Key Human Dimensions of Gaps in Global Biodiversity Conservation

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The conservation of global biodiversity increasingly relies on a network of protected areas, such as national parks and other types of reserves, to help ensure the survival of selected plant and animal species. Recent research identified gaps in this network—occurrences of key species not covered by protected areas—along with priority locations for creating new protected areas to fill the gaps. In this study we examine human demographics, land cover, and agricultural suitability in the priority gap locations to assess their potential for hosting some form of biodiversity conservation. Our results indicate that many gaps in the protected area network occur in settings conducive to conservation, characterized by limited human presence, large contiguous tracts of conservation-compatible habitat, and low agricultural potential. Detailed studies of gap locations, using local data and incorporating input from key stakeholders, will allow conservation actions that are appropriate for their human context.

Keywords: biodiversity conservation, conservation planning, gap analysis, human context, protected area

The current global loss of plant and animal species at rates 1000 or more times greater than background levels marks mass extinction of a magnitude virtually unknown in the planet's history (Pimm et al. 1995, Rosenzweig 1995). Humans and human activities are the ultimate cause of this rapid biodiversity loss, as unprecedented numbers of people compete with other species to meet growing per capita demands for land and resources (UNDP et al. 2000, McKee 2003). By the end of the 20th century, humans used about 40% of the earth's gross terrestrial primary productivity and had converted nearly one-third of the land area to urban settings and agricultural fields (Vitousek et al. 1997, UNDP et al. 2000). The Millennium Ecosystem Assessment (2005) identified continued biodiversity loss as an important contributor to the decline of key ecosystem services that humans and other species rely upon. With the human population expected to increase from 6.5 billion in early 2006 to about 9.1 billion by 2050 (United Nations 2005, US Bureau of the Census 2006), conserving Earth's remaining biological heritage and the many benefits it provides will pose an enormous challenge in coming decades.

In the face of expanding human impacts, conservationists and governments increasingly turn to protected areas, such as national parks and other types of reserves, as an effective and efficient strategy to conserve biodiversity (Brandon et al. 1998, Bruner et al. 2001, Balmford et al. 2002). But growing reliance on such areas for conservation requires that the global network of protected areas cover all species requiring protection and provide conditions necessary for their long-term survival (Pressey et al. 1993, Margules and Pressey 2000). A recent global gap analysis evaluated how well the existing network of protected areas around the world covers vertebrates with known ranges of occurrence (Rodrigues et al. 2004a, 2004b). Using data on more than 11,600 species of amphibians, freshwater turtles and tortoises, mammals, and globally threatened birds, that study compared protected areas with the geographic distributions of species to identify animals not occurring in a protected area. A major result was the identification of critical gaps in existing protection—nearly 1400 locations (corresponding to cells from the half-degree global grid used in the global gap analysis) that lie outside the protected area network (figure 1). These areas are highly irreplaceable (the species within them have restricted ranges) or highly vulnerable to the loss of biodiversity (the species within them are threatened with extinction), and thus are priorities for some sort of protection to ensure that key conservation goals are met. However, although identifying where these gaps occur is an important first step in systematic conservation planning, in a world dominated by humans, efforts to expand biodiversity conservation must consider the human context of any potential conservation location. We know where the gaps in global conservation occur, but how well would these locations support protected areas to maintain biodiversity, given key indicators of human activity or value for future human use?

