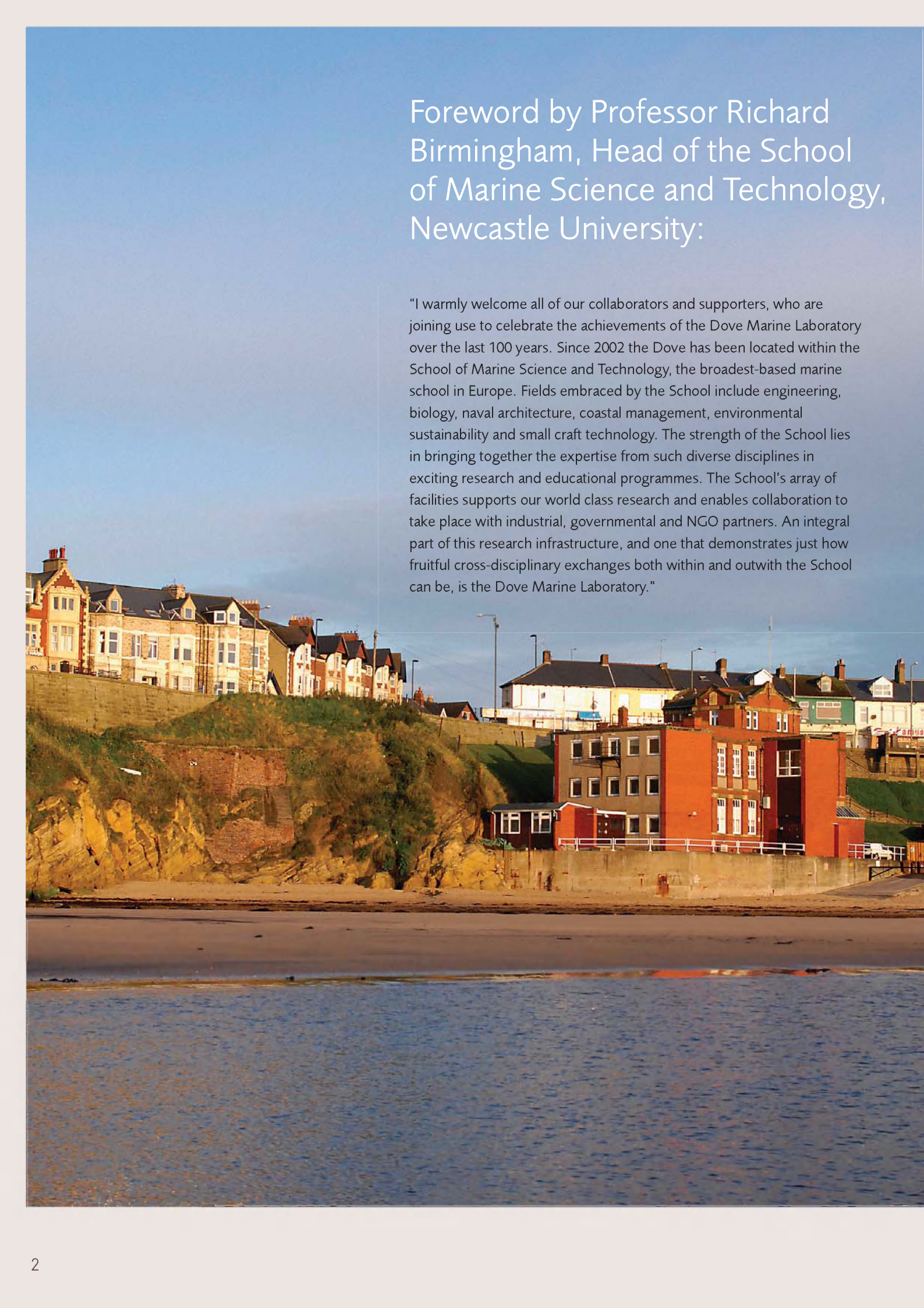


# DOVE MARINE LABORATORY

CELEBRATING A CENTURY OF EXCELLENCE IN MARINE SCIENCE

A photograph of a coastal town. In the foreground, there is a calm body of water. Behind it is a sandy beach. A concrete sea wall runs along the beach. Above the wall, a row of colorful houses (red, orange, yellow, and white) is built into a grassy cliff. Further up the cliff, more houses are visible, some with red roofs. The sky is a clear, pale blue.

## Foreword by Professor Richard Birmingham, Head of the School of Marine Science and Technology, Newcastle University:

"I warmly welcome all of our collaborators and supporters, who are joining use to celebrate the achievements of the Dove Marine Laboratory over the last 100 years. Since 2002 the Dove has been located within the School of Marine Science and Technology, the broadest-based marine school in Europe. Fields embraced by the School include engineering, biology, naval architecture, coastal management, environmental sustainability and small craft technology. The strength of the School lies in bringing together the expertise from such diverse disciplines in exciting research and educational programmes. The School's array of facilities supports our world class research and enables collaboration to take place with industrial, governmental and NGO partners. An integral part of this research infrastructure, and one that demonstrates just how fruitful cross-disciplinary exchanges both within and outwith the School can be, is the Dove Marine Laboratory."



