Infestation and infection dynamics of tapeworms (*Eubothrium* sp.) in farmed Atlantic salmon, *Salmo salar*

Haakon Hansen, Mari Darrud, Norwegian Veterinary Institute, Fish Health Research Group
Egil Karlsbakk and Kristian Ruud, University of Bergen, Norway, Fish Disease Research Group
Trine Sakariassen, University of Tromsø, Department of Arctic and Marine Biology
Sigmund Sevatdal, VESO

Veterinærinstituttet
Norwegian Veterinary Institute

Project title:
Infections with *Eubothrium* sp. in Norwegian fish farms: resistance, distribution and impact on fish health and growth (FHF 901449).

Prosjektgruppe:

Haakon Hansen, Norwegian Veterinary Institute – project leader
Sigmund Sevatdal, VESO
Kristin Eikemo, Lerøy Vest
Anna Lena Kleppa, Randi V. Thon og Marianne Elnæs, Henrik Trengereid MOWI
(former Marine Harvest Norway)
Margunn Sandstad, Skretting
Egil Karlsbakk, University of Bergen

Master Students
Trine Sakariassen (University of Tromsø – The Arctic University)
Kristian Ruud (University of Bergen)

Background for the project

Use of anthelminthic drugs in salmonid farming in Norway 2001 - 2016 - kg active substance pr year
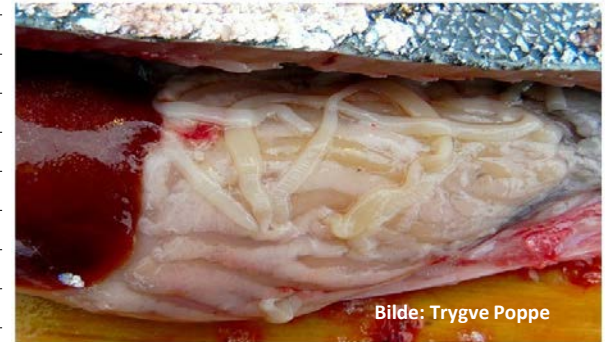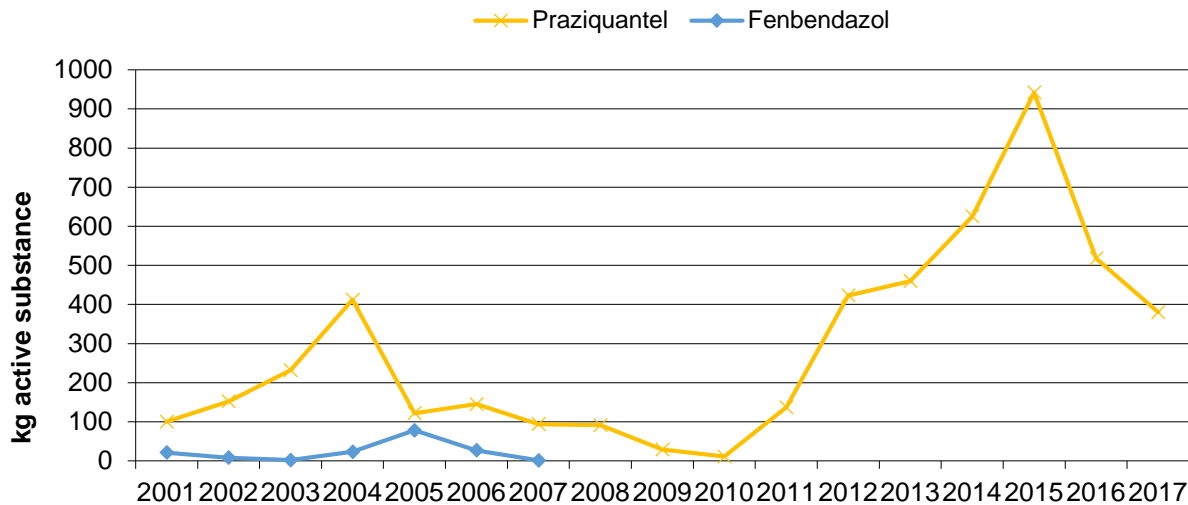
Source: Folkehelseinstituttet

- Praziquantel is the most commonly used treatment against *Eubothrium* in Norwegian fish farming
  - There are worries that the parasite develops resistance towards the drug leading to inefficient treatment
  - Decreasing sale (and use) of Praziquantel due to a combination of treatment failure and cumbersome procedure before treatment is permitted (*off-label* use requires evaluation of environmental consequences).

