Biomarkører og evaluering av smoltkvalitet

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Institutt for Biovitenskap

UNIVERSITY OF BERGEN

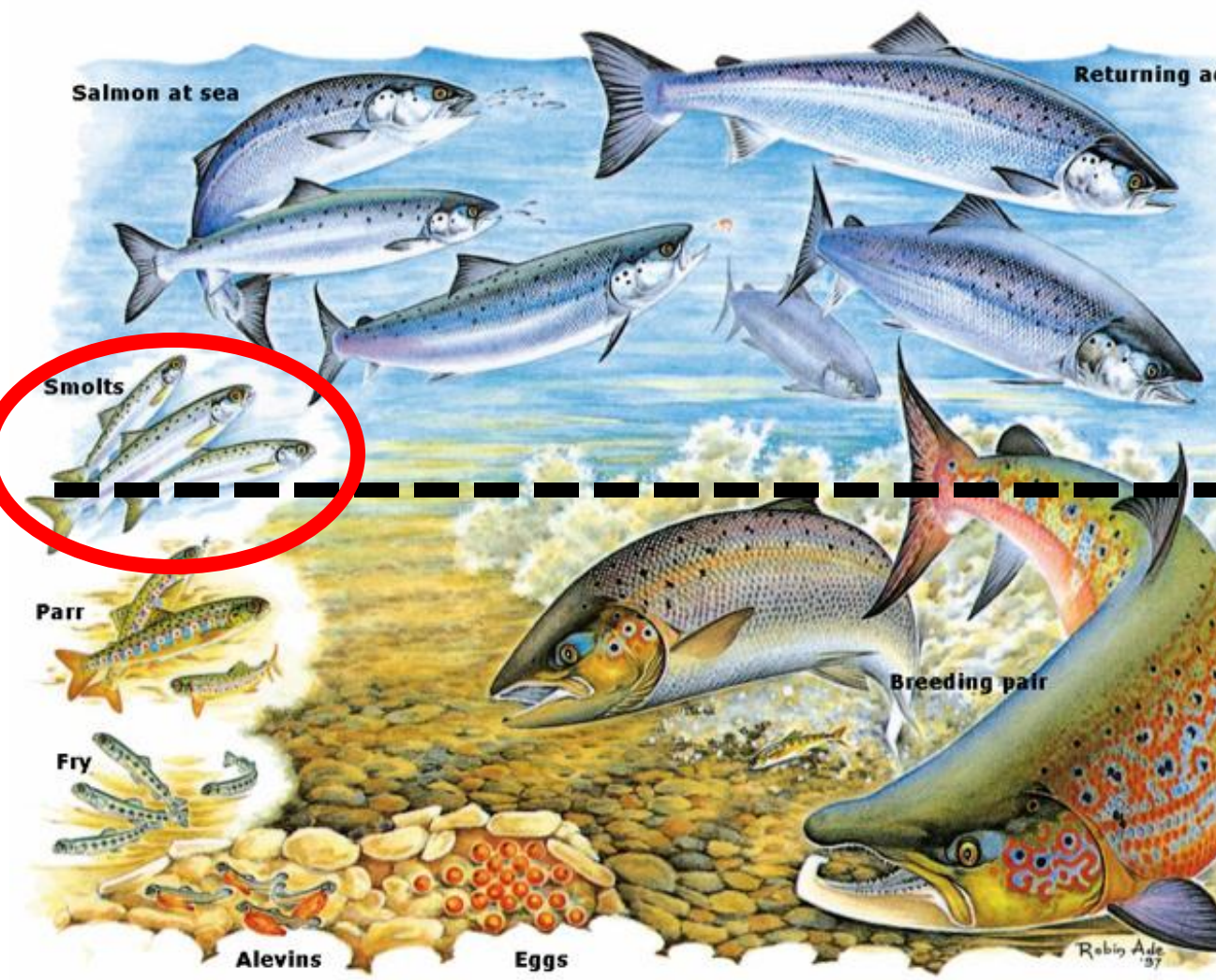
Livsstadie

Hva er en smolt?

Smolt begrepet benyttes vanligvis bare om den fisken som er klar for sjøen

Hva er smoltifisering?

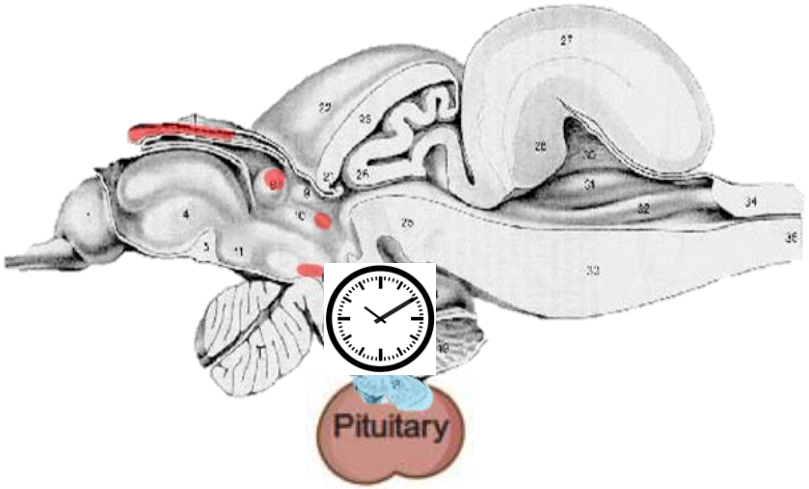
Smoltifisering skjer **forut** for utvandring til sjø, fisken **tilpasser** (pre-adapterer) seg til et marint liv **før** den vandrer ut fra elven



