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Measuring biodiversity in ICCAs: problems and possibilities

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ABSTRACT
Indigenous Peoples and Local Community Conserved Territories and Areas (ICCAs) are managed as common pool resources by local and indigenous communities, with the specific feature of containing relevant biodiversity. The sustainable management of natural resources can be achieved by either traditional or new rules or institutions, or a combination of the two. The categories of ICCAs were developed in the context of the IUCN and UNCBD to acknowledge the important role that local communities and indigenous peoples have in conserving biodiversity globally, according to context specific relationships of a localized human group with the natural resources it depends upon for livelihoods or religious meanings. The fact that ICCAs are internationally acknowledged as conserved areas is itself a strong indication that they are effective in preserving biodiversity. However, the effect of community based management on natural resources, especially biodiversity, is not easy to demonstrate in measurable terms. Indeed, the literature review shows that very few cases of ICCAs have empirically been tested, due to the intrinsic features of ICCAs. In many cases, governance mechanisms have been existing for centuries independently of State law. Many ICCAs are not recognized or not even acknowledged. Under such conditions, it is methodologically impossible to implement forms of measurement or monitoring biodiversity before and after the introduction of new rules. In other cases, effective community governance has been revived or newly established. In some countries, ICCAs are officially sustained and included in the official system of protected areas. Many ICCAs, either recognized or not, overlap with official protected areas. Such cases can provide insights on ways to correlate biodiversity indicators to community governance. In this paper, the problem of measuring biodiversity in ICCAs will be addressed by analyzing three case studies selected from different regional contexts of the world and different modality of interaction with the official system of protected areas: the Regole of Cortina d'Ampezzo, Italy, an Alpine common that established an official protected area; Indigenous Protected Areas (IPAs) in Australia, formally included in the official protected areas system of the country; the Guassa area of Menz, high altitude Ethiopian highlands, where customary governance has been revived with new modalities. The analysis of the selected case studies highlights difficulties in providing a definitive methodological answer to the difficult problem of measuring biodiversity in relation to community governance, but potentials can be identified in terms of combining data from different GIS and remote sensing methods. Methodology based on remote techniques needs to be validated and complemented by interdisciplinary in-situ enquires, keeping into account the leading governance role of the indigenous peoples and local communities. This requires giving special attention to indigenous knowledge to devise context specific modalities of participatory monitoring.

1. Introduction

In the last two decades, local communities, indigenous peoples, NGOs, scholars and experts connected in networks related to the IUCN and the UNCBD have developed the concept of Indigenous Peoples and Local Community Conserved Territories and Areas (ICCAs). This is a category that allows the consideration of the conservation effect derived by a variety of governance solutions adopted by indigenous peoples and communities, independently of the formal State structure and legislation, hence outside the classic category of government or private protected areas. Some States have legislated to incorporate ICCAs in the national system of conservation of biodiversity, thus creating a new typology of protected area. However in most cases, ICCAs are unrecognized and accordingly fall within the broader category of 'conserved areas', which are recognized today as key to the achievement of the UNCBD Aichi Target 11 on increasing the coverage of conserved areas, and Target 18 which is specifically dedicated to valorise conservation by local and indigenous communities (Woodley, Bertzky, and Crawhall 2012).

Box 1.

Aichi Target 11

By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.

Aichi Target 18

By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels.

The fact that ICCAs have been recognised as governance modality of protected areas and have explicitly been addressed in the CBD Programme of Work and the Aichi Targets is in itself a strong indication of their effectiveness. Yet, the literature review shows that very few cases of ICCAs have scientifically been assessed or monitored. As mentioned by Kothari et al. (2012), what is already known is indicative of the enormous importance of ICCAs, although that there is very inadequate documentation and understanding of their multiple and widespread values and benefits (Kothari et al. 2012). The difficulty of systematically correlating biodiversity indicators to governance should surely be attributed to the intrinsic features of ICCAs.

The aim of this article is to identify possible methodological lines of work to address the problem of scientifically assessing and monitoring biodiversity in ICCAs, considering the specific features of ICCAs. Three main objectives will be taken into consideration:

1. *Identifying potential ICCAs, based on the assumption that the decision makers of most ICCAs might not have awareness about the existence of this internationally recognized category of conserved areas*
2. *Assessing the overall relevance of ICCAs in global conservation*
3. *Identifying methods to monitor biodiversity for adaptive management by the community, and simultaneously contribute to national and global biodiversity monitoring*

This study is primarily based on the critical assessment of the available literature. First the qualifying features of ICCAs are identified, with the objective of highlighting the specific constraints to scientific monitoring. ICCAs will be considered in relation to common natural resource management (CBNRM) with the objective to extrapolate established monitoring methods, such as participatory management. In addition, other monitoring modalities will be addressed, such as remote satellite technology and methods of in-situ customary monitoring. Some essential features of local and indigenous knowledge will also be considered, since cultural-specific elements structures the local and indigenous monitoring and therefore cannot be immediately converted into universal criteria of assessment. Finally, three case studies of ICCAs were selected in a way to consider the diversity among ICCAs, and to highlight the different problems that can arise. The case studies were analysed using a literature review, official websites, and one informal phone interview with the director of one of the natural parks. I considered cases that can give indications about both customary and new governance, and the interlink with the official protected area system. The case studies were selected from both developed and developing countries.

2. Defining ICCAs

2.1 Protected areas and ICCAs

Protected areas for the conservation of wildlife and plants have been established by national governments since the end of the 19th century, but especially during the 20th century. Various definitions have been used. The International Union for the Conservation of Nature (IUCN) greatly contributed to create common understanding, up to the adoption of the globally accepted definition of protected area as:

> *An area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means* (IUCN 1994).

