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CHAPTER 5

THE USE OF DOMESTIC HERBIVORES IN THE MANAGEMENT OF WETLANDS FOR WATERBIRDS IN THE CAMARGUE, FRANCE

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Introduction

Wetlands are ecological systems which are often unstable and dynamic (Weller 1978). Many are subject to rapid sedimentation and water depth can vary by an order of magnitude from one year to another when rainfall is erratic. These edaphic conditions, extreme and variable, mean that the structures of wetland plant communities are often unstable; they often tend towards mono-dominance and abrupt limits (Haslam 1971).

When wetlands are managed for waterfowl, the goal of the manager is often to maintain the same conditions, eg of hydrology, vegetation, etc, each year. Without judging the validity of such an approach, it is clearly a difficult one to realize. The manager will need a flexible approach and a range of different techniques.

A common problem in management for wintering waterfowl is the control of emergent vegetation. Many techniques have been used for this, including cutting by boat, mowing, ploughing and chemical herbicides (see previous chapters). One of the oldest and most widespread means of cutting wetland vegetation is by grazing. For many wetland ecosystems grazing by wild or domestic herbivores is a primary determinant of ecosystem structure and function (cf Westhoff 1971, Bakker 1978). In the Camargue herds of horses and cattle have grazed the wetlands for centuries, even millennia (Vlassis 1978), and have proved a useful tool for management of marshes for waterfowl, especially in marshes where the water level is under the control of the manager. At the same time grazing allows the economic exploitation of the wetland plants which are often highly productive and of good nutritive value.

As for all tools, so the use of grazing for management requires a good understanding of its effects, and an appreciation of the constraints which can limit its usefulness. The aim of this paper is to outline these effects and constraints on the basis of some examples of marshes managed for waterbirds, mainly Anatidae and Ardeidae, in the Camargue.

The Camargue

The Parc Naturel Régional de Camargue (850 sq km) is made up of the Grande Camargue, between two arms of the Rhône River, and the Petite Camargue to the west. The landscape, formed under the influence of the Rhône and the sea, is flat.

The highest points are recent maritime dunes; the lowest are the bottoms of the many marshes and lagoons. The soils, apart from the sandy coastal strip, are silts. There are few clays and the soils contain high levels of salt, particularly in areas where particle size is small, as in the southern part.

High rates of evaporation coupled with moderate rainfall (mean annual rainfall 620 mm at Arles and 540 mm at Salin de Giraud on the coast) concentrated in the cooler months (October to April) mean that the smaller wetlands dry out in the summers of most years unless they are irrigated. Rainfall, as elsewhere in the Mediterranean, is variable and over 78 years varied between 300 mm and 930 mm at Salin de Giraud (Aris 1976).

The wetlands

The Camargue contains both natural and artificial wetlands. The artificial ones were created for a variety of purposes (fish-farming, hunting, etc). Most are small (c 1 ha) and of recent origin. By far the commonest are rice fields; in 1960 these covered 25 000 ha, today only 7000 ha. These rice fields are equipped with drainage and irrigation ditches and many are managed as shallow freshwater wetlands for nocturnal feeding by wintering ducks (Tamisier 1972, Pirot 1982).

The natural wetlands cover 30 000 ha and have recently been surveyed, classified and mapped by Britton and Podlejski (1981). About a half are euhaline to hyperhaline and contain no significant emergent vegetation. The remainder are freshwater to polyhaline (<16 gm/1 of NaC1). These wetland cover some 14 000 ha and are distributed in an arc around the central National Reserve.

Like the artificial wetlands, most of the natural ones have been equipped with ditches which allow them to be irrigated or drained. Water levels can be controlled, at least in theory, and this allows at least partial compensation for the irregularity of rainfall. This irregularity in rainfall can cause considerable differences in both the mean depth of water and the length of the drying-out period, as can be seen in Fig 1, unmanaged section.

The vegetation of the freshwater marshes, unlike the more saline ones, varies considerably. The range goes from open water with well developed submerged vegetation (often *Potamogeton* sp or Characeae) to tall, dense beds of *Phragmites* reeds (Britton and Podlejski 1981). Topography and soil play their parts in determining the composition of the vegetation, but the dominant factor is management. With abundant water and no mowing or grazing, *Phragmites* reedbeds cover many of the wetlands. Mowing or grazing clears the reeds to different extents depending on the timing and intensity of the intervention; emergent vegetation may be partly or wholly replaced by submerged plants (Table 1), probably because the removal of reeds increases the amount of light available to submerged species (cf Dawson and Kern-Hansen 1979).

