Hydrobiologia **488:** 43–55, 2002.
D.M. Harper, R. Boar, M. Everard & P. Hickley (eds), Lake Naivasha, Kenya.

Aspects of the biodiversity of the rivers in the Lake Naivasha catchment

Mark Everard[1,*], Anthony Kuria[2], Michael Macharia[2], Jacqueline A. Vale[4] & David M. Harper[3]
[1]*The Natural Step UK, 9 Imperial Square, Cheltenham, Gloucestershire GL50 1QB, U.K.*
[2]*Department of Ornithology, National Museums of Kenya, P.O. Box 40658, 00100-GPO, Nairobi, Kenya*
[3]*Department of Biology, University of Leicester, Leicester LE1 7RH, U.K.*
[4]*Environment Agency, Rio House, Waterside Drive, Aztec West, Almondsbury, Bristol BS32 4UD, U.K.*
[*]*Present address: Environment Agency, King's Meadow House, King's Meadow Road, Reading, Berkshire RG1 8DQ, U.K. E-mail: mark.everard@environment-agency.gov.uk*

Key words: tropical river, RHS, birds, plants, feeding guilds

Abstract

The diverse river systems of the Lake Naivasha catchment provide a wide range of habitats. Distribution of a number of flowering plant species along river corridors appears most strongly linked with altitude and topography, although some species have an affinity with river edges. A distinct dry land/savannah flora is represented close to river channels in the lower, temporary rivers, while other plant species are ubiquitous. More physically diverse river habitats support more diverse plant assemblages. Bird biodiversity and abundance appears to be strongly linked with habitat diversity and feeding guild data suggest that this is related to the availability of a range of food items. Diversity is not linked with rarity. Changes in land use patterns and intensity in the catchment can affect its capacity to support rich biological communities.

Introduction

The shores of Lake Naivasha, Kenya (0° 45′ S, 36° 20′ E), offer fertile soils, a relatively constant climate, equatorial intensity of solar radiation over a near-constant day-length, ready access to fresh water, and an inexpensive labour force with which to pursue intensive agriculture. This has attracted a large number of horticultural interprises to the flat lands around the lake shore. Production has been predominantly of luxury products – cut flowers, fruit and out-of-season vegetables – for European markets, to where they are daily flown from Nairobi. This form of development has proven extremely profitable. Together with geothermal energy production, tourism, and commercial fisheries, it comprises a major element of the economic development of the Naivasha region (Anon, 1999) and horticulture is now the largest industry in Kenya.

The lake, which is at the center of this activity, was designated as a Ramsar site in 1995 (Ramsar, 1971, 1996; Anon, 1999). By contrast, the wider catchment comprises predominantly land tilled for subsistence and cash crops with some rough pasture in the river valleys. Its environmental protection is non-existent and knowledge of its value is confined to rare bird distribution (Bennun, 2001).

Many tropical wetland areas are now sites for development due to their high productivity (Dugan, 1990). Many wetland systems have suffered in the past from unsympathetic intensive development, which has led to their destruction or degradation with the loss of wetland 'services' and biodiversity (Dugan, 1990; Denny, 1991, 1994). A Lake Naivasha management plan has begun to address lakeside issues through a process of consensus-building (Enniskillen, this volume) but there is no equivalent impetus in the catchment.

Tropical catchments are infrequently inventoried to gain an understanding of their total contribution to biodiversity (Bennun, 2001). Those that are studied often use the rivers as indicators of the overall catchment health (Ormerod & Jüttner, 1999). Many catchments include small wetlands: swamps and marshes, occupying an intermediate position between fully aquatic and fully dry habitat types, which perform many physico-chemical, hydrological and ecological functions, valuable to ecosystems and local human populations (Dugan, 1990; Thenya, 2001). Wetlands are a precious wildlife resource, threatened at the global scale yet crucially important for both their wildlife and the resources they provide for human society. They are also highly productive, resulting in their all too frequent over-exploitation for agriculture and other human uses which, if too intensive and poorly planned, generally destroy the wetland habitat and with it the 'services' that it provides (Denny, 1995).

This paper describes a preliminary inventory of the plant and bird biodiversity in the Naivasha catchment as the first step in understanding the conservation needs of a predominantly subsistence rural economy and as a precursor to a full management strategy for the protection of the Lake Naivasha Ramsar site.

Methods

The catchment (see Fig. 3) was biologically surveyed at the same time as the River Habitat Survey described in Everard et al. (2002). A complete inventory of flowering plant and fern species was undertaken in the river channel and up to one metre from the landward edge of the bank top at each 500 m river stretch. Abundance data were not generally recorded.

A series of transects were taken across the eastern Gilgil floodplain on the Marula Estate immediately upstream of the lake's North swamp. Four replicate quadrats of one square metre, each separated by one metre in a series parallel to the river channel, were taken at 25 m intervals from the *Cyperus papryrus* swamp edge to the *Acacia xanthaphloea* woodland at the floodplain fringe. Taxa were assessed in each quadrat using the DAFOR scale.

Bird data were also collected at RHS sites on the river systems (visited once), sections of the lake shore (visited twice) and some sites outside the catchment (for comparative purposes). Cumulative bird sampling along the whole Kwamuya River system (i.e. three contiguous RHS sites) resulted in a survey length of 1500 m, and the two contiguous Gilgil sites at Maasai Ridge were recorded with a contiguous bird survey length of 1000 m. Shannon species diversity indices were calculated from abundance in timed counts and additional indices calculated separately for foraging guilds (Owiunji & Plumptre, Unpubl. report). A coefficient of species overlap was used to compare sites, taken from the coefficient of community overlap in Whittaker (1975).

Results

Plant taxon richness

Gross numbers of taxa (species and families) of flowering plants are reported by site along river corridors in Figures 1 and 2. Species richness ranged from 11 (at the stressed Kwamuya site downstream of the South Lake Road) to 102 (at the boulder-strewn dry Karati River upstream of the gorge). Diversity was particularly high (greater than 60) at eight sites:

Simba River (73 species)
Ol Kalau River (80 species)
Nyambug River (67 species)
Kiriundu River (83 species)
Morindati River at Kahuho School (67 species)
Karati River upstream of the gorge (102 species)
Karati River at the gorge (62 species)
Nyamithi River gorge (60 species)

All these sites are energetic (boulder/bedrock dominated) with surrounding trees, with the exception of the Kiriundu River site on the headwaters of the Gilgil system. This contains diverse habitat however, comprising a rocky gorge section enclosed in shrubs downstream, open pasture on the mid section, and mature woodland at the upstream end. This habitat diversity appears also to enhance plant diversity, as the site also contains many unique taxa: 13 species from 12 families occur only here, including unique types such as epiphytic ferns and an epiphytic orchid. It is also the only site at which the families Balsaminaceae, Orchidaceae and Papaveraceae are represented.

