Coupled Human And Natural Systems (CHANS)

Lecture 1 of 16, Dr Marion Pfeifer

25/11/2019

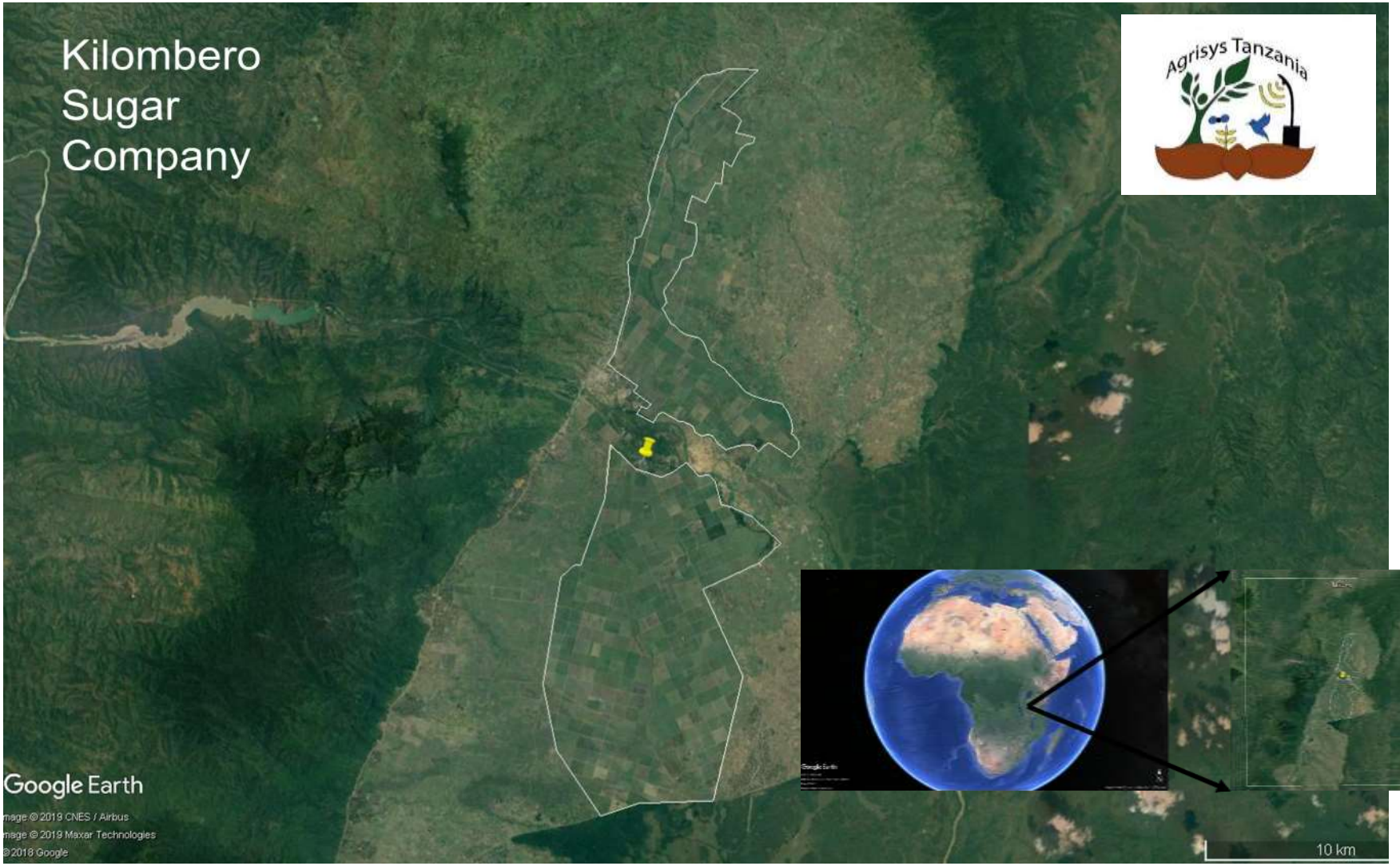
Outline of this lecture

(1) Define CHANS
(2) Provide some context
(3) List some key case studies

Key papers:

- Liu et al. 2007 Complexity of Coupled Human and Natural Systems. *Science* 317: 1513-1516.
- DeFries et al. 2010 Interactions between protected areas and their surroundings in human-dominated tropical landscapes. *Biological Conservation* 143: 2870-2880
- Goddard et al. 2010 Scaling up from gardens: biodiversity conservation in urban environments. *TREE* 25: 90-98
- Palomo et al. 2014 Incorporating the Social–Ecological Approach in Protected Areas in the Anthropocene. *BioScience* 64: 181-191

The Agrisys Tanzania project



https://blogs.ncl.ac.uk/agrisystanzania/

Google Earth
Image © 2019 CNES / Airbus
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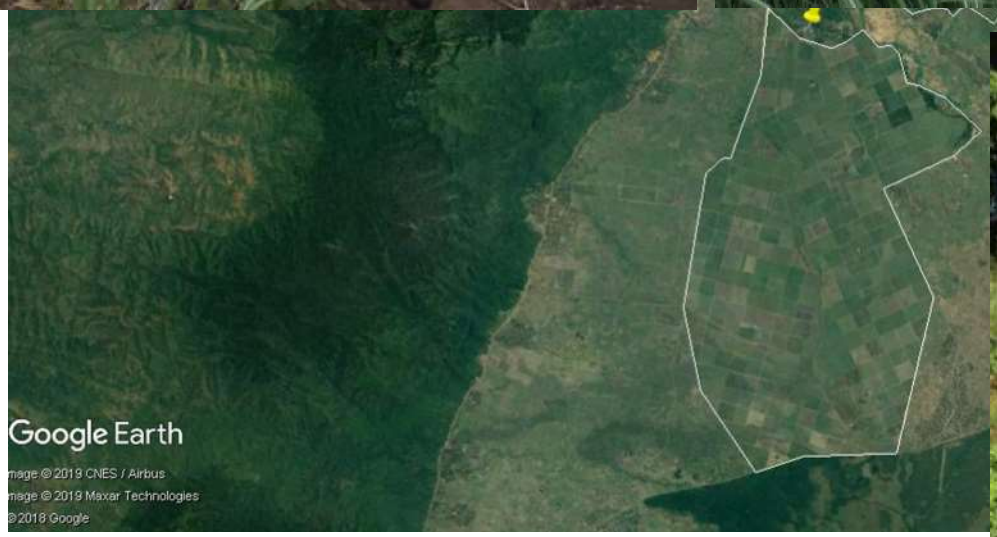

