



‘Flamingo Conservation and Ramsar Site Management at Lake Bogoria’

***FINAL REPORT (June 2003 – June 2006)
Earthwatch Institute (Europe) & University of Leicester***

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1. Darwin Project Information

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| Project Reference No. | 162/12/003 |
| Project title | Flamingo Conservation and Ramsar Site Management at Lake Bogoria |
| Country | Kenya |
| UK Contractor | Earthwatch Institute (Europe) |
| Partner Organisation (s) | University of Leicester (UofL) through the Lakes of the Rift Valley (LoRV) project, Lake Bogoria National Reserve (LBNR), University of Nairobi (UofN), National Museums of Kenya (NMK) |
| Darwin Grant Value | £175,791 |
| Start/End date | July 2003 – June 2006 |
| Project website | www.kenya-rift-lakes.org |
| Author(s), date | Dr David Harper, Project Leader, University of Leicester Steve Gray, Earthwatch Institute (Europe), December 2006 |

2. Project Background/Rationale

Lake Bogoria is one of a chain of lakes in Kenya's Rift Valley, which is the Eastern arc of the main Rift that runs through Uganda and Tanzania. Lake Victoria sits on a plateau between the two. Almost all of the Eastern Rift lakes are saline, because water runs from the escarpment slopes and mountains within the valley to the valley floor. Evaporation leaves behind saline-alkaline water.

Lesser Flamingos (*Phoeniconaias minor*) rely on this unique environment. They are nomadic birds, whose main meta-population of about 2 million, is confined to about a dozen lakes in the Rift between Tanzania and Ethiopia with a single breeding site, Lake Natron. Three other meta-populations exist in the old world, each much more limited in size and distribution: in southern Africa, western Africa and western Asia, associated with a few, shallow salt pans.

The species is considered 'near-threatened' by IUCN because the main breeding site, Lake Natron, is unprotected (and in 2006 was threatened with commercial soda extraction proposals). Very little however, was known about the species' feeding requirements and the extent to which different lakes are able to meet them, or for how long. Studies had been carried out in the 1970s at Lake Nakuru, but none since then.

In 2000 a major mortality event occurred at Lake Bogoria, killing several hundred thousand *P. minor*, young and old. Three earlier mortalities had been recorded between 1975 and 1995. Causes suggested in press and website reports at the time, but not substantiated by any peer-reviewed studies, were heavy metal and pesticide pollution. Suspicion fell upon industries in Nakuru city, within the drainage basin of Lake Nakuru. The mortality in 2000 however, occurred exclusively at Lake Bogoria.

This project proposal was first written just after the mortality events, which lasted for about 9 months and ended as mysteriously as they began at the end of 2000. The proposal coincided with Lake Bogoria being declared a Ramsar site by the Kenya

Government, but with almost nothing being known about its limnology.

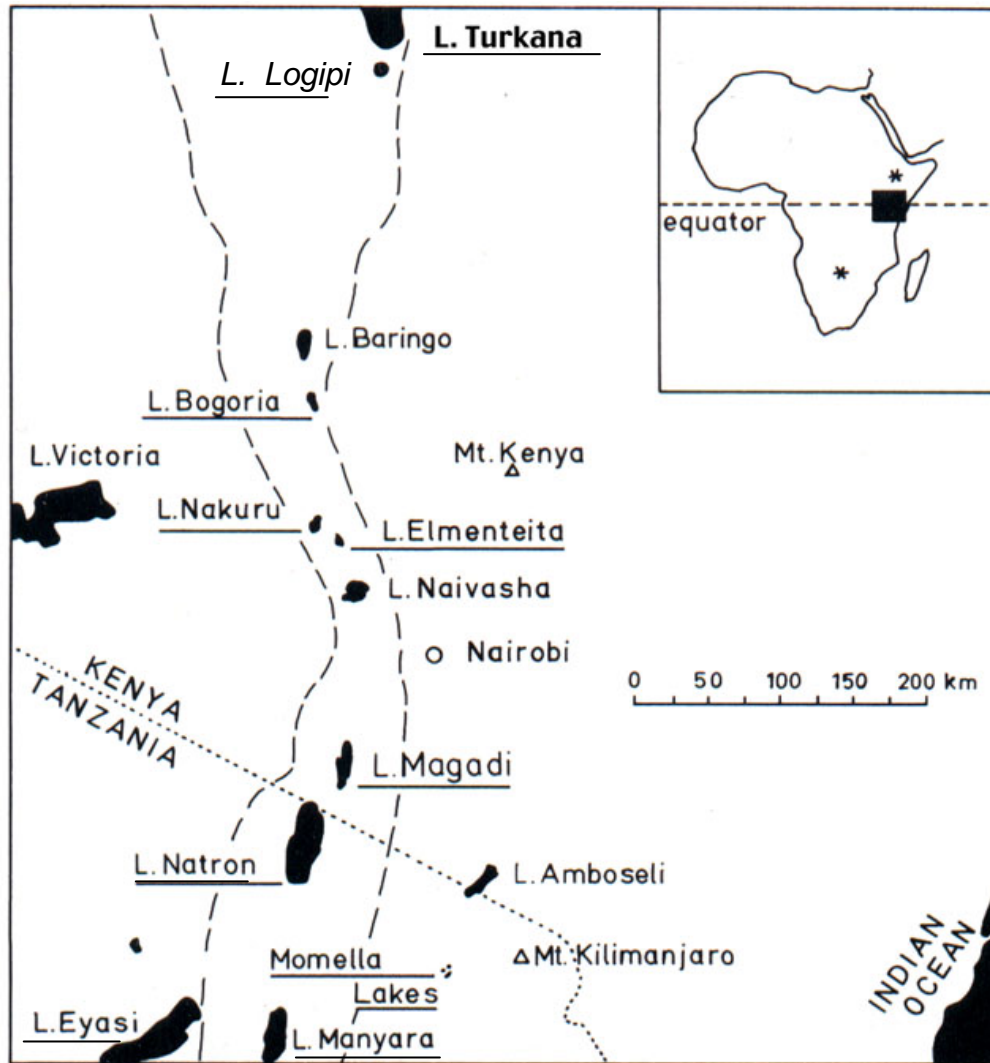


Figure 1. Lakes of the Kenyan Eastern Rift Valley. Saline lakes are underlined.

Dr Harper had started working at Lake Bogoria in 2000 with funding from the Earthwatch Institute as part of the 'Lakes of the Rift Valley' research programme. This was initiated in partnership with the two County Councils – Koibatek and Baringo – who manage the lake, as a National Reserve, and their Senior Warden, William Kimosop. The Lakes project has been funded continuously by Earthwatch since 1987 (starting at Lake Naivasha), undertaking field research with international volunteers. These included young African conservationists, funded through different grants to Earthwatch (e.g. from the European Union and several corporate partners). The project had not however, made a major contribution to in-country training although it had worked closely with the University of Nairobi to provide field experience for postgraduate students for many years.

3. Project Summary

The project was conceived with three main objectives. The first was scientific - to advance limnological understanding of Lake Bogoria specifically and soda lakes in general. Part of this was to ascertain how stable the lake's ecosystem was in consistently providing adequate food (the cyanobacteria commonly known as spirulina –

Arthrospira fusiformis) for *P. minor*. Part was to understand how the lake contributed to the conservation of other water bird species and also how the lake linked with the terrestrial part of the reserve and the Ramsar site. This would enhance the scientific content of the Ramsar Management Plan, which by the end of 2002 was under development by the County Councils with facilitation by the Worldwide Fund for Nature (WWF) East Africa Programme.

The second objective was to understand more about the ecology of *P. minor* through their range in Kenya and East Africa. Part of this was to understand the factors that influenced their movements (such as quality and quantity of food) and the factors causing mass mortalities.

The third objective was to strengthen the environmental education activities of our Kenyan partners who were involved in the Reserve. This was at every educational level – universities which use the Reserve for teaching; secondary and primary schools located around the reserve as well as those which visit from afar; reserve visitors of all origins and perhaps most importantly, the local community upon whom the long-term sustainability of the Reserve depends.

These original objectives were maintained throughout the project, with minor changes to the activities which were set to achieve these objectives. The articles of the CBD which were best, but no means exclusively, supported by this project, are 6, 8, 12 & 13.

The project has met all its objectives. In the scientific objective, we have published 5 peer-reviewed papers and will have at least 3 more by the end of 2007. We elucidated the food chains of the lake and the ways in which energy flows from lake to land. We established a container laboratory in Kenya which has also provided laboratory consumables to new laboratories on every other lake in Kenya, both soda and fresh (Naivasha, Elmenteita, Nakuru, Bogoria & Baringo) which are included in the Lakes project. We have also enhanced the capacity of communities through sustainable livelihood activities (e.g. beekeeping and honey production), enhanced the physical capacity of 13 schools surrounding the Lake Bogoria National Reserve (LBNR) for conservation education and made the written material available for use in national education through the Wildlife Clubs of Kenya.

4. Scientific, Training, and Technical Assessment

• Research

We followed the spirulina density and biomass in detail in the three basins of Lake Bogoria throughout 2003-6 in two Earthwatch research camps each year. Spirulina accounts for 99% of the primary production of Bogoria and *P. minor* are the only macro-consumers. The only other grazers are protozoa. On the same Earthwatch teams we quantified the decomposer food chain leading through a single species of chironomid (lake fly) in the mud and two diptera species on the littoral rocks, to greater flamingos (which scruff up the larvae and then filter them), to black-necked grebes (which dive for emerging pupae) and Cape teal (which dabble for emerging adults). We elucidated the food chains on the lake edge, going from *P. minor*, through their discarded feathers on the shoreline, to tiger beetles and from flamingo carcasses through earwigs to predatory spiders and beetles. We published one overview ecology paper at the start of the project and two more – the food web results and the productivity studies – will be published in 2007.

On the Reserve we made the first biodiversity inventories of Coleoptera, Odonata, Lepidoptera, running water invertebrates and we added to the existing lists for plants and birds. These were inserted into the Reserve's Ramsar Management Plan as appendices. Many species of Lepidoptera and Coleoptera are new to science, requiring careful descriptions, which will take several years to complete to publication.

We mounted satellite tags on 7 individual *P. minor* and tracked them throughout East Africa. The science of capturing and tagging the birds formed some of the publications

and the novel capturing methods developed formed the basis of others. This has also enabled new lines of research into population genetics to be pursued. Our Kenyan partners maintained the three-lake survey of flamingos and water birds associated directly with the soda lake ecosystem (plus water sampling) six times per year, from July 2003 through to early 2006. The time between surveys was longer than originally anticipated because each survey was more expensive than predicted, but more than enough were carried out to produce a clear picture of the relationship between flamingos and spirulina. This will be brought to publication in 2007.

