Delineating boundaries for sites identified using the new standard

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1. INTRODUCTION

1.1 Key Biodiversity Areas: definition, background and consultation process

Biodiversity loss is a grave and irreversible threat. Protecting sites of exceptional importance to biodiversity has been highlighted through numerous international conventions and frameworks as one key means of preventing further global biodiversity loss. Most recently, the Aichi Targets of the Convention on Biological Diversity highlight the need for expanded protected area coverage to support biodiversity, particularly through the opening clause of Target 11 (http://www.cbd.int/sp/targets/):

> "By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity…"

Key Biodiversity Areas, defined as sites of global significance for biodiversity conservation, represent targets for the expansion of protected area networks (Eken et al, 2004). Key Biodiversity Areas (KBAs) are identified based on the presence of globally threatened or geographically restricted species, globally-significant congregations of species, and biome-restricted species that benefit from habitat conservation at the site scale, though to date most KBAs have been triggered by globally-threatened and restricted-range species. The KBA approach uses globally standard criteria and thresholds, based on vulnerability and irreplaceability. BirdLife International developed the concept of KBAs in the late 1980s, applying it to birds. BirdLife and partner organizations worked on identifying, conserving, and monitoring the status of biodiversity in Important Bird Areas (IBAs). Several other organizations later expanded this approach to other taxonomic groups, including plants and butterflies, as well as through the establishment of the Alliance for Zero Extinction. In 2004, the concept was expanded to include all species through a workshop and publication (Eken et al, 2004), and much subsequent work included the identification of sites for all birds, mammals, and amphibians, as well as other groups, with mechanisms like the Critical Ecosystem Partnership Fund using this work as a basis for its Ecosystem Profile strategies.

In 2007, the best available information on KBAs was consolidated as one component of a set of guidelines in a volume of IUCN Protected Areas Guidelines (Langhammer et al, 2007). This document set out detailed guidelines on using a bottom-up approach to identifying, delineating, and prioritizing amongst KBAs. Its aim was both to set out practical guidelines for KBA identification in any region and to provide a basis for gap analyses that would identify candidates for the expansion of protected area networks. While the primary focus of the document was on terrestrial sites, the authors address the applicability of the approach to freshwater and marine ecosystems. In the foreword, Ibrahim Thiaw, then Acting Director General of IUCN, stated, "I am sure that the process and standards for identifying Key Biodiversity Areas will evolve over time, with input from the Species Survival Commission, the World Commission on Protected Areas, and numerous other stakeholders."

In the years since the publication of these guidelines, much work has occurred in various parts of the world, both on bottom-up KBA identification, but also on testing KBA thresholds and criteria, especially the marine and freshwater ecosystems. To take advantage of these advances and to move towards the development of consolidated criteria and standards around the identification of KBAs, the IUCN Species Survival Commission and the World Commission on Protected Areas convened a joint taskforce on 'Biodiversity and Protected Areas' in late 2009 (http://www.iucn.org/biodiversity_and_protected_areas_taskforce).

A primary objective of this taskforce is to solicit wide stakeholder input to gain consensus around standards and criteria for the identification of areas identified using the new standard, and to place this process under the umbrella of IUCN. As such, in June 2012 a framing workshop, "Consolidating the standards for identifying sites that contribute significantly to the global persistence of biodiversity," was organized. A series of technical consultation workshops focusing on specific topics related to areas identified using the new standard will follow the framing workshop. These are: 1) thresholds to identify areas significant to the global persistence of biodiversity; 2) end users and application; 3) criteria and delineation; and 4) governance of the process for identifying these areas.

1.2 Purpose of option paper on the delineation of biodiversity sites

This paper is meant to provide the necessary background for participants of the criteria and delineation working group. Along with several key publications cited here, this document should serve as a basis for discussion during the consultation workshop. It summarizes factors that should be considered when undertaking the delineation of areas identified using the new standard, and presents potential approaches to delineation based on past analyses undertaken in various parts of the world, in terrestrial, marine, and freshwater ecosystems.

This paper addresses the delineation of areas identified using the new standard based on the confirmed presence of target (or "trigger") species and, potentially, ecosystems. Questions regarding global standards around criteria and thresholds for site identification are discussed in a separate paper. The identification of these sites is usually undertaken at a national or subnational scale, though there are cases where a site identification analysis is carried out for a multinational region. This is especially true for freshwater systems, which are often transboundary by nature and benefit from multinational conservation approaches.

1.3 Delineation of areas identified using the new standard

The importance of identifying site targets for biodiversity conservation is clear. Perhaps less clear is the need for a precise line around, or delineation of, such sites. Any act of drawing boundaries can be contentious and politicized. In the case of KBAs, sites must by definition be ecologically derived (in terms of their triggers) and currently or potentially managed for conservation (Langhammer et al, 2007). An older definition provided by Grimmett and Jones (1989) for IBAs provides some details relevant for site delineation. According to their definition, priority sites should, as far as possible, 1) be different in character, habitat or conservation importance from the surrounding area; 2) exist as an actual or potential protected area, or be an area that can be managed in some way for nature conservation; and 3) alone or with other sites, be a self-sufficient area which provides all the requirements of target species during the time they are present. Several other definitions exist in the literature, but most utilize very similar language.

While some ecological units are clearly defined, such as catchments, the requirements of ecological derivation and sufficiency and manageability for conservation can be interpreted in numerous ways. The combination of the two often leads to confusion or dispute regarding exactly what "ecologically derived" and "manageable" refer to. Each of these terms will be discussed in more detail below.

Beyond the primary definition of site delineation, a number of additional factors must be considered. If boundaries are drawn at all, how precise should they be? Who should undertake site delineation, and when? How do you ensure transparency and repeatability across multiple sites and different contexts? The answers to all of these questions depend on the scale of the region of analysis, data quality and availability, the time-frame of the analysis, the expertise and background of those undertaking the work, and the local sociopolitical context. Each of these considerations and their implications for delineation will be discussed below.

It will not be possible to reach consensus on a single standardized delineation process to be applied in all geographies across the globe. Perhaps more than any other aspect of a site identification analysis, delineation must be context-dependent. Thus, it may be possible to reach agreement on a set of general steps or guidelines. These steps would provide a broad outline for site delineation. Within this framework, the specific delineation decisions would then vary based on the local context.

