

Enseignement

ZOOLOGY IN THE ITALIAN UNIVERSITY SYSTEM: AN OVERVIEW

par

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Zoology is a basic component of the natural sciences, which in turn are an essential part of the scientific culture and of general knowledge. In Italy, zoology teaching is currently carried out at university level, since the programs of high schools include only minor elements of animal biology and that only in a few types of schools. Zoology has traditionally been a primary element of the culture provided by scientific university degree courses, such as Biological Sciences, Natural Sciences and Environmental Sciences.

A review is given of the numerous changes in the Italian university system during the last twenty years, which have radically transformed the structure of the university degree courses and have caused a notable reduction in zoological teaching. Nowadays, zoology is mainly present as a basic part of the first three-year cycle degree in Biological Sciences and in Natural Sciences. The presence of zoological courses in the Italian University scientific Degrees with biological, naturalistic or environmental orientations is synthetically examined.

The significant reduction in the presence of zoology in the Italian University programs corresponds to:

- a decrease in the teaching and research staff dedicated to this field of research, as a consequence of a lack of turnover in recent years as a result of budgetary cuts;
- a still insufficient visibility of the zoological profession in different contexts, due in part to the increasing pressure of other cultural areas, which are more sectorial and drive most of the current biological research (biochemistry, molecular biology, genetics, biotechnology). These tend to attract more students and direct them to other disciplines;
- a growing decrease in the occupational activities dedicated to taxonomy, systematics and museum tasks;

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- a gradual lowering of the cultural basic level of the three-year graduates due to an organization of curricula that fails to include interdisciplinary cultural teachings (e.g. Biological evolution);
- a significant reduction in the number of courses focussing on specific or applied zoological topics, which are necessary in the Degrees of Biological, Natural and Environmental Sciences.

The hope is that in the current framework of reorganization of the Italian university system the diversity of research interests necessary to form the culture of future graduates is taken into account. Moreover, the application of zoological sciences to traditional professional activities that are currently in decline (taxidermy, conservation of museum collections) as well as to new and emerging expertises (environmental biologist, conservationist, etc.) should be strongly supported and enhanced.

Keywords: zoology, natural sciences, biological sciences, university education system, Italy.

L'enseignement universitaire de la zoologie en Italie : un aperçu

La Zoologie est un composant de base des sciences naturelles qui, à leur tour, sont une partie essentielle de la culture scientifique et de la connaissance collective.

En Italie, l'enseignement de la Zoologie est actuellement délivré au niveau universitaire, puisque les programmes des lycées ne comprennent que des éléments mineurs de la biologie animale, et seulement dans quelques types d'écoles. La Zoologie a toujours été un élément essentiel de la culture fournie par les programmes d'étude scientifique des diplômes universitaires, tels que ceux en Sciences biologiques, Sciences naturelles, Sciences de l'environnement, et d'autres.

Sont présentés les nombreux changements dans le système universitaire italien qui, dans les vingt dernières années, ont radicalement transformé la structure des cours de diplôme universitaire et ont provoqué une réduction notable du nombre des enseignements zoologiques. Aujourd'hui, ces derniers sont principalement présents comme des enseignements de base dans le premier degré du cycle de trois ans en Sciences biologiques et en Sciences naturelles. La présence de cours zoologiques dans les diplômes scientifiques de l'Université italienne avec des cibles biologiques, naturalistes ou environnementales est examinée de façon synthétique.

La réduction significative de la présence de la Zoologie dans les programmes de l'Université italienne correspond également à :

- une réduction du personnel dédié à l'enseignement et à la recherche, conséquence de l'absence de remplacements au cours des dernières années en raison de compressions budgétaires ;
- une visibilité plus difficile et encore moins évidente de la profession de zoologiste dans différents contextes, aussi déterminée par la pression croissante des autres disciplines, plus sectorielles, qui correspondent davantage à la recherche biologique actuelle (biochimie, biologie moléculaire, génétique, biotechnologie), et qui ont donc tendance à attirer plus d'étudiants et à les diriger aussi vers le choix d'études ultérieures ;
- une diminution de plus en plus grande des activités professionnelles dédiées à la taxonomie, à la systématique et aux activités muséologiques ;
- un abaissement progressif du niveau de base culturel des diplômés de trois ans en raison d'une organisation des programmes d'étude qui ne parviennent pas à comprendre des enseignements culturels interdisciplinaires (par exemple, l'évolution biologique) ;

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– une réduction significative du nombre de cours axés sur des sujets précis ou zoologiques appliqués qui sont nécessaires dans le Degré en Biologie, en Sciences naturelles et Sciences de l'environnement.

