Experimental Manipulation of Water Table and Grazing Pressure as a Tool for Developing and Maintaining Habitat Diversity for Waterbirds

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Experimental manipulation of water table and grazing pressure as a tool for developing and maintaining habitat diversity for waterbirds

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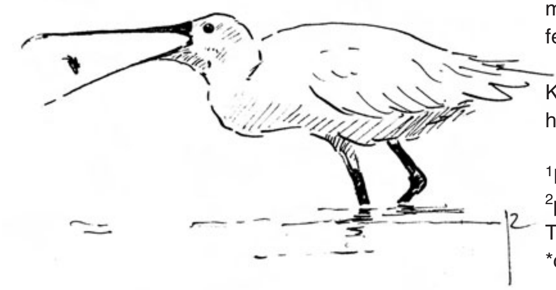
The relationship between reed *Phragmites australis* cover of ditches and habitat use by marshland birds was studied in an experimental area of the Oostvaardersplassen nature reserve in The Netherlands. Water table and grazing by cattle and horses had an important impact on the development of *P. australis* in ditches and pools, resulting in three different types of habitat: deep open water, shallow open water and shallow water with *P. australis* vegetation. Shallow water bodies with a reed cover of less than 10% were most frequently visited by foraging Eurasian Spoonbill *Platalea leucorodia*, Smew *Mergellus albellus*, herons, ducks, waders and rails. Breeding grebes and marshland passerines, however, preferred parts with more reed cover. It is concluded that the creation of shallow water bodies, together with adjusted water table management and grazing pressure are suitable tools for restoring habitats preferred by marshland birds.

Key words: marsh birds, *Phragmites australis*, reed cover, water table regimes, habitat restoration



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Phragmites australis is often a major component of the vegetation of freshwater marshes in temperate regions (e.g. den Hartog *et al.* 1989). The balance between expansion and retreat of *P. australis* is strongly related to hydrological conditions (e.g. den Hartog *et al.* 1989, Ostendorp 1989, Vulink & van Eerden 1998), but *P. australis* vegetation is also greatly affected by vertebrate herbivores such as Muskrat *Ondatra zibethicus* (van der Valk & Davies 1978), Coypu *Myocastor coypus*, waterfowl (Boorman & Fuller 1981) and geese (Kvêt & Hudec 1971, van Eerden *et al.* 1997).

One of the functions of *P. australis* in freshwater marshes and shoreline vegetation is to protect against shoreline erosion by diminishing wave impact (Coops *et al.* 1996). Many species of marsh birds nest in extensive *P. australis* stands (Hudec & Šťastný 1978, Graveland & Coops 1997), or find sufficient shelter and food there during moulting (van Eerden *et al.* 1997). Regrettably, *P. australis* stands have declined in most western and central European countries (den Hartog *et al.* 1989, Ostendorp 1989, van der Putten 1997, Brix 1999) with negative effects on wildlife, e.g. loss of habitats for marshland birds (Graveland & Coops 1997).

We asked to what extent water table variation and grazing by livestock could act as substitutes for ecological processes in freshwater marshes and could be used as management techniques in the restoration of habitats of marsh birds. Although the impact of grazing by livestock on habitat use by waterbirds has been examined in several studies (Larsson 1969, Soikkeli & Salo 1979, Holechek *et al.* 1982, van Wieren 1991, Duncan 1992), there is little information on the combined effects of grazing and water table management on vegetation structure and habitats for marshland birds (e.g. Duncan & d'Herbès 1982, Vulink & van Eerden 1998). We therefore set up an experimental area in the Oostvaardersplassen nature reserve, The Netherlands, to study the integrated effects of water table regimes

