



Hvordan lysstyring påvirker vekst og kjønnsmodning hos laks

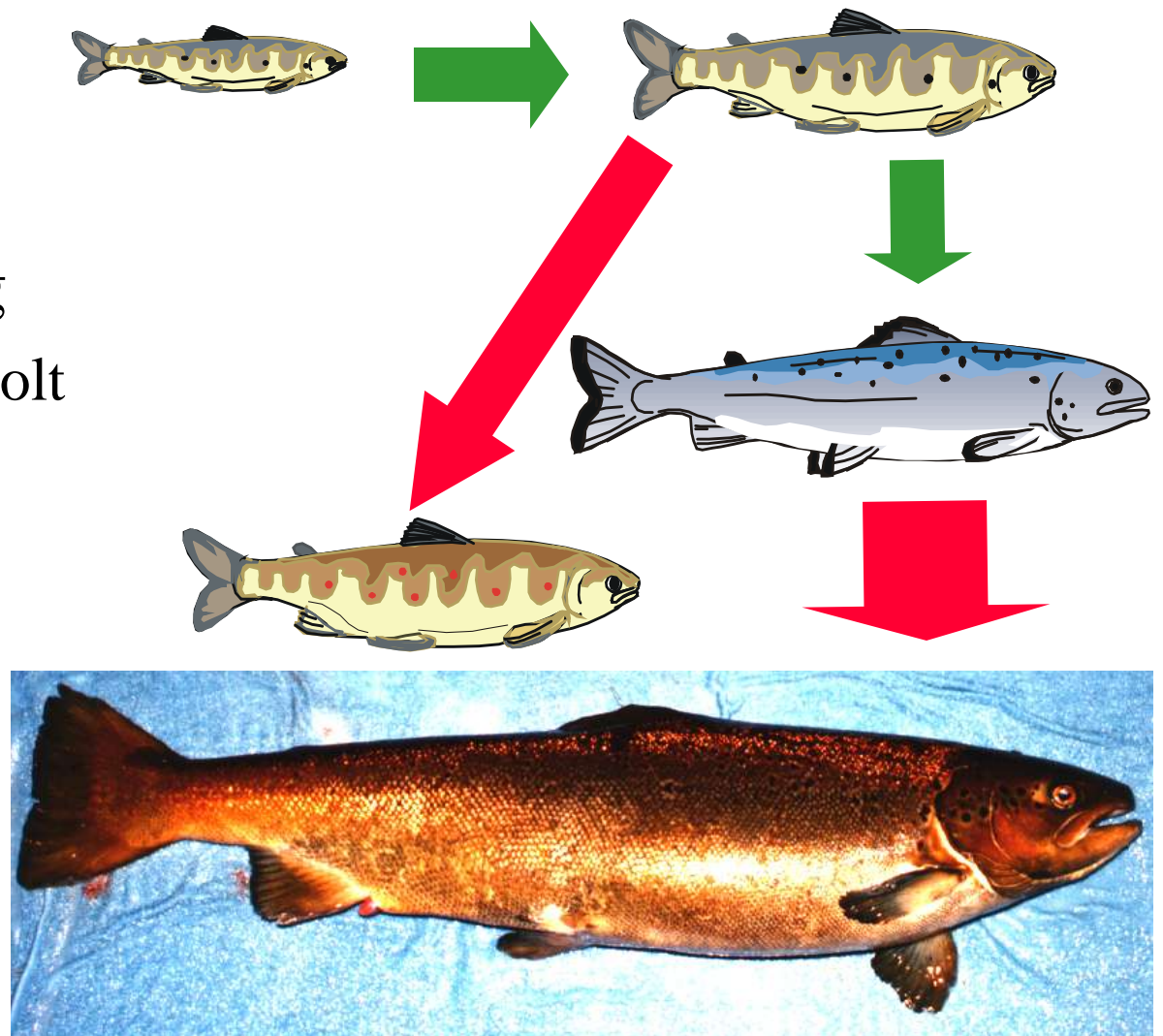
Tom Hansen



INSTITUTE OF MARINE RESEARCH
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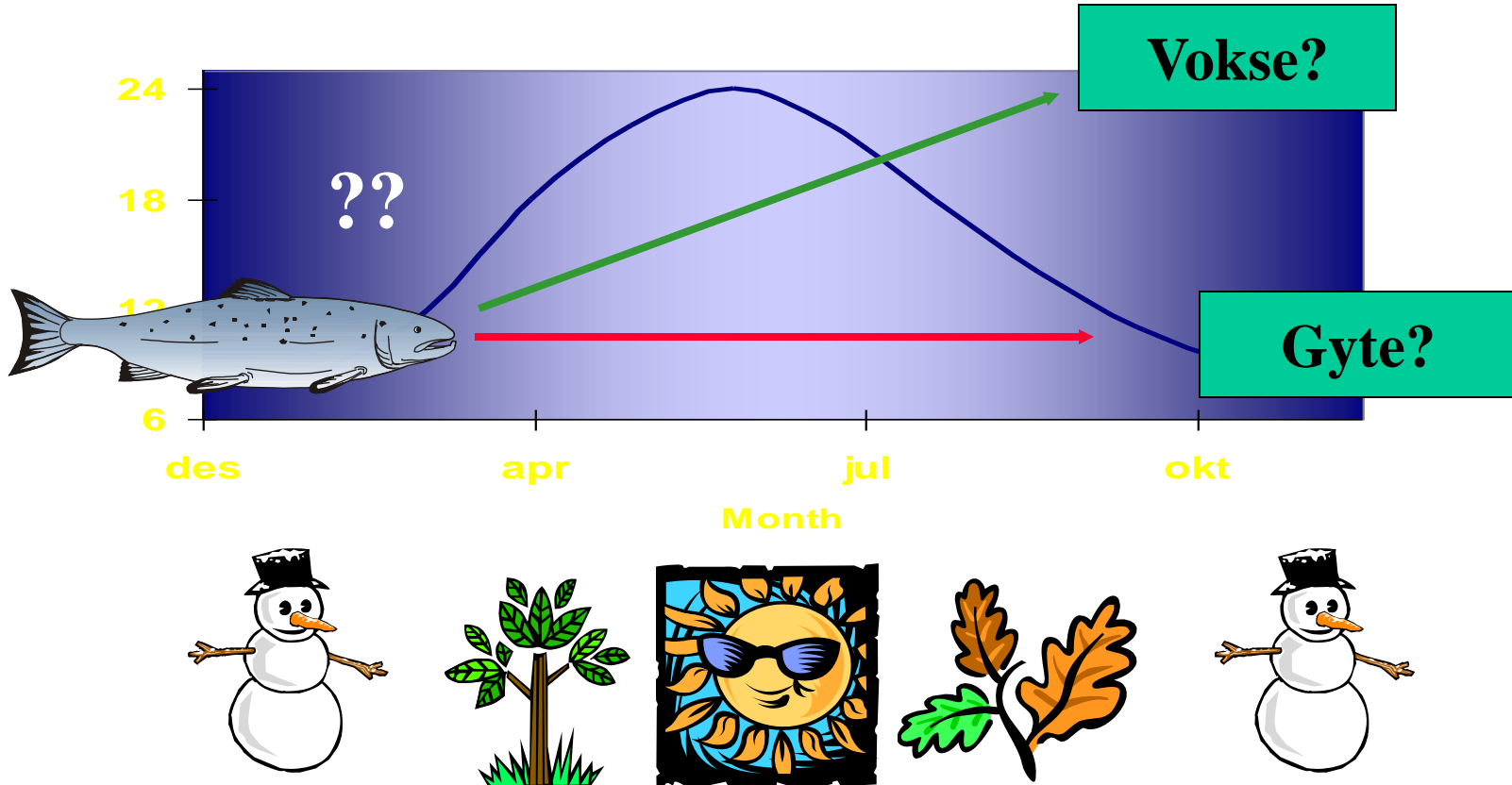
Lyset styrer utviklingen hos laks

- Vekst
- Smoltifisering
- Kjønnsmodning
 - parr, postsmolt
 - tert, 2SW
- Gytetid



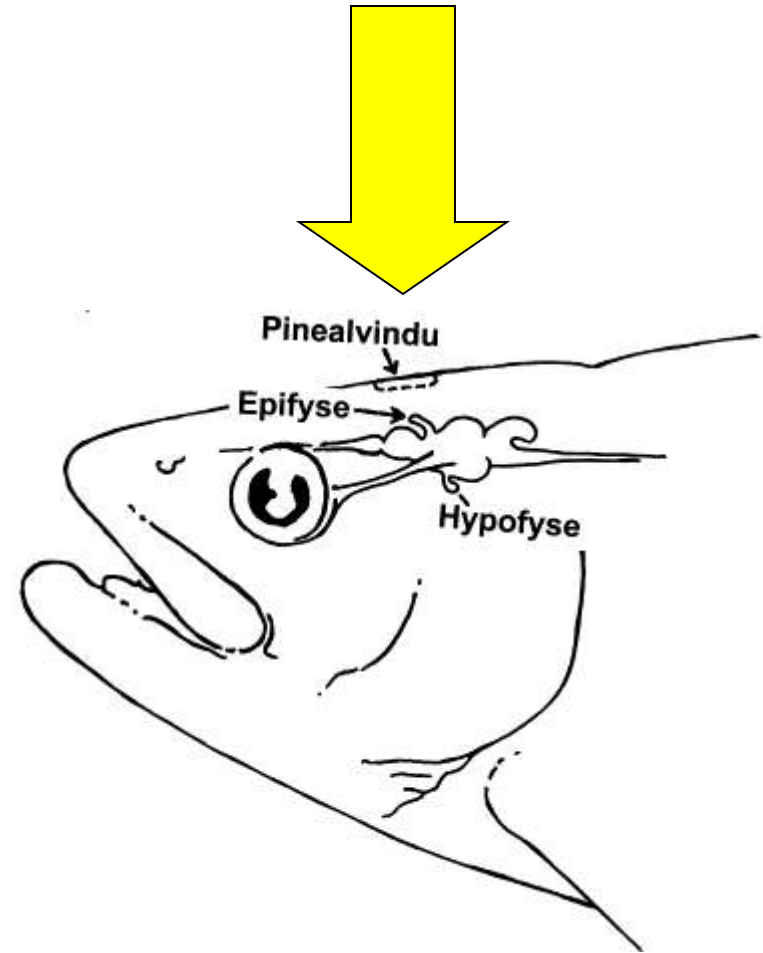
Lyset gir kalenderinformasjon

- Daglengden er den viktigste 'tidgiveren' for laks



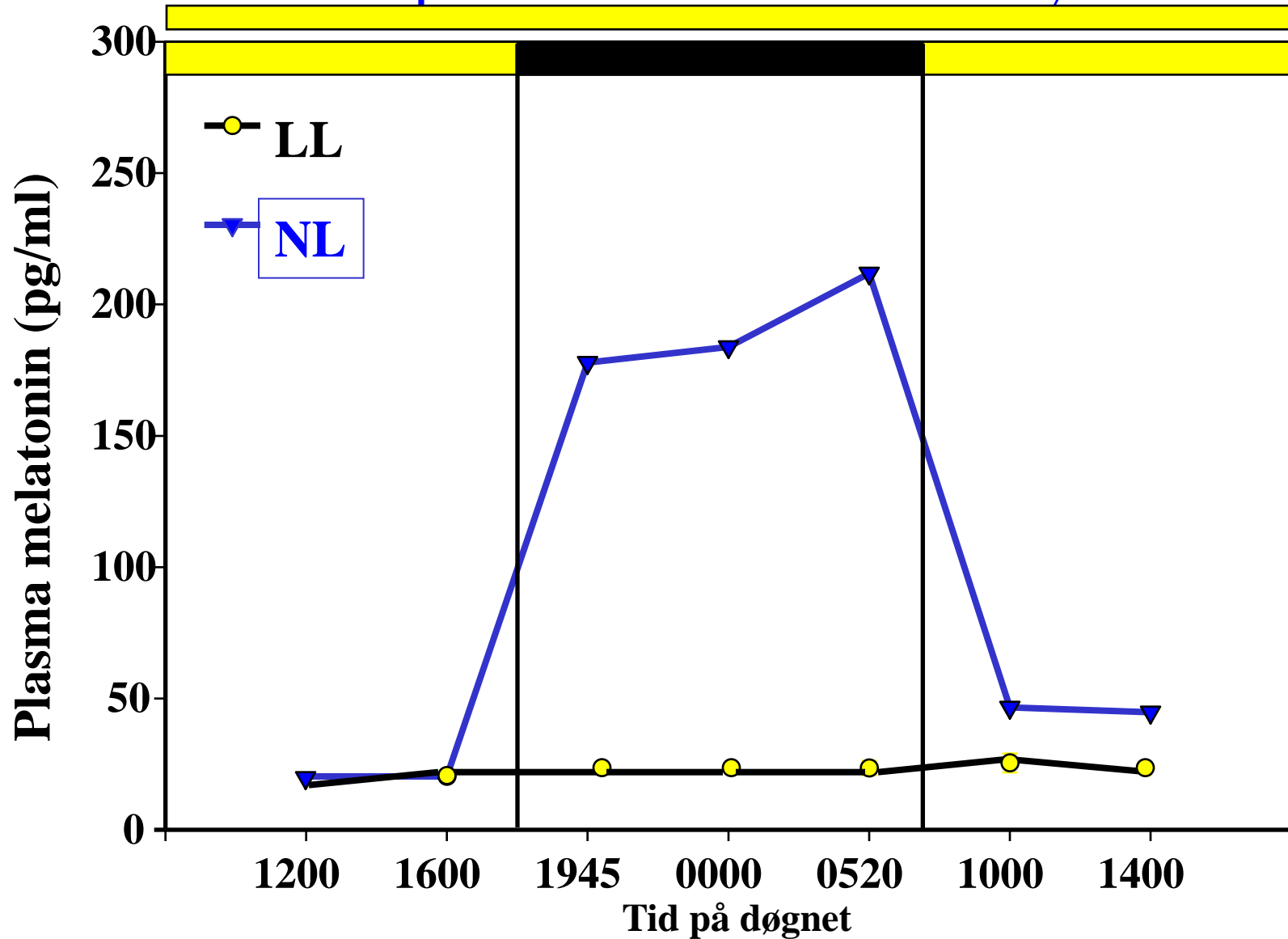
Hvordan oppfatter fisket lyset?

