

Luigi Vezzulli

Full professor

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Education and training

Associate Professor

University of Genoa

Academic experience

Associate Professor

University of Genoa

Work experience

Associate Professor

University of Genoa

Teaching activity

- **2017/2018:** lecturer for teaching the course “**Environmental Microbiology (5 CFU)**”, Degree in Environmental Sciences, University of Genoa.
- **2017/2018:** lecturer for teaching the course “**Environmental Microbiology (6 CFU)**”, Degree in Biological Sciences, University of Genoa.
- **2016/2017:** lecturer for teaching the course “**Environmental Microbiology (5 CFU)**”, Degree in Environmental Sciences, University of Genoa.
- **2016/2017:** lecturer for teaching the course “**Environmental Microbiology (6 CFU)**”, Degree in Biological Sciences, University of Genoa.
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- **2010/2011:** lecturer for teaching the course “**Environmental Microbiology (5 CFU)**”, Degree in Environmental Sciences, University of Genoa.
- **2010/2011:** lecturer for teaching the course “**Environmental Microbiology (6 CFU)**”, Degree in Biological Sciences, University of Genoa.
- **2009/2010:** lecturer for teaching the course “**Environmental Microbiology (4 CFU)**”, Degree in Environmental Sciences, University of Genoa.
- **2009/2010:** lecturer for teaching the course “**Environmental Microbiology (2 CFU)**”, Degree in Biological Sciences, University of Genoa.
- **2009/2010:** lecturer for teaching the course “**Applied Microbiology (3 CFU)**”, Degree in Biological Sciences, University of Genoa.
- **2008/2009:** lecturer for teaching the course “**Environmental Microbiology (4 CFU)**”, Degree in Environmental Sciences, University of Genoa.
- **2008/2009:** lecturer for teaching the course “**Environmental Microbiology (2 CFU)**”, Degree in Biological Sciences, University of Genoa.
- **2007/2008:** lecturer for teaching the course “**Environmental Microbiology (4 CFU)**”, Degree in Environmental Sciences, University of Genoa.
- **2007/2008:** lecturer for teaching the course “**Environmental Microbiology (2 CFU)**”, Degree in Biological Sciences, University of Genoa.
- **2006/2007:** lecturer for teaching the course “**Environmental Microbiology (4 CFU)**”, Degree in Environmental Sciences, University of Genoa.
- **2006/2007:** lecturer for teaching the course “**Environmental**

Microbiology (2 CFU)", Degree in Biological Sciences, University of Genoa.

Postgraduate research and teaching activity

Supervision of PhD students, residents and post-doctoral fellows

Tutorship of graduate and doctorate thesis

Since 2001 Luigi Vezzulli has been tutor/advisor for **32** graduate thesis and **5** PhD thesis in Environmental Sciences and Biological Sciences at the University of Genoa and other Italian Universities

Tutorship of visiting research fellowships funded by foreign Universities

- **2012 (June to August):** Esther Rubio Portillo (PhD student at University of Alicante Spain) – Project: study of *Vibrio* spp. populations in *Oculina patagonica* and in *Cladocora caespitosa* in the Western Mediterranean Sea.
- **Sep 2018- Sep 2020:** Dr. Aide Lasa (Postdoc student at the University of Santiago de Compostela, Spain) – Project: Investigating polymicrobial infection diseases in shellfish: metagenetic analysis of the “microbiome” and “vibriome” in contrasting bivalve species (*Crassostrea gigas* and *Mytilus galloprovincialis*) differently affected by abnormal mortality episodes in Europe

PhD committees membership

- **2008:** Scientific board member: doctorate degree course in “GENETICA ONCOLOGICA E BIOLOGIA DEL DIFFERENZIAMENTO”, [DOT0511141], University of Genoa
- **2009/2012:** Scientific board member: doctorate degree course in “GENETICA”, [DOT0911723], University of Genoa
- **2013/-:** Scientific board member: doctorate degree course in “SCIENZE E TECNOLOGIE PER L'AMBIENTE E IL TERRITORIO (STAT) [DOT1311038], University of Genoa

