Revista Chilena de Historia Natural

Creating a new cadre of academics capable of integrating socio-ecological approach to conservation biology

Creando una nueva generación de investigadores capaces de integrar los aspectos socio-ecológicos en conservación biológica

RODRIGO A. ESTÉVEZ[1,2*], DIEGO A. SOTOMAYOR[1,2], ALEXANDRIA K. POOLE[3] & CRISTOBAL PIZARRO[2,4]

[1] Programa de Magíster en Ciencias Biológicas m/ Ecología de Zonas Áridas, Departamento de Biología, Universidad de La Serena, Casilla 599, La Serena, Chile.

[2] Instituto de Ecología y Biodiversidad (IEB), Chile.

[3] Doctoral Program, Department of Philosophy and Religion Studies and M.A. Department of Environmental Sciences, University of North Texas; UNT-Chile Biocultural Conservation Program.

[4] Programa de Magister en Ciencias Conservación y Manejo de Recursos Naturales en Ambientes Subantárticos. Universidad de Magallanes; Parque Etnobotánico Omora, Puerto Williams Chile.

*e-mail for correspondence: rodrigoestevez@yahoo.com

ABSTRACT

As education shapes the mindsets of the next generation of scientists going into the field, the nature of the tools used, and the way the role of humans within nature is conceived will significantly impact scientific studies, policy and decision making. In this article, our objective is to analyze how Ecology and Natural Resources Management programs in Chile integrate socio-ecological aspects in their conservation biology courses. Moreover, we present our perspectives about the process, benefits and challenges that come with participating in programs with interdisciplinarity components and socioecological approaches. In Chile, 9 PhD and 13 MS programs acreditted by the National Commision of Standarization are related to Ecology and/or Natural Resources Management, and of those, around 70% have a Conservation Biology course. Despite the integration of socio-ecological aspects in these programs, the educational content of these programs appear to follow an utilitarian paradigm, instead of a environmental ethics paradigm, such as the ideas presented by Aldo Leopold's land ethic. We argue that a paradigm shift is necessary in the educational approach to Conservation Biology within Chile that encompasses the evaluation of both social and ecological aspects beyond their utilitarian or instrumental value, and that it should build upon the non-equillibrium model of Ecology already established. The shift would expand methodology to include 4 additional components: Biocultural Mindset, Interdisciplinarity, Multidirectional Comunication and Participation, and, Field Experience and Direct Encounters with nature.

Key words: Conservation Biology, Interdisciplinarity, Graduate Education, Biocultural approach, Chile.

Introduction

Conservation biology, and the conservation sciences generally, arose from a recognized need by scientists to study the impact of human activity on species diversity, biological communities, ecosystems and ecological processes so that they could better advise land management strategies (Vitousek et al. 1997, Sanderson 2002, Foley et al. 2005, Rozzi et al 2006). Scientists strive to develop methodologies which enable sustainable management of natural resources for both human and non-human well-being and in response to the increasing homogenization of ecosystems (Ehrlich 2002, Liu et al. 2007). The success of studies that are able to account for both the human and natural component of ecosystems has often depended upon the ability of researchers to perceive biotic systems as socio-ecological systems, a perspective that motivates multiple disciplines to explore the interrelated and multi-facted dimensions of these coupled human and natural systems. In recent programs such as those found in the Omora Ethnobotanical Park, researchers recognized this need within conservation biology, leading to the emergence of a biocultural approach that integrates considerations of biological, cultural and linguistic diversity in conservation analysis (Rozzi et al. 2006a).

Here we argue that in order for conservation biology to successfully incorporate human and natural systems into one unit of study, it is necessary to redefine the fundamental framework and methodologies used to study biotic systems, furthering the paradigm shift that ecology has already undergone with the development of the non-equillibrium model (Pickett 1997). This requires studying biotic systems not as isolated social or ecological

systems, which in turn requires separate ‘soft’ or ‘hard’ sciences of study, but as socio-ecological systems whose attributes are interrelated and in turn, require an interdisciplinary approach that uses a broader toolset to study these multi-facted biocultural systems (Daily & Ehrlich 1999; Ehrlich 2002). According to this argument, we consider that it is crucial to include socio-economic aspects in addition to ecological consideration throughout postgraduate education in Ecology and Conservation studies, to enable students from those programs to be able to fully incorporate the broader realm of human understanding, experience which will have far-reaching impact throughout their careers.