In order to overcome the problem of different denominations in the different countries, a global classification of protected areas categories was introduced, based on the management objectives that have motivated their establishment

Insert here Table 1

The work done within the IUCN was key to the formulation of the United Nation Convention on Biodiversity (CBD 1992) which in article 2 provides the definition of protected areas agreed by the member States in terms of “a geographically defined area, which is designated or regulated and managed to achieve specific conservation objectives”.

The practical experience in managing protected areas worldwide has showed that the pure top-down approach of protecting area by governmental decision and implementation has shortcomings in terms of both geographical coverage and efficacy. In addition it involves serious ethical problems, especially in developing countries, were local and indigenous communities have often been forced to leave the territories that they had for centuries used in ways compatible with the conservation of biodiversity (West, Igoe, and Brockington 2006). The need to acknowledge the role of communities in protected areas was solved by considering the different modalities of governance of protected area (Dudley 2008; Grazia Borrini-Feyerabend et al. 2013). The previously agreed classification in 6 categories was not changed, but the additional dimension of governance was added to the objective-based IUCN classification of protected areas. The result is the matrix reported in Table 1. In short, in addition to the standard protection established and implemented by government, it is now internationally agreed that the same objectives can be achieved in a collaborative way by involving communities, by private actors, or by local communities and indigenous peoples (ICCAs). This last category is internationally acknowledged with the acronym ICCAs. In line with the IUCN and CBD definitions of protected areas, ICCAs are defined as:

natural and/or modified ecosystems, containing significant biodiversity values, ecological benefits and cultural values, voluntarily conserved by indigenous peoples and local communities, through customary laws or other effective means' (Kothari et al. 2012: 16)

In order to be acknowledged as such ICCAs need to display three crucial characteristics:

1. A well-defined people or community (or peoples/communities) that possesses a close and profound relation with an equally well-defined site (a territory, area or species' habitat; though, the boundaries may be flexible) and/or species; this is a relation rooted in culture, sense of identity and/or dependence for livelihood and well-being.
2. The people or community is the major player in decision-making and implementation regarding the governance and management of the site and/or species, implying that local institutions have the de facto and/or the de jure capacity to develop and enforce decisions. Other right holders and stakeholders may collaborate as partners—especially when the land is owned by the state—but the local decisions and management efforts are predominant.
3. The people's or community's management decisions and efforts lead to the conservation of habitats, species, genetic diversity, ecological functions/benefits and associated cultural values, even when the conscious objectives of management are not conservation alone or per se (see below on key objectives or motivations for ICCAs). (Kothari et al. 2012: 16)

As shown by the third characteristic, in ICCAs the conservation of biodiversity might not be the primary objective of the community. Conservation of relevant species and habitats is rather the result of the community's need to exploit the natural resources in a sustainable way, or for religious or cultural motivations. The second characteristic stresses the primacy of the community in decision making and the enforcing mechanisms, which do not necessarily require legal recognition by the State. This implies that customary rules, leaders and cultural values of indigenous peoples, local communities, tribes and ethnic groups are acknowledged as effective governance mechanisms, as well as new modalities agreed by local communities in response to new challenges and needs. ICCAs thus include a wide variety of local realities, legally recognised or informal and unrecognised, based on old, new or revitalized governance, and in all continents and ecosystems.

Such diversity is in itself a challenge to the scientific assessment of the ICCAs performance in conservation of biodiversity. In the frequent case of ICCAs based on customary governance the sustainable use of natural resources has persisted through time. It is methodologically impossible to implement standard forms of measurement or monitoring of biodiversity before and after the introduction of new rules. Presence of relevant biodiversity at a certain time in history would be an indirect indicator that the previous form of governance was effective. The fact that many official protected areas have been established on territories governed under customary governance, both in developing countries and in Europe, would also indicate this (Borrini-Feyerabend, Kothari, and Oviedo 2004). The selection of areas for conservation is in fact based on ecological surveys: the best territories are singled out for their biodiversity value and proposed to the national environmental authorities for gazetting them as protected areas. The relevance of this situation is signalled by the very recent adoption of Motion 29 during the last IUCN World Conservation Congress, 'Recognising and Respecting Territories and Areas Conserved by Indigenous Peoples and Local Communities (ICCAs) Overlapped by Protected Areas', but not quantitative study could so far be implemented for lack of systematic data on ICCAs (IUCN 2016).

This leads to the fundamental problem of identifying ICCAs. The demarcation of land, may not be clearly defined, due to the lack of legal enforcement. Communities may keep ambiguity in classifying themselves as ICCA for a number of reasons, including no awareness of the ICCA global process, fear to lose autonomy under the authority of the national environmental conservation agency, or having no need to be recognised. Efforts have been made to come to unambiguous demarcation and systematically list ICCAs as shown by the ICCA Registry[1], a global platform designed to store information about ICCAs with the prior and informed consent of the involved communities. Yet, communities do engage in the process of recognition and in communicating their data only if they have special reasons to do it.

[1] http://www.iccaregistry.org/; 09/06/2017

2.2 ICCAs, CBNRM and CPR

To a large extend ICCAs shares elements with a practice known in the literature as Community Based Natural Resource Management (CBNRM). This concept has especially been used within the framework of sustainable development, to qualify an approach by which an external agent (mainly NGOs) activates a process that improves the capacity of the local or indigenous community to sustainably use the natural resources in a well-defined piece of land. It differs from ICCAs for the fact that ICCAs exist independently of external action, and have their own established governance mechanisms. ICCAs must additionally include relevant biodiversity or ecosystem services. Normally, in CBNRM, the land and the inherent resources are not individually owned, but are instead managed by the entire group, a feature common to most ICCAs. ICCAs can also be considered within the more comprehensive theoretical framework known as Common Pool Resources (CPR), which includes every commodity directly or indirectly provided by the environment. Several studies, including by the Nobel Prize winner Elinor Ostrom, have shown that under appropriate circumstances local resource users can be successful in regulating access to common resources by local and nonlocal actors. This is achieved by a range of community institutions and resource management practices (Pomeroy 1996; Johannes 2002; Ostrom et al. 2002). Thus, under the CBNRM approach, as well as in the case of ICCAs, it is assumed that communities and community-based organizations closely related to the relevant natural resources pool are best positioned to foster sustainable resources use, not least for their local knowledge of the context.

