Current Trends and Status of Freshwater Biodiversity: Research Priorities

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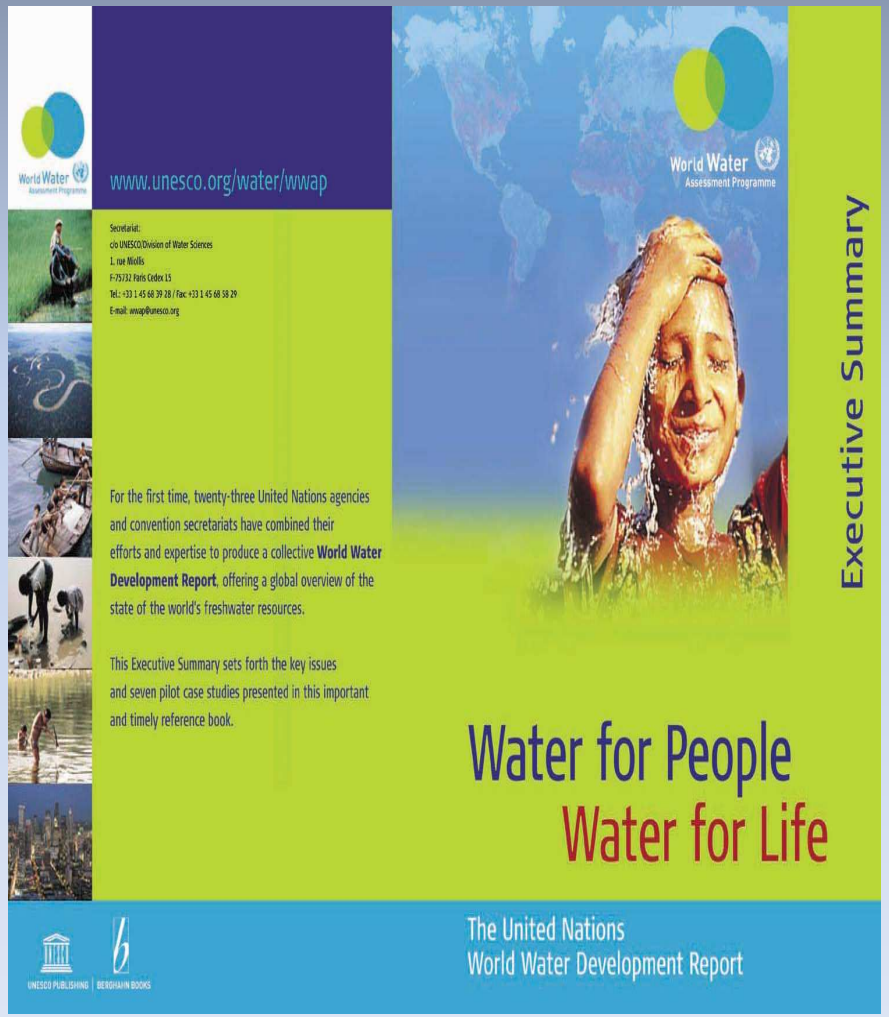
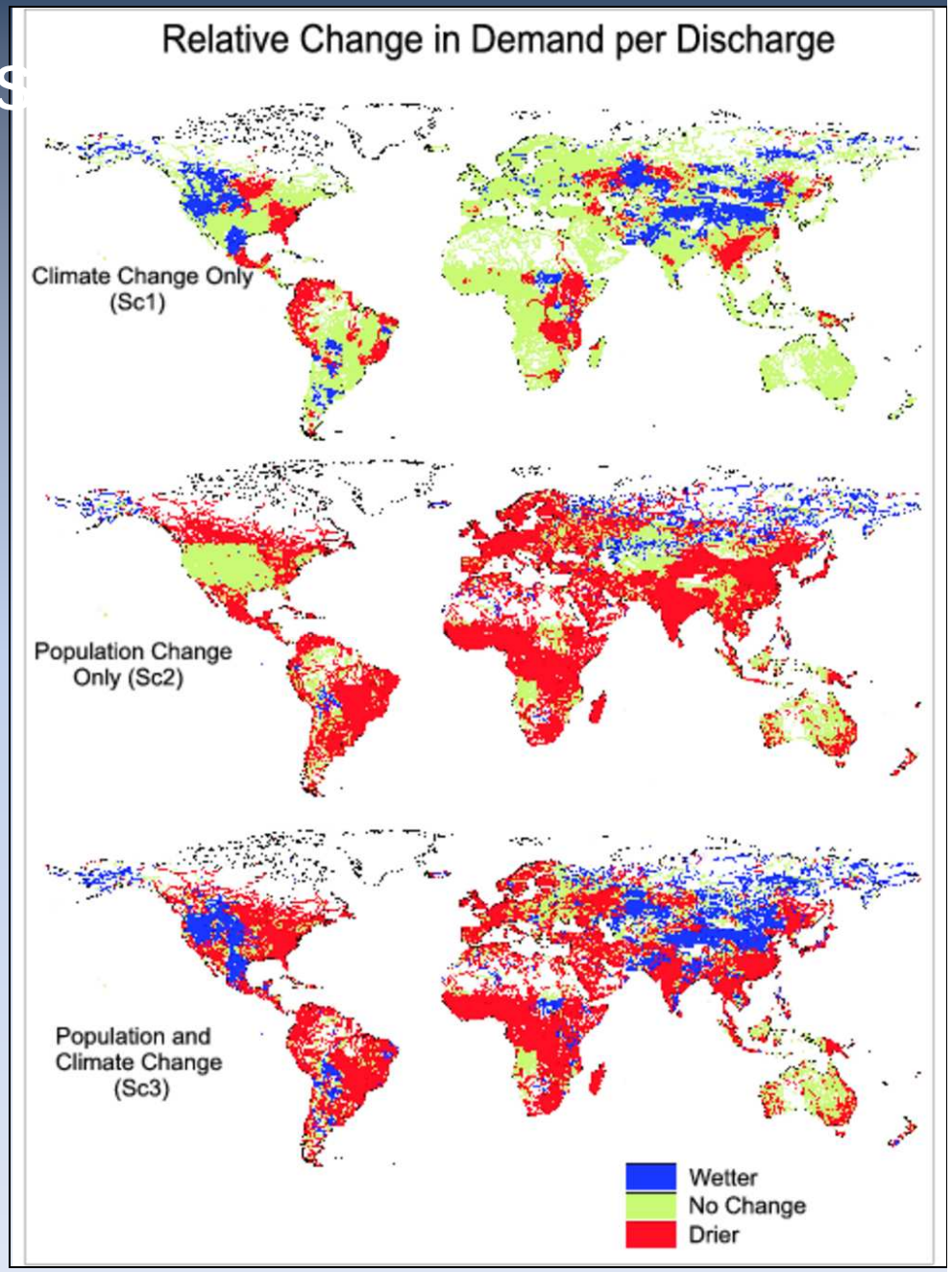
What is ‘Special’ About Freshwaters?