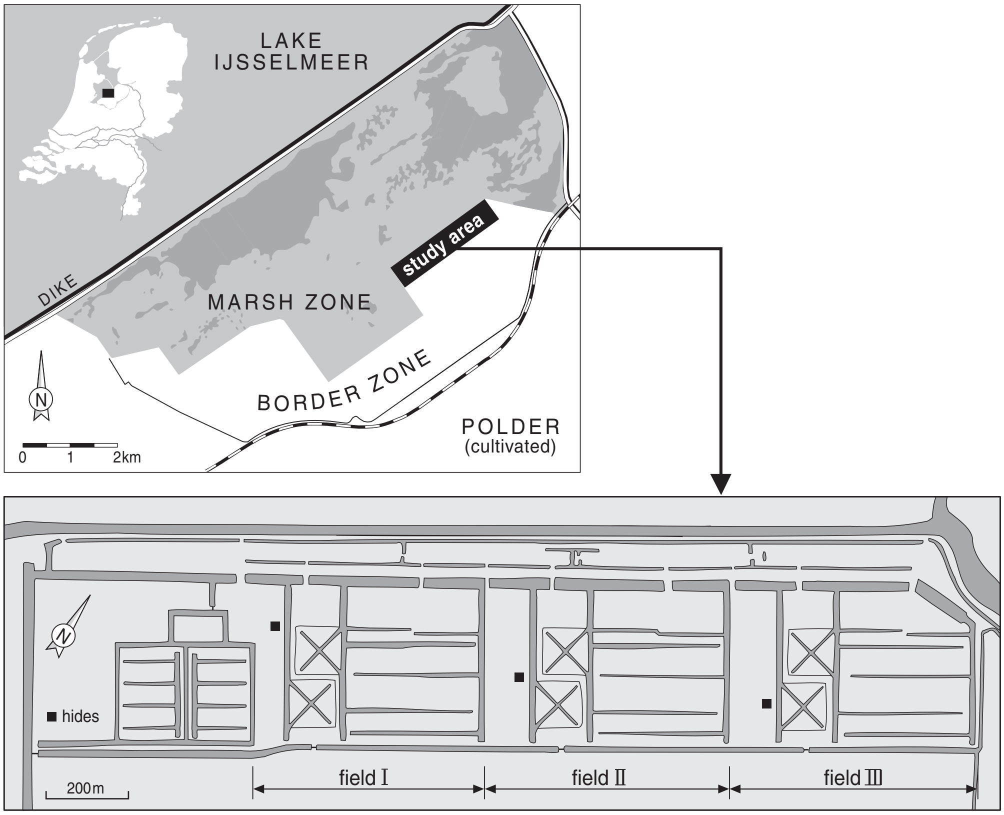

Figure 1. A general view of the study area in the Oostvaardersplassen nature reserve.

and grazing by cattle and horses on *P. australis* vegetation in shallow ditches. Our aim was to derive practical management guidelines that could later be used in the nature reserve. The study investigated: (1) the impact of different water table regimes and grazing on the development of *P. australis* in shallow ditches; (2) the use made by foraging and breeding marsh birds of vegetation types differing in reed cover. The results are discussed in relation to the ecological restoration of habitats for marshland birds.

METHODS

Study area

The Oostvaardersplassen nature reserve (52°26'N, 5°19'E) consists of a 3600 ha *P. australis* marsh, which developed in the late 1970s and early 1980s in the low-lying parts of Zuidelijk Flevoland, a polder (about 4.5 m below sea level) reclaimed from lake IJsselmeer in 1968. Since that time, a diverse avian wildlife community has spontaneously developed, with large numbers of breeding bird species such as Eurasian Spoonbill *Platalea leucorodia*, Great Egret *Casmerodius alba*, Great Bittern *Botaurus stellaris* and Bearded Reedling *Panurus biarmicus*. Between 1985 and 1995 23 species (breeding and non-breeding) were regularly found in numbers exceeding 1% of the flyway population (M.R. van Eerden, unpubl. data).

In the early 1980s, a well-drained zone (border zone; 1900 ha) was added to the nature reserve. About 900 ha had already been converted to arable fields. Part of this area was used to carry out the experiment to study the effects of water table and grazing by livestock on the feeding habitats of piscivorous marsh birds such as Eurasian Spoonbill and Great Egret.

The uniformly flat 50-ha study area, which had homogeneous soil characteristics, was divided into three fields of the same shape and area (fields I, II, III; Fig. 1). Within each field, five types of ditches and one type of pool were dug in duplicate. The ditches differed in slope, depth and width. The depth of the water in the ditches and the pool ranged from 0 m to 2 m, depending on the water table regime. The pools had slightly sloping sides and were wider than most of the ditches. For a detailed description of the characteristics of the ditches and pools, see Voslamber (1996). As is general practise in the Netherlands, the hydrology of the area was carefully controlled. Each field had its own water table regime (Fig. 2). In field I the water table was raised 20 cm above mean winter level in early summer. In field II the water table was kept constant throughout the year. A more or less 'natural' water level was mimicked in field III: large areas became inundated during the winter months, and some of the ditches fell dry during summer. The water table was regulated by means of a float-valve mechanism and let-down hoses. The total 50 ha consisted of *c.*10 ha of open water and *c.* 40 ha of unfertilised sown grassland. The study area was grazed annually by cattle and horses from May to November at a stocking rate ranging of 0.9–1.7 animals/ha. No mechanical ditch cleaning took place.