During the last two decades, conservation biology courses and programs have emerged and been established in a variety of universities, at both undergraduate and graduate levels throughout the world (Collett & Karakashain 1996). In certain countries, such as the United States of America, the majority of programs in conservation biology are cross-disciplinary, incorporating faculty from outside the biological disciplines in their conservation biology programs (Jacobson 1990, Jacobson et al. 1995). However, the current program offerings in conservation biology and conservation related courses has yet to be characterized in Chile. In this article, our objective is to analyze how Ecology and Natural Resources Management programs in Chile integrate socio-ecological aspects in their conservation biology courses. Moreover, from our experiences as graduate students, we present our perspectives about the process, benefits and challenges that come with participating in programs with interdisciplinarity components and socioecological approaches. The particular questions we are considering include: Is the socioecological approach being included in conservation biology courses in graduate education in Chile? How should it be included? Why is it necessary to use a socio-ecological approach? Further, how do we relate the

socioecological dimension to Long Term Socio Ecological Research (LTSER) sites in terms of graduate education? We hypothesize that in spite of the general knowledge of human impacts on ecosystems, the development of crucial interdisciplinarity projects, and the inclusion in the curricula and educational programs of a interdisciplinarity approach in other countries of the world, graduate programs in Chile in Ecology and Natural Resources Management do not generally integrate the socio-ecological approximation. While we have begun to incorporate the human component into our ecological models however, it remains to be seen how well we are implementnig this conceptual shift in our educational programs, and further, we still have to determine the best way to go about incorporating the human component into the ecological system as we have conceived it. As education shapes the mindsets of the next generation of scientists going into the field, the nature of the tools used, and the way the role of humans within nature is conceived by these scientists, will significantly impact scientific studies, policy and decision making in the future.

Graduate Programs in Ecology and/or Natural Resources Management in Chile

As of January 2009, of the 117 PhD and 176 Master academic programs accredited by the the Comisión Nacional de Acreditacion (CNA) (National Commision of Standarization) in Chile, a total of 9 PhD and 13 MS programs are related to Ecology and/or Natural Resources Management. Our initial survey included a review of the study plans of all graduate study plans as available on the internet. Then, we requested the curricula for the Conservation Biology courses for all those 22 programs through the contact information of the Program's Director available on the Internet. Table 1 and 2 show a complete list of the surveyed PhD and Master programs, respectively. Also, Figure 1 shows the geographic

distribution of such programs, where it can be noted that Master's programs are located spanning more chilean territory than PhD programs.

Of those 22 programs mentioned above, 15 PhD and MS programs included a specific Conservation Biology course, and only 7 (46,7 %) sent us their curricula. The analysis of program contents reveals that the majority of those programs use socioeconomic indicators and evaluations to inform the management of natural resources, including the tools used for species management and environment management systems. In the analyzed curriculums this socioeconomic approximation is not explictly integrated into the framing of methodology and formulation of studies problems in terms of a socio-ecological interdisciplinary structure (Primack et al. 2001). However, some of the programs do have contents related to socioeconomic, social and ethical aspects of the world biodiversity crisis, moreover, they have aspects related to the threats to biodiversity, as land use, climate change and exotic species. Another curricula deals with a local problems analysis, human dimension, politics and economic approach. Nevertheless, these 2 particular programs are the exception to the trend of the total curricula analyzed. When we analyzed the total portion of each course the integration of social and ecological components subject matter was covered, we found that they were only dicussed in the introductory part of the courses.

