Environmental Audit Committee Inquiry: UK's role in Arctic sustainability

Due date and time: 1000 hrs Monday 24th April 2017

Response from the National Oceanography Centre

The National Oceanography Centre (NOC) is the United Kingdom's centre of excellence for oceanographic sciences. The NOC has a remit to provide national capability and leadership for big ocean science.

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1. Scientific research: What are the most significant environmental changes taking place in the Arctic, what is changing and what does it mean for the Arctic and the UK?

Major changes

1.1 The Arctic Ocean is warming, resulting in increased ice melt and, in turn, influencing levels of stratification (due to freshening of surface waters). This influences the supply and replenishment of nutrients from deeper waters.

1.2 Atmospheric concentrations of CO_2 are increasing, causing more CO_2 to dissolve and ultimately lowering the pH of surface waters (ocean acidification).

1.3 Satellite-derived estimates of pan-Arctic primary production suggest that it is increasing but the underlying mechanism remains unclear. These estimates also exclude primary production by ice algae and therefore their implications remain difficult to ascertain (could it be that increased pelagic primary production is a consequence of reduced under-ice primary production due to loss of sea ice?).

1.4 Reduced ice cover is opening up new shipping routes and exploitation opportunities (e.g. oil and gas).

What does it mean?

1.5 Warming has a direct (positive) effect on metabolic rates, potentially reducing the overall efficiency (in terms of carbon) of Arctic ecosystems that are adapted to life in the cold, i.e. a greater proportion of the available organic matter may be respired and turned back into CO_2, thereby lowering overall ecosystem productivity and the potential for carbon export to the benthos and sequestration [via the remineralization of carbon-rich organic matter in deeper water].

1.6 Blooms of ice-associated diatoms are expected to decrease as the ice melts. This has potential ramifications for the herbivorous animals (copepods: *Calanus* spp.) that

consume the nutrient- and energy rich diatom biomass and use this to fuel their annual spawning.

1.7 Anything that impacts upon *Calanus* could have implications for fisheries (*Calanus* spp. dominate the Arctic zooplankton and thus represent a major trophic interface between primary producers and fish) and the wider ecosystem.

1.8 Loss of ice diatoms also has potential implications for the amount of organic carbon that sinks out of the surface ocean, ultimately changing the amount of carbon stored in deeper waters.

1.9 Increased surface stratification and hence reduced nutrient supply has implications for the types of primary producers that prevail – potentially moving away from diatoms and increasing the abundance of flagellated microplankton. This may change the availability of energy and nutrients for grazing animals (*Calanus* spp. etc.).

1.9.1 Lowered surface pH has implications for calcareous animals as this makes it harder for them to produce their shells/skeletons.

1.9.2 Adult *Calanus* appear to be robust to future ocean acidification scenarios but recent evidence suggests that the juvenile developmental stages and/or reproductive processes may be more sensitive.

1.9.3 Increased primary production has the potential to mitigate at least some of the above issues.

1.9.4 Increased shipping has the potential to deliver new contaminants (e.g. copper from the antifouling paints on ships' hulls).

1.9.5 Oil and gas exploration/exploitation has the potential for leakage/spillage of hydrocarbons.

2. Scientific research: How does the Government's focus on promoting and funding UK scientific research in the Arctic increase its influence with Arctic States and other international fora relevant to the Arctic? How does the UK's involvement in international scientific fora (such as the International Arctic Science Committee) and bilateral research projects between countries help?

2.1 The answer to this remains to be seen. In my opinion, strengthening and developing the UK's expertise and presence in the Arctic Ocean (and associated initiatives) will undoubtedly increase our influence in this region. Fostering (and funding) international collaborations will strengthen the sense of a shared responsibility for understanding the Arctic and operating within it in an appropriate manner. Beyond this, it is difficult to know how the UK's influence in this region will change/increase.

3. Scientific research: What impact has the Natural Environmental Research Council's (NERC) recent 5 year research programme had so far? What is being done to assess its impact in the future? What is the process for deciding what follows?

3.1 There is uncertainty here about which programme is being referred to, as one Arctic programme has just ended and another has just started. The NERC *Changing Arctic Ocean: Implications for marine biology & biogeochemistry* programme[1] (officially started in February 2017) has not being going long enough to achieve an impact. The impact of this programme will be assessed in different ways - for further information on this, please speak to NERC's Jessica Surma, Programme Coordinator, Shelf Sea Biogeochemistry Programme: (jetc@nerc.ac.uk).

1. NERC *Changing Arctic Ocean: Implications for marine biology & biogeochemistry* programme

   http://www.nerc.ac.uk/research/funded/programmes/arcticocean/