



## Perspective

## Conservation at the edges of the world



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## ARTICLE INFO

## Article history:

Received 19 January 2013

Received in revised form 14 May 2013

Accepted 21 May 2013

## Keywords:

Remote  
Ecosystem service  
Tourism  
Community  
Biodiversity  
Conservation  
GIS  
Protected area

## ABSTRACT

Remote areas harbor some of the world's most undisturbed ecosystems. Major conservation gains can be made by effectively protecting nature in these remote zones. Conducting conservation work in remote settings presents both unique challenges and promising opportunities. We discuss how five commonly used approaches for conservation (buy and protect conservation; conservation motivated by the intrinsic values of nature; ecosystem service based conservation; ecotourism driven conservation; and conservation enabled by community planning) can be optimally applied to protect ecosystems in these special settings. In this discussion we draw examples from two model remote sites: Palmyra and Tabuaeran Atolls. Spatial analyses conducted using population density as a proxy for remoteness indicate that many existing recognized protected areas already include remote regions, but that the vast majority of the overall remote zones on the planet are not yet formally protected. Initiating discussions that directly consider both the roadblocks and opportunities for conservation in remote areas will help increase our odds of successfully protecting biodiversity in these unique and strategically important contexts.

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## 1. Introduction

Extremely remote locales host some of the most intact ecosystems and richest biodiversity on the planet. Examples include remote and uninhabited islands in the central Pacific, the interior forests of Borneo, certain inaccessible sections of Western Australia, and isolated tracts of Amazonian forest. All parts of the earth have been influenced by humans to some degree (Kareiva et al., 2007). This is particularly apparent in an age when climate change and its myriad insidious ecological effects (e.g. ocean acidification, hydrological regime change) have truly reached across the globe. Nevertheless, extremely remote sites stand out in our globally altered bioscape as places where ecosystems have been evolving for millennia with less disturbance from our species. As such, they are some of our most valuable scientific and cultural assets.

Threats to the integrity of extremely remote ecosystems have rapidly emerged in the past several decades as human populations expand, transportation networks enlarge, economies develop, and technology seeps to the edges of civilization (Kramer et al., 2009). Many strongholds of biodiversity that had long received some measure of de facto protection by virtue of their remote position now increasingly require the aid and intervention of conservation. Antarctica provides a fitting example. The continent of Antarctica, sometimes hailed as one of the most remote and pristine places on the planet (Halpern et al., 2008), is now under risk from exploitation from industrial fishers and whalers (Croxall and Nicol, 2004; Ainley, 2011). The Galapagos Islands, north-central Democratic Republic of Congo, and mountainous sections of Papua New Guinea are just a few of the many other iconic, once remote regions that presently face similar risks (Laporte et al., 2007; Durham, 2008; Shearman et al., 2009).

Recent estimates calculate that only about 10% of the world's land area can still be considered "remote" – when remote is defined as locations that are more than 48 h travel from large cities (>50,000 people) (Nelson, 2008). Similarly, Sanderson et al. (2002) estimated (now more than a decade ago) that the 'human footprint' extends to 83% of the world's land surface, and Halpern et al. (2008) reported >95% of the world's oceans are impacted by humans. As the extent of our influence advances and the frontiers of remoteness fall back, conservation must acknowledge that the strength of this traditional ally will be greatly weakened.

The suggestion that remote areas are deserving targets for conservation is not wholly new. The value of inaccessible "wild" areas has long been appreciated (Nash, 1967) and modern conservation scientists have used a variety of different strategies to identify and draw attention to the world's remaining less-impacted wilderness regions (Bryant et al., 1997; Sanderson et al., 2002; Mittermeier

et al., 2003; Brooks et al., 2006). Despite this fascination with remote sites and these attempts to map out where they remain, little attention has been given to considering how the rules for conservation may differ in these isolated and inaccessible contexts. We believe, in fact, that practicing conservation in highly remote zones presents a suite of fundamentally unique challenges. Nevertheless, awareness of these obstacles and recognition that doing conservation in extremely remote contexts is often different than it is elsewhere can enable progress to be made in these strategically important regions.