Veterinærinstituttet
Norwegian Veterinary Institute

Infections with Eubothrium sp. in Norwegian fish farms: resistance, distribution and impact on fish health and growth..
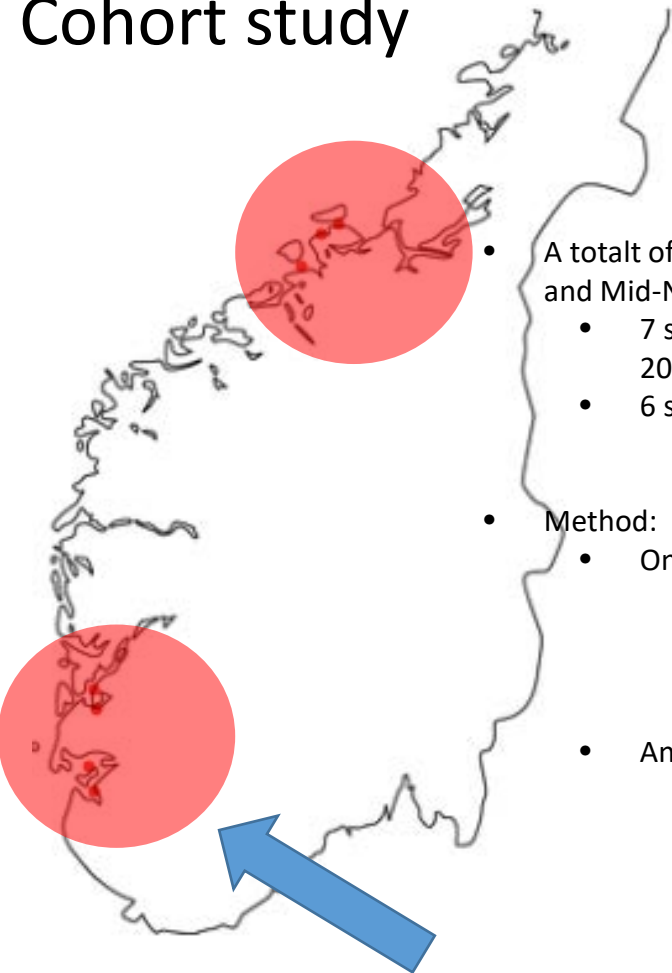## 2017 – 2020 (FHF 901449)

Aims of the project:

➢ **To map the distribution of tapeworms in Norwegian fish farms, here under the distribution of resistance towards Praziquantel.**

➢ To study genetic differences between both farmed and wild populations of *Eubothrium*, both in freshwater and saltwater

➢ To establish a method for detecting tapeworms in faeces swabs from live fish.

➢ To contribute towards knowledge about how tapeworms infections influences the health and growth of the fish.

➢ **To study the life cycle and infection dynamics of the parasite.**
    ➢ **Is the risk of infection dependent on time of stocking (spring versus autumn) and/or size of the fish at time of stocking? How does the infection develop in the host?**
➢ To test and optimize different treatment regimes and to how to best evaluate the effect of treatments.

Veterinærinstituttet
Norwegian Veterinary Institute

Eubothrium sp.; morphology and life cycle

Phylum: Platyhelmintes
- Class: Cestoda (Cestoidea, for some authors)
  - Sub class: Eucestoda
    - Order: pseudophyllidea
      - Genus: Eubothrium

Life cycle, *Eubothrium* sp.:

- An intermediate host, a copepode, is necessary in the marine life cycle (Akhmerov, 1962)
  - Only *Salmo* salar experimentally infected by intake of copepodes (Saksvik, Nylund, Nilsen & Hodneland, 2001)

Apical disc, «attachment»

Bothria, «sucking grooves»

Scolex

Strobila

Proglottides

Plerocercoid

Plerocercoid

Voksen i tarm

småfisk

Procercoid

Egg

Copepoder

Basert på Hodneland 1995

Cohort study

- A totalt of 13 cohorts in the Southwest and Mid-Norway.
    - 7 stocked in the sea in autumn 2017
    - 6 stocked in sea spring 2018

- Method:
    - On the locality:
        - Samples: before sea transfer, 1 month after sea transfer, then every third month.
    - Analyses
        - Intestine and pylorus examined for tapeworms
        - *Eubothrium* sp. counted (number of scoleces) and weighed

Tabell viser en oversikt over tidspunkt ved prøveuttak

Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8
Hatchery	1 month at sea	3 months	6 months	9 months	12 months	15 months	18 months

