

Partners In Conservation:

The Wildlife Institute of India and the U.S. Fish and Wildlife Service

An Indo-U.S. Collaboration, 1989-1994

**A Final Report To
The U.S. Fish And Wildlife Service
September 1996**

EXECUTIVE SUMMARY

Current conservation initiatives and programmes in India began in the early seventies with the promulgation of the Wildlife (Protection) Act in 1972 and the launching of Project Tiger in 1973. However, these early initiatives often suffered from a lack of competent scientific and managerial personnel and research information.

The Wildlife Institute of India (WII) was created in 1982 in response to the country's need for a scientific foundation to its wildlife conservation efforts. The new institute was to operate training courses in wildlife management for foresters and conduct field research to help formulate priorities and guidelines for wildlife conservation.

As wildlife science in India was still in its formative stages, the new institution was faced with a lack of trained personnel for recruitment to its faculty and the need to develop a curriculum for its teaching and training programmes. Toward this, the United Nations Development Programme/Food And Agriculture Organization (UNDP/FAO) helped WII get established during its earliest years. This was followed by a 5-year project called "Development of the Wildlife Institute of India" under the programs of the Indo-U.S. Sub-Commission on Science and Technology. The objectives of this were to train the WII faculty in modern research techniques, and provide equipment for use in wildlife training and research including advanced computer hardware and software.

The contracting parties were the Wildlife Institute of India and the U.S. Fish and Wildlife Service (FWS). Project expenditures were Rs. 1,07,77,000 and U.S. \$420,000. Rupee funds were provided from the U.S.-India Fund (USIF) as authorized by FWS. Dollar funds were provided by the U.S. Agency for International Development (USAID) and the FWS. These funds were managed by FWS and used for meeting the cost of assigning U.S. experts to WII, meeting fellowship costs of WII faculty while in the United States and purchase of imported equipment and consumables. The project period, initially planned for 1987-91 was from January 1989 to December 1993 and was extended to June 1994.

There were 12 subject areas decided as core fields for implementation. Of these, ten were dealt in considerable detail, wherein each had a specific programme developed including exchange visits by respective scientists. These were:

- Wildlife in Managed Forests
- Field Research Methods
- Interpretation and Conservation Education
- Geographic Information System
- Systems Analysis
- High Altitude Ecology
- Wetland Ecology and Management
- Wildlife Health
- Animal Damage Control
- Library and Documentation

The remaining two subject areas, Habitat Evaluation and Captive Breeding of Mammals and Birds, were not developed as full-fledged independent programmes. Habitat Evaluation was taken up under other subject areas and Captive Breeding of Mammals and Birds was ultimately determined to be of low priority in the Institute's immediate development plans.

Under the program 18 WII faculty members, including the Director and project nodal officers, visited scientific institutions, protected areas and other field locations in the United States to get acquainted with their research and training programmes and management techniques. At the same time, 33 American scientists visited India to transfer technology.

The project provided WII with equipment purchased from both within India (utilizing Rs. 21,85,000 from the rupee budget) and outside of India (utilizing U.S. \$117,300 from the dollar budget). Ten field workshops were organized in order to disseminate knowledge and skills to the end users - both managers as well as scientists.

This project has been immensely successful in achieving its objectives of facilitating the development of WII and its faculty in its formative stages. An important by-product has been the establishment of formal as well as informal scientific information exchange relationships between the WII faculty and a large number of research, training and management institutions and agencies in the United States. With the completion of the "Development of the Wildlife Institute of India" Indo-U.S. project in June 1994, a second phase was approved in 1995 to run until 2000 and is comprised of seven field based projects, which will consolidate the gains made thus far and expand the application of modern wildlife research and management techniques.

ACKNOWLEDGMENTS

This is the terminal report of the first five year collaboration project (1989-1994) between the Wildlife Institute of India and the U.S. Fish and Wildlife Service, prepared on the basis of various reports submitted by the concerned WII faculty members and visiting U.S. specialists.

The Institute thanks the Ministry of Environment and Forests, Government of India, and the State Forest Departments of various states for whole heartedly supporting this collaboration throughout the duration of the program. It wishes to acknowledge the essential role played by the Service's Office of International Affairs in programme and fund management and the equally important role of the American Embassy's Science Office in facilitating Indo-U.S. coordination. Sincere thanks are due to the U.S. Agency for International Development's Small Grants Programme and the U.S. Fish and Wildlife Service for provision of the project's dollar budget and to the U.S.-India Fund for provision of the rupee budget. Also, deep appreciation is expressed for assistance provided by all contributors to the project, those in India, the U.S. and elsewhere.

In times to come this project will be seen as a milestone in conservation cooperation.

H.S. Pabla, Joint Director S.K. Mukherjee, Director

Wildlife Institute of India Wildlife Institute of India

LIST OF ACRONYMS

ADC Animal Damage Control

ARK Animal Record Keeping

BNHS Bombay Natural History Society

CB Captive Breeding

CD-ROM Compact Disc-Read Only Memory

EIA environmental impact assessment

ESRI Environment Systems Research Institute, California

FRM Field Research Methods

FWS U.S. Fish and Wildlife Service

GIS Geographic Information System

GLEES Glacier Lakes Ecosystem Experiment Site, Wyoming

GMSARC George Miksch Sutton Avian Research Center, Bartlesville, Oklahoma

HAE High Altitude Ecology

HE Habitat Evaluation

IGNFA Indira Gandhi National Forest Academy

IIRS Indian Institute of Remote Sensing

INSTAAR Institute of Arctic and Alpine Research

ISLT International Snow Leopard Trust

IVRI Indian Veterinary Research Institute

KPLTER Konza Prairie Long Term Ecological Research

L&D Library and Documentation

MBG Missouri Botanical Garden

MESC Midcontinent Ecological Science Center, Colorado

NERC National Ecology Research Center, Fort Collins, Colorado

NWRC National Wetland Research Centre at Lafayette, Louisiana

RMFRES Rocky Mountains Forest and Range Experiment Station

SA Systems Analysis

SACON Salim Ali Centre for Ornithology and Natural History, Coimbatore

SAIC Science Application International Corporation, Santa Barbara, California

SFCP Special Foreign Currency Programme

UNDP/FAO United Nations Development Programme/Food And Agriculture Organization

USA United States of America

USAID U.S. Agency for International Development

USIF U.S.-India Fund

WE Wildlife Extension

WEM Wetland Ecology and Management

WIE Interpretation and Conservation Education

WII Wildlife Institute of India

WH Wildlife Health

WMF Wildlife in Managed Forests

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BACKGROUND

During the late sixties and seventies as the degrading state of the Indian environment became apparent, the preservation of natural habitats and their associated wildlife became a serious concern for the Government of India. This resulted in the promulgation of the comprehensive Wildlife (Protection) Act in 1972 and the launch of Project Tiger in 1973. Project Tiger was a large scale international effort to protect the tiger and its threatened habitats across the country. By 1983 the National Wildlife Action Plan had been adopted by the country. This envisaged a network of protected areas which would be representative of India's biogeographic diversity, and would ensure preservation of viable samples of the country's diverse ecosystems and populations of endangered species.

Although natural habitats had started to receive attention and some protection before this period, those efforts suffered from insufficient knowledge and experience with the field situation, and a lack of clear, specific objectives. The country had an excellent forest department with a long history but it had been focused more on the industrial and economic potential of the forests and less on ecological values.

Wildlife conservation in India called for a scientific as well as a practical approach. However, such an approach to managing and conserving wildlife was not yet a defined reality. Protected areas, then over 200 national parks and sanctuaries, were (and continue to be) under the charge of the forest department whose personnel were trained in forestry but not so in managing wildlife. The situation called for a mechanism that could marry the two, effectively and holistically.

Thus, in 1982, came into being the Wildlife Institute of India (WII) at Dehra Dun, located in a balmy valley at the foothills of the Himalaya in the northern state of Uttar Pradesh. The Institute was created by combining the Directorate of Wildlife Research and Education of the Forest Research Institute at Dehra Dun and the UNDP/FAO funded Crocodile Breeding, Management and Training Institute at Hyderabad (Andhra Pradesh). The Wildlife Institute of India was to become the apex organization of the Government of India concerned with wildlife training, research and monitoring. Its work objectives were to :

- Train managers and wildlife biologists for the management of protected areas and for wildlife research;
- Train education and extension specialists for protected areas directed at eliciting public support for wildlife conservation;
- Provide conservation orientation courses for those involved in land use management (forestry, soil conservation, wasteland management and rural development);
- Conduct and coordinate applied wildlife research and evolve relevant techniques suited to Indian conditions;
- Create a database for a computerized wildlife information system employing modern analytical techniques and equipment; and
- Provide advisory and consultancy services to Central and State governments, universities, research institutions and other official and non-official agencies.

For the new institute the path was neither easy nor, in fact, well defined. Although forestry was an established field, wildlife, as a subject discipline, had not yet been introduced in the country in any significant measure. A wildlife bias needed to be developed among foresters and a cadre of biologists and socio-economists was needed for studies and research in the field. This was required for conservation management as well as a training resource. As such, WII had to not only give forest management a wildlife slant, but also create and develop the very resources with which it could go about its task.

A decade's experience with Project Tiger had brought to the fore two important issues in wildlife conservation through protected areas. Unlike the developed countries, protected areas in India support scattered but large human populations living within and around them. These people depend on forest resources for their survival and well being. Therefore, protective efforts need to include sociological considerations. On the biological plain too, the approach needs to be holistic rather than concentrated on protecting mainly a few individual species.

This was indeed a challenge! The Wildlife Institute of India was not addressing an established or static field, but had to find its place in a scenario stirred by a rapidly growing environmental consciousness. It had to constantly re-align itself, refurbish its

resources and establish milestones in wildlife conservation and development of wildlife science. With wildlife not yet a studied discipline, the Institute was also faced with a paucity of trained personnel to draw upon. There was a pressing need for the Institute to develop a proper faculty for itself. As such the major priority for the Institute became the development of a trained faculty capable of teaching and guiding research in wildlife science, while fulfilling the other tasks of its mandate.

In its formative years, the Wildlife Institute of India was supported by UNDP/FAO by way of the project "Establishment of the Wildlife Institute of India". Under this project the Institute was formed with three faculties: wildlife biology, wildlife management and wildlife extension, along with supporting facilities and services including library, computers, laboratories, audio-visual aids, etc.

The new staff came from broad backgrounds in the biological sciences. Most of them had been following a research career but not necessarily in wildlife science. Though they would be following a similar vocation at WII, they were to address a more specialized trainee audience with specific and immediate issues and problems. The young cadre of scientists received specialized training under the UNDP/FAO project. This project strengthened the Institute's research and training programme and assisted in developing and conducting the first two-year Master of Science (Wildlife) course. This course was begun to fill a long felt need for trained wildlife biologists.

The UNDP/FAO project was operative from 1983 to 1988, and was then extended for a second phase by two years. In 1986 WII was granted autonomy which gave the desired flexibility and boost to its training, research and institutional development plans. The need to upgrade its faculty and other programmes now became all the more pressing.

The formal Indo-U.S. collaboration between WII and the U.S. Fish and Wildlife Service (FWS) began around the time the first phase of the UNDP/FAO project was being completed (FWS had been interacting with the Institute activities on an informal ad hoc basis since its inception). The proposal for this collaborative effort largely evolved from the need for modern, scientific protected area management and research techniques in India, and the availability of such management techniques in the United States. The collaboration was to allow WII scientists to learn specialized technical skills from U.S. wildlife experts. Going beyond mere technology transfer, it would seek to increase WII's capacity in applying appropriate technologies to local conditions.

Keeping close to the principles and objectives of the UNDP/FAO project, the Indo-U.S. collaboration followed a similar pattern of execution as well. It was to provide more specific, intensive and advanced training, making available state of the art technology and equipment for the study of wildlife. While the UNDP/FAO project sought the "establishment" of the Institute and its new agenda, the Indo-U.S. project was aimed at "development" of the Institute in existing and emerging fields.

OBJECTIVES

The objective of the Indo-U.S. collaboration, simply stated, was to provide technical and financial assistance which would lead to the strengthening of both the technical skills of the Institute's faculty and the Institute's established curriculum in selected subject areas. Originally ten subject areas of collaboration were identified. Over the course of the programme's development and initiation of projects, the list of subject areas evolved. During this process new titles were included, the scope of some was redefined or enlarged, while others were eliminated or reduced in scope. The subject areas eventually delineated were as follows:

1. Wildlife in Managed Forests
2. Field Research Methods
3. Interpretation and Conservation Education
4. Geographical Information Systems
5. Systems Analysis
6. High Altitude Ecology
7. Wetland Ecology and Management
8. Wildlife Health
9. Animal Damage Control
10. Habitat Evaluation
11. Captive Breeding of Animals and Birds
12. Library and Documentation Services

AGREEMENT

The concept of the proposal was endorsed by the Indo-U.S. Sub-Commission on Science and Technology in New Delhi on 10 April 1985 and subsequently formally accepted at its meeting in Washington in October 1986. It was then sent to the Government of India for ratification. The approval was accorded by the Department of Economic Affairs, Ministry of Finance through its letter No. 2(23) PL 480/87, dated 8 June 1988.

The contracting parties were the Wildlife Institute of India (Ministry of Environment and Forests, India) and the U.S. Fish and Wildlife Service (FWS, Department of the Interior). FWS is the primary U.S federal government agency concerned with wildlife resources, particularly the preservation of endangered and migratory species. FWS has been collaborating with the Government of India on joint wildlife conservation programmes

since 1977. Many of these programmes have been in direct support of wildlife training and research which culminated with the establishment of WII. These were funded through the U.S. government's Special Foreign Currency Programme available for international wildlife conservation and training under the Endangered Species Act of 1973.

FWS was to provide, at the request of WII, support from U. S. organizations, institutions, individuals or government agencies which would assist in developing the Institute's training and research programme. Funds were also to be provided to support training in the United States of selected Indian faculty from WII.

Specifically, FWS would:

- a) Assist WII in obtaining resources such as technical advisors, other personnel and/or material;
- b) Provide dollar funds received by it from USAID and other sources;
- c) Provide Indian rupees from the U.S.- India Fund (USIF) and the Special Foreign Currency Programme (SFCP) to defray expenses associated with task performance in India;
- d) Facilitate the visit of U.S. personnel to India, and of the Indian personnel to the United States; and
- e) Provide overall coordination for the project.

For its part, the Wildlife Institute of India would:

- a) Assume full responsibility and supervision for the project in accordance with the approved proposal;
- b) Provide in-country assistance for project implementation including identification of Indian personnel;
- c) Provide infrastructural facilities, and logistical and administrative support for work in India; and
- d) Provide technical and fiscal reports to the FWS on a regular basis.

METHODOLOGY

At WII, faculty members were selected for training in the selected subject areas. They were to work with their respective U.S. counterparts from FWS or various scientific institutions and universities, thus forming informal 'teams'.

According to a mutually agreed plan, U.S. scientists and specialists would visit India for brief periods to understand Indian technology needs, interact with and train their respective team counterparts at WII and help in the conduct of courses and research projects. The WII faculty members would be sent to the United States on short study tours for on-site studies and exposure to wildlife research and management techniques in the selected subject areas.

