



Grazing Potential of the Wetland Located in the West of the Kızılırmak Delta

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ARTICLE INFO

ABSTRACT

Received 17/07/2025

Accepted 26/10/2025

Keywords:

Wetland,
water buffalo,
grazing capacity,
yield,
quality degree

This research was carried out in 2022 and 2023 to determine the forage yield and grazing capacity of the Habilli wetland, located west of the Kızılırmak Delta and south of Karaboğaz Lake. According to the results of the two-year study, the total dry forage yield of the grazing area was found to be 15.73 t/ha over the 180-day grazing period. The botanical composition by weight was found to be 71.65% grasses, 21.30% legumes and 7.06% forbs. The grazing area quality grade was found to be 6.62, indicating good condition. The water buffalo were the predominant grazing species in the wetland. The grazing capacity was calculated based on water buffalo and found to be 767.56 ACU. It was determined that an area of approximately 0.98 hectares was needed for one water buffalo during the grazing season in the wetland.

1. Introduction

Kızılırmak Delta is one of the largest deltas in Turkey formed by the alluvium carried by the Kızılırmak River. The 56000 hectare Kızılırmak Delta Bird Sanctuary, which is included in the UNESCO World Heritage Tentative List, located on the borders of 19 Mayıs, Bafra and Alaçam districts of Samsun, is the only wetland on the Black Sea coast of Turkey, whose natural features have been preserved to a great extent (Yavuz, 2011). It contains habitats with different ecological characteristics such as sea, river, lake, reeds, marsh, meadow, pasture, forest, dune and agricultural areas together, and the richness of nutrients and favourable climatic conditions ensure that the Delta has a rare biological diversity (Gül, 2020). As well as providing a habitat and food source for many plant and animal species, wetlands play an important role in collecting and retaining

soil water. Given this function, wetlands are important not only in their own right, but also for the surrounding ecosystems (Greb et al., 2006). Since wetlands are flooded during certain periods of the year, grazing periods are directly proportional to the availability of water in the area (Morris and Reich, 2013). Light to moderate grazing has been reported to benefit wetland vegetation by increasing species richness and diversity, thus creating favourable habitats for wildlife (Papanastasis, 1990). Grazing in wetlands has been indicated to benefit biodiversity conservation (Barth et al., 2000; Kazogoglou & Papanastasis, 2001; Krüger, 2006; Krawczynski et al., 2008). However, it has also been reported that traditional herbivores such as sheep, goats, horses and cattle may not be able to graze in wet conditions, which can have fatal consequences for



the animals (Petermann et al., 2008). Wetland grazing is necessary to create natural shelters needed by waterfowl, but cattle and horses alone are insufficient for this task. Buffalo are the most suitable species for this purpose (Krawczynski et al., 2008). Water buffalo live in wetlands because they struggle to withstand high temperatures. This is because they have skin that is about six times thicker than cattle and about one-sixth of the number of sweat glands (Samraus and Spannflor, 2005).

This study aimed to determine the forage yield and grazing capacity of the wetlands in the Karaboğaz Lake-Habilli region, which is located to the west of the Kızılırmak delta.

2. Materials and Methods

Materials

This research was conducted in the village of Habilli in the Alaçam district of the Samsun province, located to the west of the wetland of the Kızılırmak Delta, between 2022 and 2023. The Habilli pasture is situated to the west of the delta. This region has natural grazing areas to the south of Karaboğaz Lake. The centre coordinates of the region are 41° 63' 39" N, 35° 44' 24" E (Figure 1). While a significant part of the area is underwater until April, the water recedes in late April and early May, revealing large plains where animals graze. The Habilli region covers an area of 117 hectares. The climatic data for the region were given in Figure 2.