Number of species per family varies from 1.2 (0–500 m upstream of the road on the Kwamuya stream) to 2.5 (Nyambug river, Morindati at the Army Barracks, Gilgil at Nakuru Road, and the Karati Gorge). Of the four sites with a species per family ratio of 1.5 or less, three were observed to be subject to severe erosion or silt input (1.2 at Kwamuya stream, 0–500 m upstream of the South Lake Road, 1.3 on the same stream downstream of the road, and 1.5 at the Malewa River at KARI). The value of 1.5 recorded at the Malewa downstream of the Turasha confluence may therefore suggest a similar stress.

The Karati site immediately above the Karati gorge is exceptional in that it contains both the most species

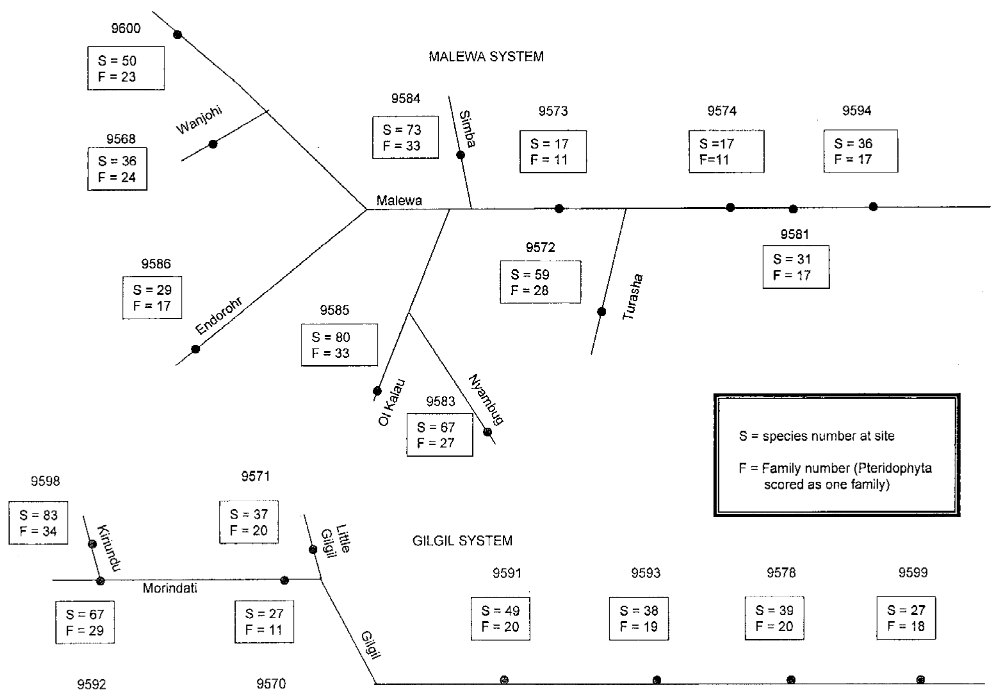

Figure 1. Numbers of plant species and families at RHS sites in the Malewa and Gilgil river systems.

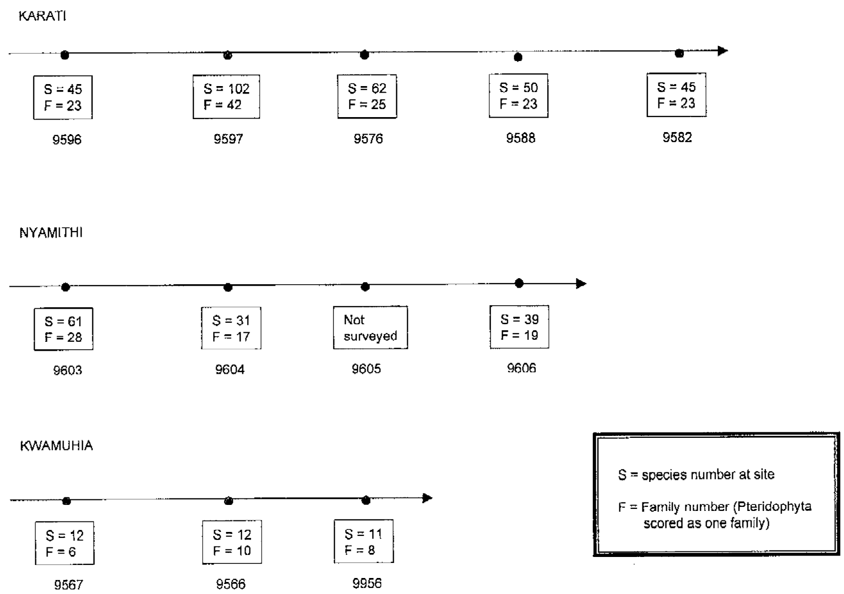

Figure 2. Numbers of plant species and families at RHS sites in the Karati and Nyamithi river systems and the Kwamuya stream.

