Biodiversity threats and human well being

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My charge

Importance of biodiversity to human livelihoods, following Millennium Ecosystem Assessment

What is happening to biodiversity and how are these changes affecting human livelihoods

To what extent biodiversity loss driven by climate change, now and in the future

How does biodiversity contribute to protecting or strengthening livelihoods threatened by climate change events

What is the importance of ensuring that mitigation and adaptation measures deliver wider environmental, biodiversity and livelihood co-benefits?

The Millennium Ecosystem Assessment

Viewed ecosystems in terms of benefits (ecosystem services) delivered to society

Provided a typology of these services

Assessed the direct and indirect drivers of changes to ecosystem services

Linked the delivery of services to human well being

Documented how the delivery of services has changed through time

Provided scenarios of future demands on services

Evaluated past societal responses to threats to services and policy needs for a more hopeful future

The main messages

We are having increasingly larger impacts on ecosystems and their services

Many segments of society have benefited from the mining of ecosystem services but the sustainability of these services is at risk

Scenarios of the future show do not show substantial abatement of degradation

But we have options to build but more favorable trajectories but these will take substantial new actions

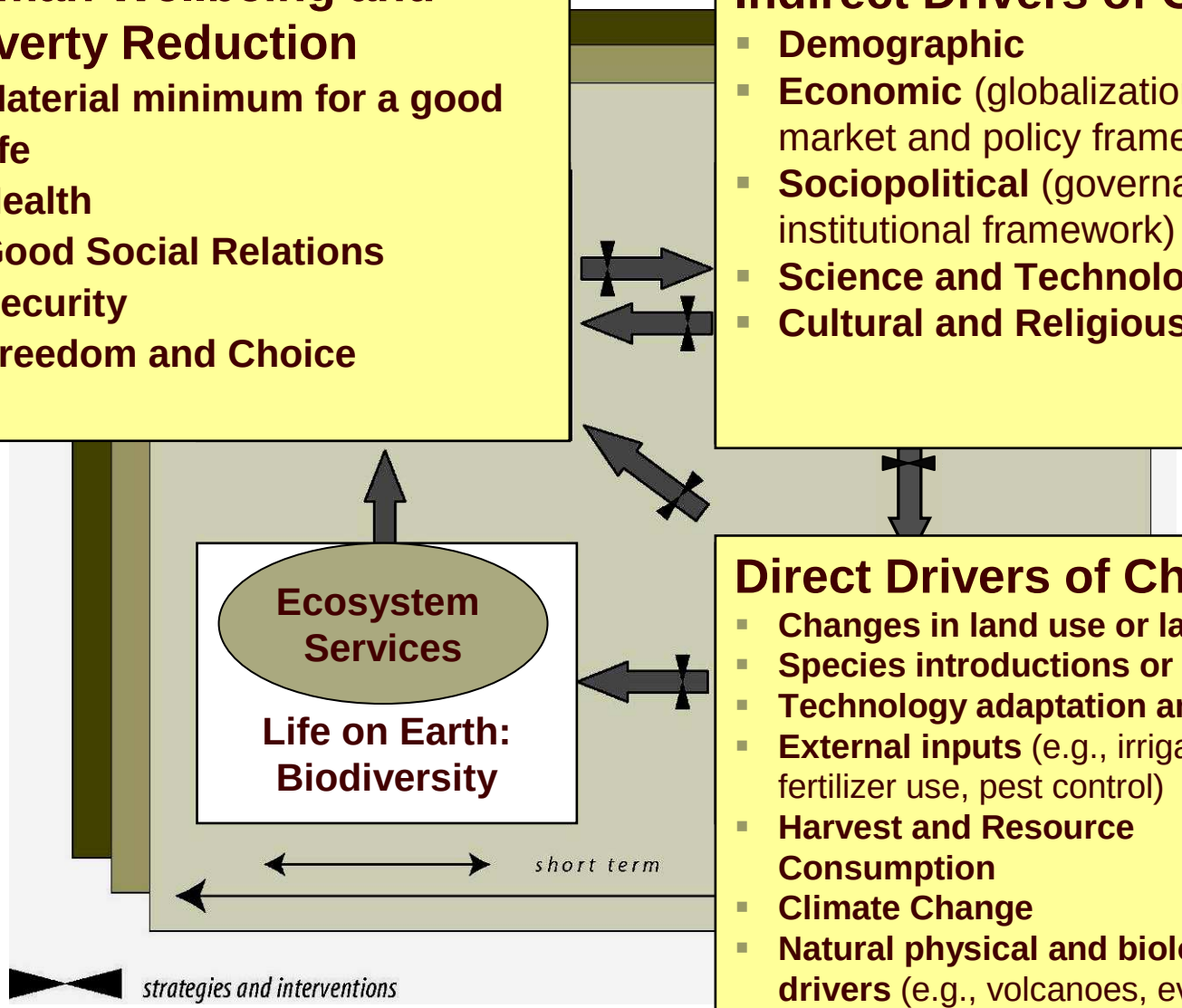
MA Framework

Human Wellbeing and Poverty Reduction

- **Material minimum for a good life**
- **Health**
- **Good Social Relations**
- **Security**
- **Freedom and Choice**

Indirect Drivers of Change

- **Demographic**
- **Economic** (globalization, trade, market and policy framework)
- **Sociopolitical** (governance and institutional framework)
- **Science and Technology**
- **Cultural and Religious**



Direct Drivers of Change

- **Changes in land use or land cover**
- **Species introductions or removals**
- **Technology adaptation and use**
- **External inputs** (e.g., irrigation, fertilizer use, pest control)
- **Harvest and Resource Consumption**
- **Climate Change**
- **Natural physical and biological drivers** (e.g., volcanoes, evolution)

Ecosystem services

Provisioning

G or

Regulating

Be
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Cultural

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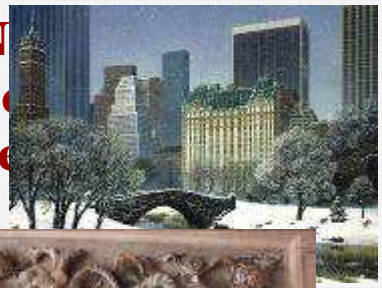
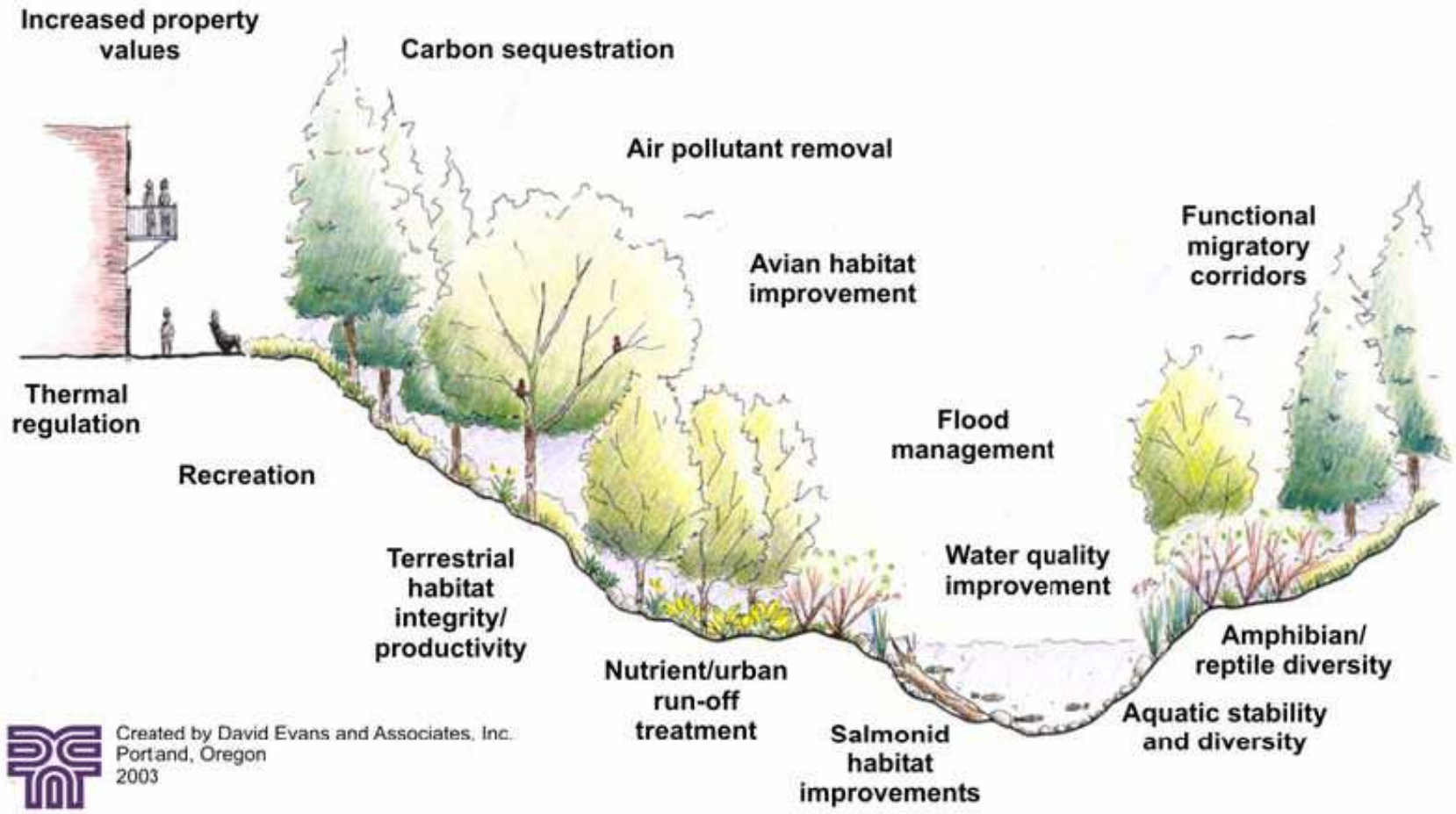


