

**Prof. Francesca Cima**  
**Curriculum vitae**

**PERSONAL INFORMATION**

<i>Place and date of birth</i>	Padova (Italy), 1966 March 29
<i>Address</i>	Department of Biology, University of Padova, Via U. Bassi 58/B - 35131 Padova, Italy
<i>Phone</i>	+39-049-8276198
<i>E-mail</i>	francesca.cima@unipd.it; ascilab@bio.unipd.it
<i>Website</i>	<a href="https://sites.google.com/site/ascidianbiologylab/staff/francesca-cima">https://sites.google.com/site/ascidianbiologylab/staff/francesca-cima</a>
<i>Nationality</i>	Italian
<i>Residence</i>	Via Beato Pellegrino, 96 - 35137 Padova, Italy

**EDUCATION AND TRAINING**

1985	<b>High school diploma</b> at Liceo-Ginnasio "C. Marchesi" in Padova with 57/60.
1990	<b>Degree in Natural Sciences</b> at University of Padova (110/110 cum laude) with a thesis entitled: 'Ultrastructure of the digestive tract of <i>Doliolum nationalis</i> (Thaliacea) ' (Supervisor: Prof. P. Burighel; Co-Supervisor: Prof. G.B. Martinucci)
1992	<b>Teacher's diploma exam in Natural Sciences, Chemistry and Geography</b> , class of qualification A060, (national qualifying competition announcement with DM 23/3/1990)
1994	<b>Ph.D. in Evolutionary Biology</b> at the University of Padova, (Rome, 22/06/1994) with a thesis entitled 'Haemocytes and immunity in the colonial ascidian <i>Botryllus schlosseri</i> (Supervisor: Prof. A. Sabbadin).
1996	<b>Enrolment in the register of teachers of Natural Sciences, Chemistry and Geography</b> (class A060) at Education Superintendency of Padova.
1996 - 1998	<b>Scholarship for postdoctoral research</b> at the Department of Biology, University of Padova (area n° 5 - Biological Sciences, Research Line 'Evolutionary biology').
1999 - 2001	<b>Research grant</b> at the Department of Biology, University of Padova, on 'Differentiation and cellular interactions in Tunicates' (Research Manager: Prof. P. Burighel)
2001 - 2003	<b>Biennial renewal</b> of the above-mentioned research grant
2001	<b>University Master's degree</b> in 'Microscopic analytical techniques in biology', University of Pavia.
2005	<b>Researcher in the SSD BIO/06 (Comparative Anatomy and Cytology)</b> Department of Biology, University of Padova, where she is responsible for the laboratory of 'Ascidian Biology'. Confirmed since 2008.
2019	<b>Associate Professor in the class BIOS-04/A (Comparative Anatomy, Cell Biology and Developmental Biology)</b> , Dept. of Biology, University of Padova.
<b>International</b>	<b>7-10 October 1997:</b> Advanced International Course on

courses

National  
courses

Immunofluorescence, Gargnano (BS).

**14-18 June 1993:** II Corso of Scanning Electron Microscopy in Biology and Medicine (S.I.M.E.), Padova.

**15 February 1997:** Training course "Evaluation and management of biological risks in relation to the DL 626/94", Padova.

**8 March 1997:** Training course "Evaluation and management of chemical and cancerogenic risks in relation to the DL 626/94: metals", Padova.

**15 March 1997:** Training course "Evaluation and management of chemical risks in the production activities in relation to the DL 626/94: pesticides", Rimini.

**5 and 12 March 1997:** Training course of Radiation Safety, Padova.

**23-28 June 1997:** Training course 'Immune defence strategies in marine invertebrates', Chioggia (Venice).

**30 June 1999:** Theoretical and practical course on laboratory autoclave utilization, Padova.

**7-10 February 2006:** Theoretical and practical course 'Introduction to methods in Molecular Biology', Padova.

**12-14 September 2007:** Theoretical and practical workshop 'Recognizing biomolecules *in situ*: problems and solutions with light and electron microscopy', Pavia.

**16 June 2010:** Training course of the Safety Area 'Working with a video terminal', Training and Development Service, University of Padova.

**03 December 2014:** Training course Legal-Administrative 'Anti-corruption and transparency, Training and Development Service, University of Padova.

**20 January 2015:** Training course of the Safety Area 'Special training for Security Supervisors', Training and Development Service, University of Padova.

**13 July 2015:** Training course of the Safety Area 'Basic security course: General Education', Training and Development Service, University of Padova

## RESEARCH ACTIVITY

Main research  
lines

COMPARATIVE  
IMMUNOBIOLOGY

### **1. Morpho-functional study of haemocytes and coelomocytes of marine invertebrates (tunicates, bivalves, sipuncula).**

Although invertebrates lack a lymphoid tissue and do not produce immunoglobulins, they can defend themselves from the attack by pathogens. Unlike vertebrates, only one form of innate or natural immunity occurs in invertebrates. The immune response is generally guaranteed by the action of cells circulating in the haemolymph (the haemocytes) or in the coelomatic liquid (coelomocytes) and cells present in various tissues. A problem still much debated is the classification of the haemocytes. The high morphological variability of these cells and the lack of definitive data on their haematopoiesis

made the topic particularly complex. In this context, the research activity is aimed to a morpho-functional characterization of haemocytes of tunicates (ascidians: *Botrylloides leachii*, *Botryllus schlosseri*, *Diplosoma listerianum*; thaliaceans: *Thalia democratica*, *Doliolum nationalis*), bivalve molluscs (*Ruditapes philippinarum*), and of coelomocytes of sipuncula (*Sipunculus nudus*) by means of cytochemical and immunocytochemical techniques. The results obtained helped to define the involvement of circulating cells in the immune defences of these species of marine invertebrates.

