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

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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:

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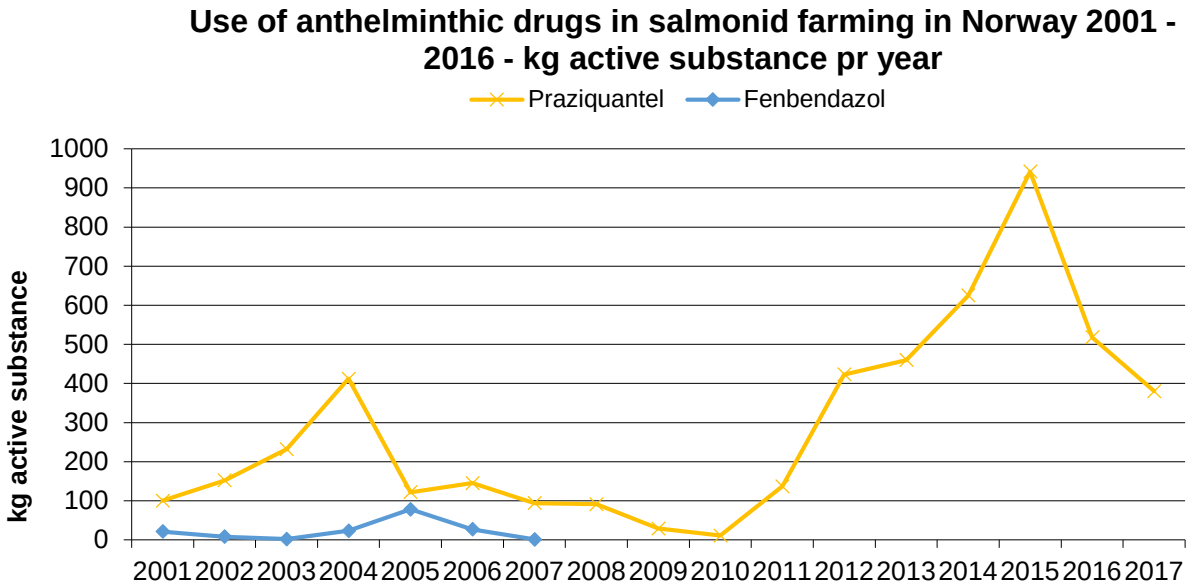
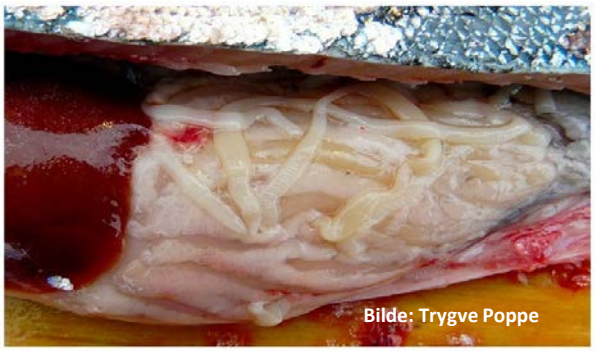
Funded by the Norwegian Seafood Research Fund

Background for the project





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).

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.

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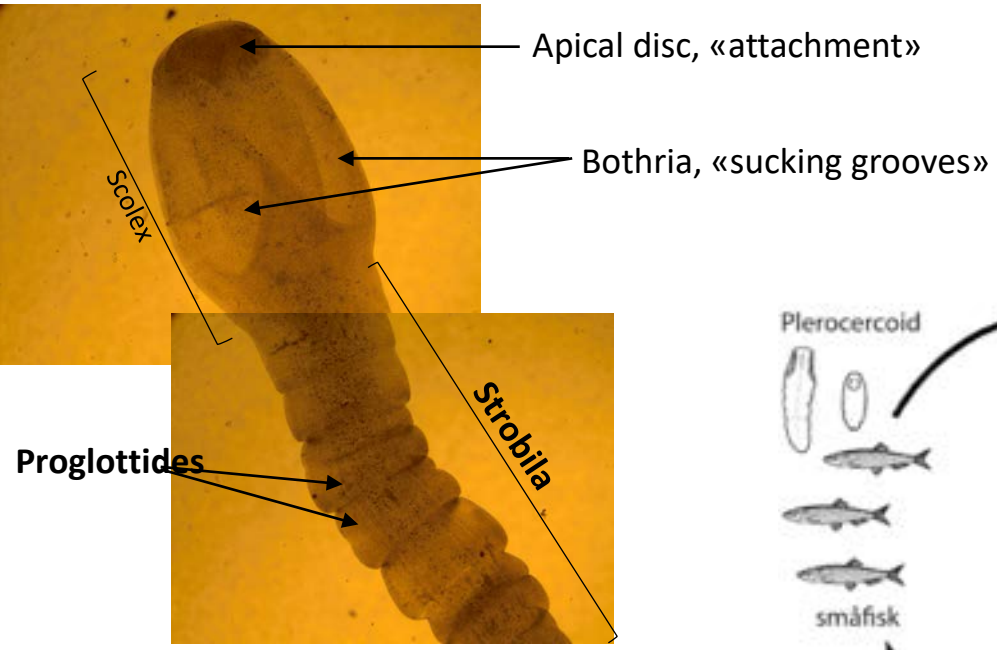
Eubothrium sp.; morphology and life cycle