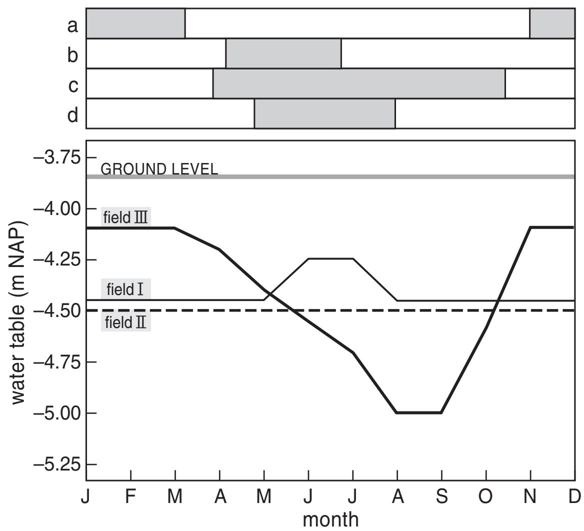

Figure 2. Water table throughout the year in the three fields of the study area. Note that field level is the height of the ground surface in the area relative to Dutch Ordnance Level (NAP). The shaded horizontal bars on top of the figure give an indication of the periods in which the most important piscivorous birds were present in the study area: a = Smew, b = Great Crested Grebe, c = Grey Heron and Little Grebe, and d = Eurasian Spoonbill and Great Egret.

Development of *Phragmites australis*

The development of reed cover in the pools and ditches of the three study fields was estimated from aerial photographs taken each summer from 1987 to 1992. The photos were ground truthed by estimating reed cover in quadrats of 2×2 m^2. The figures for reed vegetation cover presented in this paper are expressed as a percentage of the total ditch and pool area (c. 10 ha). In order to study the effects of grazing on vegetation in more detail, exclosures (5×30 m^2) were built across the ditches, with their long axes perpendicular to the ditches, in spring 1992. They were located in such a way that at the time of construction reed height and reed cover were identical inside and outside the exclosures.

On the basis of another study in the Oostvaardersplassen (Huijser *et al.* 1996), which had demonstrated a significant positive relationship between reed cover and reed height, we used reed height as an indicator of reed cover. The reed height was measured inside and outside the exclosures once a year, during autumn. This was done in strips of about 0.5×20 m^2 perpendicular to the ditches.

Food supply of piscivorous marsh birds

Fish proved to be the main food source for the birds observed in the study area (Voslamber 1996). Fish density was determined by sampling with a scrape net at night in the shallower parts of the ditches to get an impression of the relative distribution of fish over the different ditches. The net, which had a mesh gauge of 0.5 cm, was swept through the water with a rapid movement, sampling a surface area of approximately 1 m^2. Over the years 1987 to 1992, we sampled at least twice each month from April to September. During winter sampling took place at a lower frequency.

Distribution of marsh birds

Between March and September of 1987 to 1992 bird counts were made at least once a week from one of three hides placed strategically on the border of the fields (Fig. 1). In the months October until February of 1990 to 1992 counting took place at least once a month. As most attention was focused on feeding habitats of Eurasian Spoonbills and Great Egrets, these birds were recorded every minute during an observation day. Other piscivorous birds, such as Grey Heron *Ardea cinerea*, Great Crested Grebe *Podiceps cristatus*, Little Grebe *Tachybaptus ruficollis* and Smew *Mergellus albellus*, were recorded every quarter of an hour. Bird visits were expressed as bird-hours or bird-days per year. The number of bird-hours or bird-days was calculated for each interval between consecutive counts as the average of these two counts multiplied by the interval length in hours or days. Data of only two winters (1990/91 and 1991/92) were available for Smew. Because of the differences in observation intensity, the visits to the ditches in the three fields are presented in this paper as a percentage of the total observed visits over the two winters.

Other birds, such as ducks and passerines, were counted per ditch type per field during each observation day. The numbers of bird-days per year were estimated by interpolation from these counts. The number of breeding pairs of the grebes was determined by means of the SOVON-BMP method (Hustings *et al.* 1985). Passerines and breeding birds were counted by observers walking along ditches. The species were grouped: see Appendix 1.

RESULTS

Development of *Phragmites australis*

The reed cover in the three study fields was almost identical at the start of the experiment (Fig. 3). During the experiment it increased in field I (raised water table during summer) and II (constant water table year-round). In the field with a more or less 'natural' water level (field III), the reed cover remained low throughout the entire period. Here, *P. australis* only developed in deeper parts of ditches.

