

CHAPTER FOUR

APPLIED MALACOLOGY: A DIFFERENT APPROACH TO TEACHING A TRADITIONAL TOPIC

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Introduction

Biological diversity, or biodiversity, is defined as the variety and variability of living beings and the ecological complex they are part of (Wheeler 1990). One of these three components, the number of species (variety) recognized fluctuates between 1.5 and 1.75 million (Crisci 2006). A little over a million of these are animals and 96% of those animals belong to the group traditionally called “invertebrates” (Fig. 4.1).

This fact makes clear the importance of the Malacology course that is offered by the Zoology Department of the Facultad de Ciencias Naturales y Museo (FCNyM) at the National University of La Plata, Argentina (UNLP) (from now on called simply Malacology), which is discussed in the present chapter. Malacology is important for many reasons, among

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them the fact that mollusks are the most successful invertebrates on the planet after Arthropods. They make up about 7% of known invertebrate species (Lanteri and Damborenea 2005) (Fig. 4.2). Mollusks are present in the deepest oceanic waters, upper intertidal areas, estuarial and freshwater environments and terrestrial habitats. The number of living mollusks fluctuates between 80,000 and 150,000 species, with at least 35,000 fossils recognized (Camacho 2008).

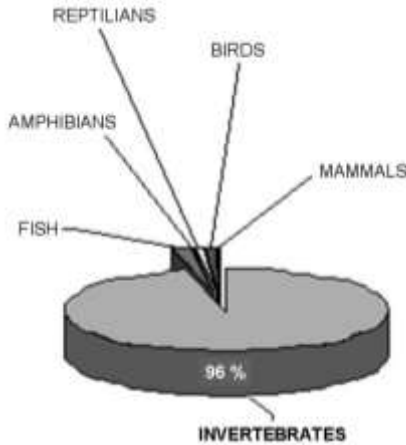


Figure 4.1. Percentage of the total number of species in the Animal Kingdom.

In addition, the new millennium finds biological diversity going through a deep crisis, mostly the result of human activity. The dimension and complexity of this crisis point out the urgent need for knowledge and comprehension of biological diversity, not only to use it as a sustainable resource, but also to develop an ethical attitude. Traditional teaching of Malacology at the FCNyM (hereafter referred to as “TTM”), and also of several other taxonomic courses, is generally based around closed and static schemes. However, Malacology itself is seen by teachers as a challenge as they attempt to reach two objectives: (1) to be a dynamic tool for organizing diversity, presenting the study of the mollusks in terms of their comparative biology, in the context of their interaction with the environment and the impact they have upon it, and (2) to develop a teaching strategy that allows students to understand biological diversity and its great potential to improve quality of life, while developing a critical attitude in relation to the crisis that biodiversity is currently going through.

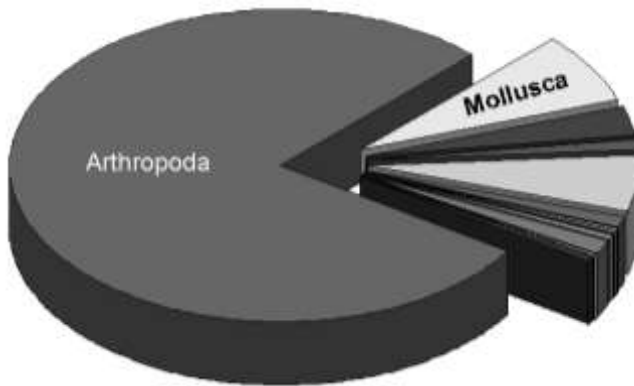


Figure 4.2. Relation of the number of mollusk species to the more numerous group on the planet, Arthropods (from Darrigran 2013a).

In general, the study of these closed, static taxonomic groups, TTM in particular, produces the perception of the subject as remote from everyday life, and in consequence, the results of its study insignificant and only of interest to a very limited group of people, people dedicated to research in isolated institutions, far from society and generating only theoretical knowledge.