An evaluation of a particular landscape



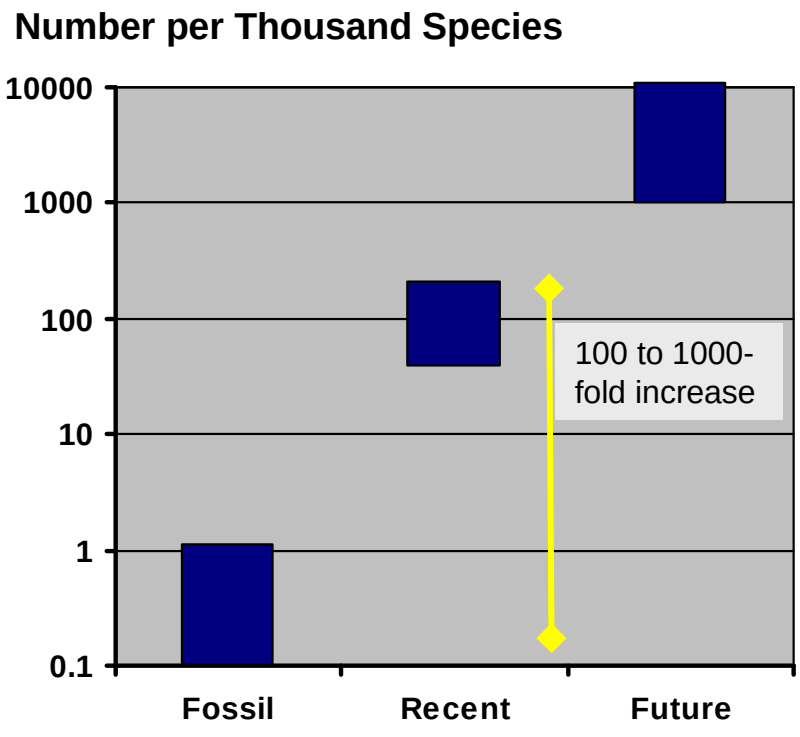
The balance sheet

	Enhanced	Degraded	Mixed
Provisioning	Crops Livestock Aquaculture Carbon sequestration	Capture fisheries Wild foods Wood fuel Genetic resources Biochemicals Fresh Water	Timber Fiber Water regulation Disease regulation Recreation & ecotourism
Regulating		Air quality regulation Regional & local climate regulation Erosion regulation Water purification Pest regulation Pollination Natural Hazard regulation	
Cultural		Spiritual & religious Aesthetic values	

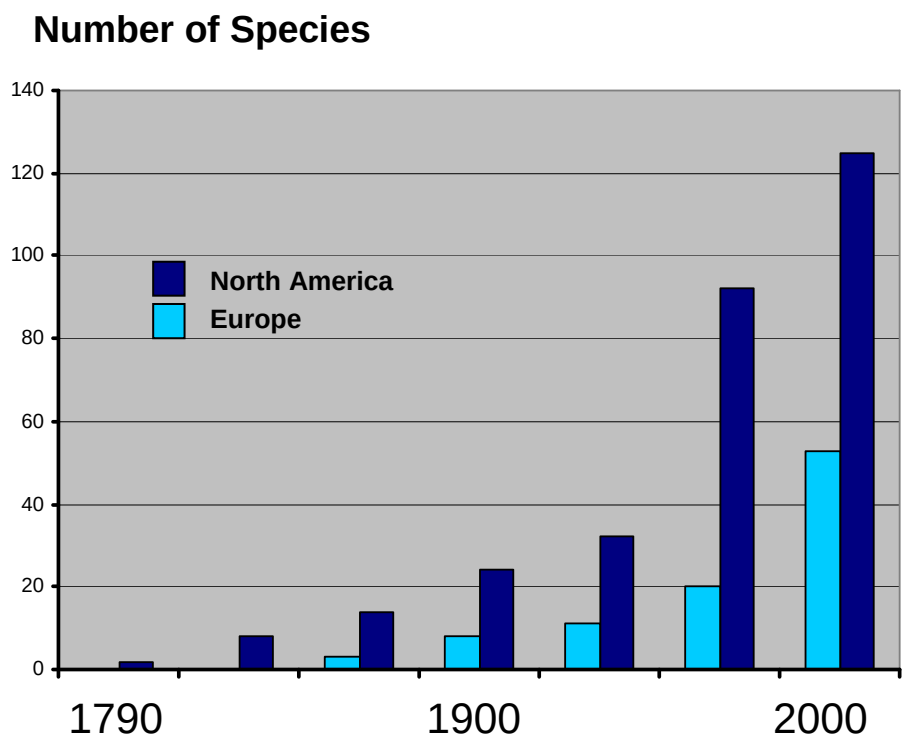
Bottom Line: 60% of Ecosystem Services are Degraded

We are losing diversity at all levels--genetic, species, populations and ecosystems

Change in *Species* Diversity-Additions and Subtractions

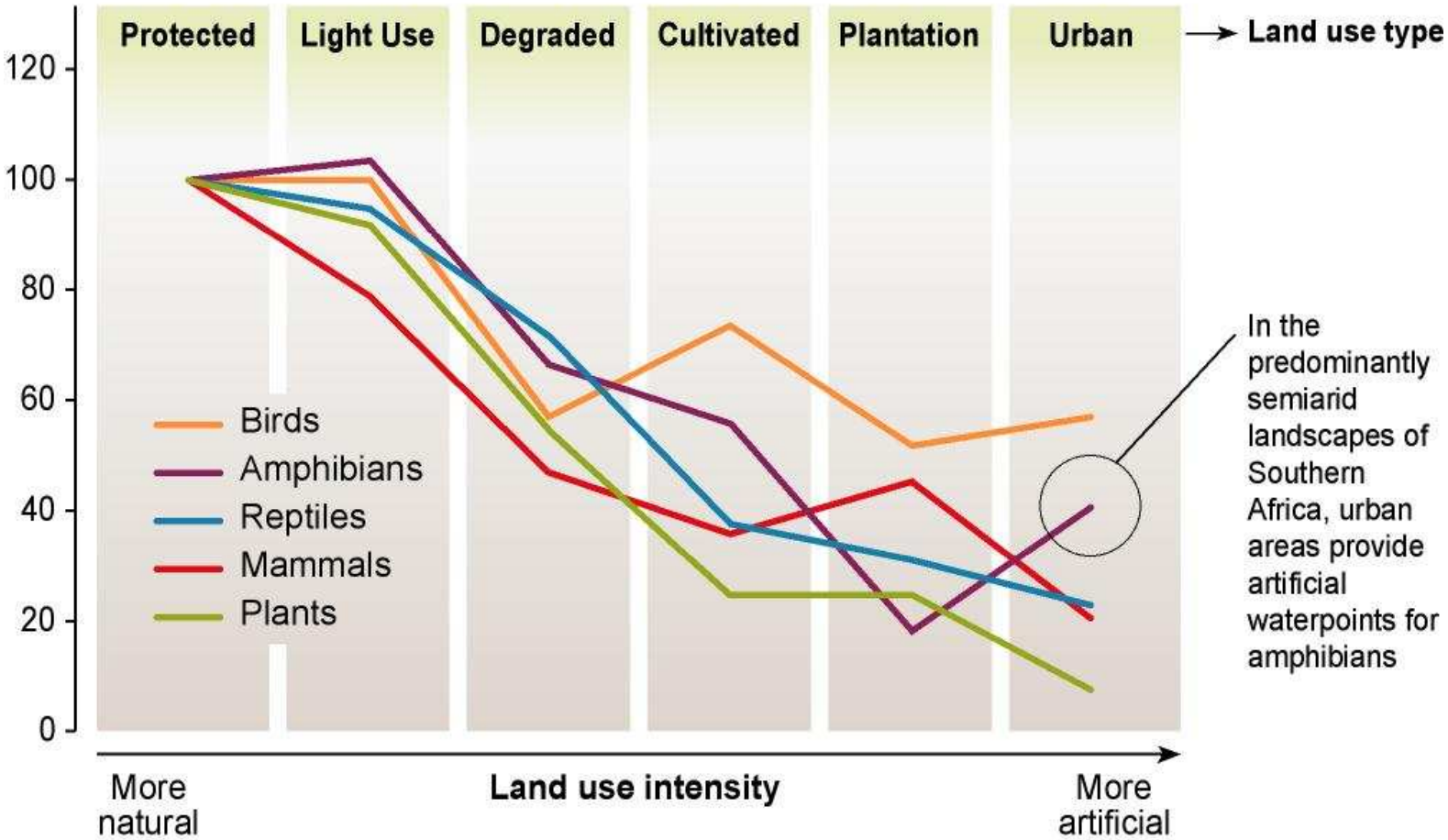


Extinctions
(per thousand years)



Homogenization
(e.g. growth in marine species introductions)