- Lyset virker både på øye og pinealorganet
- Pinealorganet produserer 'mørkehormonet' melatonin
- En tror at melatonin formidler informasjon om dag-lengde og sesong til fisken



Tegn. S. Mortensen

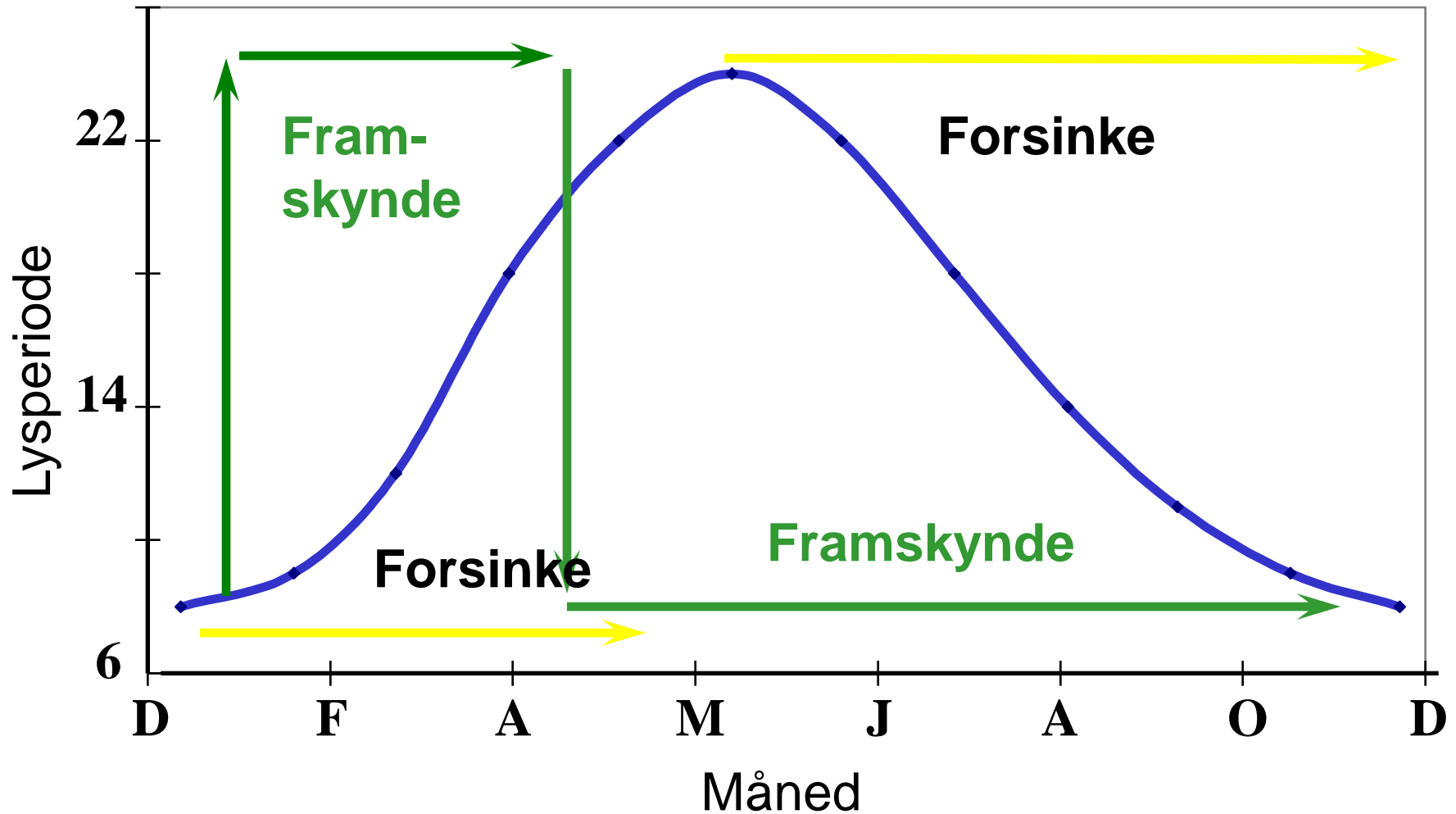
Melatoninprofil hos laks i innendørs kar



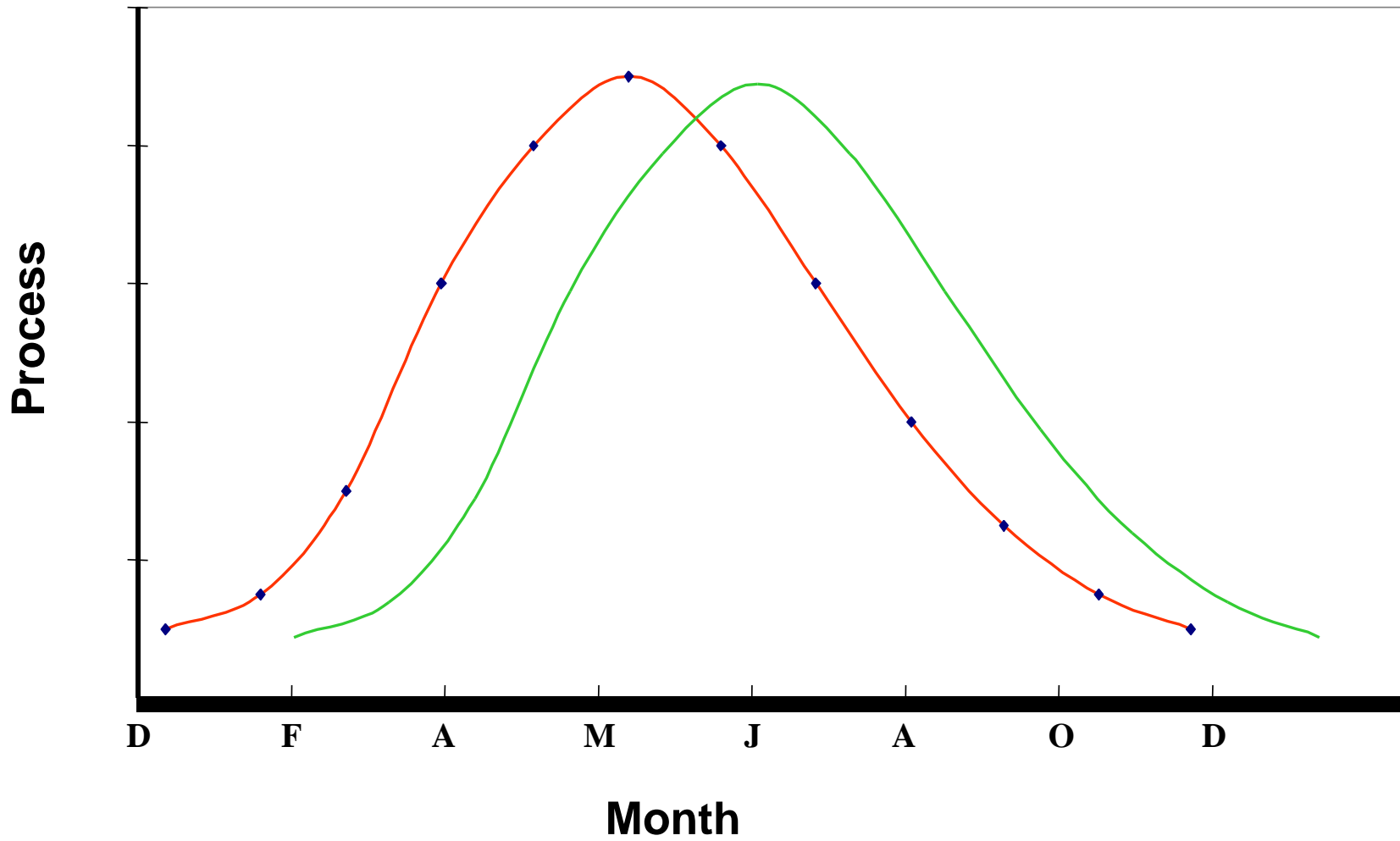
Rytmer

- Hos dyr finner vi rytmer av ulik varighet
 - Døgnrytmer
 - Månedstrytmer (f.eks menstruasjon)
 - Årsrytmer
- A-mennesker har en rytme nær 24 timer, mens B-mennesker har en rytme nær 25 timer

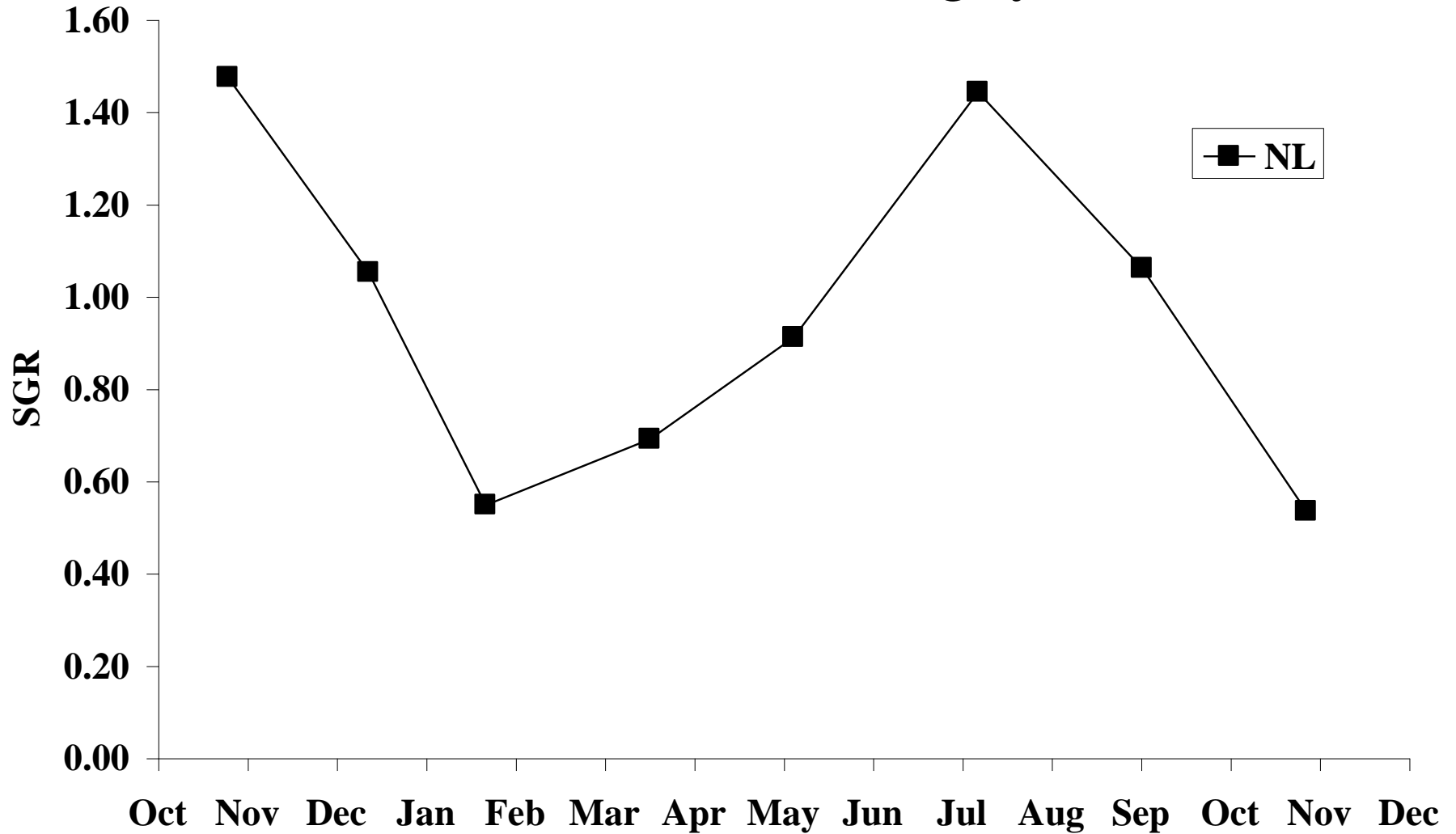
Lysperiode og indre rytmer: styrer tidspunkt for reproduksjon, smoltifisering, og vekst



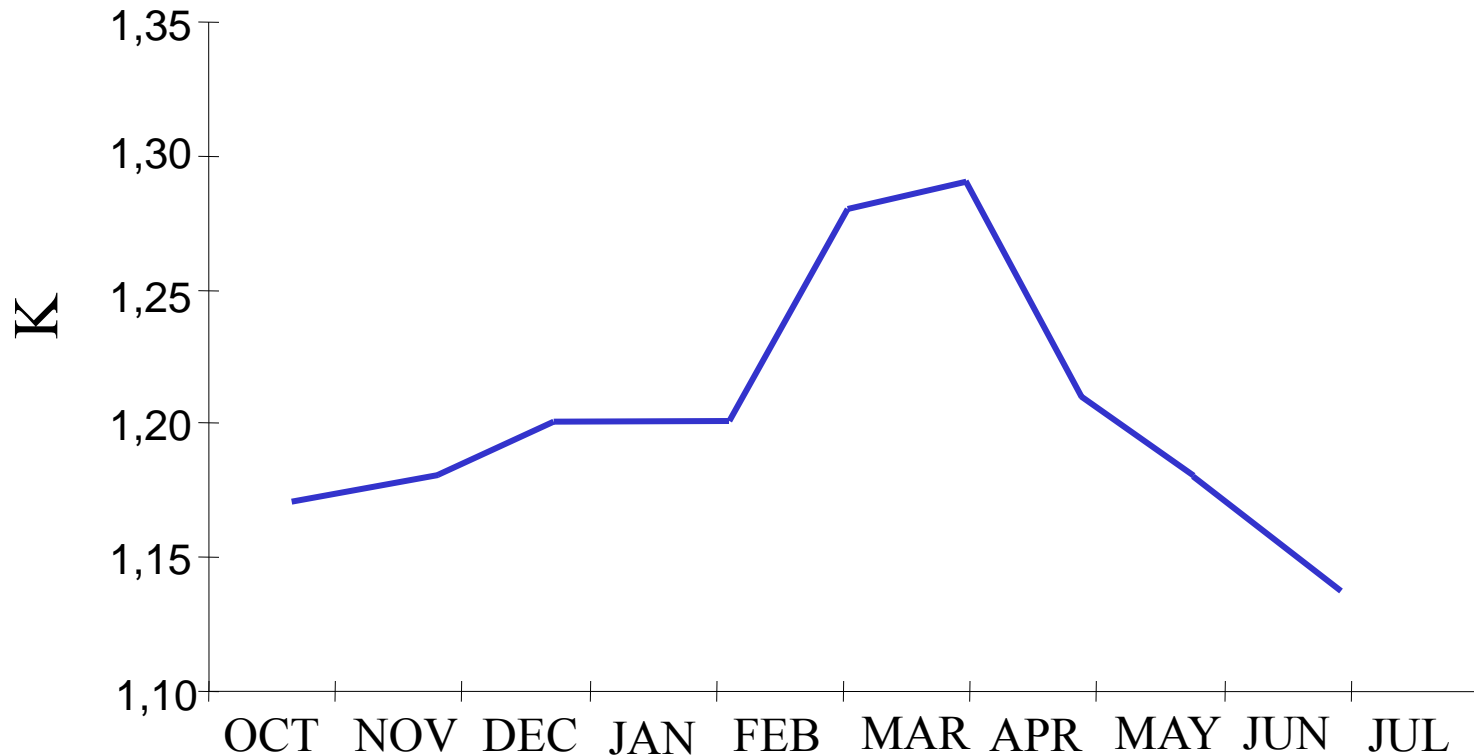
Daglengden framskynder eller forsinker prosesser