CBNRM is recognized by the science community to be crucial in order to meet the Suitable Development Gaols discussed in the 2012 Earth Summit. In fact, the aim of CBNRM is to integrate human activity with environmental sustainability. It is considered a process capable of balancing exploitation and conservation of natural resources, hence to simultaneously address environmental and social economic concerns (Kellert et al. 2000), features that are taken for granted in ICCAs. The CBNRM process implies devolution of decisional power over the use of natural resources from the central government to the local scale (Brosius, Tsing, and Zerner 1998). With ICCAs, no action might be required at all. Yet, the international literature shows that in most cases as a minimum requirement ICCAs need national and international recognition to enable communities to enforce their traditional governance, being their customary modality to interact with the environment endangered by new social, economic and political processes. In many cases, local and indigenous communities have themselves developed new rules, or revived old rules in new context, based on indigenous knowledge (Borrini-Feyerabend, Kothari, and Oviedo 2004). In this respect, the experience done under the CBNRM approach can be relevant to ICCAs, especially when their customary governance has been weakened by external factor and the community wishes to engage in a process of revitalization.

Similar to ICCAs, it has been acknowledged that under the CBNRM approach in order to exercise power over a certain territory the community has to be recognized as *de facto* or *de jure* owner of the area by the government. Local decision-making can be enhanced by building on existing institutional arrangements, or by establishing new ones. The combination of different formal and/or informal institutes appears to be one of the fundamental factors of successful. Those institutes work at different levels, macro, meso and micro (Leach, Mearns, and Scoones 1997). In terms of the expertise involved in the CBNRM process, the "adaptive co-management approach includes roles for local government, local community members, NGOs, and private institutions and decision making inclusive of people affected by and knowledgeable of the issues" (Gruber 2010). The opinion of experts, scientists and NGOs workers may be crucial in strengthening interaction and allowing communication and cooperation between different institutions. Furthermore, they can provide policy maker with knowledge of management practices and of needs of the community (Borrini-Feyerabend et al. 2004).

3. Methods based on GIS and remote sensing.

3.1 Identifying ICCAs by overlapping biodiversity and land management maps using GIS

As mentioned, one of the main problems with ICCAs is identifying them, a pre-condition to implement Aichi Target 18. While some ICCAs have been already acknowledged in national legislation or by information uploaded to the ICCAs registry, most of them are still unnoticed. Others have been replaced by more conventional government protected areas (West, Igoe, and Brockington 2006).

The establishment of the LandMark Global Platform of Indigenous and Community Lands gives the opportunity of identifying ICCAs using geographic information systems (GIS) based platform analysis. The LandMark Global Platform is an ongoing project. It has already started to collect georeferenced indigenous and community land maps, both current and in historical perspective. These include lands collectively-held by indigenous peoples or communities, recognised and unrecognised by government[2]. These maps can be overlapped with biodiversity-related maps, such as the one provided by the Biodiversity Mapping project, which makes available global maps of biodiversity related to mammals, amphibians and birds[3]. Species distribution can also be downloaded from the Global Biodiversity Information Facilities (GBIF) database[4]. For this purpose, the distribution of threatened species is also available on the IUCN Red List website[5]. Areas that match both the presence of community or indigenous land governance and high biodiversity value can be considered as potential ICCAs.

One limitation of this approach is that the mentioned mapping projects, both on biodiversity and on collectively-held land, are works in progress, and, therefore, some areas may not be detected due to missing data. Furthermore, in order to qualify as an ICCA, the effectiveness of conserving biodiversity over time should also be assessed. The fact that biodiversity-related maps may not have historical records makes this operation difficult. However, in the case of some biodiversity indicators, the effectiveness of conserving biodiversity over some limited time span may be verified using satellite remote sensing (SRS), as will be discussed below. The quantification of the overlap of conservation with land use maps can give insights on the potentiality of ICCAs in reaching the Aichi Target 11.

Detecting ICCAs that have been replaced or incorporated by more conventional protected areas is possible by overlapping maps of collectively-held lands with protected area maps. Protected area maps are available on the World Database on Protected Areas (WDPA), which is the most complete database on protected areas[6]. Identifying such lands would introduce the possibility of opening a discussion on re-integrating community participation in these areas, in line with the mentioned IUCN Motion 29 (IUCN 2016).

3.2 Indirect ways of studying ICCAs biodiversity conservation

The approach of overlapping collectively-held land, protected area and biodiversity maps also provides an indirect way to study the effectiveness of ICCAs in conserving biodiversity. This method

2 http://www.landmarkmap.org/; 09/06/2017
3 http://biodiversitymapping.org/; 09/06/2017
4 http://www.gbif.org/; 09/06/2017
5 http://www.iucnredlist.org/; 09/06/2017
6 https://www.protectedplanet.net/; 09/06/2017

is indirect as it involves inferring conservation by the fact that, at a certain point in time, high biodiversity value was recorded. For example, it is possible to study the spatial coincidence of biodiversity and collectively-held lands. If an area under indigenous or community management presents a higher value of biodiversity, we can infer that its management system is – or, at least, was - effective in terms of conserving biodiversity. However, only a longitudinal study could confirm this and, as previously noted, this may not be possible due to the lack of historical data on biodiversity. It is also possible to consider a reverse procedure, by correlating biodiversity loss to the de-legitimization of customary rules. This method, however, while demonstrating that what was in place before was better than the current situation, does not prove the effectiveness of ICCAs in conserving biodiversity. Yet, monitoring of biodiversity loss could provide a legitimising claim for the regain of governance by local communities. As mentioned, many ICCAs demand recognition, meaning that they claim governmental empowerment and favourable policy, to enable local communities to enhance their governance.

