绢丝丽蚌年龄与生长的研究

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摘要: 绢丝丽蚌一年生长一个生长轮。年轮可肉眼观察贝壳外表面凹陷的生长轮来鉴定, 用纵剖贝壳明暗相间层数与打磨后观察棱柱层和珍珠层上的生长轮来验证。绢丝丽蚌10龄以前生长较快, 10龄以后生长逐渐减慢。10龄以前年龄(A)与壳长(L)呈直线相关, 年龄与壳重(W_s)、体重(W)均呈幂函数相关, 其10龄以前的方程式分别为: $L=0.8980A+0.8600$($r=0.9883$), $W_s=1.0175A^{2.3399}$($r=0.9997$), $W=1.3188A^{2.3333}$ $r=0.9997$)。10龄以后年龄与壳长、壳重和体重均呈直线相关, 其回归方程式分别为: $L=0.1817A+7.9085$ ($r=0.9813$), $W_s=10.7720A+61.1930$($r=0.9902$), $W=13.6960A+78.8690$($r=0.9903$)。壳长与壳重、体重之间均呈幂函数相关, 其相关方程式分别为: $W_s=0.6303L^{2.4846}$($r=0.9999$), $W=0.8181L^{2.4775}$($r=0.9999$)。壳重与体重之间呈线性相关, 其回归方程式为: $W=0.3560+1.2744W_s$($r=0.9999$)。

关键词: 年龄与生长; 绢丝丽蚌
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绢丝丽蚌 *Lamprotula fibrosa* (Heude) 在分类学上隶属于软体动物门 Mollusca、瓣鳃纲 Lamellibranchia、古异齿亚纲 Palaeheterodonta、蚌目 Unionoida、蚌科 Unionidae、丽蚌属 *Lamprotula*。因其贝壳坚厚皎白, 故为制作珍珠核的一种优质特有丽蚌。有关丽蚌属年龄与生长的研究, 国内外仅见甘西和高健[1]报道过有佛耳丽蚌 *L. mansugi*。绢丝丽蚌为我国特有种, 刘月英等[2]简要报道过其形态特征、生态习性、地理分布及其经济意义, 朱子义等[3]报道了其繁殖习性, 龚世园等[4—5]报道了其食性与贝壳形态。作者对其年龄与生长进行研究, 期望为我国水域中绢丝丽蚌的资源保护和增殖提供基础理论资料。

1　材料与方法

1.1　样本来源　用于年龄与生长研究的幼蚌和成蚌是在1995年至2001年10月饲养于学校水产试验站和湖北省阳新县网湖池塘中的绢丝丽蚌, 以及在网湖用丽蚌耙捕捞的绢丝丽蚌, 共2085枚。

1.2　形态指标测定与统计分析　用游标卡尺测定壳长、壳宽, 用电子天平测定其体重、壳重, 用直线方程 $L=a+bA$ 和幂函数方程 $W=aL^b$ 回归分析了年龄与壳长、年龄与壳重、年龄与体重、壳长与壳重及体重、壳重与体重等形态指标间的相关关系。

1.3　年龄与生长轮　为了准确鉴定年龄, 特在水产站成鱼池塘和网湖池塘中将绢丝丽蚌饲养三周年来验证其每年生长一个生长轮还是两个生长轮。试验前, 测定其壳长, 用锯条锯成缺刻, 标记最后一个生长轮。如此重复三年。生长轮的轮数依据其贝壳外表面环纹线粗细凹凸采用肉眼观察并计数所得。年龄用池塘饲养一周年绢丝丽蚌贝壳上新增长的生长轮数或壳长来确定。副轮以轮纹线是否完全即轮纹线是否从左端一直清晰地延伸到右端来确定, 不完全者即为副轮。用细砂石或砂石纸打磨贝壳外表面, 观察棱柱层和珍珠层上生长轮数, 或从壳顶用钢锯垂直锯向腹缘, 依明暗相间的壳层来计数生长轮数, 以此来证明肉眼观察贝壳外表面生长轮数的准确度。