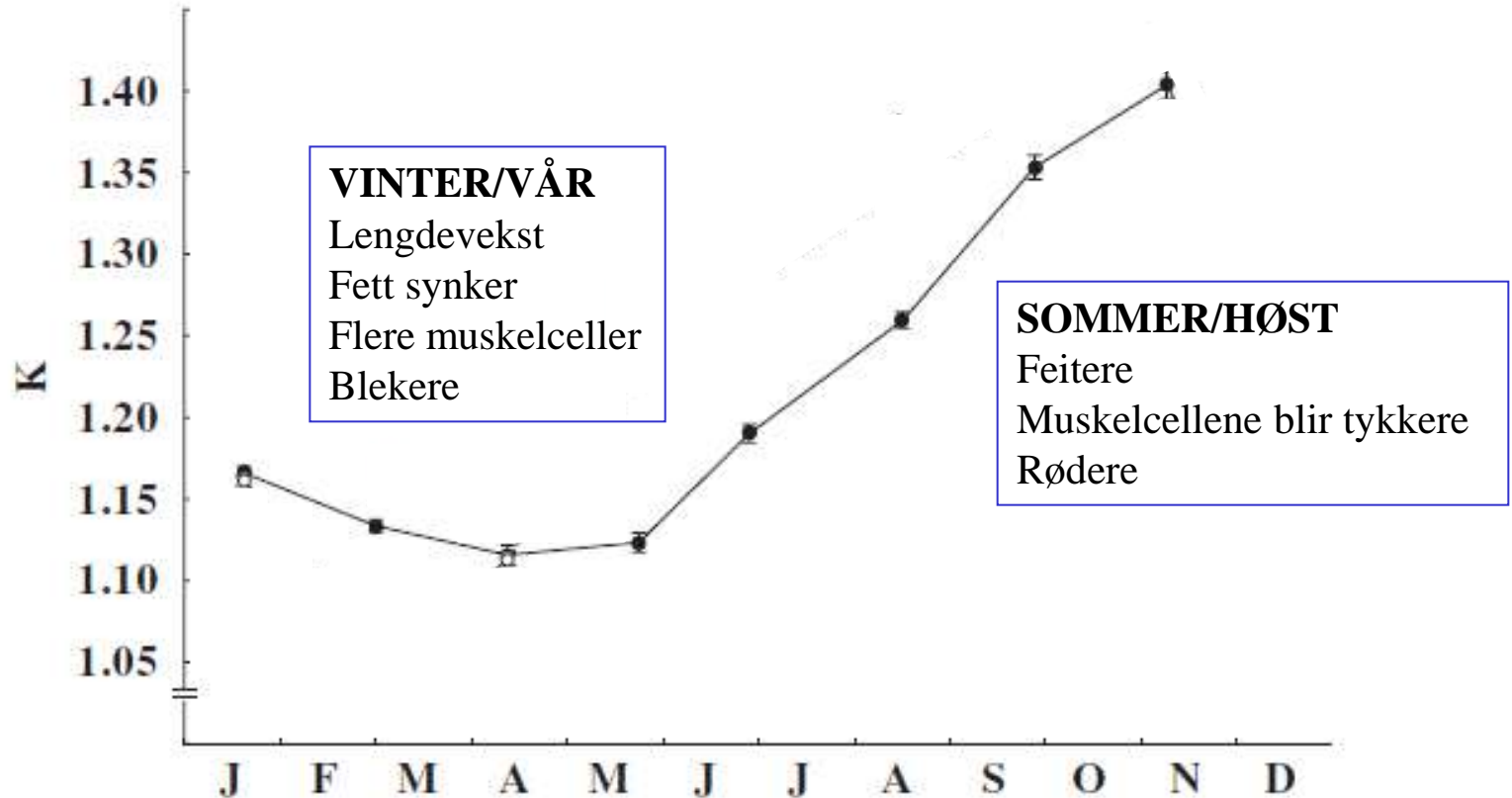
Vekstrate ved naturlig lys



Utvikling i kondisjonsfaktor på settefisk

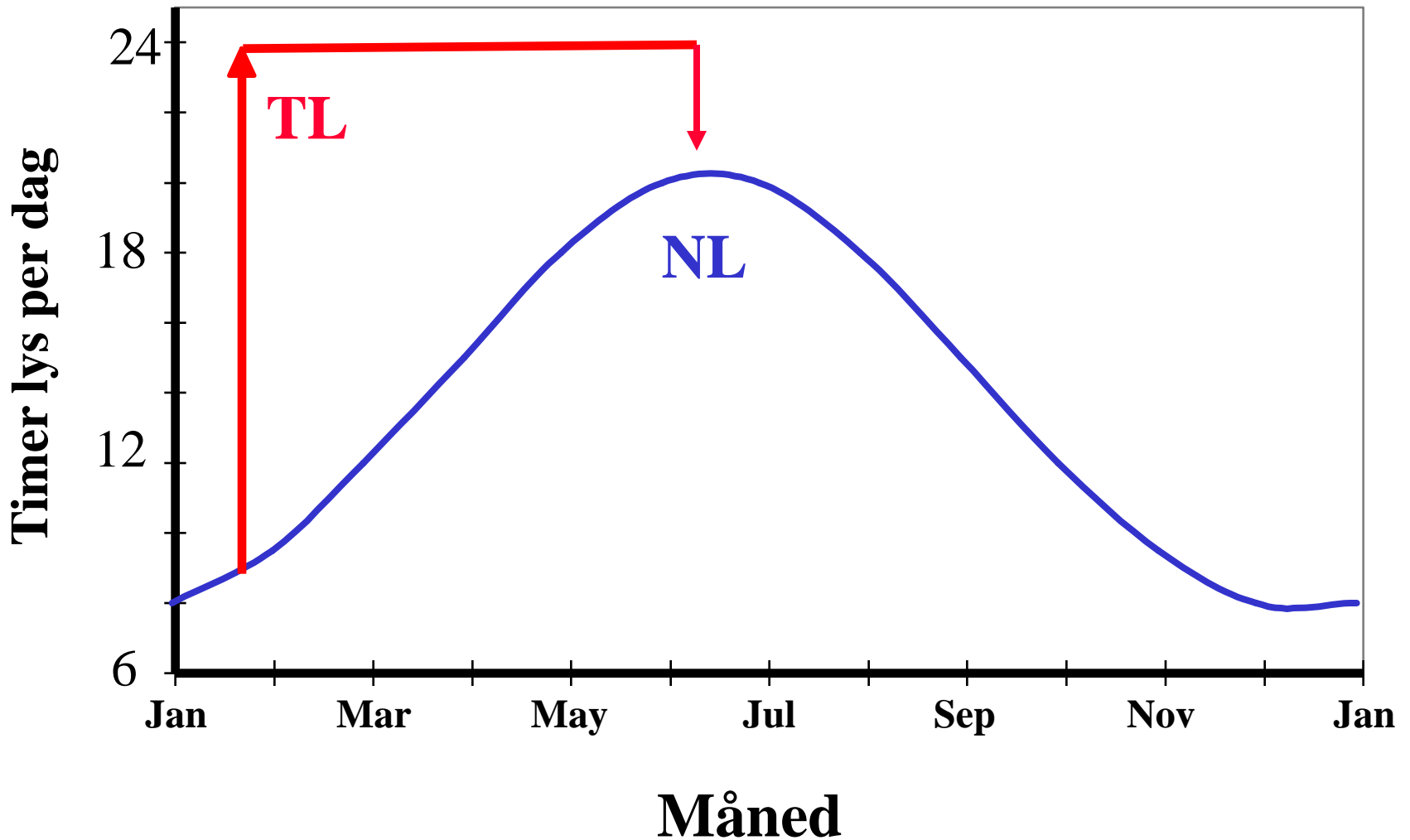


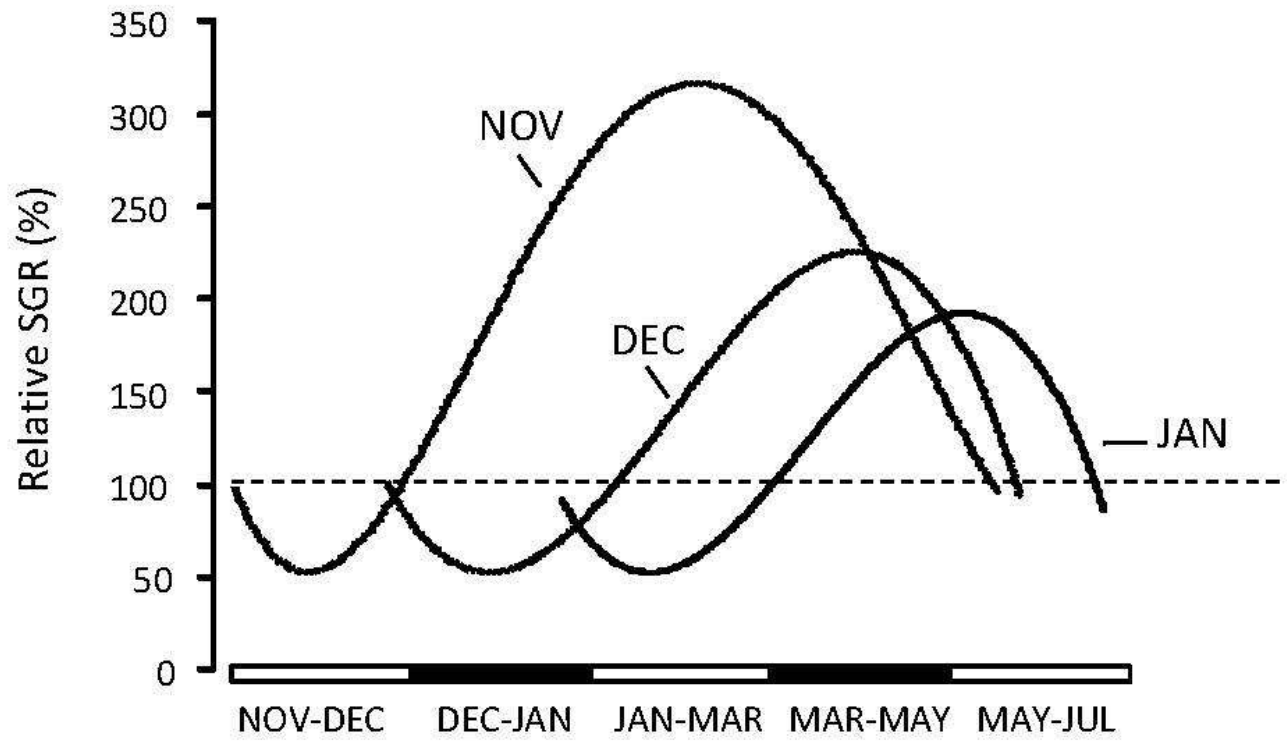
Naturlig lys



Laks som vokser fra 1 til 5 kg

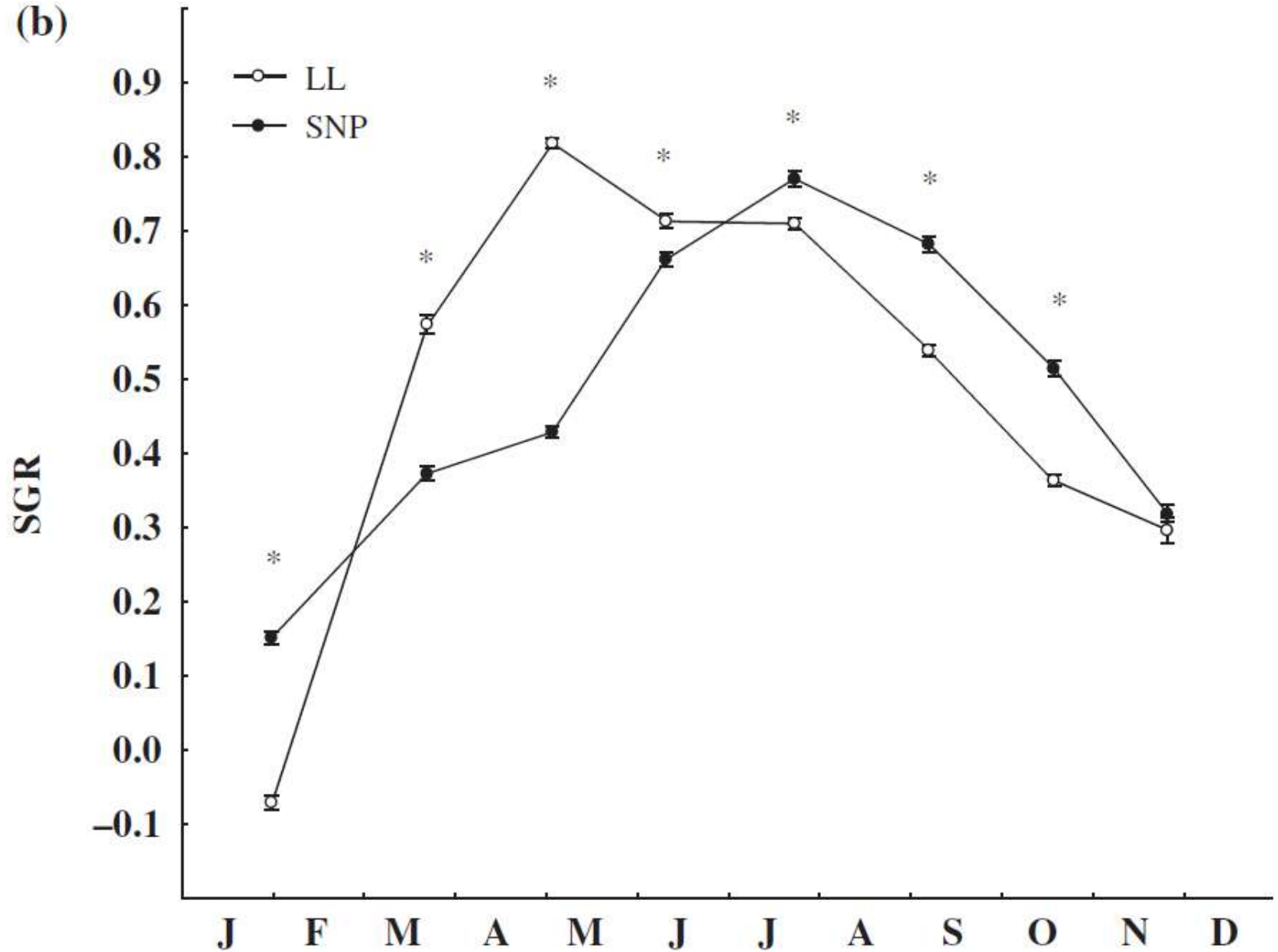
Typisk lysregime brukt i sjøvann



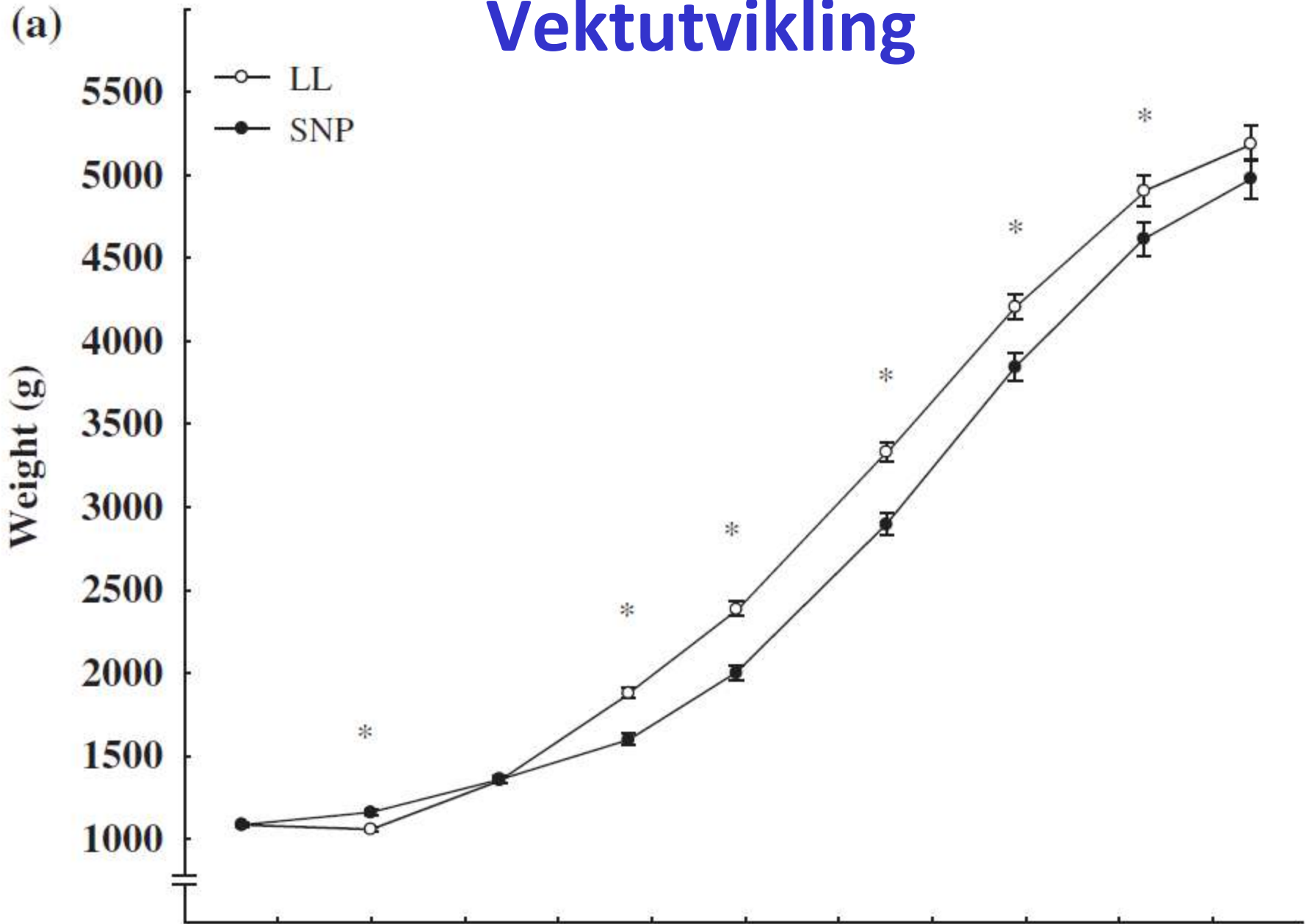


Vekstrate

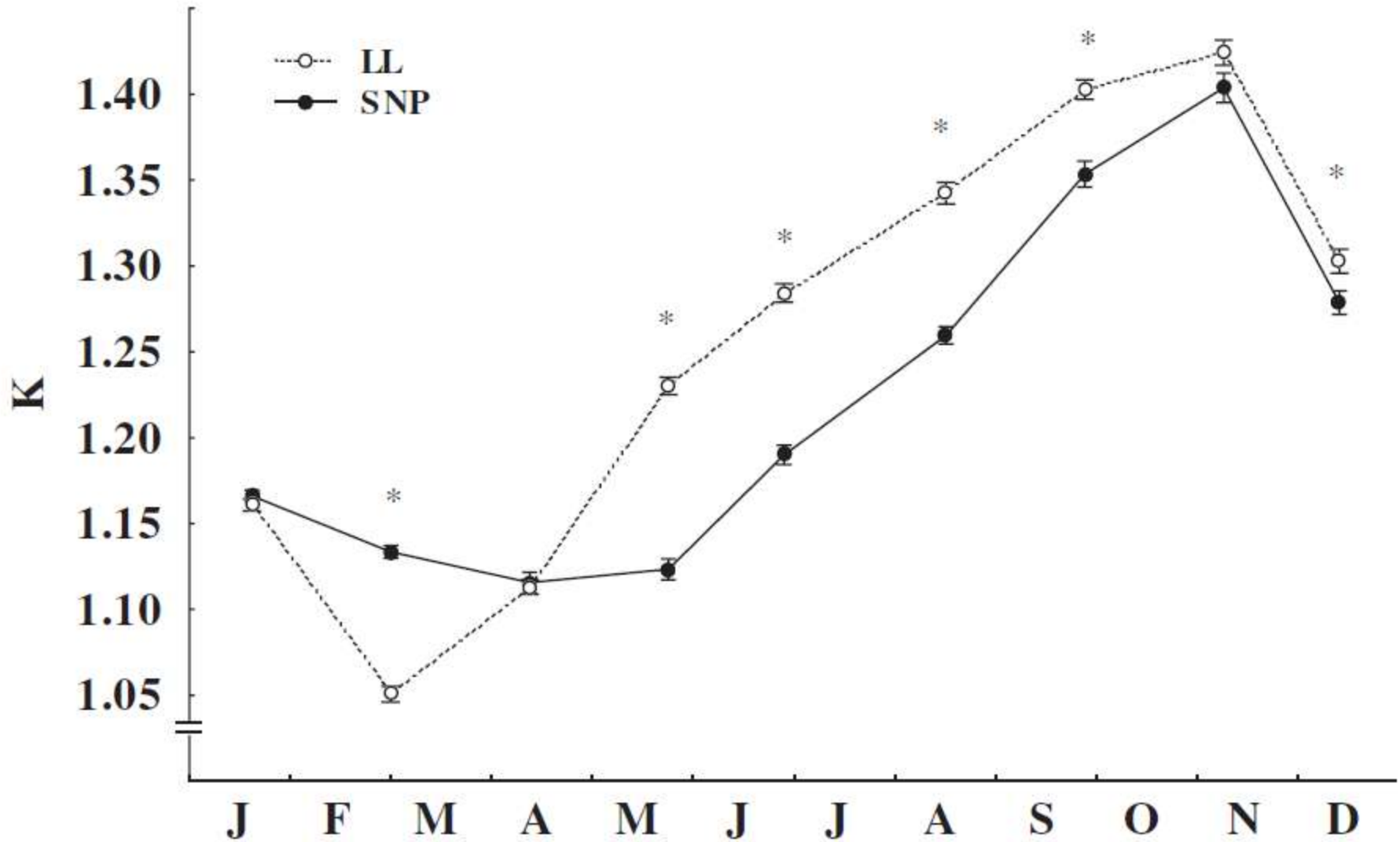
(b)



