

Downstream migration through a shipping canal: challenges on the road

BIOMATH



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NATURE AND FOREST



Jenna Vergeynst

jenna.vergeynst@ugent.be

Atlantic salmon

95 cm
6.7 kg



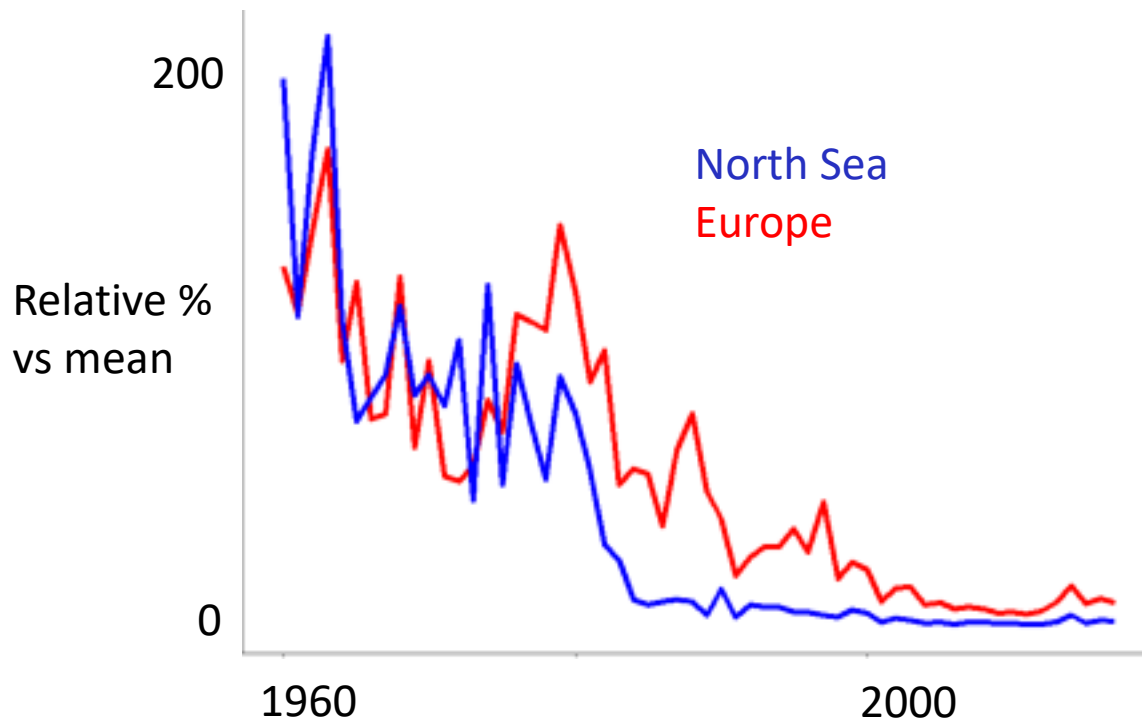
European eel



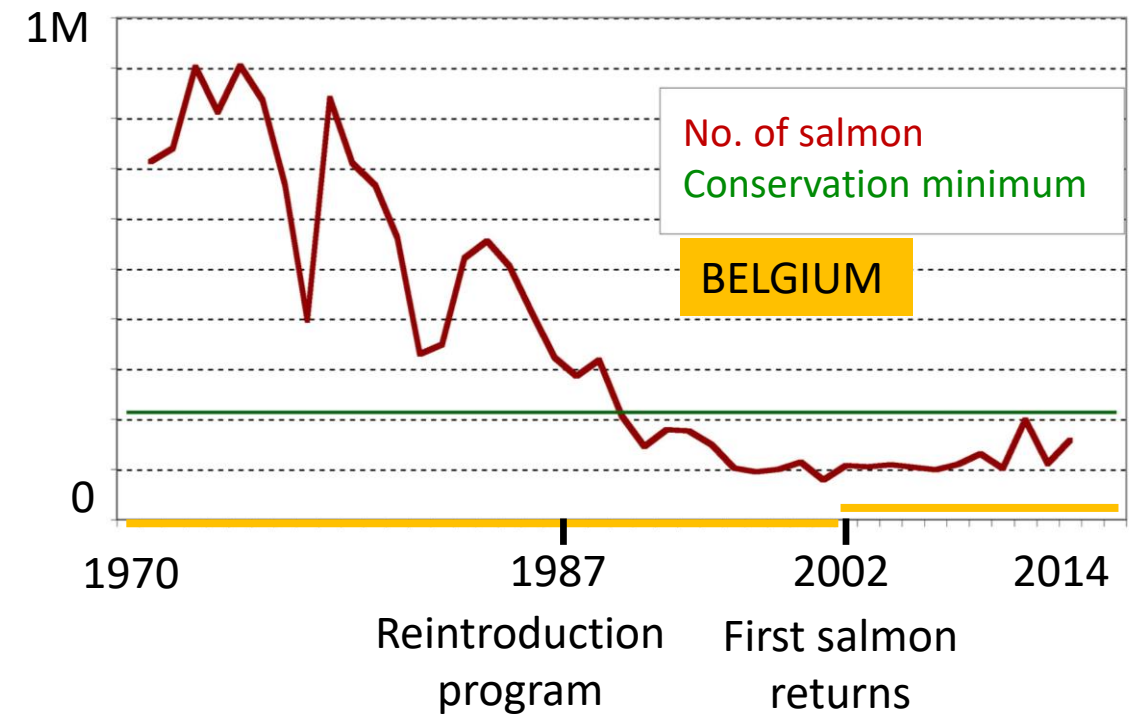


European eel and Atlantic salmon are worldwide in decline

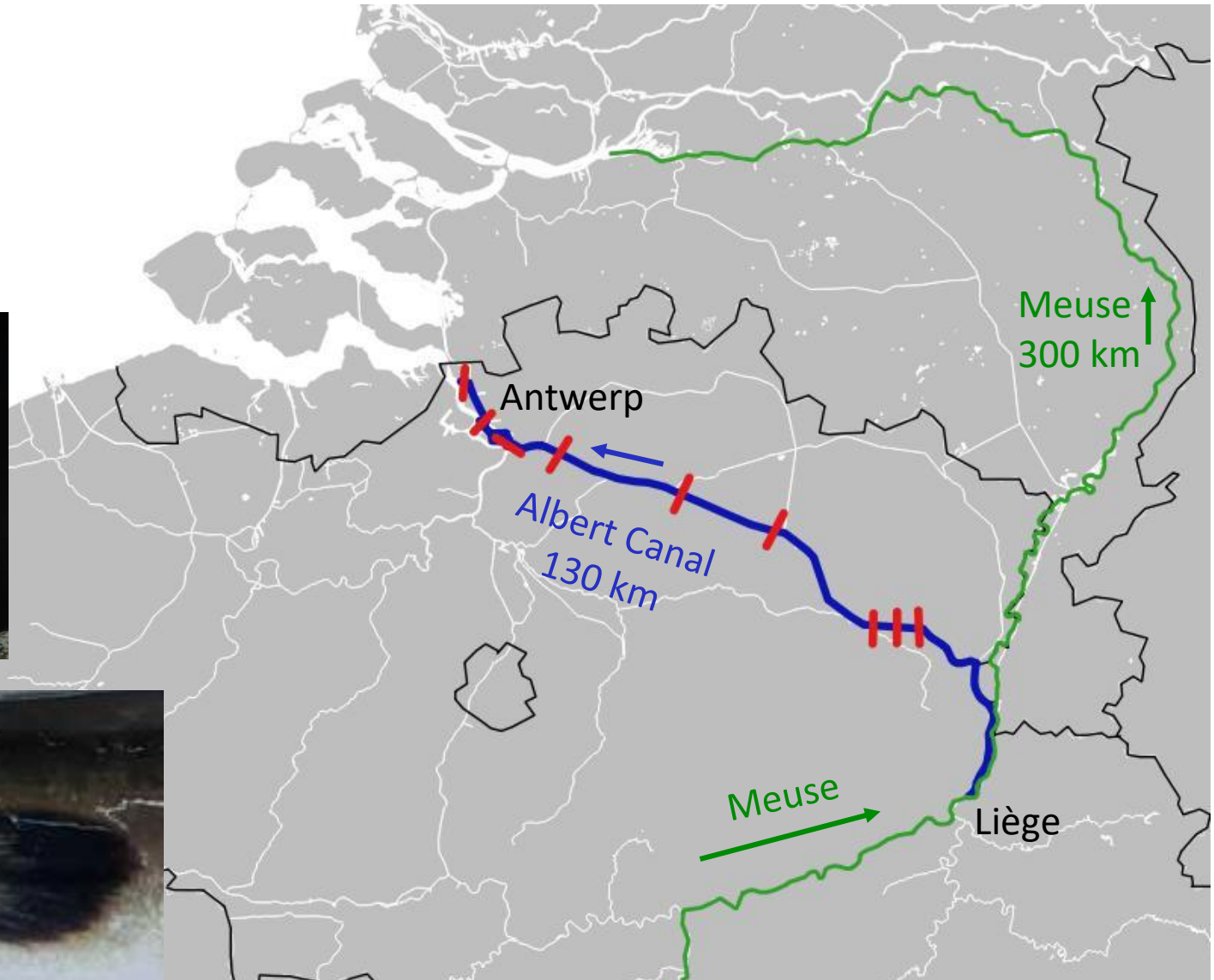
European eel (*Anguilla anguilla*)
90-99% decline since 1980s (ICES 2015)



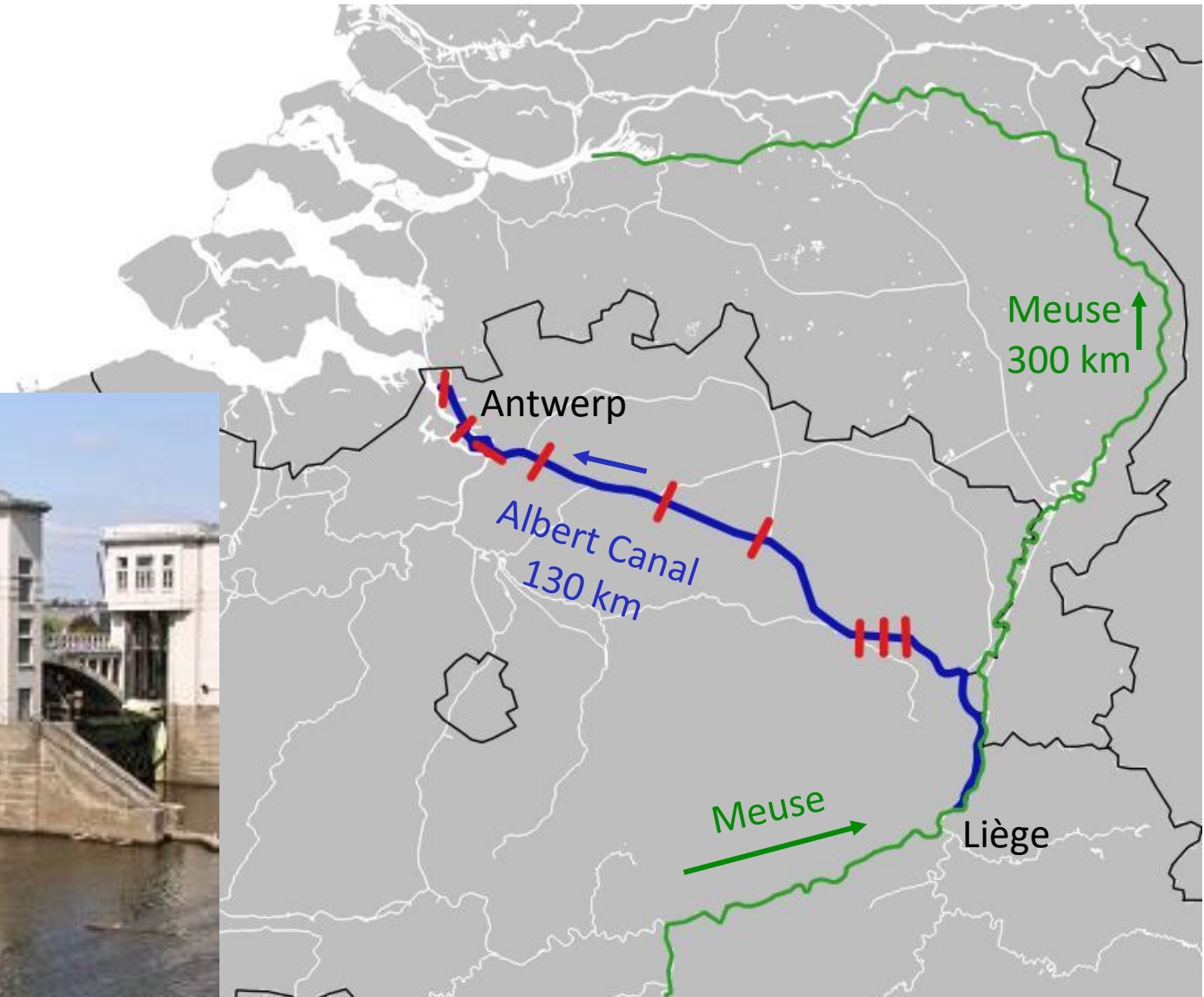
Atlantic salmon (*Salmon salar*)
90% decline since 1970s (ICES 2013)



Salmon smolts and silver eels migrate downstream in the Meuse River

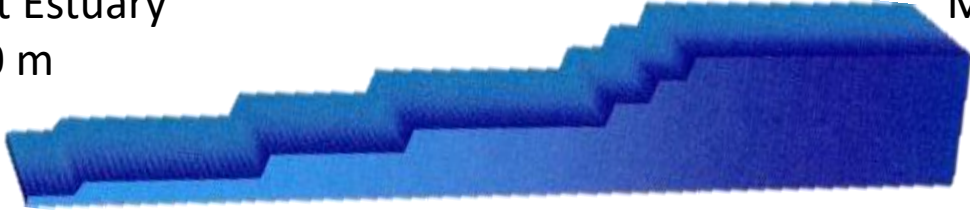


The Meuse is dam(n)ed...

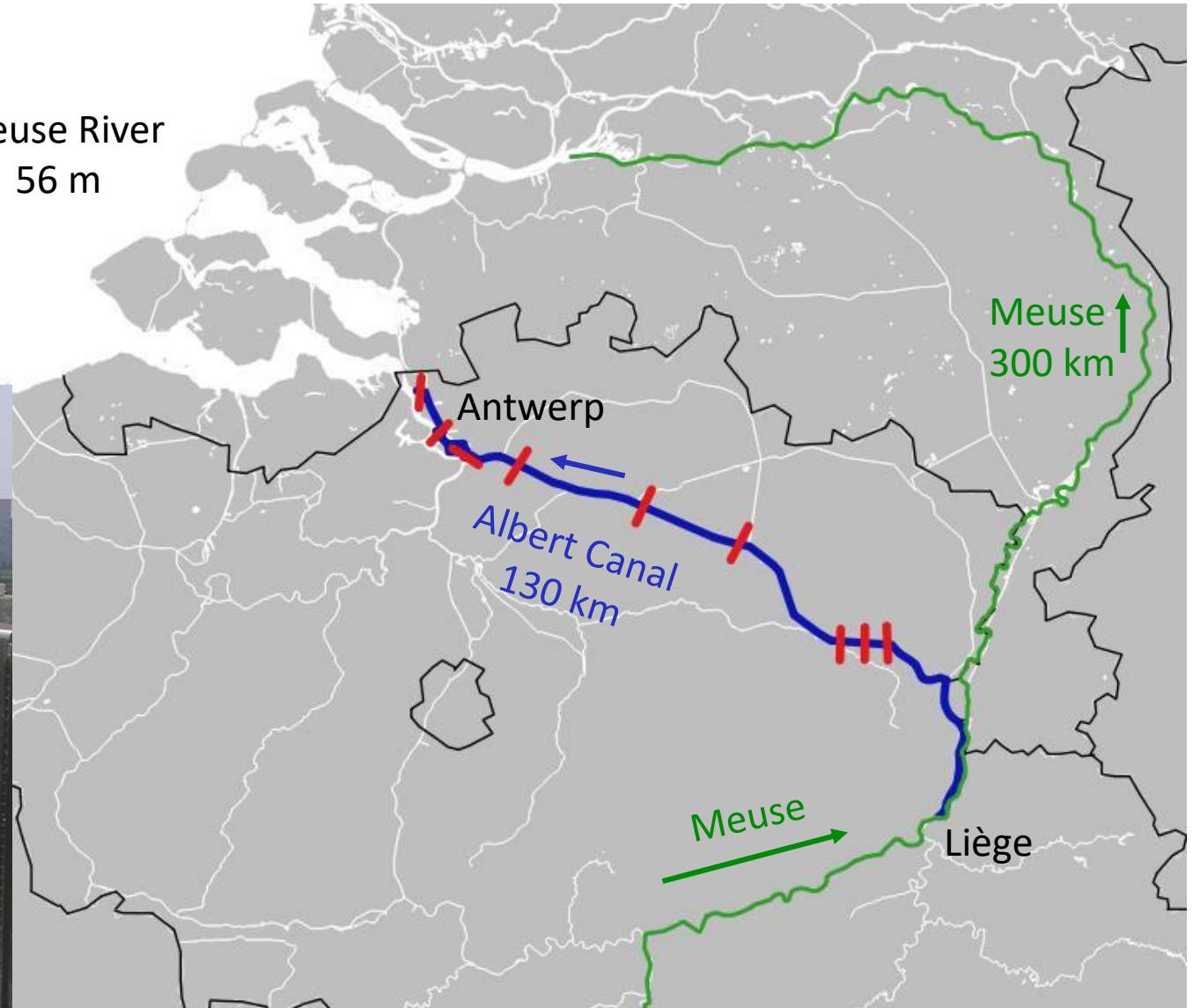


The Albert Canal has navigation locks...

