Wining & dining in RAS.

Understanding the smolt’s conundrum on feeding and drinking

Antony J Prabhu Philip, PhD
Erik-Jan Lock, PhD

Our Post-Smolt Recirculating Aquaculture System (RAS) is designed for growing large Smolt – fish of 400–800 grams.

The traditional size Smolt is a fish of around 100-200 grams. Experience has shown that the use of larger Smolt results in a shorter production time at sea. Typically, a Post-Smolt will be at sea for around one year, whereas a traditional Smolt would be at sea for one and a half years before it is ready for harvest.

Nofima

Large post-smolts

Grieg Seafood

ATLANTIC SALMON | RECIRCULATING AQUACULTURE SYSTEMS (RAS) | LAND-BASED PRODUCTION SYSTEMS +4 more

9 June 2023, at 7:30am

Cermaq approves €60 million post-smolt RAS

Akva group has been awarded of a wins €60 million contract to build a new RAS for Cermaq which will have the capacity to produce 12 million post-smolts a year.

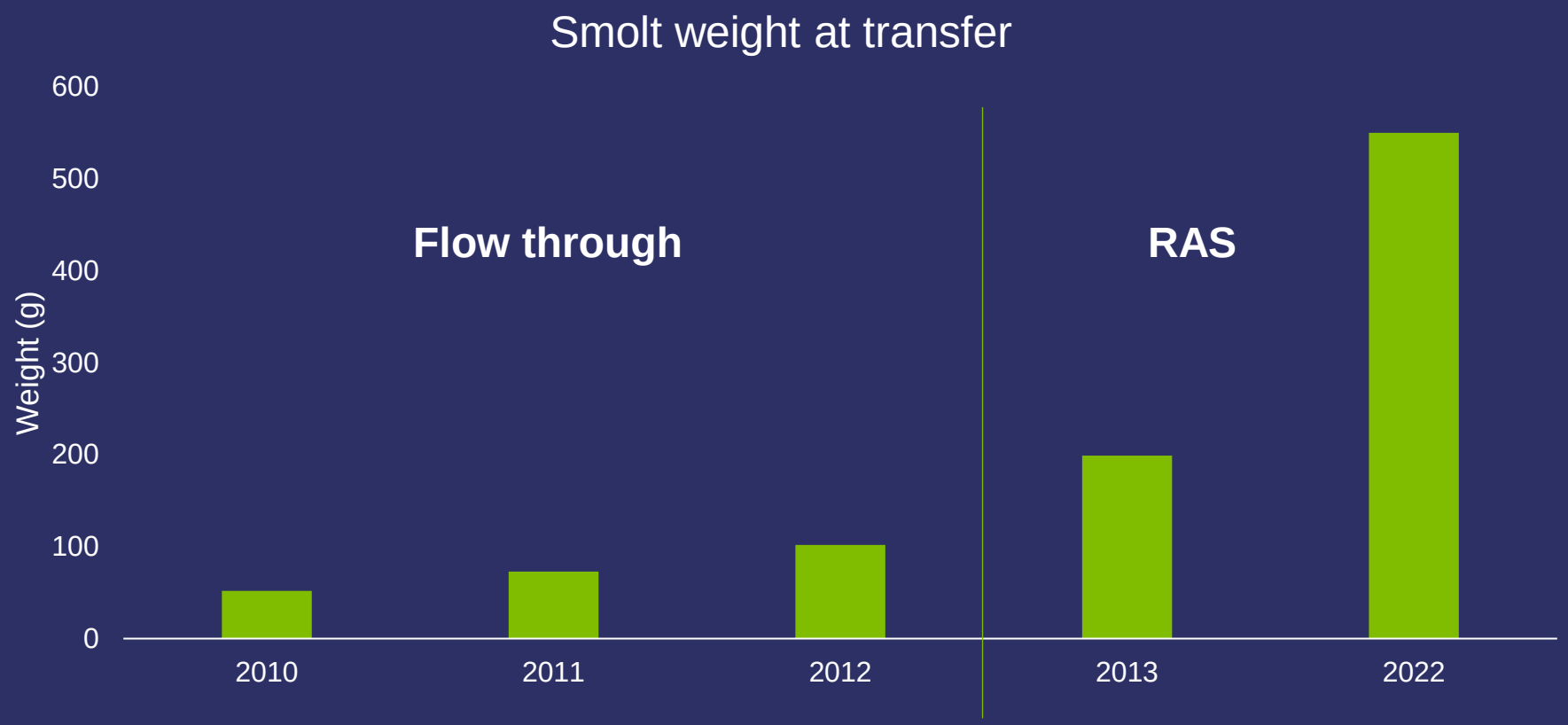
OUR IMPACT

More sustainable farming with post smolt

Piloting our strategy in Rogaland

Throughout the company, we are little by little releasing larger smolt into the sea. Post smolt require substantial investments in land based facilities. Grieg Seafood is pioneering our strategy in our Rogaland region, where the average size of smolt transferred to the sea has increased from 90 grams in 2014 to 550 grams in 2022.

RAS helps to get larger smolts to sea



Data source: Mathisen, Greig seafood. AquaNor 2013.
https://griegseafood.com/our-impact-post-smolt

Challenges with large post-smolts

- Performance of larger smolt could be poorer than smaller smolt
- bigger smolts have more issues related to mortality and also, in growth during the first period in seawater
- so many factors, it’s difficult to pinpoint which is giving the bigger smolt problems
- This report provides recommendation on optimal range for different prodction parameters in large post-smolt production

