

TRAINING BIOLOGISTS AND RESOURCE MANAGERS IN LESSER DEVELOPED COUNTRIES

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The destruction of natural habitats throughout the world has become a problem of increasing concern, particularly in the last decade. Although incidences of such destruction have been reported from all parts of the world, they tend to be concentrated in Lesser Developed Countries where population pressures and poor economic conditions often are extreme (Myers 1980). Despite the pressing economic needs in these countries, it is generally agreed that wholesale, unplanned disruption of natural habitats for short-term gain have long-term, negative effects (Gentry and Lopez-Parodi 1980; Smith 1981). Undisturbed native habitats are of both aesthetic and economic value, being important as watersheds, as repositories of economically important plants and animals, as sources of genetic diversity, and for many other uses (Westman 1977; Roush 1982). In addition, when they are well managed, such areas may provide sustained yields of timber and other forest products, and be important to tourist and recreational industries. Thus, preservation and proper management of natural habitats is extremely important.

To be successful in a long-term, continuing sense, any manage-

ment/conservation program must be a local one, directed and operated by citizens of the country in question. For many countries, this currently is impossible because of a lack of sufficient biologists trained in ecology, wildlife and resource management, and general conservation practices. At the same time, the population of these countries often lacks environmental awareness, which, in addition to being partly responsible for the lack of trained personnel, deprives environmental programs of the public support vital for their successful operation. The problem is how to develop a corps of local individuals trained to manage their country's resources.

Most individuals associated with academia or with agencies involved in resource management in developed countries could easily outline a training program that probably would include basic education in one of the life sciences followed by graduate study in a particular discipline with a particular group of organisms. The chief problem with such an approach is time. Forests and other habitats are disappearing so rapidly that inaction over the minimum period of three to six years required for training can result in significant losses. Such programs also can be expensive.

exceeding the resources available in the country in question, as well as from sources of foreign aid. As a result, much of the training that has been accomplished to date has been conducted informally on an ad hoc basis as opportunities and funds have arisen, rather than according to any formalized plan. Although flexibility is an important ingredient in a training program of this type, organized programs with defined goals and procedures can be far more effective and efficient when time and funds are limited. Nevertheless, very little effort has been made to develop specific plans for training programs in biology and resource management for Lesser Developed Countries, and more attention has been paid to philosophical than to operational issues.

In the present paper, I outline a plan for such a training program. The plan grew from a program developed by the U.S. Fish and Wildlife Service, the National Forest Service of Paraguay, and the U.S. Peace Corps for training Paraguayan personnel. It was developed largely by trial and error under severe time and budgetary constraints. Herein I present the plan in a more formal way that others may find useful in attempting to develop similar environ-

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mental/conservation training programs. I am concerned primarily with developing an overall program design rather than with specifying particular subject matter. Because the program was designed for use in Paraguay, it was geared, in many ways, directly to the needs of that country. With minor modifications, however, it should be appropriate for training personnel in any country.

The training involves three levels of increasing complexity and length, and as a result, is particularly suited for use in developing countries. For one thing, trainees may enter the system at any level, depending upon their specific backgrounds. In addition, because the training is divided into discrete units, individuals may move, or the program as a whole may be expanded, from one level to the next, as time and resources permit. Finally, the plan provides immediate, short-term training sufficient to enable individuals to initiate and execute simple but effective management and conservation programs before advanced training is completed.

Program Goals

Although the primary aim of a training program is to instruct local individuals in how to run their own environmental programs, by combining field and classroom training it is possible to make substantial progress toward the achievement of other goals as well. Examples of such objectives include inventories of the flora and fauna of the country, identification of species and habitats of critical concern, monitoring of commercial trade in wild organisms, development of materials for use in environmental education programs, and development of a political force for conservation and habitat management in the country. Although these activities may seem diffuse, they can be integrated relatively easily, as illustrated below.

