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# The role of pastoral systems in the creation and maintenance of Nature's Contribution to People in Spain

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**Abstract.** Pastoral systems in Spain have been consistently overrepresented in systematic reviews of pastoral and agroecological systems at both global and regional scales. These pastoral systems have been studied extensively through the Ecosystem Service lens, but an examination of Spanish pastoral systems using the Nature's Contribution to People framework was missing from the literature. The Nature's Contribution to People framework builds on the Ecosystem Services framework and aims to be more inclusive of social sciences. We hypothesise that the Nature's Contribution to People framework is well suited to the analysis of pastoral systems as socio-ecological systems where human-nature relationships are inherently linked and only decoupled for analytical purposes. In this article, a qualitative comparative analysis was conducted to explore trends throughout the literature on Spanish pastoral systems. Our results displayed that pastoral systems in Spain are regularly studied in terms of only a few dominant Nature's Contribution to People with *Habitat creation and maintenance, Food and Feed* and *Supporting identities* representing 52% of the Nature's Contribution to People in this analysis and *Habitat creation and maintenance being the most common* Nature's Contribution to People *in the analysis*. These results emphasise the importance of pastoral systems beyond food production.

**Keywords:** Socio-ecological systems, Mediterranean, Pastoralism, Global change, Ecosystem Services

***Le rôle des systèmes pastoraux dans la création et le maintien de la contribution de la nature aux personnes en Espagne***

***Résumé.*** *Les systèmes pastoraux en Espagne ont été systématiquement surreprésentés dans les revues systématiques des systèmes pastoraux et agroécologiques à l'échelle mondiale et régionale. Ces systèmes pastoraux ont été largement étudiés à travers le prisme des Services Écosystémiques, mais un examen des systèmes pastoraux espagnols utilisant le cadre de la contribution de la nature aux personnes manquait dans la littérature. Le cadre Contribution de la Nature aux Personnes s'appuie sur le cadre services écosystémiques et vise à inclure davantage les sciences sociales. Notre hypothèse est que le cadre Contribution de la Nature aux Personnes est bien adapté à l'analyse des systèmes pastoraux en tant que Systèmes Socio-Écologiques où les relations homme-nature sont intrinsèquement liées et découplées uniquement à des fins analytiques. Dans cet article, une Analyse Comparative Qualitative a été menée pour explorer les tendances dans la littérature sur les systèmes pastoraux espagnols. Nos résultats ont montré que les systèmes pastoraux en Espagne sont régulièrement étudiés en termes de quelques contributions de la nature aux personnes dominants, avec la création et la maintenance d'habitats, la nourriture et l'alimentation et les identités de soutien représentant 52% du contribution de la nature aux personnes dans cette analyse et la création et la maintenance d'habitats étant la Contribution de la Nature aux Personnes le plus courant. Ces résultats soulignent l'importance des systèmes pastoraux au-delà de la production alimentaire.*

***Mots-clés.*** *Systèmes socio-écologiques, Méditerranéen, Changement global, Élevage, Services écosystémiques*

## I - Introduction

The Mediterranean basin has been a place of intense human activity for more than 2,000 years, with pastoral systems being an important part of human history in the region (Pardini, 2004), providing a wide range of tangible and intangible social, economic and environmental

contributions throughout the Mediterranean basin. Pastoral systems are complex socio-ecological systems, defined as an "adaptive network of biophysical and social flows generated and maintained by the movement of shepherds and livestock" (Oteros-Rozas et al., 2012). They are defined by their adaptability, which allows pastoral systems to use all available resources as pastoralists efficiently use resources that are separated both spatially and temporarily (Krätli et al., 2013). Today the role of pastoral systems in addressing many key global challenges, particularly food security and biodiversity conservation, is starting to be acknowledged, particularly in arid and semi-arid and mountain regions such as the Mediterranean basin (López-i-Gelats et al., 2011; Niamir-Fuller and Huber-Sannwald, 2020).

Spain arguably hosts some of the most studied pastoral systems in Europe (Fernández-Giménez, 2015; López-i-Gelats et al., 2016; Oteros-Rozas et al., 2014; Plieninger and Huntsinger, 2018). Thanks in part to the continued existence of nationally protected pastoral infrastructure such as drove roads. The capacity of Spanish pastoralism in providing goods and services beyond meat and milk has been largely proved, with pastoral systems being of vital importance for the maintenance of many of Spain's biodiverse landscapes. From mountain pastures to lowland grasslands and Dehasas (Oteros-rozas, 2015; Plieninger and Huntsinger, 2018). Spain has also shown itself to be consistently prominent in meta-analysis regarding pastoral and agroecological systems, even at global scales (Dean et al., 2021; Hanaček and Rodríguez-Labajos, 2018; Plieninger et al., 2014). Highlighting a potential bias towards Spain in the agroecological and pastoral literature. Spanish pastoral systems have been extensively studied using the Ecosystem Services framework (Fernández-Giménez, 2015; Oteros-rozas, 2015), but not through the Nature's contribution to people (NCP) framework.

