Prosjektet

- Aim : Production of juvenile FPM for release into non or weak recruiting populations.

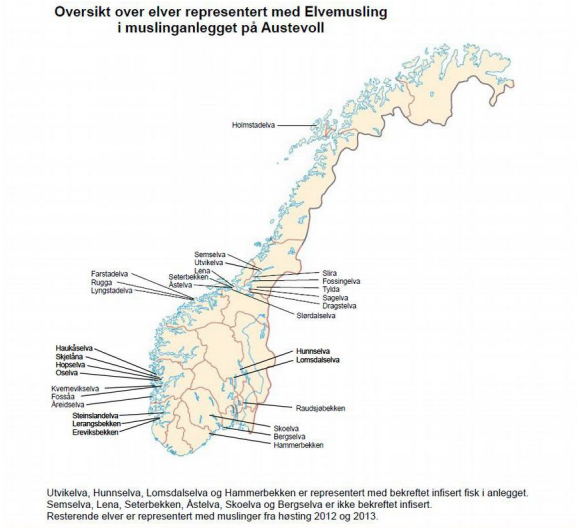
- Project leader
- Per Jakobsen
- Employes
- Tore Bjånesøy
- Ragnhild Jakobsen
- Eivind Schartum
- Collaboration:
- Jürgen Geist
- Michael Lange
- Ondreij Spisar
- Martin Kalbe
- Stein Mortensen
- Jørn Scharsack
- Bjørn Mejdell Larsen
- PhD and masterstudents

The Mussel Farm

Norway has 170 viable populations

But also 357 weak or non recruting populations

FPM production



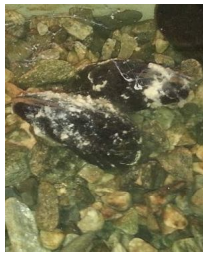
Utvikelva, Hunnselva, Lomsdalselva og Hammerbekken er representert med bekreftet infisert fisk i anlegget.
Semselva, Lena, Seterbekken, Åstelva, Skoelva og Bergselva er ikke bekreftet infisert.
Resterende elver er representert med muslinger fra høsting 2012 og 2013.

Collection of glochidia

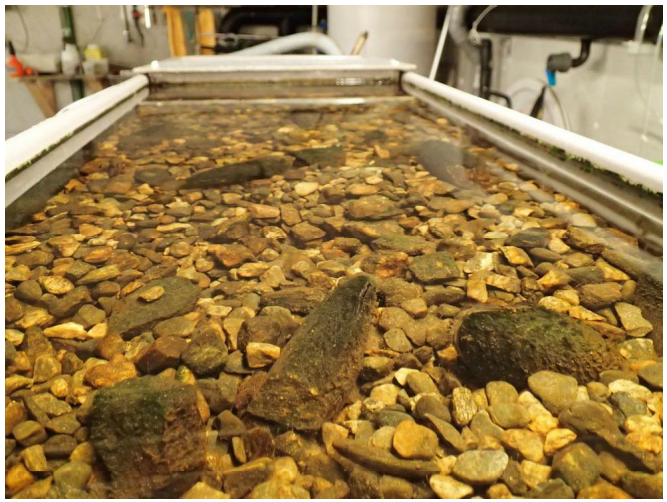
Infection in the farm

- More than 40 adult mussels used
- Better control of timing of the spat
- Use farmed disease free fish- low mortality
- Can control number of glochidia relasing mothers.

