Low flows and potential impacts on the ecosystem Rhine

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International Commission for the Protection of the Rhine

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IKSR CIPR ICBR

Internationale Kommission zum Schutz des Rheins

Commission Internationale pour la Protection du Rhin

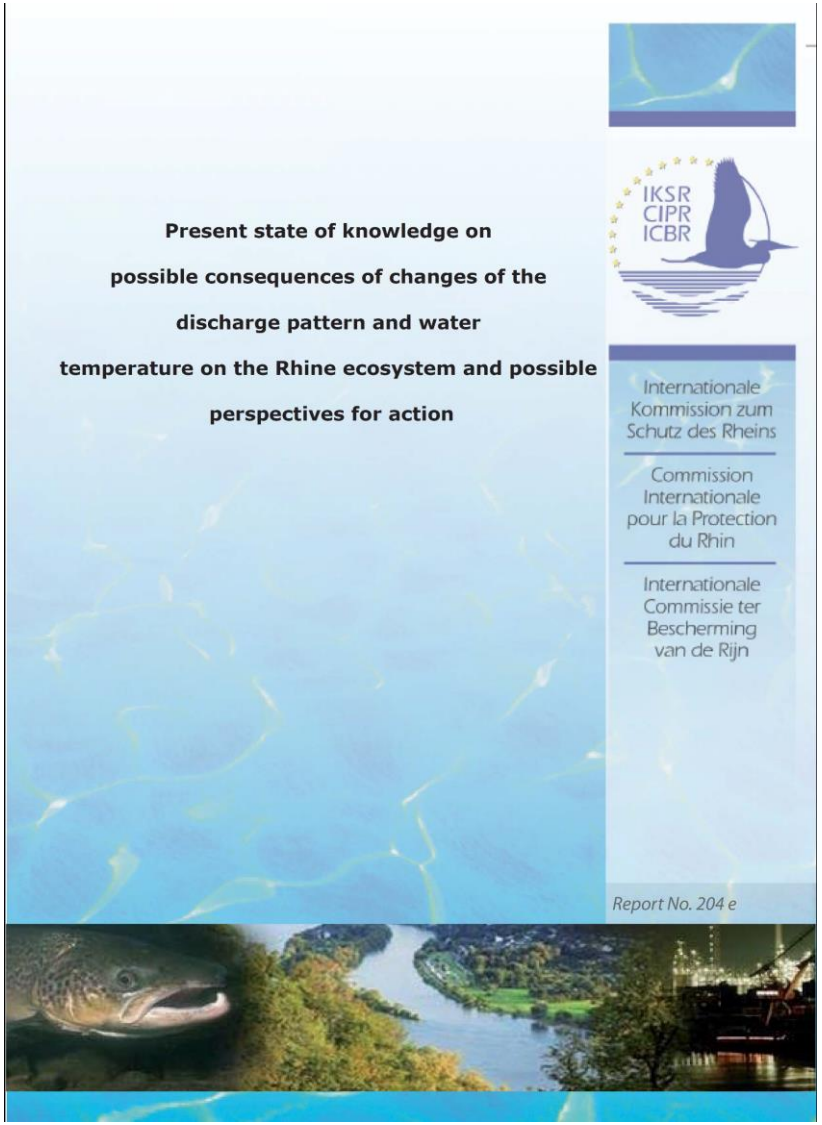
Internationale Commissie ter Bescherming van de Rijn

International Commission for the Protection of the Rhine

Content of presentation

- abiotic and biotic processes influenced by low flows
- vulnerability
- Impact on flora and fauna
- Mitigation measures

