

# Activity patterns of three piscivorous species in a reservoir studied with the Vemco Positioning System

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► **General: influence of environmental variables on fish behavior**

- In a French hydroelectric **reservoir** with water level fluctuations

► **Pikeperch, Pike and Perch** are common in reservoir (Dorner *et al.* 2007)

**Pikeperch** - *Sander Lucioperca*



**Pike** – *Esox lucius*



**Perch** – *Perca fluviatilis*



► Behavior describe with **activity** and **spatial distribution**



**seasonal changes** and **individual variability**

- ▶ Data set collected in 2012 and 2013 showed:

## Pikeperch



A high variability  
between individuals

## Pike



Only between 3 and 6  
individuals monitored

- ▶ Presentation focus on perch:



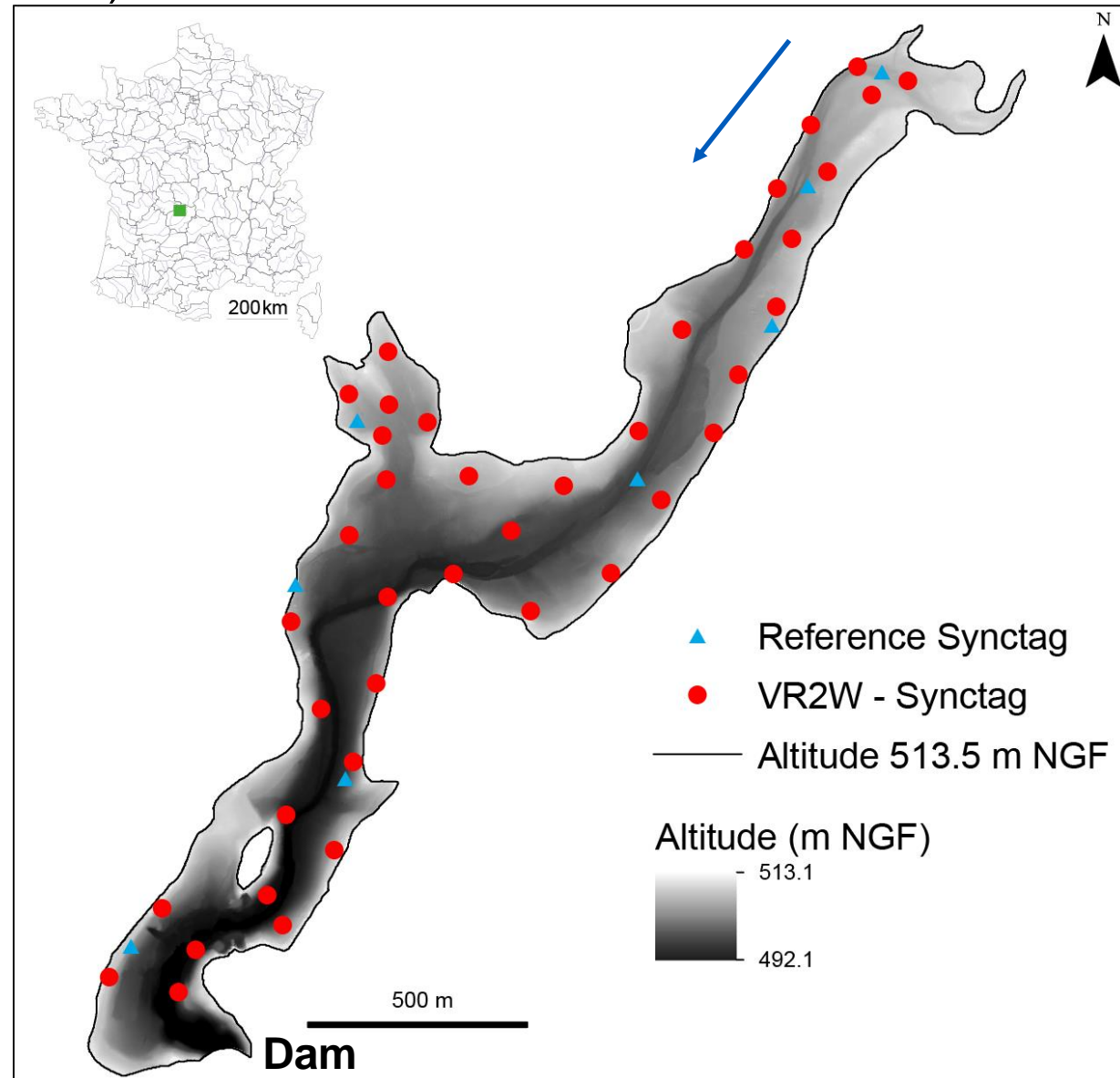
seasonal changes and individual variability

- ▶ 40 receivers (Vemco VR2W) distributed in the entire reservoir

**Area** : 81 ha

**Mean depth** : 7 m

**Maximal depth** : 19 m





► **27 perchs:**

- **captured** by gill-nets and fishermen
- **anesthetized**
- **tagged** (tag inserted into the body cavity)