A very important aspect of this development project was the supply of advanced equipment to WII for its use in wildlife training and research. This could be bought in India, if available, or otherwise imported from the United States.

If the subject area involved installation of high-tech equipment, such as the Geographical Information System, the U.S. members would help get this done during their visit to WII and also train others on the faculty or staff who might not be going to the United States for training.

Towards the end of the interaction on particular subject areas, WII would organize workshops either at the Institute itself or at any other relevant place in the country for dissemination of knowledge to the end users. These workshops, aimed at foresters, wildlife managers, biologists and researchers, NGOs and related subject interest groups and individuals, would be jointly addressed by the U.S. specialists and the Indian faculty.

FINANCIAL PROFILE

The project budget had both a rupee and dollar component in order to address different needs. Total expenditures amounted to Rs. 1,07,77,000 and U.S.\$420,600 respectively. The funding in foreign exchange was provided by the United States Agency for International Development (USAID) and FWS and used for meeting the cost of assigning U.S. experts to WII, meeting fellowship costs of WII faculty while in the United States and purchase of necessary equipment and other materials. Of the equipment, that which was obtained in India was purchased with Indian currency while imported equipment was supplied by FWS with dollar funds.

CHANGES AND REVISIONS

Originally, the project was planned for the 1987-91 period. But the mandatory Government of India clearance was received only in mid-1988. Following this the project was launched in October 1988. The first-year funds were received by WII in February 1989 and it was thus agreed that the project term would be considered January 1989 - December 1993. However, the project was formally initiated only in the first week of May 1989 with the arrival of the first high-level team from the United States. The team had a familiarization tour of WII, interacted with the faculty and made an assessment of the specific requirements under each subject area.

This first visit, while not part of the formal bilateral project, was felt to be essential for introducing U.S. scientists to India. This would enable the Indian and U.S. counterparts to

meet and interact with each other and mutually develop appropriate work plans for their subject areas. It would also allow them to meet as a group with participants of project components other than their own and thus permit a more holistic and integrated approach to accomplishment of the project's objective. This procedure was repeated again when possible to reinforce the cohesion created.

The programme commenced with an activity under the High Altitude Ecology component. The same year Mr. H. S. Panwar, Director (WII) and Mr. Kishore Rao, who was the initial nodal officer for the joint project, visited counterpart institutions in the United States and interacted with experts who would be involved in the collaborative venture. The tour enabled them to review the planning and implementation of the various components of the project and refine the application and administration of the overall programme.

The time lag, between when the proposal was originally made and when it was actually initiated, forced a revision in the project. Due to the steep increase in both international and within-country travel costs, besides other cost escalations, the financial aspects of the project were revised. Accordingly, the dollar component of the budget which was initially decided as \$266,000 was increased to \$516,500 (although only \$420,600 was actually expended by the end of the project). Similarly, the Indian currency from USIF was increased from Rs 87,00,000 to Rs 1,07,78,000. It may be mentioned that this increase was necessitated to cover inflation only.

In October 1991 a three-member team from the United States visited India and WII for a mid-term evaluation of the WII-FWS project. The evaluation team found progress on the overall project satisfactory and in accordance with the objectives and aspirations of the collaborating agencies.

During interactions with the evaluating team, the Government of India's Additional Inspector General of Forests, Mr. S. Deb Roy mooted the idea of a second five-year phase for the project to fully realize the benefits of the collaborative effort. This second phase was to immediately follow the first phase so as to maintain the momentum of the current project. Agreeing with this suggestion, the evaluation team strongly recommended a second phase for the project that would essentially concentrate on expanding and strengthening the expertise in the existing disciplines.

DISCUSSION OF PROGRAMME COMPONENTS

WILDLIFE IN MANAGED FORESTS (WMF)

Although concern for wildlife is inherent to the Indian cultural ethos and the working plans for the managed forests in the country have provided protection to wildlife, active management for its conservation has only lately begun. In fact, the concept of management of wildlife in managed forests (WMF) is relatively new in India. It was first introduced by Dr. Jack Ward Thomas (now the Chief of the USDA Forest Service) at a 1982 International Workshop on Wildlife Research & Management conducted jointly by

the forerunner to WII, the then Directorate of Wildlife Research & Education, and the FWS in Kanha National Park, Madhya Pradesh.

In India the importance and need for managing wildlife in managed forests was mentioned in policy documents for the first time in the National Wildlife Action Plan (1983). The National Forest Policy (1988) too lays ample stress on biological diversity and its conservation. Today WMF has become a significant feature of the modern conservation initiatives in the country, and is vital for futuristic planning of India's protected area network.

In 1989, following an earlier visit to the United States (1984-85) to gain first-hand experience in WMF technology application, V. B. Sawarkar of WII went on a four-week WII-FWS programme U.S. study tour. It was during this tour and the May 1989 planning meeting in Dehra Dun that a WMF programme was developed as part of the collaboration. Dr. Harold Salwasser (U.S. Forest Service) became the project leader from the U.S. side.

As with many of the components, the original concept for the WMF interaction was revised and fleshed out as needs were identified and background material was gathered. It would become obvious that no one "expert" from the U.S. could provide all the information necessary to address the identified Indian needs. Salwasser and Sawarkar devised an extended programme that involved six U.S. forest/wildlife specialists each adding separate but integrated pieces to meet the overall objectives.

The focus of this component was to develop the new WMF concepts in the Indian context, to evolve a field guide for integrated forest management that would address the conservation of forest diversity and find a prudent balance between serving the immediate needs of the people while maintaining options for future generations. Toward this end, a biodiversity project in Satpura Hills in central India was developed. It was to lead to a regional scale field demonstration model of integrated forestry, and a management handbook on conserving forest diversity. The handbook was to be used in training foresters and biologists.

The area identified in the Satpura Hills covers some 7500 sq. km. across parts of two states - Madhya Pradesh and Maharashtra. It comprises two national parks and three sanctuaries and considerable reserve forests, presenting a rich and diverse habitat that is home to a variety of fauna and flora including many threatened and endangered species. The landscape offers some of the finest teak growing areas and plantations. These forests also support the subsistence economy of inhabitants in some 200 tribal villages and other habitations of pastoralists besides providing them forestry based employment for at least nine months of the year. There are also monuments and sites of historical or cultural interest, with high tourism potential. Indeed, the Satpura Hills is an ideal location to put the concept of managing for forest diversity to the test.

Nine biologists/managers from the USDA Forest Service usually in two member teams representing both the scientific and management sides came to India during different

periods in 1990-91 to help prepare background materials and conduct a national workshop as the first step in the Satpura Biodiversity project. With Salwasser guiding, reviewing and modifying the entire project, Dr. Winnifred B. Kessler and Mr. Richard S. Holthausen began the effort by preparing an overall project design, and developing the WMF concepts and framework of an integrated planning process. Dr. Bruce G. Marcot and Mr. Thomas Darden followed and prepared the draft chapters for the proposed handbook and visited the field sites and confirmed the utility of the Satpura Hills area for field work. Dr. John F. Lehmkuhl and Mr. Robin Vora developed and prepared the draft framework of ecological classification, vegetation and habitat description, and also surveyed field plots in the Satpura Hills. And finally, Dr. Hal Salwasser, Dr. Jack Ward Thomas and Dr. Martin Raphael helped prepare and conduct the national workshop, and drafted chapters on basic concepts of biological diversity. These U.S. scientists also delivered lectures and seminars at WII as part of the overall effort to develop the faculty's skills.

Under the WMF programme, two workshops were held. The first was the "Regional Seminar on Integrated Forestry Planning and Management" (24-26 September 1990) held at WII and attended by some 20 middle and senior level wildlife and forestry officials including planners and administrators from Madhya Pradesh and Maharashtra. The plenary was attended by about 150 forestry scientists from the Forest Research Institute (Dehra Dun) and WII. The workshop outlined the objectives of the Satpura Hills project and sought to develop the scientific concepts of WMF directed at integrated forest planning and management. Dr. Bruce Marcot of the U.S. Forest Service team spoke on "An Introduction to Biodiversity Concepts for Planning." An important feature of the workshop was the discussion of three forest plans in the Satpura region - one under implementation in Madhya Pradesh and two in the final stages of drafting.

The second workshop was the highlight of the WMF programme in India. Held in the third week of January 1991 at Pachmarhi (Madhya Pradesh), a resort town in the Satpura Hills, the International Workshop on Integrated Forest Planning and Management was the first of its kind held in India. It was jointly conducted by WII-FWS-USDA Forest Service scientists and line and staff officials from the Madhya Pradesh and Maharashtra forest departments. About 60 foresters and biologists from all over India gathered to discuss integration of forest management with forest biodiversity, with the economy of the forest dwellers being an overriding consideration.

Seven days of intensive interactions and discussions, in an appropriate wildlife setting, drove home the shortcomings of past approaches and experiences. Clearly foresters and biologists had been laying too much stress on the commercial, subsistence and recreational products of the forests and not enough on the interdependencies of life in a forest. It is because of these interdependencies that forest diversity cannot be conserved by isolating the protected areas or by merely applying more science and management inputs. The challenge lay in tempering the demands for forest products and integrating the essential roles that all categories of forests must play in meeting the three timeless goals of forest sustainability: ensuring environmental security; meeting basic human needs; and providing forest products and uses for economic development.

It was realized that while sanctum sanctorum are essential for securing certain aspects of diversity in a forest, people and livestock cannot be completely removed from all forests. There is a need to keep a balance. Planning and management for any single area must take into consideration the broad goals and actions for adjacent and nearby areas. Integrated planning and management at the regional scale are needed to conserve biodiversity. Multi-use forestry is not a threat, but is in fact essential to conserving forest diversity and productivity.

In June-August 1992 Mr. H. S. Pabla, who took over from Mr. Kishore Rao as the nodal officer for the joint project after the latter's departure from WII, went on a study tour to the United States under this subject discipline. While the main purpose of this trip was to give exposure to USDA Forest Service operations, Pabla was also expected to meet individuals and visit other institutions in order to help coordinate and finalize the next segment of the programme. In July-August Sawarkar, Dr. P.K. Mathur, Dr. S. Chowdhury, and Mr. V.K. Uniyal (WII) also traveled to the United States on a study tour. Their tour, joined by Mr. Pabla, involved interactions with USDA Forest Service staff and line officers and officers of the Boone and Crockett Club wildlife conservation group. It included field visits to Yellowstone National Park; Grand Teton National Park and the surrounding managed forests; the privately owned Mooncrest Ranch; Gifford Pinchot National Forest; Mount St Helens site and monument; Mount Hood National Forest; Umatilla National Forest; Starkey Experimental Forest and the Pacific Northwest Experiment Station at Le Grande; the Columbia Gorge Scenic Area; the coastal redwood forests of California; and the Redwoods Research Station. The tour included discussions and visits with forest managers and researchers of USDA Forest Service, and with a Council member and biologist of the Yakama Indian nation.

The WMF itinerary was planned by Salwasser and Marcot and they took turns accompanying the WII scientists throughout their visit. With the focus being on WMF inter-alia integrated forest planning and management, the Indian scientists were exposed to a cross-section of topics: recreation, hunting, catchment management, endangered species management, management of terrestrial habitats, riparian systems, pastures and livestock, historical monuments and sites, human dimensions, issues in old growth management, biological research and forest planning. All these scientists and two others from the WII faculty, Dr. P. K. Mathur and Dr. S. Chowdhury, attended an "International Workshop on Biodiversity" at Sacramento (California) in July 1992. Sawarkar and Uniyal presented a paper on "Satpura Diversity" at the workshop.

The WMF programme at WII has become larger and more applied than originally envisioned. Instead of intensive technical interactions between WII faculty and the U.S. counterparts to develop a handbook of new concepts and planning tools, the project took on the development of a prototype integrated management plan for a real geographic area.

In the beginning the WMF programme focussed on wildlife, but by the end of 1991 it was addressing the maintenance of biological diversity as the major concern. This is reflective of the rapid evolution in scientific thinking during the late 1980s. It is also

appropriate as India's National Forest Policy (1988) mandates forest managers to maintain biological diversity across all forest lands, i.e. the variety of native plants and animals that live in forests, the variety of human lifestyles that depend on forests, and the productivity of the forests to supply our economies with natural resources.

The gains from this WII-FWS-USDA Forest Service collaboration are significant. A major accomplishment has been the evolution in thinking about what integrated forest management entails. This change in thinking may have large and long lasting benefits for forestry in the two countries. The collaboration is also significant as it exemplifies the positive results from the interactions of the participants in starting with a concept, collecting and analyzing information, and formulating a comprehensive programme that addresses a major natural resource issue. The initial "task" was viewed in its holistic perspective and an integrated approach was formulated. This bilateral cooperative action evolved from a simple "technical exchange" to a comprehensive collaboration to help address and provide direction to an important conservation initiative.

For the U.S. participants the India experience has been inspiring and educational, and each has returned home with a broader outlook and appreciation for the roles of forestry in the future of the two countries, and the world at large.

The WII faculty has a good understanding of the WMF concepts and an approach is being developed towards achieving the mandates set out in the National Wildlife Action Plan of 1984 and the National Forest Policy of 1988. A beginning has also been made to move from theory to practice, and already the forest plans of East & West Melghat Division (Maharashtra) have been strongly influenced by WII's WMF programme. At the same time, WMF concepts and principles have been introduced in the curricula of the Indira Gandhi National Forest Academy and State Forest College, Dehra Dun, and relevant sections on the subject have been added in the WII training programmes for middle and senior level forest and wildlife managers. WMF also constitutes a significant section of the draft "Manual for Wildlife Management Planning for Protected Areas and Managed Forests in India" developed by WII. The logical extension will find the concepts and principles modifying the forest plans code substantially. There is every indication that forest plans will now radically reorient their approach.

Currently WII is the only organization in India with the capability of influencing forest management to adopt a modern system for maintaining biological diversity. Such a system would, in turn, support the protected area network. The Satpura Biodiversity project will substantially help the WMF technology develop further, and could be a landmark in the conservation of forests in India. In another two years, it is hoped that WII will be able to draft a field guide for integrated forests planning and management for the Satpura landscape. Taking the project approach, the initiative of WMF can be demonstrated and should have a good chance of being adopted into mainstream forest management.

The WMF concepts currently being employed in most countries of the world, including the United States and India, are in a rudimentary stage. There is a need for management

tools and approaches such as ecological classifications of the landscape, multi-resource inventories, planning and evaluation models for futuristic assessment, coordinated management/working plans, ecologically sustainable economic development schemes, research and monitoring, and professional curriculum development. The WII-FWS-USDA Forest Service work on the WMF programme could be developed further to look into the above mentioned priority areas but this would require substantially higher investments of people, time and resources than are currently available.

The relationship with the U.S. Forest Service developed through this project has evolved into a 5-year Phase II project titled, "Management of Forest Ecosystems for Biodiversity and Productivity - A New Perspective." This project will further test the applicability of the 'Satpura Concepts' to a range of managed forest situations in different biogeographic zones of the country, and will further evolve guidelines to continue conservation and productivity in forest management.

FIELD RESEARCH METHODS (FRM)

Wildlife research in India is of comparatively recent origin, and the techniques for research or monitoring wildlife and protected areas are yet to be standardized. Considering the need and urgency of research for wildlife conservation, developing suitable methodologies and their standardization for various field techniques required for research and monitoring is of utmost importance. Appropriately then, "Field Research Methods" was taken up for consideration under the WII-FWS collaboration.