Research interests

The research activity of Luigi Vezzulli is mainly focused on the study of the biology and ecology of pathogenic bacteria belonging to the genus *Vibrio*. Research conducted in this field explored the mechanisms of persistence and survival strategies of *Vibrio* bacteria in the aquatic environment. Studies have shown that zooplankton and other aquatic organisms represent important environmental reservoirs and/or hosts of *V. cholerae* and other *Vibrio* species. In particular, research on molecular determinants

that are responsible for *V. cholerae* interaction with environmental substrates highlighted the role of outer membrane proteins in mediating *V. cholerae* adhesion to chitin containing substrates. Special attention was given to N-acetyl glucosamine-binding protein A (GbpA) of *V. cholerae* which is involved in colonization of both human intestinal cells and environmental chitin surfaces via the same binding specificity. The *gbpA* gene is located in a non mobile region of chromosome II and was found ubiquitously in *V. cholerae*. The gene is also present in *V. vulnificus* and *V. parahaemolyticus* with conserved and species specific hypervariable regions. These properties make *gbpA* a good phylogenetic marker for human pathogenic *Vibrio* species and allowed the development of new molecular protocols for detection and quantification of *V. cholerae* in complex environmental matrices (including historical formalin-fixed environmental samples). Studies on GbpA showed that this ligand plays an important role in *V. cholerae* interaction with its main environmental reservoirs in coastal water (e.g. copepods). Moreover, due to the upregulation exerted by temperature on its expression, GbpA is likely to contribute to the enhanced *V. cholerae* colonization capability of zooplankton organisms at high environmental temperature, thus partially explaining the role of ocean warming in promoting the spread of these bacteria in the aquatic environment. Ongoing research in this field is devoted to study possible use of GbpA as a component of vaccine against *V. cholerae* in collaboration with the University of Maryland (USA) and the Centre of Biotechnology of the University of Maputo (Mozambique).

In the field of non-human diseases research activity was devoted to study *Vibrio* species that cause diseases in marine animals (e.g. corals and bivalves). Studies were conducted to assess the role of thermodependant *Vibrio* pathogens in mass mortality events of benthic invertebrates in the NW Mediterranean Sea which are related to sea surface temperature anomalies registered during the recent years. Such studies resulted in the identification of the TAV24 *Vibrio* strain, later identified as *V. coralliilyticus*, which was demonstrated to trigger mass mortality events of the purple gorgonian *Paramuricea clavata*, a key structuring species of the coralligenous assemblages in the NW Mediterranean Sea. Ongoing activity in this field is carried out in collaboration with the Australian Institute of Marine Sciences (AIMS) aimed at the genotypic and phenotypic characterization of the TAV24 strain and the assessment of involved virulence factors using transposon and site-specific mutagenesis. In the field of bivalve diseases ongoing activity in collaboration with IFREMER (France) and other European Institutes (in the frame of European projects FP7-BIVALIFE and Horizon 2020-VIVALDI) is focused on the study of the biology and ecology of *Vibrio splendidus* and *Vibrio aestuarianus* which are involved in abnormal mortality events of the Pacific oyster *Crassostrea gigas* in the Atlantic ocean. Particular focus was given to the study of *V. aestuarianus* and *V. splendidus* interaction with bivalve hemocytes and other bivalve defense mechanisms. Major findings in this field resulted in the identification of a mussel serum opsonin (matching the protein precursor of *Mytilus edulis* extrapallial protein -EP) directed towards D-

mannose binding bacterial ligands that were shown to mediate *V. aestuarianus* 01/032 interactions with *M. galloprovincialis* haemocytes. In the presence of *M. galloprovincialis* EP protein (MgEP), *C. gigas* haemocytes killed *V. aestuarianus* 01/032 almost as efficiently as mussel phagocytes. These findings suggest that the different sensitivity of 01/032 strain to the antibacterial activity of oyster and mussel haemolymph might partly depend on the fact that *C. gigas* serum lacks MgEP-like opsonins.

