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Neue Erkenntnisse zur Schwallproblematik und mögliche Lösungsansätze

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Austrian rivers affected by hydro peaking

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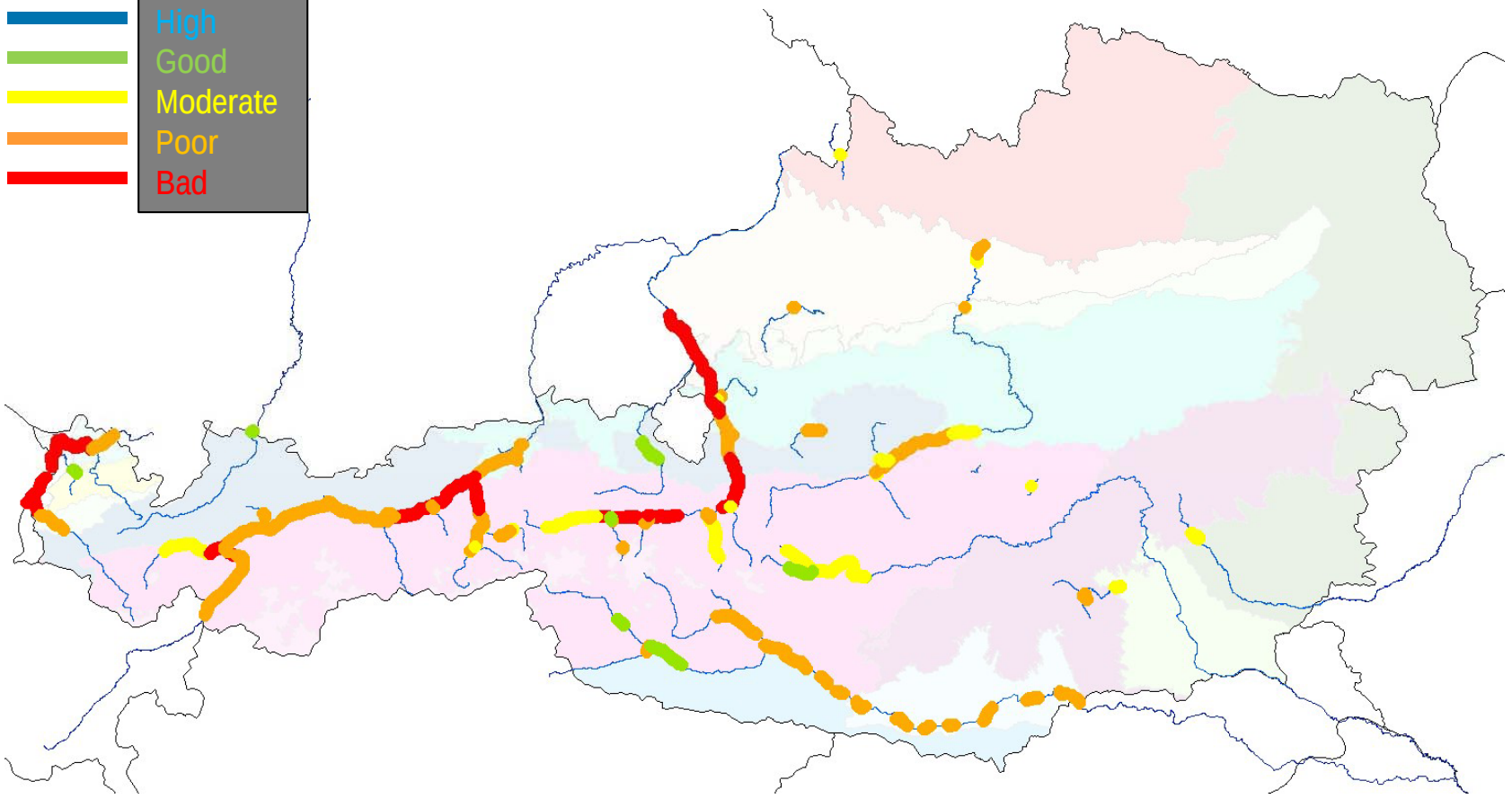
78 water bodies on a length of 802 km (2,6% of 31.000 km total) are affected by hydropeaking



Data source: National River Basin Management Plan 2009, BMLFUW

Fish sampling sites

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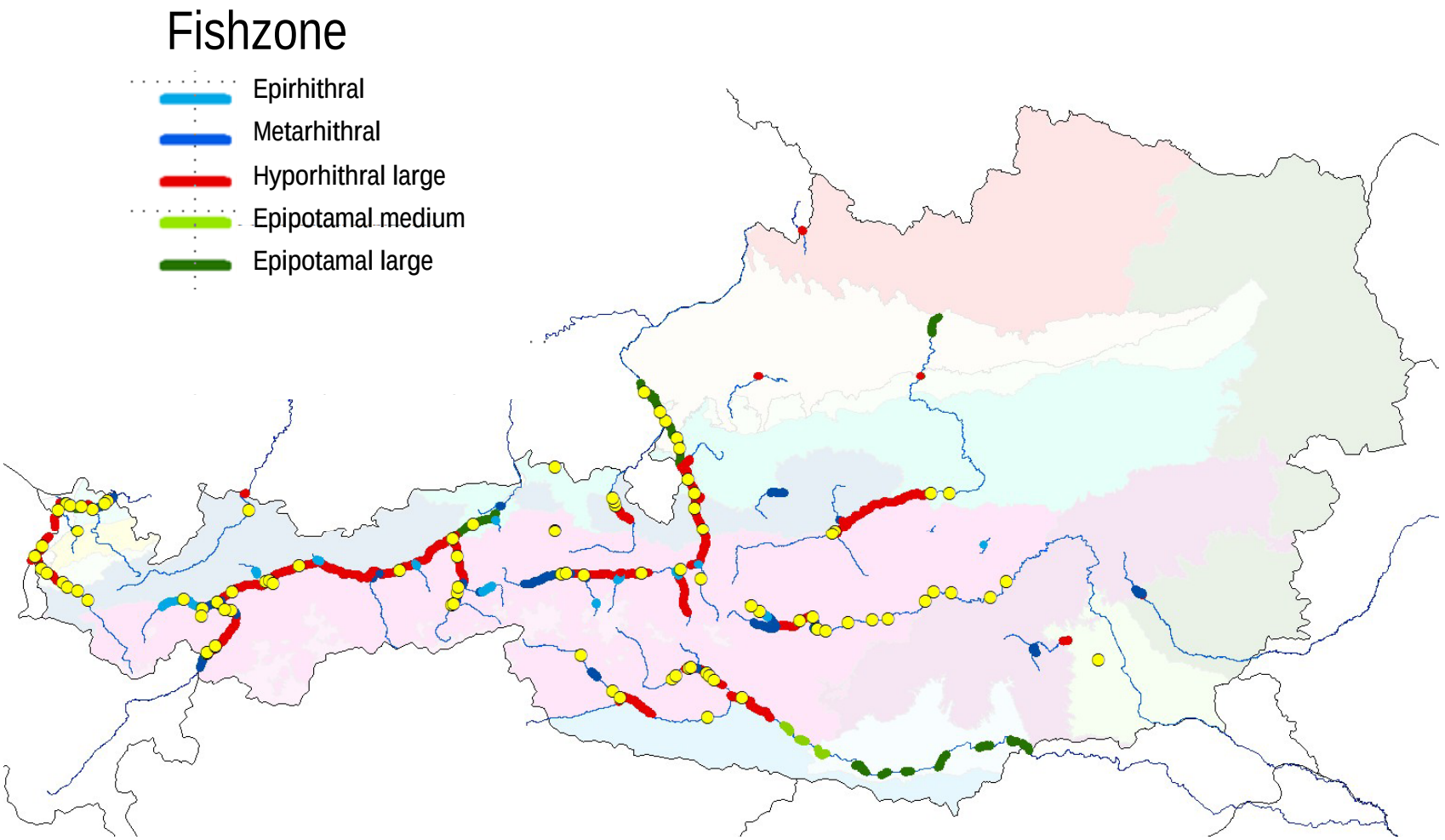

