CONDITION-BASED PROTECTED AREA ZONING TIED TO CONSERVATION PLANNING AND TARGETS

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ABSTRACT

Human use protected area zoning assigns different uses of land and marine resources to different management zones, in theory, to avoid or curtail activities incompatible with management objectives. Despite its global popularity, however, human use zoning generates problems such as the separation of compatible uses and consequent user conflict (e.g., researchers and ecotourists). It allocates more resources to manage human uses than to biophysical conditions that protected areas are charged to conserve. It reduces manifestations of the same use (e.g., intensive and small-scale agriculture) into just one scale of impact. It uses objective criteria to define zones in situations where subjective values may conflict. In response, alternative zoning schemes have emerged, among them, resource condition-based approaches. These, however, tend to be highly technical, poorly evaluated, and show little evidence of adoption by protected area systems, especially in developing countries. This paper therefore proposes a condition-based approach that addresses these weaknesses by using pre-defined conservation targets as the principal criteria to define zones, thus clearly linking conservation planning (such as the Open Standards for the Practice of Conservation) and management zoning. Condition-based zoning focuses on strategic conservation actions with the use of conditions, indicators, standards, and corresponding preventative and corrective management actions, rather than being prescriptive and punitive as with the human use zoning model. Furthermore, the article proposes technology and methodology that are more appropriate for the technical capacity of developing countries. It also traces the development of condition-based zoning from early urban zoning and presents a pilot application in Costa Rica's Monteverde Cloud Forest Reserve.

Key words: human use zoning, Monteverde Cloud Forest, Costa Rica, limits of acceptable change, management plan, Open Standards, ecological integrity

INTRODUCTION

Protected areas have long stood as a cornerstone strategy to protect biodiversity, but strict preservation rarely serves as an area's sole objective because protected areas must provide multiple values for multiple users in society. One tool often employed to manage these value demands is zoning. Managers have deployed zoning in recent decades to allocate different uses to different spaces within protected area boundaries. The assumption is that by zoning off human activities incompatible with natural resource conservation from areas of greatest natural value, managers better protect natural resources (Gilg, 1981).

Spatial zoning is not a new idea and did not originate in natural areas; the concept can be traced back to Germany in the 1800s (Hirt, 2007). German urban planners created zones to separate incompatible uses. They also included mixed-use zoning where some uses could coexist in the same space. American cities later imported this model, but did not adopt mixed-use zoning at first, which generated numerous urban problems well documented in the literature (Logan, 1976; Wickersham, 2000). This model of 'human use zoning' (HUZ), that later migrated to terrestrial wildlands (Shafer, 1999) and then marine protected areas, also generated theoretical and practical challenges (Russell, 1994) such as conflicts among different users competing for the same spaces (e.g., tourists and conservationists).

Though the HUZ model is widely cited in important protected area texts about management planning (Young & Young, 1993; Miller, 1978; Clark, 1979; Thomas & Middleton, 2003; Manning, 2011; McCool et al., 2007; Leung et al., 2018) and employed by all the countries' general management planning guidelines cited hereafter, managers face difficulty translating zones from paper to reality for several reasons. Often zones are defined for large swathes of terrestrial and

marine areas, and thus lack sufficient detail to address local realities. Other times political realities change, say a new claim on land tenancy, in ways that the zoning system cannot respond. Consequently, managers may feel obligated to ignore assigned zones or rezone conflict areas into a less-restrictive category or exclude them from the zoned area altogether.

This paper presents a zoning approach to overcome conceptual HUZ problems and be more suited to implementation, especially for developing country park systems such as that of Costa Rica. It also demonstrates that a condition-based zoning (CBZ) approach is compatible with conservation planning approaches, such as the Open Standards for the Practice of Conservation (Conservation Measures Partnership, 2020), a methodological framework for the adaptive management design and monitoring of conservation projects and already required in many Latin American countries' management planning guidelines. Our objectives then are that CBZ should a) better focus resources and attention on priority conservation threats, b) prove relatively easy to implement, c) require fewer resources and a light learning curve to apply, and d) integrate into conservation planning processes often adopted in developing countries. Thus, CBZ should contribute to on-the-ground conservation decision-making, resolve some stakeholder conflicts about disputed resources, and prove sufficiently adaptable in a rapidly changing world.

PROBLEMS OF HUMAN USE ZONING

The main concept of HUZ — one principal land or economic use per zone — was initially developed in German cities to separate incompatible uses such as slaughterhouses and glue factories from residences, but also included mixed-use zoning to accommodate compatible uses (Hirt, 2007). American cities adopted HUZ during the industrial revolution (Logan, 1976), but did not adopt mixed-use zoning at first. Rather planners segregated all principal uses (residential, commercial, industrial and green space), compatible or not (Gerckens, 1994). This separation provoked numerous management problems (Logan, 1976; Walther, 1986; Wickersham, 2000):

- Separation greatly expanded infrastructure requirements such as transportation, sewer, water and electricity networks wasting resources across zones;
- Separation segregated economic classes and broke down communities unleashing suburban growth;
- Separation provoked competition among users for some spaces and left others unoccupied; and
- Zoning is subject to many exceptions, variances, amendments, favouritism and rezoning, motivated often by political rather than community benefits (Kramer, 1982; Russell, 1994).

