Die Bedeutung von experimentellen Untersuchungen für eine ökologische Optimierung der Wasserkraft

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Priv.-Doz. Dipl.-Ing. Dr. Christoph Hauer

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17. Oktober 2025, Schloss Luberegg

CD-Labor „Sedimentforschung und -management“ (2017-2024)

Modul 1 (Verein für Ökologie und Umweltforschung)

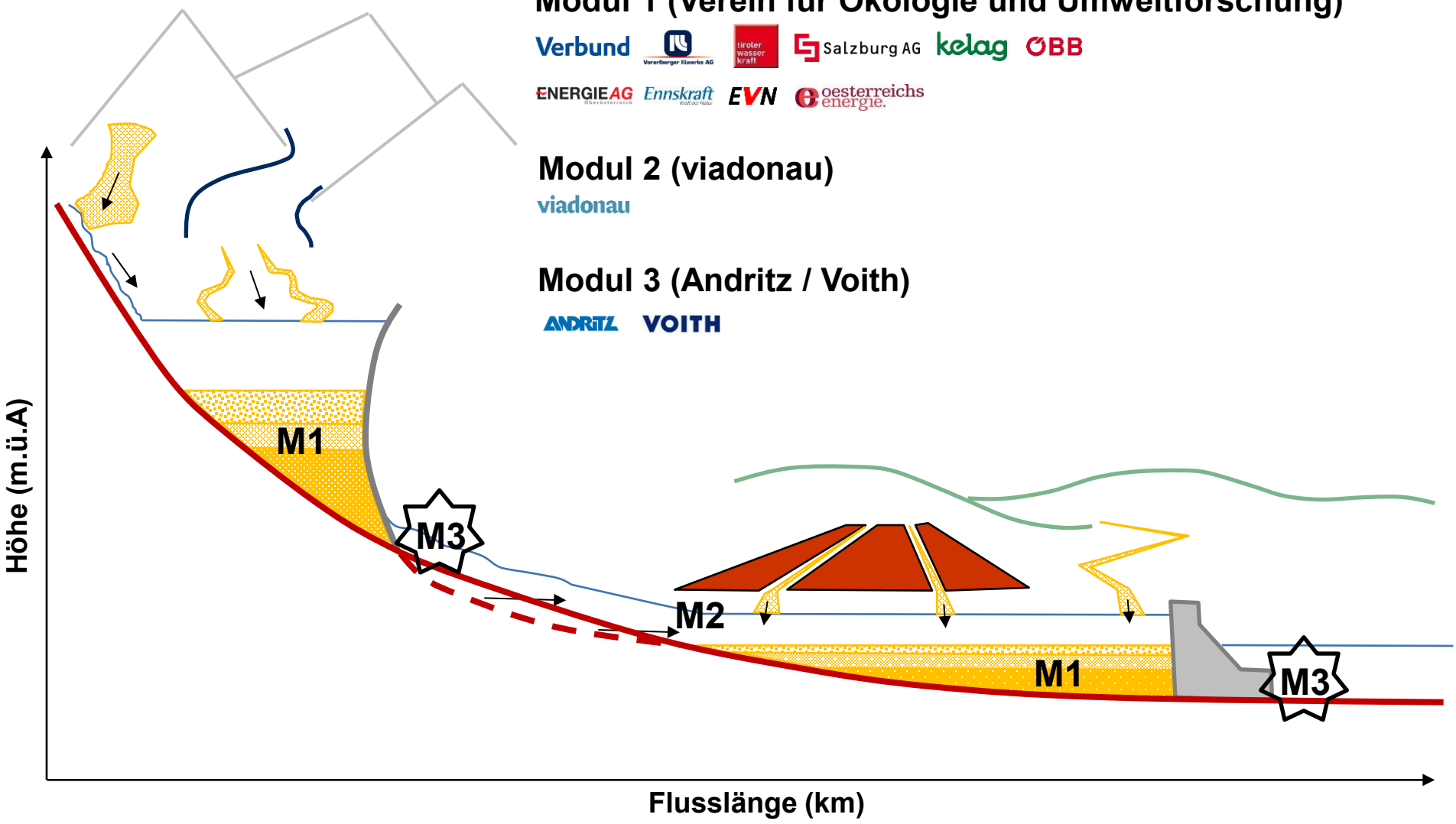
Verbund · Vorarlberger Illwerke AG · tiroler wasserkraft · Salzburg AG · kelag · ÖBB · ENERGIE AG Oberösterreich · Ennskraft · EVN · oesterreichs energie.

Modul 2 (viadonau)

viadonau

Modul 3 (Andritz / Voith)

ANDRITZ · VOITH

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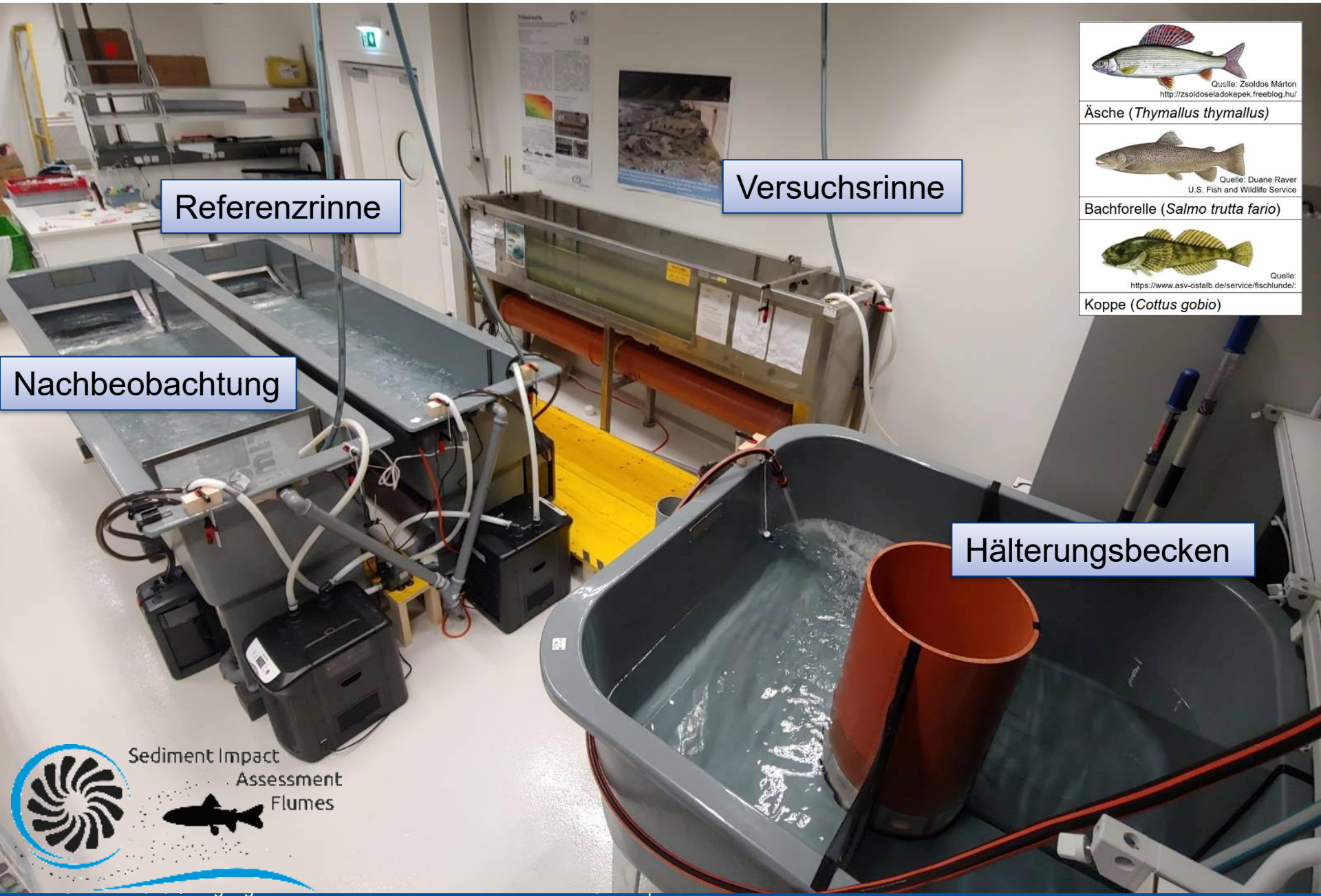
Sediment Impact Assessment Flumes (SIAFs)