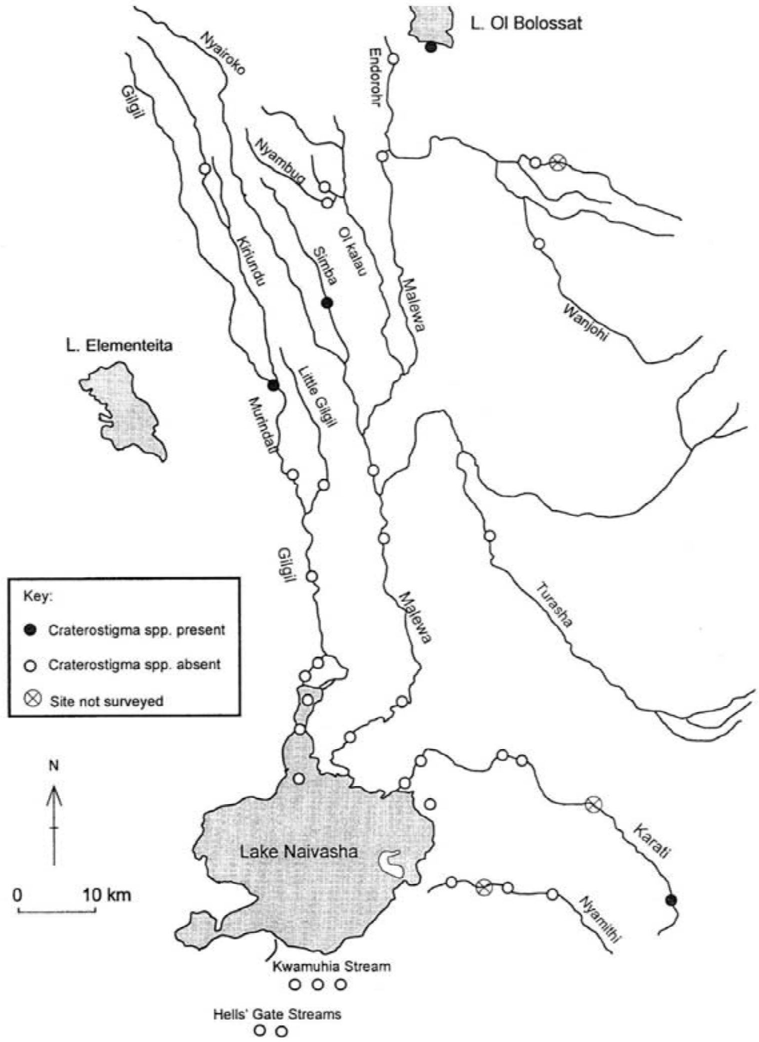

Figure 3. Distribution of *Craterostigma* spp. at RHS sites in the Naivasha catchment, and on the riparian zone of Ol Bolossat and the North Swamp.

(102) and families (43), as well as one of the highest species to family ratios (2.4), recorded at any site. As well as being a rocky gorge site, it is also an interface reach between a plateau immediately upstream and the rock gorge below, and it has semi-continuous tree cover on each bank with attendant shading of the channel, overhanging boughs and exposed bankside roots. Energetic rivers at mid-altitudes (2400–2700 m) therefore appear generally to be host to high plant richness.

Flowering plant assemblages are more closely related to altitude than to the river system in or near which they occur. The catchment may be divided into three altitude classes plus the wetlands formed at the river inlets by low lake levels. These are:

Montane rivers (>2500 m). Only one montane river is represented, the Malewa at Kirima (altitude 2500–2700 m). Species richness was nevertheless higher than average (50 species, with a species to family ratio of 2.2) and three species of plants occur only at one other site: *Brachylaena huillensis* (Compositae) which is also at the higher altitude and nearby Wanjohi River site (RHS 9602); *Artemesia afra* (Compositae) is also present in a disturbed temporary stream in Hell's Gate (outside of the catchment RHS 9607); and *Plantago palmata* (Plantaginaceae) which is also present at the diverse Kiriundu site (RHS 9598).

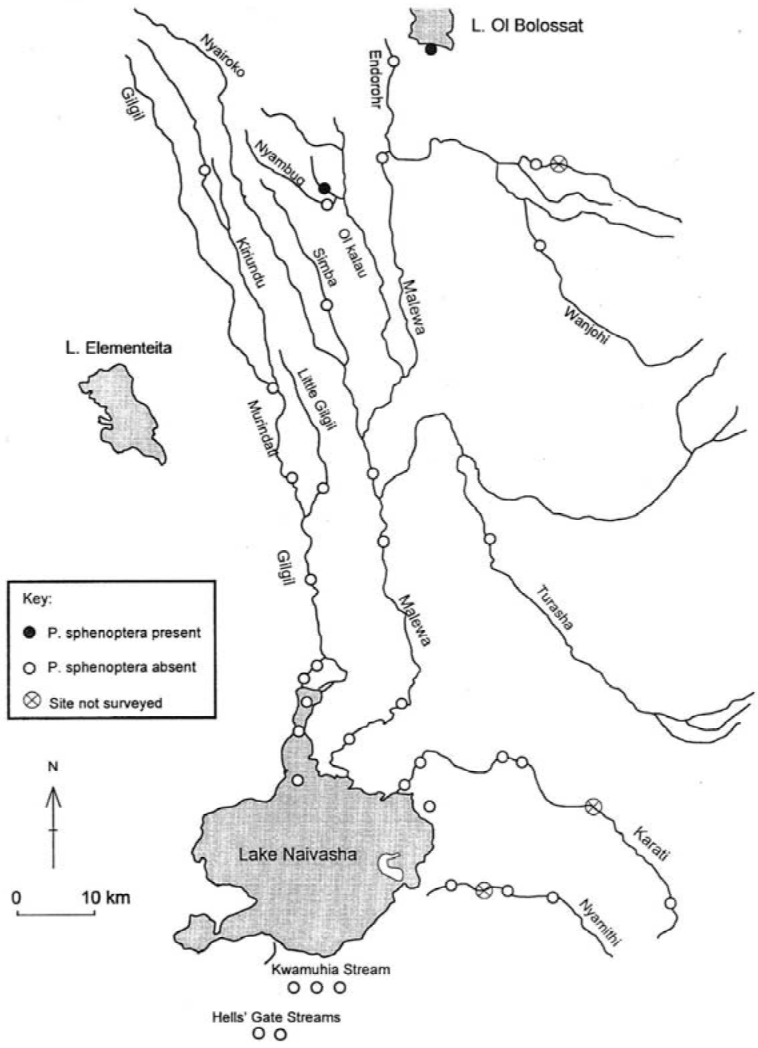

Figure 4. Distribution of *Polygala sphenoptera* at RHS sites in the Naivasha catchment, and on the riparian zone of Ol Bolossat and the North Swamp.

Upland rivers (2000–2500 m). In the cooler moist uplands in which the Gilgil and Karati river and many of the Malewa headwaters rise, a similar riparian flora occurs in all river systems. Characteristic upland genera include *Craterostigma* (Fig. 3), *Geranium*, and *Polygala sphenoptera* (Fig. 4). *Ethulia vernonioides* (Compositae) is an example of species less restricted, occuring in all three major river systems from montane through to medium altitudes (Fig. 5). At altitudes below 2400 m, a wider mix of herbs and grasses are present, with the virtual absence of some of the characteristic upland herbs.

Lower catchment rivers (1890–2000 m). The flatter lands near the lake shore contain a more typical savannah flora, represented by dryland species such as the Kikuyu grass *Pennisetum clandestinum* and many composites such as abundant *Senecio mesogrammoides*.

