# Aquatic macrophyte growth season in central (and northern) EU and the implications for aquatic macrophyte risk assessments for herbicides

**Helena Crosland**

ERAR, York, 14th June 2022

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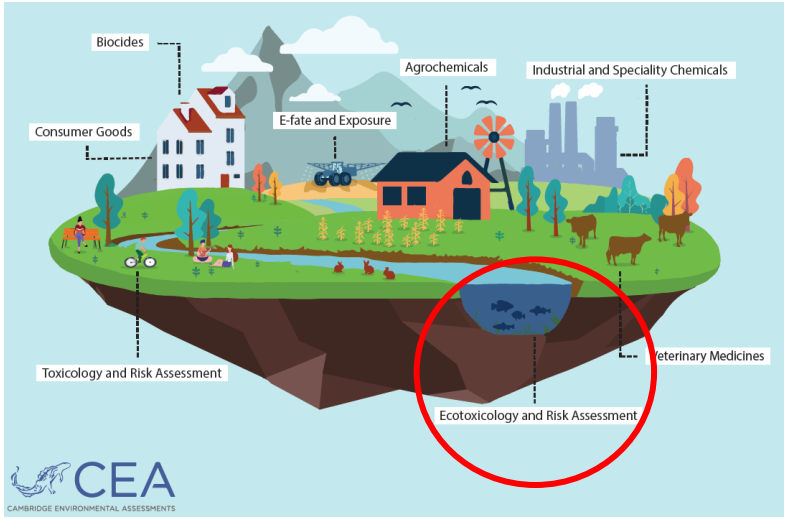
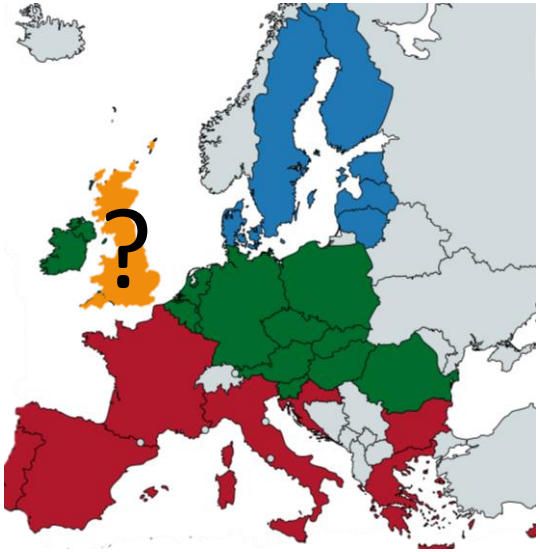
# Context



