Removal of Dams

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Structure of Presentation

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3. Legal Aspects
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1. Introduction

Definition:

Partial or complete removal of a dam and cancellation or limitation of all connected socio-economic purposes.

1. Introduction

Developments of last decades:

70'ies: Increase of ecological awareness, including rivers, in industrial states.

80'ies: First new laws and regulations in industrial states about water management.

--> described objective:
Limitation of unwished biotic, chemical and abiotoc impacts and at the same time maintenance of purposes.

Meanwhile a big number of dams have aged.

2. Reasons for Dam Removal

Three main reasons for dam removal

- Rentability
- Dam Security
- Biology/Ecology

additionally: Social-cultural heritage and recreation

The discussion about dam removal occurs often when the licence must be renewed.
After 50/75 years there is a new legal situation which requires higher ecological-social standards.

2. Reasons for Dam Removal

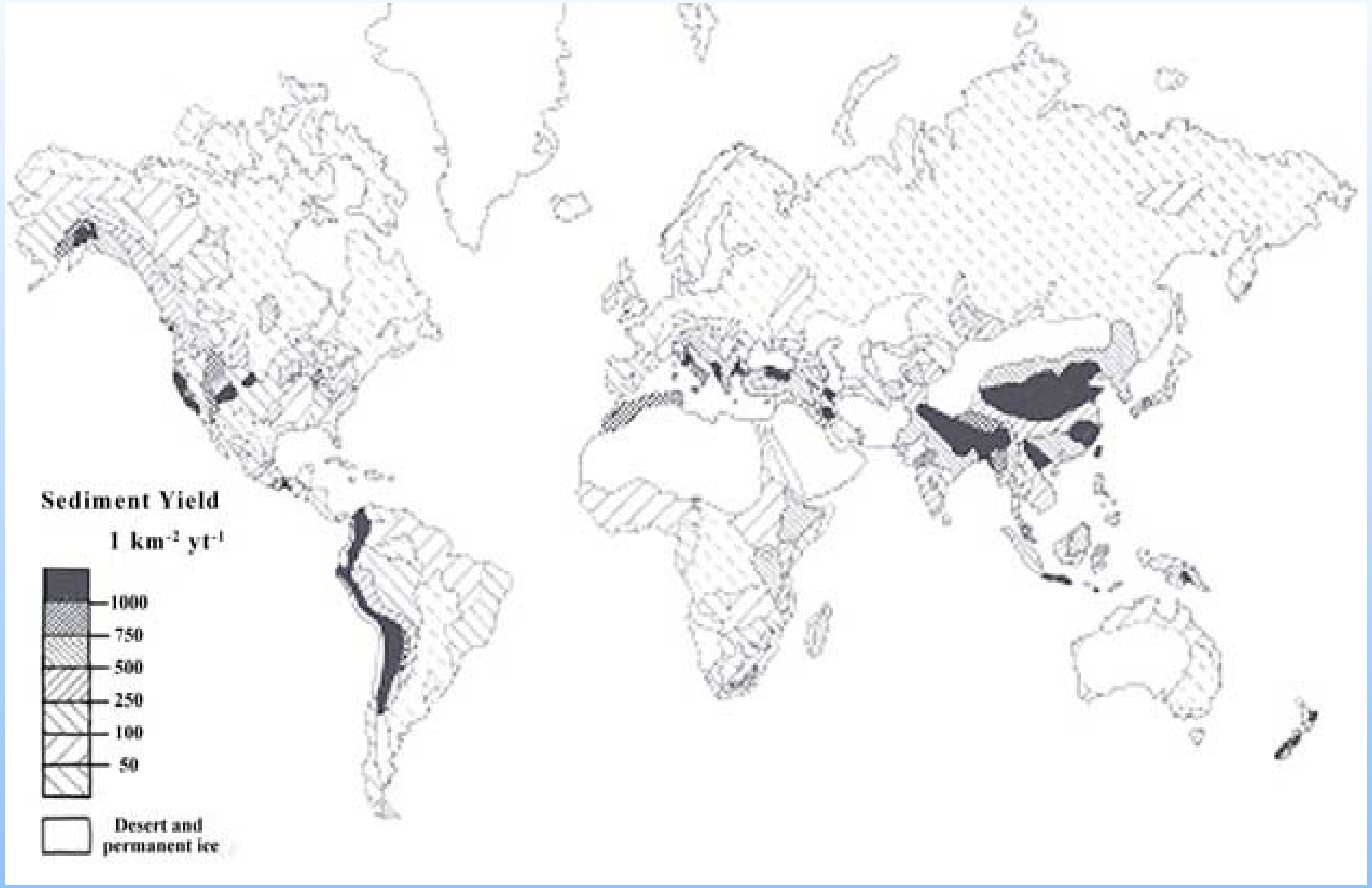
Rentability

Due to changing socio-economic conditions abandoning of purposes completely or partially
This is valid especially for drinking and industrial water supply.

Rentability can be abandoned through a high sedimentation rate of dam reservoir.

Sometimes the removal costs may be lower than a rehabilitation of a dam in middle or long term.
--> affects the decision.

2. Reasons for Dam Removal



2. Reasons for Dam Removal

Dam Security

→ The most dams have to be rehabilitated 50 to 100 years after the construction

EU: For 2-3 decades many rehabilitation projects
USA: up to 30 % of dams need to be rehabilitated according to ASCE.

When due to need of rehabilitation or ongoing poor security the socio-economic benefit is too small, the removal may be done.

→ security question is often a economic question

2. Reasons for Dam Removal

Biology/Ecology

