

Thiamine deficiency in salmonids

Steve Lindley, NMFS SWFSC

Steve.Lindley@noaa.gov

Thiamine Research Team

NOAA: Nate Mantua, John Field, Steve Lindley, Tommy Williams

USFWS: Taylor Lipscomb, Scott Foot, William Ardren

USGS: Donald Tillit and Dale Honeyfield, retired

CDFW: Kevin Kwak, Mark Adkison, Brett Kormos

SUNY, State University of New York Brockport: Jacques Rinchard

Idaho State University: Bruce Finney

Moss Landing Marine Laboratory: Iliana Ruiz-Cooley

Monterey Bay Aquarium Institute: Steve Litvin

UCD: Anne Todgham, Carson Jeffres, Nann Fangue, Esteban Soto, Heather Bell, Dennis Cocherell, Sage Lee

Management Team

NOAA West Coast Region: Charlotte Ambrose, Amanda Cranford



Thiamine Deficiency Complex (TDC)

Thiamine is **Vitamin B₁**

It is an essential vitamin (We all require)

Fish don't make it

Observed between hatch and first feeding
and characterized by:

- Loss of equilibrium
- Swimming in a spiral pattern
- Lethargy
- Hyperexcitability
- Hemorrhage, etc.

*Neurological
Symptoms*



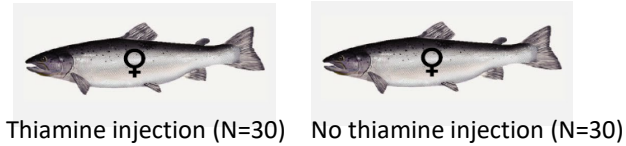
Healthy



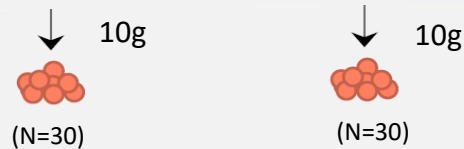
B1 deficient

1. Symptom Tracking: Winter Run Treatment Experiment

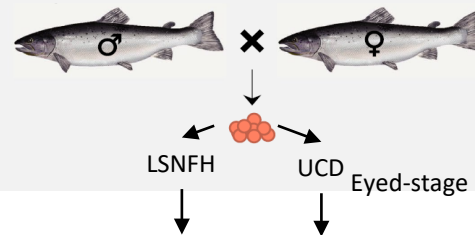
1. Experimental treatment



2. Egg thiamine measurements



3. Spawn & track females by treatment

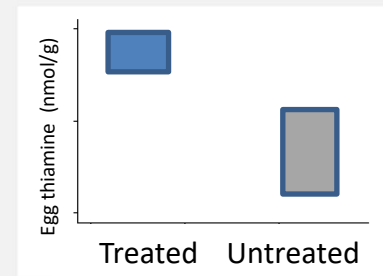


4. Survival & early development

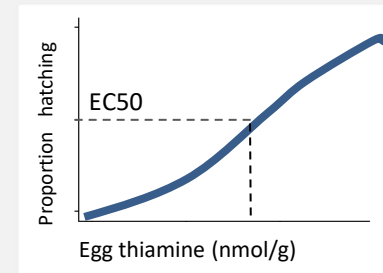


Measure time to eye, silver eye, time to hatch, [chorion movement; UCD] hatching success, size and age at hatch

