

INTEGRATED ASSESSMENT OF PASTORAL - WILDLIFE INTERACTIONS IN EAST AFRICA

NARRATIVE SUMMARY

This report covers two grants received in 2001. First, we received an Assessment Team grant in early 2001 to organize a collaborative team and develop a proposal for submission to the GL-CRSP. Secondly, we were awarded a GL-CRSP research grant beginning 1 July 2001. The AT activities took place early in 2001; those activities are reviewed briefly in this report. However, most of the report reviews activities carried out under the GL-CRSP research grant during the period of July 1, 2001-September 30, 2001.

The Assessment Team activities were aimed at greater involvement of East African scientists, managers and stakeholders, to assure that their concerns about pastoral-wildlife interactions would be addressed in the new phase of the GL-CRSP project.

Once we received a new GL-CRSP grant, an extensive planning exercise was undertaken to meet with East African agency, university, and local community collaborators in order to develop more fully the Integrated Assessment agenda for each study area. The information gathered during these meetings contributed directly to the development of project work plans and specific questions/scenarios to be explored in the project's focal areas over the next year.

Research activities conducted during the three-month period were limited. Intensive Integrated Assessment for the Ngorongoro Conservation Area (NCA), Tanzania, commenced with the visit to the NREL by Victor Runyoro, Director for Research and

Planning, NCAA. During July-September, we reviewed the status of NCA modeling progress from the first phase of the project and prepared new materials. Progress in model development included SAVANNA modification to communicate with an economic-oriented mathematical programming model aimed at identifying optimal solutions to management questions facing pastoralists.

Field research on Maasai land use and affects on wildlife and the ecosystem was continued by NREL graduate student Jeff Worden. Progress was made on: 1) data collection and analyses of abandoned settlement sites; 2) site selection for vegetation transects; and 3) woody vegetation sampling.

RESEARCH

Problem Statement. As human populations grow and land use intensifies, options for pastoralist-livestock land use and wildlife conservation are reduced and conflicts are intensified. Different patterns of land use (extensive pastoralism, mixed agro-pastoralism, intensive agro-pastoralism, irrigated agriculture within rangelands, etc.) and/or different pathways to development have alternative implications for the future. There is a need to determine how land use policies and patterns will influence wildlife density and diversity, livestock production and health, ecosystem state, and human economic status. There is also a need to promote decisions which optimize positive outcomes for people and wildlife.

We have initiated a demand-driven collaborative program aimed at: 1) identifying critical problems at the pastoralist-livestock-wildlife interface; 2) developing Integrated Assessments to address those problems; and 3) defining the probable outcomes of alternative policies, practices, and decisions and their effects on people, livestock, and wildlife. Our research focuses on assessments at local (site-specific) and regional levels.

Assessment Team Formation and Activities (January-April, 2001)

Progress. The formation of the Assessment Team and its actions, January through April 2001, were aimed at greater involvement of East African scientists, managers and stakeholders, to assure that their concerns about pastoral-wildlife interactions would be addressed in the new phase of the project. This affirmed that the project would be demand-driven and that specific applications addressed in the problem model were determined by East African scientists, institutions and stakeholders. By working directly with our East African team members and partner organizations, they obtained ownership of the process of problem model development. The project team thus formed a broad multi-institutional problem-solving group, not an external advisory group trying to push a specific agenda on the partner organizations.

The problem model and specific research goals were identified and prioritized by East African project team members, collaborators and institutional representatives during the Assessment Team period. The problem model and sites were selected through an iterative process that first involved querying Phase I team members to get suggestions for Phase II. Secondly, these ideas were presented to approximately 40 East African collaborators and institutional representatives, during visits by M.

Coughenour to Tanzania and Kenya in February 2001. Thirdly, responses obtained by Coughenour were synthesized by the project team and presented at a workshop convened by Ellis and Reid in Nairobi, and attended by 35 collaborators in March, 2001. Prior to the Nairobi workshop, a series of five one-day stakeholder workshops was held with Maasai pastoral groups in southern Kenya. The purpose of these workshops was to solicit pastoral viewpoints on priority problems that project research should address. Representatives of the stakeholder groups were invited to the Nairobi workshop. Participants at the Nairobi workshop selected and prioritized problems to be emphasized and defined objectives to be pursued, during the second phase of the project. Institutional representatives designated where they were willing to become project partners, and how the partnerships could be implemented. The results of the Nairobi AT workshop formed the basis for the successful research proposal submitted to the GL-CRSP Management Entity in April of 2001.

GL-CRSP Project Activities (July 1-September 30, 2001)

Progress. Although the time period under consideration covered only three months, the project team was active in several areas. Planning for the new GL-CRSP two-year grant took precedence during this 3-month period, however the team also continued ongoing research, initiated new research, conducted community outreach activities, developed publications and carried out numerous administrative activities associated with USAID / GL-CRSP requirements. Research categories include: integrated assessment, model development, field research, regional analysis and literature-based research.

Activity One Planning

Planning activities consisted of a series of meetings held in East Africa in August. The goal of these meetings was to meet with agency, university and local community collaborators in order to develop more fully the Integrated Assessment agenda for each study area. The information gathered during these meetings contributed directly to the development of project work plans and specific questions/scenarios to be explored in project's focal areas over the next year. Meetings took place in Ngorongoro Conservation Area, Tanzania and Arusha Tanzania, for the Tarangire/Manyara Ecosystem; and in Nairobi, Kenya for Meru National Park and for the Kajiado District Group Ranches in Kenya. The attendees at the Project Planning Meetings (including title and organizational affiliation) are listed below.