Ecological status

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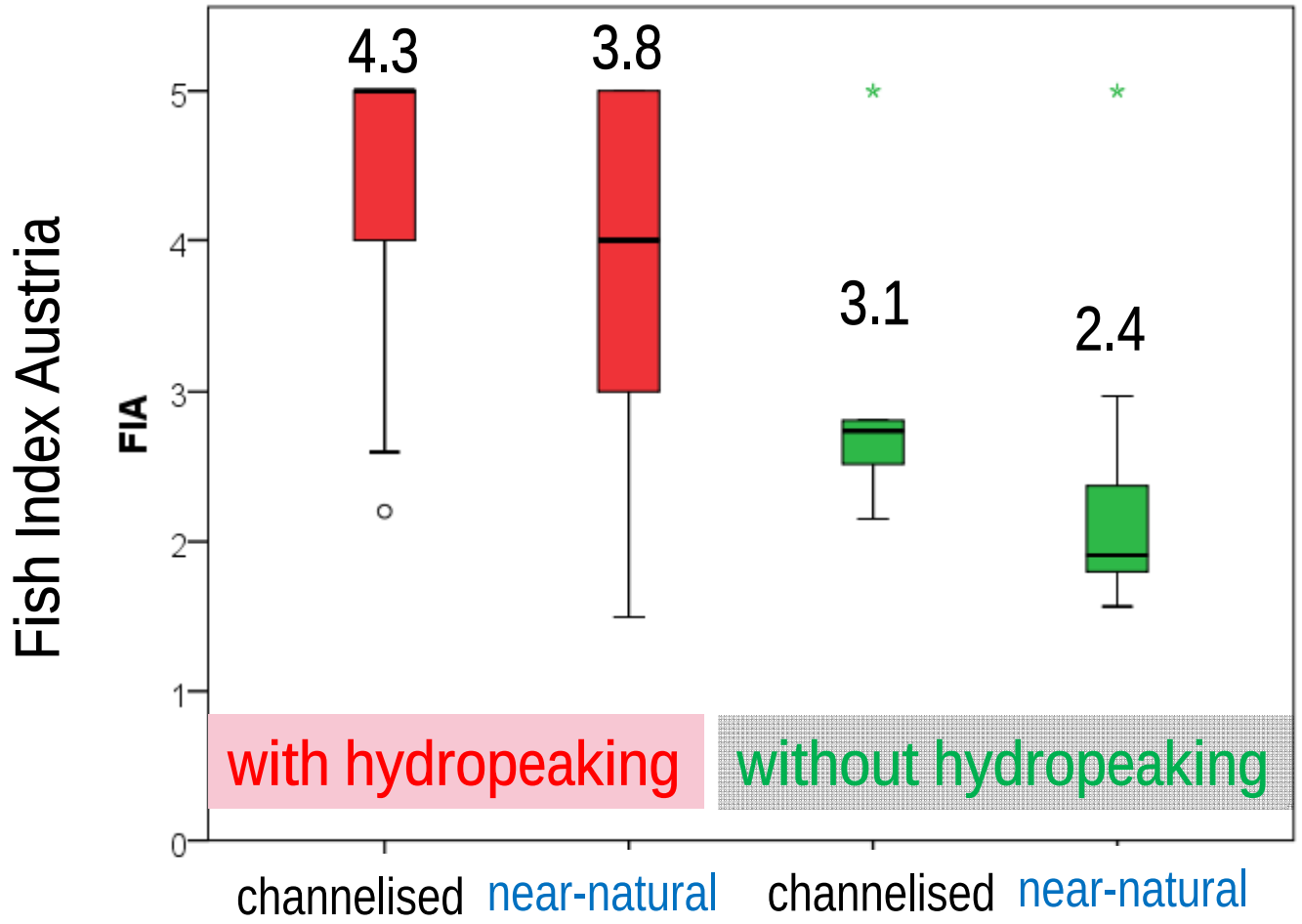

Mean:

Jungfischdichte Äsche

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Hyporhithral - Jungäschen pro 100m Uferlinie			
	Referenz	**Schwall**	
	naturnah (n=15)	naturnah (n=25)	naturfern (n=41)
0+ per 100m	9,6	2,4	2,4
1+ per 100m	2,5	1,4	1,6

Jungfischdichte Bachforelle

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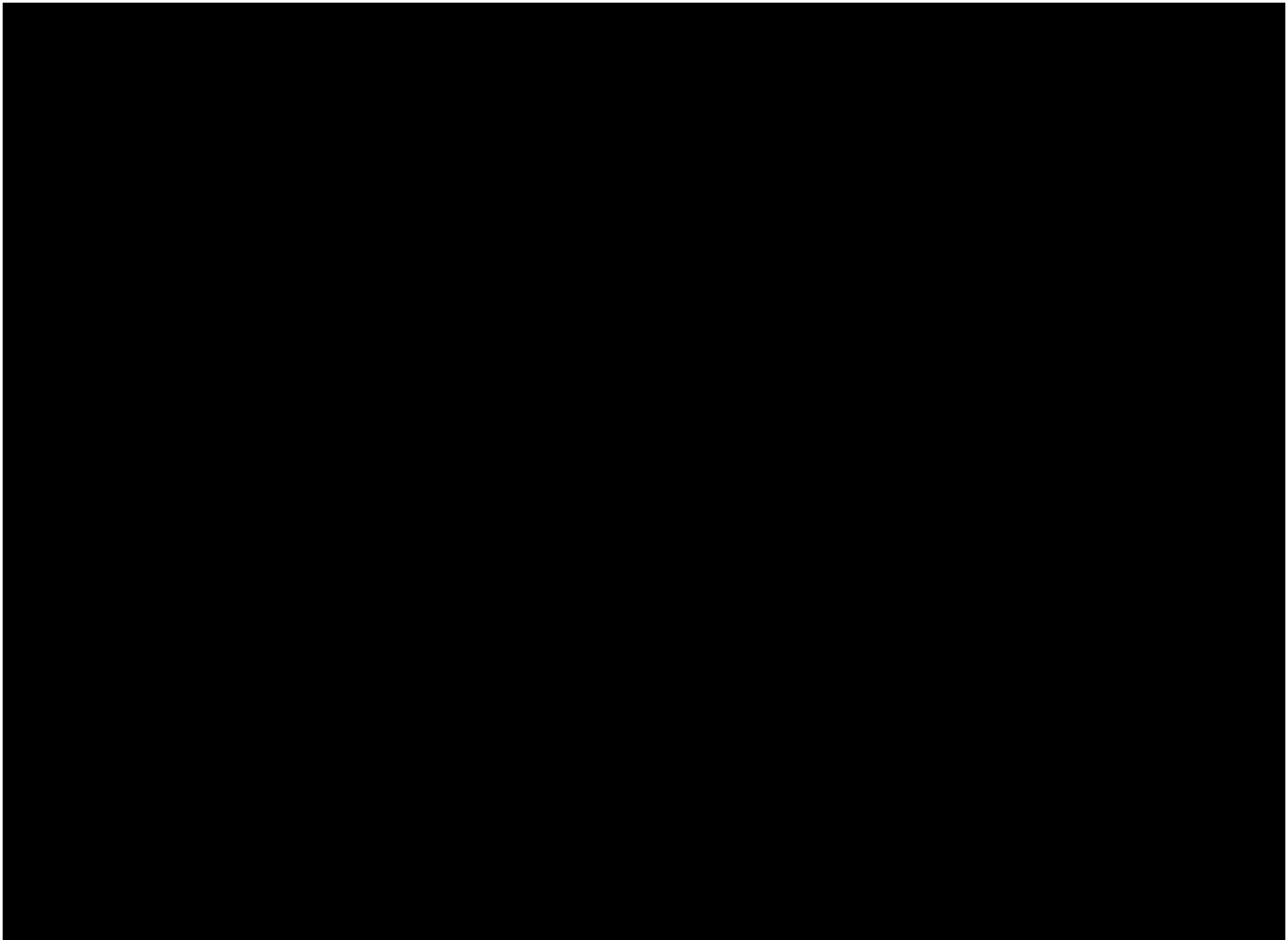
Metarhithral - Bachforellen pro 100m Uferlinie			
	Referenz	**Schwall**	
	naturfern (n=10)	naturnah (n=10)	naturfern (n=3)
0+ per 100m	17,1	4,9	1,8
1+ per 100m	20,7	3,8	0,7