Another option is to study spatial coincidence of collectively-held lands with protected areas. One of the aspects considered when establishing a protected area is the high biodiversity value, calculated in terms of number of total endemic or threatened spices of the area, as well as the total number of species (Brooks et al. 2006). This means that, if a protected area is established on an area previously under indigenous and communities' governance, their management was effective in order to conserve biodiversity, at least until the protected area was established. By overlapping these types of maps, it is possible to make a quantitative estimation of the proportion of protected areas that were previously collectively-held, and the proportion of collectively-held lands that were converted to protected areas. This would give an overview of the importance and effectiveness of ICCAs in conserving biodiversity, and their relevance at a global scale.

3.3 The use of satellite remote sensing (SRS)

Historical and current collectively-held land maps can be combined with historical satellite imagery. For example, LANDSAT started collecting satellite imagery in the 1970s. SRS imagery can be used to extract information on biodiversity, using GIS analyses. However, only some biodiversity indicators - mainly those related to plants at an ecosystem and habitat level - can be extracted (Pettorelli et al. 2016). Such Biodiversity indicators include the ones recognized as valuable for global biodiversity assessment such as the ones selected in the Essential Biodiversity Variables (EBV) framework

(Walters and Scholes 2017). It is also possible to use more recent satellites (e.g. Sentinels and LiDAR), which have a better spatial and temporal resolution, and therefore allow better analysis of the current biodiversity of the area. However, the use of these satellites does not enable long-time historical analysis (Vihervaara et al. 2017).

This approach is suitable for studying diverse cases of ICCAs, including stable ICCAs and those whose customary practices have been abandoned or re-established. For example, biodiversity changes over time can be correlated with a shift in governances of such areas. In this case remote sensing techniques would have to be complemented with ethno-historical field enquire. An additional analysis within this approach could be to compare SRS assessment of biodiversity, inside and outside of an ICCA. However, in order to do this, it is necessary to have comparable ecosystems or conditions. This is not always the case, as, for example, some ecosystems may only appear inside the ICCA.

Although SRS represents a potentially valuable tool for studying biodiversity, as satellite data analyses are new and still in need of verification, *in-situ* observation is still required in order to validate indicators developed with this method (Walters and Scholes 2017). Combining data collected *in-situ* using global position system (GPS) can significantly enhance the power of SRS assessment (O'Connor et al. 2015). Community participation in monitoring can also improve biodiversity assessment by adding geographic information, such as land use or environment contamination in remote areas (Ferrari, de Jong, and Belohrad 2015).

Integrating *in-situ* monitoring with SRS techniques can fill the gaps in knowledge regarding biodiversity status both at a local or global level that are not possible to monitor via satellite (Chandler et al. 2016). This demonstrates that while GIS and SRS systems have high potentiality to monitor biodiversity in ICCAs, they are not sufficient alone. Therefore, a system of local monitoring is necessary in order to fully assess biodiversity status in ICCAs.

4. Methods based on *in-situ* monitoring

4.1 Community based monitoring (CBM)

The CBNRM approach has stimulated the development of a variety of monitoring techniques where scientists involve local communities and indigenous peoples at different levels of participation. Such monitoring system is generically known under the name of Participatory Monitoring, or Community-based monitoring (CBM). In the literature, different definitions and sub-categories have been outlined. These definitions are generally based on the community and indigenous' involvement in the monitoring at different steps of the process: planning and purpose of monitoring, collection, analysis and usage of the data.

It is generally recognized that the participatory approach refers to a system in which external institutions, such as academia, governmental agencies and local institutions take the local community into account by allowing them to give their point of view, to set the priority, and to participate in the actual monitoring (Whitelaw, Vaughan, and Craig 2003). There is no a definitive agreed typology and nomenclature for CBM, due to the variety of modality of community's involvement at each phase. Danielsen et al. (2009) provides a guideline for an easy and straightforward classification. Such classification is based on the participation of local communities and the scientific community in two main steps of the monitoring: the design of data gathering, (what to monitor and how to monitor) and data usage (data interpretation and how to use it for management or research purposes). In this system of classification, a number of categories are considered in terms of a spectrum, ranging from autonomous local monitoring (ALM), where the community have complete control over the land, to scientific executed monitoring, where the scientific community are the only actors.

CBM has been tested, for example, by implementing parallel monitoring by the scientific and the local community. It demonstrated positive outcomes in terms of cost and effectiveness and reliability of the data, even though this varies between cases (Danielsen, Jensen, Burgess, Altamirano, et al. 2014). This is particularly true for some of the EBV indicators previously identified for usage by non-trained local staff (Danielsen, Pirhofer-Walzl, et al. 2014). Furthermore, one of the main advantages of CBM is that the observations cover larger areas at higher resolution. In addition, CBM produces a larger amount of diachronic data, compared to scientific monitoring programmes, as the high costs involved in scientific monitoring programmes make difficult to collect large amounts of data over long periods (Chandler et al. 2016; Moller et al. 2004). One of the main advantages of most CBM monitoring techniques is the capacity to make the community relevant and proactive in a process that is still based on scientific methodology to gather the information. This makes CBM better equipped to provide data that can be used in global framework on biodiversity assessment, especially when communities are provide with technological equipment (Brammer et al. 2016).