Rapport 12/2023 • Utgitt mai 2023

Nofima

Kunnskapskartlegging-produksjon av stor laksesmolt

Faglig sluttrapport

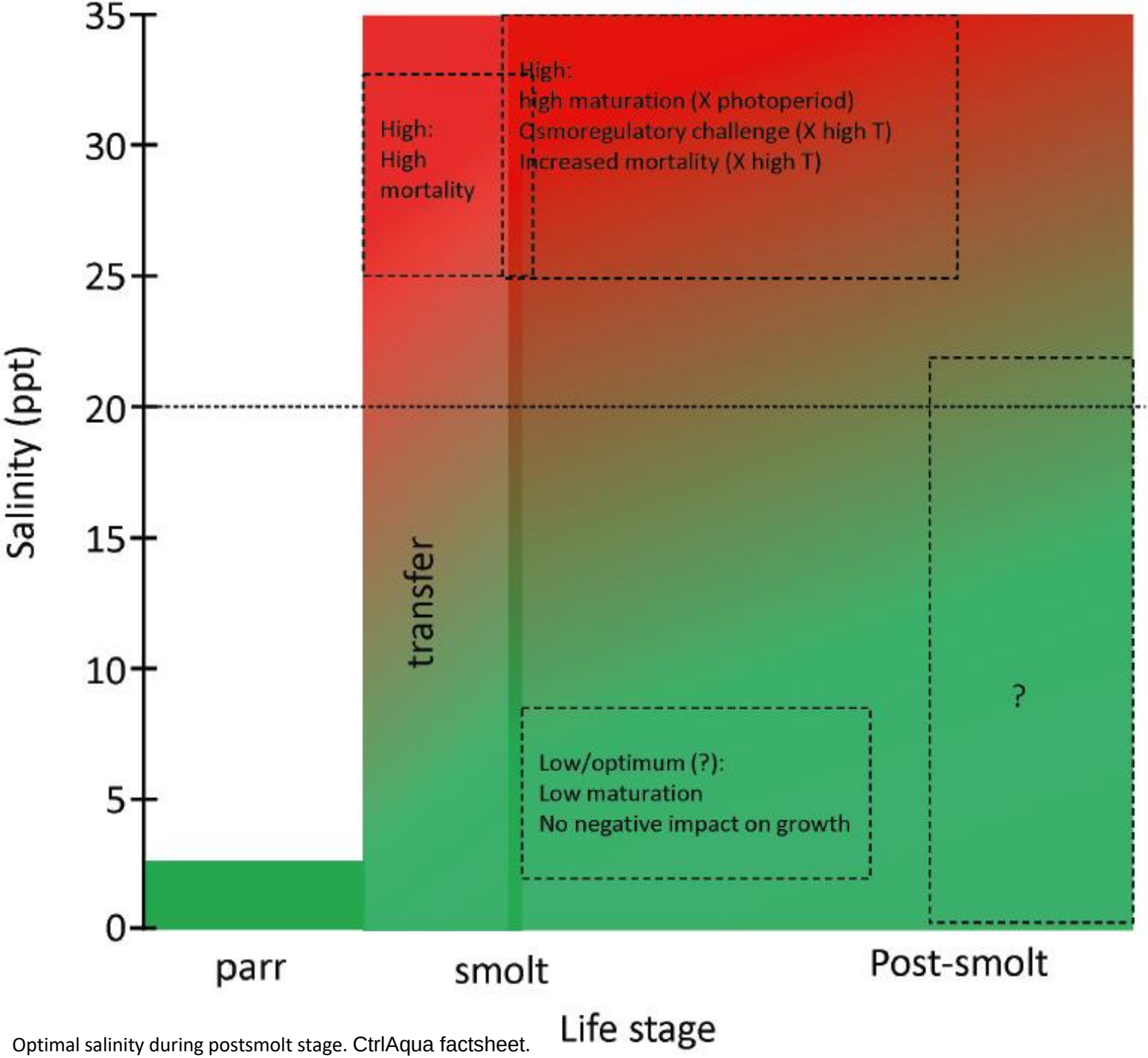
Trine Ytrestøyl[1], Iris Jenssen[2], Vibeke Emilsen Wetterwald[3], Anja Striberny[1], René Alvestad[1], Rùni Dam[4], Heidi Mortensen[5], Ellie Johansen[3], Åsa Espmark[1], Lill-Heidi Johansen[1], Jelena Kolarevic[6], Jørund Larsen[2], Merete Gisvold Sandberg[3], Tom Ole Nilsen[7]

[1]Nofima, [2]Åkerblå, [3]BDO, [4]Avrik, [5]Fiskaaling, [6]UiT, [7]UiB

Salinity: a crucial factor in producing quality large post-smolts

In RAS, it has been shown that 12 ppt can provide better growth and skin health, but it is uncertain whether this is sufficient to maintain seawater tolerance in larger fish. Several farmers are testing 20 ppt, but effects on performance in the seawater phase have not yet been documented.

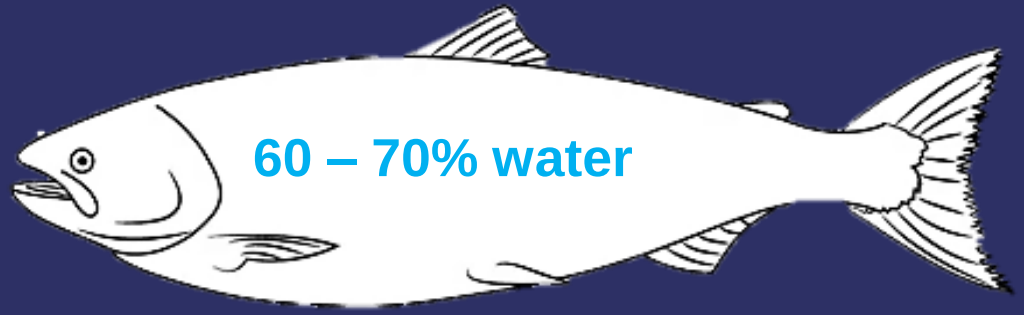
- Knowledge mapping -production of large smolts (Ytrestøyl et al. 2023).

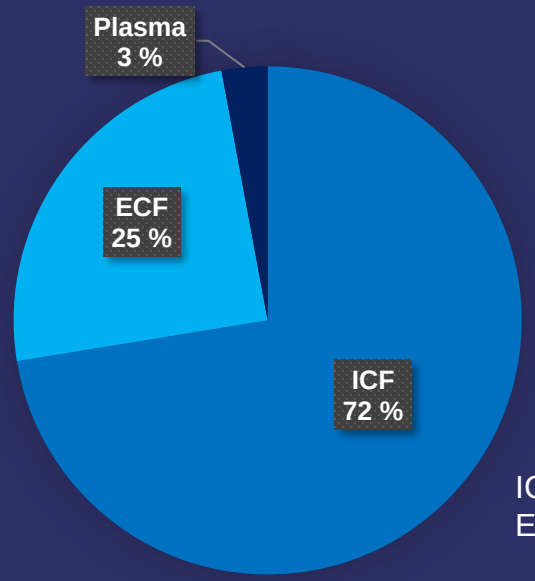


Optimal salinity during postsmolt stage. CtrlAqua factsheet.

What is a fish, anyway?

