THE RATE OF ALGÆ (LUMUT) PRODUCTION IN THE DAGAT-DAGATAN SALT-WATER FISHERY EXPERIMENTAL STATION FISHPONDS.[1]

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FIVE TEXT FIGURES

SUMMARY

Lumut is the Tagalog term used to designate the assemblage of filamentous green algæ (Chlorophyceæ) sometimes intermingled with filamentous blue-green algæ (Myxophyceæ) growing in brackish and salt-water ponds and composing the main bulk of the natural food of cultivated bañgos, or milkfish, *Chanos chanos* (Forskål).

The present experiment is intended to provide the basic rate of production data that may eventually be used as a standard of estimate of productivity in bañgos fishpond projects. It was undertaken at the Dagat-dagatan Salt-Water Fishery Experimental Station, Malabon–Navotas, Rizal, in six equally-sized ponds lying side by side, for a period of eight months and divided into two experimental runs of four months duration.

"Lumut" is a vernacular term (Tagalog) used for the assemblage of filamentous green algæ (Class Chlorophyceæ) and sometimes intermingled with some of the filamentous blue-green algæ (Class Myxophyceæ) which grow in brackish and salt-water ponds in the Philippines. It composes the main bulk of the food of *bañgos,* or milkfish, *Chanos chanos* (Forskål) under cultivation.

The following experiment on lumut is intended to provide a method of estimating the total production of the algæ per unit area under conditions obtaining in Philippine milkfish ponds. This should provide a basis in estimating the bañgos productivity in fishpond projects. Experimental work was undertaken from November 1, 1949 to February 27, 1950 and from July 31, 1950 to October 30, 1950 at the Dagat-dagatan Salt-Water Fishery Experimental Station, Malabon–Navotas, Rizal Province, Luzon.

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MATERIALS AND METHODS

Six ponds of nearly identical construction, each 50 square meters in area (5 × 10 meters), and located side by side were selected for the experiment. The ponds were drained, leveled, then dried. With the gates properly screened, a limited amount of water was allowed into the ponds. Lumut growth was started in each pond by planting on the pond bottom six patches of weighed algæ of about same age stage obtained from one spot of another pond of the station.

Microscopic examination of the algæ used showed that they were predominantly composed of *Chaetomorpha* sp. with few stray filaments of *Enteromorpha intestinalis* and *Cladophora* sp. and rarely some closely adhering filamentous blue-green algæ.

Observations on temperature, pH, salinity, depth of pond water and general weather conditions were made two days each week (Tuesdays and Fridays). Two observations, one in the morning at 9:00 o'clock and the other in the afternoon at 3:00 o'clock, during these two days were made from the beginning until the end of the experiment.

These two experimental runs extended for a period of four months each, one for the high-salinity dry period (November to February) and the other for the low-salinity rainy period (July to October). The depth of the water was regulated during each period by not allowing the ponds to dry up nor go beyond a depth of one meter in order to minimize interference with the normal growth of the lumut. Renewal of the water in each of the experimental ponds was made once a week, the time for this procedure depending on the condition of the tide.

The observations on the rate of lumut growth in these six ponds were divided into three groups as follows:

GROUP A. *Ponds I and II.*—All the lumut planted in these two ponds was collected and weighed after every seven days. This lumut was returned to the same pond from where it was taken. The above procedure and other pertinent observations (meteorological and hydrographic observations) were undertaken in these two ponds during the entire span of the experiment.

