

# FRANCISCO BRAVO

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Coastal ecologist & ecosystem modeller

Marine Biologist  
Oceanography PhD



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## Summary

Francisco's professional and research interest are focused on the management, monitoring, and modelling of coastal processes, including natural and socio-economic dimensions. He aims to contribute from marine sciences, and the integration with other disciplines, to the understanding of the interactions between human beings and the environment in coastal areas, and how this knowledge can help to ensure the sustainable use of coastal resources for the benefit of future generations.

He has worked actively in consulting and research projects in areas such as innovation and entrepreneurship in small scale fisheries, evaluation of environmental interactions of industrial activities, modelling of socioecological systems and ecosystem services in coastal areas, among others.

The collaboration and passion for his work are central aspects of his career.

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## Research interests

- i. Coastal and estuarine biogeochemistry
- ii. Aquaculture-environment interactions
- iii. Modelling and quantification of coastal ecosystem services
- iv. Benthic ecology and sediment biogeochemistry

## Education

- i. 2011 – 2016. PhD in Oceanography. Dalhousie University, Canada.
- ii. 2008-2009. Environmental Management Graduate Diploma. Universidad Arturo Prat. Valdivia, Chile.
- iii. 2007. Marine Biologist. Universidad Austral de Chile. Valdivia., Chile.

## Publications

- i. **Bravo F**, Sidhu S, Bernal P, Bustamante R, Condie S, Gorton B, Herzfeld M, Jimenez D, Mardones F, Steven A. Hydrodynamic connectivity, water temperature, and salinity are major drivers of *Piscirickettsia salmonis* dispersion and transmission among salmon farms in Chile. *Aquaculture Environment Interactions* 12:263-279. <https://doi.org/10.3354/aei00368>
- ii. **Bravo F**, Grant J (2020) Benthic habitat mapping and sediment nutrient fluxes in a shallow coastal environment in Nova Scotia, Canada. *Estuar Coast Shelf Sci*:106816. <https://doi.org/10.1016/j.ecss.2020.106816>.

- iii. Steven AD, Aryal S, Bernal P, **Bravo F**, Bustamante RH, Condie S, Dambacher JM, Dowideit S, Fulton EA, Gorton R, others. 2019. *SIMA Austral: An operational information system for managing the Chilean aquaculture industry with international application*. Journal of Operational Oceanography.1–18. <https://doi.org/10.1080/1755876X.2019.1636606>
- iv. **Bravo, F.**, and Grant J. *Modelling sediment assimilative capacity and organic carbon degradation efficiency at marine fish farms*. Aquaculture Environment Interactions. DOI: <https://doi.org/10.3354/aei00267>
- v. **Bravo F.** *Playing with Mud. Investigating the ecological value of coastal sediments*. Current Tides, Volume 3, 2017. Dalhousie Oceanography Research Magazine. <http://currenttides.ocean.dal.ca/>
- vi. **Bravo, F.**, and Grant J. *Predicting sediment assimilative capacity of organic wastes at marine fish farms: implications for environmental management*. Bull. Aquacul. Assoc. Canada 2016-2, 1-5.
- vii. Woelfl, S., Mages, M., Encina, F., & **Bravo, F.** (2006). *Trace metals in microcrustaceans and Brazilian waterweed from a contaminated Chilean wetland using total reflection X-ray fluorescence spectrometry*. Microchimica Acta, 154(3-4), 261-268.
- viii. Schrödl, M., Alarcón, M. A., Bedriñana, L. R., **Bravo, F. J.**, Bustamante, C. M., Carvalho, R., ... & Salmen, A. (2005). *Nudipleura (Gastropoda: Opisthobranchia) from the southern Chilean Comau Fjord, with redescription of Polycera priva Marcus, 1959*. Vita Malacologica, 3, 23-33.

## Other publications

- i. **Bravo, F.**, Duarte, G., Bieler, R. & Schrödl, M. 2005. *Plocamopherus from Chile*. [Message in] Sea Slug Forum. Australian Museum, Sydney. Available from <http://www.seaslugforum.net/find/14695>
- ii. Fecci, E., Ilabel G., Ríos W., Klett B., Gonzalez G., **Bravo, F.** *Metodología de emprendizaje en programa complementario de emprendimiento. Aprender a emprender*. Memorias XXI Congreso Latinoamericano sobre Espíritu Empresarial. ISBN: 978-958-8357-45-4. 2015.
- iii. **Bravo, F.** 2006. *Sediment biogeochemistry to Reloncaví fjord and estuary, X region, Chile*. Undergraduate thesis. Marine Biology. Universidad Austral de Chile.
- iv. Rovira et al. 2008. *Estudio de Prospectiva Regional 2008-2018. Región de Los Ríos, Chile*. Technical Report · October 2008.

