Environmental Flows

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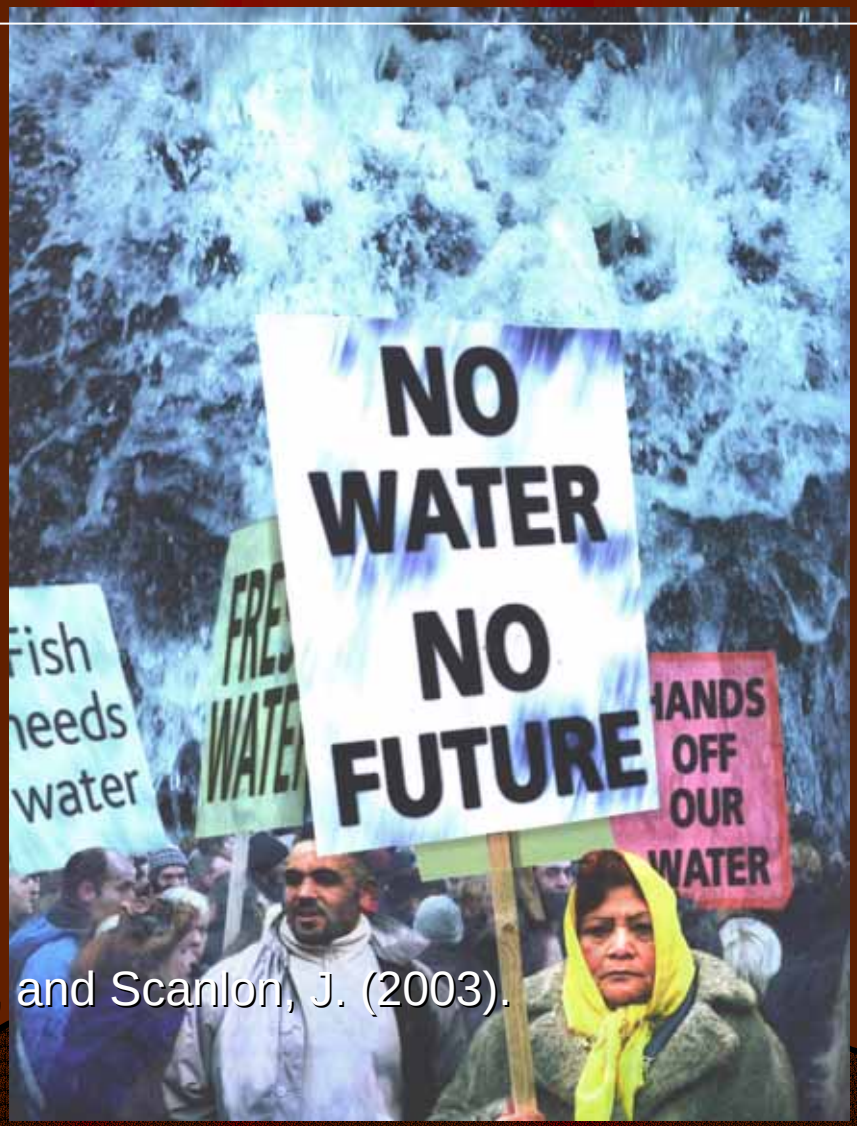
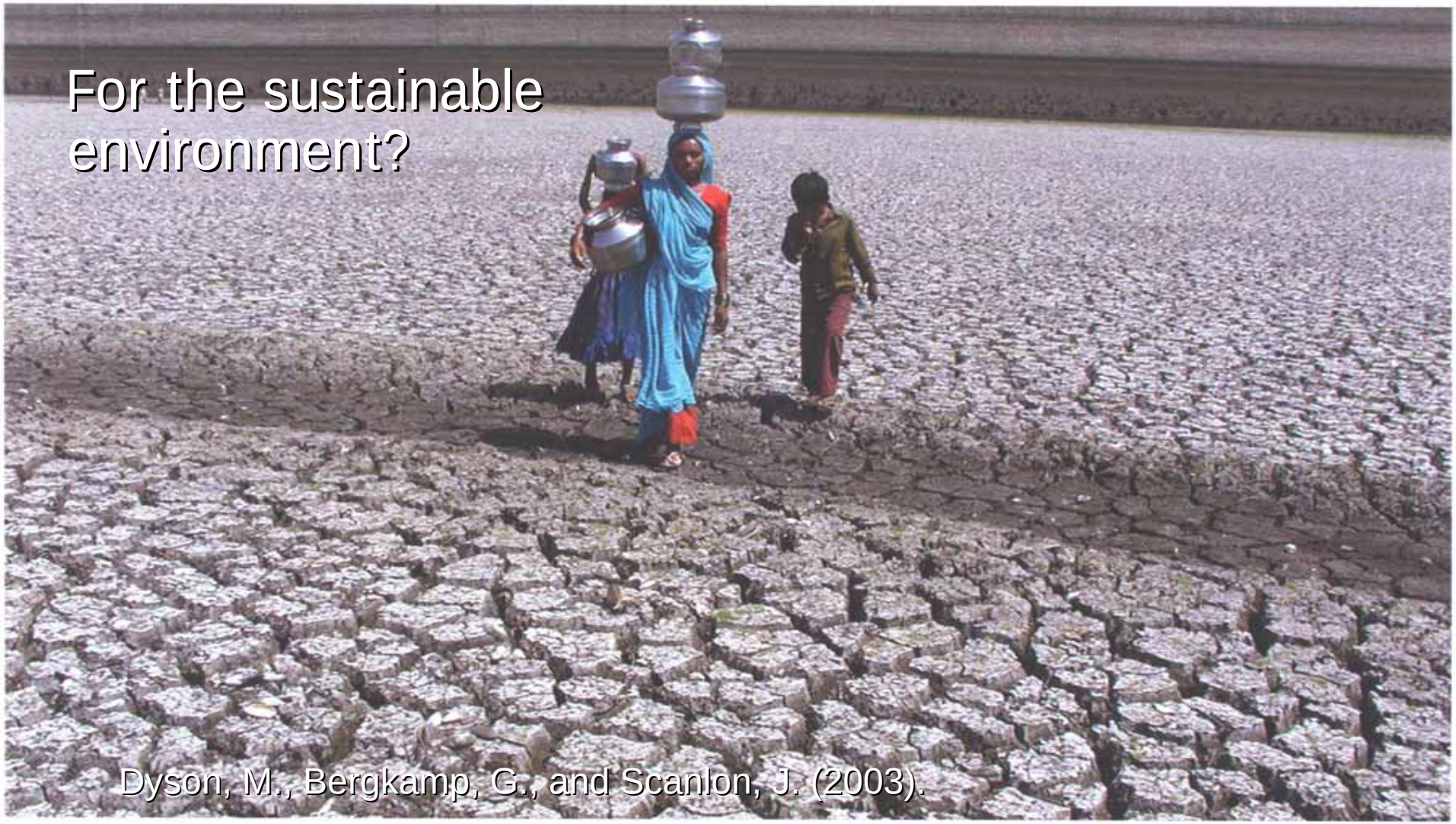
Need of Water