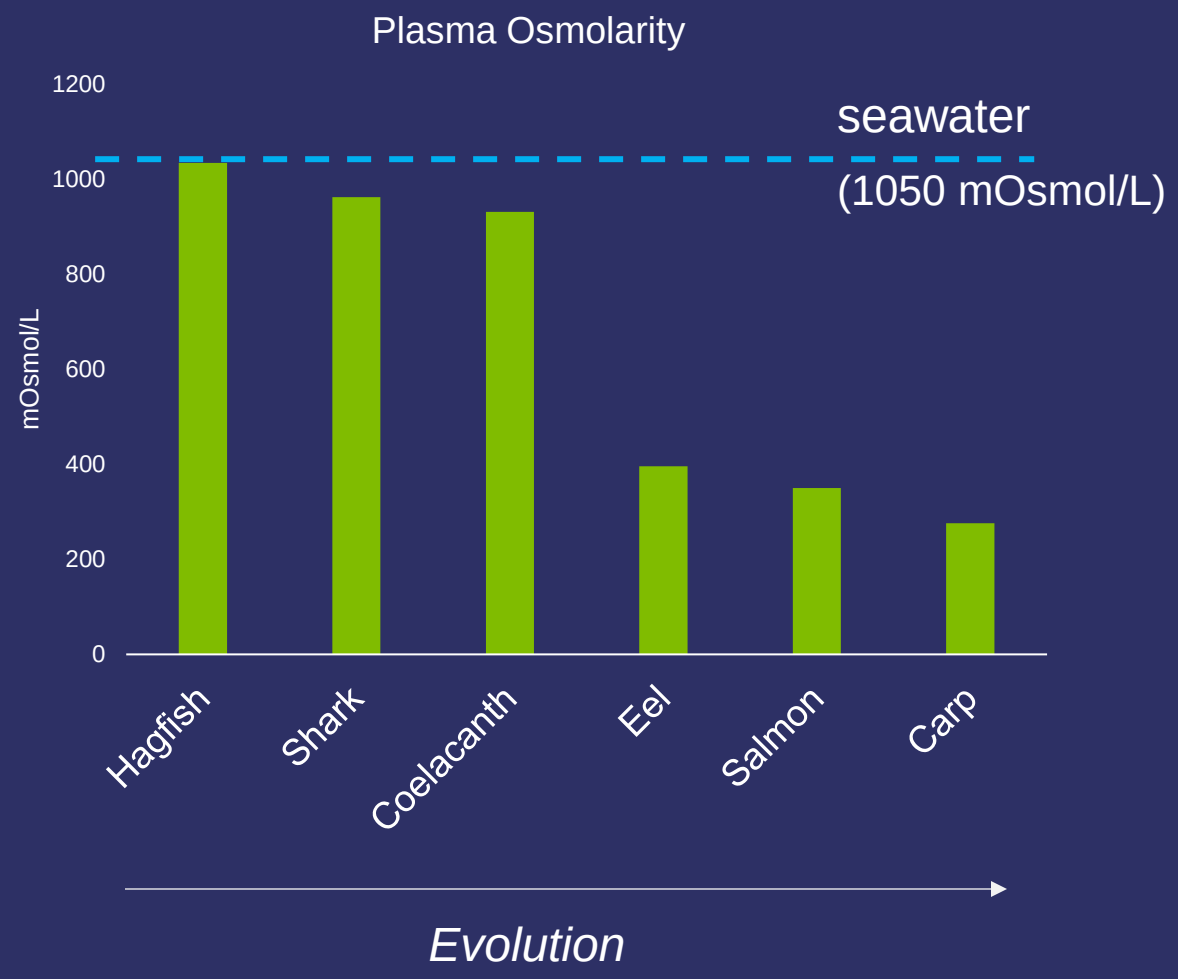
More water than anything else.





ICF – Intracellular fluid
ECF – extracellular fluid

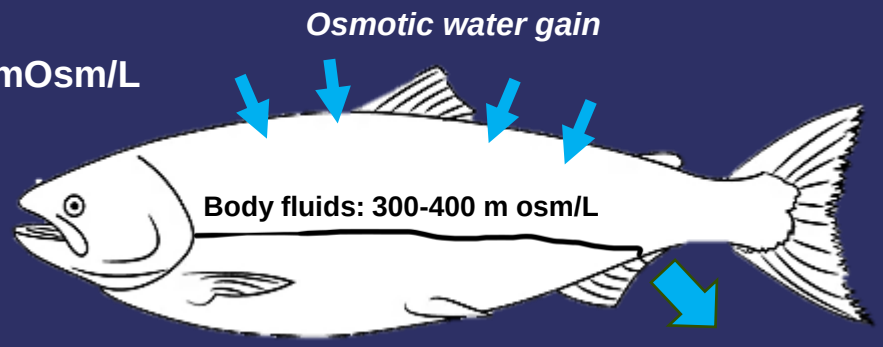
How does fish maintain water balance in the body?



- Osmo-conformers
  - Hagfish
  - Coelacanth
  - Elasmobranchs
- Osmo-regulators
  - Teleost