# The Dove Marine Laboratory – a facility for the future.

On September 29<sup>th</sup> 1908 the Duke of Northumberland opened the Dove Marine Laboratory, beginning a fruitful century of scientific endeavour in Marine Biology. The Lab has since played a pivotal role in contributing to our understanding of fisheries science, marine organismal biology, ecology, and of human impacts on our oceans. The region's natural history is as a result among the best known in the world. In celebrating our centenary, we are entering a new era. Marine science is a research area of global importance in the 21<sup>st</sup> century, with issues such as climate change, biodiversity and habitat loss, ocean acidification and marine species invasions challenging our expertise and capabilities. Marine science is also furthering biotechnological and pharmaceutical competence through the development of novel techniques and new drugs. It reveals to us the possibility of providing protein for global human populations through sustainable aquaculture technologies. Our oceans and seas are clearly a new 'frontier' in which sustainable development in this age of critical population growth must be addressed. This is therefore an exciting period in the Dove's history, as new refurbishments and infrastructure developments will enable us to contribute to a greater understanding of the related scientific issues, and to pioneering engineering and technological solutions to these challenges. It will allow the Dove to maintain its proud tradition of contributing to UK and internationally renowned research and education.

*"The Dove Marine Laboratory's current refurbishment works are a reflection of the important part it plays in Newcastle Science City's continuing development. It's exciting and innovative research and public engagement activities are inspiring a new generation of scientists to realise how rewarding studying science can be and its impact on all of our lives. The Dove Marine Laboratory's prestigious research history and its enriching education programme make it a unique and inspirational centre."*

Dr Peter Arnold, Chief Executive of Newcastle Science City

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# Marine Ecology: species interactions to marine systems

We are in an age where technological advances and an increased demand for commodities has led us to utilise areas of the oceans and marine-derived compounds that have been previously inaccessible to humans. Understanding the functioning of marine systems is an urgent research priority if we are to address the effects these activities have on the environment.

Much of the work undertaken at the Dove is underpinned by this need for a solid understanding of fundamental processes. Research is being conducted from algal-grazer interactions to patterns of invertebrate recruitment, and we are exploring the role biodiversity has in sustaining essential ecological 'services' using intertidal systems as models.

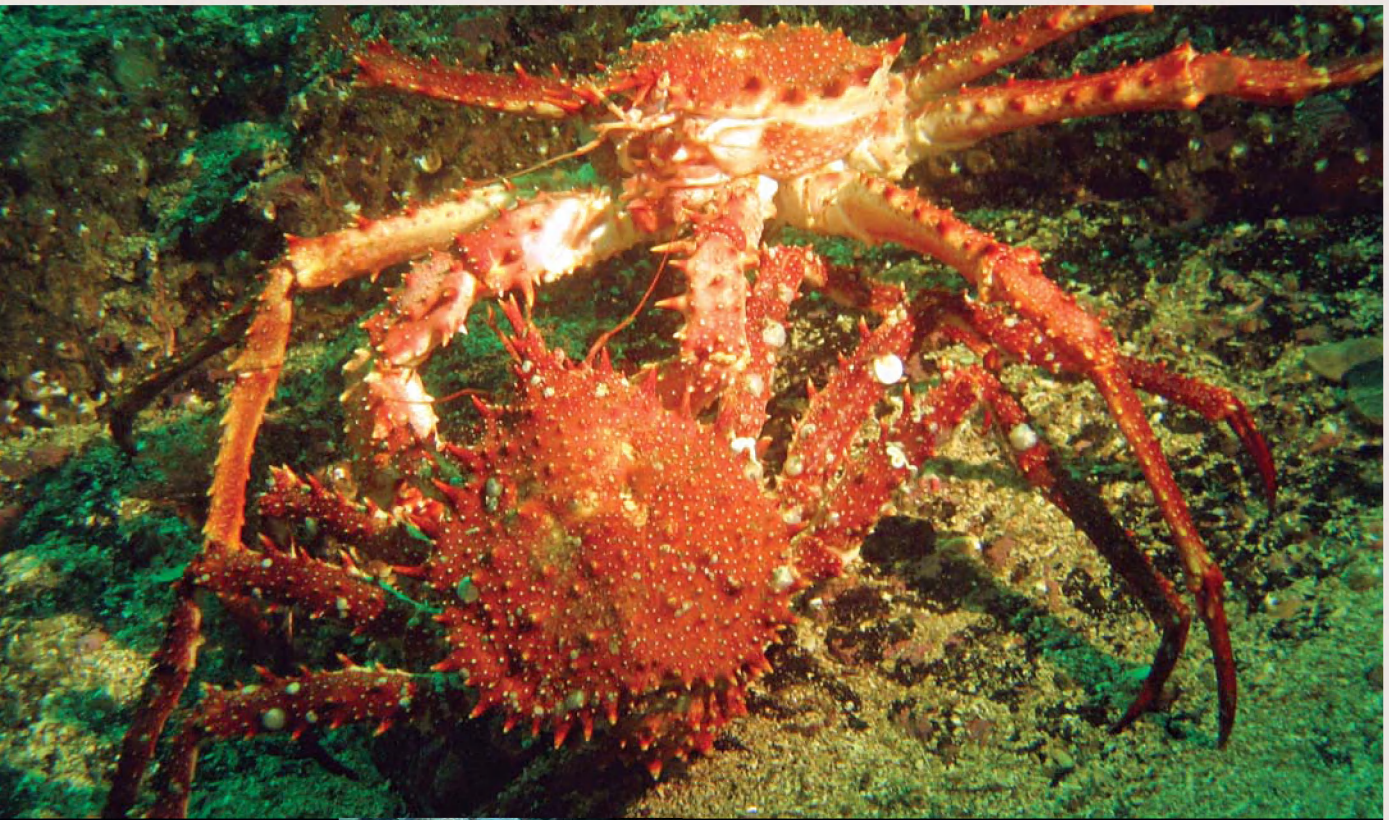
The Dove was at the forefront of research into ecosystem based approaches to the management of North Sea fish stocks. Work continues with the assessment of the efficacy of Prohibited Trawl Areas (PTAs) off the north-east coast. Researchers are using custom built baited video units and fish traps to assess the species richness, abundance and size class distribution of fishes within these PTAs compared to open trawled ground.

