

# THE GENITAL CYCLE OF *ASTERINA BURTONI* GRAY (ASTEROIDEA) FROM THE GULF OF ELAT, RED SEA.

by

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## Résumé

Les différents types génitaux d'*Asterina burtoni* Gray du Golfe d'Elat et leur distribution aux différentes périodes de l'année sont décrits. Un hermaphrodisme occasionnel a été observé. De ces recherches, l'auteur conclut que la ponte a lieu entre les mois de décembre et de mars et que la maturation dure au moins deux ans.

## Introduction

Preliminary observations on the genital cycle of *Asterina burtoni* Gray have already been described elsewhere (Achituv, 1969). The number of animals studied, there, was very small and it was not possible to draw a clear picture of the genital cycle. The presence or absence of the sexual mature individuals during the periods of the year could not be explained. The large number of animals available for the present study enables the completion of our knowledge on the genital cycle of *Asterina burtoni*.

## Material and Methods

Animals were collected in october 1969, and monthly from may 1971 to april 1971 at Marsa Mukebla, 30 km South of Elat. The animals were dissected and examined for the presence of the parasite *Dendrogaster asterinae* Achituv. Only animals without parasites were used for the present study to avoid any possible interference by the parasites. The number of animals studied was 139. The gonads were taken out and fixed in Allen B15 or Carnoy. In small animals up to  $R=5$  mm, it was not possible to remove the gonads and a part of the animals containing interradius was fixed in Allen B15. The stains used were Groat Hematoxylin, Ehrlich Hematoxylin and Erythrosin as a counterstain.

## Results

### The genital types

An attempt was made to use the symbols for genital types as proposed by Bruslé (1969). However, it was not possible to apply the symbols used for *Asterina gibbosa* Pean. to all the stages of *Asterina burtoni*. An adapted system of Bruslé symbols was used as shown

Symbol	Genital type
o	Rudimentary gonads
+	Vesicular tissue
♂	Beginning of spermatogenesis
♂ ♂	Progressing spermatogenesis
♂	Developed testes
♂	Testes after spawning
o → ♀	Beginning of ovogenesis
♀	No vitelline activity
♀ ; ♀ ♀	Developed ovaries
♀	Ovaries after spawning

FIG. 1  
*Asterina burtoni*

The symbols used for describing the different genital types.

in Fig. 1. The results of the histological study are given in Figs 2 and 3. Generally, the histology of the gonad is similar to that described by Cognetti and Delavault (1962) for *Asterina gibbosa*.

#### 1. Indistinguishable genital types

##### (1) Rudimentary gonads

In these gonads, which were very small, the genital nature of the gonocycles could not be distinguished. Sometimes only the gonad rudiments could be seen. Gonads of this type were found in small animals in which R (R is the distance between the center of the oral disc and the tip of an arm) was less than 5 m.

##### (2) Gonads containing vesicular tissue (Pl. 1.a)

The vesicular tissue consists of cells with large vacuoles. It was described in Asteroidea by Bacci (1949). There were several animals

13							♂;♂				
12											
11							♂;♂				
10	♂+		+;o+		♂;♂;♂;♂		♂;♂	♂		♂+	
9					♂o+		♂;♂	♂;♂	♂;♂;♂+	♂+	+
8		♂	o+;♂+;♂+	♂;♂	♂♂;♂o+		♂;♂	♂;♂	♂		♀
7		♂+	o+;♂+;♂+;♂+		♂+		♂;♂		♂	♂	♂+;o+;+
6			♂+			♂				♂;♂;♂	
5					♂+		♂♂				♂
4	o		o	o	o						
3	o										
2								o			
R mm.	July	Aug.	October	Nov.	December	Jan.	Feb.	Mar.	April	May	June

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FIG. 2  
*Asterina burtoni*  
 The distribution of the male genital types during the year in relation to the animal size.

in which the gonads contained only vesicular tissue. The symbol + indicates the presence of vesicular tissues but, when accompanied by another symbol, then the gonad also contains genital tissue.

## II. Testes

### (3) Beginning of spermatogenesis

These glands contained spermatocytes or very small spermatogenic columns in the periphery of the gonad. There were two variations of this type. In specimens with R smaller than 5 mm (Pl. 1.b), interstitial cells which stained dark with hematoxylin were usually found in the middle of the gonad. In larger specimens, there was vesicular tissue in the middle of the gonad. In a few cases, residual spermatozooids were also found in the middle of the gonad's lobe (Pl. 1.c.).