GROUP B. *Ponds III and V.*—The lumut planted in these two ponds was collected and weighed after every 28 days. It was returned to the same pond and properly oriented to the condition very close to its state previous to weighing. This procedure and other pertinent observations

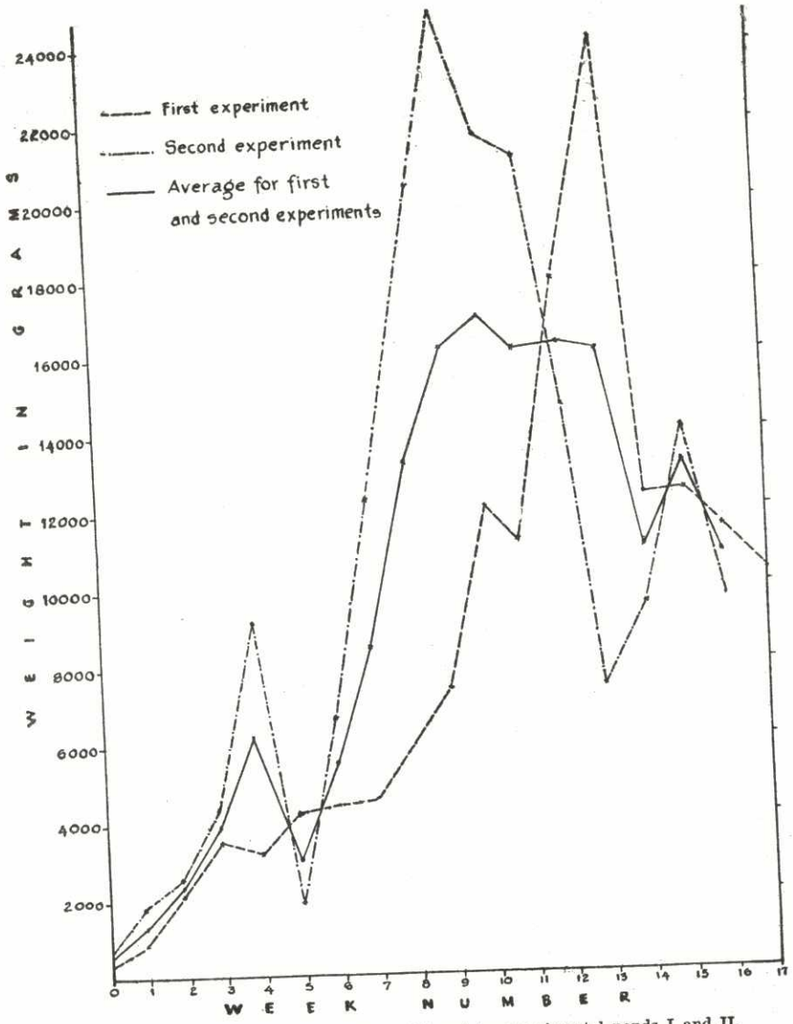

FIG. 1. Weekly increase in weight of lumut in experimental ponds I and II.

were undertaken in these two ponds during the entire span of the experiment.

GROUP C. *Ponds IV and VI.*—The lumut planted in these two ponds was collected and weighed at the end of the experimental period. Except for the above procedure the same observations as in groups A and B were made on these two ponds during the experiment.

The evaluation of the entire crop of lumut produced from each of these ponds at the end of the experiment is interpreted in terms of wet weight; that is, the weight taken as soon as water stops dripping from the algæ that have previously been hung on a line in the shade.

RESULTS AND DISCUSSION

Ponds I and II.—Tables 1 to 3 and fig. 1 show the trend of algal growth in these two ponds which was sampled weekly. Except for slight fluctuations, the rate of growth of lumut in these two ponds was very rapid during the first few weeks. In the first experiment the rapid rise begins at the start of the experiment until the thirteenth week while in the second the rapid rise lasted only up to the ninth. After a maximum growth is attained there seems to be a decline in the amount of lumut. The weekly sampling showed in some cases very wide fluctuations showing either sharp increases or decreases. This may be due to sudden environmental changes such as sudden rainfall or sudden salinity change of the water. It may also be due to the frequency of handling, these two ponds having been subjected to weekly weighing of lumut. It seems that the maximum growth attainable is better in the second experiment or during the low salinity rainy period.