Integrating the socioecological dimension into the Conservation Biology curricula

The limitations of conservation efforts and the strain on natural resources have shown that humans are indeed an integral and far-reaching component in the natural ecosystem. The classic ecological model, or the ‘equillibrium’ ecological model, was centered around the ‘balance of nature’ ideal that nature has a specific state that should be maintained, was self-

regulating and that this state was unrelated to other systems. Along with the idea that ecosystems were ‘closed’ came the idea that disturbances were exceptional and atypical of system behavior, and therefore, not worth considering in management strategy. Further, humans were excluded because they were thought to be outside land management control and the internal dynamics of the closed natural system (Pickett 1997). Often referred to as the ‘pristine’ model of nature, humans were thought to be innately unnatural and damaging to the environment and therefore were physically isolated from areas that need to be conserved to prevent damaging ecological processes. The pristine ecological model collapses under the pressure of the growing human population and complexity of natural ecological processes withn ecosystems that cannot be contained by territorial lines drawn on a map (Vitousek et al 1997, Sanderson 2002, Foley et al 2005).

To address such limitations, many authors have pointed out the importance of interdisciplinary work for the further development and new directions of scientific research, and for conservation biology in particular (Lubchenco et al. 1991, Daily & Ehrlich 1999). Based on our experience as graduate students and our participation in many fruitful discussions in the courses of Conservation Biology taught in our graduate programs, as well as in the Tracing Darwin’s Path Biocultural Conservation field course taught in the Omora Ethnobotanical Park (Rozzi et al. 2006b), we propose 4 components to consider towards an integration of the socioeconomic and natural aspects in graduate conservation biology courses that will enable conservation educational programs to overcome the dominance of the utilitarian approach within ecological studies which consequently pervades the language of scientists and the policy-makers who reference these studies. Our proposal is not only intended to develop theory and concepts in the interdisciplinary work, moreover, it is

intended to develop methodologies for practical activities in the courses that contextualize and promote the interdisciplinary learning in Conservation Biology courses. Here, we argue that a paradigm shift is necessary in the educational approach to conservation biology within Chile, and that it should build upon the non-equillibrium model already established. The shift would expand methodology to include 4 additional components: Biocultural mindset, interdisciplinarity, multidirectional comunication and participation, field experience and direct encounters.

Biocultural Mindset

The integration of the socioeconomic aspects in the Conservation Biology research and activities requires scientists to adequately address both the human and biological dimensions of ecosystem health. (Daily & Ehrlich 1999). A In the 1990s, studies revealed a general correlation between linguistic, cultural and biological diversity; human communities coevolved with their local ecosystems and in doing so, developed particular ways of describing their local habitat and their relatioship to it. This interrelation between biological and cultural diversity has been dubbed biocultural diversity and the enunciation is an attempt to recognize the intrinsic link between the diversity of human cultures, languages and ecoregions (Maffi 2001). For example, in north-central Chile, the extensive use of natural grasslands by goats generates a high impact on the vegetal which puts pressure on pastoral communities that depend directly upon that ecosystem. A biocultural approximation could deal with this issue by considering not only the development of sophisticated strategies to manage the ecosystem in terms of productivity (a classical management approximation), but more completely, aid in the consideration and comphrension of the dynamic interplay between the local community, their cultural and

land management practices, and how these practices impact the surrounded enviroment. Further, understanding the ecosystem in terms of its cultural and biological components is a more appropriate approximation when dealing with mining industry or crop production and their far-reaching impact upon the environment. It also allows us to recognize that the way we describe and articlate our understanding of the environment is unique to our own linguistic, cultural and ecological locus.

Interdisciplinarity

By developing the biocultural concept as a theoretical and practical model we can integrate the natural sciences with philosophy to address both the conceptual and pragmatic issues that arise from a worldview that perceives humans and natural systems as fundamentally separate. The practical implications of a paradigm shift that perceives social and ecological systems as one unit, as socio-ecological or biocultural entities, is that it will be necessary to adopt interdisciplinary educational programs and management strategies that approach both social and ecological concerns simultaneously, taking both components into consideration for management strategies.

For example, Sung et al. (2003) state that the interdisciplinary culture should be as influential in the lives of the young scientists as the one imparted in their own departaments. In fact, interdisciplinary education allows to develop collaborative methods, multidisciplinary work teams and to promote new communication and collaboration ways between teams (Graybill et al. 2006); in that way, interdisciplinarity adds to a diversity of knowledge and perspectives in order to perceive the different aspects of environmental problems. Another way to add to a diversity of knowledge and perspectives, is the inclusion

of students from different countries, as they have different backgrounds and they can face problems with different strategies. From our experience, the integration of a international component has provided very interesting discussions which really helped to face environmental issues.