2. WHY DELINEATE SITES?

2.1 Potential disadvantages of site boundaries

The first question surrounding delineation becomes whether boundaries are needed at all for sites that contribute significantly to the global persistence of biodiversity. Some would argue that once a line is drawn, it becomes difficult to modify this boundary in the future, even if it is later found to be inaccurate. This is also a concern given climate change-induced species range shifts. Defined boundaries may suggest that all other areas are less important, or that all remaining areas should be opened for development. Also, boundaries are often themselves the source of conflict, especially where land tenure is contested; boundary delineation can in such cases be equated with taking a particular side in a dispute. In still other cases, needed data may not exist to suggest a way forward with delineation, or obtaining necessary data might be costly or time-consuming to the point that valuable resources are taken away from conservation activities on the ground.

2.2 Advantages of delineating sites

The absence of boundaries can also be problematic. Since people find delineated areas easier to understand as places, it will in most cases be difficult for governments, corporations, and others making development decisions to ignore site priorities with defined boundaries. Delineated sites are easier to take into account when planning new protected areas, biodiversity offsets, identifying sensitive areas to avoid in moving forward with mining projects, and so on. Bounded areas are also required for conducting protected area gap analysis, site prioritization exercises, and calculating whether percentage area targets under national or international law and policy instruments have been met. Delineated sites also set a baseline for monitoring and valuation (assessing change in habitat cover, carbon stock, etc.), whether conducted at a sub-national, national, or global scale.

Another advantage of delineation is that it provides a basis for improvement and refinement over time through input from scientists, policy-makers, indigenous groups, and other stakeholders. Sites with points or imprecise boundaries are not as straightforward for most stakeholders to conceptualize and discuss.

3. CONSIDERATIONS IN DELINEATING PRECISE BOUNDARIES

3.1 Potential approaches to delineation

If we decide that site boundaries are indeed necessary for effective resource investment and biodiversity conservation, then what form should these boundaries take, and what should they be based on? As discussed above, sites identified using the new standard must be ecologically sensible and manageable as single units. Sites must be ecologically sensible so that the sites can conserve the species in question, while they also need to be manageable from a political context because without such manageability, it will be hard for local, national, or regional actors to administer sites. In practice, given multiple and often conflicting needs and data layers, where the delineation of a site should lie on the continuum from the ecological needs of the target species to the sociopolitical needs on the ground has been context-dependent. Factors influencing delineation decisions fall into three main categories that relate to: 1) ecology and habitat, 2) the presence of pre-existing KBAs, and 3) political context and management needs. The importance assigned to each of these categories has varied from region to region, and based on the organizations leading the analysis. One or more consultation workshops or informal meetings with scientists, government officials, and other stakeholders often provide additional context and data to inform delineation. In this manner, preliminary delineation might be modified by lumping or splitting sites, or modifying boundaries.

Additionally, site identification analysis overall is an iterative process, with the number of sites and their boundaries being modified time as better data are incorporated. The goal of each iteration is to produce more precise and accurate boundaries based on stakeholder input, survey and monitoring data, remote sensing data, and other means. Such refinement could be undertaken for the entire region that was the focus of the original analysis, or on a site-by-site basis based on investment patterns and funding availability.

3.2 Boundaries based on ecological, land-use, and habitat data

Within the category of ecologically derived boundaries, there are a number of considerations. These include habitat integrity and continuity, the existence of bounded natural features, or habitat specificity of target species (altitudinal range, specific habitat conditions, biome, etc).

Many IBAs and KBAs globally have been derived primarily based on such ecologically derived boundaries (Figure 1). In the absence of management data, for example in wilderness regions that lack clearly-defined management areas, or in areas of highly complex, fine scale management, ecologically derived boundaries may be the best option for delineation.

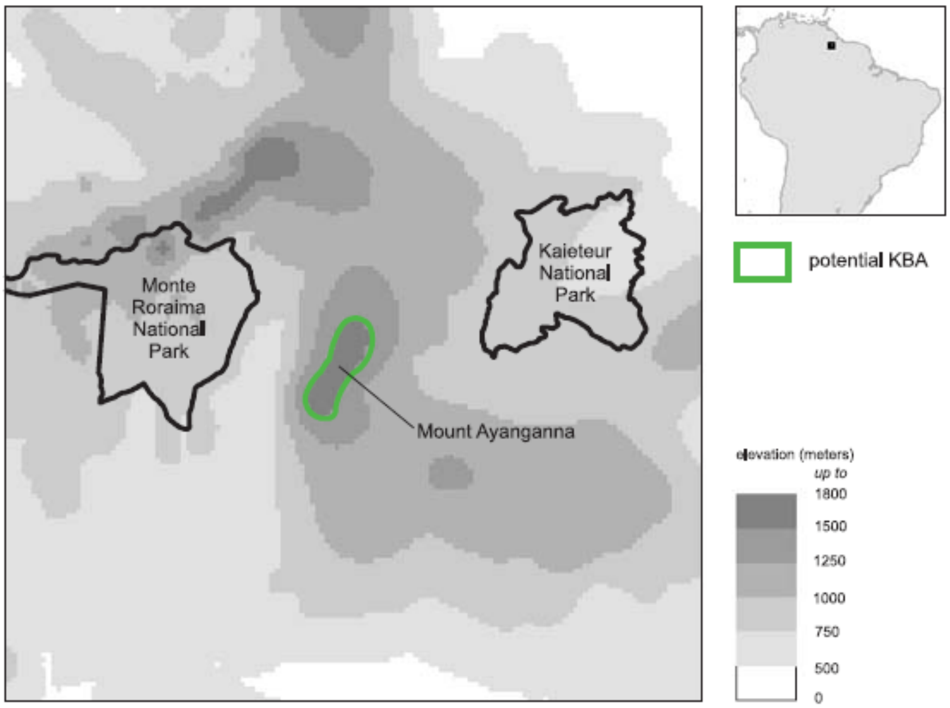

Figure 1. In Guyana, three species of vulnerable amphibians with restricted ranges, *Stephania coxi, S. ackawaio, S.ayangannae*, occur only on Mount Ayanganna above 1,490m (Macculloch and Lathrop 2002). The contour line demarcating 1,490 m, shown in dark green, was used to delineate a KBA for these species. When using altitude to delineate sites, it is important to also consider other ecological boundaries, such as catchment borders. This delineation assumes that this KBA is potentially manageable for conservation. From Langhammer et al, 2007.

