

S.S.R.A. REPORT NO. 108.

REGROWTH OF ASCOPHYLLUM NODOSUM AFTER CUTTING.

(With 1 figure in text).

BY

F. T. WALKER.

Institute of Seaweed Research,
Inveresk Gate,
MUSSELBURGH,
MIDLOTHIAN.

December 1948.

INTRODUCTION.

Experiments on the regrowth of Ascophyllum nodosum have been carried out on the Skerry of Work, situated in the Bay of Work off the south-east coast of the Orkney Mainland and a few miles N.E. of Kirkwall, the chief town and port of the Orkney Islands.

The Bay of Work faces east to Shapinsay Sound which connects with The String, the recognised shipping channel to Kirkwall from the South, where tidal streams reach 4 knots at springs.

The Skerry is extensive and most of its 21 acres are accessible during periods of low tides, when it is wholly uncovered and can be explored on foot from the Mainland, while during high tides a small motor boat can safely cruise over the area.

The seaward perimeter of the Skerry is bounded by rocks a little higher than the general level and these break the full force of incoming water.

The Skerry supports over 600 tons of seaweed with a density of 30 tons/acre, composed of Ascophyllum nodosum with occasional plants of Fucus vesiculosus and F. serratus.

The area is ideally placed for the growth and study of Ascophyllum nodosum. This species was chosen as it represents 62% of the 180,000 tons of littoral seaweed recorded in the survey of Scotland and Islands (1).

EXPERIMENTAL PROCEDURE.

During August 1946, an area was chosen on the Skerry where the weed cover was uniform, for the study of the regrowth of Ascophyllum nodosum. Four strips, each 20 yards long by 1 yard wide, were marked out and the weed cut. The four strips were contiguous and in a direction approximately parallel to the rock formation.

Moving North - South, the weed was cut as follows:-

Strip A. All plants cut leaving 2 inches (5.1 cm) of thalli.

"	B.	"	"	"	5	"	(12.7 cm)	"	"
"	C.	"	"	"	8	"	(20.3 cm)	"	"
"	D.	"	"	"	11	"	(27.9 cm)	"	"

During September 1947, the area was revisited and weed was cut by yard quadrat and weighed from each strip. Plants from each strip were brought back to Inveresk Gate laboratories for individual analyses of growth.

During August 1948, the area was again revisited and the above procedure repeated.

Each plant taken from the four strips in the summers of 1947 and 1948 was divided into new and old growth. All growth above the original cut was, of course, taken as new; pigmentation was taken as an indicator of new and old growth, for the younger branches are yellow while the older ones are green.

Comparison of the analyses of regrowth of the individual plants with the percentage increase in weight of weed by measured quadrats

RESULTS.

The fresh weight of weed found on the Skerry of Work in 1947, after one year's regrowth and in 1948, after two year's regrowth was:-

Area	Cutting		1947		1948		Increase in weight during 1947-8 based on 1947 weight (%)	Increase in weight during 1947-8 based on 1948 weight (%)
	ins.	cm.	(lb/s.yd)	(kg/s.m.)	(lb/s.yd)	(kg/s.m.)		
Strip A	2	5.1	3.75	2.04	9.50	5.16	153	61
" B	5	12.7	5.75	3.12	11.50	6.24	100	50
" C	8	20.3	10.25	5.57	20.00	10.86	95	49
" D	11	27.9	14.25	7.74	25.00	13.58	75	43

The fresh weight of weed within a quadrat, where the weed was fully developed and the cover 100%, was:-

1947	23.5 lb/sq.yd.	(12.7 kg/s.m.)
1948	24.5 lb/sq.yd.	(13.2 kg/s.m.)

Mean density of fully established weed may therefore be taken as 24 lb/sq.yd. (13 kg/s.m.), where Ascophyllum nodosum completely covers the substrate.

The analyses of the individual plants, where the weight of new growth is expressed as a percentage of the total weight of the cut plant, showed a mean value for 10 plants to be:-

Strip	Original cutting		1946-1947 % new growth	1947-1948 % new growth (by subtraction)	1946-1948 % new growth.
	ins.	cm.			
A	2	5.1	19	45	64
B	5	12.7	19	51	70
C	8	20.3	18	42	60
D	11	27.9	19	42	61

DISCUSSION

Taking the above value of 24 lb/s.yd. (13 kg/s.m.) for the density of fully established seaweed in this area, then it is seen that strip D (where the plants had been cut to leave the thalli 11 inches long) has fully recovered the original density in two years, while strips A (2 inches B (5 inches) and C (8 inches) have regained 40%, 48% and 83% of the original density, respectively.

While cutting plants of Ascophyllum nodosum to leave 11 inches of the thalli enabled regrowth to return the weed density to its maximum in two years, the individual plants did not regain their original length, rather did they put out many secondary branches and become bushy. Thus cutting a second time to leave 11 inches of thalli would not reduce the weed density to the same extent as the original cutting.

The analyses of individual plants, cut on the skerry and allowed to grow for one or two years, indicates the percentage new growth to be of the same order for each strip during both 1946-7 and 1947-8.