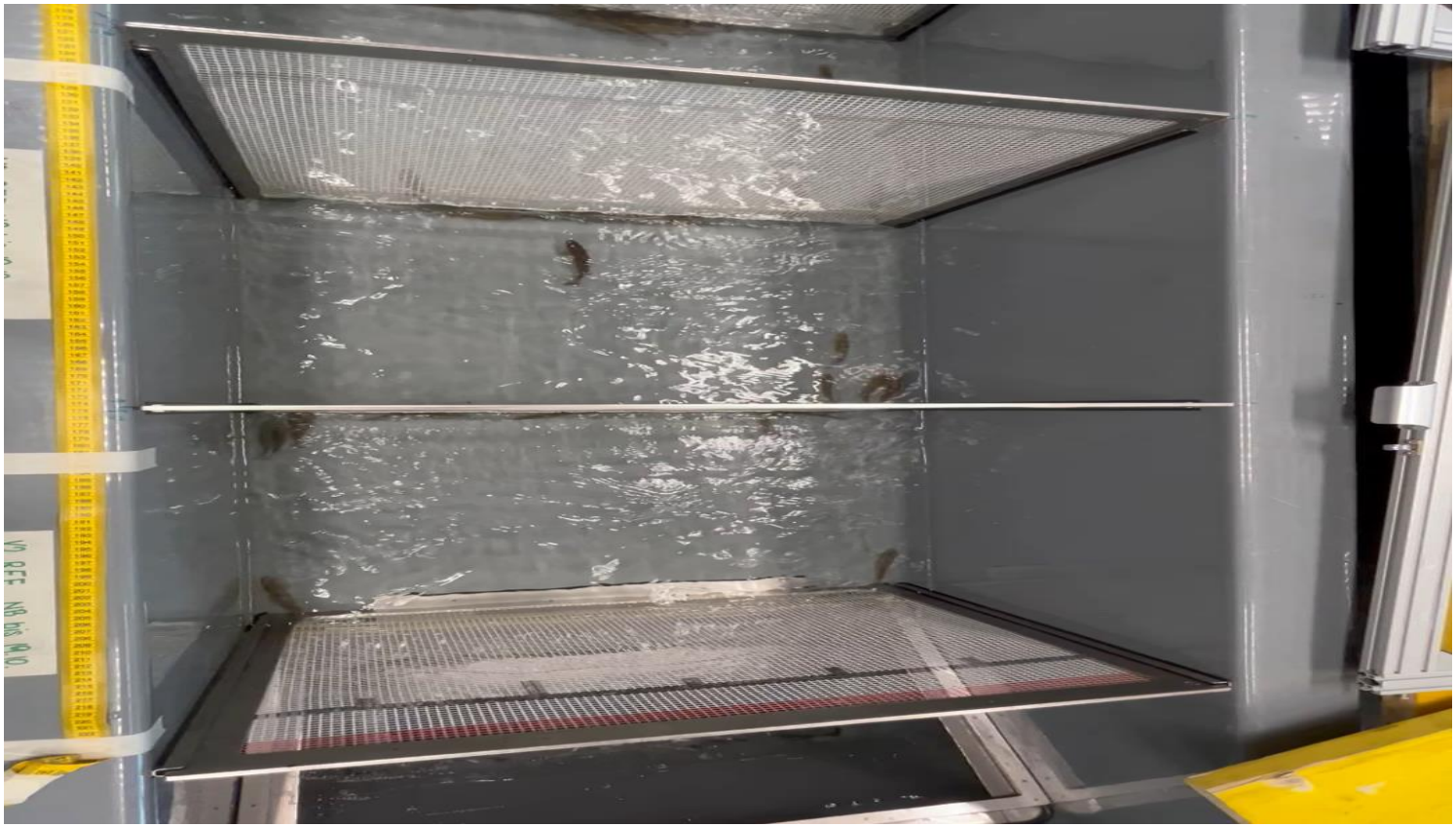
Äsche (*Thymallus thymallus*)

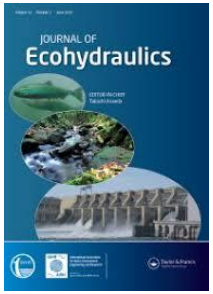
Bachforelle (*Salmo trutta fario*)

Koppe (*Cottus gobio*)

RHEOTAKTISCHES VERHALTEN

Untersuchungsdesign





Hauer *et al.* (2025)
Journal of Ecohydraulics to be submitted end of June.

