Systems in action: Modelling a muddle
Part 1

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GINA LANDOR: Herring in the North Sea. It's a shoaling species, each shoal having a complete age range from juveniles to those of spawning age. Feeding on plankton, they in turn form prey to larger fish, like cod. Part of the ecosystem of the seas around Britain, but they also interest us for another reason - food.

[WATER GUSHING]

Along with many other species, they are caught and landed by fishermen and form an important component of the food production system. These fish will either be eaten as they are, processed into prepared food, or used as an animal feed. They're a significant source of protein for Britain and the European community. They also support a substantial fishing industry. But fish like these may suffer another fate, dumped back into the sea. Why?

This is part of the answer. The herring fishery of Lowestoft in the 1930s. Herring boats daily went out to the North Sea to harvest what appeared to be an inexhaustible supply of a high protein food source. But within a very short time, the fishery completely collapsed taking with it the hundreds of associated processing jobs. Lowestoft today. In the early morning, a single trawler unloads its catch of cod and flatfish. A stark contrast to the frenetic activity of yesteryear. To prevent something like the collapse of the herring fishery happening again, some control needs to be exerted.

GINA LANDOR: If the quantity of fish coming into the ports were uncontrolled, the result could well be catastrophic stock depletion. So the industry must be managed. But what should be managed? Parts of this fishery system appear to be prime candidates for muddling. What intervention should you make?

GINA LANDOR: Where do you start?

GINA LANDOR: Is there any particular component of the system that is amenable to representation by a model?

GINA LANDOR: From the experience of the collapse of the herring fishery, we need to understand something of the dynamics of a fish population and how fishing affects it. Models to achieve just that have been developed by scientists at the Ministry of Agriculture, Fisheries and Food.
COLIN BANNISTER: In order for scientists to give advice about the management of fisheries, we need to know something about the operation of the fishery. For example, how many vessels are there, where do they fish, what gear do they use, how much do they catch. Something about the life history and biology of the species, for example, where are the spawning nursery and feeding grounds, how fast do they grow, and so on. But thirdly and crucially, what is the impact of a fishery on the fish stock itself?

And in looking at that, we're interested in how that impact changes with the level of fishing and whether we might do better or possibly avoid some problems if we fished either less hard or with a different pattern. Now these are obviously fairly complicated factors and it helps us to understand the process if we try and simplify them and just look at the bare essentials. To do that, we can use a model.

Now in this case, we've actually got a physical model. And this physical model aims to represent three important aspects: the recruitment of young fish coming into the population, and two factors which we can vary the level of fishing, what proportion of the fish are actually caught and secondly, the level of natural mortality what proportion of the population is dying from natural causes each year. This pinball arrangement represents the fate, the game of chance if you like of fish in the year as they are either caught by the fishery or die from natural causes or collect at the end of the year as survivors.

So what I'm going to do is to set this at something like just over 10% at year, which is a normal value for certain types of fish species. And I'm going to set this at 40%, which is a pretty high rate of fishing, which is the sort of level that we find in many of our fisheries at the present time. So I'm now going to pull this lever down and the balls are going to cascade down and we'll see what happens.