STELLER SHUTTLE

Should I Stay or Should I Go: Developmental, Physiological, Behavioural and Morphological Differences between Offspring from Alternative Life Histories

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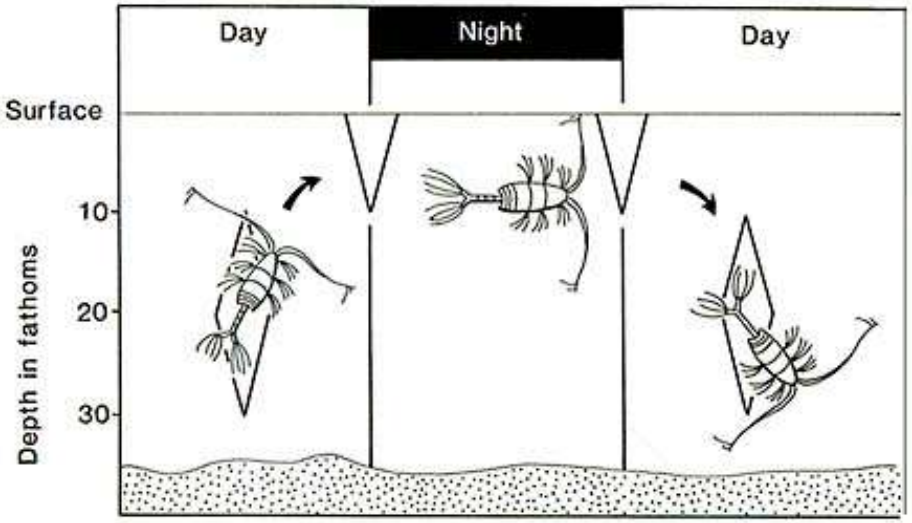
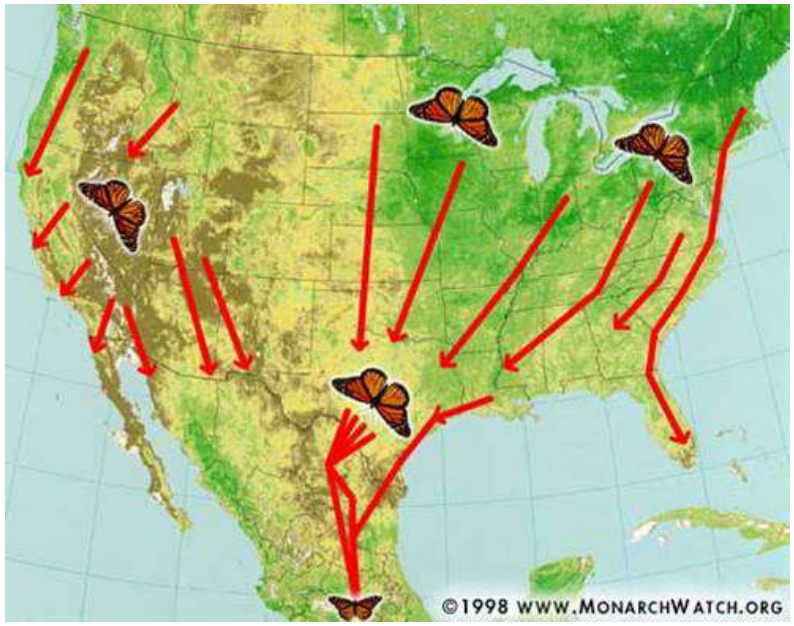
NSERC CRSNG

Animal Migration





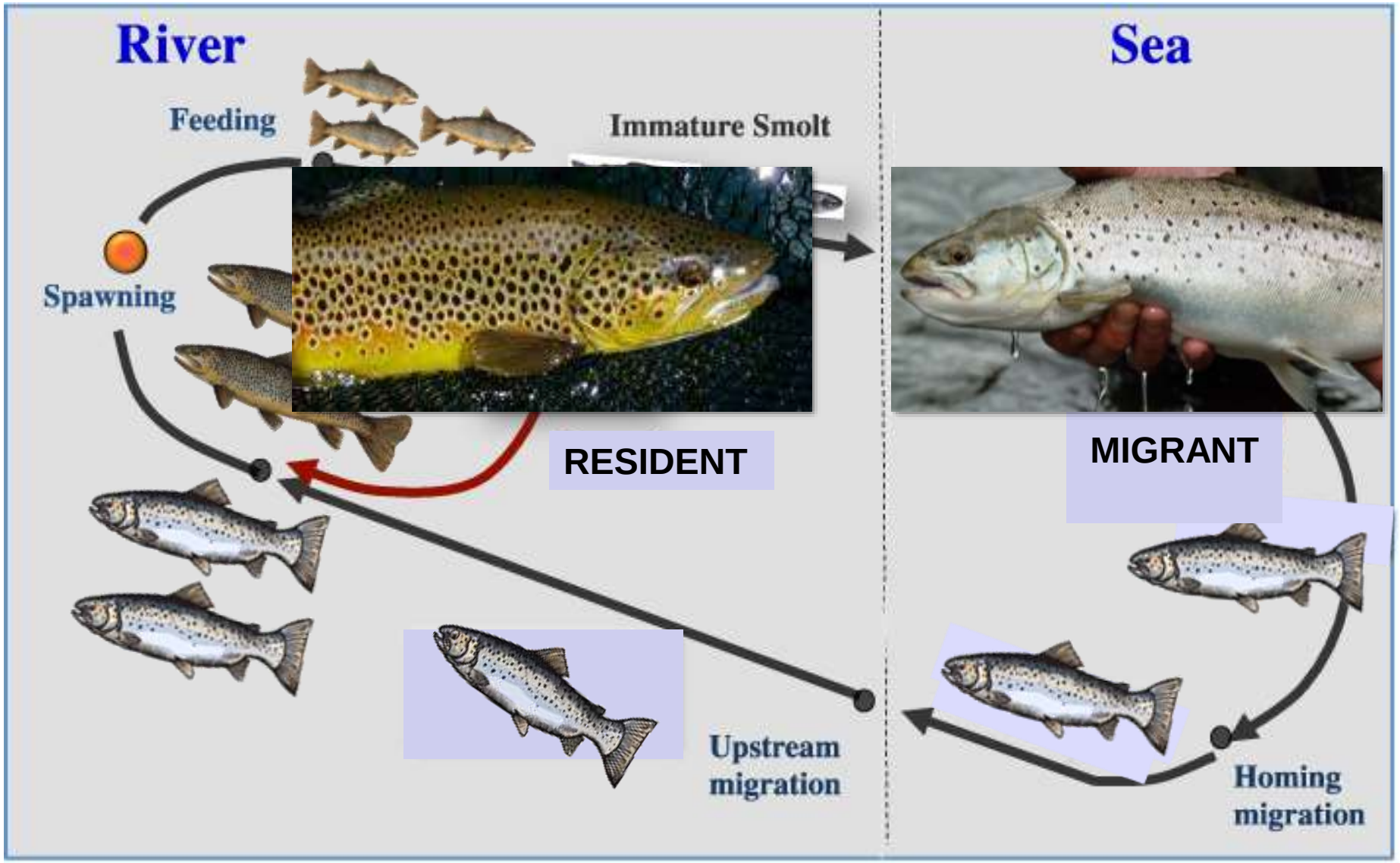
Types of Partial Migration

Breeding partial migration: migrants and residents breed allopatrically but spend the non-breeding period together (e.g. American Dipper (*Cinclus mexicanus*))

