



Tara Oceans Returns

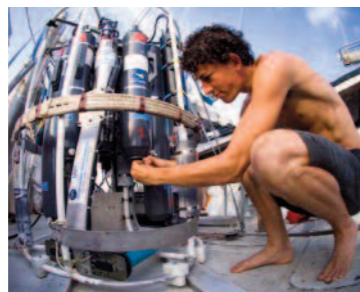
Tara Oceans has just returned from its epic, world plankton tour. It was both a daring and fruitful adventure, and it marks just the beginning of an impressive amount of analysis to be done. What will the data gathered show us about the way marine ecosystems work and their role in the planet's ecological balance?

Research: Full Speed Ahead

Scouting plankton biodiversity



Lorient, Saturday March 31. The oceanographic schooner Tara and her crew of sailors and scientists returns from a 938 day expedition, proudly completing the first large-scope study of plankton ecosystems. Several dozen visitors, parents, friends and others interested in the project met them in port to make their springtime arrival a real celebration.



Experts' briefing in the central mess. Left: Brett Grant, bridge engineer from New Zealand preparing the "rosette" for an upcoming immersion. Right: Hervé Le Goff, oceanographer and Hervé Bourmaud, captain of Tara, bring up the "rosette".

In port at last. On March 31, the schooner Tara moored in Lorient after a 117,000-km journey (73,000 miles). This two-and-a-half-year trip around the world measured the population of marine life that can only be identified with powerful microscopes and genetic analyses – plankton. This fragile, long-ignored world is what the scientists went in search of. On board Tara, scientists from all different backgrounds with a vast range of specialties were all brought together by a thirst for knowledge and answers to the same question: how will these micro-organisms, major players in oxygen production and carbon absorption,

adapt to the warming of the planet and ocean acidification? The question is all the more important because we know relatively little about plankton fauna and flora, giant viruses, bacteria and the mysterious protista that are floating about the ocean. We know equally little about their distribution in vast, organized ecosystems.

A scientific, technological and human adventure

To learn more about them, researchers had to get inventive. Tara Oceans is first and foremost the symbol of the success of an integrated scientific



Island scientists discussing matters in the exterior cockpit. Left: Brett the Kiwi and Jean-Michel the Corsican.



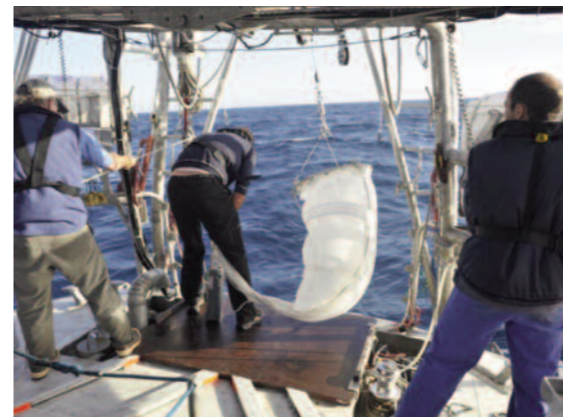
Steffi Kandels-Lewis filtering away in a damp lab.



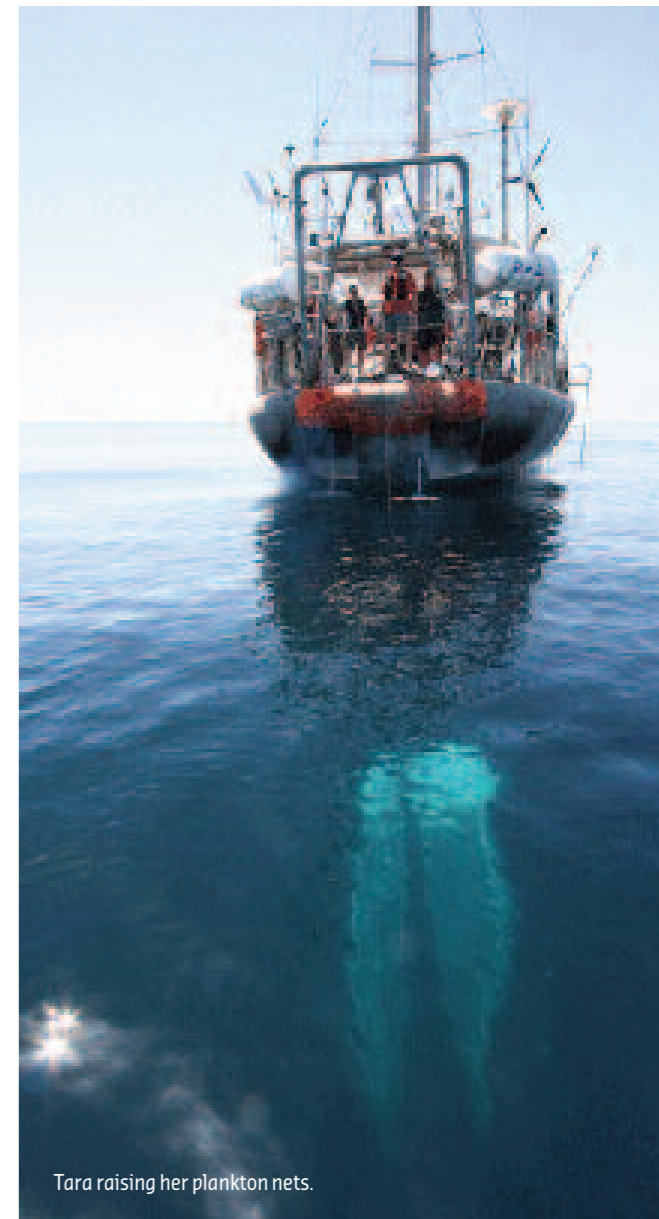
Raphaël, biologist, filtering samples of protista.