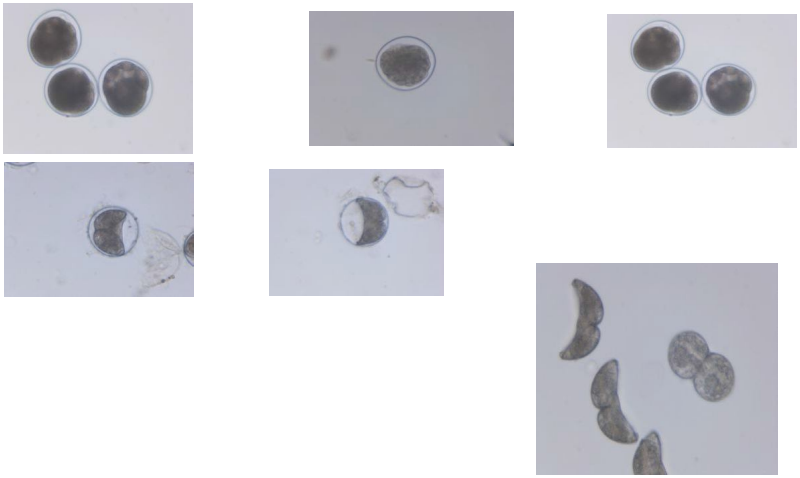
Kunstig elv med kjønsmodne muslinger



Gytende muslinger fra Semselva, Trøndelag

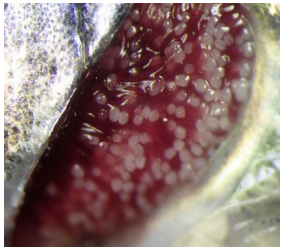


Control of the spat twice a day and evaluation of infectivity and number, state and size of spats for each mothermussel



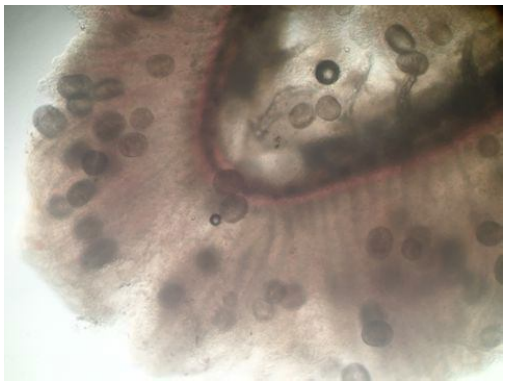
When host preference unknown we have to use both salmon and trout as hosts.

Salmon gills



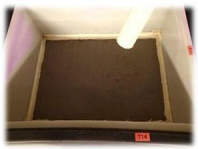
Trout gills

Above the anadromous stretch- only trouts infected



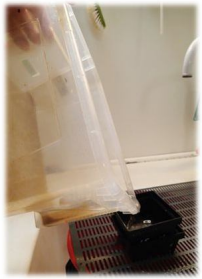
Harvesting

- Fisk settes i silekar – mai/juni
- Muslinger på sil høstes annenhver dag (0,4 mm)
- Muslingene renses og telles under lupe
- Overføres til bokser for videre stell og fôring

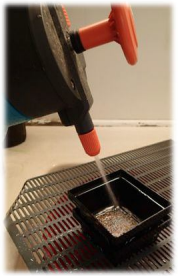


Feeding

- Mussels are sieved, water changed and new algae and detritus changed, each second day


Siling


Muslinger på sil

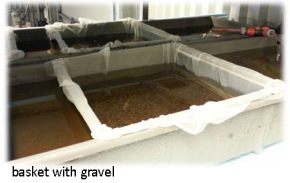

Rensing


Vann + alger


Mudder

Artificial rivers

- Mussels > 2 mm placed in artificial rivers with gravel and resirculated water with biofilter


basket with gravel


Artificial river

22 months old mussels

However- 2014 was a hells-kitchen
Pollution, combined with the highest temperatures ever measured

Rebuilding the farm

-In order to avoid future problems with pollution and extreme temperatures , we have now alternative water sources-resirculation of water and storage-treatment

-Better control of the water coming in.

-Temperature controlled room for production of the first 12 month old mussels.

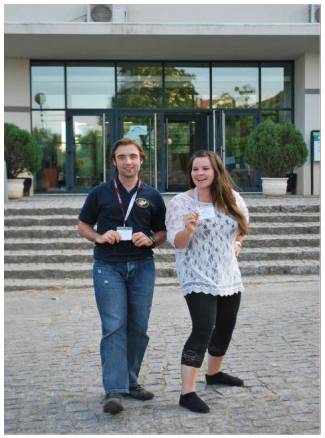
36 baby rivers for production

Pretest of baby rivers in 2014 gave fear results with respect to survival, and growth.