Centering training around a project with a specific purpose that will provide information necessary for later programs is particularly effective. In practice, the trainees learn by doing. One project that may be especially productive, depending upon how well the resources of the country are known, is a Biological Inventory. Individuals are trained to make surveys of plants and animals, including such things as identification, collection and preservation, and estimation and sampling of populations, while they gather data that will be useful in identifying endangered or threatened species, habitats of special concern, and so forth. Such an inventory is being con-

ducted in Paraguay. In addition, the Inventory Project in Paraguay has been associated with the development of a National Museum of Natural History which will serve as a physical and intellectual center for studies in ecology, systematics, behavior, management, and conservation. Specimens deposited there will serve as vouchers of species recorded in the country, form the basis of much future research, and provide a foundation for the development of educational materials. For example, the staff of the museum in Paraguay is using information obtained from the inventory to develop guides to the common animals and plants of several national parks. These guides will be available to park visitors and also will be used as teaching aids for environmental education programs in the local school system.

Who Will Run The Program?

A country that needs a training program, but lacks personnel with the expertise to conduct it, must find someone to run it. Often, this will involve some type of cooperative agreement between an appropriate manage-

ment or conservation group in the country (Forest Service, Park Service, Bureau of Land Management, or some other government agency) and a similar group in the country providing training. The U.S. Fish and Wildlife Service, for example, has cooperative agreements of this type with agencies in several developing countries, as do various universities, research institutions, and international conservation agencies.

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As much of the training as possible should be conducted in the home country so that the trainees will gain maximum exposure to native organisms and habitats and will become familiar with problems characteristic of their own areas. In-country sessions also will enable maximum numbers of individuals to be trained, at least at general levels, for minimum costs. Although ideally professional biologists and research managers should work with trainees for extended periods in the developing country, scientists usually are unable to set aside other responsibilities for more

than a few weeks at a time. Furthermore, the full time employment of such individuals on training projects of this type is severely limited by the availability of funds.

In Paraguay, this problem was effectively circumvented and continuity provided to the training program through the cooperation of U.S. Peace Corps volunteers selected because of their backgrounds in wildlife management and the biological sciences. Scientists from the U.S. Fish and Wildlife Service and other organizations visited Paraguay periodically to work with the project for intervals of two to four weeks. Together with Paraguayan Forest Service personnel and Peace Corps volunteers, they planned long-term activities and held field, laboratory, and lecture sessions to train individuals in the methods to be used. Then, under the direction of the volunteers, training and activities continued between visits by the scientists. This procedure was extremely effective not only in providing continuity, but also in maintaining the momentum of the training program, and sustaining the interest and enthusiasm of the participants. In addition, partici-

pation by more scientists representing a greater variety of disciplines was possible.

Out-of-country training takes place at universities, museums, or other research and educational institutions where individuals with a particular expertise or programs in a particular discipline are located and can provide specialized training in particular subject areas.

Selecting Candidates For Training

The first step in developing a training program is to identify the individuals to be trained. Often, the agency in charge of resource management and conservation will have designated certain individuals to participate. Sometimes however, particularly if the program is just starting, new personnel will need to be located either within the existing organization or from other sources such as Life Science departments

at local universities. An attempt should be made to select individuals who are best qualified in terms of education, prior experience, and interest, but the field of candidates from which to choose may be extremely limited for a number of reasons. Traditionally, universities in developing countries have stressed programs with practical applications. Thus, education in the life sciences generally has emphasized pre-medical or other training in health-related fields, agronomy, and sometimes forestry. Ecologically or behaviorally oriented courses are generally lacking or very limited. In addition, because job opportunities in biology and management also have been limited or nonexistent, even when an appropriate course of study has been available, few students have elected to follow it. Thus, the academic preparation of some individuals may be deficient, and also their knowledge and understanding of what biological research and resource management involve may be extremely limited. It is, therefore, critical that candidates be exposed to field, laboratory, and office work early in the training period, so that they may determine if such work is of interest to them.

Another means by which individuals who wish to be involved in this line of work may be identified is through publicity about the program in newspapers, on local news programs, and in public lectures. In Paraguay, a lecture series dealing with wildlife-related topics not only attracted potential candidates for employment in the project, but also helped increase public awareness of environmental issues.

The Training Program

Level One

Level One training involves both lectures and practical field experience (Table I). The major aims of this part of the program are to familiarize potential workers with the need for and functions of biological research, resource management, and environmental conservation, and with the kinds of laboratory and field work that may be involved.