Scheldt Estuary
0 m



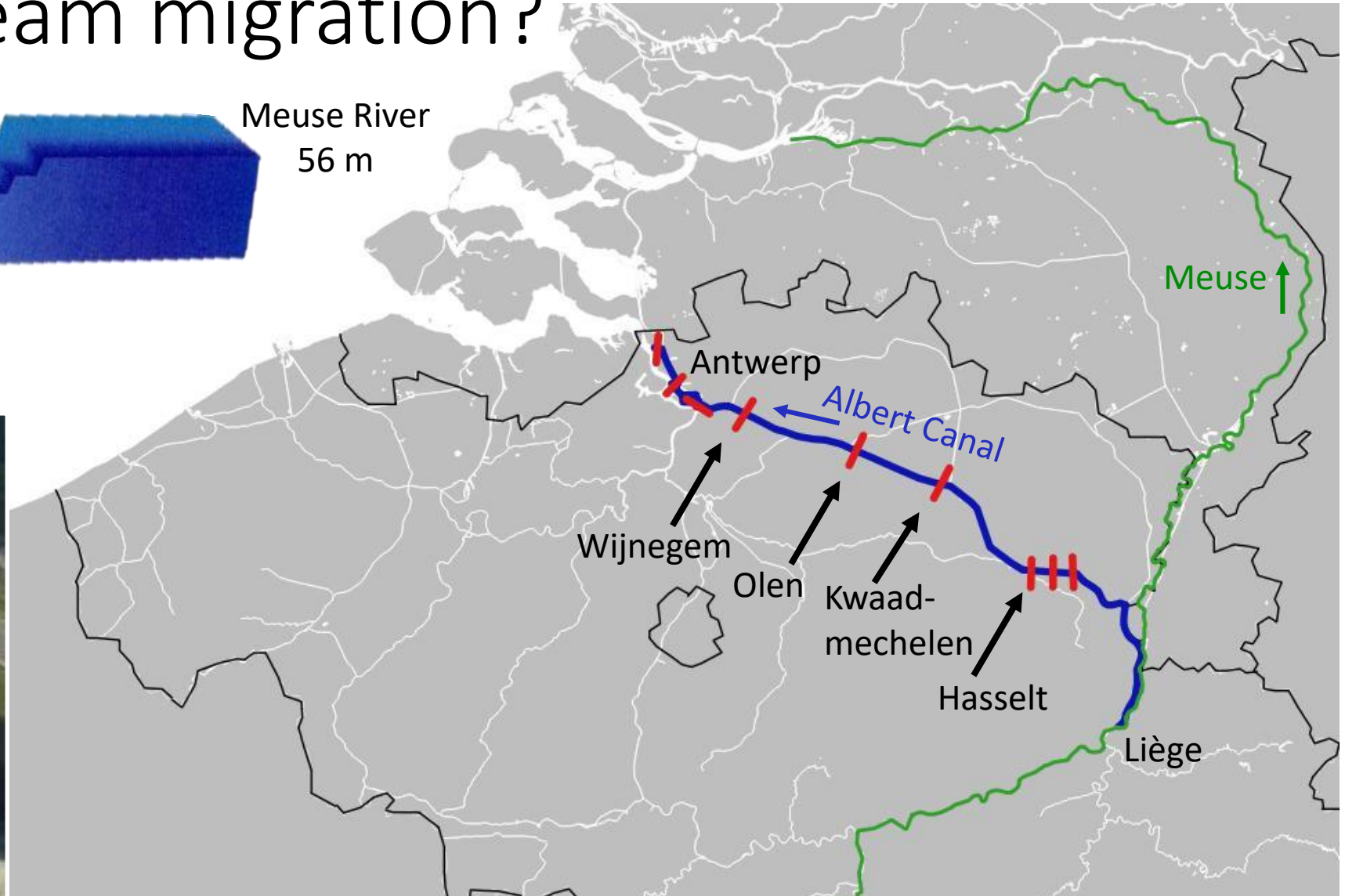
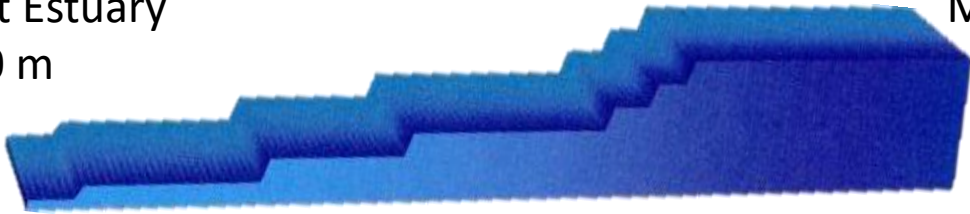
Meuse River
56 m



The Albert Canal: short-cut or ecological trap for downstream migration?

Scheldt Estuary
0 m

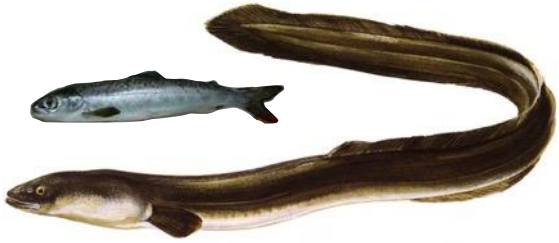
Meuse River
56 m



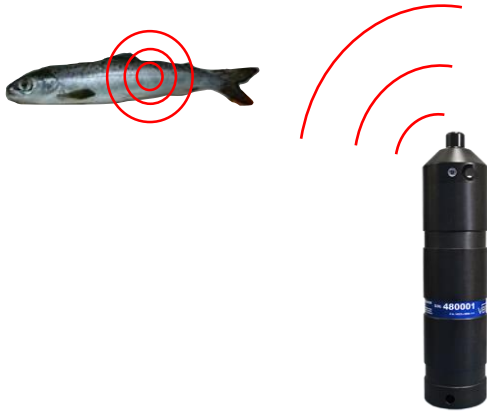
The Albert Canal: short-cut or ecological trap?

2 tools

Two indicator species



Acoustic telemetry

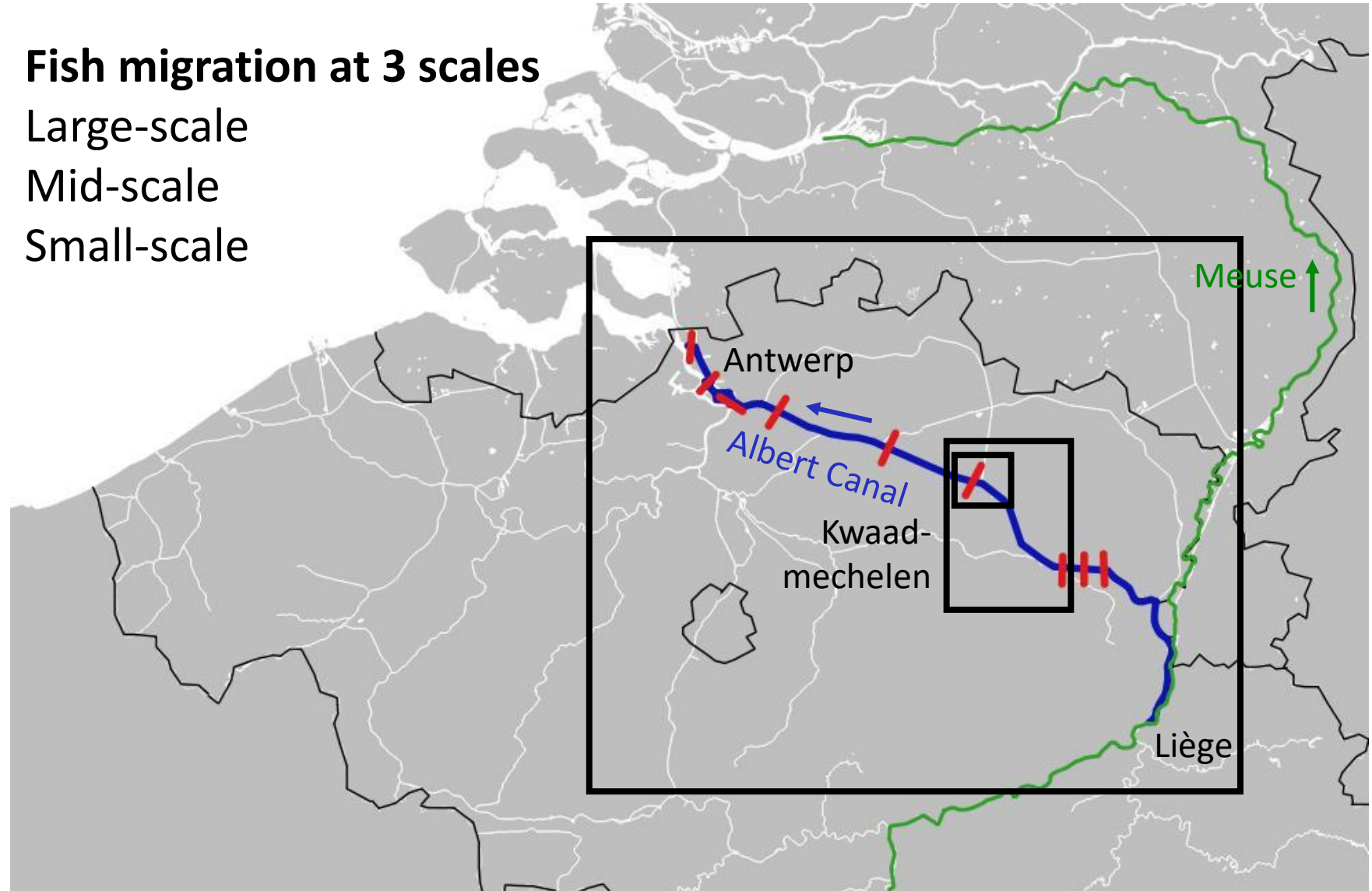


Fish migration at 3 scales

Large-scale

Mid-scale

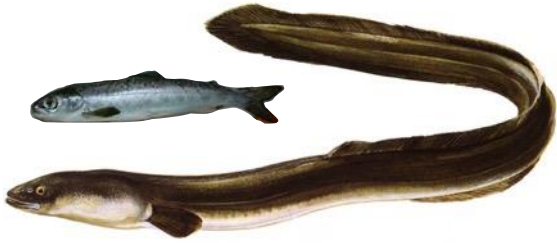
Small-scale



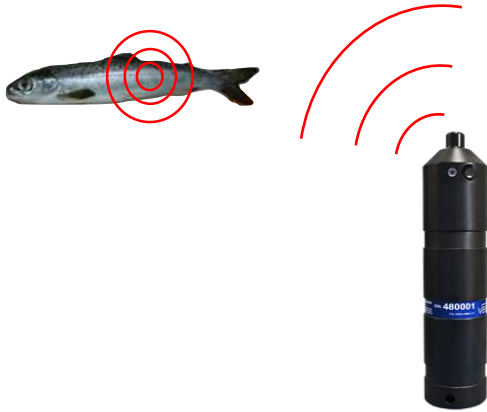
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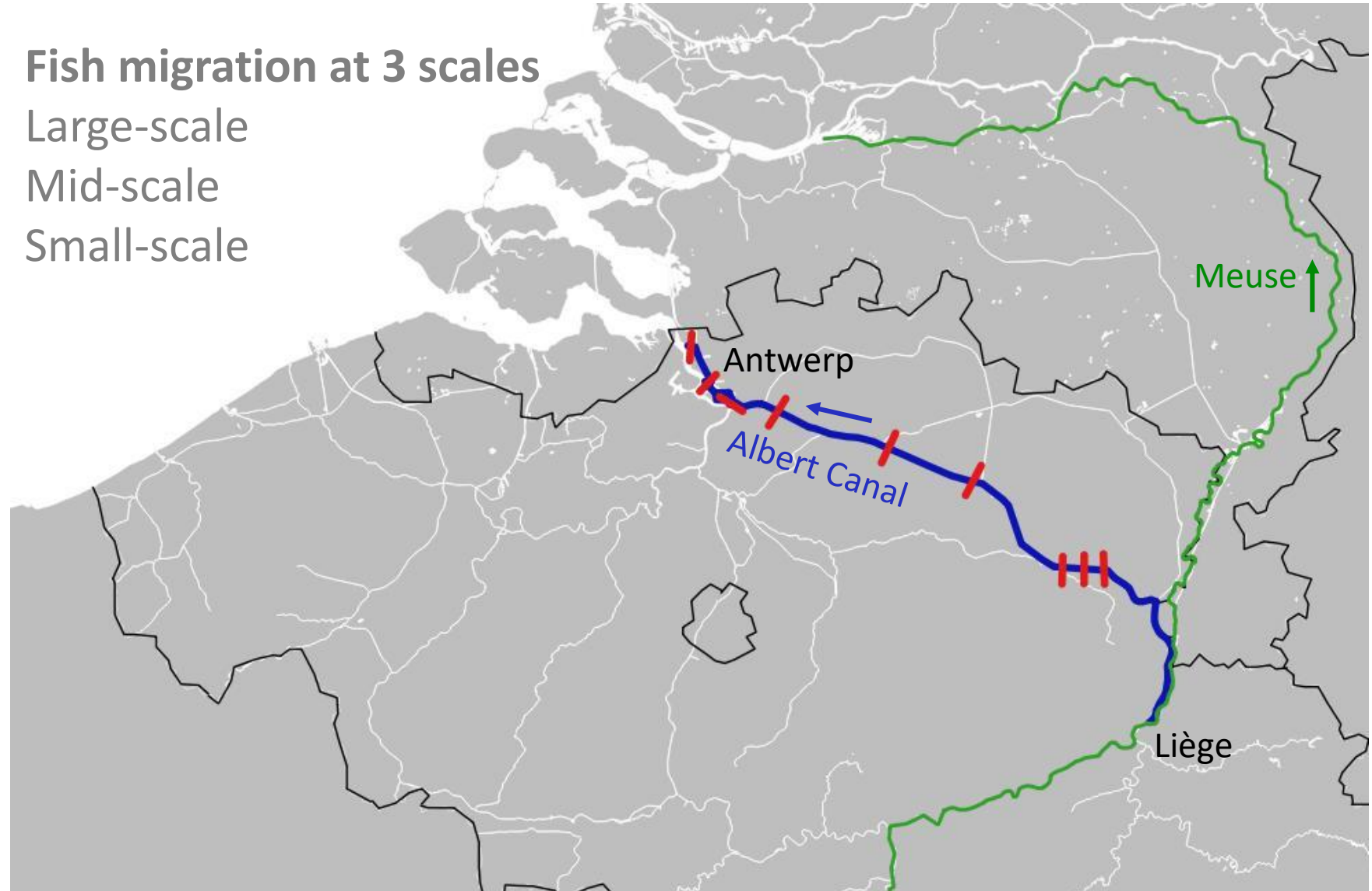


Fish migration at 3 scales

Large-scale

Mid-scale

Small-scale



Tagging expert Raf Baeyens (INBO) in operation

European eel (silver eel)



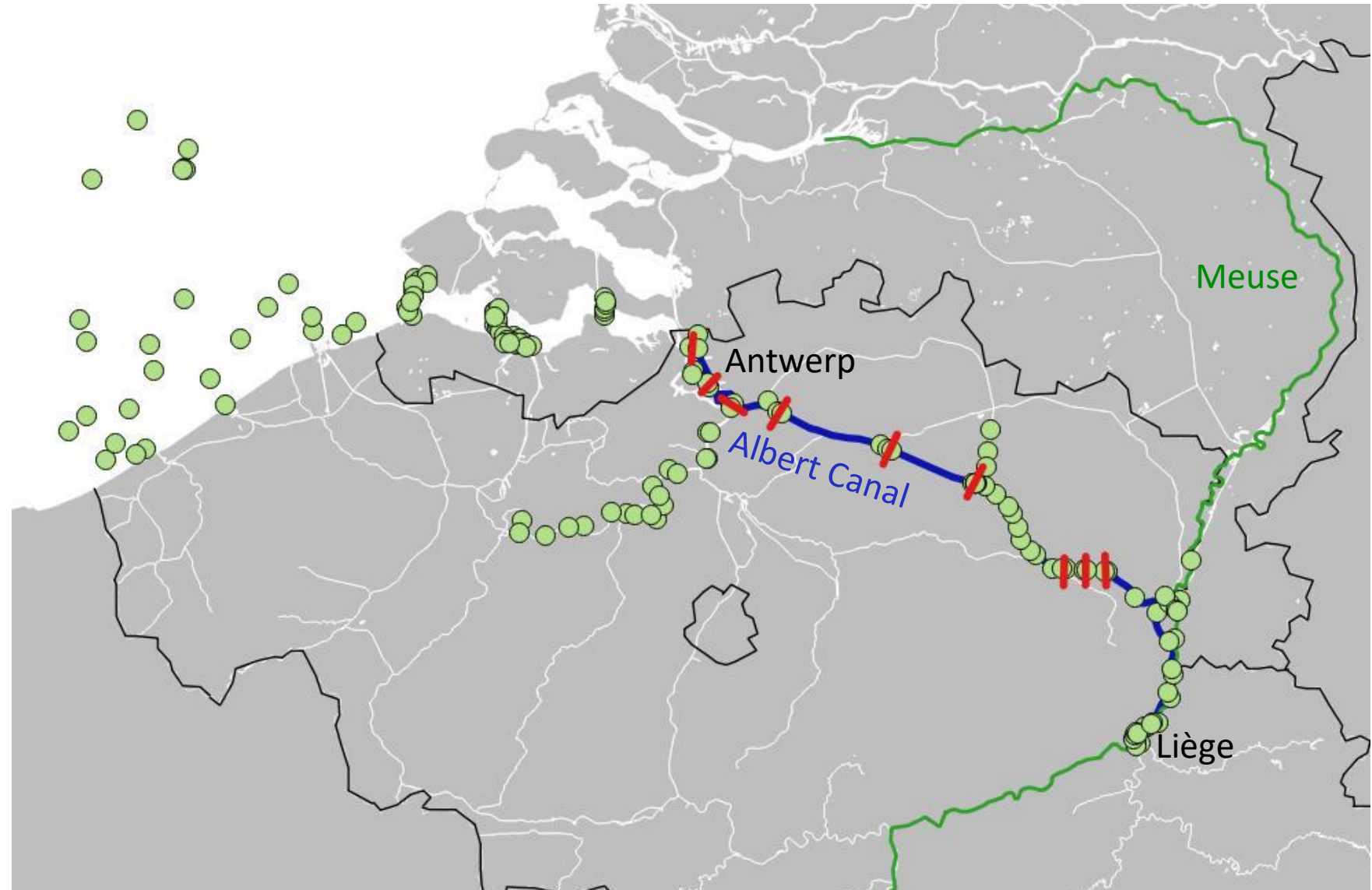
Atlantic salmon (smolt)



The Belgian Receiver Network for fish tracking



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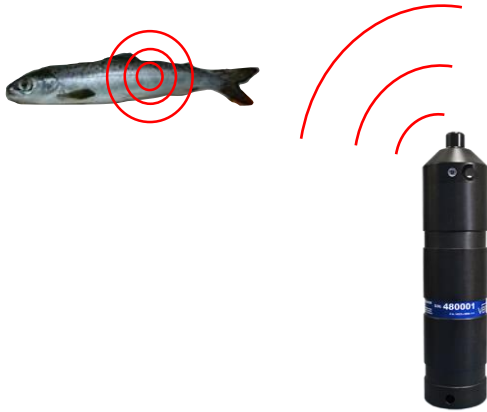
The Albert Canal: short-cut or ecological trap?

