



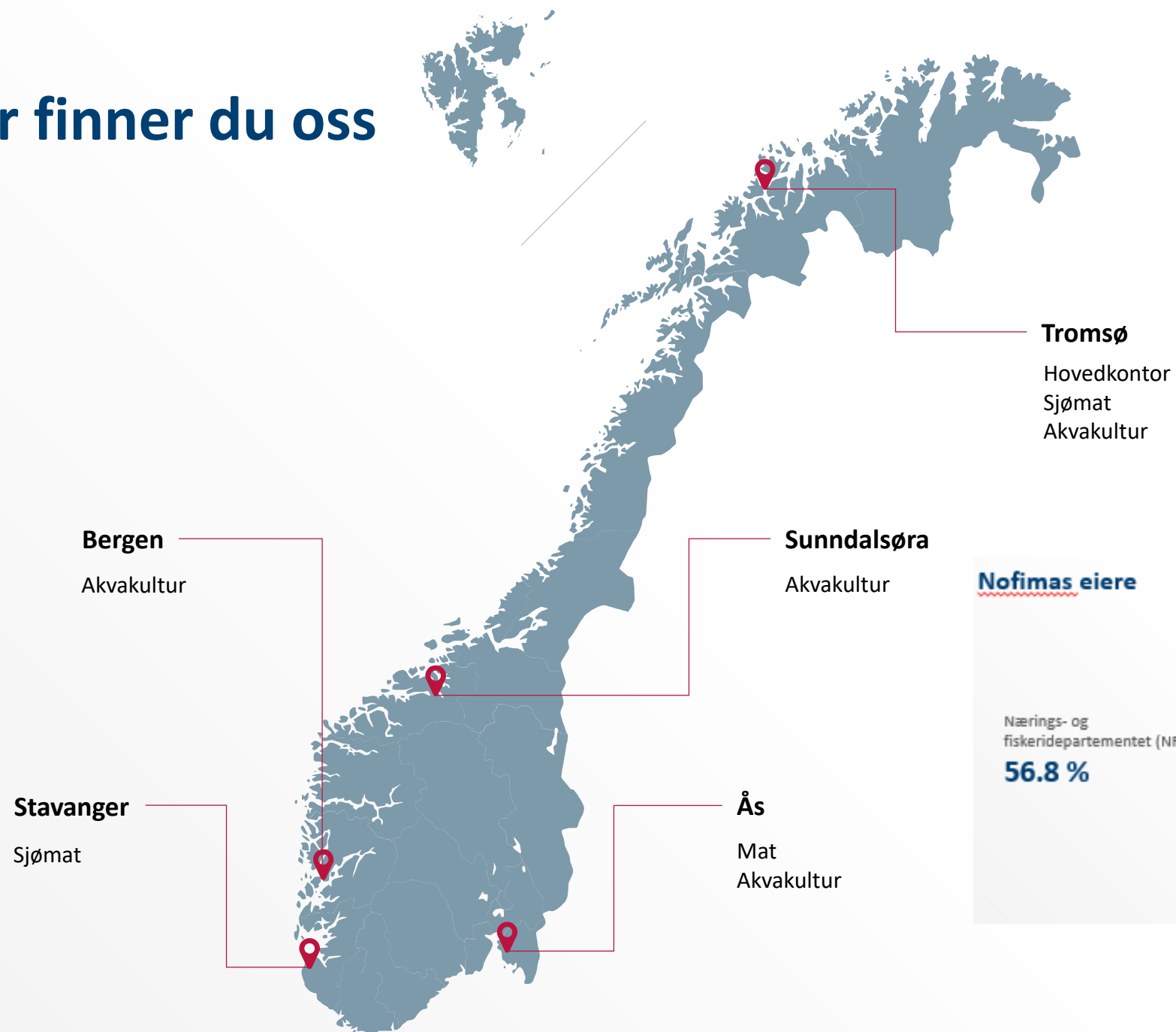
# Har vi bommet på fett:protein i fôr?

**Dr. Jens-Erik Dessen, Nofima**

Prof. Kjell-Arne Rørvik, Dr. Runi Weihe, Dr. Thomas Larsson, Prof. Turid Mørkøre

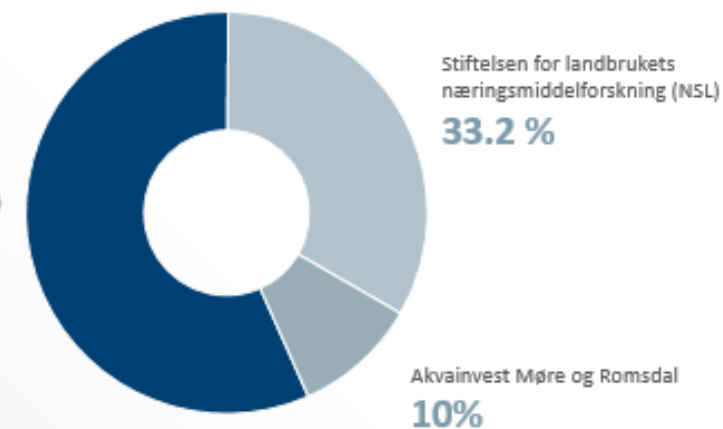
6 juni – Lofotseminaret 2019

# Her finner du oss



## Nofimas eiere

Nærings- og  
fiskeridepartementet (NFD)  
**56.8 %**





# Algene som forsvant



BY ULF WINTNER  
SEPTEMBER 21, 2018

COMMENTS



Husker du *Chrysochromulina*, *Prymnesium* og *Alexandrium*? Det er det nok mang sjømatnæring som ikke gjør. Og godt er kanskje det.



## – Det gikk bare et øyeblikk, så begynte det å regne død fisk

(SKÅNLAND, TROMS): På én uke har en giftig alge påført oppdrettsnæringen i Norges største oppdrettsfylker katastrofale tap. Søren Balteskard så nær all fisken i oppdrettsanlegget sitt bli utslettet på kort tid av den dødelige algen.



**Dødsalgen dreper oppdrettsfisk for milliarder. Kasse på kasse med ubrukelig fisk fraktes til land.**

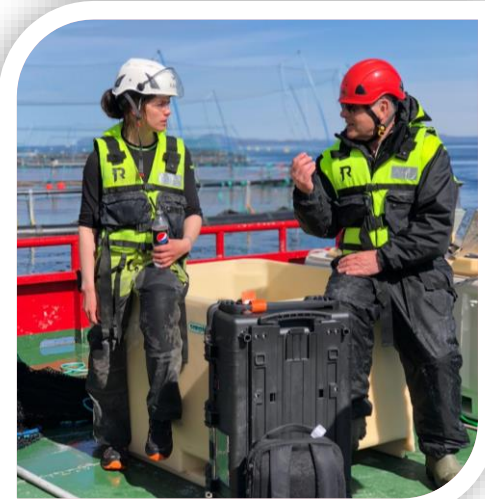
Den dødelige algen truer oppdrettsanlegg i Troms og Nordland. - Det har vært en forferdelig uke, sier daglig leder ved oppdrettsanlegg.



FOTO: Northern Lights Salmon

Ved landbasen til Northern Lights Salmon i Balteskard i Sør-Troms helles kasse på kasse med død laks opp på kalle.