In 1987, the final TTM course was run at UNLP. Twenty five years later, the topic was reinstated and the Malacology course is now offered again. It is a 78 hour course divided into two stages for didactic purposes. The first stage involves the study of the macrosystematics of the group, including morphology and functional anatomy as well as geographic and chronological distribution. In the second stage, the direct relationship between society and certain groups of mollusks is considered.

Malacology is offered to students of the last two years of the basic degree (locally called *Licenciatura*) in Biology, and also to postgraduate students hoping to put the credits towards their doctorate programs at local or foreign universities. Accordingly, strategies for ensuring all students achieve significant learning must be based on the development of two approaches:

- 1) **Academic.** Develop and offer a wide range of course contents with emphasis on the systemic, evolutionary and inclusive; not just a simple enumerative listing of groups of organisms. With this focus, and

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taking into account the theoretical knowledge necessary to students of Malacology, the following is proposed:

- The results of biological evolution and the diversity of the species living in the wild could be organized in hierarchical structures guided by ancestor-descendant relationships (Fig. 4.3)
- Ecosystemic components of biodiversity

The selection of malacological topics to include should avoid the fragmentation of knowledge, choosing and assembling them in conjunction with the other courses offered by the department (*i.e.* introduction to taxonomy, animal histology and embryology, invertebrate zoology, ecology, biogeography, evolution and protection and conservation of nature).

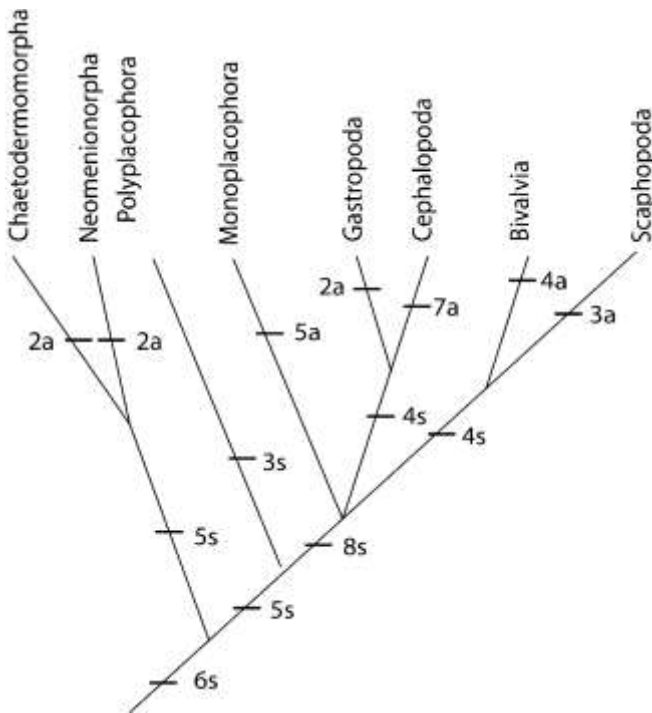


Figure 4.3. A phylogenetic hypothesis of the major clades of mollusks. Numbers correspond to the number of synapomorphic characters (s) or autapomorphic characters (a) that support the clades.

2) **Professional.** The degree student of Malacology has a short period of time until graduation, at which point he or she will be looking for help and advice regarding his or her future. Not only the path of entering the national scientific system (for which the FCNyM prepares them) but also other professional possibilities should be pointed out (*e.g.* consulting, management). These suggestions focus both on the study of mollusks and on the management of mollusks in the contexts of both environment and society:

- Management of the protection and conservation of species at risk of extinction
- Management of the exploitation of mollusks as a resource
- Management of the prevention/control of hazard species (*i.e.* pests, invaders)

The development of Malacology as an academic subject is based on these two closely related approaches.

Development

The Impossibility of Managing that which is unknown

Malacology is taught while taking into account the students' potential to add his or her future work as a researcher to previous generations' knowledge of this important taxonomic group. Therefore, the student will be capable of assessing, for example, the sustainable management of mollusks from Argentina. To this end, it is necessary to consider what mollusks mean for today's society and encourage the application of knowledge generated, but without disregarding the importance of basic research. It is necessary, therefore, to know not only the taxonomy of the group (because as we know, it is the basis for any further study), but also the relationships that exist between this zoological group, the environment and society.