Here we review some of the shared qualities of remote ecosystems and consider some of the difficulties and opportunities that may be encountered when applying commonly used conservation tactics in these special environments. The issues we consider are pertinent to conservation professionals working in remote zones situated in a wide variety of different geographic and cultural contexts. However, to focus and ground this discussion, we draw heavily from examples from two model remote sites in the central Pacific with which we have direct experience: Palmyra and Tabuaeran Atolls. Providing an in-depth treatment of these two illustrative case studies helps to more cogently exhibit some of the specific opportunities and challenges that face conservation practitioners working in remote zones.

## 2. What is remote?

Remote sites, regardless of their location, tend to share a number of common characteristics. By definition remote sites are isolated from large human settlements, are uninhabited or sparsely populated, and are difficult to access. Barriers to access are generally geographic, but can also be political or climatic. Remoteness does not necessarily correlate with biological richness. Extremely high latitude, high altitude, or otherwise physically harsh remote areas are less likely to harbor large quantities of biodiversity, although they may still contain a high proportion of endemic and evolutionarily unique species. The dynamic between biodiversity and humans in remote places varies considerably. In some remote areas local communities have caused rapid ecological change, while in others – particularly those with long histories of evolutionary association with humans – biodiversity has been shown to benefit from human activity (Smith and Wishnie, 2000; Bliege Bird et al., 2008). A disproportionately large number of the world's remote areas occur in developing nations (Nelson, 2008).

## 3. Portrait of the remote: Palmyra and Tabuaeran Atolls

The two model remote sites that we will use to illustrate our points in this discussion are Palmyra (5°52'N, 162°04'W; USA)



**Fig. 1.** Palmyra Atoll is one of the most remote sites in the United States and serves as an excellent example of how less-disturbed reef ecosystems function. Palmyra was directly purchased to conserve the biodiversity that it harbors. Courtesy of Kydd Pollock.

and Tabuaeran Atolls (3°52'N, 159°20'W; Kiribati), located in the Northern Line Islands. The discreteness of these particular remote island sites provides a clear way to view some of the issues that may be faced when doing conservation in isolated settings.

Palmyra has been largely uninhabited, save for a brief but intense occupation by the US military during World War II. Palmyra was purchased in 2000 by the Nature Conservancy (TNC) and is currently administered by the US Fish and Wildlife Service as a wildlife refuge (Fig. 1). Palmyra hosts some of the most intact reef ecosystems in the world (Stevenson et al., 2007; McCauley et al., 2012). Its terrestrial and lagoon ecosystems were, however, considerably damaged by military activities and as yet are slowly recovering.

Tabuaeran, 350 km southeast of Palmyra, has approximately 3000 residents (SPC, 2007). Located approximately 3000 km from the political and economic center of Kiribati, Tabuaeran lies literally at the periphery of the nation's minimally developed commerce and transport networks. Since 1997 cruise ships have periodically called at Tabuaeran providing residents with an intermittent source of cash and jobs. In the absence of the cruise line, the only sources of income for the people of Tabuaeran come from sporadically traded seaweed, copra, dried fish, sea cucumbers, and shark fins.

#### 4. Conservationists' toolbox

There are many different strategies for conservation. Here, we have selected five conservation approaches and discuss the potential strengths and weaknesses of applying these in remote areas: (1) purchase and protect conservation, (2) intrinsic value motivated conservation, (3) ecosystem service based conservation, (4) ecotourism linked conservation, and (5) conservation enabled by community planning. In a science as complex as conservation, there are myriad possible approaches for protecting ecosystems. Often the lines between these different strategies blur conceptually; such is the case with these selected strategies. However, herein we treat each separately for the purposes of rhetorical clarity. We consider these five strategies for our discussion because they are commonly used by conservation practitioners.

##### 4.1. Buy and protect

One of the oldest tactics in conservation has been to simply buy up and take over the ownership of ecologically important areas. This may be a particularly useful strategy in remote areas because larger blocks of land are more likely to be for sale at more affordable prices than they might be within or near to human population centers. This was the approach used by TNC leaders who organized \$37 million to purchase and protect the uniquely intact and biodiverse ecosystems of Palmyra.

