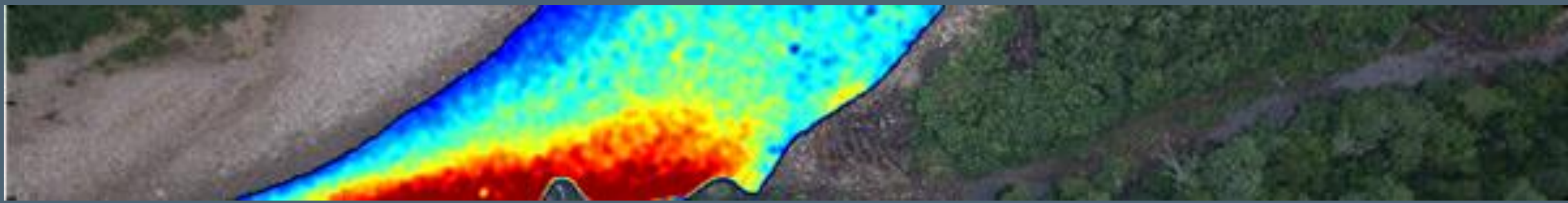


Remote sensing for fish ecology – experiences and future needs

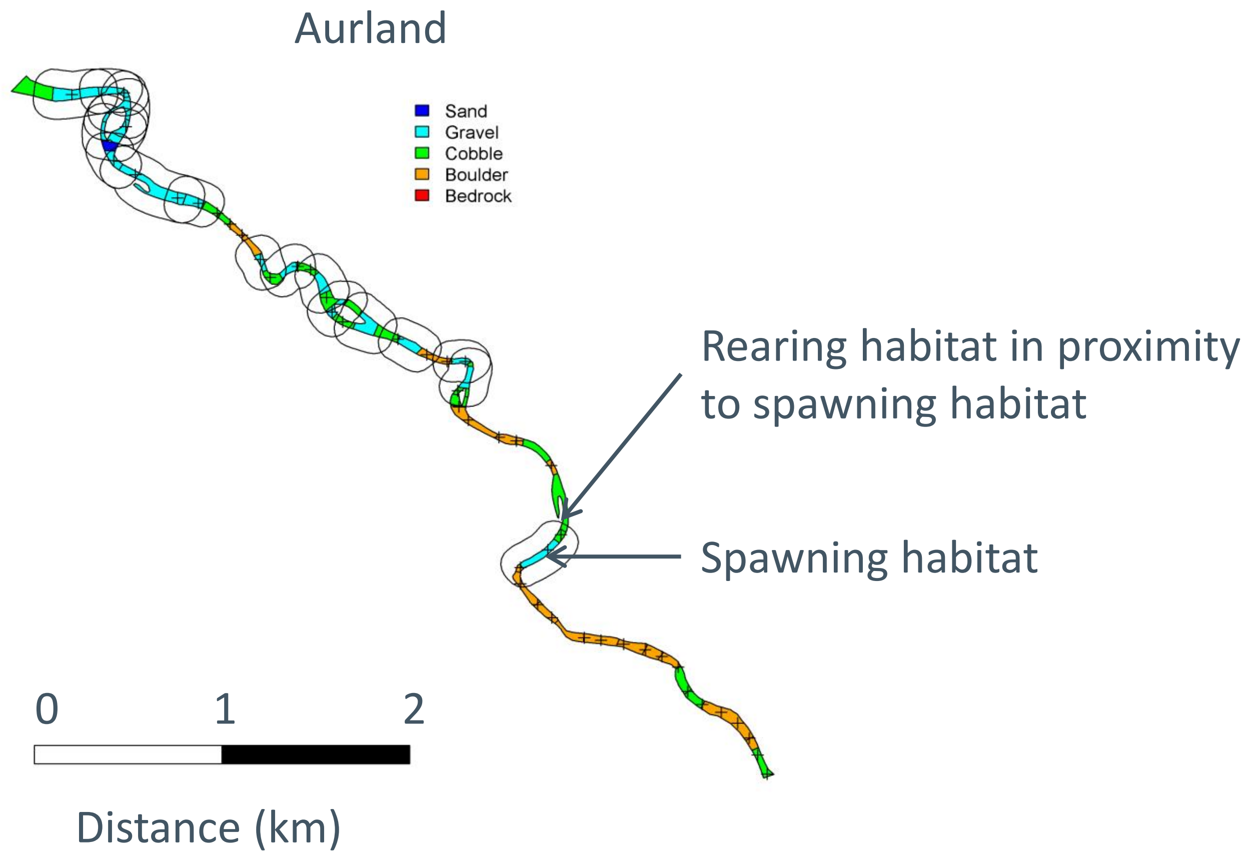
Richard Hedger and Anders Foldvik

NINA
Norsk institutt for naturforskning

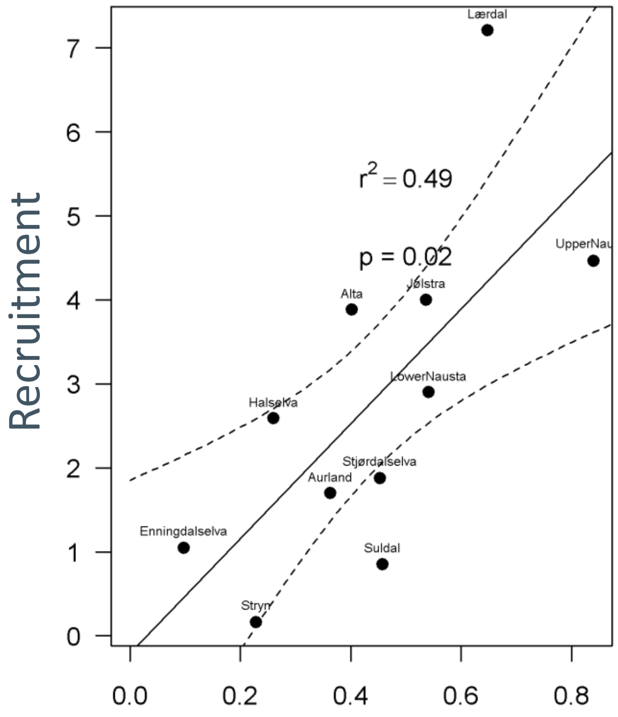
Fish ecology

- We want to understand how fish use habitat
- Individual fish use a range of habitats
    - different spatial and temporal scales
- Ideally, we need to have habitat data across the entire river

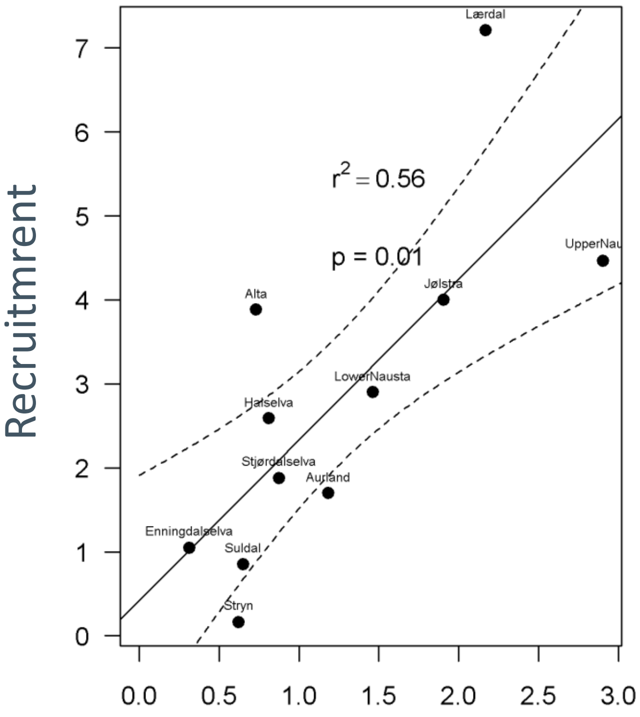
Including spatial relationships



Including spatial relationships



Spawning habitat (gravel)



