

Salmon lice in Danish salmonid populations EURL Nov 3, 2020

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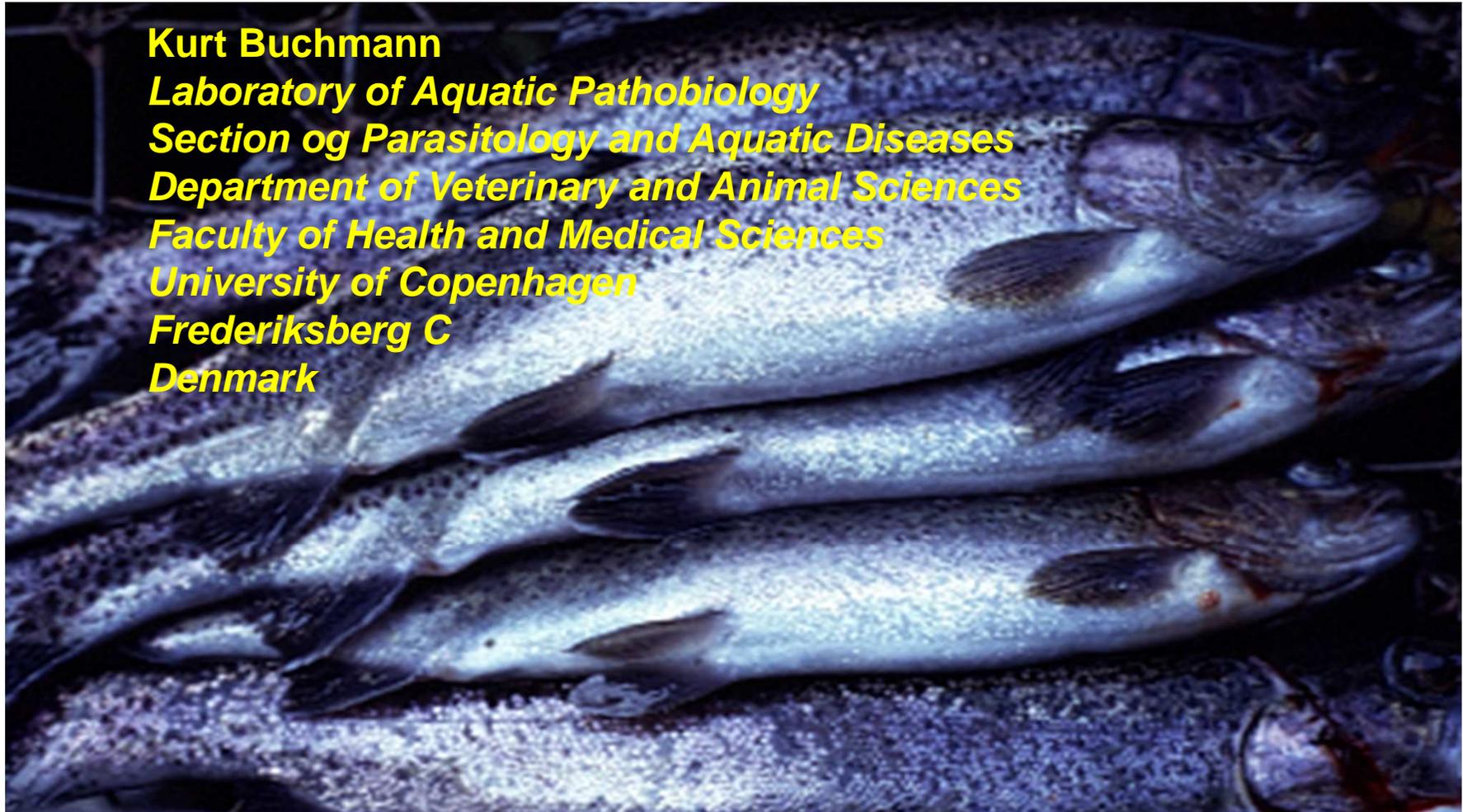
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Salmon louse

Lepeophtheirus salmonis

Salmon louse
Lepeophtheirus salmonis

Crustacea:
Order Copepoda, suborder Siphonostomatoida, family Caligidae

Sea lice and Denmark

The Danish zoologist Henrik Nikolai Krøyer 1799-1870 described the salmon louse in 1838 in *Naturhistorisk Tidsskrift* (Journal of Natural History)

The original Danish description as
Caligus salmonis from 1838

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Om Snyltekrebsene,
især med Hensyn til den danske Fauna*),

af

Henrik Krøyer.

