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Challenges of conservation of dryland shallow waters, Ewaso Narok swamp, Laikipia District, Kenya

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Abstract

Ewaso Narok Swamp, formed along the Eng'are Narok river, is located in the semi-arid part of the Laikipia District, Kenya. The area, of bushy grassland, is characterised by low rainfall (less than 750 mm annually) and episodic rivers. Before the 1970s, the dominant land use was large scale ranching and nomadic pastoralism. Since 1970, this has slowly been transformed into high density small-scale farming. There has been a strong trend towards settlement along riverine and wetland areas due to their suitability for farming and easy availability of water for cultivation. Ewaso Narok swamp has a rich species diversity of over 170 bird species, resident and migrant, over 100 plant species and it also provides an important dryland refuge for both domestic and wild animals. The swamp also provides socio-economic products such as plant matter for building. The result of its land use transformation has been ecosystem alteration, habitat modification and destruction both for wetland and rangeland species. This change has also been accompanied by escalating human–wildlife conflict. However, although this process is self-destructive, the lack of economic returns from wildlife to some extent justify the land use transformation since the communities settling here have to satisfy the basic requirements of food and shelter. This poses the challenge of the developing appropriate ways to conserve the dryland wetlands whilst attaining maximum returns for the local community.

Introduction

Apart from their important hydrological functions, tropical wetlands also provide important paleartic wintering habitats for waterfowl. They are also highly endangered ecosystems, especially in dry areas, due to human activities associated with land use transformations. This is a particular problem in the tropics. Kenya's wetlands are among the country's most important resources for social-cultural and economic development (Kareri, 1992). However, increased demand for natural resources has resulted in their over-exploitation thus affecting their structure, ecology and utilisation (Kareri, 1992).

Ewaso Narok swamp, is a riverine wetland dominated by *Cyperus papyrus* L. within a semi-arid area and forms a biogeographical island with ecological and socio-economic importance. It is faced with the problem of land use transformation from large scale ranching to small-scale farming. Its presence in a dry area makes it a point of concentrated human activities, which is slowly transforming it into a cultivated area. This has been necessitated by the unreliable rainfall for rain-fed agriculture and the fact that the immigrants are crop cultivation communities as compared to the traditional use of the swamp by nomadic pastoralists. Part of this wetland has now been drained for crop cultivation as a consequence of a study done by the colonial government in Kenya between 1958–61, which recommended the draining of the swamp for farming. Although this was the global view of wetlands at that time, the same recommendation is contained in the 1989–93 and 1994–96 Laikipia District Development Plan. This diametrically contradicts the Ramsar convention of 1972 on wise use of wetlands which does not advocate draining of wetlands.

During the colonial period, Laikipia District was formally used for ranching and large scale farming whereby the wetlands were used as a source of water and grazing land. With the sub-division of land

in the 1970s and subsequent population increase, human activities in wetlands increased, especially in the 1990s. As no clear policy on the use of wetlands exists in Kenya, draining started in an uncoordinated manner to meet the food demand for the settling population (Thenya, 1998).

Stream seasonality, coupled with high evaporation rates cause a major water deficit in this dryland district where river water is usually supplemented by boreholes, roof harvesting and dams. The general direction of river flow is northward but even the main river, Ewaso Ngiro, does not reach the Indian Ocean as it disappears in the Lorian Swamp through excessive evaporation. Currently, declining river flows in this drainage basin have raised much concern. The decreasing discharge has been accompanied by increasing flash floods, which pose a threat to humans and ecological systems. Some of the major threats include reduced biodiversity supported by these rivers, and increased food deficit. The major cause of this hydrological change is believed to have been excessive de-vegetation of the catchment area, reducing infiltration area coupled by heavy water abstraction for irrigation of adjacent dryland.

Most wetland research in Kenya has concentrated on large lacustrine wetlands of the rift valley, coast and Lake Victoria. Little research has been done on the riverine wetlands, especially those occurring in arid areas. They have long been regarded as having minimal use both ecologically and socially. However, small wetlands in arid areas are very important both for domestic use and dry season grazing. An understanding of their ecology and socio-economic resources will help to promote sustainable utilisation by the local community. The aim of this study was to understand the socio-economic uses of the swamp and the value of its flora and fauna.

Description of study site

Laikipia District is located in the Rift Valley province lying across the equator between latitudes 0° 17′ S and 0° 45′ N and between 36° 15′ E and 37° 20′ E (Fig. 1). It covers an area of about 9723 km^2. The eastern boundary of Laikipia is marked by the Nyambene Hills and the cone of Mount Kenya, while on the southwestern side by the Nyandarua Ranges (Aberdares). The Western boundary follows a spectacular complex of fault line volcanic ridges and escarpment overlooking the Rift Valley and Lake Baringo (Hackman, 1988). The overall morphology of Laikipia District is a saucer-shaped plateau formed by extrusive miocene phonolites (Government of Kenya, 1994).

The district rises to 1800 m in the North and 2100 m in the South. Rainfall ranges between 400 and 1000 mm, which is bimodal. The mean maximum temperature range is between 20 and 37°C annually. High rainfall occurs on the southern and western parts with Nyahururu area receiving 900 mm. However drier parts of Mukogondo and Rumuruti divisions receive rainfall of less than 650 mm annually. Ewaso Narok Swamp is located in Rumuruti Division, between latitudes 0° 15′ and 0° 17′ N and between 36° 34′ and 36° 41′ E along the Eng'are Narok river. The swamp is set in a semi-arid grassland plateau with frequent drought and unreliable rainfall (Government of Kenya, 1994), which causes swamp area to fluctuate between 14 and 20 km^2 between dry and wet seasons each year.

The drainage system forming this swamp originates from the Nyandarua ranges and the Lake Ol'Bolossat catchment, with a minor contribution from the Oraimutia river draining the Sabugo highlands in Nyahururu, which is currently heavily deforested. The swamp represents a remnant of a series of once-numerous wetlands, which formerly existed in Laikipia District but have been drained in pursuit of food sufficiency.