Spawning habitat (gravel)
+ rearing habitat (cobble)
in proximity

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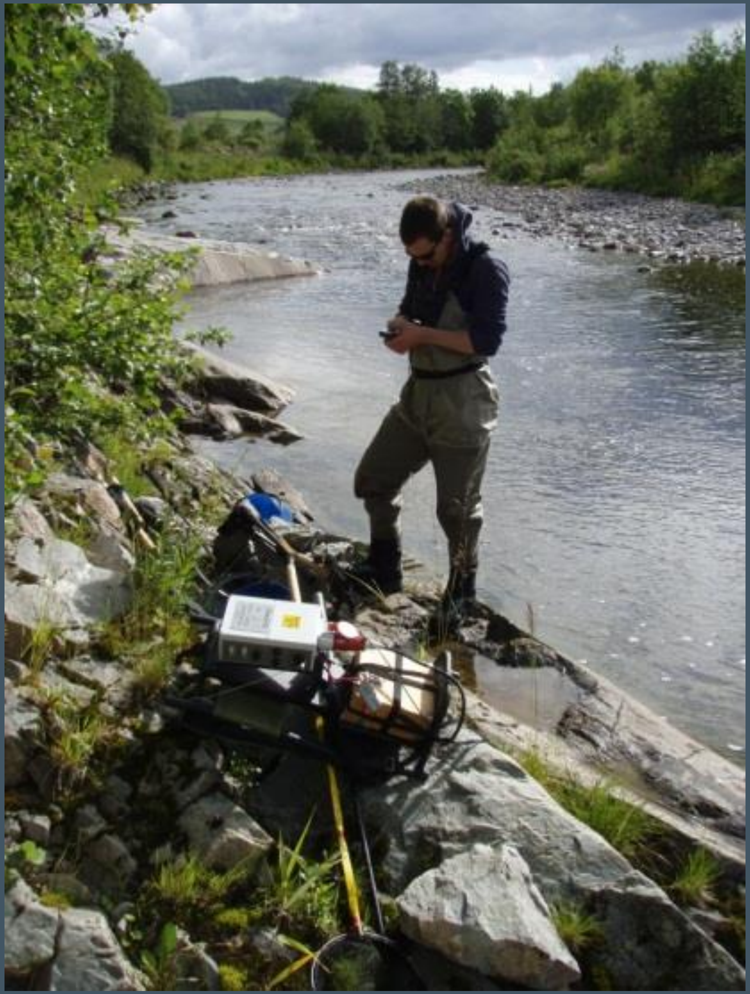
Mapping?



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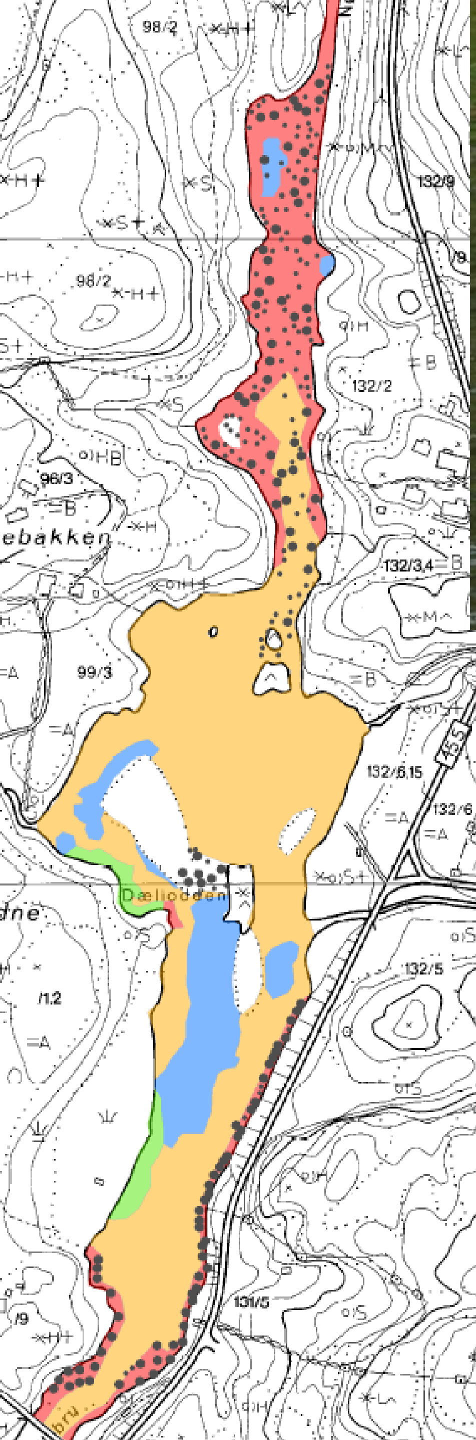
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Dæliodden
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131/5
455


Reinåa
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118
116
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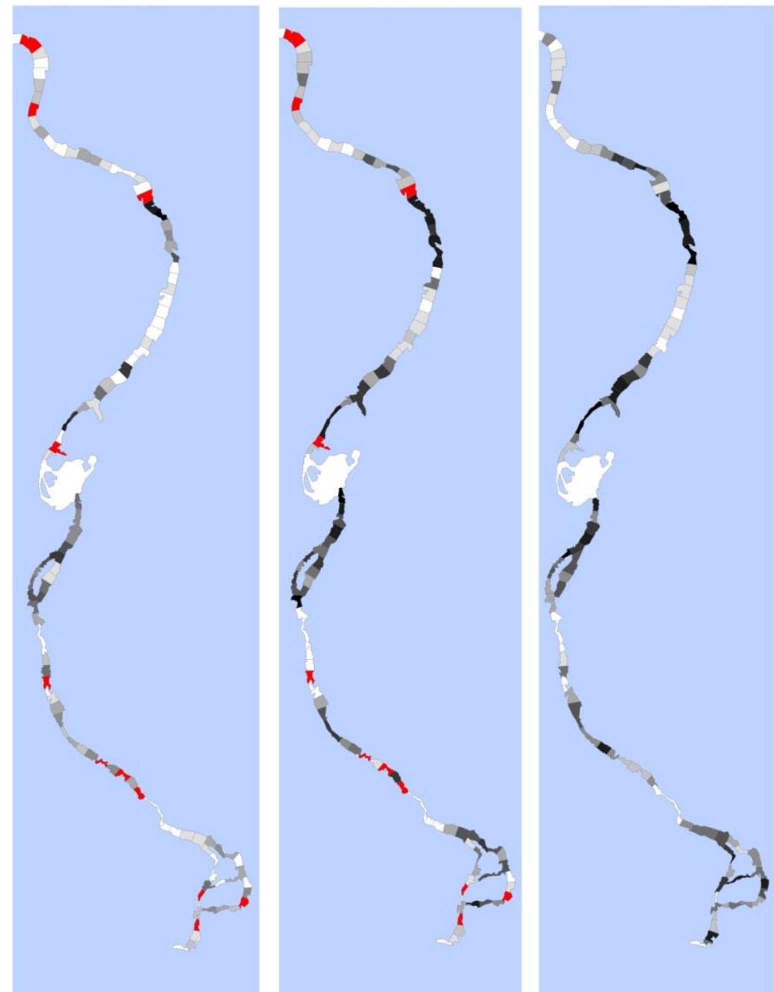
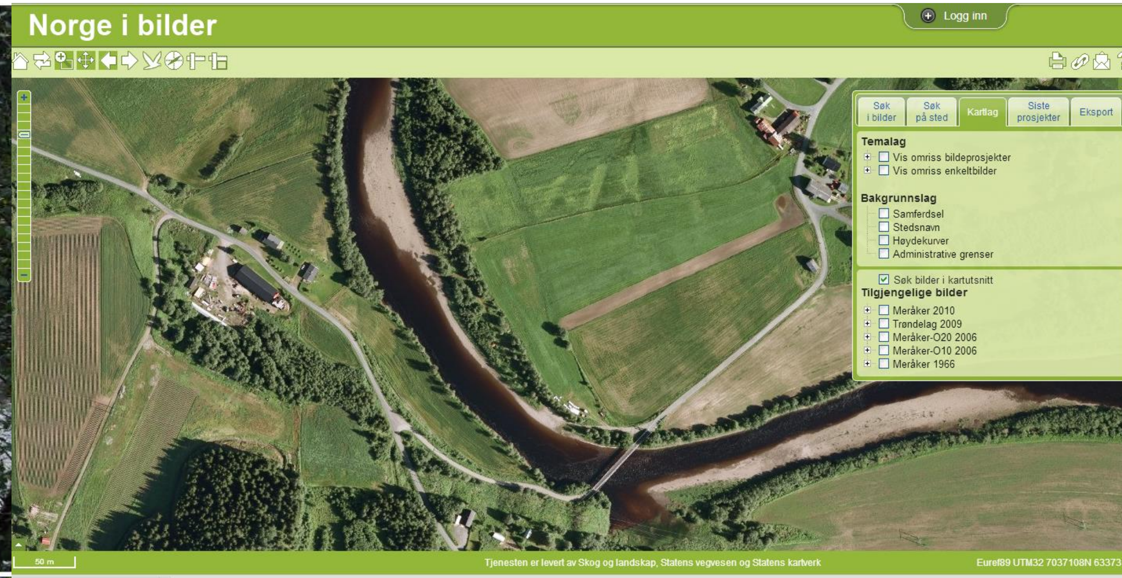
114
113





