species (consumed more than its availability)
$\text{JSI}_i = 0$: Indifferently consumed species (consumed proportionally to its availability)
$\text{JSI}_i < 0$: Avoided species (consumed less than its availability)

Repetition: cows within days

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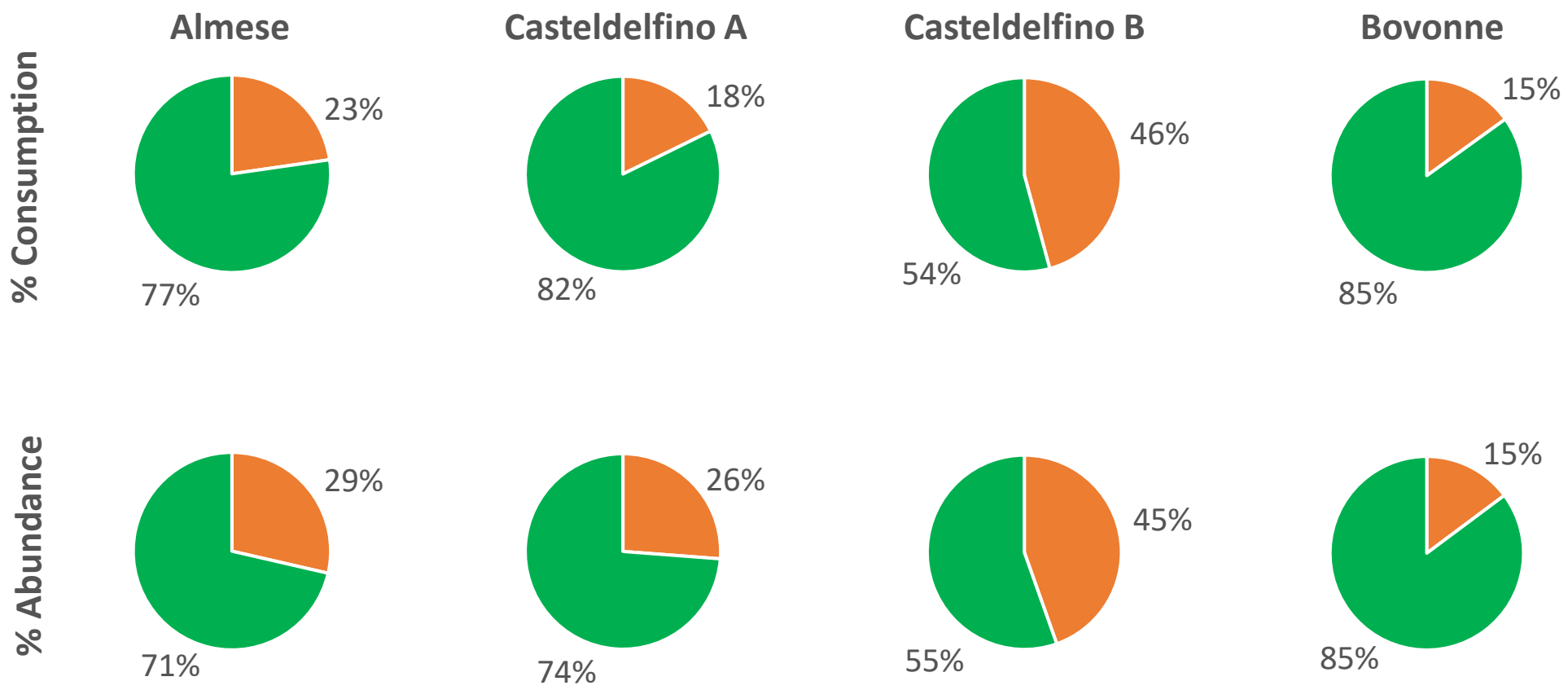
Results: percent consumption

