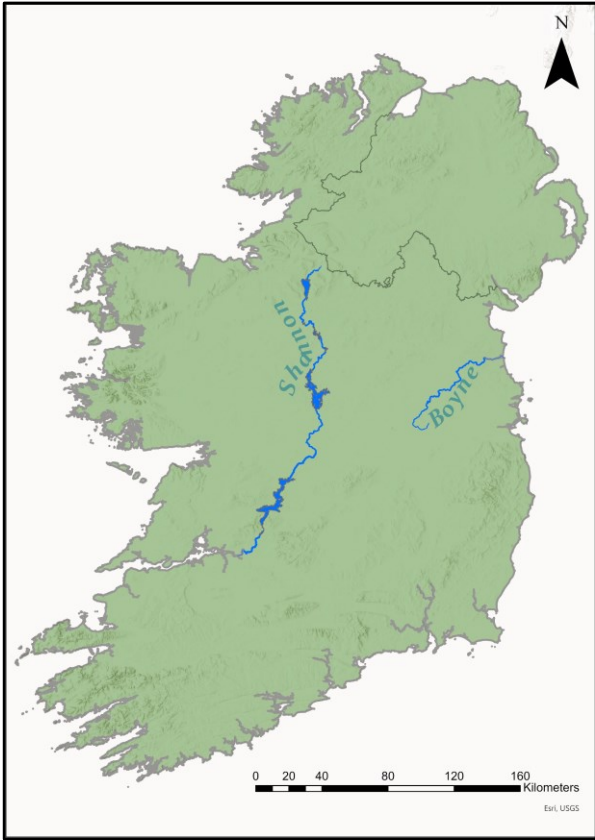


# Invisible Actors: Thermal Responses to Low Head Impounding Structures

Róisín Donovan, Brian Coghlan, Sarah Keane, Ciara O'Leary

National Barriers Programme, Barrier Mitigation Research Programme  
Inland Fisheries Ireland

# Barriers in an Irish Context: Culture



River Shannon



River Suir





# Barriers in an Irish Context: Fish

## Native (11):



## Non-native (selection from 13):



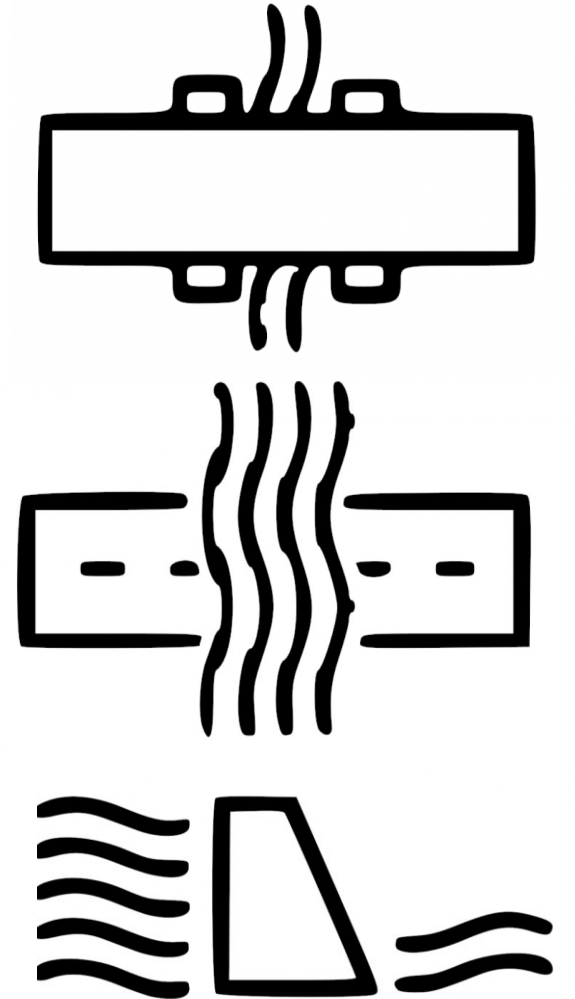
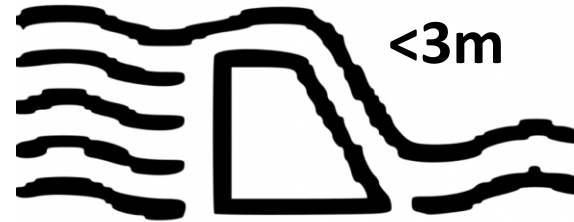
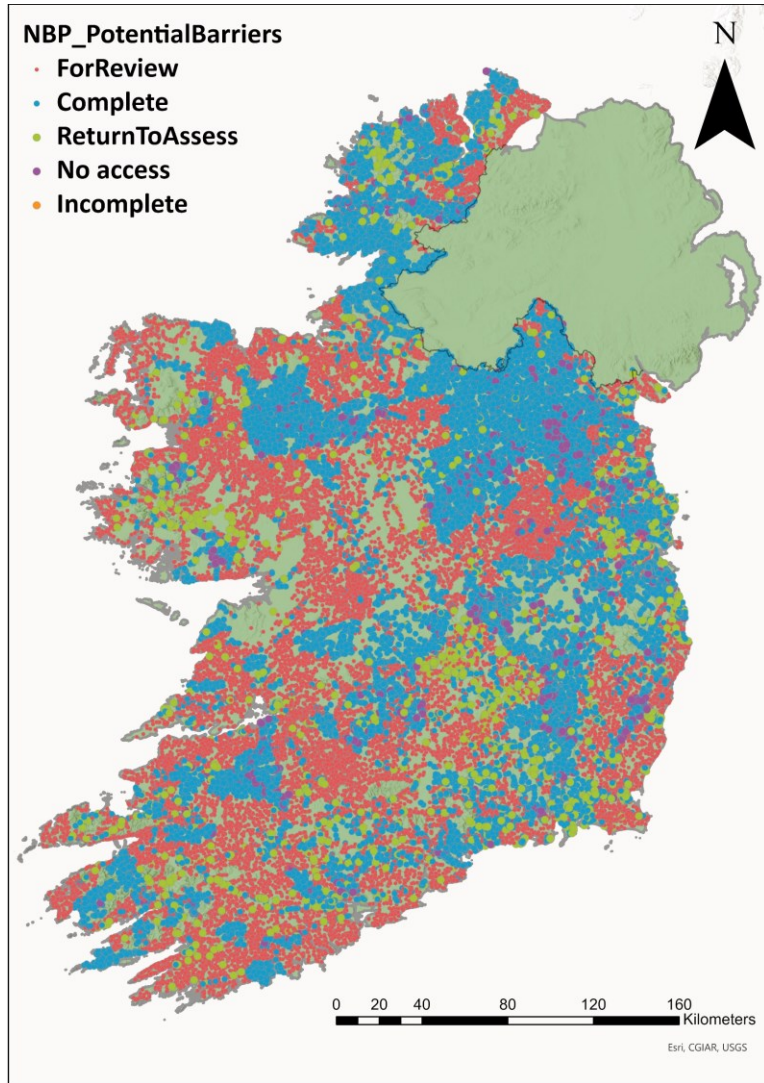
King, J.L., Marnell, F., Kingston, N., Rosell, R., Boylan, P., Caffrey, J.M., FitzPatrick, Ú., Gargan, P.G., Kelly, F.L., O'Grady, M.F., Poole, R., Roche, W.K. & Cassidy, D. (2011) *Ireland Red List No. 5: Amphibians, Reptiles & Freshwater Fish*. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