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Two indicator species



Acoustic telemetry

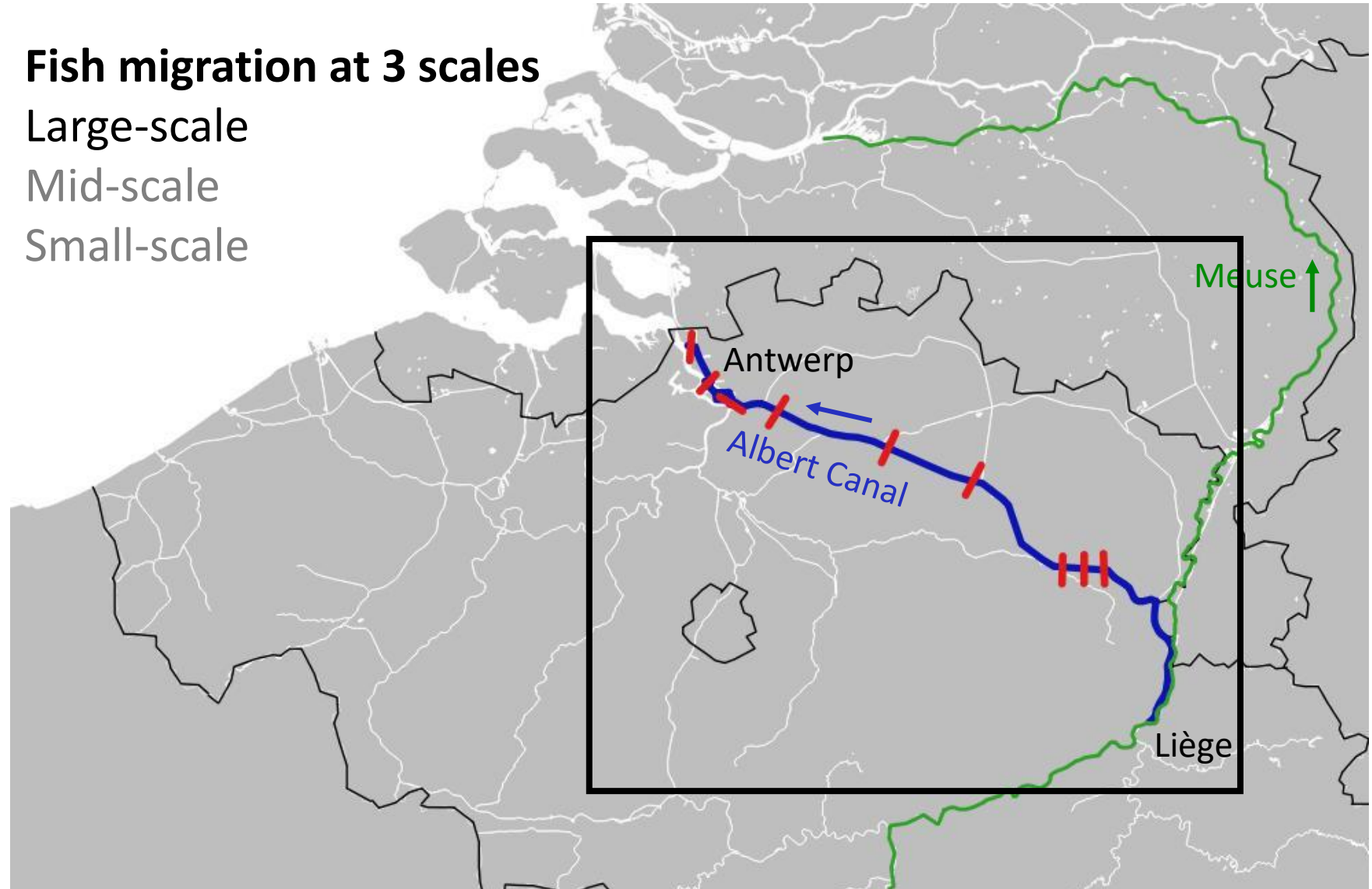


Fish migration at 3 scales

Large-scale

Mid-scale

Small-scale

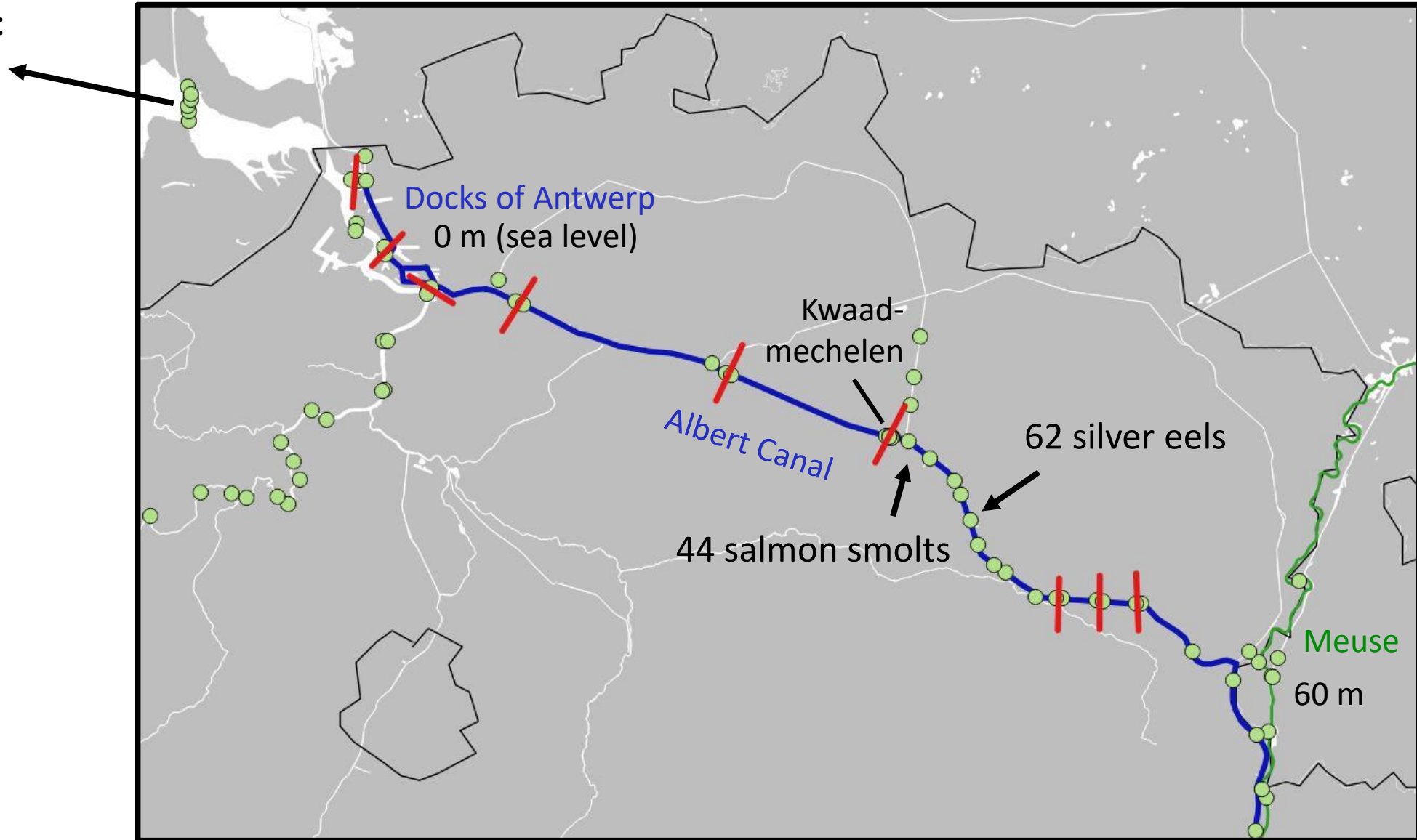


3 lock complexes and 1 tidal sluice to overcome

Escapement to the sea:

23% of silver eels

9% of salmon smolts



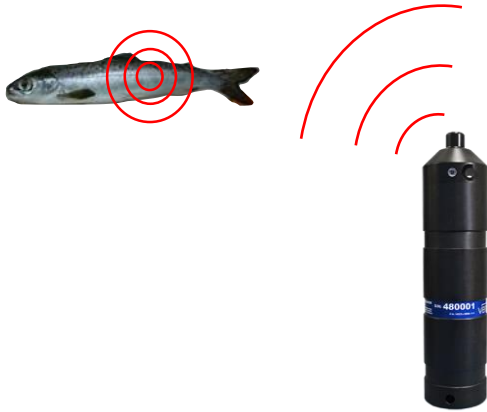
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2 tools

