

# Fish on the move

Methods to study fish behaviour in the field

Erwin Winter, IMARES, Wageningen UR



# Fish behaviour: different spatio-temporal scales

- Larger spatial and/or temporal scales:
  - Individual home ranges and habitat use
  - Migration patterns during entire life-cycle
  - ...
- Smaller spatio-temporal scales:
  - Foraging behaviour
  - Interaction with conspecifics, e.g. mating, schooling ...
  - Responses to predators, (human) disturbance ...
  - ...

# Methods for field studies on fish behaviour

- Traditional techniques:
  - Fishing gears: patterns in time
  - Direct observation: clear water
  - Marking and tagging
- More recently developed techniques:
  - Fish counters
  - Telemetry: tracking individual behaviour
  - Microchemistry: reconstructing individual histories
  - DIDSON: high resolution sonar camera

# Traditional gears: spatio-temporal patterns



Active gears: abundance

Passive gears: abundance + activity

# Traditional gears: spatio-temporal patterns

Seine net



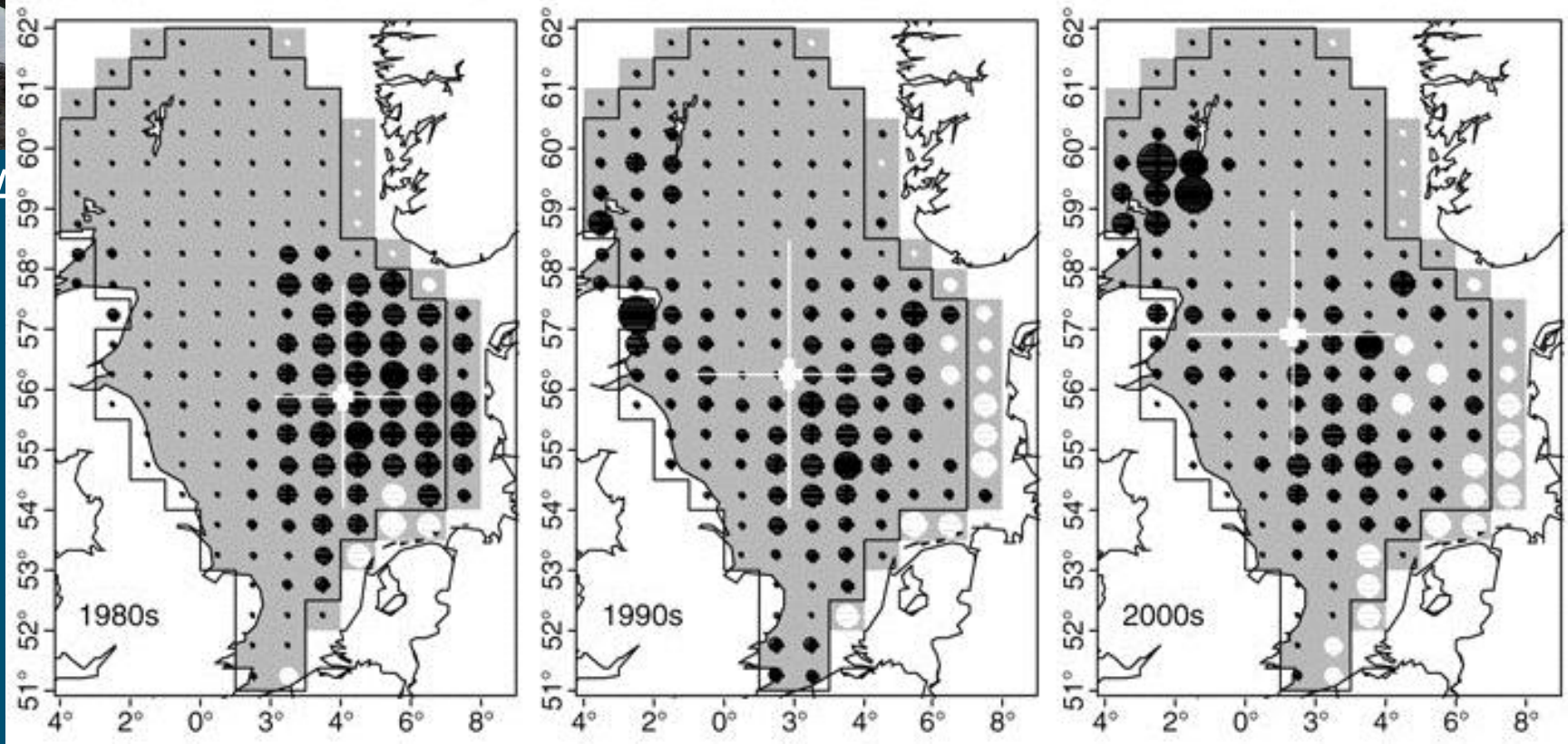
Electro



Fykenet



Gill nets

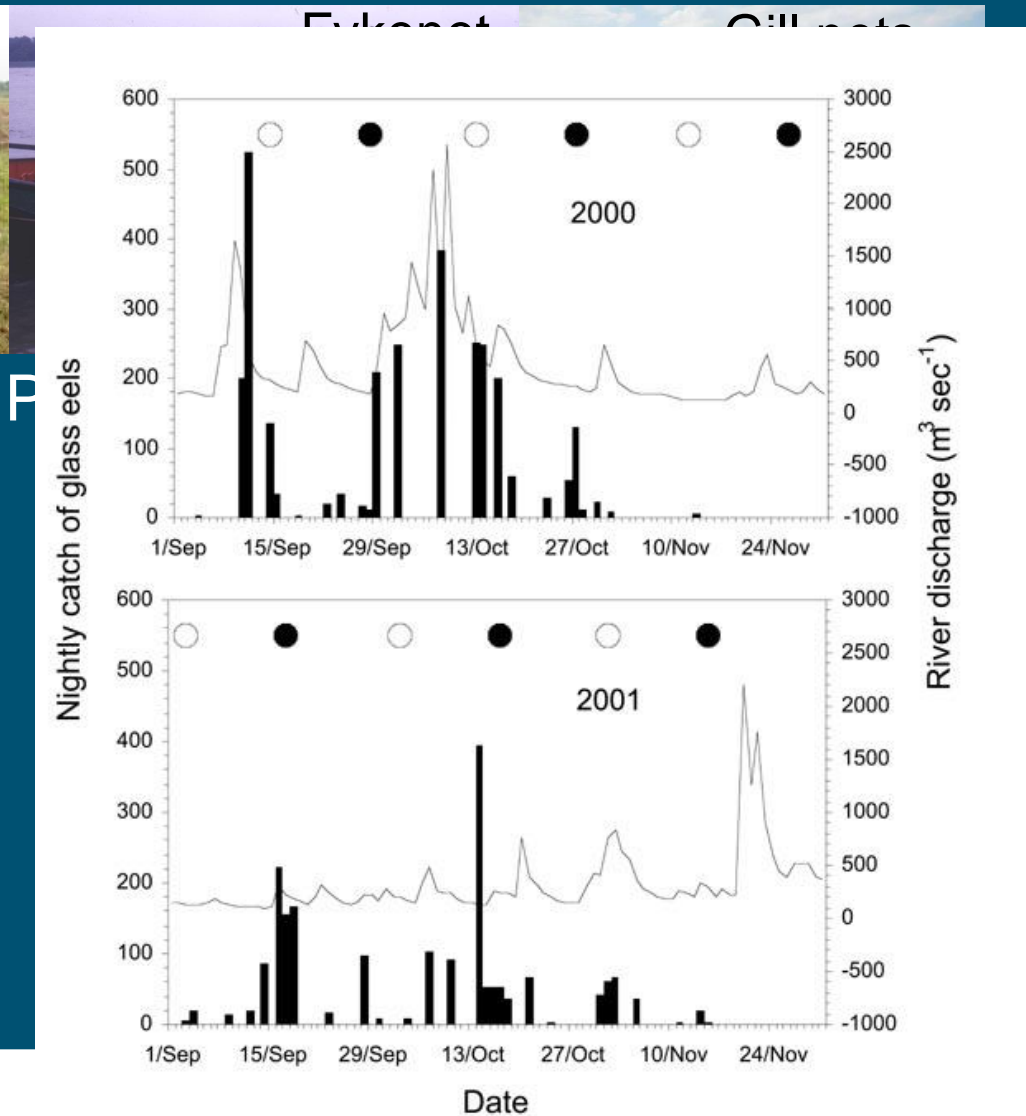


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# Traditional gears: spatio-temporal patterns