<https://www.fisheriesireland.ie/species> (Accessed March 2024).





# Barriers in an Irish Context



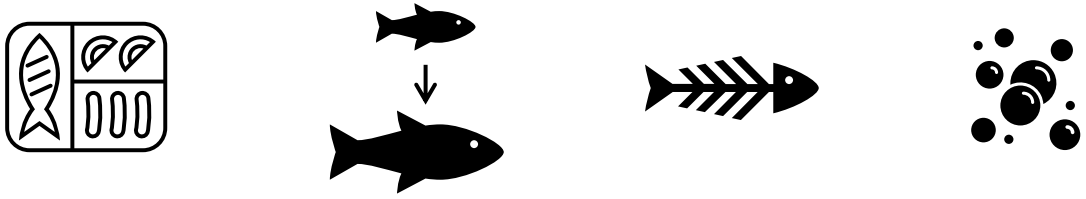
# River Temperature: Invisible but Critical



Virginia Weir



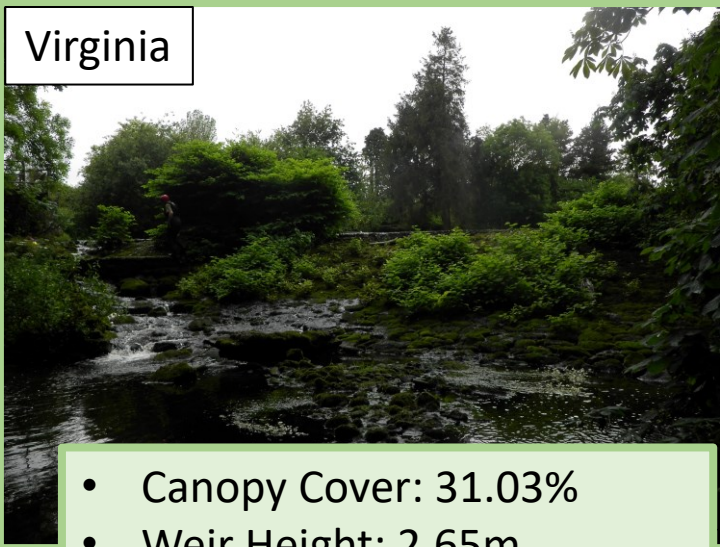
Moynalty





# Study Design: 2018-2020

Virginia



- Canopy Cover: 31.03%
- Weir Height: 2.65m
- Imp. Vol.: 49,644.51m<sup>3</sup>
- Res. time: 4hrs 37mins
- Gr. Influence: Low

