

# Ecosystem services for aquatic macrophytes: linking ecology to risk assessment of chemicals

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## Background

- Ecosystem services are the benefits people obtain from ecosystem structures and processes [1,2];
- The potential impact of toxicants on ecosystem services was recognized 25 years ago [3], but the incorporation in risk assessment has only been considered recently [4];
- Risk assessment of chemicals could benefit from quantification of important ecosystem services;
- Here we focus on plants as important key service providing units (SPUs) [4];
- Aim: to collate quantitative information of ecosystem services from three different types of aquatic macrophyte vegetation:
  - seagrass beds as a representative of submerged macrophyte vegetation;
  - duckweed vegetation as a representative of floating macrophyte layers;
  - reed as a representative of emergent macrophyte stands.

## Ecosystem services delivery by SPUs

**Table 1.** : Ecosystem services provided by Sea grass beds, Duckweed layers and Reed beds.

Service groups	Seagrass	Duckweed	Reed
<b>Provisioning</b>	mattress stuffing	proteins	thatching, litter, cover
<b>Regulating:</b> (g C/m <sup>2</sup> aboveground biomass)	<i>Zostera marina</i> :110; <i>Z. noltii</i> : 30	15.6	615
<b>Regulating:</b> C-fixation g C/m <sup>2</sup> /year	138		1.63
<b>Regulating:</b> erosion prevention g sediment/m <sup>2</sup> /day	0,1 – 116		12,5 – 25
<b>Regulating:</b> nutrient retention mg N or P/m <sup>2</sup> /day	69 - 140 (N)	120 - 590 (N) 14 - 74 (P)	63013 (N) 4383 (P)
<b>Cultural</b>	Low	Low to high	High
<b>Supporting:</b> primary production g above ground dry weight/m <sup>2</sup> /day	<i>Zostera marina</i> : 5.2 <i>Z. noltii</i> : 1.1	Lemna minor: 1,4	0.8-11.4 aboveground 7.7-30.6 belowground

After Duarte 1990, Duarte & Chiscano 1999; Greenway & Woolley 1999; Kohl et al. 1998, Asaeda et al. 2002; Laube & Wohler 1973; Mei & Xang 2007; Pedersen & Borum 1993, Moore 2009

## Conclusions from Table 1

- Aquatic macrophytes are important SPUs in aquatic ecosystems;
- Provisioning services are common and were/are economically favourable;
- Regulating services include carbon fixation and storage, primary production and nutrient retention.

## How to link ecosystem services to risk assessment quantitatively?

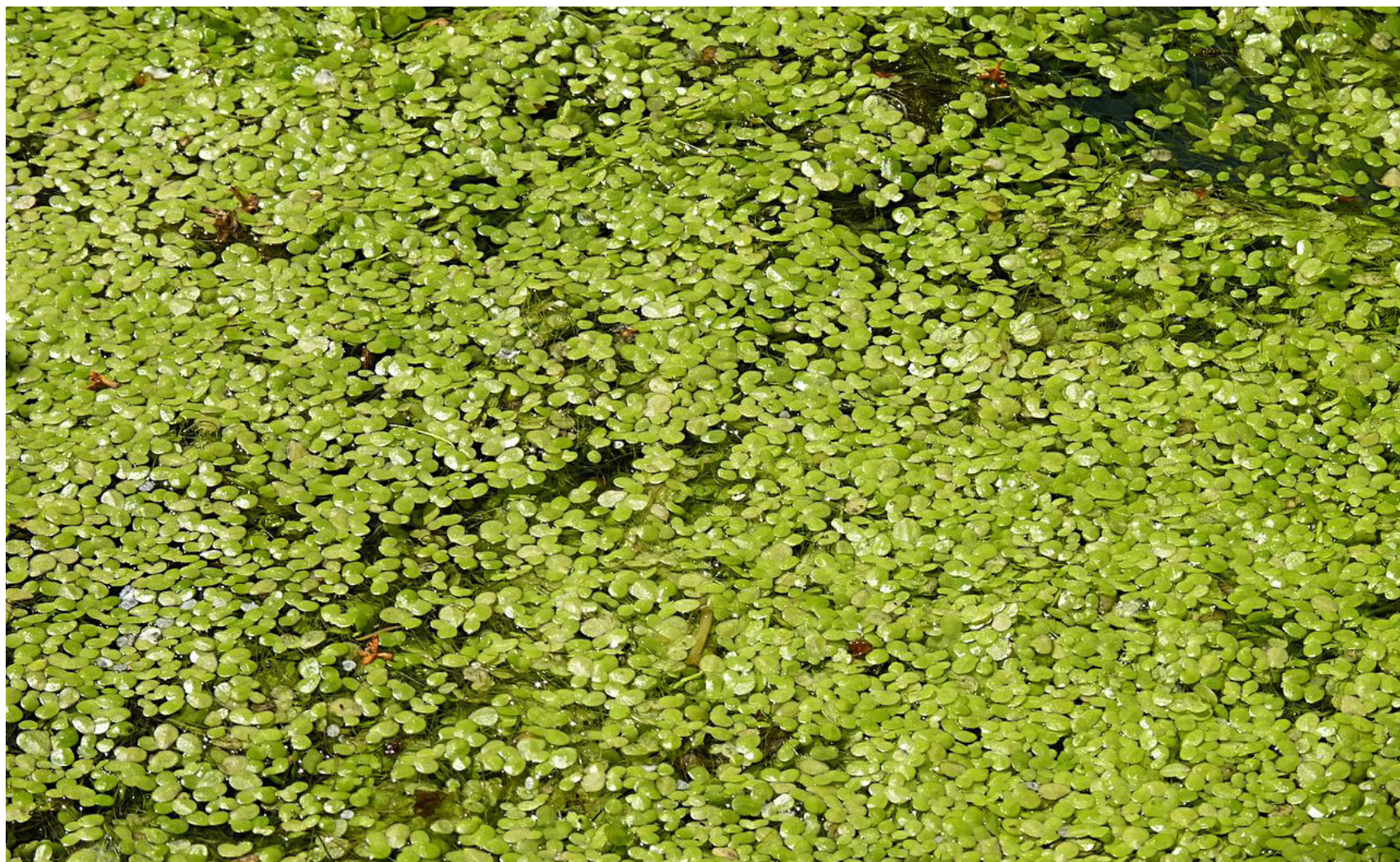
- Macrophyte assessment endpoints need to be linked to SPUs;
- Biomass seems to be a promising endpoint:
  - It is included as one of the assessment endpoints in the protection goals;
  - Can be linked to the ecosystem services provided by aquatic macrophytes;
  - Is an important output of macrophyte experimental studies and models assessing the effects of chemicals;
  - Approach needs further elaboration and quantification.
  - Application in ecosystem services mapping and quantification of effects of chemicals on important ecosystem services;

## References

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Seagrass beds



Duckweed floating layer



Reedbeds