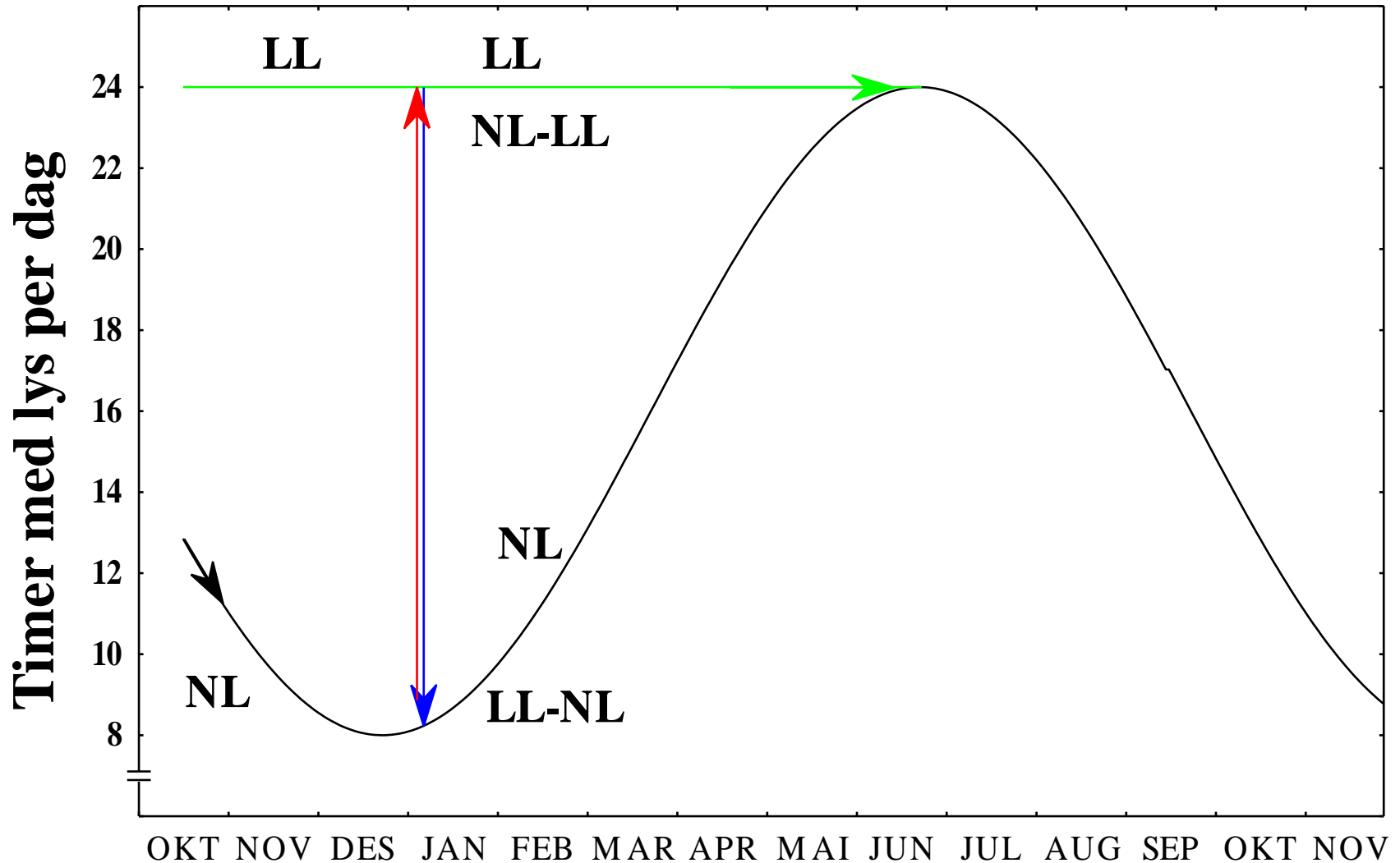
Vektutvikling



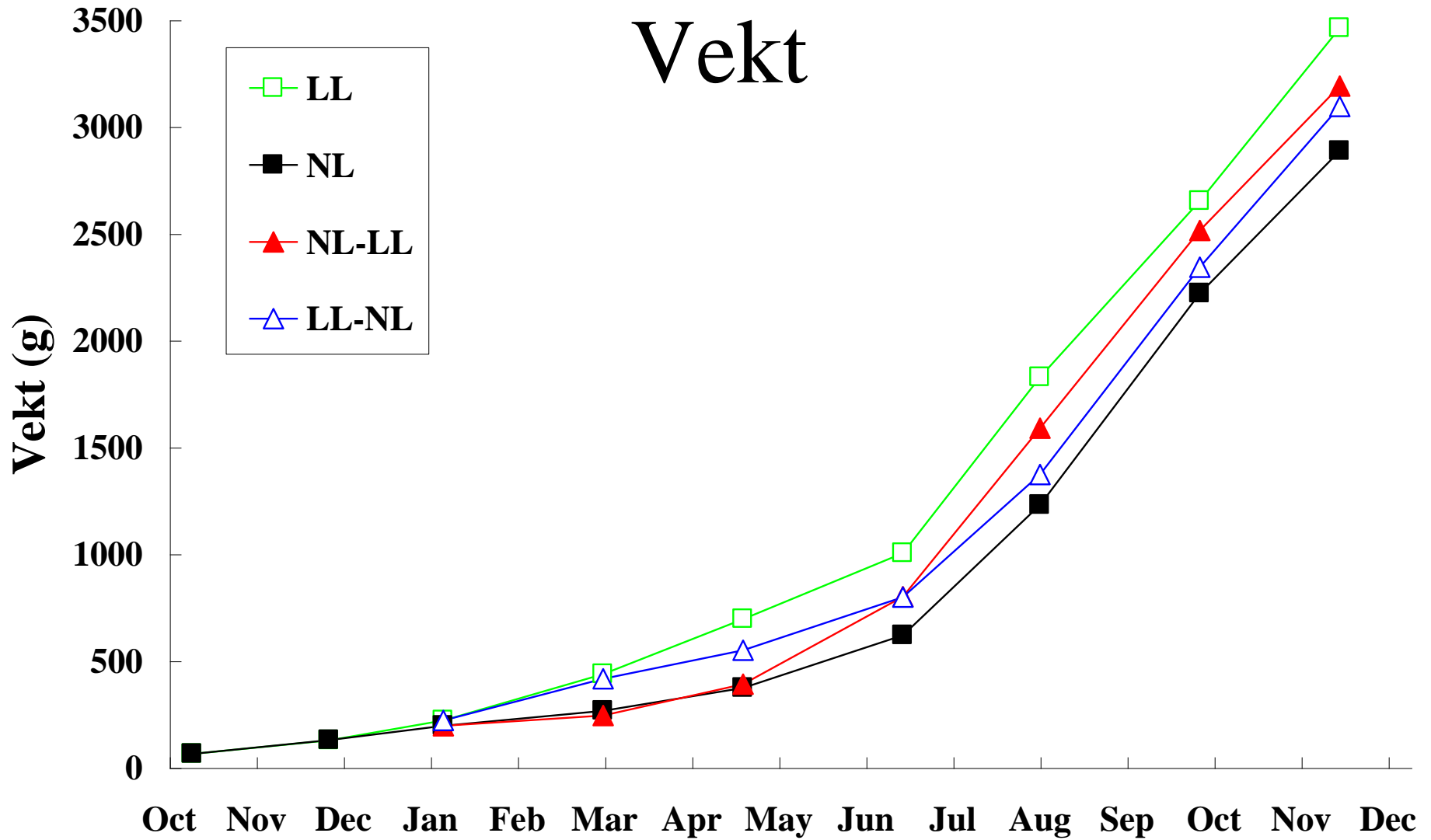
Kondisjonsfaktor



Lysregimer høstsmolt



Vekt



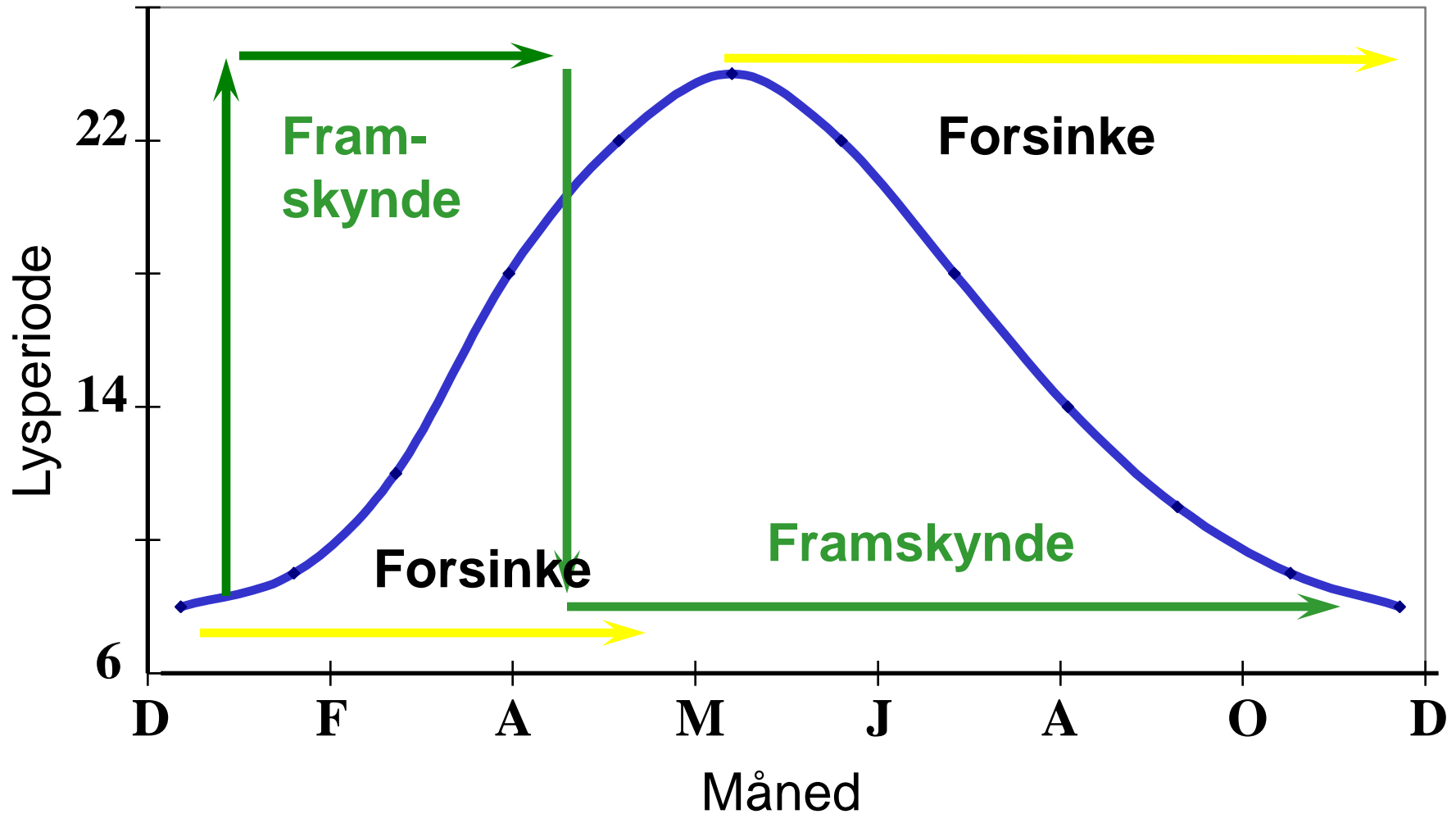
Problem med tidlig modning

- Hovedproblem: tert (som blir moden etter 1,5 år i sjø) – økende problem også på høstsmolt?
- Postsmoltmodning kan bli et problem ved storsmolt – lukkede enheter!
- Noen år modningsproblem også på lyssatt fisk (temperatur)
- Tapt vekst fra juni og utover
