Traditional forest reserves and their contribution to conservation biology in Babati District, Tanzania

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Abstract

Traditional forest reserves are protected natural forests established by ancestors to perform many socio-cultural functions and are protected in accordance to customary laws, not based on government legislation. These reserves generally have a long history with well preserved forests that could demonstrate what the surrounding environment could have looked liked, if humans had not altered it. Therefore, the traditional forest reserves might have significant ecological value and a potential high biodiversity. During February and March of 2009 a field study with semi-structured interviews and field observations was carried out in Babati District in Manyara Region in Tanzania, to study the possible contribution TFRs might have to conservation. The information collected were then analysed using Metapopulation Theory, Island Biogeography Theory and local knowledge concepts. The analysis indicates that there is a higher biodiversity in TFRs compared to surrounding areas and unprotected forests as a result of a rigid traditional protection that local people respect. Further on the MPT and IBT show how TFRs could benefit conservation as islands of refuge for threatened species or as migration corridors between nearby forest reserves and national parks. The future for TFRs and possible conversion into CBFM must include respect and support for the local beliefs as a basis for protection and thereby conservation.

Keywords: Metapopulation Theory, Island Biogeography Theory, local knowledge, indigenous knowledge
Abbreviations

BBD – Babati District
CBFM – Community Based Forest Management
FR – Forest Reserve
NFR – National Forest Reserve
SSI – Semi-Structured Interview
TFR – Traditional Forest Reserve
MPT – Metapopulation Theory
IBT – Island Biogeography Theory
TEK – Traditional Ecological Knowledge
JFM – Joint Forest Management
Ha - hectares
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1. Introduction
1.1 Background

During the last century, natural ecosystems changed into ecosystems dominated by mankind. The use of biodiversity provided a great benefit to man, but the consequences of short term use of ecosystem resources are now showing, for example through loss of biodiversity, degradation of ecosystem services that we depend on and spreading poverty. According to the Millennium Ecosystem Assessment, biodiversity benefits people through more than just its contribution to material welfare and livelihoods. Biodiversity contributes to security, resiliency, social relations, health, and freedom of choices and actions (Millennium Ecosystem Assessment 2005).

The value of biodiversity in an ecosystem can generally be valued in two ways; use values and non-use values. The use values can be divided into additional groups as direct-use values and indirect-use values where the former consist of food, medicine, biological control, industrial material, recreational harvesting and ecotourism. Indirect-use values can consist of creating an environment that can sustain life, for example by cycling gigatonnes of vital elements such as carbon, nitrogen and oxygen. The indirect-use value of biodiversity is based on the many functions it performs that are crucial for human existence. Other recognized ecosystem services that have indirect-use values are nutrient cycling, pest control, photosynthesis, pollination and soil formation and maintenance. Another aspect of the indirect-use value includes all the species further down the food chain, that support the species that we consider to be of direct use and of economical importance (Gaston & Spicer 2004).

The non-use values are biological resources that are neither used directly or indirectly. They can be divided into at least four components. First is the optional value that says that biodiversity should be maintained for possible future use. There could be great potential in many species concerning medicinal or industrial use that we cannot grasp yet. Secondly the bequest value states that biodiversity should be passed on to the next generation in an intact condition because justice demands it. Third, the existence value states that biodiversity or single species may have a value although it may not come to any good use for people. Classic examples here are big mammals. A lot of people value them although they probably will
never see one or have any benefit from them; nevertheless their pure existence is valued. And
last is the intrinsic value that says that, apart from all the former values that rest on human
principles, biodiversity can have values independently of human valuation (Gaston & Spicer
2004).

Only within the last hundred years, the earth’s forested areas have shrunk from an estimated 5
billion hectares to today’s 4 billion hectares (Global Forest Resources Assessment 2005). According
to the World Resources Institute (WRI), the majority of the forests that are left standing are highly disturbed or only small patches of what they use to be. Only 40 % are
classified as relatively undisturbed from human activities and big enough to sustain their
biodiversity (World Resources Institute 1997).

The strain on today’s remaining forests continues with an increasing demand for firewood and
lumber for paper and building material. One of the most important issues is the fuelwood
consumption in the developing world. According to FAO’s forest statistics (ForesSTAT)
early 75% of all forest harvested in the developing world is used as fuel wood. In Tanzania
wood fuel accounts for 80% of the total energy consumption (Millennium Ecosystem
Assessment 2005).

Tanzania has a large and valuable forest resource that is the basis for many economic
activities, especially in rural areas, and for the economic development of the country as a
whole. Although forests have played an important part in the development of Tanzania, the
situation today calls for attention for environmental problems such as deforestation and forest
degradation. The consequences of this unsustainable land use in form of shifting agriculture
and the need of people to fulfill their basic needs have resulted in forest degradation, loss of
biodiversity and decline in forest products such as fuel wood (National Forest Program in

Along with the Democratic Republic of Congo, Indonesia and Brazil, Tanzania has been
declared a “megadiversity” due to its high biodiversity thanks to a great variety of habitats.
This biodiversity exists both on an ecosystem, species and on a genetic level. Although
Tanzania has already allocated over 25% of its total land area for national parks, game
reserves and game controlled areas, increased pressure is put on the forests through intrusion
and changing habits in agriculture which results in a loss of natural forest cover and forest biodiversity (National Forest Program in Tanzania 2001-2010, 2001).

In Tanzania 38% (33,5 million ha) of the land area consists of forest and woodlands. Approximately 13 million ha of the 33,5 million ha are protected as forest reserves. Accounted for are then 83,000 ha of industrial plantation and 1,6 million ha of strategic forests in the form of water catchment areas or mangrove forests. The strategic forests are managed and owned by central and local governments through the Forest and Beekeeping Division in the Ministry of Natural Resources and Tourism. Of those 1,6 million ha of strategic forest, 600,000 ha are managed by local governments. Forest on general land that is not under any forest reserve protection estimates 20 million ha. Private and community forestry consist of farm forestry, natural forest on leasehold lands, traditional forest areas and specific trees. The National Forest Policy says it is important to work for a more private and community based forestry, including village forest reserves. The area under private and community forestry is estimated to be 70,000-150,000 ha including small community woodlots with a size of up to 1 ha (National Forest Program in Tanzania 2001-2010, 2001).