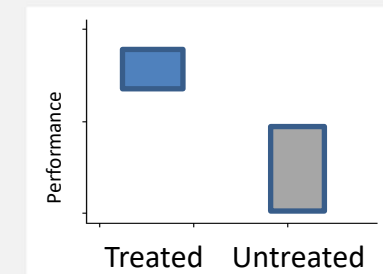
5. Egg thiamine analyses



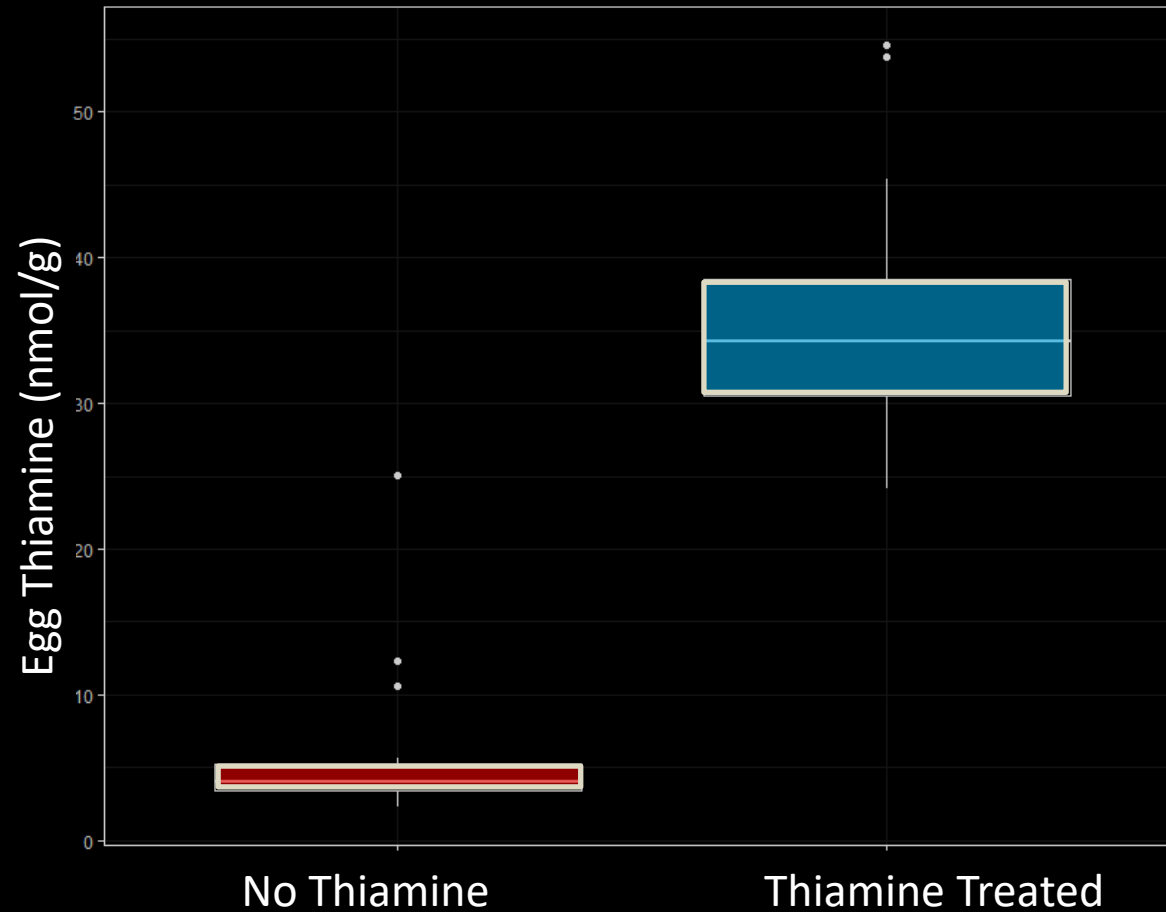
6. Early life stage threshold analysis



7. Secondary effects of low thiamine



Thiamine Injections were wildly successful



What level is too low for early life survival?