RHEOTAKTISCHES VERHALTEN

Untersuchungsdesign

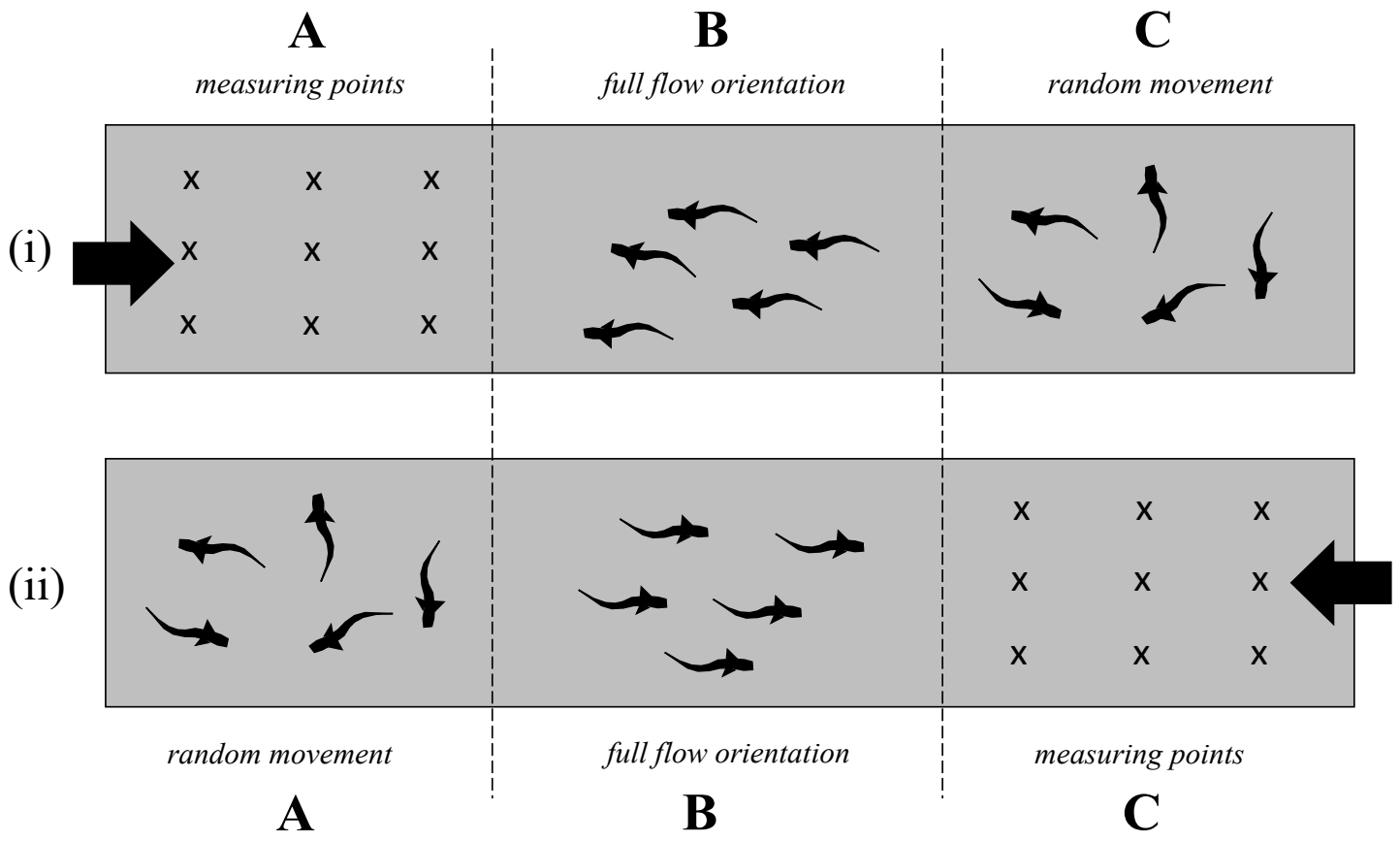


Figure. Experimental and measuring design of the rheotaxis studies in the SIAF facilities; (i) flow direction from the left, (ii) flow direction from the right; A = arrangement of the measuring points, B = full flow orientation of the entire group of fish (100%), C = random movement of fish with one fish oriented towards the current (20%).

RHEOTAKTISCHES VERHALTEN

Untersuchungsdesign

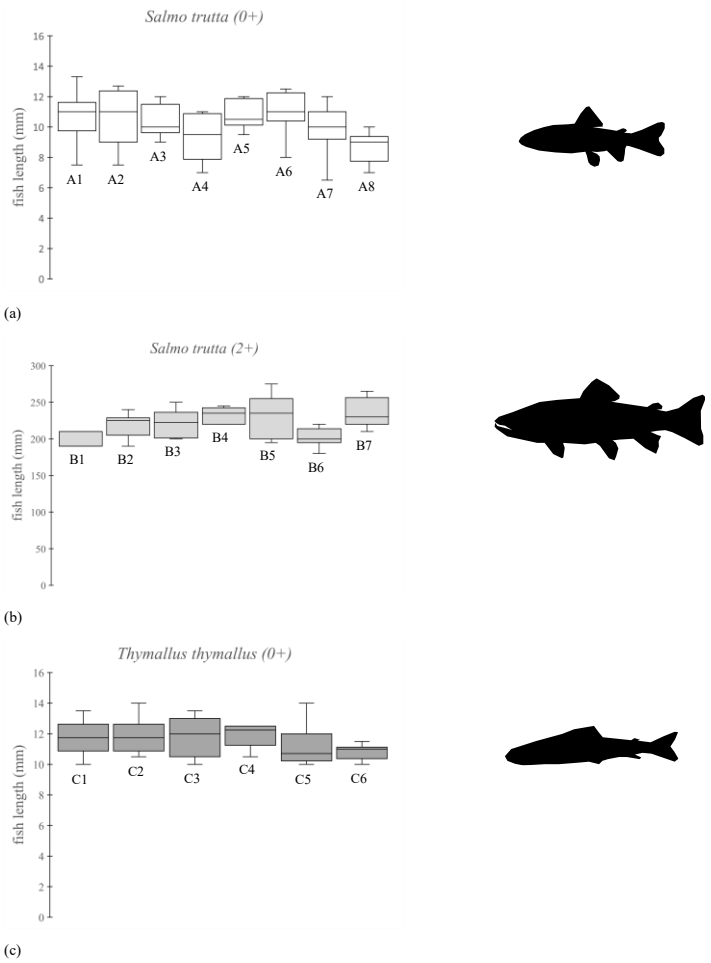


Figure. Variability in focal length of fish used in the rheotaxis experiments, (a) 0+ brown trout (Group: A1 – A8), (b) 2+ brown trout (Group: B1 – B3) and (c) 0+ grayling (Group C1 – C6); please note: different scaling of y-axis for (b).

RHEOTAKTISCHES VERHALTEN

Ergebnisse

- Rheotaktisches Verhalten in Bezug auf die Fließgeschwindigkeit

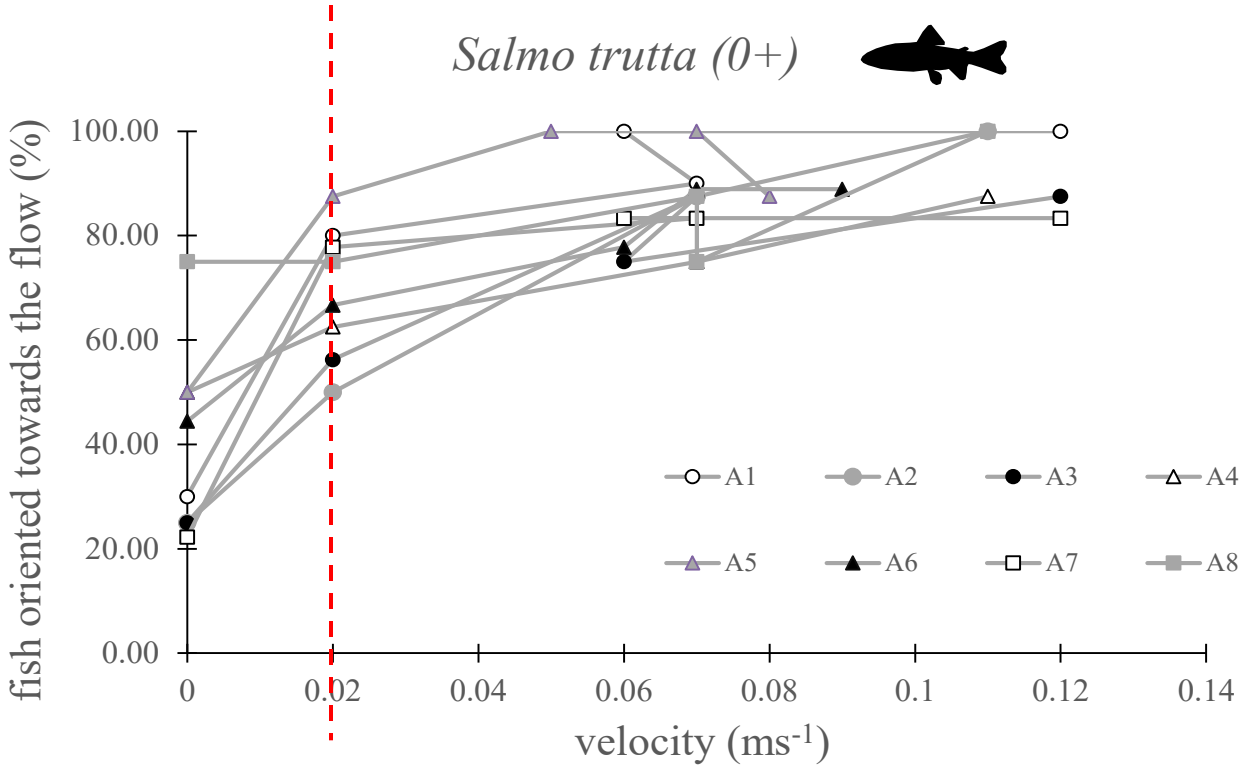


Figure. Rheotaxis strength increases with flow velocity for the selected fish species and life stages - brown trout (0+).