Apart from forest reserves established on a national or district level with a top-down management like national forest reserves, there are additional reserves in Tanzania, many of them not mentioned in village by-laws or other governmental laws. These reserves, termed traditional forest reserves (TFRs), are managed under traditional and customary laws and according to Gerdén & Mtallo (1990) generally well preserved with intact natural forests. The geographical extent of the traditional forest reserves are usually rather small but typically with a long history that could demonstrate what the surrounding environment could have looked like, if humans had not altered it. Therefore, the traditional forest reserves might have significant ecological values, for instance as an area of potentially high biodiversity, as a safe haven for threatened species or environmental value as a source of water or acting as protection against soil erosion. Their very importance in the area of conservation could prove to be essential, for example when comparing the low number of violations made in the reserves compared with governmental forest reserves (Gerdén & Mtallo 1990).
1.2 Aim of the study and scientific questions

The aim of this paper is to study the connection between TFR and their potential contribution in conserving a high biodiversity and also to examine the possible importance of protecting them alongside national forest reserves as a way to ensure an effective conservation strategy. This paper will also examine the size and the geographical distribution of TFRs through the theories of metapopulation and island biogeography. Another aim is to examine if the TFRs are protected and how local knowledge and protection may play an important role concerning district protection of forests. The following questions will try to be answered:

- What is the difference between TFRs and non protected forests?
- How are TFRs contributing to conservation?
- Are TFRs better protected than other forests?
- What role can TFRs play in the future for conservation and maintaining a high biodiversity?

1.3 Method

To answer the questions above the method for this study is a qualitative one. The reason for choosing this method is based on the circumstances and opportunities given in BBD with a limited amount of time and possibilities to visit TFRs. By implementing interviews the aim was to apprehend a broad view of what people’s impression and knowledge was concerning TFRs and thereafter generalize to get a comprehensible result. By doing this, my intention was to pick up the people’s views alongside the biological one to be able to understand the connection between them. Data consist of both primary and secondary sources. The secondary sources are a good balance to the local data collected to put the results in a bigger perspective. All informants interviewed as primary sources gave their approval to have their names published in this paper. The questions were adapted to the person(s) being interviewed and divided into three different groups: locals and elders, district officials and the biologist since they all have different approaches towards TFRs (see appendix). The gender distribution among the people interviewed was unfortunately uneven due to local conditions, as there were only males interviewed. This was nothing that the author of this paper could have affected.
1.3.1 Primary sources

The primary data consist of interviews carried out in BBD in Tanzania in February and March of 2009. The total amount of days used for interviews were nine and a total of nine interviews were conducted with thirteen persons. The results from the interviews from each group (locals, chairmen and elders, district officials and the biologist) were summarized to get a generalized view. The amount of interviews conducted were a result of available time, and there were as many interviews and field observations carried out as time allowed.

To get a general view of what different stakeholders know about TFRs both district officials, a biologist and local people, usually village chairman or elders in the village responsible for the TFR, were interviewed. Four TFRs were visited to get a personal impression about the size, location and composition of the reserves.

All of the interviews, except one interview done by e-mail, have been semi-structured (SSI). This means that they contain a few predetermined questions as a basis and then, depending on the answer, the following questions are adapted. Using this interview method allows the interviewer to establish a relaxed relation to the persons being interviewed and thereby making them comfortable. This will hopefully lead to a relatively open discussion instead of an unwanted interrogation. The interviews have only been recorded with notes on paper and not by any electronic device.

The interviews with the district officials and the biologist (Mr. Kavishe, Mr. Maanga and Mr. Moshi) were all conducted in English without any field assistant or interpreter. The rest of the interviews were done with the help of a field assistant as an interpreter. The interviews were interpreted from English to Kiswahili and vice versa but in one of the cases the interview had to be translated from English to Kiswahili to a local Iraqw language. This, of course, made some small language misunderstandings unavoidable.

1.3.2 Secondary sources

The secondary data in this paper consist of scientific reports, books and to a small extent of internet sources that relate to the subject. To put the case study in BBD in Tanzania in a bigger context, and to be able to answer all of the mentioned questions, some of the literature
concerns global issues and more general theories about conservation biology. The secondary sources have been chosen with respect to their relative interest to conservation, forests and TFRs.

### 1.3.3 Definition of TFR

To be clear about what is a TFR and what is not; this paper adopts the definition used by Gerdén & Mtallo (1990) who in their study drew attention to TFRs in BBD and their possible environmental advantages.

A TFR is according to Gerdén & Mtallo (1990):

“A forested area no less than approximately 0.04 ha which is protected by the residents of the adjacent area in accordance with their customary laws”.

“The existence and management of TFRs are not based on government laws. The TFRs are solely rooted in the local communities”.

### 1.3.4 Study Area

Babati District is one out of five administrative districts in Manyara Region. It is situated in and above the Rift Valley of north-central Tanzania in an altitude range of 945 meter to 2450 meter above sea level (Maanga, unpubl.) and cover an area of 6069 km² with a population of 302,523 (National Website of the United Republic of Tanzania 2009a). The district has two rain seasons; one short period between November and December and a longer one between February and May (Maanga, unpubl.). Parts of the district are very dry, while other parts are semi-humid highlands. Rainfall varies from 500 to 1200 mm annually. The forest type in BBD is typically Miombo woodland, generally found in Tanzania, and with a domination of species like *Brachystegia* and *Jubernadia* (Kavishe, unpubl.).
2. Theoretical framework