TABLE 1.—*Weekly increase in weight of lumut in Experimental Ponds I and II*

[First experiment—November 1, 1949 to February 27, 1950]

Date	Duration of culture (weeks)	Weight of lumut (gm.)	Growth from initial stock	
			Weight (gm.)	Per cent
1-XI-49	Initial stock	494.2		
7-XI-49	1	914.4	420.2	85.0
14-XI-49	2	2,113.2	1,619.0	327.6
21-XI-49	3	3,586.4	3,092.2	625.7
28-XI-49	4	3,206.5	2,712.3	548.8
5-XII-49	5	4,217±3	3,723.1	753.4
12-XII-49	6	4,430.3	3,936.1	796.5
19-XII-49	7	4,548.7	4,054.5	820.4
26-XII-49	8	5,924.7	5,430.5	1,098.9
4-I-50	9	7,300.7	6,806.5	1,377.3
10-I-50	10	12,247.0	11,752.8	2,378.5
16-I-50	11	10,810.8	10,316.6	2,087.5
23-I-50	12	11,704.0	17,209.8	3,482.4
30-I-50	13	24,579.1	24,084.9	4,873.5
6-II-50	14	12,229.1	11,734.9	2,374.5
13-II-50	15	12,417.8	11,923.1	2,412.6
20-II-50	16	11,453.4	10,959.2	2,217.6
27-II-50	17	10,489.5	9,995.3	2,022.5

TABLE 2.—*Weekly increase in weight of lumut in Experimental Ponds I and II*

[Second experiment—July 10, 1950 to October 30, 1950]

Date	Duration of culture (weeks)	Weight of lumut (gm.)	Growth from initial stock	
			Weight (gm.)	Per cent
7-VII-50	Initial stock	776.0		
14-VII-50	1	1,895.6	1,119.6	144.3
21-VII-50	2	2,565.7	1,789.7	230.6
28-VII-50	3	4,365.9	3,589.9	462.6
4-VIII-50	4	9,213.7	8,437.7	1,087.3
11-VIII-50	5	1,871.1	1,095.1	141.1
18-VIII-50	6	6,690.6	5,914.6	762.2
25-VIII-50	7	12,275.5	11,499.5	1,481.9
1-IX-50	8	20,440.5	19,664.5	2,534.1
8-IX-50	9	25,061.3	24,285.3	3,129.5
15-IX-50	10	21,553.0	20,777.0	2,677.5
22-IX-50	11	21,092.4	20,316.4	2,618.1
29-IX-50	12	14,628.3	13,852.3	1,785.1
6-IX-50	13	7,300.1	6,524.1	,840.7
13-X-50	14	9,475.6	8,699.6	1,121.1
20-X-50	15	14,017.0	13,241.0	1,706.3
30-X-50	16	9,752.4	8,976.4	1,156.8

TABLE 3.—*Average weekly increase in weight of lumut in Experimental Ponds I and II*

[First and second experiments]

Duration of culture	Weight of lumut (gm.)	Growth from initial stock	
		Weight (gm.)	Per cent
Initial stock	635.1		
1	1,405.0	769.9	121.2
2	2,339.4	1,704.3	268.4
3	3,976.1	3,341.0	326.1
4	6,210.1	5,575.0	877.8
5	3,044.2	2,409.1	379.3
6	5,560.4	4,925.3	775.5
7	8,412.1	7,777.0	1,224.5
8	13,182.5	12,547.4	1,975.7
9	16,181.0	15,545.9	2,447.8
10	16,900.0	16,264.9	2,560.1
11	15,951.6	15,316.5	2,411.7
12	16,166.2	15,531.1	2,445.5
13	15,939.6	15,304.5	2,409.8
14	10,852.3	10,217.2	1,608.8
15	13,217.6	12,582.5	1,981.2
16	10,602.9	9,967.8	1,569.5
17	5,244.7	4,609.6	725.8

Ponds III and V.—Tables 4 to 6 and fig. 2 show the monthly growth in these two ponds. As in ponds I and II the rate of growth of lumut in these two ponds showed very rapid rise from the beginning of the culture period to the second month. There may be increases during the third and fourth month but these may be very gradual and even actual decreases may be registered showing a tendency to level off after attaining a

peak. Again the second experimental period of the low salinity rainy period showed higher maximum growth of lumut. Actually the highest growth of lumut for all the ponds during