RHEOTAKTISCHES VERHALTEN

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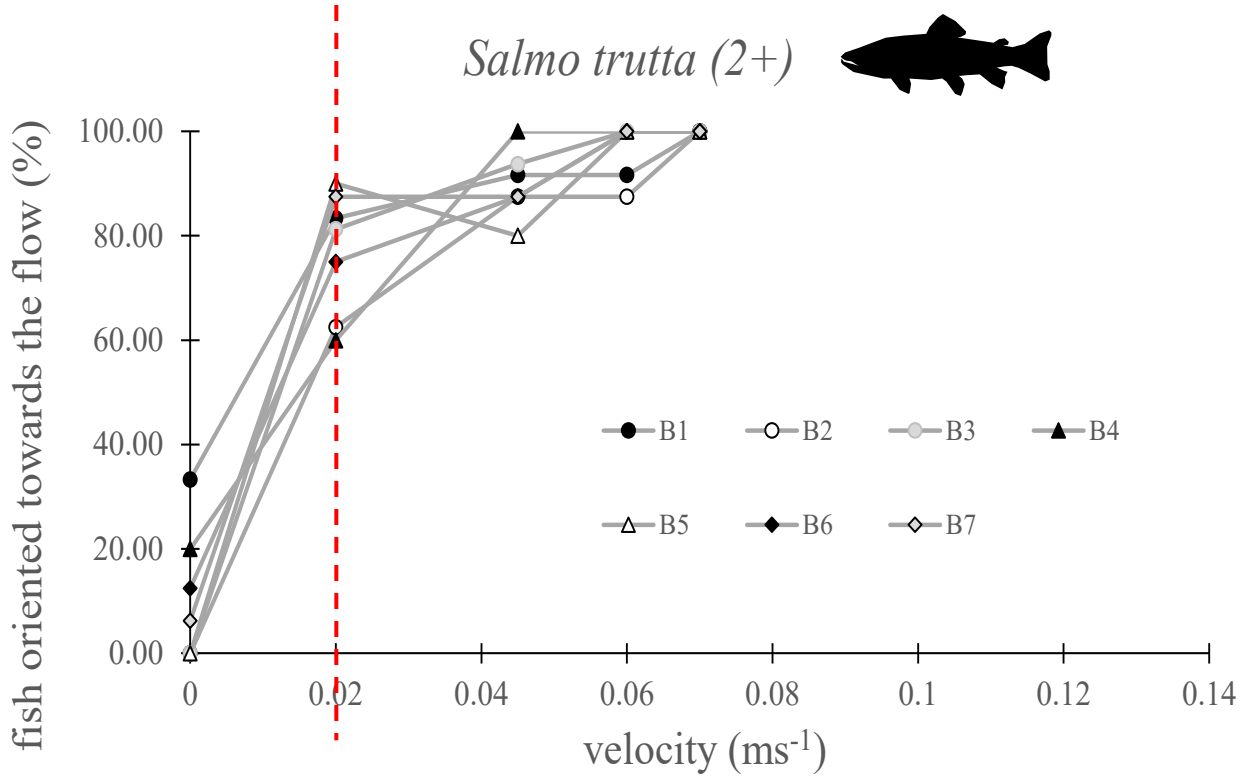

Figure. Rheotaxis strength increases with flow velocity for the selected fish species and life stages - brown trout (2+).

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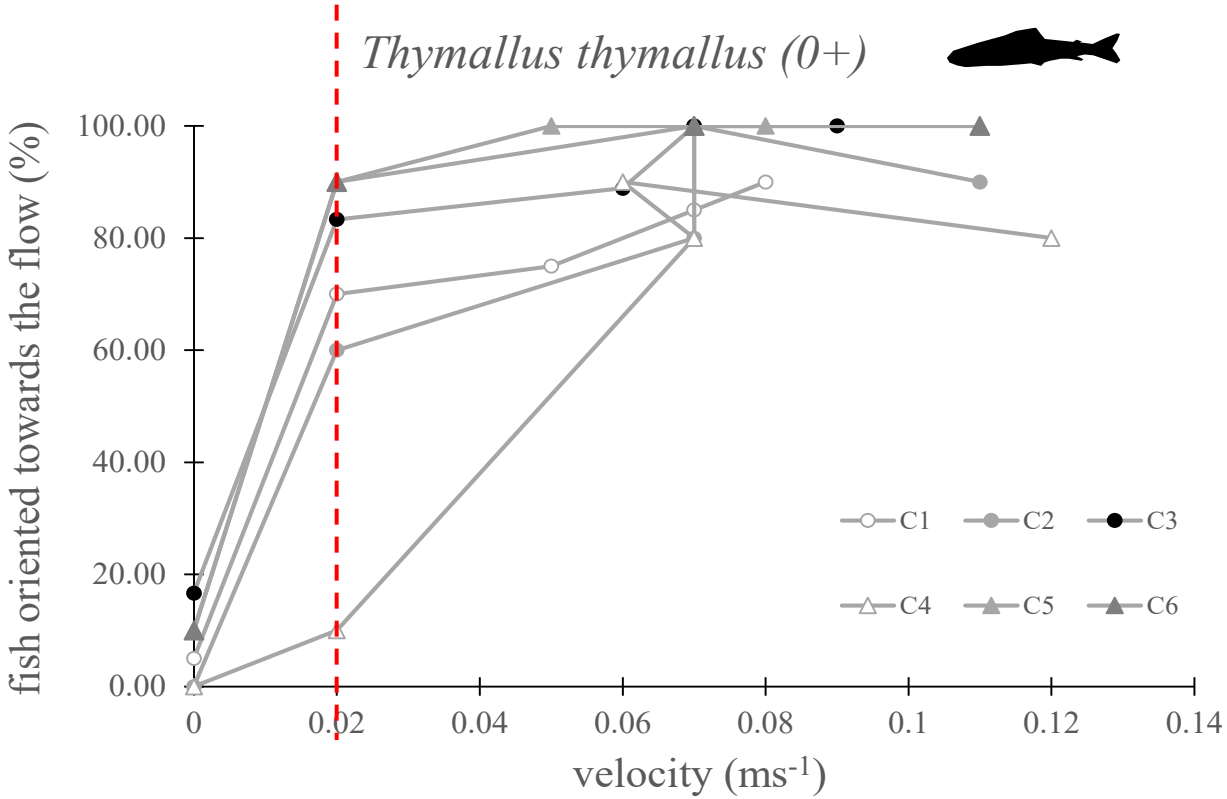
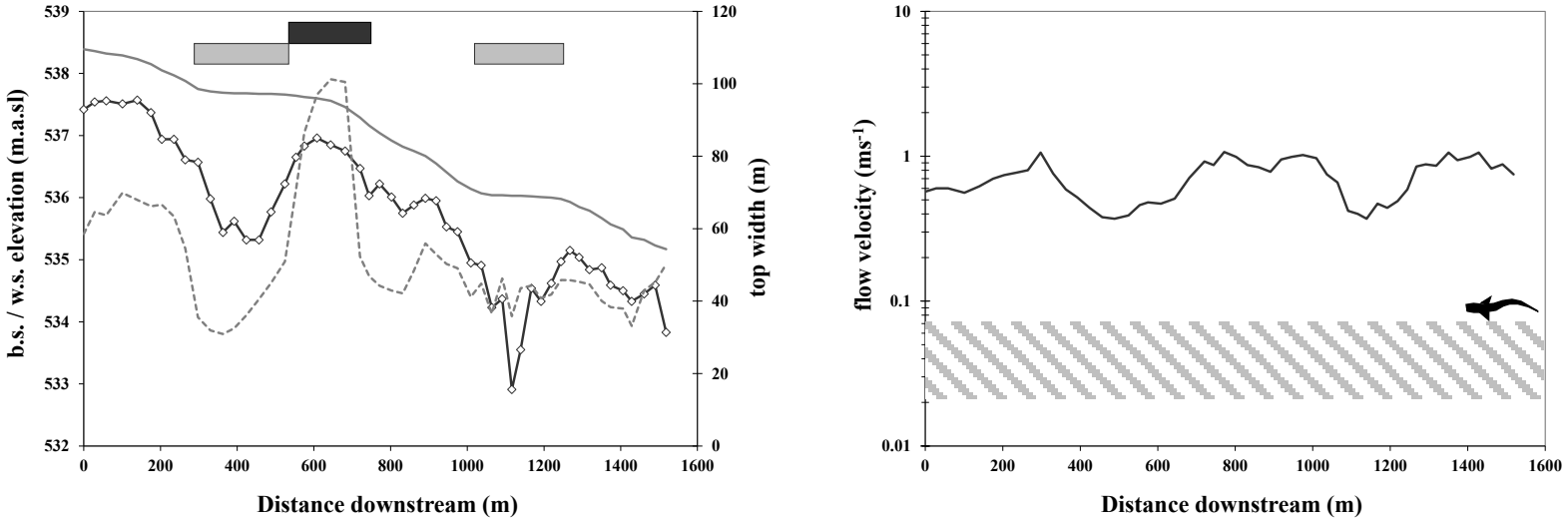