2.1 Metapopulation Theory

In MPT one crucial understanding is important. Islands or patches in this case do not have to be islands in an ocean of water; it can be islands on mainland contained due to altitude (mountain tops), soil types or vegetation. When looking at the abundance of species in a certain area, it is crucial to take into account the dynamics of immigrants and emigrants to that area. Most species populations are fragmented and patchy, and the patches themselves differ in size and composition (Hanski 1998). Patchiness is a crucial factor in many ecological processes since there are a lot of interdependences between the patches, for example prey and predator and species that demand a certain habitat to survive. There are two factors that control the abundance of organisms that make up the patches. Firstly, the characteristics of the habitable site, and secondly the dispersal distance of each population. Based on this, population sizes can for example be relatively small due to:

- Few patches that provide the required conditions and resources
- The habitat site supports few individuals
- The habitat site remains habitable only for a short time
- The dispersal distance between different sites (patches) is great in relativity to the potential dispersibility of the species in question (Townsend et al 2003)

Metapopulation theory (MPT) and island biogeography theory (IBT) have a lot in common, and the later was a basis out of which metapopulation theory was formed. The foundation of both the theories is that they show how the distribution of species on islands (that in the case of TFRs consist of different vegetation types in nature) is a balance between extinction and colonization. The concept of MPT is based on patchy and subdivided populations where population dynamics are controlled in two ways. Firstly, the dynamics of individuals within patches and secondly, the dynamics of the occupied patches, where each patch itself has a realistic chance of going extinct, within the metapopulation (Townsend et al 2003). According to Levin’s model (he first proposed the idea of MPT back in 1969), a metapopulation will have a stability as a whole, although none of the local populations are stable in their own, as long as intrinsic rate of colonization exceeds the intrinsic rate of extinction within the patches (Hanski & Gilpin 1991). The birth and death of whole subpopulations and the movement of
species and individuals within the metapopulation are balanced through colonization and extinctions. This way the entire metapopulation may be stable although none of the individually patches are on their own (Townsend et al 2003).

In the case of TFRs, there are generally quite small populations, and the understanding of small populations in the area metapopulation and conservation is rather limited. Small populations are more vulnerable due to high levels of uncertainty, whereas bigger populations can be described as ruled by the laws of average. When it comes to the future for small populations, there are three different kinds of uncertainty. The first one is the demographic uncertainty which describes the varying numbers of male and female individuals that are born, yearly variations in death and reproduction and the genetic quality. Secondly, the environmental uncertainty deals with unpredictable changes in environmental factors such as floods, storms, droughts etc. Thirdly, the spatial uncertainty states that many species consist of more or less discrete patches of subpopulations that might have different dynamics concerning colonization, extinction, environmental uncertainty and demographic uncertainty, that could affect the risk of extinction of the metapopulation as a whole (Townsend et al 2003).

In BBD, and elsewhere in Africa and Tanzania, there is a decrease in habitat area for a lot of species, and this will, according to Townsend et al. (2003), generally result in a reduction of the size of populations and might additionally lead to a risk of more semi-isolated subpopulations. Further fragmentation of habitats can result in a decrease in patch size and distance between them. Here the balance between the fact of connectedness and dynamics between subpopulations becomes important. If the subpopulations, in areas struck by a loss of habitat and an increase in fragmentation, have a high connectedness, then they will have a better chance of repopulating patches where a subpopulation has gone extinct. Therefore, in a certain area, one should not be fooled by the consistency of overall abundance in the whole unit. There might be subdivided units that coexist to make up the metapopulation, and the individually units may have high variations in individuals (Townsend et al 2003).

The metapopulation theory can be a useful tool when looking at TFRs geographical distribution to try to determine the possible dispersal distance for species. Both the dispersal to nearby patches made up of other TFRs as well as the proximity to bigger islands like Tarangire National Park and Lake Manyara National Park or the more nearby national forest
reserves like Ufiome and Nou forest reserves, can be of considerable conservational value. Furthermore, the characteristics of the vegetation in TFRs usually vary from the surrounding areas and this can prove to be important in determining the significance of TFRs as a habitat. The vulnerability of the small populations that generally occupy TFRs and their connectedness are also important to emphasize.

2.2 Island Biogeography Theory

One of the fundamentals in ecology, concerning the subject of species richness, is that the amount of species correlates with the size of the island. Larger areas should be able to support a greater variety of habitats, and all the different species adapted to these environments. Islands in this case, as mentioned in MPT, do not have to be islands in an ocean of water; it can be islands on mainland contained due to altitude (mountain tops), soil types or vegetation for example. But, as put forward by MacArthur and Wilson in their *equilibrium theory of island biogeography* in 1967, there are more factors determining species richness, like the distance to the nearest island and the balance between immigration and extinction. In their theory they put forward a few predictions:

- The number of species on an island should eventually become roughly constant through time
- This should be a result of a continual turnover of species, with some becoming extinct and others immigrating
- Large islands should support more species than small islands
- Species numbers should decline with the increase remoteness of an island (Townsend et al 2003)

The difference between MPT and IBT is that the later is based on the idea of an existing mainland as a rich source of colonists that can occupy (through emigration) smaller islands whereas in MPT the landscape consists of islands without a dominating mainland (Hanski & Gilpin 1991).

Another interesting issue brought up by Townsend et al. (2003) concerning species richness discusses the relation whether richness is only a consequence of the island size, or if the factor of habitat diversity could play an even more important role. Studies show that it depends on
what animal or vegetation group your look at. According to that, the species richness on islands respond differently depending either on the size of the island or its habitat diversity, but the location and distance to nearest island or mainland matters as well. Therefore, an island might potentially support more species than it actually does, because it is limited by remoteness and/or the time to allow new species to colonize (Townsend et al 2003).

Island biogeography theory explains a few important factors that highly concern the abundance of species in TFRs. Firstly, that the distance to the mainland determines the amount of species. But it also highlights the possibility that this might not be the only determining aspect because the habitat type itself could, if a high enough variation in abundance, be an even more essential reason for a high biodiversity. As MPT also established, IBT emphasizes the geographical relatedness to big islands as essential; in this case for example, nearby national forest reserves such as Ufiome or Nou, as well as National Parks such as Tarangire or Lake Manyara.