- Agriculture
- Industries
- Domestics
- Livestock
- etc.



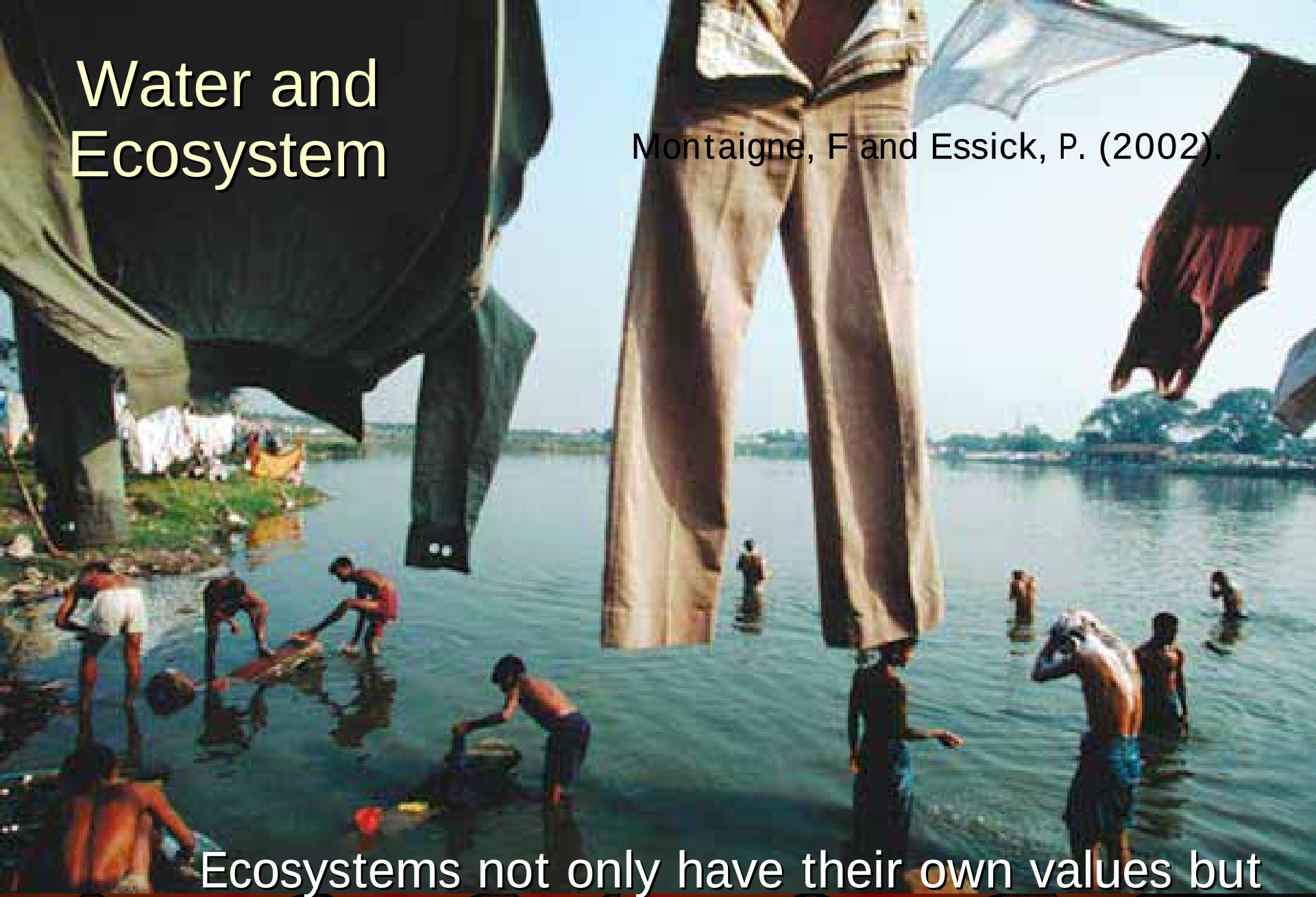
Dyson, M., Bergkamp, G., and Scanlon, J. (2003).