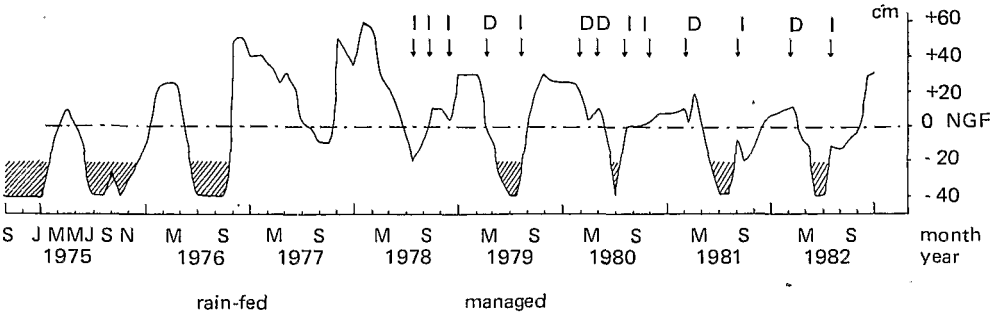

Fig 1. The water level of the St Seren over four years without water management (1975–78) and five with management. The marsh is dry at −40 cm NGF. Note the prolonged dry period in 1975 and the lack of drying out in 1977 and 1978. The timing and duration of drying out in the following years was managed by irrigation (I) in the summers, and drainage (D) during the spring.

Table 1.

Mean biomass densities (gm/m^2 dry weight) in May of emergent *(Phragmites* and *Scirpus maritimus*) and submerged plants (Characeae and *Ranunculus baudotii*); Relongues marsh.

Date	Biomass (gm/m^2 ± se) Emergent	Submerged
1975	205± 42	42±18
1982	16.0 ± 2.3	251 ± 26.7

The waterbirds

The freshwater marshes of the Camargue contain populations of eight species of herons and egrets (Ardeidae) which breed in the delta. Some of these are internationally important, such as that of the Little Egret *Egretta garzetta* (10% to 15% of the Mediterranean population) and Purple Heron *Ardea purpurea* (24%, Tour du Valat 1978).

In winter, up to 130 000 individuals of fifteen species of ducks (Anatidae) are present (Tamisier 1972). These birds are important regionally as a hunting resource and internationally from a conservation point of view. For the Red-crested Pochard *Netta rufina*, for instance, the Camargue population represents 25% to 50% of the numbers in the Mediterranean region.

Of the Ardeidae, three species require extensive areas of dense *Phragmites* reedbeds, the Bittern *Botaurus stellaris* for nesting and resting and the herons *Ardea cinerea* and *A. purpurea* for nesting. The other Ardeidae and the Anatidae require more or less open water for feeding, resting, or both (Hafner 1977, Pirot 1982).

For the first group, maintenance of suitable reedbeds will require the exclusion of mammalian herbivores. Cutting or burning may be necessary to remove litter periodically so as to maintain dense stands (Mook and van der Toorn 1982, Dykyjová and Květ 1978).

Management for the second group, which includes all the species of economic importance, requires techniques for cutting emergent vegetation over large areas. Grazing can be an effective and economically interesting tool for this, but it has disadvantages and constraints to its use. These points will be considered below.

Impact of grazers on the emergent vegetation

1. Impact on *Phragmites* reedbeds

The dominant reed *Phragmites* is an extremely good forage species for all herbivores. In its young stages it has a high crude protein fibre ratio (23%:31% pers obs) and no known secondary compounds. It is therefore preferred to other monocotyledons. Furthermore, this species is particularly sensitive to grazing because it has its meristem at the internodes. When the shoots are bitten off below water level, rotting may set in and cause the death of the shoot. Both horses and cattle will feed readily in water up to 1 m deep; under heavy grazing *Phragmites* is quickly reduced in height and frequency. In Fig 2 are shown photographs from a single wetland with heavy grazing in one half and light grazing in the other. A similar effect is shown in Fig 3 where a reedbed has grown up in protected study plots within a heavily grazed marsh. Quantitative data from these study plots are given in Table 2.

The progressive effect of an increasing herd of horses on one marsh can be seen in Fig 4. As the grazing pressure increased from 40 to 90 horse-days/ha, the mean density of *Phragmites* fell from 120 to 1.5 shoots/m^2. *Scirpus maritimus* (c 50 shoots/m^2) did not change significantly. The mean height in summer varied more erratically, perhaps in relation to variations in the depth and duration of flooding, but fell from 71 cm to 16 cm in the same period.

