THE BIOTIC FACTOR IN MODIFICATION OF GRASSLAND.

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The subject matter of this paper is based on two somewhat seemingly diametrically opposed concepts: (1) Stock in large numbers adequately fed make the country. (2) Stock in large numbers inadequately fed ruin the country. In the first ease the modification is towards a progressively higher producing, more vigorous, luscious, and longer growing sward. In the second case the trend of development is from high to low production, from luscious and vigorous growth, to stunted, harsh and inactive growth, from desirable first class grasses and clovsrs to second and third rate grasses and clovers or to weeds

The master factor in the swing of the develment, one way or the other, lies in the difference between adequately fed stock and inadequately fed stock, and the explanation of the change for the better in the one case and for the worse in the other case lies in the demands of the plant itself. Stock in large numbers adequately fed on grassland return to the land residues, particularly of a nitrogenous nature, adequate for the fertility requirement of the higher producing pasture plants and under a system of high soil fertility maintenance and high leaf production, severity of grazing is seldom pronounced. In the case of inadequately fed stock, high production at ary one time is never possible : the stock residues are in lesser amounts and are of less value as plant foods, and leaf production is never adequate for the healthy root development of the sward. The close and persistent grazing concomitant of overstocking overprunes the grasses and intensifies the paucity of leafage produced. The non-shade producing nature of' the closely grazed sward is favourable to flat and mat weed development and the growth of these inhibit tillering in the grasses and what leafage is produced is forced erect where it is nibbled off by the ever-grazing, inadequately fed stock. The constant dribble wars away the hardest rock; the constant nibble wears down the best of swards.

Changes in Vegetation as a result of Grazing by Stock Inadequately Fed.

Under this heading we may consider two aspects of grassland development. (1) The wearing down of scrub and fern growth by a system of forcing(inadequate feeding) stock to a point where conditions are made so difficult for plant growth that they go out, being replaced by hardy, aggressive, low producing grassland of the Danthonia pilosa type. Such change must be regarded as a beneficial one to the farmer for the reason that the grass vegetation produced is feed for a payable class of stock such as sheep, but none the loss the development from a vegetation point of view is a retrogressive succession, and hence serves to indicate the axiom that stock in large numbers inadequately fed ruin the country from the vegetation point of view in so far as the forward development to forest is stopped and retrogressive development instituted.

(2) The wearing down of high production swards through a series of insidious changes where the oncoming vegetation is of a lower order than that which is being displaced. I refer here to potentially or

originally high producing country where ryegrass, cocksfoot and white clover may predominate, to a sward dominated by flat weeds of the field daisy, ribgrass, catsear, penny-royal type or such low producing grasses such as Brown top, Poapratensis, Sweet Vernal, Danthonia pilosa, Poa annua, Hairgrass, Suckling clover, blustered clover, striated clover, Haresfoot trefoil; etc.

More intensive grazing Still as by over-crowding by rabbits results in a complete baring of the surface and were it not for the presence of certain unpalatable mat plants (Scabweeds) a veritable desert would result until such time as the overstocked conditions werereduced by death through starvation.

Specific examples of retrogressive development. of vegetation as a result of stocking with animals inade-quately fed may be seen on every side. The deforested hill country regions of the North Island and the depleted tussock country of the South Island are striking examples. Much also of the ploughable country of both Islands beers evidence of retrogressive development or tardy progressive developmentas a result of inadequately feeding the stock held there for ths greater period of the year,

Tho stock factor in these changes is strikingly seen comparing adjoining areas separated only by a wire fence. Fence-line ecology is perhaps one of the most profitabls to explore as yielding data relative to modification of grasslands or of vegetation types other than grassland. The fence line tells its story not only in the case of retrogression but also strikingly in the case of progressive development, be those changes observed in grassland or in the successions from scrub to forest or from fern and scrub to grassland. True the stack factor is not wholly responsible far these changes for man himself - a biotic factor nonetheless - will often confine his labours with the slashhook or firestick to definits areas bounded by the fence line. Manurial topdressings also arc; usually confined within the area fenced, but nonetheless there is a wealth of information to be gleaned along 'the fence lines and the stock factor is the prime factor giving rise to those differences presented.

