

Potential effects of petroleum pollution and increasing water temperature on life-history traits in polar cod (*Boreogadus saida*)

Morgan Lizabeth Bender¹; Marianne Frantzen²; Maxime Geoffroy^{1,4}; James Meador³; Jasmine Nahrgang¹

¹ Institute of Arctic and Marine Biology, UiT, Norway

² Akvaplan-niva, Tromsø, Norway

³ National Oceanic and Atmospheric Admin., NOAA Fisheries, Seattle USA

⁴ Fisheries and Marine Institute of Memorial University of Newfoundland



morgan.l.bender@uit.no
PhD candidate

The Call

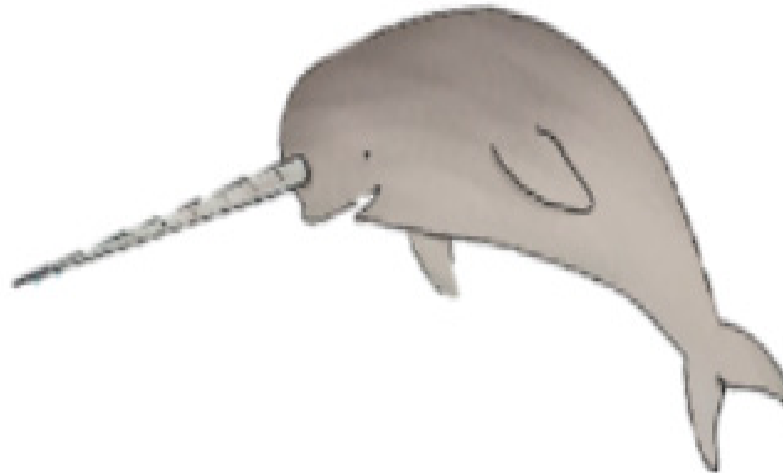
Rapid environmental change in the Arctic with increased influx of warmer Atlantic water, reduced sea ice extent, and increased anthropogenic activities are potential stressors for organisms living in the Arctic

The Species

Abundant, circumpolarly distributed, and holding a key role in the marine ecosystem, polar cod can act as a focal species for studies of climate and as an indicator to assess the effects of oil pollution on the Arctic marine system

The Focus

1. Life-history traits
2. Reproductive development and physiology of adult polar cod
3. Development and sensitivity of early life stages



The Aim

Ecology under Arctic Warming

Investigate life history traits of polar cod from Arctic and Atlantic influenced waters in European Arctic ^A ^B

Toxicity of Petroleum

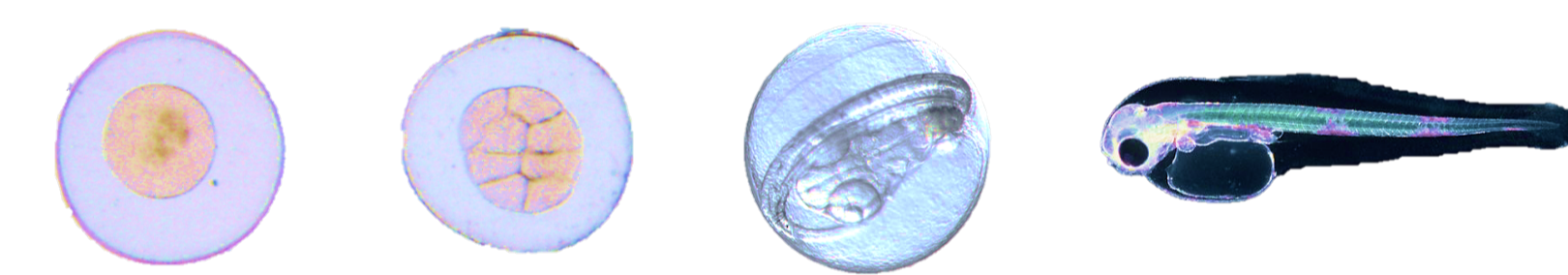
Elucidate physiological effects of petroleum exposure on early life stages ^C and reproducing polar cod ^D

Assess the sensitivity and resilience of polar cod to increasing water temperature, petroleum exposure, and the potential synergistic effects of these two stressors

The Hypotheses

Arctic warming (i.e. "Atlantification") will alter life history traits ^A (age at maturity, fecundity, age and size structure, reproductive and embryonic development), ^B habitat use (ice free areas, water mass associations), and ^A diet (stomach content) in polar cod

