Causes and consequences of fish migration

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23-25 augusti

What is migration?

Move between well-defined habitats
Return journey
Temporally predictable

cf dispersal – no return

Why migration?

”nothing in biology makes sense except in the light of evolution”

Theodosius Dobzhansky, 1973

Why migration?

Decision to migrate is made by individuals

Migration is a strategy to increase fitness

Fitness benefits from migration minus costs of migration must exceed fitness of residents

Natural selection → evolution of migration

Types of migration

Defined by function

Spawning migration – different habitats optimal for growth vs reproduction

Types of migration

Defined by function

Refuge migration – move to avoid predation

Types of migration

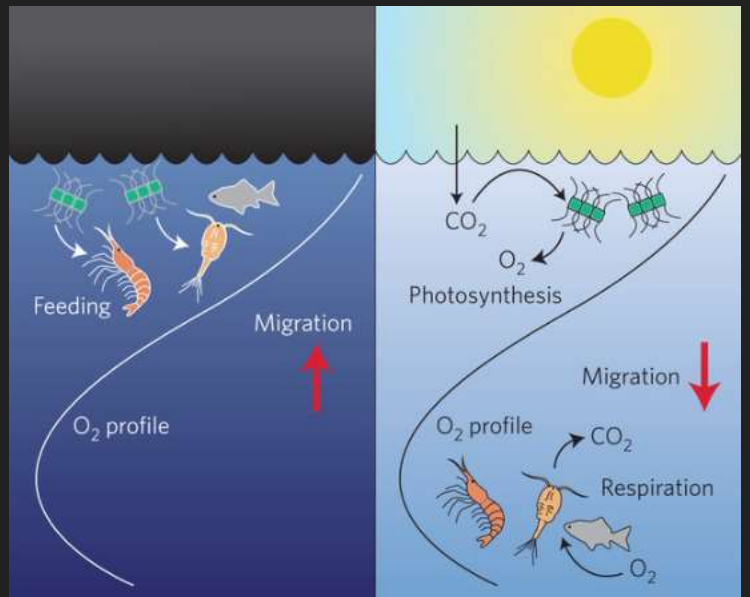
Defined by function

Environmental migration – move to avoid e.g. low oxygen or other harsh conditions

