Deltares

Analysis tool for passability of fish at weir complexes in river systems

A case-study for the Meuse river (NL)

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Project in assignment of RWS

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Fish migration in the Netherlands

Implementation of WFD in 2027.

Main rivers and large lakes

- Rhine and IJssel accessible
- Measures Haringvliet and Afsluitdijk
- Fish passages at barriers in Meuse river and Nederrijn

Regional water system

- Many weirs, pumping stations

Bron: ATKB, 2015

PBL/apr18
www.clo.nl/nl135009

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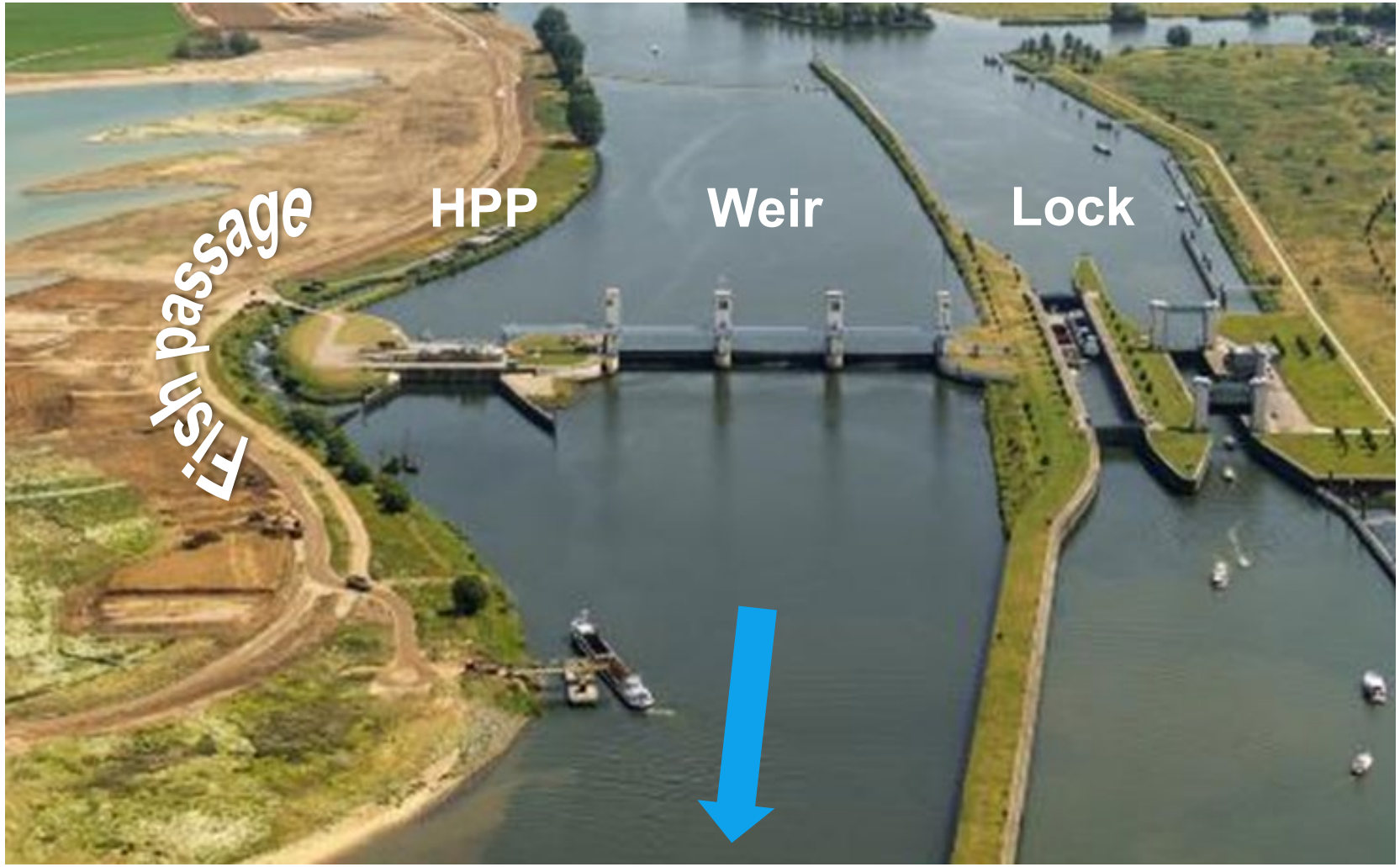
Weir complex Lith