Only those baby-rivers that matured before release of mussels showed good results

A snapshot of some of the related reseach going on in the project

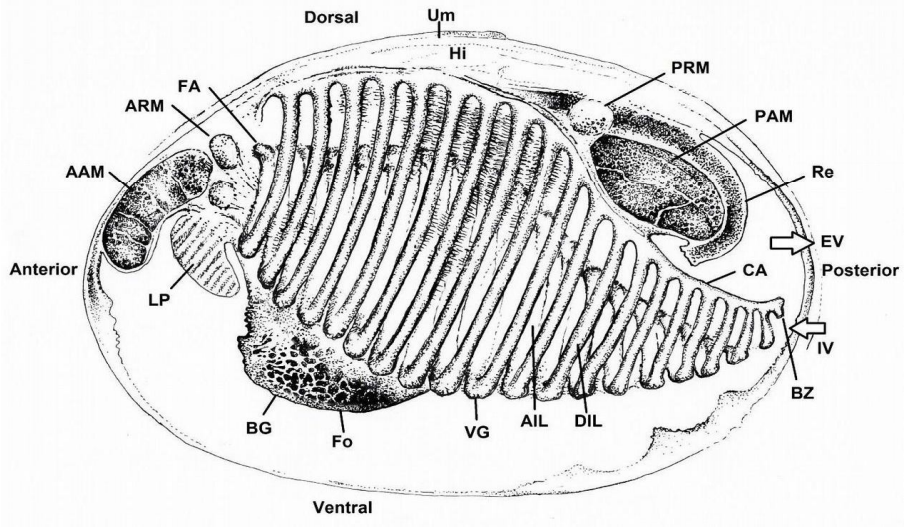
Daniel Ophof and Jaenette Gramstad



Eivind Schartum

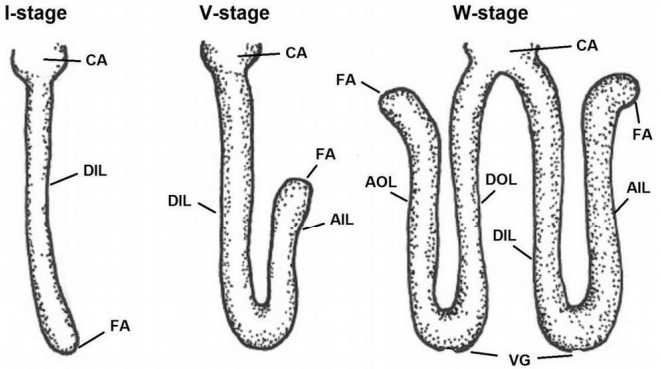
Gjelle / filterorgan / ctenidium

Fot



Anatomy of a V-stage postlarva with the left shell and mantle lobe removed. Fo, foot; PC, pallial cavity; AAM, anterior adductor muscle; PAM, posterior adductor muscle; PRM, posterior retractor muscle; LP, labial palps; Re, rectum; DIL, descending inner lamella; AIL, ascending inner lamella; CA, ctenidial axis; Fi, filament; BZ, budding zone; IV, inhalant valve; EV, exhalant valve; Um, umbo. The figure illustrates the structure of the left inner demibranch, where the ctenidium hangs freely into the pallial cavity (PC). Water is pumped by lateral cilia between the filaments into the suprabranchial chamber

Three stages



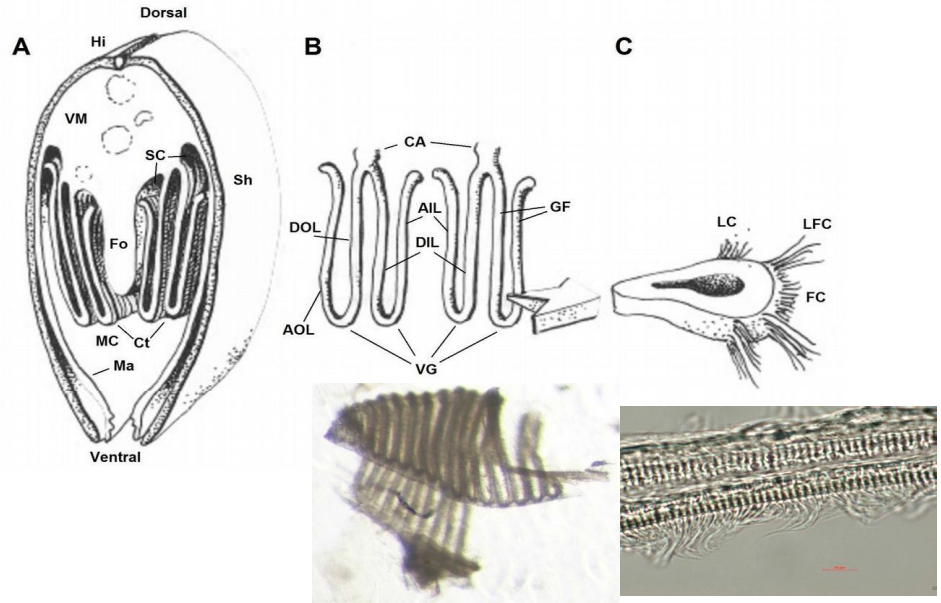
CA – Ctenidial axis
FA – Filament apex
VG – Ventral groove
DIL –Descending inner lamella
AIL – Ascending inner lamella
DOL – Descending outer lamella
AOL – Ascending outer lamella