One indicator species



Acoustic telemetry

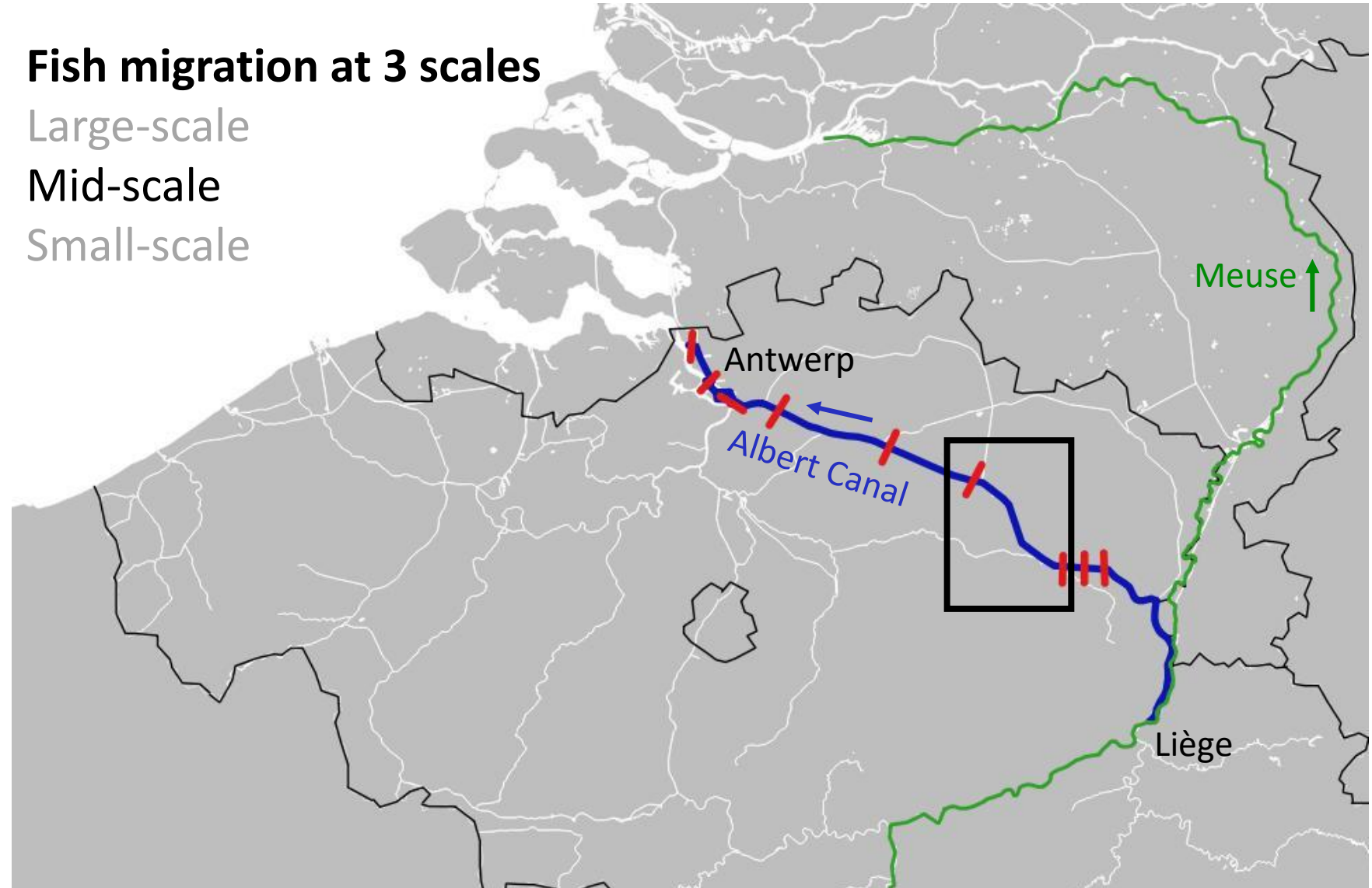


Fish migration at 3 scales

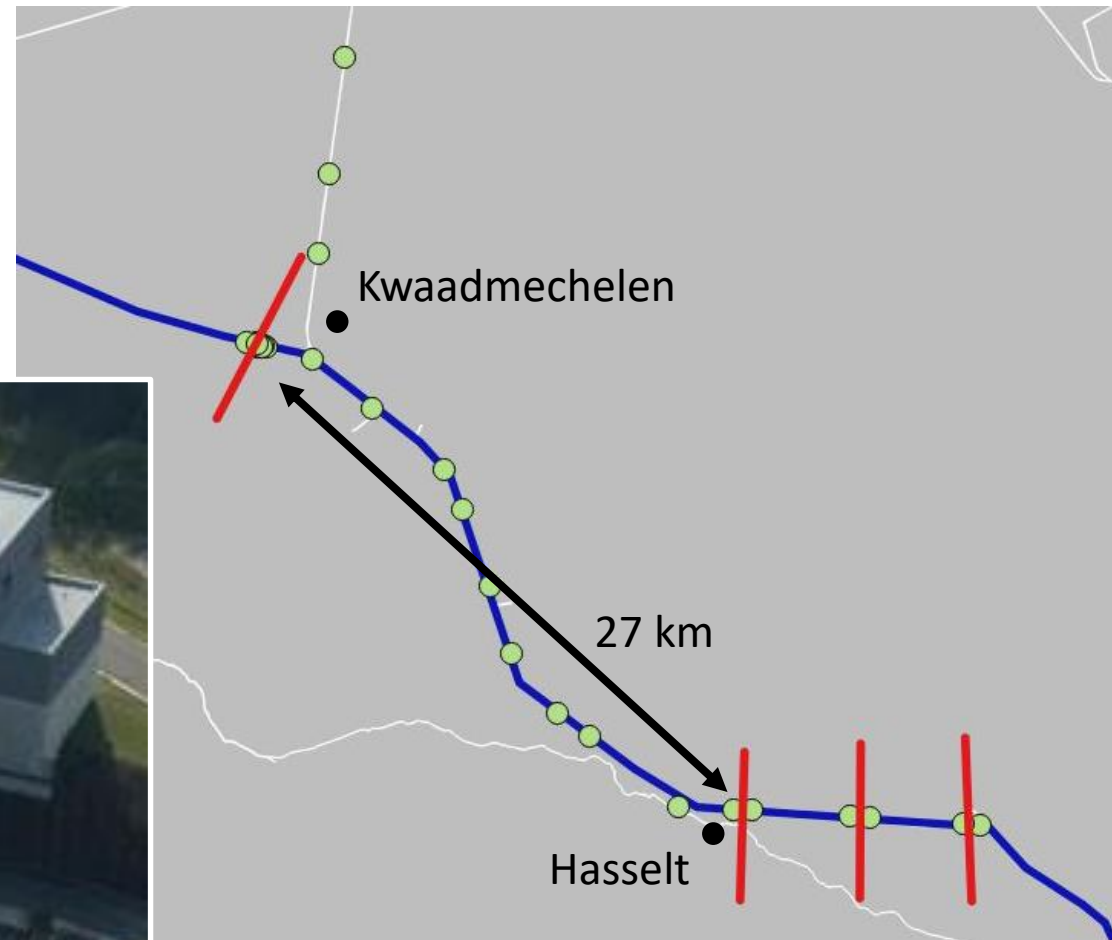
Large-scale

Mid-scale

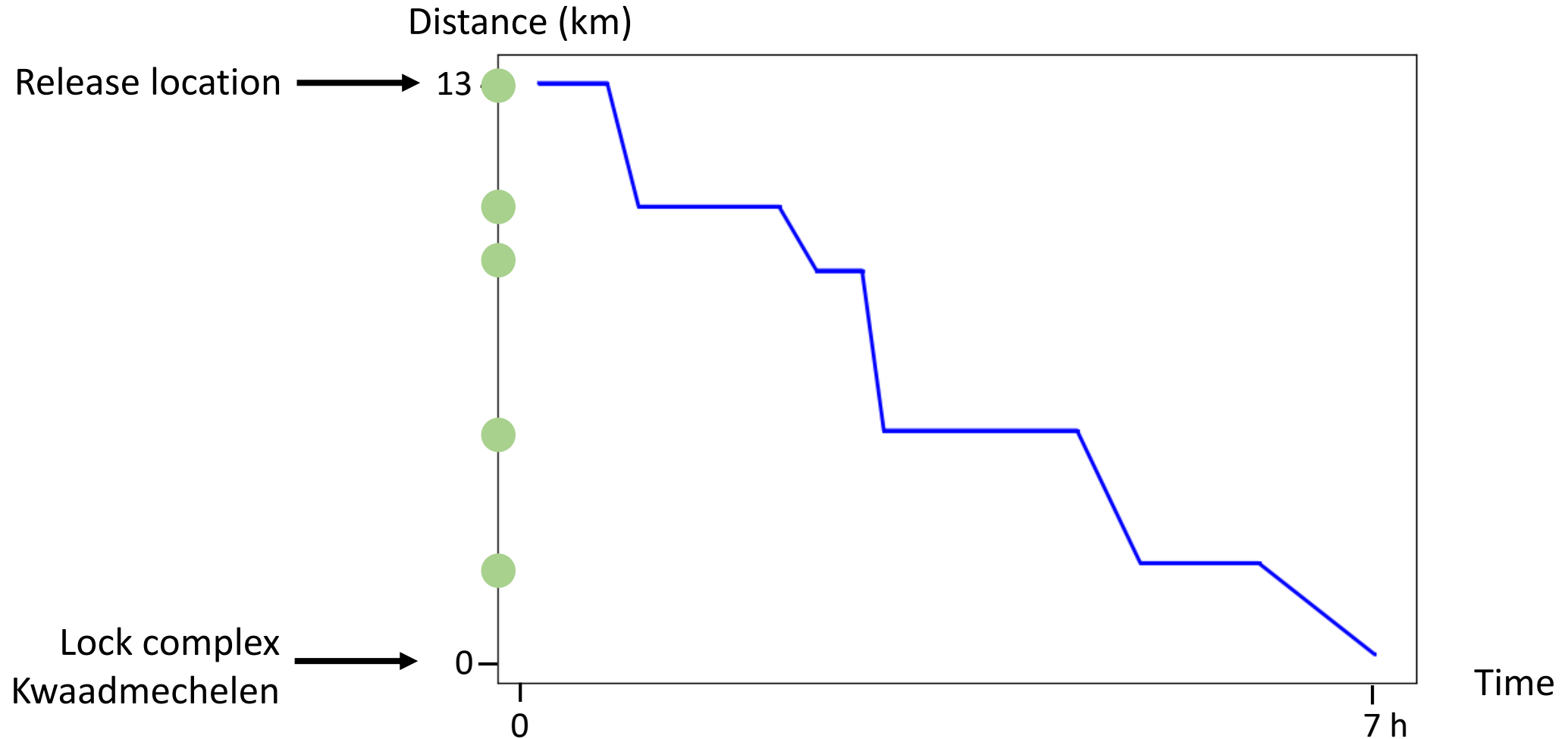
Small-scale



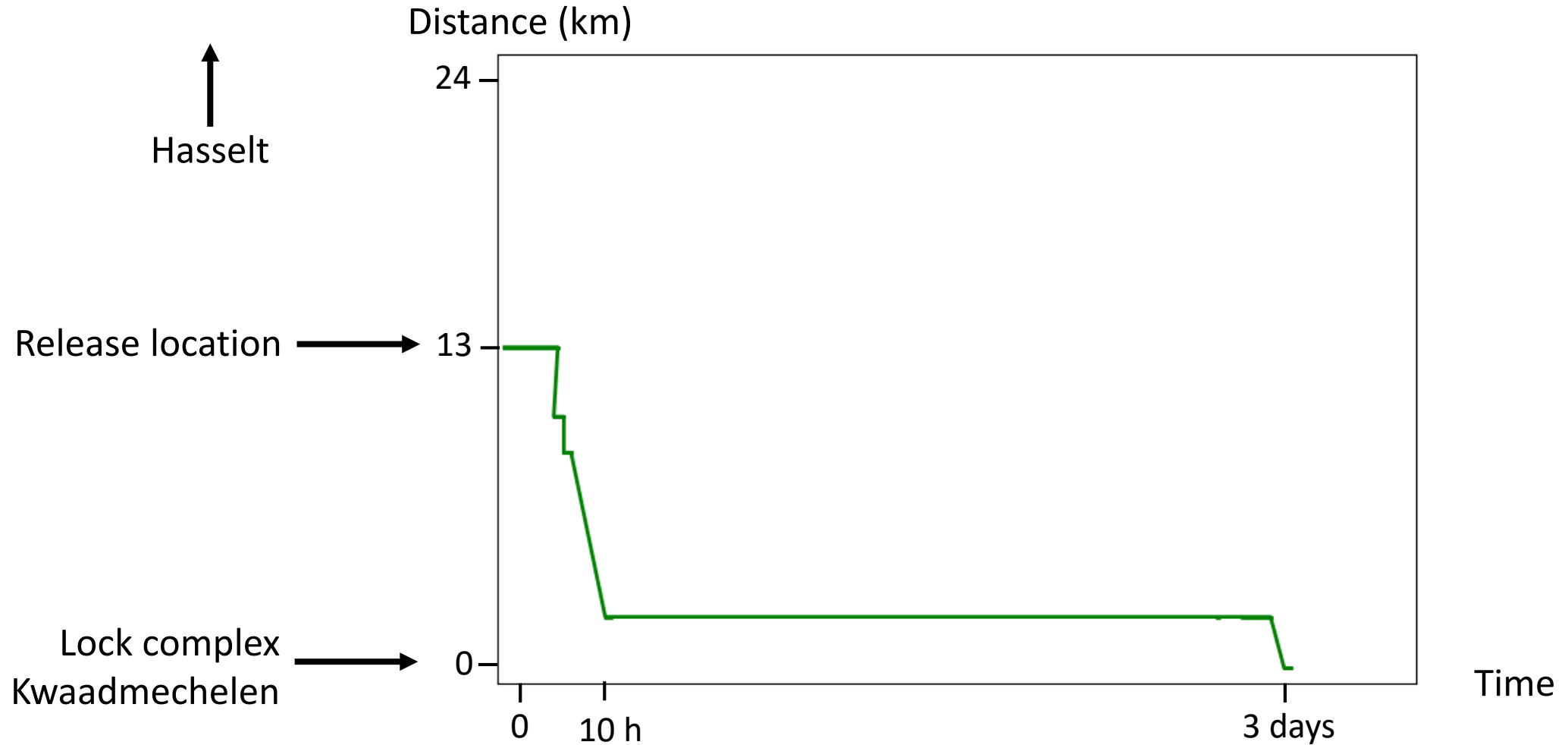
In the canal pound between Kwaadmechelen and Hasselt, we placed 10 receivers 3 km apart



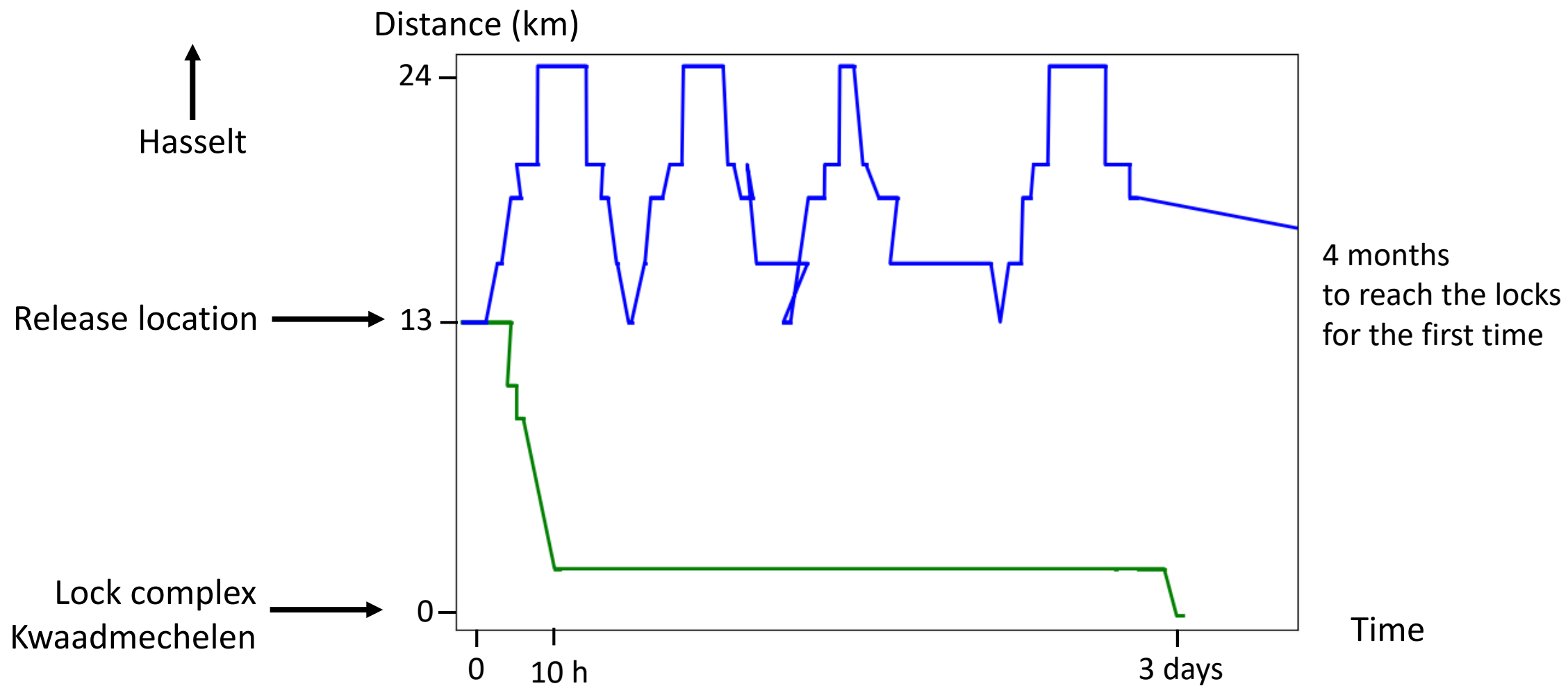
Some fish swim straight from release place to the downstream lock complex



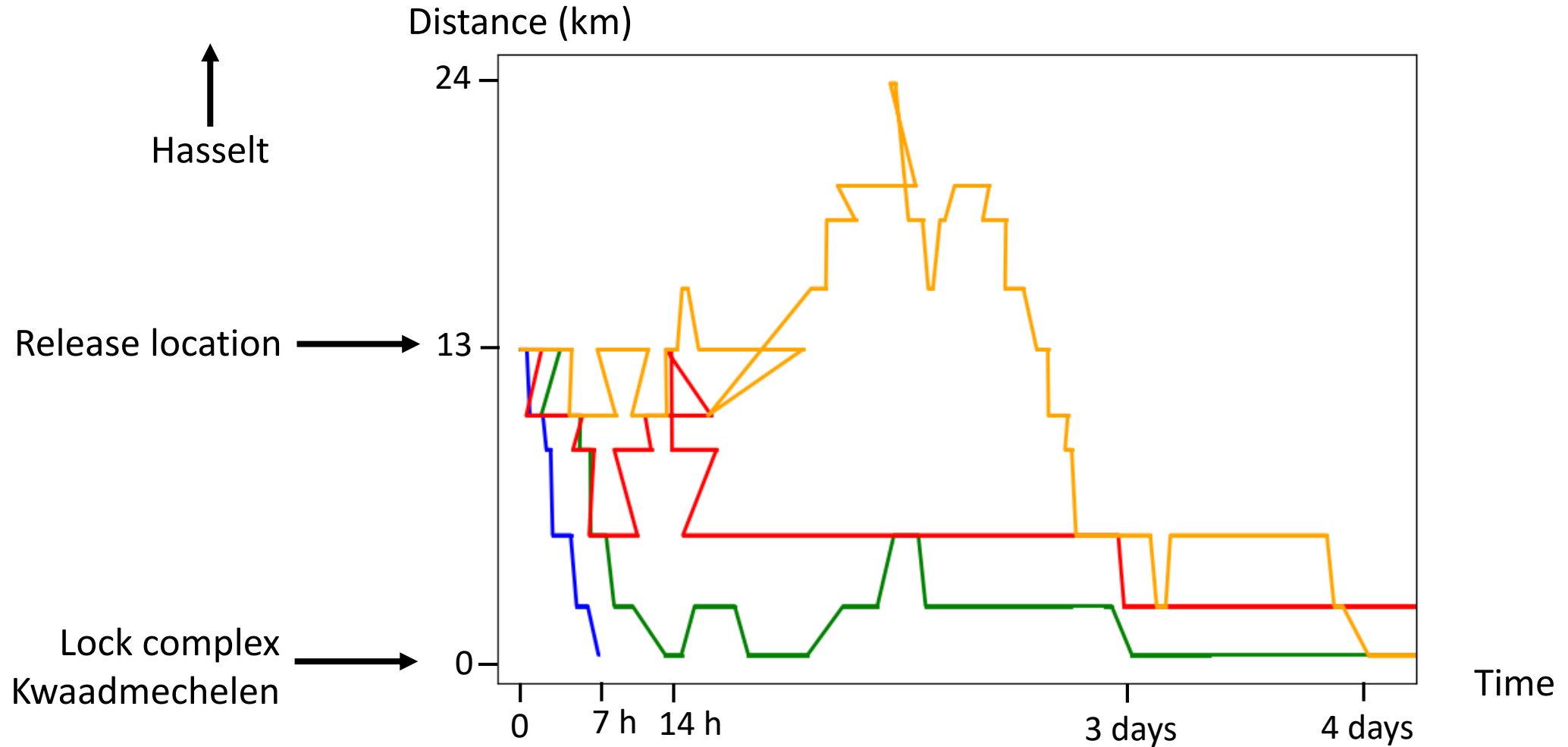
Some fish swim straight downstream but with some delay ...



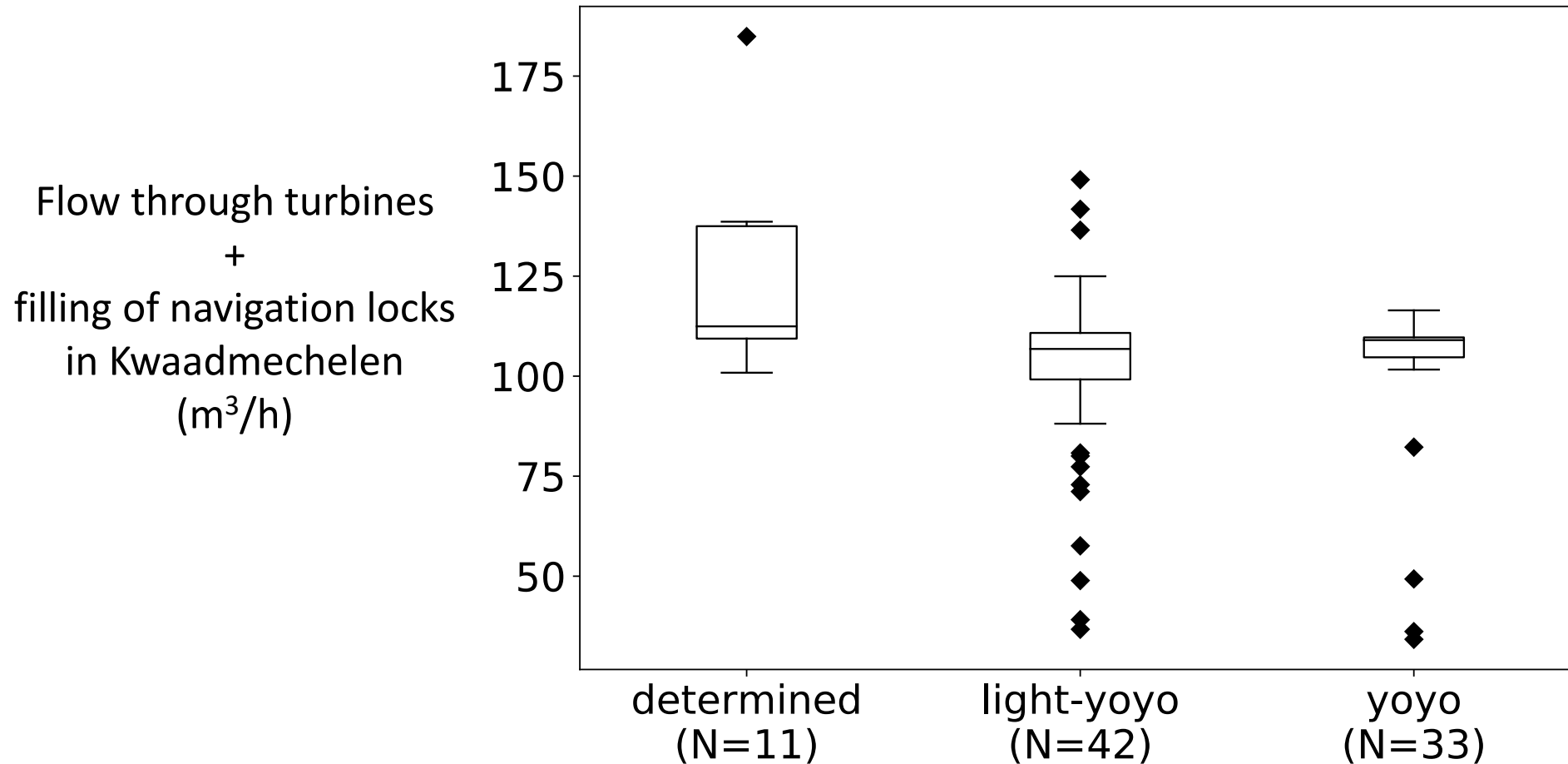
... other fish “go wild” completely...