L'espoir est que, dans le cadre actuel de la réorganisation du système universitaire italien, la diversité des intérêts nécessaires pour former la culture du futur diplômé de recherche soit prise en compte. En outre, l'application des sciences zoologiques à des activités professionnelles traditionnelles qui apparaissent actuellement en déclin (taxidermie, conservation des collections des musées), ainsi que d'expertises nouvelles et émergentes (biologiste de l'environnement, écologiste, etc.) devrait être fortement soutenue et renforcée.

Mots-clés : zoologie, sciences naturelles, sciences biologiques, système éducatif universitaire, Italie.

Zoology within the Natural Sciences

Zoology is a basic component of the natural and biological sciences, which in turn are essential parts of the scientific culture and general knowledge.

In Italy, zoology is currently taught mainly at University level, since the programs of high schools include only minor elements of animal biology and diversity, and then only in a few types of schools.

Zoology has traditionally been a primary element of the culture provided by scientific University Degree Courses, such as those in Biological Sciences, Natural Sciences, Environmental Sciences, and few others.

The University system in Italy and its recent transformations

The Italian University system has been the subject of numerous recent changes, which in the last few decades have radically transformed the structure of the University Degree Courses and have caused a notable reduction in the amount of zoological teaching.

Before 1999 the Italian University system provided for Degree Courses lasting 4 or 5 years, rarely 6 years (e.g. Medicine), with a total number of exams ranging from 19 to as many as 58. Lessons of each course were given over the entire duration of the academic year.

1. The European Higher Education Area (EHEA)

The Conference of the European Ministers of Higher Education held in Bologna in June 1999 (the “Bologna Process”), and later the intergovernmental agreement of cooperation formally signed during the ministerial conference held in Budapest and Vienna in March 2010, started the project of the European Higher Education Area (EHEA).

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This project, based on academic freedom, institutional autonomy and participation of teachers and students to the administration of higher education, had many goals. It aimed at improving academic quality, economic development and social cohesion, at encouraging mobility of students and teachers, at developing the social dimension of higher education, at promoting employability and lifelong learning of graduates, at considering both students and faculty as members of the academic community, and at exporting know-how and working with higher education in other parts of the world.

The ultimate goal was to make Europe globally competitive by harmonizing in all the European states the organization of higher education courses and the main objectives of the various study periods.

Within the EHEA, European governments have set some important structural reforms, such as:

- the introduction of a university system with clear and comparable qualifications (the system in three cycles of first, second and third level);
- transparency of the courses through a common system of credits based on the workload and the learning results, and through the Diploma Supplement;
- the accreditation of qualifications and periods of study;
- a common approach to quality assurance;
- the implementation of a framework of qualifications for the European Higher Education Area.

2. The first Italian reform: the Law 509/1999

The first reform of the Italian University system was the Law 509 introduced on 3/11/1999 by the Minister of University and Scientific and Technological Research (Ortensio Zecchino).

The major novelties were:

- the organization of the University education system into two study cycles (“3+2”): a Triennial Degree of first level (TD, 3 years) and a Specialist Degree of second level (SD, 2 years);
- the introduction of the University Education Credit system (*Crediti Formativi Universitari*, CFU);
- the establishment of Study Classes, with homogeneous general learning objectives;
- the setting up of external Work Experience and Training periods;
- the introduction of Postgraduate Education (Research Doctorate).

The main objective of this law was to comply with the European process of reform of the higher education system by:

- creating a system of studies at two levels according to the formula 3 + 2, and specifying the requirements for the access to the Specialist Degree;
- combining methodological-cultural teaching, which has always been a prerogative of the University, with professional training;
- shortening the time to graduation and reduce the drop-out rate of students;

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- facilitating student mobility at national and international levels through the introduction of the credit system;
- introducing a postgraduate educational level: the Research Doctorate.

