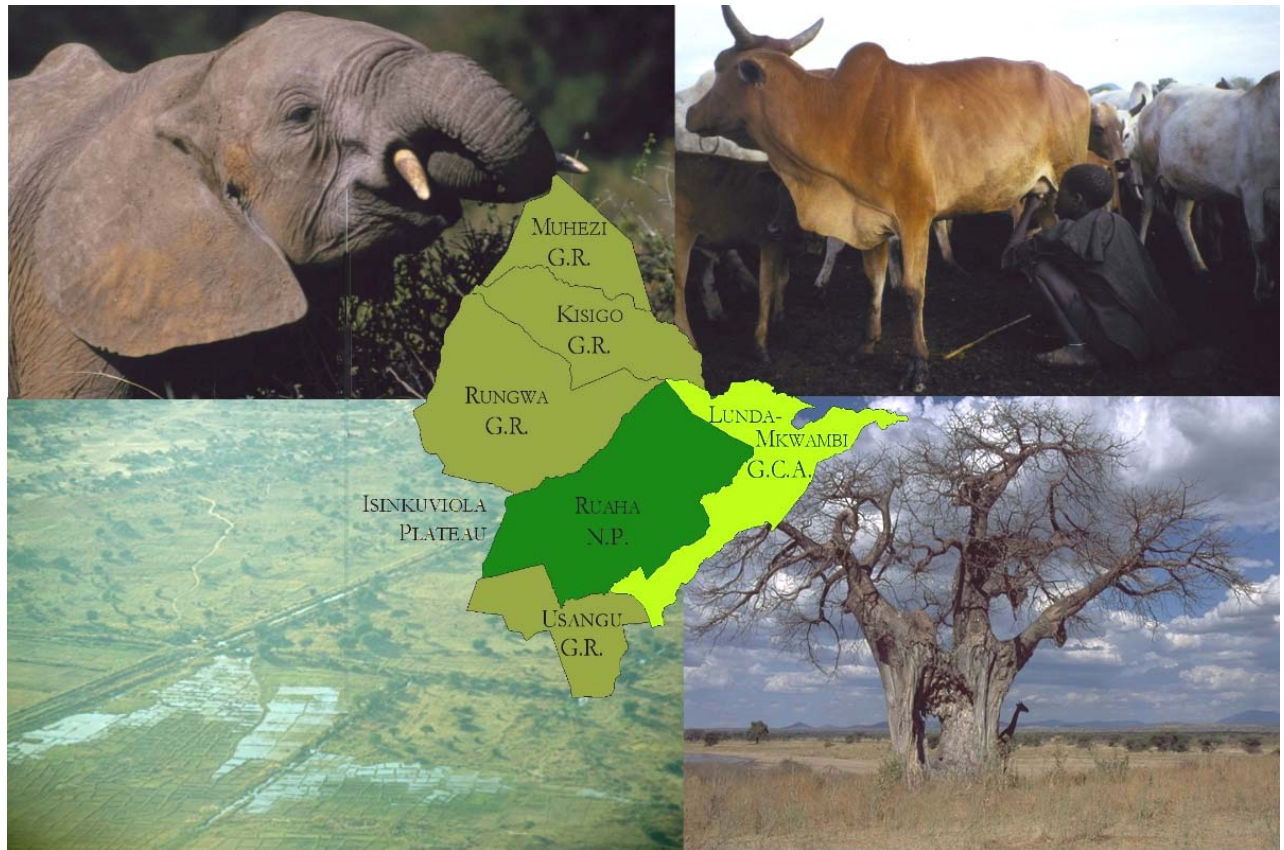


# A PRELIMINARY SITUATION ANALYSIS FOR THE RUNGWA-RUAHA LANDSCAPE, TANZANIA



A report to WWF International “Improving Conservation and Development within  
Ecoregions Programme”

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## Executive Summary

### *Findings*

Six major threats confront the Rungwa-Ruaha Ecosystem:

1. Over and mis-use of water
2. Unmanaged fire
3. Disease
4. Unregulated grazing
5. Illegal hunting
6. Water pollution

Preliminary data on the severity and spatial extent of each of these threats is presented, along with general assessments of the stakeholders associated with the origin and with mitigation of each threat. Potential interventions are listed for each threat.

This preliminary assessment of each threat does not allow quantitative analysis of the relative severity of each threat, or the effect of any on wildlife populations or human livelihoods. Nevertheless, the data presented here demonstrate that the Rungwa-Ruaha Ecosystem is overall ecologically functioning and globally significant for biodiversity. However, the ecological integrity of the ecosystem is severely threatened, most notably by the drying of the Ruaha River, the Landscape's only large, perennial river. Anecdotal data suggests that disease interactions are not currently having large effects on wildlife, but the potential for serious ecological consequences is apparent. In contrast, fire is having complex effects throughout the landscape, enhancing habitat in some areas, and degrading forage and habitat quality in others.

Recommendations for future research and a list of potential interventions follow descriptions of threats and stakeholders.

### *About this document*

This document provides preliminary assessment of conservation issues in the Rungwa-Ruaha Landscape. It is created as a living document to be evaluated, updated and corrected as threats, conservation targets, levels of understanding and stakeholder capacities change. These changes may occur through activities supported by the Project, through another project, or they may simply reflect larger, socio-economic or political factors in Tanzania.

This document also provides an institutional memory for the Rungwa-Ruaha Landscape Program. This record will help current and future project staff, donors and partners understand the evolution, of the project, the data and logic (or lack thereof) used in decision making

This document also contains frank and potentially sensitive assessments of institutional capacities, and individual opinions, financial records and data released only to partner organizations. Therefore it is a confidential document **NOT FOR DISTRIBUTION BEYOND WWF-International** without consent of the Rungwa-Ruaha Landscape Program.

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## Introduction: Biological and Economic Values of the Rungwa-Ruaha Landscape

The Rungwa-Ruaha Landscape is one of Tanzania's largest wild areas. Covering an area larger than Denmark (>45,000km<sup>2</sup>), this sprawling ecosystem reaches from the Rift Valley and the alluvial plain of the Great Ruaha River, up the Rift Valley escarpment to higher elevation *miombo* woodlands and relict forests of the Isinkuviola Plateau, which form the headwaters of the Rungwa River. Nearly 90% (over 40,000km<sup>2</sup>) of the Rungwa-Ruaha landscape is within six protected areas: Ruaha National Park (RNP), Rungwa (RGR), Kisigo (KGR), Muhezi (MGR) and Usangu (UGR) Game Reserves, and the Lunda-Mkwambi Game Controlled Area (LMGCA; see *Map below*).

The conservation significance of this landscape is extraordinary. First, the ecosystem harbors a nearly intact fauna, including as many as 12,000 elephants, and Africa's 3<sup>rd</sup> largest population of wild dogs, a critically endangered large carnivore that has disappeared from more than 95% of its original range. The forests of the Isinkuviola Plateau are largely unsurveyed, and like the Eastern Arc Forests to the east and the Albertine Rift forests to the west, are expected to contain high levels of biodiversity and endemism. Equally important are the ecosystem's sheer size and level of intactness. At the core of the ecosystem is Ruaha National Park (RNP). Though somewhat smaller than Serengeti, Ruaha suffers from far less illegal hunting (particularly compared to Serengeti's western corridor. As such, Ruaha represents the largest unhunted block in Tanzania, largely because managed areas surround RNP, and it faces far lower human population pressure).

These conservation values are recognized in numerous global priorities, including the "Global 200" (#102 *Zambesian woodlands and Savannas*) and "Last Wild Places" (*Miombo-Mopane Woodlands*). The Ihefu wetlands and wetlands associated with Mtera Reservoir are "Important Bird Areas" for Tanzania, and both are in the process of becoming "Wetlands of International Importance" under the Ramsar Convention.

The Rungwa-Ruaha landscape is biogeographically significant as well. It sits in a global hotspot of mammalian species richness and is a critical link between Tanzania's Maasai Steppe and the western wildlife corridor. Rungwa-Ruaha is at the crossroads between the "wildebeest ecosystems" of northern Tanzania and Kenya, and the "megaherbivore-ecosystems" found in *miombo* woodlands. It is the only place where greater and lesser kudu and roan and sable antelope are all found.

