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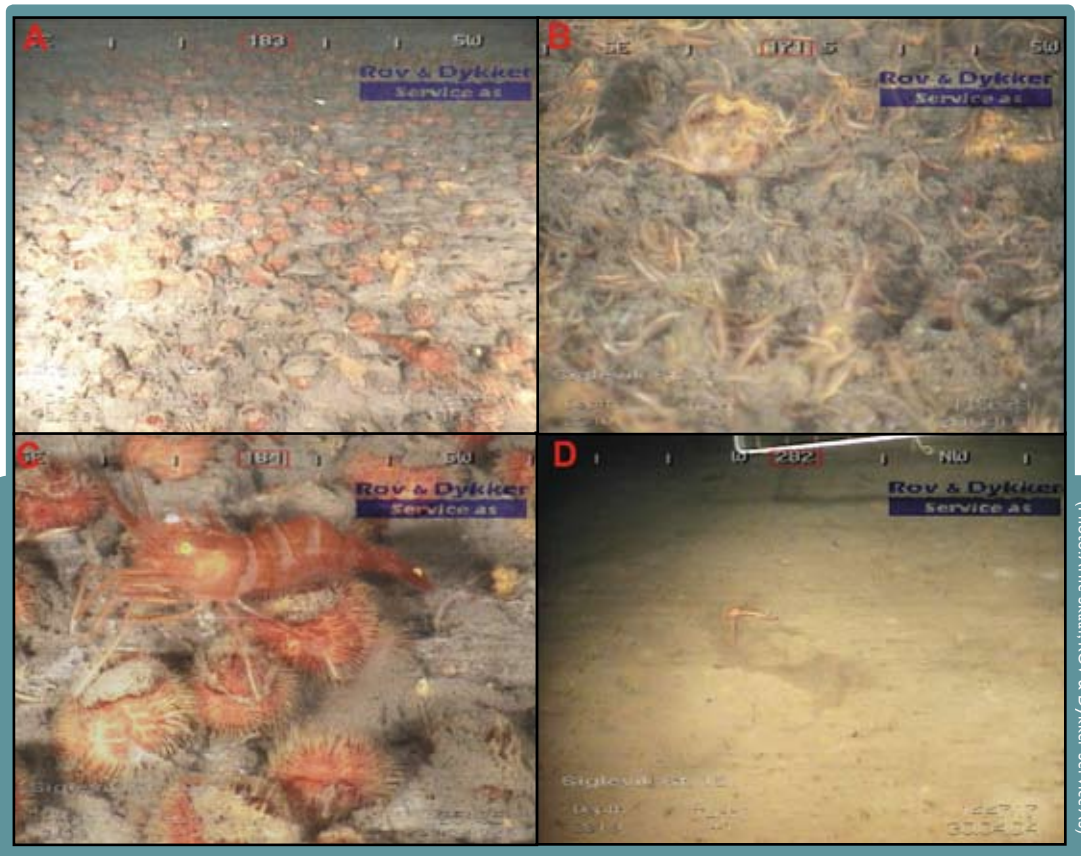
Aquaculture stimulates animal life in the fjords

A trip with a mini submarine in Norway's deep fjord basins can be a fairly boring experience – endless mudflats with few animals to be seen. This is because little food is available down there. However, if a fish farm is operated correctly, its waste products can stimulate and increase the activity on the seabed.

BY TINA KUTTI

It is well known that fish farming in open cages entails the release of large quantities of organic matter to the water around a fish farm. At maximum feeding rates, a medium-sized fish farm may emit 1500 to 3000 kilos a day. The waste consists first and foremost of fish excreta, but even today, some feed is still wasted. This supply of nutrients from aquaculture is an extra source of nutrition capable of increasing the biomass of benthic fauna.

