Practical guide to reed beds

Restoration of reed beds

Sustainable establishment of cattail reed beds and other reed species – planting methods, protective measures against grazing, maintenance

Reeds for Life

LEBENDIGE RÖHRICHTE

Contents

Introduction

You can find a practical guide to coypu control here:

lebendige-roehrichte.de/service/downloads-offener-bereich

Initial plantings as a method – Restoration of reed beds

Reed beds are a characteristic feature of nutrient-rich still waters and oxbow lakes. Particularly tall-growing stands such as common reed and cattail reed beds perform key ecological functions: They stabilise shorelines and shallow water zones, bind sediments, reduce nutrient levels, improve water quality and provide valuable breeding, resting and feeding grounds for numerous animal species, some of which are protected. Their conservation is therefore essential for the ecological stability of these water bodies.

The Bienener Altrhein, together with the Millinger, Hurler and Empeler Meer, is one of the most significant oxbow lake systems along the Lower Rhine. Until the early 2000's, these waters featured extensive shallow areas with species-rich bankside and aquatic vegetation. Characteristic features included extensive floating-leaf zones and tall reed beds, in particular stands of narrow-leaved cattail, which had a significant impact on the landscape 1.

In the following years, however, the structure of the reed vegetation changed considerably. While low-growing communities such as pioneer reed beds with water mint and sedge stands remained largely stable, populations of tall reed beds declined sharply. Between 1995 and 2018, around 65% of these stands disappeared. The cattail reed beds were especially affected, having almost entirely vanished from large parts of the area 2.

The invasive coypu [Myocastor coypus] has been identified as the cause of the local disappearance of cattail reed beds. It feeds, among other things, on the growing points of cattails, preventing the plants from regrowing. Studies at the Bienener Altrhein have demonstrated a direct link between grazing by coypu and the disappearance of cattail reed beds (VOSSMEYER et al. 2016).

That is why the LIFE project "Reeds for LIFE – Lebendige Röhrichte" (2018–2026) was launched. The aim is to restore stable reed communities through a combination of measures including grazing-protected plantings, coypu control, dynamic water level management, clearing of woody vegetation and monitoring. In particular, the methodology for initial planting developed during the course of the project can be applied to similar restoration projects.

This practical guide summarises the experience gained with regard to initial plantings and offers practical advice and specific recommendations for the successful restoration of reed beds.

1 The cut-off meander of the river Rhine at Bienen in 1995, with extensive reed islands of narrow-leaved cattail, reed belts, and large areas covered with water lilies and pond lilies.

2 The cut-off meander of the river Rhine at Bienen in 2017. All of these valuable habitat elements are now absent.

Reed species

Overview of planted reed species – Ecology and practical experience

As part of the LIFE project, six species of reed were planted, with a focus on narrow-leaved cattail. Other species included broad-leaved cattail, common reed, reed sweet-grass, slender tufted-sedge and greater pond sedge. The overview provides information on the ecology, preferred water depths, water level dynamics, seed germination, flowering period, and the natural spontaneous occurrence of the species within the project, as well as their suitability for initial plantings and their vulnerability to coypu grazing.

Symbole

- plant height
- preferred water depth
- preferred water level dynamics
- flowering period
- development in the project
- vulnerability to coypu grazing

Narrow-leaved cattail [Typha angustifolia] 1

Perennial plant; colonises sandy to gravelly as well as muddy soils ranging from nutrient-poor to nutrient-rich conditions. A creeping pioneer of early succession in infilling zones, usually with short subterranean rhizomes. Stands develop significantly more slowly than those of broad-leaved cattail, but are then more persistent over many years. It often forms belt-like stands situated in front of common reed stands.

- 100–300 cm
- 1–100 cm
- Tolerates large water level fluctuations of up to 100 cm; stands remain stable even under persistently high water levels
- June–August
- Low natural spontaneous occurrence after 3–5 years; initial plantings are required. The species is well suited for planting
- very high vulnerability

Broad-leaved cattail [Typha latifolia] 2

Perennial plant; prefers nutrient-rich sites, often with a muddy substrate. A pioneer species of infilling zones with long creeping rhizomes; due to its high seed production, it can rapidly establish dense and extensive dominant stands on exposed mudflats.

- 100–250 cm
- 1–50 cm
- Prefers low water level dynamics and shallow water conditions; permanently high water levels above 50 cm weaken stands
- June–August
- High natural spontaneous occurrence on mudflats; initial plantings are usually not necessary if the area is free of coypu
- very high vulnerability

Common reed [Phragmites australis] 3

Perennial plant with extensively creeping below- and above-ground shoots (so-called stolons up to 500 cm long), enabling the formation of very large, highly competitive, and long-lived stands. Often found in pure stands in still or slow-flowing waters; it also colonises wet and waterlogged terrestrial areas.

200–300 cm

0–80 cm

Prolonged summer low-water periods promote its spread; consistently high water levels prevent it

July–September

High natural spread from the bank via stolons, which develop roots at the nodes, extending into exposed marginal areas and mudflats towards the water. Plantings in wind-exposed locations with wave action are not successful. Wind-protected, low-wave areas can be successfully planted if adequately protected against grazing by waterfowl

medium to low vulnerability

Reed sweet-grass [Glyceria maxima] 4

Perennial plant; a riparian grass of standing or slow-flowing waters. In water bodies with strongly fluctuating levels between mean and low water, it may replace common reed or occur in the drawdown zone in front of reed stands. It typically grows on nutrient-rich, usually muddy substrates. Constantly medium to high water levels lead to a decline or disappearance of stands.

80–200 cm

0–30 cm

Requires strongly fluctuating water levels ranging from moderate depths to periods of drying out; a typical species of the drawdown zone. Constantly medium to high water levels lead to a decline or disappearance of stands

July–August

Good natural dispersal under fluctuating and low water levels; die-back occurs at medium to high or permanently high water levels. Only of limited suitability for planting

medium to low vulnerability

Slender tufted-sedge [Carex acuta] 5

Perennial plant with subterranean rhizomes up to 30 cm long, sometimes also forming dense swards; found on nutrient-rich, groundwater-fed and seepage-wet sites, e.g. along banks and in infilling zones of floodplains. It only tolerates higher water levels and winter inundation to a limited extent.