Dr. Paul R. Krausman from the University of Arizona was selected as the U.S. specialist for this component and attended the May 1989 planning session at WII. Under the programme he was to interact with the researchers in the ongoing WII projects, visit select field study sites and suggest additions and modifications in methodologies toward meeting the study objectives. The WII counterparts were Dr. A. J. T. Johnsingh, Dr. P. K. Mathur, Dr. S. P. Goyal and Dr. S. Chowdhury who would visit the United States and interact with various scientists there to develop this component in the Indian context.

Krausman's subsequent visit to WII in October-December 1989 coincided with the Institute's annual research seminar, and this immediately provided the concerned research scholars and their supervising faculty an opportunity to interact with him on the research methods used in these studies. After the seminar the scholars and faculty met him on an individual research project basis for advice on modifying field data collection and analysis techniques and methodologies. Krausman also visited Rajaji National Park, Sariska Tiger Reserve, Kedarnath Musk Deer Sanctuary and Dudhwa National Park to advise on the current projects there. While at Sariska, he was also able to participate in the 'techniques' training of the Institute's Diploma trainees and M.Sc. students in the field.

Krausman's next visit (July-August 1990) again coincided with WII's annual research seminar. He arrived ahead of the seminar and provided guidance to the research scholars and concerned faculty on various methods of data analysis and preparation of reports for

the seminar. Krausman focussed attention on the need to improve research project proposals and scientific writing-publications capability. Together with Mr. Tom Thomas, the U.S. conservation education specialist with the Interpretation and Conservation Education Component, Krausman provided guidance and assistance to the researchers and their supervisors in making effective presentations of their scientific work.

Earlier (January-March 1990) one of the Indian counterparts in the programme, Dr. S. P. Goyal, was in the United States for training on a FAO fellowship. The training programme allowed him to acquire specialised knowledge in wildlife research aspects such as census methods for ungulates and lesser carnivores, physical capture techniques, use of micro-histological techniques in food habits and use of telemetry in determining home range and ranging patterns, etc. He attended the "55th American Wildlife and Natural Resources Conference" at Denver, Colorado, besides workshops on managing habitats for viable populations and presented a number of seminars.

Krausman was in India again from December 1991 - February 1992. He spent most of January in the field where he provided advisory and technical assistance to primarily four projects in order to strengthen their methodologies and thus enhance their gains. These projects were "*Distribution and Population Structure of Wild Ass in Little Rann of Kutch, Gujarat*"; "*Impacts of Management Practices on Ungulates and Lion Habitats in Gir Forest, Gujarat*"; "*Evaluation of Elephant Habitat in Relation to Fragmentation, Degradation, Mining and Other Disturbances in the Saranda Forest, Bihar*"; and "*Satpura Biodiversity Project, Madhya Pradesh*." The advice on using the availability-utilization method for data analysis, which has jointly been developed by Krausman, was valuable. His other suggestions touched topics like animal census and monitoring, habitat utilization, integrated forest management and the use of radio telemetry.

Besides advising on procuring field equipment to enhance the accuracy of field data collection, Krausman also helped a number of faculty members and researchers in procuring literature that was not available at the Institute.

In 1992 the remaining three Indian counterparts did their overseas study tours, visiting various institutions and protected areas and interacting with scientists, academicians and park managers. Though the WII team had some common destinations and programmes, each member also had exclusive programmes covering their specialised research interests.

Johnsingh went to Switzerland, Canada, and United States (June-August 1992) with the aim of seeing as many research projects as possible so as to broaden his knowledge of different large mammal species, their habitats and the various field research methods currently being used to study them. He was particularly interested in the use of drugs and tranquilization equipment, satellite telemetry and trap control transmitters. During the tour, he also gave talks at various places on Indian wildlife covering issues such as habitat diversity, status and studies on large mammals and the general wildlife conservation scenario in the country.

Mathur was on a U.S. study tour during June-August 1992. He picked up new field and laboratory techniques used in studies on fire as a management tool, and forensic and genetic studies including the use of morphometry, serology and DNA fingerprinting techniques. At the National Cancer Institute, Maryland, Mathur had discussions with Dr. Stephen O'Brien, Chief, Laboratory of Viral Carcinogenesis, and learned techniques pertaining to the extraction of DNA from skin/tissue/blood samples. At the National Wildlife Forensics Laboratory, Ashland, Oregon, he discussed the possibility of collaboration in developing wildlife forensic capability at WII.

Chowdhury's U.S. study tour also took place in June-August 1992 and focussed on insitu and exsitu conservation, management and research of endangered ungulates, carnivores and birds. He also looked into the habitat management aspects such as habitat monitoring techniques, fire management, water management, protected area-human habitat interface conflicts and the impacts of mining on wildlife habitats. His exposure included radio-telemetric studies and the use of drugs for chemical restraint of wild animals. Chowdhury and Mathur also attended the "International Conference on Biodiversity in Managed Landscapes" at Sacramento, California (13-17 July, 1992) in which Sawarkar and Uniyal presented a paper (See Wildlife in Managed Forests).

One of the objectives of this component was to bring wildlife biologists and managers together to collate, discuss and evolve field research methods appropriate in the Indian context. Toward this purpose, a workshop titled "Field Research Methods" was organized at WII on 26 February - 1 March 1993. The workshop was attended by thirty-six persons, representing state wildlife departments, research organizations and universities. Resource persons included those from outside WII who were involved in wildlife research including Krausman and Dr. David Jessup, a veterinarian with the California Department of Fish and Game. The topics covered separately in various sessions were animal census and status surveys, behavioral research methods, quantification of habitat variables, studying wildlife-habitat relationships, quantifying human-wildlife habitat interactions, studying environmental impact assessment, etc. The proceedings of the workshop are planned for publication.

The Field Research Methods component of the Indo-U.S. collaboration has greatly helped the WII faculty and researchers improve and streamline their research projects. The faculty is now confident of handling the training, teaching and research work related to physical capture, wildlife habitat relationships, resource management, wildlife forensics and fire as a tool in wildlife management. The techniques studied and seen in overseas tours are being employed in the ongoing research projects and are also being taught in the regular courses at the Institute. U.S. scientists and their Indian counterparts under this programme formulated the following research proposals for Phase II of the Indo-U.S. collaboration: "*The Relationship Among Large Herbivores, Habitat and Humans in Rajaji-Corbett National Parks*"; "*The Impact of Fragmentation on the Biological Diversity of Rainforest Small Mammals and Herpetofauna of the Western Ghats*"; and "*The Establishment of a Wildlife Forensic Capacity at WII.*"

Quite definitely, the subject area is bound to grow in stature and importance once the acquired technical skills are transferred to Protected Area officials. The resultant enhanced data collection will lead to improved management and conservation of wildlife.

INTERPRETATION AND CONSERVATION EDUCATION (WIE)

Awareness of the state of the environment, and the need to conserve it must be instilled in people through interpretation and education on conservation issues. These are important tools for eliciting public support and participation in environmental conservation. In the case of protected areas some conservation approaches have alienated people living around these areas, and failed to enthuse and expose visitors to the areas' true values.

The existence of Wildlife Extension (WE) as one of the three main Faculty divisions at WII underscores the realization that people can no longer be ignored. This Faculty division provides teaching inputs on interpretation in the regular courses at the Institute and has developed slide, film and video libraries and an audio-visual unit as necessary adjuncts to teaching. It publishes a quarterly newsletter titled "WII Newsletter" and is also responsible for creating exhibitions on wildlife issues.

With interpretation and conservation education taken up for development as part of the WII-FWS joint project, Mr. Tom D. Thomas, a subject specialist retired from the U.S. National Park Service was selected to work on this programme. Mr. R. N. Acharya and Mr. Sharad Gaur were the counterparts at WII.

After an initial planning meeting at Dehra Dun in May 1989, Thomas returned to the Institute in September-October 1989 and a general strategy for the joint programme was developed. He reviewed and suitably added to the subject inputs in the existing WII syllabi, organized a workshop and a seminar in communication skills for the Institute's faculty, trainees, researchers and students, and visited Rajaji National Park and Malsi Deer Park near Dehra Dun to assess their potential for interpretive, extension and conservation education activities. Moreover, he worked out a package of training needs for his WII counterparts and finalized their fellowship tour programme to the United States scheduled for the next year. It was also decided that more specialists would visit WII in due course as part of this component.

Acharya's U.S. study tour in May-July 1990 was coordinated by Thomas and supported by a FAO fellowship. The objectives of the study tour were to provide Acharya knowledge of environmental education and interpretation techniques, services and facilities and their functioning in the field, and to acquaint him with the various AV equipment used in interpretive programmes. Acharya, most often accompanied by Thomas, visited interpretation facilities in many national parks, interpretation staff training institutions, and interpretive materials design and development centres. He also attended seminars and workshops on the subject. On his return to India, Acharya was involved in an interpretive planning exercise for Melghat Tiger Reserve in Maharashtra for which he then developed an interpretive plan.

Thomas returned to WII in July-August 1990, the visit coincided with the Institute's annual research seminar. In conjunction with Dr. Paul Krausman, he provided guidance and assistance to the researchers and their supervisors in making effective presentations of their scientific work. Thomas was at WII again in January 1991 with Dr. Ervand M. Peterson, a U.S. conservation education specialist. By this time, Gaur had left the Institute and was replaced by Mr. Suhas Kumar as the WII counterpart for the programme.

Around this time, WII's new campus at Chandrabani was coming up. Commanding a vantage view of the Doon valley and surrounding hills, and itself impressive in its floral and avifaunal attributes, the campus offered an ideal location for laying out a nature trail. In fact, during their visit, the U.S. advisors, along with Kumar and Acharya, set about planning such a self-guided trail. This has since been instituted and developed by the WE faculty, along with a printed trail leaflet. Thomas and Peterson also helped conduct some workshop sessions with the Institute's trainees, both in classroom situations and in the field. Also, during their stay, preliminary planning was done for a prospective full-fledged workshop.

Under the WII-FWS cooperative programme, Kumar undertook a May-July 1991 fellowship tour to the United States. This tour was organized and for the most part accompanied by Thomas. The visit exposed Kumar to a wide range of interpretive facilities and activities at the various national parks and natural history museums in Colorado, California and Arizona, and conservation education programmes in and around Sacramento and Marin County, California. He also went to the U.S. National Park Service's Harper's Ferry Center in West Virginia to observe the design and publication of interpretive materials.

Thomas' next visit to WII was in September-October 1991. He was accompanied by Mr. Warren E. Bielenberg, a U.S. National Park Service specialist in interpretive program development, supervision and management. The workshop plans which had been made during Thomas' previous visit, resulted in an "Interpretation and Conservation Education Workshop" organized in Dehra Dun on 16-24 September 1991. The objectives of the workshop were to focus attention on conservation issues, the need for conservation education and the use of interpretive methods as management tools. There was a very encouraging response from applicants for the workshop, but due to space and other considerations only 30 were selected of which finally 27 participants attended. These represented various government and non-government organizations and agencies in the wildlife, forest, tourism, environment and defense sectors.

Spread over nine days, the workshop was conducted in 32 sessions following an informal, participatory approach that included the use of AV support, group exercises, case studies, field visits and field-based discussions and presentations by the participants themselves. The participants were provided with considerable literature on the subject, and an exhibition of interpretive publications and posters was also put up. Case studies included interpretive plans and programmes at Kanha National Park, Melghat Tiger Reserve, the Delhi Zoo, and the Silent Valley Conservation Education Campaign in

Kerala. Visits were conducted to Malsi Deer Park, Rajaji National Park and sites in Mussoorie where the Indian army's Eco Task Force has been doing reforestation work on degraded land. Presentations made by the participants on their own areas of work were frankly analyzed, discussed and commented upon by Thomas.

After the workshop, Thomas, Bielenberg and Acharya went on an orientation tour to Melghat Tiger Reserve and Kanha National Park to study their ongoing interpretive programmes. The team also visited Panna National Park in Madhya Pradesh where they were joined by Kumar and Pabla, and assessed the interpretive potential of the park. In an informal meeting with the District Collector, the Park Director and a nearby hotel manager, it was suggested that a guide training programme be organized for promising youngsters from adjoining villages, so as to promote wildlife tourism in the area, thereby inculcating conservation awareness among the visitors.

The training programme for park guides was conducted in Panna National Park on 22-26 February 1992 and was a joint endeavor of WII, the park management and Hotel Chandela Khajuraho. The participants, selected by the park management, included 10 youngsters from two villages located on the boundary of the park. The methodology included lectures, AV presentations and field visits, with emphasis on orienting these young people to the values of the park and the need for conserving such areas. The qualities of a good guide such as conduct with the visitors and concern for their safety were also discussed. At the end of the programme, each participant made a presentation on the course and was awarded a certificate of completion. This concept of guide training has resulted in similar courses in Corbett National Park, Kanha National Park and Bandhavgarh National Park. This has resulted in employment of local guides in the park who remove this responsibility from the Forest Department.

Also under this component, Dr. Muriel Crespi, a socio-anthropologist at the National Park Service visited WII in October-November 1991 with the purpose of interacting with WII faculty on the socio-economic aspects of natural resources interpretation. She presented seminars on the subject to the Institute's faculty, trainees and students. She visited Rajaji National Park, Ranthambhore National Park, the Tribal Development Institute in Ahmedabad, the Institute for Rural Management at Anand and other related institutions so as to understand the field perspective of the socio-economic situations occurring in the country. An outcome of this sub-component was an annotated bibliography on socio-anthropology and allied topics prepared by Tarak Dutta, an anthropologist, who was employed by the project for this purpose. His work has provided access to information hitherto not available.

The Wildlife Extension Faculty has since grown in experience; Kumar ably imparted subject knowledge and skills to an additional faculty member. This was essential, considering the faculty had only three members at the time. Now, besides interpretation and conservation education inputs in the regular WII courses, periodic courses are also organized on the subject for officers of the armed forces, and for NGOs, zoo and protected area managers and tourism officials. In fact, the workshop on interpretation

and conservation education has become a regular activity. The Institute is also now capable of doing interpretive planning for protected areas.

Popular talks and films on wildlife and nature conservation are organized in local schools. Sometimes children are invited to the WII campus or taken to the Rajaji National Park for nature orientation field excursions. There has also been considerable increase in the volume of publications planned or produced by the WE faculty, and also in the number of articles on wildlife in local, regional and national periodicals. The AV is now being extensively used in all the training programmes, workshops and seminars, while the DeskTop Publication and Reprographic Unit are well equipped to handle a large number of in-house publications. The increasing quality and number of publications, exhibition material and AV programmes by WII are a fair testimony to the knowledge and skill acquired by its WE faculty in interpretation and conservation education.

Some of the concrete gains have been the production of a film "The Wildlife Institute of India" and an audio-visual programme titled "We are Nature. Nature is our Word", which have been funded primarily by the WII-FWS project. The film is an introduction to the Institute, detailing its programmes and activities. The audio-visual, an ambitious production operating on nine slide projectors (besides its edited video version), is a broad discussion on the conservation scenario in India and WII's role in it. Both these productions have been featured on the national television network, and are otherwise routinely shown to important guests at the Institute.

