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INFLUENCE OF TEMPERATURE AND FOOD ON THE GROWTH OF THE PESTIFEROUS SLUG *LAEVICAULIS ALTE* (SOLEOLIFERA: VERONICELLIDAE)

A. Panigrahi[1] and S. K. Raut[1]

ABSTRACT – *Laevicaulis alte* (Férussac) is a serious agrihorticultural slug pest in India and neighbouring countries. A wide range of food plants are acceptable to it. A series of experiments were conducted under different temperatures with different plant foods to note the influence of these factors on the growth of the slugs. A zero-day old slug, on an average, consumed 153.38 g, 268.38 g, 315.18 g and 180.30 g mixed food (12 varieties); 15.93 g, 216.75 g, 218.15 g and 189.76 g lettuce; 12.68 g, 57.63 g, 84.46 g and 65.28 g amaranth at 20, 25, 30°C and room temperatures (18.0-36.5°C), respectively, during the period of six months. Individual slugs, on an average, added 41.38 mm, 16.98 mm, 5.83 mm and 2.81 g; 82.59 mm, 26.55 mm, 9.09 mm and 11.52 g; 7.06 mm, 24.63 mm, 8.45 mm and 10.53 g; 60.30 mm, 21.71 mm, 6.78 mm and 5.57 g to their body lengths, body breadths, lengths of ocular tentacles and body weights, respectively, at these temperatures during the study period. Irrespective of plant foods, growth rate was highest at 25°C and lowest at 20°C. Growth rate declined with the rise of temperature from 25°C to 30°C. The slugs exposed to 10°C, 15°C and 35°C died between the 4th and 19th days. The results obtained on the growth rate of the slugs in respect to plant foods indicates that the density of natural slug populations can be reduced to a considerable degree by cultivating less preferred food-plant species consecutively for a few years.

Key words: *Laevicaulis alte*, plant foods, temperature, growth rate.

INTRODUCTION

Slugs and snails causing damage to economic plants have drawn the attention of a number of workers (*vide* Hyman, 1967; Runham & Hunter, 1970; Godan, 1983). Various aspects of ecology and biology of these gastropods have been studied with a view to formulating control methods. However, much yet needs to be learned in order to make snail and slug control more effective.

Laevicaulis alte (Férussac) is a serious agrihorticultural slug pest in India and neighbouring countries (Raut & Mandal, 1984; Raut & Panigrahi, 1988a, b; 1989; 1990; 1991; Subba Rao *et al.*, 1989). Attempts to collect data on biology and ecology of these slugs are in progress with a view to formulating effective control measures. The current report is on the influence of temperature and food on the growth of *L. alte*.

MATERIALS AND METHODS

To obtain newly hatched (zero-day old) *Laevicaulis alte*, a large number of egg-clutches were collected from a local habitat of the slugs at Sandeshkhali, 24-Parganas

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(North), West Bengal, India. The eggs were maintained under favourable conditions for hatching in the laboratory. The eggs hatched within a few days. Depending on the date of hatching, 21 batches of slugs, each consisting of 10 individuals zero-day old, were used for our studies. Altogether, 21 terraria, each measuring 50 x 45 x 15 cm, were used for the experimental studies. Each terrarium was provided with loose, moist soil up to 8 cm deep. A batch of 10 newly hatched (zero-day old) slugs were put into each of the 21 terraria.

Of the 21 terraria, 18 were placed inside Biological Oxygen Demand (B.O.D.) chambers (S.N. Mullick & Co., Calcutta) adjusted to different fixed temperatures, while three terraria were kept at room temperature. For each treatment, three terraria were used. The slugs of one terrarium were supplied with 12 kinds of food-plant species, of which 11 were cultivated species, *viz.*, amaranth (*Amaranthus gangeticus* Linnaeus), coriander (*Coriandrum sativum* Linnaeus), China rose (*Hibiscus rosasinensis* Linnaeus), field mint (*Mentha arvensis* Linnaeus), gourd (*Lagenaria vulgaris* Seringe), garden spinach (*Spinacea oleracea* Linnaeus), lettuce (*Lactuca sativa* Linnaeus), bean [*Lablab purpureus* (Linnaeus) Sweet], marigold (*Tagetes patula* Linnaeus), rose (*Rosa centifolia* Linnaeus), tuberose (*Polianthes tuberosa* Linnaeus), and one was supplied with a wild plant species, akund [*Calotropis procera* (Willdenow) Dryand ex W. Aiton]. The slugs of the other two terraria were supplied separately with lettuce and amaranth. The experiments were conducted at 10°C, 15°C, 20°C, 25°C, 30°C, and 35°C temperatures in the B.O.D. chambers and at room temperatures (18.0°C - 36.5°C).

The experiments were continued for a period of six months (April-September, 1986). The fresh leaves, twigs and stems were weighed daily before they were supplied (for a period of 24 hours) to the slugs. The weight of the remaining food portions was again taken after 24 hours to calculate the actual amount consumed. To record growth, four parameters, *viz.*, body length, body breadth, length of ocular tentacles and body weight, were measured. Measurements of these parameters of the zero-day old slugs were taken at the time of selection for experiments and the measurements were continued fortnightly until the slugs were six months old.

Based on the data collected on 30 individual slugs (10 slugs x 3 replicates) individually, the average growth rate and the total average consumption rate of different food items were calculated. In all the terraria, 40-45% soil moisture and 80-90% relative humidity were maintained regularly by spraying water at regular intervals. Strict hygienic conditions were maintained by regularly removing unconsumed food and faecal material. Statistical analysis of data was done following Goon *et al.* (1976). The value given after ± indicates standard erroe. Voucher specimens of the slugs have been deposited in the National Collection of the Zoological Survey of India, Calcutta (No. M 22294/4).

RESULTS

Food consumption on 12 plant species

At 10°C, the newly hatched slugs (zero-day old) became inactive within 4-5 hours of exposure. They did not consume the plant foods supplied and died between the 7th and 11th days.

At 15°C, the slugs stopped feeding within a few hours of exposure and became less and less active with the progress of exposure time. They became totally inactive on the 4th day and died between the 13th and 19th days.

At 20°C, the slugs thrived well. They fed on all the 12 plant foods offered. The rate of feeding varied with the plant species. During the period of six months, 10 slugs consumed lettuce the most (475.69 g) and tuberose the

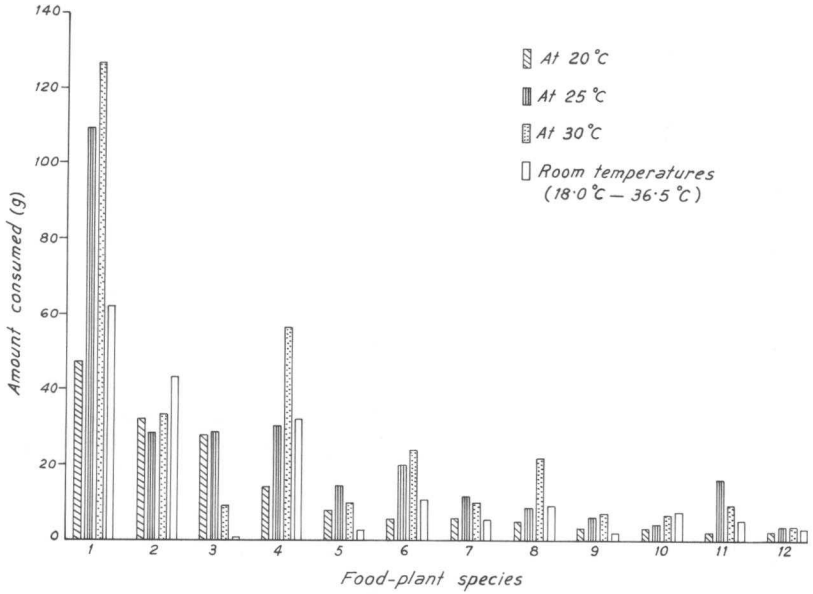

FIG. 1. Amount of food consumption (g) by one individual of *Laevicaulis alte* of the 12 plant species under different temperatures during the six-month (180 days) period. (1) *Lactuca sativa*, (2) *Lagenaria vulgaris*, (3) *Coriandrum sativum*, (4) *Amaranthus gangeticus*, (5) *Calotropis procera*, (6) *Spinacea oleracea*, (7) *Lagenaria vulgaris*, (8) *Tagetes patula*, (9) *Rosa centifolia*, (10) *Hibiscus rosasinensis*, (11) *Mentha arvensis*, (12) *Polianthes tuberosa*.

least (14.31 g). The mean amounts consumed per individual slug in respect to food-plant species is shown in Fig. 1. On the whole, the 10 slugs consumed 1533.73 g of plant materials belonging to the 12 different kinds during the period of six months. Based on the amount of consumption, the order of preference was determined (Table 1).

At 25°C, the slugs fed on all types of food plants supplied to them. The leaves of succulent plants were eaten completely. The stems were often cut into pieces. The lamina of rose and bean were eaten; the veins and venules were not. Irrespective of plant foods (except gourd), the total amount of consumption was higher than that recorded at 20°C. At this temperature also, the slugs (10 individuals) consumed the most lettuce (1092.16 g) and the least tuberose (26.91 g) during the same time period. The mean amount of total consumption of each plant food by a slug individual is shown in Fig. 1. The 10 slugs consumed 1150.01 g more than the amount noted at 20°C, irrespective of plant species, during the period of six months. The order of preference is shown in Table 1.

At 30°C, the slugs consumed the plant foods lavishly. The rate of food consumption was higher than that noted at 25°C. Lettuce and tuberose were the most and the least preferred foods, respectively. The total food

TABLE 1. Order of food preference (based on amount of food consumed) in *Laevicaulis alte* when the slugs were fed with a mixture of 12 species of food plants at different temperatures.

Temperature (°C)	Food-plant species											
	A. gangeticus	*C. procera*	*C. sativum*	*H. rosasi-nensis*	*L. purpur-eus*	*L. sativa*	*L. vulgaris*	*M. arvensis*	*P. tuber-osa*	*R. centifol-ia*	*S. oleracea*	*T. patula*
30	2	6	8	11	7	1	3	9	12	10	4	5
25	2	7	3	11	8	1	5	6	12	10	4	9
20	4	5	3	10	7	1	2	11	12	9	6	8
Room temp. (18.0-36.5)	3	9	12	6	7	1	2	8	10	11	4	5

TABLE 2. Monthly total consumption (g) by 10 *Laevicaulis alte* individuals of *Lactuca sativa* and *Amaranthus gangeticus* supplied separately at different temperatures for six months.

Month	Amount consumed							
	Lactuca sativa				*Amaranthus gangeticus*			
	20°C	25°C	30°C	Room temp.	20°C	25°C	30°C	Room temp.
1986								
April	11.40	22.62	26.69	23.50	9.69	11.83	16.16	17.44
May	19.55	50.54	75.90	54.19	14.44	16.65	51.07	18.68
June	24.29	208.60	346.43	246.56	19.21	32.83	103.31	45.80
July	28.41	465.04	511.24	282.65	21.04	77.33	184.75	71.01
August	31.28	659.85	580.35	641.27	25.35	114.93	212.22	176.65
September	44.32	760.76	630.85	649.41	37.05	322.72	277.07	323.16

consumption by the 10 slugs, irrespective of plant species, during the period of six months was 3151.72 g. The average total food consumption by a slug with respect to food-plant species is shown in Fig. 1. The order of preference depending upon the rate of consumption is shown in Table 1.

At 35°C, the slugs (zero-day old) became inactive day by day. They did not consume any of the plant foods supplied and died between the 4th and 6th days following exposure.

At room temperatures (18.0-36.5°C), the slugs initially started feeding on lettuce and amaranth. The other types of foods were consumed later as the slugs became older. Although the 10 slugs fed on all the plant foods offered, the total consumption varied from 620.29 g (lettuce) to 5.74 g (coriander) during the six-month period. The mean total consumption by an individual is shown in Fig. 1. The order of preference is shown in Table 1.

Food consumption of single plant species

Lettuce: The 10 slug individuals consumed 159.26 g at 20°C, 2167.41 g at 25°C, 2172.47 g at 30°C and 1897.58 g at room temperatures (18.0-36.5°C) during the six-month period (April to September, 1986). The mean total

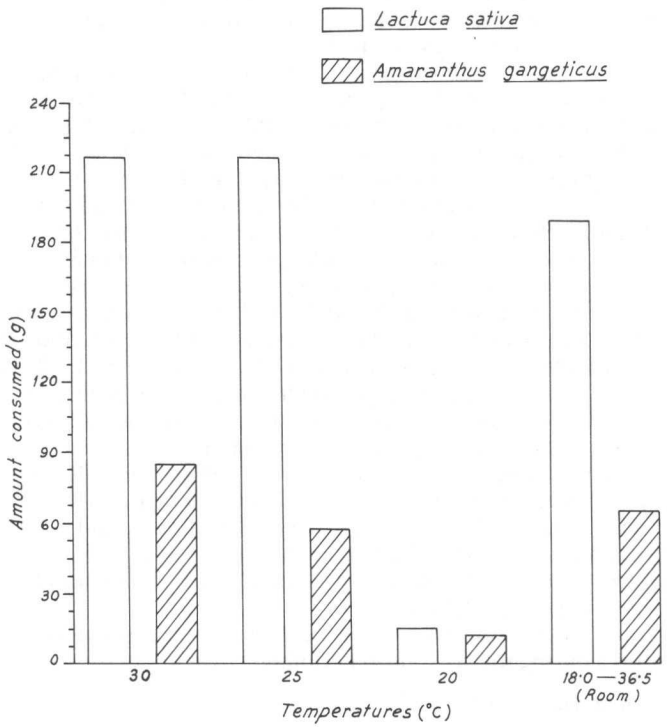

FIG. 2. Rate of consumption of lettuce (*Lactuca sativa*) and amaranth (*Amaranthus gangeticus*) by one individual of *Laevicaulis alte* maintained under different temperatures for a period of six months (180 days).

amount of consumption per individual is shown in Fig. 2. In all cases, the rate of consumption was gradually higher as the slugs aged (Table 2).

Amaranth: In a period of six months (180 days) between April to September, 1986, the 10 slug individuals consumed 126.79 g, 576.29 g, 844.58 g and 652.75 g plant foods, respectively, at 20, 25, 30°C and room temperatures (18.0-36.5°C). The mean total consumption per individual is shown in Fig. 2. The rate of food consumption was gradually higher as the slugs aged (Table 2).

Growth due to consumption of mixed food (12 plant species)

At 30°C, the newly hatched slugs (zero-day old) with 6.97 mm (± 0.29 mm s.d.) in body length, 2.30 ± 0.18 mm in body breadth, 1.55 ± 0.07 mm in length of ocular tentacles and 0.02 ± 0.0 g in body weight attained 83.03 ± 1.17 mm in body length, 26.93 ± 0.58 mm in body breadth, 10.00 ± 0.02 mm in length of ocular tentacles and 10.55 ± 0.28 g in body weight at the age of 180 days. The growth rate was faster during the first 45 days as the slugs added 47.31 mm, 16.58 mm, 3.45 mm and 3.04 g to the body length, body breadth, length in ocular tentacles and in body weight, respectively. After that, growth continued, but at a slow rate, and the slugs added 28.75 mm, 8.05 mm, 5.00 mm and 7.49 g, respectively, to the measured parameters during the next 135 days (Figs. 3a, 4a, 5a, 6a).

At 25°C, the zero-day old slugs with 7.50 ± 0.39 mm in body length, 2.05 ± 0.12 mm in body breadth, 1.30 ±0.06 mm in length of ocular tentacle and 0.021 ± 0.002 g in body weight attained 90.09 ± 1.41 mm, 28.60 ± 0.21 mm, 10.39 ± 0.39 mm and 11.54 ± 0.33 g, respectively, in body length, body breadth, length in ocular tentacle and body weight on the 180th day (Figs. 3b, 4b, 5b, 6b). The rate of growth in body length and body breadth was faster during the first 60 days. The slugs gained 82.59 mm in body length, 26.55 mm in body breadth, 9.09 mm in length of ocular tentacles and 11.52 g in body weight within the study period of six months (180 days).

At 20°C, the zero-day old (newly hatched) slugs with 6.33 ± 0.32 mm, 2.52 ± 0.09 mm, 1.25 ± 0.09 mm and 0.02 ± 0.0 g in body length, body breadth, length of ocular tentacle and body weight added 41.38 mm, 16.98 mm, 5.83 mm and 2.80 g to the respective parameters during the period of 180 days (Figs. 3c, 4c, 5c, 6c). The growth was faster during the first 15 days and the same became slower with the progress in age of the slugs.

At room temperatures (18.0-36.5°C), the newly hatched slug individuals (zero-day old) measuring 7.45 ± 0.23 mm in body length, 2.18 ± 0.59 mm in body breadth, 1.92 ± 0.20 mm in length of ocular tentacle and 0.02 ± 0.0 g in body weight attained, respectively, within a period of 180 days 67.75 ± 2.31 mm, 23.89 ± 0.73 mm, 8.70 ± 0.58 mm and 5.59 ± 0.37 g. The trend in growth rate is shown in Figs. 3d, 4d, 5d, 6d.

The rate of food consumption by the slugs maintained under different temperatures during the six-month period is shown in Fig. 1.

Growth due to consumption of lettuce

At 30°C, the zero-day old slug individuals with 6.94 ± 0.08 mm in body length, 2.03 ± 0.07 mm in body breadth, 1.58 ± 0.04 mm in length of ocular

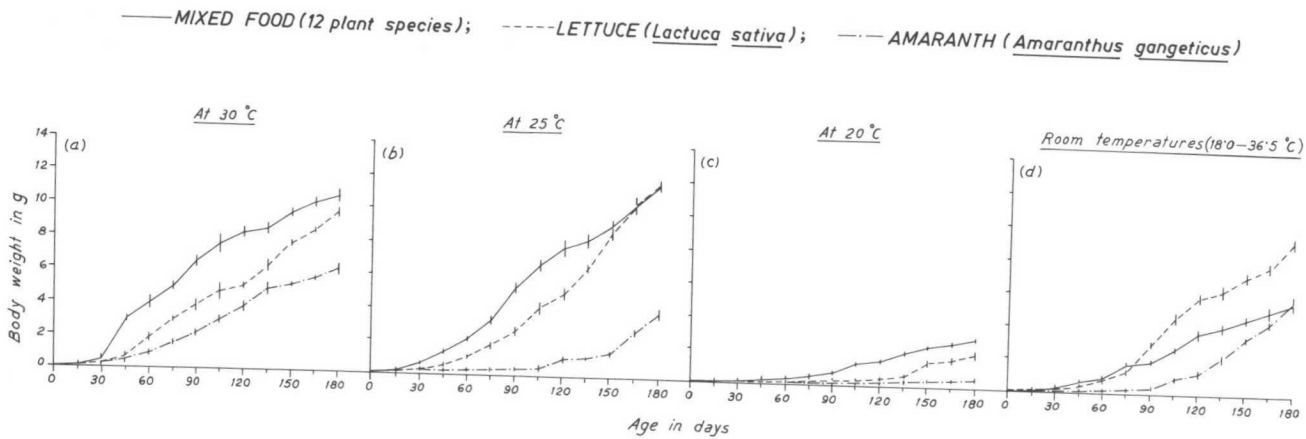

FIG. 3(a-d). Growth rates in body length in *Laevicaulis alte* maintained under different temperatures with different foods for a period of six months (180 days). Vertical bars indicate standard errors.

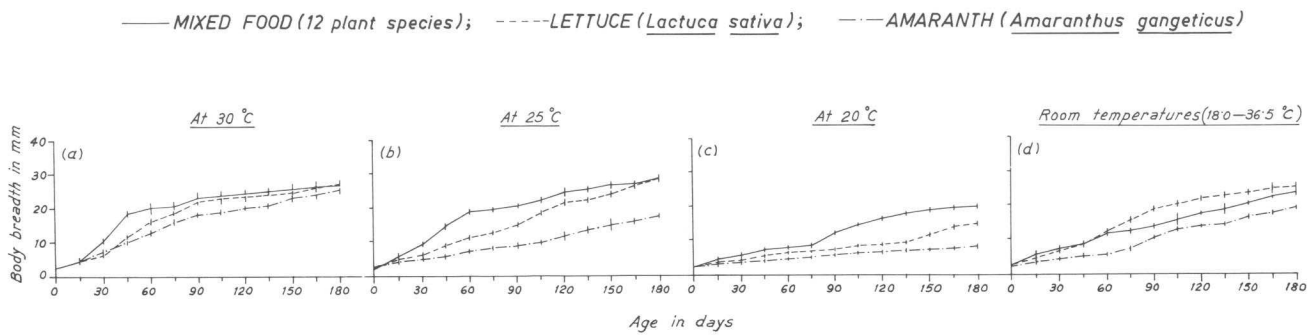

FIG. 4(a-d). Growth rates in body breadth in *Laevicaulis alte* with the supply of different foods and exposed to different temperatures for a period of six months (180 days). Vertical bars indicate standard errors.

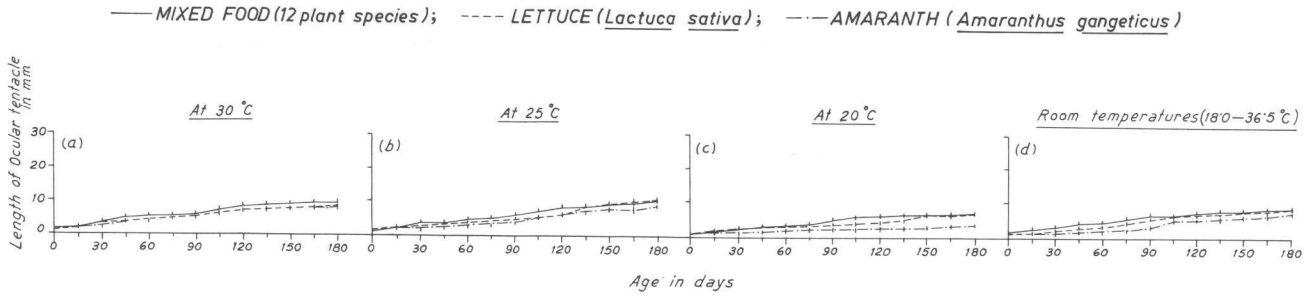

FIG. 5(a-d). Growth rates of ocular tentacle lengths in *Laevicaulis alte* exposed to different temperatures with different food items for a period of six months (180 days). Vertical bars indicate standard errors.

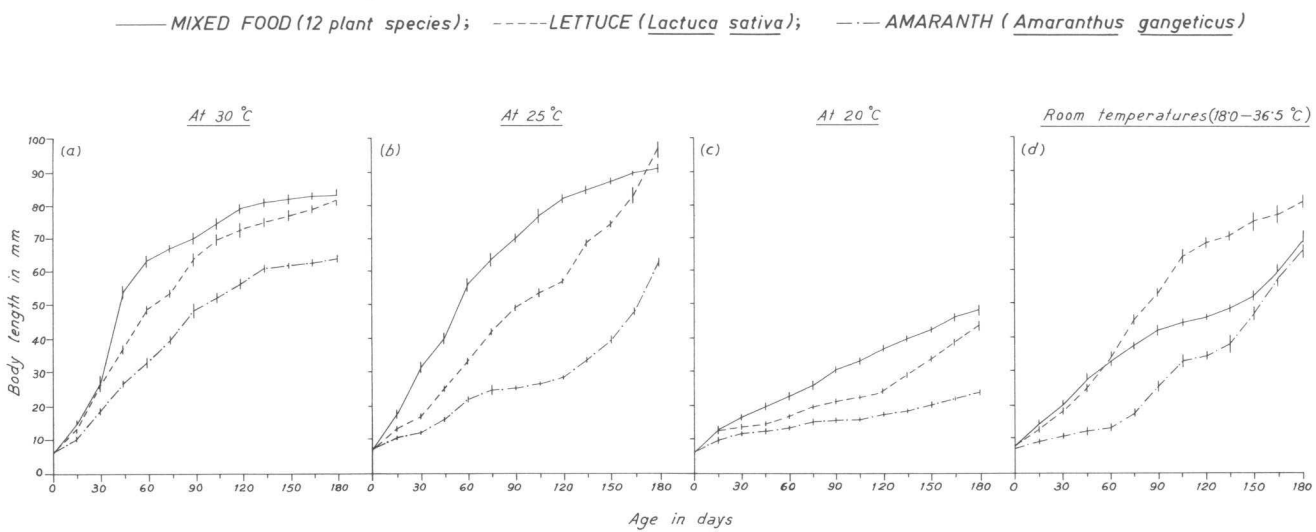

FIG. 6(a-d). Growth rates in body weight in *Laevicaulis alte* maintained under different temperatures and different foods for a period of six months (180 days). Vertical bars indicate standard errors.

tentacle and 0.02 ± 0.0 g in body weight grew to 81.34 ± 1.04 mm, 26.84 ± 0.83 mm, 8.93 ± 0.20 mm and 9.64 ± 0.31 g in body length, body breadth, length of ocular tentacles and body weight, respectively, within a period of 180 days (Figs. 3a, 4a, 5a, 6a). Body length grew at an increasing rate up to 90 days. During the first 90 days, 57.23 mm were added to body length, while only 17.17 mm were added during the last 90-day period.

At 25°C, the newly hatched (zero-day old) slugs were 6.70 ± 0.40 mm, 2.20 ± 0.14 mm, 1.26 ± 0.07 mm and 0.02 ± 0.0 g in body length, body breadth, length of ocular tentacle and body weight, respectively. They added 89.63 mm, 25.90 mm, 9.24 mm and 11.59 g, respectively, within a period of 180 days (Figs. 3b, 4b, 5b, 6b). The growth in body length and length of ocular tentacles was at an increasing rate throughout.

At 20°C, the zero-day old slugs were 6.90 ± 0.3 mm, 2.52 ± 0.13 mm, 1.25 ± 0.07 mm and 0.02 ± 0.0 g in body length, body breadth, length of ocular tentacle and body weight, respectively. They attained 42.50 ± 1.07 mm in body length, 14.50 ± 0.52 mm in body breadth, 6.82 ± 0.36 mm in length of ocular tentacles and 1.98 ± 0.28 g in body weight in 180 days. The rate of growth in body weight steadily increased with age up to 135 days. This was followed by a faster growth rate for a period of two weeks. The rate of growth in respect to age of the slugs is shown in Figs. 3c, 4c, 5c, 6c.

At room temperatures (18.0-36.5°C), the zero-day old slug individuals measuring 7.25 ± 0.25 mm in body length, 2.03 ± 0.13 mm in body breadth, 1.30 ± 0.06 mm in length of ocular tentacle and 0.02 ± 0.0 g in body weight grew to 79.40 ± 2.02 mm, 25.17 ± 1.12 mm, 9.03 ± 0.21 mm and 8.94 ± 0.41 g, respectively, within a period of six months (180 days) (Figs. 3d, 4d, 5d, 6d). The rate of consumption of lettuce by *Laevicaulis alte* maintained under different temperature grades during the six-month period is shown in Fig. 2.

Growth due to consumption of amaranth

At 30°C, the zero-day old slugs measuring 6.72 ± 0.16 mm, 2.04 ± 0.11 mm, 1.63 ± 0.06 mm and 0.02 ± 0.0 g, respectively, in body length, body breadth, length of ocular tentacle and body weight attained, respectively, 63.04 ± 1.24 mm, 24.94 ± 0.61 mm, 8.17 ± 0.18 mm and 6.18 ± 0.24 g during the six-month period. The rates in growth varied with the age of the individuals concerned (Figs. 3a, 4a, 5a, 6a).