Consequently, urban planners proposed alternative zoning to overcome these weaknesses, such as performance-based (Russell, 1994) and form-based code (Talen, 2009; Madden & Russell, 2010). The former model focuses on regulating impacts rather than uses, similar to managing for impacts on biological resource conditions. The second regulates building form and location, and is also condition-based. Both allow a mix of different uses as long as they uphold the established conditions (Thede et al., 2014). Planners use both approaches today.

Transition OF HUZ to Wildlands

Discussion of urban zoning is relevant because it was eventually applied to rural land use planning in the 1920s (Rowlands, 1933), protected area buffer zones in the 1930s (Shafer, 1999) and then to protected areas globally. UNESCO, for example, adopted such zoning for biosphere reserves (McNeely, 1990), while seminal texts in park literature (cited in the introduction) advocate HUZ largely based on the benefit of resolving use conflicts and breaking down larger protected areas into more manageable zones with specific management objectives. As with cities, HUZ caused problems in wildlands too:

- Protected areas are zoned according to human uses rather than the conservation objectives for which protected areas are created (Lindberg et al., 1997);
- Knowing the use does not indicate the resource condition desired in zoned areas;
- HUZ assumes the incompatibility of different uses pitting one use against another, often unnecessarily, reducing overall the kinds of users in a protected area. Some uses are compatible such as research and ecotourism. In some cases, a minor compromise of one conflicting goal could satisfy both goals (Cole & McCool, 1997);
- HUZ reduces different manifestations of use categories to just one scale of impact (industrial and small-scale agriculture to 'agriculture' or strip-clearcutting experiments and bird banding to 'research');
- HUZ, such as absolute conservation or core zones, gives the illusion of exclusion when in fact multiple uses take place together. For example, the most protected zones are often the most desirable for tourism;

- As with carrying capacity, managers often regard prohibition as the central enforcement tool associated with zoning. This can cause controversy due to equity issues about who can enter and how, and who cannot (Kohl & McCool, 2016); and
- HUZ in urban and wild settings is insensitive to different uses which in urban contexts motivates planners to create variances, amendments and other exceptions, while in protected areas, it can either promote lax enforcement or rezoning to accommodate different stakeholder needs.

In addition to these conceptual challenges, there is often little evaluation of zone effectiveness. Lourival et al. (2011) argue that for biosphere reserves land uses are often assigned ad hoc to zones not designed to be quantitatively measured for success. This lack of a quantitative monitoring plan for zones may be more widespread than just biosphere reserves. Similarly, Simons-Legaard et al. (2018) indicate that since habitat monitoring is rare, zones designed to protect species and habitat likewise cannot be evaluated. Thede et al. (2014) in their evaluation of Canadian national park zoning refer to zone evaluation in general,

> ...it remains questionable if such a monitoring framework for standards and indicators on the scale of a national park, given the sometimes simplistic nature of some zoning systems, could actually achieve its goals. It is probably for that reason that not many evaluations of a zoning system in protected areas have ever been undertaken (p. 639).

Two motmots hang out on a clear day in a cloud forest © Jon Kohl

While a few cases of zone monitoring exist in the literature, for example, New South Wales Marine Parks Authority (2009), Emslie et al. (2015) and Strand et al. (2019), it would appear that the lack of zone evaluation may be due to the larger lack of quantitative monitoring plans for protected areas, a deficiency that the condition -based zoning model precisely aims to improve.

Zoning Proposals to Overcome HUZ Weaknesses

Proposals for alternative protected area zoning have proliferated, such as risk-control zones (Zeng et al., 2012), zoning designed to reduce conflicts (Davos et al., 2007; Lin & Li, 2016; Pristupa et al., 2018), the habitat suitability approach for pandas (Liu & Li, 2008), highly technical condition-based zoning for cumulative impacts vs. activity impacts in isolation (Halpern et al., 2008), and others. Despite these, few have been assessed for effectiveness or even whether park systems have adopted them. Only one paper among the nearly 120 reviewed here indicated explicitly that their model was not adopted (Ruiz-Labourdette et al., 2010). This is especially problematic when many developing countries still do not even use zoning (del Carmen Sabatini et al., 2007). Important reasons for not adopting or using zones include:

- *Inappropriate technology* For example, many decision-support tools need significant investment so that under-resourced park systems can incorporate them into management structures such as Marxan with Zones management software (Watts et al., 2009; Jumin et al., 2018). There is significant literature on the barriers to transferring decision support tools to real-life contexts (Mora et al., 2012; Street et al., 2018). Many proposals are also highly technical, mathematical and data intensive especially for developing country systems. Boon et al. (2014) admit that their own proposal may in fact be too data intensive for Cambodia where they applied their model.
- *Too little real participation* Naughton (2007) notes that many zoning proposals claim to be participatory but are really top-down. Consequently, without authentic public support many policies never reach implementation.
- *Inability to incorporate subjective and conflicting values* Academics often promote zoning as objective, technical exercises, much like carrying capacity, which leave little room for subjective decision-making and conflict resolution. As mentioned, proposals have emerged to manage conflicts, and few have explicitly tried to incorporate visitor perception and other subjective values. Only two proposals, for example, include part of the Limits of Acceptable

Change (LAC) approach (Roman et al., 2007; Bentz et al., 2016). Thus, when conflicts emerge that zoning cannot resolve, managers either rezone, implement exceptions or override their zoning system altogether.

- *Lack of information* In many new protected areas, initial management plans are undertaken, at times because of donor insistence, when there is still inadequate baseline resource information. Sometimes, in the case of Monteverde, adequate baselines do not exist for priority conservation targets either.