Fish length: 240 – 486 mm




► Detections post-processed with the **Vemco Positioning System (VPS)**

(Vemco. 2008 ; Smith. 2013)



vemco 

- ▶ **Data analysis** (specific study of the VPS accuracy, Roy *et al.* 2014)
  - Filtering the data set with the **HPE** (Horizontal Positioning Error **estimated** by VEMCO)

 **HPE < 15** was a good compromise between the accuracy (mean **calculated** error of **3.3** m) and the sample size (**79 %** positions had HPE < 15)

Season	Period	Nb. day	Nb. ind	Nb. pos	Temp (°C)
Summer 2012	26 June – 07 August	40	10	53 577	21
Autumn 2012	05 October – 17 November	44	6	44 901	13
Winter 2013	11 February 20 March	38	12	113 264	4
Spring 2013	21 March – 30 April	40	11	113 372	8

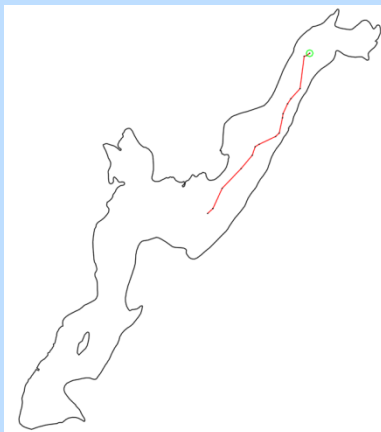
## ► Data analysis: metrics to describe **activity** and **spatial distribution**

### Activity

- **Seasonal home range (95 %) and core area (50 %)**

Brownian Bridge Movement Model  
(Horne *et al.* 2013 ; Calenge. 2013)

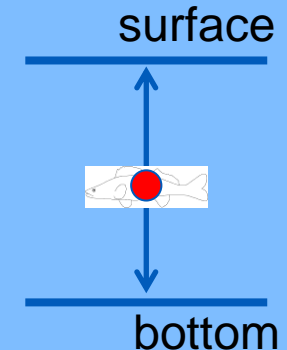
- **Moved Distance per Hour**  
Minimum of 8 positions per hour