Active gears: abundance



# Traditional gears: spatio-temporal patterns



Active gears: abundance

Passive gears: abundance + activity

Coarse methods: by deduction, prone to misinterpretation

# Direct underwater observations

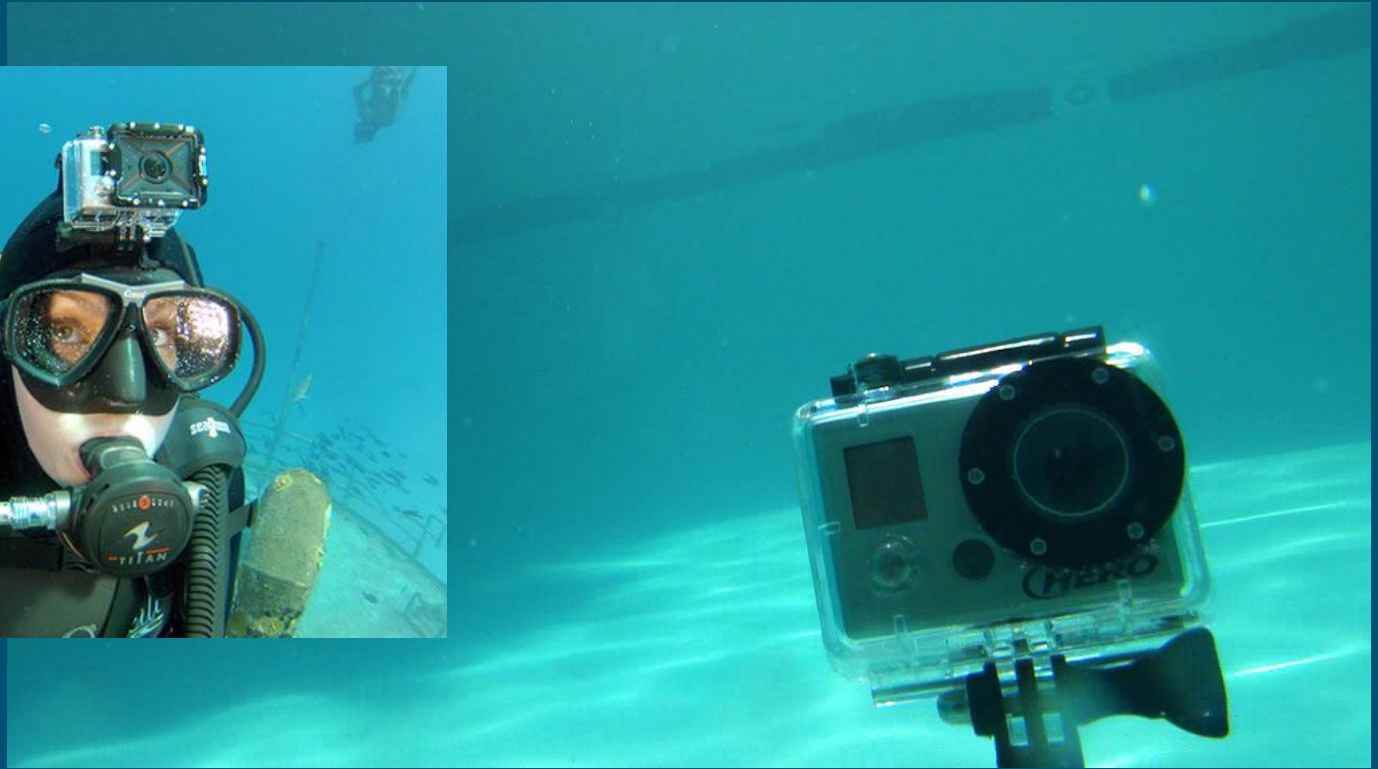


With divers or cameras

... clear water is needed



# Direct underwater observations



Gopro cameras

... clear water is needed

# Marking and tagging techniques

Batch marking: colour marks, dyes