Smoltifisering styres av miljøparametere

Endringer i daglengde veldig viktig

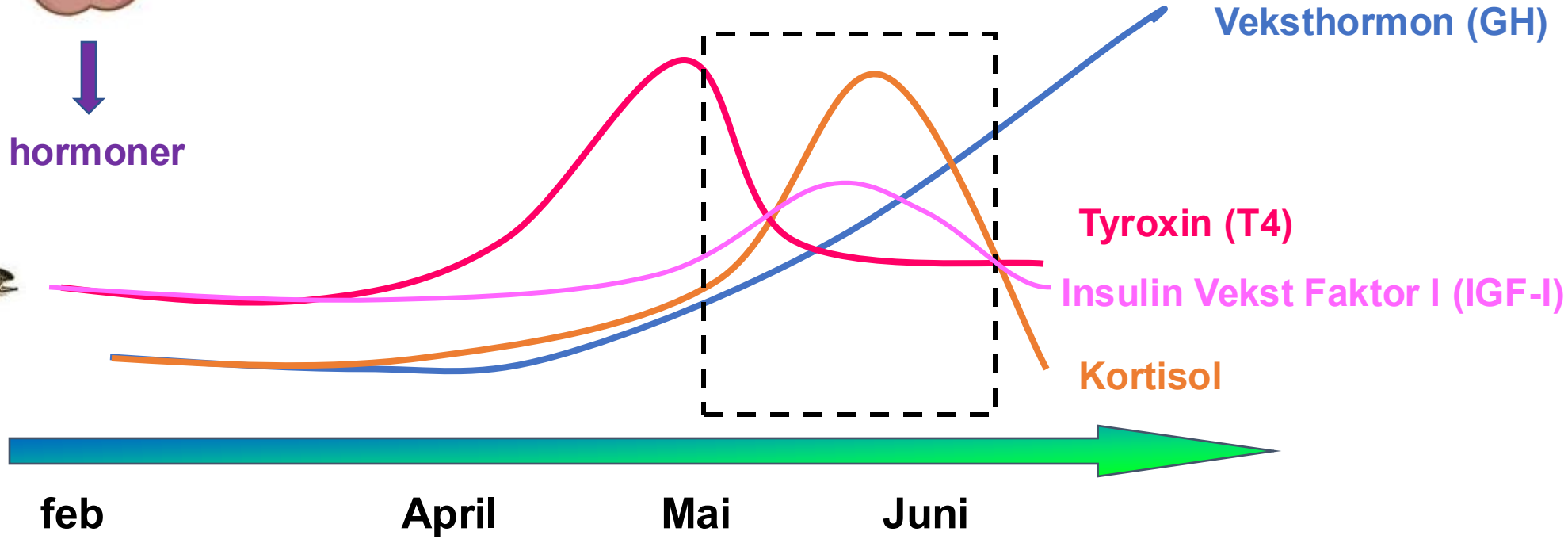
Temperatur viktig for utviklingshastighet



