

**PRELIMINARY OBSERVATIONS OF THE SEAGRASS
CYMODOCEA NODOSA (UCRIA) ASCHERSON IN THE
MEDITERRANEAN WATERS OF ALEXANDRIA, EGYPT**

H. M. MOSTAFA*

Department of Oceanography, Faculty of Science, University of
Alexandria, Moharrem Bey, 21511-Alexandria-Egypt.

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ABSTRACT

Samples of the seagrass Cymodocea nodosa (Ucria) Ascherson were collected seasonally during 1993 from seagrass bed at Montazah Bay (east of Alexandria), Egypt. Different phenological parameters (shoot density, leaf density, etc.), were measured. Generally, the highest values of phenological parameters were recorded in early summer, while the lowest were recorded during autumn and Winter. Maximal leaf area index was recorded in June ($2.01 \text{ m}^2 \cdot \text{m}^{-2}$) and minimal in February ($0.14 \text{ m}^2 \cdot \text{m}^{-2}$). The maximum leaf biomass was recorded in June ($90.7 \text{ g dw} \cdot \text{m}^{-2}$) and the minimum in November and February (35.2 and $28.3 \text{ g dw} \cdot \text{m}^{-2}$ respectively). The length of the internodes of the plagiotropic rhizome was minimal during Winter (4 mm). Toward early summer, it reached its maximum length (26 mm), decreased toward mid summer (21 mm), reaching its least in autumn (10.5 mm). Neither flowers nor seed were detected. It seems that the growth of Cymodocea nodosa is most probably related to changes in water temperatures and other environmental factors.

INTRODUCTION

Seagrasses are submerged rooted marine aquatic angiosperms, completely adapted to live in the marine environment, occurring world-wide in shallow coastal waters, except for the most polar latitudes (Pirc *et al.*, 1986). In the Mediterranean Sea, *Cymodocea nodosa* (Ucria) Ascherson is considered the second most widely distributed seagrass, behind the endemic Mediterranean seagrass *Posidonia oceanica* (L.) Delile (Buia *et al.*, 1985) and extend along the Atlantic coast of Africa (Den Hartog, 1970). These seagrasses form the basis of critical, yet extremely fragile ecosystems in the shallow coastal embayments. Seagrass meadows are highly productive and particularly vulnerable to different environmental impacts (eutrophication, erosion, etc.), (Mostafa, 1991).

The regression of *P. oceanica* meadows is mostly replaced by *C. nodosa* and as a result, *P. oceanica* and *C. nodosa* do not form mixed persistent stands (Den Hartog, 1977). *C. nodosa* living in a less stable environment and having a long life span (perennial species), shows rapid development and strong rhizome and leaf growth and a clear seasonality in meadow structure (Buia and Mazzella, 1991). The phenology, growth and distribution of *P. oceanica* have been recently investigated along the coastal waters of Alexandria (Mostafa, 1991). However, little is known about the populations of *C. nodosa* in this area.

Apart from the dated work of Nasr and Aleem (1949) and Aleem (1955), no recent attempt has been made to study the distribution and phenology of *C. nodosa* in the coastal waters of Alexandria. The present work is the only recent preliminary investigation of the distribution and phenology of the seagrass *C. nodosa* in the Mediterranean waters off Alexandria.

STUDY AREA

This study was conducted at a semi-enclosed bay, Montazah Bay (Lat. 31 00'N and Long. 30 00'E). This bay is connected to open waters through two main adjacent openings (Fig.1). The main large opening allow considerable quantities of water to enter the bay, while the other smaller opening allow water exchange on a small scale. The water circulation in the bay is very complicated with common eddy movements due to the limited closing area of the bay and its two adjacent openings. The maximum water depth of the bay is about 6 to 7 m.

