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

Seine net  Electro  Fykenet  Gill nets

Active gears: abundance  Passive gears: abundance + activity
Traditional gears: spatio-temporal patterns

Seine net  Electro  Fykenet  Gill nets

Engelhard G H et al. ICES J. Mar. Sci. 2011;icesjms.fsr031
Traditional gears: spatio-temporal patterns

Seine net

Electro

Eukorotroopter Gill net

Active gears: abundance

Passive gears: abundance + activity

Nightly catch of glass eels

River discharge (m³ sec⁻¹)

2000

2001

Date

1/Sep 15/Sep 29/Sep 13/Oct 27/Oct 10/Nov 24/Nov

0 100 200 300 400 500 600

0 500 1000 1500 2000 2500 3000

0 -500 -1000
Traditional gears: spatio-temporal patterns

Seine net  Electro  Fykenet  Gill nets

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

Alcian blue
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
Marking and tagging techniques
Batch marking: VI elastomer colour marks
Marking and tagging techniques

Batch marking: Visible Implant Elastomer (VIE) colours.
Marking and tagging techniques
Individual tags (unique code)
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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
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)
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- Physiological tags (heart rate)
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)
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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Nedap-transponder:

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

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small, cheap, small detection distance

Nedap-transponder:

Applicable in fresh-brackish water, up to 15 m depth
Long battery life up to 4 years
Archival tags
Continuous recording: temperature, depth, light,
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Continuous recording: temperature, depth, light,

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