Dove scientists are working with oil and gas producers in the North Sea, on a programme to assess the role of active installations as refugia for commercially exploited fish species. Using state of the art ROVs (Remotely Operated Vehicles) and free-fall camera systems we hope to gain insight into the impact of commercial fisheries on marine communities.

We are also active in research on the trophic biology of benthic communities in deep waters of the Mid-Atlantic Ridge and European continental margins. Data are being collected from depths of over 2km using an array of specialised equipment; stable isotope and fatty acid analytical techniques are allowing us to gain an understanding of how deep-sea food webs function in variable habitats, and how the energy supply to deep water systems can influence the development of animals at various stages of their life-cycle.







Understanding the role of species interactions is fundamental to unravelling the complexity of marine ecosystems.

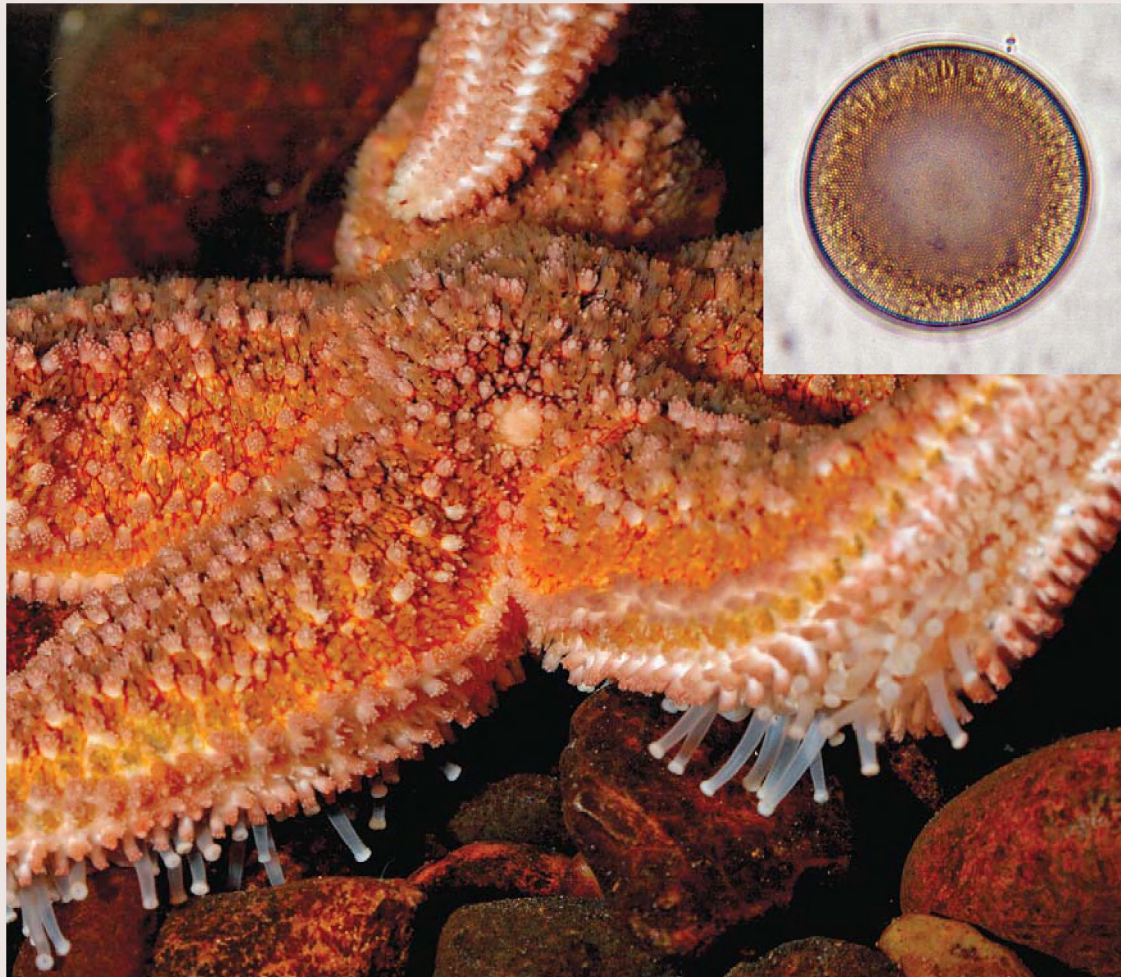
Ongoing work at the Dove explores the effects of fishing on marine communities.

