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AGE AND GROWTH OF STINGRAY DASYATIS PASTINACA IN THE EGYPTIAN MEDITERRANEAN WATERS OFF ALEXANDRIA.

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ABSTRACT

Age and growth of **Dasyatis pastinaca** were determined by reading vertebrae. The results showed that annual rings formed during December-April with a midpoint in February.

Counts of growth rings on vertebral centra were employed to back-calculate length at ages for the full range (18-49 cm D.W.). Males and females had nearly similar growth rates though femal grows much longer than males. The oldest female was 5 years at 47.01 cm and 3769 grams, while the oldest male was 4 years at 40.33 and 2387 grams. The values of Von-Bertalanffy parameters D, W , K and t_o were 77.33148, 0 163915 and -0.709532 for females; 64.56773, 0.211352 and -0.635598 for males; and 79.75796, 0.154589 and -0.7491096 for combined sexes, respectively. A close agreement between the theoretical and calculated disc width values are clearly existing.

The disc width-weight relationship for Dasyatis pastinaca is curvilinear and the calculated formula for female was $W = 0.0207\ DW^{3.1454}$, for males was $W = 0.01224\ DW^{3.2945}$, while for combined sexes was $W = 0.0141\ DW^{3.2522}$.

INTRODUCTION

Age and growth are interrelated subjects each of them leads to the other. Growth is the change in size with the direct function of time.

For cartilagenous fishes, age was determined mainly by length frequency method (Olsen; 1954, Richards et al., 1963; Sage et al., 1972 and Others); Tag-recapture technique (Babel, 1967; Holden, 1972 and Grant et al., 1979); Dorsal spines (Ketchen, 1975 and Tucker, 1985) and recently by Uertebrae (Haskell, 1949; Daiber 1960, Richards et al., 1963; La Marca, 1966; Du Buit, 1972; Stevens, 1975; Cailliet et al., 1983 a & b and Du Buit & Maheux, 1986).

Disc width-weight relationship was also studied for **Dasyatis** species by Struhsaker, 1969 and Snelson et al., 1989.

The present study on **Dasyatis pastinaca** revealed the validity of vertebrae in age determination. Therefore, time of ring formation, growth factor and Von-Bertalanffy growth equation were evaluated in order to calculated the annual increment in both disc width and weight as well as maximum disc width aquired.

MATERIAL AND METHODS

Age determination was carried out by reading the cartilagenous vertebrae of **Dasyatis pastinaca** procured for the present study from Al-Anfoushy fish market which receives the fisheries landing of Mediterranean water around Alexandria. Each fish was sexed, and lengthed for its disc width to the nearest cm and weighed for the nearest gram. Fish specimens collected for the age and growth studies were dissected to get the anterior vertebral column, which removed, cleaned then left to dry for quite some time. The most representing vertebrae are the 5th to 12th.

The technique adopted here for reading the rings was formulated by the authors after several trials based on the previous work by Stevens (1975). The vertebrae stained with 1% silver nitrate, left to dry then immersed in xylol for reading under the binocular microscope of 15x magnification using reflected light on a dark background.

The distance from the focus of vertebrae to the successive annuli (i.e. to the end of the dark ring) and to the margin was measured by a micrometer division. The relationship between the vertebral radius and disc width was expressed as a linear relation. The fish disc width at each year of life was backcalculated by using direct relation between vertebral radius and fish disc width.

Disc width-weight relationship was obtained by applying least square method. In this equation gutted weight is best used to avoid the bias may occur by the weight of stomach and gonad. Theoretical growth in disc width as Bertalanffy's growth equation was calculated by using Gulland's method (1965). Theoretical maximum weight calculated by the conversion of theoretical maximum length by the disc width-weight equation.