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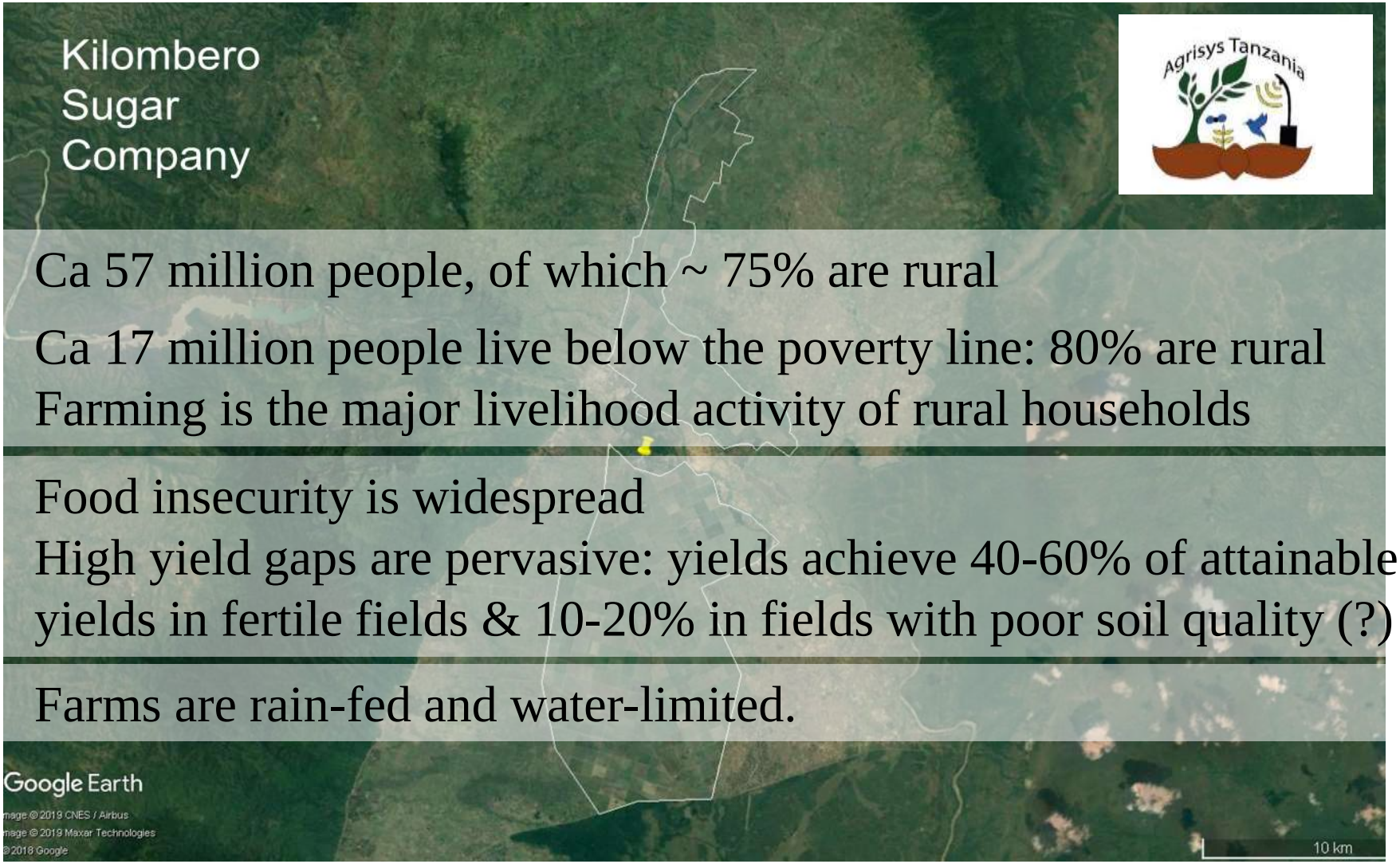
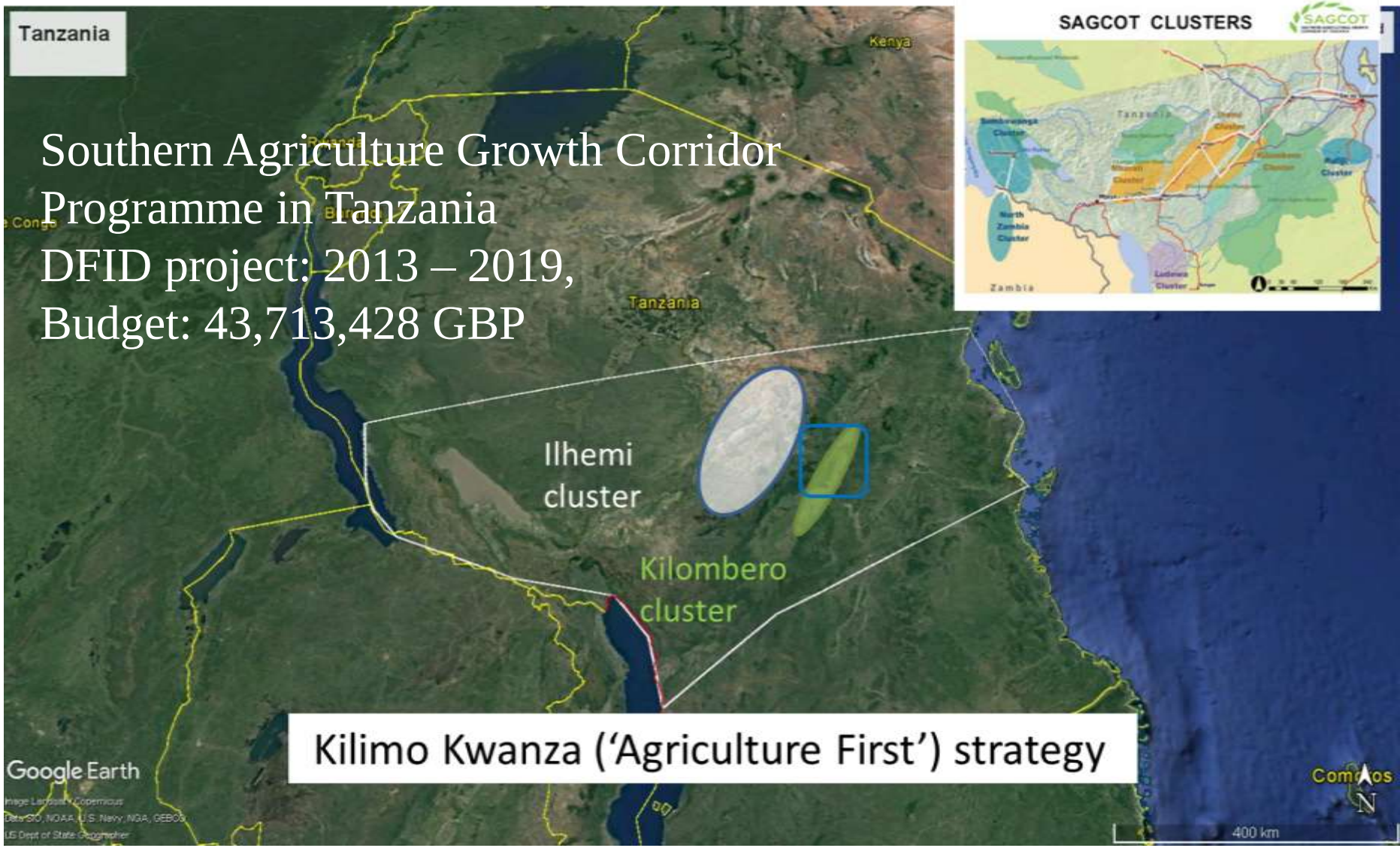
The Agrisys Tanzania project



- Ca 57 million people, of which ~ 75% are rural
- Ca 17 million people live below the poverty line: 80% are rural
- Farming is the major livelihood activity of rural households
- Food insecurity is widespread
- High yield gaps are pervasive: yields achieve 40-60% of attainable yields in fertile fields & 10-20% in fields with poor soil quality (?)
- Farms are rain-fed and water-limited.

https://blogs.ncl.ac.uk/agrisystanzania/

The Agrisys Tanzania project



Southern Agriculture Growth Corridor Programme in Tanzania
DFID project: 2013 – 2019,
Budget: 43,713,428 GBP

SAGCOT

Southern Agriculture Growth Corridor Programme in Tanzania
DFID project: 2013 – 2019,
Budget: 43,713,428 GBP

Objectives: (1) raise rural incomes, (2) increase food security by contributing to the improvements in the business environment for commercial agriculture in Tanzania as well as growth in number and scale of commercial agribusinesses and substantial improvement in the market operations of a number of agricultural commodity markets.

Agricultural growth corridors

Agricultural intensification Benefits? Costs?

