4. PUTTING THE TWO TOGETHER – INITIATIVES

4.1. INTRODUCTION

Ecological networks "…can be an important stepping stone towards a sustainable future." (Wolters and Bouwma, 1998). These need to be planned efficiently and effectively. Store (nd) states that "An efficient instrument is needed for solving complex planning problems and conflict situations related to the use of natural resources." GIS seems to be the best method so far (Store, nd) but its efficiency and effectiveness can be refined and improved by great lengths.

From the previous chapters, it is clear, that both ecological networks and GIS have numerous benefits, each in their own right. The benefit of combining these, to optimise the design of ecological networks would be along the lines of de Bono's logic, where he suggests that the combination of the two is more than the sum of the parts.

In this chapter various case studies are described. Three different levels of scale are outlined with the major initiatives at these respective scales introduced. It is not possible, within the scope of this thesis, to describe all the initiatives or those that are described in great detail. An attempt is made to extract the most fundamentally important aspects with regards to scale and criteria. These can then be translated into a "wish list" (in chapter 5) and system requirements in chapter 6.

Thus far there have been a fair number of attempts (table 4.1) at designing, planning and implementing various ecological networks. These cases are at different stages of implementation and occur at different levels of scale. Enabling the knowledge gain at very different levels. The number of ecological network initiatives will have increased in the last two years.

Continent	Number of networks	Percentage of total
Intercontinental	10	9%
Europe	42	35%
North America	29	25%
South America	16	13%
Asia	12	10%
Africa	5	4%
Australasia	5	4%
Total	119	100%

Table 4.1: Location of known ecological network initiatives (from Bennett and Wit 2001)

4.2. INITIATIVES

Case studies provide a unique opportunity to learn from others. After exploring a case study it is possible to see what worked and what didn't work in a particular case. These cases are

initiatives in ecological networks (or based on the principal aims and or objectives of an ecological network), which are or are not using GIS at various scales. The scales which are considered are: Global, Meso, and local scales. Global scale considers the problem on a worldwide level. At the global scale one initiative—The Global 200 Programme—is considered, and a further number of organisations, which provide *ecological knowledge networks* are considered. Meso scale considers the problem from a continental, sub continental and multi national point of view. At a meso scale, a European case—Pan-European Ecological Network—and a Southern African Development Community case—Peace Parks—are considered. Local scale considers the problem at a national or sub national level. At a Local Scale, the Dutch National Ecological Network and the South African based Gondwana Alive Corridors, specifically the prototype Cradle-to-Cradle corridor, is considered.

4.2.1. Global Scale:

At a global scale (i.e. earth in its entirety) there are few initiatives in developing ecological networks in a classic sense (as described in chapter 2). Yet initiatives at a larger scale (e.g. European) or much larger—local—scale (e.g. Brabant) have a direct or indirect global impact.

4.2.1.1. The Global 200 Programme

The Global 200 Programme, spanning across all 7 continents, is organised by the World Wide Fund for Nature (WWF). It aims to conserve the broadest variety of the world's species and the ecological and evolutionary processes that maintain the web of life (Bennett and Wit 2001; WWF, nd). The main components of the network are ecoregions, which include core areas, corridors and restoration areas (Bennett and Wit 2001). The Global 200 Programme identified 26 major habitat types within seven biogeographic realms (WWF, nd). Within each major habitat type the most distinctive example of biodiversity in the form of an ecoregion was chosen. These choices were based on the following parameters (WWF, nd):

- species richness
- endemism
- higher taxonomic uniqueness (e.g., unique genera or families, relict species or communities, primitive lineages)
- extraordinary ecological or evolutionary phenomena (e.g., extraordinary adaptive radiations, intact large vertebrate assemblages, presence of migrations of large vertebrates)
- global rarity of the major habitat type

Within each of these ecoregions there are projects to promote sustainable development, or research into what is possible to sustain these ecoregions and the communities that live there. This is a good example of how a global scale project transcends the scale levels down to local scale, which the communities, at grassroots, understand.

What is happening more and more, at a global level, is the sprouting of many initiatives and organisations that stimulate the growth and sharing of knowledge for the protection of the environment. These could be seen as ecological knowledge networks, an abstract sense of ecological networks[1]. The work surrounding the Earth Summits, held in Rio (in 1992) and Johannesburg (in 2002), is valuable in getting organisations to commit to, and work towards sustainable development. Not to mention, exposing environmental issues to the broader public. UNEP with its numerous projects and publications—for example Global Environment Outlook (GEO – a comprehensive global state of the environment report)— aims to provide "leadership and encourage partnership in caring for the environment" (UNEP). Parallel to this is UNESCO's *Man and the biosphere program*, a World network of Biosphere Reserves. "The World Network fosters exchanges amongst biosphere reserves - for example, research results or experience in resolving specific issues - and facilitates co-operative activities, including scientific research and monitoring, environmental education and specialist training" (UNESCO). Biosphere Reserves can be partly or wholly Ramsar and/or World Heritage Sites. These are generally linked closely to hotspots globally. Based on sound ecological and socio-economic principals, Biosphere Reserves should be included as core areas within an ecological network. Significant knowledge may be gained from this network. This knowledge needs to be included within the design of an ecological network.

In terms of the sharing of specific knowledge about ecological networks in a "classic" sense the European Centre for Nature Conservation (ECNC) is recognised as a main centre of expertise (Machado, 1996). But the ECNC does most of their work at a European level.