Types of migration

Defined by function

Feeding migration – move to follow food when predictable in time and space

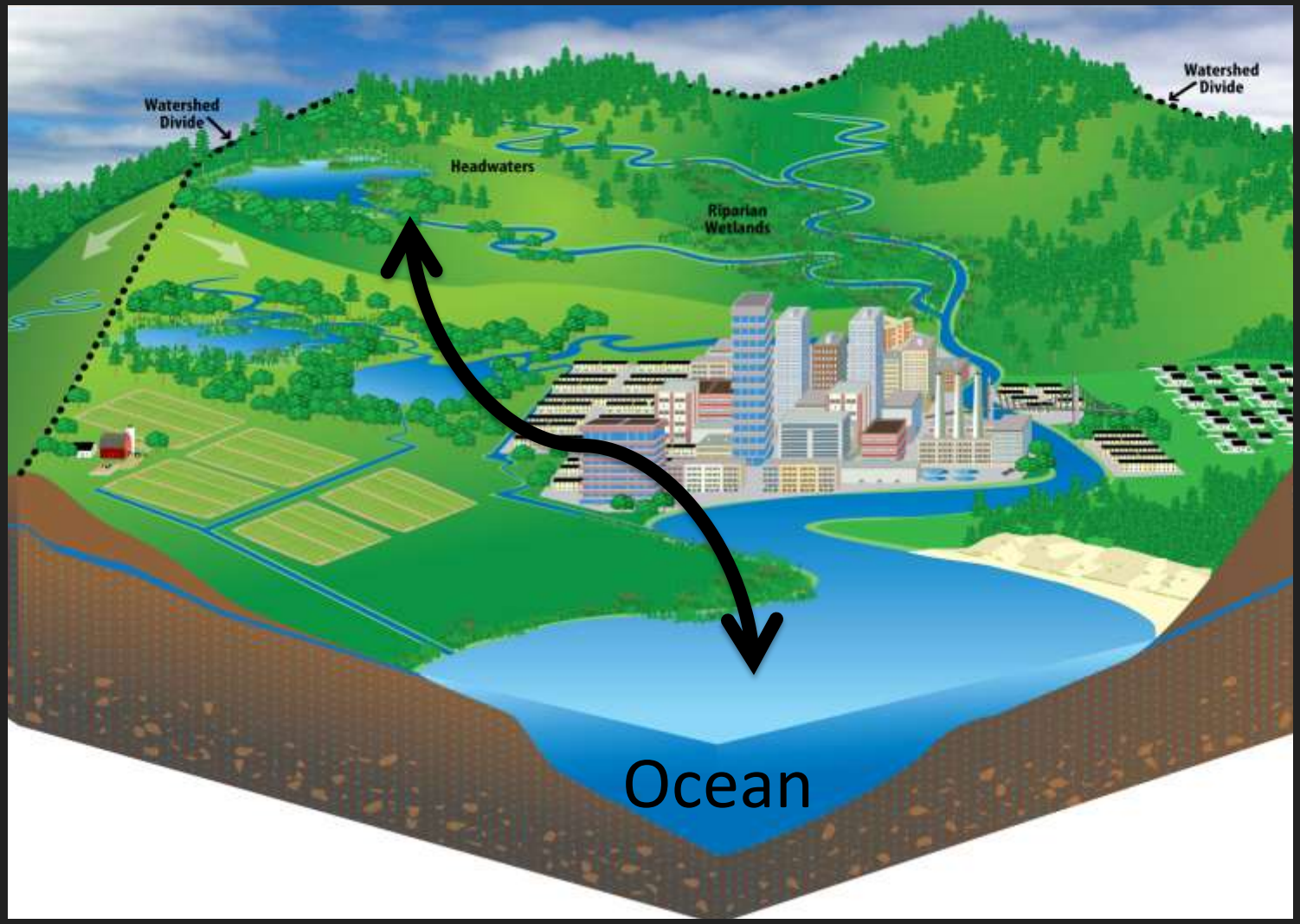


Types of migration

Defined by habitat

Diadromy – freshwater and marine habitats

Diadromy


Watershed Divide
Watershed Divide
Headwaters
Riparian Wetlands
Ocean

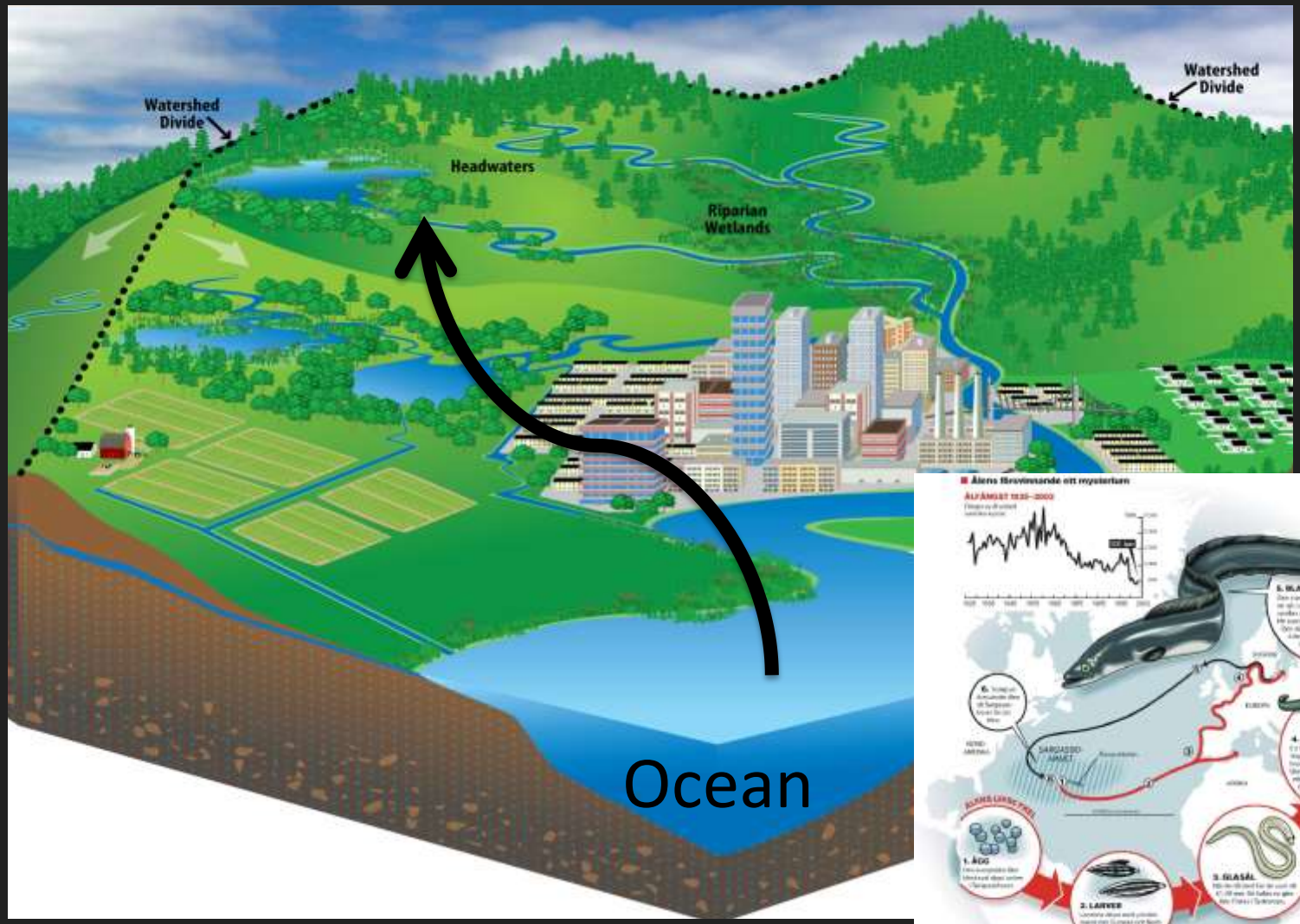
Types of migration

Defined by habitat

Diadromy – freshwater and marine habitats

Catadromy – from marine to freshwater

Catadromy


Watershed Divide
Watershed Divide
Headwaters
Riparian Wetlands
Ocean

Types of migration

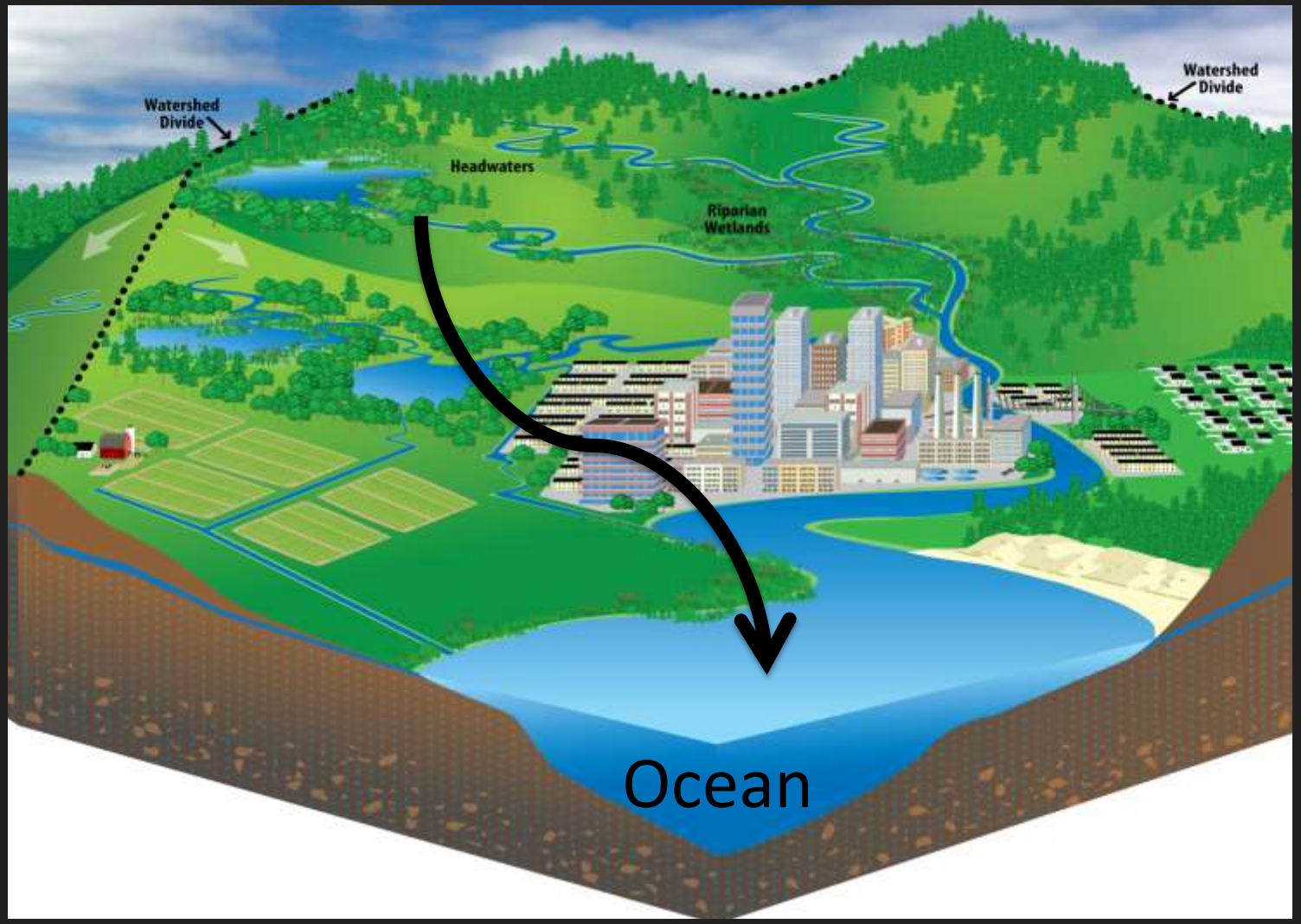
Defined by habitat

Diadromy – freshwater and marine habitats

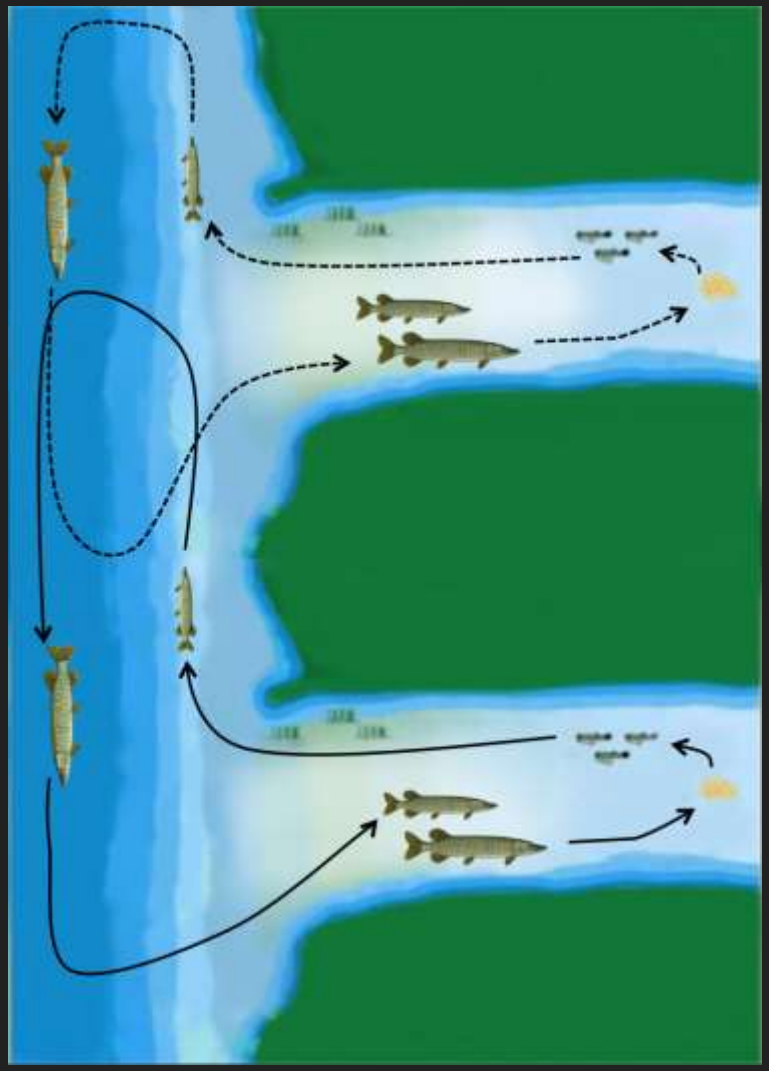
Catadromy – from marine to freshwater

Anadromy – from freshwater to marine

Anadromy

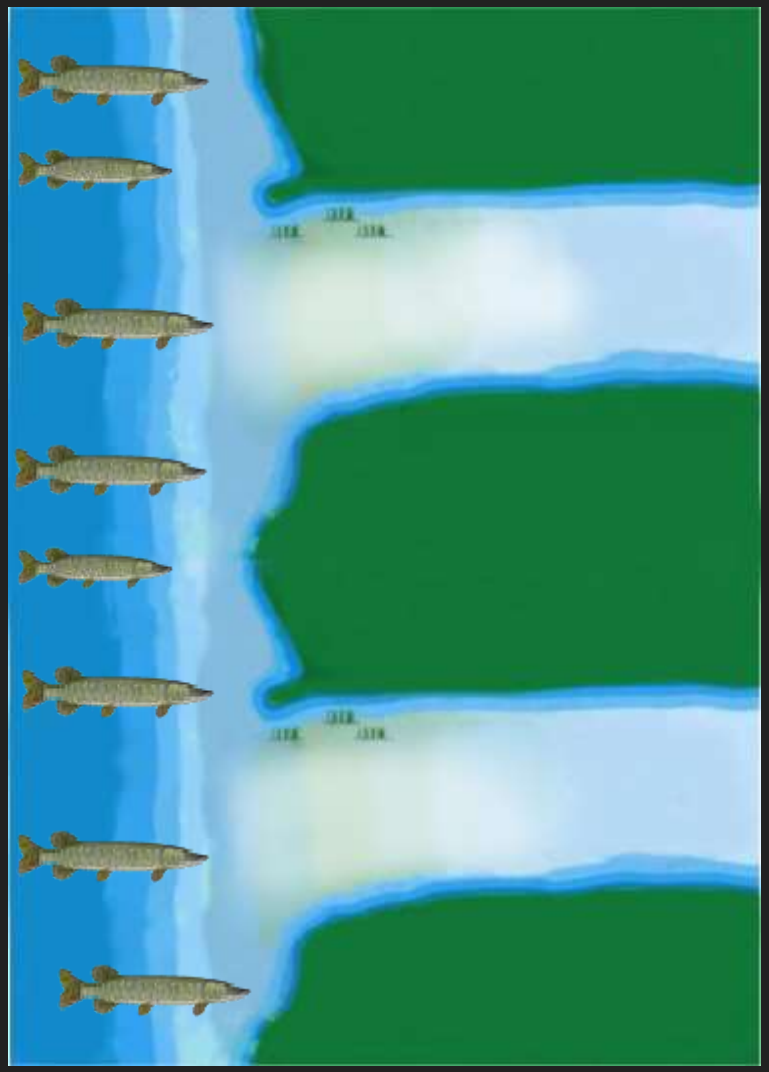

Watershed Divide
Watershed Divide
Headwaters
Riparian Wetlands
Ocean

Anadromy



Tibblin et al 2015, American Naturalist; Larsson et al 2015, Ambio

Anadromy



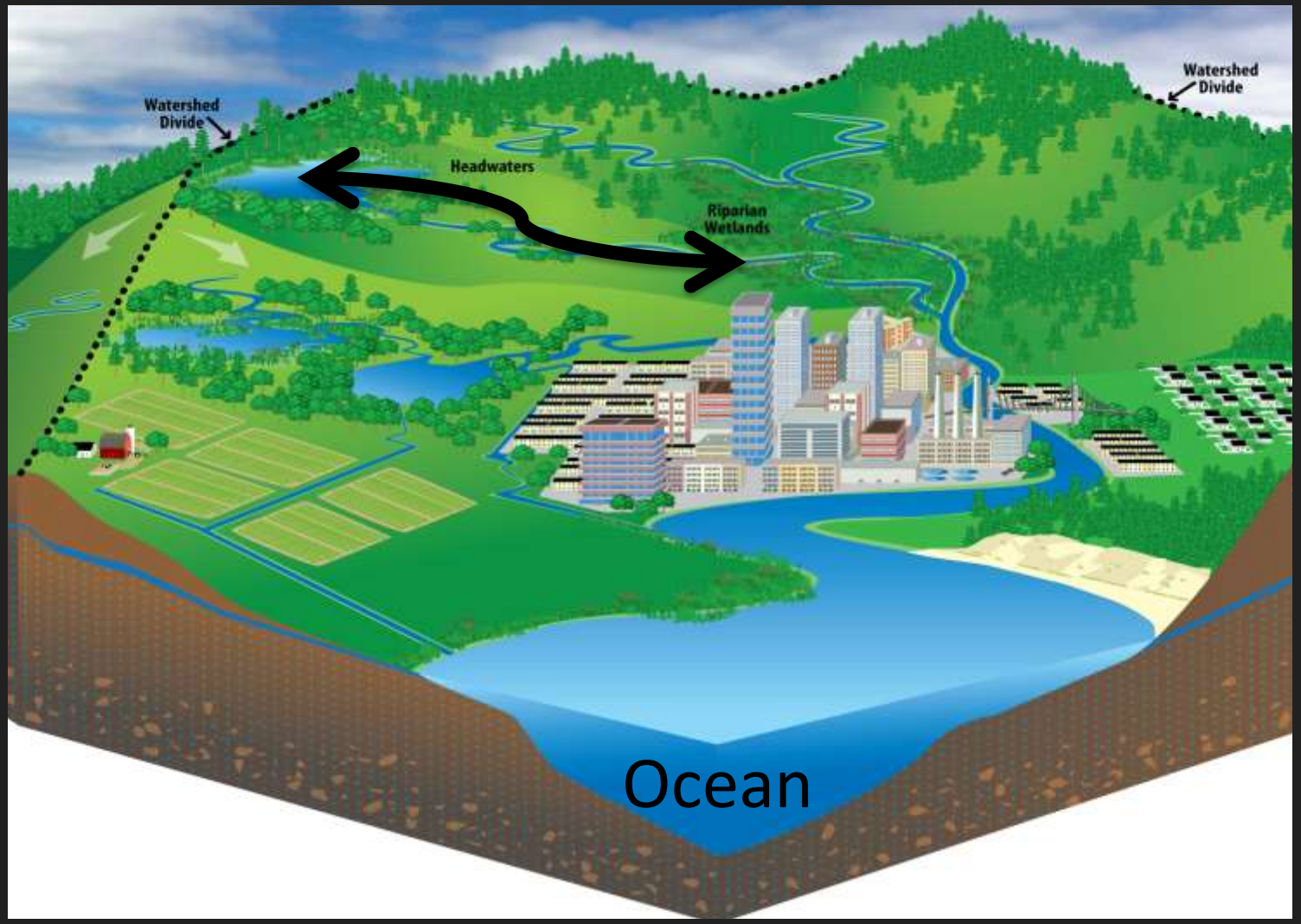
Tibblin et al 2015, American Naturalist; Larsson et al 2015, Ambio

