Fishery Technology
2005, Vol. 42(1) pp : 21 - 26

Effect of Body Weight on Reproduction and Mobilization of Organic Reserves in Female Sailfin Molly *Mollienesia latipinna* (Le Sueur)

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Reproduction and mobilization of nutrients and energy for reproduction were studied in female *Mollienesia latipinna* as a function of body weight. Total reproduction (TR), reproductive effort (RE) and somatic condition factor (SCF) increased with increase in body weight. Gonad was not developed in the smallest female tested (0.313 g) and gonad weight was highest before parturition (breeding) and it significantly declined after varied parturition. The proximate composition and energy in somatic and gonad tissues varied with increase in body weight of female *M. latipinna* and it suggests the deposition of nutrients with the advent of the reproductive period. Low level of lipid in soma and high level of lipid in female gonads indicate the mobilization of lipid from soma to gonad to provide nutrients for the development of eggs and fry. Nutrients and energy were more in soma and gonad before parturition and they significantly reduced after parturition. *M. latipinna* being an ovo-viviparous fish, utilized significant amount of nutrients and energy for the development of ova, egg and fry which led to the reduction of energy contents after parturition.

Key words : Reproductive analysis, nutrients, energy, mobilization, *Mollienesia latipinna*

Fishes exhibit large variations in their biochemical compositions among each other and among different body parts. The proximate composition of fish is of paramount importance in relation to nutritive value and physiological condition (Brown & Murphy, 1991). The biochemical composition of an individual fish is the result of interactions between physical and biological factors like size, sex, temperature, feed availability and reproductive stage (Basade *et al.*, 2000). Studies of proximate composition and energy allocation patterns in an animal often includes four energy compartments viz., maintenance, growth, storage and reproduction, among which trade-off may occur. For example, energy used in reproduction is unavailable for growth or maintenance. Allocation of energy to growth, maintenance or reproduction need not be immediate; however, as energy may be stored when abundant and then used later when demands arise. Many authors have studied the fluctuation of proximate composition in muscle of many fish in relation to season, spawning migration, annual growth and reproduction (Dygert, 1990; Tidwell & Robinette, 1990; Geetha *et al.*, 1991; Patil & Kulkarni, 1994). Nevertheless, studies on the allocation energy for growth and reproduction in different life stages of ornamental fishes are scanty. Hence, the paper present report on the detailed profile of biochemical composition and energy content in the muscle and gonad tissues of sailfin molly, *Mollienesia latipinna*, as a function of body weight.

Materials and methods

Different size groups (0.31, 0.54, 0.94, 1.36 and 1.86 g) of *M. latipinna* from early stage to sexually matured brood female were selected from the laboratory bred brood stock and acclimated separately for a week. They were fed *ad libitum* with minced pieces of beef liver twice a day. After 2 h of feeding,

unconsumed feed was removed by pipette. The aquarium water was completely changed twice a week and replenished with chlorinated free well water. Two series of experiments were conducted in the present study.

Series 1: Reproductive and somatic analysis

The chosen female size groups of *M. latipinna* were starved for 24 h to analyse the total reproduction (TR), reproductive effort (RE) and somatic condition factor (SCF). The standard length of test female was measured by graph sheet. The largest size (1.86 g) group of female *M. latipinna* was selected for the experimental study only after release of young ones. Ten individuals in each size group were randomly selected from the respective tanks (1.75' x 1.50'; capacity 110 l) and their ovaries were dissected and the number was counted under a dissection microscope (5x). Eggs and embryos were sorted out into one of six categories, primarily for detection of superfetation: (1) immature ova: ova in the process of yolking but sub mature in size; (2) mature ova: fertilized egg-full sized ova, unfertilized or recently fertilized; (3) primitive streak: primitive streak present, but eyes not yet distinguishable; (4) early eyed: eyes present, but not full sized; little dorsal pigmentation; (5) middle eyed: eyes full sized; moderate to extensive dorsal pigmentation and (6) late eyed:little yolk remaining; near parturition. Total reproduction refers to the summation of total number of eggs and embryos of 2-6 developing stages of embryos in a clutch. Category 1 was considered preparatory to actual reproduction since it includes immature members. Subsequent to counting, ovaries and their contents were placed into tarred aluminium pans, dried to constant weight at 50-60°C for 2 d and weighed to the accuracy of 1 mg in electrical monopan balance. The remainder of fish, minus the digestive tract, was similarly treated and weighed. Reproductive and somatic dry weights (RDW and SDW) were obtained respectively. The fish were preserved in 10% formalin and stored in 35% isopropanol, to get same effect of preservation on length or weight for all groups. Somatic condition factor and reproductive effort of each fish were calculated following the method of Meffe (1985).

$$\text{Somatic condition factor (\%)} = \frac{\text{SDW}}{\text{SL}} \times 100$$

$$\text{Reproductive effort (\%)} = \frac{\text{RDW}}{\text{SDW} + \text{RDW}} \times 100$$

Where SDW, RDW and SL are somatic dry weight, reproductive dry weight and standard length of fish respectively.