### Spatial distribution

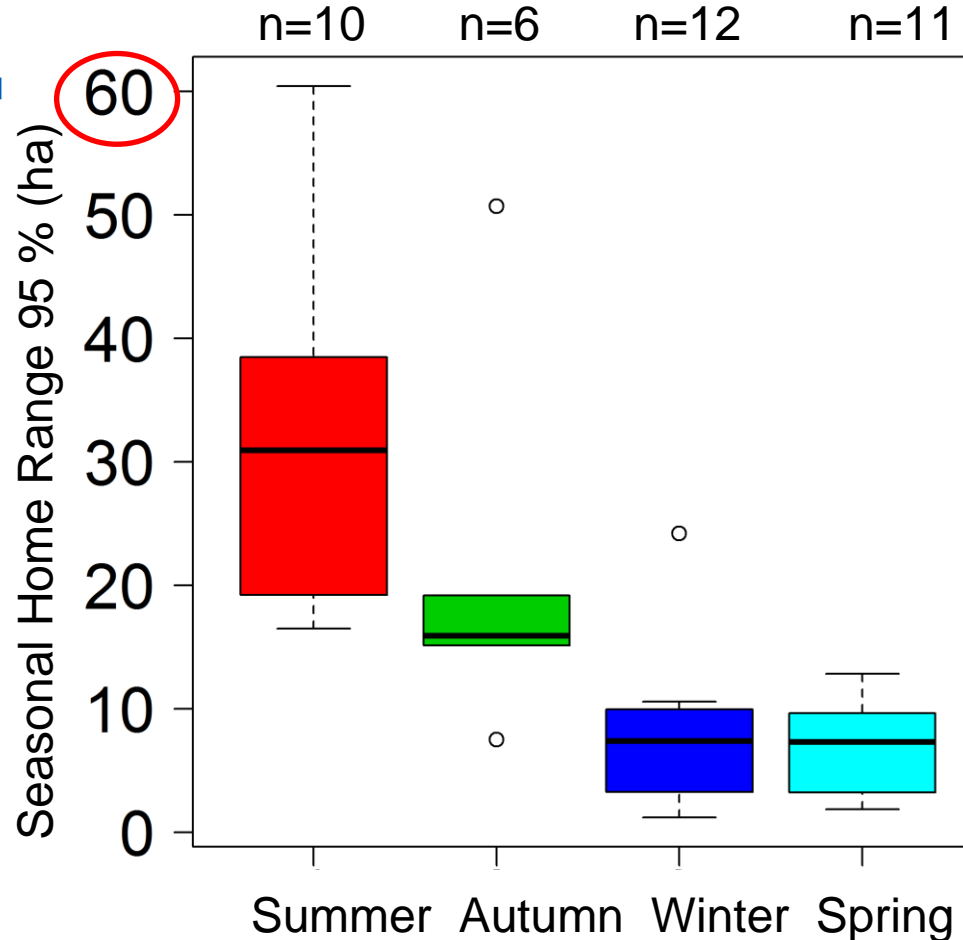
- **water column depth**

Bathymetric map



## Activity: seasonal changes of home range size

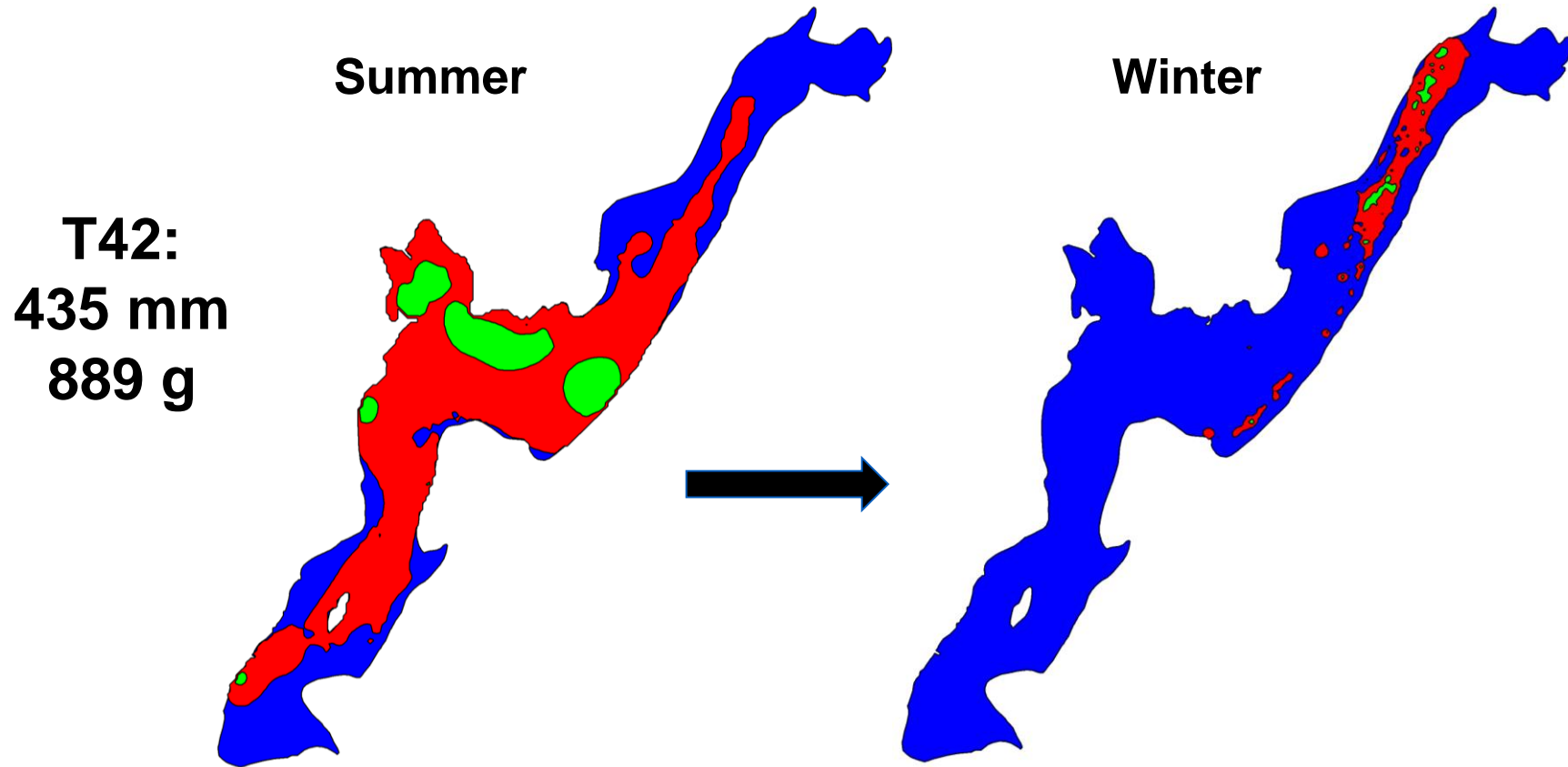
75 % of the  
reservoir area



- Home range (and core area) **decrease** with **temperature** between summer and winter
- **High variability** between individuals in summer