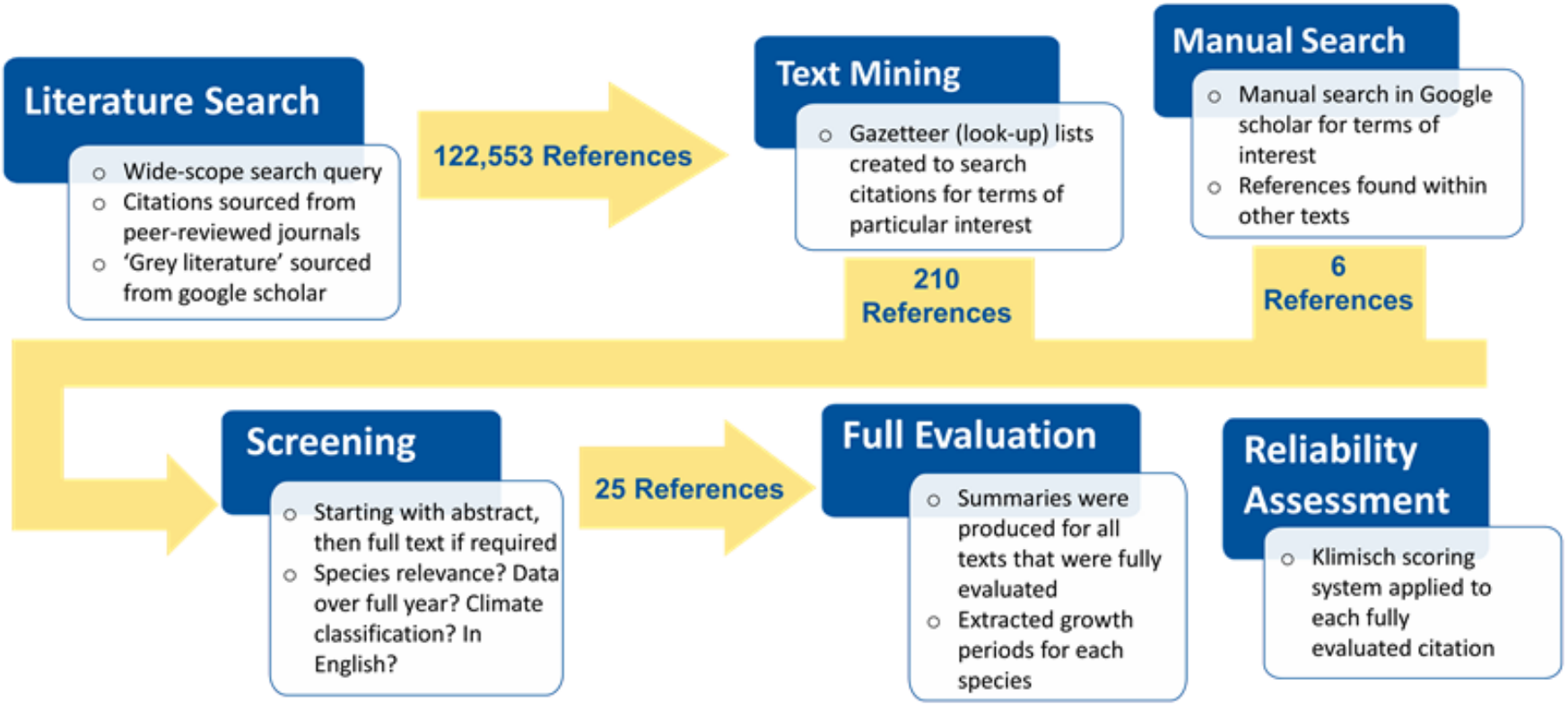

- Chemicals such as Plant Protection Products (PPPs) can enter surface waters through their use
- This can result in exposure of aquatic organisms such as macrophytes – risk assessment may be required, particularly for PPPs with herbicidal Modes of Action (MOAs)
- However, some MOAs are only effective on plants which are actively growing (e.g. sulfonylureas)

# Our question

- What is the main active growing period for macrophytes in natural freshwater bodies in NZ and CZ EU?
  - Relevance to risk assessment for PPPs which act on actively growing plants?
  - A further question for today: are these conclusions still relevant to GB?



# Literature search



# Rapid screening

- For the reference to be deemed relevant to the scope of this literature review, several criteria had to be met:
  - *Is the study performed on a freshwater aquatic plant?*
  - *Does the study potentially contain data on seasonal growth?*
  - *Did sampling occur over a full year to allow determination of the start of the growth period?*
  - *Has the study been undertaken in a climatically relevant region for Northern and Central Zone EU?*

# *Is the study performed on a freshwater aquatic plant?*

- Only freshwater species (or at least test system freshwater)
- Plant species were grouped into the following categories (based on Sculthorpe 1985):
    a) **Emergent** (i.e. rooted to substrate with at least some plant structures emergent from the water)
    b) **Floating leaved** (i.e. rooted to the substrate with leaves floating on water surface)
    c) **Submerged** (i.e. rooted with no emergent plant structures)
    d) **Free-floating** (i.e. not rooted to the substrate)
- Also separated into monocots and dicots

