Bringing together Managers, Modelers and Observationalists

Notes from meeting at GoMOOS – Sept. 24, 2004

This meeting was co-sponsored by GoMOOS and UNH's Center for Coastal Ocean Observation and Analysis (COOA). The purpose was to address the questions:

- What are the information needs of resource managers?
- Will the models being developed meet these needs?
- What are the data needs of modelers?
- Are observations being made to meet the needs of models?

Attending were: Ru Morrison (UNH), Jeffrey Runge (UNH), Lew Ineze (USM), David Townsend (UMaine), Michael Fogarty (NMFS), John Annala (GMRI), Huijie Xue (UMaine), Fei Chai (UMaine), Linda Mercer (Maine DMR), Janet Campbell (UNH), Paul Howard (NEMFC), Earl Meredith (NMFS and on detail to NEMFC), Josie Quintrell (GoMOOS), and Collin Roesler (Bigelow).

Lew Ineze gave an introductory presentation: What is meant by a model? (Fig. 1) Currently, fisheries management relies on population models (mostly single-species) developed from survey data. Researchers use GoMOOS-like data and possibly fisheries data (and CPR data going back 40+ years) and create research models. But there is little connection between the research models and the fisheries management forecast models (Fig. 1a).

As a first step, we can take information from the long-term records provided by fisheries surveys and CPR data to characterize system properties, shifts and "events" (Fig. 1b). This information can be provided to managers in an advisory capacity even if we don't understand what is causing the shifts and events. Feedback will lead to coupled system models; population models will become multispecies, and as we get feedback from managers to observationalists, scientists will develop hypotheses about why the events / shifts occurred (Fig. 1c).

Mike Fogarty explained that the models designed to take information from surveys to provide a picture of where the population is currently (now casts) and where it's been in the past (hindcasts) do not take into account environmental factors. Another class of models – forecasting models – attempt to explain the observed variability in terms of environmental factors (Fig. 2). In the absence of knowledge about the future environmental factors, they make stochastic forecasts and present a range of outcomes with associated probabilities.

<u>Managers: What are their information needs?</u>

Linda Mercer (Maine DMR) and Paul Howard (NEFMC) spoke about the needs of managers. Linda described changes observed in the nearshore communities (e.g., sea urchins replaced by kelp) and asked why these changes have occurred. She admitted that it is hard to conceive of ways to use forecast models for HABs in their HAB monitoring

system. The latter must be very precautionary. Linda also pointed out the mismatch in scales: DMR is concerned with what's going on inshore whereas GoMOOS observations tend to be farther offshore.

Paul Howard described 3 issues related to management needs: (1) water quality is important to emphasize. Despite the emphasis of the Pew and Oceans Commission reports there still seems to be a reluctance to tackle water quality issues. Fishermen feel that they are an easy target. (2) Marine Protected Areas (MPAs) – we need to understand the effect of closing an area. Since 1994 we've closed about 28% of Georges Bank, and a smaller part (10%) of GoM to rebuild stocks. Haddock stocks have gone from severely depleted to almost rebuilt, why is that? is it because of reduced fishing pressure? protected habitat? what are the best areas to close to rebuild stocks? Right now we're doing it piecemeal and it's taking forever. (3) forage species – we're harvesting lots of foraging species (herring, squid, sand lance, etc.) and there's a move to expand that fishery. In our management of these species, we're only considering the economics of harvesting them, not the forage value of the species. How can we manage a forage species for the benefit of the ecosystem (i.e., in terms of its value to predators and not just its economic value)? Everything he reads is that stocks are declining worldwide. It is not true that fisheries are in trouble in the Gulf of Maine. They are improving for some species. Most stocks are growing great except for Cod. We don't understand why this is.