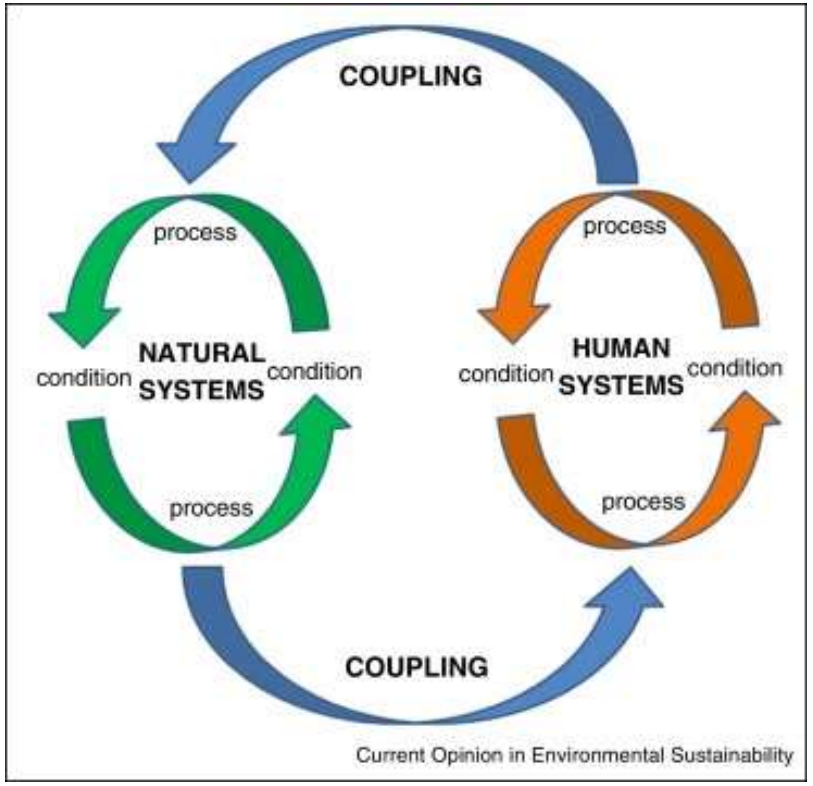
Crop production potential can be modest. Environmental & social costs may be large.

Define CHANS

Coupled human and natural systems are integrated systems where humans and nature interact (Boyd Kramer et al. 2017 *Ecology and Society* 22).

Also called:

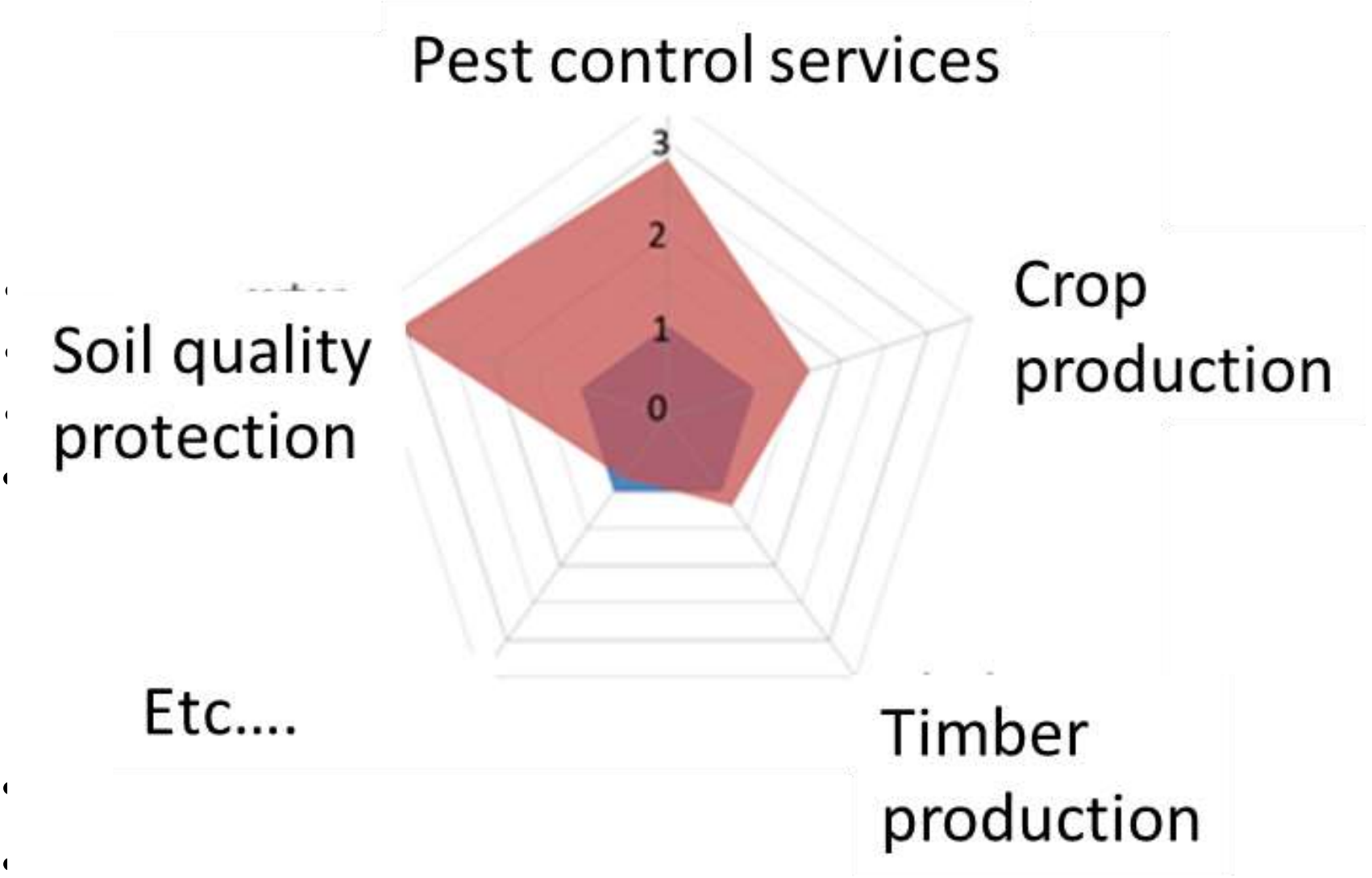
- coupled human-environment systems
- social-ecological systems
- ecological-economic systems
- population-environment systems



http://dx.doi.org/10.1016/j.cosust.2016.02.001

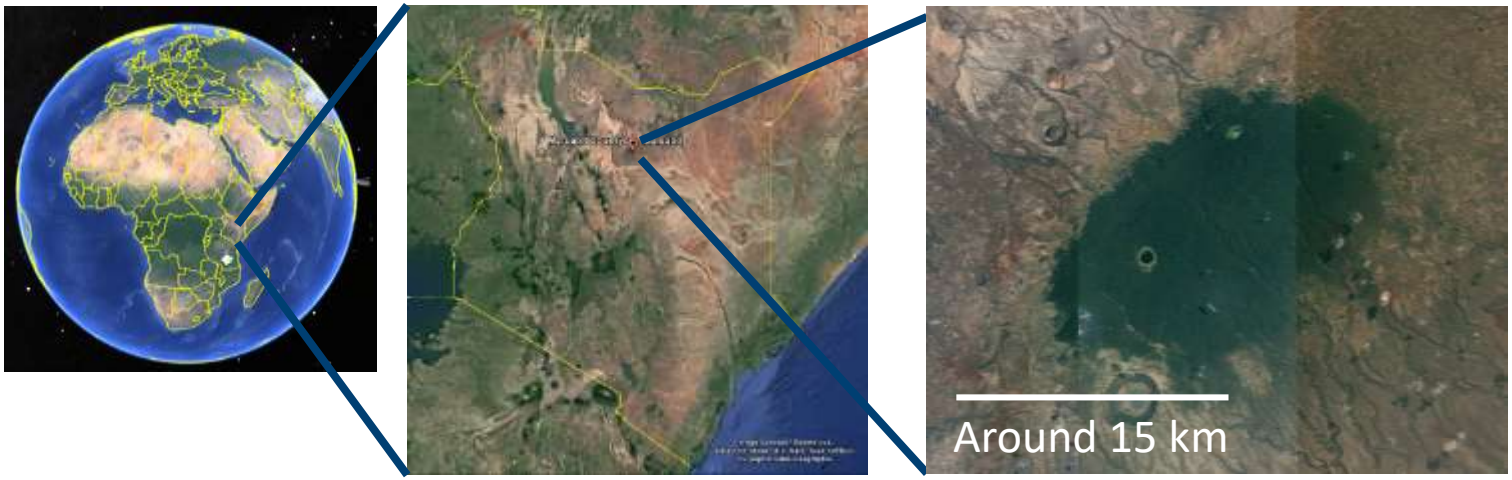
From Baerwald et al. 2016 *Curr Opinion Environ Sustain*

Trade-off analyses



Case studies

Kenya. Marsabit. Protected Area and Marsabit Town.