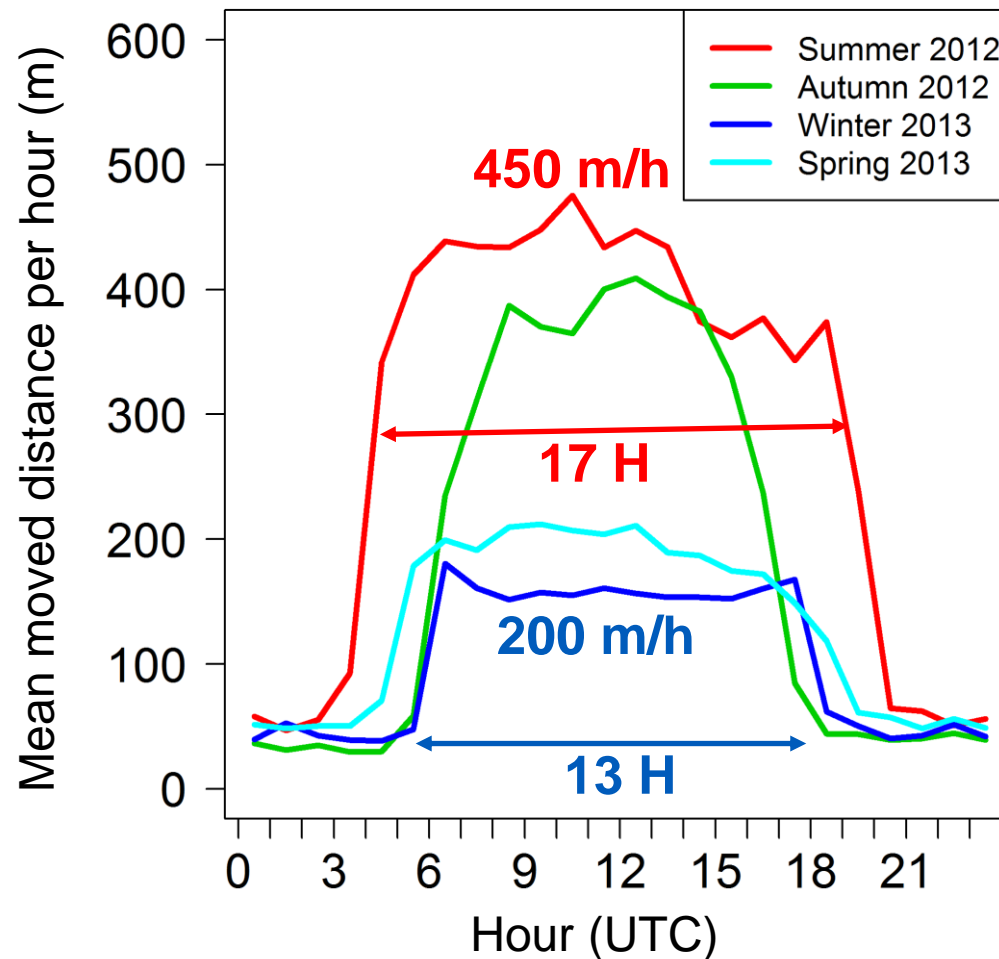


► Activity: example of seasonal changes



	Summer	Winter
Number of positions	3 038	14 453
Home range (ha)	60.4	4.5
Core area (ha)	9.5	0.5