PHENOLOGY OF *CYMODOCEA NODOSA*

The surface water current values ranged between 6.4 to 11.3 cm.sec⁻¹ and between 4.9 to 15.9 cm.sec⁻¹ at 3 m depth. The water salinity ranged between 38.7‰ in surface waters and 39.1‰ in bottom waters. Dissolved oxygen values ranged between 4.2 and 4.5 mg O₂ L⁻¹ in surface and bottom waters respectively. Percentage of oxygen saturation values varied between 88 in surface waters and 86 in bottom waters. Light measurement indicated that secchi disc was always clear at the bottom. Inorganic phosphorus ranged between 0.7 and 0.8 g atom L⁻¹ in surface and bottom waters. Inorganic nitrate concentrations varied between 6 and 8.6 g atom L⁻¹ in surface and bottom waters respectively. Total suspended matter ranged between 3 g/m³ in surface waters and 11 g/m³ in bottom waters. The percentage composition of sediments for grain size analysis showed that coarse sand constituted 27.9 , medium sand 42.8 , fine sand 28.6 and mud was only 0.7 (Oceanography department, scientific report on Montazah bay ecosystem-October 1991-March 1992; unpublished).

MATERIALS AND METHODS

The distribution of the seagrass *C. nodosa* was mainly performed using skin and SCUBA diving along the shallow coastal waters of Alexandria (down to about 6-7 m depth). It is to be mentioned that there is no facility to use aerial photography or satellite imagery. Samples of the seagrass *C. nodosa* were collected during February, June, August and November 1993, from Montazah Bay at 3.5 m depth. The sampled bed is about 6 m. in length and about 4 m in width (it is more or less rectangular in shape). A metal frame of 0.5 m² surface area was used to collect the seagrass shoots. The plants grow mostly buried in coarse sand, and only parts of the leaves are visible. Three replicates were collected during each sampling with whole rhizomes, shoots and roots and were placed immediately in plastic bags and kept on ice. The bottom temperature was measured to the nearest 0.01C using an ordinary thermometer. In the laboratory, the shoots and roots were separated from the rhizomes and were washed separately with fresh and distilled water. The alternating leaves were separated according to Caye and Meinesz, (1985 a). Shoot density, leaf density, number of leaves per shoot and leaf area indices were recorded. The leaf area index was calculated by multiplying the length of the leaf by its width and the total leaf area indices were calculated as the sum of all leaves measured. The leaf area indices of the new leaves were not taken into account. For biomass

measurements, leaves, root and rhizomes after being washed with fresh and distilled water, were placed separately in an oven at 80 C for 48 hours and the biomass was recorded by weighing the material using a Mettler digital balance Model 1310 to the nearest 0.01 g.

The annual cycle (growth of rhizomes and length of internodes), was measured by applying a small metal ring behind the apex of the rhizome (Caye and Meinesz, 1985a). Twenty rhizomes were marked each season and left for 15 days after which the plants were collected and measurements of rhizome growth and length of the internodes were determined.

RESULTS

The water temperature recorded during collection were 16.6 C in winter, 25.3°C in late spring, 28.3°C in summer and 20.3°C during autumn. Temperature recorded during different seasons were highly correlated with leaf biomass and the number of leaves per shoot (0.957 and 0.928 respectively, n=32).

The distribution of the seagrass *C. nodosa* along the city coast of Alexandria declared that the seagrass is mainly confined to local small patches. These patches are found scattered among different algal associations (*Ulva* and *Colpomenia*) in muddy, sandy and rocky substrates at shallow depths (0.5-3 m.) and mostly in areas subjected to domestic sewage (e.g. Gleem, Sidi-Gaber and El-Shatby, Fig.1). Towards the east, *C. nodosa* beds are located in semi-enclosed embayments with sandy bottoms that are protected by rocky formations (e.g. Miami and Montazah, Fig.1). These beds are under the impact of domestic pollution and fresh water run-off. Towards the west, meadows of *C. nodosa* were discovered at depths of 4 to 6 m. near areas mainly occupied by the seagrass *P. oceanica* with mainly sandy bottoms (e.g. El-Agami and El-Hanovil, Fig. 1). These beds are subjected to open water waves and storms during winter season, (Mostafa, 1991). It should be noted that such observations are to be considered the first in more than 35 years (since the work made by Aleem,1955). The distribution of *C. nodosa* beds inside Montazah bay (Fig.1), shows that the seagrass beds are located in the eastern part of the bay between 0.5 and 4 m depth. This distribution is probably related to the water circulation inside the bay. The plant is always buried in the sand and only the green leaves are shown.