The lack, except in impoundments, of **aquatic vegetation** in the river beds is marked, apparently reflecting the combined effects of turbid waters and unconsolidated beds. Wetland species are relatively rare in the catchment and occur predominantly near the water's edge in low-gradient lowland rivers, as well as opportunistically in stillwaters (e.g. the Turasha Dam) and pools in rock gorges (e.g. in the Karati gorge). Examples include *Ludwigia stolonifera* (Fig. 6) and *Sphaeranthus suaveolens* (Fig. 7). Marginal

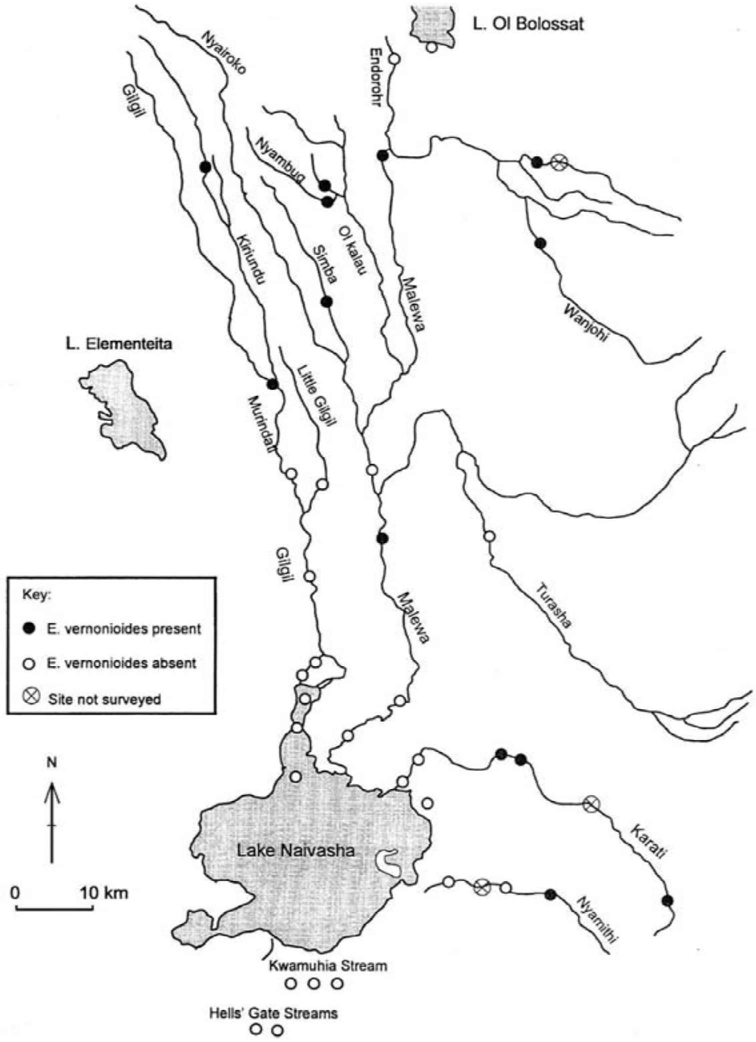

Figure 5. Distribution of *Ethulia vernonioides* at RHS sites in the Naivasha catchment, and on the riparian zone of 01 Bolossat and the North Swamp.

emergent vegetation was frequent however, with opportunist amphibious species such as *Justicia betonica* or *Commelina* spp.

Ruderal 'weed' species such as Mexican Marigold *Tagetes minuta* (Fig. 8) and the Gallant Soldier *Galinsoga parviflora* are common throughout the catchment, right up into the cooler and less populated uplands where subsistence agriculture is extensive along river valleys. A few species such as the star grass, *Cynodon dactylon* (Fig. 9), occur ubiquitously across the catchment.

In the floodplain of the Gilgil on former lake bed (Fig. 3 shows the extent of the lake at its highest water levels) there were 27 species representing 18 families (Fig. 10). The data illustrate distribution and dominance patterns across the floodplain. Fully aquatic vegetation (*Eichhornia crassipes* and *L. stolonifera*) occur only where water is present or close. Semi-aquatics, such as *Diplachne fusca* occur in the grassland zone near the water's edge. Further across the floodplain, *C. dactylon* and *P. clandestinum*-dominated grassland, with opportunist species such as the crucifer *Lepidium bonariense*, were extensive, grading into *Achyranthes aspera/Solanum incarnum* scrub before reaching mature *A. xanthophloea* woodland. The relatively low flowering plant species diversity therefore masks the structural diversity.

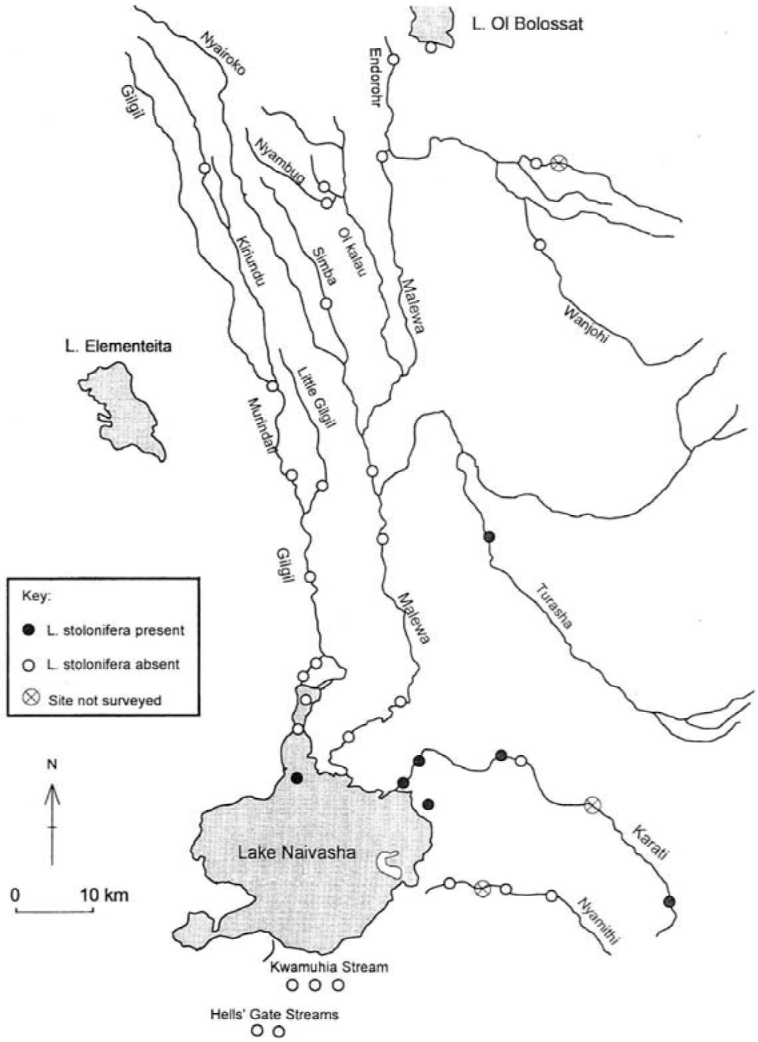

Figure 6. Distribution of *Ludwigia stolonifera* at RHS sites in the Naivasha catchment, and on the riparian zone of Ol Bolossat and the North Swamp.