### (4) Progressing spermatogenesis (Pl. 1.d)

This is a transitional stage in which developed spermatogenic columns could be seen, but no spermatozooids were found. Sometimes, there was residual vesicular tissue in the middle of the gonad.

### (5) Developed testes (Pl. 1.e)

There were developed spermatogenic columns in these gonads and the center of each lobe was full of spermatozooids. Usually, there was no sign of vesicular tissue.

### (6) Testes after spawning (Pl. 1.f)

Only residual spermatozooids were found in these gonads. The quantity of spermatozooids was small and neither spermatogenic columns nor spermatocytes could be seen. In most cases, vesicular tissue was found in the periphery of the gonad lobes enveloping the residual spermatozooids.

## III. Ovaries

### (7) Beginning of ovogenesis (Pl. 2.a)

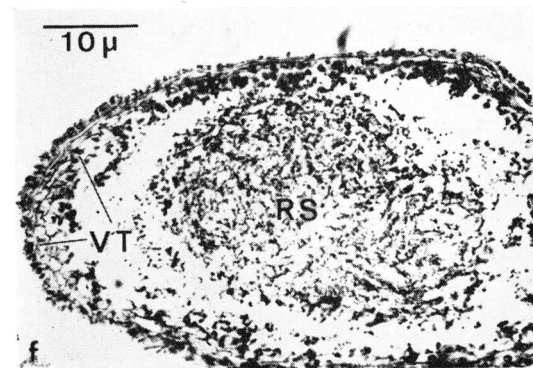
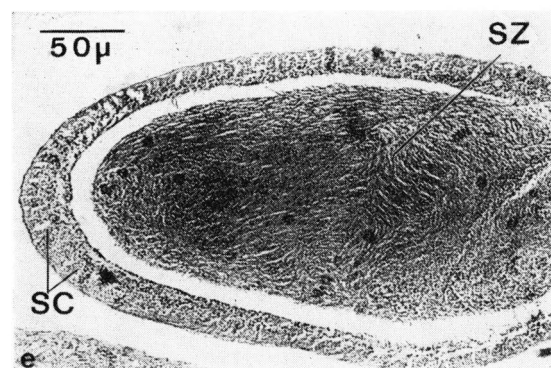
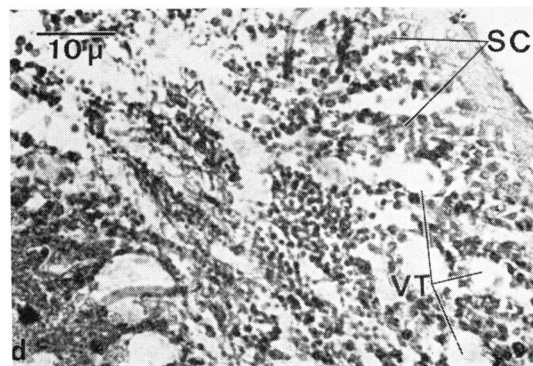
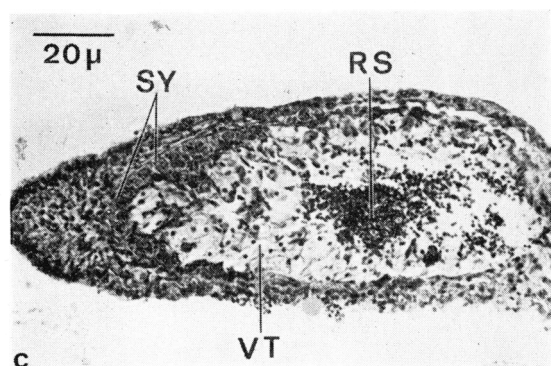
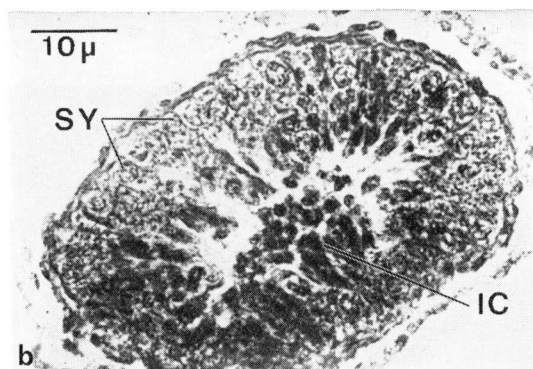
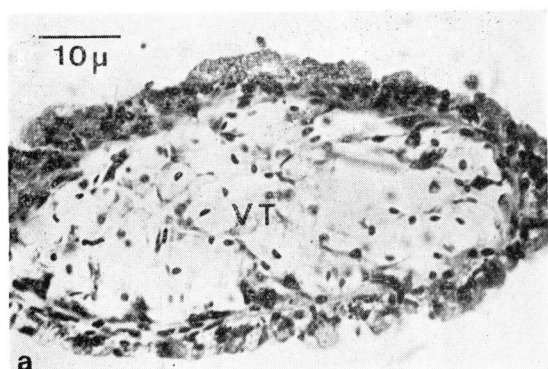
In these gonads, only small ovocytes lying among interstitial cells were found. No vitelline activity could be seen. Usually, these were small animals, in which R was smaller than 6 mm.