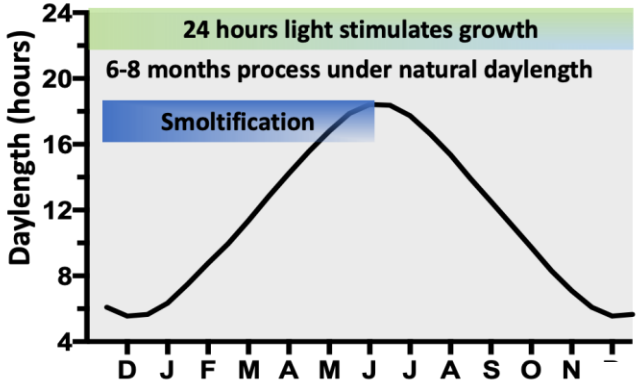


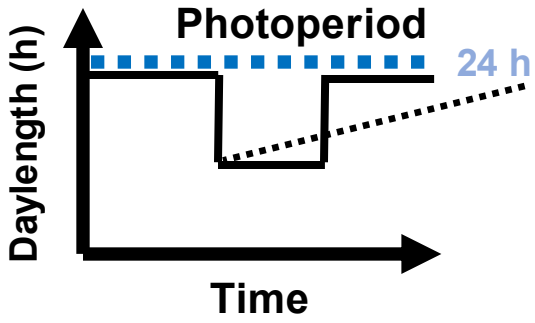
Plasma hormoner

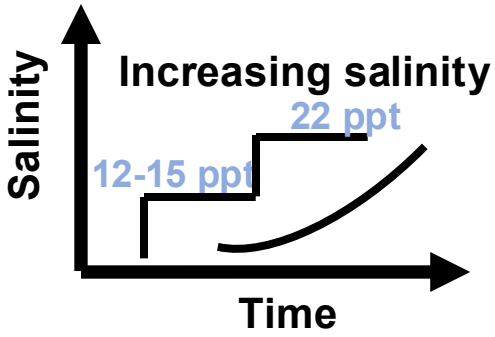


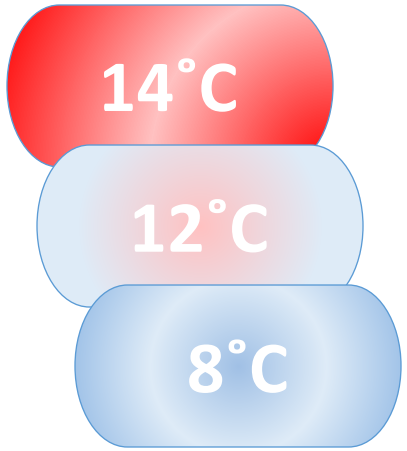


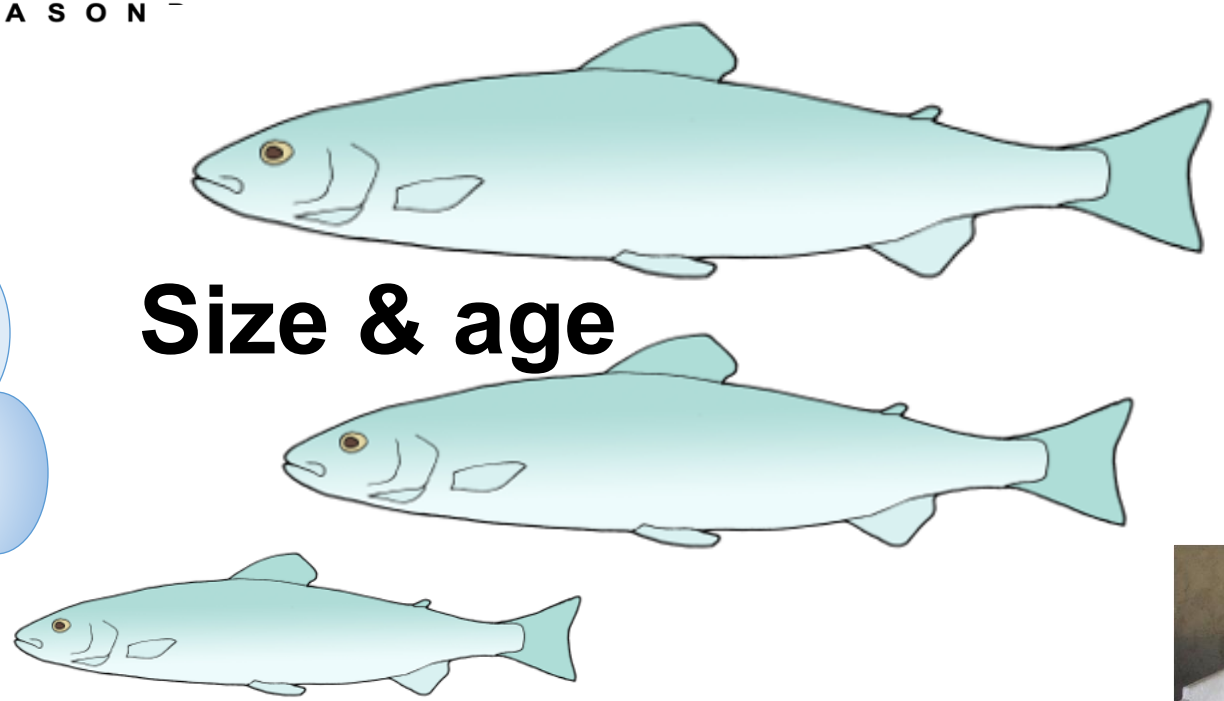
Smoltifiseringsforløpet i oppdrett påvirkes av mange faktorer

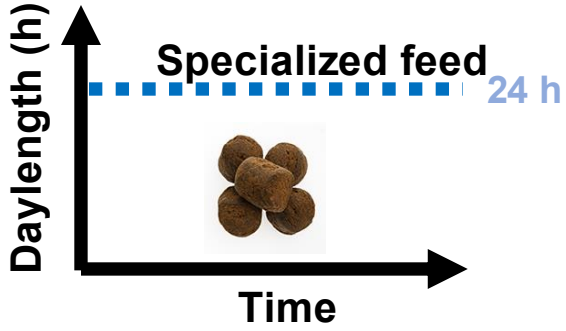










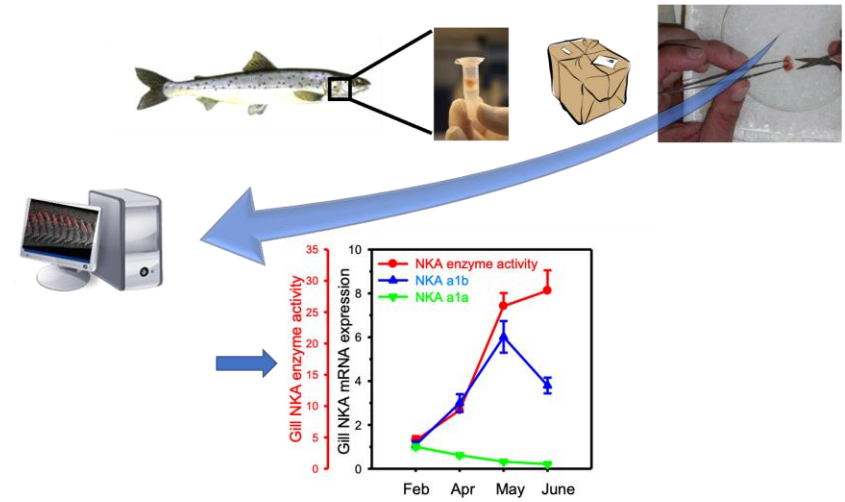


Water quality



Hvordan best evaluere status til fisken?