A wide diversity of behaviours is possible



Determined fish also took advantage of beneficial circumstances



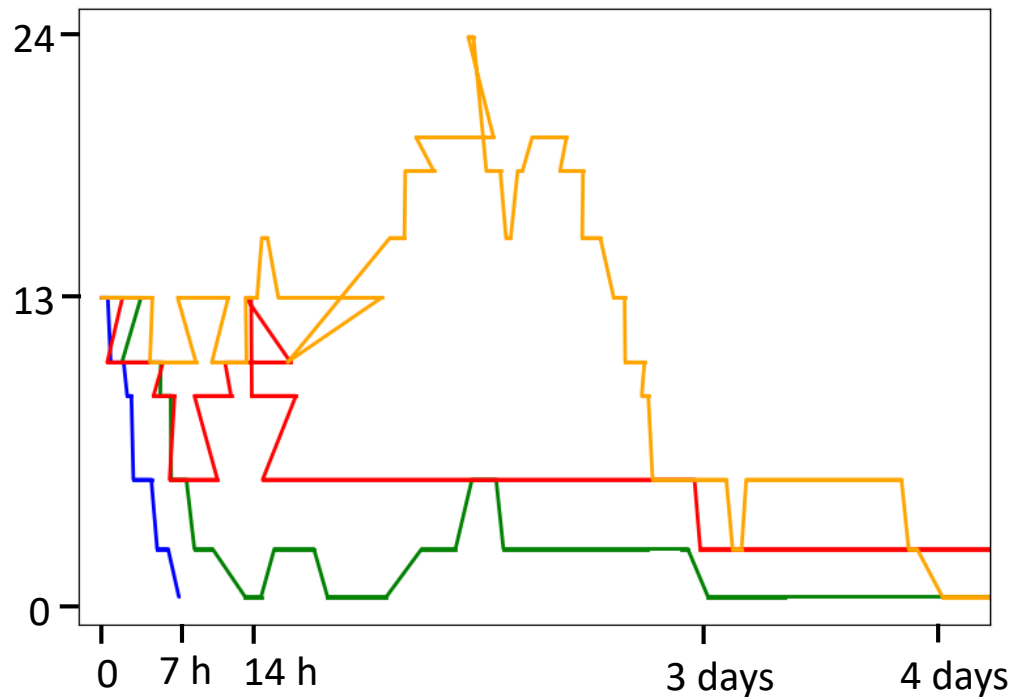
Fish behaviour in the canal pound probably results from a combination of ...

individual behaviour

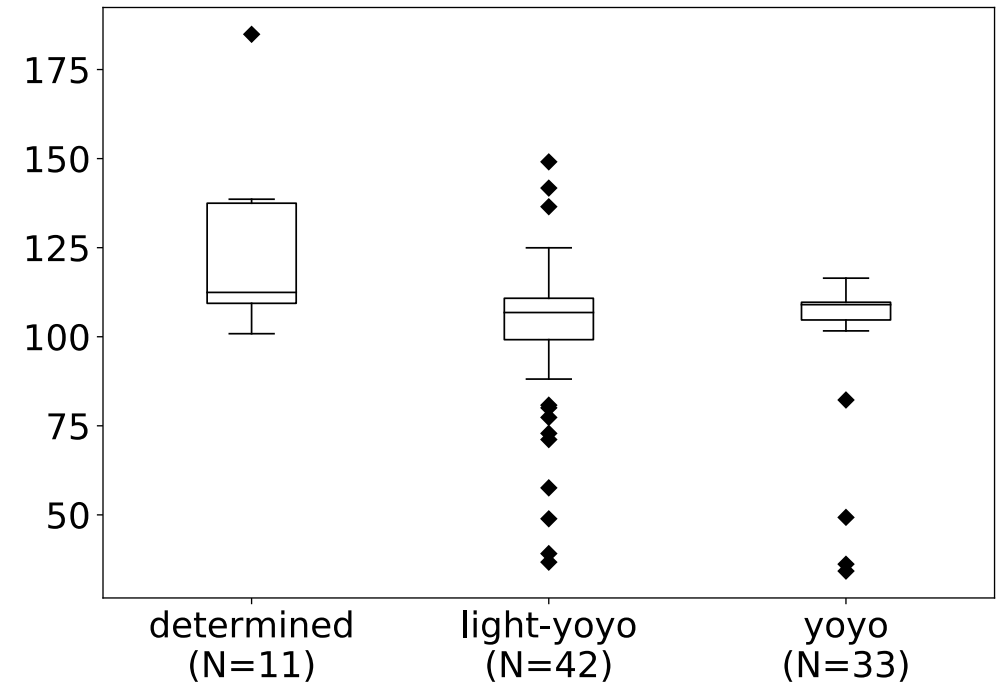
&

flow at the downstream complex
(Kwaadmechelen)

Distance (km)



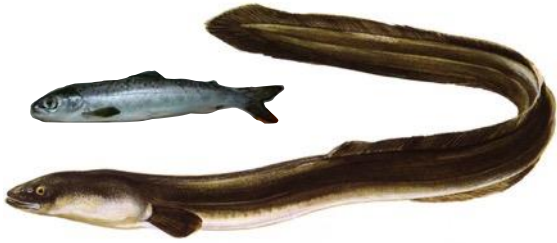
Flow (m³/h)



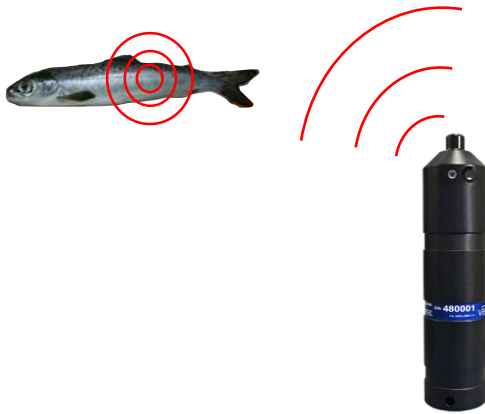
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Acoustic telemetry

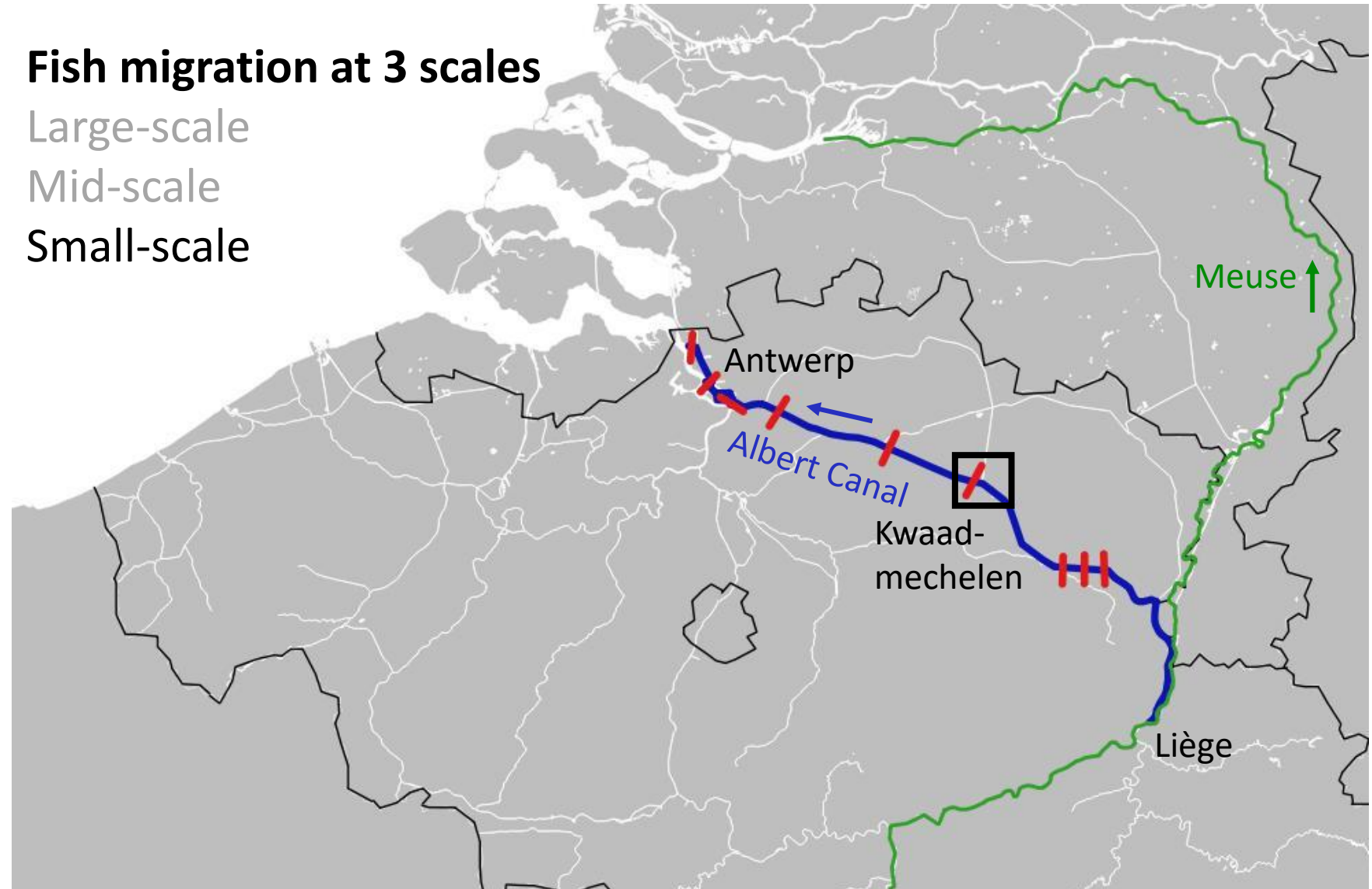


Fish migration at 3 scales

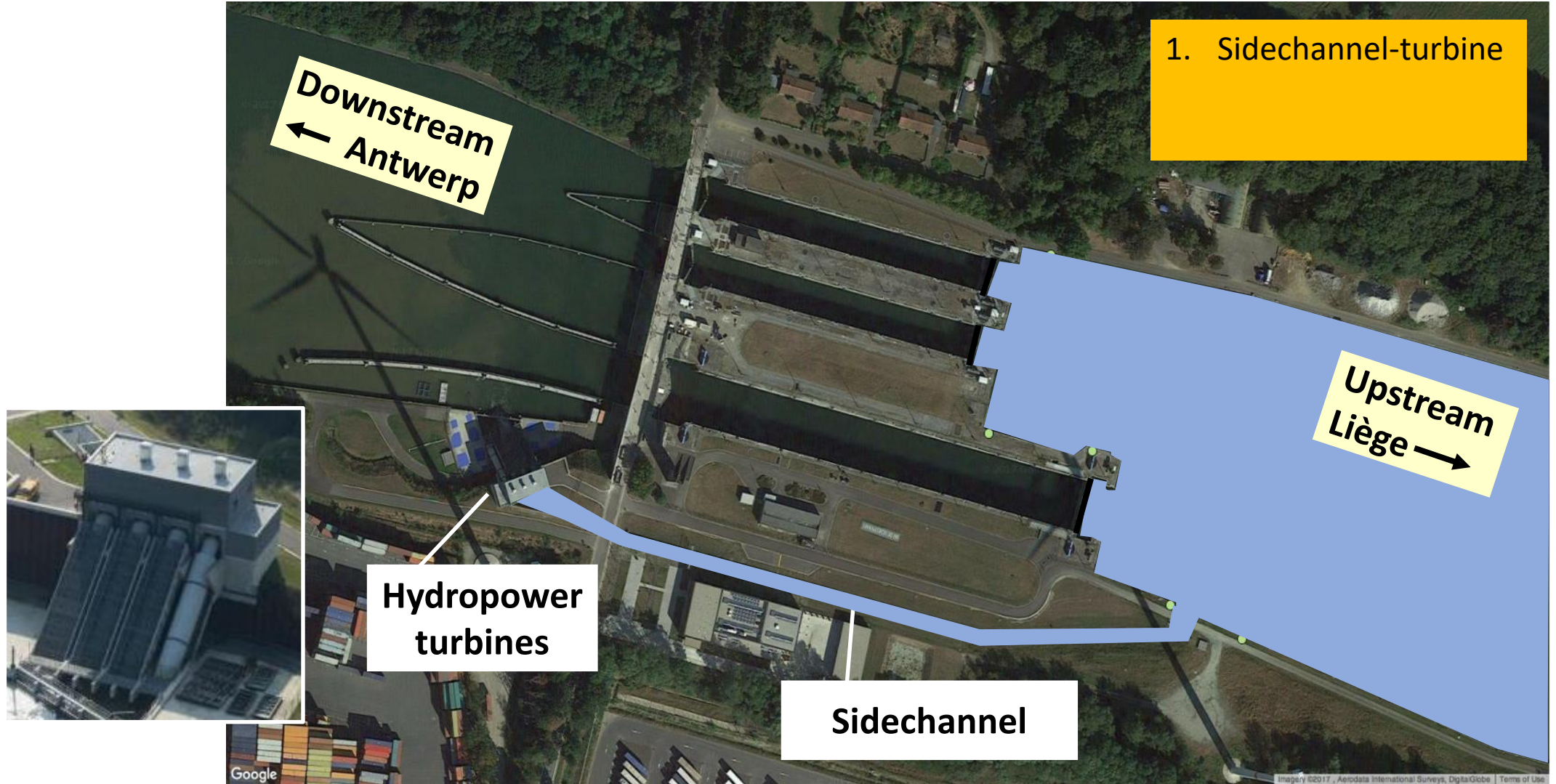
Large-scale

Mid-scale

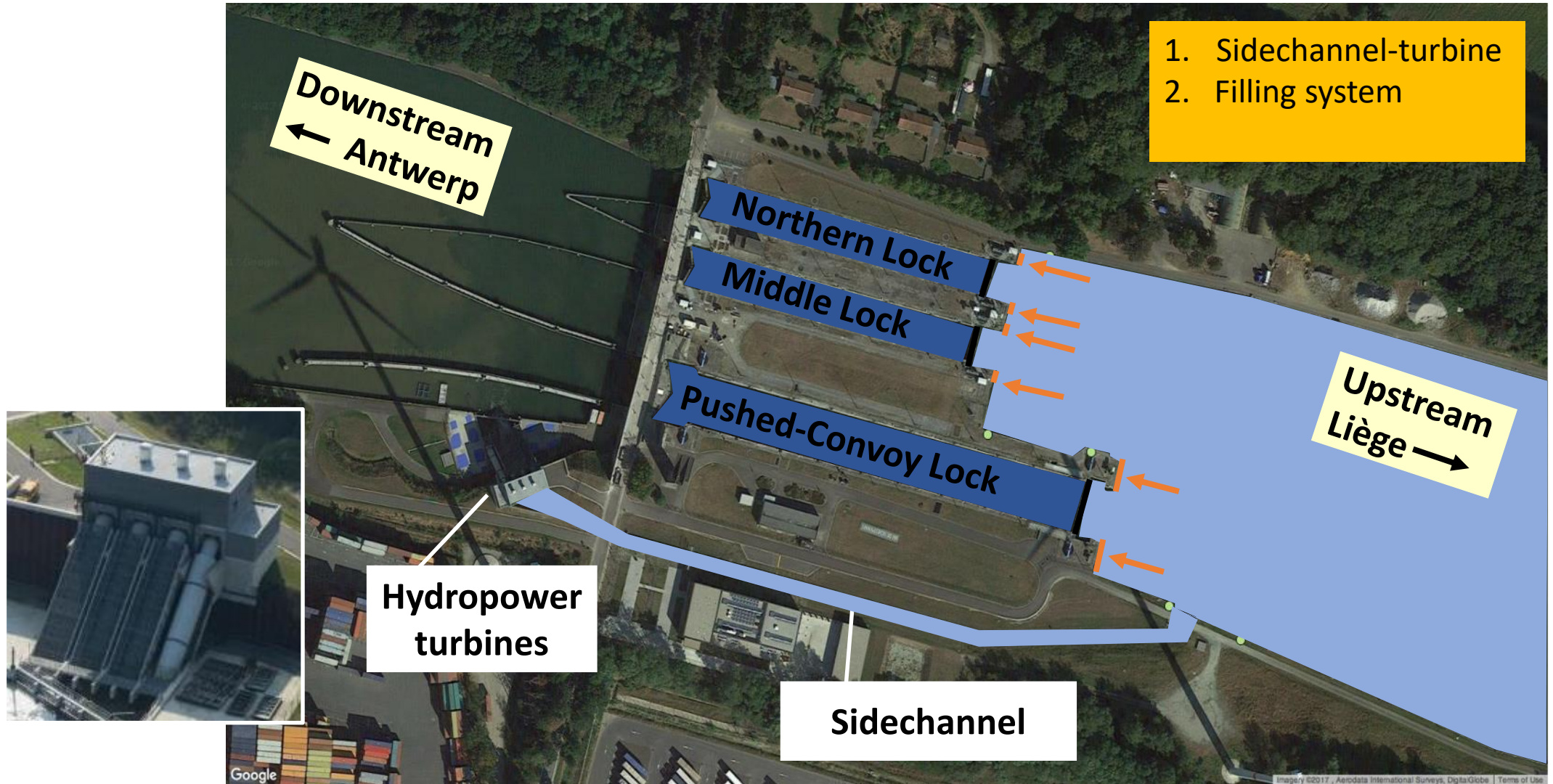
Small-scale



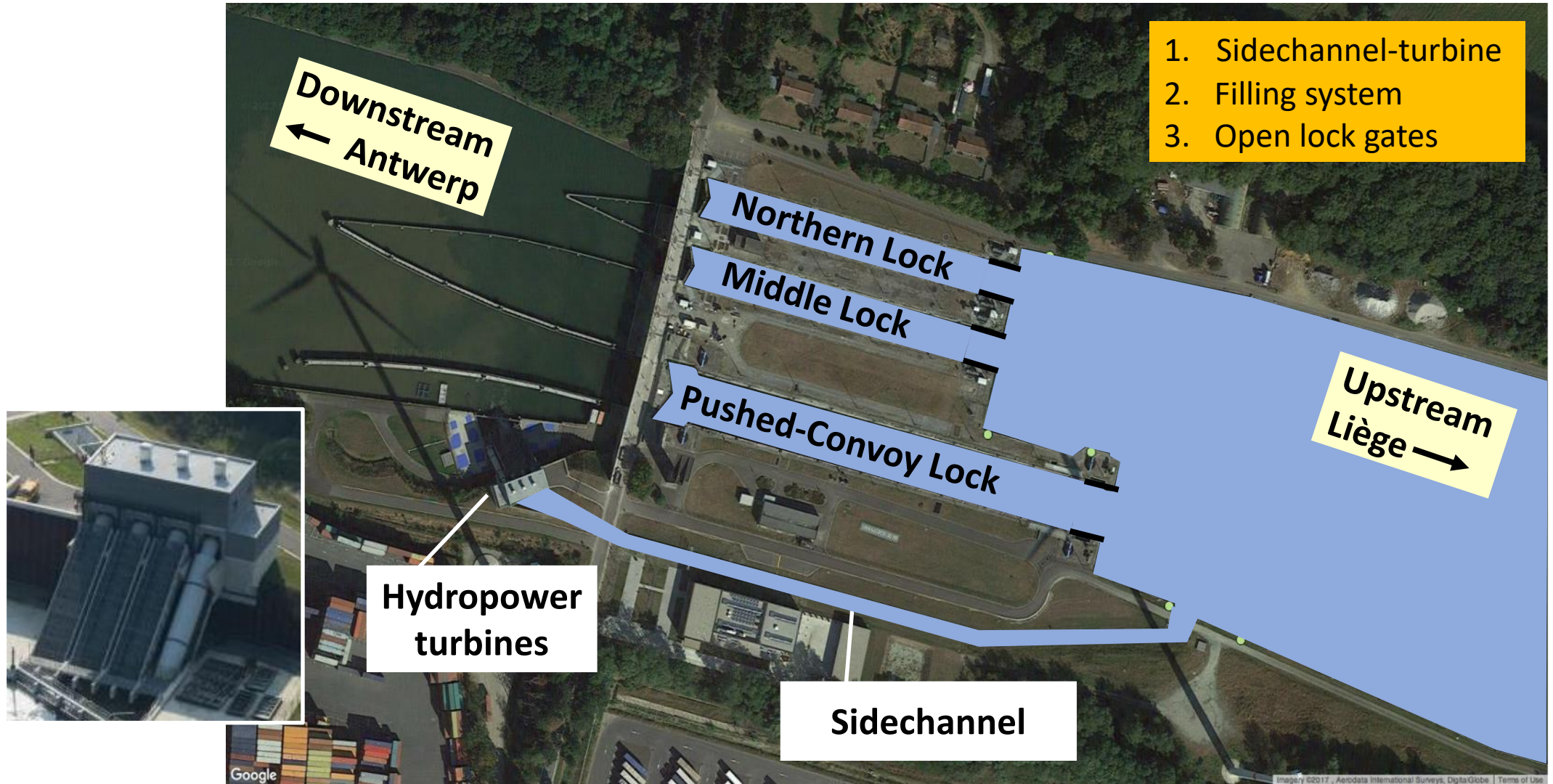
3 routes to pass the navigation lock complex