However, the practical application of this law presented a number of problems for universities, not only relative to the didactic organization but, above all, in terms of cultural aspects. In fact, the substantial legislative changes that have occurred since 2001 have deeply changed the role of the university teacher and the mode of teaching.

An enormous proliferation of proposed new Courses of Study, especially of Triennial Degrees, took place in most Scientific-disciplinary areas, resulting in over 3,200 Degree Programs. Even for Specialist Degrees, the number of activated Courses was close to 3,000.

Moreover, medium and small universities in several cases planned an excessive didactic proposal, with consequent problems of lowered teaching quality.

3. The “reform of the reform”: the Law 270/2004

The second reform of the Italian university system was the Law 270, introduced on 22 /10/2004 by the Minister of University and Scientific and Research (Letizia Moratti). The new law came into effect in the academic year 2008-2009.

The major novelty was the introduction of constraints in organizing Degrees, both of first and second levels:

Triennial Degree of first level (TD):

- no more than 20 exams in the entire curriculum;
- Y-path of the study plan, with a common first year followed by two different paths.

Magistral Degree of second level (MD):

- no more than 12 exams in the entire curriculum;
- autonomy of the two study levels from each other.

The aims of Law 270 were numerous.

As concerns Degree Classes, the law focussed on:

- making it easier for individual Universities to organize customized study paths;
- creating two paths in a single TD, the one culturally wider, the other more targeted to professional aspects; avoiding excessive repetitiveness between similar Courses of study.

As for Magistral Degrees, the law intended to favour opportunities for students to pursue MD not in line with the TD previously followed, in order to encourage cross-disciplinary education.

Also, the introduction of “Interclass Courses”, which are courses of study organized into more than a single Class Course, showed the law’s attention to an interdisciplinary education.

The application of Law 270 highlighted some problems, mainly related to the excessive rigidity of constraints in planning the Courses of study.

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Moreover, all these teaching innovations were introduced at “no cost” (i.e. without additional funding), and thus bore heavily on the working University staff, without any planning of adequate recruitment of teaching personnel.

4. Subsequent reforms

A number of subsequent government reforms have contributed to the radical change of the Italian University system through:

- application of heavy cuts to the Ministerial ordinary funds for Universities;
- introduction of strict criteria to evaluate teaching and research activities of the University staff;
- further constraints in reorganizing the Courses of study, aimed at reducing their excessive number in many Universities.

One of the most important recent legal measures in this field was the Law 133/2008, known as the “Brunetta Decree” from the name of the Minister promoter, which came into force on 6/8/2008.

The Decree was titled “Urgent provisions for economic development, simplification, competitiveness, stabilization of public finance and tax equalization”. Even if it was not specifically directed at Universities, it contained some very important topics concerning them, among which were:

- the possibility of transforming Universities into Foundations;
- the decrease of teaching staff through a reduced turnover;
- the reduction of the Ministerial ordinary funds for the management of Universities.

5. Law 240/2010 - Law “Gelmini”

The most important recent law reorganizing the Italian University system was Law 240, better known as the “Law Gelmini”, introduced on 30/12/2010 by the Minister of University and Scientific and Research (Mariastella Gelmini), and applied since 1/1/2011.

Law 240 comprised 29 articles and covered a number of University aspects, from organization to didactics and research.

Some focal points were:

1. reorganization of Departments, which also acquired didactic functions, with consequent disappearance of Faculties;
2. possible fusion or federation of Universities, with the aim of reorganizing and optimizing the overall teaching proposal;
3. reform of the Scientific-Disciplinary Sectors (SSD), which are the base for the National Qualification System, introducing criteria for the access and evaluation of both evaluated and evaluating persons;
4. disappearance of Researchers with a permanent contract, through the introduction of fixed-term Research Contracts;
5. introduction of an evaluation system for the teaching, research and administrative activities of the teaching staff, based on criteria of productivity, international significance and ability to attract funds;

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6. development of evaluation systems for enhancing the quality and efficiency of Universities as a whole, introducing reward mechanisms;
7. starting an accreditation system for Universities and Courses of Study and a system of periodic evaluation of indicators provided by ANVUR (Agenzia Nazionale per la Valutazione del Sistema Universitario e della Ricerca);
8. revision of accounting rules of universities:
 - a. dual governance (Rector and Administrative Board);
 - b. general use of procedures for evaluating activities of universities and teachers through the ANVUR evaluating system ex-post of recruitment policies.