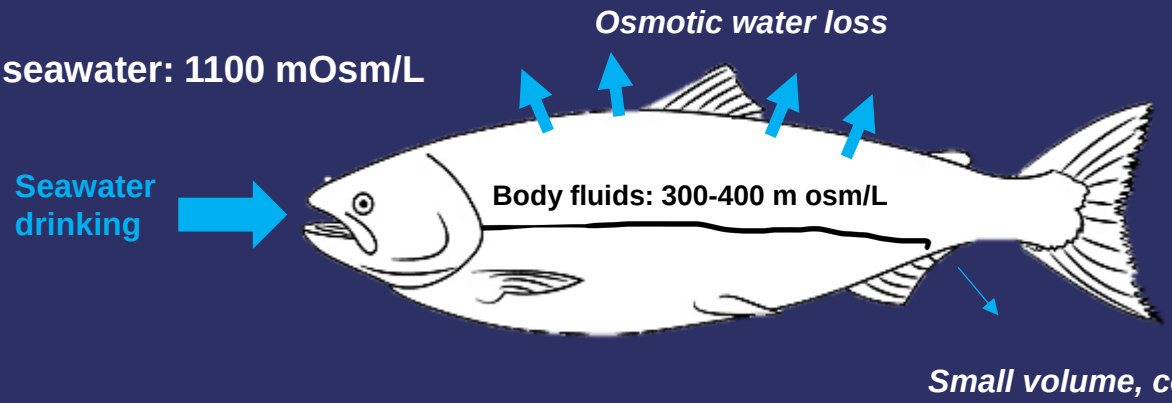
Significance of the RAS within salmon

Freshwater: 50 mOsm/L

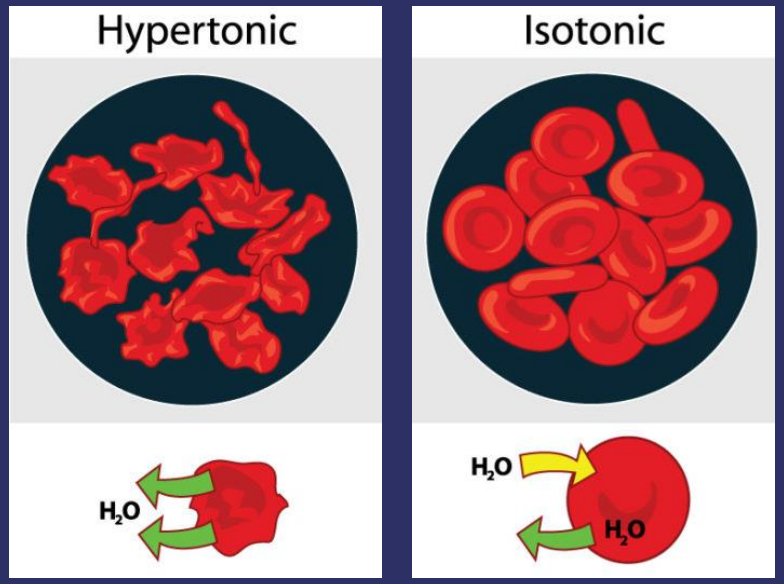


seawater: 1100 mOsm/L

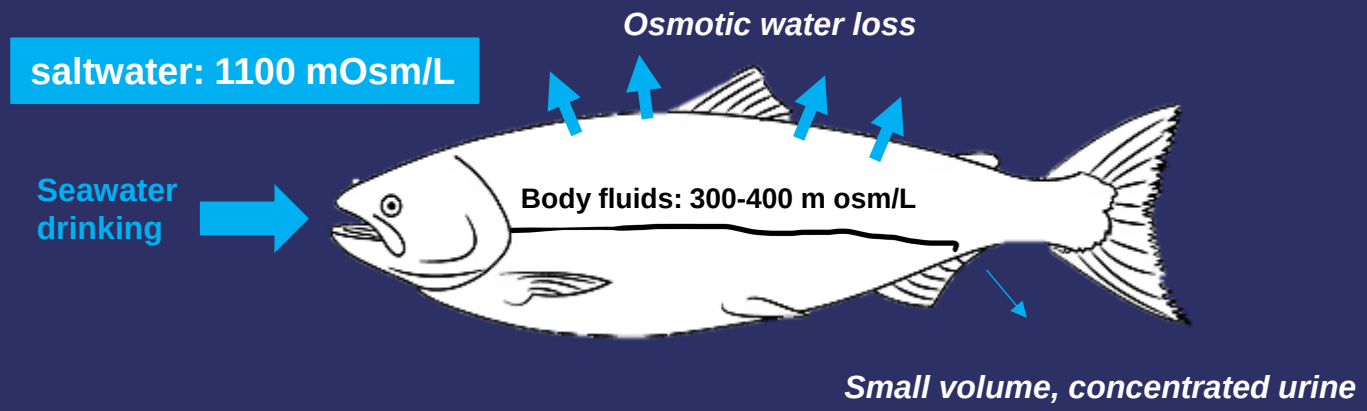
Renin
Angiotensin
System



What happens when salmon is transferred to seawater?