Norge i bilder
Logg inn
Søk i bilder
Søk på sted
Kartlag
Siste prosjekter
Eksport
Temalag
Vis omriss bildeprosjekter
Vis omriss enkeltbilder
Bakgrunnslag
Samferdsel
Stedsnavn
Høydekurver
Administrative grenser
Søk bilder i kartutsnitt
Tilgjengelige bilder
Meråker 2010
Trøndelag 2009
Meråker-O20 2006
Meråker-O10 2006
Meråker 1966
50 m
Tjenesten er levert av Skog og landskap, Statens vegvesen og Statens kartverk
Euref89 UTM32 7037108N 633731Ø

Norge i bilder
0%
100%
Søk i bilder
Søk på sted
Kartlag
Siste prosjekter
Eksport
Temalag
Vis omriss bildeprosjekter
Vis omriss enkeltbilder
Bakgrunnslag
Samferdsel
Stedsnavn
Høydekurver
Administrative grenser
Søk bilder i kartutsnitt
Tilgjengelige bilder
Meråker 2010
Trøndelag 2009
Meråker-O20 2006
Meråker-O10 2006
Meråker 1966
50 m
Tjenesten er levert av Skog og landskap, Statens vegvesen og Statens kartverk
Euref89 UTM32 7037151N 633418Ø

What is currently available

- Coarse-scale imagery (Norge i bilder)
- DEM data – too coarse for longitudinal gradient
- Scattered ground-surveys

Useful habitat information

- Subtrate size
- Depth
- Channel characteristics
  - width
  - channel shape
  - longitudinal slope
- Derived characteristics
  - hydraulic properties
  - reach type (sill, glide, rapids etc.)

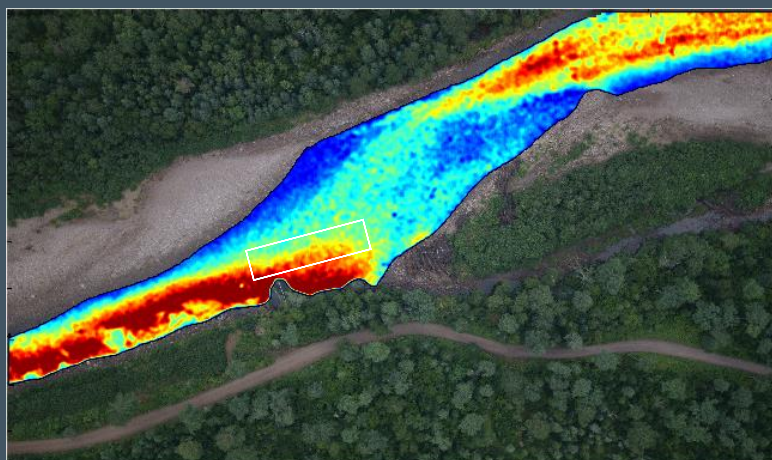
Remote sensing extraction of habitat

- Visible, thermal infrared, LIDAR
- Satellite, aircraft, UAV

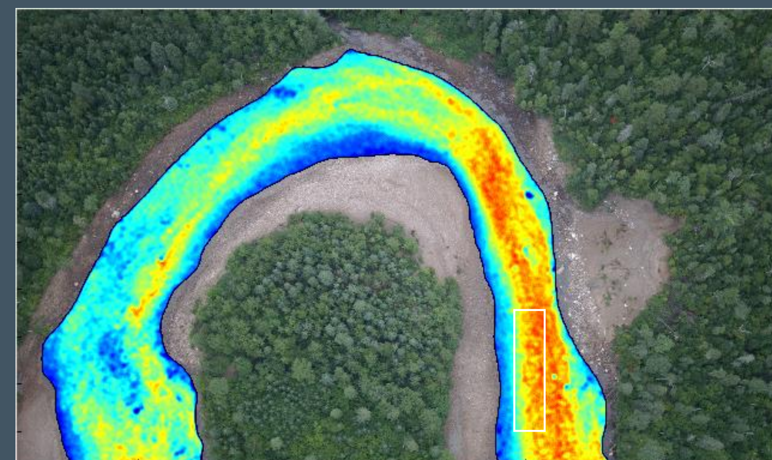
2 case studies

- Helicopter imagery (Quebec)
- UAV imagery (Norway)

