

# EFFECT OF REPEATED HARVESTING ON THE GROWTH OF SARGASUM SPP AND TURBINARIA CONOIDES OCCURRING IN MANDAPAM AREA

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## Abstract

Studies were made on the effect of repeated harvesting on the growth of *Sargassum cristaefolium*, *S. ilicifolium*, *S. polycystum*, *S. wightii* and *Turbinaria conoides* occurring at Mandapam coast for a period of 2 years during June 1986 to November 1988. The growth of these algin yielding seaweeds depended on the period of harvesting and interval between one harvest and next. The maximum standing crop with plants of maximum stature was found during the period September to January in these brown algae. An interval of 7 months is required for the regrowth of these plants to harvestable size and the suitable season for commercial exploitation of these algae is September to January.

## Introduction

In India, the brown algae *Sargassum* and *Turbinaria* are used for the production of sodium alginate by the seaweed industries. At present *Sargassum cristaefolium*, *S. ilicifolium*, *S. polycystum*, *S. wightii* and *Turbinaria conoides*, *T. decurrens* and *T. ornata* are being exploited from the natural seaweed beds in the southeast coast Rameshwaram to Kanyakumari and used as raw material for manufacturing sodium alginate. Studies were made by various workers (Valson, 1955; Umamaheswara 1969; Umamaheswara Rao, and Kalamuthu, 1972; Kaliaperumal and Kalimurthu, 1976, Kaliaperumal *et al.*, 1977; Chennubhotla *et al.*, 1978, 1982 ; Kalamuthu, 1980) on the growth and algin contents in species of *Sargassum* and *Turbinaria* growing at Mandapam area. Some information is available on the effect of repeated harvesting on the growth of agar yielding seaweeds. Hence investigation on this aspect was undertaken during 1986-88 in *Sargassum cristaefolium*, *S. ilicifolium*, *S. polycystum*, *S. wightii* and *Turbinaria conoides* growing at Krusadai Island, Pudumandam and Kilakkarai in the vicinity of Mandapam and the results obtained are presented in this communication.

**Table 1** Harvested biomass of *Sargassum cristaefolium* from Krusadai Island

| Month of harvest | Quadrat number and seaweed biomass (g wet wt/m <sup>2</sup> ) |      |      |      |       |       |      |      |      |      |      |      |
|------------------|---|------|------|------|-------|-------|------|------|------|------|------|------|
|                  | 1   | 2    | 3    | 4    | 5     | 6     | 7    | 8    | 9    | 10   | 11   | 12   |
| July '87         | 2650  | 2260 | 3850 | 1600 | 550   | 1270  | 1680 | 2300 | 2385 | 5120 | 2640 | 412  |
| August           | 490   |      |      |      |       |       |      |      |      |      |      |      |
| September        | 1220  | 2000 |      |      |       |       |      |      |      |      |      |      |
| October          | 170   | 310  | 700  |      |       |       |      |      |      |      |      |      |
| November         | 100   | 890  | 700  | 2500 |       |       |      |      |      |      |      |      |
| December         | 500   | 340  | 550  | 400  | 1700  |       |      |      |      |      |      |      |
| January '88      | 150   | 93   | 100  | 120  | 670   | 2240  |      |      |      |      |      |      |
| February         | 15  | 35   | 35   | 40   | 10    | 55    | 70   |      |      |      |      |      |
| March            | 55  | 95   | 95   | 90   | Trace | Trace | 115  | 85   |      |      |      |      |
| April            | 105   | 125  | 80   | 110  | 75    | 160   | 90   | 140  | 265  |      |      |      |
| May              | 300   | 273  | 200  | 290  | 210   | 325   | 340  | 410  | 725  | 1250 |      |      |
| June             | 630   | 760  | 935  | 830  | 895   | 1040  | 750  | 845  | 1070 | 920  | 1220 |      |
| July             | 720   | 810  | 610  | 710  | 745   | 840   | 580  | 830  | 810  | 530  | 755  | 1600 |