# *Does the study potentially contain data on seasonal growth?*

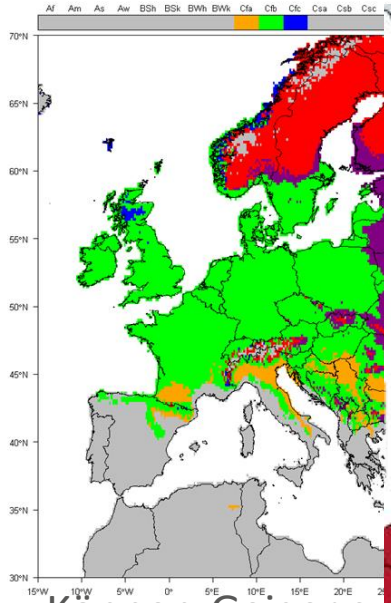
- Only references presenting data on plant growth (e.g. biomass, percentage cover) over time were considered relevant
- Studies only reporting consolidated seasonal or annual growth were not considered relevant

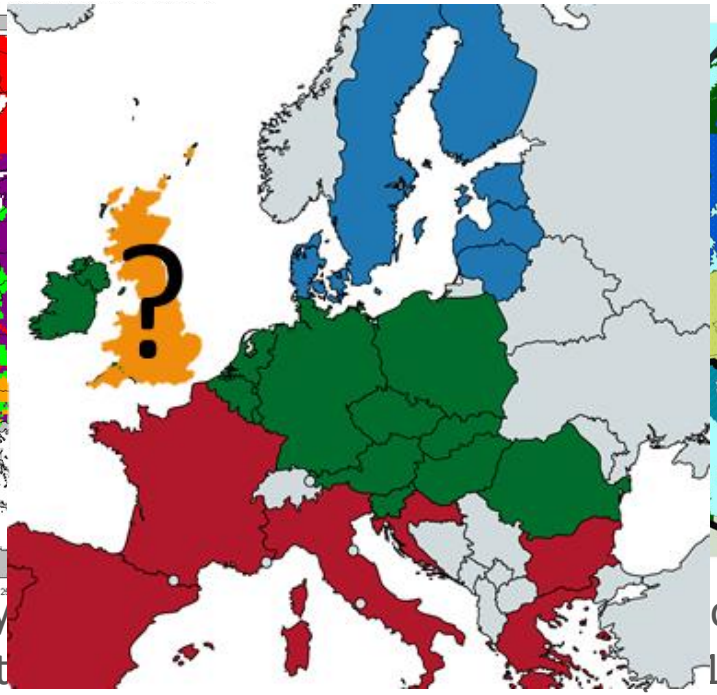
# *Did sampling occur over a full year to allow determination of the start of the growth period?*

- Aimed for data covering start and end of the year
- Exceptions made where the start of growth period could be inferred, but the given reliability score was less
- E.g. Growth up to November was 0, sampling beginning again in April also 0 biomass – suggests no growth between November and April

# *Has the study been undertaken in a climatically relevant region for Northern and Central Zone EU?*

- EPPO and Köppen-Geiger systems used to categorize climates in studies
- Included UK climates, therefore conclusions relevant for GB



Köppen-Geiger sy ons as defined in climate classificat 14)

# Full evaluations and Reliability scoring

- The Klimisch scoring system was used for all studies that were fully evaluated:
  - Test procedure in accordance with generally accepted scientific standards and described in sufficient detail - [Reliability 1]
  - Study well documented, meets generally accepted scientific principles, acceptable for assessment - [Reliability 2]
  - Significant methodological deficiencies or unsuitable test system - [Reliability 3]
  - Secondary literature or documentation insufficient for assessment - [Reliability 4]

# Results

- 216 references were screened for relevance: 25 (15%) were considered relevant, 188 (87%) were not considered relevant and 3 (1.4%) could not be fully evaluated due to not being presented in English
- 18 references were considered to have a reliability score of 2, and 7 were considered to have a reliability score of 3. Reliability didn't impact growth period, so all 25 references were used
- Main reasons for rejection:
  - Unsuitable data
  - Area not climatically relevant

# Results

- A summary was prepared for each reference considered relevant and the growth period was summarised in a tabulated format
- Example of how individual growth periods were tabulated:

pale grey cells = minor growth period; dark grey cells = significant growth period