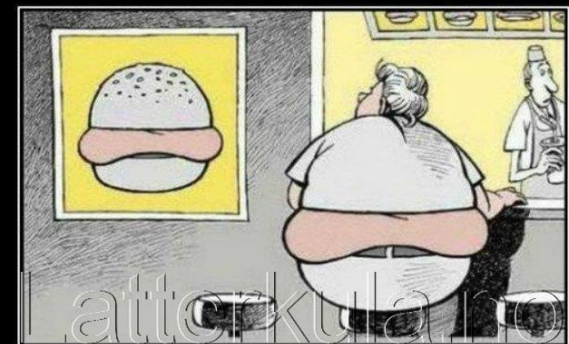
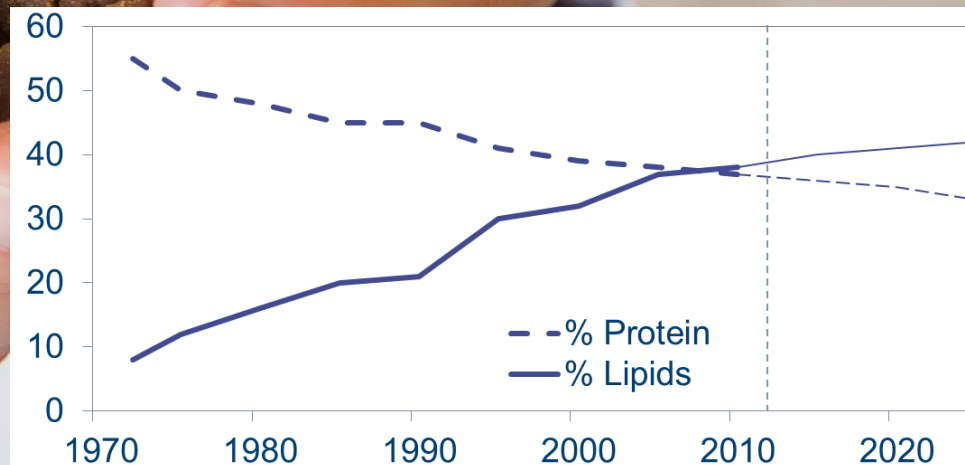
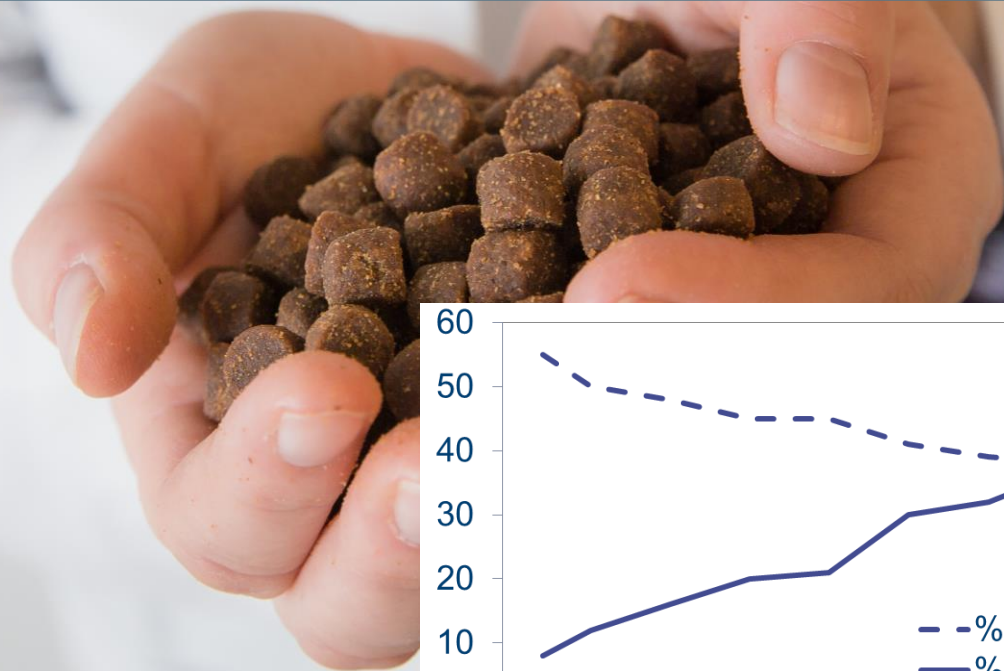






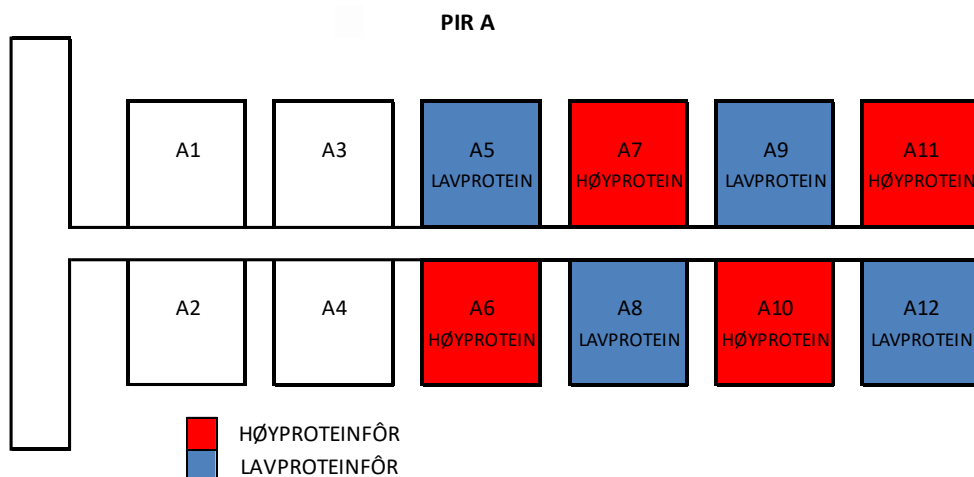
# Fôr og ernæring

- Mange meninger, studier og fôrvarianter
- Resultater → sammenligningsgrunnlag
- Ikke minimums krav
- Test av ulike protein/fett ratioer
- Biologiske konsekvenser / effekter



Det sies at vi blir  
hva vi spiser..

# Forsøk med Havsbrún 2012 - 2014



Aquaculture 473 (2017) 345–354



Contents lists available at ScienceDirect

Aquaculture

journal homepage: [www.elsevier.com/locate/aquaculture](http://www.elsevier.com/locate/aquaculture)



Different growth performance, lipid deposition, and nutrient utilization in in-season (S1) Atlantic salmon post-smolt fed isoenergetic diets differing in protein-to-lipid ratio



Jens-Erik Dessen<sup>a,d,\*</sup>, Rúni Weihe<sup>c,d</sup>, Bjarne Hatlen<sup>b</sup>, Magny S. Thomassen<sup>d</sup>, Kjell-Arne Rørvik<sup>a,d</sup>

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<sup>c</sup> Havsbrún P/F, Bakkavegur 48, FO-530, Fuglafjørður, Faroe Islands

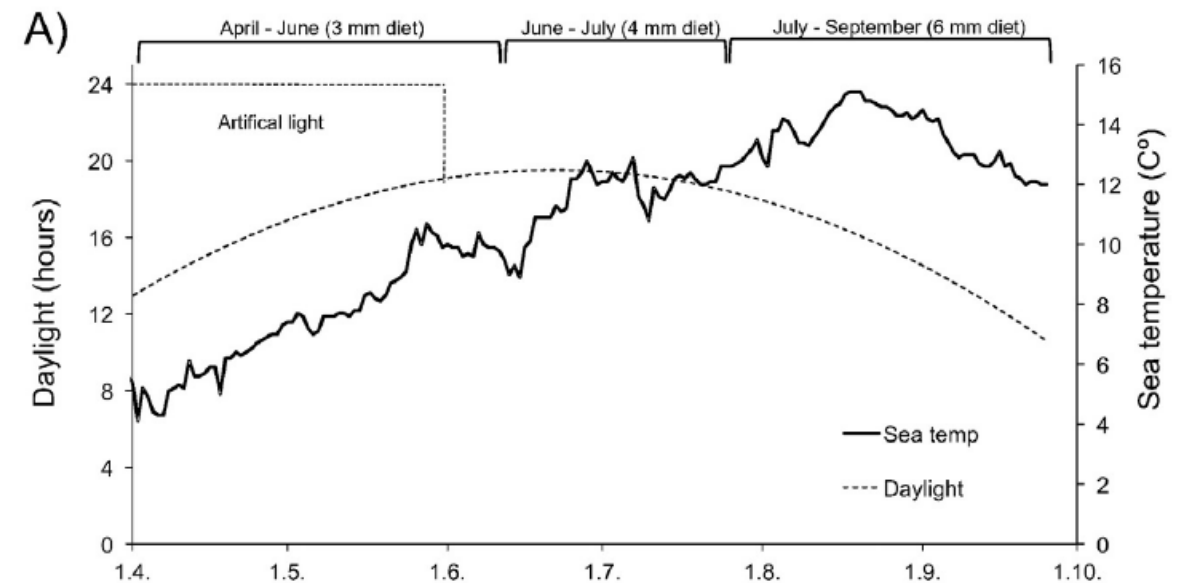
<sup>d</sup> Department of Animal and Aquacultural Sciences, Norwegian University of Life Sciences, NO-1432 Ås, Norway