14 days
150 hours
11’356 observations
29 different cows

RESULTS



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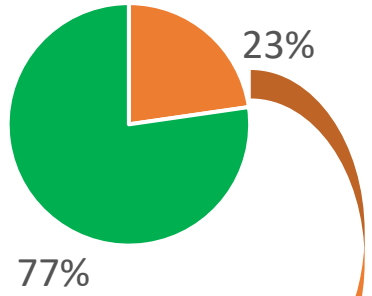
Results: percent consumption

14 days
150 hours
11’356 observations
29 different cows

Herbaceous species
Woody species

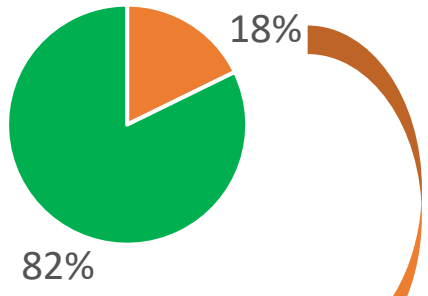
% Consumption

Almese



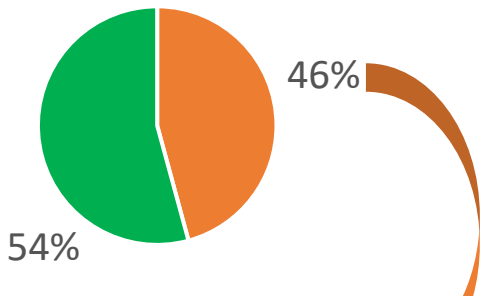
Frangula alnus 3.4%
Prunus spinosa 2.9%
Fraxinus ornus 2.9%
Rubus sp. 2.6%
Other woody species 11.0%

Casteldelfino A



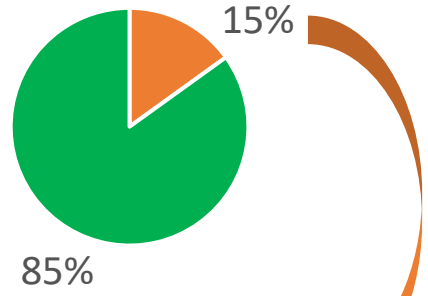
Prunus spinosa 4.8%
Rubus sp. 2.7%
Corylus avellana 2.4%
Rosa sp. 2.3%
Other woody species 5.6%

Casteldelfino B



Rubus idaeus 40%
Fraxinus excelsior 2.1%
Acer pseudoplatanus 1.8%
Other woody species 2.4%

Bovonne



Alnus viridis 11.9%
Picea abies 2.2%
Other woody species 1.1%

RESULTS

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Results: preference indices (Almese)