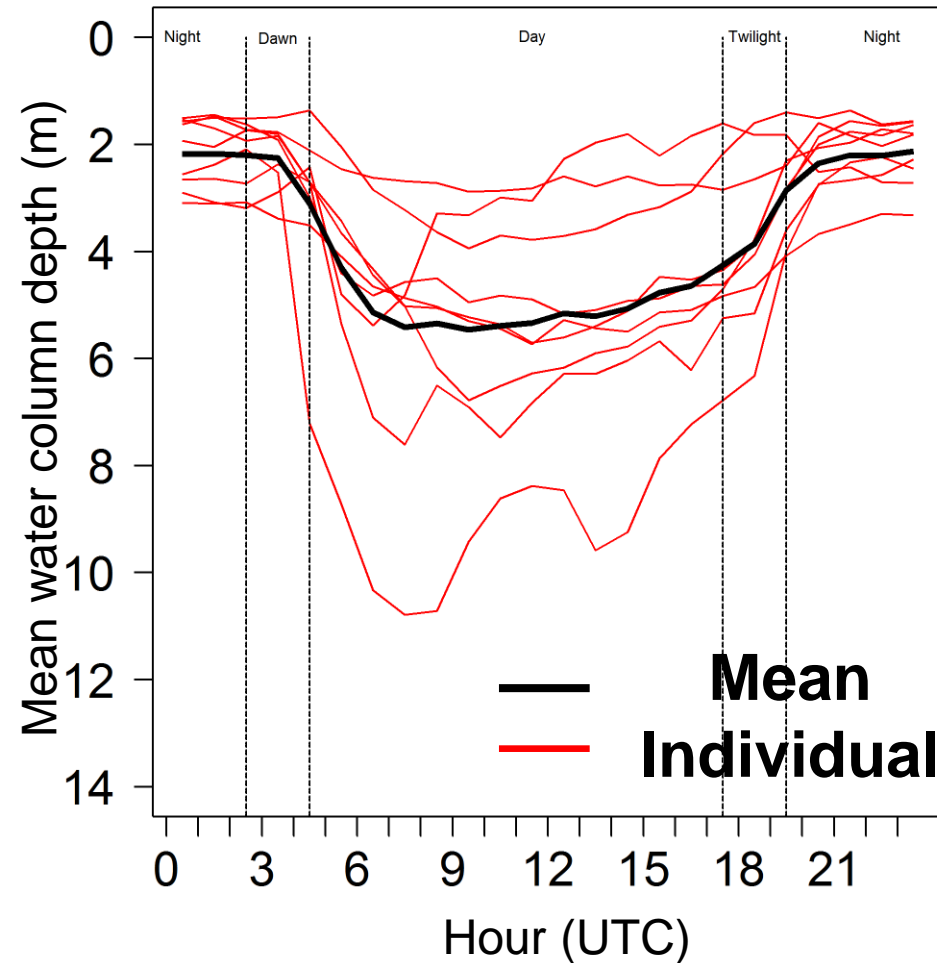
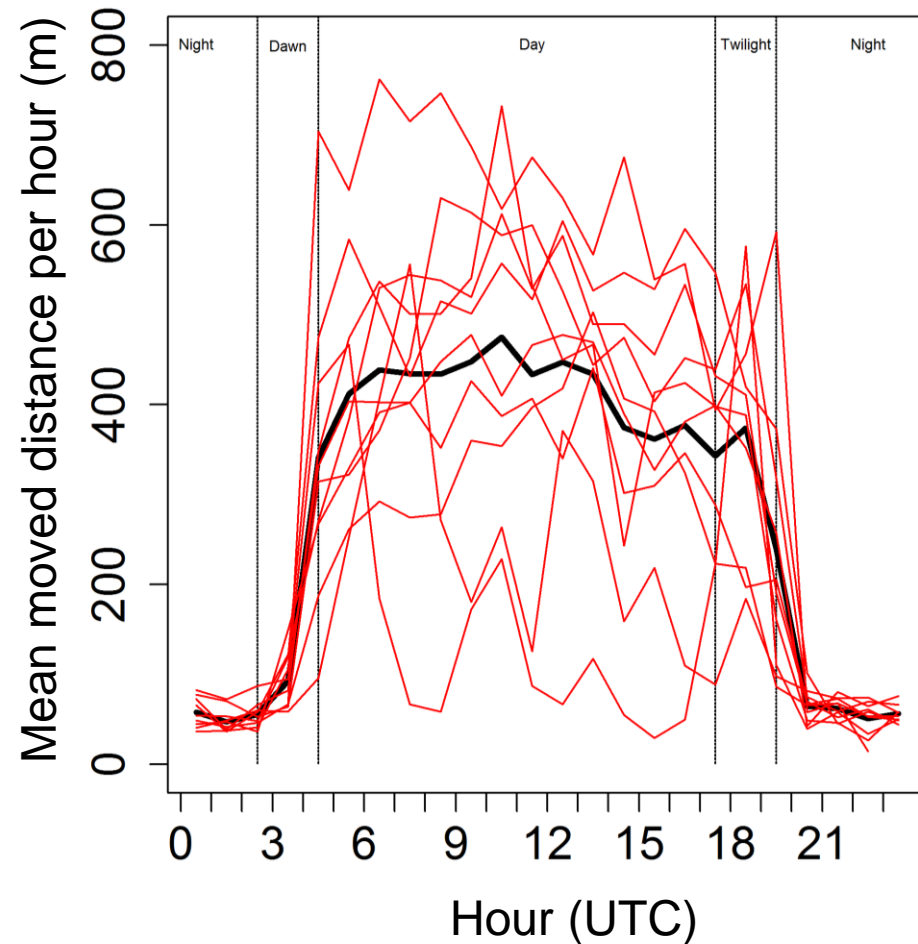
## ► Activity during a 24 H period: seasonal changes



- A **specific diel activity** pattern for each season
- Activity **decrease** (in intensity and duration) between summer and winter