<u>Modelers: What are their data needs? Can their models meet needs of managers?</u>

Mike Fogarty, Huijie Xue, Fei Chai and Jeff Runge spoke about models. Mike Fogarty showed a diagram of a complex ecosystem model (see figure). GoMOOS and scientists are focusing on lower tier, whereas fisheries managers are focusing on the upper tier (fish). In terms of the energy, it's tightly bound. There's not much left over. Implication is that if you manipulate one part of the system, it will have impacts on other parts. We now have a system that is strongly dominated by planktivorous fish and suspension feeding benthos (e.g., scallops). Over the past 40 years, there's been a fundamental shift in how the system is working. Today there is more dominance of lower levels of food web. Two messages: we do have these types of models that go back 20+ years. We have dynamic analogs to the static picture shown in the figure. Dynamic models focus on one part of system. They wouldn't typically deal with all aspects.

Managers need to understand regime shifts. Jeff Runge illustrated the effects of a regime shift in the Pacific with photographs of shrimp hauls from different years. Low frequency variability (decadal scale) is important to understand, whereas the high (interannual) frequency variability is not as important. Climate has certainly been changing. The impact of climate change on ecosystem is not understood. Fei Chai showed results of a biogeochemical model that he has developed and applied to Pacific ecosystems. He has applied this model in GoM but doesn't have faith in the ecological model here because we lack the necessary data. He showed comparison between SeaWiFS climatology and model results. Model has low chl nearshore whereas SeaWiFS "chlorophyll" is high there. We should account for CDOM and then compare SeaWiFS climatology with model results.

Jeff Runge showed evidence of low frequency variability as seen in long time series (e.g., paper by Pershing et al. based on CPR record). Variations in stocks of small zooplankton species are correlated whereas *Calanus* is forced by different factors. Jeff also showed simulation of *Calanus* abundance (integrated) over annual cycled derived by embedding a life-cycle model into a physical model (temperature, circulation) – assumes phytoplankton are not limiting. Also showed model runs (J. Pringle model) whereby uniform distribution of particles are put into water column in the western Gulf of Maine – and using climatological winds for one month the simulation shows how high concentrations of particles end up in Mass Bay and other particles flow through the Great South Channel. Jeff recommends a system of coupled models.

Next steps: What data are needed for models and managers?

Lew Ineze recommends that we begin by developing a set of questions – general questions that the managers will still want answers to 10 years from now. Questions should be specific enough to refer to regional issues. Dave Townsend pointed out that there has been a seeming inability of the management (fisheries) community to define the problems that can be attacked by scientists. It is worth a conference devoted to this question alone. What are the scientific questions that will improve fisheries management? Although today's discussion has spoken of fisheries, society is also wanting us to address the ocean environment – why do we have jelly fish washing up on the beaches? In the end, if we're going to move this forward, we need a clearly articulated set of goals.

Collin Roesler said if we do have broad questions, we can all go back to our respective jobs and address the questions from our own perspectives. Timing and magnitude of spring bloom will affect ecosystem. We all need to understand the questions that we can attack from different directions. The low-frequency signals are a good place to begin. Earl Meredith said we need information that will help with the models we are now using. How do we fine tune models for management purposes -- What do we need in terms of variability and complexity for management purposes?

Mike Fogarty warned not to try to define the management questions. Instead, we should ask what are the most important scientific questions that GoMOOS and COOA can address? There's no question that understanding the nutrient and phytoplankton dynamics at the base of the food web is important. It's not up to us to define what the management questions are.

Fei Chai argued that modeling is a cost-effective way to understand the system. Observations will never give us enough data. Adding one more mooring will not give you the information you need. Instead, invest in a model and then the model will give you more information. Collin: the model can even tell you where to place that next mooring. Jeff: models should be more like a Monet painting – not a Wyeth with lots of detail. Lew: what we have now is a Picasso.