# Studie ved brukt av 1-årig smolt

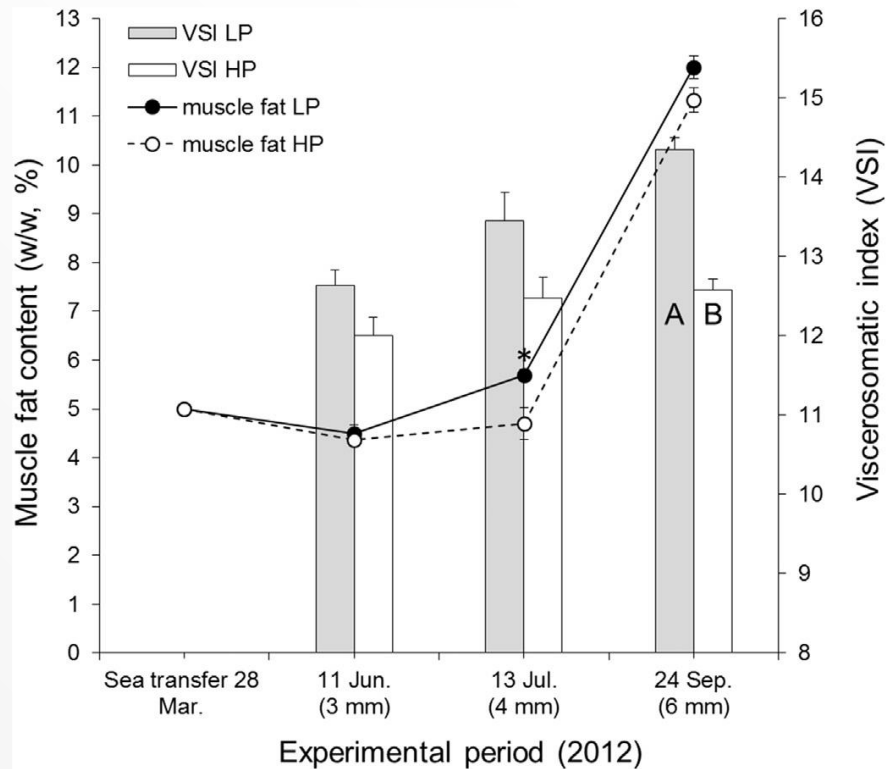
- Two dietary series: HP - High protein LP – Low protein
- Formulated against equal digestible energy (DE)
- Constant difference of 4 % crude protein
- 4 replicates (net-pens) 95 grams – to ~1 kg final weight
- Three periods: Apr-Jun, Jun-Jul and Jul-Sep

| Pellet size (mm)            | 3    |      | 4    |      | 6    |      |
|-----------------------------|------|------|------|------|------|------|
| Diet code                   | LP   | HP   | LP   | HP   | LP   | HP   |
| Crude protein, %            | 44   | 48   | 41   | 45   | 39   | 44   |
| Crude lipid, %              | 29   | 26   | 33   | 29   | 35   | 32   |
| DE MJ kg <sup>-1</sup>      | 20.6 | 20.3 | 21.5 | 20.6 | 22.1 | 21.8 |
| DP/DE g MJ kg <sup>-1</sup> | 18.5 | 20.5 | 16.5 | 18.9 | 15.2 | 17.4 |
| P/L – ratio                 | 1.55 | 1.86 | 1.26 | 1.59 | 1.12 | 1.40 |

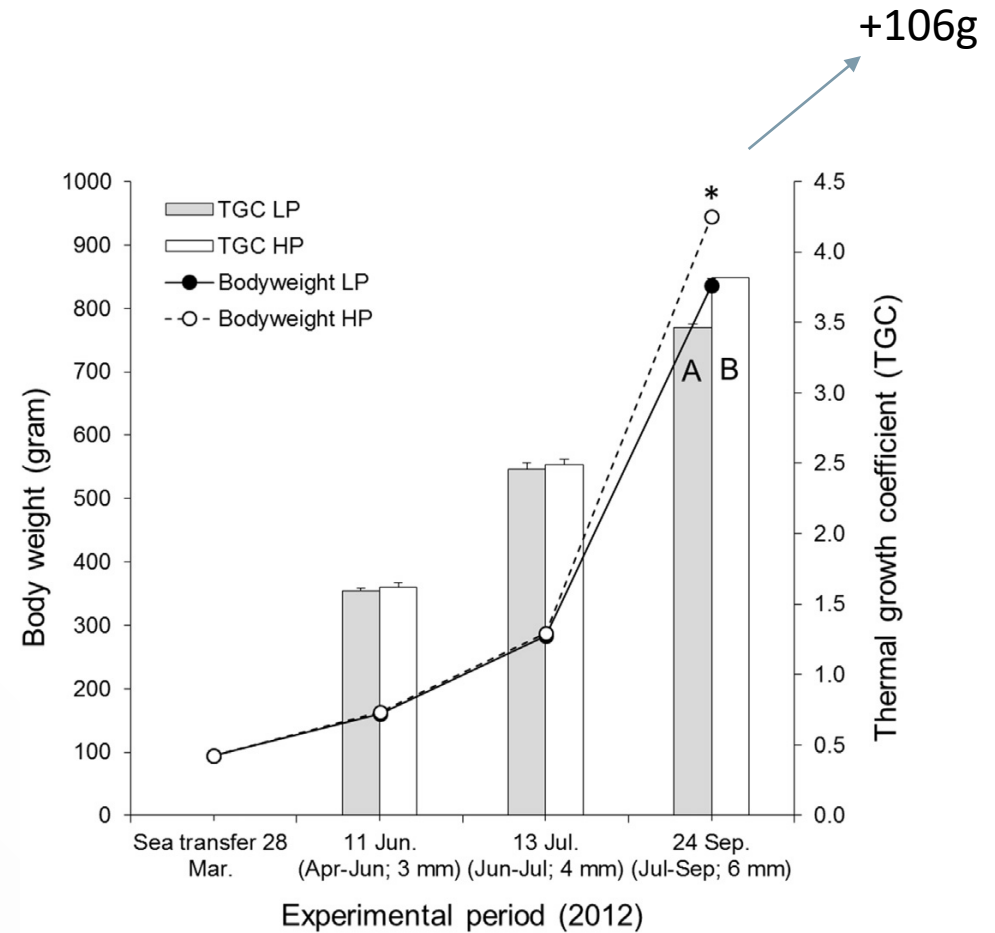




# 1-årig smolt (90 – 1000 gram) April - Sept

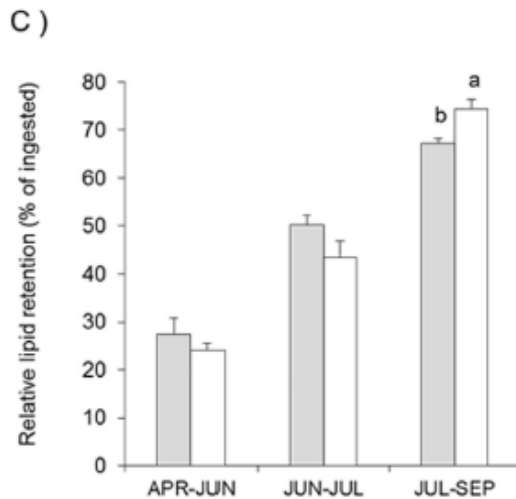
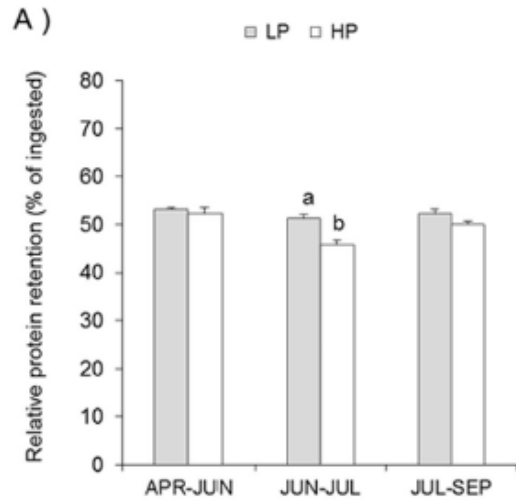


- HP, stable visceral mass – opposite for LP
- HP, reduced fat



- Differences in the last period in TGC and final BW
- Feed effect and lipostatic regulation?

# 1-årig smolt (90 – 1000 gram) April - Sept



**Table 4**

Weight gain, feed intake and feed utilization (mean  $\pm$  SEM, n = 4).

| Dietary group                          | LP              | HP              | Dietary effect (P-value) |
|----------------------------------------|-----------------|-----------------|--------------------------|
| <i>April – June, 3 mm diet</i>         |                 |                 |                          |
| Weight gain, g                         | 66 $\pm$ 1      | 67 $\pm$ 2      | 0.533                    |
| SFR                                    | 0.55 $\pm$ 0.01 | 0.54 $\pm$ 0.00 | 0.205                    |
| FI, g <sup>-1</sup> fish <sup>-1</sup> | 52 $\pm$ 1      | 51 $\pm$ 1      | 0.487                    |
| FCRb                                   | 0.79 $\pm$ 0.01 | 0.76 $\pm$ 0.02 | 0.277                    |
| FCRg                                   | 0.93 $\pm$ 0.02 | 0.88 $\pm$ 0.01 | 0.087                    |
| <i>June – July, 4 mm diet</i>          |                 |                 |                          |
| Weight gain, g                         | 123 $\pm$ 2     | 126 $\pm$ 2     | 0.383                    |
| SFR                                    | 1.03 $\pm$ 0.02 | 1.05 $\pm$ 0.02 | 0.536                    |
| FI, g <sup>-1</sup> fish <sup>-1</sup> | 92 $\pm$ 1      | 95 $\pm$ 2      | 0.280                    |
| FCRb                                   | 0.74 $\pm$ 0.00 | 0.75 $\pm$ 0.01 | 0.210                    |
| FCRg                                   | 0.89 $\pm$ 0.01 | 0.88 $\pm$ 0.01 | 0.372                    |
| <i>July – September, 6 mm diet</i>     |                 |                 |                          |
| Weight gain, g                         | 552 $\pm$ 9.3   | 658 $\pm$ 2.3   | <0.001                   |
| SFR                                    | 1.33 $\pm$ 0.02 | 1.38 $\pm$ 0.01 | 0.054                    |
| FI, g <sup>-1</sup> fish <sup>-1</sup> | 452 $\pm$ 9     | 527 $\pm$ 2     | <0.001                   |
| FCRb                                   | 0.81 $\pm$ 0.01 | 0.80 $\pm$ 0.00 | 0.126                    |
| FCRg                                   | 0.98 $\pm$ 0.01 | 0.93 $\pm$ 0.00 | 0.013                    |

SFR, specific feed intake; FI, feed intake; FCRb, biological feed conversion ratio. FCRg, feed conversion based on gutted weight.