During the second year the percentage new growth was more than twice that of the first year.

In correlating the increase in plant growth with the increase in seaweed density in situ after two years, the following results are obtained:-

64%	new plant growth of the plants cut 2"	has brought the weed density to 40% of original density before cutting.
70%	do.	do. 5" do. to 48% do.
60%	do.	do. 8" do. to 83% do.
61%	do.	do. 11" do. to 104% do.

The relationship is not directly proportional for reasons given later.

In the light of harvesting Ascophyllum nodosum the following facts emerge from this experiment.

Taking the mean density of fully established seaweed beds on the Skerry of Work as 24 lb/sq.yd. where the weed cover is 100%, then,

A.	Cutting to leave 2 inches, 3 lb/s.yd. are left and 21 lb/s.yd. harvested.
B.	" " " 5 " 5 lb/s.yd. " " " 19 lb/s.yd. "
C.	" " " 8 " 9 lb/s.yd. " " " 15 lb/s.yd. "
D.	" " " 11 " 12 lb/s.yd. " " " 12 lb/s.yd. "
After two years the seaweed available will be:-	
A.	10 lb/s.yd., making a total harvest in 2 years of 31 lb/s.yd.
B.	12 " " " " " " " " 31 "
C.	20 " " " " " " " " 35 "
D.	25 " " " " " " " " 37 "

It is therefore, unprofitable to completely harvest an established area of Ascophyllum nodosum apart from the other disadvantages, such as loss of fruiting material and protection of germlings.

The distribution of weight of a plant of Ascophyllum nodosum is not uniform over its length, secondary branches and reproductive bodies (receptacles) make for a greater quantity of material in the

middle regions. This is seen in the following data where six plants from the Skerry of Work, collected in December 1947, were cut across at 7.5 cm. intervals of their length and the fresh tissue weighed;

(cms.)	(g)	(g)	(g)	(g)	(g)	(g)
0 - 5.0	5.7	1.6	1.8	0.8	1.6 *	3.7
5.0 - 12.5	7.6	2.3	2.5	1.6	1.2	7.3
12.5 - 20.0	8.5	1.5	2.1	2.6	0.8	7.1
20.0 - 27.5	12.7	1.8	2.8	3.9	1.1	6.8
27.5 - 35.0	18.1	1.9	4.1	2.9	1.3	5.1
35.0 - 42.5	21.9	1.7	6.4	3.9	1.8	7.2
42.5 - 50.0	23.6	2.4	6.3	3.0	3.4	7.4
50.0 - 57.5	31.1	2.6	6.1	3.0	2.4	10.4
57.5 - 65.0	29.7	7.7	10.1	4.0	5.8	12.3
65.0 - 72.5	31.7	20.4	12.8	2.7	4.9	19.8
72.5 - 80.0	31.2	30.9	11.9	6.2	8.1	26.9
80.0 - 87.5	32.1	35.8	16.7	9.9	12.8	33.3
87.5 - 95.0	48.9	43.9	15.0	7.7	16.8	48.1
95.0 - 102.5	45.3	57.5	14.5	11.2	13.8	51.7
102.5 - 110.0	32.9	65.8	16.2	11.7	15.6	67.3
110.0 - 117.5	31.2	49.8	19.4	13.2		61.0
117.5 - 125.0	37.2	50.6	20.2	8.4		70.3
125.0 - 132.5	33.2	43.9	18.6	7.1		24.5
132.5 - 140.0	31.9	29.2	15.1	9.1		1.2
140.0 - 147.5	20.4		4.8	7.0		
147.5 - 155.0	11.7		0.4	1.3		
155.0 - 162.5	4.1					
162.5 - 170.0	4.3					
170.0 - 177.5	1.6					

* This plant had few reproductive organs.

The receptacles appear on the mature plant some distance from the holdfast and the air bladders occur every 6 to 7 inches (15 to 18 cm.), for example,

Plant	Frond length		Bladders	Distance of first receptacles from holdfast.	
	(ins)	(cm)		(ins)	(cm)
1	63	160	11	20	51
2	48	120	7	18	46
3	59	150	9	18	46

The mean fresh weight of a receptacle and stalk is 0.115 g. and without stalk 0.114 g, (Dec.).

The mean fresh weight of an air-bladder ranging from 1.5 to 2.5 cm in length is 0.66 g.

A plant of Ascophyllum nodosum was cut proximal to each air-bladder and the intervals measured and weighed. The receptacles were weighed separately. The whole is diagrammatically shown in fig. 1.

The figure shown on the left of a frond is the length (cm.) and on the right the fresh weight (g.) of the frond and bladder, while the figure in brackets is the fresh weight of the reproductive organs, (g).

The increase in weight in the middle regions of the thallus is seen to be due to the presence of the reproductive tissue, the weight of which is greater than that of the frond which bears it in many plants.

It has been stated (2) that an air-bladder is produced every year, in which case the plant in figure 1 is over 14 years old. It is surprising that a plant can survive for so long on the Skerry of Work. It is quite usual for the growing tips to be broken off and secondary fronds continue to give the plant its length.

The clearing of a seaweed bed allows the entry of new plants whose growth will be more rapid than those which start life overshadowed by mature plants.