2　结果

2.1　年轮特征

沿纵向锯开贝壳可知, 绢丝丽蚌的贝壳由明暗相间的壳层组成, 亮层与暗层分别与壳表面的一组凹陷和突起的环纹线相对应, 这就构成了绢丝丽蚌的年轮。用肉眼观察贝壳表面生长轮可知, 贝壳表面环纹线粗壮且凹陷的为生长轮即年轮, 细弱且突

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起的为生长环纹线即非生长轮或年轮。这一点, 通过贝壳纵切面明暗相间的层数可得到验证, 也可用砂轮磨除贝壳的角质层或棱柱层, 根据棱柱层和珍珠层上的生长轮均可有效地鉴定绢丝丽蚌的年龄。

2.2 年龄与生长轮

检测放养三年绢丝丽蚌的结果表明, 绢丝丽蚌一年生长一个生长轮, 生长轮即为年轮。

2.3 捕捞群体组成

由捕捞群体结构分析表明, 网湖绢丝丽蚌由26个年龄组组成, 其中7—10龄和1—15龄的枚数分别占总枚数的33.48%和46.09%, 壳重占总壳重的22.34%和48.53%, 体重占总体重的22.69%和47.40%。因此, 网湖绢丝丽蚌以7—15龄为主要捕捞对象。优势壳长为7.15—10.64cm, 优势壳重为99.40—160.62g, 优势体重为126.04—276.09g(表1)。

表1 捕捞群体年龄组成

Tab. 1 The age composition of fishing colony

年龄 Age(a)	1—6	7—10	11—15	16—20	21—26
数量百分比(%) Percentage in quantity	0.78	33.48	46.09	11.18	8.47
壳重百分比(%) Percentage in shell weight	0.15	23.34	48.53	15.45	13.53
体重百分比(%) Percentage in body weight	10.18	22.69	47.41	15.66	14.06

2.4 壳重、体重与壳长生长

绢丝丽蚌壳重、体重与壳长生长见表2。由表2可以看出, 绢丝丽蚌壳长、壳重与体重的相对增长率均随年龄增加而下降, 10龄以前生长较快, 10龄以后生长逐渐减慢。

表2 绢丝丽蚌壳重、体重与壳长生长

Tab. 2 The growth in shell weight, body weight and shell length of *L. fibrosa*

年龄(a) Age	壳长 Shell length		壳重 Shell weight		体重 Body weight	
	均值(cm) Mean value	增长率(%) Increasing rate	均值(g) Mean	增重率(%) Increasing rate	均值(g) Mean value	增重率(%) Increasing rate
2	2.32	96.60	5.10	436.84	6.58	217.48
4	4.48	46.55	26.17	206.57	33.61	205.40
6	6.67	24.33	70.07	83.85	89.75	83.52
8	8.48	13.66	127.71	41.13	163.28	40.96
10	9.30	4.84	160.62	12.85	205.23	25.69
12	9.87	3.07	186.21	7.97	237.82	7.94
14	10.39	2.63	211.54	6.80	270.07	6.78
16	10.89	2.41	237.75	6.20	303.42	6.17
18	11.37	2.20	264.64	5.66	337.64	5.64
20	11.73	1.58	285.95	4.03	364.75	4.02
22	12.04	1.32	305.09	3.36	389.09	3.34
24	12.22	0.75	316.55	1.88	403.67	1.77
26	12.38	0.66	326.95	1.64	416.88	4.27

2.5 年龄与壳长的关系

经点图分析, 绢丝丽蚌的年龄与壳长呈直线相关, 依据不同年龄相应的平均壳长, 求得其10龄以前年龄与壳长的直线回归方程为: $L = 0.8980A + 0.8600$, $r = 0.9883$。10龄以后年龄与壳长的直线回归方程为: $L = 0.1817A + 7.9085$, $r = 0.9813$。式中, L 为壳长(cm), A为年龄(a), r为相关系数。其相应的曲线分别见图1, 图2