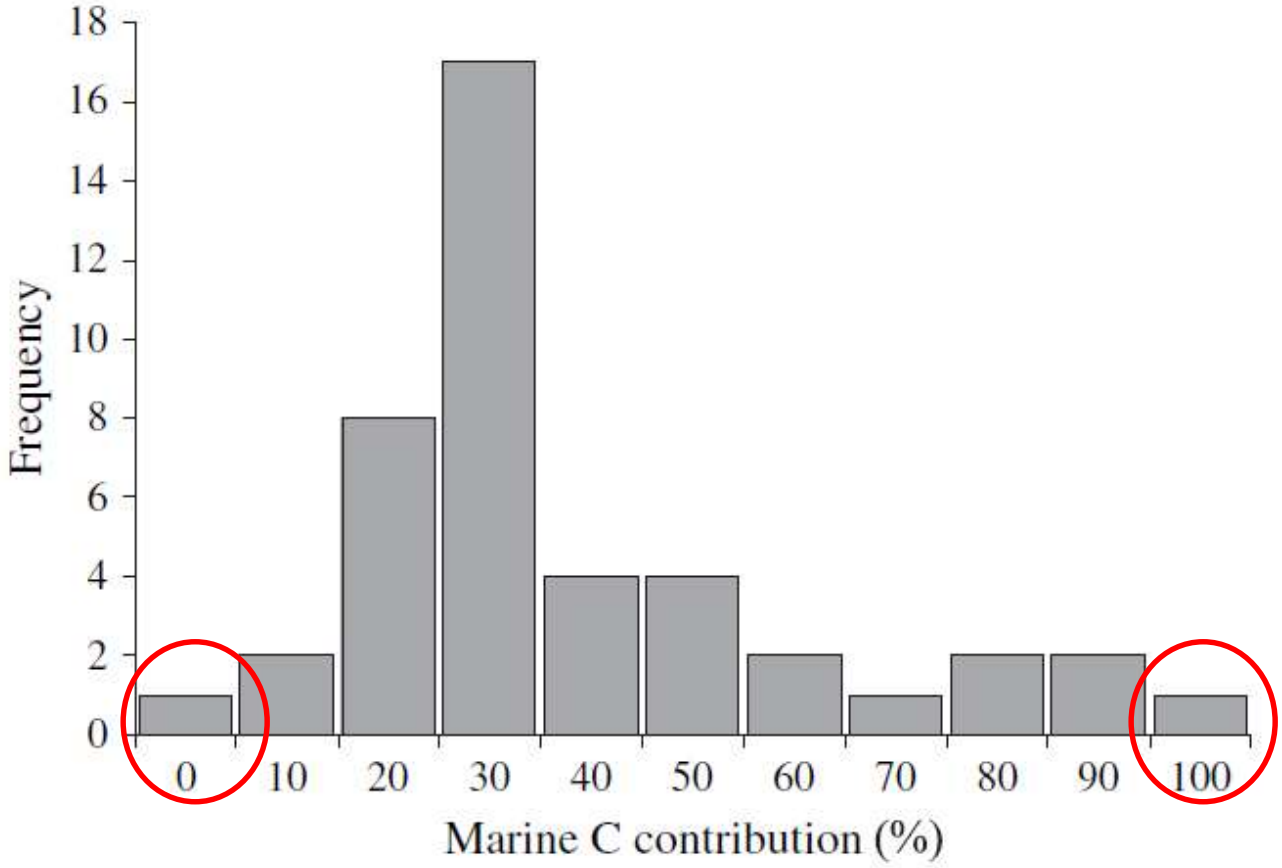
Skipped-breeding partial migration: migrate to breed but not every year (e.g. Green turtles (*Chelonia mydas*))

Non-breeding partial migration: migrants and residents generally breed sympatrically but spend the non-breeding period apart (e.g. Brown trout, Atlantic salmon (*Salmo trutta;Salmo salar*))

Life History Variation(BrownTrout)



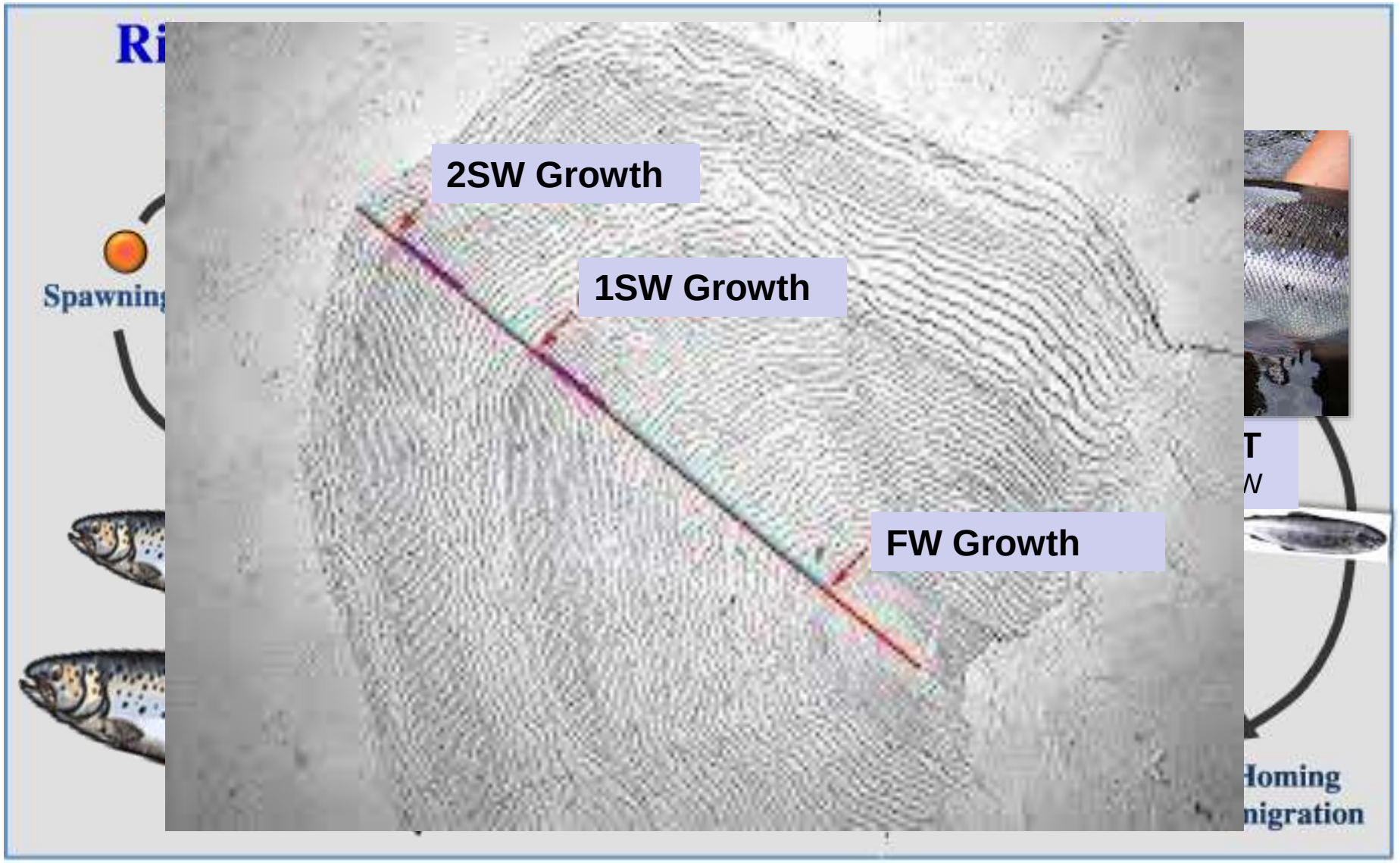
Continuous Variation (e.g. Loch Lomond)