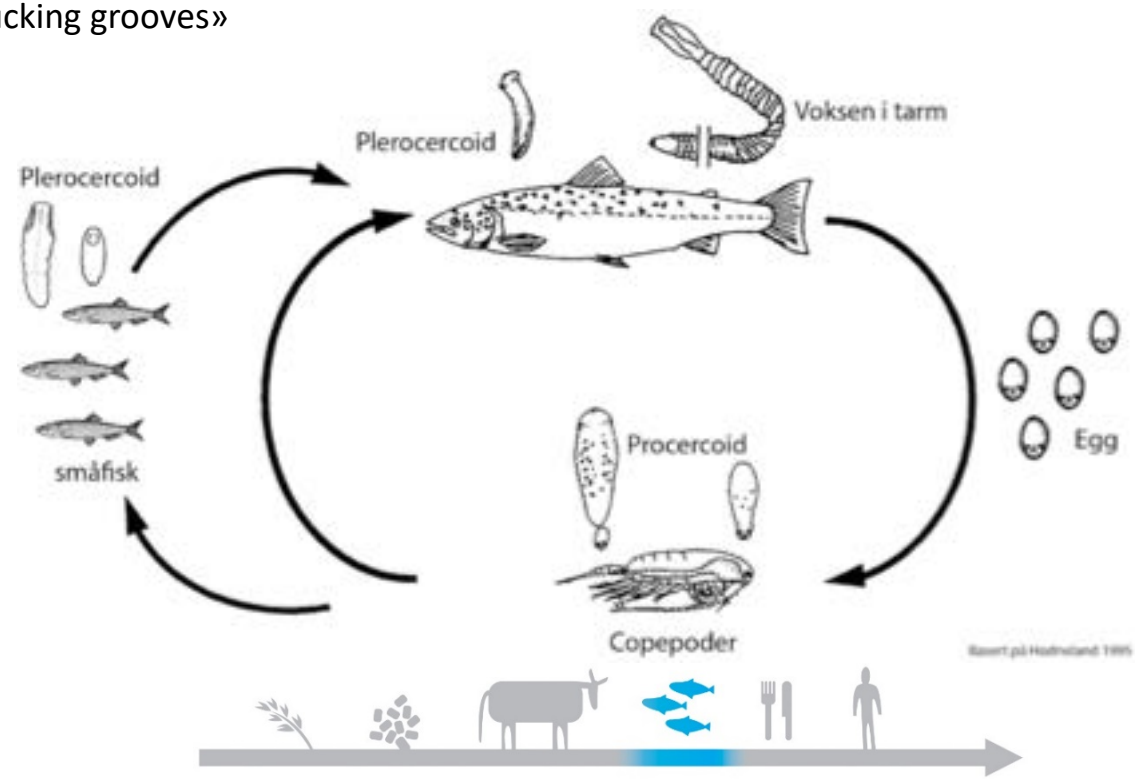
Phylum: Platyhelmintes

- 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)



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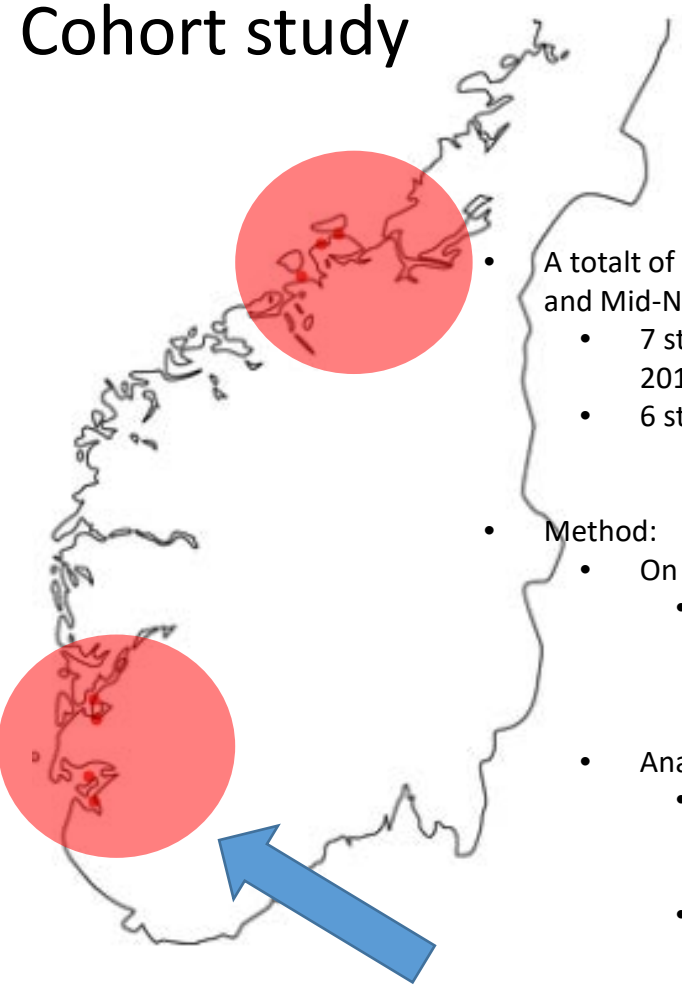
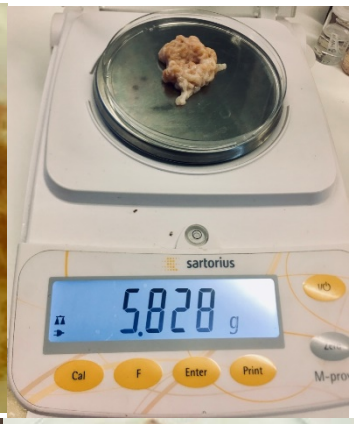
Cohort study



