

COMMUNICATIONS

Computer programs, Master thesis and PhD dissertation

Computer programs

MetaMorphos 1.8: A unique tool for understanding the body plans of metazoans, including holothuroids

Igor Eeckhaut and Nathan Puozzo

Biologie des Organismes Marins et Biomimétisme; 6 Av. Champ de Mars; Université de Mons; 7000 Mons;

igor.eeckhaut@umons.ac.be

MetaMorphos 1.8 (from Metazoan Morphology) is a program that illustrates the body plans of metazoans by high quality 3D reconstructions. It is intended for those wishing to understand the invertebrate body architecture. Intended for use by naturalists, zoologists, students or professors in animal biology. The 1.8 version is the first released. It includes the body plan of invertebrates from eight phyla: an anthozoan (Cnidaria), a tentaculate (Ctenophora) a turbellarian (Plathelminthes), a polychaete (Annelida), a gastropod (Mollusca), a secernentea (Nematoda), a holothurian (Echinodermata) and an ascidian (Urochordata).

The invertebrates in MetaMorphos are presented through avatars. An avatar is a 3D reconstruction of a typical organization including the major features of a high-ranking taxon in the Linnaean hierarchy, usually a class. With MetaMorphos, the user can analyze the external morphology of the avatars and their systemic organization. The visualized organ systems are the digestive, excretory, nervous, reproductive, circulatory and the respiratory systems with some other unique systems observed in some taxa (e.g. the ambulacral system of echinoderms).

An organic system may be viewed alone or with other systems, inside a translucent representation of the animal body or without it. A mobile arrow-shaped cursor identifies the systemic organs. The avatar can be oriented in all dimensions of space thanks to two functions allowing rotation and displacement. A zoom function allows magnifying the analyzed body part. The two icons "snapshot" and "printscreen" take pictures of the avatars in jpg 300 dpi with a white or a colored background, respectively, allowing the user to insert any position of the avatar in, for example, a power point presentation. The Fig. 1 is a printscreen of the avatar "holothuroid" showing all the organs seen from the dorsal side (with the body translucent) and Fig. 2 is a snapshot of the digestive system, hemal system and the respiratory trees. The "histology" icon allows observing a layout of the histological tissues making the organ pointed by the cursor. Fig. 3 is the layout obtained when the cursor points a part of the hemal system. The two "larva" icons give views on a young and a late larvae from which an external or an internal view can be seen. In the case of the holothuroid, the auricularia (Fig. 4) and the pentactula (Fig. 5) are presented. Each taxon is described through a scientific text file that is illustrated by original drawings made by the excellent malgachian drawer Rakotomahefa Solofondraibe Jamieson Albert.

MetaMorphos 1.8 is available on PC, MacIntosh, Android devices and IOS devices. The program will be updated every two months by a new avatar, the ultimate goal being to illustrate the maximum number of phyla. A free demo-light version of the holothuroid is available on the stores.

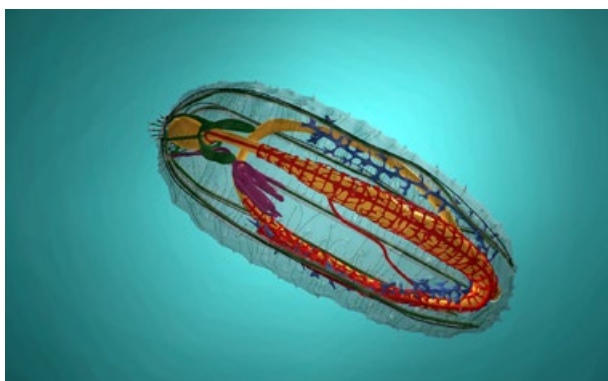


Figure 1. The avatar “holothuroid” showing all the organs seen from the dorsal side (body is translucent).

