Reproductive investment and adult body growth compared among Atlantic and Pacific herring populations

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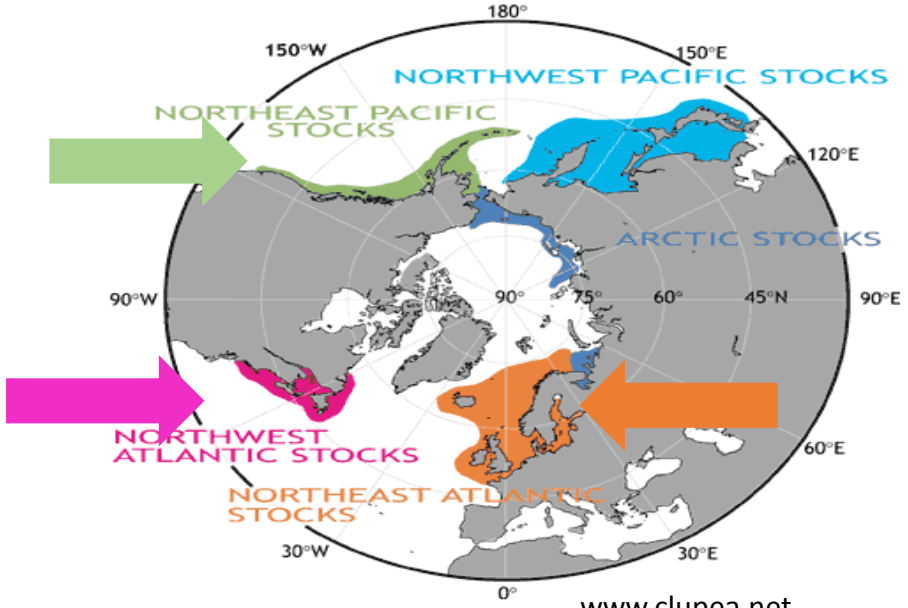
Background: Global distribution

Clupea spp.

- Atlantic herring (*Clupea harengus*)
  - Northwest Atlantic herring
  - Northeast Atlantic herring
- Pacific herring (*Clupea pallasii*)
  - Northwest Pacific herring
  - Northeast Pacific herring



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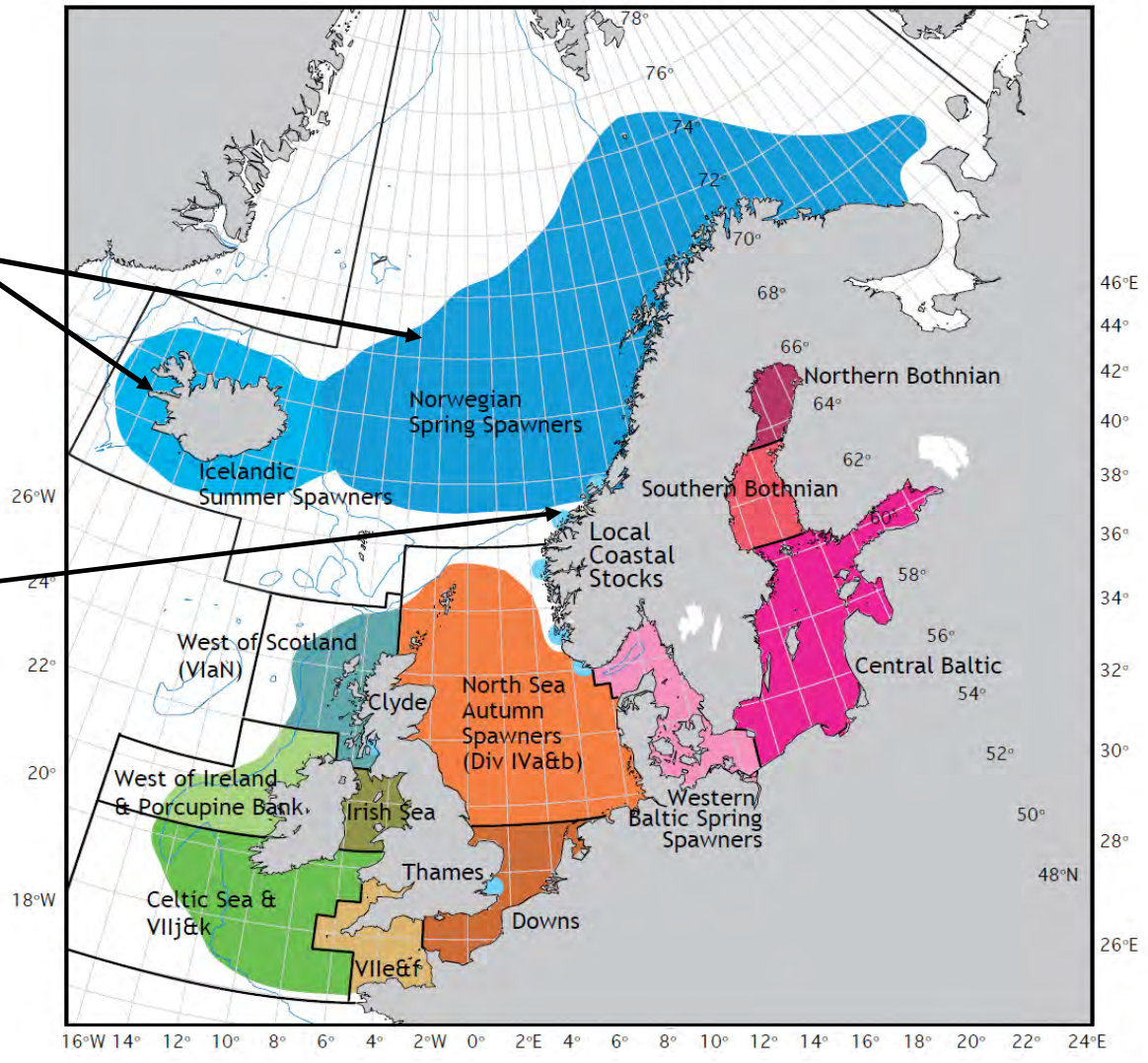
Background: Spatial distribution

