Environmental Capital

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The water, soils, biodiversity, ecological processes and ecosystem services of a region.

Key indicators:

• Biodiversity
• Vegetation communities
• Landscape fragmentation
• Water
1. Biodiversity

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Impacts on Biodiversity

• Direct impacts on species (e.g. air and water temperatures over thresholds, disrupted reproduction, changes in seasonal cues, altered soil moisture, increased fire frequency, decreased flooding frequency)

• Indirect impacts on species will be as great or greater (e.g. lack of pollination, changes in predator-prey relationships, increased competition)

• Combined impacts on species = changes in population demographics, community structure, trophic interactions, food web structure, ecosystem processes and services

• Increases in pests and already overabundant native species

• Likely extinctions and shifts in ecological character

• Winners and losers
Species most at risk from climate change are those:

- reliant on seasonal flooding and flow regimes
- with narrow habitat requirements,
- low tolerance to salinity or other stressors
- small population size
- already threatened (4 communities, 304 plants, 3 mammals, 16 birds, 2 reptiles, 1 frog and 5 fish)
- limited dispersal ability and/or
- low reproductive capacity & recruitment rates
Gaps for Biodiversity

- Poor understanding of species-specific responses to expected climate change impacts, including tolerances to water availability, salinity, acidity and other stressors
- Effects of current status of flora and fauna populations on future vulnerability and adaptive capacity
- Knowledge of best fire management practices and post-fire recovery of different species and communities
- SAMDBNRMB Plan gaps include lack of:
  - Fine-scale vegetation mapping
  - Condition mapping (including restoration activities)
  - Access to indigenous knowledge
  - Knowledge on distribution, abundance and relative importance of threats
An ecological community = group of populations that coexist in space and time and interact directly or indirectly (i.e. affect each others' population dynamics).

Vegetation communities = vegetative subset (plants) that occupy a defined area (i.e. an abstraction created by ecologists).

Vegetation communities provide the architecture for the ecosystem.
Impacts on Vegetation Communities

- Changes in plant species survival and dominance will change the vegetation communities
- Tendency towards tolerant, generalist and opportunistic species
- Increased chance of vegetation community shifts over time and space
- Trophic implications are enormous!
Gaps for Vegetation communities

- Knowledge of species-specific responses to climate change & resultant effects on vegetation community structure and function
- Limited data and understanding of threats to different communities (terrestrial and aquatic)
- Knowledge of future soil condition for terrestrial vegetation (e.g. salinity, sodicity, pH)
- Knowledge of future water regimes, water quality and sediment quality for aquatic vegetation
3. Landscape fragmentation

Landscapes from an ecological view capture high levels of genetic variation and support ecosystem processes (e.g. dispersal, adaptation, facilitation, competition, predation).

Highly fragmented landscapes:
- low connectivity (e.g. population, hydrologic)
- have reduced numbers of refugia
- are exposed to threats (pest plants and animals, fire)
- compromise the adaptive capacity of species
- increase chances of localised extinction
The degree of fragmentation is a key indicator for potential impacts of climate change on terrestrial landscape.
Impacts on Landscape fragmentation

• Increased population fragmentation
• Increased stress and mortality plus reduced dispersal success will reduce genetic variability
• Loss or degradation of refugia
• Increased distribution and abundance of adaptable pest plants and animals
• Increased disconnection between terrestrial & aquatic ecosystems
Gaps for Landscape fragmentation

- Identification of regional refugia (terrestrial and aquatic)
- Fine scale assessments of future suitability of ecosystems for pest plant and animals
- Understanding of the roles of different species and processes in maintaining landscape connectivity
4. Water

- River Murray is the major SAMDB water resource
- Eastern Mount Lofty Ranges (EMLR) tributaries relatively minor volumes and intermittent flows but locally important for the different capitals.
- Locally important groundwater supplies (e.g. Angas Bremer, Mallee, EMLR)
- Rainfall varies: \(~250\) to \(900\) mm/\(y\)
• Lower River Murray flows and volumes highly dependent on flows over the South Australian border (entitlement 1,850 GL/y)
• Highly modified river system: series of ponds controlled by weirs and barrages
• Highly (over) utilised river system (only 27% of median natural flow reaches the sea)
• Adelaide and rural SA’s water taken from the lowest and most vulnerable reach
Water Pipelines from the River Murray in South Australia

[Map showing locations along the River Murray, including Port Augusta, Whyalla, Port Pirie, Wallaroo, Moonta, Swaa, Blanchetown, Morgan, Walkeria, Swan Reach, Mannum, Murray Bridge, Tailem Bend, Goolwa, Lake Alexandrina, Lake Albert, Moningie, Keith, Murray Mouth, North, Goolwa, and Kangaroo Island.]
Regulated water regime: **mostly static**