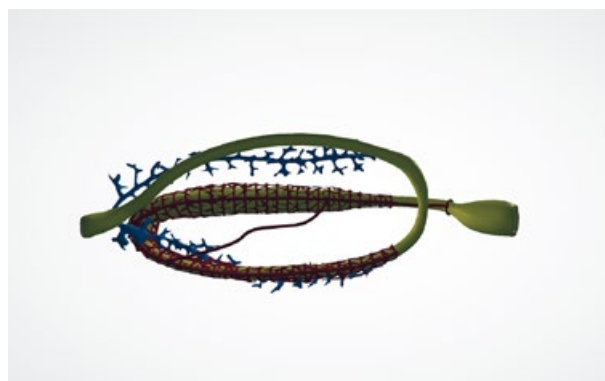


Figure 2. The digestive system, hemal system and respiratory trees of the avatar “holothuroid” (without the translucent body).

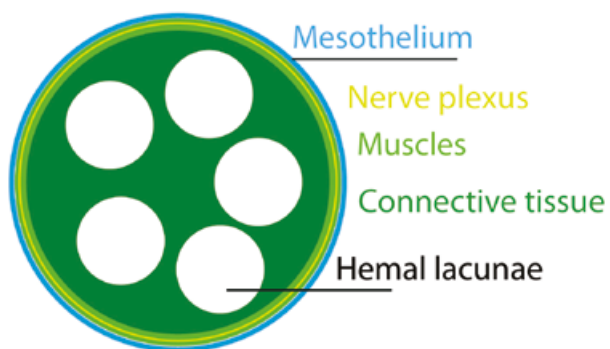


Figure 3. Layout obtained with the “histology” icon showing the histological tissues making the hemal system.

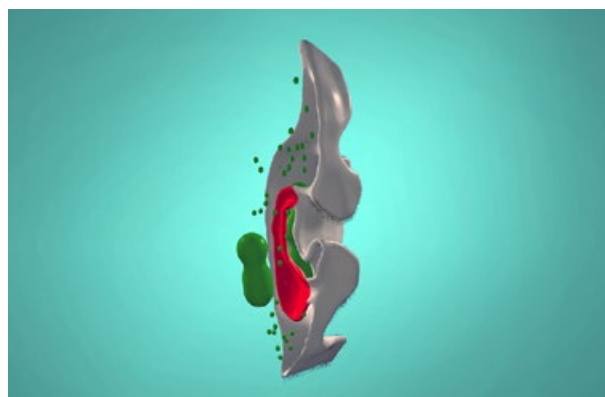


Figure 4. The auricularia larva with half part of the body showing the internal organs, especially the disposition of the coelomic cavities.

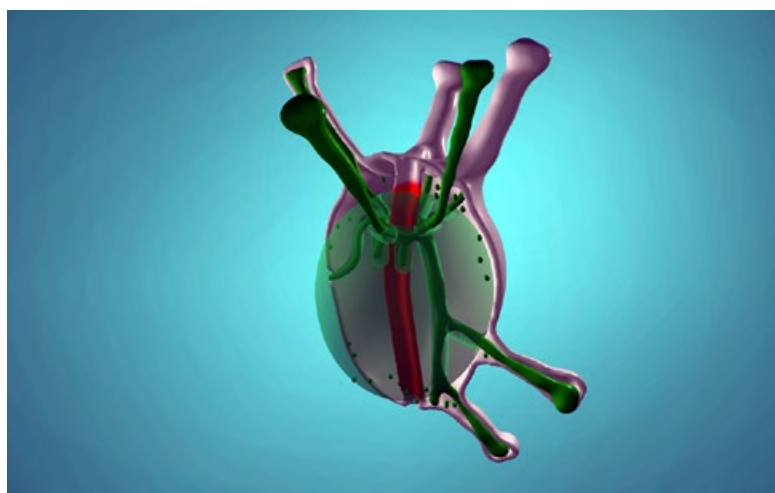


Figure 5. The pentactula larva with half of the body showing the internal organs, especially the disposition of the coelomic cavities.