Tunicates are invertebrates closely related to vertebrates from a phylogenetic point of view because they belong to the same phylum Chordata. Since main problems of the innate immunity of these organisms include the classification of haemocyte types, that is still hotly debated, and their role in immunity, the colonial ascidian *Botryllus schlosseri* was a particular object of the study: it is widely used by various international laboratories as a recognised good model for research in comparative immunobiology because it shows characteristics of rejection and genetic fusion between colonies.

In the haemolymph of this species, collected in the Lagoon of Venice, where it is widespread and easily reared in lab, several cell types are present, which have been the subject of investigation in order to characterize them from a morpho-functional point of view and define the main differentiation lines and their fate from undifferentiated pluripotent circulating cells. The results show that there are at least two main differentiation lines of immune cells: the phagocytic line (macrophage-like cells and their precursors, the hyaline amoebocytes) and the cytotoxic line (morula cells and their precursors, the granular amoebocytes). It has been dealt with the century-old debate about the role of undifferentiated circulating cell types: the haemoblast (or lymphocyte-like cell), by assessing the frequency during the colonial cycle and characterizing them using anti-CD antibodies as typical markers of mammalian undifferentiated (i.e., stem) cells (haematopoietic cells); the cell cycle of circulating haemocytes was blocked in the presence of anti-mitotic substances, and, after bacterial stimulation, the proliferation and differentiation potentials were demonstrated in a circulating undifferentiated type in the absence of specific haematopoietic tissues till now not recognized in this species. The ability to distinguish self from non-self within the same species occurs in colonial ascidians as 'colonial specificity', for which the contact between colonies through their marginal ampullae of the tunic blood vessels can lead to the fusion in one chimerical colony or to a rejection reaction with the appearance of a necrotic area throughout the edges of contact. The phenomenon is genetically controlled and fusion occurs when the colonies in contact share at least one allele at a histocompatibility locus, which is highly polymorphic. The cytotoxic cells, namely morula cells, in response to humoral factors released from the incompatible colony, accumulate initially within the lumen of the contacting ampullae, then they leave the blood circulation through

the largely fenestrated ampullary epithelium, migrate into the tunic, where they release the content of their vacuoles and undergo a progressive degeneration contributing to the formation of necrotic masses. These cells contain phenoloxidase (PO) within their vacuoles, which, after its release under a process of exocytosis in response to humoral factors, is responsible for the cytotoxicity observed along the edges of contact between the incompatible colonies. This is confirmed by an increased activity of phenoloxidase along the of contact edges between incompatible colonies before the appearance of the necrotic masses, as well as the release of PO in the culture medium of haemocytes incubated in the presence of incompatible plasma. The increase in PO activity in the incubation medium also leads to an increase in haemocyte mortality: this enzyme is responsible for the cytotoxicity that is observed in the areas of necrosis caused by oxidative stress resulting from the generation of reactive oxygen metabolites during the oxidation to quinones of the polyphenol substrates contained within the same haemocytes. The increase in mortality of haemocytes incubated with incompatible plasma disappears in the presence of PO and protease inhibitors, suggesting that PO is present within the cells as an inactive proenzyme. During the initial events of the allorecognition, most of the haemocytes belonging to the cytotoxic line is immunopositive to anti-IL-1-a and anti-TNF-a mammal antibodies, suggesting that, in spite of what was previously thought, invertebrates are able to produce cytokine-like molecules. In *B. schlosseri*, recombinant IL-1- $\alpha$  and TNF- $\alpha$  present in the culture medium of the haemocytes, on the one hand increase cytotoxicity, on the other they stimulate the activity of the phagocytes (opsonization) suggesting an interesting crosstalking between the phagocytic line and the cytotoxic line.

The hyaline amoebocytes belong to the phagocytic line. They are very mobile phagocytes, also able to cross the epithelial cells and adhere externally on the folds of the tunic that covers the siphons, exposing themselves to water flow and playing a probable role of immune surveillance to anything that enters the pharynx with the seawater flow. Therefore, the presence of these particular sentinel-cells in ascidians was first described: with the help of microscopic, histochemical, histoenzymatic and immunohistochemical techniques, it was possible to show that they share many morpho-functional characteristics with the phagocytic line, from which probably arise, and are able to recognize and engulf foreign particles of various kinds. These cells are involved in a complex and unique series of local and systemic immune events, because, as observed under ultrastructural level, after crossing the epithelia they present and send signals that cause a massive recall of the cells of the cytotoxic line in the siphonal sinus. The so-stimulated morula cells respond in turn with a significant degranulation by releasing various substances, among which cytokine-like molecules that stimulate large circulating scavenger phagocytes. The latter engulf bacteria in large quantities and are eliminated

through the peribranchial chamber. Investigations with histochemical and immunohistochemical assays for light microscopy also revealed the presence of heparin and histamine which co-localize within the granules of hyaline amoebocytes and are released by degranulation after stimulation with bacteria. The presence of serine protease suggests a role similar to the mast cells of vertebrates, opening interesting questions in the context of the evolution of the immune system inside the phylum and the role of heparin and biogenic amines in invertebrates. Mast cell-like cells were also found in *B. leachii* (granular cell), *D. listerianum* and the thaliacean *Thalia democratica* but only in *B. schlosseri* a single multifunctional type has been found which is able of both engulfing non-self particles and showing mast-cell like quality (heparin, histamine, TNF- $\alpha$ , choroacetylsterase, tryptase, chymase). In this species, a receptor for histamine H2 class (GenBank: ART 85726.1, Histamine receptor H2 [Botryllus schlosseri]) was recently discovered: it is not only involved in ciliary beating but also in immunity, being expressed on the cell surface of morula cells: studies are currently in progress to recognise its role in immunity, signal transduction within these cells, the ways of communication with immune cells of other differentiation lines and modulation with cytokines.