OCEANIC POPULATIONS:
extensive annual migration

LOCAL POPULATIONS:
restricted to fjords, coastline or sea lochs



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Background: Spawning season

Herring is a total spawner with determinate fecundity, but spawning season differs between the two species and among populations

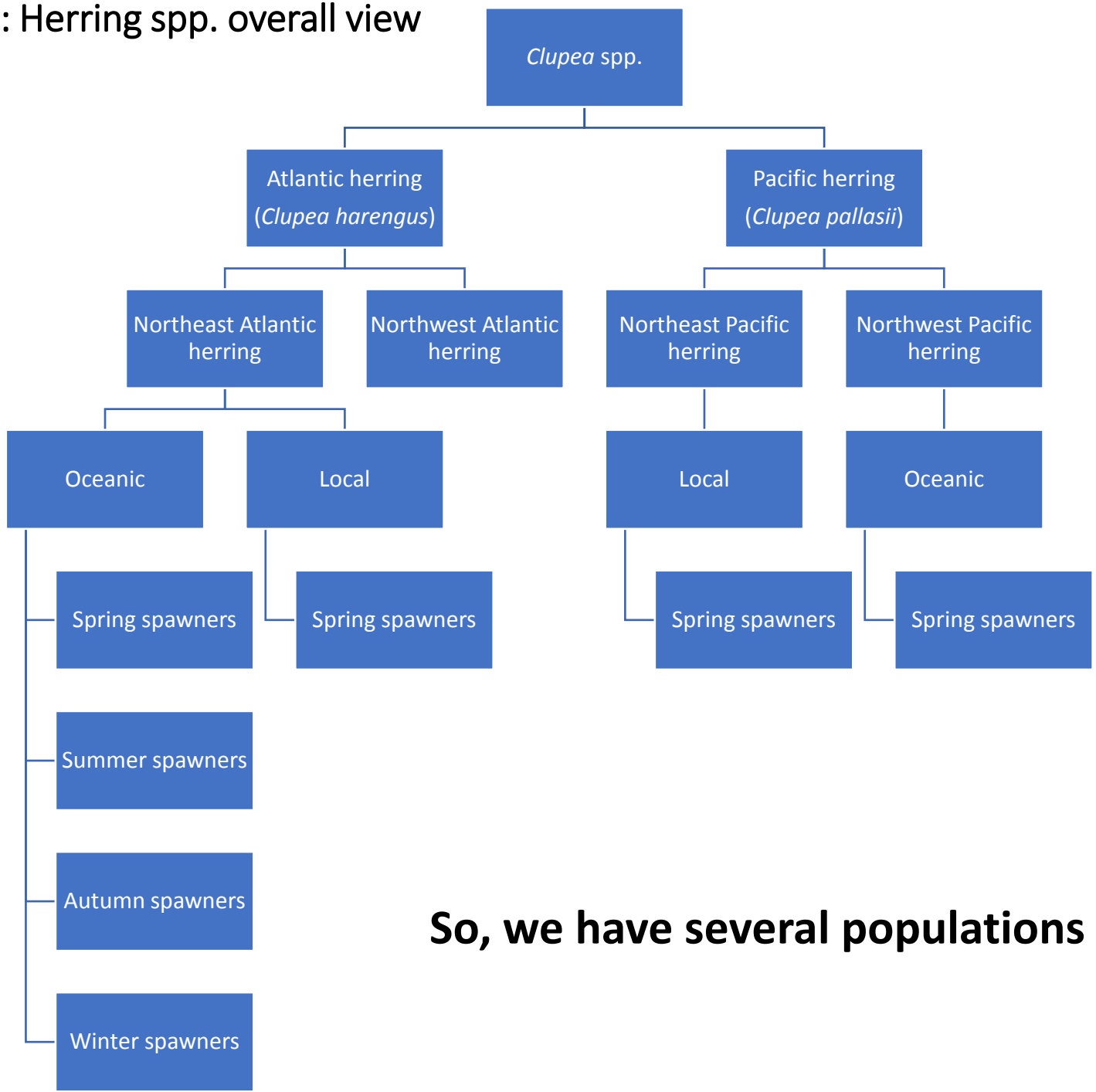
Pacific herring:

- exclusively spring spawners

Atlantic herring:

- spawn during the entire year but in a specific season (summer spawners, spring spawners, autumn spawners)

Background: Herring spp. overall view



So, we have several populations

Based on these hierarchical levels and diversity of herring, we see differences in life history traits among populations

Objective:

Investigate different life history traits (adult body growth and reproductive investment) between Atlantic and Pacific herring taking into consideration different spatial distributions, migratory behavior, and spawning seasons

Material and Methods:

14 herring populations were studied:

Northeast Pacific herring
(British Columbia herring)

PH1
PH2

Northeast Atlantic herring

Norwegian spring-spawning herring (NSSH)
Icelandic summer-spawning herring (ISSH)
Norwegian summer autumn-spawning herring (NASH)
North Sea autumn-spawning herring (NSAH)

Northwest Atlantic herring

Scotia-Fundy summer-autumn spawning herring (SFH)

Local Norwegian herring populations

Balsfjord herring (BFH)
Lake Rossfjord herring (LRH)
Trondheimsfjord herring (TRH)
Gloppenfjord herring (GFH)
Sognefjord herring (SGH)
Lindås herring (LPH)
Coastal Skagerrak herring (CSH)
Landvik herring (LVH)

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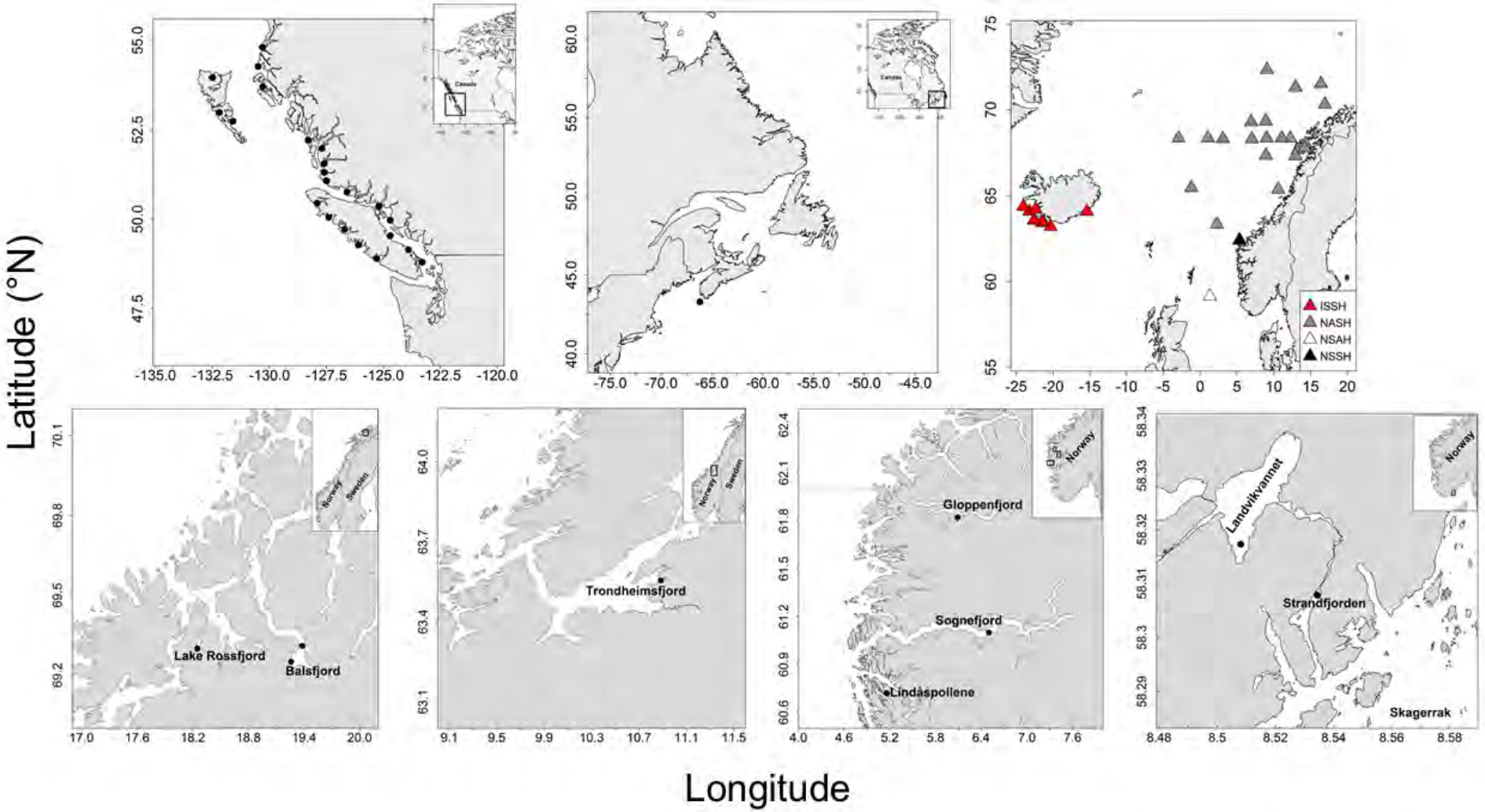


