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Population Dynamics of *Melanopsis praemorsa* [(L., 1758) (Thiaridae)] Snails in Yarmouk River, (Jordan) and Its Seasonal Infection with Larval Trematodes[1]

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ABSTRACT. A total of 5600 *Melanopsis praemorsa* (L., 1758) snails were collected from two stations near El-Maqaren at Yarmouk River, Jordan during the period from May 1982 to March 1984. Of these 6.04% were infected with larval trematodes which included nine different types of cercariae: *Cercaria melanopsi* I through VII, a tailless cercaria, and *Cercaria levantina* 5. Overall infection rates of *M. praemorsa* with larval trematodes varied seasonally and three peaks have been observed. The first was during September-October, the second during January, and the third during May-June. The most abundant type of larval trematodes was the tailless cercaria and exhibited the same seasonality as the total infection. The appearance of young snails (3-6 mm long) during July 1983 may indicate that *M. praemorsa* reproduces at least once a year. The heavy rains and flooding during February 1983 has drastically affected the snail population at one of the stations. The relationship between the density of snails and the infection rates with larval trematodes is discussed.

Melanopsis praemorsa (L., 1758, Buccinum) is a conically elongated, dark-brown to black prosobranch snail which may exceed 2 cm in length. This snail is widely prevelant in freshwater bodies of the Mediterranean (Tchernov 1975, and Brown and Wright 1980). In Jordan, it is one of the most abundant snails present in ponds, springs, streams, and rivers (Schütt 1983). Therefore, it is to be expected that this snail may act as an intermediate host for digenetic trematodes. Ismail and Abdel-Hafez (1983) reported the occurrence of 10 different types of cercariae: *Cercaria melanopsi* I through VII, a tailles cercaria, a pleurolophocercous cercaria, and *Cercaria levantina* 5 in *M. praemorsa* collected from Yarmouk River. This snail was also found infected with larval trematodes, in Yarkon, Palestine (Ullman 1954), Megiddo springs, Palestine (Lengy and Stark 1971), Azraq Oasis, Jordan

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(Ismail *et al.* 1983, and Ismail and Abdel-Hafez 1984), and in Savanda Stream, Turkey (Tareen 1976).

The aim of the present study is to examine the habitat and the population dynamics of this snail in Yarmouk River, and to investigate the seasonal variation in the infection rates of this snail with various types of larval trematodes.

Material and Methods

Study Area

Yarmouk River runs in a deep valley that separates Jordan from Syria and connects westerly with the Jordan River. A locality map of the study area is given by Abdel-Hafez and Ismail (1983). Snails were collected from two stations near El-Maqaren, Makhadah (referred to here as M) and south of Makhadah (referred to here as SM) (Fig. 1). The former station is called Makhadah because the water of the river slows down and runs in a coil form. The latter station is about 75 m south of Makhadah and the water runs smoothly but fast (Table 1). The edge of the M station is rocky with crevices containing thin layers of mud, while the edge of the SM is muddy with pebbles and small stones.