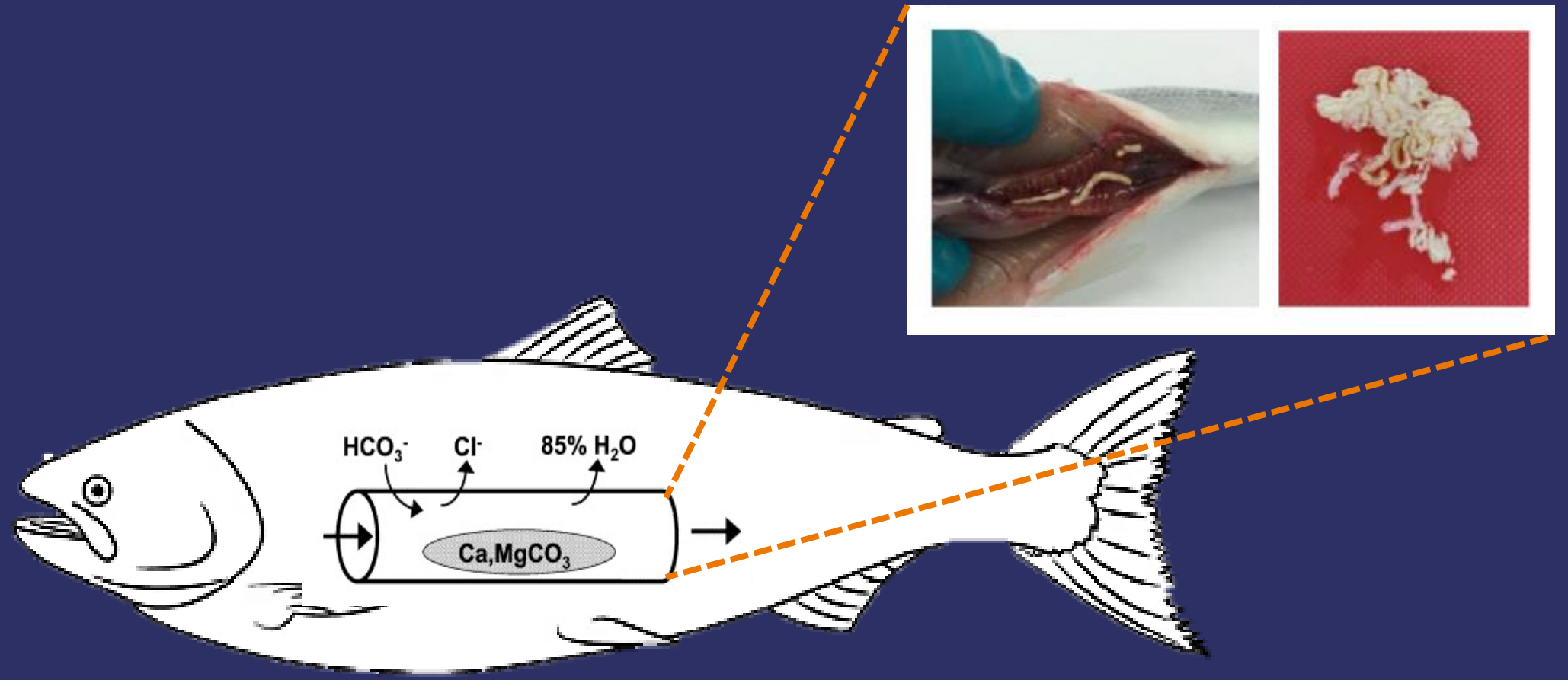


lumenlearning.com



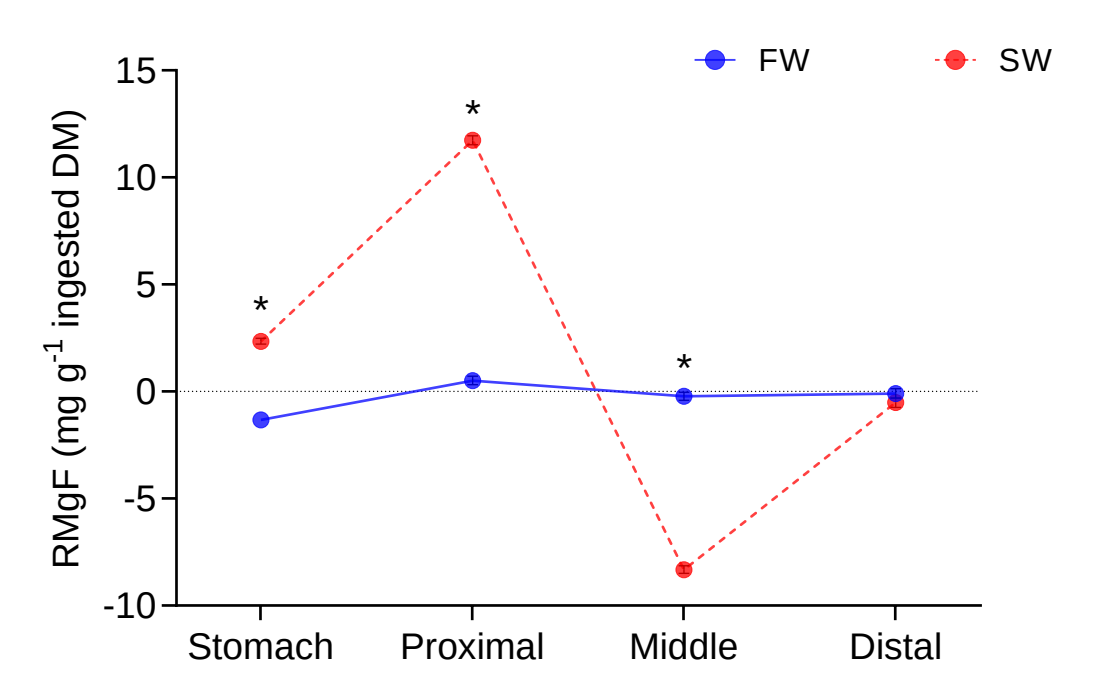
Although salmon drinks seawater, its not easy to absorb water

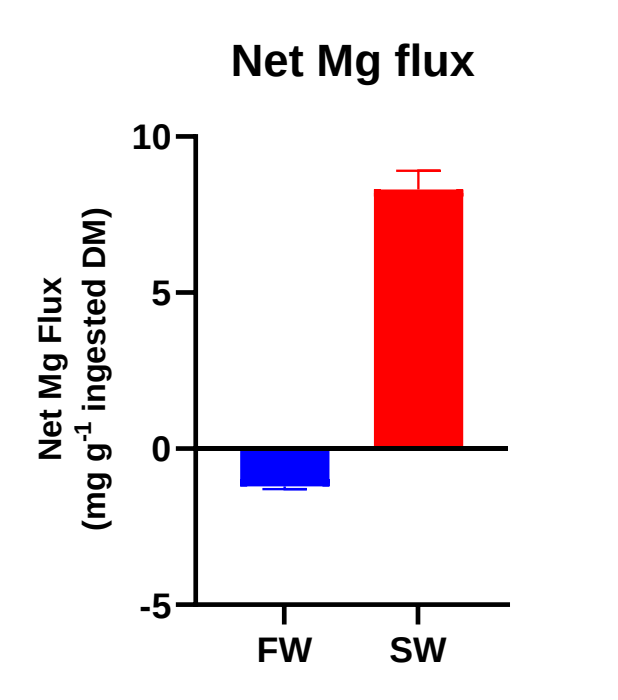
Salmon builds its own desalination plant