The wet weight of the ovary was correlated with body weight of test animals and expressed as ovarian index (OI) using the formula of Dahlgren (1979).

$$\text{Ovarian index (\%)} = \frac{\text{Weight of the ovary}}{\text{Weight of the animal}} \times 100$$

Series 2: Estimation of biochemical composition and energy

To estimate biochemical composition and energy contents in somatic (soma) and gonad tissues, another 10 individuals from each size group of female *M. latipinna* were selected from the stock tanks and somatic and gonad tissues were removed separately. They were separately dried in hot air oven at 50°C for 2 d and then used for analysis. Protein, lipid and carbohydrate contents in soma and gonad of test animals were estimated following the method of Lowry *et al.* (1951), Bragdon (1951) and Plummer (1984) respectively. The energy content of samples was estimated by wet combustion method (Karzinkin & Tarkovskaya, 1964). Student's 't' test was followed to detect the significance of mean values between the experimental groups. Correlation and regression was adopted following the method of least square (Zar, 1974).

Results and Discussion

Total reproduction, reproductive effort and somatic condition factor of female *M. latipinna* increased linearly with increasing of body weight. The TR of 0.54 g size female *M. latipinna* was 11.67% and it significantly increased to 29 ($t = 3.67$; $P < 0.05$), 65 ($t = 3.65$; $P < 0.05$) and 80% ($t = 3.67$; $P < 0.05$) in 0.94, 1.36 and 1.86 g sized females respectively (Table 1). A significant and positive ($P < 0.989$; $P < 0.01$) correlation was obtained between body weight and TR. Similar trend was also obtained in RE and SCF. Meffe & Snelson (1993) reported that reproductive performance increased with increase in developmental stages and body weight in mosquito fish, *Gambusia holobrooki* and sailfin molly *Poecilia latipinna.*

Gonad was not developed in the smallest female tested and it increased with increase in body weight; however, the gonad weight of female *M. latipinna* declined after breeding (Table 1). For instance, the gonad weight of female *M. latipinna* before breeding was 0.230 g and it significantly declined to 0.186 g ($t = 12.57$; $P < 0.01$) after the breeding. Similar result was obtained in ovarian index also. Increase of gonad weight and ovarian index indicates the ovary maturation and fry development and decline of both reflects the shifting of ovarian energy reserves to development and release of fry subsequently. James & Sampath (2003) found that gonad weight and gonadosomatic index increased with increase in rearing period and body weight in *Xiphophorus helleri* and supports the present study.

The nutrients and energy in soma and gonad tissues increased with increase in body weight in female *M. latipinna* (Table 2). This indicates the deposition of nutrients with the advent of the reproductive period (Lambert & Dehnel, 1974). The predominant organic reserves of organisms are carbohydrate, lipid and protein that are accumulated in soma and gonad tissues during development. It has been shown that the organic materials particularly the carbohydrate/glycogen may serve as reserve food materials to be utilized for the formation of gonadal element (Basade *et al.*, 2000). In the present study, low level of lipid in soma and high level of lipid in gonad of female *M. latipinna* indicates mobilization of lipid from soma to gonad. This

Table 1. Effect of body weight on total reproduction, somatic condition factor and reproductive effort in female *Mollienesia latipinna*. Each value is the average (X ± SD) of 10 estimations.