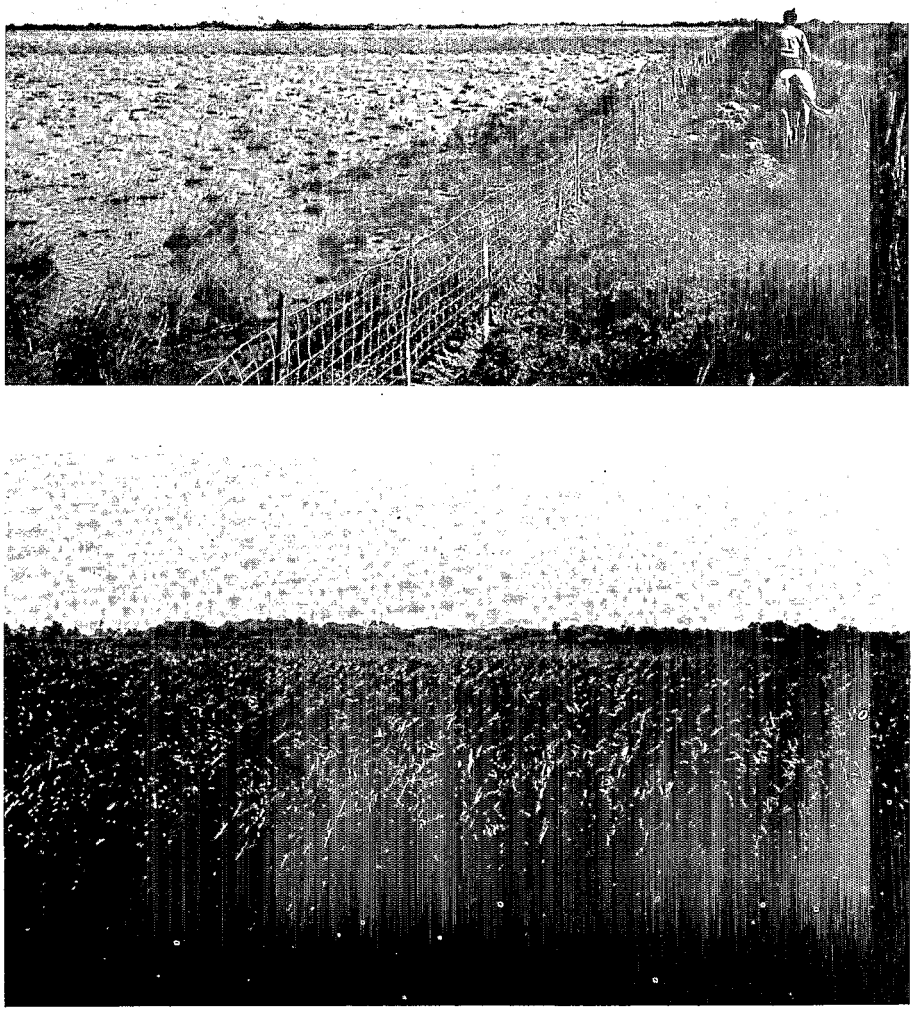

Fig 2. A wetland in the Camargue with one part heavily grazed (upper) and the other lightly (lower). *Photos P Duncan.*

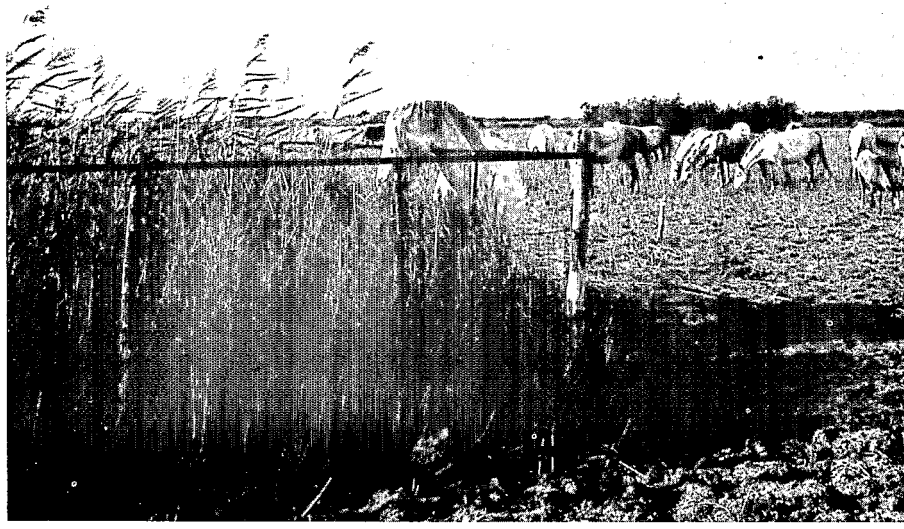

Fig 3. The effect of protection from grazing in a heavily grazed marsh. *Photo P. Duncan.*

Table 2.

Mean densities and heights of the emergent plants in a plot protected for six years and an adjacent control plot in a heavily grazed marsh; Relongues 1982.

		Protected plot	Grazed plot
Grazing pressure (horse-days/ha)		nil	90
Plant species			
Phragmites	Density (shoots/m^2)	72 ± 8.4	0
	Height (cm)	218 ± 4.7	–
Scirpus tabernaemontani	Density	66 ± 15	3
	Height	19 ± 4.1	10.0
Scirpus maritimus	Density	102 ± 8.5	234 ± 30
	Height	150 ± 3.8	8.4 ± 0.50
Total	Density (shoots/m^2)	240 ± 20	241 ± 28