Differences in reed cover between the three fields were mainly the result of variation in grazing pressure caused by the differences in water table regime. In the field with a high water table in summer (field I), the water level was too high for *P. australis* to be grazed during the growing season. In the field with a constant water table (field II), some of the *P. australis* vegetation was in water too deep for grazing cattle. Finally, in the field with a low water table during summer (field III), *P. australis* could be grazed throughout the entire growing season. When the water table in this field rose in autumn, the water reached the stubble of the grazed *P. australis*, which was subsequently trampled by the cattle, causing *P. australis* to rot from the inside (van Deursen & Drost 1990, Duncan 1992). As a result, the reed cover in this field remained low throughout the study period. In all three fields *P. australis* did not develop in the deeper parts (deeper than 0.6 m) of the pools and ditches because the water was to deep for reed growth, but all parts with water between 0.3 and 0.5 m deep were completely overgrown with *P. australis*.

The exclosure experiments showed that, on average, the effects of grazing on *P. australis* vegetation were the same in all the ditch types studied within one field. Reed height in the fields with constant and high summer water tables (fields I and II) was higher inside the exclosure (ungrazed) than outside (grazed) (Fig. 4A and B). The main effect was visible along the borders (between 1 and 2 m from the centre of the ditch) where reed height in the exclosure could be up to 2 m higher than in the grazed situation. The effect of grazing was most extreme in field III (low summer water table; Fig. 4C). In the grazed situation, almost all *P. australis* was grazed. Once the exclosure was put in place and grazing ceased, the *P. australis* vegetation recovered and after three years was, on average, the same height as in the other fields. The difference in vegetation height between the grazed and the ungrazed areas was over 2 m.

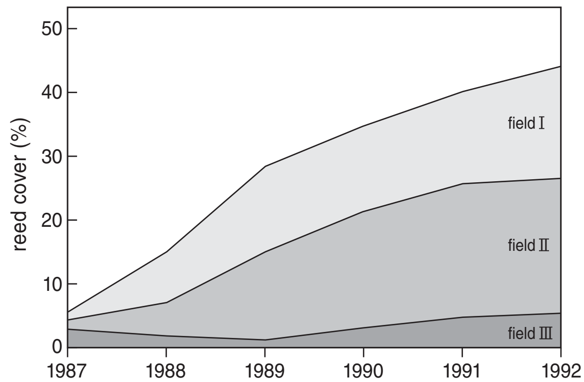

Figure 3. Development of the reed cover, as a percentage of the total area of pools and ditches, in the three fields of the study area over the years 1987–92.

Food supply of piscivorous marsh birds

The main fish species in the study area were Three-spined Stickleback *Gasterosteus aculeatus* and Ten-spined Stickle-back *Pungitius pungitius*. There were no differences in total fish densities between the fields (ANOVA: $F = 1.59$, $P = 0.205$), although there were large differences between years.

Table 1. Distribution (%) of foraging piscivorous birds over three study fields (1987–1991; for Smew 1990/91–1991/92). *n* is the number of hours (hour) or observations (obs.) on which the percentages are based.

Species	Field I	Field II	Field III	*n*	
wading birds					
Eurasian Spoonbill	17	14	69	2166	hour
Great Egret	26	26	49	1806	hour
Grey Heron	14	14	73	7527	hour
diving birds					
Great Crested Grebe	30	39	31	353	obs.
Little Grebe	47	44	8	407	obs.
Smew	2	21	77	1079	hour

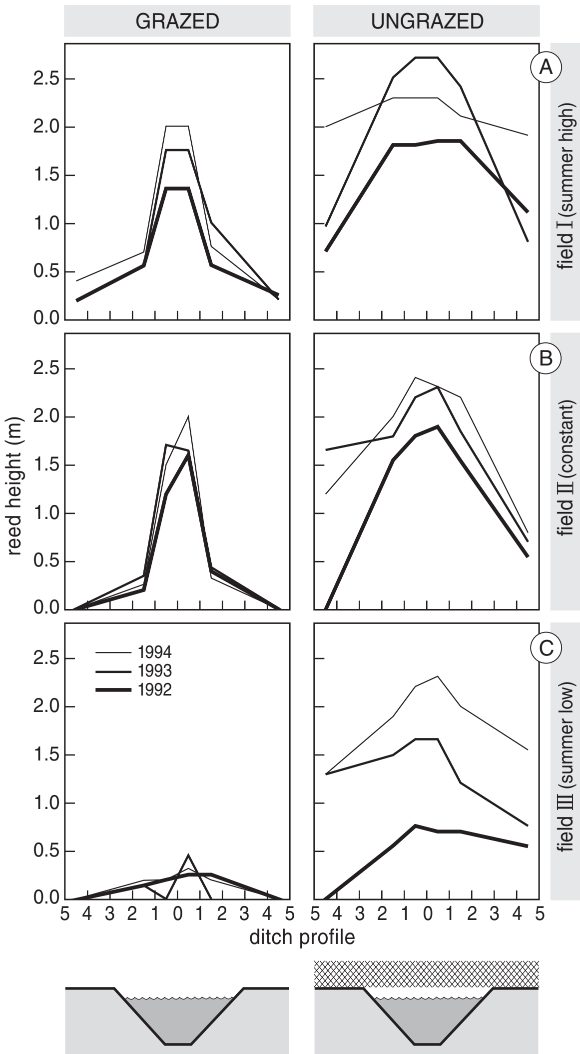

Figure 4. Development of average reed height inside (ungrazed) and outside (grazed) the exclosures in one of the ditches in the three fields of the study area over the years 1992–94.