A brisingid deep sea echinoderm.



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*Asterias rubens*, starfish and *Coccinodiscus concinnus*, a centric diatom, occupy the benthic and planktonic Dove Time Series samples respectively.

The dominance of copepods in North Sea plankton means that they have been researched intensively as potential indicators of climatic trends.



## The Dove Time Series

Long-term biological datasets are an invaluable tool to our understanding of the relative importance of hydro-climatic, biotic and anthropogenic drivers of marine systems. The Dove holds ownership of two such important datasets, and welcomes collaboration and utilisation of this information:

The **Dove Time Series Standard Plankton** is an archived collection of physical plankton samples and associated data sampled monthly from a single station at 55° 07N 01° 20W, since 1969. A comprehensive analysis of zooplankton abundance has been conducted, and published work has focused predominantly on the dynamics of key copepod species. More recently, work has focused on the phytoplankton component, and its linkages to the grazer fraction from short-term to decadal scales.

The **Dove Time Benthic Series** have been sampled biannually (Station M1) and annually (Station P) off the Northumberland coast since 1972 and 1971 respectively. Macro-invertebrate analysis has been completed for all samples. While historically the benthic samples had not been stored post-study, from now on we intend to maintain physical samples in a preserved form for future life-history and associated analysis.





*Aplysia punctata*, the sea hare.  
Marine invertebrates are investigated  
as a source of novel compounds.