4.2.2. Meso Scale

Ecological processes do not end at man-made administrative boundaries but span continents and the Globe. The migratory processes of some large mammals and birds do just that. A prime example is the annual migration of the wildebeest (*Connochaetes taurinus*) (Last Refuge 2001) across the African plains of the Masai Mara, in Kenya, and the Serengeti, in Tanzania. Two birding examples are that of the European Swallow (*Hirundo rustica*) which breeds in Europe migrating south to Africa (McLachlan and Liversidge, 1978, pp 348), and the Arctic Tern (*Sterna paradisaea*) migrating from Europe and America to the Southern African, west and south coasts. A bird originating in Greenland was recovered at Doringbaai (South Africa) 12 500 km south of Greenland (McLachlan and Liversidge, 1978, pp 213). These migrations will be (and are) facilitated with the development of ecological networks at this scale.

[1] These are beyond the scope of this thesis.

4.2.2.1. European Union (EU):

> "*By setting clear targets that can be tracked and evaluated over the next several years, European leaders will demonstrate their commitment to achieving an environmental renaissance in this complex and dynamic region*," Klaus Töpfer, Executive Director of the United Nations Environment Programme. May 2003

As a direct result of the decline in Europe's biodiversity (Bennett & Wolters 1996) the European community developed a proposal for a European Ecological Network – EECONET. This evolved further; at the Maastricht conference, held in 1993, into "The ECCONET Declaration" which was adopted by the conference (Bennett & Wolters 1996). The Declaration states that there was a need for a *European Biological and Landscape Diversity Strategy* (PEBLDS). The Strategy was adopted at the Ministerial Conference 'Environment for Europe' in October 1995 (Bennett and Wolters, 1996; Prillevitz, 1996). The Strategy encompasses the development of a European Ecological Network (Council of Europe *et. al.* 1996) amongst other items. The Pan European Ecological Network (PEEN) is allegedly considered one of the most important means to implement the strategy (Foppen *et. al.,* 2000). The identification of the PEEN forms a crucial part of the Kyiv Resolution on Biodiversity[2] (Environment for Europe, May, 2003). Indicating that PEEN is at the forefront of the European initiative to conserve and rehabilitate a functioning landscape.

4.2.2.1.a. Pan-European Ecological Network (PEEN)

Since its inception in 1995, the Pan-European Ecological Network (here after called PEEN) has received a lot of political attention and support (Foppen *.et. al.* 2000), and is driven by the European Centre for Nature Conservation (ECNC).

Europe is made up of a series of small countries, which means that there are a large number of governments and organisations to coordinate. Despite this the PEEN project has progressed significantly. In October 2002 Rob Wolters (ECNC's Executive Director) presented an indicative map (figure 4.1) of the location of the European Ecological Network for Central and Eastern Europe. Wolters stated "The map should be used in a wise way. It is not a blue print. It indicates the location of nature values of European importance, but does not show the ecological networks of national and sub-national importance. It is the complete picture of ecological networks on all geographical scales that ensures a sustainable future for Europe's nature and biodiversity" (ECNC 2002). PEEN provides ecological coherence between relevant areas in an effort to enhance the projection and restoration of a robust and well chosen system of natural and semi-natural areas.

[2] Adopted in May 2003, at the 5th Ministerial Conference 'Environment for Europe'.

To create the indicative map (figure 4.1), many different data sources and formats in numerous disciplines needed to be integrated. For the first time information of ecosystems, habitats, and species had to be brought together within one coherent European methodological approach (ECNC 2002), according to the development criteria (see Box 4.1). This was (and still is) a major undertaking, as data had to be located, after which permission for its use, copy write, authorisation, and payment for each and every dataset had to be obtained (Bouwma *Pers.Com* 2002). Not to mention aligning the classification methods/types of datasets (Bouwma *Pers.Com* 2002). For example, land use, originating from different sources, and countries. Besides this, for a number of ecosystems and species, data and, or information was very poor or lacking (ECNC 2002). In some countries the data was more abundant than others (ECNC 2002). Weiers *et. al.* (2003) state that this lack of consistent, up-to-date information on biodiversity is a major constraint for the European biodiversity strategy, so also the development of PEEN.