If (longitudal) connectivity is restored, the healthy of a river increases often fast. Better reproduction conditions for species.

Objetive: Increase of biogenous communities in river channel and wetlands through habitat restoration.

Endangered species (EU: FFH List) may be decisive for a removal of a dam.
--> USA+F: Salmon

2. Reasons for Dam Removal

River ecosystems are the most rich landcsape element.

Example Germany: 5 % of area, but 64 % of all plant species.
74 % of all fish species in rivers have disappeared and are endangered.
Dams one of the main reason: also according to BfN (federal agency on nature conservation)

2. Reasons for Dam Removal

Restoration of socio-cultural values

In (all) societies the request to conserve cultural values increases continuously. .

The demand to restore a river stretch of high culturaland affected by dams value can be become strong in a town, region or state.

Particularly the request is posed by indigenous people or by opressed ethnic-religious groups
In the USA+Canada in several cases the main reason for dam removal.
In the north-kurdish provinces Dersim (Kurdish Alevits) this request increases.

2. Reasons for Dam Removal

Recreation and Landscape

With the increasing the socio-cultural consciousness and increasing activities in the nature the request to restore river stretches can become important in societies.

Also due to a new consideration of the landscape/nature the removal of a dam can be a strong demand.
Dams are no longer considered as a „natural element“ of the nature.
--> new reacreational opportunities

3. Legal Aspects

In EU: European Water Framework Directive (WFD)

For the WFD the criterion connectivity is a main reason for the “good ecological condition” of rivers.
--> Dam Removal one option for this goal.

But exceptions for heavily modified rivers.
--> Usually this means for dams no removal!

Actually the operator of dams decides

4. Impacts of Dam Removal

Through removal the former physical and biological natural situation will not be achieved fully.

Abiotic impacts determine mainly the biotic and chemical impacts.