## Activity and spatial distribution during a 24 H period

### Individual variability in summer

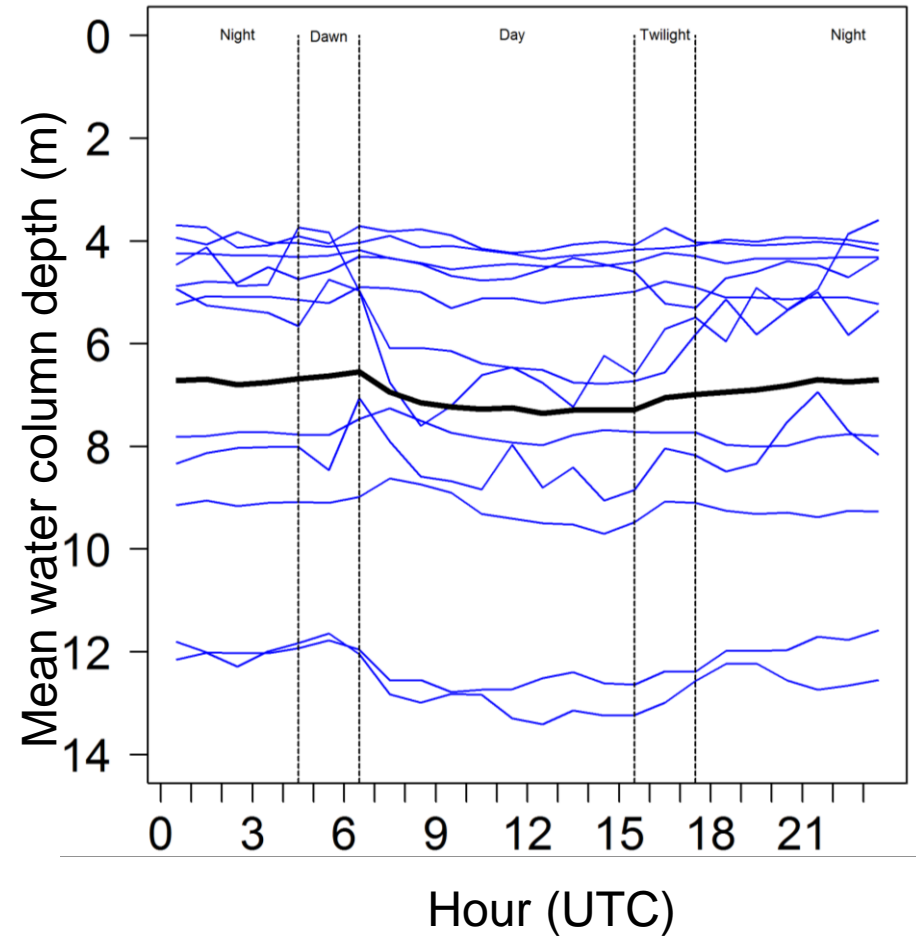
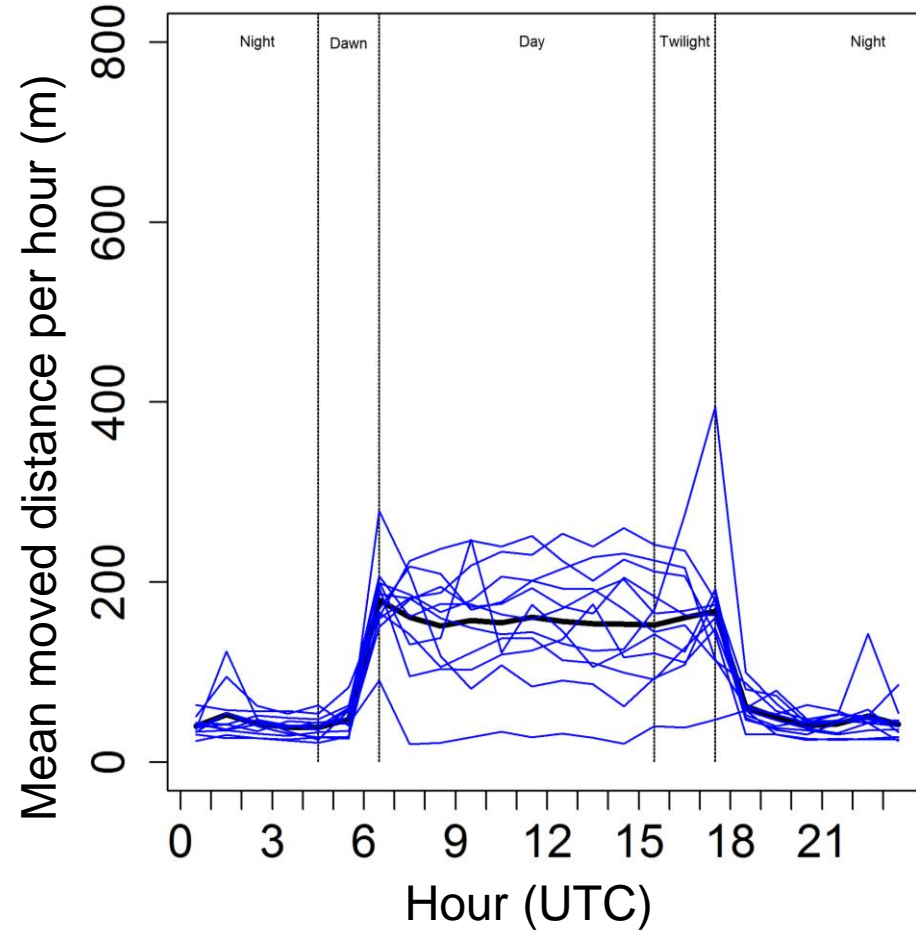


■ Higher activity level and deeper areas used during the day compared to the night