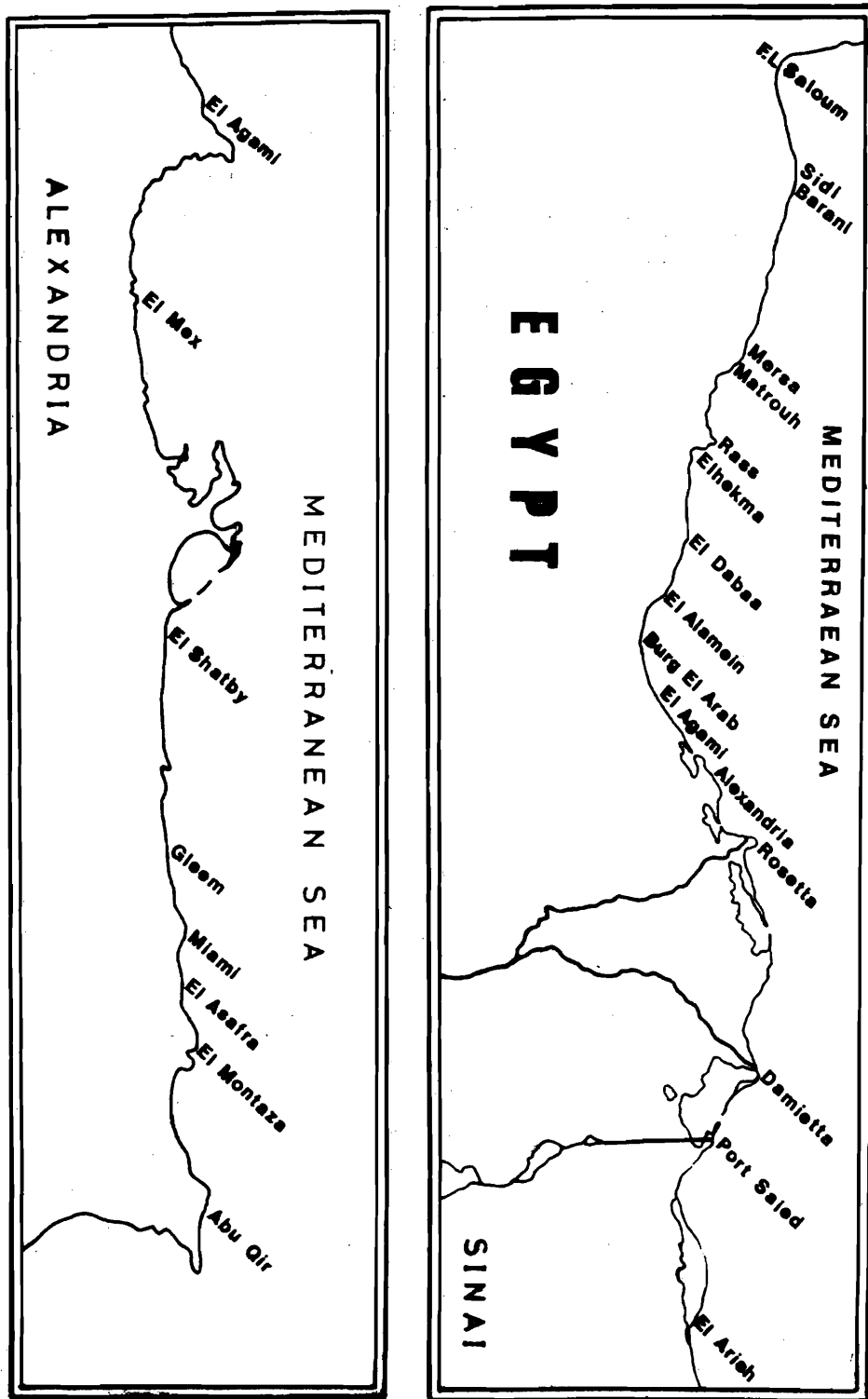


Fig.(1): The study area showing the sampling location.