At 25°C, the newly hatched (zero-day old) slugs added 53.83 mm, 15.34 mm, 7.63 mm and 3.74 g to their body length, body breadth, length of ocular tentacles and body weight, respectively, in 180 days to their initial measurements. A little variation in growth trends was noted at different ages of the slugs (Figs. 3b, 4b, 5b, 6b).

At 20°C, although growth rates in body length, body breadth, length of ocular tentacle and body weight were not uniform throughout (Figs. 3c, 4c, 5c, 6c), the newly hatched slugs with 6.70 ± 0.40 mm, 2.04 ± 0.13 mm, 1.20 ± 0.06 mm and 0.02 ± 0.0 g in body length, body breadth, length of ocular tentacle and body weight, respectively, grew to 23.67 ± 0.57 mm, 7.60 ± 0.15 mm, 3.34 ± 0.30 mm and 0.41 ± 0.02 g within a period of 180 days.

At room temperatures (18.0-36.5°C), the zero-day old slug individuals were 7.40 ± 0.46 mm, 2.06 ± 0.13 mm, 1.35 ± 0.06 mm and 0.02 ± 0.0 g,

respectively, in body length, body breadth, length of ocular tentacle and body weight. They grew, respectively, to 64.44 ± 2.36 mm, 19.25 ± 0.87 mm, 7.35 ± 0.15 mm and 5.66 ± 0.44 g during the six-month period. The variation in growth rates in relation to age of the slugs is shown in Figs. 3d, 4d, 5d, 6d.

The rate of consumption of amaranth by the slugs maintained under different temperature grades during the six-month period is shown in Fig. 2.

To analyze the data recorded on body length, body breadth, length of ocular tentacle and body weight at 20, 25, 30°C and room temperatures (18.0°C - 36.5°C) with different foods, *viz.*, mixed (12 plant species), lettuce and amaranth, the two-way fixed effect homoscedastic ANOVA (analysis of variance) model was applied. The results (Tables 3-6) revealed no interaction among the different temperature levels and different foods. But, the differences among the different levels of temperatures and foods are significant (at the 5% significance level). Among the temperatures and foods, 30°C and mixed food had the maximum effect on body length (Table 3), body breadth (Table 4), length of ocular tentacles (Table 5) and body weight (Table 6).

DISCUSSION

Slugs hatch at various times after the eggs are laid. The young slugs then grow at different rates. These variations are noted even in animals hatching from the same egg clutch (Runham & Hunter, 1970). By following the weights of individual *Arion ater* Linnaeus, *A. subfuscus* Draparnaud, *A. intermedius* Normand, *A. hortensis* Férussac and *A. fasciatus* Nilsson, Abeloos (1944) discovered that in the first four of these species there are three growth phases: an infantile phase which had the fastest rate of growth; a juvenile phase; and a mature phase. Frömming (1954a,b) reported that *A. circumscriptus* Johnston increased to 6-8 mm from 4-5 mm at hatching during a period of 30 days, to 24-27 mm during a six-month period and 35-40 mm during 11 months. Reports on the rates of growth in land snails are also available from the studies of Mohr (1949), Lange (1950), Ghose (1963), Kondo (1964), Kekauoha (1966), Masurekar & Bangalkote (1976) and Raut & Ghose (1982), but none of these workers, both on snails and slugs, pointed out the role of temperature and food plants in relation to their growth rate.

The results of the present studies revealed that growth rates in *Laevicaulis alte* are very much influenced by foods and temperatures. Since the individual slugs maintained with lettuce and with mixed foods exhibited similar trends in growth, irrespective of temperatures, and the slugs consumed more lettuce than other foods in the mixed food experiments, lettuce is obviously the most preferred food for *L. alte*. As the growth rate exhibited by *L. alte* individuals fed with amaranth is much lower, lettuce perhaps contains materials that are more favourable in maintaining a higher growth rate in *L. alte*. Since the slugs exhibited highest growth rate at 25°C and gradually less at 30°C, room temperatures (18.0°C - 36.5°C) and 20°C while fed on lettuce, it is clearly evident that temperature plays an important role in maintaining the growth rate in the slugs, irrespective of foods. It is further clear that the slugs do not make a mistake in selecting the favoured plant food (*i.e.*, lettuce amongst 12 plant foods) while exposed to different thermal

TABLE 3. Analysis of variance (ANOVA) to justify the data on body length in relation to different temperatures and foods in *Laevicaulis alte.*

Source of variation	d.f.	SS	F_{cal}	$F_{tab.(5\%)}$
Temperature (T)	3	19136.07	14.54	2.60
Food (F)	2	10526.67	11.99	3.00
T x F	6	3235.87	1.23	2.21
Error	144	63173.12	—	—
Total	155	96070.73	—	—

TABLE 4. Analysis of variance (ANOVA) to justify the data on body breadth in relation to different temperatures and foods in *Laevicaulis alte.*

Source of variation	d.f.	SS	$F_{cal.}$	$F_{tab.(5\%)}$
Temperature (T)	3	1712.737	11.986	2.60
Food (F)	2	1022.538	10.734	3.00
T x F	6	259.111	0.906 < 1	2.10
Error	144	6811.051	—	—
Total	155	9805.437	—	—

TABLE 5. Analysis of variance (ANOVA) to justify the data on the length of ocular tentacle in relation to different temperatures and foods in *Laevicaulis alte.*

Source of variation	d.f.	SS	$F_{cal.}$	$F_{tab.(5\%)}$
Temperature (T)	3	85.079	4.85	2.60
Food (F)	2	82.572	7.06	3.00
T x F	6	6.846	0.195 < 1	2.10
Error	144	853.771	—	—
Total	155	1010.268	—	—

TABLE 6. Analysis of variance (ANOVA) to justify the data on body weight in relation to different temperatures and foods in *Laevicaulis alte.*

Source of variation	d.f.	SS	$F_{cal.}$	$F_{tab.(5\%)}$
Temperature (T)	3	263.623	12.55	2.60
Food (F)	2	162.790	11.63	3.00
T x F	6	69.675	1.66	2.10
Error	144	1001.035	—	—
Total	155	1497.123	—	—

conditions. Such habits of *L. alte* indicate these slugs' power of selection of those plant foods that are able to maintain their growth at the maximum level.

Since the slugs exhibited the maximum growth at 30°C, in contrast to 25°C (as in the case of lettuce) while fed with amaranth and almost at an equal level at 25°C and at room temperatures, the impact of temperature on the growth rates of *Laevicaulis alte* cannot be ruled out for less preferred plant foods. As the slugs consumed lettuce almost equal in amount at both 25°C and 30°C, but exhibited higher growth at 25°C, it is not due to the amount of consumed food but the power of assimilation and utilization of nutrients that determine the growth rates in slugs. So, it is the thermal environment that determines the ability to utilize nutrients in promoting growth in *L. alte.*

Since the growth rate in *Laevicaulis alte* fed with mixed food is similar to the growth rate of lettuce-fed individuals, the growth rate is mostly dependent on the amount of lettuce consumed by the slugs along with other plant foods available to them. This is evident from the similar trends in growth at 30°C when the slugs consumed a total of 315 g (120 g lettuce) of foods of the 12 varieties (in the mixed food experiment), in contrast to a total consumption of 218 g of lettuce in the single food experiment. It is not clear whether 126 g of lettuce may be considered enough to maintain the growth rate at the rate noted in the slugs that consumed 218 g lettuce or if it is the 189 g of other plant foods consumed that take part in influencing growth rate to gain the body length almost equal to the length gained by the slugs maintained exclusively on lettuce. At the growth rate exhibited at 30°C, it is clear that the slugs needed 189 g of the other 11 varieties of plant foods (supplied as mixed food) to compensate the growth rate to be maintained by 97 g lettuce.

In the mixed food experiments, in spite of the availability of an adequate amount of lettuce, the slugs consumed some of the other 11 varieties of plant foods, the total amount of which was greater than the amount of lettuce consumed. This indicates that the slugs prefer to feed on a number of plant foods rather than on a single plant food. Such food habits may reflect a diversity in taste.

Whatever be the fact of food consumption and utilization of nutrients to promote growth in slugs, it is clear that growth of slugs is very much influenced by the type of plant foods available to them. This may be due to the nutrient status of the foods concerned, as has been suggested by Ahmed & Raut (1991) in the case of growth of the giant African land snail, *Achatina fulica* Bowdich.

Of the different key factors, temperature is a critical environmental factor in the ecology of most organisms (Precht *et al.*, 1973; Wieser, 1973; Magnuson *et al.*, 1979). The terrestrial molluscs, especially the slugs, are found predominantly in moist and cool places (Godan, 1983) and certain parts of their life is temperature dependent (Dainton, 1954; Godan, 1958; Segal, 1959; Mellanby, 1961; Reichmuth & Frömming, 1961; Roy, 1963; Rigou, 1964; Rising & Armitage, 1969; Runham & Hunter, 1970). In regard to the rate of food consumption with respect to temperature, *Laevicaulis alte* consumed higher amounts of foods with increase in temperature from 20°C to 30°C, but the growth rate was maximum at 25°C and minimum at 20°C. The total gain in body length in the slugs was a little less at 30°C than at

25°C. This suggests that the higher growth rate in slugs is associated with higher rate of food consumption, but only up to a certain range of temperature. Since the rate of food consumption was at an increasing rate even at 30°C, the gain in growth rate perhaps is reduced to maintain the metabolic activities of the slugs at the expense of more energy than that required by the slugs exposed to 25°C. This resulted in reduction of the growth rate in the slugs. Thus, it appears that within the favourable range of temperatures, the slugs consumed food at increasing amounts with a view for maintaining growth at an increasing rate. This suggests that temperature and food jointly influence the growth rate in the slugs *L. alte.*

The varying growth rates in slugs, following consumption of different plant foods, have a direct impact on natural populations, as well as on the rate of damage of standing economic plants. The slugs occurring in an area of cultivation having more nutritive food plants would show higher population densities than those occurring in cultivated areas with less nutritive food plants. The well-fed slugs would attain sexual maturity faster and then reproduce for a longer time, thereby giving rise to a larger number of individuals. This would adversely affect pest management programmes, and agricultural damage would be greater and the loss would be higher.

From our results, it would appear that the rate of population increase of *Laevicaulis alte* is dependent on the rate of food consumption, which is influenced by the thermal conditions and the type of food-plant species available in the area concerned. Certain plant species, *viz., Spinacea oleracea, Lablab purpureus, Tagetes patula, Rosa centifolia, Hibiscus rosasinensis, Mentha arvensis* and *Polianthes tuberosa,* are not liked by *L. alte,* and result in lower growth rates. It is suggested that if less preferred food plants are cultivated for a few years in slug-infested areas, the density of slug populations will be reduced.

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AN UPDATE ON THE STATUS OF THE INTRODUCED VERONICELLID SLUGS OF TEXAS: NEW DISPERSAL METHODS AND EXPANDING GEOGRAPHICAL RANGE

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ABSTRACT – The current status of the three species of tropical veronicellid slugs that had established populations in southern Texas is reported. *Sarasinula plebeius* has been reduced in population densities due to drought conditions, but appears to be a permanent member of the fauna. *Angustipes ameghini* has also suffered population declines, but remains the most common veronicellid in this area. Several additional populations of *A. ameghini* are now known for southern and coastal areas of Texas, with one additional locality located in the innermost Coastal Plain of south central Texas. Some of these populations are permanently established, whereas others are likely to be extirpated by drought. *Laevicaulis alte* appears to have been extirpated by a combined severe freeze and extended drought in deep southern Texas.

Key words: Veronicellidae, slugs, introduced species, *Angustipes ameghini, Laevicaulis alte, Leidyula moreleti, Sarasinula plebeius.*

INTRODUCTION

Previous reports on the occurrence and status of populations of introduced veronicellid slugs in Texas (Neck, 1976, 1981, 1985, 1990) have been limited to localities in the Lower Rio Grande Valley at the extreme southern tip of Texas. Previous publications have documented one species (*Leidyula moreleti*) that never established a viable population and three species that thrived in varying abundance. Populations of one of these latter species (*Laevicaulis alte*) were subsequently decimated by an unusually severe and long-lasting period of sub-freezing conditions (Neck, 1990). The purpose of this note is to document the non-persistent occurrences of one species (*Sarasinula plebeius*) in localities that are probably not suitable for permanent populations and the further spread of another species (*Angustipes ameghini*) into more northerly locales, some of which are suitable for the establishment of permanent populations.

Sarasinula plebeius (P. Fischer 1898)

Sarasinula plebeius is native to the Caribbean islands and has been introduced into Florida (Stange, 1978; Deisler & Stange, 1984; Deisler & Phelps, 1985) and Texas (Neck, 1976, 1990). Two additional localities of non-persistent occurrences have been discovered during the examination of museum collections.

Dallas Co., Texas – The Strecker Museum (Baylor University, Waco, Texas-SM 23197 and 23198) contains two specimens that were collected by Ottys Sanders in Dallas, Dallas Co., Texas, on 10 August 1968. The exact collection locality is not provided and Sanders (in litt., 5 October 1986) does not recall any details of the collection of these individuals.

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Nueces Co., Texas – A single specimen of *Sarasinula plebeius* from Corpus Christi, Nueces Co., Texas, exists in the collection of the Academy of Natural Sciences of Philadelphia (ANSP-A8020). This specimen was collected by Jean Andrews in her residential yard on 1 August 1979. No other specimens were observed by Andrews (personal communication, 24 April 1987). These two records undoubtedly involve specimens that were transported to residential yards via commercial nursery stock from the Brownsville area (latitude 25°50'N). No establishment of viable populations would be expected at the latitude of Dallas (32°45'N). *Sarasinula plebeius* should be able to survive at the latitude of Corpus Christi (27°50'N), particularly in such proximity to the climate-ameliorating effects of the Gulf of Mexico. Isolated populations could survive in urban areas that receive supplemental watering and contain suitable cover objects to provide relatively moist refugia during drought periods. No establishment of feral populations of *S. plebeius* would be expected in the Corpus Christi area.

One correction concerning a population of this species needs to be reported here. In the initial report of veronicellids from Texas (Neck, 1976), I reported a population of *Angustipes ameghini* (as *Veronicella ameghini*) from the Rabb Palm Grove (now the Sabal Palm Grove Sanctuary of the National Audubon Society). Re-examination of a preserved specimen from this locality has revealed that this population was *Sarasinula plebeius*, not *A. ameghini*. However, this palm grove population was extirpated by drought conditions in the late 1970's or early 1980's. Several surveys of this palm grove locality (27 September 1983, 21 March 1984, 26 September 1984, 8 May 1985), some during rainy periods, have revealed no specimens of veronicellid slugs. On 18 September 1986, the long-time caretaker of the palm grove area, Ernesto Ortiz, identified live specimens of *S. plebeius* as the slug seen in the palm grove area including his residence. He reported that he had not seen any specimens for "maybe a year and a half." This temporary population was likely established from specimens in potted tropical plants that were placed in this palm grove during the 1960's. Survival of *S. plebeius* in the Brownsville area appears to require supplemental watering and suitable cover objects. Natural cover objects in the palm grove would probably be sufficient under a climatic regimen of greater rainfall than the normal Brownsville annual precipitation of 26.75 inches (Orton *et al.*, 1967).

Leidyula moreleti (Fischer 1871)

Leidyula moreleti, a native of Mexico and Central America, was observed by this author in a residential yard of Brownsville in 1965. Further surveys of this neighborhood have revealed no permanent populations were established. Nursery records of this species were recorded by Dundee (1974) for Hidalgo and Willacy counties. A record for Cameron County apparently referred to an outdoor population, quite likely the same population observed by this author.

Angustipes ameghini (Gambetta 1923)

Angustipes ameghini is native to Bolivia and Paraguay, but this species has established populations in Florida, Louisiana, and Texas (Dundee, 1974;

Neck, 1976; Stange, 1978; Deisler & Stange, 1984; Deisler & Phelps, 1985). Texas populations have been observed in many neighborhoods in the Brownsville area and one population each has been reported from Edinburg and Santa Ana National Wildlife Refuge, both Hidalgo Co. (Neck, 1987). Subsequent field surveys and specimens presented to me from other collectors have revealed an additional dispersal method in the Brownsville area and populations in three additional cities, all beyond the Lower Rio Grande Valley of Texas.

Bexar Co., Texas – Two adult *Angustipes ameghini* were collected from flood debris piles in the floodplain on the right bank of the Medina River immediately downstream of the U.S. 281 highway bridge on 26 March 1992. These debris piles were deposited by one of several floods on this river during the cool season of 1991/1992. This locality is located in a rural area with very few residences or plant nurseries that might provide a nearby source for this introduced species. The Medina River via Leon Creek, one of its major tributaries, does drain the western third of the city of San Antonio. An as yet undiscovered urban population in San Antonio could have provided individual *A. ameghini* that rafted down the creek and river to the discovered locality; no populations of *A. ameghini* were known to malacologists in the San Antonio area at the time of discovery of this Medina River population (H. D. Murray, personal communication). The immediate collection site is a floodplain woodland dominated by boxelder (*Acer negundo* Linnaeus) and Texas sugarberry (*Celtis laevigata* Willdenow). Other gastropods inhabiting the debris piles in this woodland include *Deroceras laeve* (Müller 1774) (probably European lineage population, by external morphology), *Oligyra orbiculata* (Say 1818), *Mesodon roemeri* (Pfeiffer 1848), *Glyphyalinia umbilicata* (Cockerell 1893), and *Rumina decollata* (Linnaeus 1758) (latter species also introduced). The likelihood of permanent establishment of *A. ameghini* at this rural site is unknown. The persistence of this species in semi-natural thorn woodlands in the more xeric Cameron Co. localities noted below would indicate that the drought conditions of central Texas should not exclude *A. ameghini* from wooded sites with protected microhabitats. No immatures or egg masses of *A. ameghini* were observed on 26 March 1992, however. Of 11 debris piles sampled that day, *A. ameghini* was recovered from only two, whereas *D. laeve* was recovered from nine (one debris pile contained both species). *Deroceras laeve* was also collected from the scarp woodland (Texas sugarberry/cedar elm-*Ulmus crassifolia* (Nuttall) at a slightly higher elevation, but *A. ameghini* was not collected in this woodland, indicating a more recent arrival (and possibly more restricted suitable microhabitat area) for *A. ameghini* than *D. laeve* at this locality.

Cameron Co., Texas – Adult *Angustipes ameghini* and an egg mass were collected on 27 April 1987 from underneath two piles of construction and yard trash deposited along Old Carmen Road within the boundaries of Resaca de la Palma State Park. All individuals observed that day were collected. A survey of the two trash pile sites on 9 September 1989 revealed no slugs, but prominent mucus trails were noted. These trails indicated that individual slugs were still present and had probably burrowed into the soil to escape the very dry soil conditions of the surface at that time. On 4 January 1990, two live individuals were found under a rotting log of Texas

sugarberry, *Celtis laevigata,* in native thorn woodland near the bank of Resaca de la Palma (approximately 400 meters from one of the trash piles). These observations not only document the continued survival of this species under anthropogenic cover objects without supplemental watering, they also indicate a further method of human-mediated dispersal from urban areas and subsequent local dispersal to suitable microhabitats in native plant communities with only naturally-occurring cover objects. Previous reports of dispersal methods used by this species were potted plants and channelized runoff of precipitation (Neck 1987). Note should be made here that a period of subnormal precipitation in the Brownsville area in the late 1980's and continuing into the very early 1990's has been responsible for substantial reductions in population levels of *A. ameghini* in residential yards. Populations seem to exist in almost all of the previously discovered urban localities, but numbers are significantly lower.

Harris Co., Texas – William L. McClure reported (in litt., 14 July 1991) that he had found adults of a slug that proved to be *Angustipes ameghini* on 10 July 1991; associated with this introduced slug were several individuals of the native slug, *Philomycus carolinianus* (Bosc 1802). On 11 September 1991, McClure collected another adult with a coiled egg mass at the same locality. This locality is a pile of lumber and other construction trash in the north central portion of Houston along the margins of Greens Bayou just west of Interstate 45. A visit by the author to this locality on 14 November 1991 with McClure revealed scattered *A. ameghini* underneath wood and other trash items in an artificial swale that parallels Greens Bayou. Associated gastropods were *Mesodon thyroidus* (Say 1816), *Polygyra texasiana* (Moricand 1833), and *Zonitoides arboreus* (Say 1816). Vegetation of the swale was dominated by giant ragweed (*Ambrosia trifida* Linnaeus), bermuda grass [*Cynodon dactylon* Linnaeus (Persoon)], and various sedges. No *A. ameghini* were located in the adjacent woodland, although suitable downed wood is not common. This woodland is dominated by water oak (*Quercus phellos* Linnaeus) and loblolly pine (*Pinus taeda* Linnaeus) with an understory of Texas sugarberry (*Celtis laevigata*), Chinese privet (*Ligustrum sinense* Loureiro) and poison ivy (*Rhus toxicodendron* Linnaeus).

On 19 October 1991, I discovered another population of *Angustipes ameghini* in the southwestern portion of Houston behind a commercial building next to the banks of a channelized portion of Brays Bayou. Slugs were found underneath old railroad ties used as landscaping timbers. Only immature slugs were observed, suggesting that the adults of this population may have burrowed down into the soil. Slugs were more common underneath ties that were shaded from direct sunlight than underneath ties with full exposure to the sun. An adult *A. ameghini* was recovered from this site on 7 March 1992. Vegetation at this site includes old, large specimens of wax-leaf ligustrum, *Ligustrum quihoui* Carriere, with a groundcover of *Calyptocarpus vialis* Lessing, *Solanum ptycanthum* Dunal, seedling *Celtis laevigata,* and *Ibervillea lindheimeri* Gray (Greene).

Subsequently, I have observed living specimens at or received specimens from several other locations in Houston. These localities have included the Houston Museum of Natural Science and residences in Westbury, Clear Lake, Briargrove and Bear Creek neighborhoods. The wide distribution of

these localities indicates the recent introduction of *Angustipes ameghini* in all areas of Houston within a period of less than two years, probably due to rapid spread via garden nursery plants.

Nueces Co., Texas – This author collected live *Angustipes ameghini* from a residential yard in the Calallen area within the corporate limits of Corpus Christi. These specimens were collected after I flooded a rotting stump, roots, and associated soil cavities of a dead honey mesquite, *Prosopis glandulosa* Torrey. Eight slugs were recovered in this manner. The slugs were not found under pots, wood, rocks, or other cover objects in the yard, because drought conditions had depleted surface moisture. The resident reported that slugs were common on lawn grass in his yard following rains. He first noticed the occurrence of these slugs in a previous residence location after putting a load of "river sand" on his yard. Live *A. ameghini* were presumably transported in potted plants from the previous residence location to his current residence. Personal collection of *A. ameghini* at this locality occurred on 2 August 1986 and 18 September 1986. Reproduction in this population was indicated by the variable size of the collected slugs. Terrestrial gastropods found living in this yard included three native species: *Oligyra orbiculata*; *Zonitoides arboreus*; and *Praticolella pachyloma* (Menke 1847). None of these species were recovered from the stump area, however.

Subsequently, Jane E. Deisler-Seno (personal communication) reported that *Angustipes ameghini* had been observed at several localities within Corpus Christi. Carol Bush collected one *A. ameghini* at the Corpus Christi Botanical Garden on 12 December 1990. This specimen was found during an examination of a fire ant mound that had been treated with pesticide several days previously (no ants were present on the day of collection of the slug). She further reported the occurrence of one individual of *A. ameghini* in a lathhouse kept for orchids in the Flour Bluff area of Corpus Christi (in litt., 12 December 1990). McClure (personal communication, 3 November 1992) observed *A. ameghini* to be common in landscaped hotel grounds in the central business district of Corpus Christi.

Webb Co., Texas – A very localized population of *Angustipes ameghini* was discovered in an urban landscaped area near the central business district of Laredo on 18 April 1990. The locality is a small, irrigated area in front of a medical office/laboratory. Additional slugs were found on 8 May 1990, but no slugs were found on 22 March 1991. Associated terrestrial gastropods were *Bradybaena similaris* (Férussac 1821), *Lamellaxis gracilis* (Hutton 1834), and *Succinea luteola* Gould 1848. Both slugs and shelled gastropods were found under landscaping rocks and leaves of the California fan palm, *Washingtonia filifera* Linden (H. Wendland). Given the hot, arid nature of the climate and the generally very well-drained sandy and gravelly soils of Laredo, permanent populations of *A. ameghini* would be expected only in very well-watered and mulched gardens. A survey of a portion of the older, well-established residential area in the western portion of Laredo on 9 May 1990 revealed no individuals of *A. ameghini*.

Laevicaulis alte (Férussac 1821)

Laevicaulis alte is native to eastern Africa but has been introduced into many tropical areas of the world. The only localities known for the United

States are Honolulu, Hawaii (Cockerell, 1925) and Brownsville, Texas (Neck, 1981, 1985). The major freeze of Christmas 1983 killed almost all of the *L. alte*, and the subsequent drought of 1984 apparently killed any that survived the record-breaking cold temperatures (Neck, 1990). Individual *L. alte* collected slightly before and after this major freeze were kept alive in the laboratory until 4 August 1988, when these last known individuals from the population of *L. alte* from southern Texas were relaxed and preserved. The long period of survival in the laboratory indicates that individual *L. alte* could have lived long enough to reproduce during wetter times if any had survived the combination freeze and drought periods in December 1983 and the first half of 1984. Frequent surveys of the urban neighborhood that supported the population of *L. alte* as recently as 25 April 1992 have revealed no individuals of this species.

DISCUSSION

The updated status of population reports and observations of additional localities for the introduced veronicellids of southern Texas reveal that two of these species have become established members of the fauna that have population fluctuations similar to those experienced by the native members of the fauna.

Sarasinula plebeius is restricted to areas with supplemental watering and sufficient cover objects that conserve the available moisture. All observations indicate that this species will remain an urban perianthropic species; *S. plebeius* is not expected to establish, much less maintain, feral populations that are dependent upon the natural precipitation for activity-regulating moisture supply. The restriction of *S. plebeius* to well-watered areas is indicated by the extirpation of the Cameron Co. palm grove population by drought.

However, *Angustipes ameghini* is a much more drought-resistant species that is spreading not only within the previously known range of its populations, but is also spreading to new localities beyond the Lower Rio Grande Valley of Texas. Some of the populations, *e.g.*, the one observed in Laredo, are expected to be short-lived colonies that will be unable to establish permanent populations. The populations at Corpus Christi will undoubtedly persist, but widely varying rainfall will cause major variations in population levels. The Houston populations observed to date are likely only a fraction of the actual occurrence at this moment. Substantial expansion of these colonies is expected along the Gulf Coast. Observations of the establishment of feral populations in native brush communities in the Brownsville area with its frequent droughts indicate that feral populations are to be expected in the Upper Gulf Coast region of Texas where moisture availability is less erratic.

Laevicaulis alte has apparently been extirpated from the single neighborhood from which it was known in Brownsville. Recurrence of this species will require an additional act of introduction. However, few sources exist for this species to be reintroduced into southern Texas.

The spread of *Angustipes ameghini* from deep southern Texas via the potted plant nursery trade is not without parallel in other faunal taxa. At

least two anurans, *Syrrophus cystignathoides campi* (Stejneger) and *Smilisca baudinii* (Dumeril & Bibron), have become established at sites in the central and Upper Gulf Coast portions of Texas following dispersal via this same plant trade (Dixon, 1987: 66, 71). These two amphibians, however, are native to southern Texas. The establishment of the Mediterranean gecko, *Hemidactylus turcicus* (Linnaeus), in the Brownsville area and subsequent transport via commercial routes throughout Texas (Davis, 1974) is more nearly parallel to the establishment and spread of *A. ameghini* in Texas.