Meru National Park Meeting (August 7, 2001) @ ILRI Headquarters, Nairobi: J. Kinyamario (Kenya PI, GL-CRSP project, and Meru Project Leader- Chairman/Professor in the Dept. of Botany, University of Nairobi); John Mworira (PhD Student, University of Nairobi); G. Olukoye (PhD Student, Kenyatta University); W. Mutero (GIS Specialist, Kenya Wildlife Service); W. Otichillo (Director, RCMRD); J. Ellis (Lead Principal Investigator (PI), NREL-CSU); K. Galvin (NREL-CSU); S. BurnSilver (Project Manager, NREL-CSU); J. Worden (PhD Student NREL-CSU, ILRI Graduate Student Fellow).

Kajiado Group Ranches Meeting (August 16, 2001) @ ILRI Headquarters, Nairobi: J. Kinyamario (Kenya PI; GL-CRSP project-Chairman/Professor in the Dept. of Botany, University of Nairobi); J. Mworira, W. Ekaya (PhD students, University of Nairobi); J. Gathua (Researcher, Department of Remote Sensing, Resource Surveys); E. Muthiani (KARI-Kiboko, ILRI); J. Wandera (Land Use Planning Coordinator, SARDEP- Kajiado); P. Rwambo

(Veterinarian, Biosystems); H. Cheruiyot (Director, Kenyan Agricultural Research Institute); J. Grootenhuis (Veterinarian, Veterinaires sans Frontieres); J. Njoka (Professor Range Science Department, University of Nairobi); S. Mbogoh (Agricultural Economist/ Professor, University of Nairobi); J. Ndathi Mwai (Environmental Conservation Dept.- M.E.N.R.); J. Worden (PhD Student NREL-CSU, ILRI Graduate Student Fellow); S. Lemiruni, J. Mayiani (Project Research Assistants- J. Worden); R. Supeet (Project Research Assistant- S. BurnSilver); T. Kasaine (Secretary- Eselenkei Group Ranch (GR)); E. Kesoi (Treasurer- Eselenkei GR); S. Kotoke (Chairman- Imbirikani GR); J. Likampa (Treasurer- Imbirikani GR); L. Partimo (Treasurer- Olgulului GR); K. Seleka (Chairman- Olgulului GR); J. Leyian (Chairman- Amboseli Tsavo Group Ranch Conservation Association (ATGRCA)/ Chairman- Eselenkei GR); J. Kilitia (Secretary ATGRCA/ Secretary- Imbirikani GR); J. Ellis, K. Galvin (NREL- CSU); S. BurnSilver (Project Manager, NREL-CSU).

Ngorongoro Conservation Area Meeting (August 21, 2001) @ NCAA Headquarters/ Ngorongoro Cons. Area, Tanzania: V. Runyoro (Principle Ecologist, Ngorongoro Conservation Area Authority); Angelo Mwilawa (Livestock Research Scientist, Livestock Production Research Institute); Allan Kijazi (Tanzanian PI, GL-CRSP, African Wildlife Foundation); Patricia Moehlman (Biologist, IUCN/SSC-Equid Specialist Group); J. Ellis (Lead PI, NREL-CSU); S. BurnSilver (Project Manager, NREL-CSU).

Tarangire/Manyara Ecosystem Meeting (August 23, 2001) @ AWF Headquarters/ Arusha, Tanzania: E. Gereta (Ecologist, Tanzanian National Parks); A. Kijazi (Tanzanian PI, GL-CRSP, African Wildlife Foundation); P. Moehlman (Biologist, IUCN/SSC-Equid Specialist Group); L. Lynen (Consultant,

Veterinary Investigative Center- Arusha); J. Ellis (Lead PI, NREL-CSU); S. BurnSilver (Project Manager, NREL-CSU)

Meru National Park Meeting. Meru National Park and the adjacent conservation reserves and National Parks including Kora N.P., North Kitui N.R., Basanadi N.R. and Rahole N.R. experienced a prolonged period of insecurity during the 1970's and 80's, resulting in a breakdown of the park's management systems, the loss of resident populations of mega-fauna and a virtual collapse of tourism in the area. Now, with an improved security situation, KWS has identified the rehabilitation of Meru N.P. and the Greater Meru Ecosystem (GME) as one of its urgent priorities, and has embarked on a program to restore the park ecologically and re-establish the tourism base. Recently, KWS has translocated populations of some wildlife species into Meru N.P. Discussions during the meeting highlighted a variety of key issues that will be crucial to the successful management and development of this area. With improvements in security, human populations have increased dramatically at the boundaries of the parks and reserves (e.g. agro-pastoralists and farmers to the East and South, and Borana pastoralists to the North). There are likely to be increasing conflicts both between wildlife and agriculturalists, and competition between pastoral livestock and wildlife for water and forage in the dry season within and near the margins of these protected areas.

Attendees at the meeting made significant progress in identifying extant data sources for the GME on land use types, and the wildlife, human and livestock components of this system. Significant gaps in existing data sources were also identified. Development of GIS data layers (soils, vegetation and land use types), accessing remote sensing images and identifying wildlife distribution patterns and abundance will be important activities for the project team in the

near future.