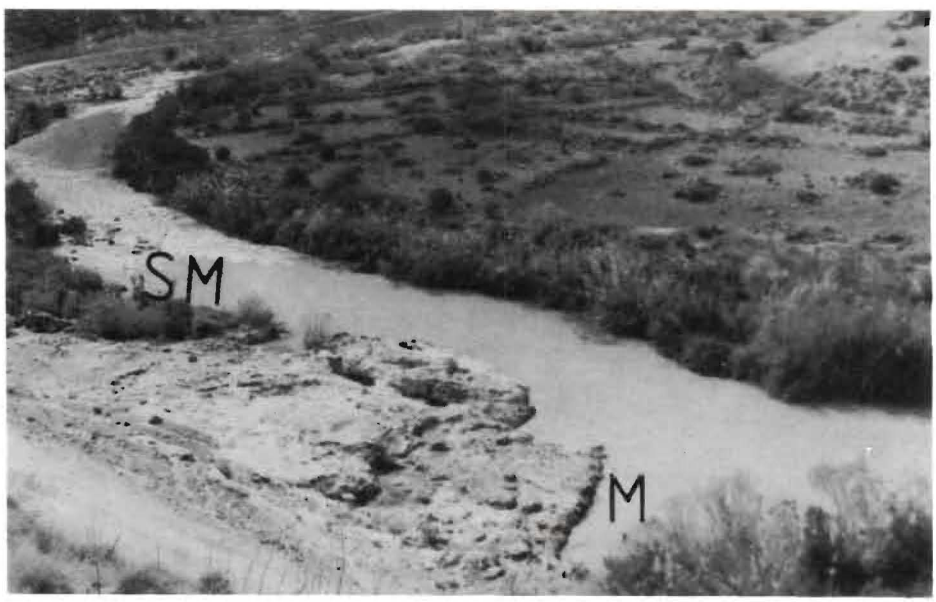

Fig. 1. A photograph of Yarmouk River showing Makhadah (M) and South of Makhadah (SM) stations from which *Melanopsis praemorsa* snails were collected

Table 1. Characteristics of water and sediment at both sampling stations during 1983 and 1984

Parameter	Makhadah		South Makhadah	
	Mean±SE*	Range	Mean±SE*	Range
Dissolved Oxygen (mgO_2/L)	10.0 ± 0.41	8.3-12.9	10.0 ± 0.43	8.3-12.8
Water Acidity (pH)	8.5 ± 0.07	7.8-8.7	8.5 ± 0.07	7.7-8.7
Salinity (ppm)	148 ± 7.7	115-199	137 ± 7.6	109-176
Percent organic carbon in sediments	0.66 ± 0.24	0.13-1.8	0.84 ± 0.13	0.11-1.81
Current velocity (m/min)	43.7 ± 3.6	19-65	91.8 ± 4.7	56-112

* Standard error.

Sampling

A total of 2227 and 3373 *Melanopsis praemorsa* snails were collected from M and SM, respectively. Snails were collected quantitatively using a 0.1 m^2 quadrate. A total of 5-10 samples were collected periodically at each station during 1982 (May, September and October), 1983 (January, March) and then monthly from May 1983 to March 1984.

Duplicate water samples were taken at each station during each sampling period made in 1983 and 1984 for salinity and pH determination. Similarly, another sample was taken, using BOD bottles, for dissolved oxygen measurements, and was fixed with manganous sulphate and alkali-iodide-azide using Winkler's method (Strickland and Parsons 1968). All water samples were transferred back to the laboratory within one hour, in containers containing ice. Moreover, duplicate sediment samples were collected for oganic carbon determinations. These were kept frozen until the time of analysis.

The current velocity at each station was estimated during each sampling period by determining the time elapsed for a floating object to travel between two fixed points along the river. Air and water temperatures were also measured.

Laboratory Analysis

The length of snails was measured, using a caliper, to the nearest mm on the same day of sampling. Examination of snails for cercariae was carried out as described by Saliba *et al.* (1978). Observations, measurements, and examination of larval trematodes recovered were made as described by Ismail and Abdel-Hafez (1983).

The salinity of water samples was determined chemically by titration with silver nitrate (Strickland and Parsons 1968). The dissolved oxygen was determined by treating the fixed water samples with sulphuric acid and titrating them with sodium thiosulphate using Winkler's method (Strickland and Parsons 1968). The organic carbon of the sediment was determined using the potassium dichromate technique (Holme and McIntyre 1971).

Results

Physical and Chemical Parameters

The salinity, acidity, and dissolved oxygen of water at both M and SM stations were similar (Table 1). The salinity averaged 148 and 137 ppm at M and SM, respectively. The water at both stations was slightly alkaline (pH=8.5) and contained 10.0 mg O_2/L. The organic carbon content of the sediment from SM (0.84%) was not significantly higher than that at M station (0.66%). The current velocity at SM (91.8 cm/sec) was faster than at M (43.7 cm/sec). The air temperature in the area was lowest during January 1983 (11°C) and the highest during July 1983 (33°C) (Fig. 2). The water temperature was also lowest during January 1983 and 1984 (16°C) and highest during June, July, and August 1983 (25°C).