- Redusert kvalitet (pigmenter, fettnivå mm)
- Begrenser slakte-sesong og -størrelse
- Økt risiko for sykdom og økt dødelighet i sjøvann (typisk 70%)
- Velferdsproblem hvis en holder fisken i sjøvann

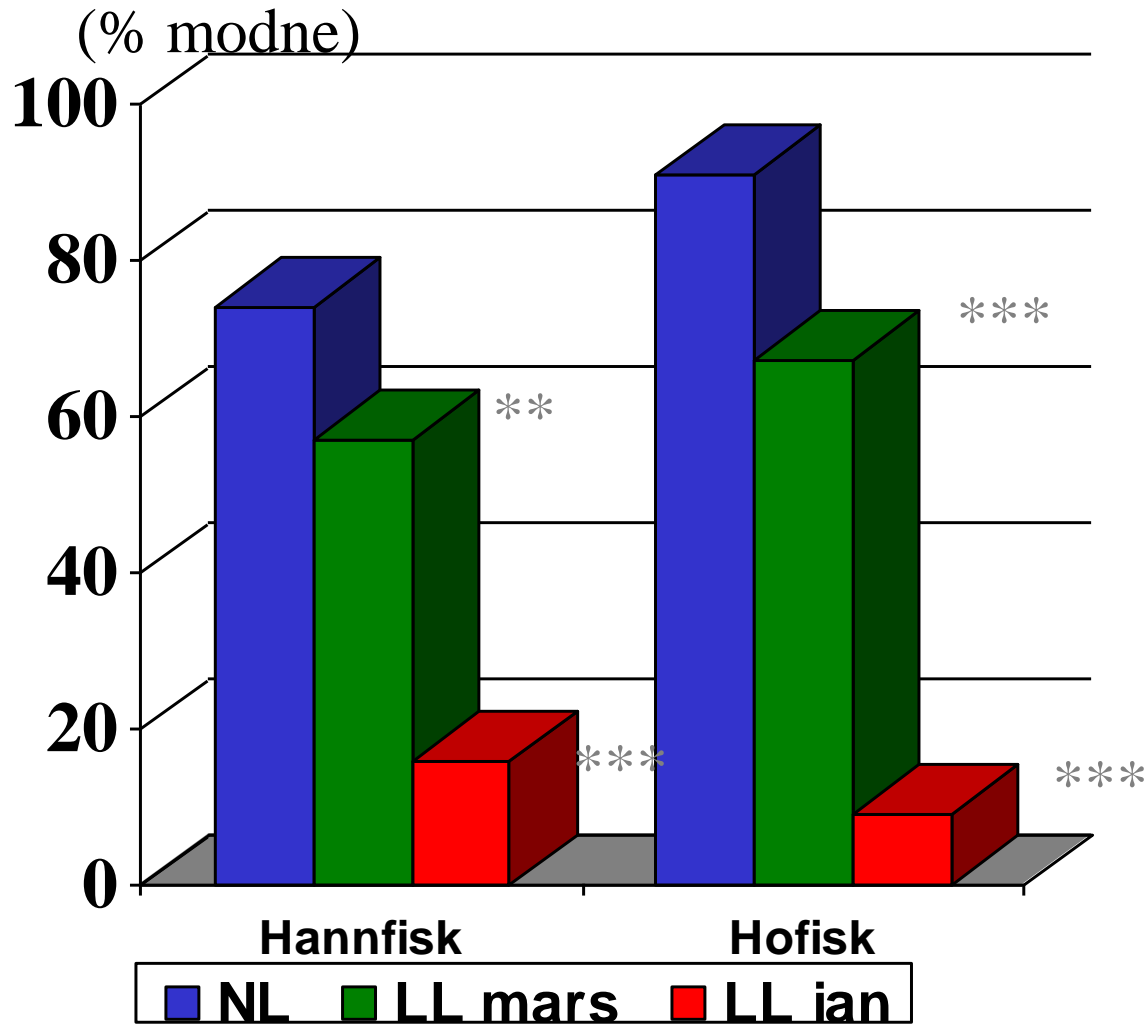




Lysperiode og indre rytmer: styrer tidspunkt for reproduksjon, smoltifisering, og vekst



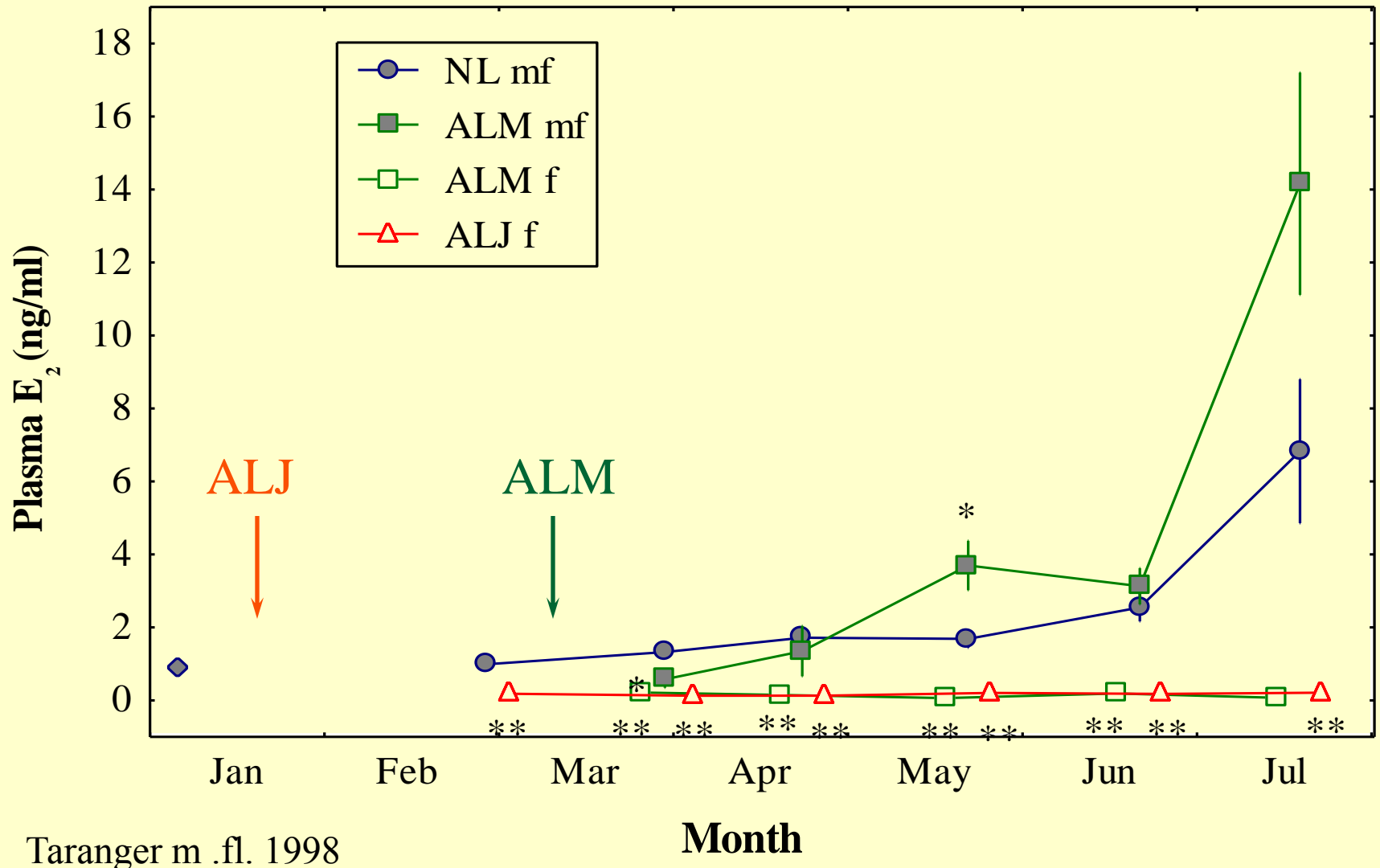
TL kan redusere andel kjønnsmodning

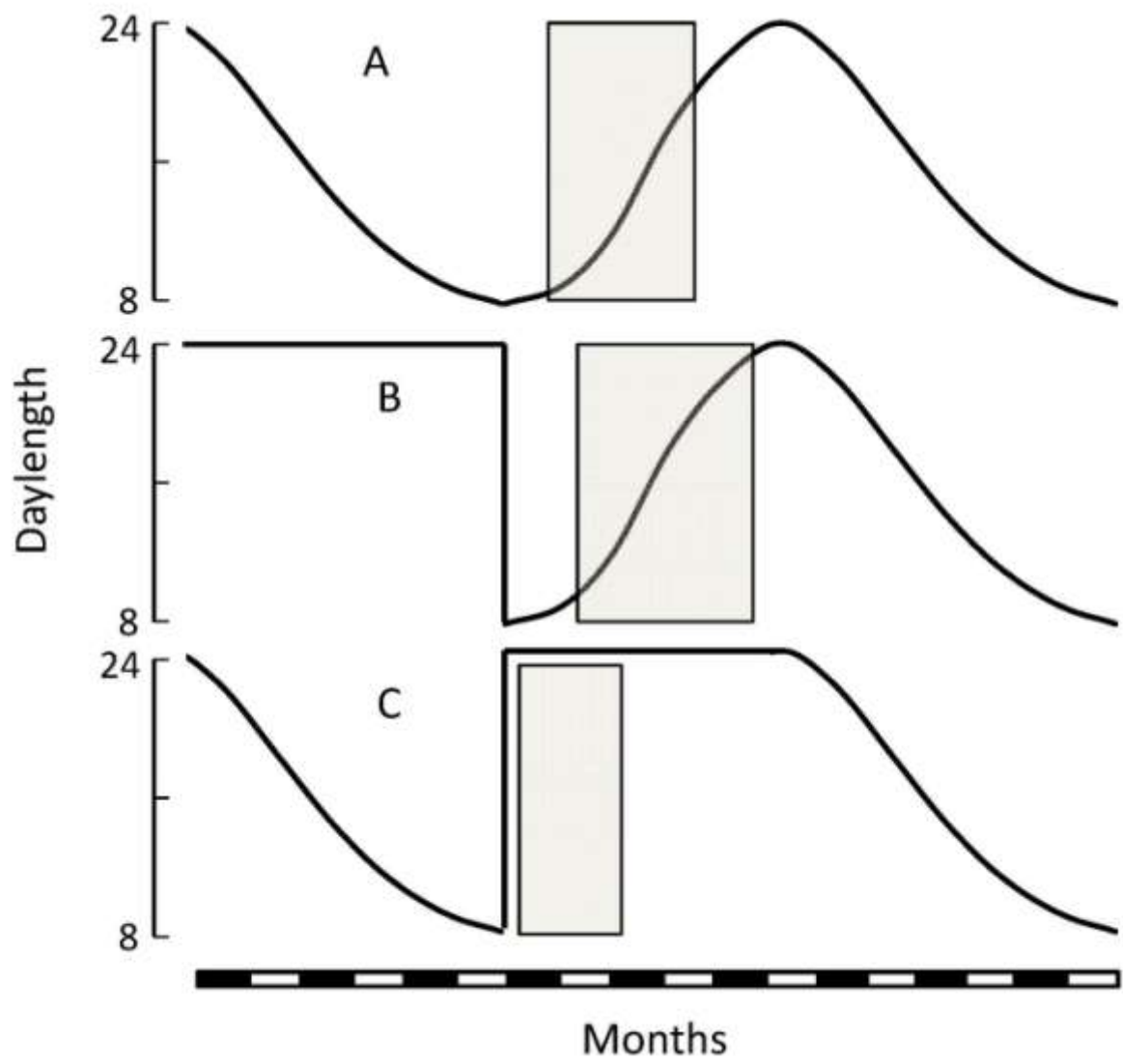


(Taranger m. fl. 1998)