- Very few brown trout in Loch Lomond can be identified as migratory or resident and instead show more of a **continuous variation** moving between fresh and saltwater

Etheridge et al. (2008)

Life History Variation (Atlantic Salmon)



Cost and Benefit

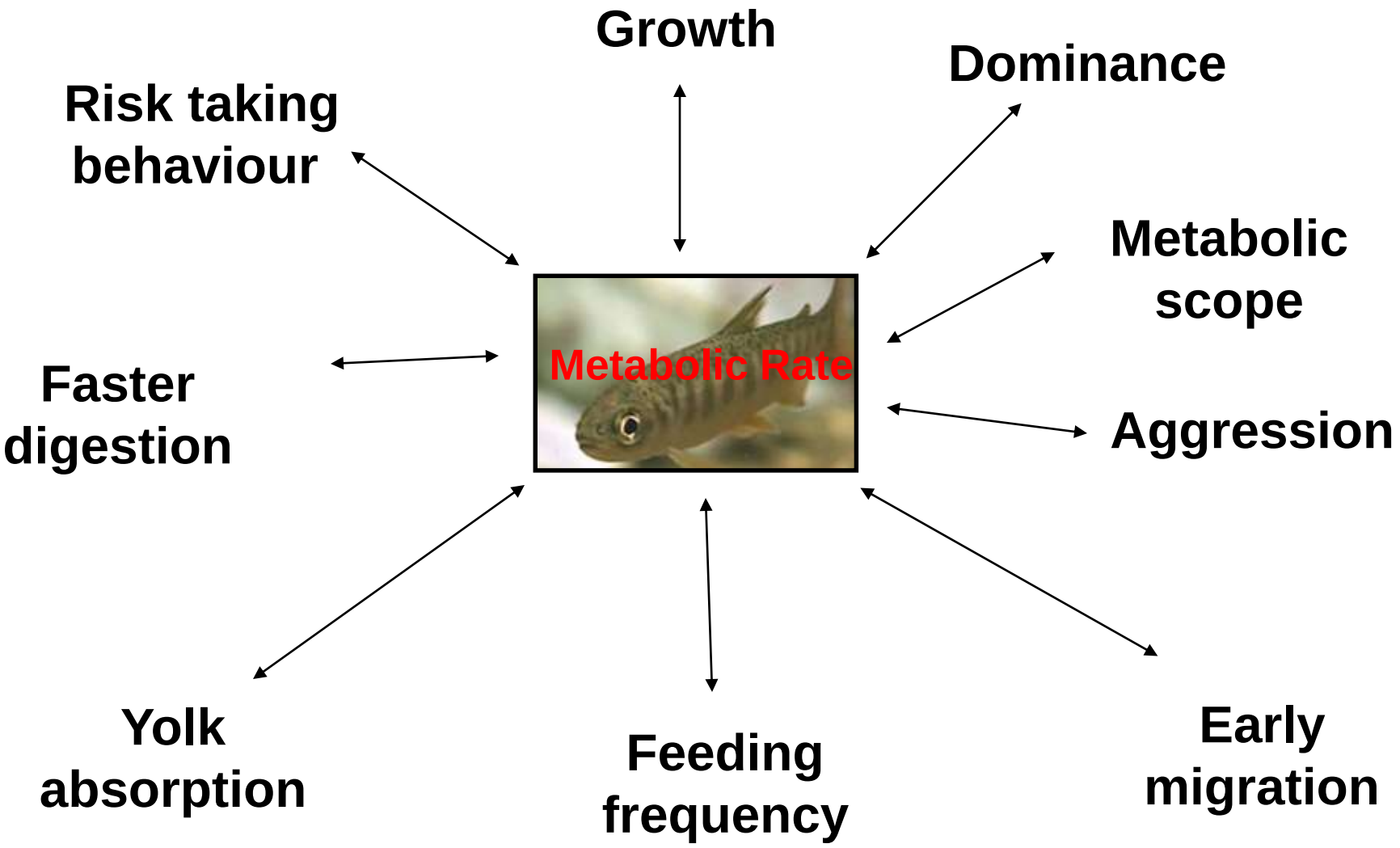
	Resident/Freshwater	Migratory/Ocean
Food Availability	Lower	Higher
Maturation	Earlier	Later
Growth/Size	Lower	Higher
Fecundity	Lower	Higher
Energetic Costs	Lower	Higher
Stochasticity of the Environment	Higher	Lower

Is Life History Driven By Environment, Genetics or Both?

Migratory

Resident

Why Metabolic Rate?



What is metabolic rate?