However, CBM designed in this modality implies the imposition of the methods from external parties. The input from external stakeholders can alter the indigenous system which is based on learning by doing (Mistry and Berardi 2016). When a new method is implemented, the new generation does not get the chance to learn from their predecessor. A second critical line points to the fact that the classic CBM approach introduces a system based on different perspectives. The community may not understand or may not recognize the effectiveness of the new method, leading to failure of the monitoring (Sillitoe 1998). These points of criticism are extremely relevant to ICCAs, whose governance is by definition based on local culture and values. It is therefore useful to briefly discuss the relevant aspects of Indigenous knowledge and monitoring that is autonomously implemented by communities (ALM).

4.2 Indigenous knowledge

Indigenous knowledge (IK) refers to the unique knowledge that people in a given community possess. Such knowledge is gained and tested over centuries. It depends on the environment, the specific livelihoods and challenges experienced by the community (IIRR 1996). Some authors highlight the difference with scientific knowledge. Scientific knowledge is a globally accepted interpretation of reality, while IK is fragmented and includes a variety of different local views (Warren, Slikkerveer, and Brokensha 1995). Furthermore, in a given community, differences exist between different sub-groups (e.g., gender, ages, occupation, social status). The differences between IK and scientific knowledge depend on the intrinsic features on which the two types of knowledge are based (Table 2).

Table 2. Indigenous knowledge compared with Scientific Knowledge. Source (Sillitoe, Dixon, and Barr 2005)

Features	Indigenous	Scientific
Relationship	Subordinate	Dominant
Communication	Oral	Literate
	Teaching through doing	Didactic
Dominant Mode of Thought	Intuitive	Analytical
Characteristics	Holistic	Reductionist
	Subjective	Objective
	Experiential	Positivist

To facilitate the establishment of participatory program such as CBM, it is advisable to first achieve reciprocal understanding of the two types of knowledge. However, due to their differences, this is not an easy task, and it can be argued that this is not always done. Such a preparatory study requires long-term research and an interdisciplinary approach, which is not always possible to implement (Sillitoe 1998). Another difficulty is that co-operation from all the parties is required. In order to achieve such cooperation high respect and preliminary understandings of the differences in the two types of knowledge is required, avoiding pre-conceived bias about superiority of scientific approach. Discussion must be open and bidirectional. Here anthropologists can be play a central role, due to their methodology based on appropriate modalities and approaches appropriate to start and maintain an open dialogue. It is also possible to include indigenous or local scientists, who are comfortable in that cultural context, although their involvement may be perceived by the community as an attempt of a particular societal group within a community to take over power and close the community dialog (Sillitoe, Dixon, and Barr 2005). Furthermore, due to the complexity of social-environment systems (SES), participatory programs should not focus only on one aspect -in this case biodiversity conservation and monitoring- but it requires analysis from different perspectives (Berkes, Folke, and Colding 2003)

Despite the differences, IK and scientific knowledge share some similarities. Both are dynamic in the way they deal with new challenges and they are both accommodative about new tools. In this way, the two knowledge systems can reciprocally benefit from correlation. In the case of CBM, while science can provide new technologies and modalities to better monitor natural resources, IK can improve scientific understanding, for example by gathering information on biodiversity needed to study global biodiversity in relation to climate change. Understanding IK can also give the chance to study indigenous local monitoring which may give new ideas and approaches in the global biodiversity monitoring framework.

4.3 Autonomous Local Monitoring (ALM)

As mentioned, Autonomous Local Monitoring (ALM) lies on one end of the monitoring framework outlined by Danielsen et al. (2009). It differs from CBM due to the lack of involvement by external parties during any stage of the monitoring process. Natural resources monitoring is autonomously carried out by indigenous or local communities through use of customary practices. Unlike CBMs, ALM is based on IK rather than scientific categories. So far only few cases of ALM have been documented, but they have been reported from both developed and developing countries (Berkes 1999).

Information about biodiversity collected using ALM mode cannot be directly used for scientific purposes, being based on different views of reality and implemented with different modalities. Nevertheless, ALM presents some similarities with the scientific methodology. The monitoring has the same function of observing the environment and extrapolating conclusions to implement decisions on the use of resources. Furthermore, even if the indigenous monitoring system is not directly aimed to assess biodiversity, the observations include the conditions of the natural resources and ecosystem services on which the community relies on. Those elements include biodiversity (Mace, Norris, and Fitter 2012). Communities rely on natural resources and ecosystem services such as wood, non-timber forest product (NTFP), wild animal, grasses, grazing land and many others. In order not to overexploit such resources, they constantly monitor parameters related to species abundancy, distribution and health. Such parameters may reflect some of those used in scientific methods. Usually scientists consider such observations biased and imprecise. In light of their similarities, a number of studies have attempted to study ALM from a scientific perspective. Roba & Oba (2009) studied the monitoring system of the Ariaal pastoralist in northern Kenya. Monitoring is carried out in order to assess the effect of grazing, and asses which area is more suitable for the upcoming year grazing. The indicators used are soil type and vegetation composition in terms of species abundances. However, in contrast to scientific methods, their system is not based on quantities, but on qualities of selected indicator. To clarify, they classify the species abundances in three categories: “not changing” (stable), “increasing” (increasers), or “decreasing” (decreases). In their studies Roba and Oba did not try to convert indigenous categories into scientific ones, except for the scientific identification of the vernacular names of 59 plant species.