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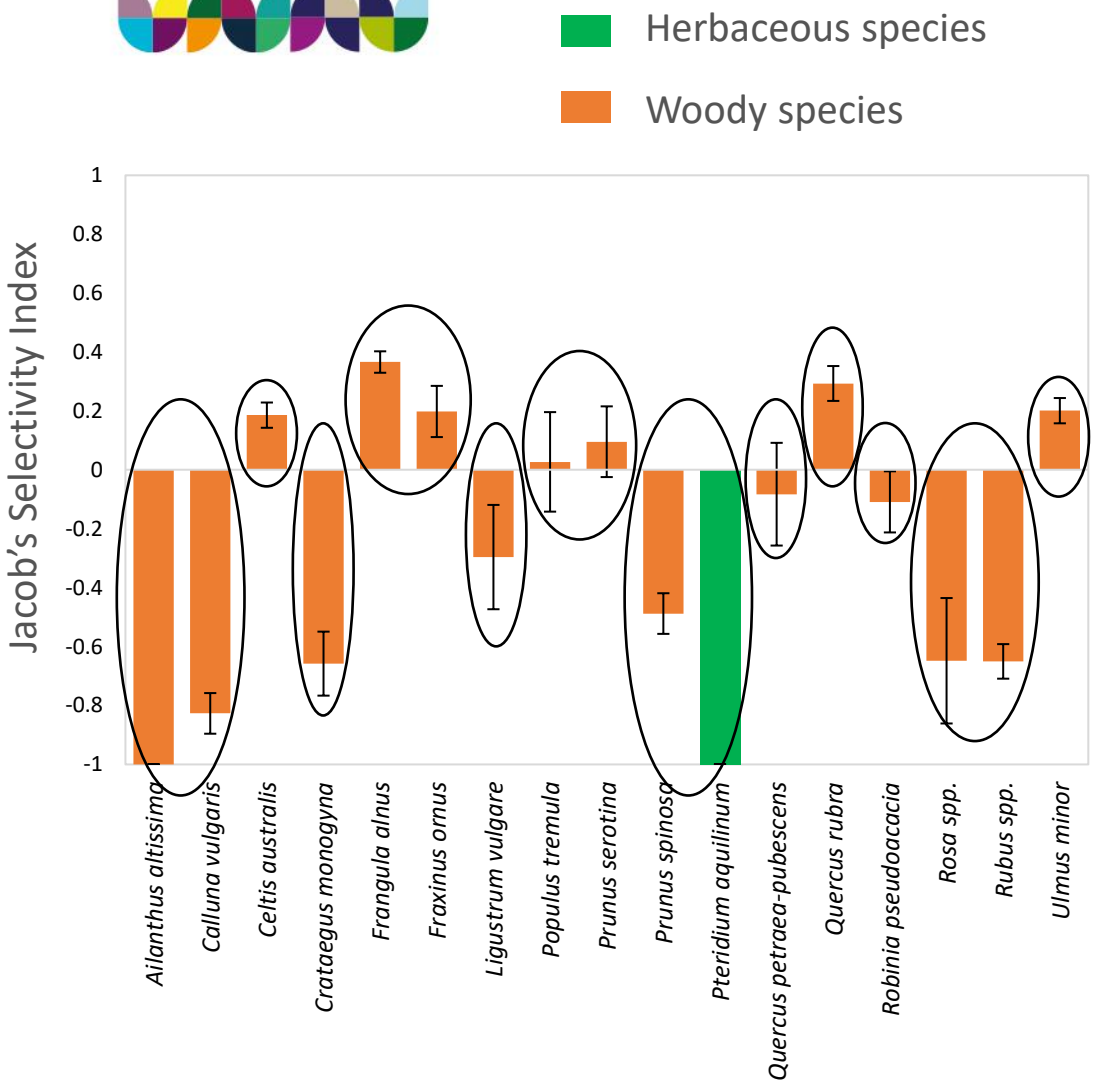

Preferred species were *Celtis australis*, *Frangula alnus*, *Fraxinus ornus*, *Quercus rubra*, and *Ulmus minor*

Indifferently consumed species were *Populus tremula, Prunus serotina, Quercus petraea-pubescens,* and *Robinia pseudoacacia*

Avoided species were *Ailanthus altissima*, *Calluna vulgaris*, *Crataegus monogyna*, *Ligustrum vulgare, Prunus spinosa, Pteridium aquilinum, Rosa* sp. and *Rubus* sp.