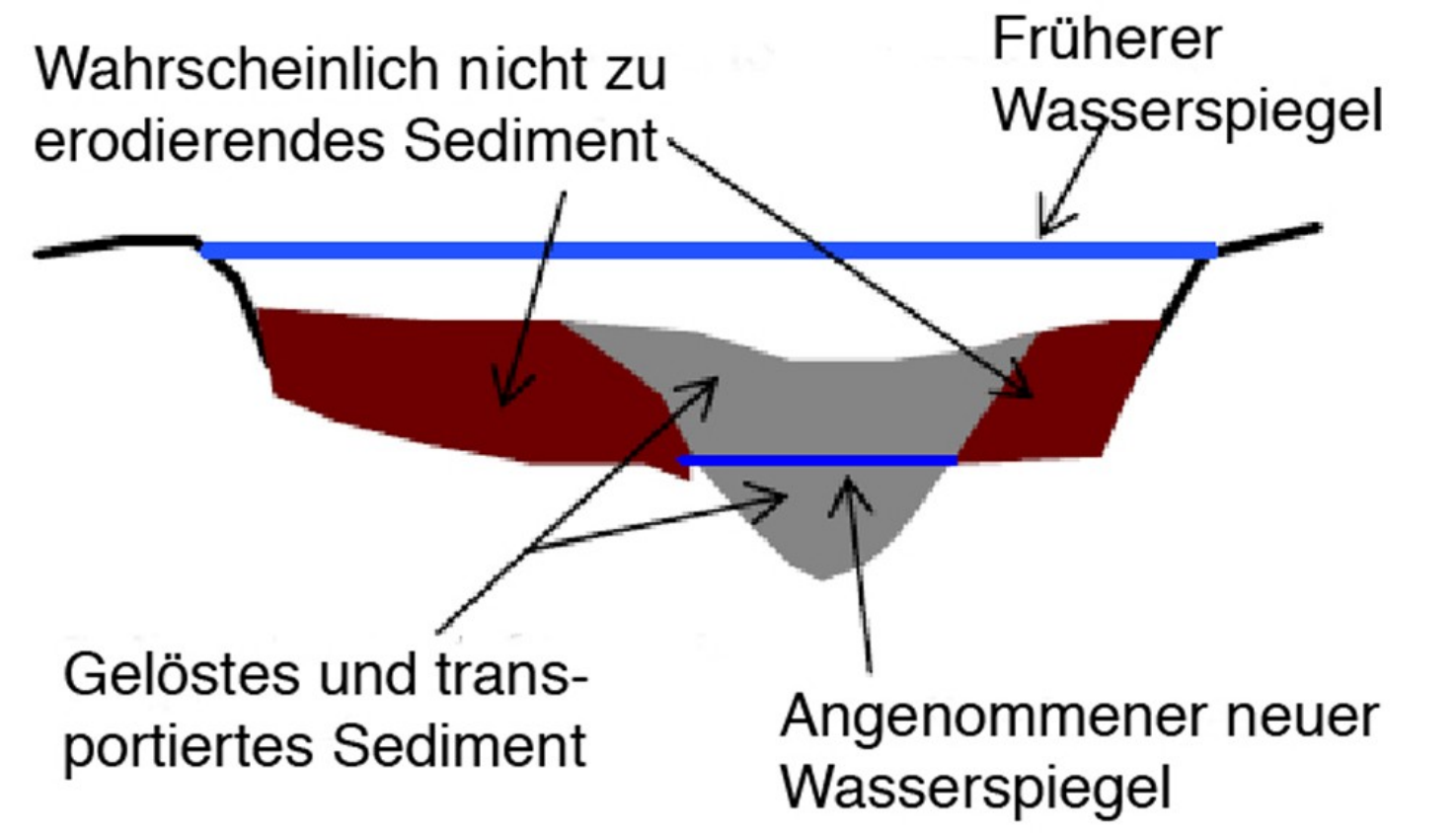
4. Impacts of Dam Removal

Abiotic Impacts:

Restoration of connectivity
Restoration of natural flow regime.
Bağlantısallık ve doğal debi rejimi restore ediliyor.
--> seasonal floods, restoration of wetlands and lateral exchange processes restored

Original sediment regime is restored. But if sediment from former dam reservoir is restored, for a period the downstream river stretches may have too much sediments.

