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RESEARCH ARTICLE

Examining Human-Nature Relationships through the Lens of Reciprocity: Insights from Indigenous and Local Knowledge

Navigating human–plant reciprocity: Commercial harvesting by professionals of a medicinal plant fosters multi-actor landscape management

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Abstract

1. Studies of human–nature relationships increasingly recognise not only nature's contributions to people but also the positive contributions of human practices to ecosystems. The concept of reciprocal contributions emphasises positive human–nature relationships. But trade-offs between natural elements implies that human favouring of one element (e.g. via the protection of its habitat) can be detrimental to others. Discussing the concept of reciprocal contributions encourages us to rethink human management of landscape by shifting from a primary focus on instrumental values associated with plant extraction, to relational values related to the multiple interests of human and non-human actors.
2. To study how relational values are integrated into the configuration of multifunctional landscapes, we focused on professional harvesters of *Arnica montana*. We asked what role professional harvesters play in the stewardship of their harvesting sites through reciprocal relations with plants, landscapes and other actors to shape the future of plant and landscape sustainability.
3. We show that even though professional harvesters live far from their harvesting sites, they develop both a strong attachment to them, and an experience-based ecological knowledge of the relationships between arnica and other plant species and the environment. This attachment and experience-based knowledge provide harvesters with legitimacy in the eyes of other actors (e.g. cattle farmers, managers of natural areas, pharmaceutical and cosmetic laboratories) and allow them to play the role of mediator between these other actors and the harvested plant in order to influence the management of the environment—for example by burning, mowing or grazing. This creates a reciprocal benefit with this particular species, but also with other co-occurring species. Integrating the interests of the harvesters with those of other stakeholders requires negotiation and the search for synergies between values.

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4. *Synthesis and applications*. Within the framework of 'reciprocal contributions', we argue that human engagement in reciprocal relations with specific species is read as a form of care that privileges the maintenance of certain lives over others; trade-offs between plants but also between plants, animals, landscape and humans have to be incorporated in the theoretical framework.

KEYWORDS
care, foraging, gathering, medicinal and aromatic plants, multifunctional landscape, reciprocal contributions, relational values, stewardship

1 | INTRODUCTION

Nature's contributions to people (NCP)—conceptualised during sessions of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (Pascual et al., 2017)—emerged from a long-term reflection on ecosystem services rendered to humans (Daily & Matson, 2008), especially cultural services (Chan et al., 2012). Stepping away from a commodification of nature (Díaz et al., 2018), NCP offers a more reciprocal and inclusive framework of human–nature relationships (Comberti et al., 2015; Ellis et al., 2019) that emphasises the coexistence and interactions of diverse worldviews, context-specific knowledges and complex relational values (Kadykalo et al., 2019), especially those of Indigenous People and Local Communities (IP&LC).

As the classical dichotomy between instrumental and intrinsic values of nature poorly accounts for human–nature reciprocity, the concept of relational values has been mobilised by scholars to address this gap in knowledge (Chan et al., 2016; Jones et al., 2016). Relational values are context-dependent (Jones et al., 2016), and their study requires attention to the diverse and 'patchy' nature of both social and ecological assemblages (Tsing et al., 2019). Relational values between humans and nature refer to the principles, beliefs or ideals that emphasise the importance of interactions between human individuals or groups with their environment. These values prioritise the quality of connections, mutual respect, understanding and cooperation. Relational values often encompass concepts such as empathy, trust, collaboration, responsibility and reciprocity. Reciprocity could be either generalised, when integrated into social structures without a calculation of return by 'altruism', or balanced, when there is an expectation that an action will produce a benefit in the long-term without necessarily knowing its temporality and spatiality (Sahlins, 1974). Historical understanding of reciprocity as an outcome of human agency has evolved to incorporate place and non-human actors (Barker & Pickerill, 2020; Jones & Cloke, 2008; Tsing et al., 2019), which has led to a re-examination of environmental management as relational praxis that is not simply human-centred but also incorporates non-hierarchical relations among human and non-human actors (Romani et al., 2022).

The concept of reciprocal contributions between people and nature (Ojeda et al., 2022) uses a construct of balanced reciprocity grounded in the recognition of trade-offs. Reciprocal contribution explicitly recognises how stewardship involves choices and trade-offs between entities within a landscape (Reisman, 2021). We use the term 'trade-off' to highlight the fact that there is no such thing as a management path that is equally favourable to all beings in a given area. We accord special importance to trade-offs because, although there are also synergies between biotic and abiotic elements in a defined area, it is when some interests are favoured over others that the values underlying the action (e.g. an environmental management practice) are best revealed.

This new focus on reciprocity has highlighted the need to document a diversity of lived experience with nature involving a reciprocal relationship of care, which we define as 'the desire to 'look after' something informed by, for example, values, meanings, emotions, preferences, and senses of attachment, connection or responsibility' (West et al., 2018: 2). Human caring for nature supports both ecosystem health and human well-being (Caillon et al., 2017; Jax et al., 2018), engaging in reciprocal relations grounded in continued observation of, and attention to, the effect of interactions between humans and nature. For decades, the most striking examples have been offered by IP&LC (Descola, 1986; Posey, 1983; Viveiros de Castro, 1992) and such examples have been integrated to shape current international policies (Anderson et al., 2022; Tengö et al., 2017). Reciprocal contribution is implicitly constructed on ethical, respectful and responsible foundations, fosters sustainability and 'entangled multi-body and multidimensional well-being' (McGuire & Mawyer, 2023: 23).