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RESULTS

RESULTS

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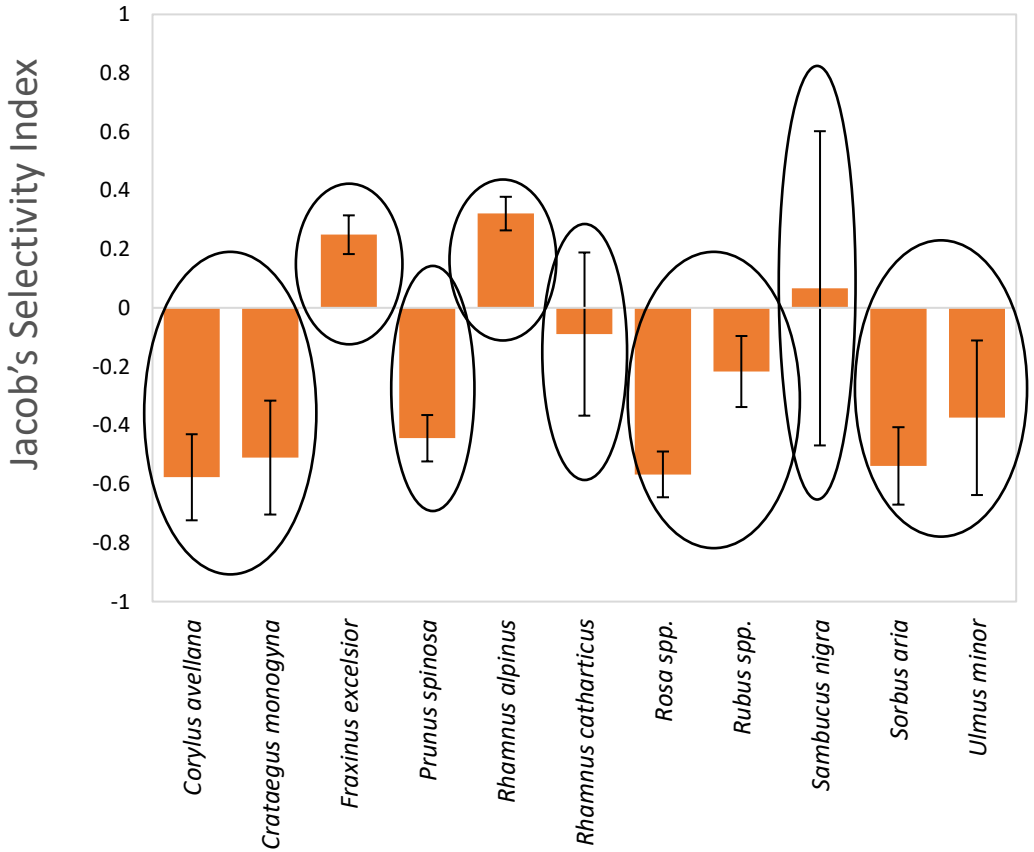
Results: preference indices (Casteldelfino A)



Preferred species were *Fraxinus excelsior* and *Rhamnus alpinus*

Indifferently consumed species were *Rhamnus catharticus* and *Sambucus nigra*

Avoided species were *Prunus spinosa, Rosa* sp., *Rubus* sp., *Sorbus aria, Corylus avellana, Ulmus minor,* and *Crataegus monogyna*