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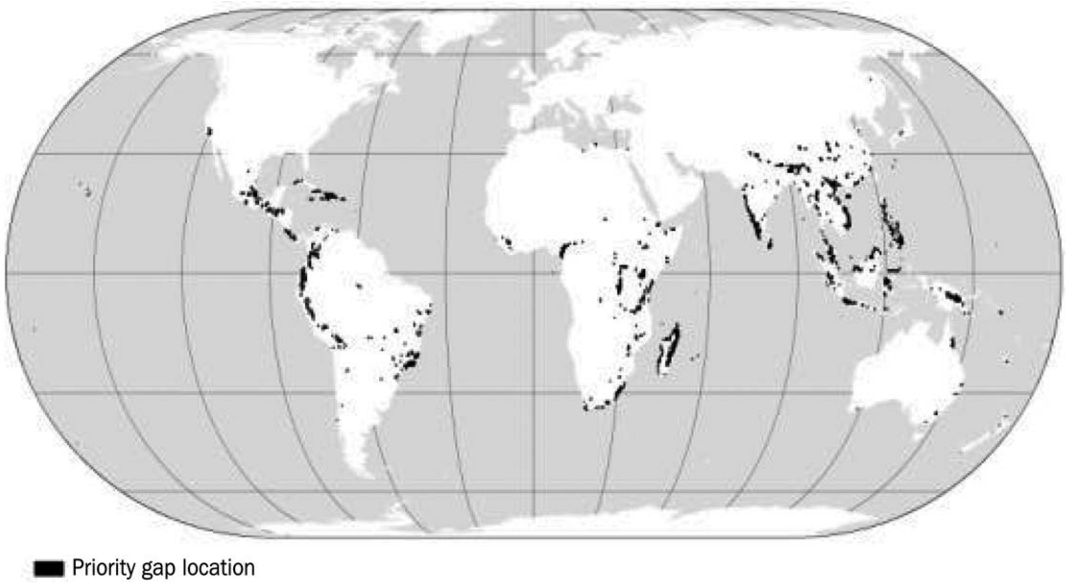

Figure 1. Global priority gap locations. Data are from Rodrigues and colleagues (2004b).

In this article, we report the results of analyzing selected human dimensions of priority locations (hereafter "gap locations") for expanding biodiversity conservation. The analysis focuses on three variables selected to understand the potential of each gap location to support long-term biodiversity conservation: (1) human demographics, (2) land use and land cover, and (3) agricultural suitability. We begin by discussing each variable briefly, focusing both on reasons for its inclusion in this study and on the data used to measure it. We then discuss the results of analyzing the gap locations in terms of these three variables, considered individually and in selected combinations. We conclude by examining the geographic arrangement of priority gap locations whose human context is conducive to biodiversity conservation, and of those whose context is not conducive to conservation, to identify any broad patterns that might help guide expansion of the global network of protected areas.

Assessing conservation feasibility in terms of human dimensions

Examining the human context of priority gap locations reveals both opportunities and challenges for conservation in those localities. Such an analysis is not without precedent. Shortly after the emergence of gap analysis in the 1980s, researchers began to call for the systematic incorporation of socioeconomic variables (Machlis et al. 1994, Forester et al. 1996). In their overview of gap analysis, Margules and Pressey (2000) noted the importance of considering socioeconomic issues in conservation planning, recognizing that economic and political considerations often compete with biodiversity for land use (see also Pressey et al. 2000). In some cases, gap analyses have included a broad range of quantifiable socioeconomic data, with types of information ranging from air quality to demographic projections, economic potential, real estate transactions, and road density (McKendry and Machlis 1993, Machlis et al. 1994, Stoms 2000, Polasky et al. 2001). In other cases, researchers have recommended using qualitative indicators to identify institutions and policies that might affect development or conservation (Angelstam et al. 2003). At a landscape scale, augmenting gap analysis with socioeconomic data helps to integrate conservation planning into the broader contexts of land-use planning (Theobald et al. 2000, Theobald 2003). Recent methodological advances make it possible (and advisable) to incorporate a broad range of socioeconomic variables during the preparation of gap analyses, defining risks and opportunities emerging from the human context that must be considered in addition to biological data in conservation decisions (McLafferty and Roghair 2003).