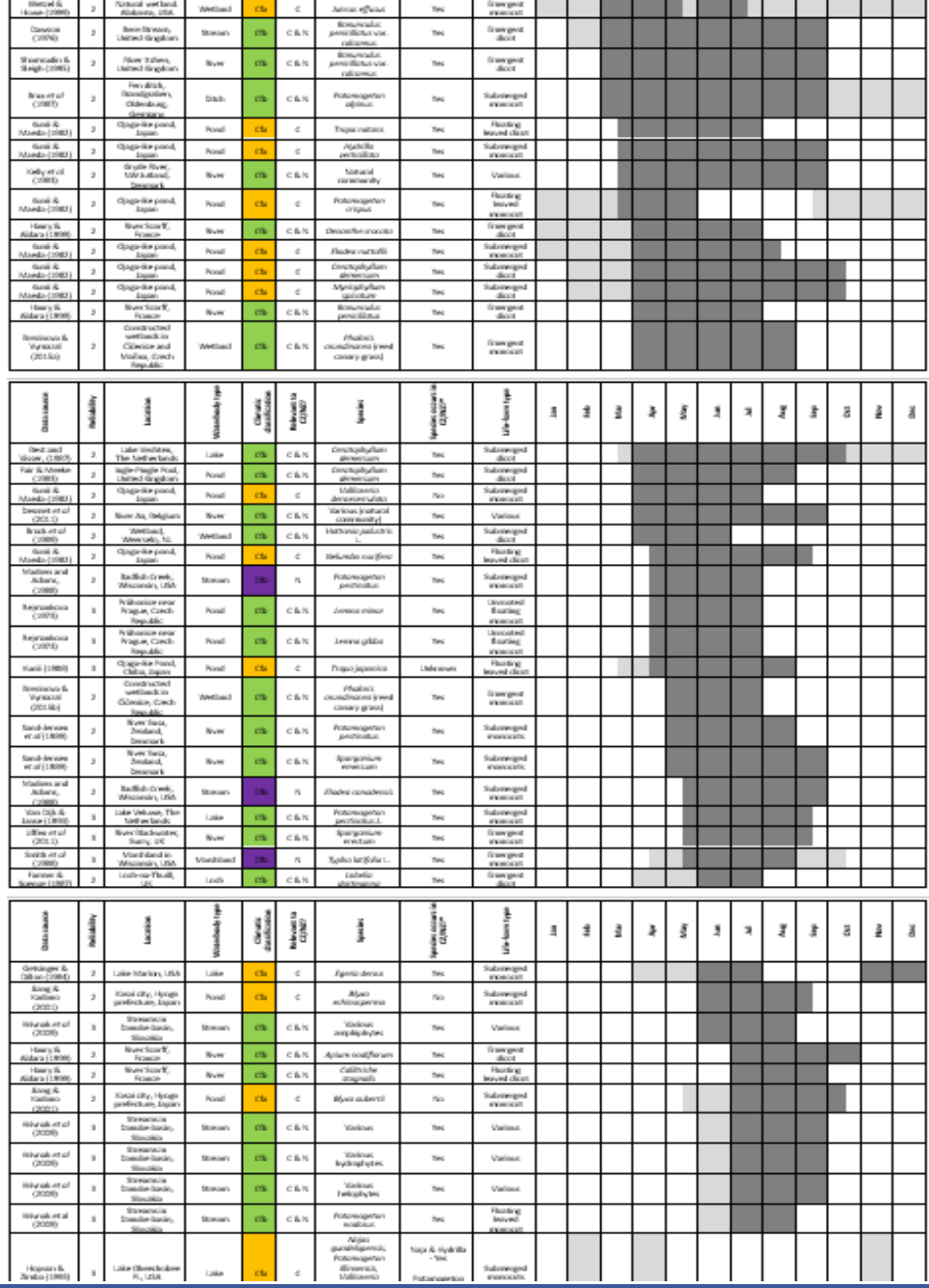
| Data source | Location | N/C-EU | Species | Macrophyte type | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Study reference | Location of study | C/N | Species name | Emergent/ Floating/ submerged Mono/dicot | | | | | | | | | | | | |