- 40–100 cm
- 0–15 cm
- Tolerates fluctuating water levels ranging from low to complete drying out; high water levels or prolonged inundation weaken stands; winter inundation is partially tolerated
- May-June
- Low natural dispersal; plantings are highly site-dependent; only of limited suitability
- low vulnerability

Greater pond-sedge [Carex riparia] 6

Perennial plant with short subterranean rhizomes; found on wet and periodically submerged, nutrient-rich sites in the infilling zones of lakes and oxbow waters. It tolerates prolonged high water levels and winter inundation, can form dominant stands; is not readily eaten by many waterbirds.

- 60–150 cm
- 0–20 cm
- Tolerates fluctuating water levels from moderate depths to complete drying out; high water levels or prolonged flooding have a significantly less detrimental effect on the stands than on the slender tufted-sedge. tolerates winter inundation
- May-June
- Very slow natural dispersal, as stands are usually stable; well suited for planting
- low vulnerability

Planting material

Seed collection and propagation – Provenance, collection periods and methods

Provenance of the seed material

If seeds or plants can be collected in the immediate vicinity, these are best adapted to the site and are entirely suitable. However, as many reed species have a wide physiological range and grow under varying site conditions, it is also possible to collect seeds from further afield. After all, in nature, numerous reed species spread through the drift of seeds or vegetative parts carried by flowing water or by wind, allowing them to colonize new sites.

Because of vegetative propagation, many stands are largely genetically uniform. Seeds from other regions can therefore help to increase genetic diversity. At the same time, site-specific ecological adaptations must be taken into account. For example, aquatic common reed may represent a different ecotype from terrestrial common reed; this should be taken into account when selecting seed material.

Collection periods

The collection times of the individual reed species are species-specific (see table on the right). It is advisable to monitor seed maturity in the field at an early stage and plan the collection date accordingly, as climatic conditions can influence ripening. The collected seed material should be stored in a cool, dark place until it is transferred to a nursery for propagation. Envelopes or sample bags are suitable for collection.

Common name Scientific name	Narrow-leaved cattail [Typha angustifolia]	Broad-leaved cattail [Typha latifolia]	Common reed [Phragmites australis]	Reed sweet-grass [Glyceria maxima]	Slender tufted-sedge [Carex acuta]	Greater pond-sedge [Carex riparia]
Source material for autochthonous propagation	Seeds	Seeds	Seeds and shoots/blades	Seeds, rooted shoots	Seeds	rooted shoots (seed propagation unsuccessful)
Planting period	June–early August	June–early August	May–June	June–early August	June–early August	June–early August
Seed harvest time/collection time of source material	September–November	September–November	November–January	July–August	May–June	May–August
Cold-stratified germinators moist + cold conditions at 0–5 °C + time → germination ability	conducive	conducive	conducive, but not required	not required	conducive	may be conducive, but was not successful in the project (see above)
Lead time (from seed collection to plantable seedlings)	10–12 months	10–12 months	8–10 months	12–14 months	12–15 months	12–24 months (depending on the required number of plants)

Propagation by seeds or shoots

Most species can be collected and propagated via seeds. In the case of common reed, propagation is also possible from culms or by transplanting sods; however, the method must be decided on a site-specific basis. In the present case, propagation from seeds was successful. Only in the case of the greater pond-sedge, seed propagation failed despite several attempts.

Here, rooted individual plants or shoots were obtained and gradually propagated in the nursery through division, which-depending on the desired quantity—requires a lead time of up to two years.

Protective measures

Fencing as protection – Wildlife fence and gabion mesh fences

As part of the project, herbivory-protected initial plantings were carried out, for which two types of fencing were installed:

- → fencing constructed using wildlife fencing and untreated round timber posts 1
- → fencing constructed from 1.0 m² wire mesh panels commonly used in gabion structures 2

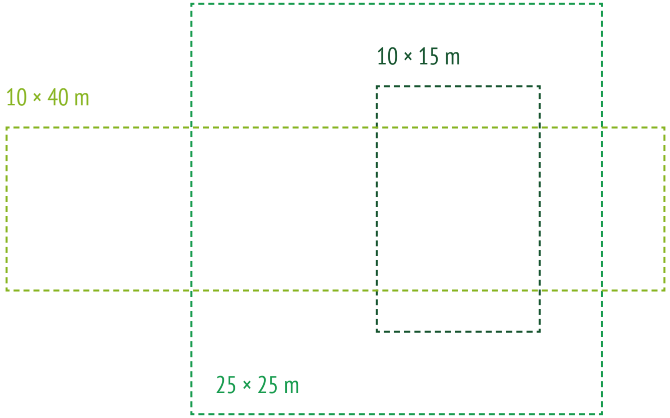
The use of two different methods was primarily due to cost considerations, as constructing all enclosures from gabion mesh panels would have been too expensive.

The following section describes the two types of fencing and compares their respective advantages and disadvantages.

Field installation of fencing –
Site selection and logistics

Preliminary survey

Field inspections were carried out using waders, or, where mud depth exceeded approximately 15 cm, neoprene boots and suits were mandatory, depending on water and air temperature conditions. Water and sediment depth were measured using a measuring stick, and a suitable location for the fencing was determined [3]. The decisive criterion is water depth, which in turn depends on the reed species to be planted.



The corner points of the fencing are marked with fence posts. It is recommended to select plot sizes in a way that fully utilises the length of the fence rolls (50 m), e.g. 25 × 25 m (2 fence rolls), 15 × 10 m (1 fence roll), or 40 × 10 m (2 fence rolls). When using mesh panels, greater flexibility is possible, as each panel measures exactly 1 × 1 m. For further details, see the adjacent sketch and the section “Plot design”, p. 16.