Multidirectional Comunication and Participation

The biggest job at the beginning of any interdisciplinaty enterprise is establishing communication (Daily & Ehrlich 1999). Discipline insularization inside biological sciences diminishes communication between specialists and the range of variables analyzed concerning environmental problems (Rozzi & Feinsinger 2006). To establish fruitful communication mechanisms between social and biological sciences in general is extremely difficult, because every discipline develops its own codes and languages which account for the difficulties that might be found (Redman 1999). This vinculation should go beyond the student-student link, but to the link between students and other actors of society. These exercises will allow graduates to be used to work in very diverse groups of people, as this situation is the most posible to find in the future when dealing with environmental issues. For example, students of the Omora Ethnobotanical Park participate in the matinanece of the park by helping ot build signs and maintain trails as part of their course.

Field Experience and Direct Encounters

Another key component to be considered in graduate education towards the incorporation of the socioecological dimension of environmental problems is the direct encounter with nature through field experience. As we stated before, going beyond the classroom to experience the real conditions of a given site counterbalances the excess of mediated

information (Rozzi et al. 2006b). Moreover, students can take advantage of the LTSER sites to facilitate these direct encounters with nature, and to gain hands on experience in research and conservartion, also reinforcing the current studies.

One of the missions proposed for the Chile LTSER network was to conduct research and encourage the growth of programs for sustainable social and ecological well-being (Anderson et al. 2008). This mission includes a participatory approach that allows for direct encounters with nature, which should be experienced on multiple scales and as a community (multidirectional flow of information), incorporating different actors of society at all levels. As we look to formulate models that incorporate the human component and construct design models that can track both human and natural components, it is important that we recognize our role as actors or citizens engaged in a creative process. We cannot just engage nature when we go into the field, but we must bring this level of engagement to our actions as members of a living community.

Discussion

As unique ecosystems are threatened and ecoregions homogenized by developing and globalized industry, the need for accurate tools that are able to measaure the value of what is lost will only increase. Efforts to describe the value of ecosystems and biodiveristy have tended to focus on the economic and monetary value of the environment, considering it in terms of a natural resource present for human consumption. The implication, of course, is that the monetary value is equivalent to and indicative of the true value of these resources, and such evaluations are conducted from the perspective of identifying value of the environment as a resource. The utilitarian maxim looks to evaluate and make decisions

based upon what is perceived to be able to produce the greatest good for the greatest many, and this premise serves as an ethical guide for resource management strategies. In response to this, recent interdisiplinary and collobaratorive efforts by ecologists and others have been made to translate eoclogical functioning, processes, and 'ecosystem services' into equivlaent monterary values to better enable policy makers to gauge the consequences of resource consumption (Costanza 1997).

However, this utilitiarian approach to decision making and evaluation has been criticized because it does not provide an accurate picture of the full spectrum of values that ecosystems and biodiversity may have. For instance, the economic value does not have any relation to whether or not these ecosystem services are irreplaceable, or if certain use will undermine the health of the ecosystem, thus destroying the ability of the resource to renew itself (Daily et al. 2000). Instead, this approach frames valuation in terms of current economical force, overlooking (while acknowledging the absence of) the often unpriced ecosystem services such as clean air and drinkable freshwater. As ecological systems are irrepleceable, placing a price tag on the resources can be misleading because they create the illusion that nature is a commodity that can be repaired or reconstructed given enough money.

The renowned ecologist and conservationist, Aldo Leopold, criticized this method of valuation for overlooking the relationship between humans and nonhuman entities, as it disregards the recreational, emotional and aesthetic value that the environment can have to humans. Leopold urges us towards a land ethic, which "simply enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land… The

land-relation is still strictly economic, entailing privileges but not obligations" (Leopold 1949). Educational models shape the type of studies completed by conservation biologists, and it is these studies that inform the policy makers when they seek insight into the consequences of land management strategies. This "system of conservation based solely on economic self-interest is hopelessly lopsided. It tends to ignore, and thus eventually to eliminate, many elements in the land community that lack commercial value, but that are (as far as we know) essential to its healthy functioning. It assumes falsely, I think, that the economic parts of the biotic clock will function without the uneconomic (i.e. the ecological) parts" (Leopold 1949).