SMR

Standard metabolic rate

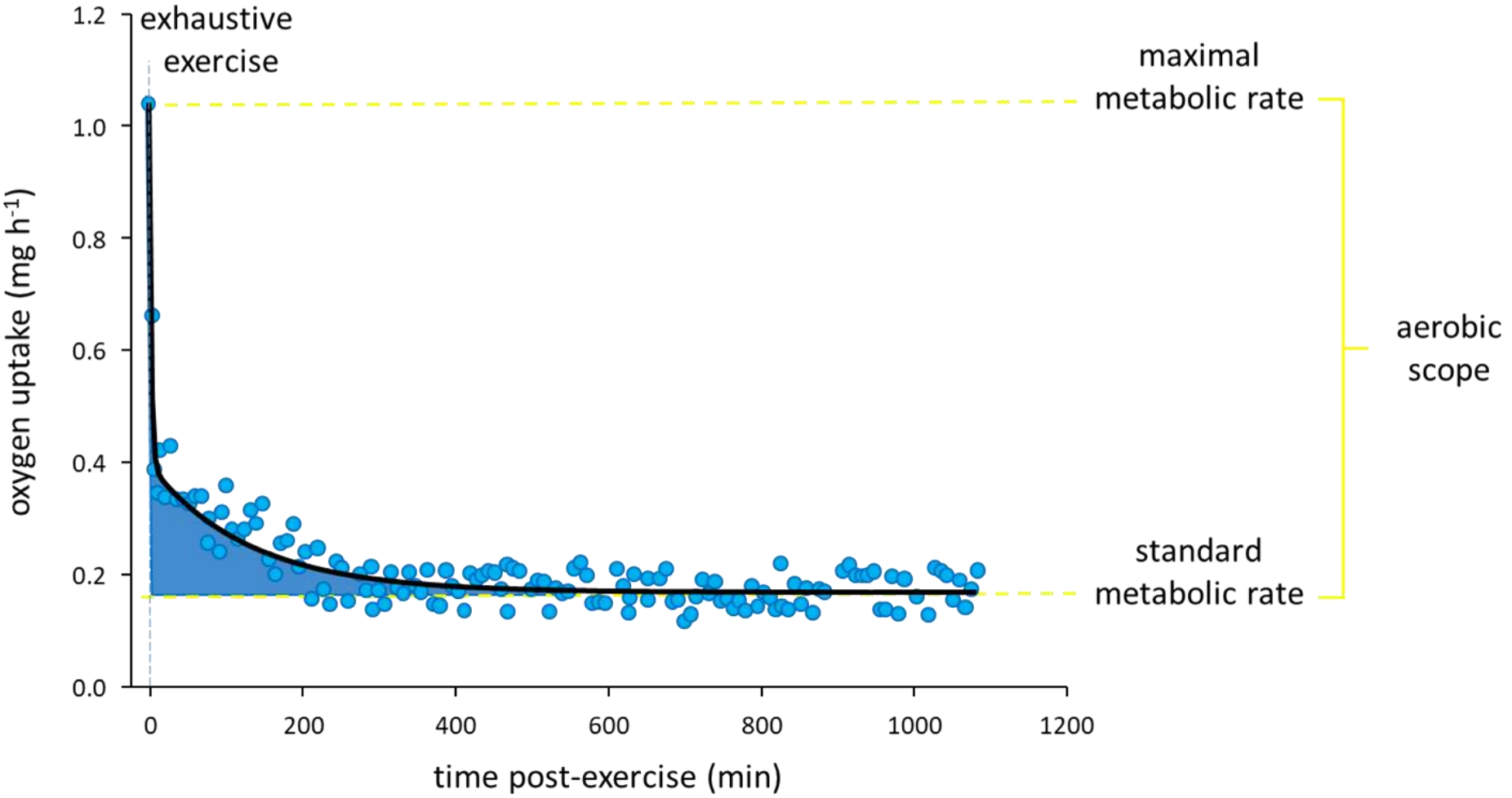
ENERGY

Aerobic scope

AS

MMR

Maximal metabolic rate


exhaustive
exercise
maximal
metabolic rate
standard
metabolic rate
aerobic
scope
oxygen uptake (mg h-1)
time post-exercise (min)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0
200
400
600
800
1000
1200

Fish Collection (Brown Trout)

Fish Rearing (Brown Trout)

Eggs

Egg troughs

Fry tanks

Migratory brown trout

Resident brown trout

Migratory females
X
Migratory males

Resident females
X
Resident males

Experiment

Differences in early developmental rate and yolk conversion efficiency in offspring of trout with alternative life histories

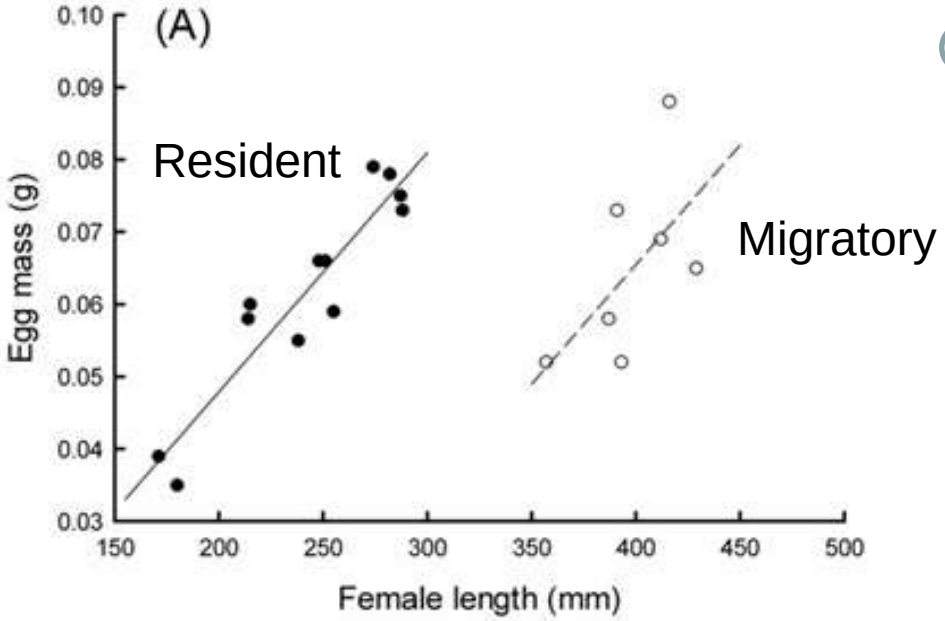
- Does the migration history of the parents affect egg size and number?

- Does the migration history of the parents affect offspring development (from egg to first feeding)?