This article examines key aspects of the human context of global priority gap locations. Actually expanding the network of protected areas will require conservation actions based on careful analyses of local biological and socioeconomic data and consideration of local stakeholder input, which are outside the scope of the research undertaken here. However, by studying the global human context of gap locations, we can assess the overall feasibility of these locations for conservation, identifying the degree to which conditions are conducive to or will challenge conservation action. To evaluate the human context of priority gap locations, we focused on human demographics, land use and land cover, and agricultural suitability. Each of these variables provides a different, complementary perspective for evaluating a location's potential to host some type of protected area.

Human population data show the number of people who might be affected adversely by creating a reserve in a priority gap location. These data also measure possible pressure on biodiversity from people in the vicinity of a new protected area. The number of humans living in a particular location does not necessarily indicate the level of threat or of incompatibility with conservation. Although extremely dense human occupation of the sort found in urban settings tends to be inconsistent with the conservation of most species, in less dense settings often it is the *activities* of people that provide a more reliable indicator of incompatibility with conservation (Gorenflo 2002, 2006). Nevertheless, because humans are the main source of pressure on biodiversity, and because human activities are potentially disrupted by conservation action, examining population levels can provide a sense of the feasibility of expanding the protected area system.

Data on land use and land cover provide insights on human activities and habitat conditions within each priority gap location. These data help to identify any land-use patterns that might conflict with conservation, and also reveal the compatibility of existing land cover in a gap location with conservation—precisely the types of information on human impacts that cannot be extracted from demographic data alone. The capacity of a particular location to support a protected area may include its potential for habitat restoration, but we do not consider that issue here because of the lack of data, focusing instead on existing land cover as an indication of current compatibility with conservation.

Finally, data on agricultural suitability make it possible to assess the cost of restricting crop production from land in the priority gap locations (Howard 1996, Ando et al. 1998, Pimm et al. 2001, Simpson 2004). As the leading cause of habitat conversion globally (Wood et al. 2000, Millennium Ecosystem Assessment 2005), agriculture remains an enormous threat to conservation—a threat that is expected to increase markedly with anticipated growth in demand for food in coming decades (Tilman et al. 2001). Although certain agricultural practices, including agroforestry (Schroth et al. 2004), can contribute to biodiversity conservation (McNeely and Scherr 2003), for present purposes we assume that land not converted for crop production will best support biological diversity. Decisions to use a particular tract of land for agriculture typically involve considerations beyond the land's suitability for growing particular crops, such as access, land tenure, the economic systems of local peoples, and market conditions (in the case of commercial agriculture). In the absence of information on these indicators at a global scale, we rely on agricultural suitability as an indicator of agricultural value, recognizing that in certain local settings other considerations will affect the degree to which suitability reliably measures agricultural value.

The data sets used in this study had the dual requirements of global coverage (thereby encompassing all priority gap locations) and geographic referencing (enabling the systematic evaluation of all three variables in each location). To examine human population, we selected a data set called LandScan 2002, a geographically referenced estimate of global population in 2002 (Oak Ridge National Laboratory 2003). With a resolution of 30 arc seconds, LandScan 2002 provides population estimates in cells of a global grid, with each cell approximately 1 square kilometer (km) at the equator (becoming smaller toward the poles). To evaluate land cover and land use, we chose Global Land Cover 2000 (GLC2000), the result of a project sponsored by the European Commission to provide critical information on the global environment at the onset of the new millennium (Fritz et al. 2002, EC JRC 2003). Based on interpretations of global satellite imagery derived from a coordinated series of regional studies, GLC2000 also consists of a 30-arc-second grid. Each GLC2000 cell is classified as 1 of 22 land-cover types: 18 representing vegetation categories and other naturally occurring land covers (e.g., snow and ice), 3 representing agriculture or agricultural mosaics, and 1 depicting artificial surfaces (e.g., urban areas). Finally, to evaluate agricultural suitability, we used a data set generated by the Global Agro-Ecological Zones (GAEZ) assessment (Fischer et al. 2002). This project created a global database of estimated yields for various crops by matching the soil type, terrain, and climate of grid cells with productivity levels for 154 land-use types documented in places with similar characteristics. The 5-arc-minute grid generated by the GAEZ assessment (about 9 km^2 at the equator, becoming smaller toward the poles) contains measures of agricultural suitability, assigned to eight categories based on estimated productivity levels as a percentage of maximum observed yields for a given crop. For the analysis described below, we considered GAEZ results for two cropping scenarios: (1) intermediate input (best-case subsistence), which included limited mechanization and some use of chemical pesticides and fertilizers; and (2) high input (commercial production), which assumed high mechanization, improved crop varieties, and optimal application of chemical pesticides and fertilizers (see Gorenflo and Brandon 2005).

