RESPONSE OF BROWN TROUT POPULATIONS TO FLOODS IN NATURAL AND BYPASS REACHES

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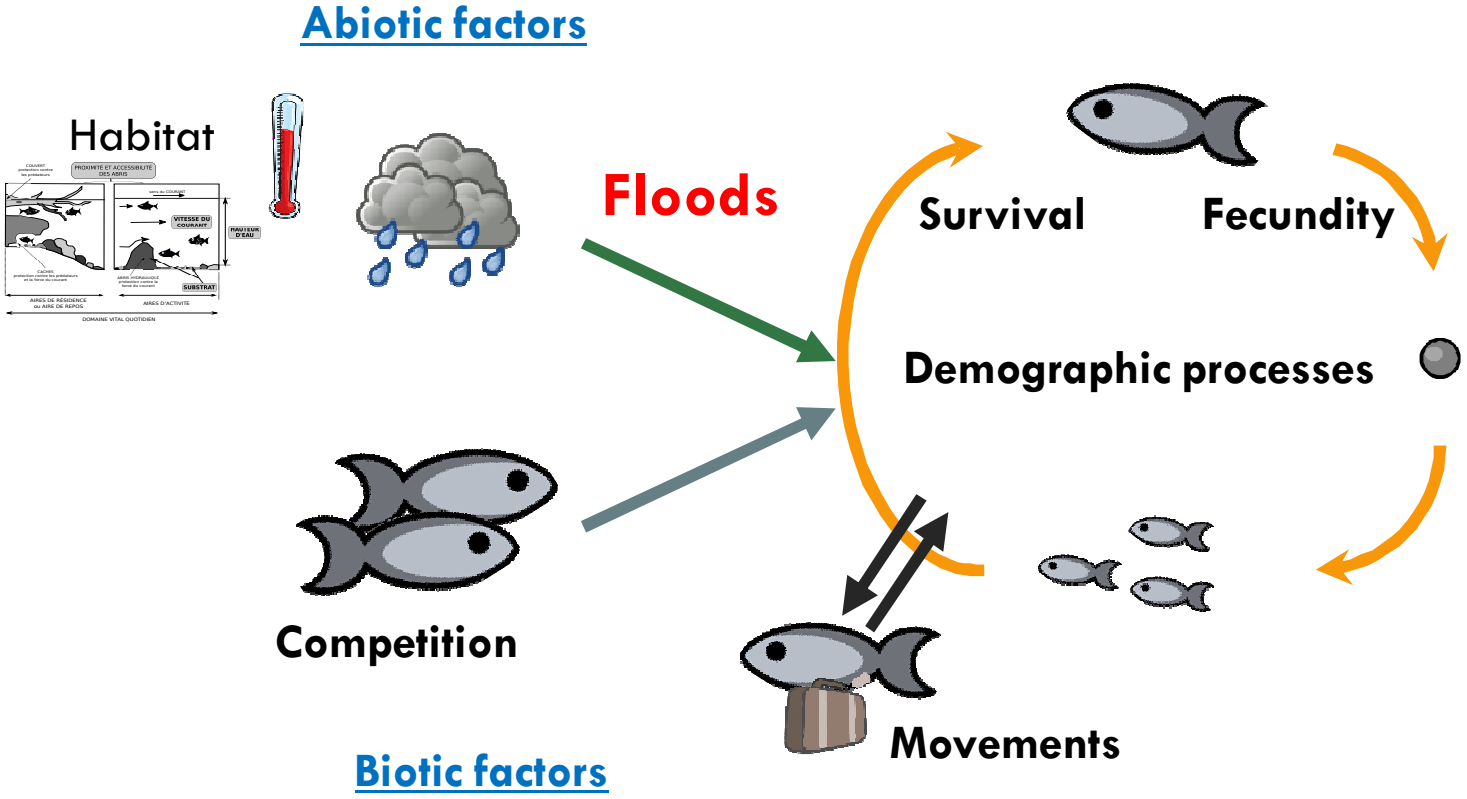
HYNES partnership