Case studies

Kenya. Forest-agricultural landscape. Semi-arid. Mountain forests

Key ecosystem services:

- Water
- Fuelwood
- Timber
- Crop production

Key processes:

- Dam construction
- Long-term forest degradation due to continuous extraction
- Decline in fog
- Reduced water flows & tree regeneration

Case studies

Tanzania. Rufiji Delta. Mangroves.

Case studies

Tanzania. Mangrove landscape. Humid.

Key ecosystem services:

- Flood protection
- Fishery
- Timber poles and charcoal
- Rice farming

Key processes:

- Declining mangrove coverage
- Increasing human population and agricultural expansion

Case studies

South Africa. Maputaland. Coastal forests and peatland forests.

Case studies

South Africa. Coastal forested landscape. Subtropical.

Key ecosystem services:

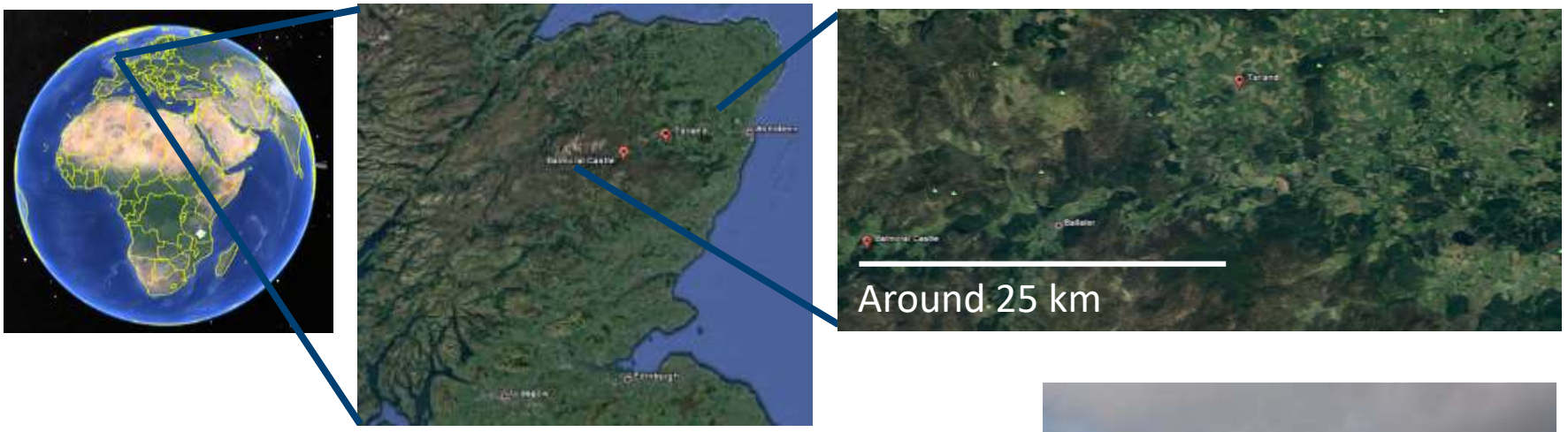
- Flood protection
- Tourism
- Timber plantations
- Mining
- Farming

Key processes:

- Forest loss & fragmentation
- Mining and reforestation with timber species
- Biodiversity decline

Case studies

Tarland catchment. Scotland. River and catchment area.



Case studies

Scotland. Rural landscape. Uplands and river catchment.

Key ecosystem services:

- Farming: sheep, beef
- Tourism

Key processes:

- Overstocking causing biodiversity loss in the uplands, soil erosion, riverbank erosion and increased run-off
- Damage to fisheries and flood defences downstream

Flooding near Balmoral Castle. https://www.eveningexpress.co.uk

Provide some context

What's its status?

- Recognized worldwide for its high densities of mammals
- Mostly forests
- In the 1970s, most of the non-tribal cultivators were evicted forcibly from the reserve and provided some land outside

Provide some context

Nagarhole National Park has a complex history with local people:

- Increasing wildlife (crop raiding)
- Restrictions on hunting

} Agriculture became impossible inside — 1970s

Chief source of livelihoods consequently involved

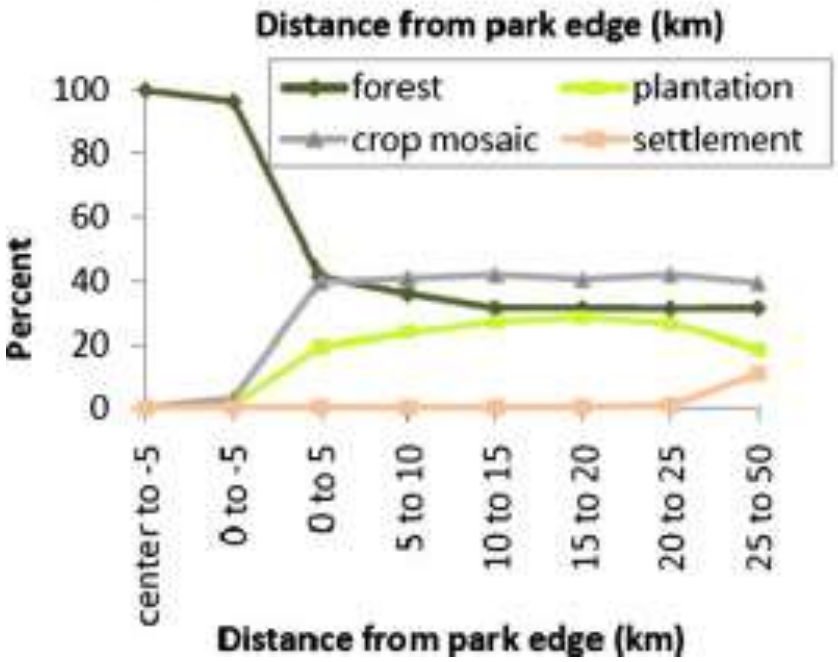
- Increasing logging and plantation work within forests
- Growing employment outside in coffee plantations
- Illegal hunting and collection of non timber forest products

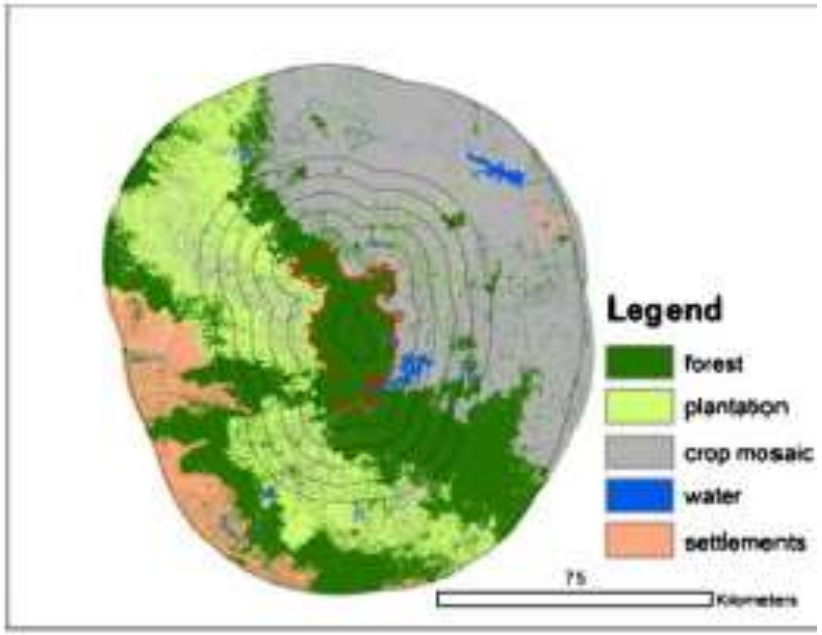
Reduction in logging to stopped logging — 1980s, 1990s

