BREAKING THE SURFACE 2013 – List of lectures

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Title: *Issues to tackle and strategies for actions: the challenges in the Mediterranean Sea*

Abstract: The Mediterranean Sea is a hotspot of marine diversity affected by many anthropogenic threats, some of which began thousands of years ago, including intensifying fishing practices and resource extraction, increasingly densely populated coastlines, invasive species, and climate change. In a recent quantification of cumulative human impacts to marine ecosystems, it has been documented that the Mediterranean marine ecoregions are among the twenty most impacted ecoregions of the 232 globally recognized. This pressure has resulted in major alterations of Mediterranean marine ecosystems and widespread conflict among users. At present, several EU and non EU agencies through the ongoing activities by EU MSFD, MAP and others provide an unprecedented opportunity to implement comprehensive and coordinated management of multiple uses and activities affecting the Mediterranean Sea marine ecosystems. But before developing basin-wide plans, it is crucial to understand present gaps of knowledge and to identify scientific robust guidelines to support decision-support tools that can inform effective marine policy over the next years. Large-scale assessments on biodiversity distribution, the recognition of the increasing diversity and intensity of human stressors acting at multiple temporal and spatial scales, the combination of different integrated approaches, which include well designed descriptive studies, manipulative experiments and mapping to investigate the effects of different combination of stressors at the proper scale, and cross-disciplinary partnerships are needed to understand how multiple threats alter the structure, functions, and services provided by marine ecosystems, and to reverse the continued degradation of the Mediterranean Sea. Here, I will discuss and document through specific examples these critical subjects that should be addressed to provide guidance regarding issues to tackle, priorities for focal locations, and strategies for action.

Speaker: Simonetta Fraschetti, Associate Professor in Ecology, University of Salento – CoNISMa, Italy

Bio: She combines field descriptive research, manipulative experiments and spatial analysis techniques with the aim of gaining a better understanding of the pattern of distribution of marine biodiversity and of the processes shaping marine communities, especially in subtidal and intertidal rocky habitats. She is collaborator or coordinator of several national and international projects for implementing the conservation and the management of marine costal systems. A specific focus of her research is on setting priorities through conservation planning tools for the identification of network of Marine Protected Areas in the Mediterranean Sea. The quantification of changes in coastal marine communities under the effects of multiple stressors and the study of the recovery of disturbed assemblages are also relevant aspects of her research. Author of 60 scientific articles on ISI journals and 12 scientific books (http://scholar.google.it/citations?hl=en&user=debN35MAAAAJ&view_op=list_works&cstart=60).

Title: *Global and regional sea-level rise*

Abstract: Global sea level has been rising over the last hundred or so years. The rise is expected to continue, and even to accelerate, in the future due to the global climate change. Some recent storm-surge events, such as those related to the hurricanes Katrina (2005), Nargis (2008) and Sandy (2012), have revealed how sensitive the coastal population is to flooding. The future sea-level rise will obviously exacerbate the sensitivity. In the presentation three different methods that are used to determine sea-level change are described first: reconstruction based on geological, biological and archaeological sea-level indicators, measurement with tide gauges of various types and measurement with satellite altimeters. Global sea-level variability revealed by these data is commented next. Moreover, it is pointed out that the variability depends on an increase of the ocean volume due to the absorption of heat, on an increase of the ocean mass caused by the melting of glaciers and ice sheets and on a change of the ocean mass related to the varying water storage on land. The presentation then briefly turns to the modeling of sea level. It is shown how modeling is used to project sea level for the twenty-first century. These projections are compared with those obtained with an independent method, which utilizes various empirical relationships between global temperature and global sea level. It is found that the two methods give different results and the reasons for the discrepancy are commented upon. The presentation next focuses on the Mediterranean area. It is shown that during the second half of the twentieth century the sea-level trends were close to zero in the Mediterranean Sea and that therefore they considerably departed from the global trends. A recent shift in the Mediterranean dynamics and the projections available for the area are considered as well. Finally, analysis and prediction of extreme flooding events are addressed and some possible ways of adaptation to inevitable changes are mentioned.

Speaker: Prof. Mirko Orlić, Andrija Mohorovičić Geophysical Institute, Faculty of Science, University of Zagreb

Bio:Mirko Orlić, geophysicist, physical oceanographer (Zagreb, Croatia, 26 May 1955). Obtained Ph. D. in physics – physical oceanography at the University of Zagreb (1988). Visited several oceanographic institutes in Europe, spent a year as visiting scholar at the Scripps Institution of Oceanography in La Jolla, Ca, USA (1993). Researcher at the Center for Marine Research of the Rudjer Bošković Institute in Zagreb (1979–1983); subsequently employed at the Andrija Mohorovičić Geophysical Institute, Faculty of Science, University of Zagreb, most recently as professor (2000–). Teaches introductory courses on physical oceanography at the undergraduate and graduate levels, and a course on wind-induced coastal dynamics at the graduate level. Supervised preparation of about thirty B. Sc. theses, six M. Sc. theses, and six Ph. D. theses. Initiated and led a series of physical oceanographic experiments in the Adriatic; since 1983 supervises tide-gauge station at Bakar. Participated in a number of projects, led five national projects and eight international projects. Editor of Geofizika journal (1990–1992), of three conference proceedings (1999, 2001, 2008) and of a book (2011), guest editor of Journal of Geophysical Research (2004–2007) and of Journal of Marine Systems (2007–2009). Member of the American Geophysical Union and The Oceanography Society, president of the Croatian Committee for Geodesy and Geophysics. Major research interests include physical processes in coastal seas and atmosphere-sea interaction, particularly in the Adriatic area. Authored and co-authored more than 70 refereed publications, about 100 conference communications, a number of professional and popular papers, and a book on the weather and climate of the Adriatic area; the publications have up to now received more than 1000 citations. Obtained the Fulbright Award, the Croatian State Science Award, and the Croatian Academy Science Award.