Zoology in the Italian University system: the current situation (academic year 2015-2016)

The current situation of the Triennial Degree Courses of first level (TD) that include zoological classes is as follows:

- 40 TD in Biological Sciences (40 Universities);
- 36 TD in Environmental and Natural Sciences (32 Universities);
- 18 TD in Zootechnical Sciences and Technologies in Animal Production (14 Universities);

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Triennial Degrees (TD) in BIOLOGICAL SCIENCES

TD in ENVIRONMENTAL AND NATURAL SCIENCES

1-2 courses of Zoology or Animal Biology
6-8 CFU (= 42-56 h lab included)

Biology of animal cell - Animal structures and functions - Fundamentals of Genetics and Ecology - Introduction to biological evolution - Basis of taxonomy and natural classification - General notions on the main animal groups (Vertebrates usually excluded)

in some TD :

1 course of Comparative Anatomy or Biology of Vertebrates or Systematic Zoology 6 CFU (42 h)
Comparative anatomy and biology of various systems - Fundamentals of ecology, biogeography and ethology of the various classes - Origin and evolution of Vertebrates

1 course of Biological Evolution or Animal Phylogeny 6 CFU (42 h)
History of the evolutionary thought - Darwin's conceptual model - Scales of evolution - Species and speciation - Evolution and phylogeny

Figure 1

Zoological courses in the Italian university triennial degree courses of first level.
Enseignements de zoologie lors des trois années du premier cycle des Universités Italiennes.

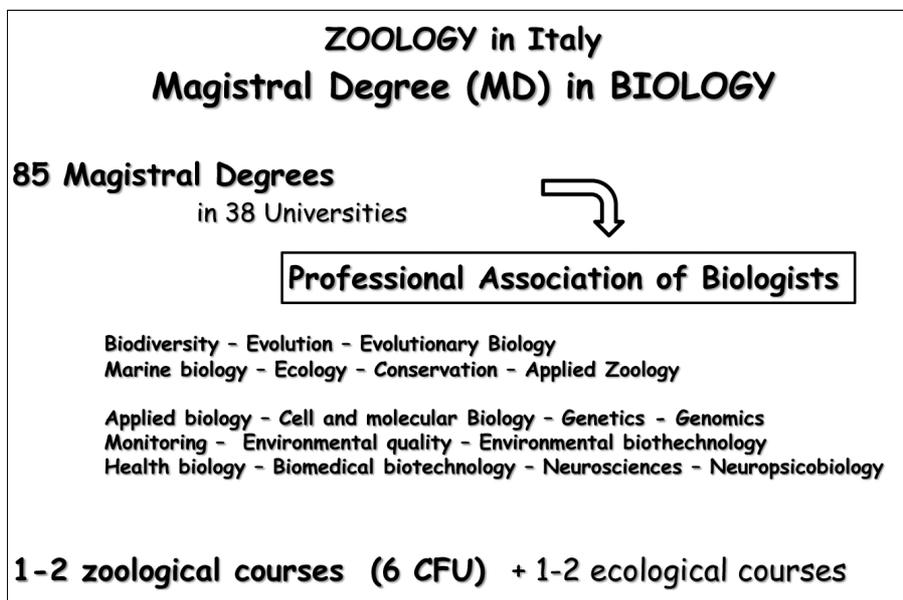


Figure 2

Zoological courses in Italian university Magistral Degree in Biology of second level.
Enseignements de zoologie lors du second cycle (Master de Biologie) des Universités Italiennes.