Types of migration

Defined by habitat

Potamodromy – between freshwater habitats

Potamodromy



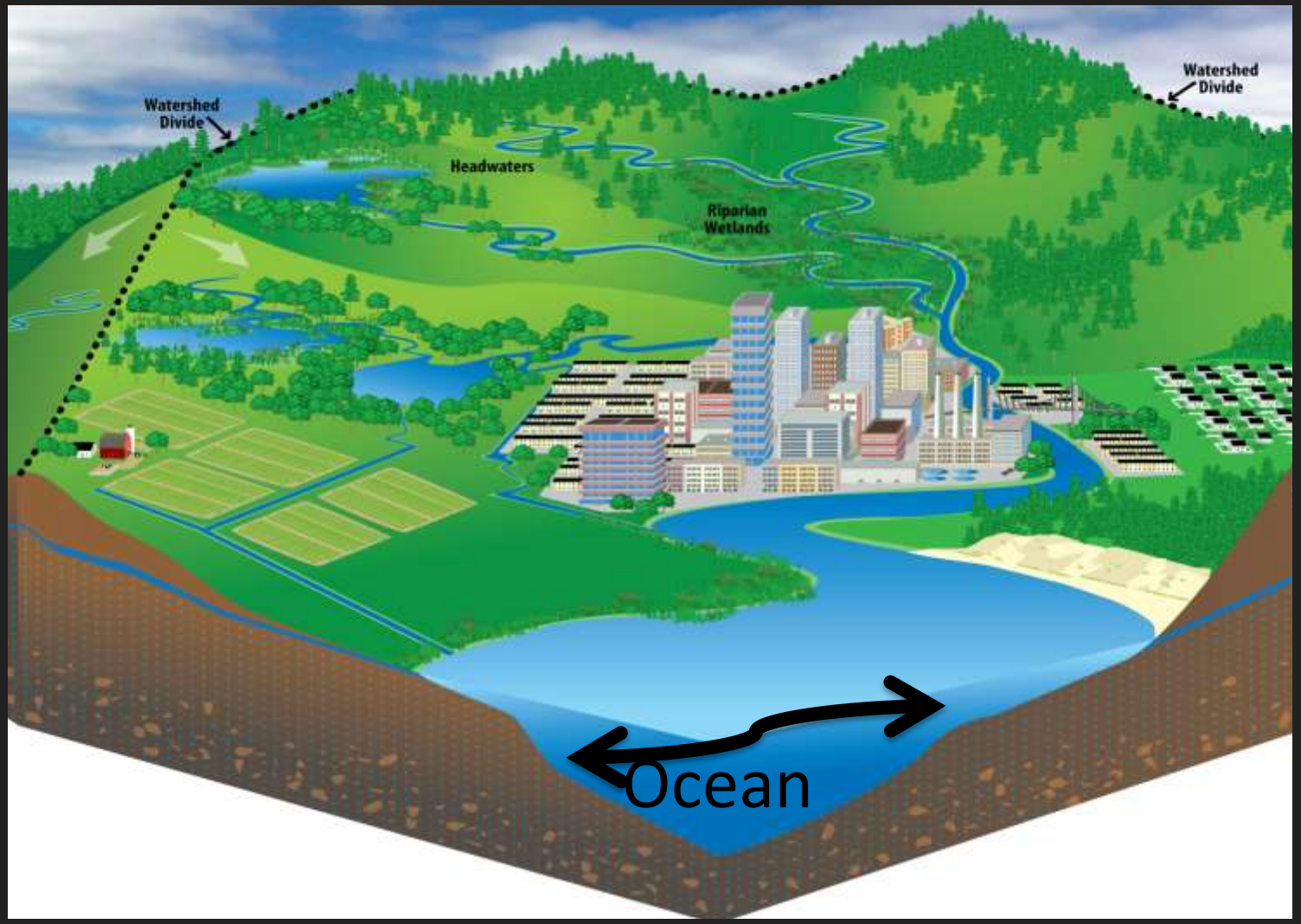
Potamodromy

Types of migration

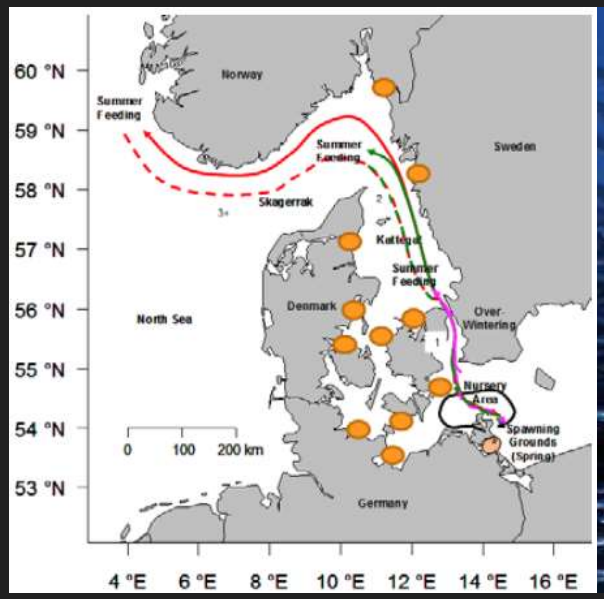
Defined by habitat

Oceanodromy – between marine habitats

Oceanodromy



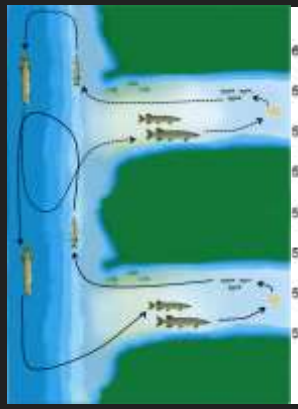
Oceanodromy

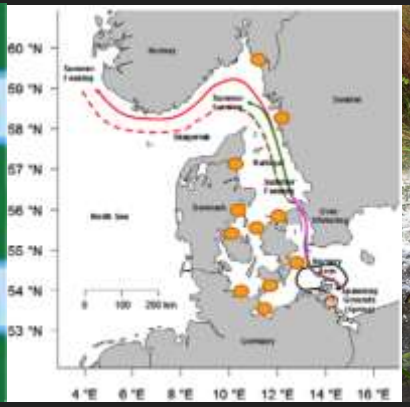


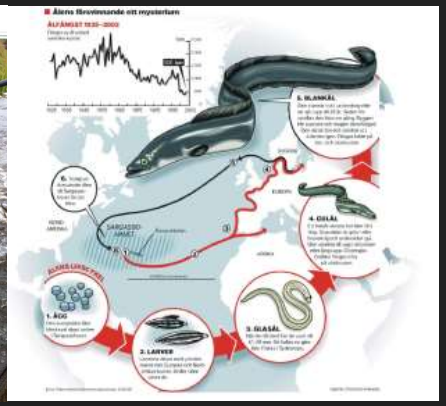
Types of migration

Defined by temporal scale

Seasonal migration





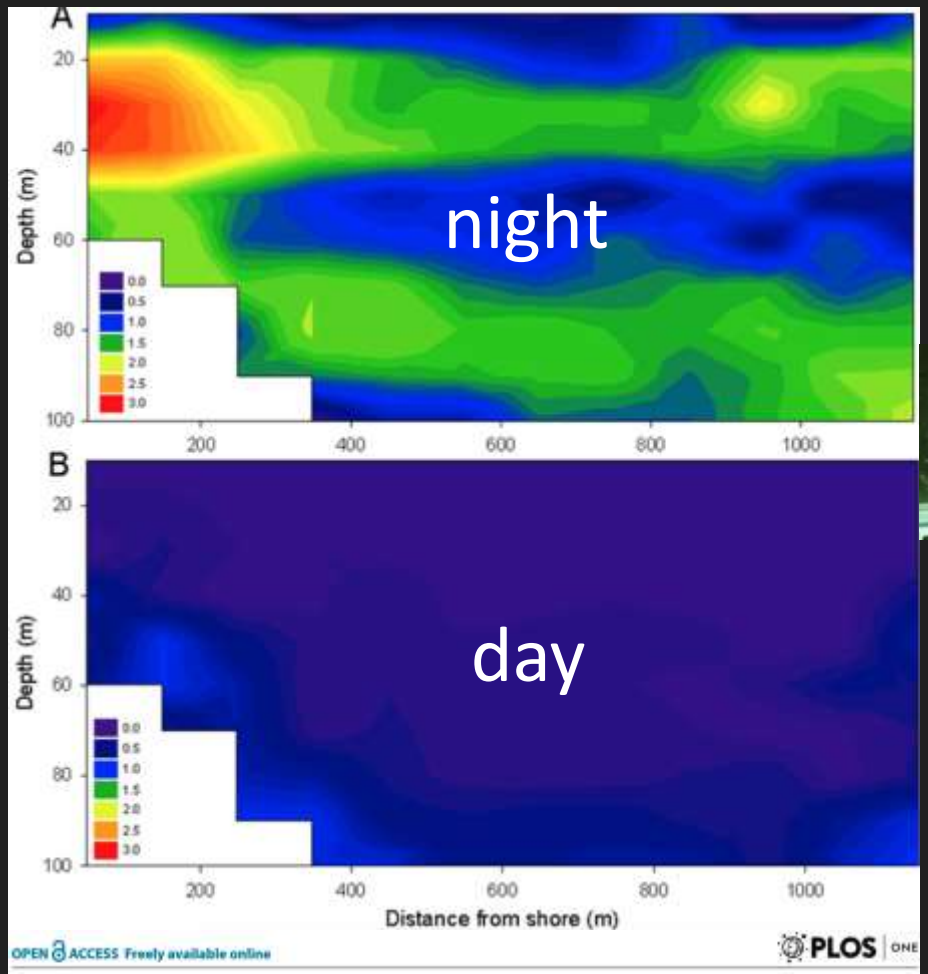


Types of migration

Defined by temporal scale

Diel migration

Diel horizontal migration



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PLOS ONE

Alien Invasions and the Game of Hide and Seek in Patagonia

Martin Lindegren[1,3*], Pablo Vigliano[2], P. Anders Nilsson[3]