Title: *Inspiration Through Exploration: Building the future on our past*

Abstract: ExploreOcean was founded inside a home-built two-person submersible. This realized dream of exploration then grew to include a five-person research submersible, Antipodes, and the company OceanGate was born. The access to the oceans that these submersibles provided led the founders of the company to establish the nonprofit ExploreOcean to give students, and the population at large, greater access to, and understanding of, the oceans.

ExploreOcean's mission is "to expand humanity's understanding of the world's oceans through exploration, inspiration, and education." We do this with manned submersibles, with ROVs, AUVs, SCUBA, and sonar, in partnership with companies and scientists using these technologies. We then turn these expeditions into curriculum for primary, university, and lifelong education. Video and web presence is our cornerstone strategy for reaching a large audience.

In the general population there is a remarkable lack of understanding about the oceans and related professional opportunities. Yet we've found a tremendous appetite to learn about the oceans. Whether it is the water, the geology, the life, the tools for exploration, or the science itself, people generally have a great fascination. Technological developments for exploring and understanding the oceans is growing at

an ever-increasing rate, which provides opportunities for youth to enter these fields. We're spreading the word, with the intention of planting the seeds of scientific curiousity for the future.

Speaker: Craig Howard, ExploreOcean.org, USA

Bio: Craig Howard is the Chairman of ExploreOcean.org, a US not-for-profit organization that provides "Inspiration Through Exploration." Mr. Howard's career has been spent expanding markets for technology, education, and improved healthcare in many parts of the world. His involvement with ExploreOcean as board Chairman has delivered him back to his roots of oceanographic fascination, with the opportunity to help students find ways to become involved in work in the oceans. Mr. Howard is based in Seattle, Washington, USA, and, along with his work with ExploreOcean, he consults to for-profit and nonprofit organizations on organizational structure and growth.

Title: *Processing of 2-D optical & forward-look sonar video for scene reconstruction and automation of submersible platform operations*

Abstract: Machine Vision systems have provided numerous key capabilities in the deployment of autonomous terrestrial robotics systems, and submersibles when operating in relatively clear waters. However, these become ineffective when submersibles are deployed in turbid environments. Under these circumstances, realizing of performance similar to those for clear water is highly desirable. This talk reviews some capabilities for benthic habitat mapping under good visibility, and then concentrates on a range of methods for the automated processing the FS sonar video data to extract various 3-D information, aimed at enabling automated operation of subsea robotics platforms and (or) reconstruction of imaged objects and environments.

Speaker: Shahriar Negahdaripour, University of Miami, USA

Bio: Shahriar Negahdaripour received S.B., S.M., and Ph.D. degrees in 1979, 1980, and 1987 from MIT, Cambridge, MA. After 4.5 years with the Electrical Engineering Department at University of Hawaii, he joined the ECE Department at the University of Miami in August 1991, where he has been a Professor of Electrical and Computer Engineering since 1999. He has held visiting positions at the University of Maryland (1988), University of Hawaii (1995), Woods Hole Oceanographic Institute (1997) Florida Atlantic University (1998), University of Girona (2003), MIT CSAIL (2010), and Centre for Maritime Research and Experimentation (CMRE), La Spezia, Italy (2013).

His research work has been primarily concerned with the development of various vision technologies for underwater applications. In recent years, he has also become involved on the application of computer vision methods to 2-D forward-scan sonar imagery, and potential integration of 2-D optical and FS sonar. He has co-organized 2 major international conferences in computer vision (CVPR'91 and ISCV'95), and served as member of technical committee of several other ones. He currently serves as area editor of Computer Vision Image Understanding Juornal, published by Elsevier.

Title: *Long-endurance AUV capabilities*

Abstract: What could we do with an autonomous underwater vehicle (AUV) that has a very long endurance? To answer that question, it is important to understand how an AUV achieves long endurance, and how design constraints for long-endurance can limit other capabilities. One approach for increasing endurance is to reduce the speed of the AUV. There is a cubic relationship between the speed of an AUV and the power needed to propel it, and reducing speed can dramatically reduce the power needed for propulsion. In an extreme case, the AUV can moor itself on the seafloor to completely eliminate the need for propulsive power. In this talk we discuss general characteristics of AUVs that are capable of long-endurance missions, and we discuss the specific case of an AUV that can moor itself on the seafloor for up to a year.

Speaker: Dan Stilwell, ECE Department, Virginia Tech

Bio: Dr. Dan Stilwell is a Professor in the Bradley Department of Electrical and Computer Engineering at Virginia Tech, Blacksburg, Virginia. He earned a PhD in electrical engineering at Johns Hopkins University in 1999, the MS from Virginia Tech in 1993, and the BS from the University of Massachusetts in 1991. Since arriving at Virginia Tech in 2002, Dr. Stilwell has become a principal contributor to the emerging field of environmental robotics. His research addresses the development of fundamental control and estimation theory for mobile sensors networks and the development of new maritime robots for underwater and surface applications. He is a past associate editor of the IEEE Journal of Oceanic Engineering. He is a recipient of the National Science Foundation CAREER award and the Office of Naval Research Young Investigator Program award, and he was named a College of Engineering Outstanding Assistant Professor

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Title: *Hybrid systems: Where are the innovations and where are the added values*

Abstract: Ifremer is strongly engaged in partnership with other international institutions (WHOI, MARUM…) and private companies (ECA robotics, ACSA…) in the design and building of a new generation of innovative Hybrid underwater vehicles. On one hand the main HROV project aims to build and qualified a multipurpose vehicle, to be deployed from non DP coastal and blue ships in different scenario, with class II classical ROV functions on the bottom, and High resolution inspection and multimedia mapping AUVcapacities. On the other side of the size scale of Ifremer underwater systems fleet (From Nautile HOV 19T to Glider and hybrid glider 50kg), a new hybrid glider-AUV system "Hglider" have been developed with ACSA and is under qualification. Both systems will be presented in details with some illustrations on their future uses.

On both projects the aim of the talk will be to explain how hybrid systems would get advantages in term of flexibility, utilities, autonomies and cost effectiveness. In that sense comparison with multivehicle exploitation would help to address the real challenges in term of modularity, mission programming, efficiency andfault tolerance compare to the use of multiplatform.