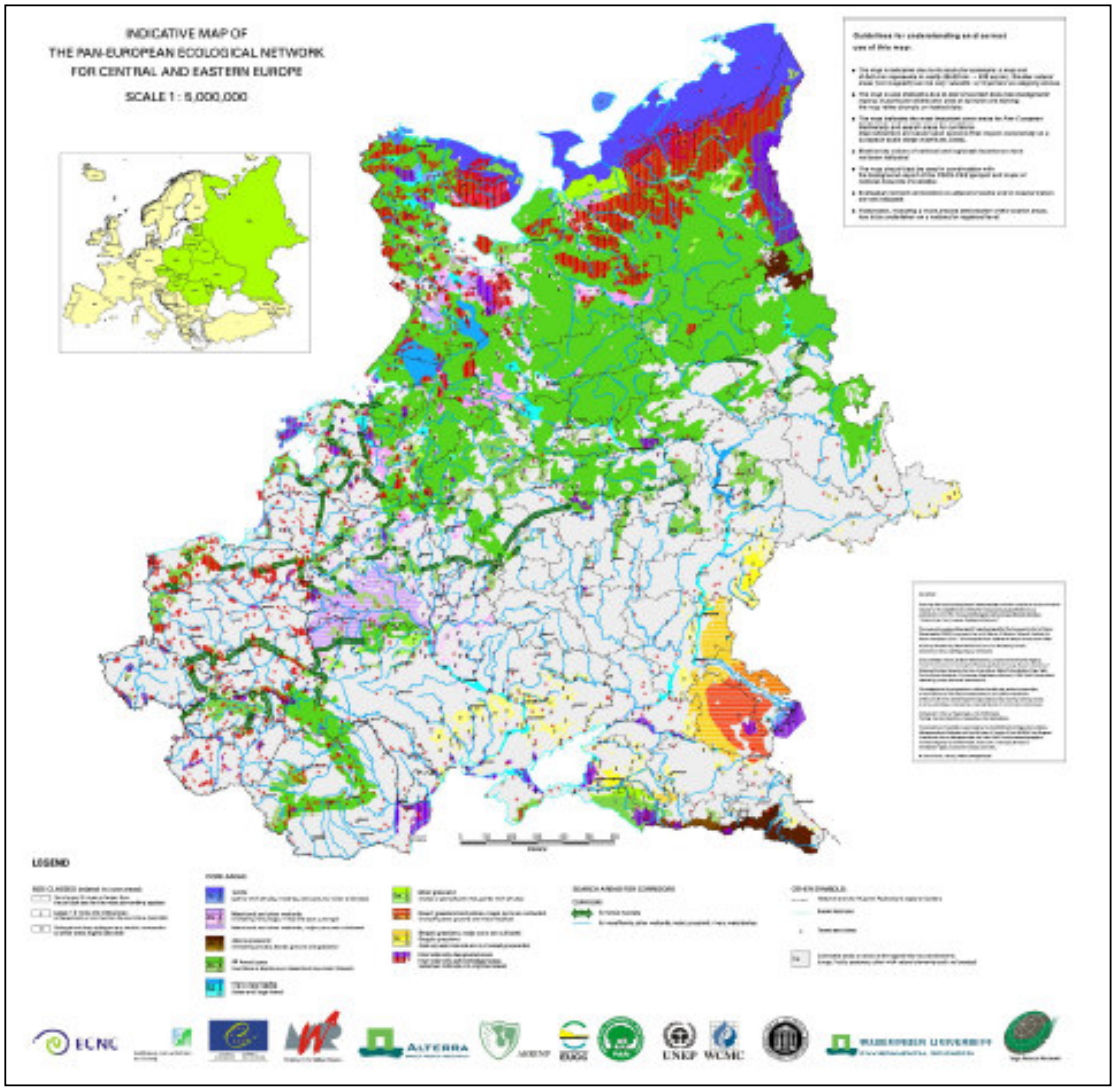

Figure 4.1: The Indicative Map of the Pan-European Ecological Network for Central and Eastern Europe. (Bouwma *et. al.* 2002)

The development criteria of the Pan-European Ecological Network is based on "sufficient insights in:"

i. the location of species and ecosystems of (Pan)- European importance;
ii. their importance for biodiversity (e.g. based upon rareness or uniqueness;
iii. their status in terms of threats;
iv. the vital environmental conditions to safeguard their habitats, and
v. the requirements in terms of area size and or connections that enable exchange of species between areas.

Box 4.1: Criteria used for development of PEEN (ECNC 2000a)

Despite the technical, organisational and logistical problems, Bouwma says that this project would "not be possible without the use of GIS" (*Pers. Comm*. 2002). PEEN is an all-encompassing network, including many other areas. It is and will be highly complementary to those networks being established (or in preparation) as the Natura 2000 Network and the Emerald Network (van Opstal 1998). This network is based on a more coherent methodology as the "…criteria are specific, unifying and strictly applied on all species and ecosystems…" (van Opstal 1998). These criteria have been modified and included in the digital interviews for evaluation (a summary of the results can be found in Appendix 1).

For a detailed explanation of the criteria, refer to van Opstal, 1998 (STRA-REP (98) 20). Since PEEN encompasses Natura 2000 – and the Emerald – Networks, these are not considered separately here.

4.2.2.1.b. LYNX (*a Special Interest Network on Ecological Networks*) project

Under the auspices of the LYNX (*a Special Interest Network on Ecological Networks*) project (in 1996) the ECNC secretariat have set up a Database on Expertise in Ecological Networks[3] (DExEN) (ECNC 2000). The database lists 119 specific different fields of expertise, which can be generalised into approximately 45 categories. These categories form one of the bases of the criteria, which appear in the digital interviews (a summary of the results can be found in Appendix 1). This gives some indication of the huge amount of knowledge needed to effectively design an ecological network.

In contrast with the numerous initiatives happening in Europe, there are few in the Southern African Development Community.

[3] Note: This database is no longer maintained.

4.2.2.2. Southern African Development Community (SADC):

> *"An Arc of diversity, both ecological and cultural, spans the sub-continent of Africa. It stretches from coast to coast, and desert to wetland, where rivers have cut deep into the continent's substrate. This arc is straddled with ecosystems traversing international boundaries, providing glimpses of animal movement from days gone by.*
>
> *In addition to the wildlife that roamed the sub-continent, there were ancient cultures that made use of the alluvial deposits from the meandering rivers. Traces of these societies have given an extra dimension to a string of diversely rich habitats that, although crossed by man-made boundaries, remain undisturbed by them."*

Box 4.2: Peace Parks Foundation on Southern Africa (from: Peace Parks Foundation (2001))

Strictly speaking there are no initiatives creating, what is termed, ecological networks in the Southern African Development Community. Eco-systems traverse man-made borders (PPF), necessitating the creation of "Transboundary" or "Transfrontier" parks, which numerous countries are working on. The number of conservation areas which span international borders has more than doubled in the last ten years, from 59 in 1988 to more than 169 in 2001 (Runyan, 2003). These International parks often provide crucial habitat to many species by breaking down artificial barriers to migration and bringing together fragments of protected land. A pioneer in creating these international parks is the Peace Parks Foundation.

