Chapter 3
Corridors: Compulsory Passages? The Malagasy Example

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Since the 5th World Parks Congress held in Durban in 2003, the maintenance or restoration of corridors with a view to improving connectivity, has become a fundamental element of new conservation policies. The objective of networking protected areas and maintaining or rehabilitating corridors is to overcome the drawbacks of former conservation strategies, based as they were on protecting one isolated area from another, and to avoid the effects of ecosystem fragmentation leading to the loss of biodiversity. In order to assess whether this new tendency constitutes a rupture or a continuity in traditional policies used for establishing protected areas, we need to explore the meaning of 'corridor' and the pertinence of its application in the field of conservation. Indeed, the notion of 'corridor' is not peculiar to scientists or conservation actors; it is part of the common discourse. It has a multiplicity of meanings, and its use has spread throughout many disciplines, going back to the 1990s. Whereas it is certainly better known in the fields of conservation and ecology, the notion of 'corridor' is similarly employed in relation to the issues of contemporary economic and urban studies, land use planning, and even to the flow of goods, people and information.

Irrespective of the scale and disciplinary context, and despite its multiple meanings, a corridor is always defined by its elongated shape and its function as a conduit or obstacle to the flow of matter and information. But is this enough to make the step from an innovative theoretical concept to a working process for biodiversity conservation? We propose at first to deconstruct the concept of 'corridor', i.e. to analyse its origins and scientific interpretations within the disciplines of the life and social sciences. We then use this analysis to explain the confusions, the ambiguities and the controversies that the use of the term 'corridor' invokes, when used in the field of conservation. Finally, we use the example of the spread of conservation corridors in Madagascar to illustrate the results of our analysis. In this regard, the Malagasy environmental approach has adopted a conservation policy centred on corridors with a view to increasing the extent of protected areas. A clarification of the anticipated environmental and economic impacts of the corridor model is welcome in this country of widespread poverty and high endemism. Considering what is at stake in terms of sustainable development, the functions of a corridor must be clearly defined, especially when

the goal is not only to create protected areas for the conservation of biodiversity, but also to contribute to the alleviation of poverty[1]. Indeed, the impact the creation of protected areas has on local populations is not well known, while the risks are far from negligible.

Corridors across Disciplines

The term 'corridor' initially comes from the field of conservation biology; however, it has been used in domains as varied as land use planning, and development economics[2].

From Game Reserves to Conservation Corridors: The Ecological History of the Concept

Corridors have a long history. At the beginning of the 20th century, they were first used to basically establish and maintain fauna in game reserves (Harris and Sheck 1991). Only later did corridors become a subject for study by scientists and a conservation tool for managers, culminating in a new science documented in a publication entitled *Corridor ecology: the science and practice of linking landscapes for biodiversity conservation* (Hilty et al. 2006).

The term 'corridor' was originally used by the first landscape ecologists in the 1940s (Forman and Godron 1986), particularly in relation to watercourses (stream corridors). A structural definition of the term linked to the elongated shape of corridors, hedges, streams, etc. then appeared. Only later did Forman and Godron (1981; 1986) introduce the matrix-patch-corridor concept which they applied to the landscape structures seen in aerial photographs and satellite images in order to describe and to analyse them. In this case, the 'matrix' is the dominant landscape element which is the most connected, while the 'patch' is a non-linear area and the 'corridor' is a linear entity (Figure 3.1). Significant vocabulary and literature describe the structure, origin, objectives and functions of corridors within this paradigm (Burel and Baudry 1999).

The corridor concept in relation to the biodiversity conservation appeared more recently, stemming from the island biogeography theory of McArthur and Wilson (1967) and from the meta-population theory (Levins 1969; McCullough 1996; Hanski and Gilpin 1997).

These two theoretical corpora form the basis of conservation biology, which advocates the use of corridors to improve the flows of animal or vegetal individuals and species. Thanks to the dynamic equilibrium theory (McArthur

