

INVITED PAPER

Evolution of the Organization for Tropical Studies

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Abstract: The Organization for Tropical Studies (OTS)/Organización para Estudios Tropicales (OET) has evolved in many ways since its founding in 1963 as a non-profit consortium offering graduate courses and facilitating research in tropical ecology in Costa Rica. By 2002, its international membership included about 65 institutions, including four from Costa Rica. It had developed three Costa Rican field stations (La Selva, Las Cruces, and Palo Verde) with excellent facilities for teaching and research, and it was constructing a new Costa Rican office at the University of Costa Rica. Combinations of internal and external pressures influenced OTS to develop in new directions in the 1980s and 1990s. It became more diversified and more concerned with applied science in its traditional areas of graduate education and research facilitation. The Organization also evolved into new niches: more applied biology, professional education, environmental education and policy, conservation efforts, and an expanded geographic distribution to other Latin American countries. OTS was composed of changing combinations of people (Boards, members, staff) with evolving and competing priorities for limited financial resources. External environmental changes also shaped OTS's evolution. New problems of increased tropical deforestation, the emergence of the biodiversity "crisis" and conservation biology, global climate change, and calls for sustainable development affected OTS constituents and funding priorities of governments and foundations. Both internal and external pressures have in some cases demanded for OTS to improve its relationship with: Costa Rican biologists and their institutions, the Costa Rican government, and Costa Ricans living around the three OTS field stations.

Key words: OTS, OET, Environmental Education & Policy, Graduate Education, Conservation, La Selva Biological Field Station, Research-Costa Rica.

The Organization for Tropical Studies (OTS)/Organización para Estudios Tropicales (OET), was founded in 1963, ten years after the *Revista de Biología Tropical /International Journal of Tropical Biology and Conservation*. Each has contributed in major ways to increasing scientific knowledge about Costa Rica and the Neotropics. The two share one common founder, have interacted in many ways, and have become closer since the late 1980s (Monge-Nájera, pers. comm.). Although this article focuses on the evolution of OTS, it will note significant interactions between the two in celebration of their anniversaries.

OTS has grown from a handful of institutions to become a non-profit consortium of about 65 universities and research institutions,

most of which are in the United States; the Costa Rican members are the Universidad de Costa Rica (UCR), Universidad Estatal a Distancia de Costa Rica (UNED), Instituto Tecnológico de Costa Rica (ITCR), Universidad Nacional de Costa Rica (UNA), and the Museo Nacional de Costa Rica. Recent new members include two universities from Perú and one each from Mexico, Canada, South Africa, and Australia (OTS Annual Meeting Book 2001). According to its current mission statement, "OTS is dedicated to providing leadership in education, research and the responsible use of natural resources in the tropics. To this end, OTS offers graduate, undergraduate and professional education, facilitates research, participates in conservation activities, conducts

environmental education programs and maintains three biological stations in Costa Rica: La Selva Biological Station in the Atlantic lowland rainforest; Palo Verde Biological Station in the Pacific deciduous dry forest; and Las Cruces Biological Station in the premontane cloud forest near the Panamanian border" (OTS Liana spring 2001).

This article focuses on why and how OTS evolved to become stronger, more diversified, and more concerned with applied science in its traditional areas of educating graduate students in tropical ecology and facilitating research in Costa Rica. The article also shows why and how OTS evolved into new niches involving more applied biology, professional education, and conservation efforts (broadly defined), and an expanded geographic distribution. Complex combinations of large and small scale internal and external pressures in different combinations influenced OTS to develop in new directions in the 1980s and 1990s. OTS was not a monolithic institution; it included changing combinations of people (Boards, members, staff) with evolving priorities for limited financial resources. External environmental changes also shaped OTS's evolution in a kind of Lamarckian way. New problems of increased tropical deforestation, the emergence of the biodiversity "crisis" and conservation biology, global climate change, and calls for sustainable development all affected OTS constituents and funding priorities of governments and foundations. Internal and external pressures combined in some cases, especially in relations with the host country and sometimes competing demands for OTS to improve relations with: Costa Rican biologists and their institutions, the Costa Rican government, and Costa Ricans living around the three OTS field stations.

MATERIAL AND METHODS

This paper is based on extensive research since 1992 in Costa Rica and the United States using published and unpublished sources and many interviews. Although OTS is discussed

briefly in many publications about tropical biology, conservation, and ecotourism, the most significant detailed studies of OTS in general appeared around the time of the organization's 25th anniversary, as many of the changes that are the focus of this paper were beginning (Stone 1988, Tangley 1988, Chazdon and Colwell 1990). A very important source focused on a key part of OTS is *La Selva: Ecology and Natural History of a Neotropical Rain Forest* (McDade *et al.* 1994); additional more specialized sources are cited in appropriate sections of this paper. Materials produced by OTS constitute valuable sources. Three bi-annual newsletters have been published for many years, the oldest being *Liana* from the main OTS office at Duke University in Durham, North Carolina; *OET al Dia* from OTS's Costa Rican office near San José; and *Amigos* from the Las Cruces Biological Station. OTS also collaborates with the Association for Tropical Biology and the Smithsonian Institution (an OTS member) to produce the quarterly newsletter, *Tropinet*. OTS has published an Annual Report since 1996; these and recent copies of the newsletters are available on-line from the OTS Web Page which also contains a great deal of information about OTS (www.ots.ac.cr and www.ots.duke.edu). Many of the sources used in this paper are in the category of "gray literature," photocopies of computer generated or typed materials that are available at OTS offices. These include "books" produced for annual meetings (usually in March) of OTS Directors and members ("Annual Meeting Book") and compilations of all the work from each course ("Course Book") as well as reports of standing and *ad hoc* committees, handbooks, grant applications and reports, and booklets, brochures, flyers, and memos. An additional very important source for this paper is a series of interviews the author conducted in Costa Rica and the U.S. since 1992 at OTS offices and field stations and other locations with most of OTS's administrators and many other employees, course instructors and students, and supporters as well as critics of OTS; many of these interviews were repeat interviews to

track various developments; interviews are identified in the text as personal communication (pers. comm.). The evolution of OTS is impossible to understand without these unpublished sources, and much of that history would be lost if it were not preserved in this paper especially because of the on-going turnover in OTS administration, personnel, course instructors, and members of governing bodies that is characteristic of many non-governmental organizations.

FOUNDING, STRUCTURE, AND SUBSEQUENT PRESSURES ON OTS

OTS has been a leader in training tropical biologists and promoting tropical research since its founding in 1963; until very recently, most of the tropical biologists in the United States and some of those in Costa Rica had taken an OTS graduate course (Gómez and Savage 1983, Chazdon and Colwell 1990). Founded by six U.S. universities and the University of Costa Rica to provide a means of training graduate students and promoting research in tropical biology, OTS grew out of a series of earlier efforts (Stone 1988). Costa Rica was originally selected as the OTS site for several reasons, a major one of which was that Rafael Lucas Rodríguez Caballero, Director of the School of Biology at the University of Costa Rica, had worked successfully with several U.S. universities to establish North American undergraduate programs there (Gómez and Savage 1983, Fournier 1991). Also, a 1962 U.S. National Science Foundation survey of Latin American and Caribbean countries was looking for places where "basic biological research and/or research training may be conducted and where the participation of foreign scientists is invited" (Stone 1988). Costa Rica was an ideal location since it possessed great biodiversity (although that term had not been invented yet) within a small geographic area. It was easy to get to from the U.S., and it was a safe, stable, democratic country with a long tradition of welcoming foreign scientists (Gómez and Savage 1983; for more on

the early history of OTS, see Stone 1988, Tangle 1988, and Christen 1994).

To understand the evolution in OTS, one needs to know about the structure of OTS, how decisions are made, and the ways in which funding constraints affect decisions. Although these areas have evolved over the years, much has remained the same. The North American Office (NAO) has been at Duke University in Durham, North Carolina since 1976, when botanist Donald Stone, became the Executive Director and then served for twenty years during the period of great growth and change in OTS. NAO "serves as the coordinating hub for consortium and corporate business" (www.ots.duke.edu) and has been "responsible for the long-range planning, fundraising, administrative oversight and financial accountability of the organization" (OTS Liana summer/fall 1993). Forest ecologist Gary Hartshorn became the Executive Director of OTS in 1996 (he had done his dissertation research at La Selva, then served as Director of the Tropical Science Center in San José, and was well known in the Costa Rican scientific community); in a subsequent reorganization, he was named President and CEO. The Costa Rican Office (CRO), in a suburb of San José, has been headed since 1998 by biologist Jorge Jiménez, CRO's first Costa Rican Director. He followed botanist Charles Schnell, who had directed CRO for the previous fifteen years. CRO is responsible "for the logistic support of the field stations, educational programming, and research activity taking place in Costa Rica" and reports to the head of NAO (www.ots.duke.edu). The staffs at both administrative offices have expanded considerably over the years as OTS and its activities have grown. OTS's biological field stations now all have full time directors, two of whom are Costa Ricans; the La Selva position is split between a Costa Rican Administrator and a U.S. Scientific Director. Each field station has its own staff, with the most employees at La Selva and the fewest at Palo Verde; each station also has an advisory committee, La Selva's being the oldest.

The Board of Directors (previously called the Executive Committee) has the ultimate

power; it is now composed of the President, five vice presidents for different areas, a secretary, treasurer, and six members at large. These people are elected by the Assembly of Delegates (previously called the Board of Directors) which meets each March in Costa Rica and is composed of two appointed representatives, at least one a scientist, from each member institution (OTS Handbook 1999). In their decision making, the Board considers reports and recommendations from the heads of NAO and CRO and their administrative departments, field station directors and advisory committees, as well as standing and *ad hoc* Board committees (D. Stone, pers. comm).

Funds have been a problem for most of OTS's history. Stone said that when it was founded, there was an expectation that OTS would receive substantial funding from the U.S. government (Stone 1988). This did not happen, so all funds come from grants and dues of the member institutions (\$8 800 per year by 2001; Costa Rican members pay the equivalent by in-kind services), plus station use fees and other service related income. The U.S. National Science Foundation (NSF) did support the graduate course program and some large scale comparative ecosystem research, but when this NSF funding ended in the mid-1970s, OTS almost went bankrupt (Stone 1988). Stone deserves the credit for rescuing OTS after he took over in 1976 and arranged to have Duke University become the fiscal agent (Tangle 1988, Chazdon and Colwell 1990; G. Hartshorn, pers. comm.). He began the successful search for new sources of funds to support the courses, turning to private foundations, and wrote a series of proposals that convinced NSF and some foundations to support the field stations and expand their facilities. As funding priorities for government agencies and private foundations evolved, these sources put new pressures on OTS to develop courses for a wider clientele and for more applied and conservation related programs as well as an undergraduate program. Although OTS needed money, it only pursued funding for purposes compatible with the organization's goals (C. Schnell, pers. comm.). By

1987, OTS had hired a development officer to look for funding. This expanded into a team at NAO and a Costa Rican fund-raiser at CRO (J. Giles, R. Vargas, pers. comm.). In 1992, OTS established a Board of Visitors "to advise OTS in areas not traditionally represented in the Board of Directors, such as financial investments, budgetary planning, fund-raising, and marketing" (OTS Strategic Plan in Handbook 1999). Although OTS has been very skillful at raising money, it is always on the edge because grants tend to run for only a few years and are restricted to certain uses. Also, in recent years, OTS has faced competition for students and researchers from a growing number of tropical programs and biological stations in Costa Rica and other tropical countries; some of these alternatives have been founded by OTS graduates and members, including Costa Rican institutions. OTS is trying to fund a series of endowments whose interest would pay for courses, scholarships, field stations, etc.; some of this fund raising has been encouraged by challenge grants from the Mellon Foundation which, along with NSF, has been urging OTS to become more self-sufficient (J. Giles, pers. comm.). In pursuit of improved financial independence, C. Schnell developed a business plan for OTS in 1995. To preserve good relations with Costa Rica, OTS set up a for-profit corporation (ESINTRO) that pays taxes to the Costa Rican government on services for ecotourists/natural history visitors and general sales of books and souvenirs from its gift shops; profit after taxes is donated to OTS (C. Schnell, pers. comm.).