Resettlement process: with 350 families relocated outside and 1000 families continuing to live inside — 2009

Provide some context

Local people have been using resources in the park, whether legal or not:

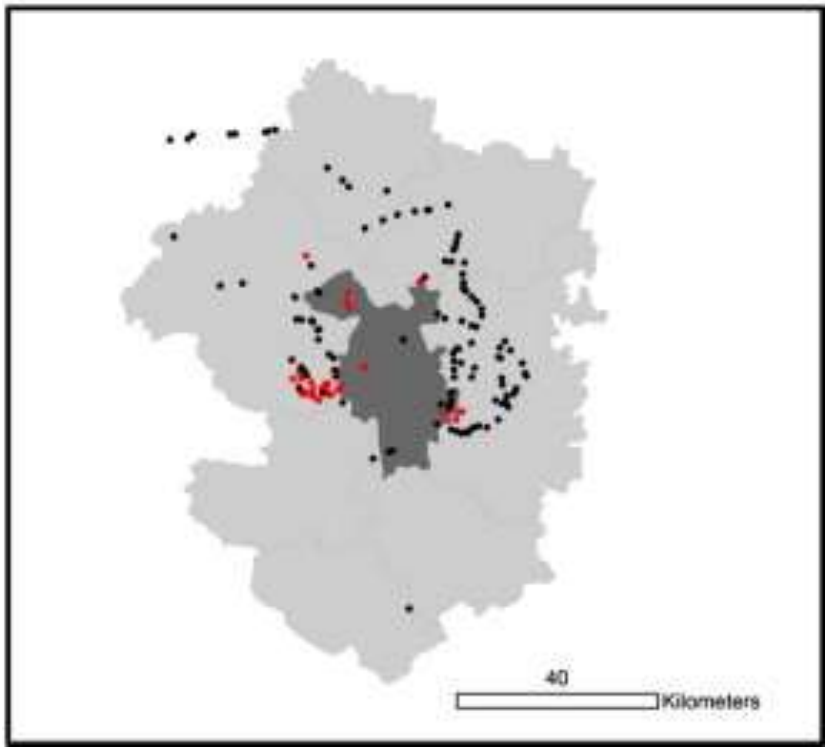




Land cover classifications are shown to the right. Red is the park boundary and black are buffers at 5 km intervals inside and outside the parks

Provide some context

Population density in the park vicinity is high with people working in the coffee plantations:



Village locations identified in the field are black dots (this is a subset of all villages). Tourist resorts identified in the field in red (~95% of all resorts present in 2009 were identified)

Provide some context

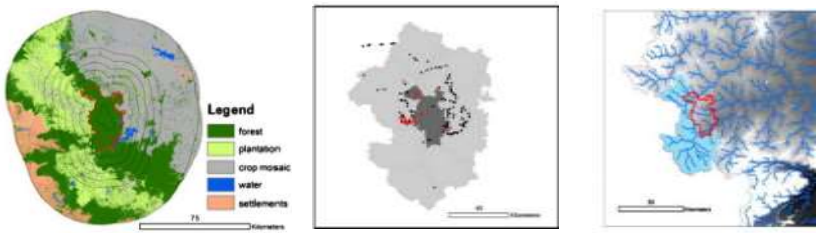
The park is also connected to the surrounding in terms of key ecological processes:

Drainage basins: streams (red), upstream watershed affectin streams within park boundary (grey)

A small portion of stream reaches inside the parks arise upstream of the protected areas. The boundary of the watershed is Cauvery Basin.

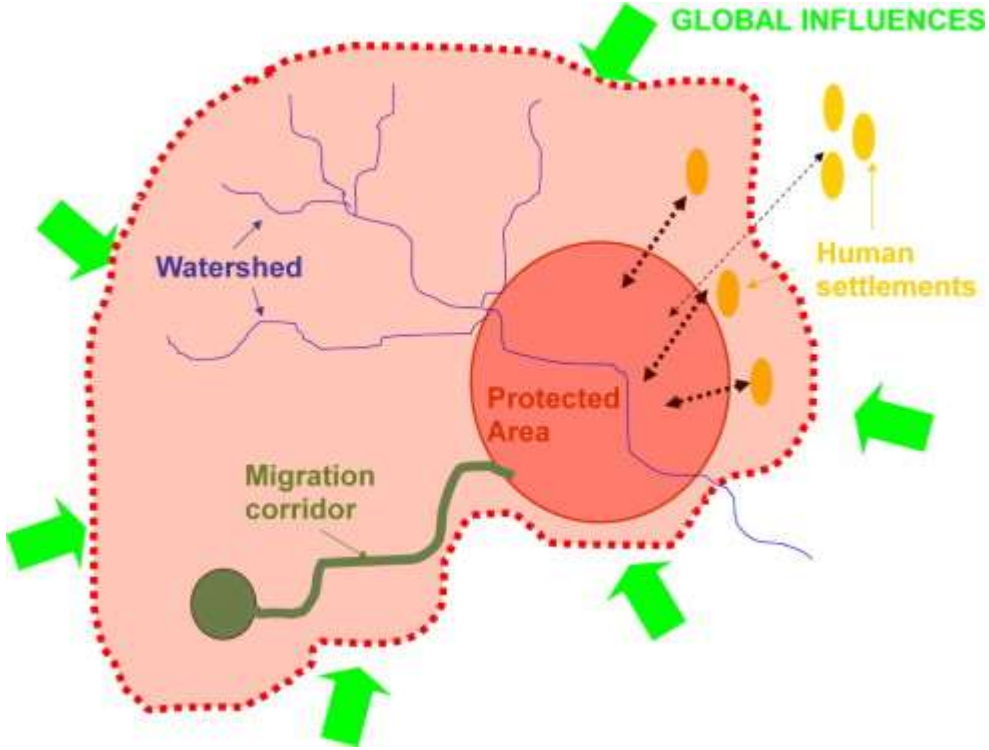
Provide some context

If these processes are affecting what's happening within the park:



When management needs to account for them.