Types of migration

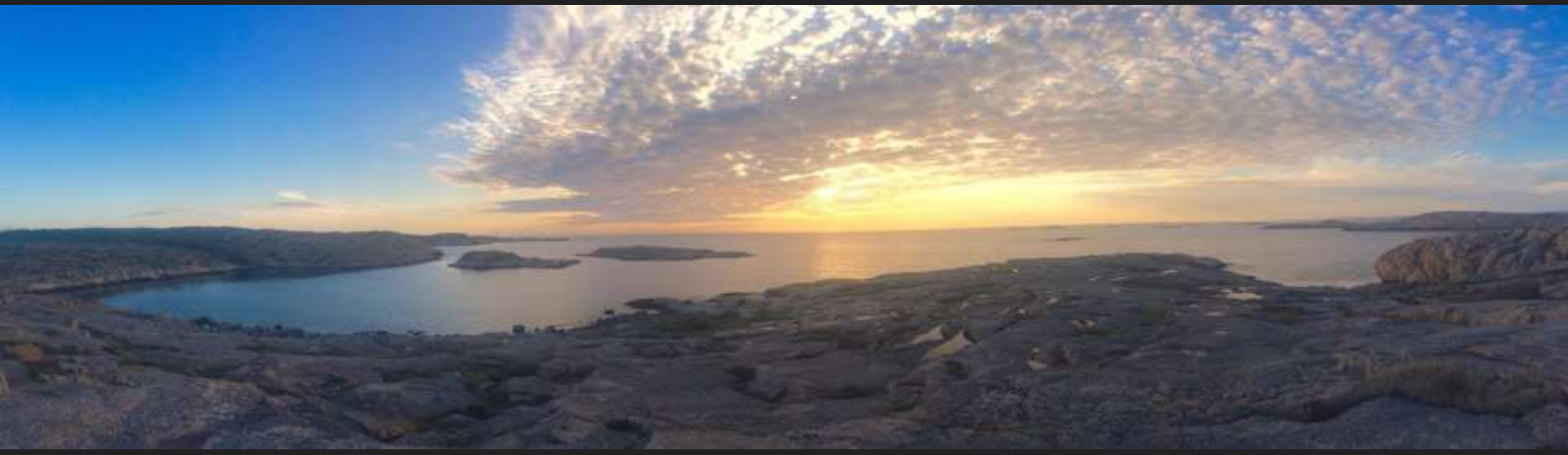
Defined by variation within populations

Differential migration

Individuals differ in migratory behaviour

Partial migration

Not all individuals in a population migrate



Why migration?

”nothing in biology makes sense except in the light of evolution”

Theodosius Dobzhansky, 1973

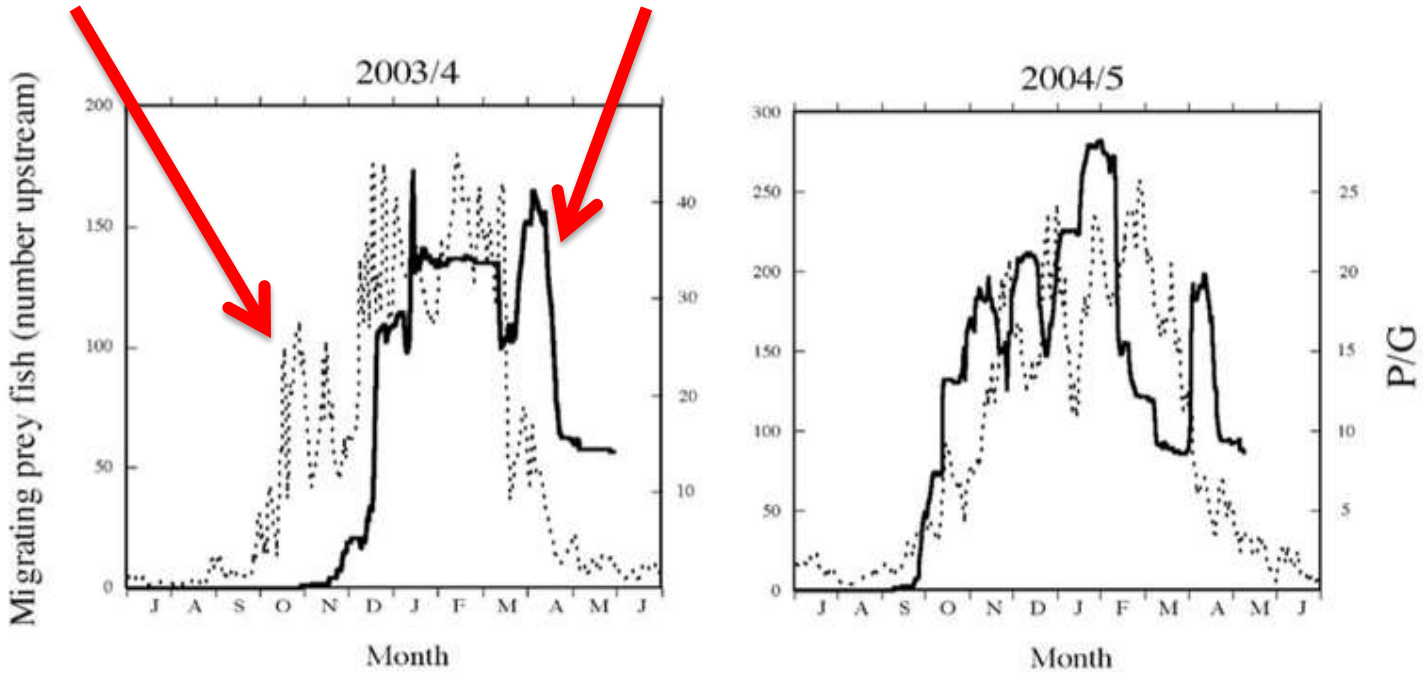
Refuge migration
Feeding migration
Potamodromy
Seasonal migration
Partial migration
Differential migration
Cyprinids


104
Sommarbo
Ellagård
Kvinnevad
Fredrikslund
Lottagården
Sandslåtthusen
Krankesjön
Ekskogen
29m
Karstgård


P/g

The method

Prediction Observed



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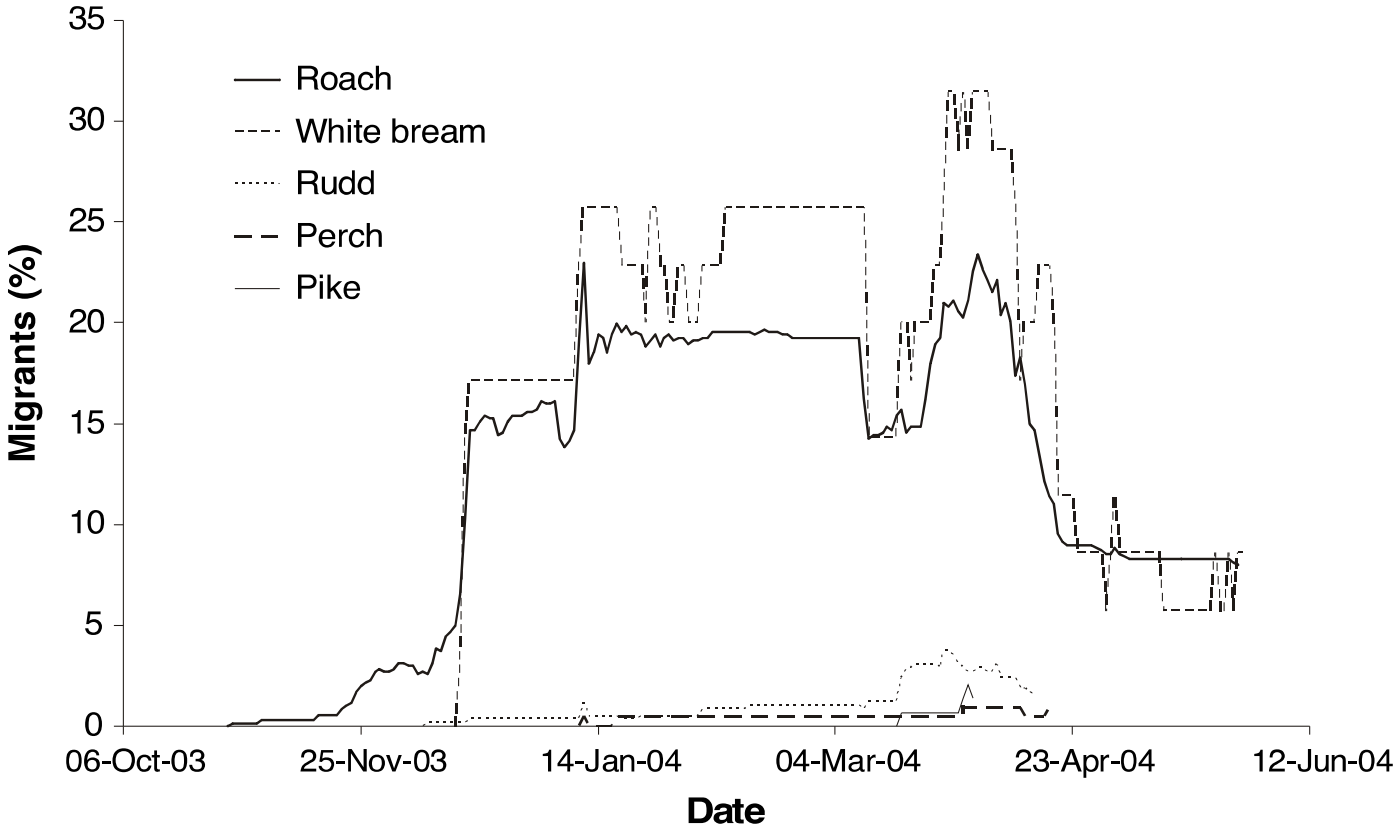
PLoS one

Seasonal Migration Determined by a Trade-Off between Predator Avoidance and Growth