Observed parameters – Wave detector

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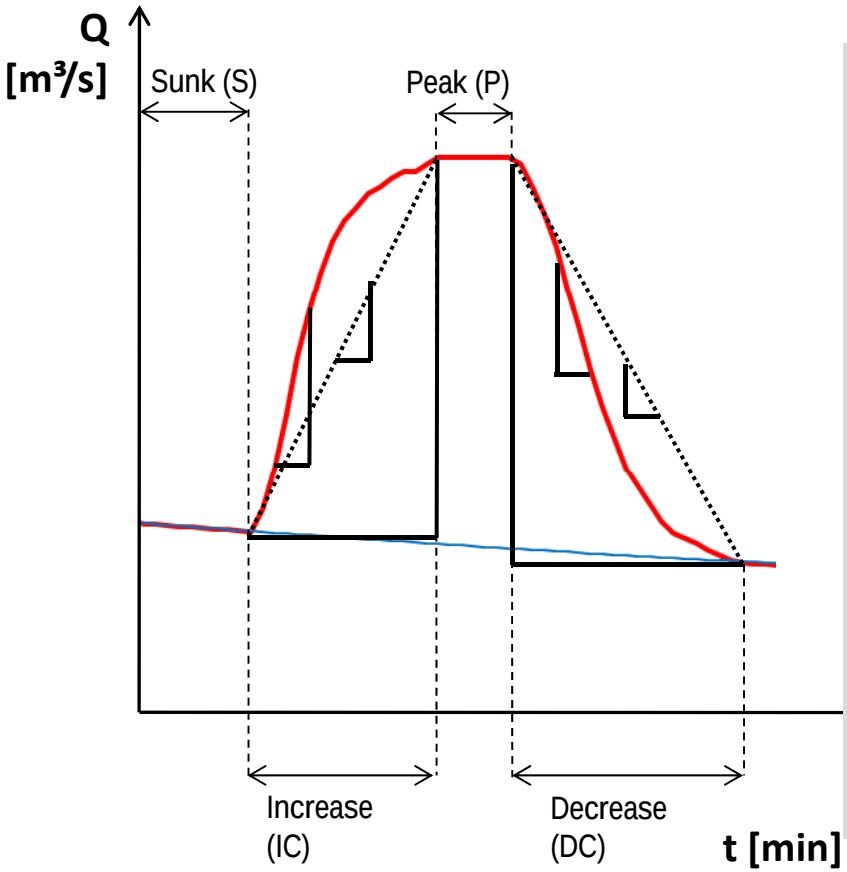

Parameters for Increase IC and decrease DC

- Duration dt (min)
- Mean IC/DC [m³/s/min]
- Maximum IC/DC [m³/s/min]
- Total IC/DC dQ_IC/DC [m³/s/event]

Biotic response to hydro peaking

Life cycle of grayling (*Thymallus thymalls*)

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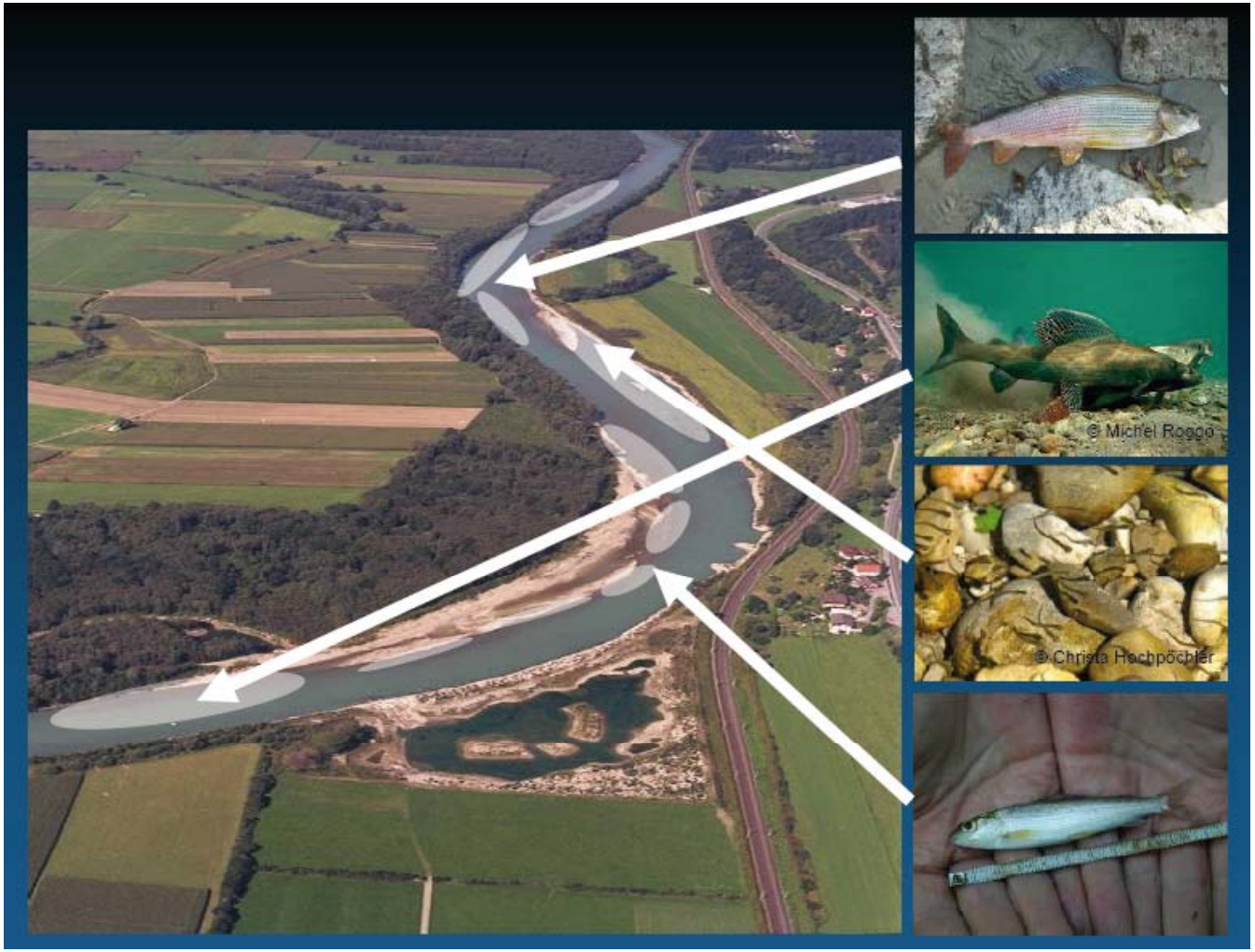

How does hydro peaking affect juvenile fish?

Cross section flow velocities

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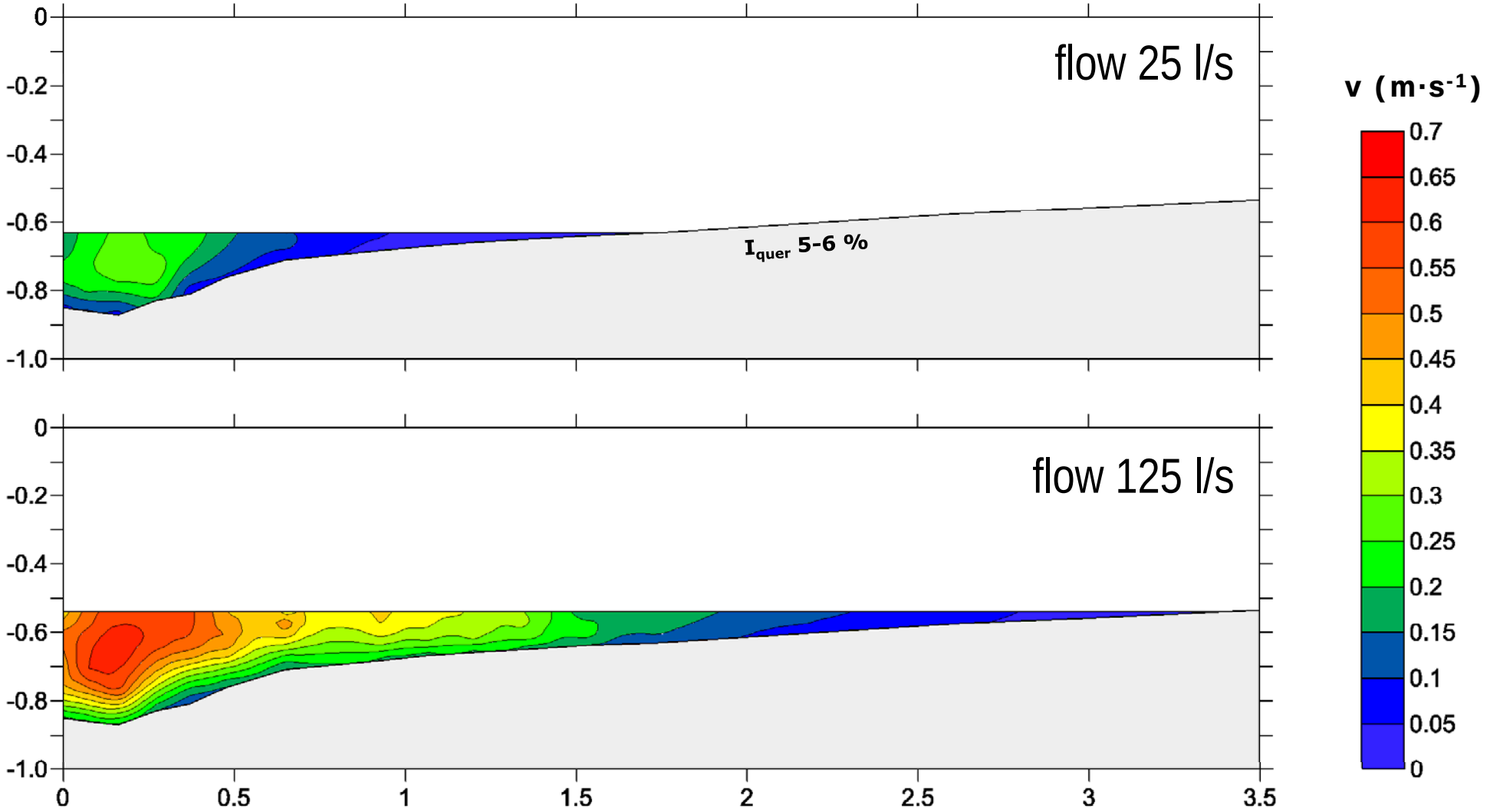