- **Topographic low points on the landscape**
- **Expand and contact rapidly**
- **Highly sensitive to climate variability**
- **Exceptional range of physiochemical conditions**
- **Hotspots of local productivity**
- **Strong surface-**



Water Stress Changes to 2025

- 80% of future stress from **population & development**, **not climate change**
- Future distortions of the water cycle are inevitable
- Consequences for FWs ….. substantial



UNH

Modified from Vörösmarty et al. 2000

Water & Societal Interfaces

- **50% of available water (31% of total FW) already appropriated for human use**
- **Global population will increase 30-35% in 30 yrs; accessible water will increase < 10%**
- **1000 Tons of water = 1 Ton grain**
- **Human appropriation of water will be 70% of that available in 30 yrs: What about environmental requirements?**

Water & Societal Interfaces - 2

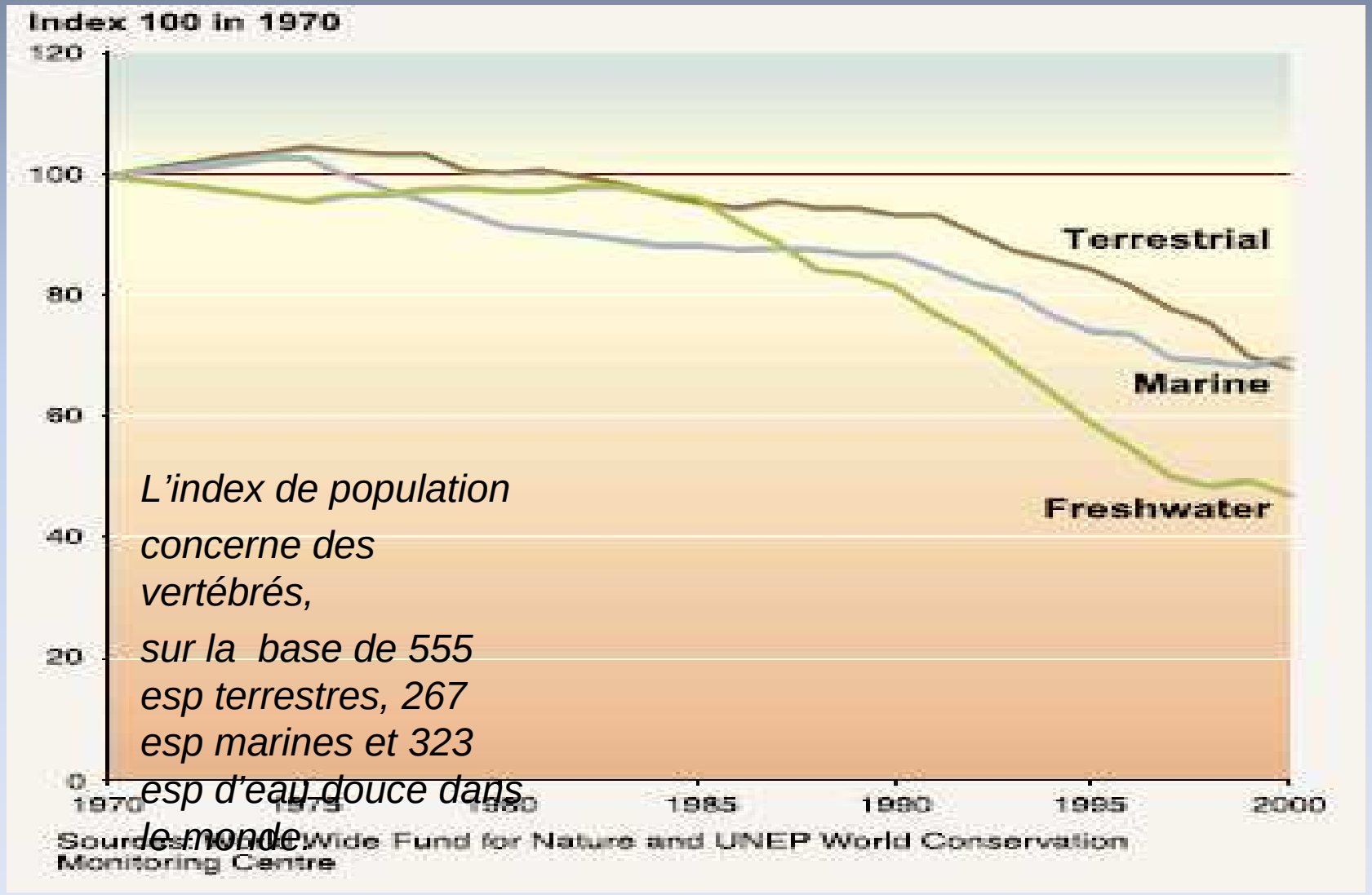
- **Year 2025: Global population needs the equivalent of an additional 24 Nile Rivers or 110 Colorado Rivers for irrigated crops**
- **~250 rivers flow through two or more countries**
- **Populations in water stressed countries (<1700 m^3/person/yr) increases 6-fold (0.5 to 3.0 B). Most are food importers**