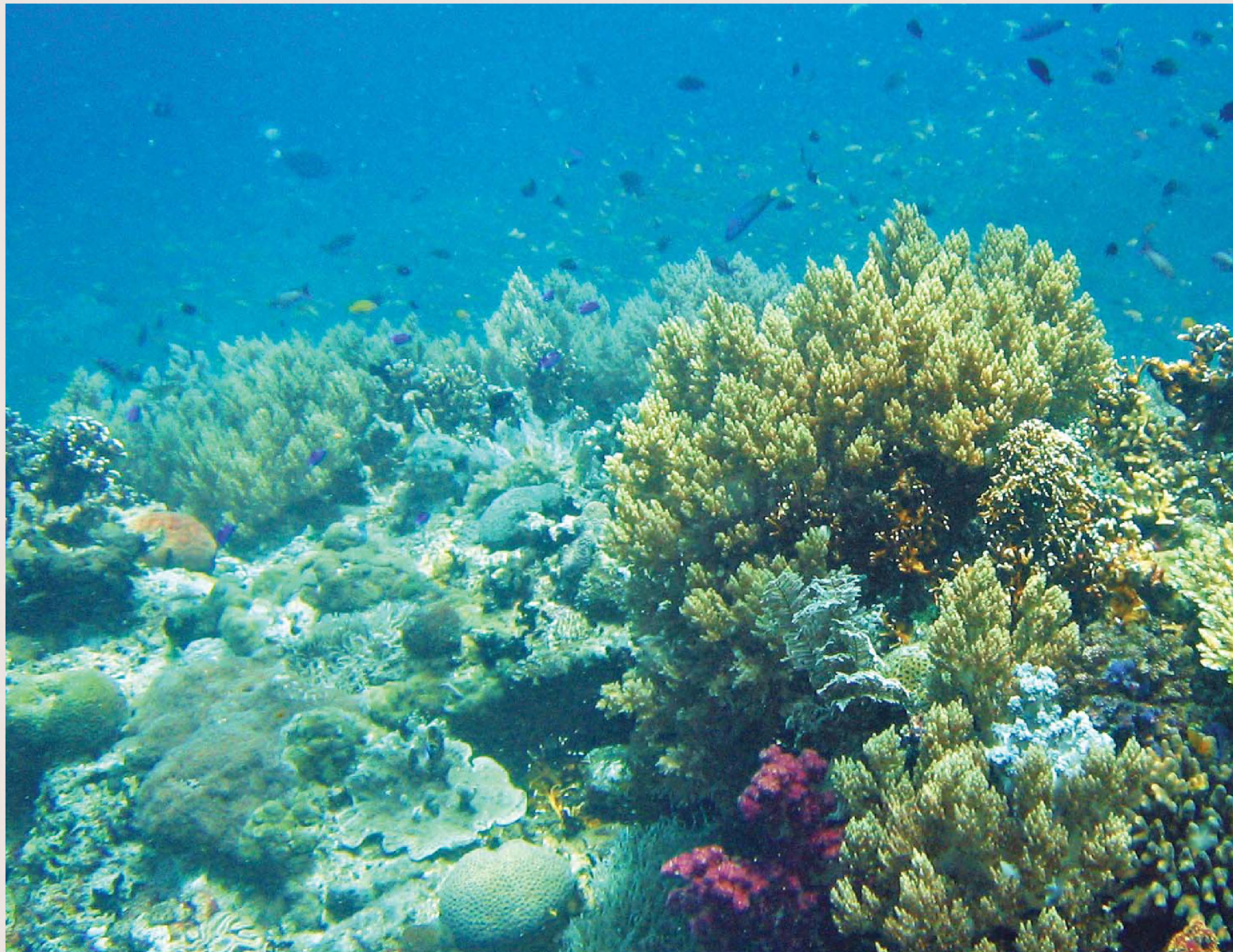
## Marine Biotechnology

Marine biotechnology is the application of marine organisms for the benefit of mankind. Marine creatures and substances made by them can be used in medicine, industry and to help the environment. It is a growth area of strategic international importance and the Dove Marine Laboratory provides expertise and facilities in support of this sector.

Invertebrates such as sponges and nudibranchs are being investigated as a potential source of new medicines and pharmaceuticals as part of the University's initiative in Drug Discovery. The culture of these organisms for research would be impossible without the flow-through seawater aquaria systems available at the Dove.

Cod liver oil has for years been used as a healthy nutritional supplement. Dove scientists are now exploring the production of these oils from marine bacteria, a more sustainable source of the material. We have recently discovered several new strains of such oil-producing organisms from deep sea environments. In conjunction with the University's Dental School, we are investigating novel techniques to reduce plaque growth on teeth using seaweed extracts. Biotechnological research at the Dove has led to innovations in aquaculture research that has implications for our sustainable harvesting of the seas' bounty.





## Chemical Ecology

Chemical ecology is the study of how chemicals influence the behaviour of organisms and their interactions with the environment. In the sea, chemicals play an extremely important role in prey recognition, predator avoidance, in the synchronisation of reproduction and in finding appropriate places for planktonic larvae to settle.

Chemicals are used by many marine animals as a form of communication, and we have identified that sex pheromones play a critical role in mate recognition of crustaceans such as the shore crab. The effectiveness of interference in pheromonally-mediated reproductive processes as a potential means of control of invasive crustacean species is a core focus of our current work.





Chemical signalling plays a communication role in highly diverse coral reef systems. Below, barnacle spat: chemical cues induce larvae to settle near adult conspecifics.



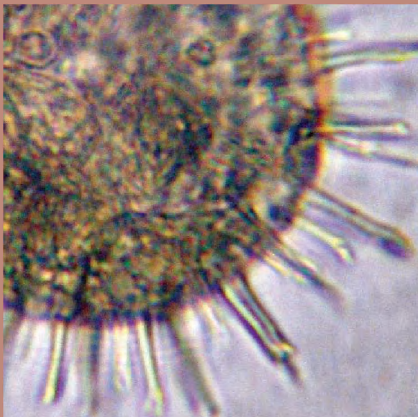
'Biofilms' created by marine microbes on submerged surfaces are often important in cueing settlement of marine invertebrate larvae, as are the presence of previously settled adults of the same species. By understanding the chemical cues these organisms recognise, we can gain a better appreciation of the development of natural underwater communities that encrust rock and algal substrata. This will also assist us in developing novel environmentally safe anti-foulants to prevent the unwanted encrusting life on manmade structures and ship's hulls.

Many interactions in plankton communities are also chemically mediated. We have shown that chemicals produced by microalgae called diatoms interfere with reproduction and development in a range of marine invertebrates that graze upon them. Understanding these algal-zooplankton interactions may lead to a reappraisal of the way we view marine food webs in the future. Current research from the Dove is looking at contemporary North Sea plankton and reference materials from the Dove Time Series over the last 40 years.

# iCASA - Invertebrate Computer Assisted Sperm Analysis

iCASA is a unique European research facility. Developed directly from human in vitro fertilisation technologies, the system has been designed to determine the reproductive health of male aquatic invertebrates. The system is an extremely powerful research platform capable of providing real time data on thousands of sperm cells in a matter of seconds. Research projects include environmental health monitoring, fertility services for the aquaculture industry and biotechnology applications including the development of new contraceptive drugs.