- **Det kommer an på hva du ønsker svar på**



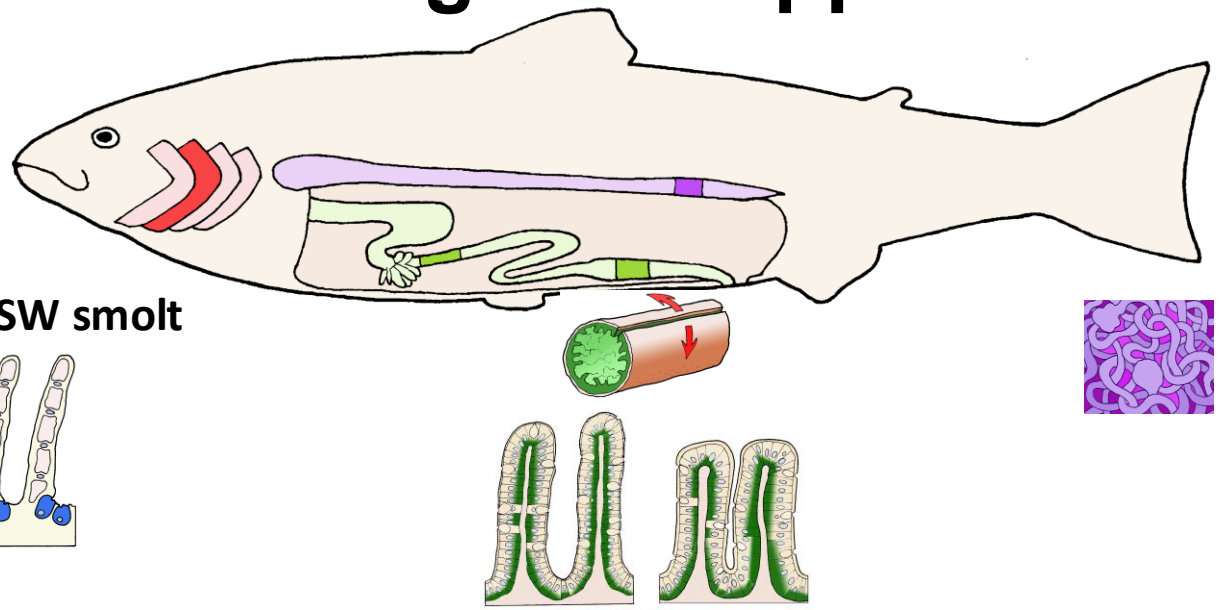
Predikativ test vs. Challenge test

- Proxy for utviklingsstadier - smoltifiseringsforløp
- Predikativ test for fremtidig prestasjon (robust)
- Teknologi plattform - Gen - Protein - Funksjonelt enzym eller Blodkjemi
- Enkeltmarkør eller panel av mange markører

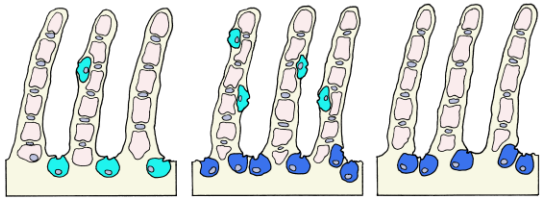
- **Uansett strategi så må markør(er) tolkes i kontekst av...**

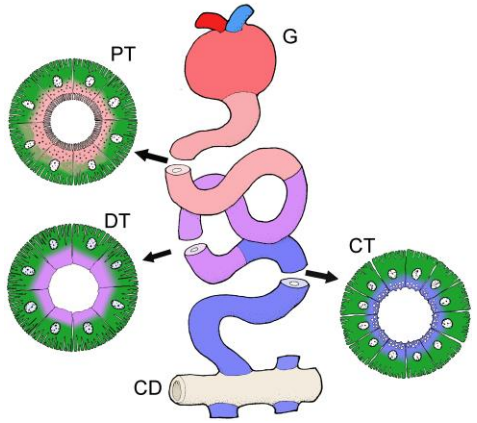
- Oppdrettsbetingelser fisken går under
- Fiskens livsstadie