In this context Malacology looks at:

(1) The dynamic development of the taxonomy of the group, where macrosystematics are studied based on a frame project: The Tree of Life Web Project (<http://www.tolweb.org/tree/>), where taxonomists the world over provide information about every organism on the planet, including phylogeny (Fig. 4.4). This is one of today's most complete and renowned projects.

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Figure 4. 4. “The Tree of Life”, modified from <http://www.zo.utexas.edu/faculty>

Also, as Schneider (2001) points out regarding bivalves (but which should be extended to the macrosystematics of all mollusks), it is necessary to study phylogeny in more depth when searching for monophyletic groups. With this in mind, when considering the macrosystematics of mollusks, we refer to Nielsen (2012) and Smith *et al.* (2011), among others.

(1) The relationship between mollusks and the natural environment. Mollusks have had clear evolutionary success. Various papers have emphasized the importance of the relationship between mollusks and their different natural environments, namely coastal limnobiots (Darrigran and Lagreca, 2005), fluvial (Rumi *et al.* 2010, Vazquez Perera and Gutierrez 2007), terrestrial (Miranda and Cuezco 2010; Naranjo García 2003) and marine (Pastorino 1995 and Salazar Vallejos *et al.* 2008). There is also the relationship between morphology and a coastal environment (Darrigran, 2013b), the fulfilment of different behavioral and trophic roles (predators, scavengers, parasites, grassers, filter feeding, benthonic, pelagic, planktonic, sessile, etc.) and the consideration of the impact they can have upon an ecosystem (*e.g.* Darrigran and Damborenea 2011) (Fig. 4.5).

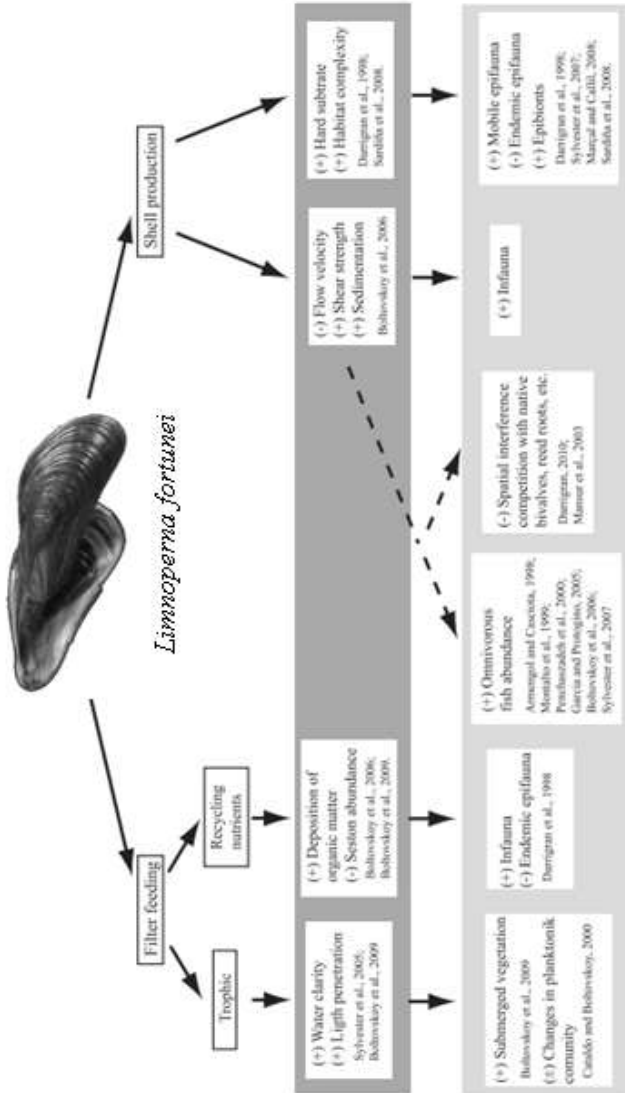


Figure 4.5. General pathway of effects engineered by *Limnoperna fortunei*. Positive (+) and negative (-) effects are indicated. Direct (solid arrows) and indirect (partial arrows) impacts of *L. fortunei* on invaded aquatic ecosystems. Dark gray: Effects on abiotic variables; light gray: Effects on biotic variables (modified from Darrigran and Damborenea 2011).