Figure. Rheotaxis strength increases with flow velocity for the selected fish species and life stages - brown trout (0+).

RHEOTAKTISCHES VERHALTEN

Diskussion

- Variabilität Fließgeschwindigkeit in Furt-Kolk Abschnitten



(a)

Figure. Hydromorphological characteristics of riffle-pool reaches of ***(a) Drau River (1)***; left panel: graph featuring bed elevation (black solid line with white squares), water surface elevation for base flow (black solid line) and flow width for base flow (grey dashed line); right panel: presents flow velocity (black solid line), grey dashed bar = rheotaxis criteria of the presented study from the first reaction to clear decrease (0.08 – 0.02 ms-1), – all parameters calculated for low flow conditions (Table 1); black bars = riffle units; grey bars = pool sections; (databasis: Hauer et al., 2011).

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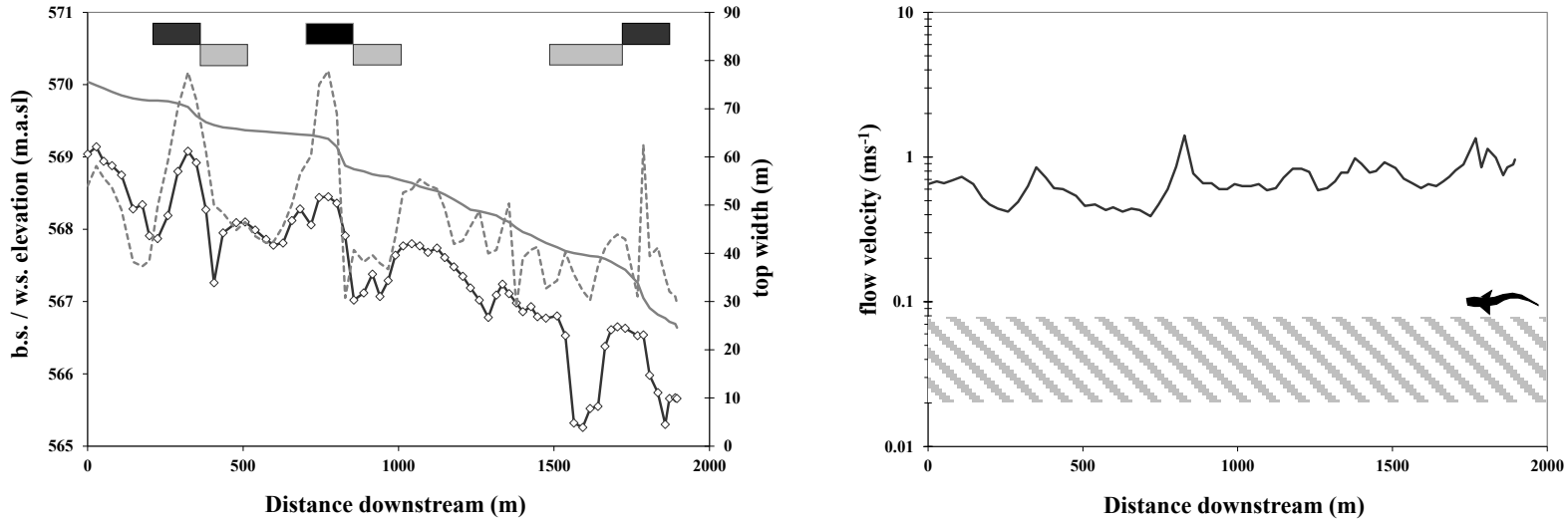

(b)

Figure. Hydromorphological characteristics of riffle-pool reaches of ***(b) Drau River (2)***; left panel: graph featuring bed elevation (black solid line with white squares), water surface elevation for base flow (black solid line) and flow width for base flow (grey dashed line); right panel: presents flow velocity (black solid line), grey dashed bar = rheotaxis criteria of the presented study from the first reaction to clear decrease (0.08 – 0.02 ms-1), – all parameters calculated for low flow conditions (Table 1); black bars = riffle units; grey bars = pool sections; (databasis: Hauer et al., 2011).

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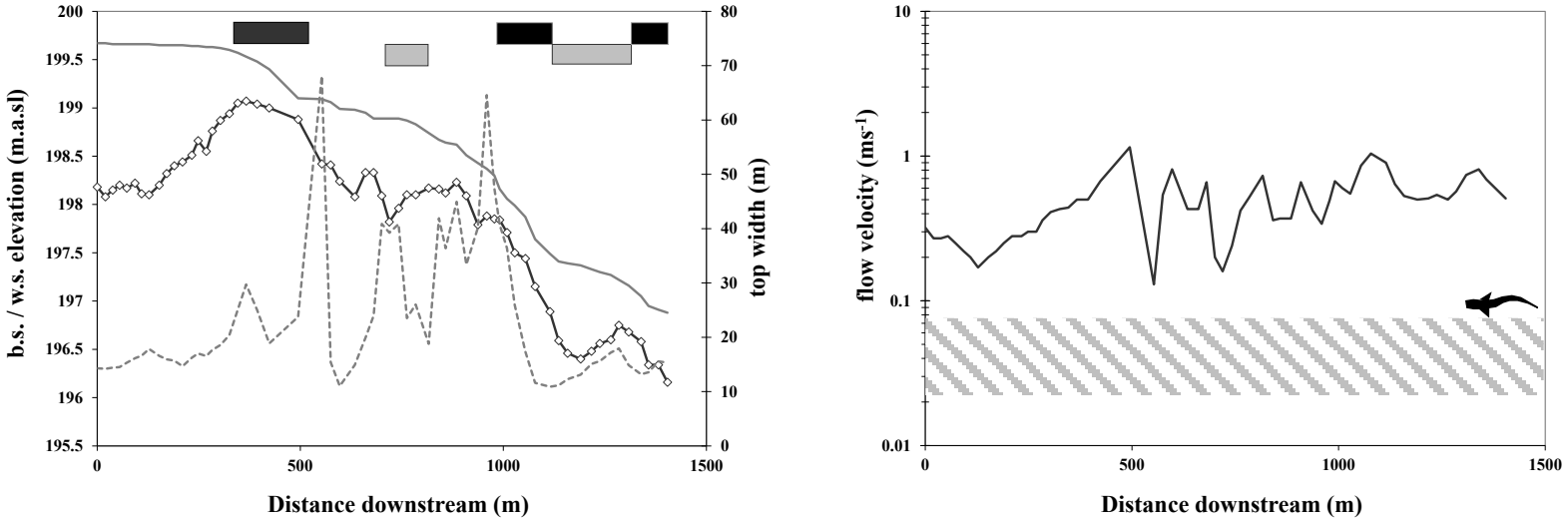

(c)

Figure. Hydromorphological characteristics of riffle-pool reaches of ***(c) Kamp River*** (1); left panel: graph featuring bed elevation (black solid line with white squares), water surface elevation for base flow (black solid line) and flow width for base flow (grey dashed line); right panel: presents flow velocity (black solid line), grey dashed bar = rheotaxis criteria of the presented study from the first reaction to clear decrease (0.08 – 0.02 ms-1), – all parameters calculated for low flow conditions (Table 1); black bars = riffle units; grey bars = pool sections; (databasis: Hauer et al., 2011).