- 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

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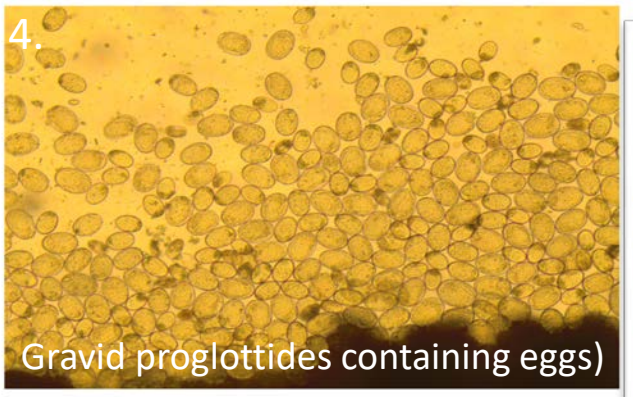
1.

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

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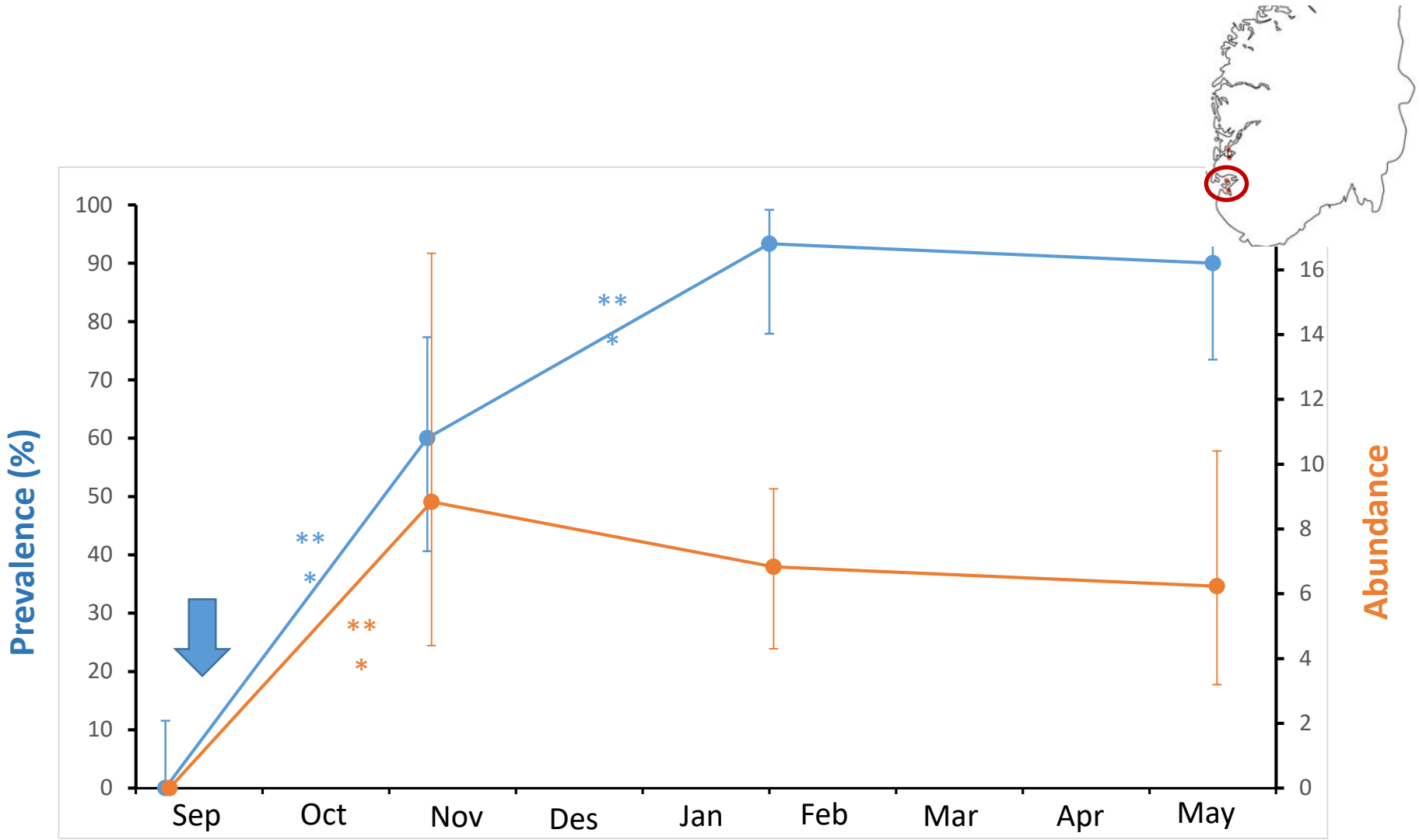
Farm 1 (j.no. 1)- stocked in autumn – Rogaland, Southern Norway