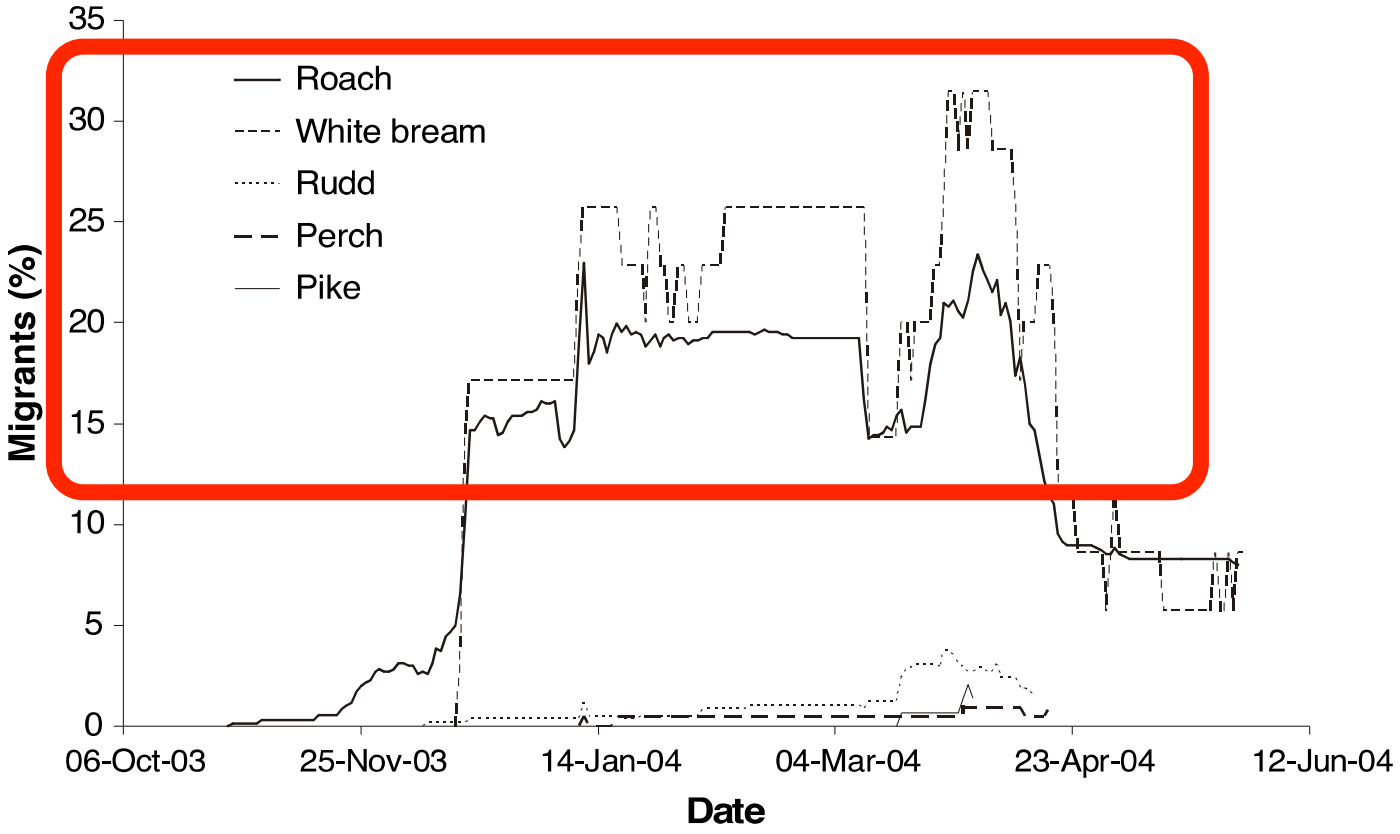
Christer Brönmark[1]*, Christian Skov[2], Jakob Brodersen[1], P. Anders Nilsson[1], Lars-Anders Hansson[1]

1 Department of Ecology, Limnology, Lund University, Lund, Sweden, 2 Danish Institute for Fisheries Research, Silkeborg, Denmark

Partial migration



Partial migration



Ecology of Freshwater Fish 2008: 17: 606–615
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ECOLOGY OF
FRESHWATER FISH

Inter- and size-specific patterns of fish seasonal migration between a shallow lake and its streams

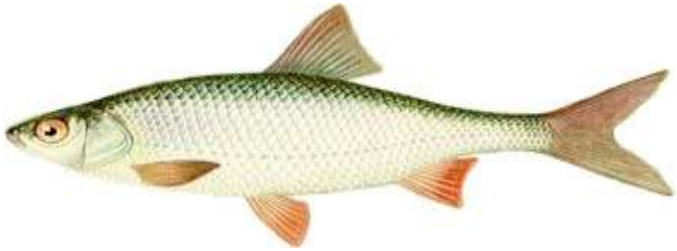
Skov C, Brodersen J, Nilsson PA, Hansson L-A, Brönmark C. Inter- and size-specific patterns of fish seasonal migration between a shallow lake and its streams.
Ecology of Freshwater Fish. 2008: 17: 606-615. © 2008 The Authors.
Journal compilation © 2008 Blackwell Munksgaard

C. Skov[1,2], J. Brodersen[1], P.A. Nilsson[1], L.-A. Hansson[1], C. Brönmark[1]
[1]Department of Ecology, Limnology Lund University, Lund, Sweden, [2]DTU Aqua, National

Condition-dependent?

Migrant?

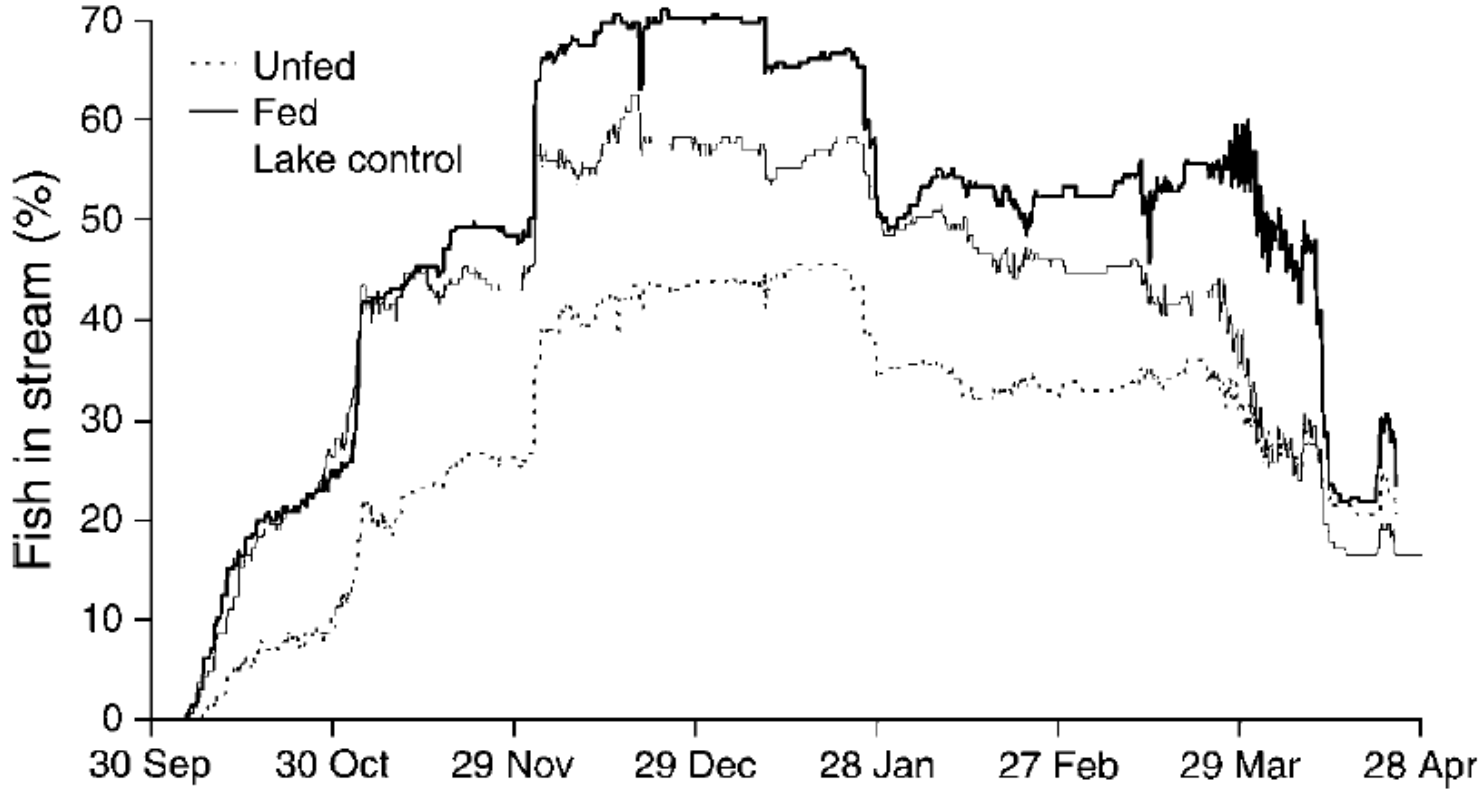
Resident?



Condition-dependent?

Condition-dependent?

Condition-dependent!