Body weight (g)	Total reproduction (%)	Somatic condition factor (%)	Reproductive effort (%)	Ovary weight (g)	Ovarian index (%)
0.313	Gonad not developed	0.27 ± 0.06	—	Gonad not developed	
0.540	11.67 ± 1.53	0.44 ± 0.03	2.01 ± 0.28	0.020 ± 0.05	3.70 ± 0.04
0.940	29.0 ± 7.55	0.77 ± 0.032	7.94 ± 0.71	0.120 ± 0.14	12.77 ± 0.04
1.360	64.67 ± 7.51	1.04 ± 0.06	13.35 ± 0.73	0.230 ± 0.17	16.91 ± 1.12
1.860	79.67 ± 3.51	1.47 ± 0.07	19.55 ± 0.87	0.186 ± 0.16	9.68 ± 0.67
r – value	0.989	0.999	0.998	0.769	0.900
Y = bx + a	Y = 66.86X – 6.46	Y = 0.94X – 0.19	Y = 16.12X – 1.99	Y = 0.15X – 0.03	Y = 39.7X – 19.56
			t – value		
	0.313 Vs 0.540	—	5.67**	—	
	0.540 Vs 0.940	5.04**	23.57**	16.94**	
	0.940 Vs 1.360	3.65*	9.0**	11.76**	
	1.360 Vs 1.860	3.67*	10.75**	12.16**	

* $P < 0.05$; ** $P < 0.01$

Table 2. Effect of body weight on proximate composition (mg g^{-1} dry matter) and energy (KJ g^{-1} dry matter) in soma and gonad tissues of female *Mollienesia latipinna*. Each value is the mean (X ± SD) of 10 estimations.

Body weight (g)	SOMA Protein	Carbohydrate	Lipid	Energy	GONAD Protein	Carbohydrate	Lipid	Energy
0.313	12.80±0.41	5.65±0.11	12.14±0.32	4.86±0.40	—	—	—	—
0.540	16.20±1.30	8.98±0.36	25.28±1.72	8.35±0.38	3.35±0.20	7.82±0.36	22.06±1.66	2.63+0.14
0.940	24.06±1.64	13.40±0.81	56.16±2.43	12.83±1.82	10.06±0.27	16.50±0.21	92.50±6.61	7.89+0.66
1.360	36.85±1.88	20.33±1.25	87.23±6.17	19.08±0.94	18.55±3.77	23.40±0.68	132.5±7.17	18.24+1.88
				After breeding				
1.860	30.10±2.06	18.55±1.10	66.44±5.77	17.70±1.28	28.64±1.84	33.50±0.63	116.76±9.5	14.67+1.65
				t – value				
0.313 Vs 0.540 g	5.60	19.59	16.76	13.96	—	—	—	—
0.540 Vs 0.940 g	8.45	11.33	17.45	5.39	44.73	48.22	7.62	18.14
0.940 Vs 1.360 g	11.52	10.5	9.93	6.79	5.05	22.26	9.19	11.63

All values were significant at $P < 0.01$ level.

process also suggests the mobilization of energy reserve to provide nutrients for the eggs and this mobilization is reflected on the upsurge in deposition of nutrients in the developing ovaries. Findings in other organisms support the present observation (Vetter *et al.*, 1983; Basade *et al.*, 2000).

The reduction of protein, carbohydrate, lipid and energy content after breeding in *M. latipinna* was 22, 50, 26 and 29% in soma and it averaged to 27, 43, 57 and 31% in gonad respectively. Hails (1983) observed 28, 55 and 35% reduction of protein, lipid and glycogen in post spawning period in females of *T. pectoraliso*. Meffe & Snelson (1993) reported that ovarian lipid level decreased during gestation period in mosquito fish (*Gambusia affinis*) and sailfin molly (*Poecilia latipinna*) and it suggests that lipid was metabolized and used by embryos during early development. They also reported that, ovo-viviparous fish may continue to provide nutrition to the developing embryos, at the cost of stored somatic lipids. Utilization of lipid as the major source has also been shown during embryonic development in various species (Vetter *et al.*, 1983; Ostrowski & Divakaran, 1991; Vasquez *et al.*, 1994).

The present study also showed that proximate composition and energy were more in soma and gonad of female *M. latipinna* before breeding and they drastically decreased after breeding (Table 2). This suggests that the stored organic reserves were utilized for the development of ova, egg or fry. *M. latipinna* being an ovoviviparous fish, nourishes embryo from the reserves stored in the eggs. During development, the absorption of organic substances and water molecules from the maternal body (Balinsky, 1970) could result in considerable amount of energy loss in female *M. latipinna*. James (1998) found that allocation of more amount of assimilated feed energy in *Xiphophorus helleri* for gonad development and production of fry left the fish with minimum energy for growth. Hails (1983) reported that *Trichogaster pectoralis* females conserved the energy resources during pre-spawning period for ovary ripening and it declined during post spawning.

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