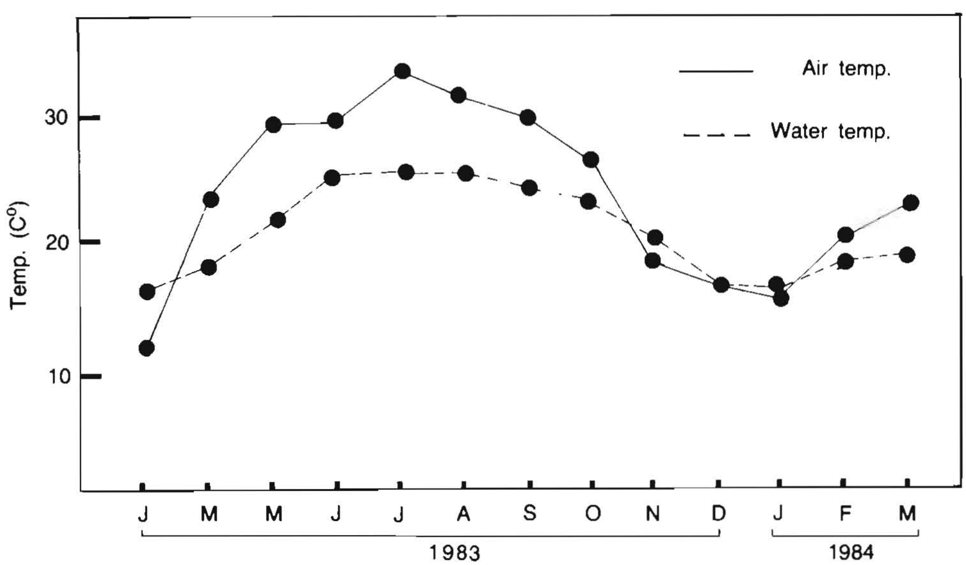

Fig. 2. Air and water temperatures at both sampling stations, Makhadah and South Makhadah during January to December 1983 and January to March 1984.

Density of M. praemorsa Snails

In general, the density (no. of snails/0.1 M^2) of *M. praemorsa* was higher at SM than M (Fig. 3). The highest density found (91) was during January 1983 at SM. The heavy rains and flooding during February 1983 have almost eliminated this snail from SM. Thus, few snails were collected from this station during March and May 1983. More snails were found during June 1983. After that the density of snails have increased (a maximum of 57 during February 1984) but was not as high