Descriptors studied:

Growth (length-at-age and weight-at-length)
Fulton's Condition factor (K)
Somatic gonadosomatic index (GSI_S)
Potential fecundity (F_P)
Somatic relative fecundity ($RF_{P,S}$: F_P/(weight- ovary weight)
Prespawning oocyte diameter (OD) = egg size
Egg dry weight (EDW)

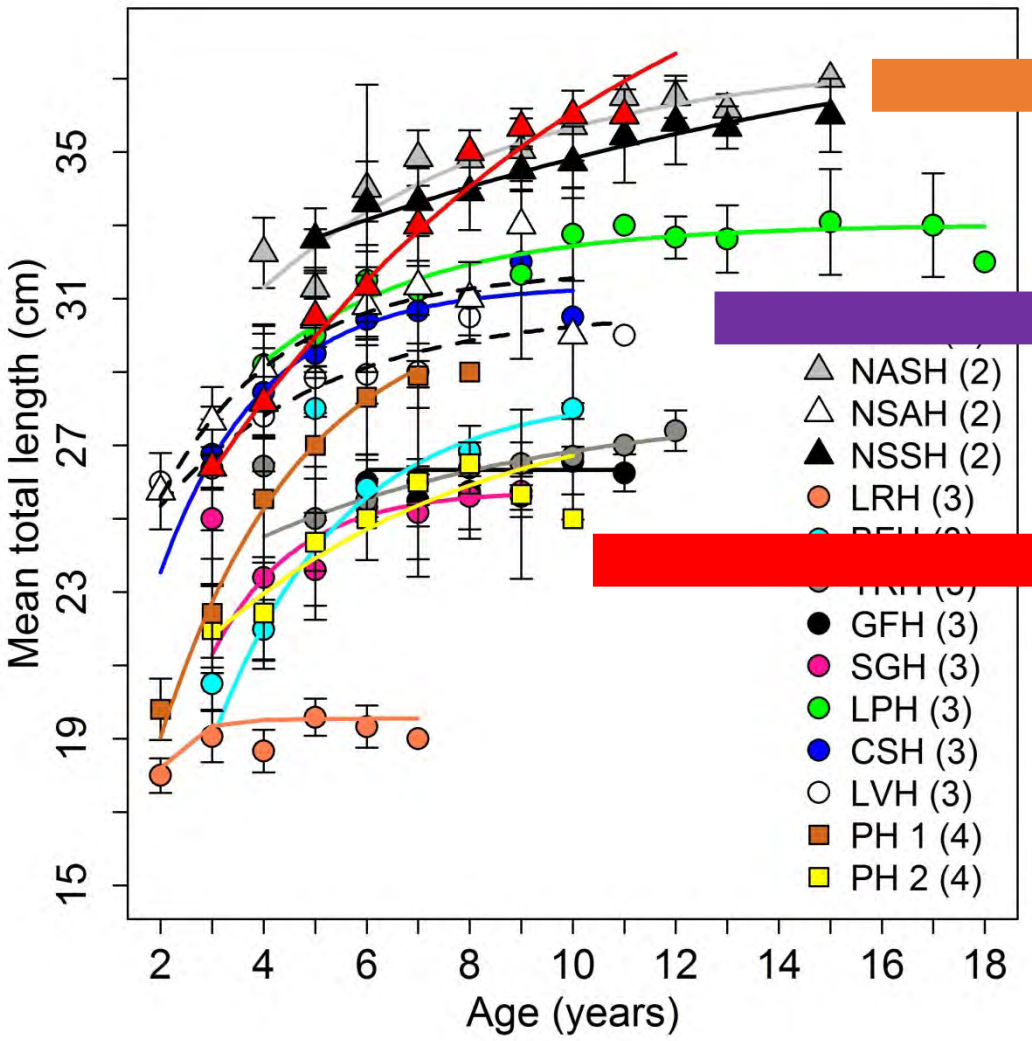
Discriminant analysis

1: biometric parameters: total length, weight, age, and K

2: reproductive parameters: GSI_S , $RF_{P,S}$, and OD

Results:

Length-at-age



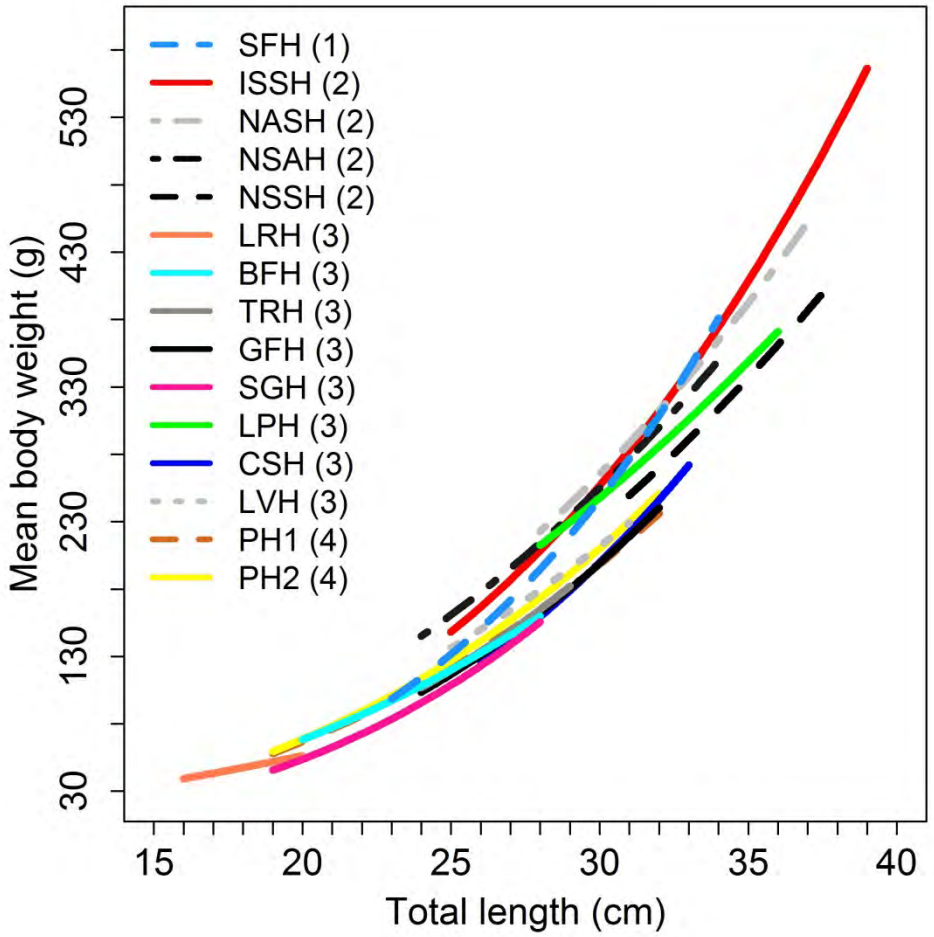
Fast growth:
OCEANIC Northeast Atlantic (Icelandic herring and both Norwegian herring populations)

Intermediate growth:
North Sea herring and
3 LOCAL Norwegian herring populations

Slow growth:
4 LOCAL Norwegian herring populations and Pacific herring

Results:

Weight-at-length



GENERAL PATTERN:

Oceanic populations: large body size

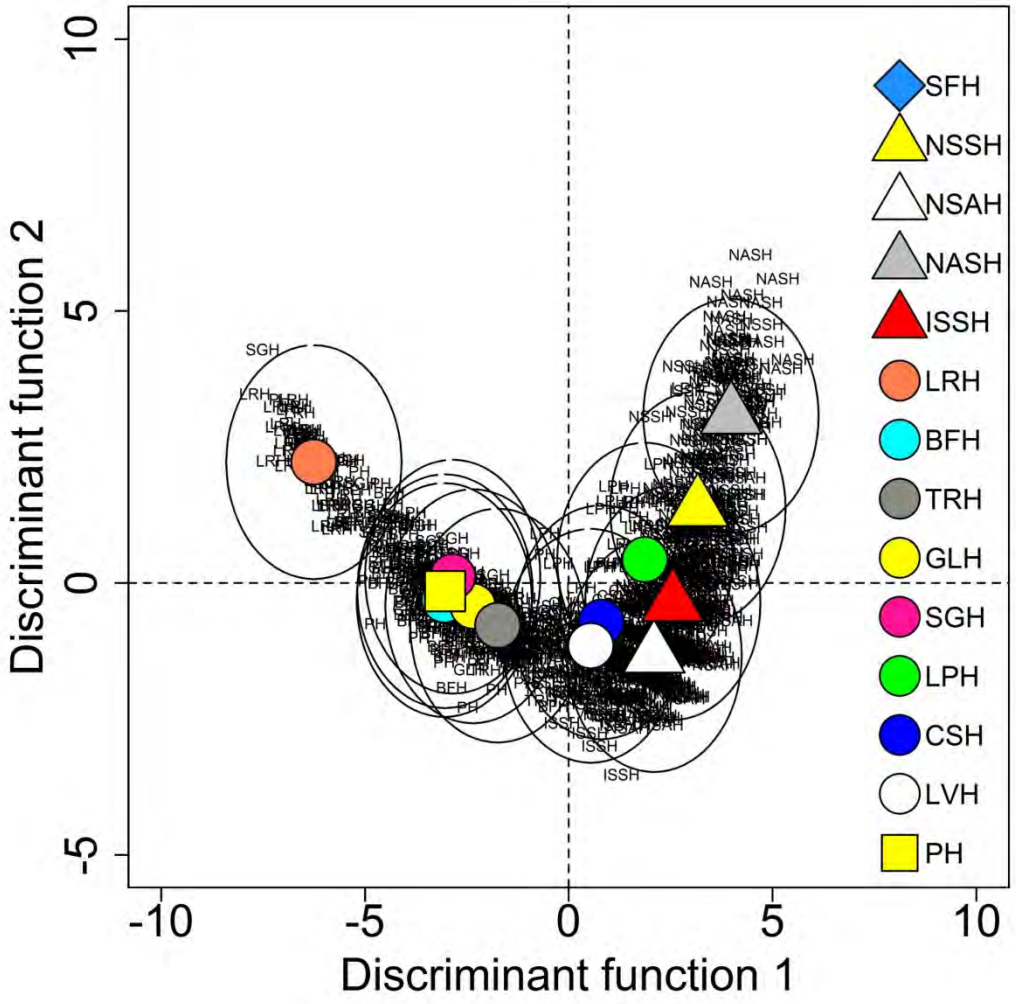
Local populations: small body size*

*Exceptions: Lindås herring, Coastal Skagerrak herring, and Landvik herring

Lake Rossfjord herring: the smallest herring population and the lowest growth rate (lives in a lake in northern Norway)