There is a broader context that affected OTS and shaped the changing priorities of funding sources: the acceleration of tropical deforestation and increasing awareness among tropical biologists, environmentalists, and educated citizens of the extent and value of biodiversity in tropical forests (Takacs 1996). Evidence of concern over these issues by leaders in OTS is seen in the 1985 symposium "Diversity and Conservation of Tropical Rainforests" at the California Academy of Sciences (Almeda and Pringle 1988) and the OTS-sponsored

symposium at the 1987 meeting of the Association for Tropical Biology on "Four Neotropical Rainforests" (Gentry 1990). Speakers at the 1986 National Forum on Biodiversity in Washington D.C., including Peter Raven, then President of OTS, clearly linked tropical research with efforts to conserve biodiversity, the importance of applied biology, and the goal of sustainable development. Raven, in a paper on "Our Diminishing Tropical Forests" said: "Of critical importance will be our ability to abandon our passivity and face the situation as it is, devoting increased resources to the exploration of diversity and using the information that we gain for our common benefit" (E.O. Wilson 1988). Since the mid-1980s, there has been a flood of publications, meetings, and proposals aimed at conserving tropical biodiversity and tropical forests; increasingly, reasons for conserving tropical forests include their importance in mitigating global warming. These issues were the central concerns of the 1992 United Nations Earth Summit in Brazil. Proposed solutions to these problems included expansion of protected areas and Biosphere Reserves, many forms of "sustainable development," and increased economic benefits from preserving forests. New fields of applied biology arose in the mid-1980s to deal with the challenges of environmental degradation; they included conservation biology, restoration ecology, agroecology, and ecologically based forestry (Meffe and Carroll 1997). Funding organizations ranging from such conservation groups as The Nature Conservancy and World Wildlife Fund to private foundations, to government foreign aid programs and the World Bank changed their funding priorities in response to these growing concerns and affected OTS (Burlingame 2000). Many OTS students, researchers, and staff members wanted to be involved with these new issues and disciplines.

Other very important influences on OTS came from Costa Rica. The country's internationally famous system of National Parks and other protected areas expanded greatly in the 1970s and early 1980s with the initial leadership of Mario Boza and Alvaro Ugalde and support

from leading Costa Rican biologists, including Pedro León and Luis Diego Gómez, and politicians. During the Oscar Arias Presidency, Environmental Minister Alvaro Umaña grouped protected parks and preserves (including OTS field stations) into regional Areas of Conservation (Umaña 1989, Fournier 1991, Anonymous 1992 and 1993, Umaña and Brandon 1992, Wallace 1992, Boza 1992 and 1993, Bohlen 1993, García 1997, ACT 1998-b, Evans 1999; Steinberg 2001). OTS students and researchers benefited in many ways from the protection of these areas as we will see. They also could not help but be influenced by what was happening outside of the protected areas, where they saw evidence of the highest deforestation rates in Central America (Gámez and Ugalde, and Pringle in Almeda and Pringle 1988; Lehman in Steen and Tucker 1992) and an increasing number of poor peasant farmers as they and OTS Board members and administrators traveled in Costa Rica. Furthermore, there was a very real threat to OTS's field station, La Selva, by the 1980s, as deforestation closed in on its borders. Also, poor people living around La Selva and Las Cruces (Palo Verde was a different case) were potentially resentful of what they saw as rich "gringo enclaves" from which they were excluded, in some cases cutting them off from access to traditional resources (Tangley 1988, Chazdon and Colwell 1990; L.D. Gómez, pers. comm.). At the national level, the Costa Rican government began requesting more assistance from OTS, especially in the form of practical and applied biology. In 1986, for example, under President Oscar Arias, OTS was asked to be an advisor for the parks; in 1995, the Executive Committee and other leaders of OTS met with President José María Figueres who asked OTS to help reach his goal of making Costa Rica a model of sustainable development (C. Schnell, pers. comm., OTS Liana spring 1995).

A third source of pressure on OTS that grew in the 1980s came from scientists in the Costa Rican member institutions of OTS who felt that they were being treated as second class citizens who were not welcome at the OTS field

stations which they also saw as “gringo enclaves” (some scientists from the U.S. recognized the validity of this complaint: Chazdon and Colwell 1990). The scientists were increasingly critical of OTS for taking knowledge and specimens out of the country and giving nothing back in return to the Costa Rican scientific community. The irony is that OTS had very good relationships with some Costa Rican scientists, especially at UCR, in the first ten years of OTS’s history. OTS even had its Costa Rican office at UCR so that there were regular interactions. Through the early 1970s, OTS arranged symposia in Spanish and helped publish books. When OTS outgrew the UCR office space, it moved to a house in San Pedro, so that it was still in the same San José suburb as UCR. This cooperative atmosphere disappeared when OTS’s administration in Costa Rica passed to some inept people, who were removed when Stone took over (Stone 1988; C. Schnell, pers. comm.). Also, in the 1970s, when OTS needed more space, it moved to the current location in Moravia which made personal interactions more difficult.

Schnell argues that a major reason for the good relationships between OTS and Costa Rican scientists in the first ten years was that Costa Rica had its own excellent, though small, scientific community so that the relationship with OTS was on an equal footing (C. Schnell, pers. comm.). The Costa Rican biological community and its institutions evolved and expanded considerably in the second half of the 20th century. (Gómez and Savage 1983, Umaña 1989, Fournier 1991, Monge-Nájera and Barrientos 1991, Monge-Nájera 1994-a, Coronado 1997). The academic center of Costa Rican biology was UCR, where the *Revista de Biología Tropical* was launched in 1953 by Ettore de Girolami, assisted by Rafael Lucas Rodríguez Caballero, one of the founders of OTS ten years later, and several other biologists, microbiologists and physicians (J. Monge-Nájera, pers. comm.; www.ots.duke.edu/tropibiojnl/tbonline/). Two years later, reforms created the Faculty of Sciences and Letters at UCR and Rodríguez

became Director of the School of Biology; he also served as co-editor of the *Revista*. Botanist Luis Diego Gómez revitalized the Museo Nacional de Costa Rica in 1970 after he became its Director, making the Museo an important scientific center and expanding the national herbarium there; he has long-standing ties with OTS and has been Station Director at Las Cruces since 1986. OTS’s other three Costa Rican members, ITCR, UNA, and UNED, were founded in the 1970s and became members later. In 1972, the Consejo Nacional para Investigaciones Científicas y Tecnológicas (CONICIT) was established to support and promote science in Costa Rica; it was headed until 1987 by parasitologist Rodrigo Zeledón (Fournier 1991, Coronado 1997) who also served as a Vice President on OTS’s Executive Committee in the early 1980s (OTS Newsletter August 1981 and September 1982). Increasing Costa Rican interest in biodiversity can be seen in the expansion of the Museo’s herbarium and the growing insect and other animal collections at UCR. Books such as *The Birds of Costa Rica* documented high species diversity in one group (Stiles and Skutch 1989). Carlos Valerio’s *La Diversidad Biológica de Costa Rica* examined the much broader picture (1991); Stiles and Valerio both have numerous links to OTS. In 1989, Costa Rica pioneered a new approach to biodiversity conservation “save it, know it, use it” when INBio was established under the directorship of virologist Rodrigo Gámez (Reid *et al.* 1993, Takacs 1996); Gámez served on OTS’s Executive Committee in the mid-1980s (OTS Newsletter May 1984 and December 1987), and a major on-going research project on arthropods at La Selva has direct ties with INBio.

Although there have been many links between OTS and the Costa Rican scientific community, the two also evolved separately. In the late 1970s and 1980s, both became much larger and the personal contacts of the earlier period diminished. Add to this OTS’s apparent growing prosperity versus the financial problems of the Costa Rican institutions (especially with Costa Rica’s debt crisis of the early 1980s) and increasing Costa Rican awareness of

cultural and scientific imperialism (found -for good reasons- in many developing countries of the time), and the stage was set for increased tensions (C. Schnell, pers. comm.).

Costa Rican scientists have held a wide spectrum of opinions about OTS. Some supporters of OTS claim that the door to OTS was open to Costa Rican scientists but few entered (L.D. Gómez, pers. comm.). Other supporters of OTS include a number of Costa Rican scientists who have had OTS contacts that have been beneficial to their careers; these contacts have included courses, research opportunities, and building relations with particular scientists who then helped them attend graduate school in the U.S.; many of these scientists have close ties to OTS. Some of these supporters were critics in the past, but they think that OTS has been improving its relations with Costa Rica (J. Jiménez, pers. comm.). Some, such as plant ecologist and historian of biology, Luis Fournier, have had fewer contacts with OTS but have had long-term favorable views of OTS; when he returned from the U.S. in 1964 with his doctorate, he learned of OTS from one of its founders, Rafael Lucas Rodríguez. Fournier wrote: "Right from the beginning, I thought that OTS was a good idea, since it was necessary to promote knowledge on the diversity and richness of the tropical environments to the people living in temperate zones... I am still convinced of the importance of the organization... As it is true for any organization, at the beginning the relations of OTS with the Costa Rican scientific community were not very close, but things have changed throughout the years, and now I think the situation is good" (L. Fournier, pers. comm.).

One critic, Costa Rican entomologist Luis Jiron, said U.S. researchers came to OTS field stations, did their research, made no effort to contact Costa Rican researchers, published in the U.S., and did not send reprints to Costa Rican libraries which were not able to subscribe to numerous foreign journals. To prepare his *Index of Entomological Publications of Costa Rica*, he had to spend two months at the Smithsonian in Washington, D.C. finding the

references; he said that most papers since 1970 were by OTS researchers, but there were no copies in Costa Rica. He concluded that the Costa Rican scientific community did not benefit from OTS's presence in Costa Rica (L. Jiron, pers. comm.). Other Costa Ricans, such as Historian of Science, Guillermo Coronado, expressed somewhat similar views; he stated that OTS and its infrastructure have been very important for developing research in Costa Rica, but that Costa Rican scientists resented a lack of sharing of information by U.S. researchers and felt that they did not want to publish in Costa Rican journals which would have made their work available to Costa Ricans. Coronado, unlike Jiron, sees improved relations in the last few years, particularly as Costa Ricans have assumed influential positions in the OTS organization (G. Coronado, pers. comm.).

In 1994, concern over decreasing funding from CONICIT led L.D. Gómez, L. Jiron, and J. Monge-Nájera to send a questionnaire (that included two questions about OTS) to 154 prominent Costa Rican scientists from all disciplines. They had a return rate of 46%. The OTS questions and responses were: "In your opinion, the integration of the Organization for Tropical Studies with Costa Rican scientists is: Good (12.7%), Average (18.3%), Poor (45%), No opinion (24%)" and "The contribution of OTS to the country is: Good (11.3%), Average (23.9%), Poor (25.3%), No opinion (25.3%); 14.1 % gave no response (L.D. Gómez, pers. comm.). Although these responses are open to differing interpretations and may indicate a biased sample return, there is a lot of negative feeling towards OTS and possible lack of knowledge about OTS (among those who responded "no opinion"). In the same year, a strong multi-pronged critique of OTS by biologist and *Revista* editor at the time, Julian Monge-Nájera, appeared in UCR's weekly newspaper, *Semanario Universidad* (Monge-Nájera 1994-b). Like Jiron and others, Monge-Nájera claimed that La Selva was a "scientific enclave" of the U.S., that Costa Rican students were treated as servants or were only field assistants to U.S. researchers, and that most Costa Ricans at the station were cooks, gardeners, and

caretakers. He said that OTS organizational charts showed that all the main positions were held by people from the U.S., that courses in Spanish had less depth and fewer resources than those in English, and that the “most odious practice” was paying the “few” Costa Ricans who worked for OTS lower salaries than U.S. employees for the same work (Monge-Nájera 1994-b). He claimed that OTS researchers had made no major scientific discoveries and, based on his study of articles published in the *Revista* and *Brenesia*, had no significant impact on Costa Rican science. There were four things he felt that OTS could do to improve the situation: (1) assess: the real economic costs of the Costa Rican members, which should be less than the wealthy foreign institutions, the value OTS receives from the Costa Rican government’s grant of tax exemptions on vehicles, and the value of the tropical forests used for OTS courses and research; (2) require equal working conditions and pay; (3) put Costa Ricans in major positions in OTS; (4) move OTS’s offices and library to the UCR campus and continue to pay expenses (Monge-Nájera 1994-b). This article produced a storm of controversy. One counter to many points in Monge-Nájera’s article was written by Enrique Villalobos Rodríguez, a UCR representative (from the School of Agriculture) on OTS’s Comité de Representantes de Instituciones Costarricenses/Costa Rican Institutions Committee (CRIC). He asserted that 1/3 of the research projects at La Selva were being done by Costa Ricans; that many Costa Rican researchers were not interested in interacting with OTS researchers so that failure to have this interaction was not necessarily the fault of OTS; that Monge-Nájera was wrong to claim that OTS made no contribution to Costa Rican biology; and that from his personal experience, academic quality and food in OTS’s Spanish course were not inferior (Villalobos 1994).