We ran three Earthwatch-sponsored research teams specifically aimed at understanding mortality causes. This research was slower than anticipated, due to the lack of significant mortality events in 2004 and 2005 in Kenya. At the time of writing, there have been major mortality events at several lakes (which started just as this project was ending) between March and June 2006. In August 2006, Lake Oloidien – which has been progressively becoming more saline through evaporation – became suitable for flamingos and the project had a centre-page photograph in *The Independent* describing this occurrence. The results from the mortality and genetics studies will be published in 2007-8.

• Training

The scientific results of our research fed directly into three training workshops, with each workshop directly following a research team. Participant selection for all workshops was through assessment of applications following an open invitation issued to project partners, other conservation bodies and publicity in *Nature Kenya's* newsletter. This plan was seriously hindered when Earthwatch had to cancel all research teams in Kenya when British Airways suspended flights to Nairobi in mid-2003 as a result of a security scare. We still ran the workshop however, but it did not follow a research camp. Nevertheless we developed themes following the research.

The first one was '*Ecosystem Health*', July 2003, taught by Dr David Harper & Professor John Cooper. This attracted 29 participants, of whom 18 were graduates and 11 non-graduates (the latter all practicing conservation staff from the Reserve or similar). The second workshop followed a research team in April 2004. Called '*Taxonomy for Biodiversity Conservation*', this was taught by David Harper, Professor John Cooper, Mr Tony Drane (Coleoptera), Mr Laban Njoroge (Entomology Department, National Museums of Kenya), Mr Kariuki Ndanganga (Ornithology Department, National Museums of Kenya) and Dr Musaya Mwasa (Herbarium NMK). 30 Kenyans attended the workshop - 17 graduates and 13 non-graduates.

In July 2005, the third workshop focused upon '*Science for Soda Lakes: Ramsar Management Plans*', using the Bogoria Reserve as its study area. It was taught by Dr David Harper, Pieris Kamau (NMK Herbarium), Timothy Mwinami (NMK Ornithology) and Michael Macharia (University of Leicester). The latter tutor taught participants the scientific approach to community participation in natural resource management, which was particularly enlightening since all tutors and participants were ecological scientists, not social scientists.

The output linkage of training workshops to research teams was effected through:

- 1) the production of protocols for *P. minor* and soda lake monitoring and their testing, with Kenyan and Tanzanian scientists, in the field ('*Ecosystem Health*' and '*Science for Soda Lakes*').
- 2) The integration of additional biodiversity information generated by research teams into teaching and community participation and then into the Management Plan ('*Taxonomy for Biodiversity Conservation*' and '*Science for Soda Lakes*').

In between the training workshops at Bogoria, in April 2005, the Darwin funding was used to sponsor four more Kenyans to join an Earthwatch-funded African Fellows research and training team at Lake Elmenteita. The four Kenyans came from the management agencies of other soda lakes in the Rift or the areas adjacent to them –

Lake Nakuru (from Kenya Wildlife Services), Shompole camp at Lake Magadi (from African Conservation Centre), Lake Bogoria catchment in Laikipia (from the Laikipia Wildlife Forum) and Lake Oloidien (from Lake Naivasha Riparian Association). Lake Elmenteita is the third of the three main soda lakes which support *P. minor* in the central Rift, lying just to the south of Lake Nakuru. The team trained 12 African Fellows from 7 countries - all of whom worked on Ramsar sites - to study the question: 'Does Elmenteita have the qualifications for a Ramsar site?' On the last day of the team, the Fellows made a presentation of the work of the research team to answer this question to senior staff from Kenya Wildlife Service (including the Kenyan Ramsar representative, Anderson Koyo). KWS subsequently proposed Elmenteita as the country's fifth Ramsar site to the Conventions' Conference of Parties in October 2005 in Kampala, Uganda. Please refer to Appendix VIII for a full report on the team.

After the end of this project (and to provide continuity to the beginning of the post-project funded period), Earthwatch sponsored 8 further African Fellows from Kenya and Tanzania to join a research team at Lake Bogoria in November 2006. These young scientists were trained in flamingo health and post-mortem techniques, spirulina counting and biomass measurements, chironomid life histories and *Acacia* Lepidoptera biodiversity. The Fellows then attended the End of Project workshop in Nairobi (please refer to Appendix IX), which was combined with the start-up meeting for the post-project extension. Forty two delegates in total from Kenyan partners to the original project, plus Tanzanian partners to the post-project, attended and participated in the discussions. A workshop report will be made by the end of 2006 and circulated to all participants and members of the IUCN Flamingo Commission.

All participants at the end of each workshop were given assessment questionnaires, both to test their own uptake of knowledge and our performance as tutors and managers of the workshop. The results of the first two were used to guide the second and third; examples of the questionnaires and the results summaries will be provided in the CD to follow this report. Each participant was given a Certificate of Attendance and most have been followed subsequently. In some cases this has led to considerable progress of the participants concerned – for example Laban Njoroge was a participant on the first workshop and tutor on the second and third; Timothy Mwinami a participant on the second and tutor on the third. These two individuals, together with Nicodemus Nalianya, also from NMK Ornithology and Ndung'u Kimani from the Herbarium, are now receiving full-time education as a result of their involvement with the Darwin and Earthwatch research projects, through part contributions of Earthwatch volunteers. Other participants now work closely with Earthwatch-funded lake teams (e.g. Isaac Ouma, Dominic Kimani and Martin Kahindi) or are involved with ongoing research plans and applications.

- **Educational capacity-building**

The most important targets for biodiversity conservation education are the young; in Kenya they make up a very high proportion of the population. The project worked in 13 schools surrounding Lake Bogoria (although there are another 6 that we did not reach in the time of the project, but are being visited by Earthwatch-sponsored research teams in partnership with the Community in 2006). The 13 schools were each visited five times to discuss partnership activities, leading to the provision of the following items:-

- a) Each school sketched its own logo, based upon an animal close to or associated with the school, which we used to design and print headed notepaper for them.
- b) Each of 2 Secondary schools received a Macmillan Science wall-chart pack and each received two Watson high powered microscopes, together with a set of prepared slides made by Dr Lindsay Oaks.
- c) Lake Bogoria Secondary School received five Macintosh computers, donated by the University of Leicester and brought in the Laboratory Container. The second, Maji Moto Secondary School, had already received 6 Macintosh computers

donated from the USA but without any software. We loaded software packages from the Leicester computers, making them functional.

d) Each school received sisal wall hangings (commissioned by us from a local artist) depicting their local wildlife and biodiversity conservation issues;

e) Each received three maps (World, Africa and Kenya).

f) Each received a box of scientific & educational books donated by the publisher Dorling Kindersley in UK (through an Earthwatch volunteer who works for them and came on a team in 2005).

g) Each was given multiple copies of two story books about lesser flamingos written by us.

h) Each was shown films about water and conservation issues from the Brock Initiative 2004 projects (please see below) in Naivasha and Ruaha. They were invited to write their own and be filmed doing them. The two secondary schools wrote a poem and a play; primary schools performed songs and one a play. All were turned into short films and shown back to them and at three village centres during two visits in 2006.

Film-making was not part of the original Darwin project, but two projects evolved from the wider Earthwatch 'Lakes of the Rift Valley' project during the course of the project. The first was Dr Harper's involvement in a project initiated by Earthwatch, called 'A Year on Earth'. Three teenagers from the US were filmed throughout their participation in 13 Earthwatch-sponsored research teams around the world. Our Lake Bogoria research team, in October 2004, was the second of these. The activities included the scientific activities of the Darwin Project (*P. minor* trapping and banding; biodiversity evaluation of spring-fed streams; analysis of spirulina biodiversity) as well as the community-based activities with the two Lobo schools, both primary and secondary. The resulting film, due to be broadcast on the Discovery Channel in December 2006, has been shown by us in local schools.

The second was Dr & Mrs Harpers' involvement at Lake Naivasha in a professional film about the state of Lake Naivasha in 1999, entitled 'The Price of a Rose', part of a series 'The Real Cost of Shopping', made by Richard Brock of Living Planet Productions. Richard retired from professional film-making in 2003, setting up the 'Brock Initiative'. The objectives of the Initiative were to give something back to the communities where his professional films had been made over the past decade, supporting their own conservation efforts through films made by him but guided by and featuring them.

The involvement of Dr Harper and Earthwatch led in 2004 to a Vodafone Group Foundation grant to the Brock Initiative, enabling Richard and an independent scientist-film maker, Ben Please, to produce two series of films for local communities in East Africa. One was at the Ruaha National Park and river basin in Tanzania, the other was at Lake Naivasha in Kenya. Showing these in local schools and villages at Lake Bogoria in 2004 was so successful that we shot footage in 2005 of local schoolchildren that was subsequently incorporated into new films featuring them, shown back to them in March and November 2006.

- **Community capacity building activities**

The Brock Initiative film-making was extended from just school education to local community capacity-building affecting their livelihoods. Two films were made in 2005 about aspects of sustainable farming (bee-keeping and grass re-seeding). These were shown both by local NGOs in the Bogoria and Baringo areas, as well as by us to Bogoria schools. Each was taken one stage further by the end of the Darwin project and, as a project exit strategy, is being developed further by Earthwatch-sponsored teams at Lake Bogoria.

The Beekeeping film (in Swahili), made with a local co-operative, shows the construction and benefits of a Langstroth hive. The partnership was developed further, with other

cooperatives and private honey sellers at the Reserve entrance, by our design and printing of labels identifying the honey as 'Lake Bogoria Natural Honey - A product of man's ancient association with his natural environment' (each label also featuring a Darwin Initiative logo). Their part of the partnership was to ensure quality control by centrifugation and filtration and then packaging in plastic jars. Until this time, there was no marketing strategy; honey was sold beside the road in glass liquor bottles with no labels and often, with bees floating on the surface. In many places it still is, but a post-project exit activity being undertaken during Earthwatch-sponsored teams is developing with a local cooperative group the linkage of the formerly disparate honey sales in Baringo and Koibatek districts to market under a common identity and common quality.

The grass re-seeding film (also in Swahili) was made in partnership with the Rehabilitation of Arid Environments Trust at Kampi ya Samaki, Lake Baringo. The Trust has developed a formula of partnership with local communities that has resulted in the successful restoration of 5000 hectares of seriously eroded land in the Baringo district during the past 20 years. Despite the Trust's success, a mere 20-30 kilometres from Bogoria, nothing was known about it in the Bogoria communities and no official attempt had been made to promote it (even though County Councillors are educated about the Trust after every new election result). Using the film, post-project activities during Earthwatch teams are focussing upon communities that are already trying to arrest erosion using their own labour, providing advice and facilitating connections with the RAE Trust.

Our activities promoting sustainable farming have utilised the Brock Initiative films made in the Naivasha catchment (terracing and mulching to mitigate erosion) and the Ruaha catchment (tree conservation and planting to conserve water) to build the capacities of communities to help themselves. We have also used films made by the only other NGO we have encountered that makes local films about practical solutions to issues hindering sustainability, PACE. The Pan African Conservation Education project, also funded by the Vodafone Group Foundation, is an initiative of the Tusk Trust and Siren Conservation Education, has produced 7 films, three of which are directly relevant – water, soil and forests. The commercial BBC video 'Greatest Wildlife Moments', introduced by Sir David Attenborough, also proved useful in putting on diverse and relevant film shows which were very popular in 2006 at village centres.