OVERVIEW OF CONDITION-BASED ZONING

Resource conditions are a different criterion by which to define zones. This application shifts focus from human uses or activities to resource conservation. A CBZ system assumes that in general human uses are acceptable as long as they do not violate desired zone conditions. This releases a great burden on managers and policymakers who expend significant energy legislating uses when a focus on biodiversity and cultural resource conditions is more mission consistent. Resource conditions are already the basis for conservation planning such as the Open Standards as well as for protected area categories (IUCN, 2008).

CBZ-based approaches began with the Recreation Opportunity Spectrum (ROS) developed in the late 1970s (Clark and Stankey, 1979; Haas et al., 1987). This system divides a protected area into different zones along a spectrum of naturalness from highly developed service areas (such as a gateway community) to primitive areas. Each zone represents a different visitor recreation experience opportunity, and management configurations vary accordingly.

ROS inspired the model developed by Kohl, Sierra and Sevilla (2006) and a zoning manual written for the Costa Rican protected area agency, Sistema Nacional de Áreas de Conservación (SINAC) (2018) which emerged from a perceived need to develop a new approach in Costa Rica. The current CBZ proposal is based on these sources. Though SINAC has mandated an HUZ approach (SINAC, 2014), relying heavily on human activity regulation, at the same time its management planning guidelines call for zones to manage desired conditions with conservation targets and objectives, but does not indicate how to combine human activity zoning and conservation planning based on the Open Standards. Thus, this CBZ model aims to bridge the gap between SINAC's official mandate to use HUZ and to use resource conditions and conservation targets. See Table 1 for a comparison of CBZ and HUZ.

This CBZ model focuses on biophysical conditions (e.g., populations, canopy coverage, biodiversity, erosion, etc.) that correspond to conservation targets defined during conservation planning, using schemes such as the Open Standards adopted in the formal management planning guidelines by Brazil (de Faria Bacellar et al., 2018), Chile (CONAF, 2017), Colombia (Ospina Moreno et al., 2020), Costa Rica (SINAC, 2014), Ecuador (Columba Zárate, 2013), Guatemala (CONAP, 2012), Honduras (Corrales, 2014), Uruguay (Mejia, 2012) and

Table 1. Comparison of CBZ and HUZ, adapted from Sierra and Arguedas (2007)

HUZ Limitation	CBZ Alternative
Focuses on human uses rather than resource conditions; primary tool is use restriction.	Zones defined by desired conservation target conditions; restriction is one of many management options.
Standardised zones applied to complex and variable situations *in situ*.	Each zone is unique to its conservation target situation; no standardised zones necessary.
Non-overlapping exclusionary use zones can provoke conflicts between users in same spaces.	Uses and zones can overlap. Integration of LAC applies in spaces with use conflicts when certain requirements are met.
Must cover entire area.	Zones not required to cover entire area. Primary zones cover only conservation targets, while secondary zones may optionally be applied to other spaces as needed.
Monitoring resources divided between human uses and conditions.	Monitoring focused on resource conditions.
Often requires complex technical determinations or expensive decision support tools to define zones.	No need for additional decision support tools. Zone definitions are updated as new information emerges.
HUZ definition considered an objective, technical process that largely excludes significant community participation and does not build their support.	CBZ integrates both objective (quantitative indicators) and subjective (negotiated among stakeholders) criteria.
HUZ often becomes official regulation, hard to update.	Often CBZ does not use a legal framework, and its approach is based on LAC-adaptive management which requires continued experimentation and improvement, thus preventing zones from becoming legalised and immutable.
Once zones are legalised, staff focus on their administration without further learning.	By focusing on monitoring conditions and negotiating conflicting uses in an adaptive management process, learning and improvement are built into the system.

others. These targets represent formal conservation objectives in management plans (Parrish et al., 2003), including for this pilot application in Monteverde Cloud Forest Biological Reserve.

The proposal also uses a methodology with appropriate technology that is easily learned and applied by local staff. It depends on local participatory decision-making, rather than on technical experts who merely consult stakeholders and then make decisions themselves. Last, it integrates LAC to give voice and process to conflicting values that require negotiation to define zones acceptable to various interests.

The CBZ Model

This model defines zones based on conservation targets, and thus is appropriate for any protected area or category that uses such targets. Each target receives one unique zone. The model does not use standardised zone categories commonly applied in protected areas, such as in biosphere reserves (core, buffer, transition). Managers tailor each zone's objectives, standards, indicators, etc. to the specific conservation target defined previously in the planning process. Without explicitly defined conservation targets, this approach may not work. Participants then map zones based on habitat/landscape features that bound the target. Zones may overlap and extend beyond area boundaries across the landscape as buffer zones (see protected landscape approach in Brown et al., 2005). Significant gaps may result between zone distributions. Managers may define these gaps as secondary zones, or whatever zone name they desire, based on other desired conditions, political, regulatory or managerial criteria (service area, villages, private inholding, etc.) or may leave them unzoned for future definition, though of course management still exists there.

As described below, where conflicts might exist between stakeholder values, managers can apply LAC to negotiate a consensus limit of acceptable change rather than an ideal conservation objective based on best available science. Where no conflict exists, managers formulate objectives based on best available science. LAC works on the premise that when two management objectives conflict (e.g., conservation and human settlement), if stakeholders can agree to prioritise one, then they can modify the second so that both become compatible. This process integrates subjective stakeholder values and requires a willingness to negotiate and the possibility of modifying management objectives. It is not always possible to negotiate, for example, with a critically endangered species conservation objective.

