

Multidimensional ecosystem service assessment within LabForest

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① Need for comprehensive assessment of ecosystem services

- Forests provide **multiple ecosystem services** (ES, compare Fig. 1) that are differently affected by disturbances and forest management practices and are under **increasing pressure**
- Often **competing objectives**, such as climate change mitigation (e.g. carbon sequestration) and adaptation (e.g. local climate), economic interests (e.g. timber production), nature conservation (e.g. biodiversity conservation), and other societal demands (e.g. recreation)
- In LabForest, multiple forest ES are quantitatively assessed (compare poster 1, 20 & 31)
- To **support decision-making in forestry**, the multitude of forest ES needs to be comprehensively assessed and evaluated for systematic comparison of management strategies
- LabForest integrates all results from the diverse work packages to create a **multidimensional assessment matrix**
- The assessment matrix enables the systematic comparison of forest management strategies, accounting for uncertainties related to climate change and socio-economic conditions.
- The matrix further facilitates the **transfer of scientific knowledge** into education and practice, and provides the basis for economic value assessment of managed forest sites

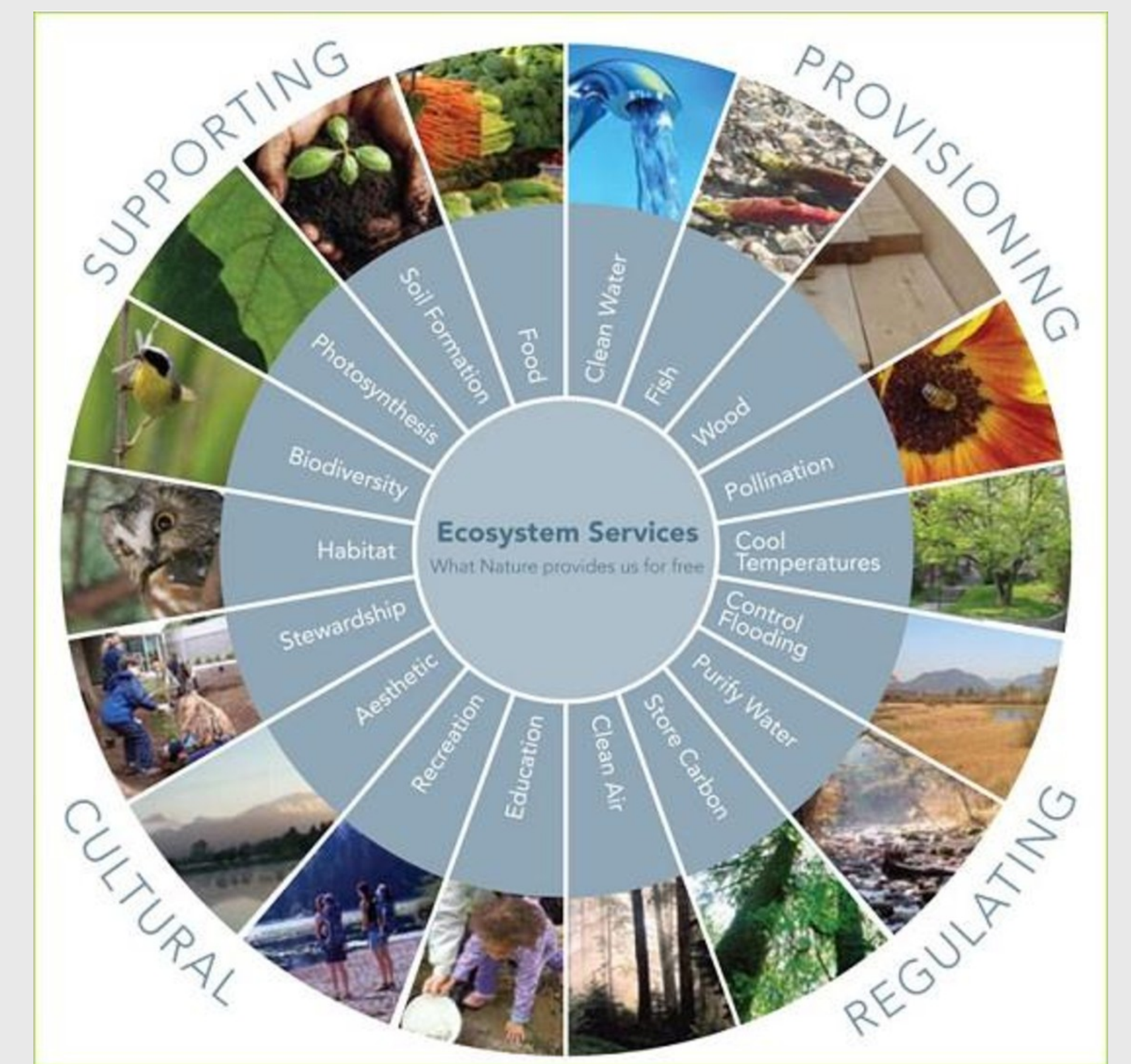


Fig. 1 - Exemplary forest ecosystem services, source: metrovancouver.org

② Workflow of the assessment framework

1) Systematically assess broad range of ES

- for conceptual consistency and compatibility with international frameworks such as the Millennium Ecosystem Assessment (MA) and The Economics of Ecosystems and Biodiversity (TEEB), we use Common International Classification of Ecosystem Services (CICES v5.2; compare Tab. 1)

2) Standardize investigated ecosystem services and integrate into multidimensional assessment matrix

3) Holistic evaluation of all project results, including final weighting within participatory process involving relevant stakeholders

4) Quantifying monetary value of ecosystem services delivered by the management strategies via dedicated workshops

Division	CICES (v5.2) Class	Code	LabForest Class type
Regulation	Runoff and baseflows	2.2.2.1	Water retention
Provisioning	Pollination	2.3.2.1	Number of wild bee pollinator species
Provisioning	Seed dispersal	2.3.2.2	Number of seed dispersing breeding birds
Regulation	Nursery populations	2.3.2.4	Biodiversity of arthropods associated with forests
Regulation	Refuge habitats	2.3.2.4	Biodiversity (beetles, bees, spiders, birds, plants, fungi)