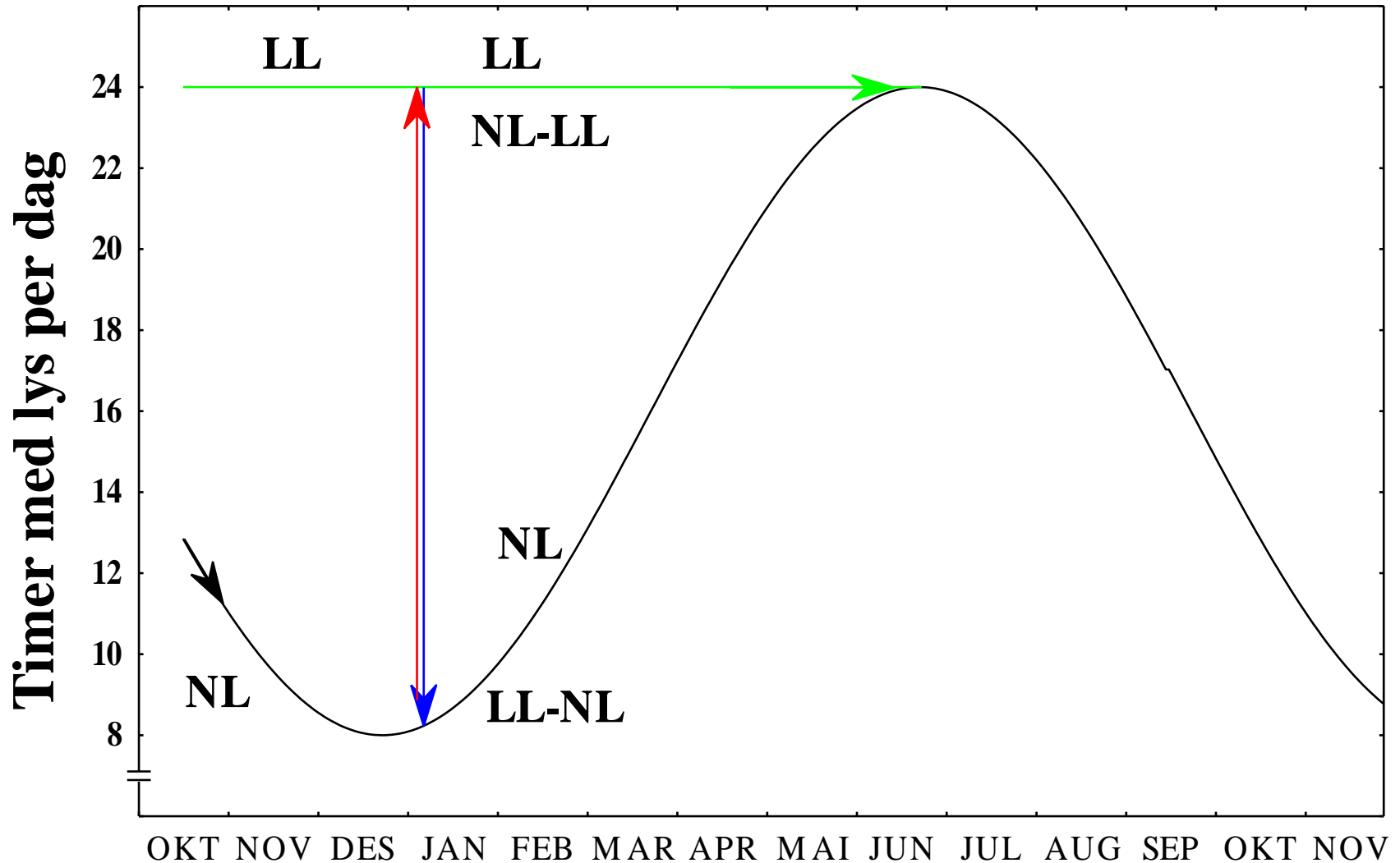


Plasma østradiol (E₂) i hofisk

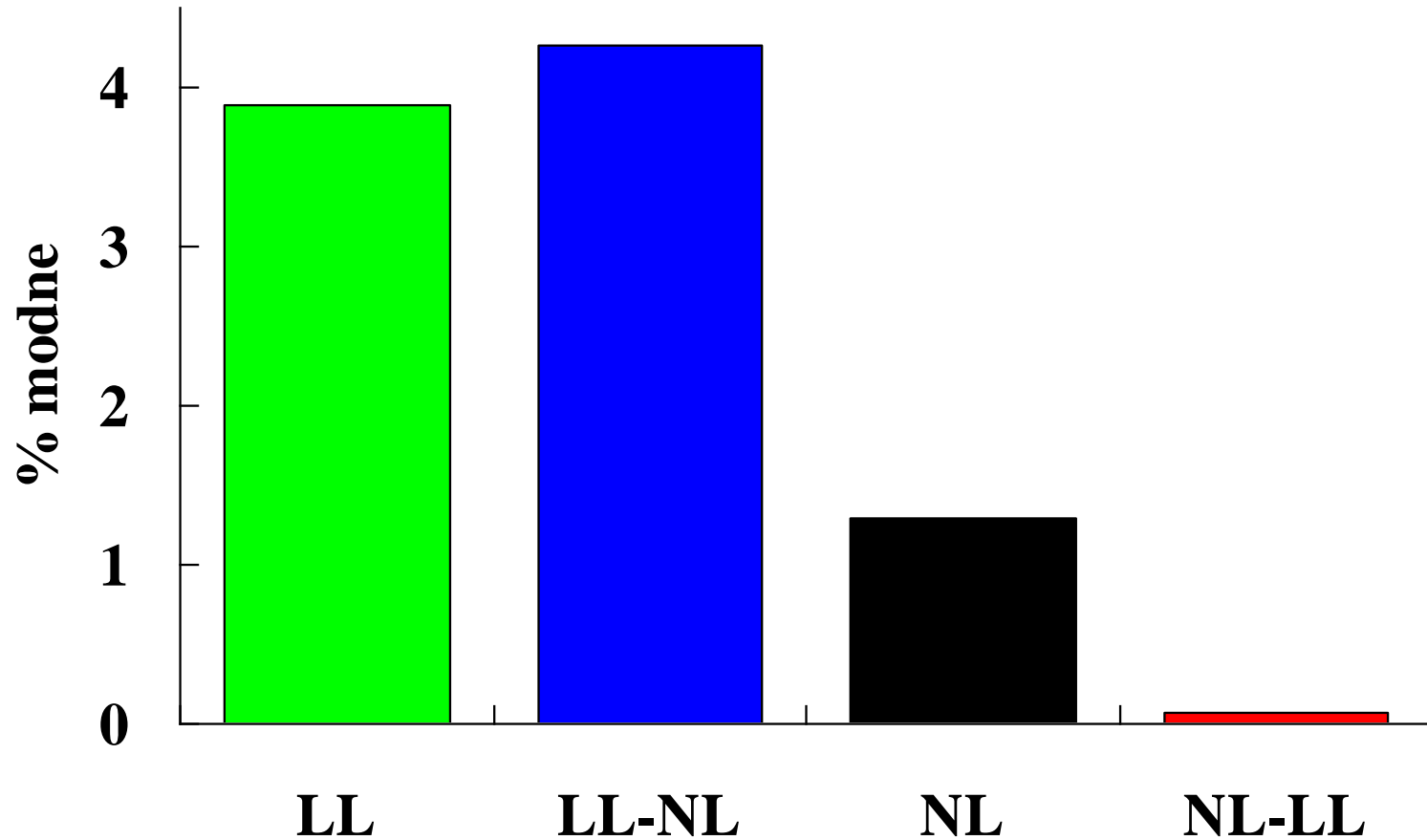


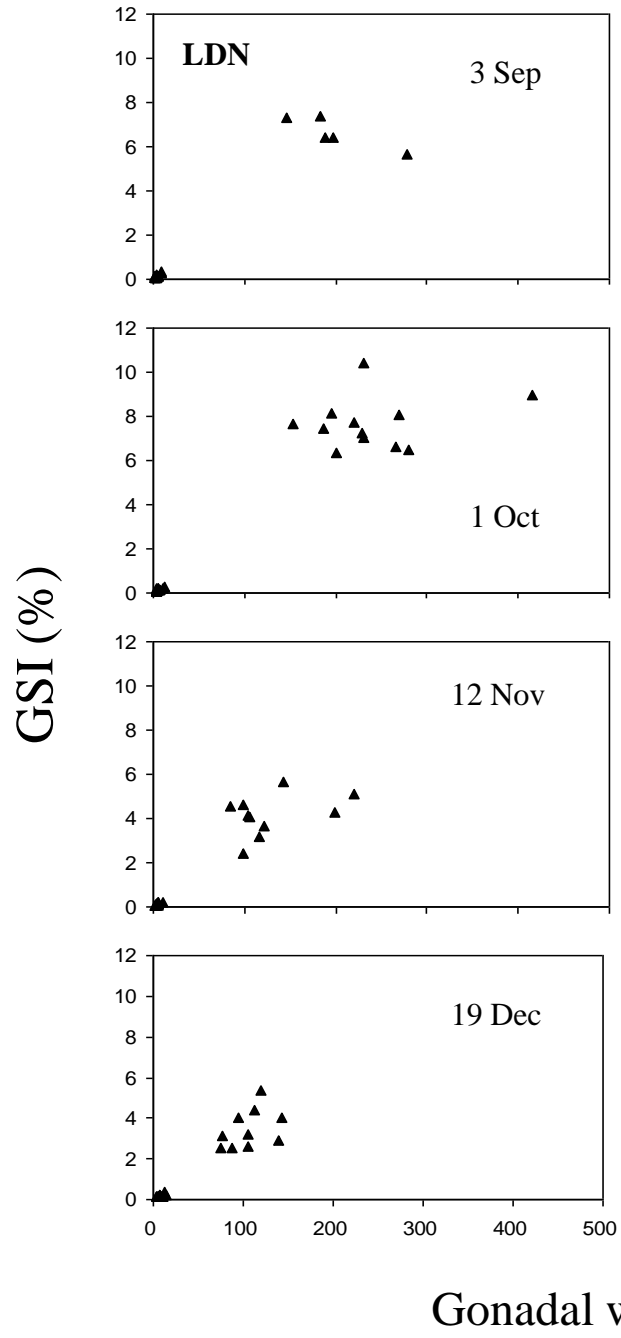


Lysregimer høstsmolt

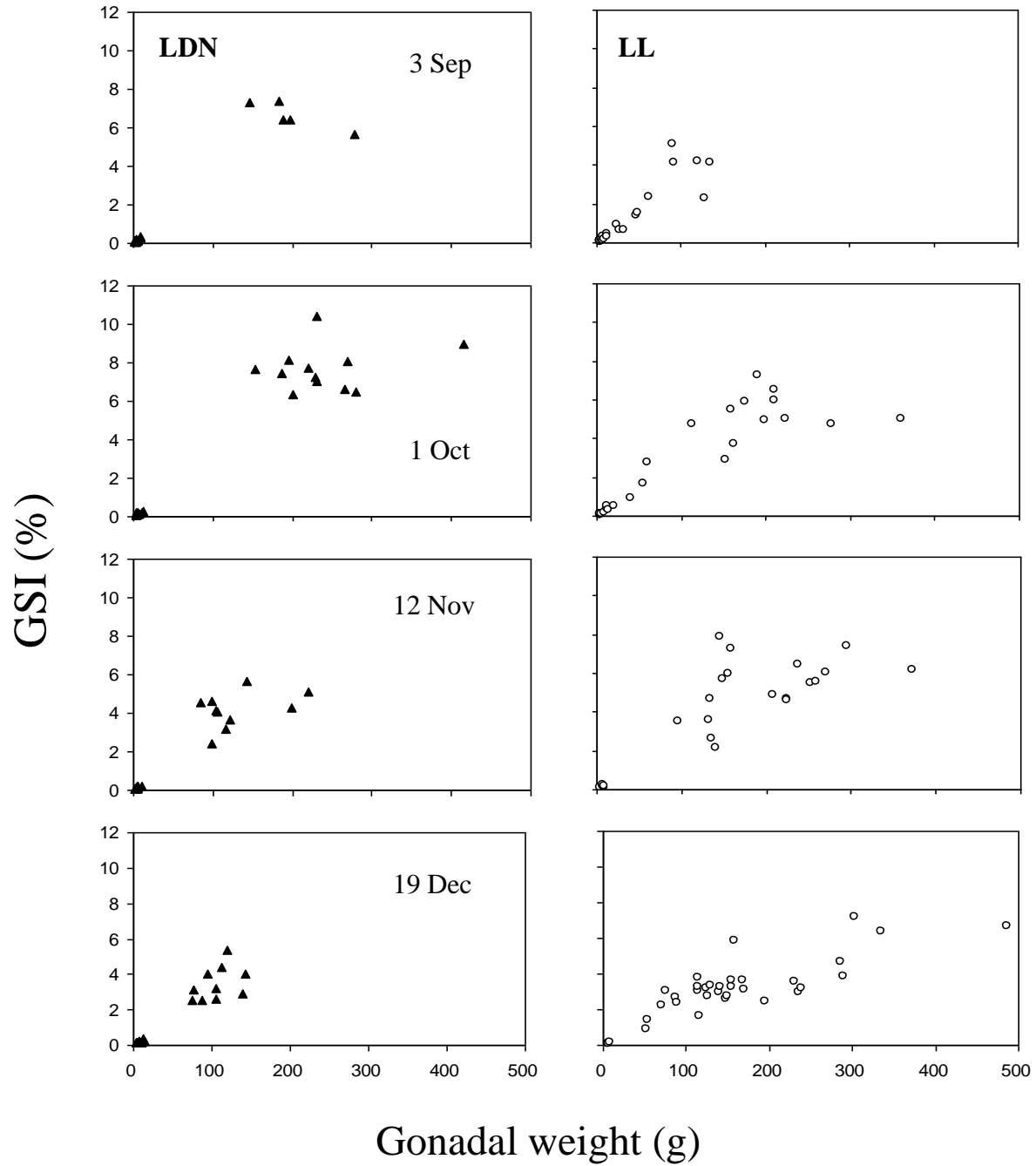


Modningsandel høstsmolt





Gonadal weight (g)



Optimal lysstyring

- Starttidspunkt: 'jan'?
- Sluttidspunkt: mai-jun?
- Modning og vekst?
- Tilpasning til miljøforhold og slaktetid?
 - temperaturprofil
- "Lysintensitet": 2-4 W/m²?
- Lysfarge/lampetype?