For varying reasons, we did not include in this study other human variables known to play an important role in conservation. For example, roads provide a key means of access for colonization, timber extraction, agricultural expansion, and other forms of land use that can substantially reduce the potential of a particular location to support conservation (Wilkie et al. 2000, Gucinski et al. 2001). Extraction of resources such as minerals, oil, and gas can adversely affect habitat and thus have a major influence on conservation potential (Miranda et al. 2003). Market conditions can greatly influence land-use patterns, providing the economic impetus for activities inconsistent with maintaining biodiversity (Sunderlin et al. 2000, Curran et al. 2004). Certain types of governance are essential to implementing conservation actions, both in enacting conservation legislation and in enforcing it (Barrett et al. 2001). People often show an attachment to places for a variety of reasons that are not necessarily tied to economic considerations (Tuan 2001), which may cause them to reject conservation or promote it, depending on the nature of that attachment (Zimmerman et al. 2001). Unfortunately, data on roads and extraction patterns are not available in global databases of sufficient quality to support an evaluation of all priority gap locations. In addition, market conditions change frequently and thus have varying impacts on particular gap locations over time. Data on governance and institutional capacity, and on emotional and spiritual attachments with particular locations, are likewise unavailable globally, and the use of the latter information is further complicated by its inherently subjective nature. Our focus on human demographics, land use and land cover, and agricultural suitability reflects both the importance of these variables and the availability of adequate global data to enable their inclusion in a study of priority gap locations. Other information on local governance, civil society, and cultural attachments to particular locations play an important role in more geographically focused analyses that must precede conservation actions.

Measuring the human dimensions of gaps in global biodiversity conservation

Using GIS (geographic information system) technology, we overlaid digital maps of the three variables listed above on the map of priority gap locations to assess the human context of each locality. Simpler analyses involved examining a single variable—for instance, calculating population density for each gap location. More complex analyses involved examining combinations of variables—for example, calculating the amount of each gap location that featured large tracts of contiguous conservation-compatible habitat with low population density. We used simple overlay analyses to examine human population, global land cover, and agricultural suitability (for subsistence and commercial agriculture scenarios) individually. We used more complex overlay analyses to examine multiple human dimensions simultaneously in various combinations.

Calculating human population in priority gap locations shows how many people the creation of a protected area would directly affect and provides a general measure of potential threat to a new protected area. Although the impact of protected areas on local populations varies, concern persists that such areas adversely affect the poor (Sanderson and Redford 2003, Adams et al. 2004). Priority gap cells with sparse settlement, or containing large tracts of land with sparse settlement, would affect fewer people and hence would be desirable locations for new reserves. As noted above, potential threat to a protected area is more accurately reflected by human activity (which we address under land use and land cover) than by population alone. Nonetheless, researchers consider human population to be the source of most threats to biodiversity (Balmford et al. 2001, Harcourt et al. 2001, Gorenflo 2002, Parks and Harcourt 2002). Studies have yet to define a clear threshold of population density beyond which biodiversity declines markedly. Relatively sparse human settlement involving certain activities, such as systematic hunting or commercial agriculture, can lead to high loss of biodiversity (Robinson and Bennett 2000, Gorenflo 2006). Previous research proposed that adverse impacts to biodiversity occur at densities of 10 or more people per km^2 (Sanderson et al. 2002). This contention is borne out empirically in at least one particularly fragile arid setting (Gorenflo 2006), and we use that density here, both as a threshold of settlement below which substantial human threats to biodiversity decline markedly and as a level of human presence at which creating a protected area would affect few local people.