Our involvement in the wider communities around Lake Bogoria was started by the film-making and this has facilitated deeper connections to their needs than the connection through the science of soda lakes could have achieved alone. The community connections have led us into new scientific partnerships, developing wise use of wetlands at the northern end of the lake, which form another part of the project exit strategy taken up by ongoing Earthwatch-sponsored research teams. The wetlands are fed by cool springs or river diversion and are over-utilised. Ecohydrological understanding of wetland function, leading to sustainable use, will be developed in partnership with the CBO Friends of Nature Bogoria (FoNB) and through them, the registered community swamp CBOs.

Our science has directly built up the capacity of the Research management; our film-making has extended our positive impact on community livelihoods and linked the two.

5. Project Impacts

The project has contributed towards the responsibilities of Kenya and neighbouring East African countries in their efforts to conserve *P. minor*, guided by the IUCN-SSC/Wetlands International Flamingo Specialist Group, which is now chaired by Dr Brooks Childress, whose interest in *P. minor* was initiated by the Earthwatch-Darwin research project, following an invitation from Dr Harper to join the team in 2000.

The obligations of Kenya to protect soda lake ecosystems has been enhanced by our contributions to the Bogoria Reserve Management Plan and our first biodiversity report

of Lake Elmenteita in early 2005, which led to it being declared a Ramsar site later in that same year (please see Appendix VIII). The Darwin post-project funding will assist the Elmenteita stakeholders to develop a management plan in the same way as was done at Bogoria.

The project has trained reserve staff from every soda lake and associated wetland in the southern Rift on our workshops, as well as Ramsar site staff from seven African countries on our associated African Fellows team at Elmenteita. Soda lake ecology and the ecosystem approach to wetland ecology and management underpinned our workshop teaching, which benefited many voluntary group members (e.g. Nature Kenya local supporters groups) on other wetland areas, such as Kinangop, Lake Ol Bolossat, Lake Victoria and Rumuruti swamp.

Although the total number of trainees in workshops was under our projections (just under 100 compared with 120), we trained more interns from universities and the National Museums ornithology, Entomology and Herbarium departments in our field research camps. This is particularly important since NMK is the regional centre for biodiversity knowledge.

The post-project funding awarded to the project will be used to scale-up the educational outputs and impacts of the project to a national level. Firstly it will extend the number of flamingo stories from two to four (the third was written during this project but has now been modified to include all soda lakes focussing upon breeding at Lake Natron). The series will be used to educate children throughout the Rift Valley about flamingo ecology, whilst entertaining them. Secondly, it will extend the film series. By the end of this project we had produced a soda lake film, but will now extend this to an East African soda lake series in parallel in the Naivasha series, convening science, school education and community capacity-building.

6. Project Outputs

The actual achievements are detailed against the stated outputs in the revised project logical framework (please refer to Appendix V), with differences explained and comments on the success of the outputs made.

Outputs:-

1.1 Explanation of the effects of changes in external factors on population of *Arthrospira fusiformis* (Spirulina)

- Five scientific papers published, at least 4 more to be completed in 2007.
- Three teams at LBNR per annum (with the exception of 2003 due to security concerns in Kenya), each with up to 12 volunteers and four scientists (maximum size) for two weeks measured photosynthesis of phytoplankton and related to *P. minor* abundance.

1.2 Explanation of the effects of dynamics upon key water birds in lake's limnology

- Research undertaken; findings submitted to LBNR (and to WWF Lake Bogoria Community Education Project), to KWS and to NMK, through our Darwin six-monthly and annual reports.
- Report of Lake Elmenteita status submitted to KWS 2005. Appendices, of biodiversity information, to Bogoria Management Plan, submitted to County Councils 2006. Lesser flamingo species action plan will be produced by IUCN in early 2007 and this report and the results of the project workshops will feed into it.

- Chironomid life histories and emergence patterns established and related to cape teal, black-necked grebe and hirundine dynamics.

2.1 Causes of movement of *P. minor* between lakes explained

- Completed. Website of flamingo movements established by the Wildfowl & Wetlands Trusts (WWT). Project reports available openly on project website www.kenya-rift-lakes.org; databases being built up and placed on website as scientific publications are written.
- End of Project workshop mandated the creation of a new website for flamingo lake data, to which participants will contribute.
- Seven birds banded and tracked; some results published, detailed results being interpreted and published.

2.2 Causes of mass mortality incidents explained and measures to minimise the risk to the species formulated

- Numbers of flamingos trapped was lower than expected due to movements away from Bogoria in 2004 and a reduced population throughout 2005. Flamingo health was measured on 4 separate occasions. In 2003 (the 1st workshop) and 2004 (during an Earthwatch team and the 2nd workshop), Professor John Cooper led this research, whilst in 2005 and 2006 work was undertaken on Earthwatch teams by Dr Lindsay Oaks and his first manuscript will be published in the IUCN annual newsletter 'Flamingo' (this will be included on the outputs CD to follow this report). A new genetics study has been initiated on the blood samples collected.
- EoP Workshop output (postponed so that it is combined with Post-Project start-up meeting, November 2006) will contain recommendations and protocols for management action, given to agencies in Kenya & Tanzania. A strategy for monitoring lake health as well as flamingo health will be discussed for soda lakes in both countries and will be put to Agency leaders and be tested during the post-project.

3.1 Scientists, conservationists, school children and the general public educated in the biodiversity value of Lake Bogoria and soda lakes

- Educational materials developed with and disseminated to 13 schools
- The number of students and interns seconded to Earthwatch teams was 15, exceeding the target of 9. School material was provided in excess of planned; supplemented by film production and showings.
- A reserve booklet was supplemented by 12 habitat-based posters, placed to both Reserve entrance office outer walls and DEEC walls. FoNB has requested that the project produce a layman's summary booklet explaining the Management Plan to local communities. This is being done as another exit strategy of the project.

3.2 Kenyans associated with LBNR and partner organisations trained in ecology/conservation and practical skills

- Three workshops were successfully run, with 28,29 and 31 attendees respectively. A fourth workshop was originally planned but proved not possible due to higher expenditure on the 1st workshop July 2003 caused by international security scare which prevented Earthwatch research team from running and co-funding, by meeting trainers air fares. Additional support from Earthwatch African Fellows programme in 2005 enabled 12 trainees on the Elmenteita workshop, 4 Kenyans funded by this Darwin project, so total trainees was 100 by EoP.

- Subsequent support from the African Fellows programme in 2006 enabled 8 East Africans to attend the November 2006 Earthwatch-sponsored team at Bogoria, giving a grand total of 108. A further 50 participants attended the EoP 2-day workshop in Nairobi.

Dissemination of project outputs will continue during Earthwatch-sponsored project teams at Lake Bogoria (at least one per year) and other freshwater lakes (3 teams per year) as well as by the continued development of the lessons learned in the post-project extension at Rift Valley lakes to the south and into Tanzania.

7. Project Expenditure

| Item | Budget | Expenditure | Balance |
|------|--------|-------------|---------|
|------|--------|-------------|---------|

8. Project Operation and Partnerships

The number of Kenyan partners at national and local government level was greater than original proposed. The most important one, consistently, was the National Museums of Kenya, Department of Ornithology. The Department of Entomology and the Herbarium became involved in the workshop tuition and all three departments contributed to scientific aspects of workshop planning. LBNR, KWS and the University of Nairobi were involved in the soda lake surveys, together with the Nakuru Water and Sewage Supply Company. This is the company created after the 2002 Water Act, which now manages the Lake Nakuru water quality laboratory. Staff of this laboratory carried out the water analysis, phytoplankton counts and benthic invertebrate assessment from the soda lake surveys. LBNR, KWS and Delamere Estates facilitated access to lakes Bogoria, Nakuru and Elmenteita respectively. Work with LBNR expanded beyond that originally planned, because during the project period an Education Officer was appointed by the County Councils, with whom we liaised for all schools work and to whom we have donated our film outputs and many other relevant videos.

The Education Officer has a high throughput of schools in the Dryland Environmental Education Centre (DEEC; built by WWF) as well as outreach beyond the immediate neighbourhood of Lake Bogoria. We were given sole use of the DEEC during Earthwatch-sponsored research teams and ran our Darwin Workshops there. The schools' education work was facilitated by partnership with the Wildlife Clubs of Kenya (WCK) and, during the duration of this project, most of the Bogoria schools were signed up as WCK members, receiving the support material from that organisation. We also worked with Nature Kenya, because their Newsletter was the most effective way of recruiting workshop participants. The Rehabilitation of Arid Environments (RAE) Trust was involved in the planning of eroded land restoration which, although none had taken place by the time the project ended, will be an important post-project activity undertaken on Earthwatch-sponsored research teams at both lakes Bogoria and Baringo.

Our community capacity-building developed an extended network of local partners below County Council level. LBNR is managed by the two County Councils, whose joint boundary passes through the lake, Baringo (northern) and Koibatek (southern). LBNR staff are county council employees and, by the end of the project, an ecologist and an education officer were in post working under the Senior Warden (William Kimosop).

We worked through the Local Environment Protection Committee (LEPC), chaired by the Lobo Veterinary Officer and through that committee to village cooperatives such as Kapkuikui Livestock Improvement Cooperative (honey processing & marketing; development of eroded land restoration); Maji Moto and Emsos Ecotourism Cooperatives (training of guides on workshops) and Kesubo & Lobo Swamp Committees – which all come under the Lake Bogoria Multipurpose Co-operative Society. The scientific and natural history aspects of the Reserve involve the community through Friends of Nature Bogoria (FoNB), which is one of the many local groups in Kenya affiliated to Nature Kenya. We have agreed future close involvement with FoNB in understanding the ecohydrology and sustainable use of the wetlands in and around Lobo at the northern entry to the reserve.

All partners at this level were fully involved with us in the planning of activities and learning from progress results. This may be measured by the project outputs, such as the production of honey labels by the end of project in partnership with the Kapkuikui Cooperative which had established a centre for honey extraction and packaging, and the collaboration over development of eroded land restoration through films and establishing links with the RAE Trust.

The main organisation with which this Project worked very closely on the ground was the WWF Lake Bogoria Community-Based Wetlands Project. This was a 5-year integrated conservation and development project that had started in January 2001, one year after the first Earthwatch-sponsored research team at Bogoria. It had developed out of two earlier WWF-funded projects - one at Saiwa Swamp National Park, Kitale; the other at Lake Nakuru.

The WWF project had, by the start of this Darwin Project, provided LBNR with a weather station, lake level recording and stream gauging, the Drylands Environmental Education Centre with two offices and subsequently a laboratory. For most of the duration of the Darwin Project, WWF staff cooperated with the Earthwatch research teams and participated in the Darwin Workshops for training.