Alcian blue

# Marking and tagging techniques

Batch marking: colour marks, dyes



Alcian blue



Bismarck brown

# Marking and tagging techniques

Batch marking: colour marks, dyes



Alcian blue



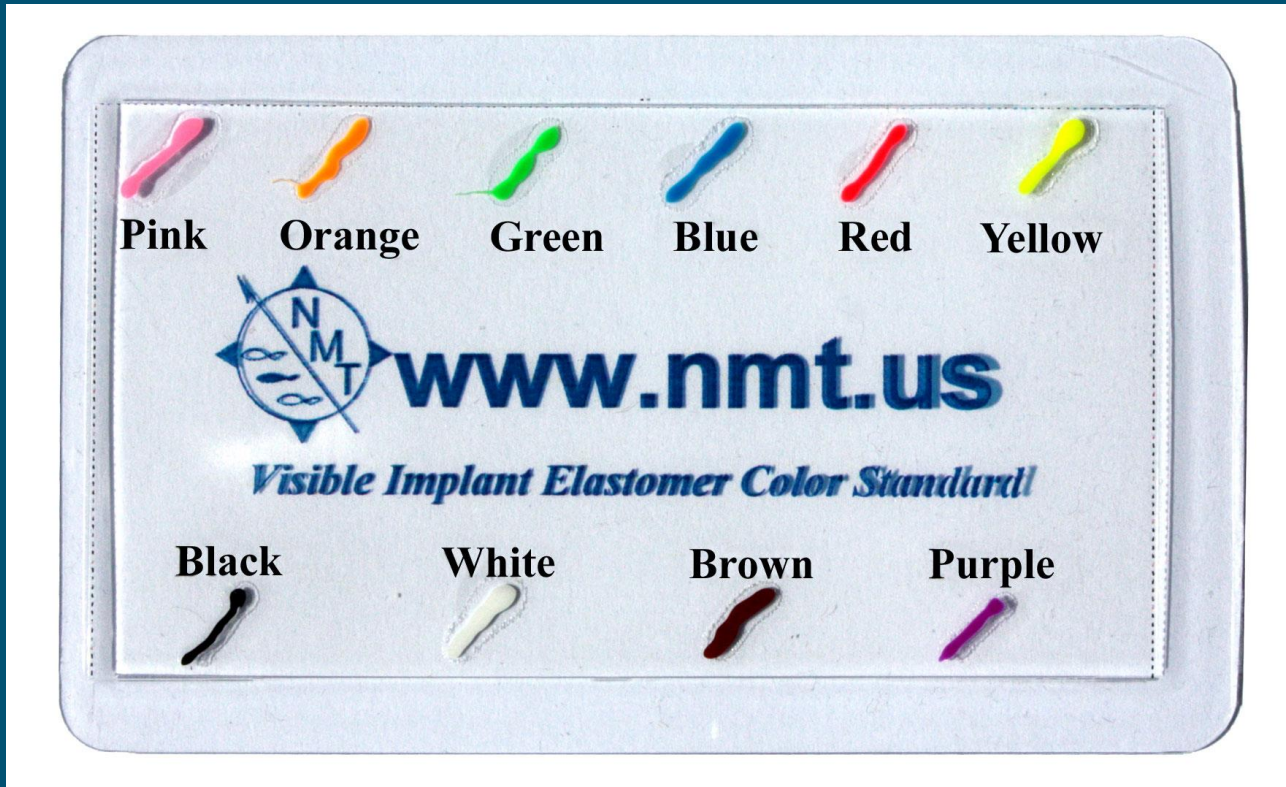
Bismarck brown



Freeze branding

# Marking and tagging techniques

Batch marking: VI elastomer colour marks

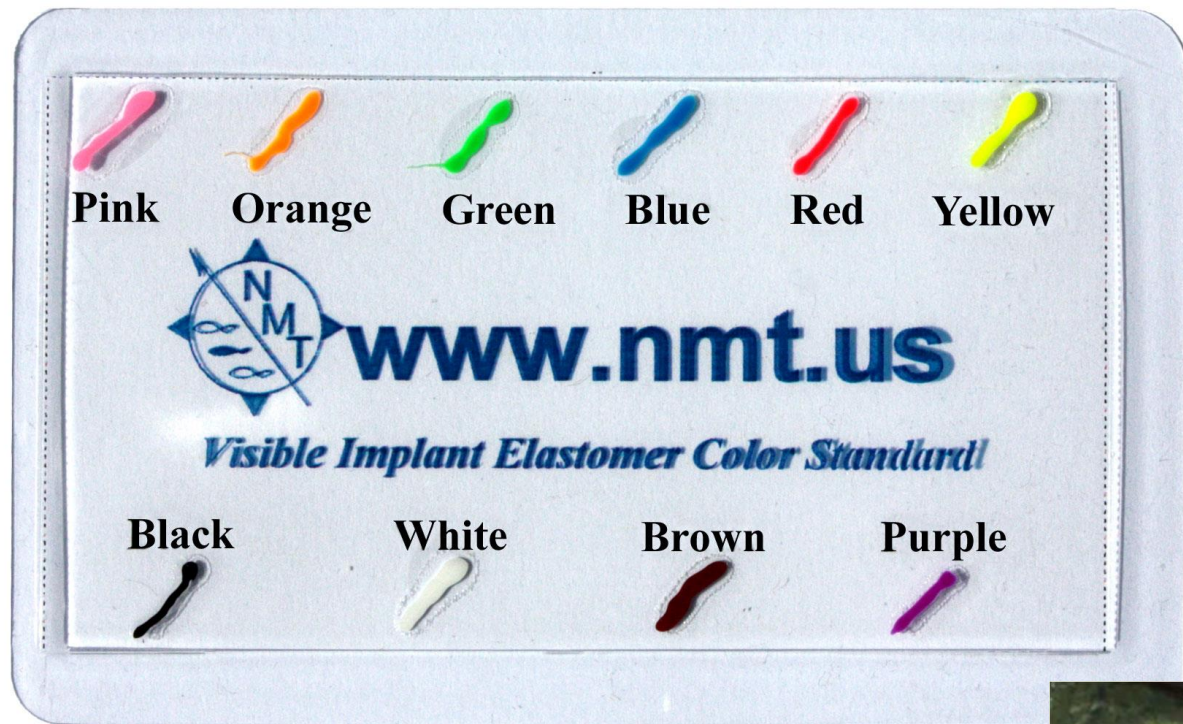


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# Marking and tagging techniques