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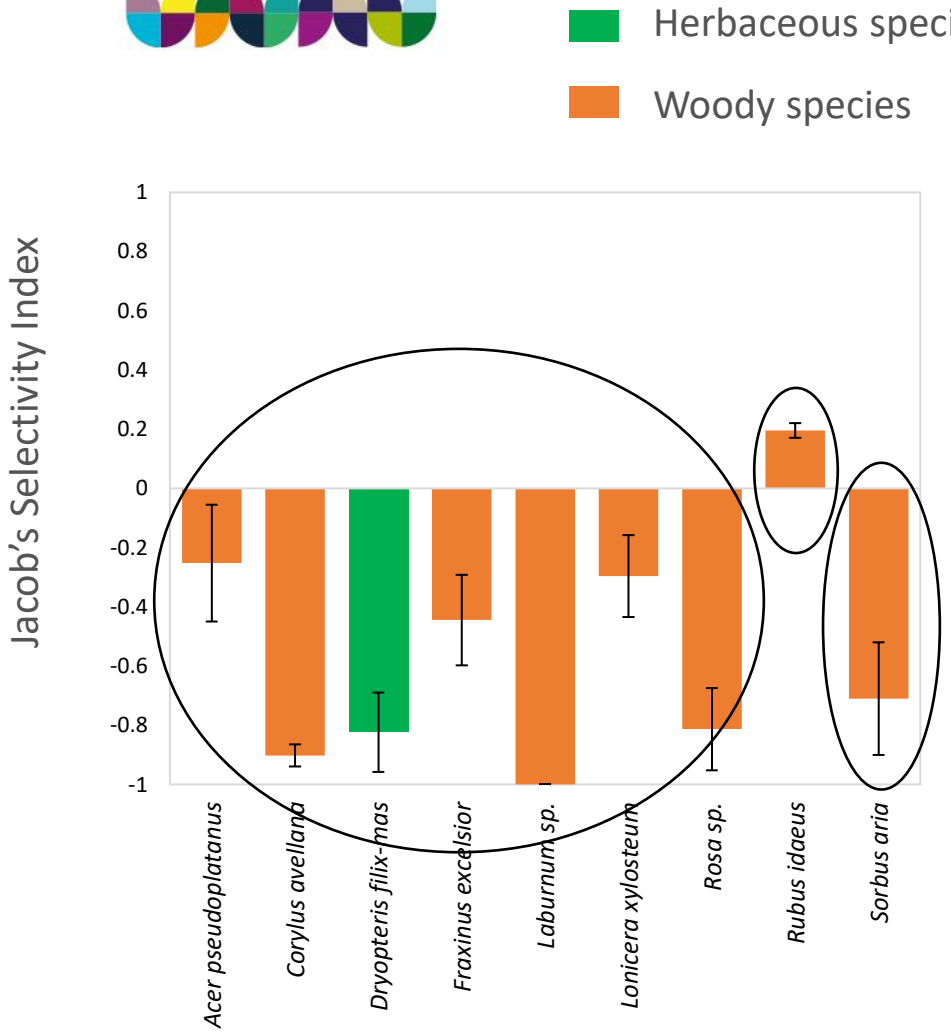
Results: preference indices (Casteldelfino B)



Preferred species was *Rubus idaeus*

Avoided species were *Acer pseudoplatanus, Corylus avellana, Dryopteris filix-mas, Fraxinus excelsior, Laburnum* sp., *Lonicera xylosteum, Rosa* sp., and *Sorbus aria*

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RESULTS

Results: preference indices (Bovonne)

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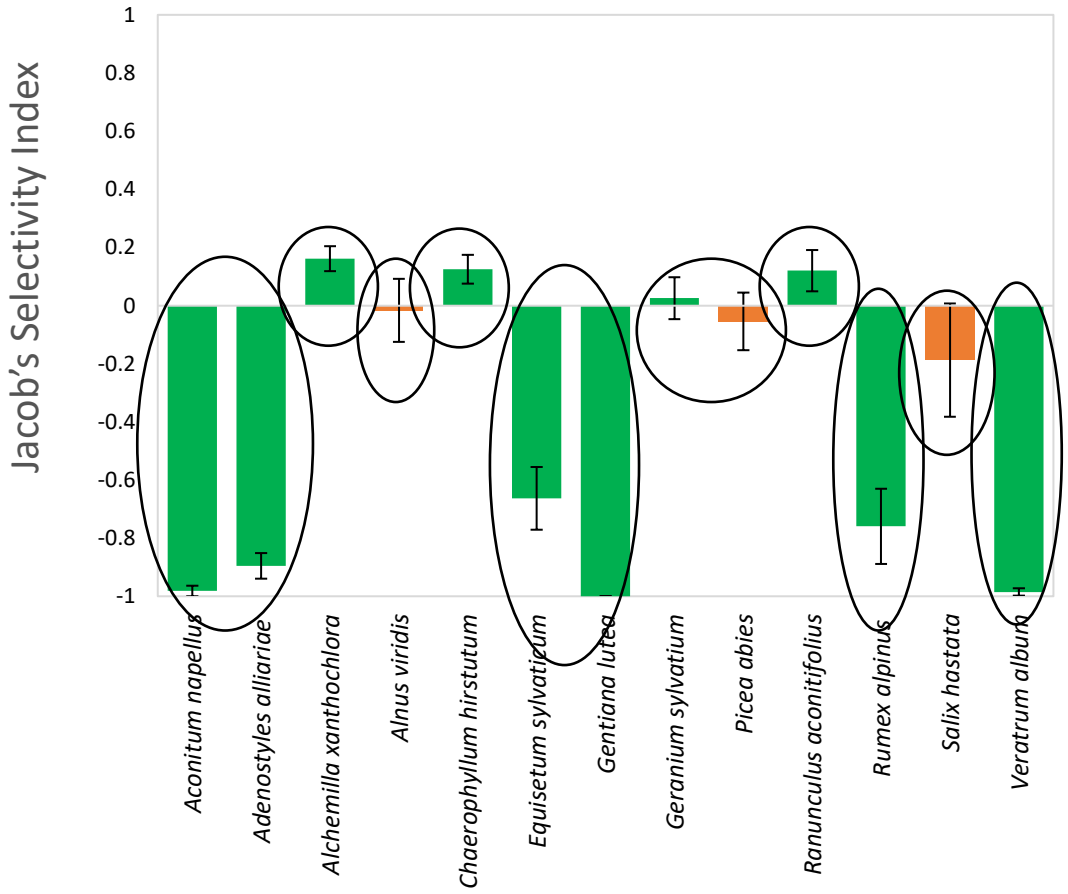