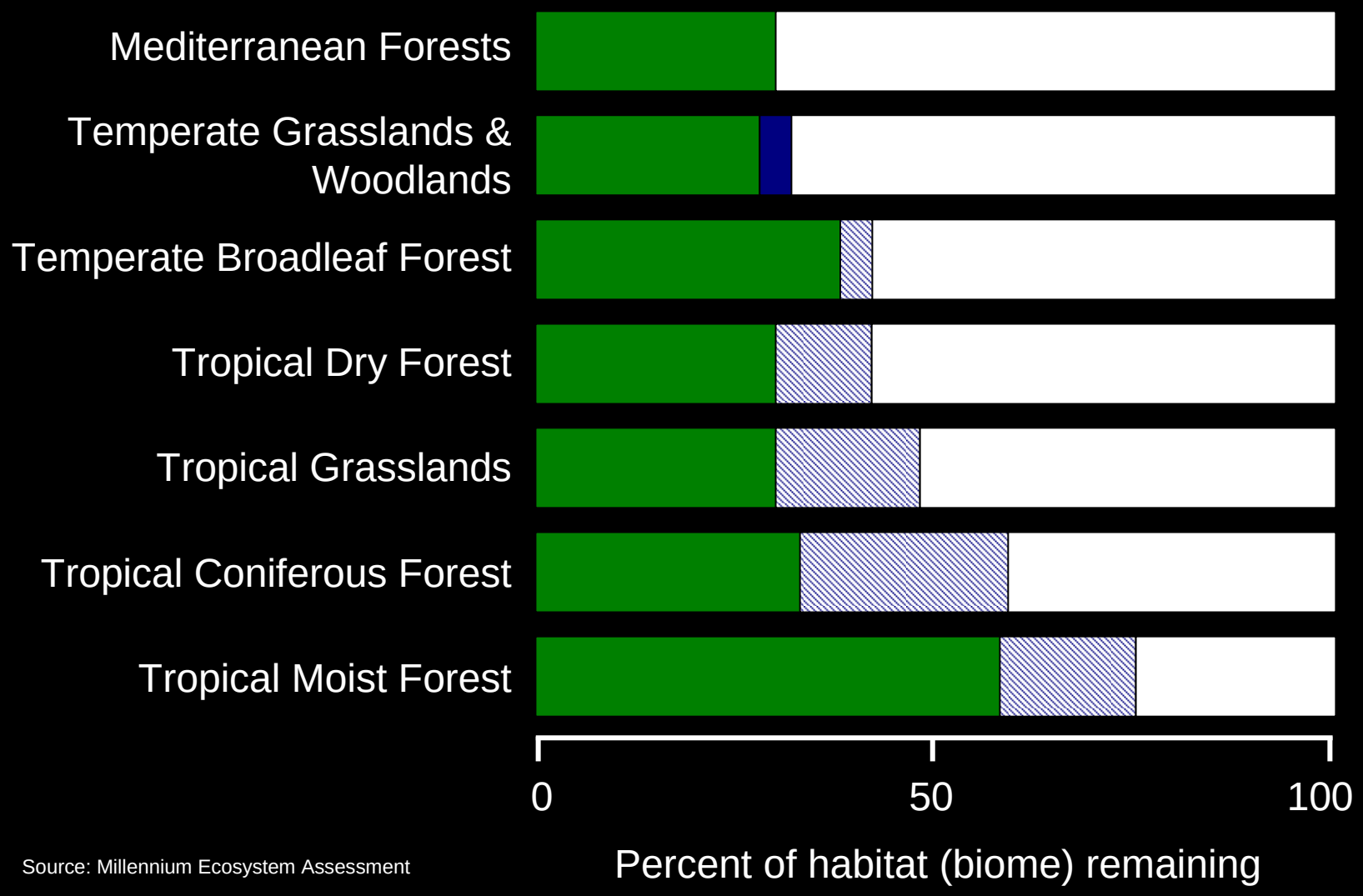
Average remaining percentage of population under each land use
compared with the pre-colonial period (index =100), 300 years ago



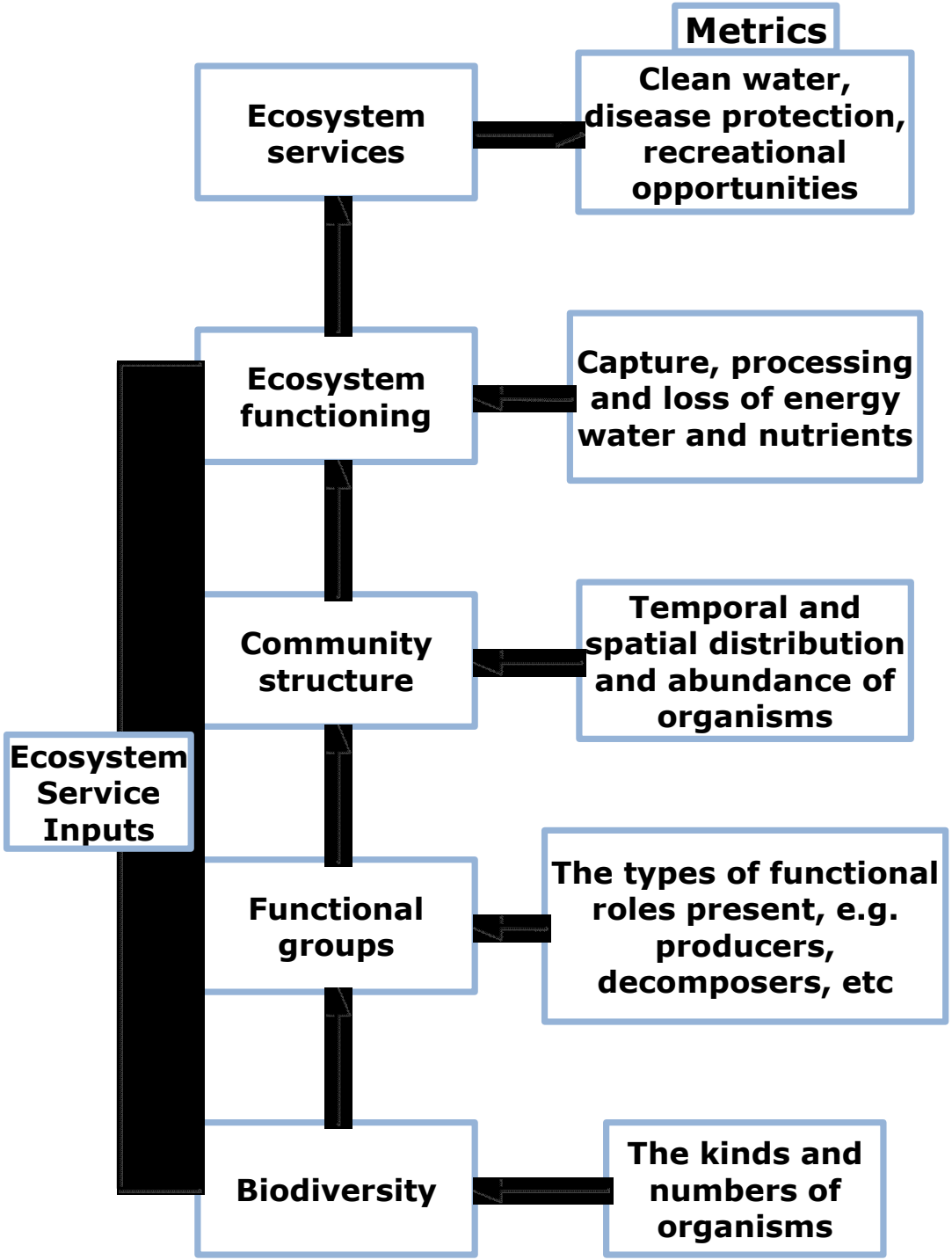
Protected areas: assumed to have intact biodiversity and therefore used as a reference
Light use: natural vegetation productively used (e.g., for grazing) within the limits of sustainability
Degraded: natural vegetation where intensity of use exceeds the natural productive capacity
Cultivated: cropland and planted pastures
Plantation: monocultures of exotic trees, mainly eucalyptus and pine species
Urban: built-up urban and high-impact mining landscapes