As a follow up to these meetings a planning visit to Meru National Park (MNP) took place between August 19 and 23, 2001, by Jenesio Kinyamario (Kenya PI-GL-CRSP/University of Nairobi), Jeff Worden (GL-CRSP doctoral student), Richard Bagine (Deputy Director, Research and Planning - KWS), and Jim Else (Tufts University). The group met with Mark Jenkins (Senior Warden, MNP), Adan Hokile Kala (Community Warden, KWS) and Timothy Marangu (Botanist Technician, MNP), as well as representatives of the Borana pastoral community to the area north of the Park boundary. The visit reviewed and recommended in detail research and monitoring activities that will be needed for the rehabilitation of the Greater Meru Ecosystem and discussed potential questions that could be addressed through the application of Integrated Assessment techniques. The working group has identified the existence of some minimal data from MNP and other stakeholders on land use and vegetation biomass within and around MNP. More baseline data will be needed for use in the integrated assessments. Additional debriefing meetings occurred between Colorado-based GL-CRSP team members J. Ellis and S. BurnSilver, and Kenya-based team members, J. Kinyamario, J. Worden, and J. Else upon their return from the Meru area.

Field Trip to Kajiado. Prior to the meeting at ILRI on August 16th, S. BurnSilver and J. Worden traveled to Kajiado District in order to contact representatives of four Maasai Group Ranches within which project researchers had concentrated their work previously. The group ranches of Olgulului/Lolarashi, Imbirikani, Eselenkei, and Osilalei had communicated their interest in continuing to work with the GL-CRSP during Phase II of the project, and this trip was another step in cementing significant ongoing participation by Maasai pastoralists

within the project. S. BurnSilver also contacted the Amboseli-Tsavo Group Ranch Conservation Association (ATGRCA), a coalition of representatives from 7 Maasai Group Ranches in the area around Amboseli National Park, which is working to represent Maasai conservation and development interests in the area. Representatives from the group ranches and ATGRCA were invited to attend the project meeting in Nairobi, in order to contribute actively to the process of prioritising project activities in the Kajiado area. Osilalei Group Ranch representatives could not attend the meeting in Nairobi, but Imbirikani, Eselenkei and Olgulului/Lolarashi GR's and ATGRCA sent representatives to attend.

Kajiado District Group Ranches. This meeting at ILRI had three goals: 1) Discussion of project research carried out previously in Kajiado District by GL-CRSP team members, with a view as to what this research suggests regarding the potential activities and future focus of project activities during phase II; 2) a focused discussion of significant land use issues and the people-wildlife-livestock interface in Kajiado group ranches; and 3) establishing a timeline for GL-CRSP activities and communication to occur in the short-term.

Kajiado District, Kenya exemplifies the implications of ecosystem fragmentation for a pastoral society and for wildlife conservation. The group ranches closest to Amboseli National Park have not yet been sub-divided, and these areas are therefore of key importance in terms of wildlife conservation. Yet, while pastoralists have co-existed with wildlife historically, a situation exists currently where they perceive they are bearing significant negative costs of wildlife and receiving few or no compensatory benefits in return. In this situation sub-division seems like a viable alternative to conservation, offering the opportunity for increasing the benefits from pastoral lands accruing directly to

individual households. The potential economic and ecological results of sub-division are under debate, but representatives from the group ranches stated there is little useful information available to assist group ranch members in the decision-making process. Local communities are actively posing questions about the potential effects of sub-division and land use change on pastoral production strategies and ecosystem integrity. A comment was made by a representative in the meeting that, "No one is preparing these GR's for their future"—if that future does indeed include sub-division. There is an important role for the GL-CRSP in Phase II to play in evaluating alternative land use outcomes in a realistic way, in order that pastoralists can access and use this information in making future land use decisions.

Discussions occurred between project researchers and group ranch representatives regarding the potential benefits of research, concluding that research is only beneficial if results are communicated. Consequently, the group discussed methods to ensure that research results are transferred systematically to community members by project researchers. Discussion also focused on ways in which the GL-CRSP could use IA methodology to explore the trade-offs between different types of sub-division, the spatial and economic components of wildlife-livestock conflicts, and the economic and ecological benefits/costs of alternative land use options within the Amboseli area.

Additional follow-up meetings with collaborators took place after the Kajiado meeting. J. Ellis, S. BurnSilver and J. Worden met with P. Thornton (ILRI- Kajiado Project Leader) to discuss prioritising activities for the Kajiado area. S. BurnSilver and P. Thornton met with J. Wandera (SARDEP) in order to explore points of similarity between the GL-CRSP Integrated Assessment approach and SARDEP's current efforts to outline future scenarios for pastoralism in Kajiado District.

Ngorongoro Conservation Area. The GL-CRSP project made significant progress in applying IA methodology to the Ngorongoro Conservation Area during Phase I of the project. Subsequently, the goals of the recent meeting held in the NCAA were to: 1) identify further scenarios and assessments which would be useful both to the policy needs of the NCAA and resident population of Maasai pastoralists, and 2) further evaluate the spatial and modelling parameters which were used as a basis for previous assessments.

Recent communications with Tanzanian government and NCAA officials indicate that significant changes in policy vis a vis cultivation allowances within the Ngorongoro Conservation Area may be imminent. Discussions at the NCA meeting highlighted that Integrated Assessment activities could be extremely powerful in illustrating the trade-off effects of disallowing cultivation on pastoral welfare, resident wildlife populations and ecosystem function. The question was asked: “If cultivation is banned, what would be alternatives for increasing livestock production levels as compensation for pastoralists?” Potential options include decreasing livestock mortality from wildlife-transmitted diseases through increased veterinary services, and increasing levels of market offtake by pastoralists. Development of IA scenarios to illustrate potential effects of veterinary programs and increased economic benefits for pastoralists through market development was discussed. It was decided that the issue of carrying capacity will be important within the scenarios under discussion. The modelling parameters underlying carrying capacity within SAVANNA will need to be revisited, and further defined. Similarly, a better spatial representation of human settlement and cultivation patterns is necessary within these new IA scenarios.