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ARION HORTENSIS S.S., AN INTRODUCED SLUG IN MICHIGAN

Timothy A. Pearce[1] and Dorothy Blanchard[2]

Davies (1977, 1979) showed that three species of similar-looking European slugs have been called *Arion hortensis*: *A. hortensis* Férussac 1819 s.s., *A. distinctus* Mabille 1868 and *A. owenii* Davies 1979. Previous records of *Arion hortensis* in North America need reexamination to determine which of the three species a given record represents. Roth (1982) examined Californ-ia records of "*A. hortensis*" and determined that *A. hortensis* and *A. distinctus* have been in California since 1941 and 1939, or before, respectively.

Previous reports of *Arion hortensis* in Michigan and Ontario (a province of Canada adjacent to Michigan) are scarce, and the reports did not indicate which of the three species of the *A. hortensis* complex the specimens represented. Previous reports of "*A. hortensis*" in Ontario exist for three locations (Pilsbry, 1948: Toronto; Oughton, 1948: Toronto and Wiarton; Chichester & Getz, 1973: Ontario; Vanderburgh & Anderson, 1987: Guelph). Dundee (1974) noted that "*A. hortensis*" had been intercepted in Michigan by the United States Department of Agriculture. L.L. Getz found "*A. hortensis*" on Macki-nac Island, Michigan in 1984 (Getz, 1987; pers. comm.). The specimens from those previous reports are not available, so we cannot confirm which species of the *A. hortensis* complex they were.

We have specimens of a slug collected in late 1992 from the west side of Ann Arbor, Washtenaw Co., Michigan. The slugs appeared to belong to the *Arion hortensis* species complex. Our examination of external anatomy as described by Davies (1977, 1979) and Cameron *et al.* (1983), and our examination of internal anatomy (the distinct flap at the base of the epiphallus that has characteristic species-specific shapes) as described by Davies (1977, 1979) revealed that the slugs are *A. hortensis* s.s. This note is the first report confirming that *A. hortensis* s.s. is present in Michigan.

We deposited voucher specimens of the slugs as UMMZ 253326 in the collection at the University of Michigan Museum of Zoology, Mollusk Division.

We are grateful to the following people for helping us in our unsuccessful search for specimens from previous reports: Maureen Zubowski at Toronto Museum Department of Invertebrate Zoology, Doree Bardes at Philadelphia Academy Department of Malacology, R.C. Anderson at University of Guelph, L.F. Chichester formerly at University of Connecticut, and L.L. Getz at University of Illinois.

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THE UNIONIDAE AND CORBICULIDAE OF THE LITTLE MIAMI RIVER SYSTEM IN SOUTHWESTERN OHIO

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ABSTRACT – This report provides the first comprehensive account of the Unionidae, or pearly freshwater mussels, of the Little Miami River and its larger tributaries. One hundred and five sites were sampled from the Little Miami River, the North Fork, Caesar Creek, Todds Fork, and the East Fork between 12 May 1990 and 11 August 1991. Thirty-eight species of unionid molluscs and *Corbicula fluminea*, the introduced Asiatic clam, were collected. Specimens of four Ohio Endangered species were discovered (*Quadrula nodulata, Pleurobema clava, Villosa fabalis* and *Villosa lienosa*). Living specimens of each of these species, except *P. clava*, were found. Furthermore, four species designated as threatened in Ohio (*Obliquaria reflexa, Truncilla donaciformis, Ligumia recta* and *Epioblasma triquetra*) and all of the unionid taxa designated as special interest (*Anodonta suborbiculata, Simpsonaias ambigua, Cyclonaias tuberculata, Pleurobema sintoxia, Truncilla truncata* and *Lampsilis fasciola*) were represented in this fauna. This is the first record of *A. suborbiculata* for any tributary of the Ohio River in Ohio. The above listed endangered, threatened, and special interest species represented 3.4% of the 6677 specimens of bivalves found during this study. All but *P. clava, L. recta* and *C. tuberculata* were found to have extant populations in the system. This fauna has proven to be one of the most diverse unionid faunas in the state, both in terms of species richness and numbers of individuals.

Key words: Unionidae, Corbiculidae, Little Miami River, Ohio.

INTRODUCTION

The collection of freshwater mussels (Unionidae) from the waters of the Little Miami River has a long history. More than 600 hundred years ago the Fort Ancient People collected unionids for food and discarded innumerable shells (Barber, 1978). Other shells were used as tools and utensils or retained for their aesthetic value. These collections provide our earliest glimpse at the unionid fauna of the river. It is not until the late 19th and early 20th centuries that there is another snapshot of the unionid community of the region.

Whiteaves (1863) provided the earliest lists of the Unionidae for the Little Miami River, and Twitchell collected shells from the Little Miami River and from the East Fork of the Little Miami River around 1900 (Mattox, 1953). Sterki (1907) summarized much of what was known about the distribution of the Unionidae throughout Ohio, including some aspects of that distribution based on shells collected from the Little Miami River (Clark, 1987).

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Our modern understanding of the Unionidae of the system begins with a series of collections made during the period 1935 through 1946 by Clarence Clark and Rendell Rhoades (Clark, 1987). These collections are supplemented by the more narrowly focused studies of Walter (1974) and those summarized in the Final Environmental Impact Statement, East Fork Lake Project, Corps of Engineers, Louisville District (Stein, 1974).

The present contribution is the most extensive study of the Unionidae of the drainage basin. The objective of the study was to document the current distribution of unionid molluscs throughout the entire watershed of the Little Miami River. This Ohio Scenic River and its tributaries drain a large portion of southwestern Ohio (1755 square miles). These streams wind through extensive areas of agricultural land, through villages, towns and one of Ohio's largest cities before emptying into the Ohio River at Cincinnati. This study provides the baseline data that can be used to demonstrate changes in the aquatic community as a result of continued urbanization or changing agricultural practices within the watershed. The Unionidae are an appropriate group of animals to monitor these changes because (1) they are, for all practical purposes, immobile and cannot move to more suitable habitats when conditions become adverse, (2) they are generally long lived, (3) even after conditions have become unsuitable they leave evidence of once having been in an area, (4) their species demonstrate a wide range of tolerance to environmental degradation, (5) their taxonomy is sufficiently understood to allow for species and subspecies identification, and (6) much of their former distribution in Ohio is known. Where there are gaps in our knowledge of the distribution of these animals in Ohio, studies like that described herein are helping to fill that gap.

METHODS

Field collections were made from 105 sites distributed throughout the Little Miami River system (Fig. 1). Forty-six sites were sampled on the mainstem of the river, eight sites were sampled on the North Fork, 16 sites on Caesar Creek, eight sites on Todds Fork and Cowan Creek, and 27 sites on the East Fork of the Little Miami River. These collections were made between 12 May 1990 and 11 August 1991. The Appendix at the end of this report gives a complete list of all the specimens collected during the study.

Most collections were made by hand while wading upstream and downstream of a bridge or other access point. A canoe was used in the lower reaches of the Little Miami River to locate suitable collecting sites. At each site an effort was made to sample all accessible habitats for unionid molluscs. A hand-held glass-bottom bucket was used to facilitate hand collecting.

All living molluscs taken were identified in the field and returned except were specifically noted in the Appendix. Ample dead shell material was present at the majority of collection sites to voucher the collections made. All of the specimens collected were deposited at The Ohio State University Museum of Zoology (OSUM).

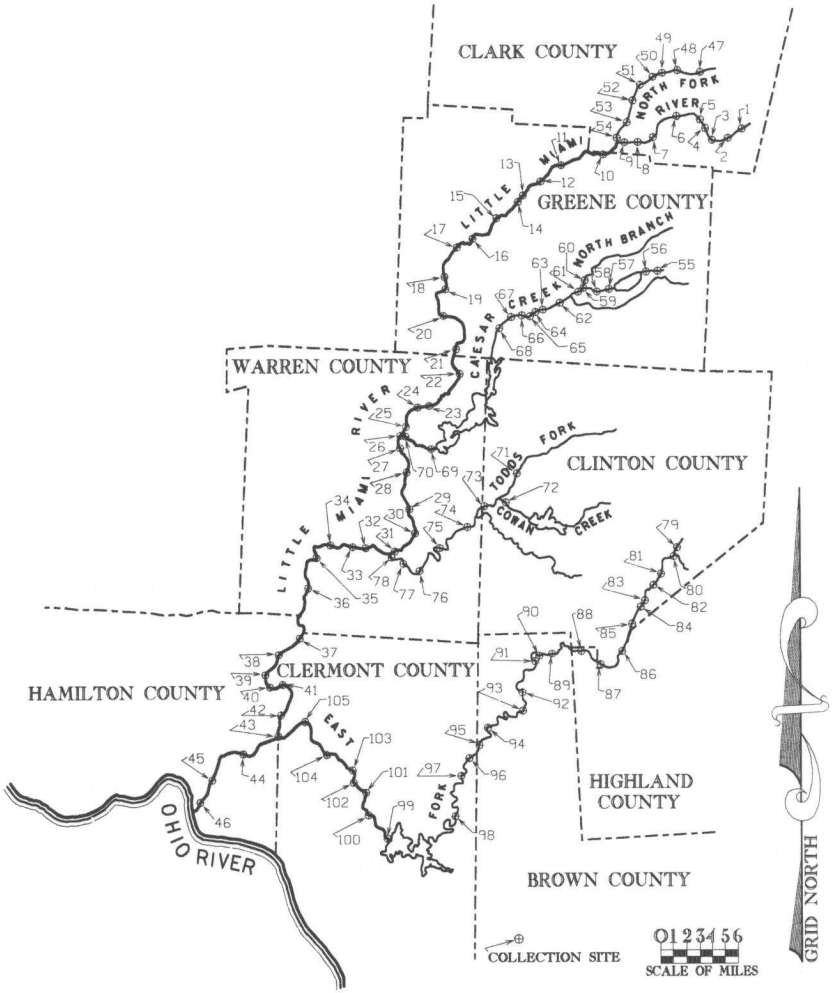

FIG. 1. Distribution of collection sites on the Little Miami River System.

RESULTS

A total of 36 species of Unionidae have been recorded from the Little Miami River in recent time (Table 1). This includes those species collected by Clark (1987), deposited at OSUM, or taken during this study. Specimens of 30 species were collected as living and/or freshly dead during this study. These species are believed to have extant populations in the river. The

TABLE 1. Distribustion of the Unionidae and Corbiculidae of the Little Miami River. (* = specimens located in The Ohio State University Museum of Zoology.)

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
A. imbecillis	*								X																	X															X				
A. suborbiculata																																X			X							X			
A. g. grandis	*							X			X	X	X										X			X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	
A. ferussacianus				X	X	X	X	X	X	X								X	X																										
S. u. undulatus	*		X			X	X	X	X	X	X	X	X													X																				
A. viridis	*						X	X	X	X	X	X	X	X	X			X	X						X	X						X	X												
A. marginata	*																											X	X	X	X	X	X	X	X	X	X	X			X			
L. complanata	*																X	X			X	X	X			X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
L. costata	*											X	X	X			X					X			X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	
L. compressa	*						X	X	X	X					X																	X												
T. verrucosa	*																							X	X		X		X	X	X	X	X	X		X	X						
Q. p. pustulosa	*										X												X				X											X					
Q. nodulata	*																																			X							X	
Q. quadrula	*																					X	X		X	X	X	X	X	X	X		X	X	X	X	X	X	X		X	X	X	
A. p. plicata	*										X		X				X	X		X		X		X	X					X		X	X				X	X					X
C. tuberculata																							X			X																		
F. flava	*										X		X	X	X		X	X		X		X	X			X	X		X	X	X		X	X	X		X						
P. clava	*																					X					X																	
E. dilatata	*										X	X	X	X	X	X						X				X	X																	
P. fasciolaris	*										X	X	X	X	X												X																	
O. reflexa																																			X	X	X			X				
O. subrotunda	*																						X		X	X																		
T. truncata	*																													X						X	X	X	X			X	X	
T. donaciformis	*												X														X	X	X	X		X		X		X	X	X	X		X		X	
L. fragilis	*																				X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
P. ohiensis	*																							X	X			X	X	X	X	X	X	X	X	X						X	X	
P. alatus	*																				X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
T. parvus	*						X	X	X	X																																		
T. lividus	*																																											
L. recta																									X																			
V. fabalis																							X								X												
V. i. iris	*										X	X	X																X														
L. r. luteola	*						X		X	X	X	X	X	X	X	X	X		X	X		X	X	X	X	X	X	X	X	X	X	X	X			X	X	X			X	X	
L. ventricosa	*										X	X	X	X	X	X	X					X	X		X	X	X	X	X	X	X	X	X	X	X	X	X			X	X		X
L. fasciola	*										X	X	X	X	X																													
E. triquetra	*																X								X	X		X	X	X		X		X		X	X						
C. fluminea																		X			X		X		X	X	X	X	X	X		X											

TABLE 2. Percent composition of the bivalve fauna (Unionidae and Corbiculidae) of the Little Miami River.

Species	Live	Dead	Weat.	Subf.	Total	%
C. fluminea		292	1		293	13.0
L. fragilis	31	159	54		244	10.9
E. dilatata	170	50	2	4	226	10.1
P. alatus	62	84	15		161	7.2
A. viridis	53	66	8		127	5.6
L. r. luteola	57	46	18		121	5.4
Q. quadrula	24	70	20	1	115	5.1
P. fasciolaris	68	36	1		105	4.7
L. complanata	48	40	17		105	4.7
A. g. grandis	30	51	22	1	104	4.6
L. ventricosa	36	37	17		90	4.0
F. flava	38	21	21	1	81	3.6
L. costata	15	39	12	1	67	3.0
T. donaciformis	9	48	5		62	2.8
A. marginata	6	35	18		59	2.6
A. ferussacianus	25	13	10		48	2.1
A. p. plicata	10	10	13		33	1.5
T. truncata	3	29	1		33	1.5
T. verrucosa	18	6	7		31	1.4
S. u. undulatus	7	9	5	4	25	1.1
L. compressa	14	1	5		20	0.9
P. ohiensis	2	12	5		19	0.9
E. triquetra		8	8	1	17	0.8
L. fasciola	6	8			14	0.6
O. reflexa		7	1		8	0.4
V. i. iris	1	3	2		6	0.3
Q. nodulata	2	2	2		6	0.3
O. subrotunda			4	1	5	0.2
T. parvus			4	1	5	0.2
Q. p. pustulosa	1	2	1		4	0.2
A. imbecillis		4			4	0.2
A. suborbiculata		3			3	0.1
V. fabalis	1			1	2	0.1
P. clava			1	1	2	0.1
C. tuberculata			2	2	0.1	
L. recta				1	1	0.1
TOTALS	737	1191	299	21	2248	

Weat. = Weathered dry shell
Subf. = Subfossil shell

unionid community of the Little Miami River was dominated by *Elliptio dilatata, Leptodea fragilis, Potamilus alatus, Alasmidonta viridis, Lampsilis radiata luteola, Quadrula quadrula, Ptychobranchus fasciolaris* and *Lasmigona complanata* (Table 2). The presence of three fairly sensitive species in this list, *E. dilatata, A. viridis* and *P. fasciolaris,* indicate the river provides good quality habitat even though localized reaches may be severely impacted (see the Appendix for site specific collection records). Endangered (E),

TABLE 3. Distribution of the Unionidae and Corbiculidae of the North Fork Little Miami River.

Species	Collection Sites							
	47	48	49	50	51	52	53	54
A. imbecillis		X			X			
A. g. grandis					X			
A. ferussacianus	X	X	X	X	X		X	
S. u. undulatus				X	X		X	
A. viridis		X	X	X	X		X	
L. compressa		X	X	X			X	
L. r. luteola			X	X				
C. fluminea							X	X

TABLE 4. Percent composition of the bivalve fauna (Unionidae and Corbiculidae) of the North Fork Little Miami River.

Species	Live	Dead	Weat.	Subf.	Total	%
C. fluminea	25	1			26	27.6
A. viridis	3	19	2		24	25.5
A. ferussacianus	3	10	2		15	15.9
L. r. luteola	6	8			14	14.9
L. compressa		2	4		6	6.4
A. imbecillis	1	3			4	4.3
S. u. undulatus		3		1	4	4.3
A. g. grandis	1				1	1.1
TOTALS	39	46	8	1	94	

Weat. = Weathered dry shell
Subf. = Subfossil shell

Threatened (T) and Special Interest (S) species collected in this river included *Quadrula nodulata* (E), *Pleurobema clava* (E), *Villosa fabalis* (E), *Ligumia recta* (T), *Epioblasma triquetra* (T), *Truncilla donaciformis* (T), *Anodonta suborbiculata* (S), *Cyclonaias tuberculata* (S), *Lampsilis fasciola* (S) and *Truncilla truncata* (S). All of these were found to have extant populations in the river except *P. clava*, *C. tuberculata* and *L. recta*.

The North Fork contained Unionidae representative of the headwaters condition of the stream (Table 3). This fauna was dominated by *Alasmidonta viridis*, *Anodontoides ferrusacianus* and *Lampsilis r. luteola* (Table 4). The Asiatic clam, *Corbicula fluminea*, was particularly abundant at the lowermost site on the stream. No state significant species were found in this tributary.

Caesar Creek had a diverse fauna below the impoundment (sites 69 and 70) and a much reduced fauna upstream (Table 5). Of the nineteen species

TABLE 5. Distribution of the Unionidae and Corbiculidae of Caesar Creek.

Species	Collection Sites															
	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
A. imbecillis															X	X
A. g. grandis		X	X	X		X									X	X
A. ferussacianus	X	X		X		X		X	X	X		X				
S. u. undulatus		X		X	X			X	X	X		X	X	X	X	X
A. viridis	X	X	X	X	X	X		X	X					X	X	X
A. marginata															X	X
L. complanata													X		X	X
L. costata									X						X	X
T. verrucosa																X
Q. quadrula															X	X
F. flava																X
P. sintoxia																X
T. donaciformis																X
L. fragilis															X	X
P. alatus																X
T. parvus		X	X													X
L. r. luteola			X	X	X	X	X	X	X	X	X	X	X	X	X	X
L. ventricosa			X		X		X		X	X	X	X	X	X	X	X
E. triquetra																X
C. fluminea														X	X	X

of Unionidae collected, all but *Epioblasma triquetra* were represented by living and/or freshly dead specimens (Table 6). The Caesar Creek unionid fauna was dominated by *Lampsilis r. luteola, Leptodea fragilis* and *Lampsilis ventricosa.* These species occur in a wide variety of habitats throughout much of the state and are usually considered to be among the most tolerant species of Unionidae. Nonetheless, this stream does support some rare species of Unionidae, including populations of *Truncilla donaciformis* (T) and *Pleurobema sintoxia* (S).

The Todds Fork unionid fauna was very similar to that of Caesar Creek (Table 7). Extant populations of all sixteen species found in this stream were discovered. Specimens of *Lampsilis r. luteola, Leptodea fragilis* and *Lampsilis ventricosa* were most common throughout the stream (Table 8). Extant populations of *Truncilla donaciformis* (T) and *Truncilla truncata* (S) were found.

The East Fork had a much more diverse fauna than the other tributaries. Twenty-five species of Unionidae were collected. The collection at OSUM records an additional three species or subspecies. Extant populations of 22 species were confirmed during this study (Table 9). The presence of two state endangered species, *Villosa fabalis* and *Villosa lienosa,* were confirmed by the presence of living specimens collected upstream of the impoundment on the East Fork. Other rare species encountered in this stream included *Truncilla donaciformis* (T), *Simpsonaias ambigua* (S), *Truncilla*

TABLE 6. Percent composition of the bivalve fauna (Unionidae and Corbiculidae) of Caesar Creek.

Species	Live	Dead	Weat.	Subf.	Total	%
L. r. luteola	202	35	47		284	27.1
L. fragilis	109	22	29		160	15.3
L. ventricosa	115	8	21		144	13.7
C. fluminea	100	29			129	12.3
A. g. grandis	71	7	10	1	89	8.5
A. viridis	1	16	18		35	3.3
S. u. undulatus	8	5	19	1	33	3.1
L. costata	19	6	6		31	3.0
A. imbecillis	17	4			21	2.0
L. complanata	10	3	5		18	1.7
A. ferussacianus	10	8			18	1.7
Q. quadrula	10		7		17	1.6
A. marginata	4	5	7		16	1.5
P. alatus	13		1		14	1.3
T. parvus		3	11		14	1.3
F. flava	6	4	1		11	1.1
T. donaciformis	3	2	3		8	0.8
T. verrucosa	3		1		4	0.4
P. sintoxia		1			1	0.1
E. triquetra		1			1	0.1
TOTALS	691	160	195	2	1048	

Weat. = Weathered dry shell
Subf. = Subfossil shell

TABLE 7. Distribution of the Unionidae and Corbiculidae of Todds Fork, Little Miami River.

	Collection Sites							
Species	71	72	73	74	75	76	77	78
A. imbecillis							X	
A. g. grandis		X		X	X	X	X	X
A. ferussacianus				X	X			X
S. u. undulatus					X		X	X
A. viridis		X	X	X	X	X	X	X
A. marginata					X		X	X
L. complanata				X		X	X	X
L. costata					X	X	X	X
Q. quadrula						X		X
T. truncata						X	X	X
T. donaciformis					X		X	X
L. fragilis			X	X	X	X	X	X
P. ohiensis					X	X	X	
P. alatus				X	X	X	X	X
L. r. luteola	X	X		X	X	X	X	X
L. ventricosa		X		X	X	X	X	X
C. fluminea		X		X				X

TABLE 8. Percent composition of the bivalve fauna (Unionidae and Corbiculidae) of Todds Fork Little Miami River.

Species	Live	Dead	Weat.	Subf.	Total	%
L. r. luteola	69	35	37		141	32.2
L. fragilis	28	39	12		79	18.0
L. ventricosa	31	10	4		45	10.3
A. viridis	5	20	16		41	9.4
A. g. grandis	5	18	16		39	8.9
P. alatus	22	9	3		34	7.8
L. costata	2	3	5		10	2.3
C. fluminea		10			10	2.3
A. marginata	3	2	3		8	1.8
L. complanata		1	5	1	7	1.6
S. u. undulatus	3	1	1		5	1.1
T. donaciformis	1	3	1		5	1.1
A. ferussacianus		3	1		4	0.9
P. ohiensis		2	2		4	0.9
T. truncata		2	1		3	0.7
Q. quadrula	1		1		2	0.5
A. imbecillis	1				1	0.2
TOTALS	171	158	108	1	438	

Weat. = Weathered dry shell
Subf. = Subfossil shell

truncata (S) and *Lampsilis fasciola* (S). The fauna was dominated by *Lampsilis r. luteola, Amblema plicata plicata, Fusconaia flava* and *Lampsilis ventricosa* (Table 10). The Asiatic clam, *Corbicula fluminea,* was also very common in this stream.

Table 11 summarizes the collections made during this study. A total of 5985 specimens of Unionidae and 692 specimens of *Corbicula fluminea* were collected.

SPECIES ACCOUNTS

The following discussion will include all of the species and subspecies recorded for the Little Miami River and its tributaries. Scientific nomenclature follows Stansbery & Borror (1983), while common names follow Turgeon *et al.* (1988). The species are listed in phylogenetic sequence. *Corbicula fluminea,* the only member of the Corbiculidae taken, is treated last.

Anodonta imbecillis Say 1829. The paper pondshell comprised 0.51% of the specimens taken during this study (Table 12). This species occurred in each of the tributaries and in the mainstem of the Little Miami River. Barber (1978) found seven specimens of this species at the Anderson Village Site and Whiteaves (1863) recorded the species from the Little Miami River near the village site. Clark (1987) discovered this species in Cowan Lake, an

TABLE 9. Distribution of the Unionidae and Corbiculidae of the East Fork Little Miami River.

Species		Collection Sites																							
		79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
A. imbecillis																							X		X	X		
A. g. grandis	*				X			X	X	X	X	X	X		X	X		X	X	X		X	X	X	X	X	X	X
A. g. corpulenta	*																											
A. ferussacianus	*	X		X	X	X	X	X	X	X	X	X	X	X	X			X	X									
S. u. undulatus	*						X	X	X	X	X	X	X	X	X	X		X	X	X	X	X		X		X		
S. ambigua	*																						X					
A. viridis	*			X	X		X	X	X	X	X	X	X	X	X	X		X	X	X		X		X		X		
A. marginata																												X
L. complanata	*											X		X	X			X				X	X	X	X	X	X	X
L. costata	*											X	X	X	X			X	X		X	X	X	X	X	X		X
T. verrucosa	*																				X	X	X	X	X	X	X	
Q. quadrula	*											X	X	X	X	X		X	X	X		X					X	
A. p. plicata	*										X	X	X	X	X	X	X	X	X	X		X	X					X
F. flava	*									X		X	X	X	X	X		X	X	X	X	X	X	X	X	X		
E. dilatata	*																						X	X	X		X	
T. truncata																												X
T. donaciformis	*																							X			X	X
L. leptodon	*																							X	X	X	X	X
L. fragilis	*																								X			
P. ohiensis	*																							X	X	X	X	X
P. alatus	*																											
T. parvus	*							X		X				X														
V. fabalis	*																	X	X	X								
V. i. iris	*																											
V. lienosa	*											X	X	X	X	X		X	X	X								
L. r. luteola	*			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
L. ventricosa	*									X		X	X	X	X	X		X	X	X		X	X	X	X	X	X	X
L. fasciola	*																						X					
C. fluminea																		X	X	X		X	X			X	X	X

* = specimen in the collection at The Ohio State University Museum of Zoology.

TABLE 10. Percent composition of the bivalve fauna (Unionidae and Corbiculidae) of the East Fork of Little Miami River.

Species	Live	Dead	Weat.	Subf.	Total	%
L. r. luteola	639	125	101		865	30.4
A. p. plicata	341	35	8	1	385	13.5
F. flava	205	48	15		268	9.4
C. fluminea	150	84			234	8.2
L. ventricosa	155	39	7		201	7.1
E. dilatata	113	10	1		124	4.3
S. u. undulatus	41	45	18	1	105	3.7
L. costata	76	16	6		98	3.4
A. viridis	12	46	38		96	3.4
T. verrucosa	72	6	4		82	2.9
A. ferussacianus	12	48	18		78	2.7
P. alatus	58	8	5		71	2.5
L. complanata	37	15	6		58	2.0
A. g. grandis	13	6	23	1	43	1.5
L. fragilis	29	5	4		38	1.3
V. lienosa	1	20	12		33	1.2
Q. quadrula	12	9	10	1	32	1.1
T. donaciformis	1	17			18	0.6
T. parvus	2		3		5	0.2
V. fabalis	1	3	1		5	0.2
A. imbecillis	3	1			4	0.1
T. truncata	1	1			2	0.1
A. marginata	1				1	--
S. ambigua			1		1	--
P. ohiensis			1		1	--
L. fasciola			1		1	--
TOTALS	1975	587	283	4	2849	

Weat. = Weathered dry shell
Subf. = Subfossil shell
-- = less than 0.1% of fauna

impoundment of Cowan Creek in the Todds Fork watershed. The species appears to have a low but stable population in the system.

Anodonta suborbiculata Say 1831. These collections represent the first account of the flat floater for any Ohio River tributary in the state of Ohio. Prior to this, the only other record of this species in Ohio is one dead specimen collected from the banks of the Ohio River in Clinton County. Since these collections, the author has taken a very old dead specimen from the Whitewater River near where the river empties into the Great Miami River. This species appears to be moving into the lower reaches of our larger rivers, including the lower Little Miami River. Only three specimens of the flat floater were taken during this study and the species comprised only 0.05% of the bivalve fauna of the system.