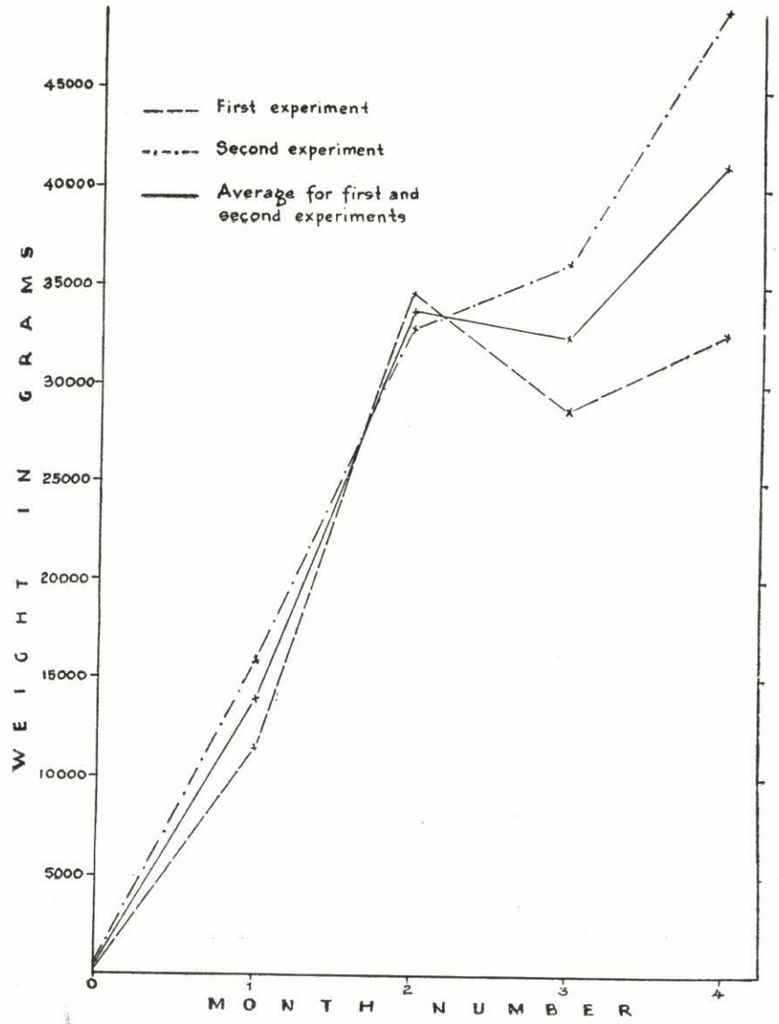

FIG. 2. Monthly increase in weight of lumut in experimental ponds III and V.

this experiment was obtained in this series with an amount of 54,658.8 grams in one pond (Pond III, 4th month) or 1,093.2 grams per square meter.

TABLE 4.—*Monthly increase in weight of lumut in Experimental Ponds III and V*

[First experiment—November 1, 1949 to February 27, 1950]

Duration of culture (months)	Weight of lumut (gm.)	Growth from initial stock	
		Weight (gm.)	Per cent
Initial stock	353.0		
1	11,731 5	11,378.5	3,223.4
2	35,182.5	34,829.5	9,866.7
3	29,033.6	28,680.6	8,164.8
4	33,055.8	32,702.8	9,264.2

TABLE 5.—*Monthly increase in weight of lumut in Experimental Ponds III and V*

[Second experiment—July 10, 1950 to October 30, 1950]

Duration of culture (months)	Weight of lumut (gm.)	Growth from initial stock	
		Weight (gm.)	Per cent
Initial stock	611.6		
1	16,329.6	15,718.0	2,561.0
2	33,311.2	32,699.6	5,346.6
3	36,798.2	36,186.6	5,916.7
4	50,689.8	50,078.2	8,188.1