4. Impacts of Dam Removal



Amount of sediment to be released depends on many factors.

4. Impacts of Dam Removal

Biotic Impacts:

Decrease of species of “staying” waters and increase of original species prefering flowing waters.

Not only fishes benefit from removal: Benthos species. Even terrestial animals may benefit.

The biodiversity in wetlands increase

4. Impacts of Dam Removal

Concern about covering of sensbile habitat in downstream stretches has not been become real.

If a river has upstream and downstream other dams, the removal may not have significant positive impacts.

Sturgeon Dam Removal, USA/2003.
Up left: Before removal.
Up right: Directly after removal.
Down right: Longer time after removal.

4. Impacts of Dam Removal

Socio-cultural impacts:

Very controverse, but less investigated.

One coopmrehensive in 1998:
Society considered the dissapearance of the reservoir more positive than expected.
Many people see the new opportunities for biodiversity and recreation.

5. Economic Consideration

Cost benefit analysis difficult because many costs and benefits not measurable monetory.
For ex: Flood protection, recreastion, biotic impacts, drinking water supply.

Use beneft analysis has been done.
--> Planning method to prepare a decision.
--> On the basis of subjective selected andweighted criteria

Economy 40%
Security 20%
Ecology 30%
Culture 5%
Social 5%.

6. Options for Dam Removal

Removal options

Depending on different factors a full removal and partial removal is possible.

a) Full removal:
Removal of all physical barriers for the flow and restoration of the connectivity.

It's possible to leave some parts of the dam body on the slopes/hangs. Even sheet pilings may be left.
Reason: Monument of cultural heritage.

6. Options for Dam Removal

b) Partial Removal:

Decrease of the level of the dam.

Reasons:
a) Conservation of cultural heritage.
b) Conservation of wetlands at the beginning of the former reservoir (birds).
c) Impeding the release of accumulated (and contaminated) sediment.
d) Prserve a buffer against floods.

USA: % 85 full removal.
France and Germany: full removal.

6. Options for Dam Removal

c) Flood control reservoir

Reasons:
- Downstream flood risk
- Released of contaminated sediment
- High cost

Empty dam reservoir.
Connectivity for fishes need to be established.

6. Options for Dam Removal

c) Bypass channel

Reasons:
- Downstream flood risk
- Released of contaminated sediment
- High cost

Precondition: Topography must be suitable

6. Options for Dam Removal

Sediment management:

a) Erosion of of accumulated sediment:
- Actually the best option
- Usually a part is transported
- If contaminated it must be limited
- Navigation may be affected

If sediment amount is high, the removal/release may be done in steps

6. Options for Dam Removal

b) Stabilization of sediment in impoundment:

Reasons:
- Negative impacts on downstream habitat
- Contamination rate is high.

Tools of bio-engineering

c) Digging of sediment:

Lowest impacts if concerns exist, but expansive.

A sediment pool directly downstream of dam body may be used.

7. Dam Removal Cases

France:

6 dams removed, 3 are in planning.
Most in the Loire basin, started in 90'ies.
→ After a long struggle against 3 big dams „Plan Loire Gran Nature“ (1995)

Dams operated by: EDF (Electricite de France)

Main reason biotic:
- Salmon
- Increase of biology of Loire, one of the last „wild“ westeuropean rivers