GENERAL EVIDENCE OF EVOLUTIONARY CHANGES

OTS responded in various ways to the pressures discussed above. During the presidency of Thomas Yuill (in the early 1980s), the Annual

Meeting Books reveal an initial concern with conservation connected with land purchases to protect La Selva, interest in applied courses and research following the 1981 western annex land purchase at La Selva, realization of the need to find funding for courses in Spanish in pure and applied fields for Latin Americans, and increasing attention to improving relations between OTS and Costa Ricans (OTS Annual Meeting Books 1981-1985). Developments in these areas accelerated with the election of Peter Raven as President in March 1985. Raven had been Director of the Missouri Botanical Garden since 1971; he made the Garden a leader in tropical research through his organizational and fund raising skills. Raven’s OTS ties go back to 1967 when he taught in the OTS Fundamentals course; he was an active member of the Board and the Executive Committee from the early 1980s. He had also become increasingly prominent as a leading advocate for tropical conservation. One of the first things he did as President of OTS was to involve the Executive Committee and then the Board in establishing a mission statement: “The Mission of the Organization for Tropical Studies is to promote leadership in education, research and the wise use of natural resources in the tropics” (OTS Annual Meeting Book 1986). There was a lot of argument over the wording of the third part of the statement, some pushing for a more explicit statement about conservation, though others said that conservation, applied fields, and sustainable development were included in the term “wise use” (because of a growing negative connotation of this term in the U.S., it was replaced in 1998 by “responsible use of natural resources in the tropics”). The 1986 Board meeting was a turning point for OTS in terms of broadening its academic focus to include more applied courses and more Spanish courses and efforts to improve relations with the host country (C. Schnell, pers. comm.). President Raven pushed for the establishment of immediate and long term goals and objectives (with long range planning looking to the year 2000). Raven was followed as President by Gordon Orians (elected spring 1988), an ornithologist who was also

concerned with conservation (he was the Director of the Institute for Environmental Studies at the University of Washington in Seattle). The emphasis on conservation and applied biology expanded under his Presidency and continued under the Presidency of Julie Denslow (elected 1994) who launched a Strategic Planning process at the end of her term. This process was endorsed and guided by the new President, world renowned geneticist Pedro León, elected in 1997 and reelected in 2000 when his title changed to Chairperson of the Board of Directors because of the restructuring of OTS; León, who had taken the OTS Tropical Biology graduate course in 1969 and later served on OTS's Board of Directors and Executive Committee, is the first Costa Rican to hold this position. The Strategic Plan was completed in 1999; its detailed goals and objectives now guide OTS's direction, decisions, and programs (OTS Handbook 1999).

In response to continued complaints by Costa Rican scientists (mainly from UCR, the only Costa Rican member until 1979 when UNA became a member), in 1980 OTS gave Costa Rican member institutions greater voice within OTS by creating a position of Vice President for Costa Rican Coordination on the Board's Executive Committee; a representative of UCR had previously served on this committee as a member at large (OTS Newsletters 1978-1980). OTS also created a committee, known as CRIC, to improve communications between Costa Rican members and OTS and deal with significant concerns; the committee is composed of two representatives from each Costa Rican member institution and a representative from the Ministry of Science and Technology. CRIC has also worked to encourage collaborations and communications between Costa Rican and U.S. researchers and helped in the selection of Costa Rican students for OTS courses and scholarships. CRIC has waxed and waned in its level of activity; the early 1990s were tense times that did lead to positive responses from President Orians and the Board who, in 1993, accepted a new CRIC document spelling out its nature and functions

(C. Schnell, pers. comm.). There were also improved communications between OTS and Costa Rican constituencies, including the launching of a new Spanish newsletter, *Oet al día* in 1995 by CRO. This is not a Spanish translation of *Liana* but a newsletter by Costa Ricans for Costa Ricans about all aspects of OTS courses, research, and activities; names, titles, and contact information for all OTS employees in Costa Rica; information on bibliographies, and recent publications and theses; fund raising activities and lists of Costa Rican donors to OTS; there also are articles of more general interest, for example, on the Conservation Areas of Costa Rica (*Oet al día* Dec. 1995-May 2000). CRIC members played an active role in the interviewing and selection of the OTS Executive Director to replace the retiring Donald Stone. Claudia Charpentier of UNA, a member of OTS's Board and of its Education Committee since 1995 was elected Vice Chair for Costa Rican Coordination in 1998; she has revitalized CRIC which has organized activities to promote active interchanges among Costa Rican and foreign researchers; she is encouraging students from UNA to do research projects at Palo Verde; she has also pushed OTS to do more environmental education at its stations (C. Charpentier, E. González, R. Vargas, pers. comm.).

All of the above pressures led OTS to develop more applied courses and to encourage more applied research, to develop environmental education and other programs for people living around the stations, to find funds to offer more courses in Spanish and courses and programs that would be useful to Costa Rica and Latin America, and to work with the Costa Rican government in a number of ways. OTS also worked to encourage more Costa Rican students and scientists to use OTS field stations (including the continuation of lower station rates for Costa Rican students and researchers), to involve more Costa Ricans in key positions throughout the organizations and address the differential pay issue, and to give greater attention to the concerns of Costa Rican member institutions, including the creation of new print

and electronic channels of communication. Communication has also been enhanced because more U.S. students and researchers speak Spanish. By 2002, OTS will realize a long-standing goal and move its Costa Rican office and library to a new building at UCR. Most former critics agree that OTS has made major strides in improving its relations with Costa Rica, although they differ in which OTS actions they think are most important (based on their ranking of 13 actions by OTS on this author's questionnaire). For example, Fournier said the five most important actions were: ongoing courses, the establishment of CRIC, efforts to encourage Costa Rican researchers and students to use the three OTS stations, OTS programs involving environmental education and outreach around the three stations, and the election of Pedro León as OTS President (L. Fournier, pers. comm.). Monge-Nájera, on the other hand, said three actions were very important: the election of Pedro León as OTS President, the appointment of Jorge Jiménez as OTS Director of CRO, and the fact that all three OTS field stations in Costa Rica now have Costa Rican Directors (with the La Selva position split between two people, one of whom is Costa Rican). He cited two other actions as having some effect: efforts to encourage Costa Rican researchers and students to use the three OTS stations, including lower rates for Costa Ricans, and the OTS web page in Costa Rica providing information (in Spanish or English) on OTS courses, research projects and researchers, the stations, and bibliographies, especially the National Bibliography which is attempting to list all publications related to all aspects of tropical biology in Costa Rica and which is linked to journals such as the *Revista de Biología Tropical* (J. Monge-Nájera, pers. comm.).

THE MAJOR AREAS OF OTS'S EVOLUTION

The rest of this paper will focus on the evolution of the main components of OTS's mis-

sion statement that was quoted on the first page of this article. It will show how developments in education, research, environmental education and policy, and "responsible use of natural resources in the tropics" were produced by combinations of the internal and external pressures that have been discussed. The results were an evolution of OTS in areas of its traditional strengths, an extension of education and research into more applied areas related to tropical problems and solutions, and increased engagement with needs and concerns of Costa Ricans living around the stations, Costa Rican biologists, the Costa Rican government, and other Latin Americans.

Understanding the evolution of OTS's three field stations within their geographical context is crucial because their natural resources, facilities, and surroundings established parameters, challenges, and opportunities for much of OTS's activity in courses, research, and environmental education and policy. Space limits in the printed form of this article do not permit the inclusion of the author's discussion of the development of these stations; however, this material is included in the Appendix of the on-line version of this article.

EDUCATION

Since its founding, training graduate students has been OTS's main purpose and activity. From 1964 through 2001, OTS offered 224 graduate courses to a total of 4 149 students; 155 English language courses were taken by 2 874 students, while 60 Spanish language courses were taken by 1 091 students, and 9 courses in Portuguese were taken by 184 students (Summary of OTS graduate courses and numbers of students, 1964-2001; B. Lewis, pers. comm.). Designed for first or second year graduate students, OTS's trademark course, Tropical Biology: An Ecological Approach, known as the Fundamentals course, has been given at least once every year since 1965. From 1965 to 1970, Daniel Janzen and others introduced methods that the course still follows, making it

an intensive field course. For many years, this course was the only graduate level Neotropical field course available to North Americans; thus many tropical biologists in the U.S. are alumni/alumnae of this course; access to this course is the main reason most U.S. universities are members of OTS (Stone 1988). Each course has a coordinator and co-coordinator (usually recent Ph.D.s), a teaching assistant, plus about 20 volunteer resource people and 22 graduate students selected from OTS member institutions who are put through an intensive field experience for about two months. The course begins with a short orientation in San José and then travels (with scientific equipment, books and reprints) to about six different field sites which represent different ecosystems in Costa Rica; field sites generally include the three OTS field stations, Monteverde or Volcán Cacao, Cerro de la Muerte, Corcovado and/or a Nicoya Peninsula coastal location. At each site, there are orientations and faculty and group field problems, guest lecturers and course resource people, and independent research projects and reports. The variety in field problems, people involved, and sites is documented in the extensive course books that are put together after the course; these books are identified by the year and course number and are available for consultation at OTS offices and field stations (Stone 1988, Tangley 1988, Chazdon and Colwell 1990, Denslow 1990, D.E. Wilson 1991, Anon. 1994; B. Lewis, pers. comm.; see also OTS OTS Course books: Table of tables and tables of contents, 3 vols. 1965-1991). The basic purpose of the Fundamentals course is still to train students how to be tropical research biologists.

Until 1973, NSF supported the Fundamentals course and a number other courses in English, mostly in various areas of pure science; in the peak year of 1970, there were nine courses. When NSF ended funding for graduate education, the course offerings were pared back to two sections of the Fundamentals course in 1973 (OTS-1 and -3 are given at different times of the year). Stone obtained funding for the English Fundamentals course from a new NSF program for 1976 to 1980, when the

A.W. Mellon Foundation began funding this course and other new courses (Stone 1988, J. Giles, pers. comm.). OTS found additional funding to develop other new courses from the mid-1980s on; all graduate courses given in Costa Rica receive academic credit from UCR. As the educational program and number of OTS members grew, OTS hired permanent staff members. The Academic Director at NAO, Nora Bynum since 1998, works with Barbara Lewis, Academic Coordinator at CRO, and others responsible for particular programs. The Education personnel are overseen by the Education Committee whose head is the Vice Chair of Education on the Board of Directors (OTS Annual Report 1999). By the mid-1990s, this Committee had received funding so that it could meet regularly and take a more active role in maintaining the quality of OTS courses, setting goals for the Academic Director, and planning for future developments, making sure they fit the mission of OTS and the interests of OTS members. They were the first OTS group to engage in detailed strategic planning, producing a 5-year plan for the Education Program in early 1997 (OTS Liana spring 1996, Annual Meeting Book 1998; C. Charpentier, B. Lewis, pers. comm.).

A number of Costa Ricans and some other Latin Americans took the English courses, but there was considerable pressure to develop a Spanish version of the Fundamentals course. UCR approached OTS with a proposal to teach such a course, primarily for UCR students (B. Lewis, pers. comm.). OTS obtained funding from the Pew Charitable Trusts and OTS 2: Ecología de Poblaciones began in 1974 as a joint course with UCR. Initially, OTS did not pay the UCR professors teaching this course because they were already getting a UCR salary and teaching this course to 10 to 15 students was seen as part of UCR's in-kind payment in lieu of OTS dues (B. Lewis, pers. comm.). Unfortunately, funding for the Spanish course did not last; the course was given sporadically until its revival in 1985, following more pressure on OTS from its Costa Rican members and subsequent new sources of funding (including

some money from CONICIT and the Costa Rican government and, most recently, from the A.W. Mellon Foundation) (OTS Annual Meeting Book 1992, J. Giles, pers. comm.). This course has been given since 1985 on an annual basis and is still a joint OTS-UCR course although (since the early 1990s) it has increasingly become an international course with 22 students from about 15 Latin American countries. As the OTS teaching load for UCR professors increased, CRO Director Schnell added supplemental pay from OTS to their UCR salary. Although the salary differential resulted from the historical factors discussed above rather than a conscious decision, some Costa Rican academics criticized OTS for paying Costa Rican course coordinators less than those from the U.S. (B. Lewis, pers. comm.). OTS's Educational Committee and personnel were responsive to these criticisms; new funding sources for the Spanish courses allowed Claudia Charpentier of UNA, Vice Chair of Costa Rican Coordination, Chair of CRIC, and member of the Education Committee, to report in 1999 to OTS's Board of Directors that: "parity in salaries has been achieved for coordinators of comparable experience in English and Spanish Courses" (OTS Annual Meeting Book 2000). CRIC plays an important role in reviewing applications and selecting students and fellowship recipients for OTS-2 and other Spanish language courses taught in Costa Rica. OTS has been able to obtain funding to provide course fellowship support for most Costa Rican and a number of other Latin American students (B. Lewis, pers. comm.). To promote more interaction between the Spanish and English language Fundamentals courses and establish contacts for greater research collaboration, in 1999 OTS initiated a several day overlap of the two courses at La Selva that included joint field projects and a symposium where students discussed their results (OTS Annual Meeting Book 2000, Liana fall 2000).

Until the mid-1980s, both the English and Spanish versions of the Fundamentals course focused primarily on pure tropical ecology, reflecting the focus of the field of ecology itself

(Bohlen 1993, Anon. 1994, Worster 1994). However, examination of the contents of course books prior to the mid-1980s reveals some attention to topics in applied ecology, agriculture, and forestry in field problems and individual projects. There is significant variation among Fundamentals courses depending on coordinators and sites the course visited, with the most applied projects at Palo Verde and San Vito/Las Cruces. Thus, for example, the second English Fundamentals course of 1971 (then called 71-5) taught by John Vandermeer and Douglas Gill had a whole section on Applied Ecology in San Vito, Cerro de la Muerte, and Turrialba, while 69-1, 72-1, 73-1, and 79-3 focused on pure biology except for one or two field problems (OTS Course books: Table of tables and tables of contents, 3 vols. 1965-1991). One English course in 1974 had enough on deforestation problems to interest at least one student in a dissertation topic on the history of natural resource use and settlement on the Osa Peninsula (B. Lewis, pers. comm.).