Bird richess and diversity

One hundred and thirty species of birds were recorded, belonging to 17 orders and 45 families (Table 1). These included the Jackson's Widowbird (*Euplectes jacksoni*), a near-threatened species in Kenya, recorded at the Turasha Dam site. Feral lovebirds, which originally occurred only around the lake, were found at many sites along the Gilgil and Karati rivers far from the lake edge. Long-toed Lapwing (*Vanellus crassirostris*), once described as common (Henderson & Harper, 1992), were quite rare, recorded only twice along the lake edge.

Little grebe (*Podiceps ruficollis*), moorhen (*Gallinula chloropus*), African black duck (*Anas sparsa*), giant kingfisher (*Cerlye maxima*) and black crake (*Limnocorax flavirostra*) represent some of the water species recorded at the Turasha Dam. Other important species included Hautlaub's Turaco (*Tauraco hartilaubi*) recorded along the Gilgil riverine sites where fruiting trees were common and Grey Crowned Cranes (*Balearica regulorum*), a wetland indicator species, recorded at the Marula site on the Gilgil floodplain and Lake Ol Bolossat.

The KARI site on the Malewa system had the highest richness (34 species) followed by the Marula Floodplain site on the Gilgil River (29). The Gilgil

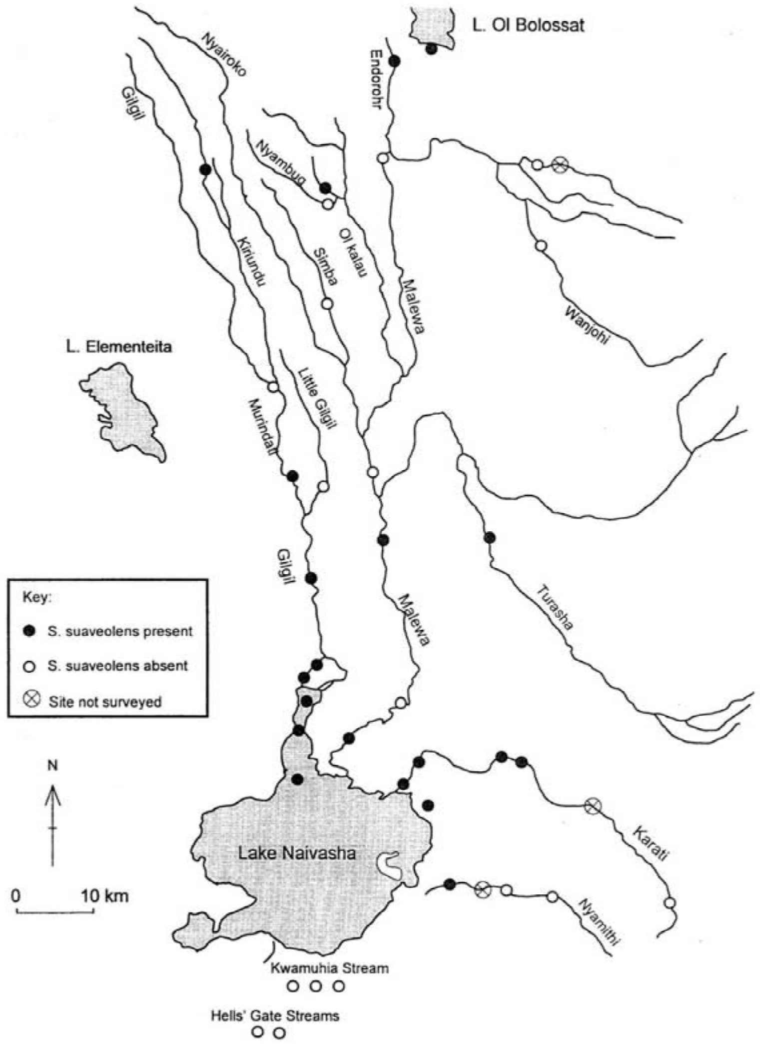

Figure 7. Distribution of *Sphaeranthus suaveolens* at RHS sites in the Naivasha catchment, and on the riparian zone of Ol Bolossat and the North Swamp.

site at Maasai Ridge and the Kwamuya river each had a total of 25 recorded species. The Gilgil river site at the Army Barracks was species-poor (only 8 species) whereas the poorest score of all was at the Karati site at Kinangop (4). The Kwamuya River had the highest bird species diversity (2.9) followed by the Karati North Swamp (2.4) then Malewa Pumphouse site (2.3). The Gilgil floodplain at the Marula Estate was the least diverse (0.31) despite having 29 species. No diversity index was calculated for the KARI site on the Malewa as numbers observed were not accurately recorded.

Grouping sites along rivers, the Kwamuya River had the highest diversity index (2.9), but on a mean basis (excluding the Kwamuya channel), Malewa sites were the most diverse (2.1) while the lake was the least (1.1). However, there was no significant difference in the mean species diversity between the river locations (Kruskal–Wallis test: $H\,(4, N = 15) = 8.02667$, $P > 0.05$).

The species data converted into feeding category, yielded 8 'forage' guilds (Table 2). The mean forage guild diversity index (FGDI) for all sites combined was 0.53, with a range of 0.44–0.67 at the Malewa mouth and the Turasha Dam respectively (Table 1). Karati River sites grouped together had the highest mean forage guild diversity (0.56) while the lake (open water) had lowest mean (0.46). The Kwamuya sys-

