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ANSWERS TO QUESTIONS ON NOTICE
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AGENCY/DEPARTMENT: COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

TOPIC: Wealth from Oceans Flagship

REFERENCE: Written Question –Senator Bushby

QUESTION No.: AI-110

What does CSIRO consider have been the most tangible, practical achievements of the Wealth from Oceans Flagship over the course of its existence?

ANSWER

There have been numerous achievements and impacts from the work of the Wealth from Oceans Flagship. The following are a small number of selected highlights.

- New tools to support **ecosystem based fisheries management** leading to ‘demonstrated and remarkable improvement in the management of Commonwealth fisheries’ (Wealth from Oceans Review Panel Report) and adopted and applied worldwide.

Examples of the Flagship’s achievements in this area include:

- The bio-economic model developed by CSIRO with fisheries industry, management and research partners that led to international acclaim for Australia’s Northern Prawn Fishery (NPF). A report by the United Nations Food and Agriculture Organization praises the NPF for its equitable, responsive and measurable management, identifying it as one of the “best managed fisheries in the world of any type (invertebrate, finfish or otherwise)” and a “global model for many aspects of fisheries management”.
- A scientific plan to rebuild the southern bluefin tuna (SBT) stock which was accepted by the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) at its Annual Meeting in 2011. The project was initiated in response to a CCSBT request to its Scientific Committee to develop a management procedure for rebuilding the stock to 20% of its unfished level by 2035, with a high level of probability (70%). The management procedure that underpins the plan was developed by CSIRO’s Wealth from Oceans Flagship in collaboration with the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES), and members of the CCSBT Scientific Committee. It is the first time such a management procedure has been adopted and implemented for any of the internationally managed tuna fisheries, and if implemented as designed and tested, it should result in the rebuilding of the stock, while increasing the economic value of the fishery.
- An Australian method - MSC's Fisheries Assessment Methodology & Guidance to Certification Bodies - led by CSIRO research for assessing the environmental impact of marine fisheries has been adopted in the United States, Canada, Ecuador and the Western

and Central Pacific, and by the international eco-labelling organisation the Marine Stewardship Council. CSIRO's 'ecological risk assessment' (ERA) method considers intended and unintended captures; threatened, endangered and protected species; and marine communities and habitats. It contributes to the strategic assessment of fisheries and flags priorities for research, data collection, monitoring and management. This research was conducted in association with the Australian Fisheries Management Authority (AFMA). The ERA process contributes to the strategic assessment of fisheries under the Environment Protection and Biodiversity Conservation Act 1999 and flags priorities for research, data collection, monitoring and management. AFMA is responding with environmental risk management strategies for each fishery and other initiatives such as a guide for fishery managers to help manage shark bycatch. The research has also yielded a database of information on more than 1000 species of mammals, seabirds, reptiles, scalefish, and sharks and rays.

- A CSIRO study (The trophic fingerprint of marine fisheries, November 2010) revealed current methods of assessing the health of marine ecosystems are ineffective. The study questions the belief that the structure of marine food webs has changed through the depletion of top predators to a greater extent than prey species. Instead revealing an intensification of fishing at all levels of the food web. This will redefine how fisheries are monitored, resulting in a shift to scientific surveys and models, and a focus on species vulnerable to fishing.
- 'Whole of system' ecosystem model Atlantis – now used in thirty-one ecosystems around the globe and actively informing marine management bodies in Australia and the US. Examples of Atlantis' success and application include:
 - CSIRO's marine ecosystem model, Atlantis, was the first to systematically explore the optimum level of complexity for an ecosystem. Its success lies in its capacity to strike a balance between realism and tractability. A version of the model, Atlantis SE, was developed to provide strategic advice on management of the Southern and Eastern Scalefish and Shark Fishery, and provided the first sound basis to evaluate integrated rather than piecemeal solutions to complex fishery management problems.
 - Atlantis contributed to a groundbreaking study of the status and management of 31 fisheries worldwide. The international team of 19 researchers used Atlantis to examine trends in fish numbers and catches, and to highlight management approaches used to rebuild fish stocks. The study found that steps taken to curb overfishing were having success in five of the 10 large marine ecosystems examined, providing new hope for rebuilding troubled fisheries.
 - The Atlantis modelling framework is regarded by The United Nations Food and Agriculture Organization (FAO) as the most effective marine ecosystem model available, and its developer, Beth Fulton, was awarded the Australian Science Minister's Life Scientist of the Year Award in 2007.
- Australia's first ocean forecasting system, **BLUElink/OceanMaps** (in collaboration with Bureau of Meteorology and the Royal Australian Navy), increasing operational awareness for defence applications, shipping, off-shore operations by providing near-real time and forecast ocean conditions as a regular web-based service. This ocean information service now underpins most local ocean hydrographic modelling around Australia. BLUElink provides:
 - daily forecasts of temperature, salinity and current velocity for oceans around Australia in near-real time, delivered through the Bureau of Meteorology's website for public use

- a high-resolution, three-dimensional ocean climate model of average monthly temperature and salinity levels, called CARS (CSIRO Atlas of Regional Seas)
- a global ocean-circulation model forecasting eddies, temperature, salinity and currents in the Asian-Australian region, run by the Bureau of Meteorology
- the Relocatable Ocean-Atmosphere Model (ROAM) that predicts atmosphere and ocean conditions for the coastal and continental shelf regions around Australia using a simple interface.