^C Exposure to petroleum in polar cod early life stages (embryo to exogenous feeding stage) will adversely affect embryonic development, growth, hatching and feeding success, swimming behaviour, and cardiac activity

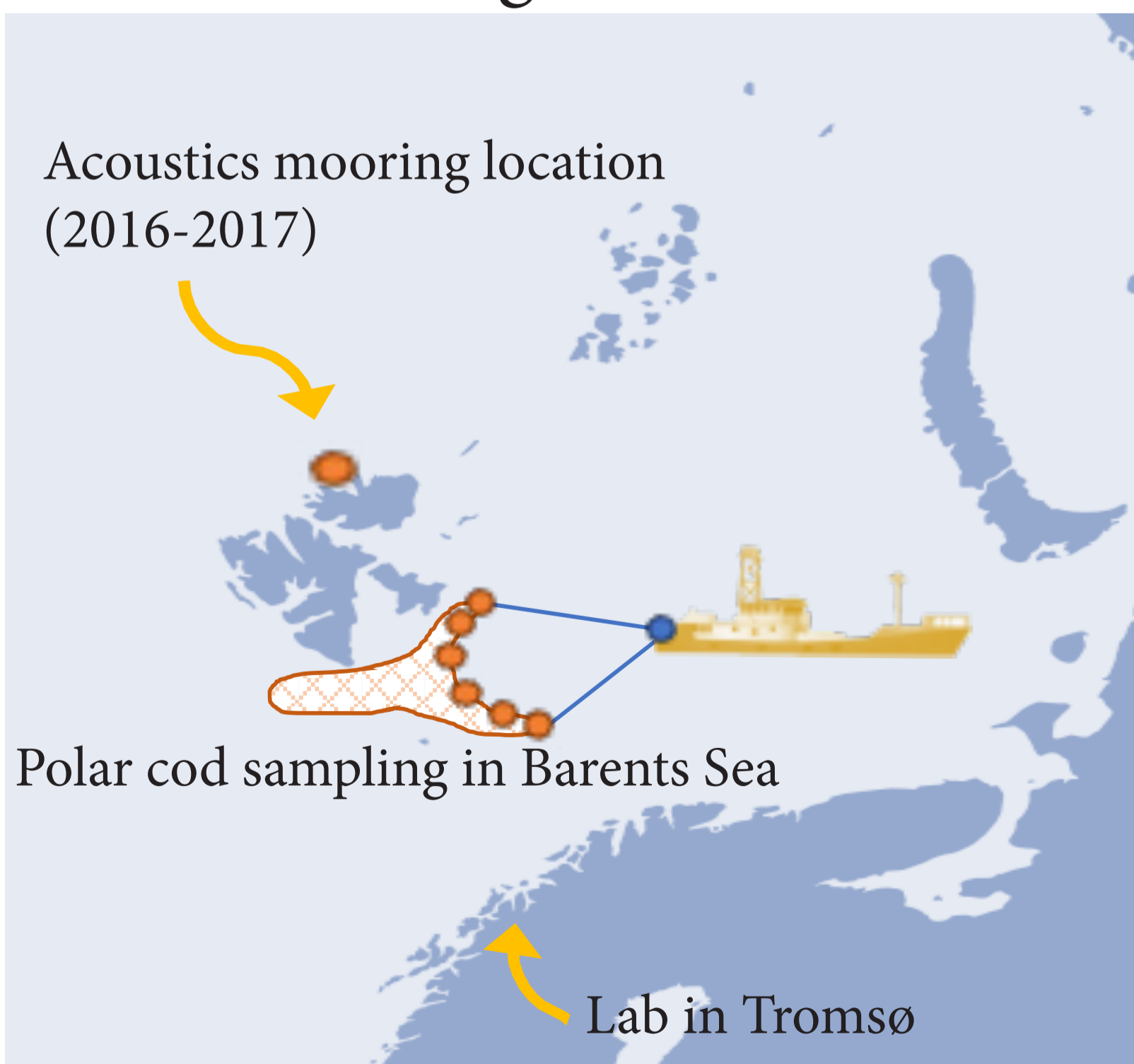


^D Exposure to petroleum in adult polar cod will adversely affect reproductive development

Central Hypothesis In Atlantic waters, polar cod will exhibit altered life history traits; furthermore, exposure to petroleum will result in adverse effects on sensitive life stages and decrease overall reproductive success