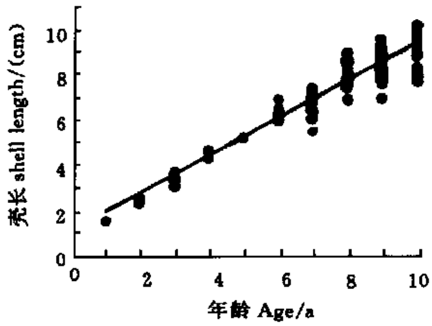

图 1　10 龄以前年龄与壳长的关系

Fig. 1　The relationship between age and shell length before 10 ages

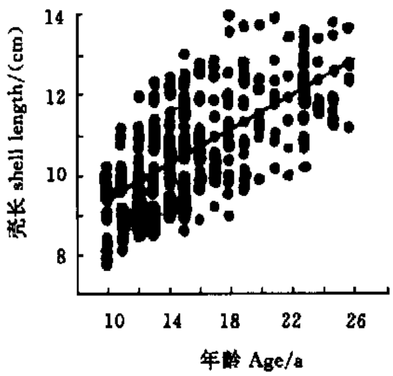

图 2　10 龄以后年龄与壳长的关系

Fig. 2　The relationship between age and shell length after 10 ages

2.6　年龄与壳重的关系

作图表明, 绢丝丽蚌的年龄与壳重在 10 龄以前呈幂函数相关, 10 龄以后呈直线相关关系, 按不同年龄相应的平均壳重, 求得 10 龄以前年龄与壳重的回归方程式为: $W_s = 1.0175A^{2.3399}$, r= 0.9997。10 龄以后年龄与壳重的直线回归方程为: $W_s = 10.7720A + 61.1930$, r= 0.9902。式中, W_s 为壳重(g)。其相应的曲线分别见图 3, 图 4。

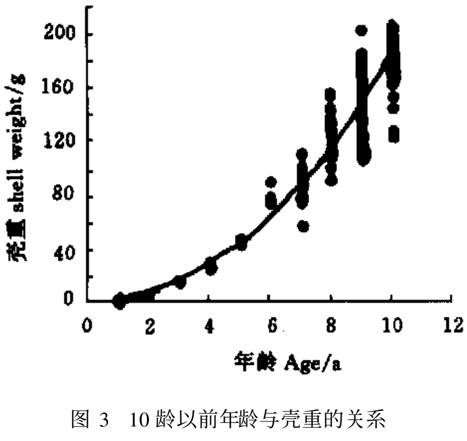

图 3　10 龄以前年龄与壳重的关系

Fig. 3　The relationship between age and shell weight before 10 ages

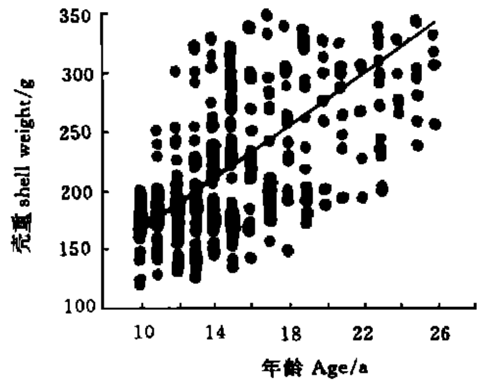

图 4　10 龄以后年龄与壳重的关系

Fig. 4　The relationship between age and shell weight after 10 ages

2.7　年龄与体重的关系

点图结果同样表明, 绢丝丽蚌年龄与体重在 10 龄以前呈幂函数相关, 10 龄以后呈直线相关, 按不同年龄相应的平均体重, 求得 10 龄以前年龄与体重的相关式为: $W = 1.3188A^{2.3333}$, r= 0.9997。10 龄以后年龄与体重的直线回归方程式为: $W = 13.6960A + 78.8690$, r= 0.9903。式中, W 为体重(g)。其相应的曲线分别见图 5, 图 6。