What is meant by models?
Present situation…

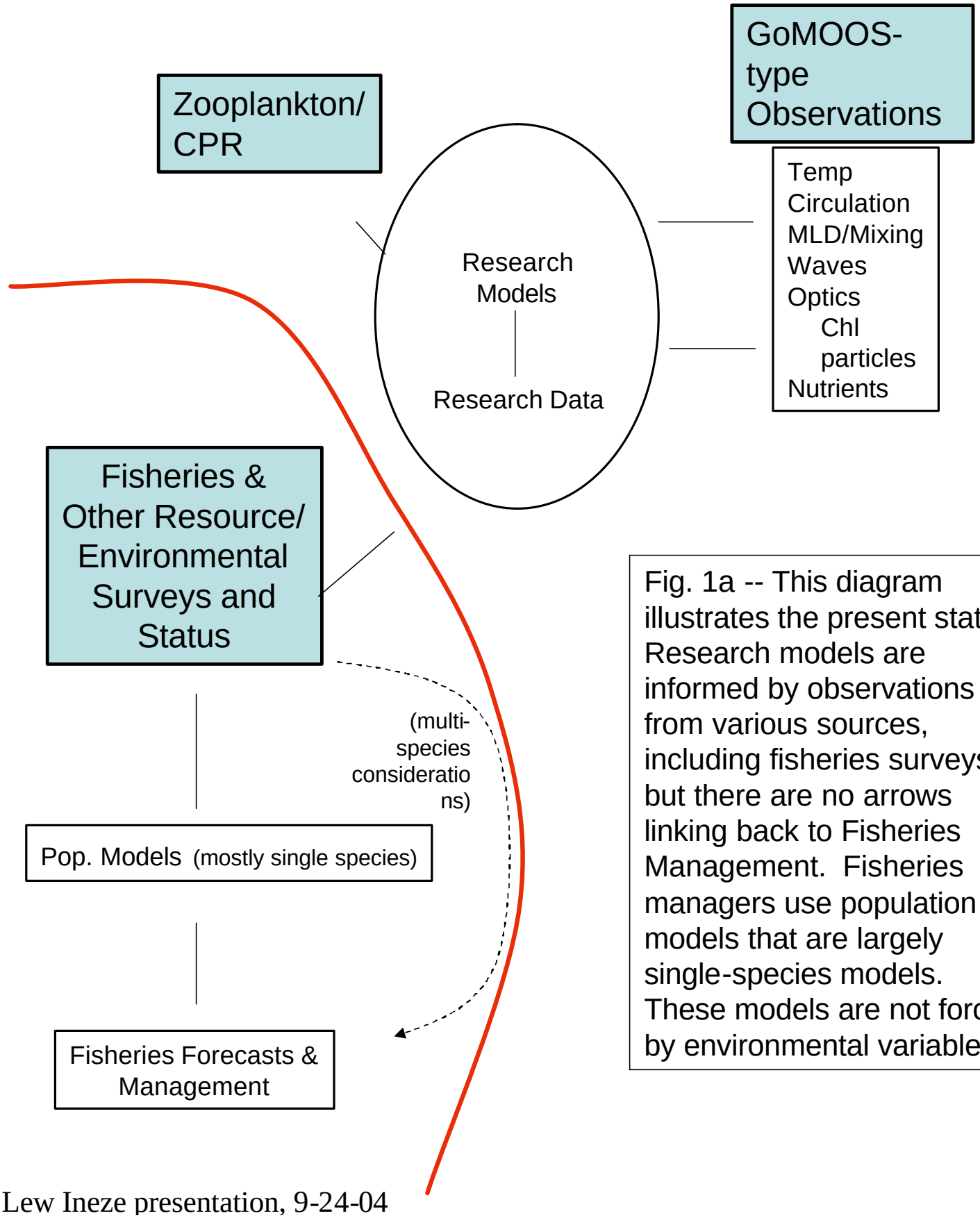
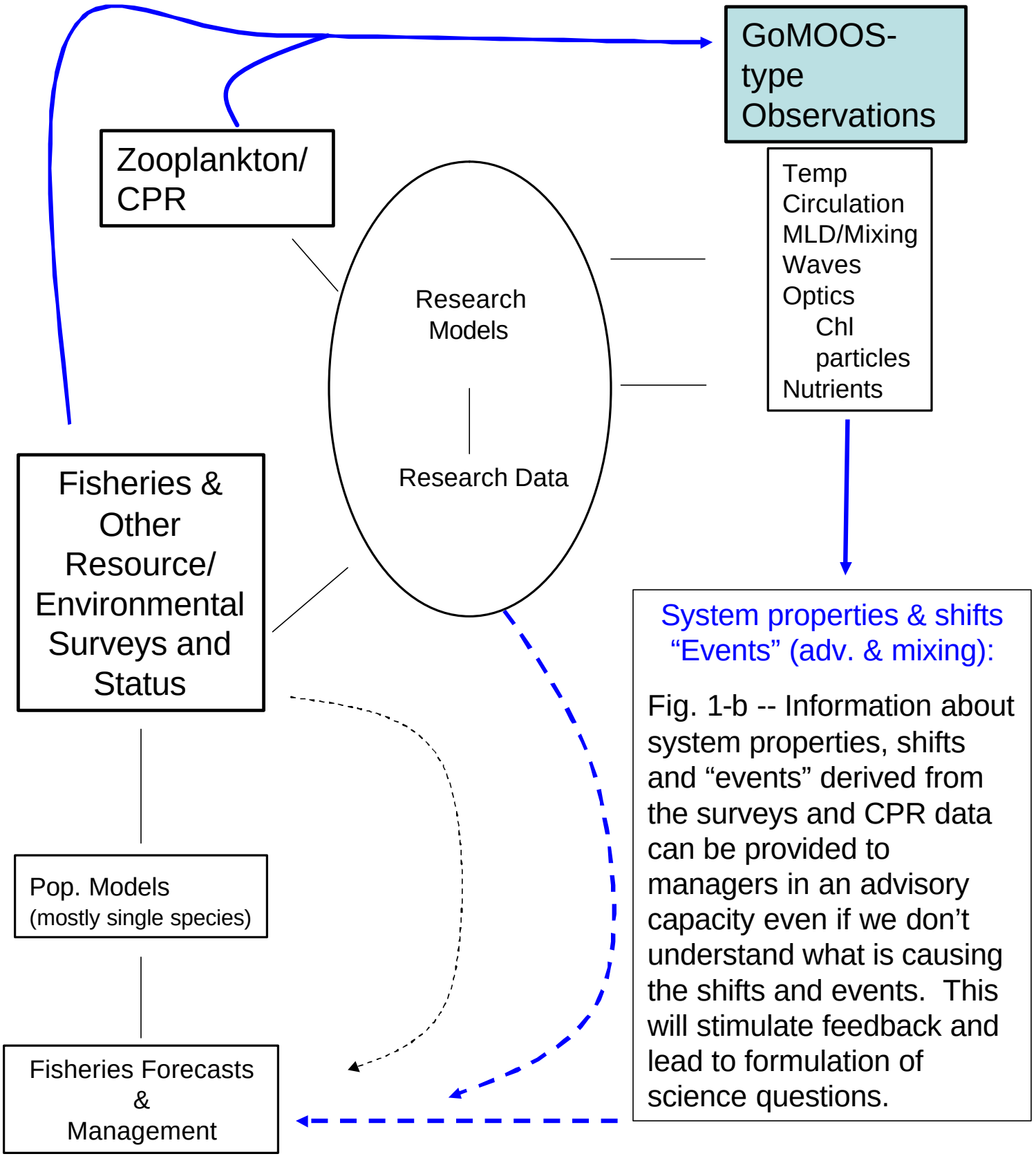