Consequences of Agreements, Attitudes, & Climate

- **Land use**
- **Disturbance Regimes**
- **Global Climate**
- **Pollution**
- **Resource Distribution**
- **Exotic Species**
- **Cumulative Effects**

M McClain, photo

Trends in Terrestrial, Marine, and Freshwater Species, 1970-2000



L'index de population concerne des vertébrés, sur la base de 555 esp terrestres, 267 esp marines et 323 esp d'eau douce dans le monde.

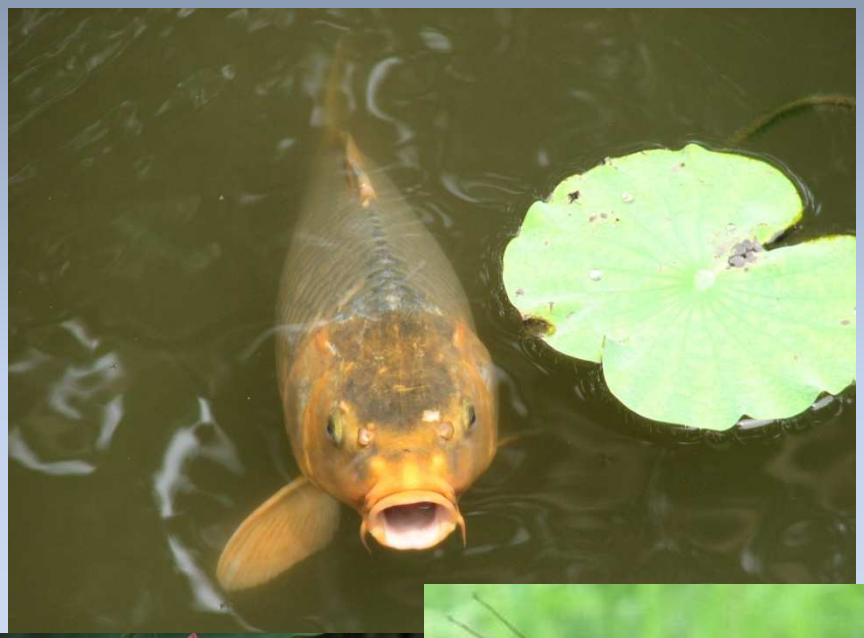
Millennium Ecosystem Assessment 2005

Freshwater Biodiversity: Priority Research Themes

- **Assessment and monitoring: Sustained leadership**
- **Disciplinary integration and learning**
- **Quantifying hydrological requirements of FW species and ecosystems**

Why FW Assessment and Monitoring?