Since the mid-1980s, responding to changing interests of instructors and students related to pressures discussed earlier in this paper, the Fundamentals courses have been dealing more with deforestation, conservation issues, and conservation biology. The amount of time spent on these topics varies with the instructors; some exposure is via lectures which are frequently not listed in the course books, but a number of coordinators state that they have included such material (B. Loiselle, N. Greig, pers. comm.). One of the 1985 courses was mainly applied biology; an upset student wanted a more theoretical course (B. Young, pers. comm.). The coordinators for 91-1, 93-3, 94-1, and 94-3 reported that at least half the applicants expressed interest in conservation biology. The latter three courses included significant conservation biology projects related to forest patches and the proposed corridor from Las Cruces to the Guaymi Reserve and to a corridor connecting Palo Verde Park with Lomas Barbudal Biological Reserve that was subsequently established (B. Loiselle, B. Young, pers. comm., Course Books for 93-3 and 94-1).

Courses 95-3, 96-1, and 96-3 each included a number of applied and conservation biology topics at multiple sites (E. Olsen, pers. comm. and Course Books). "Palo Verde was the most popular site" for 99-1 "due to the intense student interest in management issues at this site" (OTS Liana summer 1999).

According to one of its coordinators, the Spanish course, OTS-2, discussed and had lectures on conservation biology at least since 1986 and increasingly had field problems related to conservation and conservation biology at the Cacao Biological Station in the Guanacaste Conservation Area and at Las Cruces (P. Paaby, pers. comm.). OTS-2 even changed its name to *Ecología Tropical y Conservación* in 1994 to reflect its evolution to include more applied and conservation biology material (B. Lewis, pers. comm.). The Course Book for 99-2, for example, contains group projects on edge effects, restoration of abandoned pasture, rapid ecological assessment of habitats for conservation, and a study of payment for environmental services for forest conservation. By 2001, OTS's web page listed conservation biology as a major topic in both courses (www.ots.duke.edu). Responding to broader internal and external shifts in priorities, OTS is also identifying itself with conservation biology on a much larger scale. Donald Stone and Gary Hartshorn published an essay in 1997, "OTS as an Institution for Conservation Biology," that argues that the Fundamentals courses in English, Spanish, and Portuguese (see below), as well as all other OTS courses, are "beneficiaries of an OTS education based soundly in conservation biology" (Meffe and Carroll 1997).

OTS has also expanded its geographic distribution. At first this was done in Costa Rica by individuals who had been students and/or instructors in an OTS Fundamentals course. Daniel Janzen, a former OTS student and instructor, helped establish a University of Pennsylvania graduate course and park field station facilities in Guanacaste Conservation Area; Lawrence Gilbert of the University of Texas-Austin offers a graduate course based at a field station he built in Corcovado (L. Gilbert, pers.

comm.). Although Janzen and Gilbert have been critical of OTS and La Selva, both continue to serve as resource faculty in OTS courses. Other alumni and an OTS-2 instructor, Ricardo Soto of UCR, gave an OTS style course, *Ecología de Poblaciones y Biología de Conservación*, in Ecuador starting in 1992 (OTS Liana spring 1993). None of these courses had any official connection with OTS, but that began to change with the advent of the Brazilian Fundamentals course in Portuguese in 1993. What has become OTS-12: *Ecología da Floresta Amazônica* grew out of an OTS International Networking Planning Committee and the personal commitments of a veteran OTS course coordinator and OTS-experienced resource person to teach such a course. The 4 week field course also depended on the existence of an internationally known study site and access to a number of Amazonian ecosystems and on partnering institutions. The Biological Dynamics of Forest Fragments Project (BDFFP, previously called Minimum Critical Size of Ecosystems Reserve) near Manaus is part of Brazil's Instituto Nacional de Pesquisas da Amazônia (INPA) based in Manaus; they and the Smithsonian Institution coordinate BDFFP with the support of the World Wildlife Fund. The other course partner is Brazil's Universidade Estadual de Campinas (UNICAMP) (Gentry 1990, OTS Annual Meeting Book 1993). Of these institutions, only the Smithsonian Institution is currently a member of OTS. Another key factor in the launching of the course was that Donald Wilson of the Smithsonian's Biodiversity Office and OTS's Education Committee, obtained initial funding for the course from the Smithsonian; subsequently, funding came from USAID and the MacArthur Foundation (OTS Annual Meeting Book 1993, 1997; B. Lewis, pers. comm.). OTS's main contributions to this course have "consisted largely of help with publicity and recruitment, and, recently, some assistance with fundraising" (OTS Annual Meeting Book 1998, www.ots.duke.edu).

OTS was more involved in the decision to launch a new Spanish language Fundamentals course in Perú in 1999. A major concern was the

large increase in demand for the Spanish language Fundamentals course (OTS-2). When it was primarily a UCR course, OTS-2 had average enrollments of 10 to 15. However, when the course was opened to other Latin American students, enrollments increased to the OTS limit of 22 students and the number of applicants increased exponentially. A table in the OTS Education Program 5-Year Plan of 1997 shows an increase in applicants from 76 in 1991 to 155 in 1997. This Plan states that “the course is recognized throughout Latin America as a premier opportunity to learn field ecology and received high praise from the 290 course alumni, many of whom have gone on to get masters degrees or Ph.D.’s and are now professionally active in conservation, biological field research and/or university education in their respective countries” (OTS Annual Meeting Book 1998). The OTS Education Committee and Education personnel went in 1996 to the Peruvian Amazon at the invitation of the U.S. based ecotourism company, International Expeditions (IE) to consider using their facilities for a course. These facilities (a lodge, camp, and biological station) offered access to flooded forests, *terra firme* rainforests, and river habitats not found in Costa Rica and a major asset that OTS lacked, an extensive (400 meter) canopy walkway system at the Amazon Center for Environmental Education and Research (ACEER), a biological station deep in the Peruvian Amazon (OTS Liana winter 1997). ACEER, built in 1991 by IE, had become an independent scientific center and wanted to encourage academic use. Funding (from USAID) to develop a second Spanish Fundamentals course was more readily available in Perú than in other locations; the A.W. Mellon Foundation was also willing to provide funding. A Peruvian university, the Universidad Nacional de la Amazonía Peruana (UNAP) in Iquitos was eager to collaborate with OTS; they became a member of OTS in 2000, agreeing to “provide in-kind services and facilities to OTS in lieu of paying dues” (OTS Annual Meeting Book 2000). A final factor leading to the development of an OTS course in Perú was that veteran OTS coordinators from

the English and Spanish Fundamentals courses as well as a number of experienced OTS course resource people were enthusiastic about teaching this course. Thus, OTS-13: Ecología de Ecosistemas Amazónicos was launched in 1999 (OTS Liana summer 1999, Annual Report 1999). There were 105 applicants for 99-13, 98 for 00-13, and 59 for 01-13; despite expectations, the Peruvian course does not seem to have taken much pressure off the Spanish Fundamentals course in Costa Rica which had 101 applicants for 00-2 and 126 for 01-2 (OTS Liana summer 1999, Annual Meeting Book 2001). As with the English and Spanish Fundamentals courses in Costa Rica, OTS-12 and 13 include material on rainforest “development” and conservation issues (OTS Liana winter 2000, www.ots.duke.edu). Also, the BDFFP’s Reserve in Brazil is a well known major research project in conservation biology.

The success of OTS efforts in Brazil and Perú fit with objectives of OTS’s Strategic Plan and provided “a viable model for geographic diversification ... partnering with other organizations that have facilities and infrastructure in the areas where we wish to work. OTS does not have to purchase a new field station and property in order to run a new course—instead we focus on exporting our educational philosophy and faculty resources of our consortium in order to create more opportunities for our students” (OTS Annual Meeting Book 1999). As OTS expanded course opportunities in the tropics, it developed an important conceptual change of emphasis: “OTS Education is committed to integration, such that we do not have a Latin American Program and North American Program, but rather courses that are offered in English, Spanish, or Portuguese, and are open to all students who can speak that language” (OTS Annual Meeting Book 1999).

The latest expansion of OTS in Latin America is into Mexico with a new 6 week graduate course in 2002: OTS 19: Ecología de Ecosistemas Costeros Tropicales. This course will be based on a partnership among OTS, the Instituto de Ecología (INECOL) of Mexico, which became a Member of OTS in 2001, and

the Center for Coastal, Energy and Environmental Resources at Louisiana State University, a long time OTS member (OTS Annual Meeting Book 2001, www.ots.duke.edu). The course will use INECOL's facilities, especially its La Mancha Coastal Research Center to add important ecosystems to OTS's course offerings as it focuses on the "ecology and management of tropical coastal ecosystems of the Gulf of Mexico, from the wetlands of the coastal lowlands to the seashore" (www.ots.duke.edu).

OTS has also extended its course offerings beyond Latin America. By partnering with other institutions, OTS has also been able to offer access to courses in East Africa, starting in 1999, to limited numbers of students from its member institutions. These graduate courses include the Smithsonian sponsored Field Course in Conservation Biology and Wildlife Management in Uganda, which has been listed as OTS-15. Access to other East African courses (in Kenya and Tanzania) for students from OTS members has resulted from a new exchange program with the Tropical Biology Association, a consortium like OTS, but based in England with European and African member institutions (OTS Annual Report 1999, Annual Meeting Book 2000, www.ots.duke.edu). With funding from the A.W. Mellon Foundation, OTS's Education Committee, Hartshorn, Bynum and others attended a planning workshop in 2001 for a cooperative educational program in South Africa's Kruger National Park with the Universities of Cape Town (which became an OTS member in 2001) and Witwatersrand (OTS Annual Meeting Book 2001).

Funding from the A.W. Mellon Foundation has also allowed OTS to evolve into specialized niches. Donald Stone deserves credit for designing OTS-9: Tropical Plant Systematics which began in 1994 and has been given in alternate years. The Spanish version, OTS-18: Sistemática de Plantas Tropicales, was given for the first time in 2001 (OTS Annual Meeting Book 1998, 2001). Two new initiatives address the problem of lack of comparative studies among different tropical sites noted in Orians's

concluding chapter of the La Selva book (McDade *et al.* 1994) and earlier in Alwyn Gentry's Introduction to *Four Neotropical Rainforests* (Gentry 1990). The four field stations discussed there were La Selva in Costa Rica, Barro Colorado Island in Panama managed by the Smithsonian Tropical Research Institute's (STRI), Cocha Cashu in southeastern Perú's Manu National Park, and the Biological Dynamics of Forest Fragments Project near Manaus, Brazil. In 2001, Orians coordinated a 10 week course (OTS 25: Advanced Comparative Neotropical Ecology) based at these four sites for researchers with recent doctorates or advanced graduate students who have done research at one of these sites (unlike other OTS courses which are for students early in their graduate careers). The course has been set up to promote detailed comparative studies (OTS Annual Meeting Book 2001, www.ots.duke.edu). Mellon is also funding a two year pilot project starting in 2001, called the "3M Initiative" for Multi-site, Multi-investigator, and Multi-disciplinary training for Plant Ecology Graduate Students that will introduce young graduate students to the four sites above and two others (in Hawaii and Kruger National Park, South Africa). Mellon has funded research projects by senior researchers at each of these six sites; students have to agree to do training modules at a minimum of three of the sites over a two year period and attend a "synthesis meeting" at the end of the second year (OTS Annual Meeting Book 2001, Liana spring 2001). Funding from Mellon will allow OTS to develop into another new niche; OTS-17: Molecular Methods in Tropical Ecology coordinated by OTS Chairperson Pedro León will debut in 2002 (OTS Liana fall 1998, www.ots.duke.edu).

APPLIED COURSES

OTS had some applied courses in the period of NSF support; there were several courses on Tropical Forestry (1968-1971) and a few courses such as "Crop Plants in a Tropical

Environment" in 1968 and "Geography: Man's Impact on Tropical Forest Ecosystems in Costa Rica, Past and Present" in 1972; these courses disappeared when NSF support ended (Stone 1988).

By the 1980s, pressure was mounting for more applied courses from U.S. member institutions with agricultural, forestry, and conservation programs and from some Costa Ricans who wanted to see more practical courses. Funding sources, such as foundations and USAID, were also moving in this direction. In 1983, for example, OTS wrote grant proposals to expand their Spanish language program to include applied courses such as agroecology, wildlife management, interpretation programs for parks and nature preserves, and teacher training in environmental education. Since these were not funded, nothing happened (Stone 1988). A major turning point came when OTS convinced the A.W. Mellon Foundation to match the William and Flora Hewlett Foundation to fund the development of an applied course in agroecology (D. Stone, pers. comm.). At the same time, there were several former OTS course instructors and alumni who argued that agroecosystems should be regarded as real ecosystems and who were interested in teaching an agroecology course. They and others on a Committee for Tropical Agricultural Ecology recommended to the Board in 1985 that the course follow the successful model of the eight week Fundamentals course and focus on field problems and individual research at a series of sites, including those around the three field stations, especially Las Cruces where agro-ecology seemed to fit perfectly in planning about what to do with Las Cruces (OTS Annual Meeting Book 1985, 1986; M. Swisher, pers. comm.).

