# Otolith deformation in hatchery reared Vosso salmon juveniles

## Does vaterite coverage increase with age after release?


(4)

SCAN ME

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### 1.1 What is an otolith?

- Otoliths are bones that can be found in the fish's inner ear (Figure 1). These bones play a role in fish's hearing, balance and movement (1).

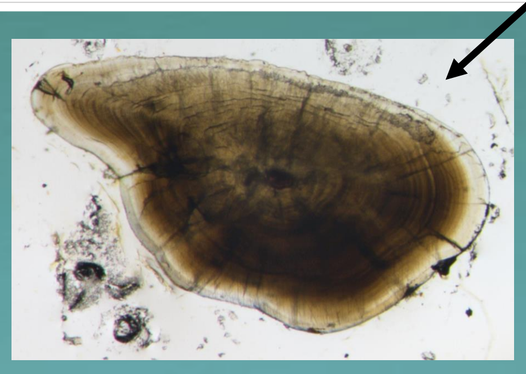

Figure 1. Normal otolith. Consisting of aragonite polymorph.

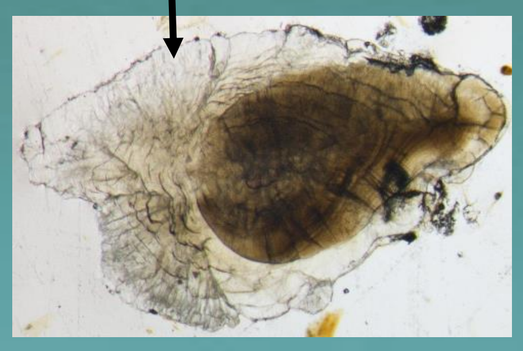

Figure 2. Deformed otolith consisting mostly of vaterite polymorph. Dark area is still aragonite.

### 1.2 What is otolith deformation?

- Usually, otoliths consist of aragonite, one of the three naturally occurring crystal polymorphs (2). Otolith deformation occurs when the otoliths crystallize into vaterite, a more fragile polymorph (Figure 2).

### 1.3 What is this study about?

- Research done in Vosso hatchery has previously shown that vaterite occurrence and coverage do increase with fish length (3).
- A cohort of salmon juveniles hatched in Vosso hatchery in April 2013. In July 2013, some of the fish were released into two different rivers.
- The aim for this study is to investigate if the number of otoliths with vaterite and the area of the otolith that is covered of vaterite increase with age. The hypothesis is that as the fish increase with age after release into the river, the larger the vaterite coverage will be.

### 2. Materials and methods

- Three samples were taken from the same cohort of fish. The first sample were taken while fish was still in the production tank in July 2013. The second sample were recaptures of salmon juveniles in Rasdalen river in October 2013, and the third sample were recaptures of salmon from both Brekkhus and Rasdalen rivers in June 2014.
- The sampling of salmon juveniles was performed by electrofishing; By stunning the fish and catching them with nets.
- The area of the sampled otoliths was measured using ImageJ software. All figures were made using R studio.

