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## Distribution of *Gracilaria verrucosa* (Hudson) Papenfuss (Rhodophyta) in Izmir Bay (Eastern Aegean Sea)

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**Abstract:** The present study includes the distribution of *Gracilaria verrucosa* (Hudson) Papenfuss in Izmir Bay (Eastern Aegean Sea). Samples were collected from a total of 35 stations along the lagoon areas seasonally between July 2001 and April 2002. In order to determine the abundance of *G. verrucosa* in 1 m<sup>2</sup> area, the stations were chosen according to the depths of the water. Results showed that *G. verrucosa* reached the highest in April 2002 by a value of 7.7 kg ww m<sup>-2</sup> and also the lowest value was 0.7 kg ww m<sup>-2</sup> in July 2001.

**Key words:** *Gracilaria verrucosa*, distribution, Izmir Bay, Eastern Aegean Sea

### INTRODUCTION

*Gracilaria verrucosa* (Hudson) Papenfuss, red algae (Rhodophyta), is naturally observed in Izmir Bay. This algae commercially contains important polysaccharide and agar-agar. Agar is widely used in food, agriculture, cosmetic and pharmacy industries<sup>[1,2]</sup>. There are limited studies on the distribution of this algae along the Turkish coastal waters<sup>[3,4]</sup>.

Many environmental factors affect the distribution of *G. verrucosa*. Jones<sup>[5]</sup> stated that the most healthy individuals of *G. verrucosa* are observed in sandy and muddy bottoms of Lagoon areas where strong water flow occur but strong wave motions are limited. Kim and Hum<sup>[6]</sup>, Kim<sup>[7]</sup> and Bird *et al.*<sup>[8,9]</sup> indicated that chemical and physical factors as salinity, light, nutrients and water movements have also an important affection on the growth ratio of *G. verrucosa*. Anderson *et al.*<sup>[10]</sup> mentioned that green algae *Ulva lactuca* is an epiphyte of *G. verrucosa* and causes a reduction on growth of *G. verrucosa*.

Previous study on distribution of *G. verrucosa* in Izmir Bay was carried out by Çıra<sup>[11]</sup> and this study showed that it was very abundant (12.5 kg ww m<sup>-2</sup> in July 1991) in the Bay.

The main objective of this study was to determine the distribution and abundance of *G. verrucosa* in Izmir Bay.

### MATERIALS AND METHODS

Samples of *G. verrucosa* (Hudson) Papenfuss were collected from total of 56 stations along the lagoon areas

in Izmir Bay seasonally in July, October 2001 and January and April 2002.

During sampling, a wooden (1x1 m) and iron frame (1x1 m), scratches and dredges were used and a balance accurate to within 25 g was used to measure wet weight of *G. verrucosa*.

In order to determine the abundance of *G. verrucosa* in an area of 1 m<sup>2</sup>, after placing, the frames at the bottom, *G. verrucosa* was collected by hand from the stations where the water depth is ranged from 0 to 70 cm, by scratches from the stations where the water depth is ranged from 70 to 2 m and by dredges from the stations where the water depth is 2 m and over. Samples collected were sorted, cleaned out from the epiphytes and weighed wet on the balance.

### RESULTS

Between July 2001 and April 2002, *G. verrucosa* was sampled from a total of 35 stations. Abundance of *G. verrucosa* seasonally was determined to be 2.6 kg ww m<sup>-2</sup> at the station number 22 in July 2001, 3.7 kg ww m<sup>-2</sup> at the station number 19 in October 2001, 4.7 kg ww m<sup>-2</sup> at the station number 20 in January 2002, 7.7 kg ww m<sup>-2</sup> at the station number 19 in April 2002. The lowest value was 0.7 kg ww m<sup>-2</sup> in July 2001, at the station number. *G. verrucosa* was also recorded at the depths ranging between 0.5 and 2.5 m in Izmir Bay.

Moreover, *Ulva* sp. and *Enteromorpha* sp. were observed in the *G. verrucosa* beds in the Bay. Especially, summer time with the increase of water temperature (average 22.5°C), *Ulva* sp. and *Enteromorpha* sp.

populations reached high values at stations between 21 and 49. *Ulva lactuca* was observed in the *G. verrucosa* beds at the stations 50, 51, 52, 53, 54, 55 and 56, however its population was not abundant as much as at the other stations. During summer at the stations cited above, it was observed that *G. verrucosa* started replacing the *Ulva* sp. and *Enteromorpha* sp. beds.

### DISCUSSION

The present study shows that *G. verrucosa* is abundant in the lagoon areas which are nutritionally rich and have strong water flows and sandy and muddy bottoms. Similar results were reported by Jones<sup>[5]</sup>, previously. At some stations in the investigation area, i.e., at 7 stations (station numbers 2, 12, 13, 14, 30, 36, 42) due to unsuitable bottom structure, 11 stations (station numbers 3, 9, 10, 15, 16, 31, 49, 51, 53, 55, 56), the water depth reaches over 2.5 m and 3 stations (station numbers 5, 6, 7), limited water movement and flow, *G. verrucosa* was not found. This result is similar to the findings of Kim and Hum<sup>[6]</sup>, Kim<sup>[7]</sup> and Bird *et al.*<sup>[8,9]</sup> who reported that salinity, light, nutrients and water movements influence the growth of *G. verrucosa*. Because of shallow waters are more nutritionally rich areas, *G. verrucosa* was not observed at the depths over 2.5 m in Izmir Bay.

In July, *Ulva* sp. and *Enteromorpha* sp. were observed densely at stations between 21 and 49 when day light and temperature (average 22.5°C) increased. This result supports the findings presented previously by Anderson *et al.*<sup>[10]</sup> who reported that there was no samples of *U. lactuca* in May, however genus *Ulva* was found extensively in August and they covered the *G. verrucosa* beds completely. They also, indicated that *U. lactuca* blooms when water movements slow down and day light, temperature and nitrogen levels increase in summer time in Saldanha Bay (South Africa).

*Ulva* sp. and *Enteromorpha* sp. were recorded to be less dense at the stations 50, 51, 52, 53, 54, 55 and 56 for the stronger water movements and lesser waste water sources.

The lowest abundance level of *G. verrucosa* was 0.7 kg ww m<sup>-2</sup> in July 2001 and also highest level was 7.7 kg ww m<sup>-2</sup> in April 2002. In previous study, the levels were 12.5 kg ww m<sup>-2</sup> for July 1991 and 2 kg ww m<sup>-2</sup> for April 1992<sup>[11]</sup>.

It may be concluded that growth of *Gracilaria verrucosa* distributing in Izmir Bay was influenced by the environmental conditions as salinity, temperature, day light, water depth and movement, the structure of seabed, over harvesting (2.000-2.500 ton ww/ year) and presence of *Ulva* sp. and *Enteromorpha* sp.

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