1 Conservation appears as a contribution to the development of Madagascar in the *poverty reduction strategy paper*.

2 The international and legal dimensions of networks and corridors are tackled in the next chapter.

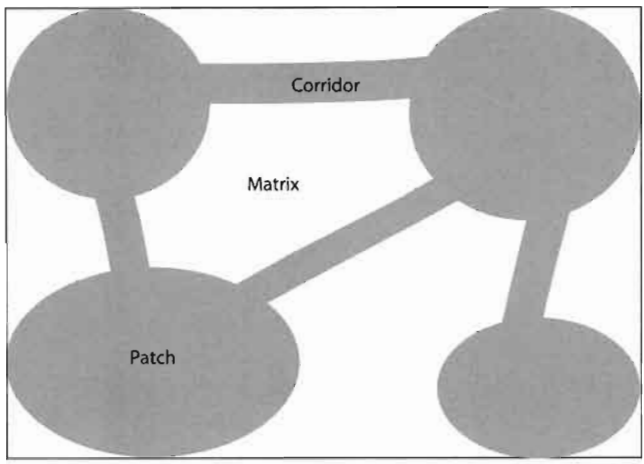


Figure 3.1 Spatial illustration of the 'Matrix-Patch-Corridor' model

and Wilson 1967), it is possible to predict the number of species present on an island, given its surface area and the distance to the closest continent representing a source of individuals (Blondel 1995). The global assumption underlying this theory sets out that species diversity on an island results directly from two dynamic processes: the colonisation rate of individuals and the extinction rate of populations. Consequently, the number of species can increase when the island is large and close to the mainland source (McArthur and Wilson 1967). This was the first theory on the influence of spatial organisation on ecological processes. Whereas this theory provoked many reactions and controversies, it also initiated much research.

From the 1980s onwards, the island model gave way to the meta-population concept, as set out by Levins (1970). It was on this research that the effects of habitat fragmentation on populations were based. A meta-population consists of small populations that become extinct and leave vacant habitats that are re-colonised locally. Furthermore, the permanence of a meta-population is only possible if the average extinction rate is less than the colonisation rate. Individuals who scatter can colonise vacant sites, and occupied sites can become vacant following local extinctions. These sites are in turn colonised by disperser individuals.

Many animal communities reflect characteristics that are accurately represented by this theory, or by theories derived from this one: the model of Boorman and Levitt (1973), the source-sink model[3] of Pulliam (1988) and Blondel et al. (1992). Local extinction processes can be dependent on the structure and dynamic of the landscape. As such, the isolation, size and shape of patches of habitat can influence colonisation and extinction rates. For example, the smaller a sub-population is, the

3 In this model, the meta-population consists of patches in which the growth rate is positive for certain (source individuals) and negative for others (sink individuals) (Pulliam 1988).

more likely it is to disappear in the face of demographic probability. Moreover, the size of sub-populations correlates with the size of their habitat, e.g. a small forest grove. The more groves there are and the closer these are to one another, the more the probability of extinction decreases, since the likelihood of immigrants arriving in each grove increases.

These theories underpin the work of conservation biologists. What is the potential role of corridors in the operation of the island model and the meta-population theory? The existence of biological corridors (forests, hedges and rivers) enabling the flow of disperser individuals between sub-populations, would theoretically favour the maintenance of meta-populations and therefore of the species in the long run. Indeed, individuals in certain species are reluctant to disperse into an environment which is not their own (in order to reproduce or feed) or which is not favourable to their survival (predation). The bridges that join similar ecosystems or sites are called 'corridors'. Their efficiency can be measured in terms of the flow of disperser animals, and therefore of genes, for the specific colonisation of small seasonally-interconnected populations (Fahrig and Merriam 1985, for the micro-mammals of the Ottawa region). These authors have shown that patches are re-colonised each spring, and that animals prefer to travel along the hedges found between groves. An increase in the number of these corridors increases the connectivity between patches, which then increases the survival time of the meta-population.

Corridors have been given a role to play in the conservation of forest ecosystems, particularly by overcoming the potential effects of their fragmentation, the resulting isolation of their animal and plant populations, and even their extinction. Managers and conservationists whose responsibility it is to protect species, will try to identify and safeguard biological corridors (hedges, forests, etc.) linking protected areas, so as to theoretically ensure the survival and adaptation of species to changes, owing to the exchange of individuals and therefore genes.

Greenways and Heritage Corridors: Land Use Planning and Landscape Ecology

Greenways are linear-shaped protected areas that are initially situated in the heart of or in proximity to urban areas. Greenways appeared in the United States in the 1970s, and increased in number from the end of the 1980s. According to Fabos (2004), the origin of greenways dates from the end of the 19th century, during which town planners imagined natural spaces within metropolitan open space systems. Subsequently, during the 1930s, the idea was to contain urban expansion by developing green lines inside or outside cities, or greenbelts, by relying on the local topography (mountains, rivers, etc.) to draw connection lines between these natural spaces. It appears that the concept of the greenway has been progressively used to specifically characterise spaces for the protection and tourist development of rivers and riverbanks. The term 'greenway' was used explicitly for the first time

in 1987 by the President's Commission on Americans Outdoors[4], which laid down the framework for a greenway development programme by drawing a parallel with the American road (or rail) network. The objective was to create "a living network of greenways", a "giant circulation system".