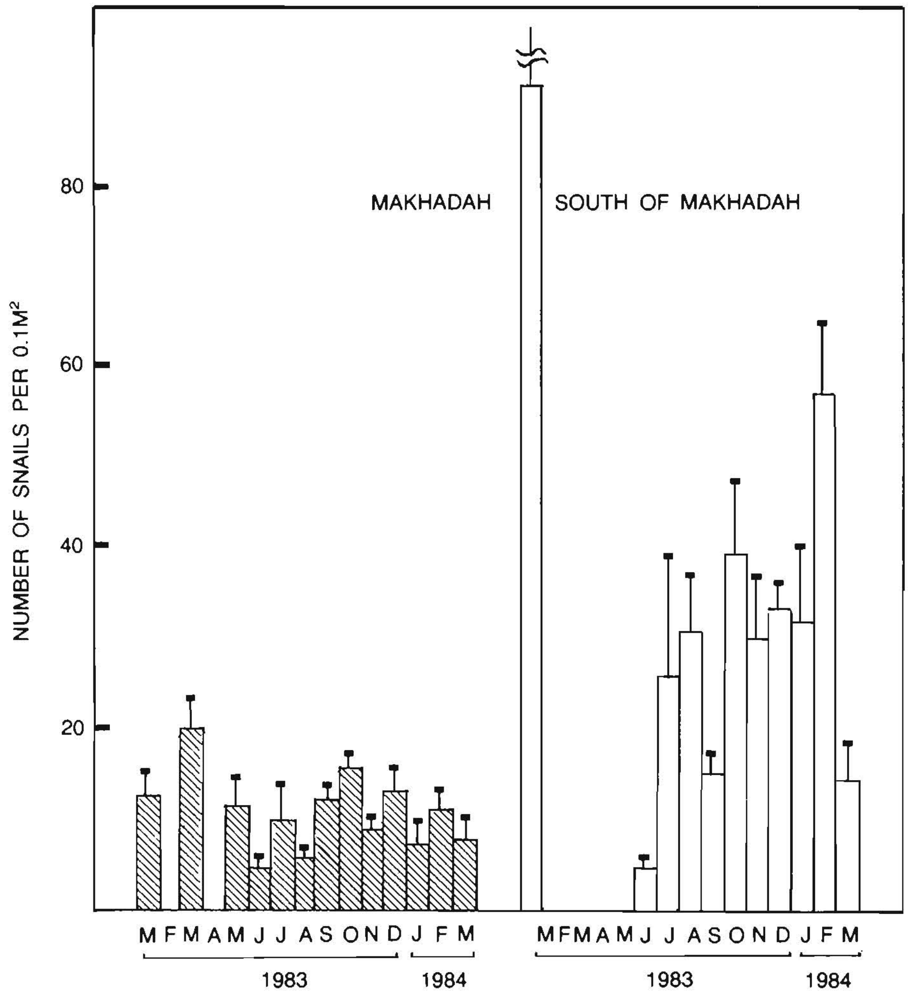

Fig. 3. Density of *Melanopsis praemorsa* snails at Makhadah and South of Makhadah stations during January to December 1983 and January to March 1984; bars indicate standard errors. Note: flooding occurred during Feb. 1983, and no sampling was done during April 1983.

as before the flooding. The effect of flooding on *M. praemorsa* density at M was not drastic. In this station, although the density of snails has increased from 12 during January 1983 to 20 after flooding (during March 1983) the snails showed a sluggish movement and did not appear to be as active as before flooding. Thus, the density has decreased to 11 and 4 during May and June 1983, respectively. After that, the density of snails has increased to pre-flooding levels.

Population Dynamics of M. praemorsa

The relative abundance of various size classes of *M. praemorsa* snails has been examined during the period from January 1983 to March 1984 (Fig. 4). The length of snails ranged from 3 to 27 mm. About 50-80% of the snails had a length of 13-18 mm during January-June 1983. The peak size during this period was 15-17 mm. A group of young snails (less than 10 mm) appeared during July 1983 and represented about 45% of the total population. Thus, two groups of snails, young (peak size 7-8 mm) and old (peak size 16-17 mm), were present during August 1983. As *M. praemorsa* snails grew in size, the ratio of the 7-8 mm snails decreased gradually and represented less than 5% during December 1983 and after. This was accompanied by the appearance of new peak sizes for the young snails (10-12 mm) and for the old snails (19-21 mm) during October to December 1983. During January to March 1984, however, there was no clear separation between the peak size of young and old snails. During this period, the majority of snails were 12-21 mm. This snail distribution pattern was close to that observed during January 1983 in which the majority of the snails were 13-18 mm.

Larval Trematodes of M. praemorsa

A total of 5600 snails were collected from both stations. Of these, 338 (6.94%) were infected with larval trematodes. Nine different types of cercariae were found from this snail: *Cercaria melanopsi* I through VII (Ismail and Abdel-Hafez 1983), a tailless cercaria (Ismail *et al.* 1983), and *Cercaria levantina 5* (Lengy and Stark 1971). The total infection rate was not significantly higher at M (6.6%) than SM (5.7%). The highest infection rate was 16.4% at SM during March 1984 (Fig. 5). However, the infection rate was generally higher at M than SM. A total of 10% or more of the snails collected from M station were infected during May and October 1982, January and September 1983, and January 1984. The infection was low (less than 3%) at M during March, August, and December 1983, and February 1984. The infection rate of snails collected from SM during this study did not exceed 8%, except during March 1984 when an infection rate of 16.4% was observed. Moreover, none of the snails collected during March, May, June and July, 1983 was infected.

Figure 6 shows the seasonal variation of infection rates of *M. praemorsa* with various types of cercariae. The tailless cercaria was the most abundant. It was