Although only about 16% of the gap locations had overall population densities of fewer than 10 people per km^2, 75% of those locations contained contiguous tracts 10,000 hectares (ha) or larger (table 1) with such sparse human occupation. Such large tracts of sparsely settled land potentially could support conventional protected areas managed primarily for biodiversity conservation, as well as other forms of management potentially compatible with conservation, such as indigenous or private reserves that involve the people whose presence has enabled the survival of key species in these localities. Moreover, because creating protected areas on sparsely settled land would affect relatively few people, impacts could be minimized through reserve design, management strategies, or compensation that effectively mitigates any adverse impacts. In addition to these types of approaches, conservation in priority gap locations lacking large tracts of sparsely settled land will require strategies that integrate biodiversity conservation actions with human livelihoods, or conservation concessions that provide direct incentives to local people to maintain habitat and faunal assemblages intact.

Analyzing land cover in priority gap locations indicates whether the conditions in each are compatible with biodiversity conservation. We considered any land cover showing evidence of human modification or use, including agriculture (intensive agriculture as well as mosaics of crops and other plants) and artificial surfaces, to represent habitat incompatible with conservation. This analytical approach yielded conservative estimates of conservation-compatible habitat in each gap location. Many species can tolerate the disturbed habitat that our evaluation excludes, particularly mosaics of natural habitat and crops. This tolerance helps to compensate for likely overestimates of conservation-compatible habitat due to certain inadequacies in the land-cover data set, such as the lack of distinction between tree crops and natural forest.

Most gap locations contain large amounts of conservation-compatible habitat (see table 1). However, because total compatible habitat may include fragmented tracts interspersed with converted habitat, we also calculated the size of the largest *contiguous* tracts of conservation-compatible habitat in each priority gap cell. More than 83% of all gap locations contained contiguous tracts of conservation-compatible habitat in excess of 10,000 ha—a size that research has shown allows the survival of many species (Terborgh and van Schaik 1997)—while 47% contained contiguous tracts of such habitat 100,000 ha or larger. In addition, 61% of the gap locations featured contiguous tracts of conservation-compatible habitat 10,000 ha or larger with a population density of fewer than 10 people per km^2, marking localities where conservation actions could involve large blocks of compatible habitat and affect few people.

Table 1. Selected human dimensions and size of priority gap locations.

Location characteristics	Number	Size of area: More than 100,000 hectares (%)	Between 10,000 and 100,000 hectares (%)	Less than 10,000 hectares (%)
Largest contiguous tracts with population density of fewer than 10 people per km^2	1396	30.5	44.1	25.4
Total conservation-compatible habitat	1396	59.4	31.4	9.2
Largest contiguous tracts of conservation-compatible habitat	1396	47.2	36.1	16.7
Largest contiguous tracts of conservation-compatible habitat with population density of fewer than 10 people per km^2	1396	20.1	41.0	38.9

Analyzing the agricultural suitability of priority gap locations measures the impact of restricting agriculture from potential new locations of biodiversity conservation. We considered six different crops or groups of crops (cereals, cotton [as a surrogate for fiber crops], oil crops, pulses, roots and tubers, and sugar crops; see Fischer et al. 2002), but assumed maximum suitability under both the subsistence and the commercial cropping scenarios (for each grid cell, choosing the highest suitability category for all crops considered). Despite this assumption, results indicate that priority gap locations tend to be poorly suited for agriculture. Under subsistence production, mean agricultural suitability for 52% of the gap locations fell into one of the three lowest categories defined by the GAEZ assessment (unsuitable, very marginal, and marginal; table 2). In contrast, no priority gap locations received a suitability rating of very high, and less than 3% received a high rating. Our analysis of commercial production indicated only slightly greater agricultural suitability than the subsistence scenario. Growing crops in most gap locations most likely would not only fail to meet high human food demands but also lead to subsequent agricultural expansion in order to generate desirable yields, and thus could result in the further loss of species (Green et al. 2005).