Adding riverscape properties



Pool / riffle habitat



Homogeneous depth and substrate

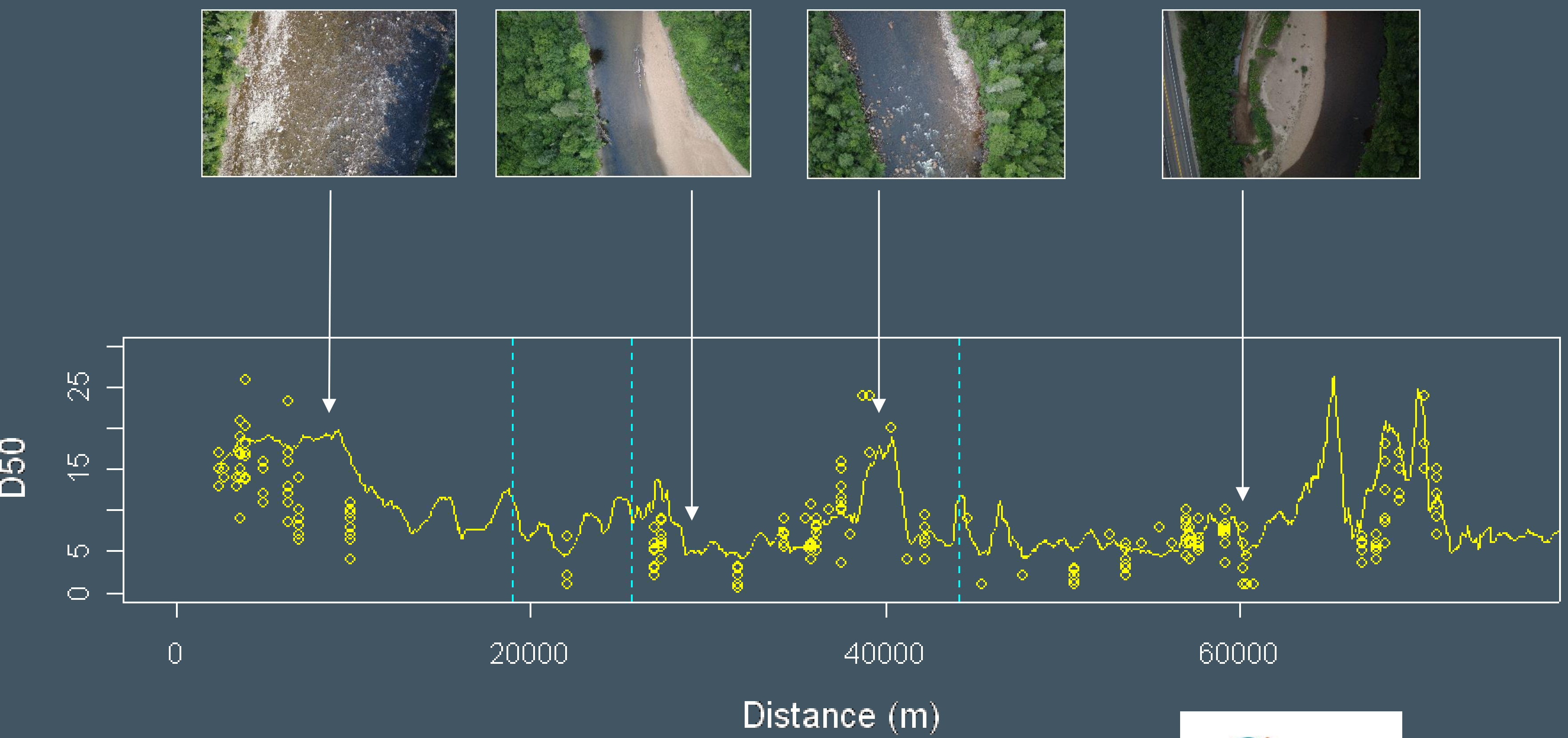
Depth (cm)

Determining habitat characteristics directly from single images

- Depth
  - Derived from light intensity (I) in red band
  - $Depth = \alpha \log(\beta I)$
- Substrate size
  - Derived by local variation in light intensity

Data obtained by CIRSA
Remote sensing data processed by P. Carbonneau

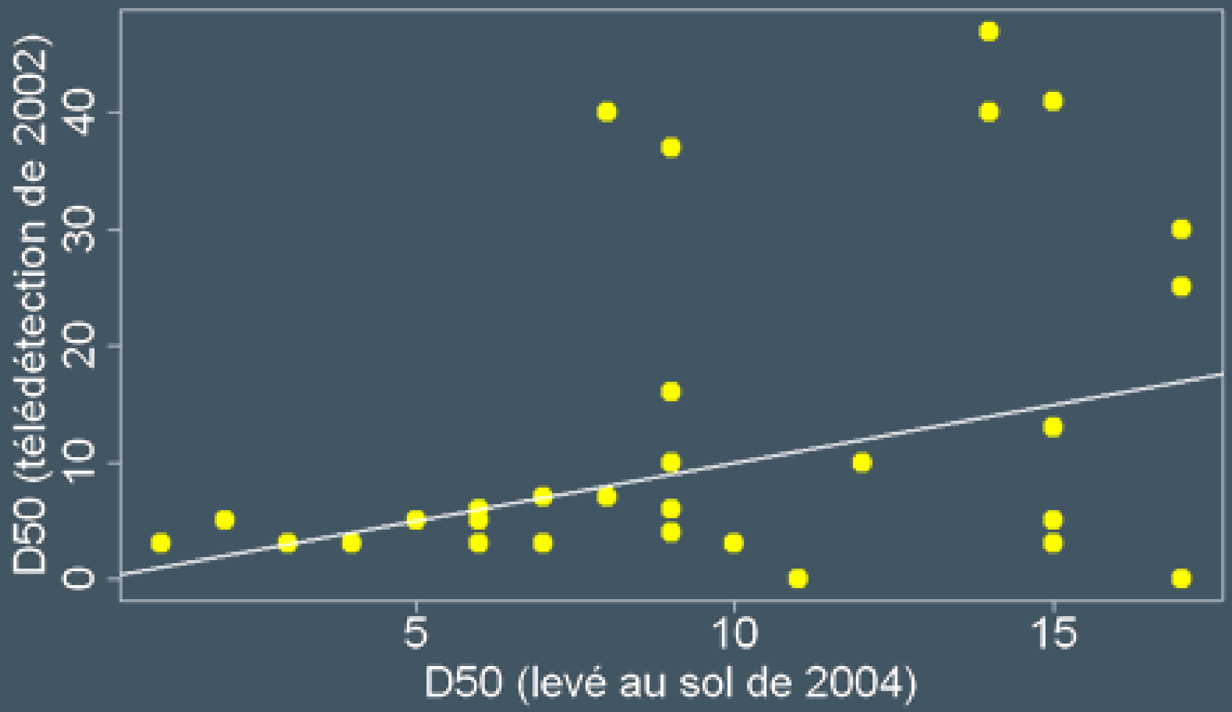
Adding riverscape data



Data obtained by CIRSA
Remote sensing data processed by P. Carbonneau

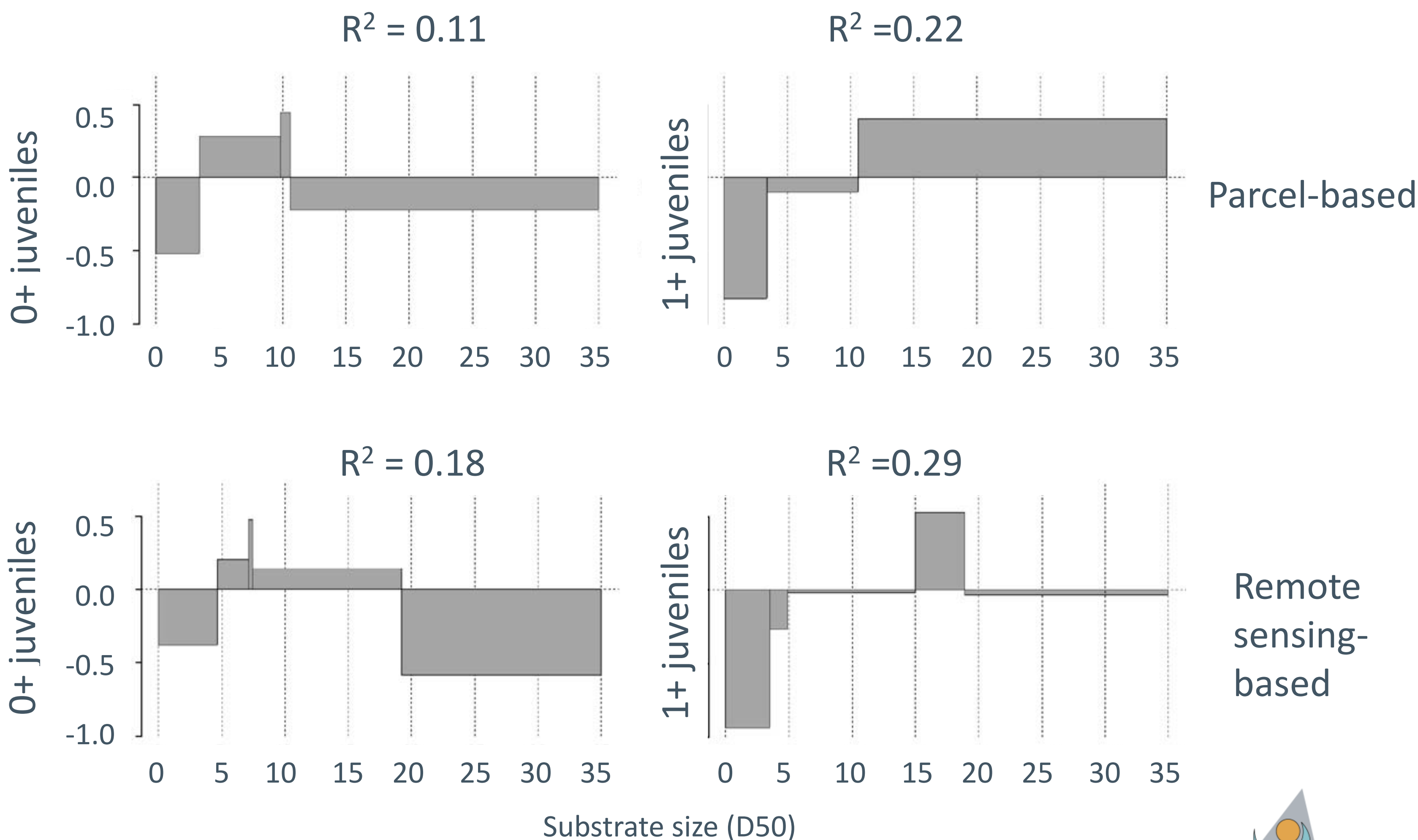
CIRSA
Centre interuniversitaire de recherche sur le saumon atlantique