Anodonta grandis grandis Say 1829. The giant floater was first recorded for the Little Miami River by Whiteaves (1863) who took specimens at Waynesville in Warren County. Walter (1972) took the subspecies from the

TABLE 11. Summary table of molluscs collected from the Little Miami River system.

Unionidae	Live	Dead	Weat.	Subf.	Total
Little Miami River	737	899	298	21	1955
North Fork	14	45	8	1	68
Caesar Creek	591	131	195	2	919
Todds Fork	171	148	108	1	428
East Fork	1825	503	283	4	2615
Totals	3248	1398	845	29	5985

Corbiculidae	Live	Dead	Weat.	Subf.	Total
Little Miami River		292	1		293
North Fork	25	1			26
Caesar Creek	100	29			129
Todds Fork		10			10
East Fork	150	84			234
Totals	275	416	1	0	692

Total bivalve molluscs collected = 6677

Weat. = Weathered dry shell
Subf. = Subfossil shell

river at Spring Valley and Stein (1974) collected it in the East Fork. Clark (1987) found populations in the mainstem, the East Fork, Obannon Creek, Cowan Lake, and in Massie Creek. During this study, the subspecies was collected from Caesar Creek, Todds Fork, the East Fork, and from the mainstem of the river. This subspecies comprised 4.13% of the bivalve fauna of the system and was taken at 53 sites.

Anodonta grandis corpulenta Cooper 1834. This subspecies was not taken during the study. Clark (1987) reported taking it from Cowan Lake but suggested that the subspecies represents an ecophenotype of the nominate subspecies. Clark argues that because the lake is of recent origin (an impoundment), and because the nominate subspecies, *Anodonta g. grandis*, is found throughout the watershed while *corpulenta* is found nowhere else but Cowan Lake, that it is more logical to attribute this population to the effects of living in a lentic rather than a lotic environment. This subspecies is recognized by Stansbery & Borror (1983), and OSUM has specimens from Cowan Lake collected by Clark labeled as *Anodonta g. corpulenta*. Turgeon *et al.* (1988) do not recognize this subspecies and the evidence presented by Clark would appear to support that conclusion. No common name has been assigned this mollusc.

Anodontoides ferrusacianus (Lea 1834). The cylindrical papershell is gen-

TABLE 12. Percent composition of the bivalve fauna (Unionidae and Corbiculidae) of the Little Miami River and its tributaries.

Species	Live	Dead	Weat.	Subf.	Total	%
L. r. luteola	973	249	203		1425	21.34
C. fluminea	275	416	1		692	10.36
L. fragilis	197	225	99		521	7.80
L. ventricosa	337	94	49		480	7.19
A. p. plicata	351	45	21	1	418	6.26
E. dilatata	283	60	3	4	350	5.24
F. flava	249	73	37	1	360	5.39
A. viridis	74	167	82		323	4.84
P. alatus	155	101	24		280	4.19
A. g. grandis	120	82	71	3	276	4.13
L. costata	112	64	29	1	206	3.09
Q. quadrula	47	79	38	2	166	2.99
L. complanata	95	59	33	1	188	2.82
S. u. undulatus	59	63	43	7	172	2.58
A. ferussacianus	40	84	39		163	2.44
T. verrucosa	93	12	12		117	1.75
P. fasciolaris	68	36		1	105	1.57
T. donaciformis	14	70	9		93	1.39
A. marginata	14	42	28		84	1.26
T. truncata	4	32	2		38	0.57
A. imbecillis	22	12			34	0.51
V. lienosa	1	20	12		33	0.49
L. compressa	14	3	9		26	0.39
P. ohiensis	2	14	8		24	0.36
T. parvus	2	3	18	1	24	0.36
E. triquetra		8	9	1	18	0.27
L. fasciola	6	8	1		15	0.23
O. reflexa		7	1		8	0.12
V. fabalis	2	3	1	1	7	0.11
V. i. iris	1	3	2		6	0.09
Q. nodulata	2	2	2		6	0.09
O. subrotunda			4	1	5	0.07
Q. p. pustulosa	1	2	1		4	0.06
A. suborbiculata		3			3	0.05
P. clava			1	1	2	0.03
C. tuberculata				2	2	0.03
P. sintoxia		1			1	0.02
S. ambigua			1		1	0.02
L. recta				1	1	0.02
TOTALS	737	1191	299	21	2248	

Weat. = Weathered dry shell
Subf. = Subfossil shell

erally found in headwaters situations. It was distributed throughout the headwaters of the streams sampled during this study. Walter (1972) took the species at Spring Valley (site 22 on Fig. 1) and Clark (1987) recorded the species from the upper mainstem and East Fork. The species comprised

2.44% of the bivalve fauna of the system and was taken at 41 sites. *Anodontoides ferrusacianus* was the second most abundant species in the North Fork.

Strophitus undulatus undulatus (Say 1817). The squawfoot was first reported for the system by Whiteaves (1863), who collected specimens from the mainstem of the river at Waynesville. Walter (1972) took the species at Spring Valley, Stein (1974) reported it for the East Fork, and Clark collected the squawfoot from the mainstem, Beaver Creek, Caesar Creek, Todds Fork, the East Fork, and Cowan Creek. The species comprised 2.5% of the bivalve fauna taken during this study and was found at 44 sites.

Simpsonaias ambigua (Say 1825). Stein (1974) reported taking one freshly dead specimen of the salamander mussel from the East Fork of the Little Miami River. The single specimen taken during the present study also was taken from the East Fork of the Little Miami River. The only known host of the glochidium of this species is the mudpuppy (*Necturus maculosus*), which apparently has never been collected from the East Fork, but has been taken in the mainstem of the river in Hamilton and Warren counties (Pfingsten & Downs, 1989).

Alasmidonta viridis (Rafinesque 1820). The slippershell mussel was first reported for the river by Whiteaves (1863). Subsequent to this, it was taken at Spring Valley by Walter (1972) and from the East Fork by Stein (1974). Clark (1987) found that the species was widely distributed in the headwaters throughout the system. During this study, the slippershell mussel was particularly abundant in the North Fork and upper Little Miami River. It was taken at 56 sites throughout the system and represented 4.19% of the bivalve fauna.

Alasmidonta marginata Say 1818. Walter (1972) was the first to record the elktoe from the Little Miami River. Clark (1987) took a total of five specimens from the mainstem and Cowan Creek. Only 84 specimens of this species were taken during the present study. The species was found in the lower reaches of Caesar Creek, Todds Fork, the East Fork, and the mainstem of the Little Miami River. It comprised 1.26% of the fauna and was taken at 18 sites.

Lasmigona complanata (Barnes 1823). The white heelsplitter is fairly tolerant of silted habitats and appears to be increasing in numbers and in distribution in Ohio. Walter (1972) took the species at Spring Valley, on the mainstem of the Little Miami River, and Clark reported taking 124 specimens from the mainstem and the East Fork. During the present study, the species was collected at 41 sites from the East Fork, Caesar Creek, Todds Fork, and the mainstem of the river. It comprised 2.82% of the fauna.

Lasmigona costata (Rafinesque 1820). This species is generally found in riffle and run reaches in firm substrate. It was first collected from the system by Whiteaves (1863) at Waynesville and Mattox (1953) reported it from the Twitchell Collection. Walter (1972) took this species at Spring Valley, while

Clark (1987) reported finding the species in the mainstem and the East Fork. During this study, the fluted-shell was collected from Caesar Creek, Todds Fork, the East Fork, and the mainstem of the river. It comprised 3.09% of the bivalve fauna and was found at 43 sites.

Lasmigona compressa (Lea 1829). The creek heelsplitter, as its name implies, is a headwaters species. During the present study it was found only in the upper Little Miami River and in the North Fork. It represented 0.39% of the bivalve fauna taken and was only found at 10 sites. Clark (1987) took one specimen from the mainstem near Waynesville where Whiteaves (1863) collected the first specimen for the Little Miami River system. This species is found in the Twitchell Collection and was taken by Walter (1972) at Spring Valley.

Megalonaias nervosa (Rafinesque 1820). Sterki (1907) reported the species for the Little Miami River, but no specimens have been recorded since then. Clark (1987) commented that the Carnegie Museum of Pittsburgh houses the specimens that are the basis of Sterki's record. The washboard is a species usually encountered in large to moderate sized streams and is probably extirpated from the system today.

Tritogonia verrucosa (Rafinesque 1820). The pistolgrip represented 1.75% of the molluscs taken during this study and was distributed within the East Fork, Caesar Creek, and the mainstem of the river. The species was represented at the Anderson Village Site (Barber, 1978) and was taken by Twitchell (Mattox, 1953) from the Little Miami River. Clark (1987) collected this species from the mainstem and the East Fork.

Quadrula quadrula (Rafinesque 1820). The mapleleaf was more abundant in the mainstem of the river than anywhere else in the watershed, but it was also found in the East Fork, Todds Fork, and Caesar Creek. The species represented 2.99% of the fauna and was taken at 33 sites. Clark (1987) took the species from the Little Miami River mainstem and Barber (1978) reported taking three specimens from the Anderson Village Site.

Quadrula cylindrica cylindrica (Say 1817). Barber (1978) found one specimen of the rabbitsfoot at the Anderson Village Site and Twitchell (Mattox, 1953) took one specimen from the Little Miami River. Clark did not find this species during his study but reported that Stein (1974) collected one specimen from the mainstem of the river. However, a search of the collections at OSUM failed to locate a single specimen from this watershed. It appears that the specimen attributed to Stein is in error and that the species has been extirpated from the system for many years. No specimens of this state-endangered species were taken during the present study.

Quadrula nodulata (Rafinesque 1820). This state-endangered species is found only in the lower reaches of the Little Miami River in Ohio. Stein (1974) collected the species from the mainstem in 1972. During the present study six specimens of the wartyback were discovered at a total of two sites. This species represented 0.08% of the bivalve fauna.

Quadrula pustulosa pustulosa (Lea 1831). Sterki (1907) reported the pimpleback from the Ohio River at Cincinnati, but the species has never before been reported from the Little Miami River system. This species was very rare in the system with only four specimens taken. Each of these specimens was taken at a different site on the mainstem of the river. The species comprised 0.06% of the fauna.

Amblema plicata plicata (Say 1817). The threeridge was the most common unionid mollusc encountered in the East Fork during the current study. The species was found at 13 sites on this tributary and accounted for 13.5% of the fauna of that stream. It was also taken from the mainstem of the river and accounted for 6.26% of the total bivalve community. During this study, 418 specimens were found. Barber (1978) reported finding 93 valves of this species at the Anderson Village Site which would indicate that the species has had a substantial population in the system for at least 600 years. Whiteaves (1863) took this species at Waynesville, Sterki (1907) reported that the species occurred in the Little Miami River, and Stein (1974) found the threeridge in the East Fork. Clark (1987) reported finding this species at 11 sites, mostly in the mainstem and the East Fork but also at one site on Caesar Creek. The Caesar Creek site is currently inundated by the impoundment on the stream.

Fusconaia flava (Rafinesque 1820). Clark (1987) found the Wabash pigtoe at 11 sites throughout the mainstem, the East Fork, and in Caesar Creek. Stein (1974) reported the species from the East Fork. During the present study, this species was taken at 34 sites. Its distribution mirrors that of the previous species in that most of these individuals came from the East Fork and the mainstem of the river. Eleven specimens were taken from the lowermost site on Caesar Creek. *Fusconaia flava* was the second most abundant species encountered in the East Fork and accounted for 5.24% of the bivalve fauna encountered during this study.

Cyclonaias tuberculata (Rafinesque 1820). Two subfossil specimens of the purple wartyback were taken during the present study. This species was first recorded for this system by Clark (1987) who took two specimens from the mainstem of the river. The species appears to be extirpated from the Little Miami River and its tributaries today.

Plethobasus cyphyus (Rafinesque 1820). The only record of the sheepnose from the Little Miami River is from the Twitchell Collection (Mattox, 1953). This state endangered species is apparently extirpated from the system today.

Pleurobema clava (Lamarck 1819). Whiteaves (1863) collected this state endangered species from the Little Miami River at Waynesville, and Walter (1972) took it at Spring Valley. One weathered and one subfossil specimen of the clubshell was taken during this study. It appears that this species is extirpated from the system.

Pleurobema sintoxia (Rafinesque 1820). Only one freshly dead specimen

of the round pigtoe was taken during the present study. That specimen was taken at the lowermost site on Caesar Creek. Clark (1987) reported finding this species at four sites on the mainstem and the East Fork. This species may be close to extirpation from the system and is apparently on the decline.

Elliptio complanata (Lightfoot 1786). The eastern elliptio is an Atlantic Slope and St. Lawrence River species that is sporadically encountered in Ohio. Barber (1978) reported finding 10 valves at the Anderson Village Site and Clark (1987) concluded that the species was too common to have been brought to the site. However, as Clark notes, there is no good explanation for the distribution of this species into the Little Miami River. It is more probable that shells of this species were collected in the St. Lawrence River system in Michigan and carried to the site, where they were later discarded. This species does not currently occur in the Little Miami River or in any other stream in Ohio.

Elliptio dilatata (Rafinesque 1820). The spike was encountered in the mainstem, where it was the second most common unionid mollusc found. It was also taken in the East Fork. This species was collected at 13 sites and comprised 5.24% of the fauna of the system. Barber (1978) found this species at the Anderson Village Site, Whiteaves (1863) took it at Waynesville, and Mattox (1953) reported that Twitchell collected the species from the Little Miami River. Clark (1987) took one specimen from the mainstem of the river and Stein (1974) reported finding this species in the East Fork.

Uniomerus tetralasma (Say 1831). Sterki (1907) reported this species from the Little Miami River. That record is documented by a specimen in the collection of the Carnegie Museum (Clark, 1987). No other records exist for this species in the system and therefore it would appear that the species is extirpated from the Little Miami River System.

Ptychobranchus fasciolaris (Rafinesque 1820). The kidneyshell was only encountered in the mainstem of the Little Miami River during the current study. Whiteaves (1863) collected this species at Waynesville, Twitchell collected it from the Little Miami River (Mattox, 1953), and Clark (1987) took the species at two sites on the mainstem and two sites on the East Fork of the river. This species comprised 1.57% of the fauna and was taken at six sites in Greene County.

Obliquaria reflexa Rafinesque 1820. The threehorn wartyback has never before been reported from the Little Miami River or its tributaries. During the present study, eight specimens were taken from four sites on the mainstem of the river. This species was restricted to the lower reaches of the Little Miami River and accounted for 0.12% of the bivalve fauna.

Cyprogenia stegaria (Rafinesque 1820). This Federal- and Ohio-endangered species is represented in the Little Miami River fauna by a collection in the Carnegie Museum (Clark, 1987). No other records document this species in the watershed. The species is believed to be extirpated from this

system. The Muskingum and Walhonding rivers may be the only streams in Ohio that still support populations of this rare species.

Actinonaias ligamentina carinata (Barnes 1823). This subspecies is represented in the Carnegie Museum by specimens from the Little Miami River (Clark, 1987). No other records document the mucket in the watershed and it is believed that it is extirpated from the system today.

Obovaria subrotunda (Rafinesque 1820). Whiteaves (1863) took the round hickorynut from the Little Miami River at Waynesville. No other specimens have been taken from the system until this study. These specimens were taken from the Little Miami River and all were weathered or subfossil shells. This species is probably extirpated from the river today.

Truncilla truncata Rafinesque 1820. Whiteaves (1863) took the deertoe at Waynesville, and the Carnegie Museum has specimens from the Little Miami River (Clark, 1987). No other records were found. This species comprised 0.57% of the bivalve fauna found during the present study. Specimens were taken from the mainstem, the East Fork, and from Todds Fork.

Truncilla donaciformis (Lea 1827). The fawnfoot was reported for the mainstem of the Little Miami River by Clark (1987) and from the East Fork by Stein (1974). During the present study, the species was collected from the mainstem, Caesar Creek, Todds Fork, and the East Fork of the Little Miami River. The species comprised 1.39% of the fauna and was taken at 20 sites.

Leptodea leptodon (Rafinesque 1820). The only specimen of the scaleshell from the Little Miami River is from the Twitchell Collection (Mattox, 1953). This species is probably extirpated from the system and may be extirpated from the state.

Leptodea fragilis (Rafinesque 1820). Mattox (1953) reported one specimen of the fragile papershell from the Twitchell Collection. Clark (1987) took three specimens from the Little Miami River and Stein (1974) reported finding this species in the East Fork. The species has become much more abundant in the watershed. During the present study, this species was the second most abundant unionid mollusc encountered and accounted for 7.80% of the bivalve fauna. It was the most abundant species in the mainstem of the river, in Caesar Creek and in Todds Fork. It was found also in the East Fork of the Little Miami River. This species thrives in soft sediments and can become very abundant in silt and sand substrates.

Potamilus ohiensis (Rafinesque 1820). The pink papershell was first reported for the Little Miami River system by Clark (1987) who took one specimen from the mainstem and one specimen from the East Fork of the river. Twenty four specimens were taken during the present study from the mainstem, the East Fork, and Todds Fork. This species was listed as endangered in Ohio, however it has steadily increased its distribution into Ohio and is now common, especially in silt impacted habitats where water quality is

otherwise good. The species is no longer considered endangered in the state.

Potamilus alatus (Say 1817). Twitchell collected this species from the Little Miami River (Mattox, 1953) and Clark (1987) took one specimen from the mainstem and one specimen from the East Fork of the river. Two hundred and eighty specimens were taken during the present study from the mainstem, Caesar Creek, Todds Fork, and the East Fork of the Little Miami River. The pink heelsplitter comprised 4.19% of the fauna and was taken at 32 sites. It was the third most abundant species taken from the mainstem of the river.

Toxolasma parvus (Barnes 1823). This small mussel was taken by Whiteaves (1863) at Waynesville, and by Walter (1972) at Spring Valley. Both sites are on the mainstem of the river. Clark (1987) reported taking one specimen of the lilliput from the mainstem of the river and one specimen from the East Fork. Twenty-four specimens were taken during the present study from the mainstem, Caesar Creek, and from the East Fork. This species was found mostly in headwaters situations and comprised 0.36% of the bivalve fauna.

Toxolasma lividus (Rafinesque 1831). The purple lilliput is designated as endangered in Ohio. One record exists for this species in the Little Miami River (OSUM). The specimen was taken in 1973. This species is probably extirpated from the watershed.

Ligumia recta (Lamarck 1819). Whiteaves (1863) collected the black sandshell from the Little Miami River at Waynesville. Only one subfossil fragment of a valve was taken during the present study and the species is believed to be extirpated from the watershed.

Villosa fabalis (Lea 1831). Whiteaves (1863) took the rayed bean from the Little Miami River at Waynesville. This state-endangered species was found in the mainstem and in the East Fork of the Little Miami River during the present study. Extant populations, including living individuals, were recorded for both streams. Seven specimens were found at five sites.

Villosa iris iris (Lea 1829). Clark (1987) reported finding one specimen of the rainbow in the Little Miami River in Greene County. Seven specimens were found during the present study from the Little Miami River in Greene and Warren counties.

Villosa lienosa (Conrad 1834). Thirty-three specimens of this state endangered species were collected from the East Fork of the Little Miami River above the impoundment. This represents the healthiest population of this species in the state. This is the first time the little spectaclecase has been recorded for this watershed; however the collection at OSUM includes specimens of this species from the East Fork.

Lampsilis radiata luteola (Lamarck 1819). Clark (1987) noted that the fatmucket is the most widely distributed and most numerous member of the bivalve community in the Little Miami River system. This species accounted

for a third of the Unionidae collected by Clark and 21.34% of the bivalve fauna of the present study. Whiteaves (1863) was the first to document this species for the Little Miami River and Mattox (1953) recorded this species from the Twitchell Collection. Walter (1972) took the fatmucket at Spring Valley and Stein (1974) reported finding this species in the East Fork. During the present study, this species was found in each of the five streams sampled. It was the most numerous species in Caesar Creek, Todds Fork, and the East Fork. The species was found at 75 sites with 1425 specimens collected.

Lampsilis ventricosa (Barnes 1823). Whiteaves (1863) collected the plain pocketbook at Waynesville and Mattox (1953) reported this species from the Twitchell Collection. Stein (1974) took the species from the East Fork and Clark (1987) reported taking this mussel from one site on the Little Miami River. Four hundred and eighty specimens were taken during the present study from the mainstem, Caesar Creek, Todds Fork, and the East Fork of the Little Miami River. The species comprised 7.19% of the fauna and was found at 58 sites.

Lampsilis ovata (Say 1817). Whiteaves (1863) reported taking this species from the Little Miami River at Waynesville. This is a big river species that is often confused with *L. ventricosa*. If the pocketbook was correctly identified, then it is no longer found in the watershed.

Lampsilis fasciola Rafinesque 1820. Whiteaves (1863) reported taking the wavy-rayed lampmussel from the Little Miami River at Waynesville. Fifteen specimens were taken during the present study from the mainstem and from the East Fork of the river. The species comprised 0.23% of the bivalve fauna and was found at six sites. No other records of this species were found for the watershed.

Epioblasma triquetra (Rafinesque 1820). This species of Unionidae has only rarely been taken from the Little Miami River system. Whiteaves (1863) took the snuffbox at Waynesville, Walter (1972) took the species at Spring Valley, and Clark took one specimen in Wayne Township, Warren County. During the present study, the species was found at the lowermost site on Caesar Creek and from 10 sites on the mainstem of the river. Eighteen specimens were collected and the species comprised 0.23% of the bivalve fauna.

Epioblasma torulosa torulosa (Rafinesque 1820). Johnson (1978) reported that a specimen in the Harvard Museum of Comparative Zoology came from the Little Miami River. This specimen could be this subspecies or the subspecies generally found in medium to smaller river and streams, *Epioblasma torulosa rangiana*. No evidence of either of these subspecies was found during this study and Clark (1987) noted that no other specimens of either subspecies were reported for the watershed. This species is apparently extirpated from the system.

Corbicula fluminea (Müller 1774). The Asiatic clam has never before been recorded for the watershed. It is not surprising to find it here and in fact the

species probably has been in the watershed for a considerable length of time. It was the second most abundant bivalve mollusc encountered during this study and was found in each of the tributaries as well as the mainstem of the Little Miami River. The species comprised 10.36% of the fauna with 692 specimens collected.

DISCUSSION

The data summarized above demonstrate that the unionid fauna of the Little Miami River system is one of best remaining in the state of Ohio. Not only are there abundant specimens living in the system but a number of rare Ohio species occur here. Still, this fauna is in jeopardy of drastic reduction both in terms of numbers of specimens and species richness. Numerous sites, and sometimes reaches representing a number of stream miles, were devoid of living unionid molluscs. Very old dead shells were all that remained to document the fauna that once occurred there.

The number of extirpated species further highlights the fragile nature of the unionid community in the watershed, and suggests a standard by which we can extrapolate to the larger community of organisms in the Little Miami River and its tributaries. One quarter of the species or subspecies that have been recorded for the watershed have been extirpated. Furthermore, another quarter of the remaining taxa are considered endangered, threatened, or of special interest in Ohio. These data would suggest that the watershed is at a critical junction. Improving water quality and the protection of existing habitats may stabilize the system and reverse the decline while any further degradation will eliminate more species. If the Unionidae are a barometer of the biodiversity of the watershed, then it is important to act now. Improved water quality, like that resulting in the discontinuation of lime sludge dumping by the City of Milford (Partee, 1991), is an important step in the right direction. Similar action should be encouraged throughout the watershed, especially below Xenia and Beaver Creek and within the extreme headwaters of the Little Miami River where the stream is badly degraded.

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APPENDIX. Site specific collection information.

Site — Locality

1 MAH:1990:23 Little Miami River at CR 370 (Huntington Rd.) bridge, 1.9 mi. E of South Charleston, 13.2 mi. SE of Springfield, Madison Twp., Clark Co., Ohio. 12 May 1990. M.A. Hoggarth. No Unionidae found.

2 MAH:1990:24 Little Miami River at SR 41 bridge, 1.3 mi. SSE of South Charleston, 12.8 mi. SE of Springfield, Madison Twp., Clark Co., Ohio. 12 May 1990. M.A. Hoggarth. No Unionidae found.

3 MAH:1990:25 Little Miami River at CR 383 (Jamestown Rd.) bridge, 1.5 mi. S of South Charleston, 12.2 mi. SE of Springfield, Madison Twp., Clark Co., Ohio. 12 May 1990. M.A. Hoggarth.

Strophitus undulatus undulatus	1 weathered

4 MAH:1990:26 Little Miami River at SR 42 bridge, 1.3 mi. SW of South Charleston, 11.5 mi. SE of Springfield, Madison Twp., Clark Co., Ohio. 12 May 1990. M.A. Hoggarth.

Anodontoides ferrusacianus	2 dead, 4 weathered

5 MAH:1990:27 Little Miami River at TR 114 (Clifton Rd.) bridge, 1.1 mi. W of South Charleston, 11.7 mi. SE of Springfield, Madison Twp., Clark Co., Ohio. 12 May 1990. M.A. Hoggarth.

Anodontoides ferrusacianus	1 dead

6 MAH:1990:28 Little Miami River at TR 117 (Dolly Varden Rd.) bridge, 3.2 mi. W of South Charleston, 8.3 mi. SE of Springfield, Madison Twp., Clark Co., Ohio. 12 May 1990. M.A. Hoggarth.

Anodontoides ferrusacianus	3 weathered
Strophitus undulatus undulatus	2 subfossil

7 MAH:1990:101 Little Miami River at CR 351 (Selma Pike) bridge, 2.4 mi. NW of Cartsville, 9.0 mi. SSE of Springfield, Sec. 11, Green Twp., Clark Co., Ohio. 30 July 1990. M.A. Hoggarth.

Anodontoides ferrusacianus	10 live, 2 dead, 1 weathered
Strophitus undulatus undulatus	1 live, 1 dead
Alasmidonta viridis	5 live, 6 dead
Lasmigona compressa	4 live
Toxolasma parvus	1 weathered
Lampsilis radiata luteola	3 live

8 MAH:1990:102 Little Miami River at TR 69 (Garbough Rd.) bridge, 3.5 mi. E of Clifton, 8.9 mi. SSE of Springfield, Sec. 13, Green Twp., Clark Co., Ohio. 30 July 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 weathered
Anodontoides ferrusacianus	6 live, 7 dead
Strophitus undulatus undulatus	1 weathered
Alasmidonta viridis	22 live, 18 dead
Lasmigona compressa	5 live, 1 dead, 2 weathered

Toxolasma parvus	1 weathered, 1 subfossil

9 MAH:1990:107 Little Miami River at CR 335 (Pitchin Rd.) bridge, 2.6 mi. ENE of Clifton, 8.7 mi. SSE of Springfield, Sec. 21, Green Twp., Clark Co., Ohio. 4 August 1990. M.A. Hoggarth.

Anodonta imbecillis	1 dead
Anodontoides ferrusacianus	7 live, 1 weathered
Strophitus undulatus undulatus	5 live, 4 dead
Alasmidonta viridis	19 live, 10 dead
Lasmigona compressa	4 live, 1 weathered
Toxolasma parvus	1 weathered
Lampsilis radiata luteola	3 live

10 MAH:1990:108 Little Miami River at access off of TR 73 (North River Rd.), 0.7 mi. E of Clifton, 9.2 mi. S of Springfield, Miami Twp., Greene Co., Ohio. 4 August 1990. M.A. Hoggarth.