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Additionally, the protection/conservation of species risking extinction is closely related to knowing the biodiversity of mollusks of the region (Fig. 4.6) (e.g. Rumi *et al.* 2006, 2008, Regnier *et al.* 2009, Nuñez *et al.* 2010); and the impact pushed on them (e.g. Penchaszadeh *et al.* 2001, Darrigran 1999).

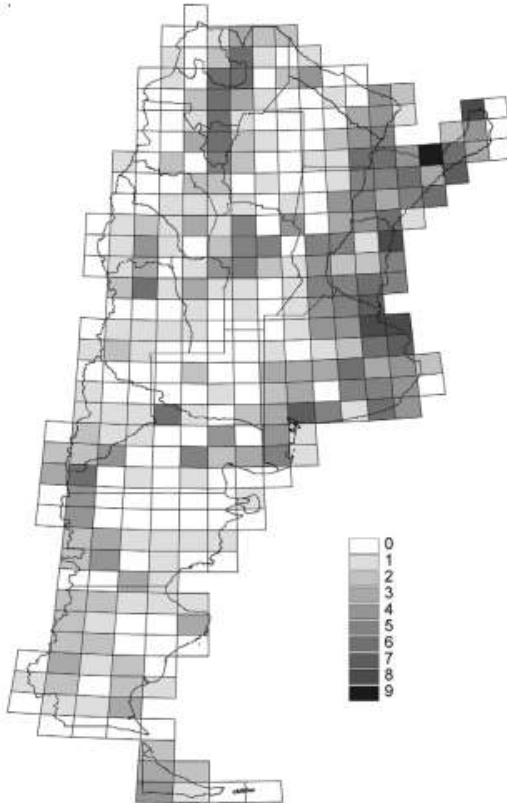


Figure 4.6. Freshwater gastropoda of Argentina. Family richness in sampling units, each representing 100 x 100 km (modified from Rumi *et al.* 2006)

When considering the impact of mollusks on society, the management and growing of edible species is one of the most important topics. Scallops, snails, mussels, oysters, clams, squids, octopuses and others are all part of the human diet, and enormous quantities of money are invested in their study and preservation and in the search for a sustainable way to

exploit them as a resource. (Brunetti *et al.* 1999; Ministerio Agricultura, Ganadería y Pesca 2013; Pascual and Castaños 2000).

Finally, in the context of prevention and control of hazard species, mollusks are considered:

- Host and/or vectors of parasites (Ministério da Saúde 2007).
- Gastropod pests in agriculture and horticulture (Berg 1979).
- Invaders, causing the occlusion or “macrofouling” of pipes and water filters (Darrigran and Damborenea 2009; Darrigran *et al.* 2008) and potential health and/or agronomic problems for the country (Gutierrez Gregoric *et al.* 2013).

Malacologia as a space for professional development

At present, society requires from its professionals a series of skills such as autonomous thinking, critical thinking, and the ability and willingness to compromise with real world conditions. In Malacology, a variety of different learning and teaching activities are used to develop these qualities. These activities are grouped into two categories:

Programmatic activities

1. Seminars
2. Lectures by invited speakers
3. Internal lectures
4. Field work

1. SEMINARS

Research seminars are one of the methods of active learning, where the students must use their own initiative to search for the information they need to develop their work in an environment of joint collaboration. Seminar work involves the students, in groups, carrying out work based on a bibliography of experiments developed in Argentina. Later, each group presents its work orally (sometimes all group members, sometimes one individual) to the other students.