In the field of *Vibrio* ecology research was also conducted to study the effects of ocean warming on natural *Vibrio* populations through the development of a novel approach which is based on the molecular analysis of formalin-fixed samples from the historical Continuous Plankton Recorder (CPR) archive. The CPR archive, which is based at the Sir Alister Hardy Foundation for Ocean Science (SAHFOS) in Plymouth (UK), is one of the longest and most geographically extensive collection of marine plankton samples in the world. For the first time prokaryotic DNA was recovered from CPR samples that had been stored for up to ~50 years in a formalin-fixed format. Protocols were developed for the application of microbiological molecular techniques (e.g. PCR-based and Next Generation Sequencing techniques) on archived CPR samples. Using such protocols we were able to demonstrate that there was an increase in the numbers of vibrios over the past half century, probably a two or threefold increase, correlated with the increase in climate temperature, and then correlated with outbreaks of vibrio infections that have been recorded in the medical records. These findings provide support for the view that global warming is having a strong impact on the composition of marine prokaryotic communities with potential important implications for human and animal health.

Grants

2002 - ONGOING

Progetti di ricerca

Participant

Principal Investigator of National Research Projects

- **2006** ATENEO DI GENOVA (*Principal investigator*): 'Mechanism of horizontal gene transfer of *Vibrio* spp in mussels' funded by the University of Genoa (euro 8,077) (2006).
- **2011** ATENEO DI GENOVA (*Principal investigator*): 'Climate and infectious disease: effects of ocean warming on the global ecology and biogeography of *Vibrio* pathogens' funded by 'University of Genoa' Principal investigator: Luigi Vezzulli (euro 7,011).

Principal Investigator of European Research Projects

- **2013-2017** SEVENTH FRAMEWORK PROGRAMME (*Coordinator of research unit*): 'Protecting the health of Europeans by improving methods for the detection of pathogens in drinking water and water

used in food preparation (AQUAVALENS)' funded by 'European FP7 topic-KBBE-2012-6', Principal investigator: Paul Hunter (University of East Anglia, England), coordinator of the research unit of Univ. Genoa since 2015 onward: Luigi Vezzulli (euro 250,511).

- **2018-2022 HORIZON 2020 (Coordinator of research unit):** 'Controlling Microbiomes Circulations For Better Food Systems (CIRCLES)' funded by 'European Horizon 2020 Call: H2020-SFS-2018-2020, Principal investigator: Marco Candela (Univ. Bologna, Italy), coordinator of the research unit: Luigi Vezzulli (euro 100,000).

Principal Investigator of other International Research Projects

- **2012-2014 ITALIAN MINISTRY OF FOREIGN AFFAIRS (Principal investigator):** 'The mesophotic zone: Conservation tool and new drugs frontier' funded by the Italian Ministry of Foreign Affairs within the the Joint Italian-Israeli R&D programme (euro 20,000).
- **2014-2015 ROYAL SOCIETY (UK) (Co-Principal investigator):** 'Global Scale Macroecology of Human Vibrio pathogens (GLOBALVIBRIO)' funded by the Royal Society (UK) within the International Exchanges Scheme - 2013/R2 (GBP 12,000) (2014:2015).
- **2018 NATIONAL GEOGRAPHIC SOCIETY (USA) (Principal investigator):** 'Macroecology of *Vibrio cholerae* in Lake Tanganyika'. funded by 'National Geographic Society (USA)' (USD 30,000).

Assignments abroad

Honorary Fellow of the Sir Alister Hardy Foundation for Ocean Science (Marine Biological Association since April 2018), Plymouth, UK

Dr Luigi Vezzulli was elected as Honorary Fellow by the Sir Alister Hardy Foundation for Ocean Science at the 28th Council Meeting in April 2005. The award was given in recognition of his work with the Foundation on WinCPR, a gridded database of plankton abundance in the North Sea compiled from monthly sampling by the Continuous Plankton Recorder (CPR) Survey (WinCPR is freely available at <http://cpr.cscan.org/>). WinCPR has been used by researchers and research institutes worldwide and has a wide range of potential applications including marine ecology, microbial oceanography, marine management, mathematics, modelling and statistical analysis. Recently WinCPR have been employed by Vezzulli et al 2012 (ISMEJ, 6:21-30) and Vezzulli et al 2016 (Proc Natl Acad Sci USA 23;113(34):E5062-71) to investigate the relationship between *Vibrio* and plankton over a multidecadal scale showing that the genus *Vibrio*, including the human pathogen *V. cholerae*, has increased in prevalence in the last half a century in the coastal waters of the North Atlantic and North Sea and that this increase is correlated significantly, during the same period, with warming sea surface temperature.