Veterinærinstituttet
— Norwegian Veterinary Institute —

1. Adult scolex

2. Strobila of adult *Eubothrium* sp.

3. Adult *Eubothrium* sp., > 1 m

4. Gravid proglottides containing eggs)
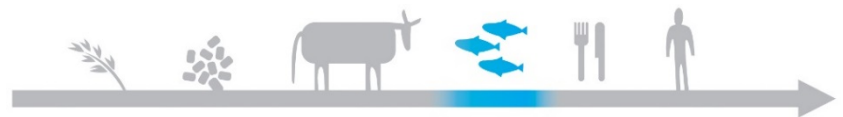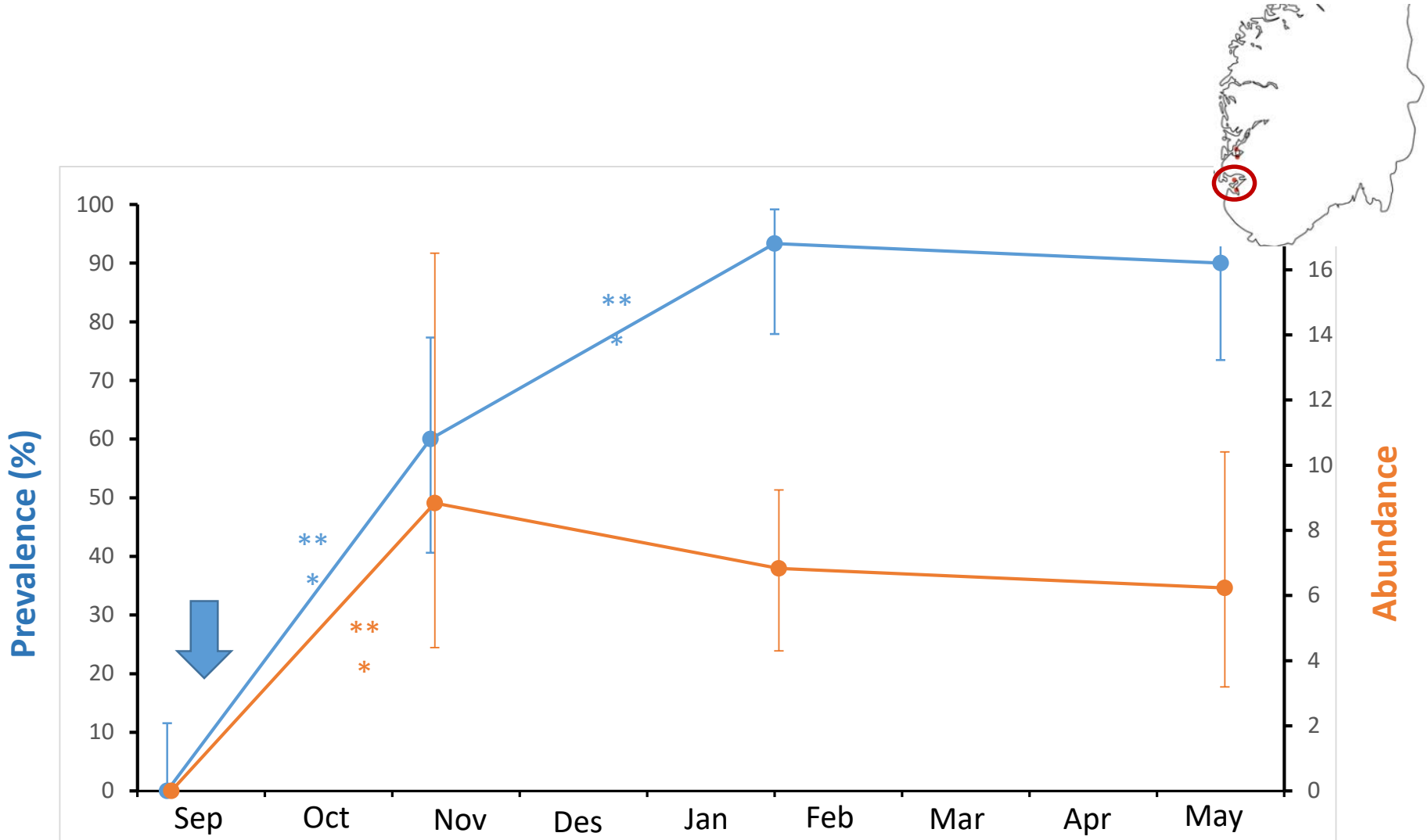
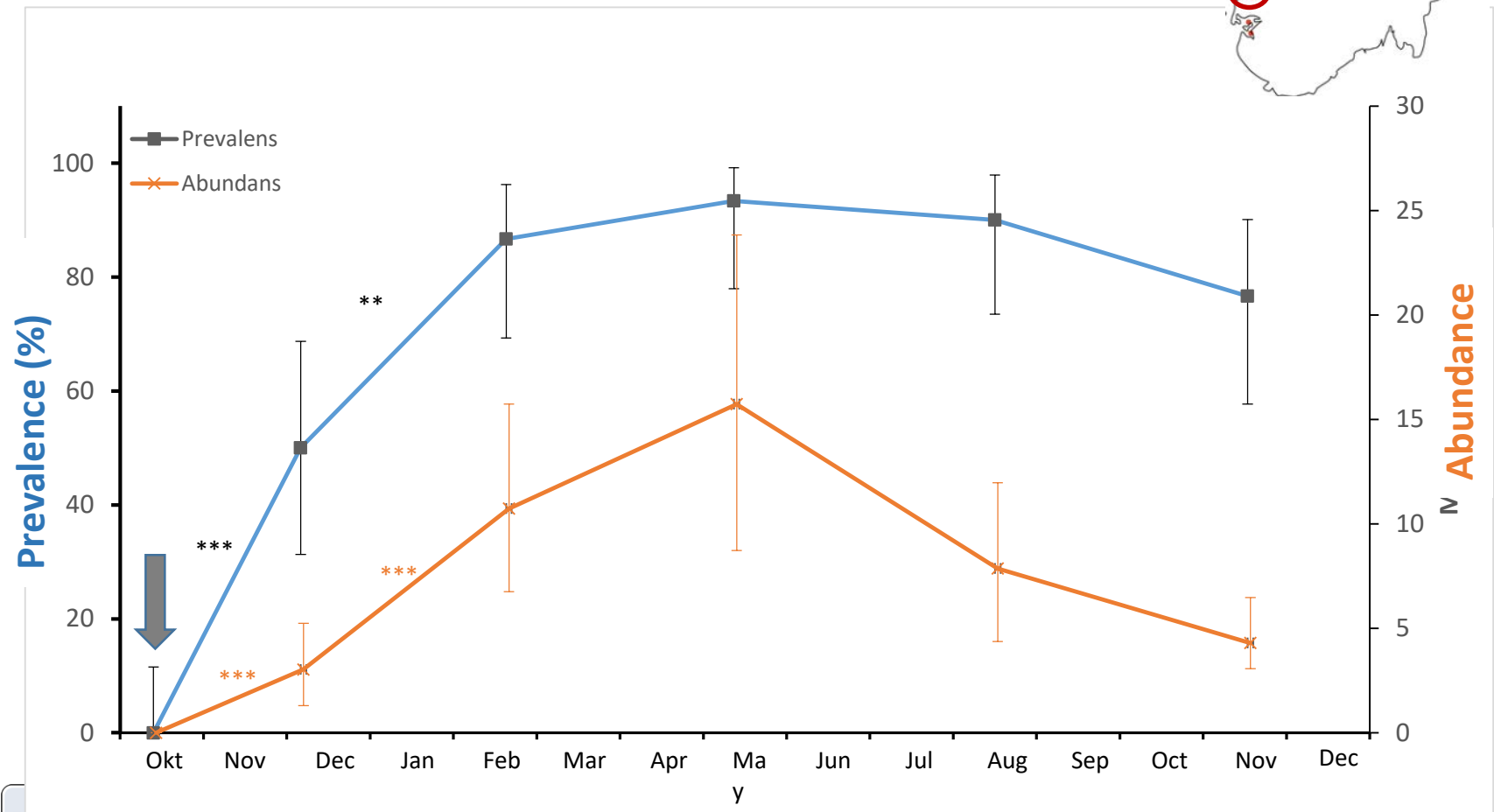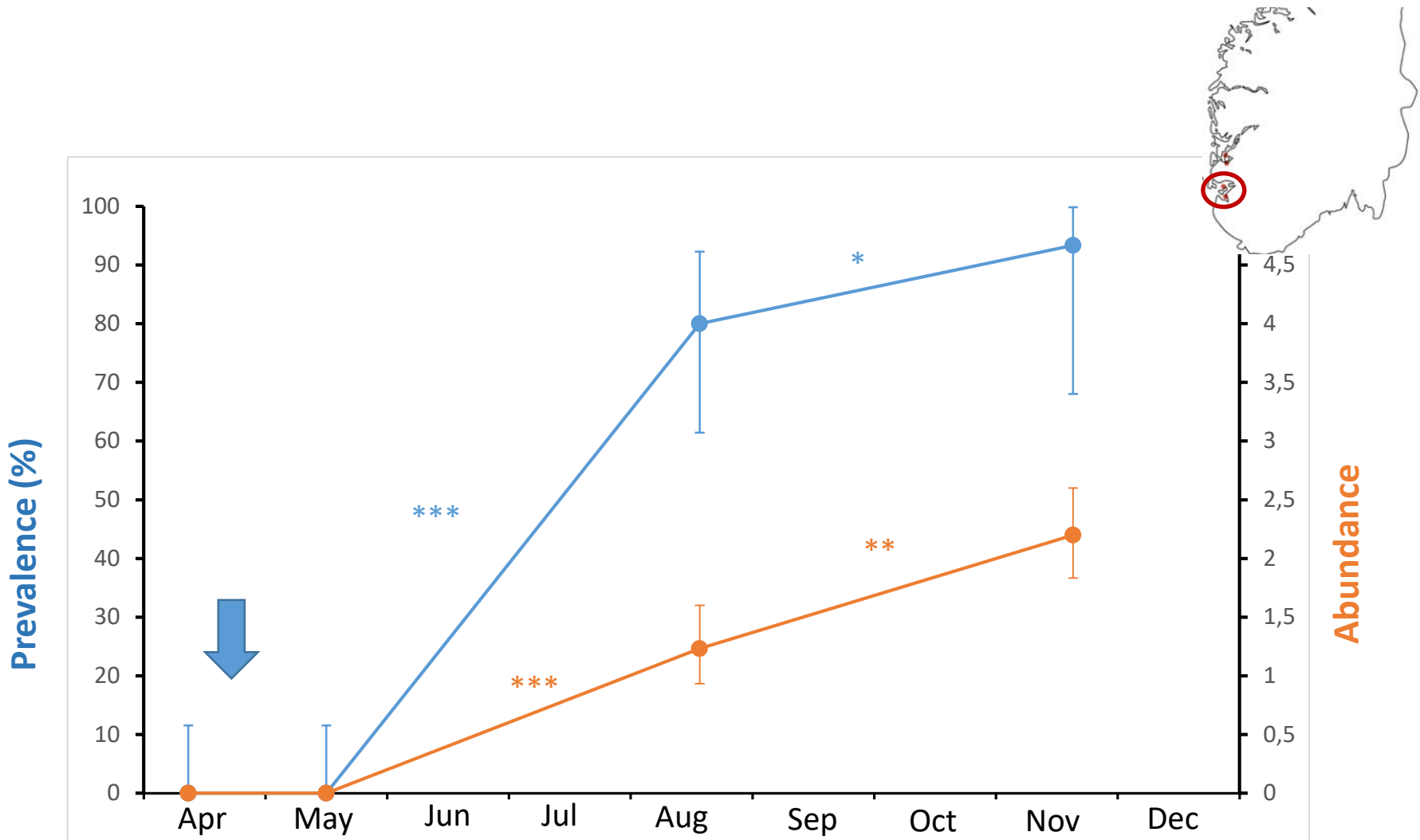5. Juvenile *Eubothrium* sp.