Fabos and Ahern (1995) propose a typology of corridors which stems from this American movement. The first category consists of greenways which have a degree of ecological importance, concentrated along rivers, coastal areas or mountain ranges. Their objective is, on the one hand, to maintain biodiversity and the migration corridors of wild species, and on the other hand to restrict human activities, by acting as a containment barrier against urban pressure. The second category corresponds to recreational corridors. The idea here is to link various natural sites endowed with potential or effective tourist appeal. These recreational corridors can be situated in rural or urban areas. Finally, the third category of corridors refers to heritage corridors, i.e. sites with a high heritage value. Here, the purpose of this category of corridor is to offer a classification of the landscape based on the history of the economic and social relations between its various points. This type of corridor, as with the other two, is linear; most of the time consisting of rivers and riverbanks, even old roads, canals or railway lines that were used for important economic activity. The most famous heritage corridor is that of the Illinois and Michigan Canal that joins Lake Michigan in Chicago to the Illinois River, and therefore creates a corridor all the way to the state of Mississippi.

This fairly broad conception of corridors through the establishment of greenways is not restricted to Northern America; corridors have also been created in Europe and certain developing countries, such as China, where a National Green Corridor Programme was implemented in 1997 to "green" all roads (Yu et al. 2006).

This use of the corridor concept goes beyond the purpose of conservation, with the exception of ecological greenways, which have an obvious relationship with the conservation corridors examined previously. Heritage and recreational corridors are situated in a heritage, recreational and non-ecological context, which differentiates them from conservation corridors. Lastly, let us note that while the meaning of 'greenways' and 'heritage corridors' appears throughout the works of American urban architects from the end of the 19th century (Frederik Law Olmsted, George Kessler and Charles Elliot among others), these terms tend to take on a stronger geographic and institutional dimension from the end of the 1970s (Fabos 2004): 'geographic' because they are extended to a region, a federal state or even a country, and 'institutional' because governmental commissions and public-private

4 The Commission on Americans Outdoors was created by former American President Ronald Reagan in 1985, and entrusted to U.S. Senator Lamar Alexander. In his 1987 report, Alexander recommended networking recreational activities to enable people (pedestrians, cyclists, etc.) to circulate free of hindrance. The Commission's report is considered by many analysts as a major political event in terms of greenway promotion in the United States.

partnerships (such as the Chrysler Canada Greenway) are multiplying with a view to promoting the 'corridor' concept. The idea often put forward is to differentiate them from the classic parks, as managed by states, so as to promote alternative forms combining public and private funds, public spaces and private properties, and so on and so forth (Zubie 1995).

Towards the Infiltration of the Term 'Corridor' in Economics

The term 'corridor' is also found in economics as in 'development and/or transport corridor'. The parallel between conservation and development corridors is pertinent. Indeed, a development corridor is a communication route between at least two urban areas, and can involve various modes of transport (i.e. land, rail or river transport) for the transit of goods, workers and, potentially, economic information. Even if there are no specific definitions validated by economists – the literature on the subject being far less than that on ecological corridors – the concept of the development corridor also corresponds to a concern with increasing or improving the connectivity of flows (Arnold et al. 2005).

There was a considerable promotion of development corridors in the 1990s. This period was marked by an acceleration in the process of economic globalisation. The idea was to build large spaces in an economic context where exchange flows and the structuring of the largest international groups, led to the twin movements of globalisation and regionalisation. Furthermore, the transversal structuring of development corridors and their importance in relation to nation states, gave priority to transnational infrastructures, private actors and their affiliation to regional free trade setups.

For this reason, development corridors exist irrespective of the development status of the country or region concerned. Corridors are found in Europe (as with the European Backbone), as well as in North America (as with the North-Pacific Portland-Seattle-Vancouver corridor and the Californian San Diego-Los Angeles-San Francisco corridor) (Rimmer 1995).

Since the issue of development corridors is as diverse as the economic flows in question, a stricter definition of 'corridor' as exchange network structure is necessary. The corridor should be envisaged as the embodiment "of the passing of a firm's logic to the economy as a whole. In a given economy, all flows can be represented as deploying inside a spatial network comprising nodes, i.e. towns and metropolitan areas, and links corresponding to the different modes of transport and communications" (Rimmer 1995: 13). These development corridors are founded with the goal to reduce costs at city level.