# Results

- 43 growth periods were extracted associated with 31 macrophyte species
- 15 dicot, 22 monocot species, spread across all life-form categories
- All growth seasons were consolidated into a single summary table and the main growth period beginning and end (where the majority of growth occurred) were estimated
- No clear effect of climate classification on growth period (but some climates were underrepresented)
- No clear effect on growth period of: waterbody type (pond, stream, ditch, etc.); macrophyte category (monocot or dicot, floating or rooted, submerged or emergent); or of sampling method or growth metric used

# Results

- Individual growth periods were consolidated into a table of growth periods
- Dark grey = major growth, light grey = minor growth
- Different climate classifications are presented in different colours



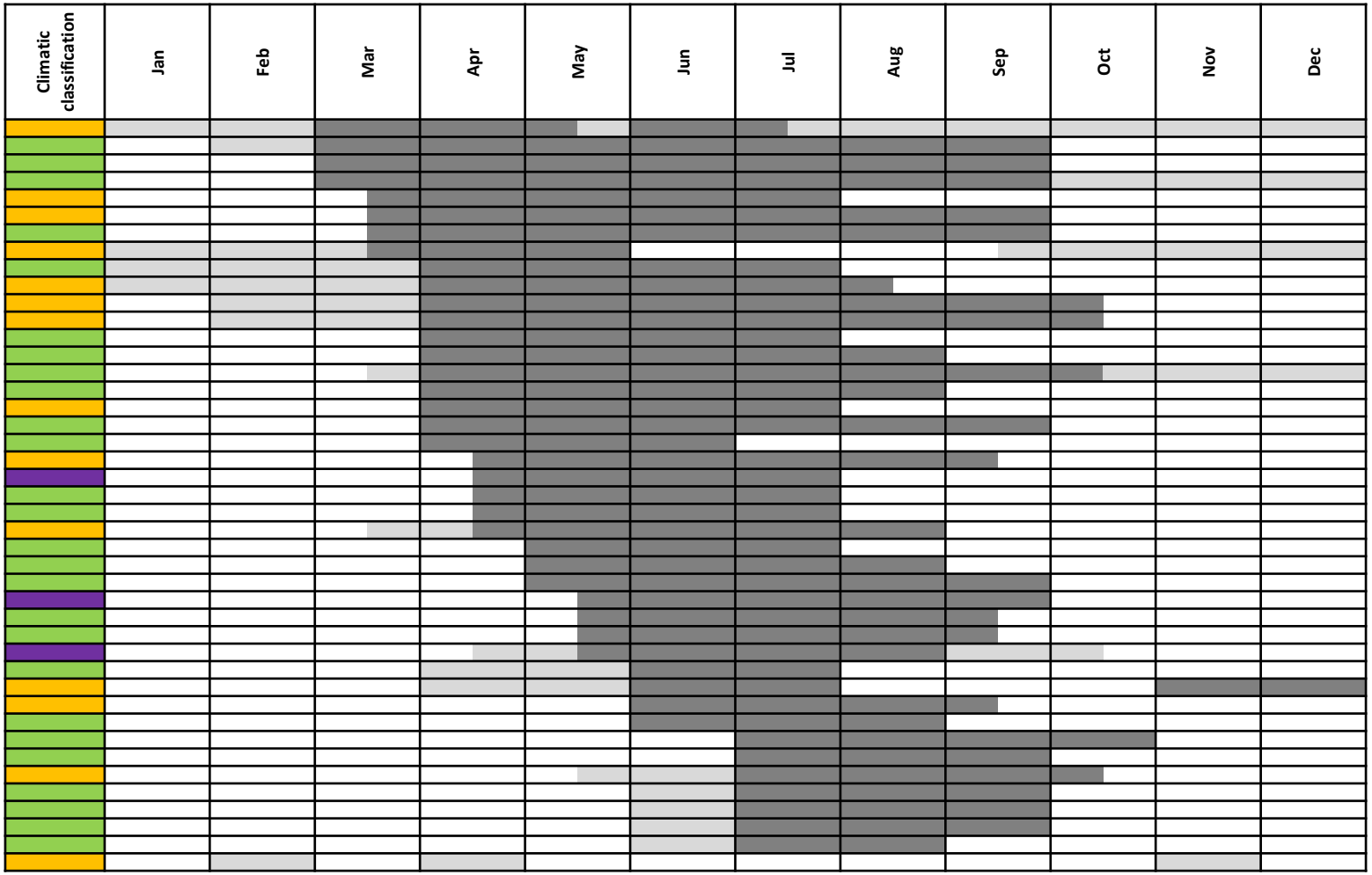
# Results

- Excerpt from consolidated results table:

| Data source | Reliability | Location | Waterbody type | Climatic classification | Relevant to CZ/NZ? | Species | Species occurs in CZ/NZ?* | Life-form type | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wetzel & Howe (1999) | 2 | Natural wetland. Alabama, USA | Wetland | Cfa | C | *Juncus effusus* | Yes | Emergent monocot | | | | | | | | | | | | |
| Dawson (1976) | 2 | Bere Stream, United Kingdom | Stream | Cfb | C & N | *Ranunculus penicillatus* var. *calcareus* | Yes | Emergent dicot | | | | | | | | | | | | |
| Shamsudin & Sleigh (1995) | 2 | River Itchen, United Kingdom | River | Cfb | C & N | *Ranunculus penicillatus* var. *calcareus* | Yes | Emergent dicot | | | | | | | | | | | | |
| Brux *et al* (1987) | 2 | Fen ditch, Brandgraben, Oldenburg, Germany | Ditch | Cfb | C & N | *Potamogeton alpinus* | Yes | Submerged monocot | | | | | | | | | | | | |
| Kunii & Maeda (1982) | 2 | Ojaga-ike pond, Japan | Pond | Cfa | C | *Trapa natans* | Yes | Floating leaved dicot | | | | | | | | | | | | |
| Kunii & Maeda (1982) | 2 | Ojaga-ike pond, Japan | Pond | Cfa | C | *Hydrilla verticillata* | Yes | Submerged monocot | | | | | | | | | | | | |
| Kelly *et al* (1983) | 2 | Gryde River, NW Jutland, Denmark | River | Cfb | C & N | Natural community | Yes | Various | | | | | | | | | | | | |
| Kunii & Maeda (1982) | 2 | Ojaga-ike pond, Japan | Pond | Cfa | C | *Potamogeton crispus* | Yes | Floating leaved monocot | | | | | | | | | | | | |
| Haury & Aïdara (1999) | 2 | River Scorff, France | River | Cfb | C & N | *Oenanthe crocata* | Yes | Emergent dicot | | | | | | | | | | | | |
| Kunii & Maeda (1982) | 2 | Ojaga-ike pond, Japan | Pond | Cfa | C | *Elodea nuttallii* | Yes | Submerged monocot | | | | | | | | | | | | |
| Kunii & Maeda (1982) | 2 | Ojaga-ike pond, Japan | Pond | Cfa | C | *Ceratophyllum demersum* | Yes | Submerged dicot | | | | | | | | | | | | |
| Kunii & Maeda (1982) | 2 | Ojaga-ike pond, Japan | Pond | Cfa | C | *Myriophyllum spicatum* | Yes | Submerged dicot | | | | | | | | | | | | |