By examining agricultural suitability of priority conservation gaps containing 10,000 ha or more of contiguous conservation-compatible land, we focused on places not yet converted to crop production, providing a measure of both the financial and the social costs of restricting agriculture in these choice locations for conservation (table 2). Under subsistence production, nearly 57% of the gap locations with large contiguous tracts of conservation-compatible habitat registered mean agricultural suitability in the three lowest categories, in contrast to slightly more than 2% in the two most productive categories. These figures amount to about 47% and slightly less than 2% of all gap locations, respectively. Under the commercial cropping scenario, roughly 53% of gap locations with large tracts of conservation-compatible habitat (about 44% of all gap locations) fell into the two lowest suitability categories, compared with about 6% (less than 5% of all gap locations) in the two most productive categories. Adding the further constraint of low population density yielded similar results. Under the subsistence crop production scenario, 65% of the gap locations with large tracts of conservation-compatible habitat inhabited by fewer than 10 people per km^2 (39% of all gap locations) had mean agricultural suitability in the three lowest categories, compared with about 2% (roughly 1% of all gap locations) of locations with mean suitability in the top two categories. Under commercial cropping, mean agricultural suitability for 66% of the gap locations (40% of all gap locations) with large contiguous tracts of conservation-compatible habitat that feature low population density fell into the three lowest categories, compared with about 5% (3% of all gap locations) in the two top categories.

The human context of priority gap locations varies in broad geographic terms, with certain categories of locations more conducive to biodiversity conservation than others. Overall, priority gap locations occur disproportionately in the tropics, on islands, and in mountainous areas (figure 1; Rodrigues et al. 2004b). Adding the requirement of large contiguous tracts of conservation-compatible habitat has little effect on the original distribution, as most gap locations feature contiguous tracts of such habitat that are 10,000 ha or larger (figure 2a). But adding the constraint of sparse population density to large tracts of conservation-compatible habitat does affect the geographic arrangement of gap locations—in particular, excluding many gap locations in coastal areas and in several island locations, such as Hispaniola, Indonesia, Jamaica, the Philippines, Puerto Rico, and Sri Lanka (figure 2b). Introducing the additional constraint of low agricultural suitability to large tracts of conservation-compatible habitat and sparse settlement excludes more island territory, selected portions of the Andes, central Mexico, central and southern Brazil, and West and East Africa (figure 2c, 2d).

The maps in figure 2 show that the greatest opportunities for expanding the current global network of protected areas to fill priority gaps in biodiversity conservation tend to occur in the tropics on larger landmasses, in noncoastal locations that often occur in mountains. In these settings, creating and managing protected areas designed primarily for biodiversity conservation may be an appropriate strategy. Addressing the gaps on smaller islands and in coastal locations, by contrast, is likely to pose greater challenges. Because of a relatively dense existing human population, land cover or land use that is incompatible with biodiversity, land that is valu-

Table 2. Suitability of selected priority gap locations for subsistence and commercial agriculture.

		Mean agricultural suitability (percentage of area)							
Characteristics	Number	Very high	High	Good	Medium	Moderate	Marginal	Very marginal	Unsuitable
All gap locations, subsistence agriculture	1396	0.0	2.7	6.5	13.8	24.7	34.5	11.0	6.8
All gap locations, commercial agriculture	1396	0.2	7.6	8.7	13.8	23.0	29.3	11.7	5.8
Gap locations with large conservation-compatible tracts, subsistence agriculture[a]	1154	0.1	2.1	5.1	12.3	23.9	40.8	11.3	4.4
Gap locations with large conservation-compatible tracts, commercial agriculture[a]	1154	0.2	5.7	6.3	12.0	23.1	37.1	12.4	3.2
Gap locations with large conservation-compatible, low population density tracts, subsistence agriculture[b]	847	0.0	2.1	3.5	7.2	22.2	45.7	13.5	5.8
Gap locations with large conservation-compatible, low population density tracts, commercial agriculture[b]	847	0.2	5.1	3.4	7.0	18.5	45.5	15.8	4.5

