Session 3: Ecosystem service classification and links to ecosystem functions and conditions

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Ecosystems as assets

- Ecosystem assets are fundamental to sustaining human well-being by:
  - providing the conditions for human life (regulating environmental processes),
  - providing (renewable) inputs to a broad range of economic activities, and through
  - absorbing and assimilating waste and emissions

- The Experimental Ecosystem Accounting Guidelines (EEA)
  - 'ecosystem assets', defined as:
    - *"spatial areas containing a combination of biotic and abiotic components and other characteristics that function together"*

Objectives

- Clarifying ecosystem services and linking them to *ecological* units – ecosystem assets

- Defining ecosystem services in a coherent and consistent manner
  - Boundary to measure ecosystem services with respect to the SNA (production boundary)?

- Do we go beyond final ecosystem services?
  - Supporting and intermediate?

Linking methods and principles – looking for commonalities

- How do we classify our assets and link them to services?

- Can the asset classification methodology be extended and applied to condition assessments?

- Can the asset classification and condition approaches then be extended to estimating services?

- *"Can this be done building on ecological science and methods to inform our choice of characteristics (SEEA)?"*
  - What is the set of characteristics?

Ecosystem Characteristics

Ecosystem characteristics

Biotic

Producers

Consumers

Decomposers

Abiotic

Other linking compounds

Is there a common thread?

- Plant structure and composition
  - Area that has a common class of plant structure and composition is a *Functional Ecosystem Unit (FEU)*

- *Autotrophs: Plants (trees, shrubs, herbs, grasses), that convert the energy [from photosynthesis (the transfer of sunlight, water, and carbon dioxide into energy), or other sources such as hydrothermal vents] into food.*

- Marine and aquatic?
  - Follow similar principles…….
    - More work

Plant structure and composition

- Classify assets by plant structure and composition
  - Links very well with ecology
- Use plant structure and composition as a basis for condition measures
  - Already commonly applied around the world (natural systems)
  - Agriculture and forestry* – link to soil condition (asset account)
- Use plant structure and composition to parameterize ecosystem service models
  - Process based biophysical and causal models