Given that the food supply did not differ between the different fields, other factors may have mainly affected field selection by piscivorous marsh birds. These factors, such as the accessibility of food and availability of breeding sites, are likely be related to reed cover. Reed cover probably was a major factor in field selection by non-piscivorous marsh birds as well.

Distribution of marsh birds

Foraging piscivorous wading species, such as Eurasian Spoonbill, Great Egret and Grey Heron, were mostly observed in field III (Table 1), the one with a high water table during winter and a low water table during summer, and consequently a low reed cover. The two other fields were frequented more often by Great Egret than by the two other species.

Breeding pairs of Great Crested Grebe (81% of 21 pairs) and Little Grebe (92% of 27 pairs) were most often found in parts with abundant *P. australis* vegetation, which occurred in fields with a constant water table (field I) or a high summer water table (field II). Foraging individuals of these species were also mainly found in these two fields, although a great number of Great Crested Grebes also fed in the field with a low water level during summer (field III) (Table 1). Smew, which were present in the study area during winter, were almost exclusively seen in field III, which had a relatively high water table during that time of the year.

Reed cover proved to be an important factor in habitat selection by marshland birds. Visits of piscivorous wading birds, such as Eurasian Spoonbill, Grey Heron and Great Egret, to a ditch or pool correlated negatively with reed cover (Fig. 5A–B). The bird-days of rails, waders and dabbling ducks and the percentage of visits of Smew declined in relation to an increase in reed cover (Fig. 5C–E) in more or less the same way as was found for Eurasian Spoonbill and Grey Heron. Numbers of breeding pairs of grebes reacted positively to an increase in reed cover: Little Grebe, $R^2 = 0.67$, $P < 0.001$; Great Crested Grebe, $R^2 = 0.52$, $P < 0.01$. Numbers of foraging Little Grebes, which were found most often near the breeding areas, correlated positively with reed cover (Fig. 5F). The distribution of foraging Great Crested Grebes was not related to reed cover (Fig. 5F). Bird-days of some passerines (wagtails and finches) declined in relation to reed cover (Fig. 5G), while bird-days of marshland passerines and Water Pipit *Anthus spinoletta* increased in relation to an increase in reed cover (Fig. 5H–I). There seemed to be no relationship between the number of bird-days of Meadow Pipit *Anthus pratensis* and reed cover (Fig. 5I).

DISCUSSION

Habitat differentiation

Vertebrate herbivores, such as Muskrat *Ondatra zibethicus* in North America (van der Valk & Davies 1978) and in Europe (Gryseels 1988, Barthelmes 1991), Coypu *Myocastor coypus* and ducks in *Sagittaria* marshes in Louisiana (Evers *et al.* 1998), moulting Greylag Geese *Anser anser* (van Eerden *et al.* 1997) and wintering Greylag Geese (Esselink *et al.* 1997) in The Netherlands, can have great effects on emergent vegetation in marsh ecosystems, resulting in habitat modification.