- Higher feed intake
- Lipostatic regulation ?
- Better feed utilization based on carcass weight
- Higher lipid retention and good protein retention
- DP/DE 15.2 to low ?  
(Einen & Roem 1997)
- Similar with isoenergetic diets

# 1-årig smolt 1 – 3.2 kg

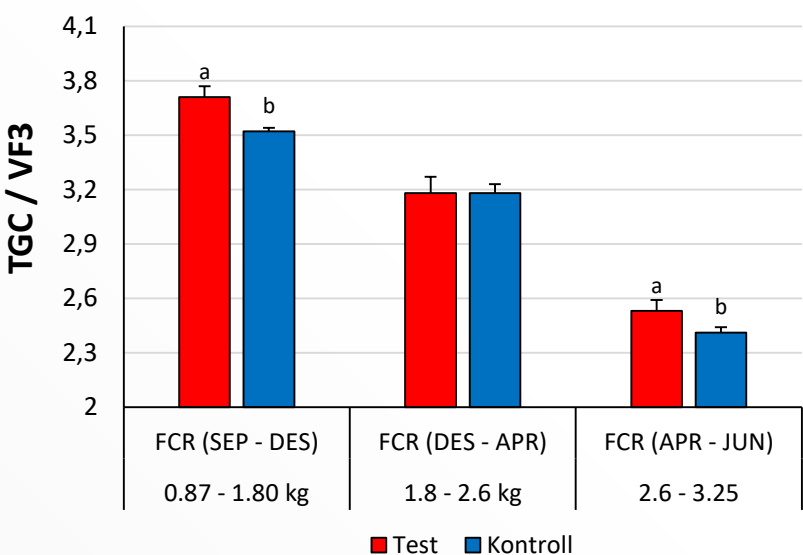
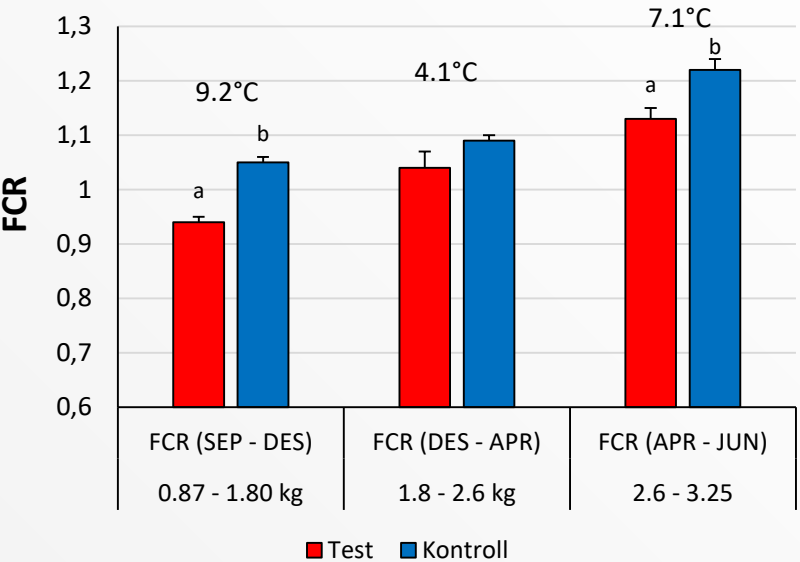
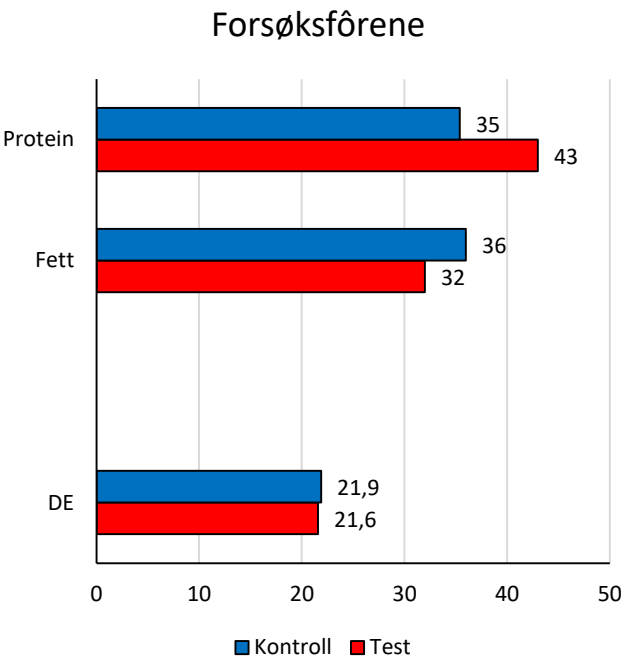
ORIGINAL ARTICLE

WILEY

Aquaculture Research

Improving production efficiency of farmed Atlantic salmon (*Salmo salar* L.) by isoenergetic diets with increased dietary protein-to-lipid ratio

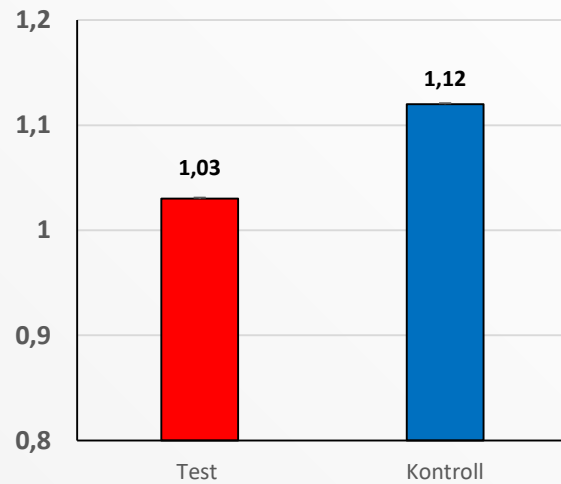
Rúni Weihe<sup>1,2</sup>  | Jens-Erik Dessen<sup>2,3</sup>  | Regin Arge<sup>2,4</sup>  | Magny Sissel Thomassen<sup>2</sup> | Bjørn Hatlen<sup>5</sup> | Kjell-Arne Rørvik<sup>2,3</sup>



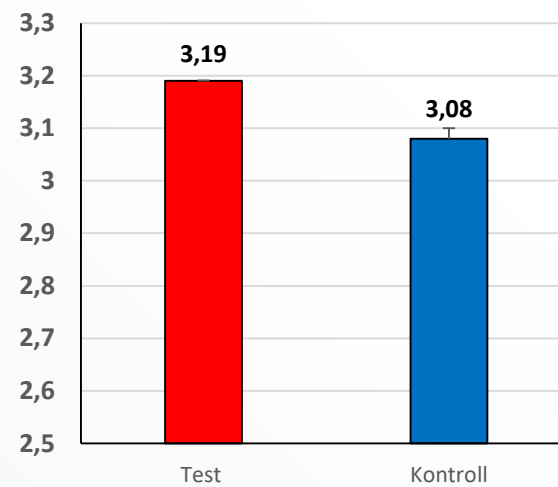


# 1-årig smolt 1 – 3.2 kg

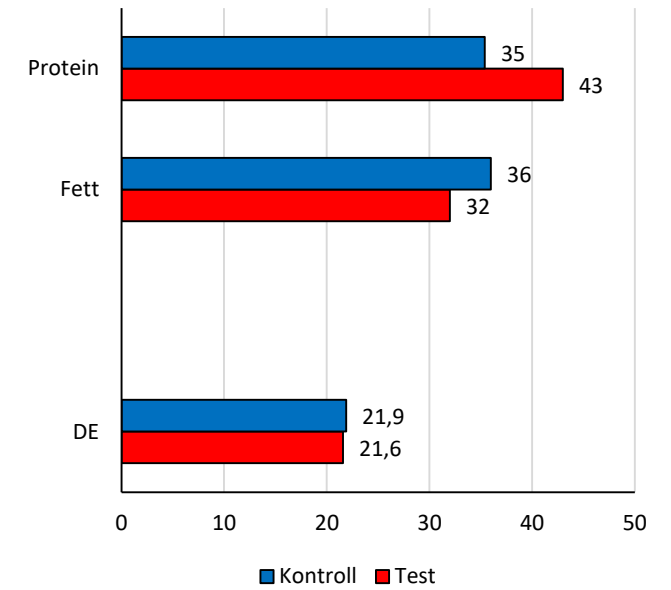
FCR total (VEKTA)