Preferred species were *Alchemilla xanthochlora, Chaerophyllum hirsutum*, and *Ranunculus aconitifolius*

Indifferently consumed species were *Alnus viridis, Geranium sylvaticum, Picea abies,* and *Salix hastata*

Avoided species were *Aconitum napellus, Adenostyles alliariae, Equisetum sylvaticum, Gentiana lutea, Rumex alpinus,* and *Veratrum album*

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RESULTS

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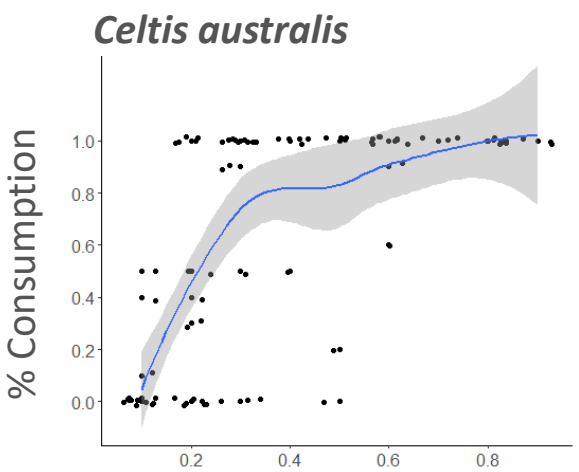
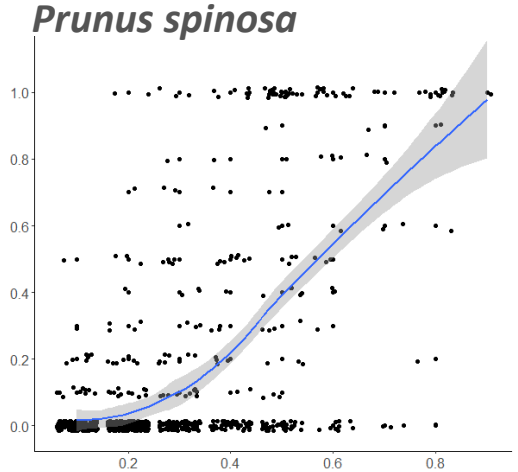
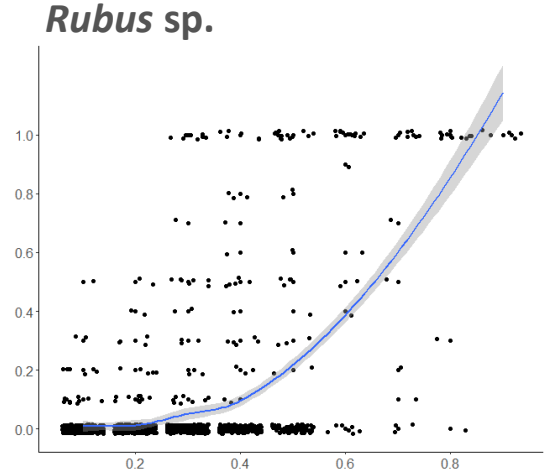
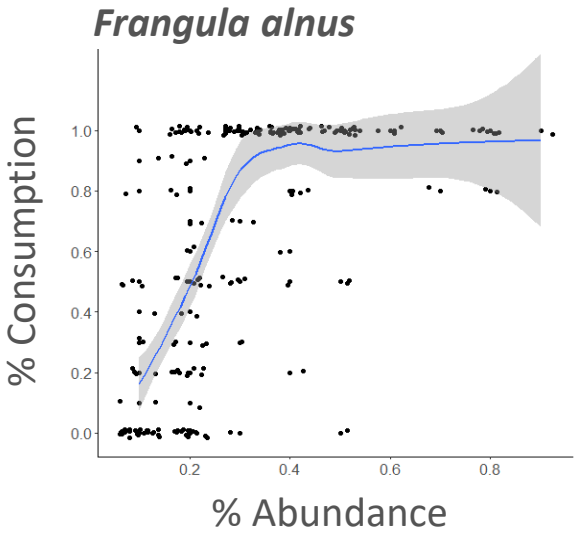
Results: relations consumption-abundance