Few permanent streams exist in Laikipia, and most of them are seasonal, usually drying up during the dry season. The Ewaso Ngiro is the major permanent river, receiving all the tributaries in the drainage basin. Important tributaries from Mt. Kenya include the Nanyuki, Burguret, Likii, Ontulili, Sirimon and Timau rivers, while those from the Nyandarua Ranges include Eng'are Ngobit, Moyok, Pesi and Mutara rivers.

Two-thirds of the District has moderately productive soils. The southern and south-eastern sides are less agriculturally productive, because of the presence of clay soils, so are mainly used for ranching. The Northern region is generally dry with poor sandy soils with some pockets of clay. The same phenomena also occur in the northeast. Plateau depressions are characterised by dark grey to black 'vertisols' and 'planosols' soil, which are unsuitable for crop production (Government of Kenya, 1994). The north and north west of Mt. Kenya have red–brown fertile soils, which are good for crop production, however this is only a small percentage of the whole district.

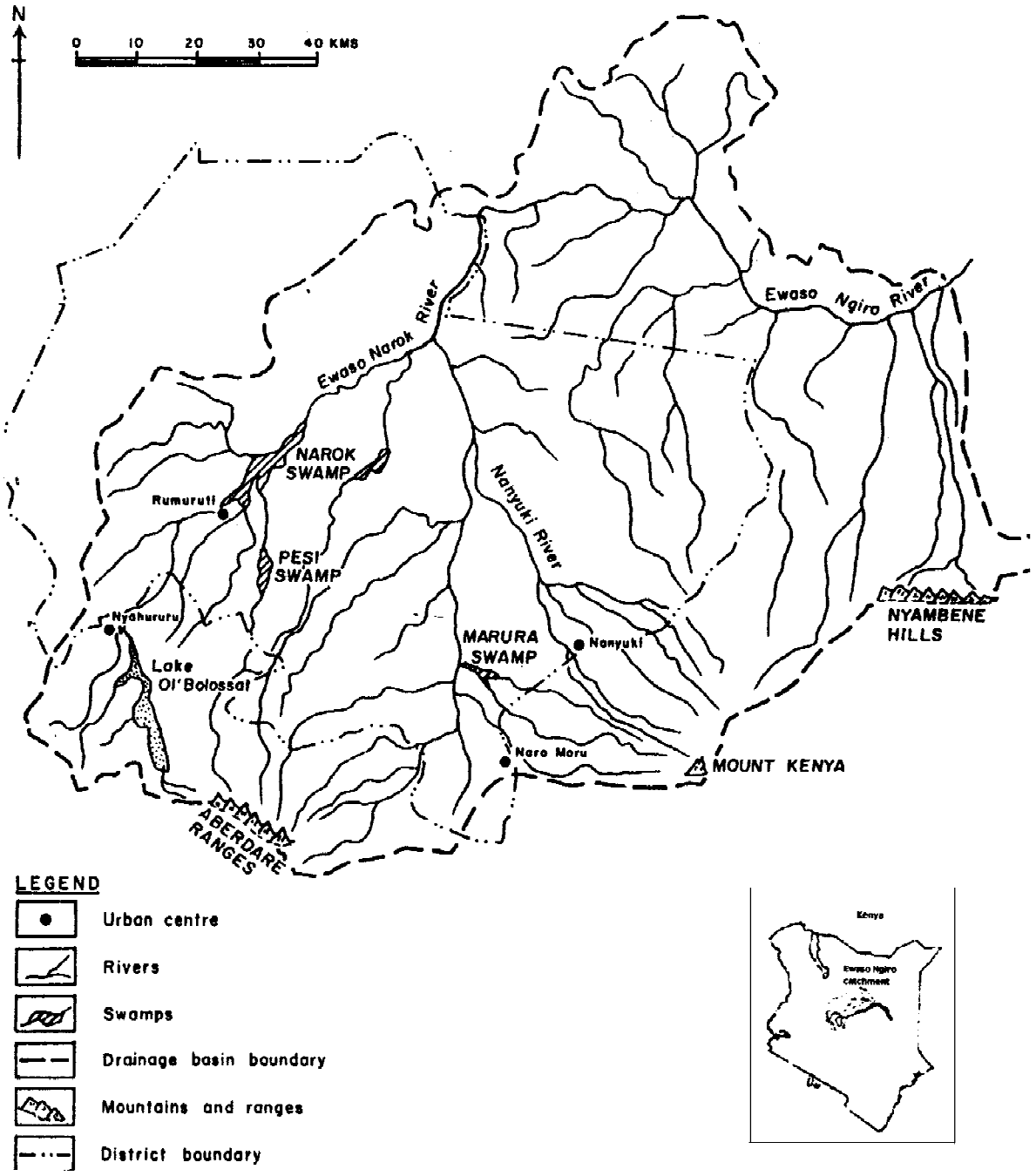

Figure 1. The location of the Ewaso Narok swamp and the Ewaso Ngiro basin, in Laikipia District, Kenya.

Vegetation distribution is strongly influenced by altitudinal pattern, with dry forest occurring on the highest elevations and a gradient of *Acacia–Themeda* bush on the plains (Taiti, 1992b). However, as exceptions to the overall regional ecological gradient are edaphic communities of *Acacia drepanolobium* Skpestedt in the central plains, escarpment vegetation and secondary communities induced by historical management factors. The gentle warping in the south has contributed to ponding in valleys leading to the formation of swamps, which are mainly dominated by *Cyperus papyrus* L. and *C. latifolia* Poir. All of these swamps occur in ecological zone V, which is mainly dry and is suitable for ranching, but is currently characterised by land transformation into small-scale cultivation.