Material transport

After selecting the site and determining the size and shape of the fenced area, a shoreline access point should be chosen that allows for the shortest possible carrying distance for materials [4] or alternatively a location close to the water if materials can be transported to the working site via pontoons or construction tubs pushed across the water. It should also be ensured that damage to existing reed stands, which may need to be crossed, is kept to a minimum. In general, however, a roughly one-metre-wide path through the reed vegetation will fully regenerate within a single growing season.

Wildlife fence step by step –
Materials, construction and installation

Material selection

With a typical water depth of 60–80 cm, a wildlife fence made of galvanized steel wire with a height of 80 cm (80/17/15) was used 1. The fence is supplied in 50.0 m rolls and, to keep out coypu, ideally has a mesh size of 15 × 5 cm. However, this mesh size is often not readily available. A mesh size of 15 × 10 cm in combination with 15 × 5 cm at a fence height of 100 cm (100/15/15) is usually available and provides protection against larger coypu and geese.

Round posts made of untreated wood (i.e., not pressure-treated) measuring 150 cm in length and 6 cm or 8 cm in diameter were used as fence posts. In areas with very deep mud (> 50 cm), posts with a length of 180 cm were used instead.

Fitting round posts with hook-headed nails

For attaching the fence to the posts, hook nails (3 × 40 mm and 3 × 50 mm) were used. The aim was to secure the fence in a way that would allow easy removal after several years. Six hook nails were driven into each fence post: three with the opening facing upwards, spaced 5 cm from the top (2 and adjacent illustration), aligned with the mesh spacing; one approximately at mid-height of the fence with the opening facing upwards; and two at the lower end of the fence with the openings facing downwards, allowing the fence to be slightly tensioned 3. Before driving in the hook nails, you must first determine how deep the posts will be pushed or driven into the ground and how far the fence should extend above the water surface. Afterwards, depending on the position of the cross wires, it is recommended to make a template (out of cardboard or plastic) that can be used to mark the positions of the nails on the posts.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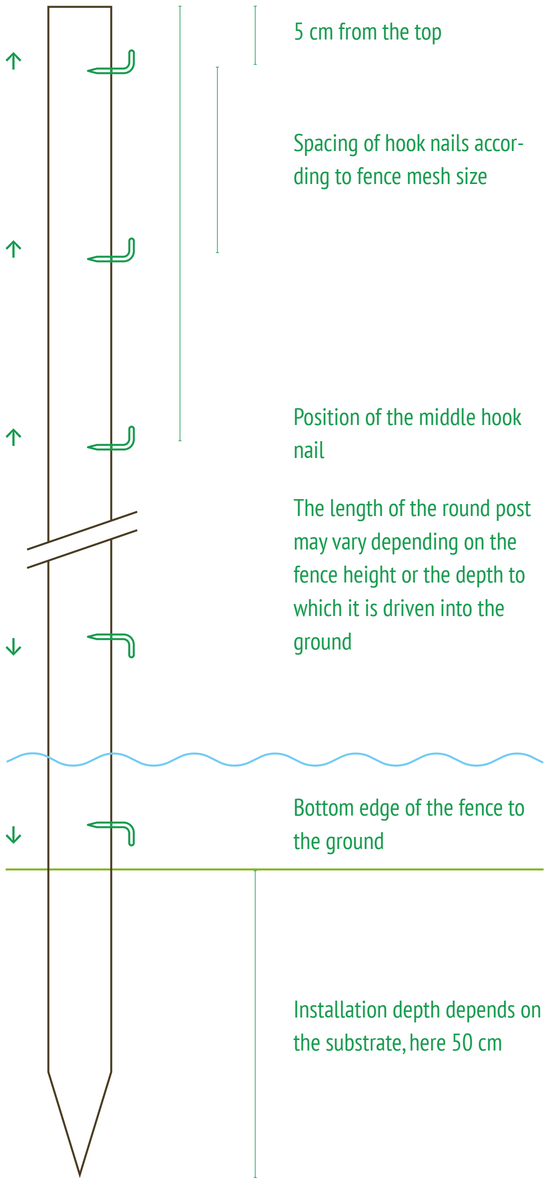


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Installing round posts

When setting the fence posts, care must be taken to ensure that the hook nails are positioned on the outside of the fence. As the Bienener Altrhein is characterised in most locations by a thick layer of mud ranging from 30 cm to over 100 cm, the fence posts were manually pressed approximately 50 cm into the sediment at intervals of about 1.3 m. In sandy areas, however, a ram had to be used to drive the posts into the ground 4.

Installing the fence

After the posts have been set, the roll of fencing should ideally be placed on a pole (broomstick, auger, or similar) by two people and unrolled from there as they walk 5. Two other people pick up the fencing and hook it onto the hook nails. Subsequently, the fence is additionally secured by one person using two cable ties on each fence post: on at the top and in the middle/ down to the bottom 6. The cable ties are 300.0 mm long and 2.5 mm or 4.0 mm thick. The fence should remain open at a point facing the shore so that the planting material can be brought into the area through this gap. Care was taken to ensure that the lowest wire of the fence ran about 5 cm above the mud in the open water to prevent penetration by root shoots in the event of successful reed establishment and development. This allows the fence to potentially be removed once a dense reed stand has developed.

Advantages

- ⊕ cost-effective
- ⊕ relatively quick to install
- ⊕ all possible configurations
- ⊕ can, if necessary, be left in place as it gradually decomposes
- ⊕ easy to install in soft, muddy substrates, as the fence posts can simply be pressed into the ground by hand

Disadvantages

- ⊖ material (fence posts) degrades over time due to decomposition
- ⊖ fence becomes permeable after approximately three years due to corrosion (rust)
- ⊖ not reusable
- ⊖ fence cannot be relocated
- ⊖ in case of ice cover on the water body, posts or the entire fence may be pulled out 7 8
- ⊖ in sandy substrates a ram is needed for installation of fence posts
- ⊖ the fence cannot be easily opened for maintenance activities (e.g. removal of willow seedlings)


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Gabion mesh fences in use –
Materials, construction and installation

Material selection

The wire mesh panels used measure 1.0 × 1.0 m with a mesh size of 5 × 5 cm 1. The wire diameter is Ø 4.5 mm (Galfan; Zn-Al wire with 3,000 hours salt spray test according to DIN 9227 NSS, a minimum coating thickness of 350 g/m², and a tensile strength of at least 450 N/mm²). The narrow mesh size provides effective protection against coypu of all sizes, muskrats, and all types of waterfowl.