The effectiveness of buy and protect conservation has received some criticism when applied in less-remote contexts (Schwartzman et al., 2000). Purchasing chunks of nature in and around populated centers can have important impacts on local residents who may be displaced from reserves or dispossessed of resource acquisition opportunities (Agrawal and Redford, 2009). However, in remote locations, where there are few or no people at all, socially just solutions can be more carefully and tractably arbitrated. Buying Palmyra, for example was an easy win because the atoll had no local inhabitants and it was a genuinely isolated place. The strategy of buying land for biodiversity protection is only relevant in contexts where land and resource rights are formally for sale. In numerous populated but also remote places, land tenure and resource access is communally managed (e.g. Western Pacific, sub-Saharan Africa) and land purchases for conservation

are not tenable. Conservation buys as straightforward and effective as that of uninhabited Palmyra may be rare, but this case is a testament of the achievements that can be made by identifying and successfully raising the funds to buy what few Palmyra-like places there are left in the world.

Application of this strategy is not, however, as simple as writing a check for a piece of remote nature, putting up a sign, and leaving it be. Protecting biodiversity has high maintenance costs, even at the edges of the world. There is no direct impact of humans. Illegal fishing vessels that have traveled many thousands of kilometers are regularly detected in the protected waters of Palmyra. A small number of dedicated poachers can undo decades of conservation progress. Conservation areas in remote zones require careful management and constant protection in order to curtail degradation. Isolation, unfortunately, is a double-edged sword: remoteness makes illegal incursions rare, but it also makes it extremely expensive and difficult to monitor, detect and respond to violations. Poacher detection at Palmyra is a major technological feat and mobilizing an effort to deliver poaching citations there can easily cost tens of thousands of dollars. Furthermore, ownership rights to land in remote areas, as elsewhere, are always subject to the caprices of political and economic change. Prior to WWII, Palmyra, as it is now, privately owned. At the onset of the war, however, the US government appropriated the atoll and converted it into a naval air station, with great costs to the integrity of Palmyra's ecosystems. This case reminds that no purchases are permanent on ecological time scales, even in the world's most out of sight locations.

##### 4.2. Conservation for nature's sake

Another traditional tool in the conservationist's toolbox has been convincing stakeholders that biodiversity deserves protection because of its intrinsic merits. While nature is considered to have multiple different types of intrinsic value, we focus here on subjective intrinsic values – or reason-oriented values for nature that are created directly by human valuers who judge nature for what it is, rather than what it can bring about (Sandler, 2012). Conservation practitioners often advocate that ecosystems should be safeguarded using an intrinsic value approach because they have aesthetic appeal, represent historically important evolutionary lineages, or have unique connections to human culture.

Intrinsic value conservation has been perhaps most successfully applied to aid imperiled charismatic large fauna (Walpole and Leader-Williams, 2002). Many of the world's most cherished megafauna have, for a variety of reasons, been driven to confinement in the world's last remote locations. This happenstance provides a useful impetus for conserving these remote regions – and the broader portfolios of biodiversity that they harbor. Another factor that makes intrinsic value conservation suitable for use in remote areas is the fact that these zones host some of our least explored and most untrammelled ecosystems. The idea of safeguarding these last outposts for “wild nature” resonates with many potential conservation supporters. These groups gain nothing tangible or direct from the existence of these far-flung places that, in most instances, they will never be able to visit. Often these supporters are simply happy to know that such places are being looked after. This emotive potential can be fostered to help generate some of the capital and support needed to help protect remote sites.

Directly integrating local communities into the planning and management of local conservation programs is a necessary part of ensuring that these activities have long life spans (Western and Wright, 1994; Berkes, 2004). Using intrinsic value strategies to build this kind of on the ground support for conservation in remote areas may present some challenges. Removed from access to

market goods and infrastructure, indigenous and local people in remote zones may be more likely to rely on nature for life's necessities. This isolation and dependency on local resources can shape one's perspective on the values of nature. For example, the red-listed bumphead parrotfish (*Bolbometopon muricatum*), the world's largest parrotfish, is popular and much appreciated by divers and snorkelers originating from populated urban areas (Donaldson and Dulvy, 2004). Yet, in Tabuaeran, where people look to the reefs for food, recreational observation of bumphead parrotfish is rare and these fish are appreciated principally for the dietary sustenance they provide and the social significance that this provisioning confers. People living in many remote locations certainly do have strong and deeply embedded perceptions of the intrinsic values of natural resources. However, it may be quite useful for conservation leaders working in remote areas to be cognizant and responsive to how this appreciation for the intrinsic value of a given natural resource ranks relative to general appreciation for the utility of the resource.