However, we argue that how people are positioned in relation to trade-offs when engaging in reciprocal contributions with nature remains largely unexplored. It is important to recognise that different people (e.g. harvesters) have specific connections to and are, therefore, positioned differently in relation to, discrete living elements (e.g. a harvested species). This implies a non-egalitarian relationship of caring and the existence of trade-offs between human values as different human actors act in a landscape (e.g. trade-offs between the values that underlie different conservation objectives; Hirsch et al., 2011). A good way to capture the dynamic and relational essence of these reciprocal contributions is to start with particular landscapes-in-the-making, with their array of human and non-human actors, entangled in multiple interactions and values. Landscape is a polysemic term that has undergone significant conceptual development in the geographical literature since the mid-19th century.

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Beyond the picturesque representation of landscape, the term has been understood mainly as the result of human action on a natural medium (de la Blache's *genres de vie* [1911], Sauer's [1925: 19–53] cultural landscape) but also progressively as a dynamic interface between nature and technology (Buttimer, 1998), and more recently under the influence of multispecies ethnographies, as a space of more-than-human transformative encounters (Tsing, 2015; Tsing et al., 2019).

Approaches that examine the contribution of wild medicinal plant harvesters to landscapes may provide insights into sustainability that complement and expand on studies of 'harvesting pressure' alone (Pulido & Caballero, 2006; Ticktin & Shackleton, 2011). Harvesting is often viewed in the scientific literature through the limited lens of an extractive relationship between the harvester and the plant, while other interactions in the landscape are rarely taken into account. Understanding this web of interactions, however, requires studying whether, and how, wild plant harvesters trigger positive impacts on the harvested plant population and the ecosystem, thereby leading to a reciprocally beneficial relationship, in particular through ecosystem management practices. Compared to most studies published on harvesting of wild plants, the European context is specific for two related reasons. First, while at the international level most of the studies on medicinal and aromatic plants fall under the definition of 'non-timber/wood forest products' (Kuipers, 1997), in Europe a large portion of species are harvested in pastoral landscapes. These environments are often species-rich and dependent on traditional management regimes (Webb, 1998). As traditional agropastoralism has declined considerably in France since the second half of the 20th century (MacDonald et al., 2000), these biocultural landscapes have been transformed and the dynamics between wild plants, harvesting practices and landscape changes are still not well-studied. Second, most studies of harvester-nature relations have focused largely on IP&LC (Anderson, 2005; Dounias, 2001; Kimmerer, 2013; Nabhan, 2020; Turner & Berkes, 2006), while commercial harvesting has received less attention. Ballard and Huntsinger (2006) were the first to highlight the diversity of practices and associated local knowledge of people dedicated to the commercial harvesting of a species, salal (*Gaultheria shallon*) in the Pacific Northwest of the United States. They highlighted how resource management knowledge differs between experienced and newcomer harvesters in the area. In France, commercial harvesting by professionals as practised during most of the 20th century (described by Larrère & de La Soudière, 1987), has been in decline since the 1980s. In its place, new harvesters have moved from the local to the country-wide scale by creating self-managed cooperatives. These growing numbers of professional harvesters are today the main suppliers of wild medicinal and aromatic plants to French and European pharmaceutical, cosmetic, homeopathic, liquor and herbal medicine producers (Garreta & Julliand, 2017). Among the wild medicinal and aromatic plant species harvested in France, *Arnica montana* L. (Asteraceae; hereafter 'arnica') is emblematic of a 'cash wild plant'. Arnica is a good model to study how harvesting practices are linked with management of the landscape as this species (i) has a central and increasing role in the medicinal and aromatic plants industry, leading to increased 'pressure' on the resource, (ii) is still mainly harvested in the wild, (iii) thrives in anthropogenic landscapes with high biodiversity value and (iv) is very sensitive to appropriate management actions.

In this paper, we conducted ethnobiological fieldwork, which emphasises an emic approach (Arrivabene et al., 2024), with actors involved in the foraging or harvesting of arnica by professional harvesters in the Massif Central, an upland region in south-central France. Our goal is to explore how people progressively establish reciprocal relations with nature through trade-offs and synergies between values associated with plants, people and landscapes. Specifically, in the stewardship of their harvesting sites, we ask how harvester-led management practices that are focussed primarily on arnica build on knowledge of other species and interact with values of other human actors.

2 | PROFESSIONAL HARVESTERS, ARNICA AND METHODS

We—French and Canadian researchers in ethnoecology, geography and ecology—chose to work with professional French harvesters (rather than with amateur ones), as they collect larger quantities of plants. Professional harvesters (*producteur-cueilleurs*), can be classed in four categories according to their practices: (1) 'Militant' artisan-harvesters, (2) 'Industrial' harvesters—cooperators, (3) 'Industrial' harvesters—independents, (4) 'Task' harvesters (Pinton et al., 2015). We worked with the second category, and, hereafter, refer to them as 'professional harvesters'. The cooperatives are collaborative structures that pool the production of dry or fresh medicinal plants to respond to orders from, and contracts with, companies belonging mainly to the cosmetics, pharmaceutical and homeopathic industries. We contacted and observed the work and organisation of two cooperatives in the Massif Central region, where drying is carried out individually by harvesters but sorting or crushing operations can be carried out at the cooperative's facilities. Both cooperatives have between three and five permanent staff, in charge of the reception, processing and shipping of plants, and administrative tasks. They are governed by a board of directors elected from among the harvesters who are members of the cooperative. Membership is structured through a contract agreed upon between the harvester and the corporate body of the cooperatives. The harvesters contract each year with the cooperative on the species and quantities to be picked, and the companies' orders are then distributed among the harvesters. The negotiation of prices with buyers is carried out by harvesters elected as sales managers. These two cooperatives bring together harvesters with a variety of profiles, ranging from farmers harvesting plants as an income supplement to full-time harvesters (Chaber et al., 2013). They each harvest from 10 to 500 distinct species, and from 50 kg to 15 metric tons (1 metric tonne = 1000 kg) in dry equivalent per year, all plants combined.

