El papel de las asociaciones de estudiantes de biología marina en la docencia universitaria y la divulgación social

Joan Josep Soto Àngel[a], María Fuertes[b], Melissa Acevedo[c], Álvaro Luis Peña Cantero[a]

La biología marina, ecología marina, oceanografía biológica o el resto de denominaciones que recibe el estudio de los seres vivos que habitan los diferentes ecosistemas marinos, ha tenido desde sus inicios una proporción considerable de la carga lectiva en los planes de estudio de la mayoría de facultades de biología del país. No obstante, salvo contadas excepciones, en la presente era del surgimiento de nuevas especialidades en forma de grado o posgrado, la carga docente de la biología marina en particular, y las ciencias naturales en general, se está viendo eclipsada por un exponencial aumento de las titulaciones relacionadas con la parte más aplicada de la biología, en un lógico impulso de satisfacer la demanda social y las necesidades mercantiles de las bolsas de trabajo. Así pues, mientras que carreras como biomedicina, bioquímica y biotecnología, gozan de su periodo de máximo esplendor académico, las materias relacionadas con el trabajo más naturalístico están reduciendo drásticamente su presencia en los planes de estudio hasta límites irreconocibles hace tan solo unas pocas décadas.

En este sentido, en un intento de maximizar la presencia de la biología marina en el ambiente universitario, son numerosos los ejemplos de asociaciones de estudiantes que tratan de fomentar, promover y potenciar la realización de actividades y eventos de diversa índole relacionados con el ambiente marino. Estas agrupaciones juegan un papel clave en la organización y/o impartición de actividades de carácter académico englobadas en el seno sociocultural de la Universidad, tales como cursos, congresos, exposiciones, seminarios y otras actividades de carácter científico o divulgativo con la biología marina como eje vertebrador. Además, su tarea no se restringe a la formación universitaria, sino que emprenden acciones concretas con el fin de implicar y concienciar a la sociedad en el cuidado, la estima y la protección del medio natural marino mediante actividades divulgativas orientadas al público general, que permitan dar a conocer la gran riqueza de nuestro patrimonio natural sumergido.

Con estas premisas, las asociaciones de estudiantes de biología marina tienen un común la creación de un entorno de autoaprendizaje donde desarrollar competencias relacionadas con el medio marino, estableciendo así un punto de inflexión en la concepción global de la biología marina, tanto por parte de los estudiantes universitarios, como por la sociedad en general.

[a] *Biodiversitat i Evolució de Cnidaris. Insitut Cavanilles de Biodiversitat i Biologia Evolutiva. Universitat de València (joan.soto@uv.es).*
[b] *Alumna de la Facultad de Biología. Universidad de La Laguna. Tenerife.*
[c] *Departament de Biologia Marina i Oceanografia. Institut de Ciències del Mar (ICM-CSIC). Barcelona.*

Research submersible ICTINEU 3, a tool to serve the scientific community

Carme Parareda Sala[a], Pere Forès Malleu[a]

Introduction

The company ICTINEU Submarins has designed, developed and built a new generation of manned submersible. The vehilcle, named ICTINEU 3 as a tribute to Narcís Monturiol and his first Ictineus, is a modern submarine, designed and built with cutting-edge technology in order to achieve a very versatile and highly operational vehicle. It incorporates outstanding innovations with respect to the other submarines that are currently on the market, in terms of design, construction materials, and in particular its energy system.

The ICTINEU 3 is a scientific submersible, a work class vehicle with high capabilities for work, observation and intervention. It has been designed for 1.200 meters depth, and a crew of three: one pilot and two observers (passengers). It will be certified and classified by Germanischer Lloyd according to the highest standards of quality and safety.

Design and performance

When the team though about building a submersible, the first thing in mind was science and ocean exploration. All the development of the vehicle has been focussed on achieving a very versatile tool, capable for a wide range of tasks, from ocean observation to industrial works and even leisure, but always focusing on research capabilities.