6. Plerocercoid

Photos: Kristian Ruud

Veterinærinstituttet
Norwegian Veterinary Institute

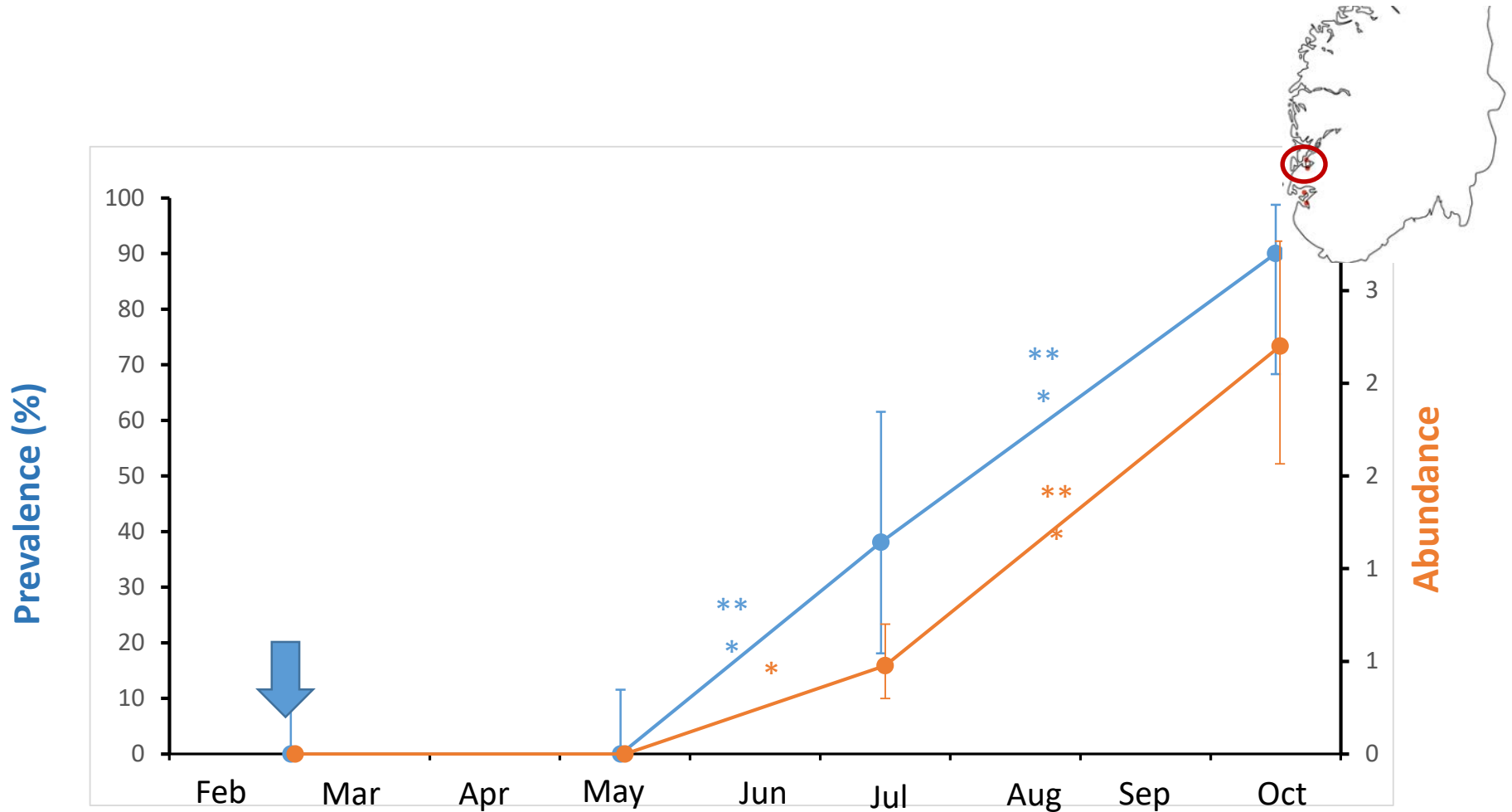# Farm 1 (j.no. 1)- stocked in <u>autumn</u> – Rogaland, Southern Norway