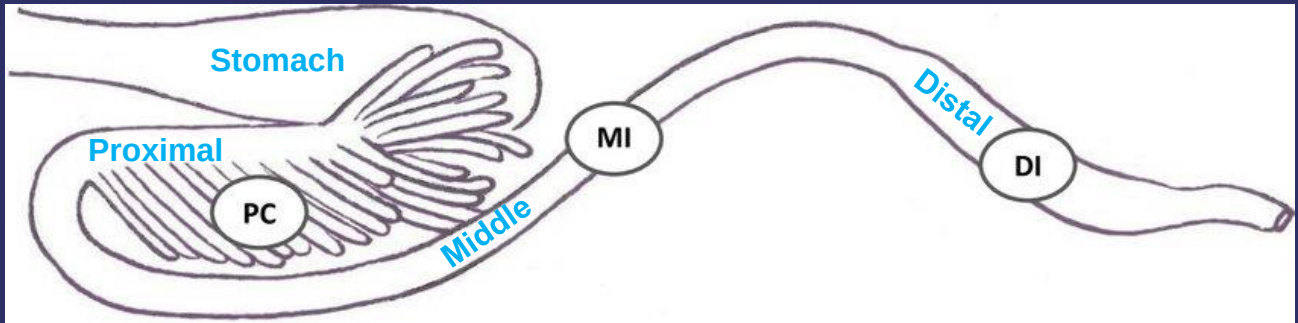


Philip et al. 2021; Wilson et al. 2022

Magnesium flux in gastrointestinal tract as indicators of drinking in seawater

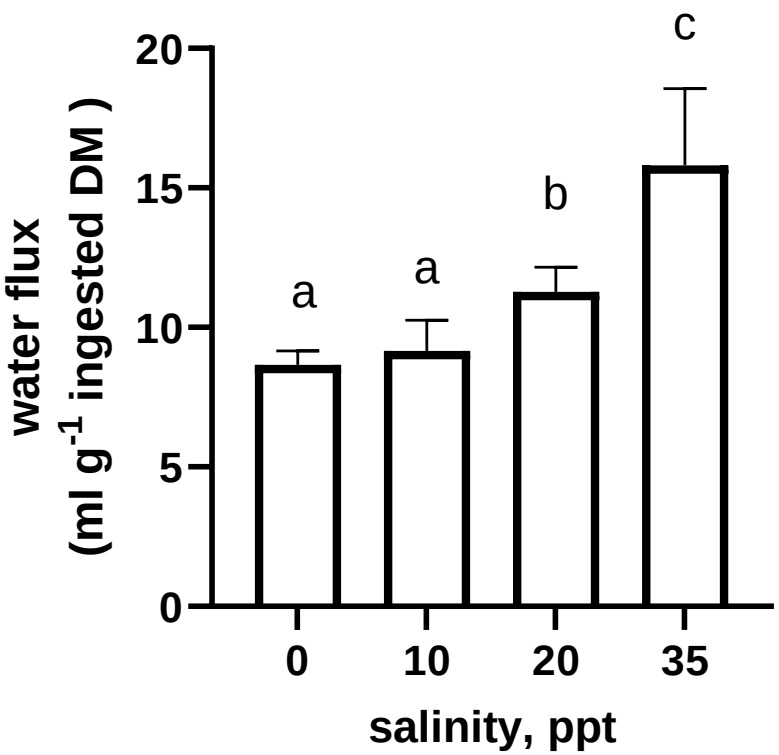


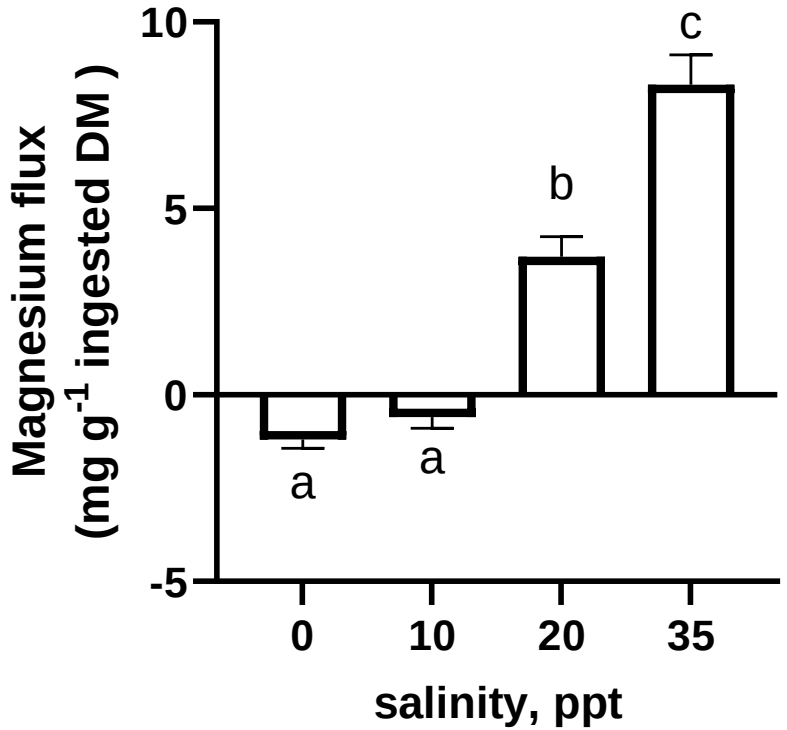




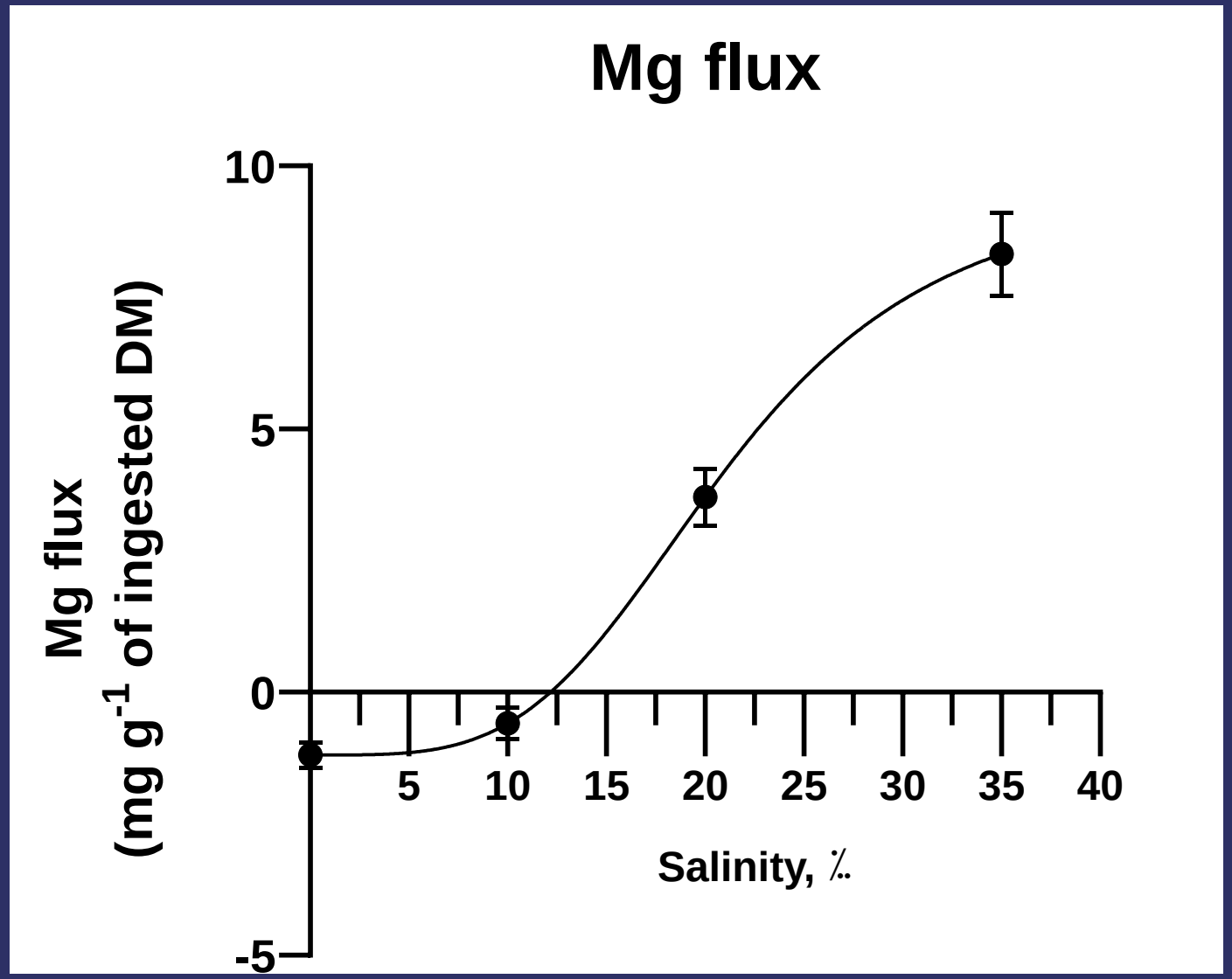
Ciavoni et al. 2024a

Water and Mg-flux in the gut





Ciavoni et al. 2023



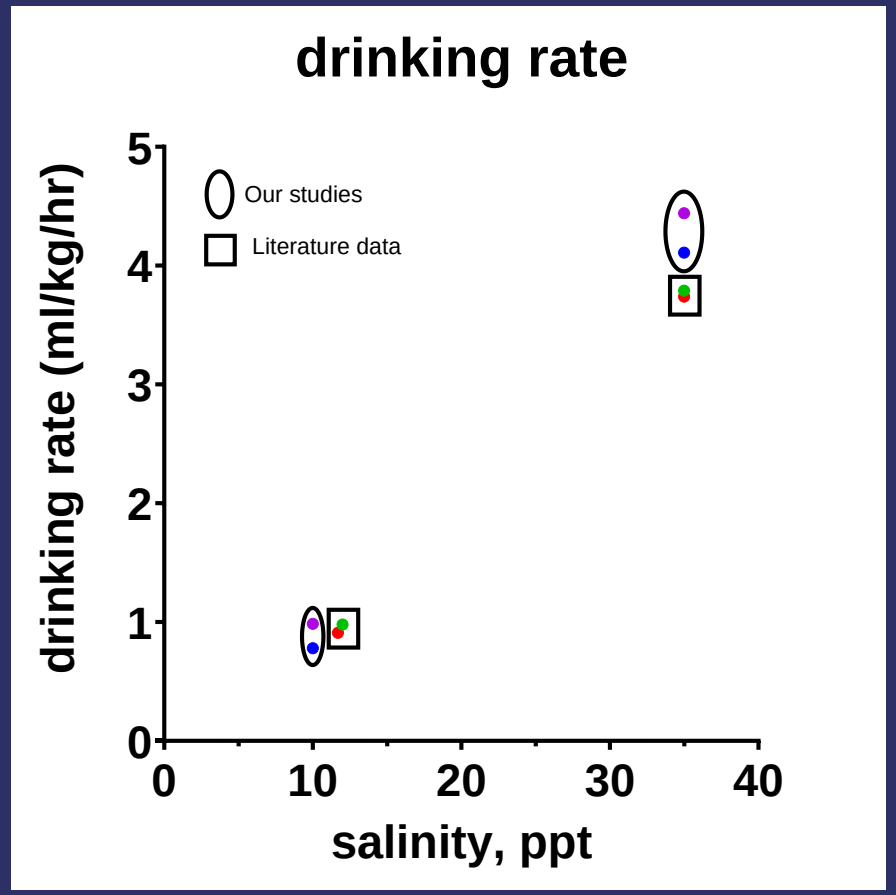
Salmon begins to drink gradually between 5-10 ‰

11-12 ‰ is ‘isosmotic point’

Over 12‰
Drinking increases rapidly

Ciavoni et al. 2024a