Results:

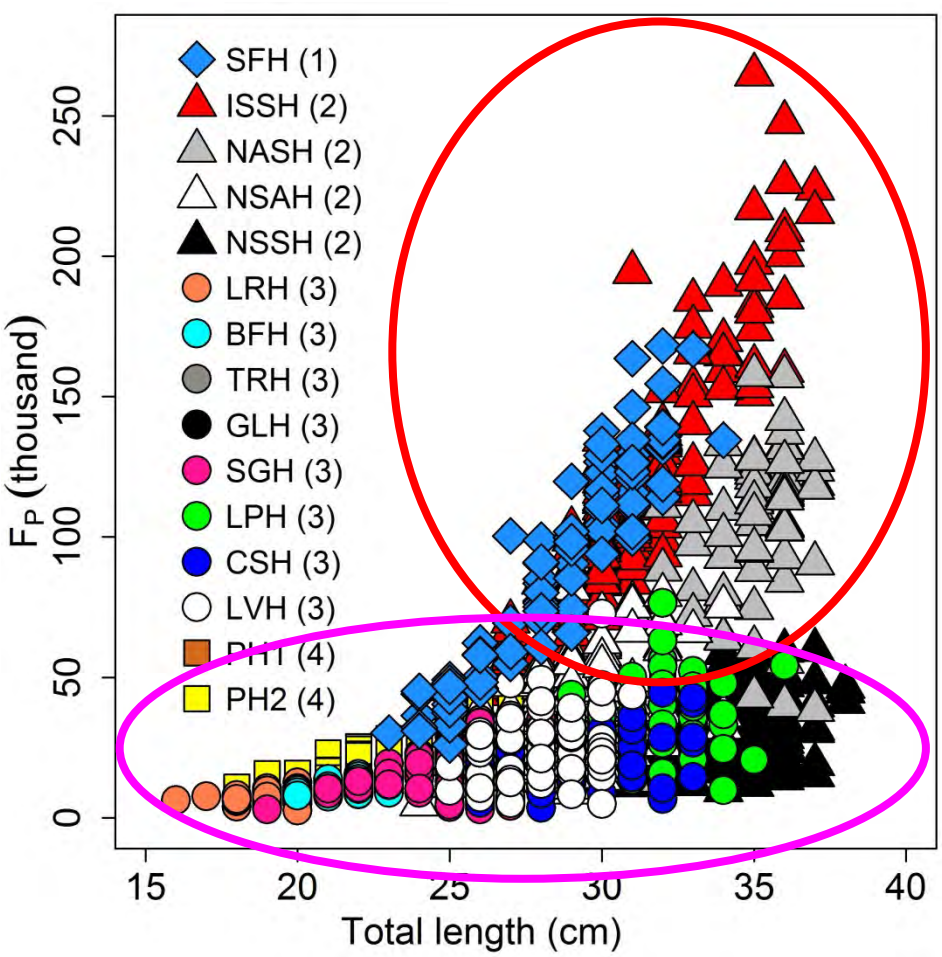
Discriminant analysis: Biometric parameters

