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Zoological Garden, Prague

**WEIGHT AND BODY SIZE OF THE POPULATION OF THE COLLARED
TURTLE DOVE (STREPTOPELIA D. DECAOCTO FRIV.)**

SYLVIE DVOŘÁKOVÁ-GRUNDOVÁ

Received November 28, 1968

Abstract: The present paper summarizes the data on the weight and the body size of the population of the Collared Turtle Dove (*Streptopelia d. decaocto*) inhabiting the Zoological Garden of Prague. Most of the standard measures used in ornithology were determined statistically on significant material. The sexual dimorphism of individual measures was verified by the t-test. The values for subadult individuals are given according to the weight categories. The comparison with the data from the literature concerning above all the length of the wing and the tail makes some earlier data on a smaller number of experimental material more precise. This offers new possibilities of evaluation of the subspecies of *Streptopelia decaocto*.

MATERIAL AND METHODS

Locality: Zoological Garden, Prague, Czechoslovakia; altitude above the sea level 180-200 m.
Material: 279 specimens obtained during 1962-65

| | Total | ♂♂ | ♀♀ |
|----------|-------|----|----|
| Adult | 149 | 79 | 70 |
| Subadult | 127 | 65 | 62 |

Note: Subadult birds were differentiated according to the development of the bursa Fabricii.

The body weight was determined by means of a laboratory balance with a precision of ± 3 g, occasionally by a spring balance, mark Pesola, with a precision of ± 5 g. The body size was measured by means of a slide rule with a precision of ± 1 mm. The current symbols according to Fisher, R. A., and Yates F., 1949 were used for the statistical evaluation.

The following values were determined:

Body weight (with full digestive tract).

Head, bill length (from the apical end of the maxilla to the mouth corners); bill width (between the corners); head length (from the end of the bill to the foramen occipitale).

Wing, length of the humerus; length of ossa antebrachii; length of carpometacarpus plus phalanges; wing length.

Tail, tail length.

Foot, length of the femur; length of the tibia; length of the tarsometatarsus; length of individual digits.

Sternum, length of crista sterni.

Pelvis, distance between the acetabuli; distance between the pubal bones.

Spine, length from foramen occipitale to the pygostyle.

RESULTS

The data and the statistical evaluation are indicated by table 1.

Note 1. Annual average. The changes of the body weight throughout the year are in direct connection with the physiological changes of the

organism, above all the sexual activity. This dependence was studied in the paper by Grundová, 1965.

The sexual dimorphism in the body size, verified by the t-test, is given in table 2.

Note 2: The length of the tail showed no statistically significant difference, even if the limiting values for the females were smaller as compared with those for males.

Table 1. Body weight and sizes — basic and statistical data

| | Sex | n | \bar{x} | x_{min} | x_{max} | s | s_x |
|------------------------------------|-----|----|-----------|-----------|-----------|-------|-------|
| Head | | | | | | | |
| bill length | ♂♂ | 76 | 22.64 | 19 | 25 | 1.19 | 0.13 |
| | ♀♀ | 70 | 22.14 | 20 | 25 | 1.22 | 0.14 |
| bill width | ♂♂ | 76 | 9.47 | 8 | 12 | 0.96 | 0.11 |
| | ♀♀ | 70 | 9.60 | 8 | 14 | 1.05 | 0.12 |
| head length | ♂♂ | 75 | 49.60 | 46 | 52 | 1.02 | 0.11 |
| | ♀♀ | 68 | 48.64 | 46 | 52 | 1.20 | 0.14 |
| Wing humerus | | | | | | | |
| ossa antebrachii | ♂♂ | 79 | 46.97 | 36 | 53 | 3.93 | 0.44 |
| | ♀♀ | 70 | 46.38 | 35 | 55 | 9.07 | 1.08 |
| carpometacarpus + + phalangae | ♂♂ | 79 | 51.62 | 43 | 56 | 2.41 | 0.27 |
| | ♀♀ | 70 | 51.10 | 46 | 54 | 2.03 | 0.24 |
| wing length | ♂♂ | 79 | 54.46 | 45 | 61 | 3.10 | 0.34 |
| | ♀♀ | 70 | 54.00 | 45 | 62 | 3.38 | 0.40 |
| wing length | ♂♂ | 40 | 174.60 | 163 | 189 | 5.10 | 0.80 |
| | ♀♀ | 44 | 170.01 | 151 | 183 | 6.22 | 0.93 |
| Tail | | | | | | | |
| tail length | ♂♂ | 39 | 132.89 | 120 | 151 | 7.37 | 1.18 |
| | ♀♀ | 40 | 130.22 | 114 | 173 | 12.93 | 2.04 |
| Foot | | | | | | | |
| femur | ♂♂ | 79 | 36.72 | 33 | 44 | 2.37 | 0.26 |
| | ♀♀ | 70 | 36.05 | 32 | 42 | 1.98 | 0.23 |
| tarsotibia | ♂♂ | 78 | 46.55 | 38 | 52 | 3.13 | 0.37 |
| | ♀♀ | 70 | 44.71 | 38 | 50 | 2.87 | 0.34 |
| tarsometatarsus | ♂♂ | 79 | 28.89 | 20 | 33 | 2.28 | 0.24 |
| | ♀♀ | 70 | 27.98 | 21 | 33 | 2.37 | 0.24 |
| 1st digit | ♂♂ | 79 | 19.31 | 17 | 23 | 1.28 | 0.13 |
| | ♀♀ | 69 | 18.97 | 17 | 22 | 1.28 | 0.15 |
| 2nd digit | ♂♂ | 78 | 23.30 | 20 | 26 | 1.20 | 0.13 |
| | ♀♀ | 68 | 22.61 | 20 | 27 | 1.44 | 0.17 |
| 3rd digit | ♂♂ | 78 | 29.88 | 26 | 35 | 1.88 | 0.21 |
| | ♀♀ | 65 | 30.88 | 25 | 35 | 2.42 | 0.30 |
| 4th digit | ♂♂ | 79 | 23.18 | 19 | 27 | 2.42 | 0.27 |
| | ♀♀ | 68 | 22.98 | 18 | 28 | 2.10 | 0.25 |
| Sternum length of crista sterni | ♂♂ | 72 | 63.40 | 56 | 70 | 2.82 | 0.33 |
| | ♀♀ | 70 | 62.50 | 57 | 70 | 2.43 | 0.28 |
| Pelvis pub. distance | ♂♂ | 73 | 10.65 | .5 | 17 | 2.88 | 0.26 |
| | ♀♀ | 67 | 11.11 | 8 | 16 | 1.92 | 0.23 |
| acetab. dist. | ♂♂ | 72 | 27.30 | 23 | 33 | 2.01 | 0.23 |
| | ♀♀ | 66 | 27.42 | 22 | 34 | 1.92 | 0.23 |
| Spine length | ♂♂ | 78 | 154.15 | 141 | 170 | 5.70 | 0.64 |
| | ♀♀ | 70 | 151.65 | 141 | 165 | 5.72 | 0.68 |
| Body weight | ♂♂ | 62 | 210.66 | 160 | 250 | 21.17 | 2.68 |
| | ♀♀ | 65 | 202.38 | 170 | 240 | 17.75 | 2.22 |

Table 2. Sexual dimorphism of body size, by t-test

| | N | t | P | $\bar{x}_1 - \bar{x}_2$ | \bar{x}_{33} | \bar{x}_{22} | significance |
|----------------------------------|-----|------|-----------|-------------------------|----------------|----------------|--------------|
| Head | | | | | | | |
| bill length | 144 | 2.93 | 0.003 | 0.50 | 22.64 | 22.14 | +++ |
| bill width | 144 | 0.21 | P > 0.05 | 0.03 | 9.47 | 9.50 | - |
| head length | 141 | 5.64 | P < 0.001 | 0.98 | 49.60 | 48.64 | +++ |
| Wing | | | | | | | |
| humerus | 147 | 0.50 | P > 0.05 | 0.59 | 46.97 | 46.38 | - |
| ossa antebrachii | 147 | 1.52 | P > 0.05 | 0.52 | 51.62 | 51.10 | - |
| carpometacarpus + + phalangae | 147 | 3.28 | 0.001 | 0.46 | 54.46 | 54.00 | +++ |
| wing length | 82 | 3.68 | P < 0.001 | 4.49 | 174.50 | 170.01 | +++ |
| Tail | | | | | | | |
| tail length | 77 | 1.13 | P > 0.05 | 2.67 | 132.89 | 130.22 | - note 2. |
| Foot | | | | | | | |
| femur | 147 | 2.03 | 0.038 | 0.67 | 36.72 | 36.05 | + |
| tarsotibia | 146 | 3.83 | P < 0.001 | 1.84 | 46.55 | 44.71 | +++ |
| tarsometatarsus | 147 | 2.67 | 0.007 | 0.91 | 28.89 | 27.98 | +++ |
| 1st digit | 146 | 2.00 | 0.038 | 0.34 | 19.31 | 18.87 | + |
| 2nd digit | 144 | 4.05 | P < 0.001 | 0.69 | 23.30 | 22.61 | +++ |
| 3rd digit | 141 | 2.72 | 0.006 | 0.98 | 30.86 | 29.98 | +++ |
| 4th digit | 145 | 0.55 | P > 0.05 | 0.20 | 23.18 | 22.98 | - |
| Sternum | | | | | | | |
| length of crista sterni | 140 | 2.19 | 0.027 | 0.90 | 63.40 | 62.50 | + |
| Pelvis | | | | | | | |
| pub. distance | 138 | 1.39 | P > 0.05 | 0.46 | 10.65 | 11.11 | - note 3. |
| acetab. dist. | 136 | 0.88 | P > 0.05 | 0.12 | 27.30 | 27.42 | - |
| Spine | | | | | | | |
| length | 146 | 2.71 | 0.005 | 2.50 | 154.15 | 151.65 | +++ |
| Body weight | 125 | 2.35 | 0.025 | 8.18 | 210.56 | 202.38 | +++ |

Note 3: Although it was possible to assume different data on the distance of the pubal bones between the males and the females, yet there was not found any difference. The determination of the connection between the degree of sexual activity in the females and the pubal width of the pelvis resulted in the following data:

| | | |
|------------|------------------|--------|
| 1st degree | $\bar{x} = 10.9$ | n = 26 |
| 2nd degree | $\bar{x} = 10.3$ | n = 26 |
| 3rd degree | $\bar{x} = 11.0$ | n = 6 |
| R. degree | $\bar{x} = 11.8$ | n = 6 |

Neither the average nor the limiting values (e.g. for the 1st degree 9—13 mm, for the 3rd 8—14 mm) showed any difference.

Body sizes of subadult individuals (Tab. 3).

The body sizes were estimated according to individual weight categories, i.e. from 130 to 230 g. The age could not be determined more precisely by this method.

In total it is possible to say that neither in the lowest categories of the body weight (130, 140 g) did the young birds differ from the old ones. Even if the total average was lower, we found the data on their body weight

Table 3. Body sizes of subadult individuals of *Streptopelia d. decacota*

| | 130 g | | 140 g | | 150 g | | 160 g | | 170 g | |
|-----------------------------|-------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| | ♂♂ | ♀♀ | ♂♂ | ♀♀ | ♂♂ | ♀♀ | ♂♂ | ♀♀ | ♂♂ | ♀♀ |
| Head | | | | | | | | | | |
| bill length | 21 | 22-23 | 20-21 | 21-22 | 22-23 | 20-24 | 21-23 | 20-24 | 21-24 | 23-24 |
| bill width | 11 | 9-10 | 8-10 | 9-11 | 10-11 | 8-11 | 9-10 | 9-10 | 9-11 | 9 |
| head length | 49 | 47-50 | 48-49 | 47-50 | 50 | 46-50 | 49-52 | 46-51 | 48-50 | 49 |
| Wing | | | | | | | | | | |
| humerus | 45-51 | 39-46 | 45-46 | 44-45 | 44-46 | 36-48 | 39-47 | 42-49 | 45-49 | 44-45 |
| ossa antebrachii | 49-51 | 50-53 | 51-52 | 50-52 | 50-54 | 48-56 | 48-56 | 49-56 | 51-53 | 48 |
| carpometacarpus + phalangae | 49-56 | 48-61 | 49-51 | 53-57 | 48-56 | 51-57 | 50-55 | 48-59 | 54-58 | 45-61 |
| wing length | 165 | 165-177 | 162-166 | 163-164 | 167-177 | 165-167 | 163-178 | 164-176 | 164-178 | - |
| Tail length | 118 | 110-124 | 113-124 | 107-116 | 112-136 | 111-130 | 126-131 | 120-142 | 122-131 | - |
| Foot | | | | | | | | | | |
| femur | 37-38 | 33-38 | 35-39 | 32-35 | 34-37 | 34-42 | 34-36 | 31-36 | 34-39 | 39 |
| tarsotibia | 45-47 | 41-49 | 43-44 | 43-45 | 40-46 | 41-48 | 42-46 | 41-47 | 40-47 | 45-46 |
| tarsometatarsus | 28-29 | 28-31 | 27-30 | 24-29 | 25-29 | 27-32 | 20-29 | 25-32 | 26-32 | 29-30 |
| 1st digit | 17-20 | 18-22 | 18-20 | 19-20 | 18-22 | 19-21 | 19-21 | 19-20 | 19-21 | 20-21 |
| 2nd digit | 21-22 | 21-25 | 22-25 | 20-23 | 22-25 | 20-23 | 23-24 | 21-24 | 23-25 | 22-23 |
| 3rd digit | 27-32 | 29-31 | 27-30 | 24-30 | 27-31 | 27-30 | 29-30 | 25-32 | 29-36 | 29 |
| 4th digit | 22-25 | 20-26 | 22-24 | 18-24 | 20-24 | 21-24 | 21-24 | 19-25 | 23-28 | 21-22 |
| Sternum | | | | | | | | | | |
| length of crista sterni | 59-65 | 55-63 | 55-63 | 55-59 | 60-64 | 61-64 | 59-64 | 59-63 | 60-66 | 60-64 |
| Pelvis | | | | | | | | | | |
| pub. distance | 5-10 | 4-9 | 4-11 | 8-9 | 5-8 | 9-11 | 8-11 | 9-11 | 5-13 | 9-11 |
| acetab. dist. | 24 | 23-25 | 24-27 | 20-27 | 26-28 | 22-26 | 22-29 | 25-29 | 26-31 | 26-27 |
| Spine length | 130 | 145-151 | 142-152 | 135-144 | 142-171 | 140-148 | 131-155 | 142-148 | 144-148 | 138-149 |

Table 3.

| | 180 g n = 19 | | 190 g n = 20 | | 200 g n = 22 | | 210 g n = 10 | | 220 g n = 10 | | 230 g n = 2 | |
|-----------------------------|--------------|---------|--------------|---------|--------------|---------|--------------|-------|--------------|---------|-------------|----|
| | ♂♂ | ♀♀ | ♂♂ | ♀♀ | ♂♂ | ♀♀ | ♂♂ | ♀♀ | ♂♂ | ♀♀ | ♂♂ | ♀♀ |
| Head | | | | | | | | | | | | |
| bill length | 20-25 | 21-24 | 19-24 | 20-25 | 20-24 | 20-24 | 21-24 | 22 | 21-25 | 22-25 | 23 | - |
| bill width | 9-11 | 8-10 | 8-10 | 8-11 | 9-11 | 7-10 | 9-10 | 8-9 | 9-10 | 9 | 9-10 | - |
| head length | 48-50 | 45-51 | 48-50 | 48-50 | 49-51 | 48-50 | 48-51 | 47-48 | 49-51 | 48-51 | 50 | - |
| Wing | | | | | | | | | | | | |
| humerus | 45-49 | 39-48 | 46-52 | 39-53 | 42-52 | 42-51 | 43-49 | 40-49 | 44-51 | 46-52 | 41-52 | - |
| carpometacarpus + phalangae | 46-54 | 47-53 | 49-52 | 49-55 | 48-55 | 44-54 | 48-54 | 48-53 | 48-53 | 51-54 | 50-51 | - |
| wing length | 51-64 | 50-60 | 47-55 | 47-51 | 50-59 | 50-56 | 50-54 | 54-56 | 51-50 | 55-56 | 56-59 | - |
| tail length | 173-175 | 162-169 | 160-173 | 171-174 | 174-178 | 166-173 | - | - | 175 | 172 | - | - |
| | 126-134 | 123-126 | 128-131 | 119-126 | 127-144 | 120-127 | - | - | 146 | 125 | - | - |
| Foot | | | | | | | | | | | | |
| femur | 33-39 | 33-47 | 31-39 | 33-40 | 35-45 | 33-38 | 36-39 | 37-42 | 35-45 | 36-38 | 39-40 | - |
| tarsotibia | 43-48 | 35-49 | 37-46 | 43-49 | 42-50 | 41-49 | 44-49 | 42-52 | 44-50 | 43-49 | 47-50 | - |
| tarsometatarsus | 24-32 | 26-32 | 26-31 | 22-35 | 22-31 | 31 | 27-34 | 26-31 | 28-30 | 31-32 | 25-31 | - |
| 1st digit | 19-25 | 18-24 | 17-21 | 16-23 | 18-24 | 18-22 | 18-20 | 18-19 | 17-22 | 18-21 | 18-23 | - |
| 2nd digit | 21-27 | 21-26 | 21-26 | 22-27 | 22-26 | 23-24 | 22-25 | 23-24 | 21-26 | 21-25 | 21-25 | - |
| 3rd digit | 26-33 | 28-32 | 27-32 | 27-32 | 26-31 | 27-33 | 28-33 | 28-30 | 28-32 | 27-34 | 28-34 | - |
| 4th digit | 20-26 | 20-25 | 21-23 | 21-24 | 21-26 | 20-24 | 23-26 | 22-25 | 22-26 | 19-25 | 22-25 | - |
| Sternum | | | | | | | | | | | | |
| length of crista sterni | 61-69 | 55-65 | 60-68 | 59-69 | 60-67 | 60-67 | 56-67 | 61-64 | 62-69 | 63-65 | 66-67 | - |
| Pelvis | | | | | | | | | | | | |
| pubal. dist. | 6-14 | 9-14 | 12 | 6-16 | 8-12 | 8-12 | 8-12 | 8-14 | 6-13 | 8-16 | 11 | - |
| acetab. dist. | 27-31 | 19-30 | 26-33 | 25-31 | 27-31 | 28-28 | 23-29 | 27-29 | 26-30 | 30-31 | 29-30 | - |
| Spine length | 150-155 | 144-158 | 145-155 | 142-158 | 143-158 | 140-155 | 149-167 | 159 | 153-157 | 150-159 | - | - |

within the varietal range of old birds. See the humerus, carpometacarpus plus phalangae, wing length, tail length, the 3rd digit, the sternum, the pelvis (pubal and acetabular widths), and spine length.

DISCUSSION

Niethammer (1962) and also Stresemann and Nowak (1958) report that the migrating population of the Collared Turtle Dove does not differ by the body sizes from the original one, i.e. the Balkan population; the different climatic conditions could not influence the structure and the size of the body within the short period of 30 years during which the invasion was taking place. This basic principle has also been confirmed by the results obtained by the author as compared with the data from the literature on the length of the tail (see Tab. 4). The wider interval in the measures of the 2nd digit, i.e. 20–33 mm, in contrast to Stresemann's data (1920), namely 23–26 mm, or Niethammer's (1962), namely 22–26 mm, may be explained by the larger number of experimental material the author had at her disposal.

Table 4. Comparison of the literature

| | | ♂♂ | ♀♀ | |
|--------------------------------|-----------------------------------|---------|---------|----------------------|
| Wing length: | | | | |
| Balkan | Macedonia | 179–185 | 177–179 | Vaurie, Ch., 1961 |
| | Macedonia | 172–185 | 170–184 | Stresemann, E., 1920 |
| | Albania | 185 | | Vaurie, Ch., 1961 |
| | Turkey | 178 | | Vaurie, Ch., 1961 |
| NW a. M. | | 170–188 | | Hartert, E., 1921 |
| Europe | | 176–185 | 174–178 | Bodenstein, G., 1950 |
| | Herford | 188 | 185 | Lachner, R., 1965 |
| | Köln/R. | 172–184 | 163–184 | Niethammer, G., 1962 |
| | Praha | 163–189 | 153–183 | author |
| India | Kushka-Murgab | 164–173 | 160–174 | Dementjev, G., 1951 |
| | | 161–171 | 160–173 | Roonwal, M. L., 1940 |
| | | 162–182 | 167–177 | Vaurie, Ch., 1961 |
| | | 174–185 | 172–184 | Vaurie, Ch., 1961 |
| China | <i>Streptopelia d. stoliczkae</i> | 175–191 | 169–188 | Dementjev, G., 1951 |
| | | 176–187 | 169–175 | Roonwal, M. L., 1940 |
| | | 180–190 | | Nowak, E., 1965 |
| | | | | |
| Tail length: | | | | |
| | | 140–149 | 130–137 | Bodenstein, G., 1950 |
| | | 130–153 | 121–144 | Niethammer, G., 1962 |
| | | 136–150 | 128–143 | Roonwal, M. L., 1940 |
| | | 132–150 | 125–143 | Stresemann, E., 1920 |
| | | 120–151 | 114–138 | author |
| Carpometatarsus length: | | | | |
| | | 23–26 | 22–26 | Niethammer, G., 1962 |
| | | 23–25 | 22–23 | Roonwal, M. L., 1940 |
| | | 23–26 | 23–26 | Stresemann, E., 1920 |
| | | 20–33 | 21–33 | author |

Wing length: Table 4 compiles the data of various authors according to the zoogeographical regions. The European population for instance does not differ by the wing length from the original Balkan population. The data on the Chinese and Japan populations display an identical varietal width. However, the measures obtained by Vaurie (1962) from India show conspicuous deviations. The population he studied had on the average a smaller

wing length. It is true that the maximum values reached identical values as compared with those of the European population (for males 182—189 mm, for females 177—183 mm), but in total minimum values prevailed and also the total average (of a sufficient material) was lower. The difference in the average values was verified by the t-test and it was found to be statistically significant: for males $N = 78$, $t = 2.98$, $x_1 = 174.50$, $x_2 = 170.17$, for females $N = 64$, $t = 2.41$, $x_1 = 170.01$, $x_2 = 166.68$. The data given by Dementjev (1951) from the Kushka-Murgab region (Turkmenyia) correspond zoogeographically, similarly as the dimensions, with the Indian population.

To make this more precise, the author studied the dependence between the wing length and the body weight in both adult and subadult birds. She did not find a direct dependence between the values; the value of the coefficient of correlation being $r = 0.48$. The author arrived at the conclusion that very young (weight 130 g) and adult birds have the same values of the wing lengths. So we may neglect the argument that the Indian population would contain subadult specimens.

The author's results support from the systematical point of view the assumptions of Vaurie (1961) and Hartert (1921), who recognized the validity of only two subspecies of *Streptopelia decaocto*, i.e. *S. d. decaocto* and *S. d. xanthocyclus*.

Note: Most of the authors differentiate three subspecies, i.e. *S. decaocto decaocto*, *S. d. stoliczkae*, and *S. d. xanthocyclus*. The differentiating characteristic feature for the two former subspecies is, in addition to the colour and the size of the white spots on the retrices, the length of the wing. Vaurie points to the difficulty with which the nominate race is differentiated according to the colour and the size of the white spots on the retrices. The author's data may help to explain the difference in the length of the wing. The data on *S. d. stoliczkae* (180—190) mm fit in the found varietal range of the *S. d. decaocto*.

CONCLUSION

- (1) Data were evaluated on the body weight and the body size of the population of the Collared Turtle Dove (*Streptopelia decaocto*). In total 279 birds were examined. Of these 149 adult birds (79 males and 70 females) and 127 subadult ones with developed bursa Fabricii (65 males and 62 females).
- (2) The basic values of individual measures and weights are given in Tabs. 1 and 2.
- (3) Subadult individuals showed that neither in the lowest weight categories (130—140 g) do young birds differ by their dimensions from adult ones.
- (4) Data on the length of the wing were compared with the data in the literature. The European population does not differ from the Balkan population, while the Indian population (incl. the data from Turkmenyia) show a statistically significant difference as compared with the European population. The measures for the subspecies *S. d. stoliczkae* fit within the found varietal range of the subspecies *S. d. decaocto*.

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ÜBER DIE UNTERARTEN
VON *ABLEPHARUS KITAIBELII* (BIBRON & BORY DE ST. VINCENT, 1833)
(SAURIA; SCINCIDAE)

ION E. FUHN

Eingegangen am 15. Juli 1968

Abstrakt: Die Revision der polytypischen Art *Ablepharus kitaibelii* (Bibron & Bory, 1833) ergab folgende Unterarten: *A. kitaibelii fitzingeri* Mertens, 1953; *A. kitaibelii stepaneki* n. ssp.; *A. kitaibelii kitaibelii* (Bibron & Bory, 1833); *A. kitaibelii fabichi* Štěpánek, 1938 und *A. kitaibelii chernovi* Darevsky, 1953.

A. kitaibelii chernovi galt als eigene Art; die Unterart *stepaneki* wurde von der ssp. *fitzingeri* abgetrennt. Für jede Form wird eine kurze Beschreibung, die Verbreitung, Fundorte und der Biotop angegeben.

Štěpánek (1938, 1944) hat die polytypische Struktur von *Ablepharus kitaibelii* (Bibron & Bory, 1833) grundlegend untersucht. Mertens & L. Müller (1940), Mertens & Wermuth (1960) und Fuhn & Vancea (1961) vertreten dieselbe systematische Ansicht, wonach diese Art in drei Subspezies zerfällt: *kitaibelii* (Bibron & Bory, 1833), *fitzingeri* Mertens 1952 und *fabichi* Štěpánek, 1938.