After the NCA meeting, J. Ellis and S. BurnSilver met with C. Sorensen from the NGO “ERETO” to discuss general progress within the

project. The ERETO organization has very strong contacts with local pastoral communities, and discussion focused on ways to communicate GL-CRSP IA activities to local pastoralists, and solicit local input on the land use and policy scenarios which would be most relevant to them.

Tarangire/Manyara Ecosystem. The Tarangire/Manyara Ecosystem is a new project area for the GL-CRSP. Consequently, the meeting had three goals: 1) Further identification of issues and problems for the area, 2) Description of currently existing databases and work in progress within the project area, and 3) Discussion of GL-CRSP project team member roles.

Discussions regarding the human-livestock-wildlife interface within the Tarangire/Manyara Ecosystem revealed a complex overlay of land use issues and conflicts. Crucial land use issues in the project area include; endangered wildlife corridors and movement patterns out of and between Tarangire and Lake Manyara National Parks, increasing human population pressure, growing areas of agriculture, associated fragmentation of pastoral grazing lands, and conflicts between hunting and photographic tourism in pastoral and agropastoral areas around the edges of the parks. There also seems to be significant confusion and concern among local pastoral populations regarding the potential effects of the new Wildlife Management Areas (WMA's) on their ability to manage local natural resources and tourism activities.

Attendees at the meeting put together a list of published data sources relating to the Tarangire/Manyara ecosystem, as well as identified the location of existing spatial data layers on vegetation, soils and precipitation. Significant discussion time was given over to identifying gaps in existing data, and assigning tasks necessary to beginning a process of synthesizing all extant data sources into a format useful for integrated assessment activities.

Activity Two: Research

The second phase of the GL-CRSP project will build on the progress and successes of the first phase. The main research objective of phase two involves the application of integrated assessment technology to policy-related issues at the interface of conservation and pastoral development. Integrated assessment includes field research, spatial analysis and simulation model analysis, among other things. The GL-CRSP team conducted research in these and other categories.

Integrated Assessment Through Model Simulation. Ecological modeling under the GL-CRSP initiative for the Ngorongoro Conservation Area (NCA), Tanzania, intensified in October 2001, with the visit to the NREL by Victor Runyoro, Director for Research and Planning, NCAA. Runyoro spent approximately two weeks at the NREL, during which the GL-CRSP team devoted near full-time to perfecting our IA approach to policy-related and carrying capacity issues at NCA. Prior to October, (July-September) R. Boone reviewed the status of NCA modeling progress from the first phase of the GL-CRSP project, and prepared new materials for advancing our current objectives and model implementation. We reviewed spatial databases for the NCA, identifying layers that need improvement. During this period, Boone visited ILRI in Nairobi, to discuss GL-CRSP objectives and plans. As a result Boone, in cooperation with Thornton, modified the SAVANNA modeling system to be able to communicate with an economic-oriented mathematical programming model, aimed at identifying optimal solutions to management questions facing pastoralists. Research on carrying capacity concepts and calculations was conducted at NREL to refine our approaches to calculate the number of livestock, wildlife, and humans that may be

supported at the NCA. The NCA Integrated Assessment serves as a demonstration 'centerpiece' for the GL-CRSP project, and will be used in demonstrations for Kenyan and Tanzanian managers and policy-makers early in 2002.

Database development for Integrated Assessment has been provided through a livestock production system mapping activity for East Africa, carried out by the GL-CRSP team at ILRI. This has been linked to information on the location and characterization of poor livestock keepers for Kenya, and further work through other projects will enhance this database for Tanzania and Uganda. These databases can provide information on what is essentially the "recommendation domain" for project activities, in terms of human populations, household characteristics, natural resource inventories, and market infrastructure, and how these may change in the future as a result of increasing human population and climate change.

Model Development. The linking of the Savanna ecosystem model to a mathematical programming package, XPRESS-MP, was carried out. This involved only a few changes to the code of Savanna, but the entire exercise has been very useful as a "proof of concept". It means that in the future, it will be possible to use Savanna routinely in resource optimization problems. This is of direct relevance for agro-pastoral systems that are more connected to the market economy, where there are needs to optimize the use of land, labour and/or capital at both household and community levels. This initial work has involved a very simple household model, but this will be made more complex and realistic in the future.

Field Research. Field research on Maasai land use and effects on wildlife and the ecosystem was continued by NREL graduate student Jeff Worden, with joint funding from

GL-CRSP and an NSF pre-doctoral fellowship. Worden's goals for field work during the period in question included 1) enter data and begin analyses of abandoned settlement; 2) site selection for vegetation transects; and 3) woody vegetation sampling.

Worden initiated data processing to stratify abandoned settlement sites in Kajiado for subsequent vegetation sampling. Over 400 abandoned settlement sites in 3 locations – Selengei, Lengesim, Lkarat were identified. At each site, data were recorded on slope, aspect, diameter, and history – including numbers of livestock, and years of settlement and occupation. These data were then used to identify a set of sites in each of five age classes spread between two different intensities (number of cattle x total number of months occupied). The initial group of abandoned settlement sites (n=431) was narrowed to include only those sites that met the following criteria:

- 1) Relative soil homogeneity
- 2) not burned
- 3) not resettled
- 4) permanent rather than temporary settlements (in this case occupied for >6 months per year)