The WWF project primarily focussed upon the community, trying to build bridges between the local villages and the County Councils because there had earlier been considerable animosity created at the time the Reserve was gazetted. WWF built capacity in the village communities, encouraging the formation of the community groups such as those named above, with whom this project worked directly and such links will be a primary component of our exit strategy.

WWF also aimed at transferring technical capacity to reserve staff by appointing parallel staff to LBNR staff and providing the equipment necessary to support LBNR staff activities. This part of their programme was less successful for several reasons and to a large extent this Darwin Project was able to make the difference. One reason was that the WWF project had a high staff turnover, so four Masters'-level project ecologists passed through it, leaving little capacity in the LBNR ecologist who had only school-leaver education. He is following the Leicester Distance Learning Certificate in '*Global Ecology & Wildlife Conservation*' and has attended both Darwin Workshops and the 2006 African Fellows research/training team. The second was that scientific equipment in the WWF Bogoria laboratory was transferred from the Lake Nakuru project, which had wound-up, but little of it was functioning. Some new equipment was put in place with no facilities for its maintenance and they no longer work (e.g. sophisticated lake level recording equipment). This has partly been rectified by donation of a microscope and sundries from the Darwin project laboratory container and has given the LBNR Ecologist capacity for Spirulina counting. This will continue in the partnership with FoNB, who will seek funding to upgrade the laboratory.

The third reason was that when WWF left Bogoria in 2005 to relocate their office to Nakuru to focus activities on the upper catchment of Lake Bogoria, almost no office equipment was left behind. The project was able to give the LBNR Education Officer, FoNB and Ecologist each a computer and one printer; the Darwin post-Project extension will work with the Education Officer in other soda lakes to broaden his experience. Future Earthwatch-sponsored research teams at Lake Bogoria will provide the continuity of contacts and support to the two LBNR staff and the CBOs. We will train LBNR staff in correct database management (weather station data is not logically stored) and encourage simple lake monitoring and recording (e.g. weekly secchi disc readings).

We did not collaborate directly with the other Darwin Projects in Kenya but were fully aware of their objectives and progress through Nature Kenya and the departments of NMK. Our activities enhanced theirs, for example our workshops trained young Kenyans on wider ecological and biodiversity conservation issues than they had previously been exposed to on the projects focussing upon bird conservation.

Our international partners were mainly on the scientific work. The Wildfowl & Wetlands Trust was the main partner in flamingo satellite tracking, together with Birdlife Belgium and the Max Planck Institute. The project also received a grant from the Vodafone Group Foundation. Through this consortium, Dr Brooks Childress raised the funds for 7 satellite transmitters, including fitting and monitoring. Veterinary skills were provided by Professor John Cooper of the University of the West Indies from 2003-4 (research and workshop tuition) and by Dr Lindsay Oaks, Washington State University, USA from 2005-6 (research and African Fellows tuition). Analysis of cyanobacterial toxins was carried out by Dr James Metcalf at the University of Dundee, Scotland (2004) and Dr Tomasz Jurczak at the University of Lodz, Poland (2006). Regular scientists on the Earthwatch-sponsored research teams at Lake Bogoria have come from the University of Jyväskylä, Finland (Dr Suzanne Mills); Queen Mary, University of London (Dr Jon Grey); the University of Cambridge (Dr Jo Darlington); Trinity College Dublin (Dr Ian Donohue); The Natural History Museum, London (Dr David Agassiz) and from independent ecological consultants specialising in Coleoptera (Mr Tony Drane) and water birds (Dr Chris Tuite). Molecular genetic analysis of flamingo blood is being undertaken by Professor Giuseppe Crosa, of the University of Insubria, Italy. Post-graduates who worked on the project in 2004 were Miss Amy Deacon and Debra Bardowicks. Miss Bardowicks returned in 2005 under the auspices of the Brock Initiative to film the schools and community activities; these films were subsequently edited by Ben Please in early 2006.

The local partnerships will continue as a consequence of Dr Harper's continued involvement as the Director of the Earthwatch-sponsored 'Lakes of the Rift Valley' project, which has guaranteed support until the end of 2007 and is highly probable for renewal for 4 years after that. The LEPC, FoNB and DEEC will continue to work with the project and recognition of the partnership will be through the incorporation of Darwin, University of Leicester and Earthwatch logos on their material (honey labels, visitor information and questionnaires). The partnership with the County Councils will continue on a wider scale, through the Earthwatch research programme supporting their conservation initiatives at Lake Baringo and its catchment (Lembus forest) and Lake Kamnarok. The Senior Warden of LBNR, William Kimosop, has been given wider responsibilities (in no small way as a consequence of him being one of the first Darwin Fellows), developing a 'Mid-Rift Wildlife Forum' of 4 County Councils in 2005, modelled on the successful Laikipia Wildlife Forum. It is now being extended to a 'Mid & North Rift' forum of 6 Councils and scientific advice for this will continue to be provided through our project.

9. Monitoring and Evaluation, Lesson learning

Our monitoring and evaluation of the project was based upon the following:

1. Scientific planning being carried out in partnership with main project partners (University of Nairobi and National Museums, Ornithology).
2. Logistical planning being carried out in partnership with LBNR.
3. Workshop return questionnaires guiding logistical planning of subsequent ones.
4. Soda lake survey results (scientific together with the opinions of surveyors about logistics) guiding the planning of subsequent ones and evolving the strategy. The effectiveness of the methods used in the Soda Lakes Survey censuses have been evaluated by comparison with the NMK national water bird count, done for Nakuru on adjacent days in July 2003 and for all lakes in an adjacent week in January 2004 and January 2005.
5. Scientific outputs being through peer-reviewed scientific publications.
6. School provision being a result of an initial survey by a qualified teacher (Mrs Maureen Harper) accompanied by William Kimosop and Mrs Margaret Cooper of each school and discussion with the Head Teacher; repeat re-visits to evaluate school use of materials.
7. Community activities only taking place in partnerships developed through prior discussion, not unsolicited donations or activities.
8. End of Project scientific workshop with all partners.

There were no main problems encountered in implementing this project, other than financial caused mainly by global security issues in 2003 and the consequent shortage of volunteers on Earthwatch-sponsored teams. These were outside our control, but modifications to activities were made which did not substantially reduce our achievements as all the project objectives have been met.

The evaluation of the project has been through 6-monthly progress reports to Darwin, which were evaluated externally and annual reports of the wider project to Earthwatch, which are internally evaluated. Scientific manuscripts have been evaluated by peer-reviewers and their comments incorporated, raising their quality. The scientific consortium that manages the 'Lakes of the Rift Valley' project has held two annual scientific planning meetings (2004, 2005) in UK and extensive communication is undertaken by email. The financial expenditure has been evaluated according to the strict rules of Earthwatch and the University of Leicester, avoiding any misappropriation or wastage and re-evaluated by Earthwatch before submission to Darwin.

Managing this project successfully under the Darwin goal over 3 years has taught the scientists involved far more about community involvement than any other scientific research funding could, or that they themselves could have achieved in their research careers. A clear lesson that has been learned for future work, is the necessity for close partnership between physical/biological scientists and social scientists. This is being effected in the post-project extension and will be part of future applications for research funding in the tropical world.

10. Actions taken in response to annual report reviews (if applicable)

The past reviews on the Annual Reports from Years 1 and 2 of the project have been highly favourable and in light of the achievements of the project and our ideas for follow-up, we were awarded a post-project grant in June 2006. This will support the project up to 2008 in replicating training and lake monitoring across a wider range of the East African Rift Valley into Tanzania.

The first annual report review requested further details on a number of areas, including evidence of communication with and engagement of government officers and details of methodology with regard to the work on other avian species.

The project responded to these queries and outlined our response in the Second Annual Report in the following ways.

1. The communication with government officers is on a daily basis during fieldwork as our research camps are at the Reserve entrance gate, Lobo. Either the County Council Reserve Warden, William Kimosop, or his deputy ecologist, James Kimaru, is present at camp. The communication with KWS occurs at least once on each visit, through the regional ecologist at Lake Nakuru National Park, Bernard Kuloba, whose remit covers Bogoria. The National Museums of Kenya are represented on each Earthwatch team at Bogoria by a staff member or intern from the Department of Ornithology.
2. The materials generated at the workshops were presented to the participants at the time as PowerPoint presentations, which were handed out as photocopies for them to take notes on (Professor Cooper's were hand-written notes which were photocopied and handed out). Each workshop (two have so far been run) has a different subject and so has had different support materials. Moreover, each workshop involves a considerable practical element.
3. The other avian species on the lake that are the focus of this work are the Cape teal and black-necked grebe, because they have been identified as dependent upon the aquatic ecosystem and both are vulnerable species in Kenya for which Bogoria is an IBA. These two species are monitored during the soda lakes surveys (undertaken approximately bi-monthly) by the project's Kenyan partners, and the population dynamics of the chironomid species in the lake is under study on an annual basis supplemented by samples taken during the soda lakes survey. The third species directly dependent upon lake the food web and monitored in the three lakes is the greater flamingo, which is an invertebrate feeder.
4. The integration of these three species into the project is based upon the data collected in the soda lakes surveys, which include the zooplankton (sampled by tow-net), littoral invertebrates (sampled by hand net) and benthic invertebrates (sampled by Ekman grab). These samples are counted, then stored at the Nakuru Water Quality lab for detailed examination by Dr David Harper during each visit.

A revised logical framework for the project (please see Appendix V) was presented as a suggestion with the second annual report. The review stated that whilst there was no doubt over the logic of these changes, they were not fully explained in the report and that a description of the logical argument behind the changes would be welcomed in this report. The subsequent half-year report explained that we wanted to move to report against the revised log frame due to the evolution of the project through the first 2 years and to assist the final review process. A more detailed explanation is also provided below.

The most significant change to the logical framework was to revise the Project Purpose into one more robust and encompassing statement (the 'Overall Project Goal'). This goal is to see 'Lake Bogoria National Reserve managed effectively and sustainably as a Ramsar site, within the context of its role in the flamingo lake chain'.

It was felt that establishing this clear goal for the project itself within the overarching goal of the Darwin Initiative would provide clear guidance and set a vision for the delivery and completion of activities in the final year of the project. The Project Goal now subdivides into two purposes that match the original project purposes from the log frame in the 2003 application and a new third purpose that has been built in to formally recognise the

strong element of public education and understanding that the project has comprised. This was not included as a key element of the project originally, and it was felt that this needed to be added to help define mounting educational activities and provide a comprehensive project framework for evaluation and assessment purposes.

11. Darwin Identity

The Darwin logo has been placed, using the large circular stickers, upon all five 'Lakes of the Rift Valley' project vehicles and the inflatable dinghy. It is therefore seen on the main Trans-African Highway, between Nairobi and Nakuru, on approximately one third of each year. It has been seen more intensively around four lake and one forest locations (lakes Bogoria, Baringo, Naivasha, Elmenteita; Lembus forest) for two-week periods, six times a year.