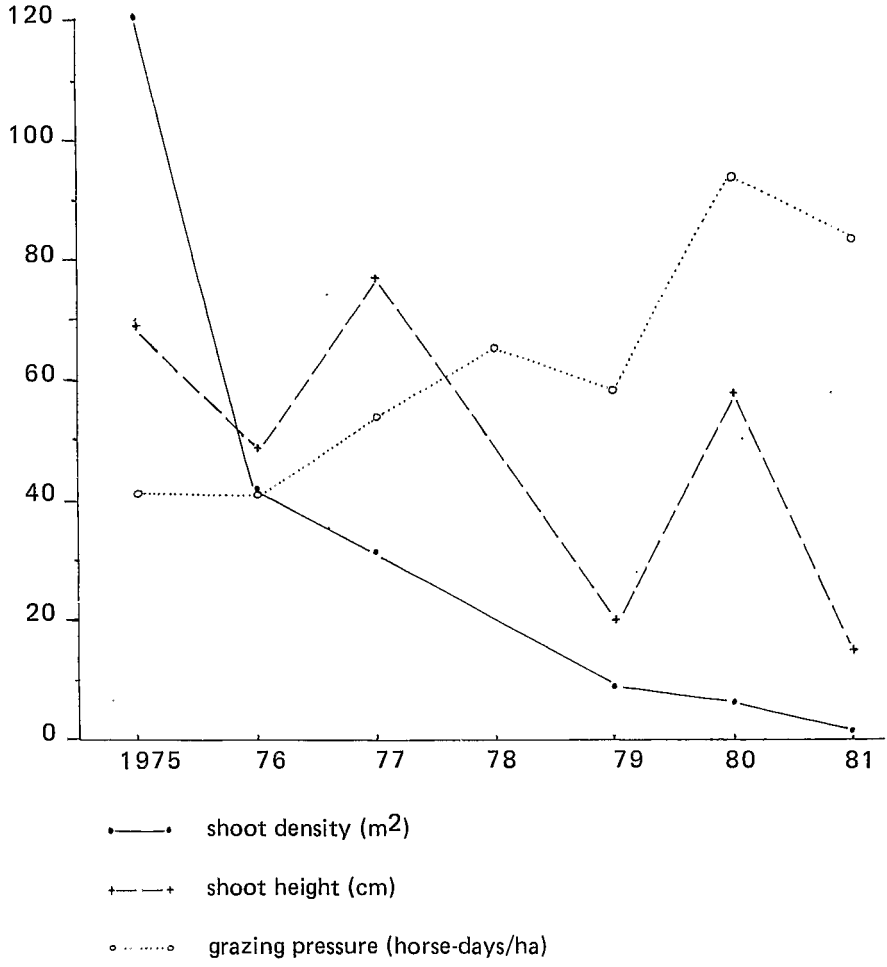

Fig 4. Decreasing shoot density and height of *Phragmites communis* after the introduction of horses (1971) into the Relongues, la Tour du Valat.

The examples above are extreme: the impact can be altered by varying the intensity of grazing. Fig 5 (upper) shows a marsh grazed lightly (22 horse-days/ha), while Fig 5 (lower) shows a greater impact (54 horse-days/ha).

If heavy grazing produces a homogenous structure (Fig 6b), patchiness is often a characteristic of lightly grazed wetlands. The animals tend to concentrate on certain areas. Here the emergent vegetation is short, whereas it remains tall in the surroundings (Fig 6a). This kind of structural diversity is not ideal for wintering waterbirds, but may be favourable for the nesting habitat of species such as Coot *Fulica atra*.

Finally, temporal variations in structure can be obtained by a rest-rotation system of grazing. Such systems are often recommended to maximize the usable plant production (eg Mundiger 1976, Whyte, Silvy and Cain 1981).

2. Impact on other emergent plant species

These can be divided for convenience into tall and short emergents.

Among the tall emergents, several species are resistant to grazing either because their meristem is at or below ground level, or because they apparently contain secondary compounds which make them unpalatable to grazers except when the shoots are young (eg *Scirpus littoralis* and *Typha angustifolia*).

In some marshes the reduction of *Phragmites* by grazing does not maintain open water, but leads to the appearance of a reedbed dominated by *Typha* and tall *Scirpus* species; a typical example is described in Fig 7c.

These tall emergents are sensitive to early and prolonged drying-out of their habitat. Their abundance can be controlled if the summer drying-out is accelerated by draining the marsh partially or wholly in spring. The earlier this is done, the more effective will be the grazers, which readily eat the new shoots of these reeds, but not mature ones.

The short emergents in the Camargue include *Scirpus maritimus, Paspalum distichum* and *Aeluropus littoralis*. These plants flourish in water of intermediate depth and are readily grazed by horses and cattle. Grazing can maintain a short, productive sward which does not hinder the feeding or resting of waterfowl. Quantitative data on the structure of two such marshes are given in Fig 7a and b.

The control of emergent species by grazing demands, therefore, not only the presence of adequate numbers of grazers, but also, for at least certain marshes whose site specific characteristics favour the tall reeds other than *Phragmites*, control over the depth and duration of flooding. As stated above, most artificial and natural freshwater marshes in the Camargue are equipped with irrigation and drainage canals which allow such control.