OBSERVATION AND RESULTS

Age Determination By Vertebrae

The vertebra of **Dasytis pastinaca** was found to have a transparent central focus surrounded by a dark ring. Alternative zones of opaque and transparent colour are seen on the vertebrae (Fig. 1). Embryonic rings have been observed in this fish species. The two faces of the vertebrae do not show any significant difference in the centrum radius and both faces were counted identically in some samples. Narrow opaque rings appear to be present in the transparent zone but rarely form continuous ring often it were obscured.

TABLE 1

The average calculated disc width of **Dasyatis pastinaca** at the end of each year of life.

a for females

Age	No of fish	disc width range (cm)	Average disc width (cm)	Av. DW_1	Cal. DW_2	disc width at end of each year DW_3	DW_4	DW_5
I	19	18.2-23.5	20.73	19.10				
II	40	23.0-33.0	27.97	19.01	27.78			
III	30	32.0-37.5	34.57	18.71	28.06	34.45		
IV	11	37.0-49.0	41.21	18.81	27.41	35.91	41.07	
V	5	47.0-49.0	48.20	18.70	27.86	36.89	42.93	47.01
Grand average disc-width (cm)				18.90	27.84	35.06	41.65	47.01
Annual increment (cm)				18.90	8.94	7.22	6.59	5.36
Percent increment (%)				40.20	19.02	15.36	14.02	11.40

b- for Males:

Age	No. of fish	disc width range (cm)	Average disc width (cm)	Av.	Cal. DW_1	disc width at end of each year DW_2	DW_3	DW_4
I	33	18.5-23.4	20.98		18.94			
II	36	23.2-31.0	27.37		18.97	27.16		
III	10	32.5-38.5	35.37		18.42	28.37	34.37	
IV	3	38.0-42.0	40.60		18.40	28.80	35.44	40.33
Grand average disc-width (cm					18.87	27.58	34.62	40.33
Annual increment (cm)					18.87	8.71	7.04	5.71
Percent increment (%)					46.79	21.59	17.46	14.16

c- For Combined sexes:

Age	No. of fish	Disc width range (cm)	Average disc width (cm)	Av. DW_1	Cal. DW_2	disc width at end of each year DW_3	DW_4	DW_5
I	52	18.2-23.5	20.89	19.00				
II	76	23.0-33.0	27.69	18.99	27.49			
III	40.	32.0-38.5	34.77	18.64	28.23	34.43		
IV	14	37.0-49.0	41.08	18.72	27.71	35.81	40.91	
V	5	47.0-49.0	48.20	18.70	27.86	36.89	42.93	37.01
Grand average disc-width (cm)				18.89	27.75	34.97	41.44	47.01
Annual increment (cm)				18.89	8.86	7.22	6.47	5.57
Percent increment (%)				40.18	18.85	15.36	13.76	11.85

TABLE 2

The average calculated weight of Dasyatis pastinaca at the end of each year of life.

a for females

Age	No. of fish	Gutted weight range (gm)	Average gutted weight (gm)	Av. W_1	Cal. gut. wt. at end of each year W_2	W_3	W_4	W_5
I	19	165 - 380	277	222				
II	40	370 - 1260	738	218	744			
III	30	1150 - 2160	1453	208	744	1418		
IV	11	1620 - 4300	2558	211	691	1615	2464	
V	5	4100 - 4940	4741	207	727	1758	2833	3769
Grand average gutted weight (gm)				215	725	1502	2579	3769
Annual increment (gm)				215	510	777	1077	1190
Percent increment (%)				5.70	13.53	20.62	28.58	31.57

b- for Males

Age	No. of fish	Gutted weight range (gm)	Average gutted weight (gm)	Av.	Cal. gut. wt. at end of each year W_1	W_2	W_3	W_4
I	33	170 - 360	280		196			
II	36	410 - 940	668		199	649		
III	10	965 - 1960	1413		181	781	1410	
IV	3	1900 - 2710	2430		180	787	1560	2387
Grand average gutted weight (gm)					196	684	1445	2387
Annual increment (gm)					196	488	761	942
Percent increment (%)					8.22	20.44	31.88	39.46