TABLE 6.—*Average monthly increase in weight of lumut in Experimental Ponds III and V*

[First and second experiments]

Duration of culture months	Weight of lumut (gm.)	Growth from initial stock	
		Weight (gm.)	Per cent
Initial stock	482.3		
1	14,030.5	13,548.2	2,809.1
2	34,246.8	33,764.5	7,000.7
3	32,915.9	32,433.6	6,724.8
4	41,872.8	41,390.5	8,581.9

Ponds IV and VI.—Sampling at the end of the experiment period—4 months (Table 7 and fig. 3). After planting the initial stock of lumut these two ponds were left untouched except at the end of the experiment when the algæ were weighed to verify whether frequent handling may have something to do with their growth. The results indicate that frequent handling has no effect as shown by the fact that the rate of growth of the algæ in these ponds did not differ significantly

with those where the lumut is weighed weekly and monthly. The growth of algæ in these untouched ponds may have fluc-

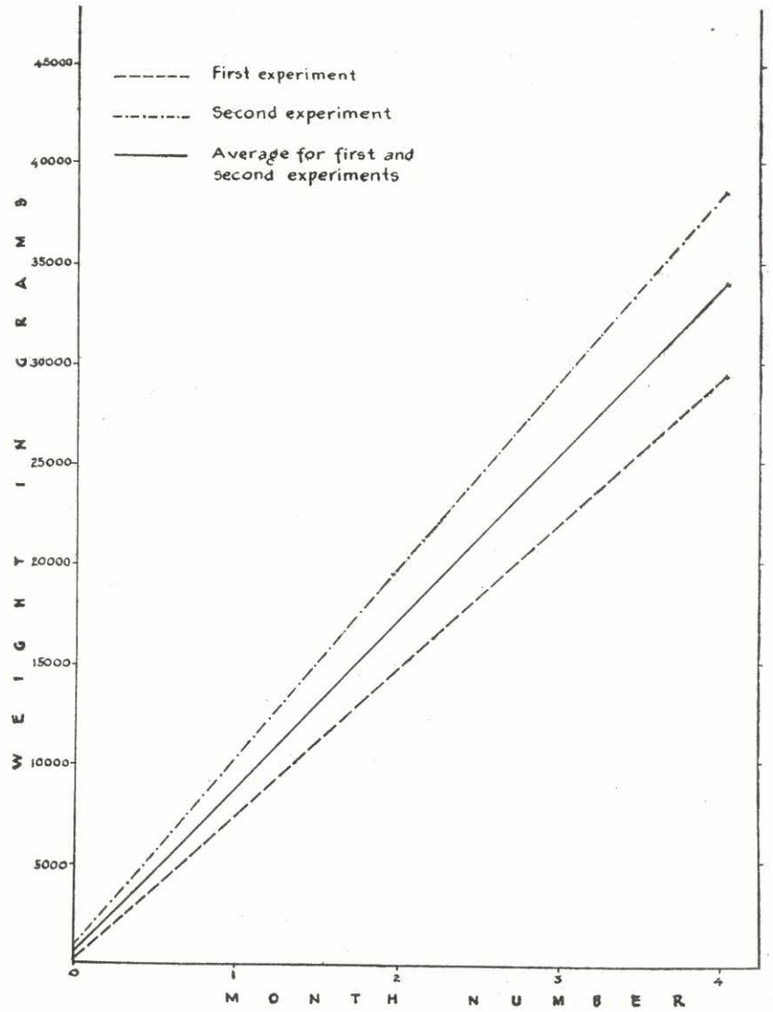

FIG. 3. Increase in weight of lumut in experimental ponds IV and VI at the end of experimental period.

tuated during the period in a similar manner as the two cases mentioned above.