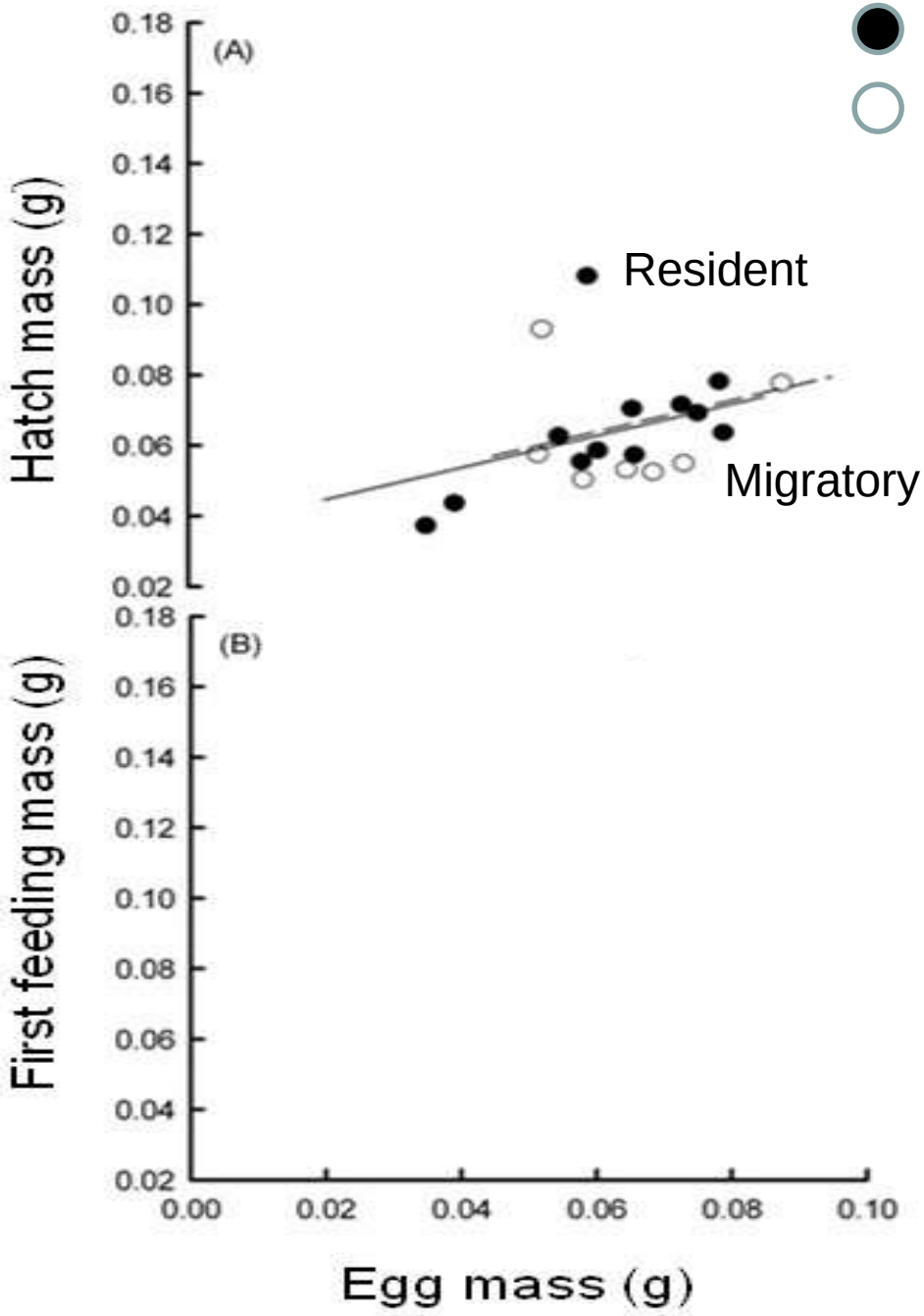
RESIDENT

MIGRATORY

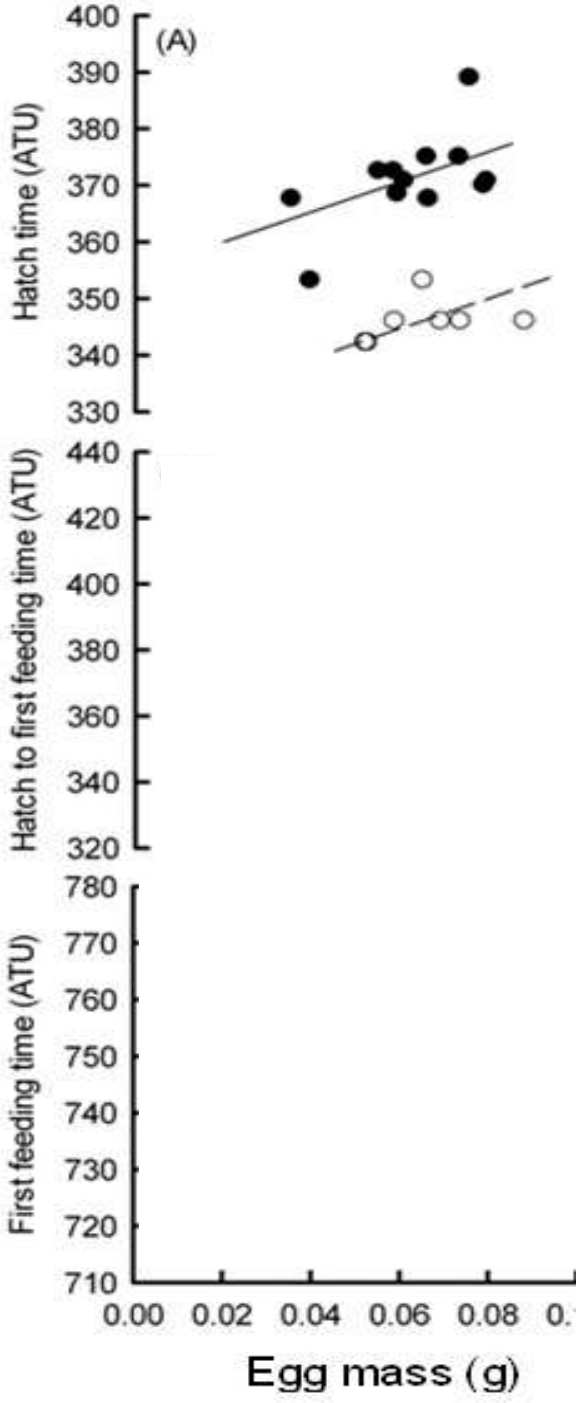
Resident females produce **heavier** eggs for a given length