Speaker: Vincent Rigaud, IFREMER, France

Bio: Dr. Vincent Rigaud is director of the underwater system Unit within Ifremer since 2003 and was formally head of the Robotics, Navigation and Vision R&D Laboratory. The underwater systems department is in charge of research and development on new underwater systems and design, integration and overhauls of operational systems for the Ifremer fleet. The activity covered AUVs (AsterX and IdefX), ROV (Victor6000), Manned submersible (Nautile),Deep tow sonar (SAR), Observatories (Antares ,Km3, Deepseanet, Esonet) and related technologies and instrumentations. He is graduated in 1990 as Doctor in Signal Processing and Automation from University of Rennes, and INRIA, France and engineering degree in oceanography from Toulon University. After an experience in the offshore industry, he joined Ifremer in 1990, and since have been involved in several projects within Ifremer, with an activity split between operational engineering and research projects, with a high level of activity at sea mainly as head of technological campaigns. He use to act as leader of several Ifremer programs and projects in underwater systems mainly in the field of Autonomous Underwater Vehicle, in relationship with industrial partners (oil industry) (Projects, UNION-IST, Sirene DESIBEL-MASTII, SWIMMER and ALIVE within Thermie EU program, FP7 Eurofleest 1 and 2). He is expert and consultant for several organizations at the regional, national and European levels (GROWTH, THERMIE, ESPRITII, TMR, and national programs ANVAR, RITMER, SARTA-CNRS, CEPM). In 2011 he has launch with his team the development of a new innovative hybrid system named HROV to be operational early 2014. In 2012 he has launched the new European Center for Underwater Technologies (CETSM), and has contributed to the setup of a new European Underwater Research Group with Marum and AWI in Germany named Phoenix. He is engaged in numerous European and industrial projects in the field of underwater systems. He has published around 118 papers since 1988, and has supervised 7 PhD students. He is teaching in several engineering schools. He is co-editor of several journals (Journal of Field Robotics, Journal of Marine Technologies). He was auditor of the Fondation Méditerranéenne d'Etude Stratégique and of the Institut de Hautes Etudes pour la Science et la Technologie. He is author or co-author of several active patents Selection of Recent significant publications). He is engaged within several international advisory boards (MARUM, ROBEX…)

Title: *Locomotion of Animals and Robots in Flow*

Abstract: Underwater robots consider flow as noise and disturbance that has to be compensated for. Swimming animals have strategies to turn flow to their advantage. This talk explains how animals perceive flow and interact with the flow and how to these strategies can be put in use on underwater robots to build more autonomous, intelligent and economic vehicles.

Speaker: Prof. Maarja Kruusmaa, Centre for Biorobotics, Tallinn University of Technology, Estonia)

Bio: Maarja Kruusmaa is a Professor of Biorobotics and a head of Centre for Biorobotics in Tallinn University of Technology (Estonia). Her research interests include underwater robotics, bio-inspired robotics, fish locomotion and sensing, flow sensing, hydrodynamic imaging and experimental fluid dynamics. She coordinated a team building the first flow sensing underwater robot in FP7 project FILOSE.

Title: *Testing Smart Technologies for Subsea Operations in Real-World Environment: Recent Results*

Abstract:

The OceanRINGS is a suite of smart technologies for subsea operations, developed over last eight years at Mobile & Marine Robotics Research Centre (MMRRC), University of Limerick, Ireland. Remotely Operated Vehicle (ROV) LATIS is a prototype platform developed at MMRRC to test and validate OceanRINGS. It is a next generation smart ROV with unique features, including multiple modes of operation, advanced 2D and 3D displays, intuitive, versatile and easy to use pilot interface, built-in autotuning of low-level controllers, voice navigation and fault-tolerant control system. With integrated state-of-the-art navigation sensors/instruments, the vehicle can achieve precision navigation and subsea positioning. Other features include ROV high precision dynamic positioning (DP) in absolute earth-fixed frame or relative to ship, robust speed/course controller with independent heading control and improved ROV – ship link. ROV LATIS has many advantages when compared to similar size commercial ROVs, including more intuitive pilot interface, better visualisation and situation awareness, and advanced semi-automatic and fully-automatic control modes, enabling ROV pilots with average skills to achieve exceptional results. Recently the OceanRINGS suite has been expanded with ability to include small inspection mini ROVs (VideoRay Pro 3 & Pro 4) for long endurance deployment on marine renewable energy resources and oil & gas underwater installations operated in real-time through remote presence (Ethernet/Internet).

System validation and technology demonstration was performed through a series of test trials with different support vessels off the north, south and west coast of Ireland, in Donegal, Bantry Bay, Cork Harbour, Galway Bay, Shannon Estuary and La Spezia, Italy. This presentation highlights the main features of the overall system, presents selected results of test trials and discusses implementation issues and potential benefits of the technology.

Speaker: Dr. Edin Omerdic, Senior Research Fellow, Mobile & Marine Robotics Research Centre, University of Limerick, Ireland

Bio: Dr Edin Omerdic received the B.Sc. and M.Sc. degree in Electrical Engineering from the University of Zagreb, Croatia, in 1997 and 2001, respectively. He received his PhD in Electrical Engineering from the University of Wales in 2004. Since his arrival to Mobile & Marine Robotics Research Centre, University of Limerick, Ireland in 2003, he was engaged in numerous research projects in the area of submersible robotics. His research interests include modelling & simulation of dynamic systems (marine platforms, ocean dynamics & disturbances), renewable energy, real-time simulators, virtual reality, development and design of guidance, navigation and control system for marine vessels, nonlinear control systems, implementation of soft-computing techniques in intelligent systems, underwater robotics and fault-tolerant systems.

