Date: Wed, 13 Oct 2010 11:26:17 -0400
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From: Lloyd Etheredge <lloyd.etheredge@policyscience.net>

Subject: 170. The Reinventing Statistics chapter: Optimal Sampling Rates in Changing/Accelerating Systems?

Dear Dr. Fischhoff and Colleagues:

In # 139 I outlined for your Study Group a meta-analysis of several alarming government forecasting failures, in different fields, and suggested the hypothesis that a National Academy recommendation to Reinvent Statistics (along several dimensions) would get better future results, and more valid measures of current uncertainty.

As one step in this project, It would be very helpful if the National Academy of Sciences could design inquiries and tools that can establish optimal sampling rates for the changing/accelerating global systems within the purview of the Global 2025 forecasts and DNI oversight responsibilities. These estimates will impact both US government investments and global practices involving the data collection of governments in the emerging G-20 global system, the IMF and World Bank, and other institutions.

For example, in developing the vision and budgets for the new astroinformatics age and the LSST, [the attachment to #162, archived at www.policyscience.net at II. D], NASA's justification for 2000 images/night (30 Terabytes/night) included the estimate of 100,000 changes/events in the Heavens every day with scientific/theoretical significance.

[The National Academy's new algorithms/estimation methods may give a range of answers: For human demographics, one census every decade might still be an acceptable sampling rate. At the other end, some leading hedge funds now want all global transaction data in all markets available in real time, with processing/analysis capacity for strategic trading in fractions of a second. Presumably the US Treasury and the CIA need some types of global economic/financial awareness at this level too.]

[A scientific basis will be helpful. Otherwise, when econometricians request reliable data more quickly than the 18-month or 3-year revision cycles, OMB may believe that they are just another interest group. And it probably is unclear to General Clapper or NSF whether any additional quantitative studies of voting and electoral behavior in other countries are needed to detect changes that we do not already know about.]

Sampling Strategies to Learn Unknown Causal Processes and Links in Changing, Complex, Adaptive Systems: Global Ocean Comparisons

Some mathematical challenges of Reinventing Statistics for changing, complex, adaptive global systems [with N causal dimensions, where N is still unknown) might benefit from a high-level, cross-disciplinary project.

For example, I am forwarding the (following) article from the Wall Street Journal of October 5, 2010 concerning the first decade-long ocean census. There are indications, in the article, that for some dimensions and causal processes there should be faster sampling rates and - perhaps - reinvented statistics to estimate uncertainties about complex causal processes and forecasts, at least below the "large predator" group:

Census Uncovers Oceans' Deep Secrets: Survey Names More Than a Thousand New Species, but Scientists Are Most Surprised by Huge Variety at Microbial Level

By GAUTAM NAIK. WSJ .10/5/2010

LONDONnHumans have studied the seas for centuries. But the publication Monday of the first global marine census suggests that the golden age of oceanic discovery still lies ahead.

Researchers participating in the census say they have now pinpointed about 250,000 species that live in the sea, but estimate that another 750,000 species still elude human discovery. And that's without counting millions of microbe species, which constitute 90% of the ocean's biomass.

"Diversity is an indicator of health in the oceans," said Ian Poiner, who chaired the census steering committee, in an interview here, where the census was unveiled. Dr. Poiner added that because of increasing human impact on the oceansnin the form of pollution, over-fishing and acidificationn"we need to understand how sea life is being altered."

In their decade of trolling the seas, the census takers added 1,200 new species to the known tally a decade ago, and have yet to formally identify another 5,000 or so species collected over the same period. The most common additions were crustaceans, followed by mollusks. Scores of new species were discovered even in the well-studied fish group.

Several findings were rich and strange: a hairy new species dubbed the yeti crab; a 21-foot-long squid; a new species of lobster weighing 8.8 pounds; an ancient shrimp thought to have become extinct 50 million years ago.

Other discoveries also took scientists by surprise. Science fiction had long imagined "anaerobic" creatures that could live without oxygen. A team sampling the deep Mediterranean found three such species. These creatures, each the size of a pin head, live their entire lives hidden in sediment on the seafloor without oxygen.