In the bivalve *R. philippinarum*, an edible species widespread in the Lagoon of Venice, four different types of haemocytes were detected: hyalinocytes (48.05%), granulocytes (32.18%), haemoblasts (18.97%) and serous cells (0.8%). Granulocytes and the hyalinocytes appear mostly round ('round cells'), but are also able to protrude pseudopodia, assuming an amoeboid shape ('spreading cells') and have a phagocytic activity influenced by plasma opsonins and a cytotoxic activity with ROS production. The presence of haemoblasts in the haemolymph of *R. philippinarum* was the most interesting discovery of this study: the positivity to anti-CD34 antibody - used to identify haematopoietic cells in mammals and applied for the first time in bivalves - suggested that the haemoblasts are stem cells capable of dividing in the blood circulation. Additional studies with XTT and bacterial stimulation in vitro and in vivo have confirmed their ability to proliferate and differentiate. The serous cells, so far poorly studied for their scarcity in the haemolymph, have revealed an immune role, as they increase in number after immunostimulation and, after aggregation, they release extracellular chromatin traps rich in proteases, heparin and histamine. Also in this case, studies on their possible mast cell-like role are in progress.

Due to the scarce information in the literature, a morpho-functional study was conducted on the coelomocytes of the worm *Sipunculus nudus*, a benthic marine species. In the coelomatic fluid several cell types have been identified: the hemerythrocytes (90%), granulocytes and hyalinocytes (9%), together with multicellular structures floating in the body cavity defined 'urn complexes' (1%). The hemerythrocytes

are nucleated cells for which any involvement in immune responses has not been shown. Two different sub-populations of granulocytes and hyalinocytes ('small' and 'large') have been identified. Moreover, by using immunohistochemical techniques, stem cells have been identified even in this species. Researches revealed that both granulocytes and hyalinocytes are phagocytes; the engulfed material undergoes a degradation process by hydrolytic enzymes. The role in immune responses of the 'urn complexes' was also defined for the first time: although a real phagocytic activity has not been highlighted, the ciliary cells of the basal layer are capable of trapping a large number of yeast cells through the mucus they produce. The positivity to some hydrolases found on the outer portion of the complex suggests that the trapped material may undergo an extra-cellular digestion. A strong antibacterial activity by lysozyme in the coelomatic fluid of *S. nudus* was also highlighted using spectrophotometric techniques and assays with agarose plates.

## **2. Bioaccumulation and immunotoxicity of xenobiotics in vertebrates (fish) and invertebrates (molluscs, sipuncula and colonial ascidians).**

The immune system is one of the first components of an organism suffering from the stress. The study of the immune system is therefore a good starting point for the identification and development of toxicity assays ('immunomarkers') that can be used in evaluation of the potential hazards of environmental contaminants. It is known that some xenobiotics are able to interact with the immune system causing immunotoxic effects with serious consequences for the survival of the organisms. In laboratory mammals and humans, organotin compounds that are biocidal products used in antifouling paints with important consequences on aquatic ecosystems tend to accumulate in lipophilic compartments and cause thymic and lymphatic tissue atrophy, inhibition of phagocytosis, and cytolysis of polymorphonuclear leukocytes, resulting in a powerful immunodepression of the cell-mediated responses. The phenomena and ways for bioaccumulation of TBT have been taken into consideration in carp (*Cyprinus carpio*), a freshwater teleost fish. The analyses, performed with both analytical methods and histology on samples from aquaculture, have shown that the compound accumulates quickly, through the gills or the alimentary canal, especially in the thymus, which has to be considered the main target organ of vertebrates, while its elimination is very slow. In the histological sections of various organs, a marked depletion of lymphoid elements was observed in the thymus and in the spleen already after one week of treatment remarking that the organotin compounds, thanks to their lipophilic properties, are easily absorbed and have a predominantly immunosuppressive action in fish. The same analytical technique was applied also on samples of sediments and tissues of bivalves (*Mytilus edulis*) collected from the Northern Adriatic revealing the ability of organotin compounds to significantly bioaccumulate also in filter-feeding invertebrates.

The information on immunotoxic effects of organotin compounds in invertebrates is scarce. Therefore, molecular targets and mechanisms of action responsible of the cell-mediated immunodepression by widespread biocidal antifouling compounds (organotin compounds: TBT, DBT, MBT, TPT, TCHT) have been studied *in vitro* on various marine invertebrates (tunicates, bivalves, sipuncula). Using rapid cytotoxicological assays represented by microscopic, cytochemical immunocytochemical, and spectrophotometric techniques, on short-term haemocytes cultures, various effects were observed: effects on cell morphology in relation to the depolymerization of cytoskeletal proteins, effects on phagocytosis of target-particles, induction of apoptosis, influence on cellular calcium homeostasis by specific and direct inhibition of calmodulin, alteration of mitochondrial oxidative phosphorylation, oxidative stress and the scavenger role of both glutathione and natural-scavenger enzyme systems. New hypotheses on the immunosuppressive effects arouse from the original results, in particular chemotaxis and phagocytosis, which are not due to an oxidative stress as described for other xenobiotics, but mainly to an influence on cell calcium homeostasis ( $\text{Ca}^{2+}$ -dependent effects) through a specific inhibition of calmodulin, which in turn produces multiple effects such as inhibition of calcium pumps, depolymerization of cytoskeletal proteins and induction of apoptosis. Direct interaction of hydrophobic nature between calmodulin and TBT was highlighted for the first time by variations in circular dichroism of the protein. These effects are added, integrated in synergy, by  $\text{Ca}^{2+}$ -independent ones involving interaction with thiol groups present in many natural substances in the cells, mainly glutathione enclosed.