Moynalty

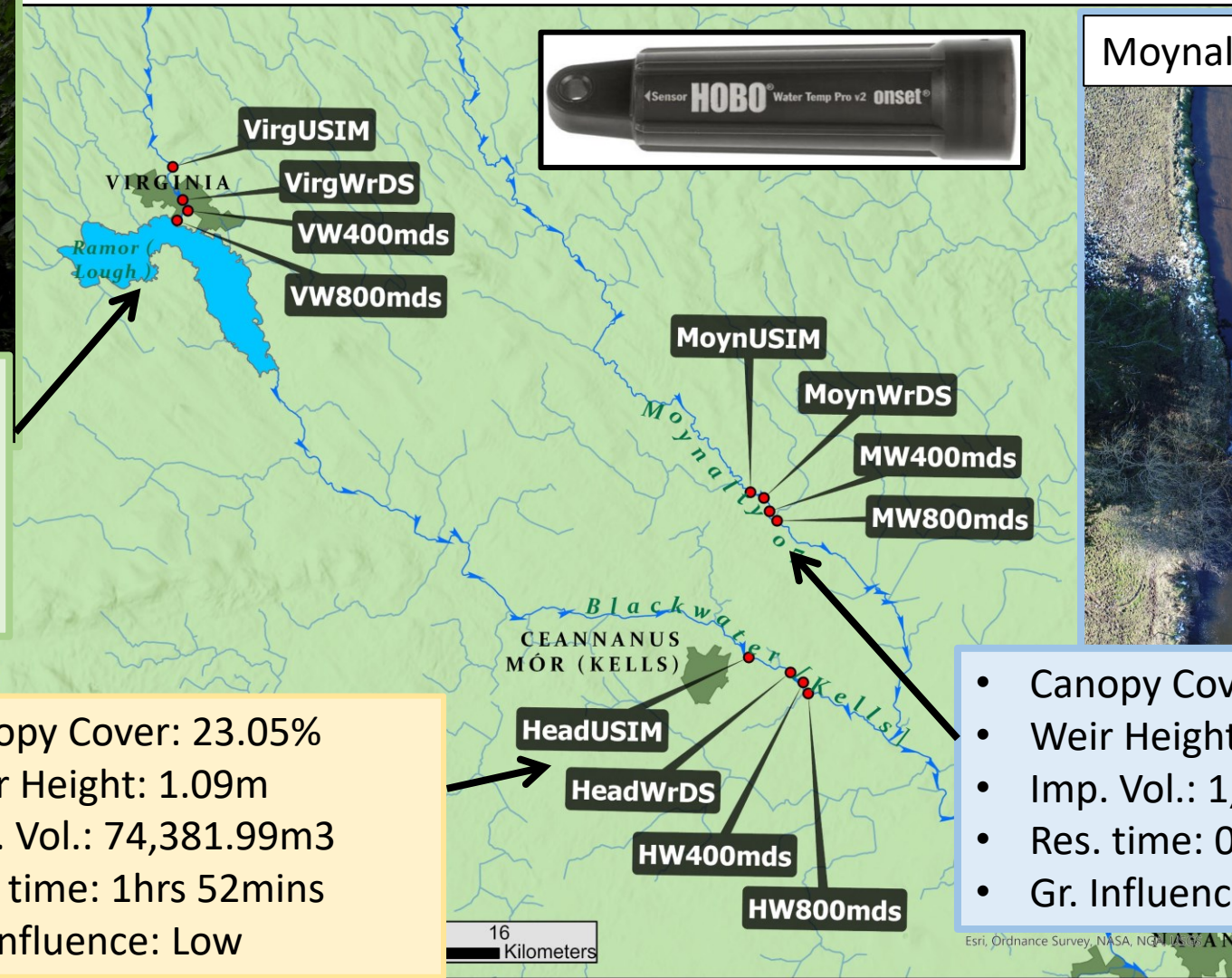


- Canopy Cover: 32.51%
- Weir Height: 1.13m
- Imp. Vol.: 1,598.18m<sup>3</sup>
- Res. time: 0hrs 9mins
- Gr. Influence: Pronounced

Headford

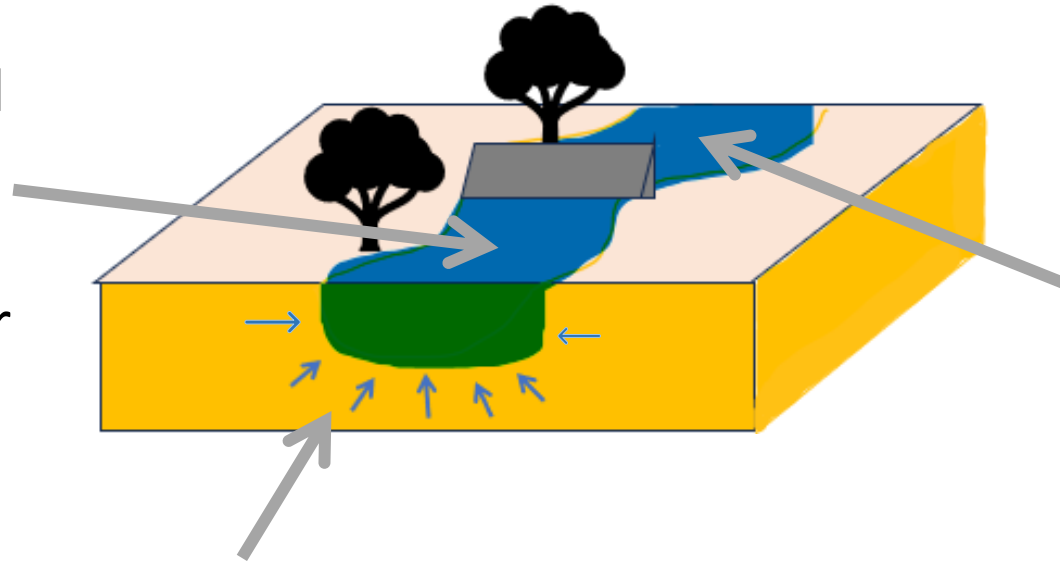


- Canopy Cover: 23.05%
- Weir Height: 1.09m
- Imp. Vol.: 74,381.99m<sup>3</sup>
- Res. time: 1hrs 52mins
- Gr. Influence: Low