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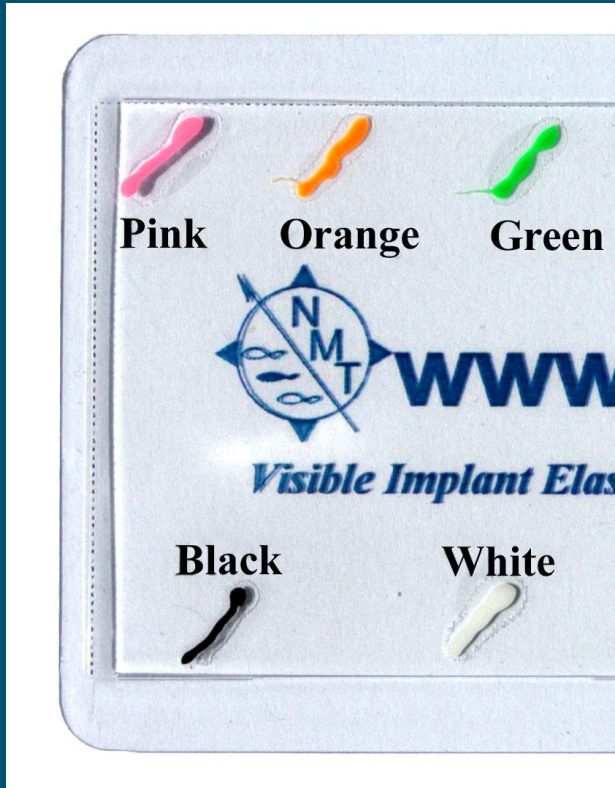


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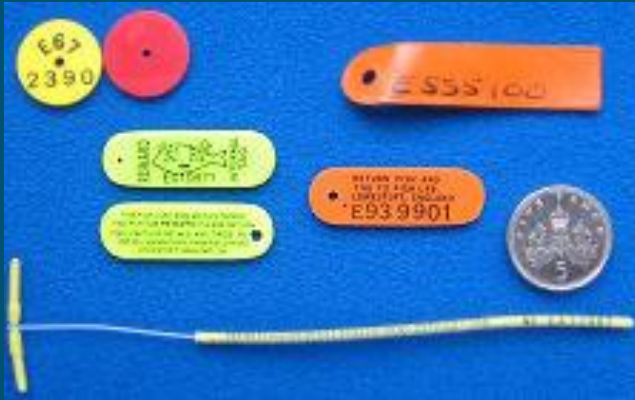
# Marking and tagging techniques

Batch marking: V



# Marking and tagging techniques

## Individual tags (unique code)



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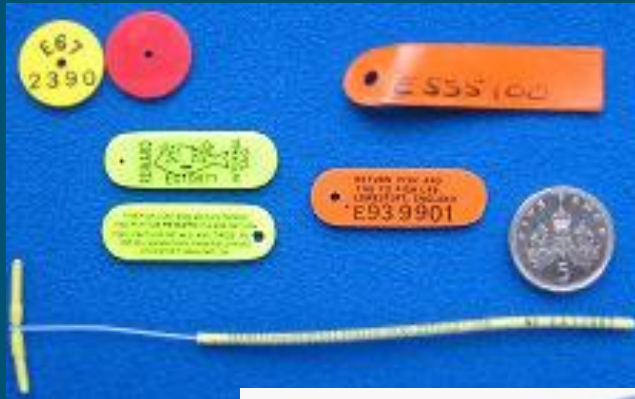
# Marking and tagging techniques

## Individual tags (unique code)



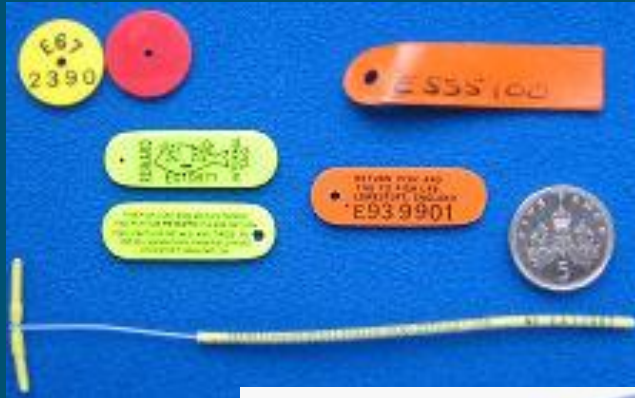
# Marking and tagging techniques

## Individual tags (unique code)



# Marking and tagging techniques

## Individual tags (unique code)



Few observations per individual (mark-recapture) → often leads to interpretations with too uniform patterns

# Fish counters

Video & infrared (automatic image analysis)