By 1995, the Laikipia population was estimated at 307 670 persons with a regional average density of 30 persons km^{-2} (Laikipia Research Programme, 1996). Nearly half of the current resident population in the district are immigrants who have moved in over the last 5–10 years (Huber & Opondo, 1995; Thenya, 1998). Most of these immigrants have come from the neighbouring and agricultural high potential districts such as Meru, Nyandarua, Nakuru, Embu, Nyeri and Kiambu. This immigration phenomenon has lead to land transformation from large-scale ranching/cultivation to small-scale plots of 2–10 h (Huber & Opondo, 1995; Thenya, 1998).

Materials and methods

The history of the swamp was gleaned from official government documents and personal recollections. The field study was then conducted with settlers between September 1996 and February 1997 through the use of questionnaires in two stratified zones in the swamp: the Thome/Jenning area on the eastern side; and along Sosian/Maralal road on the western side of the swamp. Stratification was based on human activities like farming, grazing and settlement. In total, 33 households were interviewed, 22 on the Thome/Jenning side and 11 on Sosian/Maralal road side from a total sample of 200 houses (Fig. 2). The respondents were randomly selected within the stratified areas. Due to seasonal migration of the inhabitants, most of the houses in the swamp area had been abandoned due to excessive flooding in September 1996. These conditions affected the survey since it was carried out at the end of the flooding period. This was one of the worst floods witnessed for many years and crops, house properties and human life had been lost. The occupants were reluctant to come back even during the dry season in January 1997.

During the same period bird, mammal and plant surveys were also carried out to record the species present using the techniques of Cain & De Oliveria Castrol (1957), Ralph & Scott (1981), Fuller & Langslow (1984), Tandiga (1990) and Pomeroy (1992).

The statistical technique used to analsyse the results was the Chi-square, to test the relationship of various wetland values (Steel & Torrie, 1986). This has been used elsewhere in the tropics to test similar socio-economic use relationships (Muiruri, 1977).

Results

Land use transformation and swamp occupation

Before 1970, extensive land use was predominant, comprising mainly of ranching and community grazing by a pastoral community across the entire District (Taiti, 1992a). Wetland utilisation and biodiversity had remained in a state of relative equilibrium without dramatic perturbations apart from natural hazards like drought, which the ecosystems were able to restore themselves. However, the advent of independence saw increased freedom of movement, property ownership and population increase which was accompanied by land transformation into small scale plots of 2–10 ha (Thenya, 1998). Most of these immigrants came from the neighbouring and agricultural high potential District like Meru, Nyandarua, Nakuru, Embu, Nyeri and Kiambu (Thenya, 1998).

The earliest settlement dates back to the 1980s in Ewaso Narok swamp, with 60% of the current occupants moving in between 1986 and 1989, reaching a peak of settlement in 1992. By 1997, the Ewaso Narok swamp had a population of 3480 persons, with a strong upward trends. The average household was six to eight persons; however, this is very dynamic, depending on season and activities. During the wet season, the population goes down significantly because of flooding, but this is reversed rapidly during the dry season as both farmers and pastoralists flock to this area for water and forage. The main factors that have been responsible for this migration into the area are aridity, reduction in farm size in the agricultural high potential areas, the africanisation process of settlement in