The prominence of Spain in the agroecological and pastoral literature warrants an individual examination of Spanish pastoral systems in the literature as users and producers of Nature's Contribution to People (NCP). This article aims to examine the NCP created and maintained by Spanish pastoral systems, due to its noted prominence in the agroecological and pastoral literature

NCP's are defined as "*all the contributions both positive and negative of living nature (diversity of organisms, ecosystems and their associated ecological and evolutionary processes) to people's quality of life*" (IPBES Plenary 5 Decision IPBES-5/1, n.d.). The NCP framework was developed by the Intergovernmental Science-policy Platform on Biodiversity and Ecosystem Services (IPBES) as a response to the shortcomings of the Ecosystem Services framework concerning it's under-representation of cultural ecosystem services (non-material NCP) and its difficulty capturing context-specific world views (Díaz et al., 2018). In the NCP framework, the categorisation system is similar to that of the ecosystem services framework. There are 18 NCP which are then placed into 3 major categories, regulating NCP, material NCP and non-material NCP (Table 1).

The NCP framework has been designed to embrace complexity and the plurality of NCP, something which is extremely rare in the ES literature (Kadykalo et al., 2019). A material NCP is capable of also being a non-material NCP depending on the context. The wool from a sheep is a material NCP, but it can also carry cultural significance as seen in Turkey (Ocak, 2016). The traditional movement of livestock such as transhumance is a way to ensure sufficient fodder for livestock (a material NCP), but it is also a cultural act that helps ensure the creation and maintenance of habitats as seen in Spain (Fernández-Giménez, 2015; Oteros-rozas, 2015). The NCP concept has gained popularity in the last four years and has become an excepted framework to study socio-ecological systems (Dean et al., 2021). A systematic review of the NCP created and maintained by pastoral systems in Spain was missing from the scientific literature. There has been criticism that pastoral systems are rarely studied as holistic systems (Manzano et al., 2021), because of which, this analysis intends to examine not only the NCP created and maintained in Spanish pastoral systems but also the patterns of association between the most commonly encountered NCP to determine if Spanish pastoral systems are

studied holistically or as claimed by Manzano et al. (2021) that pastoral systems are normally studied in terms of only a few variables.

## II - Methods

A systematic literature review and meta-analysis about Spanish pastoral systems was performed using the Qualitative Comparative Analysis (QCA) (Rudel, 2008; Young et al., 2006). The QCA methodology is an accepted method of the identification of trends within the literature through an inductive process of reading in the field of environmental global change and socio-ecological systems (Dean et al., 2021; López-i-Gelats et al., 2016).

**Data collection for literature review**

The Web of Science search engine was used to identify literature focusing on pastoral systems in the Mediterranean. To identify the literature, a custom search string was created:

"*TS=((grassland* OR rangeland* OR shrubland* OR scrubland*) AND (grazing OR pastoral) AND (livestock OR horse* OR sheep OR cattle OR goat*) AND Mediterranean*".

The search string resulted in 296 scientific papers for examination. The literature was required to display the following information as part of the selection criteria:

- Peer-review journals that contained primary data.
- Written in English and published between 2003 – 2019
- Articles should be based in Spain.
- The relationship between pastoral systems and Nature's Contribution to People should be discussed and examined.
- Characterises of the pastoral system in the region must be described
- Not set on experimental farms unless it is specifically stated that traditional practices are being reproduced

The literature extracted from the search string was then exported to a database and examined against the inclusion criteria in a four-step process (1) The publishing journal, (2) The title and keywords, (3) Analysing the abstract, (4) Analysing the full article. This initial examination resulted in 47 articles being selected for analysis. Each article was read several times to ensure that all NCP were captured for analysis. An additional 11 articles were then included based on expert recommendations in the field of Spanish pastoral systems. The database was designed to host dummy variables where NCP were coded based on their presence (1) or absence (0). Following previous analysis of NCP in terrestrial systems, only NCP which could be considered as positive were classified (Dean et al., 2021).