### 2.3 Local Knowledge

In contrast to the contemporary western view on management of ecosystems and values of non-human species, indigenous groups of people can offer alternative knowledge and views on conservation and management of land, based on their own locally developed practices. Those often differ from the western view where man is seen as self-ruling and in control of the natural world. Their own methods of cultural internalization and traditional practices have developed and this has lead to a more appropriate world view (i.e. more sustainable due to their respect for nature) and cultural values (Berkes et al. 2000). Indigenous people that have lived on and of the same land over a long period of time have generally gathered a broad knowledge base on the local ecological conditions in their area. This knowledge, or information, has been gathered and then passed on from one generation to another. Such historical records can very well be of great value and be complemented with western ecological research. Local use and dependencies on the land for survival and food have led people to establish a stake in conserving the land. Indigenous people are aware of, that a high biodiversity is of great importance to sustain the ecological services that they depend on. And through their way of using the land, like trying to modify it into increasing its heterogeneity for example, sometimes benefits biodiversity. The basis for their practices, indirectly in favor of biodiversity, is probably a progression of rules that came into being through trial and error.
over time. This kind of local knowledge can sometimes collide with the western way of seeing ecosystem management. That said; it is still important that the local way of seeing and using the land is taken into account when management of ecosystems is planned. This is best done through a decentralization of management and decision making into a more community based one (Gadgil et. al 1993).

Although generally seen as a positive contribution to understanding a possible sustainable use of resources, management of ecosystems based on local tradition has not always been in harmony with nature, and not all indigenous people today outside industrialized societies are so either. Hunter-gatherers for example, who are not tied to any particular resource as a base for survival and often wander over large areas, may not gain much from a particular cautious management of land. Further, slash-and-burn agriculture technique which is used in some parts of the developing world may not be beneficiary for conservation (Gadgil et. al 1993).

The understanding and adaption of local land management and in this case local TFR management can prove to be essential. The history of trial and error that has lead up to present management methods has no equivalent in modern research. Furthermore, traditions and respect for nature are closely linked to land management and protection, which might prove to be one of TFRs most essential assets. Therefore, it is important to include this social framework that is ensuring the existence of TFRs even to be able to understand why they might have a good protection and high biodiversity.

3. Forests and conservation in Babati District

Tanzania has a total surface area of approximately 94 million ha, where 22 million ha is made up of reserves scattered across the country. This is the largest area, proportionally to country size, that any sub-Saharan country has allocated for reserves. National parks constitute 4.2 million ha, game reserves 7.7 million ha and forest reserves make up 10.1 million ha (National Website of the United Republic of Tanzania 2009b).

In BBD which is situated in the Manyara region in the northern part of Tanzania, there are several national parks and forest reserves. In the east lies Tarangire National Park and in the north Lake Manyara National Park (see figure 1). There are also four government established forest reserves in the district, covering a total area of 25 133 ha (Nou 13520 ha, Ufiome 5635
ha, Bereko 5373 ha and Haraa 605 ha). In the whole of BBD there is an estimated forest area of about 80 000 ha and the forest type is typically Miombo woodland (Maanga, unpubl., Kavishe unpubl.).

As a result of population growth and its peoples growing demand for forest products and an agriculture areas, the forests have to put out with an extensive and continuing stress. There is one positive project in BBD, in Duru-Haitemba that is particular successful, where CBFM has succeeded in turning the unsustainable use of the local forest into a sustainable one. The reason for this, according to Mr. Kavishe, is that it is important that management of the natural resources must rely on local knowledge, in this case of, the local community. According to him the local people are “the strongest and most effective guardians of the resources”. This is an example of what local determination can achieve (Kavishe, unpubl.).

4. Results

4.1 Results based on interviews and field observations

To sustain the information about TFRs and to answer the intended questions, a field study with observations and interviews were carried out. In BBD in Manyara Region in Tanzania, four TFRs were visited in Mutuka, Ayasanda, Sigino and Endagwe. In Endagwe there were three different TFRs relatively close, all in sizes 20-40 ha but only one was visited. Another interview was conducted concerning a TFR in Ayayae, but I was not able to visit there. A total of five TFRs and thirteen interviews concerning them are the basis for the results. Two of the interviews were with district officials and one with a biologist from the Open University of Tanzania in Babati. The results are based on questions found in Appendix.

<table>
<thead>
<tr>
<th>Traditional Forest Reserve</th>
<th>Size (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mutuka</td>
<td>2.5</td>
</tr>
<tr>
<td>Ayasanda</td>
<td>1</td>
</tr>
<tr>
<td>Sigino</td>
<td>25</td>
</tr>
<tr>
<td>Endagwe</td>
<td>40</td>
</tr>
<tr>
<td>Ayayae</td>
<td>25</td>
</tr>
</tbody>
</table>

*Table 1. TFRs visited and subjects in interviews*
4.1.1 Local villagers, chairmen and elders

According to the interviews, in some cases TFRs are restricted to a certain tribe or ethnic group that has access to the TFR, for example the Manda people in Mutuka. They are the only one that can grant access for other people to go into the TFR. In other places you have to become a member in the group managing the TFR to be able to visit the TFR, as in the case of Ayasanda where it costs a fat bull and honey liquor to be able to join the group. If you don’t have a bull you can pay 200 liters of Pombe (local beer). Most TFRs in BBD are used as Qaymandas (places where men are circumcised) and it is often also believed that the area inside the TFR can make rain or conserve water. Some other causes for protection are traditional dances, graveyard or protecting big trees. It is most common that only men are allowed into TFRs, especially when it is a Qaymanda.

Although TFRs are protected, it is still allowed in most cases for the people with access to the TFRs to pick dead wood to use as fuel wood. It is not allowed to cut down a tree for fuel wood. Grazing of animals and farming activities are not allowed. Only in one case, in Sigino, local people were allowed to lead their herds into the TFR for water. But that was about to be forbidden in the near future according to Daudi Nogi, the local villager, due to their negative effect on the TFR and for a higher protection. Harvesting honey can also be allowed, but not by using fire. The differences in protection vary from access to a walkthrough for outsider to total protection from almost everyone.