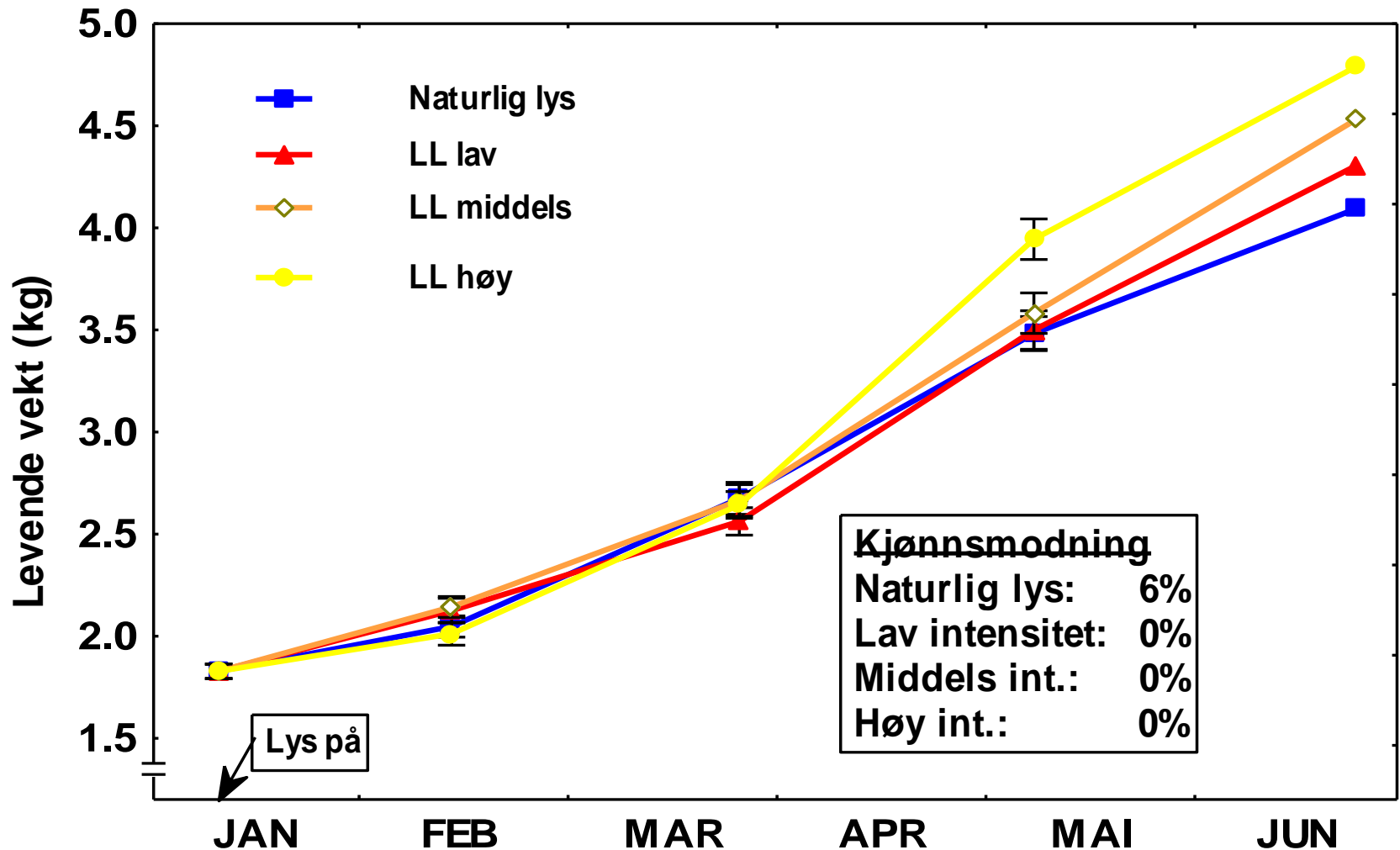
Annet?

- Fisketettheten påvirker intensiteten/irradiansen
- Fiskens adferd/svømmeaktivitet vil påvirke hvor ofte og hvor kraftig den eksponeres
- Lysplassering?

Lysintensitet

Gruppe	KL-HØY	KL-MED	KL-LAV	NL	Dagslys
Wattstyrke	3200	600	280		
Reduksjonsfilter (% red.)		55-0*	88		
Beregnet wattstyrke	3200	270-600*	35		
W/m ² overflate	22,2	1,9-4,1*	0,24		
Illuminans i lux (5m dyp)	340	60	27	0,0	749
Illuminans i lux (10m dyp)	56	17	5	0,1	594
Irradians i Wm ⁻² (5m dyp)	0,749	0,144	0,060	0,000	2,3
Irradians i Wm ⁻² (10m dyp)	0,120	0,037	0,012	0,003	1,6

Effekt av ulik lysintensitet - vårs molt



Oppedal m. fl. 1997, NFR 107537/120

Intelliled
400W lamper

LED 100-1	LED 100-3
MH- 3	LED 100-1
MH- 1	MH- 2
LED 50	LED 75
LED 1	LED 25
NL 2	NL 3
	NL 1

modning

3.6

6.3

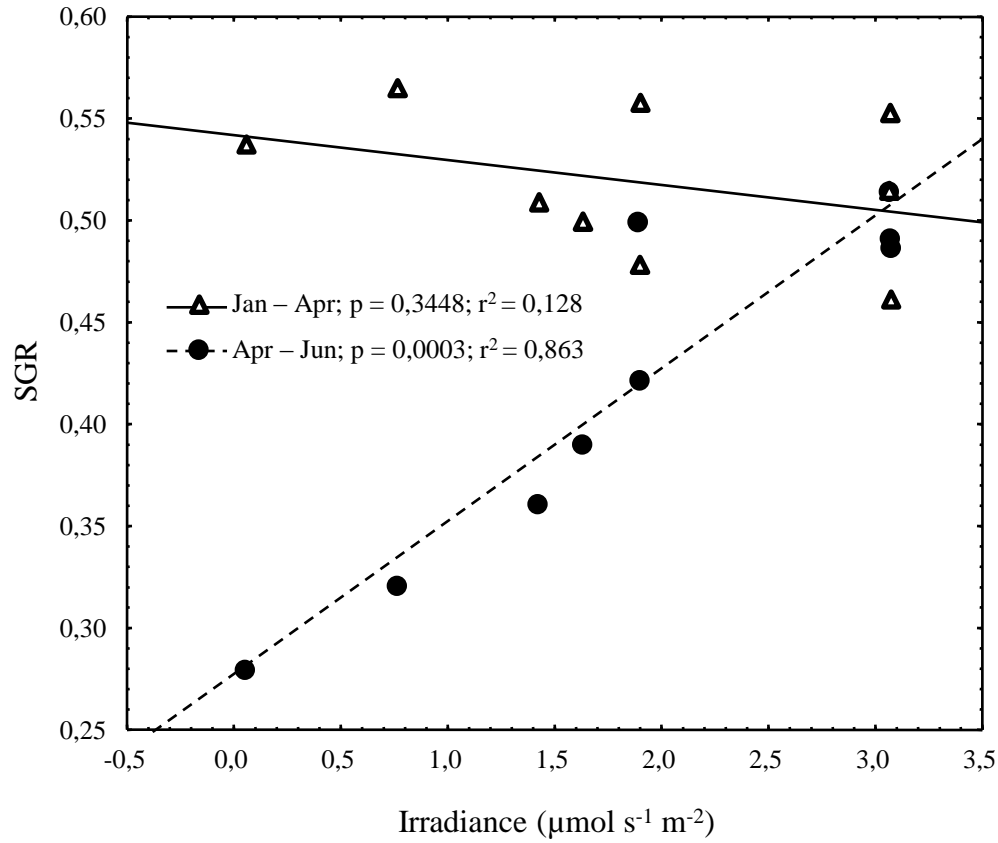
←presenning

2.5

5.6

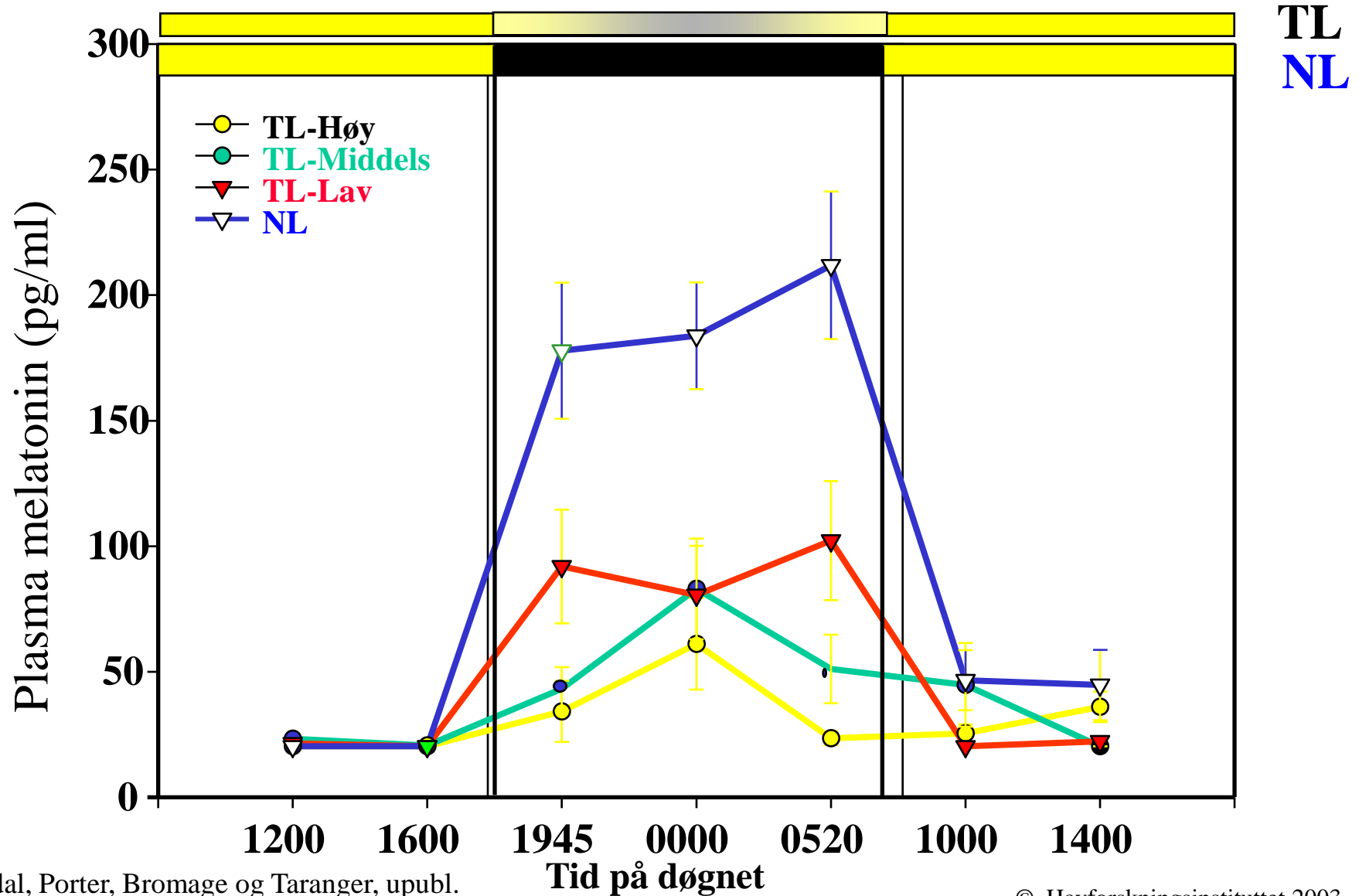
13.7

6 kg

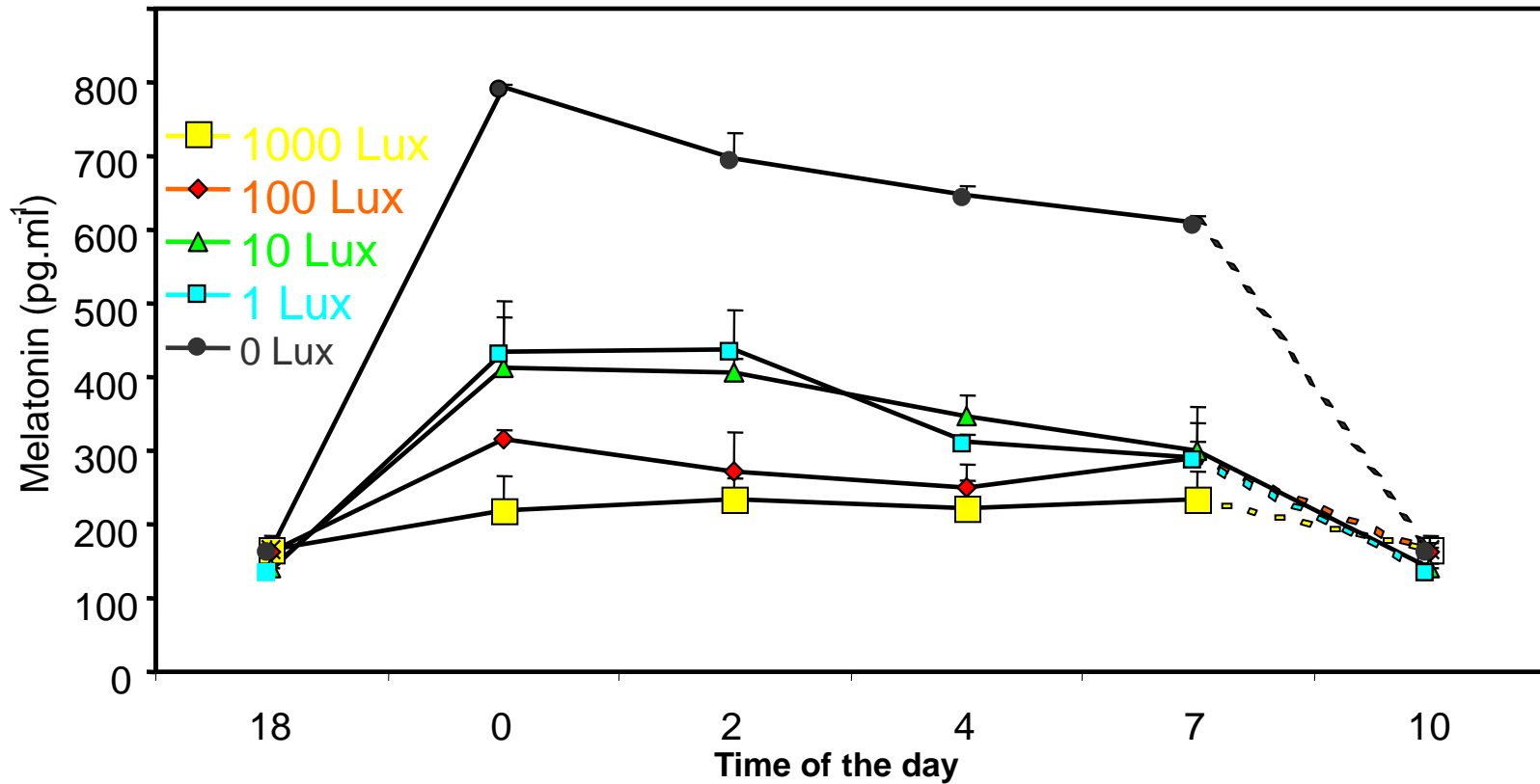


7.3 kg

Melatoninprofil laks i merd med tilleggslys (TL)