Where habitat is fragmented or topographic or other natural landscape variation provides delimited areas of suitable habitat, delineation may be straightforward, with remaining intact habitat comprising the site In highly fragmented areas, the boundaries of KBAs delineated outside of existing protected areas have frequently been delineated along the small fragments of native cover that remain (Figure 2).

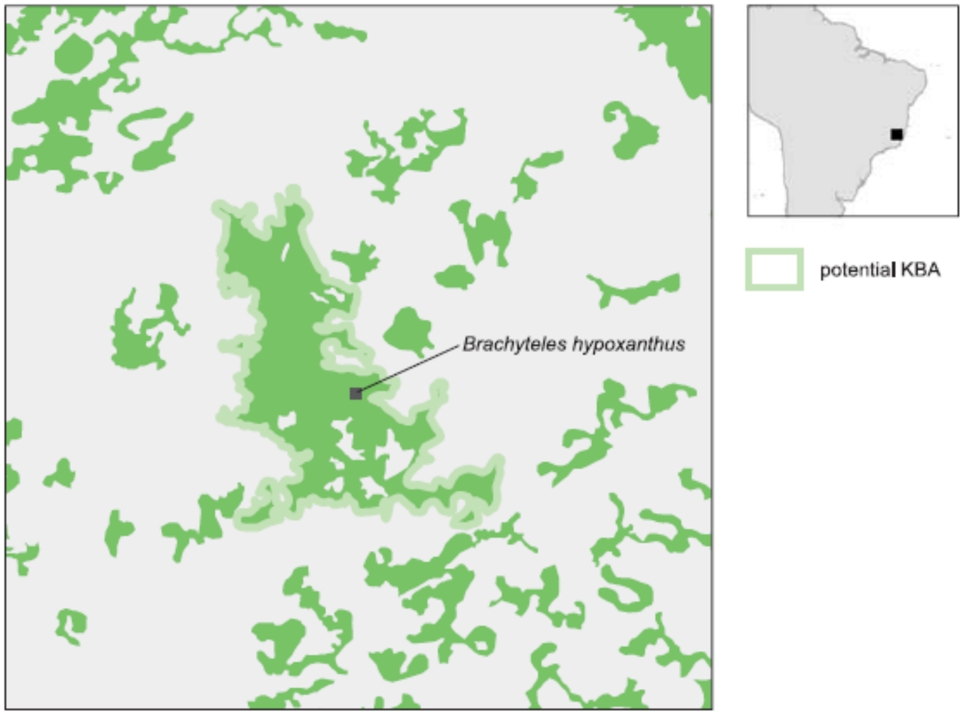

Figure 2. This point locality for Northern Muriqui *Brachyteles hypoxanthus,* depicted by the black square, is within a forest fragment in the Atlantic Forest of Brazil. The KBA, shown with the light green line, was delineated to follow the borders of that fragment. From Langhammer et al, 2007.

Delineating sites in wildernesses, on the other hand, presents several additional challenges. Low biodiversity survey effort in these often remote areas mean that biological data are sparse, and the difficulty of accessing these areas can result in data that are biased geographically toward access routes such as roads and rivers. In addition, wilderness areas present extensive tracts of intact habitat and biophysical homogeneity, which can make delineation along geographical boundaries difficult. Formal land management structures may be lacking, which precludes delineation along existing management boundaries (see Figure 1). The greater ecological and socioeconomic uniformity of wilderness areas can result in the delineation of larger sites than are found in more threatened areas. Despite these challenges, delineating areas in wildernesses provides an opportunity for proactive conservation by protecting the most important sites for biodiversity conservation before threats to these areas intensify and more habitat and species are lost (Upgren et al, 2009).

3.3 Boundaries based on pre-existing KBA boundaries

A major consideration for delineation involves the existence of one or more types of pre-existing KBA boundaries in the vicinity (Important Bird Areas, Important Plant Areas, and so on). In many cases, multi-taxonomic site boundaries can simply follow boundaries of pre-existing KBAs, which were themselves based on protected area boundaries, habitat patches, or other clearly demarcated areas. In other cases, range or habitat requirements of additional target species may require either the expansion of pre-existing KBA boundaries or the delineation of two or more adjacent sites (depending on political context, as described below) (Figure 3). In still other cases, there may be multiple pre-existing KBAs with overlapping boundaries, which would necessitate cross-walking conflicting delineation. Finally, pre-existing KBAs may be so much larger or smaller than needed for additional target species that site boundaries cannot be merged, but rather need to be maintained separately (at least in the short term).

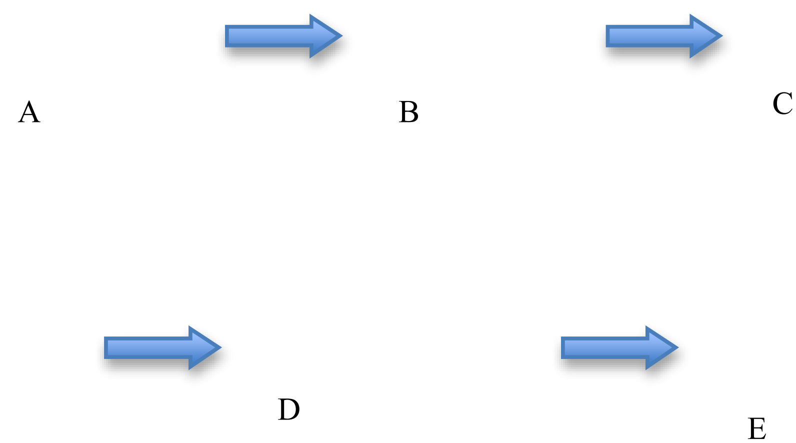

Figure 3. A fictional IBA (A) was triggered by a globally-threatened bird. When KBAs were identified for the landscape, a site identified for a globally-threatened amphibian overlapped with the IBA (B, in red), and the two areas were merged into a single site that was manageable as a single unit (C). Five years later, an additional site was identified for the amphibian based on new data (D, in red). Because it did not overlap with the existing KBA, and because it was manageable as a unique site, the area triggered by new data became a new site (E).