Es bleibt ein besonderer Verdienst Štěpánek's, dass er diese drei Rassen unterschieden hat, denn wie auch Wettstein (1953 : 785) später bemerkte „der Unterschied zwischen *kitaibelii* und *fitzingeri* ist wohl sehr gering“.

Der Vergleich der rumänischen Populationen mit Serien von Johannisechsen aus verschiedenen Fundorten ihres Areals, ergab manche Fragen und machte weitere Untersuchungen notwendig, deren Ergebnisse hier erörtert werden.

GEOGRAPHISCHE VARIATION DER MERKMALE

Folgende Merkmale, bzw. ihre geographisch gerichtete Variation wurden von Štěpánek (op. cit.) beachtet: Gestalt; Kopfbreite; Länge der Extremitäten; Länge der vierten Zehe; Zahl der vorderen Supralabialia; Zahl der Schuppenreihen um die Mitte des Rumpfes; Verhältnis der Schwanzlänge zum Rumpf; Färbung, bzw. Zeichnung des Rückens.

Die Diagnosen der drei von Štěpánek unterschiedenen Unterarten können in folgender Weise aufgestellt werden (Tabelle 1).

Nach Štěpánek gehören die nördlichen, slowakischen und ungarischen Populationen, ferner die rumänischen und bulgarischen, der Unterart *pannonicus* (= *fitzingeri*) an, alle südlichen hingegen (einschliesslich Griechenland)

sind der Unterart *kitaiibeli* zuzurechnen. Eine Ausnahme bilden die auf einigen kleinen östlich von Kreta liegenden Inseln lebenden Skinke, die als besondere Unterart (*fabichi*) aufgefasst werden. Štěpánek entschied sich erst in seiner zweiten (1944) Veröffentlichung über *Ablepharus*, die nördlichen Populationen von den südlichen als verschiedene Taxone zu betrachten und schreibt (1944 : 141) dass „genaue Grenzen zwischen beiden Rassen heute schwer zu beurteilen sind“.

Tabelle 1

| Merkmale | <i>fitzingeri</i> | <i>kitaiibeli</i> | <i>fabichi</i> |
|--|--|--|--|
| 1 — Gestalt | gross, robust | auffallend schlank | gross, robust |
| 2 — Kopfbreite | auffallend breit | schmal | breit |
| 3 — Länge der Gliedmassen | kurz, stark | schwach und dünn | auffallend lang und stark |
| 4 — Länge der 4. Zehe | kurz | kurz | lang u. schlank (5 mm) |
| 5 — Verhältnis der Schwanzlänge zur Rumpflänge | 2 : 1 | 2,7 : 1 | — |
| 6 — Zahl der vorderen Supralabialia | 4 (bzw. 63 %) | 3 | 3 |
| 7 — Zahl der Schuppenreihen um die Mitte des Rumpfes | 20—22 | 18 | 20 |
| 8 — Färbung und Zeichnung | licht, grünlicher Glanz, 4—6 Längsreihen kleiner, weisser, schwarz gesaumter Flecken | dunkel oder schokoladenbraun; ohne Zeichnung | hell braungrün mit Perlmutterglanz, 2—4 Reihen schwarz-weisser Flecken |

Obwohl Štěpánek ein umfangreiches Material aus verschiedenen Fundorten untersucht hat (160 Stücke), werden biometrische Angaben über grössere Serien nicht veröffentlicht. Uns lagen etwa 153 Stücke vor (nämlich: Attika — 17, Delos — 6, Rhodos — 4, Cypern — 21, Mikronisi — 9, Syrien — 3, Israel — 19, Rumänien — 60, Bulgarien — 5, Ungarn — 9) vor; die Variation ihrer Merkmale wird in Tabelle 2 gegeben.

Bezüglich der Variabilität der in Betracht genommenen Merkmale, lässt sich folgendes erörtern:

Gestalt und Masse (Kopf-Rumpflänge) — ♂♂ stets kleiner als die ♀♀ — schwankt zwischen ähnlichen Werten bei den Populationen aus der ČSSR, Ungarn, Rumänien und Bulgarien, zeigt etwas kleinere Werte in Griechenland und den Aegäischen Inseln (mit Ausnahme der Populationen östlich von Kreta, die mit den rumänischen gut übereinstimmen) und ist am zierlichsten in Israel. Die Abmessungen des Kopfes sind auch geringer bei den griechischen, ägäischen und israelischen Populationen. Die Gliedmassen sind, wie allgemein bekannt, exakt nur schwer zu erfassen. Es ist aber unverkennbar, dass die Vertreter südlicher Populationen kürzere Beine haben. Der Versuch die Segmente genau zu messen ergab für Rumänien-Vorderbeine 7 mm, Hinterbeine 9,5 mm; östlich von Kreta — Vb 9 mm, Hb 12 mm;

Israel — Vb 5 mm, Hb 8 mm. Gleichzeitig mit der Verkürzung, werden die Gliedmassen auffallend dünn und zierlich, wie aus der Abb. 6 klar zu erkennen ist. Die Länge der vierten Zehe ist nur bei den *fabichi*-Populationen besonders gross. Das Verhältnis von Rumpflänge zur Schwanzlänge, sowie der Abstand der Gliedmassen zur Rumpflänge (etwa 1,7 bei den ♂♂ und 1,5 bei den ♀♀) zeigen keine bemerkenswerten Unterschiede. Die Zahl der Schuppenreihen um die Mitte des Rumpfes variiert von 18—22. Die nördlichsten Populationen (ČSSR) haben eine höhere Zahl als die südlichsten (Israel), aber zwischen diesen zeigt dieses Merkmal ein Gefälle, das mit den „Grenzen“ der Unterarten nicht übereinstimmt. Färbung und Zeichnung gestatten eine Trennung zwischen den Populationen aus der ČSSR, Ungarn, Rumänien und Bulgarien einerseits und denen Griechenlands, der Aegäis und Israel's andererseits. Desgleichen, werden die Populationen der ČSSR und Ungarns von denen Rumäniens, Bulgariens, Griechenlands, der Aegäis und Israel's durch die Zahl der vorderen Supralabialia getrennt.

Es ist eine bemerkenswerte Tatsache dass die *Ablepharus*-Populationen aus den Inseln östlich Kretas, trotz ihrer zentralen Lage inmitten der südlichen Populationen nicht wie es zu erwarten wäre den benachbarten, sondern den nördlichen Populationen am nächsten stehen. In Hinsicht auf die mosaikartige Verbreitung von *Ablepharus* liegt die Vermutung nahe, dass jene Populationen einen überlebenden Rest eines ursprünglichen conspezifischen Astes von *kitaibelii* darstellen, der jetzt durch die jüngere südliche Form fast allgemein ersetzt wurde.

DIE INNERARTLICHE GLIEDERUNG VON ABLEPHARUS KITAIBELII

Die subspezifische Gliederung der *kitaibelii*-Populationen ist demnach nicht stark geprägt. Man ist zunächst geneigt, die Art nicht aufzuspalten (Štěpánek, 1938). Eine nähere Betrachtung der Merkmal-Variationen erlaubt dennoch Unterarten zu unterscheiden, die der natürlichen Gliederung entsprechen. Es werden folgende Subspezies getrennt:

1. *Ablepharus kitaibelii fitzingeri* Mertens, 1952

A. kitaibelii fitzingeri Mertens, 1952, Zool. Anz. 149, 1/2 : 48. Holotypus: ZM Berlin, verloren [nom. nov. pro *Ablepharus pannonicus* (Fitzinger, 1823)] — Terra typica restricta (Mertens & Wermuth, 1960): Ofen, Budapest, Ungarn.

Diagnose. Körper kräftig, untersetzt, Kopf breit (5 mm), 4 vordere Supralabialia (bzw. ein doppeltes drittes Supralabiale, durch zusammenfliessen der Supralabialia 3 und 4); Schuppenreihen um die Mitte des Rumpfes 20—22. Deutliche Rückenzeichnung aus schwarzweissen unterbrochenen Längslinien.

Verbreitung. ČSSR (Slowakei), Ungarn.

Bemerkungen. In der ČSSR, zeigen fast alle Individuen 4 Supralabialia

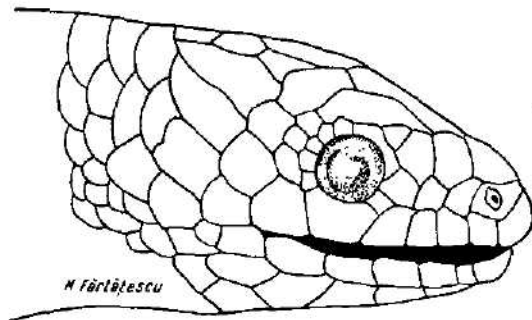


Abb. 1. — *Ablepharus k. fitzingeri*: Seitenansicht des Kopfes (4 vordere Supralabialia)

Štěpánek, in litt.). Obwohl noch keine Bearbeitung von grösseren Serien ungarischer Populationen vorliegt, lässt sich eine gewisse Intergradierung bemerken (Auftreten von Stücken mit 3 Supralabialia).

2. — *Ablepharus kitaibelii kitaibelii* (Bibron & Bory de St. Vincent, 1833)

Ablepharus kitaibelii Bibron et Bory, 1833, in Bory, Expéd. sci. Morée, 3, 1: 69. Holotypus: MNHN Paris Nr. 5392 — Terra typica restricta (Mertens & L. Müller, 1923): Ruinen von Pylos, Messonien.

Diagnose. Körper schlank, Kopf klein und schmal (Länge 5 mm, Breite 4 mm), Gliedmassen kurz und auffallend zierlich; 3 vordere Supralabialia; Schuppenreihen um die Mitte des Körpers 18—20; Rückenzeichnung fehlt oder nur durch feine Punkte bzw. Striche angedeutet.

Verbreitung. Griechenland, Aegäis, Türkei, Cypern, Rhodos, Syrien, Israel, Transjordanien, Irak (?), Halbinsel Sinai.

Bemerkungen. Es ist wohl anzunehmen, dass intergradierende Populationen im Süden Jugoslawiens, in Albanien und Bulgarien vorkommen.

3. — *Ablepharus kitaibelii stepaneki* n. ssp.

Holotypus: MIN G. Antipa Bukarest Nr. 150, Paratypen: IBTS Bukarest Nr. 839—872; 1793—94; 1906—908; 1921; 1925; 1931; 1978—79; 1992; 1995; 2040; 2071; 2126—27; 2306 bis 309; 2583; 2610 — Terra typica: Cernica Wald (Bukarest), Rumänien.

Diagnose. Körper kräftig, Kopf breit (5 mm), Gliedmassen stark, 3 vordere Supralabialia, Schuppenreihen um die Mitte des Körpers 20; Rückenzeichnung 2—4 Linien aus schwarz-weißen Bruchstücken von Längslinien.

Verbreitung. Rumänien, Bulgarien.

Derivatio nominis: diese Unterart wurde zu Ehren des bekannten Prager Herpetologen Herrn Dr. O. Štěpánek benannt.

Bemerkungen. Die jugoslawischen und albanischen Populationen, über die es nur spärliche Literaturangaben gibt und von denen uns auch kein Material vorlag, dürfen wahrscheinlich in der Nähe von *stepaneki* stehen. In den Zonen wo sie in Berührung mit *kitaibelii* kommen, sind intergradierende Populationen zu erwarten.

4. — *Ablepharus kitaibelii fabichi* Štěpánek, 1938

Ablepharus pannonicus fabichi Štěpánek, 1938, Sborn. národn. Mus. Praha 1 B, Zool.: 7. Holotypus: NM Wien Nr. 18426 — Terra typica: Insel Mikronisi der Hagios-Nikolaos-Gruppe an der Ostküste Kretas sowie Insel Karpatos.

Diagnose. Körper kräftig, untersetzt, Kopf gross und hoch (länger und breiter als bei *fitzingeri*); Gliedmassen lang und kräftig (Vb 9 mm, Hb 12 mm in Vergleich mit Vb 7, Hb 9,5 bei *stepaneki*); die 4. Zehe sehr lang und dünn (5 mm in Vergleich mit 2,5—4 mm bei den anderen Unterarten); Schuppenreihen um die Mitte des Körpers 20; Zeichnung und Färbung wie bei *fitzingeri* und *stepaneki*, aber schärfer.

Verbreitung. Insel Mikronisi, Insel Karpathos, Insel Kasos, Insel Armathia.

Bemerkungen. Das Auftreten der *fabichi*-Populationen ausschliesslich auf den kleinen Inseln östlich von Kreta sowie ihr Fehlen auf Kreta stellt eine noch ungelöste tiergeographische und ökologische Frage. Desgleichen muss hervorgehoben werden, dass *fabichi* der nördlicheren *stepaneki*-Rasse näher steht als den sie umgebenden *kitaibelii*-Populationen, welche sowohl auf dem

kleinasiatischen Festland als in Griechenland und den ägäischen Inseln vorkommen. Es handelt sich also entweder um eine frühere von der neueren *kitaibelii*-Rasse verdrängte Entwicklungsstufe deren überlebende Reste diese insulären Populationen sowie die nördlichen Grenzpopulationen bilden, oder *fabichi* ist das Ergebnis einer parallelen Evolution kleiner Insel-Populationen.

5. — *Ablepharus kitaibelii chernovi* Darevsky, 1953

Ablepharus chernovi Darevsky, 1953, Bull. mosk. obšč. isp. pryr. otd. biol. 58,2 : 39—41.
Holotypus: ZMMU Moskva Nr. 2810; Paratypen: ZIL Leningrad Nr. 16230 — Terra
typica: Arsakan, Zentral-Armenien, Tzakumantz-Gebirge, Arax-Tal, Zanga-Fluss.

Diagnose. Körper schlank, Kopfproportionen wie bei *fitzingeri*, Gliedmassen kurz, Tympanöffnung fehlt (bzw. nur eine Einsenkung vorhanden); Schuppenreihen um die Rumpfmittle 18—19; Unterseite rötlichorange (bei allen anderen Rassen schwarzgrau-bläulich); Rücken braun, mit 4 unterbrochenen dunklen Längslinien.

Verbreitung. SSR Armenien, Türkei (Olty)..

Bemerkungen. Die Populationen von *chernovi* bilden ein kleines, isoliertes Areal ausserhalb der Verbreitungsgrenzen der anderen *kitaibelii*-Unterarten. Wenn wir aber von der rötlichen Bauchfärbung und dem Fehlen, bzw. der Verdeckung der Ohröffnung absehen, dann erinnern Habitus, Masse und Lepidosis so nahe an *kitaibelii*, dass ich *chernovi* als Unterart dieser Spezies betrachten muss. Es ist hervorzuheben, dass die zwei grossen, streifenförmigen Supraocularia und die zwei ungleichen Supraciliaria nur bei *kitaibelii* und *chernovi* unter allen *Ablepharus*-Arten (sensu Fuhn, 1969) vorkommen. Dieselbe Ansicht wurde auch von Dr. I. S. Darevsky (in litt.) vertreten.

Bestimmungsschlüssel der Unterarten von *Ablepharus kitaibelii*

- | | |
|--|-------------------------|
| 1 (2) Ohröffnung sichtbar, Unterseite schwärzlich grau-bläulich | 3 |
| 2 (1) Ohröffnung fehlt, Unterseite rötlich-orange | <i>chernovi</i> |
| 3 (8) Körper und Gliedmassen stark bzw. massig, Kopf breit, Rückenzeichnung meist deutlich vorhanden (2—4 schwarz-weiße Fleckenreihen) | 4 |
| 4 (5) Gliedmassen und Zehen verhältnismässig kurz | 6 |
| 5 (4) Gliedmassen und Zehen lang (Vorderbein 9 mm, Hinterbein 12 mm, vierte Zehe 5 mm) | <i>fabichi</i> |
| 6 (7) Vordere Supralabialia 4 oder meist (63 %) vier | <i>fitzingeri</i> |
| 7 (6) Vordere Supralabialia 3 | <i>stepaneki</i> n. sp. |
| 8 (3) Körper schlank; Gliedmassen auffällig kurz und dünn; Kopf klein und schmal; Rückenzeichnung fehlt | <i>kitaibelii</i> |

BEMERKUNGEN ZUM BIOTOP

A. k. fitzingeri: Südslowakei: warme Südhängen, an Rändern (oder auch inmitten) lichter, von Sonne durchwärmte Eichenwälder . . . fast ausschliesslich in abgefallenem Laub . . . nur ausnahmsweise . . . unter einem Stein oder im Gras . . . (Olexa, 1965).

Ungarn: trockene Wiesen — mit Gestein-Kalk oder Ton; Mergel (Fejervary, 1912).

A. k. stepaneki: Ränder und Lichtungen lichter Eichenwälder (insbesondere Flaumeichenwälder) des Flachlandes, im abgefallenem Laub oder im Gras; sonnige, mit Gras bewachsene steinige Hänge.

Bulgarien: . . . an warmen, mit uppiger Vegetation bewachsenen Orten Ost-Bulgariens. Diese Eidechse meidet die Gebirge . . . (Buresch & Zonkov, 1934).

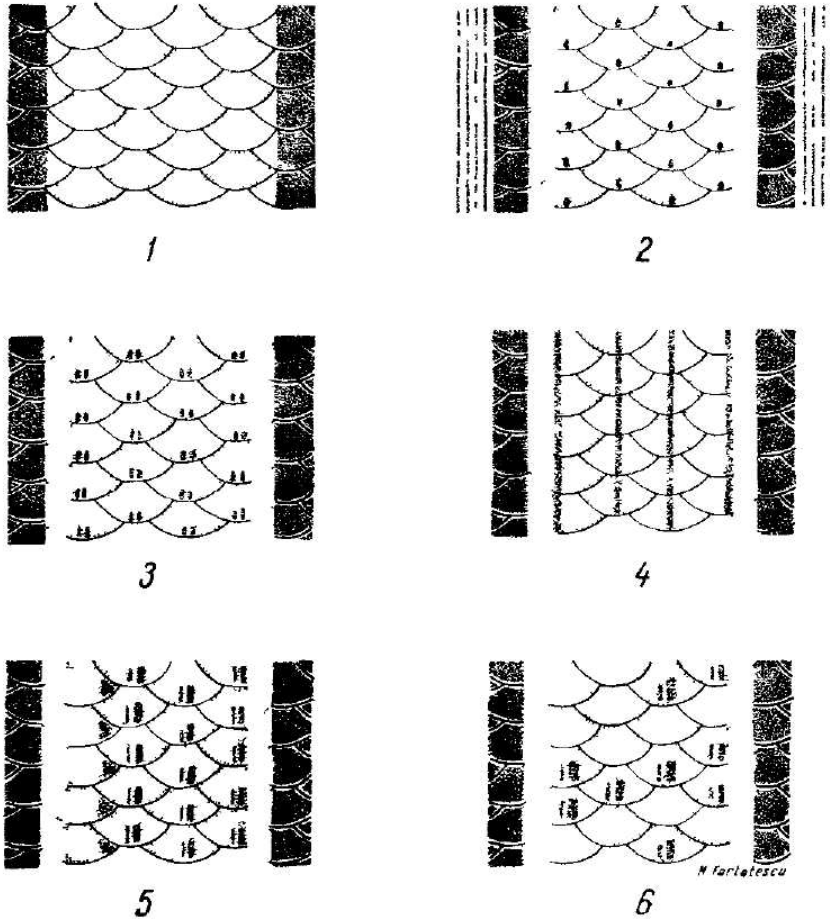


Abb 7 — Rückenzeichnung 1. — *A. k. ktaibelii* (Israel), 2 — Idem (Delos), 3 — Idem (Attika); 4 — *A. k. fitzingeri* (Ofen bei Budapest), abnormale Streifenzeichnung, 5 — *A. k. stepaneki* (Rumanien), 6 — *A. k. fabichii* (Insel Mikronisi bei Kreta)

Jugoslawien Mazedonien „ . . . mit Farnkrautern bewachsenen Boden . . . an der Grenze des *Castanea vesca*-Waldes, wo es sich in den Strauchern der *Juniperus communis*, *Buxus sempervirens* und den gefallenem vorjährigen Blättern der Edelkastanien versteckt . . . “ (Dimoski, 1964)

Albanien: bei Avlona, am Strand, im Sand (Siebenrock, 1922).

A. k. chernovi bewohnt ein „reliktes Areal auf dem ostlichem Hang der Mishan-Gebirge in Zentral-Armenien. Diese Gebirge sind eine durch quartäre Lavagüsse isolierte Insel, wo viele Tierarten, die in den benachbarten Gegenden fehlen, überleben konnten. *Ablepharus* lebt hier auf steinigem mit spärlicher und xerophyler Vegetation bewachsenen Hängen, wo es sich unter Steinen verbirgt“ (I. S. Darevski, in litt.).

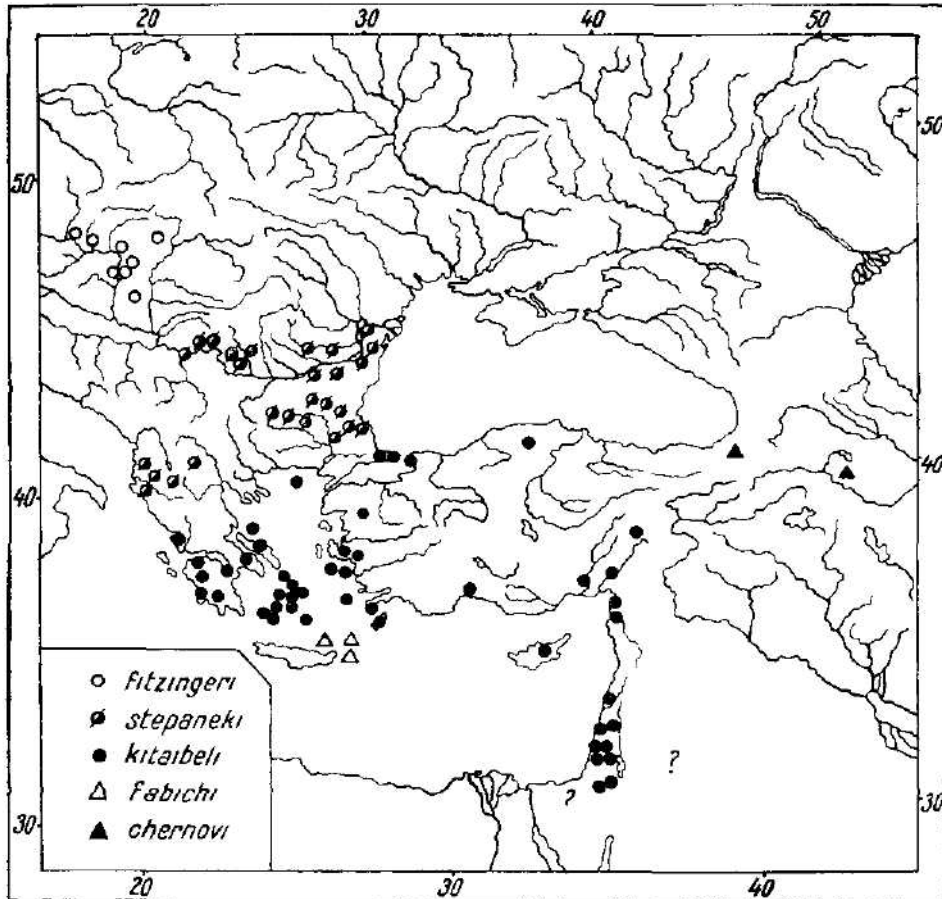


Abb 8 — Verbreitung der Unterarten von *A. kitaibelii*

A. k. kitaibelii Griechenland „ . . fast nur auf den mit Gras bewachsenen Orten . . am hellen Tag wie in der Dämmerung“ (Cyrén, 1941). Aegäische Inseln auf grasigen Stellen (Wettstein, 1953).

In Israel, lebt *A. k. kitaibelii* „ . . fast überall . . wo es Unterkunft unter Steinen, Felsen u s w gibt, die ein geeignetes Mikroklima bieten, wo eine massige oder uppige jährliche Vegetation gedeiht . . bei einer Feuchtigkeit von 200—800 mm im Jahr. Die Tiere leben in den mediterranen Niederungen sowie in den Quercetum-Wäldern von verschiedener Dichte und überleben

auch in den künstlichen mit Nadelholz bewaldeten Gebieten . . . es muss hervorgehoben werden ein bemerkenswertes vordringen nach Süden in der Vorwüste, den trockenen Wasserbetten entlang wo eine gewisse Konzentration von Feuchtigkeit geringer als vorher angegeben wurde. *Ablepharus* ist selten oder fehlt überhaupt in den dichten, schattigen Wäldern vom Maquis-Typus; auf den Sanddünen und leichten steinlosen Boden, in steinlosen . . . und schweren, alluvialen Boden; in der ganz trockenen Vorwüste und Wüste, sowie in den kultivierten Boden, wo Steine und Felsen entfernt wurden“ (J. H. Hoofien, in litt.).

Das Areal von *Ablepharus kitaibelii* überdeckt sich fast mit der Verbreitung der Flaumeiche (*Quercus pubescens* Willd.).

A. kitaibelii ist eierlegend (ovipar) und legt 2—5 Eier

FUNDORTE

A. k. fitzingeri. ČSSR, Südslowakei — Kováčov, Štúrovo. Ungarn — Ofen bei Budapest Eger, Gödöllő, Vac, Budafok, Keckemet, Pilis n. Borszöny-Gebirge.

A. k. stepaneki. Rumänien — Dubova, Orsova, Rudari, Plenita, Craiova, Daia, Peris, Bukarest, Snagov, Lehlu, Bugăc, Oltina, Băneasa-Căpâna, Fetii, Almanu, Murlatlar, Babadag, Slava Rusa, Ciucurova, Lunca Vita.

Bulgarien — Kotel, Beg Ljubotem, Liubni Planina, Strandja Planina bei Sofia, Belgradeik, Lakatnik, Dumtovo, Kodope-Gebirge.

Jugoslawien — Beograd, Zvezda, Avali, Kosutnjak, Palic-See, Skoplje, Nezilovo, Han Adipasa, Gopes, Brestovacka, Banja.