This was seen along strip A, where the 2" cut plants, overshadowed and partially covered by fully developed plants, attained in the first year a rate of growth only half that of the exposed cut plants.

If a seaweed bed composed of Ascophyllum nodosum is completely cleared, it is possible that other littoral algae will first recolonise the area. An example is afforded on the four causeways connecting the southern islands of Orkney. The dominant species of littoral weed in the vicinity of the causeways is Ascophyllum nodosum but the many thousands of blocks forming the breakwater have been colonised by Fucus vesiculosus with some F. spiralis. Very young plants of A. nodosum are now appearing on the blocks after five or six years.

In the light of the data of this experiment it is advisable when harvesting Ascophyllum nodosum to leave enough thallus to include some of the receptacles. This will ensure a supply of young plants and protection for them. After two to three years, the partially harvested seaweed may be cleared but in a manner that will leave the young plants. In this way a maximum crop will be obtained and recolonisation by Ascophyllum nodosum guaranteed.

SUMMARY.

A study of the regrowth after cutting of Ascophyllum nodosum on the Skerry of Work, Orkney, has been carried out from 1946 to 1948. The plants produced 19% new growth during the first year and more than doubled this during the second year. Recovery to the original weed density in situ was attained where the plants were cut down to 11 inches of thallus. Cutting down to 2, 5 and 8 inches did not recover so well. A maximum crop would be obtained in two years by cutting to leave 11 inches of thallus in this area. Details are given showing the distribution of tissue of plants of Ascophyllum nodosum.

Due acknowledgement is made to Miss Betty Mitchell and Miss June Gav n, who carried out the 1946 cuttings; to Miss Emily Clay who obtained the 1947 data and to Miss Margaret Smith who obtained the 1948 data.

REFERENCES.

- (1) Walker, F.T. (1947) Proc. Linn. Soc., 159, pt. 2, 3.
- (2) MacFarlane, C., (1931-32), Proc. Nova. Scotian Inst. Sci. 18. (2). 27.

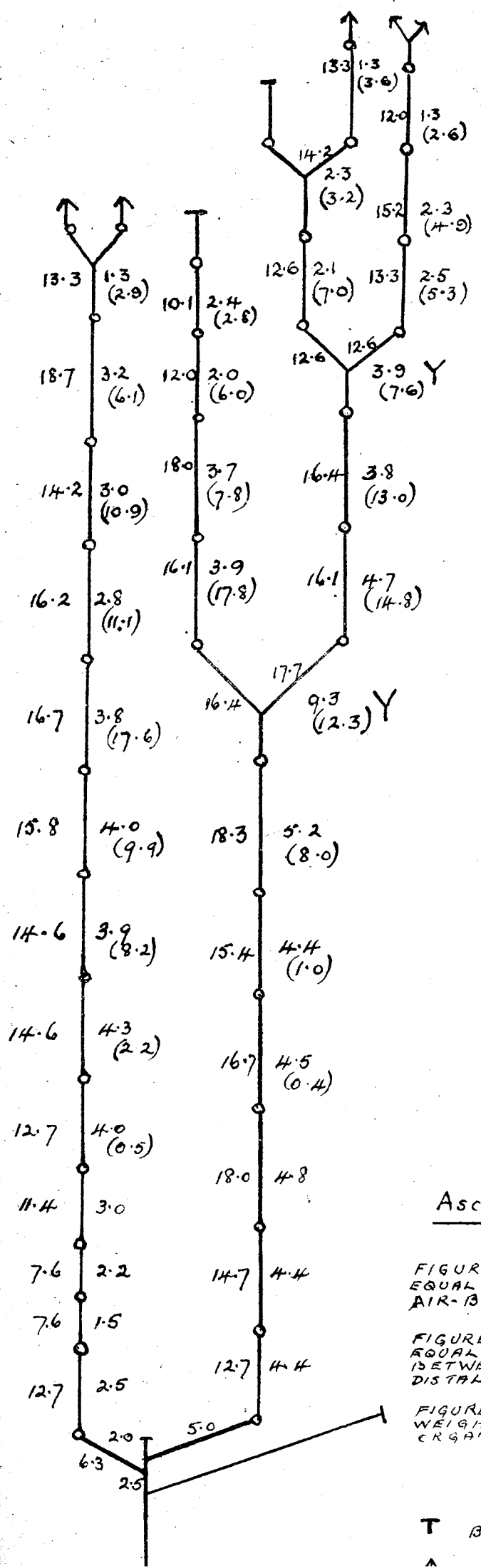


FIG. 1.

Ascophyllum nodosum (DEC. '47)

FIGURES ON LEFT OF FROND
EQUAL DISTANCES BETWEEN
AIR-BLADDERS (CMS)

FIGURES ON RIGHT OF FROND
EQUAL WEIGHTS OF FROND
BETWEEN AIR-BLADDERS PLUS
DISTAL BLADDER (GRAMS)

FIGURES IN BRACKETS EQUAL
WEIGHT OF REPRODUCTIVE
ORGANS (GRAMS)

T BROKEN TIP.