

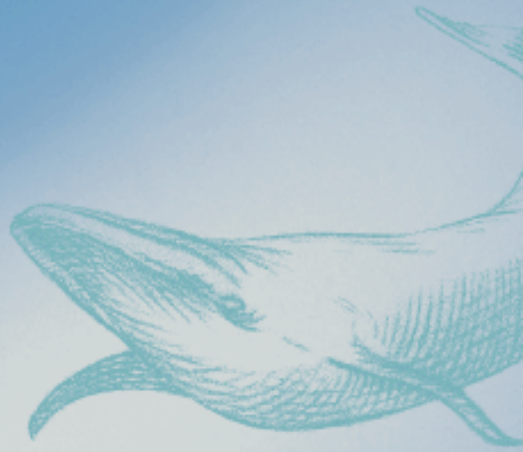

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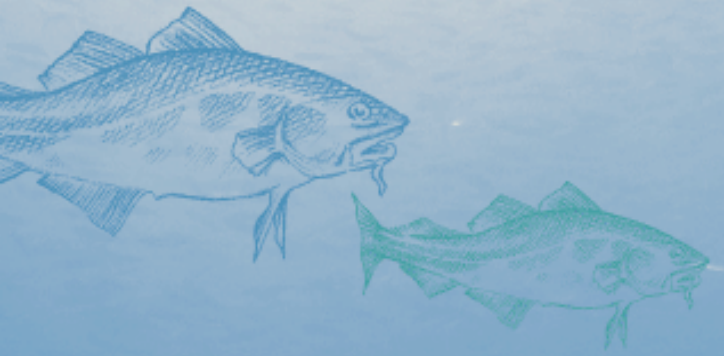

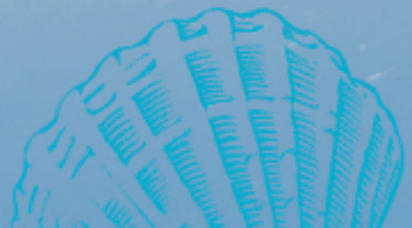

Reproductive performance of farmed and wild-caught halibut

Birgitta Norberg, Børre Erstad, Jone Bjelland, Walter Olsen-Ryum, Margareth Møgster, Ragnfrid Mangor-Jensen, Sara Olausson, Jeanette Veivåg, Francois Chauvigné, Joan Cerda, Kristin Hamre, Anders Thorsen, Dinos Mylonas

Co-funded by the Seventh Framework Programme of the European Union

Objective

- **Improve fecundity and gamete quality in F1/F2 broodstock.**
  - **Better selection of broodstock**
  - **Optimize spawning performance**

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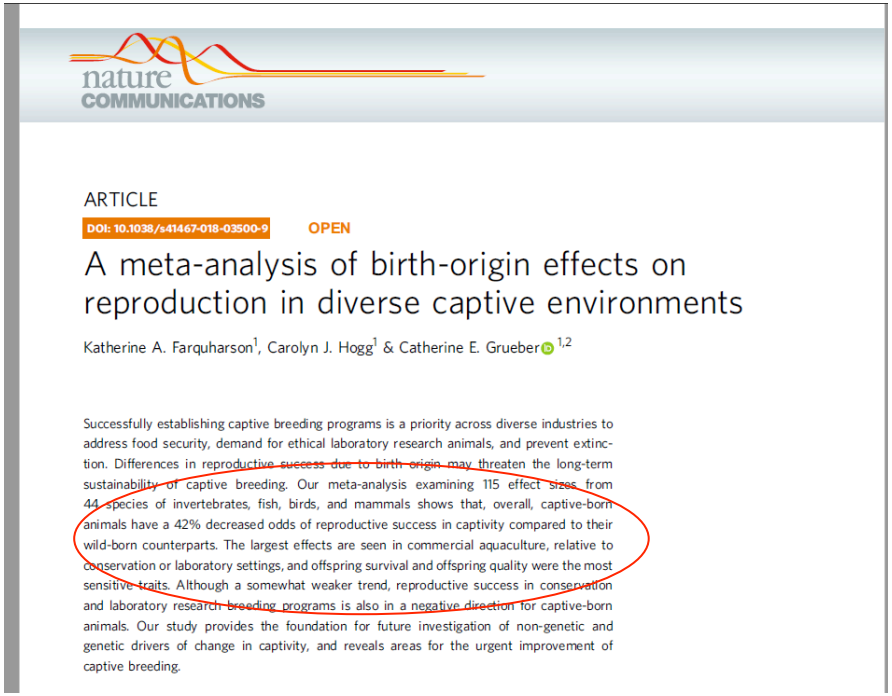
Background