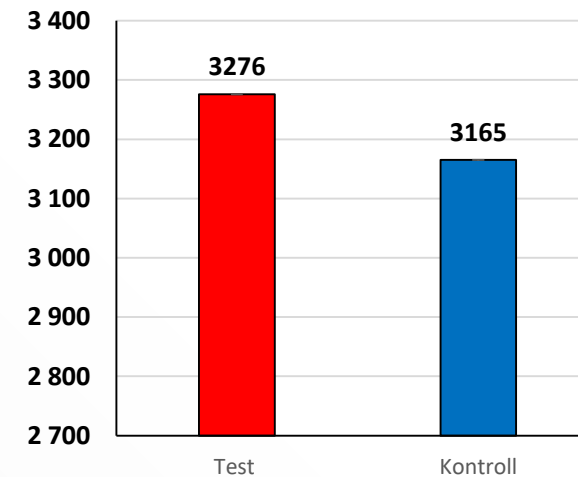
TGC total (VEKTA)



Forsøksfôrene



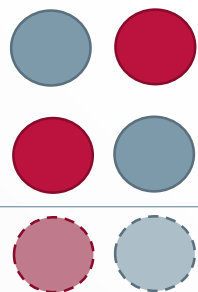
Sluttvekt (gram)



# FoU-konsesjoner

R&D site  
4 x 120 m  
2 fôrtyper

2340 tonn (3MTB)



## Sør-Norge

Bergen / Hordaland  
**Blom fiskeoppdrett**



## Midt-Norge

Trondheim / Nord-Møre  
**Lerøy Midt**



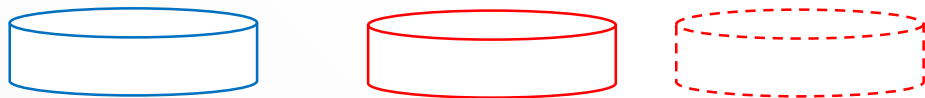
## Nord-Norge

Harstad / Bjarkøy  
**Nordlaks**



1. Periode 2014 - 2016
2. Periode 2017 - 2021

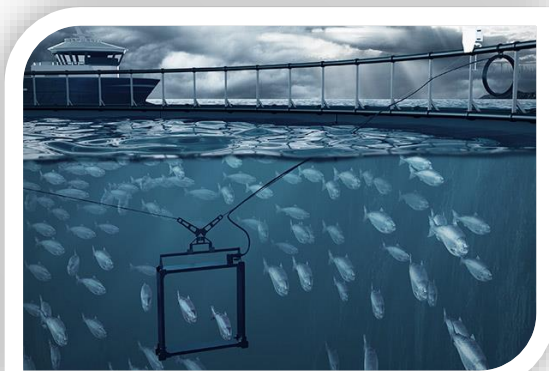
# FoU-arbeid i storskala



Utvikling i biomasse / vekt



Estimering / verktøy



- Excel – antall, fôrmengde, fôrfaktor
- Målerammer

Sjekk og uttak av fisk



- 100 fisk målt ved not
- 10 fisk som representerer snittet av merder blir tatt ut
- Disse fiskene blir brukt som indikator på kvalitetsmålingene (fett, farge osv.)

Slakt og evt. korrigerering



- 3 vektklasser 4, 5 og 6 kg rundvekt
- Korrigerering av antall og vekt mht. produksjonsdata ut i fra pakkerapporter fra slakteri
- Kun gutted weight / 0.83 som fatkor ellers sjekke ved slakteri

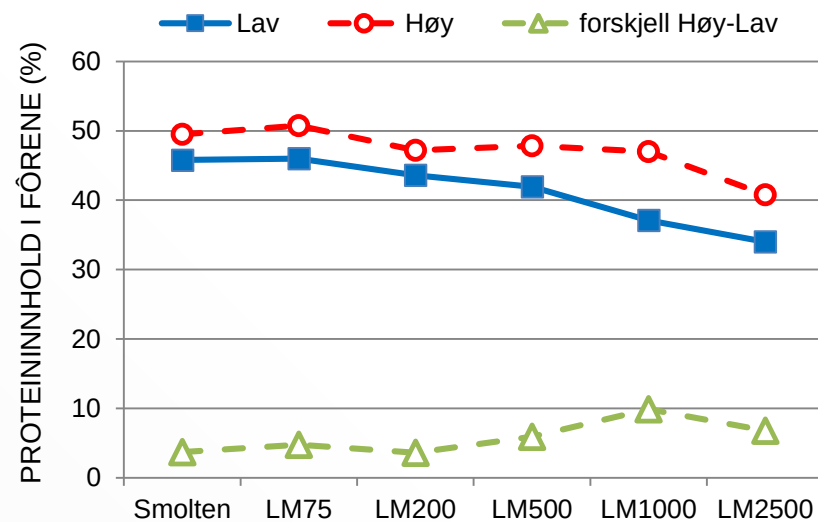
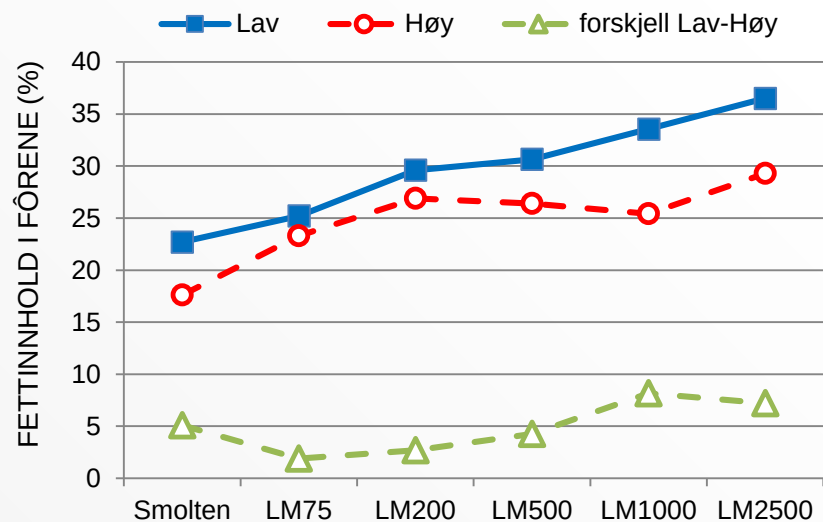


# FoU-arbeid i storskala

- 100 fisk målt ved not
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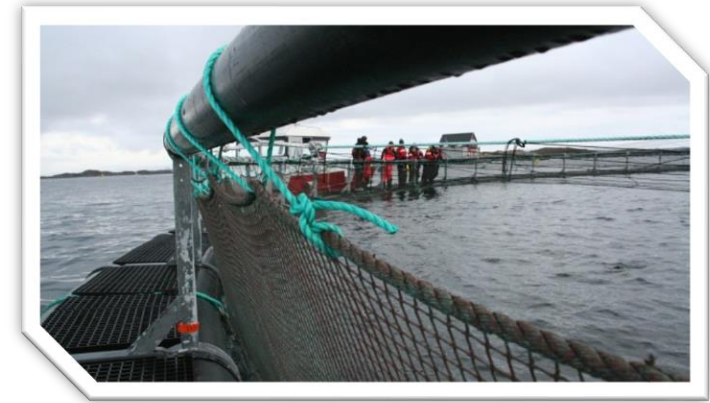
# Fôr brukt i Midt-Norge 2014-2015