#### 4.3. Ecosystem services

Another important conservation strategy involves protecting ecosystems in the name of preserving the supply of tangible services that they provide to humans. While some consider the more intangible contributions provided by ecosystems that we discuss above to also be ecosystem services (MEA, 2005; Seppelt et al., 2011), for the sake of this discussion we will focus on the realm of more utilitarian ecosystem services; e.g. water purification, pollination, carbon storage, food provision. Proponents of the ecosystem service approach to conservation point out that it is economically rational, and often even profitable, to protect ecosystems because they deliver a variety of these kinds of necessary human life support services (Costanza et al., 1997; Daily and Ellison, 2002; Engel et al., 2008). The logic of this more practical approach could potentially have more resonance with the people living in remote areas. Because the residents of Tabuaeran draw many of their necessities for life directly from the reefs and forests of their atoll, they are likely to be more attuned than many cosmopolitan dwellers to the status of the natural resources and ecosystems that surround them. Communities in remote places, however, are by no

means immune to the same risks of resource overexploitation experienced in less accessible contexts. Nevertheless, the heightened awareness often found in remote places that community health and environmental resource health are linked, may help make ecosystem service based conservation programs gain traction in these settings.

There is, however, some danger in overzealous application of ecosystem service conservation in remote contexts. Encouraging communities to monetize the values they place on biodiversity and imposing market-based metrics of value that are sometimes foreign in remote communities may encourage economically profitable but ecologically and sometimes socially damaging activities (Gómez-Baggethun et al., 2010; Kosoy and Corbera, 2010). Tabuaeran's sharks provide a good example. Reef sharks are one of the flagship species of coral atoll ecosystems. In the face of global declines in reef shark abundance (Robbins et al., 2006), much concern is emerging about how best to protect these icons of reef biodiversity and potentially important players in reef ecosystems. In Tabuaeran, however, this kind of appreciation for sharks is less well recognized. Here sharks steal fish from fisherman and pose a liability to people's safety. Sharks at Tabuaeran are worth more dead than alive: their meat is used for food and their fins are a top source of cash income on the atoll (Fig. 2). It is difficult to imagine how ecosystem service conservation can provide for biologically unique and valuable taxa like sharks when they are costly to preserve. Effectively implementing ecosystem service based conservation in remote areas may mean dealing with the logical inconsistency of advocating that certain services should be drawn from ecosystems, while other potentially profitable resource should be left unharvested – and certain ecosystem disservices be endured.

Remote places are also, almost by definition, sub-optimally situated for the application of ecosystem services conservation. The low population densities and isolation that characterizes remote areas means that there are fewer endemic service recipients in these zones and that it may be harder to trace service provision from remote ecosystems to populated centers. Palmyra provides a good example. Researchers are currently investigating whether Palmyra, as a less-disturbed marine ecosystem, may help replenish reef biodiversity at other populated atolls in this region via larval



**Fig. 2.** Reef sharks have been severely depleted across their range, but still remain abundant in certain remote ecosystems. The residents of Tabuaeran Atoll harvest reef sharks for their meat, fins, skin, and teeth. Shark fins are one of the few sources of cash income for the members of this remote atoll.

(e.g. reef invertebrates) and adult (e.g. shark) dispersal. While genetic evidence derived from the study of a number of reef species at Palmyra suggest that there is a fair amount of mixing between the atolls and archipelagos in the region (Schultz et al., 2007; Skillings et al., 2011; Whitney et al., 2012), it is not known how many of Palmyra's marine taxa are capable of long-distance dispersal, as self-recruitment is also common in coral reef ecosystems (Jones et al., 1999). Besides the putative benefits that regional replenishment provides when it occurs, it is hard to identify other services that the atoll provides. None of the members of Palmyra's ecosystems sequester carbon particularly well; they do not clean water; they do not pollinate crops; and they do not feed anyone. For these reasons, ecosystems service conservation may be more challenging to apply in the Palmyra-like places that exist at the extreme end of the remoteness spectrum.