Note: Agricultural suitability categories are based on the estimated yield of a particular crop under a given agricultural scenario, as a percentage of the maximum observed yield for that same crop under the same scenario. Suitability categories are as follows: very high (> 85% of maximum yield), high (70%–85%), good (55%–70%), medium (40%–55%), moderate (25%–40%), marginal (5%–25%), very marginal (0%–5%), and unsuitable.

a. Large tracts are defined as contiguous tracts 10,000 ha or larger. Of the total gap locations, 1154 meet this criterion, and percentages shown in the associated row refer to this subset.

b. Low population density is defined as fewer than 10 people per square kilometer. Of the total gap locations, 847 meet the criteria for large tracts with low population density, and percentages shown in the associated row refer to this subset.

able for crop production, or some combination of these factors, conservationists will have to propose a variety of conservation actions. These actions will vary from species-based pride and awareness campaigns, to conservation incentive agreements with local people to maintain species or their habitat, to community-conserved areas that receive international support.

Conclusions

To conserve global biodiversity in the face of growing threats and with limited time and resources, conservationists must prioritize their efforts. Increasingly, conservation of the world's plant and animal species relies on a network of protected areas that provide the conditions necessary for these species' survival. The global gap analysis identified inadequacies in the existing protected area network and priority locations for expanding biodiversity conservation. But the feasibility of conserving biodiversity in those locations largely depends on their human context. To assess the challenge of conservation actions to fill priority gaps, such as creating protected areas, we examined selected human dimensions of each gap location. In a world dominated by people, effective protected areas for biodiversity conservation will require that each be created and appropriately managed, given the site-specific context of human presence and use (Brandon 2002).

Our findings indicate that the human context of priority gap locations often is conducive to conservation. This result is encouraging, although in some ways unexpected. Studies at several different geographic scales indicate that human settlement is disproportionately associated with areas of high biological value (Balmford et al. 2001, Dobson et al. 2001, Arújo 2003, Luck et al. 2004). In contrast, our analysis indicates that nearly three-quarters of the priority gap locations include large tracts of sparsely settled land. The global gap analysis used threatened status as one of its criteria for identifying gap species. Yet our analysis found that the majority of gap locations did not feature high levels of anthropogenic threat, at least in the form of human population or habitat incompatible with conservation. In locations where threat is a defining criterion, such unexpected results most likely indicate situations where threats were greater in specific parts of species' range, while other parts remained free of dense human occupation and converted habitat.

For other priority gap locations, our analysis identifies a human context that one might anticipate for localities containing threatened vertebrates: denser human occupation, limited areas of conservation-compatible habitat, valuable agricultural land, or some combination of the three. These less suitable locations for conservation represent areas where conservation actions, such as creating a new reserve, will be more difficult; where actions will have to incorporate human use; and where many conservation strategies may well experience considerable future pressure. It is in these types