Anodontoides ferrusacianus	2 live
Strophitus undulatus undulatus	2 dead, 2 weathered
Alasmidonta viridis	4 live, 14 dead
Lasmigona compressa	1 weathered
Toxolasma parvus	1 weathered
Lampsilis radiata luteola	1 live, 1 dead

11 MAH:1990:109 Little Miami River at CR 27 (Grinnel Rd.) bridge, 1.8 mi. SSE of Yellow Springs, 7.5 mi. NNE of Xenia, Sec. 13, Miami Twp., Greene Co., Ohio. 4 August 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 live
Strophitus undulatus undulatus	1 live, 1 dead
Alasmidonta viridis	1 live, 1 weathered
Amblema plicata plicata	1 live
Fusconaia flava	1 live
Elliptio dilatata	16 live, 6 dead
Ptychobranchus fasciolaris	4 live, 2 dead
Villosa iris iris	1 weathered
Lampsilis ventricosa	1 dead

11 MAH:1990:112 Little Miami River at CR 27 (Grinnel Rd.) bridge, 1.8 mi. SSE of Yellow Springs, 7.5 mi. NNE of Xenia, Sec. 13, Miami Twp., Greene Co., Ohio. 11 August 1990. M.A. Hoggarth & Susan Bradford.

Anodonta grandis grandis	2 weathered
Strophitus undulatus undulatus	1 subfossil
Alasmidonta viridis	1 live, 4 dead
Quadrula pustulosa pustulosa	1 dead
Amblema plicata plicata	1 live, 1 dead
Fusconaia flava	3 live, 6 dead
Elliptio dilatata	41 live, 11 dead
Ptychobranchus fasciolaris	7 live, 10 dead
Lampsilis radiata luteola	4 live, 4 dead
Lampsilis ventricosa	3 live, 3 dead
Lampsilis fasciola	2 live, 1 dead

12 MAH:1990:113 Little Miami River at TR 82 (Jacoby Rd.) access, 3.1 mi. SW of Yellow Springs, 5.6 mi. NNE of Xenia, Xenia Twp., Greene Co., Ohio. 11 August 1990. M.A. Hoggarth, Susan Bradford & Jacob Brogan.

Anodonta grandis grandis	1 weathered
Strophitus undulatus undulatus	1 dead
Alasmidonta viridis	7 dead
Lasmigona costata	1 dead
Elliptio dilatata	23 live, 6 dead
Ptychobranchus fasciolaris	3 live, 6 dead
Villosa iris iris	1 live, 1 dead
Lampsilis radiata luteola	7 dead
Lampsilis ventricosa	2 live, 2 dead
Lampsilis fasciola	1 live, 2 dead

13 MAH:1990:114 Little Miami River at U.S. Rt. 68 bridge, 4.7 mi. SW of Yellow Springs, 4.4 mi. N of Xenia, Xenia Twp., Greene Co., Ohio. 11 August 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 subfossil
Strophitus undulatus undulatus	1 weathered
Alasmidonta viridis	3 dead
Lasmigona costata	2 live, 1 dead
Amblema plicata plicata	1 dead
Fusconaia flava	19 live, 6 dead
Elliptio dilatata	73 live, 21 dead
Ptychobranchus fasciolaris	49 live, 11 dead
Truncilla donaciformis	1 dead
Villosa iris iris	2 dead
Lampsilis radiata luteola	12 live, 3 dead
Lampsilis ventricosa	2 live
Lampsilis fasciola	2 live, 2 dead

14 MAH:1990:115 Little Miami River at SR 235 bridge, 5.1 mi. SW of Yellow Springs, 3.9 mi. N of Xenia, Xenia Twp., Greene Co., Ohio. 11 August 1990. M.A. Hoggarth.

Alasmidonta viridis	1 live, 2 dead
Lasmigona costata	1 dead
Fusconaia flava	2 live, 1 dead
Elliptio dilatata	17 live, 6 dead, 1 weathered
Ptychobranchus fasciolaris	5 live, 2 dead
Lampsilis radiata luteola	3 live, 5 dead
Lampsilis ventricosa	2 live, 3 dead, 2 weathered
Lampsilis fasciola	1 live, 2 dead

15 MAH:1990:116 Little Miami River at CR 20 (Fairgrounds Rd.) bridge, 3.3 mi. NW of Xenia, 7.0 mi. SW of Yellow Springs, Xenia Twp., Greene Co., Ohio. 12 August 1990. M.A. Hoggarth.

Alasmidonta viridis	2 weathered
Lasmigona compressa	1 live
Fusconaia flava	2 live, 1 weathered
Elliptio dilatata	1 subfossil
Ptychobranchus fasciolaris	5 dead
Lampsilis radiata luteola	7 live, 3 dead
Lampsilis ventricosa	1 live, 3 dead

Lampsilis fasciola	1 dead

16 MAH:1990:117 Little Miami River at U.S. Rt. 35 bridge, 4.1 mi. WNW of Xenia, 9.5 mi. SW of Yellow Springs, Beaver Creek Twp., Greene Co., Ohio. 12 August 1990. M.A. Hoggarth.

Elliptio dilatata	1 weathered
Lampsilis radiata luteola	2 weathered
Lampsilis ventricosa	1 weathered

17 MAH:1990:118 Little Miami River at CR 36 (Indian Ripple Rd.) bridge, 1.3 mi. S of Alpha, 5.1 mi. W of Xenia, Beaver Creek Twp., Greene Co., Ohio. 12 August 1990. M.A. Hoggarth.

Lasmigona complanata	1 live, 1 weathered
Lasmigona costata	1 weathered
Amblema plicata plicata	1 live, 2 weathered
Fusconaia flava	1 weathered
Lampsilis radiata luteola	1 weathered
Lampsilis ventricosa	1 weathered
Epioblasma triquetra	1 dead

18 MAH:1990:125 Little Miami River at CR 86 (Upper Bellbrook Rd.) bridge, 2.2 mi. NE of Bellbrook, 6.3 mi. WSW of Xenia, Sugar Creek Twp., Greene Co., Ohio. 18 August 1990. M.A. Hoggarth.

Anodontoides ferrusacianus	1 dead
Alasmidonta viridis	1 weathered
Lasmigona complanata	1 live
Amblema plicata plicata	1 weathered
Fusconaia flava	1 weathered
Corbicula fluminea	1 weathered

19 MAH:1990:126 Little Miami River at TR 172 (Washington Mills Rd.) bridge, 1.7 mi. NE of Bellbrook, 6.6 mi. WSW of Xenia, Sugar Creek Twp., Greene Co., Ohio. 18 August 1990. M.A. Hoggarth.

Anodontoides ferrusacianus	1 weathered
Alasmidonta viridis	2 weathered
Lampsilis radiata luteola	2 dead

20 MAH:1990:127 Little Miami River at SR 725 bridge, 2.5 mi. W of Spring Valley, 7.7 mi. SW of Xenia, Sugar Creek Twp., Greene Co., Ohio. 18 August 1990. M.A. Hoggarth.

Amblema plicata plicata	1 weathered
Fusconaia flava	1 weathered
Lampsilis radiata luteola	1 weathered

21 MAH:1990:128 Little Miami River at CR 69 (Wilson Rd.) bridge, in Roxanna, 2.1 mi. S of Spring Valley, 8.7 mi. SSW of Xenia, Spring Valley Twp., Greene Co., Ohio. 19 August 1990. M.A. Hoggarth.

Lasmigona complanata	1 dead
Leptodea fragilis	2 weathered
Potamilus alatus	1 weathered
Corbicula fluminea	2 dead

22 MAH:1990:129 Little Miami River at Spring Valley Lake access, 0.8 mi. SE of Mt. Holly, 4.1 mi. NE of Waynesville, Wayne Twp., Warren Co., Ohio. 19 August 1990. M.A. Hoggarth.

Lasmigona complanata	5 weathered
Lasmigona costata	1 subfossil
Quadrula quadrula	1 subfossil
Amblema plicata plicata	3 weathered
Fusconaia flava	2 weathered
Elliptio dilatata	1 subfossil
Pleurobema clava	1 weathered
Lampsilis radiata luteola	1 dead, 3 weathered
Lampsilis ventricosa	4 weathered

23 MAH:1990:130 Little Miami River at CR 251 (Harveysburg Hill Rd.) bridge, in Corwin, 0.5 mi. E of Waynesville, Wayne Twp., Warren Co., Ohio. 20 August 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 weathered
Lasmigona complanata	1 live, 1 dead, 2 weathered
Corbicula fluminea	4 dead

24 MAH:1990:131 Little Miami River at SR 73 bridge, in Waynesville, 4.3 mi. WNW of Harveysburg, Wayne Twp., Warren Co., Ohio. 20 August 1990. M.A. Hoggarth.

Tritogonia verrucosa	1 weathered
Amblema plicata plicata	1 weathered
Leptodea fragilis	4 dead
Potamilus ohiensis	1 dead
Lampsilis radiata luteola	1 weathered

25 MAH:1990:136 Little Miami River at Corwin Covered Bridge, 2.2 mi. S of Waynesville, 4.6 mi. W of Harveysburg, Wayne Twp., Warren Co., Ohio. 1 September 1990. M.A. Hoggarth.

Alasmidonta viridis	1 weathered
Lasmigona costata	1 dead, 1 weathered
Tritogonia verrucosa	1 weathered
Quadrula quadrula	1 dead
Amblema plicata plicata	3 weathered
Fusconaia flava	1 weathered
Elliptio dilatata	1 subfossil
Leptodea fragilis	2 live, 15 dead, 21 weathered
Potamilus ohiensis	2 dead, 1 weathered
Potamilus alatus	2 dead
Obovaria subrotunda	1 weathered
Ligumia recta	1 subfossil
Lampsilis radiata luteola	1 live, 1 weathered
Lampsilis ventricosa	1 dead, 1 weathered
Epioblasma triquetra	1 weathered
Corbicula fluminea	6 dead

26 MAH:1990:139 Little Miami River at the mouth of Caesar Creek, 2.9 mi. S of Waynesville, 5.1 mi. W of Harveysburg, Wayne Twp., Warren Co., Ohio. 2 September 1990. M.A. Hoggarth.

Anodonta imbecillis	1 dead
Anodonta grandis grandis	4 dead
Strophitus undulatus undulatus	1 subfossil
Alasmidonta viridis	1 weathered
Lasmigona complanata	1 dead
Lasmigona costata	1 weathered
Quadrula quadrula	2 dead, 1 weathered
Cyclonaias *tuberculata*	1 subfossil
Fusconaia flava	2 weathered
Elliptio dilatata	1 subfossil
Pleurobema clava	1 subfossil
Ptychobranchus fasciolaris	1 subfossil
Leptodea fragilis	3 live, 28 dead, 8 weathered
Potamilus alatus	1 live, 3 dead, 5 weathered
Obovaria subrotunda	1 subfossil
Lampsilis radiata luteola	4 dead, 1 weathered
Lampsilis ventricosa	1 dead
Epioblasma triquetra	1 weathered
Corbicula fluminea	37 dead

27 MAH:1990:141 Little Miami River at access off of Corwin Rd., 4.0 mi. S of Waynesville, 5.6 mi. SW of Harveysburg, Turtle Creek/Wayne Twp., Warren Co., Ohio. 3 September 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 live
Lasmigona complanata	1 dead
Lasmigona costata	1 live
Tritogonia verrucosa	1 weathered
Quadrula pustulosa pustulosa	1 dead
Quadrula quadrula	2 weathered
Leptodea fragilis	13 dead
Potamilus alatus	5 live, 7 dead
Truncilla donaciformis	1 live
Lampsilis radiata luteola	1 dead
Lampsilis ventricosa	2 weathered
Corbicula fluminea	1 dead

28 MAH:1990:140 Little Miami River at bridge in Oregonia, 5.3 mi. S of Waynesville, 5.8 mi. SW of Harveysburg, Turtle Creek/Washington Twp., Warren Co., Ohio. 2 September 1990. M.A. Hoggarth.

Anodonta grandis grandis	4 live, 1 dead
Lasmigona complanata	2 live, 2 dead
Lasmigona costata	1 dead
Quadrula quadrula	2 dead, 2 weathered
Fusconaia flava	1 weathered
Leptodea fragilis	7 live, 14 dead, 1 weathered
Potamilus ohiensis	1 live
Potamilus alatus	5 live, 1 dead
Truncilla donaciformis	2 dead
Lampsilis radiata luteola	1 weathered
Lampsilis ventricosa	1 weathered
Epioblasma triquetra	1 subfossil
Corbicula fluminea	171 dead

29 MAH:1990:142 Little Miami River at SR 350 bridge, 3.8 mi. N of Morrow, 5.8 mi. E of Lebanon, Turtle Creek/Washington Twp., Warren Co., Ohio. 3 September 1990. M.A. Hoggarth.

Anodonta grandis grandis	2 live, 4 dead
Alasmidonta marginata	1 live, 5 dead
Lasmigona complanata	2 dead
Lasmigona costata	2 dead
Tritogonia verrucosa	1 dead
Quadrula quadrula	2 live, 1 dead
Fusconaia flava	2 dead
Leptodea fragilis	8 dead
Potamilus ohiensis	2 dead
Potamilus alatus	5 live, 7 dead
Truncilla donaciformis	1 dead
Villosa iris iris	1 weathered
Lampsilis radiata luteola	2 live, 1 dead
Lampsilis ventricosa	6 dead
Epioblasma triquetra	2 dead, 3 weathered
Corbicula fluminea	68 dead

30 MAH:1990:145 Little Miami River at access upstream of Senior, 2.6 mi. NE of Morrow, 6.7 mi. ESE of Lebanon, Salem/Washington Twp., Warren Co., Ohio. 8 September 1990. M.A. Hoggarth.

Anodonta grandis grandis	2 live, 1 weathered
Alasmidonta marginata	2 dead, 5 weathered
Lasmigona complanata	1 dead, 1 weathered
Lasmigona costata	2 dead
Tritogonia verrucosa	1 live
Quadrula quadrula	2 live, 2 weathered
Amblema plicata plicata	1 live
Fusconaia flava	1 weathered, 1 subfossil
Leptodea fragilis	2 live, 9 dead, 7 weathered
Potamilus ohiensis	1 weathered
Potamilus alatus	1 live, 2 dead, 2 weathered
Truncilla truncata	1 live
Truncilla donaciformis	7 live, 2 weathered
Lampsilis radiata luteola	1 live, 2 dead
Lampsilis ventricosa	1 live, 2 dead
Epioblasma triquetra	1 weathered
Corbicula fluminea	1 dead

31 MAH:1990:146 Little Miami River at SR 123 bridge, in Morrow, 1.2 mi. W of Roachester, 6.8 mi. SE of Lebanon, Salem Twp., Warren Co., Ohio. 8 September 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 live, 8 dead
Alasmidonta marginata	2 live, 2 dead, 1 weathered
Lasmigona complanata	10 live, 2 dead, 2 weathered
Lasmigona costata	5 live, 7 dead, 2 weathered
Tritogonia verrucosa	2 live, 1 dead
Quadrula quadrula	6 live, 1 weathered
Leptodea fragilis	2 live, 4 dead, 3 weathered

Potamilus ohiensis	1 weathered
Potamilus alatus	6 live, 3 weathered
Villosa fabalis	1 live kept
Lampsilis radiata luteola	10 live, 5 dead, 3 weathered
Lampsilis ventricosa	8 live, 2 dead, 1 weathered

32 MAH:1990:167 Little Miami River at CR 35 (Stubbs Mill Rd.) bridge, 2.2 mi. E of South Lebanon, 2.5 mi. W of Morrow, Union/Hamilton Twp., Warren Co., Ohio. 29 September 1990. M.A. Hoggarth.

Anodonta *suborbiculata*	1 dead
Anodonta grandis grandis	1 live, 2 dead, 2 weathered
Alasmidonta viridis	1 dead
Alasmidonta marginata	1 live, 1 dead, 1 weathered
Lasmigona complanata	2 dead
Lasmigona costata	2 dead, 3 weathered
Tritogonia verrucosa	2 dead
Amblema plicata plicata	1 dead, 1 weathered
Fusconaia flava	1 weathered
Leptodea fragilis	1 live, 1 dead, 1 weathered
Potamilus ohiensis	2 dead, 1 weathered
Potamilus alatus	5 dead
Truncilla donaciformis	1 dead
Lampsilis radiata luteola	1 live, 1 dead
Lampsilis ventricosa	3 live, 2 dead, 1 weathered
Epioblasma triquetra	2 dead
Corbicula fluminea	2 dead

33 MAH:1990:168 Little Miami River at access 1.4 mi. E of South Lebanon, 3.1 mi. W of Morrow, Union/Hamilton Twp., Warren Co., Ohio. 29 September 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 weathered
Alasmidonta viridis	1 dead
Alasmidonta marginata	1 weathered
Lasmigona complanata	7 live
Lasmigona costata	2 live, 2 dead, 1 weathered
Lasmigona compressa	1 weathered
Tritogonia verrucosa	12 live, 2 weathered
Quadrula quadrula	1 live, 2 dead
Amblema plicata plicata	5 live
Fusconaia flava	8 live, 1 dead, 5 weathered
Leptodea fragilis	3 live, 3 dead, 2 weathered
Potamilus ohiensis	1 live
Potamilus alatus	8 live, 4 dead, 1 weathered
Lampsilis radiata luteola	3 live
Lampsilis ventricosa	9 live, 1 dead

34 MAH:1990:169 Little Miami River between bridge in South Lebanon and SR 48 bridge, 5.0 mi. W of Morrow, Union/Hamilton Twp., Warren Co., Ohio. 29 September 1990. M.A. Hoggarth.

Alasmidonta marginata	2 dead, 3 weathered
Lasmigona complanata	3 dead
Lasmigona costata	1 dead

Tritogonia verrucosa	3 live, 1 dead
Quadrula quadrula	2 weathered
Fusconaia flava	1 dead
Leptodea fragilis	2 dead, 1 weathered
Potamilus ohiensis	1 weathered
Potamilus alatus	1 dead, 1 weathered
Truncilla donaciformis	1 weathered
Lampsilis ventricosa	1 weathered
Epioblasma triquetra	1 dead

35 MAH:1990:173 Little Miami River from broken dam at Middletown Junction to below SR 150 (Grandin Rd.) bridge, 0.5 mi. SE of Kings Mills, 2.0 mi. SW of South Lebanon, Deer Field/Hamilton Twp., Warren Co., Ohio. 1 October 1990. M.A. Hoggarth.

Anodonta *suborbiculata*	1 dead
Anodonta grandis grandis	3 dead, 3 weathered
Alasmidonta marginata	5 dead
Lasmigona costata	1 dead, 2 weathered
Quadrula quadrula	3 dead, 1 weathered
Leptodea fragilis	2 dead
Potamilus ohiensis	1 dead
Potamilus alatus	3 dead, 1 weathered
Lampsilis ventricosa	2 dead

36 MAH:1990:174 Little Miami River at U.S. Rt. 22/SR 3 bridge, 1.7 mi. W of Maineville, 3.9 mi. SSW of South Lebanon, Deer Field/Hamilton Twp., Warren Co., Ohio. 1 October 1990. M.A. Hoggarth.

Anodonta grandis grandis	3 dead, 1 weathered
Alasmidonta marginata	2 dead
Lasmigona complanata	5 dead, 1 weathered
Lasmigona costata	1 dead
Tritogonia verrucosa	1 weathered
Quadrula quadrula	8 dead, 2 weathered
Leptodea fragilis	2 live, 2 weathered
Potamilus ohiensis	1 dead
Potamilus alatus	3 dead, 2 weathered
Truncilla truncata	2 dead
Truncilla donaciformis	1 dead
Lampsilis radiata luteola	2 dead, 1 weathered
Lampsilis ventricosa	1 live, 6 dead
Epioblasma triquetra	2 weathered

37 MAH:1991:22 Little Miami River at SR 48 bridge in Loveland, Symmes/Miami Twp., Hamilton/Clermont Co., Ohio. 20 July 1991. M.A. Hoggarth.

Anodonta imbecillis	1 dead
Anodonta grandis grandis	5 live, 6 dead, 3 weathered
Alasmidonta marginata	2 live, 7 dead, 2 weathered
Lasmigona complanata	7 live, 6 dead, 1 weathered
Lasmigona costata	2 live, 5 dead
Tritogonia verrucosa	1 dead, 1 weathered
Quadrula quadrula	12 live, 44 dead
Quadrula nodulata	1 live kept, 2 dead, 2 weathered

Amblema plicata plicata	6 dead
Fusconaia flava	3 live (1 kept), 4 dead, 3 weathered
Leptodea fragilis	1 live, 9 dead
Potamilus alatus	10 live, 8 dead
O. reflexa	5 dead
Truncilla truncata	1 live, 8 dead
Truncilla donaciformis	23 dead
Lampsilis radiata luteola	3 live, 2 dead
Lampsilis ventricosa	2 live, 1 dead
Epioblasma triquetra	2 dead

38 MAH:1991:23 Little Miami River at Lake Isabella access, 0.8 mi. SSW of Branch Hill, 3.2 mi. SW of Loveland, Symmes/Miami Twp., Hamilton/Clermont Co., Ohio. 21 July 1991. M.A. Hoggarth.

Anodonta grandis grandis	2 live, 4 dead, 1 weathered
Alasmidonta marginata	5 dead, 1 weathered
Lasmigona complanata	2 dead
Lasmigona costata	4 dead
Quadrula quadrula	1 live, 3 dead, 2 weathered
Quadrula pustulosa pustulosa	1 weathered
Amblema plicata plicata	1 dead, 1 weathered
Leptodea fragilis	9 dead
Potamilus alatus	5 dead, 1 weathered
Obliquaria *reflexa*	1 dead
Truncilla truncata	1 live, 16 dead
Truncilla donaciformis	16 dead
Lampsilis radiata luteola	1 dead

39 MAH:1991:24 Little Miami River at Remington Rd. bridge, 0.3 mi. E of Remington, 4.2 mi. SW of Loveland, Symmes/Miami Twp., Hamilton/Clermont Co., Ohio. 21 July 1991. M.A. Hoggarth.

Anodonta grandis grandis	2 weathered
Alasmidonta marginata	4 weathered
Lasmigona complanata	1 dead, 1 weathered
Lasmigona costata	3 dead, 1 weathered
Quadrula quadrula	3 dead
Leptodea fragilis	8 dead, 2 weathered
Potamilus alatus	11 dead
Obliquaria *reflexa*	1 dead
Truncilla truncata	2 dead
Truncilla donaciformis	3 dead

40 MAH:1991:25 Little Miami River at Camargo Rd. bridge, 0.6 mi. W of Miamiville, 4.8 mi. SW of Loveland, Symmes/Miami Twp., Hamilton/Clermont Co., Ohio. 22 July 1991. M.A. Hoggarth.

Anodonta grandis grandis	4 live, 1 dead, 1 weathered
Lasmigona complanata	2 dead
Leptodea fragilis	2 dead
Potamilus alatus	5 dead, 1 weathered
Lampsilis ventricosa	1 dead

41 MAH:1991:26 Little Miami River at SR 126 bridge, 0.4 mi. SE of Miamiville, 4.2 mi. SSW of Loveland, Symmes/Miami Twp., Hamilton/Clermont Co., Ohio. 22 July 1991. M.A. Hoggarth.

Anodonta grandis grandis	4 live, 3 dead, 2 weathered
Lasmigona complanata	4 live, 2 dead, 3 weathered
Lasmigona costata	3 live, 1 dead
Quadrula quadrula	1 weathered
Leptodea fragilis	1 live, 5 dead, 4 weathered
Potamilus alatus	10 live, 2 dead
Truncilla donaciformis	1 live
Lampsilis radiata luteola	3 live, 1 weathered
Lampsilis ventricosa	1 live, 1 weathered

42 MAH:1991:29 Little Miami River at SR 28/U.S. Rt. 50 bridge in Milford, 0.8 mi. NE of Terrace Park, Columbiana/Miami Twp., Hamilton/Clermont Co., Ohio. 3 August 1991. M.A. Hoggarth.

Anodonta grandis grandis	1 live, 9 dead
Alasmidonta marginata	4 dead
Lasmigona complanata	1 live, 2 dead
Lasmigona costata	2 dead
Quadrula quadrula	1 dead
Leptodea fragilis	2 live, 11 dead
Potamilus ohiensis	1 dead
Potamilus alatus	2 live, 9 dead
Truncilla truncata	1 dead
Lampsilis radiata luteola	1 dead

43 MAH:1991:30 Little Miami River at Newtown Rd. bridge (Bass Island access) to the mouth of the East Fork, 0.8 mi. NNE of Newtown, Columbiana/Anderson Twp., Hamilton/Clermont Co., Ohio. 5 August 1991. M.A. Hoggarth.

Anodonta imbecillis	1 dead
Anodonta *suborbiculata*	1 dead
Anodonta grandis grandis	2 live, 3 dead
Lasmigona complanata	13 live, 4 dead
Lasmigona costata	1 dead
Quadrula quadrula	2 weathered
Leptodea fragilis	3 live, 8 dead
Potamilus ohiensis	2 dead
Potamilus alatus	3 live, 2 dead
Obliquaria *reflexa*	1 weathered
Truncilla truncata	1 weathered
Truncilla donaciformis	2 weathered

44 MAH:1991:31 Little Miami River at Newtown Rd. bridge (Bass Island access) to SR 125/32 bridge, 0.8 mi. NNE of Newtown, Columbiana/Anderson Twp., Hamilton/Clermont Co., Ohio. 11 August 1991. M.A. Hoggarth, K.L. Cook-Hoggarth and Mark Hoggarth.

Lasmigona complanata	1 live
Amblema plicata plicata	1 live
Quadrula nodulata	1 live
Lampsilis ventricosa	1 live

45 MAH:1991:32 Little Miami River from SR 125/32 bridge to U.S. Rt. 52 bridge in Cincinnati, Hamilton/Clermont Co., Ohio. 11 August 1991. M.A. Hoggarth, K.L. Cook-Hoggarth and Mark Hoggarth. No Unionidae found.

46 MAH:1991:33 Little Miami River from U.S. Rt. 52 bridge to its mouth in Cincinnati, Hamilton/Clermont Co., Ohio. 11 August 1991. M.A. Hoggarth, K.L. Cook-Hoggarth and Mark Hoggarth. No Unionidae found.

47 MAH:1990:93 North Fork Little Miami River at TR 96 (Newlove Rd.) bridge, 2.3 mi. NW of Lisbon, 8.1 mi. ESE of Springfield, Sec. 26, Harmony Twp., Clark Co., Ohio. 29 July 1990. M.A. Hoggarth.

Anodontoides ferrusacianus	2 dead, 1 weathered

48 MAH:1990:40 North Fork Little Miami River at SR 41 bridge, in Thorps, 6.1 mi. ESE of Springfield, Sec. 2, Springfield Twp., Clark Co., Ohio. 26 May 1990. M.A. Hoggarth.

Lasmigona compressa	1 dead

48 MAH:1990:94 North Fork Little Miami River at SR 41 bridge, in Thorps, 6.1 mi. ESE of Springfield, Sec. 2, Springfield Twp., Clark Co., Ohio. 29 July 1990. M.A. Hoggarth.

Anodonta imbecillis	1 live
Anodontoides ferrusacianus	1 live, 2 dead
Alasmidonta viridis	6 dead
Lampsilis radiata luteola	1 dead

49 MAH:1990:95 North Fork Little Miami River at TR 230 (Ridge Rd.) bridge, 1.0 mi. W of Thorps, 5.4 mi. SE of Springfield, Sec. 2/8, Springfield Twp., Clark Co., Ohio. 29 July 1990. M.A. Hoggarth.