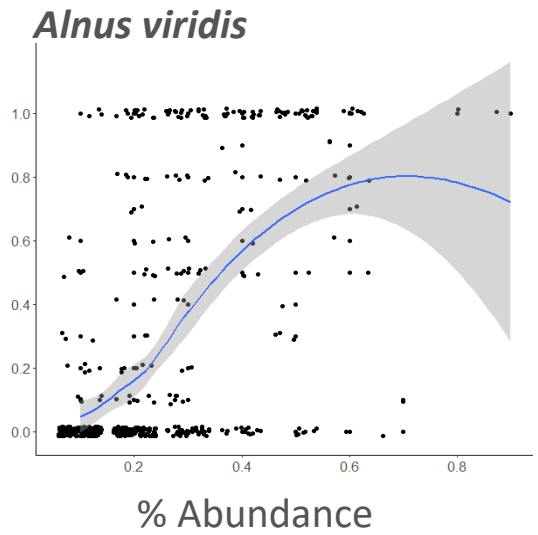
RESULTS

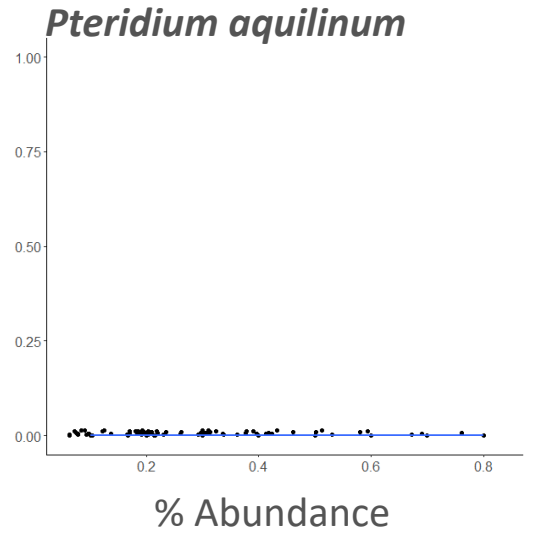












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CONCLUSIONS

- Highland cows included a large amount (15-46%) and variety of woody species in the diet
- They expressed a clear selection towards woody plants
- The feeding behavior of this cattle breed suggest it could be used for the sustainable exploitation of **marginal mountain areas** with abundant woody vegetation
- This management could contribute to **reduce shrub encroachment**, and likely increase forage quality, plant diversity, and other ecosystem services (e.g., landscape quality, tourism attractiveness)

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