**Table 2** Harvested biomass of *Sargassum ilicifolium* from Krusadai island

| Month of harvest | Quadrat number and seaweed biomass (g wet wt/m <sup>2</sup> ) |       |      |      |       |       |      |       |       |       |      |      |
|------------------|---|-------|------|------|-------|-------|------|-------|-------|-------|------|------|
|                  | 1   | 2     | 3    | 4    | 5     | 6     | 7    | 8     | 9     | 10    | 11   | 12   |
| July '86         | 260   | 1740  | 4770 | 1120 | 3560  | 3900  | 3160 | 3660  | 3520  | 5340  | 3580 | 3400 |
| August           | 140   |       |      |      |       |       |      |       |       |       |      |      |
| September        | Trace   | 270   |      |      |       |       |      |       |       |       |      |      |
| October          | Trace   | Trace | 555  |      |       |       |      |       |       |       |      |      |
| November         | 10  | 30    | 115  | 110  |       |       |      |       |       |       |      |      |
| December         | 40  | 50    | 110  | 75   | 370   |       |      |       |       |       |      |      |
| January '87      | 35  | 140   | 20   | 75   | 375   | 1000  |      |       |       |       |      |      |
| February         | Trace   | 15    | 60   | 15   | 60    | 50    | 200  |       |       |       |      |      |
| March            | 30  | 50    | 25   | 73   | 75    | 40    | 125  | 100   |       |       |      |      |
| April            | 50  | 90    | 50   | 100  | 75    | 40    | 20   | 55    | 80    |       |      |      |
| May              | Trace   | 10    | 30   | 30   | Trace | Trace | 40   | Trace | Trace | Trace |      |      |
| June             | Trace   | 90    | 80   | 80   | Trace | 15    | 50   | 55    | 80    | 75    | 200  |      |
| July             | 63  | 40    | 55   | 45   | Trace | 85    | 55   | Trace | Trace | Trace | 90   | 75   |

## Material and Methods

Plants of *Sargassum cristaefolium* C.A. Agardh, *S. ilicifolium* (Turner) C. Agradh and *Turbinaria conoides* Kuetzing grow abundantly on the subtidal reef at Krusadai Island. *S. polycystum* C. Agradh and *T. conoides* occur on the subtidal reef at Kilakkarai. The intertidal rocks at Pudumadam bear luxuriant growth of *S. wightii* (Greville) J. Agradh. For studying the effect of repeated harvests on the growth of these algae, 12 permanent quadrats (1. sq.m area each) were marked randomly for each species in their natural beds by fixing four iron pegs at the four corners of the quadrats. At the start of the experiment the plants were hand picked from these 12 quadrats leaving the basal portion of the plants as followed in commercial harvesting. After one month period, the first quadrat with one month regrown plants was harvested. In the second month the first and second quadrats with one month and two months regrown plants respectively were harvested. The method of harvesting was continued till the end of the experiment for a period of 1 year to study the effect of harvesting every month. The wet weight of the harvested plants from each quadrat was taken every month. This study was made for a period of one year for *S. cristaefolium* and *S. ilicifolium* occurring at Krusadai island and *S. polycystum* and *T. conoides* growing at Pudumadam and Krusadai Island respectively.

## Results

Data collected on the biomass of *S. cristaefolium*, *S. ilicifolium*, *S. polycystum* and *S. wightii* are presented in Tables 1 to 4 and for *T. conoides* in Tables 5 and 6. The biomass of *S. cristaefolium* harvested initially from 12 quadrats during July '87 varied from 550 to 5120 g/m<sup>2</sup>. The quadrats reharvested for the first time during September '87 - January '88 showed the maximum standing crop with fully grown plants and it varied from 700 to 2500 g/m<sup>2</sup>. The quadrats reharvested for the first time and in successive months during the period May to July '88 also had high biomass (1220 to 1660 g/m<sup>2</sup> but the plants were young (Table 1).

The first harvest of *S. ilicifolium* was made from 12 quadrats in July '86 and the weight of the harvested plants varied from 260 to 5340 g/m<sup>2</sup>. Maximum biomass of plants was obtained from the quadrats reharvested for the first time during the months September '86 to January '87 and it ranged from 110 to 1000 g/m<sup>2</sup>. The quadrats reharvested for first time in all other months and in successive months in all quadrats had only less biomass (Table 2).