Fig. 1a -- This diagram illustrates the present state. Research models are informed by observations from various sources, including fisheries surveys, but there are no arrows linking back to Fisheries Management. Fisheries managers use population models that are largely single-species models. These models are not forced by environmental variables.

Easily implemented next step to remedy the situation:



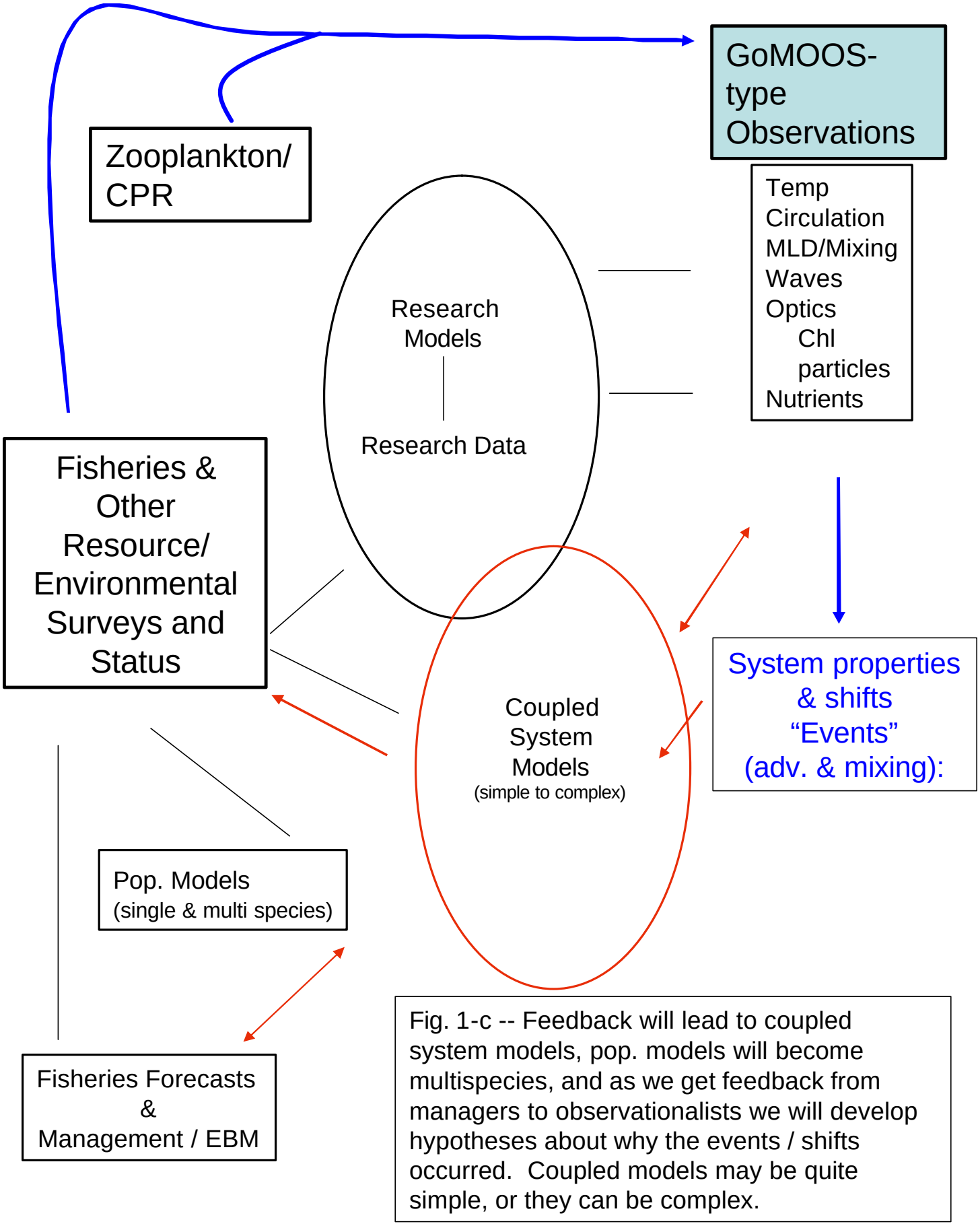


Fig. 1-c -- Feedback will lead to coupled system models, pop. models will become multispecies, and as we get feedback from managers to observationalists we will develop hypotheses about why the events / shifts occurred. Coupled models may be quite simple, or they can be complex.