4.2.2.2.a. Peace Parks Foundation

The establishment of Peace Parks (or TFCA's[4]) allows ecosystems to function unhindered by man-made boarders (mostly international boarders). Co-management of an eco-system as a whole, tremendously benefits the species that inhabit it. It ensures the flow and integrity of the previously impeded gene pools (PPF, n.d.). Genetic isolation is perceived as one of the biggest dangers to sustainable conservation. The Peace Parks concept, re-unites isolated protected areas, which, in turn, guarantee healthy and stable wildlife populations (PPF, nd). The concept reduces landscape fragmentation and improves the gene pool. That is, it has at least two of the same functions as an ecological network.

It is a known fact that opening of man-made borders [especially in Africa] eventually leads to the re-establishment of the ancient migratory patterns of the area's (Africa's) wildlife (PPF, nd). A third parallel to ecological networks.

[4] The abbreviation TFCA stands for **T**rans**f**rontier **C**onservation **A**rea, in other words, a cross-border (usually international) park.

At present 8 TFCAs are in various stages of implementation and development, in the SADC region (Figure 4.2).

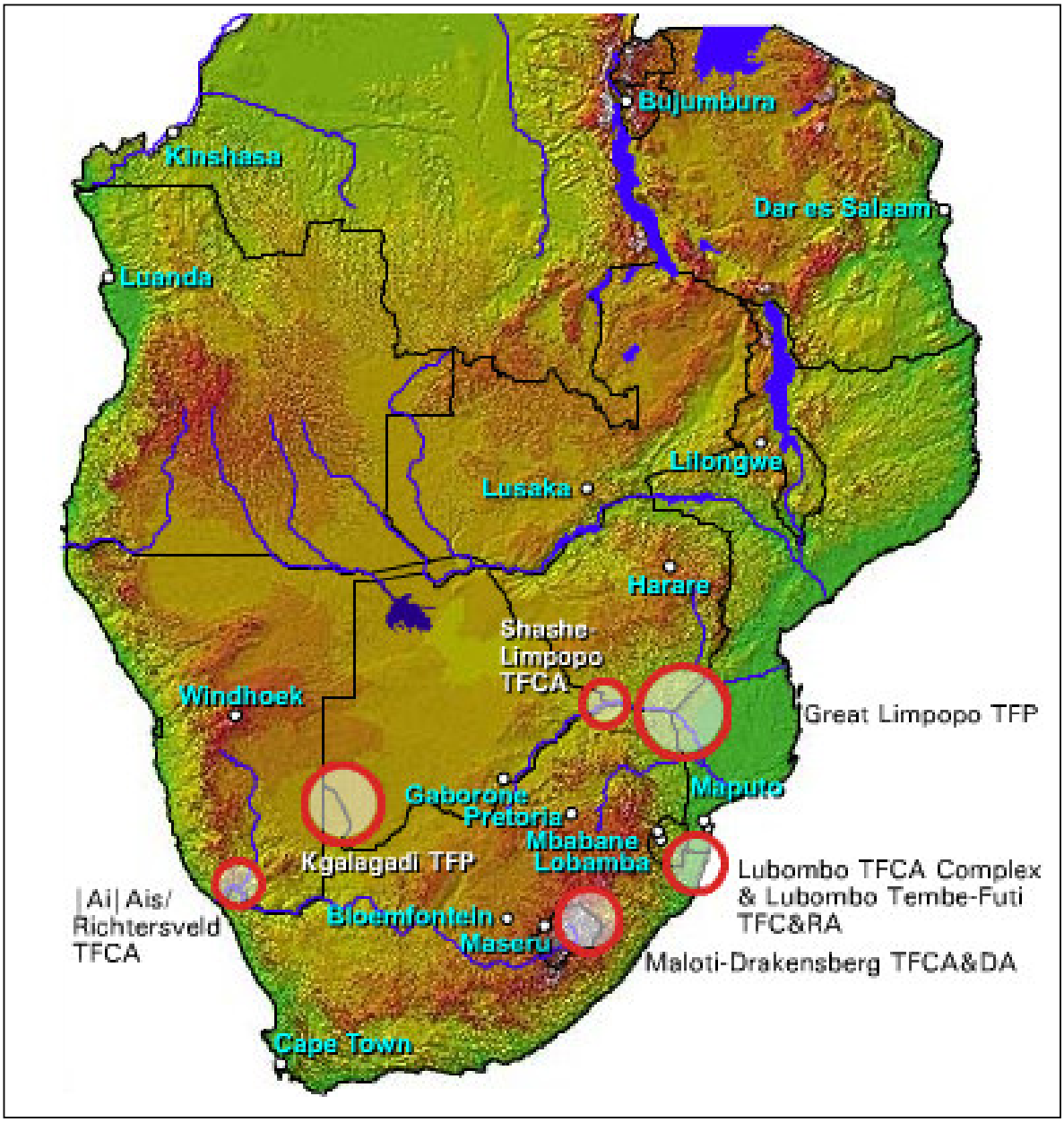

Figure 4.2: Transfrontier Conservation Areas within SADC.

Each of the TFCAs, require extensive planning to facilitate their management and ensure sustainability. This requires a working spatial knowledge of the conservation area concerned. This is required, in order to provide the advisory and technical committees with the correct information, for the decisions they are required to make. The most effective and efficient means to this spatial knowledge is through a Geographical Information System (GIS) (PPF). Each of the TFCAs follow a similar planning route (Box 4.3).