The foliage of *C. nodosa* was particularly dense in June with maximum recorded leaf density (1695 ± 57 leaves $\cdot m^2$, $n=92$) and shoot density (404 ± 30 shoots $\cdot m^2$, $n=4$), (Fig. 2). These values decreased towards summer (1348 ± 32 leaves $\cdot m^2$ and 332 ± 19 shoots $\cdot m^2$ for both the leaf density and the shoot density, respectively). The minimum leaf and shoot densities were recorded in winter (472 ± 20 and 202 ± 17 $\cdot m^2$ respectively) (Fig. 2). The leaf area index was maximal in June (2.01 ± 0.49 $m^2 \cdot m^2$, $n=92$), with a maximum number of 4.2 leaves per shoot and minimal in February (0.14 ± 0.05 $m^2 \cdot m^2$, $n=68$) with a minimum number of 2.3 ± 0.2 leaves per shoot. Variations in LAI have been noted in other marine phanerogammes (*Posidonia* and *Thalassia*) (Mostafa, 1991 ; Zieman, 1975).

The leaf biomass (g dw $\cdot m^2$) was maximal during June (90.7 ± 1.6 g dw $\cdot m^2$, $n=4$) and minimal in February (28.3 ± 0.8 g dw $\cdot m^2$) (Fig.3), while the rhizome and root biomass were also maximal in June (135.4 ± 12.8 and 60.7 ± 3.9 g dw $\cdot m^2$ respectively, $n=4$) and showed decreasing values towards summer and autumn. The minimal values for rhizome and root biomass were recorded during February (46.4 ± 1.5 and 32.5 ± 1.7 g dw $\cdot m^2$ respectively, $n=4$). The root biomass during winter was more or less comparable to that of autumn (39.7 ± 1.3 g dw $\cdot m^2$), (Fig. 3).

The annual cycle of the long plagiotrope rhizome showed seasonal variations. In late winter, the length of the internodes was very short (4 ± 1 mm), towards the end of spring, the maximum growth in the length of the internodes was recorded (26 ± 4 mm). In summer, the growth was decreased to about 21 ± 4 mm, while in autumn, it decreased to about half of that of summer (10.5 ± 2 mm). A Kruskal-Wallis one way analysis of variance for all the results, showed that there was statistically significant difference for all the groups measured ($P=0.000027$) ($n=92$). A Pearson Product Moment Correlation between all the parameters measured revealed that temperature was highly correlated to the number of leaves per shoot (0.974 , $p=0.026$) ($n=92$). This correlation indicates the importance of temperature for the growth of the leaves of the plant. The number of leaves per shoot was highly correlated to the leaf, rhizome and root biomass (0.959 , $p=.041$; 0.952 , $p=.048$ and 0.94 , $p=.049$ for leaf, rhizome and root respectively, $n=92$), as well as to the annual rhizome growth cycle (0.983 , $p=.017$; $n=20$).

PHENOLOGY OF *CYMODOCEA NODOSA*

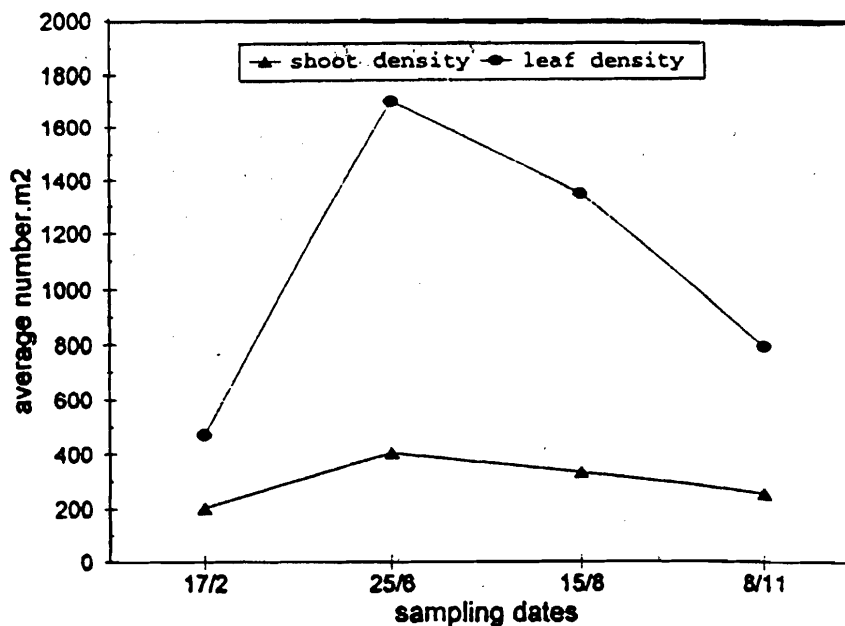


Fig.(2): The shoot density (number .m²), leaf density(number .m²), number of leaves per shoot and the leaf area index per shoot and per m² of the seagrass *Cymodocea nodosa* at Montazah bay during 1993.