Title: *Satellite remote sensing for mapping and monitoring habitats and species in marine ecosystems*

Abstract: Satellite remote sensing is a useful tool for mapping and monitoring nearshore environments where water visibility allows detection of the seafloor from space. Passive optical remote sensing – the use of 'satellite images' – uses reflected solar radiation to both map bathymetry and identify broad categories of benthic habitats, such as mud, sand, rock, and a range of habitat-forming sessile organisms such as algae, seagrass and corals. With supporting field data for calibration, the species and densities of these sessile organisms may also be estimated, and with time-series of remote sensing data changes can be monitored and quantified. Limitations to the use of satellite remote sensing in the nearshore environment derive mainly from scattering and absorption of solar radiation in the water column; this limits the depth to which the technology can be used to make inference about the sea floor and reduces the accuracy of the derived maps. Maps of bathymetry and benthic habitats can directly inform marine spatial planning, and can also serve, along with other spatial data, as input to models that seek to predict the distributions of species of interest, or ecosystem variables such as herbivory or resilience to climate change. This presentation will provide a broad overview of the different uses of remote sensing in the marine environment with examples primarily drawn from past and current research projects.

Speaker: Anders Knudby, Assistant Professor, Simon Fraser University, Department of Geography, Canada

Bio: My research interests cover several topics within the field of remote sensing and its application to environmental research and management, ranging from development of image processing protocols and improved knowledge extraction from imagery to application of remote sensing and other spatial data products in species and habitat distribution modeling. For my PhD research I focused on extending the standard range of remote sensing products available for a tropical nearshore environment and on investigating how the fish fauna responds to the mapped aspects of the reef environment, which ultimately enabled me to produce maps of fish biomass and diversity. I worked with the Wildlife Conservation Society in Fiji to produce similar maps there and to further develop the approach to enable production of maps of ecosystem resilienceindicators. These maps currently feed into marine spatial planning in Fiji. As I worked as conservation coordinator of a small marine protected area in Zanzibar during part of my PhD, the tropical nearshore environment also became the focus of other research projects, including mapping of seagrass and detection of long-term change trajectories, all with a focus on practical application of the results in science and management. I am currently involved in research that aims to upscale the mapping of seagrass to all of Zanzibar and use the resulting maps to investigate the effect of seagrass density, extent and species on invertebrate distributions. I am also developing projects to map seagrass and kelp in British Columbia, and to track their distribution changes over recent decades. In the future my technical focus will be on image processing including object-based classification, data fusion and time-series analysis, while my application focus will remain the marine environment, expanding from the nearshore to also include the deep ocean.

Title: *Inside the technologies available for mapping deep habitats*

Abstract: Mesophotic and deeper habitats are becoming of more scientific interest due to the presence of several rare and protected species and habitats that, despite their ecological importance, are threatened by anthropogenic impact. After the pioneering exploration made by Cousteau more than 50 years ago, we had to wait for the beginning of the 2000s (at least in Italy), to have research vessels equipped with very high-resolution echo sounders able to map with precision and velocity large seabed areas. High-performance remotely operated vehicles equipped with several sophisticated cameras are now available at a reasonable cost and can be used to explore these undiscovered habitats by collecting images and samples of never-before-observed organisms. All this effort can be focused on the creation of thematic maps that illustrate the seabed features as well as the presence and distribution of most of the important species and habitats. These maps are the first step towards creating marine protected areas and establishing protection measures.

Speaker: Dr. sc. Simonepietro Canese, *Italian National Institute for Environmental Protection and Research,* Rome, Italy

Bio: My early studies were focused on fishery research and habitat, distribution and movements of large vertebrates in open sea areas. I started working in ICRAM (now ISPRA) in 1999 and since 2007 I have spent lot of time in tagging Swordfish, Giant devil ray, Sandbar shark, Moonfish and Fin whale specimens with satellite transmitters- this work was the argument of my PhD discussed in 2005 at the University of Genova. In 2007 I started using an ROV (remotely operated vehicle) for a marine biodiversity monitoring program. Today more than 500 sites around Italy at depths between 50 and 550 meters were explored in collaboration with all Italian principal research institutions. Also, in this way the presence and distribution

of several new, rare, uncommon and protected species has now been described around Italy. My most relevant discoveries are the beautiful meadow of black coral (*Antipathella subpinnata*) close to the Messina Strait, the bioluminescent zoanthid, not yet fully classified, found by chance along the west side of Sicily and the forest of millenarian smooth black coral (*Leiopathes glaberrima*) found south of Sardinia.

At present I am a full time researcher at ISPRA and scientific coordinator of three projects aimed at finding and mapping the presence and distribution of precious red coral. I continue to collaborate with all researchers that give me the possibility of exploring deep habitats by means of ROV.

Title: *Adding value to habitat surveys in the offshore and deep-sea through the development of habitat suitability models to predict large area habitat distributions*

Abstract: There is a pressing need to produce concrete proposals for the improved management of deep-sea fisheries and other resources while taking into account the need to conserve biodiversity (Grehan et al., 2007). Implementation of such policies relies on information that is in short supply in the offshore and deep-sea despite increasing access to advanced survey technologies such as Remotely Operated Vehicles and Autonomous Underwater Vehicles.

The EC CoralFISH project (www.eu-fp7-coralfish.net) has developed new tools and methodologies to address this lack of data. In so doing, project partners assessed the interaction between corals, fish and fisheries, and then used this information to develop monitoring and predictive modelling tools for ecosystem-based management in the deep waters of Europe and beyond. This unique project received funding of EUR 10.8 million, of which EUR 6.4 million came from the European Commission. This enabled, for the first time, extensive mapping of new coral areas in Iceland, France and the Azores, and the quantification of coral habitats in these and three other areas – off the west coast of Ireland, the Eastern Norwegian Sea and in the Ionian Sea (Italy). The project developed a software programme called COVER (Customisable Video Image Observation Record) to facilitate standardised video analysis for deep seafloor habitat mapping.

This information was then used to develop 'state of the art' models to predict where corals (and other vulnerable species such as sponges) could be found at the scale of national EEZs (Rengstorf et al., 2013), the NE Atlantic (Rengstorf et al., 2012) and in the global ocean (Yesson et al., 2012). Predicting the whereabouts of corals will help policy makers understand how to best use marine space – for fishing, telecommunications cables and mineral exploration, while also protecting the environment - in line with a proposed new EC Directive (COM, 2013) establishing a framework for maritime spatial planning and integrated coastal management.