- **~578 known biodiversity databases; only ~50 are related to FW (see http://www.tdwg.org/biodiv-projects/)**
- **Spatial coverage & status of ~125,000 described *animal* species poorly known (http://fada.biodiversity.be Balian et al. 2008)**
- **Broad-based need for a *comprehensive* database that is widely *used***



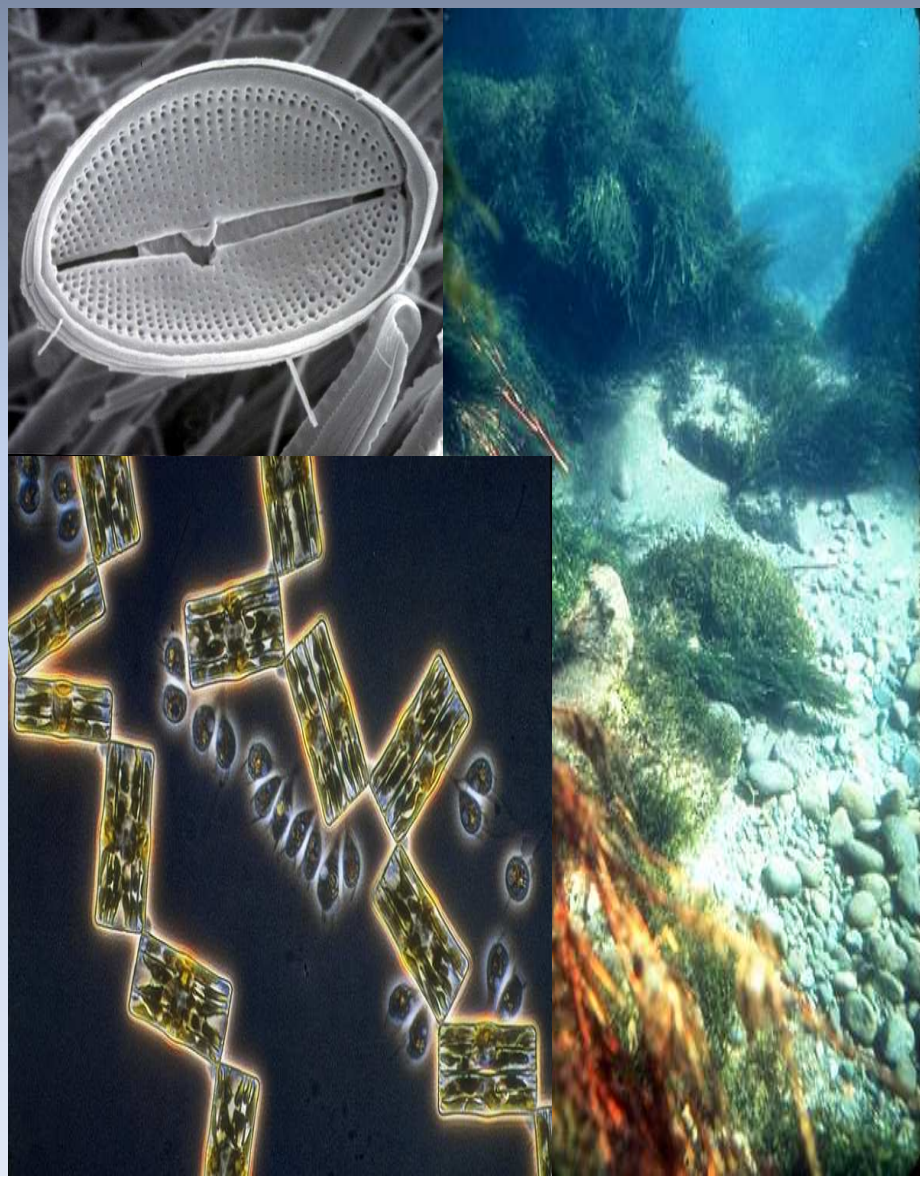
A Focus on Key FW Issues - 1

- **Rapid species detection, especially for yet-to-be described FW organisms (e.g., DNA, molecular assays)**
- **Biodiversity and the maintenance of important ecosystem processes (e.g., clean water, fisheries)**
- **FW biodiversity and health of human & wild organisms (e.g., diseases & nutrition)**
- **Scenarios of probable effects of environmental change on FW diversity and species'**