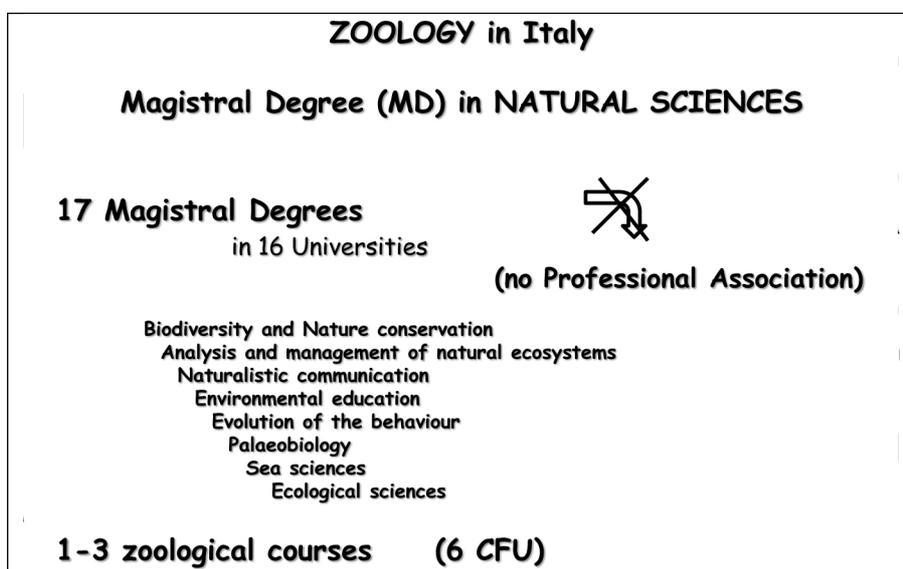


Figure 3

Zoological courses in Italian university Magistral Degree in Natural Sciences of second level.
Enseignements de zoologie lors du second cycle (Master de Sciences naturelles) des Universités Italiennes

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– out of the 86 Italian Universities (68 State Universities + 18 private Universities, excluding virtual (*telematica*) universities).

It is worth noting that not all of the TDs allow access to the national professional qualifying examination, which qualifies the graduate to practice certain professional activities (i.e. Biologist). Membership of a professional association in Italy is a requirement in order to perform independent work.

A synthetic overview of the TDs and MDs currently available is provided in Figures 1-4, in which the “Class of the Course of Study”, the title of the Degree Course, the minimum number of zoological courses and the relative “weight” in Education Credits (CFU) and corresponding duration in hours are specified, as well as the possibility of access to the national qualifying examination.

Summarizing, in the reformed Italian University system the zoological courses have decreased in number and also in weight (CFU) in the Degrees Courses of the first level (TD), especially because of the reduction in the total number of the exams imposed by Law 270 and the consequent selection of the core courses.

In Degree Courses of the second level (MD), geared towards specific professions, the constraint on the total number of exams does not allow the inclusion of “cultural” courses in the curriculum. Thus there are only specific courses, usually of applied zoology, and then only in those degree courses that have targets requiring zoological skills.

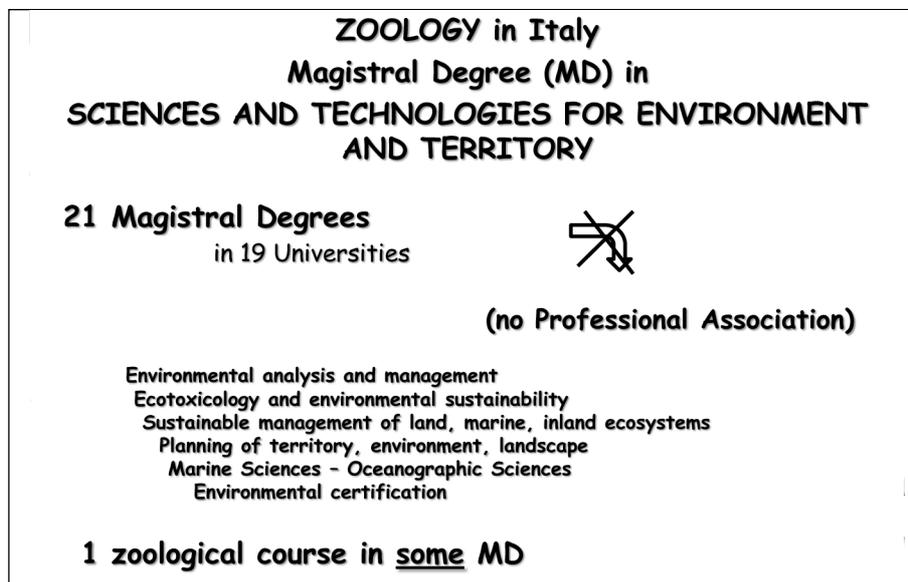


Figure 4

Zoological courses in Italian University Magistral Degree
in Sciences and Technologies for Environment and Territory of second level.
*Enseignements de zoologie lors du second cycle (Master de Sciences et Technologies
de l'Environnement et du Territoire) des Universités Italiennes.*

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It should be stressed that the significant reduction in the presence of zoology in the current Italian university programs also corresponds to a decrease of the teaching and research staff dedicated to this discipline, due to the lack of turnover in recent years induced by general budget cuts.