Master's thesis

Master's thesis, University of Algarve, Centre of Marine Sciences (CCMAR)

Filipe Freitas Henriques: Genetic connectivity patterns in *Holothuria mammata* considering different spatial scales. 84 p. project CUMFISH.

filohippos@gmail.com

PhD dissertation

Demeuldre M. 2015. Defence mechanisms in sea cucumbers: Morphology, biochemistry and mechanics of Cuvierian tubules in two species from the genus *Holothuria*. Laboratory of Marine Organisms and Biomimetics. UMONS (Belgium). Melanie.Demeuldre@umons.ac.be

2015 Meetings

15th International Echinoderm Conference, Mexico

25–29 May 2015

Francisco Alonso Solís Marín, Alfredo Laguarda Figueras

Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México, Mexico

Oral presentations

- How many species of psolids are there in Mexico?
Arriaga-Ochoa JA, Solís-Marín FA, Laguarda-Figueras A (arriagaocchoa@gmail.com)
- Discovery of novel peptide regulators of mutable collagenous tissue
Blowes L.M., Gupta H.S. and Elphick M.R. (UK.l.m.blowes@qmul.ac.uk)
- DNA methylation and regulation of DNMTs in aestivation sea cucumber *Apostihopus japonicus*
Chen M., Yang H., Zhao Y. and Storey K.B. (chenmuyan@ouc.edu.cn)
- Adhesion of Cuvierian tubules in *Holothuria forskali*: Identification of putative adhesive proteins
Demeuldre M., Wattiez R., Ladurner P., Lengerer B., Hennebert E. and Flammang P. (melanie.demeuldre@umons.ac.be)
- Echinoderms' symbiotic gastropods
Dgebuadze P (Russia.p.dgebuadze@gmail.com)
- Reproductive cycle of the sea cucumber *Holothuria leucospilota* in Hong Kong waters based on the application of the standardized gonadosomatic index
Dumestre M., Sadovy de Mitcheson Y. and Dumas P. (marielle.dumestre@gmail.com)
- Annotated checklist of the echinoderms distributed in Mexican waters.
Frontana-Uribe S.C., Solís-Marín F.A., Caballero-Ochoa A.A., Hernández-Robles D., Laguarda-Figueras A. and Durán-González A. (sfrontana@conabio.gob.mx)
- Night and day monitoring of reef echinoderms: Can we use the data for management purposes?
Herrero-Pérezrul M.D. and Gardea-López A.M. (dherrero@ipn.mx)
- Echinoderm phylogeny reconstruction with broad sampling and a novel transcriptome based workflow.
Linchangco G.V., Reid R., Foltz D., Rouse G., Wray G., Kerr A. Hunter R. and Janies D. (glinchan@uncc.edu)
- New insights on elasipodids and dendrochirotidids from southwestern Atlantic Ocean (0–3,500 m).
Martínez M.I. and Penchaszadeh P. (mmartinez@macn.gov.ar)
- Higher level systematics of the walking, swimming, and burrowing Holothuroidea (Echinodermata): A six-gene molecular phylogenetic approach.
Miller A.K., Kerr A.M., Pawson D.L., Pawson D.J., Paulay G., Carvajal J.I. and Rouse G. (USA.a33miller@gmail.com)
- Feeding rate and sediment selection in the sea cucumber *Parastichopus regalis* (Aspidochirotida).
Ramón Galimany E., Pérez-Ruzafa A. and Leonart J. (Spain.mramon@icm.csic.es)

- Potential impact of ocean acidification on reproductive output of the subarctic holothuroid *Cucumaria frondosa*. Verkaik K., Mercier A. and Hamel J.-F. (khv043@mun.ca)
- The diversity and distribution of sea cucumbers in Singapore. Ong J.Y. and Tan K.S. (tmsojy@nus.edu.sg)
- Expanding inclusion of sea cucumbers in IMTA systems. Zamora L. and Slater M. (lzam004@aucklanduni.ac.nz)
- The movement and feeding behavior of the sea cucumber *Apostichopus japonicus*. Zhang L., Yang H., Zhang T., Pan Y. and Sun J. (China.libincas@163.com)
- Advances in the culture of *Isostichopus badionotus* in Yucatan, Mexico. Zhang-Huang B., Yinta L., Ramírez-González S., Pacheco-Vázquez P.J., Manrique-May C.B., Rosado-Romero W.J. and Santana-Cisneros A.D. (C.V.mvzsusana@hotmail.com)