<u>The Deforested Hill Country Under Overstocking</u>.

The most outstanding change from the original high fertility of the forest burn is from the rysgrass, cocksfoot, white clover sward to the dominantly Brown top, Sweet Vernal, Yorkshire Fog, Suckling Clover on the wetter and more shady country or to one of Danthonia pilosa, Suckling clover, Hairgrass, Sweet Vernal, Ratstail, etc., on the drier and sunnier country. Where these two major vegetation types have not asserted them-selves, flat weeds of the Catsear, ribgrass, hairgrass, Cudweed, moss, etc., type have come in, or hardy unpalatable plants such, es piripiri, hard fern, manuks, rush (Juncus species) Sedge(Carex species) etc. All these changes are largely stock induced and probably one of the major problems confronting the grassland farmer and research worker is to stay the retrogressive succ-essions on hill country and to turn the tide back once more to a forward development, where Crested Dogstail, Poapraten siswhite clover and perennial ryegrass and Cocksfoot begi n

to reassert themselves and rise ultimately to dominance in the sward . In the case of induced vegetation such as Hard fern, piripiri, Manuka, Tahinu, Pomaderris, Pimelea, Scabweed ate., change in the stock manipulation, usually in the direction of a more definite rotational system of grazing rather than close and continuous, is imperative. Close and continuous grazing is the most potent factor leading to retrogressive succession, and such grazing nay be said to be the outcome of inadequate feeding of the stock concerned, and further, close and continuous grazing, persisted in, results in a less and less adequate feeding of the stock concerned for the reason that retrogressive succession - from a higher to a lower producing sward - is surely, if slowly, taking place. The ultimate phase as seen in close and continuous rabbit grazing, is a veritable desert. In the hill country of the North Island one is inclined to the opinion that Danthonia pilosa represents the ultimate phase- ths base level of retrogressive succession - but there is accumulating evidence that Danthonia itself will not persist indefinitely under close and continuous grazing, and this is particularly true on the more shady and wetter country where moss is likely to gain the upper hand.

Inadequate feeding of stock on ploughed and sown country, or on flat country still holding to the original surface sowing on the forest burn,. is reflected in a change from the high producing grasses and clovers to one where weds are dominant, Rushes (Juncus spp.) Sedges (Carex spp.), fi eld Daisy, Pennyroyal, Plantain, Ribgrass, catsear, oxeye daisy, Ragwort - the two latter more particularly on dairying country - are among the chief.

Modifications in vegetation that are a feature of retrogressive succession are but Nature's method of harmonising plant life to environmental forces - the harder the habitat the lower producing is the plant population. Each plant is virtually a measure of the environmental forces of the habitat and it can be laid down as an axiom that the plant which is increasing in the sward is producing the most growth and this is 'true in progressive succession as well as in retrogressive succession.

Stock Adequately Fed.

Turning now to the concept that stock in large numbers adequately fed make the country we find that modification as a result of 8 progressive succession culminates in a dominant 'ryegrass sward. The ideal per acre stock concentration we aim at is such that a sward of ryegrass and white clover nay be maintained with ryegrass dominant over white clover, and my contention is that-such a sward may be perennially produced only under a high psr acre stock concentration and where the stock are adequately fed, or where tho stock residues are such as to adequately provide for the nitrogen requirements of perennial ryegrass. To effect this it would appear, one dairy cow per acre or eight ewes per acre is approximately the requisite stock per acre figure, and further the more such'stock may be concentrated in the course of grazing, the farm, paddock by paddock, the better the progress towards the ryegrass - white clover ideal.

'A high per acre stock concentration - up to 140 sheep or 15 dairy cows per acre - gives the following results:-

(1) A uniform and rapid sating down of the sward - whereas a low per acre stocking in the midst of plenty leads to a selective grazing where rank and closely grazed patches characterise the swards a high per acre stocking gives little or no chance for such selective grazing.

(2) A uniform hoof cultivation is given the pasture and a more uniform distribution of stock residue - urine and dung results.

... Under light stocking there is frequently overtreading and over manuring of spots where the fewer numbers camp night after night whereas under a high per acre stocking camping facilities on a small area are not provided.