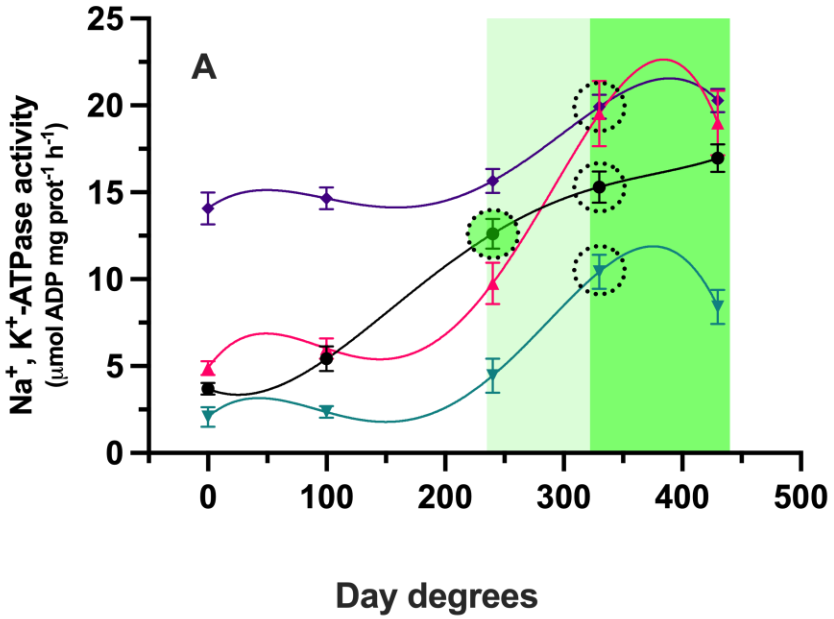
Integrative approach

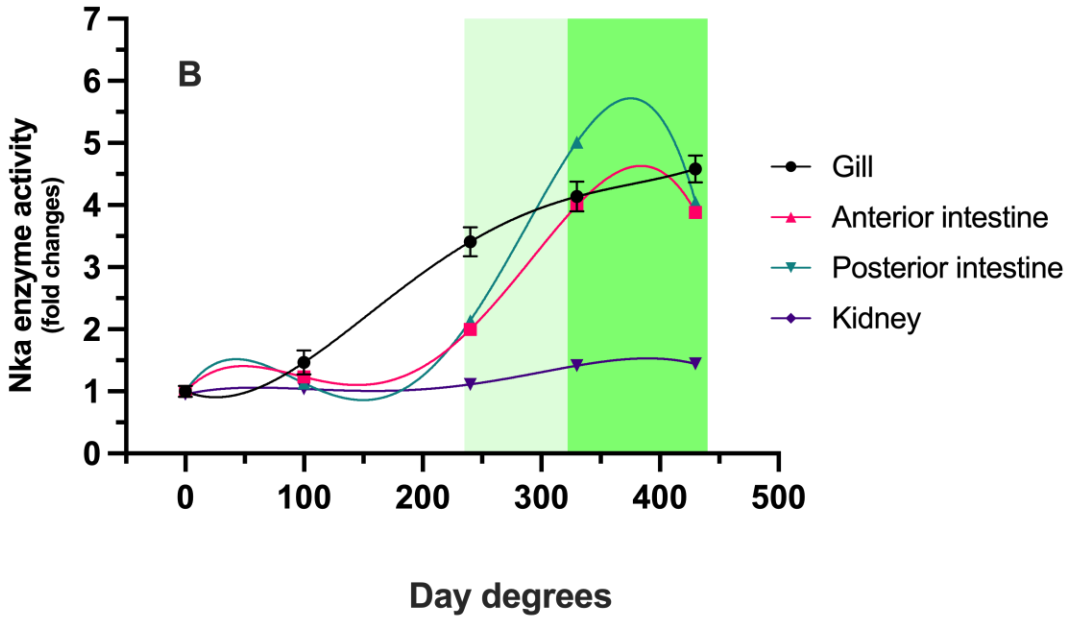


FW parr FW smolt SW smolt