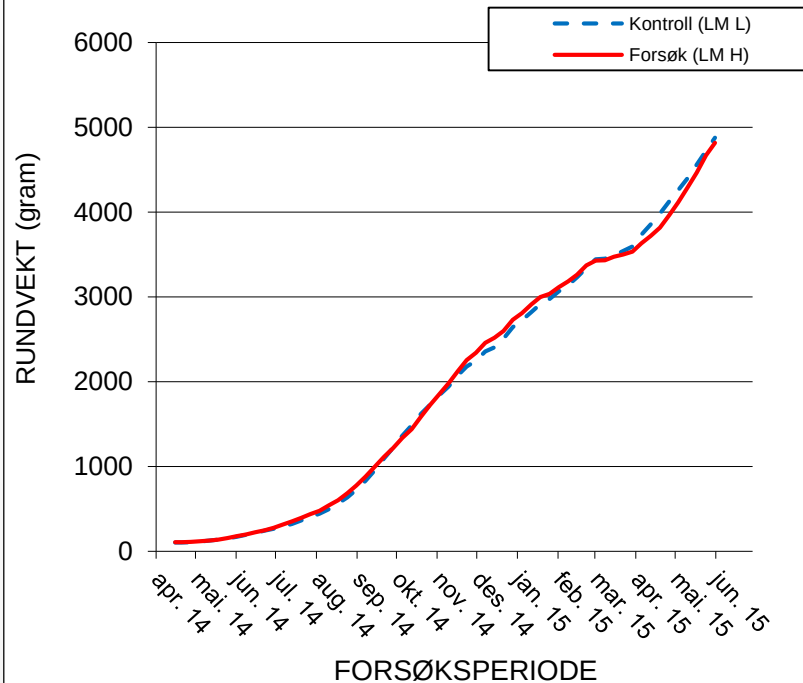
# OPPFØLGING SJØFASEN MIDT-NORGE

## VEKTUTVIKLING OG FCR

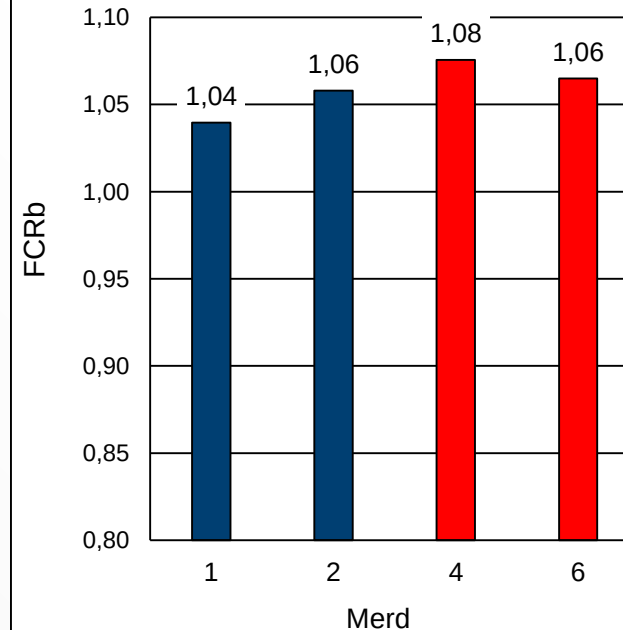
- Tap av fôrfaktor etter overgang til 40/30
- Likt vektutvikling – rundt 5 kg i slaktevekt
- Relativt lik FCR



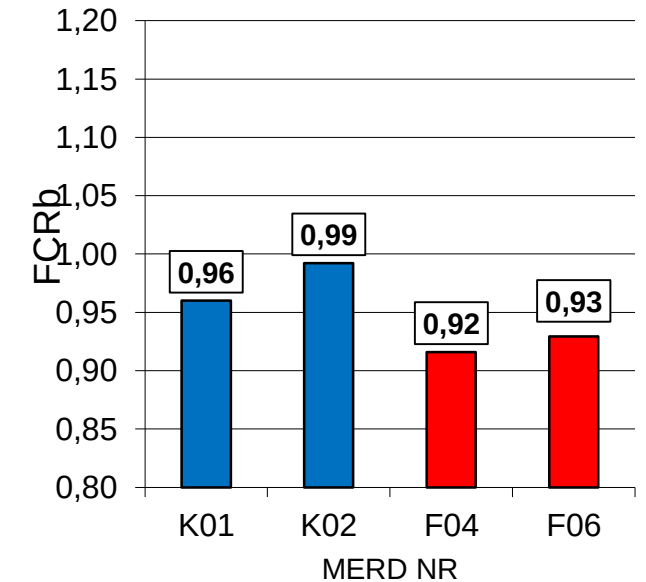
VEKTUTVIKLING MERD NIVÅ



Biologisk fôrfaktor



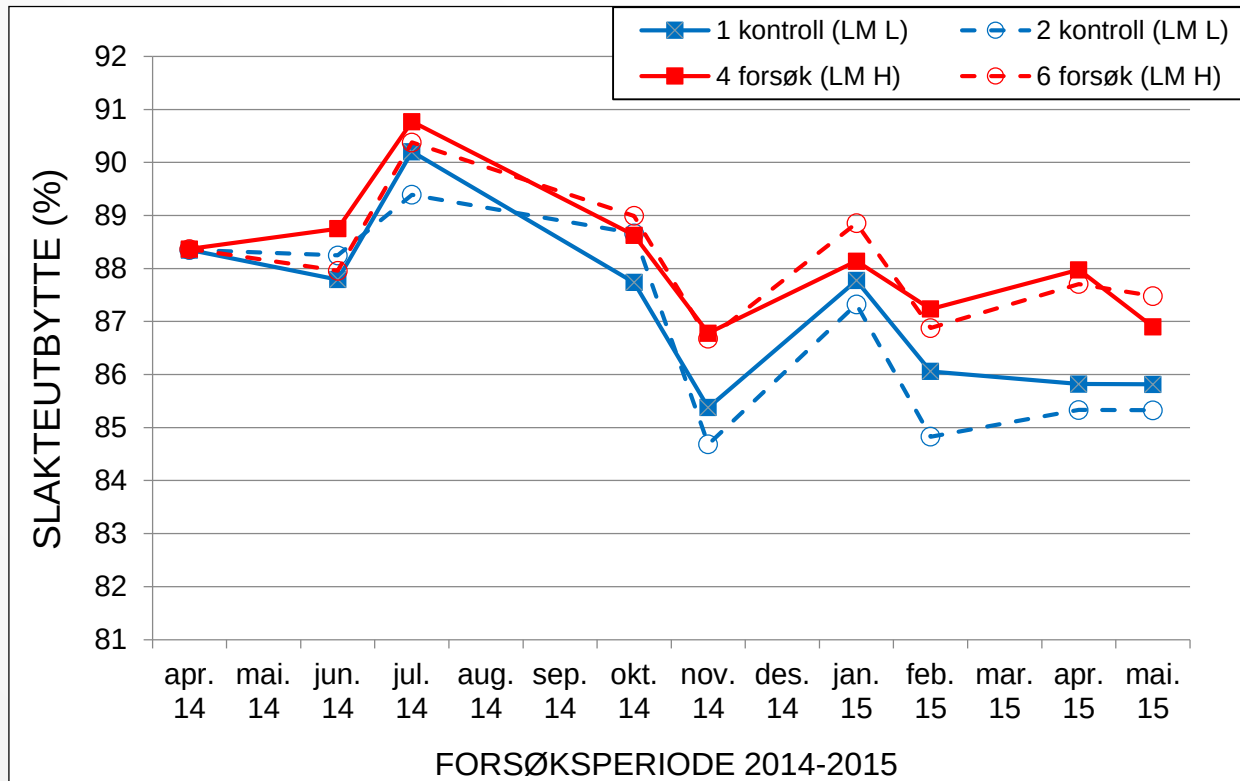
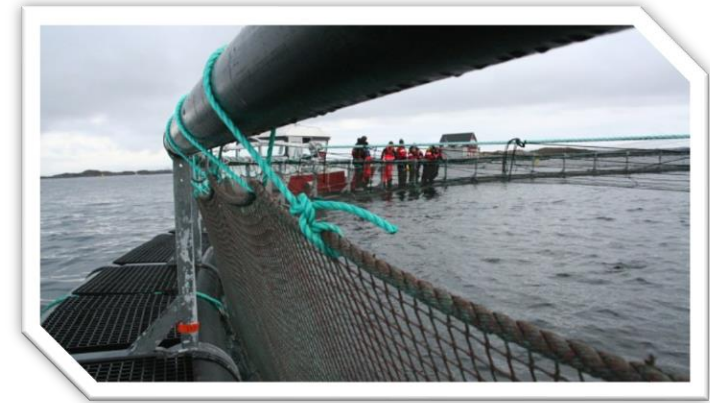
Estimert biologisk fôrfaktor  
apr - des