Regulation	Pest control	2.3.3.1	Roe deer density
		2.3.3.3	Wind protection
Regulation	Local temp. and humidity	2.3.6.2	Evaporative cooling
			Number of European spruce bark beetles (<i>Ips typographus</i>) and six-toothed spruce bark beetles (<i>Pityogenes chalcographus</i>)
Regulation	Pest control	2.3.3.1	Future pioneer deciduous (from natural regen.) - for construction material use and platform chemical use
Provisioning	Wild plants for nutrition	1.1.1.1	Future pioneer deciduous (from natural regen.) - low quality stems used for energy
Provisioning	Fibres or materials	1.1.1.2	Future amount of wood volume damaged by <i>Ips typographus</i> & <i>Pityogenes Chalcographus</i>
Provisioning	Plants for Energy	1.1.1.3	Damage in neighboring forest stands by <i>Ips typographus</i> & <i>Pityogenes Chalcographus</i>
	Fibres or materials - wild plants	1.1.5.2	AGB from major trees pre clearing
Provisioning	Fibres or materials	1.1.1.2	AGB + timber provision
Provisioning	Plants for Energy	1.1.1.3	AGB from major trees pre clearing
	Fibres or materials - wild plants	1.1.5.2	Future timber provision from natural rejuvenation
Provisioning	Fibres or materials	1.1.1.2	Timber provision
Provisioning	Plants for Energy	1.1.1.3	Timber provision
	wood-based materials	1.1.5.2	Future pioneer deciduous (from natural regen.) - for construction material use and platform chemical use
Provisioning	wood-based energy	1.1.5.3	Future pioneer deciduous (from natural regen.) - low quality stems used for energy
Regulation	Pest control	2.3.3.1	Future amount of wood volume damaged by <i>Ips typographus</i> & <i>Pityogenes Chalcographus</i>
Regulation	Pest control	2.3.3.1	Damage in neighboring forest stands by <i>Ips typographus</i> & <i>Pityogenes Chalcographus</i>
Regulation	Chemical comp. of atmosphere	2.3.6.1	AGB from major trees pre clearing
Regulation	Carbon sequestration/storage	2.3.6.1	AGB + timber provision
Regulation	Chemical comp. of atmosphere	2.3.6.1	AGB from major trees pre clearing
Regulation	Carbon sequestration/storage	2.3.6.1	AGB + timber provision
Regulation	Carbon sequestration/storage	2.3.6.1	Atmospheric GHG emissions assessment
Regulation	Health-supporting nature	3.1.1.2	CO2 storage of forests, wood products and soil over time
Cultural	Symbolic natural features	6.4.1.1	Presence of low vegetation
Regulation	Visual screening	2.1.2.3	Presence of low vegetation
Cultural	Nature observation	3.1.1.2	Presence of low vegetation
			Biodiversity (beetles, bees, spiders, birds, plants, fungi)

Tab. 1 - Translation scheme for LabForest class types into CICES v5.2 framework classes.