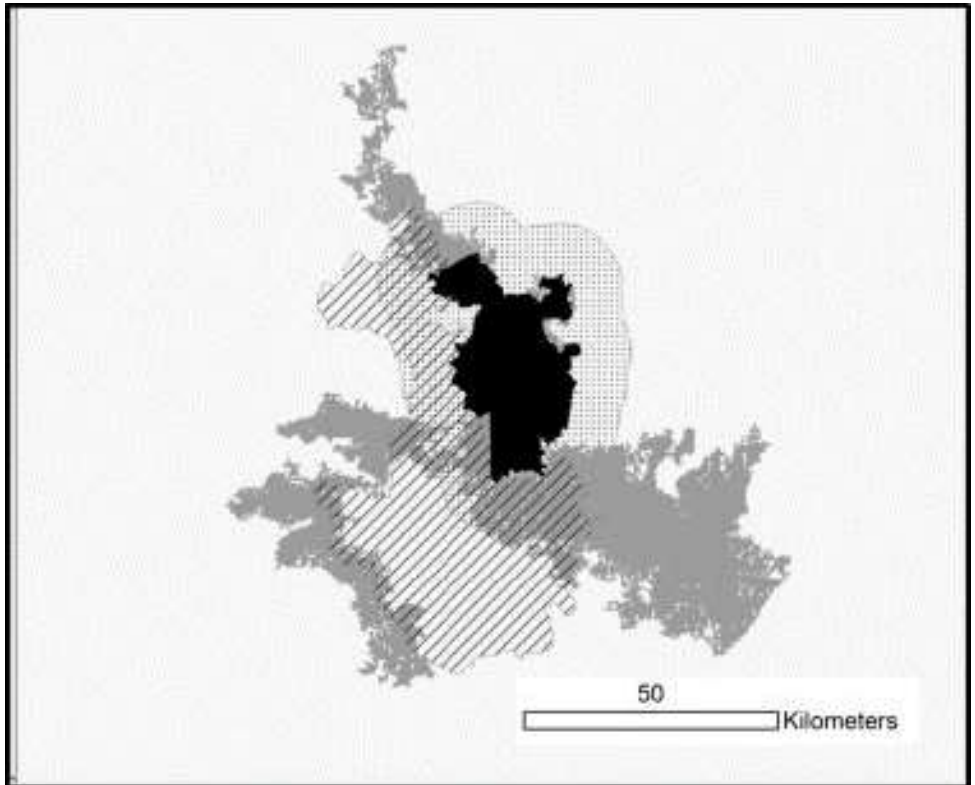
The zone of interaction (ZOI) delineates the landscape with strong hydrologic, ecologic, and socioeconomic interactions between PAs and their surroundings.



Provide some context

The zone of interaction concept:

Prof Ruth DeFries, Columbia University



Black is the park, gray is contiguous forest, hatched is watershed affecting flows into the park, and stippled is 10 km buffer. The total ZOI is the union of these component

Provide some context

Traditionally, natural and social sciences have operated in isolation from each other : looking at either the ecological data and processes or the human variables.

Ecological data & processes

- Landscape patterns
- Landscape modification
- Habitat quality
- Habitat degradation
- Wildlife distribution
- Wildlife movements
- Biodiversity turnover

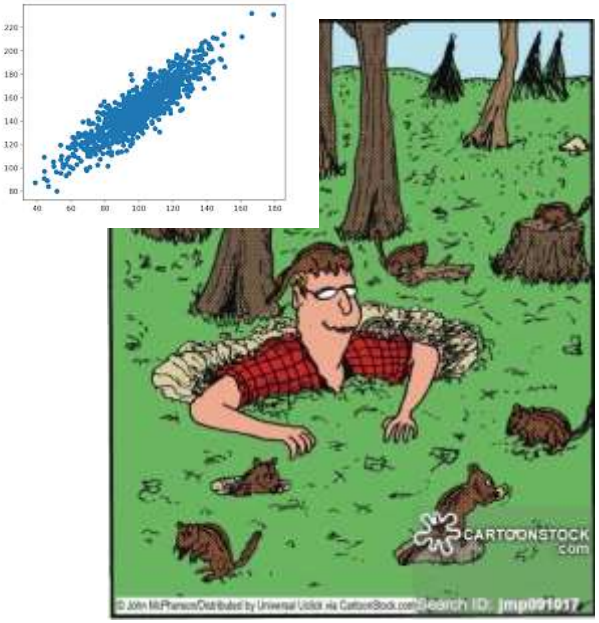
Human variables

- Well-being
- Wealth
- Socio-economic processes
- Gender dimensions
- Governance structures
- Social networks
- Social actors

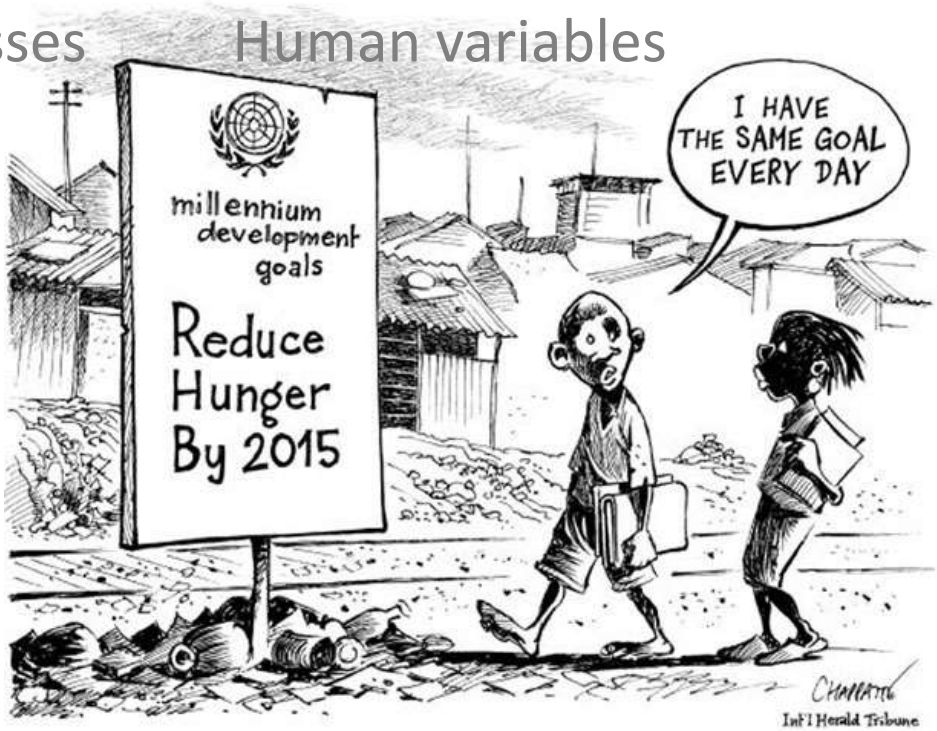
Provide some context

Traditionally, natural and social sciences have operated in isolation from each other : looking at either the ecological data and processes or the human variables.