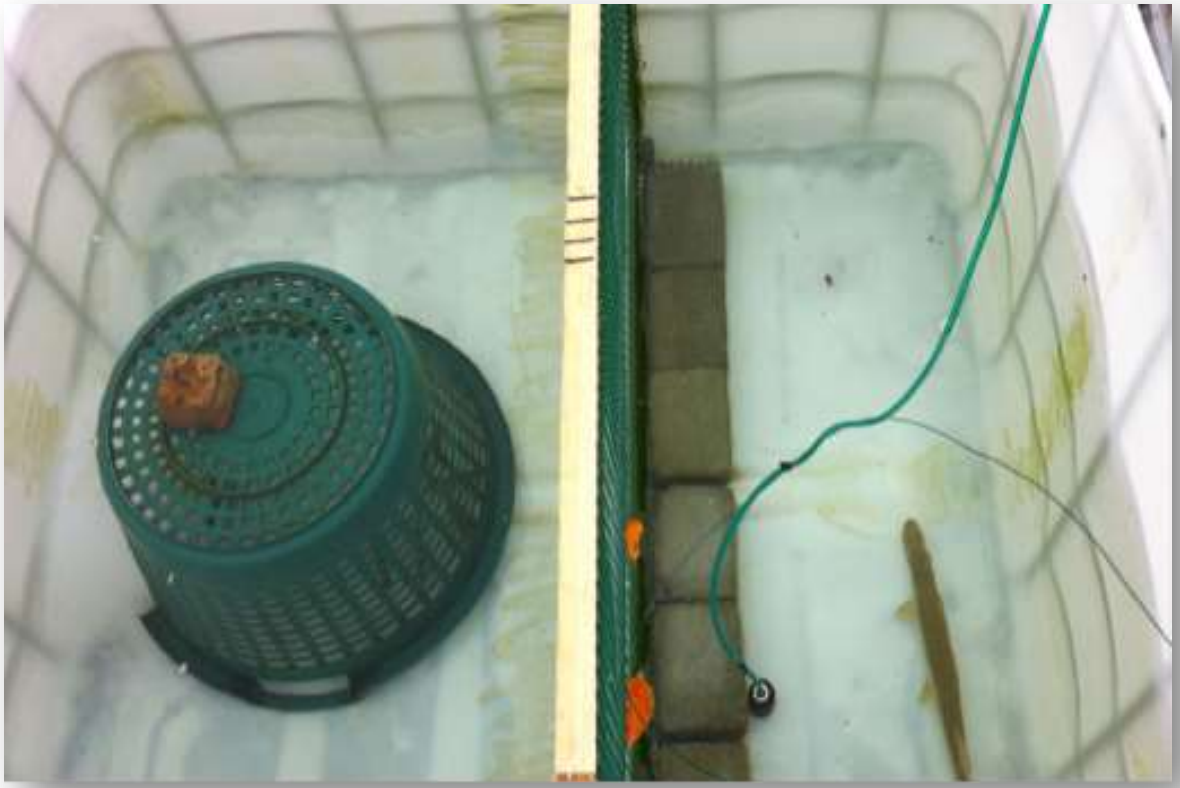
Ecology, 89(5), 2008, pp. 1195–1200

CONDITION-DEPENDENT INDIVIDUAL DECISION-MAKING DETERMINES CYPRINID PARTIAL MIGRATION

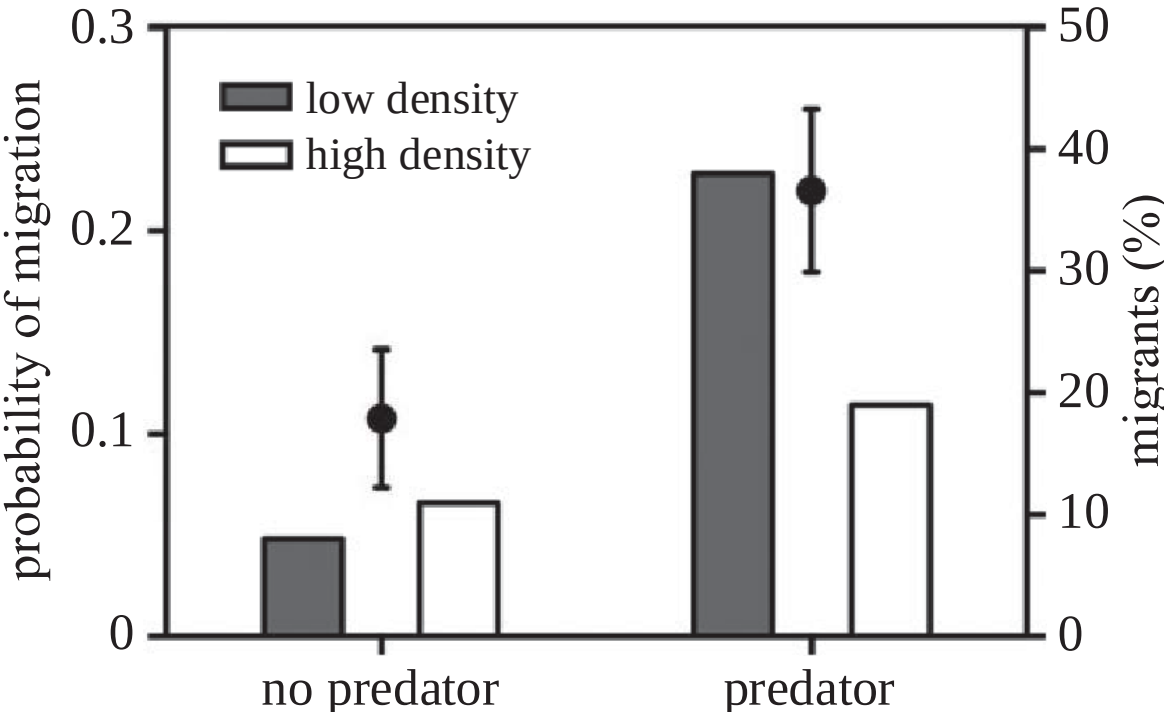
JAKOB BRODERSEN,[1,3] P. ANDERS NILSSON,[1] LARS-ANDERS HANSSON,[1] CHRISTIAN SKOV,[2] AND CHRISTER BRÖNMARK[1]

Perceived risk of predation?

Perceived risk of predation?



Perceived risk of predation!



BIOLOGY LETTERS

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Research

Animal behaviour

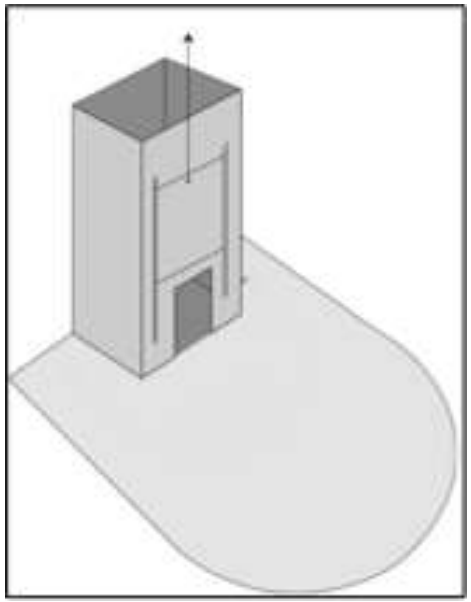
Escaping peril: perceived predation risk affects migratory propensity

Kaj Hulthén[1], Ben B. Chapman[1,2], P. Anders Nilsson[1,3], Jerker Vinterstare[1], Lars-Anders Hansson[1], Christian Skov[4], Jakob Brodersen[5], Henrik Baktoft[4] and Christer Brönmark[1]

Animal personality?

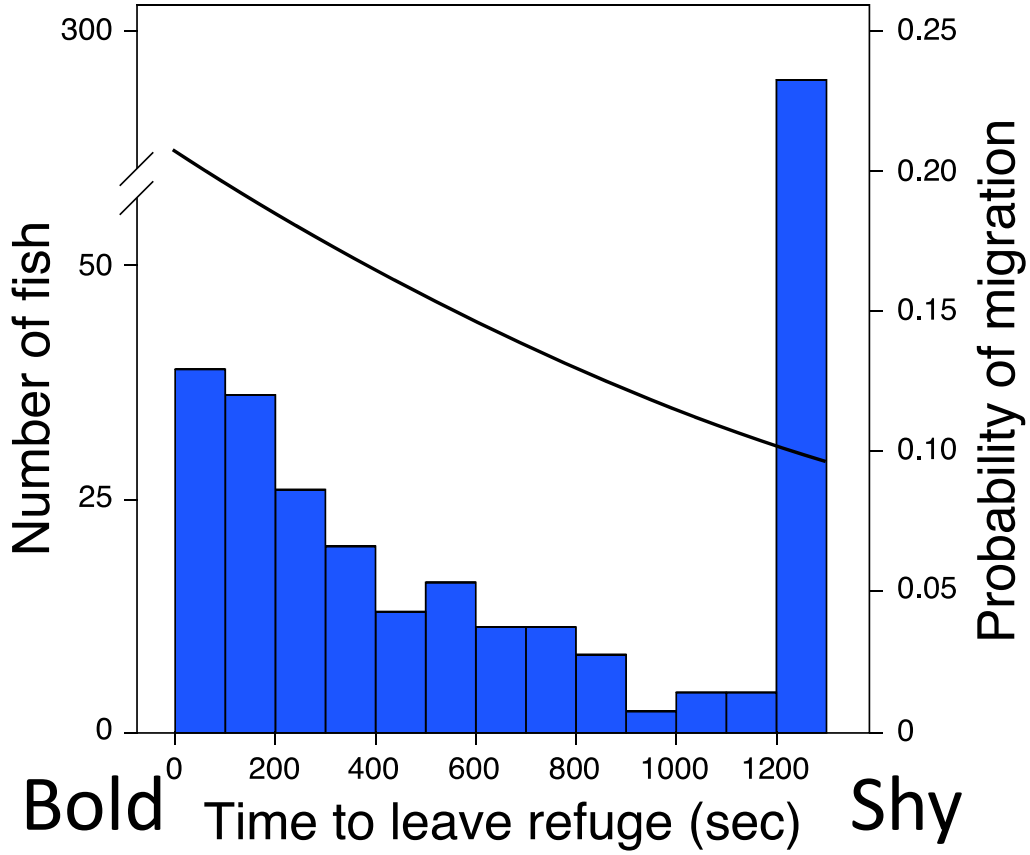
Shy-Bold continuum

Animal personality?



Time to leave refuge in a novel environment

Animal personality!

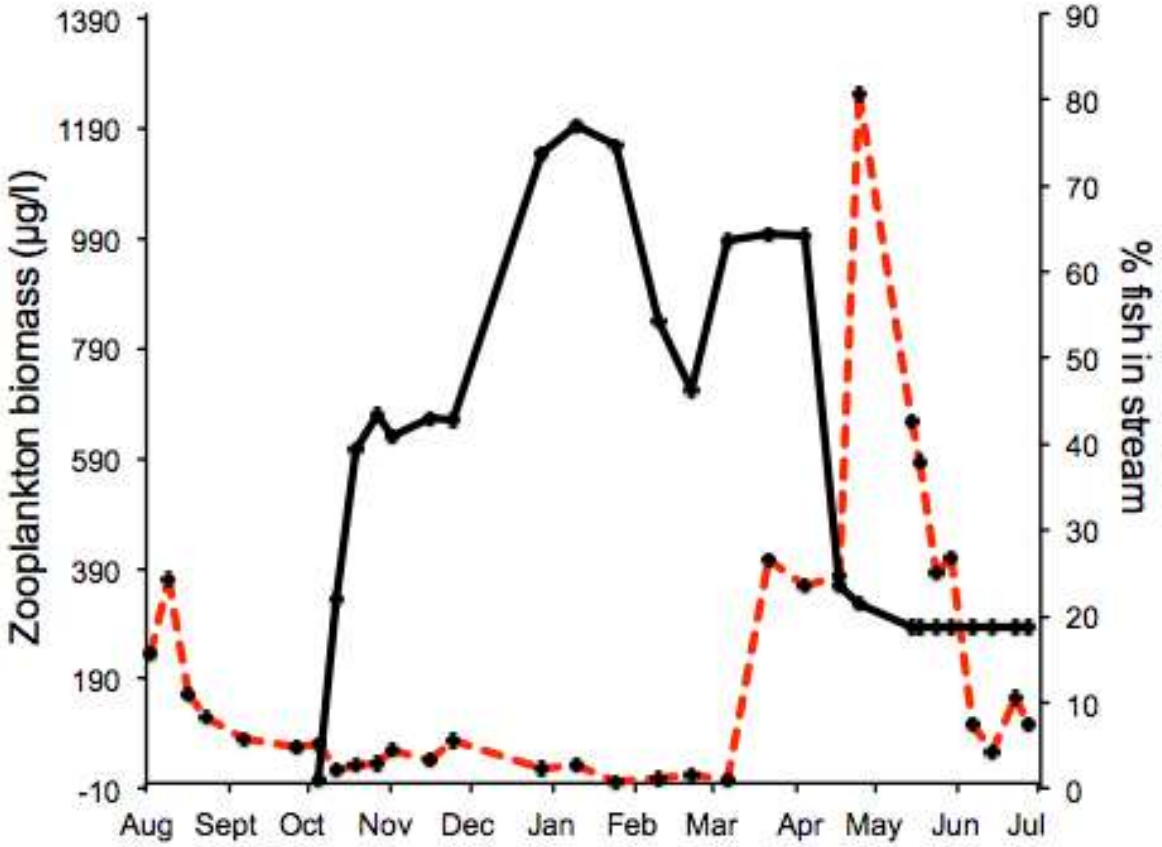


ECOLOGY LETTERS
Ecology Letters, (2011) 14: 871–876 doi: 10.1111/j.1461-0248.2011.01648.x