#### 4.4. Ecotourism

Tourists play a pivotal role in supporting conservation in many accessible natural areas by providing needed capital for conservation and investing local stakeholders, literally, in the notion that nature has value beyond its extractive worth (Budowski, 1976; Balmford et al., 2009; Wearing and Neil, 2009). Tourism also can reinforce and reward "traditional ecological knowledge" within local human communities contributing to the survival of both biodiversity and culture (Drew, 2005). Unfortunately using ecotourism to advance conservation at extremely remote sites is difficult. Because transport to these sites can be involved, time-consuming, and unpredictable, only the extremely wealthy or extremely flexible are likely to visit. However, these initial challenges may be turned into opportunities. As accessible wildlands closer to urban centers fill up, the inaccessibility and exclusivity of remote areas may serve as an attractant that can help the niche for remote-place ecotourism to grow. Low volume, high end tourism in particular has the potential to provide some of the revenue needed to manage the costs of biodiversity protection – provided a sufficient portion of the profit from these activities is invested in local ecosystems and communities (Sandbrook, 2010). While limited visitation to remote places may conflict with often held democratic ideals for access to nature, reduced visitorship to remote places may help preserve the integrity of these sensitive locales.

As is often discussed, poorly managed ecotourism of any volume can, however, contribute as much to the degradation of ecosystems as to their conservation (Buckley, 2004; Krüger, 2005). This is particularly true in semi-pristine remote areas that are highly vulnerable to human disturbance. Influxes of wealth into the coffers of remote reserves from small-scale tourist activities can provide a real temptation to develop new infrastructure to regularize tourist access and income (see for example Watkins and Cruz, 2007). Such improvements to access can easily erode any remaining default protection that isolation confers to remote ecosystems. Infusions of cash from tourism can also greatly amplify the impacts that local communities have on biodiversity and alter their traditional relationships with ecosystems (King and Stewart, 1996). Tourist revenues can be used by members of remote areas to procure technologies that can increase the efficiency with which goods are harvested from nature. In Tabuaeran, for example, income from tourist cruise ships provided inhabitants with the means to purchase motors for fishing canoes, gillnets, longlines, and specialized gear for shark fishing. Making tourist operations sustainable in remote settings will require that local managers use revenues to help protect the near-pristine quality of the ecosystems upon which their niche market depends – while meeting goals for regional development and investors bottom lines. This is a complicated charge in ecologically fragile and cash-starved remote places.

#### 4.5. Community planning

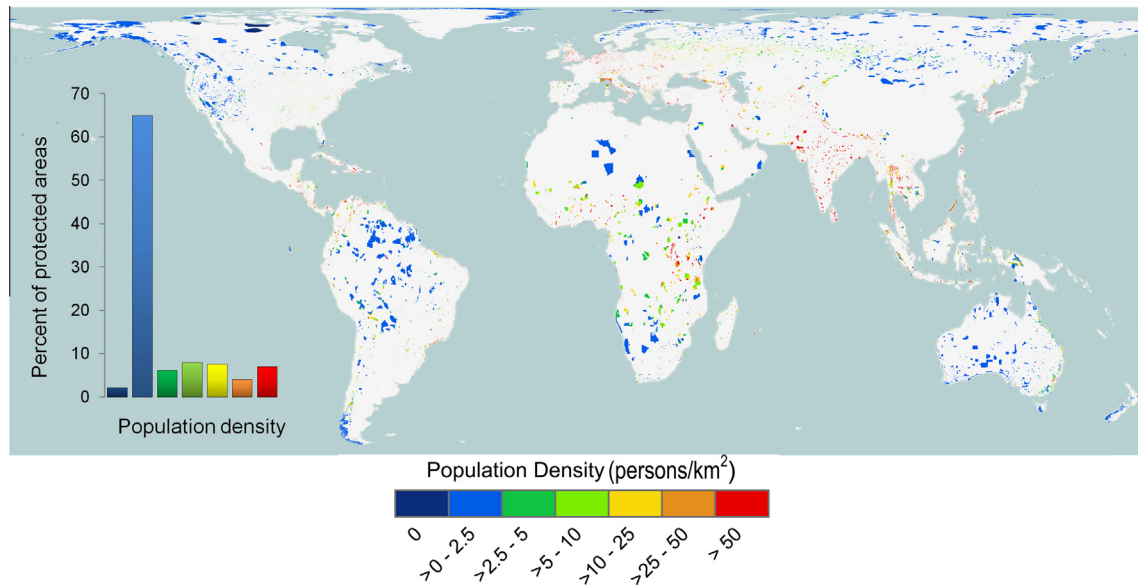
In much of the world conservation is forced to react to the existing architecture of human societies. Settlements, fields, roads, and waterways have already been built and it becomes the job of conservation to determine the best way to meld conservation strategies into and around these mosaics of development. In remote areas, however, local managers often have the unique luxury of being able to proactively anticipate and guide development – effectively using community planning as a conservation tool. Decisions made about immigration policy and settlement establishment are two areas of community planning that can dramatically affect the future of remote natural areas. The authority for guiding these actions is held by regional planning authorities, but local conservation professionals can help communicate to these leaders information about how planning decisions may influence biodiversity.