So at the design phase it was decided that it had to be easy in operation, highly automated and efficient. The main goals to be achieved were: high observation capabilities, very low weight (<6 tones), easy to transport and operate worldwide, highly operational and passenger access from sea. It might seem only a few goals, but it has been a really difficult challenge to accomplish them all together. It has taken 8 years of development. Main facts and performance are described next.

The pressure hull is 1.7 meters in diameter and it has two acrylic domes, one on top (entry hatch) and one in front, 1.5m in diameter. The position of the front dome has an inclination of 10 degrees forward in respect of the vertical, so the vision on the sea floor is improved This allows the three passengers a large field of view and excellent capabilities for ocean observation, as well as the possibility to take high quality photography and video recording from inside, without the need of special pressure tolerant cameras and housings. In fact it's the first vehicle to go below 1000m with an hemispherical acrylic window. Ergonomics have also been taken in account so working in a sub does not mean any more uncomfortability.

Figure 1. Image of unfinished submersible assembly and detail of visibility in the front acrylic window, in summer 2011

[a] *ICTINEU Submarins (cpareda@ictineu.net)*

The weigh of the vehicle will be about 5.300kg, a very reduced weight for a 1.200m and 3 people rated submarine, so it can be operated from most research vessels. As it has a very reduced size it can fit in a 20 feet open-top container, so it's easy to transport to the work place by road, ship or air.

Passengers can go in/out from water surface in good sea state, what makes easier the exchange of passengers, without the need of lifting and recovery operations from mother ship every time a shift is needed. It can also be towed from harbour if working area is near the coast.

The power system is based on last generation lithium-ion-polymer batteries, which give the vehicle a high power capacity: 30kW continuous, 42 kWh (10 hours full autonomy at normal load capacity). This means that it is able to work for more than 8 hours with thrusters, lights and all instruments and sensors simultaneously, and can travel up to 20 miles underwater.

Propulsion and manoeuvring are based on a complete 6 controllable degrees of freedom system. The configuration of the 8 thrusters, 2,5kW each, provide a vectorial propulsion system on 5 axis: 3 translation (XYZ), 1 yaw, 1 roll. Trimming (pitch) is provided by internal buoyancy tanks, that also provide the buoyancy system, so that Z axis is redundant (thruster and ballast). Piloting is done by a PLC- assisted console: 1 joystick, 3 axis (advance, lateral translation and yaw), plus 12 manoeuvring control buttons (buoyancy, pitch, up/down).

Figure 2. Illustrations of ICTINEU 3 configuration and detail of basket and manipulators

As it is said, it has always been a must the versatility and capacity of operation of the vehicle. In this sense the power and communications system has been dimensioned in order to be able to adapt to any task and mission requirements. A sensors platform has been designed in a way that it is capable to upload any instrument or sensor from the client in an easy and quick way. This is done through an oil filled, pressure tolerant junction box, with 18 extra shielded twisted pairs for connections, and a choice of 12VDC or 24VDC in series for power. Inside the pressure hull, direct access to distribution board is allowed.

The payload of the submersible is 300kg that can be distributed between instrumentation, samples collection or any tools or markers to be placed on the sea floor. A basket will be available for that purpose in front of the vehicle. Front protection bars pay also the role of masts and support for cameras, flashes and other instrumentation that can be easily fixed on them.

As basic equipment the vehicle will have an underwater telephone, VHF for surface communications, flux-gate compass, GPS, sonar, altimeter, redundant depth control, Doppler velocity log, 6 LED lights and a couple of 6-function hydraulic manipulator. Additionally, a CTD and multi-parametric probe will be always mounted on board, continuously logging data. Information recorded during the mission and during the ascent and descent along the water column will be available to the scientific community after each dive. The Doppler velocity log, a Teledyne Workhorse Navigator, can be used also as a current profiler.