As a result of the definitive ban of antifouling paints containing organotin compounds new biocidal compounds in various combinations were introduced in the last decade from both agriculture and the pharmaceutical industry. However, in most cases the risk assessment was inadequate, so there is currently great interest with regard to the possible effects on aquatic ecosystems. The mechanisms of action and the molecular targets of immunodepression of the cell-mediated responses caused by some widespread antifouling biocide compounds have been studied *in vitro* in marine invertebrates (tunicates and bivalves), which were previously considered good bio-indicators for organotin compounds. Using rapid cytotoxicological assays consisting of microscopic, cytochemical and immunocytochemical techniques on short-term cultured haemocytes, the effects on cell morphology have been put into highlight in relation to depolymerization of cytoskeletal proteins, effects on phagocytosis of target-particles, induction of apoptosis, influence on cellular calcium homeostasis, decrease of the reduced glutathione, alterations in mitochondrial oxidative phosphorylation, oxidative stress, and interactions of isodynamic mixtures between biocides which are co-present in formulations at present put on the market. Many of these compounds are able to significantly reduce the functionality of haemocytes stressing the potential immunodepression sometimes

comparable with that of organotin compounds and highlighting the problem of a rapid bioaccumulation in non-target filter-feeding organisms and destruction of coastal communities. Therefore, the issue of the dismantling action on communities by new antifouling products widely used on hulls and various artefacts submerged in the lagoon area was addressed on the '*Botryllus* community', a benthic biocoenosis of macrofouling of hard-substrate formed of various species of ascidians, among which colonial species dominate. Some descriptors of biodiversity (species richness, community structure, cover-abundance index, similarity index) were chosen and then applied on wooden and steel panels covered with antifouling paints and submerged for one year in three stations of the Lagoon of Chioggia with different hydrodynamic and depth characteristics. The active principles taken into account were copper oxidule, copper thiocyanate, Sea-Nine 211, Chlorothalonil, Dichlofluanid, Irgarol, Diuron, TCMS pyridine, Zinc Pyrithione, Zineb, and Endosulfan. The comparison of these indexes allowed to evaluate the effects on the ability to settlement by fouling organisms, changes in the community and propose possible dismantling causes that lead to selection of dominant species often different from those of the natural climax. At the same time, an analysis of the temporal evolution of macrobenthic community of hard substrate has been made in the southern basin of the lagoon with the aim of developing an environmental quality index' ('*Bioindex*') which is cheap, relatively easy to calculate, sensitive to various environmental situations, and considers the time variation of physico-chemical parameters that are highly significant for the lagoon environment in addition to biotic data.

### **3. Apoptosis and colonial cycle in the ascidian *Botryllus schlosseri*.**

The colonial cycle of *B. schlosseri* shows a periodic and cyclical regression - with a weekly frequency at 18° C - of the zooids, which are replaced by the next blastogenic generation: this species is therefore an excellent model for the study of cyclic apoptosis involving progressively and in a selective manner along an antero-posterior gradient all tissues of adult zooids. The colonial cycle was then examined in relation to changes that occur at the individual cellular and tissue levels, during the periodic regression of the adult zooids and the generational change. The study with expression markers related with apoptosis and recognition of senescent cells in colonies subject to regression revealed the presence of scavenger phagocytes, which express Bax, Fas, FasL, but not Bcl-2 suggesting that the mechanisms of induction of programmed death have been preserved during evolution of chordates. Moreover, during the regression an increase of phagocytes expressing phosphatidylserine and the receptor for thrombospondin on their plasma membrane occurs, supporting the hypothesis that the mechanisms of recognition of senescent cells are the same known in vertebrates.

### **4. Xenobiotic embriotoxicity and change in the larval development in**

### **marine invertebrates.**

In teleost fish, some widespread xenobiotics like the organotin compounds cause mortality or malformations in embryos and larvae. Among invertebrates, information is scarce: bivalve molluscs undergo an embryonic block to early stages, but little or nothing is known about the mechanisms of action of these substances at the level of the development and metamorphosis. The effects on embryonic development (inhibition, delay and malformations) have been assessed exposing embryos the solitary ascidian *Styela plicata* and sea urchin *Paracentrotus lividus* to various concentrations of organotin compounds to try to locate a) the most toxic compounds, b) the most sensitive development stages beginning from the fertilized egg to the larva together with ultrastructural observations of treated embryos, c) mechanisms of action at a biomolecular level. The results obtained, also supported by ultrastructural observations, suggest that the inhibition of the embryonic development is dose-and time-dependent and closely related to the liposoluble properties of organotin compounds, which tend to accumulate on the mitochondrial cristae causing inhibition of oxidative phosphorylation and act on mechanisms that regulate the cellular calcium homeostasis with severe effects on the general architecture of embryo or larva and on morphogenetic movements. The most sensitive stages appear gastrula and neurula, during which stopping and anomalies of development occur, with a greater sensitivity detected in sea urchin than in ascidians, probably because it lacks the system of egg envelopes that wraps around the outside of the tunicate embryo.

### **5. Spermatogenesis in appendicularians.**

For their specializations, the tunicate sperms are distinguished from the 'primitive' sperm type and can be recognized as 'ascidiosperms', which are typical only of ascidians and thaliaceans. Appendicularians, planktonic tunicates found in all the oceans, have a short life cycle that completes in about three days with the release of gametes and death of the animal. As a difference of ascidians for which numerous are the studies on structure and biology of their gametes, in appendicularians the studies were limited to the behaviour of sperms during fertilization of *Oikopleura dioica*, the only gonochoric species. Therefore, attention was paid to the understanding of gonad and male germ cells differentiation of this species. A detailed study of the spermatogenesis was carried out at the ultrastructural level, based on analysis of variations that both gonad and gametes undergo during differentiation.