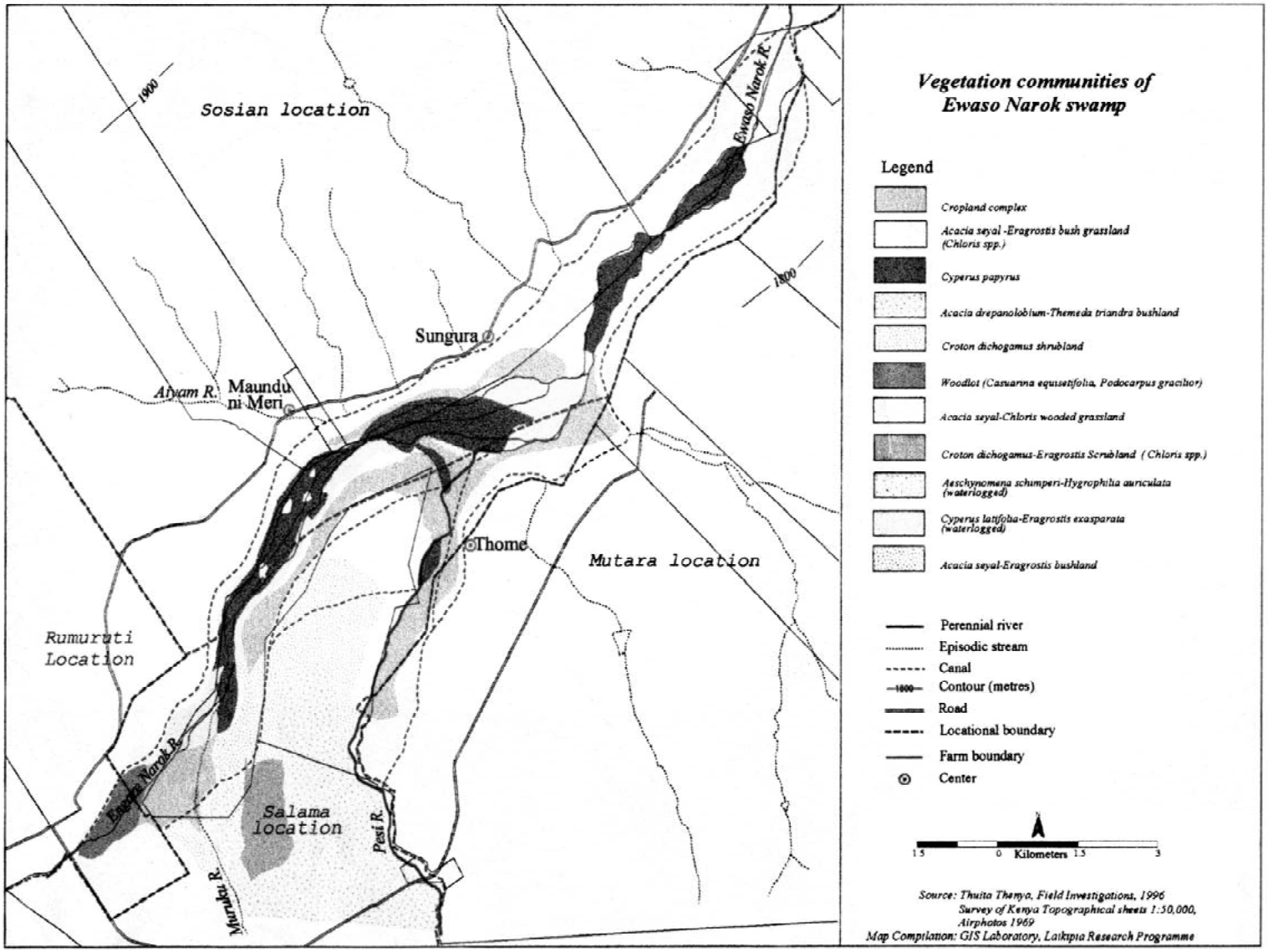

Figure 2. The vegetation communities of the Ewaso Narok swamp.

former white highlands, and human-wildlife conflict. Factors attracting settlement on the wetland include wetland fertility and water availability for those allocated lands in nearby arid zones. Currently, Ewaso Narok swamp holds a total of 580 households, with an estimated population of 3480 persons holding an average of 2.28 acres per households. The land is public, hence settlement is easy here, which is followed by inter-family transfer of land.

Due to aridity, erratic rainfall and frequent drought in this area, the small-scale farmers primarily involved in subsistence cultivation are forced to move to the riverine area, where water availability is guaranteed. This is followed by draining of wetland to open up cultivation of the plots and abstraction of water for irrigation of nearby dryland plot using gravity irrigation. This practice has contributed to the draining of numerous wetlands in the District, among them Pesi, Moyok, Mutara and Marura.

A change of attitude and way of life have also accompanied these changes of land use. The local nomadic tribes have slowly been changing to agro-pastoralists as a result of the declining grazing land and changing economy in general. While this change is a progression move towards the regions food sufficiency, it also exerts a great pressure on the few water resources available and contributes greatly to reductions in macrophyte and riparian vegetation cover through harvesting as building materials, hence destroying habitat in the process.

This greatly interferes with important dry season grazing zones and puts immigrant farmers into direct conflict with wildlife and pastoralists who have used the wetland for time immemorial as grazing land. Due to the increased farming practices which are using irrigation, the water available from the wetlands and rivers is not adequate to meet demand, hence the increasing conflicts between farmers for water. The local administration has to intervene on frequent occasions to solve water-related conflicts. Drainage of the wetland is also strongly held belief among government officials as beneficial in creating more farming land and boosting food production in the district.

Vegetation composition

A total of 106 species of flowering plants, grasses, trees and shrubs from 26 families were identified in the swamp. They were contained in three major vegetation formations based on floral homogeneity around the swamp:

Sedge zone (waterlogged), dominated by *Cyperus papyrus* L., *Cyperus latifolia* Poir. *Eragrostis exasparata* Peter;

Drawdown/transitional (semi-waterlogged), dominated by *Aeschynomena schimperi* A. Rich., *Hygrophilia auriculata* (Schnum.) Heine, *Spaeranthus* sp.;

Dry eco-type, dominated by *Eragrostis* sp, *Aristida* sp, *Sporobolus* sp., *Croton dichogamus* Pax, *Chloris* sp., *Casuarina equisetifolia* L., *Podocarpus pilger gracilior* (P. falcatus Mirb), *Acacia drepanolobium* Skpestedt, *Themeda triandra* Forsk, *Acacia Seyal* Del. (Thenya, 1998).

Birds

Ewaso Narok Swamp provides a suitable habitat to a large number of bird species, which include both African and paleartic migrants. A total of 173 bird species were recorded between September 1996 and January 1997. Out of these 98 species were non-swamp (NS) birds found mostly along the ecotone, 25 species were generalist (G) and 50 species were swamp specialists (SS) (Thenya, 1998). A large difference occurred between the wet (September–November) and dry (December–February) seasons, with wet season holding a total of 83 species while the dry season had 154 species. Out of the 56 migratory species recorded, 12 were African migrants, while 44 species were paleartic migrants.

Mammals

The swamp also provides important habitat, watering and grazing ground for species of mammals. Thirteen species use the swamp from time to time. These include the African water buffalo *Syncerus caffer* Sparrman, bushbuck *Tragelaphus scriptus* Pallas, hippopotamus *Hippopotamus amphibious* L., Patas monkey *Erythrocebus patas* Schreber and carnivores like Cape clawless otter *Aonyx capensis* Schinz (Thenya, 1998). Due to its location in a dryland area, Ewaso Narok Swamp acts as a pseudo-biogeographical island, playing an important and significant ecological role in Laikipia. However, these animals are now a major source of human–wildlife conflict due to the destruction of crops.

Wetland utilisation

Socio-economic activities in the swamp have a very high temporal and spatial dynamism. This is brought

about by variation of climate alternating between wet and dry extremes. Since the wetland is government land, people have been allocated land here on a temporary basis and have a free access to the land. The sizes of the farms range between one to two acres (this is an arbitrary measure used locally in Ewaso Narok swamp to signify any piece of land, which can range from a plot of 10 m^2 to 1 ha or more), but the size does not necessarily adhere to strict conventional measure and it could be bigger or smaller than the figure given.

Table 1 shows the main wetland uses found. From the interviews undertaken, 89.3% of respondents agreed that the wetland holds some important beneficial values at various levels. These values are due to its natural state, for example grazing, or as a result of draining some sections of the swamp are used for farming. The local residents in Ewaso Narok agree that the swamp has significant values as a wildlife habitat, which was ranked highly (Table 1). The importance here is appreciated in different ways, which may deviate from the true sense of wildlife habitat conservation. A similar number, however, felt that the swamp has no importance as a wildlife habitat, which presents an interesting contradiction emanating from differences in perception, and it helps explain the wildlife and human conflict.