The project has also financed the production of four colour posters on the lesser known endangered species of India - Indian Giant Squirrel, Lesser Florican, Western Tragopan and Forest Cane Turtle. These posters (including their small sticker versions) are part of the handouts to important visitors to the Institute.

GEOGRAPHIC INFORMATION SYSTEM (GIS)

The collation of data on the spatial distribution of significant properties of the earth's surface and their systematic mapping have always been useful tools in integrated resource management. Geographic Information System (GIS) technology which permits recording the earth's spatial resources in digital form is an advancement on that technique as it permits quick, quantitative analysis of complex spatial data and modeling of spatial patterns. This technology is today being utilized in management of many resources throughout the world including forestry in India.

With the integration of GIS and remote sensing technologies almost complete, a great deal of future work at WII rests on acquiring and developing these capabilities and applying them in wildlife studies. More than half of all future studies at WII plan to use this technology to some degree.

Originally this technique was to be included under a component called Habitat Evaluation. But with recognition of the need for special expertise in this rapidly growing technology Mr. Donald Hunter of FWS' National Ecology Research Center (NERC), Fort

Collins, Colorado was selected as the U.S. consultant. (This center is now assigned to the U.S. National Biological Service and is known as the Midcontinent Ecological Science Center.) Dr. S. N. Prasad from WII was his initial counterpart on this subject area. Hunter was part of the U.S. initiating team to WII in May 1989. Only a relatively small GIS programme was initially envisioned for the Institute. But subsequent interactions on the scope and need for GIS enlarged the plan to transferring a more ambitious GIS programme, so much so that it became one of the most important components of the Indo-U.S. collaboration.

The sub-project took off when Hunter revisited WII in September-October 1989. During this visit faculty and research fellows at the Institute were introduced to basic GIS concepts, and an EPPL7 programme was installed. From the outset, it was clear that the software being used for the initial training was only an entry level package and the Institute would subsequently graduate to a new programme after adequate experience had been gained. For this purpose EPPL7, a DOS based GIS package, proved adequate and apt for the Institute's GIS needs through the transition period to a larger, permanent system. The Indian counterpart and four other members of the WII faculty were also trained in the more advanced analytical use of GIS and GIS subsystems.

Hunter also visited the Institute's Narmada Sagar impacts assessment project study area in order to assess the need for gathering reliable map data for use in the Narmada GIS study. Earlier, at the initiation meeting in May, two potential prototype projects were discussed. The Narmada Sagar study was one of these which exemplified environmental assessment. The other, involving ecological research, was the snow leopard project in Ladakh. Additionally, a coordination meeting was organized between WII and two other scientific organizations in Dehra Dun, namely the Indian Institute of Remote Sensing (IIRS) and the Survey of India to discuss issues pertaining to technology use, data sharing and interaction.

Prasad went on an overseas training programme in March-June 1990 to visit the GIS facilities at the FAO headquarters in Rome (Italy), various institutional locations in the United States and the Asian Institute of Technology, Bangkok (Thailand). The programme enabled him to obtain hands-on experience with a variety of GIS and remote sensing software that were similar to those required by the Institute. At the end of his stay there, he and Hunter drafted an Implementation Plan, based on an assessment of WII's workload over the next five years, which outlined the staffing and software/hardware needed to set up a full-fledged functioning GIS-remote sensing facility. Included was the digital image processing of remotely sensed data, since it is closely linked to the GIS.

The Implementation Plan was finalized during Hunter's revisit to WII in June-July 1990. Hunter also participated in the joint WII-FWS "High Altitude Ecology Workshop" and provided inputs on use of remote sensing and GIS techniques for the analysis of snow leopard habitat. In addition, he made suggestions and recommendations for altering the new WII building facilities then under construction to accommodate the approved GIS revisions.

In 1991 WII received an updated version of EPPL7. IDRISI 3.3 was also acquired for teaching purposes and proved quite useful with satellite digital data. On the recommendations of the Implementation Plan, a UNIX based SUN Sparc 2 workstation was procured along with peripherals such as a digitizer, a plotter and an ink jet printer. The accompanying GIS software was GRASS 4.0 which incorporated an image processing capability. In October Mr. Rajesh Thapa, the System Manager at WII, took three weeks of training in the United States on systems administration and operation of the SUN workstation at the Sun Microsystems training center in Maryland. He also received training on the use of GRASS at the U.S. National Park Service, Denver, Colorado. The equipment reached WII in November. Around this time Hunter and Mr. Peter Strong of the U.S. National Park Service, a UNIX and GIS specialist who had earlier tested the system at NERC, also arrived to set the system up and give training to Prasad and Thapa. With the establishment of this system WII has become one of the select organizations in the country to be using this technology.

The GIS cell at the Institute was delayed in becoming fully operational due to WII moving to its new campus and the consequent unstable power situation. The joint programme also received a setback when Prasad, who had received most of the training under the GIS component, transferred from WII to the Salim Ali Centre for Ornithology and Natural History (SACON), Coimbatore, in 1992. This left only Thapa at the Institute with any formal training in UNIX and GIS, and that too of just a few weeks. The degree of GIS facility that WII had acquired would normally have employed a staff of three to five professionals with five to ten years experience. It may be mentioned that it was indeed commendable of Thapa and his assistant Mr. Lekh Nath Sharma to keep the system operational, and advance their own learning, largely through a diligent learn-as-you-go method in the absence of any other trained faculty.

Trained and committed personnel are of prime importance to the success of a GIS facility. This urgency was realized and Dr. V. B. Mathur and Mr. Qamar Qureshi, both of the WII faculty, were earmarked for training. They are now responsible for further development of the GIS facility at the Institute.

In March 1993 the GIS cell at the Institute was activated with Thapa beginning work on the Narmada - Environment Impact Assessment project. Minor problems encountered were solved in-house or sometimes through fax advice from NERC.

So, by the time Hunter next visited WII in July-August 1993, this time with Mr. Chris Emmerich, a UNIX and GIS expert (at NERC, Fort Collins), the GIS system was already in competent operation. During their visit, GRASS 4.1 was loaded and the GIS staff at WII trained in it. Emmerich also sorted out software problems the GIS cell had been facing, and assisted with digitizing, topological correction of vector data and importing satellite data into GRASS.

The U.S. specialists were confident that the GIS could now process the voluminous Narmada-EIA data and handle the desired GIS applications so as to answer the research questions. However, it was felt that an extended training session by an experienced

technical person was needed to assist the GIS faculty in full development of their capabilities. Towards that end, Dr. Ralph Root, a GIS specialist from the National Biological Service (Denver, Colorado), came to WII for three months, November 1993-January 1994. During his stay at WII, Root conducted training courses for the Institute's GIS team on GRASS, ELAS and the UNIX operating system.

The new WII-GIS counterparts, Qureshi and Mathur, were assigned for overseas training programmes starting in January and May 1994 respectively. Qureshi was in the United States for six months and attended the spring semester at Colorado State University, Fort Collins, besides intensive training at NERC, and the National Biological Service's office in Denver. The course topics covered GIS, remote sensing, spatial modeling and C-programming, and included intensive practicals and laboratory work. Qureshi also attended several workshops and seminars on related topics.

Mathur was in the United States for two months on a UNDP fellowship, receiving training in GIS and GPS technologies at the Environment Systems Research Institute (ESRI), California and at NERC (subsequently renamed Midcontinent Ecological Science Center - MESCC), Colorado. He also made a presentation on "GIS Application in Wildlife Planning and Management" at the 14th International ARC/INFO User's Conference at Palm Springs, California.

The GIS work on the Narmada-EIA has been completed, and its final report sent to the Government of India. As a first task, it was a challenge for WII which has since been successfully met. The use of GIS in the Narmada Sagar project has helped with the analyses, and has provided a professional medium for presenting study results. On the basis of the study analyses and findings, new protected areas (total 788 sq km) in the Narmada Sagar project area have been recommended by WII as a mitigation measure.

The GIS facilities at WII are now fully operational. The cell itself comprises two faculty members, four computer professional staff and two research associates. Today, at least seven research projects of WII are using the GIS technology. Within the Institute, other researchers as well are encouraged to develop an understanding of GIS and are required to do the digitizing of their respective study areas. "Introduction to GIS" forms part of the curricula of the Master's course in wildlife science and in the regular management courses at the Institute. It is also imparted to other researchers. A three-day workshop on "GIS in Natural Resource Management" is now planned to bring together GIS professionals to share their experience.

The WII's GIS facility today is state-of-the-art and regionally exclusive. With the skill, knowledge and experience gained by the professionals associated with GIS at WII, along with the Institute's commitment to develop and support the use of this technology, the GIS facility is bound to continue to expand. Efforts are being made under a UNDP/FAO Program to obtain an additional SUN SPARC workstation and Arc/Info Rev. 7 GIS software along with ERDAS image processing software. This is necessary to keep abreast of the latest advances in this rapidly growing field. Further training of the staff still forms the fulcrum for future development. A second phase of the collaborative effort is a

necessary and logical corollary of this effort and will build on the gains of the first phase. This will be done through the Phase II component of the Indo-U.S. collaboration titled "Identification of potential areas for conserving biodiversity in the Indian Himalaya."

SYSTEMS ANALYSIS (SA)

Systems Analysis allows a better understanding of the functioning of complex ecological systems and can provide managers a predictive tool for resolving serious management problems such as wildlife-people interface conflicts in and around the protected areas. As such, this approach is today being increasingly applied in research and management of natural resources.

From the WII faculty, Dr. B. K. Mishra, a scientist with experience in modeling the functioning of rural ecosystems with special emphasis on energy and monetary flow patterns; and Dr. Ajith Kumar, a quantitative biologist with similar experience in population ecology and habitat fragmentation, were identified for specialized training in this subject area. Dr. Stephen Berwick, a Washington based expert in SA with wide experience working in protected areas in developing countries, and Donald Hunter of NERC, Fort Collins (Colorado) were the U.S. counterparts.

The collaboration commenced with Berwick and Hunter visiting WII in 1989 and 1990 to acquaint their Indian counterparts with the fundamentals of SA and GIS. Topics covered included the driving philosophy and mechanics of systems thinking and the importance of goal seeking and feed back phenomena in biology and how to reflect them in model structure. During this period, STELLA, a Macintosh based user friendly SA software, and EPPL7, a GIS package, were also installed at WII and its faculty trained in their use. Mishra and Kumar in particular gained fair knowledge of the technology and could translate basic model structure into code and depict graphical results on the computer.

A training workshop on Systems Analysis and Ecological Systems Modeling Methods was conducted by the SA team on 21-22 September 1989. It was attended by members of the WII faculty and researchers. The participants developed the skills needed to produce a focussed, appropriate model structure which could generate a working model. Rajaji National Park near Dehra Dun was made the basis for this workshop and a basic model structure of its people-wildlife system was generated which could be of use for various purposes, e.g. testing management policies and developing research priorities. A similar workshop to generate models on wildlife-people systems was carried out on the Narmada Sagar studies being done by WII.

Berwick returned to WII again in February-March 1990. During this visit, a workshop on Integrated Planning Technology was conducted by the WII faculty at the Ranthambhore Tiger Reserve (Rajasthan) in collaboration with USAID's multi-disciplinary team which was separately investigating opportunities for ecodevelopment in the buffer zone of the reserve. This was attended by representatives of the various interest/user groups in the area. Based on the deliberations at this workshop, the WII faculty developed a tentative model for the tiger reserve.

As part of the joint programme in SA, Mishra and Kumar went on a 70-day study tour (March-June, 1990) to the United States and Thailand. Funded through a FAO/UNDP fellowship, the tour was planned by Berwick so as to give the Indian scientists experience in the application of the systems approach to resource management and research, and also to show them several fully developed GIS facilities and give them hands-on experience in GIS in at least one of them. The capability accrued from the training would help prioritize WII's research, plan integrated ecodevelopment in the buffer zones of India's protected area network system and analyze environmental impacts of large river dam constructions.

At the University of Maryland's Chesapeake Biological Laboratory (United States) and the Asian Institute of Technology's Natural Resource Department (Bangkok, Thailand), Mishra and Kumar were exposed to the latest and the best in the various uses of STELLA and the efforts to link raster based GIS and system dynamics STELLA models. While the exposure was valuable, it was eventually realized that this linkage was still in development and was not yet a practical tool in resource management. At the University of Maryland, Mishra and Kumar enhanced and refined the Ranthambhore model which they had prepared after the "Integrated Planning Technology" workshop at the Ranthambhore Tiger Reserve earlier in the year. This was then presented at a meeting in the WWF office in Washington D.C. and was well received. A part of this was later also presented at the "Second International Symposium on Advanced Technology in Natural Resource Management" at Washington D.C. in November 1990.

The National Ecology Research Center (NERC) at Fort Collins, Colorado, provided training in digitizing and habitat suitability index modeling, besides interaction with range land system analysts. At the University of California, Santa Barbara, the Indian scientists learned about forest growth models which have been successfully used worldwide over the past two decades. They were also shown the application of a global climate model which is used to evaluate effects of changed temperature and rainfall conditions on forest growth due to the global warming process. The scientists at this university have also been using past weather records to predict future weather conditions. Some of these approaches may be adapted to model the changes in structure and composition of the protected area forests of India in response to the people's use of forest resources. At the university itself, the WII faculty also visited the National Centre of Geographic Information Analysis to see its well known GIS laboratory and learn about its GIS course curriculum for university students. At the Science Application International Corporation (SAIC) in Santa Barbara, California, Kumar and Mishra saw the advances made in environmental impact assessment (EIA) analysis.

A short visit to the Conservation Data Centre at King Mahidol University, Bangkok (Thailand) provided an opportunity to discuss mutual experiences in handling wildlife data bases. The WII scientists also interacted with the officials in the Royal Forest Department of Thailand on ecodevelopment related works.

Returning home, the Indian counterparts have been able to pursue their interest and research in SA further. They have prepared a curriculum in the subject for the post

graduate M.Sc. (Wildlife) study course, and have presented lectures in all the long and short term training courses. Efforts to refine the Ranthambhore model continued with the inclusion of new parameters and updating old data. Although the training in SA has been of a basic nature, the application of the technology to planning of buffer zone programmes is found to be of considerable value and will help WII plan environmentally sustainable development of park side communities.

HIGH ALTITUDE ECOLOGY (HAE)

Mountains play a key role in shaping regional bio-climate, hydrology, soil productivity, biodiversity and land use patterns, and yet they are intrinsically so fragile that the slightest perturbation can lead to serious and long term ecological problems. This is even more true of a mountain system like the Himalaya which has a dominant influence over India's well being, but which is geologically still young and yet to settle.

In the last several decades degradation in the Himalaya has become a serious cause of worry for environmentalists, academicians, resource managers and the people living therein. It is appropriate that WII should look into the Himalayan issues of concern and take up High Altitude Ecology (HAE) as an area for study and research. In fact at WII this subject area has been given a priority-one rating for research purposes. The HAE sector of the WII-FWS collaborative project started with the objective of strengthening WII's research capabilities in the mountain areas. This would help in the collection and collation of data relevant to better management of those regions.