The main purposes of this activity are:

- To guide the students in carrying out their own bibliographic searches

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- To learn and practice correctly using scientific language in order to prevent meaningless discourse (Galagovsky *et al.* 1998).
- To stimulate their classmates to question assumptions. This is common practice in scientific meetings. Some topics discussed in previous seminars are: mollusks for commercial use; fishing for mollusks; parasitology in malacology and mollusks as bioinvaders.

2. LECTURES OF GUEST SPEAKERS

About three lectures per year are usually arranged with professionals with large amounts of experience in the field. It is intended that students will gain:

- A more diverse range of contexts in which to consider the subjects of the course
- The chance to evaluate different approaches to the same problems
- Contact with specialists

Due to the up-to-date lectures given by these guest speakers, who deal with different, relevant topics each year, and because of the excellent response that students have had to these lectures, in the coming years they will be recorded (with the cooperation of the Multimedia Production Centre, a service of the National University of La Plata) and available online to students from all courses.

3. INTERNAL LECTURES

These lectures take place only within the normal schedule of the Malacology course. Doctorate students are in charge of these lectures, which are usually on the topic of their research and personal experiences in the scientific system of Argentina.

4. FIELD WORK

At least one day of field work is arranged. This is an important part of the course because it involves the practical integration and application of subjects already studied in the laboratory. It also provides the opportunity for each individual to develop important personal skills such as creativity, imagination, the forming of new ideas, social integration and the establishment of respectful attitudes to colleagues, cooperation, solidarity and friendship (Legarralde *et al.* 2009).

A specific field work area is chosen in which the students will be able to meet the following objectives:

Applied Malacology

- 1) The acquisition of methodological skills by means of:
 - Observation of organisms in their natural environment and characteristic communities
 - Identification of the relationships between the live beings and abiotic factors
 - The use of specific sample methods
 - Recording basic environmental data
 - Preparation, preservation and fixation of the collected material

To avoid a significant impact on the environment, only a few specimens are collected. Those specimens will later be studied and preserved in the Malacology collection at the FCNyM

- 2) The ability to describe the biodiversity of mollusks present in aquatic and terrestrial environments.

Extraprogrammatic activities

These are conducted according to opportunities that arise during the year, such as access and availability, and sometimes what the weather allows, and include:

1. Visits to places related to malacology.

The usual places to visit are the malacology collections of different institutions e.g. Museo de La Plata (UNLP) or Museo Argentino de Ciencias Naturales “Bernardino Rivadavia”; places where the growing of snails is managed, and areas affected by invasive mollusks (e.g. *Limnoperna fortunei*).

2. Participation in meetings

Considering that academic communication and the exchange of knowledge between colleagues are essential to the practice of scientific research, participation in scientific meetings is fundamental. During 2013, teachers and students participated in the first Argentine Malacological Congress (1 CAM), where they made several presentations of work produced by the Malacology course, both in the First Symposium on Education in Malacology (Torres *et al.* 2013a), and as Free Communications (Quiroga *et al.* 2013; Torres *et al.* 2013b; Coria *et al.* 2013) (Fig. 4.7).

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Figure 4. 7. http://www.malacoargentina.com.ar/images/stories/ICAM/Libro_Resumenes_1_CAM_2013.pdf

The results of a survey on Malacology (Torres *et al.* 2013a) highlight the wide range of teaching strategies and the variety of approaches used, and the possibility of creating links between students and experienced researchers. Graduate students, especially, consider it a genuinely worthwhile way of learning the practices and techniques of professional work and research, including the integration of theoretical disciplinary knowledge.

In conclusion, the general objective of the Malacology course - that is, to create a space where professional malacologists, graduate and undergraduate students can interact - was achieved. As a result of this interaction, development, not only of the professional kind, as described before, but also of the equally important personal kind, was shown by the spirit of collaboration and general cordiality existing among all participants in the course to have been accomplished.

Acknowledgments

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