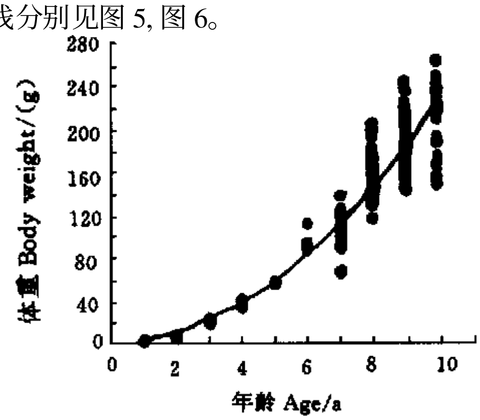

图 5　10 龄以前年龄与体重的关系

Fig. 5　The relationship between age and body weight before 10 ages

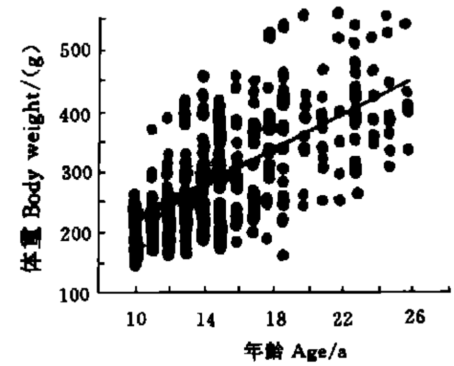

图 6　10 龄以后年龄与体重的关系

Fig. 6　The relationship between age and body weight after 10 ages

2.8 壳长与壳重、体重之间的关系

经点图表明, 壳长与壳重、体重均呈幂函数相关, 其相关式分别为: $W_s = 0.6303L^{2.4846}$, r= 0.9999。$W = 0.8181L^{2.4775}$, r= 0.9999. 式中, W_s 为壳重(g), W 为体重(g), L 为壳长(cm)。其相应的曲线分别见图7, 图8。

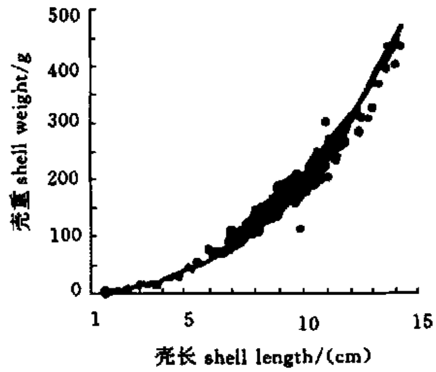

图7 壳长与壳重的关系

Fig. 7 The relationship between shell length and shell weight

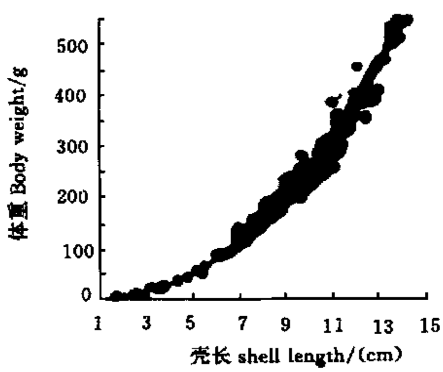

图8 壳长与体重的关系

Fig. 8 The relationship between shell weight and body weight

2.9 壳重与体重的关系

经点图表明, 壳重与体重呈直线相关, 其相关式为: $W = 1.2744W_s + 0.3560$, r= 0.9999。其相应的曲线见图9。

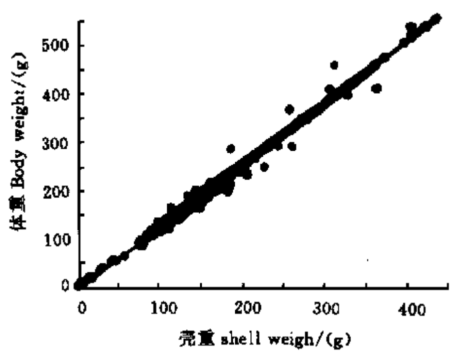

图9 壳重与体重的关系

Fig. 9 The relationship between shell weight and body weight

3 讨论

3.1 关于年龄与生长轮

研究结果表明, 绢丝丽蚌一年形成一个生长轮, 与文蛤[6], 何氏笠贝 *Collisella heraldi*[7]、栉孔扇贝[8]、佛耳丽蚌[1]相一致, 与古川优[9]报道的 *Corbicula sandai* 一年形成两个生长轮, 即一个在6月形成, 一个在12月至2月之间形成的不同, 也与Marta bretos[10]报道的 *Fissurel crassa* 在一年的冬、夏各形成一个生长轮的不同。