Conservation within the area is also potentially precedent-setting for the rest of Tanzania. The Lunda-Mkwambi Game Controlled Area is scheduled to become one of Tanzania's first Wildlife Management Areas (WMA), where management authority and benefits from wildlife will be devolved to local communities. This will set a powerful precedent for Tanzania by establishing a new policy mechanism enabling conservation outside protected areas. Finally, the concurrence of National Park, Game Reserves, Wildlife Management Area, Forest Reserves and undesignated lands makes the Rungwa-Ruaha ecosystem an ideal testing ground to establish multiple use landscapes that protect biodiversity while providing sustainable means to enhance rural livelihoods. A successful model developed in Rungwa-Ruaha could provide an important template for conservation and rural development in other heterogeneous landscapes in Tanzania and the rest of savanna Africa.

Despite its size and importance, the Rungwa-Ruaha landscape has generated vastly less conservation attention than northern Tanzania's "tourist circuit." Ruaha N.P. received some external support for infrastructure (WWF), strategic planning (WCS), and a growing ecological monitoring and enforcement program (WCS). Following the drying of the Ruaha River (see *Threats*, below), Usangu G.R. and the Lunda-Mkwambi GCA were foci for natural resource and environmental management projects. Two such projects, SMUWC (Sustainable Management of the Usangu Watershed and its Catchment) and MBOMIPA (*Matumizi Bora ya Malibai Idodi na Pawaga*, or Sustainable Use of Wildlife Resources in Idodi and Pawaga' Project) Projects established an important and sound foundation for future conservation work, but both have now ended. WWF has been working with the government of Tanzania on water-policy issues to restore the flow of the Great Ruaha River and currently plans to continue this work through the life of GCP II (specific collaborative activities are discussed in section IV Objectives, Proposed Activities & Results).

## 1. Threats

### 1.1 Over-/Mis-use of Water

**Summary:** Before 1993 the Great Ruaha River never stopped flowing. Since 1993 the River has stopped flowing every dry season, and for longer each year. Most of the flow problems are attributed to water management (or the lack thereof) in the Usangu area. Eight perennial rivers continue to flow into Usangu, but only the Ruaha flows out. Usangu consists of the Bohoro Flats, a large seasonally flooded area used for rice cultivation and seasonal grazing, and the Ihefu Swamp, a perennially flooded area that has shrunk significantly as the water problems have intensified. In many places now, the Ihefu is reduced to a narrow channel, bisected by small earthen dams used for fishing (see photo, below). The

Sustainable Management of the Usangu Wetland and its Catchment (SMUWC) Program was a multi-year investigation of the water problems in Usangu primarily from an agricultural engineering perspective (Reports available at

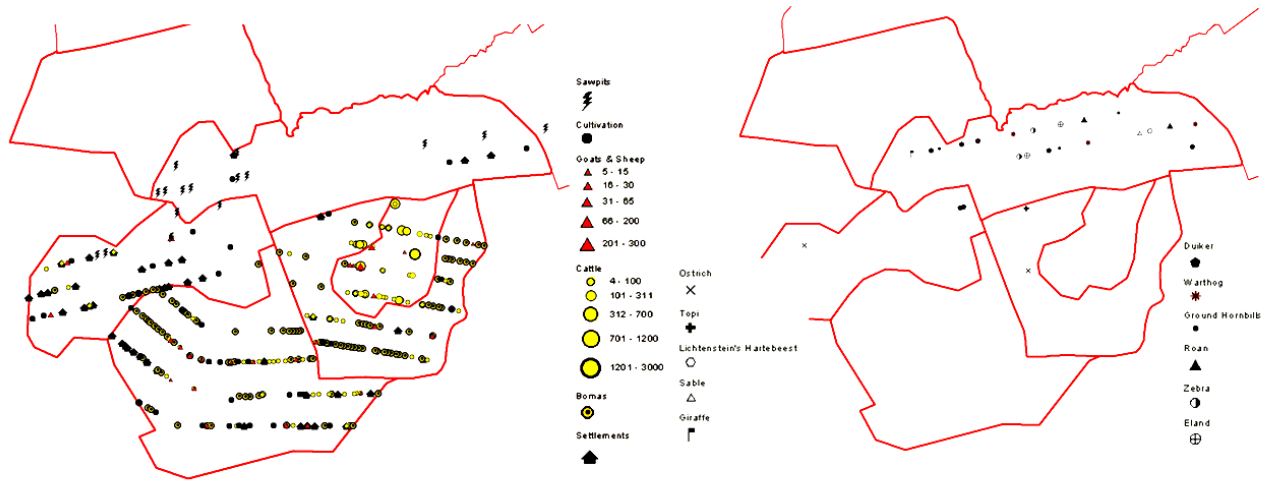
[www.Usangu.org](http://www.Usangu.org)). Some SMUWC research continues under the aegis of RIPARWIN, a research program run through

Sokoine University of Agriculture (SUA). Unfortunately, the 2<sup>nd</sup> phase of SMUWC, in which it's recommendations would be implemented, was not funded.



**Stakeholders Driving:** Two principle factors drive the hydrological problems in Usangu: misuse of water for irrigation, and heavy grazing by cattle. Usangu Game Reserve, which contains Ihefu swamp, the primary area regulating the Ruaha River, is overrun with cattle, as shown in the figure below. Around 90% of the cattle biomass belongs to Sukuma agropastoralists who have immigrated to Usangu from Shinyanga,

Mwanza and Tabora Regions<sup>1</sup>. Emigration from Sukumaland began in the late 60s and early 70s and many of the current residents lived in other regions of Tanzania before coming to Usangu. The heavy grazing and burning has severely reduced the water



Note that the data presented are in actual positions observed during the aerial survey, hence the linear appearing distributions. Also note that the woodlands in the northwestern portion of Usangu were not surveyed.

holding capacity of the wetlands, so that they no longer act as a 'sponge' that slowly drains throughout the wet season. Instead, water now flows straight through with little held back to sustain dry season flows.

The second major driver of hydrological change is diversion of water for small and large scale irrigation. The Ruaha River was originally diverted to provide water for Madibira, Mbarali and Kapunga industrial rice schemes. The delivery canals for these areas are cement lined to ensure that all the water reaches the farms, but the return canals are only earthen. The result is that many smallholders dig into the return canals and use water for unsanctioned, small-scale production nearby. Few of these small farms have return canals, so the water is simply left to leak out after it is used, as shown in the inset aerial photograph.



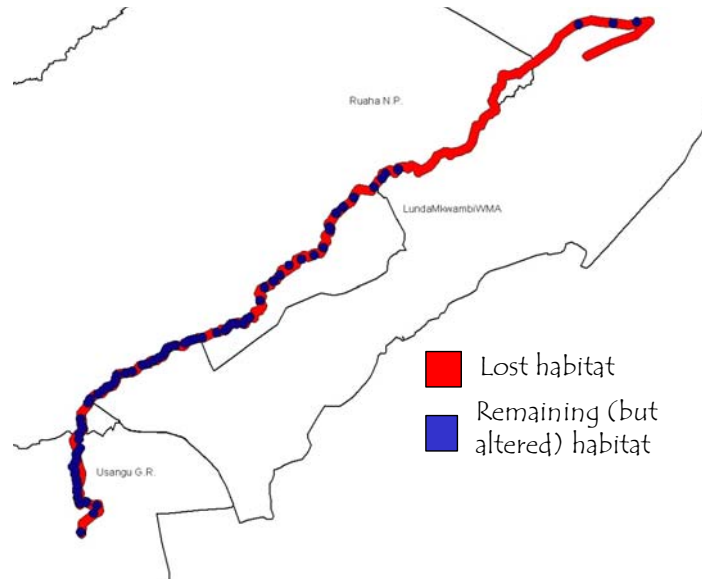
<sup>1</sup> Charnley (in prep; pers comm.) and Charnley, S. (1994). Cattle, Commons and Culture: The Political Ecology of Environmental Change on a Tanzanian Rangeland. *Department of Anthropology, Stanford University*: 391; Charnley, S. (1997). "Environmentally-displaced peoples and the cascade effect: Lessons from Tanzania." *Human Ecology* 25(4): 593-618.