OTS 4: Tropical Agricultural Ecology began in 1985; by 1989, it evolved into the broader Tropical Managed Ecosystems to appeal to more students. The Spanish version, OTS 7: Agroecología, started in 1988 with funding from several foundations. An Agroecology Coordinator, based at Las Cruces, was hired in 1990 to help with the courses and encourage research on the subject. Although

there were some differences between the courses due mainly to the fact that most Latin American students already had some basic knowledge of tropical agriculture, both courses increasingly focused on modules, such as the ecology of agricultural systems from big agriculture for export crops to subsistence farming; sustainable development; and conservation biology (M. Rosemeyer, M. Swisher, pers. comm.). The English course was given for the last time in 1993 and was replaced in 1995 by OTS 11: Tropical Conservation Biology which was discontinued after its second offering in 1996. Another course included applied material and lasted longer; OTS 10, Tropical Diversity and Conservation, began in 1990 and changed its name to Tropical Biodiversity in 1996. Unlike any other OTS graduate courses, this short course was open to students who were not from OTS member institutions and it charged enough to cover all its expenses. In 2000, there were only nine students in the course; it has disappeared from subsequent course listings. Different explanations for the failure of these applied courses have been offered. There were funding problems and difficulties finding instructors, relatively low numbers of applicants, and serious differences in viewpoints and values between students and some instructors from biology versus those from the social sciences. The OTS governing structures have been dominated by ecologists, and some of those take responsibility for not doing enough to publicize the courses outside of Biology Departments in their home institutions (OTS Annual Meeting Book 1998; B. Lewis, M. Quigley, C. Schnell, M. Swisher, pers. comm.). As noted above, conservation biology has increasingly been integrated into the Fundamentals courses in Latin America and forms a significant part of the courses newly available to OTS students in Africa; OTS's Academic Director anticipates new course approaches to conservation biology in the future (N. Bynum, pers. comm.).

In contrast to the fate of the English applied courses, the Spanish course Agroecología continues, having been given every year since 1988

despite the fact that it has had some of the same problems as the English version. However it has had more applicants and dedicated support from CRO and certain course instructors. A UCR biologist told an OTS Board education discussion group that a major reason for the success of the OTS 7 course was students' Spanish language abilities that allowed direct communication with farmers and others in the field (OTS Annual Meeting Book 1998; B. Lewis, M. Swisher, pers. comm.).

Since the mid 1980s, and especially following the success of the Trials Project involving native Costa Rican tree species (discussed below), there has been increasing interest in developing an ecologically based forestry program for OTS. There has also been considerable pressure in this area from the more than twenty member institutions that have forestry schools. Gary Hartshorn did give a course on Agroforestry in 1987 and in 1988, but there was no sustained funding. In the 1990s, a resurgent interest in a forestry program led to OTS Board sub-committee reports, the hiring of a Forestry Coordinator, and plans for courses in English and Spanish; again, funding did not materialize for the courses (OTS Annual Meeting Books 1992-1995). OTS has organized a number of workshops on the Trials project and supported, along with USAID, the publication of two editions of *Sistemas Agroforestales*, a manual of agroforestry (Montagnini *et al.* 1992). *Ad hoc* forestry committees continue to urge more OTS involvement in forestry.

OTS has evolved since the late 1980s into other important niches by developing applied courses and workshops to train professional decision makers and managers of wildlands in Latin America. These developments will be discussed below in the Environmental Education and Policy section.

Funding has been a constant concern for courses. Tuition revenues cover only a portion of the costs for each graduate course; most of the additional funds come from grants that are restricted in use for certain courses. A major aim of the current Campaign for OTS is to fund the expansion of educational facilities at the new

OTS building on the UCR campus and at the three field stations and to develop endowments whose incomes will support key courses, scholarships, post-course grants, and the field stations (OTS Annual Meeting Book 2001). As the Campaign goes forward, an OTS Committee is undertaking a comprehensive review of all aspects of the Graduate Education Program to determine ways to improve it and to document the influences OTS courses have had on their alumni/alumnae (OTS Annual Meeting Book 2001; www.ots.duke.edu has survey forms in English and Spanish).

Another niche that OTS exploited was an undergraduate semester abroad program for U.S. students. Many professors from the U.S. and Costa Rica have organized their own field trips and courses for their undergraduates at OTS field stations; OTS can make some or all the arrangements for these groups for a fee and now promotes this service as a way to increase station occupancy (A. Carter, pers. comm.). About half of the undergraduate groups visiting La Selva, which has more such groups than the other stations, have been Costa Rican students; they pay lower station charges than non-nationals at all three stations as part of OTS's policy to encourage their visits (OTS Annual Meeting Book 1994, www.ots.duke.edu). OTS's administration, Board, and Education Committee had talked for years about adding an OTS undergraduate program; it would easily fit with OTS's mission of providing leadership in education in the tropics (OTS Annual Meeting Book 1996). The immediate stimulus to develop such a program came from the A.W. Mellon Foundation, the primary source of funds for the Fundamentals and a number of other graduate courses; they were encouraging OTS to become more financially self-sufficient. The Foundation provided planning and start-up funds that enabled OTS to launch its undergraduate program 1997 in a strong competitive environment with many good existing semester programs in Costa Rica for U. S. undergraduates run by (in the order of founding) the Association of Midwestern Colleges (ACM), the Monteverde Institute, the School for Field Studies, the

Institute for Central American Development Studies (ICADS), UCR, and others (Burlingame 2000). OTS had the advantage of its strong reputation for and experience with graduate field courses and its three well developed biological stations. The start-up funds paid for a program team and gave them time to do careful planning; the course has had its own faculty, including Costa Rican biologists with doctorates and Costa Rican graduate student field assistants.

The program consists of four semester (15 week) long courses (with academic credit granted through Duke University): Fundamentals of Tropical Biology, Field Research in Tropical Biology, Environmental Science and Policy of the Tropics (mainly conservation biology and "the development and economic consequences of the agro-export economy, with specific emphasis on coffee, banana, and timber industries"), and Spanish and Latin American Culture (including intensive Spanish language instruction and a home-stay with a Costa Rican family) (Duke/OTS Undergraduate study program in Costa Rica fall 2001). As with the graduate courses, this program stays at OTS's field stations and in Corcovado and Cerro de la Muerte. In the first eight semesters (Fall 1997 through spring 2001), there were 188 students, with 24 to 25 students each semester since spring 1998 (K. Mendez, pers. comm.; OTS Annual Meeting Book 2001). The Program added a summer course in 1999 on Tropical Ecology in Costa Rica, which includes topics in conservation biology. A second summer course was added in 2000; Luis Diego Gómez teaches Introduction to Field Ethnobiology (his growing interest in this area can be seen in his articles in the Las Cruces newsletter, *Amigos*). This course is centered at Las Cruces and includes visits to several different indigenous groups to learn about their uses of plants and animals (OTS Liana spring 2001; see also www.ots.duke.edu). OTS's Undergraduate Program has been successful in attracting students (mostly from non-OTS member institutions); new grants starting in 1999 fund a minority scholarship program that has expanded the pool of students to

include more African American, Hispanic, and Native American students (OTS Liana fall 2001). The Program has also benefited OTS financially by improving station occupancy, particularly in off-season, and by providing surplus income that can help support graduate courses (OTS Annual Meeting Book 2001).

The Strategic Plan argues that OTS must "Continue to support and strengthen core offerings [the Fundamentals courses] that serve the needs of member institutions" and "Increase diversity of course offering and expand the scope of the educational program to reach a broader spectrum of participants, using methods that build upon OTS's established strengths in inquiry-based field training" (OTS Handbook 1999). The Plan foresees more applied and more interdisciplinary courses, such as sustainable forestry, and it calls for continued geographic expansion, as in the Amazonian courses. Also, the Plan stresses developing more courses for undergraduates, secondary students and their teachers, policy makers, natural resource managers, and journalists. Once the planning was completed in 1999, the Education Staff and Committee began to implement rolling 5-year plans to reach the more general goals and objectives of the Strategic Plan (OTS Annual Meeting Books 1999-2001; N. Bynum, pers. comm.).

RESEARCH

After education, the second most important part of OTS's mission is providing leadership in research. Unlike the Smithsonian Tropical Research Institute (STRI) in Panama which has its own paid full time scientific researchers, OTS facilitates research by visiting scientists and students (although the station Directors and other employees pursue their own research part time). OTS's web page stated (in May 2002) that "research at the OTS stations has added significantly to what is known about tropical biology and forest ecosystems-more than 300 scientists from 25 countries work at OTS sites each year." In fiscal year 2001, there were more than

100 publications based on research at OTS stations; most of these publications resulted from research at La Selva, whose total publication count was 2237 (OTS Annual Report 2001). All OTS based publications (that they know of) for each station are listed on OTS's web site (www.ots.duke.edu/www.ots.ac.cr).

This article will treat research briefly because so much of that research has been published and because there are already extensive published analyses and discussions of OTS research. Many early researchers at OTS field stations reported findings from their work in the 1983 *Costa Rican Natural History* edited by Janzen. Few OTS researchers published in the *Revista* until the late 1980s; either they published in U.S. journals or in *Brenesia*, a journal created by Luis Diego Gómez after he became Director of the Museo Nacional de Costa Rica in 1970. In 1987, the *Revista* published a full issue based on OTS research (Monge-Nájera, pers. comm.). Today, OTS researchers publish in journals from all over the world, including the *Revista*, as may be ascertained by examining the station bibliographies. Almeda and Pringle (1988), Gentry (1990), and McDade *et al.* (1994) are three extensive books that discuss research done at OTS stations, especially La Selva. Other important studies of OTS based research include: D.B. Clark (1985), D.B. Clark in Almeda and Pringle (1988), Stone (1988), Tangley (1988), Chazdon and Colwell (1990), D.B. Clark in Gentry (1990), Stone and Hartshorn in Meffee and Carroll (1997), and Matlock and Hartshorn (1999).

This section of the article stresses two main themes, the extent to which OTS based research has become more applied and ways in which OTS has worked to include more Costa Rican and Latin American researchers and to promote better communication between foreign and Costa Rican scientists. Both of these topics are related to internal and external pressures that have shaped the ways OTS facilitates research. First of all, OTS provides researchers with three field stations whose land acquisitions were shaped by decisions and events on and off the stations; the stations are also surrounded by land

that has been subject to varying uses that offer opportunities for many kinds of research (see the section on the evolution of the stations in the Appendix of the electronic version of this article). OTS assists independent researchers by providing food, housing, meeting places, laboratory space and equipment, greenhouses and shade houses, computers and data bases and other on line information, communication services as electronic mail and phone service, fax and photocopy machines, libraries, herbaria, and living plant collections at its three field stations; the evolution of these facilities and services were shaped by assumptions about what type of research they would support (D.B. Clark, pers. comm.). OTS offers services ranging from fashioning equipment to laundry. Logistical assistance includes hiring Costa Rican assistants, transporting people and equipment in or to and from Costa Rica, making reservations, and helping with government permits for collecting, exporting or importing specimens, as well as visas and information of all kinds (D.B. Clark in Gentry 1990, OTS Strategic Plan 1999, Liana spring 2001). La Selva is marked off in a grid for use with their GIS; in 1999, they added a permanent Global Positioning System; OTS staff can help researchers use these (OTS Liana summer 1999). To encourage graduate students to carry out research at OTS stations, OTS offers a variety of post-course grants and research fellowships for thesis research; information on these is available on the web page; annual reports list recent recipients, their projects, and their institutional affiliation. OTS has been raising more funds to increase the number and endowments for these grants (OTS Annual Report 2001). Each station has Directors, resident biologists and naturalists who can orient researchers and help with many problems. In return, researchers pay room and board charges (with higher rates for senior researchers and lower rates for students), plus lab table charges and overhead on grants, and costs for some of the other services mentioned above (fees are detailed on OTS's web page).

OTS has tried to encourage more Costa Ricans to do research at OTS stations in a

variety of ways. Members of CRIC are actively working to recruit more Costa Rican researchers from their institutions to do research at OTS stations. Claudia Charpentier, Vice-Chair representing CRIC on the Board, has organized workshops to promote knowledge of research opportunities at the stations; CRIC is also actively working to establish collaborations between Costa Rican and foreign scientists (OTS Liana winter 2000; C. Charpentier, pers. comm.). OTS charges lower rates for Costa Rican scientists and students; students can receive research grants noted above. However, as a number of Costa Rican scientists have pointed out, it is still too expensive for most Costa Rican students or senior scientists to stay at OTS field stations, and they have many cheaper alternatives ranging from field stations run by Costa Rican universities to just going to a location, renting a room, and conducting their research (J. Jiménez, pers. comm.). Certain researchers from the U.S. have made a point of recruiting Costa Rican students to do research on their projects and use that towards graduate degrees in the U.S. For example, Braulio Vílchez from ITCR is a co-PI with Robin Chazdon, from the University of Connecticut, and Deborah Lawrence of the University of Virginia on a project called BOSQUES that is studying forest regeneration on abandoned cattle pastures near La Selva (OTS Liana spring 2001). Catherine Pringle's work with Rodney Vargas on drinking water for a town near La Selva as an extension of her STREAMS research is discussed below in the environmental education sections.