TABLE 7.—*Increase in weight of lumut in Experimental Ponds IV and VI determined at the end of experimental period (four months)*

Experiment Number	Duration of culture	Weight of lumut (gm.)	Growth	
			Weight (gm.)	Per cent
First	Initial stock	384.0	29,511.0	7,685.2
	4 months	29,895.0		
Second	Initial stock	677.7	38,558.7	5,689.6
	4 months	39,236.4		
Average for first and second	Initial stock	530.8	34,034.9	6,412.0
	4 months	34,565.7		

The general meteorological and hydrographic observations (Tables 8 and 9, and fig. 4).—Considering that bangos ponds are brackish, the salinity remained at comparatively high level during the period of the first experiment—the lowest recorded being 20.6°/₀₀ and the highest 34.2°/₀₀ with an approximate average of 29.9°/₀₀. During the second experiment the salinity was comparatively much lower, ranging from 9.0°/₀₀ to 22.2°/₀₀ with an approximate average of 14.9°/₀₀. These fluctuations

TABLE 8.—*Average meteorological and hydrographic observations for Experimental Ponds I to VI*

[First experiment—November 1, 1949 to March 3, 1950]

Period (weeks)	Salinity °/₀₀	Rainfall (mm.)	Depth of pond water (cm.)	pH	Remarks
First	28.0	49.0	10.7	7.8	Water newly freshened, turbid; weather clear to passing shower.
Second	21.7	61.9	13.2	8.4	Lumut planted growing; water slightly turbid, deep; weather overcast to passing shower.
Third	27.8	8.3	10.9	8.2	Water turbid, deep; weather clear to passing shower.
Fourth	30.3	0	8.6	8.3	Good growth of algae; water turbid, low; weather generally fair.
Fifth	31.3	130.1	8.6	8.1	Water newly drained, turbid, low; weather clear to changeable,
Sixth	29.6	19.4	13.9	8.1	Water newly freshened, slightly turbid deep; weather cloudy to clear.
Seventh	23.5	0	8.9	7.7	Good growth of algae; water turbid, low; weather stormy.
Eighth	29.5	0	9.5	8.3	Water very slightly turbid, low; weather generally fair.
Ninth	27.9	21.4	6.0	8.2	Letting out water, turbid, low; weather clear to passing shower.
Tenth	29.8	11.2	11.5	8.2	Water newly freshened, turbid; weather generally fair.
Eleventh	31.2	3.8	9.5	8.0	Pond with a good growth of algae; water turbid, deep; fair weather.
Twelfth	31.7	2.3	18.6	8.2	Water slightly turbid, deep; weather generally fair.
Thirteenth	33.2	23.8	7.5	7.7	Letting out water, very turbid, low; weather clear to cloudy.
Fourteenth	31.5	0	14.9	8.0	Water newly freshened, turbid, deep; weather clear, gentle wind.
Fifteenth	32.3	0	11.6	8.3	About 80% of the pond area is covered with algae; water turbid; weather clear.
Sixteenth	33.5	4.1	12.2	7.8	Water turbid, deep; fair and very calm weather.
Seventeenth	33.3	0.3	10.3	7.5	Water turbid, low; weather clear to passing shower.
Eighteenth	33.8	0	18.4	-----	Pond newly freshened; water turbid, deep; weather generally fair.

TABLE 9.—*Average meteorological and hydrographic observations for Experimental Ponds I to VI*

[Secondary experiment—July 10, 1950 to October 30, 1950]