No difference in hatch mass



Resident offspring take **longer** to hatch

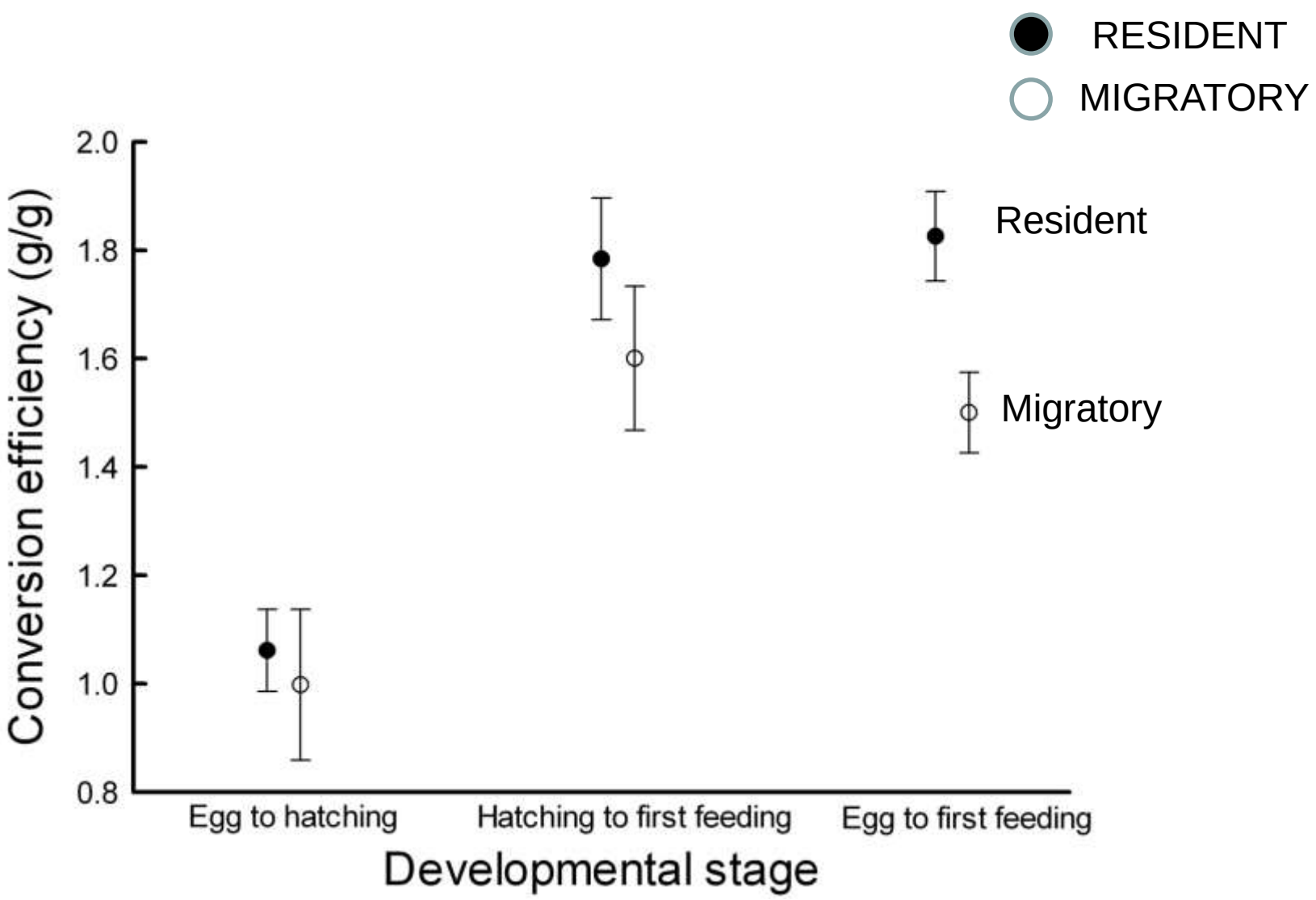


RESIDENT

Resident

MIGRATORY

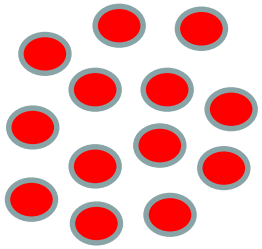
Migratory



Resident offspring have a **higher** conversion of egg mass to fry mass

What does this potentially mean?

Migratory



Conversion Efficiency

% of migrants

More eggs=higher density of fish

% of migrants

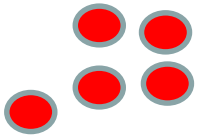
Slower to develop and smaller at first feeding

% of migrants

Lower conversion efficiency

% of migrants

Resident



Conversion Efficiency

% of migrants

Less eggs=lower density of fish

% of migrants

Faster to develop and larger at first feeding

% of migrants

Higher conversion efficiency

% of migrants

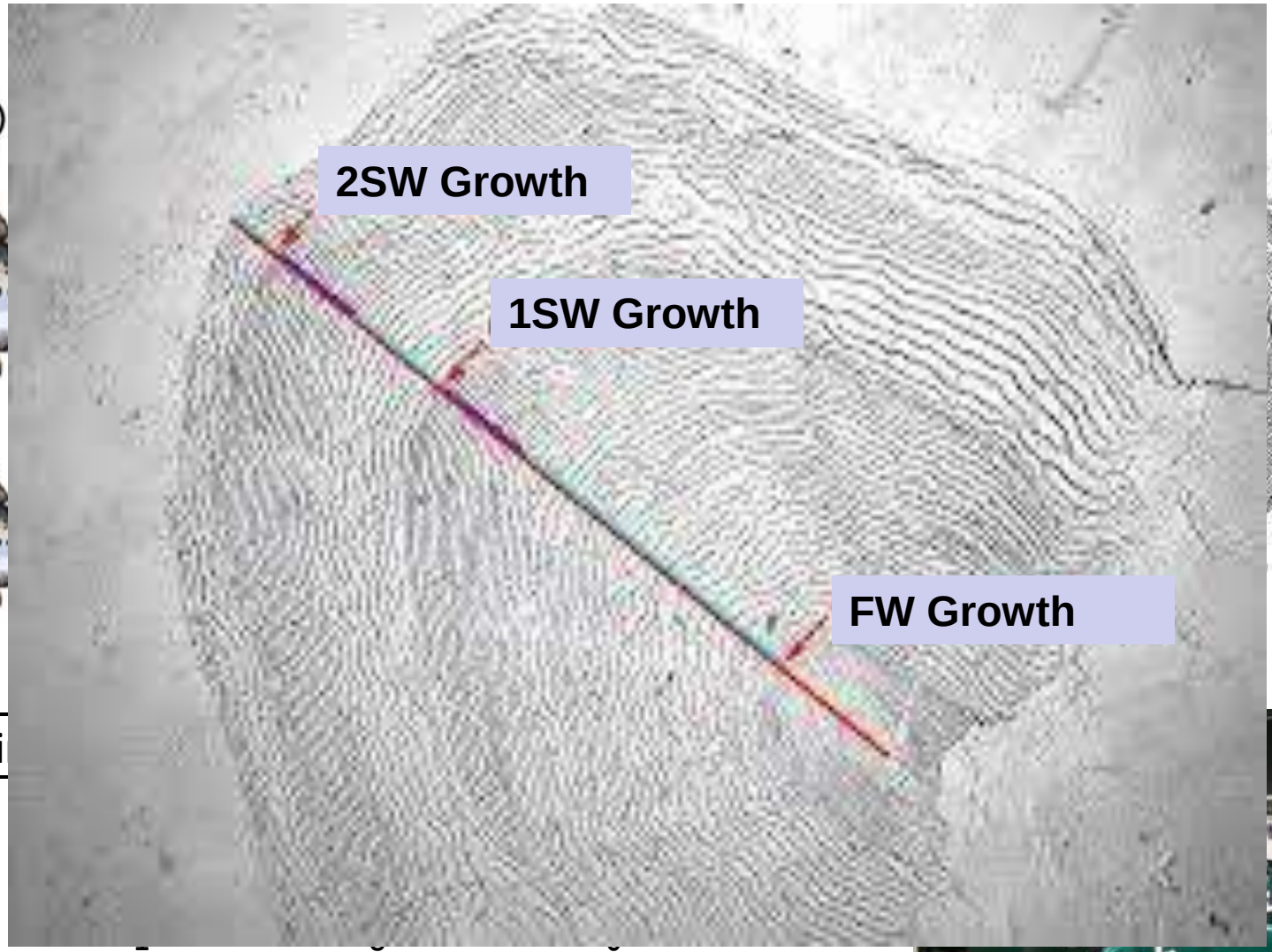
Fish Collection (Atlantic Salmon)