It would be interesting to determine the number or percent of Costa Rican fellowship recipients and researchers at each station, but this is difficult. Many students and researchers are listed in the Annual Reports and on-line as affiliated with a particular Costa Rican university or institution, but this includes foreign students studying at those institutions. In other cases, Costa Ricans doing graduate work outside Costa Rica are identified by their graduate school. For example, Victor Carmona, is listed in OTS's Annual Report for 2001 as a recipient

of an OTS Fellowship and as a researcher at Palo Verde; his institutional affiliation is given as the University of Arkansas. It is only because this author knows Carmona (from his earlier positions as the person in charge of La Selva's labs and then a teaching assistant for several Fundamentals courses in English) that she knows he is a Costa Rican. Thus, there are no easy ways to arrive at accurate figures in this matter.

A major complaint of Costa Rican scientists in the past was that foreign scientists did not send them reprints and that they did not know what research was being done at OTS stations. OTS was aware of the failure of researchers to send reprints—they were not getting them either; its February 1976 Newsletter carried a reminder that researchers were supposed to send six copies of each article to CRO; two copies would then go to UCR, two to CONICIT, and two to OTS, but there was no way to enforce this. Costa Rica's 1992 law of Wildlife Conservation did provide some "teeth" because scientists had to apply in advance for collecting and export permits, had to deposit duplicates of collected specimens at UCR or the Museo, and had to send reprints; if they did not follow these procedures, they would not get future permits (M. Quesada, pers. comm.).

Jorge Jiménez, now OTS Director of CRO, came to OTS as its Scientific Director with a vision of creating a major web-based presence for OTS that would provide information about all aspects of OTS, including on line bibliographies of all OTS research publications (the separate station bibliographies existed in paper copies before, but they were difficult to obtain and were always out of date). Jiménez and librarians at several Costa Rican institutions also wanted to create a bibliography that would include all published research done in Costa Rica in biology, agriculture, forestry, environmental sciences, natural resources, and veterinary medicine; thus was born BINABITROP: Bibliografía Nacional en Biología Tropical. The bibliographies have expanded through the extensive research of data base manager Gilbert Fuentes and with the able direction of OTS's

librarian, Ana Beatríz Azofeifa. On line since 1997, BINABITROP consisted of more than 19 000 entries by May 2002, according to the web site (one gets to this bibliography through the OTS web site). The bibliography can be searched by keyword in Spanish or English; entries include a short abstract and, when possible, locations of the item in Costa Rica, and links to other similar publications. Azofeifa has already assembled an extensive collection of reprints; she hopes eventually to obtain every item cited in OTS's bibliographies and many other publications (A. B. Azofeifa, pers. comm.). OTS's library catalogue is now on-line and researchers are welcome to use the library at CRO; the library will become more accessible once OTS moves to its new building at UCR. Jiménez claims that the electronic resources OTS has made available will do more than anything else to improve relations between Costa Rican scientists and OTS (J. Jiménez, pers. comm.).

Until the mid 1980s, most of the research at and around OTS field stations was primarily basic research, particularly in ecology, physiology, and taxonomy, and there was and continues to be a lot of it, as may be seen in the 1994 book: *La Selva: Ecology and Natural History of a Neotropical Rain Forest*. (McDade *et al.*). This book's Appendix I, Patterns of Research Productivity 1951-1991, by McDade and Bawa notes that "initially, most research was concentrated in the fields of systematic biology, general ecology and community ecology." The table in McDade and Bawa by subject and date shows a pattern similar to that Monge-Nájera found in his analysis of papers published by subject in the *Revista de Biología Tropical* (Monge-Nájera and Díaz 1998). McDade noted that beginning in the mid-1980s, there was a marked growth in publications in applied ecology, starting with forestry. Many of those publications were linked to the Tree Trials research (see below) and then to OTS's new applied courses. They wrote that "increased concern about the loss of tropical forests and species has also resulted in publication of a number of conservation-oriented papers" and they state that "the assault on the

environment and natural resources worldwide has brought the issues of conservation and management of natural resources to the forefront; we expect to see continued evolution of the research mix and of the researcher community at La Selva."

The best known and most successful example of applied research, known as Trials, established clear evidence of the possibilities and benefits of reforestation using native species of trees; previously, reforestation used mainly exotic non-native trees such as pine and eucalyptus. OTS first became involved in experimental forestry in 1983, when it collaborated with the Costa Rican Forest Service to establish a tree plantation on the La Guaria annex; this was followed by a 1985 collaboration there, which was the first to use native trees. The MacArthur Foundation offered a large grant (about a quarter of a million dollars) to fund an expanded version of this. OTS was taken aback since they had no staff scientists to do research, so there was a scramble to locate a principal investigator; Gary Hartshorn was named PI. Eventually, Rebecca Butterfield was put in charge and in 1987 began screening over 80 promising but little known tree species selected from over 800 tree species in the area. Butterfield designed a complicated experiment to test this many trees at once; for comparison, she included popular non-native species traditionally used for reforestation (the exotics did not perform well against the natives in most conditions). For these experiments, trees were grown in different types of degraded soils on the La Guaria Annex and on the even worse soil in the Peje Annex. A second focus of the experiment was to see which trees were best for restoring degraded land. In 1988, small pilot plantations were planted in real conditions on farms in the area. As part of this whole experiment, Butterfield established a tree nursery near the main road to produce seedlings for the different plantings. By 1987, she had gotten strikingly good results with a number of native species and visitors began to arrive to see her results; they included people from the forestry department, many foresters, and local farmers. A

Trials II project followed with work on the pilot plantations on the farms and studies of the best trees to use for seeds as well as analysis of wood quality from the different trees (Butterfield Ch. 25 in McDade *et al.* 1994). The success of the Trials Program was a great feather in the cap for OTS, which continues to point to it with pride in their publications.

Several projects have built on the successes of the Trials project. A similar project, originally dubbed Trials III or Trials South, was carried out by co-PIs, J.D. Richter (of Duke University) and J. Calvo (of ITCR and subsequently Director of the Tropical Science Center) in southern Costa Rica on the Pacific slope to select and test trees native to that area that would be suitable for plantation forestry. Funded by USAID, this five-year project involved work with local farmers to encourage reforestation and the establishment of tree nurseries and help with technical advice and training (OTS Amigos December 1993, Liana spring 1995). A number of Costa Rican scientists launched their careers from the three Trials projects (E. González, pers. comm.); their names can be found in the extensive list of publications based on Trials that is available on OTS's web page; by May 2002, the list included 140 publications. The trials Projects thus illustrate OTS's move to more applied research that was useful to Costa Rica and demonstrated the third part of its mission, "the responsible use of natural resources in the tropics." The Projects also show greater opportunities for Costa Ricans in research linked with OTS.

The Trials programs have ended; they mark the only cases where OTS hired its own researchers. The rest of the researchers working at OTS come with their own grants or pay out of their own pockets. A number of large scale, multi-investigator projects funded by NSF, Mellon or other large institutions are underway, mainly at La Selva. I have already referred to BOSQUES and STREAMS which involve applied science and close collaboration between U.S. and Costa Rican investigators. Another project that does this is code named PLAGAS, whose funding from USAID began in 1992.

Robert Marquis, Walter Marin, and others first worked with the TRIALS plots and then established plantations at La Selva to study pests and pathogens of native tree species, how damage to trees varies in shade or in sunlight, and how their managed ecosystem compares with the natural one (Matlock and Hartshorn 1999, R. Marquis, W. Marin, pers. comm.). Another large project, ALAS, Arthropods of La Selva, deals with biodiversity issues. The NSF funded large team of researchers is developing new more accurate ways to estimate the magnitude of tropical biodiversity by using a variety of sampling and collecting methods. This is the only OTS project tied in with INBio. An additional project (CARBONO) deals with research related to global warming, while another (HUERTOS) focuses on issues of sustainability (Matlock and Hartshorn 1999). Most of the researchers at La Selva work on much smaller scale projects which span the spectrum of pure to applied research as can be seen from listings of researchers in Annual Reports or on the OTS web page under La Selva.

Publications resulting from research at Las Cruces from 1960-1984 were primarily in systematic biology and population ecology. Starting in 1985, there was a marked increase in research in agroecology, forestry, horticulture, conservation biology, and other topics related to sustainable development (OTS Research at the Robert and Catherine Wilson Botanical Garden 1988). The rise of these areas is linked to the beginning of the Agroecology course in 1985 and OTS's push to develop these areas at Las Cruces. By the mid 1990s, conservation biology and landscape restoration became the major focus of research activities. Much of this research relates to studies of forest fragments in the area. These recent shifts are documented in OTS's Annual Reports, on line lists of researchers' publications by station, and, in a more qualitative way, in articles on individual researchers, in Las Cruces's newsletter Amigos.

At Palo Verde through the early 1980s, scientists pursued mostly pure research in taxonomy and ecology. By 1990, about half the research was in the areas of conservation

biology, management, and other applied areas. OTS's grant application to NSF for the development of Palo Verde facilities cited such recent studies as: "marsh regeneration, cattail elimination, waterfowl breeding and feeding, fire control by reforestation and cattle grazing, and protection of rice fields from wild ducks. In the agricultural areas outside the Park, studies have included: productivity and sustainability of traditional and mechanized agriculture, agroforestry, restoration of wetlands and forests, management of fires, impacts of agricultural runoff, and control of wildlife damage to crops" (OTS Improvement of facilities at the Palo Verde Field Station, proposal to NSF 1993). The proposal includes a list of research projects since 1979; since they are arranged by year, it is easy to observe the shifts in research interest. A graph in the proposal, "Nationality of Palo Verde Researchers," demonstrates considerable growth in the number of Costa Ricans conducting research at Palo Verde; there are strong ties between several researchers from UNA and Palo Verde; now their students are also doing research at Palo Verde. CRIC is actively promoting research by Costa Ricans and held a workshop on ways to do this at Palo Verde (OTS Liana winter 2000). As with the other stations, updated lists of researchers, their projects and publications are available through OTS's web site and annual reports.

OTS's Strategic Plan of 1999 recommends that OTS continue in its role as a facilitator of research at the three field stations, upgrading facilities and on-line information and databases. While stressing the importance of basic research, it also lists as an objective the promotion of "research that addresses immediate and emerging problems in the tropics"; it recommends that OTS "promote and sustain cross-cultural cooperation among scientists" and "improve the transfer of knowledge among scientists and potential users of research findings" (OTS Strategic Plan 1999). Concerned that the number of researchers at the stations was not continuing to grow and that OTS needed to do more to promote new research priorities, including research on land around the stations, in 1998

OTS created a new Vice-President for Research on the Board. David B. Clark, who was codirector of La Selva for many years, was named to this position. He conducted an on-line survey in 2001 of selected people associated with OTS and the Ecological Society of America on the topic of "challenges and opportunities in tropical biology"; although fewer than half of those contacted responded, those that did stressed the importance of topics in conservation biology and applied biology (OTS Annual Meeting Book 2001). Thus, it is likely that research at OTS field stations will continue to move toward more applied areas and that OTS will increase efforts to encourage more research by Costa Ricans and other Latin Americans at OTS field stations.

ENVIRONMENTAL EDUCATION AND ENVIRONMENTAL POLICY PROGRAM

Environmental education and environmental policy began in the mid-1980s and represent two very important new areas in OTS's evolution. Relatively little beyond brief discussions has been published on OTS's activities in these fields (Stone 1988, Tangley 1988, Chazdon and Colwell 1990, McDade and Hartshorn Ch. 2 in McDade *et al.* 1994). Developments in these areas differed from those discussed above because they reached out to new constituencies: school children and adults living around the field stations, primary and secondary school teachers, non-scientific visitors to the field stations (especially natural history visitors or ecotourists), journalists, park managers, and policy makers from the local level to the national and international levels.

OTS moved into environmental education and policy for many internal and external reasons. One reason was to protect the field stations and earn the support of people living right around them, especially in the case of La Selva whose potential problems with respect to its neighbors are noted in the section on field stations (in the Appendix of the electronic version of this article). A second reason operated on a

broader scale. By the mid-1980s, there was growing interest from OTS personnel, especially CRO's Director at the time, Charles Schnell, and from a number of U.S. and Costa Rican scientists associated with OTS, including those in CRIC, who wanted OTS to give more back to their host country and to other Latin Americans (C. Schnell, pers. comm.). At the same time, Costa Rican Presidents were asking OTS for help in promoting their environmental agendas, Costa Rican environmental and educational organizations were requesting that OTS to work with them on various projects, and Costa Ricans living near the field stations were seeking help with a number of local problems.