Once each of these TFCA's have been established and are sustainable, the idea is to link the parks in the form of a sub-continental ecological network (figure 4.3). Beech & van Riet (2003) state that "… there is now an opportunity to link these ecological and cultural footprints [TFCAs]". Thus having started at a local, abite cross-border scale, in numerous places, it is the Meso-Scale picture (figure 4.3), which drives the foundation.

"*An area, known as Coutada 16, straddles the border between Mozambique and South Africa forming part of the proposed Gaza-Kruger-Gonarezhou TFCA (Figure 4.2). In pursuing its proposal, the Foundation acquired hard copy geographic data and USGS satellite imagery relating to territory on the Mozambique side of the border. Various environmental features were stored in a GIS and evaluated for their biodiversity and their sensitivity to disturbance. According to the foundation (2001), the touristic value of the region was also assessed using GIS techniques. To locate rural settlements, Landsat 7 imagery was georeferenced, mosaicked and manipulated in ERDAS image processing software.*

Spatial tools and techniques were instrumental in developing a land use 'zonation' plan for Coutada 16. This zoning helps those who manage natural resources make sound decisions regarding land use practices, thereby ensuring long-term sustainability. The foundation hopes that this approach will re-establish ecological diversity, both by facilitating animal migration movements that are unimpeded by man-made boundaries and by promoting alternative forms of rural land use."

Box 4.3: Planning a TFCA (from: Peace Parks Foundation, 2001)

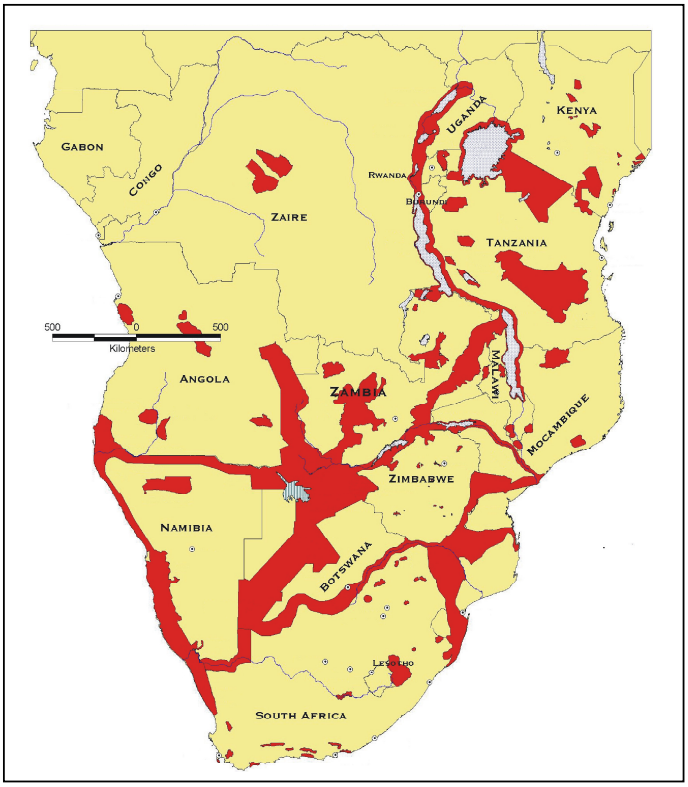

Figure 4.3: Peace Parks - the dream (from PPF)

4.2.3. Local /national scale

The study of large complex networks and ecosystems may help ecologists answer certain questions. However Jordán and Scheuring (2002) maintain that, for the evaluation of the role of species in a community, a more local view of interspecific interactions needs to be taken. Many studies are (and have been) taking place at this level. The question really is whether the findings found at one study site pertain for all areas. None the less, there are many ecological network initiatives taking place at a local scale. These are easier to manage and implement, as there are less stakeholders and regulations and/or policies which need to be considered. Ideally though, these local networks need to form part of the meso and global scale networks (figure 4.4).

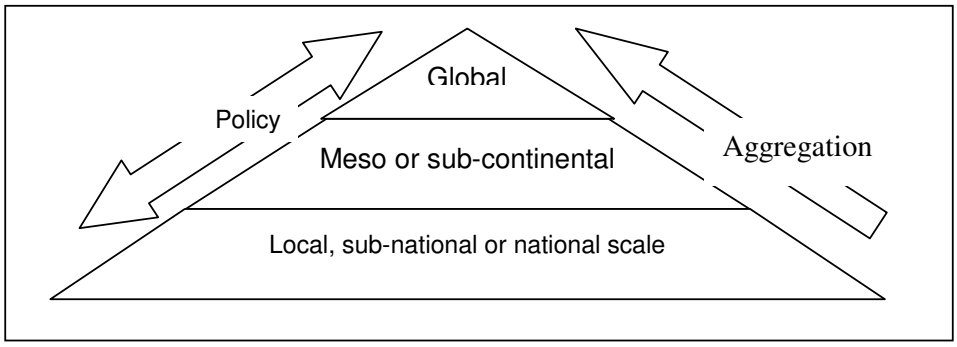

Figure 4.4: Interaction between varying scaled networks.

The Global Biodiversity Strategy (1992) states "…given the global nature of the biodiversity crisis…" is a global problem however "Effective conservation efforts begin in the fields, forests, watersheds, grasslands, coastal zones, and settlements where people live and work," (Global Biodiversity Strategy, 1992). This, however, cannot be done in isolation. The effects have repercussions, be they positive or negative due to the nature of the system[5]. Thus starting at grassroots level within the global context is necessary. There must be support, firstly from National (Governments), then Multi-national (Council of Europe, European Union, SADC, NEPAD) and ultimately global organisations (WWF, UNEP) for these initiatives.