**Severity and Spatial Distribution:** The effects of hydrological disruptions are severe and far reaching. At the most basic level it undermines Usangu provides hydrological ecosystem services: holding water for the Ruaha River and sustaining its dry season flow for wildlife, fisheries, livestock, and hydropower in Mtera Reservoir. For species that are heavily dependent on water, i.e. those that must remain within one kilometer of water (e.g. buffalo, waterbuck, many waterbirds) the lack of water has reduced the dry season habitat by nearly 60%. The figure below shows a simple calculation of the amount of dry season habitat lost as the Ruaha River has dried up.

Note that this is a minimum estimate because other affected rivers (the Ilusi, Little Ruaha and Kisigo) are not included in the analysis.

What's more, Usangu has significant conservation value itself: it was home to hundreds of thousands, if not millions, of breeding waterbirds, and plains game, including the only population of topi in the Rungwa-Ruaha Landscape.

Wattled cranes have not been recorded for nearly 5 years. One group of topi was recorded during the joint WCS-WWF Survey in 2003. The Survey revealed that large mammals have been driven from the majority of the reserve and have been replaced by settlements and cattle herding. (See spatial data page 6)



**Stakeholders Mitigating:** The Rufiji Basin Water Office has the authority to regulate water use in Usangu, but in the past they have been plagued by a lack of funds. Funding for RBWO comes from the central Government, TANESCO, and from the Water Users. In the past neither TANESCO nor the industrial farms have paid their bills; as of writing, TANESCO had paid their bill to RBWO, but the farms had not. As of September '04, the RBWO intended to withhold water from both smallholders and industrial users who had not yet paid. If both TANESCO and the rice growers all paid their bills and enforcement of water use guidelines took place, this would represent a huge step forward.

**Possible Interventions and Probability of Success:** Because the Ruaha River has received tremendous attention and has been the focus of numerous workshops, a wide variety of issues potentially affecting the river have been identified. These range from the major ones outlined here (rice and cattle) to insufficient infiltration from pine needle ground litter. All of these factors may have some effect on the river, but it is clear that rice and cattle are major drivers of the river's decline. Therefore, WCS's position is that these two issues must be resolved before moving on to other, less clearly important issues. Clearly, the river cannot be restored without solving these two issues. What's more, if these two problems are resolved, we may also have the luxury of ignoring the other issues.

Another additional consideration is the fact that the legal mandates and frameworks for dealing with rice and cattle already exist, whereas many other issues, like planting of

exotic species and less-than-ideal cultivation practices are currently legal. Dealing with these more distant issues will require new regulation and will likely be perceived as further infringements on individuals rights. It also makes little sense to establish new regulations to combat factors whose significance is unknown, when existing regulation to combat known severe threats remains unenforced. Based on this logic we are proposing the following interventions.

First, water use guidelines must be adhered to. This has been an extremely contentious issue in the past, with weirs broken open and people threatened. RBWO's strategy has focused principally on enforcement in the past, but with little success. This year however, with funding from TANESCO, RBWO had more success. Anecdotal observations suggest that these interventions are indeed having their intended effects, as the river is still flowing despite low wet season flows.

We are also proposing a 2<sup>nd</sup> mechanism to complement and strengthen RBWO's enforcement of water use guidelines. The mechanism would provide an incentive for small holders to conform to water use guidelines, by linking more profitable distribution and sale of their rice to water compliance. This will be achieved by providing transport and marketing at cost to those farmers who conform to the water use regulations. This would be a significant benefit for the smallholders who are forced to pay a markup rate to transport rice to market. Furthermore, there is significant collusion among middlemen to hold down prices paid for rice in the villages, so as to maximize the profit upon delivery to town. We are currently developing a proposal to establish a pilot cooperative to transport and sell rice for growers who obey the existing water use regulations. As mentioned earlier, compliance with the water use guidelines is compulsory for farmers to be included in the marketing scheme. A similar pilot program in Zambia (CONACO) has promoted "conservation farming" in Zambia with encouraging preliminary results. We are proposing the pilot scheme in two villages, followed by an evaluation and expansion if it is deemed successful.

Second, cattle must be removed from Usangu Game Reserve (UGR). Like the water use regulations, enforcement—even heavy handed attempts—has met little success in removing the cattle from UGR. WCS is working with the WWF Ruaha Water Program to complement enforcement activities by the Wildlife Division through the following. First, we will identify suitable rangelands outside UGR to mitigate the lost pasture in the reserve. Second, WCS will collaborate with the District Veterinary Office to evaluate the known constraints on livestock productivity (specifically bovine tuberculosis, contagious bovine pleuropneumonia, the lack of rangeland resources like water, and uncertain land tenure) and to identify interventions that will help pastoral and agropastoral producers improve their rangeland management by maintaining smaller, higher-quality, higher productivity herds. Veterinary services, land tenure and access to the 'new' areas will be given only to those people relocating cattle from Usangu Game Reserve. This will minimize the chances that benefits will attract cattle from elsewhere, and will provide an incentive to leave the reserve. This will accordingly strengthen the political base for enforcement, which is currently weak in the absence of other options for herders. We also plan to help the Wildlife Division monitor the spatial distribution and abundance of wildlife and livestock in Usangu Game Reserve in order to track the efficacy of our interventions and progress in Usangu's ecological recovery.

Interventions we have chosen not to pursue include: promotion of higher yield, faster growing rice; further investment in water use efficiency in rice production, and borehole development for tail-end users. A major concern is that the benefits of higher and faster



yields will only mean more rice from the existing system, rather than more water downstream. For such a system to translate water savings to river restoration would mean a restriction on rice production to only one crop per year. Given that existing regulations are not enforced, and that any additional regulation will be met with huge political opposition, it seems sensible to avoid such a path. Finally, boreholes for the tail end users will reduce the vulnerability of small scale producers at the end of the distribution scheme to misuse upstream, but they will not ensure that any more water flows downstream to Ruaha National Park, or the people of Idodi and Pawaga, where the Ruaha River dries.

We hope that the strategy outlined above will maximize the probability of success for the following reasons. First, the incentives outlined are all closely linked to enforcement, so that they reinforce each other. Second, small holder marketing and transport scheme has the potential to reach every producer, unlike enforcement, which is unevenly (sometimes randomly) distributed in time and space. Finally, the interventions prescribed focus on known, severe threats that must be confronted if the river is to be restored.

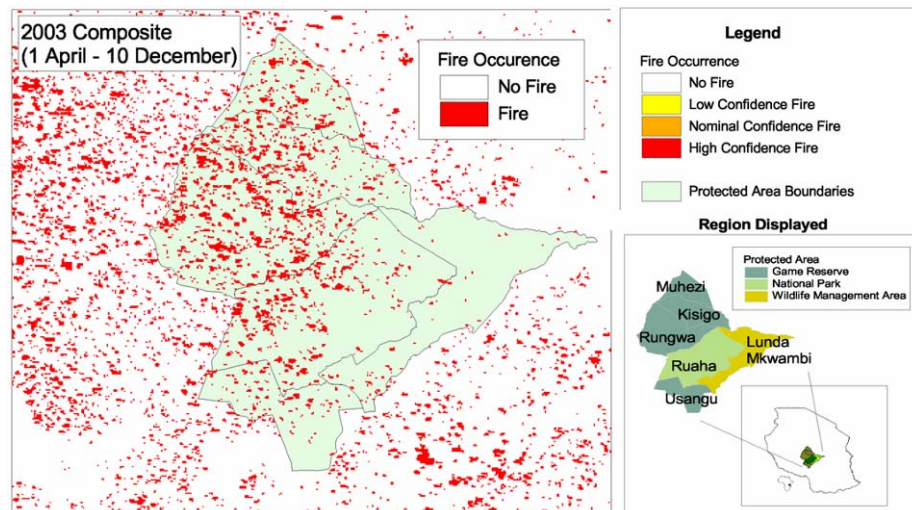
### 1.2 Unmanaged Fire

**Summary:** Fire is pervasive in the Rungwa-Ruaha Landscape (and indeed throughout Tanzania during the dry season). Fire is pervasive in the Rungwa-Ruaha ecosystem; it is a management tool, a means for illegal hunting, and an incidental impact of other land uses like bee keeping and fuelwood collection. Fires influence the behavior and movement of herbivores and allow people to move more easily through grassland areas (for legal and illegal purposes). When unmanaged, fire frequencies increase and late season fires in particular can be a significant threat to biodiversity. For herbivores, late fires can significantly reduce dry season carrying capacity, which is influenced by the quantity of standing biomass left from the previous wet season. Repeated fires over a number of years may also affect soil chemistry and negatively affect forage quality by volatilizing nitrogen,