Drinking rate in salmon: how much does salmon drink?



Salmon drinks
3.5 – 4.5 ml/kg/h
in full strength
seawater

Feed intake drops during early days after seawater transfer

ELSEVIER

Aquaculture

Volume 94, Issue 4, 15 May 1991, Pages 309-326

Effects of transfer to seawater on growth and feeding in Atlantic salmon smolts (*Salmo salar* L.)

M.L. Usher [a b *], C. Talbot [a], F.B. Eddy [b]

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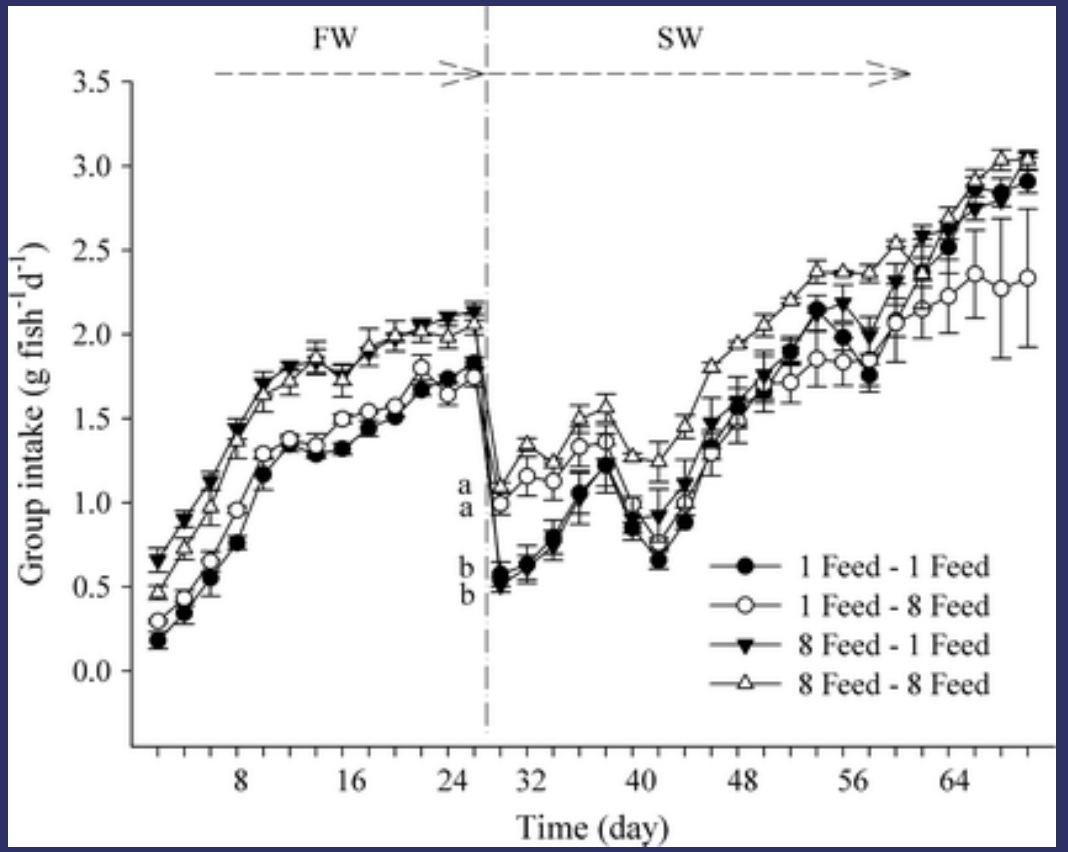
https://doi.org/10.1016/0044-8486(91)90176-8 Get rights and content