Spermatogenesis was first described by proposing a subdivision into seven stages related to shape and size changes of the testis during development compared to other organs in the trunk. These stages were then related to the morphology of the gametes at the ultrastructural level taking into account the relationships between external appearance and cytology. The observations, compared to what is known for others tunicates, led to some interesting adaptive

and evolutionary conclusions: the presence in mature sperm of a small and globoid nucleus with a large acrosome and a 'mid-piece', where a single mitochondrion is present migrated from a previous position alongside the nucleus, suggests that the appendicularians, despite having a sperm different from the typical 'ascidiosperm' of ascidians and thaliaceans probably in relation to the ability to form an acrosome process during fertilization, have not plesiomorphic but apomorphic sperms, and formed an oligopyrenic nucleus as an adaptation to the assembly of many sperms in the confined space of the genital cavity.

#### **6. Morpho-functional aspects of the appendicularian alimentary canal.**

Appendicularians have an original way of nutrition, on which their adaptive success is based: Unlike other classes of tunicates they have a general structural simplification for a particularly efficient system in energy transfer. As a difference with ascidians and thaliaceans filtration of nutritive particles suspended in the water does not take place through the passage in a branchial pharynx perforated by ciliary stigmata, but inside a mucous bubble called 'house', in which the animal lives, that regulates the flow of water through the beats of the tail: it is an extraordinary elaborate external 'disposable system', built several times during their short life and equipped with filters and channels able to capture and concentrate on food before it is conveyed to the mouth. Despite this apparent singularity and the ecological importance of these animals, little or nothing is known about cytology and functions of the various tracts that form the alimentary canal in the three families of this class, since the last articles on this topic were written between the 19th and early 20th centuries.

A comparative ultrastructural study of the alimentary canal in the families Oikopleuridae, Fritillariidae and Kowalevskiidae has been performed supplemented by histochemical and histoenzymatic analyses. The results, obtained using electron microscopy-based techniques produced new contributions to the recognition and localization of the main cell types and especially of their specializations in propulsion of food, digestion, absorption, formation of faecal pellets, reserve substances accumulation, excretion and regulation of internal fluids. The compared observations on the alimentary canal also suggests that Oikopleuridae appear overall more primitive than the other two families which, in addition to confirming a higher affinity for sharing different characters, tend to reach the maximum structural simplification.

1998

**Paolo Gatto's National Award of the Accademia Nazionale dei Lincei** for her work regarding issues of the Venice Lagoon and, in particular, for original and innovative research of biomarkers (toxicity indexes) and bio-indicators (sentinel-organisms) of environmental pollutants with a high impact on coastal marine ecosystems (organotin compounds) through the use of selected immunotoxicity and embryotoxicity assays on tunicates, molluscs and echinoderms. The award, unique and indivisible, was awarded on 19.06.1998 in Rome, Palazzo del Quirinale, in the presence of the President of the Italian Republic Oscar Luigi Scalfaro.

## **RESEARCH PROJECTS**

*Scientific  
Coordinator*

**since 2005:** Research Project 'ex 60%-DOR Funding grant' of the University of Padova '*Tunicate immunobiology with particular reference to the role of the hemocytes*'.

**1999-2000:** Research Project for Young Researchers of the University of Padova: '*Development of new bioindicators and biomarkers for the environmental impact study by organotin compounds on the coastal ecosystems*'.

**2008-2010:** University Research Project (CPDA082501/08) '*Multifunctional programmed characterization of a primitive cellular system discovered in protochordates and consisting of unusual migrating cells of the immune system similar to the mast cells of vertebrates on the basis of the first evidence of the presence of heparin, histamine and adrenomedullin*'.

**2023-2025:** Department Research Project (BIRD231875) '*An evolutionary insight to chordate inflammation: Searching for the origin of mast cells in tunicates and their role in acute inflammation*'.

*Participation in  
international  
projects*

**1998-2001:** European Project EC MAST-III '*EURAPP*' ('*European Appendicularians*') MAS3-CT98-0161 (Coordinator: G. Gorsky, Station Zoologique de Villefranche-sur-mer; Local Coordinator: Prof. P. Burighel, University of Padova).

**since 2017:** Working Group under the Project COST Action CA16203 '*Stem cells of marine/aquatic invertebrates: from basic research to innovative applications*' (*MARISTEM*) (Local Coordinator: Prof. L. Ballarin, University of Padova).

*Participation in  
national projects*

**1993-1995:** CNR-MURST Project '*The Lagoon of Venice System*' II phase, Sub-project 4, Research line 4.2. (Coordinator: Prof. V. Albergoni).

**1996-1997:** CNR Project '*Marine pollution and bioaccumulation of organotin compounds. Studies of embryotoxicity and immunotoxicity in invertebrates and vertebrates; new derivatization analytical technologies*' (National coordinator: Prof. L. Ballarin).

**1999-2000:** University Project '*Natural immunity in vertebrates and ascidians: Immunità naturale in vertebrati ed ascidiacei: a comparison study*' (Coordinator: Prof. L. Ballarin).

**2000-2003:** Co.Ri.La. Project '*Biodiversity in the Lagoon of Venice*' (Local coordinator: Prof. P.M. Bisol).

**2004-2006:** PRIN-MIUR '*Evolution of the innate immunity. Components of the inflammatory reaction of the ascidians and molecular phylogenesis of Chordates*'. Local project: '*Innate immunity and immunomodulation in the colonial ascidian Botryllus schlosseri*'. (National coordinator: Prof. N. Parrinello).

**2004-2007:** Co.Ri.La Project '*Indicators and indexes of environmental quality for the Lagoon of Venice*' (Coordinator: Prof. A. Marcomini; Local coordinator: Prof. P. Bisol).

**2006-2008:** PRIN-MIUR Project '*Lectin repertoires in protochordates. Evolution of recognition mechanisms and innate immunity*'. Local project: '*Lectins and immunomodulation in the colonial ascidian Botryllus schlosseri*'. (National coordinator: Prof. N. Parrinello).

**2007:** Co.Ri.La. Project '*Check-up of the applicability of environmental quality indexes to the Lagoon of Venice*' (Coordinator: Prof. A. Marcomini; Local coordinator: Prof. P. Bisol).