Of the five studied TFRs in this survey, two were protected both formally on a community level and by traditional law and the remaining three were protected only by traditional law. Violation of the customary laws that protect TFRs could result in either punishment based on traditional beliefs or in a form of monetary punishment if the TFR is protected in any village by-law. Usually the traditional punishment is much harder than the official one. The official fine is on a sum per tree basis, ranging from 15 000 to 50 000 Tanzanian shilling. The traditional punishment is either a substantial fine like a bull or two, depending on the degree of the violation, or the punishment could also be a more spiritual one where the village
members curse the violators’ house and his/her family for future bad luck and mark their home somehow, for example wrapping it up in white sheets.

When discussing the history of the TFRs and how long they have existed, the answers were often quite vague. A few the informants said the 1950’s and some said “before colonial time” and “long before I was born” or just “a long time ago”. But all in all it can be assumed that every one of the TFRs are at least 50 years into their existence but probably older.

When asked about the abundance of animals all of the persons asked claimed that there were more birds and small animals in the TFRs than in the surrounding area and occasionally big mammals. In Mutuka for example, due to its relative proximity to Tarangire National Park mammals sometimes wander into the village area and seek shelter in the TFR. Inside this TFR the animals are protected and anyone who wants to remove or shoot an animal must ask for permission from the local Sandawe people. The Sub Chairman of Ayayae Village mentioned another reserve close by that by the time of the interview had become a community based forest management (CBFM) area but had earlier been a TFR. After becoming a CBFM it had lost some of its protection and people had started using it differently and therefore it had lost biodiversity. When it was managed under traditional law and was a TFR there were elephants and hyenas, which at the time of the interview had already migrated to Nou Forest Reserve.

One big distinction that the people interviewed emphasized was the size of the trees inside the TFRs compared with the surrounding areas or unprotected forests. In Sigino, for example, the villagers claimed that the observed higher biodiversity existed thanks to a higher amount of big trees in the TFR. The villagers also mentioned that leopards were not uncommon in the TFR in Sigino which stretches over a crater. Local informants stated that the most important function of the TFR is the protection of the trees. They generally think that big trees have a lot of positive side effects and functions such as a higher biodiversity, conserving water, making a stable climate etc. In some TFRs there are certain trees that receive a higher protection than others. *Ficus* is one of those, and Mtongi – *Fagaropsis* is another. In other TFRs the whole area is protected as an entity and no certain species have a higher protection than any other.

About half of the TFRs mentioned here are, according to the informants, known by local authority. That means that BBD knows that they exist but they have not made any administrational effort to officially acknowledge those TFRs. The existence of the other half is not known by Babati Forest Office.
When asked about the history of the TFRs and their future prospects, the majority of the interviewed locals stated that TFRs have lost importance during the last 10-15 years. The rest said that the usage hadn’t changed much over time. “Before, people had more respect for the TFR, but now they are losing it, resulting in trees being cut down” argued one informant. Another said that earlier the corridors between TFR and human activity were larger and no grazing or agriculture occurred in close proximity, but now they are squeezing in closer. In Ayasanda the chairmen mentioned that farmers, who had fields right next to the TFR, took a few inches from the borderland every year when plowing, so the TFR actually had shrunk a bit.

During the author’s visits to all of the TFRs, the impression of a variety and extensive amount of birds singing was overwhelmingly present. The rich biodiversity and abundance of bird and butterfly species could be confirmed visually. The landscape and flora consisted of mainly of old trees which kept most of the sunlight from coming in through the thick canopy. A thick layer of soil covered the ground. This confirmed the local’s impressions and statements.

### 4.1.2 District officials

According to district officials, in this case Mr. Maanga (District Forest Officer) and Mr. Kavishe (District Advisor), TFRs are purely for traditional beliefs, rainmaking, and traditional dances for men or praying. Men and women do not share the same TFRs. The most common purpose for a TFR is circumcision for men or social ceremonies for women, for example educational ceremonies on how they should “handle men”.

The quantity of TFRs in BBD is unknown but “more than fifty” according to Mr. Kavishe and he claims as well that they are sometimes included in village by-laws and sometimes not. In the whole of Tanzania he says they exist “pretty much everywhere”. Where they are not protected by village by-laws the punishment for violating the TFR are usually one bull and some Pombe (local beer). This bull then gets slaughtered for the benefit of those local people who are responsible for the TFR. TFRs are covered generally in Forest Act nr 14 2002 in section 42-43 and violations can result in fine or prison. TFRs are also mentioned in Forest Policy 1998, Forest Regulations, Land Act and Environmental Act.
According to the two interviewed district officials, it is generally allowed to pick firewood, but not always, and the people highly respect the TFRs and “the old traditions keeps the people away from the reserves”.

In accordance with the information from local people Mr. Maanga stressed the fact that the numbers of species are higher inside TFRs than compared to normal forests. When asked about the abundance of animals he mentioned that hares, snakes, butterflies and birds were more abundant in and in the vicinity of TFRs. It is more common with big trees inside a TFR and the *Ficus* tree has a special protection and is forbidden to cut down in and outside TFRs. Also, the Sausage tree is protected for medicinal purposes. Both district officials are convinced that the protection of TFRs affects biodiversity in a positive way.

When asked about the importance of TFRs over time Mr. Maanga said that it was decreasing significantly due to new technology which leads to people losing interest in old customs and traditions, but also that the government have banned circumcision on girls and thereby leaving some TFRs unused and open for other activities. In some areas TFRs are embodied into CBFM making them more formal but with a decrease in protection.

An existing future for TFRs is according to Mr. Kavishe very important. He stresses the importance of local knowledge, and that it can be shown by the example of TFRs that directly or indirectly local knowledge result in management of their land wisely. He also points out the significance of an understanding and respect for the management of TFRs when incorporating them on a more official level. He ends the interview with an important and difficult discussion of how to legalize TFRs on a district and national level.

### 4.1.3 Biologist

According to Mr. Moshi, a Tanzanian biologist, traditional forest reserves are protected natural forests (small or large areas) established by ancestors to perform many socio-cultural functions and are protected in accordance to customary laws, not based on government legislation.

