ENVORINMENTAL MONITORING AT HAVSUL 1

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Stressed Seas

In addition to a global degradation of the earth environment caused by the use of fossil fuels the European coastal marine ecosystems are under pressure due to eutrophication, over fishing, persistent organochlorides pollution, ships traffic, extraction of sand, to name a few. In this context, it is important that any new large scale exploration of renewable offshore energy sources be accompanied by investigations on the positive or negative effects they might have on the ecosystems.

Known effects from Offshore Wind Farms

The oldest large-scale offshore wind farms can be found in the southern Baltic and southern North Sea. There, research programs have investigated the effects on the environment. The main finding based on these investigations is that the construction period causes the most negative effects on the environment. The strongest impact is on the small toothed whale species, i.e. harbour porpoise, which during pile-driving of monopile foundations are deterred by the intense noise. During the operating phase, the strongest effect is the reduction of bottom trawling which is often not compatible with a wind farm. This reduced not only the regular degradation of marine benthic communities caused by trawling, but also sedimentation in the area. The wind farm has, in these cases, become protected areas where fish communities are able to find a refuge for example feeding or spawning. Other more subtle effects included displacement or change of habitats, underwater noise and introduction of electromagnetic fields. There is a general lack of understanding about the cumulative impacts on the ecosystem by these and other small and sub-lethal effects acting at a large spatial scale over a long period of time. This include for example the cumulative effects from multiple installations along the migration route of species such as eel, but also the ecosystem scale effects from long-term introductions of low level noise. The foundations also introduce hard structures in an environment dominated by soft sediments. These structures can act as stepping stone habitats for alien species and facilitate the spread of biological invasions.

Norwegian conditions

Norwegian coasts are dramatically different to the shallow water and calm seas typically found in the southern Baltic and southern North Sea where the sea-bed is dominated by soft sediments. Coastal areas in Norway are exposed to the powers of strong winds and large oceanic waves that wash off sediments and result in a complex underwater topography with rocks, boulders or gravel. The habitats that are found there are more diverse depending of depth and exposure to waves and currents. In shallow areas, dense kelp forests are common while depths below 20 meters are often dominated by bare rocks covered with crust-forming algae. The biological communities are composed of species that either are anchored to the substrate such as leather corals, barnacles and crust forming algae, or they are actively moving species that can take shelter if needed, such as sea-stars, fish, and crabs. Both the kelp forest and the bare rock communities are highly diverse habitats comparable with tropical coral reefs. Norwegian coastal ecosystems can also be considered as less degraded by anthropogenic stress factors, as mentioned above, in comparison with the more densely populated areas around the southern North Sea and the Baltic Sea. Stocks of commercially important fish and shellfish species are also less depleted. Because of these fundamentally different biological, oceanographical and physical conditions it is difficult to make predictions about the marine ecosystem effects from large scale offshore wind farms along the Norwegian coast.

The first full scale offshore wind farm in Norway

Off the island Harøya on the coast of Møre and Romsdal Vestavind Offshore AS plan to build Havsul 1, a large wind farm of up to 350 MW installed effect. This site is typical for Norway in that it is dominated by underwater rocks and stones. The average depth is around 50 meters. Shallower (above 15 meters) inner areas are dominated by a dense kelp forest that is currently being harvested every fifth year for providing raw material to the alginate industry. Alginate is today used in various pharmaceutical preparations. The deeper (below 70 meters) outer parts of the area is probably used as spawning grounds for the Norwegian spring spawning herring, one of the largest single stocks of commercially important fish available on earth. Since the area is full of breakers and very shallow areas, ship traffic is avoiding the site. For the same reasons, we have very little previous data on the marine benthic life. However, a recent scientific cruise to Møre and Romsdal found no less than four species new to science, two of which were very large seastars. One other important reason to the limited knowledge about this area is the domination of rocky sea beds. While the diversity of life forms inhabiting a sediment seabed can easily be investigated in great detail by sieving samples collected by grabs, rocky sea beds must be sampled at the site. Traditionally this has been done by divers but rough seas and great depths are preventing the use of divers at Havsul.

Seastar Photo: Joar Elgåen

Monitoring the environment at Havsul 1

Monitoring of environmental effects from the wind farm is therefore a challenge and requires innovative approaches to be cost effective and scientifically meaningful. We have started a program that aim at detecting general ecosystem shifts, habitat change and disturbance in community structure and diversity. The program is based on a before after control impact (BACI) design that use baseline studies before the actual impact occurs. Data collected in the impact area is compared to data from a reference area that will allow us to identify other sources acting on the whole region such as global climate change. The sea bed is monitored using video-data collected from a remotely operated vehicle (ROV). The video data is assembled into single picture files and analysed for coverage of biological features using specially designed computer algorithms. Coverage of features can be compared over several years and between impact area and the control area. The kelp forest is a key biotope in the shallower parts of the area and sustains a community of associated organisms of a very high diversity. It is also an important habitat for spawning and provides a nursery area for fish. The kelp forest is currently harvested here, an activity that may stop after the construction of the wind farm. This will probably increase average age of the individual kelp plants and thus increase the diversity of kelp-associated species. The kelp is monitored by taking samples of the fauna growing on it. The age structure is also recorded at each station since we expect the average age to increase when trawling halts.

Kelp Photo: Marie-Lise Schläppy

Currently, there is no reason to expect any large effects on the marine environment from the wind farm at Havsul. However, both managers of marine resources and the offshore wind industry have expressed the need for scientific data collected in Norwegian conditions. The Norwegian Water Resources and Energy Directorate writes that the results and experiences gained from the Havsul 1 wind farm will be the basis for decisions about future offshore wind projects. The industry acknowledges the fact that the raising public concern for the future global environment is a key driving force for investments in offshore renewable energy. The same awareness could become a show-stopper if management is based on people's preconceptions rather than on sound science. Management of natural resources must be based on science to be effective in preventing misuse and degradation. In this way it will be accepted by a larger part of the population and more stakeholders with conflicting interests.