Period (Weeks)	Salinity °/₀₀	Rainfall (mm.)	Depth of fond water (cm.)	pH	Remarks
First	22.2	85.2	15.1	7.8	Pond newly planted with 6 patches of algae; water turbid, deep; weather cloudy with showers.
Second	15.2	213.5	25.0	7.7	Water newly freshened, turbid, deep; weather very stormy.
Third	12.6	100.6	38.3	7.2	Algae growing; water turbid, deep; weather very stormy.
Fourth	12.9	135.2	36.4	7.6	Water very turbid, deep; weather clear to passing showers.
Fifth	9.0	118.9	37.1	7.2	Do.
Sixth	10.1	24.4	23.8	8.0	Pond was drained; water very turbid, deep weather calm; partly cloudy.
Seventh	9.7	18.6	22.4	8.1	About 75% of the pond area is covered with algae; water turbid, deep; weather fair.
Eighth	15.3	27.9	21.5	7.9	Pond with a good growth of algae; water turbid, deep; weather cloudy to passing showers.
Ninth	19.0	37.2	22.2	8.1	Do.
Tenth	18.7	57.3	24.6	8.1	Pond newly freshened, water turbid, deep; weather clear, calm, partly cloudy.
Eleventh	18.7	70.1	22.8	8.1	Pond was drained, very turbid deep; weather overcast to changeable.
Twelfth	18.3	155.2	35.9	8.0	Water newly freshened, turbid, deep; weather calm cloudy to overcast.
Thirteenth	10.9	42.7	39.0	7.5	Algae dying, disintegrating; water very turbid, deep; weather very stormy.
Fourteenth	13.0	35.1	23.3	7.4	Pond was drained, water very turbid deep; weather generally fair.
Fifteenth	13.1	59.5	21.3	7.3	Algae dying, disintegrating, water turbid, deep; weather generally clear.
Sixteenth	20.9	18.8	27.6	7.3	Experiment due.

were mainly influenced by variation in rainfall during the period.

The pH appeared within normal limits prevailing in bangos ponds, that is, it remained at slightly basic conditions ranging from 7.1 to 8.6 with an average of 7.7 for the first experiment and 7.2 to 8.1 with an average of 7.7 for the second experiment. The lack of abnormal values for pH shows that it is not a very important factor in lumut growth in the ponds.

The depth of the pond water was hard to control with the soil dikes and wooden gates but it remained low enough for normal growth of lumut. Rapid rises of the depth during a short duration due to rainfall or leaks from the dikes occurred, but these have not produced any significant effect on the results of the experiments.

Both experimental periods were not completely devoid of rainfall. During the first experiment, the drier period, the weekly total of rain varied from nil to 130.1 millimeters. During the second experiment, which was the rainy period, there was no week that was devoid of rain, with the weekly total ranging from as low as 18.6 millimeters to as high as 213.5 millimeters.

Except probably for salinity which remained at consistently high level during the first experimental period and comparatively lower during the second experimental period, the other factors mentioned (pH, rainfall and depth of water) did not affect lumut growth very much. The higher salinity recorded