# Fish counters

e.g. VAKI systems

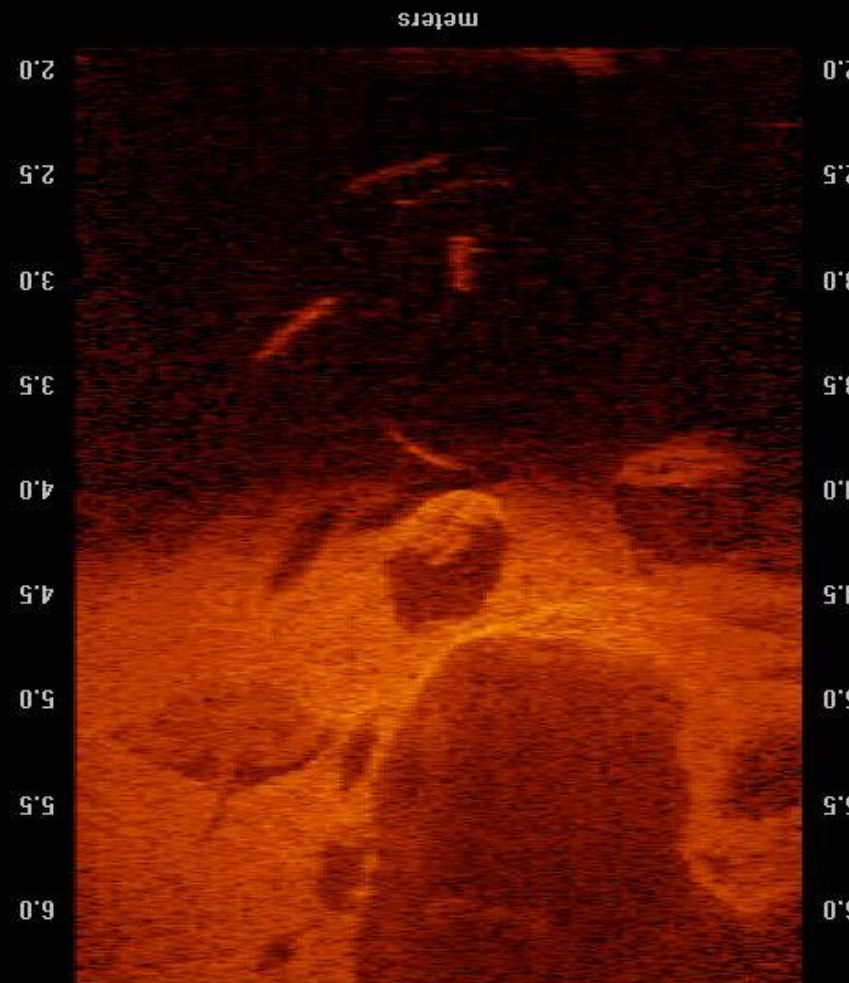
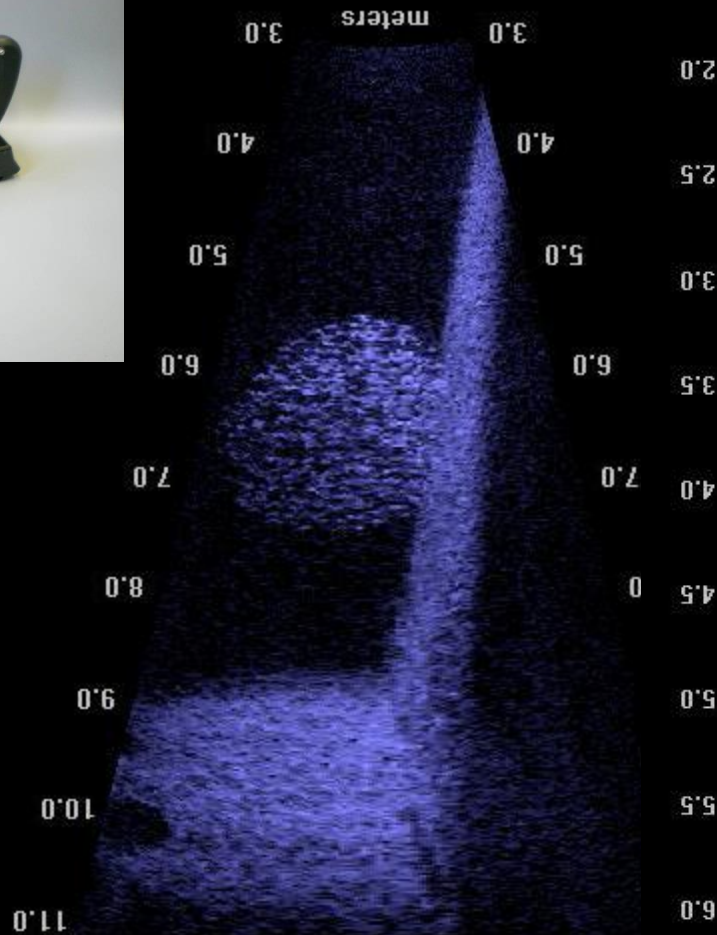
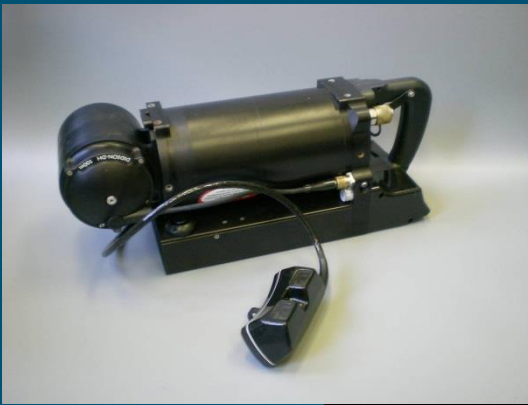


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# Didson (acoustic high resolution camera)