The HAE component had two sub-components: trans-Himalaya and alpine Himalaya. The trans-Himalaya is the cold desert region of the Himalaya over 12,000 feet in altitude. The objective of the trans-Himalaya component was to improve the field methodology for studying mountain ungulates and review the data collection for WII's ongoing research study by R.S. Chundawat on the ecology of snow leopard and associated prey species in Hemis National Park, Ladakh. This study was a follow-up to an earlier WII-FWS-International Snow Leopard Trust (ISLT) survey project (1985-1986) for the snow leopard and associated species in the Northwest Himalaya. Dr. Joseph L. Fox, a U.S. scientist with the Institute of Biology and Ecology, University of Tromso, Norway, was selected as the counterpart for the trans-Himalaya sub-component. Fox who had been associated with the 1985-86 survey project visited the study site twice during 1989 and provided technical help to Chundawat, while Dr. G.S. Rawat, a high altitude botanist, provided the habitat ecology study inputs.

During the same year (June-July 1989), Chundawat undertook a one month study tour to the United States which was arranged by FWS and was partially supported by the International Snow Leopard Trust (ISLT), Seattle (Washington). This included working with ISLT, the University of Montana, and NERC at Fort Collins, Colorado. The training provided the researcher valuable exposure to techniques associated with wildlife research in mountain ecosystems and also in the use of the GIS techniques for the snow leopard research study. These techniques were found to be very useful for extremely remote and inaccessible areas where physical surveys are difficult, time consuming and

expensive. During Chundawat's visit ISLT identified certain WII equipment needs for high altitude work and then acquired these items for the Institute.

The U.S. visit also helped Chundawat establish a time-frame to complete his Ph.D. including a tentative outline and schedule for his research. Fox assisted Chundawat with the preparation of the presentations made by the latter in the United States and with a paper on Chundawat's snow leopard project. This was presented by Fox himself in October 1989 at the Sixth International Snow Leopard Symposium held in Alma Ata, USSR.

As a major activity of the joint collaboration under this subject, a "High Altitude Ecology Workshop" was organized on 3-5 July 1990. The preliminary planning for this workshop was done during Fox's visit in August 1989. The workshop was intended to help in setting priorities for future work in high altitude areas. This was WII's first attempt to bring together India's researchers and managers working in high altitude areas.

The HAE workshop was initially desired to be a gathering of wildlife researchers and managers working in the Indian Himalaya so as to focus on wildlife ecology and management problems in these regions. However, participants also came from other montane areas in the country, namely the Western Ghat (Kerala), Aravalli (Rajasthan) and Vindhya (Madhya Pradesh).

The workshop was held at the Forest Research Institute, Dehra Dun, where WII was then located. It was attended by 68 participants (including 31 from WII) representing academic institutions, autonomous government organizations, forest departments, wildlife management agencies, and non government organizations, and representatives from the Smithsonian Institution and ISLT.

Besides the snow leopard study in the trans-Himalaya, WII's two other high altitude studies, a habitat ecology study at Kedarnath, Garhwal (Western Himalaya), and the Takin survey in Arunachal Pradesh (Eastern Himalaya), provided the regional framework for the workshop. The ideas and discussions generated in the workshop explored the broad and difficult decisions facing wildlife managers in montane areas, and outlined guidelines that would be helpful in developing comprehensive strategies and action plans for the conservation of fragile mountain ecosystems.

A major recommendation to come out of the workshop was that there be more and better managed protected areas in the high altitudes. As yet, the Protected Area network was in a state of flux in terms of size, location, legal status and management strategies. The lack of definitive data for many species made management decisions difficult. As such conducting basic surveys of wildlife occurrence and abundance needed to be taken up as a priority. Such surveys and other research must be the responsibility of not only WII but, more importantly, the state forest/wildlife departments.

The other major recommendation concerned the human habitations in and around the protected areas. It stressed the need to address the economic development of these people

The objective of the alpine Himalaya component was to develop the skills of WII faculty in habitat inventory and plant community ecology for alpine regions. Dr. Rawat was identified for specialized training under this sub-component and went on a U.S. study tour in August-September 1992. He visited various high altitude research sites such as the Institute of Arctic and Alpine Research (INSTAAR) at the University of Colorado; USDA Forest Service's Rocky Mountains Forest and Range Experiment Station (RMFRES) at Fort Collins, Colorado; Konza Prairie Long Term Ecological Research (KPLTER) site and laboratory at Kansas State University; and Missouri Botanical Garden (MBG) at St Louis, Missouri. Detailed discussions on the methods of identifying and mapping various micro sites (for species distribution) and mesosites (for vegetation composition and biomass distribution) including methods for mapping plant communities and collection of data on the geobotanical aspects for long term vegetation monitoring were useful. At Glacier Lakes Ecosystem Experiment Site (GLEES), Wyoming, he saw an ongoing integrated ecosystem level research program where the effects of atmospheric changes on alpine and subalpine ecosystems and the upper treeline ecotone were being studied. Other study subjects covered alpine grasslands ecology and in-situ plant conservation. Rawat also saw the use of GIS techniques for monitoring long term changes in the vegetation and various factors of the ecosystem (such as snow packing, depth of organic layer, soil chemistry, soil moisture, etc.), an exercise that would prove useful in the Indian Himalaya.

Dr. Donald A. Walker of the Institute of Arctic and Alpine Research, University of Colorado, became the counterpart for the alpine Himalaya sub-component and visited WII in October-November 1993. The main objectives of his visit were: (1) to provide training in methods of sampling and analysis of alpine vegetation; (2) to hold discussions leading to the development of a hierarchic geographic information system for the Himalayan alpine study areas; and (3) development of a strategy for long term monitoring of anthropogenic and climatic changes in the alpine regions. The visit mainly included overviews of ongoing research projects in high altitudes and training at the Institute; trips to the Valley of Flowers and Kedarnath Musk Deer Sanctuary areas in the Western Himalaya to gain background knowledge for two of the main field areas in this segment of the HAE programme; and seminars and training sessions for geobotanical research in alpine regions.

This collaboration has significantly increased WII's research and management capabilities in high altitude areas. So far, two major projects (viz. snow leopard study in Ladakh, and large mammal-habitat ecology project in Kedarnath) have been completed and the researchers involved in these projects have since been absorbed into WII as permanent faculty. Currently there are four major research projects in high altitude areas under the supervision of WII faculty. Moreover, all the other projects too have benefitted, directly or indirectly, from the HAE sector of the WII-FWS project.

WETLAND ECOLOGY AND MANAGEMENT (WEM)

From the conservation point of view, freshwater and coastal wetlands have hitherto been largely seen as areas for the protection of fish and wildlife. Their ecological values as "nature's kidneys" and accordingly, their importance as areas for water management and conservation have been recognized only recently.

Today, wetlands have been accepted as one of the vital subject areas in the country's future wildlife conservation programme. It was also identified as an important component in the WII-FWS joint project. However, for a considerable period, there was no specialist faculty assigned to this subject programme at WII. The Indo-U.S. Science and Technology Subcommission's Environment and Ecology Working Group meeting in October 1991 reiterated the importance of this subject area for future collaboration. The mid-term evaluation of the WII-FWS project noted the need for appointment of a faculty member in this subject area.

Subsequently, the wetland subject area was broadly classified into freshwater and marine wetlands, and Mr. B. C. Choudhury and Mr. Sanjeeva Pandey were assigned to this programme. While Choudhury's interests lay in coastal and riverine habitats, Pandey's major area of work was in the inland lake systems with emphasis on avifauna. Dr. A. Lee Foote from the FWS' National Wetlands Research Center, Lafayette, Louisiana was selected as the U.S. specialist on the subject. (This center is now assigned to the U.S. National Biological Service and is known as the Southern Science Center.)

In July-August 1992 Choudhury and Pandey went on U.S. study tours, each according to his separate areas of interest and specialization. Choudhury's emphasis was on interaction with U.S. scientists on wetland research and management both at the species and habitat levels. His itinerary exposed him to ideas that would help him with his present and future research studies at WII.

Choudhury visited Foote at NWRC where he was introduced to seed-bank studies based on core-samples collected from wetland beds, impact of nutria damage to habitat, and utilization of mammalian resources in wetlands. He also visited the Louisiana State University which is involved in developing biologists for field research and long term monitoring programmes by state wetland management agencies. This integration of university research and state managed specialized research agencies and protected area managers was appreciated. Choudhury participated in an aerial survey for marine mammals over the Gulf of Mexico, courtesy of the National Oceanic and Atmospheric Administration and National Marine Fisheries Research Centre, which provided him insight into the logistics, techniques, and use of data in regional development plans. Of more immediate interest was the interaction with Dr. Ren Lohofener on FWS' marine turtle recovery plan, and the monitoring of predation pressure on sea-turtle nests involving volunteer university students during holidays. The exploratory interaction with Dr. John Clark, a marine protected area planner, on developing a training course with emphasis on integrated coastal zone management was valuable in light of a marine protected area under development in India. WII is planning to train managers in this special category.

While in the United States, Choudhury attended the "International Turtles & Tortoises Conference" at the New York State University, 11-16 July 1993, and presented the research methodology and findings of the WII-FWS collaborative freshwater turtle and land tortoise conservation project, a separate WII-FWS cooperative venture. He also participated in the "Eighth Symposium on Coastal and Ocean Development - Coastal Zone 93" at New Orleans, Louisiana, 19-23 July 1993. He presented a seminar on "Research and Management of Endangered Aquatic Fauna in India - The Role of the Wildlife Institute of India" at NWRC.

Pandey's study tour covered the United Kingdom and the United States. In the United Kingdom, he visited the International Waterfowl and Wetlands Research Bureau, Slimbridge. His discussions there focussed on new research initiatives in wetlands, with emphasis on people related aspects of protecting and managing wetlands.

Pandey's interactions in the United States covered subjects such as impact assessment of dams, wetland plant ecology, water level management, estuarine ecology and captive breeding of waterfowl. He met with Dr. David Cooper, Colorado State University, Fort Collins, who has been working on restoration of rivers and wetlands and has set up a series of experiments to look at the impact of dams. At Lafayette, Louisiana he met Foote whose work on Louisiana coastal wetlands is critical for informed decision-making on the effects of planned, deliberate human interference in wetland hydrology via impoundment and management. The visit included the FWS' Patuxent Wildlife Research Center, Laurel, Maryland which has successfully conserved the endangered Whooping Crane ex situ, and has run specific captive breeding programmes. Particularly impressive were the General Care Protocol for food, water, health, and pen maintenance being used for different species on a daily or annual basis. He also visited the Lilian Annette Rowe Sanctuary along the Platte River in Nebraska. It was established by the National Audubon Society for the conservation of migratory cranes and other aquatic birds on land purchased from people who shared a concern for the Platte and its wildlife.

Pandey presented seminars on wetland and wildlife in the western Himalaya at NERC, Fort Collins; on his Pong Dam Bird Sanctuary work at the FWS Centre in Grand Island, Nebraska; on Himalayan biodiversity and its conservation through ecodevelopment at NWRC, Lafayette, Louisiana; and on manmade wetlands in India and ecodevelopment initiatives for their management at Patuxent Wildlife Research Centre, Maryland. He attended the "Wetland Symposium on Prairie Ecosystems: Wetland Ecology, Management and Restoration", North Dakota, 11-12 August 1993, and presented a paper titled "Changes in waterbird diversity due to the construction of Pong Dam Reservoir, Himachal Pradesh, India."

These study tours helped Choudhury and Pandey fine-tune their own ideas and skills in both research studies and teaching, as well as in developing management plans for wetlands.

Foote came to India in January-February 1994 for the purpose of exchanging information with WII faculty on wetland aspects and to help strengthen the course

curriculum on wetland ecology. During his stay, he traveled to representative wetland problem areas throughout India, presenting seminars and holding discussions with state wildlife managers.

In Dehra Dun, he visited the Herbertpur Reservoir where he assisted Pandey with a waterfowl survey. With Pandey, he also traveled to Himachal Pradesh, and with Choudhury he visited protected areas and some institutions in the Bombay, Gujarat, Madras and Calcutta regions effectively covering representative areas of the entire country. At WII, he gave a talk on "The National Wetlands Research Center Research Programme on Marsh Management" to the faculty and trainees. He also made presentations at several protected area locations, universities and institutions.

While the subject of wetlands has taken an important position in current conservation thinking and endeavors, and there are several study plans on the anvil as well, it is not WII's intention as yet to develop it as a major programme. This is essentially because in India two other organizations, the Bombay Natural History Society (BNHS), Bombay, and SACON in Coimbatore have already been vigorously pursuing research work in this field; and it would be of no benefit at present for WII to duplicate such studies. More purposeful would be closer interactions between the three organizations. Steps have been taken in this direction and SACON will be directly involved in projects that form part of Phase-II of the WII-FWS collaboration.

However, exposure to issues and emerging trends in wetlands management and conservation helped Choudhury and Pandey in their respective study projects and programmes. It also assisted in upgrading WII's regular training and educational programmes. The Institute is planning to hold a course on the subject for wildlife managers of the SAARC (South Asian Association for Regional Cooperation) countries in the near future.

WILDLIFE HEALTH (WH)

Rapid environmental degradation and loss of suitable habitats has led to decreased nutrition and lower resistance to disease in India's wild animals. Animal crowding raises the concentration of pathogenic organisms in the environment and their transmission to wild populations resulting in increased morbidity and mortality. At the same time, with the increasing intermingling of wild and domestic animals due largely to space pressures, the transmission of infectious and parasitic diseases has the potential for catastrophic consequences for both populations. As such, the subject of wildlife health becomes intrinsic to both wildlife ecology and animal biology, and vital for the planning and execution of wildlife management programmes.

Studies of wildlife diseases in India have been minimal. But responding to the felt need, health maintenance in free ranging and captive wildlife has today been accepted as an integral part of a comprehensive wildlife management programme. Wildlife health has been a part of WII's programmes since the very outset. In 1982 at the international wildlife research and management workshop in Kanha National Park, Dr. Albert W.

Franzmann from the Alaska Department of Fish and Game provided a useful basis of introduction. In 1985 under FAO sponsorship, he returned to India and spent six months at the Institute. At the end of that period he made cogent recommendations for the improvement of the wildlife health programme. Thus as part of the Indo-U.S. collaboration, it was planned to improve this facility and capability at the Institute. Dr. Milton Friend, Director, and Dr. F. Joshua Dein, Veterinarian, both from FWS' National Wildlife Health Research Centre (NWHC), Madison, Wisconsin visited WII in May 1989 to identify the Institute's needs and draw up a programme for collaboration in this subject area. Dein and Dr. Louis Sileo (NWHC) were identified to stay at WII for three months each. While Sileo would cover research methods, disease investigation and pathological techniques, Dein would focus on veterinary and laboratory procedures and immobilization. (The NWHC is now assigned to the U.S. National Biological Service.)

Sileo was at WII during July-September 1989. He provided training to WII's Dr. P. K. Malik in wild animal sampling methods and demonstrated necropsy techniques to the Institute's M.Sc. students. Sileo also assisted Malik, other faculty and a researcher in surgically implanting a radio transmitter in an otter at the National Zoological Park, New Delhi as a trial for establishing the technique before it was used in the field. Assistance was also provided to the wildlife department of Haryana in wild animal translocation, and training was provided to the staff at the Keoladeo National Park, Bharatpur in the capture of feral cattle by chemical immobilization.