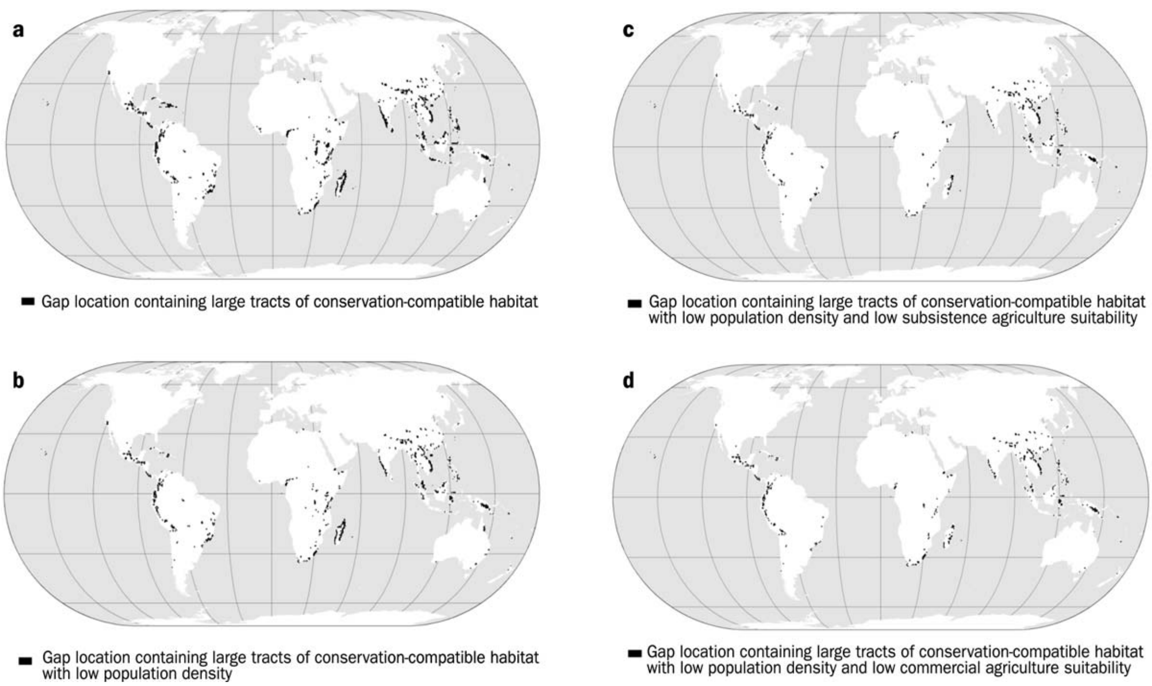

Figure 2. Global priority gap locations with selected characteristics: (a) contiguous tracts of conservation-compatible habitat 10,000 hectares (ha) or larger, (b) contiguous tracts of conservation-compatible habitat 10,000 ha or larger with a population density of fewer than 10 people per square kilometer (km^2), (c) contiguous tracts of conservation-compatible habitat 10,000 ha or larger with a population density of fewer than 10 people per km^2 and low suitability for subsistence agriculture, and (d) contiguous tracts of conservation-compatible habitat 10,000 ha or larger with a population density of fewer than 10 people per km^2 and low suitability for commercial agriculture.

of settings that expanding the global network of protected areas will face its greatest challenges.

In maintaining a global scope, this study incorporated certain simplifications. We focused on three variables to characterize the human context of gap locations, bypassing other human dimensions of biodiversity. Lack of adequate data on these other variables at a global scale precluded their consideration in our analysis, though the potential effects of accessibility, key natural resources, changing market conditions, governance, and cultural diversity on conservation feasibility are often critical. Moreover, our analysis is static and cannot incorporate the inherently dynamic nature of human settlement and activity. Projections of both population and agricultural land use exist (Scharlemann et al. 2004, CIESIN 2005). However, because these projection horizons are separated by more than three decades, incorporate several different scenarios (in the case of the agricultural projections), and attempt to encompass many complex processes at a global scale, we decided to maintain a focus on current data and the current potential of priority gap locations to support protected areas.

In a rapidly changing world experiencing both substantial population growth and increasing per capita demand for land and resources, biological diversity will continue to decline without explicit steps guided by systematic conservation planning to maintain the plant and animal species that remain. Areas established at least in part to conserve biodiversity are one such step, but they must be placed strategically both with respect to conservation targets and with respect to the human environments where they occur. More geographically focused analyses, employing higher-resolution data and involving local stakeholders in crucial decisions, will enable evaluations of the economic, cultural, and spiritual value of any tract identified for a potential protected area. Timely action can enable the expansion of biodiversity conservation actions, using approaches that are compatible with existing settlement, current land use, and potential agricultural expansion.

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