Ecological data & processes



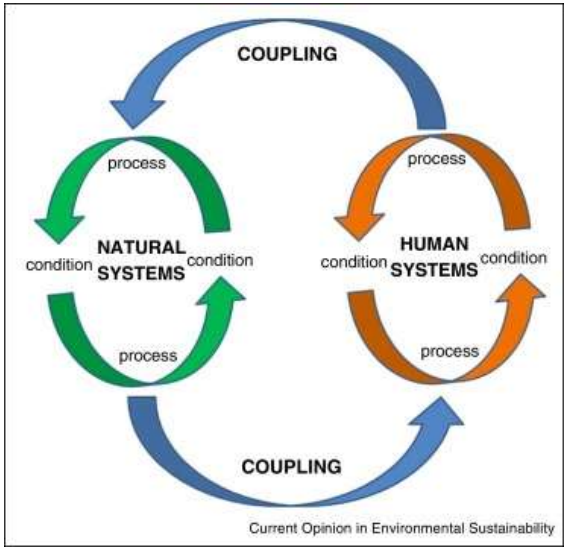
Human variables



Provide some context

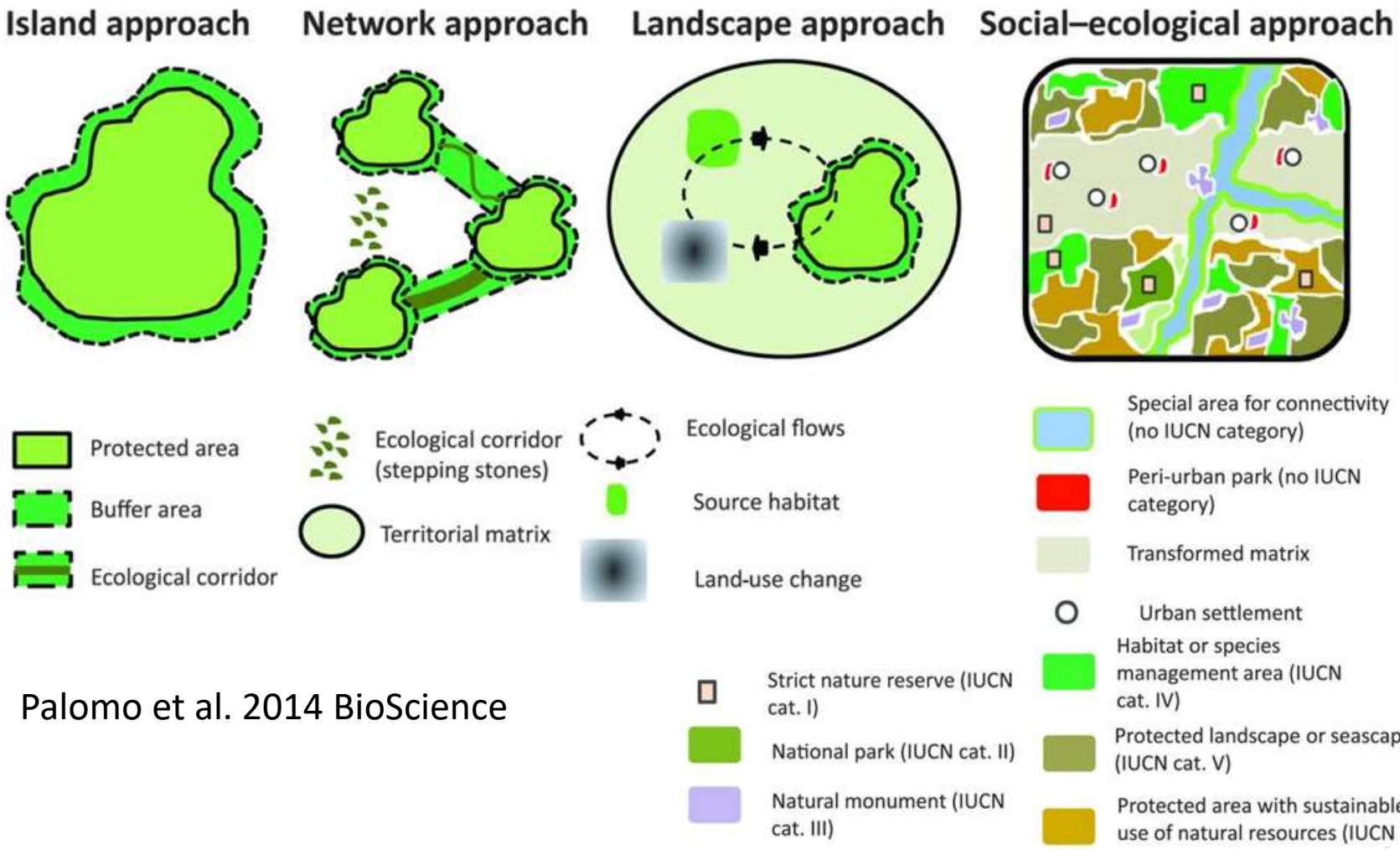
Integrating tools and techniques from ecological and social sciences as well as other disciplines are needed to analyse, understand and manage complex interactions between humans and natural systems.

Ecological data & processes Human variables



Protected area management

A landscape framework to include human variables



Palomo et al. 2014 BioScience

How can I include human variables?

Have a think and talk to your neighbour. Discuss your thoughts for 2 minutes. Talk to your neighbouring group for another two minutes. Write two key answers on a piece of paper. If you can add some details. We will communicate them to the whole group afterwards.

Human variables

How can I include human variables?

- forest ecosystems: to reduce the deforestation, protection zones can be built around the vulnerable area.
- Ocean ecosystems: protected areas to combat overfishing can be implemented.

How can I include human variables?

- The development of human variables in protected area management depends on the local people's needs and their perception of how the protected area resources meet their needs in terms of livelihood, security, income, and socio economic processes and assessing the trade-offs between meeting the locals' needs but also doing that a sustainable way
- The inclusion of the various human variables and their success depends on how well we, as ecologists, and social scientists communicate with and involve all the relevant stakeholders in the decision-making process in a participatory manner; through meetings, workshops, open discussions and talks..etc., in order to avoid or minimize the conflicts that may arise during the implementation of the management plan.

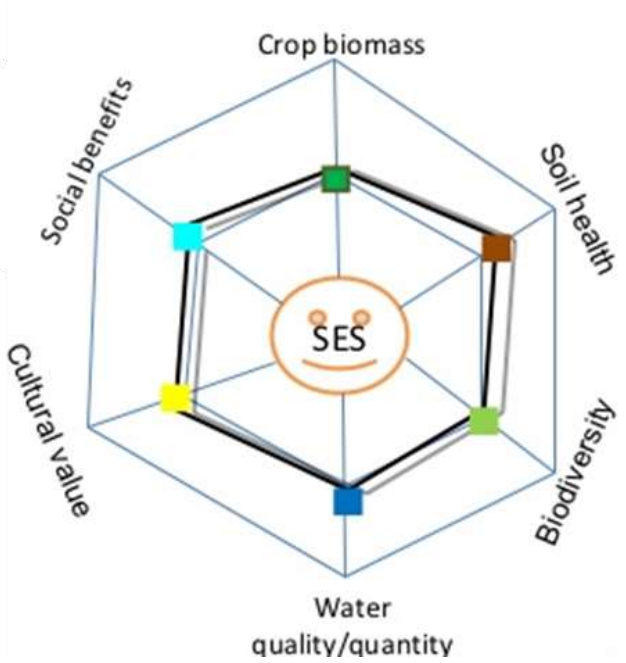
- a good way of including more social science variables would be to conduct an initial survey of local stakeholders to determine sentiments and identify what potential areas of concern/priority are. That would be compiled into a list of related variables that would then be ranked by priority by the local stakeholders and hypothetical scenarios/solutions could be created based on the initial survey that stake holders would have to identify as strongly agreeing, agreeing, disagreeing, or strongly disagreeing with (a neutral option would be removed) to understand perceptions of different potential solutions.

https://www.youtube.com/watch?v=l8wKZc-mEOU

Tools for including human variables

1. Develop stronger societal support based on the benefits and values of the services the protected areas provide (Ecosystem services concept, MEA 2005)

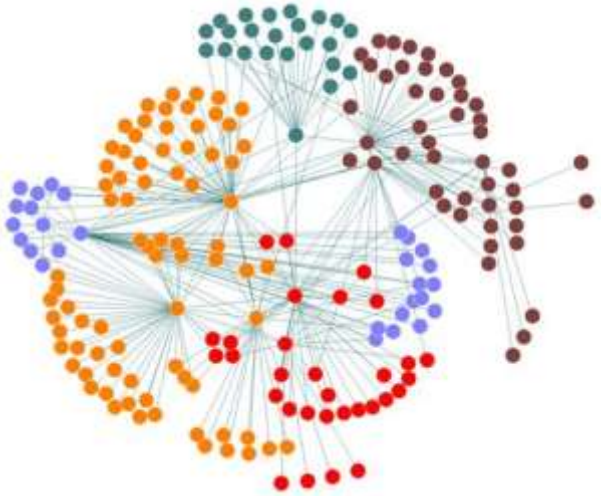
Trade-off analyses



Tools for including human variables

1. Develop stronger societal support based on the benefits and values of the services the protected areas provide (Ecosystem services concept, MEA 2005)
2. Participatory processes and co-management to reduce social conflict (as opposed to command – and control governance)