Anodontoides ferrusacianus	2 live, 1 dead
Alasmidonta viridis	2 live, 1 dead
Lasmigona compressa	1 dead, 2 weathered
Lampsilis radiata luteola	6 live

50 MAH:1990:96 North Fork Little Miami River at TR 225 (Mitchell Rd.) bridge, 1.8 mi. W of Thorps, 5.1 mi. SE of Springfield, Sec. 7/8, Springfield Twp., Clark Co., Ohio. 29 July 1990. M.A. Hoggarth.

Anodontoides ferrusacianus	2 dead
Strophitus undulatus undulatus	2 dead
Alasmidonta viridis	11 dead
Lasmigona compressa	1 weathered
Lampsilis radiata luteola	7 dead

51 MAH:1990:97 North Fork Little Miami River at TR 218 (Crabill Rd.) bridge, 1.2 mi. S of Locustgrove, 5.1 mi. SE of Springfield, Sec. 13, Springfield Twp., Clark Co., Ohio. 29 July 1990. M.A. Hoggarth.

Anodonta imbecillis	3 dead
Anodonta grandis grandis	1 live
Anodontoides ferrusacianus	3 dead
Strophitus undulatus undulatus	1 dead
Alasmidonta viridis	1 dead

52 MAH:1990:98 North Fork Little Miami River at CR 351 (Selma Pike) bridge, 0.6 mi. NW of Pitchin, 6.0 mi. SSE of Springfield, Sec. 24, Green Twp., Clark Co., Ohio. 30 July 1990. M.A. Hoggarth. No Unionidae found.

53 MAH:1990:99 North Fork Little Miami River at CR 28 (Jackson Rd.) bridge, 1.3 mi. S of Pitchin, 7.5 mi. SSE of Springfield, Sec. 24, Green Twp., Clark Co., Ohio. 30 July 1990. M.A. Hoggarth.

Anodontoides ferrusacianus	1 weathered
Strophitus undulatus undulatus	1 subfossil
Alasmidonta viridis	1 live, 1 weathered
Lasmigona compressa	1 weathered
Corbicula fluminea	1 dead

54 MAH:1990:100 North Fork Little Miami River at TR 73 (North River Rd.) bridge, 2.3 mi. ENE of Clifton, 8.3 mi. SSE of Springfield, Sec. 21, Green Twp., Clark Co., Ohio. 30 July 1990. M.A. Hoggarth.

Corbicula fluminea	25 live

55 MAH:1990:154 Caesar Creek at SR 72 bridge, in Jamestown, 10.5 mi. E of Xenia, Silver Creek Twp., Greene Co., Ohio. 22 September 1990. M.A. Hoggarth.

Anodontoides ferrusacianus	1 dead, 4 weathered
Alasmidonta viridis	5 dead, 6 weathered

56 MAH:1990:155 Caesar Creek at U.S. Rt. 35 bridge, 1.2 mi. W of Jamestown, 9.4 mi. E of Xenia, Silver Creek Twp., Greene Co., Ohio. 22 September 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 dead
Anodontoides ferrusacianus	2 dead
Strophitus undulatus undulatus	1 dead, 5 weathered
Alasmidonta viridis	1 dead, 1 weathered
Toxolasma parvus	1 dead, 3 weathered

57 MAH:1990:156 Caesar Creek at CR 39 (Plymouth - New Jasper Rd.) bridge, 3.4 mi. WSW of Jamestown, 7.7 mi. ESE of Xenia, New Jasper Twp., Greene Co., Ohio. 22 September 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 weathered
Alasmidonta viridis	3 dead, 1 weathered
Toxolasma parvus	2 dead, 6 weathered
Lampsilis radiata luteola	14 live, 2 dead, 9 weathered
Lampsilis ventricosa	3 weathered

58 MAH:1990:157 Caesar Creek at CR 58 (New Jasper - Paintersville Rd.) bridge, 4.5 mi. WSW of Jamestown, 6.5 mi. ESE of Xenia, New Jasper Twp., Greene Co., Ohio. 22 September 1990. M.A. Hoggarth.

Anodonta grandis grandis	3 dead
Anodontoides ferrusacianus	1 weathered
Strophitus undulatus undulatus	3 weathered
Alasmidonta viridis	1 dead
Lampsilis radiata luteola	3 live, 2 dead, 6 weathered

59 MAH:1990:159 Caesar Creek at TR 99 (Long Rd.) bridge, 5.7 mi. WSW of Cedarville, 5.2 mi. SE of Xenia, New Jasper Twp., Greene Co., Ohio. 22 September 1990. M.A. Hoggarth.

Strophitus undulatus undulatus	1 weathered
Alasmidonta viridis	1 dead
Lampsilis radiata luteola	1 dead, 4 weathered
Lampsilis ventricosa	2 weathered

60 MAH:1990:158 North Fork Caesar Creek at confluence with Caesar Creek, 5.8 mi. WSW of Jamestown, 5.2 mi. SE of Xenia, New Jasper Twp., Greene Co., Ohio. 22 September 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 subfossil
Anodontoides ferrusacianus	1 weathered
Alasmidonta viridis	3 weathered
Lampsilis radiata luteola	1 dead, 3 weathered

61 MAH:1990:160 Caesar Creek at CR 32 (Hoop Rd.) bridge, 6.1 mi. SW of Jamestown, 5.2 mi. SE of Xenia, New Jasper Twp., Greene Co., Ohio. 24 September 1990. M.A. Hoggarth.

Lampsilis radiata luteola	1 live, 1 dead, 1 weathered
Lampsilis ventricosa	1 weathered

62 MAH:1990:161 Caesar Creek at TR 157 (Stone Rd.) bridge, 4.8 mi. SE of Xenia, 7.6 mi. WSW of Jamestown, New Jasper Twp., Greene Co., Ohio. 24 September 1990. M.A. Hoggarth.

Anodontoides ferrusacianus	1 dead, 1 weathered
Strophitus undulatus undulatus	1 dead, 1 weathered
Alasmidonta viridis	1 dead
Lampsilis radiata luteola	1 dead

63 MAH:1990:162 Caesar Creek at U.S. Rt. 68 bridge, 4.7 mi. SSE of Xenia, 6.1 mi. E of Spring Valley, Xenia/Caesar Creek Twp., Greene Co., Ohio. 24 September 1990. M.A. Hoggarth.

Anodontoides ferrusacianus	1 dead, 1 weathered
Strophitus undulatus undulatus	1 weathered
Alasmidonta viridis	1 weathered
Lasmigona costata	1 dead
Lampsilis radiata luteola	2 dead
Lampsilis ventricosa	1 live, 1 dead

64 MAH:1990:163 Caesar Creek at CR 98 (Winchester Rd.) bridge, 4.5 mi. SSE of Xenia, 5.5 mi. E of Spring Valley, Xenia/Caesar Creek Twp., Greene Co., Ohio. 24 September 1990. M.A. Hoggarth.

Anodontoides ferrusacianus	2 dead
Strophitus undulatus undulatus	1 dead
Lampsilis radiata luteola	2 weathered
Lampsilis ventricosa	1 dead, 2 weathered

65 MAH:1990:170 Caesar Creek at TR 70 (Henville Rd.) bridge, 4.7 mi. S of Xenia, 4.6 mi. E of Spring Valley, Xenia/Caesar Creek Twp., Greene Co., Ohio. 30 September 1990. M.A. Hoggarth.

Lampsilis radiata luteola	1 weathered
Lampsilis ventricosa	1 weathered

66 MAH:1990:171 Caesar Creek at CR 3 (Anderson Rd.) bridge, 4.0 mi. E of Spring Valley, 4.4 mi. S of Xenia, Spring Valley Twp., Greene Co., Ohio. 30 September 1990. M.A. Hoggarth.

Anodontoides ferrusacianus	3 dead
Strophitus undulatus undulatus	1 subfossil
Lampsilis radiata luteola	1 weathered
Lampsilis ventricosa	1 dead, 2 weathered

67 MAH:1990:143 Caesar Creek at SR 380 bridge, 3.0 mi. E of Spring Valley, 5.0 mi. S of Xenia, Spring Valley Twp., Greene Co., Ohio. 4 September 1990. M. A. Hoggarth.

Strophitus undulatus undulatus	1 dead
Lasmigona complanata	1 weathered
Lampsilis radiata luteola	3 weathered
Lampsilis ventricosa	1 weathered

68 MAH:1990:172 Caesar Creek at CR 75 (Spring Valley - Paintersville Rd.) bridge, 2.3 mi. E of Spring Valley, 6.1 mi. SSW of Xenia, Spring Valley Twp., Greene Co., Ohio. 30 September 1990. M.A. Hoggarth.

Strophitus undulatus undulatus	1 weathered
Alasmidonta viridis	1 weathered
Lampsilis radiata luteola	1 weathered
Lampsilis ventricosa	1 weathered
Corbicula fluminea	1 dead

69 MAH:1990:138 Caesar Creek downstream of dam at Caesar Creek Impoundment, 3.0 mi. SW of Harveysburg, 3.4 mi. SSE of Waynesville, Wayne Twp., Warren Co., Ohio. 1 September 1990. M.A. Hoggarth.

Anodonta imbecillis	15 live, 2 dead
Anodonta grandis grandis	50 live, 3 dead, 1 weathered
Strophitus undulatus undulatus	7 live, 2 weathered
Alasmidonta viridis	1 dead, 4 weathered
Alasmidonta marginata	1 live, 1 dead
Lasmigona complanata	1 live, 1 dead
Lasmigona costata	7 live, 3 dead, 1 weathered
Quadrula quadrula	1 weathered
Leptodea fragilis	50 live, 4 dead, 5 weathered
Lampsilis radiata luteola	100 live, 8 dead, 3 weathered
Lampsilis ventricosa	50 live, 1 dead, 1 weathered
Corbicula fluminea	100 live, 4 dead

70 MAH:1990:132 Caesar Creek at CR 47 (Corwin Rd.) bridge, 2.5 mi. S of Waynesville, 4.7 mi. WSW of Harveysburg, Wayne Twp., Warren Co., Ohio. 20 August 1990. M.A. Hoggarth.

Anodonta imbecillis	1 dead
Anodonta grandis grandis	1 live, 7 weathered
Strophitus undulatus undulatus	1 live, 4 weathered
Alasmidonta viridis	1 live, 2 dead

Alasmidonta marginata	3 live, 3 dead, 7 weathered
Lasmigona complanata	6 live
Lasmigona costata	12 live, 2 dead, 2 weathered
Tritogonia verrucosa	3 live, 1 weathered
Quadrula quadrula	7 live, 2 weathered
Fusconaia flava	4 live, 1 weathered
Leptodea fragilis	47 live, 7 dead, 15 weathered
Potamilus alatus	13 live
Truncilla donaciformis	3 live, 2 dead, 3 weathered
Toxolasma parvus	1 weathered
Lampsilis radiata luteola	62 live, 5 dead, 9 weathered
Lampsilis ventricosa	59 live, 3 dead, 4 weathered
Epioblasma triquetra	1 weathered
Corbicula fluminea	11 dead

70 MAH:1990:137 Caesar Creek at CR 47 (Corwin Rd.) bridge, 2.5 mi. S of Waynesville, 4.7 mi. WSW of Harveysburg, Wayne Twp., Warren Co., Ohio. 1 September 1990. M.A. Hoggarth.

Anodonta imbecillis	2 live, 1 dead
Anodonta grandis grandis	20 live, 1 weathered
Strophitus undulatus undulatus	1 dead, 1 weathered
Alasmidonta viridis	1 dead, 1 weathered
Alasmidonta marginata	1 dead
Lasmigona complanata	3 live, 2 dead, 4 weathered
Lasmigona costata	3 weathered
Quadrula quadrula	3 live, 4 weathered
Fusconaia flava	2 live, 4 dead
Pleurobema *sintoxia*	1 dead
Leptodea fragilis	12 live, 11 dead, 9 weathered
Potamilus alatus	1 weathered
Toxolasma parvus	1 weathered
Lampsilis radiata luteola	22 live, 12 dead, 4 weathered
Lampsilis ventricosa	5 live, 1 dead, 3 weathered
Corbicula fluminea	13 dead

71 MAH:1990:181 Todds Fork Little Miami River at SR 3/ U.S. Rt. 22 bridge, 3.3 mi. NE of Clarksville, 6.5 mi. ENE of Wilmington, Adams Twp., Clinton Co., Ohio. 8 October 1990. M.A. Hoggarth.

Lampsilis radiata luteola	1 weathered

72 MAH:1990:182 Todds Fork Little Miami River at SR 132 bridge, 1.5 mi. NE of Clarksville, 7.5 mi. SW of Wilmington, Vernon Twp., Clinton Co., Ohio. 8 October 1990. M.A. Hoggarth.

Anodonta grandis *g grandis*	3 dead
Alasmidonta viridis	9 dead, 6 weathered
Lampsilis radiata luteola	2 dead, 14 weathered
Lampsilis ventricosa	1 dead, 1 weathered
Corbicula fluminea	5 dead

73 MAH:1990:180 Todds Fork Little Miami River at CR 40 (George Rd.) bridge, 0.5 mi. NE of Clarksville, 8.4 mi. WSW of Wilmington, Vernon Twp., Clinton Co., Ohio. 8 October 1990. M.A. Hoggarth.

Alasmidonta viridis	1 weathered
Leptodea fragilis	2 dead

74 MAH:1990:179 Todds Fork Little Miami River at TR 210 (Gum Grove Rd.) bridge, 2.3 mi. SW of Clarksville, 6.2 mi. NE of Morrow, Washington Twp., Warren Co., Ohio. 8 October 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 dead, 1 weathered
Anodontoides ferrusacianus	1 dead
Alasmidonta viridis	2 dead
Lasmigona complanata	1 dead, 2 weathered
Leptodea fragilis	1 live, 5 dead, 2 weathered
Potamilus alatus	1 weathered
Lampsilis radiata luteola	4 dead, 11 weathered
Lampsilis ventricosa	2 dead, 2 weathered
Corbicula fluminea	2 dead

75 MAH:1990:178 Todds Fork Little Miami River at CR 45 (Middleboro Rd.) bridge, 1.1 mi. NW of Middleboro, 3.5 mi. E of Morrow, Salem/Harlan Twp., Warren Co., Ohio. 7 October 1990. M.A. Hoggarth.

Anodonta grandis grandis	4 dead, 2 weathered
Anodontoides ferrusacianus	2 dead
Strophitus undulatus undulatus	1 dead
Alasmidonta viridis	2 weathered
Alasmidonta marginata	2 weathered
Lasmigona costata	2 weathered
Leptodea fragilis	12 dead, 3 weathered
Potamilus ohiensis	1 dead
Potamilus alatus	1 dead
Truncilla donaciformis	1 dead
Lampsilis radiata luteola	3 dead, 3 weathered
Lampsilis ventricosa	1 dead, 1 weathered

76 MAH:1990:177 Todds Fork Little Miami River at SR 123 bridge, 1.6 mi. SSE of Roachester, 2.8 mi. SE of Morrow, Salem/Harlan Twp., Warren Co., Ohio. 7 October 1990. M.A. Hoggarth.

Anodonta grandis grandis	5 weathered
Alasmidonta viridis	1 weathered
Lasmigona complanata	1 weathered
Lasmigona costata	1 weathered
Quadrula quadrula	1 weathered
Leptodea fragilis	1 live, 6 dead, 3 weathered
Potamilus ohiensis	1 dead, 1 weathered
Potamilus alatus	1 live, 2 dead, 2 weathered
Truncilla truncata	1 dead
Lampsilis radiata luteola	8 weathered
Lampsilis ventricosa	1 dead

77 MAH:1990:148 Todds Fork Little Miami River at CR 40 (Blackhawk Rd.) bridge, 1.0 mi. SW of Roachester, 1.2 mi. SE of Morrow, Salem Twp., Warren Co., Ohio. 10 September 1990. M.A. Hoggarth.

Anodonta imbecillis	1 live
Anodonta grandis grandis	5 live, 1 dead, 7 weathered

Strophitus undulatus undulatus	1 weathered
Alasmidonta viridis	8 dead, 1 weathered
Alasmidonta marginata	1 live, 1 weathered
Lasmigona complanata	2 weathered
Lasmigona costata	1 live, 2 dead, 1 weathered
Leptodea fragilis	7 live, 8 dead, 2 weathered
Potamilus ohiensis	1 weathered
Potamilus alatus	13 live, 4 dead
Truncilla truncata	1 dead
Truncilla donaciformis	1 dead, 1 weathered
Lampsilis radiata luteola	29 live, 14 dead
Lampsilis ventricosa	16 live, 5 dead

78 MAH:1990:147 Todds Fork Little Miami River at SR 3/U.S. Rt. 22 bridge, in Morrow, 1.5 mi. SE of Roachester, 6.8 mi. SE of Lebanon, Salem Twp., Warren Co., Ohio. 10 September 1990. M.A. Hoggarth.

Anodonta grandis grandis	9 dead, 1 weathered
Anodontoides ferrusacianus	1 weathered
Strophitus undulatus undulatus	3 live
Alasmidonta viridis	5 live, 1 dead, 5 weathered
Alasmidonta marginata	2 live, 2 dead
Lasmigona complanata	1 subfossil
Lasmigona costata	1 live, 1 dead, 1 weathered
Quadrula quadrula	1 live
Leptodea fragilis	19 live, 6 dead, 2 weathered
Potamilus alatus	8 live, 2 dead
Truncilla truncata	1 weathered
Truncilla donaciformis	1 live, 1 dead
Lampsilis radiata luteola	40 live, 12 dead
Lampsilis ventricosa	15 live
Corbicula fluminea	3 dead

79 MAH:1990:51 Unnamed tributary of the East Fork of Little Miami River at SR 73 bridge, 2.0 mi. NW of New Vienna, 8.9 mi. SE of Wilmington, Green Twp., Clinton Co., Ohio. 16 June 1990. M.A. Hoggarth.

Anodontoides ferrusacianus	4 dead

80 MAH:1990:52 East Fork Little Miami River at TR 139 bridge, 1.9 mi. NW of New Vienna, 8.5 mi. SE of Wilmington, Green Twp., Clinton Co., Ohio. 16 June 1990. M.A. Hoggarth. No Unionidae found.

81 MAH:1990:53 East Fork Little Miami River at SR 28 bridge, 2.7 mi. W of New Vienna, 3.8 mi. E of Martinsville, Green Twp., Clinton Co., Ohio. 16 June 1990. M.A. Hoggarth.

Anodontoides ferrusacianus	4 live, 7 dead
Alasmidonta viridis	1 dead
Lampsilis radiata luteola	4 live, 6 dead

82 MAH:1990:54 East Fork Little Miami River at TR 272 (Layman Rd.) bridge, 3.1 mi. ESE of Martinsville, 3.3 mi. WSW of New Vienna, Clark Twp., Clinton Co., Ohio. 16 June 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 dead

Anodontoides ferrusacianus	12 dead
Alasmidonta viridis	3 dead
Lampsilis radiata luteola	2 live, 43 dead

83 MAH:1990:55 East Fork Little Miami River at West Chapel Cemetery, 4.2 mi. SW of New Vienna, 3.1 mi. SE of Martinsville, Clark Twp., Clinton Co., Ohio. 18 June 1990. M.A. Hoggarth.

Anodontoides ferrusacianus	2 live, 4 dead, 2 weathered
Lampsilis radiata luteola	1 live, 2 dead, 12 weathered

84 MAH:1990:56 East Fork Little Miami River at SR 134 bridge, 3.2 mi. SE of Martinsville, 4.8 mi. SW of New Vienna, Clark Twp., Clinton Co., Ohio. 18 June 1990. M.A. Hoggarth.

Anodontoides ferrusacianus	2 live, 6 dead, 3 weathered
Strophitus undulatus undulatus	13 dead, 6 weathered
Alasmidonta viridis	6 weathered
Toxolasma parvus	2 live, 1 weathered
Lampsilis radiata luteola	2 live, 4 dead, 25 weathered

85 MAH:1990:57 East Fork Little Miami River at CR 47 (Canada Rd.) bridge, 2.9 mi. NNE of Lynchburg, 3.9 mi. SE of Martinsville, Clark Twp., Clinton Co., Ohio. 18 June 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 weathered
Anodontoides ferrusacianus	1 live, 2 dead, 1 weathered
Strophitus undulatus undulatus	1 dead, 3 weathered
Alasmidonta viridis	1 weathered
Lampsilis radiata luteola	10 live, 6 dead, 10 weathered

86 MAH:1990:63 East Fork Little Miami River at bridge 0.2 mi. SW of Lynchburg, 6.7 mi. SE of Westboro, Clark/Dodson Twp., Clinton/Highland Co., Ohio. 23 June 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 dead, 7 weathered
Anodontoides ferrusacianus	1 dead, 3 weathered
Strophitus undulatus undulatus	1 live, 4 dead, 1 weathered
Alasmidonta viridis	2 dead, 10 weathered
Toxolasma parvus	1 weathered
Lampsilis radiata luteola	2 live, 7 dead, 10 weathered

87 MAH:1990:64 East Fork Little Miami River at CR 29 (Wise Rd.) bridge, 1.6 mi. SW of Lynchburg, 5.8 mi. SE of Westboro, Clark Twp., Clinton Co., Ohio. 23 June 1990. M.A. Hoggarth.

Anodonta grandis grandis	2 weathered
Anodontoides ferrusacianus	1 live, 4 weathered
Strophitus undulatus undulatus	2 live, 1 dead, 4 weathered
Alasmidonta viridis	1 dead, 5 weathered
Fusconaia flava	3 weathered
Lampsilis radiata luteola	14 live, 6 dead, 15 weathered
Lampsilis ventricosa	3 dead

88 MAH:1990:65 East Fork Little Miami River at abandoned bridge, 2.8 mi WSW of Lynchburg, 12.7 mi. WNW of Hillsboro, Dodson Twp., Highland Co., Ohio. 23 June 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 weathered
Anodontoides ferrusacianus	1 weathered
Strophitus undulatus undulatus	1 live
Alasmidonta viridis	1 dead, 1 weathered
Amblema plicata plicata	1 subfossil
Lampsilis radiata luteola	1 dead, 2 weathered

89 MAH:1990:66 East Fork Little Miami River at SR 251 bridge, 0.8 mi. N of Saint Martin, 3.3 mi. NNE of Fayetteville, Perry Twp., Brown Co., Ohio. 30 June 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 live, 3 weathered
Anodontoides ferrusacianus	2 live, 2 dead
Strophitus undulatus undulatus	10 live, 2 dead
Alasmidonta viridis	7 live, 6 dead, 9 weathered
Lasmigona complanata	1 live
Lasmigona costata	2 dead
Quadrula quadrula	1 live, 2 weathered
Amblema plicata plicata	39 live, 3 dead, 4 weathered
Fusconaia flava	23 live, 6 dead, 2 weathered
Villosa lienosa	2 dead
Lampsilis radiata luteola	139 live, 7 dead, 4 weathered
Lampsilis ventricosa	19 live, 4 dead, 1 weathered

90 MAH:1990:67 East Fork Little Miami River at U.S. Rt. 68 bridge, 1.2 mi. NNW of Saint Martin, 3.1 mi. N of Fayetteville, Perry Twp., Brown Co., Ohio. 30 June 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 weathered
Strophitus undulatus undulatus	1 weathered
Amblema plicata plicata	1 live, 2 weathered
Fusconaia flava	2 live, 3 weathered
Lampsilis radiata luteola	3 live, 1 dead, 5 weathered
Lampsilis ventricosa	1 weathered

90 MAH:1990:68 East Fork Little Miami River at U.S. Rt. 68 bridge, 1.2 mi. NNW of Saint Martin, 3.1 mi. N of Fayetteville, Perry Twp., Brown Co., Ohio. 1 July 1990. M.A. Hoggarth.

Anodonta grandis grandis	3 weathered
Anodontoides ferrusacianus	4 weathered
Strophitus undulatus undulatus	17 live, 1 dead
Alasmidonta viridis	6 dead
Lasmigona costata	1 weathered
Quadrula quadrula	1 live, 1 subfossil
Amblema plicata plicata	130 live, 12 dead
Fusconaia flava	33 live, 1 dead, 3 weathered
Villosa lienosa	1 live, 2 weathered
Lampsilis radiata luteola	137 live, 8 dead
Lampsilis ventricosa	23 live, 2 dead

91 MAH:1990:69 East Fork Little Miami River at TR 406 (Morgan Rd.) bridge, 1.5 mi. W of Saint Martin, 2.4 mi. N of Fayetteville, Perry Twp., Brown Co., Ohio. 1 July 1990. M.A. Hoggarth.

Anodontoides ferrusacianus	3 dead
Strophitus undulatus undulatus	1 live, 2 dead
Alasmidonta viridis	1 live, 1 dead, 3 weathered
Lasmigona complanata	1 dead, 1 weathered
Lasmigona costata	1 dead, 1 weathered
Quadrula quadrula	1 dead, 4 weathered
Amblema plicata plicata	37 live, 4 dead, 2 weathered
Fusconaia flava	22 live, 6 dead
Toxolasma parvus	1 weathered
Villosa lienosa	6 weathered
Lampsilis radiata luteola	43 live, 2 dead, 3 weathered
Lampsilis ventricosa	3 live, 3 dead

92 MAH:1990:70 East Fork Little Miami River at U.S. Rt. 50 bridge, 0.5 mi. W of Fayetteville, 3.3 mi. SSW of Saint Martin, Perry Twp., Brown Co., Ohio. 1 July 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 dead
Anodontoides ferrusacianus	3 dead
Strophitus undulatus undulatus	1 live, 6 dead
Alasmidonta viridis	2 live, 5 dead
Lasmigona complanata	5 dead
Lasmigona costata	3 dead
Quadrula quadrula	2 live, 2 dead
Amblema plicata plicata	22 live, 5 dead
Fusconaia flava	3 live, 9 dead
Villosa lienosa	11 dead
Lampsilis radiata luteola	36 live, 4 dead
Lampsilis ventricosa	6 live, 8 dead

93 MAH:1990:71 East Fork Little Miami River at SR 131 bridge, 0.7 mi. WNW of Chasetown, 1.6 mi. S of Fayetteville, Perry Twp., Brown Co., Ohio. 1 July 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 weathered
Strophitus undulatus undulatus	2 live, 1 dead
Alasmidonta viridis	2 live, 1 dead
Quadrula quadrula	1 live, 1 weathered
Amblema plicata plicata	7 live
Fusconaia flava	2 live, 3 dead
Villosa lienosa	1 dead
Lampsilis radiata luteola	13 live, 2 dead
Lampsilis ventricosa	2 live, 3 dead

94 MAH:1990:74 East Fork Little Miami River at McCafferty Rd. bridge, 4.0 mi. SW of Fayetteville, 7.1 mi. SW of Saint Martin, Perry Twp., Brown Co., Ohio. 7 July 1990. M.A. Hoggarth.