I-stadiet: (0.8-1.1mm)
Indre lamelle vokser ventralt

V-stadiet (1.1-4.5mm)
Lamellen snur, vokser dorsalt og får en V-form.

W-stadiet (>4.5mm)
En ytre lamelle begynner å vokse ut, og gjellene får sin adulte form.

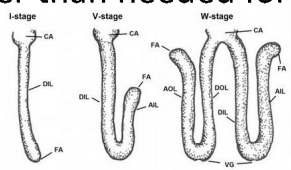
Illustrasjon: Stein Mortensen (IMR)

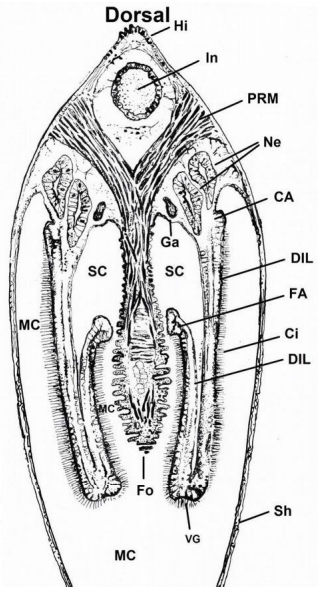


A: Transversal lamellibranch gill anatomy. C: Cross-section of gill filament. B: Pair of W-shaped lamellibranch filaments. Vi, visceral mass; Fo, foot; Sh, shell; Hi, hinge; Ct, ctenidium; Ma, mantle; MC, mantle cavity; SC, suprabranchial chamber; GF, gill filament; CA, ctenidial axis; VG, ventral groove; AOL, ascending lamella of outer demibranch; DOL, descending lamella of outer demibranch; DIL, descending lamella of inner demibranch; AIL, ascending lamella of inner demibranch; FC, frontal cilia; LFC, lateral frontal cilia; LC, lateral cilia. Source: Ridewood (1903).

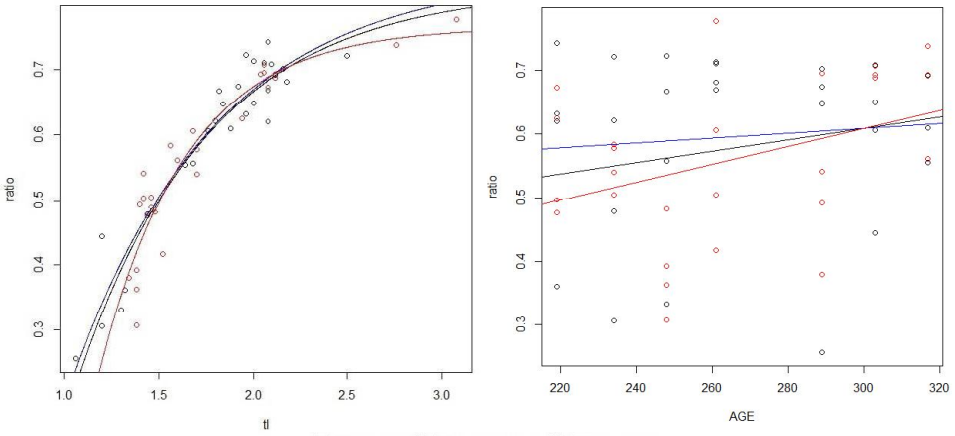
Pedalfeeding or filtering- A conflict on the I stage and early V stage.

- The foot inhibits the left and right lamella to create an early gill basket
- Movement of the foot blocks the cilia-connection at the filament (FA)
- An I shaped filament has a weak resistance to pressure.
- Movement of the foot means that the shell opening is larger than needed for filtration

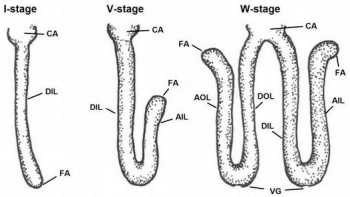




Size or age?