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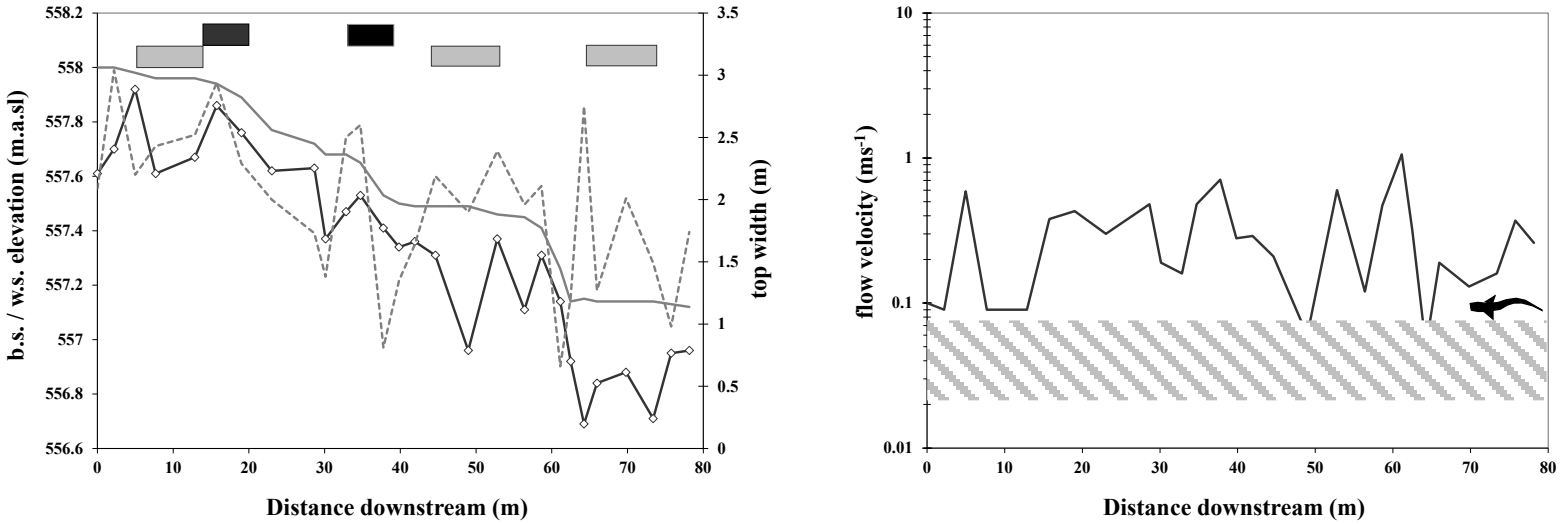

(d)

Figure. Hydromorphological characteristics of riffle-pool reaches of ***(d) Kleine Mühl River*** (1); left panel: graph featuring bed elevation (black solid line with white squares), water surface elevation for base flow (black solid line) and flow width for base flow (grey dashed line); right panel: presents flow velocity (black solid line), grey dashed bar = rheotaxis criteria of the presented study from the first reaction to clear decrease (0.08 – 0.02 ms-1), – all parameters calculated for low flow conditions (Table 1); black bars = riffle units; grey bars = pool sections; (databasis: Hauer et al., 2011).

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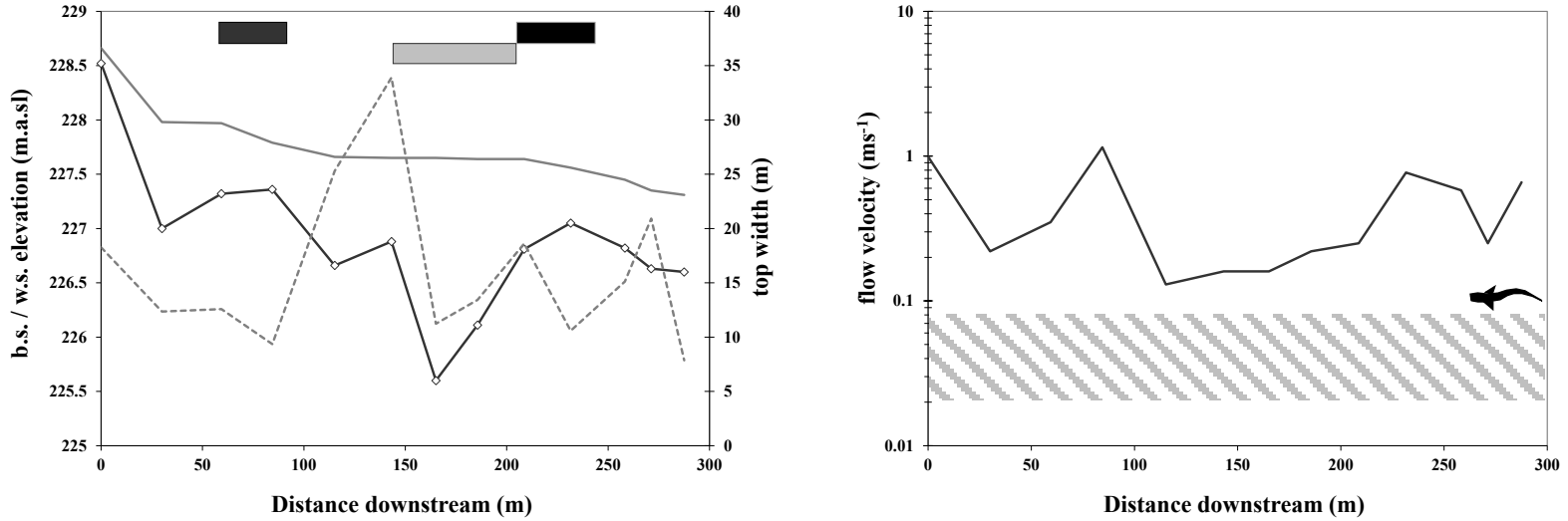

(e)

Figure. Hydromorphological characteristics of riffle-pool reaches of ***(e) Pielach River*** (1); left panel: graph featuring bed elevation (black solid line with white squares), water surface elevation for base flow (black solid line) and flow width for base flow (grey dashed line); right panel: presents flow velocity (black solid line), grey dashed bar = rheotaxis criteria of the presented study from the first reaction to clear decrease (0.08 – 0.02 ms-1), – all parameters calculated for low flow conditions (Table 1); black bars = riffle units; grey bars = pool sections; (databasis: Hauer et al., 2011).