# Environmental Variables

- Riparian Canopy Cover
- Long Term Mean Annual Discharge (LTMAD)
- Distance from Source
- DS Distance from Barrier



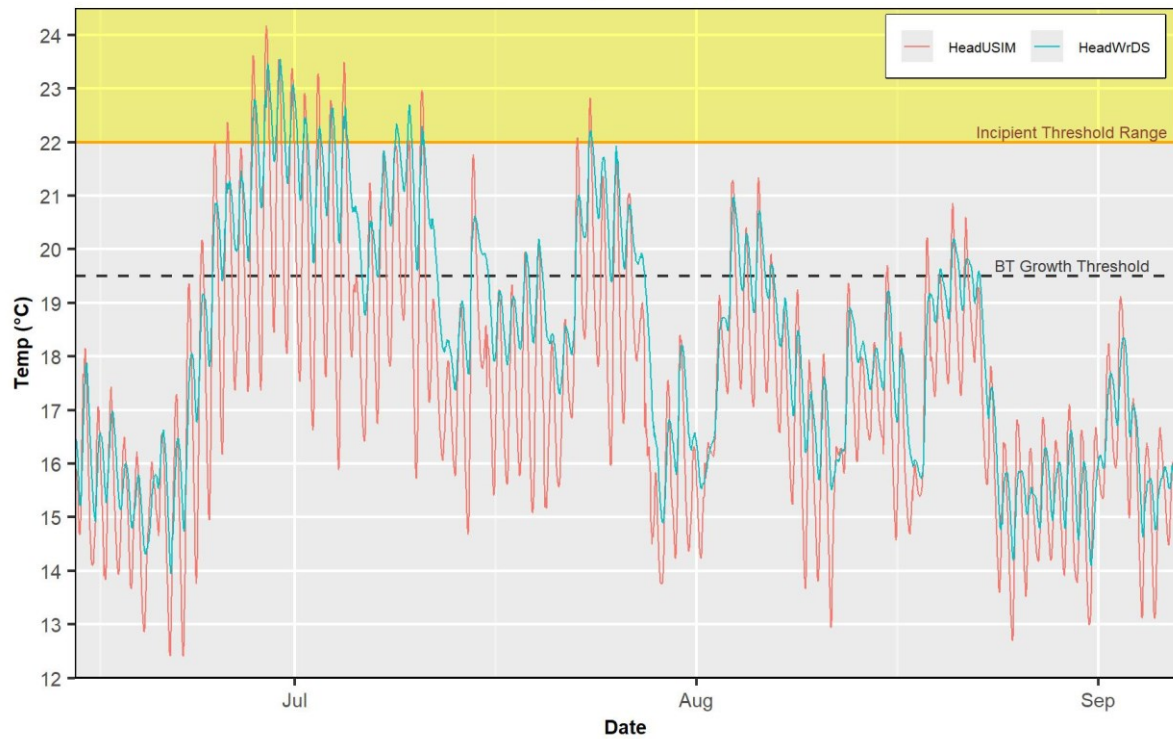
- Groundwater Influence

- Weir Height
- Impoundment Surface Area
- Impoundment Depth
- Impoundment Volume
- Residence time