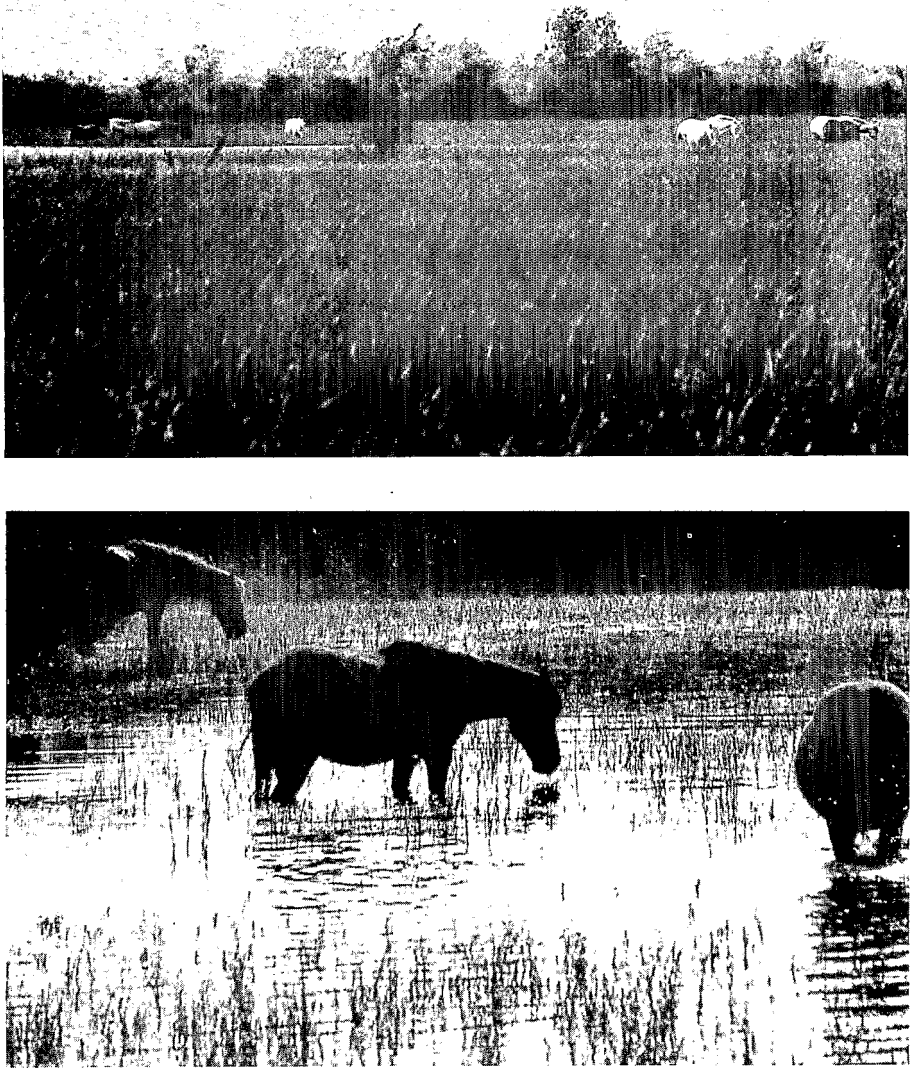

Fig 5. Marshes with a light (upper) and an intermediate (lower) grazing pressure. *Photos A M Duncan.*

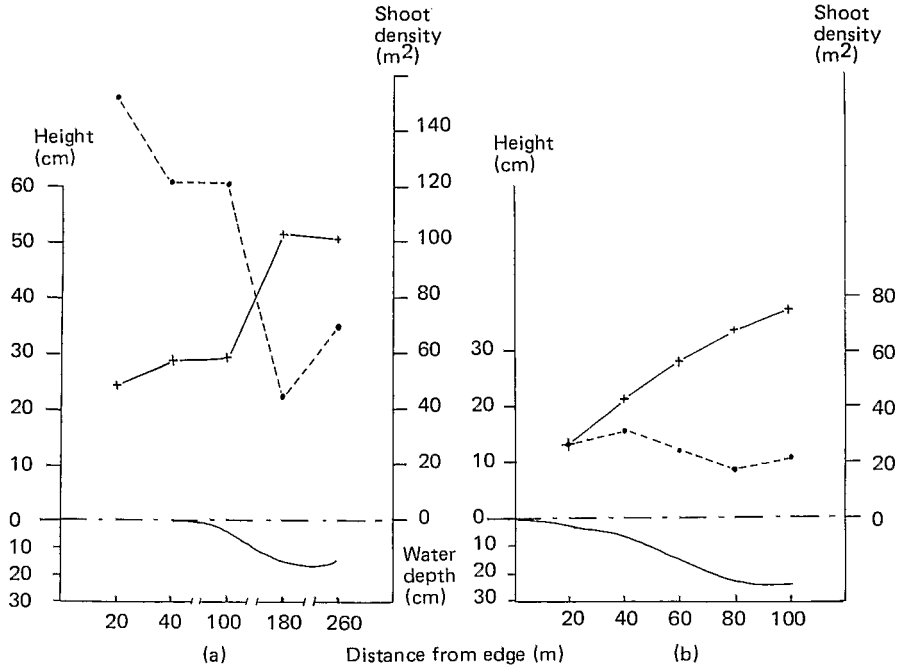

Fig 6. Mean shoot heights (+——+) and densities (·------·) of *Scirpus maritimus* on transects from the edge to the centre of two marshes. Note difference in scale on x—axes. Water depth is also given.
(a) St Seren, lightly grazed.
(b) Relongues, heavily grazed.