Variability of brown trout populations among reaches



KEY ROLE OF FLOODS

Floods

Trout population

All-age stages *(Young and al. 2010)*

Young of the year 0+

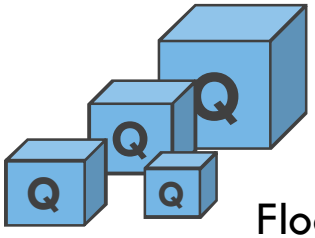
(Jensen & Johnsen, 1999; Cattanéo et al., 2003; Unfer et al., 2011)

≠ degrees of impact

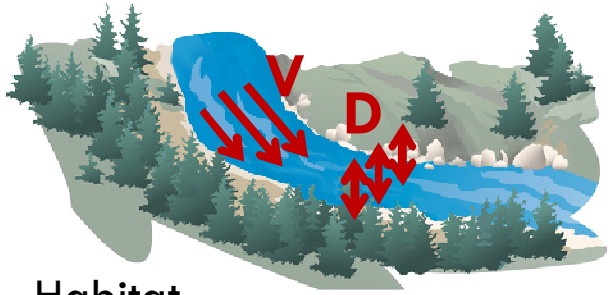
Hayes, 1995; Sabaton et al., 2008; Alonso et al., 2011; Alonso-Gonzàlez et al., 2008; Nicola et al., 2009

QUESTIONS

- How to quantify this effect of floods?

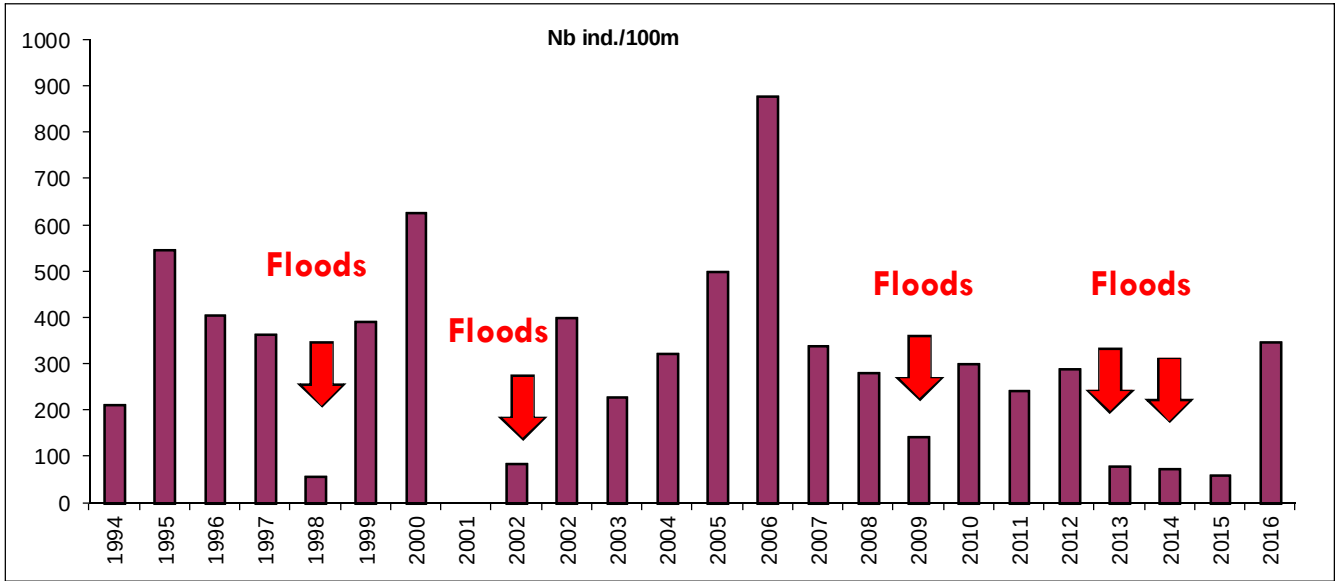


Floods



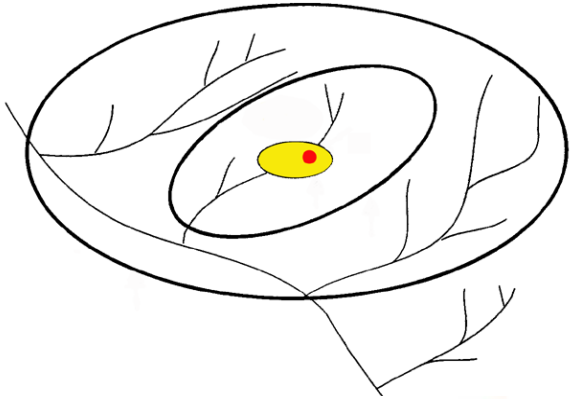
Habitat

- How to diagnose population status in taking into account effect of floods and other processes?