Farm 2 (J.no 4) – stocked in <u>autumn</u> – Hordaland, Western Norway
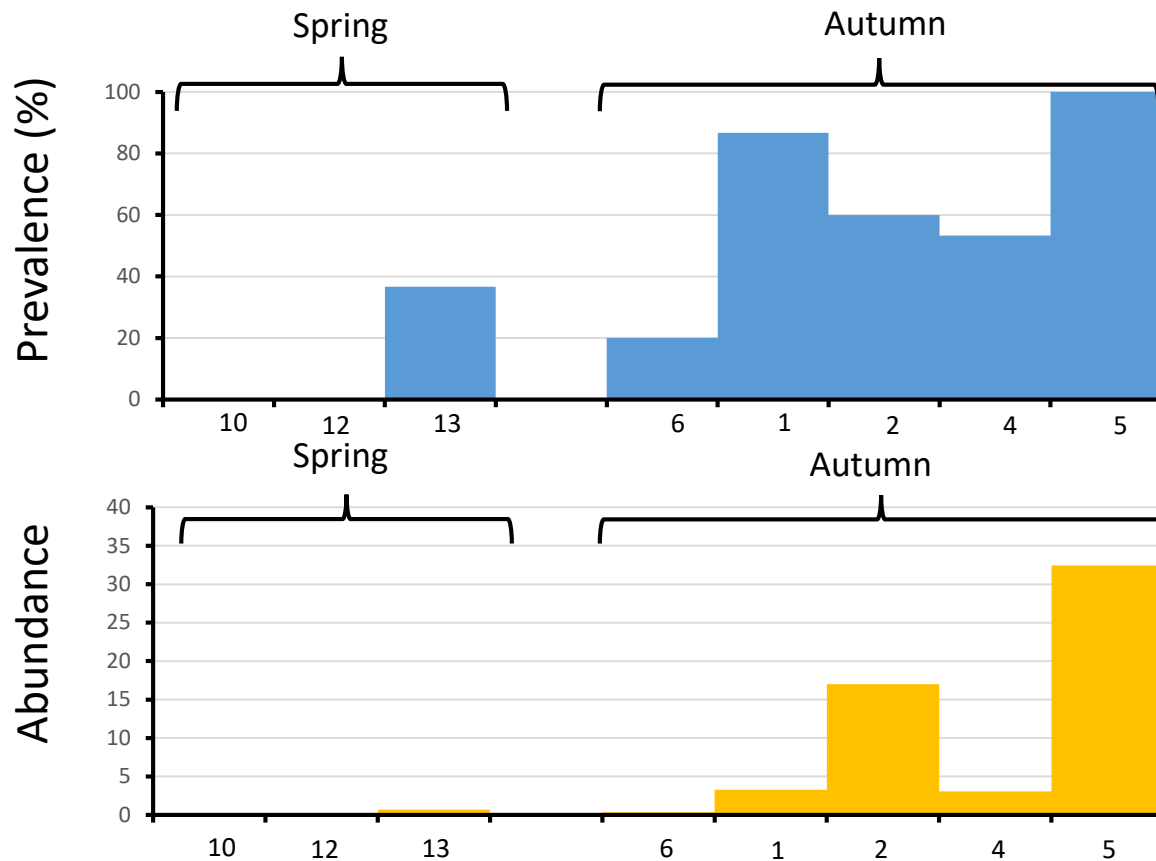
Farm 3 (J.no 10) – stocked in spring, Rogaland, Southern Norway