**2009-2012:** Excellence Project CARIPARO '*The colonial ascidian Botryllus schlosseri as a new chordate animal model for the study of differentiation and regeneration of the cardiovascular and nervous systems*' (Coordinator: Prof. L. Ballarin).

**2010-2013:** ha partecipato al Progetto PRIN (MIUR) '*Genes and molecules of the invertebrate immunity. Structure, functions, evolutionary precursors and transferability in applied research*'. (National and local coordinator: Prof. L. Ballarin).

**2015-2017:** University Project '*Inflammation and neurodegeneration: evolution and clues from ascidians*' (Coordinator: Prof. L. Manni).

## **COLLABORATIONS WITH RESEARCH INSTITUTES**

*Nazionali Istitutes* |

1. Department of Environmental Sciences, University of Venice (Prof. M.

*Internazional  
Institutes*

- Bragadin);
2. Department of Pharmacology and Anaesthesiology, University of Padova (Prof. S. Bova);
  3. Department of Veterinary Medical Sciences, University of Bologna (Dr. A. Pagliarani);
  4. Stazione Zoologica Anton Dohrn, Naples (Dr. P. Sordino).
1. Department of Chemistry, De Montfort University, Leicester, U.K. (Prof. P.J. Craig);
  2. Department of Biology & CESAM, University of Aveiro, Portugal (Dr. R.J.G. Calado);
  3. Department of Animal Ecology, German Federal Institute of Hydrology, Koblenz, Germany (Dr. M.A. Wetzel).

**TEACHING ACTIVITY**

**Scientific lectures**

- 1997, June 14* Lecturer of a theoretical lesson – (*Immunity in colonial ascidians*) and a practical lesson (*Recognition and characterization of Botryllus schlosseri haemocytes. In vitro assays of phagocytosis, haemagglutination, cytotoxicity*) for the Training Course "**Immune defence strategies in marine invertebrates**", organized by the Department of Biology of the University of Padova at the Hydrobiological Station of Chioggia (Venice).
- 2000, June 20* Speaker at a lecture titled *Immunotoxicity of organotin compounds in vertebrates and marine invertebrates* for the Ph.D. School of Pharmacology and Toxicology at the "E. Meneghetti's" Department of Pharmacology and Anaesthesiology, University of Padova.
- 2002, April 4* Lecturer of two seminars titled *History of the Mediterranean Sea: Paleogeographic and palaeontological aspects* and *The Mediterranean Sea today: chemical and physical aspects, climate change, biogeographic patterns, bathymetric data* for "*Marine Biological Resources*", course of BD in Biology – field of study: "Marine Biology" – at Palazzo Grassi in Chioggia (Venice).
- 2002, April 18* Lecturer of a seminar titled *Fossils and fossilization processes* for "*Unity and Diversity of Organisms*", course of the BD in Biology (repeated on 2003 March 3).
- 2003, February 6* **Invited Lecturer** for a lesson titled *Life cycles of tunicates* for the Master in "**Assessment and Management of Living Marine Resources**" at Palazzo Grassi in Chioggia (Venice).
- 2003, June 23-25* Lecturer of two theoretical-practical lessons titled *Sectioning for light microscopy* and *Cytochemistry and Immunocytochemistry for light and electron microscopy* for the "**Course of Microscopy**" of the Ph.D. School

in Evolutionary Biology at the Department of Biology, University of Padova (repeated on 2004, May 26 and June 9).

2004, October 21-22

**Invited Lecturer** for two theoretical-practical lessons titled *Anatomical drawing of Vertebrates* and *Preparation of skeletons* for the **Master in Naturalist Museology** (Director: Prof. S. Casellato) Department of Biology, University of Padova.

**Pre-role teaching**

A.Y. 2001-2002

1. 25h of educational support and assistance in lab practice of *"Institutes of Biology II"* (Course leader: L. Ballarin) for BD in Science and Technology for Environment (STAM).

A.Y. 2002-2003

1. 25h of educational support and assistance in lab practice of *"Institutes of Biology II"* (Course leader: L. Ballarin) for BD in Science and Technology for Environment (STAM).
2. 25h of educational support and assistance in lab practice of *"Biological Methods"* (Course leader: Prof. P. Cardellini) for BD in Biology.
3. 25h of educational support and assistance in lab practice of *"Fundamentals of Zoology"* (Course leader: Prof. GB. Martinucci) for BD in Science and Technology for Nature.

A.Y. 2003-2004

1. 25h of educational support and assistance in lab practice of *"Institutes of Biology II"* (Course leader: L. Ballarin) for BD in Science and Technology for Environment (STAM).
2. 25h of educational support and assistance in lab practice of *"Cell Biology and Histology"* (Course leader: Prof. E. Reddi) for BD in Science and Technology for Nature.
3. 25h of educational support and assistance in lab practice of *"Fundamentals of Zoology"* (Course leader: Prof. GB. Martinucci) for BD in Science and Technology for Nature.
4. **Holder of an appointment without tenure** of *"Cell Biology"* (70h) for four-year degree in Natural Sciences.

**Institutional teaching**

(CFU = ECTS;

L: frontal lesson;

E: lab practice)

A.Y. 2004-2005

1. Manager of lab practice (20h) for *"Cell Biology and Histology"* (Course leader: Prof. E. Reddi) for BD in Science and Technology for Nature.
2. Manager of lab practice (25h) for *"Biology Mod. A"* (Course leader: Prof. G. Zaniolo) for BD in Optics and Optometry.
3. Manager of lab practice (30h) for *"Organization and Diversity of Animals 2"* (Course leader: Prof. G. Zaniolo) for BD in Biology.