The logo is printed upon all our output material. Every visitor to Bogoria National Reserve passes the logo and the 12 habitat posters at the reserve entrance gate (about 80,000 per year). Every visitor who buys a reserve booklet sees it. Every recipient of correspondence by the Headmaster of 13 schools receives it on their headed notepaper, or who visits the school and sees the new school logo on its poster. Every reader of one of our school story book sees it on the outer cover. Every member of a film audience sees it in the credits.

Around 12 Kenyan scientists have consulted Dr Harper directly about funding opportunities for Darwin projects or scholarships. Some have been inappropriate and directed elsewhere (e.g. conservation of leopards). Some have been incorporated into our work (e.g. Lake Elmenteita ecotourism group had written independently to Darwin and is part of the Post-Project extension). Some have been incorporated into future plans for research and capacity-building work (e.g. discussions about Ewaso Njiru North river basin with Laikipia Wildlife Forum) as a result of a staff member attending the Elmenteita workshop. William Kimosop has used his title 'Darwin Fellow' extensively since gaining it and this generated wide international publicity among the tourist industry through company email circular newsletters as well as the national press when it was awarded to him.

Understanding of the Darwin Initiative is high amongst the educated scientific community in Kenya. There is also a general understanding, even amongst the rural poor, about the need for biodiversity conservation and environmental sustainability. This is always combined with understanding of its actual or potential economic value and desire to realise that value. In the Bogoria area, we have worked hard to generate an appreciation of our identity, because the Reserve was originally set up against opposition; about 14 families were displaced and compensation has not been paid. Moreover, most scientists (even Kenyan) are perceived as 'foreigners' who make fleeting visits, which have no bearing on the lives of the community. We are using the words and logos of Darwin and Earthwatch to change this perception and give us a recognised and valued project identity within local communities.

Nationally, our project has developed a distinct identity because it is the only soda lake project that is more than a single-scientific study. Two Kenyans are doing PhD studies, one Kenyan lecturer from Kenyatta University is associated with a German-led project, but these studies are strictly scientific and have no connection with the communities of the lakes. Ours is the only project also to have a wide partnership base.

12. Leverage

Throughout the project, 6 Earthwatch volunteer teams with a total of 36 volunteers provided 3,456 hours of labour and the equivalent of £28,500 sterling to the project, in addition to the 16 Earthwatch-sponsored teams at other lakes whose contributions supported the project camp infrastructure for its use at Bogoria. Earthwatch volunteers have individually supported the education of Kenyans involved in the Project to the

equivalent of about £1,000 per year.

A notional value of £70,000 pounds is attached to the scientific equipment that has been donated by the University of Leicester and Shell International. Surplus to requirements in Europe, all provide an increase in capacity for the laboratories that are being supported in the Rift Valley. The Mobile laboratory itself has a value – it would cost around £10,000 in Kenya to replace it should this become necessary.

During the project lifetime, the outputs of funds provided by the Vodafone Group Foundation (£10,000) enabled the development of biodiversity conservation and sustainable livelihood films, which were the most successful tool for capacity-building on the project.

In 2004, two separate teams of undergraduates joined the project work at Bogoria, resulting in a continuous monitoring of spirulina for 7 months, providing an excellent continuous record during what subsequently turned out to be a decline to a crash. These students had raised their own funds (approximately £5,000) from various charitable donors (such as Edinburgh Zoological Society).

In 2005-6, grants for river basin exchanges between Poland, UK and Kenya from the EU Framework 6 body 'Twinbasin' (approximately £9,000) enabled future possibilities of biodiversity conservation and sustainable livelihood initiatives to be explored by developing proposals linked to the CDM through carbon trading under the Kyoto Convention through both tree planting and soil carbon accumulation on restored grassland plots. The Percy Sladen Fund, administered by the Linnean Society, gave a grants of £750 to David Agassiz for Lepidoptera studies at LBNR.

Dr Harper and Brooks Childress were part of a consortium led by a German university, which unsuccessfully proposed a project entitled 'Biosal' to the EU Framework 6 in 2003. David Harper led another consortium involving partners from 4 East African countries, which unsuccessfully submitted an application to a subsequent call of Framework 6 entitled 'EuRiftWet' in 2005. Later in 2005, Earthwatch unsuccessfully submitted an application to the EU 'Environment & Forests' Development Programme. The partners are continuing to explore trans-Atlantic possibilities of joint funding for work on flamingo health issues and will be alert for the possibilities of applications under the EU Framework 7, which starts in 2007. The 'Lakes of the Rift Valley' consortium already includes aquatic scientists from 4 EU countries (Ireland, UK, Italy and Poland).

13. Sustainability and Legacy

The project infrastructure will continue as the 'Lakes of the Rift Valley' research programme supported by Earthwatch. Its research activities will continue on soda lakes, including Lake Bogoria at least once annually, so that achievements will continue to be supported by the partnerships established. All partners will thus maintain contact.

In the post-project extension we will re-establish contact with those participants of the workshops we are not presently in contact with; to ensure that those who are working in biodiversity conservation/sustainable livelihoods associated with soda lakes and their environs have the opportunity to apply for the more advanced research/training camps in 2007/8. The achievements of the project will be applied to a proposed common monitoring strategy for soda lakes, to be discussed at the EoP Workshop in late November 2006. This will maintain the ecological link between spirulina and lesser flamingos, which no other monitoring programme has attempted before. The proposal will include a 'Flamingo Report' document, which gives easy indicators of soda lake health which a non-scientist is able to compile, together with a link to the series of protocols written for each scientific component of the project.

14. Value for money

We believe the project has delivered excellent value for money. The infrastructure was already in place when the project started in July 2003, as a consequence of the existing

Earthwatch 'Lakes of the Rift Valley' project. The underlying costs of scientists' participation was borne by the Earthwatch project and, in particular, it was possible in this way to bring in appropriate international experts as the project developed (e.g. Dr Lindsay Oaks, a veterinarian specialising in infectious diseases; Dr Tomasz Jurczak, an expert in cyanobacterial toxins and Dr Giuseppe Crosa, a molecular ecologist).

The project has met all key scientific and training objectives, whilst over-achieving beyond set goals on the engagement of local communities.

15. **Appendix I: Project Contribution to Articles under the Convention on Biological Diversity (CBD)**

| Project Contribution to Articles under the Convention on Biological Diversity | | |
|--|------------------|---|
| Article No./Title | Project % | Article Description |
| 6. General Measures for Conservation & Sustainable Use | 10 | Develop national strategies that integrate conservation and sustainable use. |
| 7. Identification and Monitoring | 10 | Identify and monitor components of biological diversity, particularly those requiring urgent conservation; identify processes and activities that have adverse effects; maintain and organise relevant data. |
| 8. In-situ Conservation | 15 | Establish systems of protected areas with guidelines for selection and management; regulate biological resources, promote protection of habitats; manage areas adjacent to protected areas; restore degraded ecosystems and recovery of threatened species; control risks associated with organisms modified by biotechnology; control spread of alien species; ensure compatibility between sustainable use of resources and their conservation; protect traditional lifestyles and knowledge on biological resources. |
| 9. Ex-situ Conservation | 10 | Adopt ex-situ measures to conserve and research components of biological diversity, preferably in country of origin; facilitate recovery of threatened species; regulate and manage collection of biological resources. |
| 10. Sustainable Use of Components of Biological Diversity | 5 | Integrate conservation and sustainable use in national decisions; protect sustainable customary uses; support local populations to implement remedial actions; encourage co-operation between governments and the private sector. |
| 11. Incentive Measures | 10 | Establish economically and socially sound incentives to conserve and promote sustainable use of biological diversity. |
| 12. Research and Training | 30 | Establish programmes for scientific and technical education in identification, conservation and sustainable use of biodiversity components; promote research contributing to the conservation and sustainable use of biological diversity, particularly in developing countries (in accordance with SBSTTA recommendations). |
| 13. Public Education and Awareness | 10 | Promote understanding of the importance of measures to conserve biological diversity and propagate these measures through the media; cooperate with other states and organisations in developing awareness programmes. |
| 14. Impact Assessment and Minimizing Adverse Impacts | | Introduce EIAs of appropriate projects and allow public participation; take into account environmental consequences of policies; exchange information on impacts beyond State boundaries and work to reduce |

| | | |
|---|-------------|--|
| | | hazards; promote emergency responses to hazards; examine mechanisms for re-dress of international damage. |
| 15. Access to Genetic Resources | | Whilst governments control access to their genetic resources they should also facilitate access of environmentally sound uses on mutually agreed terms; scientific research based on a country's genetic resources should ensure sharing in a fair and equitable way of results and benefits. |
| 16. Access to and Transfer of Technology | | Countries shall ensure access to technologies relevant to conservation and sustainable use of biodiversity under fair and most favourable terms to the source countries (subject to patents and intellectual property rights) and ensure the private sector facilitates such assess and joint development of technologies. |
| 17. Exchange of Information | | Countries shall facilitate information exchange and repatriation including technical scientific and socio-economic research, information on training and surveying programmes and local knowledge |
| 19. Bio-safety Protocol | | Countries shall take legislative, administrative or policy measures to provide for the effective participation in biotechnological research activities and to ensure all practicable measures to promote and advance priority access on a fair and equitable basis, especially where they provide the genetic resources for such research. |
| Total % | 100% | Check % = total 100 |

16. Appendix II: Outputs

Please quantify and briefly describe all project outputs using the coding and format of the Darwin Initiative Standard Output Measures.