Dein followed Sileo at WII during September-December 1989. He, Sileo and Malik conducted a workshop on "Wildlife Health Monitoring and Disease Survey" at WII on 26-28 September 1989. They were assisted by Dr. Julie Langenberg from the International Crane Foundation, Wisconsin, a guest visitor to WII, who covered wild avian health aspects. In all there were 24 participants: research and veterinary officers from state wildlife organizations, scientists from the Indian Veterinary Research Institute (IVRI) and the Haryana Agricultural University.

The theme of the workshop was 'Field Investigation of Wildlife Diseases'; and the objective was to provide training to the wildlife managers, biologists and veterinarians on prevention and control of disease problems in free ranging animals. The major topics covered were important bacterial, viral and parasitic diseases of wild animals, and safety considerations for both wildlifers and investigators. A special emphasis was laid on recording and submitting specimen history data, specimen collection and preservation, and transport of samples. Disease prevention and control measures were also discussed. As part of the workshop, the participants were taken to Rajaji National Park for a field exercise in the physical health assessment of wild animals and sample collection.

After the workshop, Dein, Sileo and Malik visited several national parks. They also met with the faculty and research staff of a few veterinary schools and the Indian Veterinary Research Institute. While the need for a wildlife health programme in the country was generally accepted, the paucity of funds was considered a major hurdle in its introduction.

Dein's major activity during his stay at WII was in formulating along with Malik, a draft planning document for the wildlife health programme at the Institute. Through interaction with the WII's Director, the following five areas of interest were identified :

(A) Improve the wildlife health curriculum included in WII's various courses.

(B) Develop animal capture and restraint as an independent course.

(C) Support WII faculty and research projects, particularly those which require animal capture and handling, sample collection, post-mortem examination and surgical implantation of radio transmitters.

(D) Assist state governments through provision of training and consultancies and produce an instructional manual on wildlife health issues for use by state forest departments and other interested agencies.

(E) Conduct research projects on wildlife health either independently by the Institute or as collaborative projects with veterinary colleges. One such independent project proposal developed was on the study of diseases of free ranging ungulates in Sariska Tiger Reserve, Rajasthan.

Dein and Malik also conducted an experimental study on the use of the new anaesthetic drug, Telazol, for capture of free ranging and captive spotted deer. Though the results obtained were encouraging, these were insufficient as the experiment was conducted on only captive animals.

Dein provided guidance to a couple of research projects on sterilization methods and on collecting skin samples without having to immobilize the animals. He also helped procure technical information that would be useful in future research work, and obtained ARK (Animal Record Keeping) software for use in WII's consultancy project on zoo management and captive breeding. During Dein's stay, he installed and advised Malik on the use of equipment that had recently been acquired for the Institute's new wildlife health laboratory.

Malik was in the United States from January to September 1990 for training funded through a FAO fellowship programme. He was located at the School of Veterinary Sciences, University of Wisconsin, Madison where his training was coordinated by Dr. Thomas M. Yuill. Besides pursuing academic course work, Malik interacted with Friend and Dr. David Brunson of the University of Wisconsin on developing a course syllabus for WII's wildlife health programme. They prepared a project proposal titled "Sero-epidemiological and Clinico-pathological Studies on Some Infectious and Parasitic Diseases in Wild Ungulates and Their Relationship with Livestock." The project, duly modified in consultation with specialists at IVRI and another veterinary school, has since been approved and is being carried out at Sariska Tiger Reserve, Rajasthan. While in the United States, Malik also gained experience in disease investigation methods at NWHC.

A workshop was organized on "Wildlife Immobilization" at Kanha National Park, Madhya Pradesh on 2-6 December 1991. It was conducted by Brunson, Dein, Malik, Dr. S. Chowdhury (WII) and Dr. P. C. Kotwal (Kanha National Park). There were 34 participants from various states including wildlife managers, veterinarians and scientists/biologists from research and academic institutions. The workshop provided both theoretical and practical aspects of immobilization: basic biology, anatomy, physiology and pharmacology of chemical restraint drugs; dosage (also drug usage for specific animal groups); monitoring of darted animals; record keeping; transportation including human exposure; health risks and emergency handling. A manual on "Chemical and Physical Restraint of Wild Animals" along with some anaesthesia monitoring equipment and a blowpipe system was given to the participants.

Malik went on a WII/FWS project supported study tour to the United States again in March-April 1994 which exposed him to wildlife disease monitoring methods. Among the wildlife health facilities that he visited were the Milwaukee County Zoo, Wisconsin, to look at its bird collection plan and the animal record keeping system; University of California Davis Veterinary Hospital & Clinic to discuss diagnosis of animal diseases and other control measures; Department of Epidemiology & Preventive Medicine, University of California to discuss their M.Sc. programme on preventive veterinary medicine; College of Veterinary Medicine, Texas to study their methods of diagnosing tuberculosis through blood tests; and Texas A&M University to understand its Marine Mammal Research Programme of which physiology and nutrition is a major part. Interactions with various wildlife health specialists such as Drs. David Jessup, California Department of Fish and Game; Dr. Murray Fowler, University of California-Davis, School of Veterinary Medicine; and Dr. Jim Carpenter, Kansas State University, College of Veterinary Medicine covered various aspects of wildlife health. At California, Malik participated in capturing black-tailed deer using helicopter and drive nets. This was done to radio-collar them and collect blood samples for a serological survey.

Malik also attended the 44th Annual "Disease in Nature Conference" at Austin, Texas (6-7 April, 1994), and delivered a talk on "Biodiversity in India: Problems and Prospects" at the Department of Wildlife & Fisheries Science, Texas A&M University. At NWHC, Madison, Malik met with his subject counterpart, Dr. Josh Dein, and they discussed the "Cooperative Wildlife Health Programme" that seeks to develop facilities and manpower in the veterinary schools in India for the Phase II collaboration between WII and FWS.

The joint work on the subject area has led to a substantial input of wildlife health in the Institute's programmes. But it is also true that WII alone cannot provide wildlife disease investigation services for the entire country, for which additional regional centres, with appropriately trained staff would be needed. It is towards meeting this lacuna that the "Cooperative Wildlife Health Programme" has been conceived: to advance the capabilities of veterinary colleges in providing diagnosis and investigation of disease outbreaks; to promote information exchange; and to provide education and consultation to wildlife managers, biologists and veterinarians. This is very feasible due to the proximity of many veterinary colleges equipped with diagnostic laboratories to large wildlife areas.

ANIMAL DAMAGE CONTROL (ADC)

Quite often wild animals invade human habitations and damage standing crops in the fields or create other problems. Remedies are needed to prevent material losses and prevent people from becoming antagonistic toward wildlife. For WII, this aspect of wildlife management cannot be ignored. It is very much a part of the Institute's research agenda. A study seeking appropriate methods to control the damage being inflicted by nilgai and blackbuck in some areas of Haryana has been undertaken and completed. The Institute has also been offering consultancy on the subject.

The WII-FWS collaboration in this subject area sought to seek and develop appropriate methods to check the culprit animals and mitigate the damages caused by them. Dr. N.P.S. Chauhan from WII was the designated faculty in this subject area.

Chauhan was sponsored by FAO for a study tour to the United States in March-May 1990. The objective was to familiarize him with various damage problems and the physical and chemical mitigation methods used. Particular emphasis was placed on animal population control measures using anti-fertility drugs and hormones and embryo-transfer techniques. The training also sought to expose him to extension education in vertebrate pest control.

The visit took him to various universities, institutions and field research stations. His studies at these sites covered animal capture techniques, data collection procedures, regulation of the reproductive activity of free-ranging herbivores, developing animal damage control curriculum and the role of extension in creating awareness among the local people in problem areas to help find effective solutions.

During his stay in the United States, Chauhan attended the "Vertebrate Pest Control Conference" at Sacramento, California and presented a paper on "Crop Damage by Over-abundant Population of Nilgai and Blackbuck in Haryana (India) and its Management." He also attended the "Conference on Predator Management in North Coastal California" at Hopland, California, and the "55th North American Wildlife and Natural Resources Conference" at Denver, Colorado.

To plan the animal damage control component of the project, Dr. John R. Tester, University of Minnesota, came to WII in July 1991. He proposed testing anti-fertility drugs on target species. However, it was felt that pursuing research on the use of anti-fertility drugs as a means of controlling overabundant problematic animals may not be appropriate for India at this stage. It was consequently decided to develop mass capture techniques for translocation and restoration of animals, and Dr. David A. Jessup, Veterinarian, Department of Fish and Game, California was identified as the U.S. specialist for further work in this subject component. He visited WII in March 1993 to interact with Chauhan. The two visited field sites in Haryana and Madhya Pradesh, and it was decided to hold a field workshop on wildlife damage and control. (During his visit, Jessup also participated in the workshop on Field Research Methods.)

A workshop was conducted on "Wildlife Damage Problems and Control" on 2-7 February 1994 at Madhav National Park, Shivpuri and Great Indian Bustard Sanctuary, Karera, Madhya Pradesh. The objective of the workshop was to bring together wildlife damage control workers, wildlife managers and scientists, and to discuss and share their knowledge and experiences on the subject. In all, there were 95 participants from various parts of the country including three from the Kingdom of Saudi Arabia - officials from the forest departments, scientists and researchers from universities and research institutions, and representatives of electric fence equipment manufacturers. On the first two days, there were seven different sessions conducted wherein 44 scientific papers, case studies and reports relating to wildlife damage problems and management issues were presented. During the remaining days various capture techniques such as the use of corral, drop net, drive net, rocket net, and net-gun were demonstrated. Immobilization equipment and relevant films were shown, and the electric fence manufacturers displayed their equipment. Being the first workshop of its kind organized in India, it helped in identifying field managers and scientists actively engaged in wildlife damage control work in the country.

Prior to this collaborative programme, the Institute was already providing consultancy on animal damage control to state government and other organizations. The capacity and capabilities have been considerably strengthened with this Indo-U.S. collaboration.

LIBRARY AND DOCUMENTATION (L&D)

Under this component, Ms. Ell-Piret Multer, a FWS Library Science Specialist with FWS's National Fisheries Contaminant Research Center, Columbia, Missouri, visited WII in January 1991. At the time, the library building was still under construction. Multer advised on the physical organization of the library in the new campus. She recommended acquisition of a CD-ROM (Compact Disc-Read Only Memory) reader which was acquired by the project and set up in the library. After the FWS provided WII a five year CD-ROM subscription to the Wildlife and Fisheries Review and Biological Abstracts, WII was able to access bibliographic references of relevant literature through the use of key words.

The Wildlife and Fisheries Review database covers world literature on mammals, birds, reptiles, amphibians and fish; and includes studies ranging from individual species to management techniques, wildlife behavior, specific habitat types, hunting, economics, diseases and parasites. The Biological Abstracts on CD contain records from its six issues published in 1989.

The library has since developed to become one of the best in the country on wildlife, containing more than 13,000 books besides reference books, theses/dissertations, reprints, maps, journals and other periodicals. The ultimate aim for the library is that it become a national information centre for wildlife management, conservation and related disciplines.

The following subject areas were separate components of the initial WII-FWS collaboration, but no full-fledged, independent programme came to be developed therein :

HABITAT EVALUATION (HE)

This component was intended to develop techniques for the analytical evaluation of habitats including remote sensing. It was, however, not taken up independently as the desired material was covered in other subject areas, particularly the components on GIS, Field Research Methods and High Altitude Ecology.

CAPTIVE BREEDING (CB)

This component was originally planned to cover captive breeding aspects of endangered species and species of economic importance with two sub-components: mammals and birds. Since the Crocodile Breeding, Management and Training Institute at Hyderabad had been combined into the newly created WII, sufficient expertise already existed for this faunal group.

Dr. M. Alan Jenkins of the George Miksch Sutton Avian Research Center (GMSARC), Bartlesville, Oklahoma, visited WII in October-November 1990 under this component. He held in depth discussions with WII personnel about goals and objectives for captive breeding programs. He also lectured to WII's faculty and students on the GMSARC eagle restoration programme. Jenkins visited several sites around the country that had captive breeding facilities. He was of the opinion that such facilities in India were not advanced far enough to engage a large scale programme of breeding birds in captivity; and so, even WII's plan of developing a pool of scientific expertise on avian captive breeding might have been a bit premature. Some important basic steps, such as avian population surveys, were needed before captive breeding programs could be launched.

The interaction between U.S. specialists and WII scientists outlined the necessary survey and research areas and provided some thoughtful insights into the type of captive breeding efforts WII could effectively become involved in. For the U.S. specialists, their gain in knowledge of the state of Indian efforts at captive avian breeding may have a future value.

Though this subject component had no concrete outcome, the Indo-U.S. interaction was helpful to WII in providing information and knowledge necessary for making decisions about what role they could/should have in this subject area. WII decided not to establish its own captive breeding facilities. But with the participation of Dr. Desai has increased activity with India's Central Zoo Authority, developed a series of regular zoo related training programmes, workshops, etc. and provided technical expertise to this field. Dr. Desai is the former Director of the Delhi Zoo and was deputed to WII in 1986.

COLLABORATION-PHASE II

The 1989-1994 WII-FWS joint project assisted in the development of the Wildlife Institute of India by enhancing the professional competence and capabilities of its faculty. It was only logical that there be a follow-up. Not merely as a test of the competence acquired, but also as an effort to consolidate the gains of the original collaboration. And so it is, a second phase of this Indo-U.S. collaboration is now in the offing for the years 1995-2000.

While the first phase of the WII-FWS collaboration was focused on faculty and facilities development, the second phase will include specific research projects whereunder field and laboratory research will be conducted by Indian scientists with active support of U.S. scientists. Other projects will also examine and adopt state of the art technology and concepts in the field of management and conservation of natural resources. Seven projects have been selected for this, which are broadly directed either at management oriented biodiversity research, or at developing laboratory or field technology and curriculum.

WII and FWS remain the main agencies in this further Indo-U.S. collaboration. The research centers which were closely associated with the wildlife health and GIS components of the first phase of this programme will continue to be involved although they have subsequently been transferred from FWS to the U.S. National Biological Service and will be reassigned to the Biological Research Division of the U.S. Geological Survey on October 1, 1996. In India, the Indira Gandhi National Forest Academy (IGNFA), the Salim Ali Centre for Ornithology and Natural History (SACON), Coimbatore and four veterinary colleges will also be actively involved in some of the projects. In addition, USDA Forest Service will continue its involvement with WII under a separate project with its origin in Phase 1 of the WII/FWS program. This project will be known as "Management of Forests for Biodiversity and Productivity - A New Perspective."

The seven new projects are :

1) Identification of potential areas for conserving biodiversity in the Indian Himalaya

This project will examine biodiversity requirements of the snow leopard in the alpine and sub-alpine Himalaya. While short listing the hot-spots in the Himalaya for intensive conservation inputs, the project will provide a major opportunity for application of the GIS skills and facilities of the Institute.

2) Evaluation of Panna National Park in Madhya Pradesh with special reference to the ecology of sloth bear

This is a much needed research programme on a species that has not been studied in detail in India. The study will make ample use of telemetry to gain a realistic assessment of sloth bear movements and habitat utilization. The project will also involve a countrywide survey of the species.