which is lost to the atmosphere. This is particularly significant in more arid parts of the landscape where nitrogen re-deposition from rainfall is limited. Fire also alters vegetation

composition and has significant effects on invertebrate communities. Finally, fire can significantly reduce water-holding capacity and increase evaporative loss, both potentially decreasing the dry season flow of the Ruaha River.

**Stakeholders Driving:** Fires come from a variety of sources, some sanctioned, some not. TANAPA and Wildlife Division both practice early burning. The stated objectives



of the early burning program are to reduce the likelihood of a hotter, late-season burn, and to promote a flush of green growth in the early dry season. Burning also opens the understory and makes walking easier and animals more visible for hunting. Unsanctioned fires come from beekeeping, clearing fields for cultivation and from illegal hunting, where it can be used as a distraction or to promote easy movement later in the year. Pastoralists also complain that early burning decreases dry season carrying capacity and promotes woody invasion of grasslands.

**Severity and Spatial Distribution:** Fire clearly influences wildlife movements and habitat use, but the timing and extent of these movements is unclear. The effects of fire on vegetation composition (both herbaceous composition and the balance of herbaceous/woody vegetation), on soil chemistry and forage quality, and hydrology are all unknown. Furthermore, the spatial extent of fires, estimates of fire frequencies and the relative importance of the ignition sources mentioned above remain unknown. Preliminary data from 2003 suggest that nearly the whole landscape burns each year, so whatever the effects of fire may be, they are undeniably pervasive. Figure XX [insert modis data]

**Stakeholders Mitigating:** Active fire control (other than early burning) within the Rungwa-Ruaha Landscape is limited to TANAPA. Other attempts to limit burning are mostly legislative, but seem to carry little weight.

**Possible Interventions and Probability of Success:** Effective management of fire requires an understanding of the effects of fire on herbivore movements, vegetation composition and hydrology, but such an understanding does not exist at present. Successful management will also require clearer and more explicit statements of the objectives of burning. Without information on fire sources and effects, it will be impossible to establish a coherent fire management strategy. RNP has identified fire management as their top priority for assistance from WCS. We will work with TANAPA and WD to 1) identify the impact of fire on the structure of vegetation communities (specifically, woody : herbaceous ratio), 2) assess fire's impact on the quality of forage for bulk grazers, and 3) monitor how fire affects herbivore movements. This work will be pursued in collaboration with the Sokoine University of Agriculture (SUA) animal science, botany, wildlife and hydrology departments.

A critical first step in dealing with the threat of fire, is to determine when it is a threat, when it is a management tool and the circumstances under which each applies. Armed with this information, informed decisions about when and how to use fire will be possible.

### ***1.3 Disease***

**Summary:** Livestock and wildlife diseases pose a significant threat to wildlife, livestock, people and human livelihoods in the Rungwa-Ruaha Landscape. A few examples highlight the severity of the issues and the lack of knowledge. Livestock productivity in the Usangu Basin is severely reduced by bovine tuberculosis, with prevalence rates as high as 80%<sup>2</sup>. Canine distemper and rabies are both endemic, with the former causing a widespread die-off of wild dogs and the latter causing a rabid hyena to attack 8 people, one of whom died from rabies and two others spent multiple months in the hospital. Finally, a poorly-understood skin disease affects more than 90% of adult giraffe in Ruaha

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<sup>2</sup> Pers comm.: Iringa District Veterinary Officer

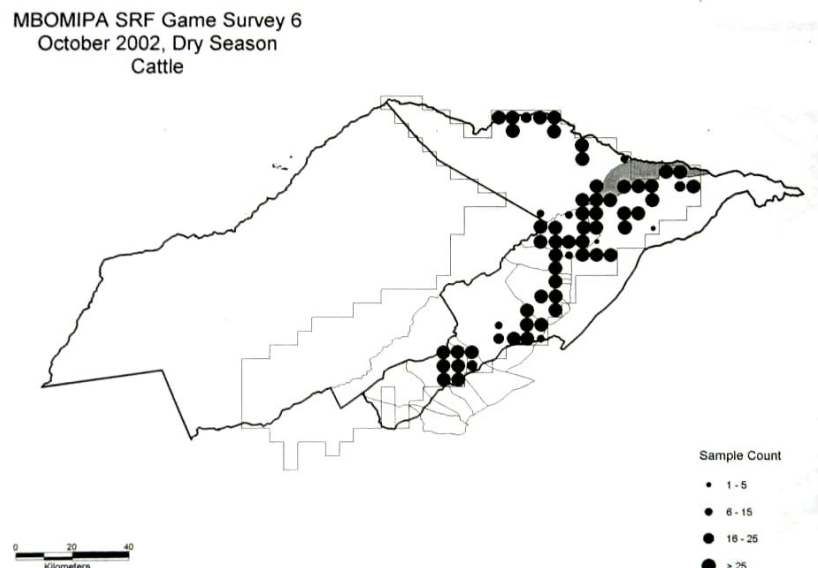
National Park, but the exact pathogen and its socio-economic and ecological significance are all unknown.

**Stakeholders Driving:** Disease transmission at the human-wildlife-livestock nexus flows in all directions. Livestock keepers are the human community principally affected by disease, but as the rabid hyena illustrates, all sub-populations are vulnerable. Wildlife are also vulnerable. The effects of bovine tuberculosis on buffalo and lions are well documented in Kruger National Park in South Africa, but it is unknown whether the disease has jumped to wildlife.

Feral dogs are also a significant risk for wild carnivores. Few if any domestic dogs are fixed in the villages surrounding the protected areas, and dogs are occasionally used for hunting.

**Severity and Spatial Distribution:** The actual severity of disease interactions is unknown. Clearly, diseases significantly undermine livestock productivity with predictable effects for food security. General perceptions hold that livestock tend to be more heavily affected than wildlife, and this is likely true for trypanosomiasis, brucellosis, and east coast fever. For other diseases it is unclear. Bovine tuberculosis is clearly a threat to livestock production and food security; it also has knock on environmental effects, from heavy stocking rates to weather die offs. It is not yet known whether any wildlife are affected by the bovine TB, but if this happens the potential consequences are grave. In Kruger NP bovine TB has affected buffalo and lions. There is also speculation that bovine TB (distinct from but related to human TB) could jump to humans, particularly immunocompromised populations. To date, however this has not been recorded in Kruger.

Mapping disease prevalence is not a likely surrogate for the probability of transmission between livestock and wildlife. Mapping zones of overlap between livestock and wildlife is probably the most appropriate way to characterize the spatial distribution of the threat. These distributions are roughly known from Systematic Reconnaissance Flight (SRF) data, but because they are aggregated within 5km grid cells, they may overestimate the actual extent of overlap. The population and productivity effects for livestock and wildlife are unknown.



