Scottish Natural Heritage

BIODIVERSITY INDICATOR

S014 – December 2011

Marine Plankton

Plankton, both plant (phyto-) and animal (zoo-) are at the lowest levels of the marine ecosystem. They are a vital food-source for higher-level organisms and so form the base of the marine food web. Generally plankton have a rapid lifecycle, producing several generations per year and are therefore more likely to show any impacts of climate change before higher trophic organisms such as fish or crabs. There is strong evidence that plankton communities have responded to warming waters around the UK, both in their distribution, and the timing of their peak occurrence through the year.

Evidence

Data from the Sir Alister Hardy Foundation for Ocean Science, which runs the Continuous Plankton Recorder (CPR), are presented here for Scotland. Phytoplankton Colour Index (PCI) is a measure of phytoplankton biomass and therefore primary production. Two common species of copepod (small crustaceans) were also examined, *Calanus helgolandicus* and *Calanus finmarchicus*. These species are indicative of prevailing conditions – *C. helgolandicus* favours warmer (temperate) waters, and *C. finmarchicus* is more frequently found in colder (boreal) waters. *Calanus* species in general are an important food source for fish and the total abundance of *Calanus* is also presented.

Change in plankton abundance, 1958 to 2010

*Continuous plankton recorder results (SAHFOS)*

Assessment

- Phytoplankton abundance increased within the assessed period and was 141% of the baseline in 2010.
- *C. finmarchicus*, a cooler water species, declined in abundance to 33% of the baseline in 2010.
- *C. helgolandicus*, a warm water species, increased in abundance to 363% of its baseline.
- Total *Calanus* (all species combined) abundance declined from the mid-1960s despite the increase in *C. helgolandicus*, but in recent years abundance has returned to 91% of the baseline.

<table>
<thead>
<tr>
<th>TREND</th>
<th>Divergent</th>
<th>DATA CONFIDENCE</th>
<th>High</th>
</tr>
</thead>
</table>
Commentary

The CPR survey has run for 80 years, with unchanged methodology since 1958. This allowed the study of long-term changes in the plankton community. During this period, the evidence for climate change (or global warming) has increased; over the last 25 years, coastal sea temperatures around Scotland have risen by 0.5 to 1.5°C (Sparks et al., 2006).

Phytoplankton form the base of the marine food web – increased phytoplankton biomass (in this case represented by PCI) may stimulate greater productivity at higher trophic levels. However, an increase in phytoplankton biomass may be due to a greater abundance of phytoplankton species which are not eaten by existing herbivores, or because of an increase in potentially detrimental species which can form harmful algal blooms (HABs). One hypothesis is that the increase in PCI is due to increased nutrient loads or eutrophication. Whilst this may be likely in coastal or sheltered regions, results from the CPR survey point to a link between changes in phytoplankton (particularly HAB taxa) and regional climate change, in particular temperature, salinity and large scale atmospheric fluctuations (Edwards et al., 2006).

Changes in the abundance of *Calanus finmarchicus* and *C. helgolandicus*, have been reported by Beaugrand et al. (2003), Edwards et al. (2005) and many others, with a strong link between changes in these species and warming seas. Recent work by Beaugrand (2012) has shown that the thermal regime of the North Sea has changed, with a northward movement of a critical thermal boundary (the annual 9°C to 10°C isotherm), causing an ecosystem shift. This has resulted in a decline in *C. finmarchicus* and an increase in *C. helgolandicus*.

During the 2000s *C. helgolandicus* became almost as abundant as *C. finmarchicus* was in the 1960s, with only a slight decrease in overall *Calanus* numbers. However, *C. helgolandicus* is known to have a lower biomass value than *C. finmarchicus*, meaning that potentially there is less food (energy) for higher trophic levels, such as fish. In addition, Thackeray et al. (2010) identified a change in the seasonal timing of the annual bloom pattern of some plankton groups (see Scott et al., 2011), with potential consequences at critical stages in the life cycles of species, potentially causing a mismatch between predators (fish) and prey (zooplankton).

Source data and updates

Data were provided by the Sir Alister Hardy Foundation for Ocean Science, Plymouth, United Kingdom. The Continuous Plankton Recorder survey has been collecting data in the North Atlantic and North Sea since 1931, monitoring the near-surface plankton species composition and abundance on a monthly basis. Data are obtained from a plankton sampling instrument towed from merchant ships on their normal sailings. This indicator is updated annually. For specialist advice contact: D. Johns, The Sir Alister Hardy Foundation for Ocean Science (SAHFOS). http://www.sahfos.ac.uk/

UK Indicators

The Scotland indicator has no current UK equivalent.

References