Melatoninprofil hos laks i kar med ulike lysintensiteter

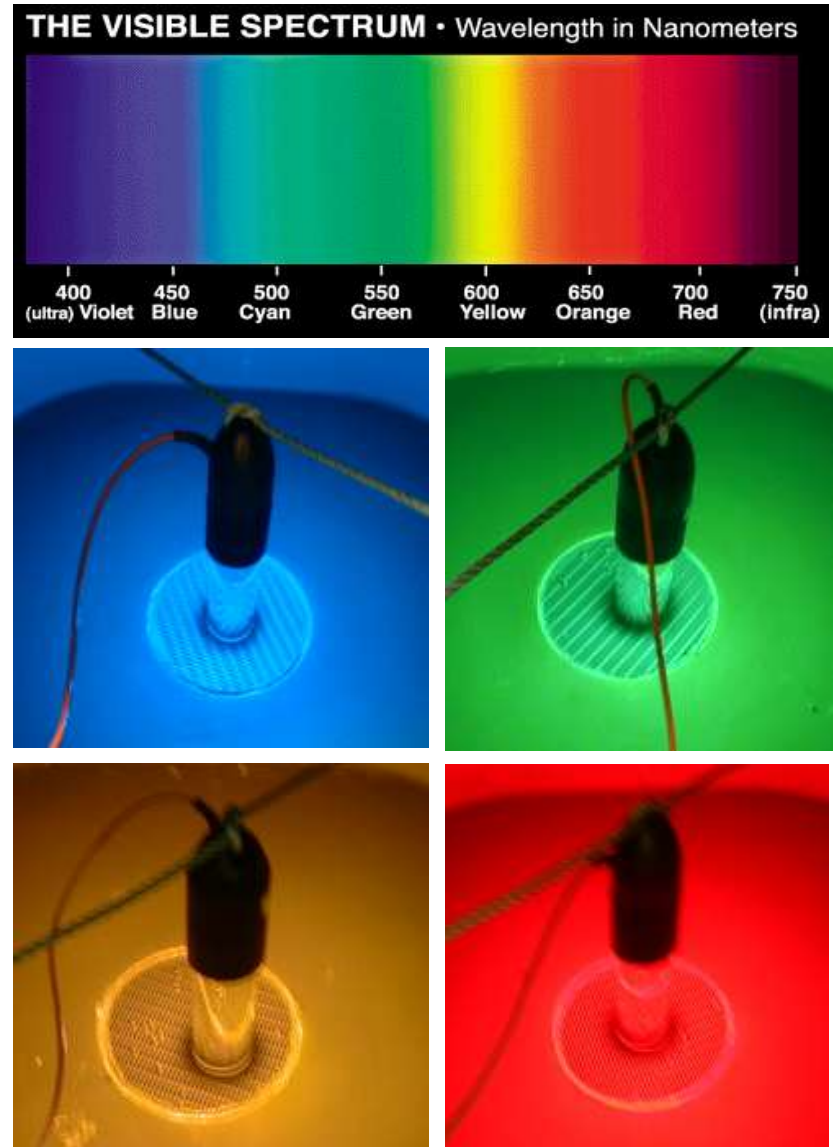


1000 Lux

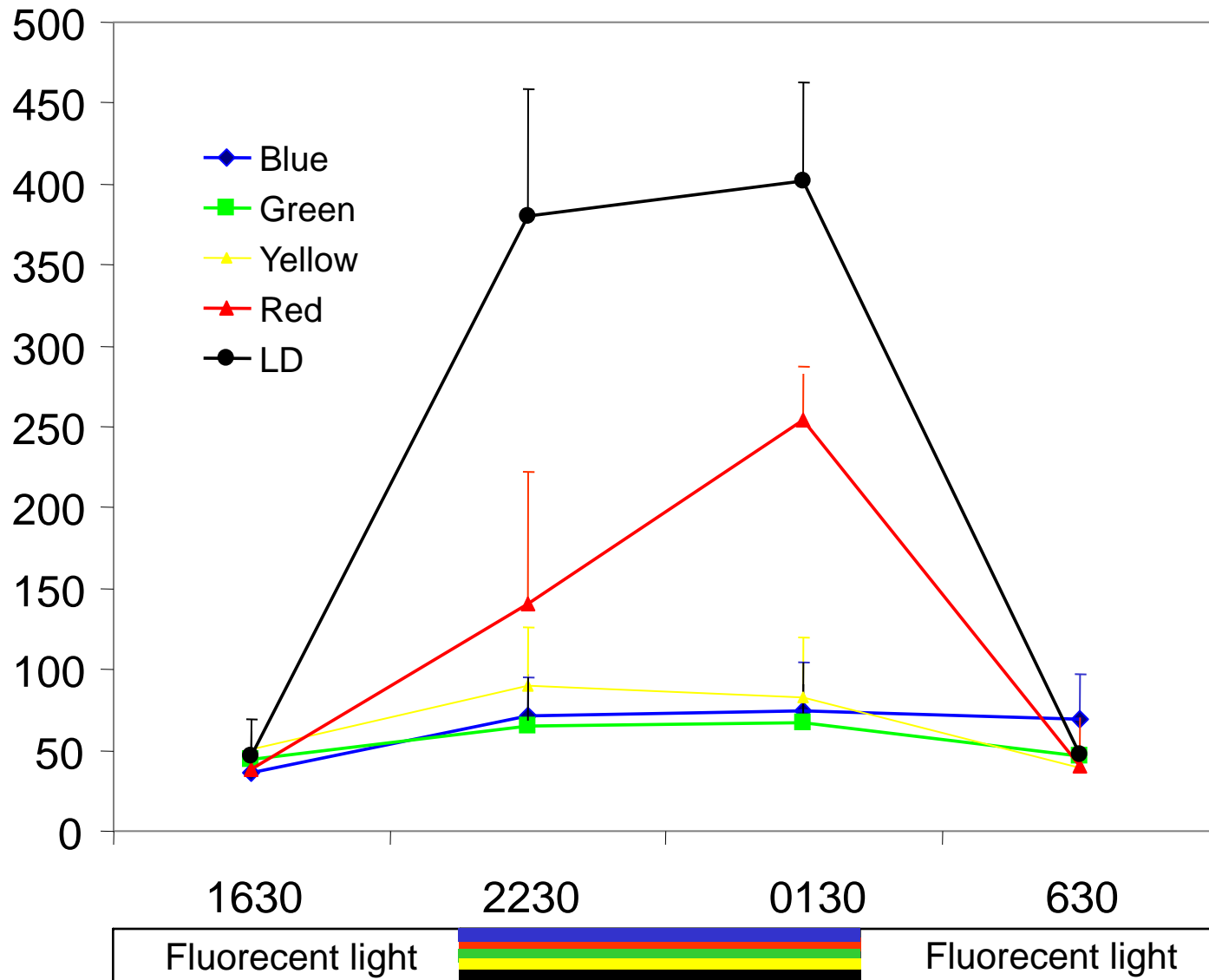
1000 Lux

Lysfarge

- Tested blue, green, yellow and red light in tanks
- Blue-green light travels far in seawater
- How do light with short wavelength influence on the melatonin profile?



Melatonin and light colour in salmon

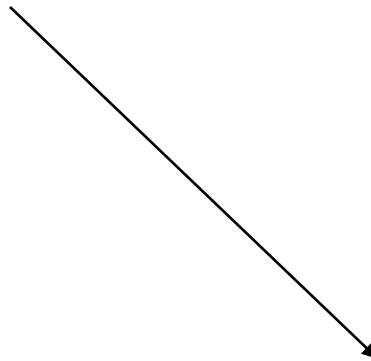
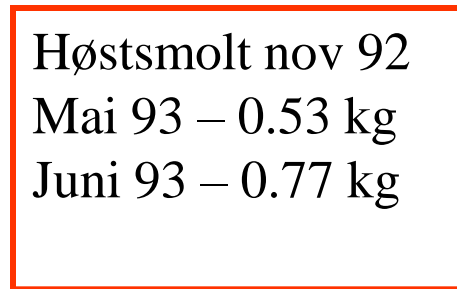
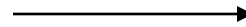


Kjønnsmodning og temperatur?

Lukket merd 1993



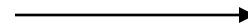
12 juli



Lukket merd 1993

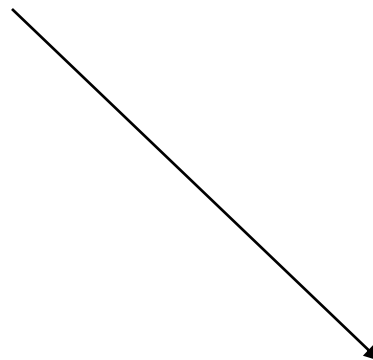
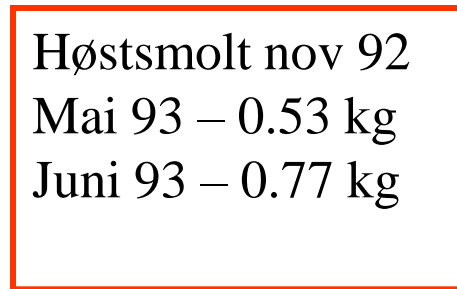


12 juli



7 %
modne
hanner

oktober



85 %
modne
hanner

!! Temperatur evt vekstrate
påvirker modningen

Kontinuerlig lys og høy temperatur øker kjønnsmodningen



Continuous light and elevated temperature can trigger maturation both during and immediately after smoltification in male Atlantic salmon (*Salmo salar*)

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^b National Institute of Nutrition and Seafood Research (NIFES), P. O. Box 2029 Nordnes, N-5817 Bergen, Norway

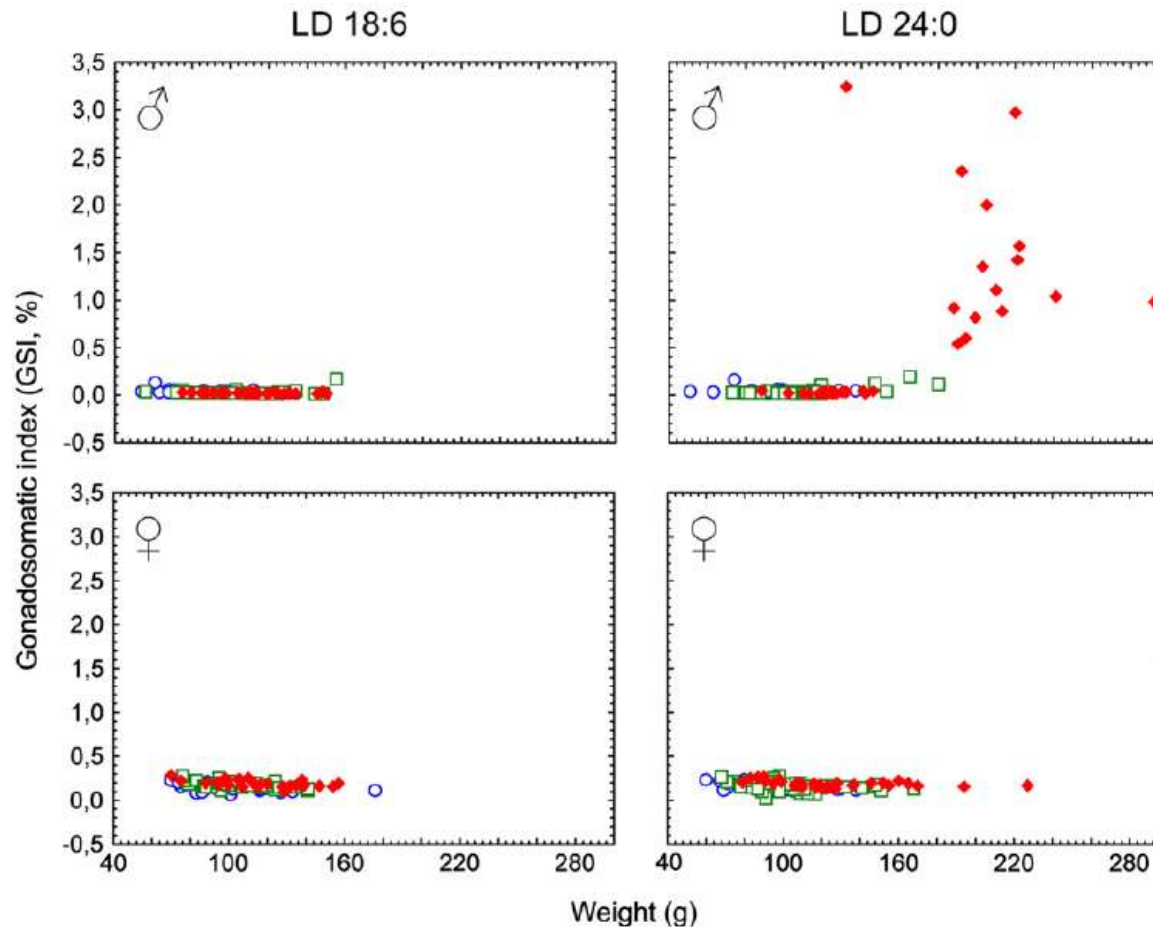


Fig. 1. GSI plotted against body weight on 14 January (exp. 1) in Atlantic salmon smolts subjected to 5 (○), 10 (□) or 16 °C (◆) at LD 18:6 or LD 24:0 for six weeks (01 December 2008 to 14 January 2009). The fish had been reared at LD12:12 until start of the experiment on 01 December.