This talk will provide an overview of the above with a focus on the challenges of providing both spatial context for, and extrapolation of, limited video survey data, to provide continuous coverage habitat maps in the deep-sea.

Speaker: Anthony Grehan, *National University of Ireland, Galway*

Bio: I'm a Senior Research Fellow in the discipline of Earth and Ocean Sciences, School of Natural Sciences, at the National University of Ireland, Galway. I obtained a PhD in Zoology in Ireland before undertaking post-doctoral studies at the Université Pierre-et-Marie-Curie, Paris VI (Laboratoire Arago, Banyuls) and at the University of Québec in Rimouski and Montreal, Canada. That work primarily focused on benthic mapping/monitoring and environmental assessments of estuaries, embayments and coastal seas, and hydrothermal vent and seep areas in the deep-sea. During the past 10 years my research has focused on the study and conservation of Irish cold-water coral reefs. Ireland is home to some of the most extensive cold-water coral reefs in the NE Atlantic and I have been fortunate to have been involved in the initial and subsequent discoveries of most of the know Irish reefs. Irish corals are generally found between 500 and 1000m depth, from 150 to 350 miles offshore, necessitating the use of ocean capable research vessels and 'state of the art' Remotely Operated Vehicles. I have participated in 10 ROV/submersible expeditions and have been chief scientist on three recent Celtic Explorer expeditions in 2005, 2009 and 2010. One of the legacies of the Irish 'Celtic Tiger' economy was the investment by the State in an ambitious multi-year, multi-beam seafloor mapping survey of the entire Irish Economic Exclusive Zone called the Irish National Seabed Survey. Over 600,000km2 of the deep-sea were mapped in three years and have provided a tremendous resource for the identification of new coral areas. We have used this information to develop habitat suitability models that use terrain attributes generated from the high resolution bathymetry to identify areas with high potential as coral habitat. These models are now sufficiently robust to be used as decision support tools in marine spatial planning. This approach has been further developed within an EC large integrated project called 'CoralFISH' (www.eu-fp7-coralfish.net), that I coordinate. The project, with participants from 11 countries, is developing monitoring and predictive

modeling tools to support ecosystem based management of resources in the deep waters of Europe and beyond.

Further information available from: http://www.nuigalway.ie/our-research/people/natural-sciences/anthonygrehan/

Title: *Seagrass monitoring in Croatia*

Abstract: The talk will review the statistical procedures and metrics necessary for evaluating the health of the shallow marine environment, and will consider those procedures and metrics with respect to Posidonia oceanica. I will discuss diachronic cartography as a means of quantifying change, the associated errors, and the statistical sample size necessary to demonstrate change. Methods will include sidescan sonar, aerial photography, and satellite imagery. I will compare these to non-cartographic methods for evaluating condition and change in condition, including boat-based videographic sampling, and scuba sampling of individual plant and meadow characteristics. This discussion will provide recommendations regarding scientifically defensible methods for quantifying seagrass health, and changes in seagrass health in Croatia, that maximize information value for a given amount of effort.

Speaker: Stewart Schultz, *University of Zadar, Croatia*

Bio: Stewart Schultz is a marine biologist, botanist, and plant evolutionary geneticist, with research interests in the organization of shallow benthic animal communities, evolution of plant mating systems, conservation of coastal resources, integrated coastal zone management, and statistical methodology. He has mentored or co-mentored over 20 dissertation projects, has supervised research as PI for an NSF grant on the evolution of plant mating systems, for a research grant from the Croatian Ministry of Science on monitoring and the ecology of marine benthic habitats in the Croatian Adriatic, and as consortium member within CoCoNet, an FP7 project on the design of an integrated network of Marine Protected Areas in the Mediterranean and Black seas.

Title: *New Adventures Underwater: Archaeology and the Role of the Citizen-Scientist*

Abstract: Continuing the BTS theme of developing new interdisciplinary partnerships, this paper draws on the practical experience of several underwater archaeological projects that have involved citizen-scientist or teacher-at-sea volunteers, and asks how the model may be applied more broadly in underwater research. As scientific funding agencies globally come under increasing financial pressure, the public demands that scientific research should yield results of immediate and obvious benefit. This leaves no room for the kind of adventurous research that often leads to major discovery, but more often leads to nothing in particular in the short term. Some of the most important projects of this nature in underwater archaeology have been supported through educational programs and private philanthropy involving vocational researchers. This paper asks how the citizen-scientist model can be strengthened and expanded, and considers its possible applications in underwater research of the future. Inter alia, I will present the latest results of the URI underwater projects in Israel.

Speaker: Prof. Bridget Buxton, University of Rhode Island

Bio:Dr. Bridget Buxton is an assistant professor of History at the University of Rhode Island and a member of URI's Archaeology Group. She obtained her Ph.D. in Ancient History and Mediterranean Archaeology from the University of California, Berkeley on a Fulbright, and her MA in Classical Studies (with distinction) from Victoria University, Wellington, New Zealand. Her archaeological field experience includes both land and underwater projects in Greece, Israel, Turkey, the Black Sea, and in her homeland of New Zealand. Since 2006 she has been involved in deep water projects under the direction of Prof. Robert Ballard of the University of Rhode Island and Prof. Shelley Wachsmann of Texas A&M Nautical Archaeology Program, and more recently joined a collaboration with the Israel Maritime Antiquities Unit. She obtained certification as an AAUS scientific diver and NAUI assistant instructor qualifications through Berkeley's scientific diving program in 2000. Her main areas of interest in addition to underwater archaeology include Roman and Hellenistic history and archaeology, and archaeological ethics. She held the McCann-Taggart lectureship in underwater archaeology for 2009-2010,

and is currently beginning a third national lecture tour for the Archaeological Institute of America, speaking on underwater archaeology and the Roman emperor Augustus, which is under contract with Cambridge University Press.