The new set (n=248) provided the basis for a detailed field assessment. Each potential site was visited and local informants interviewed to confirm and cross-check site history and physical/ecological characteristics. The most important variables used to select sites are soil homogeneity, landscape position relative to other sites, and activity level. Sites in low run-on areas and flood plains as well as those found in areas of high soil heterogeneity were discarded. Work by Western and Dunne, Young et al., and Muchiru et al. on abandoned settlement sites suggest that the impact of a settlement extends to 150m, so all sites within 200m of another site will be removed from the sample. Initial assessment reveals that activity level is another significant component potentially influencing

both on and off-site vegetation. With this in mind, all sites are ranked based on the degree of current human impact unrelated to the condition of the site, during its initial occupation or subsequent abandonment. This field assessment will identify a final set of sites. These sites will be divided into 5 age classes (years since abandonment):

- 1 = 1 to 9 years
- 2 = 10 to 19 years
- 3 = 20 to 29 years
- 4 = 30 to 39 years
- 5 = 40 plus years

and two intensity classes, High and Low intensity (the ranges will be established from those found in the final set).

Sites will be selected so that each age class is represented over the entire study area. Sites for intensive vegetation sampling will be randomly selected from each of the 5 age classes by intensity. We will sample 60 sites for herbaceous and woody vegetation composition, structure and biomass following the rains in October.

One of the primary goals of this research is to document the large scale changes in settlement pattern across three Group Ranches (Eselenkei, Osilalei, and Olguliluli/Lolarashi). This detailed survey of abandoned sites will be coupled with an aerial photo analysis and interview data from local informants to reconstruct movement and settlement patterns since the 1950s. Early evidence from interviews with elders in each of the study areas suggests that grazing and settlement patterns have changed dramatically. Group Ranch policy now dictates where individuals can settle (or where they cannot) and when certain areas are open for grazing. It appears that the overall system has shifted from one of dry season congregation at permanent water sources and wet season dispersal into areas with only seasonal water sources, to one of wet season congregation at permanent water (pipeline, wells, and boreholes)

and dry season dispersal into protected grazing areas. Whether this is a result of an increasing human population or the development of new water sources (or both) is less clear, but the implications for livestock productivity and landscape level vegetation patterns due to an altered disturbance regime may be significant. An aerial photo analysis will be conducted following the completion of this field season in January.

Regional Analysis. The GL-CRSP team at ILRI (Atieno, Waweru, Muchiru and Reid) initiated a regional analysis of current hotspots of land-use and settlement in pastoral ecosystems of northern Tanzania and southern Kenya. The analysis began with a fine-scale analysis of landscapes that are well known to the team: Amboseli and the Mara. From July to Sept, 2001, the team developed a set of training sites for the analysis and verified the training sites for the Mara site. These 'test landscapes' will be used to develop a reliable set of spectral signatures for current and old Maasai bomas, smallholder crop farming, villages, and large-scale commercial farming. By the end of 2001, these training sites will be used to classify a mosaic of Landsat images for Maasailand. In 2002, the computer classification will be validated on the ground.

As part of the regional analyses for the project, Joyce Acen is finalizing plans to conduct a regional evaluation of the wildlife protected area network for adequacy both to conserve representative wild herbivores in areas used for pastoral livestock grazing, or surrounded by pastoral areas. The main objectives of the study are 1) to predict the potential distribution of wildlife and livestock on the landscape; 2) identify and map the distribution of unprotected or inadequately protected wildlife species and communities; 3) assess the connectivity of habitats and corridors for seasonal migratory wildlife and seasonal livestock movements;

4) assess impacts of surrounding land use type and intensity on the protected areas; and 5) evaluate the impact of future scenarios of land use and management on the maintenance of habitat suitability for wildlife and livestock.

These analyses will be performed at three nested scales: at a coarse regional scale covering Kenya, Tanzania and Uganda, at intermediate scale in the Kenya-Tanzania cross-border region, and at fine resolution in Tarangire-Manyara ecosystem. During the reporting period, research proposal development and the compilation of species-habitat association data from published literature were initiated, and available spatial baseline data sources were documented.

Literature-Based Research. An extensive literature review was of community-based conservation activities and the implementation of the proposed Wildlife Management Areas in Tanzania was conducted by J.T.McCabe and his students. The literature consisted of articles and books published by mainstream presses and reports and accounts found in the grey literature. The results of this review will 1) summarize work done by researchers and non-governmental organizations working in the northern Tanzanian region; identify individuals and groups that should be contacted, and highlight subject areas where the GL-CRSP team can make important contributions. It will serve as a point of departure for research and integrated assessment in the Tarangire-Manyara Ecosystem.

GENDER

This project has a good balance of female scientists. All but one of our current graduate students are female, including J.Acen, S. Lynn, J Pinho, and several senior investigators are women (Galvin, Reid, Moehlman, BurnSilver). Gender issues, such as access to resources and decision-making roles, are routinely addressed

in our socio-economic surveys. Effects of gender bias on economic and development status of women are topics of research in some of our analyses. Pinho's research addresses gender differences in Maasai attitudes toward wildlife and livestock-wildlife interactions.

POLICY

The Integrated Assessment applications that we plan are very directly policy-oriented (NCA IA application, Kajiado IA application, Tarangire IA application Meru Ecosystem IA application). In these situations, contentious issues having to do with land use and conservation policy are under review and policies are very likely to be changed. Our IA applications have an excellent opportunity to enlighten policy makers about the probable outcomes of their alternative policy choices. Some of these applications are also management-oriented (Meru). In these cases, policies may also be influenced by weighing the results of the IAs and the implications for development and conservation policy, nation-wide.