based on ICPR report No. 204 (2013) and national activities



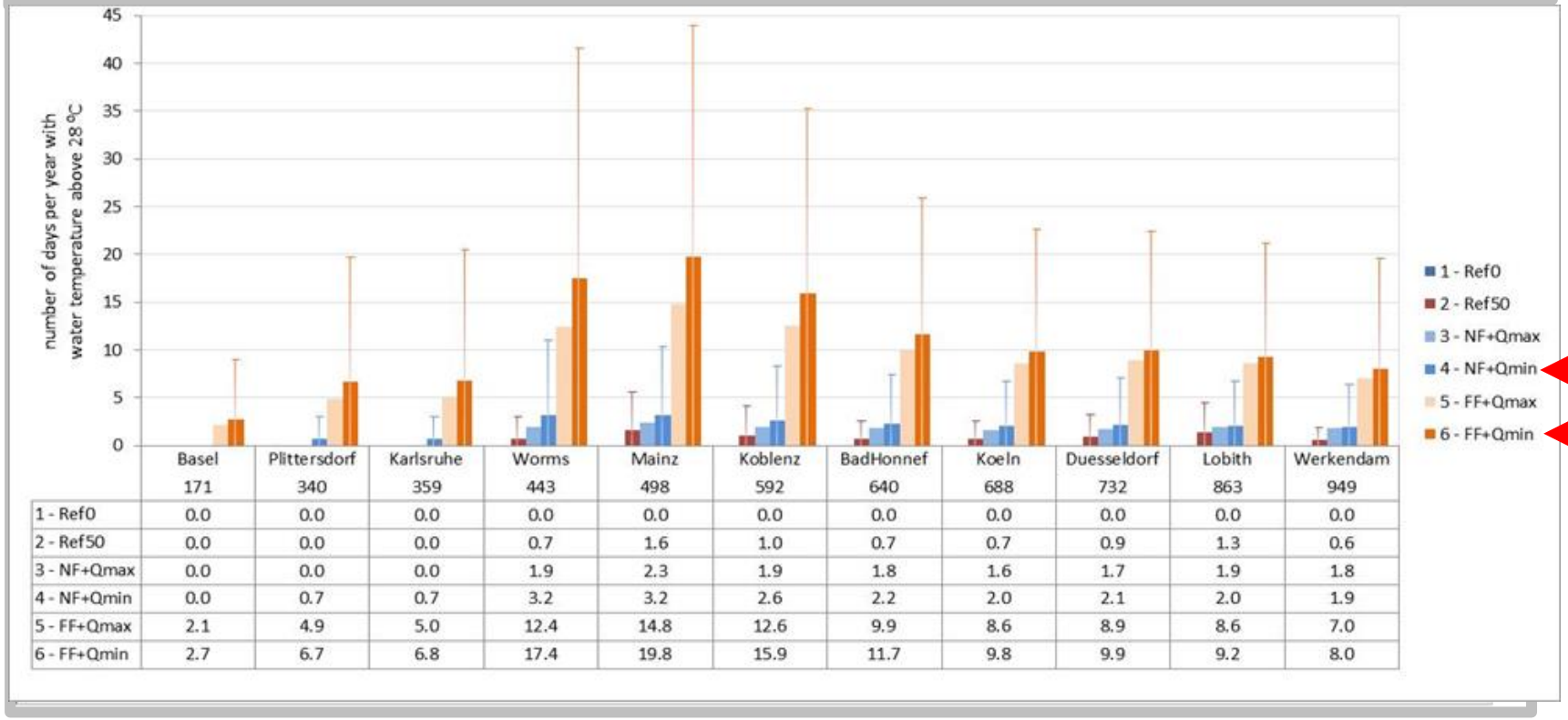
Abiotic parameters influenced by low flows

- water temperature ↑
- flow regime (quantity and velocity) ↓
- oxygen content ↓
- nutrient and pollutant concentration ↑

Impact of climate change on the water temperatures of the Rhine

estimations based on study of scenarios for discharge regime of the Rhine (ICPR report no. 188)

