Monitoring a marine invasion

Monitoring the consequences of environmental change, such as invasion by an alien species, is often expensive, sometimes prohibitively so. Many studies have shown effects of environmental change on bird populations, but it is not often that birds themselves have been used to monitor changes in the populations of other animals.

Since 1979, Phil Hockey and colleagues have studied the diet and population dynamics of the African Black Oystercatcher *Haematopus moquini* on islands off the South African west coast. Where oystercatchers feed their chicks, piles of emptied shells form which are easily collected and analysed, allowing researchers to follow changes in diet from year to year. Mussels and limpets are the main food items, and the birds eat these shellfish in approximately the same proportions as they occur on the shore. Thus, a change in the diet indicates a change in the structure of shellfish populations.

In the late 1970s, limpets comprised 30–40 per cent of the diet, much of the balance being made up of indigenous ribbed mussels *Aulacomya ater* and some black mussels *Choromytilus meridinalis*. By the mid-1980s it was obvious that black mussels were becoming commoner in the diet and ribbed mussels and limpets were becoming rarer. By 1989, the proportion of ribbed mussels in the diet had dropped to less than one per cent, and on one island the proportion of black mussels had risen to 92 per cent. We were witnessing the beginning of a rare event in the sea – invasion by an alien species.

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During the mussel invasion, oystercatcher breeding success increased on west coast islands.

In this case the alien, which superficially resembles the indigenous black mussel, was identified as being a Mediterranean species, *Mytilus galloprovincialis*.

The alien mussel is a very strong competitor on the shore, ousting the indigenous ribbed mussel, which apparently was being driven close to extinction above the low-water mark (where oystercatchers feed). Limpets, too, appeared to be suffering. Throughout the early and mid-1990s, the oystercatchers' diet remained constant, suggesting that the invasion had stabilized. During this time, however, we decided to investigate the interactions between mussels and limpets on the shore. Here again, something interesting was happening – the mussels were covered in young limpets!

Normally, young limpets have a tough time when they first settle on the shore – they are frequently bulldozed off the rock by the larger adults as they graze across the rocks. The mussels, therefore, were providing a relatively safe haven for young limpets during their early months on the shore. Limpets growing on the backs of mussels eventually become too large to remain on their temporary hosts, and have to move on to open rock. We predicted that in time, through sheer pressure of numbers, they might gain a competitive advantage over the alien mussels and that this would be reflected in the oystercatchers' diet. By the summer of 1996/7, it seemed as though this prediction had come true.

The proportion of *Mytilus* in the diet dropped from about 65 per cent to about 30 per cent, ribbed mussels were showing evidence of a comeback, and the proportion of limpets was the highest recorded since 1979.

What will happen next? One possibility is that the high mortality being inflicted on limpets by the oystercatchers will once again cause the 'balance of power' to shift back to the mussels. We predict that we will see a series of years in which the relative proportions of mussels and limpets in the diet will oscillate, but these oscillations will become progressively smaller and and perhaps eventually stabilize at some new balance point.

Interestingly, the mussel invasion also had an effect on the oystercatchers. Because the mussels provided more food for the oystercatchers, the birds produced more young. It is several years before young oystercatchers return to the islands to breed for the first time, so it is only now that we are starting to see the consequences of this. The populations of oystercatchers on Jutten and Malgas islands are now larger than they have ever been – and their breeding success is still high!

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