Figure 1. Habilli wetland (41° 63' 39" N, 35° 44' 24" E)

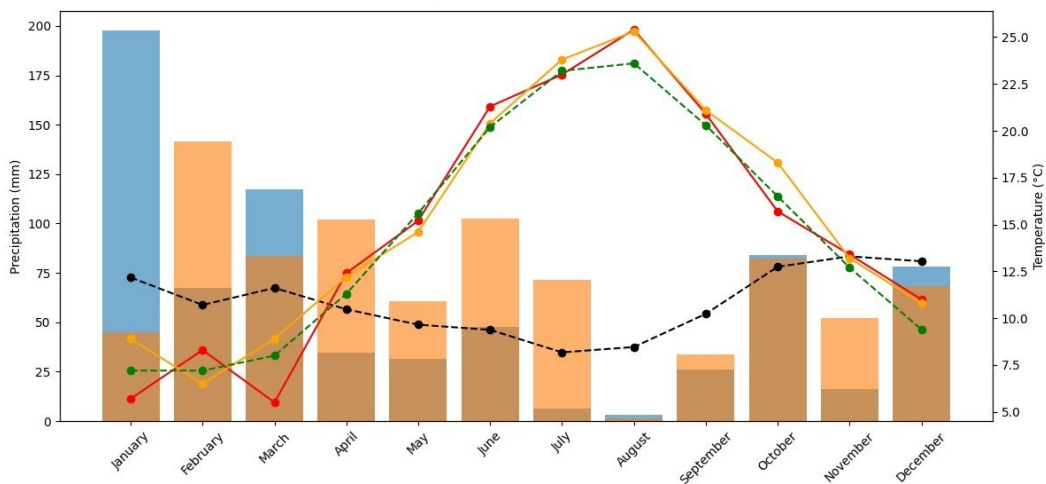


Figure 2. Precipitation (mm) and temperature (°C) values of the research area

Methods

In April 2022, ten wire cages measuring 50 x 70 cm were placed at various locations within the grazing area. Between June and November of both 2022 and 2023, observations were taken inside and outside the cages approximately every 30 days.

The botanical composition of the species (legumes, grasses and forbs) in the cages was determined based on weight during the flowering period of the plants at the beginning of June in both years, and the following formula was used (Sürmen, 2010);

Botanical composition

Weight of Species A in the Sample

Proportion of Species A (%) = ————— x 100

Total Weight of the Sample

Grazing Quality Degree (GQD)

The grazing quality degree (GQD) is a measure that compares the existing vegetation with the best vegetation that could develop under those conditions (Koç, 1995). The botanical composition

is made up of species that are given quality scores between -1 and +10 according to their characteristics (Table 1). Tasty, well-growing species are scored +10; poisonous species, -1; and non-grazing species, 0 (De Vries et al., 1951).

Σ (Proportion of species in botanical composition x Quality score)

GQD = —————
100

The quality scores of the plants were obtained from previous studies conducted by Gökkuş et al. (2000), Babalık (2008), Aydın and Uzun (2002),

and Karakuş (2014). It was recommended to write it this way.

Table 1. Classification according to grazing area quality grade

Quality grade	Grazing area situation
8-10	Very good
7-8	Good
4-6	Fair
2-4	Poor
0-2	Very poor

Dry forage yield and grazing degree

To determine the grass production potential of the grazing area, forage was harvested using quadrats measuring 30 x 40 cm (0.12 m²) inside and outside the placed cages. In both years of the study, forage harvests started in June and continued every 30 days until November (six months), with

monthly forage yields of the delta determined. The grass from the 0.12 m² quadrat was separated by species, placed in paper bags and dried at 60 °C until it reached a constant weight, after which the dry forage yield was determined (Töngel, 2018). To determine the grazing intensity of the grazed areas in the Kızılırmak Delta, in-cage and out-of-cage grass yield values were used.

In-cage yield – Out-cage yield

Grazing degree (%) = ————— x 100

In-cage yield

Under normal conditions, grazing is considered appropriate when half of the forage produced is eaten, i.e. when the difference between the two yields is close to 50%. However, in more

favourable regions in terms of rainfall, this rate can increase to 70% (Aydın and Uzun, 2002; Altın et al., 2011) (Table 2).