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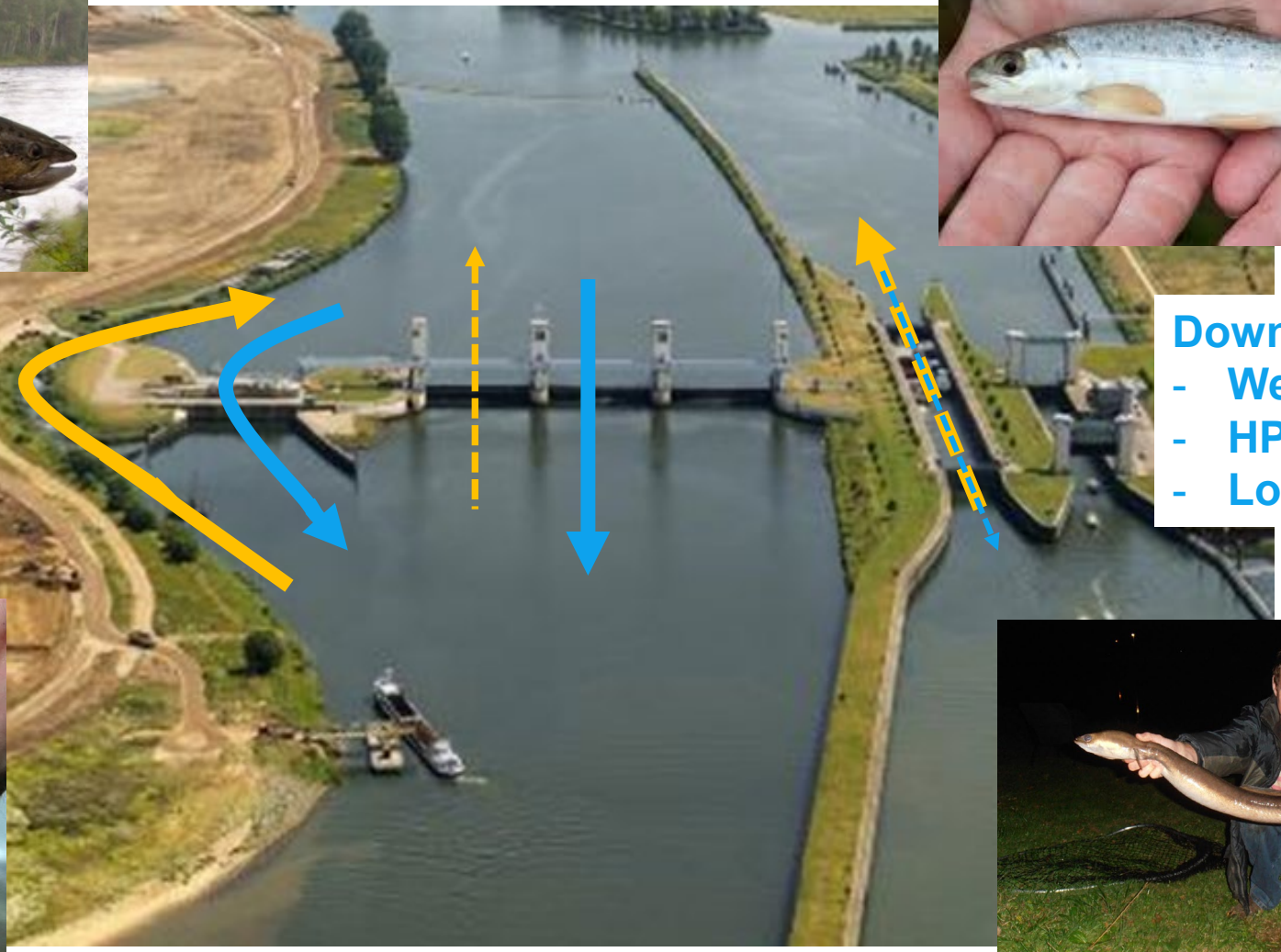
Weir complex Lith



Upstream:
- Fish passage
- Locks
- Weir

Downstream:
- Weir
