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# Anthropogenic stressors interacting with climate change

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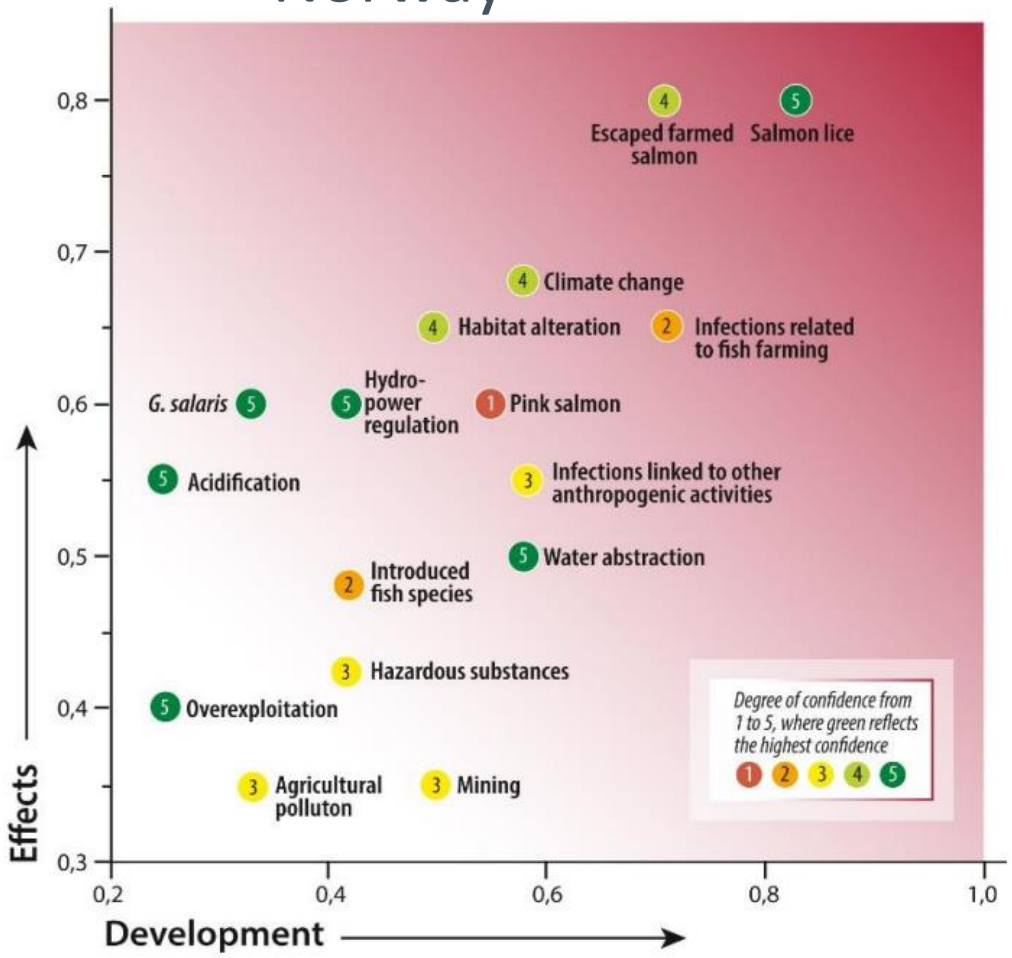
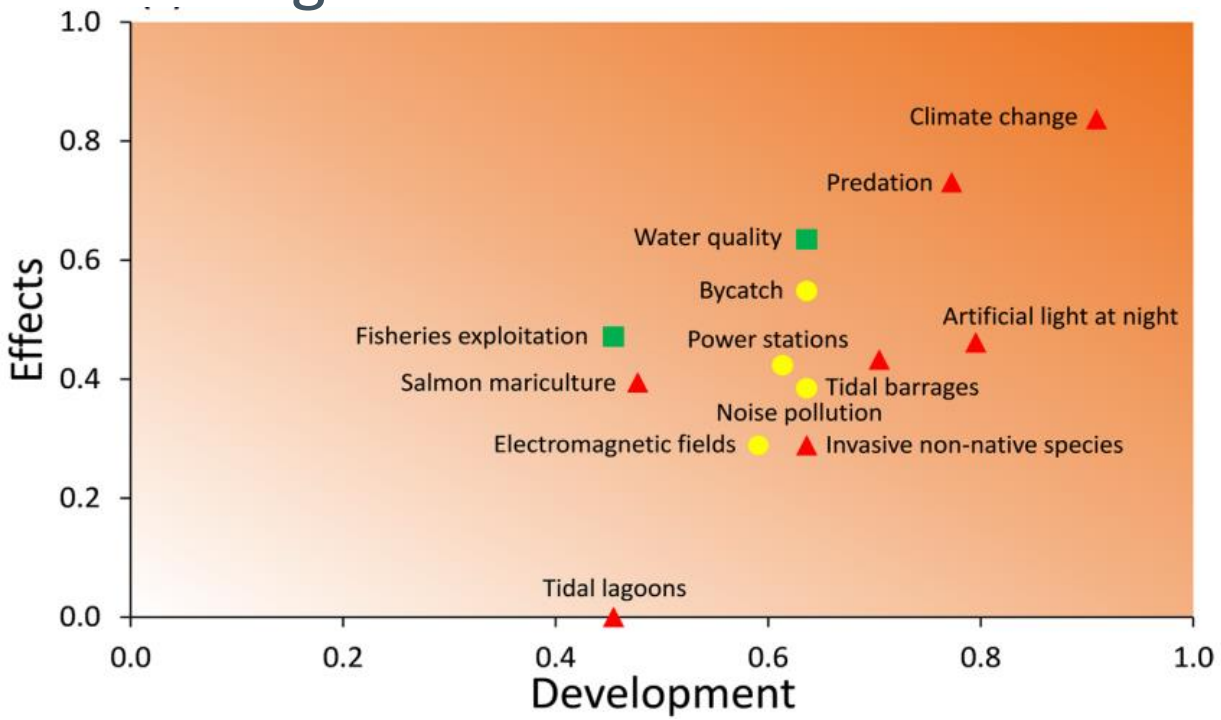
# The major stressors - ranked