Results of experimental channel
Survival of larval grayling during a single peak event

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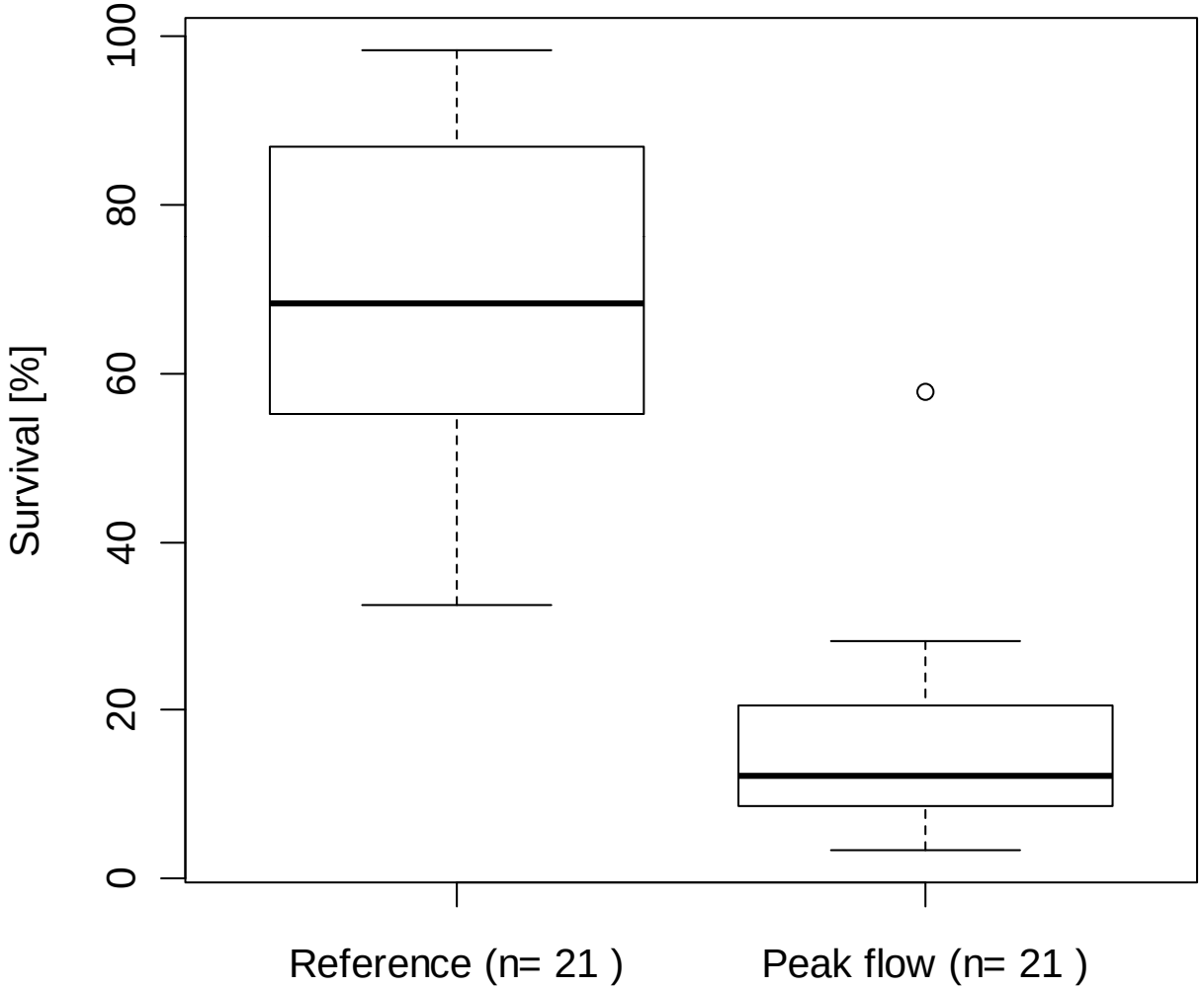

In the reference channel **five times** more fish remained than in the hydro peaking channel

First results of experimental channel ***Stranding*** *of larval grayling during a single peak event*

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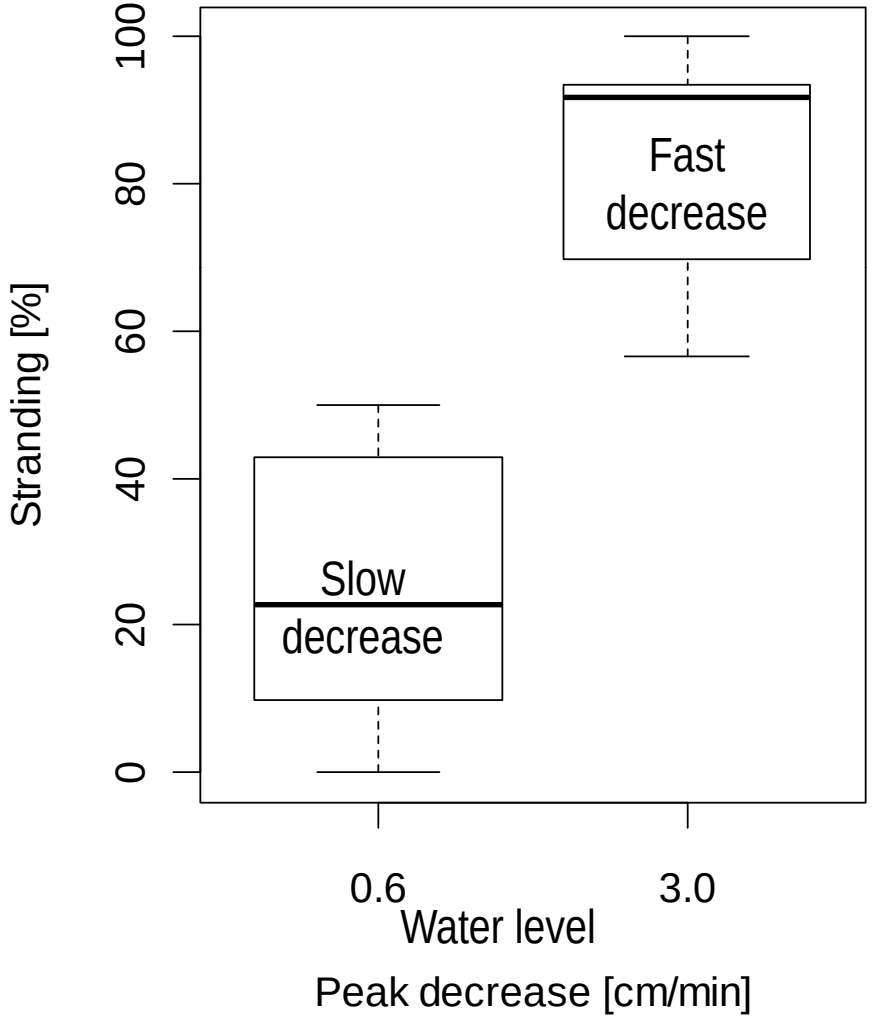