How much water is needed?



An Indian woman walks across a dried lakebed carrying pitchers on her head to collect water in Rajkot district of Gujarat

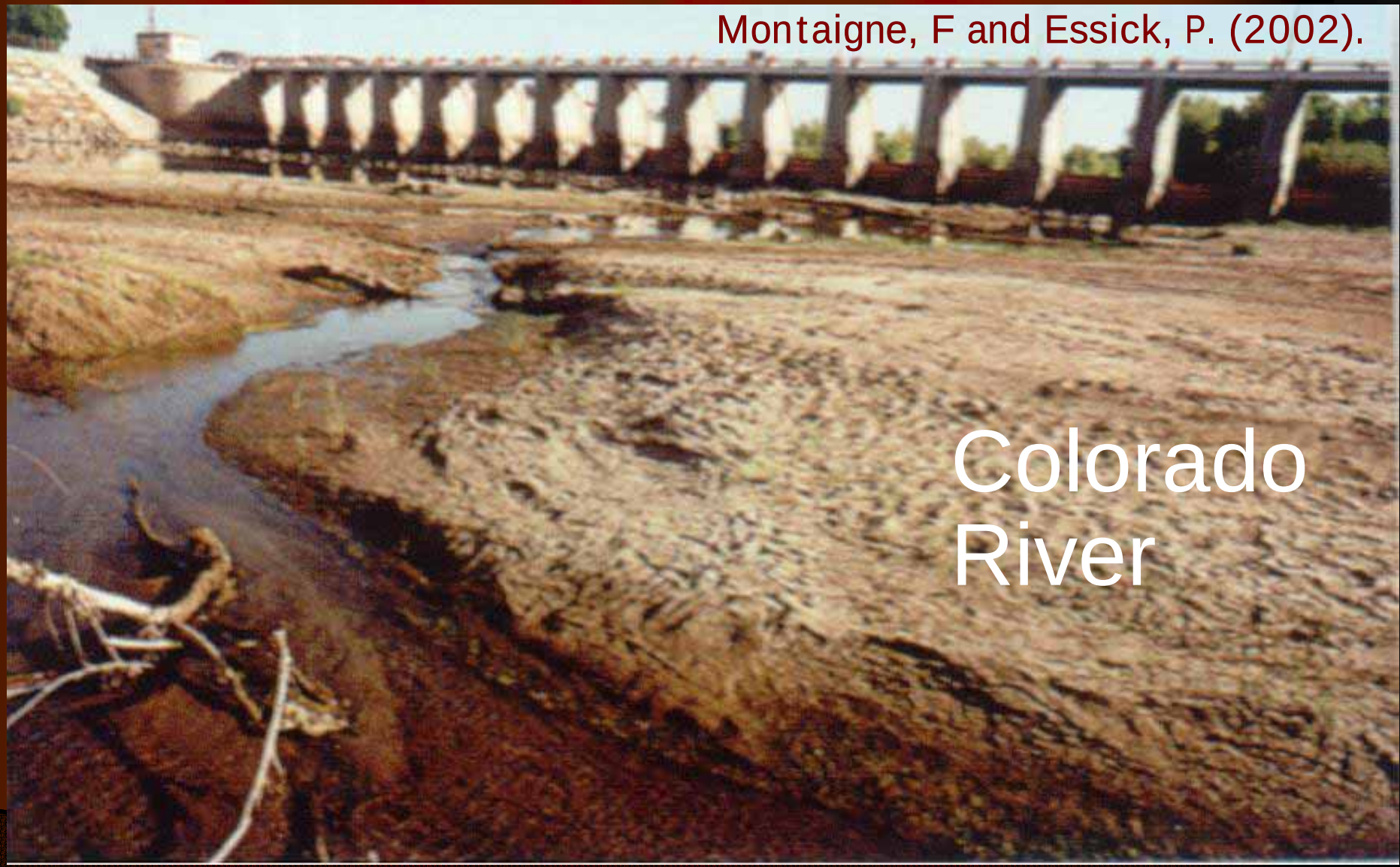
Water and Ecosystem



Montaigne, F and Essick, P. (2002).

Ecosystems not only have their own values but also provide humans with essential services.

Sustainability of water resources requires participatory ecosystem-based management.