Title: *A marine geoarchaeological survey in Caska bay (Pag Island, Croatia): Preliminary results*

Abstract: In the framework of the international interdisciplinary research project *Cissa antiqua*, directed by the University of Zadar (Croatia) and Centre Camille Jullian, CNRS (France), a detailed marine remote sensing survey was carried out in the semi enclosed and elongated shallow bay of Caska, located in the central part of the island of Pag (Croatia). The survey was carried out between 17th and 24th May 2012 by the Laboratory of Marine Geology and Physical Oceanography of the University of Patras (Greece).

The objective of the geoarchaeological survey was threefold: (I) to investigate in detail an ancient shipwreck which is located at the northern end of the Caska bay, (II) to detect surface targets of potential archaeological significance, and (III) to study the palaeogeographic evolution of the bay during the last 10 kyrs based on the seismic stratigraphy. The survey was conducted using: (i) an Elac Nautic Hydrostat 4300 echo sounder, (ii) a high resolution 3.5 kHz subbottom profiling system with Geopulse transmitter/receiver, Triton Elics acquisition system and an over-the-side 4 array transducer, and (iii) an E.G. & G. Model 272-TD dual frequency (100, 500 kHz) side scan sonar tow fish in association with digital recording unit Edgetech 4100P topside. Positioning data were obtained by a Hemisphere V100 GPS with an R.M.S. accuracy of 2m.

The 3.5 kHz profiles showed that the upper 15m consists of three distinct seismic sequences overlapping the gentle folded acoustic basement. The results of the seismic data in correlation with the present coastal geomorphology of the area suggest that these sequences correspond to phases of inundation by brackish water before seawater flooded the gulf, as the consequence of the sea-level rise.

The side scan sonar survey revealed a large number of targets of potential archaeological interest. Moreover, the TARGAN software, a MATLAB based software which can be used for the quantification; classification and clustering of side scan sonar targets, was used for the selection of most important targets from archaeological point of view.

Speaker: Prof. George Papatheodorou, Laboratory of Marine Geology and Physical Oceanography, Department of Geology, University of Patras, Greece

Bio: George Papatheodorou, marine geologist, has more than 25 years experience in applied oceanographic work. He is a Professor in the Geology Department of the University of Patras, Greece and Director of Laboratory of Marine Geology and Physical Oceanography. His research interests include: gas charged sediments, submarine gravitative mass movement processes, marine pollution (heavy metals in sediments and marine litter) and marine geoarchaeology (application of remote sensing techniques to the underwater archaeology). He is/was coordinator of many national projects with an applied aspect – oceanography in relation to offshore installations (submarine power and telecommunication cables, submarine pipelines and harbours) and to sea waste disposal and its ecological consequences on the marine environment. He has participated in EU research programmes on gas migration in the marine sediments and development of submarine observatories (ASSEM), on the monitoring of oxygen depletion and associated processes in aquatic systems (HYPOX), on coastal zones of great archaeological interest (APREH and SASMAP). He has carried out marine geoarchaeological surveys in Alexandria of Egypt with the collaboration of Centre d' Etudes Alexandrines (J-Y Empereur), in archaeological sites of Greece (Kyllene harbour, Cape Sounio, Poros and Dokos Islands, Zea and Mounichia ancient harbours) with the co-operation of Finnish Institute at Athens, University of Peloponnesus, Hellenic Institute of Marine Archaeology, Zea harbour Project (Danish Institute) and Ephorate of Underwater Archaeology of Greece, and in Cyprus with the collaboration of the University of Cyprus. He has more than sixty five (65) publications in International Refereed Journals (Science Citation Index, S.C.I.) with a total impact factor of more than 110 (mean: 2.30) and more than 750 citations (h-index: 17-19). He has also published many full papers (over 90) in International Conferences in the field of Environmental Oceanography and Marine Science. He has served as reviewer in fifteen Journals of Science Citation Index.

Title: *Recording the Gnalić Shipwreck*

Abstract: Since the mid-19th century the use of photographic images to determine the dimensions and shape objects have not stopped evolving. Commercial, off-the-shelf software allows quick and accurate recordings of objects using small portable computers. Recording archaeological objects, however, is a complex task that requires knowledge and experience. This paper will describe the recording of the Gnalić shipwreck site during the 2013 excavation season and attempt to evaluate the advantages and shortcomings of computerized mapping.

Speaker: Filipe Vieira de Castro, Texas A&M University USA

Bio: Filipe Vieira de Castro is Professor of Anthropology, holds the Frederick R. Mayer II Fellowship of Nautical Archaeology, and is the Director of the Ship Reconstruction Laboratory at Texas A&M University. He has a degree in civil engineering from Instituto Superior Técnico, a Master of Business Administration from the Catholic University of Lisbon, and a PhD in Anthropology from Texas A&M University. He has conducted field work in Portugal, Panama, Puerto Rico, Italy, and Croatia, and his main interests are the history of wooden shipbuilding technology and European seafaring in the late medieval and early modern periods.

Title: *Deep sea investigations in Sicily*

Abstract: A new frontier of underwater archaeology is deep sea research. In Sicily beside many discoveries of interesting archaeological finds in deep sea waters made by fisherman using drag-nets, such as the Phoenician bronze Reshef from Selinunte, the Satyr of Mazara del Vallo and the elephant's foot, the first real research in deep waters was done by us in the beginning of this century in the Egadi Islands.

We selected an area south of Favignana where we knew from fisherman that there was an ancient wreck that we surveyed using a multibeam provided by Geolab company. After the identification of a possible target at a depth of around 70 m we identified it as a wreck using a small ROV that gave us the possibility to understand the nature and chronology of that wreck. It was a medieval small ship full of small amphorae, different varieties of vases and tiles sailing from a nearby harbor of western Sicily (Mazara del Vallo?) towards Marsala or Trapani.

Other deep sea survey with side scan sonar, multibeam and ROV were carried on in the same campaign around Levanzo, Favignana and western Sicilian shores.