Two other diseases worth noting are rabies and canine distemper. Rabies is endemic in Iringa Region, and has been recorded multiple times in wild carnivores, including the hyena that killed one person and bit 7 others in Malinzanga. At least two die offs from

canine distemper have been observed in wild dog packs, and their disappearance for long periods (up to 18 months) suggests this may have happened multiple times. It is not known whether lions, jackals or other carnivores were affected, as observed in Serengeti in 1994. The spatial distribution of rabies and distemper are unknown. Wild dogs, jackals, hyena and lions all move outside the protected areas with significant overlap with domestic carnivores. Smaller resident carnivores (mongooses, civets, genets, honey badgers, aardwolf, bat eared foxes) all also occur outside the protected areas and could represent a reservoir for rabies in particular.

Fifty hippo died of anthrax in the late dry season 2003, but the origin of the disease was not known. Anthrax die offs have occurred periodically, but their overall severity or population effects have not been summarized.

Finally, a skin disease suspected to be *Dermatophilus* affects over 90% of adult giraffe in Ruaha NP. Lesions are evident on the inside of the front legs. The severity of the lesions range from fluid-filled and bleeding, affecting the animals walking ability, to dry and healed scars which appear to pose no burden to affected individuals. Anecdotal observations outside the park suggest that the prevalence rate is lower. It is not clearly known whether *Dermatophilus* is a secondary infection or the primary driver of the infections.

**Stakeholders Mitigating** The District Veterinary Officer (DVO), under the Ministry of Water and Livestock Development is the principle authority for livestock disease issues. The DVO is also called in for consultations when the TANAPA Southern Zonal Veterinarian is unavailable. TANAPA tends to be more active in dealing with disease than the Wildlife Division, which adopts a policy of “letting nature take its course.” However, there are no clear criteria for when a disease is a natural phenomenon to be left unmanaged, versus when it is an anthropogenic threat. The high rates of bovine TB and infectious feral dogs or dogs used for illegal hunting are clear examples of anthropogenic causes, but in cases where the origin is unknown it may be more difficult to formulate a disease management position. TAWIRI has a veterinary program, primarily focused on research rather than management. The Wildlife Division does not have an active veterinary program.

**Possible Interventions and Probability of Success:** Because so little is known about disease interactions in the Rungwa-Ruaha Landscape, and because a disease monitoring strategy will ultimately be needed, the logical first step in disease management seems to be to establish current benchmarks for disease prevalence. For diseases posing greater threats to wildlife, humans and with large economic implications (i.e. rabies, canine distemper and bovine TB) studies of the severity of each disease and its population and economic effects should be initiated. These data will provide a foundation for developing a disease monitoring and response strategy within the landscape. The first step in this process will be to collate and summarize existing disease data, as a great deal of observations and ad hoc data have been collected, but not systematically analyzed.

### ***1.4 Unregulated Grazing***

**Summary:** Grazing is a major driver behind the water problems in Usangu. Pastoralists in Idodi and Pawaga also complain that their grazing areas are being increasingly cultivated, reducing the area available for livestock, which increases stocking pressure in grazed areas and land use conflicts at the margins. These land use conflicts pose significant challenges for sustainable land use planning. High stocking rates also decrease

cattle body condition and increase disease prevalence, as discussed above. Finally, as grazing areas shrink, encroachment into wildlife areas, specifically RNP, Lunda North and village WMA areas, increases.

**Stakeholders Driving:** Maasai, Barabaig, and Sukuma comprise the majority of Pastoralists in the area. In Usangu, around 90% of the cattle biomass belongs to Sukuma; in Idodi, the majority of pastoralists and pastoral livestock are Maasai, and in Pawaga there is a more even mix of Maasai, Barabaig and Sukuma. A few Gogo, Sangu and self-described Hehe and Bena pastoralists also graze animals in the area.

**Severity and Spatial Distribution:** Disease and hydrological effects are discussed above, so only rangeland resource issues are discussed here. Significantly degraded areas have not been systematically mapped, but it appears that there are locally-degraded areas at the margins of some villages, notably Malinzanga and Mafuluto in Idodi, and in a number of places in Pawaga (where village territories are smaller and grazing pressure appears to be more intense).

Degradation appears to be most severe on red soils, where annual grasses are finished early in the dry season or the late wet season, and bare soil remains. (See photograph at right).



**Stakeholders Mitigating:** Grazing issues figure prominently in the land use planning process, which involves the MBOMIPA Association, village governments, Livestock Extension Officers, Agricultural Extension Officers, and Pastoral Associations, where they exist. Pastoralist Associations are a recent development in Malinzanga, Mafuluto and Pawaga, and an association is developing in Tungamalenga. These associations have asked for areas to be formally designated as livestock pasture in Tungamalenga, Malinzanga, Mafuluto, and Pawaga. These areas would not allow any cultivation or livestock to remain in the area overnight. This would limit the ability of outsiders to come and settle in the grazing reserves, and particularly in Malinzanga, the Pastoralist association has agreed to prevent an open access situation.

**Possible Interventions and Probability of Success:** As mentioned above, formal recognition of grazing areas will provide pastoralists a longer term perspective on land management, and it is hoped that this will lead to better stewardship. Toward that end, WCS, the DVO and the MBOMIPA Association have incorporated grazing areas in the land use planning process for gazettment of Lunda-Mkwambi WMA. WCS will also assist with disease research at the livestock and wildlife interface, in order to a) increase tolerance for wildlife on grazing lands, b) increase livestock productivity and reduce the need for heavy stocking, and c) maintain productive livestock grazing areas and reduce the pressure to encroach into wildlife management areas.

## 1.5 Illegal hunting

**Summary:** Most illegal hunting is for subsistence purposes. Most reports suggest that the dominant form of hunting is with rifles, some homemade 'goboles', which are made from the tie-rod of an old land rover. Snaring and steel leg-hold traps are used (photo next page), but neither is common. Most people report that overall, illegal hunting has declined. Poisoning of water holes and large scale commercial elephant poaching were common in the past, but are rare now. A few temporary increases in elephant poaching have been reported in the last 15 months, but RUNAPA, MBOMIPA and the District Anti-poaching office have responded quickly.



Licensed hunters' non-compliance with hunting regulations is also considered here, as it is technically illegal. Reported issues are hunting too close to the RUNAPA boundary, hunting near water, and hunting from vehicles. Another reported offense is overshooting permits (i.e. buying a permit for 1 animal, and using it repeatedly). There are also reports of outsiders coming to villages with fake hunting permits, or bribing

individuals for unsanctioned permits.

**Stakeholders Driving:** Many respondents report that a majority of local hunters come from the village of Kipera, which is on the escarpment between Kidamali and Ismani, but a formal assessment of arrest records has yet to take place. Resident hunters are mostly local, from Iringa Region. There are two resident hunting associations, which mostly play an advocacy role for resident hunting access and quota prices, but in the future these groups could be mobilized to help promote better hunting practices.

**Severity and Spatial Distribution:** The distribution of illegal hunting is mostly unknown. Most people report that illegal hunting takes place in village territories, outside the villages themselves, but avoiding the protected areas themselves. There are still sufficient numbers of wildlife outside the protected areas to make hunting worthwhile without incurring the risk of being inside the protected areas (particularly RUNAPA). One exception is commercial elephant poaching, which has been recorded even in core areas of the Park.



The elephant shown in the photograph was found less than 100m from a main Park road, shot once through the head, and with the tusks removed.

**Stakeholders Mitigating:** MBOMIPA, TANAPA, and the Wildlife Division all conduct enforcement activities. MBOMIPA Village Game Scouts must be accompanied by a Division Game Officer, as they are not authorized to make arrests on their own. MBOMIPA and Wildlife Division enforcement activities are constrained by limited resources, including vehicles, field equipment like tents, boots and even food and supplies during patrols. Wildlife Division is less hampered by this problem because enforcement activities are entrusted to tourist hunting companies to whom hunting blocks are leased. Commitment and efficacy of the patrols vary across companies. TANAPA in contrast is better equipped and often assumes a leadership role in joint operations when warranted. As mentioned above, the resident hunters associations have not yet been engaged in either enforcement or in improving hunting practices and compliance with regulations.