## Scholarships and awards

- i. Non-cash reward for exceptional performance. CSIRO Chile Foundation. May 2019.
- ii. Best poster presentation. IMBER conference 2017. Woods Hole Oceanographic Institution, US.
- iii. Best poster presentation. AMEMR (Advances in Marine Ecosystem Modelling Research) Conference 2017. Plymouth, UK. July 2017.
- iv. Aquaculture Association of Canada. Travel award to attend AAC 2016 (September 2016).
- v. European Space Agency scholarship to attend IMBIZO IV meeting (October 2015).
- vi. Scholarship holder of BECASCHILE 2009 for doctoral studies.
- vii. Exchange scholarship – POME (Prediction and Observation of the Marine Environment) exchange program 2014. Dalhousie University - University of Bergen. 2014.
- viii. Sea Experience scholarships to participate in Bermuda Atlantic Time-series Study (BATS). Dalhousie-BIOS Experiential Learning Fund. 2015.

## Academic internships

- i. Commonwealth Scientific and Industrial Research Organization (CSIRO). 2019. Ocean and Atmosphere Division. Receiving researcher: Dr. Beth Fulton. Area of collaboration: Risk analysis in aquaculture and whole-of-system model.
- ii. Geophysical Institute, University of Bergen, Norway. November-December 2014. Receiving researcher:

Dr. Corinna Schrum. Area of collaboration: Training in the coupled physical-biogeochemical model ECOSystem Model (ECOSMO).

## Teaching

- i. Teaching assistant. BIOL 4160. Political Ecology. Biology Department. Dalhousie University. September-December 2015.

## Projects and professional experience

*Research Coordinator. Pollutant characterization and designing of a monitoring network for Quintero Bay, Chile. Ministry of the Environment - Undersecretary of the Environment. 2020-2021*

*Principal Investigator. Environmental and farm practices at mussel farms in Los Lagos region, Chile. Identification of optimization opportunities. Industry funds. 2020-2022.*

*Principal Investigator. Regional Strategies of Development and public digital transformation: Development of supporting tools for assessment of future climate change scenarios in the Chilean Patagonia. The Science & Technology Development Fund (FONDEF). 2020-2022. <https://research.csiro.au/modelo-sistemas-patagonia/csiro/>*

*Researcher. Hyper-spectral digital fingerprint of red tide species through the coupling of remote and in situ bio-optical signals in Southern Chile. The Science & Technology Development Fund (FONDEF). 2019-2020.*

*Co-Investigator. "Environmental dynamics of of *Piscirickettsia salmonis*". National Fisheries and Aquaculture Service (SERNAPESCA) and The Salmon Technological Institute (INTESAL). 2019.*

*Co-Investigator. Consultancy for high resolution hydrodynamic model in Macrozone 5 within EPIVET project "Integrated Epidemiology for the early detection, diagnosis and control of *Piscirickettsia salmonis* and parasitism by *Caligus rogercresseyi* that affect Atlantic salmon in Chile. EPIVET Chile. 2019.*

*Co-Investigator. SIMA Austral, the FIE V008 -Integrated Ecosystem-based Sanitary and Environmental Management System for the Aquaculture of Chile. 2017-2019.*

*Graduate thesis. NSERC-Cooke Industrial Research Chair in Sustainable Aquaculture. Dalhousie University. 2014-2017.*

*Co-author and co-executant. Technology diffusion program "Develop of technical competences to integrate the chain value of sea products from artisanal fisheries of Los Ríos region, Chile" (fix term contract). Fundación Chiquihue. Co-financed by InnovaChile of CORFO. February 2011.*

*Alternate director. Project "New management systems, technologies and international market requirements associated to benthic resources coming from Management and Exploitation Areas for Benthic Resources (AMERB, in Spanish), in China and Japan". Fundación Chiquihue. Co-financed by InnovaChile of CORFO. November 2009.*

*Executive. Technological transfer Node project in fisheries and aquaculture in Los Ríos Region, Chile (fix term contract). Science and technology Institute of Arturo Prat University. Co-financed by InnovaChile of CORFO. March, 2009 to March 2010.*

*Co-Investigator. Evaluation of sea bottom conditions associated to geographic areas used by salmon farming in Aysen Fjord, Aysén Region. Litoral Austral Consultant –Universidad Austral de Chile. 2009.*

*Co-Investigator. Chemotherapeutics in salmon farming. Effects on the structure and biogeochemical properties on benthic communities to Valdivia river, Southern Chile. Universidad Austral de Chile grant. 2008-2009.*

*Work team. Regional consultancy responsible for the preparation of the Regional Agenda of Productive Development and of Plans of improvement of the competitiveness in Los Ríos Region, Chile. Universidad Austral de Chile. September-November 2008.*

*Work team. Fisheries baseline study in Los Ríos Region. In the frame of activities developed in the project*

“Regional prospective study of development 2008 – 2018, Los Ríos Region”, Universidad Austral de Chile. July-September 2008.