3.4 Boundaries based on political context and management data

Similarly, political context refers to a number of factors, including the existence and utility of protected area boundaries, the importance of political boundaries, and the clarity of land tenure.

3.4.1 Protected Areas

The first of these involves the existence and utility of protected area boundaries for conservation. In many countries, protected areas are the primary tool in meeting biodiversity conservation goals. As a result, in many cases, sites identified using the new standard which align with protected areas will simply follow existing protected area boundaries (Figure 4). Though a large protected area may only have a key frog in one tiny pond in it, the protected area may be the management unit at which level conservation action will be funded, planned and permitted, in which case it is an appropriate conservation site.

Figure 4. The KBA boundary for the Mt. Isarog KBA in the Philippines is identical to the previously defined protected area, Mt. Isarog Natural Park, since all point locality and the majority of distribution data for the trigger species fall within the protected area. From Langhammer et al, 2007.

This practice becomes more complicated where there are multiple overlapping types of protected areas. For instance, the Wollemi Pine (*Wollemia nobilis,* CR) is an Alliance for Zero Extinction (AZE) trigger species (a species that leads to the identification of a conservation site) restricted to Wollemi National Park in Australia. However, Wollemi National Park and 6 other nearby national parks fall within the Blue Mountains World Heritage Area. Both are management units and confer a level of protection. In this case, the national park boundary was used for delineating the AZE site, since it contains the entire range of the AZE species and confers a high degree of protection. However, in other cases, overlapping parks, forest reserves, wildlife management areas, and other units can result in confusion regarding which management units are most appropriate, or can be inadequate for conserving the species in question. General practice in site delineation has been to use the protected area type that confers the most restrictive level of management (according to the IUCN protected area categories, for instance), or the set of boundaries that are most recent or most precise. Another option is to select a protected area that provides the most effective protection for the species of concern. In some cases, this requires consultation with government agencies or a site-by-site approach. For instance, during a KBA analysis in Sumatra, slightly different protected area boundaries were provided by two national government agencies that each had some authority over those protected areas.

Where the expansion of existing protected areas is more likely than the creation of new ones, the delineation of sites identified using the new standard might include a combination of a protected area and adjacent suitable habitat (Figure 5).

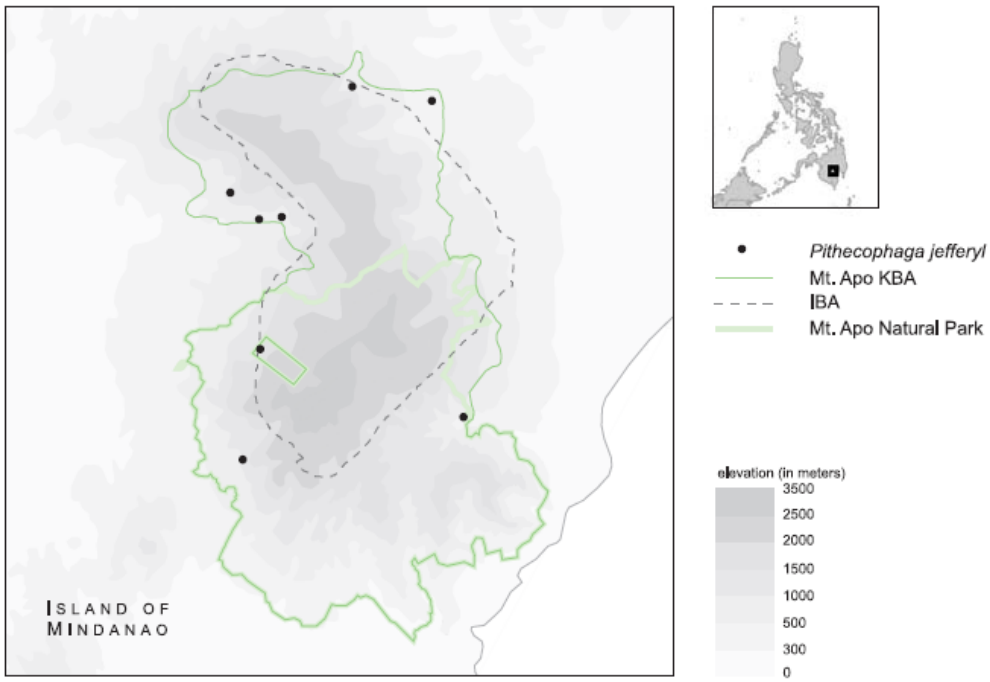

Figure 5. The inclusion of new data on Philippine Eagle *Pithecophaga jefferyi* nesting sites resulted in the expansion of the Mt. Apo KBA in the Philippines beyond the boundaries of the existing IBA and protected area. From Langhammer et al. 2007.

<u>3.4.2 Political boundaries</u>

Beyond protected areas, we need to consider the importance of political boundaries in conservation management. Again, context matters, and the consideration of political boundaries might be limited to national boundaries, or might include provincial boundaries or even local government units such as counties.

In general, past KBA analyses have avoided the delineation of transnational KBAs. For example, Mt. Nimba, which is intersected by Guinea, Côte d'Ivoire, and Liberia, was identified as three separate KBAs, one per country, to allow for management by each nation. Management across national boundaries is always complicated, though there are a few instances where the delineation of transboundary sites might be sensible. Where peace parks or other transboundary parks already exist, those boundaries might be adopted for priority sites under the new standard. Where a boundary is disputed, there may be cases where a transboundary site might make sense. Transboundary sites can also be the best solution for ecosystems that need to be managed as transboundary units, such as freshwater sites that include rivers that are the boundary between countries, or multi-national sites in which the "upstream" country would have some responsibility for downstream parts of the ecosystem in a neighboring country.

The delineation of sites within provincial or finer scale political boundaries must be based on the political and management context in the area of analysis. For instance, in China, nature reserves and other protected areas are the primary means of conservation. While numerous levels of protected areas exist, new protected areas are generally designated by a county, and managed by a county government; a cluster of adjacent county reserves may later be promoted into a single provincial or national nature reserve. As such, outside of the existing protected area network, it may make sense to divide sites by county boundary. In such cases, suitable habitat on either side of the county boundary would independently be designated a priority site, as long as the presence of target species can be confirmed.