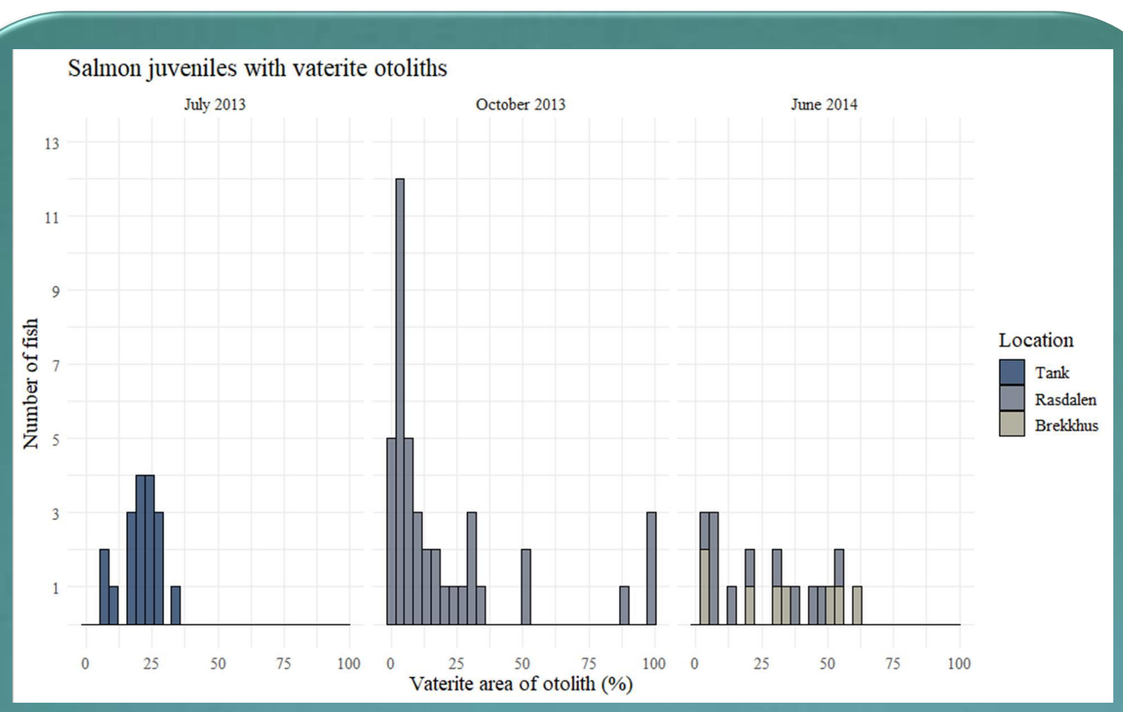


Figure 3. number of salmon juveniles having vaterite in at least one otolith versus the area of the otolith with vaterite.

### 3. Results

- The first sample from July 2013 had the lowest vaterite coverage and the least number of fish with vaterite otoliths (Figure 3).
- The sample from October 2013 had the highest number of fish with vaterite otoliths and large variations in vaterite coverage. Several otoliths was fully crystallized into vaterite (Figure 3, Figure 4).
- The third sample from June 2014 had a decrease in the overall percentage of fish with vaterite otoliths, but an increase in mean vaterite coverage (Figure 4). This sample was taken from both rivers.

### 4. Discussion

Seasonal variability and stress may play a role in vaterite formation:

1) Seasonal: October 2013 is right after the summer, where more food is available, there is more sunlight and higher temperatures, which may increase the growth rate of fish. Rapid growth can cause vaterite formation in farmed fish's otoliths (5)
2) Stress: Vaterite in wild fish might occur due to stress in nature (6). Rasdalen experience continuously cold-water input, which can alter mineral content, water temperature and result in more movement. Thus, fish in Rasdalen river might experience more stress.

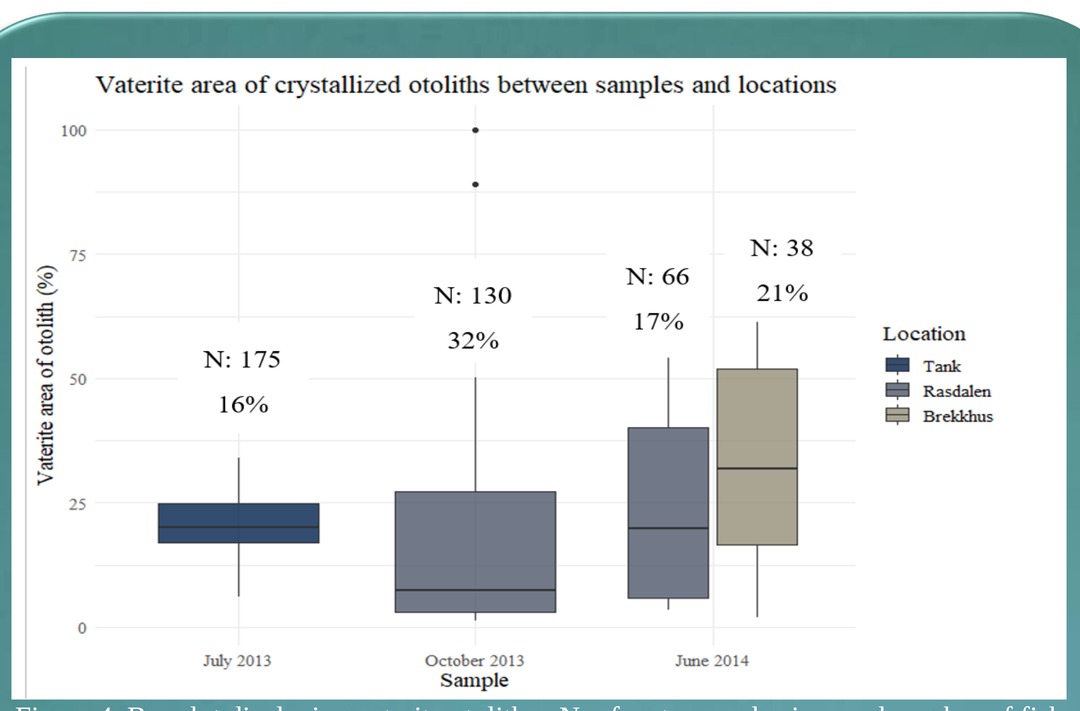


Figure 4. Boxplot displaying vaterite otoliths.. N refers to sample sizes and number of fish included in each boxplot. Percentage of fish with vaterite otoliths are shown below N.

### 5. Conclusion

- This study suggests that the overall percentage of fish with vaterite otoliths does not increase with age, but that vaterite cover does. Other factors may also be important in vaterite formation.


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