OBJECTIVES

- Determine at which spatial scale operate the effect of floods



- Quantify effect of floods on population dynamics and disentangle effects from other parameters

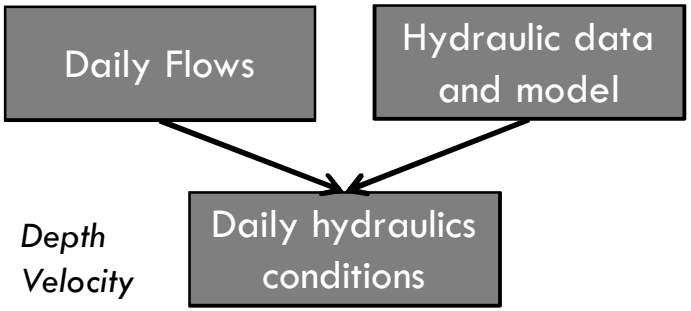
- Assess if ≠ between natural and bypass reaches

Natural reaches

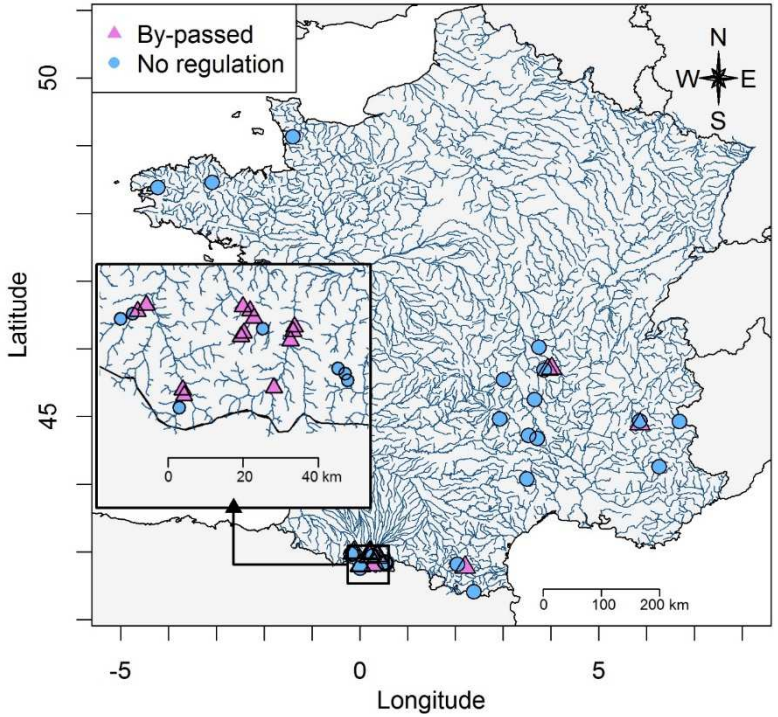
Bypass reaches

DATASET

- 40 reaches
  - ✓ 23 French rivers
  - ✓ 19 bypass reaches
- Electrofishing samplings (from 4 to 20 years per reach)



(Details on data collection in Bret et al. 2015)

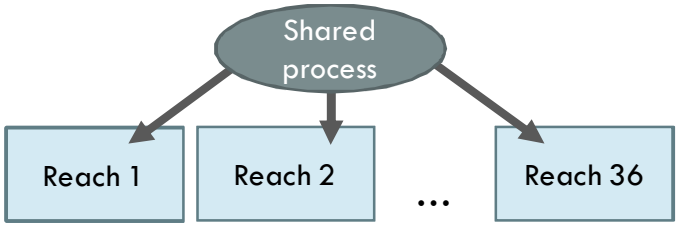


- Measures
  - ✓Shelter availability
  - ✓Mean water temperature
  - ✓Mean wetted width
  - ✓Habitat suitability index
  - ✓Upstream dam