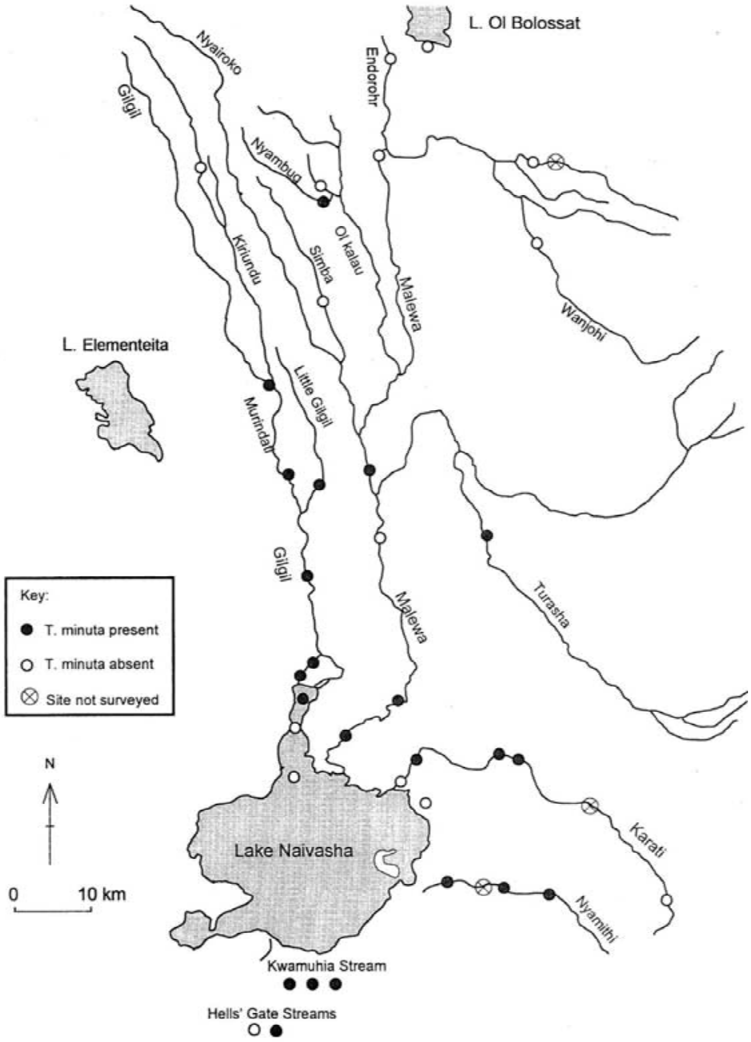

Figure 8. Distribution of *Tagetes minuta* at RHS sites in the Naivasha catchment, and on the riparian zone of Ol Bolossat and the North Swamp.

tem, with an effort of one, had an FGDI of 0.54. No significant difference in FGDI emerged between the five general locations sampled (Kruskal–Wallis test: H $(4, N = 16) - 5.325736$, $P > 0.05$). Insects were the most abundant food items (insectivores; FGDI = 2.42) followed by seeds (gramnivores; FGDI = 2.06) over the whole study area. Amongst the least abundant foragers were 'scavengers' (0.10) and 'carnivores' (0.49).

The data above, recalculated as Coefficients of Species Overlap (CSOs) (Table 3), showed strong overlap (0.77) between the Gilgil Mouth and the Malewa mouth sites but only weak link with the other lake edge site (the KWS Fishery Annex site). Relatively strong overlap (0.64) occurred between Little Gilgil and the Malewa site at KARI and the Kwamuya sites, and the Little Gilgil and the Karati site at the North Swamp and the Gilgil sites the Army Barracks (0.56). Within river systems, the two Malewa sites at the Pumphouse and KARI and the two Gilgil system sites at Little Gilgil and the Army Barracks had relatively strong species overlap coefficient (each 0.56) between them. Mean coefficient of species overlap from a combination of sites on discrete lake/river system locations revealed fairly strong overlap within the lake (0.47) followed by the Malewa (0.37). Overlap along the Karati River was poorest (0.17), perhaps reflecting the diverse topography of that river system. The Pumphouse and below the Turasha confluence

Table 1. Bird species richness and indices

Location and site number	No. of species	Richness index	FGDI	CSO
Malewa River	(96)	2.03	0.54	0.37
Turasha Dam (1)	23	2.19	0.67	
Malewa Pumphouse (2)	24	2.28	0.46	
Malewa Below Turasha (3)	15	1.63	0.53	
Malewa at KARI (4)	34	–	0.51	
Gilgil River	(99)	1.13	0.55	0.33
Gilgil Floodplain at Marula (5)	29, ((9.7))	0.31	0.46	
Little Gilgil (6)	17	1.06	0.52	
Gilgil at Army Barracks (7)	8	1.57	0.62	
Gilgil Maasai Ridge (2 sites) (8)	25, ((12.5))	0.64	0.51	
Gilgil below Lake Road (9)	20	2.1	0.61	
Karati River	(52)	1.95	0.56	0.17
Karati at Kinangop (10)	4	1.37	0.58	
Karati gorge (11)	17	2.08	0.53	
Karati North Swamp (12)	21	2.41	0.56	
Lake Open Water	(57)	1.12	0.46	0.47
KWS Fishery Annex (13)	23	1.56	0.47	
North Swamp, Gilgil Mouth (14)	15	1.13	0.47	
North Swamp, Malewa Mouth (15)	19	0.67	0.44	
Kwamuya (16)	(25) ((11.4))	2.89	0.54	

Notes:
All are mean figures by location.
() total number of birds recorded in that river.
(()) extended figure for extent of sample distance.
FGDI = Forage Guild Diversity Index.
CSO = coefficient of species overlap (from Whitaker, 1975, coefficient of community overlap).

Table 2. Foraging guilds and indices for birds recorded in the Lake Naivasha catchment

Foraging guild	FGDI (Guild Diversity Index)
INS (Insectivores)	2.42
GRA (Gramnivores)	2.06
CAR (Carnivores)	0.49
NEC (Nectarinivores)	1.19
HER (Herbivores)	0.38
FRU (Frugivores)	0.96
SCA (Scavengers)	0.10
PSI (Piscivores)	0.87

sites on the Malewa system, the Karati gorge, and the Gilgil site at the Army Barracks had no overlap.

The data demonstrate considerable richness of bird species within the catchment, and between habitat types within the catchment. Hotspots of bird diversity do not necessarily overlap strongly with those of plant diversity. For example the Karati site above the gorge, which contained the maximum diversity of both species and families of plants, had the second-lowest score for both bird abundance and species diversity. Conversely, the Kiriundu site, which had extraordinary proportions of rare plants, also held the highest diversity of bird species as well as the third highest abundance.

Discussion

The initial purpose of the Naivasha catchment research programme was to establish a baseline, identify ‘hotspots’ of biological interest and problems, thus supporting land use decisions. Diverse river flow types and flow regimes stem from the local Rift Valley topography and microclimate, ranging from perennial to ephemeral channels, open confluences to the lake to blind channel endings, erosive rocky gorges and cascades to slack depositional channels, and mont-