| Code | Total to date (reduce box) | Detail (←expand box) |
|-------------------------|--|--|
| Training Outputs | | |
| 1a | Number of people to submit PhD thesis | - |
| 1b | Number of PhD qualifications obtained | - |
| 2 | Number of Masters qualifications obtained | One - Laban Njoroge M.Sc. Kenyatta University of Technology, Nairobi |
| 3 | Number of other qualifications obtained | One – Nicodemus Naliyanya Diploma in Wildlife Management, Mweka, Tanz. |
| 4a | Number of undergraduate students receiving training | Six taking distance-learning certificate in Global Ecology & Wildlife Management at University of Leicester i) Timothy Mwinami, University of Nairobi B.Sc ii) James Kimaru (LBNR), Reuben Ndolo & John Kaba (LRV staff), Dominic Kimani (NMK) & Isaac Ouma (Lake Oloidien) |
| 4b | Number of training weeks provided to undergraduate students | 30, to interns from WWF, NMK Univ of Nbi and L.Bogoria reserve, on Earthwatch research teams |
| 4c | Number of postgraduate students receiving training (not 1-3 above) | 54, on 4 workshops; 3 of 1 week and 1 of 2 weeks |
| 4d | Number of training weeks for postgraduate students | 64, on the workshops |
| 5 | Number of people receiving other forms of long-term (>1yr) training not leading to formal qualification(i.e. not categories 1-4 above) | 1, James Njoroge, trained as driver/mechanic for 4wheel drive vehicles |
| 6a | Number of people receiving other forms of short-term education/training (i.e. not categories 1-5 above) | 49 non-graduates on the four workshops. 3500 schoolchildren (estimated) shown conservation films and given talks 2 other trainees: i) Philemon Ole Nachuru, LBNR Assistant Warden, given an Earthwatch African Fellowships in Ghana ii) Reuben Ndolo, LRV project assistant, given an Earthwatch African Fellowship in South |

| Code | Total to date (reduce box) | Detail (←expand box) |
|------------------------------|--|---|
| | | Africa |
| 6b | Number of training weeks not leading to formal qualification | 56 (51 workshops and 5 weeks school teaching) |
| 7 | Number of types of training materials produced for use by host country(s) | 8 - Protocols, wall-charts, posters, films, handouts, published books, story books, reserve booklet. |
| Research Outputs | | |
| 8 | Number of weeks spent by UK project staff on project work in host country(s) | 54 weeks on Earthwatch teams and Workshops 6 weeks on project management |
| 9 | Number of species/habitat management plans (or action plans) produced for Governments, public authorities or other implementing agencies in the host country (s) | 2 Bogoria Ramsar Management Plan) for Koibatek & Baringo County Councils and report of the Elmenteita training team for KWS |
| 10 | Number of formal documents produced to assist work related to species identification, classification and recording. | 1 Manuscript on biodiversity of Lepidoptera submitted, c. 3 more in preparation |
| 11a | Number of papers published or accepted for publication in peer-reviewed journals | 5 plus 4+ in preparation |
| 11b | Number of papers published or accepted for publication elsewhere | 5 (two Kenya Birds, two Vet News and one Flamingo) |
| 12a | Number of computer-based databases established (containing species/generic information) and handed over to host country | 4 - Lesser flamingo counts, Spirulina counts, flamingo mortality details and post mortems of lesser flamingo details |
| 12b | Number of computer-based databases enhanced (containing species/genetic information) and handed over to host country | - |
| 13a | Number of species reference collections established and handed over to host country(s) | 4 – Coleoptera, Lepidoptera and Odonata of LBNR; Leps . of Elmenteita |
| 13b | Number of species reference collections enhanced and handed over to host country(s) | 3 – Birds of Bogoria and Elmenteita; plants of Bogoria |
| Dissemination Outputs | | |
| 14a | Number of conferences/seminars/workshops organised to present/disseminate findings from Darwin project work | 4 – three training workshops during project and one to summarise findings Nairobi November 2006 |
| 14b | Number of conferences/seminars/ workshops attended at which findings from Darwin project work will be presented/ disseminated. | 2 to date – Darwin workshops Feb & October 2006 London 2 planned in 2007 |
| 15a | Number of national press releases or publicity articles in host country(s) | 4 in Nature Net (Nature Kenya), 1 in Kenya Airways in-flight magazine Msafiri, 1 in Daily Nation |

| Code | Total to date (reduce box) | Detail (←expand box) |
|-------------------------|--|--|
| 15b | Number of local press releases or publicity articles in host country(s) | 2, relating to the Kimosop fellowship in 2003 |
| 15c | Number of national press releases or publicity articles in UK | 2, Times Higher Education Supplement and The Independent |
| 15d | Number of local press releases or publicity articles in UK | 2, Leicester Mercury |
| 16a | Number of issues of newsletters produced in the host country(s) | n/a |
| 16b | Estimated circulation of each newsletter in the host country(s) | n/a |
| 16c | Estimated circulation of each newsletter in the UK | n/a |
| 17a | Number of dissemination networks established | n/a |
| 17b | Number of dissemination networks enhanced or extended | n/a |
| 18a | Number of national TV programmes/features in host country(s) | 0 |
| 18b | Number of national TV programme/features in the UK | 0 |
| 18c | Number of local TV programme/features in host country | 0 |
| 18d | Number of local TV programme features in the UK | 1 - East Midlands News |
| 19a | Number of national radio interviews/features in host country(s) | 0 |
| 19b | Number of national radio interviews/features in the UK | |
| 19c | Number of local radio interviews/features in host country (s) | |
| 19d | Number of local radio interviews/features in the UK | 1, interview, Radio Leicester |
| Physical Outputs | | |
| 20 | Estimated value (£s) of physical assets handed over to host country(s) | £70,000 (laboratory) |
| 21 | Number of permanent educational/training/research facilities or organisation established | 4 – new Rift Lakes laboratories equipped at Naivasha, Elmenteita, Nakuru & Bogoria |
| 22 | Number of permanent field plots established | - |
| 23 | Value of additional resources raised for project | £10,000 from Earthwatch volunteers in kind (books) or money (contributions to education) £28,500 through Earthwatch volunteer contributions |

17. Appendix III: Publications

| Type * (e.g. journals, manual, CDs) | Detail (title, author, year) | Publishers (name, city) | Available from (e.g. contact address, website) | Cost £ |
|---|---|---|--|--|
| *Journals (five) | See below | See below | *Provided on accompanying CD as pdf files | - |
| *Films (all in Swahili) | 1. Maji ni Uhai 2. Miti ni Uhai 3. Songs & Poems from Bogoria and Baringo 4. Sustainable dryland agriculture (Nyasi ni Pesa) 5. How to Make a Modern Beehive | Brock Initiatives | *Provided on 4 accompanying DVDs Richard Brock, Dumpers Cottage, Chew Magna, Bristol | further copies on application at cost |
| *Childrens' books | 1. Bogor the Lesser Flamingo 2. Kim the Lesser Flamingo Meets the Scientists | University of Leicester | *Provided as two hard copies. David Harper/Maureen Harper | further copies at cost per volume |
| Information booklet | * A Visitor's Guide to Lake Bogoria National Reserve. D. Bardowicks & D.M.Harper | University of Leicester with Koibatek & Baringo County Councils | *Provided as hard copy. David Harper | further copies at cost per volume |

1. Harper, D.M., R.B. Childress, M.M. Harper, R.R. Boar, P. Hickley, S.C. Mills, N. Otieno, T. Drane, E. Vareschi, O. Nasirwa, W.E. Mwatha, J.P.E.C. Darlington, X. Escuté-Gasulla (2003) Aquatic biodiversity and soda lakes: Lake Bogoria National Reserve, Kenya. *Hydrobiologia* **500**: 259-276.
2. Childress B., D.M. Harper, B. Hughes, W. Van den Bossche, P. Berthold & U. Querner (2004) Satellite tracking lesser flamingo movements in the Rift Valley, East Africa. *Ostrich – Journal of African Ornithology* **75**: 57-65
3. Childress, R.B., D. M.Harper, B. Hughes & C. Ferris (2005). Sex determination in the Lesser Flamingo (*Phoenicopterus minor*) using morphological measurements. *Ostrich – Journal of African Ornithology* **76**; 148-153.
4. Childress, B. and Jarrett, N. (2005). Methods of capturing and handling wild Lesser Flamingos for research. In: Childress, B., Béchet, A., Arengo, F. & Jarrett, N. (eds.) Flamingo, Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group, No. 13, December 2005. Wildfowl & Wetlands Trust, Slimbridge, UK.
5. J. L. Oaks, T Walsh, D. Bradway M. Davis & D.M. Harper (2006) Septic Arthritis and disseminated infections caused by *Mycobacterium avium* in Lesser Flamingos, Lake Bogoria, Kenya. In: Childress, B., Béchet, A., Arengo, F. & Jarrett, N. (eds.) Flamingo, Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group, 14, Wildfowl & Wetlands Trust, Slimbridge, UK.

(Relevant but published as a result of Earthwatch research in 2002). Hickley, P, Boar, R.R. & Mavuti, K.M. (2004). Bathymetry of Lake Bogoria, Kenya. Journal of the East African Natural History Society **92**; 107-118.

18. Appendix IV: Darwin Contacts

To assist us with future evaluation work and feedback on your report, please provide contact details below.

| | |
|---------------------------------------|---|
| Project Title | 'Flamingo Conservation and Ramsar Site Management at Lake Bogoria, Kenya' |
| Ref No. | 162/12/003 |
| UK Leader Details | |
| Name | Dr David Harper |
| Role within Darwin Project | Lead scientist on Earthwatch Lakes of the Rift Valley project and overall co-ordinator of activities in Kenya |
| Address | Department of Biology, University of Leicester, University Road, Leicester, LE1 7RH |
| Phone | |
| Fax | |
| Email | |
| Other UK Contact (if relevant) | |
| Name | Brookes Childress |
| Role within Darwin Project | Flamingo Researcher & Chair IUCN-SSC/Wetlands International Flamingo Specialist Group |
| Address | Wildfowl & Wetlands Trust, Slimbridge, Gloucestershire, GL7 2BT |
| Phone | |
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19. Appendix V: Approved logical framework for 2005-6 reporting

Darwin Initiative goal

To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but poor in resources to achieve the conservation of biodiversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources

Overall Project goal

Lake Bogoria National Reserve managed effectively and sustainably as a Ramsar site, within the context of its role in the flamingo lake chain

Purposes

1. Essential lake ecosystem properties identified and quantified

2. Movement of flamingos (*P. minor*) between soda lakes understood and incidents of mass mortality explained

3. Public understanding and conservation of Lake Bogoria and neighbouring soda lakes strengthened through education and capacity

Outputs

1.1. Explanation of the effects of changes in external factors on population of *Arthrospira fusiformis* (*Spirulina*)

1.2. Explanation of the effects of dynamics upon key water birds in lake's limnology

2.1. Causes of movement (*P. minor*) between lakes explained

2.2. Causes of mass mortality incidents explained and measures to minimise the risk to the species formulated

3.1. Scientists, conservationists, school children and the general public educated in the biodiversity value of Lake Bogoria and soda lakes

3.2. Kenyans associated with LBNR and partner organisations trained in ecology/conservation and practical skills

- 1.1.1. Measure spirulina density and productivity
- 1.1.2. Establish chironomid histories and emergence patterns
- 1.1.3. Understand ecological connectivity within the reserve
- 1.1.4. Build up biodiversity inventory of LBNR
- 1.1.5. Establish mobile laboratory at Bogoria to support research
- 1.1.6. Feed relevant information and findings into Lake Bogoria's Management Plan

- 1.2.1. Relate *A. fusiformis* fluctuations to *P. minor* numbers
- 1.2.2. Explain chironomid in terms of *A. fusiformis* productivity
- 1.2.3. Relate cape teal, black-necked grebe abundances to chironomid dynamics
- 1.2.4. Quantify pathways of energy from lake to land
- 1.2.5. Feed relevant information and findings into Lake Bogoria's Management Plan

- 2.1.1. Place transmitters on birds and track movements by satellite
- 2.1.2. Analyse and interpret data from birds tracked and evaluate importance of all sites visited by them
- 2.1.3. Provide LBNR with computer for satellite downloads
- 2.1.4. Conduct regular censuses of *P. minor* and basic parameters on Kenya's main soda lakes
- 2.1.5. Feed relevant information and findings into Lake Bogoria's Management Plan