Posters

- Sea cucumbers (Echinodermata: Holothuroidea) in Mexican waters of the Gulf of Mexico and the Mexican Caribbean . Cervantes Aguilar I.P., Solís-Marín F.A. and Durán Gonzalez A.
- Thermal tolerance and immune response of the sea cucumber *Parastichopus regalis* exposed to a gradient of high temperatures. Galimany L., Baeta M. and Ramón M. (Spain.mramon@icm.csic.es)
- Novel use of PIT tags in sea cucumbers: Promising results with the commercial species *Cucumaria frondosa*. Gianasi B., Verkaik K., Hamel J.-F. and Mercier A. (brunolg@mun.ca)
- Illegal trade of echinoderms in Mexico: Threats and consequences. Herrero-Pérezrul M.D., Castro-Peláez M., Reuter A. and Mosig-Reidl P. (dherrero@ipn.mx)
- Taxonomic identification of holothurians (Echinodermata: Holothuroidea) from Cocinas Island, Jalisco, Mexico. Luna-Cruz A.K., Solís-Marín F.A., Laguarda-Figueras A. and Durán-González A. (analun93@gmail.com)
- Morphological phylogeny of the sclerodactylids and phyllophorids (Holothuroidea: Dendrochirotida) . Martins L., Souto C. and Tavares M. (martinsrluciana@gmail.com)
- First record of the sea cucumber *Holothuria grisea* Selenka, 1867 (Aspidochirotida: Holothuroidea) for the Golfo de Morrosquillo, Colombian Caribbean. Padilla J.M., Nisperuza C.A. and Quiros J.A. (junigon991@hotmail.com)
- Review of the family Cucumariidae (Holothuroidea, Dendrochirotida) at the Colección Nacional de Equinodermos "Dra. Ma. Elena Caso M" ICML, UNAM. Sánchez D., Arriaga-Ochoa J.A., Caballero-Ochoa A., Solís-Marín F.A. and Laguarda-Figueras A. (dmsalanzo@hotmail.com)

Participants of the
15th International
Echinoderm Conference,
Playa de Carmen, Mexico



MARE conference, June 2015, Amsterdam

Centre for Maritime Research – 8th People and the Sea Conference “Geopolitics of the Oceans”

- **Governability of global value chains originating from small-scale sea cucumber fisheries**
Prescott J.
- **On the fisheries management merry-go-round: A blur of images passing by**
Eriksson H.
- **Understanding social wellbeing and values of SSF among the Sama-Bajau of archipelagic South-east Asia**
Stacey N., Steenbergen D., Clifton J. and Acciaioli G.

International seminar on the exploitation and sustainable management of sea cucumber resources: Lessons learned and recommendations for the State of Yucatan, Mexico

10–11 September 2015 in Mérida City, Yucatan, Mexico

Prepared by: Alejandro Flores, Alessandro Lovatelli, Matthew Slater and Veronica Toral

1. Introduction

This seminar was funded and organised by the State Government of Yucatan, Mexico, through the State’s Rural Development and Fisheries Secretariat and the technical guidance of the Food and Agriculture Organization (FAO) led by Alejandro Flores (Senior Fisheries and Aquaculture Officer, FAO, Chile) and Alessandro Lovatelli (Aquaculture Officer, FAO, Rome). The workshop aimed at building a road map towards the sustainable use of sea cucumber resources in Yucatan within acceptable economic, social and environmental boundaries. The workshop benefitted from the presence of national scientists, entrepreneurs, market representatives and fisher as well as international researchers and managers.