3.4.3 Community based conservation and culturally derived boundaries

In still other cases, factors relating to culture and land tenure become particularly important for site delineation. This is the case in Papua New Guinea, where conservation management is often most effectively undertaken at the level of the community or tribe. However, division strictly according to tribal boundaries would be difficult due to unclear, disputed or nonexistent boundary mapping. Sites based on tribal boundaries would also reduce the likelihood that the resulting sites would be large enough to meet the habitat requirements of target species. While having sites large enough to maintain viable populations of target species is not a requirement of site identification or delineation, it is a desirable outcome wherever possible. In the case of Papua New Guinea, KBAs crossed tribal boundaries, but were generally delineated within the boundaries of a single language group. The reasoning behind this decision was that while implementation of conservation activities would likely be undertaken by individual tribes, groups of tribes within a language group would be more likely to work together to meet conservation goals.

3.4.4 Privately owned land

The majority of land in many countries is privately owned by individuals, groups, families and companies. While such areas are well suited to site delineation, since they are often at the scale at which conservation management must be taken, gathering land tenure data on such sites can be difficult. In many developed countries, however, conservation action (through easements, outright purchase, etc.) frequently occurs on privately owned land.

3.5 Generalized boundaries

3.5.1 Leaving sites as points

In situations where sites are not delineated, they are often depicted simply as points. This is the case where data, time, or other resource limitations prevent delineation. Also, the larger the region of analysis, the more inaccuracies can be introduced through site delineation. For instance, the 2005 global Alliance for Zero Extinction (AZE) data set was presented in its final form as a point layer. However, bottom-up regional KBA delineation had advanced significantly by the time of the 2010 AZE update. Also, the volume of nationally-validated protected area data held within the World Database on Protected Areas (WDPA) had greatly increased. Finally, more accurate species range polygons were available for a large number of species (particularly mammals, as a result of the Global Mammal Assessment). As a result, nearly all AZE sites were delineated in 2010.

3.5.2 Grid cells

Another alternative to manual delineation of sites is the use of so-called "neutral" boundaries such as grid cells or clusters of grid cells. This approach has very occasionally been used where automation of the delineation process through models is desired. However, such automation does not necessarily save time, and could result in site boundaries that are irrelevant for target species and local stakeholders. Attempts to increase accuracy and relevance often lead to the use of very small grid cells, and to clusters of grid cells that approximate habitat, geographical features, or political boundaries. At some point, the level of effort begins to exceed that of manual delineation.

3.5.3 Imprecise polygons

Another option is to come up with boundaries that intentionally lack precision. Such "fuzzy" boundaries explicitly highlight the need for further delineation prior to or during conservation investment. For instance, the freshwater KBAs identified through the Critical Ecosystem Partnership Fund for the Eastern Afromontane Biodiversity Hotspot were initially delineated based on lake or watershed boundaries (CEPF 2012). As such, they tended to be very large, and quite often crossed national boundaries. They generally included multiple protected areas, developed areas, and areas of unprotected natural habitat. Some freshwater KBAs also included one or more terrestrial sites within their boundaries. Since the boundaries of terrestrial KBAs were themselves based on protected areas, pre-existing IBAs, habitat extent or suitability for trigger species, and refined based on expert/ stakeholder input, merging them with the much larger freshwater KBAs would result in the loss of a great deal of valuable fine-scale information. The two overlapping data layers were therefore maintained separately. The preliminary freshwater KBAs would be refined as better data became available and national, bottom up processes emerged. Such efforts are already underway (as of early 2013) in regions such as the Mediterranean, where catchments as small as 10 km^2 have been mapped using newly available GIS layers (HydroBASINS). As a result, we are no longer restricted to using only large sub-catchments as freshwater site units.

3.6 Additional considerations in boundary delineation

The main factors one needs to consider in delineating priority sites are habitat or ecological data, the presence of pre-existing KBAs, and political or land management data. However, a number of other factors also influence delineation, and need to be kept in mind.

3.6.1 KBA size

There are no fixed limits to the size of a site identified using the new standard. While the average size of terrestrial KBAs is 889 km^2, terrestrial KBAs delineated to date range greatly in size, from 0.001 to 320,453 km^2 in size (Table 1).

Average area	889
Max area	320,453
Min area	0.001
Sum area	9,830,980

Table 1: Average, maximum and minimum sizes and total sum area of 11,062 terrestrial KBAs (km^2). Source: BirdLife International and Conservation International, 2012.

Larger sites could result in a greater likelihood that a site will meet site criteria or thresholds determined for the new standard. For instance, expanding site boundaries could increase the likelihood that a given area of interest would contain point locality data for Endangered or Critically Endangered species, thereby guaranteeing its inclusion as a priority for conservation. Similarly, where site identification is based on meeting absolute or percentage thresholds for restricted range species, larger sites increase the likelihood that the required number of individuals will be found within site boundaries. Nevertheless, the boundaries of sites identified using the new standard should not be enlarged solely to meet criteria, since each site should be actually or potentially manageable as a single unit. Some extremely large KBAs have been identified in the past, but most of these sites are based on existing management data, and in particular, on protected areas. Examples include a number of unusually large protected areas in western China. In other cases, such sites are based on habitat requirements of trigger species, and might need further refinement of site boundaries or zonation for conservation action. This is the case for some freshwater sites, where a catchment may be identified as a site using the new standard but the precise boundaries of the site would be determined after appropriate conservation actions were determined by stakeholder workshops.

At the other extreme, very small sites are in many cases unlikely to support the presence of target species over time. As mentioned above, though viability of populations is not part of the definition of sites identified using the new standard, sites should contribute to the conservation of target species (either alone, in combination with surrounding areas, or as part of a network of sites).

3.6.2 Extent of analysis

In general, the larger the area of analysis, the less precise site delineation tends to be. In multi-country site identification processes, delineation is sometimes necessarily imprecise due to time and data constraints imposed by the size of the area, or based on the need to subsequently refine sites through increased stakeholder involvement at finer geographic scales. Correspondingly, in sub-national processes, greater stakeholder involvement and locally available data can allow the delineation of more precise site boundaries. For example, 17 KBAs covering 344,496 hectares were identified in Haiti as part of a Caribbean-wide KBA identification process in 2009 (CEPF 2010). Following the 2010 Haitian earthquake, additional funding was secured that focused solely on Haiti, allowing initial analyses to be expanded. After additional analyses were conducted, 31 KBAs covering 931,776 hectares were identified. Many of the new KBAs are small and isolated. Many areas in Haiti remain un- or under surveyed, and new sites of conservation importance are likely to be identified in the future. Interestingly, none of the 31 KBAs in Haiti were delineated according to management boundaries, but were based primarily on biological criteria (Timyan, 2012).

