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Preliminary studies on the conversion of *Tubifex tubifex* as food by elvers of *Anguilla nebulosa* (Gray and Hardwicke)

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Elvers of *Anguilla nebulosa* were reared at 23° C in confined waters and their food intake, growth and conversion efficiency (K_1:%) were studied. Elvers weighing 278·33±14·35 mg were fed on an *ad libitum* diet of the oligochaete worm *Tubifex tubifex* for 60 days. On an average, the test individuals consumed 99·55±19·81 mg food/elver/day amounting to 35·76% of the initial biomass; during the corresponding period the elvers exhibited a growth rate of 5·03±2·42 mg gain in weight/elver/day which is equivalent to 5·06% of the consumed food. Thus the 'housekeeping' of these elvers may be regarded as established. In 50 days, the food required amounts to 0·358×50 = 17·90 times the initially stocked biomass. That is, 1 kg of initially stocked elvers may need 17·90 kg of *T. tubifex* to produce 0·912 kg of elver meat. A poor conversion ratio of 20 : 1 may be one reason for the slow growth of the elvers.

I. INTRODUCTION

Eel culture was initiated in Taiwan (Chen, 1969, 1972) and is now being widely practised in many South-East Asian countries. In India, the culture of eels has come into prominence recently after Nair (1973) successfully cultured the short finned eel, *Anguilla bicolor*. So far the other eel prevalent in the east coast of India, the long finned *A. nebulosa* has not been experimentally cultured. In view of the immense food value of the eels as well as the export value for the elvers and cultured eels, a preliminary investigation was undertaken to culture and grow elvers of *A. nebulosa* in the laboratory.

II. MATERIAL AND METHODS

Elvers of *Anguilla nebulosa* were collected from the Dowleshwar barrage on the Godavari river in Andhra Pradesh, South India (Srinivasachar *et al.*, 1975). The elvers were transported to Bangalore and stocked in the Fisheries Research Station at Hesaragatta. From this stock, nine elvers in a weight range of 110 to 562 mg were selected and maintained individually in an aquarium containing 2 l of freshwater at a temperature of 23·0±1·0° C. The elvers were starved for a period of 3 days prior to the start of the feeding experiment to elicit 'hunger' (Windell, 1967). From the fourth day the elvers were fed on an *ad libitum* diet of the oligochaete worm *Tubifex tubifex*. The elvers were offered a known amount of worms at 10.00 h daily and next day, the uneaten worms were reweighed. The total food less the uneaten food yielded the amount of the worms consumed by each elver per day. This food intake was expressed as mg of food intake/elver/day. Feeding was continued for a period of 60 days when the individual elvers were again weighed and the gain in weight (growth) was recorded and expressed as mg gain in weight/elver/day. To compare the values of growth with those of other workers, specific growth rates were also calculated.

The efficiency of food conversion into body substance (K_1) was expressed as a percentage and calculated as follows:

$$K_1 = \frac{\text{growth (mg) day}^{-1}}{\text{food intake (mg) day}^{-1}} \times 100.$$

III. RESULTS AND DISCUSSION

FEEDING BEHAVIOUR

As soon as the worms were dropped into the aquaria, the elvers which are olfactory feeders (Bardach *et al.*, 1972) showed enhanced swimming activity, but not however a feeding response until a lapse of about 30 min.

TABLE I. Food intake, growth and conversion efficiency of elvers of *Anguilla nebulosa*

No. of elvers	Food intake (mg *T. tubifex* elver/day)	Growth (mg gain in weight/elver/day)	Conversion efficiency (K_1 : %)
1	77·74	3·38	4·36
2	87·32	5·88	6·73
3	90·14	6·15	6·82
4	91·91	5·78	6·28
5	92·98	2·93	3·15
6	96·59	3·33	3·44
7	105·48	4·55	4·31
8	123·32	2·80	2·27
9	130·47	10·47	8·02
	99·55±17·291	5·03±2·432	5·04±1·976