Profession: Zoologist

1. Who is now a zoologist?

Today the real problem is the reduced visibility of the profession of zoologist, due to the increasing pressure of other, more sectorial, cultural areas driving most of the current biological research (e.g. biochemistry, molecular biology, genetics and biotechnology). Of course, these disciplines attract more students and direct their subsequent study choices. Thus there has been a gradual decline in some occupational activities usually carried out by zoologists.

The traditional professional activities of the zoologist, considered as a scientist with an extensive naturalistic base, have mainly concerned:

- research in taxonomy, systematics, phylogeny and biology of animal groups;
- conservation of museum animal collections;
- preparing animal specimens for archiving;
- teaching zoology in schools and universities.

The change or, more exactly, the recent extension of the professional interests of the zoologist to new fields reflects a natural transformation of scientific themes in zoology, following the acquisition of new, powerful technologies.

However, at the same time there is also a crisis in some natural disciplines that have traditionally been purely zoological has become evident. Examples are taxonomy and systematics, and more generally the “natural sciences” as a cultural heritage.

Nowadays, zoological interests and activities tend to shift from the organismic level to lower or higher levels:

- cellular/molecular: specialization in research on cell biology, molecular biology, genetics, biotechnology, etc., due to the availability of new technologies;
- ecological/ecosystem: zoological inventorying and monitoring for faunistic management, environmental biological control, etc.

2. The zoologist profession today: what and where?

As we have seen above, the current activity of the zoologist is mainly applied to:

• Research and teaching

Taxonomy, animal biology, ecology, ethology, animal biotechnologies, animals as research models for biomedical and pharmacological testing, etc. (universities, public entities, research centres, private companies).

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- **Zoological collections and archives**

Conservation of collections, sampling, identification and preparation of specimens for collections, taxidermy, zoological databases, photographic documentation, organization of exhibitions, production of catalogues and inventories, etc. (museums, private animal collections, bioinformatic organizations).

- **Faunistic management and conservation**

Management of wildlife, checklists, atlases of species distribution, conservation plans for endangered species, control of alien and invasive species, monitoring life conditions of animals in captivity, etc. (parks, public organizations, environmental associations, zoos, aquariums, circuses).

- **Environmental and faunistic education**

Knowledge of the environment: abiotic and biotic components, environmental protection and conservation, faunistic conservation, etc. (environmental organizations, schools).

- **Scientific communication and popular science**

Documentary and publishing activities, interactive activities in museums, zoos, aquariums, citizen science, etc. (television, radios, journals, magazines, web, museums, aquariums, zoos)

3. What has happened to the traditional activities of the zoologist?

An exemplary case: taxonomy and systematics

Over the past few decades, taxonomy has faced one of its deepest crises (HOPKINS & FRECKLETON, 2002; STAAB *et al.*, 2015).

Possible causes are:

- the difficulties in disseminating taxonomic information;
- the complexity of the living world which overwhelms the capacity of taxonomists to describe new species;
- the decline of financial support;
- the gradual loss of taxonomic positions through non-replacement of retiring taxonomists.

Taxonomy: one step back

After Linnaeus' time, researchers willing to describe an ever increasing number of species lacked effective means of communication, which meant that they often had to work without access to the publications of others. The obvious consequence of this limitation was the heritage to current taxonomists of more than 250 years of confusion.

Most taxonomists spend an important part of their careers in interpreting the work of their predecessors, seeking bibliographic sources that are often difficult to find, interpreting old descriptions of species that are often inadequate and lack illustrations, searching with difficulty museum collections and sometimes finding them in poor condition. Although this activity can give individual satisfaction, it is very

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long and difficult: this could be called the first, intrinsic crisis of taxonomy (GODFRAY, 2002).

Taxonomy: the causes of crisis

A second factor of the crisis can be identified in the richness and complexity of the living world, a complexity more and more difficult to manage even for a large group of taxonomists. A third and more recent negative factor has been the decrease during the last few decades of economic support for taxonomic research.