Stakeholder workshops and social network analysis



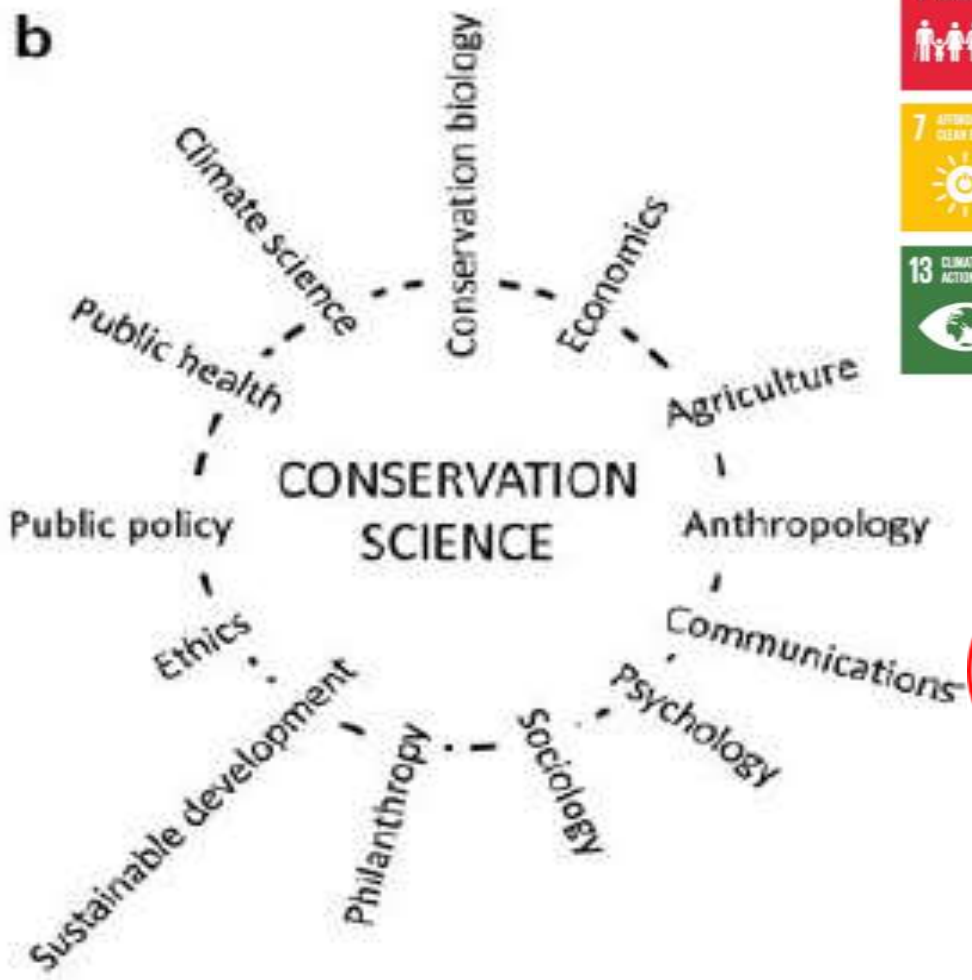
Including human variables

1. Develop stronger **societal support** based on the benefits and values of the services the protected areas provide (Ecosystem services concept, MEA 2005)
2. Participatory processes and **co-management** to reduce social conflict (as opposed to command – and control governance)
3. Involve **relevant governance institutions**: e.g. regional water agency, tourism related enterprises and government bodies, agriculture relevant enterprises and government bodies, ….)

Including human variables

1. Develop stronger societal support based on the benefits and values of the services the protected areas provide (Ecosystem services concept, MEA 2005)
2. Participatory processes and co-management to reduce social conflict (as opposed to command – and control governance)
3. Involve relevant governance institutions: e.g. regional water agency, tourism related enterprises and government bodies, agriculture relevant enterprises and government bodies, ….)
4. Involve **beneficiaries**: who will benefit from which services now and in the future

Provide some further context



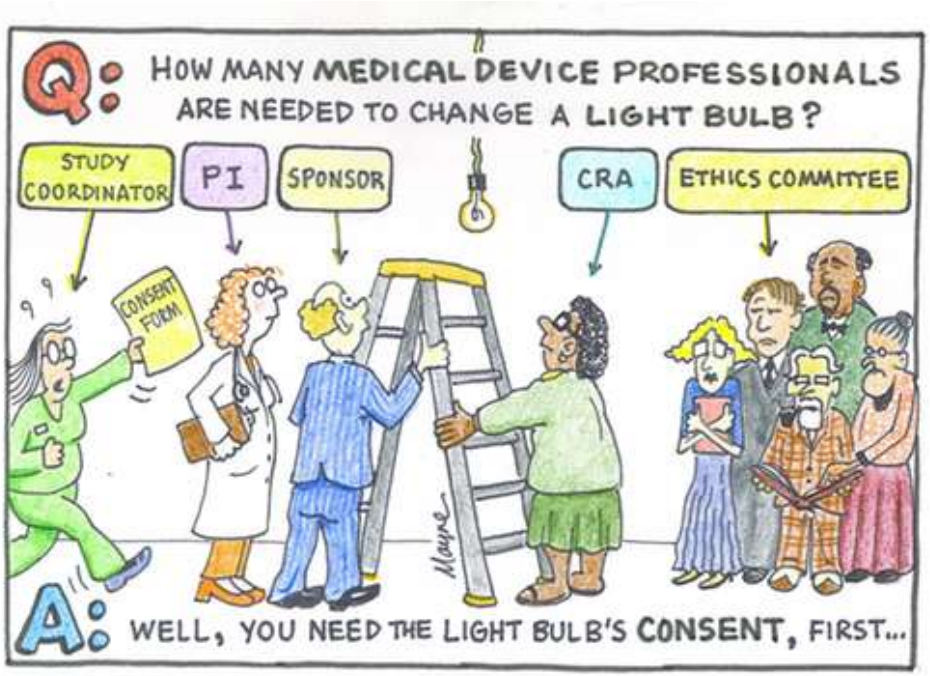
Instrumental value

We must save nature to help ourselves (Conservation Science)

Provide some further context

Human variables

- Well-being
- Wealth
- Socio-economic processes
- Gender dimensions



Ecologists are not necessarily good social scientists or policy makers.

Collaboration and cross-disciplinary as well as cross-sectoral communication have become an essential skill.

Questions?

You can also post questions on Blackboard.

Sustainability & well-being

Sustainable resource use: *The use of natural resources at a rate that does not lead to the long-term decline of biological diversity but maintains its potential to meet the needs and aspirations of present and future generations* (Godfray et al. 2010 Science).

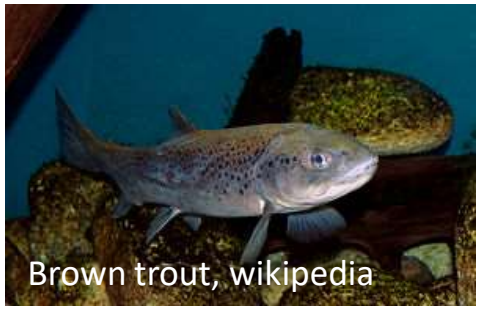
Human wellbeing *includes the dimensions of basic materials for a good life, security, health, social relations and freedom of choice and action, considering all aspects of a person's experience of life* (Woodhouse et al. 2015 Phil Trans Roy Soc B).

Case studies

Lake Racken. Sweden. Lake and catchment area.

Case studies

Sweden. Rural landscape. Boreal.


Brown trout, wikipedia

Key ecosystem services:

- Fishing
- Tourism


Henrik Trygg/imagebank.sweden.se;Fredrik Sandberg/Scanpix;Patrik Neckman/Flickr

Key processes:

- Acidification in 60s
- Decrease in noble crayfish due to acidification, overfishing & fungal disease
- Catch-based management of resources

Case studies

UK. Urban green spaces. Garden biodiversity

Key ecosystem services:

- Well-being (Fuller et al. 2007 Biol Lett)
- Less mortality from circulatory disease (Mitchell & Popham 2008 Lancet)

Key processes:

- Habitat fragmentation & loss
- Novel communities: exotic species
- Increased air temperature: altered vegetation growth
- Different surfaces: altered hydrology
- Altered species interactions: shift in food web dynamics
- Behaviour adaptation: e.g. bird songs