Albanien — Avlona.

A. k. kitaibelii. Griechenland — Prevesa, Pylos, Attika, Oion, Hymetos-Gebirge, Taygetos-Gebirge, Efessos, Patras, Corynth, Olympia, Insel Korfu.

Aegäische Inseln — Delos, Syra, Skopelos, Mykonos, Paros, Tria Nisi, Antiparos, Siphnos, Andros, Kythera, Furni-Archipel, Nikaria, Samothrake, Euboea, Tinos, Seriphos, Milos, Simi, Kalki, Kos, Xanthos, Rhodos und Cypern; Türkei — Istanbul, Poloneskoyu, Bosphorus, Küçükçekmece, Kastamonu, Harbiye (Hatay), Beykoz, Seleuk, Toros, Adana, Amanos, Antalya, Budrum, Izmir, Soma (in litt., Prof. M. Basoglu); Libanon — Amium, Beirut; Syrien — Jarpuz, Amanus; Israel — Tiberias, Hulda, Dan, Yessod Hama-ala, Beith Oren, Alonim, Wadi Agrim, Ramath Hadassa, Tel Yeroham, Kefar Yehoshua, Kefar Menahem, Idmith, Khirbet Mishmash, Har Adir, Sarona-Jaffa, Haifa, Berg Carmel, Motza, Jerusalem, Safed (die meisten Ortschaften wurden mir in freundlicher Weise von Herrn J. H. Hoofien, Tel-aviv, mitgeteilt); Sinai; Irak (?).

A. k. fabichti. Mikronisi Inseln, Karpathos, Kasos, Armathia.

A. k. chernovi. S.S.R. Armenien — Arsakan, Bjni, Arax, Zanga — und Razdan-Tal; Türkei, Dorf Eriuk bei Olty (von Nikolsky, 1915 als *A. pannonicus* bestimmt).*

Für die grosszügige Unterstützung durch Übermittlung von lebendem oder konserviertem Material (geschenkt oder leihweise) und Beantwortung vieler Fragen bin ich folgenden Kollegen und Museen sehr zum Dank verpflichtet: Dr. J. S. Darevsky (Leningrad), J. H. Hoofien (Tel Aviv), Prof. J. Guibé (Paris), V. A. Beschkov (Sofia), Dr. O. Štěpánek (Prag), Dr. J. Eiselt (Wien), Prof. M. Basoglu (Borova, Izmir), Brukenthal-Museum (Sibiu).

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The plates will be found at the end of this issue.

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**LEUCOCHLORIDIUM PAPILLOCIRRATUM N. SP.
(TREMATODA: LEUCOCHLORIDIIDAE) IN RALLUS AQUATICUS LINN.**

JINDŘICH GROSCHAFT & JIŘÍ SITKO

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Abstract: The present paper contains a description of a new species, *Leucochloridium papillocirratum* n. sp. ascertained in *Rallus aquaticus* Linn. in the southern Bohemian pond area. From the hitherto known species, this new species differs by the shape of cirrus as well as by a number of characters occurring isolated in other species, viz., by the shape of intestinal branches, extent of the uterus and lobate testes.

During our investigations on the helminthofauna of ralliform birds in the southern Bohemian pond area, we examined 8 individuals of *Rallus aquaticus* during migration. In the cloaca of one of them, we found 10 individuals of a trematode of the genus *Leucochloridium* Carus, 1835, showing marked difference from the hitherto known species in some of their characters. On ground of a comparison of the characters of our specimens with the hitherto described and morphologically allied species, we have concluded that our specimens cannot be identified with any of the hitherto known species.

According to the peculiar shape of the cirrus of this new species, we named it *Leucochloridium papillocirratum*.

Leucochloridium papillocirratum n. sp.

Host: *Rallus aquaticus* Linn.

Location: Cloaca

Locality: The Red Pond (district of Jindřichův Hradec), southern Bohemia, Czechoslovakia.

Among the eight hosts examined, one was positive. Intensity of invasion, 9 adults and 1 juvenile trematode.

Description of the holotype: Body oval in shape, with maximum width in the area of acetabulum. Cuticle smooth, without spines, with very fine cuticular spinules only in the anterior part of the body. Body length 2.46 mm; body width 1.0 mm. Terminal oral sucker 0.48 by 0.68 mm. Pharynx well developed, 0.19 by 0.25 mm. Oesophagus absent. Intestinal branches connected directly with the pharynx from which they proceed to the mouth sucker and return, spiral-shaped, to the posterior end of the body. Acetabulum situated in the lower part of the anterior half of body, its upper margin touching the intestine in the place of its bifurcation. Anterior margins of both suckers 0.73 mm apart. Acetabulum 0.60 by 0.53 mm. Testes lobate, situated slightly transversal one behind the other but both passed by the longitudinal axis of body. Anterior testis 0.17 by 0.14 mm; posterior testis 0.18

by 0.19 mm. Ovary oval in shape, 0.14 by 0.11 mm. It is situated above the posterior testis in its close proximity. Uterus situated strictly intercoecal; by its ascending part, it passes the acetabulum on both sides, forming two loops at its upper level and returning in the same way towards the posterior part of the body, passing between the anterior testis and the ovary and

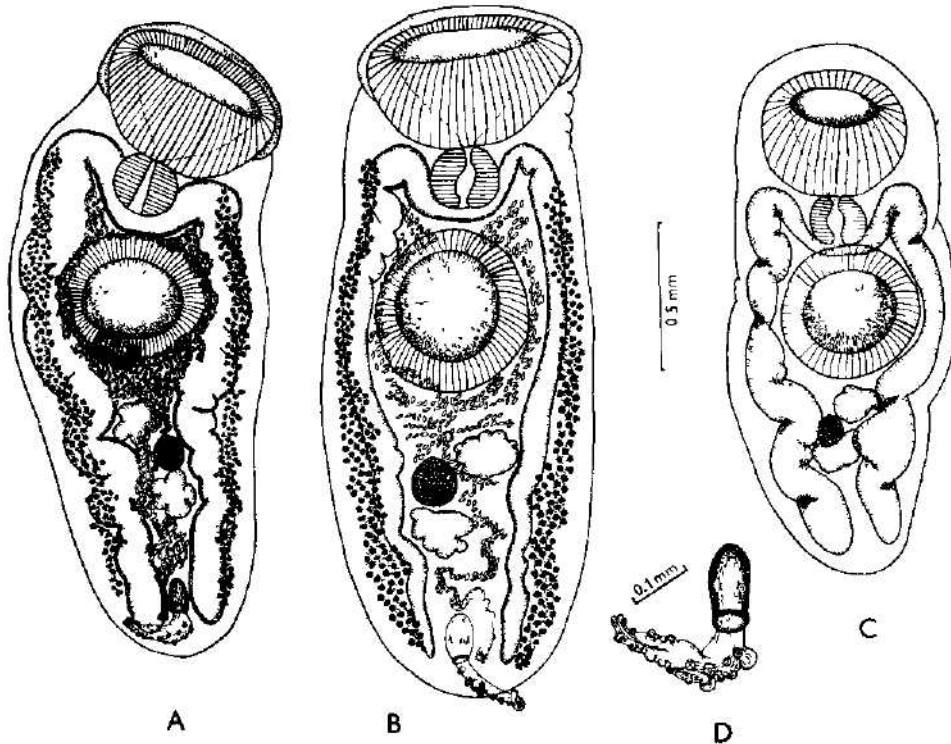


Fig. 1. *Leucochloridium papillocirratum* n. sp. A — holotype, B — paratype, C — juvenile specimen, D — cirrus of the holotype

ending between the cirrus sac and the left branch of the intestine. Lateral branches of uterus indistinct. Eggs relatively few in number, measuring 0.023 by 0.017 mm. Yolk clusters form very small follicles situated on the sides of body, mostly in the extracoecal zone. They occupy the whole area along the intestinal branches but do not exceed over them in either anterior or posterior part. Cirrus sac situated medial between the distal ends of intestinal branches; it is cup-shaped and measures 0.17 by 0.087 mm. Cirrus conspicuously big, well developed and measuring 0.30 by 0.06 mm. All along its length, it is covered with 21 globose papillae, the diameter of which is 0.036 mm in the proximal and 0.007 mm in the distal part of the cirrus.

Description of the paratypes (nine adult specimens): All adult specimens agreeing with the holotype in the shape of body. Cuticle of body smooth, with minute cuticular spinules in front of the sucker in some specimens. Oral sucker terminal, pharynx invariably well developed, oesophagus absent. Acetabulum invariably situated in the lower part of the anterior half

of body. Upper margins of both suckers 0.65 to 0.82 mm apart. Intestinal branches of much the same course as in the holotype but not as distinctly spiral-shaped. Arrangement and shape of sexual glands as in the holotype but the lobate form of the testes more or less distinct. Uterus situated intercoecal in all cases, and in all directions at that, but less developed and with lower numbers of eggs in the paratypes. Yolk clusters of much the same character as in the holotype but sometimes reaching the upper or lower end of intestinal branches. Situation and shape of the cirrus sac as in the holotype but differing in size (cf. Tab. 1), the same as the cirrus which, in addition, shows differential number of papillae (8 to 21). The dimensions of all specimens found are given in Tab. 1.

Tab. 1. Survey of body dimension of the *Leucochloridium papillocirratum* n. sp. (in mm)

| Dimension of: | holotype | eight specimens of paratype | juvenile spec. |
|--------------------------|---------------|-----------------------------|----------------|
| Body length | 2.46 | 2.05—2.60 | 1.66 |
| Body width | 1.0 | 0.09—1.10 | 0.78 |
| Oral sucker | 0.48 × 0.67 | 0.48 —0.54 × 0.60 —0.70 | 0.44 × 0.48 |
| Ventral sucker | 0.60 × 0.53 | 0.55 —0.65 × 0.55 —0.70 | 0.45 × 0.48 |
| Pharynx | 0.19 × 0.25 | 0.18 —0.22 × 0.23 —0.30 | 0.17 × 0.21 |
| Cirrus pouch | 0.17 × 0.08 | 0.13 —0.25 × 0.07 —0.14 | 0.14 × 0.06 |
| Cirrus | 0.30 × 0.06 | 0.20 —0.40 × 0.05 —0.07 | — |
| Testis I (anterior) | 0.17 × 0.14 | 0.12 —0.17 × 0.13 —0.24 | 0.12 × 0.18 |
| Testis II (posterior) | 0.18 × 0.19 | 0.14 —0.18 × 0.15 —0.23 | 0.13 × 0.15 |
| Ovary | 0.15 × 0.12 | 0.10 —0.17 × 0.10 —0.17 | 0.11 × 0.10 |
| Ova | 0.023 × 0.017 | 0.023—0.027 × 0.015—0.019 | — |
| Distance between suckers | 0.73 | 0.65—0.82 | 0.61 |

DISCUSSION

At the present time, the genus *Leucochloridium* Carus, 1835, comprises 44 species (cf. Yamaguti, 1958). According to Bychovskaja-Pavlovskaja (1951), only *L. macrostomum* (Rud., 1819), *L. holostomum* (Rud., 1819) and *L. actitis* McIntosh, 1932, are considered valid species. In our opinion, this viewpoint is justified. In identifying our specimens, we compared them with the original descriptions or redescriptions of some other members of the genus *Leucochloridium*, viz., *L. insigne* (Loose, 1899) — according to Larios (1943); *L. sime* Yamaguti, 1935; *L. turdi* Yamaguti, 1939; *L. cardis* Yamaguti, 1939; *L. holostomum* (Rud., 1819) — according to Pavlov (1962); *L. perisorisae* Neiland, 1953; and *L. phragmitophila* Bychovskaja-Pavlovskaja et Dubinina, 1951.

L. papillocirratum n. sp. shows much similarity to *L. holostomum* (Rud., 1819) and some species considered to be synonymous with this latter species (*L. insigne* Looss, 1899; *L. flavum* Travassos, 1922; *L. turanicum* Soloviev, 1912). With these species, *L. papillocirratum* agrees in the shape of body, topography of organs, extent of yolk clusters and, with *L. insigne* (according to Larios, 1943) and *L. flavum*, in the lobate shape of testes. From the latter two species, however, *L. papillocirratum* differs by the absolute size of the suckers. Larios (1943) states that in *L. insigne* found in *Querquedula discors*, the uterus is situated intercoecal; it is evident from the illustration, however, that the uterus exceeds both intestinal branches laterally. The descriptions

of the above species, however, do not state the size and shape of the cirrus. In *L. papillocirratum* n. sp., this organ is of so unusual shape and size that it would hardly be overlooked as an important morphological character. While we acknowledge the validity of the results of Bychovskaja-Pavlovskaja (1951), evidencing the wide morphological variability of the members of the genus *Leucochloridium*, we have been led by the above-mentioned unusual shape of the cirrus as well as by the set of the above-mentioned additional differential characters to consider our discoveries to belong to a new species.

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ON THE OCCURRENCE OF LAMPETRA PLANERI (BLOCH, 1784)
IN THE POPRAD RIVER (NORTHERN SLOVAKIA)
AND NOTES TO ITS TAXONOMY AND ECOLOGY

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Abstract: The author deals with the problem of the taxonomic status and occurrence of lamprey living in the basin of the Poprad river. On the base of study of adult specimens he determines this lamprey to be *Lampetra planeri* (Bloch, 1784). Number of trunk myomeres and some other plastic features are, however, more or less similar to those of *Eudontomyzon mariae* (Berg, 1931). The author supposes the introgressive influence of the last mentioned species which is in great extent sympatric with *L. planeri* only in the Vistula basin. The proportionate changes of some measurements during both larval and adult stages are observed and discussed, as well as some notes on the ecology of this lamprey.

INTRODUCTION

The list of Slovakian Cyclostomes contains 4 species: *Eudontomyzon danfordi* Regan, 1811 living in the Tisa river drainage, Eastern Slovakia, *E. vladykovi* Oliva et Zanandrea, 1959 inhabiting the direct tributaries of the Danube river, *E. gracilis* (Kux, 1965) stated as sympatric with *E. danfordi*, and *Lampetra planeri* (Bloch, 1784) reported from the Poprad and Dunajec rivers and their tributaries. While the validity of *E. gracilis* is not clear (probably it concerns the starvation form of *E. danfordi*), the occurrence of *L. planeri* from the Poprad river basin was still questionable, despite the fact that this species was the first to be reported from the territory of Slovakia (Grossinger, 1794, Vutskits, 1913, Hykeš, 1921). There were no verified specimens from the older authors, therefore the occurrence of this species was supposed at first, but justifiable doubts arose after the surprising discoveries of *E. mariae* made by Oliva and Hensel (1962) and Oliva (1966) from the Rudawa and Skawa rivers, tributaries of the upper Vistula river in Poland. Balon (1964a, 1964b, 1966) did not mention *L. planeri* in Slovakia any more and all older and recent findings (Kux and Weisz, 1960) from the Poprad and Dunajec rivers spoke about *E. mariae*. On the contrary, Oliva, Hrabě and Lác (1968) do not mention the last mentioned species at all and stated only *L. planeri* from this territory, basing their statement on the findings of *L. planeri* by Kux and Weisz (i.e.). The last mentioned authors assert, in the paper especially devoted to the lampreys of the Black Sea and the Baltic Sea watershed of the Carpathian mountains (Weisz and Kux, 1966) that *L. planeri* only inhabits the basin of the Poprad and Dunajec river. They are sceptical on the discovery of *E. mariae* by Oliva and Hensel and on the opinion of Balon. According to Weisz and Kux the occurrence of *E. mariae* here is not excluded, but it may be considered sporadic only. Rembiszewski (1967) however, proved the findings made by Oliva and Hensel by discovering *E. mariae* in the Jeziorka river, the right tributary of the Vistula river near Warsaw. Furthermore (Rembiszewski, 1968) he ascertained also *L. planeri* in the same river (in the upper part of it) and also the hybrids between *L. planeri* and *E. mariae* which were collected in the zone of contact of the both species. Obviously, the question on the systematic status lampreys living in the Poprad and Dunajec rivers has remained still open. Moreover Kux and Weisz did not mention any concrete data on the dentition of the mouth neither bring its illustration.

MATERIAL AND METHOD

In 1967 the Slovak National Museum (SNM) in Bratislava received some samples of lampreys from the Poprad river basin, both ammocoetes and adult (transformed) specimens. These animals originated from the following waters:

Lubický brook (right-side tributary of the Poprad river) in Lubica village (630 m above the sea level), near the Vrbický mill (650 m), 5.—7. 4. 1967, leg. Dr. E. K. Balon, 2 females, 1 male, SNM RY—1864; 10.—12. 5 1967, leg. I. Ďurčík, 2 females, 1 male, SNM RY—1212; 10. 7. 1967, leg. I. Ďurčík, 34 ammocoetes, SNM RY—1350.

Biela Voda brook (left-side tributary of the Poprad river) between the Mlynčeky settlement and Kežmarok town (689.5—608.8 m), 8. 7. 1967, leg. I. Ďurčík, 2 females, 1 male, SNM RY—1347, 19 ammocoetes 1348.

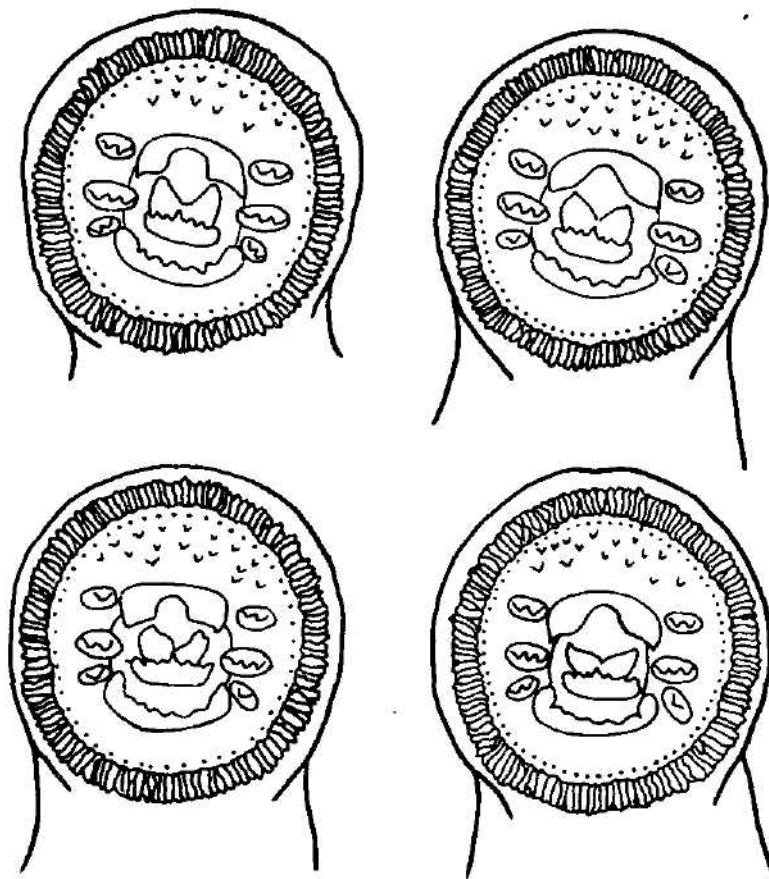


Fig. 1.: Dentition of the *Lampetra planeri* from the Poprad river basin. (Scheme of four types of sucking disc).

Poprad river between the mouths of the Lubický and the Biela Voda brooks (608,0 m), 21. 6. 1947, leg. I. Ďurčík, 1 male (partly damaged, SNM RY—1349.

Beside these the sample of 12 ammocoetes was studied which were caught in the Velický brook at Poprad town (left-side tributary of the Poprad river — 675 m) by Mr. L. Zubáň, November 12, 1967, SNM RY—1403.

The material was worked out as usually in lampreys by the scheme and using the terminology developed by Vladykov and Follett (1958, 1967). Comparison (it concerns only the trunk myomeres number) was made with lampreys from several other river basins using the statistical

calculations. I have used the M_{diff} method (comparison of the mean values), the C. D. method (comparison of overlapping) as well as the graphical method created by Hubbs and Hubbs (1953). The literary data have been also exploited. To compare the position of the Poprad river lamprey with other populations and to determine its position between the *L. planeri* and *E. mariae*, so called *hybrid index* of Hubbs and Kuronuma (1942) has been also used.

Our samples of lampreys have been compared with those originating from the following waters:

The Zdobnice river near Slatina and Peklo (right-side affluent of the Orlice river, basin of the Elbe river, Bohemia), 9.—11. 6. 1964, leg. Dr. K. Lohniský, 5 males, 6 females.

The Stropnička brook near Borovany (basin of the Vltava river, the left tributary of the Elbe river, Bohemia), 23.—24. 4. 1953, leg. Dr. V. Kulhavý, 6 males, 4 females.

The Oliwa rivulet near Gdańsk (small flow streaming directly into the Baltic Sea, Poland), November 1966, leg. Mgr. J. M. Rembiszewski, 5 ammocoetes.

Chojnatka at Jeruzal village near Skiernewecz (left-side tributary of the Vistula river, Poland), leg. Mgr. J. M. Rembiszewski, 4 males, 2 females.

RESULTS AND DISCUSSION

The results of counts and measurements of lampreys from the Poprad river basin are summarized in the Tables 1 and 2, and in the Fig. 1. From the dentition of the sucking disc it is obvious unambiguously that this lamprey belongs to the species *Lampetra planeri* (Bloch, 1784): posterials and outer laterals are absent, while anterior and posterior laterals are mostly bicuspid, middle laterals mostly tricuspid. The caudal fin border is without any pigmentation. The number of trunk myomeres, however, is significantly higher than that of populations investigated till now. Table 3 summarizes both literary and our data of the myomeres number in populations of the brook lamprey from Sweden up to Naples, Italy. It can be seen that the myomeres number in lamprey populations from the Poprad river basin and that from the Polish flows Oliwa and Chojnatka stands nearer to myomeres number found in *E. mariae* by Rembiszewski (1967) than to that in *L. planeri* from other European waters.*) This statement is proved both by M_{diff} and C. D. coefficients (Tab. 4) and mainly by hybrid index determining the position of lampreys investigated with regard to *L. planeri* from Sweden and *E. mariae* from Poland (tab. 5). Also the Fig. 2 proves this striking and unexpected fact. It can be seen, here is no clinal gradation concerning the myomeres number, and populations of *L. planeri* from the South are practically the same like those from the North, despite the geographical isolation of the first (Fig. 3). It seems to me that the most probable explanation of this phenomenon is the introgressive influence of the species *E. mariae* sympatrically inhabiting the Vistula river basin together with *L. planeri*. It is true, that *E. mariae* lives also in the other river basin, namely in the Nemen river (Žukov, 1965a, 1965b, 1969)**) as well as *L. planeri* in the Siret river basin, Roumania (Black Sea watershed — Banarescu 1969) but in these cases only single and isolated findings were made. As mentioned above Rembiszewski (1968) has proved the presence of F_1 hybrids between *L. planeri* and *E. mariae* in the Jeziorka river. The majority of characters of this hybrid showed the intermediate position between the parents (dentition, pigmentation). The myomeres number in hybrids was even rather higher like that in *E. mariae*.

*) Seemingly higher myomeres number of lampreys from Bohemia is due to absence of ammocoetes in samples.

***) I do not consider the occurrence of *E. mariae* in the Yugoslavian rivers near Sarajevo described by Zanandrea (1958a) because of suspicion with interchange with *E. vladikovii* Olive and Zanandrea, 1959.

Table 2. Measurements of the brook lamprey ammocoetes caught in the Biela Voda brook, 8. 7. 1967

| TL (mm) | Ave. (Ranges) | 32.10 (22.0—38.6) | 48.6 (40.5—59.1) | 66.1 (66.0—66.2) | 92.0 (87.0—97.8) | 110.1 (101.2—131.5) |
|--------------------------------|---------------|-------------------|---|------------------|------------------|---------------------|
| number of specimens | | 4 | 5 | 2 | 4 | 4 |
| In % of TL: | | | | | | |
| a—C | | 18.4 (15.7—22.0) | 22.3 (20.4—24.5) | 25.9 (25.2—26.6) | 27.3 (25.4—28.7) | 26.9 (26.2—27.4) |
| B ₇ —A | | 55.0 (53.2—58.5) | 54.9 (51.6—58.8) | 54.0 (51.2—56.8) | 53.7 (51.3—57.4) | 53.3 (51.6—56.6) |
| B ₁ —B ₇ | | 15.9 (15.0—16.7) | 14.4 (13.3—15.2) | 14.9 (13.8—15.9) | 12.9 (12.6—13.6) | 12.1 (11.5—13.2) |
| d | | 5.0 (4.4—6.1) | 4.3 (3.4—5.0) | 4.5 (3.9—5.0) | 3.4 (2.6—3.9) | 2.9 (2.4—3.3) |
| d ₁ —B ₁ | | 9.4 (9.2—9.5) | 9.1 (8.1—9.9) | 9.5 (9.2—9.8) | 7.6 (7.2—8.0) | 7.1 (6.1—7.7) |
| hD ₂ | | 1.5 (0.9—1.8) | 1.1 (1.0—1.2) | 1.2 (1.2—1.2) | 1.6 (1.0—1.9) | 1.6 (1.4—1.8) |
| 0 | | 1.6 (1.5—1.8) | 1.4 (1.2—1.7) | 1.8 (1.7—1.8) | 1.5 (1.3—1.8) | 1.5 (1.1—2.1) |
| 0—B ₁ | | 2.9 (2.4—3.3) | 3.4 (2.5—4.0) | 3.9 (3.5—4.2) | 3.1 (2.9—3.4) | 2.7 (2.2—2.8) |
| number of myomeres | | | | | | |
| | | | 63.83 (60—66), $\sigma = 1.70$, $\bar{x} = 0.40$ | | | |

Table 3. Comparison of myomeres number in different populations of brook lamprey with those of ukrainian lamprey (ammocoetes, subadult and adult animals are mixed)

| Locality | Author | n | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | \bar{x} | σ | \bar{x} |
|---------------------------|----------------------|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----------|----------|-----------|
| Sweden | Zanandrea 1958 | 38 | 1 | 8 | 16 | 8 | 5 | | | | | | | | | 60.48 | 1.00 | 0.16 |
| Narva river | Abakumov 1964 | 100 | 2 | 8 | 20 | 21 | 21 | 10 | 9 | 3 | | | | | | 61.50 | 1.85 | 0.19 |
| Olwa and Chojnarka brooks | our results | 11 | | | | | 2 | 2 | 2 | 1 | 2 | | | | | 63.72 | 1.25 | 0.38 |
| Vltava river | Lohnický 1967* | 14 | | | | 5 | 5 | 1 | 2 | 1 | | | | | | 62.21 | 1.26 | 0.34 |
| Peklo and Slatina brooks | our results* | 10 | | | | 2 | 3 | 4 | 1 | | | | | | | 62.90 | 1.37 | 0.43 |
| Stropnička brook | our results* | 10 | | | | 1 | 3 | 3 | 2 | 1 | | | | | | 62.50 | 1.56 | 0.50 |
| Poprad river | our results | 57 | | | | 1 | 3 | 4 | 11 | 14 | 10 | 3 | 1 | | | 64.19 | 1.29 | 0.17 |
| Rome | Zanandrea 1958 | 18 | 1 | 2 | 3 | 2 | 3 | 3 | 3 | 1 | | | | | | 61.67 | 1.97 | 0.46 |
| Naples | Zanandrea 1958 | 35 | | | | 12 | 9 | 9 | 5 | | | | | | | 61.20 | 1.06 | 0.18 |
| Jeziora brook | Rambiszewski 1967**) | 60 | | | | 3 | 3 | 3 | 8 | 10 | 11 | 14 | 7 | 3 | 1 | 66.90 | 1.86 | 0.24 |

*) adult specimens only. **) *Eudontomyzon mariae*

Beside the myomeres number also other features resemble those in *E. mariae*: branchial length, second dorsal fin height, diameter of disc and diameter of eye. The lampreys from the Chojnarka river even show pigmentation of the caudal fin, character typical for the genus *Eudontomyzon*, though it is rather weak and not so distinct.