“Dual Frequency Identification Sonar” – DIDSON



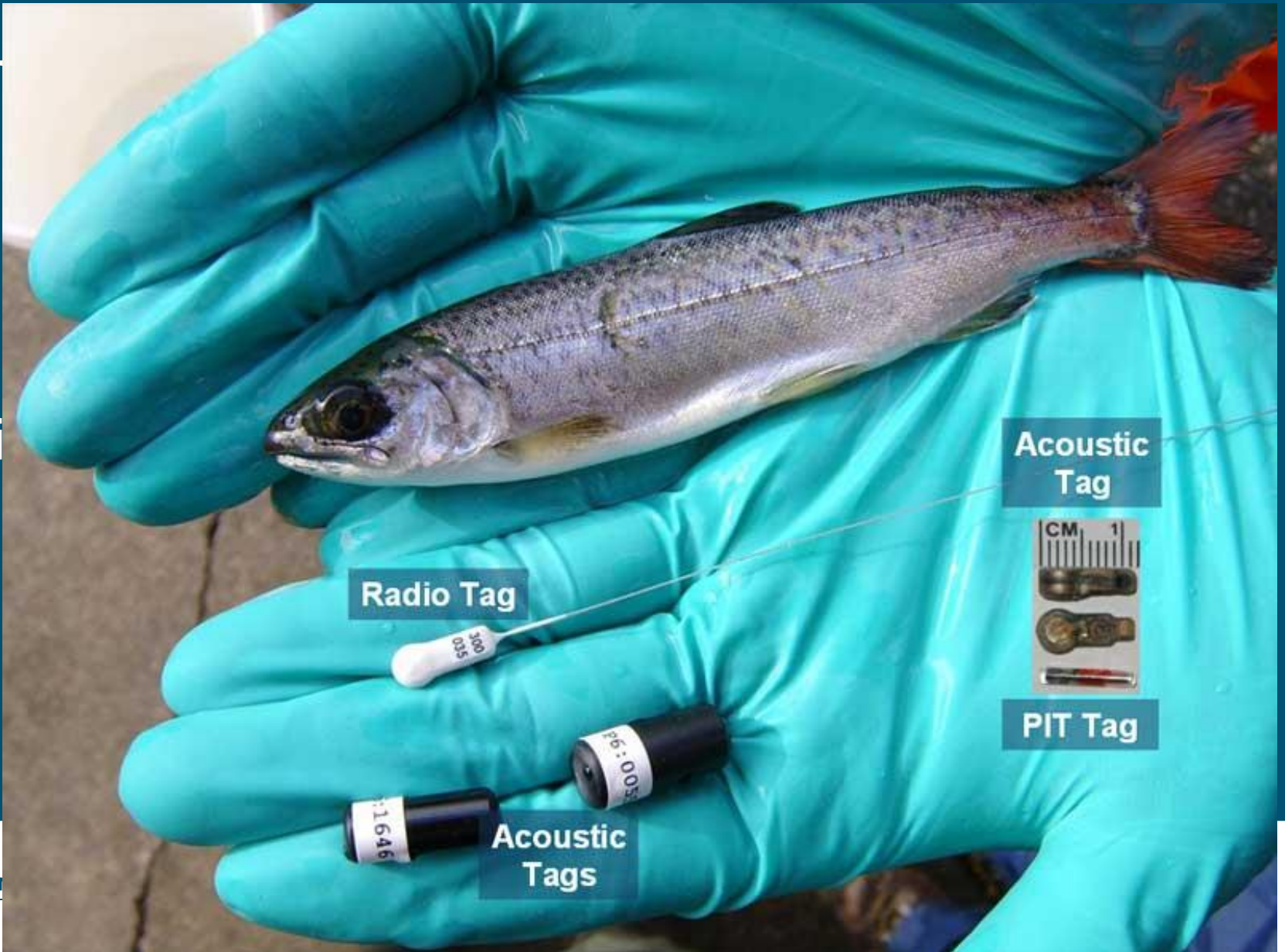
# Telemetry: tracking individuals

- Tracking positions in time:
  - Radio telemetry
  - Transponder (inductive coupling)
  - Acoustic telemetry
- Hi-tech telemetry:
  - Archival tags (continuous recording temp, depth, tilt, acceleration ..)
  - Physiological tags (heart rate)

# Telemetry: tracking individuals

■ Tr

■ Hi



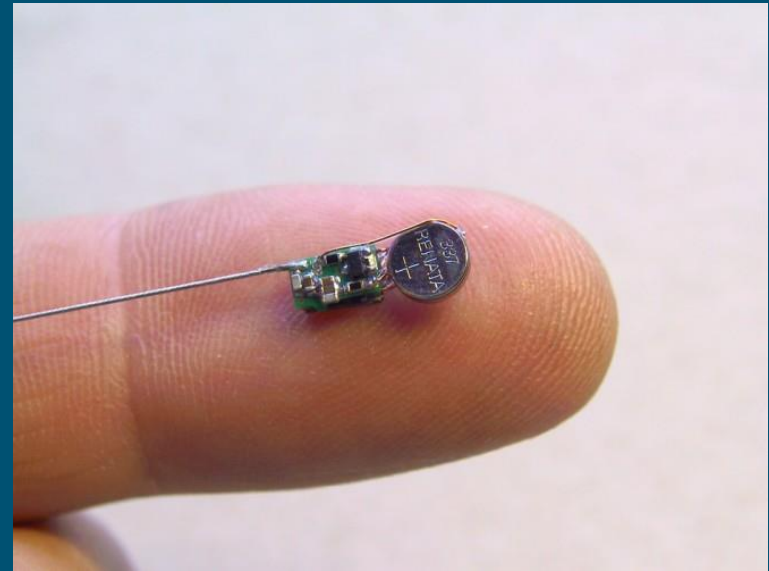


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# Radio telemetry

Active (following or searching with antennae) or passive (with array of fixed antennae or stations)



Only applicable in shallow waters up to a few m (signal travels well in air, but quickly dies out in water)



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# Acoustic telemetry

e.g. Biosonics, HTI, VEMCO



Applicable in fresh to salt water,

Best in deep water, worst in shallow or turbulent water

# Transponder techniques

PIT-tags (e.g. BIOMARK, OREGON):  
small, cheap, small detection distance



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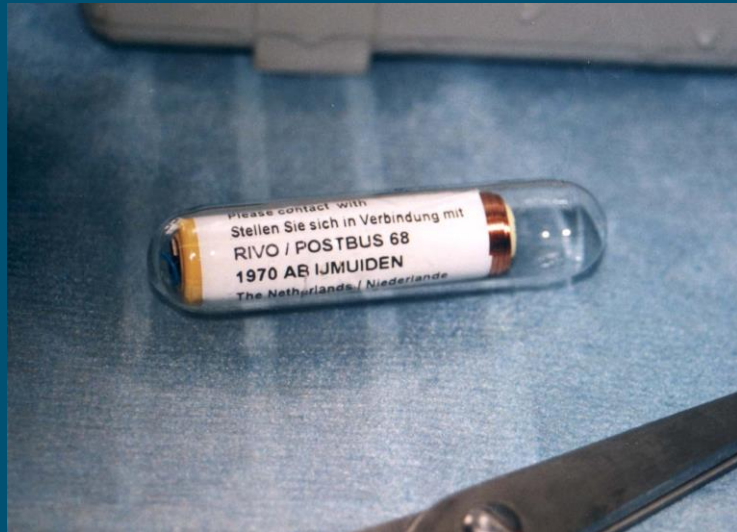
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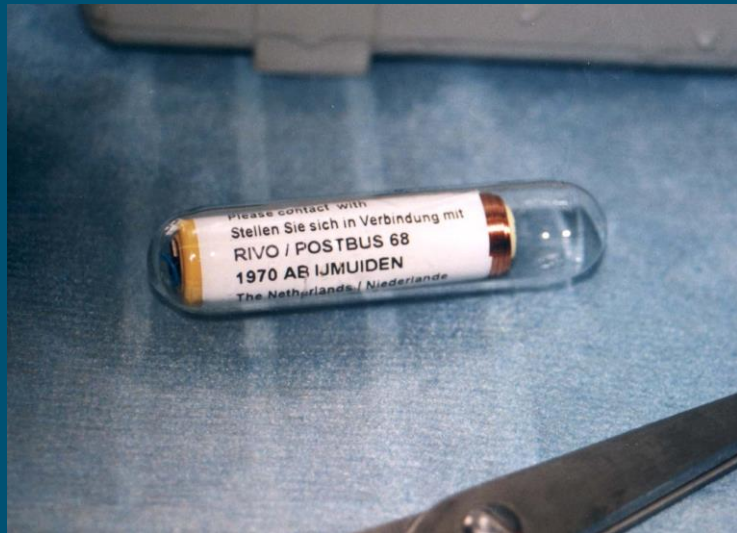
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Nedap-transponder:



Applicable in fresh-brackish water, up to 15 m depth  
Long battery life up to 4 years

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# Archival tags

Continuous recording: temperature, depth, light,



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# Archival tags

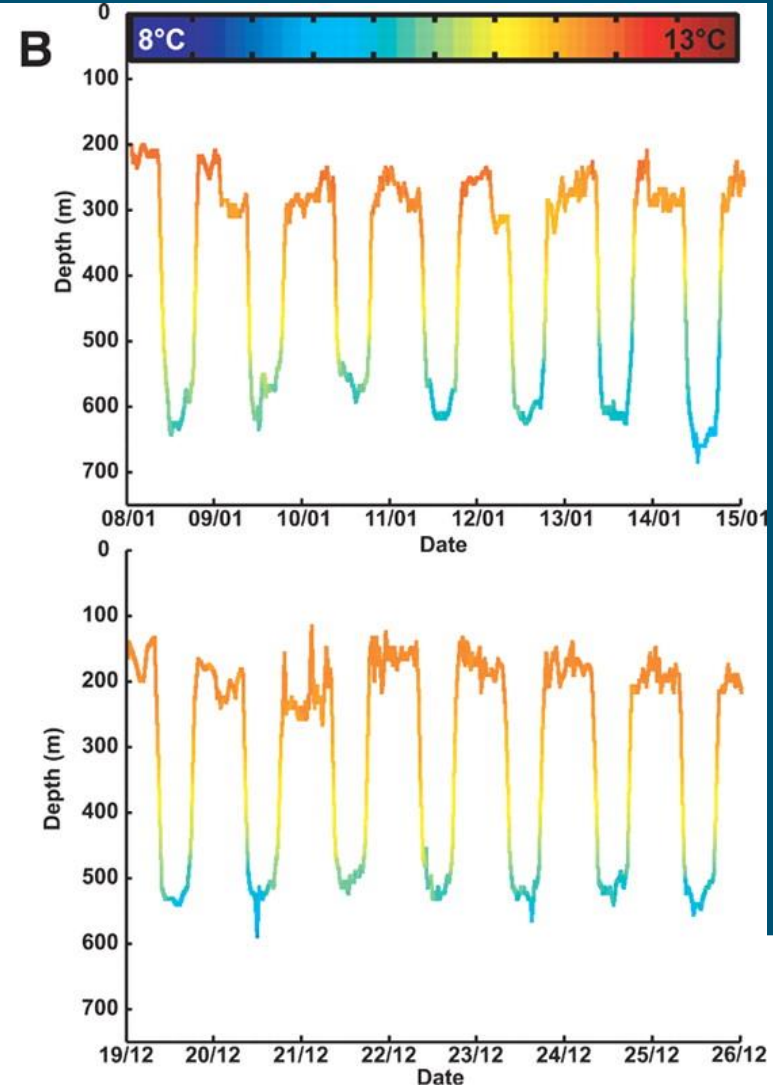
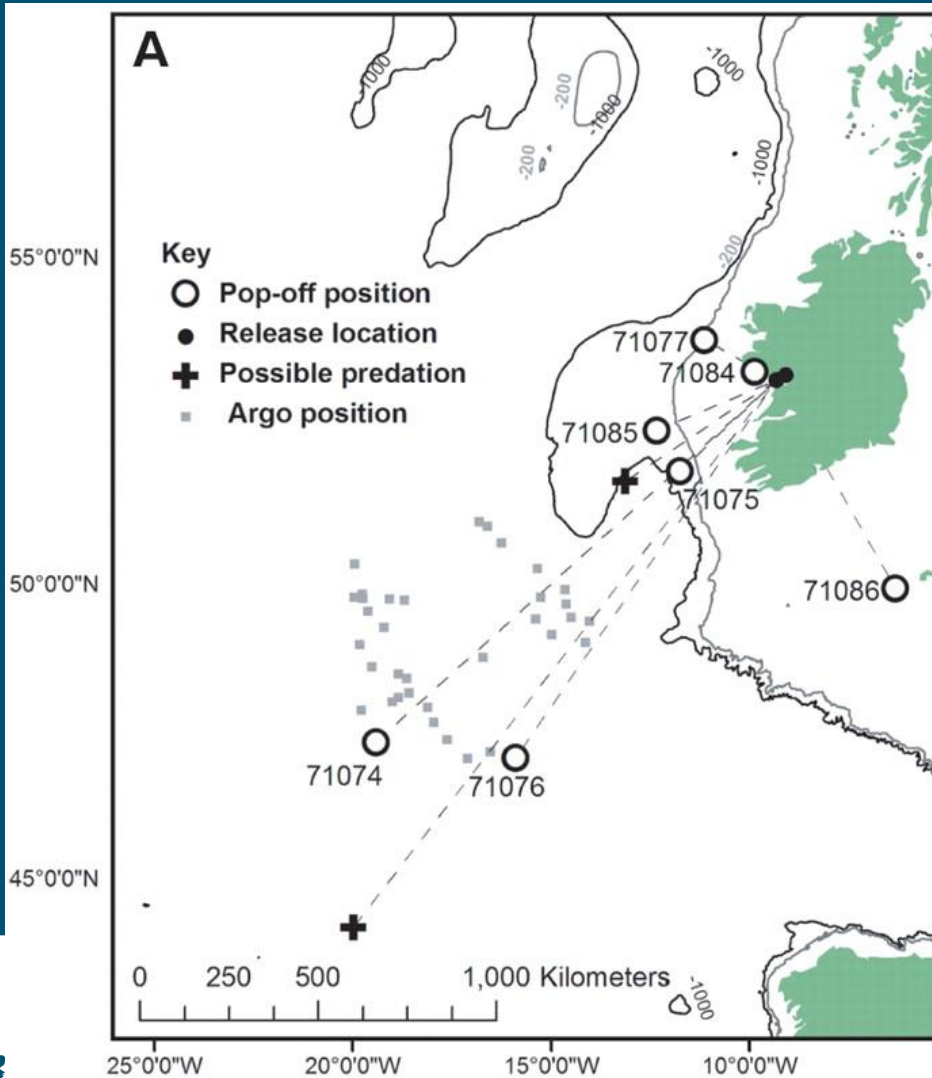
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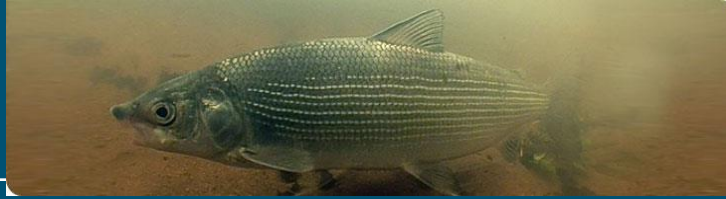
Pop-up satellite archival tags