■ Some similar patterns of activity and spatial distribution between individuals

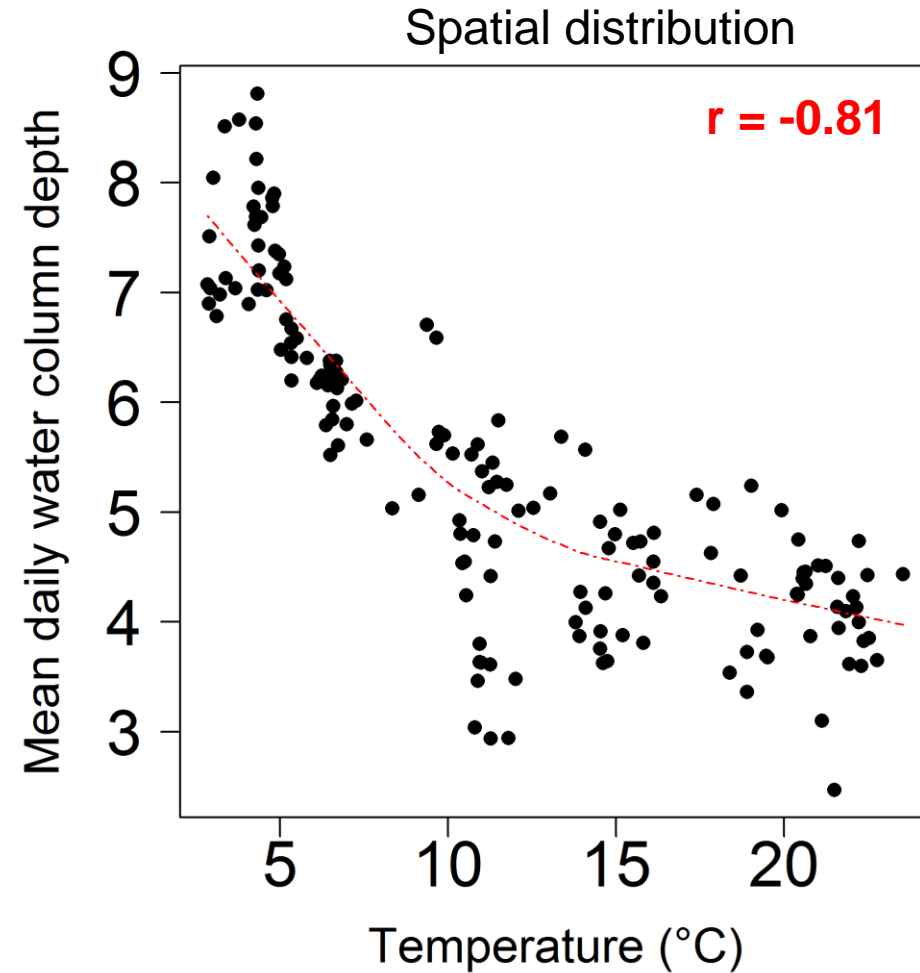
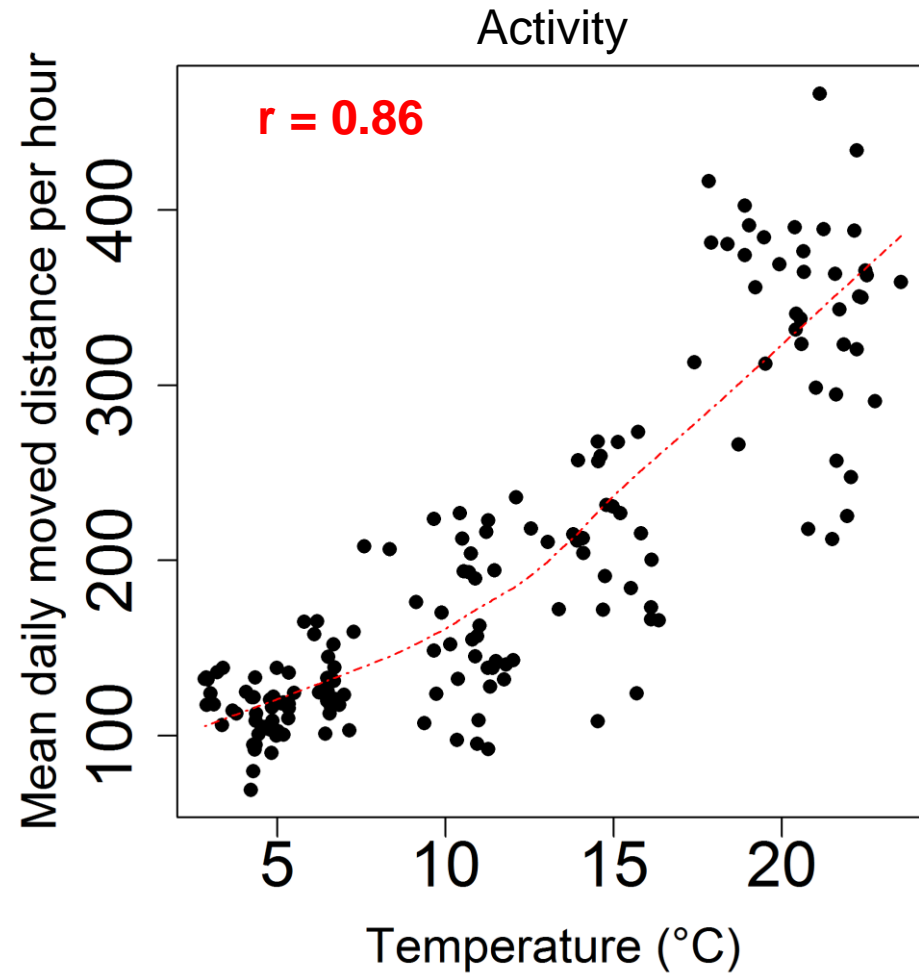
## Activity and spatial distribution during a 24 H period

### Individual variability in Winter



- Higher activity level but **no** pattern concerning water depth used during the day
- Some **similar** patterns of activity and spatial distribution between **individuals**

## Activity and spatial distribution: relationship with water temperature



- Activity level **increased** and water column depth used by perches **decreased** with water temperature