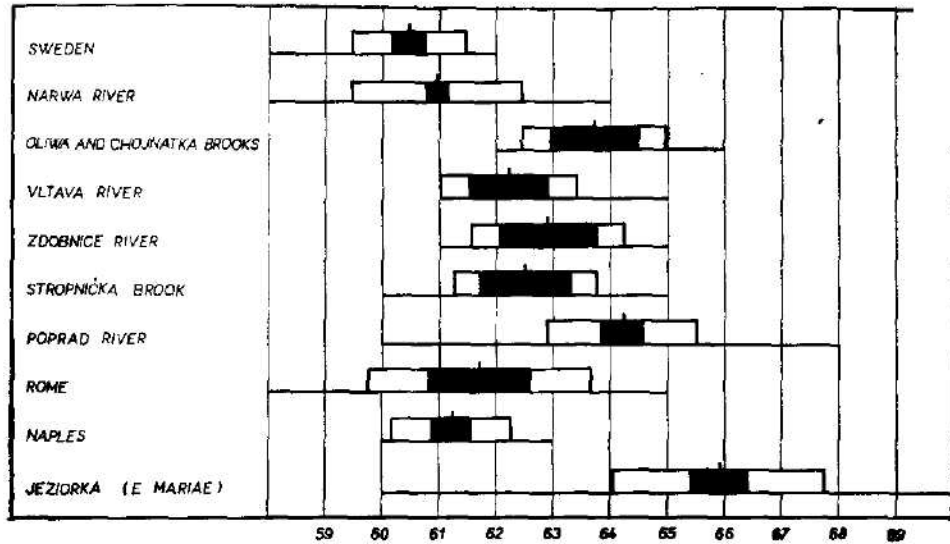


Fig. 2: Number of trunk myomeres in some populations of *L. planeri* in comparison with that of *E. mariae*. Variation is shown by a heavy horizontal line, the mean (\bar{x}) by a short abscissa. The blackened part of each bar comprises 2 standard errors of the mean on either side of \bar{x} . One-half of each black bar plus the white bar at either end outline 1 standard deviation on either side of \bar{x} . Data from table 3.

However, the question of systematic status of different populations of *E. mariae* as well as their hybridization with *L. planeri* needs thorough investigations. I can state that the number of myomeres in different populations of *E. mariae* is different, as it follows from the literary data. The Abakumov (1966) writes on 59—65 trunk myomeres (61.8 in average) to be in the adult *E. mariae* and 58—64 (60.9) in ammocoetes from the Kuba river basin (Azov Sea watershed), while Rembiszewski (1967) mentions remarkably higher number (62—70, 65.90 in average) in both groups of *E. mariae* from the Vistula river basin (Baltic Sea watershed), and Žukov (1969) reports 63—70 (66.67 in average) trunk myomeres in the same species from samples caught in Belorussian waters (probably from both Baltic Sea and Black Sea watershed). Žukov (1965, 1969) writes that the same spawning grounds are occupied by both *L. planeri* and *E. mariae* in the Nemen river basin, the spawning time, however, in both species differs. *L. planeri* reproduces considerably later than *E. mariae*. But in the Jeziorka river, as it follows from Rembiszewski (1968), the spawning time of both species is apparently the same, while here is some space isolation: *L. planeri* occupies the upper part of the flow (100—185 m altitude, 1.77% slope gradient), *E. mariae* inhabits the lower part (85—100 m, 0.83% slope gradient). The findings of Oliva and Hensel, however, were made at 197 m altitude.

Unexplained is also the high number of myomeres in ammocoetes of *L. planeri* from the Oliwa rivulet, which flows directly into the sea. This flow is not inhabited by *E. mariae* which is, as known, the pure freshwater, nonmigratory form.

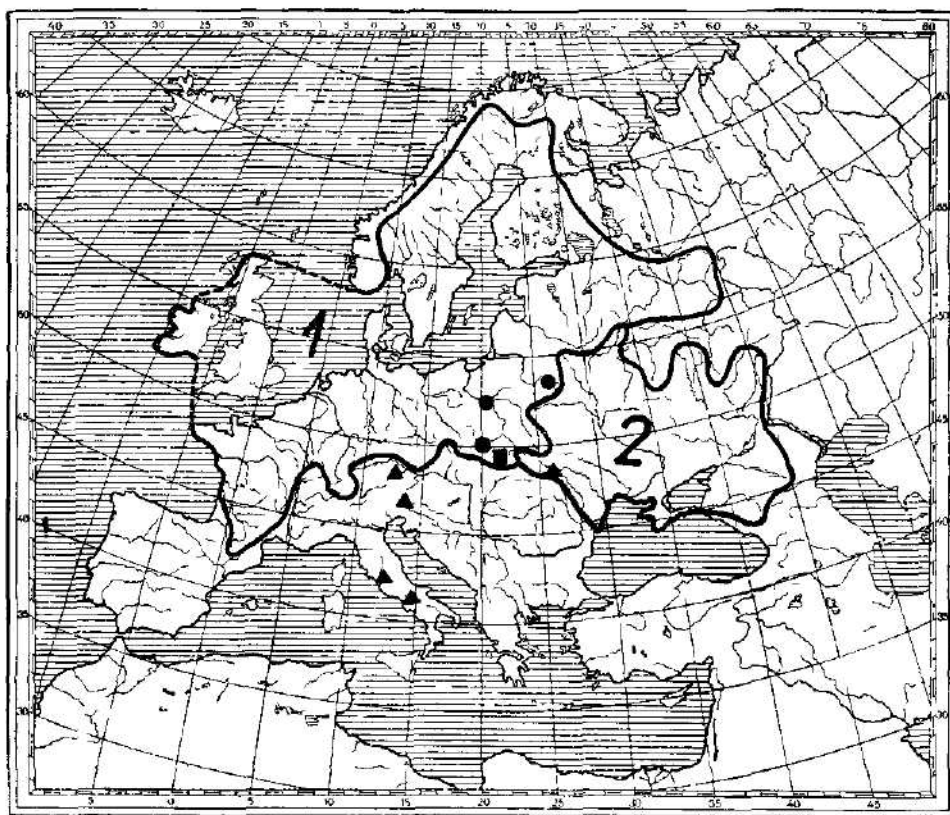


Fig. 3: Geographical distribution of *Lampetra planeri* (cipher 1 and black triangles) and *Eudontomyzon mariae* (cipher 2 and black circles). Black rectangle — area of the Poprad river basin.

Summarizing the above mentioned facts I come to the conclusion that the Poprad river basin and other adjacent rivers in this territory (e.g. the Dunajec, the Belá etc.) is inhabited by the species *Lampetra planeri* (Bloch, 1784), which bears, however, the elements of *E. mariae* and not only those of *L. fluviatilis* which is the ancestor of *L. planeri* and which, as it seems, causes its considerable uniformity. I suppose, *E. mariae* cannot be found on the territory of Northern Slovakia because it prefers the flows with less altitude and less slope gradient.

Table 2 offers information on measurements of ammocoetes from the Biela Voda brook. It can be seen that different features are subject of considerable changes during the growth of animal: tail length increases continuously, while the trunk length, branchial length, diameter of disc and praebranchial length decrease. The postorbital length increases at first, but when the larva

reaches about 80 mm of total length it begins to decrease. Our findings are in agreement with those of Balon (1957) and Lohniský (1968) for *L. planeri*. Simultaneously, the opinion of the last author is confirmed, concerning unsuitability of the lamprey measurements for taxonomical purposes.

Owing to the fact that our adult lampreys were caught in different months in the course of spring and summer of 1967 and that the samples although small are mutually equivalent,*) it is possible to follow the growth changes

Table 4. C. D. and M_{diff} values of myomeres number in different populations of brook lamprey (data of the previous table are used)

| | | M_{diff} | | | | | | | | |
|-------|---------|------------|-------|-------|--------|-------|---------|--------|------|--------|
| | | Sweden | Narwa | Oliwa | Vltava | Peklo | Stropn. | Poprad | Rome | Naples |
| C. D. | Sweden | — | 4.12 | 7.86 | 4.60 | 5.27 | 3.85 | 15.95 | 2.42 | 3.00 |
| | Narwa | 0.36 | — | 2.92 | 1.66 | 2.98 | 2.32 | 10.94 | 0.37 | 1.15 |
| | Oliwa | 1.44 | 0.39 | — | 2.97 | 1.44 | 1.96 | 1.13 | 3.44 | 6.07 |
| | Vltava | 0.77 | 0.24 | 0.60 | — | 1.26 | 0.48 | 5.21 | 0.94 | 0.03 |
| | Peklo | 1.02 | 0.43 | 0.51 | 0.42 | — | 0.61 | 2.79 | 1.95 | 3.14 |
| | Stropn. | 0.79 | 0.29 | 0.43 | 0.10 | 0.14 | — | 3.20 | 1.11 | 2.44 |
| | Poprad | 1.62 | 0.86 | 0.19 | 0.78 | 0.49 | 0.69 | — | 5.14 | 12.06 |
| | Rome | 0.40 | 0.46 | 0.64 | 0.16 | 0.37 | 0.24 | 0.77 | — | 0.95 |
| | Naples | 0.35 | 0.10 | 1.09 | 0.44 | 0.69 | 0.50 | 1.25 | 0.16 | — |

of different measurements in adult lampreys too (Table 1). First of all, the body length decrease can be observed, known in transforming specimens, but not in adult ones, as follows from literature. During three months (from April 5th up to the May 8th) the body length decreased and is 19.2% less. Comparing the measurements we can state a slightly increasing course of the tail length, diameter of disc, diameter of eye and of postorbital length, considerably increasing course of praebranchial length and height of second dorsal fin, while the trunk length decreases slowly and the branchial length is more or less stable. The known gradually joining of the dorsal fins have to be mentioned here, too.

Table 6 summarizes the data on fecundity of 4 females. The number of eggs found is in agreement with the literary data concerning brook lamprey from other water-bodies (Staff, 1950; Berg, 1948; Dyk, 1949; Abakumov, 1964). Balon (1957) found in one female from the Stropnička brook 2175 eggs which number is rather high and unusual for *L. planeri*. Comparing the number of eggs with regard to the total length and weight of female it can be seen the continuous decreasing of eggs number or increasing of them during the course of shortening of the body length. Similar fact but without any comments was observed by Staff (l.c.). It is apparent that the shortening of the body is due to degeneration of intestine during sexual maturation, impossibility to take any food and continuous growth of ovaries.

*) The finding places of the brook lamprey in the Bela Voda and the Lubický brooks are practically the same. Both brooks join the Poprad river at the same place, they flow on the territory with the same geological substrate and with the same vegetation. The distance between the sample stations is 5 km only.

Table 5. Number of myomeres and hybrid index in several brook lamprey populations (*Lampetra planeri* from Sweden = 0, *Eudontomyzon mariae* from the Jeziorka brook = 100)

| Species | Locality | Average number of myomeres | Hybrid index |
|----------------------------|----------------------------|----------------------------|--------------|
| <i>Lampetra planeri</i> | Sweden | 61.50 | — |
| | Narwa river | 60.93 | 18.3 |
| | Oliwa and Chojnátka brooks | 63.72 | 59.7 |
| | Vltava river | 62.21 | 32.0 |
| | Peklo and Slatina brooks | 62.90 | 44.8 |
| | Stropnička brook | 62.50 | 37.3 |
| | Poprad river | 64.19 | 68.4 |
| | Rome | 61.67 | 22.0 |
| | Naples | 61.20 | 13.3 |
| <i>Eudontomyzon mariae</i> | Jeziorka brook | 65.90 | — |

From the data mentioned above follows that the spawning time of lamprey in the Poprad river basin is remarkably retarded: the animals from April, May and June were still not spawned. Only the sample caught in July was taken just in the spawning time: the dorsal fins were completely joined and most high and one female had no more eggs while the other one displayed only 100 eggs in her ovary, the weight of which was 0.06 grams. The single specimen does not allow me to suppose if here is a part spawning or forcible interruption of the spawning act due to fishing procedure. The spawning time of brook lamprey in other basins is from the end of March up to beginning of June, at the water temperature 8—20° C (e.g. Berg, 1948; Dyk, 1949; Abakumov, 1964; Žukov, 1965; Lohniský, 1966). The delay of spawning in our lampreys can be explained by the higher altitude of the Poprad river basin (600—700 m) and by rough climatic conditions of this territory (+16° C of average air temperature in July, —6° C in January, 600—700 millimetres of rain annually).

Table 6. Fecundity of the brook lamprey from the Poprad river

| No. coll. | 1864/2 | 1864/3 | 1211/3 | 1211/2 | Ave. |
|------------------|--------|--------|--------|--------|--------|
| TL (mm) | 136.8 | 144.0 | 145.0 | 153.8 | 144.90 |
| W (g) | 3.36 | 3.90 | 4.59 | 6.57 | 4.61 |
| ovary weight (g) | 0.42 | 0.42 | 0.52 | 0.81 | 0.54 |
| number of eggs | 1403 | 1439 | 1227 | 1052 | 1280 |
| maturity index | 8.00 | 9.39 | 8.83 | 8.11 | 8.58 |

It follows from the observations made by Mr. Ďurčák in 1967, that the adult lamprey concentrated in places with shallow and quiet water which were followed by stream. The bottom was covered with small stones and gravel, the lamprey were seen to be attached on stones (Lubický brook, April—May). The spawning was directly observed in July, 8th, in the Biela Voda brook on places with shallow and quiet water and sandy bottom.

SUMMARY

1) The author deals with the occurrence and systematic status of the lamprey from the Poprad river basin, Northern Slovakia. On the base of dentition of lamprey disc he came to the conclusion that this lamprey is *Lampetra planeri* (Bloch, 1784).

2) The author has found a considerably higher number of trunk myomeres in this population showing thus a close relation to the species *Eudontomyzon mariae* (Berg, 1931). The author believes that this is an introgressive influence of the last mentioned species, which is sympatric with *L. planeri* in the Vistula river basin, to which the Poprad river belongs. Some other characters like branchial length, second dorsal fin height, diameter of disc and diameter of eye display the resemblance with *E. mariae* from the Vistula basin.

3) *Eudontomyzon mariae* probably cannot be found in the territory of Northern Slovakia. This species prefers lower altitude and lower slope gradient.

4) The morphological changes of the adult lamprey continue also in transformed specimens: body length decreases — during three months of 19.2%, tail length, diameter of disc, diameter of eye and postorbital length increase slowly and praebranchial length and the second dorsal fin increase considerably.

5) The spawning time of lamprey in the Poprad river basin is more delayed in comparison with that observed in other populations: it sets in at the end of June and beginning of July. The number of eggs varies between 1052 and 1439 with average of 1280, at the body length 144.9 mm and average body weight of 4.61 g. During the shortening of the body the number of eggs and the ovary weight increase.

Acknowledgements

I am greatly indebted to the persons who kindly supported this work by supplying me with the samples of *L. planeri*: Mr. Durčik and Mr. Zubáň gladly accepted my request to collect the brook lamprey in the Poprad river basin and extended interesting field observations. My colleague Dr. Balon has kindly offered me his own material from the same river and as well as facilities to work out this interesting problem. Dr. Lohniský has kindly lent me a sample of *L. planeri* from the Zdobnice river and Mgr. Rembiszewski those from the Oliwa and Chojnátka from Poland.

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STUDIES ON THE DEVELOPMENT
OF *RAPHIDASCARIS ACUS* (BLOCH, 1779) (NEMATODA: HETEROCHEILIDAE)

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Abstract. A description is given, with a full account of all developmental stages, of the nematode *Raphidascaris acus* presenting the results of the author's experimental studies on the life cycle of this nematode. Our experiments confirmed that one intermediate host (fishes of various families) participated in the life cycle of this nematode species. The third-stage, invasive, larva of *R. acus* develops in the internal organs (mainly in the liver) of these intermediate hosts. It has further been found that predatory fishes — the definitive hosts of *R. acus* — can also be utilized as intermediate hosts. Various invertebrate species act as reservoirs of the second-stage larva. Two more larval moults occur in the definitive host.

Although various authors have studied the life cycle of *R. acus* (Linstow, 1872; Mozgovej et Kosinova, 1963; Engašev, 1964a, b, 1965a, b; Kosinova, 1965; Kosinova et Mozgovej, 1965) its knowledge is still scarce and the data obtained are often conflicting. Until the present, no studies have been available on the development of this nematode in its definitive host. Also little work has been done on the life histories of other members of the genus *Raphidascaris* except some information on the cultivation of the eggs of *R. gigi* — (Kataoka et Momma, 1934) and a short note on the development of *R. canadensis* — (Thomas, 1937).

The possible high pathogenicity of *R. acus* to its hosts calls for more general knowledge on its development both from the theoretical and practical point of view. In an attempt to elucidate the complete life cycle of *R. acus*, we studied this problem in the years 1964—1967 and are presenting the results in this paper.

MATERIAL AND METHODS

The eggs of *R. acus* were dissected from the uteri of mature female nematodes, removed from the intestinal tract of the brown trout (*Salmo trutta m. fario*) and cultivated in water in small petri dishes. The invertebrates were infected by keeping them for 1—2 days in petri dishes filled with water and some detritus to which either numerous eggs containing fully formed larvae or hatched free larvae had been added. The intermediate fish hosts were infected with the eggs which were transported directly into their stomach with a pipette. Predatory fishes, the definitive hosts of *R. acus*, were fed with loach liver containing large numbers of third-stage larvae. The livers obtained from either artificially or naturally infected loaches (*Noemacheilus barbatulus*) were placed into the stomach of the definitive fish hosts with a pipette. Both the invertebrates and fishes were examined at various intervals.

RESULTS

The egg and larval development

The egg is opaque, almost spherical, size 0.066—0.078 by 0.081—0.087 mm, its surface is smooth. The hyaline wall of the egg is distinctly bilayered, attaining a thickness of up to 0.012 mm. During egg deposition its content is either uncleaved or cleaved into maximally 4 blastomeres.

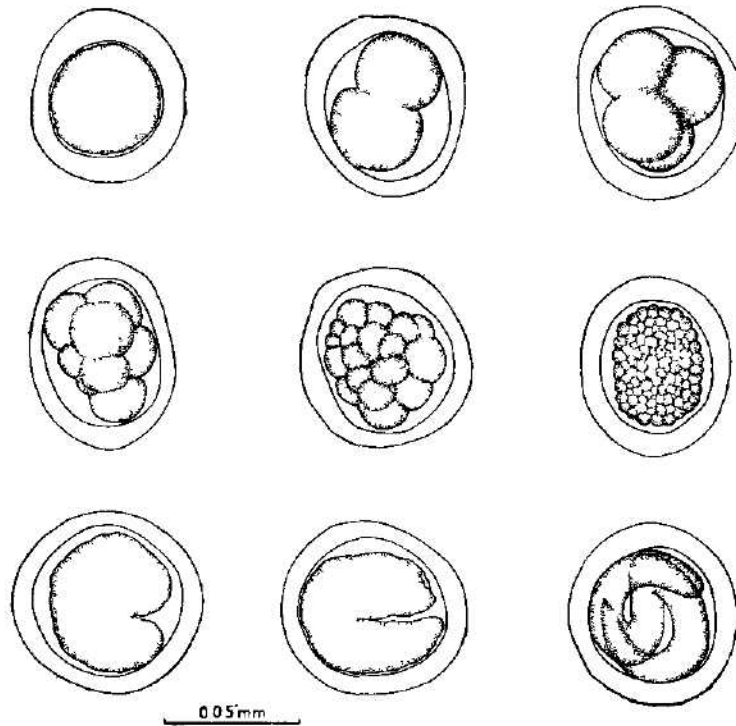


Fig. 1. *Raphidascaris acus* (Bloch, 1779) — cleavage of the egg and development of the larva.

The eggs develop in water and the rate of cleavage is affected considerably by the temperature (see Table 1). The eggs are very resistant to low temperatures and can survive even in frozen water as confirmed in our experiments. After the water has melted, the majority of these eggs continue in their normal development.

In the laboratory, formed but still immobile larvae were observed inside the eggs after 24 hrs at an average temperature of 22° C. Two to three days later the larvae started to move and on the 4th day, the first moult took place inside the egg. At first, the second-stage larvae remained inside the eggs, but on the 7th day, some larvae hatched spontaneously from the eggs. On the 30th day most larvae had emerged from the eggs, however, many larvae remained inside the egg and gradually died there. The liberated larvae live for a relatively short time in water, this being also dependent on the temperature. At 22° C the larvae live for 1—2 days, at 7° C for 3—10 days.

Table 1. Dependence of the development of *R. acus* larvae inside the eggs on temperature

| | Appearance of the first-stage larva | Emergence of first larvae from the egg capsules | Death of last larvae inside the eggs |
|-------|-------------------------------------|---|--------------------------------------|
| 7° C | days 15 to 18 | day 30 | day 82 |
| 22° C | days 1 to 3 | day 7 | day 59 |
| 30° C | days 1 to 2 | day 5 | day 12 |

Table 2. List of invertebrates used for experimental infection with eggs and larvae of *R. acus*

| Class | Species | No. of specimens in exper. | No. of positive specimens | Intensity of infection |
|---|-------------------------------------|----------------------------|---------------------------|------------------------|
| <i>Hydrozoa</i> | <i>Hydra attenuata</i> | 6 | — | — |
| <i>Oligochaeta</i> | <i>Phreoryctes gordioides</i> | 9 | — | — |
| | <i>Chaetogaster diaphanus</i> | 18 | 9 | 2—3 |
| | <i>Pristina foreli</i> | 3 | — | — |
| | <i>Tubifex tubifex</i> | 210 | 9 | 1 |
| | <i>Stylodrilus</i> sp. | 24 | — | — |
| <i>Hirudinea</i> | <i>Helobdella stagnalis</i> | 24 | — | — |
| | <i>Erpobdella testacea</i> | 6 | — | — |
| <i>Gastropoda</i> | <i>Bithynia tentaculata</i> | 15 | — | — |
| | <i>Spiralina vortex</i> | 18 | 12 | 1—5 |
| | <i>Lymnaea stagnalis</i> | 3 | — | — |
| <i>Copepoda</i> | <i>Macrocylops albidus</i> | 60 | 12 | 1 |
| <i>Malacostraca</i> (<i>Isopoda</i> and <i>Amphipoda</i>) | <i>Asellus aquaticus</i> | 33 | 6 | 1 |
| | <i>Niphargus tatrensis</i> | 3 | — | — |
| <i>Insecta</i> | <i>Diptera (Chironomidae):</i> | | | |
| | <i>Phytochironomus</i> sp. larv. | 3 | 3 | 1 |
| | <i>Macropelopia</i> sp. larv. | 3 | — | — |
| | <i>Polypedilum</i> sp. larv. | 201 | 148 | 4—50 |
| | <i>Procladius olivacea</i> | 276 | 117 | 2—43 |
| | <i>Chironomidae</i> gen. spp. larv. | 5 | — | — |
| | <i>Ephemeroptera:</i> | | | |
| | <i>Habrophlebia lauta</i> larv. | 6 | — | — |
| | <i>Ecdyonurus</i> sp. larv. | 6 | — | — |

Our findings are in general agreement with the data recorded by other authors (Linstow, 1872; Engašev, 1965a, b; Kosinova, 1965); however, Engašev (1965b) maintains that temperatures below 19° C prevent hatching of the second-stage larvae. By contrast, we found in our experiments (see Table 1) that the larvae emerge from the eggs at considerably lower temperatures (7° C) but much later than in laboratory temperatures.

Experimental infection of invertebrates

To clarify questions on the intermediate hosts of *R. acus*, members of various groups of water invertebrates were exposed to liberated second-stage larvae and eggs containing second-stage larvae. A list of the invertebrates involved is given in Table 2.

