Floating wicker mats

- *Type: makes use of natural forces and biobuilders;*
- *Varieties used: Reeds (Phragmites australis), Bolboschoenus maritimus, Epilobium hirsutum, Iris pseudacorus. It may be possible to use equivalent varieties.*
- *Application: fresh waters with moderate flows. Dry periods are not an issue. For example: urban docks, sheltered sections of rivers. Highly brackish and salt waters will probably have an adverse effect on the preservation of the actual mats.*
- *Contributes to:*
  - Natura 2000 habitats [1]: 'Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation', 'Rivers with muddy banks with Chenopodion rubri pp and Bidention pp vegetation', 'Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation', upstream (brackish) section of 'Estuaries', 'Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels';
  - Natura 2000 species [2]: among others: fish, marsh birds, dragonflies, amphibians, mammals;
  - Water Framework Directive (WFD) [3]: transitional waters, rivers, lakes and canals;
  - Can contribute to the National Ecological Network as a stepping-stone or connecting zone.

The mats described in this fact sheet are made from woven wicker on which reeds or other varieties are planted, creating a floating marsh. To maintain the buoyancy of the mats, floats are integrated in the wicker.

The weight and stiffness of the floating wicker mats attenuate waves. The size of the mats and any attachment to the bed follow from the location-specific wave patterns and currents. Rolling waves are broken, protecting natural embankments and vegetation. The floating mats can also be used near hard dikes or embankments to prevent overtopping.

The floating marsh that develops on the mats is very appealing for birds and insects such as dragonflies and butterflies. A habitat is also created below the floating mats for fish that can take refuge between the roots.

Furthermore, the floating mats provide shelter in the direction of the banks in certain situations so that suspended sediment settles and water becomes clearer. This is good for the submerged aquatic flora, resulting in an aquatic vegetation zone.

It is possible that, in time, the floating mats will become redundant if the aquatic vegetation zone on the natural embankment can take over, providing protection and wave attenuation.

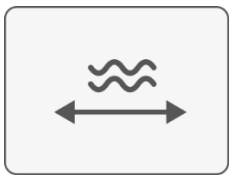
In the freshwater tidal area, floating mats used to be a natural feature. They consisted of plant flotsam that had been driven together. The resulting clumps, known locally in the Netherlands as 'veek' or 'deek' or, elsewhere, 'daak', and 'floating islands', 'tussocks', 'floatons', or 'suds' in English, move up and down with the water and are never submerged. Seeds and cuttings grow in them, creating a robust mass of roots. The older and denser the formation, the denser the vegetation. Sections of these floating islands can break off and float away and so they can act as nurseries and distribute plants in the freshwater tidal delta.

Finally, the vegetation that grows captures carbon dioxide in the biomass.

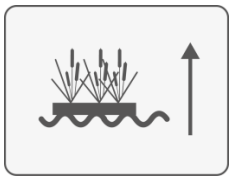
Specimen projects:

- *Floating reed marsh, Zeeburg Amsterdam*
- *Floating reed marsh, Houtribsluizen Markermeer* [4,5]

Spatial aspects



Minimum width 20 m



Shallowing effect

Variation in vegetation possible

Services[7, 8, 9]

Ecosystem services generate benefits if people can exploit the services and capitalise them.

Erosion control

Floating mats attenuate waves and can therefore prevent the erosion of tidal shoals and banks.

Cleaning

Improving water quality by enhancing clarity (if suspended matter is a difficulty in the current situation). Bankside vegetation improves the chemical water quality (through the uptake of nutrients).

Biodiversity

A suitable habitat is created for marsh vegetation. The different types of flora and fauna that will be attracted to the area closely match the varieties found in the marsh zone and on a natural embankment (see both fact sheets), helping to achieve the objectives of the WFD and Natura 2000. The introduction of floating structures at regular intervals alongside banks allows the bank to serve as a connecting zone for migrating species.

Water dynamic

Contribution to flood risk management through the creation of sheltered areas and wave attenuation.

Uptake of particulate matter

One hectare of reeds captures 10 kg of particulate matter a year. A natural embankment makes an indirect contribution through the vegetation to better air quality.

Carbon capture

Reed banks capture approximately 6.8 kg C per hectare a year. In that way, a reed bank can help to mitigate climate change.

Urban climate

Vegetation and water provide cooling and cleaner air. Marsh vegetation has a large surface area and it can improve local micro-climates. In addition, floating reed marshes have a constant supply of water and they can therefore contribute continuously to the cooling process.

