

## NOAA (Coastal Research Branch) Marine Biotoxins Program

Dr. John Ramsdell is chief of the Coastal Research Branch of NOAA, the acronymic name of the National Oceanic and Atmospheric Administration of the United States Government. Ramsdell heads a staff of about 20 scientists, organized in five or six teams, one of which is the Analytical Response Team, a multidisciplinary group of 7 scientists whose responsibility is to rapidly and accurately determine the cause and nature of "mortality events." These are the strange and often devastating destructions of marine life that occur unpredictably in coastal waters. Trained as a scientist himself, Ramsdell makes a practice of reading business literature to educate himself on management principles and practices.

He found *Adaptive Enterprise* on amazon.com, and was intrigued by the idea of designing an organization explicitly to deal with unpredictability. That is a defining characteristic of so-called "red tides" -- the popular name given to toxic algae blooms that are a frequent cause of marine mortality events.

The Coastal Research Branch benefited from a clear mission statement, one that met the criteria of a Sense & Respond Reason for Being. It reads as follows:

*To provide scientific guidance and directed research to promote effective management of living marine resources, ecosystem health and public health on issues related to marine biotoxins and harmful algae.*

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From this it is unambiguously clear that the outcome to be produced by the CRB is *scientific guidance and research* that promote effective management of our marine resources, ecology and public health. Equally clear is the role for whom this outcome is created: the *managers accountable for marine resource management in state and federal agencies*, for example, state Fishery and Wildlife agencies, and the federal agencies responsible for oversight of marine life. These managers need accurate information, and need it in time to make informed choices about what remedial actions to take when an event occurs--for example, choosing the appropriate medicine to control seizures in still-living animals that are victims of a toxic algae bloom..

As recently as 1987, the means of assessing the cause of mortality events was primitive. In that year, there was a massive dolphin kill on the eastern seaboard of the United States. The suspected cause was red tide toxin, but that could not be confirmed by the technique that was state of the art at that time -- analyzing tissue samples of the dead dolphins. This, to use Ramsdell's metaphor, is about as accurate and sophisticated as using a rabbit to ascertain pregnancy. Because managers were unable to confirm the cause, they had to be concerned about a variety of possibilities, which might be anything from a virus to a polluted estuary discharge, and take precautions to cover each.

The Analytic Response Team was formed to take on the challenge of giving decision-makers information that was much more precise, and make it available in time to be useful in managing the event.. Over an intensive five year period of research and testing, the team developed new, highly sophisticated instruments and methods to identify toxins in minute quantities with absolute identification down the elemental chemical composition. This has transformed toxin detection from the traditional use of animal-based samples to the application of chemical detection methods having the resolution of one-tenth the mass of elemental hydrogen. It is what information technology people call a "killer app."

But in 1998, a major sea lion kill in California made it clear to Ramsdell that technology and methods weren't enough. In this large scale event, individual members of the response team found themselves inundated by massive amounts of uncoordinated data from a large number of independent sources. It took a major effort and a significant amount of precious time to clean up, reconcile and relate all this input. The team spent an entire week coming up with a *preliminary* result. Even though they were ultimately successful in identifying, for the first time, the existence of domoic acid in sea animals, this wasn't good enough for Ramsdell and his staff. They needed a way to align multiple data sources, even when the sources and data required couldn't be predicted in advance. This challenge was on his mind when he ran across the ideas in *Adaptive Enterprise*.

Recognizing that the Analytic Response Team was, in effect, the Sense and Interpret support for his customers, the managers, he decided to design the team itself as an interactive set of roles that corresponded to the Sense-Interpret-Decide-Act (SIDA) loop. A coordinator role was established, accountable for sensing data sources and serving as a central clearing house for all data. The entire multidisciplinary team of toxicologists, chemists, biologists and taxonomists was used to populate a role whose accountability was to interpret the data. During this process the coordinator might be asked to dispatch resources outside the team to obtain additional data sources, perhaps in the form of water samples and specimens. Finally, the team would dispatch a response role to prepare the report for the state and federal managers accountable for taking remedial action.

The performance of the Response Team improved remarkably after they began operating as an event-driven, modular organization that dispatched its capabilities (as opposed to a process-driven organization that pre-scheduled them). In the 1999 Florida dolphin mortality event, the team identified, for the first time ever, the existence of brevetoxin in dolphins -- and they were able to confirm this finding before the event was concluded.

In 2000, there were multiple significant events on the California coast involving sea lions, whales and sea otters. The team was able to detect domoic acid in multiple species and determine not only the cause in each event, but that the events were related and how they were related. They credited their adaptive loop organizational structure with improving their response to "near real time."

As a result of these accomplishments the Marine Biotoxins Analytical Response Team was recognized at the Federal Employee of the Year Awards in 2000. Their citation reads, in part:

*The organization of the team [is] based on the premise that unusual mortality events [are] largely unpredictable. This team was designed on the principles of a sense and respond unit. It is comprised of early event listeners, a multidisciplinary team of event assessors and a team leader responsible [for] designing an event-specific solution. Key to the success of the team [is] that the response was based upon the unique expertise of the people rather than a pre-designed response and that all the people worked together on a daily basis in a mission-based Program. This approach represents a revolutionary design in business in which "business is an adaptive system for responding to unanticipated requests in unpredictable environments (Haeckel, Adaptive Enterprise, Harvard Business School Press, 1999.)"\**

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\* ( <http://www.chbr.noaa.gov/CoastalResearch/SpecialEvents.htm> )