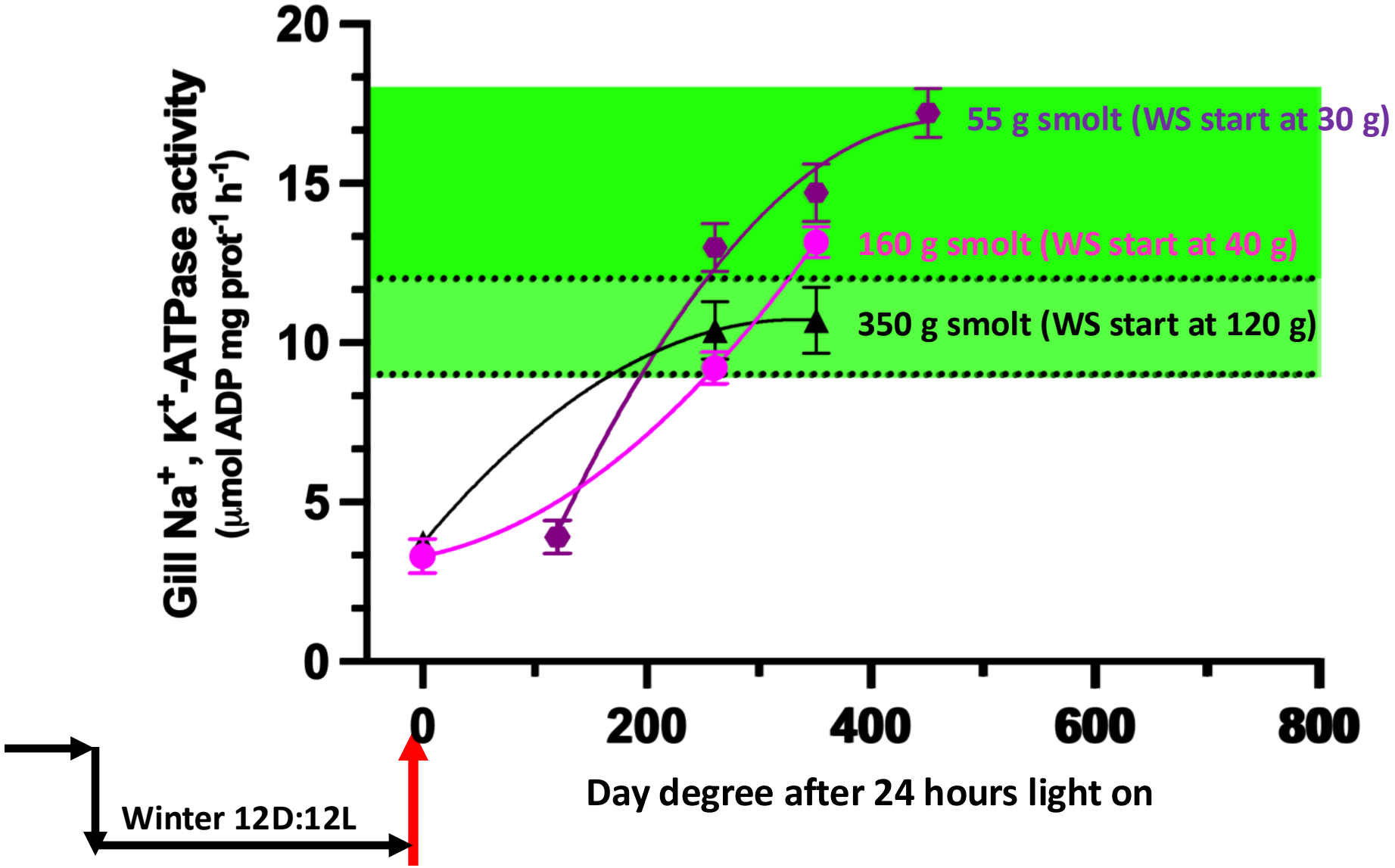






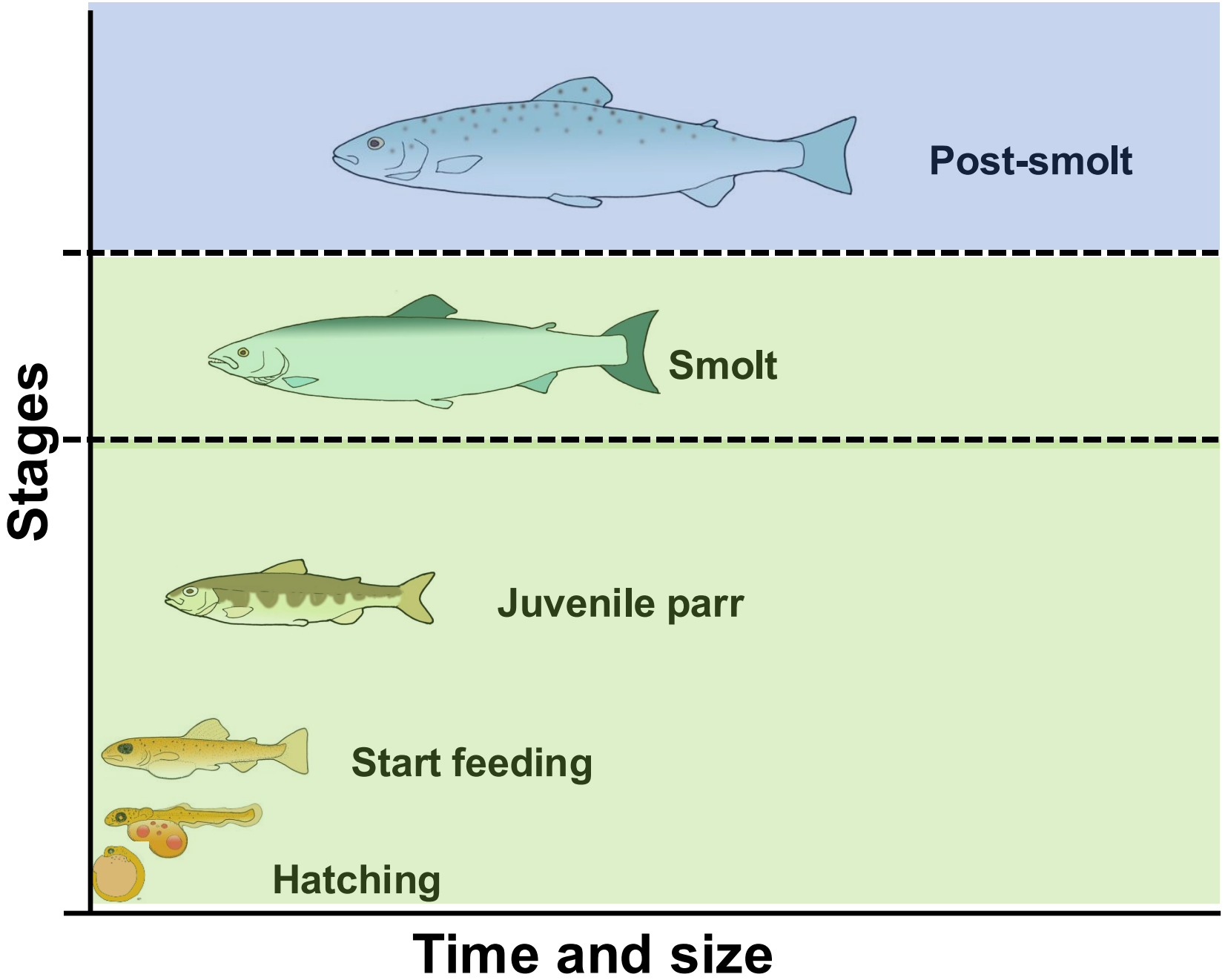
Takvam & Nilsen et al 2023, Aqucul.