3 ≠ APPROACHES

1. Density synchrony analysis

SYN

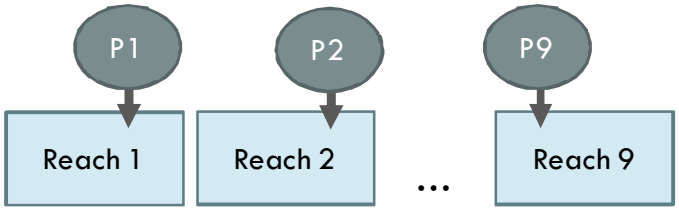


Bret et al. 2015

36 reaches

2. Deterministic population dynamics model on 9 reaches

MODYPOP

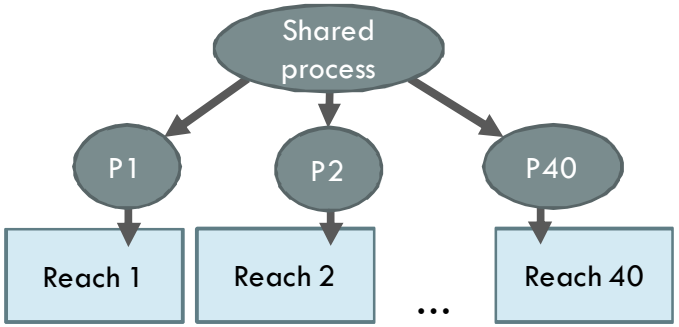


Gouraud et al. 2001, 2008
Tissot et al. 2016

9 reaches

3. Hierarchical Bayesian Model

DYPOP

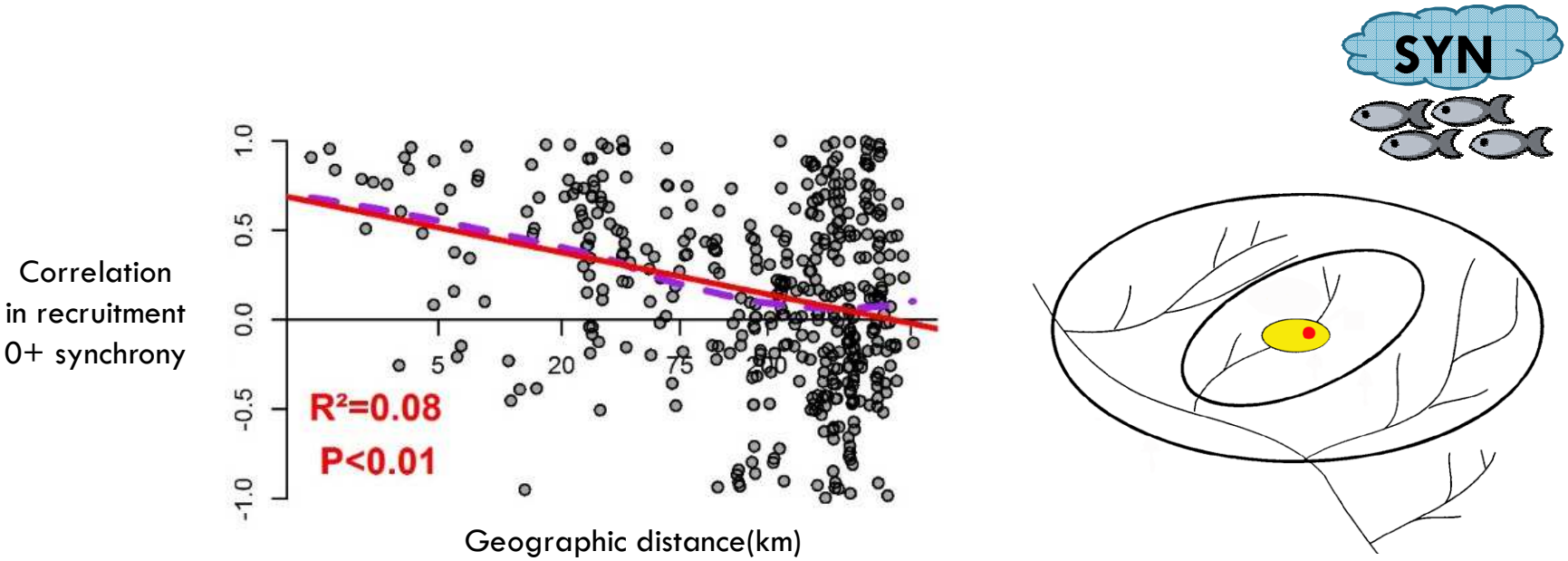


40 reaches

Bret et al. 2016