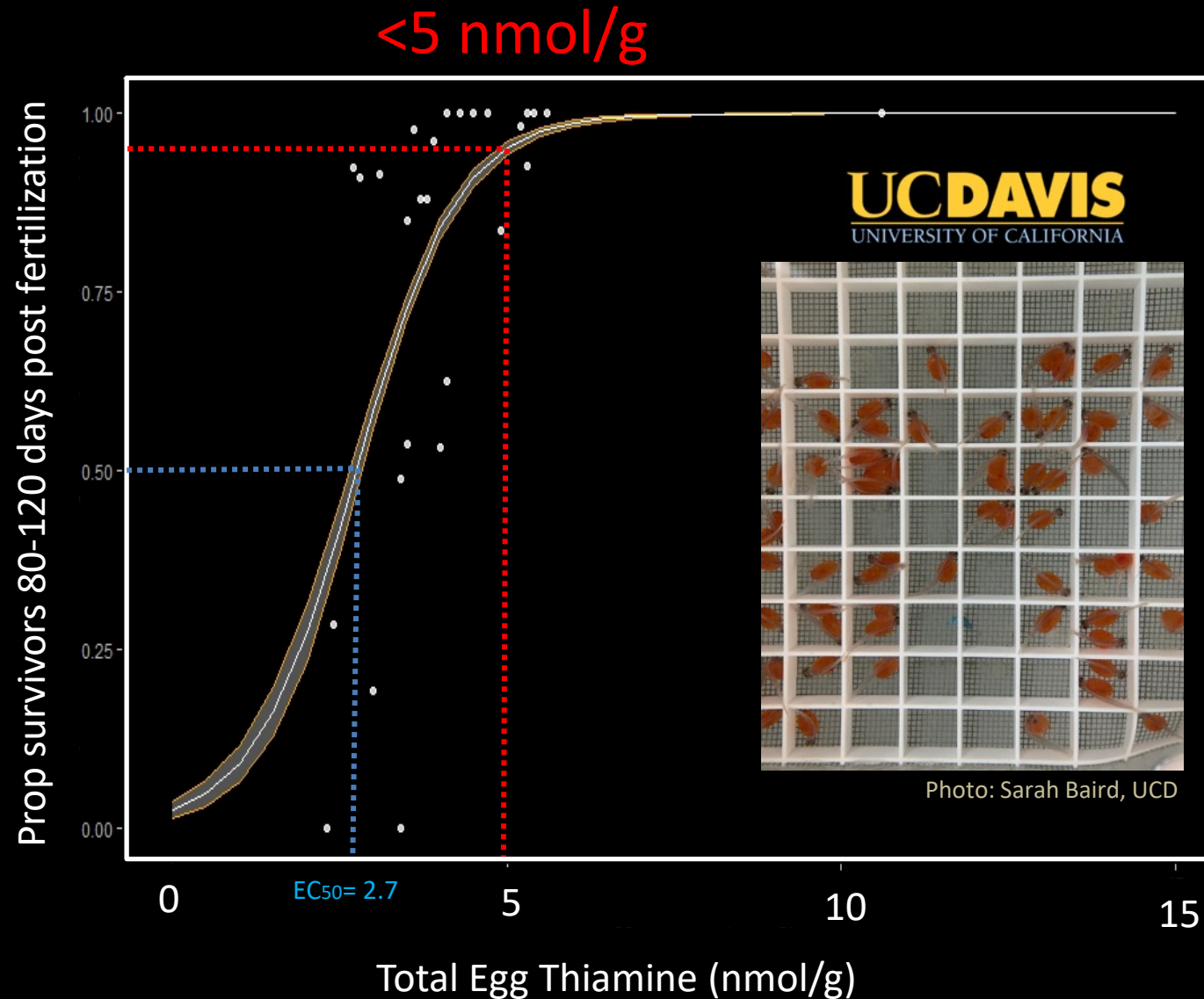