Second-stage larvae (either liberated or still within their egg capsules) are carried with the food to the digestive tract of the invertebrates. There, the larvae are liberated by digestive ferments and the free larvae penetrate the wall of the intestine on their passage to the body cavity, in molluscs also to the hepatopancreas and the leg. However, many of these larvae, having come to the digestive tract with ingested food, remain there and are expelled with the feces. The larvae in the body cavity are mobile at first, but coiled and immobile later. Encystment of these larvae as reported by Engašev (1965a, b) has not been observed. In all instances only free larvae, without cysts, were found in the body cavity.

We observed that the larvae behaved differently in members of various invertebrate groups. While no changes in size of the larvae or only a slight size increase were observed in the oligochaetes or molluscs, a distinct growth occurred in larvae invading the larvae of the fam. *Chironomidae*, in which they attained a length of as much as 0.447 mm; however, there was never any sign of moulting. Larvae in crustaceans (*Macrocyclops albidus* and *Asellus aquaticus*) exhibited regressive trends (decrease in size, very little mobility) and, after several days, even dead larvae were found in these crustaceans. Also a comparison of the incidence and intensity of infection in artificially invaded invertebrates revealed largely higher values in larvae of the fam. *Chironomidae* than those in the other species. This supports the fact that, although *R. acus* utilizes various members of water invertebrates as reservoirs, the most suitable hosts seem to be larvae of the family *Chironomidae*. We succeeded in finding *R. acus* larvae in the larvae of the family *Chironomidae* even in nature.

Experimental infection of intermediate fish hosts

In our feeding experiments with eggs of *R. acus* containing second-stage larvae we used a total of 71 fishes belonging to several species (see Table 3). The complete development in the body of the intermediate host has been studied only in the loach (*Noemacheilus barbatulus*).

The eggs having reached the intestinal tract of the loach are attacked by digestive ferments and the second-stage larvae are liberated. These start immediately to penetrate the intestinal wall with the aid of the anterior boring tooth and to enter the body cavity and the liver. As early as two hours from the outset of the feeding experiment numerous free mobile or coiled second-stage larvae were found in the liver of the loach. When feeding large numbers of eggs to the loach, the passage of the larvae through the gut

wall and internal organs was followed by a shock reaction (approximately 1—2 hrs after the feeding of the eggs). Part of the larvae remained active in the mucosa of the intestine; considerable numbers of larvae got stuck in the intestinal wall on their passage into the body cavity and encysted there. The cysts were spherical, oval or ovoid, unilayered, measuring 0.012—0.015 by 0.012—0.024 mm. The larvae inside these cysts were coiled and motionless (Fig. 4) and survived there for several days or even weeks. The free larvae in the mucosa of the intestine, in the mesenteries and the liver grew evenly until they attained a size of 0.738—1.050 mm (in about 15—55 days); then they started their second moulting. In the mucosa of the intestine, the third-stage larvae remained active for several days after the second moulting and then started to encyst and to increase slightly in size. The larvae, which penetrated the liver, continued to grow after the second moulting and, after 153 days, attained a length of 3.02—5.20 mm. At this time the larvae are covered already with thin-walled cysts, each containing 1—6 larvae. From then onwards the larvae changed neither morphologically nor metrically. Typical for these third-stage larvae are: the extended anterior end of the oesophagus and the absence of the cuticular boring tooth at the anterior end of their body. The anlage of the lips and mouth papillae are found, however, only in larger larvae from the liver. By feeding third-stage larvae from the intestine and liver of loaches to rainbow trouts (*Parasalmo gairdnerii*) we confirmed that both these larval types are capable of infecting their definitive host.

Table 3. Survey of fishes infected experimentally with *R. acus* eggs

| Fish | No. of specimens in exper. | No. of positive specimens | Intensity of infection | Location |
|--|----------------------------|---------------------------|------------------------|--|
| <i>Noemacheilus barbatulus</i> | 26 | 25 | 1—147 | liver, intestinal wall, intestinal mucosa, mesentery |
| <i>Cottus gobio</i> | 1 | — | — | — |
| <i>Phoxinus phoxinus</i> | 16 | 8 | 3—30 | intestinal wall, intestinal mucosa |
| <i>Gobio gobio</i> | 1 | — | — | — |
| <i>Leucaspis delineatus</i> | 1 | — | — | — |
| <i>Tinca tinca</i> | 1 | — | — | — |
| <i>Leuciscus cephalus</i> (length 10—12 cm) | 9 | 8 | 1—23 | intestinal mucosa |
| <i>Leuciscus cephalus</i> (length 28—30 cm) | 3 | — | — | — |
| <i>Parasalmo gairdnerii</i> (length 6—9 cm) | 10 | 3 | 2—3 | intestinal mucosa, stomach, liver |
| <i>Parasalmo gairdnerii</i> (length 26—33 cm) | 4 | — | — | — |

In smaller specimens of *Leuciscus cephalus* (length 10—12 cm) and *Phoxinus phoxinus* the development of *R. acus* larvae was similar to that in the intestine of the loach. While no larvae were found in the liver of *Ph. phoxinus*, the livers of *L. cephalus* contained numerous minute dead and calcified larvae. All attempts to infect large specimens of *L. cephalus* (length 28 to

30 cm) with these larvae remained negative. This may have been due partly to defence reactions of the host's organism, partly to the different structure of the individual organs in the various fish species or in different age groups of the same fish species (thickness of the intestinal wall etc.).

Feeding experiments with eggs of *R. acus* to rainbow trouts (Table 3), the possible definitive host of *R. acus*, showed that even predatory fishes (the definitive hosts) may be utilized by *R. acus* as intermediate hosts. In addition these experiments confirm that the development of *R. acus* is impossible without the participation of the intermediate hosts as suggested by Ljajman (1939, 1949). By contrast, we found in our experiments that certain fish species do not act as reservoirs of *R. acus* (see Ljajman, 1939, 1949) or as its second intermediate hosts as suggested by Ginecinskaja (1958) and Engašev (1965a, b), but that these are the only obligatory intermediate hosts of this nematode.

Experimental infection of the definitive fish hosts

A total of 53 specimens of four fish species were used in our feeding experiments with the definitive hosts of *R. acus* (for survey see Table 4). These fishes were fed with the liver of infected loaches (with a pipette directly into the stomach). The liver contained always at least 50 invasive larvae of *R. acus* measuring 3.02—5.44 mm in length. Then the fishes were kept in an aquarium at 15° C and fed with minced meat.

Table 4. Survey of feeding experiments with predatory fishes

| | No. of fishes in exper. | No. of positive fishes | Intensity of infection |
|------------------------------|----------------------------|---------------------------|---------------------------|
| <i>Salmo trutta m. fario</i> | 25 | 15 | 2—30 |
| <i>Parasalmo gairdnerii</i> | 24 | 16 | 3—57 |
| <i>Esox lucius</i> | 3 | 0 | — |
| <i>Perca fluviatilis</i> | 1 | 0 | — |

In the definitive host the larvae settled in the anterior portion of the gut and in the pyloric appendages and the largest of them started their third larval moulting 3—4 days after invasion. The fact that these larvae started moulting at a time when they measured 5.83—6.25 mm suggests that smaller larvae need a much longer time before starting to moult because, having entered the intestinal tract of the definitive host they first must attain this length. As we confirmed in our experiments, very young third-stage larvae (at a length of 0.79 mm) are already infectious to their definitive hosts. Even in nature we found very small larvae (only slightly above 1 mm) in the intestinal tract of the brown trout (*Salmo trutta m. fario*).

The fourth-stage larvae continued growing in the intestinal tract of their definitive host and the last (fourth) larval moulting was observed 21 days after the outset of the experiment. The length of the male larva just undergoing the moult was 7.89—9.07 mm, that of the female larva 8.16 mm. On day 33 we found the first mature male (length 13.67 mm) and 3 females (length 18.78—19.09 mm) with immature eggs in their uteri. However, as late as on day 64 one mature female (length 43.86 mm) was found depositing

eggs into the gut of the host. This shows that *R. acus* completes its development in the definitive host (up to egg production) in approximately two months.

We also observed that at a higher temperature of the water (24° C) the worms leave their hosts, the same occurring also during host starvation. A starving host loses all its *R. acus* larvae after 8 days at a water temperature of 15° C.

Description of the individual stages

First-stage larva (Fig. 2)

First-stage larvae were obtained by pressing them out of the eggs on day 2 and 3 of the experiment at laboratory temperature. The overall length of

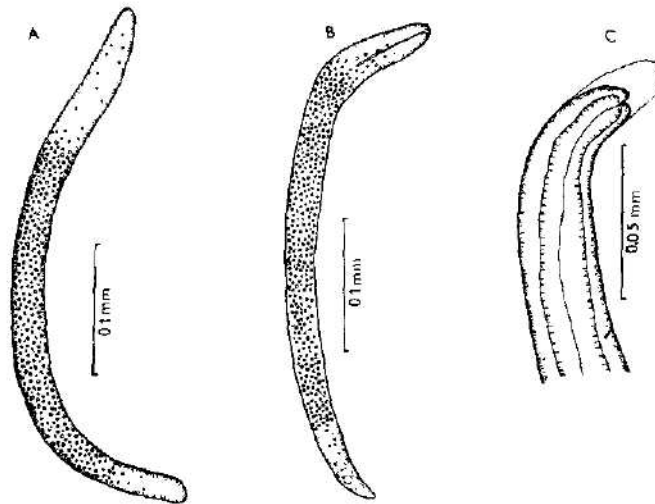


Fig. 2. *Raphidascaris acus* (Bloch, 1779). A — younger first-stage larva, B — older first-stage larva, C — larva at the transitory stage during the first moult.

these larvae was 0.366—0.450 mm, maximum width 0.024—0.030 mm. Body elongate, relatively thick, at first rounded at both ends, in older larva conical at the posterior end. Cuticle very fine, smooth. Body filled with dark granules covering the internal structure of the larva. This granulation was considerably less dense at both ends of the larval body making the anterior oesophageal portion and the posterior end of the larval body appear much lighter. In older larvae the oesophagus was only feebly visible, measuring approximately 0.090 mm in length. Anus indistinct.

Moulting larvae of the intermediary stage (4th day) were very similar in shape to second-stage larvae. The oesophagus was more distinct, the excretory pore could be discerned. However, the internal organisation of the larval body was still obscured by dense granulation. The shed exuvia remained inside the egg shells.

Second-stage larva (Figs. 3, 4, 5, 6)

Second-stage larvae shortly after moulting were obtained by pressing them out of the egg capsule. Their mouth armed with a ventral cuticular tooth

enables the larva to emerge from the egg shell and to penetrate the tissues of the intermediate host. Oesophagus still scarcely visible, gut densely granulated. Narrow cuticular alae extending along both sides of the larval body.

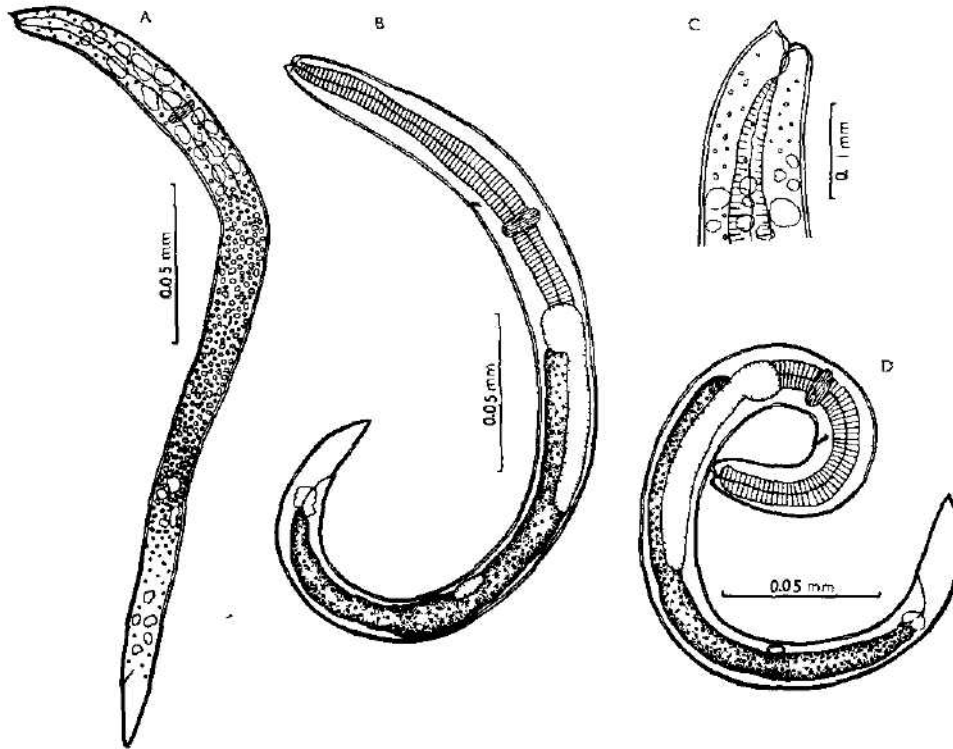


Fig. 3. *Raphidascaris acus* (Bloch, 1779). A — young second-stage larva from the egg, B — free second-stage larva, C — cephalic end of second-stage larva, D — second-stage larva from *Tubifex tubifex* 15 days p.i.

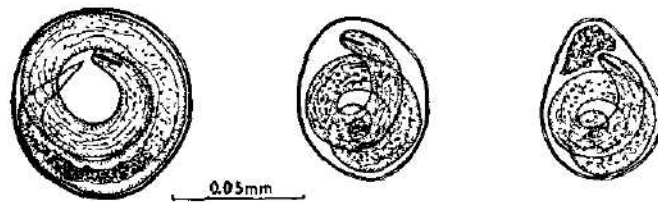


Fig. 4. *Raphidascaris acus* (Bloch, 1779). Encysted second-stage larvae from the intestinal wall of *Noemacheilus barbatulus* 16 days p.i.

The structure of the body of second-stage larvae is more distinct after emerging from the egg capsules. The larvae are relatively plump, slightly attenuated towards both ends. Cuticle fine, smooth, forming a narrow cuticular ala along each side of the body, slightly broader at cephalic end. Mouth ventrad armed with a conical tooth of 0.001 mm in length. Oesophagus

relatively long, with thin walls. Nerve ring encircling oesophagus at about the border of its second and third third. Ventriculus present, slightly longer than broad. Ventricular appendix relatively short. Intestine straight with numerous brownish granules. Rectum long, colourless, surrounded by rect.

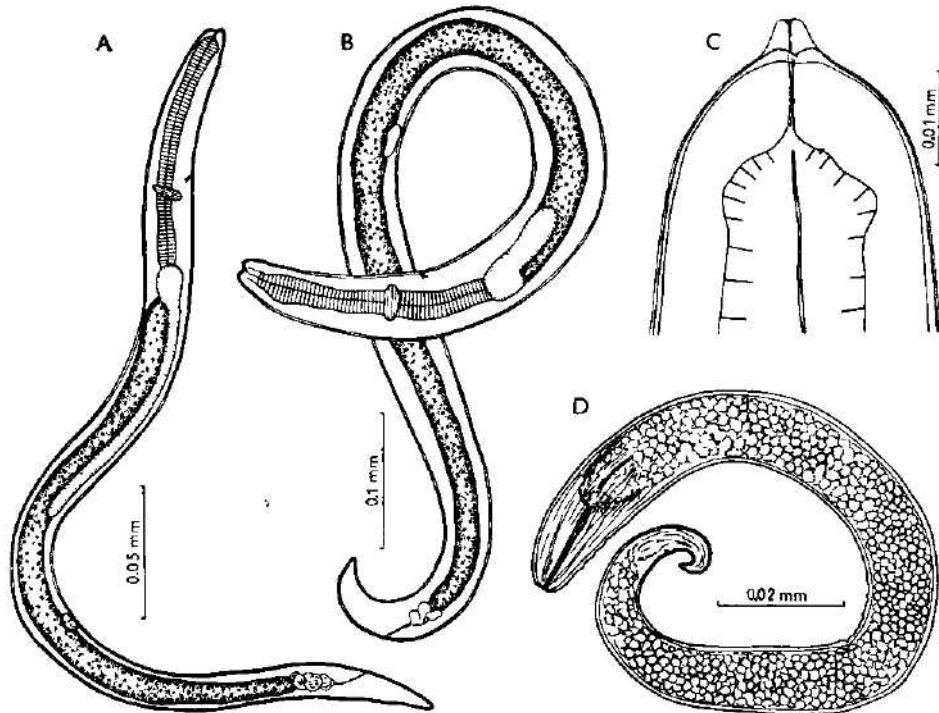


Fig. 5. *Raphidascaris acus* (Bloch, 1779). A — second-stage larva from the intestine of *Leuciscus cephalus* 7 days p.i., B — older second-stage larva with an atypical ventricular appendix from the liver of *Noemacheilus barbatulus* 55 days p.i., C — cephalic end of larva during second moult (from the liver of *Noemacheilus barbatulus* 55 days p.i.), D — dying second-stage larva from the intestinal wall of *N. barbatulus* 55th day p.i.

Table 5. Measurements of free second-stage larvae of *R. acus* after various authors

| | Kosinova 1965 | Engašev 1965b | Own material |
|--|---------------|---------------|--------------|
| Body length | 0.275—0.318 | 0.306—0.363 | 0.240—0.375 |
| Body width | | 0.014—0.019 | 0.015—0.021 |
| Length of oesophagus | | | 0.060—0.129 |
| Size of ventriculus | | | 0.012—0.018 |
| | | | × |
| | | | 0.008—0.012 |
| Length of ventricular appendix | | | 0.021—0.057 |
| Distance of nerve r. from anterior end | | | 0.054—0.096 |
| Distance of excret. p. from anterior end | | | 0.045—0.084 |
| Length of tail | | | 0.018—0.030 |

glands. Tail conical. Excretory pore slightly in front of the level of nerve ring. Genital primordium situated at about the border of the second and third third of intestinal length.

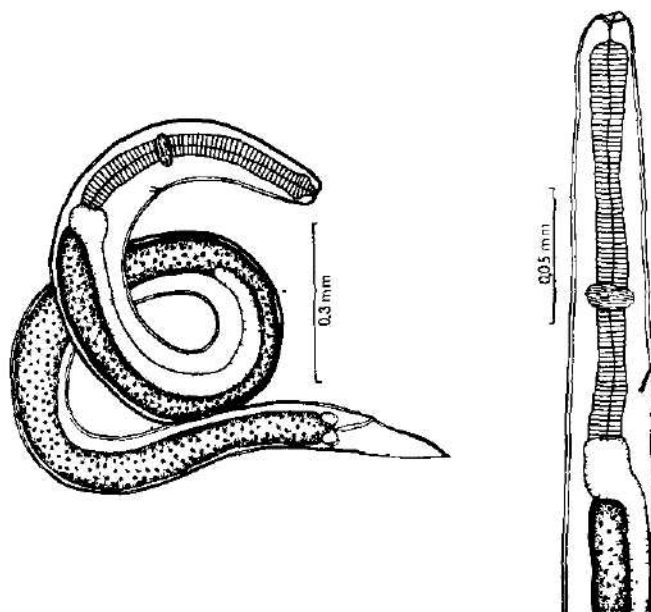


Fig. 6. *Raphidascaris acus* (Bloch, 1779) — very young third-stage larvae from the intestine of *Parasalmo gairdnerii*.

Engašev (1965a, b) and Kosinova (1965) reported that the internal organs of these free second-stage larvae were not yet differentiated. By contrast, in all free second-stage larvae we found all internal organs as evident from our description. This corresponds also to the observations by Linstow (1872).

The second-stage larvae grow in the internal organs of their intermediate fish hosts until they attain a length of 0.738—1.050 mm and then start to moult. Almost no morphological changes were observed during this period of growth except a prolongation of the ventricular appendix and a slight shifting of the excretory pore below the level of the nerve ring (see Table 7).

Third-stage larva (Fig. 7)

Overall length of larval body 0.810—5.447 mm, this being dependent partly on the age of the larva, partly on its location in the intermediate host (for measurements and growth see Table 7). While the larvae confined to the intestine of their intermediate fish host grew very little after their second moulting and were morphologically very similar to the second-stage larvae, the larvae in the liver grew very quickly and changed morphologically mainly in the development of the mouth organs and the rectal glands.

The body of the larger third-stage larva from the liver was long and slender, its cuticle with dense, transverse striation. Maximum breadth of lateral alae,

Table 6. Measurements of second-stage larvae of *R. acus* from invertebrates

| | From <i>Tubifex tubifex</i> | From <i>Spiratulus vortex</i> | From <i>Polyphemus</i> sp. larvae | From <i>Proclimacia obtusica</i> larvae |
|--|-----------------------------|-------------------------------|-----------------------------------|---|
| | 15 days p.i. | 1 day p.i. | 8 days p.i. | 1 day p.i. |
| Length of body | 0.300 | 0.237 | 0.279—0.285 | 0.294—0.309 |
| Width of body | 0.018 | 0.018 | 0.018 | 0.015—0.021 |
| Length of oesophagus | 0.084 | 0.091 | 0.069—0.120 | 0.096—0.126 |
| Size of ventriculus | 0.015 × 0.012 | 0.008 × 0.007 | | 0.015—0.018 |
| Length of ventricular appendix | 0.063 | 0.036 | 0.066 | 0.009—0.012 |
| Distance of nerv. r. from anterior end | | | | 0.036—0.072 |
| Distance of excret. p. from anterior end | 0.036 | 0.042 | 0.042 | 0.039—0.063 |
| Length of tail | 0.027 | 0.018 | 0.021 | 0.045—0.075 |
| | | | | 0.018—0.024 |
| | | | | 0.270—0.378 |
| | | | | 0.444—0.447 |
| | | | | 0.016—0.018 |
| | | | | 0.024 |

Table 7. Growth of *R. acus* larvae in the liver of *Neomachilis barbata*

| | 9 days p.i. | 16 days p.i. | 21 days p.i. | 41 days p.i. | 55 days p.i. | 153 days p.i. | 365 days p.i. |
|--|----------------|--------------|---------------|--------------|--------------|---------------|---------------|
| | Length of body | 0.465—0.663 | 0.612—0.987 | 0.738 | 0.852 | 0.810—1.450 | 3.019—5.154 |
| Width of body | 0.030—0.036 | 0.030—0.045 | 0.036 | 0.045—0.048 | 0.042—0.069 | 0.096—0.136 | 0.108—0.138 |
| Length of oesoph. | 0.111—0.135 | 0.132—0.195 | 0.138 | 0.144—0.150 | 0.135—0.270 | 0.465—0.748 | 0.680—0.788 |
| Size of ventrio. | 0.016 | 0.018—0.024 | 0.018 × 0.018 | | 0.018—0.024 | 0.036—0.060 | 0.048—0.054 |
| Length of ventr. appendix | 0.012—0.018 | 0.018—0.024 | | | 0.018—0.024 | 0.036—0.063 | 0.048—0.054 |
| Distance of nerv. ring from anter. extremity | 0.123—0.168 | 0.072—0.135 | 0.213 | 0.159—0.225 | 0.195—0.270 | 0.476—0.625 | 0.503—0.544 |
| Distance of excret. pore from anter. extremity | 0.093—0.105 | 0.096—0.150 | 0.093 | 0.105 | 0.087—0.117 | 0.201—0.306 | 0.315 |
| Distance of excret. pore from anter. extremity | 0.087 | 0.078—0.144 | 0.126 | 0.120 | 0.111—0.144 | 0.222—0.348 | |
| Distance of excret. pore from anter. extremity | 0.030—0.051 | 0.036—0.051 | 0.036 | 0.042 | 0.048—0.057 | 0.114—0.163 | 0.108—0.176 |

extending along both sides of the whole body, 0.030—0.036 mm. The mouth surrounded by three lips, the dorsal lip bearing two, both ventrolateral lips one large mouth papilla each. Nerve ring at about the second third of oesophagus length, excretory pore following closely behind it. Ventriculus spher-

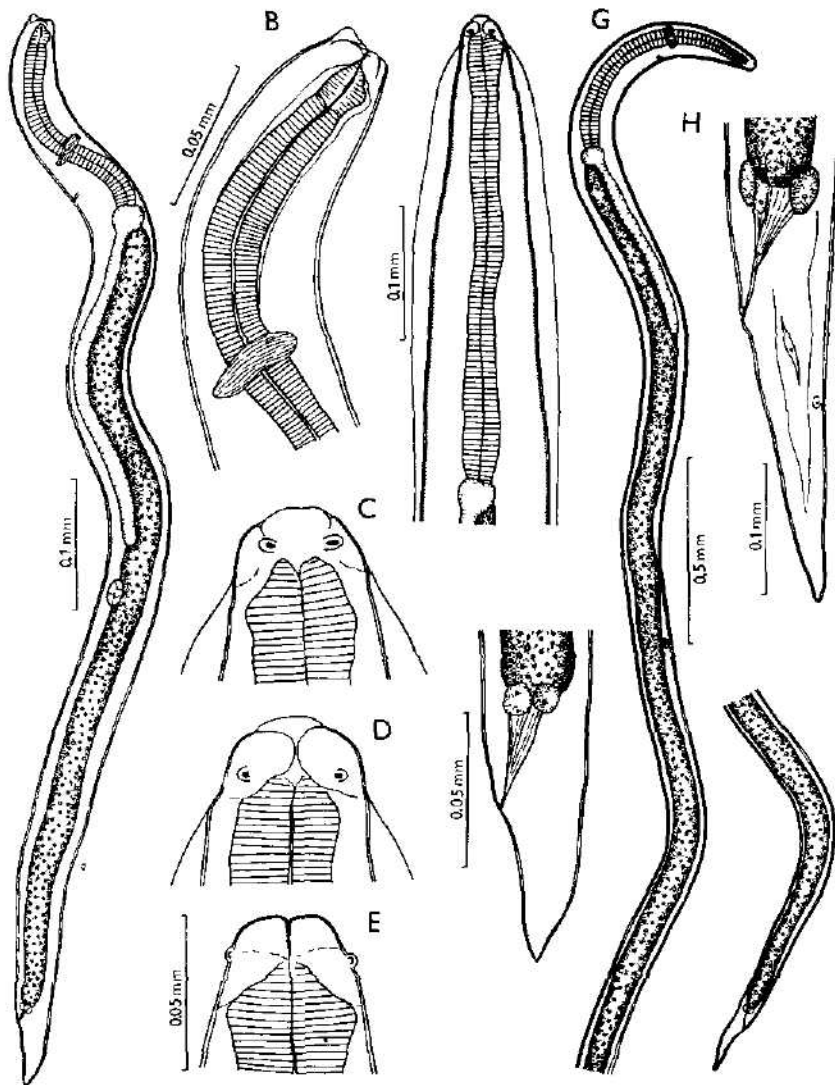


Fig. 7. *Raphidascaris acus* (Bloch, 1779). A — younger third-stage larva from the liver of *Noema-cheilus barbatulus* (22 day p.i.), B — cephalic end of younger third-stage larva, C, D, E, F — cephalic end of older third-stage larva, G — older third-stage larva from the liver of *N. barbatulus* (153 days p.i.), H — tail of older third-stage larva, I — tail of younger third-stage larva.

rical or only slightly broader than long. Ventricular appendix either as long as oesophagus or slightly shorter. Intestine dark-brown, straight, occupying almost the entire breadth of the body. Rectum short, colourless, with three

large, unicellular rectal glands opening into it. Two of these glands ventral, one dorsal. Tail conical. Genital primordium at anterior half of body.