- HPP
- Locks

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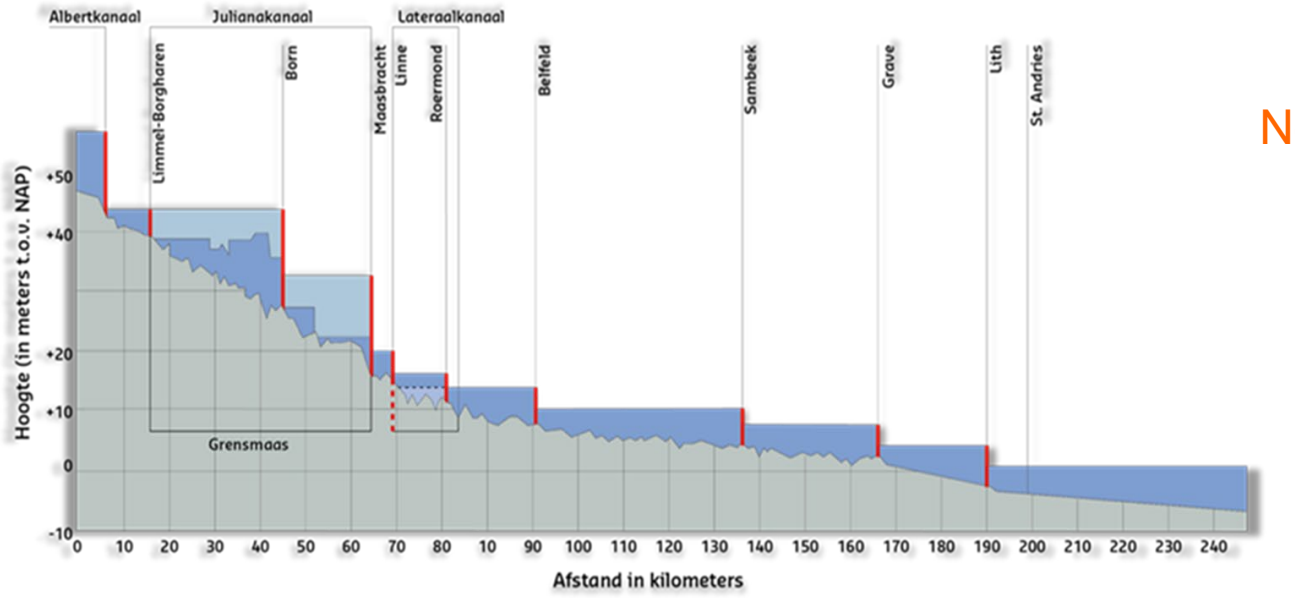
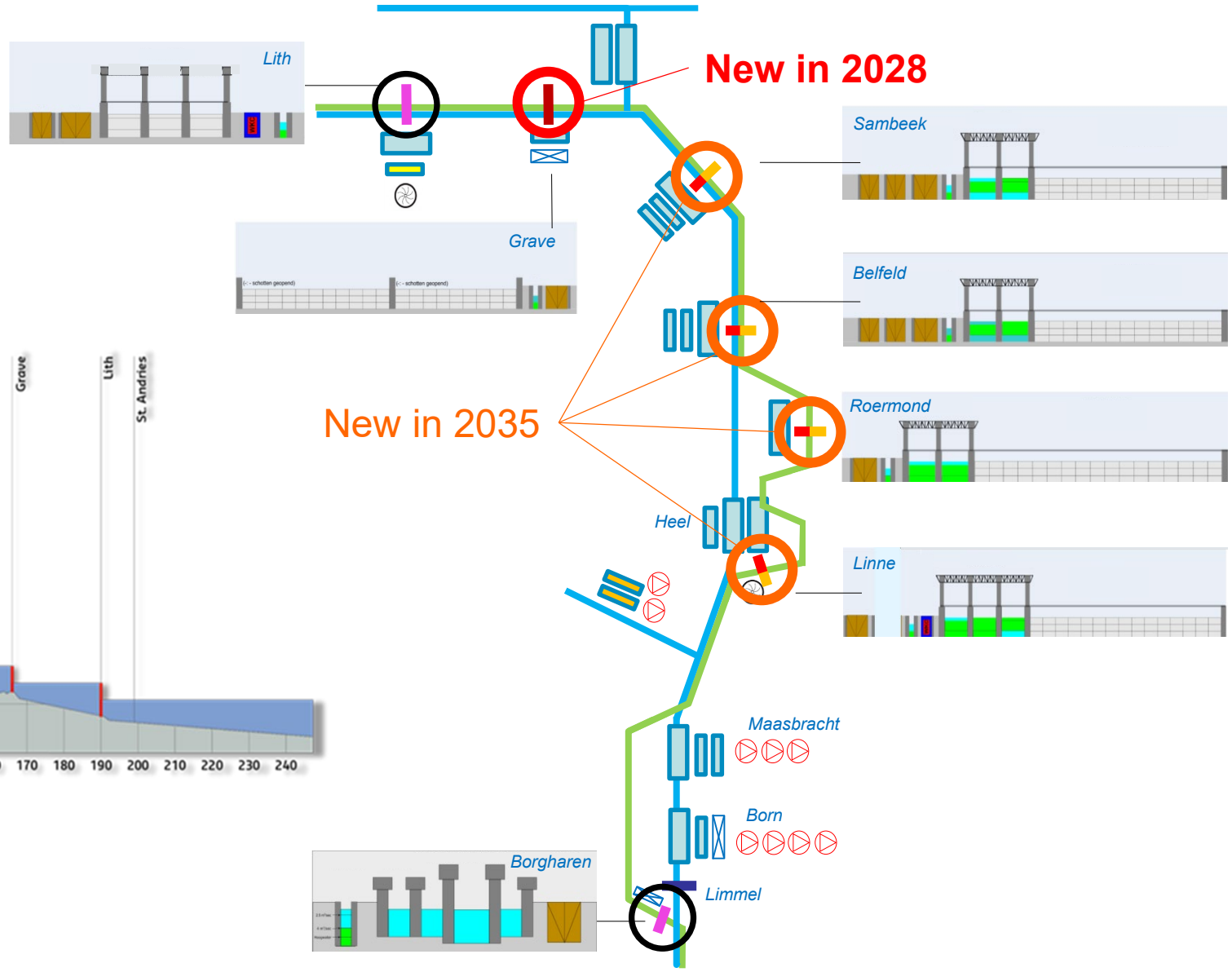
Meuse: 7 weirs