### (8) Ovaries without vitelline activity (Pl. 2.b)

Small ovocytes were found in these gonads and no interstitial cells or vitelline activity could be seen. The ovocytes were enveloped by follicle cells.

### (9) Developed ovaries (Pl. 2.c)

Vitelline activity was seen in these ovaries and most specimens contained big ovocytes. Vitelline activity was found in all stages of development. It was difficult to distinguish between ripe ovaries and partially developed ovaries, since there were no sharply defined histological stages. However, large gonads which seemed to be ripe were marked with a double symbol. It should be mentioned that even in ripe ovaries, small ovocytes without any vitelline activity could

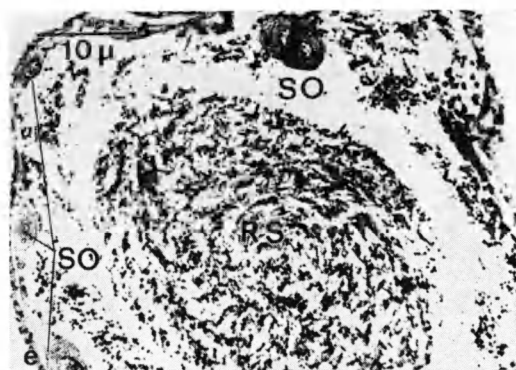
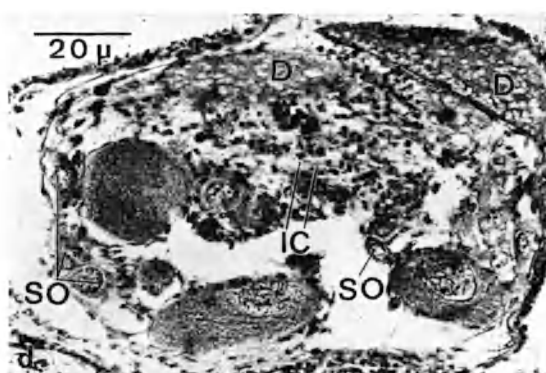
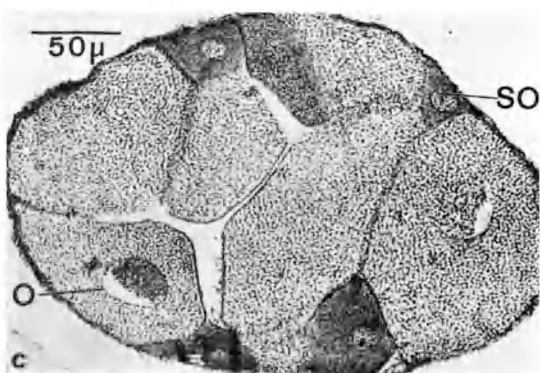
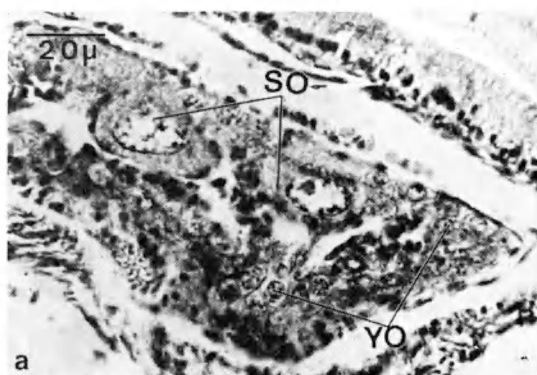


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PLATE 1  
*Asterina burtoni*

a: A gonad containing only vesicular tissue; b: beginning of spermatogenesis (a specimen in which R is smaller than 5 mm); c: beginning of spermatogenesis (R larger than 5 mm); d: testes in progressing spermatogenesis; e: a ripe testes; f: testes after spawning.