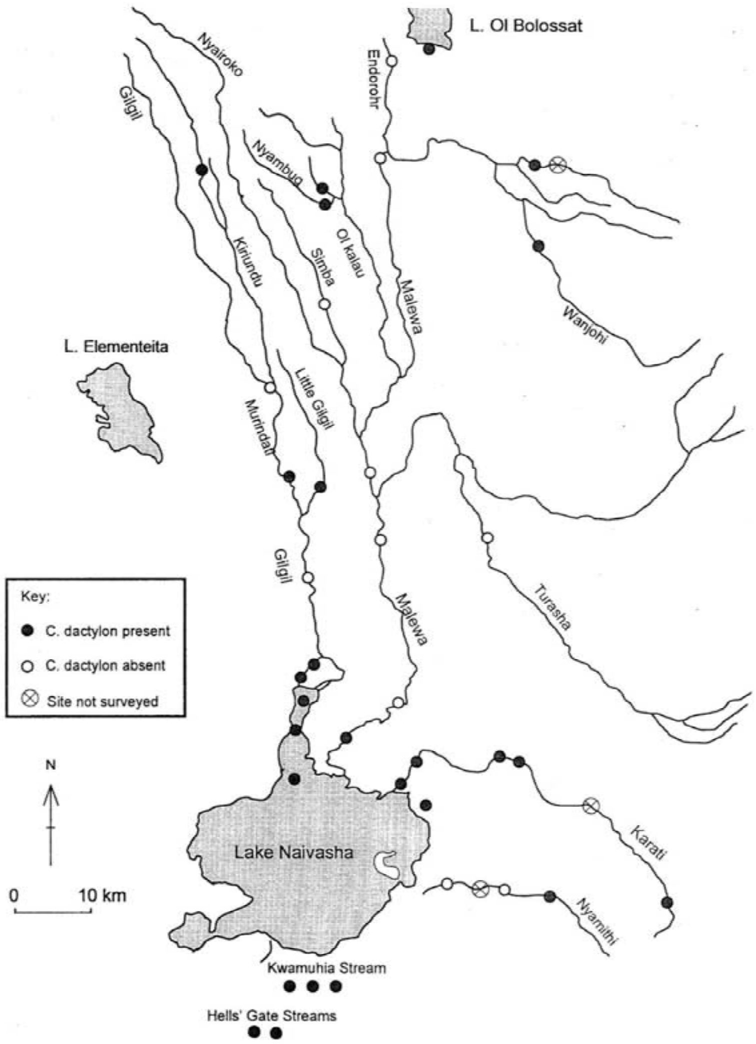

Figure 9. Distribution of *Cynodon dactylon* at RHS sites in the Naivasha catchment, and on the riparian zone of Ol Bolossat and the North Swamp.

ane forest to papyrus-dominated swampland. Biological diversity in the river corridors is related to this considerable diversity of morphology and hydrology.

Data on physical habitat diversity, plants and birds serve to form an initial description of elements of the biodiversity of the Lake Naivasha catchment. Extension of this work is important to add further substance to insights into ecological, physical and biogeochemical processes of the river systems. Expansion of research into other elements of biodiversity (other taxa, genetic diversity, habitat and land use away from the river channels) would add depth to this understanding. An understanding of biodiversity and ecosystem processes is in turn fundamental to achieving sustainable development by the human population.

River conservation has only relatively recently been perceived as an important issue in the developing world as a means for stemming ecological damage, and consequent adverse social and economic harm (Barel et al., 1985). It is well known that adverse development in lake catchments, often remote from the lake itself, can contribute to lake degradation, promoting the need to address integrated sustainable development at the catchment scale rather than merely the local lake ecosystem (Everard, 1999). Through this integrated approach to protection of the wider lake and catchment ecosystems, the natural resources

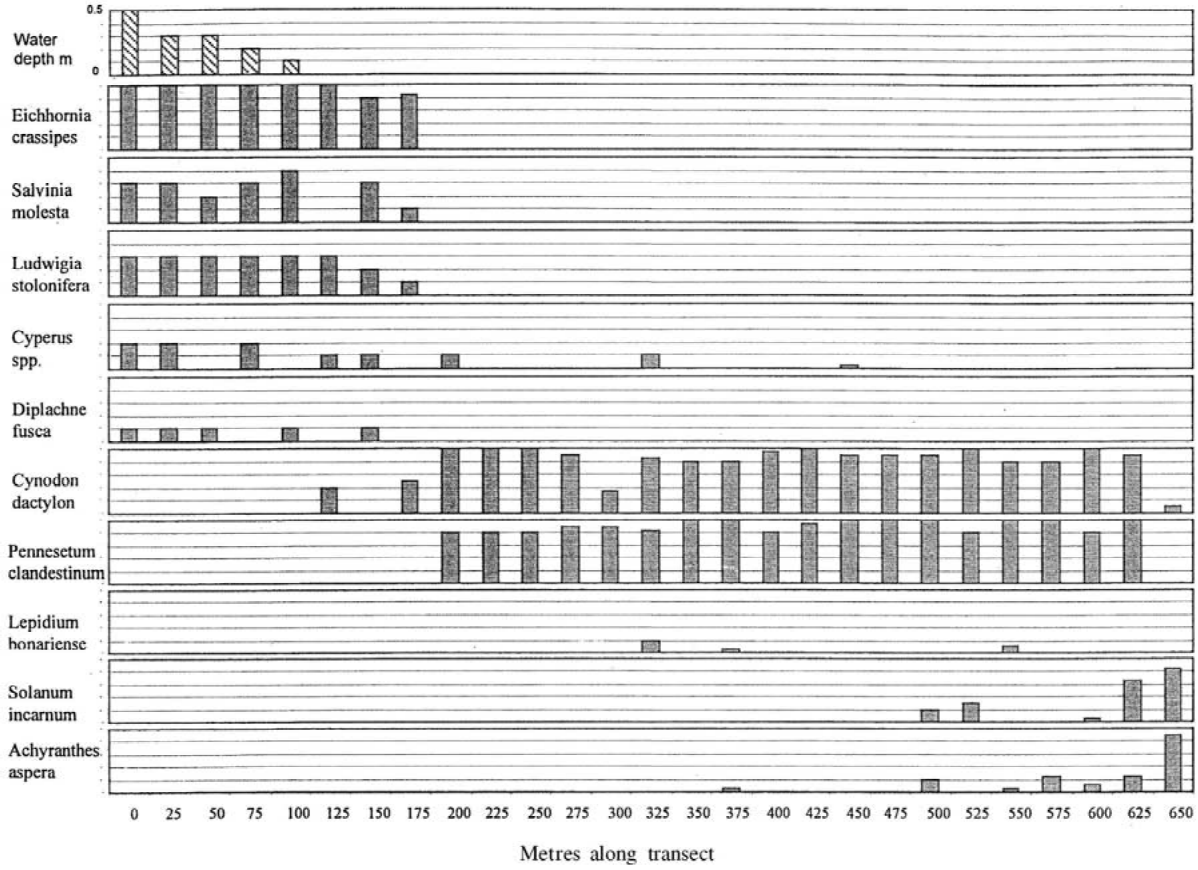

Figure 10. Distribution of macrophytes in a transect across the Gilgil floodplain at the Marula Estate, based on DAFOR measurements in replicate quadrats.

and services supporting social and economic needs can be sustained. Although this reasoning may appear self-evident, the attainment of sustainability is beset with many obstacles ranging from vested local interests, myopia about the distant effects of unsympathetic wetland development within catchments and socio-political barriers (O'Riordon, 1993). Tropical wetlands in particular have all too often been degraded or destroyed through unsympathetic development for short-term gain, resulting in catastrophic loss of wildlife and ecosystem services (Denny, 1995).