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Timeline

- Implementation of WFD 2027

- Replacement of weir Grave scheduled for 2028
- Replacement of weir Sambeek, Belfeld, Roermond, Linne scheduled for 2035
- Renovation of weir Borgharen and Lith scheduled for 2035

- **Huge opportunity to improve the passability of the weir complexes!**

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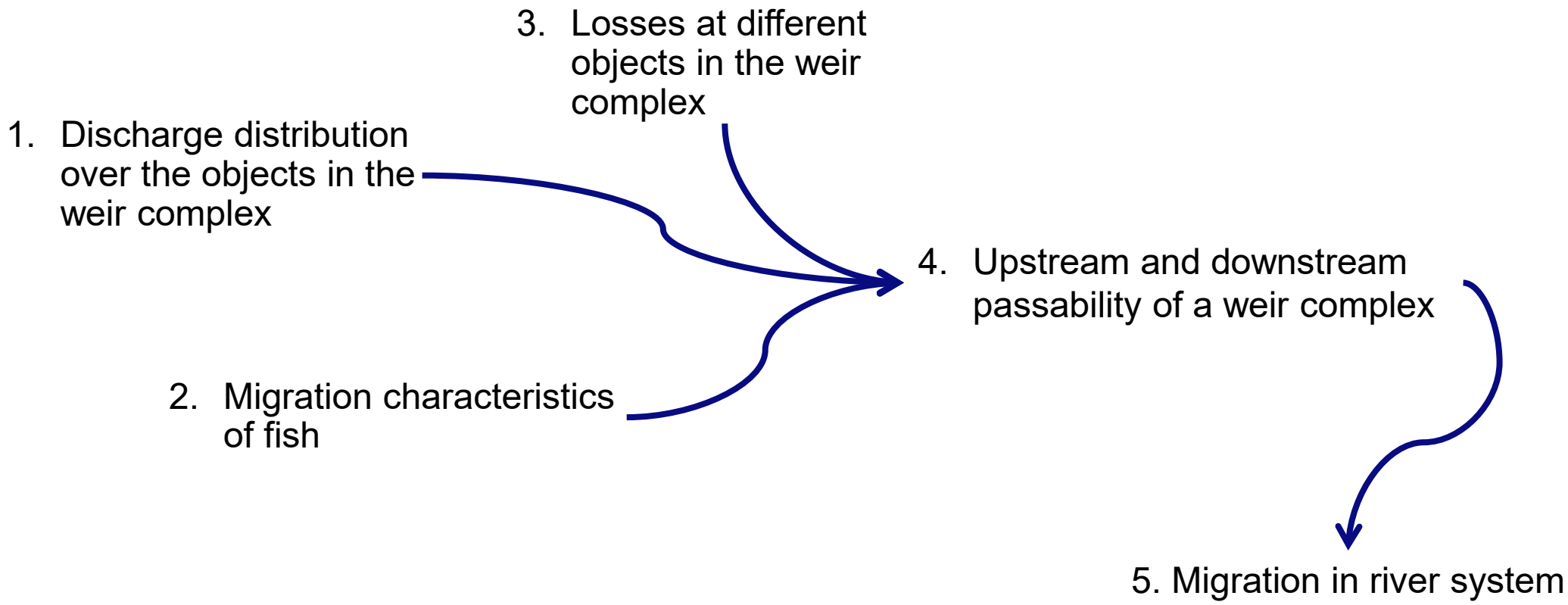
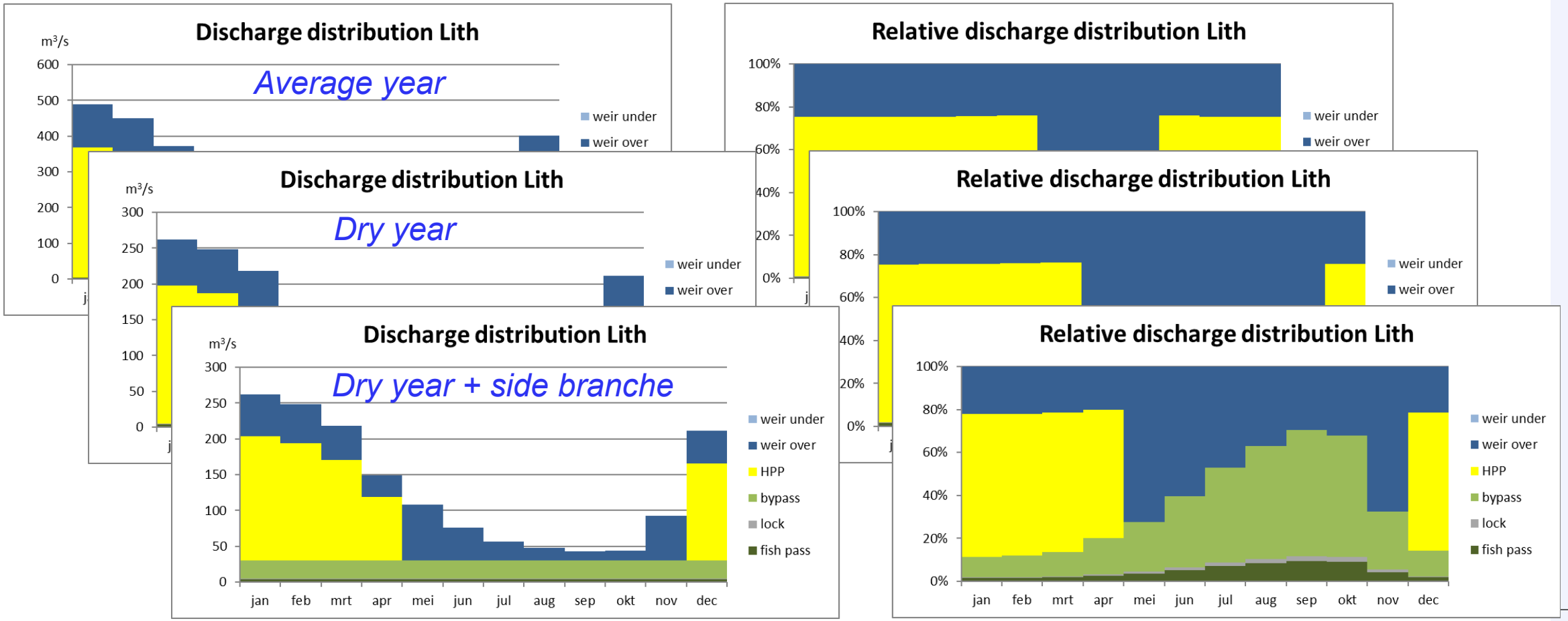
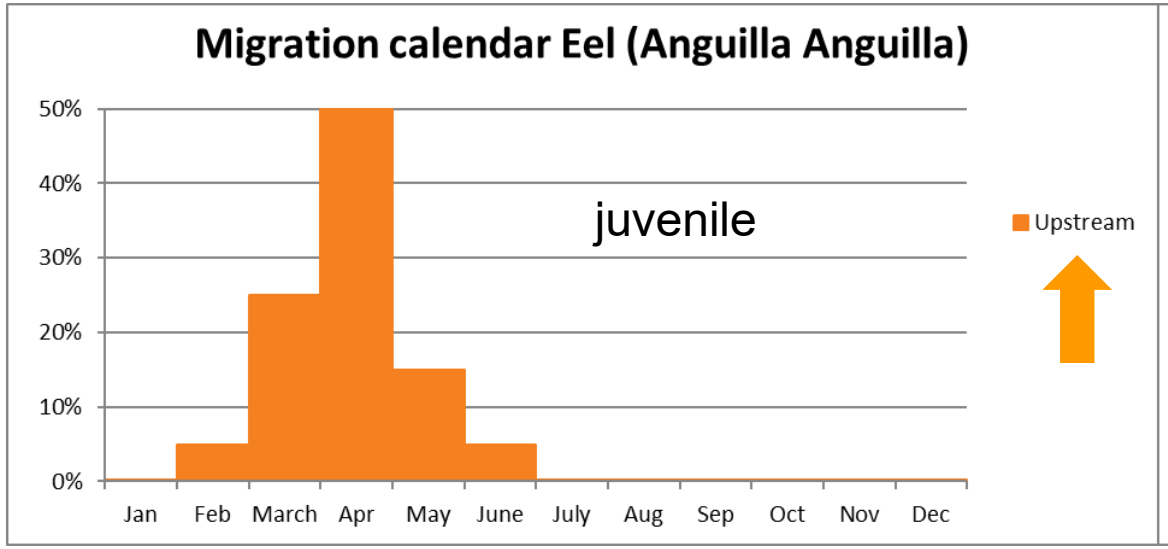
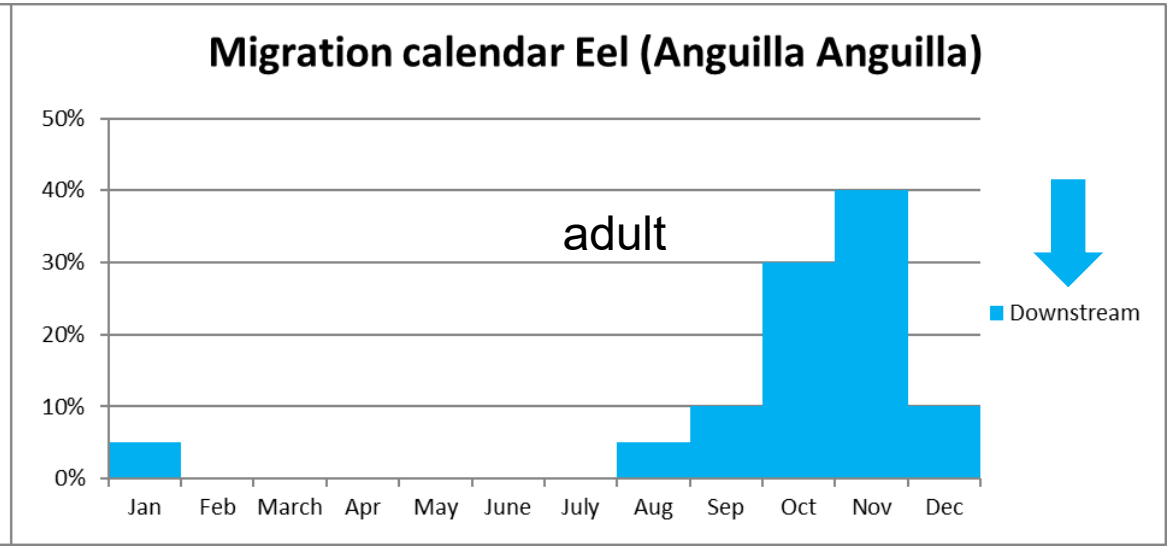