Isabelle Taupier Letage, head scientist, and Benedetto Barone, oceanographer, noting the extremely rich water at the surface.



Bringing up a net of plankton. From left to right: David Mountain and Grigor Obolensky, oceanographers, Julien Daniel, head mechanic, at the winch.



Tara raising her plankton nets.

approach that combines physical and biological oceanography with the latest in imaging and DNA analysis technology. The unique project is the only one of its kind in terms of the scope of research, which includes the study of all marine micro-organisms and their environment. Christian Sardet, one of the expedition's coordinators, reminds us that, "The main effort was focused on collecting everything that lives in a water column, from viruses to fish larvae." As the ship traveled through the 153 stations, samples and measurements of the physical and chemical characteristics of the water were taken, storing up a treasure trove of information. It

will be used for research, to give us a better understanding of plankton biodiversity and also help scientists better model the ocean as a whole. That is essential if we are to be able to predict changes in marine life and understand the carbon cycle in the oceans. Tara's mission was also truly outstanding because of how it played out, both in the scientific exchanges and the conditions of the voyage. Nothing could dampen the crew's spirits on this ship; "Between Buenos Aires and Ushuaia, we used a very precise routing based on both oceanographic information and weather forecasts to optimize the scientists' work aboard the vessel in absolutely

“ In Djibouti and Malé, we had to fight the elements and work against the extremely hot temperatures to preserve our samples. ”

Rainer Friedrich, Logistics manager for shipping of samples gathered onboard the schooner

QUESTIONS FOR

COLOMBAN DE VARGAS

biologist and expedition coordinator

“The samples taken during Tara Oceans will help deepen our knowledge about plankton, in both its strengths and its weaknesses,” says Colomban de Vargas.



Plankton, the great unknown

Why is plankton so important to environmental balance?

Colomban de Vargas: It’s an ecosystem that is very alive, and also very productive. These micro-organisms, which are estimated to represent 1% of the planet’s biomass, produce as much oxygen and trap as much carbon as all of the land-based ecosystems together. And they do it with an amazingly high speed of regeneration. Sea plankton completely reconstitutes its population in just a week’s time. In comparison, it takes years for a forest to regenerate.

Can you give us an idea of the biodiversity of plankton?

C.D.V.: Plankton comprises all types of organisms, from viruses to small vertebrates. It’s an overview of four billion years of evolution. This biodiversity, while very important, is relatively simple compared to the biodiversity in a forest or a coral reef. In that sense, it makes an extraordinary model to be able to learn about a planet-wide ecosystem in its entirety. I think that by studying plankton we will be able to discover some general laws of evolution and the Earth’s systems.

What do we know about the impact of global warming on these micro-organisms?

C.D.V.: It’s a sensitive ecosystem that has already experienced several mass extinctions. The ocean in the industrial age is becoming more stratified, warmer and more acidic. It appears that plankton communities are experiencing decreases in number, size and biodiversity. They could therefore become less productive. If that happens, it will have a negative effect on the ocean as a carbon pump. If we affect plankton, it could have planet-wide repercussions. We don’t yet know how serious they could be, so it is very important to do more research.

awful sailing conditions. It was a kind of life-sized video game, but we did it and it was truly a pleasure,” says Eric Karsenti, the scientific director of the expedition.