## Ballast Water Research



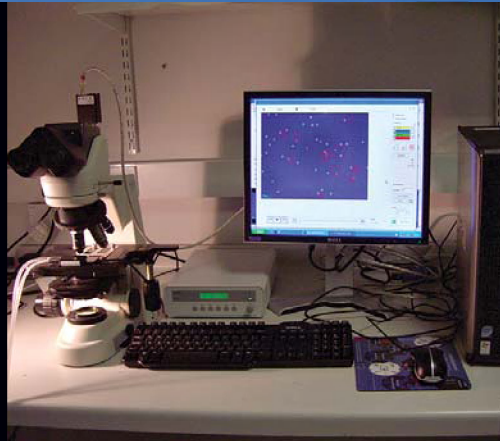
Dinoflagellate cyst

The problem regarding marine invasive species in ballast water has resulted in significant ecological, economic, and public health impacts. Invasions result from the establishment of species beyond their historical geographic range, and have been a focus of increasing attention from scientists and policy-makers, as the observed rate of new invasions in recent time has increased exponentially for coastal habitats worldwide. Internationally agreed standards for the control and management of ships' ballast water have been set by the International Maritime Organisation (IMO), but a universal solution to the problem has yet to be identified. A wide range of approaches for the evaluation of ballast water treatment systems is in existence, but these hold inherent logistical problems, and employ such diverse treatment conditions and response measurements that cross-comparison is difficult. The challenge is to develop a tractable standardised evaluation procedure of 'treatment success', that can be routinely employed at manageable cost, and that encompasses the necessary spectrum of variables.

The School of Marine Science and Technology is uniquely positioned in the UK to contribute to such research. Benefiting from the fusion of expertise in biology and technology, it is one of the European and International leaders in BW research (research and consultancy income in excess of £1M in recent years). The Dove Marine Laboratory, with its high capacity water storage and on-shore location provides the Phase II scale of facilities essential for testing of treatments before on-board ship deployment. With complimentary facilities on campus, we aim to develop the Dove to establish an **International BW Test Centre**.



iCasa research facility



In order to ensure that treated ballast water is meeting the Ballast Water Performance Standard set by the IMO's international convention, it is a requirement that viable cells within certain size ranges be detected and enumerated. A key resource in our research capability is the **FlowCAM®** system. By combining the capabilities of flow cytometry, microscopy, digital imaging and fluorescence detection, this equipment automatically counts, images, analyzes and classifies the particles or cells in a discrete sample or a continuous flow. It ensures a high degree of accuracy in sample processing, and permits the fastest, most intuitive ballast water analysis available. Such technology is also being utilised by Dove scientists to understand the phenology of coastal plankton populations using Dove Time Series samples.



Zooplankton images captured with FlowCAM





Calcified organisms on coral reefs are vulnerable to ocean acidification. Below, a sea urchin larva reared at elevated CO<sub>2</sub> concentration displaying abnormal development.



## Ocean Acidification

One of the greatest threats to the health and wellbeing of the marine environment is ocean acidification. The increase in atmospheric carbon dioxide concentration due to fossil fuel combustion has led to a concomitant increase in the absorption of carbon dioxide by the oceans. This has the undesirable consequence of making seawater more acidic. Many marine organisms including corals, molluscs and crustaceans form their shells and skeletons from calcium. It is suspected that as seawater shifts towards acidity these organisms will be unable to form their hard structures, perhaps ultimately leading to their extinction.

Recent work at Newcastle University has been directed towards understanding the potential impacts of ocean acidification on marine invertebrates. We study not only organisms from temperate systems such as the North Sea but also from tropical environments and polar seas in collaboration with the British Antarctic Survey. We have specifically been investigating the effects of ocean acidification on the reproductive and early developmental biology of marine invertebrates. Early work has shown that as seawater pH declines, embryos are unable to complete their development resulting in death of the larvae. We are currently in the process of designing a system to be installed onboard a British Antarctic Survey ship to experimentally alter pH during research cruises in the Southern Ocean to investigate acidification effects on krill larval development.





## Training the Marine Scientists of the future

Since its inception the Lab has been a key resource for the training of our undergraduate and postgraduate students in field ecology and marine survey skills. Our graduates have gone on to secure positions of responsibility in fields of management, research and policy across the world, working from the tropics to polar seas. Our Marine Biology degree is the first of its kind in the UK to be accredited by the Institute of Marine Engineers Scientists and Technologists. With our more recent amalgamation with colleagues in Marine Technology, we are insuring that our new generation of Marine Science and Engineering graduates will have a broader understanding of how man's technology and use of the seas' resources can be managed in ways that do not impinge on the integrity of our oceans. We are also proud to provide first rate services for Continuing Professional Development of both marine professionals and educationalists.

From the top: students learn sampling techniques on rocky shores outside the Dove; postgraduate student undergoing training in Antarctic waters; underwater surveying.