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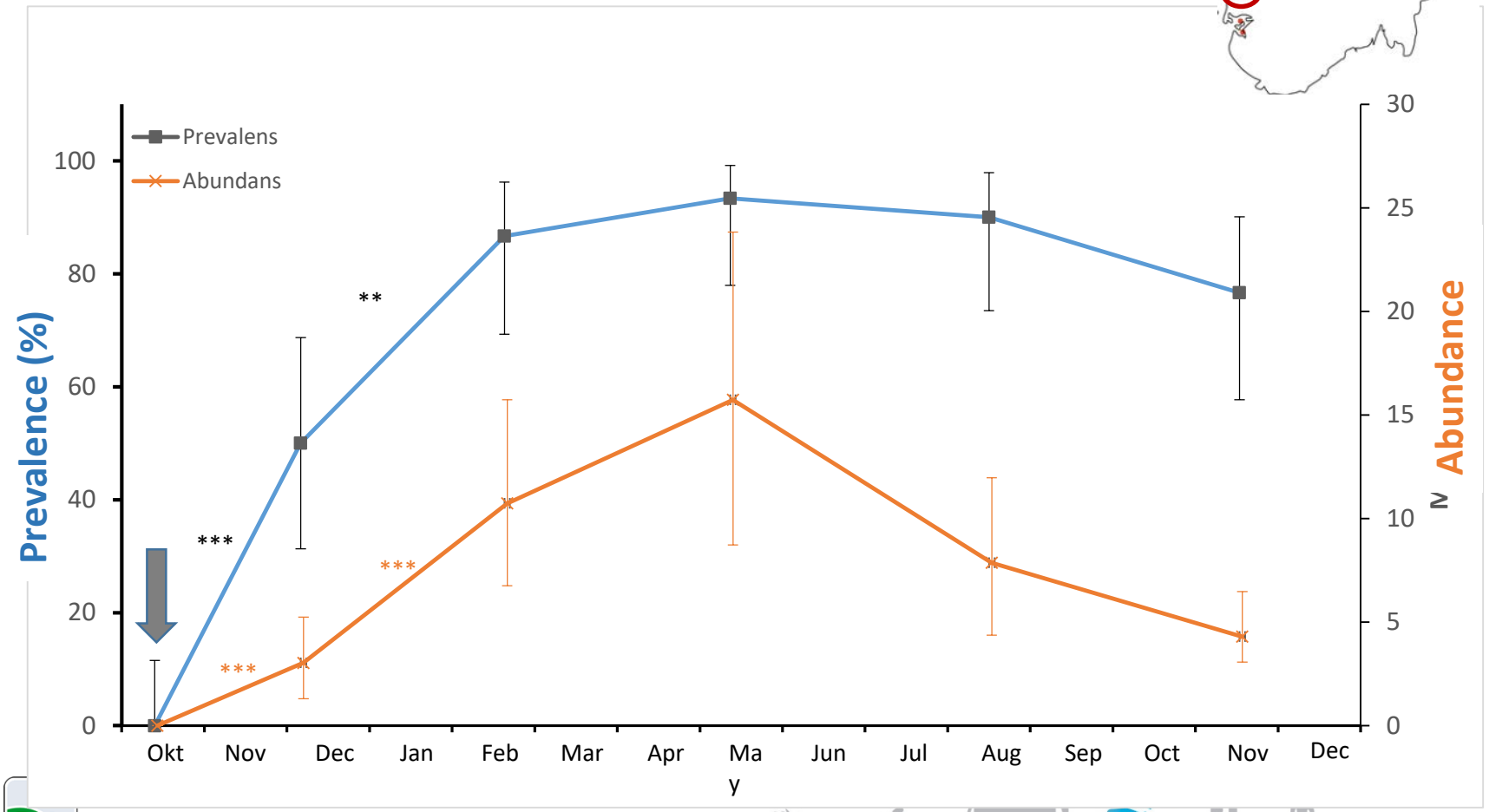
Farm 2 (J.no 4) – stocked in autumn – Hordaland, Western Norway