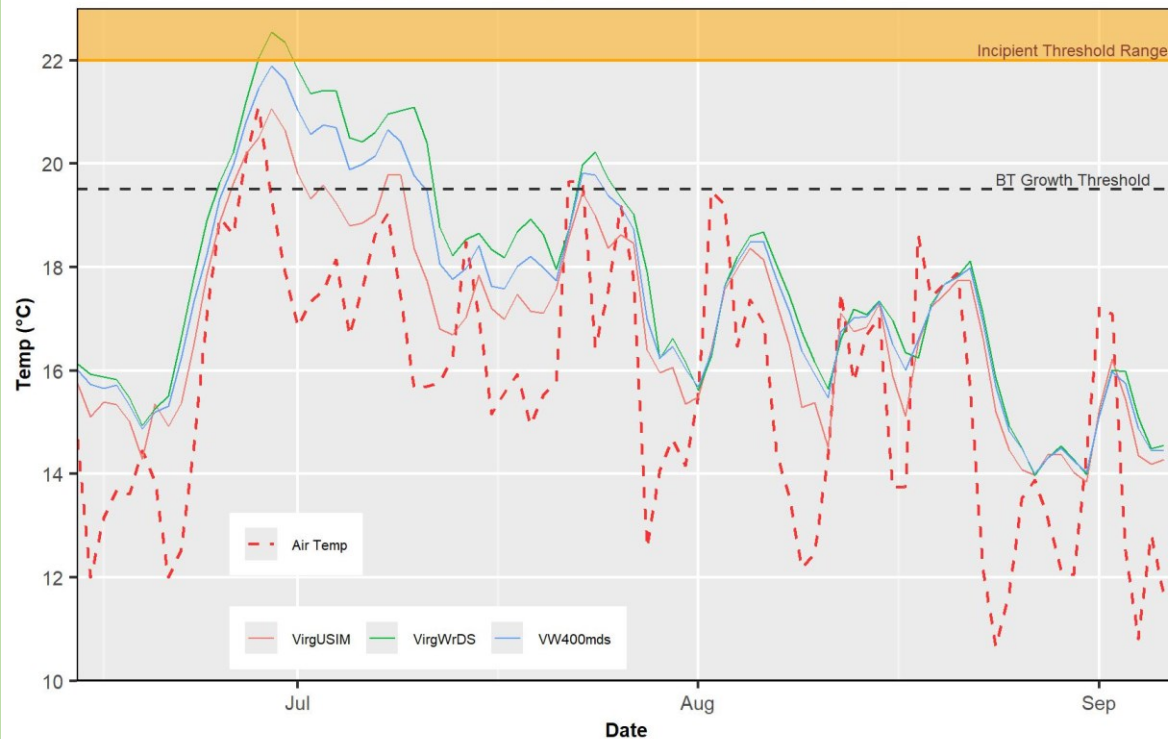
# Results 2018

Headford Temp June to Sept 2018



Site	Mean.Dif	Mean.Daily.Max.Dif
USIM_WrDS	0.89	2.15

Virginia 2018: Daily Air vs Daily Water Temperature



Site	Mean.Dif	Mean.Daily.Max.Dif
USIM_WrDS	0.81	1.46
USIM_400ms	0.52	1.01

Irish Independent News Opinion Business Sport Life Style

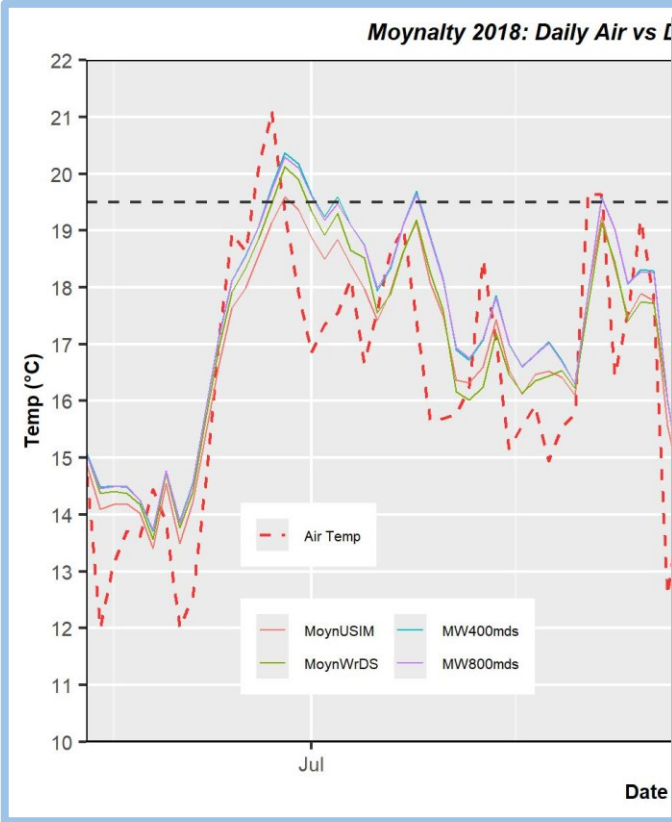
Home / Irish News

Summer 2018 was one of the driest ever recorded thanks to heatwave

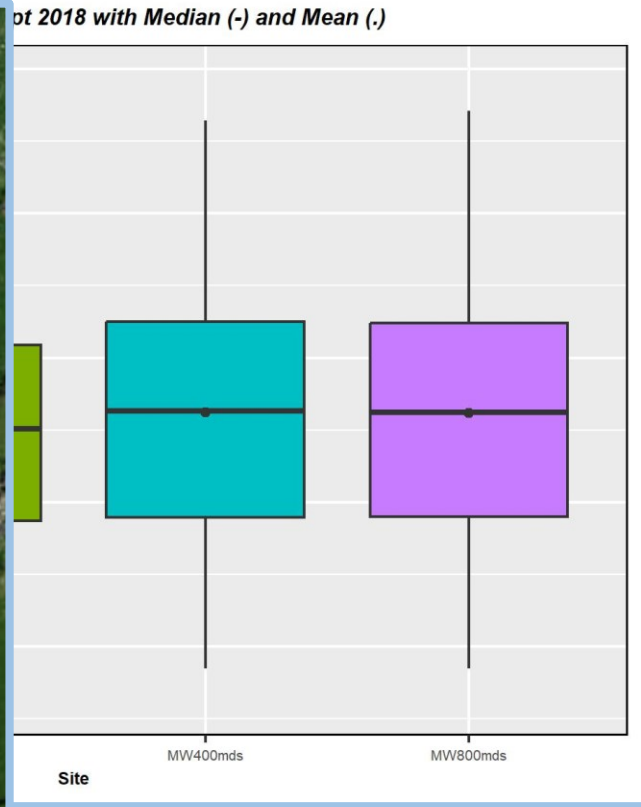
Elliott, J. and Elliott, J.A., (2010). Temperature requirements of Atlantic salmon *Salmo salar*, brown trout *Salmo trutta* and Arctic charr *Salvelinus alpinus*: predicting the effects of climate change. *Journal of fish biology*, 77(8), pp.1793-1817.