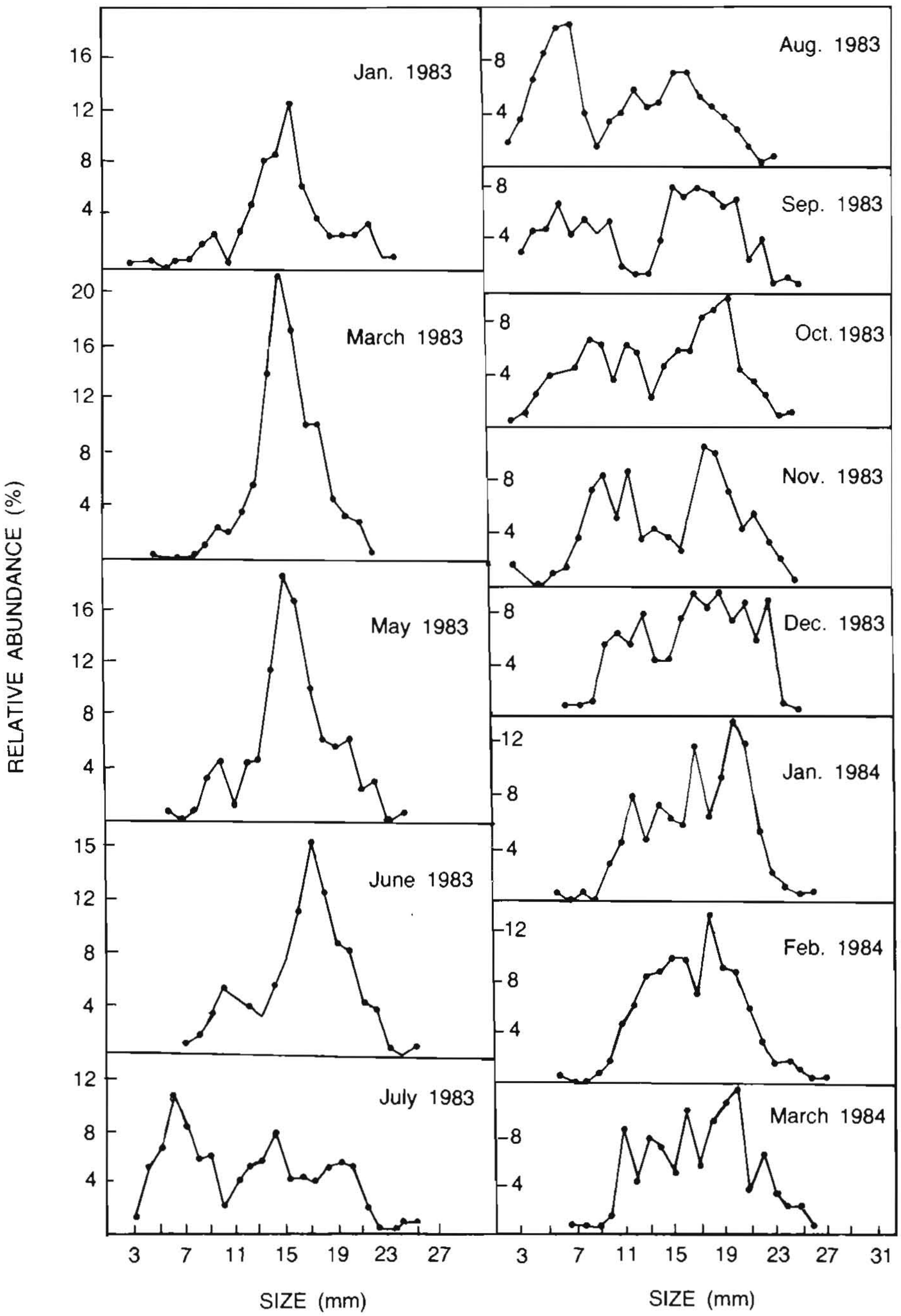

Fig. 4. Relative abundance of various size classes of *Melanopsis praemorsa* snails during 1983 and 1984