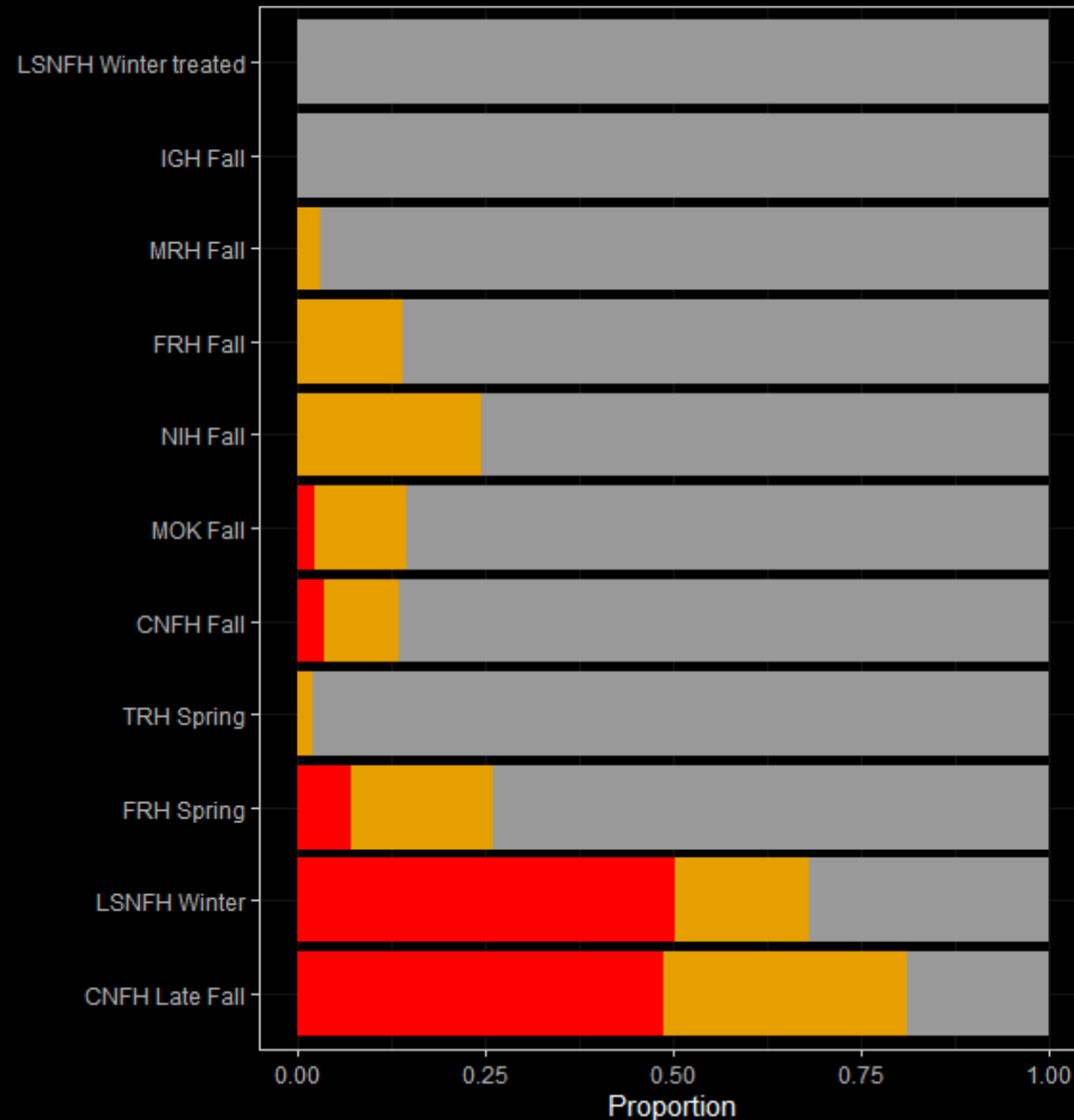


