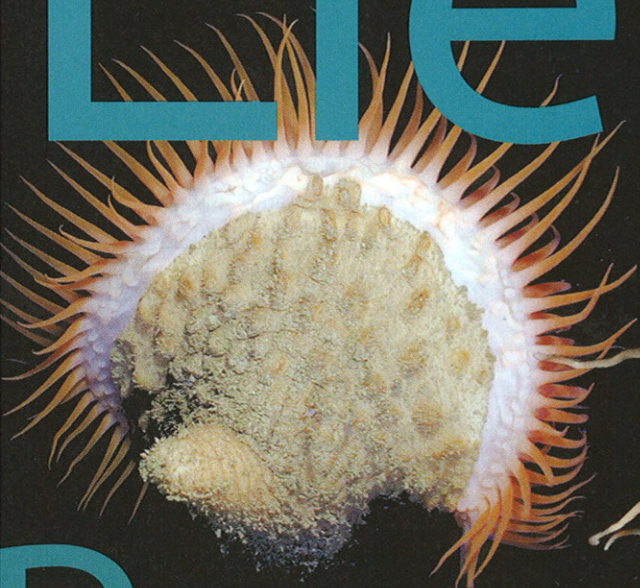


# What Lies Beneath



◀ A new species, this blind lobster with bizarre chelipeds belongs to the rare genus *Thaumastochelopsis*. The lobster was given the scientific name *Dinochelus ausubeli*—derived from the Greek *dinos*, meaning terrible and fearful, *chela*, meaning claw, and *ausubeli*, honoring Jesse Ausubel.



↑ Venus flytrap anemone (*Actinoscyphia* sp.), photographed in the Gulf of Mexico

## Interview with Jesse Ausubel Co-Founder, Census of Marine Life

by Amy Entwisle

*Vampyroteuthis*, or vampire squid, is a cephalopod that lives in the oxygen minimum zone of Monterey Bay, California, at depths of 600-900 meters →



◀ *Crossota norvegica*, a jellyfish, collected from the deep Arctic Canada Basin



◀ Multilayered structure of the shell of *Crysmallon squamiferum*, a recently discovered gastropod mollusk from the Kairei Indian hydrothermal vent field. It is unlike any other known natural or synthetic engineered armor.

### How did you come up with the idea for the Census of Marine Life?

In 1996, Professor Fred Grassle of Rutgers University approached me with a report, published in 1995 by the National Research Council, called *Understanding Biodiversity*. Fred served on the committee of authors, and said to me, "This was a good report, but none of the recommendations are being implemented. There's so much to discover and the oceans are changing very fast." Fred said that something big needed to be done. I said, "Big means global. You can't just look at the North Atlantic or the Caribbean. You should do a worldwide census." I'd had experience organizing cooperative international scientific programs, so over the course of the next hour and a half we came up with the idea of the worldwide Census of Marine Life.

### What were some of the first findings of the Census?

Deep in the North Atlantic, in the world's longest mountain range, is a sort of canyon called the Charlie Gibbs Fracture zone, through which a lot of water passes. It had never really been explored. Using Mir submersibles—the Russian submersibles that found the Titanic—a Russian-American expedition explored the zone and discovered a tremendous amount and variety of life: amphipods, copepods, decapods, zooplankton, and new kinds of squid. That was in the summer of 2003.

### What's been the biggest surprise for you so far?

A huge surprise for me was the importance of very small life in the oceans, of single-cell organisms such as bacteria and archaea. Very small life makes up about 90 percent of all the biomass in the oceans. And we found enormous variety within that. There might be 38,000 different kinds of bacteria in a liter of sea water.

The other big surprise is the amazingly cosmopolitan behavior of the large animals that connect the oceans. Bluefin tuna swim back and forth between Sicily and Cuba and between Los Angeles and Yokohama. White sharks swim back and forth between Australia and South Africa. Some turtles circumnavigate the entire Pacific. A turtle might set off from a beach in Central America, go down to South America, swim across the South Pacific over to Australia, up to the Philippines, up to Japan, and then swing all the way back around to California and down to Central America again.

### Can the Census tell us anything about global warming and its effects on the ocean?

Part of the reason for the Census is that we believe that global changes are taking place. There are changes in noise in the ocean, in acidity, probably in currents and temperature. We wanted to create a baseline so that in 2015 or 2050, we could make comparisons. But even within

In 2000, *Imagine* published an article about the Census of Marine Life (COML), then in its infancy. Over the ensuing 10 years, researchers from over 80 countries participated in this unprecedented scientific exploration to measure and explain the diversity, distribution, and abundance of life in the world's oceans. Today, the COML represents the most comprehensive inventory of marine life ever compiled: 28 million records and growing. Here, Jesse Ausubel—Director of the Program for Human Environment at The Rockefeller University, adjunct faculty member at Woods Hole Oceanographic Institution, and co-founder of the Census of Marine Life—explains why small is really big, and why he has hope that we will preserve the biodiversity of our oceans.