Experiment with juvenile grayling

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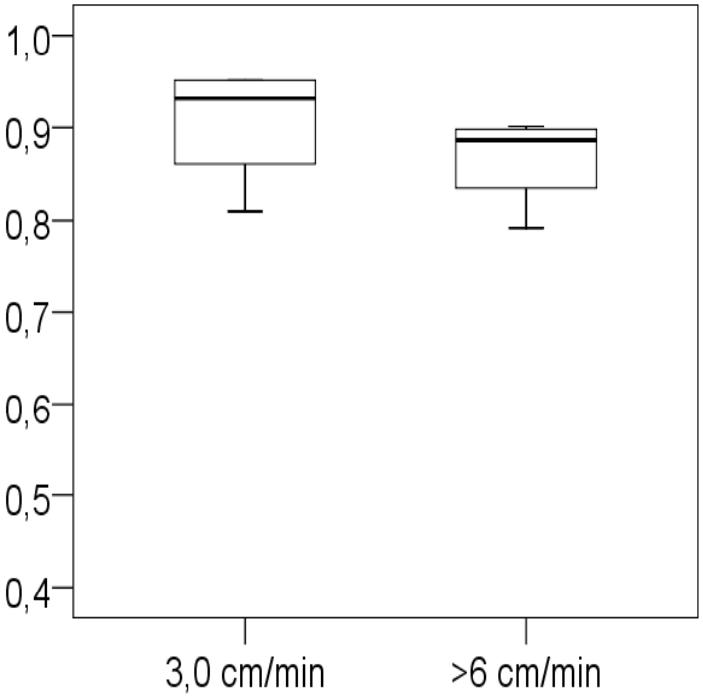
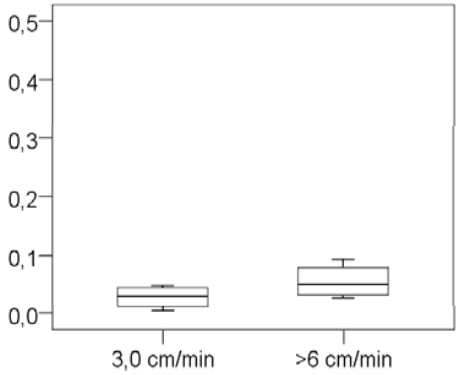
Size of fish: 35 mm

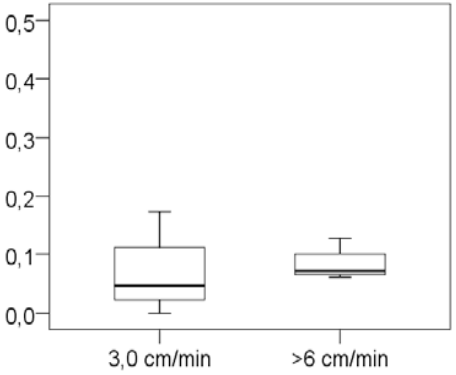
Habitats tested: large bays

Survival





Stranding



Drift

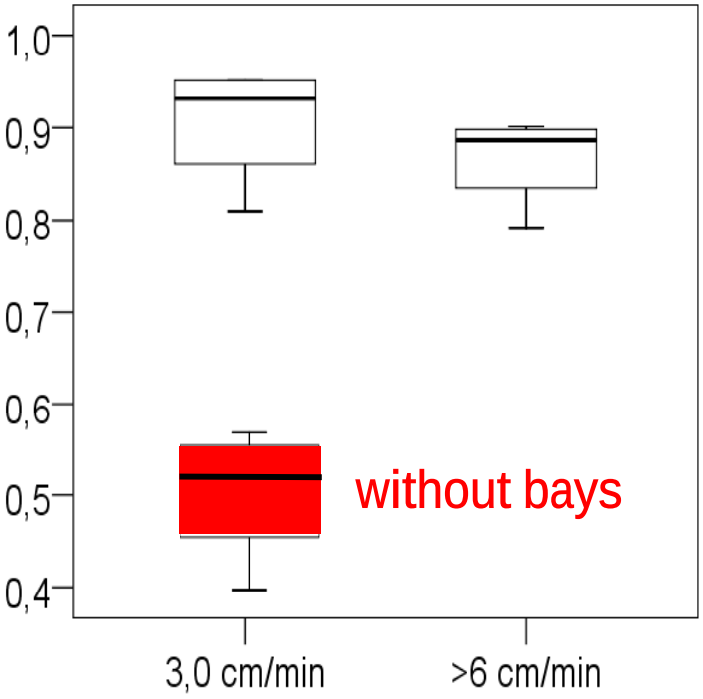
Experiment with juvenile grayling

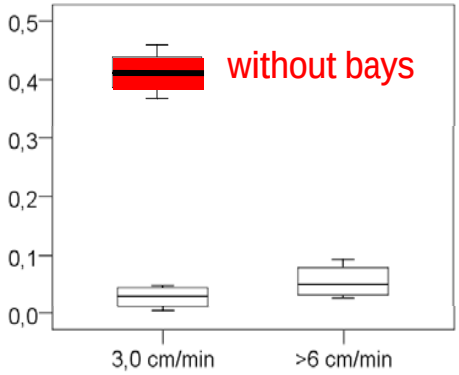
www.wau.boku.ac.at

Size of fish: 35 mm

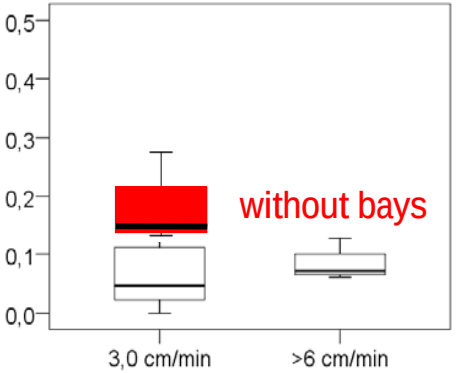
Habitats tested: large bays

Survival





Stranding



Drift

Hydromorphological effects

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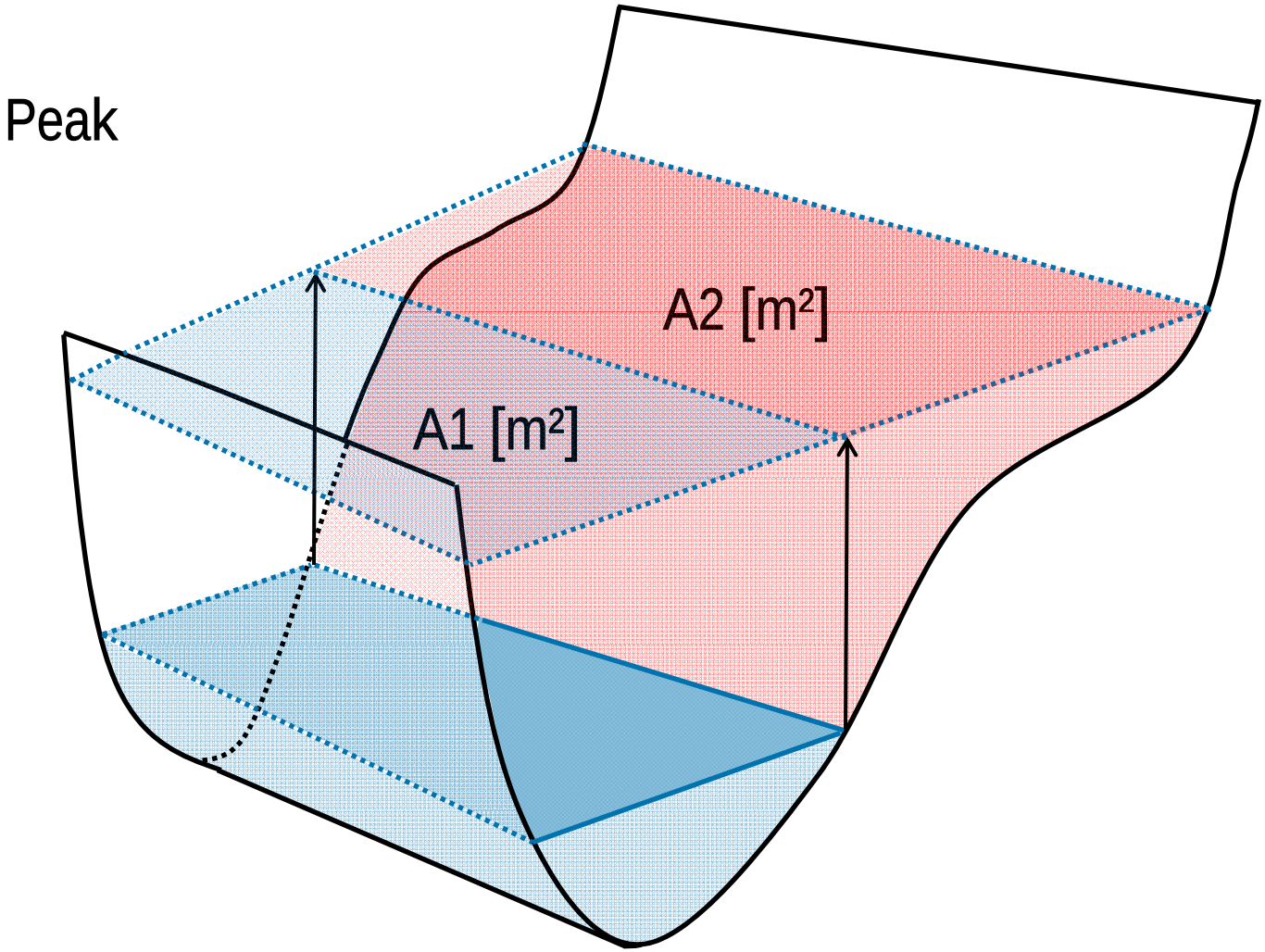