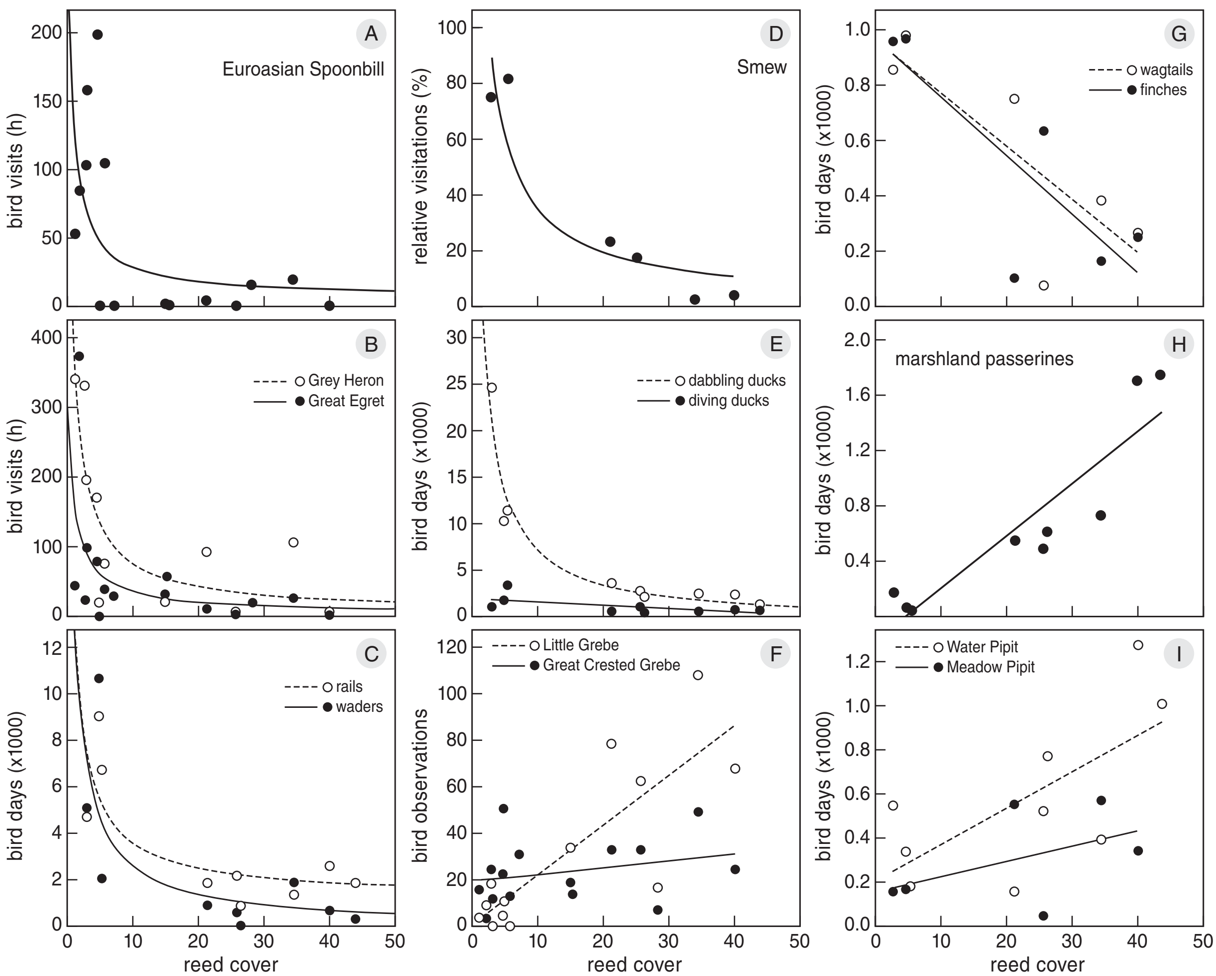

Figure 5. The relationship between reed cover and visits of different marsh bird species in the study area. Each point gives the number of bird-hours (A, B), the number of bird-days (C, E, G, H, I), the percentage of visits (D) or the number of observations (F), for a given year to one of the fields. (A) Eurasian Spoonbill: $R^2 = 0.26$, $P = 0.053$; (B) Grey Heron: $R^2 = 0.73$, $P < 0.001$; and Great White Egret: $R^2 = 0.25$, $P = 0.06$; (C) rails: $R^2 = 0.57$, $P < 0.05$; and waders: $R^2 = 0.50$, $P < 0.05$; (D) Smew: $R^2 = 0.82$, $P < 0.05$; (E) diving ducks: $R^2 = 0.45$, $P = 0.05$; and dabbling ducks: $R^2 = 0.94$, $P < 0.001$; (F) Great Crested Grebe: $R^2 = 0.11$, $P = 0.22$; and Little Grebe: $R^2 = 0.66$, $P < 0.01$; (G) wagtails: $R^2 = 0.66$, $P < 0.05$; and finches: $R^2 = 0.68$, $P < 0.05$; (H) marshland passerines: $R^2 = 0.83$, $P < 0.001$; (I) Water Pipit: $R^2 = 0.47$, $P < 0.05$; and Meadow Pipit: $R^2 = 0.24$, $P = 0.33$.

Grazing cattle were also found to have an impact on the shoreline vegetation of small ponds in southern Texas (Whyte & Cain 1981). In that study, breeding marshland birds and passerines showed a preference for the less intensively grazed ditches, as was also found in riparian vegetation in Oregon (Taylor 1986). In South Dakota, Blue-winged Teal *Anas discors* bred in largest numbers in areas with a controlled grazing intensity (Kaiser *et al.* 1979).