3) The relationships among large herbivores, habitat and humans in Rajaji-Corbett national parks

This project will focus on habitat fragmentation caused by human developments and biotic pressures caused by pastoralists who live in the forest and villagers living in proximity to forests. The objective will be to develop large scale ecosystem models that will allow humans and wildlife to coexist. This will be done by examining landscape use patterns by large mammals (primarily herbivores) and humans.

4) Impact of fragmentation on the biological diversity of rainforest small mammals and herpetofauna of the Western Ghat mountains, south India

The south Indian rain forests, confined to the Western Ghats mountain ranges, have a very high biodiversity, particularly flora, herpetofauna, and small mammals. Nearly a century of human activities in this area have removed vast areas of rain forests. The remaining rain forests (ca. 5000 km²) occur as a number of isolated small fragments which differ in their size, shape, isolation and type of ownership. This project proposes to make an assessment of the conservation value of the remnant patches and of the management options to retain or improve these values.

5) Establishment of a wildlife forensic capacity at the Wildlife Institute of India

Wildlife species native to India are exploited illegally for the trade in products derived from them. Enforcement of wildlife protection laws is often hampered because of the lack of materials and methods necessary to identify the species source of evidence. This project will develop identification procedures and assemble reference materials for vertebrate species to provide law enforcement support to the wildlife conservation effort.

6) Development of an Indian Cooperative Wildlife Health Programme

WII does not have the facilities or manpower to provide disease investigative services for all of India, therefore, additional regional centers, with appropriately trained staff are needed to conduct wildlife health monitoring programs and provide timely consultation and investigation of mortality events. This project will pool the resources of WII and Indian veterinary colleges to form a cooperative wildlife health program similar to the Southeastern Cooperative Wildlife Disease Study in the United States and Canada's Cooperative Wildlife Health Center. This approach is appropriate for India because of the availability of veterinary colleges, with their associated diagnostic laboratories, in proximity to large wildlife areas.

7) Planning and development of interpretive facilities in selected protected areas in India

This project will develop and initiate the implementation of interpretation design plans for three Indian protected areas. These are Corbett, Panna and a third as yet unidentified national park.

As was the case in the first phase, FWS will authorize provision of rupees from the U.S.-India Fund to the Institute, manage project dollar funds, identify U.S. scientists to participate in the various components, make available project equipment purchased in the United States and coordinate activities in the United States. WII will provide administrative support, contract researchers and other staff for the projects, conduct research, procure equipment locally and generally coordinate project activities in India.

The five-year Phase II WII-FWS collaboration will have both a rupee and a dollar budget as did Phase I. The rupee budget will be used for activities within India, and has been obtained from the U.S.-India Fund. Dollar funds will be required for expenses to be incurred in the United States such as purchase of equipment which can not be acquired in India and travel costs for Indian scientists visiting the United States in connection with project implementation. WII and FWS will work together to raise the dollar funds. In that context, in August 1993, FWS facilitated Ms. Krishna Roy of the U.S. National Fish & Wildlife Foundation in conducting a "Grantsmanship Workshop" for the WII faculty. The workshop presented the fund-raising scenario in the United States and discussed ways of raising funds for research. This was followed by a grant writing exercise by the U.S. and Indian collaborators to prepare proposals for submission to grant organizations.

CONCLUSION

The Indo-U.S. collaboration has provided WII's faculty an opportunity to hone their skills and talents, an opportunity that it has used to the fullest. The project has given direction to the development of the Institute and its faculty. WII is already considered a major centre for training and research in wildlife conservation in Asia, for which significant credit undoubtedly goes to this Indo-U.S. collaboration.

It might be appropriate at this time to mention the high degree of dedication brought by both the WII and FWS to this endeavor and the strong commitment to producing practically oriented, workable presentations and technology transfers that were not only state of the art but crafted to fit Indian conditions. The comfortable give and take approach to problem solving is also a tribute to the individual specialists involved. Starting with ideas, the various subject area components were developed to meet Indian needs. This often required major revisions of the focus for each subject. But this was recognized as an important aspect of the Indo-U.S. cooperation.

WII can now more confidently approach its tasks seeking to fulfill the mandates charted out in the country's forest and wildlife policies and plans. Protected area management no longer means simply saving the trees for their timber or individual wildlife species. It entails a holistic integrated approach that includes the management of human habitations in the vicinity. The Satpura Biodiversity project now underway, an output of the collaboration, will underline these upcoming concerns and approaches for conserving wildlife in managed forests.

The interactions on field research methods have led to improvement and streamlining of the study projects in the various subject areas - high altitude ecology, wetlands, wildlife

health, animal damage control, habitat evaluation and socio-economics. In due course, as these improved research skills and techniques get transferred to field officials and individuals, there will be better quality and greater quantity of data collection which, in turn, will lead to better management of wildlife.

Conservation cannot be done in isolation, nor must it be seen to be done so. Conservation awareness of the public at large has become very important, and along with it - communication. The communication media itself has diversified a great deal in the recent past, and an expertise in each has become necessary. The joint project has helped WII faculty achieve this expertise, and despite the fact that some of the assigned and trained faculty members left the Institute, the new entrants have picked up the threads successfully.

A significant part of the joint project was the supply of computers and other equipment to WII and the training of the concerned faculties in their application - particularly the acquisition of hardware and software for GIS and remote sensing, and training in their operation and application. It may be mentioned that GIS is still a fledgling technology worldwide, with a vast potential for being applied in wildlife research leading to improved analytical and modeling techniques.

For the U.S. scientists and specialists, the collaborative experience has been equally worthwhile, giving them an insight into the problems, workings and situations in a developing country which are so very different from those in their own country. In fact, this dichotomy may also have led to one of the few shortcomings of the project - that, at times, it tended to address issues from a standpoint that was, in the context of India, far ahead of its times or not quite relevant. The study tours to the United States particularly exposed the Indian faculty to some such situations. Some of the methodologies learned will, if at all, take some time to be fully employed here. Nevertheless, these have helped the faculty develop a vision for the future which is so very important.

Having said that, it might be added that lacunae have been minimal, and most were evened out in the interactions between the participating members of the two countries. The main objective of the collaboration was to develop WII faculty's capabilities in wildlife research and training, and to provide the Institute with state-of-the-art research equipment - and in this the present project has succeeded.

The WII-FWS joint project has promoted a long term professional relationship between these two agencies. It has fostered similar relationships with other major conservation agencies, namely, the USDA Forest Service, the U.S. National Park Service and the U.S. National Biological Service. These agencies as well as several universities contributed actively to the success of this project. In addition, the project has enabled WII faculty to develop professional links with a host of scientists and their institutions across the world. For WII, this has opened a global window to knowledge and information which is critical for the development of a modern research institution. The international recognition and status which WII has earned over the years is largely due to the new communication channels facilitated by this collaboration.

This project will be seen as one of the foremost examples of international cooperation in wildlife conservation. The gains made in it are now expected to be strengthened, made more broad-based and sustained by a second phase of the Indo-U.S. collaboration.

ANNEXURE-1

STUDY TOURS AND VISITS ABROAD

Mr. H. S. Panwa

Director

August/September, 1989

Mr. Kishore Rao

Nodal Officer

August/September, 1989

Mr. V. B. Sawarkar

12 August-4 September 1989; U.S.A.

6 July-24 July, 1991

30 June - 31 July 1992; U.S.A.

Wildlife in Managed Forests

Mr. H. S. Pabla

Nodal Officer

21 June - 19 August 1992; U.S.A.

Wildlife in Managed Forests

Mr. V. K. Uniyal

30 June - 19 August 1992; U.S.A.

Wildlife in Managed Forests

Dr. A. J.T. Johnsingh

11 June - 14 August 1992; Switzerland, U.S.A. and Canada

Field Research Methods

Dr. P. K. Mathur

12 June - 13 August 1992; U.S.A.

Field Research Methods

Dr. S. Chowdhury

4 June - 6 August 1992; U.S.A.

Field Research Methods

Mr. Suhas Kumar

12 June - 12 July 1991; U.S.A.

Interpretation and Conservation Education

Mr. Rajesh Thapa

14 September -5 October 1991; U.S.A.

GIS and Systems Analysis

Dr. Qamar Qureshi

3 January - 2 June 1994; U.S.A.

GIS

Dr. R. S. Chundawat

11 June - 10 July 1989; U.S.A.

High Altitude Ecology

Dr. B.C. Choudhury

July - August 1993; U.S.A.

Wetland Ecology

Mr. Sanjeeva Pandey

29 July - 21 September 1993; UK and U.S.A.

Wetland Management

Dr. G. S. Rawat

15 August - 18 September 1992; U.S.A.

High Altitude Ecology

Dr. P. K. Malik

*9 January-14 September, 1990 **

5 March - 26 April 1994; U.S.A.

Wildlife Health

Mr. Rabi Acharya

*5 May-12 July, 1990; U.S.A. **

Interpretation and Conservation Education

Dr. S. N. Prasad

*28 March-17 June, 1990; U.S.A. **

GIS

Dr. Ajith Kumar

*28 March-11 June, 1990; U.S.A. **

Systems Analysis

Dr. B. K. Mishra

*28 March-11 June, 1990; U.S.A. **

Systems Analysis

Dr. N. P. S. Chouhan

*2 March-3 May, 1990; U.S.A. **

Animal Damage Control

Dr. S. P. Goyal

*4 January-22 March, 1990; U.S.A. **

Animal Damage Control

** An FAO-UNDP fellowship programme coordinated by FWS under Phase 1*

ANNEXURE-2

U.S. PROGRAMME PARTICIPANTS

Administration and Coordination

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U.S. Fish & Wildlife Service

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Project Mid-term Evaluation Team

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Ordway Professor of Ecosystem Conservation
Florida Museum of Natural History
University of Florida
Gainesville, FL 32611*

*Mr. Peter Jackson
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Minneapolis, MN 55455*

*Dr. Albert W. Franzmann
International Wildlife Veterinary Services, Inc.
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Captive Breeding

Mr. M. Alan Jenkins

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*Dr. Steve Sherrod, Director
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Bartlesville, OK 74005*

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Forest & Rangeland Ecosystem*

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U.S National Biological Service
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Corvallis, OR 97331*

ANNEXURE-III

WORKSHOPS

Systems Analysis and Ecological Systems Modeling Methods

Dehra Dun; 21-22 September 1989

Coordinator: Dr. B. K. Mishra

Wildlife Health Monitoring and Disease Survey

Dehra Dun; 26-28 September 1989

Coordinator: Dr. P. K. Malik

Integrated Planning Technology

Ranthambhore, Rajasthan; March 1990

Coordinators: Drs. B. K. Mishra and Ajith Kumar

High Altitude Ecology

Dehra Dun; 3-5 July 1990

Coordinator: Dr. G. S. Rawat

Integrated Forest Planning

Dehra Dun; 24-26 September, 1990

Coordinator : V.B. Sawarkar

Integrated Forest Planning and Management

Pachmarhi, Madhya Pradesh; 21-27 January 1991

Coordinator: V.B. Sawarkar

Interpretation and Conservation Education

Dehra Dun; 16-24 September 1991

Coordinator: Suhas Kumar

Wildlife Immobilization

Kanha National Park, Madhya Pradesh;

2-6 December 1991

Coordinator: Dr. P.K. Malik

Field Research Methods

Dehra Dun; 26 February-1 March 1993

Coordinator: Dr. A.J.T. Johnsingh

Wildlife Damage Problems and Control

Madhav National Park and Karera GIB Sanctuary, Madhya Pradesh;

2-7 February 1994

Coordinator: Dr. N.P.S. Chauhan

ANNEXURE-IV

REPORTS AND PUBLICATIONS

Berwick, S.; Kumar, A.; Mishra, B.K. Using systems planning for resource development and conservation. Paper presented at the Second International Symposium on Advanced Technology in Natural Resource Management. Washington, DC; 1990 Nov.

Berwick, S.; Kumar, A.; Mishra, B.K. Methods used in modeling Ranthambhore buffer zone system. In: Groenfeld, D.; Alcon, J.; Berwick, S.; Flickinger, D.; Hatzios, M., eds. Opportunities for eco-development in buffer zones: An assessment of two cases in Western India. Biodiversity Support Programme-WWF, Washington DC.

Chauhan, N.P.S. Crop damage by over-abundant populations of nilgai and blackbuck in Haryana (India) and its management. Presented at Vertebrate Pest Control Conference, Red Lion Inn, Sacramento, CA. 1990 March 6-8.

Chundawat, R.S. Habitat selection by snow leopard in Hemis National Park, India. Proceedings of the VIth International Snow Leopard Symposium at Alma-Ata, Kazakstan USSR. 1991:85-92.

Chundawat, R.S. Ecological studies of snow leopard and its associated prey species in Hemis High Altitude National Park, Ladakh (J&K). Jaipur, India: Univ. Rajasthan; 1992. Dissertation.

Chundawat, R.S.; Rawat, G.S. Snow leopard in Ladakh: distribution, habitat use and food habits. Proceedings of the Seventh International Snow Leopard Symposium, Xining, China, 1992.

Chundawat, R.S.; Rawat, G.S.; Panwar, H.S. Ecological studies of snow leopard and its associated prey species Hemis High Altitude National Park, Ladakh. Tech. Rep. No. RRI; 1990. Wildlife Institute of India, Dehra Dun.

Dixit, A.M. Mitigation planning of Narmada Sagar and Omkareshwar Projects using remote sensing and GIS techniques. Paper presented at the Annual Research Seminar, Wildlife Institute of India, Dehra Dun; 1994 Sept. 28-30.

Dubey, Y. Establishing spatial database for conservation and monitoring in Tadoba Tiger Reserve. Presented at the Annual Research Seminar, Wildlife Institute of India, Dehra Dun; 1994 Sept. 28-30.

Foote, A. L.; Pandey, S.; Krogman, N.T. (In Press). Wetland loss in India. Environmental Conservation 23(1):___

Krausman, P.R.; Johnsingh, A.J.T. Conservation and wildlife education in India. Wildlife Society Bulletin. 18:342-347; 1990.

Mathur, V.B. Application of GIS technology in wildlife planning and management in India. Presented at the 14th International ARC/INFO User's Conference, Palm Springs, CA; 1994 May 23-27.

Nath, L. Evaluation and identification of wildlife corridor network between Kanha and Bandhavgarh Tiger Reserves using GIS technology. Presented at the Annual Research Seminar, Wildlife Institute of India, Dehra Dun; 1994 Sept. 28-30.

Prasad, S.N.; Chundawat, R.S.; Hunter, D.O.; Panwar, H.S.; Rawat, G.S.; Remote sensing snow leopard habitat in the trans-Himalayan region of India using spatial models and satellite imagery, preliminary results. Proceedings of Resource Technology 90 ASPRS, Washington, DC. 1991.

Rawat, G.S.; Panwar, H.S.; Fox, J.L.; Chundawat, R.S. editors. Proceedings of the High Altitude Ecology Workshop, Wildlife Institute of India, Dehra Dun. July 3-5, 1990. Technical Report No.1. 1992:73p.

Sawarkar, V.B.; Uniyal V.K. Satpura Diversity. Paper presented at the International Conference on biodiversity in managed landscapes. Sacramento, CA; 1992 July 13-17.