4.2.3.1. The Netherlands

The Netherlands is recognised as European leaders in the construction of “ecological networks” (lifeeconet, 2002). The concept of a National Ecological Network, in the Netherlands, was introduced in the Nature Policy Plan (RIVM, 2002). This policy was approved in 1990 (RIVM, 2002; Lammers and van Zadelhoff, 1996; Jongman and Kristiansen, 2001), with the creation of the national ecological network playing a major role in the policy.

[5] The system being that of a number of interrelated subsystems within other subsystems (e.g. The earth in the planetary system; our solar system within the galaxy within the universe.)

4.2.3.1.a. Ecologische Hoofdstructuur (EHS)

The Ecologische Hoofdstructuur's (EHS) aim is to reverse the deterioration of natural ecosystems in the region. To create a spatially coherent environmental network, linking areas of high conservational value (Lammers and van Zadelhoff 1996)—an ecological network (see chapter 2).

To be able to decide on the location and kind of elements which need to appear in the components of the network, criteria needed to be determined. The development of the National Ecological Network was based on the following general criteria (Lammers and Zadelhoff, 1996):

- Selecting a representative set of ecosystems of (inter) national importance;
- Increasing the size and connectivity of (semi-) natural ecosystems;
- Taking account of landscape-ecological relations.

The more specific criteria are linked to the main components of the network.

Core areas: designated areas where the ecological value is of national or international importance provided they cover at least 500 ha (in the case of natural areas at least 250 ha, in the case of coniferous forests at least 1000 ha) (Lammers and Zadelhoff, 1996; Bennett and Wit 2001). These include the presence of (inter) nationally rare or threatened fauna and flora (Jongman 1995). These areas include agricultural areas of historical and scenic value, large lakes and parts of the Wadden Sea and North Sea. (Bennett and Wit 2001)

Ecological corridors: are areas that facilitate migration and dispersal between core areas (Lammers and Zadelhoff, 1996; Bennett and Wit, 2001). These are often based on linear features such as old canals, dikes, creeks and hedgerows (Jongman and Kristiansen, 2001) and can be of different types as described in chapter 2.

Buffer zones: are areas that help to create sustainable conditions enabling the desired ecological value to be reached or maintained within the ecological network (Bennett and Wit 2001). These areas protect the network against desiccation and pollution (Lammers and Zadelhoff, 1996).

Nature development areas: are areas that offer realistic prospects for the development of ecological values of national or international significance (Lammers and van Zadelhoff, 1996; Bennett and Wit 2001). These areas are selected on the basis of natural characteristics e.g. soil, hydrology and relief (Jongman and Kristiansen, 2001), adding greater potential to the network, if they are developed close to already existing core areas.

Part of the Criteria for the National Ecological Network is to protect species. Priority is given to threatened or vulnerable species; Species for which the Netherlands carries a special

international responsibility; Species which have seriously declined due to loss of biotope; and Rare species in biotopes characteristic of the Netherlands.

In the development of this National Ecological Network a number of primary conflicts and opportunities came to the fore. The primary areas of conflict developed between biodiversity conservation and the following (Bennett and Wit 2001):

- Recreation and tourism;
- Urbanisation;
- Agriculture (acidification, eutrophication, soil contamination and disturbance, lowering of water tables);
- Industry;
- Infrastructure;
- Defense;
- Mineral exploitation;
- Certain forms of Forestry;
- Groundwater extraction;
- Fishing; and
- Hunting.
-

This is a much longer list than the one of the opportunities, which arose (Bennett and Wit 2001):

- Agriculture: Management agreements;
- Recreation/tourism: Landscape conservation;
- Infrastructure: Ecological development of roadsides, ecotunnels;
- Mineral extraction: nature development along rivers.

Not with standing the conflicts, the development of the National Ecological Network in the Netherlands has progressed well. The map, below (figure 4.5) is the proposed broad outline for the Dutch National Ecological Network. The whole network should be implemented by 2018 (Bennett and Wit, 2001).

4.2.3.2. South Africa

In South Africa there is as yet no initiative to create an ecological network in the classic form. The ideas and knowledge generated by the development of ecological networks elsewhere is being utilised in adapted forms. One such initiative, which is not strictly only a South African project, is the Gondwana Alive Corridors. The Prototype Corridor is however a South African one.