Mesh panels with dimensions of 2.0 × 1.0 m can also be used 2. However, these are only suitable for sandy or gravelly substrates. In such conditions, they can be easily carried and installed despite their size and weight. They can also be removed after a few years with relatively little effort, at least if care is taken to ensure that roots do not grow through the lower section.
On muddy ground, however, 2.0 × 1.0 m mesh mats are unsuitable, as their size and weight make them very bulky and difficult to carry in the mud. Furthermore, they sink deeper into the mud, are more easily grown through by roots and can ultimately only be retrieved with great effort.

Construction of the fencing

Mostly rectangular or square enclosures of various sizes were erected; see also the section 'Area design', pp. 17–18 and 3. The four corner posts used to mark out the area beforehand are best connected with a pasture tape. Along these lines, the planting cages and wire mesh panels can then be installed.

To ensure high stability, cube-shaped planting cages are constructed from the mesh panels at the corners and then at intervals of 4.0 m; these are open at the bottom but closed at the top 1 and 3. Four mesh elements are then joined together, followed by the next planting cage. The wire mesh panels are connected using so-called spiral connectors 4. Only the lids of the planting cages are fixed on each side with two cable ties. The mesh elements are pressed only slightly (5 cm) into the mud, unless they have already sunk that far under their own weight. On sandy/firm ground, they are simply placed in position and are not pressed further into the ground.

Time schedule

For a team of four people, it is most efficient for two people to assemble the wire mesh panels while the other two deliver the materials. In an eight-person team, two separate installation teams and two delivery teams can be formed.
The construction of an enclosure measuring 26.0 × 26.0 m or approximately 100.0 m of fencing takes about 8 hours with a four-person team (including preparation, transport over a distance of approx. 2.0 km to the water body, and cleaning of all equipment).


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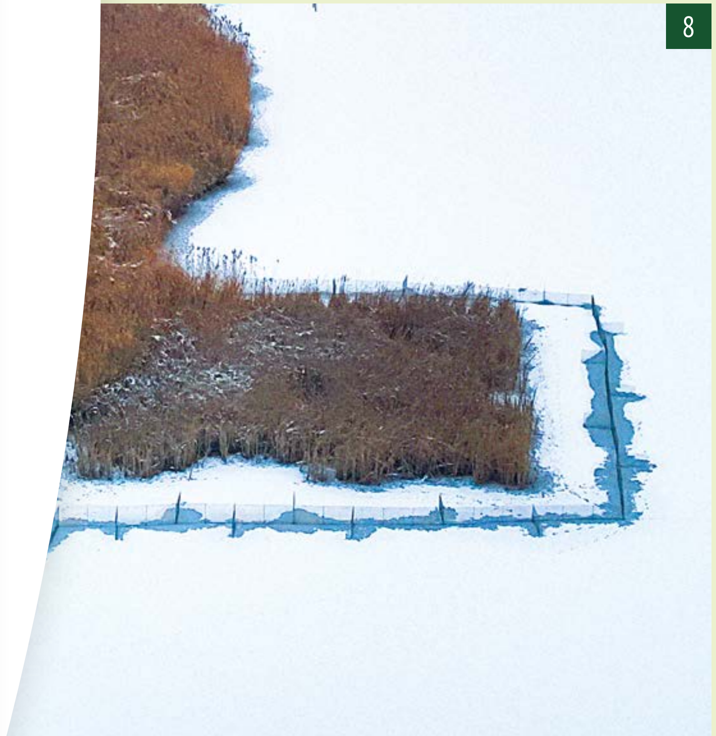

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Advantages

- modular, simple construction
- very durable and can be repeatedly dismantled and reassembled (service life of over 15 years) 5 6
- particularly easy to install on sandy substrates
- resistant in icy winters: when covered by ice and an ice layer generating buoyancy, they are not pulled out (unlike wildlife fences)
- optimal protection against feeding damage by coypu, muskrats, and waterfowl approaching from outside
- protection against burrowing large fish
- promotes increased sedimentation through water calming (3–5 cm per year), which can positively contribute to the formation of mudflats during low-water phases. This creates potential germination sites for natural reed expansion 7
- can be easily accessed at any time by removing individual spiral connectors (“door effect”)
- the elements can be easily shifted further outward once the planted reeds reach the fence, allowing for a gradual expansion of the reed bed area 8

Disadvantages

- wire mesh panels reduce water movement, leading to increased sedimentation (3–5 cm per year); as a result, in muddy substrates they may become embedded 20–30 cm deeper into the sediment/mud after a few years. Therefore, removal or relocation after no more than 4 years is recommended 7
- wire mesh panels can be grown through by the rhizomes of reed plants, which makes removal and reuse somewhat more difficult, as the rhizomes first have to be cut through with a spade
- high cost
- weight: one mesh panel weighs approx. 5 kg. For an enclosed area of 26.0 × 26.0 m with 8 internal additional cages, 220 mesh panels are required, resulting in a total transport weight of around 1.1 tonnes
- mesh panels have relatively sharp edges, which must be considered when using waders, as carrying the elements can cause damage to the waders. Neoprene suits or trousers are therefore preferable

Plantings


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From seedling to reed bed – Timing, plant size and water level

Timing of plantings

In general, planting is possible from late May/early June onwards, depending on the daily temperature and water level; see the table on p. 15. An earlier planting date in the year offers the advantage that reed species have more time for growth and for developing into a sufficiently tall, resilient plant. Both factors are crucial to ensure the plants survive their first winter, which is usually accompanied by higher water levels. Within just a few weeks after planting, the plants must reach a sufficient height that allows them to extend above the winter water levels; otherwise, they will die off.