FOOD INTAKE, GROWTH AND CONVERSION EFFICIENCY

Table I represents the average daily food intake, growth and conversion efficiency of elvers of *Anguilla nebulosa* on completion of the 60 day feeding period. On average the elvers consumed 99·55±17·29 mg of worm substance/day and had an average growth rate of 5·03±2·43 mg/elver/day. There was considerable individual variation. This has also been observed in elvers of *A. anguilla* (Bardach *et al.*, 1972). The mean value of growth rate presently observed is low compared to the growth rate value reported for elvers of *A. bicolor* (Nair, 1973) which was equivalent to 290 mg of growth/day. The slow growth obtained in this study may be due to the rearing of the elvers in static water in contrast to the elvers of *A. bicolor* which were confined in running water. Running water has been found to be better for eel production (Bardach *et al.*, 1972). The mean value of conversion efficiency of elvers was 5·04± 1·98%. The conversion ratios obtained for elvers fed with traditional foods e.g. chopped fish, silkworm pupae and trash fish were reported to be poor in comparison to pellets (Bardach *et al.*, 1972). Though *Tubifex tubifex* is known to be highly nutritive to fish (Galinat, 1960), the conversion efficiency has been considerably low indicating that *Tubifex* may not be meeting total nutrition requirements of the elvers.

TABLE II. Balance sheet of elver culture of *Anguilla nebulosa*

No. of elvers	Initial biomass of (mg)	Yield (mg)	Amount of food given (mg)
1	304·10	513·00	4664·3
2	163·30	516·00	5233·4
3	190·30	559·70	5402·9
4	265·90	612·90	5514·5
5	170·00	346·30	5578·9
6	110·40	304·30	5795·5
7	279·60	552·70	6328·5
8	561·20	729·20	7409·4
9	460·20	1088·60	7827·9

SPECIFIC GROWTH RATES AND EFFICIENCY OF ELVER CULTURE

Table II indicates total increase of 2717·70 mg in the weight of the elvers while the total of the initially stocked biomass was 2505·00 mg. In 60 days, the specific growth rate, calculated is: $2717{\cdot}70/2505{\cdot}00/60 = 0{\cdot}018$ which represents 0·018 mg/day. On the other hand, the total amount of food given was 53755·30 mg which is equivalent to $53755{\cdot}30/2505{\cdot}00/60 = 0{\cdot}358$ mg/day. A daily ration of fish food equivalent to 35·76% of the initial biomass produced a daily weight increment of elver flesh equivalent to 5·06% of the given amount of fish food during the 60 days. Thus the ' housekeeping ' in elver culture of *A. nebulosa* may be established. In 50 days the necessary food will amount to $0{\cdot}3576 \times 50 = 17{\cdot}90$ times of initial biomass, while the daily increment accumulates to yield $0{\cdot}3576 \times 50 \times 0{\cdot}051 = 0{\cdot}912$ times the initial biomass; i.e. 1 kg of initially stocked elvers in the weight range of $278{\cdot}33 \pm 14{\cdot}35$ mg may need 17·90 kg of *Tubifex tubifex* as food to produce 0·912 kg of elver flesh (*Kosi onodera* 1962).

References

Bardach., J. E., Ryther, J. H. & McLarney, W. O. (1972). Culture of true eels (*Anguilla* sp.) In *Aquaculture*, pp. 385–395. New York: Wiley-Interscience.

Chen, T. P. (1969). Eel culture. *FAO Fish Cult. Bull.* **1**, 8.

Chen, T. P. (1972). Eel culture in Taiwan. *FAO Aquacult. Bull.* **5**, 13.

Galinat, A. (1960). Experimental studies on the utilization of natural food by young crusian (*Carassius carassius* L.) and tench (*Tinca tinca* L.). *Polskie Archivm Hydrobiol.* **8**, 129–152.

Kosi Onodera (1962). *Some Data on Eel-culture in Japan.* Occasional paper 62/6, Indo-Pacific Fisheries Council.

Nair, R. V. (1973). On the export potential of elvers and cultured eels from India. *Ind. J. Fish.* **20**, 610–616.

Reddy, S. R. (1973). Mosquito control through larvivorous predators. Ph.D. thesis, Bangalore University.

Srinivasachar, H. R., Rajagopal, K. V. & Rao, Dwaraka S. (1975). Resources of elvers of the genus *Anguilla* of India and possibilities of its culture. *Symp. on Multiuse of Coastal Zone.* Conducted by Indian Fisheries Ass., Bombay (Abstract) pp. 9.

Windell, J. T. (1967). Rates of digestion in fishes. In *The Biological Basis of Freshwater Fish Production*, pp. 151–173. (Ed. Gerking, S. D.). Oxford and Edinburgh: Blackwell Scientific Publications.