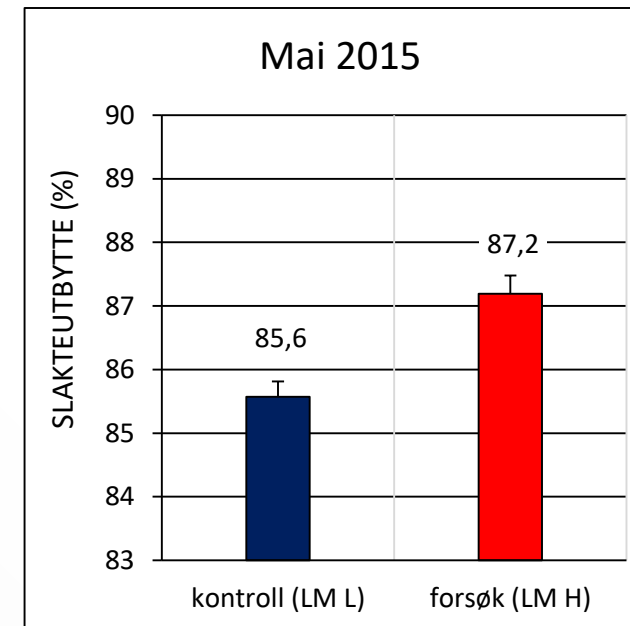
# OPPFØLGING SJØFASEN MIDT-NORGE

## UTVIKLING I SLAKTEUTBYTTE

- Jevnt over høyere slakteutbytte hos LMH gruppen
- Signifikant forskjell i mai ( $P = 0.05$ ), hvor LMH gruppen har 1.6 % høyere utbytte



Diet:  $P = 0.05$   
+ 1.6%

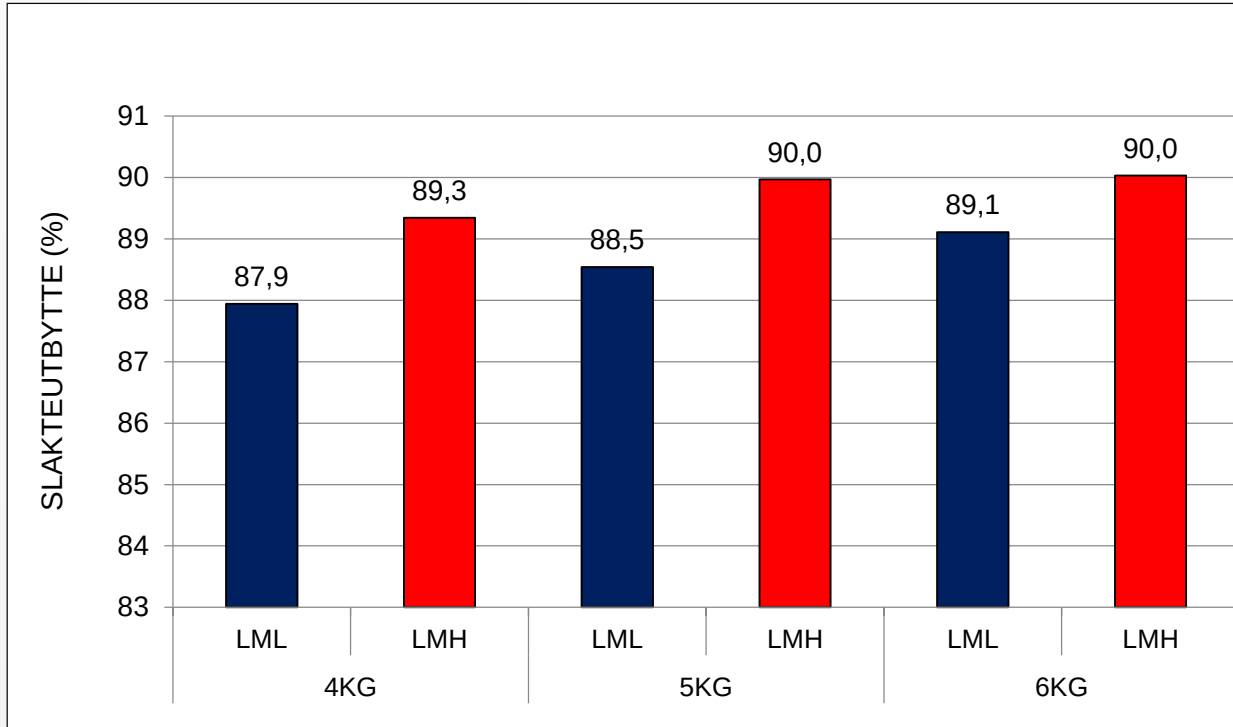




# KVALITETSDATA SLAKTELINJA MIDT-NORGE

## SLAKTEUTBYTTE

- Signifikant effekt av fôr uavhengig av vektklasse
  - Diet:  $P = 0.03$
  - Vektklasse:  $P = 0.28$

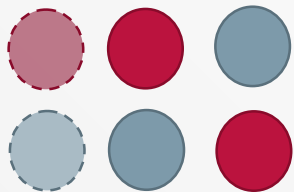
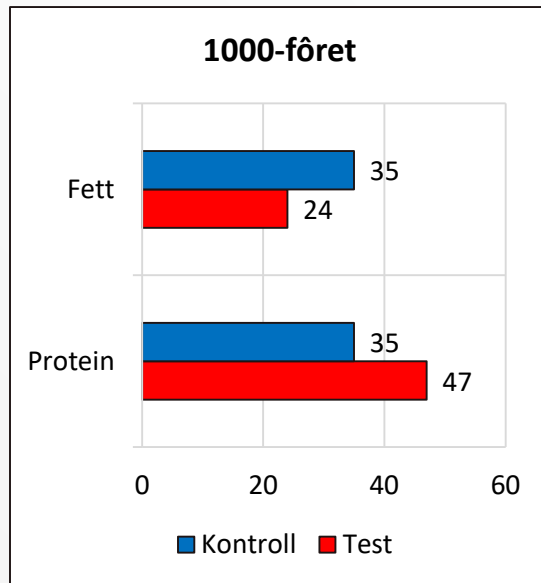


Normal sulteperiode

Lang sulteperiode

# Erfering rundt sykdom

PD – redusert dødelighet og taper  
fisk med høy protein-fôr



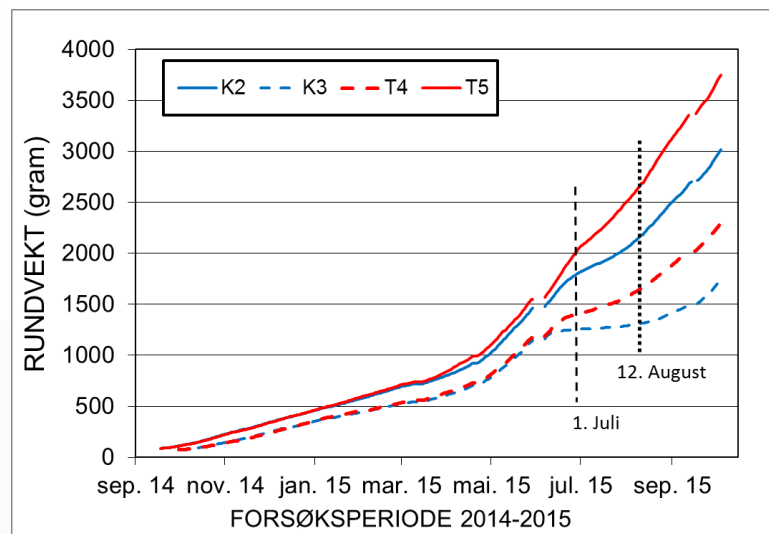
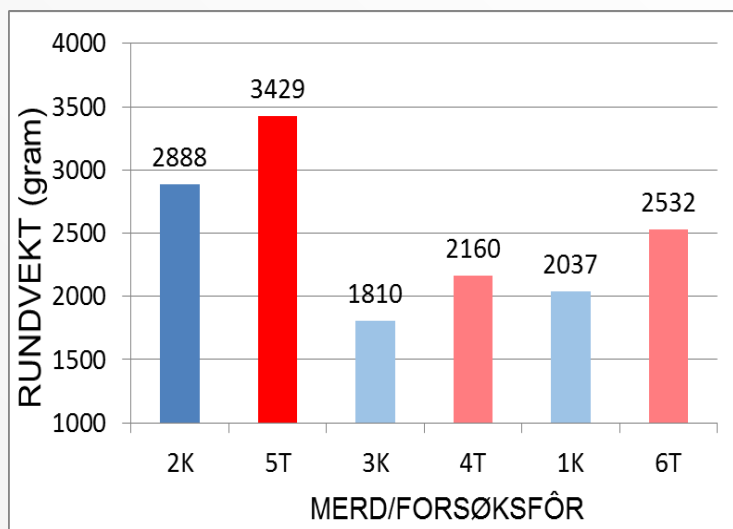
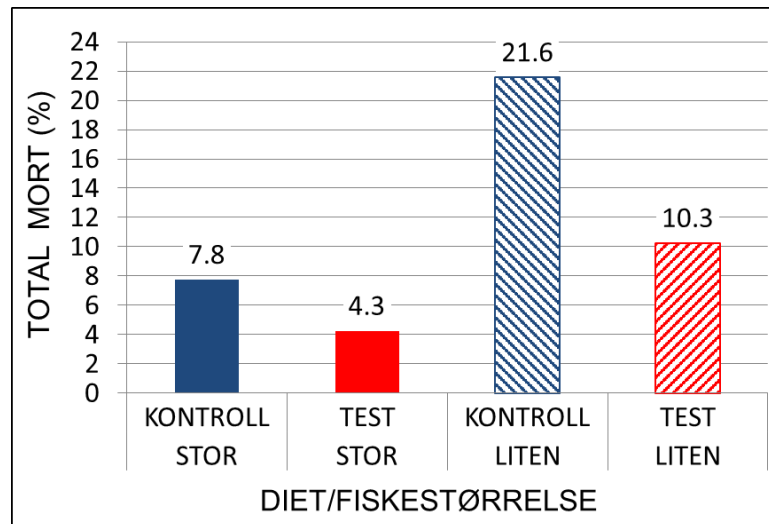
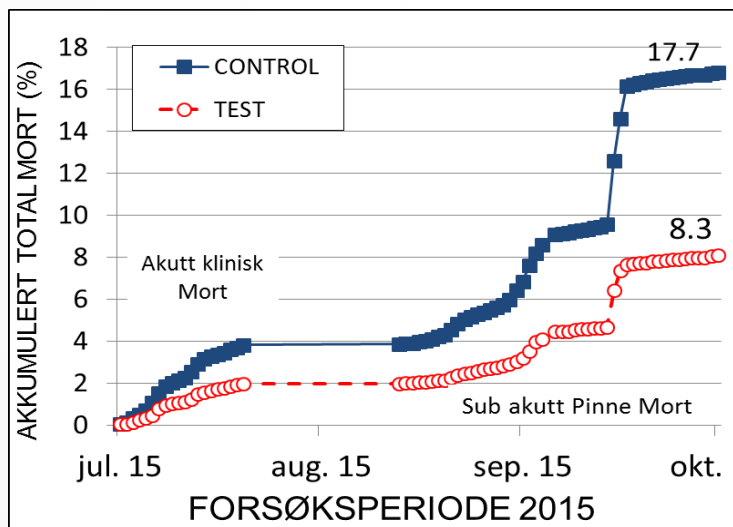
## ORIGINAL ARTICLE