Most of the corridors established in poor countries, such as those found in Africa, address a need to secure transport routes. They must be considered as a simpler form of the development corridor. They focus on the flow of goods between two or more points, often between a harbour and an urban area with no access to the sea. In fact, these corridors are often called 'transport' or 'transit

corridors', the idea being that economic development in these countries cannot take place without an increased mobility in production factors.

The concept of 'corridor' in Economics can therefore take on various forms, from a simple vision, such as the transport corridor, where the emphasis is placed on the connectivity of towns (playing the role of a conduit for goods) with a strong territorial dimension, to the development corridor focused on the more or less complex networking of information flows. In the last case, territorial identity or geographic coherence is not essential, thus giving the impression of dealing with a 'paper' corridor existing only on maps, without any physical reality. In defining this type of corridor, Rimmer (1995) speaks of an "infrastructural scene".

Finally, one notes that development corridors, like conservation corridors, are rarely defined in an integrated manner. They do not take into account all the characteristics (e.g. cultural identities) or the scales required for land use planning.

Corridors: a Ragbag Concept

As we have just shown, corridors have many – and even sometimes diverging – definitions and functions. The absence of a clear and coherent terminology results in the actual objectives of corridors becoming confused (Simberloff et al. 1992; Bennett 1999). Concerning more specifically the conservation corridor, of which we have shown the significance in the field of conservation, we will see how the different definitions, concepts and expectations, as well as the lack of scientific conclusions, make conservation corridors barely workable in the context of biodiversity conservation.

Conduits or Habitats?

The movement of plants and/or animals (Hess and Fischer 2001) through a corridor is central to the majority of definitions: it is the function of conduit. Noss (1993) establishes that the two major functions of a corridor are to supply a habitat, in the sense of residence, and also to ensure a conduit for the purpose of movement. Rosenberg et al. (1995) separate clearly these functions of habitat and conduit. A corridor that enables travel between two patches, although it might not necessarily enable reproduction, represents the function of a conduit. When a corridor supplies the resources required for survival, reproduction and travel, it then plays the role of a habitat. As such there are ambiguities regarding the roles of conduit *versus* habitat when defining the function of a corridor. Indeed, some show that if a corridor constitutes a prime habitat for a species, this also facilitates the dispersion of that species (Bennett et al. 1994), and therefore its long term survival. Others focus on the conduit function and exclude from this concept spaces that constitute habitats but do not serve as conduits (Beier and Noss 1998). Nevertheless, in the 1990s a consensus existed among certain authors that the function of a corridor

can range from a simple passage, to the role of both habitat and conduit (Hobbs 1992; Merriam 1991).

A Matter of Scale

Corridors also vary according to the time scales involved (Harris and Scheck 1991). 'Species' supposedly use corridors as conduits to move from one site to another, intermittently and over short periods of time, for very specific activities during their life (Beier and Loe 1992). This type of movement includes seasonal migrations, the daily search for food and journeys made for mating purposes (Noss 1991; Bennett et al. 1994). When a corridor is wide and long compared to the distances travelled by an animal, that species will use it over several generations. Beier and Loe (1992) call it a corridor dweller, and note that a corridor can be a habitat if it can support the reproduction of a species over several generations. Harris and Scheck (1991) link corridor width to usage type and duration. Individuals moving through narrow corridors do so in hourly or monthly time scales. Larger corridors support the movements of entire species over an annual cycle, and species assemblages can move through even larger corridors over decades or centuries. Narrower corridors can provide a habitat function because movements take place over several years. Movements within very large corridors concern whole communities and processes at the ecosystem level, enabling plant and animal species to travel between reserves over several generations. These have been called 'landscape linkages' and their purpose is to ensure regional connectivity (Noss 1991; Harris and Scheck 1991). Bennett (1999) prefers the term 'link' to that of 'corridor' to emphasise the conduit and landscape connectivity functions.