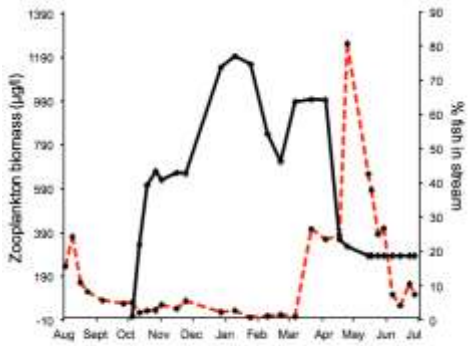
LETTER

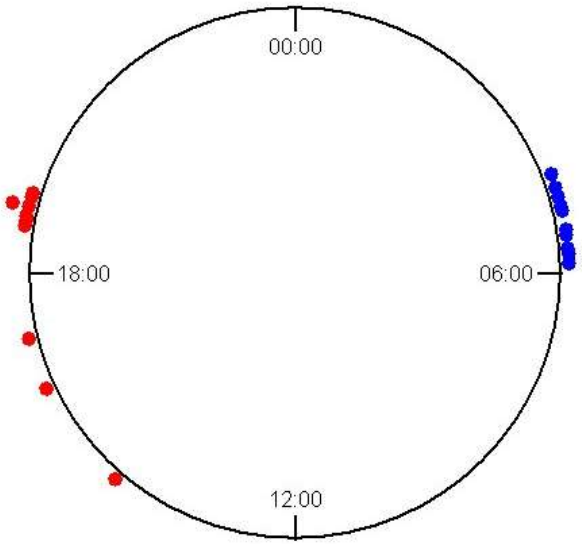
To boldly go: individual differences in boldness influence migratory tendency

Return migration timing



Return migration timing





Dusk - dawn
lake excursions

Hulthén et al., manuscript

Consequences of fish migration

Consequences of fish migration

Lake Krankesjön (3km^2) roach

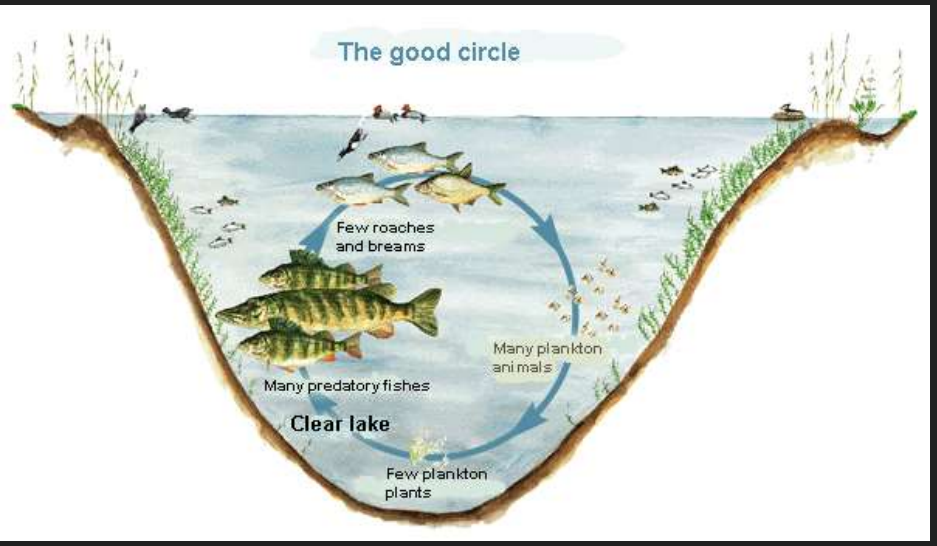
25-80% migrating = 7.5-24 tonnes migrating

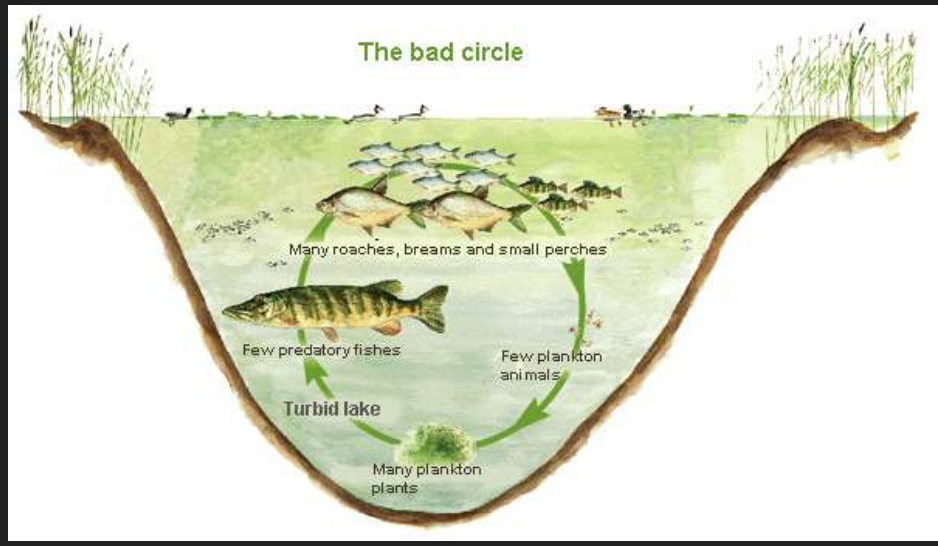
Why migration?

”nothing in biology makes sense except in the light of evolution”

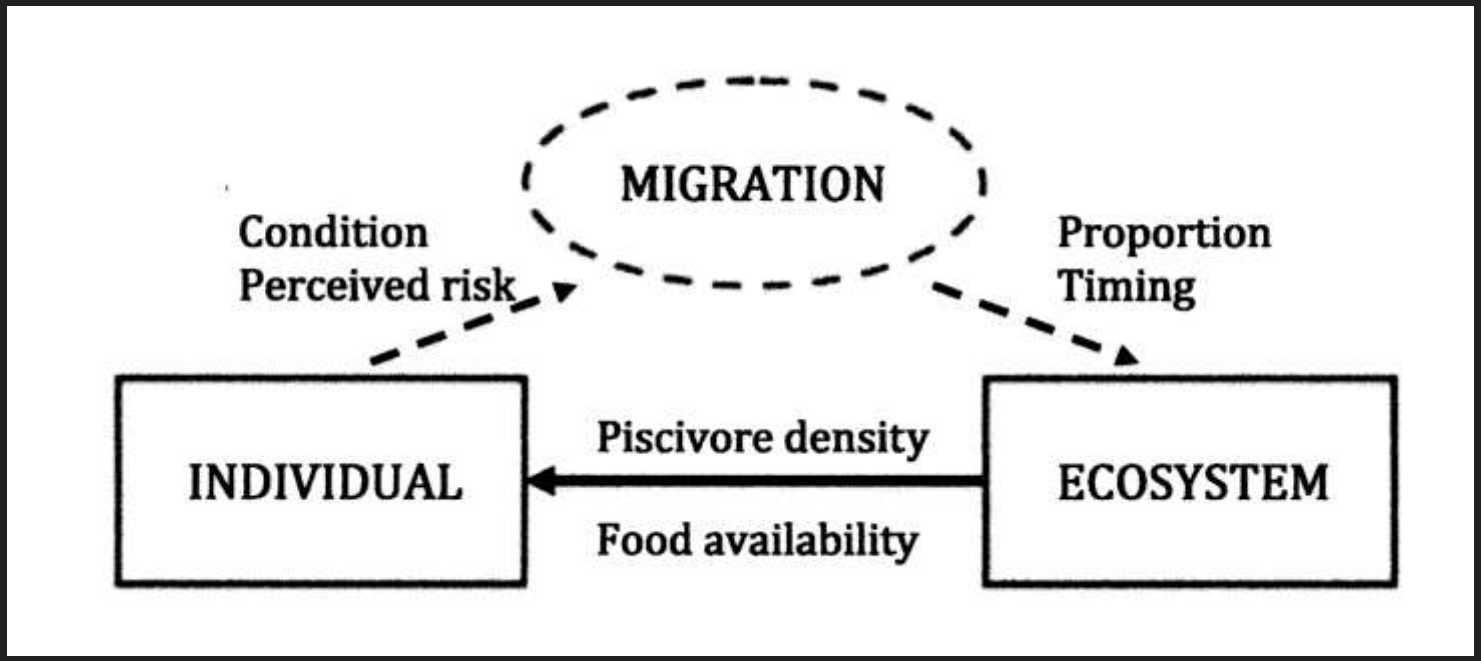
Theodosius Dobzhansky, 1973

Migrants escape predation, survive better, and likely have higher fitness


The good circle
Few roaches and breams
Many plankton animals
Many predatory fishes
Clear lake
Few plankton plants


The bad circle
Many roaches, breams and small perches
Few predatory fishes
Few plankton animals
Turbid lake
Many plankton plants

Consequences of fish migration



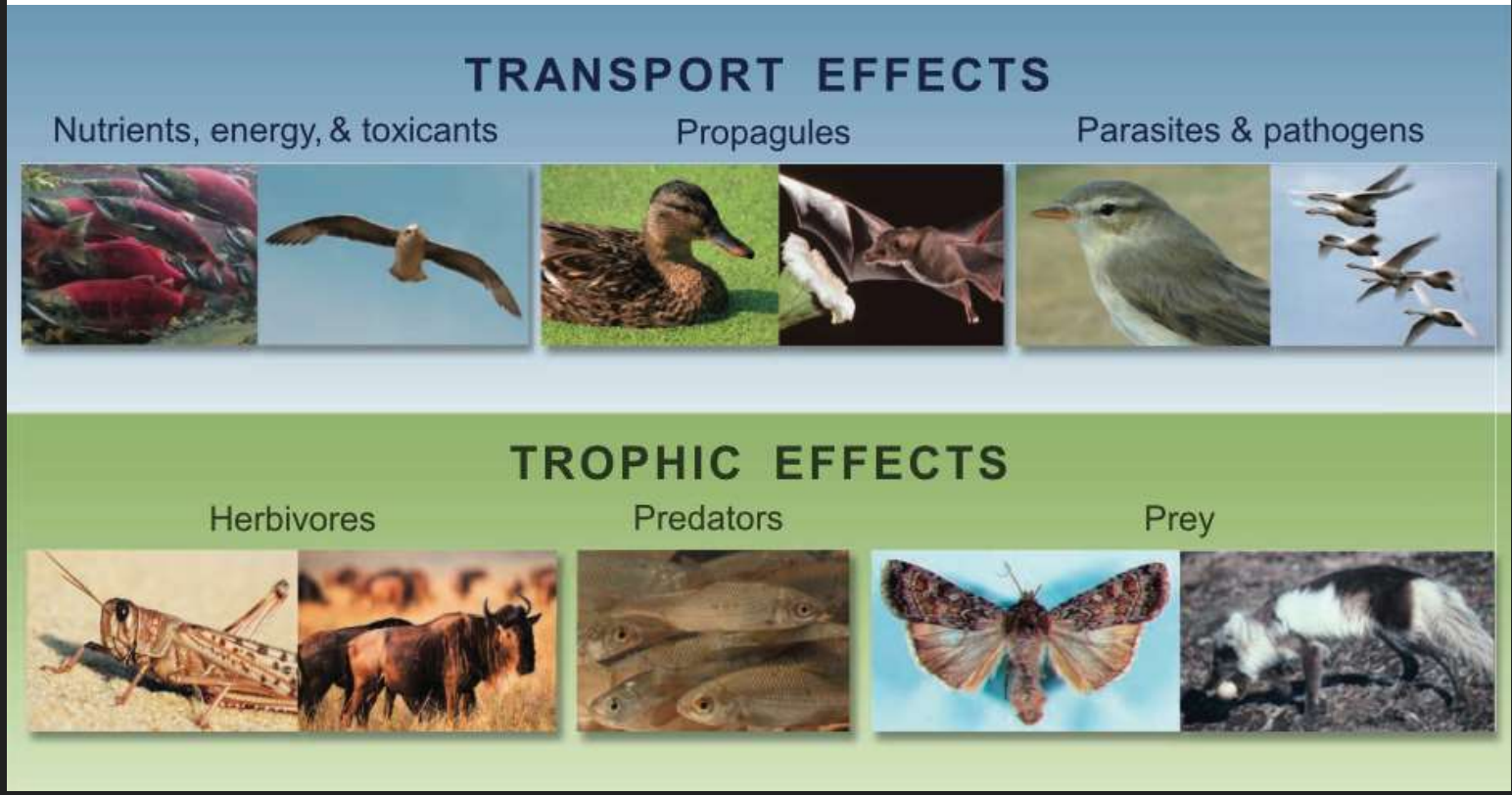
Hydrobiologia (2010) 646:91–100
DOI 10.1007/s10750-010-0165-3