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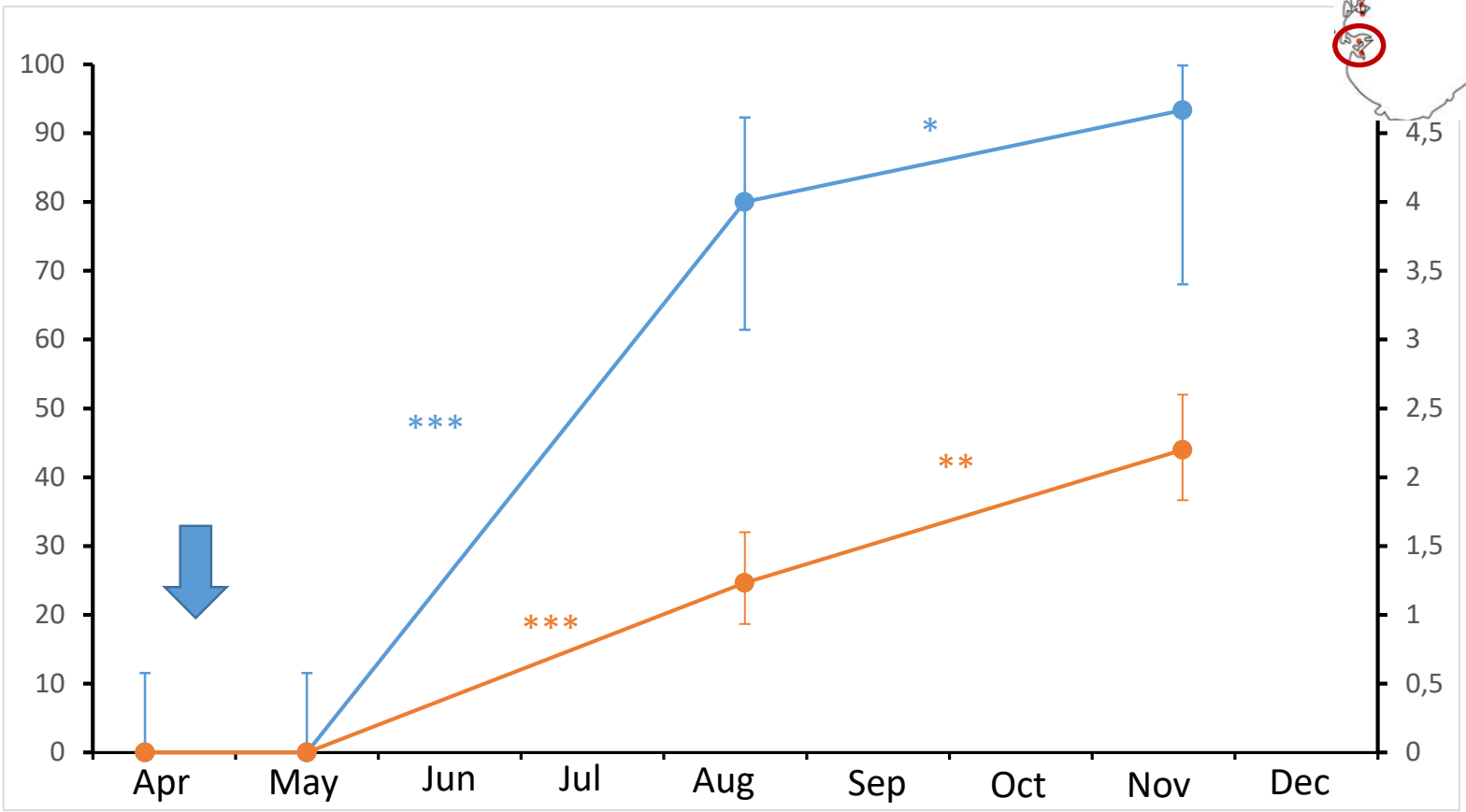
Farm 3 (J.no 10) – stocked in spring, Rogaland, Southern Norway



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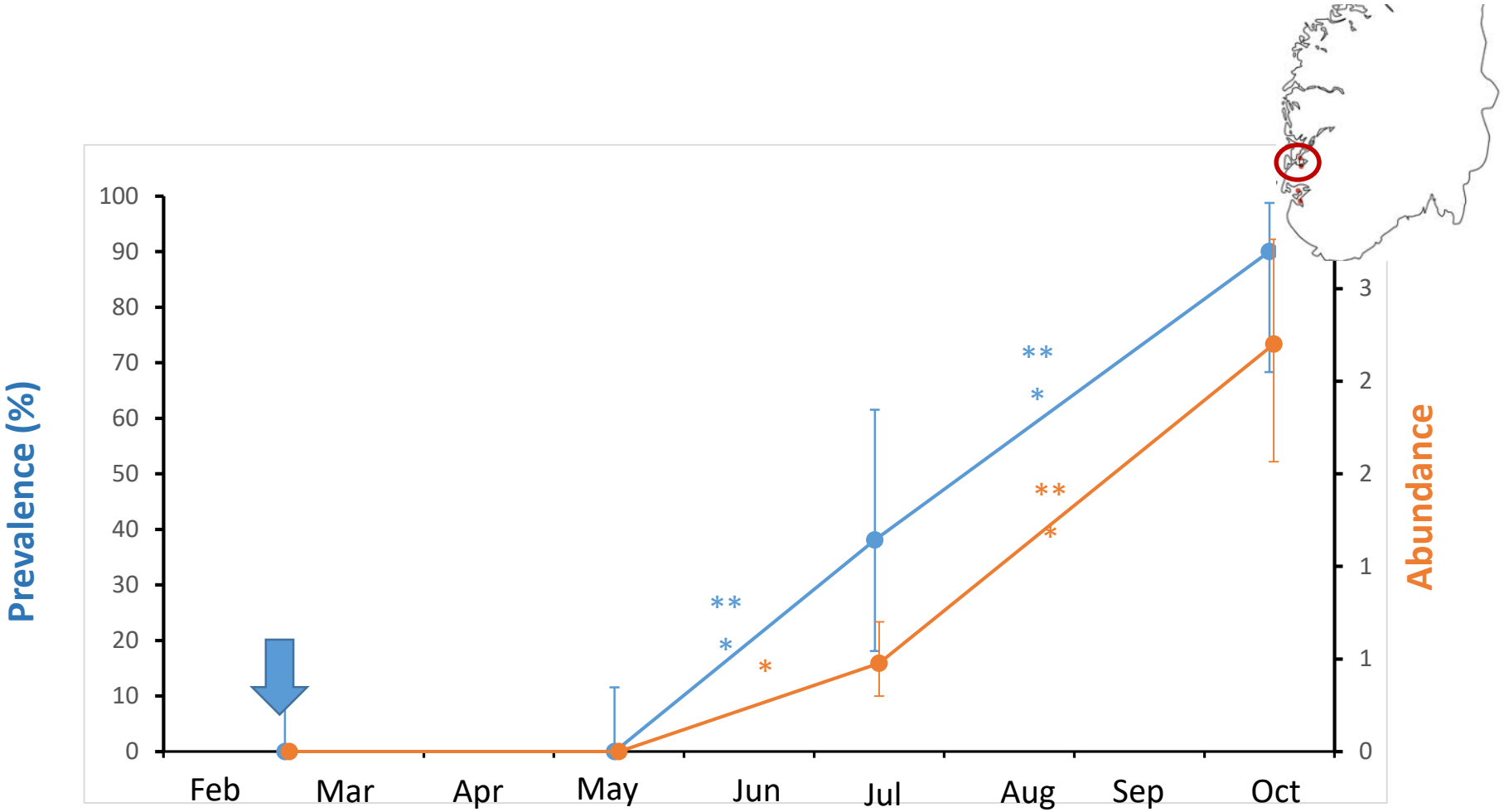
Farm 4 (J.no 12) – stocked in spring – Hordaland, western Norway