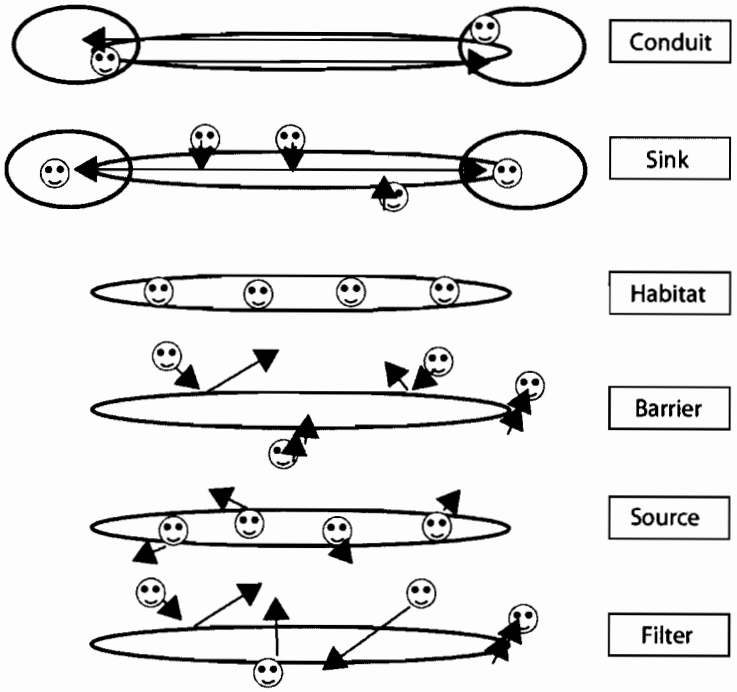
Little data is available to establish a link between these theories, the anticipated functions of conservation corridors and the creation of protected areas. The problem remains that the size of a corridor is closely dependant on the species under consideration and on the size of its territory. This is why conservationists work on the principle that conserving the largest territory belonging to a species enables the conservation of other species.

Conservation Corridors: from Theory to Practice

Obtaining operational data that can be of use to managers to delimit and manage conservation corridors is difficult, due to the diversity of corridor functions that varies by scale. Much confusion results partly from the double usage of the term 'corridor' on a structural and a functional level (Rosenberg et al. 1995). On the one hand, the connectivity provided by the corridor may be structural, a landscape linkage (Foreman 1995), and on the other it can be functional, contributing to the maintenance of meta-populations (Levins 1970; Hanski and Gilpin 1997; McCullough 1996). Baudry and Merriam (1988) distinguish structural from functional connectivity in that the linear elements of a landscape, which provide structural connectivity, do not automatically provide functional connectivity.

These definitions are particularly important when managers need to act. Indeed, when does one determine whether a process will have an impact on the functional connectivity of a corridor? The answer depends on its expected functions, the species involved, the time scales and the spaces considered.

These theoretical considerations conceal an even more complex reality as far as the efficiency of corridors for conservation is concerned. Corridors have positive effects on more than just species. They can conduct, slow down or even stop flows (Burel and Baudry 1999) and corridors, hedges and forests often come into conflict with the communication corridors established by humans (roads, paths, highways, sailing routes, etc.). Depending on the scale involved, these different corridors interact with a given species to constitute either a major route, or an insurmountable obstacle (See Figure 3.2).



Source: Burel and Baudry (1999).

We can distinguish a bridge role (forests) for the passage of animals between two forest patches for example; a sink role (landscape element with a negative growth rate, therefore one which absorbs individuals) or a source role (with a positive growth rate which issues forth individuals); an ecological habitat role for species (a stream for a fish species); a barrier role (a river for terrestrial animals); a filter role, allowing the passage of certain species but not others.

Figure 3.2 The different roles of corridors depending on species and scales

A corridor which can be beneficial to the conservation of a species can also be detrimental to another. At this stage, we can already begin to comprehend the degree of complexity, and the potential conflicts, between what can be advantageous for one species and not for another; particularly when humans, as a species that also moves and builds communication routes for their own development, are a part of the system.

Lack of Data: A Source of Scientific Controversy

In practice, a significant amount of literature concerns the positive effects of corridors on animal flows, but far more rarely on the efficient flow of genes (e.g. the genetic homogeneity of a species along a corridor) which would enable a species to adapt over the long term. The many controversies shed light on the pernicious effects of corridors on species, populations and ecosystems. Many authors have in fact exchanged views in specialised journals regarding what Simberloff and Cox (1987), called the "consequences and costs of conservation corridors". These authors decided to raise the issues related to the lack of knowledge about the many effects of corridors, such as their importance in the transmission of pests, predators, diseases and bio-invasions, amongst others (Thomas et al. 2006). Notably, they questioned the balance between the ecological benefits and the (often considerable) economic costs related to the maintenance or implementation of corridors in order to save species inside and outside protected areas. One of their main arguments is that, in 1987, very little empirical data was actually available.