*Thesist. Sediment Profile imagery of coastal marine sediments and its temporal biogeochemical signature.* (FONDECYT Grant). 2005-2007. Universidad Austral de Chile.

*Principal Investigator. Revision of coastal marine invertebrates of Juan Fernandez Islands.* Chile. Universidad Austral de Chile Grant (Marine Biology School). 2005.

## Certificate courses and specialization

*IMBER ClimEco5 Summer School.* 2016. University of Rio Grande do Norte, Natal, Brazil

*Use of Remote Sensing and Geographical Information Systems for Studying Marine Biogeochemical Cycles and Ecosystems.* Austral Summer Institute X (ASI X). January, 2010. Responsible academic: PhD. Ajit Subramanian. Lamont Doherty Earth Observatory at Columbia University, USA. Universidad de Concepción. Concepción, Chile.

*Persistent Organic Pollutant in marine environments (POPs).* Second advanced course in marine pollution. September 2008. Organized by Chilean National Oceanographic Committee (CONA). Universidad de Concepción. Concepción, Chile.

*Sediment biogeochemistry: From the coast to the abyss.* Austral Summer Institute VIII (ASI VIII). December 2007. Responsible academic: PhD. Per Hall, Göteborg University, Sweden. Universidad de Concepción. Concepción, Chile.

*Harmful Algal Blooms (HAB) and ficotoxins.* January, 2007. MECESUP USC 0303 program. Responsible academic: Nelson Silva S., Universidad Católica de Valparaíso. Valparaiso, Chile.

*Experimental design and advanced biostatistics.* September 2005. Responsible academic: PhD. Roberto Nespolo R., Universidad Austral de Chile. Valdivia, Chile.

*Aquatic contamination.* Zoology Institute. Universidad Austral de Chile. March to June, 2004. Responsible academic: PhD. Steffen Woelfl, Universidad Austral de Chile. Valdivia, Chile.

*Systematic and ecology of opisthobranch gastropods from Chile.* MECESUP AUS 0101 program, Zoology Institute to Universidad Austral de Chile. Responsible Academic: PhD. Michael Schroedl, Zoological State Collection Munich. March and April 2004. Valdivia, Chile.

*Autonomous and semi autonomous diver license.* Dirección General de Territorio Marítimo y Marina Mercante, Armada de Chile. 2003-2004. Valdivia, Chile.

*Osmoregulation and stress in teleostean fishes.* June of 2004. MECESUP AUS 0101 program. Embriology Institute to Universidad Austral de Chile and Universidad de Cadiz. Valdivia, Chile.

*Marine necton.* August to December of 2003. Zoology Institute. Universidad Austral de Chile. Responsible academic: PhD. German Pequeño, Universidad Austral de Chile. Valdivia, Chile.

## Conference presentations (2013 onward)

“*Explorando la biodiversidad bentónica de los principales grupos de macroinvertebrados en la ecorregión de fiordos y canales chilenos: prospección preliminar a partir de datos de GBIF*”. Leslie Novoa, Araceli Villegas, Francisco Bravo, María Paz Acuña Ruz, Cristian Aldea. XL Congreso de Ciencias del Mar. Punta Arenas. May 2021.

“*Conectividad hidrodinámica, temperatura y salinidad del mar como principales impulsores de la transmisión de piscirickettsia salmonis entre centros de cultivo de salmón en Chile*”. Francisco Bravo, Jatinder Sidhu, Patricio Bernal, Rodrigo Bustamante, Scott Condie, Bec Gorton, Mike Herzfeld, Fernando Mardones, Farham Rizwi, Andy Steven, Daniel Jimenez. Congreso de Ciencias del Mar. Punta Arenas. May 2021.

“*Risk of waterborne transmission of SRS among fish farm sites in Los Lagos region*”. EPIAQUA workshop. Puerto Varas, Chile June 2019.

“*Support tools for coastal resource management: Explicit assessment of animal health, production and environmental risk for salmon farming*”. Congreso de Ciencias del Mar 2018. Valdivia, Chile, May 14-18