In order to be able to use ALM for scientific biodiversity assessment more complex elaborations are required. Attempts to test the reliability of ALM information for scientific purpose were made by Daniels and colleagues among the Miskito and Mayangna forest dwellers in the Bosawas Biosphere Reserve of Nicaragua (Danielsen, Jensen, Burgess, Coronado, et al. 2014) and Mueller and colleagues (2010) in the areas of Boumba and the W National Park in southwestern Niger. The first study combined focus groups discussions with scientific method of biodiversity monitoring such as the line transects technique. The outcome of the research showed that the community members are able to assess without bias the abundances of species especially for birds and plants. The second study aimed to assess the ability of local communities’ consensus on trees and grasses characteristics such as high, richness, and selected spices density. The study adopted rapid

Participatory Rural Appraisal techniques (focus groups discussions, interviews…) to extract information from the community, to be compared with scientific based surveys. They found that communities were able to assess most of the indicators without bias. However, the authors also identified a differential gender based attitude in evaluating certain grass species. The authors explain that the reason for this mismatch between women and men and scientific surveys depend on the differential use of different grass spices by the genders.

The mentioned studies indicate a possible approach to start understanding and linking IK with scientific monitoring. However, even in cases where bias is relatively low, converting indigenous categories into scientific ones remains a problem, due to the lack of precision of the data collected (Danielsen, Jensen, Burgess, Coronado, et al. 2014).

5. The ICCAs case studies

5.1 The Regole of Cortina d'Ampezzo, Italy

The *Regole of Cortina d'Ampezzo* in Italy are the union of 11 commons in the territory of the famous Alpine resort. Estate price is among the highest in Europe, a condition that led to strong pressure on natural resources. During the last 50 years protection of the landscape was achieved thanks to the revived governance of the territory based in the ancient *regole* (rules). This is an institute found throughout the Alps. Valley communities used to commonly manage the forest and the high elevation summer pastures. In the Middle Ages, many of these communities codified their customary laws and rules to protect their rights after incorporation into larger feudal estates. Such *regole* remained operative until the Napoleonic reform weakened customary governance by imposing the modern structure of administration based on the communes. In the 20th century, the *regolieri* (registered members to the commons, based on *fuoco*, 'fire', meaning an extended family) of Cortina and few other similar Alpine commons engaged in a series of court cases against the Italian State to regain autonomy in the management of the forest. From the mid 20th century legislation in Italy started to grant such recognition. The community re-established the functionality of the deliberative institutions and functionaries, preventing rampant building in their territory and other forms of soil consumption. In the late 20th century, the ancient land uses were no longer economically crucial to the communities, but old management practices of the woods and pastures were revived and/or adapted to the new reality as a way to protect the landscape, the real wealth for the local community. By protecting the landscape, biodiversity and endemic species were also protected, until the community faced a new threat in the form of military use of the land. The community sought the national system of protected areas as a way to further enforce its action of protection. In the early 1990s, they negotiated an *ad hoc* law with the Regional Government to establish the new Park of Dolomiti d'Ampezzo, including a large portion of the land registered under the *Regole*, as well as woods managed by the municipality and some private estate. The management of the official protected areas was entirely delegated to the management body of the *Regole*, and old uses concerning forest utilization were accepted (Lorenzi and Borrini-Feyerabend 2010).

In the established protected area, biodiversity monitoring is done based on the standard method imposed by the national legislation. Such monitoring is carried out by technical staff. However, as highlighted by Michele da Pozzo during an informal skype interview[7], the local community and tourists also voluntarily participate in monitoring by providing extra information on species not included in the official monitoring. This information is largely related to vertebrates and plants, which are easier species to identify by non-expert. Hunters and ex-hunters also contribute to monitoring, as they are knowledgeable of the ungulate fauna. Amateur and professional photographers provide information on birds. Plant amateurs inform about plant species, some of which were previously considered extinct is some areas. The community also reports extraordinary events such as diseases spread in forest patches, allowing a fast response from the local authorities, who may need more time and resources to detect it. This results in more effective forest management. Furthermore, the contribution of the community is extremely valuable for the area of the *Regole* outside the national park, where the national park staff does not regularly monitor. Due to this extensive monitoring of the last decades, there is a high knowledge of the biodiversity and its history in the *Regole* area. Thanks to such knowledge there is no need to integrate biodiversity monitoring with SRS techniques.

7 13/06/2017. Michele da Pozzo is the Director of the Dolomiti d'Ampezzo Natural Park.

5.2 Indigenous Protected Areas (IPAs) in Australia

Indigenous Protected Areas (IPAs) are voluntarily declared by indigenous people as an expression of their commitment to conserve the biodiversity and cultural values of their traditional indigenous territories. The Australian Government recognizes IPAs as official protected areas. Being part of the national system of conservation the government provides funding to support the plans proposed by the indigenous community and the management of the area (Smyth 2006; Szabo and Smyth 2003).

After the first declaration of IPA by the Nepabunna Community in 1998, nowadays 72 IPAs have been established, covering 40% of the Australian protected area system[8]. The importance of IPAs in converting enormous extension of land to new protected areas is evident. From the government's prospective, this allows protection of large extension of land at relatively low cost. In fact, the government does not need to own the land and to build facilities and infrastructure as required in conventional natural parks. This makes IPAs economically competitive with an annual budget of $ 64 million over 65 million hectares[9]. In return, indigenous peoples get an opportunity for recognition and receive some support for the management of their territories, and some employment opportunity as ranger and in tourism. Effective management is achieved by a combination of codified and customary mechanisms, including customary law and indigenous knowledge, restrictions on access to indigenous land, collaborative partnership with civil society, research institution and governmental agencies. The indigenous people's deep knowledge of their territories and resources is a key advantage in making the management program. The combination of IK with scientific inputs from the academic community allows accurate analysis of environment, easy assessment of priorities and successful opportunities in management design. The indigenous communities are also particularly careful in educating tourists in respecting the environment, including imposing ban on access to certain sacred areas (Kennedy 2008). This is an advantage, as the impact of tourism on biodiversity in natural parks is an acknowledged global problem.