But a strong acceleration to deep sea archaeological research in Sicily was given when we started a fruitful collaboration with RPM Nautical Foundation and Aurora Trust as well as with specialized scuba divers who, using re-breather and gas blends, can reach a depth of slightly more than 100 m.

Speaker: Sebastiano Tusa, University of Naples "Suor Orsola Benincasa", Italy

Bio: Sebastiano Tusa was born in Palermo in 1952. His parents were both archaeologist. He received PhD in the University of Rome "La Sapienza" in 1975 discussing a thesis on Mediterranean prehistory. In the same University he got his specialization in oriental archaeology. Between 1972 and 1985 he performed and directed archaeological researches and excavations in Pakistan, Iran and India. During 1978 and 1979 he was general secretary of the Italian – Irak Institute of Archaeology directing archaeological excavations in the Diyala valley and in the Mosul area that he performed for many years. Since 1980 till 1982 he was prehistoric archaeological inspector at the Prehistoric Museum "L.Pigorini" in Rome. Since 1982 till 1993 he was research fellow of prehistory at the University of Rome "la Sapienza" and Palermo. In 1993 he started his career in the archaeological service of Sicily where he was directing many branches. In 2004 he created the first "Soprintendenza del Mare" in Italy, a research and control centre dealing with marine cultural heritage of Sicilian seas that he directed till 2010. Between 2010 and 2012 he was Superintendent of Cultural heritage of Trapani province. Since 2012 he was again Superintendent of "Soprintendenza del Mare". He is also contract professor of prehistory at the University of Naples "Suor Orsola Benincasa" and was contract professor of underwater archaeology at the University of Bologna (Trapani branch) till 2012. Nowadays he is directing land and marine excavations in Sicily, Libya and Japan. He is author of about 700 articles and books dealing with historical and archaeological Mediterranean and Oriental topics either on scientific scale and popular. He was also qualified in a national selection for a full professor chair of prehistory at the University of Cagliari.

Title: *Maritime Security*

Abstract: The application of robotics to maritime security is motivated by the large volume of ocean and coastal embayments to be monitored, the expense of providing adequate coverage (space and time) with manned vessels, and the diversity of possible threats to commerce, offshore resource exploitation and territorial incursion. Response to the threat spectrum can be broadly classed into mine countermeasures, anti-submarine warfare and harbor and coastline defense. Robotic platforms developed for maritime security can be broadly classed into autonomous surface vehicles and autonomous underwater vehicles. Unmanned aerial vehicles are also useful in maritime security applications. The most useful tool for maritime security is an integrated systems consisting of a combination of these platforms, capitalizing on the strengths and unique sensing capabilities of each. Examples of component vehicles will be described. Integration of these vehicles into specific systems designed to counter the various threats will be examined in terms of the current state-of-the art and possible future directions. Finally, research needs will be identified that will extend the current limitations of such systems.

Speaker: Thomas B. Curtin, Ph.D., Institute for Adaptive Systems, Arlington, VA USA

Bio: Thomas Curtin is currently a Senior Fellow at the Institute for Adaptive Systems with a research focus on estimating spatial-temporal gradients through feedback control of mobile sensing. The goal is to provide valued options for decisions in uncertain and risky environments.

From 2008 to 2011, Dr. Curtin served as Chief Scientist at the NATO Undersea Research Centre in La Spezia Italy, providing strategic direction in planning and managing naval science and technology research for NATO. From 2007 through 2008, he was the Chief Knowledge Officer at the Association for Unmanned Vehicle Systems International, responsible for information on air, ground and maritime unmanned systems. From 1984 to 2007, Dr. Curtin managed programs at the United States Office of Naval Research (ONR) in Physical Oceanography, Arctic Sciences, Ocean Modeling and Prediction, Undersea Autonomous Operations and Undersea Surveillance. These programs ranged from basic research (6.1) to advanced development (6.3). He also served as Deputy Director of ONR for Strategy and Planning (2003). While at ONR, he developed and led basic research initiatives in surface gravity waves, Arctic leads, sea ice mechanics, Arctic acoustics, deep ocean convection and adaptive sampling networks; and applied research initiatives in acoustic communication, autonomous underwater vehicles, autonomous surveillance and reconnaissance, mine countermeasures and persistent littoral undersea surveillance. He has been instrumental in transitioning communication technology (acoustic and electromagnetic), autonomous vehicle systems (platforms and sensors) and advanced numerical models (ocean and acoustic) to a number of acquisition programs and operational commands. He initiated an Autonomous Underwater Vehicle Fest in 1997 to better connect research and operational communities. He established an annual autonomous underwater vehicle student competition in 1998 that is now an international event designed to stimulate student interest in maritime systems engineering. From 1979 to 1984, Dr. Curtin was an Assistant Professor at North Carolina State University, teaching several courses and serving as principal investigator on numerous research grants and contracts. From 1969 through 1971, he was an oceanographer at the Fisheries Research Institute in Penang Malaysia. He has been Chief Scientist on over 25 oceanographic cruises in the mid-latitude and equatorial Atlantic and Pacific Oceans, the Arctic Ocean, the Ross Sea in Antarctica, and the South China Sea.

Dr. Curtin received the B.S. degree in Physics from Boston College, the M.S. and Ph.D. degrees in Physical Oceanography from Oregon State University and the University of Miami, respectively, and the M.B.A. degree from Massachusetts Institute of Technology. His thesis topics focused on electrical fields in the ocean, coastal ocean frontal dynamics, and research management using system dynamics and real option valuation. He has been guest editor of several journals (IEEE, AGU), has authored over 35 peer-reviewed papers, 21 technical reports and 2 patents. He holds a pilot's license (land and sea ratings) and SCUBA certification. He has been awarded the U.S. Navy Meritorious Civilian Service Medal, the U.S. Navy Superior Civilian Service Medal, the U.S. Navy Unit Commendation and the U.S. Coast Guard Arctic Service Medal.