*"We have been running a successful undergraduate field course at the Dove for 17 years. We value the Dove's proximity to both pristine and impacted shores, enabling us to provide a highly applied field course. Our students are challenged by investigations of the effects of estuarine barrages, and studies of shores recovering from coal spoil dumping. We have always found the Dove to be a welcoming, informal venue with exceptionally helpful staff."*

Professor Martin Wilkinson, Heriot-Watt University

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## Outreach and Public Engagement

For over two decades the Dove Marine Laboratory has been working to engage young people and community groups with their local natural environment. This work is underpinned by the belief that sustainable management of ecosystems can only be achieved through a sense of 'ownership' and stewardship of the natural world around us, and that effective open dialogue regarding the role of science in informing sustainable management is crucial. We believe that the furtherance of scientific knowledge itself is a democratic pursuit.

**The Dove's Outreach Programme operates on a three-pronged approach:**

- Awareness Raising and Promoting Stewardship
- Education
- Research into Models of Public Empowerment and Management of Local Environments.

### **Awareness Raising and Promoting Stewardship:**

The Lab acts as a forum for outreach activities conducted by MAST raising the profile of marine environment related issues.

We liaise with partners from local Authorities, Natural England, Wildlife Trusts and related organisations and facilitate a number of marine stewardship events held across Northumberland and Durham each year. We host a range of events linking to local and regional events, including Harbour Day in aid of the local RNLI, and the national Heritage Open Days cultural programme.

Pupils carry out desalination experiment during 'Desert Island Survival Day' as part of pilot studies for 'InspiringSeas' resources.

Cullercoats pupils learn about local *Nephrops* fisheries.





# Education: our future guardians of the environment

The "**InspiringSeas**" project is developing science and technology learning resources with a marine focus for Key Stage 3 pupils (11-14 year olds) to promote science, technology and citizenship learning in schools; an additional objective is to support educators in the transition to the new GCSE curriculum (2008-09). The materials have been developed in collaboration with partner schools in Newcastle and London, and are downloadable from a dedicated website [www.inspiringseas.co.uk](http://www.inspiringseas.co.uk)

"**InspiringOceans**" builds on the success of the project above and extends the remit to Key Stage 4 pupils. It will provide career-focused materials for young learners, and aims to promote self-confidence and raise aspirations. It will provide opportunities for this age group to consider science and technology disciplines as potential areas of rewarding careers.

The Dove provides a suite of National Science School Curriculum-linked, and post-16 classes for school groups of all ages. Schools join us from across the region and from as far as Carlisle, Berwick, Yarm and Bradford on a regular basis. Schools have even visited us from France. We cater for up to 500 school children a year in this particular format.

North Tyneside Council funded the Dove's "**Fishy Things**" enabling 6-9 years old to partake in marine environment courses. Running on Saturday mornings for a period of 5 weekends for each group, a total of 300 such places have been provided over three years providing enrichment learning outwith the school curriculum.

The Dove's **Environmental Summer Schools** are aimed at 11-14 year olds building a sense of pride through science learning. A range of natural habitats are explored and the children complete a **BA** Bronze Crest award. The Dove has provided up to four such courses each summer since 2001, and National Lottery funding has meant that we can give priority of places to pupils from disadvantaged backgrounds.

The Dove Marine Laboratory is proud to be involved in regional and international educational initiatives including **Science City Education** and the **United Nations Regional Centre for Education for Sustainable Development**.

Seeded from an evening course run for local adult learners, in 2008 we launched **Delve Deeper**— a 6 month distance learning course in marine biology. Participants attending the first residential field course in Newcastle came from Greece, Belgium, the Netherlands and across the UK. The Dove is committed to opening access to marine science education to all.

Exploring the environment  
as part of the Dove's Summer  
School programme.



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Volunteers working with Dove staff monitor coastal habitats.

## Models of Public Empowerment and Management of the Natural Environment

The Dove's remit is wider than just dissemination of scientific information. Much of our research centres on the value of lay-expertise and local knowledge in sustainable management of marine and coastal environments. We are exploring routes towards a more successful dynamic between publics and their natural environments and between publics and professional scientists. We are seeking to gain a better understanding of the role science can play in informing social and environmental policy and what that means at the grass roots level. We are looking at effective models that can be translated into other contexts and other settings internationally. We are working with the **iKnow Beacon for Public Engagement Team** to develop this further. Our success stories include:

The **Cullercoats; Past, Present and Future** project involves young people of Cullercoats, working in collaboration with The Watch-House group, The RNLI and The Dove Marine Laboratory to collect information about the rich social, cultural and environmental heritage of Cullercoats. This project aims to consolidate pride and existing knowledge of the heritage and community.

**Sustaining our Coastal Heritage: the value of local knowledge** provides opportunities for the Blyth Valley community to share their knowledge about the coastal traditions that have shaped the identity of the community today. We hope to raise awareness and improve access to Blyth Valley's coastal heritage, change people's perceptions of their local coastal environment and generate wider public appreciation of management issues so as to create a lasting benefit for future generations.

**Coastal Issues and Fragile Habitats:** Pupils in King Edward VI school worked with staff at the Merck Sharp and Dohme plant at Cramlington to conduct surveys and investigations of the habitat at Druridge Bay; this information was used to establish an "environmental management plan" for the site; MSD staff provided labour for the implementation of environmental actions proposed by the children as well as contributing to the educational and research activities. A further theme of this project was intergenerational exchange of environmental knowledge from children to adults.