Our study shows that grazing by cattle and horses can keep shallow pools and ditches free from *P. australis* vegetation and thereby have positive effects on feeding sites of e.g. Eurasian Spoonbill, herons and waders. A high water table in summer prevented *P. australis* from being grazed. As a result the parts of the ditches and pools in which water was between 0.3 and 0.5 m deep became completely overgrown. However, water bodies that were more than approximately 0.6 m deep during the growing season were almost free of *P. australis*; from this we infer that reed growth was limited by water depth. A low water table in summer allowed cattle and horses to graze all parts of the ditches, resulting in water bodies which were almost free of *P. australis* vegetation.

The study showed that three habitat types developed under the three different water table regimes combined with livestock grazing: deep open water, shallow water without *P. australis* vegetation and shallow water with *P. australis* vegetation. The differentiation into the three habitat types, enabled bird species of rather open habitats (Eurasian Spoonbill, herons, waders and ducks) to co-occur with birds preferring dense *P. australis* stands (breeding grebes, marshland passerines, Water Pipit) in a relatively small area (50 ha) (Table 2). For the wading piscivorous Eurasian Spoonbill and herons, the low summer water table and heavily grazed ditch banks made their prey much more accessible than in the other less intensively grazed areas. A reed cover of about 10% seemed to be the upper limit for these species of open habitats. Diving piscivorous birds such as grebes and Smew were mainly found in the parts with deeper, open water. Breeding grebes and marshland passerines, on the other hand, benefited from dense *P. australis* stands in the shallow water bodies in other parts of the study area.

Table 2. Preferences of different groups of birds for different types of water bodies within the study area. For species composition of the groups, see Appendix 1.

	Deep (> 0.6 m) Open	Shallow (0.3–0.5 m) Open	Shallow With vegetation
Eurasian Spoonbill, Grey Heron and Great Egret		x	
Grebes and Smew, feeding	x		
Grebes, breeding			x
Waders		x	x
Rails	x		
Dabbling ducks		x	
Diving ducks	x		
Marshland passerines		x	x
Other passerines	x		x

Implication for conservation management of small wetlands

The Netherlands, the most densely populated country in Europe, has an intensive land-use pattern. This has resulted in relatively small wetlands (van den Tempel & Osieck 1994), which are characterised by small fluctuations in water level and a high nutrient content (e.g. van der Putten 1997). The stable water table and high nutrient level has led to a decline in *P. australis* stands, especially inundated *P. australis* vegetation (Ostendorp 1989, van der Putten 1997). The decline of the area of inundated *P. australis* vegetation has entailed a decline in numbers of marsh birds which are associated with this habitat, as has been shown for Great Bittern and Great Reed Warbler *Acrocephalus arundinaceus* (Osieck & Hustings 1994, Graveland 1998). The most effective measure to restore inundated *P. australis* vegetation is considered to be to induce fluctuation in water level with relatively high levels during winter and low levels during summer (van der Putten 1997, Graveland & Coops 1997, Graveland 1998). The long-term presence of inundated *P. australis* vegetation is also affected by succession of the emergent vegetation. Grazing and the periodic drop or rise in water level, characteristic processes for natural wetlands, can slow down or reset the vegetation succession in man-made wetlands (Vulink & van Eerden 1998). Our study shows that the creation of shallow ditches and integration of water table regimes and grazing by cattle and horses, can be a suitable tool for restoring or improving habitats for marsh birds in small areas, characterised by little variation in micro-topography and water table, as occur in the Netherlands in fields withdrawn from agriculture. An important pre-condition for the success of these restoration measures is location of the improved areas near large wetlands.

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SAMENVATTING

Riet *Phragmites australis* is een belangrijke vegetatiecomponent van zoetwatermoerassen. De dynamiek van rietvelden wordt voor een belangrijk deel bepaald door de hydrologie van het gebied, maar de vraat van Muskusrat *Ondatra zibethicus*, Beverrat *Myocastor coypus* en grasetende watervogels speelt evenzeer een grote rol. Met riet omzoomde oevers van moerassen zijn beschermd tegen de afkalvende werking van golfslag. Juist in deze randen wemelt het van moerasvogels die er broeden, foerageren en ruien. In dit onderzoek dat in een klein gedeelte van de Oostvaardersplassen plaatsvond, werd onderzocht op welke wijze kunstmatige variatie van het waterniveau, in combinatie met begrazing door koeien en paarden (van mei tot november, 0,9–1,7 dieren/ha), kan bijdragen aan het behoud en het herstel van moerasvegetaties. Het onderzoekgebied de Waterlanden, gelegen in het buitenkaadse gedeelte van de Oostvaardersplassen, werd in drie vlakken van gelijke oppervlakte onderverdeeld. Elk vlak werd vervolgens onderworpen aan een eigen regime van waterstand en begrazing: (1) waterstand in vroege zomer 20 cm boven de gemiddelde winterstand, (2) constant waterniveau gedurende het hele jaar, en (3) een min of meer