Source: Scholes and Biggs 2005

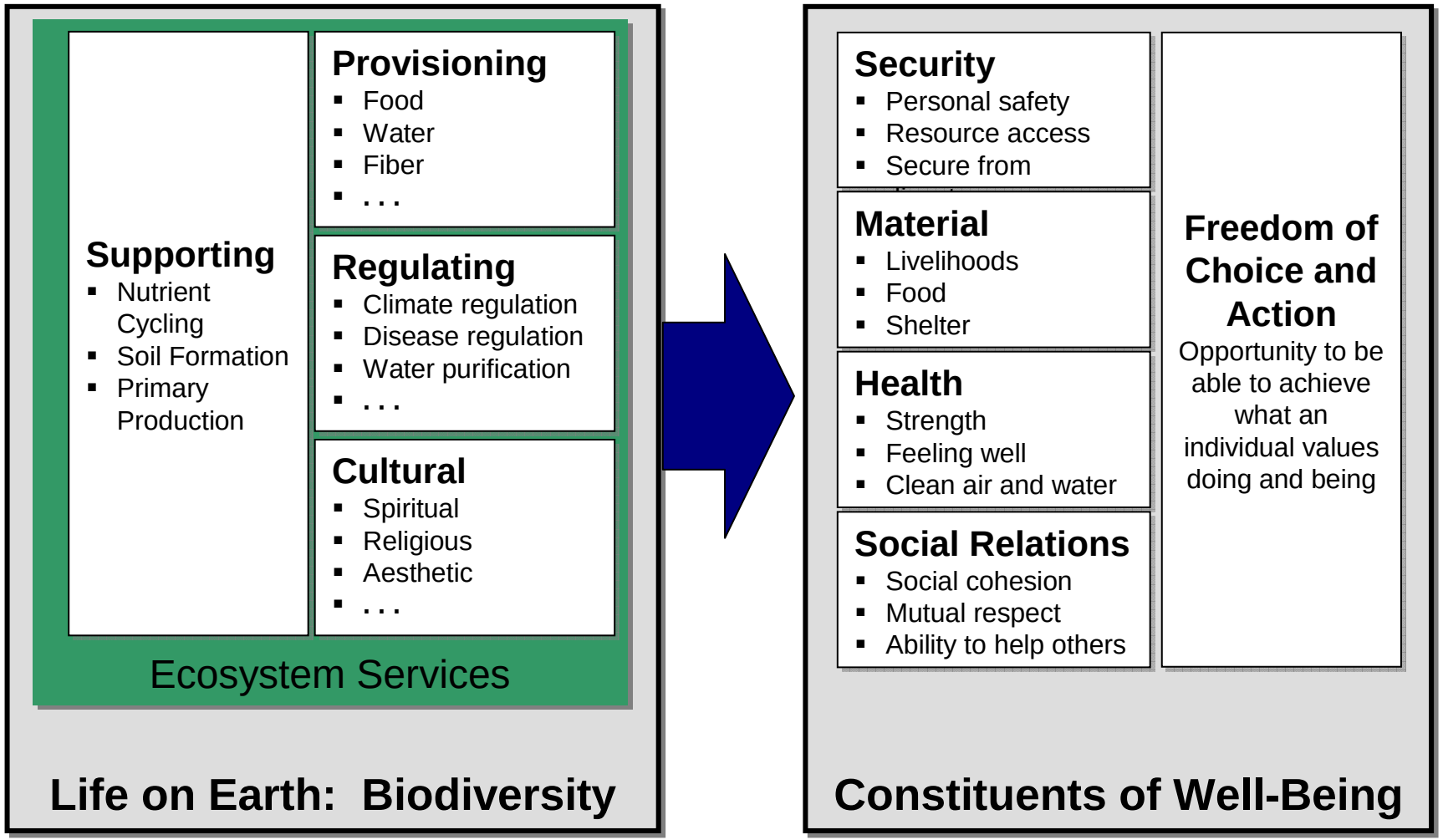
Habitat Loss to 1990 and 2050



Source: Millennium Ecosystem Assessment


Metrics
Ecosystem services
Clean water, disease protection, recreational opportunities
Ecosystem functioning
Capture, processing and loss of energy water and nutrients
Community structure
Temporal and spatial distribution and abundance of organisms
Ecosystem Service Inputs
Functional groups
The types of functional roles present, e.g. producers, decomposers, etc
Biodiversity
The kinds and numbers of organisms

Linking Ecosystem Services to Human Well-Being



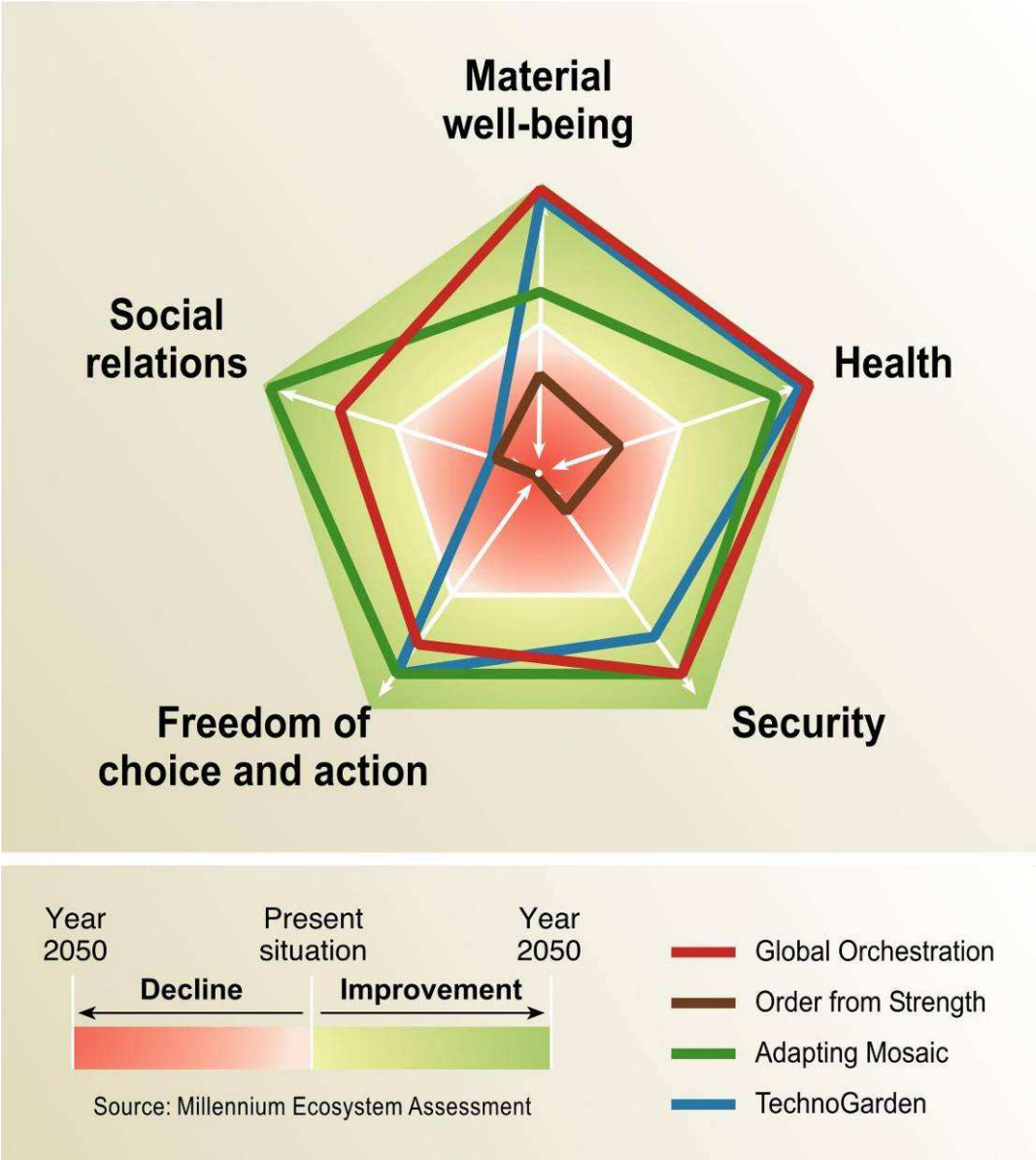
Main findings of the MA-MDG's

Changes the perception that development objectives are at odds with environmental objectives

Provides a framework that makes it easy to ID and assess benefits & trade offs to achieving the MDGs

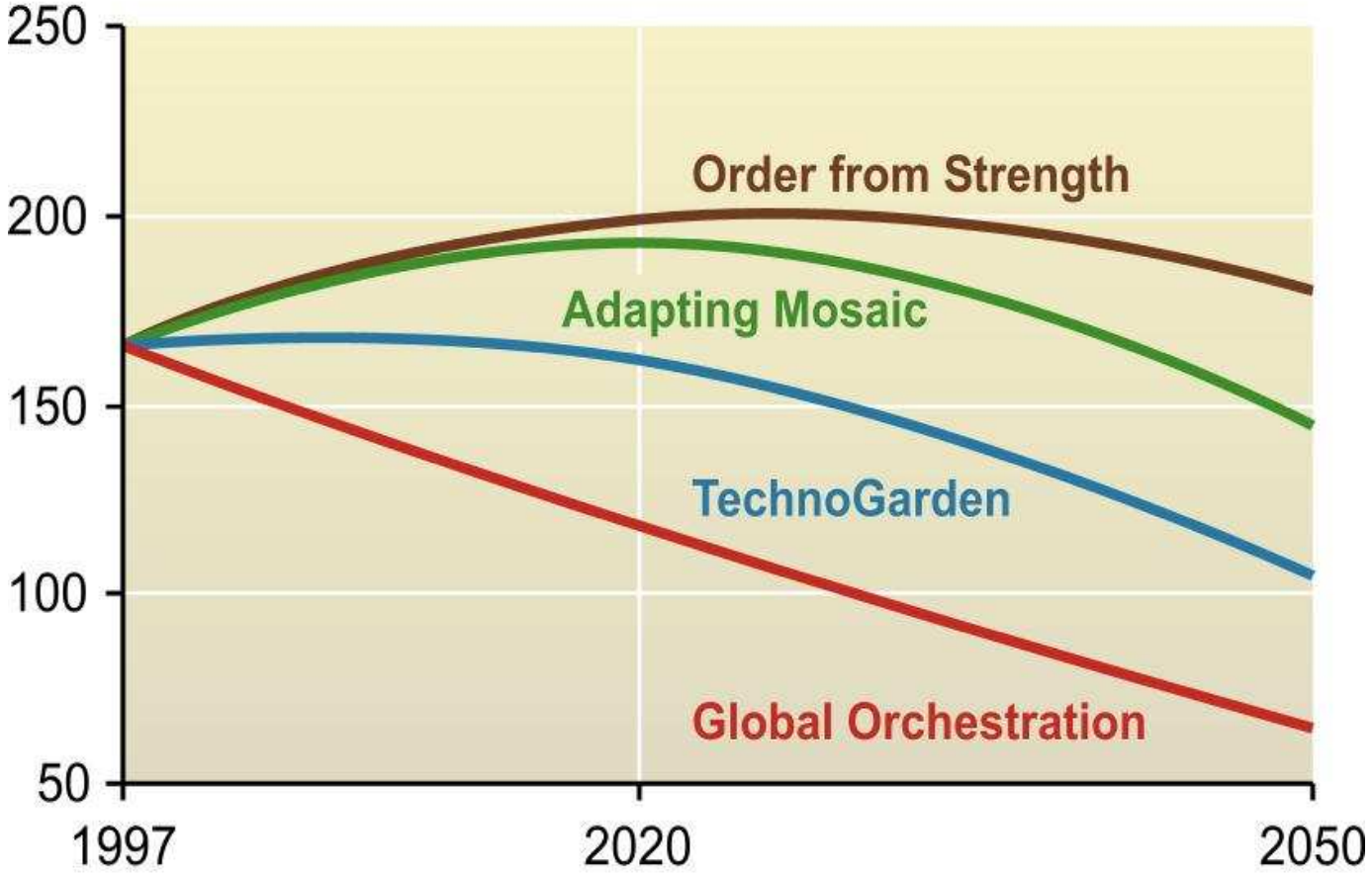
Tools to see how environmental change links to services & human well-being

