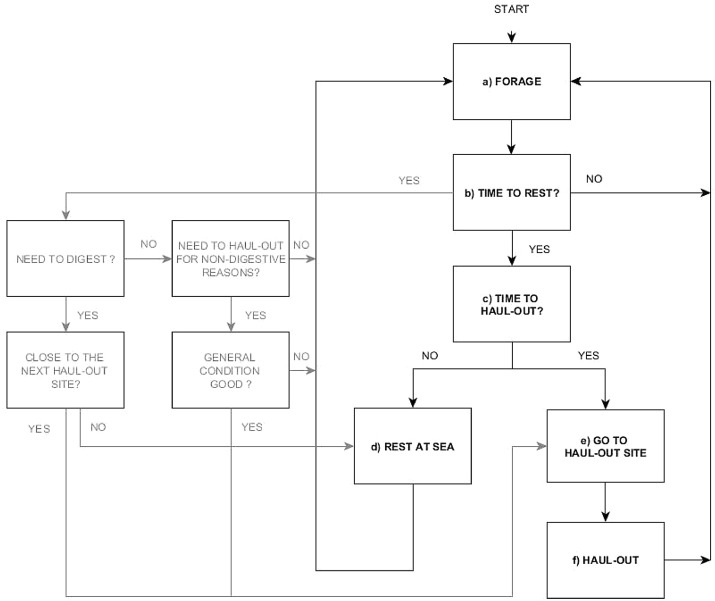
In contrast, AgentSeal is the first step in building such a tool for marine central-place foragers. ABMs allow us to explicitly represent individual animals and their behavioural decisions. The incorporation of the relationship between these decisions and seals’ physiology and energetics, as well as the spatially explicit design and high temporal resolution of AgentSeal makes it a good candidate to become a reliable management and conservation tool. AgentSeal could be further developed, for example, to simulate short term effects of offshore disturbance on movement of seals and physiological consequences of this disturbance. Currently, AgentSeal only includes adult individuals which convert all their surplus energy budget into body reserves. The next step of AgentSeal could be incorporation of an all year-round dynamic energy budget (DEB as presented in [Sibly et al., 2013](https://www.sciencedirect.com/science/article/pii/S0304380020304610?via%3Dihub" \l "bib0066)) in the model, which would include growth, moulting and reproduction. The DEB framework can explicitly model how the relative use of energy for these various purposes can differ under different circumstances, such as different disturbance scenarios. In this way AgentSeal could be used not only to study short-term consequences of human disturbance on movement of seals but also the effect on body condition and reproductive success.



The fifth case study concerned another follow-up application of Nabe-Nielsen et al. ([2013](https://onlinelibrary-wiley-com.ep.fjernadgang.kb.dk/doi/full/10.1111/oik.08078?casa_token=1upziVDU7HsAAAAA:FogT-0lK9E4fUfsFUZ_xhRIJc4UFM6g847MaxASM4XbPbEXPikE11-WVepxFGdoJcWab_iQZ84f9M4o#bib-0054), 2018) with an ABM to predict population consequences from alternative sound exposure scenarios in harbour porpoises (Nabe-Nielsen et al. [2018](https://onlinelibrary-wiley-com.ep.fjernadgang.kb.dk/doi/full/10.1111/oik.08078?casa_token=1upziVDU7HsAAAAA:FogT-0lK9E4fUfsFUZ_xhRIJc4UFM6g847MaxASM4XbPbEXPikE11-WVepxFGdoJcWab_iQZ84f9M4o#bib-0055)). A novelty here is that not only the agents have more advanced features that reflect realistic behavioural patterns of this species, but also that alternative spatial planning scenarios were evaluated for the construction of a large number of wind farms across the North Sea. The model used by Nabe-Nielsen et al. ([2018](https://onlinelibrary-wiley-com.ep.fjernadgang.kb.dk/doi/full/10.1111/oik.08078?casa_token=1upziVDU7HsAAAAA:FogT-0lK9E4fUfsFUZ_xhRIJc4UFM6g847MaxASM4XbPbEXPikE11-WVepxFGdoJcWab_iQZ84f9M4o#bib-0055)) was a modified ABM application of the earlier versions and here labelled the DEPONS model (Disturbance effect on the harbour porpoise in the North Sea). The DEPONS model integrates movement patterns based on correlated random walk simulations, taking spatial memory and potential avoidance behaviour into account. The animals in the model spend energy while moving, which is replenished when encountering food patches. Additional life cycle traits such as reproduction and mortality are also incorporated into this model.