Adding riverscape data



Data obtained by CIRSA
Remote sensing data processed by P. Carbonneau

Meso-scale information from remote sensing



UAV


Savnet
i pappenheimområdet
NETTAVISEN NYHETER
FORSIDEN NYHETER POLITIKK ØKONOMI SPORT MENINGER MOTE HELSE TRENING TEKNOLOGI BIL/MOTOR VITENSKAP
Shopping | Reisetips | MittOppdrag | Match | Kuponger | Odds | Lotto | Trav | Horoskop | Kontaktlinser | Forbrukertips | B2B TIPS OSS 468 30 050
Droner skaper problemer i Lærdal
Publisert 19.01.14 11:02 Sist oppdatert 19.01.14 11:02
Lærdalsøyri (NTB): Droner - små førerløse fly - skaper problemer for helikoptre som er satt inn i Lærdal. Politiet ber folk få dronene ned fra luften, ifølge VG.
Droner kan blant annet brukes til å fotografere fra luften.
- Det kan oppstå farlige situasjoner og kan utgjøre en fare for helikoptrene, sier Nils Erik Eggen, pressevakt ved Sogn og Fjordane politidistrikt til VG.
Han ber dem som har sendt opp droner om å ta dem ned. (©NTB)
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MPEL: Dette er en drone av typen
tom 2 Vision, med kamera. Det er
jent hvilken type drone som ble
i smuglingsforsøket.
rasjonsfoto: NTB Scanpix.
e smugle narkotika
i fengselet med en
ne
ert vanskelig å stoppe.
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amera
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Field work in Børsa & Skjoma

Anders Foldvik

Ragnvald Larsen
http://www.mindland.com

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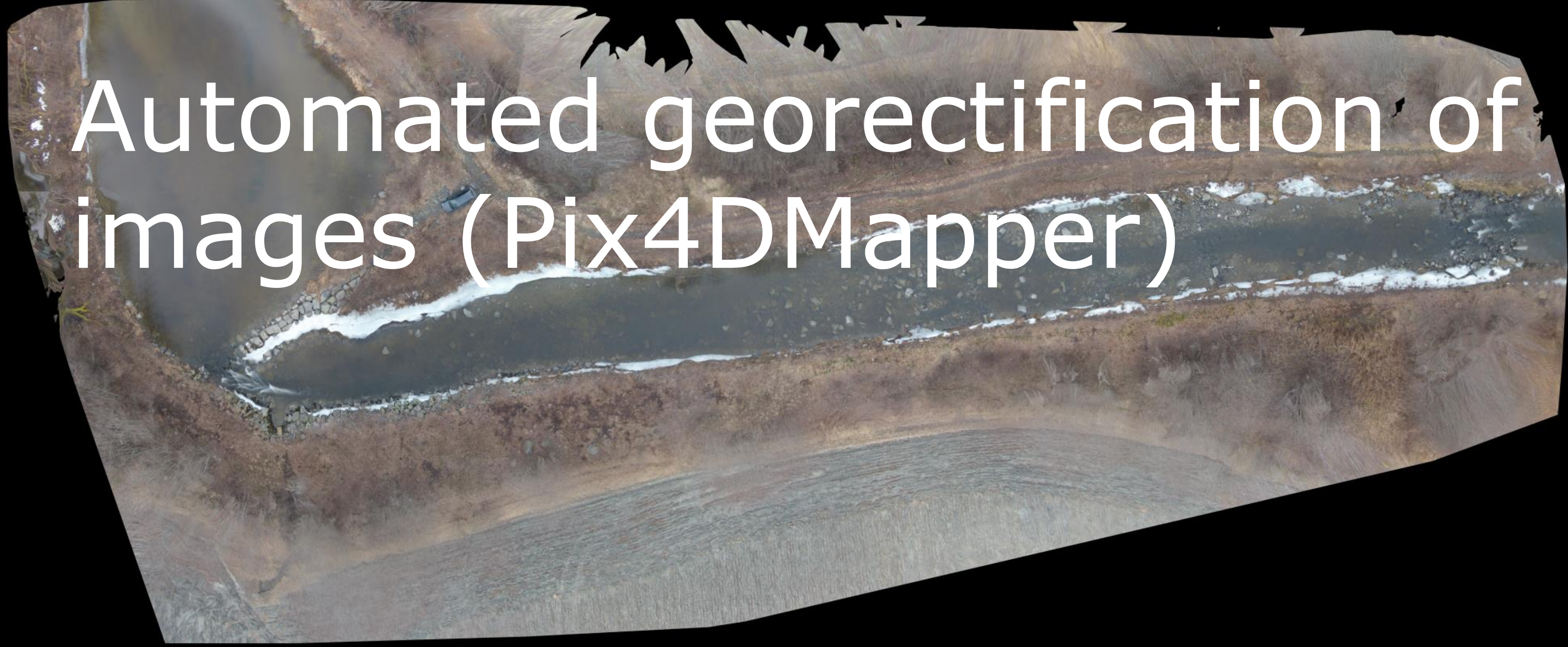
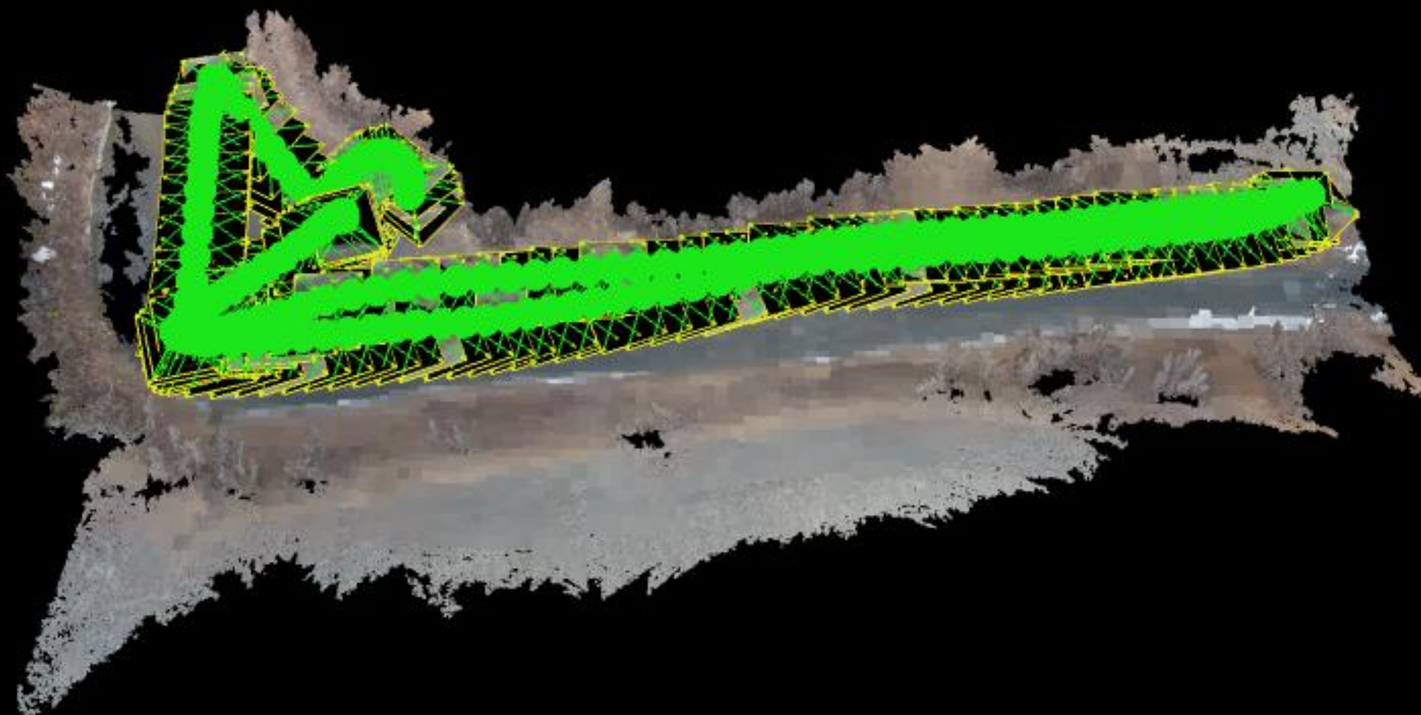
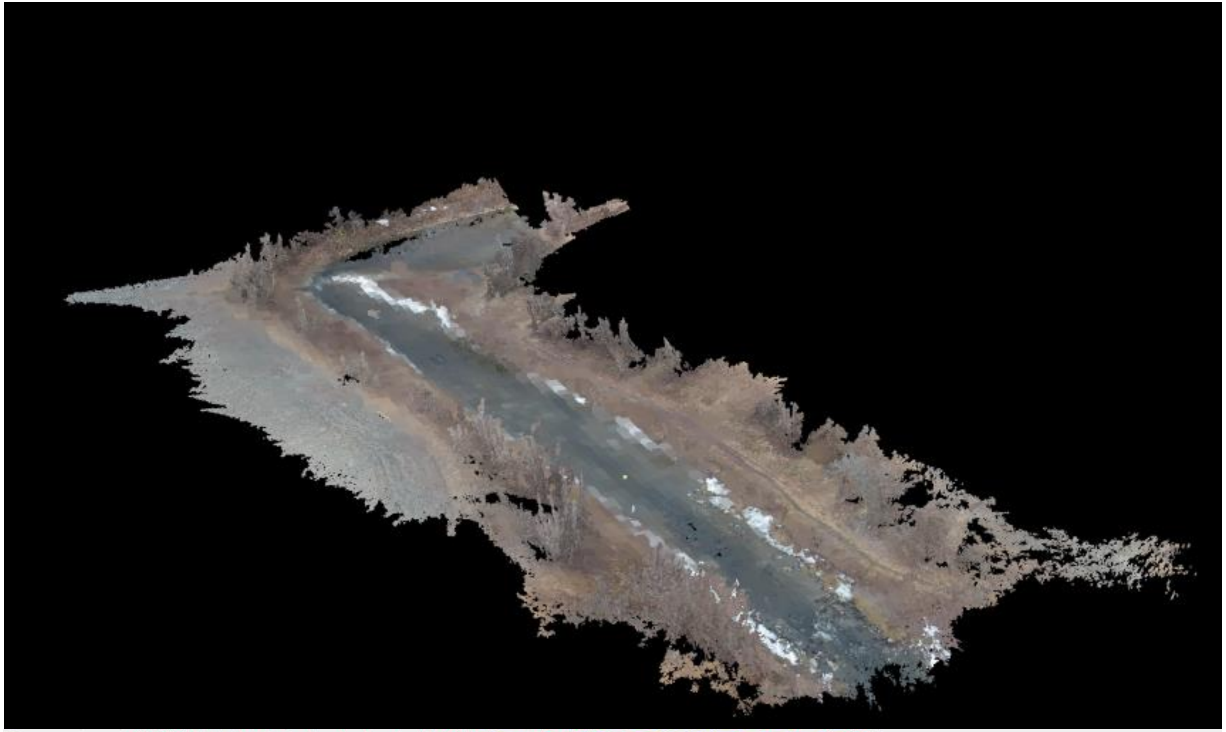
Automated georectification of images (Pix4DMapper)