The appreciation of the swamp as offering good wildlife habitat should not be viewed only in positive ecological terms but also more as a source of wildlife nuisance. The presence of these animals and their habitats are noticed due to their damaging effect on crops. So the appreciation or recognition of the swamp as forming good habitat may be brought about as a consequence of the damaging behaviour of these animals. People holding such perceptions would always wish to see the animals and the birds eliminated from the swamp. The best way to achieve this is through wetland clearing, which would save crops from damage. Thus the wish of the majority of the people is actually to have the wild animals removed through the process of swamp draining.

As a recreation site, Ewaso Narok swamp currently holds low value and no significant formal recreation takes place here. During the study, only one site downstream at the lower end of the swamp was significantly used for recreation, where there is a private campsite but, which the local people do not use. Thus the calculated χ^2 values (1.325) could be misleading unless other factors not investigated are in operation. The local residents are still struggling for basic needs like food, shelter, sanitation and clean water. All this is done on temporary settlements, which leaves little or no room for recreation. Time that could otherwise be devoted to recreation is actually spent tilling the land, fetching water or looking after livestock.

The downstream part of the river flowing through Ewaso Narok swamp supports an important tourist industry. Three important reserves in eco-climatic zone five along Ewaso Ng'iro river include Samburu National Reserve, Buffalo Springs and Shaba National Reserve. These protected reserves have a number of important tourist hotels like Intrepids Club, Serena lodge, Samburu Lodge and Sarova Shaba. The downstream flow of Ewaso Narok river therefore supports important biodiversity concentration points on which the tourism industry is dependent. This means that the Ewaso Narok swamp acts as an important upstream catchment for these biodiversity conservation areas in spite of the upstream community's low regard for wildlife and a totally different priority for usage of the resource.

Ewaso Narok swamp usually provides a reliable source of dry season livestock forage. Harvesting of forage is a low-key activity unless for young calves or when people have to keep animals indoors due to insecurity. Most of the time, the animals are taken to graze either near the swamp or further in the rangelands. Animals that are mainly fed with harvested forage are 'shoats' and young calves. Grazing forms an important component of utilisation of this swamp, and the area is especially important for grazing during the dry season when most other areas are dry. In this way, the swamp acts as fall-back grazing for dry seasons. Most grazing takes place in the grassland areas adjacent to the swamp.

The main hindrance to grazing in the undisturbed inner swamp is the unstable substrate due to heavy waterlogging. The *Cyperus papyrus* and *Cyperus latifolia* are also not edible except when very young. However, the two sedge species can be chopped into small bits and combined with appropriate additives as a source of livestock food. Harvesting of macrophytes for house construction, mat-weaving and making of fishing traps are important functions of wetlands. In the inventory of ethnobotany of Uasin Gishu district wetlands in Kenya, various uses of macrophytes were recorded, which included fuel, fodder, medicine, food, construction, handcraft and thatching in that order of merit (Kareri, 1992; Odongo, 1996). In Ewaso Narok swamp, the macrophytes were found to have less diversified uses by the local community and are mainly used for roofing, weaving and fuel. All of

Table 1. Ecological importance of Ewaso Narok swamp

Wetland values	Significance Rank values in %							
	χ^2	Sign.	Yes critical	No	Very important	Important	Less important	Not important
Habitat	2.186	0.534	Y	–	36.7	16.7	13.3	33.3
Recreation	1.325	0.723	Y	–	13.3	20.0	10.0	56.7
Forage	0.517	0.772	Y	–	–	3.6	7.1	89.3
Grazing	0.734	0.865	–	N	12.1	51.5	30.3	6.1
Forage	1.982	0.576	Y	–	6.1	51.5	36.4	6.1
Roofing	1.227	0.541	Y	–	46.7	46.7	6.7	–
Weaving	2.592	0.458	Y	–	25.0	34.4	28.1	12.5
Fishing	0.381	0.826	–	N	3.6	7.1	64.3	25.0
Farming	1.866	0.393	Y	–	60.6	33.3	6.1	–
Jobs	0.810	0.667	Y	–	–	41.4	10.3	48.3
Fuel	1.342	0.719	Y	–	12.5	28.1	46.9	12.5
Extra farming	0.519	0.771	–	N	40.6	53.1	–	6.3
Dumping	6.270	0.099	Y	–	3.7	7.4	22.2	66.7

Source: Thenya, 1998. Y, yes; N, no.

these involved direct extraction of materials from the swamp.

The local people extract building materials from the swamp mainly from *Cyperus* and *Echinochloa* species, for thatching or partitioning of rooms. The use of macrophytes for building was also ranked very highly with 47% putting it as a very important wetland value. A survey in the field revealed that all the houses within the swamp had used macrophytes for thatching. The main reason could be that macrophytes provide a cheaper source of building material. Other materials used in construction in this area come from *Acacia* trees particularly *Acacia seyal* Del, *Acacia xanthophloea* Benth and *Acacia drepanolobium* Skpestedt which provide rafters and standing posts. However, this practice has contributed to significant devegetation of the adjacent rangelands and riparian area.

The second major use of wetland resources is weaving. According to the results of the field survey, this was ranked highly by about 30% of respondents (Table 1). *Cyperus papyrus* is weaved into mats that are used either for partitioning houses or making walls or sleeping mats. This is especially suitable because of the high risk of flooding and constant abandonment of shelter. It offers a buffering effect and reduces losses of more expensive materials such as foam mattresses during floods. Most of the houses are temporary, as too are most other in-house goods, and this has significant implications for the natural resources in the area. Since the houses are not constructed frequently, the activity is not detrimental to the swamp system and can be utilised at a sustainable rate. Reconstruction only takes place after the floods to repair the damaged houses at most once per year.