SHALLOW LAKES

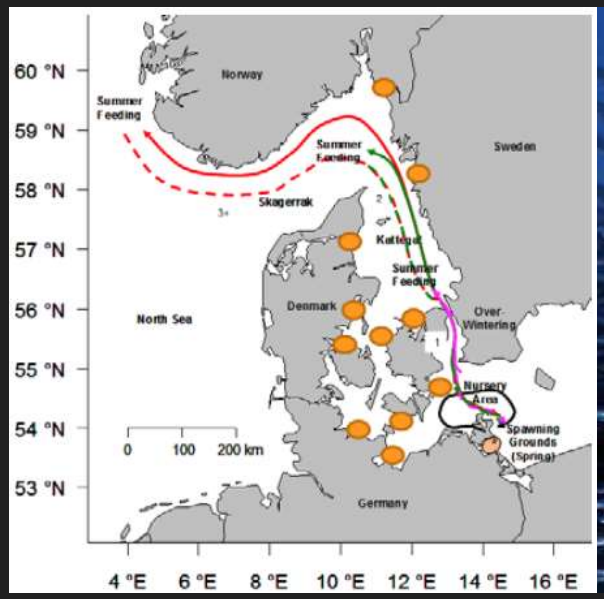
Regime shifts in shallow lakes: the importance of seasonal fish migration

Migratory Animals Couple Biodiversity and Ecosystem Functioning Worldwide

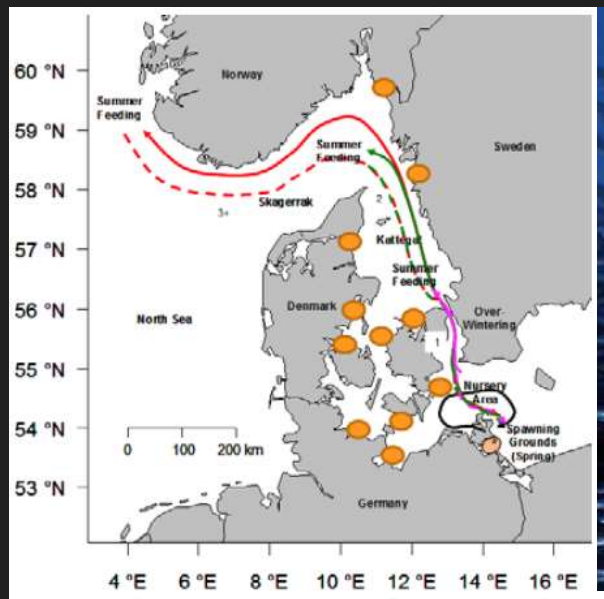
Cite this article as S. Bauer, B. J. Hoye, *Science* **344**, 1242552 (2014). DOI: 10.1126/science.1242552



Oceanodromy



Oceanodromy



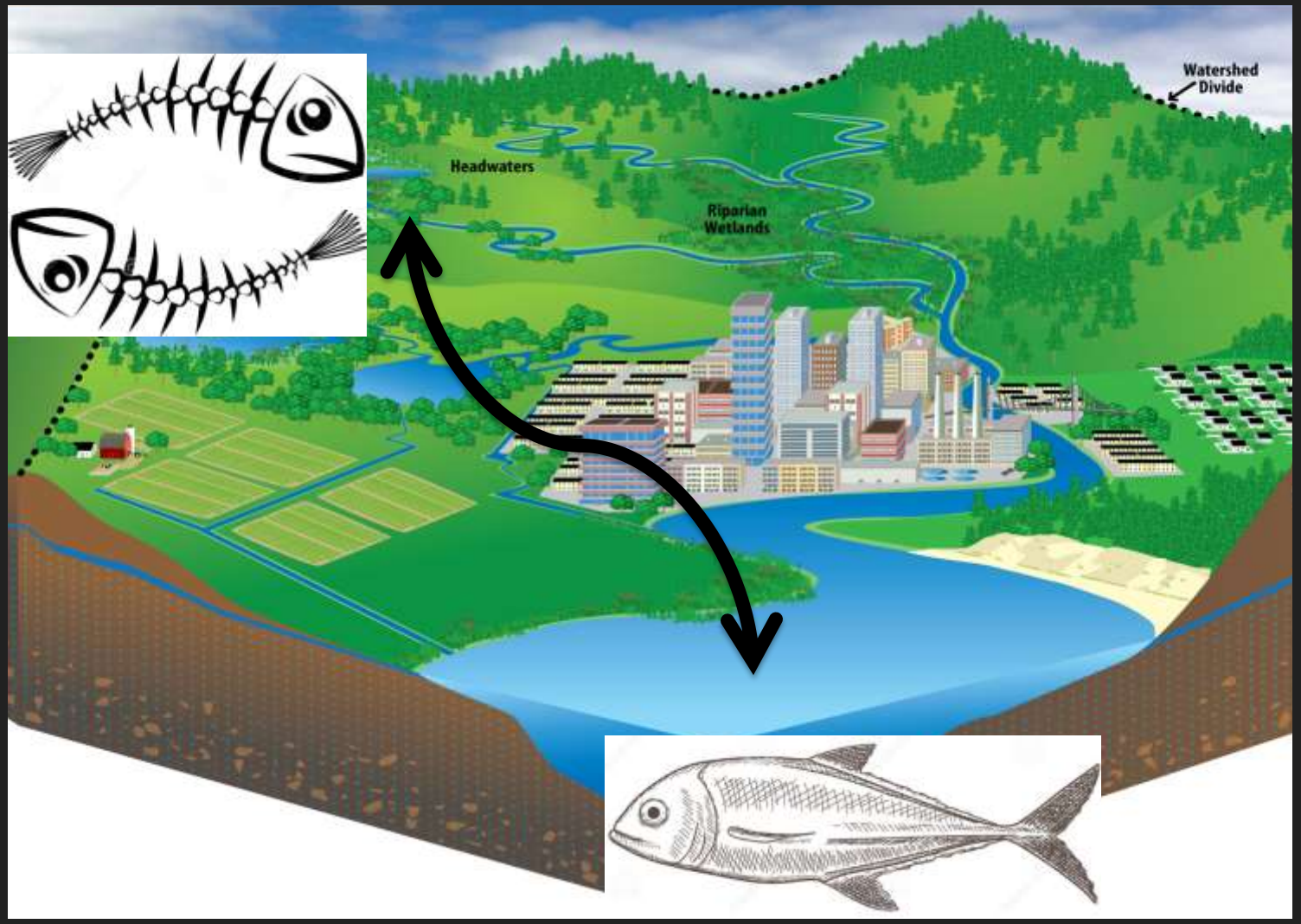
Ecology and Evolution

Open Access

Marine ecosystem connectivity mediated by migrant–resident interactions and the concomitant cross-system flux of lipids

Mikael van Deurs[1,2], Anders Persson[1], Martin Lindegren[2], Charlotte Jacobsen[3], Stefan Neuenfeldt[2], Christian Jørgensen[5] & P. Anders Nilsson[1,4]

Semelparity × diadromy = energy and nutrient transport



Holtgrieve et al. Ecology 2011

Migratory characteristics are adaptations!

”nothing in biology makes sense except in the light of evolution”

Theodosius Dobzhansky, 1973

”understanding adaptation is pivotal for successful conservation”

Anders Nilsson, 2016

Causes and consequences of fish migration

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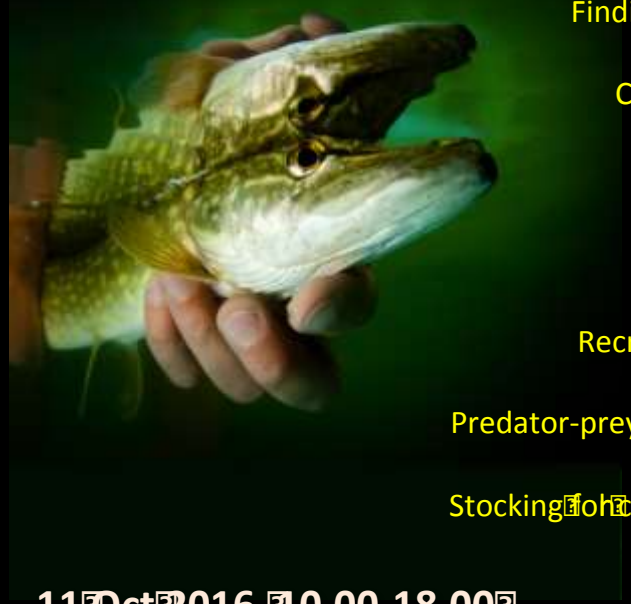
Hans Kristianssonsymposiet

Biology and Ecology of Pike

Pike researchers meet in Lund and present their favourite topics



Finding food and staying alive
Anders Nilsson

Coping with environments
Jonna Engström-Öst

Spatial ecology
Lene Jacobsen

Population genetics
Lovisa Wennerström

Recruitment and populations
Thrond Haugen

Predator-prey and trophic interactions
Anders Persson

Stocking for conservation and fise ries
Nicolas Guillerault

Habitat restoration
Olof Engstedt

Stocking for lake restoration
Christian Skov

Recreational piking
Thomas Klefoth

Commercial fise ries
Anna Kuparinen

Invasive northern pike
Kristine Dunker

11 Oct 2016, 10.00-18.00

Blue Hall, Ecology Bldg,
Sölvegatan 37, Lund University

Register by 30 Sept 2016 to
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The Symposium is free of charge, but with limited seats and binding registration.

Chairs: Anders Nilsson, Lund University; Christian Skov, Danish Technical University