There was a wide variety of opinion and considerable debate within OTS from the mid-1980s about the extent to which it should be responding to the above pressures and pursuing the third part of its mission, "providing leadership in the responsible use of natural resources in the tropics" (C. Schnell, pers. comm.). The Report of the OTS 2000 Committee (1991) commented that some U.S. members of OTS "tolerated" OTS activities that went beyond running the basic graduate education courses and promoting research at the stations if they did not detract from those two primary responsibilities. The 2000 Committee, however, took a much more pro-active stance and endorsed environmental education focused around the stations and environmental policy courses. By the time the Strategic Plan was approved in 1999, the part of the mission statement on sustainable development had been extended to all aspects of OTS's operations, and environmental education for children and adults around the stations and environmental policy were seen as essential OTS activities (OTS Strategic Plan 1999). At its Annual Meeting in 2000, OTS created a new Board of Directors' position of Vice Chair for Public Awareness "to address OTS's leadership in environmental education and outreach" (OTS Liana fall 2000). This new Vice Chair presented a "Typology of Public Awareness Activities" at the next Annual Meeting that shows the very wide range of activities OTS carried out under the heading of

Public Awareness (OTS Annual Meeting Book 2001).

A third reason for evolution in these areas was the need to deal with the growing number of visitors, including many in undergraduate courses from U.S. and Costa Rican institutions and ecotourists, such as bird watchers, and people interested in tropical rainforests or in botanical gardens. Tourism, which grew dramatically during the 1980s, replaced bananas as Costa Rica's number one source of foreign exchange in 1994, and all the guidebooks recommend visits to the OTS field stations. These visitors represented a potential disruption to scientific activities, but they also were potential sources of political and financial support. The flood of Costa Rican and foreign visitors increased as highway access improved for all three stations.

A final reason OTS expanded in these areas relates to financial considerations. On the one hand, grants were available from foundations, conservation organizations, and government agencies increasingly concerned with sustainable development, including environmental education and especially environmental policy. Once OTS decided these fields represented an important extension of its mission, the administration began generally successful searches for funding to support new initiatives from such sources as USAID, the Ford Foundation, the World Wildlife Fund, the W. Alton Jones Foundation, the William and Flora Hewlett Foundation, the U.S. Fish and Wildlife Service, the Tinker Foundation, and others (OTS Annual Meeting Books 1986-2001). On the other hand, OTS was pressured by its major funding sources, NSF and the Mellon Foundation, to become more financially self-sufficient and generate more income and find more alternate sources of funding to support its activities. Expanded funding enabled OTS to hire additional personnel, primarily Costa Ricans, to develop programs, courses, workshops, and other activities in environmental education and policy and to expand marketing efforts (J. Giles, J.M. Rodríguez, pers. comm.).

Environmental Education began at La Selva in 1984 in response to growing local

resentment. A similar program was started at Las Cruces in 1986 following the government's expropriation effort. Environmental Education was not extended to Palo Verde until 1990 and has been sporadic since, largely because the Tempisque Conservation Area has its own Environmental Education program in the sector. Charles Schnell, who had become the Director for OTS's operations in Costa Rica, was instrumental in pushing OTS into this new area. He had previously taught at UNA and was aware of increasing negative feelings towards OTS among Costa Rican academics and politicians. In 1985, Schnell hired a half-time environmental education specialist, Ana Chaves, who first developed environmental education at La Selva and then worked at OTS's San José office to develop OTS programs at the national level (OTS Newsletter March 1985; A. Chaves, C. Schnell, pers. comm.). Costa Rica had been developing environmental education since the late 19th century (Monge-Nájera 1994-a, Evans 1999), but OTS was trying to determine its role in the field. Although OTS continues to work with national coordinating groups, it now focuses more on the areas round its field stations; the Environmental Education programs at La Selva and Las Cruces also benefited from several U.S. Peace Corps's volunteers. The largest program is still at La Selva.

OTS's Environmental Education Program has evolved in a number of areas. The greatest amount of effort has gone into educating primary and secondary school children about tropical biology and the need for conservation efforts as well as what goes on at the stations in terms of research and graduate education. These and other environmental education efforts have been aided at La Selva since 1986 by the construction of a visitor's center funded by the W. Alton Jones Foundation and by renovations in the Holdridge Arboretum (OTS Annual Meeting Book 1986). Classes were brought to the stations for a day of lectures, slide shows, hands-on experiences, and guided educational tours of the rainforest and different research projects. In 1992, for example, over forty different school groups visited La Selva

and the staff provided programs tailored to the different ages; for a number of these children, it was their first visit to a rainforest (H. González, pers. comm.). La Selva's Scientific Director Robert Matlock and Environmental Education Coordinator Carlos Barquero, refocused the program in 1999 to tie in with Costa Rica's Ministry of Public Education's revised biology curriculum for the 4th, 5th, and 6th grades. The La Selva program works in ten schools with about 500 local students per year, offering classroom instruction in natural history, ecological processes, and human-environment interactions; the students come to La Selva twice each year for hands-on experience with tropical wet forest biological topics they have studied. Some of these students also have created environmental projects, such as planting native trees, in their home communities (OTS Liana spring 2001, Annual Report 2001). An innovative program for high school (colegio) students grew out of research by Catherine Pringle (University of Georgia) on streams in La Selva; her graduate student, Rodney Vargas, did his Master's thesis research on problems related to the drinking water supply of Puerto Viejo de Sarapiquí, near La Selva (Vargas 1995). Other Pringle students and a student from UNA helped establish a program (including a manual in Spanish) in 1995 for the colegio students to test and monitor the water quality in streams important for Puerto Viejo's drinking water, by adapting a Georgia program, Adopt-a-Stream, to the local situation (S. Pohlman, R. Vargas, pers. comm.). Adopt-a-Stream was extended in 1998 to a colegio near Las Cruces by Raúl Rojas, the resident biologist (OTS Amigos November 1998). Las Cruces's subsequent resident biologist, Rodolfo Quiros has developed "The Garden as a School" program for biological and conservation education of students from elementary through university levels; 700 local students came to the Garden for this program in fiscal year 2001 (OTS Annual Report 2001, Liana spring 2002).

OTS also has developed educational and community outreach programs for adults living near the stations. OTS staff have visited schools

to help teachers develop their own environmental education instruction (this includes providing them with educational materials) and they have worked with communities on recycling and organic gardening projects (O. Vargas, J. Porras, pers. comm.). The OTS staff also meet with a number of local groups; they give presentations and provide information for community groups such as the Water Committee in Puerto Viejo (OTS Liana winter 1993; R. Vargas, pers. comm.). They have brought local farmers to see the Tree Trials Project, and they have worked with a local women's co-op that grows medicinal plants near La Selva (H. González, pers. comm.). In fiscal year 1997, more than 100 student and local groups visited the three OTS stations; the following fiscal year, more than 1560 local students and residents visited the stations (OTS Annual Reports 1997, 1998).

A third area of Environmental Education is the organization of or participation in special events such as workshops and short courses for a national audience; many of these activities have been held at the field stations and often are the result of OTS collaboration with Costa Rican universities, government agencies, and NGOs. They have held three nationwide workshops on Environmental Education at La Selva (1988-1990); they have run workshops with the Costa Rican Forestry Service on the Tree Trials Program. On the national level, since the mid-1980s, OTS has served on a number of government environmental commissions that range from a National Environmental Education Committee to Commissions on Water and Forests and another on Endangered Species. In 1987, OTS signed an agreement with the government of Costa Rica to provide technical advice in all the areas in which it has expertise, including National Parks (Tangley 1988; A. Chaves, L.F. Murillo, C. Schnell, pers. comm.). Currently, staff from all three stations are involved with local, regional, national (and for Palo Verde, international) efforts to study, monitor, protect, and even restore water resources (rivers, watersheds, and wetlands) near the stations (OTS Liana spring 2002).

In a fourth category, the growth of nature tourism presented new problems for OTS's field stations. Foreign scientists coming to Costa Rica marked the first stage of natural history tourism in Costa Rica; by the mid-1970s, there were enough foreign scientists spending money for research at La Selva and other protected areas, including Monteverde and Costa Rican parks, to have measurable effects on the Costa Rican economy, especially as friends and families of these scientists also came to visit. The big expansion of nature tourism beyond scientists came in the late 1980s as bird watchers flocked to Costa Rica because of its very high avian biodiversity, much of which could be observed at OTS's three field stations (Stiles and Skutch 1989, Ehrlich 1994, Sekerak 1996). In the very late 1980s and early 1990s, nature tourism expanded to a much broader clientele, numbers of visitors increased dramatically; tourism became the number one source of foreign currency for Costa Rica by the mid-1990s (Laarman and Perdue 1989, Boo 1990, Rovinski 1991, Wallace 1992, Evans 1999, Honey 1999, Burlingame 2000). OTS's three field stations were included in all the nature travel books as "must visit" sites (Rachowiecki 1994, Sheck 1996, Blake and Becher 1997 are the best of such books). OTS's field stations had to figure out how to deal with all the ecotourists as well as with increasing numbers of student and other groups from the U.S. and Costa Rica who wanted to visit. Many scientists were concerned that these visitors would interfere with their research; also, OTS faced liabilities if tourists were free to wander on their own. OTS realized that it could require reservations and establish structured and guided environmental education programs for these visitors. The guides could also provide station orientations for scientific visitors. In turn, OTS could earn money from ecotourists by charging them more than researchers for visits, meals, and overnights and might favorably impress some visitors to become donors. Las Cruces was particularly successful at raising funds from ecotourists (G. Hewson, pers. comm.).

However, greater numbers of people wanted to visit La Selva, which was much easier to get to from San José once the new highways opened. The problem was the lack of guides, so two ecologists from La Selva developed an innovative program to train local people to be natural history guides (Paaby *et al* 1991, Paaby and Clark 1995). The course, funded by the World Wildlife Fund-U.S., met for 12 Saturdays in 1989 and 1990. The course targeted local people who needed employment; its purpose was to provide a broad environmental education that would open a number of employment opportunities and create a vested interest in preserving protected areas. All of the graduates of the program immediately found jobs, including several at La Selva; one of the graduates went on to become the station naturalist (O. Vargas, pers. comm.; OTS Liana spring 2002). Led by Pia Paaby and others at La Selva, the project produced a long report on their approaches; this report was sent to other areas of the country where it served as a model for training local people to be naturalist guides. The one flaw in the program was that there was not time to teach English and most of the visitors spoke English (P. Paaby pers. comm.). Some of the guides learned English on their own; others participated in a subsequent program in 1994 that stressed intensive training in English in addition to natural history (Laing 1994). La Selva required all natural history visitors to have guides, thus ensuring employment for a number of guides in addition to those who already worked for La Selva.

Because of tourism's profitability, OTS established a Marketing Program to increase the number of visitors by offering guided tours and working with tour companies. These tours are publicized in a variety of ways, including on the back page of Liana (see, for example, Liana fall 2001 and spring 2001). In 1999, OTS established a new program, BioCursos, for Costa Ricans. These weekend excursions to locations all over Costa Rica stress environmental and conservation education and activities and deal with topics ranging from Costa Rican frogs, to medicinal plants, to sea turtles, to birds found in

different parks, to diseases of orchids. These mini-courses are widely advertised, including on OTS's web site; they have been very popular, with 74 courses, 2100 participants, and 25 themes in the first six months of the program. In addition to promoting ecological and conservation awareness, these courses help to create a favorable image of OTS and, along with the other programs for visitors, generate funds for OTS (OTS Annual meeting book 2001, Annual report 2001). Since Costa Rica taxes tourist activities, OTS set up a company, ESINTRO to collect and pay taxes on these activities and on profits at station gift shops; whatever money is left is donated to OTS (R. Sheck, C. Schnell, pers. comm.).

Finally, OTS has prepared, printed, distributed, and sponsored (or financially contributed to) many educational materials ranging from a variety of guides to the stations (including maps and species lists), to newsletters, brochures, workshop proceedings, and books, including *Costa Rican Natural History* (Janzen 1983) and its subsequent Spanish translation (1991) and *Sistemas Agroforestales* (Montagnini *et al.* 1992). In recent years, OTS has expanded its public relations efforts to distribute information about OTS to the print and television media in Costa Rica and the U.S. OTS even sponsored "The Ecological Minute" on Costa Rican television and, in 1996, La Selva hosted a live television broadcast on "Science in the Rainforest" for the Turner Network Adventure Learning series for children (C. Schnell, O. Vargas, pers. comm.). Since the late 1990s, OTS has dramatically expanded its electronic presence in English and Spanish on its web site, www.ots.ac.cr/www.ots.duke.edu. Extensive material is available about all aspects of OTS for students, researchers, members, natural history visitors, and others. OTS's newsletters, including a new Spanish version of Liana, are now available on line along with annual reports, bibliographies, and links to other related sites. Usage of the site has grown exponentially to about one million hits in 2000 (OTS Annual Meeting Book 2001).