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Harvested in European cultural landscapes, arnica thrives in pastures, hay meadows and moors of the crystalline and basaltic mountain massifs and has a long history of coexistence with human pastoral practices. The European Directive 92/43/EEC on the conservation of natural habitats defined arnica's main habitat—species-rich *Nardus* grasslands (code 6530)—as a priority habitat (Janák & Galvánek, 2008). Arnica is very sensitive to environmental conditions, and its presence is tightly associated with appropriate environmental management practices. Intensification of agriculture in pastoral areas through fertilisation leads to local extinction (Hollmann et al., 2020), but arnica also disappears as rangelands are abandoned and reforested (Vikane et al., 2019). Arnica may be described as an 'umbrella' species, according to the definition of Roberge and Angelstam (2004), as concern for this plant could contribute to the conservation of the whole habitat. The harvesting of arnica flower heads for pharmaceutical and cosmetic preparations is traditional in several regions of Europe, probably since the 16th century (Mayer & Czygan, 2000). Since the middle of the 20th century, markets such as cosmetics have expanded, with the total annual demand reaching about 50 metric tons of dry flower heads in Europe in the 1990s (Lange, 1998). Demand has doubtless continued to increase since then. In parallel, the development of the homeopathic sector has created a market for the whole plant, which has introduced new harvesting practices (i.e. harvesting of the whole flowering plant). In 2014, Pasquier and Godin (2014) estimated the French annual production of fresh whole plant to be 10–20 metric tons. The harvesters interviewed for this study had contracts for quantities ranging from 50 to 1000 kg of fresh whole arnica plant for a season, and up to 150 kg of flower heads.

Between September 2020 and October 2022, we used an ethnographic approach based on participant observation during arnica harvesting (8 days in the harvesting season in June–July 2022, with four different harvesters), visits to farmers (i.e. cattle breeders) located near arnica harvesting sites, and three meetings between stakeholders aimed at defining management plans. We completed our set of data through semi-structured surveys with 13 professional arnica harvesters living in different villages in central France, out of about a hundred living in France. We interviewed the 'biggest' as well as the 'smallest' harvesters in terms of quantity harvested per year. The 13 harvesters all agreed to discuss their arnica practices.

Interviews ran from 1 to 3 h each and were conducted either at the harvester's home, at the cooperative or during visits to arnica sites. Interview questions involved harvesters' general views on their activities, relations they have to arnica and to other plant species, the history of their harvesting practices and sites, and their relations with other stakeholders. In addition to interviews with arnica harvesters, we conducted interviews by phone with four purchasing managers from industrial user companies. We sought information about the history of their arnica supply, prices, quality control and traceability, their knowledge of the sites, their strategies for securing supplies and their involvement in site management. We also conducted surveys by phone with four natural-area operators (managers of regional protected areas and agents of the *Office National des Forêts*) and asked questions about their knowledge of arnica ecology, their views on arnica harvesting, and management actions taken and planned.

All the interviews were recorded, transcribed and thematically coded using the QDA miner software, using a combination of predefined questions guided by our research question and by our knowledge of the literature, and questions that emerged during interviews and participant observation. As in most social-science disciplines, our questions and hypotheses evolved over the course of the research, shaped both by the responses of persons we interviewed (i.e. what is important for them) and by insights from the scientific literature, both old and new. Personal data were anonymised using codes instead of names in all electronic or paper documents. The CNRS ethics committee does not propose, review or adjudicate ethics protocols for qualitative research involving humans. Accordingly, we followed the Code of Ethics of the International Society of Ethnobiology (2006). Before conducting the interviews, the objectives of the study and the type of data collected were explained to the interviewees, and the participants gave their prior informed consent verbally.

3 | BUILDING UP MULTIDIMENSIONAL ECOLOGICAL KNOWLEDGE

The richness of knowledge that IP&LC harvesters have about their surrounding environment has long been described by ethnobiologists (Turner & Bell, 1971). However, questions regarding non-IP&LC professional harvesters' knowledge, not only about the wild plants they harvest, but also about these plants' interactions with other plant and animal species and with the landscape, are not well understood. It might be thought that the stories professional harvesters share about their activity during our interviews would revolve around the volumes harvested, or the profit made on different occasions. We found that this was not the case. Instead, the conversations we had with harvesters were full of stories of plants, observations of the many facets of the relationship of plants with their environment, and accounts of the behaviour and dynamics of the plant populations or individuals they encountered as they harvested. These narratives emphasise the importance harvesters give to observing and interpreting ecological signs or indicators, whether or not these are directly useful to them. These practices of reading the landscape or 'arts of noticing', as Tsing (2015: 37) describes them, integrate a knowledge of humans, animals, other plants and microclimates, but are also arts of interpretation. For example, during a harvest, the first author noticed that arnica flower heads had been cut, and asked the harvester whether they were cut by another harvester or by a deer. He explained that the way a harvester picks is not the same as that of a deer, both in the spatial pattern and in the shape of the sectioned stem and that these cuts were thus the

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result of another harvester's action. In another area, a harvester noticed that where rhododendron (*Rhododendron ferrugineum* L., Ericaceae) had been growing for several years, the arnica had disappeared. Most harvesters also noticed what few botanists have acknowledged, that arnica responds very strongly to the height of the surrounding plants: arnica becomes taller (harvesters say *plus charnue* ['fleshier']) when plants around it are higher (Locqueville et al., 2023). These stories contrast with the idea often conveyed of 'industrial' harvesting in comparison with IP&LC and even local, artisanal or familial harvesting: small-scale harvesting is generally supposed to be less impactful and to respond to more sensitive and relational values than commercial harvesting, which is generally supposed to be more driven by the need for profitability. In fact, most professional harvesters develop a relationship of care and attention to the behaviour of the plants and the place where they grow, a place they name a *site* or a *spot*. Of course, harvesting cannot be improvised and requires experience and knowledge of harvesting, transporting and processing techniques. However, part of harvesting can be described as relational, and concerned with the dynamic links between the plant, people and the landscape. The ecological knowledge of harvesters is also built in conjunction with academic and institutional knowledge, acquired for example through exchanges with officers of national and regional parks.