10 years later, Beier and Noss (1998) published a bibliographical review entitled *do habitat corridors provide connectivity?* While they were less clear-cut in their conclusions, they recognised that "generalisations about the biological value of corridors will remain elusive", particularly because of the fact that models depend on one species alone. As such, there is no clear answer regarding whether corridors maintain functional connectivity. However, they do note that, in 12 research articles, empirical works testify to the usefulness of corridors as conservation tools. Unlike those who are sceptical about corridors, Beier and Noss conclude that in the absence of valid data, and despite the high cost of these conservation actions, it is advisable to consider that a connected landscape is more desirable than a fragmented one. Therefore the precaution principle prevails in most conservation discourses and actions. As such, Beier and Noss (1998: 1250) address those who would contribute to the non-protection of these ecosystems by arguing that they "should bear the burden of proving that corridor destruction will not harm target populations".

Illustrating Corridor Challenges: the Case of Madagascar

Madagascar is the perfect example for understanding and analysing the process of implementing conservation corridors in a developing country. The dynamic set in motion by the Durban Congress played a part in the development of the Malagasy environmental policy. Indeed, it was on that occasion that the Malagasy President, Mr Marc Ravalomanana, declared that the country was to place 10% of its territory under protection, in order to meet international objectives. To this end, he proposed – in what is called in Madagascar the "Durban Vision"[5] – to triple the surface area of protected areas in the country within five years (Méral et al., this publication). Confronted with this particularly short deadline, urgency became the key word of all post-Durban conservation measures, while conservation corridors became the preferred tool for the creation of protected areas (Carrière-Buschsenchutz 2006).

Malagasy Corridors

The corridor concept came up in environmental policy debates in Madagascar during the *scientific workshop on the definition of the conservation priorities of biological diversity* in 1995. This concept, in a break from the model of protected areas classically applied in this country, is however perfectly adapted to the linear shape of the forest relicts (See Plate 11). Mixing the physical shape of the corridor with the ecological function of a conduit is an ideal reflection of the geographical reality of these forests. Within this framework, it was established that the forest 'corridors' would contribute towards establishing connectivity between protected areas, thereby playing a vital role in the maintenance of long term biodiversity (Carrière-Buschsenchutz 2006). These corridors are justified mainly by the connectivity they would ensure between protected areas, and also because the majority of the forests to be protected are situated within these forest strips. A major portion of the wooded area of Madagascar (around 50%, including currently protected areas) is affected, whether directly or remotely, by this corridor-centred approach. The evolution of conservation corridors (in red on plate, Plate 11), in relation to the remaining forest territories, testifies to their significance for conservationists. On such a scale, could all these corridors, were they contiguous, form regional landscape linkages that would be useful to the evolution of a species

5 "Durban vision" is a technical support group created by the Environment, Water and Forestry Directorate to implement the President's will via the System of Protected Areas in Madagascar (SAPM – système d'aires protégées malgache). Headed by the Secretary-General of the Department of Environmental and Water Affairs and Forestry, this group is made up of around 100 members representing more than 40 national and international organisations. The group on "Prioritisation" is responsible for proposing priority zones for the conservation of biodiversity, while the group on "Management and Legal Categorisation" is responsible for defining management objectives according to the potential categories of conservation areas.

over many generations? From a local corridor linking two protected areas, one moves here to a national system of meta-corridors, which logically has different expectations and objectives.

From the end of 2005, no less than one million additional ha were placed under protection – most by temporary decree – with 80% of these concerning forest corridors: the corridor of Anjozorobe-Angavo (52,000 ha), Ankeniheny-Zahamena (between 425,000 ha and 510,000 ha according to the sources) and the Makira Forest (around 350,000 ha). In the future, the surface area of the corridors of Eastern Madagascar ought to increase, since the corridors of Marojejy-Anjanaharibe-Sud (400,000 ha), Ranomafana-Andringitra-Midongy (240,000 ha), Tsitongambarika (147,000 ha), Marovoalavo (202,000 ha) and probably Fandriana-Marolambo (unknown surface area) should be added to those already established.

A Front for Conservation: From Political Choice to Theoretical Justification

The definitions, roles and expectations of corridors vary according to the actors and disciplines involved to form a fairly large overall concept. The surveys conducted in Madagascar lead to a similar conclusion. Depending on the interlocutors, the corridor – implicitly perceived in Madagascar as a forest corridor – is defined as a sort of "forest track", an "intermediary area" resulting from the wide expansion of a high priority ecosystem, a "biological bridge", a link between two protected areas, what remains of the forests, and even a "gene bank". Its function is also the subject of various interpretations, among which are the strategic role for the migration of species, the economic role of water tower for rice fields, a guaranty for genetic mixing, a natural protection for the species, a transition zone between two protected areas, a zone of sustainable management activity, and a forest full of natural resources, to name but a few. Certain conservation NGOs even integrate into their definition the idea that these corridors facilitate the creation of new protected areas, thereby ensuring the continuation of their activities.