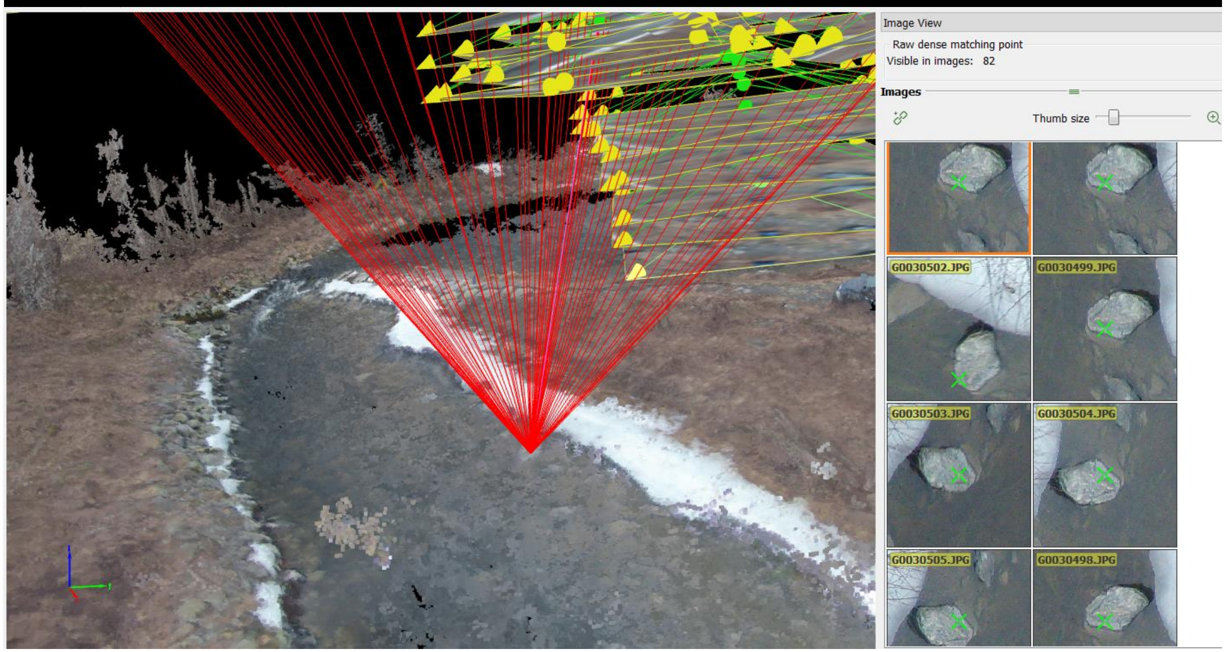


Image View
Raw dense matching point
Visible in images: 82
Images
Thumb size
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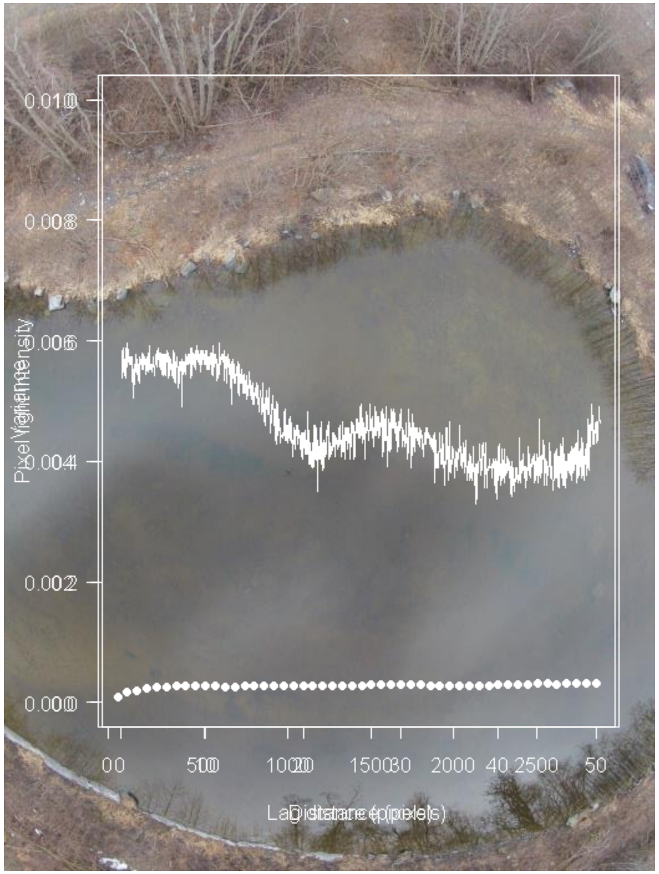
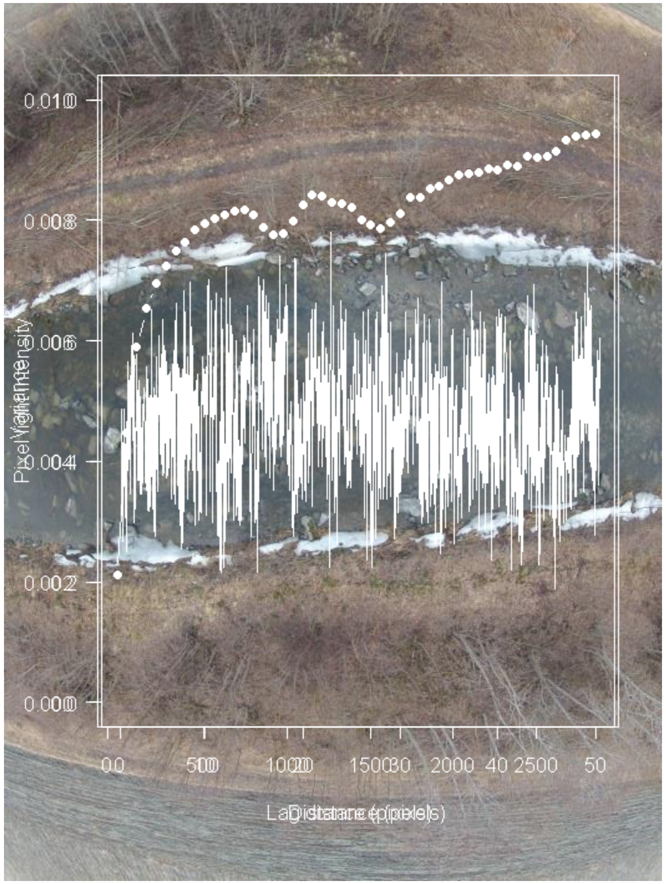
G0030503.JPG