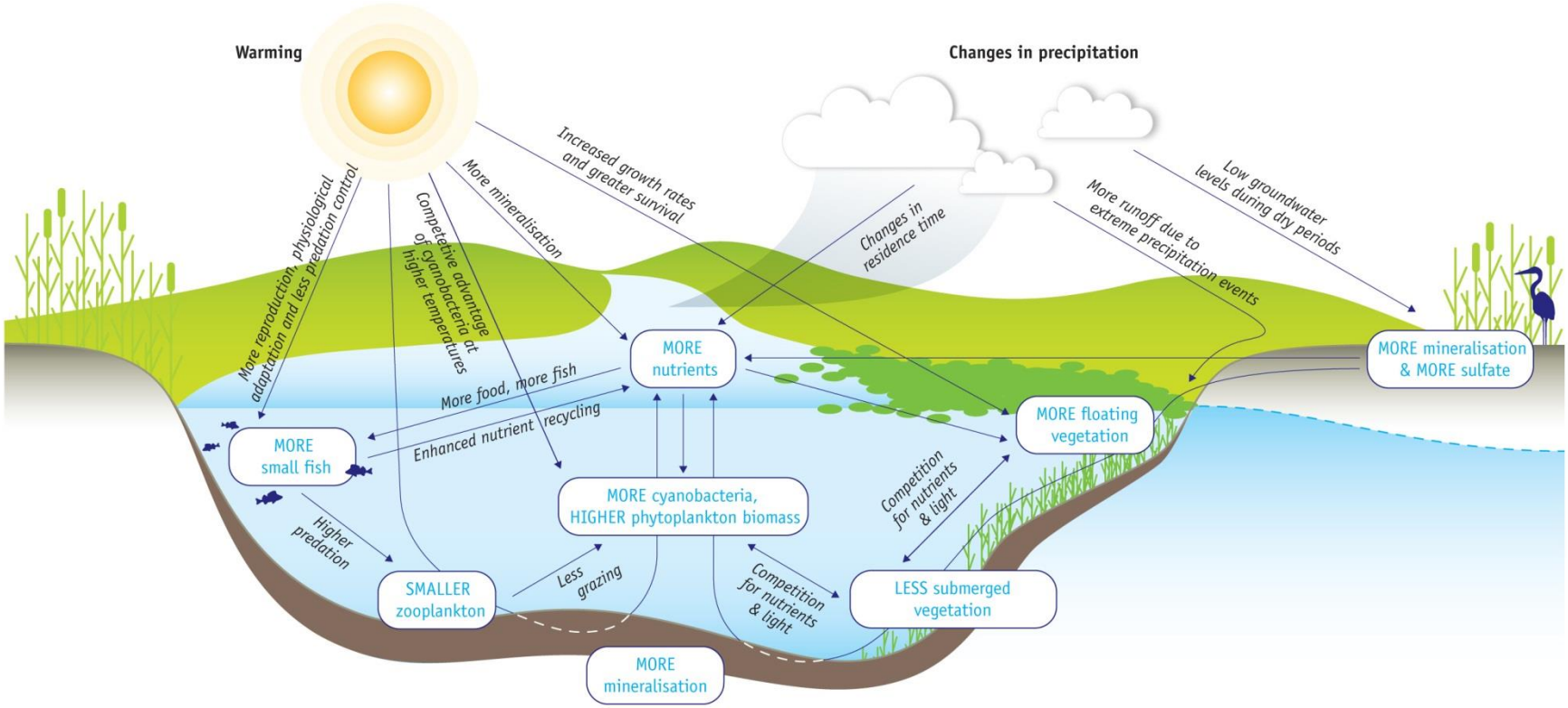
Average number of days per year with a Rhine water temperature above 28 °C in the near and in the far future



	Basel	Plittersdorf	Karlsruhe	Worms	Mainz	Koblenz	BadHonnef	Koeln	Duesseldorf	Lobith	Werkendam
	171	340	359	443	498	592	640	688	732	863	949
1 - Ref0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2 - Ref50	0.0	0.0	0.0	0.7	1.6	1.0	0.7	0.7	0.9	1.3	0.6
3 - NF+Qmax	0.0	0.0	0.0	1.9	2.3	1.9	1.8	1.6	1.7	1.9	1.8
4 - NF+Qmin	0.0	0.7	0.7	3.2	3.2	2.6	2.2	2.0	2.1	2.0	1.9
5 - FF+Qmax	2.1	4.9	5.0	12.4	14.8	12.6	9.9	8.6	8.9	8.6	7.0
6 - FF+Qmin	2.7	6.7	6.8	17.4	19.8	15.9	11.7	9.8	9.9	9.2	8.0

ICPR reports no. 213, 214

Climate change and eutrophication



Source: STOWA 2011, according to Moss et al. 2011 (International Society for Limnology)