Water and ecosystem

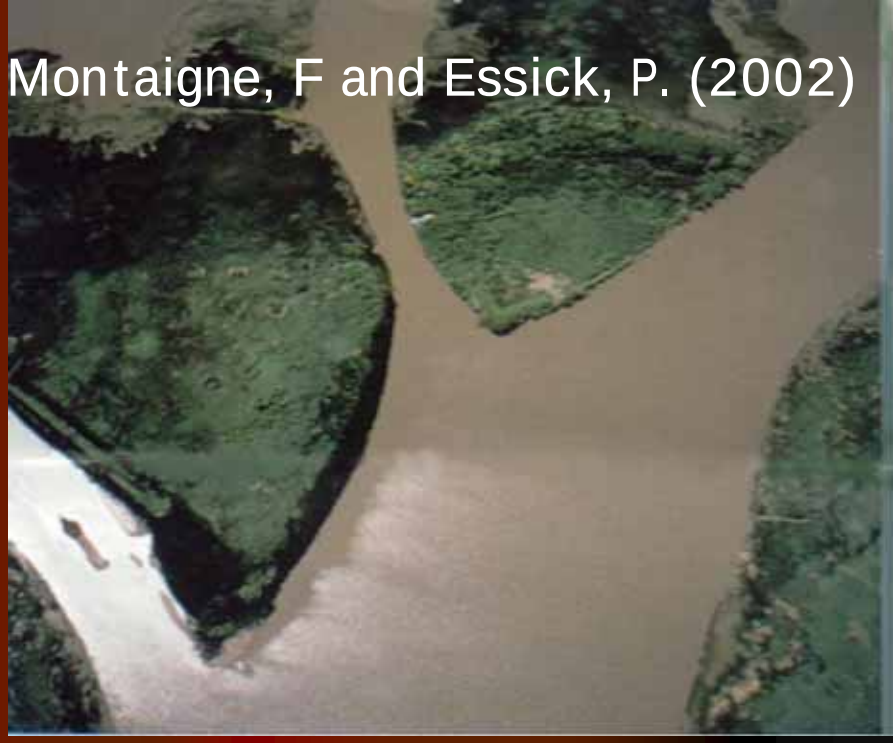
What are Environmental Flows?

No universally agreed definition of environmental flows.

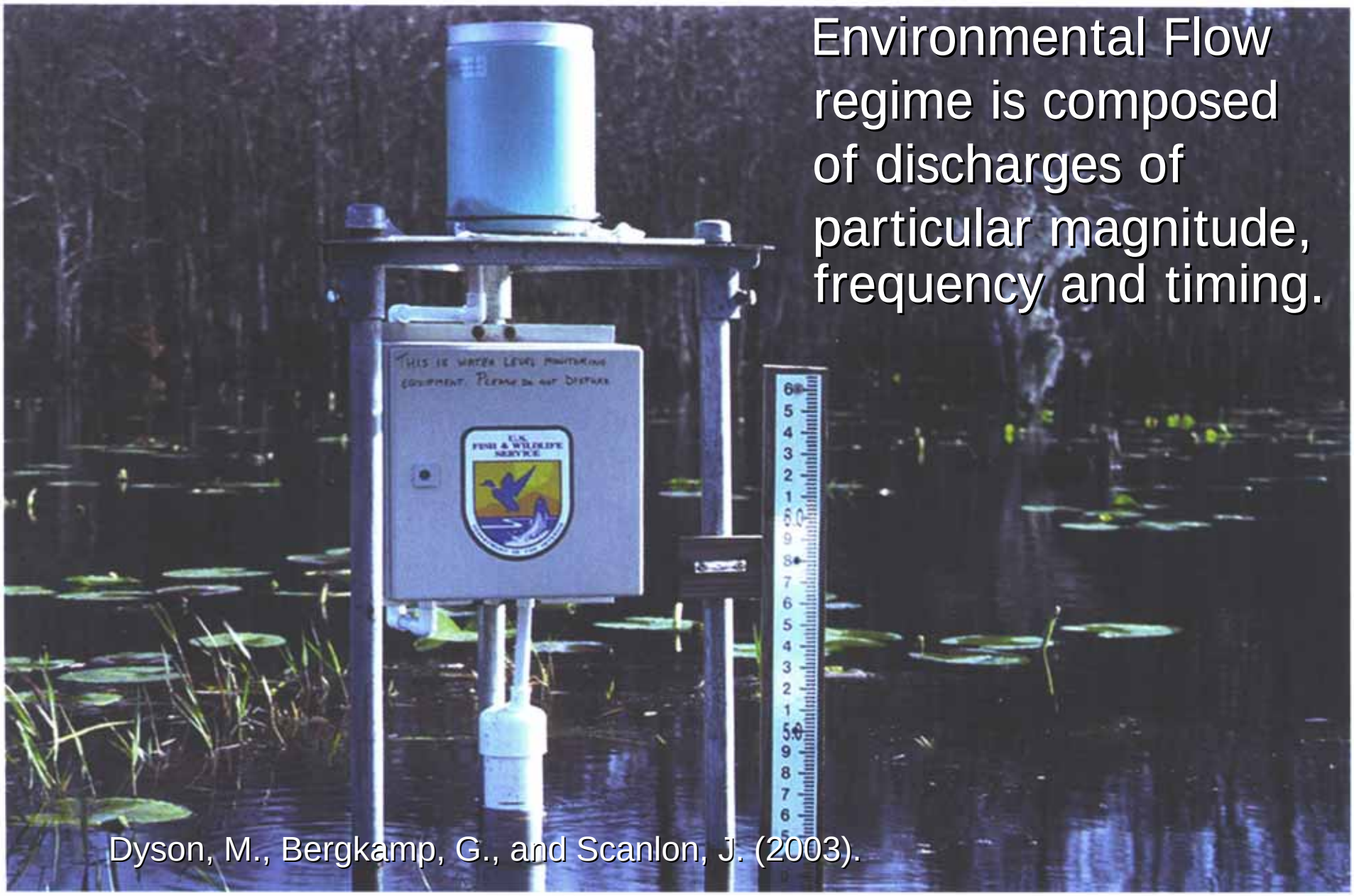
Smakhtin,V.and Dassenaike,L.2004)