Planting in May/June is often not possible, or only possible to a limited extent, particularly in protected areas, as it may conflict with bird conservation and can disturb breeding activities. Therefore, such measures should be restricted in time and space as far as possible, and the relevant nature conservation aspects must be carefully weighed against each other. Appropriate official exemption permits must be obtained well in advance of the start of planting activities.

Based on project experience, planting in May/June is mandatory only for common reed [Phragmites australis]. Plantings carried out in August were not successful for this species. All other species can also be planted in late July/early August after the breeding season (see table p. 15).

Plant height/size and pot diameter

The seedlings should be at least 50 cm tall at the time of planting. Ultimately, however, the required seedling height is determined by the water level during and after planting. With a water depth of 60 cm, they should extend at least 20 cm above the water surface in order to ensure sufficient photosynthetic activity and thus growth.

The plants were delivered in 24-cell plastic trays measuring 9 cm in diameter 1. These are reusable, so there was virtually no waste. The plants could simply be removed from the trays and then transported to the planting site using a wheelbarrow 2 and/or a construction tub 3 (90 l mortar tub).


1

Water level height

Water level is a crucial factor in reed bed planting. The different reed species have varying ecological requirements – including in terms of water depth; see table on p. 06. In general, low water levels proved to be optimal for planting and transporting the seedlings of all the reed species used, as, on the one hand, they can simply be pressed by hand into the substrate by hand – in our case, mostly muddy – and, on the other hand, a water level of approx. 10–20 cm allows the seedlings to be transported in the water using 90-litre construction tubs.These act as floating pontoons, eliminating the need to carry the seedlings laboriously to the planting site.

For species that tolerate higher water levels well, manual planting reaches its limits at water depths of around 50–60 cm, as arm length is no longer sufficient to press the plants into the mud. At higher water levels, an alternative method is recommended: planting seedlings using so-called BESE elements (Biodegradable Elements for Starting Ecosystems) 6.


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Planting in water –
Methods for all water depths

Manual planting at water depths of 0–50 cm (max. 60 cm)
The seedlings are delivered as close as possible to the selected planting site and are then carefully removed from the pots or 24-cell trays by gripping them at the base of the plant 1. They are transferred into 90 l construction tubs. Depending on the nature of the ground, these can be carried to the water's edge or transported by wheelbarrow 2. If planting in water, the tubs can be easily pushed along the water's surface to the planting site once the water is at least 10 cm deep 3. There, the seedlings are simply placed into the mud 4. If the substrate is sandy, a spade must be used 5. This is driven in to a depth of about 20 cm and then the handle is pressed forwards and backwards once, creating a wedge-shaped gap in the sand. The spade remains in place and you let the seedling slide into the gap along the surface of the spade, press it firmly, pull the spade out and close the gap slightly again. This method has proven particularly effective in conditions of high water turbidity, when there is no visibility of the bottom and work must essentially be carried out "blind."

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Manual planting at water depths from 50–60 cm (up to max. 100 cm) using BESE elements
In deeper water, the bottom can no longer be reached by hand. However, it is still possible to plant using so-called BESE elements (Biodegradable elements for starting ecosystems).

These are biodegradable elements for restoration projects, distributed by the Royal Netherlands Institute for Sea Research (BESE-PRODUCTS (O.D.)). The elements consist of a stackable 3D matrix made from potato waste and a starch-based biopolymer derived from it. Individual panel elements can be connected to form a grid. In this case, they were specially manufactured for the LIFE project with planting holes 7 cm in diameter. The seedlings were pressed into these, secured with skewers, and then submerged in the water and firmly pressed down with the foot 6–9.

The individual elements should ideally be assembled into a three-layer matrix in the field on a tarp, as small fragments may occasionally break off. However, it is not essential to build the matrix in three layers. Planting can also be carried out using single-layer elements, which saves both time and costs. According to the manufacturer's specifications, the mats biodegrade within 10–20 years.

Plant density and protection against birds – Strategies for large and small areas

Plant density

Depending on the size and shape of the area, different planting densities and methods are suitable. Small, elongated, narrow areas can be planted uniformly at a density of 3–5 seedlings per square metre 1. Large areas can also be planted across the entire surface if cost is not a limiting factor. Otherwise, it is advisable to plant only the edge area to a width of 1.0–2.0 m, using 5 seedlings per square metre; see also the section 'Area Design' on p. 17. In the case of wire mesh panels, it has also been observed in large areas planted only along the edges that the greatest planting success occurred within the enclosed cages, while other seedlings often disappeared after the first winter. In the following years, expansion typically started from the planted cages 2 3.

2

3

1

Protection against waterfowl

Large areas must be protected against the landing of waterfowl if they are water-covered and the water depth allows birds to swim and access the site. This can be achieved using pasture fence tape (white, 20–30 mm), which is stretched across the area in strips or in a zigzag pattern (see figure 7, p. 18).

Common name Scientific name	Narrow-leaved cattail [Typha angustifolia]	Broad-leaved cattail [Typha latifolia]	Common reed [Phragmites australis]	Reed sweet-grass [Glyceria maxima]	Slender tufted-sedge [Carex acuta]	Greater pond-sedge [Carex riparia]
Planting period	June–early August	June–early August	May–June	June–early August	June–early August	June–early August
Height of the seedlings	> 50 cm or at least > 20 cm higher than water level	> 50 cm or at least > 20 cm higher than water level	> 50 cm or at least > 20 cm higher than water level	> 50 cm or at least > 20 cm higher than water level	> 50 cm or at least > 20 cm higher than water level	> 50 cm or at least > 20 cm higher than water level
Recommended water level at the time of planting	0–60 cm	0–30 cm	0–50 cm	0–30 cm	0–15 cm	0–20 cm
Pot diameter of the seedling	9 cm	9 cm	9 cm/26 cm	9 cm	9 cm	9 cm
Planting method in muddy/ sandy substrate at water depths from 50–60 cm	Use of BESE-elements	Not suitable for this water depth	Use of BESE-elements	Not suitable for this water depth	Not suitable for this water depth	Not suitable for this water depth

Area design

1

2

Area shape and formation –
Costs, layout and expansion

Various designs were chosen for the fencing – the cost-benefit factor was a key consideration in this regard.

