occur in response to coitus[2]; there is a 5–8 day cycle of testosterone secretion, and a rather similar 5–6 day cycle is sometimes apparent in beard growth.

Changes in beard growth may well indicate changes in androgen secretion in man, related to sexual behaviour, in that they suggest a release of androgen in anticipation of intercourse, a decline in androgen secretion with continued sexual activity, and hypersecretion of androgen in response to intercourse after prolonged sexual abstinence.

ANON

The identity of the author of this communication has been suppressed for reasons which may be self-evident, but the author, whose work has been vouched for by a colleague, has answered a number of questions raised by a referee.

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Efficiency of Grass Carp (*Ctenopharyngodon idella* Val.) in controlling Submerged Water Weeds

THE Asiatic grass carp is a herbivorous fish which is being bred and extensively cultured for food in Russia and eastern Europe. In Britain where freshwater fish are seldom eaten, apart from eels and salmonids, grass carp are arousing interest because of the possibility of using them as a supplement, or in some situations as an alternative, to present methods of weed control—mechanical cutting or the use of herbicides[1]. The chief factors involved in the possible use of grass carp have been discussed[2,3], one of the most important being the density of fish needed to achieve a desired degree of control. We report here the work done on this topic in 1969.

Nine similar and adjacent ponds, each 0·025 hectares in size and about 0·8 m deep, were cleared of indigenous fish by using rotenone. The rather heterogeneous weed growth present was sampled by means of a grapnel at regular intervals along evenly spaced transects and recorded as relative frequencies, that is, the number of samples in which submerged weeds appeared as a percentage of the total number of samples per pond. Between forty-five and fifty-five samples were taken at each pond.

A stock of grass carp had been obtained in April 1968 from Hungary, where they were hatched in June 1967. After the first weed sampling the fish were introduced into six of the nine ponds on May 21 at the rates of 238, 241, 242, 484, 716 and 959 kg/hectare. The mean weight of individual fish was 168 g. Subsequent assessments of weed abundance were made in July, August and September.

In initial approximate order of abundance the submerged plants present were: *Myriophyllum verticillatum*, *Callitriche* sp., *Lemna trisulca*, *Potamogeton pectinatus*, *Zannichellia palustris* and *Ceratophyllum demersum*. The emergent and chiefly peripheral species were *Typha latifolia*, *Sparganium erectum* and *Alisma plantago-aquatica*. Although not all these species were present in each pond, when they occurred in ponds stocked with grass carp they were all grazed.

During the summer all species of weed in the ponds containing the fish decreased while the weed density in the three control ponds increased to a mean value of 110 per cent of the original. In the most heavily stocked pond the relative frequency of submerged weeds decreased from eighty-four in May to eighteen in August when plant roots—presumably pulled up by the fish—were seen floating on the water; it was clear too that the lowermost leaves of *T. latifolia* had been eaten. By September all traces of submerged plants had gone and all the *T. latifolia* leaves touching the water had been attacked by the fish. Grass carp are known to prefer some plants to others[4–7], and our results suggest that *Callitriche* sp. was preferred to *M. verticillatum*, but the initial variation in plant population between ponds and the method of assessment did not permit a reliable comparison.

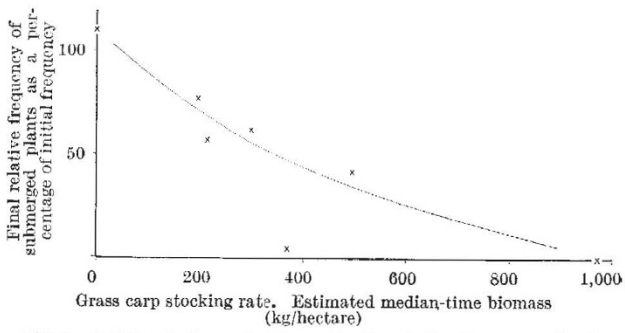

Fig. 1. Relation between the change in the relative frequency of submerged weeds from May to September and the grass carp stocking rate.

On September 22 and 23 the grass carp populations were estimated by a mark-recapture method and the fish were subsequently removed, weighed and measured. Mean survival was 61 per cent with a range of 34 to 97 per cent and the mean weight increment was 37·8 g (7·7–139 g).

From the initial stocking figures and the final numbers and weights of fish, a median-time biomass was estimated for each pond, assuming growth and mortality to have been linear and exponential respectively. The values obtained are plotted in Fig. 1 against the September relative frequencies of submerged weed expressed as a percentage of the May values and give a reasonably good curvilinear relation. The very low point in Fig. 1 is believed to be due to the fact that the initial plant population was low in this pond and consisted chiefly of *Callitriche* sp., which is not only readily eaten by grass carp but also tends to die back as the summer progresses as it did in the control ponds.

Thus in the summer of 1969 at a site where the daily mean water temperature was 15·8° with a range of 8·5° to 21·5° C, and with plants which are readily eaten, a stocking density giving a mid-season biomass of approximately 300 kg of 2 year old fish per hectare reduced plant growth to about 50 per cent of its potential. In the conditions of the experiment this mid-season biomass would, it is estimated, have required an initial stocking rate of 343 kg/hectare.

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B. STOTT
Salmon and Freshwater Fisheries Laboratory,
Ministry of Agriculture, Fisheries and Food,
Whitehall Place (East Block),
London SW1.

T. O. ROBSON
ARC Weed Research Organization,
Yarnton,
Oxford, OX5 1PF.

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