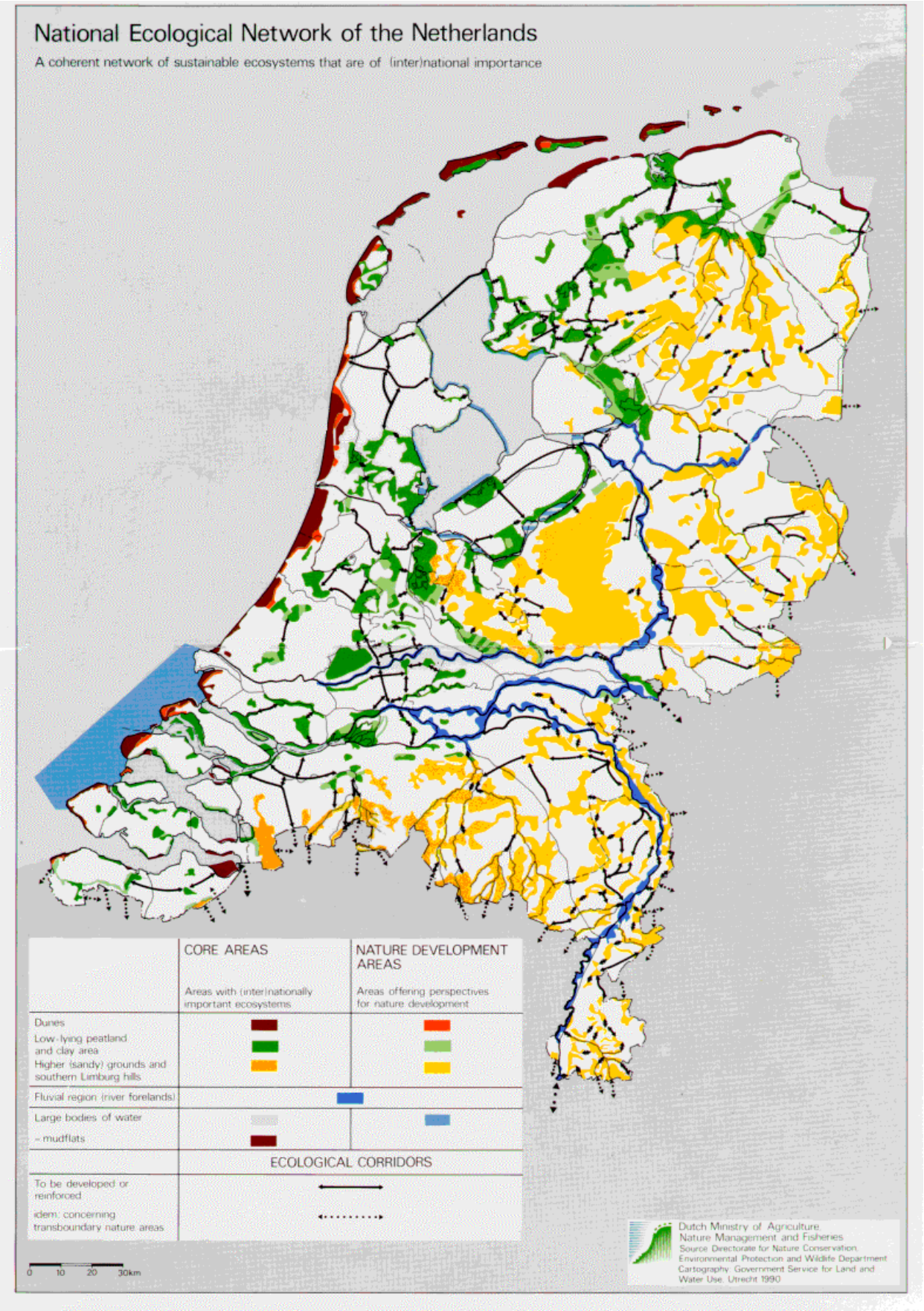

Figure 4.5: The Dutch National Ecological Network (from Lammers and van Zadelhoff, 1996)

4.2.3.2.a. Gondwana Alive Corridors

The Gondwana Alive Corridors are not a typical example of an ecological network. The concept operates on both local and Gondwana wide scales. Anderson and de Wit (2003) envisage "…an unbroken girdle–or, more precisely, network–of corridors spreading across the family of Gondwana continents…". Each of these corridors consists of two basic elements: a core theme and holistic management.

More specifically a corridor (Anderson and de Wit, 2003):

- May extend up to approximately a 1000 km in length and 50 km in width;
- Will be an autonomous unit, yet integrated in the greater network;
- Can be visualised as a belt of landscape incorporating hotspots;
- Will be managed holistically to ensure that persons involved (at all levels) take pride, curatorship and proprietorship of the corridor.
- Will allow equal right to existence for all plant, animal and biological communities.

Each corridor will be scientifically and spatially delineated according to its core theme. But not excluding the crucial bio-physical criteria for a sustainable and functioning ecosystem. It is envisaged that a spatial, analytical model will be created (van Wyk, *Pers. Comm.*, 2003). This model will allow for the selection of a "theme" variable, along with the numerous criteria, necessary to ensure a sustainable and functioning ecosystem. This will standardise the development of the corridors along sound scientific principals. The first version of this model will be tested on the prototype Corridor — Cradle of Life to the Cradle of Humanity Corridor (van Wyk, Pers. Comm., 2003).

The Cradle-to-Cradle Corridor is located in South Africa. It tracks a journey through two thirds of Earths geological history. Starting at the "Cradle of life" in the Barberton Greenstone Belt (3,570–3,060 Ma) (Anderson and de Wit, 2003), through geological time and ending at the "Cradle of Humanity" at the Sterkfontein World Heritage Site (3,5 – 1,0 Ma)—richest of all fossil hominid sites in Africa (Anderson and de Wit, 2003).

The Cradle-to-Cradle Corridor is one of 15 prototype corridors (Figure 4.6) proposed (Anderson and de Wit, 2003). This list has subsequently been extended to 40 Corridors (Anderson, Pers. Comm., 2003), each having a unique theme.

