

## **Bridging Scientific Knowledge, Education, and Application in Temperate Ecosystems of Southern South America**

The temperate forest ecosystems of southern South America are isolated from other forest formations within the continent by large orographic and climatic barriers. As a consequence, these southern forests have evolved a rich and largely endemic biota. Among the vertebrates (147 species), 50% of the fish, 80% of the amphibians, 36% of the reptiles, 30% of the birds, and 33% of the mammal species are endemic to the Chilean temperate forests (Arme­sto et al. 1995a). Regarding the flora, 34% of the woody genera are

endemic to the southern temperate rain forest, and 80% of the tree genera are monospecific (Arroyo et al. 1995). Some community and ecosystem properties, such as the relative importance of plant–animal interactions for plant reproduction, the high nutrient retention within forested watersheds, and the chemically pristine quality of fresh water, air, and soils also seem remarkable among temperate forests of the world (Arme­sto et al. 1995b). In the last decade, however, scientists and environmentalists alike have expressed great concern for the survival of the southern rain forest ecosystems, in the face of high rates of deforestation, species losses, and large-scale replacement of native trees for commercial forestry (Lara and Veblen 1993). The increasing involvement of scientists in education and management decisions can

change this trend of environmental degradation, by promoting sustainable forestry practices based on scientific knowledge, and increasing people's appreciation of the value of native ecosystems.

The necessity to integrate three crucial spheres of activity in ecology—research, education, and environmental decision-making—has been emphasized by the Ecological Society of America in its “Sustainable Biosphere Initiative” (Lubchenco et al. 1991). It is hoped that this integration will provide a new context for understanding and changing the present relationship between human societies and nature, with the aim of insuring the long-term sustainability of the global environment. The major threats to the global environment can be summarized in the concept of global change, which has as its major contributing processes (1) changes in

the chemistry of the atmosphere/land/water systems, (2) losses of biodiversity, and (3) changes in land cover/land use (Vitousek 1994). To address these critical problems it is essential to act at both the regional and local scales, to change people's perception of their environment, to critically examine traditional land use and resource management practices, and to understand the biological and cultural relevance of each local system in terms of its impact on the global environment. Furthermore, the approach of landscape ecology (Pickett and Cadenasso 1995) has made explicit to ecologists that our task is not only to describe the natural patterns and processes, but also to become actively involved in the design, management, and protection of the environment that surrounds us.

With these goals in mind, a group of Chilean and international ecologists has decided to establish a new scientific institution in southern South America, the Institute of Ecological Research Chiloe (IER-Chiloe). This institute is conceived as a research center that will encourage collaboration among scientists from various disciplines and institutions, the formulation of research programs to address local and regional environmental problems, and the communication of scientific findings to the public and other professionals. We have based the institute in the heart of the temperate rain forest region of southern South America, in the Island of Chiloé, Chile (42°30'S, 73°50'W), taking advantage of the extensive scientific background derived from several years of work by Chilean and international scientists in this region (Armesto et al. 1995b). In addition to being the geographical center of the temperate rain forest region, the Chiloé archipelago and its neighboring mainland currently represent a zone of transition between increasingly human-impacted landscapes towards the north (Armesto et al. 1994), and almost pristine ecosystems towards the south (see Hedin et al. 1995). The Chiloé region was described as nearly pristine in Darwin's Voyage of the Beagle (1839). Most

severe land cover changes have occurred only in the past 50–100 years, due to expansion of the agricultural frontier and large-scale deforestation around human settlements (Willson and Armesto 1995). The southern half of the island and its coastal ranges still support large expanses of primary rain forest, undisturbed by humans. Some sectors of the Chiloé archipelago are still inhabited by indigenous people, descendants of the pre-Hispanic inhabitants of the region, and keepers of a rich legacy of knowledge of their natural environment.

The flexible organization and integration of multiple scales and disciplines required to achieve the goals of the IER-Chiloe is hardly possible within traditional academic institutions or government agencies. Some of the limitations of traditional institutions are the fragmentation of related disciplines in different professional schools, large bureaucracy, and excessive centralization. The recognized complexity of global and local environmental issues makes it necessary to develop effective channels for communication between scientists and professionals in charge of land management, environmental policy, and decision-making within each region. The IER-Chiloe, although maintaining specific collaborative links with universities, governmental agencies, and non-governmental organizations, is conceived as an independent non-profit organization, with a simple administrative structure led by scientists. The IER-Chiloe will provide concrete opportunities for the interaction among scientists, managers and other professionals, in the form of workshops, seminars, and project development. As a way of implementing the program of the IER-Chiloe, we have established a Biological Station, Senda Darwin (Darwin's Trail), located 10 km north of the town of Ancud on the northern coast of Chiloé Island, with easy access from the main highway and 1 hour away from Puerto Montt's airport on the mainland. Sections of the old road from Ancud to Chacao, traveled by Darwin in 1835, are found

within the property. The 53 hectares of land include streams, patches of second-growth and riparian evergreen forests, shrublands, and reclaimable pastureland. In addition, through agreements with the Chilean Forest Service, scientists may have access to 45,000 ha of forested landscape, including many pristine watersheds, within Chiloé National Park, 1–2 hours from the Station. Native forests in Chiloé National Park provide an additional opportunity to compare the functioning of ecosystems that remain largely untouched by people with those of areas under increasing degrees of anthropogenic influence. Such studies can provide a unique resource for understanding how humans have modified biogeochemical processes in this and other regions of the world (Hedin et al. 1995). The IER-Chiloe also has access to private forest lands granted by local owners. At present, a residence is available to visiting scientists, and in the future, pending national and international support, we plan to add laboratory facilities, and conference and exhibit rooms. A library and a database on South American temperate ecosystems are being planned. Senda Darwin is open to Chilean and foreign scientists and students as a natural laboratory to enhance knowledge on the ecology of southern South America.

One goal of current research activities in Senda Darwin is to understand how traditional land use practices influence and transform the landscape, and alter communities and ecosystems. Presently we are evaluating the effects of forest fragmentation and land clearing on the survival of endemic bird species (Willson et al. 1994; Sieving et al., *unpublished manuscript*). These studies will provide guidelines on how these birds can survive in a fragmented landscape, and will be used to develop forms of conservation that are compatible with traditional agricultural practices. Pastures, fields, and forests in Senda Darwin will be managed to demonstrate the coexistence of sustainable agriculture with the conservation of the native biota.

Our present educational program is centered on four related efforts that seek to increase the people's understanding and appreciation of their native environment:

- A series of courses and activities planned for schoolteachers, students, and park guards, that are intended to build understanding of the natural history of the local flora and fauna.
- Establishing native woody species and plant communities in schoolyards and urban parks.
- Developing a native tree nursery in Senda Darwin, to support these activities and future ecological restoration programs in Chiloe Island.
- Providing citizens and the large number of tourists that visit Chiloe Island with an opportunity to learn about the native forests, we are constructing a botanical garden that will include representative trees from the whole temperate region of South America. This garden and its associated educational materials are part of an ongoing collaborative effort with scientists of the Royal Botanic Garden, Edinburgh, Scotland, an institution that holds a long-standing tradition of cultivating Chilean native tree species.

For further information on current activities and to find out how to collaborate with this initiative, please contact:

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