## Norway




Norwegian Scientific Advisory Committee for Atlantic Salmon

## England – marine stressors




Gillson et al. (2022)

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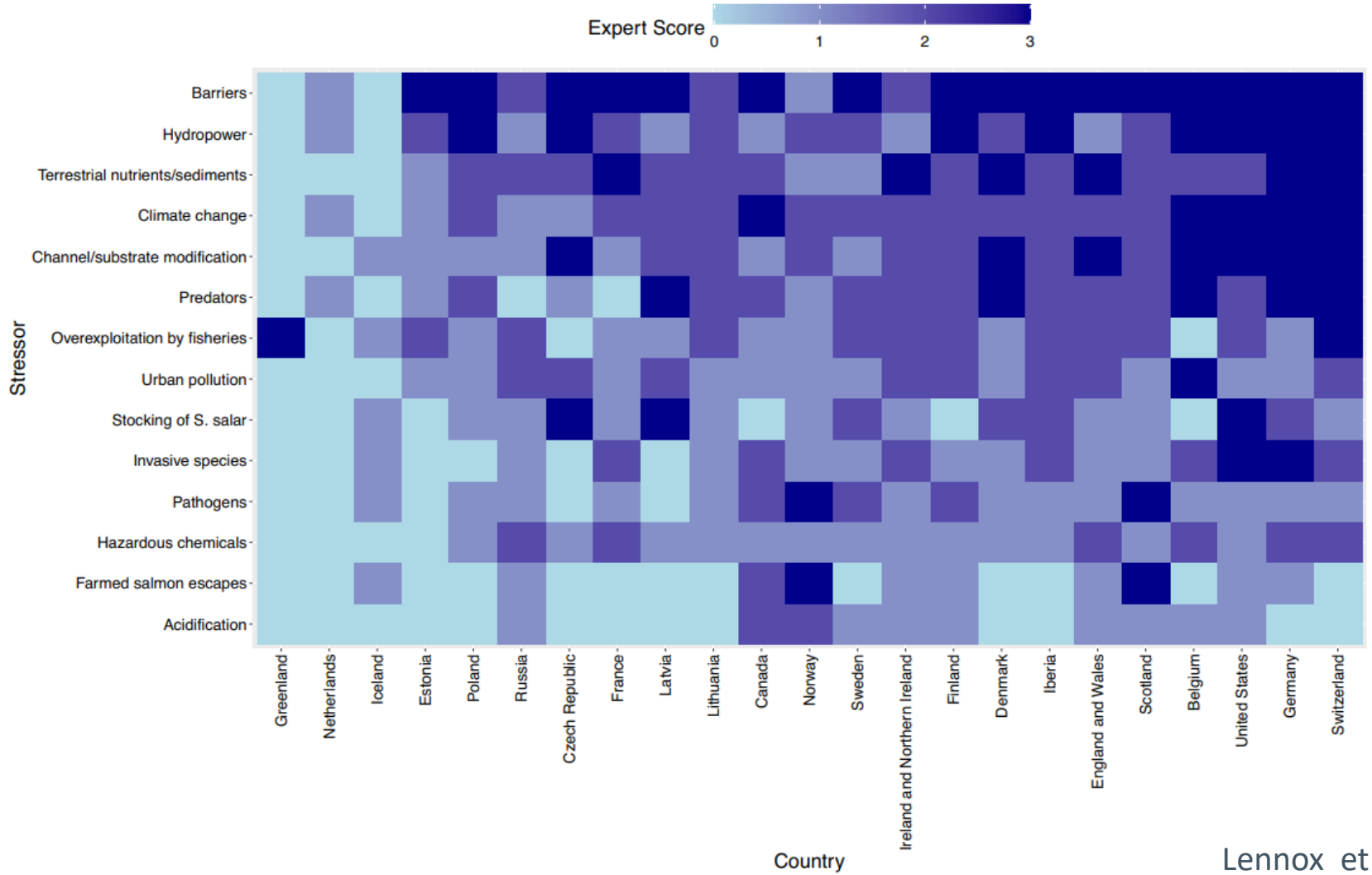
# 23 regions/countries (expert asessment)




Lennox et al. (2021)

# Interactions

- Potential interactions between climate change and Anthropogenic stressors are numerous
  - Few have been properly studied
- **Direct interaction** due to the environmental changes
- **Indirect interactions** due to societal changes and climate adaptation

# Salmon lice and infections related to fish farming

- Increased production of lice larvae in farms
  - thermal effects on developmental time
  - increasing treatment challenges in farms
- Expanding area with lice effects
  - Northern areas lose their thermal protection
  - Increased farming in the north
- Smolts more susceptible to lice infestations
  - Elevated river temperatures and smaller smolts
- Proliferation of other infective agents
  - furunculosis bacteria



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# Habitat alterations

- Thermal challenges in weir pools and slow flowing stretches
- Flood protection measures - channelization and embankments!


# Invasive species

- Changes in the distribution range of different species!
  - new competitors & predators
- Increased abundance
  - pink salmon
- Ice-free Northeast Passage

# Hydropower regulations

- Reservoir-based hydropower
  - Positive effects of increased temperature
  - Potential for mitigating low flow events
- Minimum or residual flow stretches
  - Thermal stress
- Increasing demand for HP
- Increasing share of intermittent energy
  - Hydropeaking & stranding

# Migration barriers

- Low flow periods
- Loss of access to higher altitude tributaries and thermal refugia
  - Adults and juveniles!

# Predators

# Watershed runoff

- Increased runoff of nutrients, fine sediments and different pollutants
  - mortality events due to toxic substances
  - long term deterioration of juvenile habitat (clogging)

# Escaped farmed salmon

- Genetic introgression of farmed salmon in wild stocks
  - loss of local adaptations and genetic variability
  - challenge the adaptability of the salmon stocks to the environmental changes



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