# Archival tags

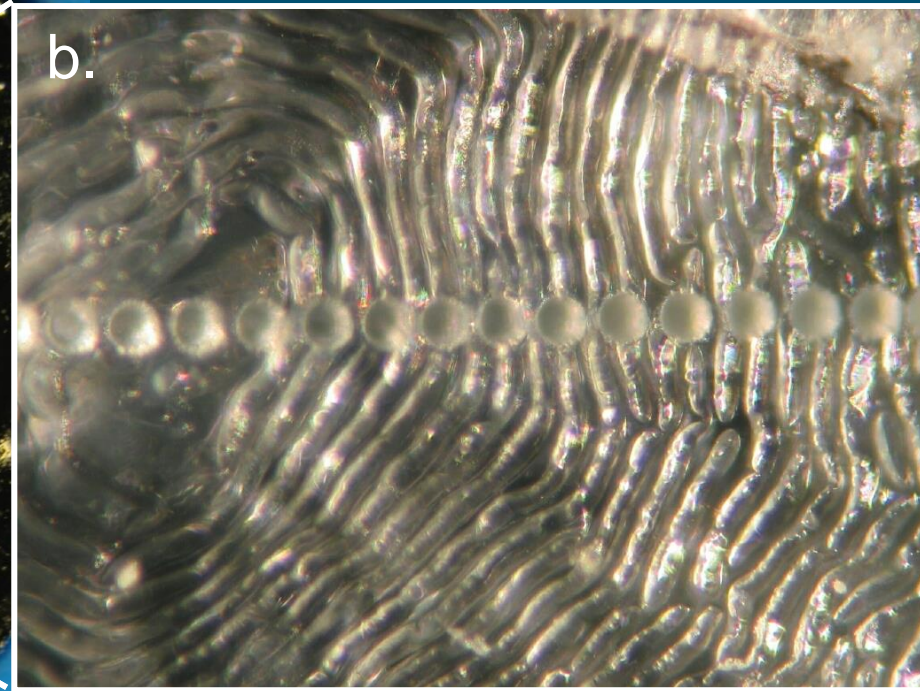
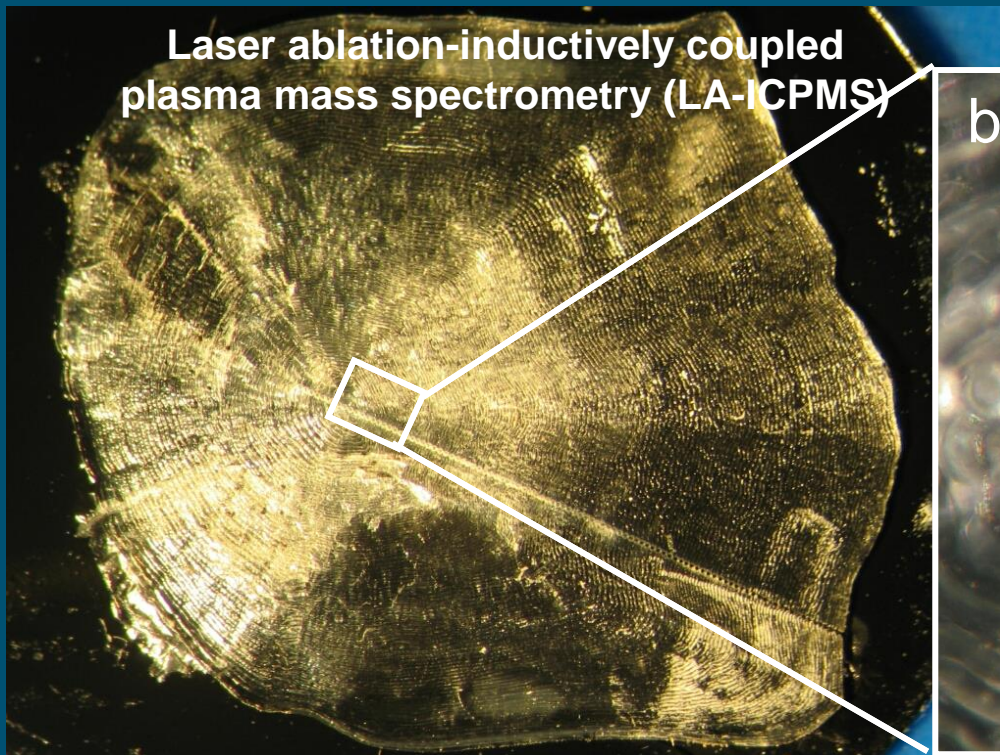
Continuous recording: temperature, depth, light,



# Micro-chemistry



- Laser ablation: Sr-Ca ratio in Houting
- Looking back in time (freshwater or marine habitat)



# Fish handling procedures & tag attachment

## ■ Anesthetics

- MS222 (mostly used in North America)
- Clove oil
- 2-phenoxy ethanol



# Fish handling procedures & tag attachment

## ■ Anesthetics

- MS222 (mostly used in North America)
- Clove oil
- 2-phenoxy ethanol

## ■ Tag attachment

- Gastric (short lasting studies)



# Fish handling procedures & tag attachment

## ■ Anesthetics

- MS222 (mostly used in North America)
- Clove oil
- 2-phenoxy ethanol



## ■ Tag attachment

- Gastric (short lasting studies)
- External (short-long lasting studies)



# Fish handling procedures & tag attachment

## ■ Anesthetics

- MS222 (mostly used in North America)
- Clove oil
- 2-phenoxy ethanol



## ■ Tag attachment

- Gastric (short lasting studies)
- External (short-long lasting studies)
- Internal (surgical implantation, long term studies)

