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More ways to be different

Diversity seems to be important in more senses than just having many species living together, says S.Ananthanaryanan.

There are many senses of diversity. There can be diversity in the speed of motion of molecules of a gas, diversity in the profiles of customers of a product or service or the age of individuals in a population. A paper by an international group of scientists working in oceanography, ecology and fisheries, reports the finding that a healthy mix of age groups in fish populations is useful for the stability of numbers.

Molecules of a gas

The accepted model of a gas is that it consists of a huge number of microscopic, but identical particles in incessant motion, ricocheting both off the sides of their container as well as off each other. The force they exert on the container is the pressure of the gas and by bouncing off each other, they maintain a distribution of different numbers of particles at different speeds.

The interesting thing is that for the particles all to be moving in some fixed band of speeds is not naturally possible, and if imposed, the imposed uniformity soon breaks down. The natural distribution is of a large number of particles in some level of speed and progressively smaller numbers at speed greater or less than the mean speed. If fast particles are removed, for example by escape into outer space at high altitudes, the particles that remain readjust their speeds to again have a number, though a lesser number, at the higher speeds.

The reason for the bulk of the particles to choose the middle speed band is that for a given total energy of the gas, there are overwhelmingly more ways for the particles to occupy the middle band, with lesser numbers in the outer bands, than for any other kind of distribution of speeds. One could say that the natural state is the state that has the greatest diversity of forms.

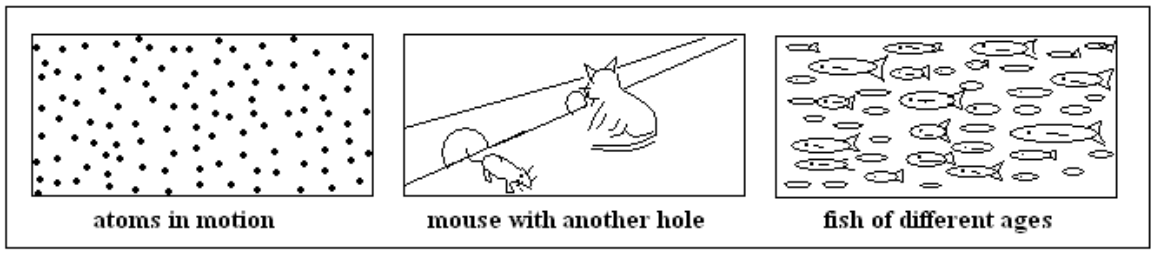
The marketplace

There is a French saying that a mouse with only one hole is soon trapped. (souris qui n’a qu’un trou est bientôt prise). A business with a specialised customer base is similarly at risk of getting wiped out. A business should ideally have different categories of customers. If conditions change and one category changes its preference, the loss could be replaced customers of other categories, so that the customer mix may settle down to a new distribution in the new conditions.

On the other hand, if the market were of a few categories only, it would take time to replace a lost group of customers and the business may not have the stamina to hold out. Or, at least, it would do badly for a long time before it recovers. This is an instance of stability that comes from diversity in the customer population. It is similar in the case of those business houses that go on and on – they have a diverse product mix – so that obsolescence of one of them has little impact and the business house is able to develop new lines or to revamp the outdated one.

Fish populations

Fish populations left undisturbed settle down to a distribution of older fish, adult fish and young fish. Unchecked build-up of older fish would discourage survival of young fish, but this, in time, would ensure less older fish, and hence more young fish. More young fish would result in more losses to predators and increase in the proportions of experienced ones and slow recovery of a stable mix.



Decline in the fisheries, world-wide has made it important to understand what is happening to these populations. The work of the George Sugihara, at San Diego and colleagues, reported this week in ***Nature,*** suggests that the challenge is not just to rebuild the biomass, but also to restore the age distribution.

The collapse of the California sardine industry in the late 1940s had been blamed by some on commercial fishing and by others on reducing sea surface temperature or on changing wind patterns. In an attempt to disentangle man-made and environmental causes, the Cooperative of fisheries in California set up a body to collect data of both exploited and unexploited fish assemblages in the same environment. To get at such differentiated information, data was collected not from the figures of landed fish but of levels of fish eggs and larvae.

Ichthyoplankton

These are fish eggs and larvae found in the upper 200 metres of the sea. The eggs stay passive while larvae develop some swimming ability only when a little older. Ichthyoplankton are an important part of living things in the water column and the larvae feed on smaller larvae and are fed upon by larger animals. But the eggs and larvae are good indicators of the spawning population present in the area at the time. Sampling the egg and larva populations is thus easier and faster than other ways of assessing adult population levels.

The San Diego group analysed the data covering 50 years, both for exploited and for unexploited areas and come to important conclusions. The first conclusion is that while commercial fishing does have an affect on fish stocks, the variability of the stock level does not fully correlate with the intensity of fishing. The other effect of fishing, which typically goes for larger fish, is to increase the number of younger fish.

This reduction can affect survival in two ways. One is that younger fish, being less experienced and less hardy, naturally fare badly under environmental attack. The other is that demographic measures, like intrinsic growth rate are affected by limiting the population to younger fish. These two effects can be separated by statistical methods of analying data.

The group found that the second of these effects, of changing the age distribution was the crucial result of commercial fishing.

This is an important finding for managing different kinds of resources and is a factual instance of selective harvesting altering the basic dynamics of the exploited population – leading to ***boom or bust*** conditions, destroying stabilizing buffers and leading to declining stock.