Farm 4 (J.no 12) – stocked in <u>spring</u> – Hordaland, western Norway

Situation at the first sample from the sea – generally after one month – for the different kohorts
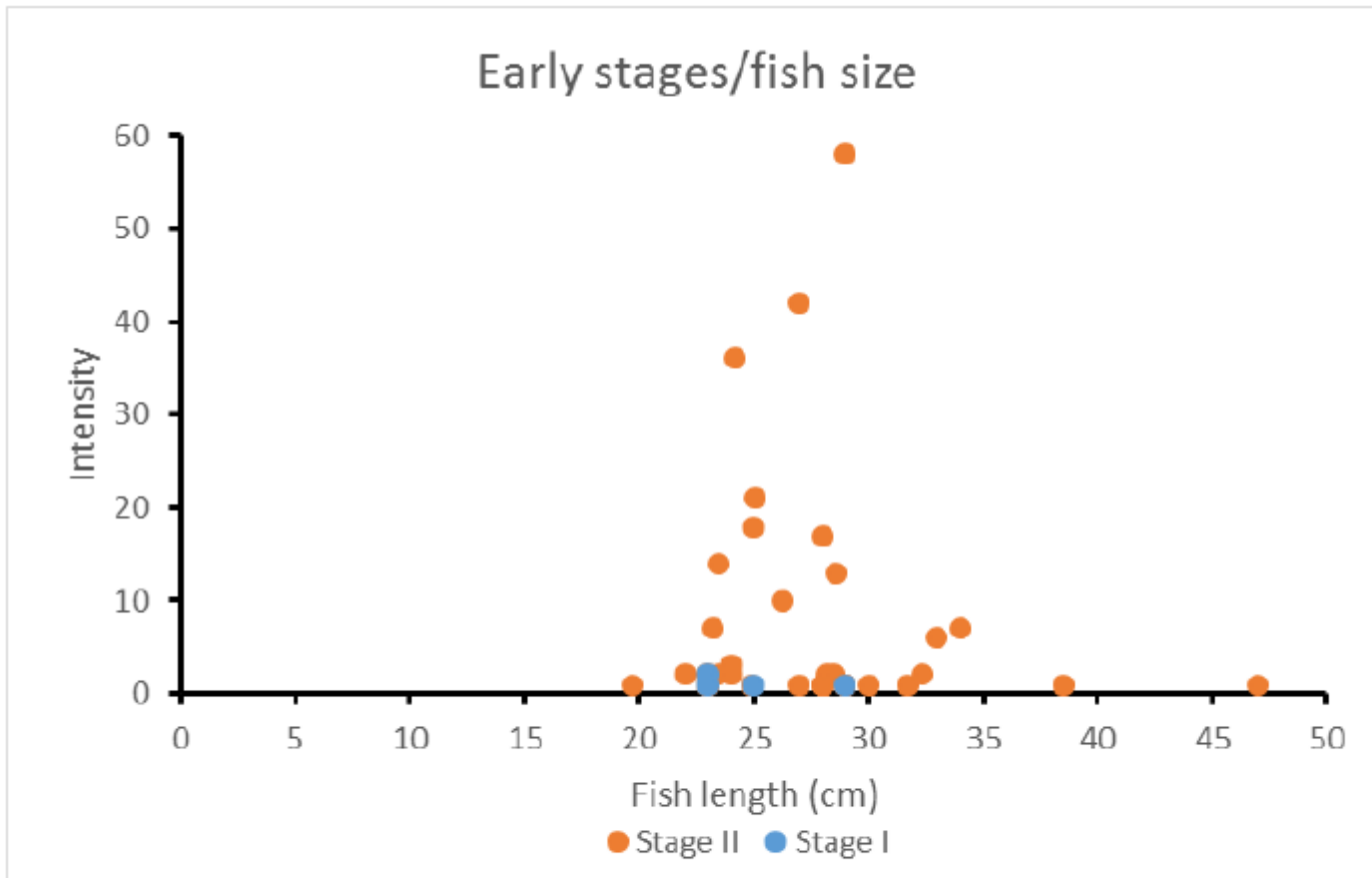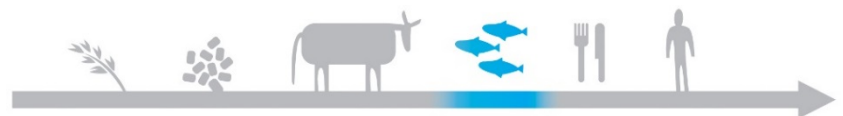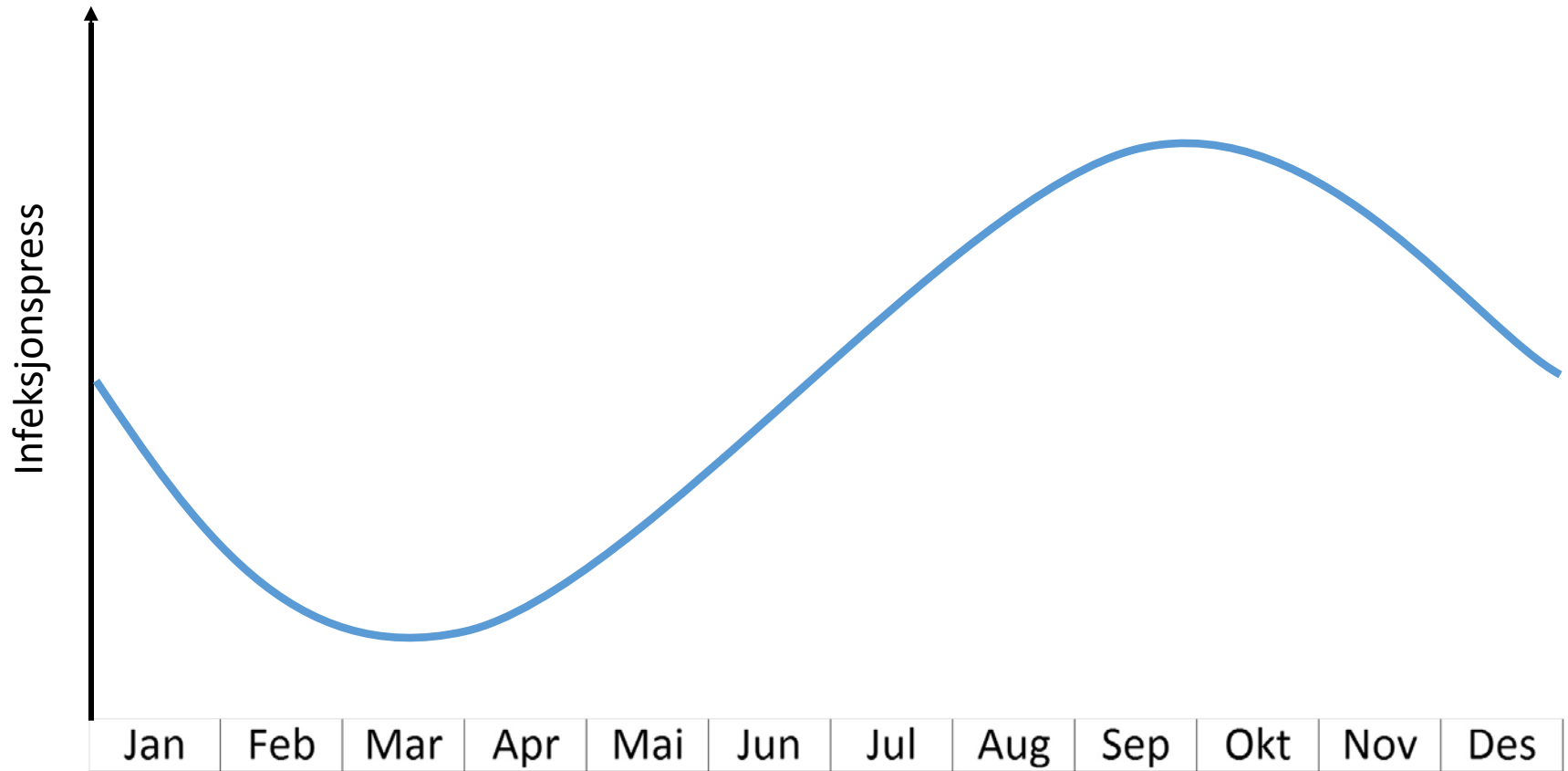
Figure 16 Occurrence of early stages of cestodes vs length of fish. Stages I (plerocercoids) and II (juveniles under 10 mm) could represent recent infections due to fish feeding on copepods.