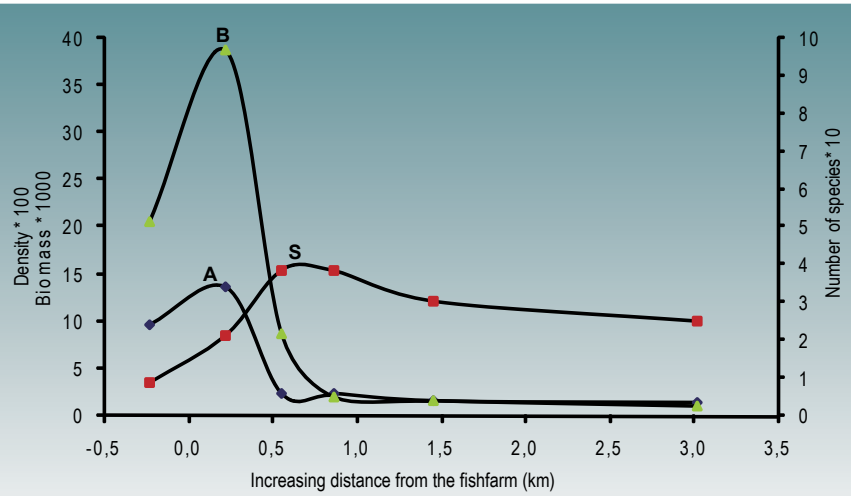
For two years, the Institute of Marine Research has been studying the dispersal of organic matter,sedimentation rates and bottom-living animals along a three-kilometre gradient centred on a salmon farm on a deepwater site in the Hardanger Fjord. The farm is a medium-sized Norwegian ongrowing facility. In the course of the production cycle, 2,910 tonnes of salmon were produced and 300 tonnes of organic waste were released. The farm is moored to a single point at a depth of 230 metres, and moves according to the direction and force of the wind and current. Its swept area is 30 times as large as the areas directly covered by the sea-cages, and the waste is thus relatively widely dispersed. Although the farm has been producing salmon for more than ten years, the site is not polluted, but major changes on the seabed, and a large increase in the quantity of benthic fauna, have been observed.



(Photo: Arne Skaar, ROV & Dykker Service AS)

Still photos taken from an ROV video study of a station 250 metres north (A, B and C) and a station 1 500 metres north (D) of the farm's mooring point one year after the start of production. The images show the high abundance of the sea urchin *Brissopsis lyrifera* and of small polychaetes within the footprint of the farm, and the desert-like unaffected area of the fjord.

Retur: Havforskningsinstituttet, Postboks 1870 Nordnes, NO-5817 Bergen, Norway



Abundance (A), biomass (B) and number of benthic species (S) larger than 1 mm from six stations along the 3 km-long gradient away from the salmon farm at peak production (September and December, 2004).

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INCREASED PRODUCTION IN THE IMMEDIATE VICINITY

The most noticeable effect of the releases of organic waste were restricted to 250 metres within the mooring point of the farm (see photo). Within this area, the sedimentation rates of organic carbon was found to be nine times as high as it was three kilometres further out in the fjord. Even so, there was no accumulation of organic matter in the sediment, but the abundance, biomass and production of small benthic animals were all much higher; 10, 35 and 60 times as high respectively as in unaffected areas (see figure). Mainly polychaetes (bristleworms), shellfish and sea urchins seemed to utilize the rise in available food.

GREATER DIVERSITY IN THE TRANSITION ZONE

Even though most of the organic material was spread over the innermost 250 metres from the mooring point of the farm, the composition of the sediments showed that some of the waste was dispersed as far as 550–900 metres from the mooring point.

In this transitional zone, a very high number of benthic species were found, but the density and biomass of small sediment ingesting animals was fairly low (see figure). When salmon production was at its peak, there were more than twice as many species here as in the immediate vicinity of the farm.

EFFECTS ON THE ENTIRE BENTHIC FOOD CHAIN?

Even though the greatest effects on benthic production were restricted to the 250 metres closest to the farm, the benthic food chain can be influenced on a much larger scale. This is particularly true for more mobile organisms such as bottom-living fish and crustaceans that live mainly off animals down in the sediments. Studies showed that the waste from the salmon farm was exploited by shrimp (*Pandulus borealis*). Shrimps caught near the farm in winter had a higher content of fatty acid in their musculature than shrimp from adjacent fjords where there were no fish farms, which suggests that their access to food was more stable throughout the year.

SIGNIFICANCE FOR SITING

These studies underline the importance of sites with good dispersal conditions and of adapting the level of production to that animals and microorganisms in the sediment can decompose. With good siting, a high level of production can be maintained over a long period of time without the accumulation of organic matter and with a greatly increased production of benthic fauna. Overloading a site can be avoided by increasing the sedimentation area of the farm's organic waste, either by mooring the farm at a single point, as in this case, or by using well-separated sea-cages instead of a compact farm.

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