# Results 2018



Site	Mean.Dif	Mean.Daily.Max.Dif
USIM_WrDS	0.13	0.86
USIM_400mds	0.37	1.11
USIM_800mds	0.36	1.05



Elliott, J. and Elliott, J.A., (2010). Temperature requirements of Atlantic salmon *Salmo salar*, brown trout *Salmo trutta* and Arctic charr *Salvelinus alpinus*: predicting the effects of climate change. *Journal of fish biology*, 77(8), pp.1793-1817.



# Results 2018

Table 2. Max no of Consecutive Hours Above 19.5°C Threshold

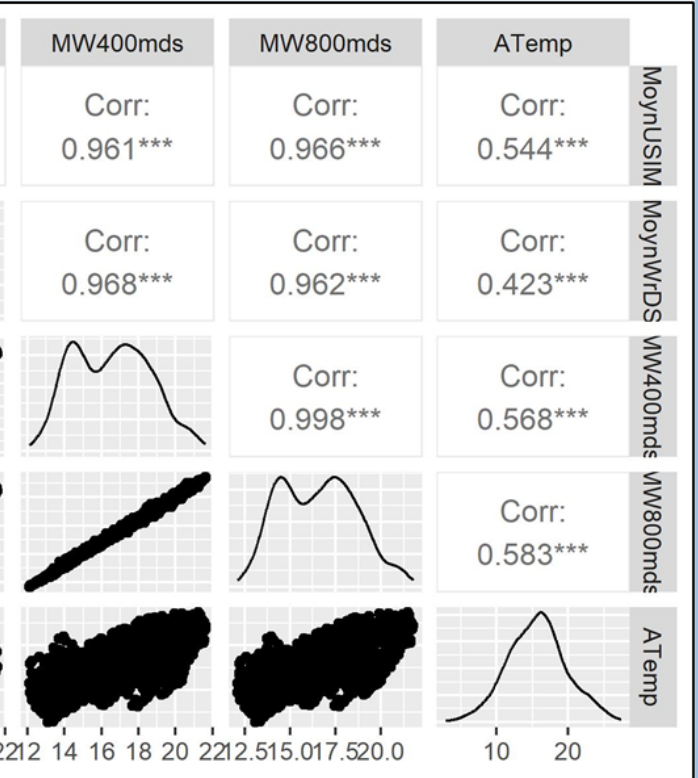
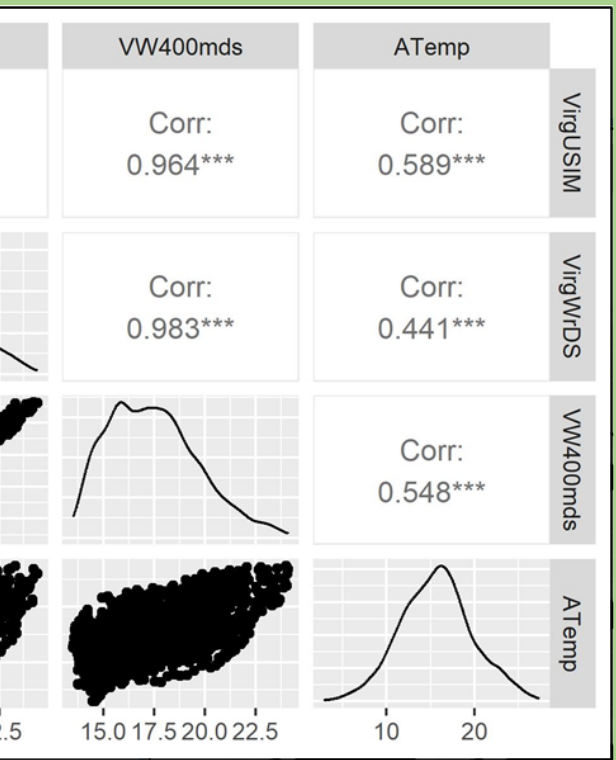
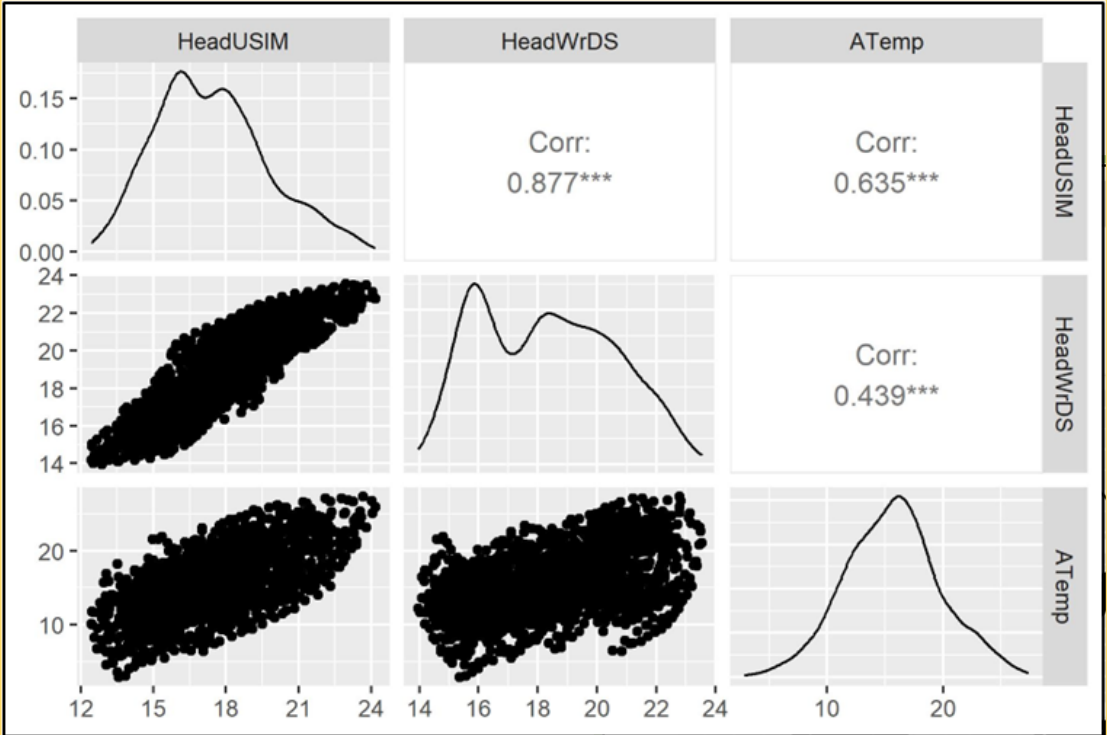
Site	Events	Hours	date_start	date_stop	date_peak
HeadUSIM	34	17.50	28/06/2018 11:30	29/06/2018 04:30	28/06/2018 18:00
HeadWrDS	17	257.00	25/06/2018 10:00	06/07/2018 02:30	29/06/2018 19:30
VirgUSIM	23	17.00	28/06/2018 11:30	29/06/2018 04:00	28/06/2018 18:00
VirgWrDS	17	187.00	26/06/2018 12:30	04/07/2018 07:00	28/06/2018 18:00
VW400mds	24	90.00	28/06/2018 09:00	02/07/2018 02:30	28/06/2018 17:00
MoynUSIM	20	12.00	28/06/2018 14:30	29/06/2018 02:00	28/06/2018 19:30
MoynWrDS	14	15.00	29/06/2018 13:30	30/06/2018 04:00	29/06/2018 21:30
MW400mds	16	18.00	29/06/2018 11:00	30/06/2018 04:30	29/06/2018 16:00
MW800mds	18	16.50	28/06/2018 12:30	29/06/2018 04:30	28/06/2018 17:00