# Summary of the infection pressure for each cohort – development of abundance

Generalized overview of the infection pressure

Conclusions

- Most farmed salmon in the southern part of Norway has a high likelihood of being infected by *Eubothrium* in the sea phase.

- Fish stocked in **autumn** are infected immediately after stocking, while fish stocked in **spring** will experience a period of growth before reaching the time of peak infection pressure.

- The infection pressure is generally highest in late summer and autumn, probably corresponding to availability of *infected* copepod intermediate hosts.

- The highest number of parasites were observed early in the production cycle, in the smallest fish, indicating a higher risk of infection for these fish sizes.

- A higher risk of infection for the smaller fish is also supported by the fact that few *early stages of tapeworms* (plerocercoids and >10mm) were found in fish larger than 35 cm length
    - Small fish are more likely to feed on copepods, gill rakers are small enough to filter out copepods.

- A decreasing abundance over time was observed which might be due to crowding effects (competion over resources), immunological reaction of the host.

Veterinærinstituttet
Norwegian Veterinary Institute
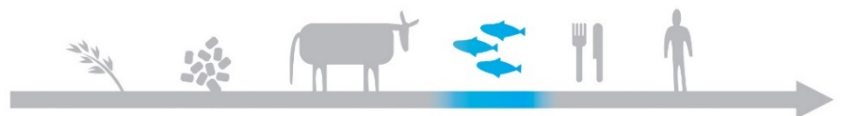
Conclusions – practical consequences

- Medical treatment of fish larger than a certain size (>40 cm) will be beneficial due to lower likelihood of re-infection.

- Stocking of larger smolts in spring might result in lower infection levels
  - too large to be infected (only feed on pellets and large gill rakers) when meeting the period of peak infection pressure (late summer/autumn).

- Use of skirts around the net pens until the fish reach a certain size and in a period with high infection pressure can be a good preventive measure

Veterinærinstituttet
Norwegian Veterinary Institute

Thank you!