Abstract

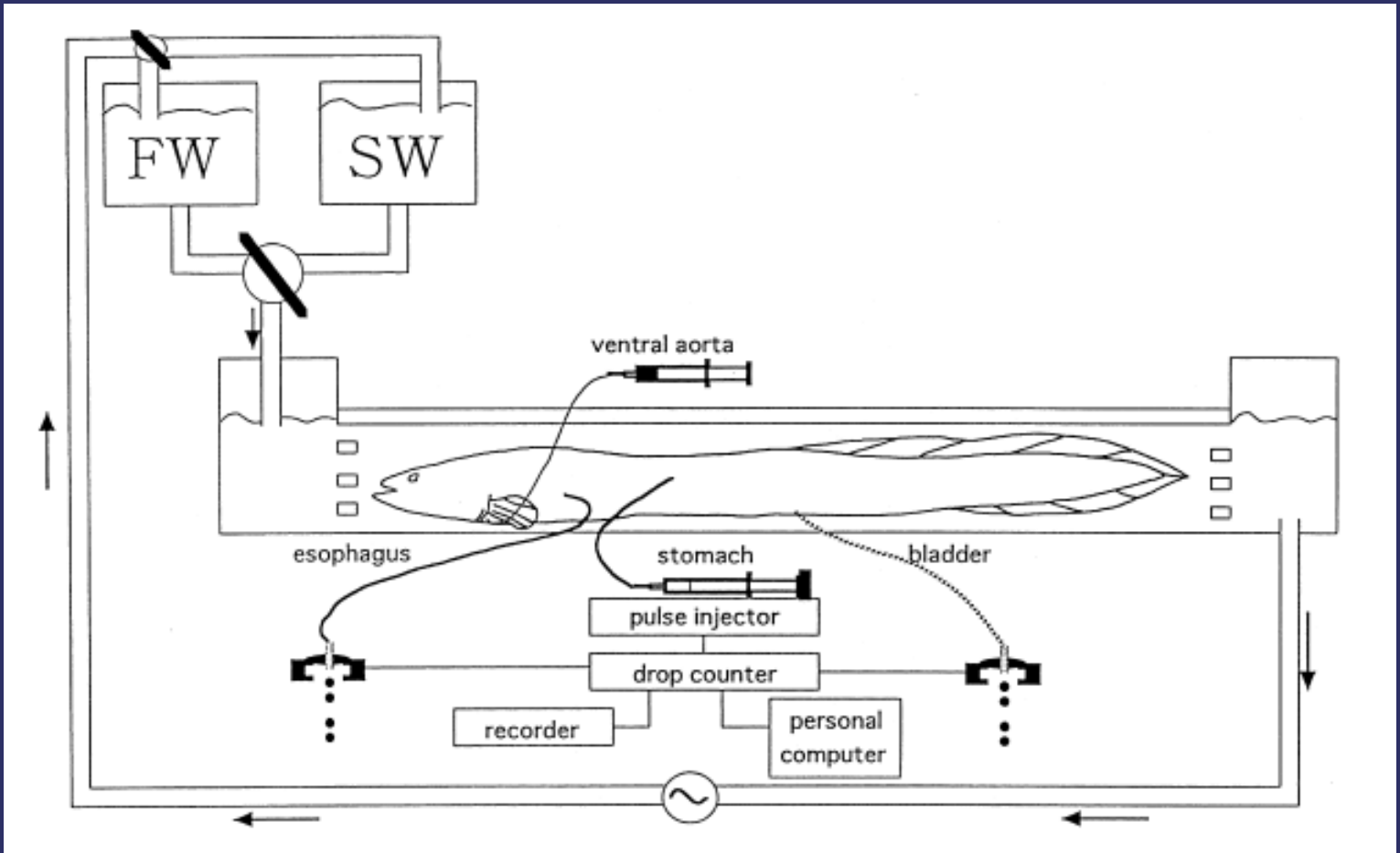
Appetite and growth are suppressed for up to 30 days in Atlantic salmon smolts following transfer to seawater. This exceeds the period of osmoregulatory adaptation which is complete within 10 days. The restoration of feeding is independent of fish size.

Usher et al. 1991



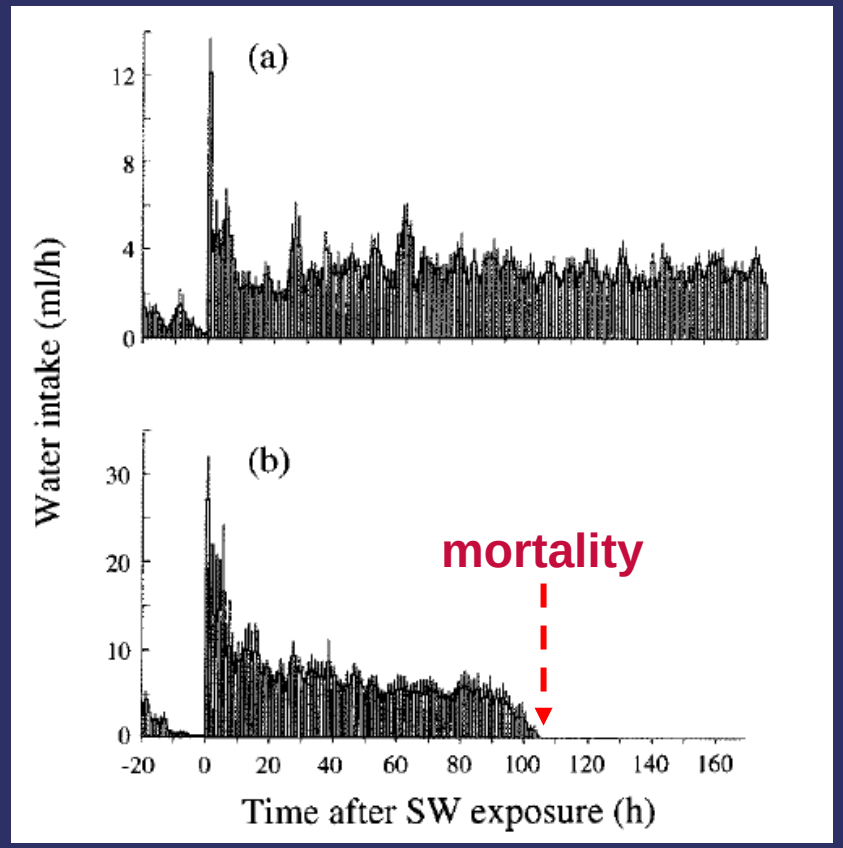
Flood et al. 2012

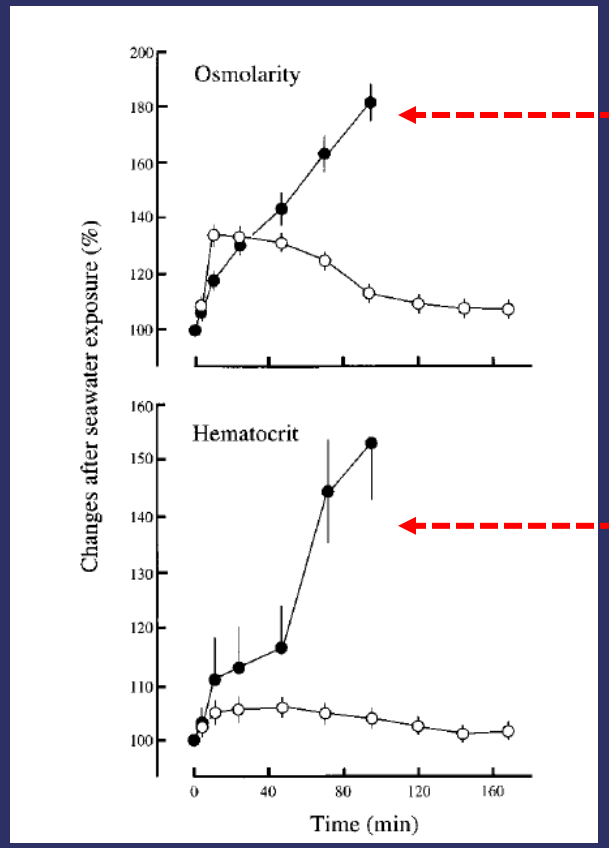
What happens when drinking is blocked in seawater fish?



Takei et al. 1998

What happens when drinking is blocked in seawater fish?





Exteremely high plasma osmolality

Reduced blood volume (hypovolemi)

Takei et al. 1998


Seawater transfer
Drinking
Feed intake

Not eating…

Sick or Stressed..

Can I get some water to drink first!
Its dehydrating in here.

Drink & Dine.