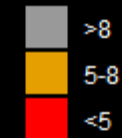
Figure courtesy Heather Bell, UCD

2. Testing: Broad scale egg surveillance to identify vulnerable popn's

Proportion of Chinook Salmon Eggs with Different Levels of Thiamine



Thiamine Levels (nmol/g)



3. Identify the cause: Are anchovies the villain?



- Anchovies produce thiaminase, an enzyme that breaks down B1
- Early evidence salmon in 2019 narrow diet only anchovy [not squid, krill or rockfish]
- Ongoing efforts to measuring thiamine, thiaminase, and stable isotopes in salmon prey from 2019 and 2020



- Fishing industry partners and CDFW Ocean Salmon Project collected and stored salmon stomachs in 2020 for gut content analysis.

- 2020 stomachs (N=337) dominated by anchovy (65%), empty (20%), Krill (7%)



3. Identify the cause: Reconstructing diet with stable isotopes

Isoscape of Marine Food web of California Current

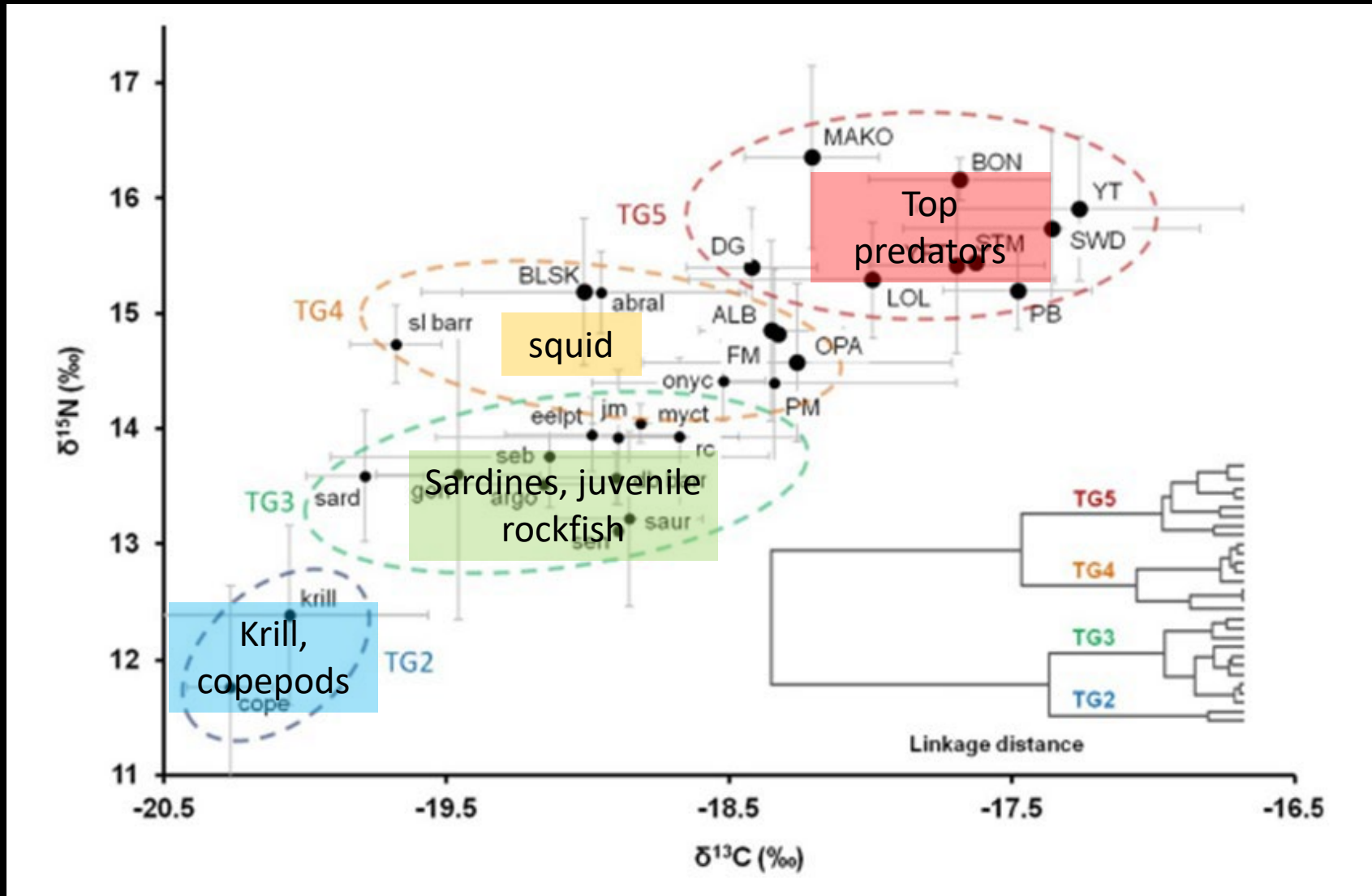
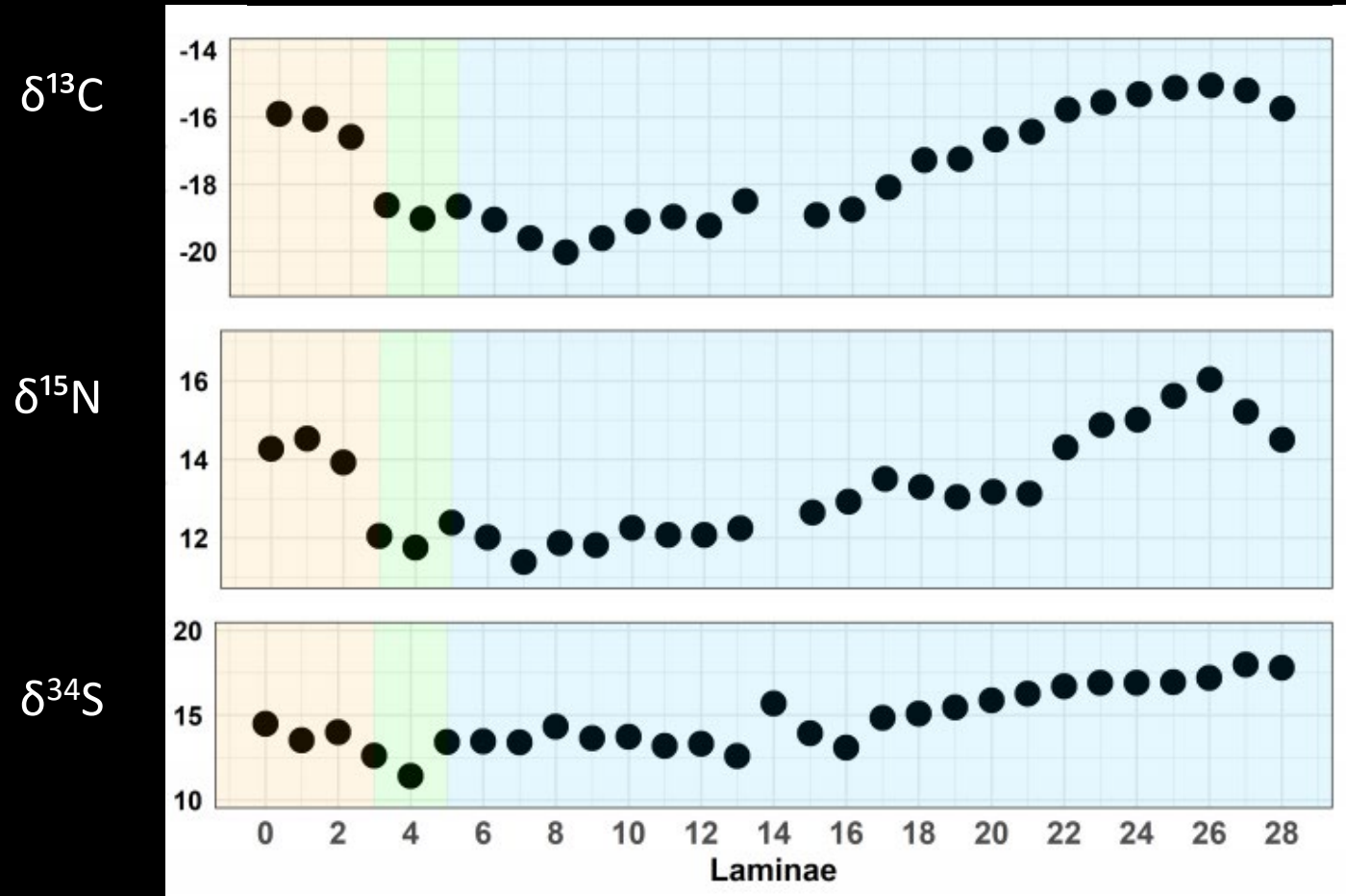