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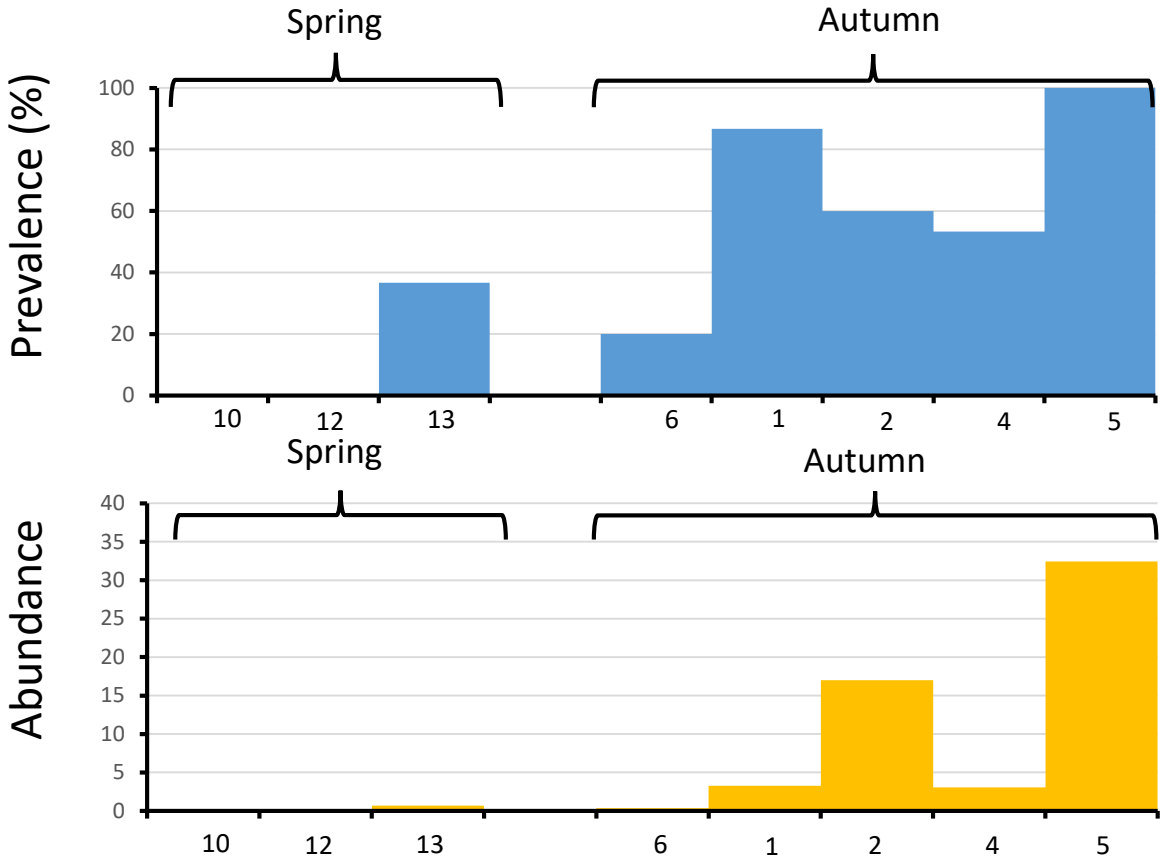
Situation at the first sample from the sea – generally after one month – for the different kohorts