Common during the summer period on the salmon in Denmark

Denne Kaligusart, som om Sommeren er temmelig hyppig paa Laren, adskiller sig fra de andre mig bekjendte Arter ved sin mørke, næsten sortblaa Farve.

Salmon louse

Lepeophtheirus salmonis

Life cycle with 8 developmental stages

Main hosts for salmon lice in Danish waters

- Atlantic salmon *Salmo salar*
- Sea trout *Salmo trutta*
- Rainbow trout *Oncorhynchus mykiss*

Extensive and successful re-stocking programmes for wild Atlantic salmon and sea trout in Denmark

- *Salmo salar*: River Skjern å and other streams (Storå, Sneum å, Varde å, Kongeå, Ribe å, Gudenå) in Jutland – annual release up to 100,000 1 year smolts per stream
- *Salmo trutta*: Sea trout stocking – 1,500,000 fish per year

Salmo trutta

Brown trout – sea trout



Originally the 887 stream systems in Denmark produced 2,640,000 smolts every year but land management destroyed many habitats. They are now being reconstructed.

In Denmark we have now 324 water systems with wild reproducing trout stocks with an annual production of 1,000,000 smolts

Hatcheries produce and re-stock with 1,500,000 trout (6 months old, 12 months old, smolts 24 months old)

Sea trout infections

- Surveys performed based on documentation from Danish anglers and divers
- Infected wild sea trout in Kattegat and northern Øresund and the great Belt

Restocked River Skjern å salmon

Salmo salar

- Surveys conducted
- Import of salmon lice to Danish waters when they return from their migrations in the North Atlantic

Lepeophtheirus salmonis infections of wild Danish salmon

- **Fish.** Naturally infected wild Atlantic salmon (*Salmo salar*) were caught by electro fishing when returning into the River Skjern Å for spawning. Lice were collected from 36 fish with body lengths varying between 69-121 cm and body weights within 3-20.4 kg. In addition, Danish anglers collected salmon lice from returning Atlantic salmon also from river Gudenå.
- **Lice.** Lice were obtained and stored in 1.5 ml Eppendorf tubes (one for each fish) containing 70 % ethanol.
- **Identification.** Both morphometric and molecular diagnosis was performed

Rainbow trout production in Denmark



Freshwater farms: treatment with
biological and mechanical filters

Marine netpens with rainbow trout
Stocking in March to April

Mariculture stocking size 500-1000 g



No salmon lice when stocked

Harvest in November to December



Following transfer to marine net pens

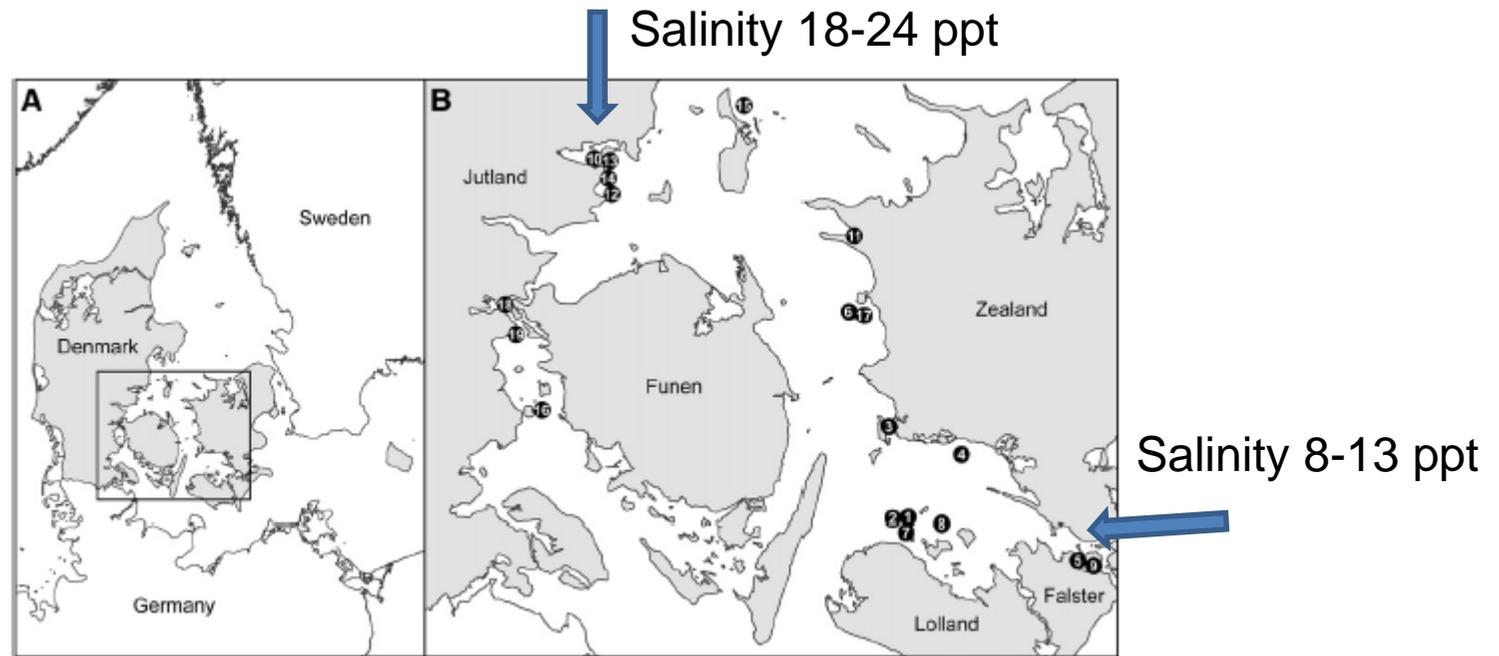
- Freshwater ectoparasites (ciliates, flagellates and gyrodactylids) are eliminated during the first few months in the marine environment