Trainees are divided into small work groups (usually including one professional scientist, one Peace Corps volunteer, and no more than six in-country participants) that may be organized taxonomically, ecologically (for example, by habitat type), or functionally (for example, around pesticide problems or water quality analysis). Training takes

TABLE I
THE TRAINING PROGRAM

LEVEL 1	
<i>Goal:</i>	to familiarize trainees with the need for and functions of biological research, resource management and environmental conservation, and to teach them basic techniques of collection and analysis
<i>Means:</i>	lectures and field work; data analysis in the laboratory
<i>Place and Time:</i>	in-country, 2 to 4 weeks
LEVEL 2	
<i>Goal:</i>	specialized instruction in specific techniques and intensive study of particular subjects.
<i>Means:</i>	training sessions, workshops and scientific meetings
<i>Place and Time:</i>	out-of-country 2 to 6 months
LEVEL 3	
<i>Goal:</i>	to provide academic training necessary to enable trainees to conduct independent research and make sound management decisions
<i>Means:</i>	graduate study
<i>Place and Time:</i>	out of-country (course work) and in-country (thesis research 2 to 6 years)

place during a series of field trips with scientists (about two trips per group per year, though individual trainees often may attend sessions of more than one group). Trainees learn techniques appropriate for the specific area in which they may work; thus, the curriculum may be tailored to fit any particular subject area or taxon. For example, instruction for wildlife biologists might include collecting and preparing specimens, trapping and marking organisms, identifying organism by using keys, and making and recording field observations. Interspersed with the

In Paraguay, several of the national parks were selected as sites for the initial training. Such an approach is recommended for two reasons. First, because the parks are discrete geographic entities, substantial progress toward the survey of their floras and faunas can be made during the training exercises. Second, the information collected can also be used to develop guides to park wildlife that may be made available to park visitors.

After several field sessions, the number of trainees probably

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field work are lectures and informal discussions on predetermined topics (for example, specific ecological principles, management techniques, or behavioral traits), as well as on those arising as a result of some field activity. Between trips, the Peace Corps volunteers continue the training along the lines developed in the field sessions and assist the trainees in carrying out other projects outlined by the scientists during their stay. This stage is extremely important in helping potential environmental biologists determine whether this is a career that they may wish to pursue.

will be considerably reduced, and those best qualified to participate in Level Two of the training sequence can be identified from among those remaining. These individuals should understand the aims and operation of research and management programs in general and specific projects in particular, and they should be familiar with various field techniques. As data are obtained, scientists, Peace Corps volunteers, and trainees should work together to analyze and interpret them so that the project may serve as a training exercise and to produce scientifically relevant information.