EFs represent the flow regime a river, wetland or coastal zone to maintain the integrity, productivity and services of freshwater dependent ecosystems.

(Smakhtin,V.and Dassenaike,L.2004)



Montaigne, F and Essick, P. (2002)



Water level monitoring is an essential element of environmental flow management.

Easy concept of EF

- EF means enough water is left in our rivers
- Which is managed to ensure downstream environmental, social and economic benefits.

Achim Steiner, Director General IUCN-The World Conservation Union

To ensure a healthy river system from ecological, economic and social aspects.

Important concept

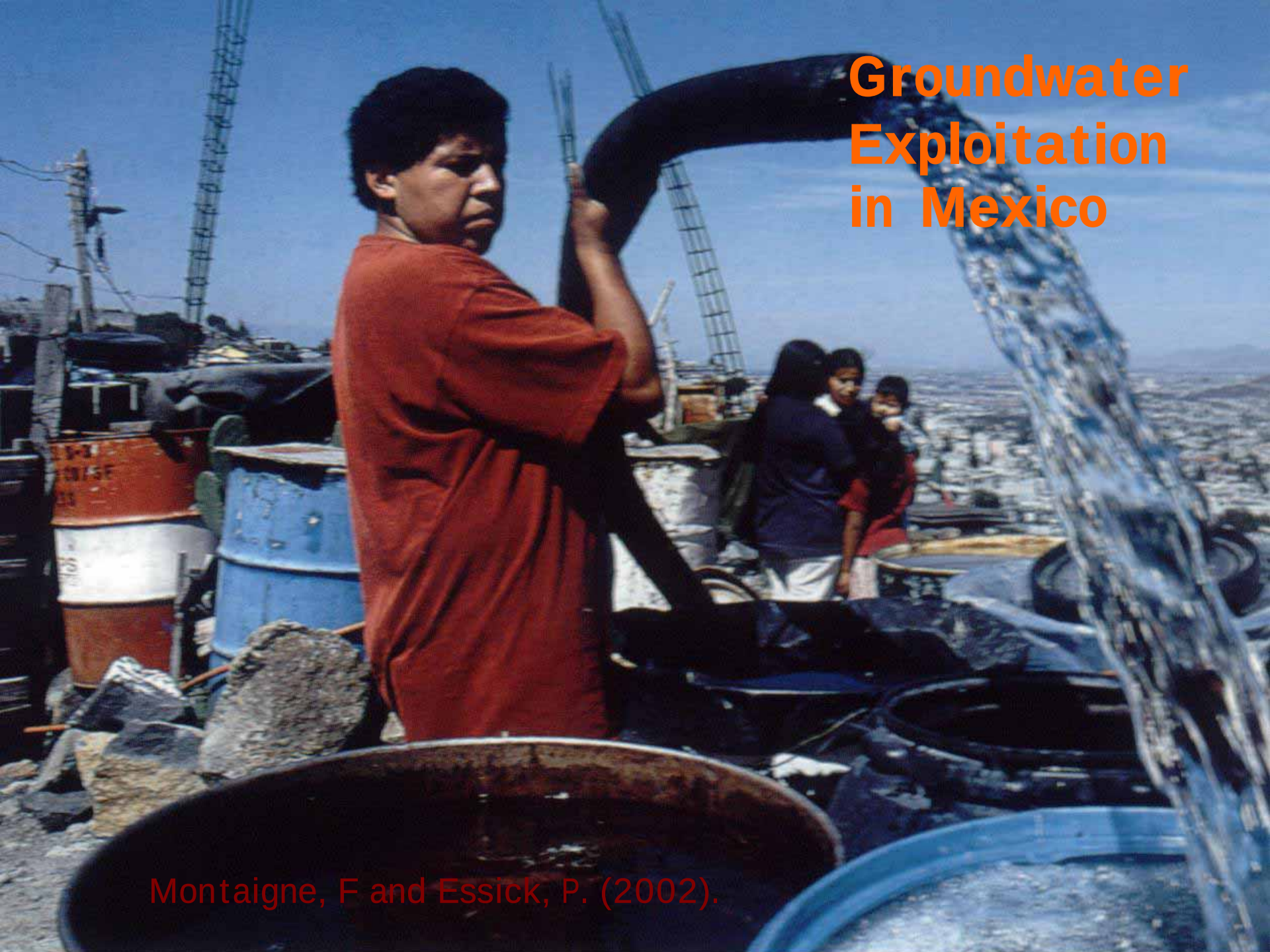
- The assessment and maintenance of environmental flows is an integral part of environmental water resources management.