Marine parasites may then colonize the maricultured rainbow trout but a series of ecological and behavioural elements will influence the infection

Surveys

- 2012-2013: No infection in 16 of 19 farms
- Over all prevalence:
- 4.7 %
- Abundance:
- 0.1
- 2016: No infection except in one farm
- One male preadult louse on one fish
- 2020: No infection at all up until now

Results from investigation of 19 Danish mariculture farms along the salinity gradient in the Danish marine waters



Survey in 2016

- Ten rainbow trout from each farm
- Only infection in one farm at 24 ppt salinity
- Only one male louse found
- Additional examination of 110 rainbow trout in the same farm
- All fish were all negative
- Over all abundance in this farm: 0.0083

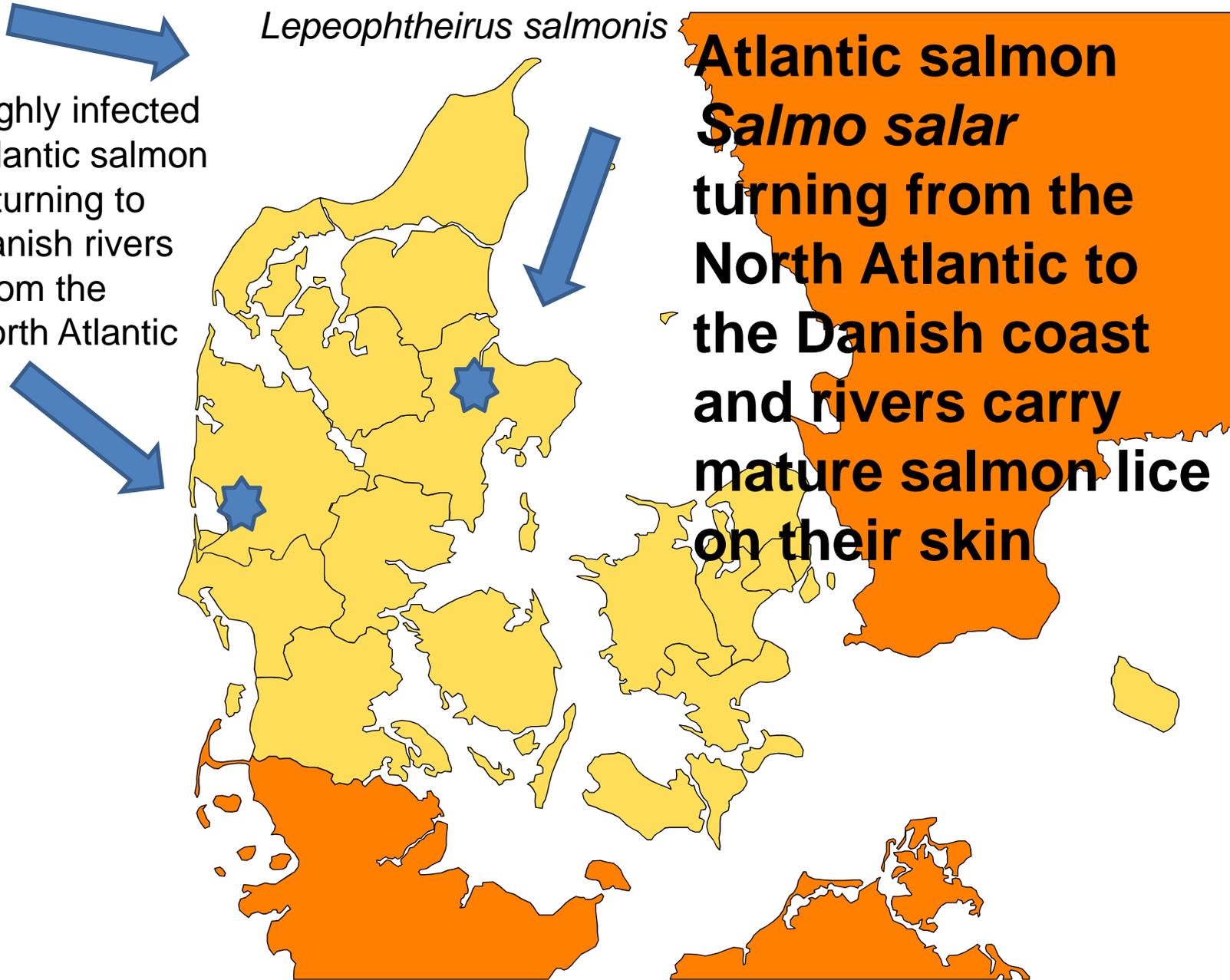
How are the salmon louse populations sustained in
Danish marine areas?