3.2 关于生长速度

绢丝丽蚌的生长速度较为缓慢, 生长寿命较长。其生长速度分为两个阶段, 10龄以前生长速度较快, 10龄以后生长速度逐渐减慢。

3.3 关于合理捕捞

绢丝丽蚌性成熟年龄为5龄。合理捕捞的壳长为7.0cm以上达到出口规格和具较大经济效益[5], 其相应的年龄为7龄, 落后于性成熟年龄2年, 对资源保护和增殖有利。如果在合理捕捞年龄的壳长、壳重和体重基础上再人工放流一定量寄生钩介幼虫后的鱼种, 将更加有利于绢丝丽蚌的资源保护与增殖, 将会获得更好的经济效益。

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STUDIES ON THE GROWTH OF *LAMPROTULA FIBROSA*

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Abstract: Juvenile and adult mussels of *Lamprotula fibrosa* which were reared from 1995 to October, 2001. The mussels were from collected from on-growing fish ponds of Aquatic Experimental Station in the Fisheries College, Huazhong Agricultural University and the ponds which are connected to Wanghu Lake, Yangxin, Hubei. 2085 mussels were collected by harrow.

For identifying the age exactly, *L. fibrosa* were cultured for three years in those ponds where they were collected to validate that the mussels grow to one or two growth rings once a year.

Before experiment, shell length was measured, gaps were sawed by saw blade and the last growth ring was marked. The steps were repeated for three years. The amounts of growth ring were gained according as the thickness and the convolve or protruding of the annular line in the shell exterior and they were observed by naked eyes and noted. The ages were confirmed by new growth rings in the shell exterior of *L. fibrosa* reared in the ponds for one year. From the vertical side of the shells, the shells of *L. fibrosa* were composed by shell layers of bright and dark. The bright layer and the dark layer consisted with the annular lines which have a group of hollow and protuberant in the shell exterior respectively. It is the annual rings. Observing the growth rings in the shell exterior through naked eyes, the annual lines in shell exterior which are thick and hollow are the growth rings or annual rings. Those thin and protuberant lines are annual growth lines and not growth rings or annual rings. This can be validated by the amounts of the layers which have bright and dark lines in the vertical side of the shell. The ages of *L. fibrosa* can be identified effectively through the growth rings of the colony layer and the pearl layer after the keratode layer or colony layer were wore away by grinding wheel. *L. fibrosa* increased one growth ring once a year. The structure analyze shows that *L. fibrosa* in Wanghu Lake were 29 age groups. The proportion of 7—10 ages is 33.48% and that of 1—15 ages is 46.09%. Their shellweight accounts for 22.34% and 48.53% of whole shell weight, respectively. Their body weight accounts for 22.69% and 47.40% of Whole body weight, respectively. *L. fibrosa* of 7—15ages covers most capture of those in Wanghu Lake. Dominant shell length is 7.15—10.64cm. Dominant shell weight is 99.40—160.62g. Dominant body weight is 126.04—276.09g. Annual ring can be identified by observing the sunken growth rings on the shell surface by eyes, and annual ring can be verified by observing the shell layers in shade and light check after opening shell longitude inner section and by observing growth rings in the prismatic layer and the pearl layer after polishing the shell. Before 10 ages, *L. fibrosa* grows faster than it does after 10 ages. Before 10 ages, the relations between age (A) and shell length (L) is linear correlated.

The relationships between age (A) and shell weight (W_S), body weight (W) all are power function correlated. The equations of regression before 10 ages respectively are:

$$L = 0.8600 + 0.8980A \qquad (r = 0.9883)$$

$$W_S = 1.0175A^{2.3399} \qquad (r = 0.9997)$$

$$W = 1.3188A^{2.3333} \qquad (r = 0.9997).$$

After 10 ages, the relationship between age and shell length, shell weight, body weight are linear correlated. The equations after 10 ages are:

$$L = 7.9085 + 0.1817A \qquad (r = 0.9813)$$

$$W_S = 61.1930 + 10.7720A \qquad (r = 0.9902)$$

$$W = 78.8690 + 13.6960A \qquad (r = 0.9903).$$

The relationship between shell length and shell weight, body weight are power function correlated. The correlative equations are:

$$W_S = 0.6303L^{2.4846} \qquad (r = 0.9999)$$

$$W = 0.8181L^{2.4775} \qquad (r = 0.9999)$$

The shell weight is linearly related to body weight, and the equation is: $W = 0.3560 + 1.2744W_S$ ($r = 0.9999$).

Key words: Age; Growth; *Lamprtula fibrosa*.