There are several types of TFRs according to Mr. Moshi:
- The sacred forests are for ritual worships, used primarily as places of worshipping by ancestors during times of sickness, drought and famine
- Forests used as clan reserves for building poles, hunting and gathering of wild foods and as hiding sites during war
- Water catchments forests
- Boundary forests between families or tribes
- Cemetery groves
- Forests used for traditional ceremonies, initiation of youth and sites to hide secret objects for ritual practices
- Forests where clan meetings are held

Mr. Moshi’s opinion on the main difference between TFRs and unprotected forests is the easily noticed variation in biodiversity levels. In TFRs the biodiversity is higher than in unprotected forests. In a normal forest everybody is free to enter and therefore there are a lot of human illicit activities but in TFRs not everyone is allowed to enter, except for those who have permission according to their respective customary laws. The difference between TFRs and national reserves or parks are not so distinct as is the case with normal or unprotected forests, both TFRs and protected forests are protected according to pre set laws such as customary laws for TFRs and government laws for government protected forest reserves. Forest destructions is more controlled in governmental reserves or parks, although there can be differences depending on local conditions.

The characteristics for a healthy forest are as stated by Mr. Moshi: “A closed deciduous non-spine scent woodland that is comprised of 10-20 meter high single storey, partly closed canopy of mostly pinnate leafed trees, a discontinuous under storey of shrubs and continuous herbaceous layer of forbs, small sedges and C4 grasses”. He mentioned a few key species like *Brachystegia spiciformis*, *Julbernardia* and *Isoberlinia*.

### 4.3 Analysis of the results

One of the key factors that contribute to the protection of TFRs became clear when asking about who has access to TFRs. The limited right to entry for an ethnic group or a group that demands a membership fee to join, has limited the access for all other people enormously. And since TFRs are established on a religious basis, people have a lot of respect for the forces
governing it; as Mr. Kavishe said “old traditions keep the people away from the reserves”. It is unclear which role women and their TFRs have in BBD, because no women were interviewed. As put forward in the other interviews done with males it can be assumed that the same rules apply for all TFRs, regardless who is responsible or who manages them. The customs being performed in the TFRs usually don’t have any physical effect on the environment. The only material effect on the reserves allowed, is to pick dead firewood. Grazing, fires and woodcutting is forbidden, which certainly adds to the protection.

Based on the gained information from the interviews, it is obvious that there is a higher biodiversity inside TFRs than outside; more hares, snakes, butterflies and birds and other small animals were more abundant in and in the vicinity of TFRs. Occasionally even bigger mammals were numerous due to the proximity to bigger reserves and national parks.

The closeness of TFRs to national parks however might not only be a good thing, although it certainly is for TFRs ecology and biodiversity. The people nearby can get affected in a negative way, having crops destroyed or being threatened by animals.

All people interviewed emphasized the importance of big trees, and the fact that they bring with them an increased biodiversity. The biologist also emphasizes the differences in the biodiversity levels inside TFRs and defined a healthy and diverse forest by the amount of tall big trees and a partly closed canopy.

This clearly shows the importance of the TFRs, since they are one of few places where big trees still stand, compared to the surrounding areas. They are adding another level to the habitat ensuring a more diverse vegetation benefitting biodiversity. The connection that the people make between big trees and a higher biodiversity, protection of water and better climate, truly benefits the indirect protection that TFRs comprise. The fact that big trees, usually *Ficus* have a higher protection than other vegetation, support that point. In most cases TFRs are although protected as an entity, not focusing on any particular specie.

Based on the fact that TFRs stand for significant ecological values, the question of how many, and where TFRs are located becomes important. According to district officials the number of TFRs in BBD is unknown. Vague estimates exist at around “more than fifty”. Although their pure existence around most of Tanzania is know, there is uncertainty about the amount, size
and distribution. The fact that they are mentioned in Forest Policy 1998, Forest Regulations, Land Act and Environmental Act prove that they are noticed, but generally only in a broad and indistinct manner. Both interviewed district officials were, despite the limited knowledge about TFRs, “convinced that the protection of TFRs affect biodiversity in a positive way”. That shows, according to their knowledge and experience as foresters, that they definitely are important for conservation.

The future of TFRs as they appear today should not be taken for granted, despite the fact that history has proven the existence of TFRs to be generally constant. The interest of young people in TFRs and the traditions and religion behind them in many cases becomes weaker and weaker due to a changing culture (Maanga unpubl.), which brings new ideals and technology. Furthermore, the Tanzanian Government has recently banned female circumcision (Maanga interview 2009-02-25) leaving all the TFRs established for that cause, unused. The consequences of this development are all but clear. One can only assume that the protection probably will decrease and thereby affecting vegetation and diversity negatively.

The possible future acknowledgement of TFRs and incorporation into district administration, which district officials have ambitions to do, could prove to have both positive and negative consequences. To attain a more formal status and greater recognition is positive because of a better possible support from district and government. But the conversion of TFRs into CBFM, as is the intention in most of the cases (Kavishe interview 2009-03-03), may have negative effects on biodiversity. Local people do not respect the reserves established on a national or district level as much as the ones on a traditional level. This is why this action could result in a decrease of respect and a change in usage of the forest could occur. This tendency is supported by information received in Ayayae where a quite large (>60 ha) TFR was turned into a CBFM. When the management and usage changed, big mammals like elephants and hyenas, that were inhabitants in that forest, moved to Nou Forest Reserve instead. This might not have been the only reason for the animals to emigrate, but it shows a possible effect. This observed development can also be backed up by Gerdén & Mtallo 1990, who state that violations in TFRs compared to other reserves, are very low which entails less disturbance of the fauna in TFRs.

A possible and more appropriate and sustainable way to turn TFRs into CBFM should incorporate the TFRs traditions and rules into CBFM regulations. TFRs could play a valuable
part in preservation, if supported by government in the right way. Respect and understanding of the local traditions that have lead to the preservation of those forest areas have to be properly supported by governments. One way of doing so is to include consultation with the people responsible for managing TFRs before taking actions to legalize them on a district and national level. The local people are in the end the ones who determine the future of TFRs, because it is them who chose to obey or refuse laws and restrictions associated with the protected forest.