Conon River

Migratory

Resident

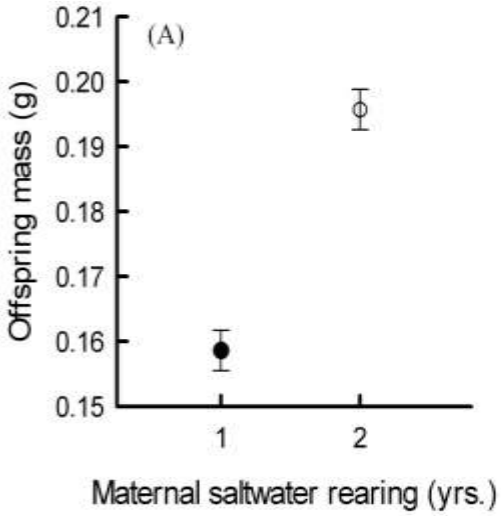
Experiment



Sex	# of fish	Ti			
F	4				
F	12				
M	3		1		
M	15		2	10	1
M	8		3	8	2

MASS

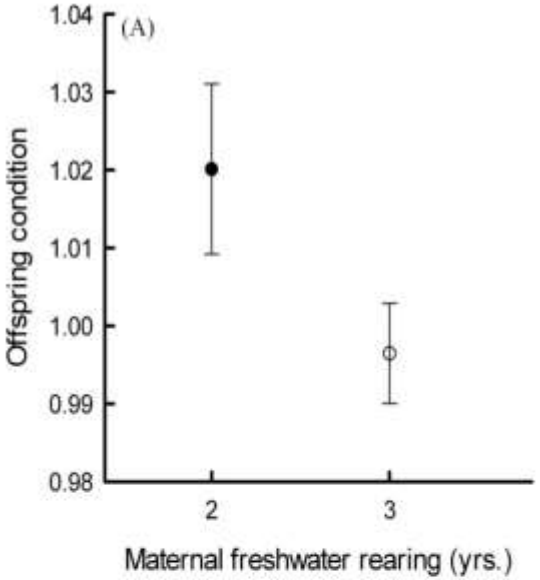
First feeding



4 months

Early development **is primarily influenced** by the **sea age** of the **mother** but advantages are **lost** after 4 months

CONDITION



Freshwater rearing environment of the mother **is important** with **early** smolting mothers producing offspring with traits **likely** to

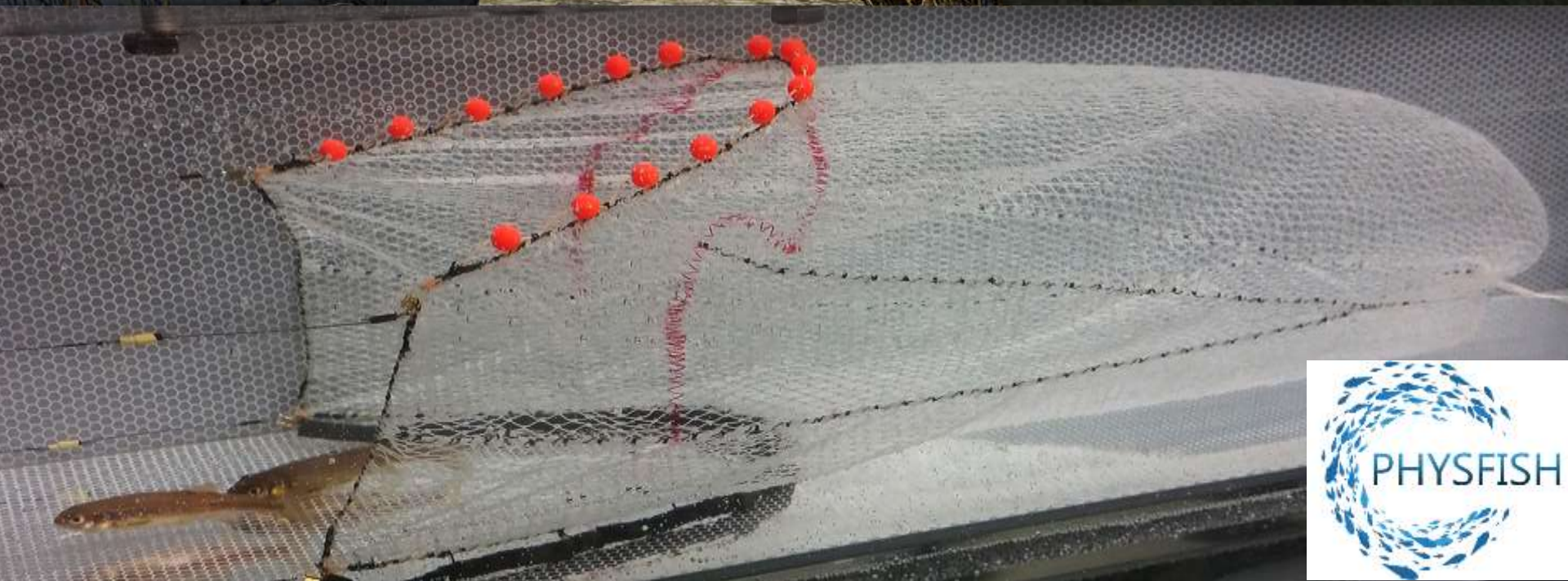
Salmon Summary

• Mothers that spent **longer** at sea produced offspring which **were heavier, longer and in better condition** at the time of first feeding but these relationships **disappeared** shortly after fry had begun feeding.

• Juvenile rearing environment (time spent in freshwater) of the mother was a better predictor of offspring traits with mothers that were **faster** to develop in freshwater producing offspring that had **higher** MMR, AS and grew faster.

•Results suggest that the duration of parental early and later life stages (i.e. their life history) **may be** a significant influence on offspring traits.