Structure and composition example

Type	Species	Target Density
Overstorey	Buloke (Allocasuarina luehmannii)	50 plants per ha
	River Red-gum (Eucalyptus camaldulensis)	
	Yellow Gum (Eucalyptus leucoxylon)	
	Yellow Box (Eucalyptus melliodora)	
	Grey Box (Eucalyptus microcarpa)	
	Waxy Yellow-gum (Eucalyptus leucoxylon subsp. pruinosa)	
Understorey Tree or Large Shrub > 5m tall	Lightwood (Acacia implexa)	Present
	Silver Needlewood (Hakea leucoptera subsp. leucoptera)	
	Sugarwood (Myoporum platycarpum subsp. platycarpum)	
Medium Shrub 1-5m tall	Gold-dust Wattle (Acacia acinacea s.l.)	200 plants per ha
	Mallee Wattle (Acacia montana)	
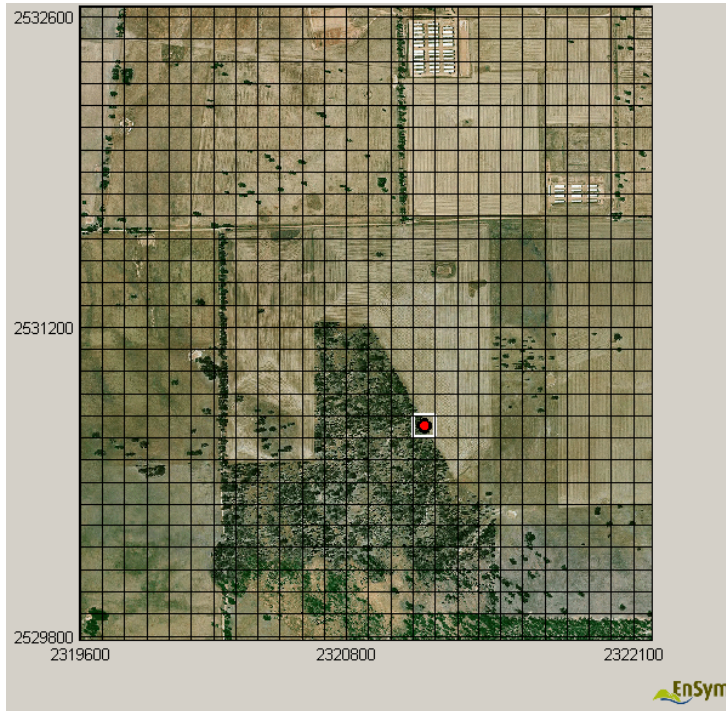
Geography
Building analytical capability
for units and ensure that GIS
standards are maintained
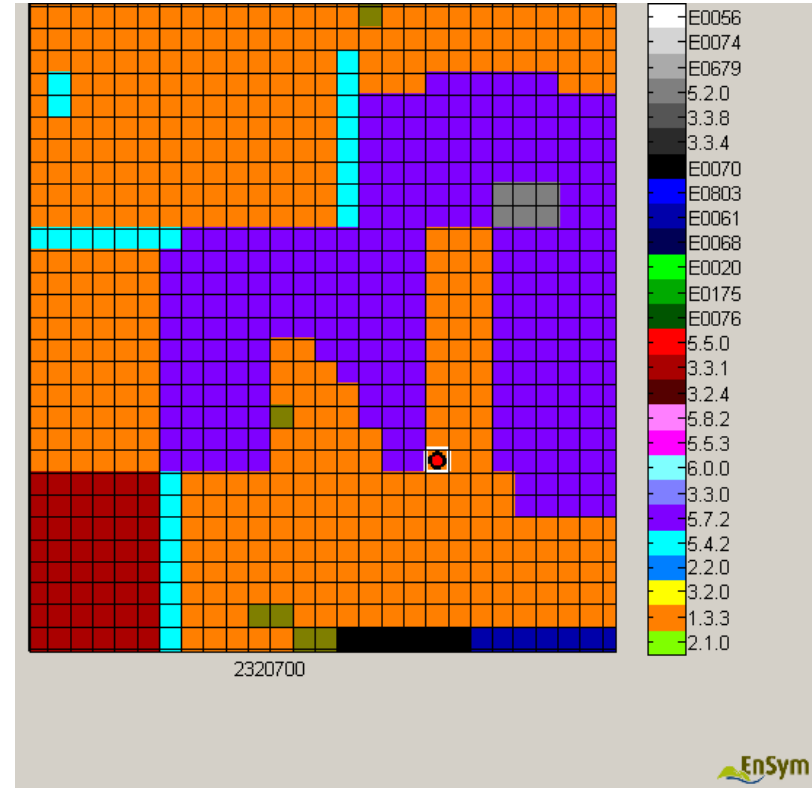
Accounting
FEU - Unified and
hierarchical classifications
for BSUs

CF – Land Cover – Extent account

	1 Artificial surfaces (including urban and	2 Herbaceous crops	3 Woody crops	4 Multiple or layered crops	5 Grassland	6 Tree-covered areas	7 Mangroves	8 Shrub-covered areas	9 Shrubs and/or herbaceous vegetation,	10 Sparsely natural vegetated areas	11 Terrestrial barren land	12 Permanent snow and glaciers	13 Inland water bodies	14 Coastal water bodies and intertidal areas	TOTALS
Opening Stock of Resources	14859	193019	0	14	135772	16830	0	11	504	0	0	0	9859	0	370868
Additions to stock															
Managed expansion						3408									3408
Natural Expansion															0
Upward reappraisals						120									120
Total additions to stock															0
Reductions in stock															
Managed regression		3408													3408
Natural Regression															0
Downward reappraisals	112													8	120
Total reductions in stock															0
Closing stock	14747	189611	0	14	135772	20358	0	11	504	0	0	0	9851	0	370868

CF to EEA – FEU

Sum of Area (ha)	AR_LU_SEEA_CF	
AR_LU_FEU	**6 Tree-covered areas**	**Grand Total**
2.2.0 Production forestry	9328	9328
3.1.3 Other forest production	6	6
Box Ironbark Forest	2227	2227
Creekline Grassy Woodland	658	658
Drainage-line Woodland	690	690
Floodplain Riparian Woodland	853	853
Grassy Woodland/Riverine Grassy Woodland Mosaic	27	27
Heathy Dry Forest	250	250
Heathy Woodland	8	8
Hillcrest Herb-rich Woodland	731	731
Low Rises Woodland	2	2
Metamorphic Slopes Shrubby Woodland	90	90
Plains Savannah	69	69
Plains Woodland	1394	1394
Red Gum Swamp	47	47
Riverine Chenopod Woodland	321	321
Riverine Chenopod Woodland/Lignum Swamp Mosaic	121	121
Riverine Chenopod Woodland/Plains Grassland Mosaic	1	1
Semi-arid Woodland	7	7
Grand Total	16830	16830