A.Y. 2005-2006	1. Teacher (course leader) of Docente del corso di "Unity and Diversity of Organisms Mod. B" (3 CFU, 24h) for BD in Biology.
A.Y. 2006-2007	
A.Y. 2007-2008	2. Teacher (course leader) of "Evolutionary History of Vertebrates" (5L + 1E CFU, 56h) for MD in Natural Sciences. 3. Manager of lab practice (34h) of "Organization and Diversity of Animals 2" (Course leader: Prof. G. Zaniolo) for BD in Biology.
A.Y. 2008-2009	1. Teacher (course leader) of "Evolutionary History of Vertebrates" (5L + 1E CFU, 56h) for both BD in Biology and MD in Natural Sciences. 2. Manager of lab practice (34h) of "Comparative Anatomy" (Course leader: Prof. G. Zaniolo) for BD in Biology.
A.Y. 2009-2010	1. <b>Aggregate Professor</b> of "Evolutionary History of Vertebrates" (5L + 1E CFU, 56h) for both BD in Biology and MD in Natural Sciences. 2. Manager of lab practice (34h) of "Comparative Anatomy" (Course leader: Prof. G. Zaniolo) for BD in Biology.
A.Y. 2010-2011	1. <b>Aggregate professor</b> of "Cell Biology" (5L + 2E CFU, 72h) for BD in Biology.
A.Y. 2011-2012	1. <b>Aggregate professor</b> of "Cell Biology" (5L + 2E CFU, 72h) for BD in Biology.
A.Y. 2012-2013	
A.Y. 2013-2014	2. Teacher (course leader) of "Evolutionary History of Vertebrates" (5L + 1E CFU, 56h) for both BD in Biology and MD in Natural Sciences.
A.Y. 2014-2015	
A.Y. 2015-2016	
A.Y. 2016-2017	
A.Y. 2017-2018	
A.Y. 2018-2019	
A.Y. 2019-2020	1. Teacher ( <b>institutional course leader as Associate professor</b> ) of "Cell Biology" (5L + 2E CFU, 72h) for BD in Biology.
2020-2021	
2022-2023	2. Teacher ( <b>institutional course leader as Associate professor</b> ) of "Evolutionary History of Vertebrates" (5L + 1E CFU, 56h) for BD in Biology.
2023-2024	
A.Y. 2021-2022	1. Teacher ( <b>institutional course leader as Associate professor</b> ) of "Cell Biology and Histology" (6L CFU, 48h) for BD in Natural Sciences.
A.Y. 2022-2023	
2023-2024	3. Teacher ( <b>institutional course leader as Associate professor</b> ) of "Principles of Animal Biology" (4L + 1E CFU, 48h) for BD in Natural and Environmental Sciences.

## INSTITUTIONAL MANAGEMENT ASSIGNMENTS

Mathematical, |

**Physical and Natural  
Science Faculty**

*2006-2007* She directed the restoration and reorganization – cataloging, extension, and preparation of new cards for the recognition in both paper and electronic form – of the vertebrate macroscopic preparations of the didactic collections of Comparative Anatomy and Vertebrate Zoology at the Department of Biology under a project funded by the Presidency of Faculty ('Grants for the teaching improvement').

*2008-2011* Member of the Committee for Lesson Timetables and Spaces for the Natural Science Area (Council of Faculty resolutions: 2008 November 9, 2009 October 28 and tacit ratifications).

**Department of  
Biology**

*2005-2010* Coordinator of the Committee for the Lesson Timetables at the Department of Biology for the degree courses in Natural Sciences (Council of the Degree Course resolutions: 2008 September 22, 2009 October 19, 2010 September 2).

*2006-2008* Member of the Committee for Sponsoring the Renewal of the Degree Course in Natural Sciences (DM 270).

*2009-2010* Member of the Committee for Education and Learning Plans (Council of the Degree Course resolution: 2009 October 19) and of the Committee for Evaluation of Three-year Degrees in the Council of the Degree Course in Natural Sciences (DM 270) (Council of Faculty resolution: 2009 May 27).

*2008-2012* Member of the Committee for Educational Services (Council of Department resolutions: 2008 December 16 and tacit ratifications until 2012).

*Since 2011* Contact person for the lesson timetables of the degree courses in Biology and Evolutionary Biology (Council of the Degree Course resolutions: 2011 June 16, 2012 October 9, tacit ratifications from 2013 to 2014, 2015 October 22, 2017 December 7).

*2013-2021* Member of the Committee for the Lesson Timetables at the Department of Biology for the degree courses in Biology and Evolutionary Biology (Council of Department resolutions: 2013 October 29, 2014 November 12, 2015 October 27, 2016 October 25, 2017 December 18)

<https://www.biologia.unipd.it/dipartimento/commissioni-dipartimentali-e-interdipartimentali/commissione-per-gli-orari-delle-lezioni/>

Since 2019

Member of the Ph.D. College of Biosciences (Department of Biology).

Since 2022

Member of the Internship and Graduation Committee of the degree course in Natural and Environmental Sciences (Council of the Degree Course resolution: 2021 October 14).

## **EDUCATION, SCIENCE POPULARIZATION, PROMOTION OF TEACHING**

1987-1993

As a member of the Scientific Committee of "L'Età Verde" ("Green Age"), a bi-monthly cultural magazine of ecological information and current affairs in the framework of lifelong education (Rome), she has published four educational-informative articles:

- 1) **Cima F.**, 1987. Alla riscoperta degli animali estinti (The rediscovery of extinct animals). *L'Età Verde*, **3**: 18-19.
- 2) **Cima F.**, 1993. Il pericolo in un fiore. Spunti per una ricerca sui veleni della nostra flora. Prima parte: flora spontanea (The danger in a flower. Ideas for research on toxic substances in our flora. First part: the wild flora) *L'Età Verde*, **3**: 12-15.
- 3) **Cima F.**, 1993. Il pericolo in un fiore. Seconda parte: flora ornamentale (The danger in a flower. Second part: the ornamental flora). *L'Età Verde*, **5**: 6-11.
- 4) **Cima F.**, 1993. Il "mare sporco" (The 'dirty sea'). *L'Età Verde*, **6**: 8-12.