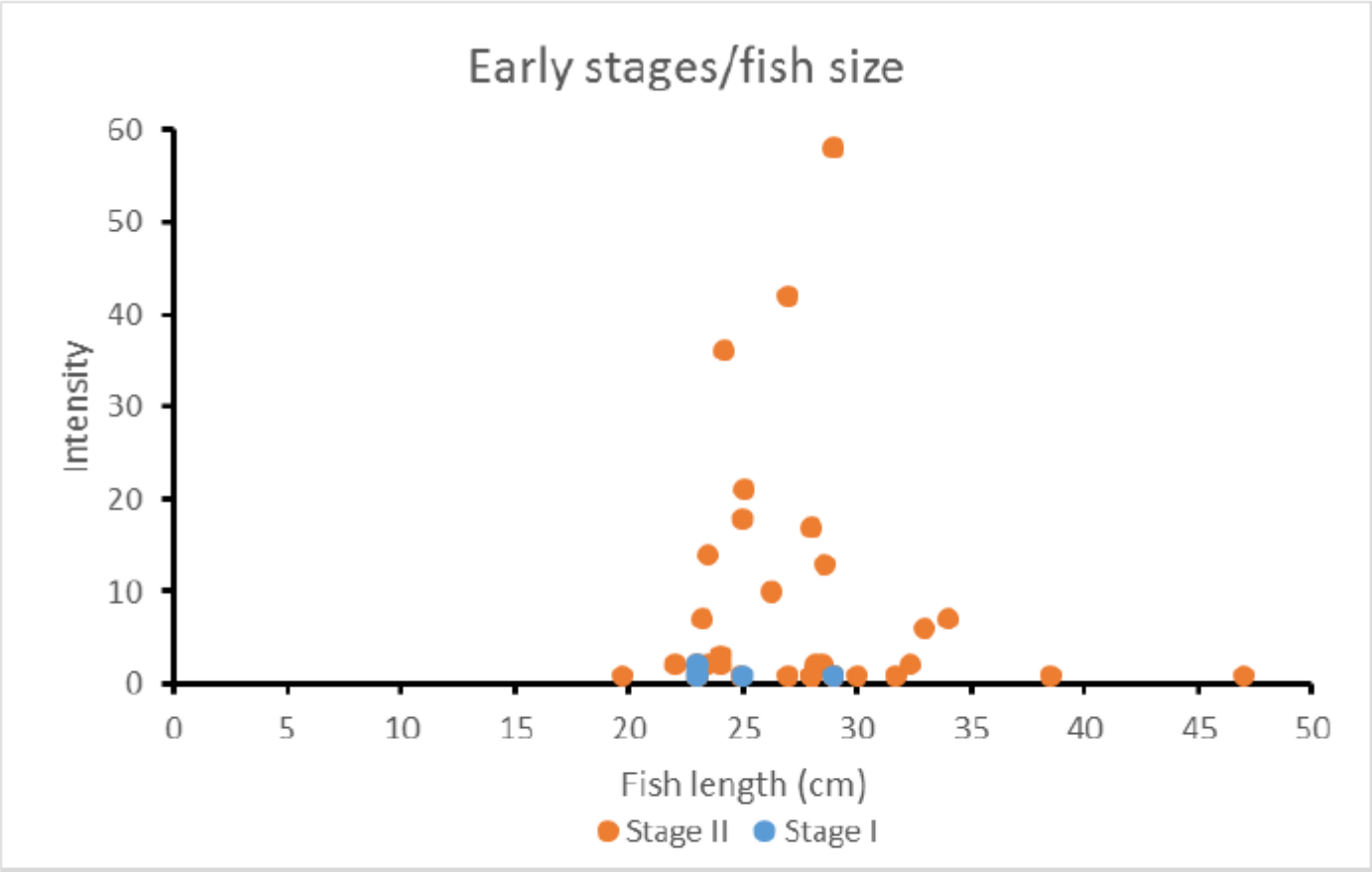
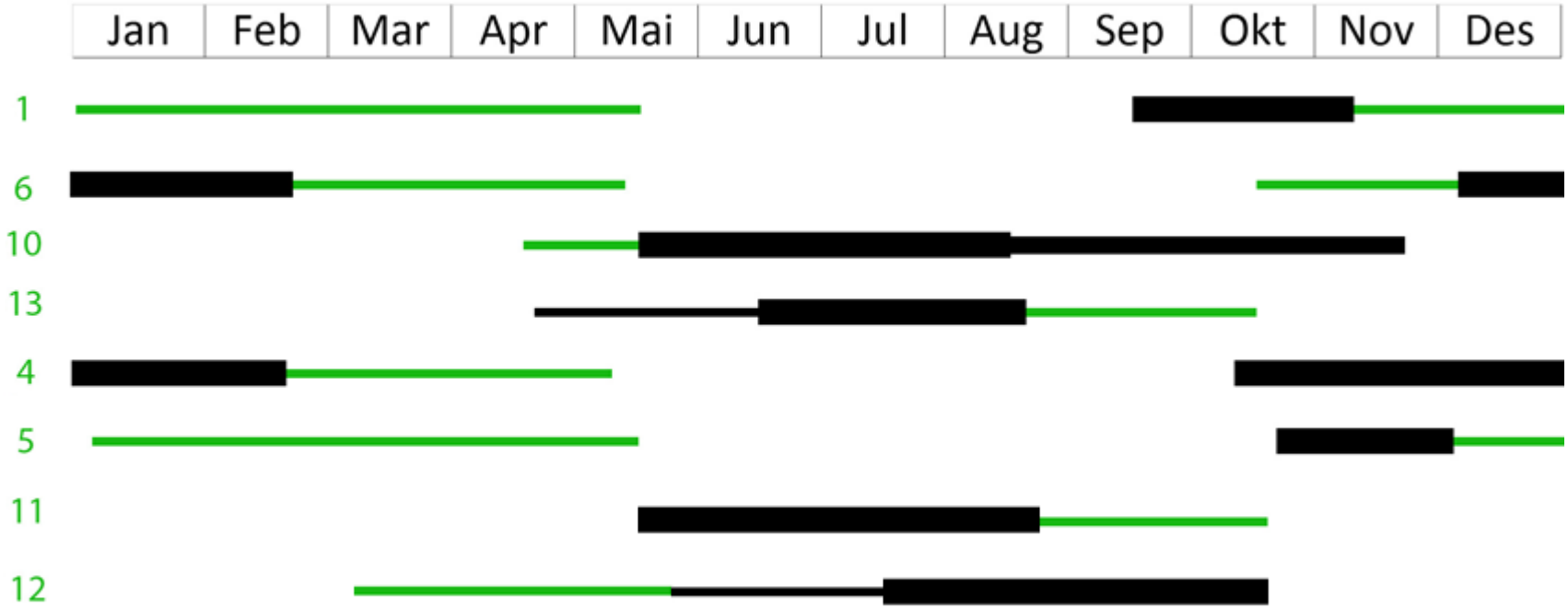
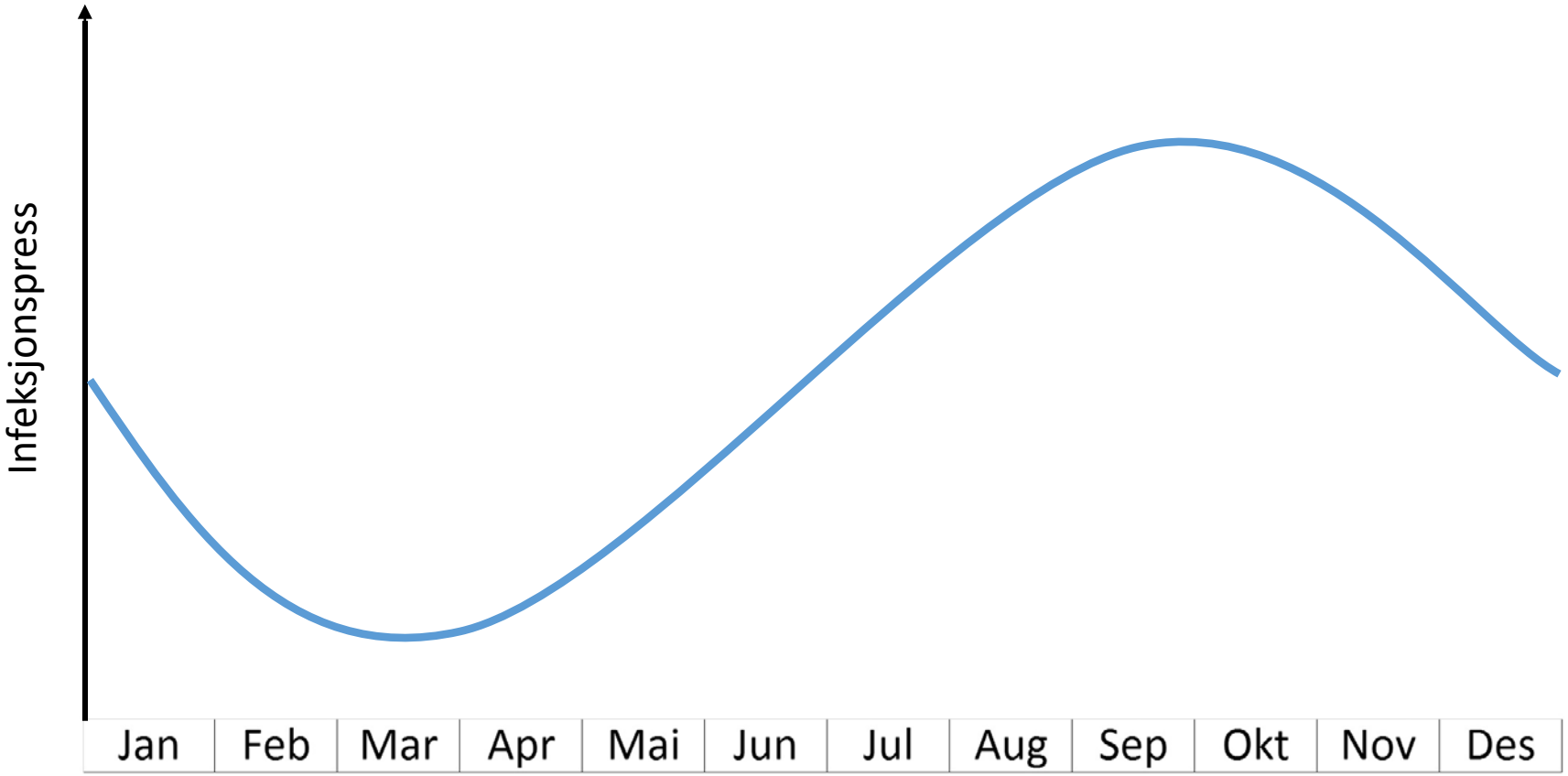


Figure 16 Occurrence of early stages of cestodes vs length of fish. Stages I (plerocercoids) and II (juveniles under 10 mm) could represent recent infections due to fish feeding on copepods.

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.

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

Thank you!

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