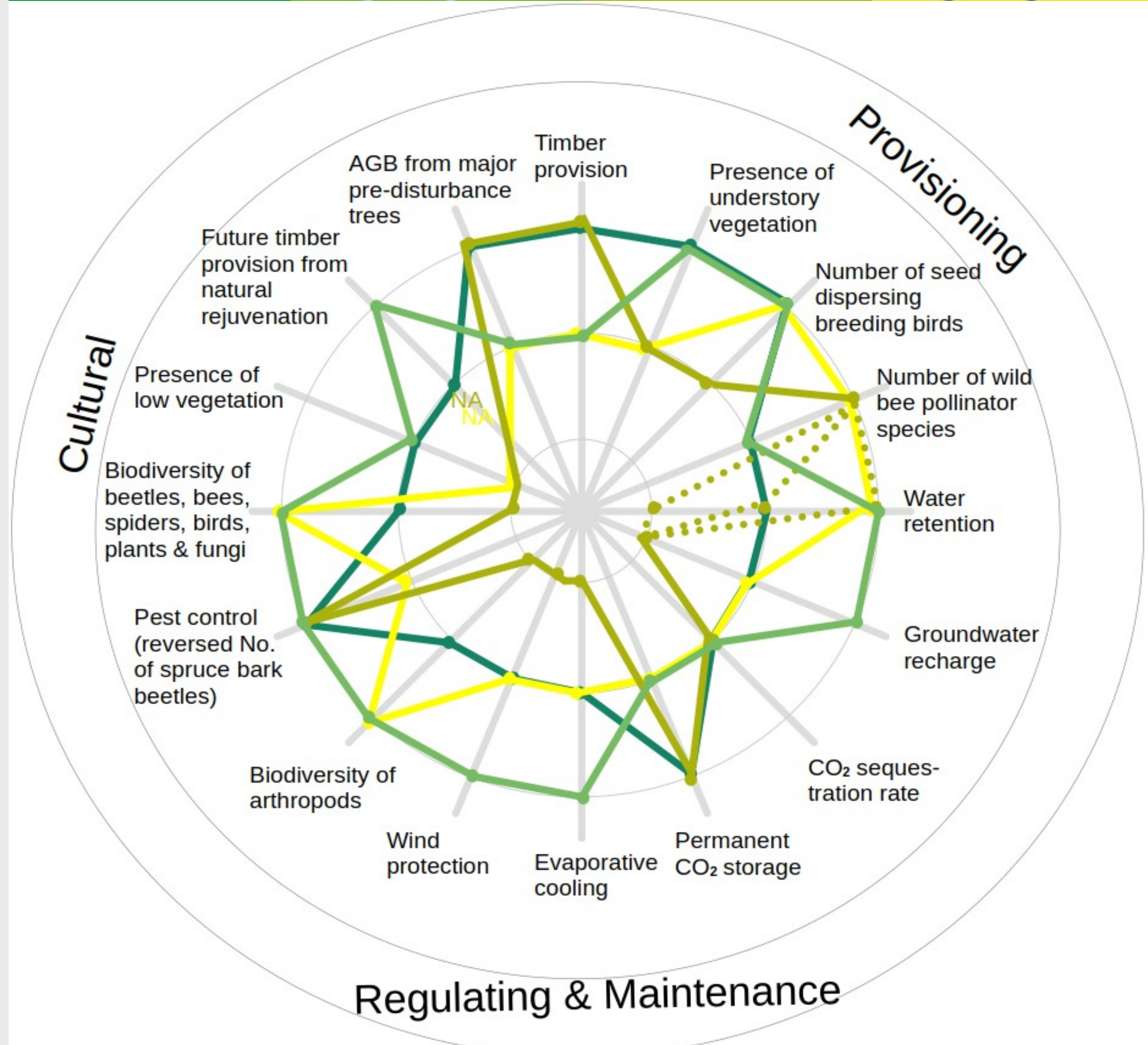


Fig. 2 - Preliminary spider chart of the impact of investigated management practices (colors) on the ecosystem services assessed within LabForest. High values (outer circle) indicate positive impacts, whereas low values indicate negative impacts (final chart will use CICES (v5.2) classes).

③ Preliminary results (partly reflecting anticipated outcomes) and outlook

- So far, many of the investigated ES are not finally assessed but rather reflect expected outcomes of the respective experts
- Visualized ecosystem service provision enables **quick overview** of the impacts of forest management and can **support conservation-related & economic decisions (synergies + trade-offs)**
- Advanced rejuvenation with (gauged) deadwood retention depicts highest overall service provision (e.g. wind protection, evaporative cooling, future timber provision, groundwater recharge)
- Cleared sites without advance regeneration show lowest provision in investigated ES (e.g. biodiversity in arthropods) and partly high uncertainty (e.g. water retention)

→ **Regional recommendations and improved understanding for establishing economically and ecologically resilient forests to cope with anticipated climatic changes**

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