- 2.2.1. Trap, band, measure and take samples from 100 flamingos per annum
- 2.2.2. Measure concentrations of metal and cyanobacteria toxins
- 2.2.3. Evaluate flamingo health field morphometrics and blood cell analysis
- 2.2.4. Develop protocols for population mortalities and autopsies of individual birds
- 2.2.5. Feed relevant information and findings into Lake Bogoria's Management Plan

- 3.1.1. Develop and provide conservation educational material for schools local to LBNR
- 3.1.2. Develop and provide educational material for LBNR visitors
- 3.1.3. Develop website of Lake Bogoria for international access and education
- 3.1.4. Write scientific and lay articles about Lake Bogoria and the project's findings

- 3.2.1. Hold capacity-building workshops at LBNR for young Kenyan research and conservation practitioners
- 3.2.2. Teach Ramsar principles and techniques at workshops to African nationals
- 3.2.3. Teach Kenyans of partner organisations principles of ecology and conservation by UoL D.L. Certificate
- 3.2.4. Provide appropriate Kenyans of partner organisations opportunity to undergo full-time training
- 3.2.5. Provide Kenyan students and interns practical experience on Earthwatch field research teams
- 3.2.6. Hold training workshop to integrate scientific findings into LBNR management plan and help elaborate a monitoring

20. Appendix VI: International Lesser Flamingo Action Planning Workshop Summary



INTERNATIONAL LESSER FLAMINGO ACTION PLANNING WORKSHOP



*ICIPE Complex, Kasarani, Nairobi, Kenya
25-29 September 2006*

An AEWA/CMS single-species action plan is being developed for the near-threatened Lesser Flamingo of Africa and Asia. Thirty-three Lesser Flamingo and action planning experts assembled in Nairobi 25-29 September 2006 for the purpose of compiling the range state data and other information needed for the initial draft of this plan.

The workshop was organized by the Flamingo Specialist Group of the IUCN Species Survival Commission and Wetlands International, with the assistance of the BirdLife Africa Partnership Secretariat, the hosts in Nairobi. It was conducted by Drs. Szabolcs Nagy of Wetlands International, Baz Hughes of Wildfowl & Wetlands Trust (WWT), and Sergey Dereliev of the UNEP/AEWA Secretariat.

Dr Geoffrey Howard, Regional Programme Coordinator in the IUCN Eastern Africa Regional Office opened the workshop with Lesser Flamingo action planning experience from the past and suggestions for the future. This was followed by presentations on workshop expectations and a biological assessment of the Lesser Flamingo by Szabolcs Nagy, Paul Ndang'ang'a, Africa Species Coordinator for the BirdLife Africa Partnership Secretariat, and Brooks Childress, Chair of the IUCN-SSC/Wetlands International Flamingo Specialist Group, respectively.

Lesser Flamingo status and distribution data for 21 range states from India to Senegal, and from Djibouti to Namibia were presented, and there were four additional presentations concerning the likely causes of the recent Lesser Flamingo die-offs in East Africa, a new technique for conducting aerial census counts and the building of an artificial breeding island for Lesser Flamingos.

The delegates agreed that the three most important threats to the future survival of the species were habitat degradation at the key breeding and feeding sites, disruption of breeding colonies and the mass die-offs occurring in East Africa. The Wildfowl & Wetlands Trust will coordinate the development and implementation of the action plan, with the first draft being available for review and comment by the range states early in 2007.

21. Appendix VII: Article from October Kenya Birds

Thousands of Lesser Flamingos at Lake Naivasha?

By David Harper^{1,2}, Muchane Muchai², Dominic Kamau² and Timothy Mwinami²

Department of Biology, University of Leicester¹ & Department of Ornithology, National Museums of Kenya²

In the second half of 2006, there were several newspaper reports of a sudden increase in Lesser Flamingos at Lake Naivasha, and that they were dying in large numbers there and at Lake Nakuru, because of pollution and toxic water. Readers with a cynical disposition might suspect that, yet again, the only news that newspapers like is bad news and if bad news doesn't exist, then reporters can twist the facts around.

The belief that Lesser Flamingos are being poisoned by humans has been around for about 15 years. A mortality of several thousand birds occurred at Nakuru in the early 1990s. The World Wide Fund for Nature (WWF), who at that time had a conservation project there, speculated in the press and on the Internet that heavy metals were causing the mortality, but proof of this statement was never published. A second mortality occurred in the mid 1990s, and then between 1999 and 2000 a very large mortality occurred at Lake Bogoria. David Harper and staff of the Museums' Ornithology Department were studying that lake during this mortality. There were about a million birds on Bogoria in early 2000, dying at a rate of about 700 a day. All ages died, even birds recently fledged. There are no sources of heavy metal pollution at Bogoria and it is highly unlikely that some birds could pick it up in Nakuru, fly to Bogoria and then die among hundreds of healthy birds.

A flamingo lives for about 40 years or so, roughly 15,000 days. (See Kenya Birds, volume 11:1) As a 'back-of-the-envelope' calculation, that means from a million birds about 70 are dying each day, naturally. But no animal populations have regular deaths, so perhaps flamingo mortality events are part of this irregular fluctuation of their environment? Is it a coincidence that each mortality event occurred at a lake where the numbers of flamingos were close a million, and during or at the end of a long drought in the country?

From 2002, scientific papers from a group of German and Kenyan scientists led by Lothar Kriennitz began to produce new evidence: that levels of toxins, naturally produced by cyanobacteria (commonly called blue-green algae), had been measured in Kenyan soda lakes and hot springs. (Kriennitz et al, 2003) The toxin levels might be high enough to kill Lesser Flamingos. A few dead flamingos were found in 2002 (but there were no big mortalities at this time) that when analysed, had levels of these toxins high enough to perhaps have killed them. These high levels were not found on a repeat visit in 2004. Inevitably, this "bad" news was picked up by the media and amplified so that every dead flamingo now means poisoned water.

In March 2006, at both Nakuru and Elmenteita, Lesser Flamingo numbers suddenly increased. Elmenteita's went from nearly nothing to 70,000; Nakuru's from a few hundred thousand to about a quarter of a million. The increase in numbers of healthy birds was accompanied by deaths – in the case of each lake a tiny fraction, about 2% of the numbers. The mortality lasted for about 2 weeks. A similar increase in numbers occurred in June, and most recently in Ololdien (see below).

Is it likely that a tiny fraction picked up poison in the lake and others did not? It is much more likely that those birds were weakened by their travels that brought them to the lake, had weakened immune systems, and were susceptible to the diseases which the birds carry but which a healthy bird can resist. Research by Dr Lindsay Oakes of Washington State University, working with the Leicester University and National

Museums' team, last year identified quite a number of bacterial and fungal diseases that individual birds were dying from – all of them displaying the same symptoms that have been claimed as evidence for heavy metal poisoning and cyanobacterial toxin poisoning. The explanation currently popular is that the mortalities in Nakuru and Oloidien are caused by Salmonella infection.

The story of exactly why flamingos die periodically is complex and almost certainly involves the combination of several factors. We must distinguish between those factors which cause the birds' immune systems to weaken – stressors – and those factors which kill weakened birds. For the first time ever, in November 2006, David Harper shall lead a research team at Lake Bogoria in partnership with Professor Kenneth Mavuti of the University of Nairobi, and the National Museums of Kenya, to which appropriate staff of Kenya Wildlife Service and Tanzanian equivalent bodies have been invited, which will have both a veterinarian (Lindsay Oakes) and a cyanobacterial toxin expert (Dr Tomasz Jurczak from Poland). We shall endeavour to conduct post-mortems on birds that have died and examine all three theories of flamingo mortality – microbial disease, cyanobacterial toxins and heavy metal poisoning. Perhaps after that, the scientific and conservation community will have a better idea of flamingo population dynamics.

To return to Naivasha, where we started this article. This is a fresh water lake which has produced many surprises, but hosting thousands of Lesser Flamingos is unlikely to remain one of them. Naivasha supports a few hundred Greater Flamingos at times, because they can find food there – Greater are carnivores feeding on insects and crustaceans and Naivasha has an abundance of water boatmen that make good Greater Flamingo dinners. Lesser Flamingos stop by in smaller numbers, because they at least can drink there, but not feed.

The event that led to the news stories though, is an abundance of Lesser Flamingos that settled on Lake Oloidien in late August 2006. Lake Oloidien, also known as the 'Little Lake', is at the south west corner of Naivasha. It is a volcanic crater lake, which was once connected to the main lake but has not been directly joined since 1979. (Sadly, many maps are sold to tourists which still show this connection, because they are based on the last-published Survey of Kenya 1:50,000, which marks the lake's high water level.) David Harper and his team have been conducting research in the Lake Naivasha basin since 1982 and have recorded Oloidien steadily becoming more saline-alkaline as it loses more water by evaporation than it receives in seepage.

This slow increase in salinity meant that it became greener and greener, for perfectly natural reasons. Lakes with high pH (alkaline lakes) have their phosphorus chemically more available, so the algae and cyanobacteria which can tolerate the pH, thrive on the phosphorus. Until this year, these were all single celled species, too small for anything but tiny invertebrates to feed on. In July 2006, Oloidien water passed the magic salinity mark that made it suitable for a much larger species, Spirulina (actually called *Arthrospira fusiformis* nowadays). Hey presto! The few Lesser Flamingos that regularly dropped in by chance stayed, because they could feed. As the numbers grew, more dropped in to join them. Twenty thousand in mid-August have turned into 200,000 by mid-October.

This is now not only an exciting spectacle for the lakeside residents, which include many well-known Nature Kenya members, but it's exciting to scientists too. Oloidien water, though far too saline for humans or cattle to drink, is NOT too saline for flamingos to drink. So you have the remarkable spectacle of groups of lesser flamingos feeding, next to groups which are drinking, next to groups which are bathing. In no other lake in the world can this be observed, we believe.

And the deaths? Once again about 2% of the resident population. That does not mean the lake is polluted, it does not mean the lake is toxic. It just means the marabou storks will not go hungry.

To follow the story of flamingos on the Rift Valley lakes, visit the website <http://kenya-rift-lakes.org>

Dr David Harper has been leading research teams to the Rift Valley lakes with Prof Ken Mavuti, of the University of Nairobi, for 25 years. Their work has been funded by the Earthwatch Institute and supported by Earthwatch volunteers since 1987. Their scientific research and community involvement in soda lake sustainability is funded by the Darwin Initiative, 2003-08. The research has been carried out in collaboration with the Department of Ornithology, National Museums of Kenya.