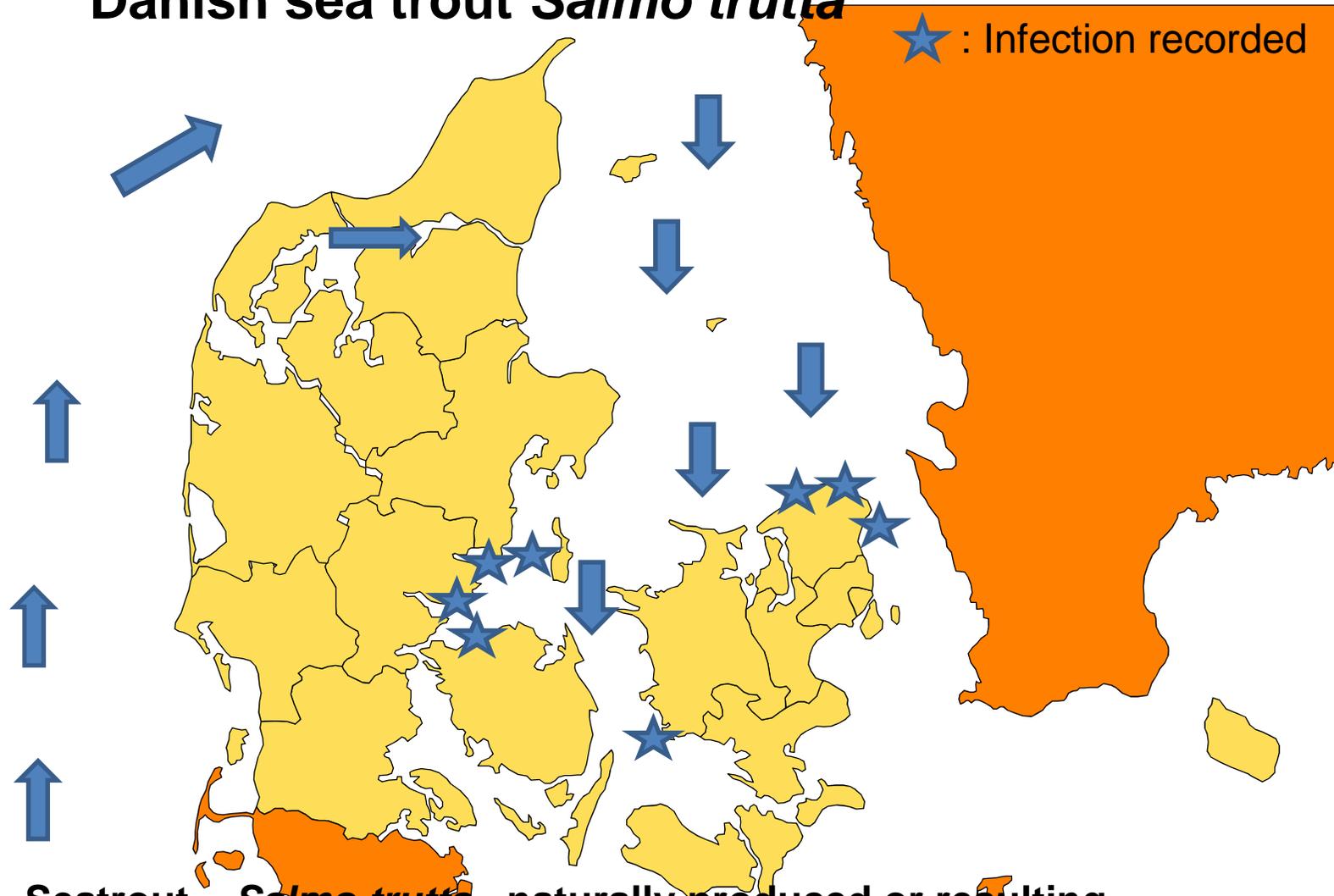
Lepeophtheirus salmonis

**Atlantic salmon
Salmo salar
turning from the
North Atlantic to
the Danish coast
and rivers carry
mature salmon lice
on their skin**

Highly infected
Atlantic salmon
returning to
Danish rivers
From the
North Atlantic