Table 1 Technical specifications of the ICTINEU 3 vehicle

General Specifications	
Max. Operating depth	1200 m
Weight in air	5300 kg
Length	4800 mm
Beam	1950 mm
Height	3000 mm
Hatch diameter	540 mm
Main (front) acrylic window diam.	1200 mm
Hatch acrylic window diameter	540 mm
Crew	1
Passengers	2
Payload	300 kg
Classification authority	Germanischer Lloyd

Life Support	
Daily life support	24 hours for 3 people
Emergency life support	+ 96 hours for 3 people
Atmospheric control by 2 digital O_2 and CO_2 analysers	

Buoyancy and trimming	
Diving tanks	600 L
Buoyancy tanks	240 L
Trimming	+/- 3 deg

Safety devices	
Emergency drop weigh	500 Kg
Diving tanks	600 L
Emergency buoy	1800 m long rope
Total buoyancy generation of	800 Kg at max. Depth

Propulsion	
Stern thrusters	4 x 2,5kW, 43Kg
Manoeuvring thrusters	4 x 2,5kW, 43Kg

Batteries	
Main group 150V, 42kWh	Lithium-ion-polymer
Service and Emergency group	24V, 1,3kWh
Working autonomy	10h
Emergency autonomy	5 days

Dynamic Characteristics	
Maximum surface speed	2,5 Knots
Maximum submerged speed	4,2 Knots
Cruising submerged speed	1,5 Knots
Autonomy range at cruising speed: 20 nautical miles	

Equipment
Underwater telephone
VHF for Surface communication
Flux-gate compass
GPS
Sonar
Altimeter
Depth control by two analogue depth gauges and one digital pressure sensor
Doppler Velocity Log
8 LED Lights of 6,000 Lumen each
6- function hydraulic manipulators
Basket for sampling
CTD multi-parametric probe with pH sensor, ORP (Redox) sensor, Dissolved Oxygen sensor, Fluorometer.

Status of project

The design of ICTINEU 3 submersible started in 2004, engineering and pressure hull calculations started in 2008 and main construction works in 2009. Eight years later the vehicle is about to be finished. All engineering has been finished, as well as the construction of pressure hull, exostructure, tanks, etc. All equipment is ready for final assembly and testing. Final certification, sea trials and classification are expected for second half of 2012. One of the main steps in the construction of a submersible is the pressure test of the pressure hull, that for ICTINEU 3 was successfully completed in summer 2011.

Operation and missions

Once the vehicle is finished, the company will operate the submersible and give diving services to any client that is interested in. Operation of ICTINEU 3 submersible is though in different ways, so it can be adapted to different needs and budget of clients.

Normal operation should be that carried on during a scientific campaign, on board of a research vessel, with one pilot and two observers or researchers. A daily mission of 8 hours can be run, and a time lapse of 5 hours is needed to re-charge the batteries. Implementation of instrumentation and sensors can be done previously or on board. Campaigns can last several weeks provided that enough oxygen bottles have been boarded on mother ship.

If operation is needed near the coast, the vehicle can be as well towed from harbour.

Due to its small size and lightweight, the vehicle can be transported to any country or any ocean by different transportation means: road, air-plane, ship.

It is expected to establish an operation centre in the Costa Brava, Catalonia, in the western Mediterranean sea. That will provide easy access and operation to all the deep canyons existing in that area. It's expected to make a good contribution to the knowledge of the area ecosystems, geomorphology, dynamics and archaeology.

New models are being explored to fund research and exploration projects. In this way the company is studying to implement a

formula where leisure clients can pay for a scientific dive, and join together in a fruitful experience. Biologists, geologists, oceanographers or archaeologists would be able to make free dives to run their works, and normal people should be sensitized about the importance of ocean research and exploration. Even influential people, decision-makers, might happen to make dives in this conditions, with a positive result in a better management of our seas.

Collaboration

CTINEU Submarins SL wants to collaborate with the scientific community, and contribute to the better understanding of the seas and oceans. To provide new data and knowledge to help us understand the mechanisms behind their complex ecosystems, to help to improve their management and exploitation, and ultimately to improve the coexistence between humans and this great unknown world.