Alder forbedrer **ikke** modellen signifikant



When do they start to filter- At a size of 2,0 - 2,5 mm

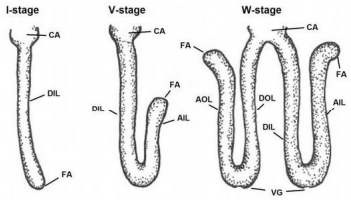
$$L(D) = L_0 - \frac{1}{K}\ln(1 - \frac{D}{D_\infty})$$

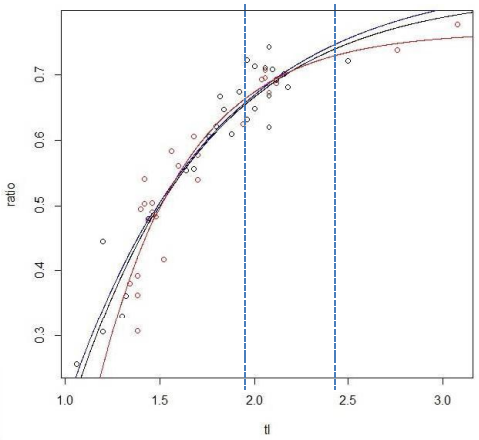
$$D_{lim} = lim * D_\infty$$

$$L(lim) = L_0 - \frac{1}{K}\ln(1 - lim)$$

$$L(0.8) = 0.8467 - \frac{1}{1.4256}\ln(1 - 0.8) = 1.98\ mm$$

$$L(0.9) = 0.8467 - \frac{1}{1.4256}\ln(1 - 0.9) = 2.46\ mm$$





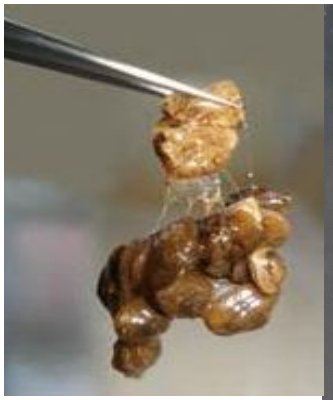
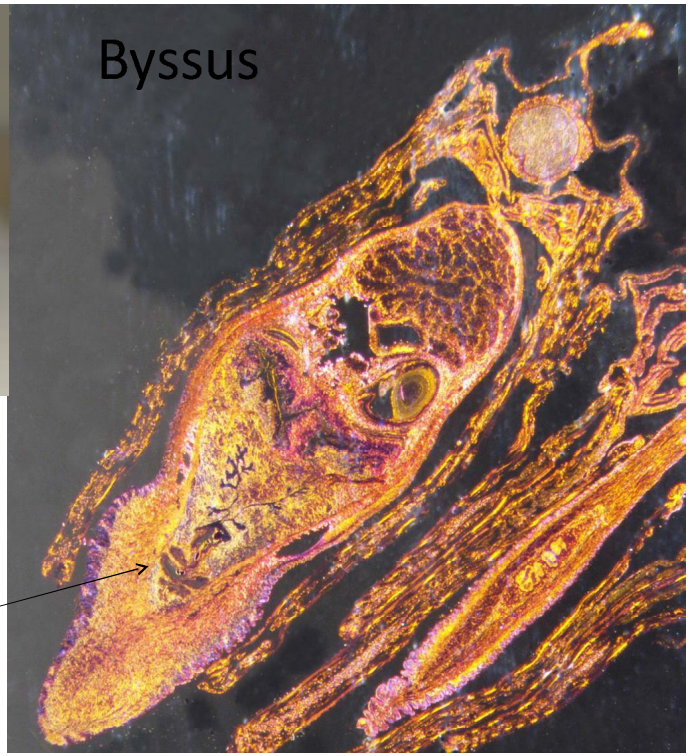