c- For Combined Sexes

Age	No. of fish	Gutted weight range (gm)	Average gutted weight (gm)	Av. W_1	Cal. gutt. wt. at end of each year W_2	W_3	W_4	W_5
I	52	165 - 380	279	203				
II	76	370 - 1260	714	203	675			
III	40	965 - 2160	1443	191	736	1405		
IV	14	1620 - 4300	2531	194	693	1596	2461	
V	5	4100 - 4940	4741	193	705	1758	2878	3867
Grand average gutted-weight (gm)				199	696	1480	2571	3867
Annual increment (gm)				199	497	784	1091	1296
Percent increment (%)				5.15	12.85	20.27	28.21	33.52

Theoretical Growth Parameters

Growth has been expressed equation in terms of Von-Bertalanffy's equation by applying Gulland method (1965). The parameters of these equation i.e. DW , K, t_o, and also W are shown in Table 3.

TABLE 3
Growth parameters for **Dasyatis pastinaca** off Alexandria

Sex	K	To	D.W.	W
Females	0.163915	-0.709532	77.33148	18035.82
Males	0.211352	-0.635598	64.56773	11253.72
Combined sex	0.154588	-0.7491496	79.75796	21579.90

The theoritical disc width values are used to calculate disc width at each year of life for each females, males, and combined sexes (Table 4). A close agreement between the theoretical and calculated disc width values are clearly existing while there are minor variations between males and females in the sense of their growth.

TABLE 4
Calculated and theoretical disc width at different years of life for females, males and combined sexes of **D. pastinaca**

Years of life	Females		Males		Combined sexes	
	Cal. (cm)	Theor. (cm)	Cal. (cm)	Theor. (cm)	Cal. (cm)	Theor. (cm)
1	18.90	18.90	18.87	18.87	18.87	18.90
2	27.84	27.73	27.58	27.58	27.75	27.61
3	35.06	35.23	34.62	34.62	34.97	35.08
4	41.65	41.60	40.33	40.33	41.44	41.48
5	47.01	47.00	-	-	47.01	46.96

Disc Width-Weight Relationship

For **Dasyatis pastinaca,** the disc width-weight relationship is curvilinear. A small variation was observed between the empirical and calculated weights for females, males and combined sexes of each disc width group (Table 5).

The caluclated formula expressing this relation are:

For female: $W = 0.0207\ DW^{3.1454}$
$n = 245\ \ r = 0.9969\ \ P < 0.001$

For male : $W = 0.01225\ DW^{3.2945}$
$n = 225\ \ r = 0.9993\ \ P < 0.001$

and for combined sexes: $W = 0.0141\ DW^{3.2522}$
$n = 479\ \ r = 0.9993\ \ P < 0.001$

It is evident from the exponent values of the equation that the rate of putting on weight is nearly the same in males or females which is equal to 3

TABLE 5

Mean observed and calculated gutted weights for disc width group for females, males and combined sexes of **Dasyatis pastinaca** off Alexandria during 1983-1984.

Disc width (cm)	Females			Males			Combined Sexes		
	No	Obs. (gm)	Cal. (gm)	No.	Obs. (gm)	Cal. (gm)	No.	Obs. (gm)	Cal. (gm)
14				1	70	73	1	70	75
16	1	164	127	4	108	114	5	119	116
18	6	168	184	10	181	167	16	176	170
20	16	239	256	22	244	237	38	242	240
22	15	321	346	28	316	324	43	318	327
24	16	403	455	19	449	432	35	428	434
26	26	585	585	28	598	562	54	592	564
28	19	695	739	43	696	718	62	696	717
30	24	887	917	27	869	901	51	878	897
32	26	1156	1125	6	1118	1115	32	1149	1107
34	33	1446	1361	11	1384	1361	44	1430	1348
36	25	1623	1628	7	1572	1642	32	1611	1624
38	15	2048	1930	7	1992	1963	22	2029	1936
42	6	2733	2643	5	2629	2728	11	2686	2680
44	6	3236	3062	3	3319	3182	9	3264	3120
46	2	3751	3521	-	-	-	2	3751	3605
48	2	3925	4023	-	-	-	2	3925	4137
50	4	4238	4576	-		-	4	4238	4727
Total No	245			225			470		