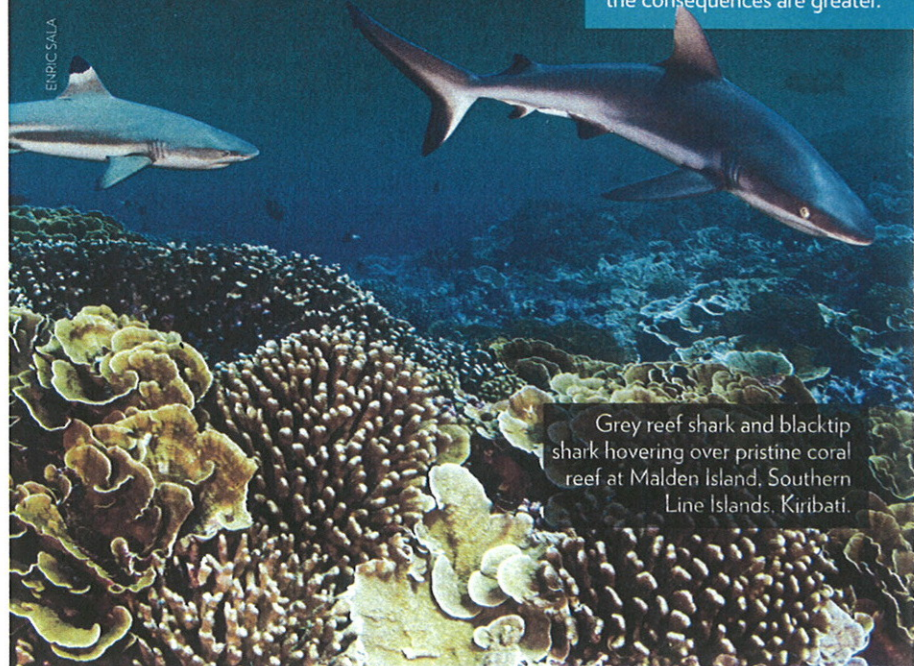


◀ The tube anemone lives in a mucous tube on the muddy bottoms of coastal waters, estuaries, and soft seabeds.

## Why Does Biodiversity Matter?

Biodiversity is a measure of the health of an ecosystem. A diverse biological community allows for greater interactions among species—greater competition, predation, and productivity—than a non-diverse community. If one species' population declines, a diverse portfolio has a greater chance of adjusting to this loss than one that is non-diverse, where the consequences are greater.

↑ South of Easter Island, Census vent explorers discovered a crab so unusual it warranted a whole new family designation, Kiiwidae, or "Yeti crab." Beyond adding a new family to the wealth of known biodiversity, its discovery added a new genus, *Kiwa*, named for the mythological Polynesian goddess of shellfish.



Grey reef shark and blacktip shark hovering over pristine coral reef at Malden Island, Southern Line Islands, Kiribati.

the decade of the study, some regional teams observed changes. Our Chinese team, looking at the South China Sea and the East China Sea, found increases in certain jellyfish populations, suggesting that the water was warming. Our Arctic team observed some species of animals living further north than had been recorded in the past, again suggesting that some change in habitat was occurring.

Animals are temperature sensitive. Some marine animals are adapted to a wide range of temperatures, but many swim north when the water is warmer in summer and go south when the water is cooler, the same way that birds migrate. It's clear that climate change would lead to a big reorganization of life in the oceans. It's hard to know whether there would be a global increase or decrease in all the life, but it'll certainly be a big reorganization.

### Aside from providing a baseline, what are some of the ways in which the findings will be used?

One of our goals was to create a complete world marine biodiversity database. The Census has already prepared maps of hotspots of biodiversity in the world's oceans, and these have been shared with the UN's international Convention on Biological Diversity. Recently in Nagoya, Japan, the Convention sought to identify what they call *ecologically and biologically sensitive areas*, or EBSAs. One hundred ninety countries came to an agreement that they'd like to increase the area of protected ocean from about one percent today to 10 percent by 2020.

Ten percent may not sound like much, but a tenfold increase in the amount of area protected from over-fishing or habitat destruction would be a tremendous step forward. The Charlie Gibbs Fracture zone is now protected. Areas of the Antarctic that are especially rich in marine life are tentatively designated for protection as well.