The use of the wetland as a source of fuel is of low value (Table 1). The main part of the macrophytes used for fuel material is the rhizomatic parts of *Cyperus papyrus* L. during the dry season when the macrophytes are burnt and the rhizomes uprooted and dried for use as domestic fuel. The stem of *Cyperus* sp. has hollow air spaces called 'aerenchyma', which makes them poor and uneconomical for fuel use. The use of macrophytes for fuel is encouraged by the presence of cleared macrophytes following land preparation. However, the process is tedious which tends to discourage the activity. Similar uses of wetland resources have been recorded elsewhere. Clay from Yala swamp in Lake Victoria, Kenya has, for example, been used for wall making, while papyrus reeds have been used for weaving baskets or fishing traps in the same area (Odak, 1992).

The results of this study show that the swamp acts as a poor source of direct food material like fish and meat. The resource was ranked low in importance, because of the socio-cultural nature of the people living in this area. While the pastoralists use domestic animals as a source of food, the recently settled community who are mainly Bantus derive their food material from crops, mainly cereals and vegetables. The thick nature

of the papyrus may not even allow fishing which may serve to discourage the activity, but the presence of hippopotamus and water buffalo act as a further deterrent.

Unstable grounds in the swamp also discourage hunting, although reports of Clawless Cape Otter *Aonyx capensis* Schinz and Bushbuck *Tragelaphus scriptus* Pallas trapping by farmers guarding crops at night have been recorded (pers. comm, local residents). This is not the case, as in other swamps in western Kenya where wetlands are important for fishing and hunting areas. The Yala and Nzoia swamp in Lake Victoria have been used as hunting ground for sitatunga (*Tragelaphus spekei* Sclater), hippopotamus (*Hippopotamus amphibious* L.) and wild pig (*Phacochoerus aethiopicus* Pallas). Birds like quail are sometimes trapped for food while ducks and whydahs are caught for feathers. These forms of resource utilisation are lacking in Ewaso Narok swamp, which can be attributed to the location of the swamp. While the Yala and Nzoia swamps are found in areas occupied by sedentary Luos and the Luhya communities which derive some of their livelihood from the swamps, Ewaso Narok swamp is located in an area that is used for temporary grazing by nomadic pastoral communities, mainly the Samburu and Maasai. During the colonial period, this area was converted into large scale ranching, which reduced human concentration and allowed the area to remain unsettled or sparsely settled for a long period of time. The culture of hunting and fishing could therefore not have developed, while the current sedentary community in the swamp is more interested in crop cultivation with little interest in fishing or hunting.

Cultivation is a very important activity in the swamp and it is on the increase. Gichuki (1992) notes that some forms of agriculture in wetlands lead to mining of accumulated nutrients for short-term agricultural gains. In Ewaso swamp, the wetland area provides an important farming ground for the local community. More than 60% of the respondents agree that the wetland forms important farming ground (Table 1). Much of the area is under horticultural produce and large areas of the land are cleared each year for this purpose. The produce mainly tomatoes and kales are sold within the urban areas like nearby Nyahururu and as far as Nairobi and Mombasa town.

Family members mainly provide farm labour; which means that employment in the swamp area is of low value and significance (Table 1). Even where employment is provided by horticultural farmers, it is very temporary and subject to market availability for the products, which comprise mainly tomatoes.

Ewaso Narok swamp is located in a rural area where garbage generation is not high; thus the issue of garbage disposal does not present a problem. However, the area lacks proper sanitation, and the wetland forms an ideal alternative. The wetland therefore forms an important dumping ground for human waste but, due to the low population, the effect is not yet serious. However, the issue of common water-related diseases like typhoid and cholera in this area means that the waste disposal may have medical implications in the course of time as the residents use the same water for drinking. As the population increases in the swamp, this problem is likely to become more severe.

Utilisation of wetlands creates environmental constraints as with most other ecosystems. The people making use of wetlands or living nearby may also face a wide range of problems. These constraints takes the form of accessibility, either due to a hostile environment (e.g., terrain) or the presence of dangerous animals (Table 2).

For a long time wetlands have been regarded as a source of diseases and other problems associated with waterlogged soils (e.g., cultivation). Although the presence of Ewaso Narok swamp confers a wide range of benefits to the local community, the ecosystem is viewed in some way as a source of occupation hazards. Some of these are natural while others are not. Some of the problems resulting from the natural state of the wetland include the harbouring of wildlife, which put in order of priority to crop damage are, hippopotamus, buffalo, otters, elephant, waterbuck and numerous birds. The results of this study showed that the presence of these wild animals can be deterrent to wetland utilisation (Table 2). Most of the animals inhabiting the swamp are nocturnal feeders which damage crops, at times clearing a whole farm. Swamp residents face permanent danger, as movement especially at night is dangerous due to the feeding animals. The crops that are mostly affected are maize, beans and tomatoes but the latter is more damaged by the greater blue-eared starling (*Lamprotornis chalybaeus*). This bird normally flocks in large numbers, often of over 50 individuals, and when they land on a tomato farm the damage is often enormous. To counteract this, farmers have resulted to poisoning this bird by putting agricultural chemicals which are placed in open tomatoes, and which kill the birds that feed on them. It was not possible to quantify how many birds have been

Table 2. Constraints of using wetland resources

Wetland values	Significance ranking values in percentages							
	χ^2	Sign. critical	Yes	No	Very important	Important	Less important	Not important
Important Wildlife menace	0.403	0.939	–	N	90.9	3.0	3.0	3.0
Floods damage	8.395	0.051	Y	–	54.5	36.4	6.1	–
Difficulty soil tillage	1.833	0.607	Y	–	15.2	21.2	45.5	6.1
Land occupied by swamp	0.387	0.942	–	N	51.5	36.4	3.0	3.0
Loss by floods	4.338	0.227	Y	–	36.4	18.2	30.3	6.1
Source of diseases	2.128	0.546	Y	–	27.3	39.4	30.3	3.0
Communication barrier	1.821	0.402	Y	N	36.4	51.5	12.1	–
Lack of clean water	0.000	1.000	–	N	–	–	39.4	42.4

Source: Thenya, 1998. Y, yes; N, no.

poisoned since they were hurriedly buried to erase any evidence.