Reference

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22. Appendix VIII: Report on Earthwatch African Fellows Team, Lake Elmenteita, April 2005



‘Achieving Sustainable Lakes in the Rift Valley, Kenya’

Earthwatch African Fellows Team, 12-27th April, 2005 – Lake Elmenteita

Report to RAMSAR Secretariat, Darwin Initiative and Kenya Wildlife Service

1. Introduction

In April 2005, 12 conservationists from RAMSAR sites in 7 African countries (Table 1 below) met at Lake Elmenteita in Kenya’s Rift Valley to join a 14-day Earthwatch research team. Each participant was part of Earthwatch’s African Fellowship Programme which aims to build capacity of emerging conservationists in Africa through scientific training and research experience. Fellowship placements were funded by various bodies including the UK Government’s Darwin Initiative, European Commission, British American Tobacco and HSBC bank.

| Fellow | Country | Organisation | Site |
|---------------------|----------------|---|---|
| John Abraham | Ghana | TORUDES/Forestry Commission | Muni-Pomadze Wetlands (RAMSAR site) |
| Elema Hapicha | Kenya | Kenya Wildlife Service | Lake Nakuru National Park (RAMSAR site) |
| Caroline Fox | South Africa | Ezemvelo Kwa-Zulu Natal Wildlife | St Lucia Wetlands (RAMSAR & UNESCO World Heritage Site) |
| Martin Kahindi | Kenya | Laikipia Wildlife Forum | n/a |
| Stephen Kigoolo | Uganda | Nature Uganda | Lake Nabugabo (RAMSAR site) |
| Andrew Kulecho | Kenya | Nakuru Water & Sanitation Service | Lake Nakuru National Park (RAMSAR site) |
| Grace Mumbi | Kenya | University of Nairobi Zoology Department | Lake Naivasha (RAMSAR site) |
| Joseph Ole Munge | Kenya | African Conservation Centre | Shompole wetlands, Lake Natron |
| Fred Omengo | Kenya | Kenya Wildlife Service | Lake Jipe |
| Anu Onafuwa | Nigeria | Nigerian Conservation Foundation | Hadejia-Nguru Wetlands (RAMSAR site) |
| Tlhokomelo Phuthego | Botswana | NCSA Okavango Delta Management Plan Project | Okavango Delta (RAMSAR site) |
| Juliette Veloso | Madagascar | Durrell Wildlife Conservation Trust | Manambolomaty and Alaotra Wetlands (RAMSAR sites) |

Table 1 – The 12 Earthwatch Fellows

The 12 Fellows were set the objective of answering the simple question: “does Lake Elmenteita meet the RAMSAR criteria?” The lake is currently the only one of a five saline and freshwater lakes in Kenya’s Rift Valley north of Nairobi that has not yet been designated as a RAMSAR site. Members of the team received professional training in the process of undertaking a baseline ecological survey of the lake and its environs to provide the raw data needed to answer this question.

The team was led by Earthwatch scientists Dr David and Maureen Harper from the University of Leicester, Dr Chris Tuite from the University of Bristol, Dr David Agassiz from The Natural History Museum (London) and National Museums of Kenya (Entomology) and Timothy Mwinami and Henry Ndithia from the National Museums of Kenya (Ornithology).

2. Research

The team spent 12 days gathering the data required to help inform relevant decision-makers as to the value of Lake Elmenteita against the RAMSAR criteria. Research was divided into four key areas: limnology, flamingos, ornithology, and Lepidoptera. By recording the chemical and microbiological make-up of the water, establishing the number of flamingos, and surveying the diversity of bird and acacia-dwelling moth species the team was able to put together a picture of the ecological value of Lake Elmenteita and how the lake and its environs differ from that of others in the Rift Valley.

3. Training

The project provided the opportunity for young conservationists working at RAMSAR sites across western, eastern and southern Africa to come together to exchange their experiences of designating RAMSAR sites and developing and implementing management plans to promote their sustainable use. The team received a formal presentation from each Fellow about the threats facing RAMSAR sites in their own country and what approach is being taken to manage these threats. The research team also received a number of formal presentations and lectures from staff and from visiting professionals involved in the conservation of wetlands in Kenya. These included the Head Wardens from Lake Bogoria National Reserve and Lake Nakuru National Park and representatives for the Lake Naivasha Riparian Association and Elsamere Conservation Centre.

Facilitated discussion sessions held as a result of these presentations, highlighted recurring challenges at many RAMSAR sites in Africa that are a cause for concern and future action, including catchment management, community involvement and education and on-the-ground implementation of management plans. Fellows also received training on the technical and personal skills of how to deliver presentations about existing or potential RAMSAR sites in a clear and coherent fashion and to how to explain scientific findings to guide policy and inform decision-makers.

4. RAMSAR Criteria

The research carried out by the Earthwatch African Fellows team found that Lake Elmenteita met 6 out of the 8 criteria for RAMSAR designation (Table 2).

| RAMSAR Criteria | Does Elmenteita meet this criterion? | How Elmenteita meets the criteria |
|--|---|---|
| 1. A wetland should be considered internationally important if it contains a representative, rare or unique example of a natural or near natural wetland type found within the appropriate biogeographical region. | ✓ | The lake is representative of a natural saline wetland type (Type Q) |
| 2. A wetland should be considered internationally important if it supports vulnerable, endangered or critically endangered species or threatened ecological communities. | ✓ | <p>The lake is an important habitat for the threatened lesser flamingo (<i>Phoeniconaias minor</i>) and regionally threatened grey-crested helmet shrike (<i>Prionops poliophus</i>).</p> <p>The sanctuary surrounding the lake supports the endangered Rothschild giraffe (<i>Giraffa camelopardalis rothschildi</i>) and black and white colobus monkey (<i>Colobus guereza</i>).</p> |
| 3. A wetland should be considered internationally important if it supports populations of plant or animal species important for maintaining the biological diversity of a particular biogeographic region. | ✓ | <p>The lake supports a high avifauna diversity (over 170 species recorded in 12 days) and has diverse mammal, reptile, amphibian and invertebrate species.</p> <p>The lake contains a significant proportion of species (e.g. lesser flamingo) adapted to saline conditions.</p> |
| 4. A wetland should be considered internationally important if it supports plant or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions. | ✓ | <p>The lake is the only breeding site for the great white pelican (<i>Pelecanus onocrotalus</i>) in East Africa.</p> <p>The lake is a critical source of food (benthic diatoms) for the lesser flamingo, particularly when food at Lake Nakuru (spirulina) is not available.</p> <p>The lake supports other wildlife by providing a sanctuary of relatively pristine acacia forest compared with surrounding habitats that have been extensively damaged or degraded.</p> |
| 5. A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds. | ✓ | The lake regularly supports over 20,000 lesser flamingos. |

| | | |
|---|---|---|
| 6. A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbirds. | ✓ | The lake regularly supports over 1% of the total global population of lesser flamingos. |
| 7. A wetland should be considered internationally important if it supports a significant proportion of indigenous fish subspecies, species or families. | x | As it is a saline lake, Elmenteita supports very few fish species and does not meet this criterion. |
| 8. A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend. | x | Lake Elmenteita is not an important source of food for fishes or a nursery/spawning ground for fish stocks, and hence does not meet this criterion. |

Table 2 – Evaluation of Lake Elmenteita against the RAMSAR criteria

On the final day of the team, the Fellows gave a formal presentation to Anderson Koyo, Kenya's RAMSAR representative from Kenya Wildlife Service (the designated signatory body to the convention for Kenya), who was accompanied by Mr Robert Ndeti, from his office. This presentation outlined the findings of the research team and recommended that a submission to RAMSAR be prepared for Lake Elmenteita to be designated as a wetland of international importance. This presentation was well received and the team ended with an announcement from Anderson Koyo that this research strengthened previous monitoring undertaken by Kenya Wildlife Service. He left with the team a copy of a draft submission for Elmenteita as a Ramsar site that Kenya will make in the near future.

5. Outcomes

The outcomes of the Achieving Sustainable Lakes Earthwatch team were:

- 12 young conservationists from 7 African nations exchanged experiences of RAMSAR sites in Africa;
- Fellows learnt scientific research techniques replicable at their own sites to monitor chemical composition, algal diversity and biomass;
- Fellows gained experience of carrying out a baseline survey of birds, moths and flamingos;
- Fellows gained experience of presenting their research to important decision-makers;
- Fellows gained from cultural and inter-personal exchange;
- Fellows gained a greater understanding of the RAMSAR Convention, in particular:
 - The criteria for identifying wetlands of international importance
 - The obligations of a signatory nation to the Convention
 - How Kenya Wildlife Service have taken forward these obligations in Kenya as the designated institution for the implementation of the Convention;
- The designation of Lake Elmenteita as a RAMSAR site will be taken forward by Kenya Wildlife Service, using the results of the Earthwatch team's research to supplement existing data.

6. Evaluation

All participants were asked to complete an evaluation form on their return, which gathered both quantitative and qualitative data on the project experience (Table 3)

| Aspect of Project | Average Rating of Participants |
|--------------------------|---|
| | 1= very poor 2 = poor 3 = average 4 = good 5= excellent |
| Field Training | 4.6 |
| Team Experience | 4.6 |
| Overall Experience | 4.6 |
| Networking | 4.7 |
| Ramsar Presentations | 4.6 |
| Cultural Exchange | 4.0 |
| Personal Development | 4.7 |
| Professional Development | 4.7 |
| Benefits to Institution | 4.7 |

Table 3. Mean rating on questionnaire returns of the experiences

Qualitative feedback on the project experience included –

Networking:

- 'I realised from other fellows' presentations that, wetlands in Africa face almost the same threats. With exchange of ideas and concerted effort by all relevant institutions, the solutions to problems of one wetland can lead to the solution of several in other countries. Networking can help solve problems worldwide'.
- 'Networking with other African Ramsar conservationists and also the scientists was an excellent opportunity to learn from other people's views and experiences'.

Institutional Benefits:

- 'My being part of the expedition will benefit the management of the Ramsar site [where I work] because I will plough back what I have learnt, thereby improving the good management of the site'.
- 'I will be able to articulate the importance of Ramsar sites to stakeholders and the public in general'.
- 'There is much to use from participating in the project. The exposure will definitely enhance the handling of future responsibilities as regards Ramsar site management in my country as I am given the opportunity'.

Cultural Exchange:

- 'I think that conservation can only benefit by different people working together and sharing expertise and experiences'.

Personal Development:

- 'The Earthwatch Fellowship has been valuable to my personal development. I have improves my skill of working with people of different backgrounds and attitude of listening to other peoples' views'.

- 'Confidence is one major skill I acquired especially on the item of water sampling and determining flamingo food, measuring the alkalinity and conductivity of water'.

Professional Knowledge:

- 'The issues of community involvement in resources management would be applied for my organisation's work and we shall advocate for community management of natural resources with support from government instead of sole government management'.
- 'I would like to apply what I gain in working with communities. It is always difficult to deal with communities, to understand them and to work with them. But I have since learnt that you need to understand them, their way of dealing with things and what they appreciate before you give them your suggestions'.

23. Appendix IX: Agenda for Darwin Workshop, November 2006, Nairobi