In the digestive tract of the definitive host the third-stage larva continues to grow until it attains a length of 5.83—6.25 mm and then starts its third moulting.

Table 8. Measurements of *R. acus* larvae from *Leuciscus cephalus* and *Parasalmo gairdneri* experimentally infected with eggs

| | <i>L. cephalus</i> | | <i>P. gairdneri</i> | |
|--|--------------------|---------------|---------------------|--------------|
| | intestinal mucosa | | intest. mucosa | liver |
| | 7 days p.i. | 9 days p.i. | 6 days p.i. | |
| Length of body | 0.351—0.465 | 0.450 | 0.549 | 0.585 |
| Width of body | 0.021—0.024 | 0.024 | 0.024 | 0.033 |
| Length of oesoph. | 0.099—0.102 | 0.093 | 0.081 | 0.129 |
| Size of ventric. | 0.015 × 0.012 | 0.015 × 0.015 | 0.015 × 0.018 | 0.015 × 0.01 |
| Length of ventr. appendix | 0.114 | 0.087 | | 0.120 |
| Distance of nerv. ring from anter. extremity | 0.081 | | | 0.087 |
| Distance of excr. pore from anter. extremity | 0.075 | | | |
| Length of tail | 0.033—0.036 | 0.33 | 0.48 | 0.36 |

Fourth-stage larva (Fig. 8)

The fourth-stage larvae in our experiments measured 5.830—9.071 mm in length, maximum width 0.136—0.190 mm. Cuticle with dense transverse striation, forming two lateral alae along both sides of the body. Mouth surrounded by three lips provided with mouth papillae. Oesophagus 1.020 to 1.360 mm long; nerve ring at 0.339—0.408 mm from anterior end of body, excretory pore at 0.476—0.495 mm. Oval ventriculus 0.075—0.122 by 0.066—0.122 mm, ventricular appendix 0.680—1.020 mm long. Tail conical, length 0.135—0.213 mm. The general organisation of the larval body is similar to that of advanced third-stage larvae, only the genital primordium in female fourth-stage larvae joins the ventral side of the body wall, forming the anlage of the vagina. Older larvae, from which the males originate, have a shorter tail. The last moulting (fourth) was observed in male larvae of 7.89—9.07 mm in length and in the female larva of 8.16 mm in length.

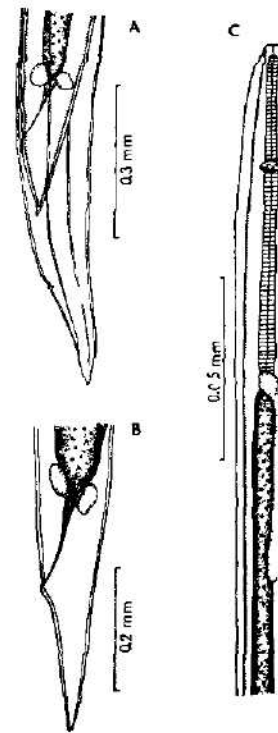


Fig. 8. *Raphidascaris acus* (Bloch, 1779) — fourth-stage larva. A — tail of larva during third moult, B — tail, C — head end (dorsal view).

Adults (Figs. 9, 10)

The adult nematodes obtained in our experiments were in general agreement with the description of *R. acus* given by Rojtm an (1963). However, it was found that the number and distribution of the tail papillae was not constant. Thus, in various specimens the number of preanal pairs of papillae was 17—20, that of postanal pairs 6; of the latter the first two pairs were generally joined together, seldom separated. In one male these two pairs of papillae were joined together at one side while separated at the other (see Fig. 10c). Measurements and growth of the adults are given in Table 9.

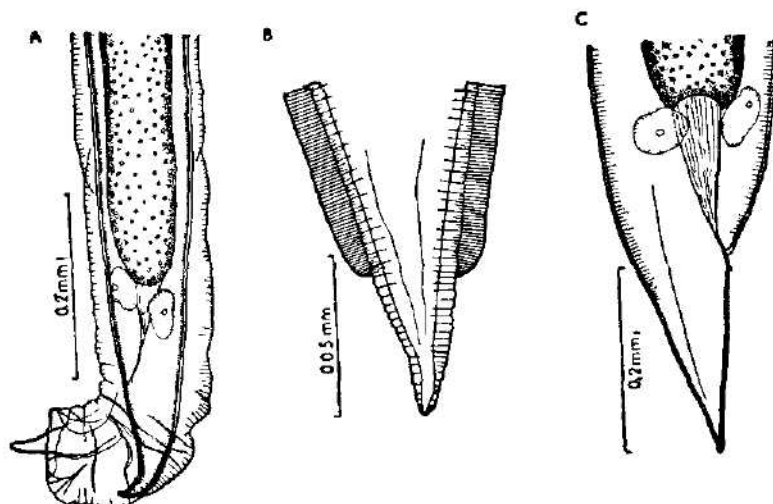


Fig. 9. *Raphidascaris acus* (Bloch, 1779). A — tail of juvenile female during last moult, B — tail end of young female (dorsal view), C — posterior end of young female.

Table 9. Growth of *R. acus* in the intestine of *Parasalmo gairdnerii*

| | 4 days p.i. | 6 days p.i. | 6 days p.i. fem. larv. | 10 days p.i. fem. larv. |
|---|-------------|-------------|---------------------------|----------------------------|
| Length of body | 3.480—5.120 | 4.936—5.848 | 6.161—6.433 | 4.121—5.766 |
| Width of body | 0.095—0.122 | 0.122—0.136 | 0.163 | 0.150 |
| Maximum width of alae | 0.030—0.033 | 0.036 | | |
| Length of oesoph. | 0.597—0.765 | 0.734—0.825 | 1.081—1.129 | 0.870 |
| Size of ventric. | 0.051—0.063 | 0.063—0.066 | 0.082—0.095 | 0.054 × 0.068 |
| | × | × | × | |
| | 0.045—0.066 | 0.060—0.069 | 0.068—0.082 | |
| Length of ventr. appendix | 0.462—0.591 | 0.584—0.612 | 0.762—0.775 | 0.612 |
| Distance of nerve ring from anter. extremity | 0.249—0.270 | 0.246—0.261 | 0.367 | 0.394 |
| Distance of exor. pore from anter. extremity | 0.258—0.300 | 0.288—0.297 | 0.408—0.462 | 0.421 |
| Distance of vulva from anter. end | | | 2.910—2.950 | 2.150 |
| Spicule length | | | | |
| Length of tail | 0.111—0.136 | 0.117—0.156 | 0.136—0.177 | 0.136 |

DISCUSSION

Views on the development of *R. acus* are most varying. Ljajman (1939, 1949) thought of a direct development of this species without intermediate hosts and of various fish species, harbouring in their internal organs *R. acus* larvae, as reservoirs. Ginecinskaja (1958) and Engašev (1965a, b) maintained that invertebrates act as first intermediate hosts and various fish

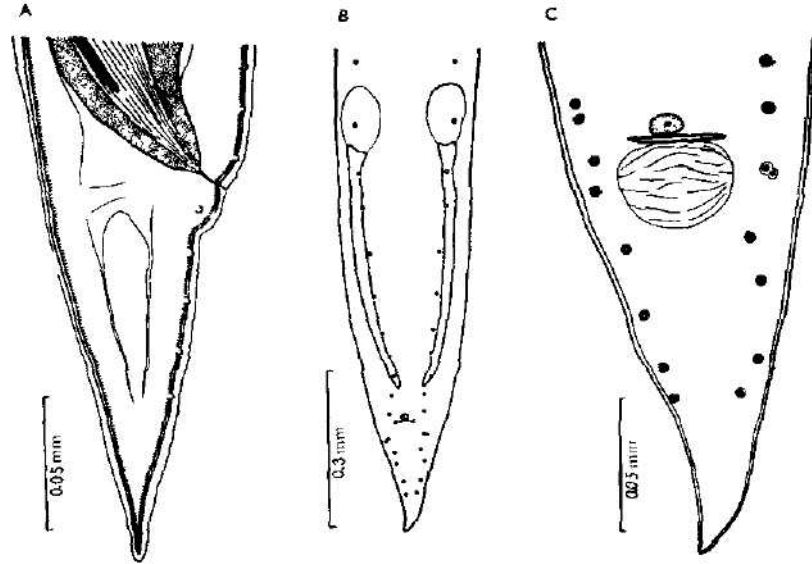


Fig. 10. *Raphidascaris acus* (Bloch, 1779). A— tail of male during last moult, B — posterior end of juvenile male (ventral view), C — tail of male with atypically distributed papillae.

| 21 days p.i. | | 33 days p.i. | | 64 days p.i. |
|--------------|--------------|--------------|---------------|--------------|
| ♂♂ | ♀♀ + fem. l. | ♂ | ♀♀ | ♀ |
| 8.160—9.996 | 7.235—10.972 | 13.668 | 18.775—19.088 | 43.860 |
| 6.177—0.218 | 0.163—0.218 | 0.272 | 0.340—0.367 | 0.880 |
| | | | 0.061 | |
| 1.265—1.496 | 1.142—1.537 | 1.876 | 2.516—2.611 | 3.169 |
| 0.082—0.109 | 0.082—0.095 | 0.109 | 0.150—0.163 | 0.272 |
| × | × | × | × | × |
| 0.095—0.109 | 0.082—0.108 | 0.122 | 0.150—0.163 | 0.272 |
| 0.884—1.061 | 0.748—0.979 | 1.251 | 1.115—1.251 | 1.591 |
| 0.408—0.435 | 0.381—0.476 | 0.476 | 0.544—0.558 | 0.734 |
| 0.476—0.530 | 0.476—0.517 | 0.571 | 0.639 | 0.857 |
| | 3.770 | | | 9.590 |
| 0.360—0.785 | | 0.435 | | |
| 0.165—0.258 | 0.180—0.320 | 0.190 | 0.286—0.408 | 0.490 |

species as second intermediate hosts. Mozgovoj and Kosinova (1963) suggested that invertebrates are the only obligatory intermediate hosts of *R. acus*, while various fish species, in which larvae of *R. acus* are commonly found, are their reservoirs.*

Various Russian investigators (Engašev 1965a, b; Kosinova 1965, Kosinova et Mozgovoj 1965) considering invertebrates to be obligatory intermediate hosts of *R. acus*, stated that the second larval moulting of the larvae occurred soon after entering the body cavity of invertebrates or while still in their gut. According to these authors, a perfectly developed digestive tract can be found only in larvae after the second moult. However, our observations showed that a completely developed digestive tract was present as early as in the second-stage larvae (see p. 41) and that no further fundamental morphological changes occurred in the structure of the larvae while in the body cavity of invertebrates. Only in some invertebrates did we observe a slight growth of the larval body and an elongation of the ventricular appendix. Due to the absorption of granules, which previously had partly obscured the digestive tract of the larvae, this becomes clearly visible after several days. In spite of repeated observations we never noticed the second larval moult in invertebrates. Also Huizinga (1966, 1967) states that in the related genus *Contracaecum* (*C. spiculigerum* and *C. multipapillatum*) the second-stage larvae may partly develop and grow in invertebrates but never realize their second moult in them. This occurs only in the intermediate fish hosts. The suggestion that no second moult of *R. acus* larvae can occur in invertebrates is supported by these facts:

a) Maximum length of larvae in invertebrates is 0.447 mm (according to Engašev as much as 0.573 mm); however, the second moult in fishes occurs when the larvae measure 0.738—1.050 mm.

b) Larvae from invertebrates do not differ morphologically from free second-stage larvae. They are provided with an anterior larval tooth, typical for the second-larval stage. The typical sign of the third-stage larva, the lip-anlage, is not yet developed.

c) When these larvae from invertebrates are ingested by the definitive hosts they do not complete their development in the intestinal tract, but penetrate the internal organs of these hosts to encyst and develop there into only third-stage larvae.

For these reasons the information on the second larval moult in invertebrates presented by the Russian authors seems rather doubtful. Should, however, these larvae moult in the invertebrates, these, according to Ryzikov's (1954) recent evaluation of reservoir parasitism, would only be reservoir hosts of *R. acus* and not intermediate hosts, because *R. acus* can complete its development without them. Therefore, we consider the invertebrates to be the reservoirs of *R. acus* larvae and the larvae of the family *Chironomidae* to be reservoir hosts, in which, according to the classification of reservoir habitationism (Ryšavý et Baruš, 1965), its growth form occurs.

The results of our studies revealed the following development of *R. acus*: The adult nematodes are found in the pyloric appendages and the anterior

* Recently also Dr. V. G. Kosinova of the Lomonosov University, Moscow, (personal communication) concluded on the grounds of her experiments that fishes may be utilized by *R. acus* as intermediate hosts.

portion of the intestine of predatory fishes and their eggs are released to the water along with the host's feces. The first-stage larva developing after several days moults inside its egg capsule and changes into the second-stage invasive larva. This development lasts five days at 22° C of water temperature. Some days later several larvae emerge from their egg shells. Invertebrates or various fish species ingest either the eggs containing second-stage larvae or free-swimming larvae. These larvae enter the body cavity of the invertebrates, where they may grow slightly but not moult for the second time. When invaded invertebrates or, accidentally, eggs or free larvae of *R. acus* are ingested by various fishes, the larvae penetrate the wall of the intestine and enter the body cavity, mainly the liver, where their additional moult occurs. At this stage the larvae are infective for the definitive host — the predatory fish, which feeds on fish containing invasive larvae. Two additional moults occur in the intestinal tract of the definitive host. The complete development of *R. acus* (until egg production) lasts approximately two months.

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**THE EYE MUSCLES IN PERIOPHTHALMUS BLOCH ET SCHNEIDER, 1801
AND CHAULIODUS BLOCH ET SCHNEIDER, 1801 (OSTEICHTHYES)**

OTA OLIVA & VLASTISLAV SKOŘEPA

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Abstract: The eye muscles topography in two fishes of fundamentally different life habits was studied. In the deep-sea fish, *Chauliodus*, there are no myodomes. In semiamphibiously living *Periophthalmus* there are both myodomes, anterior and posterior one, well developed. The posterior myodome is divided into two chambers, the upper one with the rectus externus muscle only, the lower chamber, which is more spacious, possesses parts of three recti muscles. The rectus medialis muscle has a bifurcated flattened origin. The presence of three myodomes in *Periophthalmus* is apparently connected with its head shape bearing strongly projecting eyes close together and semiamphibious mode of life.

METHODS

Two heads of the walking goby or mud skipper (*Periophthalmus schlosseri*) and of the viper fish (*Chauliodus sloanei*) were used for dissections by use of the same technique described in former communications (see Oliva & Skořepa, 1968).

Explanations to Abbreviations

| | |
|---------------------------------------|-----------------------------|
| AMY — anterior myodome | P — pectoral fin |
| ASPH — alisphenoid | PAL — palatinum |
| BS — basisphenoid | PFR — praefrontal |
| EL — lateral ethmoid | PRO — prootic |
| FR — frontal | PS — parasphenoid |
| ME — mesethmoid | re — rectus externus muscle |
| MX — maxillar | ri — rectus inferior muscle |
| MY ₁₋₂ — posterior myodome | rm — rectus medialis muscle |
| no — optic nerve | rs — rectus superior muscle |
| oi — obliquus inferior muscle | SPH — sphenotic |
| os — obliquus superior muscle | VO — vomer |

RESULTS

Chauliodus sloanei Bloch et Schneider, 1801

There is no anterior myodome. The obliqui muscles, which are very thin, originate from the fibrous septum between the lateral ethmoid and parasphenoid. The inferior obliquus originates from the same point of origin as superior obliquus and the inferior obliquus of the opposite eye communicates with it. The obliquus inferior muscle does not cover the attachment of the musculus rectus inferior. The musculus obliquus superior originates similarly as the obliquus inferior, attaches on the eye bulb and covers the insertion of the musculus rectus superior. There is no posterior myodome. The recti

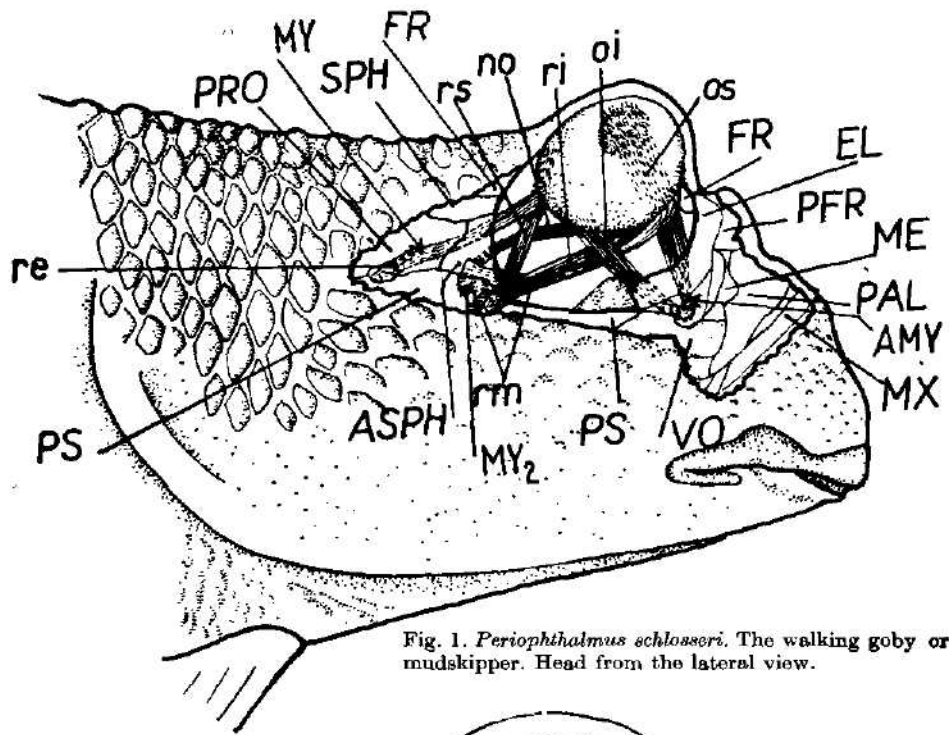


Fig. 1. *Periophthalmus schlosseri*. The walking goby or mudskipper. Head from the lateral view.

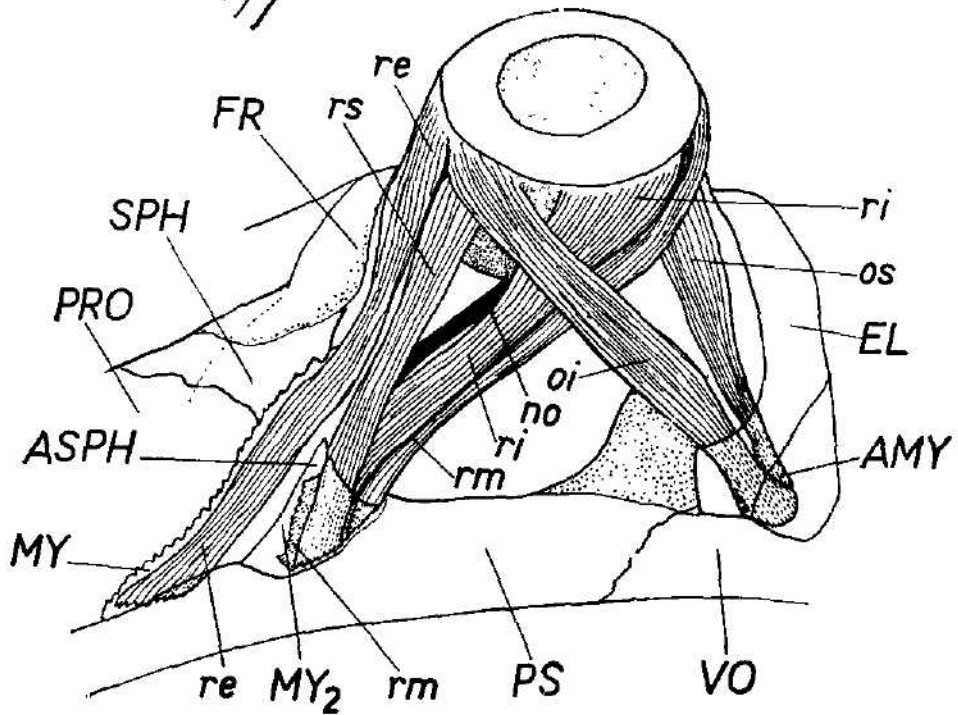


Fig. 2. A detail view of eye muscles topography and insertion of muscles.

muscles originate from the parasphenoid and the fibrous tissue filling the foramen, the roof of which is formed by the basisphenoid and prootic arches, the floor by the parasphenoid. The rectus externus muscle originates aborally from all rect and forms a wide attachment on the eye bulb. The rectus inferior originates close in front of the rectus externus. Its attachment is in connection with the attachment of the obliquus inferior, but the latter does not cover it. The rectus medialis muscle is relatively short, does not reach the point of origin of other recti muscles. Its originates from the fibrous stalk by which the eye capsule is attached to the cleithrum (according to Tchernavin, 1952). The rectus superior muscle originates most orally from all recti exclusive of the rectus medialis. It is flat, attaches on the eye bulb, where it is covered by the attachment of the obliquus superior muscle.

Periophthalmus schlosseri (Pallas, 1770)*)

In the walking goby or mud skipper, there is an anterior myodome, formed by the lateral ethmoid, mesethmoid, praefrontal and parasphenoid. Both obliqui muscles arise in it. The obliquus inferior muscle arises from the ethmoidal cartilage, laterally from the origin of the superior obliquus, which arises more dorsally to it. The shape of the obliquus inferior is lateromedially

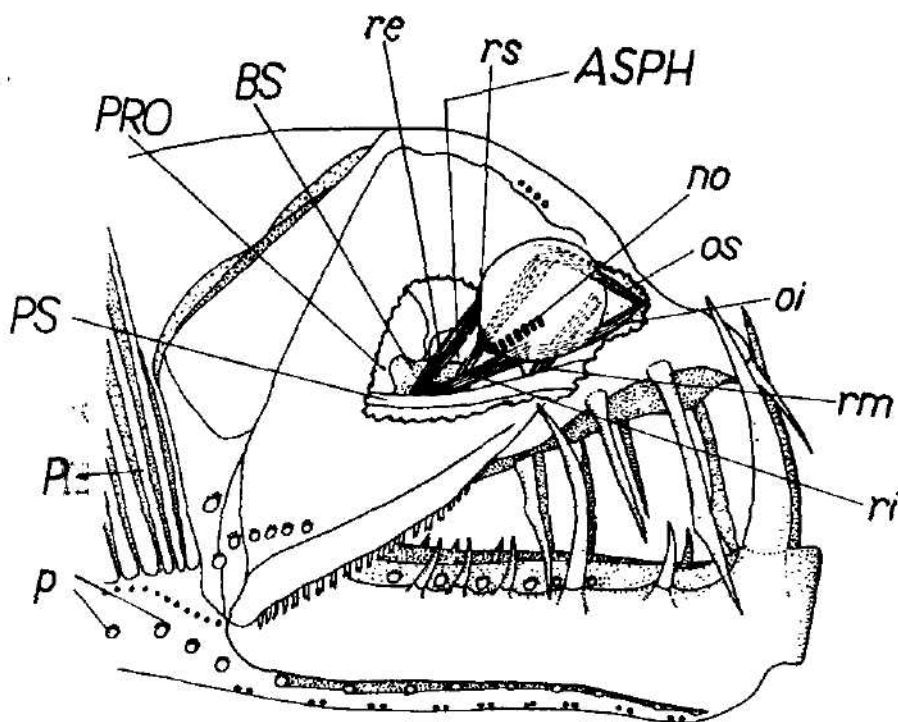


Fig. 3. *Chauliodus sloanei*. The viper fish. The head from the lateral view.