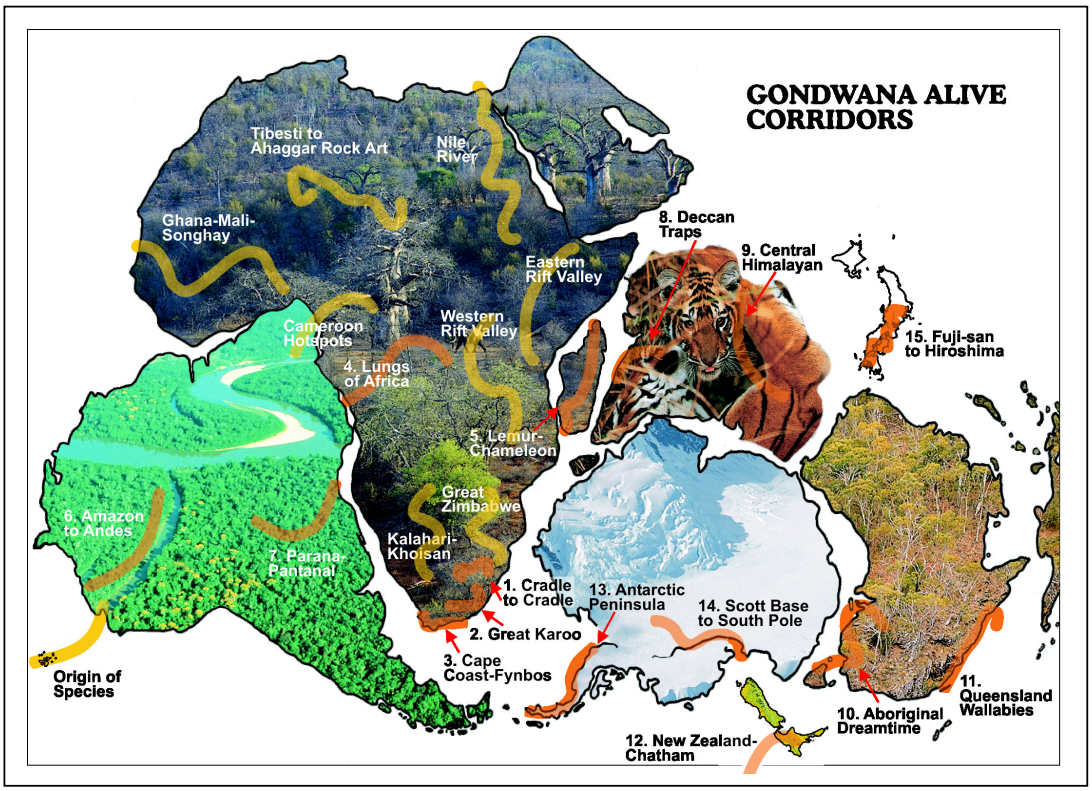

Figure 4.6: 15 prototype Gondwana Alive Corridors.

4.3. SUMMARY

The general criteria, which are apparent in the selected initiatives are summarised below in table 4.1. The "y" indicates the criteria's presence in the case study. These criteria are the bases for the criteria in the digital interviews (see Appendix 1) of which the results will be analysed in chapter 5.

	Global 200 Programme	**Pan-European Ecological Network**	**Peace Parks or Trans-frontier Conser-vation Areas (TFCAs)**	**Dutch National Ecological Network (EHS)**	**Gondwana Alive Corridors**
location		y			
scale	y	y	y	y	y
area size		y		y	y
proximity				y	
Rareness / uniqueness / importance	y	y		y	
endemism	y				
species	y	y	y	y	
rare or threatened fauna and flora	y	y		y	
land use			y		
habitat	y	y	y		
ecosystems		y		y	
biodiversity / ecological value / richness	y	y	y	y	
vital environmental conditions / natural characteristics		y		y	y
sensitivity to disturbance			y		
sustainability			y	y	
landscape fragmentation			y		
connectivity		y		y	
exchange of species / dispersal		y		y	
migration movements	y		y	y	
extraordinary ecological or evolutionary phenomena / the touristic value (e.g., extraordinary adaptive radiations, intact large vertebrate assemblages; agricultural areas of historical and scenic value)	y		y	y	y
landscape-ecological relations				y	
integration		y	y		y
hotspots / existing protected areas		y	y	y	y
Holistic management			y		y
community involvement			y		y
theme					y
equal right to existence					y

Table 4.2 General Criteria of the selected initiatives

Only a selection of initiatives occurring at different levels of scale have been described. This description is by no means exhaustive, or highly detailed. For a further review of some of these and other ecological network initiatives, currently being developed or implemented see Bennett and Wit (2001).

In many cases it is not explicitly stated as to what criteria or methodology is used to arrive at the result. However, in most cases, there is at minimum, a broad description of the criteria used. Irrespective of the scale of the initiative, the most common criteria across the board are: species; biodiversity / ecological value / richness; hotspots or existing protected areas; and extraordinary ecological or evolutionary phenomena / the touristic value. It is apparent that different approaches were used in the development of the initiatives as some of the criteria differ, including the terminology used to describe them.

It is interesting to note, that within the criteria, it is apparent that the initiatives in the developing world (in Africa) explicitly state the need for community involvement. In contrast to those initiatives of the developed world, for whom, perhaps it is implicit.

Numerous criteria are implicitly spatial orientated. This would suggest that spatial technologies are (were or should be) utilised in the analytical process. Many initiatives (described here and elsewhere) don't state that they used GIS, but from the accompanying maps and criteria, it is quiet clear that some form of GIS was used.

These criteria have been sourced in the review of the initiatives form the basis of the digital interviews, which were sent to an expert knowledge base. The results of these interviews are examined in chapter 5.

The combination of environmental modelling, planning and GIS, extends perception further than previously possible (Mackey nd). It is these possibilities, which allow for better planning of the environment. Some of these possibilities have been utilised in the initiatives described, especially in PEEN. It is this combination, which facilitates the design of ecological networks—part of stemming the Sixth Extinction.