Figure from Madigan et al. 2012

3. Identify the cause: Reconstructing diet history using eye lenses

Adult salmon lifetime diet reconstruction



Freshwater

Marine



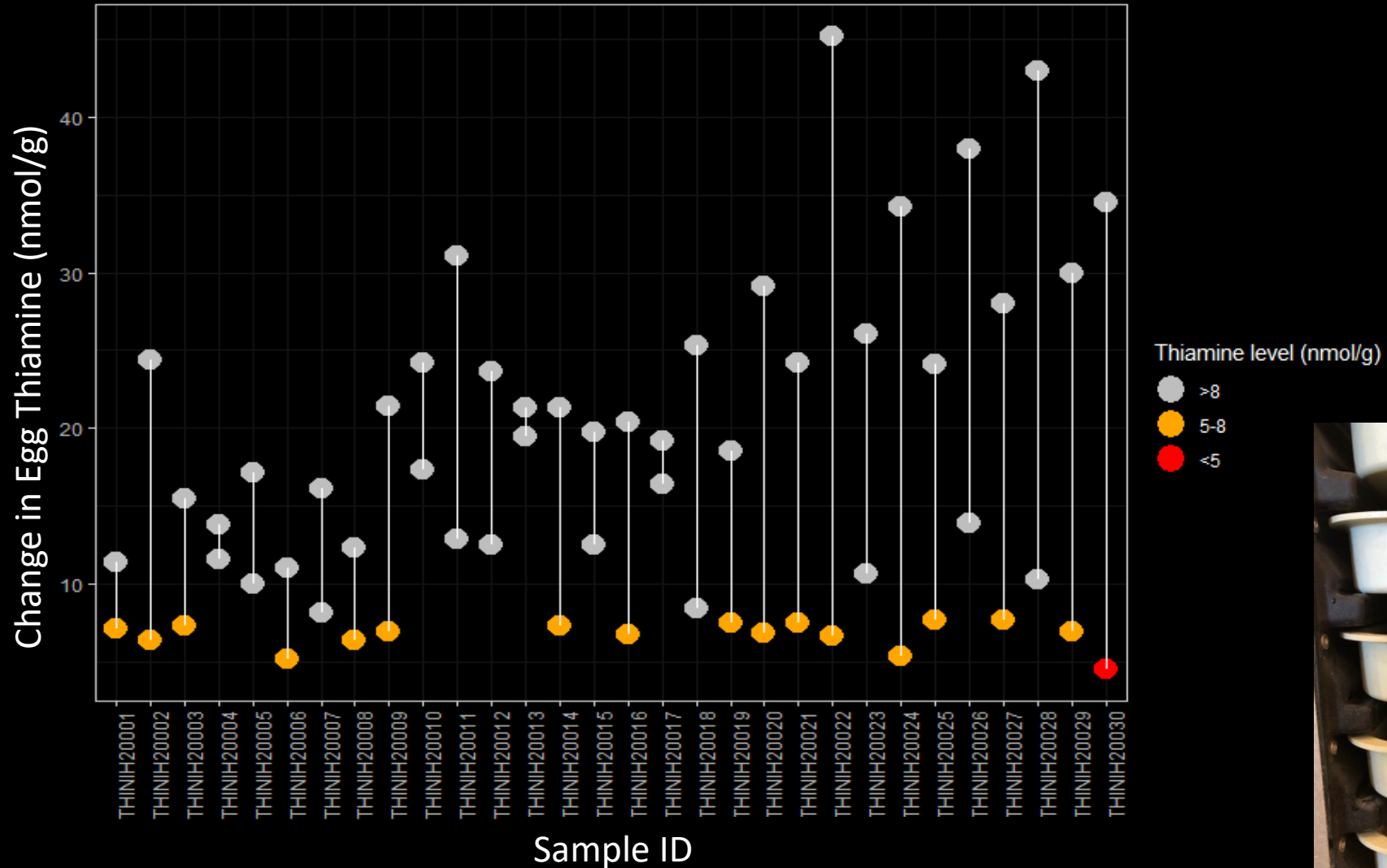
Photo: Jim McKinney



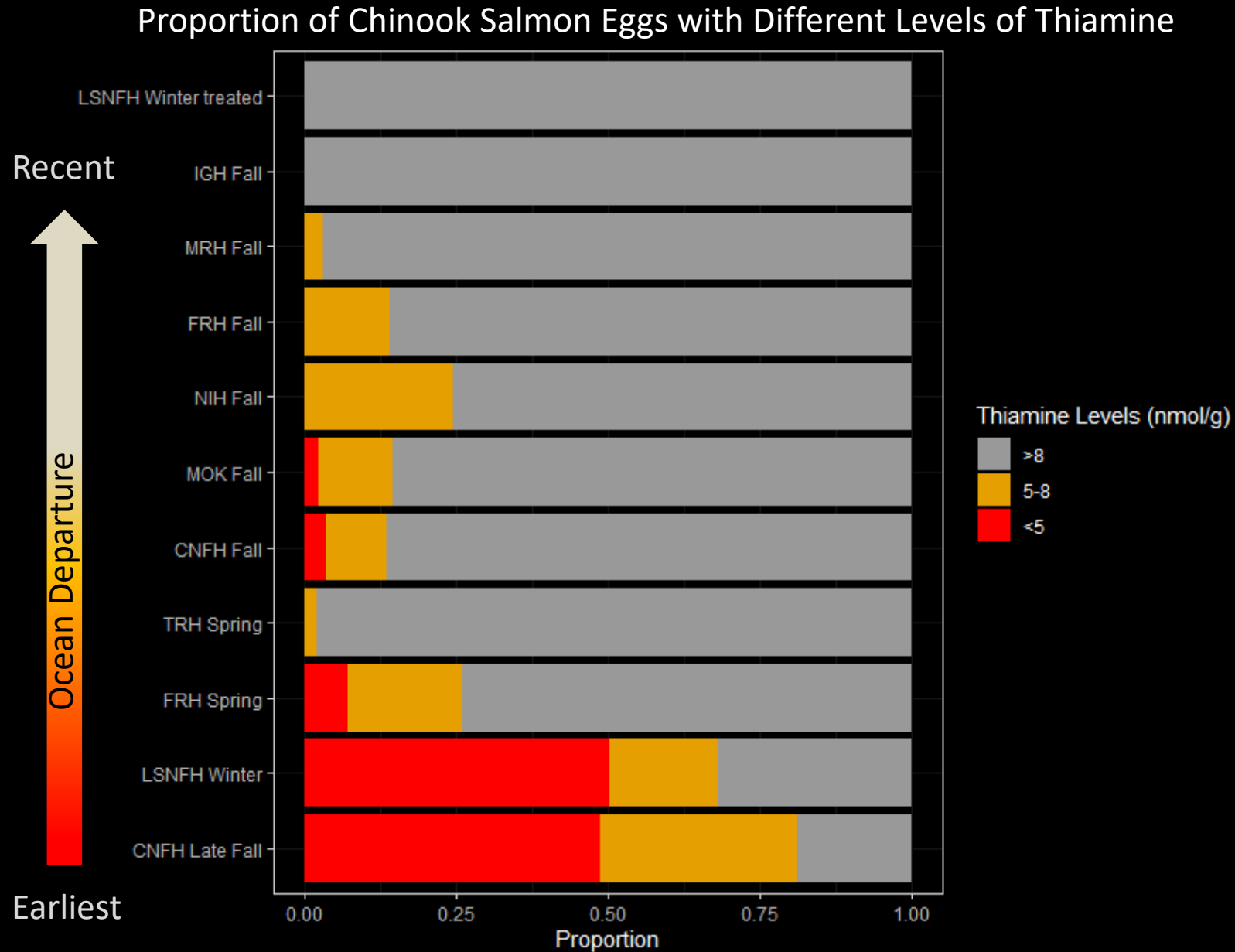
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4: Treating eggs with thiamine when adults can't be injected

Change in Egg thiamine between no treatment and high treatment



5. Flattening the curve or surge: Evidence for end of pandemic?



Considerations for salmon fisheries

- Hatchery practices
- Natural production
- Survival and maturation at sea