Thapa, R. Mapping of distribution of tigers. Presented at the International Conference To Assess the Status of Tigers, Huay Kha Khaeng Wildlife Sanctuary, Thailand; 1994 Oct. 20-24.

ANNEXURE-V

EQUIPMENT

WILDLIFE HEALTH

Suction Unit, for removal of fluids e.g. during surgery

Dopler Model 811-AL with 2 probes, and one carrying case, blood pressure monitor

Transducer Gel

Sartorius Industrial Scale

PH Meter Orion Model

Katadyn Water Filter

Telazol (immobilizer, 5ML)

Centrifuge #0206

Norcold Refrigerator/Freezer

Microscope, Dual Viewing, Scope Adaptor

Microscope Bulbs

Abbocath-T (intravenous catheter), Abbocath K-9 (intravenous catheter), Ketaset (immobilizer, 100MG), Banamine (analgesic, 50cc)

Telazol (immobilizer, 5ML), Diazepam (immobilizer

Metronidazole (kills parasites, 500mg), Naloxone (reverses effects of immobilizer, 0.4mg/ml), Sterile Vials

Naloxone (reverses effects of immobilizer, 4MG 10ML), Sterile Vials, Metronidazole (kills parasites, 500MG), 100 ML RTU Vial

Telazol (immobilizer, 5ML), Panolog Oint (antibacterial topical ointment, 7.5CC), Diazepam (immobilizer, 5MG/CC 10CC), Anased (used in conjunction with immobilizing drugs, 100MG 50CC), Mannitol (drug used to treat head injuries, 100CC),

Dexco IV Set w/tube (used for intravenous therapy in large animals), Simplex IV Set (used for intravenous therapy), Abbocath K-9 (intravenous catheter), Indwell (catheter for longterm use), Sod Bicarb (8.4% 50CC), Conform Strch Edge 2" (bandaging material)

6 Tray Hiproof Box

M 99 Etorphine HCL 0.1% (2-20 ml sterile multidose vials, used for immobilization)

2-Syringe Connectors

3-Syringe Venting Pins

2-Silicone Sleeves, Green for vario needles

3-5 ml vario Practice Syringe

3-Practice Needles for all syringes

1-CO2 Equipment Set for vario IV Pistol

10-Co2 Powerlet 16 gms. for vario pistol, IV and 4V rifles

3-1.6X38mm Needles

33-1.6 X38 mm Needles, collard

2-Vario 6 ml Syringes

5-Stablizer (Tailpice, red for 3 ml vario syringe

1-Vario IV pistol w/foot pump, 11 mm barrel

10-Stablizer/Tailpice, red/yellow, for 5 ml and 10 ml blowpipe and vario syringes

1-Barrel for IV pistol or IV rifle

3-1 ml Syringe adapted for use in Vario IV pistol and or IV rifle barrels and Vario rifle 3 ml barrels

2-1.5X30 mm Needles

1-Gas Rifle, Model 50

15-Charges for syringes 1-5 ml

10-Charges for syringes 7-10 ml

15-Cartridges white

10-Cartridges black

10-Cartridges orange

20-Cartridges brown

30-Syringe Barrel for 1 ml

20-Syringe Barrels for 2 ml

20-Syringe Barrel for 4 ml

25-Elephant Canula RE6

10-Syringe Canula 16 mm

10-Syringe Canula 19 mm

15-Syringe Canula 28 mm

15-Syringe Canula 28 mm

15-Syringe Canula 32 mm

15-Syringe Canula 38 mm

15-Syringe Canula 28 mm

50-Rubber Pistons

15-Feathered Syringe Stabilizers

15-Syringe Front Piece

15-Complete Syringe 2 ml

15-Complete Syringes 3 ml

20-FLIP Automatic 1 ml Canula 25 mm

20-FLIP Automatic 1 ml Canula 13 mm

20-Syringe Body 2ml Mini-Ject 2 ml

20-Syringe Body 3 ml Nini-Ject 3 ml

15-Softy Syringe 3 ml

20-Woolen Stabilizers

10-25 mm Canula for blowpipe syringes

10-25 mm Canula for softy syringes

15-Easy Syringe 3 ml

5-Plastic Sleeves for canulas

5-Gas Cartridges 65 ml for easy and mini

25-Gas Sparklets for Model 50

1-Sp. Barrel for Model 50

1-Sp. Shooting Device for paintball

20-Paintballs

GIS

Leedex 100 Monitor 12"

Computer Accessories (8 pin male din plug, small battery for IBM, assortment of plugs)

MAP II Map Processor Software

IDRISI: a grid based GIS analysis system

Computer, Desktop, 16MB Ram, 207MB HD, Sun Microsystems (Model 147)

Computer, Micro, portable-laptop w/Internal modem, Toshiba (Model T1100 Plus)

Digitizer, 36" X 48", w/controller, Altek (Model ACT-36048-2BLS)

Drive, CD Rom, Sun Microsystems Model 411)

Drive, Optical, 600MB, Relax Technology (Model none)

Drive, Tape, 669MB, Sun Microsystems (Model EXP-2)

Monitor, Color, Sun Microsystems (Model GDM19628)

Plotter, Pen, Calcomp (Model 1023)

Printer, Color, Tektronix (Model 4696)

Terminal w/ Keyboard, Wyse (Model WY-60)

Mundocart GIS Database (by Petroconsultants), Version 2.0

SUN Workstation (by Sun Microsystems)

SUN C software

SUN/CD ROM, Version None

Drive, Disk, Bernoulli, Portable-44MB (Model B144P)

Toshiba T1100 Plus, Portable Lap-Type Computer w/640 K RAM, internal modem and printer

Bernoulli Cartidges 44MB 5 1/4" (3 pkg)

PC Adapter Card

Bernoulli Disks

SUN SPARK II Port Extender

Computer Tool Kit

Power Converters

Audio Speakers

SUN Micro D Cable

Optical Disks

Power Strips

2 Surge Protectors, 1 GRASS manual, 1 digital multimeter, computer cables

EPPL7 Software

GRASS 4.0 Software

GRASS 4.1 Software

SYSTEMS ANALYSIS

Mac Plus, 1MB Incl. Hypercard

Computer

H Disk MAC 20MB FX20 (w/cable)

Hard Disk

Datashow for MAC (projects data from computer onto screen)

Datashow HR/MAC Projection (software to run Datashow)

Datashow HR/ Video Adapter (Voltage Transformer)

Datashow Repair

Mouse Pad (Hardware)

Stella for Academe (Software simulation language which allows modeling and testing of the outcome of various environmental policies, also identifies and prioritizes research needs.)

Books (Forrester/ Principles, 5 copies, Goodman/ Study Note System, 1 copy, Richardson/Intro Sys Dyn, 5 copies, Randers/ Elements Syst Dyn, 1 copy, Gutierrez/Ecosystem, 1 copy)

Books (Roberts Computer Simulation, 1 copy)

PHYLIP - Phylogeny Inference Package (version 3.3)

28 programs for analysis of genetics data

STELLA II

Ethernet Kit

3HCL Busybee PC XT with printers

Apple MacIntosh Classic Computer

Zenith ACER Notebook Computer

2 DL 3400 Fujitsu Dotmatrix Printer 24 pin, 132 column

Citizen LSP-100 Dotmatrix Printer 9 pin, 80 column

Panasonic KX 2123 Dotmatrix Printer

101 Keyboard

HCL Electornic Copy Board

Seagate 40 MB Hard Disk

Datasharer with cable

Amketter Floppies

Constant Voltage Transformer

HIGH ALTITUDE ECOLOGY

REI Cordura Duffle Bag

REI Stretch Ragg Socks

Asolo Trail Boots II

REI Mens Wilderness Jacket W/Hood

Therm-A-Rest Campr Air Mattress

REI Kletter sack Knapsack

Bee Seal (wax) Plus-Jar

Silva Ranger Compass TDCL

Summit II Changeab, Sun Glasses

2 Delux Strap

Outdoor Prod. Comb, gator leggings to keep legs dry

Z-Dry Polypro Inne, liner for socks

Maxi Toggle for closure

Mini Toggle for closure

2 Sorel 3/8" Liner for boots MN

2 REI Thrmx Bi-Ply Crew Navy Underware

2 REI Thrmx Bi-Ply Btms Navy Underware

2 Goat Skin Rappelling Glove

Renaissance-15, sleeping bag

Free-spirit Vestibule for tent

Outdoor Prod. Comb. gators to keep legs dry

REI Mens Wilderness jacket w/ hood

REI Supplex Wind Pants

REI Supplex Wind Pants

REI Supplex Wind Pants

REI Polar Plus Jacket

REI Supplex Wind Pants

REI Woolined Mountain Parka

Freespirit Vestibule for tent

Outdoor Prod. Comb, gators

Heliopower Solar Lantern

Renaissance 15 Sleeping Bag

Sorel Caribou Mens Boots

Sorel Caribou Mens Boots

REI Super Jacket

REI Polar Plus Jacket

2 Tents and 4 prs Glacier Glasses

Books

FIELD RESEARCH METHODS

Two Noise Cancelling, Low Impedance Headphones for radio telemetry work

Two RA-2A 150/152 MHZ Antennas supplied with RW-2 and carrying pouch, needed for telemetry work

Organiser II Mdl XP, a field computer for storing information

128K DataPak, a micro chip used with the Organiser II

Comms Link, allows downloading of information from the Organiser II to a personal computer

Model V 16 Vertical Gel Electrophoresis Apparatus

Analytical Teflon Combs

Glass Plates (3 pairs per set)

Tube Gel Adapter for use with Model V 16

Glass Gel Tubes (1 pk)

Grommets and Stoppers

Digital WeatherPro

Weather Station with rainfall collector

Colored Bird Bands

100 bands ordered in each of six different colors for each size 2 - 5. Total bands provided = 2400

POPSYS Series 1 and 2 plus applications package (population systems analysis software package)

Infra-red Triggering Devices and associated Cameras for counting and photographing animal traffic on a trail including 4-Trail Master (TM) 1500s w/Camera Connector, 2-35 mm Cameras, 2-TM Treepods, and 1 TM 24 Portable Printer

Gallic Acid (5 gm), Catechin Hydrate (10 gm), Epicatechin (1 gm)

Spherical Densiometer (An instrument for measuring forest overstory density)

WILDLIFE INTERPRETATION AND EXTENSION

Nikon Camera 8008

Lens 35-70 mm

Camera Batteries

Camera Strap

Nikon ES

Paterson Darkroom Kit

Nikon TC-16A

Nikon Lens 70 - 210 mm

Nikon 55 mm Lens

SB-20

Nikon 500 mm f/8

Bogan Tripod

National M-T Camcorder

National C-15 VCR

Ambico Video Tripod

#49 UM Microphone

Aluminum Camera Case

Tapes T 120 (5 pack)

Character Generator (National

UM CGIEC)

2 Kodak Carousel Projectors (Model 147-5373)

2 Projector Cases

PS-6 Slide Copy Adapter

PS-6 Bellows Focusing Attachment

2 Panasonic PV-BP-88 Batteries

Penetrating Oil

Film Cleaner

Books - Rabi's Cornell Course

Books - Rocky Mt. Nature Association

Video Production Manual

Tilden's Book -

Univ. of

N.C. Press

Dehumidifier

Smithsonian's New Zoo - a publication by Jake Page

Minolta Camera X700 and Tamcac case

One Lens F 3.5 50 mm

Bogan Tripod Model 3040

Polaroid Digital Palette Film Recorder System

Freelance Graphics for DOS

S811 Olympus Micro-cassette Pearlorder with 21 micro Cassettes

Bogan Tripod Model 3040

5 - Minolta X-700 Camera Bodies

5 - Minolta MD 28-70/3.5-4.8

Macro MD Zoom

2 - Minolta MD 2X Tele Converters 300-S

2 - Minolta 70-210/4 Macro MD Zoom lenses

ACCUPRO II (device for stacking of slide projectors during lapse dissolve programs)

Multi-effects Filter Kit

Wireless Microphone

Ektachrome slide duplicating film- 36 exp. 20 rolls

Kodak Projection Ektanar C Lens

Kodak Slide Projector

LIBRARY SCIENCE

CD-ROM Disc Reader (Model TCDR-6000)

Wildlife and Fish CD ROM One Year Subscription

Wildlife Review and Fisheries Review CD ROM Five Year Subscription

One 2,000 KHz Miniature Telemetry Receiver with 164/166 MHZ coverage, supplied with one single wide leather case, one RP-2 110 AC charger, one RP-3-12 VDC charger cord for vehicles, one RA-2A antenna (164/166 MHZ) supplied with RW-2 and carry pouch, and one 60 inch coaxial cable.

ANIMAL DAMAGE CONTROL

Drop Nets (2)

Drive Nets

ALL COMPONENTS

Maruti Gypsy Jeep (reg. plate # DNA 1612)

Registration, weighing, gas, license plates and delivery costs for Maruti Jeep

Fax Machine

ANNEXURE-VI

FINANCIAL STATEMENT-RUPEE FUNDS

BUDGET EXPENDITURE

Salary & Wages 12,42,000.00 11,33,206.67

Materials, Supplies 5,50,000.00 8,33,285.96

and Services

Travel Expenses

Within country 9,76,000.00 8,62,080.11

International 21,76,000.00 25,49,595.50

Equipment 16,75,000.00 21,84,889.16

Other Direct Costs 11,13,000.00 9,51,089.36

Reports & Publications 8,00,000.00 7,01,843.17

Miscellaneous 3,00,000.00 3,16,924.93

Workshop & Seminars 13,46,000.00 11,46,660.14

Evaluation 6,00,000.00 3,425.00

Total 1,07,78,000.00 1,07,77,000.00

ANNEXURE VII

FINANCIAL STATEMENT-U.S. DOLLAR FUNDS

FISCAL YEAR	GRANTS	PER DIEM FOR U.S. TRAVEL	EQUIPMENT	FEES AND TUITION	MISC. EXPENSES
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1989	48,756.00	6,187.00	13,076.00		
1990	39,626.00		8,734.00		1,850.00
1991	84,230.00	7,444.00	76,864.00	7,319.00	18,964.00
1992		34,587.00	6,253.00		5,891.00
1993	22,222.00	8,911.00	11,191.00		344.00
1994		11,265.00	1,161.00	5,140.00	600.00
TOTAL	194,834.00	68,394.00	117,279.00	12,459.00	27,649.00

GRAND TOTAL \$420,615.00

ANNEXURE-VIII

SOURCES FOR U.S. DOLLAR BUDGET

AID Biodiversity Small Grants Programme 6,187.00

AID Biodiversity Small Grants Programme 149,912.00

AID Biodiversity Small Grants Programme Amendment 136,150.00

AID Subtotal 292,249.00

FWS/OIA Funds FY 89 20,350.00

FWS/OIA Funds FY 90 15,000.00

FWS/OIA Funds FY 91 30,255.00

FWS/OIA Funds FY 92 8,287.00

FWS/OIA Funds FY 93 37,119.00

FWS/OIA Funds FY 94 17,355.00

FWS/OIA Subtotal 128,366.00

GRAND TOTAL \$420,615.00

Note: FWS/OIA = Office of International Affairs, U.S. Fish and Wildlife Service