In addition to its negotiation function, LAC also involves seven to ten (depending on the version) overarching process steps that make it an adaptive management process or cycle (McCool, 2013). The CBZ model uses these steps to define the process to develop condition-based zones, since zone development and management should also be adaptive, as seen in Table 2.

Given that CBZ is not a prescriptive or regulatory tool, rather one that focuses attention on conservation targets, a protected area still needs to control and enforce human activities. The methodology assumes that protected areas will still have regulations in addition to the management actions defined for primary or condition-based zones. They would still apply across zones as necessary, focused on human activities that do not relate to target conditions. See Kohl and Herrera-Fernández (2021) for how human uses can be modified to be more consistent with conservation target conditions.

Table 2. Comparison of Standard LAC and CBZ Model Process Steps. Source: Stankey (1985) modified by Cole and McCool (1997)

Step	LAC	CBZ Process Based on LAC
1	Define goals and desired conditions	Assemble and train planning team
2	Identify issues, concerns and threats	Determine conservation targets, objectives, threats and conditions
3	Define and describe prescriptive management zones	Draw and name zones around conservation targets
4	Select indicators	Identify conflicts and decide whether to use ideal objectives or limits of acceptable change
5	Specify standards	Define objectives or limits of acceptable change and indicators
6	Identify management actions	Define standards
7	Implement actions	Determine preventive and corrective management actions
8	Monitor	Implement actions and monitor

APPLICATION OF CBZ IN MONTEVERDE

Site Description

The Monteverde Cloud Forest Reserve is managed by the Tropical Science Centre (TSC), a Costa Rican non-profit whose mission is "to be the scientific organization of excellence in innovative solutions for conservation and sustainable development". Consistent with that mission, TSC's four protected areas stopped using SINAC's formal management planning guide some years ago (personal communication, Carlos Hernandez, 2019) in favour of what it considers more innovative management approaches. Monteverde, therefore, along with the PUP Global Heritage Consortium, a US-based natural and cultural heritage management non-profit, sponsored the CBZ model testing as part of its management planning process.

The reserve covers 4,125 ha and hosts conservation priority bird species such as the Resplendent Quetzal (*Pharomachrus mocinno*) and Three-Wattled Bellbird (*Procnias tricarunculatus*) and amphibians such as the Ring-tailed Salamander (*Bolitoglossa robusta*) and the Highland Dink Frog (*Diasporus hylaeformis*). Cloud forest covers much of its surface.

Figure 1 shows that Monteverde's 2005 zoning map consisted of four use-based zones: Absolute protection (core), public use, special use and social interaction (buffer zone inside the adjacent biological corridor).

Reserve staff indicated that their area was unique in that it did not have significant threats to its conservation targets or inappropriate uses within its boundaries. It did indicate that climate change would almost certainly produce serious challenges through drought, changing food sources, cloud cover reduction and invasive species, all of which have already begun.

Given that in 2019–2020, Monteverde updated its 2005 management plan, it agreed to implement the CBZ model as part of that process both to teach staff new conservation approaches and innovate a more useful zoning model.

Pilot Application

The authors crafted these steps into a methodological manual (Kohl & Herrera-Fernández, 2021) based on various references (SINAC, 2014, 2018; PUP Global Heritage Consortium, 2015; Conservation Measures