**Possible Interventions and Probability of Success:** Probably the most important intervention possible is for local people to recognize, *and receive* benefits from wildlife. This creates an incentive for illegal hunters to stop poaching and for the wider village populations to assist in protection of what is now their resource. These two incentives, combined with traditional enforcement have already helped decrease illegal hunting.

Simply ensuring that these incentives exist will have short term value, but the small revenues being generated presently will likely not be enough over the long term. Realizing these benefits will require an expansion of the benefits from wildlife. This expansion must include a broader set of sources of revenue, as well as an overall increase in the economic benefits themselves. To date, the only source of revenue from wildlife has been resident hunting, which has provided between 16 and 18 million shillings (\$US 15-17K) per year. Two locally owned tourist camps have been built, but only one is operating at present. One other mid-level tented camp is open and providing around \$US 1/ bed night to MBOMIPA. The MBOMIPA Association is also working to establish hiking trails and interpretive materials for tourists and to establish Lunda-Mkwambi as part of the growing “Southern Circuit” in Tanzania. An important aspect of this process will be to ensure that these activities are clearly linked to wildlife, so that the revenue and political support for tourism contribute to wildlife conservation activities.

## ***1.6 Water Pollution***

**Summary:** To date, the discourse surrounding water has focused on quantities of water, rather than quality. But as flows have declined and land uses increased, there are growing indications that water quality is declining as well. And while most of the research attention and debate has surrounded the Great Ruaha River, other watersheds, like the Little Ruaha, the Ilusi, and the Kisigo Rivers are also being affected.

**Stakeholders Driving:** Two major sources of water pollution are a) the Iluma (artisanal) Gold Mine in Muhezi Game Reserve (photo at right), and 2) smallholder spraying of agricultural pesticides and herbicides in the highlands. Gold mining is illegal in Game Reserves, but the Iluma Mine was established



before Muhezi GR, so it was grandfathered in. Mercury, used to extract gold, is not properly disposed of and many miners are unaware of its toxicity.

**Severity and Spatial Distribution:** Decades of mining may have left significant amounts of mercury in the soil around Iluma Mine, and in the Kisigo River and Mtera Reservoir, but the spatial extent and severity have yet to be assessed. Obligate piscivores, like fish eagles, herons, and crocodiles are probably the most strongly affected through bioconcentration. There is also a significant fishery in Mtera Reservoir, so mercury contamination may be a public health issue as well as a wildlife conservation issue. Finally, a store of poison used to control ducks on the industrial rice farms has been left defunct for over a decade now. The actual level of threat is not clear, but the potential—particularly with lower water levels—is great.

**Stakeholders Mitigating:** Water quality is regulated by the Rufiji Basin Water Office (which also is principally responsible for flow issues mentioned above). With so much energy focused on water quantity, very little energy has been dedicated to water quality.

**Possible Interventions and Probability of Success:** The actual severity and spatial distribution of pollution issues is almost totally unknown. Therefore, the first step must be to assess whether these issues are as severe as expected, and if so, where the effects are observable. It seems logical that the most significant effects will be observed in the piscivorous species in the lower reaches of the Great Ruaha (below the entry point of the Little Ruaha), and in the lower Kisigo, where it flows into Mtera. If high mercury and pesticide concentrations are observed, further investigation of the areas affected, human and wildlife health implications and possible management responses will be necessary.



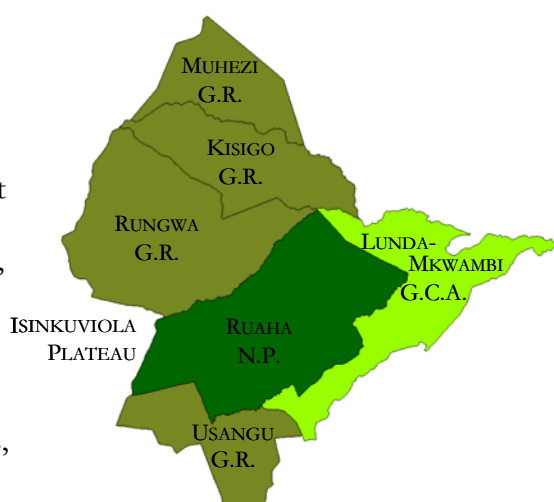
## 2. Stakeholder Descriptions

### 2.1 Rufiji Basin Water Office

As mentioned above, the Rufiji Basin Water Office is in charge of all water uses affecting quantity and quality. This includes establishment and management of water use associations, enforcement of water use guidelines, and sustainable funding mechanisms for water use enforcement. The two major sources of funding for RBWO are TANESCO and rice growers, who constitute the the major water users. In 2004, TANESCO paid its fees, which greatly increased RBWO's capacity for enforcement. As of September 2004, the situation looks promising as the Ruaha River is still flowing despite early indications that this would be an extremely bad dry season.

### 2.2 MBOMIPA Association

The MBOMIPA association is vying for "Authorized Association" (AA) status under the Wildlife Management Areas Regulations, which allows villages to manage and benefit directly from wildlife in village lands. MBOMIPA benefited tremendously from eight years of DFID funding, which ended abruptly in 2002. After nearly a year with little progress, MBOMIPA is moving again. Both WCS and WWF-Tz are facilitating MBOMIPA in establishing Lunda-Mkwambi Wildlife Management Area. The association's strengths are its broad support in the 19 member villages, and its well developed management structure, which includes two representatives and ten village game scouts from every village.



MPOMIPA currently generates from \$US15-18K, depending on the quota and current year prices (see Iringa Resident Hunters Association, below). This money is supplemented each year by the Wildlife Division, with around \$90K in support to cover the remainder of MBOMIPA's budget. Currently, resident hunting is the only source of revenue. MBOMIPA has asked for permission to sell tourist hunting licenses, as this is vastly more lucrative, but its first request was denied. Very small revenues beginning to flow from tourism. Investors in all natural resource activities, including tourism, within the entire Lunda-Mkwambi Pilot WMA are now required to negotiate with MBOMIPA. Some tensions have developed when individuals and villages have broken with the association to negotiate deals outside the MBOMIPA framework, but to date, all of these have been stopped and renegotiated within the Association's framework. The present situation presents some ambiguity, because the Association, which is registered and operating, has yet to formally be given "Authorized Association" status. This allows the villages, which normally have sweeping powers when it comes to land use, to claim that they retain their authority until the WMA is formally gazzetted and MBOMIPA receives its AA status.

MBOMIPA has very little technical capacity, which is a significant challenge given the rigorous requirements of the WMA establishment process. The “Pilot Phase” for the WMA legislation finishes at the end of 2005. There is some uncertainty about exact significance of the end of the pilot phase of Building this capacity in the course of establishment is unrealistic, given the fast timeline and the acute needs.

MBOMIPA, with support from WCS is nearing the final stages of the WMA application process. Land use planning has been completed in all 19 villages; all outstanding border disputes between villages (originally about 10 different disputes) have been reconciled, and the boundary descriptions and spatial data have been delivered to the District Lands Office. The next step, boundary demarcation, will be the most expensive part of the process. After that, a “Joint Agreement Committee” must be formed and the village governments must formally approve the land use plan that is to be submitted to the Wildlife Division.

### ***2.3 Ruaha National Park***

Of all the institutions managing the Rungwa-Ruaha Landscape, Ruaha National Park (RUNAPA) has the most significant capacity. RUNAPA generates between 1/3 and half its budget through about 7,000 bed nights, but like other Tanzanian National Parks, it is supported by surpluses from Kilimanjaro and Serengeti National Parks. Management priorities in the Park seem to be roughly organized as follows:

1. Resource protection (anti-poaching)
2. Fire management (early burning and late season fire control)
3. Staff management (health, morale, infrastructure)
4. Tourism Management (compliance, tourism infrastructure)
5. Abatement of indirect and spatially distant threats
6. Ecological monitoring and research

These priorities are reflected in the Park’s infrastructure and staffing, which are heavily skewed toward protection. This observation is not to suggest that this allocation of resources is inappropriate, but it is very significant in the development of joint activities and identifying areas for capacity building. The Park Ecologist, who holds an undergraduate degree in Wildlife Management, is in charge of all ecological monitoring, fire management and research. She does not have a vehicle, staff or a significant budget to speak of. Therefore, in the short term, any joint activities will have to be substantially (virtually totally) supported by WCS or other partner organizations. Obviously, RUNAPA’s significant logistical and enforcement capacity could be substantially expanded to include stronger research, monitoring and technical capacity. It is hoped that the benefits of research and monitoring and the extent to which they make other management operations more effective and/or efficient will be demonstrated through joint activities, and RUNAPA will allocate human and financial resources accordingly.