The main objectives of the workshop were to: (a) present the main constraints affecting sea cucumber fisheries from the scientific, legal and livelihood points of view; and (b) propose concrete actions to improve the management and sustainable use of these valuable benthic organisms, based on local knowledge and lessons learnt from other regions within Mexico and further afar.

The event served as a platform to gather the views of local fishers and authorities regarding ways forward in better managing the fishery stimulated by a series of presentations from a broad range of national and international experts including: Alejandro Flores (FAO, Chile), Alessandro Lovatelli (FAO, Rome), Alvaro Hernández Flores (Marista University of Mérida, Mexico); Arlenie Rogers (Environmental Research Institute, University of Belize); Jesús C. Osuna (National Federation of Fisheries Cooperative Associations, Mexico); Javier Villanueva García Benítez (FAO, Chile); Armando Wakira Kusunoki and Alicia Poot Salazar (Regional Fisheries Research Center, Yucalpetén, National Fisheries Institute of Mexico); Jean-Francois Hamel (Society for the Exploration and Valuing of the Environment, Newfoundland, Canada); Miguel Olvera Novoa, Juan Carlos Murillo Posada and Oswaldo Huchim-Lara (Center for Research and Advanced Studies, National Fisheries Institute, Mérida, Mexico); Matthew Slater (Alfred-Wegener-Institute, Germany); and Manuel Mendoza (fisherman).

The two-day workshop was opened and attended by the Secretary of Rural Development and Fisheries of the State of Yucatan, Mr J. Carrillo Maldonado, clearly indicating that management of this marine resource is high in the State agenda.

Following completion of the workshop, international attendees were offered a field trip to the aquaculture research facility managed by Merida’s Centre for Research and Advanced Studies (Unidad Mérida del Centro de Investigación y de Estudios Avanzados - CINVESTAV) in Telchac Puertoon located on the coast northeast of the State capital, Merida.

Sea cucumber fisheries in the Gulf of Mexico focusses on *Isostichopus badionotus* (also known as the four-sided sea cucumber). The fishery have exhibited the all-too-familiar “boom” phase similar to many other



Group photo of the participants attending the Mérida sea cucumber seminar. Visible in the front Mr A. Flores (second from the left) and Mr M.G. Aguilar Sánchez, the Federal Government Commissioner of Aquaculture and Fisheries (third from the left).

fisheries elsewhere; at present the resources have clearly entered the “bust” phase. Initial attempts to manage the fishery with limited licencing and closure periods met with increasing resistance from fishers and an expanding IUU fishery. Beyond the evident ecological concerns, the fishery is also associated with negative social impacts and conflict within fishing communities and also with increasing numbers of fatal decompression events among divers. Efforts to manage the fishery in a participatory manner continues, led by local and national fisheries authorities (the State Commission and the National Commission for Fisheries and Aquaculture, respectively) and the National Institute of Fisheries, responsible of stock assessments. Several research groups are also taking initial steps to establish aquaculture facilities with one commercial company currently establishing a hatchery and growout facilities off the coast of Campeche (the company is already farming *Isostichopus fuscus* on the west coast of Mexico).

2. Methodology

The workshop focused on three work areas: (a) research and management; (b) legal and governance; and (c) social and co-management. A number of working groups were established and worked separately. Each group identified key problems in each area of work and provided suggestions on how to deal with or minimise the threat identified. The results from each working group were then pooled together and frequency of the results expressed in percentage. A management roadmap was hence drafted through the identification of the main threats affecting the sustainable exploitation of sea cucumber and the recommendation of specific measures required to overcome these threats.

The first day of the seminar focussed on plans and strategies for managing sea cucumber fisheries. Presentations were made by state and national level actors from Mexico; these were significantly supplemented by presentations by international experts offering insights into lessons learned and best practices for management. The second day included a session focussed on aquaculture practices, lessons learned and advances in Yucatan (Mexico) in terms of culture applications. Additional presentations were delivered on social impacts of the fishery, as well as fishery monitoring and management in the wider region for example in Belize and the Galapagos Archipelago.