The results from the fieldwork have indicated that TFRs contribute to conservation in BBD. This can be shown more clearly looking at TFRs using metapopulation theory and island biogeography theory. There has been no close examination of the exact migration patterns of species between TFRs, but looking at the distribution of the known TFRs in BBD one can see a pattern that should support migration between them. Since there are only 46 confirmed TFRs with a total area of 288 ha (Gerdén & Mtallo 1990), but most certainly a lot more to be recorded, one can assume that the distribution of TFRs are greater than seen in figure 1. This said, and with the informants giving evidence of a higher biodiversity in TFRs, it demonstrates their significant role when it comes to acting as safe havens and migration paths for species coming from bigger islands such as forest reserves or national parks. In the area southwest of Babati, where the most effort has been put into mapping TFRs (Gerden & Mtallo 1990), the distance between TFRs are at the most a few kilometers, but generally much less, thus forming a closed formed pattern of islands. In all other directions seen from Babati, where less TFRs have been studied (not saying that there are no more to be found there), the distance between TFRs could be up to 10 kilometers. In these areas, with a less narrow pattern of islands, compared to the area southwest of Babati, the connectedness between islands might not be as good. But species that are mobile, either themselves or their seeds, could find their way to other protected patches thus forming a network of refuges. According to Mr. Moshi, biologist at Open University, there are more vegetation levels in TFRs than in surrounding areas, which supports a greater variation in species. This means that animals, birds in particular, might play an important part in spreading for example seeds from plants inside TFRs to other TFRs or into the surrounding area. In doing this, they are contributing to the spreading of biodiversity.

According to MPT and IBT (Townsend et. al 2003) there is a possibility that small islands such as TFRs may not be self sufficient in supporting species. This might be the case in many TFRs. Instead they can act as stopovers for birds, or the island can together with other islands make up migration corridors due to their particular geography and their proximity to bigger forest reserves.
and national parks such as Tarangire National Park and Lake Manyara National Park (see figure 1). The vulnerability of small populations occupying TFRs due to demographic, environmental and spatial uncertainty is probably very dependent on their connectedness to these bigger islands that disperse species and act as a source of biodiversity. According to IBT, generally, the distance to a mainland is crucial when looking at the amount of species in smaller island spreading out from the mainland and it is here the relatedness, migration and emigration patterns, becomes significant.

Figure 1. This picture illustrates the distribution of known TFRs and distance to other larger islands such as forest reserves and national parks. 
Source: Gerdén & Mtallo 1990 (modified by author)
There is one more potential factor that is of great importance for the amount of species. According to IBT, the characteristics of the vegetation on the island play a bigger role than the size of the island and the distance to mainland when deciding the amount of species it supports. This means that if a TFR even if it is quite small has a diverse habitat type that supports a lot of species, this could possibly be a more significant factor than the actual distance to a forest reserve or national park. It has been shown earlier that the vegetation levels in TFRs are higher, and that there are more big trees that support a greater variety of animals. In contrast, according to Wilson and MacArthur (Townsend 2003), small islands should support less species richness. But when compared to surrounding areas like fields and rural areas, there might still be a high richness in biodiversity.

The question, which of the theories, either MPT or IBT, is most applicable in association with the distribution of TFRs must be raised after the above described colliding analysis. This could depend on which scale you look at it. In a bigger geographical scale they might be a small factor in the larger IBT with large mainlands supporting little islands with biodiversity. On the other hand, there is a fairly big probability of the TFRs to support populations themselves on a more MPT level, not really dependent on the large island made up of forest reserves and national parks. Of course this all depends on the species need for migration and space, where big mammals most probably fit in the IBT and insects and small animals under the MPT.

Protecting and managing these islands, that have proven to consist of a high biodiversity, is essential for the future contribution they might have on a larger scale for conservation. The history of trial and error that has lead up to present traditional management has no equivalent in modern research (Gerdén & Mtallo 1990). The connection between nature, culture and tradition is the factor that has given TFRs the protection they have today and is probably one of its essential asset. But although it has been proven that the historical management has been favorable for the biodiversity in TFRs, the future management might need input from other disciplines. Up to today the traditional management has worked, but today’s rapid expansion of human population and the stress it puts on the ecosystems (Millennium Ecosystem Assessment 2005), might need a more holistic approach to management. Since TFRs are managed on a local level, they may miss the important administration that could, on a national or district level, be more beneficial to conservation. To tackle a more national or global
environmental problem the bigger picture is needed. New scientific research can have a lot to add to the local knowledge and together make the best out of the situation in conserving the land in a favorable way for all actors.

5. Discussion

5.1 TFRs and the future

According to the National Forest Program in Tanzania; *Forest Resources Conservation and Management Program*, there are a few key issues concerning forest biodiversity conservation and management. And one of those key issues is “Inadequate application of indigenous knowledge in biodiversity conservation”. The key strategy to deal with that shortcoming is to “assess forest biodiversity sites and habitats with high endemism and species richness under major ecozones and create conservation strategies and joint management agreements”, such as JFM and CBFM. The question that needs to be raised here is whether the conservation of biodiversity in TFRs will benefit from a more acknowledged existence and incorporation into JFM and CBFM. To be recognized on a district level may in fact be a part in losing some of its protection. The fact that a lot of TFRs are unknown to the majority of the people, may be one of the key reasons why they are so well protected. Another aspect to consider is if the CBFM concept is developing towards a higher protection and a better conservation strategy, i.e. if there will be a lot more tall big trees and thus greater support for a higher biodiversity in the future. One possible way towards this could see the incorporation of traditional regulations into CBFM policies. The people’s traditional non-material values on nature and their respect for non human animals and plants could inspire and become a good base for conservation since it is an example of a functioning indigenous conservation system. The Tanzanian government, at both district and national level, should do what it can to help preserve the tradition surrounding TFRs. Laws that provide legal sanction for TFRs, but will not supersede customary laws, may help to ensure the continued existence of TFRs and thereby its favorable contribution to conservation biology.