The IPA system is built through a structured funding program. A new IPA is established on the basis of an agreement. All the details are agreed in a written contract, in which everything is defined, including the management program, role and responsibilities of different institutions, groups and

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8 https://www.dpmc.gov.au/sites/default/files/publications/IPA_FS_2015_1.pdf; 09/06/2017
9 http://www.environment.gov.au/land/indigenous-protected-areas; 09/06/2017

individuals. The system ensures that the sustainable goals indicated in the contract are reached (Smyth 2006). Funding is renewed every year but only if the agreed objectives are met by successful management.

While this system provides tools to the indigenous communities to design management, some authors argue that indigenous people participate rather than control the process. A qualitative study implemented in Nantawarrina Indigenous Protected Area — the first established IPA — points to the paternalistic attitude of the Aboriginal Lands Trust (ALT), the governmental agency that has legal title to the land. ALT is a party to many IPAs' contracts, with control over the funding. Based on the 1966 Aboriginal Lands Trust Act, ALT has the capacity overturn any decisions made by the community (Muller 2003). Other problems are connected to the objective of the IPA funding, strictly related with conservation priority: they do not always match the indigenous priorities.

Being part of the Australian Natural Reserve System, conservation goals in IPAs are monitored by the government, involving indigenous people, volunteers and other organizations in various CBM modalities. In the Djelk IPA, indigenous rangers work together with professional ecologists. Rangers are involved from the planning stage. In the Laynhapuy IPA, indigenous rangers were able to express priorities for the indicators during an informal workshop (Ens 2012). Indigenous peoples are also trained to use GPS devices to collect data. Other CBM programs in IPAs are briefly described in Altman et al. (2011). The authors highlight lack of baseline data as one of the main problem. This makes impossible to compare the status of biodiversity after the establishment of an IPA. However, the study of flora and fauna done by Neagle and Armstrong (2010) in the mentioned Nantawarrina IPA confirms the positive outcome of indigenous management in biodiversity conservation. The authors compared data with previous scientific surveys. Success is attributed to reduction of pastoral activates, which was intensive from the 1850s. The practice was not abolished under the indigenous management, but substantially reduced. Others treats to biodiversity were identified, such as the spread of non-indigenous species. The authors stress the need of further researches especially in area where access is difficult. In fact, due to cost and resource availability, only accessible areas were covered by the survey.

5.3 The Guassa area of Menz, Ethiopia

The Guassa Plateau is a large Afroalpine tall-grass ecosystem in Ethiopia, at an altitude above 3200 m. It is outside the official protected areas system of the country, but it persisted in unusually well-preserved conditions. In fact, it still hosts important populations of gelada baboon, *Theropithecus gelada* Rüppell, Ethiopian wolves, *Canis simensis* Rüppell — the most endangered canid in the world —, 111 bird species including 14 endemic to Ethiopia, as well as numerous species endemic to the Horn of Africa, such as the thick-billed ravens *Corvus crassirostris* Rüppell. The grassland is apparently natural, but it is indeed in a semi-pristine state, having been under specific management rules at least since the 17th century. Several grass species of *Festuca* were especially useful for thatching the roofs of the local houses, and the area as a whole was considered a "last reserve" pasture during droughts (Ashenafi, Leader-Williams, and Coulson 2012). Under the feudal Ethiopian system, the area was entrusted to leaders from a specific clan with the responsibility to restrict access and use of the natural resources. This type of traditional management system is locally known as *Qero*. Under the *Qero* system, the area was entirely closed for several consecutive years, based on the evaluated status of *Festuca spp* growth, and only briefly opened to selected users. Sanctions and punishments were enforced on those breaking the restrictions. Such a system implies the presence of an ALM to assess grasses re-growth and abundances. Such a monitoring system was likely implemented in order to prevent over-exploitation of the resources. Unfortunately, there is no record of the details of how such monitoring system was carried out.

With the Ethiopian socialist revolution in 1974, the *Qero* system was abolished and the area was affected by more intensive use and some agricultural encroachment. However, even under the socialist period the community managed to achieve some protection by engaging the governmental administration in establishing a formal committee for its protection. After the collapse of the socialist regime the community was assisted under the CBNRM approach to re-establish more efficient rules for the conservation of the area, with the adoption of a management plan (Ashenafi and Leader-Williams 2005). After the legal recognition of the Guassa Community Conservation Area, the Frankfurt Zoological Society supported the local community in conservation activity[10].

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10 https://fzs.org/en/projects/afroalpine-conservation/guassa/; 09/06/2017

Despite being outside the official protected areas, the area is monitored by researchers based in USA and European universities, with a focus on the endangered species. For instance the Ethiopian wolf is monitored in the area since 1997 through the Ethiopian Wolf Conservation Program (Marino 2003; Marino and Sillero-Zubiri 2011). Also, a 220-member *T. gelada* band has systematically been monitored from December 2005 by an international team. In 2009 the team was able to observe the response of the gelada baboon to the exceptional occurrence of a desert locusts swarm[11]. The gelada baboon modified their behavior and movement patterns to maximize the availability of that unusual source of food. The team also recorded intensive feeding by birds, and even one Ethiopian wolf systematically eating desert locusts. Such modified hunting patterns in species normally characterized by highly specialized diet raises concern about the use of pesticides as the most common measure to control the desert locusts (Fashing, Nguyen, and Fashing 2010).

Literature on Guassa especially reports scientific monitoring, due to presence of species that attract great attention. Not much information seems available about the ALM which is likely to be fundamental for the protection of habitat which enables the survival of such species.