*) For determination we have used Eggert's revision of Periophthalminae, rejecting *Periophthalmodon* Bleeker, 1874 as a distinct genus. This view is not accepted e.g. by Sterba (1959) or Bandurski et al. (1968).

compressed, narrow. The insertion on the eye bulb crosses with the insertion of the rectus inferior. The obliquus superior is flat in the shape, it possesses the wide insertion on the eye bulb. The insertion here lies closely to the insertion of the rectus superior but both insertions do not cross. The postero myodome of the walking goby is very curious and it is possible to speak about two posterior myodomes. The longer one is formed by the rectus externus and it is bordered by the prootic, alisphenoid, parasphenoid, and partially, by the frontal. The other three recti, namely the rectus medialis, superior and inferior enter into the second myodomic cavity, lying in ventral plane and bordered by the parasphenoid, alisphenoid and prootic. The rectus externus muscle is narrow and its insertion is dorso-ventrally flattened, towards its origin it becomes wider and flattened lateromedially. In the posterior myodome it passes alone, it originates from the parasphenoid and partially from the prootic. The rectus superior originates from the parasphenoid and partially from the alisphenoid. The shape of this muscle is lateromedially flattened, seen from lateral, it covers the origin of the rectus inferior. The insertion lies on the medial face of the eye bulb. The rectus inferior originates from the parasphenoid and partially from the alisphenoid closely to the rectus superior. The rectus medialis is flattened lateromedially and is the widest of all. The insertion lies between the obliquus superior and the rectus inferior on the eye bulb. This muscle has two points of origin, namely the first thinner one passes from the alisphenoid, near the suture with the parasphenoid, the second, wider one, from the alisphenoid beginning on its dorsal part and downwards it occupies the considerable part of it.

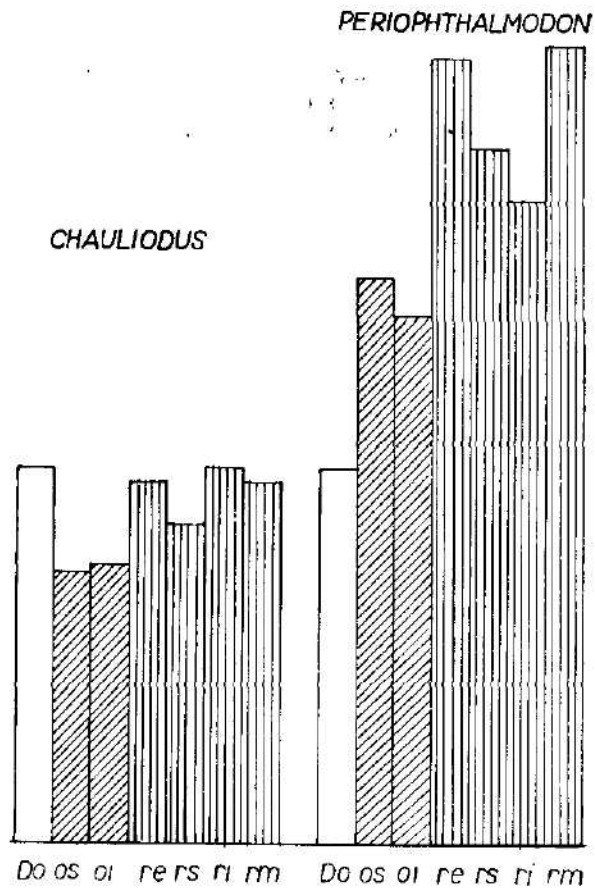


Fig. 4. Relative length of eye muscles in *Periophthalmus* and *Chauliodus*. D = diameter oculi calculated as being 100 p.c., the individual length of each eye muscle is calculated in percents of the eye bulb and illustrated graphically to make comparison possible. Correct the inscription *Periophthalmodon* in right to *Periophthalmus*.

DISCUSSION

With regard to the fundamental questions, namely:

- 1) eye mobile, results: long eye muscles and the presence of the myodome,
 - 2) eye immobile, results: short eye muscles and the lack of the myodome,
- we can summarize our observations as follows:

Periophthalmus has very mobile eyes (Günther, 1886; Boulenger, 1904; Plate, 1924; Stoye, 1935; Sterba, 1959), about the mobility of eyes in *Chauliodus* there are no literary data, but because the orbit is narrow we may assume that the eyes are very little mobile or immobile. Comparing this fish species the presence of myodomies is apparently connected with the mode of life. *Periophthalmus* lives in shallow water and on the mud flats in ebbside and skips about by means of the muscular, scaly base of its pectoral fins (Boulenger, 1904; Stoye, 1935; Eggert, 1935; Sterba, 1959; Sachs, 1963). The remarkable position and the form of eyes in *Periophthalmus* suggests that the fish has a good sight and is adapted for seeing both in water and air medium. (Günther, 1886; Plate, 1924). The explanation of the generic name *Periophthalmus* — one, who is able to look in every direction (see Stoye, 1935) shows that the mobility of eyes was apparent also to both old ichthyologists Bloch et Schneider (1801). Generally, walking gobies are distributed on the mud-flats at the mouths of rivers in tropical Africa, Asia and North West Australia (Boulenger, 1904).

Periophthalmus schlosseri lives individually in pools and lies often on mangrove roots. Every specimen defends its territory against other individuals. The species is fully adapted to terrestrial existence and it must be hunted by men to run away into the sea. But also in the sea the mud skipper stay close the coast and also by using of boat it is impossible to force them to swim into the open sea (Eggert, 1935). These observations confirmed recently Bandurski, Bradstreet and Scholander, 1968 on the Australian mud skipper, *Periphthalmodon australis* (= *Periophthalmus schlosseri australis* Castelnau, 1875, syn. *P. barbarus* McCulloch and Ogilby, 1919; sensu Eggert, 1935).

According to Bandurski and coauthors the fish is "highly active and leads an essentially terrestrial existence. During low tide it runs on the mud flats and during high tide retreats to higher ground or perches on mangrove roots. Even when swimming, the mud skipper "hydroplanes", keeping its head above water. Thus, in view of its adaptation to a terrestrial environment, this gill fish seemed of unusual comparative interest. It has been established that there are physiological mechanisms which act to prevent oxygen deficiency in brain tissue. Mud skipper behaves similarly to mammals in response to oxygen stress. Secondly it was observed that lactate accumulates in both muscle and brain tissue of the mud skipper during oxygen stress, and this, again, is expected response of an animal adapted to a terrestrial environment".

Similar observations above the closely related *Periophthalmus sobrinus* were published by Gordon, Boetius, Evans and Oglesby in 1968. They studied the mud skippers at Nosy Bé, which were abundant, in and around mangrove areas and on intertidal mud and sand flats. Despite the lack of apparent territoriality, individual mud skippers were spaced at significant distance from each other (about 10 cm or more)". Klausewitz, 1968 found in mud skippers from East African coast near of Mombassa that has had

a territory of 3 to 4 square feet. Gordon et alii (1968) observes also with coincidence regarding other authors, the mud skippers from Nosy Bé, when undisturbed, "clearly preferred to spend virtually all of their time completely out of water. At intervals, however, they did actively seek at least brief contact with water. Even though fish visited the water at short intervals during the day, they rarely got completely wet. They usually submerged only their mouths, then occasionally moved their gill covers for less than 1 min. Even during the heat of bright, sunny days they usually moistened their body surface less than once an hour. There appeared to be no correlation between the timing of these visits to water and feeding activities. Physiological experiments carried out on mud skippers at Nosy Bé demonstrated that these fish were: 1) quite resistant to desiccation, 2) tolerate considerable amounts of dehydration, 3) have an oxygen consumption that is broadly independent of whether or not they are in water, 4) show no evidence of "diving asphyxia" while either in or out of water over long periods, and 5) are strongly euryhaline and excellent osmotic regulators" (Gordon et al., 1968).

On the contrary, the genus *Chauliodus* represents fishes living in dark depths of seas and oceans (Brauer, 1908). *Chauliodus sloanei* was obtained according to Goode et Bean, 1896 in the Mediterranean, off the coast of Morocco in 560 fathoms, at Madeira, in the Bay of Bengal (1590 fathoms) and at various stations in the deep waters of the Atlantic. The largest depth recorded was 2069 fathoms (69°02'30" WL, 38°19'20" NL). Brauer (1908) recorded the largest depth 2200 m (water depth 4709 m south of Cocos Island (26°3'6" SW, 93°43'7" EL). Because many specimens were collected 1500—2500 m above the sea bottom, Brauer, 1908 believes this species provided bathypelagial mode of life.

Chauliodus is believed to be very voracious (Günther, 1886; Jordan & Evermann, 1896). "There is no reason to suggest that the light organs of *Chauliodus* by lighting of oral cavity attract small fishes and possibly crustaceans to come close to the mouth gape and even to try get into the mouth of the aggressor through the space between jaws" (Tchernavin, 1953).

New data of Gibbs and Hurvitz, 1967 suggest the species live predominantly at depths greater than 500 m.

Brauer, 1908 studied the luminiscent organs and eyes of *Chauliodus sloanei* Bloch et Schneider, *Stomias valdiviae* Brauer, *Stomias nebulosus* Alcock, *Macrostomias longibarbatulus* Brauer, *Idiacanthus fasciola* Peters, *Astronesthes elucens* Brauer, *Barthelychnus cyaneus* Brauer (all members of the family Sternoptychidae in sensu Brauer l.c.), and he has nothing noticeable concerning eye muscles. "Auf das Leben in Dunkeln deutet bei allen in gleicher Weise der Mangel an Zapfen, die langen, schmalen Stäbchen, die 1/3—1/2 der Retinabreite ausmachen, und die vollige Dunkelstellung des Pigments der Retina."

With regard to tubular or telescopic eyes in some of deep water fishes the presence of myodomes may be assumed, but this is not true, e.g. by precise observations of Brauer, 1908 on the larval "*Stylophorus paradoxus* Brauer, 1902, which is the larva of *Idiacanthus* Peters, 1874, family Idiacanthidae see Berg, 1955) the myodome is lacking and the recti muscles are originating from the wall of the orbit, the obliqui muscles from the antorbital process. Later with the prolongation of the eye stalk formed from the antorbital

process theobliqui became shorter, the recti, in contrary longer, without forming any myodomes (see Brauer, 1908, 178—182, figures V—VII).

From broad phylogenetic aspect, *Chauliodus* belongs between Clupeida (= Clupeiformes Berg, 1955), representants of this order possess generally myodomes (*Clupea* — Svetovidov, 1952; Oliva, Skořepa and Stokłosowa, 1968; *Salmo* — Allis, 1928; Gregory, 1933, 1951; *Hydon* — Allis, 1919; *Esox* — Huxley, 1871; Oliva, 1966). On the contrary, *Periophthalmus* belongs to Percida (Berg, 1955), the representatives of which are also known to have myodomes (in general Bütschli, 1921; *Perca* — Oliva, Skořepa and Stokłosowa, 1968; *Blennius* — Allis, 1909, 1919; *Scomber* — Allis, 1903; Edgeworth, 1935; *Trigla* — Allis, 1919; *Cottidae* — Allis, 1919). The presence of well developed myodomes in *Periophthalmus* can be explained by its adaptation to the semiamphibious mode of life and occurs simulatenously with interesting physiological properties as shown by Gordon et al., 1968, Bandurski et al., 1968. On the contrary the absence of myodomes in *Chauliodus* can be caused by the ecological conditions influencing in general the fish life in the darkness and depths of the ocean.

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SUMMARY

1) The well developed anterior myodome was found in the viper fish (*Chauliodus*). This structure is absent in the mud skipper (*Periophthalmus*).

2) The unique structure of the posterior myodome was found in the walking goby, where the myodome is divided into two chambers. The upper one is penetrated by the rectus externus muscle only, the lower, more spacious chamber, with three resting recti muscles. The rectus medialis muscle has a bifurcated flattened origin. In *Chauliodus* the posterior myodome is absent.

3) The presence of myodomes in the mud skipper and alternatively their absence in the viper fish has apparently a connection with the head shape of both species and ecological conditions, too. The former species lives semiamphibiously on river banks in tropics, the latter is a deep sea fish possessing photophores and probably „baiting” its prey. The influence of ecological factors seems to be evident here, both examined fish species belong to the same order of perciform fishes (Percida).

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**SUSCEPTIBILITY OF SOME PARASITIC MITES FOUND
IN MOLE-NESTS TO CURRENT CONTACT INSECTICIDES**

VÁCLAV RUPEŠ

Received November 21, 1968

Abstract: The susceptibility of hungry females of 5 species of parasitic mites (*Haemogamasus hirsutus* Berl., *Haemogamasus nidi* Mich., *Haemolaelaps fahrenheitzi* Berl., *Laelaps hilaris* C. L. Koch and *Hirstionyssus musculi* (Johnston)) to imidan, fenitrothion, malathion, bromophos, p,p'-DDT and gamma HCH was followed. Imidan was the most toxic, the highest LC50 values were found in gamma HCH.

In females of the species *Haemogamasus hirsutus* collected in 3 treated localities a significant decrease of susceptibility to p,p'-DDT was found as compared with susceptibility of females of the same species collected in 4 untreated localities.

In females and protonymphs of the species *H. hirsutus* the latency period of insecticides was followed up and in the females of the same species dependence of mortality on the length of contact with a certain insecticide concentration was studied.

Literary data on susceptibility of parasitic mites of the suborder Parasitiformes are concerned especially with species *Dermanyssus gallinae* (De Geer) and *Ornithonyssus sylviarum* (Can. et Fanz.).

From among other species of this group greater attention was paid to the influence of silica aerogel (SG 67) upon *Ophionyssus natricis* (Gerv.), *Haemolaelaps glasgowi* (Eving), *Haemolaelaps casalis* (Berl.) and *Ornithonyssus bacoti* (Hirst) (Tarshis, 1961, 1964, 1967).

Camín and col. (1964) studied effects of 45 insecticides and insecticides preparations upon *Ophionyssus natricis* (Gerv.) in laboratory conditions with the view of finding the most suitable substance for control of these mites in terraria.

In addition to other problems Furman (1963) pays attention, in his investigations, also to susceptibility of *Haemogamasus liponyssoides hesperus* Radovsky, mentioning its LC50 when in contact with glass the surface of which was treated with Sevin and 1-naphtol.

Axtel (1966) compared the toxicity of 20 different insecticides for larvae of *Musca domestica* L. and for adults of nonparasitic mites of the species *Macrochaeles muscaedomesticae* (Scopoli).

No further more detailed data on susceptibility of parasitic mites of the group in question (with the exception of *Dermanyssus gallinae* (De Geer) and *Ornithonyssus sylviarum* (Can. et Fanz.) were found by us in the accessible literature.

The present paper of ours deals with susceptibility of several parasitic species of mites found in nests of moles (*Talpa europaea* L.) with regard to 6 current insecticides.

MATERIAL AND METHODS

In our experiments females of the following wild populations of mites were used: *Haemogamasus hirsutus* Berl., *Haemogamasus nidi* Mich., *Haemolaelaps fahrenheitii* Berl., *Laelaps hilaris* C. L. Koch, *Hirstionyssus musculi* (Johnston). In the species *H. hirsutus* Berl. the susceptibility of protonymphs was tested as well.

Mites were obtained from winter nests of moles (*Talpa europaea* L.) dug out in the period from November till March in 1965 and 1966. Whole dug out nests were firmly packed into linen bags and brought to the laboratory where the bags were put into paper bag of several layers and separated from each other by sheets of wet filtration paper. The bags were then maintained at +5 till +15 °C.

Females began to be tested after getting completely hungry, that is 5–21 days after the nests had been dug out. Tests with protonymphs were undertaken 10–20 days after digging out the nests.

In the indicated time intervals hungry mites were quickly creeping out on the inner surface of the linen bags when these were handled. Thus they could be sucked up without any damage for them into test tubes.

If not indicated otherwise, the essays were made with mites collected from that part of the Poděbrady locality (Central Bohemia) where insecticides were not used. For comparison sake the susceptibility to p,p'-DDT of *H. hirsutus* females collected in untreated localities Osečel, Čelákovice and Neratovice (all of them being parts of the Central Bohemia Region) was tested.

Treated localities were Strážnice and Mikulčice (both being parts of Southern Moravia). These localities were treated from aeroplanes against mosquitoes regularly from 1951 till 1966 always in spring. The DDT was used in concentrations 1–1.6 kg active substance for 1 hectare.

Poděbrady — the treated part: This part was treated from aeroplanes by DDT always in April or at the beginning of May during the years 1963–1967. The concentration used was 0.7 kg of active substance for 1 hectare.

For susceptibility tests the method already described (Rupeš, 1968) was used. Its principle in short is as follows. Mites are sucked up by means of a vacuum pump into glass test tube with inner surface of 10 cm² impregnated with a known concentration of the insecticide. One end of the test tube is covered by a sillon tissue and other is closed by a plastic stopper after sucking up the mites. Similarly are prepared the recovery tubes. Mites without any indication of movement are considered as dead. Into each impregnated tube always 20 mites were sucked up. All tests were effected at the temperature of 23–25 °C and 100 per cent relative humidity.

With each series of experiments, at least one nonimpregnated tube was used as a control. If the mortality in the control tube was greater than 5%, the whole experimental series was excluded from further evaluation.

Sufficient quantity of material permitting, experiments were performed with the following insecticides: imidan, fenitrothion, malathion, bromophos, p,p'-DDT and gamma HCH. The substances were dissolved in acetone and the tubes impregnated by evaporation of 0.1 ml of the solution.

RESULTS

LC50 values

The mites were exposed to a given concentration for 24 hours and after that time the mortality was read. Every experiment was performed 3–5 times with each concentration.

The assessment of LC50 values was done by means of the graphic probit method according to the Lichtfield and Wilcoxon described in the publication of Roth and col. (1962). For each insecticide 5–8 concentrations in geometrical series were used, mortality lines were plotted on the logarithmic-probability paper by eye and the correctness of its construction was verified by the χ^2 -test.

The results are given in table 1. The most toxic was always imidan, s

Table 1. LC50 values for female and protonymphs of the above mentioned species of parasitic mites.

| Compound | LC ₅₀ in µg/m ² | Fiducial limits in µg/m ² | Slope of ld-p lines | Number of treated animals |
|--|--|---|---------------------------|---------------------------------|
| <i>Haemogamasus hirsutus</i> — females | | | | |
| imidan | 1.65 | 1.2 — 2.1 | 2.1 | 225 |
| fentrothion | 5.7 | 4.9 — 6.6 | 1.75 | 294 |
| malathion | 25 | 17 — 35 | 2.1 | 298 |
| bromophos | 75 | 62.5 — 90 | 2.35 | 356 |
| p,p-DDT | 120 | 109 — 132 | 4.1 | 712 |
| gamma HCH | 130 | 101 — 166 | 3.2 | 624 |
| <i>Haemogamasus hirsutus</i> — protonymphs | | | | |
| fentrothion | 0.35 | 0.28 — 0.42 | 2.2 | 238 |
| malathion | 5.4 | 4.3 — 6.7 | 2.2 | 245 |
| bromophos | 32.5 | 28.8 — 39.3 | 1.9 | 215 |
| p,p-DDT | 170 | 140 — 205 | 2.1 | 240 |
| gamma HCH | 170 | 138 — 209 | 1.95 | 221 |
| <i>Haemogamasus nidi</i> — females | | | | |
| imidan | 1.3 | 1.04 — 1.6 | 1.95 | 160 |
| fentrothion | 2.5 | 2.03 — 3.07 | 2.2 | 167 |
| malathion | 45 | 32.1 — 63 | 3.4 | 174 |
| bromophos | 42.5 | 34.8 — 51.8 | 2.0 | 249 |
| p,p-DDT | 170 | 137 — 210 | 2.2 | 202 |
| gamma HCH | 420 | 362 — 487 | 1.9 | 258 |
| <i>Hirstionyssus musculi</i> — females | | | | |
| fentrothion | 21.4 | 12.5 — 36.4 | 1.65 | 138 |
| p,p-DDT | 21.4 | 12.5 — 36.4 | 1.65 | 138 |
| bromophos | 130 | 100 — 160 | 2 | 98 |
| <i>Haemolaelaps fahrenheitzi</i> — females | | | | |
| fentrothion | 7.2 | 5.4 — 9.5 | 2.8 | 166 |
| bromophos | 90 | 56.2 — 144 | 1.95 | 150 |
| p,p-DDT | 120 | 142 — 341 | 3.6 | 110 |
| <i>Laelaps hilaris</i> — females | | | | |
| fentrothion | 5.1 | 4.1 — 6.5 | 1.75 | 100 |

far as it was followed up, other substances following in this succession: fenitrothion, malathion, bromophos, p,p'-DDT and gamma HCH.

Differences between the susceptibility of the *H. hirsutus* females collected in treated localities of Strážnice, Mikulčice and treated part of the locality Poděbrady to p,p'-DDT in comparison with that of the females of the same species collected in four untreated localities (Poděbrady, Oseček, Neratovice and Čelákovice) are evident from the Fig. 1. LC50 differences are in all cases significant (for $P \leq \leq 0.05$) (Table 2).

Fig. 1. — Dosage-mortality relationship of 3 population of *Haemogamasus hirsutus* collected in long time treated localities (1) — Poděbrady (treated part), (2) — Strážnice, (3) — Mikulčice and average values of females collecting in 4 untreated localities (N) when in contact with p,p'-DDT.

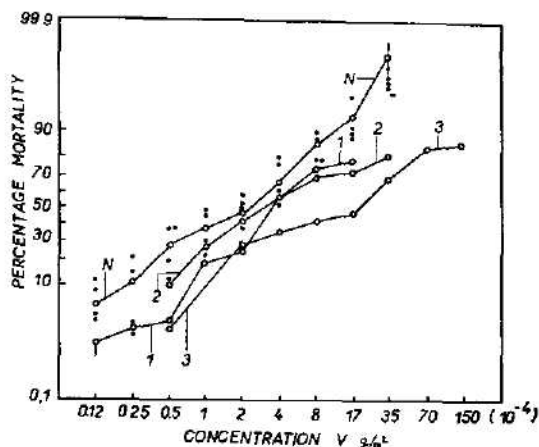


Table 2. LC50 of females of *Haemogamasus hirsutus* collected in 3 treated localities (Poděbrady, Strážnice, Mikulčice) and the average values of LC50 of females from 4 untreated localities when in contact with p,p'-DDT.

| Localities | LC50 in $\mu\text{g}/\text{m}^2$ | Fiducial limits in $\mu\text{g}/\text{m}^2$ | Slope of ld-p lines | Number of treated females |
|--|-------------------------------------|--|---------------------------|---------------------------------|
| Poděbrady treated part | 370 | 284 — 481 | 3.8 | 329 |
| Strážnice | 370 | 255 — 526 | 6.3 | 272 |
| Mikulčice | 1200 | 746 — 1680 | 8.04 | 242 |
| Average from 4 untreated localities | 150 | 115 — 195 | 4.65 | 1296 |

Dependence of mortality on the length of contact

H. hirsutus females were exposed for 30, 60, 120, 240, and 480 minutes to the lowest used concentration of each insecticide giving always 100% mortality at the 24 hours contact. The following concentrations were used (in $\mu\text{g}/\text{m}^2$): p,p'-DDT — 3500; gamma HCH — 1700; bromophos — 800; malathion — 200; fenitrothion — 25; imidan — 12.

After exposition for the time intervals indicated the females were over-sucked into recovery tubes and mortality read after 24 hours. In all the time intervals by 20 mites were exposed.

Results obtained are given in the Fig. 2. Time of the contact necessary for 50% mortality can be read. This time is shortest in malathion, longest in gamma HCH.

Time of the insecticidal latency

The females and protonymphs of the species *H. hirsutus* were exposed in tubes impregnated with fenitrothion, malathion and bromophos in concentration of 7000 $\mu\text{g}/\text{m}^2$ for 7.5 minutes. After this time they were over-sucked into recovery tubes and the mortality read continuously at the given time intervals.

The time interval during which 50% of the females die is considered as the latency period of 50%. Figs. 3 and 4 show the results of experiments with organophosphorus compounds. In protonymphs and females the shortest latency period was found in malathion, the longest in bromophos.

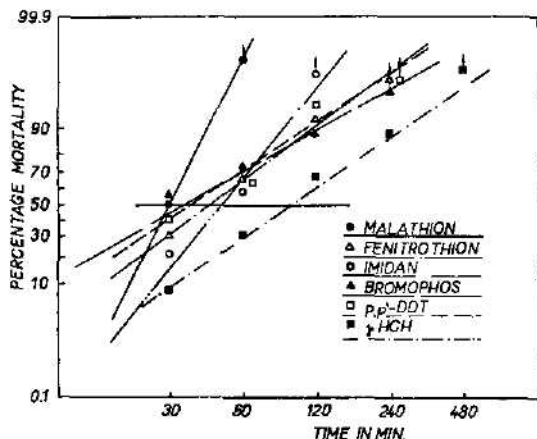


Fig. 2. — Mortality dependence on the length of contact with a concentration of insecticides in females of *H. hirsutus*.

Table 3. — Latency period of p,p'-DDT in females and protonymphs of the species *H. hirsutus* when in contact of 7.5 min. duration with the concentration of 0.5 g/m^2 .

| Time after exposure in minutes | Females | | Protonymphs | |
|--------------------------------|-----------------|----------------|-----------------|----------------|
| | number of mites | mortality in % | number of mites | mortality in % |
| 60 | 41 | 8.8 | 60 | 3.3 |
| 120 | 41 | 85.3 | 60 | 30 |
| 240 | 41 | 95 | 60 | 82.5 |

Table 4. — Latency period of gamma HCH in females and protonymphs of the species *H. hirsutus* when in contact of 7.5 min. duration with concentration of 0.06 g/m^2 .

| Time after exposure in minutes | Females | | Protonymphs | |
|--------------------------------|-----------------|----------------|-----------------|----------------|
| | number of mites | mortality in % | number of mites | mortality in % |
| 60 | 45 | 31.7 | 79 | 5 |
| 120 | 45 | 48.9 | 79 | 10.1 |
| 240 | 45 | 85.3 | 79 | 24 |
| 480 | 45 | 92.6 | 79 | 92.4 |

No measurable values were reached while using p,p'-DDT and gamma HCH in the concentration of 7000 $\mu\text{g}/\text{m}^2$. The mortality did not exceed

10–20% not even 24 hours after exposition in this case. For this reason the concentration of 0.06 g/m² for gamma HCH and 0.5 g/m² for p,p'-DDT was used.