Census takers also uncovered a living Caribbean fossil, the only remaining species of a genus of deep-water clams that flourished worldwide for more than 100 million years, and was thought during the 1800s to have died out long ago.

"But the biggest surprise for me was microbial diversity," said Paul Snelgrove, a professor in the Ocean Sciences Centre at Memorial University of Newfoundland, Canada, who led a group charged with synthesizing elements from the various census projects. Microbe species in the sea "could number a billion, swamping the number of other marine creatures."

Life on land depends heavily on life in the sea. Ocean creatures are a vital source of food and help to regulate the planet's climate, while marine algae called phytoplankton provide half our oxygen.

Since the marine census began, its data has yielded some 2,600 scientific papers. One study published July in the journal Nature found a strong link between rising sea temperatures and the decline of marine algae, the basis of the oceans' food chain.

Another census-based study in Nature found that warmer seas can hurt marine diversity, potentially rearranging the distribution of ocean life.

The census takers conceded Monday, however, that they still have a poor understanding of both sea microbes and sea plants, both of which play a crucial role in oceanic life. And so far there are only limited data about marine life in the Arctic and Antarctic seas, and in large swaths of the deep ocean.

Better understood is life at the top of the food chain. The populations of many large predators—tuna and shark, as well as reef fish, deep-sea fish and turtles—have declined by an average of 90% from historical levels, in part because of overfishing. At the same time, seal and whale populations have partly rebounded in recent years after receiving protection in various parts of the world.

The main goal of the census is to provide a baseline for future measurements in three areas: diversity, distribution and abundance. Where do various sea creatures dwell and how are their lives interconnected? Which species are thriving and which ones are dying?

"By comparing data over time periods we'll be able to tell what is changing" in the oceans, said Dr. Snelgrove.

The decade-long effort is the result of one of the biggest collaborations in the history of science, incorporating the work of 2,700 researchers from 80 countries, who logged 540 ocean expeditions.

It began in 2000 with $75 million in funding from the Alfred P. Sloan Foundation and completed at a total cost of $650 million, with hundreds of other institutions, laboratories and governments pitching in. The 30-million marine observations made over the past decade will be available to researchers and the public online.

The census is part of a wider push to create digital libraries of biological data about life on earth. The marine data will feed into the Encyclopedia of Life project, an effort to document all 1.8 million named species on earth. There's also an International Barcode of Life project assembling DNA barcodes for all multi-cellular organisms. cientists intend to use such libraries to study biodiversity on a planet-wide level, just as different types of meteorological data are pooled to predict weather. Spurring the efforts is a new field known as biodiversity informatics, which uses sophisticated computer techniques to sift and analyze data in novel ways.

Dr. Snelgrove likened the census to a flashlight used to explore a dark house. While it's a start, "we haven't turned on the lights yet," he said.

[sidebar]

[Ten-Year Project Deployed Technology Old and New]

The 2,700 researchers engaged in the global marine census were collecting specimens from some of the most inhospitable terrain on earthnfrom deep-ocean abysses and hydro-thermal vents to giant underwater mountains and frigid waters in the Antarctic.

An array of technology—new and old—was brought to bear. Aircraft remotely sensed the presence of animals using devices that measured the properties of scattered light. Larger creatures were tagged and their travels recorded and zapped to researchers via satellites.
Fish got tagged, too, and their migration patterns were picked up as they swam past acoustic listening lines. Near the shore, nets, dredges and simple buckets were used to collect specimens. More elaborate collecting gear was dropped near coral reefs. Mud samples from the sea floor were pulled up with hollow drill bits known as coring devices.

An especially difficult place for a population census is the deep sea. The old-fashioned—and cheap—way is to send down a sampling container at the end of a long rope. "But that's like trying to collect worms from a hot-air balloon at night," says Paul Snelgrove of Memorial University of Newfoundland.

In recent years, scientists have relied on robotic submersibles that can dive to great depths. Though expensive, such missions are useful for sampling life in areas devoid of light and under crushing pressure.

In waters deeper than 1,000 meters, the census discovered squids with "elbows." The creatures were up to 21-feet long and waved large, long fins.

--By Gautam Naik]

best wishes,
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