Lebensraumnutzung (Ufer) Äsche im zeitlichen Verlauf

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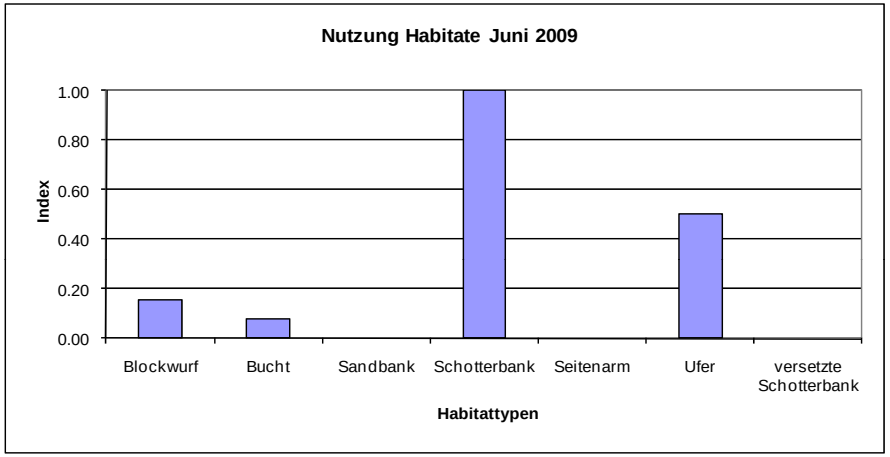

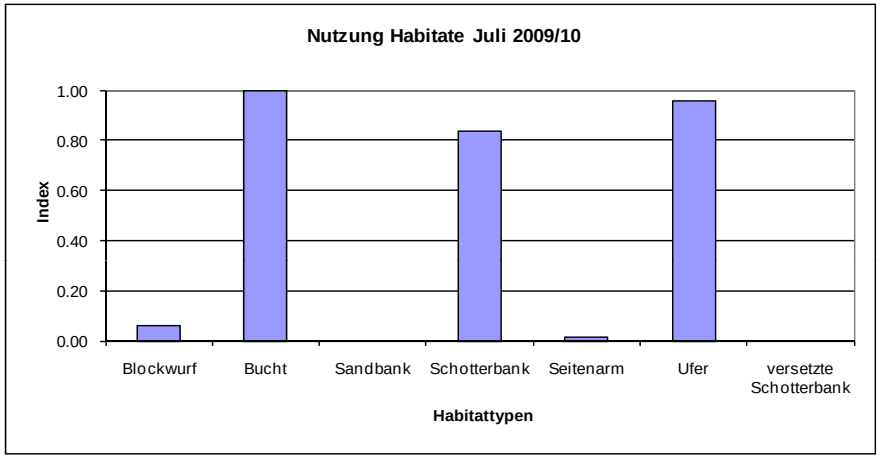

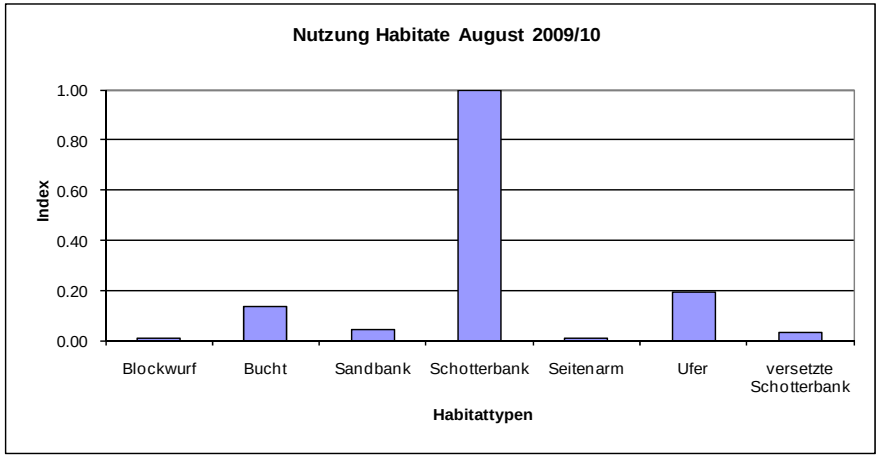

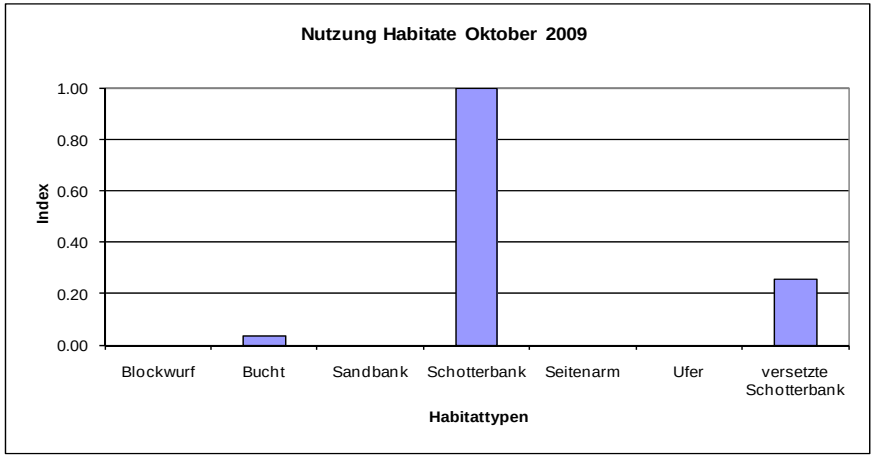

Habitatnutzung der Jungäsche im jahreszeitlichen Verlauf
Fallstudie Drau (Unfer et al. 2011)