A lobster pot is mended.  
Blyth's coastal heritage.





# History of the Dove

Towards the end of the 19th century marine biology was greatly influenced by the German, Anton Dorn, and his ambitious scheme of creating "zoological stations" at coastal sites. Such was the inspiration that gave birth to the first lab at Cullercoats, a primitive wooden hut on the shore next to the old salt water baths. It was built by the Northumberland Sea Fisheries Committee in 1897, but was unfortunately burnt down in 1904.

Academics from Armstrong College, the precursor of Newcastle University, approached the owner of the site, Mr Wilfrid H. Hudleston, M.A., F.R.S., regarding the construction of a new laboratory. Entirely, at his own cost, Mr Hudleston, an eminent geologist and ornithologist, funded the new structure suitably adapted for marine science. Hudleston was descended through his mother's side from the Dove family; he named the building after his ancestor Eleanor Dove which explains the puzzling name! It was designed by a Newcastle Architect, Mr Lish, and was opened on the 29th September 1908 by the Duke of Northumberland. The joint Coat of Arms of the Hudleston and Dove family occurs on the west gable along with the motto "Soli deo honour et Gloria"

The Dove Marine Laboratory became a Department of Armstrong College with a Marine Laboratory Committee representing the College, the Northumberland Sea Fisheries Committee and the Northumberland Education Committee. Armstrong College were yearly tenants, but exercised scientific control of the research, and staff of the laboratory were employed by the University. The apparatus and the library however were funded from a Government organisation - H.M. Development Commission. The latter organisation also funded the 1959 extensions to the building. The building subsequently passed entirely into the ownership of the university in 1967.

The Dove Marine Laboratory shortly after it opened.



Right, the wooden lab prior to 1904.



Below, the public aquarium as it originally was.



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## Development and Refurbishment: taking the Dove into the 21st Century



The Dove Marine Laboratory has undergone many changes over the course of its lifetime as our needs changed and the emphasis of the research shifted. The centenary presents an opportune time to once again reflect on and re-evaluate the role this facility plays within the University, its contribution to the economic and social development of the region, and its importance to marine science both nationally and internationally.

We have embarked on a long-term programme of improvement to ensure the full potential of the Laboratory as a 21st century Marine Science facility is realised. We have adopted a phased approach to this work: commencing with the Centenary year improvements followed by securing funding for Phase II works. Within this short to medium term period, we aim to maximise the efficiency of space usage, and enhance the comfort and accessibility of the facilities for our users. By increasing use of the building by both internal and external customers, generating new income streams, and raising the profile of the Dove, we hope to catalyse a period of investment, with substantial re-working of the building footprint and layout. This will guarantee the Dove's place as a major international marine science facility for the next 100 years.



Architect's impression of the Dove as it could be





### Phase I Developments 2008-2009

As part of our Centenary Celebrations, we are:

- Developing the existing mezzanine laboratory as the Buchanan room – a multi-purpose meeting space and training suite providing collaborative working areas for users both across the university and externally
- Re-developing the ground-floor reception offices and library area as a dedicated Teaching and Outreach Facility.
- Upgrading the lavatory facilities on the first floor.
- Reinforcing and relining the deep-water flow-through tanks in the main aquarium with structural improvements to walls and drainage
- Providing long-overdue disabled access to the Laboratory
- Restructuring and reviewing the Dove library fit for purpose as a modern teaching resource and to appropriately provide archival facilities for older texts of value
- Conserving the Challenger Reports in appropriate display housing



### Phase II Developments 2009 - 2012

- New Ecology Research labs on ground floor with adjoining wet-processing room
- New Marine Biotechnology labs on second floor
- New researcher offices
- Provision of new reception area

### Phase III Developments 2012-2018

- Expansion of the aquarium footprint to incorporate a public outreach facility and new research space
- Establishment of a new 'conference wing' with theatre to seat 80 delegates, break-out rooms, and office space
- Creation of multi-purpose spaces and office suite to engage 'spin-in' companies, and to generate a regional 'Marine Science Hub' with ICZM focus.
- Provision of Marine Environmental Technology Assessment Centre to incorporate facilities for Ballast water and Anti-fouling technology testing.

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## Centenary Year Celebrations: Calendar of events

29th September 2008	Commemoration of the opening of the Laboratory
October – December 2008	Phase I refurbishment works
December 2008	Dove Christmas Public Lecture
February 2009	Official opening of the new Education and Meeting rooms. Community and Outreach Celebration.
March 2009	Scientific workshop: "The Changing Marine Environment in the 21st century"
May 2009	Delve Deeper residential fieldcourse for adult learners
July 2009	Summer Celebration Bar-B-Que; the Dove welcomes all of its alumni and supporters to join us.
July– August	Environmental Summer Schools for Key Stage 3 pupils
September 2009	The Way Forward