WILEY *Journal of Fish Diseases*

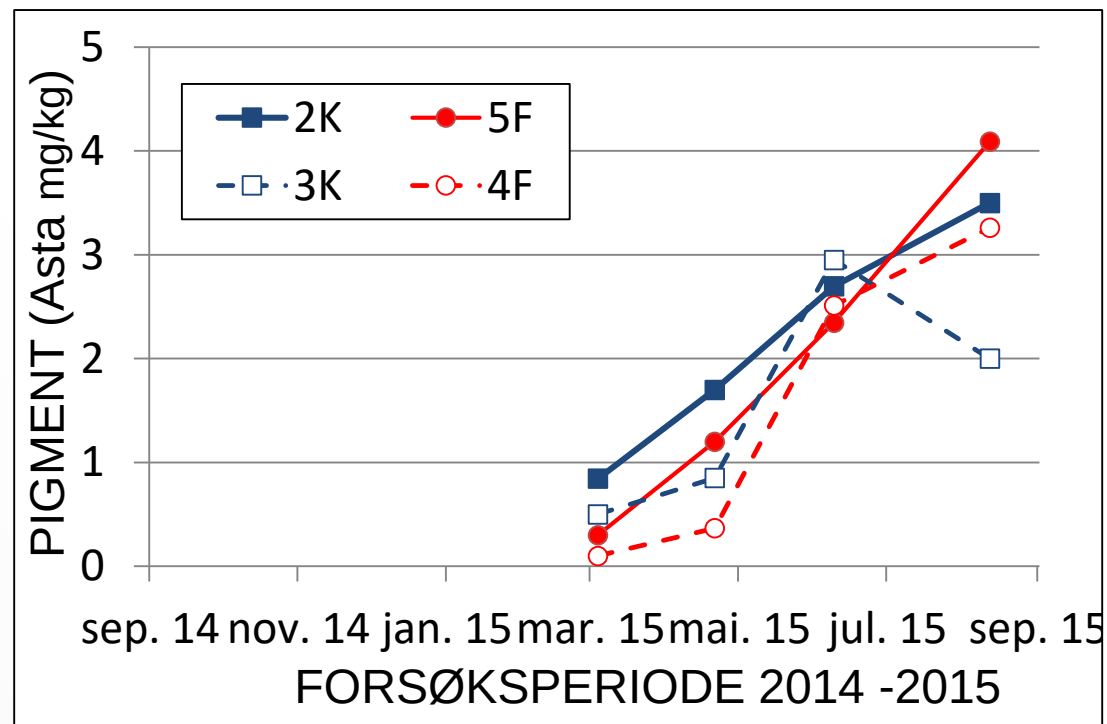
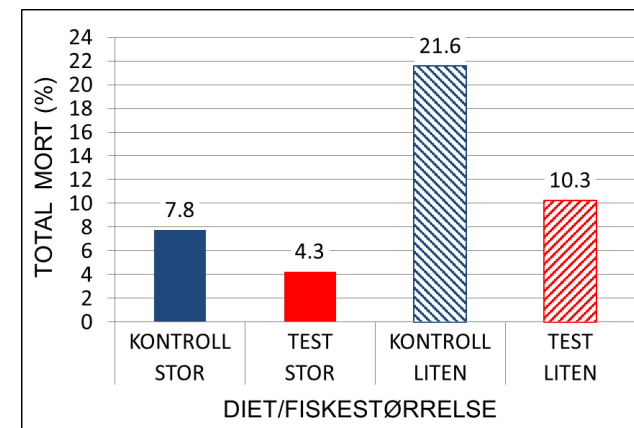
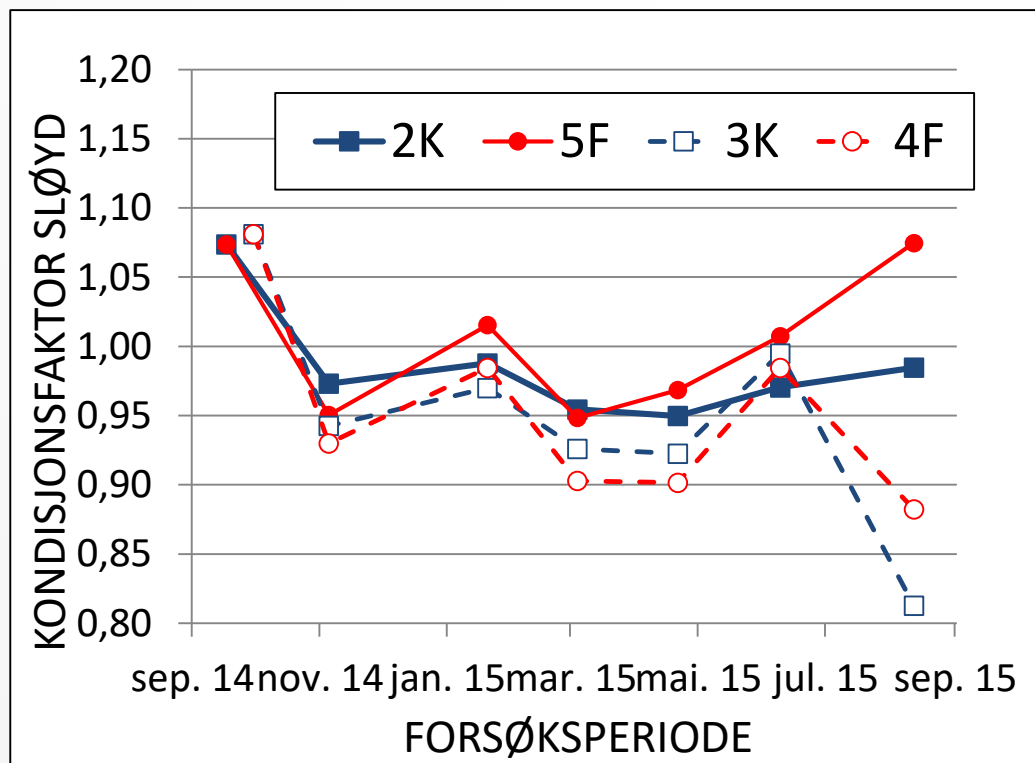
Increased dietary protein-to-lipid ratio improves survival during naturally occurring pancreas disease in Atlantic salmon, *Salmo salar* L.

Jens-Erik Dessen<sup>1,2</sup>  | Turid Mørkøre<sup>1,2</sup> | Jan Ivar Bildøy<sup>3</sup> | Stig N. Johnsen<sup>3</sup> | Lars Thomas Poppe<sup>4</sup> | Bjarne Hatlen<sup>5</sup> | Magny S. Thomassen<sup>2</sup> | Kjell-Arne Rørvik<sup>1,2</sup>

# Erfering rundt sykdom



# Erfaring rundt sykdom – hva ser man etter ?







**Takk for oppmerksomheten**  
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