HR08
HR09
HR01
HR02
HR03
HR04
Dubh Lochan
HR05
HR06
HR13
HR10
HR07
HR12
HR11



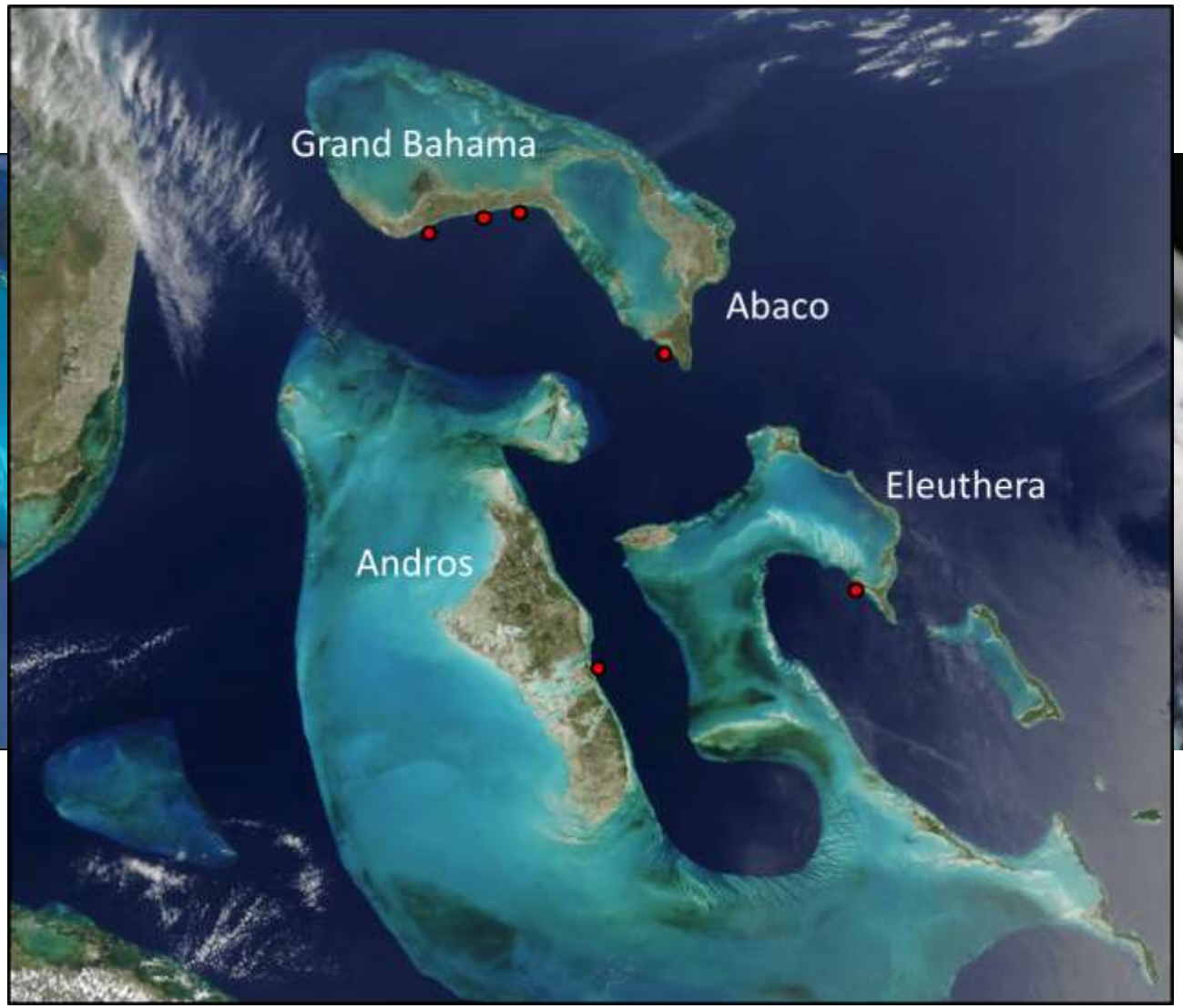
PHYSFISH

Bonefish (*Albula vulpes*)

https://vimeo.com/219127472

Cape Eleuthera Institute

Identifying spawning sites of bonefish in The Bahamas

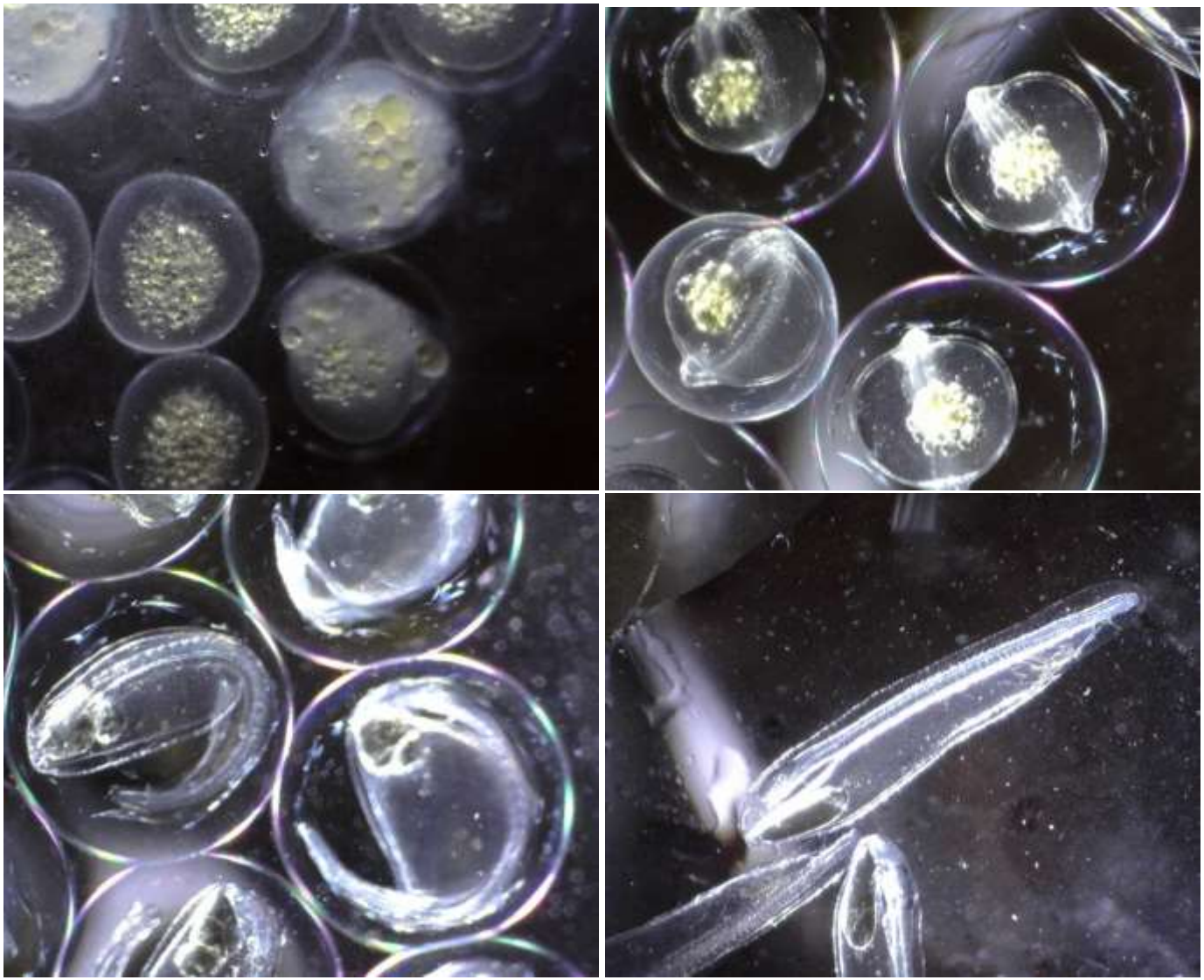


Cape Eleuthera Institute

Investigating the hormonal cycle of maturation in captive bonefish

Cape Eleuthera Institute

Spawning and rearing of bonefish in captivity



The End