But what is the role of their ecological knowledge, when most of these harvesters only come to harvesting sites, old and new, once or twice a year during the harvesting season? Each harvester has a vast and scattered 'territory of harvesting'. For arnica, a harvester depends on various sites, each of which can be up to 100 ha in extent, and where the plant is not necessarily homogeneous in density. Some harvesters working in the Massif Central also harvest arnica in more than 10 different administrative *départements*, from the Vosges to the Pyrenees (i.e. a 1000-km range). While this diversity of sites, along with long-term use of sites, makes it possible to mitigate the ecological and social risks for a harvester, the infrequency of their visits (e.g. once or twice a year) would not seem to favour a reciprocity between harvesters and their sites. We are aware that IP&LC harvesters often develop a strong sense of attachment to plants and place, even though they may not live on sites, as they follow seasonality of species. IP&LC have also shown their ability to secure and transmit these values of attachment even after forced relocation from their traditional territory by colonial or national governments (Anderson & Pierotti, 2022; Turner et al., 2022).

The lack of attachment of the more mobile French harvesters is in fact a criticism voiced by some of the more local ones, who are able to observe arnica year-round. However, we noted that even the harvesters who only come once a year to their site are very attached to it and have a detailed knowledge of it. Carrying out sustainable harvesting is not simple, because it requires being attentive to multiple indicators and a knowledge of plant reproductive processes. For example, in certain sites, the population of arnica is very 'young', with numerous individuals resulting from seedlings of the two preceding years. Collecting the 'whole plant' is then equivalent to digging up the whole individual, while for older arnica plants, 'whole-plant' collecting actually harvests only a ramet (a vegetative unit) of each plant, as arnica spreads by phalanx-type clonal growth. The plant population is thus more severely impacted when whole young arnica is harvested. Such observations have led some harvesters to decide not to practise whole-plant harvesting when arnica is young in order to maintain a viable population for future harvesting.

Harvesters become 'allies' of the harvested species and give a voice to the plant by seeking to understand all of its ecological links, all of its interactions with other species and with its abiotic environment. For example, one harvester explained: '[When I go harvesting], I also take the opportunity to walk around, I don't just pick, there is also a whole ecological dimension that interests me'. A harvesting site thus represents more than a place of supply; it also embeds a dynamic network of species in interaction with each other and with abiotic elements of the landscape, a place that supports the building up of complex ecological knowledge based on an empirical and experimental approach, and also on attachment.

4 | WHEN STEWARDSHIP IMPLIES TRADE-OFF

As the years go by and the sites change, harvesters have to choose between looking for better harvesting sites and sustaining arnica populations in already known sites. For the vast majority of wild medicinal and aromatic species, professional harvesters prefer moving to new sites when a change occurs, be it a change of ecological or social (i.e. access rights) nature. However, for a few species, including arnica, professional harvesters have begun to invest time and energy in trying to maintain the plant on their sites by contributing to the management of these sites (Figure 1). A comparison with the harvesting process reported by Larrère and de La Soudière (1987) in the Massif Central region in the 1980s shows how the cost of searching for new sites has changed. Among local farmers, the harvests were carried out in a perimeter of a few communes (a commune is an administrative division governed by a mayor and a municipal council), and harvesting rights were negotiated between acquaintances. By contrast, professional harvesters typically reside outside the local territory and must, therefore, make the effort to find property owners, establish social links with them and secure authorisation to access sites. Moreover, for the purpose of traceability and to demonstrate their environmental concern, the industrial sector is also increasingly requesting written authorisations for harvesting, which adds time-consuming procedures to the practice of harvesting. The search for a new site also implies numerous motorised trips and can last up to a week. In addition, some sites may already be used by harvesters who are not part of their network of acquaintances, which makes the task more complex.

Landscape management by harvesters can be seen as the outcome of the ongoing observation and care described above. Rather than planning to manage the sites from the beginning, harvesters

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often begin to think about management after observing ecological changes that occur following several years of 'opportunistic' harvesting on a site. Many harvesters report having observed management-induced changes in ecological dynamics of their sites:

> I found another site, which is also on the massif of X (…), in fact this site was where I was harvesting pine buds, ten years ago, it was full of fern, common heather with Scots pine. I think it was the farmers who used it to put their cows, well they burned it, everything burned, 1 day I went there in March for pine buds, I said 'oh no'. The next year, I went back and saw hundreds of thousands of little rosettes of arnica that had sprouted. And here we are, the following year, it was full of arnica. Two or three years ago there was a huge bloom, (…) but it's been two years since there's not been a lot.
>
> (a harvester, Dec. 3, 2020)

Here, the harvester shows that when collecting a species, he or she notes events that are not necessarily connected to his or her purpose of the day, and relates them to other useful species, in this case arnica. More globally, the harvester is describing how land use alters ecological dynamics.