G0030504.JPG
G0030505.JPG
G0030498.JPG

Extraction of elevation

Extraction of substrate size





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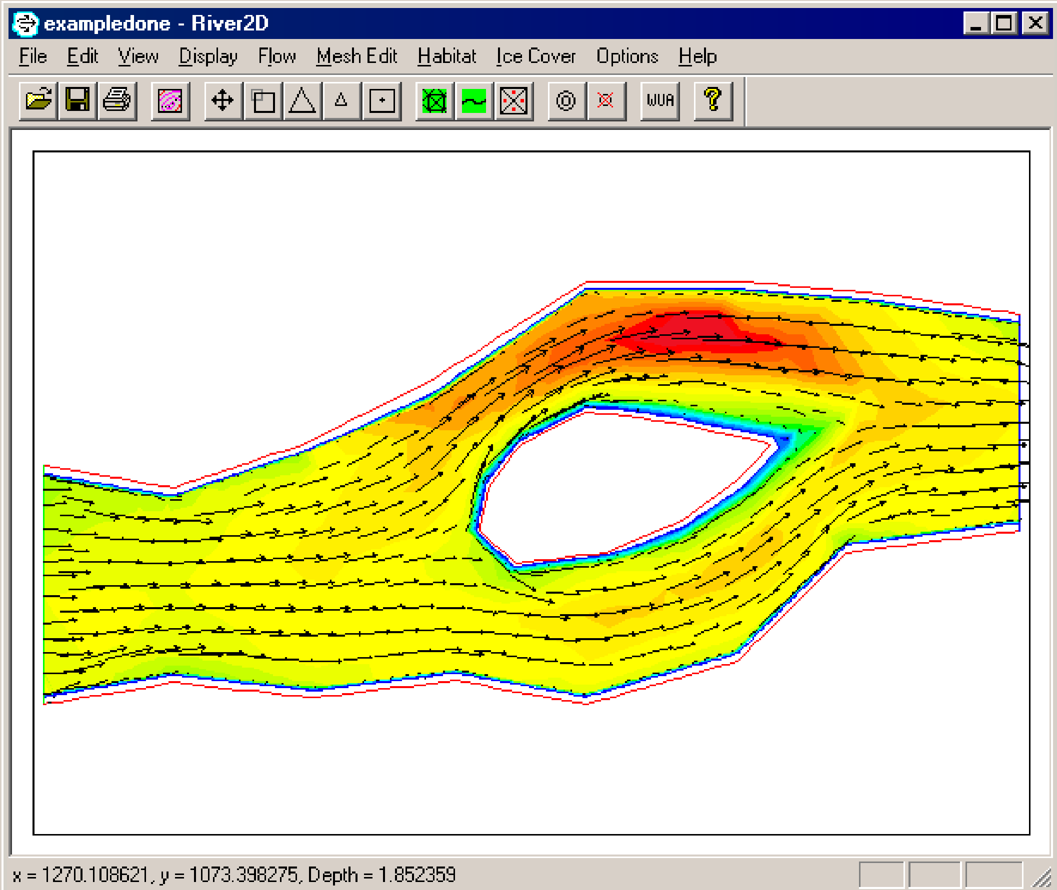
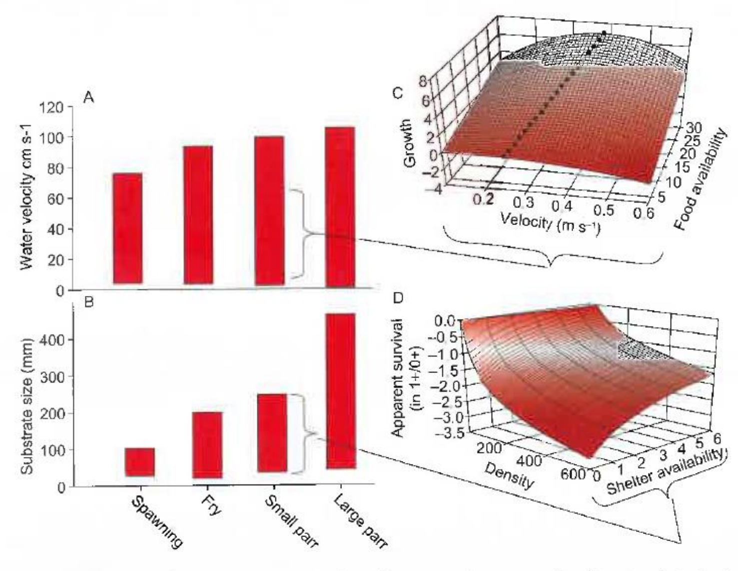
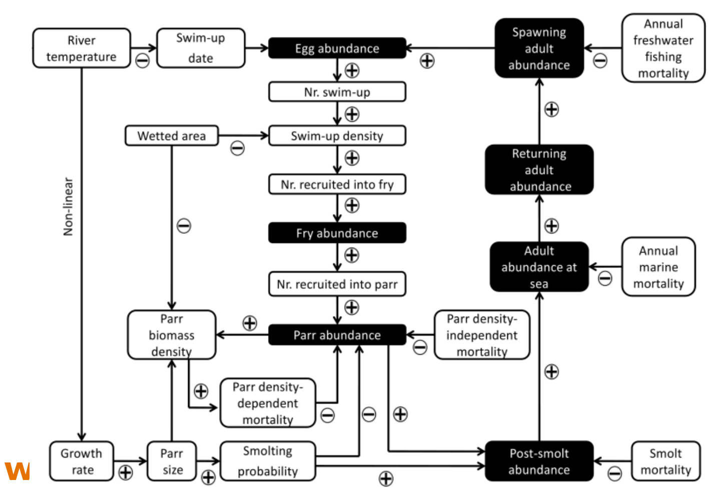