Title: *Identifying new candidate technologies for effective maritime security missions: Utilize robotic platforms in order to reduce the cost without sacrificing key performance*

Abstract: The use of unmanned/robotic/autonomous systems has the potential to transform the maritime security capability from legacy systems focused on time consuming operations with surface ships, to a quickly deployable (air/sea lift), scalable system which offers an order of magnitude increase in speed of operation, reduction in life-cycle cost and increased interoperability over existing systems. With the continuing move towards the use of remote systems for maritime security and the reduction in numbers of dedicated assets, it is important that both surveillance and intervention can be achieved from remote

platforms. The systems at the heart of the maritime security programs are, in fact, extreme realizations of autonomous information-decision chains: autonomous (robotic) vehicles that have

missions, sense their physical environments search for and classify targets, interpret their signal environment, and take actions depending on their autonomous interpretation. CMRE conducts state-of-the-art scientific research and experimentation ranging from concept development to prototype demonstration. CMRE consists of two departments: scientific and engineering which jointly utilize the advances in robots' navigation, control, and signal processing to design and perform experiments at sea. CMRE is a leading example of enabling nations to work more effectively to verify the potential of emerging robotic technologies to the missions of maritime security. Robotics spreads through all research activities at CMRE: Autonomous Naval Mine Countermeasures, Cooperative Anti-Submarine Warfare, Environmental Knowledge and Operational Effectiveness, and Maritime Security. There exists an initiative for Costal Ocean Observatory (Long Term Test Site) in which the robots would be a part of the nodes for an Autonomous Oceanographic Sampling Network (AOSN), would work 24/7, and would greatly contribute to the maritime security research activities.

Speaker: Dr. Vladimir Djapic, Centre for Maritime Research and Experimentation (CMRE), La Spezia, Italy

Bio:Dr. Vladimir Djapic is a Scientist and Project Leader for Mine Reacquisition and Identification of an Autonomous Naval Mine Countermeasures Programme at CMRE, and a Technical Director of Student Autonomous Underwater Challenge – Europe (SAUC-E).

He received a PhD from UC Riverside in 2009 and earned the MS and the BS both from UC San Diego in 2000 and 2001, respectively. His research interests are in applying behavior-based, nonlinear, and adaptive algorithms to control of cooperative autonomous vehicles. His interest is also in novel methods for autonomous navigation of multiple heterogeneous vehicles in difficult marine environment. The objective of his research effort at CMRE is to design a low cost, but at the same time robust and effective mine intervention system based on cooperative autonomous vehicles. He leads a team of researchers and mentors several students on topics in navigation and control of autonomous robots. He served as a Subject Matter Expert (SME) for US Navy future Expeditionary Unmanned Undersea Vehicle Neutralization System (EUNS). His previous employment was at the US Navy's SSC Pacific in San Diego, where he had worked since April 2002. His Office of Naval Research funded work focused on utilizing advances in navigation, control, and sonar processing to exploit autonomous vehicles for increasingly complex missions, a particular one being ship hull inspection. He has led a number of collaborative research projects as a PI on behalf of CMRE (Maritime Security and Autonomous Vehicles Joint Research Project, SAUC-E, NEST, euRathlon - The European Roboathlon, NATO Applied Vehicle Technology Panel (AVT) - as ex-officio member from CMRE) and has more than 30 peer-reviewed publications either as journal papers, conference articles, or technical reports. Recent relevant journal/magazine publications are in IEEE Journal of Field Robotics, IEEE Transactions on Control, IEEE Journal of Oceanic Engineering, Sea Technology, IEEE Robotics & Automation Magazine, and Sea Discovery. Also, recent relevant presentations were at the Workshop on Marine Robotics and Applications in Las Palmas (the workshop invitees - invitation only were world's experts in marine robotics) and at the 2nd Workshop on Robot Competitions: Benchmarking, Technology Transfer, and Education of the European Robotics Forum in Lyon.

Title: *Maritime Domain Awareness Technologies and Applications*

Abstract: Our maritime domain awareness work develops and applies emerging technologies in support of layered surveillance. The layers include satellite-based synthetic aperture radar for wide area views of the ocean, high-frequency radar systems providing over-the-horizon situational awareness, and near-shore and harbor sensing systems centered on underwater acoustic and video technologies. Integration of these systems accomplishes threat detection, classification, identification, and tracking from individual swimmers to large container ships. In addition to our research, we have developed and delivered applications for end-users including the U.S. Coast Guard and the U.S. Customs and Border Protection that deliver actionable information in operationally relevant settings. In the area of underwater robotics, we have linked our passive acoustics threat detection system with an unmanned underwater vehicle, sending the vehicle to investigate a signal perceived by the acoustics system. In addition, our education programs are training the next generation of maritime security professionals through a Summer Research Institute and through masters' degree fellowships. Our nine fellowship students have successfully completed internships at national laboratories and the U.S. Coast Guard (Sector NY and Atlantic Area). The talk will describe our work in these areas and some of the products and technologies that we have developed.

Speaker: Dr. John Dzielski, Davidson Laboratory, Stevens Institute of Technology, Hoboken, NJ USA

Bio:John Dzielski earned a BS in mechanical engineering from Carnegie-Mellon University in 1982, and MS and Ph.D. degrees in mechanical engineering from the Massachusetts Institute of Technology in 1984 and 1988, respectively. For almost 21 years, he was employed at the Applied Research Laboratory at the Pennsylvania State University. In his final position there he was head of the Unmanned Vehicle Systems Department and directed the development of software for autonomous vehicles as well as being responsible for operation of the vehicles at-sea. He has worked on numerous UUV programs ranging in size from 20 kg to over 8200 kg. operating for periods of time ranging from seconds to many days. In 2009, he accepted the position of Deputy Director of the Maritime Security Laboratory at Stevens Institute of Technology. In that position he directed research applying UUVs and acoustic technology to the protection of ports and maritime assets, and research related to UUV operations in estuaries. In this role, he applied knowledge and experience acquired from UUV sensor system integration to support the integration and operational testing of sensing technologies in support of maritime domain awareness research programs. In his role as a member of the Davidson Laboratory, he is conducting research into the modeling and control of cavity-running bodies.