Amblema plicata plicata	1 live, 1 dead
Lampsilis radiata luteola	2 dead

95 MAH:1990:75 East Fork Little Miami River at SR 286 bridge, 5.1 mi. SW of Fayetteville, 8.0 mi. SW of Saint Martin, Perry/Jackson Twp., Brown/Clermont Co., Ohio. 7 July 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 weathered
Anodontoides ferrusacianus	2 dead
Strophitus undulatus undulatus	4 live, 4 dead
Alasmidonta viridis	6 dead
Lasmigona complanata	5 live
Lasmigona costata	6 live, 1 weathered
Quadrula quadrula	7 live, 2 dead, 1 weathered
Amblema plicata plicata	100 live, 3 dead
Fusconaia flava	15 live, 4 dead
Villosa fabalis	1 live, 1 dead, 1 weathered
Villosa lienosa	2 dead, 3 weathered
Lampsilis radiata luteola	100 live, 3 dead
Lampsilis ventricosa	33 live, 2 dead
Corbicula fluminea	50 live, 61 dead

96 MAH:1990:76 East Fork Little Miami River at Blue Sky Park Rd. bridge, 5.6 mi. SSE of Newtonville, 6.2 mi. E of Owensville, Jackson Twp., Clermont Co., Ohio. 7 July 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 dead
Anodontoides ferrusacianus	2 dead
Strophitus undulatus undulatus	4 dead
Alasmidonta viridis	2 dead, 1 weathered
Lasmigona costata	2 dead
Quadrula quadrula	2 dead, 1 weathered
Amblema plicata plicata	4 dead
Fusconaia flava	11 dead
Villosa fabalis	1 dead
Villosa lienosa	4 dead
Lampsilis radiata luteola	5 dead
Lampsilis ventricosa	4 dead
Corbicula fluminea	3 dead

97 MAH:1990:77 East Fork Little Miami River at Jackson Pike bridge, 3.1 mi. N of Williamsburg, 5.6 mi. E of Owensville, Jackson Twp., Clermont Co., Ohio. 7 July 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 dead
Strophitus undulatus undulatus	3 dead
Alasmidonta viridis	7 dead
Quadrula quadrula	1 dead
Amblema plicata plicata	3 dead
Fusconaia flava	4 dead
Villosa fabalis	1 dead
Villosa lienosa	1 weathered
Lampsilis radiata luteola	4 dead
Lampsilis ventricosa	1 dead
Corbicula fluminea	2 dead

98 MAH:1990:78 East Fork Little Miami River at SR 133/276 bridge, in Williamsburg, 6.3 mi. N of Bethel, Williamsburg Twp., Clermont Co., Ohio. 8 July 1990. M.A. Hoggarth.

Strophitus undulatus undulatus	1 live, 3 dead, 1 weathered
Lasmigona costata	1 live, 1 dead, 1 weathered
Tritogonia verrucosa	1 dead, 2 weathered
Fusconaia flava	1 live, 1 dead, 1 weathered
Lampsilis radiata luteola	4 live, 3 dead, 2 weathered
Lampsilis ventricosa	1 dead
Corbicula fluminea	2 dead

99 MAH:1990:79 East Fork Little Miami River below East Fork Dam, 3.7 mi. E of Amelia, 4.7 mi. SSE of Batavia, Batavia Twp., Clermont Co., Ohio. 8 July 1990. M.A. Hoggarth.

Anodonta grandis grandis	2 live
Strophitus undulatus undulatus	1 live
Alasmidonta viridis	3 dead, 1 weathered
Lasmigona complanata	2 live, 1 dead
Lasmigona costata	3 live, 1 dead
Tritogonia verrucosa	3 live, 1 weathered
Quadrula quadrula	1 weathered
Amblema plicata plicata	1 live
Fusconaia flava	2 live, 1 weathered
Lampsilis radiata luteola	17 live, 4 dead, 4 weathered
Lampsilis ventricosa	2 live, 2 weathered
Corbicula fluminea	3 dead

100 MAH:1990:80 East Fork Little Miami River at SR 222 bridge, 1.8 mi. S of Batavia, 3.2 mi. NE of Amelia, Batavia Twp., Clermont Co., Ohio. 8 July 1990. M.A. Hoggarth.

Anodonta imbecillis	1 dead
Anodonta grandis grandis	2 live, 1 weathered
Simpsonaias ambigua	1 weathered
Lasmigona complanata	2 live, 1 weathered
Lasmigona costata	50 live, 3 dead
Tritogonia verrucosa	50 live, 3 dead, 1 weathered
Amblema plicata plicata	2 live
Fusconaia flava	100 live, 1 dead, 2 weathered
Elliptio dilatata	100 live, 10 dead
Lampsilis radiata luteola	100 live
Lampsilis ventricosa	50 live, 1 dead
Lampsilis fasciola	1 weathered
Corbicula fluminea	100 live, 6 dead

101 MAH:1990:81 East Fork Little Miami River below low-head dam in Batavia, 6.3 mi. W of Williamsburg, Batavia Twp., Clermont Co., Ohio. 9 July 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 subfossil
Strophitus undulatus undulatus	1 weathered, 1 subfossil
Alasmidonta viridis	1 dead
Lasmigona complanata	1 live
Lasmigona costata	9 live

Tritogonia verrucosa	15 live
Fusconaia flava	1 live
Elliptio dilatata	7 live
Truncilla donaciformis	1 live kept
Leptodea fragilis	29 live
Potamilus alatus	35 live
Lampsilis radiata luteola	6 live, 3 dead, 7 weathered
Lampsilis ventricosa	3 live

102 MAH:1990:82 East Fork Little Miami River between Clermont Co. Park and U.S. Rt. 32 bridge, 1.1 mi. NW of Batavia, 7.1 mi. SE of Milford, Batavia Twp., Clermont Co., Ohio. 9 July 1990. M.A. Hoggarth.

Anodonta imbecillis	2 live
Anodonta grandis grandis	6 live, 1 weathered
Lasmigona complanata	3 live, 1 weathered
Lasmigona costata	7 live, 1 dead
Tritogonia verrucosa	2 live, 1 dead
Fusconaia flava	1 live, 1 dead
Elliptio dilatata	6 live
Leptodea fragilis	1 weathered
Potamilus ohiensis	1 weathered
Potamilus alatus	23 live, 1 weathered
Lampsilis radiata luteola	5 live, 2 dead, 2 weathered
Lampsilis ventricosa	12 live, 2 dead, 3 weathered

103 MAH:1990:83 East Fork Little Miami River at gravel dredging operation 1.1 mi. S of Stonelick, 2.7 mi. NNW of Batavia, Batavia Twp., Clermont Co., Ohio. 9 July 1990. M.A. Hoggarth.

Anodonta imbecillis	1 live
Anodonta grandis grandis	2 live
Strophitus undulatus undulatus	1 weathered
Alasmidonta viridis	1 weathered
Lasmigona complanata	10 live, 2 dead
Lasmigona costata	1 dead, 2 weathered
Tritogonia verrucosa	2 live
Fusconaia flava	1 dead
Leptodea fragilis	1 weathered
Potamilus alatus	1 dead, 2 weathered
Lampsilis radiata luteola	1 live, 1 dead
Lampsilis ventricosa	1 dead
Corbicula fluminea	2 dead

104 MAH:1990:84 East Fork Little Miami River at bridge in Perintown, 3.8 mi. SE of Milford, Union Twp., Clermont Co., Ohio. 9 July 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 dead
Lasmigona complanata	10 live, 5 dead
Tritogonia verrucosa	1 dead
Quadrula quadrula	1 dead
Elliptio dilatata	1 weathered
Leptodea fragilis	4 dead
Potamilus alatus	5 dead, 1 weathered
Truncilla donaciformis	9 dead

Lampsilis ventricosa	1 live, 4 dead
Corbicula fluminea	2 dead

105 MAH:1990:85 East Fork Little Miami River at access off of U.S. Rt. 50, 1.6 mi. ESE of Milford, 7.4 mi. NW of Batavia, Union Twp., Clermont Co., Ohio. 9 July 1990. M.A. Hoggarth.

Anodonta grandis grandis	1 weathered
Alasmidonta marginata	1 live kept
Lasmigona complanata	3 live, 1 dead, 3 weathered
Lasmigona costata	1 dead
Amblema plicata plicata	1 live
Leptodea fragilis	1 dead, 2 weathered
Potamilus alatus	2 dead, 1 weathered
Truncilla truncata	1 live kept, 1 dead
Truncilla donaciformis	8 dead
Lampsilis ventricosa	1 live
Corbicula fluminea	3 dead

Walkerana, 1992, 6(16): 295-313

DR. MARIA ISABEL HYLTON SCOTT (1889-1990). A BRIEF BIOGRAPHY AND BIBLIOGRAPHY[1]

Néstor J. Cazzaniga[2,3]

Dr. María Isabel Hylton Scott, a well known Argentinean specialist in terrestrial gastropods, passed away in the city of La Plata on September 1, 1990, at the respectable age of 101.

María Isabel Hylton Scott-Birabén.

Born in Córdoba, Argentina, Dr. Hylton Scott graduated as a teacher in her natal city and then continued her studies at the Universidad Nacional de La Plata under the guidance of Dr. Miguel Fernández and his wife, Dr. Katy Marcinowsky-Fernández. The latter are known mainly for their contribution to embryology, in particular to the morphogenesis of ascidians, polyembryony in armadillos, and the mesodermic origin of the vascular system in vertebrates. The influence of these two advisers is evident in the first scientific works of Dr. Hylton Scott. Her doctoral thesis dealt with the embryology of the viviparous freshwater fish, *Fitzroyia lineata* (now under *Jenynsia*, Characiformes: Jenynsiidae).

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During the course of her university studies, Dr. Hylton Scott met Max Birabén, who not only became her husband and loving friend throughout life, but also provided steadfast encouragement in her work. They both received the diploma of Doctor en Ciencias Naturales in 1917, the first two to be issued by the Museo de La Plata in the Zoology branch. Dr. Hylton Scott was thus the first woman in Argentina (and also perhaps in the whole of South America) to obtain a Doctorate in Zoology.

She spent almost her entire career as a university professor at La Plata, teaching Invertebrate Zoology and Comparative Anatomy. Her university activity was interrupted for approximately a decade due to the political situation in Argentina, which had repercussions in the universities throughout the country. She returned to the chair in 1955, after the civil-military "Liberating Revolution."

Dr. Hylton Scott's interest in mollusks began with her embryological and anatomical studies on the largest non-marine snails from Argentina (*Pomacea canaliculata* and *Strophocheilus lorentzianus*); her taxonomic work commenced as a result of a trip to Jujuy, in the northern frontier of Argentina (1947). Thus at the mature age of 58 she embarked upon the malacological line of research, which she was to continue up to the publication of her last paper in 1985, by which time she was 96 years old.

Between 1954 and 1977, together with her husband, she edited the journal *Neotropica*, a general journal on zoology, which even today is indexed in *Malacological Review*, mainly due to the many papers of hers appearing there, together with those of her disciples and relatives.

Her papers, published mostly in La Plata and all in Spanish, with the exception of one (in French), gained early recognition by the international community of malacologists. The monograph on Argentinean Ampullaridae (1957) is widely cited, as are her papers on Endodontidae and Bulimulidae. Henry A. Pilsbry visited her house in La Plata during his trip to Argentina in 1949-1950, and was full of praise for her work and collections (Parodiz, 1951).

Dr. Hylton Scott resigned from her post in La Plata in 1965 to accompany her husband to Buenos Aires, where he had been designated Director of the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia." Only in 1974, when Dr. Max Birabén became gravely ill, did the couple retire from official activity. However, Dr. Hylton Scott never abandoned her research career and went on to publish nine papers between 1975 and 1984.

Dr. Birabén died in 1977. During his last years his wife attended him with the devotion and utter dedication that grew out of their sixty years of common enterprise and harmonious life together.

On the occasion of the Centenary of the Museo de La Plata (1977), Dr. Hylton Scott was conferred a special award and in the same year she was named an Honorary Member of the Asociación Argentina de Ciencias Naturales. But what award could be greater than the honor of winning a

María Isabel Hylton Scott-Birabén with Henry A. Pilsbry, La Plata, Argentina, 1950.

lasting place in the esteem of her colleagues, who even now find themselves referring back to her pioneering work on terrestrial mollusks in southern South America. Juan José Parodiz, at the Carnegie Museum, published a catalogue of the land mollusks of Argentina (1957) in which the importance of Hylton Scott's work is clearly manifested. An update of the catalogue by Fernández in 1973 demonstrates that she continued to be the main specialist on terrestrial gastropods in Argentina. Right until shortly before her death her advice was still sought (Breure, 1978; Fernández & Rumi, 1983; Quintana, 1983; Miguel, 1987), and she was posthumously designated Honorary President of the 1st Latin American Congress on Malacology (Caracas, July 1991).

When she reached the age of 100, Dr. Hylton Scott decided to do a further service to science and donate her very important personal collection of mollusks to the Museo de La Plata.

With this public eulogy I should like to commemorate the life and work of a truly remarkable woman who added to her merits by adhering to the age-old virtue of never claudicating (Cazzaniga, 1989, 1990, 1991). In a personal

letter to me, her son Dr. Max Birabén-Scott has upheld this appraisal of the character and integrity of his mother, who until the last continued as head of the family, earning love and respect for her remarkable intellectual brilliance.

In homage to the first woman zoologist in Argentina, here follows an annotated list of her published works, which I commend kindly to her memory.

LIST OF PUBLICATIONS BY MARIA ISABEL HYLTON SCOTT-BIRABÉN

1. – HYLTON SCOTT, M.I. 1918. Sobre el desarrollo intraovarial de *Jenynsia lineata* (Nota preliminar). *Anales de la Sociedad Científica Argentina*, 86: 349-354, two text-drawings. Buenos Aires.

   Description of the embryonic development of this viviparous freshwater fish, with histological sections of the ovaric sac and the embryo. She discovered a peculiar relationship among the embryos and their mother: foldings of the uterine epithelium enter the branchial cavities of the foetuses, thus allowing for a more efficient oxygenation.

2. – SCOTT BIRABÉN, M.I.H. & MARCINOWSKY FERNANDEZ, K. 1921. Variaciones locales de caracteres específicos de larvas de anfibios. *Anales de la Sociedad Científica Argentina*, 92: 129-142, 13 drawings, one table. Buenos Aires.

   Description of the buccal morphology of tadpoles of some Argentinean amphibians (genera *Bufo* and *Ceratophrys*). Analysis of the variability of the series of papillae and little buccal rods that were considered diagnostic features for the specific recognition. The variations are interpreted as being locally induced by ecological factors

3. – HYLTON SCOTT, M.I. 1927. Sobre gemelos uniovulares de *Fitzroyia lineata*. *Physis*, 8(31): 568-572, two schematic drawings. Buenos Aires.

   Description of the embryonic blood circulation in this freshwater viviparous fish, and the modifications produced in a rare case in which two embryos were developed within the same ovule.

4. – HYLTON SCOTT, M.I. 1928. Sobre el desarrollo intraovarial de *Fitzroyia lineata* (Jen.) Berg. *Anales del Museo Nacional de Historia Natural*, 34: 361-424, 15 text drawings, a seven-page table and 13 plates with 21 photographs and drawings. Buenos Aires.

   This constitutes the main part of Dr. Hylton Scott's Doctoral Dissertation on the reproductive biology of this viviparous fish. Describes the external and internal morphology of the female genital system, its histology, the egg and its envelopes, the location of the eggs within the ovary and its foldings, the fecundation process, segmentation, the degenerative process of a part of the eggs, the development of the embryo, and its nutrition and respiration.

5. – HYLTON SCOTT, M.I. 1934. Sobre el desarrollo embrionario de *Ampullaria canaliculata*. *Revista del Museo de La Plata*, 34: 373-385, 28 schematic drawings in six plates. La Plata.

This is the first embryological study on mollusks made in Argentina. Describes in detail the segmentation up to the 32-blastomere stage, and the morphology of the embryo during organogenesis until it becomes a fully developed embryo.

Most of this paper was reprinted as a part of [31], listed below.

6. – BIRABÉN, M. & HYLTON SCOTT, M.I. 1937. Departamento de Zoología (Invertebrados). Informe del Jefe del Departamento y Profesor Suplente: Viaje alrededor de Santa Cruz. *Revista del Museo de La Plata, Sección Oficial*, 1936: 93-164. La Plata. Reprinted in *Argentina Austral*, 209 (November 1948), 211 (January 1949), 225 (March 1950) and 232-233 (December 1950), Buenos Aires.

Report on a long trip through the coastal and the desert steppe zones of the Province of Santa Cruz (Southern Patagonia, Argentina). Includes some biological information on different animals and descriptions of environments and landscapes. An ample comment on this trip was published by Cazzaniga (1989).

7. – BIRABÉN, M. & HYLTON SCOTT, M.I. 1939. Observaciones sobre el pingüino *Spheniscus magellanicus* (J.R. Foster). *Physis*, 16(48): 245-251. Buenos Aires.

Description of the physical characteristics of a nesting site of the Magellan penguin near Puerto Deseado (Santa Cruz Province), the nesting behavior, and diverse reactions of the penguins. The authors include a comment on a frustrated attempt to industrialize penguins in 1935, and a call for regulation of this activity in the future.

8. – HYLTON SCOTT, M.I. 1939. Estudio anatómico del borus *Strophocheilus lorentzianus* (Doer.) (Mol. Pulm.). *Revista del Museo de La Plata (nueva serie), Zoología*, 1: 217- 278, three photographs and 25 text drawings. La Plata.

Description of the external morphology, shell, and anatomy of the different parts of the digestive, muscular, genital and circulatory systems. The nervous ganglia and the statocyst, suprapedial gland and pallial organs are also studied. Almost all the described organs are illustrated.

9. – HYLTON SCOTT, M.I. 1939. Un "test" de *Arbacia dufresnii* tetrarradiado. *Notas del Museo de La Plata, Zoología*, 4(16): 1-5, three photographs in one plate, and one text drawing. La Plata.

Description of a teratological specimen of this common Argentinean sea urchin (Echinoidea), giving some hypotheses on its possible internal

anatomy, since the specimen was found empty.

10. – HYLTON SCOTT, M.I. 1943. Sobre la organización de *Ampullaria* (*Asolene*) *megastoma* Sowerby. *Notas del Museo de La Plata, Zoología,* 8 (70): 269-280, six text drawings. La Plata.

A study of the first specimens of this species found in Argentina. Describes the basic anatomy: mandibles, radula, male and female genital systems and nervous system. A drawing shows, without description, the position of the pallial organs.

11. – HYLTON SCOTT, M.I. 1945. Fáunula malacológica de Tilcara. *Revista del Museo de La Plata (nueva serie), Zoología,* 4: 195-211, six photographs in one plate and six anatomical drawings in the text. La Plata.

Description of the malacological material collected during a trip to Jujuy (northern Argentina) made in February 1944. Describes ***Succinea aurea*** sp.n.: shell, general features of the soft parts, radula, mandible and genital organs. Cites *Gastrocopta nodosaria* (d'Orb.), with a correction to the original description and a radular study. Cites *Pupoides paredesi* (d'Orb.), describing the shell, mandible, radula and with a short mention of the genital system and retractor muscles. Describes *Agriolimax laevis* (Müller): general features, internal shell, mandible and radula. Redescribes *Bulimulus stelzneri hector* Holmberg, giving it a new subspecific status based on its anatomy: shell, mandible, radula, pallial and genital organs. Redescribes *B. jujuyensis* Holmberg: shell, mandible, radula, genital and pallial organs, and retractor muscles. Citation of *Scolodonta semperi* (Doering): shell, general features of the soft parts and radula.

12. – HYLTON SCOTT, M.I. 1946. Hallazgo del género *Vertigo* en la Argentina (Mol. Pulm.). *Notas del Museo de La Plata, Paleontología,* 11(94): 359-361, one text figure. La Plata.

Description of ***Vertigo frenguellii*** sp.n., on fossil shells from the Platense stratum in Córdoba. This genus is cited for the first time in the Southern Hemisphere.

13. – HYLTON SCOTT, M.I. 1946. Primera noticia sobre la presencia del género *Obeliscus* en la Argentina (Mol. Pulm.). *Notas del Museo de La Plata, Zoología,* 11 (97): 363-370, five text figures and four photographs in one plate. La Plata.

Description of ***Obeliscus (Rectobelus) birabeni*** sp.n., from Jujuy: young and adult shells, features of the soft parts, pallial and genital organs, mandible and radula.

14. – HYLTON SCOTT, M.I. 1948. Moluscos del biotopo de Cerro Colorado (Salta). *Acta Zoologica Lilloana,* 6: 229-239, four text drawings, and two plates with 15 photographs. San Miguel de Tucumán.

Redescription of *Cyclodontina* (*Spixia*) *pyriformis* (Pilsbry): shell, foot, mantle, mandible, radula, pallial and genital organs. Describes, on the basis of shells alone, ***Cyclodontina* (*Spixia*) *dubia*** sp.n., ***C.* (*Plagiodontes*) *multiplicatus crassus*** ssp.n. (incorrect specific and subspecific spellings due to the lack of gender concordance), ***Bulimulus sporadicus gracilis*** ssp.n. and ***Neopetraeus stelzneri apertus*** ssp.n.

15. – HYLTON SCOTT, M.I. 1948. Moluscos del noroeste argentino. *Acta Zoologica Lilloana*, 6: 241-274, 33 drawings in the text and 14 photographs in one plate. San Miguel de Tucumán.

A study of the malacological collection of the Instituto Miguel Lillo (Tucumán, Argentina). Describes ***Pomacea canaliculata chaquensis*** ssp.n., from the "chaco" in Salta and Formosa province. Citation of *Adelopoma tucma* Doering and *Succinea aurea* Hylton Scott. Description of ***Gastrocopta crucifera*** sp.n., from La Rioja province: shell; ***G. pulvinata*** sp. n., from Salta: shell, general features of the soft parts and radula. Citation of *Zonitoides* (*Zonitellus*) *arboreus* (Say) and *Vallonia pulchella* (Müller). A more detailed study of the Endodontidae, describing ***Stephanoda jujuyensis*** sp.n.: shell, foot, mandible and radula, and ***Radiodiscus katiae*** sp.n.: one shell (type), both species coming from Jujuy. Citation of *Cecilioides consobrina* (d'Orbigny): shell; *Leptinaria bacterinoides* (d'Orbigny): shell and radula; *Happia skiaphila* (d'Orbigny): taxonomic discussion, general description of the soft parts, radula, pallial complex, retractor muscles and genital organs. Description of ***Drepanostomella circumscripta*** sp.n., from Salta: shell, general features of the soft parts and radula; ***D. tucma*** sp.n., from Tucumán: shell; ***Guppya lilloana*** sp.n., from Jujuy: shell, foot, mandible and radula; ***G. aenea*** sp.n, from Jujuy: shell, animal, mandible and radula, and ***Peronaeus* (*Lissoacme*) *birabeni*** sp.n., from Salta: shell. Citation of *P.* (*L.*) *torallyi* (d' Orbigny): shell.

16. – HYLTON SCOTT, M.I. 1951. Nuevos moluscos terrestres del Norte argentino. *Acta Zoologica Lilloana*, 10: 5-29, 10 photographs in two plates and seven text figures. San Miguel de Tucumán.

Description of ***Pilsbrylia*** gen.n. and its type species, ***P. paradoxa*** sp.n., from Jujuy: shell, mandible, radula and genital organs. Description of ***Cyclodontina* (*Spixia*) *pyrgula*** sp.n., from Córdoba: shell, animal, mandible, radula and genital organs; ***C.* (*S.*) *cela*** sp.n., from Córdoba: shell; ***C.* (*Spixinella*) *parodizi*** sp.n., from Córdoba: shell, mandible, radula, and pallial and genital organs; ***Plagiodontes daedaleus costatus*** ssp.n., from Córdoba: shell; ***P. multiplicatus parvus*** ssp.n. from Santiago del Estero: shell; ***P. patagonicus magnus*** ssp.n., from Sierra de la Ventana (Province of Buenos Aires): shell, animal, mandible, radula, and pallial and genital organs; ***Bulimulus elatior*** sp.n., from Formosa: shell; ***B. apodemetes dispar*** ssp.n. from Salta: shell; ***Protoglyptus ramosae*** sp.n., from Salta: shell. Citation of *Drymaeus abyssorum* (d'Orbigny), *Gonyostomus turnix albolabiatus* Jaeckel: mandible, radula, pallial and genital organs; *Vertigo frenguellii* Hylton Scott: cited as an extant species, since known only as a fossil. She

also gives the new name ***Succinea aurita*** to *S. aurea* Hylton Scott 1945 (*non S. aurea* Lea 1841).

17. – HYLTON SCOTT, M.I. 1951. Nuevas *Epiphragmophora* (Gastr. Pulm.) del noroeste argentino. *Physis,* 20(58): 252-258, three drawings, four photographs. Buenos Aires.

Description of ***Epiphragmophora puella*** sp.n. from Catamarca: shell, mandible, radula, general anatomy, pallial complex, genital system; ***E. semiclausa*** sp.n. from Catamarca: shell, and ***E. proseni*** sp.n. from Jujuy: shell.

18. – HYLTON SCOTT, M.I. 1951. *Kuschelenia.* Nuevo género de Bulimulidae (Moll. Pulmonata). *Acta Zoologica Lilloana,* 12: 539-543, four text figures. San Miguel de Tucumán.

Description of the new genus and its type species, ***Kuschelenia simulans*** sp.n., from Bolivia: shell, foot, mantle, pallial organs, radula, mandible and genital organs.

19. – HYLTON SCOTT, M.I. 1954. Sobre Limnaeidae [*sic*] argentinas (Mol. Pulm.). *Physis,* 20(59): 401-408, six text drawings. Buenos Aires.

Citation of *Pseudosuccinea columella* (Say) for the first time from Argentina: shell, mandible, radula and genital organs. Description of ***Limnaea*** [*sic*] ***plicata*** sp.n., from Chubut: shell, radula and genital organs.

20. – HYLTON SCOTT, M.I. 1954. Una nueva especie de *Bostryx* (Bulimulidae) (Mol. Pulm.). *Physis,* 20 (59): 409-413, seven text drawings. Buenos Aires.

Citation of *Bostryx* (*Platybostryx*) *cuyana* Strobel: shell, maxilla, radula and genitalia. Description of ***Bostryx*** (***Platybostryx***) ***doelloi*** sp.n., from Mendoza: shell, animal, maxilla, radula and genitalia.

21. – HYLTON SCOTT, M.I. 1954. El género *Hemisinus* (Melaniidae) en la costa fluvial argentina (Mol. Prosobr.). *Physis,* 20 (59): 438-443, one text drawing and three photographs. Buenos Aires.

First record of this family in Argentina. Description of ***Hemisinus guaraniticus*** sp.n. from Misiones: shell, general anatomical information and radula.

22. – HYLTON SCOTT, M.I. 1954. Notas sobre la morfología de *Gundlachia* Pfr. (Ancylidae) (Mol. Pulm.). *Physis,* 20(59): 467-473, 12 text drawings. Buenos Aires.

States the priority of *Gundlachia* Pfeiffer over *Hebetancylus* Pilsbry, and describes the closed form of the shell of *G. moricandi* (d'Orbigny). Gives an anatomical explanation of the process of formation of the ventral septum of the shell and describes the general morphology of the animal without shell, radula and penis.

23. – HYLTON SCOTT, M.I. 1954. Un caso de anomalía de forma en *Tropicorbis peregrinus*. *Physis*, 20(59): 498-499, two text figures. Buenos Aires.

Description of a shell whose last whorls go down with respect to the twisting plane, giving an unusual form to the specimen.

24. – HYLTON SCOTT, M.I. 1954. Hallazgo del género *Nenia* (Fam. Clausiliidae) en la Argentina. *Physis*, 20 (59): 502. Buenos Aires.

Abstract of [25].

25. – HYLTON SCOTT, M.S. 1954. El primer clausílido de la Argentina (Mol. Pulm.). *Neotropica*, 1(1): 1-4, seven figures. La Plata.

Description of ***Nenia argentina*** sp.n., from Jujuy: shell, mandible, radula, clausilium and genital apparatus.

26. – HYLTON SCOTT, M.I. 1954. Dos nuevos melánidos del Alto Paraná. *Neotropica*, 1(3): 45-48, six text photographs. La Plata.