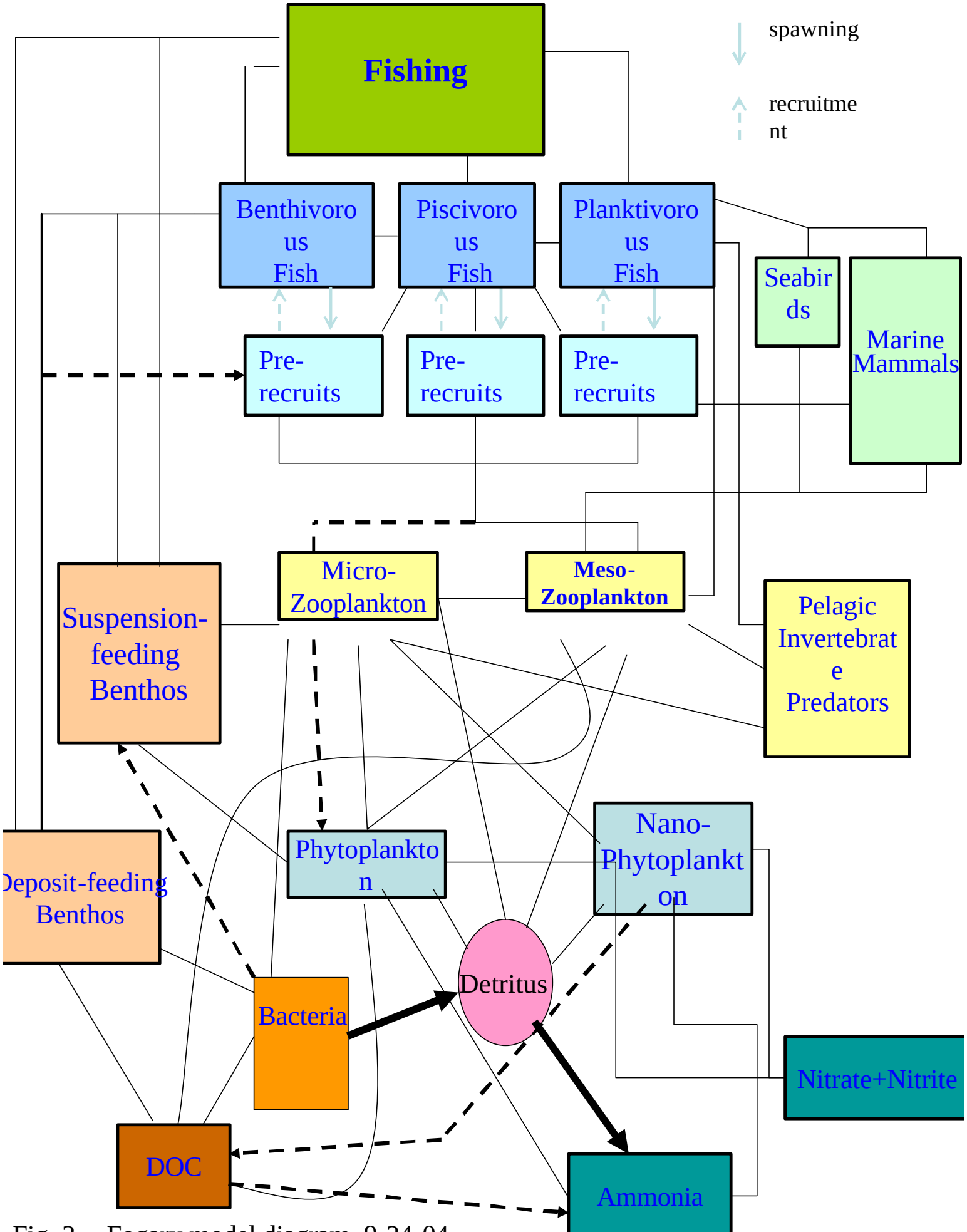


Fig. 2 -- Fogary model diagram, 9-24-04