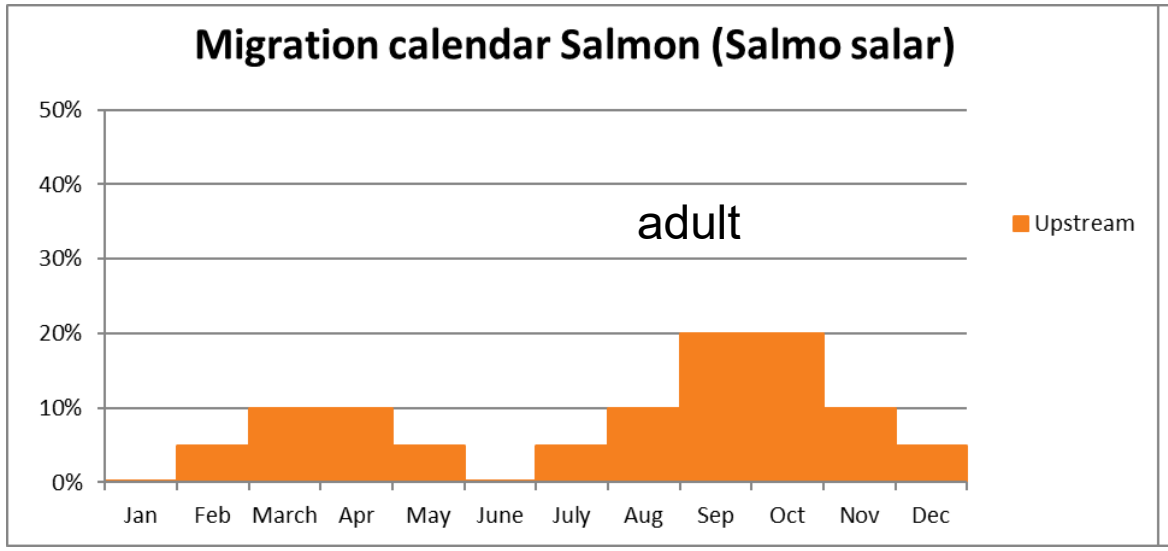
1. Discharge distribution weir complex

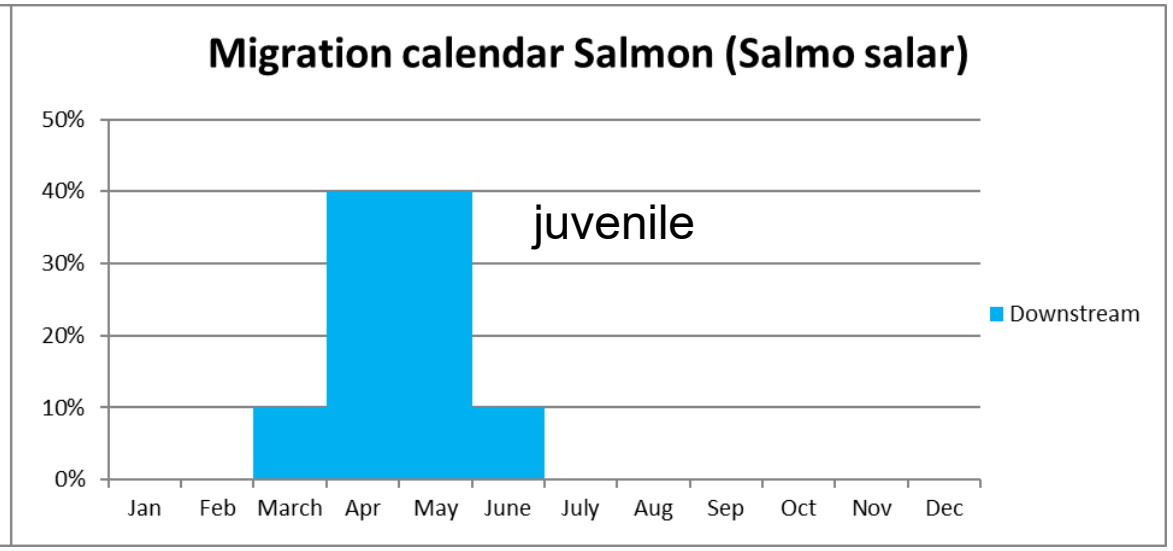


2. Migration characteristics





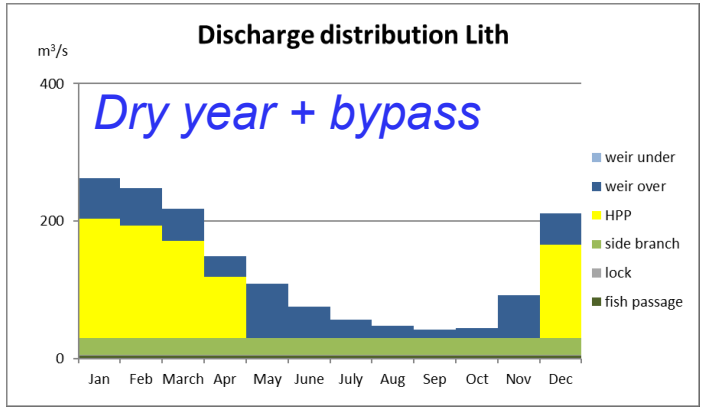


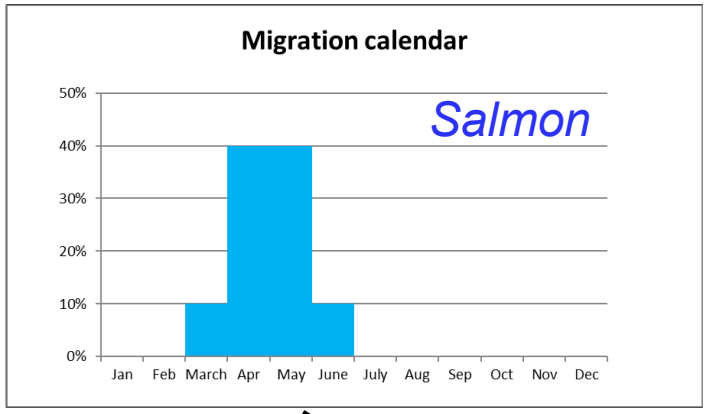


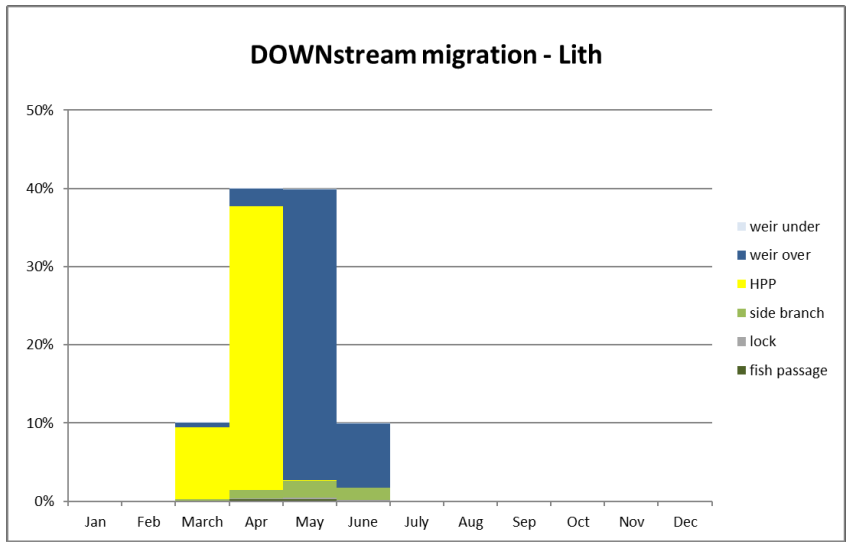
2. Migration characteristics

Combination of:

- discharge distribution at the weir compex
- and migration calendar of fish







to estimate the distribution of fish passing the weir complex,

assuming "~~fish follows flow~~".

"Croze-Larinier".

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3. Downstream losses at weir objects

DOWNstream	Eel (adult)	Salmon (smolt)	other
Weir underflow	1,0%	1,3%	3,0%
Weir overflow	1,0%	1,3%	3,0%
HPP	18,0%	9,4%	6,0%
Lock	0,5%	0,5%	0,5%
Natural bypass	0,4%	0,4%	0,4%
Fish passage	0,04%	0,04%	0,04%

(photos from https://oldrivershannon.com)

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3. Upstream losses at weir objects

UPstream	Eel (glass eel)	Salmon (adult)	other
Weir underflow	-	-	-
Weir overflow	-	-	-
HPP	-	-	-
Lock	0,5%	0,5%	0,5%
Natural bypass	0,4%	0,4%	0,4%
Fish passage	0,04%	0,04%	0,04%