Table 2. Degree and Condition of Grazing Areas (For Areas with Adequate Rainfall)

Grazing degree of the area (%)	Grazing status of area
50 and below	Light grazing
51-70	Fair grazing
71 and above	Heavy and excessive grazing



Figure 3. Kızılırmak delta grazing area, Habilli-Turkey

Grazing capacity

The following formula was used to determine grazing capacity (Babalık, 2008).

$$\text{Grazing capacity (*ACU)} = \frac{\text{Grazing area} \times \text{hay yield} \times \text{utilization factor}}{\text{Daily feed requirement of an animal} \times \text{number of grazing days}}$$

$$\text{Grazing area per animal (ha)} = \frac{\text{Number of grazing days} \times \text{Daily feed requirement of an animal}}{\text{Hay yield} \times \text{utilization factor}}$$

* ACU (Adult Cattle Unit)= This corresponds to a live weight of 500 kg for cultivated cattle. One female buffalo corresponds to a weight of 0.75 (375 kg). Grazing capacity was calculated on the basis of one female buffalo. (Utilization factor: %70; Daily feed requirement of an animal: 9 kg for water buffalo; number of grazing days: 30 days).

3. Results and Discussion

Botanical composition

Vegetation surveys carried out at the beginning of June identified 12 different species in 2022 and 10 in 2023. In the first year, three species (22.36%) were leguminous, four species (68.47%) were grasses, and five species (9.17%) belonged to forbs. In the second year, the proportion of species was as follows: legumes (20.23%), grasses (74.82%), and forbs (4.95%). The number of forbs decreased to three (Table 3). From July to November, when grazing ended, *Paspalum* became the dominant species in the botanical composition due to the grazing area being a wetland and covered the entire area. In the relatively dry areas, *Cynodon* species became dominant. Other species withdrew from the vegetation during the summer grazing period (Table 3). *Paspalum paspalodes* thrives in wetlands where species diversity is low due to excessive water. Its tightly developed roots prevent other plants from taking hold. It is an excellent source of food for cattle and birds. These floodplain

meadows, which can be grazed on all summer long, are sensitive to changes in the delta system and in the amount of water because they form close to lakes when alluvium spreads into the delta (Albayrak, 2023). Wetlands are home to numerous animals, and wetland plant communities are vital to these productive ecosystems. Wetlands, in general, are dominated by herbaceous plants and are characterized by wet soils during the dry season and stagnant water during the rainy season. Therefore, describing the types of vegetation a wetland supports is the first step in assessing its health (Moges et al., 2017). In our study, the average proportion of grasses in the botanical composition was found to be 71%. Tsiobani et al. (2014) reported that water buffaloes spent more time feeding on grasses (74%) in comparison to woody species (21.5%) and forbs (4.5%) in Greece wetland. The proportion of grasses in the study area was similar to the findings of the above study. Tsiobani et al. (2019) found that *Cynodon* and *Trifolium* species were dominant in the wetland during the summer period, which supports our study.

Table 3. Vegetal characteristics of the grazing area of Habilli region

Plant species	Plant cycle type	Botanical composition		Quality score	Grazing Quality Degree	
		2022	2023		2022	2023
Legumes						
<i>Trifolium resupinatum</i>	A	11.23	9.18	6	0.67	0.55
<i>Lotus corniculatus</i>	P	7.46	6.25	8	0.60	0.50
<i>Trifolium campestre</i>	A	3.67	4.80	7	0.26	0.34
TOTAL		22.36	20.23		1.53	1.39
Grasses						
<i>Cynodon dactylon</i>	P	28.45	23.77	6	1.71	1.43
<i>Paspalum distichum</i>	P	22.17	18.46	8	1.77	1.48
<i>Lolium perenne</i>	P	14.23	25.84	8	1.14	2.07
<i>Poa annua</i>	A	3.62	6.75	4	0.14	0.27
TOTAL		68.47	74.82		4.76	5.24
Forbs						
<i>Plantago lansolata</i>	P	3.11	2.26	4	0.12	0.09
<i>Spergularia media</i>	A/P	2.14	1.73	1	0.02	0.02
<i>Bellis perenne</i>	P	1.58	0.96	3	0.05	0.03
<i>Euphorbia</i> sp.	A/P	1.19	-	-1	-	-
					0.01	-
<i>Eryngium creticum</i>	A	1.15	-	0	0.00	-
TOTAL		9.17	4.95		0.18	0.14
TOTAL		100	100		6.47	6.77