However, the roots of this crisis seem more cultural than rational, because taxonomy has long been considered “out-of-date” and has sometimes been reduced to the status of a technical discipline and thus not research. This misperception is mainly due to the identification of the taxonomy with what is called “alpha taxonomy”, i.e. the simple identification and description of new species, but taxonomy and systematics go well beyond that, especially when attempting to reconstruct phylogenetic relationships which can allow a correct classification.

However, it must be said also that the attitude of some taxonomists has been quite individualistic and sometimes not keen on providing data to other disciplines such as ecology and the preservation of nature. That definitely did not help to reverse this trend (GODFRAY, 2002).

Biodiversity and taxonomy

In recent years, the increasing awareness of the biodiversity crisis (the “Sixth Extinction”) and the concomitant need to implement the Global Taxonomy Initiative under the Convention of Biological Diversity (Rio de Janeiro, UNEP 1992) have been the main reasons that for the international revival of interest in taxonomy. For an effective conservation of biodiversity, it became evident that there was a need to get over the so-called “taxonomical impediment”, that is the global scarcity of taxonomists for the identification and description of species, determining their taxonomic relationships and making predictions about their properties (DE CARVALHO *et al.*, 2007).

The “taxonomic impediment” is particularly felt by ecologists, because simple and fast methods for detecting and quantifying biodiversity are especially required for ecological studies. However, traditional taxonomy is neither simple nor fast: it needs specialists for each group and may take a long time to yield results.

“Morphospecies” and “taxonomical surrogates”, mainly based on morphological criteria but in most cases not corresponding exactly to valid species, have been introduced by ecologists within the so-called “parataxonomy”, for practical uses. However that method may lead to identification errors of even 100% (KRELL, 2004).

The proposal of a “Barcode” based on analysis of DNA sequences for identifying species was welcomed with enthusiasm (HEBERT *et al.*, 2004). The idea was to develop a database of DNA barcodes of all the species, which would be a critical tool for identifying with certainty the specimens collected (JANZEN, 2004).

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Actually the use of DNA in taxonomy was not new (MORITZ & CICERO, 2004), but this proposal stood out for the wideness of the possible screening and the standards introduced, and it was largely publicized by media. The general perception that taxonomy based on DNA is much more “secure” and “objective” has led to these sequences being considered as the basic reference system for taxonomy (TAUTZ *et al.*, 2003).

The barcoding approach has been strongly criticized on several grounds, but it is certainly a valuable additional tool for the study of biodiversity (LIPSCOMB *et al.*, 2003; SEBERG *et al.*, 2003; LEE, 2004; WATERTON *et al.*, 2013).

Crisis or renaissance?

The renewed general interest in biodiversity suggests that this opportunity could be taken for creating a new profession of (zoological) taxonomist, focused to provide the bases for species information and conservation.

This objective can be achieved by:

- recovering traditional morphological taxonomy,
- using new taxonomical methodologies (i.e. molecular markers),
- creating taxonomical databases

and also by:

- spreading data,
- exploiting the potentiality of the World Wide Web for sharing data with other specialists.

Taxonomy on the Web and Bioinformatics

“Cybertaxonomy” has been indicated as the only way to “reinvent” this discipline by GODFRAY (2002), who highlights in particular the need for taxonomical revisions to be made available through free online access to all interested researchers.

This powerful tool could be the keystone also to stimulate the training of new taxonomists who would no longer encounter problems in finding specialist literature, as well as encouraging the dissemination of taxonomy. Of course, this requires a basic taxonomic knowledge on the part of the user, to maintain the link between database and taxonomy and avoid creating what WHEELER (2004) calls “*misinformatics*” as opposed to “bioinformatics” (see also CARVALHO *et al.*, 2014).

The “new” taxonomy implies storing and sharing data on biodiversity

Starting from the consolidated data of traditional morphological taxonomy, the future of taxonomy also involves:

- molecular taxonomy;
- bioinformatics;
- close collaboration and data exchanges between specialists;
- using validated data provided by amateurs;
- “open access” species descriptions;
- public banks of images and of molecular sequences.

