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Herbert Austin
Virginia Institute of Marine Science

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by

Herbert Austin

Virginia Institute of Marine Science
School of Marine Science
College of William and Mary
Gloucester Point, Virginia 23062

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Science maybe defined as the orderly development and presentation of knowledge in which the results have been derived from controlled experiments or field observations. The scientific method develops a hypothesis, then tests it. From science we develop an understanding of natural phenomena and the underlying causes and effects.

This understanding must only be based on the results of the experiment or observation. No personal opinions, bias, or intuition. Intuition can, however, initially guide the researcher in the right direction, never-the-less, the results must not be intuitive, and must be repeatable.

Research is a slow exacting travail, experiments are replicated, subjected to statistical scrutiny, peer review, and finally, presented before a group of ones peers or published in the reviewed literature. The communication of the results in the literature is the generally acceptable means of information transfer, and usually the criterion for professional advancement. A process that can add up to a year or more to the communication of scientific results.

By its very definition, and normal communication channels, science (basic science anyhow) is going to run into a confrontation with the marine resource manager, angler, or waterman. These users of scientific data or information need answers today, better yet, yesterday. The scientist rarely

has an opportunity to run an experiment or gather observationswithin the needed time frame.

He or she tries, from a knowldge of other species to interpolate or extrapolate to the situation at hand. A technique that violates the scientific method. No hypothesis is generated or tested. Often a career is placed on the line for a quick answer. A scientist, with an understanding of the decision making process, its constraints, outside pressures,and need for timeliness can make a positive contribution. The manager, understanding the difficulty of providing a definitive answer in a short time, carefully phrases the question, and recognizes the trade-off of time for accuracy.

The reason Government scientists, Federal or State, are so often accused of producing shoddy work, is the unrealistic time constraints under which they work. Research takes time. Scientific information and research results are not always one and the same. Case in point was the VIMS "monitoring" study of hydraulic dredging for hard clams in the James River. In order to properly answer the question, "does the hydraulic escalator dredge destroy the bottom?", a two year , before, during, and after study needed to be conducted. The operation of the dredge needed to be carefully controlled in order to reduce variables.

But, VIMS scientists could only watch and record; and they had only four months to observe the "before" and during operation. Efforts to draw from other studies in Maryland and Florida to estimate ecosystem recovery were met with distain from watermen and members of the Virginia Marine Resources Commission alike. In the end, the Virginia General

Assembly made a decision, to ban the use of the dredge in Virginia, before the results of the study could be analyzed.

Science is also to develop an understanding of "why". Most watermen know "what" and "when", sometimes intuitively. Here the scientist and waterman can work together. The scientist is well advised to learn the "why" of the system that took generations to learn the what and how.

Scientists work three ways. They conduct basic research, delving into the why of the natural systems. Why are fish abundant one year and gone the next; how do crabs know which way is down bay; why do oysters strike on one shell and not the next? Answers to these basic questions are not always useful to the manager, but they do broaden our understanding of the system and how one unit interacts with another. Often new questions are the result, and the research changes direction. Applied research is conducted, on the other hand, to answer a specific question. No tangents, someone is waiting for an answer. Further, the answer will probably place the scientist in a position where he will appear to be taking sides, usually against the harvester. Against the short term gain in favor of the long term. He tries to side with the crab, oyster, and fish's side.

Where and when do the rockfish spawn? A regulation is to be written, protecting them when and where they do. The surveys are conducted, the eggs counted, and even tho we know eggs drift downstream after spawning, where they are collected is the designated "spawning ground". The spawning grounds are closed during spawning to protect the dwindling resource. Watermen react to the control, it's the scientist's fault.

The third category of scientific effort is monitoring. Monitoring is not fun, it's not glamorous, it goes on year after year; but it's the scientist's way of taking the pulse of the Bay or tributaries. Monitoring keeps track of the changes that take place, the trends; and if properly designed, provides the scientist with data to begin to understand the "why" of many of the changes.

Our rockfish studies typlify this. "Why have the rock declined"? Overfishing, pollution, or natural causes? There is evidence for all three. Immediate relief can be provided by reducing fishing pressure. In the James River rockfish production is up since the Kepone closure. Pollution is insideous, takes decades to be noticed, and decades to clean up, assuming it can be stopped. Basic research has pointed out the effects of climate change, starvation and predation. Applied research the location and timing of spawning, and monitoring, the year to year fluctuations in abundance.

Who is the VIMS scientist here to help? The regulatory commissions including the VMRC, SWCB, and PRFC? Data used by regulatory agencies generally results in a reduction in catch to watermen, to the benefit of the longterm catch, a point that is often missed. Watermen rarely use scientific data. They deal on a daily basis with the changing microcosim, their piece of the river or bay. Marine research is generally geared towards river or Bay-wide resolution. The results are an integration of the catch of many watermen. For the river, or the waters of the Commonwealth, the results are accurate; but for the segment of the river worked by a single waterman, of little use.

VIMS provides data and information to management agencies, and to watermen and anglers that ask specific questions. VIMS is not under the administrative control of any management agency. As such there is less pressure to produce results that grease political decisions. There is less "specialized interest" pressure on the results.

VIMS serves the people in Roanoke, Lynchburg, and Fairfax just as the people in Menchville or Guinea. The reseach strikes a balance between increasing the short term benefits to the harvester, and conserving the resource for the next generation to catch them. The next generation waterman and western Virginia angler that makes a once a year trip to the Chesapeake Bay to fish for spot, flounder, or to eat fresh crabs or oyster.

Dr. Perkins mentioned stock predictions. Predicting fish or crab abundance is more difficult than predicting the weather, in part because stock predictions must be based upon predictions of weather. Never-the-less this is a major focus of our research. Accurate stock predicitons are the Holy Grail of fishery managers, industry, and anglers. Managers need them to develop stock quotas, not legislate inefficient techniques to keep the catch down. Quotas become the decision making basis for industry, and as such considerable economic weight is carried by them. They must be accurate.

Dr. Diener alluded to the development of a comprehensive management plan for the Chesapeake Bay. For the fisheries this will require not only accurate stock forecasts, but data on growth rates, age at sexual maturity, location and duration of spawning, rates of recruitment, and rates of

mortality, both natural, pollution caused, and fishing. Scientists must be prepared to provide this information, and it will be in large part the watermen that will be our eyes and ears. We must work together in an atmosphere of trust and mutual respect. The long term gain is theirs.