IC: interstitial cells; RS: residual spermatozooids; SC: spermatogenic columns; ST: spermatogonia; VT: vesicular tissue.



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PLATE 2  
*Asterina burtoni*

a: Ovary beginning of ovogenesis; b: ovary without vitelline activity; c: developed ovary; d: ovary after spawning; e: hermaphrodite gonad.

D: degenerated ovocytes; IC: interstitial cells; O: developed ovocytes; RS: residual spermatozooids; SO: small ovocytes; YO: young ovogonia.

14									♀ ♀		
13							♀ ♀		♀ ♀		
12							♀				
11						♀ ♀; ♀ ♀		♀ ♀			
10		♀	♀		♀	♀				♀	♀
9	♀; ♀	♀; ♀; ♀	♀	♀; ♀	♀; ♀; ♀	♀; ♀; ♀	♀	♀ ♀	♀ ♀		♀; ♀
8	♀	♀	♀; ♀	♀	♀; ♀; ♀	♀; ♀		♀ ♀	♀ ♀		♀; ♀
7	♀; ♀	♀+	♀; ♀	♀; ♀	♀	♀	♀	♀ ♀; ♀ ♀	♀ ♀; ♀ ♀; ♀	♀	♀; ♀
6			♀				♀		♀		♀
5		♀	♀			♀	♀		♀		♀
4			♂→♀	♂→♀; ♀			♂→♀				♀
R mm	May	June	July	August	October	Novem.	Dec.	January	February	Mar.	April

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FIG. 3  
*Asterina burtoni*

The distribution of the female genital types during the year in relation to the animal size.

always be found. The ovaries were of the type called, by Cognetti and Delavault (1962), asynchronic. In few cases small quantity of vesicular tissue was found among the ovocytes.

(10) Ovaries after spawning (Pl. 2.d)

These gonads contained small ovocytes. In some cases, there were also large ovocytes in different stages of degeneration. In the degenerated ovocytes, large vacuoles within the vitellin could be distinguished. Among the ovocytes there were interstitial cells which could be distinguished from vesicular tissues by the absence of large vacuoles and by staining darkly with hematoxylin.

(11) Hermaphrodite gonads

One case of hermaphroditism was found. In this case, the gonad was a testes after spawning, in which residual spermatozooids as well as vesicular tissue were found. In the periphery of the gonad, small ovocytes were seen (Pl. 2.e).

## DISCUSSION

### The annual genital cycle

#### Spermatogenesis

During july through october and, sometimes, the first half of november, gonads beginning spermatogenesis and containing only small spermatogenetic columns were found. Vesicular tissue was usually found in the middle of the gonad lobes. From november through december, spermatogenesis was more active, the spermatogenetic columns were high and small quantities of spermatozooids could be seen. Ripe testes were found from december through march and it appears that spawning occurred up to march. From april through june, the testes were in an after-spawning condition and there was a strong development of vesicular tissue in the periphery of the gonad. When new spermatogenesis began, this tissue was pushed to the middle of the gonad lobes by the developing spermatocytes. April through june can be considered as the genital resting period. It should be mentioned that, in *Asterina gibbosa*, vesicular tissue exist mainly in females (Delavault, 1962).

It appears that the small specimens ( $R=5$  m), which are designated by the symbol O, can be considered as males, since females of this size contain minute ovocytes. The occurrence of animals with small and inactive gonads, males and females, during the reproduction season, indicates that maturation of *Asterina burtoni* takes at least two years.

#### Ovogenesis

During may through december, ovaries without vitelline activity were found as well as ovaries in different stages of development. From january through march, the ovaries were large and apparently



ripe. As has been shown from the male cycle, this is the reproductive season. Degenerating gonads were found in april, which seems to be the resting period.

Occasional hermaphroditism in gonochoric species has already been described in other Asteroids, as it has been reviewed by Delavault (1966). The type of hermaphroditism found here was defined by Delavault as labile gonochorism. It seems that in the male with the small ovocytes, the hermaphroditism found is only cytological and not functional.

### Summary

The different genital types of *Asterina burtoni* and their distribution during the periods of the year is described. Occasional hermaphroditism was found. It is concluded that spawning occurred from December to March, and that maturation takes at least two years.

### Acknowledgements

I wish to thank the technical staff of the H. Steinitz Marine Biology Laboratory at Elat for helping me to collect the material. Thanks are also due to Professor R. Delavault of the Laboratoire de Biologie Animale, Faculté des Sciences d'Orléans for his valuable advice.

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