Even if scientific results are lacking, the promotion of corridors in Madagascar is driven by good sense. All the scientists refer to the presumed role of corridors in the country by using the conditional tense (Carrière-Buschsenchutz 2006). All of them relate the controversies developed at the international level, as explained above. In Madagascar, the precaution principle largely justifies the conservation of these corridors, yet, these forest corridors are very rich in endemic species and this alone would be enough to justify their conservation. We can see here that while these forest strips could just as well be providing the functional role of a corridor, they represent excellent opportunities for conservation to successfully protect 10% of the land.

From being indispensable to the flow of genes, corridors have become indispensable to conservation policy in order to meet the challenge of the Durban vision. They went from species-rich ecological habitats to conduits for animals, which doubly justifies why they should be protected. The definition and delimitation of corridors are becoming redundant since, irrespective of what

happens, the remainder of the Malagasy forests will have to be conserved. The function of corridor brings in an additional argument to justify conservation interventions, and especially to seek funds for their implementation. The proof being that the development plans of future conservation sites are not overly focused on the territories of a few key species using these corridors, but indeed on ecological forest or reef habitats (Chaboud et al., this publication), with all that they encompass.

Still, many scientists draw attention to the fact that each situation must be studied within the context of its specificity (Primack and Ratsirarson 2005). Some researchers have shown that species can react differently to the fragmentation of large forest blocs (Langrand and Wilmé 1997; Goodman and Rakotondravony 2000). Moreover, no development plan can provide an exhaustive and accurate report on the positive and negative effects (e.g. bio-invasion) expected from each one of these corridors. Recent studies have shown that the positive or negative role of corridors could be linked to the context and particularly to the frequency of disturbances. Indeed, when these are frequent, corridors can contribute to reducing the fixation of alleles beneficial to a species, whereas when they are rare, they increase it (Orrock 2005). Considering the extent of the disturbances on the Malagasy ecosystems (Goodman and Razafindratsita 2001; Lowry et al. 1997; Carrière and Ratsimisetra 2007) and the omnipresence of human activities in the remaining forests, we can ask whether it would not be relevant to test these hypotheses in the Malagasy context, before promoting the indiscriminate creation of protected areas covering all corridors.

All these studies only seem to justify further these conservation interventions when, for instance, there is a crucial need to integrate them into the other socioeconomic data, with a view to planning and conserving the land in a sustainable way or even develop it at the same time. The shortage of data should be an incentive to collect more, of better quality and on more relevant issues, rather than serve to make the argument against corridors (Carrière-Buchsenschutz 2006).

The Difficulty of Changing from Rhetoric to Practice: the Economic Argument

The economic justification for extending conservation corridors in Madagascar also reflects a gap between the political objectives and the efficient management of these corridors. Two arguments can be put forward.

Finance for the institutions responsible for the administration of these corridors is not guaranteed. The Malagasy Foundation for Biodiversity could have fulfilled this role, but it seems that the finance supplied by the trust fund will only just cover the recurrent costs of Madagascar National Parks, which manages 1.7 million ha of protected areas (Méral et al., this publication). The question of the financing of these corridors, which is reckoned to be $7 million for the first year, and $2 million of recurrent costs per year, is largely underestimated in the current debates and negotiations. One of the reasons for this is the possibility for the NGOs

and the Malagasy state to resort to direct foreign financing (e.g. conservation contracts and private contributions, among others).

Furthermore, there remains the risk that the process for monitoring and managing the funds, assuming these cover the operating costs of the protected area, might keep the resident populations even further removed from the sources of financing. Indeed, the sums mentioned above concern only the operating costs of the institutions responsible for managing the protected areas, and not the opportunity costs endured by the local populations as a result of the restrictions thus created. What will be the compensation rules and measures for the locals? What shall constitute the ground rules for the maintenance of the forest cover which is required to obtain financing? All these questions, already the subject of debate among institutions responsible for securing permanent funding, are not tackled in the post-Durban deliberations. As an example, the surface of the core area of the Ankeniheny-Zahamena corridor (See Plate 11) is estimated to be 180,000 ha by the decree which established it. Confronted with such considerable surface areas, greater attention should be given to these crucial issues. Whereas evaluations performed on the existing network indicate a deficit in the compliance of the resident populations who only partially understand (and sometimes not at all) the advantages of conservation, the creation of vast protected areas – of the corridor type – appears somewhat irrelevant from the perspective of the challenges of sustainable development.