Each of the scenarios, explored by Nabe-Nielsen et al. ([2018](https://onlinelibrary-wiley-com.ep.fjernadgang.kb.dk/doi/full/10.1111/oik.08078?casa_token=1upziVDU7HsAAAAA:FogT-0lK9E4fUfsFUZ_xhRIJc4UFM6g847MaxASM4XbPbEXPikE11-WVepxFGdoJcWab_iQZ84f9M4o#bib-0055)), involved long series of pile driving events, covering the construction of 3900 turbines in 65 offshore wind farms, simulated over a span of several years. Sound propagation was calculated using spherical spreading. The three scenarios tested were: 1) wind farms built in random order; 2) wind farms built in sequence and from the east to the west of the North Sea; and 3) construction order as in the first scenario, but with a 1-day break between consecutive piling events instead of the 2-day break used in the other scenarios. Avoidance behaviour of the harbour porpoises was incorporated as a relationship between sound level and a bias to swim away from the sound source.

Nabe-Nielsen et al. ([2018](https://onlinelibrary-wiley-com.ep.fjernadgang.kb.dk/doi/full/10.1111/oik.08078?casa_token=1upziVDU7HsAAAAA:FogT-0lK9E4fUfsFUZ_xhRIJc4UFM6g847MaxASM4XbPbEXPikE11-WVepxFGdoJcWab_iQZ84f9M4o#bib-0055)) were able to show that population effects were discernible if behavioural responses exceeded distances of 20–50 km away from the pile driving locations. The outcome was strongly dependent on the food availability and other parameters responsible for translating the disturbance into bioenergetics. Interestingly, they found a scenario-dependent effect in that the scenario of continuous or near continuous (short breaks) construction had the largest impact. This indicated that the modelling approach can be used to explore potential mitigation strategies in operational planning to minimize population disturbances.

The studies by van Beest et al. ([2017](https://onlinelibrary-wiley-com.ep.fjernadgang.kb.dk/doi/full/10.1111/oik.08078?casa_token=1upziVDU7HsAAAAA:FogT-0lK9E4fUfsFUZ_xhRIJc4UFM6g847MaxASM4XbPbEXPikE11-WVepxFGdoJcWab_iQZ84f9M4o#bib-0096)) and Nabe-Nielsen et al. ([2018](https://onlinelibrary-wiley-com.ep.fjernadgang.kb.dk/doi/full/10.1111/oik.08078?casa_token=1upziVDU7HsAAAAA:FogT-0lK9E4fUfsFUZ_xhRIJc4UFM6g847MaxASM4XbPbEXPikE11-WVepxFGdoJcWab_iQZ84f9M4o#bib-0055)) are, in our view, currently the most advanced examples of ABM applications for spatially explicit analyses to estimate population consequences of acoustic disturbances through effects on animal movement and bioenergetics. They recently followed-up with an additional study at this advanced level (Gallagher et al. [2020](https://onlinelibrary-wiley-com.ep.fjernadgang.kb.dk/doi/full/10.1111/oik.08078?casa_token=1upziVDU7HsAAAAA:FogT-0lK9E4fUfsFUZ_xhRIJc4UFM6g847MaxASM4XbPbEXPikE11-WVepxFGdoJcWab_iQZ84f9M4o#bib-0026)), in which they evaluated population consequences of disturbance from the spatially variable impact of seismic surveys on harbour porpoise. They investigated underlying drivers of vulnerability, which varied with season and were largely determined by lactation costs, water temperature and amount of body fat reserves.

We therefore assume that indirect variables, such as hydrographic variables associated with the distribution of food resources, are excellent for modelling, rather than the distribution of food itself. Three of the case studies (Van Beest et al. [2017](https://onlinelibrary-wiley-com.ep.fjernadgang.kb.dk/doi/full/10.1111/oik.08078?casa_token=1upziVDU7HsAAAAA:FogT-0lK9E4fUfsFUZ_xhRIJc4UFM6g847MaxASM4XbPbEXPikE11-WVepxFGdoJcWab_iQZ84f9M4o#bib-0096), Heinänen et al. [2018](https://onlinelibrary-wiley-com.ep.fjernadgang.kb.dk/doi/full/10.1111/oik.08078?casa_token=1upziVDU7HsAAAAA:FogT-0lK9E4fUfsFUZ_xhRIJc4UFM6g847MaxASM4XbPbEXPikE11-WVepxFGdoJcWab_iQZ84f9M4o#bib-0038), Nabe-Nielsen et al. [2018](https://onlinelibrary-wiley-com.ep.fjernadgang.kb.dk/doi/full/10.1111/oik.08078?casa_token=1upziVDU7HsAAAAA:FogT-0lK9E4fUfsFUZ_xhRIJc4UFM6g847MaxASM4XbPbEXPikE11-WVepxFGdoJcWab_iQZ84f9M4o#bib-0055)) also make use of this approach to inform the agents about suitable habitat or other external stimuli known to affect their behaviour. We conclude that ABMs with movement rules that are integrated with hydrodynamic modelling and species distribution modelling based on habitat suitability allow more complex decision steps for the agents, which are therefore more likely to result in realistic spatial distributions in the simulated worlds.

Questions:

* Tips to join DHI and SMRU
* How to contact DHI people? Should I talk about 2 weeks to implement ABM? Could I cc you?