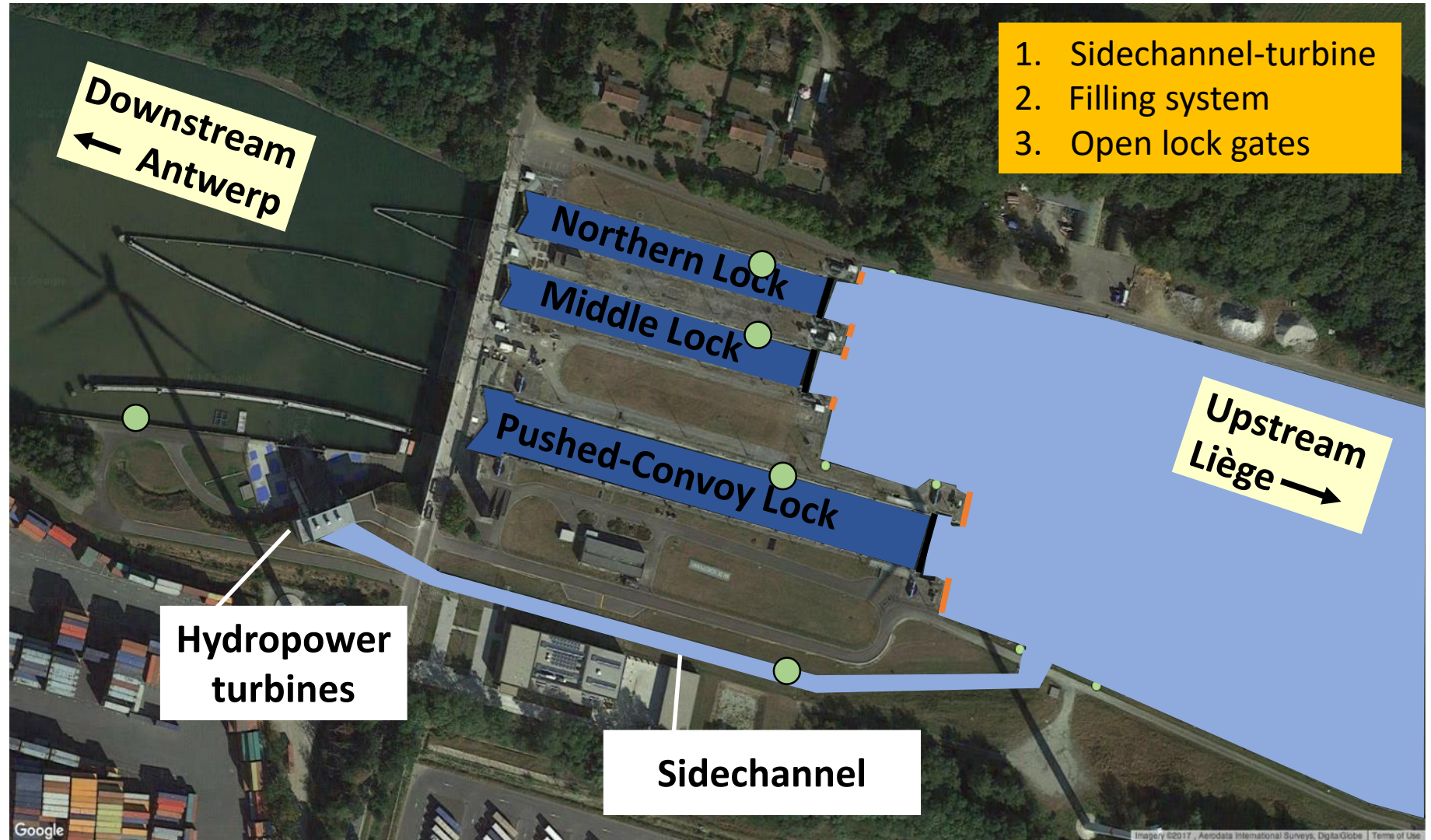
3 routes to pass the navigation lock complex



3 routes to pass the navigation lock complex

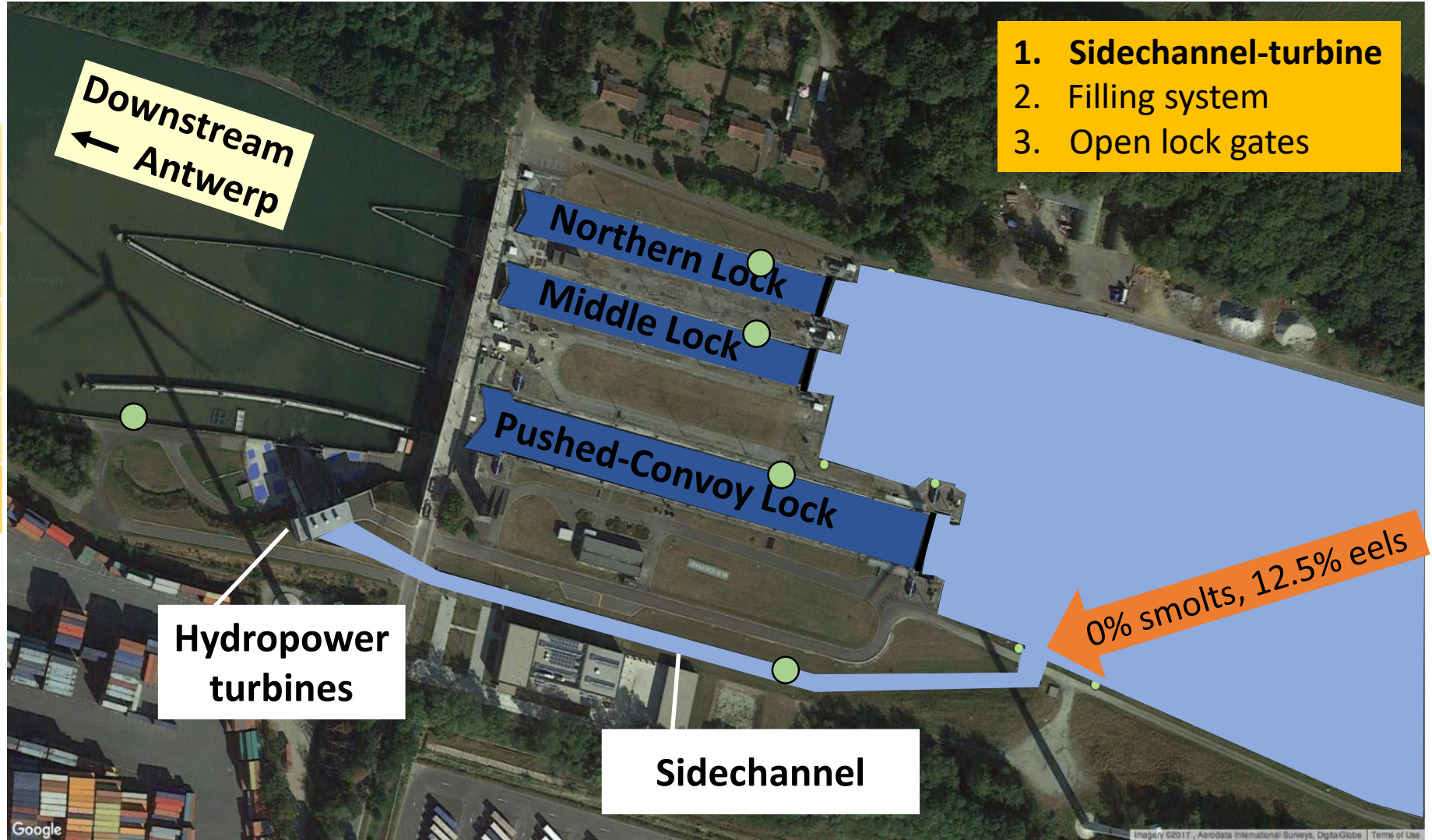


5 receivers to verify the passage route

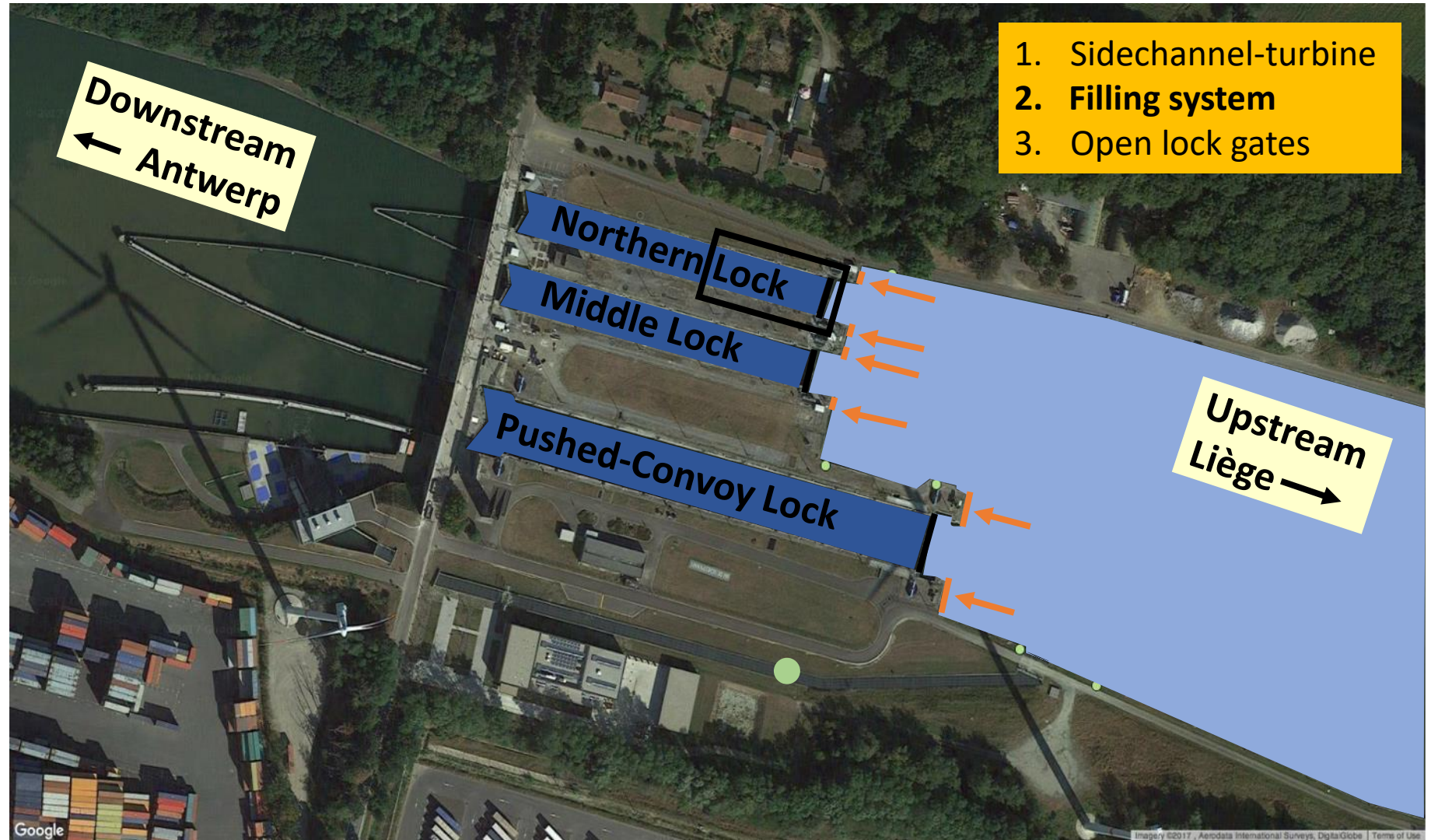


Via the hydropower turbines: continuous flow

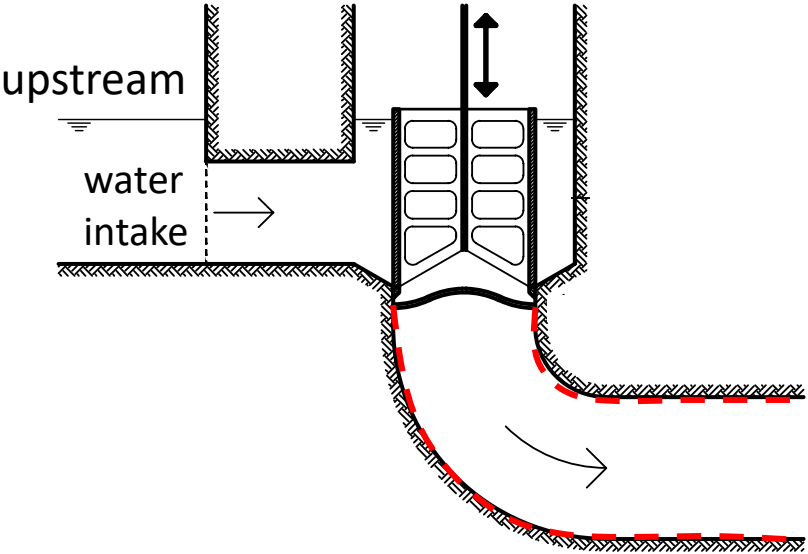
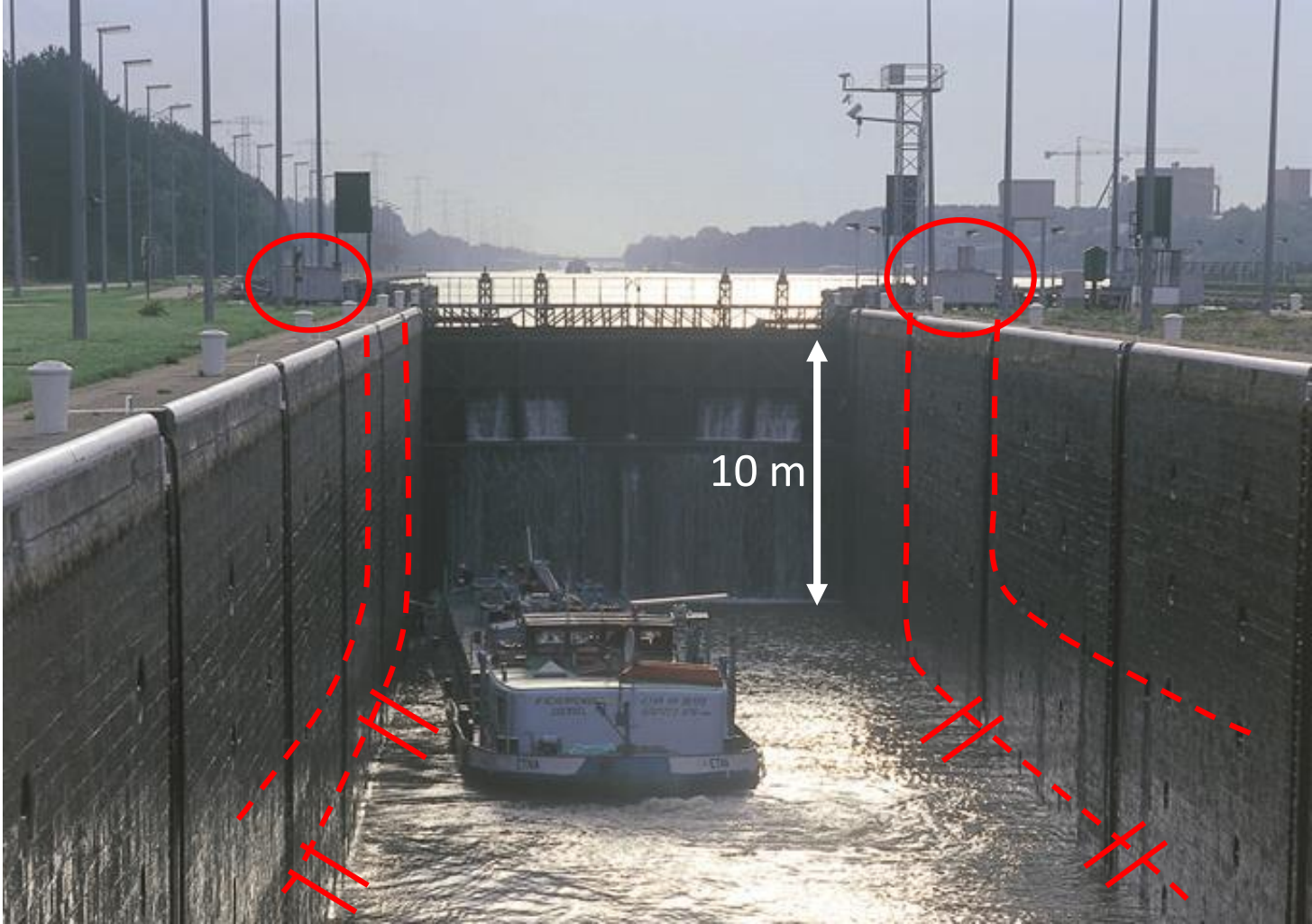
	Smolt (%)	Eel (%)
1. Turbine	0	12.5
2. Filling system		
3. Gates		