Begins with a commentary on the paper by Morrison (1954) where the "melanias" have been rearranged. She acknowledges that the Argentinean species belong to the family Thiaridae and to the genus *Aylacostoma* Spix 1827, and transfers to this one the species described in [21], as *A. guaranitica*. Description of ***A. chlorotica*** sp.n. and ***A. stigmatica*** sp.n., both from Paraguay. The three names are incorrect spellings: she considers the genus name as feminine, but the ending *-stoma* makes it neuter; the spellings must be corrected as *A. guaraniticum*, *A. chloroticum* and *A. stigmaticum*.

27. – HYLTON SCOTT, M.I. 1955. *Ulpia*, nuevo género de Gastropoda terrestre. *Neotropica*, 1(5): 65-68, four text figures. La Plata.

This new genus of Odontostominae is dedicated to ULPI (Universidad de La Plata Internado), a university institution whose ex-fellows contributed financially to the edition of *Neotropica*. Describes its type species, ***Ulpia venusta*** sp.n., from Salta: shell. A key is added for the recognition of the genera within the subfamily Odontostominae.

28. – HYLTON SCOTT, M.I. 1957. Endodóntidos neotropicales. I. *Neotropica*, 3(10): 7-16, nine drawings in three text figures. La Plata.

Dedicated "to the memory of Alcides d'Orbigny," and stating that she began the collection and study of the Endodontidae several years ago. Gives the diagnosis of Family Endodontidae Pilsbry 1894 and Genus *Radiodiscus* Pilsbry & Ferriss 1908, and describes the shell of *R. coppingeri* (E.A. Smith 1881), *R. magellanicus* (E.A. Smith 1881), *R. riochicoensis* Crawford 1939, ***R. kuscheli*** sp.n., from Chile and ***R. pilsbryi*** sp.n., from Tucumán.

29. – HYLTON SCOTT, M.I. 1957. Endodóntidos neotropicales. II. *Neotropica*, 3(12): 79-87, 12 text drawings. La Plata.

Describes ***Radiodiscus costellifer*** sp.n., from Paraguay; ***R. misionensis***

sp.n., from Misiones; ***R. tenellus*** sp.n., from Paraguay and ***R. titicacensis*** sp.n., from Bolivia. A list and a key for the recognition of the species of *Radiodiscus* known in South America is added.

30. – HYLTON SCOTT, M.I. 1957. Henry A. Pilsbry, 1862-1957. *Neotropica,* 3(12): 87-89, with a portrait in the text. La Plata.

Brief biography and comments on the scientific production of the late Dr. Pilsbry. The very words used by Dr. Hylton Scott in praise of Pilsbry became equally applicable to herself 33 years later: "He has slipped gently into old age, or old age has encroached gently upon him, without affecting either his intelligence or his spirit; without exhausting his patience as a researcher or impairing his eminent intellectual qualities. When the moment arrived to leave behind his bodily exterior he had the good fortune to be surrounded by affectionate admirers and to be respected by all those who knew him. To the last he did not allow life's lengthy course to leave even a trace of resentment in his everlastingly young heart."

31. – HYLTON SCOTT, M.I. 1957. Estudio morfológico y taxonómico de los ampulláridos de la República Argentina. *Revista del Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" e Instituto Nacional de Investigación de las Ciencias Naturales, Ciencias Zoológicas,* 3(5): 233-333, 23 plates with 42 anatomical drawings, 18 embryological schemes and 12 shell photographs. Buenos Aires.

This is hitherto the most complete study on this family in Argentina. Description of the anatomy of the digestive organs (including musculature of the pharyngeal bulb, oesophagus, stomach, intestine and digestive gland), respiratory organs, *i.e.,* ctenidium and lung, circulatory, nervous and genital systems. Re-edition of the embryological information on *Ampullaria canaliculata* [see 5 above] with comments on other species. The systematic part gives a key to identification of the genera and specific keys for each Argentinean genus. Description, synonymy and distribution of: *Ampullaria insularum* d'Orbigny, *Amp. canaliculata* Lamarck, *Amp. canaliculata chaquensis* Hylton Scott, *Amp. scalaris* d'Orbigny, *Asolene* (*Asolene*) *platae* (Maton), *As.* (*As.*) *pulchella* (Anton), *As.* (*As.*) *spixi* d'Orbigny, *As.* (*Pomella*) *megastoma* (Sowerby), *As.* (*P.*) *americanista* Ihering, *Felipponea neritiniformis* (Dall), *F. elongata* (Dall), *F. iheringi* (Pilsbry) and *Marisa planogyra* Pilsbry.

32. – HYLTON SCOTT, M.I. 1957. Anotaciones sobre la morfología de *Tropicorbis peregrinus. Revista del Museo de La Plata (nueva serie), Zoología,* 7: 1-22, 19 drawings, nine photographs. La Plata.

Anatomical description of specimens from La Plata. Refers to shell, general morphology of the animal, cephalic region and mantle, pallial organs, radula, digestive organs and genital system.

33. – HYLTON SCOTT, M.I. 1958. Nueva especie de *Chilina* del norte argentino. *Neotropica,* 4(13): 26-27, two photographs. La Plata.

Description of ***Chilina megastoma*** sp.n., from Misiones: shell.

34. – HYLTON SCOTT, M.I. 1960. Sobre la presencia del género *Pupisoma* en la Argentina (Pulm. Pupillidae). *Neotropica,* 6(19): 25-29, nine text figures. La Plata.

Report on the finding of *Pupisoma dioscoricola* (C.B. Adams 1845) in Chaco (Argentina). Description of ***P. latens*** sp.n., from Córdoba: shell, features of the animal, radula, and ***P. puella*** sp.n., based on a single shell. [There is an explanatory footnote referring to the type locality of *P. puella* (Iguazú, Misiones) in *Neotropica,* 6(21): 69. La Plata].

35. – HYLTON SCOTT, M.I. 1960. Nueva familia de pulmonado basomatóforo (Mollusca). *Neotropica,* 6(21): 65-69, four text figures. La Plata. [A summary was published in: *Physis,* 22(61): 52. Buenos Aires.]

Statement of the new family Acrorbidae, for genus *Acrorbis* Odhner, and description of ***A. odhneri*** sp.n., from Misiones: shell, animal, maxilla and radula.

36. – HYLTON SCOTT, H.I. 1961. Sobre la presencia de *Limnaea* [*sic*] *viator* en Tucumán. *Neotropica,* 7(23): 46. La Plata.

Brief comment on the presence of this species in small ponds marginal to the Medina river, Departamento Burruyacu, and reference to its importance in the transmission of *Fasciola hepatica* in the region.

37. – HYLTON SCOTT, H.I. 1962. Dos nuevas especies de *Epiphragmophora* del noroeste argentino. *Neotropica,* 8(27): 104-110, six photographs and three text drawings. La Plata.

Description of ***Epiphragmophora variegata*** sp.n., from Catamarca: shell, genital system, and ***E. jujuyensis*** sp.n., from Jujuy: shell, genital system. The genital anatomy of both species is compared to that of *E. argentina* Holmberg, which is illustrated for the first time.

38. – HYLTON SCOTT, M.I. 1962. Primeras etapas del sistema circulatorio de *Fitzroyia lineata. Revista del Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" e Instituto Nacional de Investigación de las Ciencias Naturales, Ciencias Zoológicas,* 8(18): 229-242, 10 semi-schematic drawings. Buenos Aires.

Describes the beginning of the blood circulation in embryos of this freshwater viviparous fish, the development of the main vessels: aorta, anterior and posterior cardinals, mesenteric artery, branchial arches, the hepatic circulation, and the blood irrigation of the body wall, fins and operculum.

39. – HYLTON SCOTT, M.I. 1963. Reconocimiento anatómico de *Vaginula solea* d'Orbigny y *V. doellojuradoi* Gambetta (Moll. Pulm.). *Neotropica,* 9(28): 1-7, three text figures. La Plata. Reprinted by the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia," in *Extra, nueva serie,* 20.

Buenos Aires.

Dr. Hylton Scott identifies these to be the most widespread native slugs in Argentina. She describes the genital system and adds a taxonomic commentary.

40. – HYLTON SCOTT, M.I. 1963. Tres nuevos endodóntidos de Tucumán. *Neotropica,* 9(29): 49-54, nine text drawings. La Plata.

Description of shells collected from Tucumán: ***Radiodiscus crenulatus*** sp.n., ***Austrodiscus golbachi*** sp.n. and ***A. superbus tucumanus*** ssp.n.

41. – HYLTON SCOTT, M.I. 1963. Moluscos terrestres y de agua dulce de la Patagonia. In: Delamare Debouteville, C. & Rapoport, E. (Dir.). *Biologie de l'Amérique Australe,* 2: 385-390. CNRS-CONICET, Paris.

List with comments on the nominal species of terrestrial and freshwater mollusks from Patagonia with the following genera: *Chilina* (19 species), *Lymnaea* (10 species), *Drepanotrema* (1), *Tropicorbis* (1), *Littoridina* (5), *Ancylus* (2), *Succinea* (5), *Gastrocopta* (1), *Radiodiscus* (3), *Stephanoda* (3), *Austrodiscus* (1), *Payenia* (2), *Limax* (1), *Deroceras* (2), *Milax* (1), *Macrocyclis* (1), *Peronaeus* (1), *Plectostylus* (1), *Anodontites* (1), *Diplodon* (1), *Pisidium* (3) and *Musculium* (1).

42. – HYLTON SCOTT, M.I. 1964. *Helix costellata* d'Orbigny a la luz de su anatomía. *Neotropica,* 10(31): 15-19, three photographs and four text drawings. La Plata.

Comments on the successive systematic changes causing the species to be assigned to different genera. Study of the shell, radula, mandible, genital apparatus. Concludes with a new combination: *Austrodiscus costellatus.*

43. – HYLTON SCOTT, M.I. 1965. Anotaciones sobre los moluscos de Chancani, Córdoba (Gastropoda Pulmonata). *Neotropica,* 11(34): 23-26. La Plata.

Makes reference to the importance of the Córdoba mountain system due to its diversity of terrestrial gastropods. Cites: *Spixia chancanina* (Doering), *S. aconjigastana* (Doering), *Plagiodontes weyenberghi* Doering, *Epiphragmophora trenquelleonis hidalgonis* (Doering) and *Neopetraeus stelzneri peristomatus* (Doering). Describes ***Bulimulus (Scansicochlea) martinezi*** sp.n., with a fine photograph of the holotype and description of mandible and radula.

44. – HYLTON SCOTT, M.I. 1965. Notas sobre la anatomía de *Microborus lutescens dorbignyi* (Doer.) (Gastrop. Pulm.). *Neotropica,* 11(35): 59-63, four figures. La Plata.

A study of five specimens from Sierra de la Ventana (Province of Buenos Aires) and description of radula, mandible, mantle, breathing organs, hearth, kidney and genitals. She concludes that it is correct to distinguish

Microborus from *Strophocheilus.*

45. – HYLTON SCOTT, M.I. 1965. Sobre el nombre *Borus dorbignyi. Neotropica,* 11(36): 116. La Plata.

A clarification of her mistaken use of the name *Microborus* instead of the replacement name *Austroborus* Parodiz 1949 as a subgenus of *Strophocheilus,* which in this brief note she considers as a genus for the reasons given in [44].

46. – HYLTON SCOTT, M.I. 1966. Nueva *Cyclodontina* y revaloración del subgénero *Clessinia* Doering, 1874 (Gastr. Pulm.). *Neotropica,* 12(37): 30-35, five text drawings and three photographs. La Plata.

An analysis of the nomenclatural and systematic history of *Bulimus cordovanus* Pfeiffer, classifying it as *Cyclodontina* (*Clessinia*) *cordovanus,* and revalidating the name *Clessinia* Doering, instead of *Scalarinella* Doering, acknowledging it to be a *nomen nudum.* Due to the feminine grammatical gender of the genus, the name should have been *C.* (*Cl.*) *cordovana* (Pfeiffer), as was already noted by Parodiz (1957). Of the latter, she describes the shell, radula, mandible and genital organs. She describes ***Cyclodontina* (*Clessinia*) *gracilis*** sp.n., from Catamarca, on the basis of the single shell (holotype).

47. – HYLTON SCOTT, M.I. 1967. Nuevas *Scansicochlea* de la región central de la Argentina. *Neotropica,* 13(40): 7-12, eight text drawings and six photographs. La Plata.

Description of ***Bulimulus* (*Scansicochlea*) *cicheroi*** sp.n., from San Luis: shell, mandible, radula, pallial complex and genitals; ***B.* (*S.*) *gladysae*** sp.n., from Catamarca: shell, mandible, radula and some details of the genitals, and ***B.* (*S.*) *lolae*** sp.n., from Córdoba: shell, mandible, radula and a brief mention of genitals.

48. – HYLTON SCOTT, M.I. 1967. Nota informativa. *Neotropica,* 13(40): 40. La Plata.

Report on a specimen of *Bulimus cordovanus* from San Marcos Sierra (Córdoba). Rectifies the locality of material studied in [46] and comments on the objection made by Dr. W. Weyrauch to the validity of *Clessinia* Doering.

49. – HYLTON SCOTT, M.I. 1967. Nuevos odontostómidos de Córdoba (Moll. Pulmonata). *Neotropica,* 13(42): 97-103, two drawings and eight photographs. La Plata.

New specimens from San Marcos Sierra convinced Dr. Hylton Scott that the material studied in [46] and [48] did not pertain to *Clessinia cordovana* but to a new species, ***Clessinia pagoda;*** describes shell, radula and genital system. Describes ***Spixia tridens*** sp.n., from Córdoba, on the basis of shells

alone and adds a citation of *Spixia pervarians* (Haas) in Argentina: shell.

50. – HYLTON SCOTT, M.I. 1967. Nota aclaratoria con respecto al género *Clessinia* Doering. *Neotropica*, 13(42): 103. La Plata.

Refers to the arguments for maintaining the name *Clessinia*, and justifying why she considers *Scalarinella* Doering to be a *nomen nudum*.

51. – HYLTON SCOTT, M.I. 1967. Un nuevo subgénero de *Bulimulus*. *Comunicaciones de la Sociedad Malacológica del Uruguay*, 2 (13): 89-93, two drawings, one photograph [see 53]. Montevideo.

Description of ***Bulimulus* (*Paracochlea*)** subg.n. on the basis of the sculpture of its protoconch, and its type species, ***B.* (*P.*) *willineri*** sp.n. from Jujuy: shell, maxilla, radula, lung and some information on the genitalia.

52. – HYLTON SCOTT, M.I. & LAPUENTE, E. 1968. Valor diagnóstico de la rádula para especies del género *Homalonyx* Orbigny. *Neotropica*, 14(44): 49-56, four text figures. La Plata. Reprinted by the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia," in *Extra, nueva serie*, 55 (1968). Buenos Aires.

Analysis of the characteristics known for *Homalonyx unguis* (Orbigny 1835) and a study of the genital anatomy and radula. They did not find any differential characteristic in the genitalia, but detected the existence of two radular types. They consider *H. patera* (Doering 1873) is a synonym of *H. unguis*. For the specimens with the second radular type, they describe ***H. gallardoi*** sp.n., from the Province of Buenos Aires.

53. – HYLTON SCOTT, M.I. 1968. *Bulimulus* (*Paracochlea*) *willineri* Hylton Scott. *Neotropica*, 14(44): 56, one photograph. La Plata.

Re-edition of the shell photograph of this species, which is the type of the subgenus described in [51], due to the low quality of the original printing. Some anatomical information is added to the diagnosis.

54. – HYLTON SCOTT, M.I. 1968. Endodóntidos neotropicales. III. *Neotropica*, 14(45): 99-102, four text drawings and two photographs. La Plata.

Description of ***Stephanoda mirabilis*** sp.n., from Bariloche, for material that was previously identified as *S. similis* (d'Orbigny) [see 41]. Descrip-tion of shell, radula, mandible, mantle, foot and genitals.

55. – HYLTON SCOTT, M.I. 1968. Répartition et biogéographie des Mollusques de Patagonie. In: Delamare Debouteville, C. & Rapoport, E. (Dir.). *Biologie de l'Amérique Australe*, 4: 269-273. CNRS-CONICET, Paris.

Account of climatic and biogeographic division of Patagonia into three main zones (northeastern steppe, southeastern steppe and western mountain zone), with mention of the most common terrestrial and freshwater mollusks found by the Delamare Debouteville's expedition.

56. – HYLTON SCOTT, M.I. 1969. Endodóntidos neotropicales. IV. *Neotropica*, 15(47): 59-63, 10 text drawings. La Plata. [See 66 below.]

Shell description of ***Stephanoda celinae*** sp.n. from Neuquén; ***S. perversa*** sp.n. from Neuquén, and ***Amphidoxa hasselae*** sp.n. from Chile.

57. – HYLTON SCOTT, M.I. 1970. Endodóntidos de la región austral americana. *Revista del Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" e Instituto Nacional de Investigación de las Ciencias Naturales, Ciencias Zoológicas*, 10(18): 267-296, 28 drawings. Buenos Aires.

Summary of knowledge on the Endodontidae from Southern Argentina. Dr. Hylton Scott refers here to *Radiodiscus coppingeri* (E.A. Smith): redescription of shell and a list of localities; *R. magellanicus* (E.A. Smith): only bibliographic references; *R. riochicoensis* Crawford: a study of shells, measurements and a list of localities; ***R. australis*** sp.n., from Isla de los Estados: shell; *Stephanoda lyrata* (Couthouy in Gould): redescription of shells, list of localities, animal, pallial organs, maxilla, radula and genitals; *S. patagonica* (Suter): citation and transcription of two previous descriptions of the shell; ***S. distincta*** sp.n., from Río Negro: shell; ***S. testalba*** sp.n., from Río Negro: shell, animal, radula and genitals; *Austrodiscus* (*Zilchogyra*) *leptotera* (Mab. & Roch.): shell, a list of localities, mantle and pallial organs, maxilla, radula and genitals; *A.* (*Z.*) *kuscheli* (Hylton Scott) comb.n.; *Payenia saxatilis* Gould: redescription of the shell, animal, mandible and radula, and ***Flammulina festiva*** sp.n., from Chile: a shell (holotype).

58. – HYLTON SCOTT, M.I. 1970. Nota referida a un pequeño Prosobranchia de Misiones. *Neotropica*, 16(50): 86-87, three drawings. La Plata. Reprinted by the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia," in *Extra, nueva serie*, 84(1970). Buenos Aires.

Description of ***Helicina hispida*** sp.n. on the basis of shells collected in the rainforest of Misiones. The shells apparently were from juvenile specimens.

59. – HYLTON SCOTT, M.I. 1970. Sobre *Lyrodes guaranitica* Doering. *Neotropica*, 16(50): 87-88, one drawing. La Plata. Reprinted by the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia," in *Extra, nueva serie*, 84 (1970). Buenos Aires.

Description of shells collected in Misiones and discussion of the variability of the sculpture, which usually forms strong spiral ribs that can be absent in other specimens.

60. – HYLTON SCOTT, M.I. 1970. El género *Pupoides* en Argentina. *Neotropica*, 16(50): 89-90, one drawing. La Plata. Reprinted by the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia," in *Extra, nueva serie*, 84 (1970). Buenos Aires.

Description of ***Pupoides centralis*** sp.n., from Córdoba, on the basis of the single shell collected.

61. – HYLTON SCOTT, M.I. 1971. *Homalonyx weyrauchi*, nueva especie de Tucumán (Gastropoda Succineidae). *Neotropica*, 17(52): 12-14, two drawings. La Plata.

Based on the criterion that the radula is a sufficient diagnostic feature for the species within this genus, a new species from Tucumán is described: radula and pallial system.

62. – HYLTON SCOTT, M.I. 1971. Novedades sobre gastrópodos serranos de la Argentina. *Neotropica*, 17(53): 73-78, six photographs. La Plata.

Shell description of ***Spixia paucidenta*** sp.n., from Córdoba, ***S. marmorata*** sp.n., from Salta, *S. champaquiana* (Doering) and ***Bulimulus (Scansiconchlea) costellatus*** sp.n., from Salta.

63. – HYLTON SCOTT, M.I. 1972. Horace Burrington Baker, 1889-1971. *Neotropica*, 18(55): 39. La Plata.

A brief obituary.

64. – HYLTON SCOTT, M.I. 1972. Lista de Gastropoda terrestres, principalmente endodóntidos, de Tierra del Fuego, Isla de Los Estados e islotes vecinos. *Neotropica*, 18(56): 67-72, five drawings. La Plata.

Citation, without description, of *Radiodiscus riochicoensis* Crawford, *R. australis* Hylton Scott, *Stephanoda lyrata* Gould, *Payenia saxatilis* Gould. Describes ***Austrodiscus (Zilchogyra) matteriae*** sp.n., from Bahía Buen Suceso, on the basis of one shell. Cites *Succinea magellanica* Gould. Comment on the scarce antecedents referring to *Happia (Austroselenites?) ordinaria* (Smith) and description of radula, shell and pallial complex. She concludes that the latter is not an Endodontidae, classifying it with the genus *Happia* (Systrophidae) and tentatively with the subgenus *Austroselenites*.

65. – HYLTON SCOTT, M.I. 1972. Abel Fornes, 1939-1972. *Neotropica*, 18 (57): 120. La Plata.

A brief obituary.

66. – HYLTON SCOTT, M.I. 1973. Endodóntidos neotropicales. IV. [*sic*] *Neotropica*, 19(59): 104-109, two drawings, six photographs. La Plata. NOTE: There is an error in the numbering of this series, and two papers appear as number IV (see [56]).

Shell description of ***Austrodiscus (Zilchogyra) paulistana*** sp.n., from Brazil, and ***Stephanoda rumbolli*** sp.n, from Islas Malvinas. The spelling of the former is to be corrected as *A. (Z.) paulistanus*.

67. – HYLTON SCOTT, M.I. 1973. Endodóntidos neotropicales. V. *Neotropica*, 19(60): 126-131, three drawings, six photographs. La Plata.

Describes the shell of ***Stephanoda antarctica*** sp.n. from Islas Malvinas,

Hirtudiscus gen.n. and its type species, ***H. hirtus*** sp.n. Adds information and illustrations on *Austrodiscus* (*Zilchogyra*) *cleliae* Weyrauch.

68. – M.I.H.S. 1973. [A note referring to the 20th anniversary of *Neotropica*]. *Neotropica*, 18(60): 131. La Plata.

69. – M.I.H.S. 1974. [A note referring to the foundation of the Asociación Malacológica Argentina]. *Neotropica*, 19(61): 47. La Plata.

70. – M.I.H.S. 1974. [A comment on: Oliveira H.P. & Rodríguez, H.H., *Diccionario Conquíleo-Malacológico*]. *Neotropica*, 19(62): 66. La Plata.

71. – HYLTON SCOTT, M.I. 1975. Endodóntidos neotropicales. VI. *Neotropica*, 21(64): 5-7, five drawings. La Plata.

Description of ***Austrodiscus calchaqui*** sp.n. from Tucumán, on the basis of one shell. Describes the second known specimen of *A.* (*Zilchogyra*) *matteriae* Hylton Scott, coming from Isla de los Estados, which is stated to be a paratype.

72. – M.I.H.S. 1975. A los entomólogos. *Neotropica*, 21(65): 71. La Plata.

A comment on the 50th anniversary of the Sociedad Entomológica Argentina.

73. – HYLTON SCOTT, M.I. 1975. Endodóntidos neotropicales. VII. *Neotropica*, 21(66): 119-121, three drawings. La Plata.

Description of ***Radiodiscus flammulata*** sp.n. (the spelling should be corrected to read *R. flammulatus*), from the Andes at Río Negro province.

74. – HYLTON SCOTT, M.I. 1975. Unas palabras a los suscriptores. *Neotropica*, 21(66): 121. La Plata.

Announcement that this will be the last number of *Neotropica* to be edited by its founders, after 20 years of continuity. They give the rights of the journal to the recently established Sociedad Zooológica del Plata.

75. – HYLTON SCOTT, M.I. 1975. Nota malacológica. *Neotropica*, 21(66): 122-124, two photographs. La Plata.

Describes ***Bulimulus*** (***Cochleornata***) subg.n. and its type species, ***B.*** (***C.***) ***ambarina*** sp.n. (the spelling must be corrected to *B.* (*C.*) *ambarinus*), from Jujuy: two shells.

76. – HYLTON SCOTT, M.I. 1978. Un reducto malacológico en el Uruguay. *Comunicaciones de la Sociedad Malacológica del Uruguay*, 5(35): 47-51, nine drawings in one plate. Montevideo.

The following species are reported in the Municipal Park at Punta del Este (Uruguay): *Zilchogyra janeirensis* (Thiele) comb.n.: shell; *Radiodiscus thomei* Weyrauch, ***Drepanostomella uruguayana*** sp.n.: shell, and *Microhappia*

brasiliensis Thiele: shell.

77. – HYLTON SCOTT, M.I. 1979. Información malacológica de la Campaña de la Transecta de Botánica de Patagonia Austral. *Neotropica*, 25(73): 3-8, three text drawings. La Plata.

A study of shells sorted from Bryophytes from southern Chile and Argentinean Patagonia, reporting the presence of *Radiodiscus riochicoensis* Crawford, *R. coppingeri* E.M. Smith, *Radiodiscus* sp., *Stephanoda rumbolli* Hylton Scott, *S. lyrata* Gould, *Payenia saxatilis* Gould, *Succinea magellanica* Gould, *Limnaea* [sic] sp., *Hydrobia hatcheri* Pilsbry. Description of ***Radiodiscus coarctatus*** sp.n., from Magallanes (51°50' S – 74°41' W): shell.

78. – HYLTON SCOTT, M.I. 1980. Comentario taxonómico. *Neotropica*, 26 (76): 169-170. La Plata.

Arguments in favour of the validity of the spellings *Radiodiscus riochicoensis* and *Zilchogyra lyrata*.

79. – HYLTON SCOTT, M.I. 1981. Sobre nuevas especies de *Guppya* Morch, 1867, (Gastropoda Ariophantidae). *Neotropica*, 27(78): 121-123, four text drawings. La Plata.

Description of the shells of ***Guppya carinata*** sp.n., from Misiones, and ***G. disconformis*** sp.n. from Chaco and Jujuy.

80. – HYLTON SCOTT, M.I. 1981. Referencia al género *Stephanoda* Albers, 1860 y la creación del género *Stephadiscus* n.gen. (Mollusca Endodontidae). *Neotropica*, 27(78): 123-126, three text drawings. La Plata.

Rejection of the spelling *Zilchogyra lyrata*, description of the new genus ***Stephadiscus***, with *Helix lyrata* as type species, and inclusion of the following species in the new genus: *Stephanoda celinae* Hylton Scott, *S. perversa* Hylton Scott, *S. distincta* Hylton Scott, *S. testalba* Hylton Scott, *S. rumbolli* Hylton Scott, *S. antarctica* Hylton Scott. Description of ***S. striatus*** sp.n. from Salta: shell.

81. – HYLTON SCOTT, M.I. 1984. Anotaciones sobre el género *Guppya* Morch, 1867 (Mollusca Pulmonata). *Neotropica*, 30(83): 89-95, two text drawings. La Plata.

From the study of 140 shell samples of this genus cited here are *Guppya aena* [*sic*] Hylton Scott, *G. lilloana* Hylton Scott (with an explanation on its spelling), *G. mayi* Baker, originally described from Brazil and cited here for the first time from Río de La Plata, *G. disconforme* Hylton Scott, 1981 (incorrect subsequent spelling). Description of ***G. altispira*** sp.n., from Bolivia.

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