## III - Results

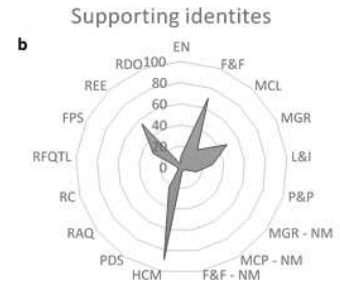
A total of 18 NCP was encountered in the analysis (Table 1). The results show that regulating NCP (n = 99) were the most common group of NCP found in the analysis, followed by material (n = 65) and non-material NCP (n = 45). Within each of these major NCP groups, a small subsection of NCP were found to dominate the analysis and accounted for 52% of all NCP in the analysis (Table 1). For material NCP, the most common NCP was *Food & Feed* (n = 29). In the non-material NCP, the dominant NCP was *Supporting identities* (n = 27) and in the regulating NCP category, the most common in NCP was *Habitat creation and maintenance* (n = 52) which was also the NCP most frequently observed in the entire analysis. Across the analysis, a median of three NCP were examined in every article. Patters of distributions emerged amount the different NCP groups, it was found that the majority of articles (n = 40) examined in this analysis contained more than 1 major NCP group (Regulating, Material, Non-

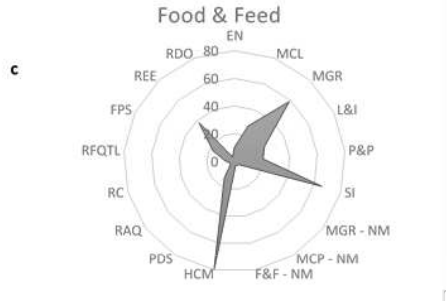
material) and 20 articles examined more NCP belonging to all 3 NCP groups. With only 19 articles examining a single NCP group. Regarding the 3 NCP that dominated the analysis, *Habitat creation and maintenance, Supporting identities, Food & Feed,* patterns of distributions were found with other NCP (Figure.1).

*Food & Feed* was found to be closely linked with four other NCP (Fig 1a); The material NCP *Medicinal, biochemical and genetic resources* (MGR) (59%), the non-material NCP *Supporting identities* (SI) (66%) and the regulating NCP *Habitat creation and maintenance* (HCM) (79%) and the *Regulation of extreme events* (REE) (38%). *Supporting identities* was also found to be associated with four NCP (Figure 1b) *Food & Feed* (F&F) (70%), NCP *Habitat creation and maintenance* (HCM) (79%), *Regulation of extreme events* (REE). (56%) and the material NCP *Medicinal, biochemical and genetic resources* (MGR) (48%), *Habitat creation and maintenance* was found to have 5 associations (Fig 1c), although all the associations were relatively weak. Two regulating, two material and one non-material NCP were found to be commonly found with *Habitat creation and maintenance*. The material NCP were *Food & Feed* (F&F) (44%), and *Medicinal, biochemical and genetic resources* (MGR) (38%). The regulating NCP were the *Regulation of extreme events* (REE) (35%) and the *Formation and protection of soils* (FPS) (21%). The non-material NCP that was found to be associated with *Habitat creation and maintenance* was *Supporting identities* (SI) (46%).

a

| NCP | NCP ACRONYM |
|---|---|
| Energy | EN |
| Food & Feed | F&F |
| Materials companionship and labour | MCL |
| Medicinal, biochemical and genetic resources | MGR |
| Habitat creation and maintenance | HCM |
| Pollination and seed dispersal and other propagules | PDS |
| Regulation of air quality | RAQ |
| Regulation of climate | RC |
| Regulation of freshwater quantity, location and timing | RFQTL |
| Formation protection and decontamination of soils and sediments | FPS |
| Regulation of extreme events | REE |
| Regulation of detrimental organisms and biological processes | RDO |
| Learning and inspiration | L&L |
| Physical and psychological experiences | P&P |
| Supporting identities | SI |
| Materials companionship and labour | MCP – NM |
| Medicinal, biochemical and genetic resources | MGR – NM |
| Food & Feed | F&F – NM |



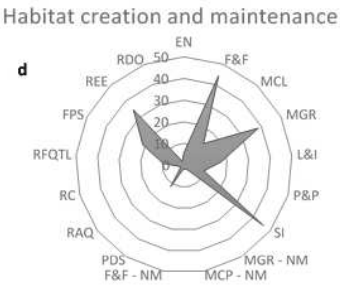




**Figure 1a** NCP in the analysis with acronyms. **Fig 1b.** NCP are present with *Supporting identities* in percentage. **Fig 1c**. NCP are present with *Food & Feed* in percentage. **Fig 1d.** NCP are found with Habitat creation and maintenance in percentage