7. Dam Removal Cases

Map „Plan Loire Gran Nature“

7. Dam Removal Cases

St. Etienne du Vigan dam Loire/Allier – 1998

7. Dam Removal Cases

7. Dam Removal Cases

7. Dam Removal Cases

left: 8 weeks later
down: 2009

7. Dam Removal Cases

Maison Rouge (Loire/Creuse) – 1998

7. Dam Removal Cases

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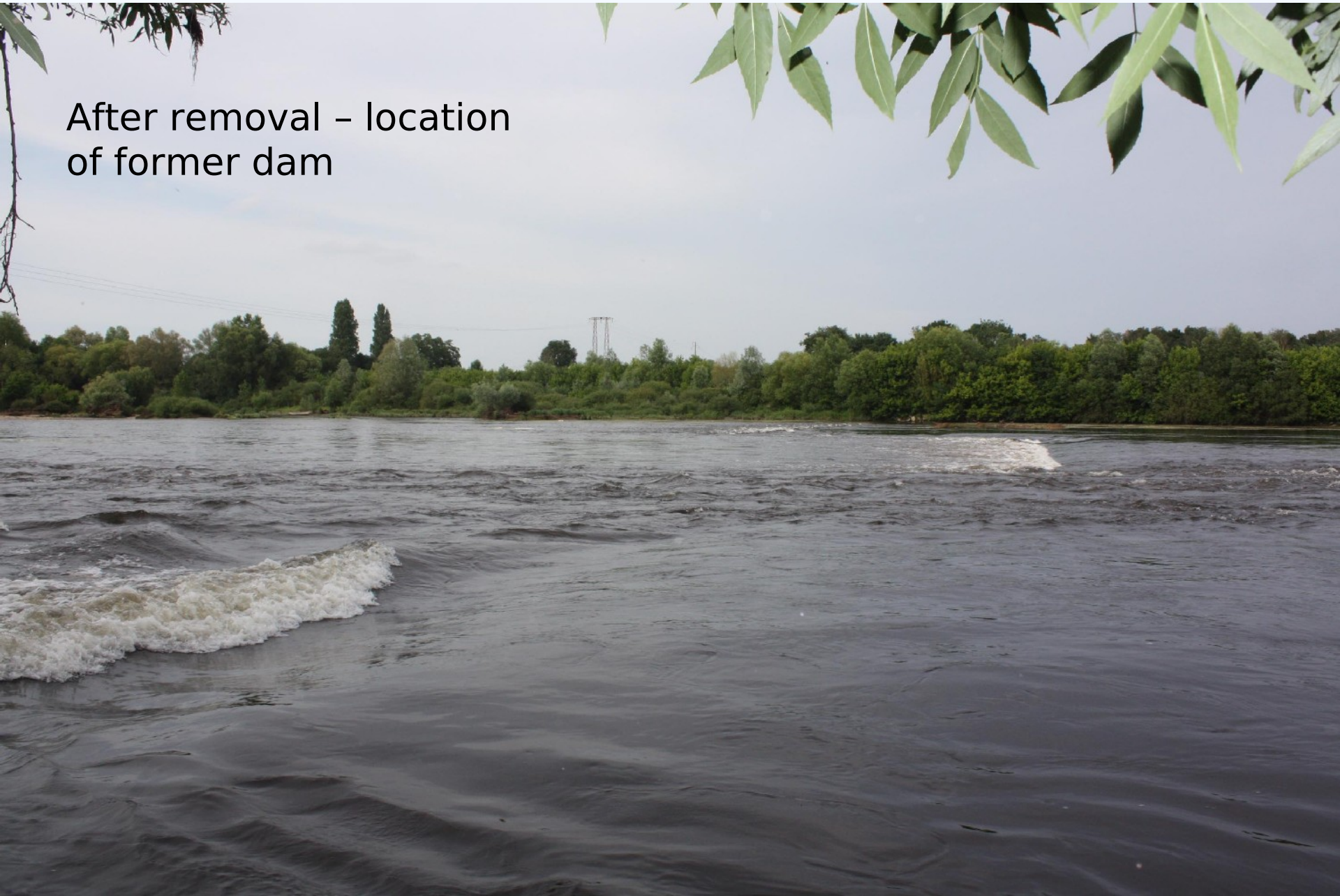


7. Dam Removal Cases

Experience in France:

EDF covered all costs.

Dams were filled partly with sediments. As almost no contamination and no downstream flood concerns, no special measures needed to be taken.

→Very positive impacts on fishes and biological life

Local authorities had some income from removal
→ Limited concerns

Decisions taken within the process of relicensing.