For wildlife fencing, elongated and narrow or smaller rectangular site configurations were often selected 1, as this type of fencing is significantly more cost-effective. However, long narrow areas or small rectangular plots require a relatively high amount of material for a comparatively small gain in reed habitat area. Square plots of 25.0 × 25.0 m were also established, as these can be fenced using 50.0 m rolls of fencing. Alternatively, rectangular plots of 10.0 × 15.0 m were used, as they can be enclosed with exactly one 50.0 m roll of fencing.

For enclosures made of wire mesh panels, a predominantly square configuration of 26.0 × 26.0 m was chosen, as such enclosures are relatively expensive and this layout provides an optimal ratio between material use and area size. In addition, for square or rectangular areas, the required material can be easily calculated in advance.

Areas measuring 26.0 × 26.0 m were established in accordance, as per p. 17 1, and planted with narrow-leaved cattail [Typha angustifolia], as this was the primary target species for the project: At each of the four corners, and subsequently at intervals of 4.0 m, cube-shaped, closed planting cages were constructed, providing complete protection of the seedlings against browsing and grazing. In between, four individual mesh panels were connected to form a 'fence', and then the next planting cage was placed, and so on.

Subsequently, only the perimeter area – that is, the outer metre or so, as per p. 17 1, was planted with 5 seedlings per square metre, in order to keep costs and labour to a minimum. The aim was for the reeds (in our case, mainly narrow-leaved cattails) to spread inwards from here into the protected area and, ideally, outwards as well, beyond the fencing.

In practice, it has become apparent that, even after the coypu had been removed from the area, the spread occurred only inwards. The grazing pressure from waterbirds – particularly geese – remained too high and prevented outward spread. Inwards, the rate of spread for narrow-leaved cattail was 1.0–3.0 m per year. A completely closed area was only achieved after approximately 6 years.

To accelerate the spread of vegetation across the entire fenced area, eight planting cages were placed in the area each year thereafter and planted, in accordance with the layout shown in Figure 1 on page 17, figure 1. In this way, the area became fully covered within 3 to 4 years.

With this arrangement, a closed stand of narrowleaf cattail can therefore be established approximately two years earlier.

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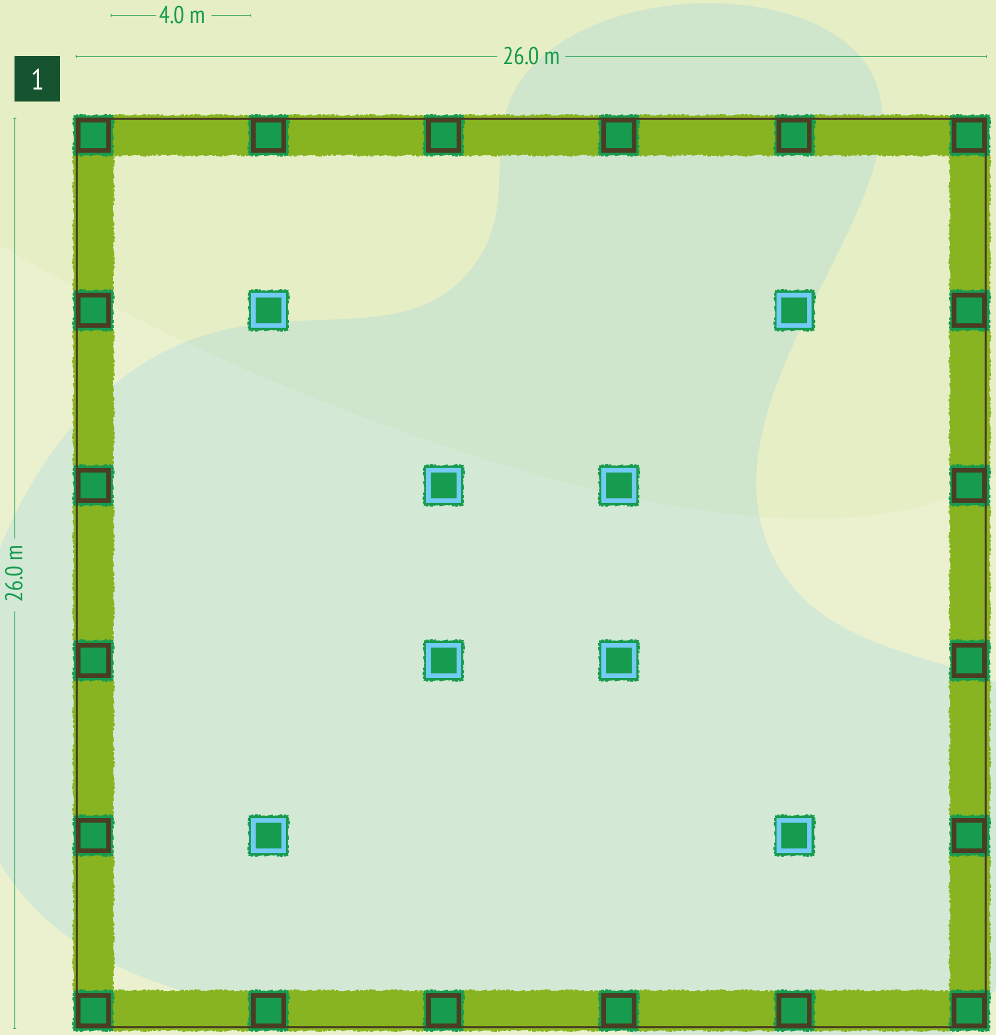