But what motivates harvesters to take the leap and start to manage arnica sites? The first reason is that arnica is a relatively rare species, or more precisely, that large sites with significant harvestable quantities of this species are increasingly rare, as its habitat tends to regress due to several factors mentioned above (decline of extensive pastoralism, climatic changes). Harvesters, especially those who harvest the largest volumes, are thus less prone to search for new sites and more willing to conserve the production potential of existing sites.

The second reason, cited by harvesters in interviews and supported by scientific literature (Kahmen & Poschlod, 2000), is that appropriate management has a strongly positive impact on arnica populations, while harvesting has comparatively less influence on them. The biological characteristics of the plant (e.g. the rates of ramet recruitment and survival), the parts harvested, and the plant's ecological niche are all important determinants of sensitivity of plant populations to harvesting and management (Ghimire et al., 2005; Ticktin & Shackleton, 2011). For arnica, a very intense harvest (>90% of the flowering rosettes) for several decades in the Markstein Massif has not caused substantial decline in the arnica population (but the individuals flower less frequently). This is not the case for all harvested species (e.g. *Nardostachys grandiflora* DC, Caprifoliaceae, in the Himalayas: Ghimire et al., 2005). By contrast, mineral fertilisation (Sugier et al., 2019) or sheep grazing (harvesters' observations) leads to arnica's disappearance in only 1 or 2 years. Arnica's relatively low sensitivity to harvesting may be due to the plant's clonal habit, with underground storage organs and only a small percentage of rosettes flowering each year (usually less than 10%).

A summary of the direct and indirect actions (as well as measures to prevent actions) that were reported in the interviews as part of the management of arnica is given in Table 1. The main ecological process that motivates harvesters to manage is the colonisation of sites by low woody species (often *Calluna vulgaris*, *Vaccinium* spp. [both Ericaceae] and *Genista* spp. [Fabaceae]). Arnica gradually declines as the low woody vegetation of the heathland outcompetes it and experiences a transitory demographic boom after partial elimination of this woody vegetation, for example by milling (with a rotary mower) or burning. Harvesters are thus confronted with trade-offs, as they promote certain species by eliminating others. Because it privileges 'the maintenance of certain lives over others', landscape care is a form of more-than-human 'biopolitics' (Reisman, 2021: 401) with its non-egalitarian rules and relations. Following Puig de La Bellacasa (2017), Reisman (2021) declares that care is 'non-innocent' and poses 'difficult questions about how to care'.

The other question harvesters have to face is 'which practice should they choose to manage landscapes?' There is an ongoing

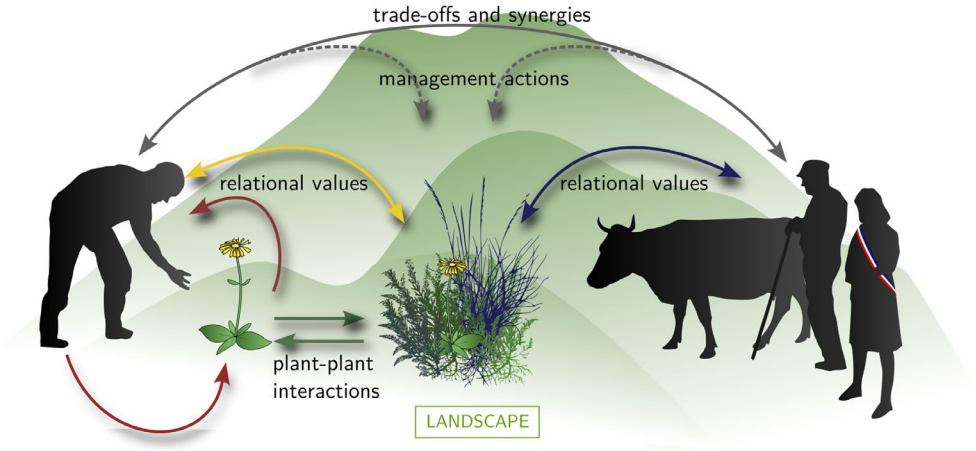

FIGURE 1 Harvesting involves reciprocal contributions between the harvesters and the harvested plant, and this involves encounters with other plants and other stakeholders. Within the landscape, understood as an assemblage, plant–plant interactions are at the heart of trade-offs and synergies between harvesters and other stakeholders.

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TABLE 1 Harvesters' knowledge and practices. Chamaephytes are the small woody perennials that dominate in many rangeland environments (essentially Calluna vulgaris and *Vaccinium* spp. [Ericaceae] and *Genista* spp. [Fabaceae]).

Type of action (or non-action)	Associated knowledge	Ecological functioning	Financial implications
Mowing with rotary mower	The preferred technique to reduce the dominance of chamaephytes in heathland environments	Removal of competition; as *A. montana* is a perennial with underground storage organs, it is one of the species that benefit the most from above-ground disturbance	Large financial investment; harvesters usually need to find funding for these actions
Prescribed burning	Positive effects on arnica by reducing the dominance of chamaephytes, but if not done properly (too hot) it can damage the soil. Whether this technique should be used generates intense debates among harvesters		
Grazing	Grazing by sheep should be avoided, as they eat arnica rosettes. Cattle grazing should be avoided before arnica flowering, because of trampling. Cattle grazing has positive effects if done at low intensity after arnica flowering, as it limits the growth of the other species		Interaction with farmers to prevent them from putting the cattle on land before arnica flowering
Fertilisation (adverse effect)	Fertilisation (to increase biomass productivity of a grassland) must be avoided as it leads to arnica disappearance	Higher soil fertility usually favours species with higher competitive behaviour, which is unfavourable to *A. montana*	Sometimes, financial compensation as large as €600 for a site is given to the farmer to compensate for the loss incurred by not fertilising