Shows environmental degradation may worsen and affect achievement of all MDGs

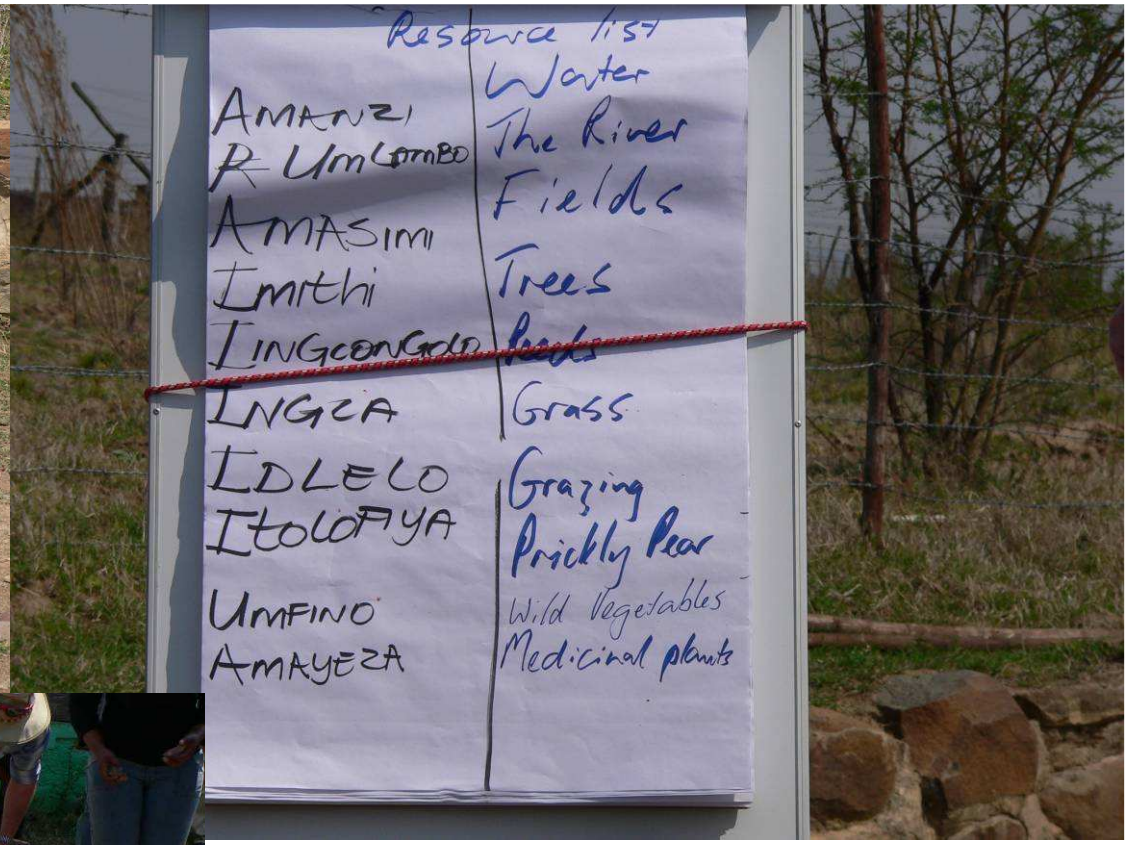

Material well-being
Health
Security
Freedom of choice and action
Social relations
Year 2050
Present situation
Year 2050
Decline
Improvement
Source: Millennium Ecosystem Assessment
Global Orchestration
Order from Strength
Adapting Mosaic
TechnoGarden

Number of Malnourished Children in Developing Countries

in million



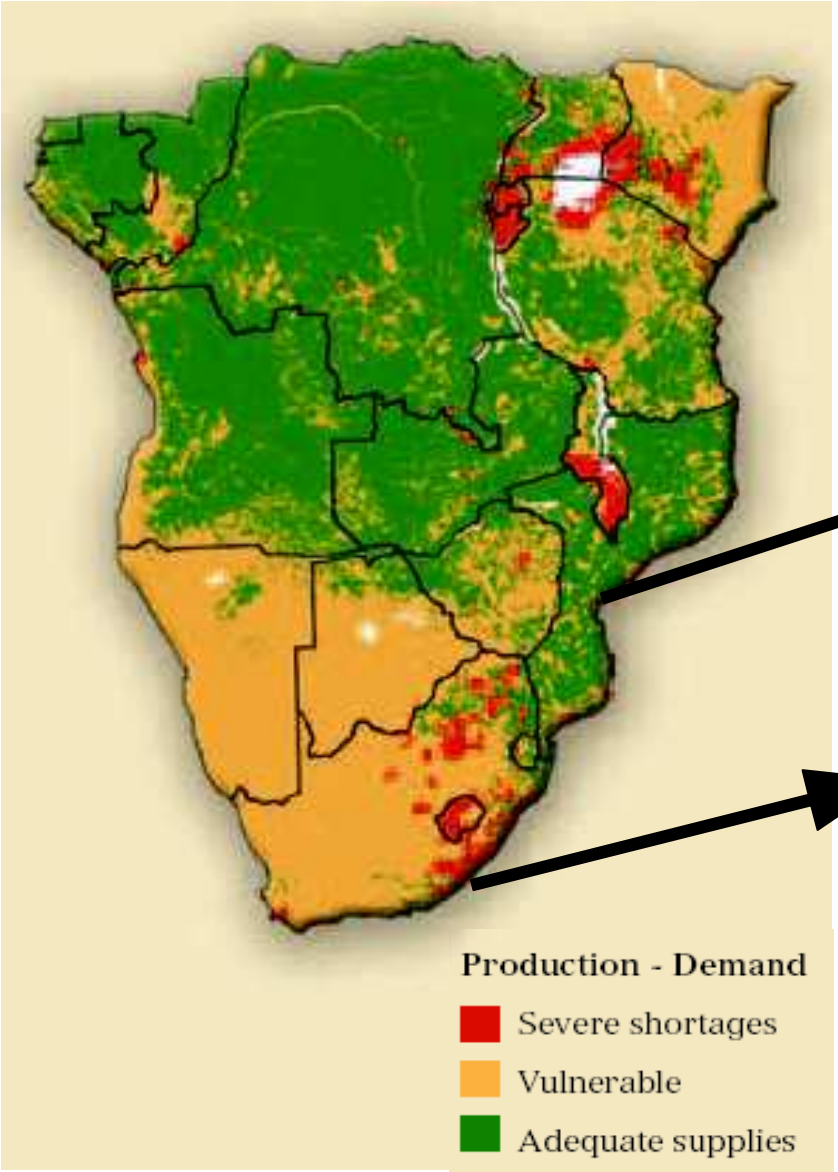
Source: Millennium Ecosystem Assessment

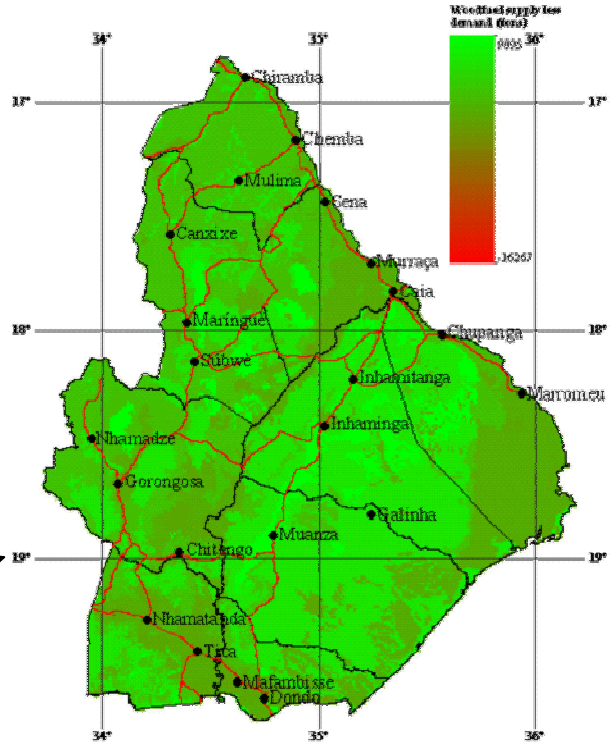


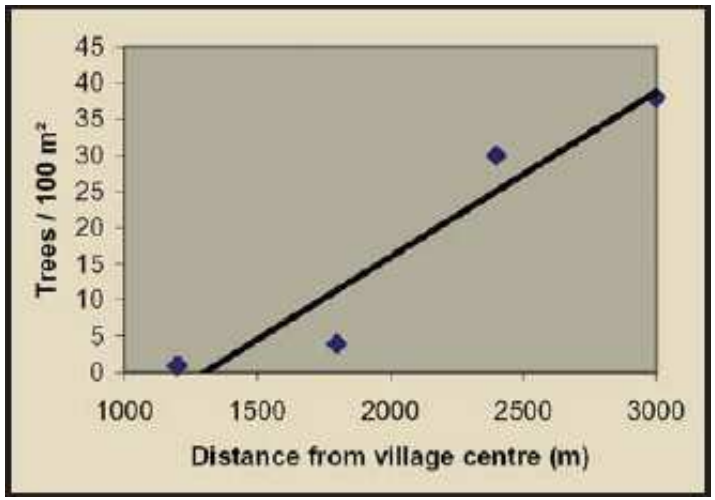
Assessing ecosystem services at the village level in South Africa