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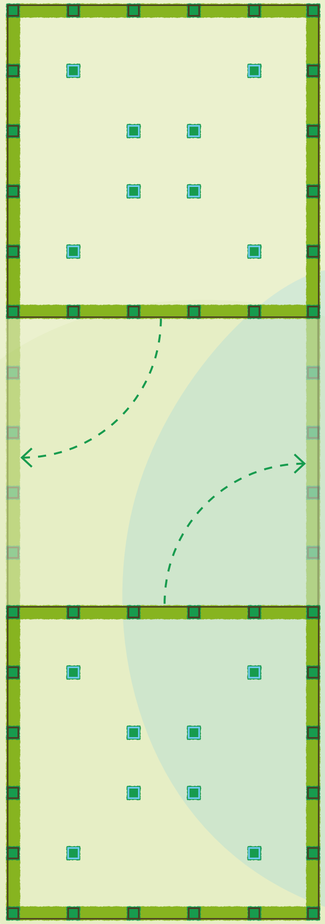


3

4

5

6

Symbols

- planting cage enclosure
- planting cage inside
- wire mesh panel enclosure
- seedlings along fence

Material (26.0 × 26.0 m)

220 pcs.	wire mesh panels 1.0 × 1.0 m
540 pcs.	1.0 m seedlings
224 pcs.	cable ties
172 pcs.	spirals

Combining and securing areas –
Expansion and protection against birds

Further savings in materials, costs, and labour can be achieved by simultaneously and parallel constructing two fenced areas of 26.0 × 26.0 m at a distance of 24.0 m apart 2. After a few years, once both areas are well vegetated, the two plots can be merged into a single area by opening the adjoining sides, creating an enclosed but initially unplanted space of 24.0 × 26.0 m between them. This central area can then either be planted as well or will, over time, be colonised by vegetation from the two adjacent reed beds 3–6.

It has become clear during the course of the project that large areas measuring 26.0 × 26.0 m or similar are not safe from waterfowl. Geese and ducks, in particular, tend to fly into these areas more frequently in the early stages and can cause considerable damage to the plants by feeding on them or even destroy the entire planting. Areas of this size must therefore be protected against waterfowl entering them. This can be done cost-effectively using white fencing tape (20–30 mm wide). The fencing tape can be stretched across the area in a zigzag pattern or, with the aid of individual wooden posts, in a crosswise configuration 7.

For any waterfowl that may still enter the area, a walkway board should be installed as a precautionary measure so that the birds can leave the site again 8.

7

8

Checkerboard pattern as a strategy –
Area size, planting and spread

A suitable plot size for plantings is a rectangle measuring 10.0 × 15.0 m, which is planted at an overall density of 3–5 seedlings/m^2. These rectangles can be enclosed either with wildlife fencing or wire mesh panels.

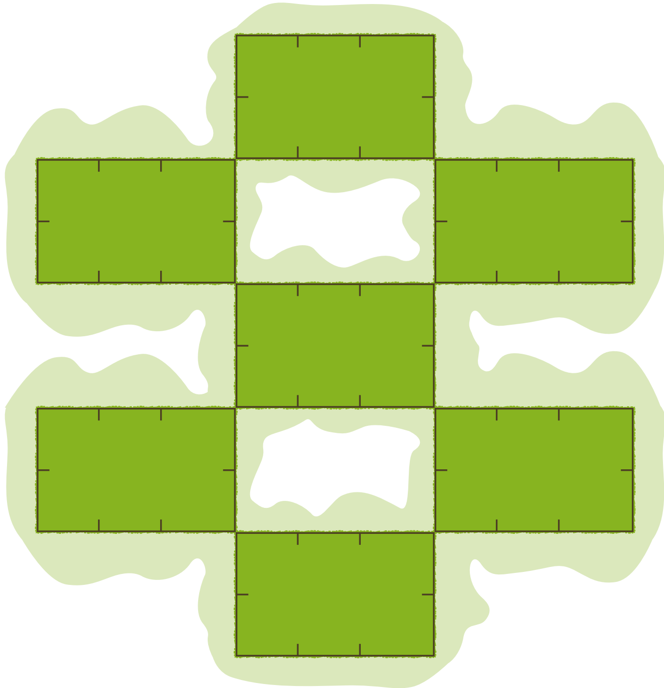
When using wire mesh panels for fencing, no planting cages need to be constructed anymore, which saves materials and costs and also facilitates dismantling or relocation of the enclosure. It is sufficient to install a wire mesh panel every 5.0 m at a 90° angle as a post 1.

If these areas are arranged in a checkerboard pattern and planted accordingly, fully enclosed but unplanted sections are created within the planting scheme. These areas can then gradually be colonised by the surrounding vegetation through natural spread.

1 Instead of erecting plant cages for stabilisation, with mesh fencing you can simply install a mesh panel every 3–5 metres at a 90° angle, either inwards or outwards, to act as a support. This saves both time and money.

Due to the small size of the individual areas and the surrounding newly established reed beds, they are unattractive to waterfowl, making it unlikely that geese in particular will land there. As a precaution, however, these areas can additionally be covered with pasture tape.

Experience has shown that plantings of this size develop a dense reed stand within a single growing season 2 3, provided they are planted uniformly between mid-June and early July. When constructed using wire mesh panels, the inner sections can already be removed in the following year and reinstalled at other locations.



Symbols

wire mesh panel fencing and panels positioned at a 90° angle

seedlings within the enclosure

1

Efficient planting of reed beds –
Material requirements and cost comparison

The following table compares the costs of a 10.0 × 15.0 m area (the basic unit for the checkerboard pattern described on the left) made of wildlife fencing or wire mesh panels with full-coverage planting. Wire mesh panels are preferable as they can be reused.