The role of conservation biologists and ecologists will require that they are able to consider both the biological and cultural components when considering the evaluation of ecosystems, so that they are able to find ways to communicate these values in political, scientific, educational and policy forums. The paradigm shift in the ecological sciences requires that the framework and methodologies used by conservation biologists gain a cultural and biological context, expanding the scope of studies to include both of these components simultaneously. Without such an integration, the evaluation of the environment as natural resources will remain oversimplified, one dimensional and a misrepresentation of biodiversity. Recalling Aldo Leopold's description of the ecological conscience, that is, the conscience that emerges with knowledge of the ecosystem, "Conservation is a state of harmony between men and land. Despite nearly a century of propaganda conservation still proceeds at a snail's pace; progress still consists largely of letterhead pieties and convention oratory… The usual answer to this dilemma is 'more conservation education'. No one will debate this, but is it certain that only the volume of

eduation needs stepping up? Is something lacking in the content as well?" (Leopold 1949). We must not just integrate the disciplines in our new approach to conservation biology, but we must also begin to use that integration to question the value-systems underlying the methodologies we use. As such, conservation biology educational programs must not just look at the structure of their programs, and the participation of diverse disciplines, but also how the content of their methodology must conceivably change in order to address this new biocultural and socio-ecological dimension.

The integration of the academic disciplines, thus far, has been following the utilitarian paradigm prevalent in global economy. Yet this decision-making system tends to under-represent the widespread, diverse social and cultural values, while emphasizing the importance economic values should play in resource management decisions. Without the use of social values it is unclear if present actions truly respresent the needs of society today and generations to come. With 77,8% of all Chilean PhD programs and 61,5% of all Chilean Master programs in Ecology and Natural Resource Management not containing any reference to conservation biology, we argue that in order to address the current environmental and social crisis, the development of Chilean educational programs must be two-fold: First, conservation and land management resource programs must exist, allowing these issues to be explored throughout educational institutions, and for multiple disciplines. Second, it must be recognized that the institutionalization of such programs are not enough without the careful inclusion and consideration of the dynamic interrelation between human and ecological components, and the way disciplines shape the valuation of these components.

Literature Cited

ANDERSON CB, GE LIKENS, R ROZZI, JR GUTIÉRREZ, JJ ARMESTO & A POOLE (2008) Integrating Science and Society through Long-Term Socio-Ecological Research. Environmental Ethics 30: 295-312.

COLLETT J & S KARAKASHIAN (eds) (1995) Greening the College Curriculum: A Guide to Environmental Teaching in the Liberal Arts: a Project of the Rainforest Alliance. Island Press, Washington DC. 328 pp.

COSTANZA R, R D'ARGE, R DE GROOT, S FARBER, M GRASSO, B HANNON, K LIMBURG, S NAEEM, RV O'NEILL, J PARUELO, RG RASKIN, P SUTTON, M VAN DEN BELT (1997) The value of the world's ecosystem services and natural capital. Nature 387: 253-260.

DAILY GC & PR EHRLICH (1999) Managing earth's ecosystems: an interdisciplinary challenge. Ecosystems 2: 277-280.

DAILY GC, T SÖDERQVIST, S ANIYAR, K ARROW, P DASGUPTA, PR EHRLICH, C FOLKE, A JANSSON, B JANSSON, N KAUTSKY, S LEVIN, J LUBCHENCO, K MÄLER, D SIMPSON, D STARRETT, D TILMAN, B WALKER (2000) The Value of Nature and the Nature of Value**.** Science 289: 395-396.

EHRLICH PR (2002) Human natures, nature conservation, and environmental ethics. BioScience 52: 31-43.

FOLEY JA, R DEFRIES, GP ASNER, C BARFORD, G BONAN, SP CARPENTER, FS CHAPIN, MT COE, GC DAILY, HK GIBBS, JH HELKOWSKI, T HOLLOWAY, EA HOWARD, CJ KUCHARIK, C MONFREDA, JA PATZ, IC PRENTICE, N

RAMANKUTTY & PK SNYDER (2005) Global consequences of land use. Science 309: 570-574.