### ***2.4 Wildlife Division (Usangu, Rungwa, Kisigo, Muhesi GRs), and Professional Hunting Companies***

Rungwa-Kisigo-Muhezi Game Reserves are managed as a single unit. There are nine hunting blocks allocated to five different hunting companies (Robin Hurt Safaris; Frontier Outdoor Adventures; Tanzania Game Trackers/Wingert Winrose Safaris; Miombo Safaris, and TAWICO). The Reserves generate around \$800K/year, but only about 15-20% of that flows back to management of the Reserves.

Like other Game Reserves, many aspects of RKM management are shifted to the hunting companies. This includes enforcement, road building, fire management and

ecological monitoring. With such a decentralized system, it is difficult to know the extent of investment and capacity in each management context, but it is safe to say that enforcement is the top priority among all operators. Fires are universal, but there is virtually no research or any management other than early burning. One exception to this rule is TGTS, which is supported by the Friedkin Conservation Fund. FCF supports monitoring and GIS in all of TGT-WR-S blocks countrywide. Many hunting operators complain that a feeling of insecurity drives them to minimize their infrastructure and investments in the blocks they occupy, because their futures there are uncertain. Another observation is that incentives for good stewardship are not linked to block tenure or quota allocations, which likely undermines their strength.

Finally, transparency remains an ongoing issue for the Wildlife Division. Hunters, Reserve Managers and other stakeholders all complain that decisions are made without open review. This engenders a sense of insecurity among some stakeholders, and may fuel accusations of corruption and/or favoritism. To date however, WCS experiences have proven contrary to these complaints. The Rungwa-Ruaha Program has enjoyed high-level access and cooperation. WCS has been invited to participate in the management planning process for Usangu, Rungwa, Kisigo, and Muhezi Game Reserves. This includes an invitation to facilitate the development of R-K-M GRs Annual Operations Plan and coordinate with WCS activities.

### ***2.5 Iringa Resident Hunters Association***

The Iringa Resident Hunters Association (also called the Iringa Wildlife Conservation Association) is the sole customer for MBOMIPA. IRHA has bought the entire Lunda-Mkwambi hunting quota for the last 9 years. IRHA then resells packages of animals to other resident hunters. This arrangement benefits MBOMIPA, because the entire quota is sold every year, but it makes them vulnerable to a single funding source. This year's quota was reduced, so even though IRHA paid higher prices, revenues to MBOMIPA went down.

The IRHA is operated primarily by its chairman, who has also recently become the sole owner of a tented camp in Lunda-Mkwambi. He has expressed interest in building seven other "hotels" in the area, which would help MBOMIPA diversify its funding base to include different revenue streams, but would further concentrate control of those funding streams. The IRHA Chairman is also involved in natural resource sector as the owner of a bottled water company and a tobacco farm. Some conflicts of interest have arisen in the past (e.g. over cutting of fuelwood for drying tobacco) and the possibility of future conflicts of interest remains.

### ***2.6 Friends of Ruaha Society***

Friends of Ruaha Society (FORS) was founded in 1984, when Ruaha National Park had far fewer resources. FORS early work was to provide boots, tents, radios and other basic essentials to the Park. As RUNAPA's capacity and infrastructure have grown FORS has searched for a new niche. Currently, FORS supports:

1. Environmental education in 8 primary schools in Idodi Division
2. An income generation project to encourage village farmers to grow vegetables for sale to Park tour operators;
3. Periodic support to Idodi Secondary School (i.e. tuition for an orphan student to attend and a copy machine and computer)
4. Advocacy for Restoration of Great Ruaha River.

FORS has two full time staff, a board of five volunteers, two vehicles and an annual budget that ranges from \$US6-12K. FORS is trying to make the transition from an expatriate dominated, volunteer organization to a Tanzanian, professional NGO. To some extent this transition will turn on their ability to raise funds to support full time staff.

The WCS-RR program was asked to support the income generation scheme, but declined because the links to wildlife or ecological threats were unclear (in fact, the vegetables are grown with water diverted from the Tungamalenga River, which also now dries during the dry season). WCS –RR has however, supported the Environmental Education Program, which consumes the lion’s share of FORS budget and human resources. The major strength of the Program is its integration with the Tanzanian National Curriculum. By tailoring the lesson plans and resources to the national curriculum, FORS has helped the teachers reduce the acute lack of resources, rather than increase their workload as an “add-on” program would have done. WCS has provided technical support by producing maps and reviewing lesson plans, and has paid for the rehabilitation of a Bedford truck to bring students into Ruaha National Park. We hope to further support FORS to expand the Environmental Education Program to include all 19 MBOMIPA Villages.

### ***2.7 WWF Ruaha Water Program***

The WWF Ruaha Water Program has 2.5 full time staff to cover a project area that reaches 10 districts. The major output over the last 2 years has been the preparation of the “Great Ruaha Water Catchment Proposal”, which is led by the Ministry of Water and Livestock Development. The proposal is seeking to Raise \$US9.3M. Obviously, with such a small staff, WWF’s role will be heavily focused on coordination and oversight of basket funding to the Government of Tanzania. A significant portion of the funding that goes to the WWF-Ruaha Water Program will support contract work on strategically targeted issues.

To date, WCS RR and the Ruaha Water Program have had a strong and collaborative working relationship, and all indications are that this will continue. WWF has asked WCS to help deal with livestock issues and rangeland restoration in Usangu Game Reserve. This was the foundation for the joint WWF-WCS survey of the Ruaha River and UGR in November 2003. The WWF Ruaha Water Program may also collaborate with WCS’s Southern Rift Program, which is active in some of the upper catchment forests in the Ruaha Watershed. As mentioned in the water section, the WCS RR program has decided to consolidate our efforts on cattle and rice, which limits the extent of spatial overlap between our respective project areas.

### ***2.8 WWF Tz Country Office***

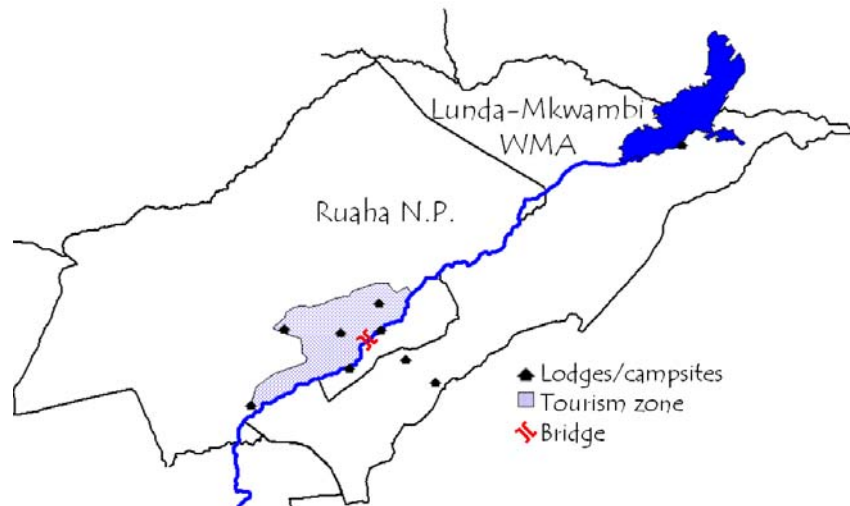
WCS and the WWF-Tz have recognized each other as “co-facilitators” of the MBOMIPA Association. WCS has agreed to support field-based activities, like population assessments, land use planning, and enforcement, whereas WWF-Tz will focus on the policy and legal aspects, most notably, de-gazetment of Lunda-Mkwambi Game Controlled Area (which is a prerequisite for WMA establishment.)