No science without patience

Now all that’s left is to make good use of the 27,000 samples collected. To do that, some 20 laboratories around the world have teamed up to form the Oceans consortium. From here on out, the adventure will continue in a very different environment: the laboratory. The studies of plankton have already revealed a surprising quantity of new genes, but there are still five to 10 more years of research to be done. To have a better view of what needs to be

done, the data must be sorted, sequenced and entered into data bases that will be open to researchers around the world. Patience is a virtue, and in this case it is a must, too, as research is a time-consuming task. In addition, Étienne Bourgois, co-director of Tara Expeditions, knows that there is always more to learn, “everyone agrees that this expedition has shown us just how little we know about the oceans.” A humble realization, but one that reveals his enthusiasm for the project – what better reason to take to the open seas again?! And in fact, a new cycle of expeditions is planned for the spring of 2013, when the ship will set a course for the Arctic Ocean and on to more adventures. Tara isn’t about to lower her sails! ■

“I’m a young scientist and in my day-to-day I sometimes feel isolated in my laboratory, far away from other researchers. On Tara, it wasn’t like that at all. I really learned to work as part of a team and share knowledge with everyone.”

Roxana Di Mauro, Argentinian scientist

QUESTIONS FOR

EMMANUEL REYNAUD

biologist and the expedition’s imaging coordinator

Tara Oceans offered a prime itinerary for studying coral reefs, and four missions were specifically dedicated to them. One of the subjects studied was coral reef bleaching, an indicator of problems in the coral ecosystem. Emmanuel Reynaud explains a bit about it.



Mission: Coral

What does coral reef bleaching tell us?

Emmanuel Reynaud: Tropical coral found near the surface of the water live symbiotically with zooxanthellae, unicellular algae that help them grow through their photosynthetic activity. Bleaching is a result of thermal stress which forces the coral to give up their symbiotic partner. They lose their photosynthetic capacity and the coral weakens and loses its color. This phenomenon can lead to the death of the most fragile species and it threatens the balance of a complex ecosystem that is based on the coral itself.

What do we know about their resilience?

E. R.: It seems that in the right environmental conditions it is possible for zooxanthellae to come back and for the symbiosis to be re-established. But we have seen few cases of regeneration after bleaching over the long-term. In Mayotte we did measure the phenomenon, which is currently underway there, and we hope to be able to follow the resilience of this coral reef. The island, surrounded by a double barrier reef, is a very interesting case study. But population growth and an increase in human activities are accelerating erosion and creating problems for water treatment, and both of those developments are a threat to the coral.

Now that you’ve returned from the expedition, how will your mission continue?

E. R. : There is some long work ahead of us archiving data. We are also planning an innovative project to make 3D models of the skeletons of the nearly 2,500 coral collected. Our hope is that scientists will be able to consult the digital database and compare skeletons without having to run around to different museums all over the world. Using the latest imaging technology, coral biology is finally entering the 21st century!

Supporting Tara, research and new services for the environment

Financing the expedition, encouraging scientific exchanges, getting the word out – the Veolia Foundation’s support for Tara Oceans comes in many colors. As a partner of the project from its beginnings, the Foundation has been promoting the expedition among the general public. “During calls in port, we organized events and meetings,” explains Thierry Vandeveld, the Foundation’s executive officer. “It’s a role we will continue to play with other events, such as the Rio+20 summit, where we will be supporting the Tara team in their fight to convey the im-

portance of ocean protection.” This is support in the long-term and it has also been accompanied by scientific exchanges as well as the involvement of Veolia Environnement in the Oceanomics project. This major collaborative research program¹ aims to encourage common-sense, sustainable use of plankton and will create a marine micro-organism data bank of the samples collected by Tara. As a partner in the project, VERI² will help get marine plankton biore-sources to economic players. This could mean new industries and tools for meas-

uring the human impact on coastal areas – “Sea water is a resource for desalination plants, for renewable energy and for developing bioactive compounds,” explains Maguy Bourbigot, project manager at the Brittany competitiveness cluster and sponsor of the Tara project. “For example, plankton biomonitoring will allow us to better anticipate the changes in the quality of water and its impact on our desalination plants. In addition, a better understanding of human impact on coastal areas will help us improve our water treatment procedures.”

1 - Recognized with an award from Investissements d’Avenir, Oceanomics was selected by the French national agency for research as part of the call for Biore-source/Biotechnology projects in 2011. Supported by the CNRS, the CEA, the UPMC and ENS, the program brings together 15 French and international laboratories on the cutting edge of high speed exploration methods – sequencing, imagery, bioinformatics and screening.
2 - VERI: Veolia Environnement Research and Innovation