Remote areas are acutely affected by the immigration of settlers moving in from populated centers (Laurance et al., 2001). The arrival of more people into a remote area generally means a greater impact on the region's ecosystems. To protect the surviving integrity of biodiversity in isolated zones, it may be desirable to try to direct flows of immigration away from these sensitive remote regions. In Tabuaeran, immigration has played an important role in the evolving relationship between humans and this atoll ecosystem. In the 1980s and 1990s the Kiribati government managed resettlement programs that moved thousands of people to Tabuaeran and other Line Islands to relieve population pressures in western Kiribati. These programs caused Tabuaeran's population to grow about five fold (ADB, 2002; SPC, 2007). The eventual government suspension of immigration to Tabuaeran almost certainly did much to improve the possibility that its current inhabitants can forge a sustainable relationship with the environment of their atoll. In the Northern Line Islands ecological impact scales with population size (Sandin et al., 2008). Tabuaeran has more than twice the number of large predatory reef fish and 1.4 times the overall biomass of reef fish than its more populous neighbor Kiritimati Atoll (Stevenson et al., 2007). The diversion of immigration from Tabuaeran provides a good example of how strategic community planning by prescient leaders can directly affect the ecological fate of biodiversity in remote areas.

When immigrants do arrive in remote regions, quite a lot can also be done to direct the kinds of environmental impacts that they have. One obvious way to regulate these impacts is through community zoning. Because even small distances may be difficult to traverse in remote areas, concentrating settlements in one part of a remote area can insulate other parts of the region from disturbance. At Tabuaeran, zoning regulations and land allocation policies concentrated all settlement activities on the west side of the atoll, leaving the remainder of the atoll largely unsettled. Native forests, seabirds, and reef ecosystems are all less impacted on the unpopulated sides of the atoll, despite the fact that they are only a short distance away from the established villages (~6 km linear distance). These default refuges may play an important role in sustaining populations of wildlife that are important targets for local harvest. In the future, as populations in zoned areas increase, so will pressures to expand into these uninhabited regions. Upcoming zoning decisions will have an important impact on the biodiversity contained in these refuges within refuges.

## 5. Conclusion

Conservation practitioners working in remote locations are presented with a number of clear opportunities, but also face numerous roadblocks, many of which are genuinely unique to these special settings. Directly recognizing both these challenges and



**Fig. 3.** Global map of the overlap between existing protected areas and human population density. Colored regions represent the intersection between IUCN protected areas (category I–IV) and different population density classes in year 2010. Blue regions (density < 2.5 persons/km<sup>2</sup>) indicate protected places that occur in putatively more remote zones. Inset depicts percentage overlap of these protected areas with different population density categories (colors match map legend). 67% of these protected areas have a population density of less than 2.5 persons/km<sup>2</sup>. (For interpretation of references to color and a Google Earth rendering of this figure, please see Appendix A.)

benefits will increase the effectiveness of remote area conservation programs.