Full supply +0.75 mAHD

Sea level ~ +0.2 mAHD

Rainfall plus policy

Rainfall not policy
Water from the River Murray

- Recent experiences of drawdown below Lock 1
  - Stranded pumps
  - Subsidence of agricultural land
  - Bank slumping
  - Dry wetlands
  - Acid sulfate soils (heavy metals, low pH)
  - Disconnection (new regulators, closed barrages)
  - Salinisation (above thresholds)
  - New ground for managers
Impacts on Water

• Temperature, rainfall & evaporation are critical climate variables
• Changes in demand, management and patterns of use are critical human variables
• Direct impacts (e.g. reduced rainfall, increased evaporation)
• Indirect impacts (e.g. reduced streamflow from increased groundwater use and reduced recharge, changes in irrigation drainage quality and quantity leading to changes in watertable)
• Disproportional effects (e.g. reduced/altered rainfall leads to amplification of reductions in run-off and recharge: 7% decrease in rainfall 1997-2006 lead to 24% less recharge)
• River Murray flows likely to decrease further (up to 50% further loss in flows to the sea by 2030)
Gaps for Water

- Effects on local rainfall and evaporation
- Effects on run-off and recharge (surface & groundwater availability)
- Poor capacity to forecast River Murray flows into SA and State operational strategies (e.g. manage existing/build new structures)
- Limited capacity to forecast water demands (urban and rural)
- Knowledge of secondary impacts on catchment processes
- EMLR: lack of detailed models & high uncertainty
- Lack of clear institutional leadership (State and MDB)
- Interactions with financial and economic capital
- Unknown capacity for recycled water to meet demands
Environmental Water

- Water Dependent Ecosystems - parts of the environment, species compositions and ecological processes determined by presence of temporary or permanent water (e.g. rivers, streams, riparian vegetation, springs, wetlands, floodplains, estuaries and lakes).

- Environmental water requirements — the water regime needed to sustain water dependent ecosystems.

- Environmental water provisions — those parts of environmental water requirements that can be met at any given time, considering existing users’ rights and social and economic impacts.
Impacts on Environmental Water

Increased periods of failure to meet EWRs leading to:

- Reduced health of river, wetland and floodplain ecosystems
- Reduction or loss of species and processes (e.g. native fish, frogs, birds, salt flushing, dilution of pollutants)
- On-going terrestrialisation of aquatic ecosystems (e.g. submerged plants turning to reedbeds, blackbox forest turning to saltbush)
- Reduced opportunity for recruitment of many water dependent biota (e.g. migratory birds)
- Reduced ecological redundancy and thus capacity to adapt
- Increased frequency of seawater intrusion into the estuary and freshwater lakes
- Strongest effects of climate change will be in the lower Murray Darling Basin
Gaps for Environmental Water

• Knowledge of how effective policies will be at providing EWRs for icon species & sites and how that translates for whole-of-ecosystem EWRs

• Poor capacity to predict future River Murray flows, lake water levels and degree of Murray Mouth openness

• Poor capacity to predict future operating rules (e.g. target water levels) and alterations to infrastructure (e.g. new weirs or regulators)

• Understanding effects of storm surges (e.g. coastal dune systems, water level attenuation within the Murray Mouth)

• Understanding of current sea level variation in Encounter Bay
Ecosystem services

• The benefits and services that human derive from ecosystems (e.g. shade, shelter, pollination, aesthetics, spiritual renewal, water purification, nutrient removal, food, fibre, medicines, pest control...)

• A recognised part of the ‘ecological character’ of wetlands under the Ramsar Convention (1971).

• The ways in which the environmental impacts of climate change will affect us.
Ecosystem services impacts

Adverse impacts on ecosystem services are adverse impacts on the environment, economy, primary production or the community e.g.

• Stock injuries and death
• Loss of biotic products (e.g. medicines)
• Altered or lost ecosystem functioning (e.g. loss of fisheries)
• Reduced or loss of productivity on farms (e.g. poor pollination, fouling of water courses, increased pest problems)
• Human health issues (e.g. disease).
Gaps for Ecosystem services

Almost everything.

• identification of ecosystem services associated with different SAMDB ecosystem types

• conceptual understanding of linkages between biota, ecosystem health, ecosystem processes and provision of ecosystem services

• knowledge of impacts of changing ecosystem service provision on social and financial capital
Questions??