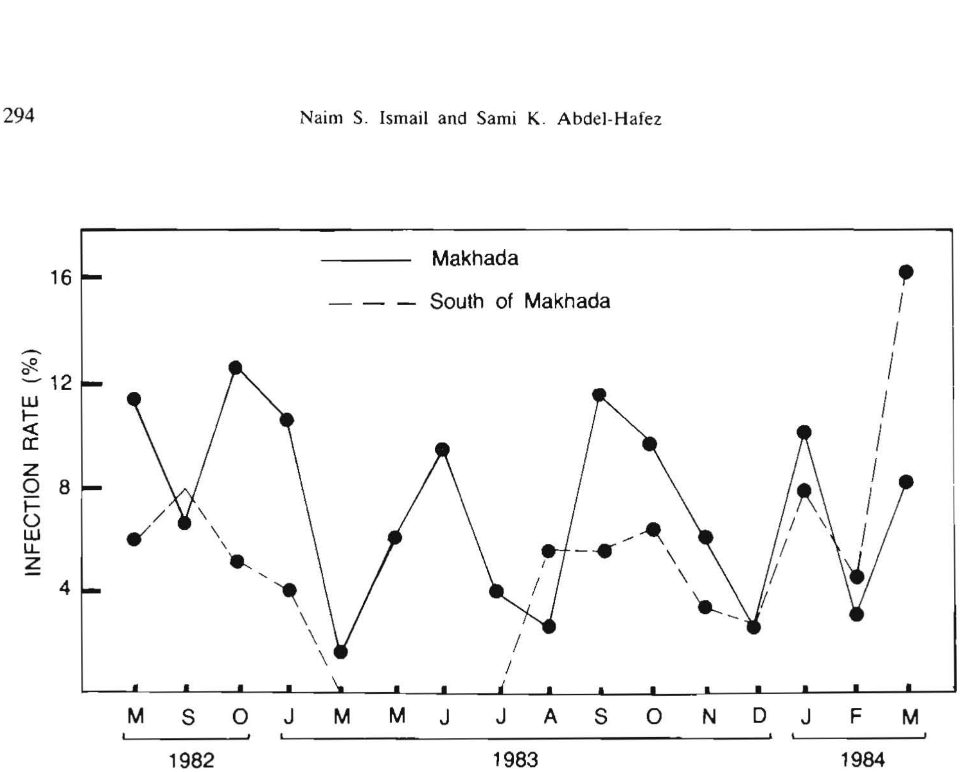

Fig. 5. Seasonal variation of the overall infection rates of *Melanopsis praemorsa* with larval trematodes during May, September and October 1982, January to December 1983, and January to March 1984.

encountered in snails from M station throughout the study period except for August 1983. High infection rates, (5% or more) were found during May 1982, October 1983, and January and March 1984. At SM, however, the tailless cercaria was abundant during September 1982 (4.4%) and October 1983 (6.0%). None of the snails collected from SM during March to July 1983 was infected. The pleurolophocercous cercariae (*Cercaria melanopsi* VI and VII) were abundant only in snails fom M station. High infection rates (4% or more) were found during October 1982 and June and September 1983. At SM few snails (less than 1%) were infected with these cercariae during October 1982 and September 1983. The highest infection rate (12.4%) with xiphidiocercariae (*C. melanopsi*, I, II, and III) was during March 1984 at SM station. During other sampling periods, however, the infection rate did not exceed 2.5% at this station. At M station, high infection rates were found during May 1982 (4.9%) and January 1983 (4.6%). The infection rate with the microcercous cercaria (*C. melanopsi* V) was generally low at both stations. The highest infection rate was 2.2% during September 1982 at M station. The brevifurcate lophocercous cercaria (*C. melanopsi* IV) was found in snails from M station during 5 sampling periods only. The highest infection rate was 2.5% during October 1982. At SM this cercaria was found during 7 sampling periods. The highest infection rate was 1.5% during September 1982. The infection with the longifurcate cercaria (*Cercaria levantina* 5) was less than 1.1% at both stations. It was found only during 5 sampling periods at M and SM stations.