In *S. polycystum* the initial standing crop from 12 quadrats varied from 200 to 440 g/m<sup>2</sup> during June '87. The quadrats reharvested for the first time during November '87 to January '88 showed maximum biomass ranging from 550 to 1260 g/m<sup>2</sup> with

**Table 3** Harvested biomass of *Sargassum Polycystum* from Kilakkarai

| Month of harvest | Quadrat number and seaweed biomass (g wet wt/m <sup>2</sup> ) |     |     |       |     |      |      |     |     |     |     |     |
|------------------|---|-----|-----|-------|-----|------|------|-----|-----|-----|-----|-----|
|                  | 1   | 2   | 3   | 4     | 5   | 6    | 7    | 8   | 9   | 10  | 11  | 12  |
| July '87         | 265   | 260 | 265 | 260   | 200 | 220  | 370  | 300 | 265 | 260 | 440 | 400 |
| August           | 240   |     |     |       |     |      |      |     |     |     |     |     |
| September        | 250   | 335 |     |       |     |      |      |     |     |     |     |     |
| October          | 65  | 50  | 15  |       |     |      |      |     |     |     |     |     |
| November         | 223   | 210 | 200 | 225   |     |      |      |     |     |     |     |     |
| December         | 260   | 390 | 270 | 270   | 550 |      |      |     |     |     |     |     |
| January '88      | 173   | 190 | 260 | 220   | 325 | 1260 |      |     |     |     |     |     |
| February         | 180   | 250 | 260 | 290   | 310 | 240  | 1000 |     |     |     |     |     |
| March            | 145   | 100 | 150 | 135   | 120 | 80   | 150  | 480 |     |     |     |     |
| April            | 155   | 55  | 60  | Trace | 95  | 90   | 85   | 90  | 210 |     |     |     |
| May              | 70  | 120 | 210 | 285   | 315 | 295  | 110  | 205 | 160 | 800 |     |     |
| June             | 175   | 110 | 180 | 190   | 190 | 210  | 210  | 240 | 290 | 290 | 750 |     |
| July             | 180   | 230 | 120 | 160   | 100 | 120  | 320  | 310 | 220 | 220 | 190 | 560 |

**Table 4** Harvested biomass of *Sargassum wightii* from Pudumadam

| Month of harvest | Quadrat number and seaweed biomass (g wet wt/m <sup>2</sup> ) |       |       |       |       |       |       |       |       |       |      |      |
|------------------|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|------|
|                  | 1   | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | 11   | 12   |
| July '86         | 3430  | 5190  | 2160  | 1500  | 1370  | 2920  | 2300  | 1190  | 730   | 1130  | 1930 | 2990 |
| July             | 840   |       |       |       |       |       |       |       |       |       |      |      |
| August           | 800   | 2930  |       |       |       |       |       |       |       |       |      |      |
| September        | 505   | 530   | 2560  |       |       |       |       |       |       |       |      |      |
| October          | 420   | 510   | 200   | 4000  |       |       |       |       |       |       |      |      |
| November         | 1060  | 1540  | 400   | 440   | 6380  |       |       |       |       |       |      |      |
| December         | 405   | 890   | 205   | 335   | 250   | 2900  |       |       |       |       |      |      |
| January '87      | 575   | 510   | 40    | 420   | 555   | 370   | 4500  |       |       |       |      |      |
| February         | Trace   | Trace | Trace | Trace | Trace | Trace | Trace | Trace | Trace |       |      |      |
| March            | 65  | 60    | 60    | 300   | 370   | 25    | Trace | Trace | Trace |       |      |      |
| April            | 430   | 510   | 240   | 940   | 800   | 365   | 45    | 230   | 75    | 40    |      |      |
| May              | 275   | 225   | Trace | 260   | 260   | 160   | Trace | Trace | Trace | Trace | 925  |      |
| June             | 260   | 245   | 160   | 485   | 140   | 640   | 65    | 150   | 60    | 40    | 810  | 1040 |
| November '87     | 4300  | 4100  | 3000  | 3100  | 4200  | 1750  | 4150  | 4250  | 3500  | 3100  | 4260 | 3950 |
| December         | 275   |       |       |       |       |       |       |       |       |       |      |      |
| January '88      | 940   | 3300  |       |       |       |       |       |       |       |       |      |      |
| February         | 570   | 140   | 860   |       |       |       |       |       |       |       |      |      |
| March            | 90  | 45    | 25    | 325   |       |       |       |       |       |       |      |      |
| April            | Trace   | Trace | Trace | Trace | 60    |       |       |       |       |       |      |      |
| May              | 165   | 235   | 290   | 850   | 295   | 460   |       |       |       |       |      |      |
| June             | 130   | 145   | 180   | 170   | 105   | 100   | 240   |       |       |       |      |      |
| July             | 420   | 220   | 110   | 270   | 110   | 105   | 130   | 320   |       |       |      |      |
| August           | 540   | 105   | Trace | 300   | 405   | 100   | 320   | Trace | 340   |       |      |      |
| September        | 445   | 550   | 180   | 540   | 290   | 330   | 150   | 560   | 190   | 220   |      |      |
| October          | 640   | 520   | 540   | 380   | 350   | 160   | 110   | 240   | 165   | 120   | 1760 |      |
| November         | 170   | 175   | 50    | 75    | 200   | 120   | 210   | 230   | 160   | 200   | 150  | 2500 |