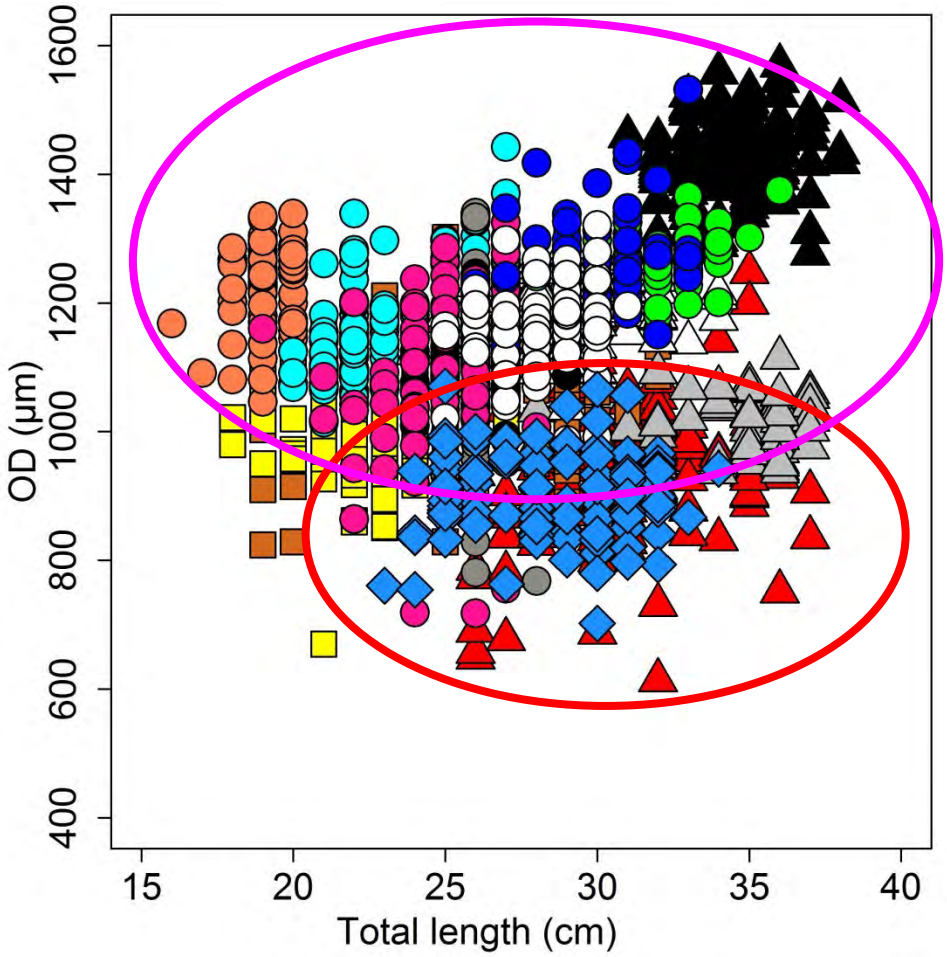


1. Lake Rossfjord: distinct population
2. Pacific herring clustered with 4 local Norwegian populations
3. Oceanic NEA herring and three local Norwegian populations: “semi-clustered”

Results:

Fecundity (F_P) vs. Egg size (OD): differ among populations and spawning seasons





Summer-autumn spawners:

High fecundity
Small egg size

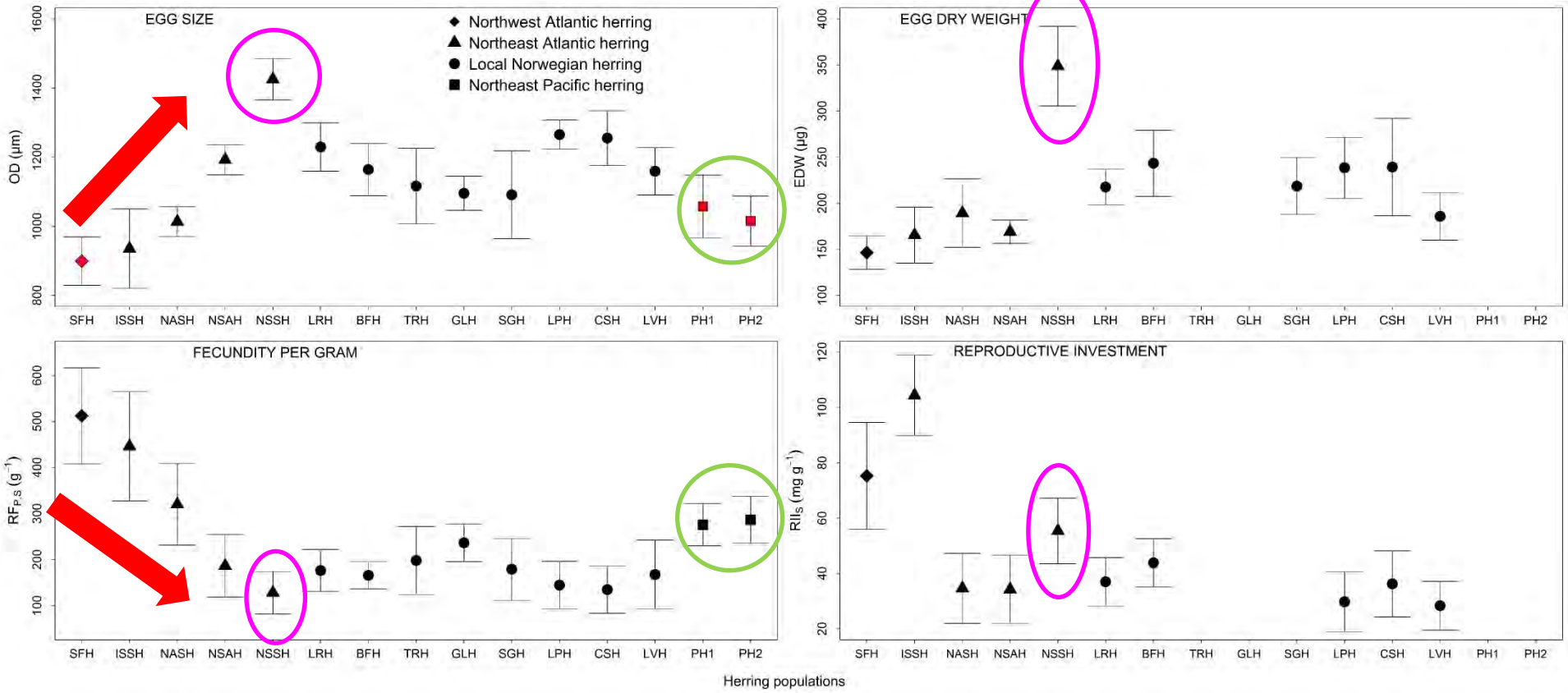
Spring spawners:

Low fecundity
Large egg size

Results:

Trade-off between fecundity and egg size:

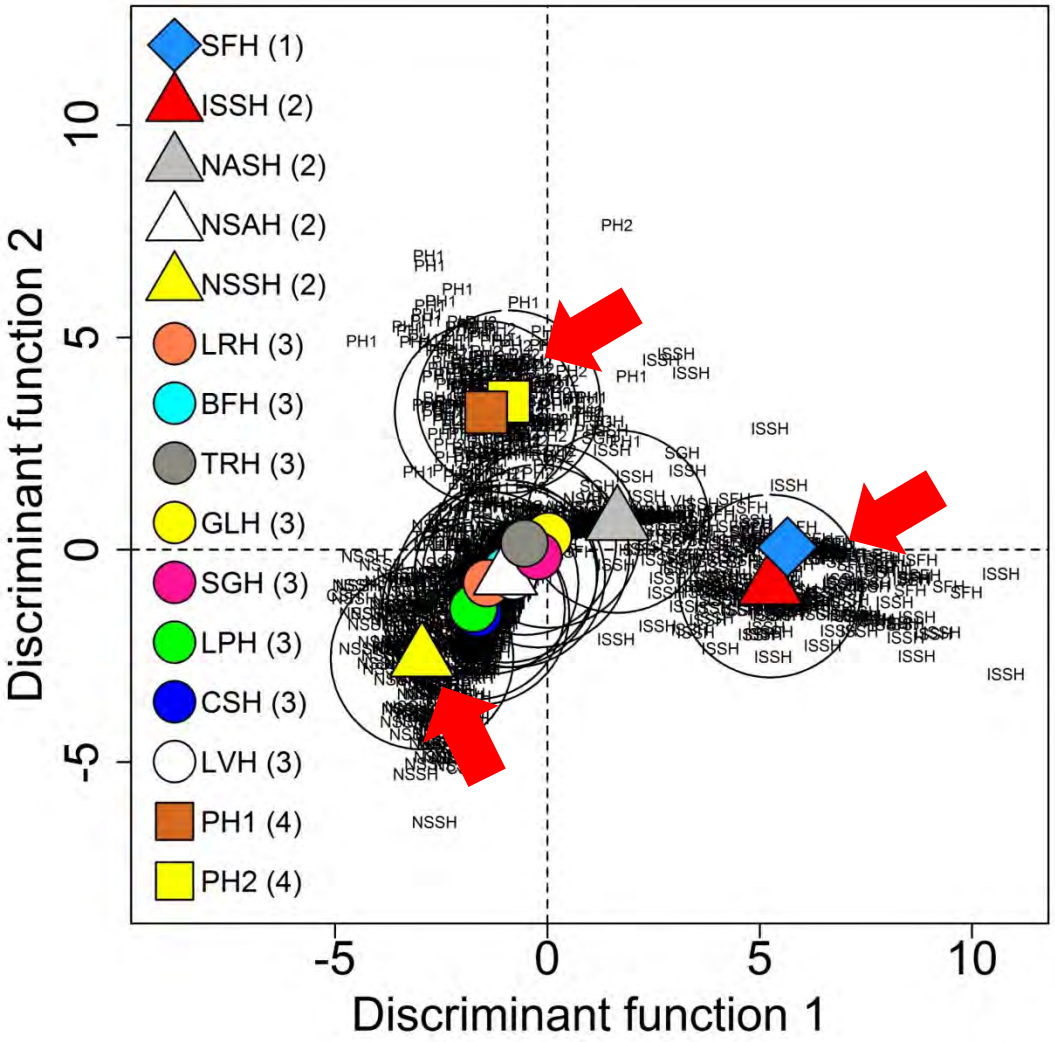
Among populations and spawning seasons.



Reproductive investment: fecundity × egg dry weight

Results:

Discriminant analysis: Reproductive parameters



1. Pacific herring differs from Atlantic herring;

2. Summer-autumn spawners herring – another group;

3. NSSH differs from the local Norwegian populations (spring spawners)

Conclusion:

ATLANTIC vs. PACIFIC HERRING

Atlantic herring: diverse species, differs at all studied levels

Pacific herring: reproductively different from Atlantic herring (high somatic relative fecundity)

OCEANIC vs. LOCAL:

Oceanic: large body size and fast growth

- Undertake long migrations

Local*: small body size and slow growth

- Restricted to the fjord system
- Adverse environmental condition, low food production in the fjord

*exceptions: Lindås herring, Coastal Skagerrak herring, and Landvik herring

- Perform some migration;
- Intermix with oceanic Norwegian spring-spawning herring

Conclusion:

Spawning season:
Summer-autumn spawners: many eggs of small size

Spring spawners: few eggs of large size

Within spring spawners:

Local populations still produce large eggs, but have smaller fecundity than Norwegian spring-spawning herring (due to smaller body size)

- Large eggs produced to increase the larval survival in these local populations?

Thank you!!