Impact of grazers on the food resources of waterbirds

1. On food abundance

The principal waterbirds of the Camargue include predatory, granivorous and herbivorous species. Management for the prey of the predatory species (mainly Ardeidae) is described in Chapter 9 and depends mainly on the management of the water regime of the marshes. The indirect influences of grazing on the abundance of fish and aquatic invertebrates are as yet poorly understood.

Granivorous waterbirds:

The principal granivorous species in the Camargue are Teal *Anas crecca* and Mallard *A. platyrhynchos*. The diet of the Teal over the winter period (Pirot 1982) is dom-

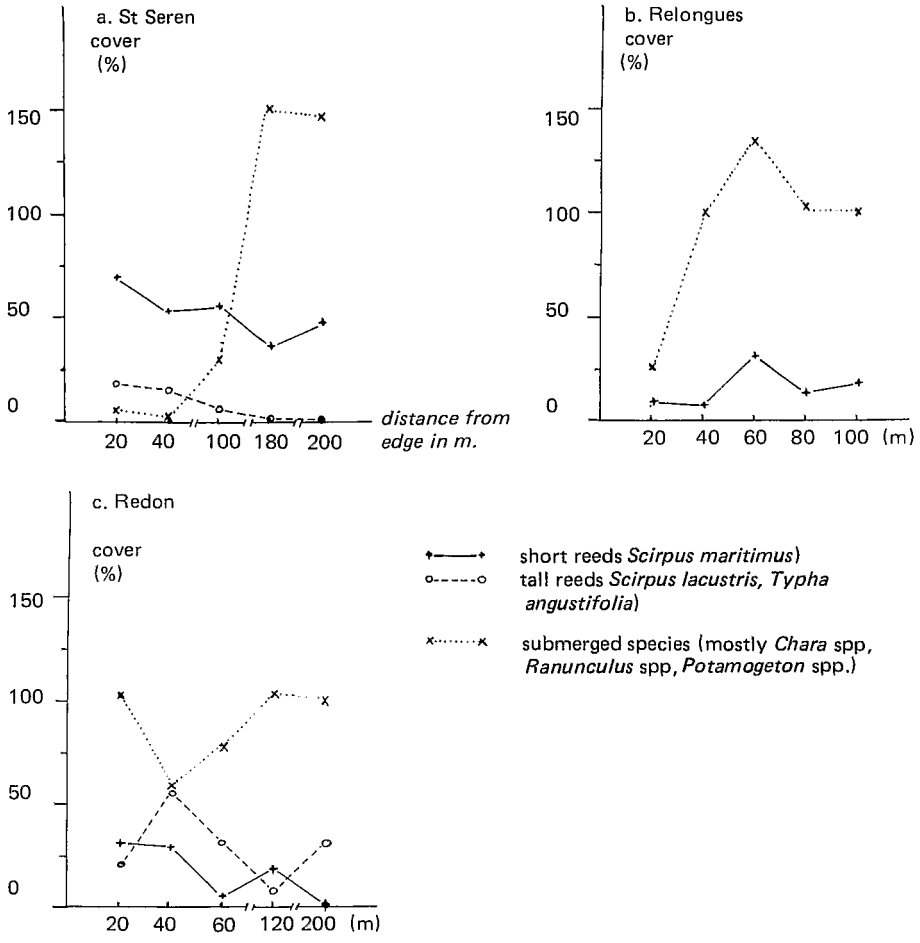

Fig 7. Cover of submerged vegetation, tall reeds and short reeds in three marshes in the Camargue.
a and c: grazing by cattle
b: heavy grazing by horses

inated by the oogonia of the submerged Characeae (48% by weight). These species are eaten only exceptionally by horses and cattle; though trampling may damage the above-ground parts of these plants, the most important, indirect, effect of grazing is probably to increase the amount of light available to the submerged macrophytes by reducing the biomass of the aerial parts of the emergents. The second most important food category (30%) in the diet of Teal is the seeds of

rice and its weeds (eg *Echinochloa* sp). These plants are naturally protected from grazing at least until harvest; grazing therefore has no effect on abundance. Thirteen percent of the diet is made up of Salsolaceae (*Suaeda, Arthrocnemum* and *Atriplex* sp) which grow around the wetlands. These plants are eaten by horses and cattle but principally in winter, after the seeds have fallen.