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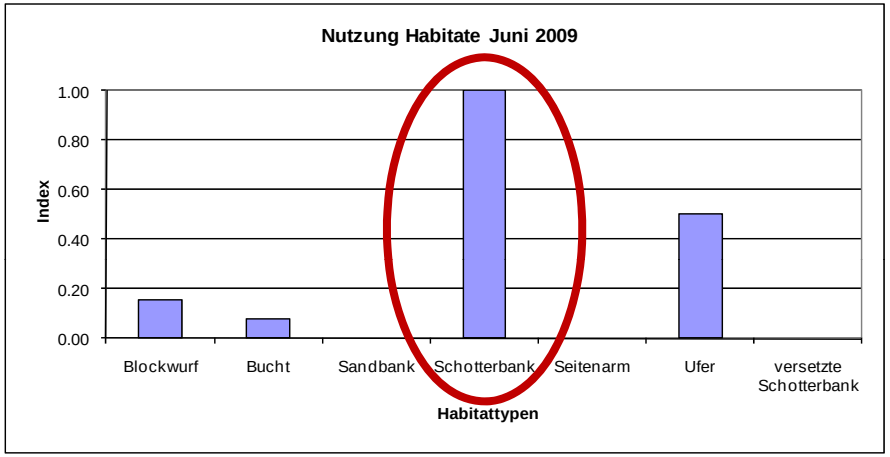
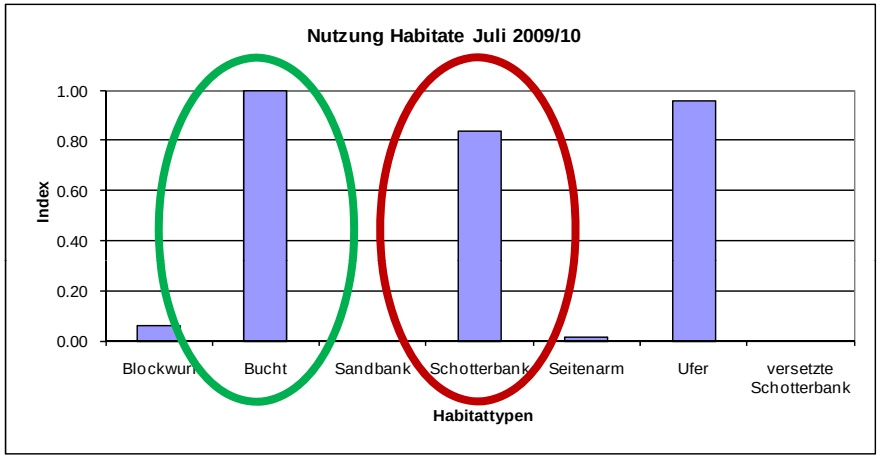
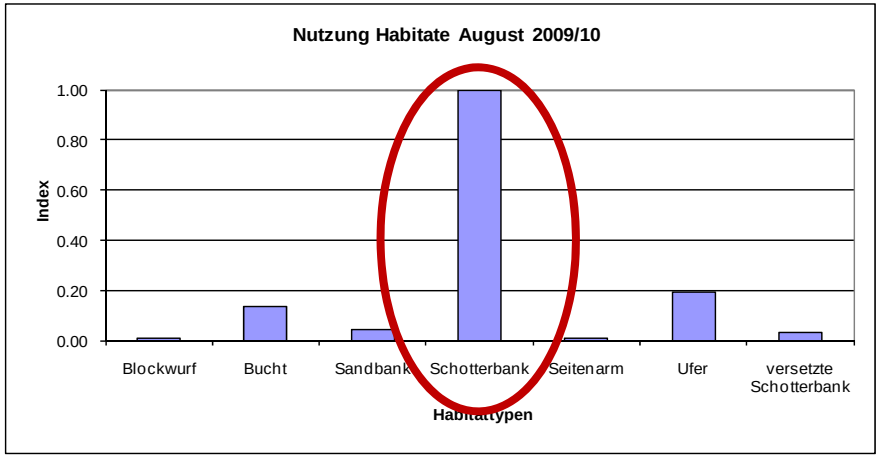
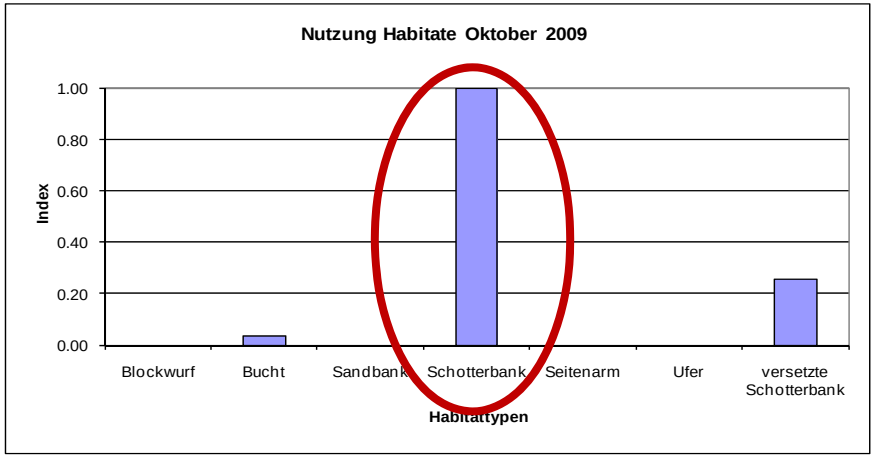
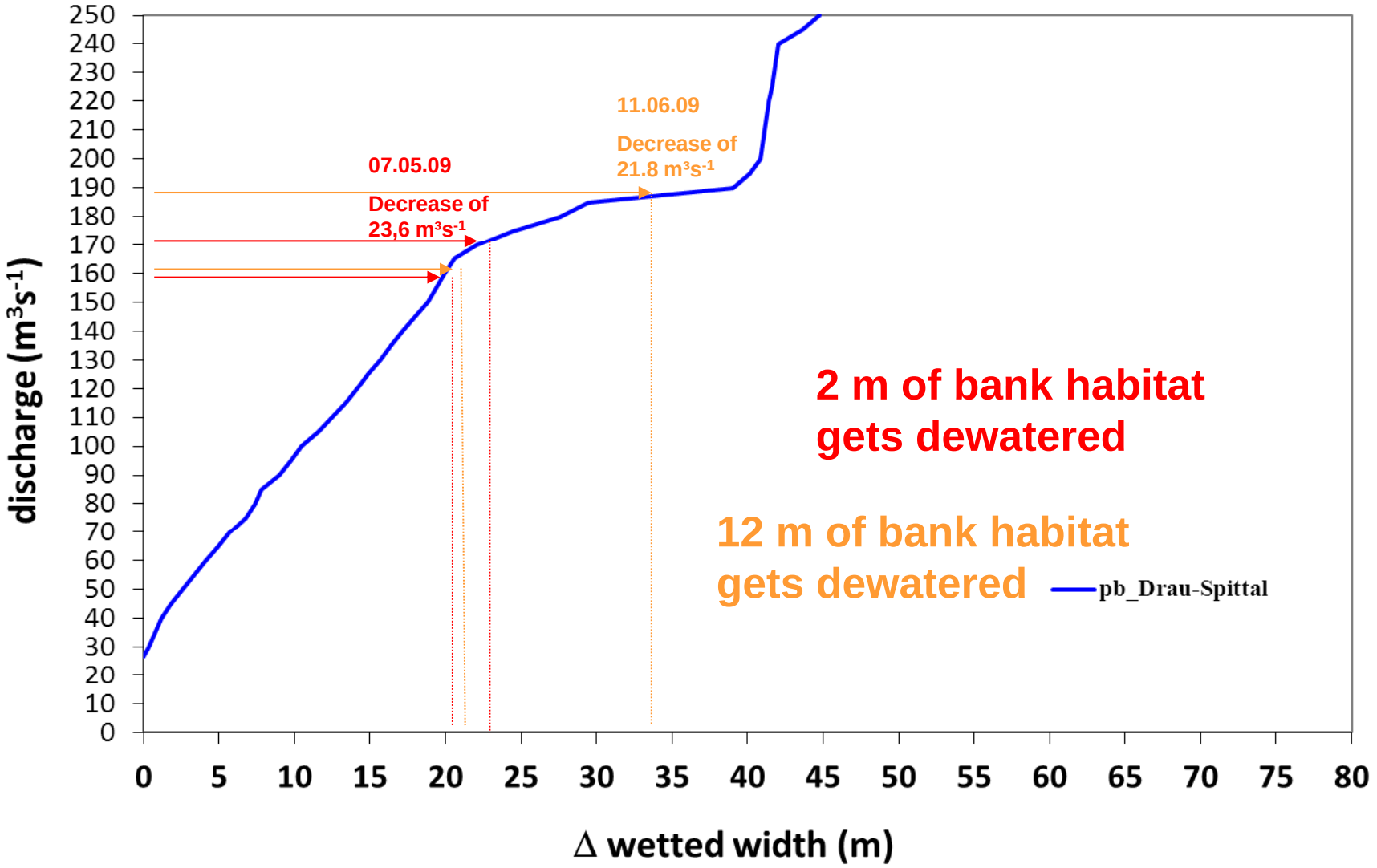
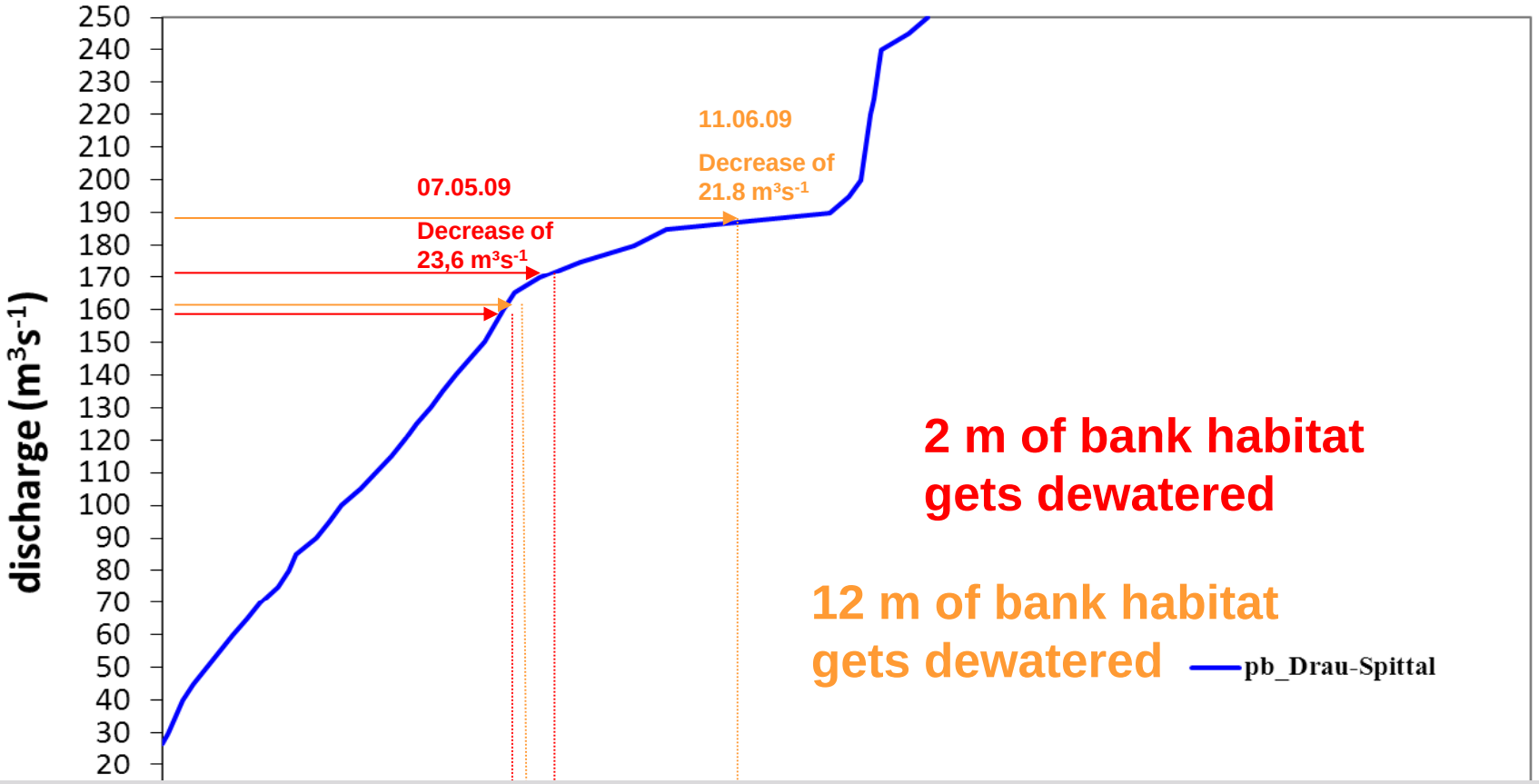