4. SITE DELINEATION IN DIFFERENT BIOMES

Priority sites under the new standard can and should be identified across all biomes. However, a number of biome-specific constraints and influences on delineation options need to be considered.

4.1 Terrestrial site delineation

To date, the vast majority of KBAs have been identified in the terrestrial realm, and these sites serve as the basis for many of the delineation options discussed here. Some considerations discussed for marine and freshwater sites do in fact also apply to terrestrial sites, though often to a lesser extent.

4.2 Marine site delineation

Despite the fact that the oceans account for 71 percent of the earth's surface, site identification and delineation historically focused primarily on terrestrial areas. Many potential challenges with marine site identification, such as site delineation with limited data or in continuous habitat, are shared with other biomes. Others, such as source-sink areas, are unique to the marine realm. Most of these considerations are described in detail in Edgar *et al* (2008). Also, some challenges are specific to particular taxonomic groups, rather than to the oceans generally.

The most comprehensive global analysis of marine KBAs to date has been undertaken by BirdLife International in identifying and delineating marine IBAs for seabirds (BirdLife, 2010; Ronconi *et al*, 2012; and many other publications). Extensive locality data for on seabird migration, foraging, and nesting were compiled through land-based, aerial, and vessel-based surveys, as well as from tracking and Landsat data. Expert opinion was used to identify candidate IBAs, often through regional workshops. Site delineation was based on estimated foraging radii for target species, data on marine protected areas, bathymetry and other biophysical layers, and habitat models. For instance, guidance regarding delineation includes the following, "where possible, the boundaries should be determined or at least influenced by those of the underlying habitats and oceanographic processes which cause the birds' presence in the area" (BirdLife International, 2010, p. 40). BirdLife International maintains a Marine E-Atlas (http://54.247.127.44/marineIBAs/default.html) of delineated marine IBAs and candidate marine IBAs. The current global map shows a range of delineated sites, with coastal marine IBAs tending to be much smaller than offshore sites.

Preliminary marine KBAs for sea turtles were identified for Melanesia (Bass *et al*, 2009), but the focus of this work was testing thresholds rather than site identification, which would need extensive stakeholder input in a region with variable and complicated local land tenure.

To date, comprehensive marine KBA delineation for multiple taxonomic groups has not been undertaken at the national level in any country except for the Philippines and Samoa; sub-nationally, multi-taxonomic KBAs in the Galapagos archipelago of Ecuador.

Despite the lessons learned from these cases, it remains relatively difficult to provide a wide range of delineation options based on cross-regional and multi-taxonomic examples.

4.2.1 Marine Protected Areas

As in terrestrial areas, marine KBAs have followed protected area boundaries where possible. In both the Philippines and Samoa, nationally recognized marine protected areas were generally used as KBA boundaries. In the Philippines, a total of 123 marine KBAs were identified and delineated in 2009 for corals, molluscs, elasmobranchs, fishes and aquatic plants, but 46 of these overlapped with previously identified terrestrial KBAs. Eight out of the 77 entirely marine sites were delineated to match existing national marine parks (Ambal *et al*, 2012). These national parks are managed as single units, and meet the habitat requirements for many target species. In the Philippines, expanding a protected area is often more feasible than declaring a new protected area, so an additional 6 entirely marine KBAs overlapped partially with existing protected areas.

In addition to its national parks, the Philippines also has approximately one thousand very small community based marine protected areas. These sites are managed by individual communities, and are only mapped as points at the national level. The majority of these sites are tiny, some comprising just a few acres of coastline and nearshore area. Stakeholder consultation in the form of a formal marine KBA workshop led to the decision to delineate sites based on species locality data and habitat requirements, but to extend or modify the boundaries to include adjacent community based reserves whenever possible.

In the Galapagos, by contrast, fine-scale marine KBAs were delineated within the boundaries of a larger national park (Edgar el al, 2008). In the Galapagos, these sites serve to highlight areas critical for biodiversity conservation through increased management, zonation for more strict protection, and other means. A similar process would need to be undertaken if marine priorities are identified under the new standard within vast marine protected areas such as the Phoenix Islands Protected Area, the Great Barrier Reef Marine Park, or the Papahānaumokuākea National Monument.

4.2.2 Delineation in contiguous habitat, or with limited data

The challenges posed by defining boundaries for marine sites in areas of contiguous habitat or limited data are the same as for terrestrial regions, and in particular, to site delineation in terrestrial wilderness areas. Habitat might be contiguous, trigger species may utilize multiple habitat types, or there may be limited subsurface data (on reefs, seagrass beds, seafloor substrate, etc).

4.2.3 Location, life-phase, and mobility

There are a number of other considerations relating to KBA delineation in the marine realm that are worth discussing. For many of these factors, there are relatively limited examples from existing analyses, especially for KBAs based on trigger species from multiple taxanomic groups. However, the marine IBA work discussed above provides preliminary guidance regarding offshore and pelagic sites. There is also preliminary guidance from the seabird and sea turtle work on marine KBAs for specific life phases.

In the near term, most marine site identification under the new standard will likely be restricted to near-shore areas due to availability of data, urgency of conservation action, and the presence of large numbers of species that benefit from site conservation. Seamounts and vent communities present cases where many of the guidelines discussed above would likely apply.

As with terrestrial and freshwater KBAs, priority sites can be defined for a single life phase of a trigger species. For marine KBAs, sites can be identified for nesting areas (which can be terrestrial in some cases, as with sea turtles and many seabirds) or feeding areas. A large number of marine species have pelagic and sedentary phases. In the case of corals, for example, KBAs have been identified only for reef areas. Anadromous and catadromous fish also might require life-phase specific KBA identification and delineation.

Along the same lines, mobile KBAs have come up regularly, especially in the context of pelagic marine species. There is much debate whether such areas could be considered KBAs, and if they can, whether they can be sensibly delineated. Depicting such sites on static maps and GIS layers clearly presents numerous challenges.