  Smakhtin,V.and Dassenaike,L.2004)

Aquifers excluded?

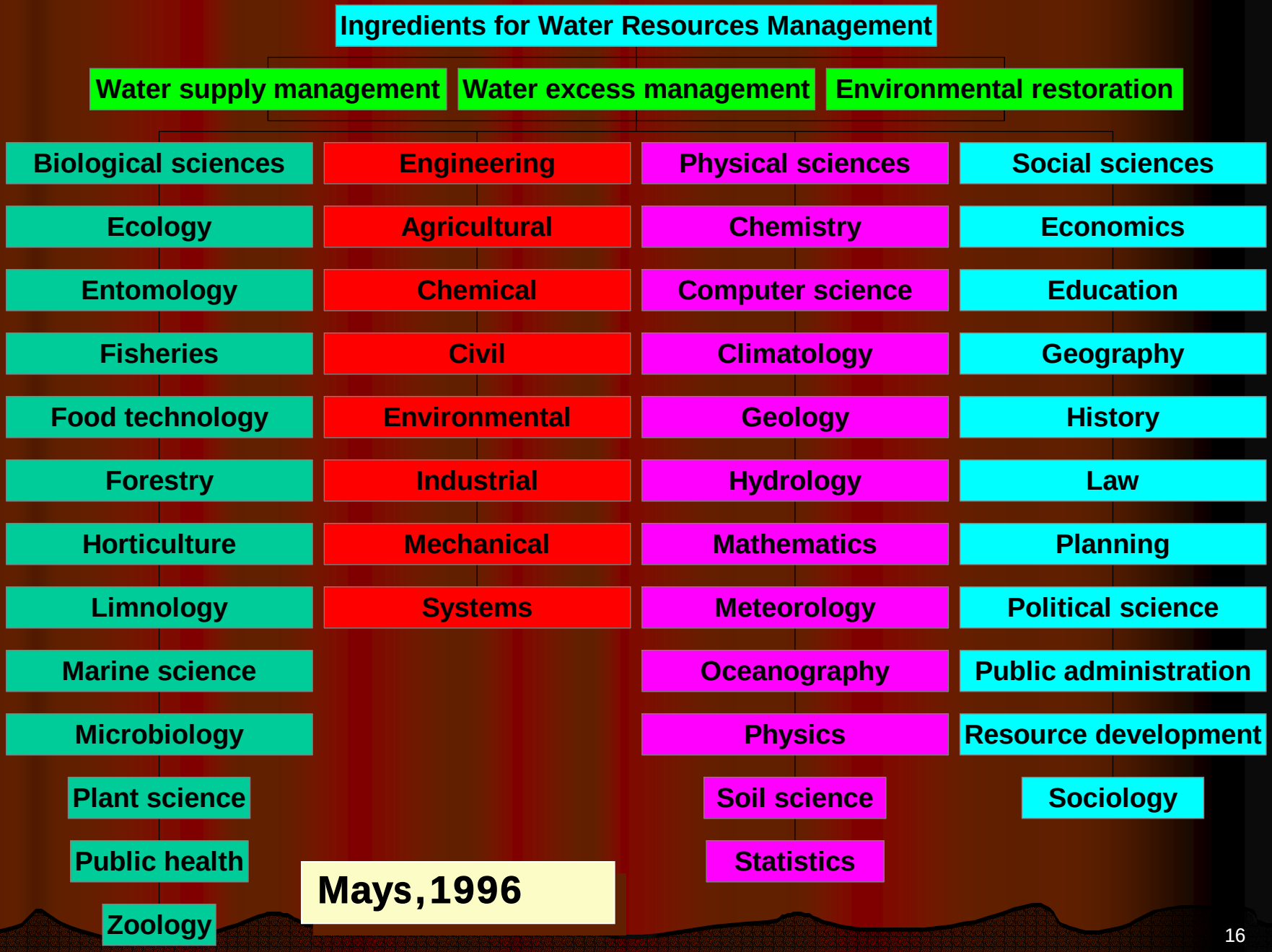
It is also possible to talk about environmentally acceptable limits of groundwater exploitation and recharge.

Smakhtin,V.and Dassenaike,L.2004)


Groundwater
Exploitation
in Mexico
Montaigne, F and Essick, P. (2002).

The Multidiscipline

- EFs require the integration of a range of disciplines.
- Also requires negotiation between stakeholders to bridge the different interests among competing users.