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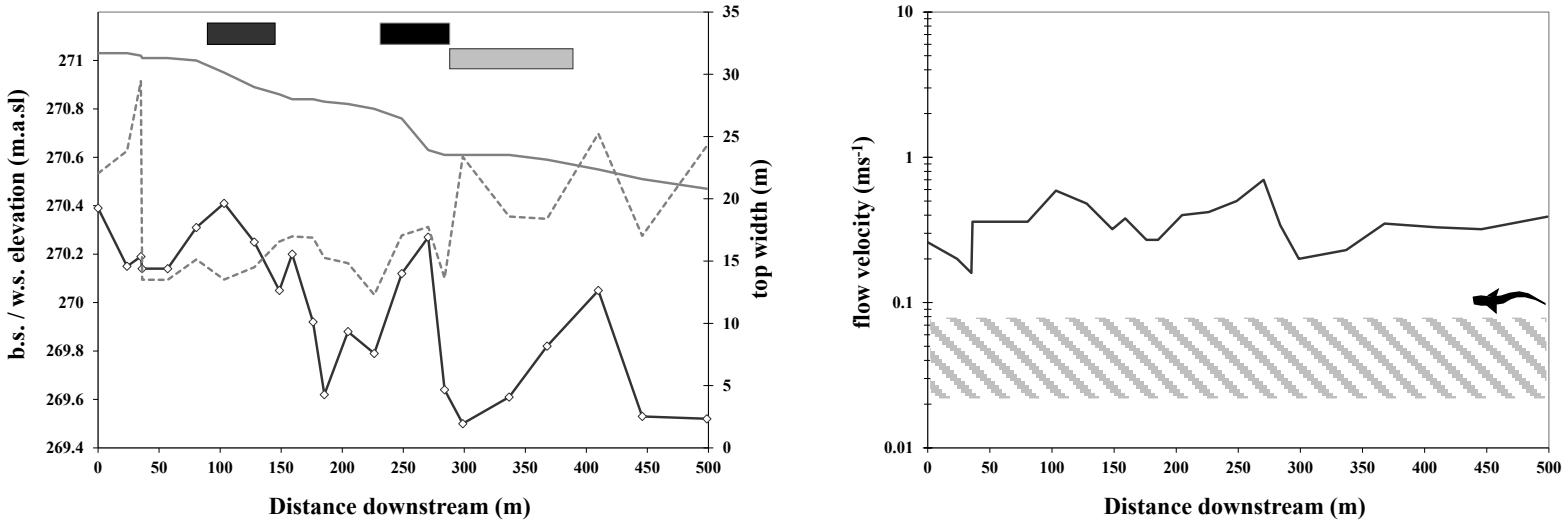

(f)

Figure. Hydromorphological characteristics of riffle-pool reaches of ***(f) Sulm River*** (1); left panel: graph featuring bed elevation (black solid line with white squares), water surface elevation for base flow (black solid line) and flow width for base flow (grey dashed line); right panel: presents flow velocity (black solid line), grey dashed bar = rheotaxis criteria of the presented study from the first reaction to clear decrease (0.08 – 0.02 ms-1), – all parameters calculated for low flow conditions (Table 1); black bars = riffle units; grey bars = pool sections; (databasis: Hauer et al., 2011).

RHEOTAKTISCHES VERHALTEN

Diskussion

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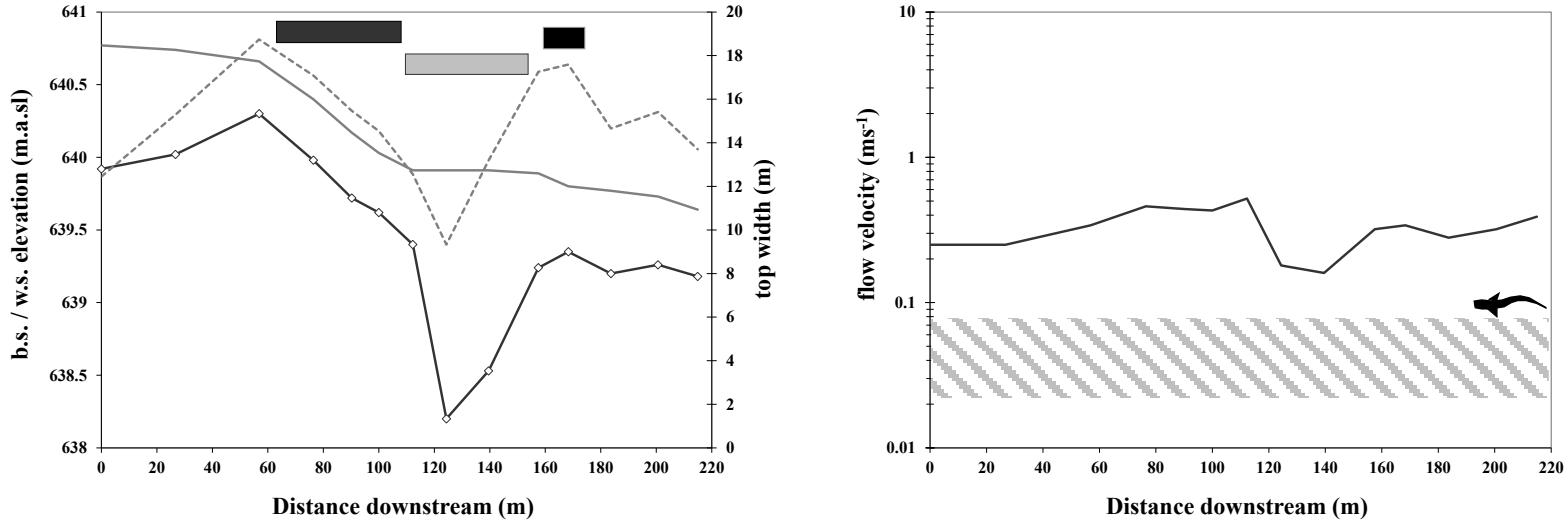
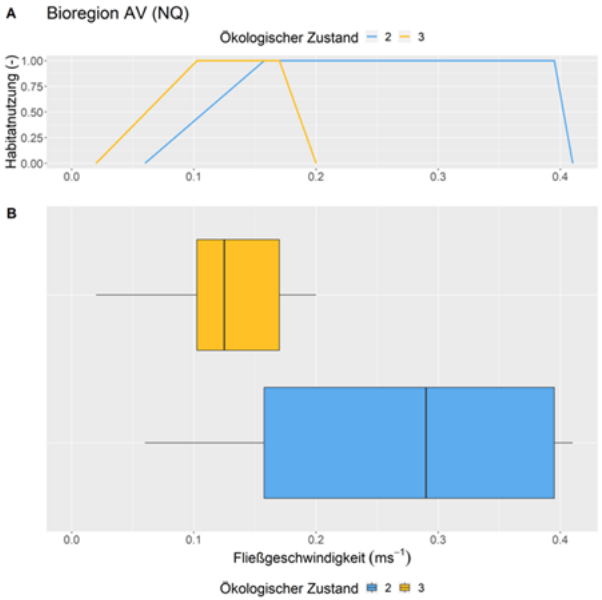


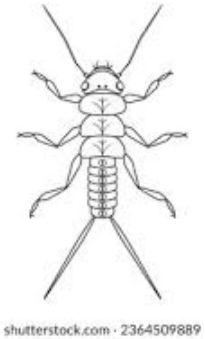
(g)

Figure. Hydromorphological characteristics of riffle-pool reaches of ***(g) Ybbs River*** (1); left panel: graph featuring bed elevation (black solid line with white squares), water surface elevation for base flow (black solid line) and flow width for base flow (grey dashed line); right panel: presents flow velocity (black solid line), grey dashed bar = rheotaxis criteria of the presented study from the first reaction to clear decrease (0.08 – 0.02 ms-1), – all parameters calculated for low flow conditions (Table 1); black bars = riffle units; grey bars = pool sections; (databasis: Hauer et al., 2011).