well grown plants. The quadrats reharvested for the first time during April to June '88 showed maximum biomass ranging from 550 to 1260 g/m<sup>2</sup> with well grown plants. The quadrats reharvested for the first time during April to June '88 had young plants with slightly high biomass of 560 to 800 g/m<sup>2</sup> (Table 3).

The plants of *S. wightii* were harvested from 12 quadrats (separately for every year) at the start of the experiments in July '86 and November '87 and the biomass varied from 730 to 5190 g/m<sup>2</sup> and 1750 to 4300 g/m<sup>2</sup> respectively. During the two years study period, maximum biomass with well grown reproductive plants ranging from 1760 to 6380 g/m<sup>2</sup> occurred in the quadrats harvested for the first time from October to January. During first year although the biomass was slightly more (925 to 1040 g/m<sup>2</sup>) in the quadrats harvested for the first time in May and June, the plants were young (Table 4).

The vegetation of *T. conoides* from Kilakkarai was harvested from 12 quadrats at the start of the experiment in August '87 and the biomass varied from 3150 to 7320 g/m<sup>2</sup>. The quadrats reharvested for the first time in December '87, January, June and July '88 had maximum biomass ranging from 2050 to 3040 g/m<sup>2</sup>. The plants reharvested during December and January were fully grown with reproductive structures while those harvested during July and August were young (Table 5).

The population of *T. conoides* from Krusadai Island was harvested from 12 quadrats (separately for every year) at the beginning of experiments in June '86 and August '87 and the biomass of harvested plants ranged from 1740 to 6700 g/m<sup>2</sup> and 4270 to 6980 g/m<sup>2</sup> respectively. During the two year period, maximum standing crop of plants ranging from 575 to 3140 g/m<sup>2</sup> was recorded from the quadrats reharvested for the first time in the months September to January. The quadrats reharvested for the first time and in successive months during May to July also had more biomass, but the plants were young and vegetative (Table 6).

## Discussion

The present study indicates that regrowth of *Sargassum* and *Turbinaria* depends on the interval between one harvest to the other. These algin yielding seaweeds take about 7 months for their regrowth to harvestable size and attain maximum stature during the period September to January. It is evident from the present investigation that the peak growth period for *S. cristaefolium*, *S. ilicifolium*, *S. polycystum*, *S. wightii* and *T. conoides* is from September to January. The results obtained in the present study agree with the earlier findings on the growth behaviour of *S. ilicifolium* (Chennubhotla *et al.*, 1982), *S. polycystum* as *S. myriocystum* (Kalimuthu, 1980 and Chennubhotla *et al.*, 1982), *S. wightii* (Umamaheswara Rao, 1969) and *T. conoides* (Umamaheswara Rao,

**Table 5** Harvested biomass of *Turbinaria conoides* from Kilakkarai

| Month of harvest       | Quadrat number and seaweed biomass (g wet wt/m <sup>2</sup> ) |      |      |       |       |      |       |      |      |      |      |      |
|------------------------|---|------|------|-------|-------|------|-------|------|------|------|------|------|
|                        | 1   | 2    | 3    | 4     | 5     | 6    | 7     | 8    | 9    | 10   | 11   | 12   |
| August '87             | 5200  | 4500 | 6300 | 5500  | 3250  | 5700 | 4780  | 3150 | 4350 | 6230 | 6750 | 7320 |
| September <sup>h</sup> | 725   | .    |      |       |       |      |       |      |      |      |      |      |
| October                | 1200  | 1140 |      |       |       |      |       |      |      |      |      |      |
| November               | 510   | 850  | 660  |       |       |      |       |      |      |      |      |      |
| December               | 900   | 1320 | 920  | 2700  |       |      |       |      |      |      |      |      |
| January '88            | 260   | 205  | 170  | 115   | 2050  |      |       |      |      |      |      |      |
| February               | 275   | 250  | 550  | Trace | Trace | 650  |       |      |      |      |      |      |
| March                  | 100   | 100  | 110  | 70    | 60    | 80   | 740   |      |      |      |      |      |
| April                  | 120   | 55   | 40   | 70    | 75    | 125  | Trace | 350  |      |      |      |      |
| May                    | 170   | 140  | 130  | 150   | 120   | 140  | 140   | 170  | 450  |      |      |      |
| June                   | 240   | 235  | 305  | 280   | 260   | 340  | 385   | 470  | 290  | 603  |      |      |
| July                   | 2690  | 2460 | 2220 | 2450  | 2495  | 1715 | 2600  | 2360 | 2765 | 2675 | 3040 |      |
| August                 | 800   | 800  | 1500 | 800   | 1000  | 1000 | 1000  | 1000 | 900  | 800  | 1200 | 3000 |