Foto: M. Lange

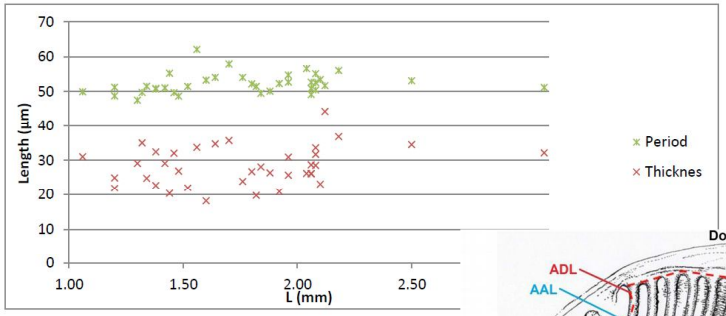
Kan forankre seg til elvegrusen med byssus når de er ca. 2,5 mm

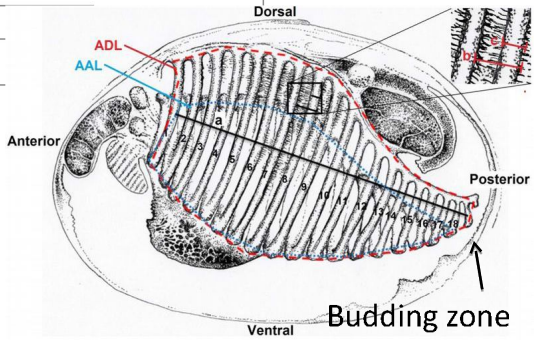
Byssuskjertel



We also found that

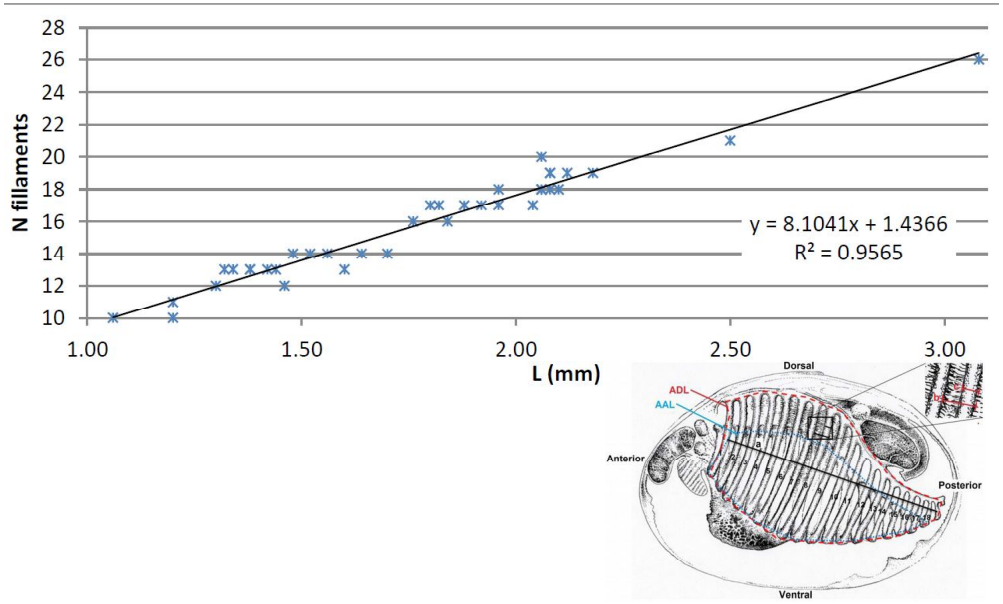
Distance between gill filaments are more or less equal between small and large -> Eats the same particlefraction.





And that:

Number of gillfilaments are linear with mussel length.

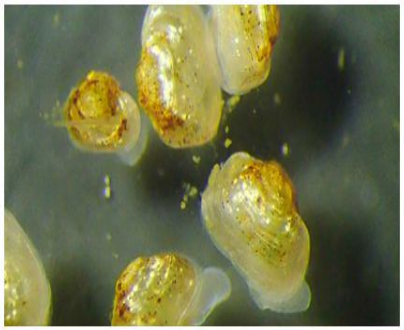


Jaenette looked food patch preference in pedal-feeding mussels

When between 0.5 and 2 mm.

- Must search to find a sufficient biofilm
- Have to stay in slowfloating areas or deep down in the riverbed to avoid beeing washed away by the current.
- May have problems finding good feeding areas.
- Have only a small energy storage and are vulnerable to starvation.
- Are exposed to a number of potensial predators than larger mussels are.