- Reproductive dysfunctions in captive animals, especially the first generations, have been reported



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A meta-analysis of birth-origin effects on reproduction in diverse captive environments

Katherine A. Farquharson[1], Carolyn J. Hogg[1] & Catherine E. Grueber[1,2]

Successfully establishing captive breeding programs is a priority across diverse industries to address food security, demand for ethical laboratory research animals, and prevent extinction. Differences in reproductive success due to birth origin may threaten the long-term sustainability of captive breeding. Our meta-analysis examining 115 effect sizes from 44 species of invertebrates, fish, birds, and mammals shows that, overall, captive-born animals have a 42% decreased odds of reproductive success in captivity compared to their wild-born counterparts. The largest effects are seen in commercial aquaculture, relative to conservation or laboratory settings, and offspring survival and offspring quality were the most sensitive traits. Although a somewhat weaker trend, reproductive success in conservation and laboratory research breeding programs is also in a negative direction for captive-born animals. Our study provides the foundation for future investigation of non-genetic and genetic drivers of change in captivity, and reveals areas for the urgent improvement of captive breeding.

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Approach

- Farmed female halibut (2007-generation) were compared with wild-caught females
- All fish were held in the same tank and given the same food
- Biometric data, fecundity, egg and larval quality, and plasma homrone prfiles ere compared.

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Biometric and spawning performance data of wild-caught and farmed female halibut

	Wild-caught females	Farmed (F1) females
n	3 (4[a])	5
length (cm)	150.7 ± 6.2	113.4 ± 3.9
weight (kg)	48 ± 5.7	19.2 ± 2.3*
number of batches ·female^{-1}	7.3 ± 0.6	9.4 ± 1.7
spawning interval (hours)	82.2 ± 8.4	72.4 ± 22.9
batch volume (mL)	2300 ± 900	700 ± 300*
total fecundity (mL·female^{-1})	16700 ± 420	6800 ± 130*
relative fecundity (mL·kg^{-1})	347 ± 70	349 ± 84
average fertilization (%)	89 ± 7	61 ± 29

[a] One wild-caught female was left undisturbed for most of the season, due to a large skin lesion, and was not included in calculations.
*Significant difference ($P<0.05$; Mann-Whitney U-test)

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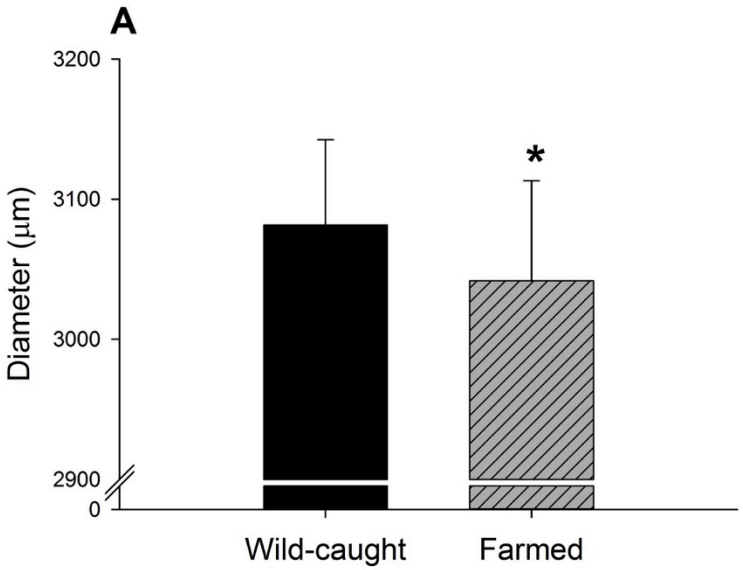
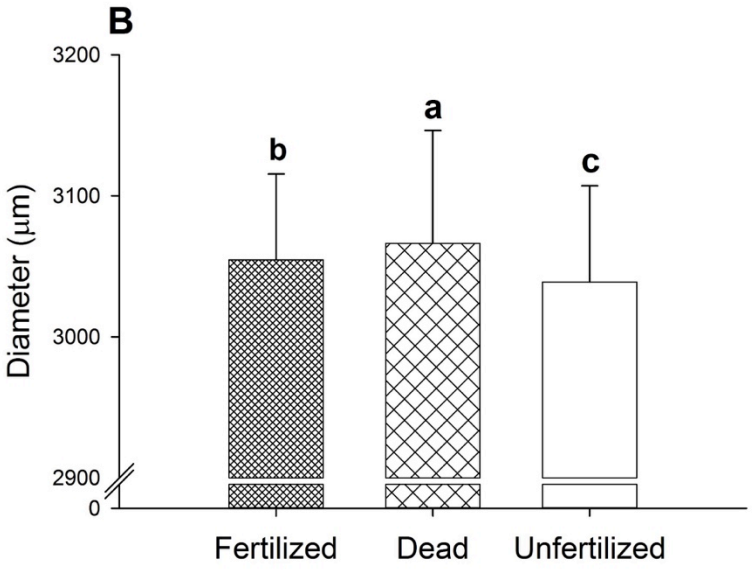
Egg diameter