## **PARTICIPATION IN EDITORIAL BOARDS OF SCIENTIFIC JOURNALS**

EDITORIAL BOARD  
MEMBER

*International  
journals with IF*

**2004-2009:** Editorial Board member of '*Applied Organometallic Chemistry*' [ISSN: 0268-2605]  
(<https://onlinelibrary.wiley.com/journal/10990739>).

**Since 2018:** Editorial Board member of '*European Journal of Histochemistry*' [ISSN: 1121-760X]  
(<https://www.ejh.it/index.php/ejh>).

**Since 2020:** Editorial Board member of '*Journal of Marine Science and Engineering*' [ISSN: 2077-1312]  
(<https://www.mdpi.com/journal/jmse>).

## PEER REVIEWS

1. Acta Histochemica
2. Applied Organometallic Chemistry
3. Biochimie
4. Cell and Tissue Research
5. Comparative Biochemistry and Physiology – part C
6. Developmental and Comparative Immunology
7. Ecotoxicology and Environmental Safety
8. Environmental Pollution
9. Estuarine and Shelf Coastal Research
10. Invertebrate Survival Journal
11. Marine Biology
12. Marine Ecology Progress Series
13. Marine Environmental Research
14. Micron
15. Nitric Oxide
16. Plankton and Benthos Research
17. Proceedings of the Royal Society of London
18. Science of Total Environment
19. Tissue and Cell
20. Water Research
21. Zoological Studies
22. Journal of the Marine Biological Association of the UK
23. Journal of Marine Science and Engineering

## MEMBERSHIP IN SCIENTIFIC SOCIETIES/CONSORTIA

<i>Since 1992</i>	<i>Unione Zoologica Italiana (U.Z.I.).</i>
<i>Since 1993</i>	<i>Associazione Italiana Naturalisti (A.I.N.).</i>
<i>Since 1996</i>	<i>Società Italiana di Immunobiologia Comparata e dello Sviluppo (S.I.I.C.S.).</i>
<i>Since 1997</i>	<i>Società di Scienze Naturali del Trentino.</i>
<i>1998-2001</i>	<i>New York Academy of Sciences (N.Y.A.S.).</i>
<i>Since 2007</i>	<i>Society for Histochemistry.</i>
<i>Since 2011</i>	<i>Gruppo Embriologico Italiano (G.E.I.).</i>
<i>Since 2015</i>	<i>Società Italiana di Istochimica (S.I.I.).</i>
<i>Since 2016</i>	<i>Consorzio Nazionale Interuniversitario per le Scienze del Mare (C.O.N.I.S.M.A.).</i>

## MEMBER OF SCIENTIFIC COMMITTEES OF SOCIETIES

<i>1987-1993</i>	Member of the Scientific Committee of 'L'Età Verde' ('Green Age'), a bi-monthly cultural magazine of ecological information and current affairs in the framework of lifelong education (Rome).
<i>1995-1998</i>	Member of the National Technical-Scientific Committee of the

2018-2021

'Associazione per la Salvaguardia, la Tutela e l'Educazione Ambientali' (A.S.T.E.A., Association for Preservation, Protection and Environmental Education).

Member of the Board of Directors of the Società Italiana di Istochimica (S.I.I., Italian Society for Histochemistry).

## ORGANIZATION OF CONFERENCES AND LECTURES

### Conferences

2007

Member of the Organizing Committee of the International Meeting "*Fifty years of Botryllus schlosseri as a model organism in biology: results and perspectives*", Padova 2007, June 29;

2011

Member of the Organizing Committee of the XII Meeting of the *Società Italiana di Immunobiologia Comparata e dello Sviluppo* (S.I.I.C.S.), Monteortone (Padova) 2011, February 16-18;

2011

Member of the Organizing Committee of the LVII Meeting of Gruppo Embriologico Italiano (G.E.I.), Monteortone (Padova) 2011 June 5-8.

### Lectures

2006, January 18

She organized the lecture titled *On the tracks of the fossil tetrapods of the Dolomites* (Lecturer: Dr. M. Avanzini, Museo Tridentino di Scienze Naturali, Trento – Division of Geology) within the Biological Seminar (Department of Biology);

2007, January 18

She organized the lecture titled *The transition from fins to limbs* (Lecturer: Dr. P. Sordino, Stazione Zoologica 'A. Dohrn', Naples) within the Biological Seminar (Department of Biology);

2008, January 17

She organized the lecture titled *Italian dinosaurs: from Scipionyx to 'Saltriosaurus'* (Lecturer: Dr. C. Dal Sasso, Museo di Storia Naturale, Milan – Division of Vertebrate Paleontology) within the Biological Seminar (Department of Biology).

## SUPERVISOR OF DEGREE THESES

Degree theses

Beginning from 1991, Francesca Cima provided various thesis themes and led undergraduate students into scientific research. She was, and still is, supervisor/co-supervisor of numerous degree theses in

Biological Sciences, Natural Sciences, Natural and Environmental Sciences, Biology, Environmental Science and Technology (STAM), Marine Biology, Evolutionary Biology, Environmental Sustainability and Education, Chemistry and Pharmaceutical Technology.

### **SUPERVISOR OF PhD THESES**

*PhD theses*

Beginning from 2019, Francesca Cima was supervisor of the following theses of the PhD course 'Bioscience':

- XXXV cycle (a.y. 2019/2020), Curriculum 'Cell Biology and Physiology' Varello Roberta. Evaluation of effects of new antifouling systems, alternative to organotin compounds, on benthic marine invertebrates at ecosystem, organismal and cellular level. (Financial Grant by RESIMIX s.r.l., Brendola, Italy)

May 2024