The remaining 9% of the diet of Teal contains seeds of some emergent species of Cyperaceae which are heavily grazed by horses and cattle, particularly, *Scirpus maritimus* and *Eleocharis palustris*. Grazing on these species, which occurs only during the growing season, can completely inhibit seed formation (Table 3), but the impact of grazing on the overall abundance of the food currently used by Teal must be considered small.

The diet of the Mallard is dominated by the three groups of plants mentioned above for Teal (domestic crops and their weeds, Characeae and Salsolaceae, 77%). Cyperaceae account for 17%; here again, *S. maritimus* and *E. palustris* play significant parts, but the overall conclusion is that, as for Teal, grazing can only have a very small effect on the abundance of the principal foods of Mallard.

Herbivorous waterbirds:

Wigeon *Anas penelope* in the Camargue feed mainly in the more saline wetlands. The principal species of the freshwater marshes are Gadwall *Anas strepera*, Pochard *Aythya ferina* and Red-crested Pochard *Netta rufina*. Little is known of the diets of these species, except that they feed almost entirely on submerged plants, especially Characeae and *Potamogeton* sp. As stated above, these plants are favoured by the impact of grazers on the emergents.

2. On food accessibility

The most important effect of grazing is the opening up of emergent vegetation. In addition, trampling of the soil surface is said to facilitate filtering for seeds by surface feeding ducks such as Teal (Tamisier 1972). This effect, sometimes called

Table 3.
Flowering of emergent plants under no grazing and under heavy grazing (90 horse-days/ha). Means of three plots; Relongues marsh, 1982.

	Percentage of plants flowering	
	ungrazed	grazed
Scirpus tabernaemontani	73	0
Scirpus maritimus	33	0
Phragmites sp	67	0

'puddling', will be more pronounced in the areas grazed by cattle than by horses which do not have cloven hooves.

Direct influences of herbivorous animals on birds.

Studies of cattle grazing meadows have shown that trampling can cause the destruction of a large proportion of nests of terrestrial species such as Lapwings *Vanellus vanellus* (see Chapter 8). This effect occurs at high densities (> 4 cattle/ha); it is probable that at the densities usual in the Camargue (0.3 to 3 animals/ha), damage to nests is rare unless the animals are driven in round-ups.

Grazing animals attract a few predatory bird species such as Cattle Egrets *Bubulcus ibis*, which sit on the animals and forage on small vertebrates and invertebrates disturbed by the passage of the large herbivores.

The grazing animals and their husbandry

1. Horses

The horses weigh 350 kg to 500 kg when adult at 7 years of age. Their shoulder height varies between 135 cm and 145 cm. Compared with other breeds of horses, they are remarkable for their broad, rather flat hooves, heavy limb-bones and white coat colour when adult. These characteristics can be interpreted as adaptations to moving through difficult muddy terrain (hooves and limbs), and to reducing the rate of attacks by biting Diptera, which abound in wetlands (white coat). The breed was recognized officially by the Haras Nationaux in 1978; its principal uses are for rounding up the cattle and for riding clubs where it is appreciated as a docile, thrifty all-purpose pony. Many are sold for meat at the end of their useful lives.

2. Cattle

The cattle which, like the horses, number about 3500 in the Delta, are smaller. Females weigh 200 kg to 300 kg and males 300 kg to 400 kg. Their coat colour is dark brown-black and their horns lyre-shaped. Their cloven hooves allow them to move easily through mud; and they are protected against biting flies by their thick hide. The main use of these animals is for the Provençal bullfight (La Course à la Cocarde); like the horses, most of the cattle end up on the meat market and provide tasty if tough joints. As a consequence of selection for combativity, the cattle are emotive and difficult to approach and handle.

3. Differences between horses and cattle

The feeding ecology of the two species is similar in that they prefer wetlands to

drier habitats in the growing season, but require the drier habitats in the winter. In the wetlands they both prefer *Phragmites* and *Scirpus maritimus* among emergent plants, and avoid *Typha* and the tall *Scirpus* sp.

In the drier habitats, both species are mixed feeders preferring herbaceous plants, particularly Gramineae when these are abundant, but eating the leaves and twigs of shrubs and trees, particularly *Suaeda* and *Arthrocnemum* sp in the salty habitats and *Ulmus, Populus* and *Salix* in the woodlands. Horses can cause extensive damage to these trees by ring-barking, especially in spring.

The ruminant digestive system of the cow allows a daily dry matter intake of 2% to 3% of live weight (ie 5 kg to 7.5 kg for a 250 kg cow), and intake declines as the forage becomes coarser. In horses, daily dry matter intake is higher (3% to 4.5% of live weight or 13 kg to 19 kg for a 425 kg horse), and intake increases with decreasing quality.

Horses, therefore, remove, per individual, two and a half times as much coarse plant matter as do cattle. Fewer horses are required to achieve the same impact on the vegetation. This means that the probability of damage to nests is less.