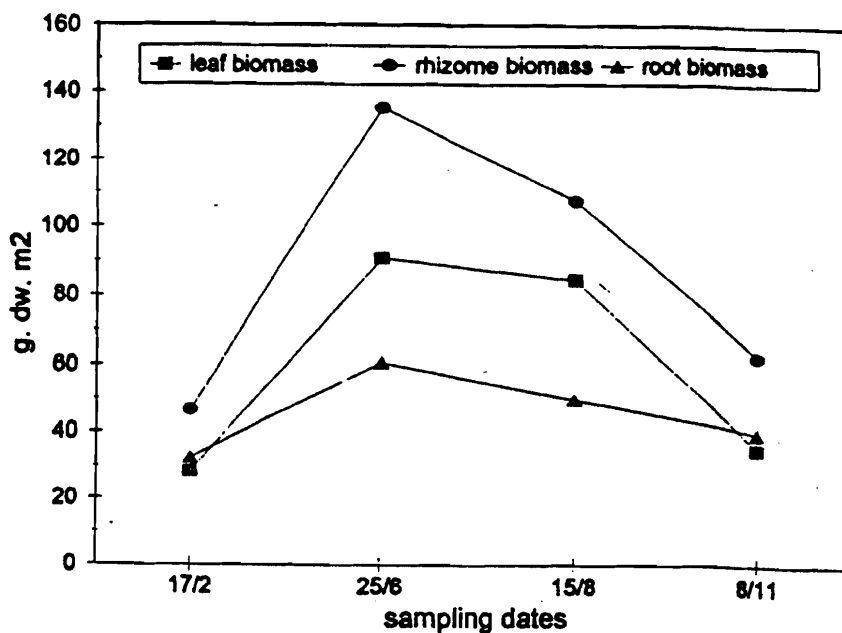


Fig.(3): The leaf, rhizome and root biomass (g dw.m⁻²) of the seagrass *Cymodocea nodosa* at Montazah bay during 1993.

DISCUSSION

The growth and production of the seagrass *C. nodosa* showed clear seasonal trend. The maximum seagrass growth was recorded at early summer and the minimum in winter. Buia and Mazzella (1991), concluded that the maximum shoot density of the seagrass *C. nodosa* was recorded during June around the Island of Ischia which agrees with the present findings. The growth and biomass of the plant showed decreasing trends from summer to late autumn (Fig. 2 and 3). This decrease is possibly correlated to leaf decay that starts already during summer (Buia and Mazzella, 1991) and /or due to the autumn and winter storms that strongly affect these meadows (Mostafa, 1991).

The seasonal growth of the plant could probably be related to change in water temperature and seasonal changes in light availability that affect the growth of the plant. According to Pirc (1984) and Mazzella and Ott (1984), the change in temperature over the year seems to play an important role in regulating the reproduction cycle of *C. nodosa* which influence the leaf growth and production. Den Hartog (1970), concluded that *C. nodosa* is a species typical for tropical waters and that it may respond differently to annual temperature change. These responses are probably related to its origin and its geographical distribution, while its morphological variability could correspond to different genotypes (Den Hartog *et al.*, 1987). Caye and Meinesz (1986), stated that environmental factors such as temperature, salinity and nutrient supply in the sediments influence the growth and production of the seagrass *C. nodosa*. According to Caye and Meinesz (1985b), sexual reproduction of *C. nodosa* seems to ensure the maintenance of meadow stability by uprooting in winter and fast rhizome growth and production in spring. Neither flowers nor seeds were observed during the time of collection which may be related to the recent introduction of very coarse sand into the Bay due to erosion of the bottom sediments towards the east. It seems that the plant could produce vegetatively. In conclusion, the rhizome and leaf growth of the seagrass *C. nodosa* seems to be mostly related to changes in temperature and possibly to other environmental factors (light intensity, nutrient load, etc..) that play a crucial role in the seasonality and productivity of the plant.

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