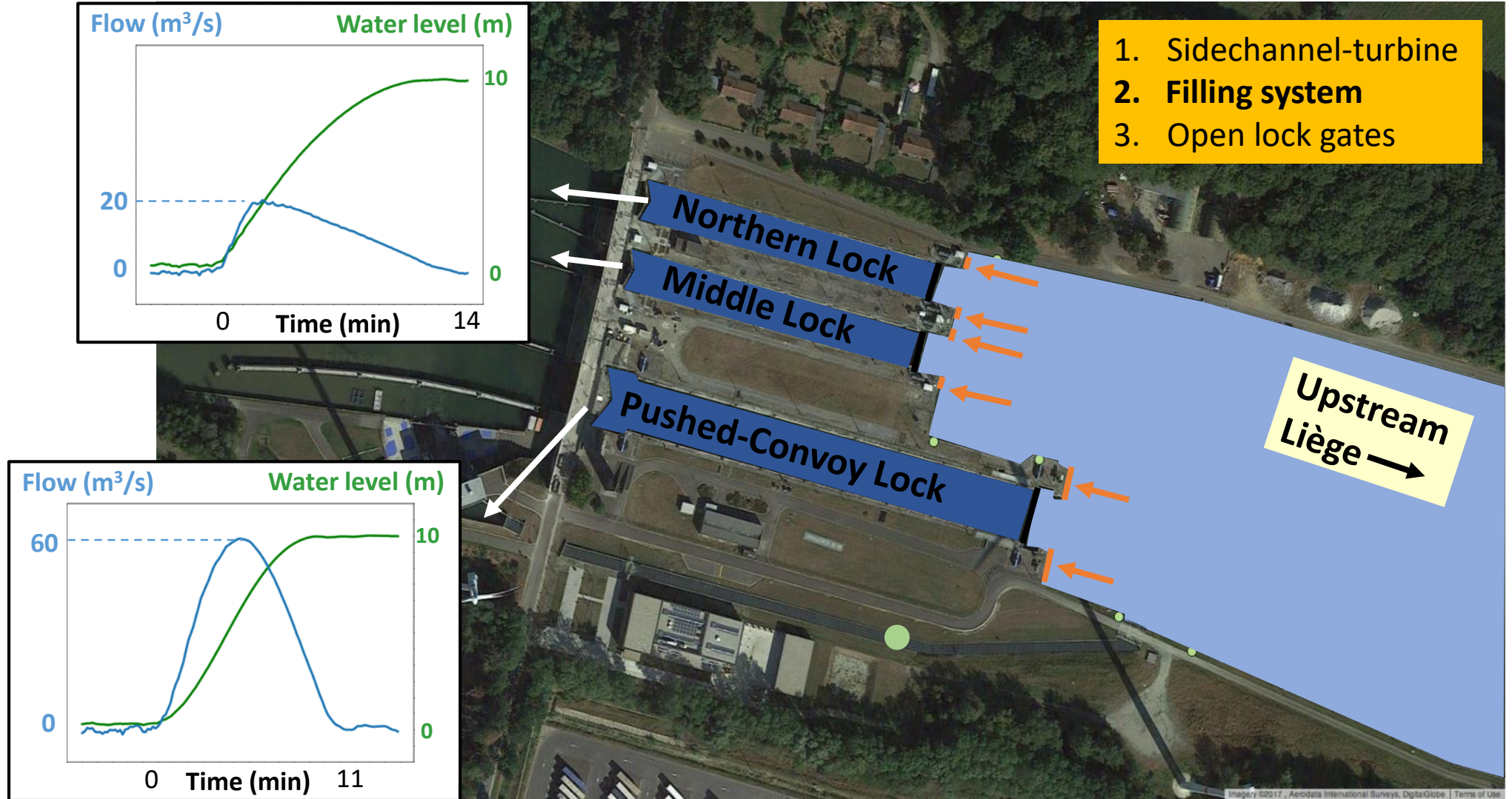
Passing via the filling system of the locks



Passing via the filling system of the locks

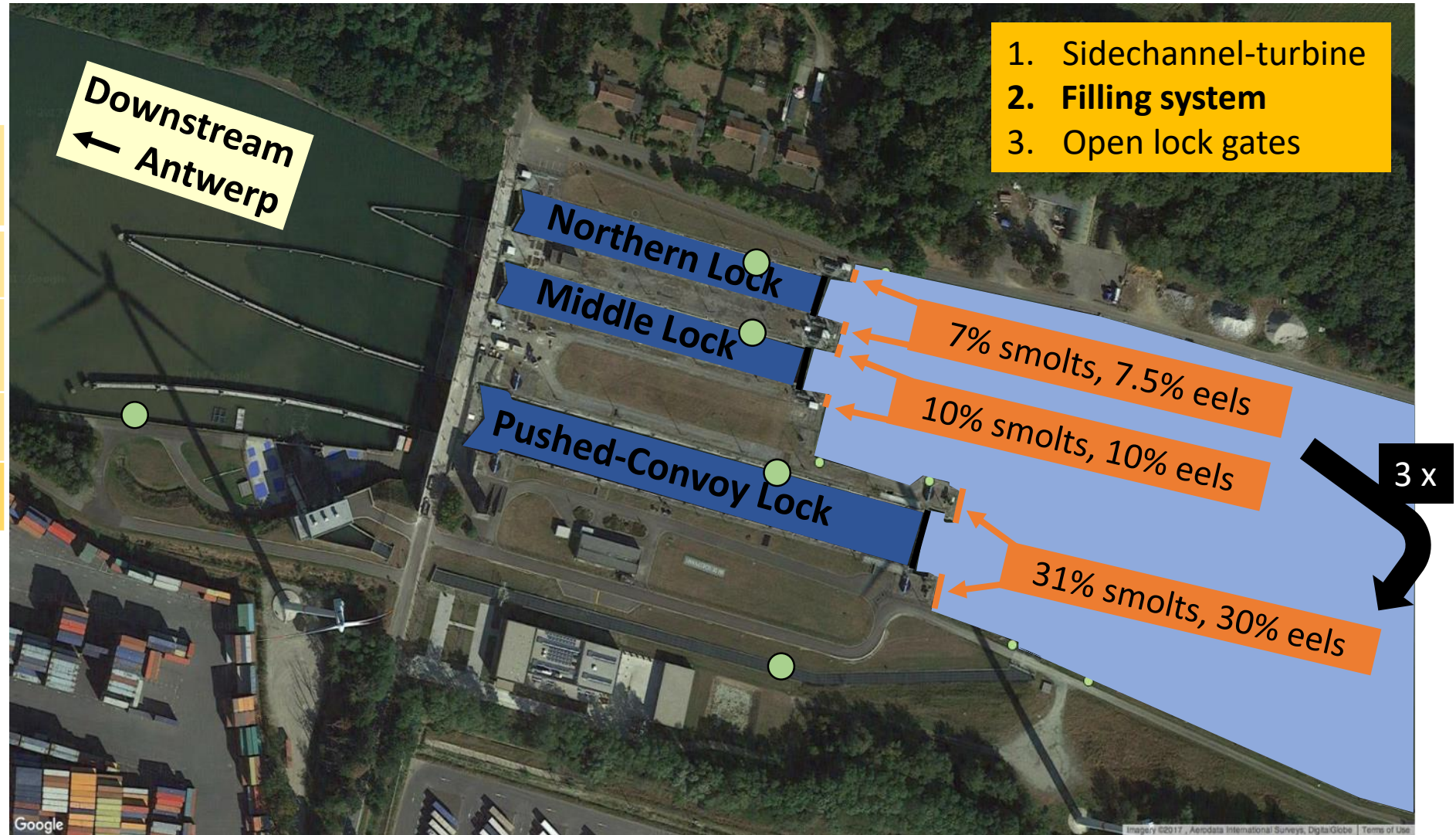


Passing via the filling system of the locks



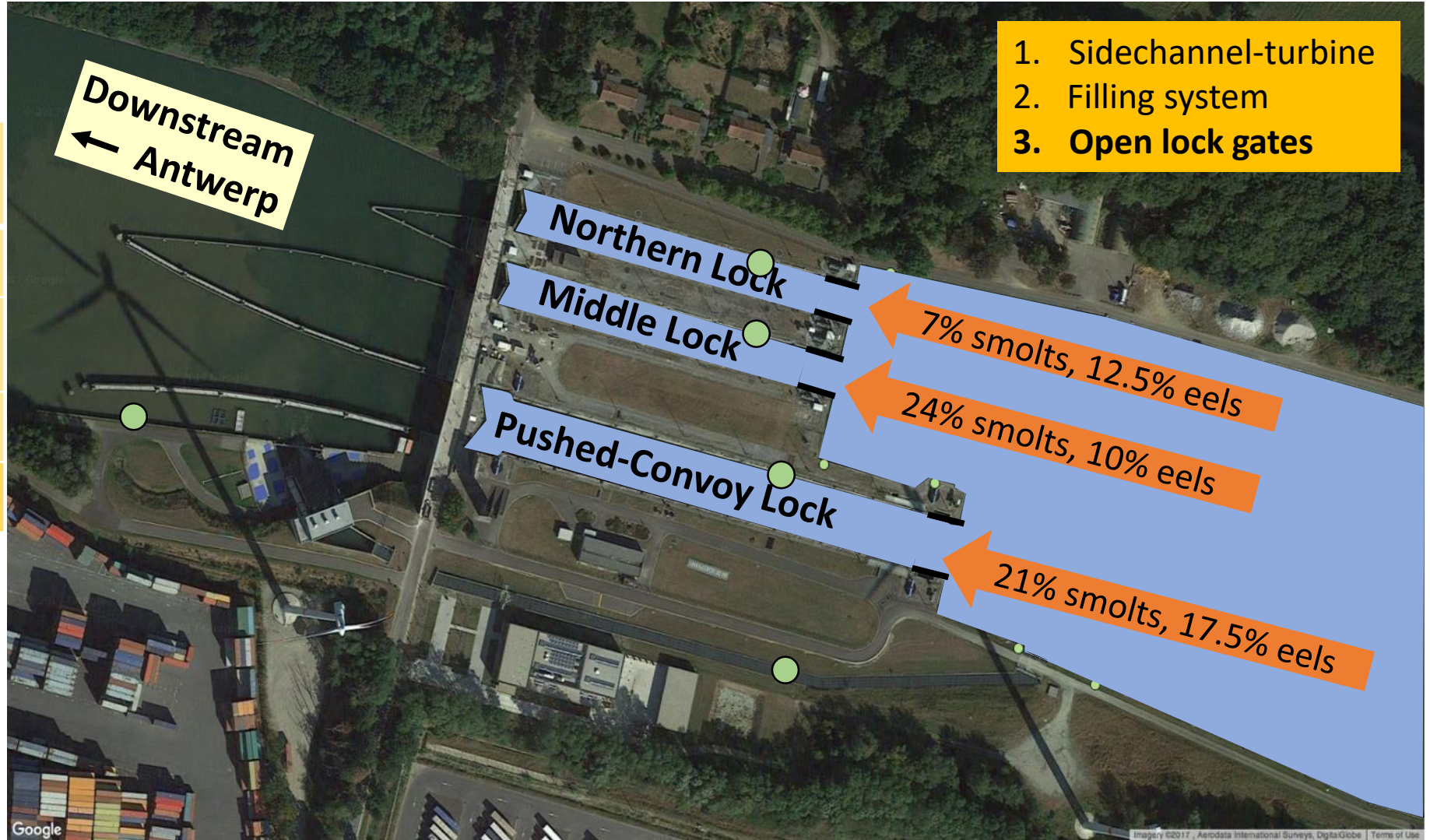
Passage via the filling system

	Smolt (%)	Eel (%)
1. Turbine	0	12.5
3. Filling system	48	47.5
2. Gates		

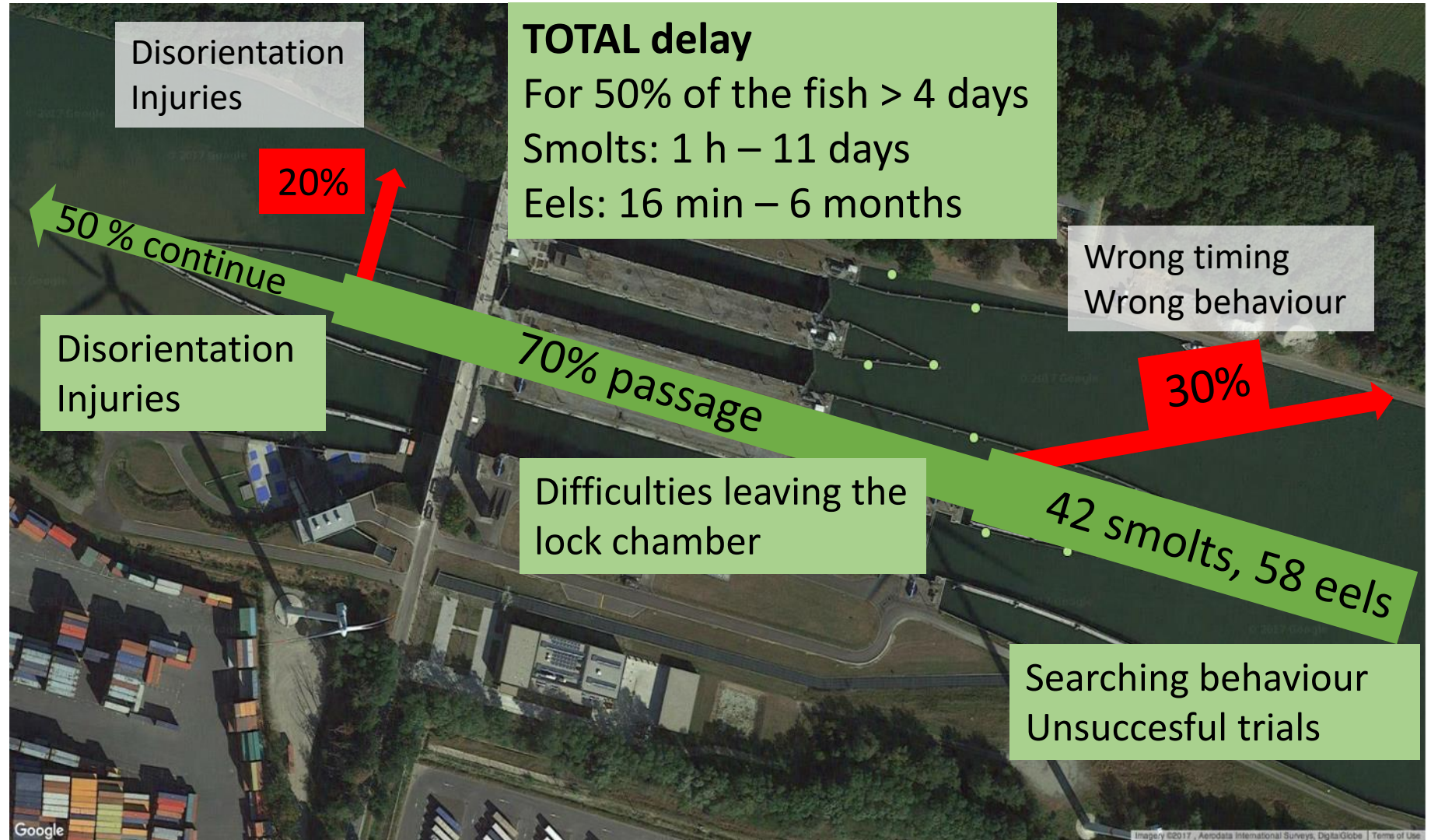


Passage via open lock gates: no flow

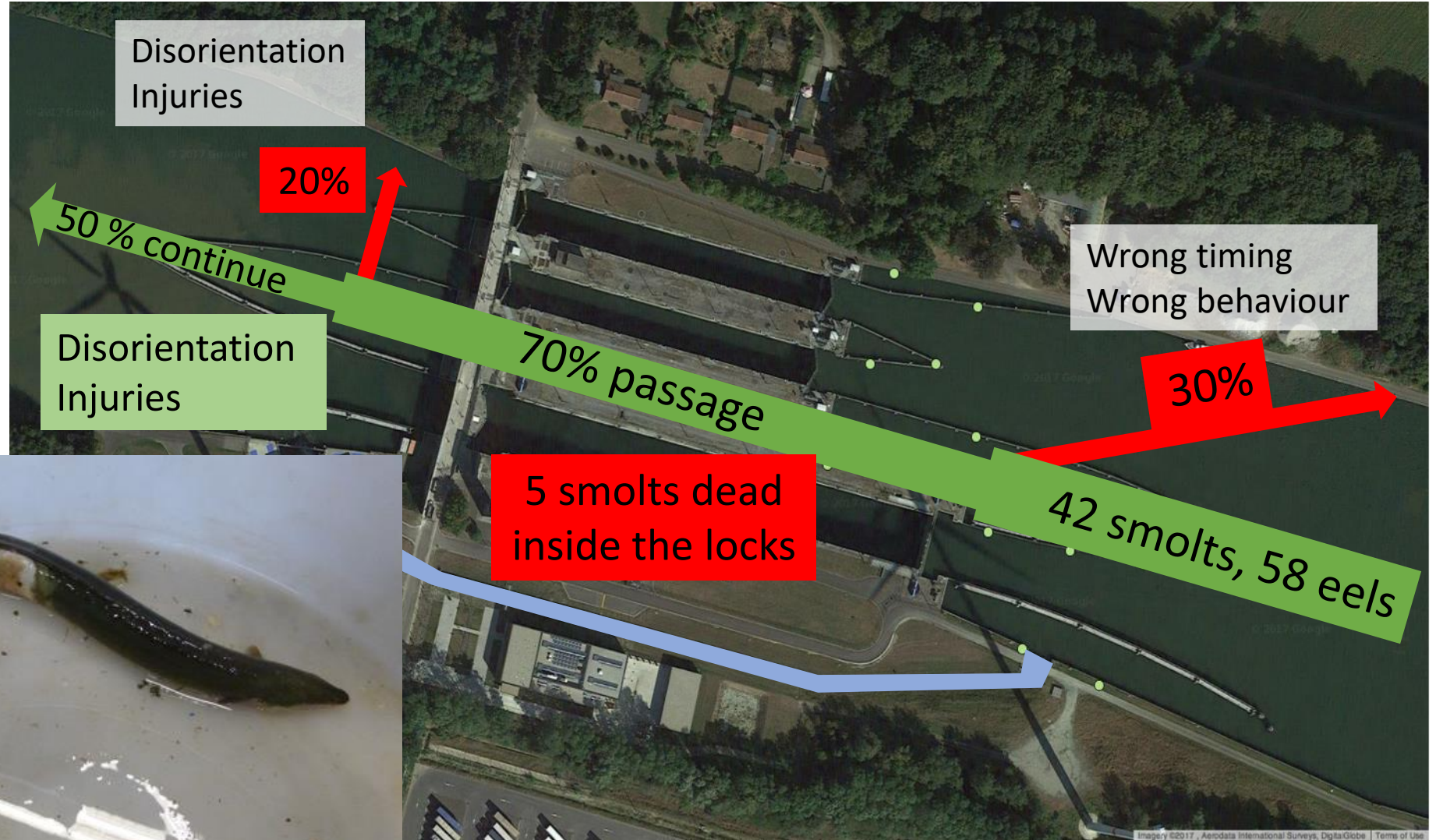
	Smolt (%)	Eel (%)
1. Turbine	0	12.5
3. Filling system	48	47.5
2. Gates	52	40
	100	100