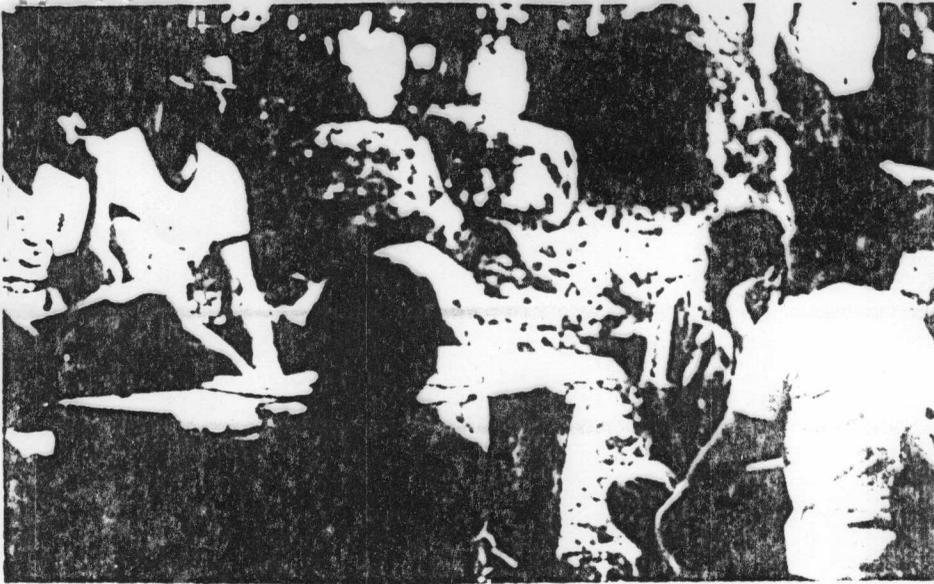


Fig. 1. Level one training sessions at Ybicui and Cerro Corá National Parks, Paraguay. Upper left: informal lecture. Upper right: trainee removing a bird from a mist-net. Lower left: habitat sampling and analysis. Lower right: preparation of specimens and data records. (Upper left and lower left and right photographs courtesy of Diane F. Wood and David Wood.)

Level Two

Level Two of the training involves short periods (2 to 6 months) of study outside the home country (Table 1). The purpose of this phase is to allow participants to associate with individuals and institutions where they can acquire specific skills requiring more extensive and specialized instruction than can be obtained in the shorter in-country training periods. Learning particular techniques, operation of specific equipment, or intensive study of some specific subject may be involved. For example, individuals designated to maintain a col-

lection of specimens might train in curatorial techniques at a research museum or herbarium. Others might learn to use special equipment for water quality or pesticide analysis, while some would concentrate on study of specific subjects. The U.S. Fish and Wildlife Service, for example, conducts courses on such subjects as "The Research, Management, and Conservation of Crocodillians," and "The Function and Management of Wildlife Refuges," and is initiating a training workshop on the "Research and Management of Migratory Birds in the Western Hemisphere."

If funds are available during this period of training, participants should be exposed to several institutions active in the conduct of work of the type in which they are training so that they can compare facilities and approaches and meet as many individuals as possible that are active in the field. Whenever possible, they also should attend the meeting of an appropriate scientific society. By these means they will meet colleagues, learn whom to contact for assistance with particular problems that may arise with their work in the future, and learn about current research activities in their areas of interest.

Trainees also should be introduced to the literature (important reference works and journals) appropriate for their fields of study and geographic areas. Library holdings, particularly periodicals, are often extremely limited or lacking in Lesser Developed Countries. Exposure to the literature will provide an idea of the information available and will identify items to be acquired when funds for library development become available.

Level Three

In Levels One and Two the training is primarily practical. Individuals learn particular techniques and procedures that enable them to obtain specific information required for specific projects. Generally, however, they do not become conversant with the theory upon which specific sampling procedures are based, the rationale behind particular management plans, the theoretical basis for given ecological principles, and so forth. Yet a certain degree of such understanding is necessary for planning management protocols, designating critical habitats, determining status of various species, and in general, designing and performing original research. Acquisition of this type of advanced training constitutes Level Three of the program.

Education of this sort generally cannot be obtained in short training periods of a few months, though progress can be made in this direction through reading, attendance at seminars, and continued practical experience. Such expertise normally requires graduate study in zoology, botany, forestry, wildlife management, or some other similar discipline at some university outside the home country. Training at the masters degree level will usually require two or three years in attendance at a university, although this will vary with the background of the individual. Some students may require an extra year to make up course work that was not available in the home country. This is followed by two years of graduate study involving course work and completion of a research project. Some individuals may wish to continue for a Ph.D. degree, which may require an additional three to five years of graduate study. Ideally, students in a formal program of graduate study will return home to conduct thesis research on some problem or subject important to environmental conservation in their own countries.

Conclusions

The sequence of training levels in this plan may seem reversed, especially to those accustomed to the typical academic progression in which a student is exposed to the theoretical bases of his work before he takes on work responsibilities. Technical training, however, usually may be accomplished more rapidly and less expensively than theoretical training and, thus, more individuals may be trained more quickly to carry out work initially designed by others. In Lesser Developed Tropical Countries, where habitats are disappearing at a rapid rate and where funds for conservation programs are strictly limited, this plan seems to represent the most practical training sequence. Otherwise, in many countries, by the time a cadre of optimally trained scientists becomes available to plan and execute an environmental management program, nothing will be left to conserve or manage.

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