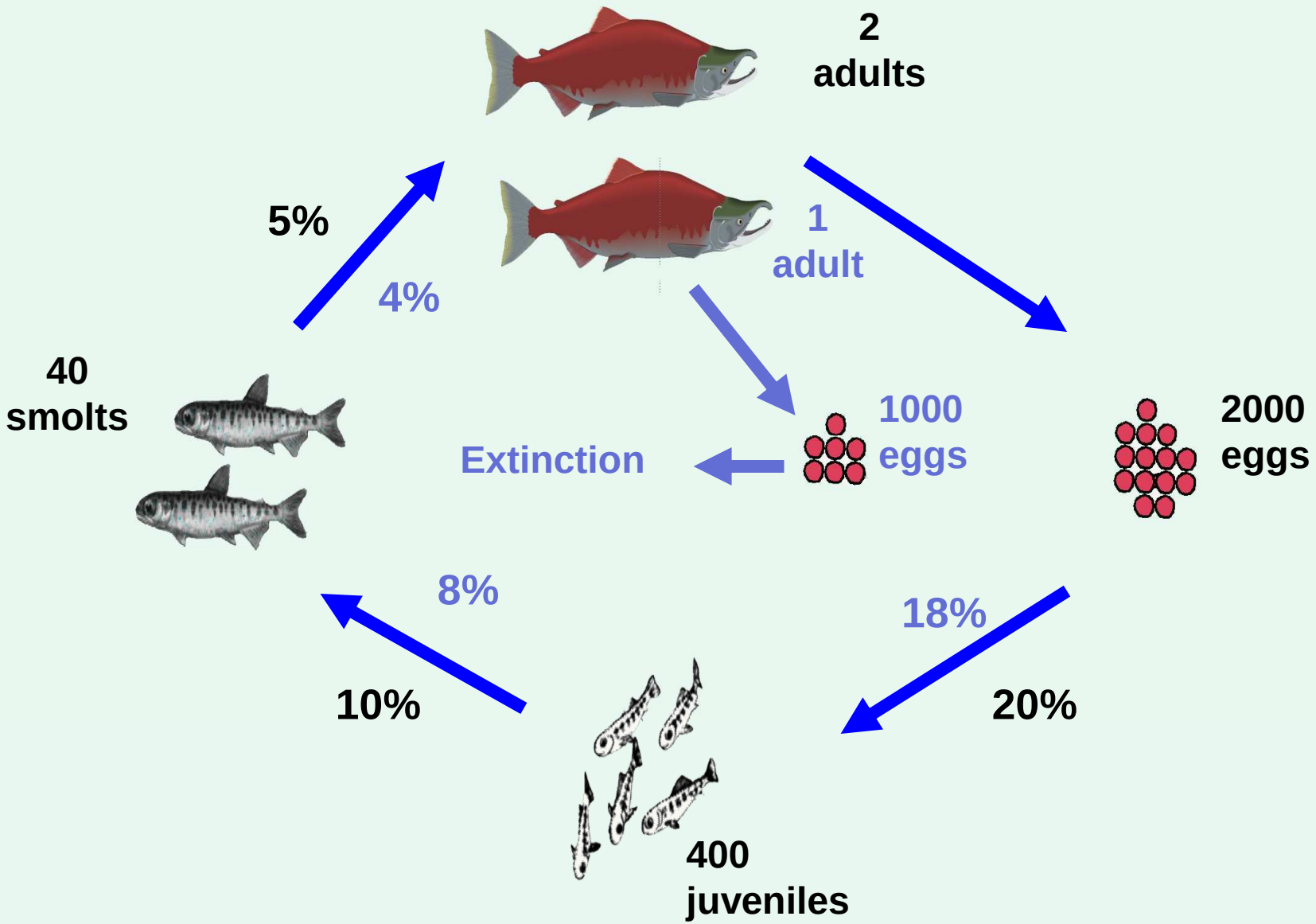
Goliath tigerfish

A Focus on Key FW Issues - 2

- **Quantifying cumulative effects of human alterations on FW biodiversity**



CUMULATIVE EFFECTS

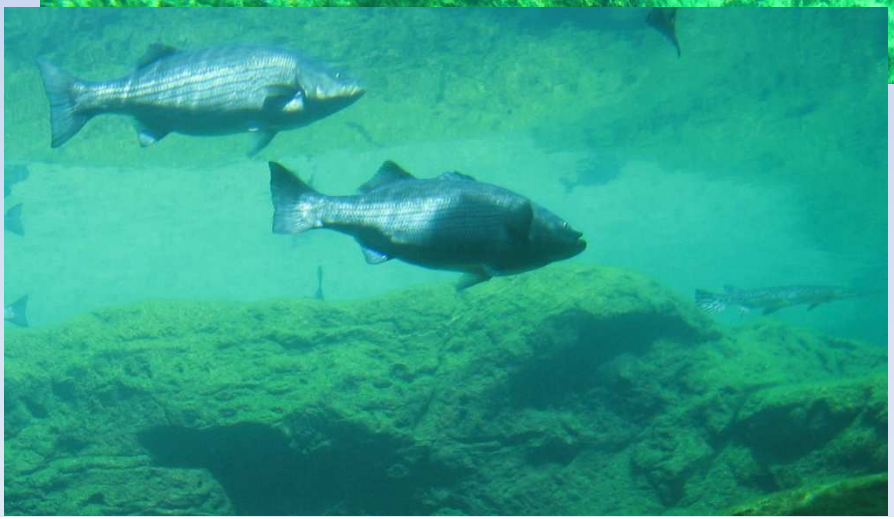


A Focus on Key FW Issues - 2

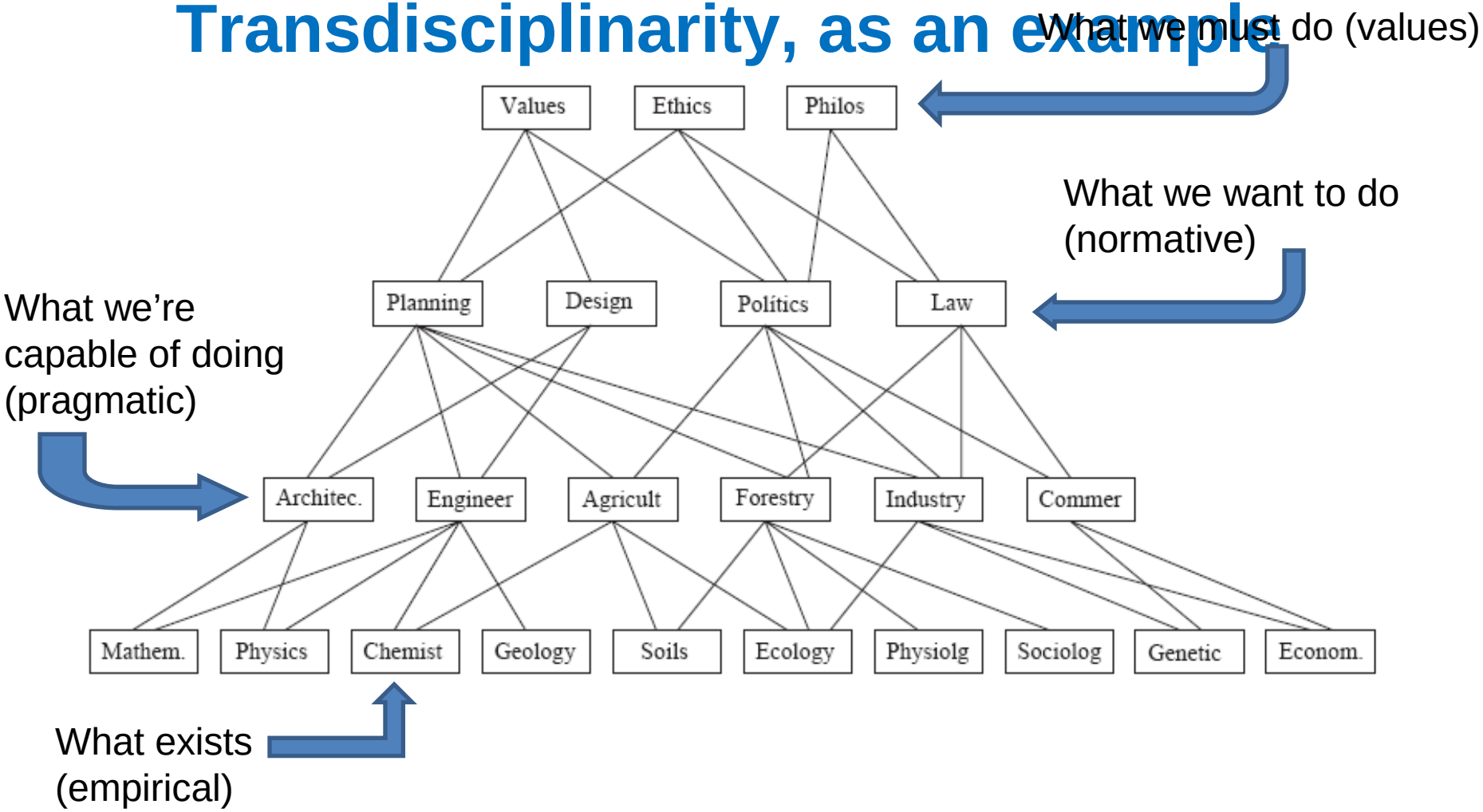
- **Quantifying cumulative effects of human alterations on FW biodiversity**
- **Linking conservation theory, research and social processes to FW *reserves* – in an innovative manner 'harmonious' with human cultures and demands for water**

How can These Issues be Effectively Addressed?

- **Link ‘comprehensive’, spatial explicit FW database(s) in ways that allow them to be queried**
- **Develop people with the skills to ask, and answer, complex questions at large spatial scales**
- **Have a ‘central’ theme**



Disciplinary Integration and Learning:
Transdisciplinarity, as an example



Max-Neef 2005

One Suggestion for a Central Theme using a Transdisciplinary Approach

Environmental Flows: Quantifying the Hydrologic Requirements of FW Species & Ecosystems

The freshwater regime necessary to maintain the biophysical components, ecological processes and health of aquatic ecosystems,

Why is the Determination of Environmental Flows Important?