7. Dam Removal Cases

Poutes Dam, foreseen for removal - 20 m high.

Ineffective elevator for fishes!

USA – Marmot Dam

Marmot Dam has been constructed in Oregon in 1912 as a part of a HEPP system.

Reason for removal: Biological and partly economic (small electricity amount).

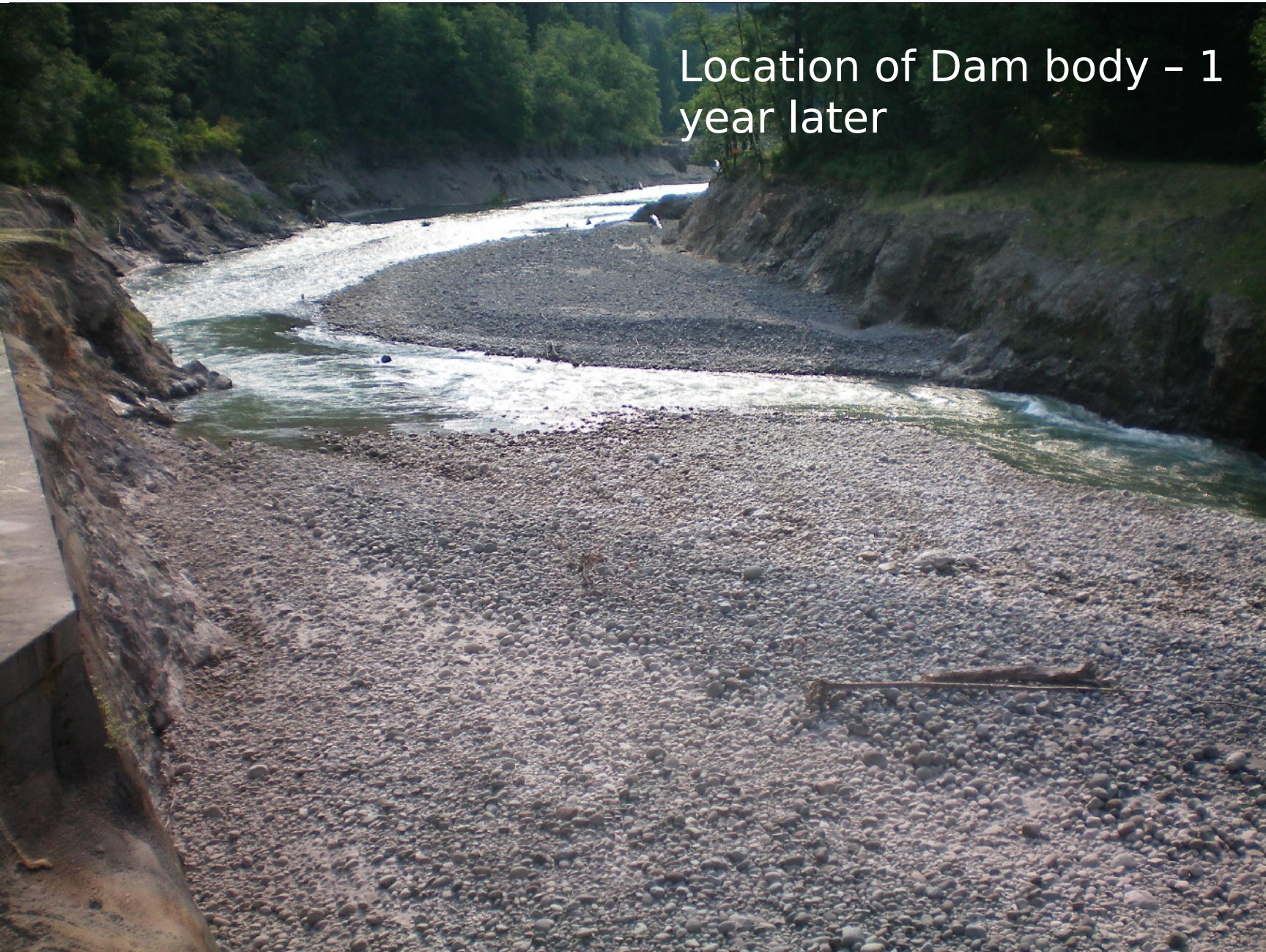
Salmon can reach 50 km more river stretch upstream.