# Results

- Simplified table of consolidated growth periods



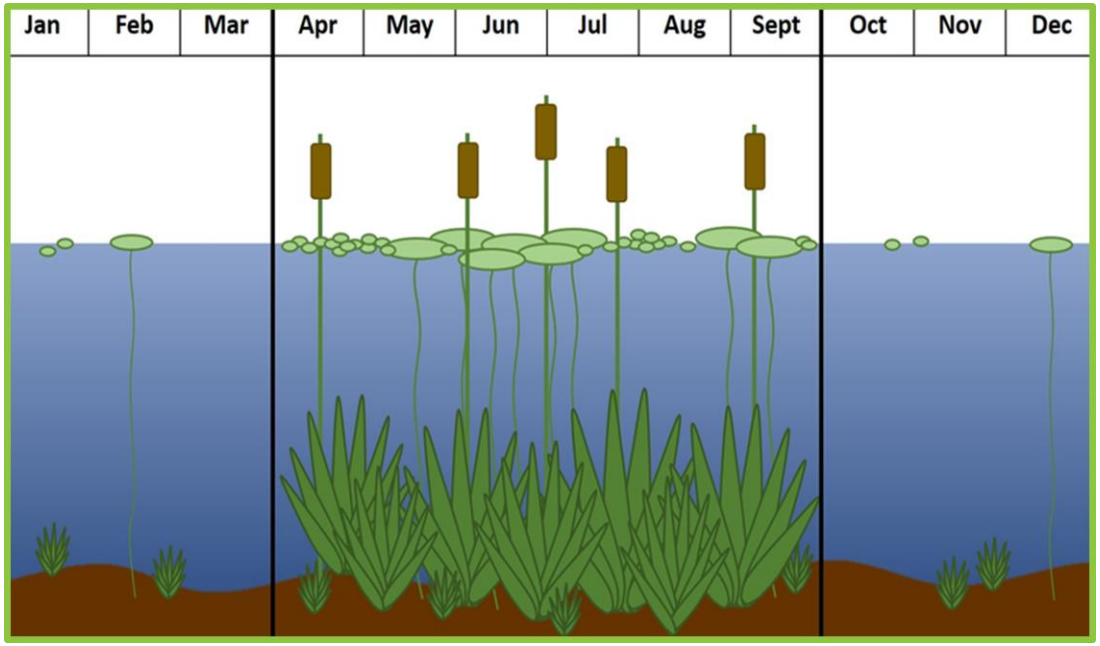
# Results

- The consolidated table of growth periods was visually assessed for the months where the majority of growth occurred, and overall conclusions were drawn
- The below table summarizes the % occurrence of no growth, slight growth, and significant growth across the year (% of growth periods of total 43 growth periods)

| Growth | Jan | Feb | Early Mar | Late Mar | Early Apr | Late Apr | Early May | Late May | Jun | Early Jul | Late Jul | Early Aug | Late Aug | Early Sept | Late Sept | Early Oct | Late Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| None | 91% | 81% | 79% | 67% | 47% | 35% | 30% | 21% | 9% | 7% | 7% | 30% | 33% | 47% | 53% | 79% | 88% | 86% | 88% |
| Slight | 9% | 19% | 12% | 14% | 9% | 9% | 7% | 9% | 12% | 0% | 2% | 2% | 2% | 5% | 7% | 9% | 9% | 12% | 9% |
| Sig. | 0% | 0% | 9% | 19% | 44% | 56% | 63% | 70% | 79% | 93% | 91% | 67% | 65% | 49% | 40% | 12% | 2% | 2% | 2% |

# Conclusions

- **Main growth period for most aquatic macrophytes begins in April**
- **Main growth period for most aquatic macrophytes ends in September**
- Conclusions are relevant for GB climates



# Regulatory implications

- For actives with a MoA on actively growing plants:
  - May be possible to conclude a low risk to macrophytes if application timing and predicted exposure is outside of active growth periods

# Acknowledgements

Thanks to Thomas Preuss for helping to co-author this work and to Bayer for funding the project.

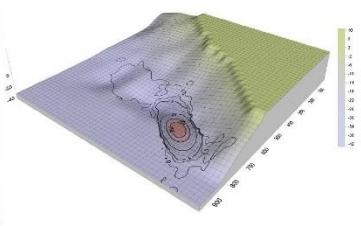
Thanks to Amy Brooks and Michael Hackett for reviewing and helping to co-author this work.

Thanks to Steve Brewer at Text Mining Solutions for delivering the literature search results.

# Any questions?

**Contact the author: helena.crosland@cea-res.co.uk**

**Find more information on our website:**
www.cea.adas.co.uk



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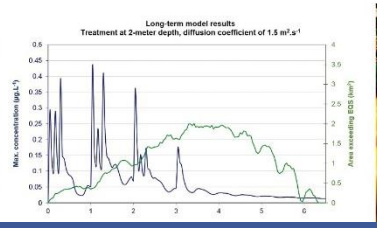
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