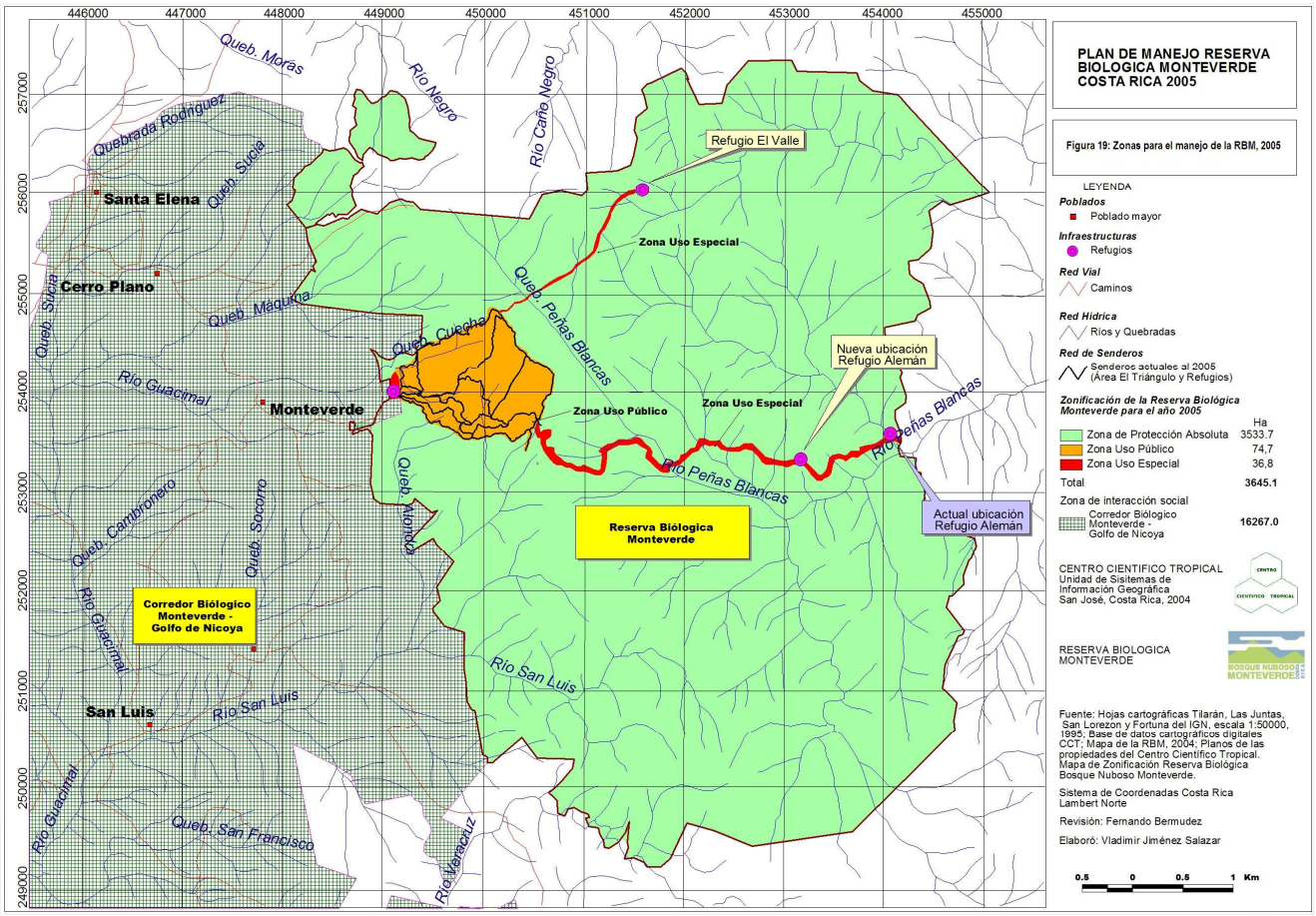
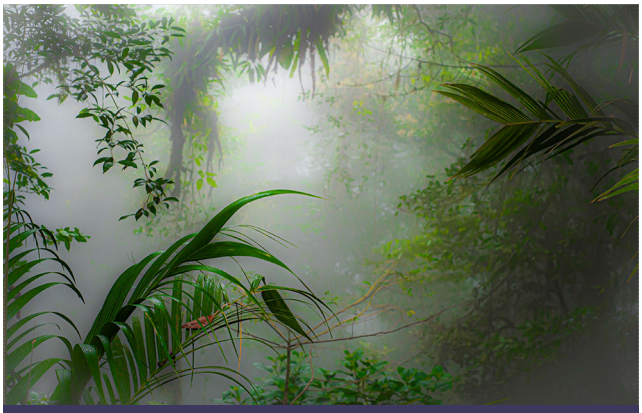


Figure 1. In 2005 Monteverde had four use zones: absolute protection, public use, special use and social interaction

Partnership, 2020). While managers can apply the theoretical steps across a wide range of methodologies, Monteverde elected to apply them during a two-day workshop. See Table 3 for a workshop overview.

The staff were shown a training video prepared by the authors and attended a Q&A session with them as well. The reserve director assumed the responsibility for studying the manual, preparing the team and facilitating the workshop. The first author (Kohl) participated in the workshop to offer a morning reinforcement training, answer questions about the methodology and its application, and document its execution, not facilitate it. He noted how well the team used the methodology and identified challenges and improvements. After the application, the authors evaluated the process against the above-mentioned objectives.



Monteverde Cloud Forest Reserve is already registering lower cloud levels likely due to climate change © Jon Kohl

RESULTS AND DISCUSSION

Given that this paper proposes a methodology whose effectiveness will not be known for some time, this section provides evidence of the methodology's implementation in Monteverde, overcoming difficulties identified in the literature on zoning implementation noted above in "Zoning Proposals to Overcome HUZ Weaknesses".

Evaluating the approach's fulfilment of its objectives

The authors proposed four objectives.

a) CBZ should better focus resources and attention on priority conservation threats.

For Monteverde, this focus shift from uses to conditions resulted in a clearer understanding of its conservation targets, the research necessary to manage those targets, and the resource reallocation to carry out that research. For example, during the workshop, staff realised that they had to increase the number of transects to measure target amphibian and reptile occurrence and run those transects during dry as well as wet seasons. They discussed how to reallocate volunteers and rangers to meet the increased needs and what the trade-offs would be. Though they began with a HUZ focus, they discovered that directly focusing on conservation not only revealed research and resource gaps, but allowed them more flexibility (rather than focusing on how to restrict human activities which requires significant energy) in conserving high-priority targets.

b) CBZ should prove relatively easy to implement.