Filled with 80 % sediment, but no contamination.

Before removal a coffer dam has been constructed.

Conrete dam!
Height: 15 m
Dam length: 600 m
Removal: 2007

7. Dam Removal Cases



7. Dam Removal Cases

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Concern about negative impact of important habitat in downstream reches did not become real.

Sandy River, Oregon

Dam Removal: Krebsbach Dam

Constructed in 1994 for Uran concentration.

Purpose in 1985 abandoned. Remained use: For flood protection and hobby fishing.

Dam had problems with floods. Bottom outlet too small designed (not really a flood protection).
Rehabilitation expansive.

Decision 'Thüringer Fernwasserversorgung' in 1998.

EIA approved in 2005.
Removal in 2007.

7. Dam Removal Cases

Embankment Dam:
18,5 m high

Impoundment length:
700 m

Basin:
14,1 km^2

Average flow:
0,089 m^3/s

Dam reservoir capacity:

7. Dam Removal Cases

Steps:

- Sediment trap directly downstream of dam.

- Important species have been transformed to other waters.

- Emptying of reservoir

- Removal at left side started with a slide, then sheel pilings were taken out

7. Dam Removal Cases

- Digged material reused.

- Bottom outlet widened.

Height of sedimentation in reservoir: 30-35 cm. Limited contamination --> no special consideration.

7. Dam Removal Cases

7. Dam Removal Cases

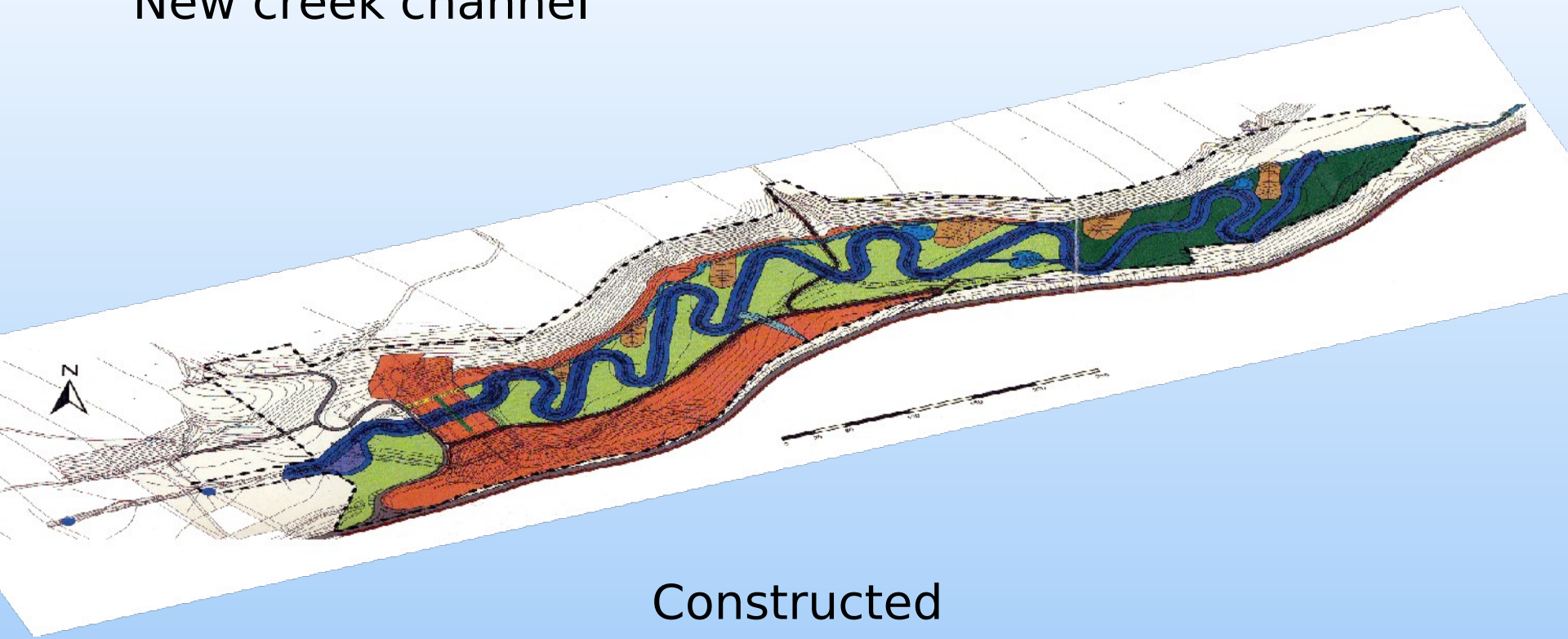
Characteristic of the new planning of Krebsbach dam reservoir:

Preformed creek channel: Meander!
1,4 km instead of 700 m!
--> unique in context of dam removal!

Reason: Flood consideration in downstream region.
Buildings constructed after dam installation.

7. Dam Removal Cases

New creek channel



Constructed
6 groynes
8 ramps
2 flood pools
1 connection channel

7. Dam Removal Cases

7. Dam Removal Cases

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July 2008

Costs: 1,2 mio. Euros

Other projects shall benefit from it.

7. Dam Removal Cases

7. Dam Removal Cases

- Constructed in 1922 Wuppertal Municipality
- 18 m high
- For drinking water
- Purpose abandoned 20 years ago
- Serious security problems
- Removed without EIA in a short time!

7. Dam Removal Cases

Elwha ve Glines Canyon Dams, removed in 2014!

Indigenous people had a 20 year struggle: Historically cultural area and salmon

Elwha Damı, 62 m

7. Dam Removal Cases

Glines Canyon Dam, 92 m

7. Dam Removal Cases

Remova
People

Uzunçayır Barajı Dam
Dersim / Turkish-Kurdistan

- Society doesn't want the dam
- Ecology most important area
- Cultural destruction
- Crucial: Sediment

8. Results and Perspectives

Results:
- Most removed dams small --> impacts positive
- No problems with water or electricty supply after removal
Increase of species and more green landscape. No concerns ove rnegative biotic or abiotic have become real

- Limited experience with removal of large dams with large amounts of sediment.
> Elwha Dams limitedly helpful in this sense

- In some industrial states the removal of dams has been accepted as an option for dams in question which lead to raising biotic negative impacts and have no or limited socio-economic benefit

8. Results and Perspectives

While around the millenium many decisions have been taken, after 2007 very few decisions on dam removal have been registered.
--> Reason: **climate change**. Three „conclusions“:

1) Dams produce „renewable energy“.
Last 6-7 years more finance for dams on international leve, particularly in southern sates (Brazil, TR, Balkan, India, Balkan). In industrial states: eqiuping existing dams with (more effective) HEPP's

2) Dam reservoirs (impoundment) may limit negative impacts of floods in downstream river stretches.

3) As precipitation will be more uncalculabe, water should be stored in dams for irrigation, industry and drinking

8. Results and Perspectives

Perspectives:

- Stop of continuation of disappearing of species
- Solution for dam reservoirs filled with sediment which have no more a benefit and are expansive for sediment “flush“
- To achieve the goals of WFD/EU --> „good ecological condition“
- For old industrial countries where the population decreases and more dams have less purposes --> Instead to rehabilitate for small purposes.
- If majority of society considers rivers as elements to be conserved/restored and accepts an alternative energy and agriculture model with small solution for water and energy!