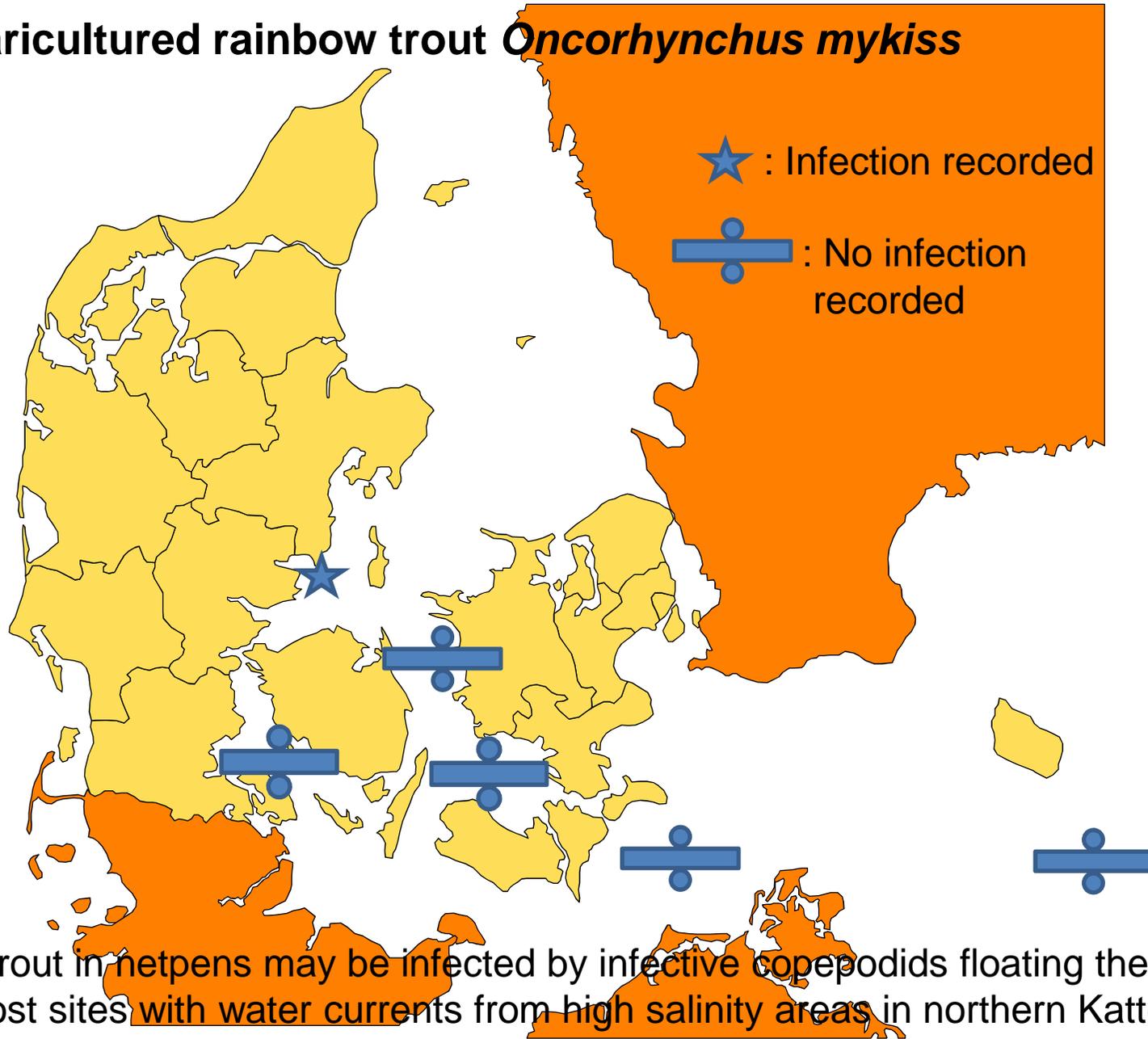


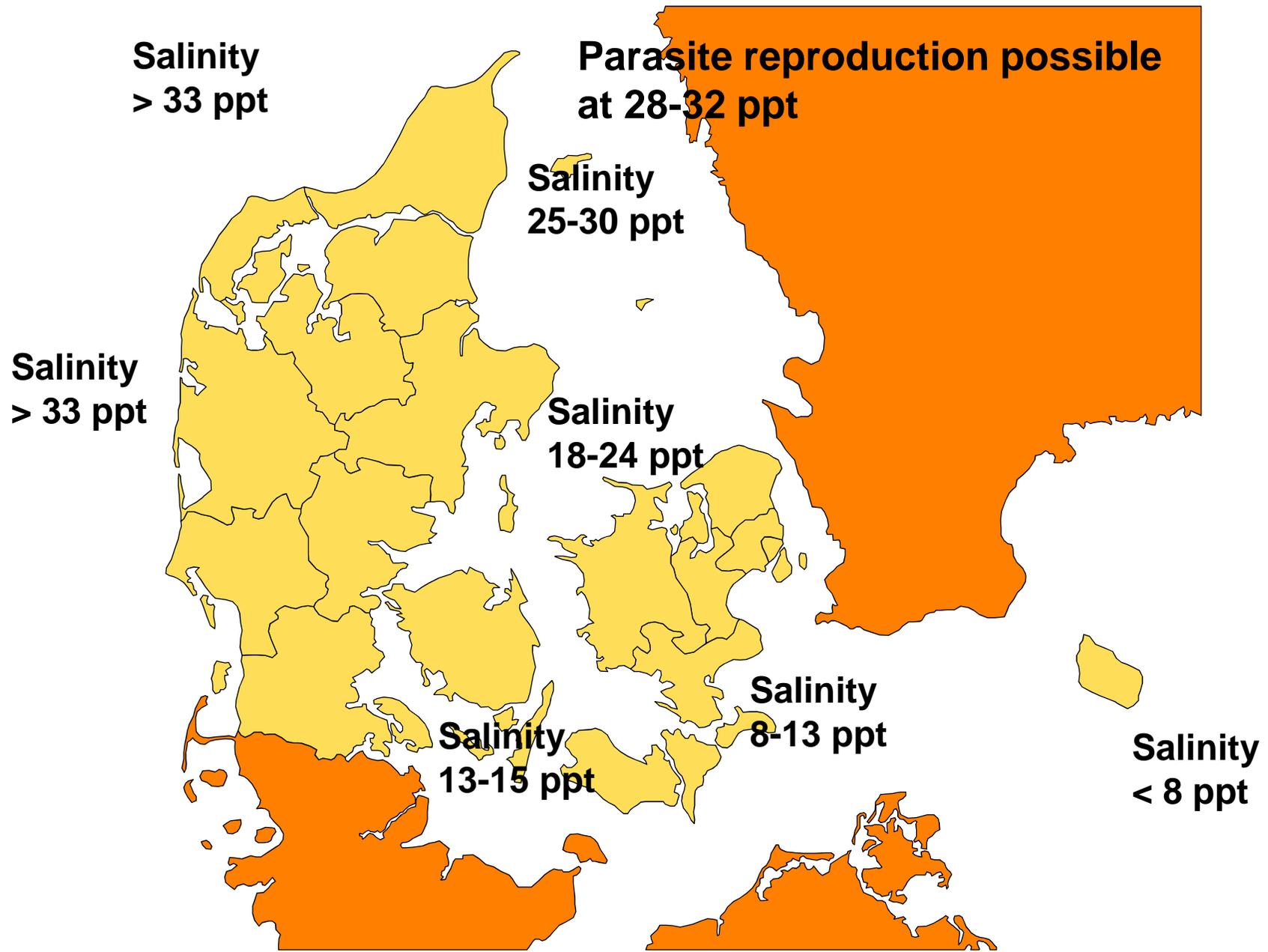
Danish sea trout *Salmo trutta*



Sea trout – *Salmo trutta* - naturally produced or resulting from re-stocking programmes become infected in high salinity areas and carry the parasites into low salinity waters and freshwater streams during their migrations around Denmark

Maricultured rainbow trout *Oncorhynchus mykiss*





Baltic salmon – a special case free from salmon lice infections



Baltic salmon stay in the Baltic sea at low salinity <10 ppt throughout its entire life-span: too low salinity for salmon louse reproduction