2 An area measuring 10.0 x 15.0 m, protected by a wildlife fence – fully planted with narrow-leaved cattail.

3 The same area a year later – the narrow-leaved cattail has taken over the entire area.

Materials required Wildlife fence	Piece	Price € (net) per Piece from	 to	Total price € (net) from	 to
Wildlife fencing 100/15/15, galvanised steel wire, 50 m roll / 2.45 mm / 1.9 mm	1	100,00	120,00	100,00	120,00
Wooden posts, 150.0 cm, round, pointed, untreated, 8.0 cm	34	3,00	4,00	102,00	136,00
Hook nails 3.0 × 50.0 mm	250	0,04	0,06	10,00	15,00
Cable tie, 360.0 × 4.8 mm, UV-resistant	100	0,03	0,05	3,00	5,00
Total cost of fencing (net)				**202,00**	**256,00**
Seedlings	750	1,00	1,20	750,00	900,00
Total cost of fencing and planting (net)				**952,00**	**1.156,00**

Materials required Wire mesh panel fencing	Piece	Price € (net) per Piece from	 to	Total price € (net) from	 to
Wire mesh panels 1.0 × 1.0 m (mesh size 5 cm)	56	20,00	25,00	1.120,00	1.400,00
Spirals	48	1,50	2,00	72,00	96,00
Total cost of fencing (net)				**1.192,00**	**1.496,00**
Seedlings	750	1,00	1,20	750,00	900,00
Total cost of fencing and planting (net)				**1.942,00**	**2.396,00**


2


3

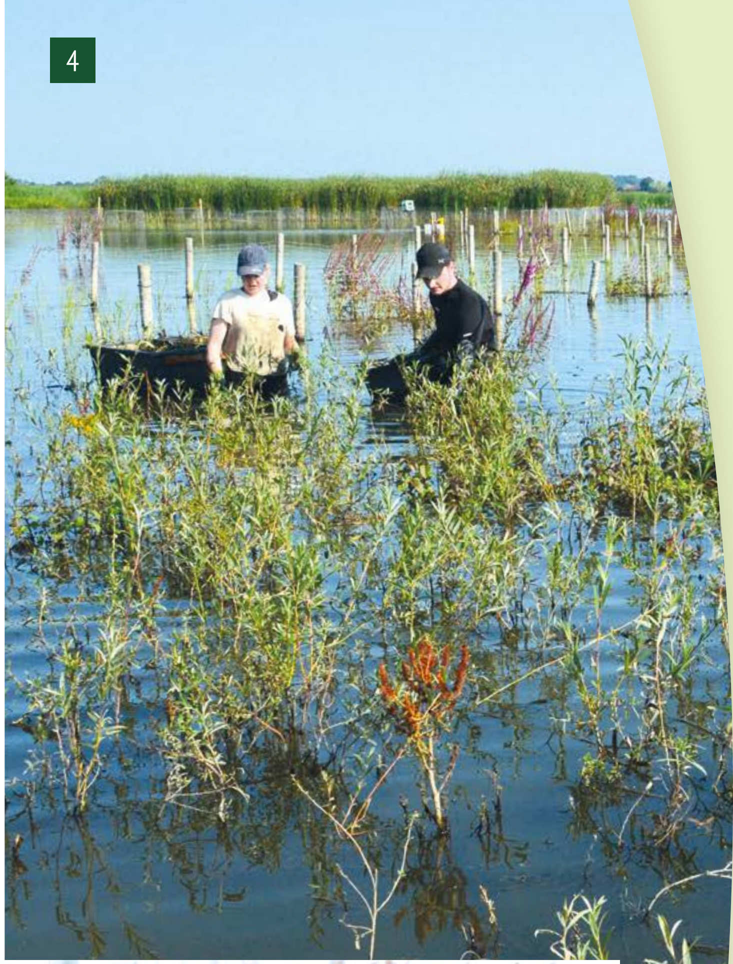
Maintenance of plantings

1 Thousands of willows can sprout in the plantations if they dry out.

2 Small willows can be easily pulled out by hand, including their roots.

3 In autumn, millions of willow shoots can be cut down using a standard grass mower.

4 If willows are not uprooted and extend above the water surface in the following year, they will continue to grow – at the latest at this point they must be removed, otherwise a dense willow thicket will develop.


4

Keeping willow growth under control – Monitoring and removal in the plantings

The plantings should be monitored regularly in the following years for the presence of willows [Salix spp.]. In many cases, young willows begin to establish already in the first year 1. To prevent them from quickly gaining height and potentially transforming the planting into a willow thicket, they should be removed as early as possible (i.e. uprooted with the root system). Clearing prevents regrowth. In principle, small willows up to 1.0 m in height can be easily pulled out by hand 2. Even larger willows up to 3.0 m in height can still be removed manually, although a spade may sometimes be required.

If the water around the plantings falls dry and mudflats emerge, it is possible that thousands of willows may sprout. To prevent this from developing into a willow riparian forest or thicket, the willows can be cut back in late autumn using a lawnmower 3 or brush cutter, depending on their size. It is important that the willows are cut back to a height of 5–15 cm. If the area is flooded again in winter and the following spring to a level where the willows remain fully submerged, they will die off. Willows that extend above the water surface will continue to grow and must then be removed by hand as soon as possible 4.


1


2


3

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Project management

NATURSCHUTZ ZENTRUM im Kreis Kleve e.V.

Project funding

Life

NATURA 2000

Ministerium für Umwelt,
Naturschutz und Verkehr
des Landes Nordrhein-Westfalen

Further funding

Kreis Kleve ... mehr als niederrhein

Deichverband Bislich-Landesgrenze

Stöckmann-Stiftung

alosa STIFTUNG

Imprint

Publisher

Publisher	Naturschutzzentrum im Kreis Kleve e.V. Niederstraße 3 D-46459 Rees-Bienen Tel. 0049 28 51 / 96 33-0 info@nz-kleve.de
Author	Achim Vossmeyer
Project	Reeds for LIFE – Lebendige Röhrichte www.lebendige-roehrichte.de
Photos	Naturschutzzentrum im Kreis Kleve e.V.
Layout/Design	Dipl.-Des. Martin Knops, Rüstwerk Designbüro www.ruestwerk.com
Print	Hansa-Druckerei & Verlag OHG, Grevenbroich climate-neutrally printed on recycled paper (FSC)

This guide for the EU project "Reeds for LIFE – Lebendige Röhrichte" (LIFE17 NAT/DE/000460) was funded by the European Union's LIFE financial instrument. However, the views and opinions expressed are solely those of the authors and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the funding body can be held liable for them.