Hierarchical (nested-grid) aggregation

Bioregions, Ecotones, Country

Ecosystem Accounting Unit (EAU)

Functional Ecosystem Unit (FEU)

Basic Spatial Unit (BSU)

Country

State

Region

Statistical Areas

Parcel

Grid cell
(e.g. 20m x 20m or 100m x 100m)
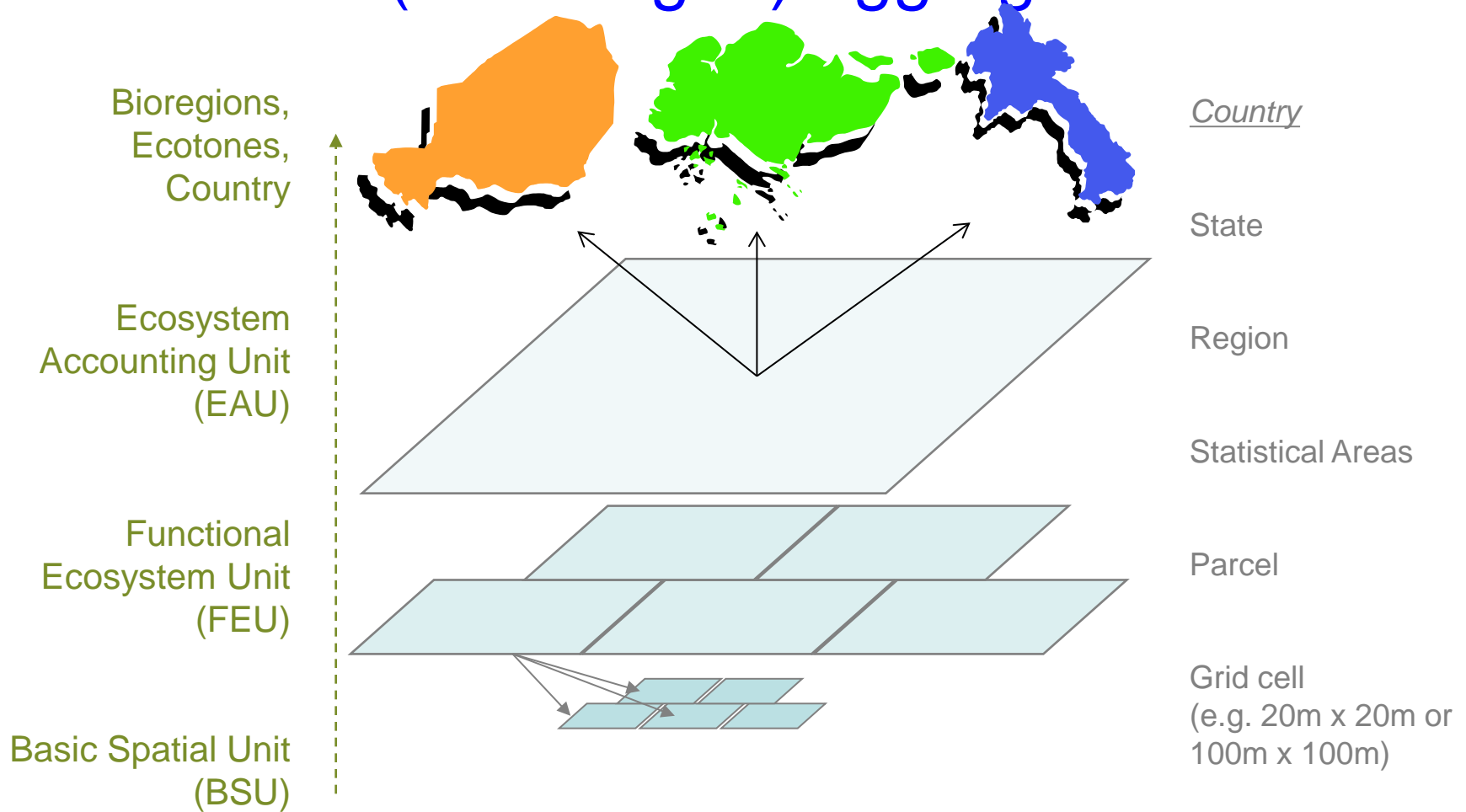
Continuum between land cover and FEU