4.2.4 Integration with terrestrial sites

In both the Philippines and Samoa, marine KBAs were identified a few years after terrestrial KBAs. In the Philippines, an effort was made in 2009 to align terrestrial and marine KBA boundaries and to delineate marine KBAs that were similar in scale to the terrestrial KBAs (where sensible to meet the needs of target species). Subsequently, some adjacent marine and terrestrial KBAs were merged (Ambal *et al*, 2012), and integrated management through ridge-to-reef conservation has been promoted in the Philippines. In Samoa, marine KBAs were identified alongside an update of the terrestrial KBAs, in which the boundaries of terrestrial sites were refined and new data on target species were incorporated (Conservation International – Pacific Islands Programme *et al*, 2010)

4.3 Freshwater site delineation

Although freshwater systems contain disproportionately high biodiversity and are one of the most threatened habitat types in the world, they have received less attention by the conservation community than terrestrial systems (Holland et al, 2012). Site conservation in freshwater systems is complicated by the systems' interconnectedness with upstream and downstream reaches and with upland areas. While conserving entire catchments may in many cases be the best approach to safeguard freshwater biodiversity, there are many freshwater species, such as range-restricted species, that can benefit from site-scale conservation (Darwall et al, 2011).

It is important to note that freshwater sites should not be delineated using rivers as boundaries. While this is often taken as the easiest option as rivers provide very convenient natural boundaries, such an approach divides catchments and thus results in a lack of protection for freshwater systems.

A key dilemma in the identification of freshwater sites, as mentioned above, is the need to consider impacts from surrounding areas, including land use in the catchment and upstream and downstream reaches. While identifying core freshwater areas based on specific species range data yields sites more in line with terrestrial and marine sites, such sites do not take into account the inherent connectivity of river, lake and wetland systems and potential impacts from threats such as pollution in the catchment, water abstraction, invasive species, etc. A question that should be discussed in the upcoming criteria and delineation workshop is whether there are specific, discrete areas within large lakes or rivers that require site conservation analogous to a terrestrial protected area, or whether we should abandon the concept of site-scale conservation areas in these larger freshwater bodies and strive for key biodiversity rivers/lakes designations. In such cases, thresholds for the criteria used to designate important biodiversity would need to be high enough to avoid having every freshwater body qualify.

In their study testing the KBA approach for freshwater biodiversity in continental Africa, Holland et al. (2012) used catchments based on the Hydro1k Elevation Derivative Database at level 6 to delineate freshwater KBAs. They considered catchments at this level to be reasonable areas for management that incorporated both connectivity with upland areas and smaller freshwater areas, such as ponds, that can be important for biodiversity but are hard to capture in regional or multi-national analyses (Holland et al, 2012).

One question that needs to be answered is where a potential freshwater site sits on the continuum from a "site" to a "landscape" in the context of calling for site-scale or landscape-scale actions. Freshwater catchments could fall anywhere on this continuum, from identifying the focal area (e.g. the spawning area) as a site, or delineating the sub-catchment as a site, which is the approach being currently applied in the identification of freshwater KBAs.

The approach taken to delineate freshwater areas identified using the new standard will be strongly influenced by the criteria used to identify these sites, reinforcing the need to discuss criteria and delineation of freshwater sites in tandem.

Extensive analysis of freshwater KBA criteria has been conducted using the Africa freshwater species dataset (Holland et al, 2012) and freshwater KBA identification is already underway in many places as part of the BioFresh Project. Discussions of freshwater sites in the upcoming criteria and delineation workshop should build upon this existing work.

4.4 Subterranean site delineation

As far as we are aware, no subterranean KBA analyses have been done to date. However, as more of a focus is placed on the frequently highly range-restricted invertebrates which inhabit such habitats (Vermeulen and Whitten 1999; Deharveng and Bedos, 2012), it is likely that at least some priority sites based on subterranean areas will be delineated under the new standard. Most such analyses will probably be part of analyses for terrestrial sites, and would probably involve similar considerations regarding delineation. It is problematic that although many biologically significant caves are mapped, this is rarely done in the context of the surface features. Additional complications are encountered in that subterranean habitats are highly dependent on the land use and water regime above them. Of particular note is that caves and cave systems are important, fragile, and underrepresented both in protected area networks and in past KBA analyses, and that there is increasing evidence of extinctions occurring as a direct impact of cement quarries (Janion et al. in press; Schilthuizen et al. 2005, Schilthuizen and Clements 2008). A great deal of data exists but there has been no attempt as yet to collate and interpret these on a broad scale which can be used for a site analysis. UNEP-WCMC is currently seeking funds to rectify this.

4.5 Integration of sites identified and delineated in different biomes

Early KBA identification processes focused either entirely on terrestrial areas, or included a few coastal, island, or freshwater sites for target species considered important by stakeholders. Once purely (or primarily) marine and freshwater KBA analyses began to be undertaken, questions arose as to whether these sites should be integrated with terrestrial KBAs in areas of partial or complete overlap. To date, there has been no consensus around this topic, and further discussion and analysis are needed on the various implications of integration.

Merging sites identified through biome-specific processes would help with branding around the new standard, and would certainly allow results to be communicated more easily to donors and decision-makers. Merged sites would greatly simplify certain aspects of data management, including the presentation of sites on a map, the entry of data on sites into databases, and so on. Another significant advantage of merging sites is the opportunity to greatly increase perceived importance of a site if it qualifies as both a terrestrial and freshwater site. For example, an existing IBA might benefit if also indentified as an important freshwater fish area.

However, the constraints discussed above, and the practicalities around which institutions would lead site integration, and which data would take precedence, are likely to complicate the integration of sites identified in different biomes.

Many aspects of site delineation will be strongly influenced by whether sites identified in different biomes are merged or held separately; a decision regarding the integration of sites identified in different biomes would be an important result of the upcoming criteria and delineation workshop and overall consultation process.

5. THE ROLE OF TAXONOMIC GROUP IN SITE DELINEATION

Including a wide range of taxonomic groups in the identification of sites is important given our goal of protecting all biodiversity. However, not all species groups have been studied to the same level. Some groups, particularly terrestrial vertebrates and some plant groups, have been studied in greater detail than others, such as invertebrates, aquatic species, and other groups of plants. While current efforts seek to provide more information on historically under-surveyed taxonomic groups, the identification and delineation of sites that contribute significantly to the global persistence of biodiversity cannot wait for current or future studies to be completed, but rather must make use of all existing available data (Langhammer et al, 2007). Since the identification of sites is an iterative process, future data should be used to refine and update existing sites.