- “Estimation of carrying capacity in aquaculture sites based on benthic indicators”*. Congreso de Ciencias del Mar 2018. Valdivia, Chile, May 14-18.
- “System perspective on Management of coastal resources in Magallanes”*. Public Seminar at Universidad de Concepción. December 2018.
- “How much is too much?, Predicting sediment assimilative capacity of organic wastes at marine fish farms”*. AMEMR (Advances in Marine Ecosystem Modelling Research) Conference 2017. Plymouth, UK. July 2017.
- “Environmental carrying capacity at marine fish-farm sites: model predictions and uncertainty in management systems.”* IMBIZO 5: Marine biosphere research for a sustainable ocean: Linking ecosystems, future states, and resource management. October 2017. Woods Hole Oceanographic Institution, Woods Hole, MA, USA.
- “Simulation of C and N cycling in shallow coastal sediments: implications for coastal management and provision of ecosystem services”*. 7th biennial benthic workshop. St Andrews, New Brunswick, Canada. October 2016
- “Modelling sediments assimilative capacity of organic wastes in sediments underlying marine fish farm sites”*. Aquaculture Canada & Cold Harvest 2016. St. John's, Newfoundland, Canada. September 2016.
- “Environmental Interactions of Marine Finfish Aquaculture model predictions and uncertainty in management systems”*. IMBIZO 5. 2-5 October 2017, Woods Hole, USA
- “Environmental carrying capacity at marine fish-farm sites: model predictions and uncertainty in management systems”*. IMBER ClimEco5 Summer School. Natal, Brazil. August 2016.
- “The integration of habitat into management models of aquaculture ecosystems”*. 2016. Grant J. Barrel J, Bravo F, McKee A. <https://www.was.org/meetings/ShowAbstract.aspx?Id=42431>
- “Spatially-explicit simulation of sediment biogeochemical cycles in coastal environments, from habitat to bay scale”*. IMBIZO IV, Trieste, Italy. Marine and human systems: Addressing multiple scales and multiple stressors. October 2015.
- “Assimilative capacity and ecosystem services in marine fish farming”*. Aquaculture Europe 2015. Rotterdam, Netherlands.
- “Remote sensing approaches for monitoring marine landscapes and assessing aquaculture environment interaction”*. Aquaculture Canada 2015. Aquaculture Canada 2015
- “Multi-scale assessment and simulation of benthic C, O<sub>2</sub> and nutrient fluxes in shallow coastal environments”*. CDOGS 2014, Conference of Dalhousie Oceanography Graduate Students. University Hall, Dalhousie University, Halifax, Nova Scotia, Canada. March 20, 2015.
- “Contribution of sediment biocomplexity to benthic nutrient and oxygen fluxes in coastal sediments: field observations and computer simulation”*. Aquaculture Canada 2014, St. Andrews, NB, June 1-4, 2014.
- “Prediction of sediment sulfide from diagenetic modelling: preliminary results”*. Aquaculture Canada 2014, St. Andrews, NB, June 1-4, 2014.
- “Contribution of sediment biocomplexity to C and N recycling efficiency in coastal sedimentary environments: field observations and computer simulation”*. C-DOGS 2014, Conference of Dalhousie Oceanography Graduate Students. University Hall, Dalhousie University, Halifax, Nova Scotia, Canada. March 22, 2013.
- “C and N recycling efficiency in coastal sedimentary environments, contribution of habitat diversity and biological interactions”*. Joint Topical Workshop. Carbon cycling in Shelf-Seas with focus on the North-Sea. Bergen University, Norway. September 10 – 12, 2013.
- “Contribution of habitat-specificity to carbon and nitrogen recycling efficiency in coastal sedimentary environments”*. ACCESS 2013. Centre for Geographic Sciences, Nova Scotia Community College, Lawrencetown, NS, Canada. 9-11 May 2013.

## Scientific outreach activities

- i. Australian Alumni Week 2021. Construindo a indústria do future. Building the Industry of the Future Brazil-Australia Scientific and Technological Collaboration. June 2020

- ii. Member of the evaluating committee of high school research projects in Regional School Congress of Science and Technology EXPLORA CONICYT in 2009 and 2010.
- iii. Volunteer monitor EXPLORA-CONICYT initiative “Abramos nuestro laboratorio a la investigación científica escolar” (Open our labs to the high school scientific research), Geobenthos Laboratory, Institute of Geosciences, Universidad Austral de Chile. 2006.

## Laboratory and field skills & techniques

### *Languages:*

- English, TOEFL IBT, 91 of 120 (February 05, 2011).
- Spanish native speaker

### *Scientific software:*

- Computer clusters, Matlab, R, ArcGIS/QGIS, LaTeX, statistical software (e.g. SigmaPlot, Statistica, Surfer 8, ImageJ).

### *Main analytical and lab techniques:*

- Membrane inlet mass spectrometry applied to dissolved gases analysis
- UV Spectrophotometry,
- Nutrient hydrochemistry,
- Preparation of biological samples for trace metal analysis,
- Sedimentological analysis.

### *Main field and sampling skills:*

- Certified SCUBA diver by National Army of Chile.
- HAPS and multicorer sampling and manipulation, CTD and PT measurement and interpretation, among others.

## References

DR. JON GRANT. Professor, Department of Oceanography, Dalhousie University.

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