Mjåtveitelva har muslinger i anlegget



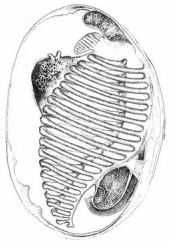
Feeding

- Mussels used their foot to feed before the filter is functional
- Filter functional when 2.mm

Her har en musling vandret rundt og kost seg i boksen

Skjeljånamusling 1 mm

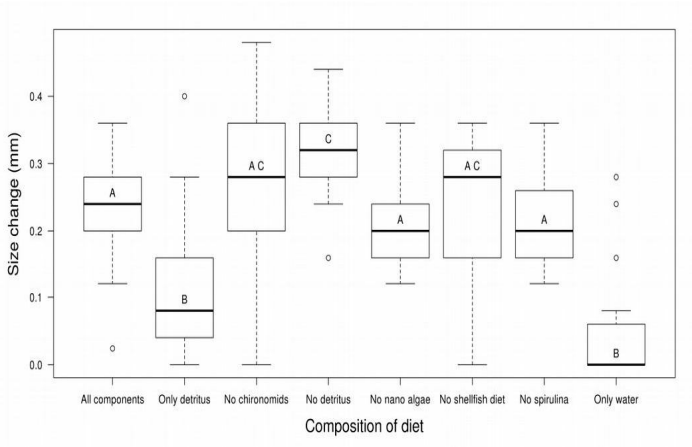
Skjeljånamusling 2,5 mm

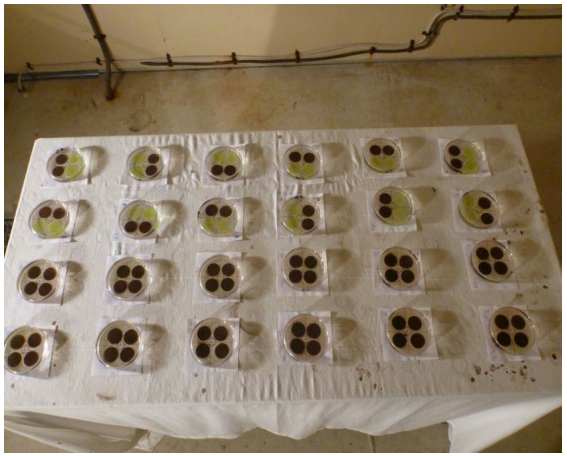


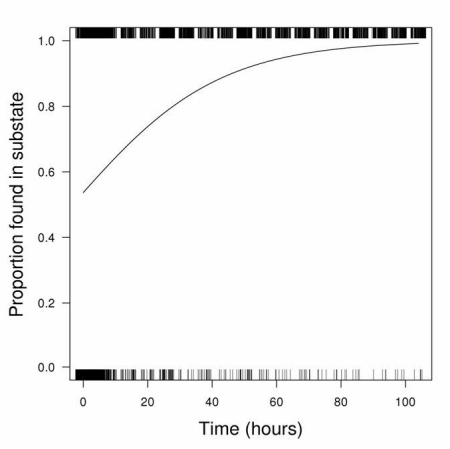
Elvemusling anatomi (Stein Mortensen)

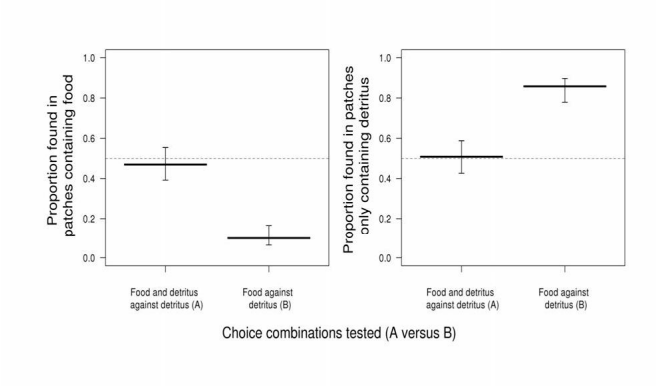
Table 1 Overview over the treatments and its identification number tested in the growth experiment.