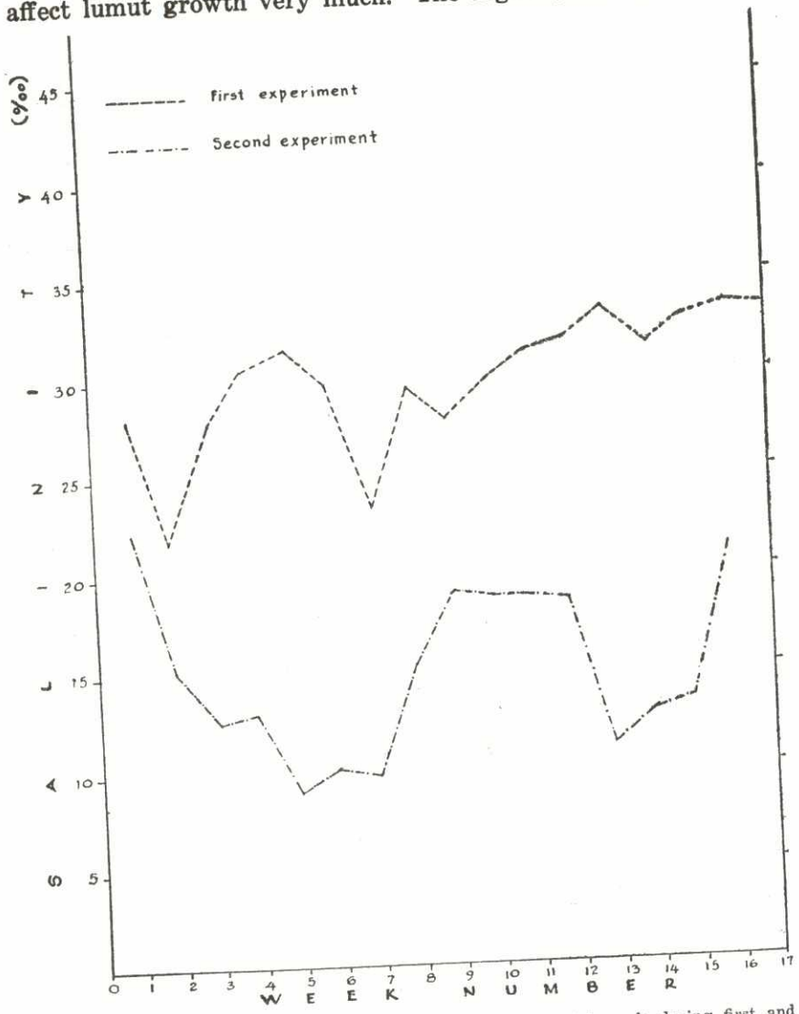

Fig. 4. Comparative salinity observations for the experimental ponds during first and second experiments.

during the period may have inhibited maximum growth of lumut during the first experimental period and explain the

The weather conditions varied from fair to inclement during the period. There were occasional showers, rains, winds and even storm.

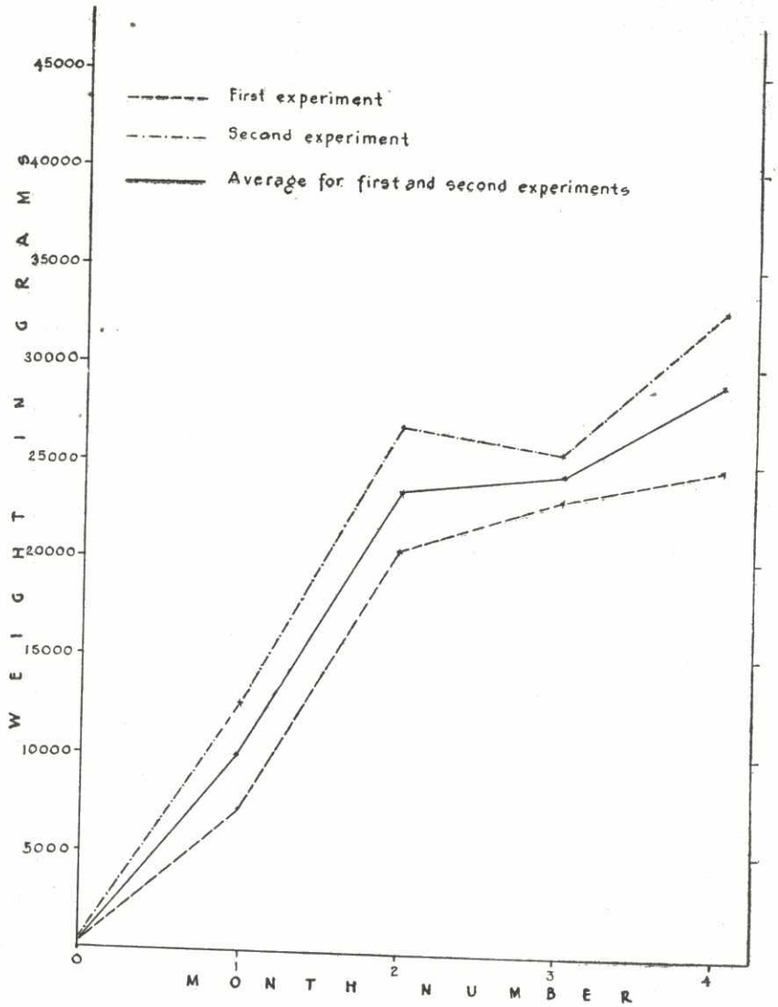

Fig. 5. Average monthly increase in weight of lumut in experimental ponds I to VI.

General observations on algæ growth (Tables 10, 11 and 12, and fig. 5).—The lumut has been observed to have undergone

ILLUSTRATIONS

TEXT FIGURES