GRAYBILL JK, S DOOLING, V SHANDAS, J WITHEY, A GREVE, GL SIMON (2006) A rough guide to interdisciplinarity: graduate students perspectives. Bioscience 56: 757-763.

JACOBSON SK (1990) Graduate Education in Conservation Biology. Conservation Biology 4: 431-440.

JACOBSON SK, E VAUGHAN & SW MILLER (1995) New Directions in Conservation Biology: Graduate Programs. Conservation Biology 9: 5-17.

LEOPOLD A (1949) A Sand County Almanac. Ballantine Books, New York. 295 pp.

LIU J, T DIETZ, SR CARPENTER, M ALBERTI, C FOLKE, E MORAN, AN PELL, P DEADMAN, T KRATZ, J LUBCHENCO, E OSTROM, Z OUYANG, W PROVENCHER, CL REDMAN, SH SCHNEIDER & WW TAYLOR (2007) Complexity of coupled human and natural systems. Science 317: 1513-1516.

LUBCHENCO J, AM OLSON, LB BRUBAKER, SR CARPENTER, MM HOLLAND, SP HUBELL, SA LEVIN, JA MacMAHON, PA MATSON, JM MELILLO, HA MOONEY, CH PETERSON, HR PULLIAM, LA REAL, PJ REGAL & RISSER PG (1991) The Sustainable biosphere initiative: an ecological research agenda. Ecology: 72: 371-412.

MAFFI L (ed) (2001) On biocultural diversity: linking language, knowledge and the environment. Smithsonian Institution Press, Washington. 578 pp.

PICKETT STA, WR BURCH JR., SE DALTON, TW FORESMAN, JM GROVE & R ROWNTREE (1997) A conceptual framework for the study of human ecosystems in urban areas. Urban Ecosystems 1: 185-199.

PRIMACK R, R ROZZI, P FEINSINGER, R DIRZO & F MASSARDO (2006) Fundamentos de conservación biológica. Fondo de Cultura Económica, México. 797 pp.

REDMAN CL (1999) Human dimensions of ecosystem studies. Ecosystems 2: 296-298.

ROZZI R & P FEISINGER (2006) Desafíos para la conservación biológica en Latinoamérica. In: Primack R, R Rozzi, P Feinsinger, R Dirzo, F Massardo. Fundamentos de Conservación Biológica, Perspectivas Latinoamericanas: 661-688. Fondo de Cultura Económico, México.

ROZZI R, R PRIMACK, P FEINSINGER, R DIRZO & F MASSARDO (2006a) ¿Qué es la biología de la conservación? In: Primack R, R Rozzi, P Feinsinger, R Dirzo, F Massardo. Fundamentos de Conservación Biológica, Perspectivas Latinoamericanas: 35-58. Fondo de Cultura Económico, México.

ROZZI R, F MASSARDO, CB ANDERSON, K HEIDINGER & JA SILANDER (2006b) Ten principles for biocultural conservation at the southern tip of the americas: the approach of the Omora ethnobotanical Park. Ecology and Society 11: 43-66.

SANDERSON EW, M JAITEH, MA LEVY, KH REDFORD, AV WANNEBO & G WOOLMER (2002) The human footprint and the last of the wild. BioScience 52: 891- 904.

SUNG NS, JI GORDON, GD ROSE, ED GETZOFF, SJ KRON, D MUMFORD, JN ONUCHIC, NF SCHERER, DL SUMNERS & NJ KOPELL (2003) Educating future scientists. Science 301: 1485.

VITOUSEK PM, HA MOONEY, J LUBCHENCO & JM MELILLO (1997) Human domination of earth's ecosystems. Science 277: 494-499.

TABLE 1

Programas de Doctorado en biología, ecología o manejo de recursos naturales acreditados por la CNA en enero 2009, según universidad, curso de conservación biológica y profesor a cargo, en Chile.