As far as trampling is concerned, the cloven hooves of the cattle are said to break up the surface of the soil to a greater extent than the flat hooves of horses. For dabbling granivorous ducks, this may be an advantage, but the importance of this effect on the availability of seeds has not been measured. Differences between the two species in the effects of trampling on submerged plants have not been measured either.

Finally, from the point of view of animal husbandry, cattle are difficult to contain and handle. They require fences with at least four strands of barbed wire and a post every metre. This increases the costs of fencing by about x 1.7. Camargue cattle are also difficult to round up as they hide in thickets, and special enclosures are required for handling. Cattle are susceptible to foot-and-mouth disease and to brucellosis (contagious abortion), and in many countries it may be necessary to vaccinate. Cattle are also susceptive to liver-flukes, which can be a serious problem, especially in wetland habitats. Regular treatment with well known drugs can solve this problem.

Horses are susceptible to none of these diseases. The commonest husbandry problem with horses is caused by roundworms (Nematoda), but animals of rustic breeds with adequate food supplies require no special treatment against roundworms.

4. Animal husbandry

A herd of horses or cattle represents a considerable capital outlay and demands

surveillance. Ideally a land manager would obtain his own animals so as to have total control over their numbers and husbandry. Because wetlands provide forage for the months April to September only, alternative food resources must be available for the other six months. Drier habitats with perennial herbaceous plants will generally produce adequate winter forage (eg *Halimione(Obione)* in saline areas, or swards of *Brachypodium, Agropyron* or *Dactylis* with forbs on the higher ground). In the Camargue 2 ha to 5 ha per horse are necessary; if such an area is not available, the animals can be fed on medium-quality hay. In this case, they should be removed from the range to avoid excessive trampling or overgrazing.

If the capital outlay necessary to buy the animals cannot be made, it may be possible to make arrangements with neighbouring farmers to graze the wetlands, the stocking rates being decided by the manager. It is advisable that such arrangements be made on an annual basis and that any charge made to the farmer be symbolic. In this way, the conservation area can make a contribution to the local economy while avoiding the constraints imposed by any legislation on tenancy.

Fencing for the horse (two strands and a post every two metres) costs 2500 French Francs per km in materials and four man-days in labour. These estimates do not include the cost of scrub clearance. There will also be incidental costs such as drinking points and bridges. A corral may be necessary. Ditches can be used for enclosing horses, but are ineffective for cattle. They are considerably more expensive.

How much the animals are handled will depend mainly on the competence of the personnel available. Ideally, the adult horses should all be catchable and halter-broken so that they can be handled easily if need be.

Revenues from the sales of young animals vary considerably; in the Camargue the average owner obtains approximately 500 FF per ha of marsh net revenue from the sale of weaning foals in the autumn. The cost of fencing large areas will therefore be considerably less than the revenues which can be expected.

Discussion

In the choice of methods for the management of emergent vegetation, the main criteria on which a manager will depend are effectiveness, costs and side-effects.

We have shown that grazing, coupled with the regulation of water levels, is effective in managing the emergent vegetation of Camargue wetlands. Grazing has the advantage over mechanical mowing in that it works over a wide range of water depths (up to about 1 m) and is thus independent of weather conditions to a considerable degree. Grazing does not allow the precision which can be obtained with mechanical mowing but is a gradual process which, by correct planning, can

create and maintain a wide range of structural states. For example, a marsh can be kept open by permanently maintaining a number of animals whose food intake equals the productivity of the emergent plants. On the other hand, if emergent vegetation is required at the beginning of the year (eg for nesting Coot) but must be removed before the winter (eg for dabbling ducks to feed), then high intensity grazing after the breeding season can achieve these goals, at least in marshes dominated by palatable emergents such as *Phragmites* and *Scirpus maritimus.*

Comparisons of the costs of grazing and mowing will vary greatly from one case to another. One such analysis is provided in Chapter 7; in this case, grazing was found to be economically superior to cutting. This will be true in many cases, for the costs of fencing are generally less than revenues from the sale of young animals.

The harmful side-effects of the presence of large herbivores include trampling of nests, which is probably rare provided that the grazers' densities are less than 3 animals per ha, and that they are left undisturbed. More serious is the fact that grazing can reduce the net primary production and, in particular, the production of seeds by emergent plants. Both will be compensated for partly or wholly by increases in the production of submerged macrophytes, but the consequences for the waterbirds which use the area will need to be evaluated carefully.

The main positive side-effect of grazing is the increase in the production of submerged macrophytes, though puddling of the soil may increase the availability of seeds for some dabbling ducks. In addition, for wetlands visited by the public, the presence of horses and cattle may have amenity value.

In conclusion, the use of large herbivores for the management of emergent vegetation will not be appropriate in all cases, particularly in small areas or where precise results are required. In larger areas, the use of these animals restores an important component of natural wetland ecosystems. The timing and intensity of grazing can be varied to suit particular objectives.

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Managing Wetlands and Their Birds

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Nargestan Ab-bandan, in the south Caspian near Ramsar, Iran. A wetland managed in the traditional way for irrigation in summer and duck hunting in winter.

Photo: Derek Scott