A: Annual, P: Perennial

Grazing Quality Degree

Pasture condition is a classification system that shows the current state of the vegetation in a pasture compared to the original vegetation under the current climate and soil conditions. A pasture condition classification based on this structure makes it easy to determine the degree of deterioration of the plant community that constitutes the pasture's vegetation or the extent to which the existing vegetation has moved away from the climax vegetation. For this reason, pasture quality grades were established for pasture sections in the research areas (Okatan, 1987). The quality score of the pasture area was 6.47 in the first year of the study and increased to 6.77 in the second year. Based on the quality score, the condition of the grazing area was deemed good. The high proportion of grasses in the botanical composition explains the good grazing conditions. Since the wetland area was completely covered with *Paspalum* from July to November, the quality score of the area likely increased during this period (Table 3).

Dry forage Yield

The wire cages placed in the wetland in April were opened at 30-day intervals from June to November, during which time the forage yield of the area was determined by mowing inside and outside the cages. Additionally, the grazing intensity of the area was determined using the yield values inside and outside the cages (Figure 4). The highest dry forage yield within the cage in both the

first and second years was obtained in the first cut (3.47 and 3.78 tons per hectare, respectively). The lowest yield was in November of both years (1.82 and 1.91 t/ha, respectively). During the six-month grazing period, the total dry forage yield was 15.11 t/ha in the first year and 16.36 t/ha in the second year. Although there is much research on dry forage yields in natural pasture areas, research on dry forage yields in wetlands is limited. Hanoğlu and Gökkuş (2021) reported that the average dry forage yields of pastures in Mediterranean, Eastern Anatolia, Aegean, Southeast Anatolia, Central Anatolia, Black Sea and Marmara regions were 0.65, 1.21, 0.76, 0.55, 0.55, 0.53, 1.33 and 0.82 t/ha, respectively. The average of Turkey was 0.90 t/ha. Füresz et al. (2023) found that the Csakvar wetland in Hungary had a yield of 15.7 t/ha during the grazing period. Although the dry forage yield we found for the wetland was considerably higher than that of normal pasture areas, it was very close to typical wetland dry herbage yield values. The highest grazing intensity in 2022 was determined to be in June at 79%. Grazing intensity decreased in the following months, reaching the lowest level of 52% in October. Similarly, in 2023, grazing intensity was 80% when the animals entered the grazing area. This intensity decreased somewhat in subsequent months. The decrease in grazing intensity was also observed to be due to the decrease in the water level in the wetland. Additionally, changes in the number of grazing animals contributed to the decrease in grazing pressure.

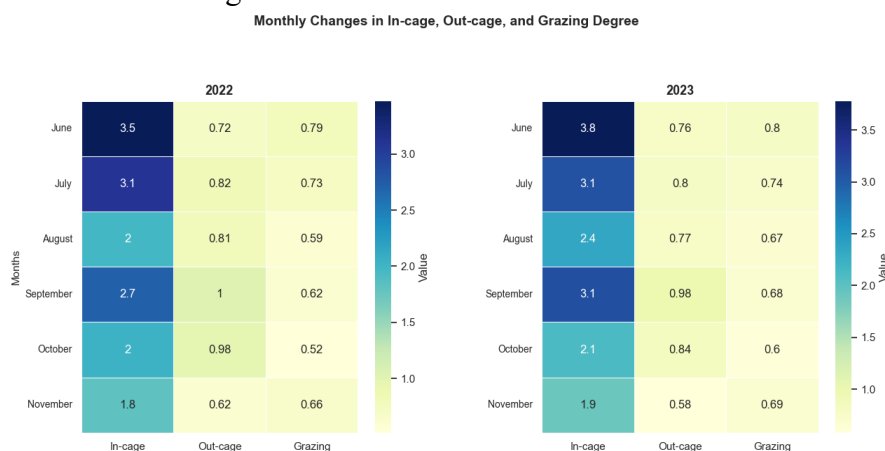


Figure 4. Monthly inside and outside cage dry forage yields (t/ha).