Ingredients for Water Resources Management
Water supply management
Water excess management
Environmental restoration
Biological sciences
Ecology
Entomology
Fisheries
Food technology
Forestry
Horticulture
Limnology
Marine science
Microbiology
Plant science
Public health
Zoology
Engineering
Agricultural
Chemical
Civil
Environmental
Industrial
Mechanical
Systems
Physical sciences
Chemistry
Computer science
Climatology
Geology
Hydrology
Mathematics
Meteorology
Oceanography
Physics
Soil science
Statistics
Social sciences
Economics
Education
Geography
History
Law
Planning
Political science
Public administration
Resource development
Sociology
Mays,1996

Environmental flows are relatively new practices for the water sector, particularly in developing countries.

- Initiatives related to environmental water management and ecosystem restoration are emerging in the world.

Montaigne, F and Essick, P. (2002).

Water Pollution and Human Settlement

Residents carry empty canisters as they walk on a dry riverbed in search of water near Hyderabad, some 160 km from Karachi.

No more flow.....when?

There is a lack of awareness throughout the sector and among the general public about EF concept and its application.

Dyson, M., Bergkamp, G., and Scanlon, J. (2003).

- Latin America, Africa and Asia do not have at present either clear environmental flow legislation, or accepted approaches for assessment of this flows.

- Existing assessment methods, developed elsewhere, are either not known, or seldom being applied.
- EF assessment methods and expertise required to implement them are limited.
- The relevant ad-hoc studies and initiatives are poorly documented.

How to Evaluate EFs?

Environmental flows are always a compromise between

water for development and water for nature.

The Assessment of EFs

- EFs may similar to the assessment of environmental water demand
- Through the process known as Environmental Flow Assessment

Smakhtin,V.and Dassenaike,L.2004)

	Overall management Objective	flow/level objective	approach used
River Babingley	maintain a wild brown trout population	ecologically acceptable flow duration curve	physical habitat modelling (PHABSIM) and naturalised flow duration curve from rainfall-runoff model
River Kennet	maintain a wild brown Trout population	flow should not fall below that which results in a reduction in physical habitat for brown trout of more than 10%	physical habitat modelling (PHABSIM)
River Avon	protect salmon migration	minimum flows at critical times of the year	radio tracking of salmon
Pevensey Levels wetland	restore and maintain ecology at 1970 levels	maintain ditch water levels not more than 300 mm below ground level Mar-Sept not more than 600 mm below ground level Oct-Feb	expert research opinion on water requirements of ecology of wetland species
Somerset Moors and Levels	restore numbers of breeding waders to 1970 level	raise water levels in Winter to produce splash-flooding and maintain water levels within 200 mm of ground surface in Spring	expert opinion on ecology of wading birds
Chippenham, Wicken, Fulbourn Fens	protection of vegetation communities	target flows identified in the River Granta and Lodes	Lodes-Granta groundwater model, test pumping, hydrological studies

Environmental Flow Assessment

- A number of scenarios
- Different flow regimes
- Different environmental and social benefit /cost
- Stakeholders decide on the best scenario
- A compromise of community's multiple needs

EFA Methodologies

- Range from quick, low-confidence, desktop type assessments

  (suitable for initial planning)

- Detail comprehensive multidisciplinary team (for detailed studies)

Smakhtin,V.and Dassenaike,L.2004)

A Flow Measurement Training

How much EF should be?

- Depends on the hydrology and ecology of a particular river.
- The primitive stage river may required 60-80% of total annual natural flow.
- While the highly-developed river may be as low as 15-20% of total natural flow.

How can EF be ensured?

The flow may be regulated through dams, channels, changing management practices for better use of available water for a more healthy river.

Environmental releases

- The release from dams may include ‘low flow’ to allow the first seasonal flood to go to the environment
- or to release flows to enhance the natural flood.

Infrastructure may be used to prevent flows to wetlands to imitate periodic natural in the time of flood and drought.

And may not be used.

And may not be used!


Land use management and specific allocation policies, in unregulated river basin, can be also used to ensured EF.

Poor ecosystem…..and land use

EFA involve with?