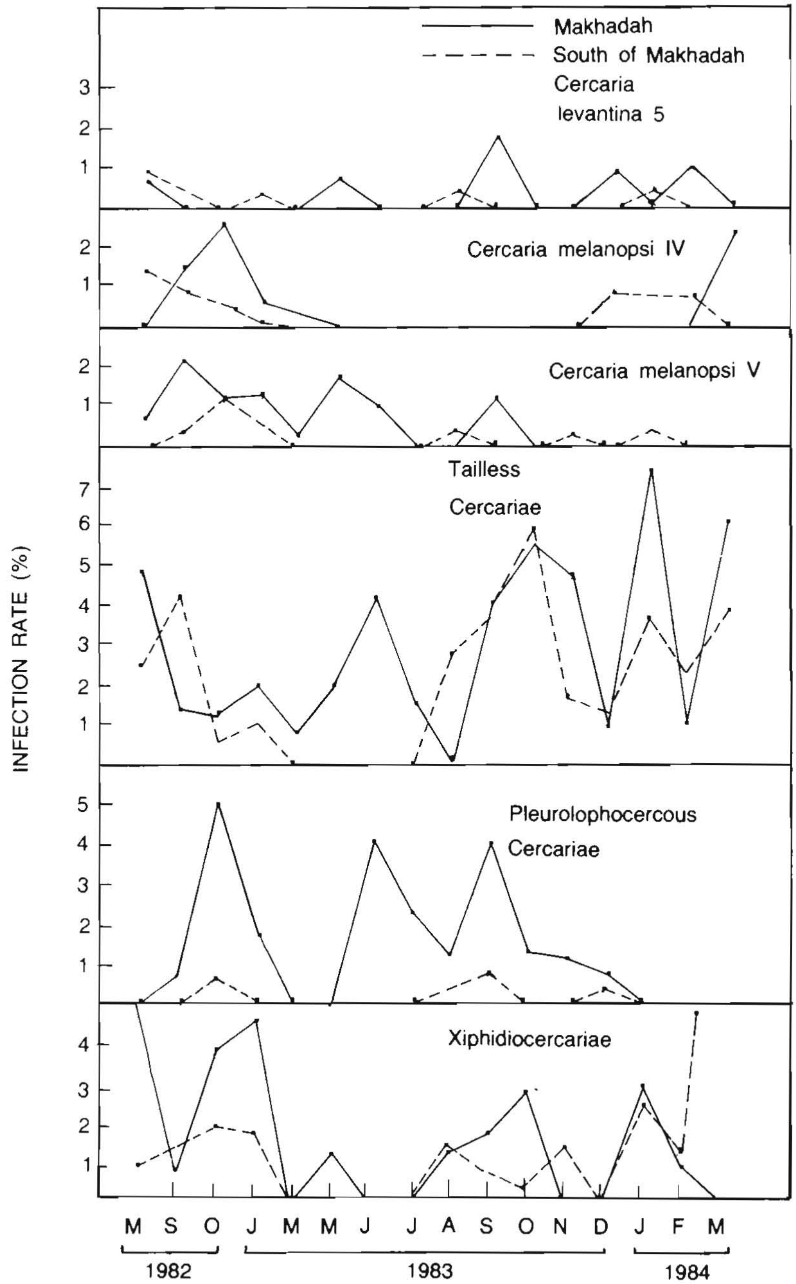

Fig. 6. Seasonal variation of infection rates of *Melanopsis praemorsa* with various types of cercariae during May, September and October 1982, January to December 1983, and January to March 1984.

Discussion

Population Dynamics of M. praemorsa

The density of *M. praemorsa* was generally higher at SM than M throughout the study, except during March and May 1983 following the heavy rains and flooding during February 1983 (Fig. 3). This may be due to the abundance of aquatic vegetation at SM. Tchernov (1975) reported that the abundance of the rock-dwelling prosobranches (*e.g. Melanopsis* which is exclusively herbivorous) in Lake Tiberias was due to the high plant productivity of the littoral zone. Hence, a positive correlation may exist between the density of the rock-dwellers and the nutrient content of the water. Nelson and Scott (1962) reported that the riffles in the stream (as at SM) are the sites of primary production, while the pools (as at M) are the sites of primary production, while the pools (as at M) are the sites of decomposition. Thus, it is to be expected that more food is available for *M. praemorsa* snails at SM than M. Other possible contributing factors that could account for the observed differences in the population dynamics between the two stations include predation, physical and chemical properties of the two sites. The physical and chemical properties of these two stations have been dealt with elsewhere (see introduction and Table 1). Several species of Cyprinid fishes including *Barbus canis*, *B. longiceps*, *Capoeta damascina* and the catfish *Clarias lazera* have all been recorded from the two stations (Dr. A. Al-Absi, personal communication) but no attempt to compare between the degree of the predatory behaviour of these fishes in the two sites has been made.

It is apparent that *M. praemorsa* snails reproduce at least once a year (Fig. 4). The appearance of young snails during July 1983 may indicate that the actual egg deposition occurred 2-3 months earlier during April-May 1983. Tchernov (1975) reported that *M. praemorsa* usually begins to spawn in Lake Tiberias in Mid-April. Tchernov noted additional egg laying during August. However, the number of eggs recovered was low. No attempt to collect the eggs of this snail has been made. Moreover, the youngest snails which were collected throughout the study were 3 mm long indicating that this is probably the size of the hatchlings. Egg laying of *M. praemorsa* during August cannot be confirmed in this study. This is because young snails (3-6 mm long) were collected during July through November 1983. Thus, it is not clear whether these young snails developed from eggs which were laid during May or those laid during August.