## 2.9 Photographic Tour Operators

Historically, photographic tourism has been limited to a small area of *Acacia-Combretum* woodland occupying less than 10% of Ruaha National Park (the shaded area, below). As wildlife numbers have increased in Lunda-Mkwambi, there is increasing interest in the area's tourism potential. Both high-end and budget tour operators have shown significant interest in the area. Both have significant potential to raise the overall income flowing to MBOMIPA and diversify their revenue streams. Lunda-Mkwambi is attractive to both types of tourism because it has the potential to be less expensive than the park and subjected to fewer regulations (walking, night driving, blinds and other activities not allowed in the Park may be developed).

Tour operators already established within the park are also keen to see that their existing situation—low volume, high value tourism that emphasizes wilderness and exclusivity—is protected.

Therefore, the existing tour operators will likely oppose any effort by TANAPA, MBOMIPA or the Ministry of Natural Resources and Tourism to promote high-volume tourism inside the park.



## 2.10 Pastoralist Associations

Pastoral Associations have been established in Malinzanga and Mafuluto Villages and Pawaga Division. A loose organization has formed in Tungamalenga, but infighting among pastoralists and conflicts with horticulturalists seems to have slowed its formal establishment. Pastoral associations have an important role to play in the overall land use scheme however, because they have the potential to protect grazing areas from encroachment for cultivation and from outsiders' cattle. More secure land tenure for pastoralists will certainly reduce land use conflicts and will likely benefit wildlife, as even heavily grazed areas serve as habitat for wildlife, particularly in the wet season.

## Appendix 1a: Summary of WWF-Supported Activities

ACTIVITY	STATUS	NOTE
Face to face meetings and semi-structured interviews with stakeholders in and adjacent to all 6 major management units in the Rungwa-Ruaha landscape. (Ruaha National Park, Rungwa, Kisigo, Muhezi and Usangu Game Reserves, and the Lunda-Mkwambi Game Controlled Area)	complete	
One to three small stakeholder workshops to review and validate threat data and to discuss principle actors associated with each the origins and abatement of each threat.	complete	Carried out in conjunction with LUP workshops
Based on the preliminary results of the threats analysis, outline a strategy for monitoring the principle threats to wildlife and the overall integrity of the Rungwa-Ruaha landscape.	ongoing	TANAPA & MBOMIPA activities agreed upon; Activities are proposed for RKM GRs and will be finalized during joint Annual operations planning Nov '04; Usangu in planning stage.
Review past and current ecological monitoring efforts, methods and data in order to inform future ecological monitoring efforts.	delayed	Data received from TAWIRI (CIMU), TANAPA, MBOMIPA, and 1 tour operator (16yr of observation data- being entered). New data being acquired from literature searches, trophy records and derived from satellite imagery
A preliminary strategy for monitoring of key threats to wildlife as identified by the stakeholder workshop(s)	delayed	Consensus on threats still being developed and initial spatial distributions are being updated.
Activities (workshops/ meetings and data collection) will be completed by June 15 2004. (Result 1)	complete	Final workshops were delayed until late August, but preliminary data collection and workshops now complete
A "Preliminary Situation Analysis Report" will be completed	complete	Preliminary report complete; will be updated annually, as new data are received, and/or as stakeholder and threat situations change.
Preliminary data characterizing the spatial distribution of human activities and potential threats to wildlife in the Rungwa-Ruaha landscape.	complete	See this report
Stakeholders associated with origins and abatement of major threats will be identified, and their capacity-building needs assessed.	complete	See this report
Recommendations for subsequent analyses (e.g. research on specific land uses, species or Root Causes or Policy Analyses) will be made.	complete	See this report
Opportunities to increase wildlife-related benefits and enhance management capacity will be identified.	complete	See this report
Preliminary baseline data from 1 wet and 1 dry season of ecological monitoring in National Park, Game Reserve and (village managed) Game Controlled Area.	delayed	Start of new monitoring activities delayed by negotiation and review of the initial workplan, particularly in Ruaha National Park. Exception: Ruaha water and Usangu Livestock distributions were assessed for the first time.
Identify and build mutual understanding of conservation targets among stakeholders.	ongoing	Initiated during Land Use Planning workshops, but will require ongoing effort. To be coordinated with Education Program and Friends of Ruaha
Specify areas for restoration.	ongoing	Preliminary areas identified. Assessments of populations' status and habitat conditions continue in other parts of the landscape
The Progress Rungwa-Ruaha Program will be evaluated by senior staff and suggestions for future work will be given.	Ongoing	Preliminary and informal visit Jan '04; Formal review scheduled for Jun/Jul '05
To integrate the Rungwa-Ruaha Program into a wider network of WWF-DGIS supported Integrated Conservation and Development Programs.	Delayed	Will pursue future proposal submission(s) to fund collaborative activities
The Rungwa-Ruaha Program will learn from and share experiences with other WWF-DGIS Supported programs.	Ongoing	WCS-RR has benefited from WWF-DGIS outputs, but has yet to contribute.



## **Appendix2: Potential WCS Activities for 2005 onwards**

### ***3.1 Implementation***

#### **3.1.1 Support for Establishment of Lunda-Mkwambi Pilot WMA<sup>3</sup>**

##### **3.1.1.1 Land Use Planning**

##### **3.1.1.2 Establishment of Joint Agreement Committees**

##### **3.1.1.3 Preparation of Resource Zoning Plan**

##### **3.1.1.4 Support for conservation-based enterprises**

#### **3.1.2 Highlighting Ruaha River Issues**

##### **3.1.2.1 Bringing Decision Makers to see River issues firsthand**

##### **3.1.2.2 Production and placement of Kids Ruaha River Film**

#### **3.1.3 Relocation of Livestock from Usangu G.R.**

##### **3.1.3.1 Identifying suitable sites for livestock**

##### **3.1.3.2 Helping to secure grazing tenure**

##### **3.1.3.3 Assess veterinary issues for livestock and potential for improving productivity**

#### **3.1.4 “Maji kwa Maisha” Pilot Scheme to Protect Wetlands in Drylands**

##### **3.1.4.1 Trial enforcement and incentive scheme in mapogoro and elsewhere**

#### **3.1.5 Technical Support for Operations Planning in RKM GRs**

##### **3.1.5.1 Facilitate integration of workplans among partners**

##### **3.1.5.2 Facilitate implementation of workplans**

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<sup>3</sup> For more on WCS's Proposed inputs to MBOMIPA SEE “WMA-Planning-WCS-Inputs.doc” available on EXTERNALHD or by request.



**3.1.6 Preliminary Evaluation of Rungwa/Chunya/Sikonge Villages for WMA and/or other CBC activities.**

***3.2 Monitoring-Diagnostic Research***

**3.2.1 Carnivore Monitoring in Lunda-Mkwambi**

**3.2.2 Dry season water distribution and human/wildlife responses**

**3.2.3 Identification of elephant corridors and areas of poaching**

**3.2.4 Technical Assistance to RUNAPA for carnivore database**

**3.2.5 Assessment of Historical Data**

**3.2.5.1 Collation of RR-SRF Data**

**3.2.5.2 Entry and analysis of Tourist sightings**

**3.2.5.3 MBOMIPA VGS Data sheets**

**3.2.5.4 Evaluation of Trophy quality trends in RKM GRs**

**3.2.6 Assessment of water pollution in Ruaha and Kisigo Watersheds**

**3.2.7 Giraffe Disease assessment**

**3.2.8 Assessment of Buffalo Decline**

**3.2.9 Monitoring Rangeland Quality**

**3.2.10 Vulture Monitoring**

***3.3 Research***

**3.3.1 Development of Landscape-wide Fire Management Plan**

**3.3.2 Carnivore Management Strategies**

**3.3.3 Legal review of wildlife offenses and prosecution rates**

**3.3.4 Investigating the effects tsetse traps on non-target species**