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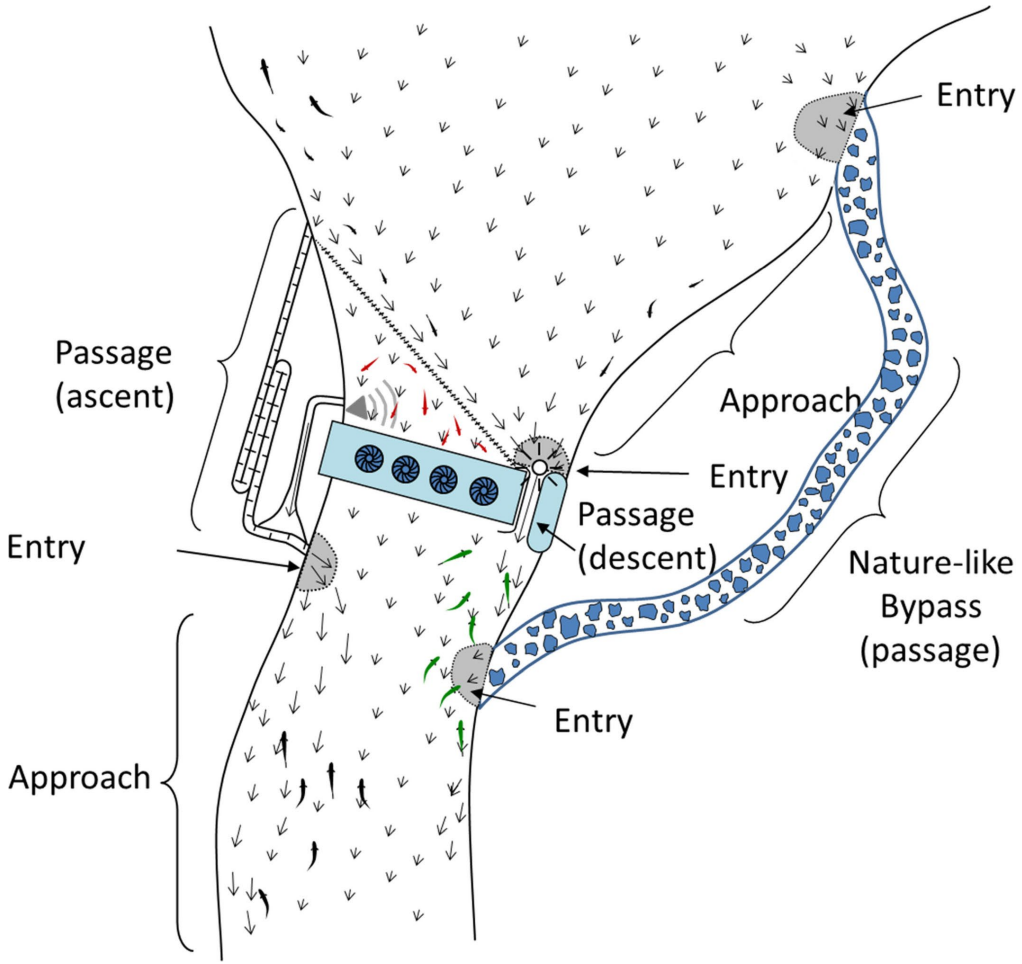
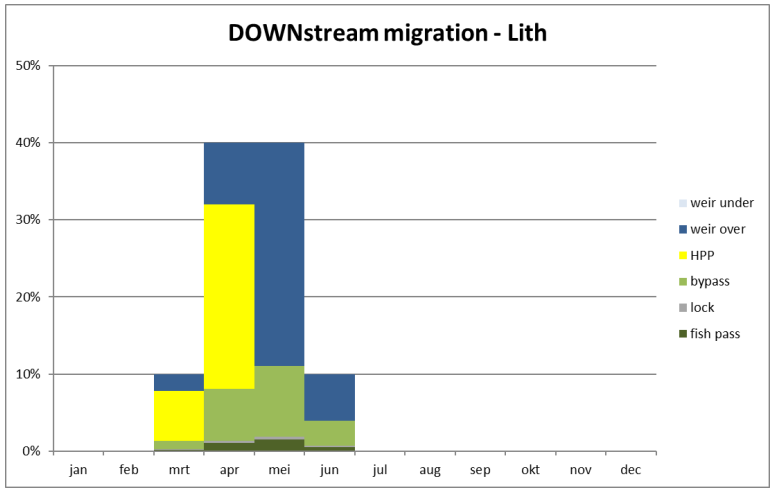
3. Upstream losses at weir objects

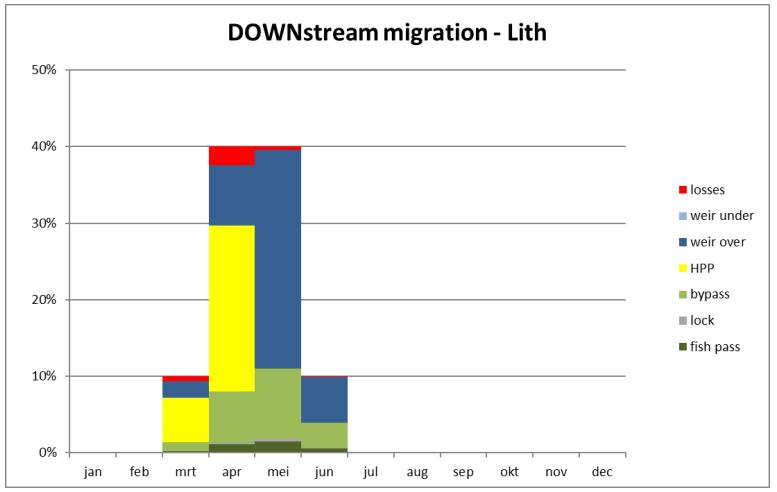


(from Silva et al, 2018)

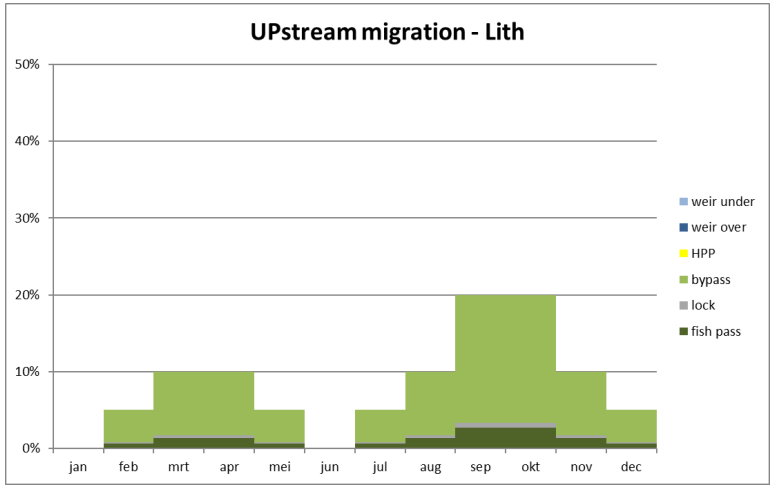
- Losses in the fish passage and bypass are limited.
- Maintenance of fish passage is crucial.
- How to find the entrance of the fish passage or the natural bypass?
- How to design a fish passage for various species?