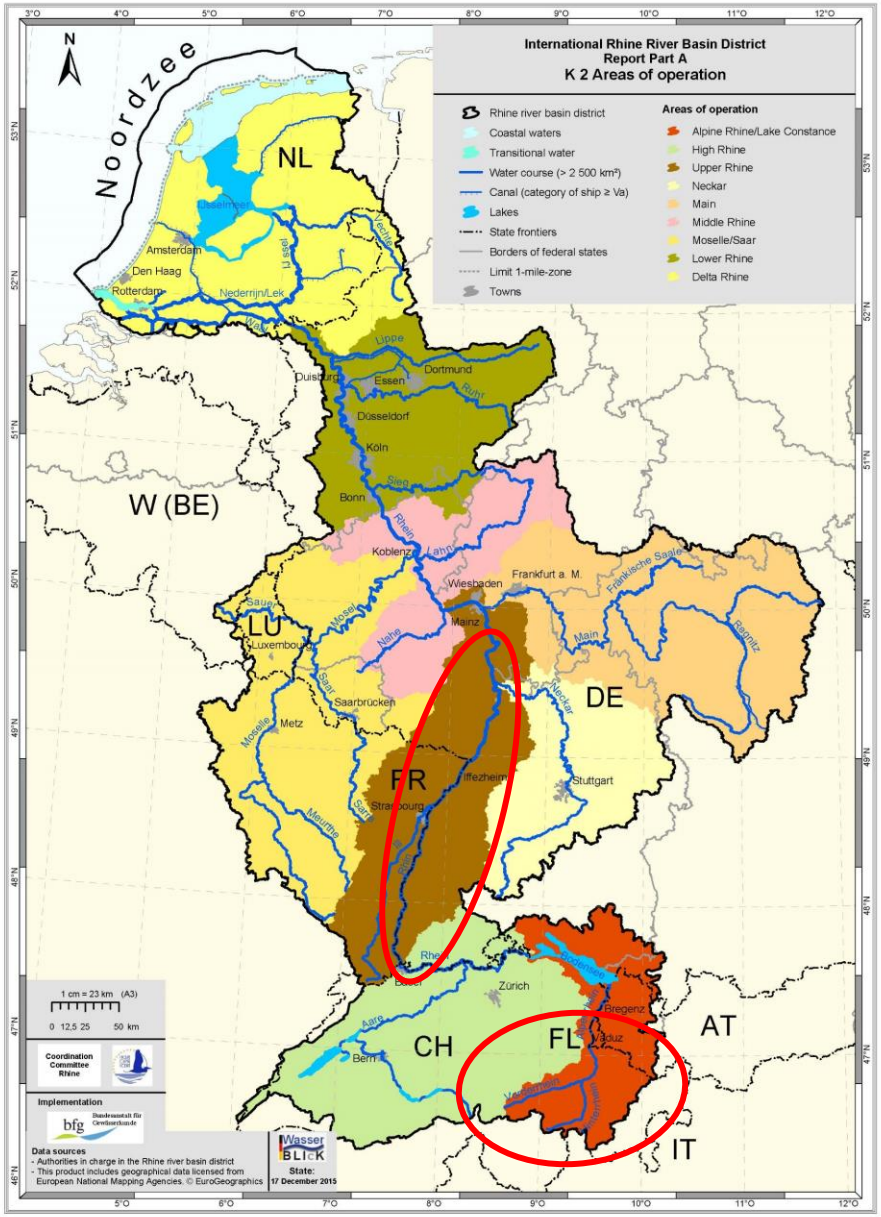
Vulnerability varies in the Rhine catchment

Most vulnerable regions

- Upper Rhine Valley
- the Alps
- drier regions
- moors, wood xerothermic vegetation and heathlands, source areas, banks of waters and coastal habitats

Less vulnerable regions

- the midlands with a cooler and more humid climate



Who is particularly at risk?

- rare species
- species with small to medium sized habitats
- endemic species, existing in a certain, spatially clearly delimited region
- species only tolerating small variations of environmental factors, so-called stenoecious or stenotopic species

Effects on phytoplankton

- predicted increase of chlorophyll concentrations caused by lower discharge, increased temperature and eutrophication processes
- risk of a strong increase of blue algae (cyanobacteria)

Koblenz Moselle, August 2017

Effects on makrophytes and phytobenthos

- high temperature and strong radiation → rapid increase of phytobenthos and macrophyte biomass
- dying off and decomposition of organic material → decrease of interstitial oxygen contents
- rise in temperature affects especially oligostenothermic plant species in small rivers rich in fine sediment