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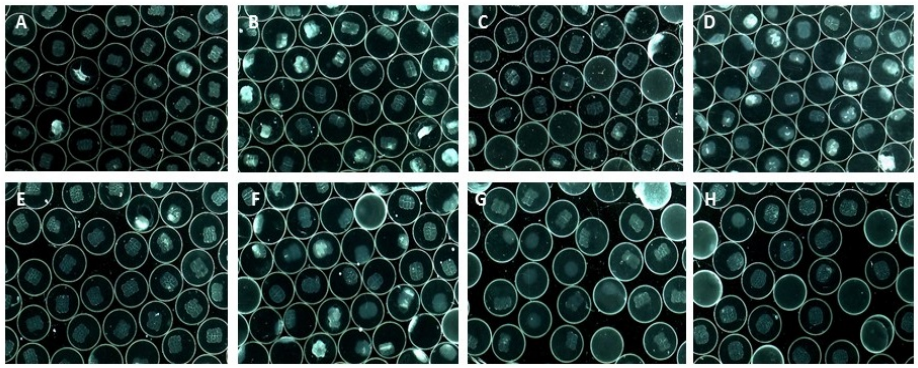
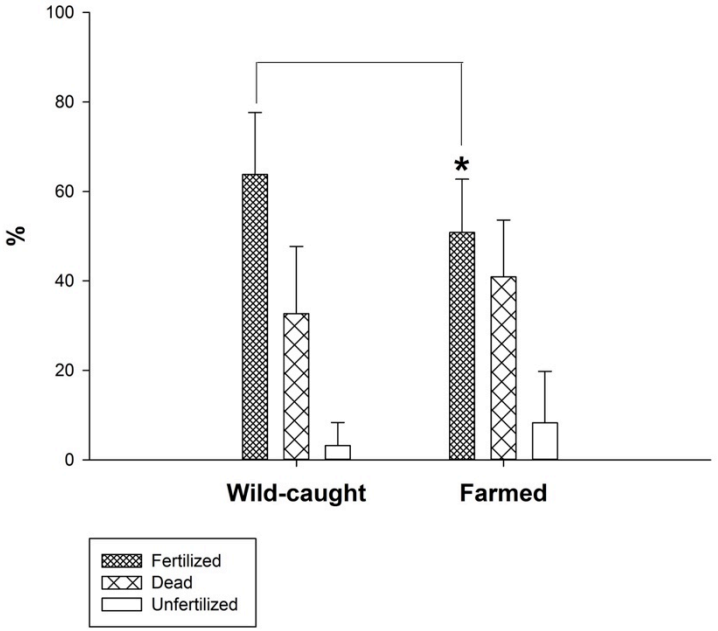
Egg viability in wild-caught and farmed females





In all females, egg batch no 3 was photographed and egg viability parameters analysed