Crop damage is more common in Thome side (eastern of the swamp) spreading to Jennin area where the floodplain is extensive thus allowing more irrigation farming. During the dry season, there is an increased number of farmers in the swamp. It is also at this time that the animals are moving into the wet areas in search of food and water, which heightens the human–wildlife conflict. To keep animals from damaging their crops, men have to stay out overnight to chase away nocturnal animals. The dry season is also occasioned by frequent water conflict due to the high demand for irrigation, which requires intervention of the local administration to resolve the issue at times.

Ewaso Narok is formed as a result of the low gradient upon which Ewaso Narok river spreads, and flooding is therefore high and a significant problem (Table 2). This usually occurs during the long rains in April to June, when the rivers flood the valley bottom spreading their water over large areas. There are no gauging stations available near the swamp, and the ones along the system are quite far from the swamp. Therefore, an analysis of flood pattern was not possible. However floods appear to have intensified over the recent years although the duration of flooding has reduced. This is partly attributed to the devegetation of upper catchment areas, which is an issue that needs to be investigated. At the start of this study in September 1996, the entire area was flooded to an extent that the local people had not experienced before. Floods have a strong detrimental effect resulting in loss of life, crops and property, including those on the drawdown area. When floods come suddenly, especially at night, damage can be very severe especially on shelters and life. The floods are ecologically beneficial, since at the end of the floods there is a strong upsurge in bird populations especially in the drawdown area, although this does not last long because it is soon disturbed by cultivation. Ewaso Narok swamp soils are clayey and hard to work on since they are sticky when wet and very hard when dry.

The swamp area residents perceive the wetland as a source of diseases like typhoid and cholera (Table 2). The low ranking of the wetland as a source of diseases could be due to illiteracy, as the level of education is very low among the residents. The most common diseases in this area include malaria and typhoid, both of which are water-related diseases. It is also important to note that the wetland in its current state acts as communication barrier, which was clearly reflected in the interviews. People have to walk long distances to find accessible crossing points to move from one side to another which can be dangerous, as one is likely to encounter dangerous animals in the thick papyrus.

The irony of moving into the wetland is that 92% of households are unable to feed themselves, with only a few commercial horticultural farmers, who take their produce out of the swamp to Nyahururu, Nairobi and Mombasa (Mathuva & Kiteme, 1997). The food insufficiency is mainly attributed to flooding, crop destruction by both domestic and wild animals, and poor irrigation methods, mainly attributed to root zone waterlogging by excess water. Apart from the effect on crops, poor-housing and social infrastructures leads to poor health with a high frequency of malaria, typhoid and pneumonia. The main sources of income for the local community includes, crops 56%, casual labour 44%, livestock 24% and charcoal/wood 16%. This

means that no direct product from the swamp like macrophytes earn the community any income.

Discussion

Although all wetland resources used are dependent on the natural state of the wetland, some resources absolutely depend on its maintenance (Gaudet, 1977; Backeus, 1993). These include habitat utilisation, recreation, tourism and grazing. They are affected most by any disturbance of the system, and their value diminishes with ecosystem disturbance. The utilisation of swamp natural resources involves extraction through harvesting, which usually attracts people to wetlands. Wetlands are known to play important socio-economic roles and they have therefore become important zones of human activities. This phenomenon is well documented in Ethiopia where wetlands have been centers of agricultural activities especially after the 1984 famine (Wood, 1997). In Kenya, the search for land and food security has pushed people into dryland areas such as Laikipia District. Since the rangelands are too dry to cultivate, wetlands offers an alternative farming areas, which has culminated in the draining of numerous other wetlands in the generally dry Laikipia District, for example like Pesi, Moyoko, Mutara and Marura swamps.

The issue of wetland biodiversity conservation in developing countries remains controversial due to the level of economical development and social needs. One is always caught between the conflicting demands of crop production and species conservation, which are both important and necessary. Without an economic return from natural ecosystem, local people are then pre-occupied with survival. This means that the immediate need to satisfy food requirement is at the expenses of species and ecosystems survival.

The results of occupation of the swamp area have been negative for the swamp ecology to a great extent. Currently, 58% of the swamp has been cleared although the swamp is able to restore itself from time to time during the wet season. There has been increased cutting of riverine vegetation, such as *Acacia xanthophloea* for charcoal burning. Due to the clearance of macrophytes and other riverine vegetation, there have been increased incidences of flash-floods. The community around the swamp has been plagued by increasing incidences of diseases like malaria, typhoid, bilharzia and pneumonia due to poor sanitation. The macrophytes are excessively harvested for building purposes and to create room for cultivation, which destroys the habitat. These changes have brought with them increased human–wildlife conflict. For the local community it is better to persevere the current sufferings for sometime while, reaping low returns and invest their efforts in shaping a system where they can grow more food to satisfy their household demands.

In view of the local peoples' desire to continue using the wetland, an opinion was sought on alternative land use for the swamp. A conflict of interest was reflected in the answers, which did not give the true picture of what the people really wanted. While 87.9% of respondents agree that the wetland should be conserved, a similar number indicated a wish to have it fully converted into farming area. It is important to note that those advocating wetland conservation actually also need to make sure that they can still use the wetland, since conservation alone denies them access. Only 6.1% were of the opinion that a government policy should be enacted to fully conserve the wetland. Conservation policy in the view of the farmers should allow free access, continued farming and settlement without government restriction. This means that theirs is a conflict of ideas on what should be done as pertains to conservation. It is important to note that conservation to the local person means an access for farming and grazing, rather than the traditional natural resources preservation.