The approach did require a new zoning model and a refresher of indicators, standards, objectives and conditions. From the outset, the director was asked to apply the training materials to lead his team through the consensus-based steps with only moderate support from authors. He did that, and the team produced a hand-drawn zoning map later digitalised (Figure 2) with precise coordinates and zone management table

Table 3. Workshop Overview

Focus Question	How do we create a zoning methodology that, with brief training, can be implemented by staff of the Monteverde Cloud Forest Reserve during a two-day workshop?
Agenda	Day 1: Training (morning); defining zones (morning–afternoon) Day 2: Indicators and standards (morning); management actions (afternoon); process evaluation (afternoon–evening)
Deliverables	• Pre-workshop baseline document describing conservation targets, threats, objectives, existing conditions and current zoning • CBZ map, hand-drawn and later digitalised • Zone narratives including conservation targets, conditions, threats, indicators, standards, management actions (preventative and corrective), cost and feasibility strategies, strategy prioritisation • Workshop proceedings including process evaluation • Draft methodological manual (updated based on the workshop, Kohl & Herrera-Fernández, 2021)

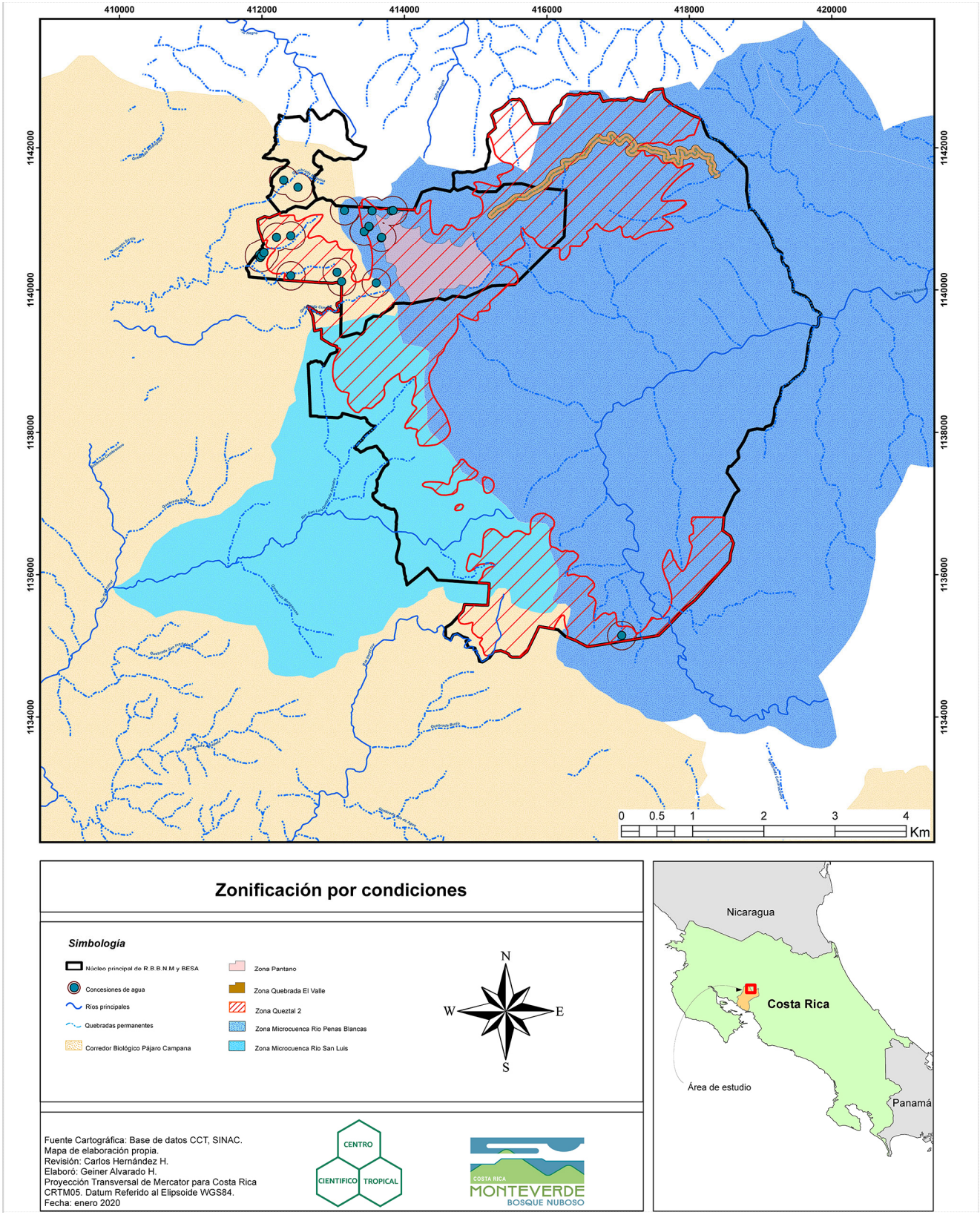
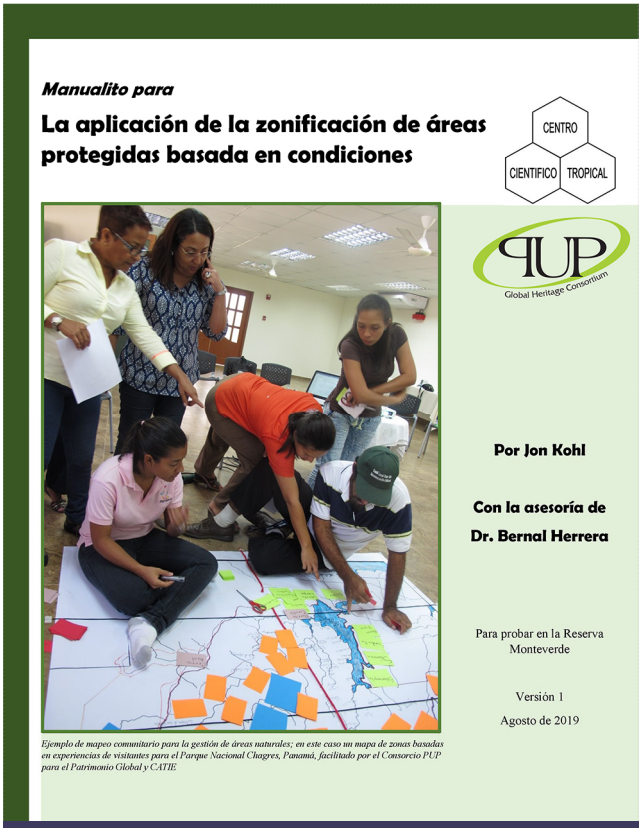