Box 3.1 Observed habitat, preferred habitat and habitat limitation



Life stage	Habitat variable	Measures	Values
Spawning	Velocity	Means	35–80 cm s^{-1}
		Minimum	>15–20 cm s^{-1}
	Water depth	Mean	25–50 cm
		Range	17–76 cm
	Substrate size	Median	5.4–7[illegible] mm
		Mean	20.7–[illegible]0 mm
	Deposition depth	Mean	15–25 cm
	Percentage fines	Range	2.3–8.0%
Fry	Snout velocity	Range	5–30 cm s^{-1}
	Column velocity	Range	20–40 cm s^{-1}
		Minimum	>5–15 cm s^{-1}
		Maximum	<100 cm s^{-1}
		Range	10–30 cm s^{-1}
	Water depth	Minimum	<10 cm
		Range	20–40 cm
		Preference	<25 cm
		Range	5–65 cm
		Maximum	<100 cm
	Substrate size	Range	16–256 mm
Parr	Snout velocity	Range	5–50 cm
	Column velocity	Maximum	>60 cm
		Maximum	<120 cm
		Minimum	<20 cm
		Preference	10–65 cm
	Depth	Range	20–70 cm
	Substrate size	Range	64–512+ mm

[1] Site of egg deposition;
[2] life stage from swim-up and throughout the first summer;
[3] juveniles from after the fry stage and until smoltification;
[4] water velocity measured at the position of the fish;
[5] water velocity measured throughout the water column.



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Thermal infrared

Quark into Huginn X1

Thermal infrared

S.J. Dugdale et al. / Remote Sensing of Environment 136 (2013) 358–373

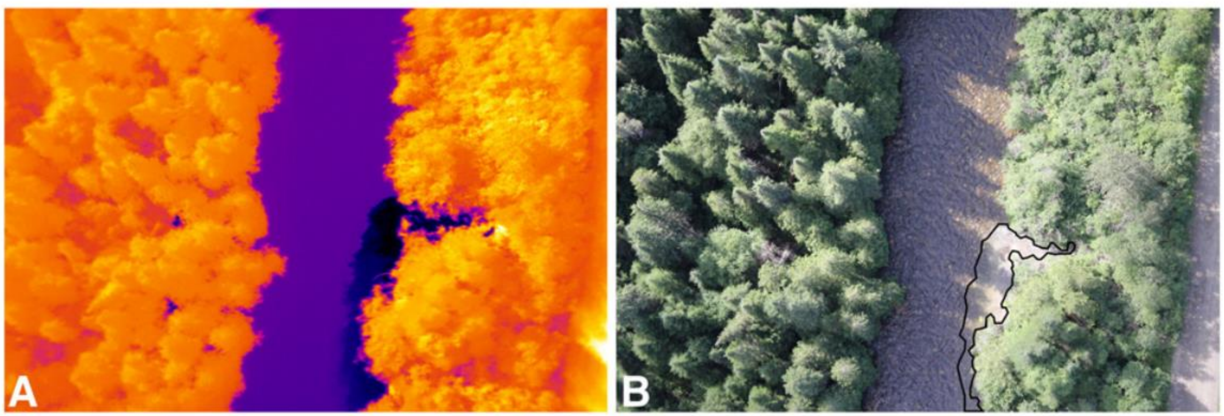

Fig. 1. A. Thermal infrared image showing thermal refuge created by the discharge of a cold tributary into the main river stem. B. Corresponding location in optical image. Modified from Bergeron and Carbonneau (2012).

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River temperature
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Atlantic salmon
Temporal variability
Hydrometeorology
Riverscape

In response to high summer river temperatures, salmonids avoid heat stress by making use of discrete units of cold water termed thermal refuges. Although recent research has documented how their spatial arrangement within a river affects salmonid distribution and behaviour, no information is currently available concerning temporal variation in the abundance and types of thermal refuges. In this study, a FLIR SC660 thermal infrared imaging camera (640 × 480 pixels, NETD <30 mK, 7.5–13 μm) mounted on a helicopter platform was used to acquire thermal imagery of an Atlantic salmon river in Québec, Canada on six occasions between 2009 and 2011, with a view to characterising temporal variability in thermal refuges and broader scale water temperature complexity. Thermal refuges detected from TIR imagery were classified into a series of process-based categories, revealing notable inter-survey variability in the absolute counts of each refuge type. Downstream temperature complexity, quantified as the standard deviation of derivatives taken of temperature long profiles of each survey, was highly temporally variable, exposing the presence of several warm and cool reaches which varied in magnitude between surveys. Data from local meteorological and discharge logging stations was used to examine whether hydrometeorological conditions could account for observed temporal variability trends. Temporal variability in the absolute counts of lateral groundwater seeps, the most frequently observed thermal refuge class, was shown to correlate strongly with long duration hydrometeorological metrics such as seasonal mean discharge ($R^2 = 0.94$, $p < 0.01$). Conversely, thermal refuges

Future needs - project types

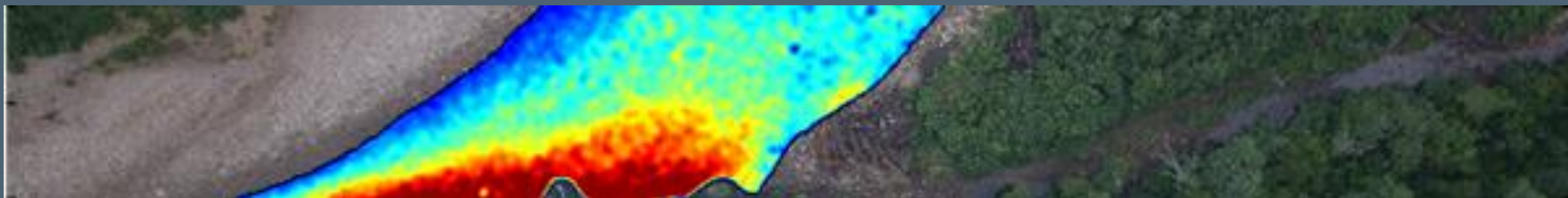
- Effects of hydropower
  - Obstructions, sedimentation, stranding, temperature
- River channel modification
  - Channel shape
  - Substrate
- Effects of flooding
- Habitat relationships
  - Spawning areas

Future needs - data

- Data types
  - Subtrate size, Depth
  - Channel characteristics
    - width
    - channel shape
    - longitudinal slope
  - Derived characteristics
    - hydraulic properties
    - reach type (sill, glide, rapids etc.)

Future needs – software development

- Differentiating water and land
- Look-angle-effect, shadows, sunglint
- Ice, vegetation in water, white water
- Depth & substrate
- Habitat features from patterns in depth and substrate
- Integration with GIS data



Thanks

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