COMMUNITY OUTREACH

Prior to the Nairobi AT workshop in March, a series of five one-day stakeholder workshops was held with representatives of the four Kajiado Maasai Group Ranches where S. BurnSilver and J. Worden carried out their PhD. research, and where the GL-CRSP project has continued to focus the project's Integrated Assessment activities (Eselenkei, Olgulului/Lolarashi, Imbirikani and Osilalei). The purpose of these workshops was two-fold; 1) to present preliminary results from the socio-economic research carried out by S. BurnSilver, and 2) to solicit community viewpoints on priority problems that future GL-CRSP research should emphasize. Community members repeatedly commented during these workshops that this

was the first time in their memory that research results had been communicated directly to "pastoralists" themselves. Elected committee members from each group ranch also were invited to the Nairobi AT workshop. The subsequent participation of pastoral stakeholders in these meetings contributed significantly to the direction of Integrated Assessment activities adopted in Phase II of the GL-CRSP.

The analysis of the interactions between people, livestock and wildlife in the Mara ecosystem was completed and presented to stakeholders and community members through community and individual meetings. The communities in the Mara described these meetings as the 'first-ever' interaction between researchers and communities. The GL-CRSP team at ILRI discussed upcoming research with the communities and used their feedback to revise hypotheses and research plans.

As part of the GL-CRSP Assessment Team, Boone developed materials that demonstrated the ecological modelling and Integrated Assessment approaches used in the project. These materials were provided to team members travelling in East Africa, to inform potential collaborators about GL-CRSP activities. A brochure was prepared that was used by Assessment Team members to inform project collaborators and potential participants at workshops and in other forums of our GL-CRSP goals and methods.

DEVELOPMENT IMPACT

Our Integrated Assessment approach was developed to address issues of conflict and complementarity between conservation and livestock development in arid and semi-arid portions of East Africa, where wildlife and pastoralists had traditionally shared the ecosystem. GL-CRSP support provided an opportunity to begin to apply models and other aspects of integrated assessment to livestock

development-related problems. These technologies have, heretofore, been used only to a limited extent in this sort of development context. Our development-relevant goals are to assist pastoral people, policy-makers and agencies to weigh alternative development and conservation strategies before implementing problematic development or conservation policies or procedures. As a result of work and demonstrations carried out in the first phase of our GL-CRSP project, and due to our outreach and communication activities, we have been asked by conservation agencies (i.e., NCAA), wildlife, land and conservation management agencies (i.e., KWS) and pastoral people (i.e., Amboseli-Tsavo Group Ranch Conservation Association) in East Africa to assist them in development planning, using integrated assessment. As we continue with these applications the results will benefit the host countries in terms of development and conservation planning and policy analysis. The project has a large team which has the net result of creating multiple linkages with numerous agencies and institutions in East Africa. IARC collaboration is through ILRI, our primary collaborator.

OTHER CONTRIBUTIONS

Support for free markets and economic growth. Our IA assessments demonstrate (and therefore support) the need for broader market involvement of pastoral peoples and for the growth of national economies of East African countries, in order to improve both human economic welfare and environmental sustainability.

Concern for individuals. The GL-CRSP Integrated Assessments are focused on household level actions and impacts. Therefore the project promotes concern for individuals.

Support for democracy. Project activities involve stakeholder input and responses, therefore promoting linkages within East African societies between stakeholders and policy-makers, a cornerstone function of democracy.

LEVERAGED FUNDS AND LINKED PROJECTS

The following projects contributed leveraged funds to the project during the period July 1-Sept 30, 2001:

U S D I / U S G S / B R D - P I : M i k e Coughenour: "Spatial Ecosystem Modeling of Yellowstone Bison and the Environment". Total Award \$ 113,034. Project Period; 6/97-5/02. Project uses SAVANNA Ecosystem Model to model interactions between bison populations and vegetation in Yellowstone N.P. Model parameterization and testing in this case contribute to GL- CRSP modeling activities in East African Sites.

EPA/STAR- PI: Mike Coughenour: "Assessing the Consequences of Climate Change for a National Park and its Gateway: Interactions of multiple stressors". Total Award \$ 894,846. Project Period, 10/99-9/02. Project uses SAVANNA Ecosystem Model to model the affects of climate on vegetation and herbivore populations. Model parameterization and testing in this case contribute to GL-CRSP modeling activities in East African Sites.

University of Alaska/NSF- PI: Mike Coughenour: "Modeling Spatial Plant-Geese Interactions in the Yukon Delta" Total Award \$ 314,403. Project Period 6/00-5/05. Project uses SAVANNA Ecosystem Model. Model parameterization and testing in this case contribute to GL-CRSP modeling activities in East African Sites.

NOAA Office of Economics and Human Dimensions of Climate Fluctuation- PI: Kathleen Galvin: "Responses to Climate Variability and Utility of Climate Forecast Information for the Livestock Sector in Arid and

Semi-Arid Zones, South Africa” Total Award \$358,914. Project Period 7/98-7/02. P. Thornton developed a model to identify the impact of climate variability on household economy. Both Thornton (ILRI) and R. Boone (NREL/CSU) linked the household model to the SAVANNA ecosystem model. Funds from the NOAA grant were leveraged to the GL-CRSP to help P. Thornton and R. Boone link the SAVANNA and PHEWS models for applications to the NCA and Kajiado GL-CRSP sites.

NSF Dissertation Improvement Grant.- PhD student: Jeff Worden: “Maasai Settlement, Landscape Mosaics, and the Spatial Patterning of Vegetation and Wildlife in East Africa”. Total Award, \$20,000. Project Period, 5/01-10/02. The PhD research of J. Worden is funded through a combination of GL-CRSP and NSF funds. Funds leveraged to the GL-CRSP through NSF have increased the scope of J. Worden’s PhD research project.