Baltic salmon caught at sea

Sampling day in the central Baltic 2017
– but no salmon lice at all

Conclusion

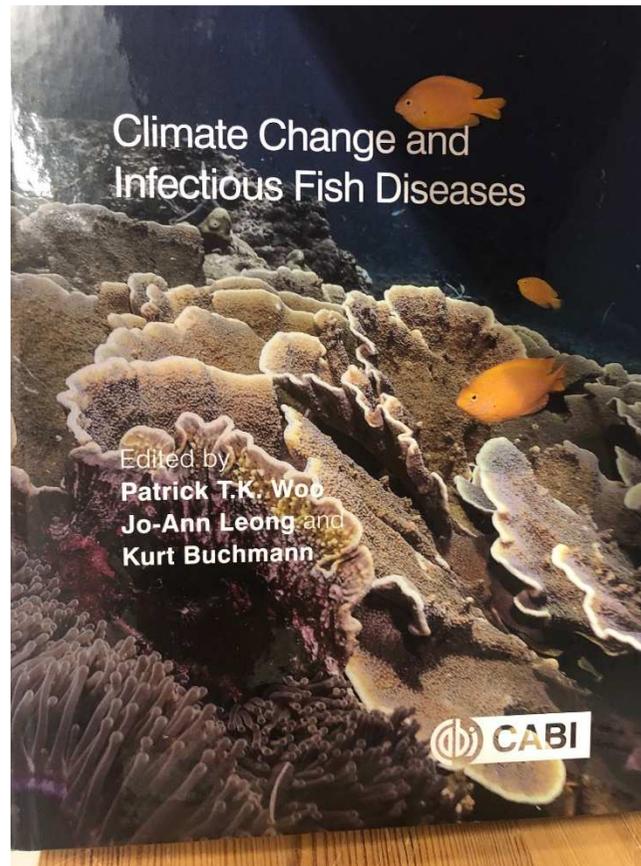
- Salmon lice populations in Danish waters are sustained by returning Atlantic salmon to rivers in Jutland
- Seatrout become infected in Danish marine areas with high salinity (North Sea, Skagerrak, Kattegat)
- Seatrout migrate with their louse burden into low salinity areas
- Maricultured rainbow trout at moderate salinity areas in Kattegat probably become infected by inflowing infective stages in high salinity water coming in from high salinity areas

Conclusion

- No salmon lice in rainbow trout farms located at salinities below 18 ppt
- A few *Lepeophtheirus salmonis* in farms located at 18-24 ppt salinity locations
- Salinity at 28-32 ppt is optimal for the life cycle and inner Danish waters are sub-optimal for the parasite performance

Restocking programmes are likely to increase the density and movements of salmon and trout whereby the overall salmon louse population is likely to increase in the future – independent of rainbow trout mariculture

Climate changes and effects on distribution:
Temperature and salinity variations may play a role and should
be investigated and monitored



Thank you for your attention