Initiation of winter signal (WS) and smolt size

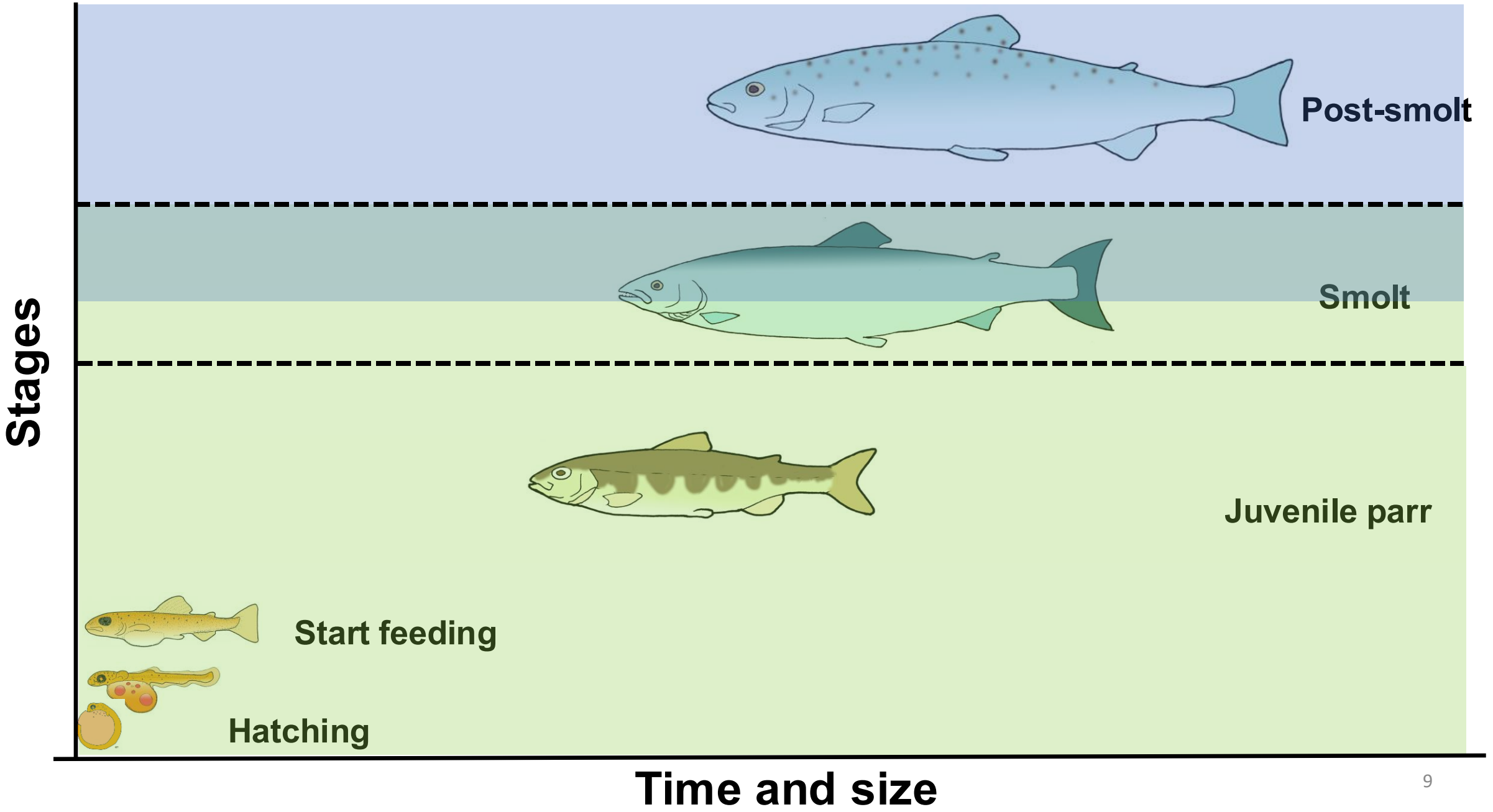


Nilsen et al., in prep

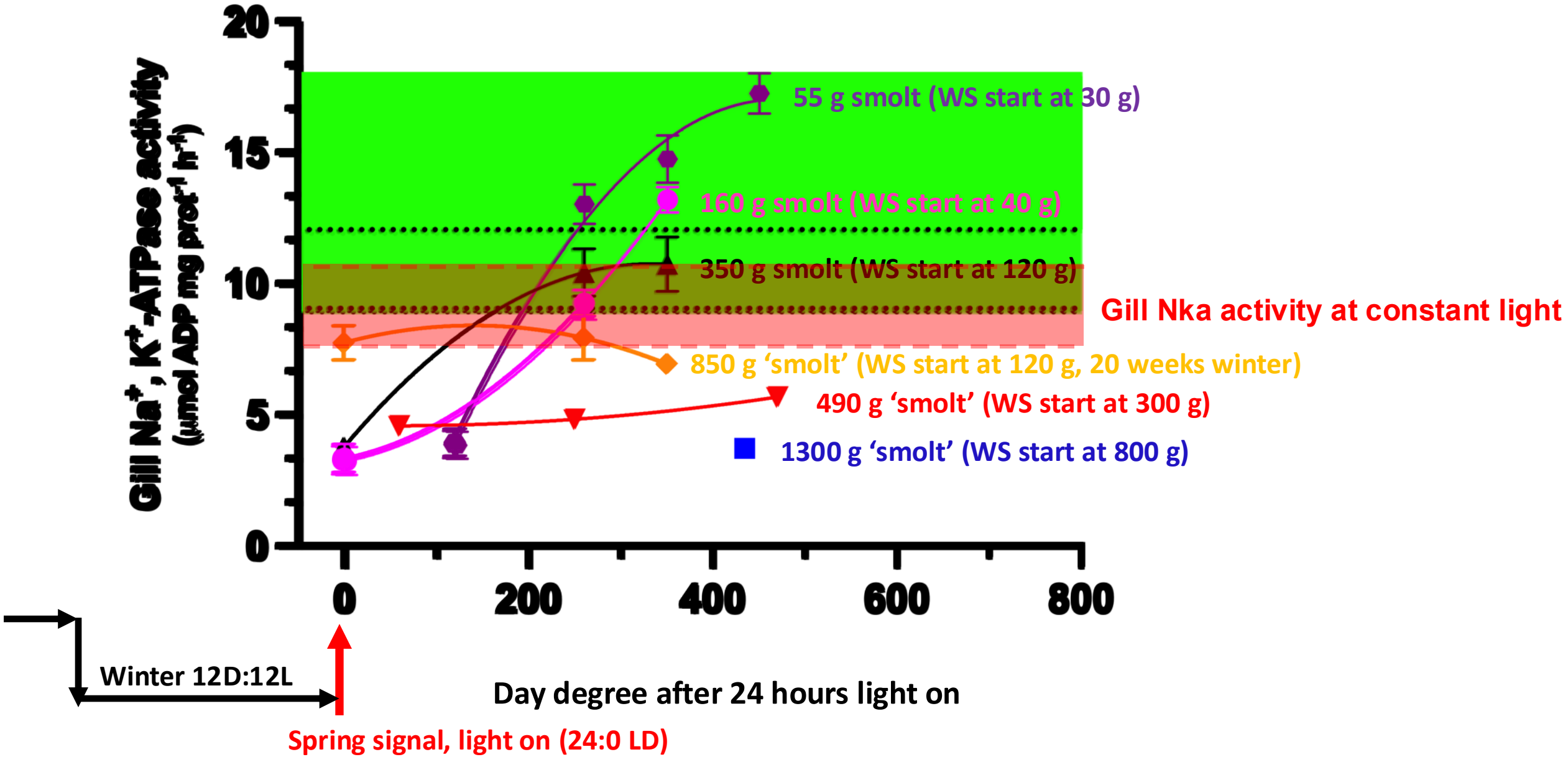
Smoltification protocols functions well for ‘normal’ sized smolts