N°	**Universidad**	**Programa**	**Curso**	**Nombre**	**Profesor**
1	Pontificia Universidad Católica de Chile	Doctorado en Ciencias Biológicas m/ Ecología	No		
2	Pontificia Universidad Católica de Chile	Doctorado en Ciencias de la Agricultura	Si	Conservación Biológica	Gloria Montenegro
3	Universidad Austral	Doctorado en Ciencias Agrarias	No		
4	Universidad Austral	Doctorado en Ciencias m/ Sistemática y Ecología	Si	Biología de la Conservación	Roberto Schlatter
5	Universidad de Chile	Doctorado en Ciencias m/ Ecología y Biología Evolutiva	Si	Ecología de la Conservación Biológica	Javier A. Simonetti
6	Universidad de Concepción	Doctorado en Ciencias Biológicas m/ Botánica	Si	Conservación Biológica	Anibal Pauchard
7	Universidad de Concepción	Doctorado en Ciencias Ambientales m/ Sistemas Acuáticos Continentales	Si	Bases Científicas para la Conservación de Sistemas Acuáticos y	S/I
				Ecología y Conservación de Peces de Agua Dulce	S/I
8	Universidad de Concepción / Universidad Austral	Doctorado en Ciencias Forestales	Si	Conservación Biológica	Anibal Pauchard
9	Universidad de la Frontera	Doctorado en Ciencias de Recursos Naturales	Si	Conservación de Suelo y Medio Ambiente	S/I

TABLE 2

Programas de Magíster en biología, ecología o manejo de recursos naturales acreditados o en proceso de acreditación por la CNA en enero 2009, según universidad, curso de conservación biológica y profesor a cargo, en Chile.

N°	Universidad	Programa	Curso	Nombre	Profesor
1	Pontificia Universidad Católica de Chile	Magíster en Ciencias Animales	Si	Conservación biológica	Gloria Montenegro
2	Pontificia Universidad Católica de Chile	Magíster en Ciencias Vegetales	Si	Conservación biológica	Gloria Montenegro
3	Universidad Austral	Magíster en Ciencias m/ Producción Animal	No		
4	Universidad Austral	Magíster en Ciencias Vegetales	Si	Conservación de Recursos Genéticos Vegetales	Andrés Contreras
5	Universidad Católica del Norte	Magíster en Ciencias del Mar m/ Recursos Costeros	Si	S/I	Carlos Gaymer
6	Universidad de Chile	Magíster en Áreas Silvestres y Conservación de la Naturaleza	Si	Conservación de Flora y Vegetación	S/I
				Conservación y Estudio de las Poblaciones Animales	S/I
				Conservación y Manejo Integrado de Suelo y Agua	S/I
				Ecofisiología para la Conservación y Gestión de la Vegetación	S/I
7	Universidad de Chile	Magíster en Ciencias Biológicas	S/I		
8	Universidad de Concepción	Magíster en Ciencias m/ Botánica	Si	Conservación biológica	Anibal Pauchard
9	Universidad de	Magíster en Ciencias m/ Pesquería	No		

	Concepción				
10	Universidad de Concepción	Tópicos sobre Conservación Biológica	Si	Tópicos sobre Conservación Biológica	Juan C. Ortiz
11	Universidad de la Serena	Magíster en Ciencias Biológicas m/ Ecología de Zonas Áridas	Si	Biología de la Conservación	Francisco A. Squeo
12	Universidad de Talca	Magíster en Horticultura	No		
13	Universidad de Tarapacá	Magíster en Ciencias Biológicas	No		

TABLA 3

Programas de Doctorado y Magíster acreditados por la CNA a enero del 2009 en Chile, según total nacional, programas en biología , ecología y/o manejo de recursos naturales, y curso de conservación biológica en éstos últimos

Programa	**Total programas acreditados**	**Programas en biología, ecología y/o manejo de recursos naturales**			
		Total		**Curso de conservación biológica**	
		n	**%**	**n**	**%**
Doctorado	117	9	7,7	7	77,8
Magíster	176	13	7,4	8	61,5
Total	293	22	7,5	15	68,2

FIGURE 1.

Geographical distribution of PhD (unfilled circles) and Masters (black dots) programs in Ecology and Natural Resources Management in Chile acreditted by CNA by January 2009.