natuurlijk regime met inundatie in de wintermaanden en droogvallen in de zomermaanden. Bij de start van het onderzoek in 1987 hadden de drie vlakken elk een geringe hoeveelheid riet. Vijf jaar later was dat volstrekt anders. In het vlak met opgezet water in de vroege zomer en in het vlak met een constant waterniveau was het riet sterk toegenomen. Dat was niet het geval in het vlak met een halfnatuurlijk waterregime. Deze verschillen hadden te maken met variaties in graasdruk. Hoe lager het water stond tijdens de groei van het riet, des te sterker werd het riet begraasd. Aan de andere kant: als de waterdiepte de 60 cm oversteeg, bleef rietgroei achterwege. De beste rietontwikkeling vond plaats bij een waterdiepte van 30–60 cm. Uiteindelijk ontstonden drie typen moeras: diep open water, ondiep open water en ondiep water met riet. Juist deze variatie leverde een palet aan mogelijkheden voor moerasvogels op. De diepere open wateren werden benut door visetende soorten als Fuut *Podiceps cristatus*, Dodaars *Tachybaptus ruficollis* en Nonnetje *Mergellus albellus* (foeragerend op stekelbaars) en door rallen, de ondiepe open wateren met een karige begroeiing door Lepelaar *Platalea leucorodia*, reigers, rallen, steltlopers en eenden, en de met riet begroeide ondiepe wateren door broedvogels (inclusief de fuutachtigen). Het onderzoek toont aan dat de aanleg van ondiepe sloten in combinatie met een kunstmatige regeling van variabele waterhoogte en een seizoenbegrazing met koeien en paarden kan leiden tot een mozaïek van moerasvegetaties met een hoge waarde voor moerasvogels.

Appendix 1. Species composition of the different groups of birds dealt with in the text. Only species observed five or more times are included.

Piscivorous wading birds	Eurasian Spoonbill	*Platalea leucorodia*
	Grey Heron	*Ardea cinerea*
	Great Egret	*Casmerodius albus*
Grebes and Smew	Great Crested Grebe	*Podiceps cristatus*
	Little Grebe	*Tachybaptus ruficolis*
	Smew	*Mergellus albellus*
Breeding grebes	Great Crested Grebe	*Podiceps cristatus*
	Little Grebe	*Tachybaptus ruficolis*
Waders	Eurasian Oystercatcher	*Haematopus ostralegus*
	Pied Avocet	*Recurvirostra avosetta*
	Little Plover	*Charadrius dubius*
	Ringed Plover	*Charadrius hiaticula*
	European Golden Plover	*Pluvialis apricaria*
	Grey Plover	*Pluvialis squatarola*
	Northern Lapwing	*Vanellus vanellus*
	Little Stint	*Calidris minuta*
	Dunlin	*Calidris alpina*
	Ruff	*Philomachus pugnax*
	Jack Snipe	*Lymnocryptes minimus*
	Common Snipe	*Gallinago gallinago*
	Black-Tailed Godwit	*Limosa limosa*
	Eurasian Curlew	*Numenius arquata*
	Spotted Redshank	*Tringa erythropus*
	Common Redshank	*Tringa totanus*
	Common Greenshank	*Tringa nebularia*
	Green Sandpiper	*Tringa ochropus*
	Wood Sandpiper	*Tringa glareola*
	Common Sandpiper	*Actitis hypoleucos*
Rails	Moorhen	*Gallinula chloropus*
	Common Coot	*Fulica atra*

Appendix 1. Continued.

Dabbling ducks	Common Shelduck	*Tadorna tadorna*
	Eurasian Wigeon	*Anas penelope*
	Gadwall	*Anas strepera*
	Common Teal	*Anas crecca*
	Mallard	*Anas platyrhynchos*
	Northern Pintail	*Anas acuta*
	Garganey	*Anas querquedula*
	Northern Shoveler	*Anas clypeata*
Diving ducks	Common Pochard	*Aythya ferina*
	Tufted Duck	*Aythya fuligula*
	Common Goldeneye	*Bucephala clangula*
Marshland passerines	Winter Wren	*Troglodytes troglodytes*
	Bluethroat	*Luscinia svecica*
	European Reed Warbler	*Acrocephalus scirpaceus*
	Bearded Reedling	*Panurus biarmicus*
	European Goldfinch	*Carduelis carduelis*
	Reed Bunting	*Emberiza schoeniclus*
Passerines	Skylark	*Alauda arvensis*
	Meadow Pipit	*Anthus pratensis*
	Water Pipit	*Anthus spinoletta*
	Blue-headed Wagtail	*Motacilla flava*
	White Wagtail	*Motacilla alba*
	Linnet	*Carduelis cannabina*