3. Results

3.1 Research and management

Regarding research, the lack of appropriate funding for long-term research programmes, scientific data collection, etc. was identified as a major constraint. Far too often insufficient data and information is provided through short-term investigation activities that make it difficult to take appropriate management decisions. Next, was the lack of synergies between different research bodies that may limit, delay or duplicate the information needed and, more importantly, sway away the confidence of fishermen in the managing institutions. The lack of adequate information on the natural population of sea cucumber juveniles was identified as a major handicap particularly when attempting to establish protection / no-take areas deemed essential for the sustainability of the fishery. Finally, the need for environmental education programmes was highlighted and deemed important to help build stewardship among the local coastal communities in better understanding the ecological and economical role of sea cucumbers.

3.2 Legal and governance

The main problem raised by all working groups at the seminar was the inadequate level with regards to inspection and surveillance, and the lack of sanctions to those fishing illegally. Corruption at all levels was also responsible for the smuggling of sea cucumber out of the country. Possible solutions included the strengthening of laws and regulations against corruption and to include a maximum time limit to export the product. This could be strengthened with educational programmes. The second problem identified was the lack of synergy between the institutions in-charge of law enforcement, including the lack of training to properly follow-up the custody chain throughout the marketing process and identification of false documentation and permits. An additional constraint raised by the seminar participants was the lack of an official degree to protect the zones where juvenile sea cucumbers are known to occur.

3.3 Social and co-management

The main problem was the lack of education on the importance of the species that could promote a sense of ownership of the resource. To solve this, the group proposed to strengthen a social-community policy which would help improve the conditions on the community and would promote ongoing education on the use of sea cucumbers by means of workshops and courses given in schools, permit granters, fishing cooperatives, etc. A second problem identified was related to health issues resulting from the fishing activity itself: decompression sickness, alcoholism, drug addiction and sexually transmitted diseases, which are in turn related to lack of training and education. On this subject, it was recommended to create a hookah diving training programs which could be accessed by all fishers and organization of awareness campaigns for diving security and possible health risks.

3.4 Roadmap

Based on the experiences from scientists, managers, entrepreneurs and fishers a roadmap dealing with each of the aspects highlighted above was conceived. It includes a chronological sequence of actions that will hopefully see the implementation of a sustainable plan for the management of sea cucumbers in Yucatan.

Several news links following the seminar:

- ✓ <http://www.spc.int/coastfish/index.php?option=comcontent&Itemid=30&id=422>
- ✓ <http://estadodemexicoalamano.com/sociales/efectuan-seminario-internacional-sobre-manejo-y-aprovechamiento-sustentable-del-pepino-de-mar/>
- ✓ <http://conapesca.gob.mx/wb/cona/11deseptiembrede2015meridayuc>
- ✓ <http://sipse.com/milenio/yucatan-expertos-bases-manejo-produccion-pepino-mar-169472.html>

A final report including summaries from speakers and working groups will be shortly published by FAO. Please contact Alejandro Flores (alejandro.flores@fao.org) or Alessandro Lovatelli for further information (alessandro.lovatelli@fao.org).

WIOMSA 9th International Symposium

Eastern Cape, South Africa 26–31 October 2015 (see www.wiomsa.org)

Oral presentations — Small-scale fisheries: Trends and impacts

- Management of sea cucumber fisheries: The problem of illegal captures
Conand C., Eriksson H., Muthiga N., Leopold M., Prescott J., Purcell S.W. and Toral-Granda M.V.
- Seychelles' sea cucumber stock assessment: Management options for sustainable fishery
Koike H., Gerry C. and Friedlander A.