Figure 2. The condition-based zone map uses six zones within the reserve and one outside, the biological corridor for the Three-Wattled Bellbird. Staff digitalised this map from the hand-drawn version

(Supplementary Material) which will have undergone modification during the following planning steps. The director (who coordinates all TSC's protected areas) indicated that his organisation intended to adopt and include this zoning in its management plan. He even budgeted (just prior to the onset of the Coronavirus pandemic) for training workshops for nearby national parks to further develop this approach and integrate their zoning systems with that of Monteverde. In short, with moderate assistance from us, the team applied the methodology without investing in new technical methods or tools and generated favourable results.

The CBZ model uses LAC's overall process steps as well as its framework for negotiating conflicting subjective values among management objectives. Given Monteverde's low stakeholder conflict, we did not apply this tool in this specific test case.

c) Applying CBZ should require fewer resources and a light learning curve.
In terms of appropriate technology, the CBZ model does not require new software or technical skills. Indeed, TSC invested no additional resources except the time required to develop training materials and Kohl's workshop accompaniment. All materials were immediately on hand. Though the team did require a refresher on indicators and standards, the director largely guided the team through the process.



Manual cover

d) CBZ should integrate into the conservation planning often adopted in developing countries.
Given that Monteverde's planning process had already defined six conservation targets, the CBZ model built on what they had done and produced zones more focused on research and condition management than human use restriction and enforcement. Since SINAC's official management planning manual requires the Open Standards, the team demonstrated a practical way to apply them to zoning. We note that because Monteverde is a private reserve, its staff enjoy more latitude to experiment than staff of national protected areas. Despite this, its technical team was not necessarily better trained or larger than that of other similarly sized parks in Costa Rica.

Lessons Learned

The team debriefed and generated four principal lessons learned from this experience.

α. Conservation targets had not been sufficiently detailed to create a monitoring and management framework, and thus the team had to break targets down into more specific components to specify conditions, indicators, standards and management actions. Nevertheless, this breakdown was an important contribution to the management planning process and one they might have skipped if not obligated by this methodology to generate those components.

β. By focusing on conservation targets rather than visitors, it became apparent that despite many years of research there were still big research gaps to establishing specific and measurable conservation objectives for their targets. The process further helped to elucidate where the reserve had to redistribute resources to carry out effective conservation activity.

χ. During application, the team discovered that Monteverde did not register significant threats or stakeholder conflicts. They considered that this may have been due in part to its history dating back to Quaker community roots and its quick ascent to fame as an isolated yet renowned ecotourism destination. At the same time, this trait made it impossible to test the LAC negotiation component even though the team applied the rest of the methodology.

δ. CBZ fitted into their management planning process and the only disruption might have been to revisit

Zoning workshop, Monteverde Cloud Forest Reserve © Jon Kohl

conservation targets previously identified to make them more operational. The lesson then is that zoning should always integrate into a larger planning process as it cannot alone achieve conservation.

CONCLUSIONS

Generalisability

The HUZ model is so dominant internationally that, one might infer, it did not even merit a single section in IUCN's (Worboys et al., 2015) one-thousand-page tome about protected area management and governance. Similarly, UNESCO's principal resource manual for protected area management, Managing Natural World Heritage, dedicates a single paragraph to human use zoning (UNESCO, ICCROM, ICOMOS, IUCN, 2012). Likewise, the HUZ approach dominates Latin America and most less developed countries. Certainly, this CBZ model could work anywhere, but would work best in systems that already use conservation planning approaches with conservation targets; in such cases, the CBZ builds on what already exists. In Latin America, at least Brazil, Chile, Colombia, Costa Rica, Ecuador, Guatemala, Honduras and Uruguay formally require conservation planning such as the Open Standards in their management planning guidelines. If the abundance of condition-based zoning approaches in the literature is any measure, the protected area management field has perceived HUZ weaknesses and thus the CBZ model contributes to a trend toward condition-based zoning.

While TSC does have a qualified team and a venerable science-based innovative non-profit to support it, their reality is not that different from technical teams throughout Latin America. With little extra training and no new technical tools needed, that the Monteverde team implemented the methodology in large measure on its first try bodes well for other technical teams across Latin America and developing countries generally with small budgets, let alone better resourced protected area systems.

Certainly, Monteverde's lesson that the CBZ model allowed its staff to focus more clearly on the nature of their conservation targets, research gaps and specific strategies may very well benefit any site that uses HUZ and which may not be investing in their conservation targets as efficiently as they might otherwise do with a condition-based focus.