Benefits and cost savings [7,8,9]

The ecosystem services referred to above generate benefits if people can exploit the services and capitalise them.

Leisure value

Creation of leisure facilities (water sports, angling, bird-spotting).

Aquaculture [6]

The floating structures can be used for reed cultivation. Commercially-managed reed marshes produce approximately 900 sheaves of reeds per hectare annually, generating income of approximately 2 euros per sheaf. When managed for nature-conservation purposes, marshes can produce 250 sheaves per hectare annually. Yields will depend upon harvesting options and will probably be lower than stated above because management is not as easy as with reed banks (since it involves more manual work and more fragmented areas).

More appealing habitats

Natural views improve residential quality and push up property values. The urban climate may improve, and this has a favourable impact on public health. Depending on the number of residents, this can become a major benefit.

Education

Children and adults come into contact with nature in the immediate vicinity.

Maintenance costs
This is an additional measure alongside the existing flood defence or embankment. Wave attenuation means that, in some locations, the dikes will not have to be raised and this saves on dike maintenance.

Natura 2000 and WFD measures
Marsh vegetation can help to achieve the objectives of Natura 2000 and WFD, eliminating the need for other measures.

Both costs and benefits are location-specific and difficult to extrapolate. Cost-benefit analyses will therefore have to be conducted for each individual location.

Implementation costs
(2012 prices)

Test in a wave flume
Willow mat measuring 20 x 5 metres tested for wave attenuation.
- Delivery and construction: EUR 6,500 including VAT;
- Planting with reed shoots: EUR 1,000 including VAT;
- Anchoring to the bed/embankment: EUR 11,000 including VAT;
- Total: EUR 18,500 = EUR 185/m ^{2}).

This cost estimate does not include measures that need to be taken to ensure public safety.

Management and maintenance
Management will mainly be water-based.
Regular monitoring, maintenance (waste removal, removing willow or poplar shoots etc.).

Monitoring is recommended after storms and high water.

Physical boundary conditions
Dynamic
Moderate flow and no dry periods. Most effective with short waves (the majority of waves generated by shipping) with a maximum height of 0.85 metres. Long waves may pass below the mats but a possible remedy is to extend the mats in the direction of the waves.

Anchoring the floating mats may be necessary when there is a current that can push away the mats, or when the wave load is too high. In the second case, the floating mats will attenuate waves better when they are anchored to the bed. The anchoring should take any major tidal differences into account.

Salinity
Fresh to moderately brackish water.

Potential sites
The most promising and effective locations are sheltered waters such as urban docks, canals without shipping, and waters and lakes branching off rivers. Floating mats are very useful indeed near river banks in deep waters where a natural embankment is difficult to create. They can provide greenery near a grey embankment without the deep water having to be filled in. Floating structures are not suitable for use on open rivers because of the flow. Better boundary conditions can be established in a river by, for example, building groynes. Floating mats can also probably be introduced between groynes. The impact of waves generated by shipping continues to be an area requiring attention.

1. *Janssen, J.A.M. and Schaminée, J.H.J. (2003) Habitattypen. Europese Natuur in Nederland. KNNV Uitgeverij, Utrecht.*
2. *Janssen, J.A.M. and Schaminée, J.H.J. (2004) Soorten. Europese Natuur in Nederland. KNNV Uitgeverij, Utrecht.*
3. *Siebelink B. (2005) Overzicht natuurlijke watertypen. Foundation for Applied Water Management Research (STOWA). STOWA report no: 2005-08.*
4. *http://www.innoverenmetwater.nl/upload/documents/Case%20Floating%20Marsh%20(wiki).pdf*
5. *Rijkswaterstaat IJsselmeergebied (2010) Pilotstudie drijvende rietmoeras Houtribsluizen. Authors: G. van Geest, G. Geerling and M.B. de Vries.*
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7. *Penning, E. and Van der Vat, M. (2007) Batenstudie KRW-WB21. Baten van natuurvriendelijke oevers. WL Delft Report.*
8. *Witteveen+Bos (2012) TEEB in de Stad, handleiding bij het rekeninstrument voor de baten van natuur en watermaatregelen. Rijkswaterstaat and 11 municipal authorities. Reference GD215-2-1/kiru/005.*
9. *Ruijgrok E.C.M. Kentallen waardering natuur, water, bodem en landschap; hulpmiddel bij MKBA´s. Ministry of Agriculture, Nature Management and Food Safety. GV706-1-1/ruie/1.*