6 Conclusions

This literature review and case-study analysis aimed to address three main objectives relevant to the study of biodiversity conservation in ICCAs. In relation to the problem of identifying ICCAs I have outlined the potential of overlapping different types of biodiversity and land tenure maps on a GIS platform. This approach may also be used to assess the overall relevance of ICCAs in global conservation. The use of protected areas maps can help to identify areas where ICCAs have been replaced by conventional protected areas, and may be used as legitimizing tool for indigenous peoples and local communities to re-appropriate their land in line with the IUCN Motion 29. However, there are several issues with this approach. One is that maps of collectively-owned lands and biodiversity related maps, are still works in progress, highly incomplete especially in relation to land holding. For instance, the case of the Regole of Cortina d'Ampezzo shares many similarities with several other commons in the Alps, whose environmental value has been granted in regional

11 The occurrence of such event at that altitude is probably a consequence of global warning.

legislation[12] and that incorporate Natura 2000 sites. Despite legal recognition no systematic GIS archive has been built so far. Clearly, before being able to systematic apply this method more mapping work needs to be implemented. The second problem of the map overlay approach is that the obtained information does directly inform about the effectives in conserving biodiversity over time. This leads to the other objective of this article, to identify possible methodological lines of to actually monitor biodiversity in ICCAs. Two possible approaches have been outlined. The first one can be implemented remotely. It consists of using SRS imagery analyses on a GIS platform. This approach also enables the study of historical biodiversity, as data have been collected for many decades. This is an important advantage of this approach, as the lack of baseline data represents one of the main problems outlined in the IPA case-study. However, there are also limitations, since SRS techniques can only detect some biodiversity indicators. To fully evaluate biodiversity conservation effectiveness, SRS needs to be complemented with *in-situ* monitoring.

While the GIS and SRS approach can be applied universally in ICCAs if data are available, differences between ICCAs make difficult to provide a definitive methodological approach for *in-situ* monitoring, as highlighted from the selected case studies. One main reason for such difficulty is that the main objective is not the conservation of biodiversity *per-se*: objectives may differ in each ICCA. Furthermore, ICCAs governance is based on indigenous knowledge that, contrary to the scientific knowledge, is not universally defined: it includes a variety of knowledge which is specific to each ICCAs. The Guassa and IPA case studies show that ICCAs operate within an ALM system, but that such system is not sufficiently investigated or spelt out. Because of the ontological differences between IK and scientific knowledge the ALM implemented by communities cannot be used to directly infer biodiversity conservation outcomes, acceptable by government or international organizations, which would be necessary to evaluate ICCAs' performance in biodiversity conservation at global scale.

When ICCAs are integrated in the national protected area system, like in the Regole of Cortina and IPA case studies, an extra scientific monitoring is implemented, through a pure scientific approach or in CBM. However, implementing monitoring by external parties can be perceived by the

[12] Relevant regional legislation was introduced in two regions in Italy, Veneto and Trentino.

community has an attempt to their autonomy, which my lead the community not to establish a formal ICCA. Furthermore, based on the ICCA definition, indigenous peoples and local communities are major players in decision-making. Other stakeholders can participate in ICCAs, but only upon agreement of the communities. In the case of monitoring, external parties might however be crucial in order to provide communities with the knowledge and new technology needed to assess environmental indicators relevant to their needs, while also serving the purpose of scientific monitoring. However, in order to develop a monitoring system which is fully accepted and recognized as valuable from both the parties, a complete understanding of each other's knowledge is needed. For example, in the Cortina d'Ampezzo case, although the monitoring system is scientific, the local community voluntarily participates giving extra information. Such participation can be understood by the fact that the community believe in the effectiveness of the monitoring. This a particular case, being in a developed country where the community has always been exposed to the scientific knowledge and therefore recognize that such monitoring systems are valuable. Such easy understanding may not be possible in other ICCAs, where the community may not be exposed to scientific knowledge or where the community have a strong traditional and cultural heritage and use an effective ALM based on customary practices. In such cases, particular attention should be paid to these cultural aspects, especially because an external monitoring system may undermine such practices, as highlighted in Aichi target 18, which states that an external system should be integrated without replacing the existing practices. Such an understanding can indeed be achieved through a participatory approach like CBM. However, because of the complexity of indigenous knowledge, a simple workshop approach, which seems the most common way in CBM, may not be enough for ICCAs. Understandings of the local indigenous knowledge and the inherent ALM can be reached only with an interdisciplinary approach and require longitudinal research. Given the leadership on the community in governance, in ICCAs much more consideration should be paid in building understandings and trust of what is normally done under the CBNRM approach, to develop a CBM that efficiently integrates the two types of knowledge. A mentioned, this may require a quite elaborated interdisciplinary field phase of study and negotiations between the community and external actors. The main advantage of integrating some aspect of the ALM in a scientific CBM is that the community strongly believe in its effectiveness. In more extreme cases, where combining ALM with CBM proves impossible, for a variety of reasons, a final solution may be to identify ways to translate ALM data to indicators compatible with current scientific standards.

The aforementioned possibilities highlight the importance of integrating different approaches, avoiding the application single universal methodology, but rather combining different approaches and techniques in ways that are appropriate to the specific case.

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Table 1 Matrix of protected areas categories (global)

Source: adapted from Borrini-Feyerabend et al. (2013) *and* Dudley (2008)

Governance type / Category (manag. objective)	A. Governance by Government			B. Shared Governance			C. Private Governance			D. ICCAs	
	Federal or national ministry or agency	Local/ municipal ministry or agency in change	Government-delegated management (e.g. to an NGO)	Trans-boundary management	Collaborative management (various forms of pluralist influence)	Joint management (pluralist management board)	Declared and run by individual land-owner	…by non-profit organisations (e.g. NGOs, univ. etc.)	…by for profit organisations (e.g. corporate land-owners)	Indigenous bio-cultural areas & Territories-declared and run by Indigenous Peoples	Community Conserved Areas - declared and run by traditional peoples and local communities
I - Strict Nature Reserve/ Wilderness Area											
II – National Park (ecosystem protection; protection of cultural values)											
III – Natural Monument											
IV – Habitat/ Species Management											
V – Protected Landscape/ Seascape											
VI – Managed Resource											