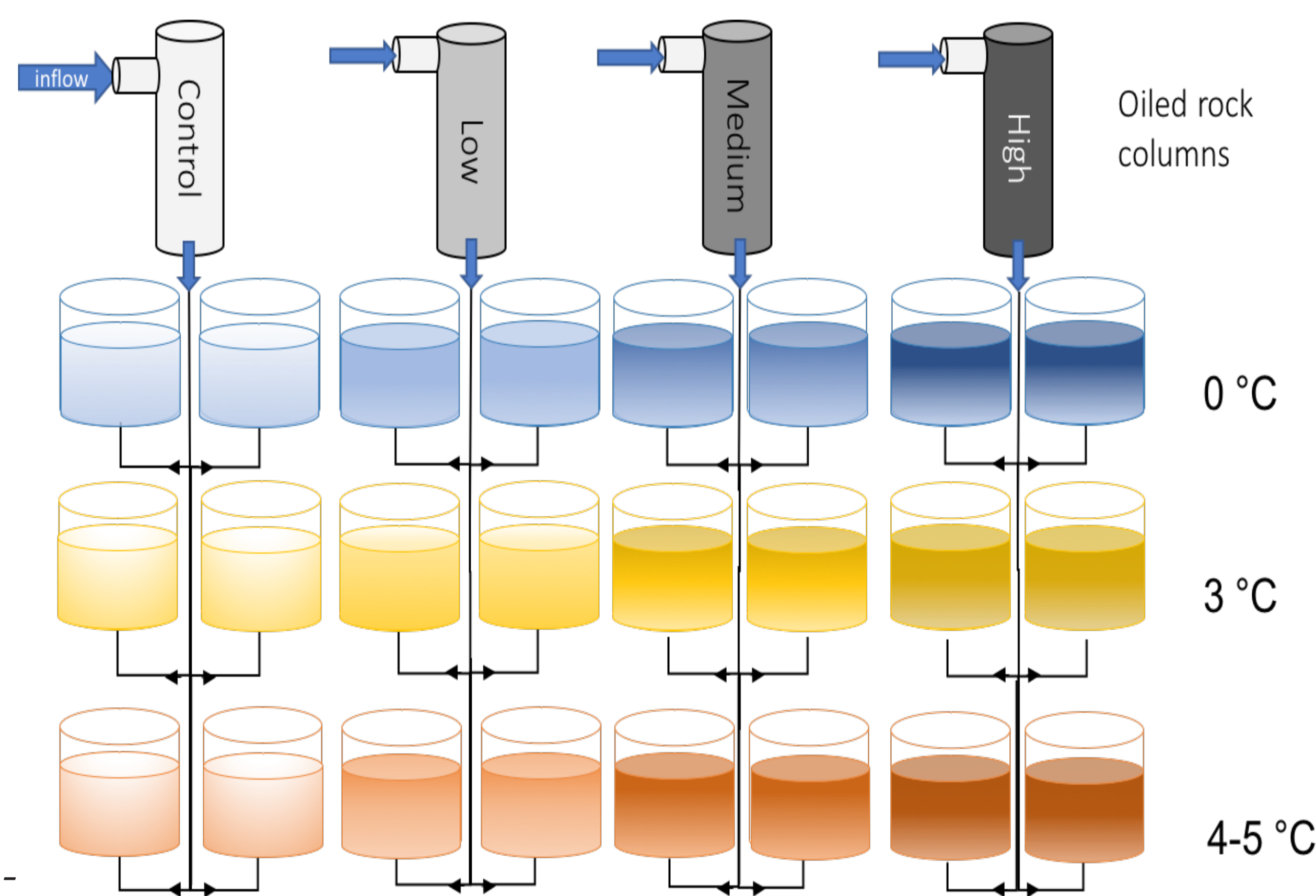
The Method

Field investigation of life history traits and impacts of Arctic warming



- ^A Field based study of Arctic and Atlantic polar cod populations in European Arctic (ongoing)
- ^B Acoustic moorings to assess ontogenetic distribution and vertical migrations (ongoing)

Investigated experimentally



^A ^C Combined exposure studies on early life stages exposed to gradients of increased water temperatures and concentrations water soluble fraction of crude oil (planned)



- ^D Petroleum exposure experiments simultaneous with period of reproductive development (Bender et al., 2016)
- ^A Experiments following reproductive development with increased temperature (planned)