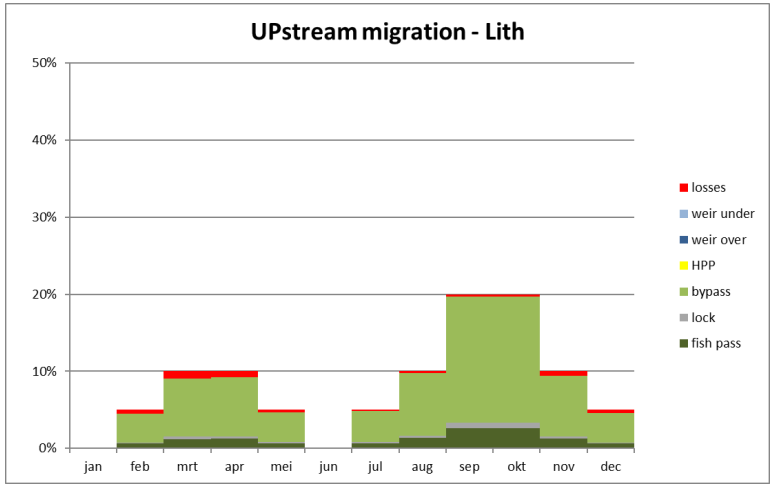
4. Downstream and Upstream losses at weir complex





Salmon – Salmo salar





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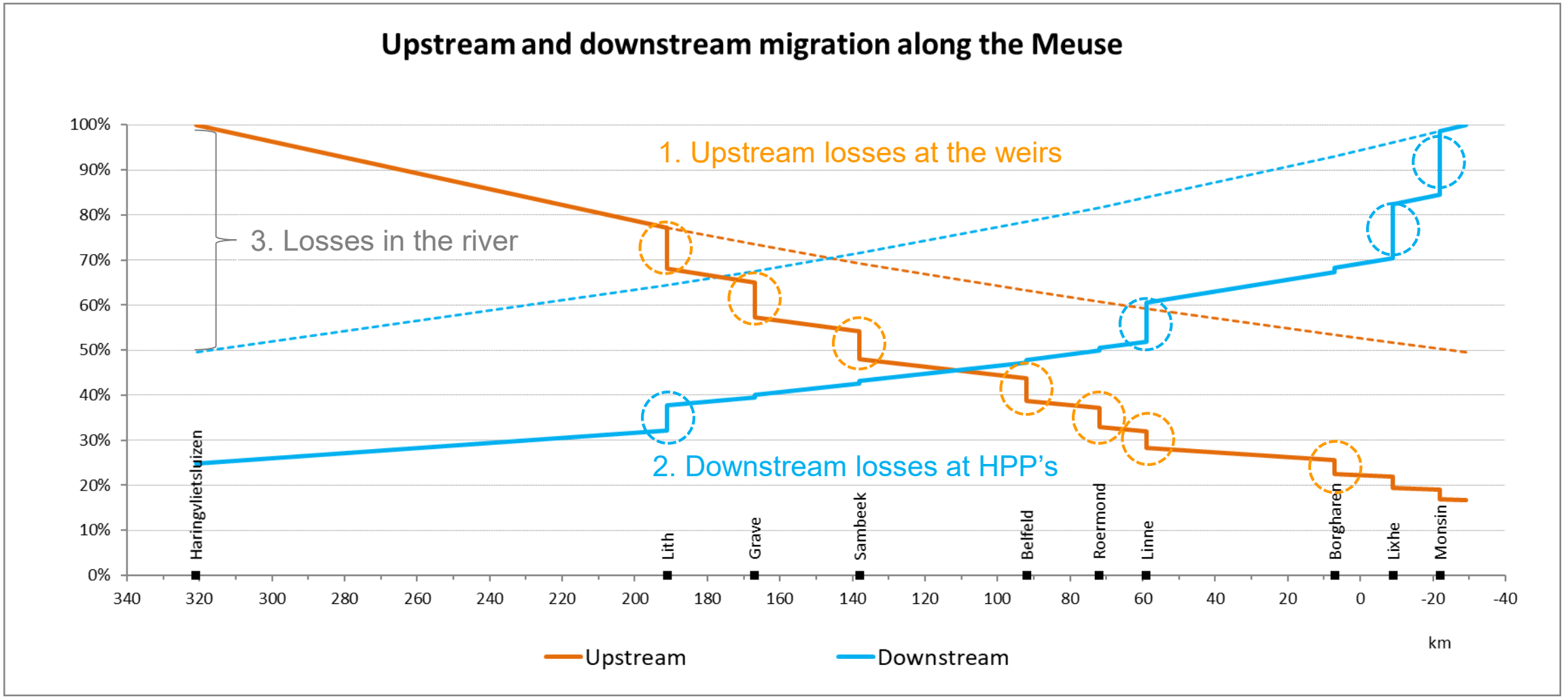
5. Migration in river system



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Eel, average discharge

Recommendations for weir renewal

- Upstream migration
  - Create next to each object in the weir complex a fish passage
  - Increase the flow in the fish passage with water from the HPP or weir or lock
  - Build weirs that can distribute the discharge over the width of the river (to guide the fish to the entrance of the fish passage)

- Downstream migration
  - Adjust the hydraulic conditions upstream of the weir to guide fish away from the entrance of the HPP
  - Increase the size of the stilling basin to reduce turbulance
  - Switch-off the HPP during migration peaks
  - Only use “fish friendly” turbines in the HPP

- River stretches
  - Improve habitats along the river (feeding, breeding, resting, shelter, etc.) to minimize losses.

Questions ?

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