Grazing Capacity

The dominant grazing animal in the Habilli Wetland is the water buffalo. Therefore, water buffalo were taken into consideration when

determining the grazing capacity. Additionally, since sheep graze in the area during the summer, their grazing capacity was calculated for the period between July and November (Figure 5). In both

years of the study, the highest grazing capacity was found in June, at 1022.27 and 1100.14 ACU, respectively. There was a decrease in July and August, followed by a partial increase in September. A further decrease in grazing capacity was observed in October and November. When grazing capacity increased, the grazing area per animal was also high. The grazing capacities determined for sheep in each month were similar to the values for buffalo. In both years, the grazing capacity in July was higher than in the other months (Figure 5). The appropriate grazing intensity in

wetlands should be determined according to the existing vegetation and its ability to recover. Grazing intensity varies according to the number of animals, the grazing interval, and the grazing regime. According to Wilson et al. (2008), ratios of approximately 0.3-1.0 head of cattle per hectare are sufficient to promote wetland plant diversity and protect wetland values. Beemster and Vulink (2013) found that an area of 0.6–0.8 hectares was suitable for cattle grazing in Netherlands. Our research findings are compatible with values reported in the literature (Figure 5).

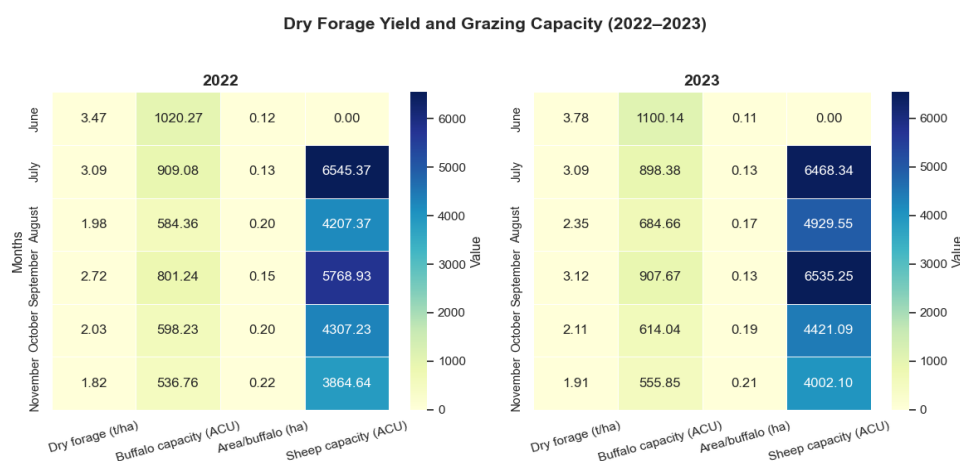


Figure 5. Dry forage yield, grazing capacity and area per buffalo and sheep.

*ACU= corresponds to a cultivated cattle with a live weight of 500 kg. 1 female buffalo corresponds to a weight (375 kg) with a coefficient of 0.75 (Grazing capacity is calculated based on female buffalo).

** ACU= corresponds to 500 kg live weight of cultivated cattle. 1 sheep corresponds to 0.1 coefficient weight (50 kg) (Grazing capacity is calculated based on sheep).

4. Conclusion

The Habilli region is located west of the Kızılırmak Delta and south of Karaboğaz Lake. It covers 117 hectares. While a significant portion of the area is underwater in the winter, the water recedes in the spring. Plants from various families were found in the area, but the *Paspalum paspalodes* becomes dominant in July, covering a significant portion of the region. In addition to buffalo grazing, the area was also used for sheep grazing. As the grazing season begins in the Habilli region, the gradual withdrawal of water from the

area must be managed. Otherwise, consider that grazing conditions will not occur if the water density is high.

Acknowledgements

This study was supported under the name of “Kızılırmak Delta Wetland and Bird Paradise Grazing Management Project” within the scope of the contract signed between “General Directorate of Protection of Natural Assets” and “AKS Planning and Engineering Ltd. Co.” on October 25, 2021.

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