Further Research

Despite the director's intent to integrate CBZ into management planning, until it can be shown that Monteverde has reallocated research resources to conservation targets, improved indicators, standards and actions, it is unclear if this approach has more likelihood of moving from park paper to park implementation than any other zoning proposal in the literature. Since this project focused exclusively on methodology, it never set out to test longer-term outcomes. For this reason, further research would be necessary to indicate how such integration proceeds and what are its associated costs and impacts.

Furthermore, the methodology needs to be applied in protected areas without the same level of resourcing and international acclaim, and with a more typical assortment of conservation threats and conflicts. It is unclear to what degree Monteverde's conditions diverge from those of surrounding national parks.

Finally, as Kohl and McCool (2016) argue, tools and approaches that require adaptive approaches, and that include subjective criteria, are ones that require a learning culture to implement (as noted in the final step of the Open Standards). It is not enough simply to train a team in the steps and tools if their organisation is not set up to encourage organisational learning, experimentation, embracing errors as learning opportunities, lower risk aversion and a stable work environment (Argyris & Schön, 1996). It may be that TSC's culture, given its emphasis on learning and innovation, makes it a more likely candidate to adopt such an approach than a more bureaucratic public institution. Such institutions are characterised by people being frequently reassigned among protected areas, with limited job security and merit-based promotions, and few resources for training and learning together, which usually results in lower implementation (Thede et al., 2014).

SUPPLEMENTARY ONLINE MATERIAL

Description of the major LAC-based steps in the CBZ Model

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RESUMEN

La zonificación de áreas protegidas para uso humano asigna diferentes usos de los recursos terrestres y marinos a distintas zonas de gestión, en teoría, para evitar o restringir actividades incompatibles con los objetivos de gestión. Sin embargo, a pesar de su popularidad mundial, la zonificación basada en el uso humano suscita problemas como la separación de usos compatibles y el consiguiente conflicto entre usuarios (por ejemplo, investigadores y ecoturistas). Asigna más recursos a la gestión de los usos humanos que a las condiciones biofísicas que las áreas protegidas deben conservar. Reduce las manifestaciones de un mismo uso (por ejemplo, la agricultura intensiva y la de pequeña escala) a una sola escala de impacto. Utiliza criterios objetivos para definir las zonas en situaciones en las que los valores subjetivos pueden entrar en conflicto. En respuesta, han surgido sistemas de zonificación alternativos, entre ellos, los enfoques basados en las condiciones de los recursos. Sin embargo, estos tienden a ser muy técnicos, a ser mal evaluados y a mostrar pocos indicios de adopción por parte de los sistemas de áreas protegidas, especialmente en los países en desarrollo. De ahí que el presente artículo propone un enfoque basado en las condiciones que aborda estos puntos débiles mediante la utilización de objetivos de conservación predefinidos como criterio principal para definir las zonas, vinculando así claramente la planificación de la conservación (como los Estándares Abiertos para la Práctica de la Conservación) y la zonificación de la gestión. La zonificación basada en las condiciones se centra en acciones estratégicas de conservación con el uso de condiciones, indicadores, estándares y las correspondientes acciones de gestión preventiva y correctiva, en lugar de ser prescriptiva y punitiva como ocurre con el modelo de zonificación basada en el uso humano. El artículo propone, además, una tecnología y una metodología más adecuadas a la capacidad técnica de los países en desarrollo. También establece el desarrollo de la zonificación basada en las condiciones desde el principio de la zonificación urbana y presenta una aplicación piloto en la Reserva Biológica Bosque Nuboso Monteverde, en Costa Rica.

RÉSUMÉ

Le zonage des aires protégées à usage humain attribue différentes utilisations des ressources terrestres et marines à différentes zones de gestion pour, en théorie, éviter ou réduire les activités incompatibles avec les objectifs de gestion. Cependant, malgré sa popularité mondiale, le zonage à usage humain génère des problèmes, tels que la séparation des utilisations compatibles et ainsi les conflits d'utilisateurs qui en découlent (par exemple, entre chercheurs et écotouristes). Il alloue plus de ressources à la gestion des usages humains qu'aux conditions biophysiques que les aires protégées sont chargées de conserver. Il réduit les manifestations d'une même utilisation (par exemple, l'agriculture intensive et à petite échelle) à une seule échelle d'impact. Il utilise des critères objectifs pour définir des zones dans des situations où les valeurs subjectives peuvent entrer en conflit. En réponse, des schémas de zonage alternatifs ont émergé, parmi lesquels des approches fondées sur les ressources. Celles-ci, cependant, ont tendance à être très techniques, mal évaluées et montrent peu de preuves d'adoption par les aires protégées, en particulier dans les pays en développement. Le présent document propose donc une approche fondée sur les conditions qui répondent à ces faiblesses en utilisant des cibles de conservation prédéfinies comme principaux critères pour définir les zones, établissant ainsi un lien clair entre la planification de la conservation (tels les Standards ouverts pour la pratique de la conservation) et le zonage de gestion. Le zonage conditionné met l'accent sur les mesures stratégiques de conservation ayant recours aux conditions, aux indicateurs, aux normes et aux mesures de gestion préventives et correctives correspondantes, plutôt que d'être prescriptif et punitif comme c'est le cas pour le modèle de zonage à usage humain. En outre, l'article propose une technologie et une méthodologie plus adaptées aux capacités techniques des pays en développement. Nous retraçons également le développement du zonage conditionnel à partir des premiers zonages urbains et présentons une application pilote dans la réserve de forêt nuageuse de Monteverde au Costa Rica.