Chrysosplenium oppositifolium

Potamogeton alpinus

Effects on macroinvertebrates

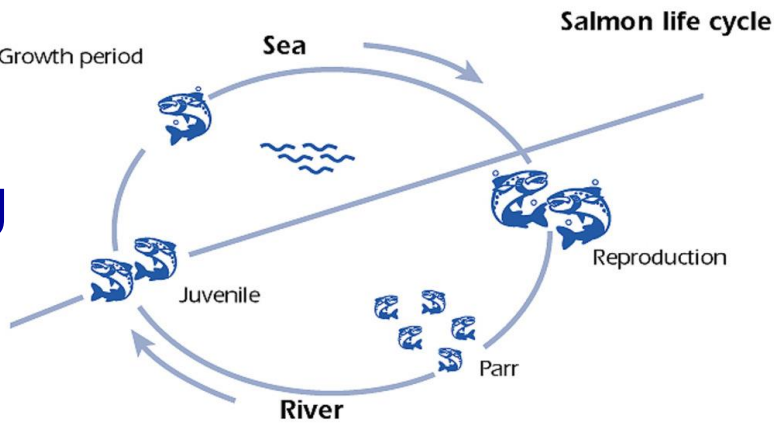
- most can deal with a change of water level < 40-50 cm/h (e.g. by migration) and only extreme events will affect the biocoenosis
- most vulnerable: oligostenothermic species in brooks, smaller rivers and the source region in mountain areas and endemic species of the Chalk Alps
- extreme hot temperatures → mussel death (2003)
- thermophilic species and invasive species could benefit
- effect on reproduction (e.g. voltinism)

Basket clam (*Corbicula*)

Physella acuta

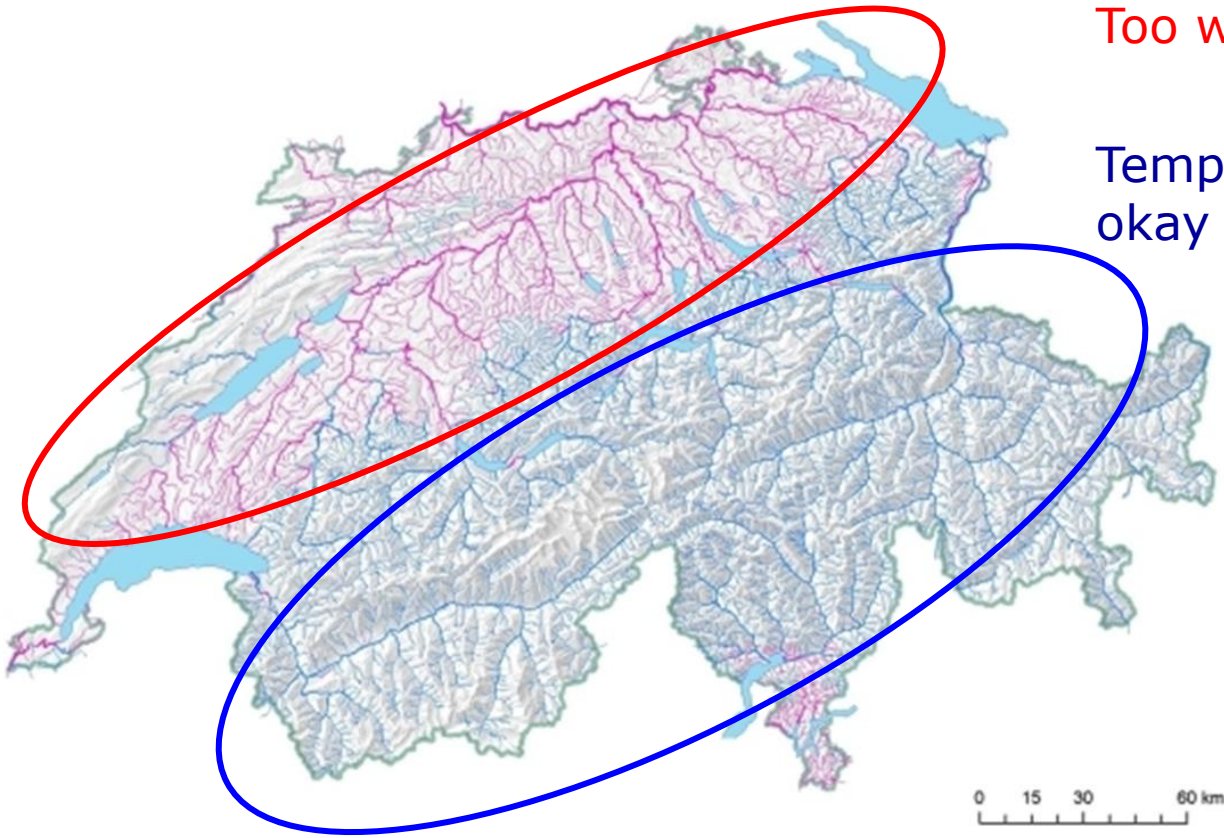
Effects on fish fauna

- low flow is unfavorable to fish migration
- risk of mortality due to fishing and predation rises
- increased fish mortality and illness
- Locally, between 4 and 22 % (at maximum 75 %) of fish biodiversity is at risk of vanishing until 2070