When data on multiple taxonomic groups are available, there may or may not be overlap among sites delineated for different taxa. In the case of Important Plant Areas (IPAs) and Important Bird Areas (IBAs) identified in Macedonia, roughly one-fifth (19% of all IPAs, or 20% of all IBAs) of the sites identified for the two different groups overlapped with each other (Melovski et al, 2012).

Some species are not suited to protection or management at the site level. Species whose populations are widespread at low densities may need conservation action at a much larger scale (Langhammer et al, 2007). While many species can benefits from landscape-scale conservation action, Boyd et al (2008) found that <1% of threatened mammals, birds, tortoises and turtles, and amphibians require broad-scale actions alone. For these species, conservation corridors or other landscape-scale conservation units may be the best means to safeguard their persistence, though other species can also benefit from such action.

5.1 Small organisms

Many of the sites identified for invertebrates, fungi, and some groups of plants will necessarily be very small, given the highly restricted ranges of some of these species. Many of these very small sites will fall into sites triggered by birds, mammals, and other larger vertebrates, and very small sites will then be incorporated into the suite of sites identified under the new standard. However, while in some cases adequate protection is given to all species at a site if there are effective umbrella species present, there are notable exceptions. In caves and certain freshwater habitats, for example, there may be no species from large vertebrate groups that adequately serve as umbrella species. Additionally, this approach would not work in areas such as isolated blocks of limestone. In such cases, different approaches must be taken. Since there are no minimum or maximum size limits for sites identified using the new standard, the addition of these taxonomic groups will likely lead to the addition of small sites for biodiversity.

5.2 Larger organisms

Since wide-ranging species are often among the most visible components of biodiversity to disappear in the midst of land conversion and associated human conflict, a useful way to incorporate them into the conservation site concept might be as "intact large mammal fauna" -- which as a component of biodiversity is getting more and more scarce. We have a pretty good notion from published analyses of where these places are in the world. As far as boundary delineation is concerned, size of protection matters the most in areas where neighboring regions are hostile and eventually such species will be confined to the management area itself.

5.3 Migratory species

The new standard to identify biodiversity sites also needs to encompass sites critical to a portion of a species' lifecycle. These sites, which protect areas used as wintering, breeding, and stop-over sites, are essential to the persistence of the species that use them. KBAs have been identified for these types of sites. One example is the Göksu Delta IBA in Turkey, which is of major importance for several breeding and wintering birds as well as birds using the site in passage. It was triggered by breeding waterbirds, including the VU Marbled Teal (*Marmaronetta angustirostris),* wintering waterbirds such as the VU Dalmatian Pelican (*Pelecanus crispus)* and birds using the delta as a stop-over site, such as the White Stork (*Ciconia ciconia),* which has 5,000-22,000 individuals at this site during migration (Birdlife International 2012).

Delineation decisions about sites used as wintering, breeding, and stop-over sites overlap considerably with discussions on criteria for the new standard. Particular attention should be paid to marine and freshwater sites for migratory species, since such sites can function differently than those identified for terrestrial species. For example, temporal or mobile KBAs, as discussed in Section 4.2, may be necessary to fully protect areas critical to the lifecycle of some aquatic species.

6. ENSURING REPLICABILITY

One concern with the existing KBA approach that is likely to be true of the new standard is that the repeatability of the approach may be compromised because delineation necessarily varies around the world, since it is based on country- or region-specific conservation and land management contexts, and on the available data used for delineation (Langhammer et al, 2007). It is true that the boundaries of both KBAs and areas identified using the new standard will differ from one place to another, since it is essential to take local or national contexts into account in site delineation, and because the availability and precision of data differ widely from place to place. While developing guidelines for the delineation of areas identified using the new standard, it will be important to provide examples of delineation given different contexts and data precision. The goal with delineation should not be to eliminate variation or flexibility based on local contexts and available data, but rather to ensure that a given site would be delineated in the same way by different assessors (Langhammer et al, 2007).

7. NEXT STEPS

At the Framing Workshop in June 2012, several questions pertaining to delineation were raised. It will be important for these and other issues to be discussed at the upcoming workshop on criteria and delineation. Some key questions from that workshop and from initial comments on this paper follow:

- How should the delineation of areas identified under the new standard align among IBAs, IPAs, AZE sites, freshwater sites, marine sites, etc? Should they necessarily be congruent? What are the costs if they are not congruent?
- How should the term “management unit” be defined? What is a clear definition that will function across biomes, while maintaining flexibility in the new standard’s approach?
- How should we deal with issues of overlap of sites as increasing numbers of different taxa are used to identify sites?

- Do scale differences between terrestrial and freshwater areas matter?
- Where do potential sites sit on the continuum from a "site" to a "landscape" in the context of calling for site-based or landscape-scale actions? Should conservation corridors and conservation units be included as well as conservation sites?
- To what extent should site boundaries be dictated by ecological vs. sociopolitical considerations?

At the upcoming workshop on criteria and delineation, it will be important for participants to keep in mind the other key issues that need to be resolved to develop the new standard. Delineation is clearly linked to decisions on thresholds. It is essential that decisions on delineation take into account the thresholds recommended to identify areas significant to the global persistence of biodiversity. Issues of data management and documentation will also be relevant.

In order for areas identified under the new standard to be accepted and used by a wide variety of end-users, the ways in which they are delineated should be clear and easily explainable. Delineation must be understood and supported by both primary end-users, who lead or influence decision-making processes to secure biodiversity, and secondary users, who may use areas identified under the new standard to achieve their biodiversity assessment or conservation planning goals.

At the Framing Workshop in June 2012, participants made several consensus recommendations related to the governance of the process. These recommendations should be kept in mind during discussions on delineation. For example, participants at the upcoming workshop on criteria and delineation should consider whether and how the IUCN should play a quality control function on issues related to delineation, ensure that delineation be easy to apply, and propose documentation requirements that are as minimal as possible.

Finally, since the upcoming workshop focuses on both criteria and delineation, it is imperative that decisions regarding both the criteria for and the delineation of areas identified under the new standard take into account the other topic.

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