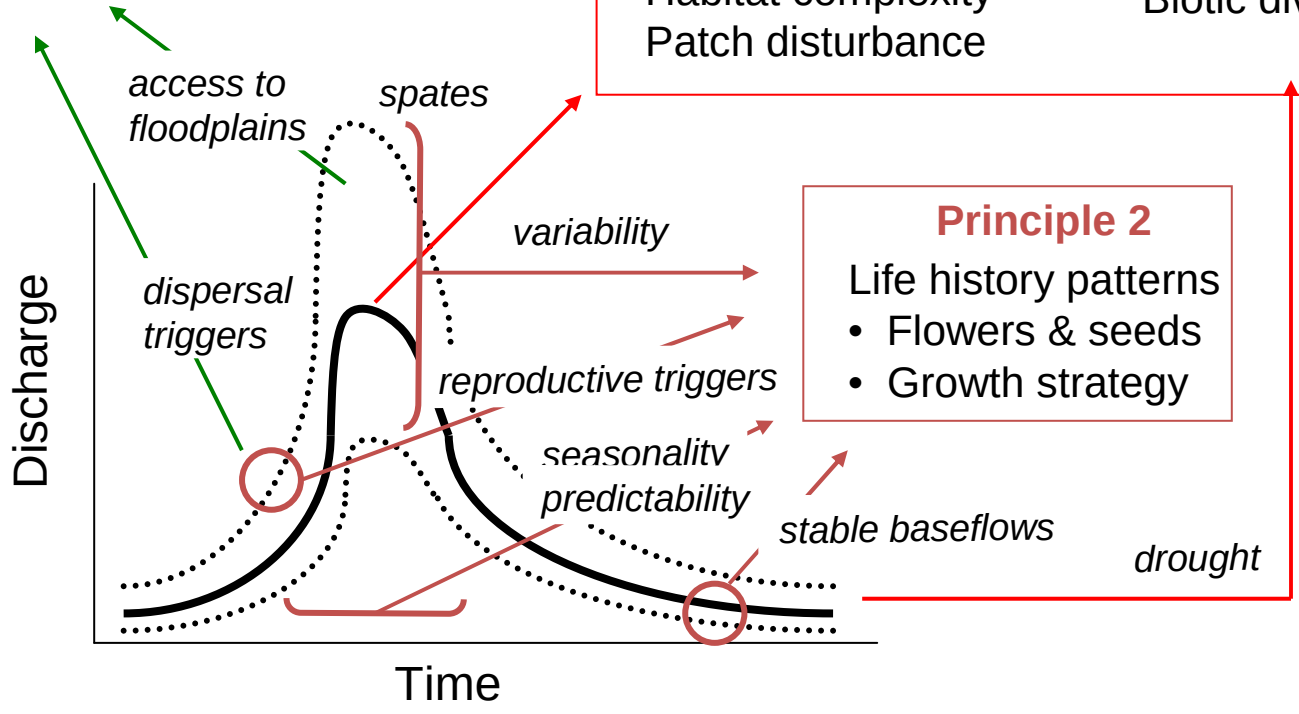
The life histories, distributions and relative abundances of freshwater & riparian organisms are intimately linked to flow regimes, as are system-scale processes,