Larval Trematodes of M. praemorsa

Three peaks in the level of infection of *M. praemorsa* by larval trematodes have been observed at M station (Fig. 5). The first was during September-October, the second during January, and the third during May-June. Similarly 3 peaks have been observed at SM, the first was during September-October, the second during January and the third during March. Many workers (as reviewed by Eramus 1972) have referred to seasonal variation in the level of infection by cercarial stages in both marine and freshwater snails. In general, two periods of high incidence occur, one at late Spring (May) and the other in late Summer (September to October). The high infection rate observed during September-October may be due to the appearance of young *M. praemorsa* snails during July which may have contacted the infection then. Several other factors may affect the seasonal variation in infection rates. These include: environmental factors such as temperature and rain which may affect drastically the snail population; and the availability of definitive hosts. Thus, it is rather difficult to explain, for example, the infection peak during January 1984 with the facts that low infection rates were recorded one month earlier (December 1983) and one month later (February 1984).

The highest infection rate among various types of cercariae of *M. praemorsa* was with the tailless cercaria, which belongs to a group of cercariae named *Mutabile* by Sewell (1922). These cercariae may develop into trematodes belonging to family Monorchiidae (Yamaguti 1958). These trematodes may utilize a fish as a definitive host. The availability of the definitive host at both stations may indicate that the differences in infection rates may be due to the changes in the snail population at both stations. Thus, similar seasonal variation was noticed at both stations, except during March to July 1983 following the flooding which has almost eliminated the snail population at SM. Similar pattern of seasonality was observed with the xiphidiocercariae at both stations, except that there was no peak during June. The seasonality of the pleurolophocercous cercariae was different from that of tailless cercaria and xuiphidiocercariae. The seasonality at M station resembled that reported in the European countries with two peaks, one during June and the other during September to October. At SM, however, the infection rate was too low to draw conclusions. This may indicate that the availability of the definitive host was not the same at both stations. This is because the pleurolophocercous cercariae develop into trematodes belonging to the family Heterophyidae (Dawes 1968) which may utilize a homiothermic vertebrate as definitive host. It was noticed that M station is more accessible to animals than SM, and the fecal matter of various animals was seen at M station. The infection rates with other types of cercariae was too low to draw conclusions.

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حركة الجماعة السكانية للقوقع ميلانوبسيس بريمورزا (لينوس، ١٧٥٨) (ثياريدي) في نهر اليرموك، الاردن والتغيرات الفصلية لمدى إصابته بيرقات الديدان المفلطحة

نعيم إسماعيل و سامي عبد الحافظ

دائرة العلوم الحياتية ـ جامعة اليرموك اربد ـ الأردن

تم جمع ٥٦٠٠ قوقعاً من نوع ميلانوبسيس بريمورزا من محطتين قرب المقارن على نهر اليرموك، وذلك خلال الفترة من آيار ١٩٨٢م إلى آذار ١٩٨٤م. وجد أن ٦,٠٤٪ من هذه القواقع مصاباً بيرقات الديدان المفلطحة (الترياتودا) والتي شملت تسعة أنواع من السيركاريا وهي: سيركاريا ميلانوبساي ١ إلى ٧، سيركاريا عديمة الذيل، وسيركاريا ليفانتينا ٥. وتبين ان معدل إصابة هذا القوقع بيرقات التريماتودا يتغير فصلياً، حيث لوحظ أن نسبة الإصابة تكون عالية خلال ثلاث فترات في السنة: الأولى خلال شهري أيلول وتشرين أول، والثانية خلال كانون ثاني، والثالثة خلال شهري آيار وحزيران. وقد كانت أكثر أنواع اليرقات شيوعاً السيركاريا العديمة الذيل.

يدل ظهور القواقع الصغيرة والتي يبلغ طولها من ٣ إلى ٦ ملم خلال شهر تموز ١٩٨٣ على أن قوقع ميلانوبسيس بريمورزا يتكاثر مرة واحدة في السنة في الأقل. لقد تأثرت دينمية الجماعة السكانية لهذا القوقع كثيرا بالأمطار والفيضانات التي حدثت خلال شهر شباط ١٩٨٣. تمت مناقشة العلاقة بين الكثافة السكانية للقوقع ومدى إصابته بيرقات ديدان التريماتودا.