People, Livestock, Environment Program Funds and ILRI Core Funds- Program Head: Robin Reid. Multiple Project Activities under the general project heading of “Land-Use and Settlement Patterns in Pastoral Ecosystems of Northern Tanzania and Southern Kenya”. The following research activities were leveraged; Salary for project supervision for R. Reid, travel funds and costs of community workshops in the Mara, the salary of biometrician to assist both A. Muchiru and F. Atieno in data analyses, and overhead costs of GL-CRSP activities not covered by GL-CRSP funds. Amount Leveraged, \$3,500.

Government of Finland- PI: Robin Reid/ILRI Associate professional officer (Finnish): Funds supported activities under general project heading of “Land-Use and Settlement Patterns in Pastoral Ecosystems of Northern Tanzania and Southern Kenya”. Leveraged funds supported the salary of an ILRI associate professional officer, contributing to a ground truthing

exercise in Amboseli (Kajiado project area) and the Mara. Amount Leveraged, \$2,000.

Swedish International Development Agency (SIDA) grant to ILRI- PI: Robin Reid/ILRI Post Doc: Funds supported activities under general project heading of “Land-Use and Settlement Patterns in Pastoral Ecosystems of Northern Tanzania and Southern Kenya.” Leveraged funds supported the salary of an ILRI Post Doc, contributing to ground-truthing land use types and community workshops in Kajiado and the Mara. Amount Leveraged, \$2,000

University of Nairobi- J. Njoka/F. Atieno: “Landscape Change Patterns, Land Use and Environmental Diversity in Kenyan Rangelands: The Case of Greater Amboseli Ecosystem 1988-1998” Leveraged funds from the University of Nairobi contributed to the salary of J. Njoka to support collaborative work on the research paper of F. Atieno (ILRI). Amount Leveraged, \$500.

Unknown Donor- D. Western/A. Muchiru: “The role of abandoned Maasai settlements on dynamics of savanna vegetation and soils, Amboseli, Kenya” Leveraged funds from an unknown donor contributed to the salary of D. Western to support work on the research paper of A. Muchiru (ILRI). Amount Leveraged, \$500.

SAIA- PI: R. Reid/R. Kruska - Funds supported activities under general project heading of “Land-Use and Settlement Patterns in Pastoral Ecosystems of Northern Tanzania and Southern Kenya” Leveraged funds provided a salary for R. Kruska (ILRI) to oversee the research activities of M. Waweru, F. Atieno, and Oderu. Amount Leveraged, \$2,500.

DFID- PI: Phillip Thornton: “Poverty and Livestock Mapping” Leveraged funds supported 1 month of salary for an ILRI research technician working on spatial poverty database for East African region. Amount Leveraged, \$1,500.

TRAINING

In Progress

- J. Acen (Ugandan) PhD student; degree date 2003; Ecology; Colorado State University.
- J. Worden PhD student; degree date 2002: Ecology; Colorado State University.
- S. Lynn .PhD student; degree date 2003; Ecology; Colorado State University.
- J. de Pinho PhD student; degree date 2003; Ecology; Colorado State University.

We anticipate training two to four more East African degree seekers as the project moves along.

Completed

No degree training was completed during the period July-Sept. 2001. However four graduate degrees were obtained as a result of the first phase of our GL-CRSP program.

Short Term

During the period July1 through Sept 30, 2001, a series of planning meetings was held in each of the four project focal areas of the GL-CRSP. Discussions took place which contributed to the development of subsequent project workplans. However, there was also a significant training component to these meetings, as project collaborators and stakeholders were engaged in a process of thinking about land use issues and the alternative managment and policy scenarios which were relevant to each project area. The goals of these meetings/workshops were to discuss the Integrated Assessment methodology, identify land use questions in each project area ammenable to the application of GL-CRSP methodology, and to discuss existing databases of information relating to these questions. Please

see section on Planning Activities for more detailed information.

COLLABORATING PERSONNEL

United States

- J. Else (Professor of Veterinary Science, Tufts University)
- T. McCabe (Associate Professor, Institute of Behavioral Science, University of Colorado)
- J. DeMartini (Veterinarian, Department of Pathology, Colorado State University)
- M. Coughenour (Principal Investigator, Senior Research Scientist NREL- CSU)
- J. Ellis (Lead Principal Investigator, Senior Research Scientist NREL- CSU)
- K. Galvin (Senior Research Scientist, NREL- CSU)
- R. Boone (Post-Doc, NREL-CSU)
- S. BurnSilver (Project Manager, Research Associate, NREL-CSU)

Kenya

- R. Reid (Program Director- People Livestock and the Environment, ILRI)
- P. Thornton (Programme Co-ordinator, Systems Analysis and Impact Assessment)
- J. Kinyamario (Kenya PI, GL-CRSP project, and Meru Project Leader Chairman/ Professor in the Dept. of Botany, University of Nairobi)
- John Mworira (PhD Student, University of Nairobi)
- G. Olukoye (PhD Student, Kenyatta University)
- W. Mutero (GIS Specialist, Kenya Wildlife Service)
- P. Mulama (Spatial Analyst, KWS)
- R. Bagine (KWS, Director of Research)
- N. Georiadis (Ecologist/Researcher, M'pala Research Center)