ENVIRONMENTAL POLICY

In the late 1980s, OTS evolved into a new important and influential niche, advanced education in Environmental Policy, that addressed a whole new constituency, environmental decision makers in Costa Rica, Latin America, and the United States. The Program was launched with external pressure in 1988, when the grants' officer at the William and Flora Hewlett Foundation offered OTS funding for a course for environmental decision makers in connection with funding for the Agroecology course; a person on OTS's Board, Barbara Bentley, agreed to organize and teach such a course with UCR's Carlos Quesada (L. McDade, pers. comm.; Saterson 1988). The course's purpose was to introduce U.S. Congressional staff to environmental issues in the tropics that were directly affected by U.S. policy by giving them some first hand experience. The one week course in Costa Rica, "Interdependence: Economic Development and Environmental Concerns in the Tropics" at first was like a mini regular OTS course. The participants visited hydroelectric and irrigation projects, banana plantations, model environmental projects, and projects that were producing environmental changes. They also talked with many Costa Ricans, including their counterparts. This course has been given every year since 1988 and carries OTS course number 8 (Summary of OTS graduate courses and numbers of students 1964-2001). A 1993 evaluation indicated that the courses had considerable impact, including influences on some U.S. foreign aid bills, but recommended a greater emphasis on policy and inclusion of people from U.S. government agencies as well as some from conservation NGOs, such as Conservation International (M. Witte, pers. comm.). OTS implemented these recommendations and, beginning in 1998, established follow-up workshops, the Policy Dialogue Series for U.S. Decision Makers, in Washington, D.C. (OTS Annual Meeting Books 1999 - 2001).

A parallel course for Latin American decision makers, *Principios Ecológicos para el*

Desarrollo Sostenible en América Latina, designated OTS course 6, also began in 1988, with funding from USAID and U.S. foundations. It was taught by Raúl Solórzano of the Tropical Science Center; he has continued to serve as course coordinator in most subsequent offerings. This course, like the English course, is deliberately non-partisan, but it is longer than the English course (currently two weeks versus one week), and it carries UCR course credit (B. Lewis, pers. comm.). It brought together Latin American legislators as well as people from executive and judicial branches of government to learn about environmental issues and problems. This course was even offered twice in 1992, and there is a waiting list of people who want to get into it. In 1999, OTS received a grant from the U.S. Fish and Wildlife Service, which funds the course, to hire an independent consultant for an evaluation of the first ten years of this course; the results of the evaluation were positive and included examples from different Latin American countries of ways participants used their course knowledge to draft and/or reform laws, establish protected areas, and plan agro-ecology projects. The evaluation also made some suggestions, since implemented, to improve the course (J.M. Rodríguez, pers. comm.). José María Rodríguez, who had come to OTS in 1989 from senior positions in the Costa Rican Park Service, played an essential role in developing the Environmental Policy Program in his role as the Program coordinator. He also served as a coordinator or resource person in most of the Policy courses given in Costa Rica.

Detailed information on each annual offering of the U.S. and Latin American Decision Makers courses is available in OTS newsletters (*Liana* and *OET al día*), Annual Meeting Books, Annual Reports, and reports to the organizations that funded these courses. Coordinators and participants are listed, along with their affiliations; there is also information about the sites the course visited and what topics were covered. These two courses and other components of the Environmental Policy Program will be supported by an endowment; \$1 million dollars had

been raised by 2000; OTS is working to raise the additional \$500 000 needed to complete the endowment (OTS Annual Meeting Book 2001; J. Giles, pers. comm.). OTS has also run three seminars for Central American business leaders involved in environmental decision making (in 1998 and 1999) and a number of seminars (since the late 1980s) on environmental issues for Central American journalists (OTS Annual Report 1999, Liana summer 1999; J.M. Rodríguez, pers. comm.).

Within the Environmental Policy Program, OTS broadened its educational mission in a significant new way when it began, in 1999, a professional training program for Latin Americans in tropical wildlands management, *Manejo de Areas Silvestres Tropicales*, OTS course 16. Unlike the short decision makers courses, this course lasted for eight weeks, making it comparable to regular OTS graduate courses. Like them, the course went to a series of Costa Rican locations for intensive hands-on field experience; however, course 16 differs markedly from other regular OTS courses because it stresses professional training of people who already have experience working in a park or other protected area. The aim of the course is to teach practical skills that will make these people more effective park managers. This course, given for the fourth time in 2002, is funded by the U.S. Fish and Wildlife Service (OTS Liana spring 2001 and fall 2001, Annual Report 2001; J.M. Rodríguez, pers. comm.).

Another impressive OTS environmental policy program occurred in 1990, when the Ford Foundation funded a series of weekend workshops for major figures in the incoming administration of President Rafael Angel Calderon. Participants were taken to selected sites where they learned about environmental issues and trade-offs through case studies in natural resource degradation, conservation, restoration, pollution, problems associated with energy production, and possible ways to control these problems. From 1992 to 1995, OTS mounted three Environmental Seminars for Central American Legislators that were funded by the W. Alton Jones Foundation (OTS Annual

Meeting Book 1992, 1996). The Ford Foundation and USAID funded a program similar to the 1990 one for the new Costa Rican administration of President José Maria Figueres that took office in the spring of 1994 (OTS Liana winter 1995). From 1994 to 1996, OTS also worked (with varying degrees of success) to extend its Incoming Governments Program to Bolivia, El Salvador, Guatemala, Honduras, Nicaragua, and Panama, all of whom had elections close to Costa Rica's 1994 one. OTS sought to aid counterpart organizations in these countries in establishing programs for their incoming governments modeled on the Costa Rican examples (OTS Annual Meeting Book 1996, Expanded environmental policy dialogue in Central America: report to the Ford Foundation 1997; J.M. Rodríguez, pers. comm.).

The Ford Foundation also provided several large grants to OTS from 1991 to 1995 to develop a program called *Enriching Environmental Policy Dialogue: Participatory Options for NGOs and Local Governments*. Its purpose was to test the relative effectiveness of several participatory methods that had been developed by the World Resource Institute to improve environmental decision making; these methods had been tried in areas of Africa, but not in Latin America. OTS, with an expanded staff paid by the grant, tested the effectiveness of different approaches in the areas surrounding its three field stations. The aim was to determine which approaches worked best to empower communities around the stations to assess the state of their natural resources and their environmental problems and to have a greater role in environmental decision making (J.M. Rodríguez, pers. comm.). These approaches ranged from workshops for local leaders around La Selva to work with all the people in a few communities around Las Cruces using a method called rapid rural appraisal, to a combination of these approaches in the Palo Verde area (L.F. Murillo, pers. comm.). In 1997, OTS published an analysis of the three approaches. They noted that local circumstances (expansion of banana plantations around La Selva and of irrigation networks

around Palo Verde versus the drop in coffee bean prices around Las Cruces) made it difficult to conclude that one of the three methods was THE one to use in all other areas; each method had advantages and disadvantages that could serve as useful lessons for others (Rodríguez and Vargas 1997).

In 2000, OTS designed and launched an important new three-year series of six training seminars for Central American and Mexican decision makers to interest them in and motivate them to create a Meso-American Biological Corridor (MABC) that would link protected areas throughout Central America and allow migration and gene flow among them. Funded by World Wildlife Fund-Central America, each seminar targeted a different audience. The first stressed the biological importance of the corridor, sustainable development, and ways to advance linkages for 18 participants from governments, non-governmental organizations, and corporations. The second seminar was for legislators, and the third was for the agro-industrial sector, the fourth for the tourism sector, and the fifth for representatives from the print and broadcast media (OTS Annual Meeting Book 2001, Annual Report 2001, Liana fall 2001 and spring 2002).

Although OTS was willingly pushed into Environmental Policy, it is now very committed to continue work in this area and expand its efforts significantly as long as it can find the funding to do so (see OTS Strategic Plan 1999). In 2002, OTS changed the name of the Environmental Policy Program to Environmental Science and Policy Program to stress its emphasis on interactions between science and policy: "Perennial courses like the U. S. and Latin American decision-makers courses explore the science-policy interface with participants from public, private, and NGO sectors. *Wildlands Management ...* focuses on practical skills for park managers from across Latin America. These courses, funded by the U.S. Fish and Wildlife Service, will continue to reflect the Program's mission to foster and advance the responsible use, management, and conservation of natural systems and resources in the tropics,

by educating individuals in leadership positions" (OTS Liana spring 2002). OTS is expanding the program to Perú and Brazil under the leadership of a new Director of Environmental Policy Initiatives, and will offer the first decision maker course in Perú in 2002 (OTS Annual Meeting Book 2001). Another means of expanding the Program is "to systematize in-house knowledge to make it exportable, adaptable, and available"; a *Wildlands Management Resource Manual* is therefore being prepared, as are resource materials that can be used for additional courses and that focus on "learning modules along themes such as Biodiversity, Forests, Freshwater Systems, Protected Areas, and Ecosystem Services" (OTS Liana spring 2002). OTS is also actively seeking partnerships with international conservation and development funding organizations to expand its training programs.

CONCLUSION

OTS has evolved in many ways since its founding. It is certainly a much larger and more diversified organization; it has developed three Costa Rican field stations with excellent facilities for teaching and research. Course offerings have expanded and are now given in English, Spanish, and Portuguese in Costa Rica and South America; OTS is a recognized leader in the training of tropical ecologists, and it has extended its field based educational methods to include conservation biology, applied biology, and professional training. OTS has also developed state-of-the art station facilities and services to promote many types of pure and applied tropical research.

Although OTS still has its critics among Costa Rican and U.S. scientists for the various reasons that were discussed in this paper, OTS has taken a number of significant steps to improve relations with Costa Rican biologists and their students in the Costa Rican member organizations. CRIC has played an important role in convincing OTS to make a number of these changes, and new leadership in OTS has

also been pro-active in promoting improvements. Responding to the need to improve relations with Costa Ricans around its stations, since the mid-1980's OTS has developed environmental education programs for neighboring children and adults. They have also pioneered programs to reach a variety of Costa Rican and Latin American decision makers with workshops and training relevant to their needs.

OTS's goals for the future build on broadening its roles and activities discussed in this paper. Its Strategic Plan, produced under the Chairmanship of Pedro León, begins with a vision of OTS in the year 2020, making "scientific contributions to the conservation and management of natural resources in the tropics" including progress in biodiversity conservation, understanding global climate change in the tropics, developing sustainable tropical forestry (especially through reforestation with native species), promoting sustainable agriculture, applying principles of conservation biology to promote corridors linking protected areas, improving the condition of wetlands, and "developing and disseminating the knowledge base to natural resource managers and policy makers" strengthening "its traditional base in Costa Rica by diversifying uses of its three field stations and promoting research that addresses local and national needs" (OTS Strategic Plan 1999).

The realization of these goals will be aided greatly by the presence of OTS's new Simons Center at UCR's Research Campus; Pedro León laid the cornerstone for the building, designed by UCR architects, in March 2001 (OTS Liana spring 2001). An extensive agreement between OTS and UCR assures that both parties will benefit considerably from this new level of cooperation (R. Vargas, pers. comm.). OTS envisions an intellectual center where students from the U.S. and Latin America can interact with "the experts concentrated in the capital city of San José, where scientists from throughout the world engage in a dialogue on the natural resource issues facing the tropics, and where politicians, corporate executives, and community leaders in the region participate in an open

exchange of ideas" (OTS Liana spring 2001).

Finally, OTS and the *Revista* are moving closer together; more research at OTS stations is being published in the *Revista* (Monge-Nájera, pers. comm.). The *Revista* is linked to OTS's web site and its articles included in the on-line BINABITROP. This article on the evolution of OTS is appearing in a special issue of the *Revista* that celebrates its 50th and OTS's 40th anniversaries.

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RESUMEN

La Organization for Tropical Studies (OTS)/Organización para Estudios Tropicales (OET) ha evolucionado en diversos campos desde su fundación en 1963 como un consorcio sin fines de lucro que ofrece cursos de especialización y facilidades para la investigación en ecología tropical en Costa Rica. Para el año 2002 sus miembros internacionales incluían 65 instituciones, incluidas cuatro de Costa Rica. Se habían desarrollado tres estaciones de investigación en Costa Rica (La Selva, Las Cruces y Palo Verde) con excelentes facilidades para la educación y la investigación, y se estaba construyendo una nueva oficina en la Universidad de Costa Rica. La combinación de presiones internas y externas obligaron a la OET a desarrollar nuevas direcciones en los años ochentas y noventas. La

OET se diversificó y se preocupó más por la ciencia aplicada en sus áreas tradicionales de cursos de especialización y facilidades de investigación. La organización a su vez evolucionó hacia nuevos nichos: más biología aplicada, educación profesional, educación y política ambiental, esfuerzos de conservación y la distribución geográfica expandida a otros países de América Latina. La OET estaba compuesta de una combinación cambiante de gentes (Juntas, miembros, personal) con prioridades mejoradas y competitivas para los recursos financieros limitados. Los cambios ambientales externos también han moldeado la evolución de la OET. Los nuevos problemas de una creciente deforestación tropical, la emergente "crisis" de la biodiversidad y la biología de conservación, el cambio climático global y las llamadas por un desarrollo sostenible afectaron los constituyentes de la OET y las prioridades de financiamiento de gobiernos y fundaciones. Las presiones internas y externas combinadas en algunos casos, han demandado especialmente de la OET mejorar sus relaciones con los biólogos costarricense y sus instituciones, con el gobierno de Costa Rica y los costarricenses vecinos de las tres estaciones experimentales de la OET.

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