Losses and delays at the complex



Losses and delays at the complex

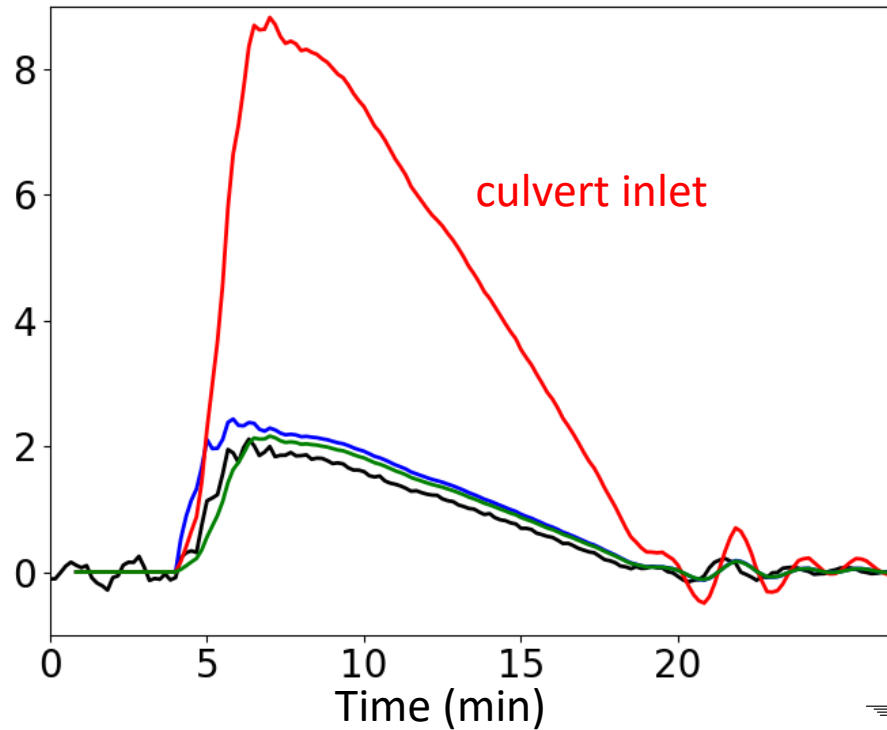


Eel injury after turbine passage



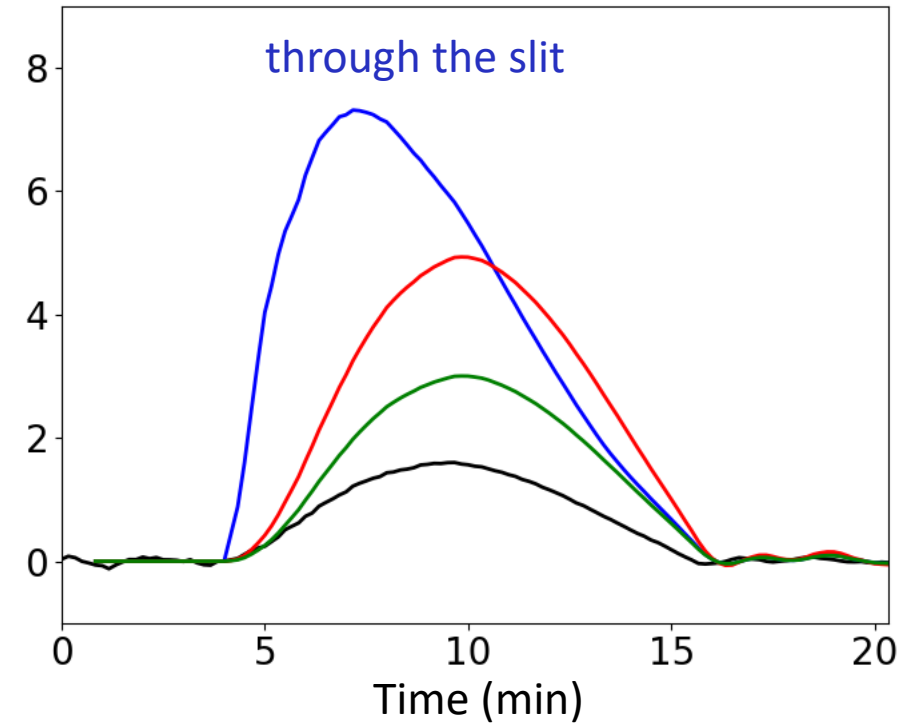
Passing via the filling system: risk for injury

Water velocity (m/s)

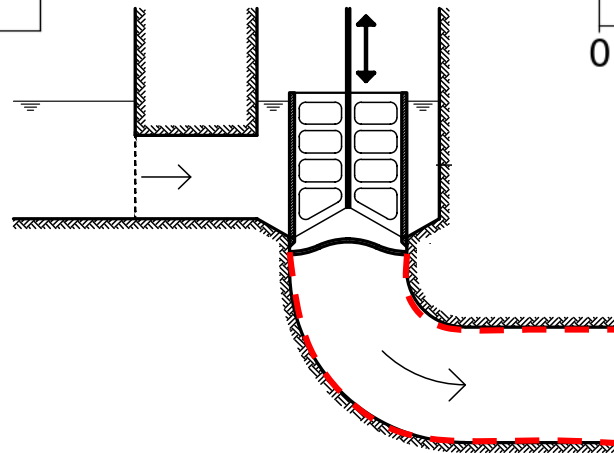


Northern/Middle Lock

Water velocity (m/s)



Pushed-Convoy Lock



The Albert Canal: ~~short-cut~~ or ecological trap?

Small-scale (lock complex)

Fail to pass

Dead in the lock

Stop migrating

Injuries, disorientation

=> Delay & predation

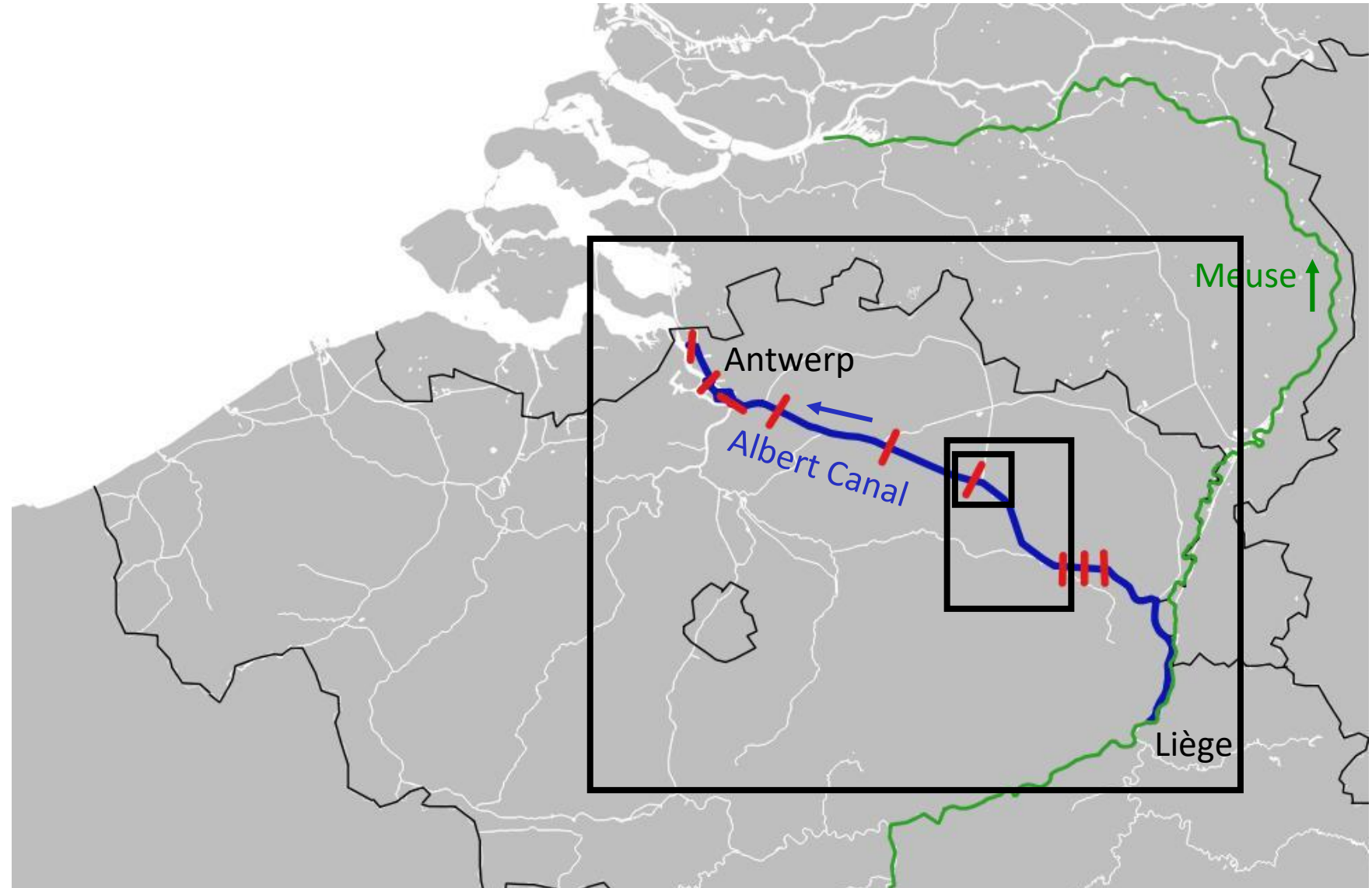
Mid-scale (canal pound)

Disorientation

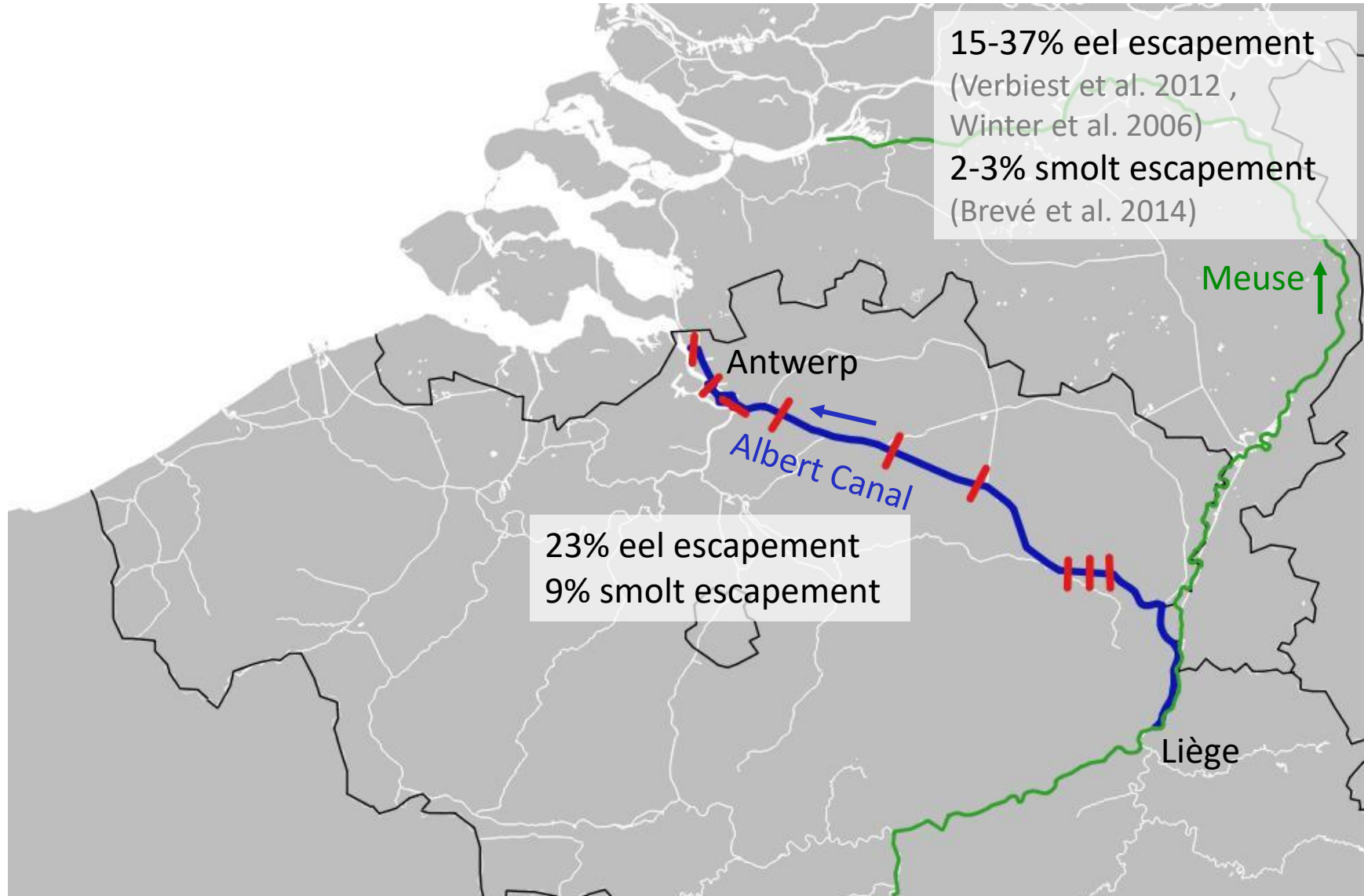
=> Delay & predation

Large-scale (entire canal)

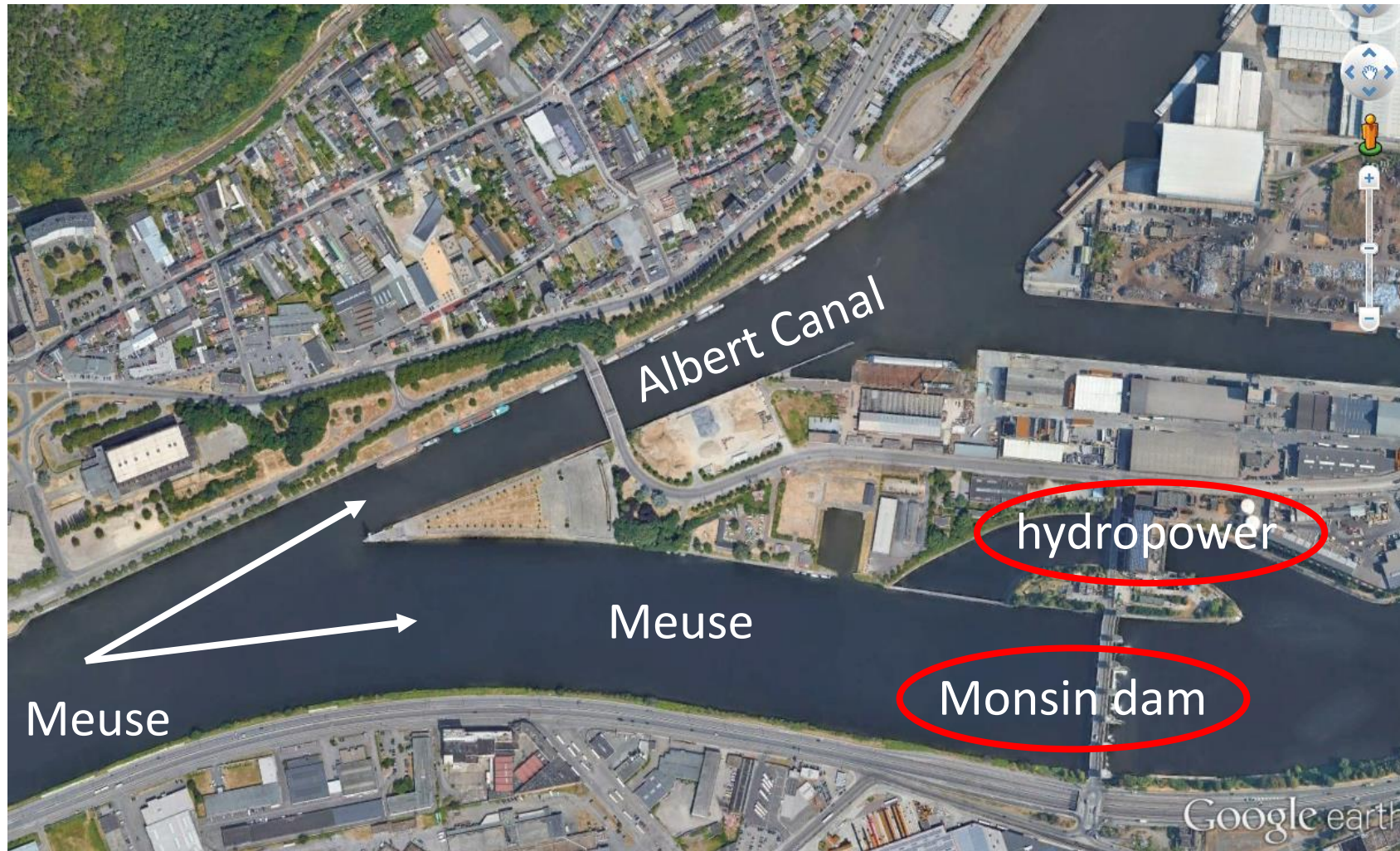
Low escapement



The Meuse River is no good alternative (yet) ...



... and it will be hard to keep fish away from the Albert Canal



We need fishfriendly locks AND safe passage of hydropower plants

Albert Canal



Meuse



Work to do...



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