**Table 6** Harvested biomass of *Turbinaria conoides* from Krusadai island

| Month of harvest | Quadrat number and seaweed biomass (g wet wt/m <sup>2</sup> ) |       |       |       |       |       |       |       |       |      |      |      |
|------------------|---|-------|-------|-------|-------|-------|-------|-------|-------|------|------|------|
|                  | 1   | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10   | 11   | 12   |
| June '86         | 2540  |       |       |       |       |       |       |       |       |      |      |      |
| July             | 325   |       |       |       |       |       |       |       |       |      |      |      |
| August           | 260   | 360   |       |       |       |       |       |       |       |      |      |      |
| September        | 30  | 140   | 1540  |       |       |       |       |       |       |      |      |      |
| October          | 695   | 125   | 995   | 1960  |       |       |       |       |       |      |      |      |
| November         | 40  | 65    | 15    | 90    | 2400  |       |       |       |       |      |      |      |
| December         | 115   | 150   | 35    | 450   | 155   | 3140  |       |       |       |      |      |      |
| January '87      | 100   | 150   | 400   | 395   | 600   | 770   | 1720  |       |       |      |      |      |
| February         | Trace   | Trace | Trace | Trace | Trace | Trace | Trace | Trace | Trace |      |      |      |
| March            | 65  | 90    | 20    | 515   | 225   | 40    | 240   | 300   | 340   |      |      |      |
| April            | 120   | 235   | 120   | 360   | 240   | 210   | 260   | 110   | 600   | 915  |      |      |
| May              | 130   | 100   | 270   | 1250  | 1350  | 1400  | 650   | 450   | 630   | 1060 | 925  |      |
| June             | 65  | 90    | 45    | 100   | Trace | Trace | 100   | 140   | Trace | 130  | 140  | 220  |
| August '87       | 6540  | 4600  | 5260  | 4320  | 4790  | 6290  | 4870  | 5920  | 6980  | 5220 | 4270 | 5250 |
| September        | 620   |       |       |       |       |       |       |       |       |      |      |      |
| October          | 600   | 800   |       |       |       |       |       |       |       |      |      |      |
| November         | 250   | 325   | 575   |       |       |       |       |       |       |      |      |      |
| December         | 700   | 500   | 440   | 1250  |       |       |       |       |       |      |      |      |
| January '88      | 800   | 560   | 860   | 260   | 840   |       |       |       |       |      |      |      |
| February         | 250   | 150   | 175   | 280   | 180   | 1020  |       |       |       |      |      |      |
| March            | 245   | 390   | 265   | 350   | 280   | 215   | 480   |       |       |      |      |      |
| April            | 105   | 155   | 225   | 160   | 165   | 200   | 155   | 650   |       |      |      |      |
| May              | 4490  | 450   | 470   | 500   | 500   | 325   | 250   | 600   | 1900  |      |      |      |
| June             | 1720  | 1540  | 1370  | 1295  | 1330  | 1660  | 1665  | 1485  | 1450  | 2325 |      |      |
| July             | 1560  | 1780  | 1160  | 1760  | 1275  | 1840  | 1275  | 1340  | 1250  | 1860 | 3500 |      |
| August           | 400   | 550   | 450   | 650   | 350   | 450   | 500   | 400   | 650   | 550  | 600  | 1100 |

1969; Chennubhotla *et al.*, 1978) growing at Mandapam coast. The suitable period for commercial exploitation of these alginophytes is from September to January for obtaining maximum biomass with fully grown plants. The harvest should be avoided during February to August to ensure regrowth of these brown algae to harvestable size.

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