Global Economic Data

Global Bioregions
ELU, other

National Economic Data
Agriculture, GDP

National Bioregions
VIM01 - Victorian Midlands

Sub-State – Avon Richardson
SEEA CF Land Accounts

State Sub-Bioregions
GOLD - Goldfields, (VIM01)

Functional Ecosystem Units

SEEA CF Land Cover Classification (14) → 6 Tree Covered Areas → EVC55 - Plains grassy Woodland Goldfields (GOLD)
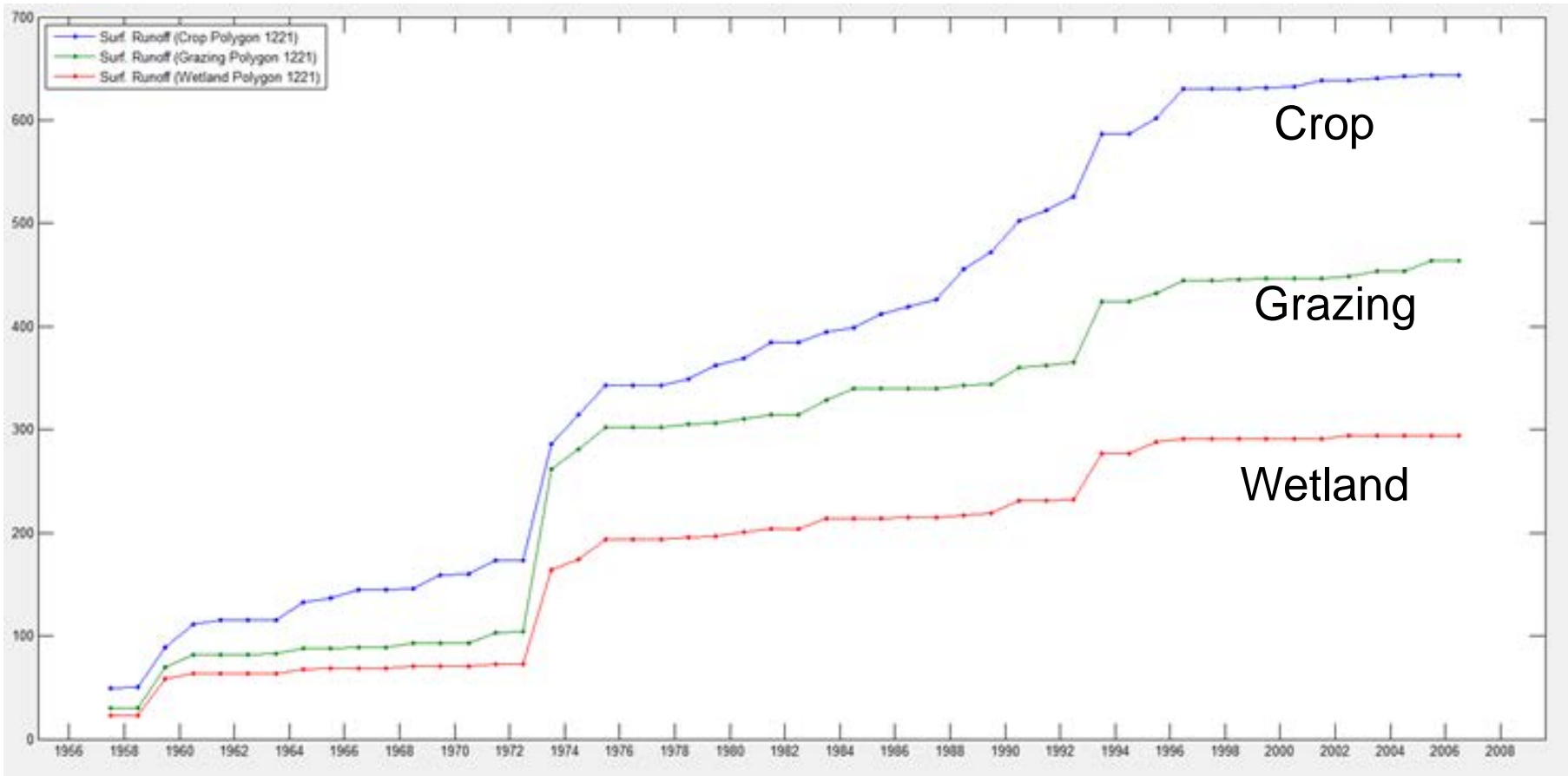
Modelling ecosystem services