Posters

- Diversity of the echinoderms of the Iles Eparses (Europa, Glorieuses, Juan de Nova), Mozambique Channel, France
Conand C., Mulochau T., Stöhr S., Eléaume M. and Chabanet P.
- Feasibility of sea cucumber farming in the Bazaruto Archipelago, Mozambique
Lavitra T.
- Test of liquid injection and elastomer implant for tagging edible sea cucumber *Holothuria scabra*
Rakotonjanahary F., Tsiresy G., Rasolofonirina R., Eeckhaut I. and Lavitra T.

Other activities

During the symposium two actions were undertaken to prepare a message from the WIO to the COP 21: The film “Hokulea” was made in South Africa and the WIOMSA declaration was prepared (www.ird.fr/toute-l-actualite/actualites/declaration-des-scientifiques-du-wiomsa)



WIOMSA 9th International Symposium participants

Course: “Application of molecular tools on fishery management, aquaculture and restocking of sea cucumbers”

23–26 November 2015, Panamá

Mercedes Wangüemert (mwanguemert@ualg.pt)

Dr Mercedes Wangüemert and Jorge Domínguez, PhD student from the Marine Resource Management team from CCMAR (<http://www.maresma.org/>), were in the Universidad Marítima de Panamá to teach the course “Application of molecular tools on fishery management, aquaculture and restocking of sea cucumbers”. The course was organized with the collaboration of Panamanian and Portuguese institutions: INDICASAT AIP (Instituto de Investigaciones Científicas y Servicios de Alta Tecnología), ARAP (Autoridad de los Recursos Acuáticos de Panamá) and CCMAR (Centro de Ciências do Mar).

This course is one of the activities linked with the project “Genetic variability and physiology of sea cucumber (*Isostichopus fuscus*, Ludwig 1875) in the Pacific coast of Panama: an exploitable resource?” funded by SENACYT and led by Dr Vergara-Chen. Dr Wangüemert is part of the research team of this project, which started one year ago to study one of the main target species of sea cucumbers in Panamanian fisheries before the current moratorium.

During the course, Dr Wangüemert and Mr. Domínguez had the opportunity to discuss about the problematic of sea cucumber fisheries and potential solutions to their over-exploitation with the General Administrator of ARAP, Mr. Iván Flores, and the National Director of Research and Development Department, Mr. Marco Mendizabal. Both demonstrated a great interest on the new molecular tools to improve the fishery management and aquaculture development of sea cucumbers. Further collaborations between the research institutions were also assessed.

The attendance profile to the course included Msc and PhD students, fishery managers, aquaculture technicians, lecturers and owners of aquaculture companies (Fig. 1). A first introduction about the current status of sea cucumbers fisheries in the world was done and later showed a general view of the sea cucumber aquaculture. The course was then focused on the application of molecular tools to fishery management, aquaculture and restocking of sea cucumbers, including a reminder of genetic basic concepts, description of the main molecular markers and genetic diversity and differentiation parameters, uses of genetics in fisheries mainly stock identification, barcoding, traceability, genetic effects from over-exploitation, and applicability of molecular tools to aquaculture such as inbreeding assessment, paternity tests, barcoding of pathogens and genetic compatibility of restocking.



Figure 1. Course participants.

2016 Meetings announcements

Second International Mares Conference on Marine Ecosystems Health and Conservation

1–5 February 2016, Olhão, Portugal
<http://www.maresconference.eu/>

13th International Coral Reef Symposium (ICRS)

19–24 June 2016, Hawaii Convention Center, Honolulu, Hawaii USA
<http://sgmeet.com/icrs2016/default.asp>

4th International Symposium on the Ocean in a High-CO₂ World

3–6 May 2016, Hobart, Tasmania, Australia
www.highco2-iv.org

3rd Latin American Echinoderm Conference

18–22 July 2016, San José, Costa Rica, Central America
<http://rediberoamericanaequinodermos.com/en/welcome-2/>

9th European Conference on Echinoderms

17–19 September 2016, Institute of Oceanography, Polish Academy of Sciences, Sopot, Poland
<http://www.iopan.gda.pl/ECOE2016/>