Table 2. Environmental Variables and Consecutive Hours Above 19.5°C

var1	var2	cor	statistic	p	method
<chr>	<chr>	<dbl>	<dbl>	<dbl>	<chr>
Hours	RCC_1kmUS	-0.77	62	0.103	Spearman
Hours	DDS	-0.33	46.7	0.518	Spearman
Hours	DFSouce	0.49	18	0.356	Spearman
Hours	weirHeight	0	35	1	Spearman
Hours	Imp_volume	0.93	2.60	0.00805	Spearman
Hours	Residence_time	0.74	9.08	0.0922	Spearman
Hours	AmpRatio	0.81	6.59	0.0499	Spearman



# Results 2018



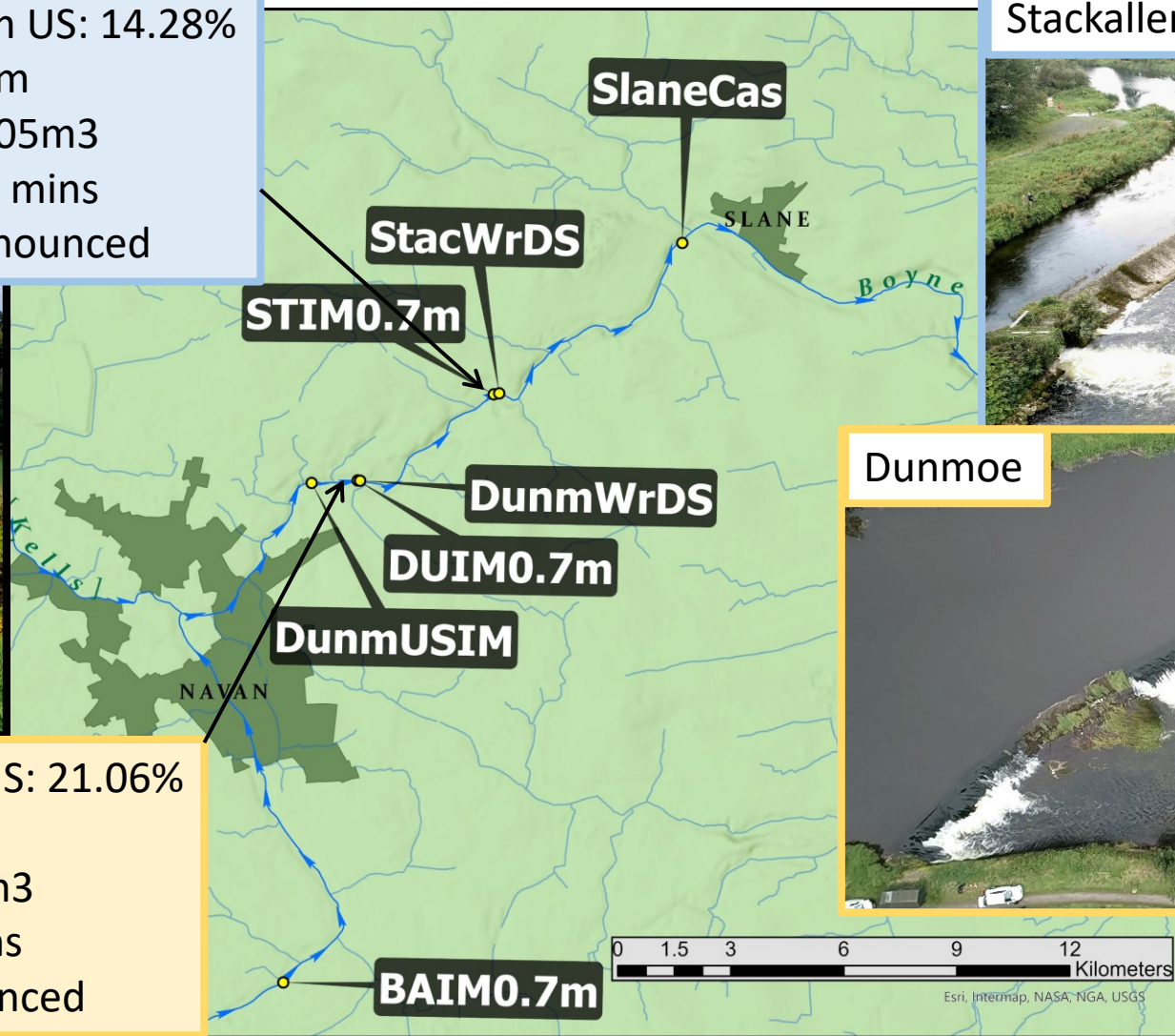
# Study Design: 2022 - Ongoing

- Canopy Cover 1km US: 14.28%
- Weir Height: 1.95m
- Imp. Vol.: 38,740.05m<sup>3</sup>
- Res. time: 0hrs 14 mins
- Gr. Influence: Pronounced

Stackallen



Ballinter Control



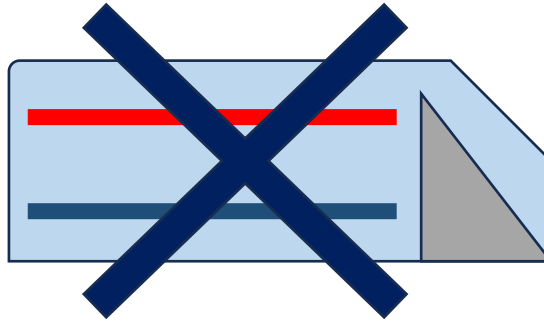
Dunmoe



- Canopy Cover 1 Km US: 21.06%
- Weir Height: 1m
- Imp. Vol.: 43,783.57m<sup>3</sup>
- Res. time: 0hrs 15mins
- Gr. Influence: Pronounced