Fuelwood supply less demand

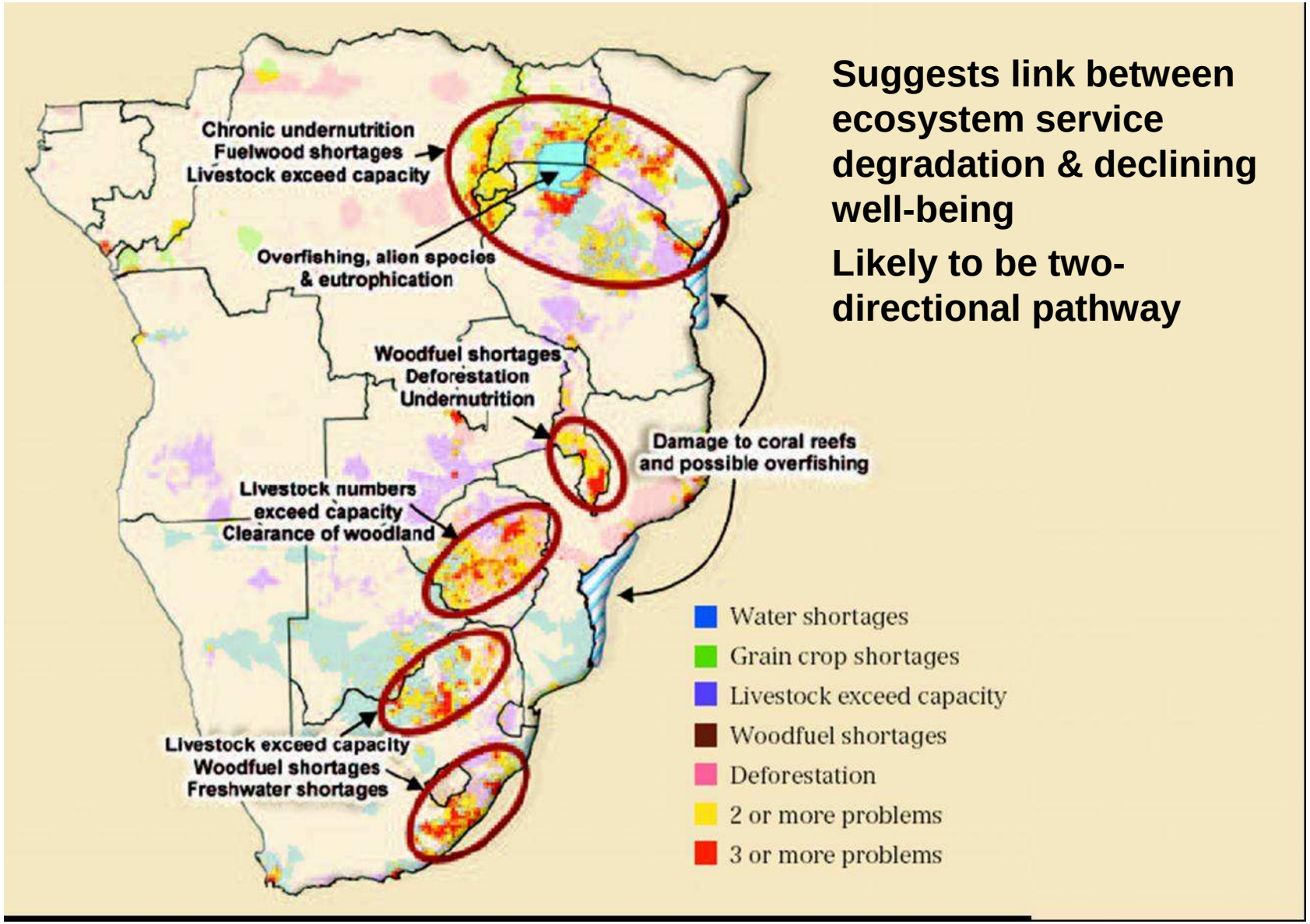
ENERGY







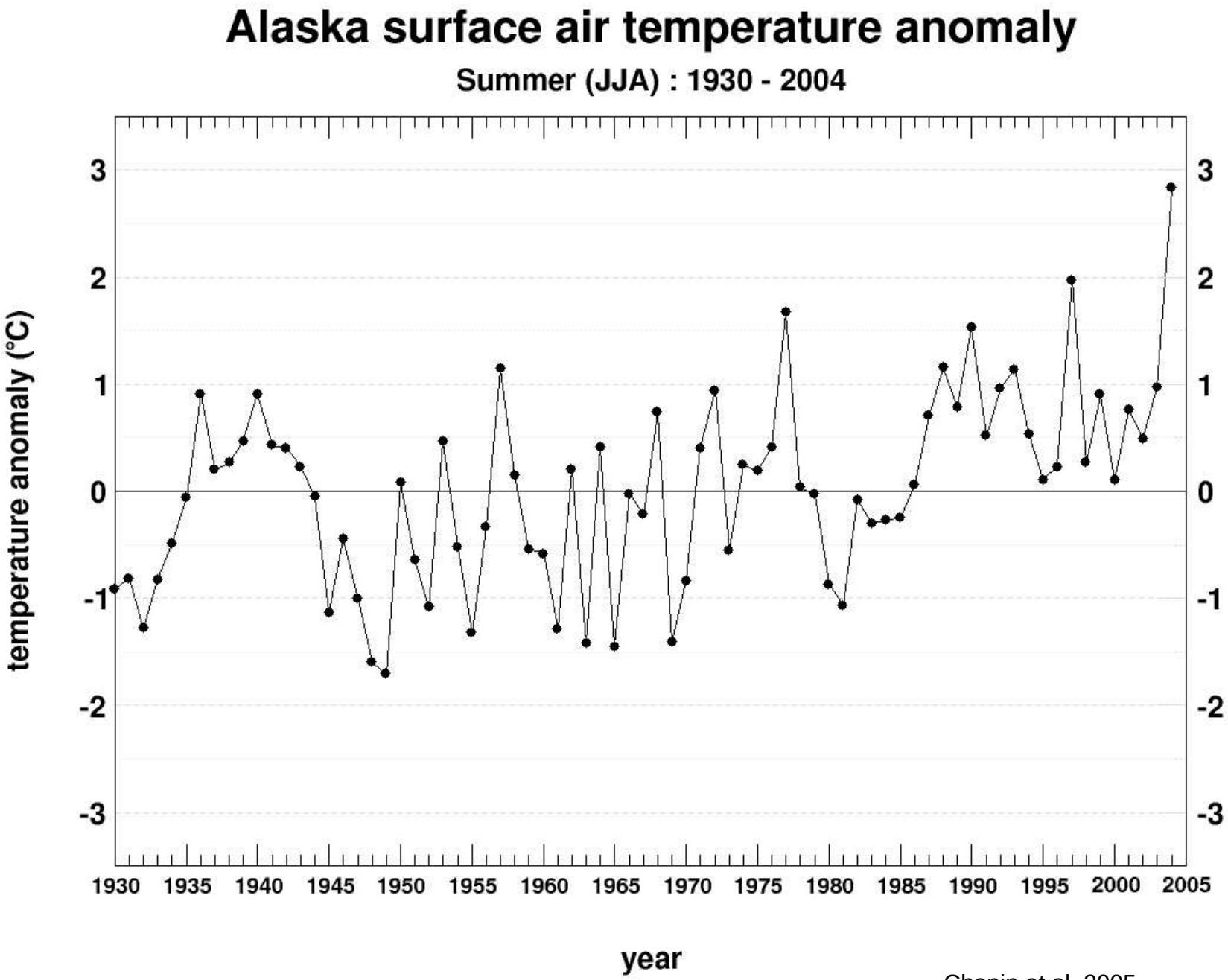
Regional synthesis



Suggests link between ecosystem service degradation & declining well-being

Likely to be two-directional pathway

An example of climate change, feedbacks and human well-being



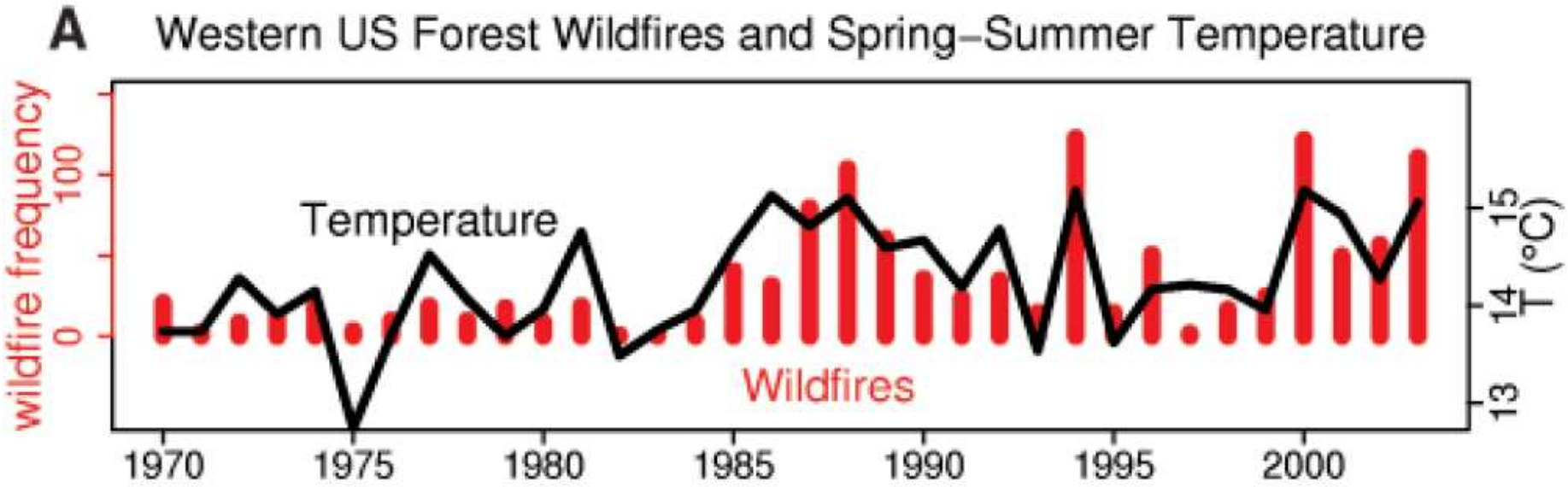
Chapin et al. 2005

A collapsing arctic ecosystem with climate feedbacks