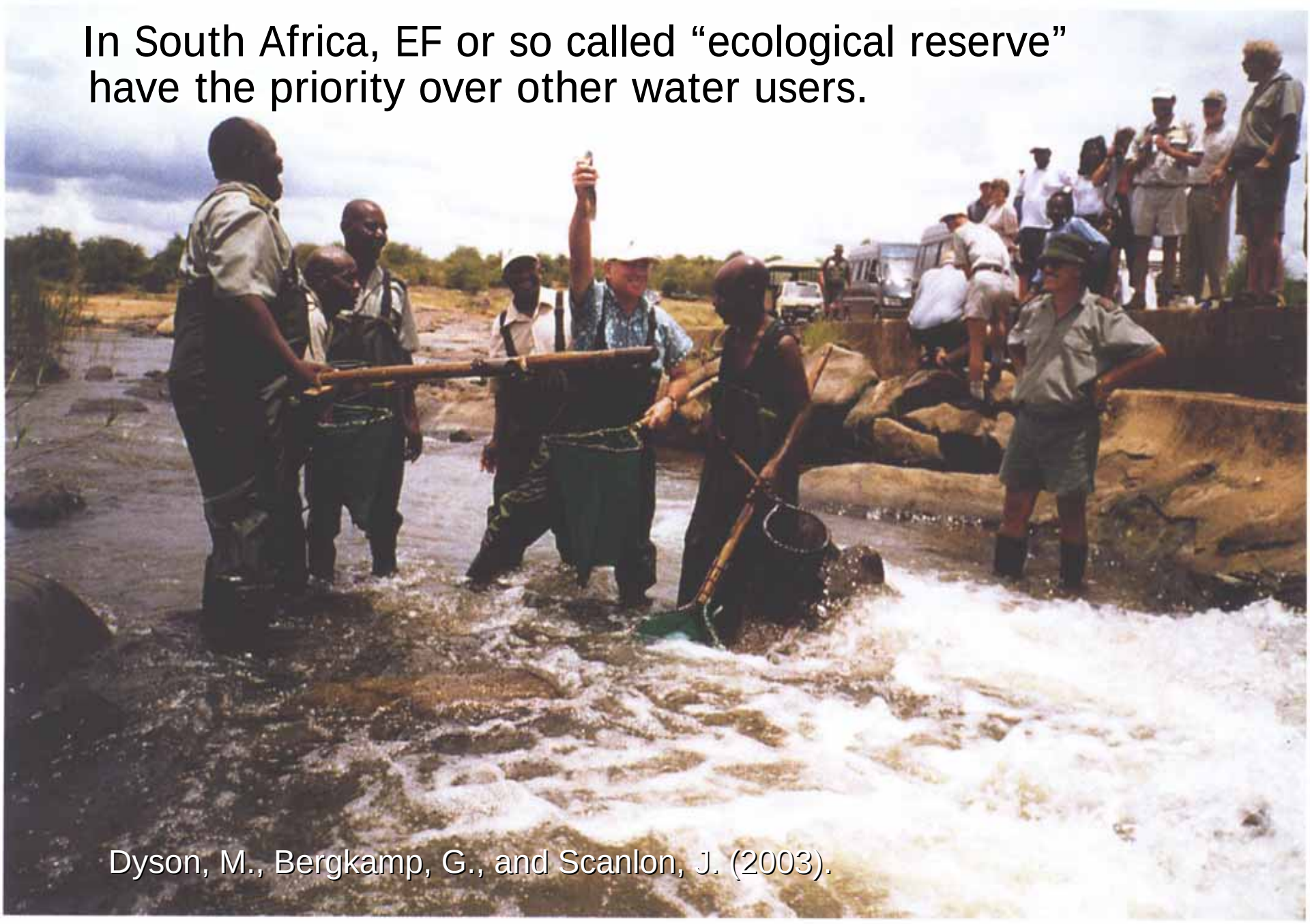
- Not only scientific aspect but also
- Social and political issue
- Many different actors
- From the highest rank of Government side
- To the local people and communities
- Water managers
- RBO
- Research organisations

EF vs IWRM

The way to maintain the productivity and essential goods and service for both human and ecosystems….

is through establishment and maintenance of EF.

In South Africa, EF or so called “ecological reserve” have the priority over other water users.



Dyson, M., Bergkamp, G., and Scanlon, J. (2003).

South Africa’s Minister of Water Resources, Ronnie Kasrils, shows the results of the River Health Programme.

Dyson, M., Bergkamp, G., and Scanlon, J. (2003).

Introduction of the Instream Flow Incremental Methodology to South Africa by Dr Bob Milhous (2nd right at rear) in the Kruger National Park Board Room, 1992.

The Five Phases of the In-stream Flow Incremental Methodology (IFIM) include:

Phase 1. *Identifying problems*

The problems are identified and broad issues and objectives are related to legal entitlement identification.

Phase 2. *Project planning and catchment characterisation*

The technical part of the project is planned in terms of characterising the broad-scale catchment processes, species present and their life history strategies, identifying likely limiting factors, collecting baseline hydrological, physical and biological data.

Phase 3. *Developing models*

Models of the river are constructed and calibrated. IFIM distinguishes between microhabitat, commonly modelled using an approach such as PHABSIM, and macro-habitat, which includes water chemistry/quality and physico-chemical elements such as water temperature. A structure for specifying channel and floodplain maintenance flows is present, but there is little guidance on specific methods. Hydrological models of alternative scenarios, including a baseline of either naturalised or historical conditions, drive the habitat models. The models are integrated, using habitat as a common currency.

Phase 4. *Formulating and testing scenarios*

Alternative scenarios of dam releases or abstraction restrictions are formulated and tested using the models to determine the impact of different levels of flow alteration on individual species, communities or whole ecosystems.

Phase 5. *Providing inputs into negotiations*

The technical outputs are used in negotiations between different parties to resolve the issues set out in step one.

Experts discuss the ecological consequences of the 1992/1993 drought on the Olifants river.

References

- Dyson, M., Bergkamp, G., and Scanlon, J. (2003). Flow. The essentials of environmental flows. IUCN.
- Smakhtin, V. and Dassenaike, L.(2004). Environmental Flows. *Environmental Perspectives on River Basin Management in Asia.* Vol.1(1). IWMI. Colombo. Sri Lanka
- Mays, L.W.(1996). Water Resources Handbook, McGrawHill, USA.
- Montaigne, F and Essick, P. (2002). Journal of The National Geographic Society 2(27) 82-113 December (Thai Version).