… over ecological and evolutionary time scales

Biodiversity and Natural Flow Regimes

Principle 3
Lateral connectivity
Longitudinal connectivity

Principle 1
Channel form
Habitat complexity → Biotic diversity
Patch disturbance

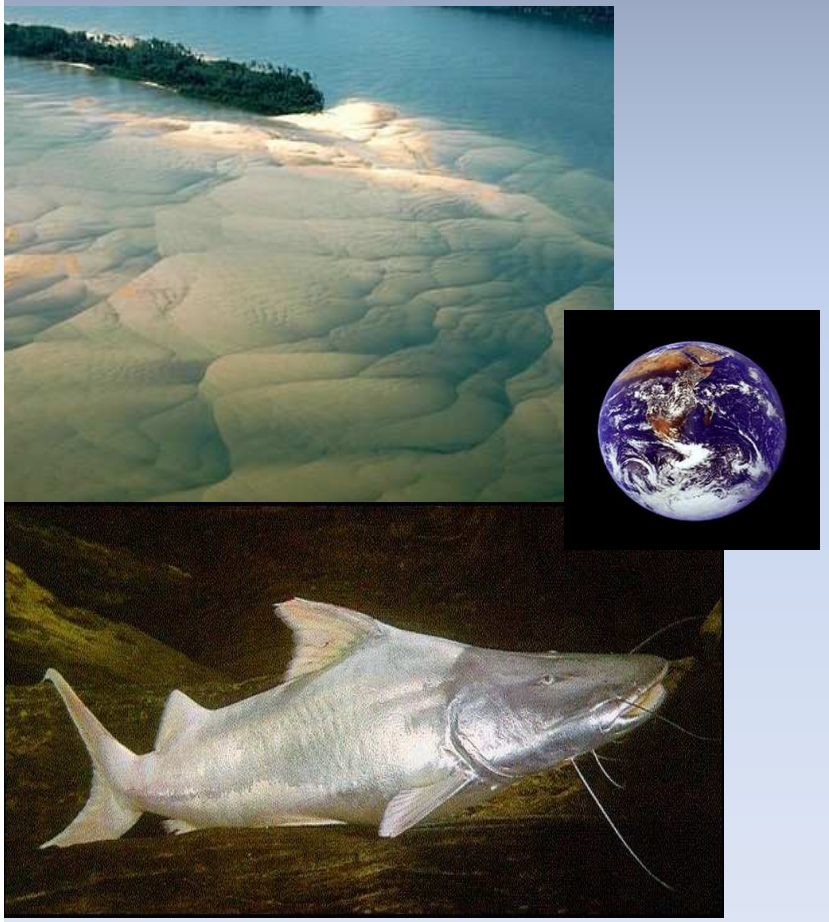


Principle 2
Life history patterns
- Flowers & seeds
- Growth strategy

Principle 4
Natural regime discourages invasions

Bunn & Arthington 2002

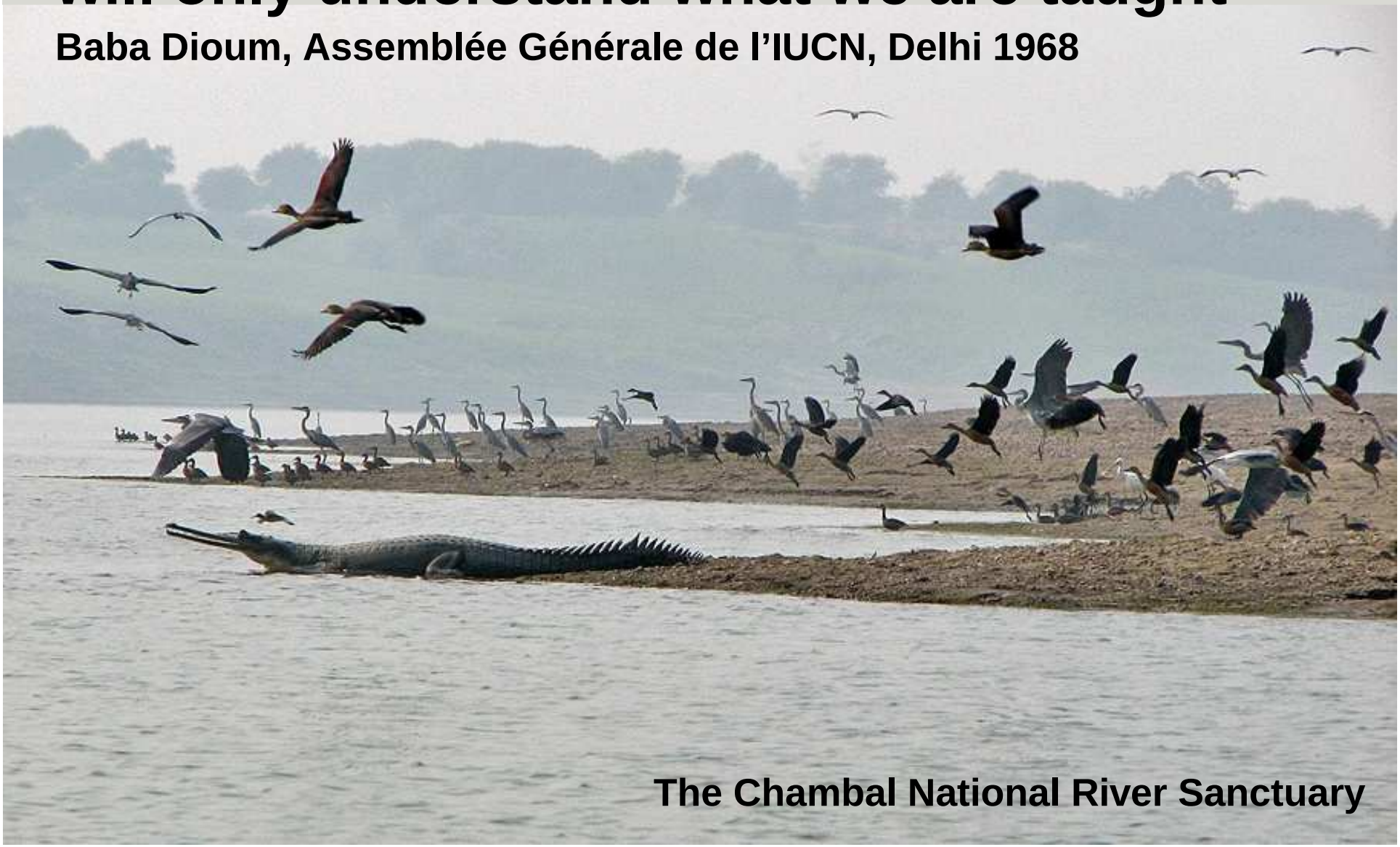
Our Challenge



Collectively, this week and beyond, we must discover how to position FW biodiversity research so that it makes a fundamental difference in the science and applications underpinning the sustainable management of water resources.

End the end we will only conserve what we love. We love only what we understand. We will only understand what we are taught

Baba Dioum, Assemblée Générale de l'IUCN, Delhi 1968



The Chambal National River Sanctuary

Implementing Forward-thinking, Biodiversity Research Requires Leadership – and Courage

Thank You!

END

Anybody who can solve the problems of water will be worthy of two Nobel Prizes – one for *peace* and one for *science*

John F Kennedy