Examples of BLUElink applications include:

- The Royal Australian Navy is now using the products of BLUElink, such as near real-time ocean temperature, ocean currents and salinity information, to support its maritime operations. Web-based 'nowcasts' are the first product of the BLUElink program and are being used by the Navy with a high degree of success in the Arafura Sea and the South Pacific.
- A Fisheries Research and Development Corporation-funded project on the ocean dispersal of southern rock lobster larvae used BLUElink models to simulate the physical environment of the larvae and calculate the degree of interdependence that exists between the various management units of the stock.
- BLUElink helped the Australian and Queensland Governments successfully find the HMAS Sydney II (2008) and Australian Hospital Ship Centaur (2009), which was torpedoed in May 1943. To focus the search area, CSIRO provided information about the unusual ocean conditions when the ship was sunk, and BLUElink forecasts were used to help plan the search schedule.
- In 2010, BLUElink was used to monitor the oil slick following the Montara well blowout and spill in the Timor Sea.
- Assessments of past global **sea level change** and its causes, and future projections of sea level around Australia and for the region. Leadership in the design and implementation of a greatly enhanced **ocean observing system** to underpin climate assessment and forecasting.
- BP oil spill response - a prototype **hydrocarbon sensor** array developed was deployed to help monitor the location and movement of the Gulf of Mexico oil spill and provided US authorities with information that helped them make decisions about fisheries. Using the CSIRO prototype hydrocarbon sensor array to map the location and movement of the oil, CSIRO scientists were able to give US authorities a good understanding of what was happening in the water during the Gulf of Mexico oil spill, and help them make important decisions, such as when fisheries could be reopened. Called in by BP, the hydrocarbon sensor team surveyed more than 8000 nautical miles. Initial data showed the condition of the water was not as bad as first expected. the CSIRO hydrocarbon sensor array detects various types of hydrocarbons - oil and natural gas - in the ocean and was originally designed for use in petroleum exploration.
- CSIRO is playing a key role in developing and operating the Global Oceans Observing System, particularly through the Argo project. Argo involves 18 countries and the European Union working together to observe the world's oceans. Through an array of over 3000 robotic ocean instruments (floats), Argo is monitoring the subsurface oceans globally and in real-time – a major advance in observing our Earth. Data from Argo underpins seasonal forecasting globally and is used as part of BLUElink which delivered the first operational ocean forecasting system in the Southern Hemisphere. At present there are around 3200 active Argo floats globally, with

the CSIRO-led Australian program being the largest and most active group in the Southern Hemisphere.

- The first Australian benchmark of climate change impacts on marine ecosystems and options for adaptation was launched in November 2009. The Marine Report Card summarises observations of impacts on 17 habitats and climate variables over recent decades, projecting forward to 2030 and 2100 with assessments of likely status. It suggests adaptation options for policymakers, industry and the community.
- The Census of Marine Life, a stocktake of global marine life involving 2700 scientists from 80 nations, was released in October 2010, completing a decade of research. CSIRO played a significant role in the Australian section by developing approaches to predict life on the seabed and pioneering the genetic barcoding technique – a global standard for identifying species. The census results are used by government agencies to improve marine biodiversity management in Australia.
- CSIRO, working as part of the Commonwealth Environment Research Facilities (CERF) Marine Biodiversity Hub, has created marine biodiversity maps of Australia's continental shelf habitats. These maps are guiding marine bioregional planning and the design and monitoring of marine reserves. New statistical modelling approaches were used to predict and map biodiversity across two million square kilometres from new and existing survey records dating back to the 1960s. The maps highlight complex patterns of biodiversity and emphasise how much remains unknown.
- CSIRO has documented the first known detrimental impact of southern hemisphere ocean warming on a fish species. Cold-blooded animals respond to ocean warming conditions by increasing growth rates, but theory and laboratory studies have shown that this has limits: as temperatures rose, signs of stress became evident. This stress was documented in a temperate Australian fish species, the *banded morwong*, pushing it past its physiological limits. Further research will determine whether climate change affects other fish in the same way.
- CSIRO, in collaboration with Hokkaido University, Japan, and the Antarctic Climate and Ecosystem Cooperative Research Centre, discovered a deep ocean current with a volume equivalent to 40 Amazon Rivers. The current is near the Kerguelen plateau in Antarctica, about 4200 kilometres south-west of Perth. It is more than three kilometres below the surface and is an important pathway in understanding the global network of ocean currents that influence climate, now and in the future.
- Published in *Nature Climate Change*, January 2012, CSIRO, as part of an international research collaboration, identified a global hot spot in the Tasman Sea. The hotspot is the result of a faster spinning ocean-wide gyre and an extension of the current towards the polar regions. The faster flow in the gyre, in turn, has pushed the East Australian Current an estimated 350 kilometres further south bringing with it the warmer waters and substantial environmental change. Research in the past 18 months has identified the ecological changes such as:
 - 34 sub-tropical species of fish from NSW and southern Queensland now reside in Tasmanian waters
 - an invasion of non-native species such as sea urchins from north of Bass Strait have begun crowding out the endemic species on the inshore continental shelf
 - a noted deterioration in giant kelp, one of the few locations in the world where this stunning species is found

- the first recorded impact of warming ocean temperatures on a fish species, at first responding healthily with faster growth and then losing condition as the animals' organs fail to keep pace with its body growth.

In addition, as part of a review of CSIRO's impact in 2010 ACIL Tasman undertook an analysis of the Flagship program. The Wealth from Oceans Flagship mapping undersea mineral deposits research was one of the case studies in the analysis and was found to have an immediate cultural and policy value and a longer term potentially high value in supporting commercial off-shore exploration. A copy of the full ACIL Tasman report is available on the CSIRO website at: <http://www.csiro.au/en/Portals/About-CSIRO/How-we-work/Budget--Performance/Performance-reviews/Impact-and-Value-2010.aspx>.