## ▶ Conclusion about the deployed methodology:

- New positioning systems by acoustic telemetry (ex : VPS) allow to monitor individuals at **very high frequency, over long period, in a large area**
  - to describe animal behavior at an **hourly** basis or **less**
  - to provide **very rich dataset** which need to be analyzed **rigorously**



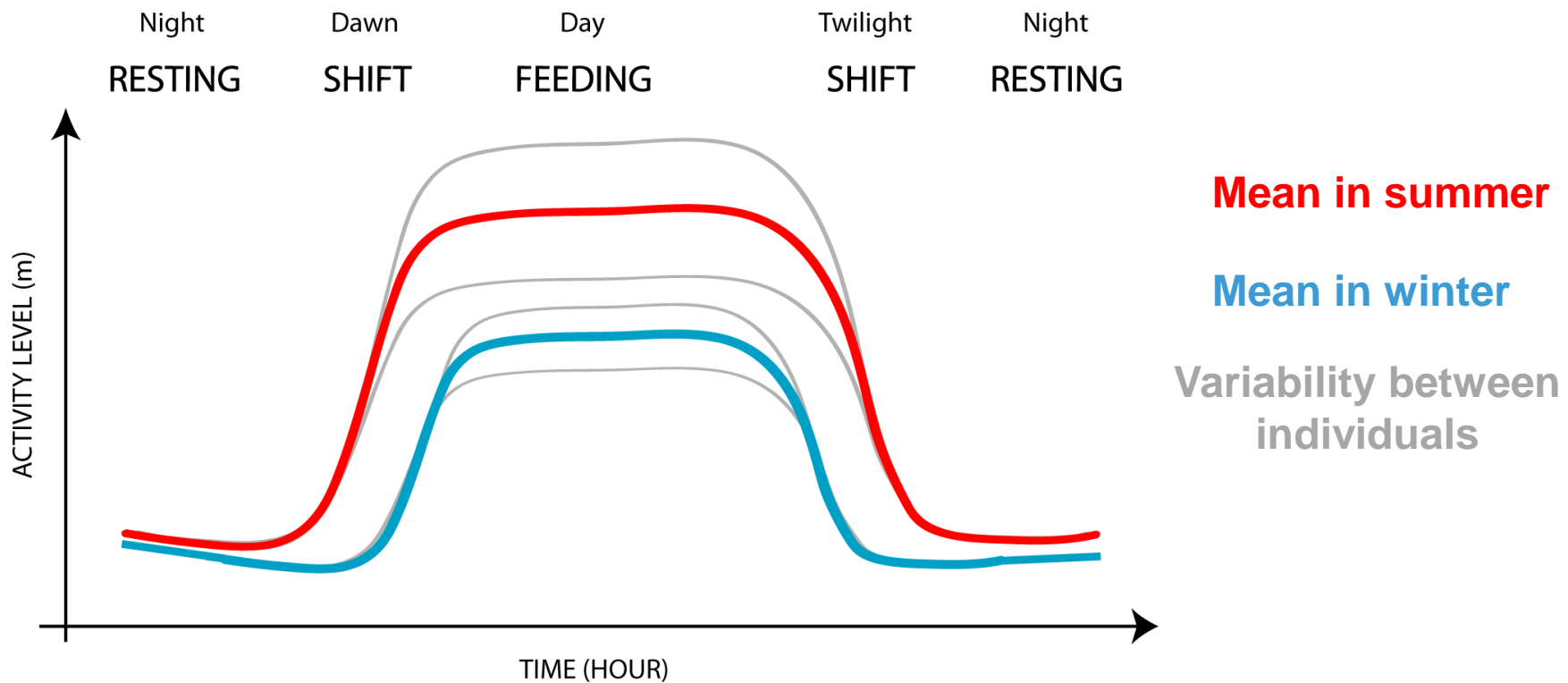
### with activity metrics :

- minimum number of position to estimate a realistic hourly distance
- methods which take into account the high auto-correlation between positions to estimate home range

## ► Conclusion about biological results:



- With activity analysis: isolate periods of the daily cycle dedicated to **rest** and **feed** (complete observations of Jacobsen *et al.* 2002)



- With spatial distribution analysis: In summer, **resting** took place in a shallower area (more complex) than the **feeding** area (pelagic area) (complete observations of Zamora *et al.* 2002)



## ▶ Conclusion about biological results:

- Similar **pattern** of activity and spatial distribution between individuals but **differences** in **intensity (activity)** and **water depth used**
- **High** dependence between activity/spatial distribution and **temperature**



Be careful with the **duration of the study period** but also with **the number of individuals tagged**

## ▶ Perspectives :

- To study the causes of inter-individual variability
- To connect fish positions (3 species, perch, pikeperch and pike) with a **habitat map** (substrate, vegetation, slope, water depth etc.) to get fish **habitat preferences** in this reservoir
- To evaluate **switches** in habitat preferences with **season, temperature, water level, ...**

# Thank you to the partners and staff



EDF R&D  
DTG  
CIH  
UP Centre  
Treignac



HYAX  
DYNAM  
EPBX  
HBAN



# Thanks for your attention

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