Local people protect plants and animals inside TFRs as an indirect effect of their way of pursuing traditions. The fact that they do not see themselves as direct protectors of biodiversity, could have negative consequences, for example when management changes, like in the case with TFRs used for female circumcision. Those TFRs are consequently left unused.
due to governmental ban. A possible appropriate way to deal with these kinds of situations, when there is evidence of a decrease in utilization and protection of TFRs, could be to make an assessment to see if it is possible to convert those neglected TFRs into CBFM areas with a more formal protection. This should happen before the traditional protection is all gone and in the forest biodiversity is affected in a negative way due to an increase in exploitation. One essential part in the future management of TFRs should be the recognition of different uses, and management should be adapted thereafter. The differences in knowledge and perspectives on biodiversity should be acknowledged and adjusted for a beneficial use for local communities in the future. Besides the benefits of biodiversity, some TFRs contribute with additional positive effects like keeping soil in place hindering erosion, acting as a watershed and supplying local people with water (Gerdén & Mtallo 1990). These important factors should not be taken for granted and included in future valuation of TFRs.

Conservation biology today is on a collision course with the expansion of mankind in pursuit of new areas to develop (Millennium Ecosystem Assessment 2005). This conflict demands attention to the forces that exert this pressure and attempt to motivate governments to take immediate action against them. One of the areas that should be in line of protection as a way of ensuring an increase or at least maintenance of biodiversity is TFRs. As mentioned before, balancing the interest of local people and their traditions and the importance of biodiversity without implications, could be a complicated task to perform, if the interests of the two stakeholders part. The local people concerned with TFRs are the ones, who ultimately, decide the outcome of a managing dispute concerning TFRs, if one should occur. Therefore, mutual understanding and respect between local people and officials are necessary to build a successful foundation for the management of TFRs in a more formal way without a resulting loss in biodiversity.

In a holistic ecological approach, the existence of TFRs in Tanzania could be of great importance. It is not possible to say with great certainty whether that is an accurate estimation or not because the TFRs geographical location, their size and many factors are not studied in detail yet. But the interconnected islands (TFRs), can very well, depending on their amount and distribution in Tanzania, form a pattern of refuges for plants and animals scattered between the greater forest reserves and national parks. On a larger scale, all these may support biodiversity conservation as put forward by MPT and together as a unity support populations that might not survive without the existence of TFRs.
5.2 Further research

During the work of this study, many different sidetracks have appeared that would be of great interest to pursue. Since this study shows clearly that TFRs very well may contribute to conservation, researching the following would be of particular interest:

- Locate the remaining TFRs in BBD
- Do a more botanical or zoological research comparing species in TFRs with unprotected forest or forest reserves
- Look closer at what might happen to TFRs formerly used for female circumcision since the government has banned that act, leaving TFRs unused
- Study TFR from a female point of view to see if there is any divergence in view on or use of TFRs compared to the male perspective
- Investigate the dispersal and migration patterns of plants and animals between TFRs
- Study the effects on TFRs if turned into CBFM areas
- Look at TFRs from an environmental history approach to see what role they have played in the past and might play in the future
- Compare TFRs used by different indigenous groups such as Iraqw, Barabaig, Gorowa and Mbugwe to see if there is any difference in use and protection
6. Conclusion

The conclusion of this study concerning TFRs and conservation is that TFRs do diverge from other forests in vegetation levels and composition. The most important factor controlling this is the protection exercised by local people. This protection, based on traditional beliefs and regulations is based on a lot of respect for nature from people living in proximity to TFRs and enables the TFRs to be relatively undisturbed which benefits biodiversity. Each TFR, seen in isolation might look like a small patch in an ocean of villages and fields, but seen as a part of a big picture, an immense ecosystem, every patch may be an island interconnected with other islands through migration and immigration of species thus supporting and benefiting conservation of those (Townsend et. al 2003). The future significance of TFRs is not clear due to a few different factors, one of them being a decrease in interest concerning local traditions from new generations (Maanga interview 2009-02-25). TFRs can nevertheless be a vital aspect in conservation in BBD and Tanzania if managed the right way, respecting and supporting the local beliefs as a basis for protection and thereby conservation. The process of merging or converting TFRs into CBFM areas is a questionable alternative to the traditional way that can have both positive and negative effects with today’s regulations of CBFM. The negative trend in Tanzania of shrinking forest areas (National Forest Program in Tanzania 2001-2010, 2001) will put higher pressure onto TFRs, thus it is important to be aware of the ecological values that TFRs exerts and manage them in sustainable way. Managing TFRs based only on local knowledge might not be as beneficial on a global or national conservation level. Modern research in the areas of ecology and conservation can contribute positively, further helping to ensure a better protection for the nature humans depend on.
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8. Appendix

8.1 Main interview questions

General questions:

- What do you know about TFR?
- How many TFRs are there in this area/village?
- What is the difference between TFRs and other reserves?
- What is the purpose of this TFR?
- Why have you chosen this area?
- What is the name of this TFR?
- How big is this TFR?
- How long has this TFR existed?
- Have you noticed any difference in vegetation if you compare the TFR to the surrounding area?
- Are there any species that are more important than other in the TFR?
- Are the area surrounding the TFR being used more today than 10 years ago?
- Do you have any contact with local administration officers about this TFR?
- Is this TFR protected in any village by-law?
- What is allowed/not allowed to do in this TFR?
- What happens if somebody violates the rules of the TFR?
- How are violations in the TFR prevented?
- What ethnic group do you belong to?
- Has the importance of TFRs increased or decreased over time?
- Who is allowed into the TFR?
- Are you protecting this area only for your own benefit?
- Do you find a rich flora and fauna important?
- Does TFR exist within CBFM areas around here?

Specific questions to the biologist:

- Are there any ecological differences between TFR and other forests or reserves?
- What is characteristic for a healthy Miombo forest?
- Are there any key species in Miombo forests?
- Do you know where TFRs are located?