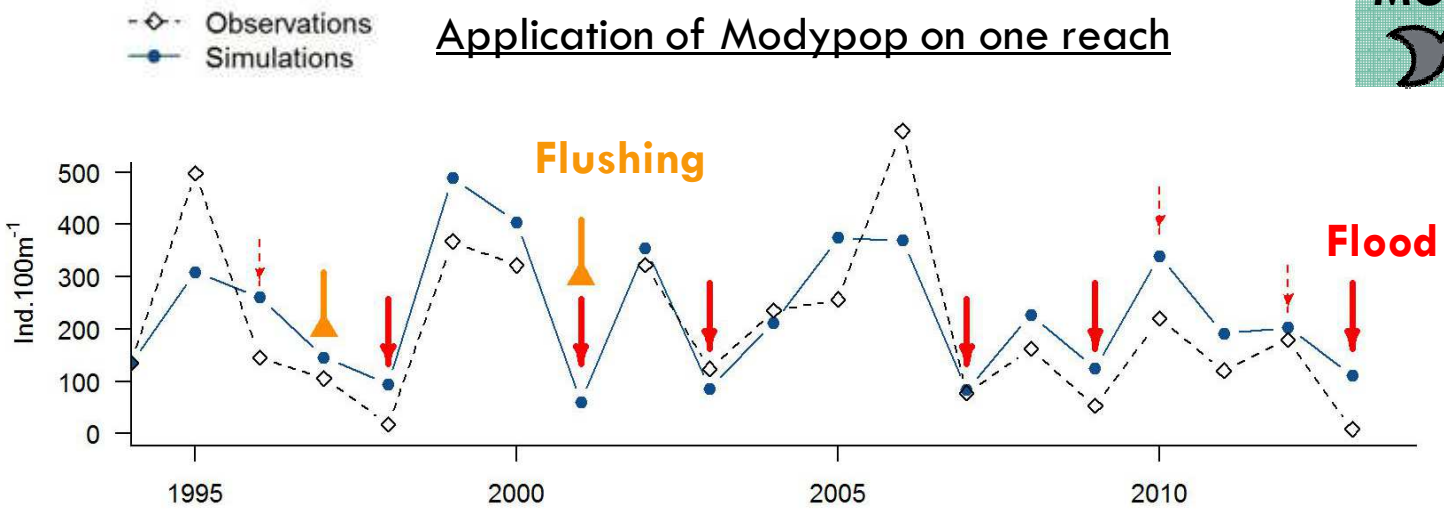
RESULTS

1. DENSITY SYNCHRONY ANALYSIS



- Strong synchrony for reaches over distances less than ~ 75 km
- Negative influence of strong discharges during the emergence period and a influence of substrate mobililty during the spawning period
- Close reaches are likely to be synchronous, even if they are separated by dams and have different flow regimes.