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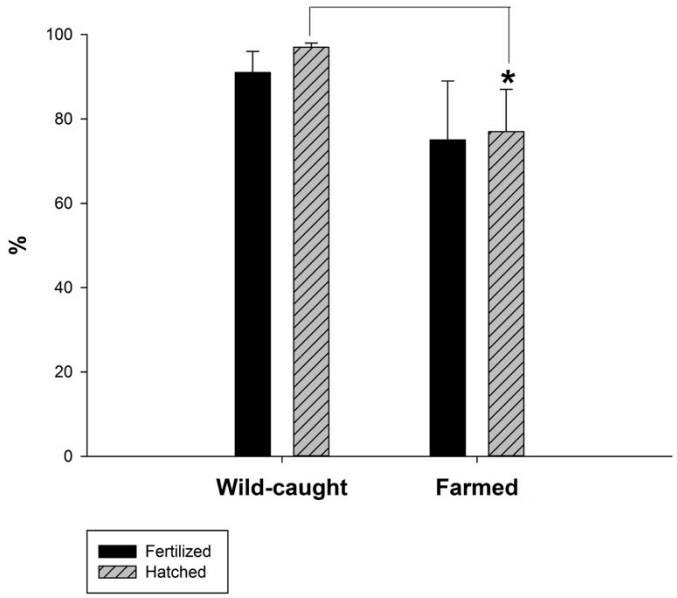
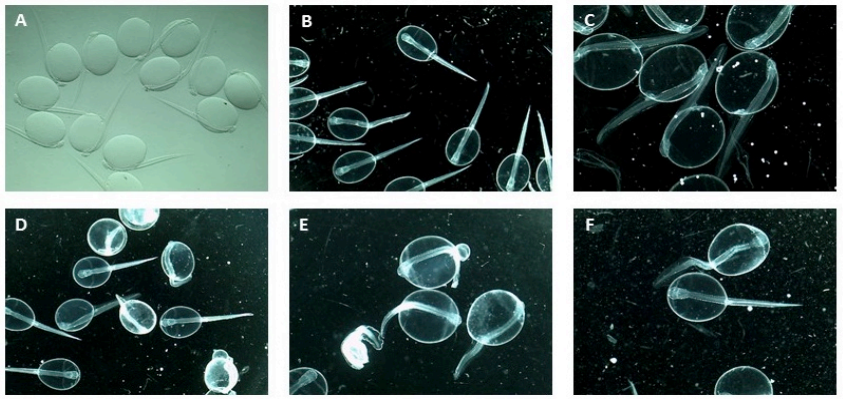
Fertilization, hatching and development in eggs from wild-caught and farmed females





- Eggs from the photographed groups were incubated in triplicate for calculation of hatching success.
- Newly hatched larvae were photographed

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To summarise:

- Farmed (F1) broodstock had more variable ovulatory intervals and fertilisation rates
- Eggs from F1 broodstock
  - Were smaller
  - Had lower fertilisation and hatching rates
  - Had higher density (heavier), leading to extra challenges in incubation

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Question

- Are the observed differences between farmed and wild-caught females reflected in plasma profiles of steroids and gonadotropins?

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Five wild-captured and five farmed female halibut breeders were followed through an annual reproductive cycle

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Sampling and analyses

- Blood samples were taken at 3-6 week intervals from September 2016 to July 2017
- Plasma concentrations of estradiol-17ß, testosterone, FSH and LH were analysed
- Time and duration of spawning was recorded

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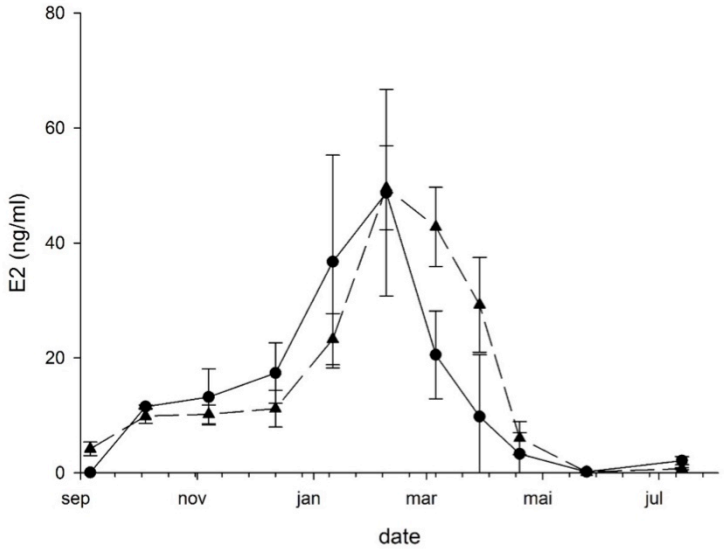
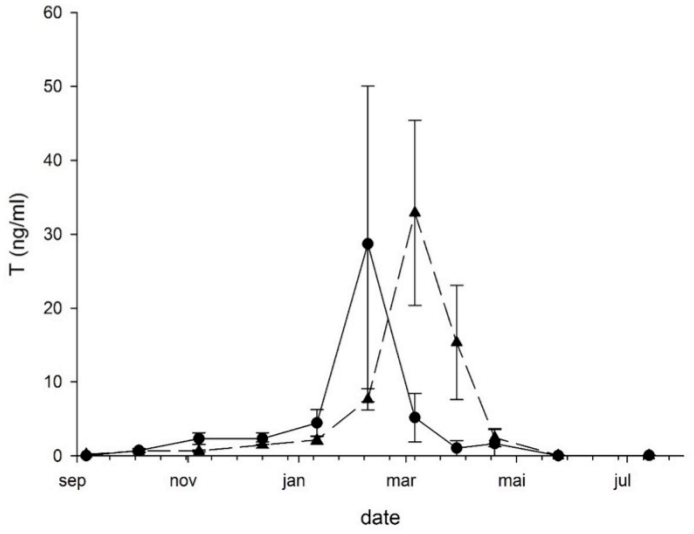
Plasma concentration of steriod hormones