The river catchments draining into Lake Naivasha require considerable further study to determine a datum, the mechanics sustaining the unique properties of the lake, biodiversity, and the social and economic needs that they support. A proposal exists, although currently 'on ice', to dam the main stem of the River Malewa to supply growing demands for fresh water at the town of Nakuru. The consequences in both the Naivasha and Nakuru catchments, together with the social and economic needs sustained by the ecosystems, could be severe. It is necessary to distinguish impacts on the lake deriving from the catchment, as distinct from those arising from intensive lake edge agriculture, species introductions to the lake, and urban and industrial development (principally in the town of Naivasha on the eastern shore of the lake). Rivers also integrate the influences of changing land use within the catchment (Newson, 1992) and so river monitoring can prove a cost-effective method for monitoring whether sustainable catchment management is being achieved (Ormerod & Jüttner, 1998).

Acknowledgements

This study formed part of the work of the University of Leicester research project at Lake Naivasha, which since 1987 has been authorized by the Office of the President, Government of Kenya under research per-

Table 3. Coefficient of Species Overlap (CSO) between sites

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Mean CSO by location
1	23																
2	0.298	24															
3	0.298	0.41	15														*0.368*
4	0.085	0.564	0.552	34													Malewa
5	0.255	0.308	0.138	0.348	29												
6	0.255	0.462	0.414	0.64	0.13	17											
7	0.17	0.308	0.414	0.606	0.174	0.56	8										
8	0.255	0.41	0.345	0.333	0.304	0.48	0.242	25									*0.284*
9	0.34	0.359	0.138	0.333	0.435	0.4	0.364	0.208	20								Gilgil
10	0.17	0.359	0.207	0.387	0.258	0.129	0.129	0.194	0.258	14							
11	0.255	0.513	0.45	0.435	0.087	0.261	0.217	0.174	0.174	0.323	17						*0.165*
12	0.085	0.359	0.207	0.278	0.391	0.56	0.182	0.333	0.5	0.129	0.043	21					Karati
13	0.17	0	0	0.091	0.13	0	0	0.042	0.045	0.065	0	0.273	23				
14	0.17	0	0	0.059	0.174	0.08	0	0	0.235	0.129	0	0.222	0.318	15			*0.467*
15	0.128	0	0	0.038	0.13	0.08	0	0	0.113	0.065	0	0.167	0.318	0.765	19		Open Lake
16	0.213	0.513	0.483	0.148	0.13	0.64	0.303	0.292	0.133	0.323	0.348	0.222	0	0	0	25	

Note: Numbering scheme is according to the numbers in Table 1.

mit to Dr D. M. Harper no. OP 13/001/12C 46. The project was funded by the Earthwatch Institute, Boston, U.S.A. and Oxford, England. The data collection would not have been possible without the assistance of numerous Earthwatch volunteers. Assistance with taxonomy was given by Twala (KWS Training Institute, Naivasha) , several staff of the National Museums of Kenya Herbarium, Nairobi, Dennis Otieno (University of Nairobi) and Henk Beentje (Royal Botanic Gardens, Kew). Our sincere thanks go to the numerous colleagues in Kenya for logistical support, in particular Jill and Angus Simpson and Velia Carn.

References

Anon, 1999. The Lake Naivasha Management Plan. Lake Naivasha Riparian Association, Naivasha.

Barel, C. N. D., R. Dorit & D. H. Greenwood, 1985. Destruction of fisheries in Africa's lakes. Nature, 315: 19–20.

Bennun, L., 2001. Long-term monitoring and the conservation of tropical wetlands: high ideals and harsh realities. Hydrobiologia 458: 9–19.

Denny, P., 1985. Submerged and floating-leaved aquatic macrophytes (euhydrophytes). In Denny, P. (ed.), The Ecology and Mangement of African Wetland Vegetation. Dr W. Junk Publishers, Dordrecht: 19–42.

Denny, P., 1991. African Wetlands. In Finlayson, M. & M. Moser (eds), Wetlands. International Wetlands and Wildfowl Research Bureau, Slimbridge: 115–148.

Denny, P., 1994. Biodiversity and wetlands. Wetlands Ecology and Management 3: 55–61.

Denny, P., 1995. Benefits and priorities for wetland conservation; the case for national wetland conservation strategies. In Cox, M., V. Straker & D. Taylor (eds), Proceedings of the International Conference on Wetland Archaeology and Nature Conservation. HMSO, London.

Dugan, P. J., 1990. Wetland Conservation: A Review of Current Issues and Required Action. IUCN, Gland, Switzerland: 96 pp.

Enniskillen, A., 2002. Introduction: The Lake Naivasha Management Plan – Consensus building to conserve an international gem. Hydrobiologia 488 (Dev. Hydrobiol. 168): ix–xii.

Everard, M., 1999. Towards sustainable development of still water resources. Hydrobiologia 395/396: 29–38.

Everard, M., J. A. Vale, D. M. Harper & H. Tarras-Wahlberg, 2002. The physical attributes of the Lake Naivasha catchment rivers. Hydrobiologia 488 (Dev. Hydrobiol. 168): 13–25.

Henderson, I. G. & D. M. Harper, 1992. Bird distribution and habitat structure on Lake Naivasha. Afr. J. Ecol 30: 223–232.

Newson, M., 1992. Land, Water and Development: River Basin Systems and Their Sustainable Management. Routledge, London.

O'Riordan, T., 1993. The politics of sustainability. In Turner, K. (ed.), Sustainable Environmental Economics and Management: Principles and Practice. Belhaven, London: 37–69.

Ormerod, S. & I. Jüttner, 1998 Catchment sustainability and river biodiversity in Asia: a case study from Nepal. In Harper, D. M. & T. Brown (eds), The Sustainable Management of Tropical Catchments. John Wiley and Sons: 187–207.

Owiunji, I. & A. Plumptre, Unpubl. report on foraging guilds of forest birds. Department of Ornithology, National Museums of Kenya, Nairobi.

Ramsar, 1971. Convention on Wetlands of International Importance Especially as Waterfowl Habitat. 2/2/71, Ramsar, Iran.

Ramsar, 1996. The Ramsar 25th Anniversary Statement. Resolution VI.14, 6th Meeting of the Conference of the Contracting Parties, Brisbane, March 1996.

Thenya, T., 2001. Challenges of conservation of dryland shallow waters: Ewaso Narok swamp, Laikipia District, Kenya. Hydrobiologia 458: 107–119.

Whittaker, R. H., 1975. Communities and Ecosystems (2nd edn). Macmillan, London.