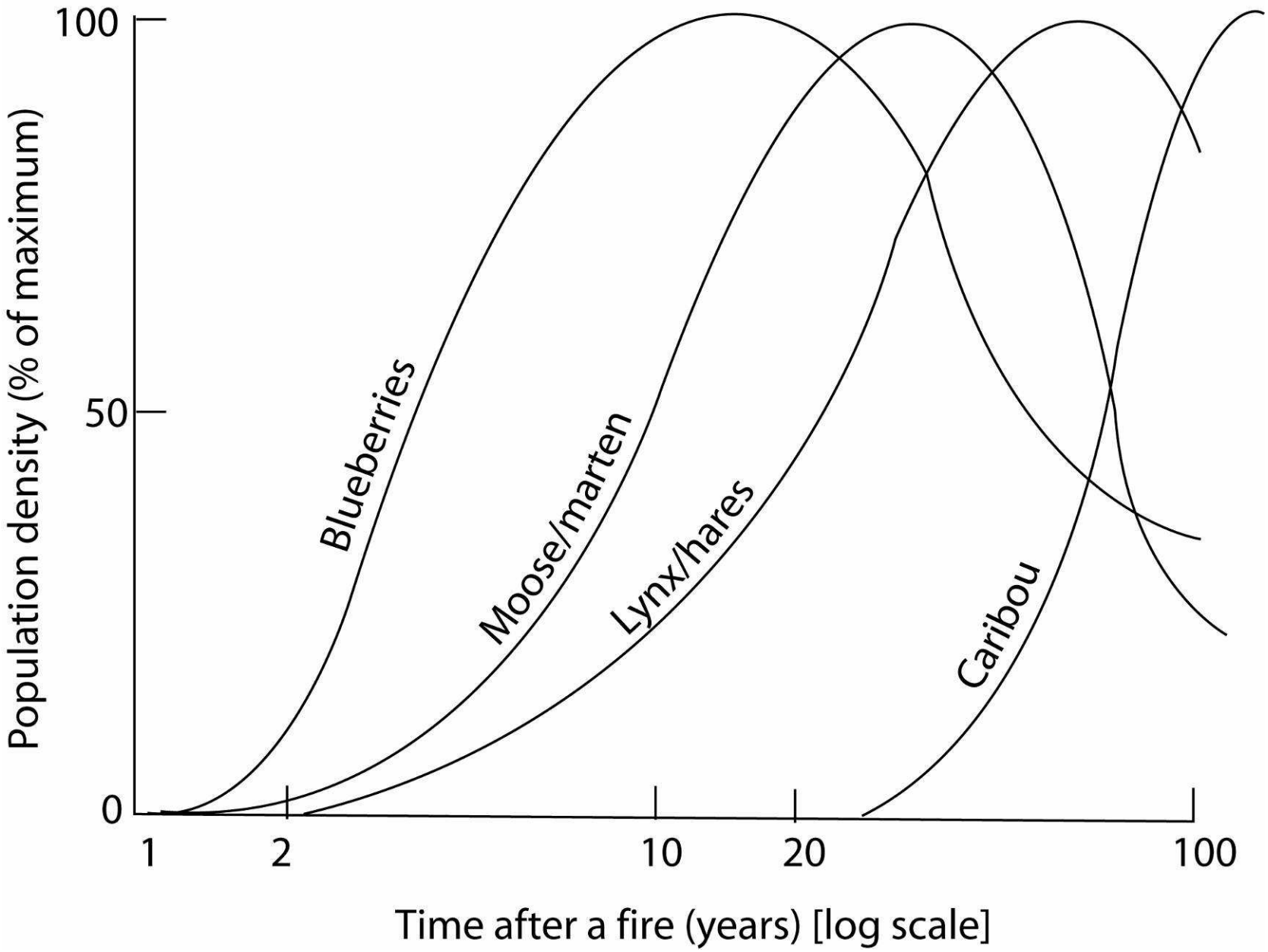
Torre Jorgenson

Netwok, Alaska

“I don’t want to live in permafrost no more,” 47 year-old Alaskan. NYT 5-27-07

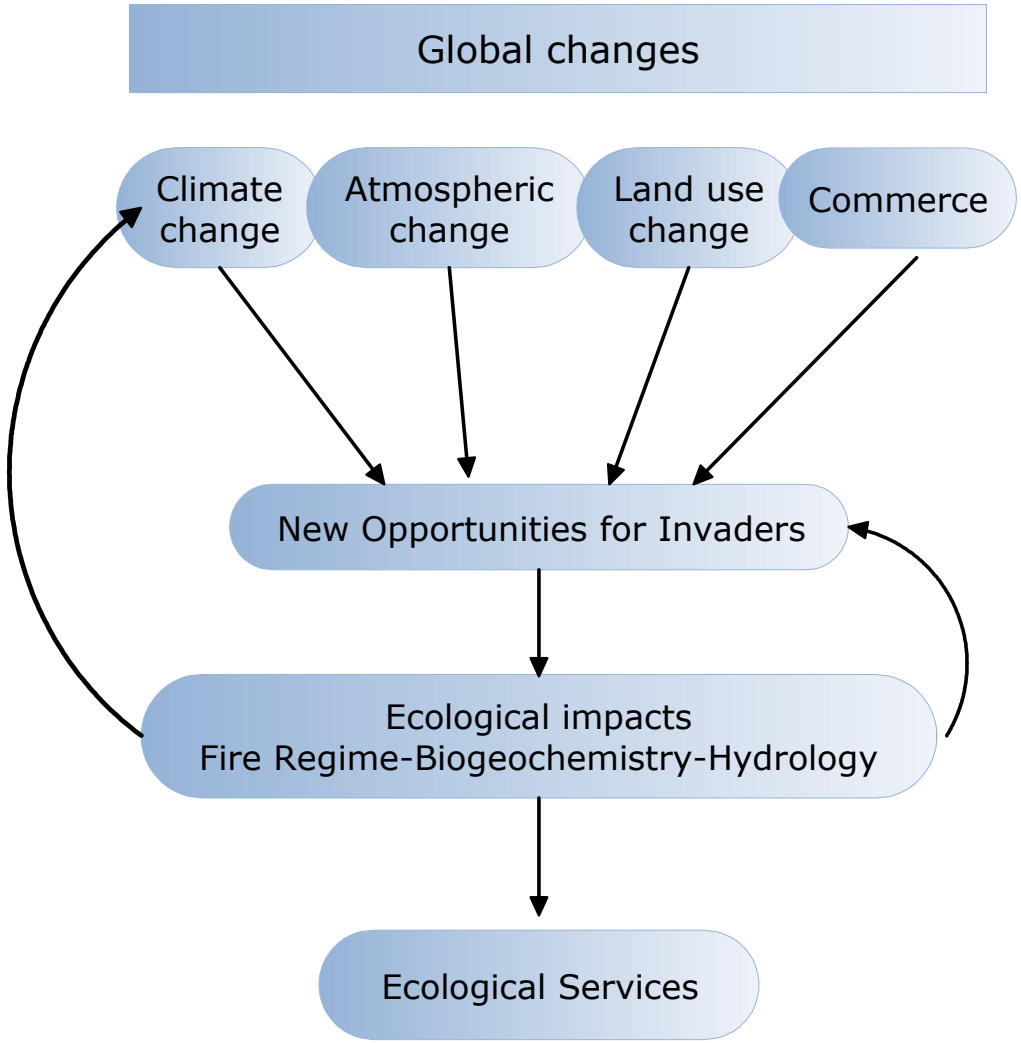


Annual fire frequency of fires greater than 400 ha in the western US mapped against mean March to through August temperature for the same region. From Westerling, et al., 2006 Science 313: 940