DISCUSSION

In the present study on **Dasyatis pastinaca** the type of zones present on the vertebral centra appeared clearly with transmitted light after using silver nitrate showed that two kinds of alternative bands occur annually on these vertebral centra (transparent and opaque). Simillar observation has been reached by Holden and Vince (1973) for **Raja clavata,** Holden (1974) for other species of **Raja,** Stevenes (1975) for blue shark **(Prionace glauca),** Pratt and Casey (1983) for short fin mako, **Isurus oxyrinchus,** Ryland and Ajayi (1984) for three species of Raja.

Such agreement of observations can be considered as a specific character for the annual growth rings. For **Dasyatis pastinaca,** observations made on the time of ring formation located at the periphery of the vertebral centra are difficult due to the presence of connective tissue. Such difficulty has also faced Holden and Vince (1973).

The present results showed that one ring is formed each year during December and April with a midpoint at February. Disc width-vertebral radius relationship for **Dasyatis pastinaca** is found to be linear as found by Stevens (1975), Du Buit (1977), Cailliet et al. (1983 a & b), and Casey et al. (1985).

The maximum rate of growth of **Dasyatis pastinaca** was attained during the first year of life and decreased as the fish gets older. The fish can reach 18.89 cm by the end of the first year of its life and by the end of the second years it reaches 27.75 cm to become 34.97 cm after three years and 41.44 by the end of the fourth year up to 47 cm on the end of the fifth year of life.

Growth curves were not accessible in any previous work on **Dasyatis pastinaca** which created a difficulty in comparing the present results with other species having different growth rates. The value of the symptotic disc width obtained from Von Bertalanffy growth equation for **Dasyatis pastinaca** was found to be 77.33 cm for females and less for males 64.56 cm while the largest female and male fish samples here were 49 and 42 cm, respectively. The value of asymptotic growth of **Dasyatis pastinaca** in weight obtained from the previous equation was found to be 18036 gm for female and 11254 gm for male while back calculation revealed that 4576 gm and 3182 gm for female and male respectively of the observed fishes. This means that always females grow higher than males which offer a better chance to be captured. Similar conclusion was drawn by Sage et al (1972) for **Dasyatis sabina** in Texas on the basis of weight histograms in which the female fish lived 6 years to be 2000 gm weight while male lived less (3-4 years) attained during which less than 1000 gm weight. The same authors noted a growth of 200 gm in weight for females during its first year of life followed by a marked increase within the second year, a condition attributed to pregnancy. Subsequent increments were recorded as 200 gm per annum for females of the same study. In case of **Dasyatis pastinaca** it has been found that the annual increase

in weight is 199 gm in average at the end of the first year, 497 gm in the second, to be 784 g and 1091 gm by the end of third and fourth then 1296 gm for the 5th year old fish.

Length-weight relationship of elasmobranchs has been discussed as a curvilinear relation by; Richards et al. (1963); Du Buit (1975); Stevens, 1975; Capape (1980); Ryland and Ajayi (1984) among others. Stevens (1975) worked on **Prionace glauca**, Struhsaker (1969) on **Dasyatis centroura** while Schuartz and Dahlberg (1978) studied **D. sabina** and Snelson et al (1989) studied **D. say**. In the Mediterranean Sea of Egypt, the present work is the only one regarding **Dasyatis pastinaca**. However, this relationship was studied for other cartelagenous fishes of the same area (Hosny, 1981 and Hussein, 1985) on **Mustelus mediterranean** and **Raja miraletus**, respectively. The value of "n" for the disc width-body weight relationship in the present study on **Dasyatis pastinaca** was found to be equal to 3.1454 for the females and 3.2945 for males. Values of exponent "n" derived here proved that males and females are nearly equal.

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