### The Census found that some of the same areas that provide for great biodiversity are also vast resources of natural gas and petroleum. Do you think it's possible to balance our need for energy with the need to sustain biodiversity?

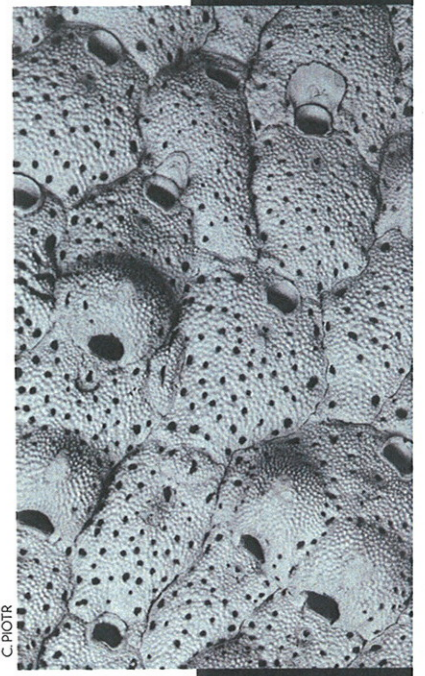
I think that we have to. Around the continents are shallow shelves that go to 200 meters, or about 600 feet deep. Then you have continental margins, or continental slopes, that go down to the vast abyssal plains, which average 10,000 to 12,000 feet. These sloping areas with the gradients—think of them as hill-sides—have unexpectedly high levels of biodiversity. They also

## The Census of Marine Life found

- more than 6,200 new marine species
- up to 38,000 different kinds of bacteria in a liter of seawater
- a Jurassic shrimp thought to have become extinct 50 million years ago
- multicellular animals thriving without oxygen at sea bottom
- fish swimming in coordinated schools as large as Manhattan Island. They commute at regular hours.

**For more information:** Download the *First Census of Marine Life 2010: Highlights of a Decade of Discovery*, a 64-page report that describes some scientific highlights of the COML, at [www.coml.org](http://www.coml.org).

The Antarctic ice fish has no red blood pigments (hemoglobin) and no red blood cells, an adaptation to the low temperature. The blood becomes more fluid, and the animal saves energy to pump blood through its body. ▼



↑ *Microporella klugei*, a new species of bryozoan from Arctic Svalbard

have enormous amounts of natural gas, and to a lesser extent, petroleum. Oil companies have been drilling and extracting oil and gas on the shelves for decades. In the last 10 to 15 years they've started drilling deeper, 1,000 meters, 2,000 meters. The Brazilian national oil company Petrolbras has made huge discoveries of gas and oil along the continental margins south of Rio de Janeiro. It's enormously valuable, and once people find it, it rarely stays in the ground. So we have to figure out how to extract the oil and gas with minimum damage. People may love the oceans, but they love their mobility, too.

### The Census refers to one of the impediments to studying marine life as "blinders we put on ourselves by choosing not to learn or spend." Do you think that the public can be persuaded to support exploration of marine life?

The public engagement with the Census has been wonderful, beyond our wildest expectations. We're delighted that the yeti crab and others of our animals are now replicated as stuffed animals, and are featured on skateboards. There has been a big increase in public interest in the varieties of marine life and the threats to marine life during the last decade.

A hundred years ago, Teddy Roosevelt established a system of protected lands—our national park system. It was not until 1975 that the first bit of ocean was protected in the U.S., and it's only recently that we've started to seriously consider the idea that we really need parks in the ocean. In 2006, a very large

park was created around the northwest Hawaiian Islands. On the basis of the Census findings, there are many more areas that we think are more valuable to people if they're left alone than if they're exploited. We hope that the blinders are coming off.

It's partly because of technology that we're able to get people's attention. We're hoping that the discoveries of the Census—the maps it's created, the interactive tools on the Web—will help people to really look at the oceans. Instead of seeing only this opaque, uniform surface, they'll see tuna commuting underwater between continents and Great Whites hanging out at the White Shark Café. They'll think, oh, underneath there are living villages and cities, blue highways and canyons—and they'll care more for them.

### You had a 10-year timetable to complete the Census. The 10 years is up. What's next?

In September of 2011 there will be a world conference on marine biodiversity in Scotland, and many members of our community are hatching plans for what some are calling Census 2020. Some of the questions to which we're seeking answers are obvious: What is the relationship of marine biodiversity to global change? How might acidification, increases in noise in the ocean, and changes in currents or temperature affect the diversity, distribution, and abundance of marine life? But there's a lot still to discover, too. There are about 250,000 known forms of marine life that earn the rank of species, but we estimate that there are three-quarters of a million forms of life yet to be discovered.