While Ewaso Narok swamp holds a rich biodiversity of flora and fauna and performs a significant ecological role, the immediate settler community is faced with needs to provide food for the increasing population. With a population of 30 persons km^{-2}, the need to provide food is high (Laikipia Research Programme, 1996). This survey of Ewaso Narok reveals that the local community has low regard for wildlife and the swamp, and would rather have it is converted into a farming area. This can be attributed to the menace that wild animals cause to their crops and the non-economic value they attach on wildlife. While the local community actually gets minimal returns from crop cultivation, there is absolutely no return from wildlife. Hence, this non-economical return from a wetland, especially dryland wetlands, make its conservation a difficult issue, especially in the face of land transformation from extensive grazing to intensive small-scale cultivation.

Dry season grazing mainly carried out by pastoralists who operate in other parts of the District and only come to the swamp during the dry sea-

son. Initially, human–wildlife conflict in the Pesi and Marura wetlands was high after their drainage, decreasing thereafter, so the human conflicts in Ewaso Narok swamp will slowly reduce as the farming community gradually increases. The increase in farming will have serious repercussions on downstream users, a phenomenon which is already being experienced. Downstream users, like Buffalo Springs and Samburu National Reserves will experience reduction in river flow overtime with some effect on their riverine biodiversity, and maybe with some effect on the tourism industry in this area.

The unfortunate neglect of semi-arid wetlands is perhaps not surprising given the limited use which has traditionally been made of these areas and the minimal impact on these areas of traditional communal grazing. These wetlands are experiencing a new wave of cultivation which puts a higher demand on their water resources than can actually be meet. The most immediate danger is that the diverse functions of these wetlands are often overlooked, and are consequently slowly being replaced by crop production to satisfy food demand. Not only is the availability of wetland products undermined, such as grazing and thatching, but there is a danger of all wetland functions being replaced by agriculture which is difficult to sustain due to its high demand on water resource. Soil studies in other wetlands within this area, like Pesi and Marura swamps which have been completely drained for many years, show almost complete degradation after 5 to 7 years (Thenya, 1998).

Ewaso Narok has remained in a natural state for a long period of time until the late 1980s and its existence must have been taken for granted. The swamp has been targeted for draining through a government Arid and Semi-arid Land (ASAL) programme and pre-drainage environmental impact has already been done (Mathuva & Kiteme, 1997). It is most likely that its ecological and economical role will therefore be lost like other numerous small swamps in Laikipia. These activities will contribute to immense biodiversity loss. Presently, the impact is greatest for the herbivores as periodic burning and draining takes place during the dry season when they need the wetland most. As vegetation cover reduces, animals such as hippopotamus and buffalo will be restricted to smaller ranges, resulting in an increased human–wildlife conflict. As the wet areas are drained during the dry season, crucial waterfowl habitats are lost and many birds dependent upon marshy areas, like African Snipe (*Gallinago nigripenis*), Grey Crowned Crane (*Balearica regulorum)*, Lesser Swamp Warbler (*Acrocephalus gracilirostris)*, will have to find alternative sites. Apart from habitat loss and alteration, direct elimination of species is occurring. Birds are the most affected species; the Great Blue-eared Starling (*Lamprotornis chalybeus)* which feeds heavily on tomatoes, is poisoned directly through the use of biocide. Incidence of primate poisoning has also been recorded. As people settle in the wetland, the need for firewood and building materials rises. The effect of this demand has been to degrade the adjacent dry area by cutting acacia trees to get firewood, charcoal and posts for house building. The trees are either harvested by cutting branches or cutting down the whole tree.

There is a need to assess the direct effects of human activities on hydrological regimes. However, it is expected that wetland degradation will disrupt hydrological river regimes and lead to extremely disturbed stream flow with far-reaching impacts on downstream areas. Loss of natural headwater reservoirs is an issue of considerable concern given the increasing scarcity of fresh water in developing countries, especially in Africa (IUCN/UNEP/WWF, 1991). In recent years, downstream areas below Ewaso Narok including Archers Post and Samburu National Reserve have been experiencing reductions in water flow. In view of the activities taking place in the swamp, conservation of the wetland is crucial for the survival of the downstream wildlife and human communities, but the economic returns of cultivation make it almost impossible to see this swamp surviving a few years from now.

As people continue moving into the wetland area and settling either in the swamp or in the nearby dry area, the seasonal population fluctuation will go down. This will seriously affect the swamp's annual recovery. This means that the swamp will follow the same fate like other swamps in the region, but the repercussion is bound to be more widespread, due to the crucial role that this swamp plays in terms of downstream water flow regulation and local ecological needs. Since Laikipia is a dry area, use of wetlands for cultivation is inevitable since rain-fed agriculture often results in a failure of crops. Since the newcomers operate small-scale farms, alternative land use like ranching is not possible due to the size of the farms. Monetary returns from tourism have often been a problem since locals do not see the benefits. In this part of the developing world people are more preoccupied with basic needs like food, shelter and clothing.

With no clear policy on alternative source of livelihood for the dry area immigrants, and no benefits from wildlife, dryland wetlands face a bleak feature. This will further be compounded by increasing population of mainly sedentary communities, which will exert greater pressure on available water resources. With the frequent drought and aridity in this area, the only alternative will be to develop this wetland into an agricultural area, seriously jeopardizing other uses. Who has the right of use, and how much, remain the key questions?

In spite of the gloomy future that faces this dryland wetland, it has shown benefits to the local community as well the whole country. With some conservation in the catchment areas and less intensive water abstraction the wetlands will have a future. Currently it is forms an important dry season refuge for both human beings and wild animals and support a crucial tourism industry downstream which a major source of income to the country. The recent development of the Laikipia Wildlife Forum, a non-governmental organisation which is making great strides in integrating tourism, agriculture and wildlife in economically sustainable, locally based projects, offers hope for this system.

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