debate among harvesters about the appropriateness of using fire. Prescribed burning was one of the key practices that historically contributed to the dominance of arnica in some mountain ranges. But the difficulty of conducting this operation with appropriate techniques, along with the depreciation by institutions of fire as a management tool (Métailié, 2006), leads many harvesters to favour mowing. Along with direct disturbance (i.e. mowing, burning, tree cutting), some indirect actions may be favoured, such as controlling the timing and intensity of grazing, preventing sheep grazing or avoiding fertilisation. Thus, harvesters' practices consist in a sometimes difficult articulation (sensu Latour, 1999) between the arnica and the associated landscape. We suggest that plant–plant trade-offs are central for landscape management, but these have rarely received much attention from social scientists. These trade-offs are part of what gives landscape management a political significance. Reciprocity-based harvesting is plant-specific and depends upon a number of economic, sociopolitical and ecological factors (Ticktin & Shackleton, 2011). The existence of uses of the plant, or of the land that compete with harvesting may impair the possibility of management. The third reason for investing in site management is that it can be synergistic with the goals of other stakeholders, a topic we discuss in the following section.

5 | NAVIGATING RECIPROCITY WITHIN A MULTI-ACTOR LANDSCAPE

Arnica harvesting sites are landscapes within which a diversity of actors interacts: farmers and pastoral associations, foresters, hunters, communes and natural-area managers (Figure 1). Each of them pays attention to, and cares for, different beings of the same place. In this context, how do the reciprocal relationships of harvesters and landscapes mesh with the values and the relationships of other actors within the landscape? The most frequent interactions are those between harvesters and cattle farmers; indeed, many of the arnica sites are located in cattle-grazing areas. At first glance, one might expect a strong divergence between harvesters and herders in the value given to arnica. Indeed, this species is not directly useful for farmers, since it is part of the refusals (non-consumed species), and often carries a negative value for farmers, as exemplified by the words of a farmer in the Massif Central to a harvester, reported by the latter: 'This arnica pisses me off, I mow it [for fodder], you understand, but the cows don't eat it; [when you harvest it] you always leave at least half of it, there's plenty left, don't you have a technique to get rid of it?' (Dec. 7, 2020). This example shows a difference in values (harvesting vs. pastoral values of the landscape) and attachment to specific plant species (arnica vs. other herbs, mostly grasses), but also a difference in visions of the activities themselves. For example, farmers in Ardèche commonly have a derogatory view of wild plant harvesting as a practice of the poor in the ancient peasant economy of this Massif.

As arnica is not attractive for cattle farmers, we might expect harvesters to encounter difficulties in implementing management practices favourable to arnica. However, these divergent interests are often reconciled. Harvesters and cattle farmers share a common ecological goal: preventing the dominance of the low woody vegetation, i.e. notably *Calluna vulgaris* L., *Vaccinium* spp.

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and *Genista* spp., all of which have a low palatability for cattle. Management practices (mowing and burning) are favourable both for grasses (*Festuca* spp., *Deschampsia flexuosa* (L.) Trin., and *Nardus stricta* L. [Poaceae]) and for several highly palatable forbs. Arnica is also favoured by the reduction in competition with woody plants, and these management actions thus introduce benefits for both harvesters and cattle farmers (Locqueville et al., 2023). Moreover, many of the open areas with arnica benefit from contracts for agri-environmental measures, which consist of a payment for environmental services (Squires et al., 2018), that is in our case, the maintenance of open areas. Actions to reopen the environment are, therefore, well accepted by cattle farmers and by other users such as hunters, who also benefit from these actions that are favourable for small game. The persistence of arnica harvesting is also of interest to land owners for financial reasons, as it has become a common practice for harvesters to pay a fee to the owner (around €1 per kg of fresh plant, for a total that can reach €600 per year).

The interests of harvesters also intersect directly with those of actors responsible for biodiversity protection. Most professional harvesters are 'nomadic' and do not live near their harvesting sites. To overcome the impossibility of being present on their site all year-round, harvesters increasingly mobilise alliances with biodiversity-related institutions (natural-area operators, agents of national parks). As stated above, arnica harvesting sites are biodiversity-rich environments that are often part of the Natura 2000 network, encompassing Special Protection Areas (European Birds Directive, 1979, revised in 2010) and Special Areas of Conservation (Habitats Directive, 1992: 92/43/EEC). European Union Member States are required to implement appropriate management measures in priority areas, in consultation with local stakeholders. The alliances between harvesters and natural-area operators have brought out the fact that management practices useful to arnica are also good practices within the Natura 2000 framework. For example, mowing of heathland favours specific bird species such as the capercaillie (*Tetrao urogallus*, Phasianidae) in the Pyrenees. Reciprocal contributions thus articulate different levels of action and encompass not only day-to-day practices of care but also strategic alliances with other actors who value differently the diverse entities of the landscape.

Some harvesters have chosen to play a leading role in defining management practices, by joining 'steering committees' [*Copil*, *Comités de pilotage*] of management projects led for example by regional parks, in order to orient actions in certain areas that are key for arnica. Because harvesters are often able to provide precise knowledge on the ecology of arnica and on vegetation dynamics, they are able to play the role of translator between scientific and local knowledge. However, while harvesters can search for synergies with the policy-driven management of environments, natural-area operators and harvesters do not initially place the cursor in the same position within the trade-off between the abundance of arnica and that of other plants. The former often express concerns about managing too much in favour of arnica, for example when discussing practices to increase arnica abundance that may decrease the abundance of other species. For example, the lichen *Cetraria islandica* (L.) Ach. (Parmeliaceae) in subalpine meadows may disappear with burning, but is not impacted very negatively by mowing. While one would expect that harvesters would push for the use of techniques that maximise arnica at the expense of other plants, we find that they integrate the values of natural-area operators. We interpret this observation to mean that harvesters operate a trade-off between an economic value (arnica production) and a set of social values such as reputation, the respect of other actors' values, and having positive relationships with natural-area operators.