- **Plant structure and composition**
  - Key input to process based biophysical models
    - Evaporation, transpiration, runoff, erosion, recharge, carbon and biomass accumulation, etc

  - Benchmarking condition to infer (via causal and associative models) ecosystem services
    - To assess how an ecosystem compares to a benchmark of *expected* structure and composition
    - Canopy cover, litter, logs, density, diversity, age, recruitment
    - Estimate – Habitat, species suitability, resilience, etc

Water services (runoff, retention, filtration)

Flow regulation services

Table 1 Ecosystem service – flow regulation – runoff (mm/annum)

AR_LU_NEW	Landuse	Sum of Surf. Runoff New	Sum of Surf. Runoff Base	Change in runoff	% change in runoff
Creekline Grassy Woodland	3.2.0 Grazing modified pastures	19	77	(57)	-75%
	3.3.0 Cropping	53	176	(123)	-70%
Creekline Grassy Woodland Total		72	253	(180)	-71%
Plains Woodland	2.1.0 Grazing natural vegetation	16	49	(33)	-67%
	3.2.0 Grazing modified pastures	3,396	8,370	(4,974)	-59%
	3.3.0 Cropping	10,733	23,874	(13,141)	-55%
	3.3.1 Cereals	5	17	(13)	-73%
	3.3.8 Legumes	313	1,062	(750)	-71%
	5.7.2 Roads	402	7,489	(7,088)	-95%
Plains Woodland Total		14,864	40,863	(25,999)	-64%
Grand Total		14,936	41,115	(26,179)	-64%

Causal Links - Habitat change Calculator

STEP 10

Current Habitat Score

Attribute	Max	Default	Assessed	Comments
Large Trees	10			
Tree canopy cover	5			
Understorey	25			
Lack of weeds	15			
Recruitment	10			
Organic litter	5			
Logs	5			
Landscape context	25			
Standardised Habitat Sco	*100*			

Causal Links – River Health (Change)

River Health Metric
Instream Current Condition
Bank Condition Score (1-4)
Temperature
Instream Large Wood Score (1-4)
Current Condition Terrestrial
Standing Trees - TCC/5 (0-1) (0 if removing trees is not allowed)
Fallen Timber - Logs/5 (0-1)
Woody Weed Condition (0-1)
Supplementary planting/revegetation
Exclude Stock(1 - grazing allowed, 0 - otherwise)

ES - Level 1	ES - Level 2	Intermediate or Final ES	Direct benefits	Indirect/Other Benefits	Description	Measure
Plant growth – biomass	Grass	Final	Animals - Input Animals - Asset (Gross Fixed Capital)	Meat, dairy products (milk, cheese, yoghurt), honey etc. Dung, fat, oils, cadavers from land, water and marine animals for burning and energy production	Reared animals and their outputs	tonnes /ha Total head
Plant growth – biomass	Wheat	Final	Wheat	Fodder / animal food	Cultivated crops - Cereals (e.g. wheat, rye, barely), potatoes, vegetables, fruits etc.	tonnes /ha
Plant growth – biomass	Nuts, berries, fungi, etc	Final	Wild berries, fruits, mushrooms, water cress, salicornia (saltwort or samphire); seaweed (e.g. Palmaria palmata = dulse, dillisk) for food		Wild plants, algae and their outputs	tonnes /ha
		Intermediate	Food source for animals outside of the FEU		Wild animals	

Conclusions / Observations

- The FEU is based on ecological principles
  - Plant composition and structure
  - Commonly applied with long history
  - Variable country capability and application
- CICES & FEGS
  - FEU is consistent with the principles of both
  - Builds on current asset in SEEA
  - Minor differences in boundary for classification of services

Conclusions / Observations

- Aggregation
  - Local to global ecological units
    - National bioregions…….
- Data and feasibility
  - Science is available, Can be data intensive
    - Start in areas of policy interest……..
  - There are alternative methods for estimating structure and composition
    - Maintain the fundamental principles

Conclusions / Observations

- Estimating ecosystem services
  - Links well with process based biophysical models
    - Physical data – water, carbon, biomass, etc
    - Local models – detailed plant structure
    - Global models – land cover (proxy for plant structure)
  - Causal models
    - Less common – but many examples to build on
    - Suitable for habitat linkages