We glimpse different ways of collaboration, aside of typical scientific campaigns -not affordable by all the scientific community. An approach should be made between researchers and vehicles operators to optimize the technological resources available.

This submersible can be used as a test platform for new instrumentation and applications. It can upload instrumentation for systematic oceanographic data logging without the need of a researcher on board. Photography and filming can be taken by the submarine crew from locations of interest previously agreed with researchers. During non-scientific work, for instance tourism dives or industrial work, probably a big amount of footage will be produced. As it will be georeferenced, it can be provided to researchers for species identification. If tourist dives are made in a normal basis, points of interest can be revisited and sampled or pictured for a follow-up.

The ICTINEU 3 team is eager and open to proposals for cooperation to the improvement of the oceans knowledge.

El mar a fondo: un proyecto educativo que acerca el mar a la escuela y a la sociedad

Josep-Maria Gili[a], Begoña Vendrell Simón[a]

En términos generales, el estudio de las ciencias naturales en el currículum de educación formal pretende que los estudiantes conozcan y entiendan el mundo natural. A menudo, resulta difícil mostrar la complejidad de la naturaleza dentro de las aulas. Una manera de hacerlo es generando interrogantes que el alumnado pueda resolver a través de la obtención de resultados derivados de emplear la metodología y las teorías científicas. Es justamente esta competencia científica la que hace falta que los alumnos aprendan a adquirir. La búsqueda de sencillez en los planteamientos y su situación en contextos locales y cercanos pueden ayudar a desarrollar esta competencia científica, creando un proceso de enseñanza-aprendizaje que implique al alumnado activamente. El mar ofrece un escenario idóneo para este tipo de actividades; además, el contacto directo del alumnado con la naturaleza puede favorecer la motivación y el espíritu de aprendizaje entre los estudiantes. «El mar a fondo» es un proyecto creado y desarrollado en colaboración entre el Instituto de Ciencias del Mar (ICM-CSIC) y la Fundación "la Caixa". Este proyecto acerca el conocimiento sobre los mares y océanos al ámbito educativo mediante varias propuestas didácticas. A partir de una plataforma virtual se podrá acceder a los contenidos educativos y participar activamente en el proyecto tanto desde centros escolares como desde el ámbito particular. El proyecto «El mar a fondo» se organiza en dos grandes bloques:

1. Vídeos originales, de corta duración, que versan sobre unidades temáticas diversas relacionadas con el mar, acompañados de guías didácticas (para profundizar más en los diferentes temas tratados) y de propuestas de actividades didácticas relacionadas con los contenidos de los vídeos o de las guías.

2. Actividades de investigación que se realizan desde los centros educativos, con materiales sencillos y siguiendo protocolos de muestreo y análisis de diferente grado de complejidad. Estas actividades de investigación ofrecen, por lo tanto, el tratamiento experimental de contenidos curriculares tanto de la educación primaria como de la educación secundaria. A través de la página web, los participantes intercambiarán resultados, impresiones, ideas y materiales, creando un diálogo entre alumnado, profesorado e investigadores.

La metodología básica del proyecto es la creación de contenidos a través de la página web. Cada bloque de contenidos comprende sus propios métodos. Todos los contenidos están encaminados al trabajo de la competencia científica, la aplicación de la metodología científica y la adquisición de conocimientos específicos y transversales sobre la temática marina. A través de los foros de cada actividad ofrecida se establece un diálogo constante entre alumnado y profesorado de los distintos centros educativos, así como entre estos colectivos y los científicos vinculados al proyecto. Con este proyecto, pues, se pretende crear nuevos recursos educativos para docentes y educadores, de modo que el medio marino pueda ser una fuente nueva y a la vez complementaria para abordar los contenidos del currículum escolar y para nutrir, en la práctica y en la teoría, los planes docentes de los centros educativos.

[a] *Departament de Biologia Marina, Institut de Ciències del Mar (CMIMA-CSIC), 08003 Barcelona (gili@icm.csic.es)*