Effects on fish fauna

Possible spreading of brown trout in Switzerland in 2050



Source: Notter & Staub 2009

→ No more brown trout in the Swiss midlands

Neobiota – profiteers of climate change?

Many invasive species are tolerant to eutrophication, salinization and, in particular, higher temperatures and thus could indirectly profit from low flows

Mild winters enhance the reproduction and spreading of most invasive species preferring warm temperatures

Dicterogammarus villosus

Mitigation measures: Enhancing ecosystems

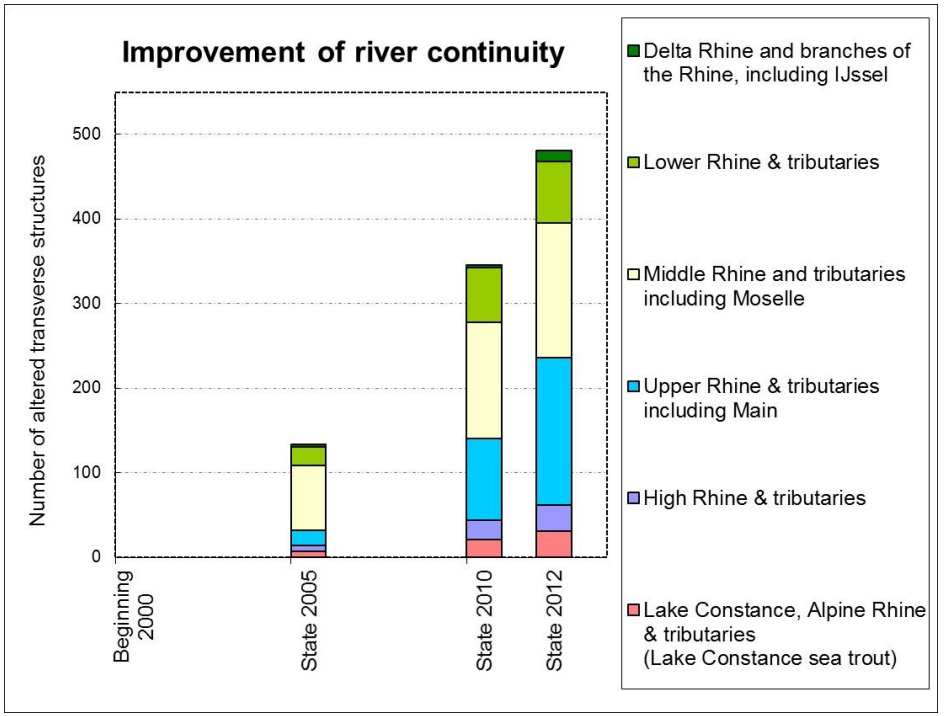
- Reconnect alluvial waters and floodplains (e.g. win-win measures incl. flood management) to the river
- designate or improve nature protection areas

→ varied habitat patchwork and connectivity enhances biodiversity and enables species to migrate to areas with a more favorable climate

Biotope network brochure and atlas, ICPR 2006

Mitigating the effects of higher water temperatures

- Restoration of river continuity: reconnect backwaters to the main stream *(→ ICPR Master Plan Migratory Fish, 2009)*
- facilitate exchange between river water and groundwater
- Increase shading by planting shrubs or allowing them to spread on the banks of small and medium-sized backwaters
- limit thermal discharges to a minimum



Examples of activities at national level

Germany: Working group LAWA/KLIWA

Source: KLIWA

Examples of activities at national level

France: ONEMA report „Freshwater fish and climate change“ (2014)

Prediction:
- Upstream shift in ranges of cold-water species
- Increase in species richness but greater uniformity of communities

Measures:
- Restore ecological continuity
- Improve hydrological and morphological conditions
- Constitute refuge zones
- More research on pressure-impact relations required (modeling)

Thank you for your attention!

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