Embedded in this institutional social network, harvesters may also play the role of whistleblowers or sentinels of species and spaces, since they are particularly attentive to the presence and abundance of the species harvested (and also its companions). For example, in the 2000s, harvesters in the Vosges Mountains alerted the regional protected-area authorities to the disappearance of arnica in areas fertilised and limed by farmers. Harvesters have been able to establish their legitimacy by using the federating notion of resource management as a lever. The term *gestion de la ressource* ('resource management'), often heard in the discourse of scientists or operators, has become widespread among harvesters since the creation of the *Association Française des professionnels de la Cueillette de plantes sauvages* ('French association of professional wild plant harvesters', AFC). During the meetings of the exploratory phase of this association in 2013, this term emerged as a bridging concept to put forward the maintenance and management of sites as a unifying theme. The term is now commonly used by harvesters, in part because it allows them to speak with a common language with other stakeholders in the management of natural areas.

One of the reasons why harvesters search for alliances in the regeneration of arnica is the cost of efficient management. The cost of mowing and tree-cutting projects can be quite high, around €1000–2000 per hectare, or several tens of thousands of euros for a harvesting site. In some cases, these costs can be covered by European funding under the Natura 2000 framework. If not, it is difficult for harvesters to afford such costs. Thus, companies using arnica have started, since the 2000s, to invest time and money in management actions. While for many other species actors have favoured cultivation as a solution, the fact that arnica is relatively difficult to cultivate has encouraged the industry to also invest in the management of wild environments in which arnica grows. At first, their involvement was mainly participation in multi-stakeholder discussions to define conservation measures, first experimented in the Vosges Mountains (Ellenberger, 1998; Jager, 2016). However, more recently (2021–2022), their participation has also been concretised in the form of financing an experiment of burning and milling of a heathland and partial cutting of *Pinus mugo* subsp. *uncinata* in a high-altitude Pyrenean pine forest (Parc naturel régional des Pyrénées Catalanes, 2022).

Bringing into focus the uneasy negotiations between humans who hold distinct and sometimes divergent values highlights the importance of trade-offs. We have seen that arnica management is mostly a collective process. As stated by Couix and

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Hazard (2013), differences in the partners' values are one of the main difficulties inherent in biodiversity management projects. The harvesters, initially simple authorised users, must seek to find their place in the management process. The establishment of a reciprocity between the harvesters and the harvested plant is thus a social matter. We argue that, since harvesters are not in a position to fully craft the environment, they play a diplomatic role, both as mediators between humans (farmers, land managers, buyers, etc.) and plants (arnica and associated plants that encourage or discourage arnica productivity), and as self-interested 'spokespersons' for arnica when it comes to guiding multispecies assemblages. As harvesters become more integrated in the institutional context of resource management (i.e. as key members of steering committees of institution-led management projects), their fragile relationship with the resource becomes more durable, with positive outcomes for sustainability. Recent contributions suggest that sustainability can be attained when the local ecological knowledge of food-plant harvesters is combined with academic knowledge (Teixidor-Toneu et al., 2022). Here, we did not always recognise a partition between local knowledge carried by harvesters and academic knowledge carried by institutions, but rather a hybridisation of knowledge. We showed that harvesters integrated and synthesised knowledge from a diversity of sources to play the role of mediators and that there was a multidirectional flow of knowledge between actors.

6 | HARVESTERS' COMPETITION FOR SITES HINDERS RECIPROCITY

Among the difficulties faced by harvesters who wish to implement management is the risk of losing access to the site when facing competition with other harvesters. This highlights one of the downsides of the harvesters' activity: access to plants without owning the land and especially without living on the spot provides a form of flexibility, but also makes the investment in management riskier. It may indeed be difficult to obtain exclusive harvesting rights on a site. Harvesting agreements with private owners are generally annual, and with the municipalities, they can be annual or concluded for longer periods of up to 5 years. This is not long enough to encourage long-term management and harvesting, and sometimes, discourages harvesters from taking on the management of sites. This is even more true as some harvesters come to collect on the same sites without authorisation. Conflicts between harvesters are becoming more and more prevalent, between members of cooperatives and between seasonal or independent harvesters selling to middlemen. In the summer of 2022, conflicts between two teams of harvesters who had both obtained authorisation from the municipality forced the latter to freeze the authorisations for 2 years. Permits had been given to both teams in separate but vaguely defined geographical areas of the commune. In addition, some of the sites covered by the authorisations were in fact private land. The arnica area was spread over two communes, and it was, therefore, necessary to deal with several administrative entities. This case exemplifies the difficulties of the formal/informal territoriality of harvest.

> There is a territorial effect, we are no longer nomads. Even if it's at the other end of France. That's what we've all felt. Drive 600 km, take small roads, go to the right, you meet a little old man, who says "no, you have to take the track that's there", you take the track and then "paf", you come across a huge site, sick, it's too beautiful, and then once harvested, fuck, I made 3000 bucks in 2 days, it's too good, it's my spot, it's my place, I'm going to maintain it. What you don't know is that there were three guys who had done the same thing the year before, and again three the year after, and now it's war. Because in your head, when you've harvested and you've made your little pilgrimage to get there, it's your own place.
>
> (a harvester, Massif Central, Dec. 7, 2020)

This harvester is clearly making the link between the act of discovering a place which leads to attachment and thus to the appropriation of its resources. The invisibility of the other harvesters, the action on the territory (harvesting) and the effort to move long distances, transform the harvester, in his or her mind, into a land owner.