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An “integrative taxonomy” was recently proposed (but not unanimously shared) as an updated taxonomical approach, combining molecular sequences, concise morphological descriptions by expert taxonomists, high-resolution digital imaging, and possibly joining open access web-publication and automated pushing of content from journal into a wiki in order to create the most efficient and sustainable way to conduct taxonomy in the future (DAYRAT *et al.*, 2005; VALDECASAS *et al.*, 2008; PADIAL *et al.*, 2010; RIEDEL *et al.*, 2013; BOERO & BERNARDI, 2014).

Rather than concentrating on descriptions of species and narrow studies of morphology and/or DNA, the duties of the professional taxonomists of the future also will be to use cyberspace and a wide range of skills to recruit, train, and provide advice for expert amateurs, young students, parataxonomists, the general public, and governments (PEARSON *et al.*, 2011).

Taxonomy in Italy

The project “Checklist of the Italian fauna” allowed for the first time in Europe the complete inventory of the animal species of a whole country (MINELLI *et al.*, 1993-95), mainly through the work of Prof. Sandro Ruffo, at that time president of the Fauna Commission of the Ministry of Environment, which supported the development and publication of the Checklist.

The project involved 272 specialists from 15 countries and was developed through an agreement between the Ministerial Nature Conservation Service and the Scientific Committee for the Fauna of Italy, which is an extension of the Italian Zoological Union and the National Academy of Entomology.

The Checklist of the Italian Fauna treats 57,468 species that are uniquely identified by numerical codes. The information included in the Checklist is: (a) distribution of terrestrial and freshwater species in 4 geographical regions of the Italian territory (North, South, Sicily, Sardinia); distribution of marine species in 3 areas (Western basins, Upper and Middle Adriatic Sea, remaining basins); (b) status of endemic or threatened species; (c) concise data on the host species (for parasites) and nesting (for birds) (www.faunaitalia.it/checklist).

Completing the Checklist allowed a new project to start, this time involving the Italian Ministry of Environment and the Museum of Natural History of Verona. The new project dealt with the computerization of the check-list of the Italian fauna and the distributional data of 6500 invertebrate species for the identification of priority areas for biodiversity conservation in Italy. The crucial role of the Checklist for nature conservation then became apparent. Moreover, the database embodied in the Checklist allowed a simple but detailed analysis of species richness in Italy (MINELLI, 1996). After the conversion of the Checklist into a database, its importance for biogeographical and ecological studies, mainly on endemics, became even more evident (STOCH, 2000).

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The project was carried out under the supervision of the Scientific Committee for Wildlife in Italy, and at the request of the Scientific Committee of Fauna Europaea, and became an important element of the latter. The project represents the most complete information tool available for the quantification of Italian wildlife resources, being indispensable for a correct and rational management of biodiversity and natural habitats. The renewal of the taxonomic tools available to in Italy is nevertheless still limited to the production of checklists, even if this has provided a basis for conservation ecology data that is unparalleled in Europe (RUFFO & STOCH, 2005) (<http://www.minambiente.it/pagina/checklist-della-fauna-italiana>).

The aims of this project were:

- updating of identification keys linked to the checklists on the web;
- complementing species databases with species descriptions;
- collecting the most important and recent specialist literature;
- allowing free access to museum collections to facilitate the work of taxonomists;
- integrating data with those from European and global initiatives for a ‘global’ taxonomy;
- constant updating of data;
- re-establishing and maintaining a reliable relation between taxonomy and bioinformatics, bearing in mind that bioinformatics is not taxonomy, but a very important tool for it (WHEELER, 2004).

More recently, the Direction for Nature Protection of the Ministry of Environment and Protection of the Territory and the Sea has published a popular guide to faunistic data coming from research within the “Habitat” Directive and Natura2000 Network, aimed at a wide public (see <http://www.minambiente.it/biblioteca/fauna-italiana-inclusa-nella-direttiva-habitat>).

The Italian Ministry of Environment and Protection of Territory and Sea has started the Project “Sistema Ambiente” which includes a number of actions for improving knowledge and protection of biodiversity (see more at: <http://www.minambiente.it/pagina/il-portale-naturaitalia-e-il-network-nazionale-della-biodiversita>).

Zoology and natural sciences in perspective

The future of zoology, like that of the other natural sciences, lies in both the new and the old zoological activities, revisited through the use of new technologies.

It is a great responsibility of the university system to form new figures of zoologists who are professionally more clearly defined and able to make use of new technological tools for research in the field of zoology.

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