Is considering how best to do conservation in remote areas a consequential topic in contemporary conservation? An examination of the percentage of existing published protected areas (i.e. IUCN categories I–IV; *IUCN and UNEP, 2010*) that may be located in remote zones, as determined using population density projections as a proxy for remoteness (*CIESIN, 2005*), suggests that it is. We estimate that 67% of the world's existing protected areas occur in remote regions with a population density < 2.5 persons/km<sup>2</sup> (Antarctica excluded, owing to data deficiency; *Fig. 3*). Population density alone is only one defining metric of remoteness and more information is needed to determine how remote these protected areas truly are. Nevertheless, this substantial overlap between protected areas and regions with low population density supports the suggestion that carefully evaluating how well traditional conservation strategies work in remote contexts is an exercise that is broadly relevant to conservation practitioners. While the high degree of intersection between population density and protected areas illustrates that we are already endeavoring to protect remote places, further analysis highlights the need to intensify these efforts. By our estimations 91% of the world's least populated (< 2.5 persons/km<sup>2</sup>) areas, or about 5.8 billion hectares of land, are located outside of formally registered existing protected zones. While this figure is startling, it should be noted that the international database of protected areas that we used to conduct this analysis does not include “unofficial” community controlled conservation areas. These grass roots conservation areas can be quite important to biodiversity protection (*Western and Wright, 1994; Johannes, 2002; Bhagwat and Rutte, 2006*). Furthermore, some of the low density, putatively remote zones that we examined are likely to be located in physically harsh regions and as such are poorly suited to serve as reserves for biodiversity. Such caveats notwithstanding, these calculations suggest that there remain many remote and biodiverse areas in the world that currently receive no protection and are apt candidates for the attention of conservation.

No empirical formula can determine which of the many existing protected areas and zones targeted for future protection most

deserve the limited aid that conservation has to offer. We feel, however, that there is much reason to redouble the attention that we give to protecting some of the truly remote places left in the world. Many of the world's extremely remote sites are our last good banks of biodiversity, libraries of evolutionary information, and living museums showcasing how ecosystems develop and function when they are not dominated by humans. Successfully doing conservation in remote areas brings its own set of unique challenges that are not to be ignored: remote areas are expensive and difficult to protect, they may be more vulnerable to extinction threat, they are difficult to share with visitors, and they may not efficiently provide tangible services to humanity. Met head on though, some of these challenges can be effectively addressed.

At present, it may seem somewhat counterintuitive to intensify our efforts to conserve remote places. How can we justify sending resources to conserve nature in faraway places that few people use or visit – especially when these remote places appear to be in decent shape? The logic of protecting remote sites, at least at first glance, conflicts with emerging notions that conservation should be approached in a triage fashion, whereby limited resources should be allocated strategically to imperiled ecosystems in which threat can be efficiently and rapidly ameliorated (*Hobbs and Kristjanson, 2003; Bottrill et al., 2008*). The protection of remote places seems to have no place in the conservation triage paradigm because the sustained management of mostly intact remote sites elicits no immediate gain; i.e. our least sick ecosystems are not as deserving of our attention now as are some of our more severe eco-casualties. We, however, contend that this conflict is illusory and arises from a systemic reluctance to identify threat and measure recovery over sufficiently long time periods. We suggest that risks to these seemingly insulated remote areas are real and will manifest themselves in coming decades, if not sooner. Moderate investments of time and effort made immediately to protect these ecologically unique remote places are likely to yield important long-term gains for global biodiversity conservation. To extend the medical analogy further, protecting remote places is as prudent a strategy as is preventive medicine.

By proactively conserving remote, near-pristine ecosystems we can effectively set up a world-wide network of biodiversity

reserves whose value will only increase with time as these special places become rarer. The dwindling integrity of remote zones and the expanding reach of humanity into once remote outposts create a double imperative for acting promptly. We encourage more constructive dialogue on how to tailor conservation strategies for application in remote zones and call for action to be taken before modernity drives remoteness to extinction.

## Acknowledgements

We thank the Woods Institute for the Environment and the National Science Foundation for funding support. This represents contribution number PARC-0096 from the Palmyra Atoll Research Consortium.

## Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.biocon.2013.05.026>. These data include a Google Map version of Fig. 3.

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