Treatment	Identification number
All components	1
Detritus only	2
No Nano algae	3
No shellfish diet	4
No spirulina	5
No *chironomidae*	6
Food components only	7
Water	8









Young mussels tries to find slow floating areas

- Jaenette Gramstad 2014, showed 0.6 mm large mussels to be attracted to an unknown component in detritus
- They grow better on algae but surprisingly , they choose the detritus.
- Thomas et. al. (2012), showed that glochidia infected fish have a reduced oxygen uptake in the period before excystment.
- That means that infected fish are distributed in lentic areas, where fine particles are sedimented . Mussels are excysted in the same areas and hence they can find food.

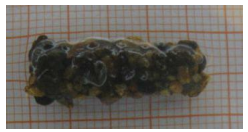
After ontogenetic habitatshift at 2mm.

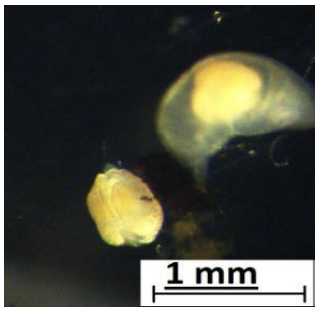
- Has more stored energy.
- A volume more than 100 times larger than at excystment. (given isometric growth)
- Byssus-tread to anchor to the surroundings or each other.
- Can feed without moving around
- Are less vulnerable to predation

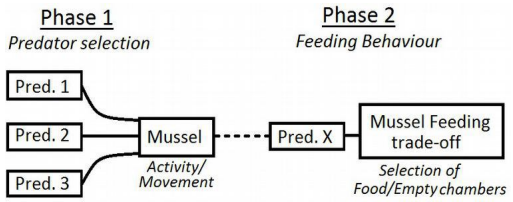
- MEANS: can stay nearer to the surface of the river bed without beeing washed away byfast flowing water.
- CONCLUSION: More robust after they are 2-2.5 mm.

Over 2mm. Can avoid beeing washed away by the water current and may filter food further up in the river bed, with stronger currents (foto Kjell Sandaas)

Predatorer på unge musling i Oselven







Activity and movement

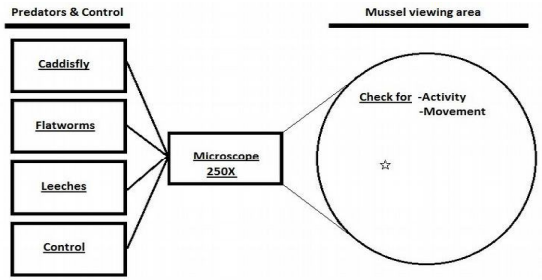
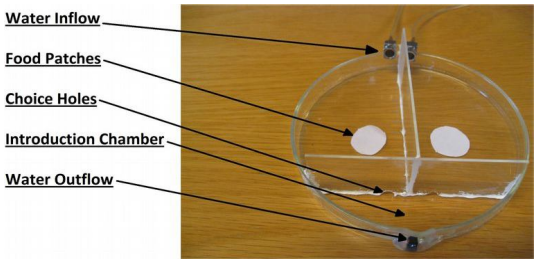
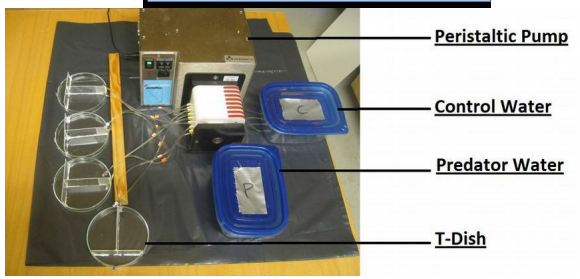


Table one-way ANOVA comparing mussel activity in control situation to mussels introduced to either of 3 predators. Compared to	Predator Type	Significance
Control	Flatworm	0.648
Control	Caddisfly	0.028
Control	Leech	0.558
Table one-way ANOVA comparing mussel movement in control situation to mussels introduced to either of 3 predators. Compared to	Predator Type	Significance
Control	Flatworm	0.001
Control	Caddisfly	0.000
Control	Leech	0.490

T dish unit



	A	B
Experiment	Water odour	
Food control	**Control**/Control	
Predator control	**Predator**/Control	
Trade off exp	**Predator**/Control	



	Food Chamber	Intro Chamber	Other	Total Trials
Food Control	37.5%	57.0%	5.5%	72
Predator Control	25.0%	52.8%	22.2%	36
Trade-Off	38.9%	61.1%	0.0%	36

- The have a short term reaction to predators, but gives priority to feeding areas over predation risk.

Thanks