– – – - Farmed

——— Wild-caught

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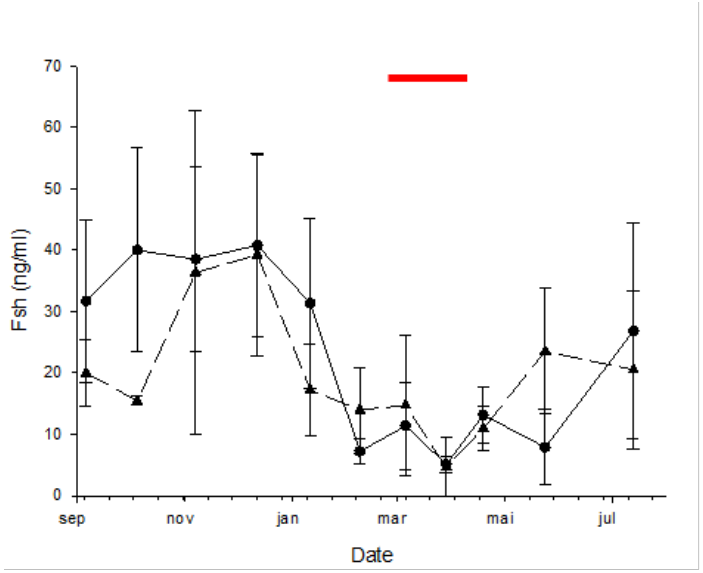
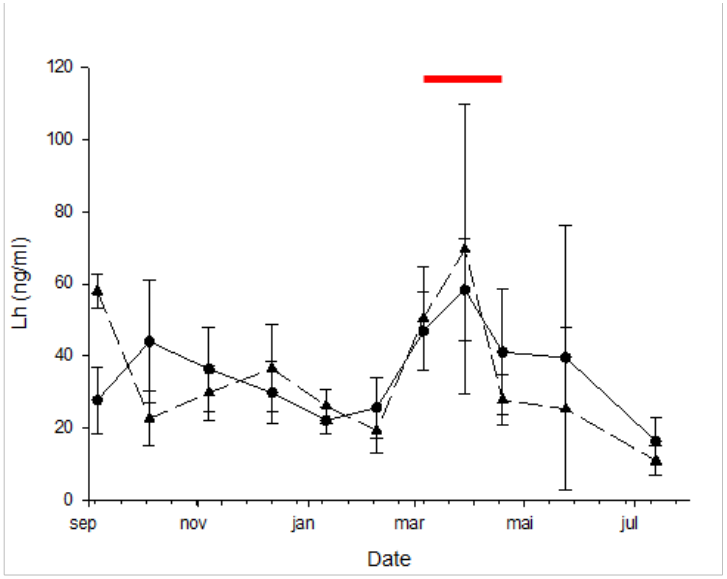
Plasma concentrations of Fsh and Lh





Farmed
Wild-caught

- Fsh concentrations were lowest, and Lh concentrations highest during spawning
- Fsh concentrations were highest during vitellogenesis
- Individual variations were high and there were no significant differences between farmed and wild-caught females.

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In conclusion

- Plasma hormone concentrations were similar in farmed and wild-caught females, and reflected maturity stage
- Plasma Fsh concentrations were low during spawning, and increased after spawning in both farmed and wild-caught females
- Plasma Lh concentrations were highest during spawning in all fish

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Future?

- Broodstock selection essential – wild-caught fish may still be necessary for some time.
- Causes for different buoyancy?
- Halibut genome is sequenced and assembled, will be made available in 2019 – markers for important traits.
- New methods for egg quality assessment (proteomics).
- Epigenetics – effects of broodstock handling, nutrition etc.

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