discharge (m³s⁻¹)
Δ wetted width (m)
07.05.09
Decrease of
23,6 m³s⁻¹
11.06.09
Decrease of
21.8 m³s⁻¹
2 m of bank habitat
gets dewatered
12 m of bank habitat
gets dewatered
pb_Drau-Spittal



…….stranding risk is – beside bank slope and grain size – substantially influenced by the combination of channel morphology, baseflow and the rate of decrease!

Hochrechnung der Strandungsmortalität

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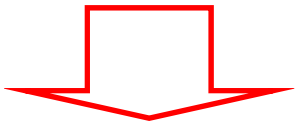
50 bis 500 gestrandete Larven pro 100 m Uferlinie

7,25 km Uferlinie mit Strandungsrisiko

70 (2009) bzw. 74 (2010) Sunkevents zw. Mai und Juli



50*72,5*70 = 253.750 gestrandete Äschenlarven

200*72,5*70 = 1.015.000 gestrandete Larven

45 adulte Weibchen/km * 22,7 km = 1021 * 3000 Eier = ca. 3.000.0000

Response of juvenile grayling to multiple peak events in Drava river

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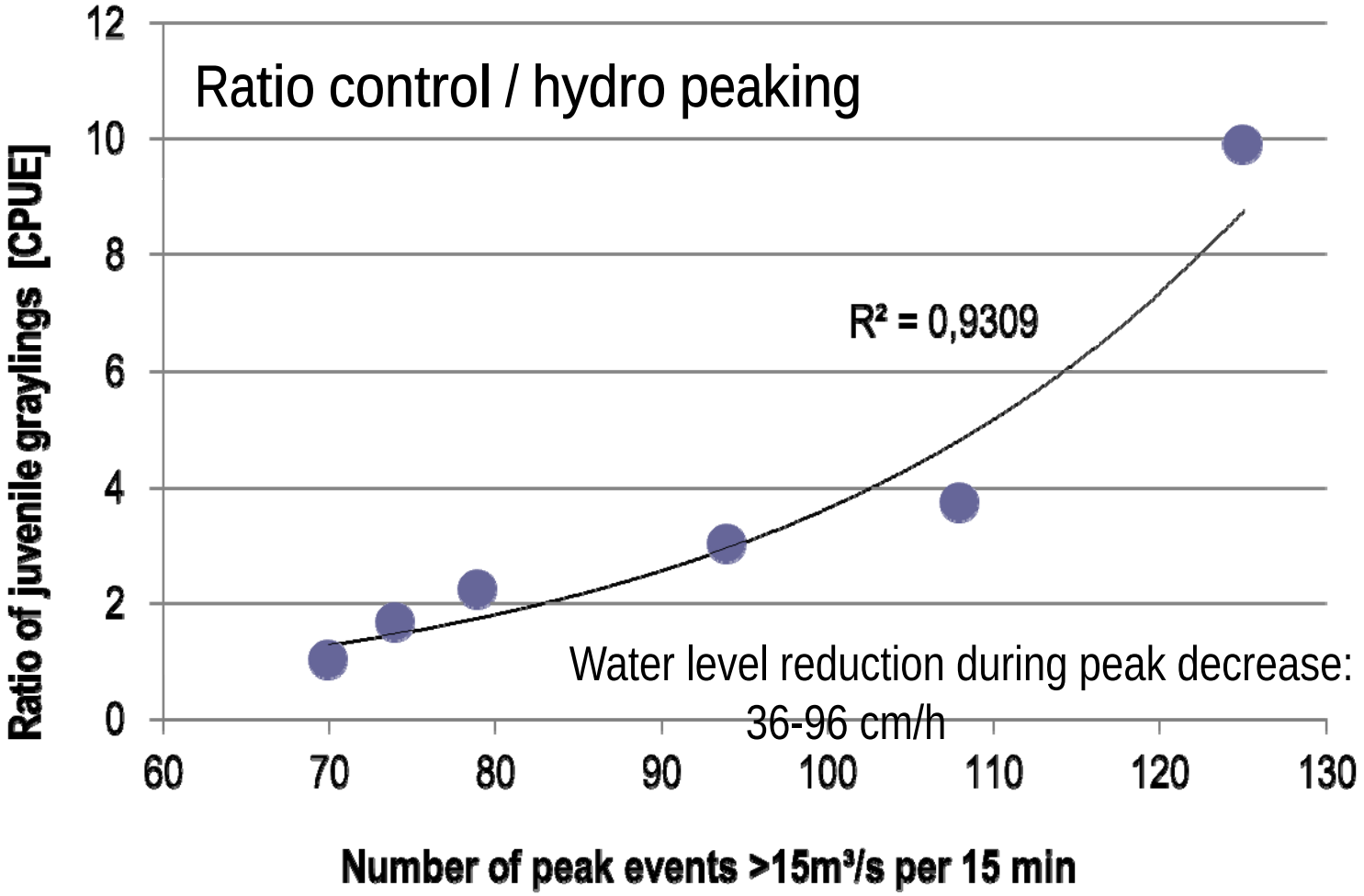

- 6 years
- May-July

Water level reduction during peak decrease: 0.6-1.6 cm/min
36-96 cm/h

Unfer et al. 2011

Summary

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- Strongest impact results from combined pressures of hydro peaking and channelisation.
- Stranding und Drift are the main causes of losses.
- Larval fish react stronger than juveniles.
- Peak increase always results in drift, independent of speed.
- Speed of peak decrease responsible for stranding.
- Peak decrease should be <0.2 cm/min (<12 cm/h) for larval fish.
- Morphological structures reduce stranding and drift of juvenile fish.

Restoration measures

- Dampening of peak
  - Peak magnitude (coordination of multiple HP)
  - Peak increase
  - Peak decrease
  - Peak frequency
- "Larval window" special regulation during larval phase
- Morphological improvements
- Peak diversion (downstream to large rivers, impoundments, lakes, sea)
  - Creating win-win situations.

Open questions

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- Biological questions
  - Influence of morphological structures (bays) on the survival of larval fish.
  - Effects of multiple peaks (long term effects).
  - Day/night effects
  - Seasonal effects (winter)
- Economic questions
  - Economic optimisation of measures

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