2. DETERMINISTIC MODEL MODYPOP



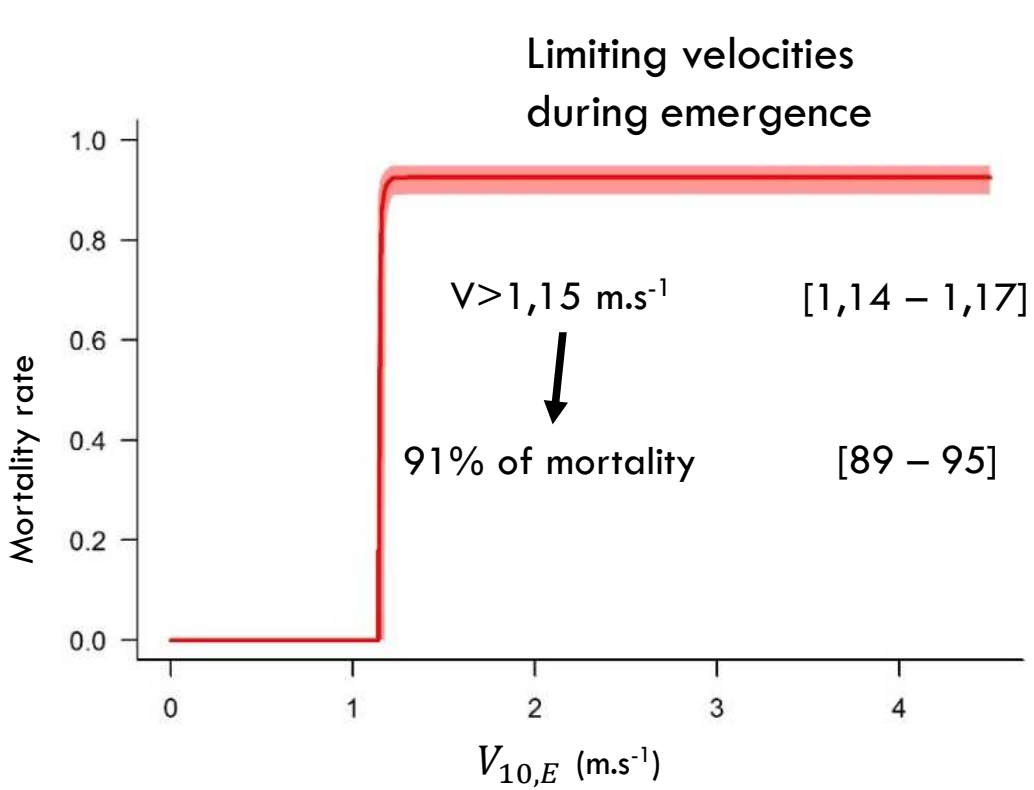
Application of Modypop on one reach

Results on 9 reaches

Bypassed section	Period	Q threshold ($m^3 s^{-1}$)	Q threshold/Q10	Nb days	Mortality rate (%)
Beyrède	March–June	35	3.3	9	75
	March–June	35	3.3	4–8	20
	November–December	60	5.7	1	75
	Whenever	94	8.9	1	75
Fontan	March–June	8	1.6	1	75
	Whenever	71	13.6	2	90
Breil	March–June	60	4.9	1	75
Pont-Haut	March–June	9	3.5	1	75
Rory	March–June	5.5	2.5	1	75

Tissot et al. 2016

3. Hierarchical Bayesian Model



- High flow => very high mortality in emerging fry (91%) for flow velocity >1.15m.s-1
- Prediction of densities and mortalities as a function of water temperature and shelter availability

Conclusion - Prospects

CONCLUSION - PROSPECTS

- **Spatial scale of floods influence**

  - Synchronism of recruitment at the watershed scale

  => Need to be taken into account for diagnosis of population status

  - Synchronism between reaches (<75 km), even if they are separated by dams

  => But, need to investigate difference of resiliency of population after floods in function of reach morphology

  => Protection of sections with high resiliency is a major issue with the climate change

CONCLUSION - PROSPECTS

- **Quantification of key role of floods**

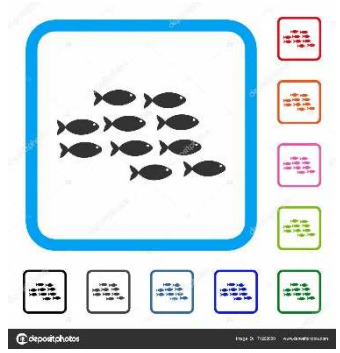
  - Strength of abiotic mortality among 0+ due to floods → ≠ thresholds of limiting flow

  - Translation in one hydraulic threshold thanks to hierarchical bayesian model

- **Dynamics population models MODYPOP and Hierachical Bayesian Model DYPOP:**

  Tools which are useful to diagnose status of populations and disentangle the effects of floods from those of other abiotic or biotic parameters

=> 2 softwares in preparation



THANK YOU FOR YOUR ATTENTION

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