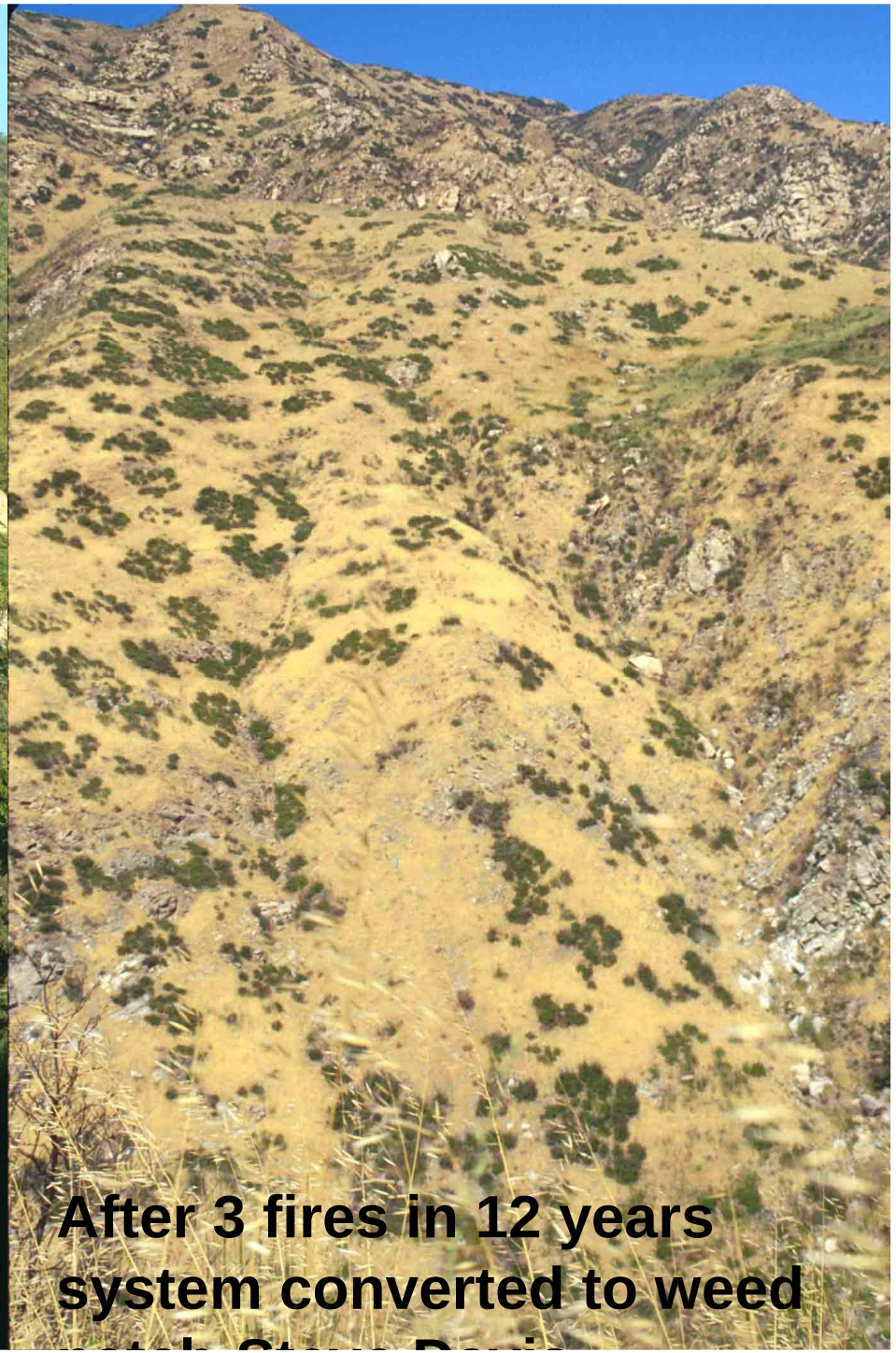

100
50
0
Population density (% of maximum)
Blueberries
Moose/marten
Lynx/hares
Caribou
1
2
10
20
100
Time after a fire (years) [log scale]

Global Changes and Invasive Species

Feedbacks, tipping points and regime shifts



Thuiller, et al. 2007

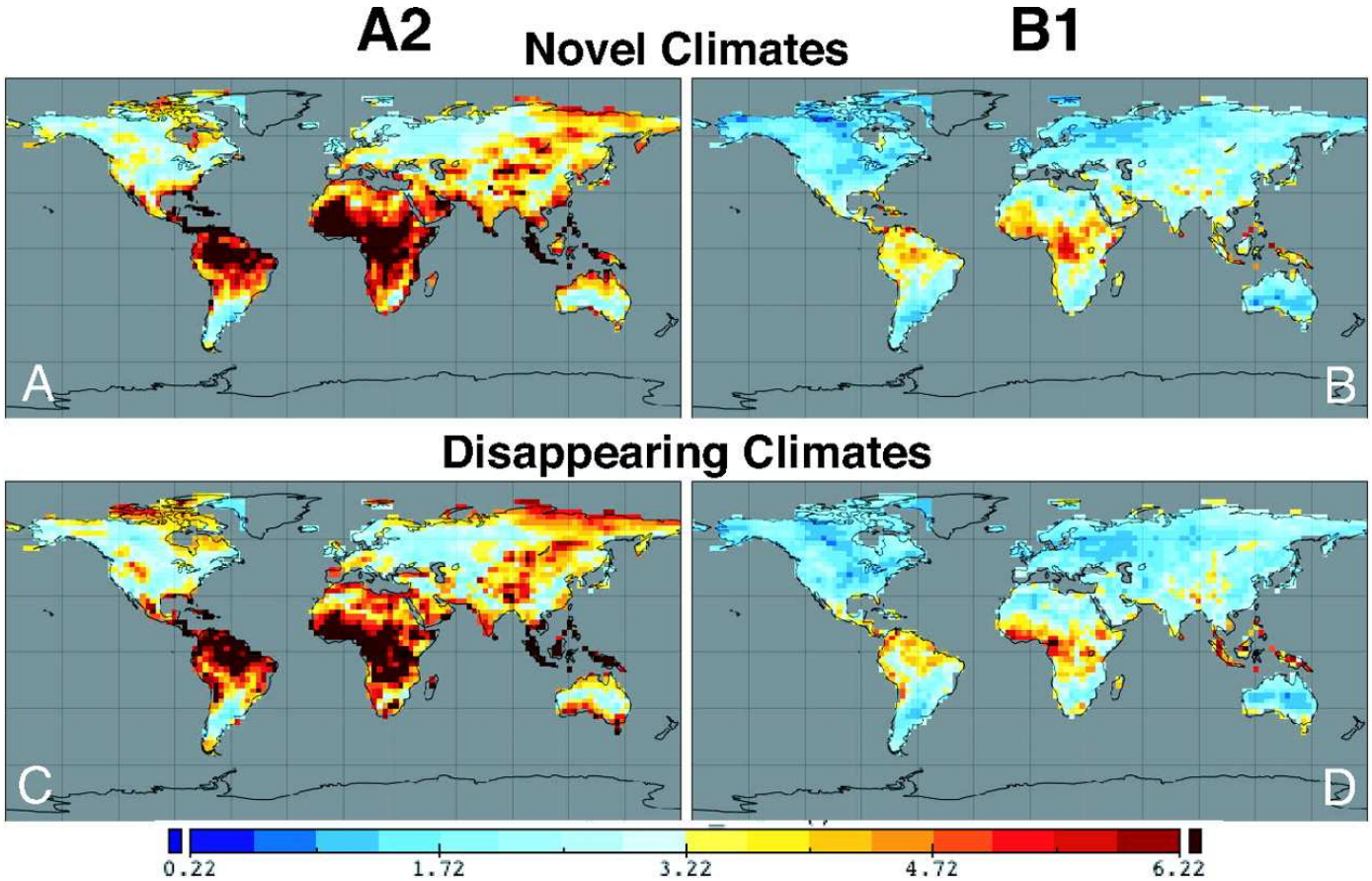

After 3 fires in 12 years
system converted to weed

On climate predictions and species distributions

"By the end of the 21st century, large portions of the Earth's surface may experience climates not found at present, and some 20th-century climates may disappear"

"There is a close correspondence between regions of globally disappearing climates and previously identified biodiversity hotspots"

Williams, John W. et al. (2007) Proc. Natl. Acad. Sci. USA 104, 5738-5742



Williams, John W. et al. (2007) Proc. Natl. Acad. Sci. USA 104, 5738-5742

A2 and BI are IPCC SRES climate responses to two emission scenarios by 2100 and dissimilarity indices to present climates

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Prepare for an uncertain future

A world of rapid change in climate and vegetation with unique combinations arising with complex feedbacks

A world of increasing extreme events

A world of weeds and diseases

A world of regime shifts

A world of rising seas and acidifying oceans

A world that has been diced and replumbed

A world of increasing carbon, nitrogen and phosphorus redistribution

A world of venture capital moving quickly among nations to places of investment "opportunity" and often environmental sensitivity (shrimp farms, biofuels, etc)

The job is urgent and has just begun

We need a follow up biodiversity-ecosystem assessment—to keep the focus, keep the momentum (MA2-IMOSEB), and to engage practitioners and policy makers

We need to develop a host of tools to make ecosystem service assessments and applications practical and more quantitative at all levels—from local to global

We need to foster approaches and innovations, from global to local, for conserving vital ecosystem services and to overcome barriers to progress

Promising responses need to applied in many sectors

Institutional

Economics

Social and behavioral

Technology

Education