# Results 2022



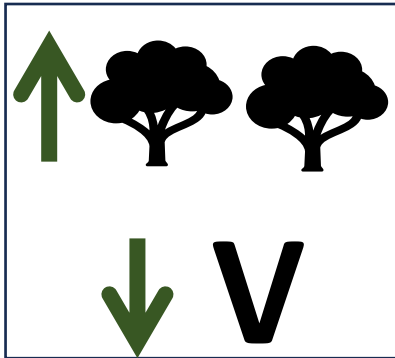
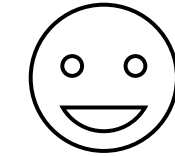
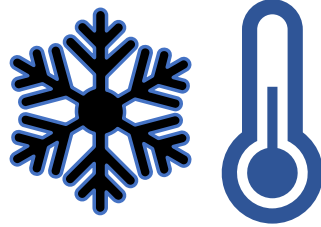
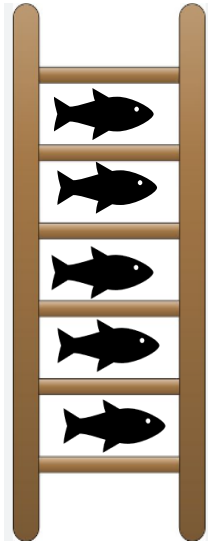
```
Pairwise comparisons using wilcoxon rank sum test with continuity correction
data: STK$Temp_degcel and STK$Logger_ID

      STK_0 STK_0.7 STK_1.2 STK_1.9
STK_0.7 0.776 -      -      -
STK_1.2 0.776 0.713 -      -
STK_1.9 0.776 0.991 0.713 -
```

```
Pairwise comparisons using wilcoxon rank sum test with continuity correction
data: DUN$Temp_degcel and DUN$Logger_ID

      DUN_0 DUN_0.7 DUN_1.2 DUN_1.9 DUN_DS
DUN_0.7 0.7210 -      -      -      -
DUN_1.2 0.8361 0.7895 -      -      -
DUN_1.9 0.8298 0.8361 0.8361 -      -
```

# Take Home Messages





# Thank You

IFI Data: <https://opendata-ifigeo.hub.arcgis.com>

IFI Website: <https://www.fisheriesireland.ie>