(3) A high per acre stocking automatically forces ons on to a system of rotational grazing and there is little doubt that such a system where growth is allowed to accumulate for a definite period makes for a greater per acre production cf herbage than under a system of set stocking, where constant grazing with infrequent shifts is the rule.

From the above it will be evident that any system of posture production that tends to increase the number of stock that can be adequately fed on the are;! loads to a modification in the pasture sward - a progressive succession towards a higher producing vegetation takes place. The history of grassland development in New Zealand , often from naturally low fertility and low producing swards, is characterised by a change from a Brown top, Sweet Vernal, Yorkshirs Fog, Ribgrass, Catsear dominant sward to one where ryegrass, white clover end cocksfoot or Paspalum become dominant. Corre sponding rises in stocking capacity and in production likewise take place, and there are many records of doubling or trebling production in butterfat or fat lamb and wool as a result of changing the original sward of Brown top etc., to ryegrass and white clover dominant. It appears quite evident that a good sward of ryegrass and white clover adequately manured and utilisod so as to enable maximum herbage production from these two species will carry one dairy cow per acre or 8 - 10 ewes, and when this state of affairs is secured the fertility cycle is adequately maintained by phosphate or phosphate and lime. The phosphat; - with or without lime - maintains the full clover growth. A good strain of white clover is essential. More clover growth means more feed, more feed more stock, more stock more rock nitrogen - urine and dung - more nitrogen means more grass, more grass more stock, and so the cycle goes on provided the clover of the sward is adequately fed with phosphate, and that that clover is grazed by stock. The high psr acre stock concentration thesis at once throws emphasis on the relationship between areas of the farm in permanent grass, and areas in roots and other supplementary fodders. Where the stocking can be raised to 1 cow or 8 ewes per acre by topdressing alone there would appear to be no need of supplementary crops other than hay and silage. A high per acre stocking however on grass alone demands a large portion of the farm be shut for hay or silage for two masons. (1) The flush periods of high production on a cow per acre farm are difficult to control and comparatively small areas of the farm will support the herd during the lush periods.

(2) Greater reserves of winter and summer fodder arc essential to maintain the herd during tho lower production periods of growth. In the case of farm not able to build to 1 cow or 8 ewes per acre by topdressing alone then it is a most point whether th; area in grass on the farm should not be considerably reduced and turned over ***to rats,*** and other supplementary crops in order that the permanently grassed portions of the farm nay have as high a per acre stocking as possible. In the caseof hill country it is quite a reasonable attitude to take up that certain of the grassland itself may for the time being be regarded as an area to provide supplementary feed. Here one paddock or more is spelled for a full growing period. Experiment and practice . have gleaned the fact that an area of grassland spelled to produce a full hay crop provides more fodder than the same area under grazing and bearing in mind the fact that more fodder means more stock and more stock means more stock nitrogen we have in spelling paddocks on hill country where top-dressing is out of the question a means of increasing the carrying capacity and hence a means of gradually improving the sward over the whole farm. The secret of this improvement lies in the fact that more fodder is produced and hence more stock may be carried. Where topdressing can be put on we have an equivalent effect without 3ockin.g up a portion of the country.

The adequate feeding of stock in hill country is soonreflected in a modification of the sward - the piripiri is lifted, Hard fern ceases to spread with the shading of the ground, Manuka and like scrubs fail to establish their seed as a resultof the denser and taller swards. The spread of Danthonia is slowed up and later retarded as taller and more shade producing plants strengthen and grow. A greater mount of feed means more powerful attacks can be launched in the process of crushing, and here again the high per acre stacking launched to concentrate ona small area is more effectivo than a low per acre stocking over a longer period.

In conclusion there are yet infinite possibilities in sward improvements over the major grasslands of New Zealand to-day and it is just a question whether there is not too much grassland in relation to the stock carried on the average farm, and I think it is safe to sag that full per acre productions of the farm is not being secured unloss the grassed portions of the farm are carrying their one cow or 8 ewes peracre of sown grassland.

The main thought that I wish to stress however is that stock inadequately fed modify the grass sward from a high to a low producing plane and that stock in large numbers adequately fed set up a change in the sward resulting in higher and higher per acre production.