BEDEUTUNG DER STRÖMUNG



Makrozoobenthos



	Bioregion	Kalkvoralpen				Granit- u. Gneisgebiet		Bay.-Österr. Alpenvorland	
	Gewässer	Schwarza			Alm	Waldaist	Taffa	Gr. Tulln	
	Abschnitt	Schwarzau	Holzwehr	Hirschwang	Grünau	Feiblmühl	Mühlfeld	Emmersdorf	Asperhofen
	Datum	09.12.2019	06.12.2019	02.12.2019	07.05.2020	16.03.2020	11.07.2023	13.03.2023	06.12.2022
Referenz	Riffle	-	-	-	-	-	AB	-	-
Referenz	Pool	-	AB	-	-	AB	AB	AB	-
Staubereich	TR5	-	AB	-	AB	AB	AB	AB	-
Staubereich	TR4	-	-	-	AB	AB	AB	AB	-
Staubereich	TR3	-	-	-	AB	AB2	-	AB	-
Staubereich	TR2	-	-	-	AB	AB2	AB	-	-
Staubereich	TR1	-	AB	AB	AB	-	-	-	-
	WEHR								

sehr gut
gut
Handlungsbedarf

Leitner *et al.* (2025)
Österreichische Wasser- und Abfallwirtschaft, 1-7.

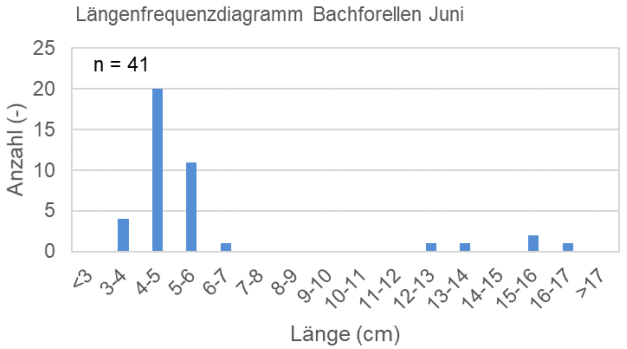
SCHWEBSTOFFE (Konzentration/Dauer)

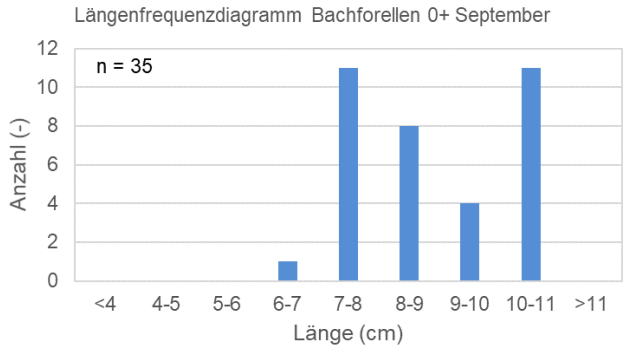
Untersuchungsdesign

SCHWEBSTOFFE (Konzentration/Dauer)

Methodik (Wildfische)

Monat	TV #	Art / Alter	TSS (g/l)	Expositionsdauer (h)
Juni	1	BaFo 0+	3	4
Juni	2	BaFo 0+	3	4
Juni	3	BaFo 1+	3	4
Juni	4	Koppe div	3.5	4
Juni	5	BaFo 0+	4.7	4
Juni	6	BaFo 0+	4.3	4
Sept.	1	BaFo 0+	7.5	6
Sept.	2	BaFo 0+	12.5	6
Sept.	3	BaFo 0+	15.8	6
Sept.	4	BaFo 0+	6.5	6
Sept.	5	BaFo 0+	10	12
Sept.	6	BaFo 0+	14.2	12
Sept.	7	Koppe 2+	13.2	6
Sept.	8	Koppe 0+	9.4	12
Sept.	9	BaFo 0+	9.9	6
Okt	1	BaFo 0+	9	24
Okt	2	BaFo 0+	7.5	24
Okt	3	BaFo 0+	8.9	8





SCHWEBSTOFFE (Konzentration/Dauer)

Ergebnisse

….0+ Bachforelle

- Randbedingung: Optimales Habitat (Geschwindigkeit/ Tiefe)

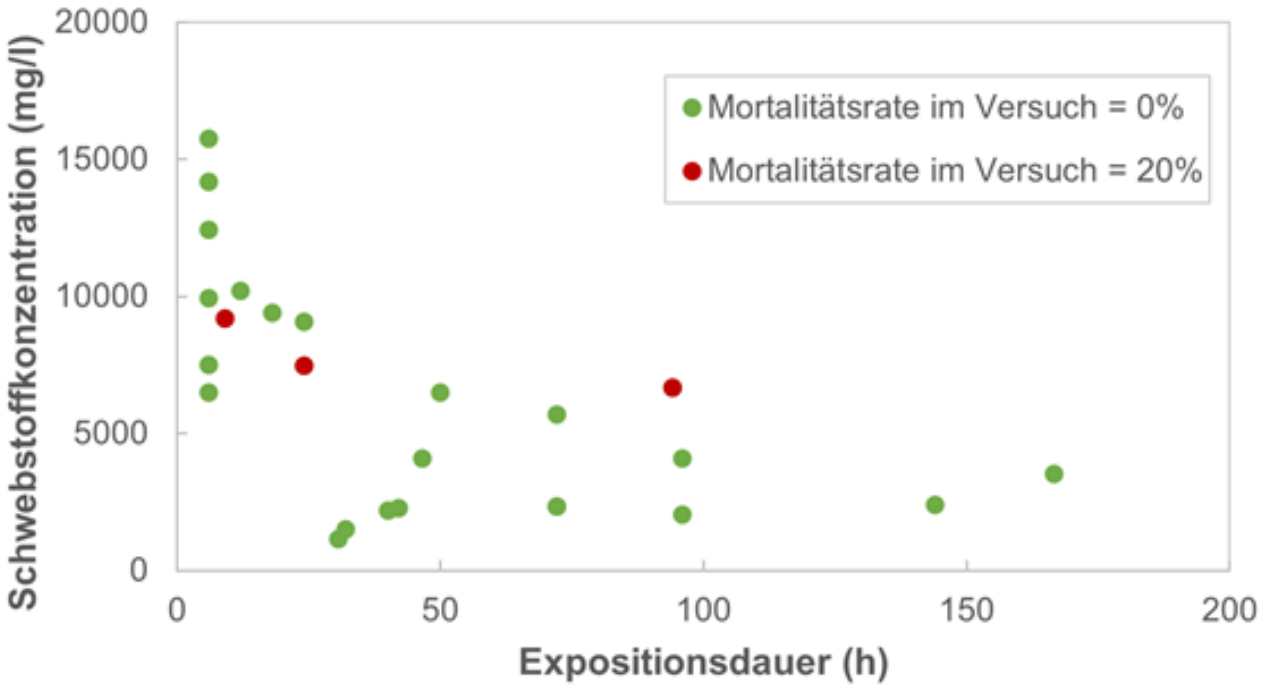


Figure. Results of the fish experiments in the CD laboratory's SIAFs regarding exposure duration (h) and suspended solids concentration (mg/l) for brown trout (*Salmo trutta*).

Hauer *et al.* (2025)
Österreichische Wasser- und Abfallwirtschaft, 1-10.

Zusammenfassung

- ***Experimentelle Untersuchungen*** und die daraus abgeleiteten Erkenntnisse sollen längerfristig ***Sicherheit in der Planung*** geben.

- Die ***Bedeutung der Fließgeschwindigkeit*** in Gewässerökosystemen ***ist unbestritten***, nur das ***rheotaktische Verhalten von Fischen*** ist sicherlich ***neu zu bewerten***.

- Für ***aktive Sedimentbewirtschaftungsmaßnahmen*** können auf Grund der Erkenntnisse aus den Versuchen durchaus ***höhere Werte für Dauerbelastungen abgeleitet werden*** – **WICHTIG** die ***hydromorphologische Qualität*** nach der Maßnahme ist in der ***flussab gelegenen Strecke zu gewährleisten***.

- Wissenschaftlich abgesicherte Ergebnisse sollen ***rasch***, gemeinsam mit dem Ministerium ***auf Sachverständigen-Ebene*** verankert werden.

Danke für die Aufmerksamkeit.