| NCP group | NCP | NCP ACRONYM | TOT Included (n) | Tot NCP group |
|---|---|---|---|---|
| Material | Energy | EN | 3 | |
| | Food & Feed | F&F | 29 | |
| | Materials companionship and labour | MCL | 9 | |
| | Medicinal, biochemical and genetic resources | MGR | 24 | 65 |
| Regulating | Habitat creation and maintenance | HCM | 52 | |
| | Pollination and seed dispersal and other propagules | PDS | 6 | |
| | Regulation of air quality | RAQ | 1 | |
| | Regulation of climate | RC | 1 | |
| | Regulation of freshwater quantity, location and timing | RFQTL | 5 | |
| | Formation protection and decontamination of soils and sediments | FPS | 11 | |
| | Regulation of extreme events | REE | 20 | |
| | Regulation of detrimental organisms and biological processes | RDO | 3 | 99 |
| Non-material | Learning and inspiration | L&L | 9 | |
| | Physical and psychological experiences | P&P | 6 | |
| | Supporting identities | SI | 27 | |
| | Materials companionship and labour | MCP – NM | 1 | |
| | Medicinal, biochemical and genetic resources | MGR – NM | 1 | |
| | Food & Feed | F&F – NM | 1 | 45 |

**Figure 2**: NCP identified in the literature concerning Spanish pastoral systems

## IV - Discussion

During the course of this analysis, we have shown that Spanish pastoral systems are most commonly associated with three NCP; *Habitat creation and maintenance*, *Food and Feed* and *Supporting identities*. This supports the results of a recent global meta-analysis of NCP in pastoral systems which found that these 3 NCP were the most common in the pastoral literature (Dean et al., 2021). Spanish pastoral systems are deeply impacted by the EU wide Common Agricultural Policy (CAP) which subsidies biodiversity-friendly farming practices (Commission, 2020), with the European Union increasingly recognising the role of pastoral systems on the environments, and their role in biodiversity management, land management and their ability to regulate grassland/rangelands as carbon sinks (Nori and Gemini, 2011). Although the historic relationship of European pastoral systems and the EU is complex (López-i-Gelats et al., 2015; Nori and Gemini, 2011; O'Rourke et al., 2016).

Spain is also considered one of the most important countries in the EU as it is considered a global biodiversity hotspot (Cuttelod et al., 2008). This helps us to understand why the results of this analysis are deeply focused on the NCP *Habitat creation and maintenance* as pastoral systems are vital for the creation of semi-natural habitats such as grasslands or rangelands that host biodiversity, but require constant maintenance to maintain the biodiversity (Squires et al., 2018). That the literature revealed that *Food & Feed* was only marginally more present than *Supporting identities* is a surprise. Cultural identity is important in pastoral systems, that is in no doubt (Fernández-Giménez, 2015) but pastoral systems both in Spain and globally are at their heart food production systems. Given the importance of pastoral systems for food production in semi-arid and arid areas such as much of the Mediterranean basin including much of Spain (Niamir-Fuller and Huber-Sannwald, 2020) and that food production is one of the primary three objectives of the CAP (Nori and Gemini, 2011) it is surprising that pastoral systems in Spain have not shown *Food & Feed* production to be a more dominant NPC. This could be because

Spain is an EU country, where industrial food and feed production are normal, and smallscale pastoral systems are being abandoned or intensified as seen in both in Spain (López-i-Gelats et al., 2015) and other parts of the EU such as Ireland and France (O'Rourke et al., 2016).

The combination of pastoral systems importance for biodiversity and the large-scale land-abandonment and intensification found in Spain could explain why researchers have focused on non-material NCP such as *Supporting identities.* As Spanish pastoral systems become less relevant economically and for food security, its value seems to have switched from food security to maintaining biodiverse landscapes, and the protection of identity and culture as a means to ensure land abandonment or intensification does not occur. As it has been demonstrated in the ecosystems services literature that cultural ecosystem services are prominent in the formation of environmental attitudes and framing (Chiesura and De Groot, 2003) highlighting their value to both policy and science.

## V - Conclusion

The focus of Spanish pastoral literature on regulating NCP particularly on *Habitat creation and maintenance* showcases the importance of pastoral systems in the eyes of researchers. One explanation for this focus is the importance of Spain in the EU as a Mediterranean biodiversity hotspot, with pastoral systems being considered vital for the maintenance of biodiverse landscapes. Although pastoralism seems to be considered secondarily as food production systems and as a form of cultural identity which is a flaw as the synergies between different NCP fail to be acknowledged when researchers focus on only a small subsection of NCP. The focus on only a small subsection of NCP reflects a potential problem with researchers of pastoral systems in Spain; the simplification of complex socio-ecological systems. If pastoral systems are to be truly understood, they cannot be thought of in only a few simplified terms.

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