Ole Kamuaru (Ministry of the Environment, Kenya)
W. Otichillo (Director, RCMRD)
J. Gathua (Researcher, Department of Remote Sensing, Resource Surveys)
C. Situma (Spatial Analyst, DRSRS)
J. Wandera (Land Use Planning Coordinator, SARDEP- Kajiado)
P. Rwambo (Veterinarian, Biosystems)
H. Cheruiyot (Director, Kenyan Agricultural Research Institute)
J. Grootenhuis (Veterinarian, Veterinaires sans Frontieres)
J. Njoka (Professor Range Science Department, University of Nairobi)
S. Mbogoh (Agricultural Economist/Professor, University of Nairobi)
J. Ndathi Mwai (Environmental Conservation Dept.- M.E.N.R.)
D. Western (Ecologist, African Conservation Center)
T. Kasaine (Secretary- Eselenkei Group Ranch (GR))
E. Kesoi (Treasurer- Eselenkei GR)
J. Likampa (Treasurer- Imbirikani GR)
L. Partimo (Treasurer- Olgulului GR)
J. Leyian (Chairman- Amboseli Tsavo Group Ranch Conservation Association (ATGRCA)/ Chairman- Eselenkei GR)
J. Kilitia (Secretary ATGRCA/ Secretary- Imbirikani GR)

Tanzania

V. Runyoro (Principle Ecologist, Ngorongoro Conservation Area Authority)
Angelo Mwilawa (Livestock Research Scientist, Livestock Production Research Institute)
Allan Kijazi (Tanzanian PI, GL-CRSP, African Wildlife Foundation)
Patricia Moehlman (Biologist, IUCN/SSC-Equid Specialist Group)
E. Gereta (Ecologist, Tanzanian National

Parks)
E. M'talo (Researcher, University College of Lands and Architectual Studies)
F. Banyikwa (Professor, Botany Department, University of Dar es Salaam)
C. Nahonyo (Professor, Zoology Department, University of Dar es Salaam)
M. Maige (Tanzanian Wildlife Department)

COLLABORATING INSTITUTIONS

Kenya

ACC (African Conservation Center)
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ATGRCA (Amboseli Tsavo Group Ranch Conservation Association)
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KARI (Kenya Agricultural Research Institute)
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KWS (Kenya Wildlife Service)
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M'pala Research Center
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RCMRD (Regional Centre for Mapping of Resources for Development)
P.O. Box 18118, Nairobi, Kenya Fax: 254 2 802767
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Tanzania

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NCAA (Ngorongoro Conservation Area Authority)
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Fax: 253 7103 Phone: 253 7048

TANAPA (Tanzania National Parks)
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TAWIRI (Tanzania Wildlife Research Institute)
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University of Colorado
Institute of Behavioral Science
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International

ILRI (International Livestock Research Institute)
P.O. Box 30709, Nairobi, Kenya
Fax: 254 2 631499 Phone: 254 2 630743

PUBLICATIONS

Boone, R.B., K.A. Galvin, N.M. Smith and S.J. Lynn. 2000. Generalizing El Nino effects upon Maasai livestock using hierarchical clusters of vegetation patterns. *Photogrammetric Engineering and Remote Sensing* 66(6):737-744.

Boone, R.B., M.B. Coughenour, K.A. Galvin, and J.E. Ellis. Addressing management questions for Ngorongoro Conservation Area, Tanzania: Using the Savanna Modeling System. *African Journal of Ecology* (In press).

Galvin, K.A., R.B. Boone, N.M. Smith and S.J. Lynn. 2001. Impacts of climate variability on East African pastoralists: Linking Social Science and Remote Sensing. *Climate Research* 19:161-172.

Galvin, K.A., J. Ellis, R.B. Boone, A.L.

Magennis, N.M. Smith, S.J. Lynn and P.Thornton. Compatibility of pastoralism and conservation? A test case using integrated assessment in the Ngorongoro Conservation Area, Tanzania. In: Displacement, Forced Settlement and Conservation. D. Chatty and M. Colester, eds., Berghahn, Oxford. (In press).

Thornton, P.K. and K.A. Galvin and R.B. Boone. An agro-pastoral household model for the rangelands of East Africa. Agricultural Systems (In press).

PIs are also pivotal in maintaining active communication and coordination between agency collaborators in East Africa, ILRI and the US-based project team. These individuals have organized consultative meetings with key stakeholders for project focal areas to schedule planning meetings, and inform them of the objectives of the project and their potential role in making it succeed. They continue to liaise with key individual participants in the project to coordinate ongoing project research and planning activities in the field.

COMMENTS: PROJECT ADMINISTRATION

A key goal of the project in Phase II was to strengthen the administrative lines of communication between the project team and the GL-CRSP Management Entity, as well as to create and maintain good mechanisms for coordination between our team, its agency collaborators and community stakeholders in East Africa. The hiring of a Project Manager, based at CSU, and two principal investigators in Kenya and Tanzania respectively, has contributed to attaining these goals during this first funding period of the project's Phase II. The Project manager is primarily responsible for 1) liaising with Kenyan and Tanzanian Principal Investigators and other East African GL-CRSP collaborators and stakeholders; ensuring that all collaborators are kept up to date on ongoing project activities; 2) assisting in reporting and administration activities of project personnel and collaborators to the GL-CRSP Management Entity (i.e. annual reports, workplans/logframes, trip reports, budget justifications, travel projections); 3) participating in the development of Integrated Assessment protocols for each of the four project focal areas; and 4) coordinating community outreach activities between the project and community stakeholders in each project focal area.

The activities of the Kenyan and Tanzanian

PRINCIPAL INVESTIGATORS

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Principal Investigator: Michael Coughenour, Natural Resource Ecology Laboratory, Colorado State University.