Conclusion

The corridor creation policies implemented in Madagascar are a good illustration of the persistent vagueness surrounding scientific knowledge and an actual corridor concept that could, under better circumstances, constitute an innovative rupture in the classic models of conservation.

Finally, although they may appear as novelties, corridors are part of a conservationist strategy based on a top-down approach, within which sites are identified only according to ecological criteria, with the sole intention of increasing the extent of protected areas. A bottom-up approach would integrate the human factor, with its social and cultural values, into the implementation of new corridors, thereby improving their management methods and efficiency in terms of both conservation and sustainable development (cf. a formulation of the reticular model in Albert et al., this publication).

By trying to apply the corridor concept in countries with very different levels of development, there is a considerable risk that greatly contrasting results, or even undesirable and unexpected side-effects, will be obtained. Implementing and expanding corridors within the framework of the Pan-European Ecological Network (Bonnin, this publication) for example, does not address the same situation and constraints as in a country of great poverty, such as Madagascar. The objectives emanating from the Durban Congress, while they appear pertinent

when viewed from the perspective of area protection networking and conservation actors, can remain difficult to implement in developing countries.

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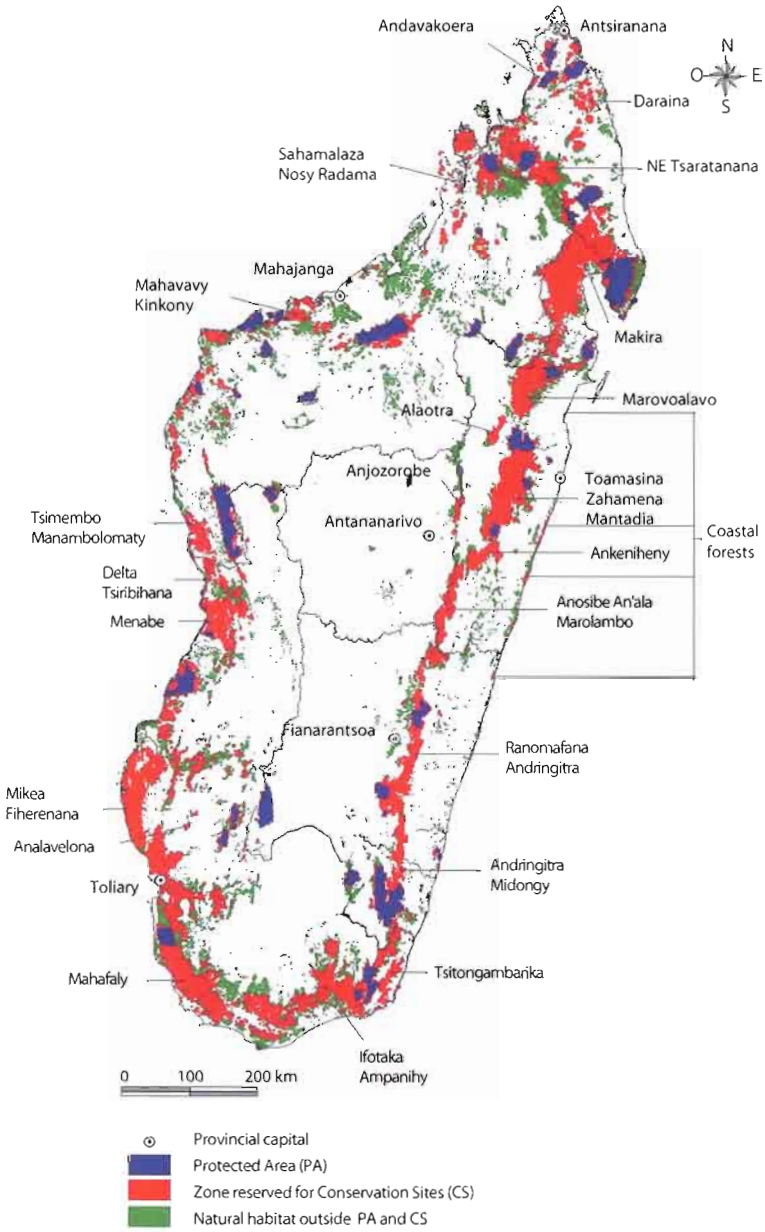

Sources: FTM, CI, WWF, WCS, WCS, ANGAP
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Plate 11 Zones reserved for conservation sites in Madagascar

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