…but smolt documentation more challenging when fish are larger



Smolt size may elicit different response in biomarkers



Nilsen et al., in prep; Bjelland MSc thesis; Gam et al., 2024

Noen tanker rundt bruk av blodkjemi



Utviklingen gir spennende muligheter til å forstå mer av fiskens fysiologi.

Blodkjemi har potensial som smoltmarkør, men gjenstår arbeid med referansegrunnlag og biologisk validering.

- **Prøvekvalitet kommer først:**

  Standardisert prøvetaking, kontroll på tiden frem til analyse eller separering av plasma, og vurdering av hemolyse er avgjørende for sammenlignbare resultater.

- **Referansegrunnlaget er fortsatt utilstrekkelig:**

  Så langt vi kjenner til, finnes det ikke et samlet, offentlig tilgjengelig sett med validerte referanseintervaller som ivaretar livsstadium, kjønn, utviklingstid og temperaturhistorikk, inkludert døgngrader, samt produksjonsmiljø. Samme blodverdi kan derfor ha ulik betydning mellom fiskegrupper.

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Blodkjemi har potensial som smoltmarkør, men gjenstår arbeid med referansegrunnlag og biologisk validering.

- **Produksjonsmiljøet må følge prøven:**

  Vannkvalitet, lys, temperatur, salinitet og produksjonssystem kan påvirke blodprofilen.

  Kommersielle data må derfor vurderes sammen med fiskens miljø og produksjonshistorikk.

- **Biologisk validering er nødvendig:**

  Endringer i blodet må underbygges av uavhengige mål på smoltutvikling og organfunksjon.

- **Velferd og underliggende vevsskader må dokumenteres.**

  Fisk som inngår i referansegrunnlaget, må være grundig undersøkt for lyter, velferdsproblemer og produksjonslidelser som kan påvirke blodkjemien over tid.

Takk for oppmerksomheten

og særlig takk til



Marius Takvam, UiB



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REVIEW

Reviews in Aquaculture

New wine in old bottles: Modification of the Na^+/K^+-ATPase enzyme activity assay and its application in salmonid aquaculture

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Abstract

The Na^+, K^+ ATPase (NKA) enzyme is important to generate the transmembrane ion gradient in the gills, intestine, and kidneys, hence, is vital for secondary transport of fluids and different solutes in teleosts. Gill NKA enzyme activity is often used as a proxy for parr–smolt transformation (PST) during which anadromous salmonids prepare for seawater (SW). Increased intensification and production of larger smolts in modern salmonid aquaculture has resulted in reports of gill NKA activity being less reliable as a proxy for smolt quality. Consequently, changes in mRNA *nka-α1b/α1a* ratios in gills are increasingly used as indicators of PST. However, *nka* isoform mRNA abundance may not reflect translation into the functional protein, nor the activity of the mature enzyme. This may limit the predictive power of molecular markers under certain environmental conditions, rearing regimes and biological scenarios. During PST, the osmoregulatory transformations necessary for SW tolerance and survival does not only occur in the gills. Equally important are the changes in ion transporting activities, including NKA activity, in the intestine and kidneys. However, to our knowledge, there are no previous studies addressing the timing and concurrent changes in NKA activity in the three osmoregulatory tissue during PST. Here we present modifications and optimization of the NKA enzyme activity protocols for gill, intestinal and kidney tissue and outline how to best utilize NKA activity measurements as part of a more holistic approach to evaluate overall smolt quality in modern aquaculture.

KEYWORDS
aquaculture, fish, Na^+/K^+-ATPase, osmoregulation, parr–smolt transformation, seawater tolerance

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