Another difficulty related to competition between harvesters is that it hinders the possibility of experimentation with management practices. Scientific and local knowledge exists on the impact of different management methods on arnica. But this impact varies according to local contexts and harvesters have to conduct experiments over several years in order to gain a better understanding and control of ecological dynamics.

> I think there is a future in this [in site management]. The problem is that we can't secure it. That's why I would have liked to see several of us buying this parcel. That would be great, because then we could know how it works. As long as we haven't secured a spot and burned it down, or done nothing, a plot where you put ponies, one where you put cows, you know, to know … Even in terms of loading, how many livestock units per hectare at most so as to not jeopardize it.
>
> (a harvester, Massif Central, Dec. 7, 2020)

This harvester is considering the purchase of agricultural land to experiment with other harvesters. However, securing land collectively does not guarantee the ability to control access to land. For example, several harvesters have set up no-pick control areas to evaluate the effects of harvesting on the arnica population. But on various occasions, other harvesters have come illegally (without authorisation of the owner) to harvest in these control areas, destroying the experiment.

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Arnica harvesting sites are often remote and it is a challenge to get the police to come and observe the offences, especially for a simple theft of plants. The risk of legal proceedings is low, and no harvesters' institution has the authority to mediate these conflicts. Competition between harvesters is, therefore, a major challenge for the implementation of management. Many harvesters, despite the appeal of the freedom of harvesting, are thus calling for increased regulation, and for control of harvesters and traceability in companies, in order to favour ethical practices.

We have demonstrated that the implementation of reciprocal practices relies on social relations. On the one hand, we have seen that obtaining and securing access is a particularly complex component of the implementation of management for harvesters. Where, for example, daily care practices in homegardens (Sovová et al., 2021) are based on management choices by a single person or family, multi-actor management of species and landscapes opens up a high degree of relational complexity. In the heterogeneous groups of actors (e.g. composed of researchers, farmers, natural-area managers) that are often involved in landscape management in Europe, management also raises questions of legitimacy and incompatibility between different visions of nature (Couix & Hazard, 2013; Larrère & Fleury, 2004).

7 | CONCLUSION

The goal of this paper was not to demonstrate the sustainability or the 'good stewardship' of commercial harvesting practices but rather to shift the focus from the sole extraction of the harvested plant to a consideration of harvesting as a practice that brings a variety of actors (including populations of plant species) into relation across landscapes of production, a space of more-than-human transformative encounters (Tsing, 2015; Tsing et al., 2019). We showed that even for an activity essentially conceived of as extractive, professional harvesters maintain a reciprocity with plants, through long-term observation, or the 'art of noticing', of the ecology of the harvested plant and its community and, in some cases, through the establishment of a landscape management. In contrast to a search for pure technical efficiency, our observations testify to the importance of the 'arts of noticing' within a harvesting landscape, that is, the art of paying attention to a social and ecological assemblage, in order to conceive of a meaningful response to the array of actors (Tsing, 2015: 37; Van Dooren et al., 2016). A response, even if expressed in concrete actions, needs to be grounded in complex relational values with a multitude of actors, both human and non-human. In the process of site management, harvesters enter into relationships not only with arnica but also with the surrounding plants, and with other actors (harvesters, farmers, land managers) who have different values relative to the landscape.

One of the difficulties in the study of values is to define the content of relational values and how they differ from instrumental ones (Himes & Muraca, 2018). As resources from one arnica population could be a priori substitutable by an equivalent arnica population on another site or by another species of similar economic value, harvesting arnica could fall under instrumental values. But first, the establishment of reciprocity through management constructs a responsibility and a strong attachment to their harvesting sites that goes beyond mere exploitation, even though harvesters do not live nearby. And second, the relationships of the harvesters with arnica plants embody the whole landscape, through the interspecific relationships between arnica and other plants, or with the practices of other human actors, including institutional ones.

Our study case contributes to the global reflection on the definition of relational values and how they relate to reciprocal contributions. Reciprocal contributions between people and plants are based, within human collectives, on a pursuit of mutually compatible relational values within the same landscape. The site management strategy implemented by harvesters needs to operate trade-offs driven by ecological (plant competitors and facilitators), economic (arnica production) and social values (negotiations and legitimacy with other humans). We argue that reciprocal contribution with a productive landscape—which consists in acknowledging trade-offs and synergies between the various elements of nature, and crafting an adequate management proposition—is embedded in a cascade of relational values between social and ecological assemblages.

AUTHOR CONTRIBUTIONS

Jonathan Locqueville collected and analysed data and led the writing. Sophie Caillon led the restructuring and rewriting of the manuscript in response to reviewers' comments. All authors developed ideas, designed the research methods and contributed substantially to writing and revising the manuscript. All authors gave final approval for publication.

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CONFLICT OF INTEREST STATEMENT

We do not have any conflict of interest in relation with this research.

DATA AVAILABILITY STATEMENT

Our data will not be publicly shared. The harvesters we interviewed did not give their permission to share the full content of the interviews. Moreover, we have guaranteed data anonymisation, and making available the contents of our interviews and fieldnotes might

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jeopardise this. Unpublished field notes often contain information that, if it were to be shared, would breach confidentiality and anonymity guarantees by divulging locations or providing other information that would allow readers to identify participants.

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