The results obtained are given in table 3 and 4. 100% mortality was found not even in one case. Mortality lines plotted through mortality values crossing the 50% point at time intervals oscillating between 60 and 120 minutes after exposure.

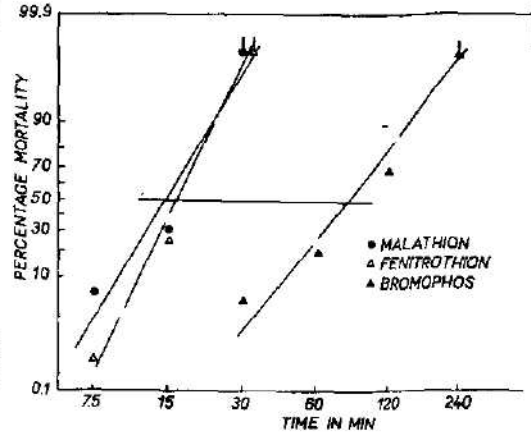


Fig. 3. — Latency period of insecticides in protonymphs of *H. hirsutus*. (Contact time = 7.5 min., concentration = 7 000 µg/m².)

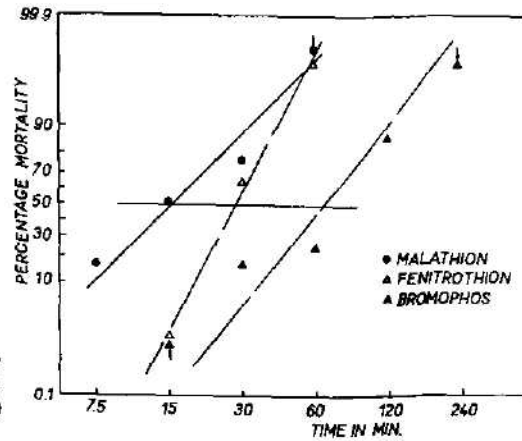


Fig. 4. — Latency period of insecticides in females of *H. hirsutus*. (Contact time 7.5 min., concentration 7 000 µg/m².)

DISCUSSION

For the females of the species *H. hirsutus*, *H. nidi* and *Haemolaela fahrenheitzi* p,p'-DDT was less toxic than all other followed up organophosphates. Similar results were found also when following up the susceptibility of *Dermanyssus gallinae* (Rupeš, Tondl, 1969). On the contrary nymphs of *Ixodes ricinus* we found that p,p'-DDT was only a little but less toxic than fenitrothion and more toxic than malathion, bromophos, diazinon (Rupeš, 1970).

Unless otherwise stated, all the experiments were performed with mites collected in untreated part of the Poděbrady locality situated at a considerable distance from the treated one and separated from it by the river.

Labe. The susceptibility to p,p'-DDT of females of the species *H. hirsutus* collected in this locality and that of females collected in the untreated localities of Oseček, Neratovice and Čelákovice did not differ significantly. Significant differences were, however, found in the susceptibility of females collected in treated localities. All localities mentioned had a character of field woods and greenwoods and lowland meadows situated along big rivers. These susceptibility changes can be attributed to the action of DDT present in the environment and can be considered as initial tolerance.

Table 5. — Mortality of the females and protonymphs of *H. hirsutus* oversucked in 3 subsequent days into non-impregnated test tubes and ovesucked on the same day into recovery tubes.

| | Number of mites | Number of dead when oversucked | | |
|-------------|-----------------|--------------------------------|-----|-----|
| | | 1st | 2nd | 3rd |
| Protonymphs | 26 | 0 | 1 | 2 |
| Protonymphs | 22 | 0 | 1 | 3 |
| Females | 20 | 0 | 0 | 2 |
| Females | 20 | 0 | 0 | 1 |

DDT present in the soil does not loose its efficacy in the course of many years as found for instance by Nash and Woolson (1967). During that time it can be gradually washed off into lower layers of the soil, where mites infesting the mole's nests are getting in contact with it. Moreover moles continuously renovate the bedding of their nests, dragging leaves and grass from the surface of the soil. In spring, when the treated actions are taking place, this renovation of the nests is very intensive. Thus mites may come into contact with plants affected by insecticides and selective action of insecticides can be then realized being supported by a relatively quick change of generations and development of these mites under conditions of sufficient nutrition.

Table 6. Mortality of *H. hirsutus* females in non-impregnated test tubes at the temperature of 23–25° C and at 100% relative humidity.

| Tube No. | Number of females | Number of dead mites during experiments days | | | |
|----------|-------------------|--|-----|-----|------|
| | | 2nd | 5th | 9th | 12th |
| 1 | 23 | 0 | 0 | 1 | 4 |
| 2 | 21 | 0 | 0 | 2 | 5 |
| 3 | 21 | 0 | 0 | 0 | 2 |

Parasitic mites of nests, especially *Haemogamasus hirsutus*, seem to be a very suitable experimental material in experiments with insecticides. Furman (1963) draws attention to the suitability of a related species of *Haemogamasus liponyssoides hesperus* Radovsky as a mite suitable for toxicologic experiments.

The testing method used was quite satisfactory. It is suitable in cases when bigger quantities of mites are to be processed. Suction and over-

sucktion of the mites does not influence the mortality as can be seen from table 5. The females and protonymphs of *H. hirsutus* were 3 times in three subsequent days sucked into clean test tubes and the same day sucked over into recovery tubes. Mortality was read every day. It is evident from the table 6 that plastelin stopers and silon tissues do not cause their higher mortality either. The table shows the mortality of females of the species *H. hirsutus* kept for 12 days in clean test tubes. In both cases mentioned above the tubes were kept at 100% relative humidity and at a temperature of 23–25° C.

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My thanks are due to Mr. D. Novák from the District Hygiene Station at Hodonín for his help in acquisition of material in the field. For the supply of substances I am indebted to the workers of the Research Institute of Agricultural Technique in Bratislava, Cela Ingelheim and Spolana Neratovice.

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*

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ZUR KENNNTNIS DER HELMINTHENLARVEN DER AMPHIBIEN
DER TSCHECHOSLOWAKEI

LUDMILA VOJTKOVÁ & KAREL KRIVANEC

Eingegangen am 11. Juni 1969

Abstrakt: Den Helminthenlarven der Amphibien wurde bei uns schon eine Menge Arbeiten gewidmet (Rašín, 1933; Vojtková, 1961, 1962, 1963a, b, 1966; Volná-Nábělková, 1964; Kozák, 1966, 1968). Bei der Fortsetzung der helminthologischen Erforschung unserer Lurchen haben wir vier weitere Arten der Trematoden- und Cestodenlarven entdeckt. Ihre Beschreibung wird in dieser Arbeit angeführt. Ausserdem werden die obenangeführten Mitteilungen durch weitere Angaben von Lokalitäten und Zwischenwirten der schon früher bekannten Larven ergänzt.

MATERIAL UND METHODIK

Das Material stammte aus verschiedenen Lokalitäten, besonders aber aus Südmähren und aus der Südslowakei. Durch die Methode einer vollständigen helminthologischen Sezierung haben wir 182 Lurchen untersucht, die zu 10 Arten gehörten: *Rana esculenta* L., *Rana temporaria* L., *Rana arvalis* Nil., *Rana dalmatina* Bon., *Bombina bombina* L., *Bombina variegata* L., *Bufo bufo* L., *Bufo viridis* Laur., *Hyla arborea* L. und *Pelobates fuscus* Laur.

Eine weitere beträchtliche Zahl der Frösche der angeführten Arten (insgesamt 456) wurde nur durch teilweise helminthologische Sezierung untersucht, nämlich nur an Vorkommen der untersuchten Larven, die zur Invadierung der Versuchstiere benützt wurden. Die auf diese Weise gewonnenen Larven wurden in einer Gelatinkapsel den Versuchstieren verfüttert. Als Versuchstiere wurden von uns stets junge, helminthologisch negative Tiere verwendet.

Für das weitere Studium wurden die Larven durch heisses Fixiergemisch oder unter mildem Druck von Deckglas durch 70 % Alkohol fixiert. Nach einer Färbung durch Mayers Alaunkarmin wurden sie im Kreosot untersucht und dann auf ein Präparat in Kanadabalsam überführt.

SAUGWÜRMER (TREMATODA)

1. *Opisthioglyphe ranae* (Froelich, 1791) Looss, 1899

(Fam. Plagiorchiidae Lühe, 1901) (Tab. Nr. 1)

Tab. 1. Übersicht der Invasion der Metacerkarien *O. ranae*

| Wirtstier | Lokalität | Untersucht | Befallen | Extensität | Intensität |
|------------------------|---------------------|------------|----------|------------|------------|
| <i>Rana temporaria</i> | Velké Karlovice | 6 | 1 | 16,6 % | 1 |
| <i>Rana arvalis</i> | Vranovice | 3 | 1 | (33,3 %) | 1 |
| | Lednice | 3 | 1 | (33,3 %) | 1 |
| <i>Bufo bufo</i> | Vigantice | 5 | 1 | 20,0 % | 1 |
| | Adamov- Vyskúvka | 6 | 3 | 50,0 % | 1—2 |

Aus der Erdkröte (*Bufo bufo*) wurden die Larven *O. ranae* noch nicht angeführt.

2. *Paralepoderma cloacicola* (Lühe, 1909) Dollfus, 1950

(Fam. Plagiorchiidae Lühe, 1901)

Wirtstier: *Rana temporaria* L.

Lokalität: Kojetín

Invasionsintensität: 1—7

Invasionsextensität: 33,3 %

3. *Leptophallus nigrovenosus* (Bellingham, 1844) Lühe, 1909

(Fam. Brachyoceliidae Dollfus, 1930) (Tab. Nr. 2)

Tab. 2. Übersicht der Invasion der Metacerkarien *L. nigrovenosus*

| Wirtstier | Lokalität | Untersucht | Befallen | Extensität | Intensität |
|------------------------|----------------|------------|----------|------------|------------|
| <i>Rana temporaria</i> | Chropyně | 11 | 1 | 9,1 % | 2 |
| <i>Bombina bombina</i> | Pouzdrány | 2 | 1 | (50,0 %) | 1 |
| | Židlochovice | 1 | 1 | — | 3 |
| <i>Bufo bufo</i> | Vigantice | 5 | 1 | 20,0 % | 1 |
| | Adamov-Vyšková | 6 | 3 | 50,0 % | 1—9 |

Rana temporaria und *Bufo bufo* sind als neue Zwischenwirte der Art *L. nigrovenosus* zu betrachten.

4. *Euryhelminis squamula* (Rudolphi, 1819) Poche, 1925

(Fam. Heterophyidae Odhner, 1914) (Tab. Nr. 3)

Tab. 3. Übersicht der Invasion der Metacerkarien *E. squamula*

| Wirtstier | Lokalität | Untersucht | Befallen | Extensität | Intensität |
|--------------------------|-----------------|------------|----------|------------|------------|
| <i>Bombina variegata</i> | Vigantice | 17 | 1 | 5,9 % | 1 |
| <i>Bufo bufo</i> | Adamov-Vyšková | 6 | 2 | (33,3 %) | 2 |
| | Velké Karlovice | 1 | 1 | — | 5 |
| | Vigantice | 5 | 2 | 40,0 % | 1 |

Metacerkarien *E. squamula* wurden bis jetzt nur beim Grasfrosch (*R. temporaria*) und beim Springfrosch (*R. dalmatina*) aus verschiedenen Lokalitäten nachgewiesen (Vojtková, Moravec, Nábělková, 1963).

5. *Alaria alata* (Goeze, 1782) Krause, 1914

(Fam. Alariidae Tubanqui, 1922) (Tab. Nr. 4)

Tab. 4. Übersicht der Invasion der Metacerkarien *A. alata*

| Wirtstier | Lokalität | Untersucht | Befallen | Extensität | Intensität |
|------------------------|-----------|------------|----------|------------|------------|
| <i>Rana temporaria</i> | Kojetín | 9 | 1 | 11,1 % | 10 |
| <i>Rana arvalis</i> | Lednice | 3 | 2 | (66,6 %) | 1—3 |

Mesocerkarien *A. alata* wurden bis jetzt nur beim Wasserfrosch (*R. esculenta*) und bei der Ringelnatter (*N.atrix*) in der Südslowakei ausfindig gemacht (Vojtek, Vojtková, 1961; Vojtková, 1963a).

6. *Echinostomatidae* g. sp.

(Fam. Echinostomatidae Dietz, 1909)

Metacerkarien befinden sich in dünnwandigen, durchsichtigen Zysten im Fettgewebe in der Orbitalhöhle, im Glaskörper und im Muskelgewebe an der Zungenwurzel. Die Zysten (Abb. 4) sind ovalförmig, von 0,280—0,350 (0,321) × 0,168—0,196 (0,178) mm Grösse. Die Wand der Zystenhülle ist sehr dünn, von 0,007—0,014 (0,009) mm Stärke. Die Larven lösen sich aus den Zysten sehr leicht, manchmal verlassen sie die Zyste in physiologischer Lösung schon von selbst.

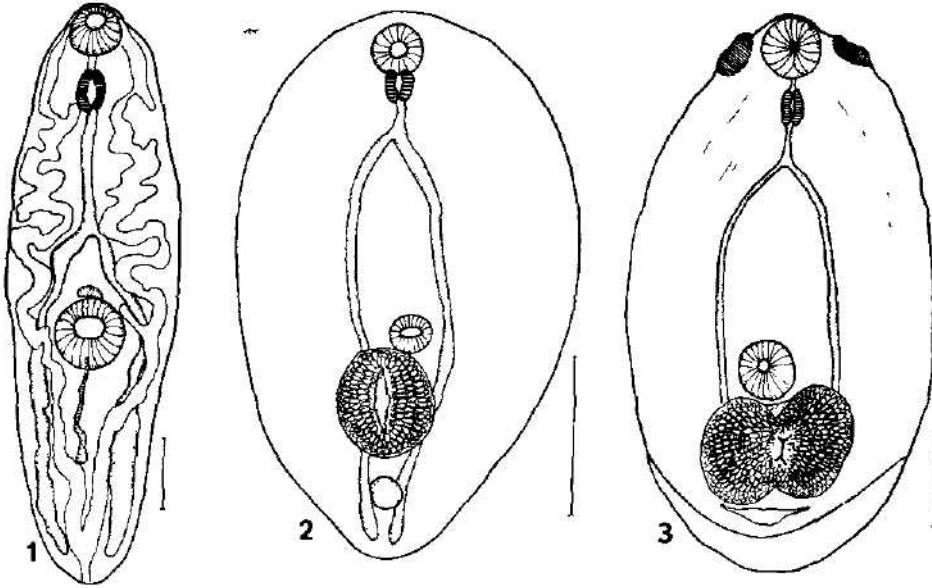


Abb. 1—3. — 1. *Echinostomatidae* g. sp. — Metacercaria, 2. *Neodiplostomum spathosides* — Metacercaria, 3. *Diplostomum spathaceum* — Metacercaria (Massstab = 0,1 mm).

Die gelösten Larven sind schlank, von gedehnter Form (Abb. 1, 5, 6), heiss fixiert von 0,483—0,574 mm Länge und 0,122—0,177 mm Breite. Der Kragen misst 0,079—0,088 × 0,049—0,061 mm. Am Kragen sind 46—49 Stacheln, in 2 Reihen geordnet. Die ganze Körperoberfläche der Larve ist mit winzigen Dörnchen bedeckt. Der Mundsaugnapf ist rund, im Ausmass von 0,061 bis 0,064 × 0,055—0,064 mm. Dahinter folgt ein sehr kurzer Praepharynx, von 0,003—0,021 mm Länge, und hinter diesem befindet sich der ovalförmige Pharynx im Ausmass von 0,018—0,036 × 0,021—0,033 mm. Der Oesophagus ist 0,009—0,030 mm lang, und gabelt sich in zwei Darmzweige, die bis zum hinteren Ende des Körpers reichen. Die Entfernung der Darmzweige vom Körperende ist 0,024—0,046 (0,031) mm. Dicht hinter der Körperhälfte liegt der grosse Bauchsaugnapf, im Ausmass von 0,061—0,088 × 0,070—0,088 mm. Die Entfernung des Bauchsaugnapfes vom Vorderteil

ist 0,226—0,284 mm. Unter dem Bauchsaugnapf liegen die Gonadenanlagen.

Die Larven, unter dem milden Druck des Deckglases fixiert, haben grössere Ausmasse, als die heiss fixierten Larven. Ein Vergleich der Masse der Larven ist in der Tabelle Nr. 5 zu finden.

Tab. 5. Ausmasse der Metacerkarien Echinostomatidae g. sp.

| Fixiert | | 70 % Alk., heiss | 70 % Alk., gepresst |
|---------------|---|----------------------|----------------------|
| Korperlänge | | 0,483—0,574 0,512 | 0,602—0,888 0,698 |
| Korperbreite | | 0,122—0,177 0,157 | 0,183—0,209 0,209 |
| Kragen | B | 0,079—0,088 0,083 | 0,107—0,147 0,118 |
| | L | 0,049—0,061 0,055 | 0,058—0,076 0,068 |
| Mundsaugnapf | B | 0,061—0,064 0,061 | 0,058—0,073 0,062 |
| | L | 0,055—0,064 0,058 | 0,064—0,070 0,067 |
| Prepharynx | | 0,003—0,021 0,011 | 0,012—0,040 0,025 |
| | B | 0,018—0,036 0,024 | 0,021—0,033 0,024 |
| Pharynx | L | 0,021—0,033 0,029 | 0,033—0,043 0,036 |
| | | 0,009—0,030 0,019 | 0,107—0,125 0,113 |
| Oesophagus | B | 0,061—0,088 0,079 | 0,079—0,098 0,089 |
| | L | 0,070—0,088 0,075 | 0,079—0,098 0,084 |
| Gonadenanlage | B | 0,012—0,018 0,015 | 0,012—0,018 0,014 |
| | L | 0,036—0,042 0,039 | 0,018—0,021 0,020 |

B = Breite; L = Länge.

Die Zysten mit Larven fanden wir gewöhnlich im Glaskörper, im Fettgewebe in der Orbitalhöhle und im Muskelgewebe an der Zungenwurzel bei Kaulquappen und Fröschen der Wasserfrösche (*R. esculenta*) in der Südslowakei. Die Übersicht der Extensität und Intensität der Invasion ist in der Tabelle Nr. 6 aufgezeichnet.

Die Zysten haben wir an verschiedene Versuchstiere verfüttert, aber alle Versuche waren negativ. Deshalb können wir nicht genau feststellen, um welche Art der Saugwürmerlarven der Familie Echinostomatidae Dietz, 1909 es sich handelt und wir bezeichnen sie daher als Echinostomatidae g. sp. Die Übersicht der Versuche ist in der Tabelle Nr. 7 zu finden.

Nach der grossen Stachelzahl auf dem Kragen (46—49) könnte es sich um Vertreter der Gattung *Hypoderacum* Dietz, 1909 handeln. Aber auch bei

anderen Gattungen dieser Familie finden wir Vertreter mit einer hohen Zahl der Stacheln (z. B. bei den Gattungen *Echinoparyphium* Dietz, 1909, *Echinostoma* Rudolphi, 1809 u. a.).

Tab. 6. Übersicht der Invasionextensität und Intensität der Larven Echinostomatidae g. sp. aus der Lokalität Pálkovičovo

| Stadium | Untersucht | Befallen | Extensität | Intensität | | |
|-------------|------------|----------|------------|------------|------|--------|
| | | | | min. | max. | mittel |
| Amphibien | 164 | 51 | 31,09 % | 1 | 194 | 13,78 |
| Kaulquappen | 48 | 11 | 25,00 % | 1 | 12 | 6,36 |

Tab. 7. Übersicht der Versuche mit Invadierung der Endwirte

| Endwirt | Nr. | Zahl der verfütterten Zysten | Zahl der gewonnenen Würmer | Dauer des Versuches (Tag) |
|------------------------------------|-----|------------------------------|----------------------------|---------------------------|
| <i>Columba livia</i> f. dom. | 1 | 32 | — | 19 |
| <i>Gallus gallus</i> f. dom. | 1 | 16 | — | 1 |
| | 2 | 22 | 8 | 1 |
| | 3 | 20 | — | 3 |
| <i>Rattus norvegicus</i> var. alba | 1 | 98 | — | 10 |
| | 2 | 27 | — | 7 |
| | | 21 | — | 17 |
| | 3 | 124 | — | 21 |
| <i>Felis domestica</i> | 1 | 146 | — | 22 |
| | 2 | 166 | — | 30 |
| <i>Anas platyrhynchos</i> f. dom. | 1 | 45 | — | 10 |

7. *Neodiplostomum spathoides* Dubois, 1937

(Fam. Diplostomatidae Poirier, 1886)

Die Larven (Abb. 2) haben wir in runden, leicht zerstörbaren Zysten gefunden. Der Körper der Larven ist gedehnt oval, 0,290—0,324 (0,307) mm lang und 0,189—0,220 (0,204) mm breit. Der Mundsaugnapf ist leicht subterminal und misst 0,027—0,030 (0,028) × 0,030 mm. Dahinter befindet sich der Pharynx, im Ausmass von 0,012—0,015 (0,013) × 0,018—0,021 (0,019) mm. Der ganz kurze Oesophagus teilt sich in 2 Darmgabel, die bis zum hinteren Körperende zu den Gonadenanlagen oder dicht dahinter reichen. Der Bauchsaugnapf ist ungefähr unter dem Anlag der hinteren Körperhälfte angebracht und misst 0,024—0,030 (0,027) × 0,021—0,024 (0,022) mm. Er ist 0,149—0,168 (0,158) mm von dem vorderen Körperende entfernt. Dahinter ist das runde Brandesche Organ gelegen, dessen Ausmass 0,049 bis 0,052 (0,050) × 0,049—0,052 (0,050) mm ist. Dicht hinter dem Brandeschen Organ ist die von einer kugelförmigen Zellenanhäufung gebildete Gonadenanlage. Sie misst 0,018—0,024 (0,021) × 0,018—0,024 (0,021) mm.

Zysten mit Metacerkarien haben wir in der Körperhöhle eines Wasserfrosches (*Rana esculenta* L.) in der Südslowakei (Opatovský Sokolec) gefunden. Bei uns wurden die Metacerkarien in grosser Zahl bis jetzt nur bei der Ringelnatter (*Natrix natrix* L.) in Umgebung von Komárno (Vojtek,

Tab. 8. Ausmasse der Metacerkarien der Art *Diplostomum spathaceum*

| Autor | | Komiya, 1938 | Jagošová, 1963 | Eigenes Material |
|----------------------|---|--------------|----------------|----------------------|
| Körperlänge | | 0,352—0,427 | 0,387—0,450 | 0,292—0,496 0,399 |
| Körperbreite | | 0,264—0,348 | 0,135—0,270 | 0,191—0,310 0,244 |
| Mundsaugnapf | B | 0,047—0,061 | 0,048 | 0,041—0,062 0,051 |
| | L | 0,053—0,061 | 0,036 | 0,042—0,058 0,052 |
| Seitliche Haftgruben | B | — | — | 0,027—0,044 0,037 |
| | L | — | — | 0,019—0,039 0,030 |
| Praopharynx | | — | — | 0,007—0,011 0,010 |
| | B | 0,035—0,040 | 0,035—0,040 | 0,015—0,023 0,019 |
| Pharynx | L | 0,018—0,025 | 0,018—0,025 | 0,039—0,046 0,042 |
| | | — | — | 0,027—0,039 0,035 |
| Oesophagus | B | 0,047—0,054 | 0,036 | 0,037—0,044 0,041 |
| | L | 0,040—0,047 | 0,027 | 0,027—0,046 0,039 |
| Bauchsaugnapf | B | — | — | 0,052—0,128 0,091 |
| | L | — | — | 0,066—0,113 0,084 |

B = Breite; L = Länge.

Vojtková, im Druck) gefunden. Dieser Fund ist bisher in Fröschen der einzige, obwohl man aus dem Gebiete der Südslowakei schon eine wesentliche Zahl von Fröschen untersucht hatte. Bei Fröschen wurde diese Art nur im Volgadelta (Dubinina, 1950) und in der DDR (Odening, 1965) gefunden. Bei den Kriechtieren wurden die Metacerkarien *N. spathoides* von einer Reihe Autoren festgestellt (Odening, 1965). Als definitive Wirtstiere dieser Metacerkarien sind sowohl in der Natur als auch unter experimentellen Bedingungen die Raubvögel (Falconiformes) anzusehen (Odening, 1965). Bei uns sind erwachsene Saugwürmer *N. spathoides* Dubois, 1937 in Raubvögeln bis jetzt nicht gefunden worden.

8. *Diplostomum spathaceum* (Rudolphi, 1819) Braun, 1893

(Fam. Diplostomatidae Poirier, 1886)

Wir haben Metacerkarien (Abb. 3) beim Moorfrosch (*R. arvalis* Nil.) in der Augenlinse gefunden, ähnlich wie bei den Fischen in der Oberflächenschicht der Linse. Die Invasionintensität war niedrig — 1—3 Larven. Ausmasse der beim Moorfrosch festgestellten Larven entsprechen den voll entwickelten invasionfähigen Metacerkarien aus den Fischaugen überein (Tab. Nr. 8). Die Gesamtzahl der Kalkkörperchen (bei einem Exemplar 216) wie zugleich auch ihre Ausbreitung entspricht den von Šigin (1965) für Metacerkarien *D. spathaceum* veröffentlichten Angaben.

Diese Metacerkarien haben wir bei einem untersuchten Moorfrosch (*R. arvalis* Nil.) aus Dolní Věstonice und bei 2 (von 5 untersuchten) aus Kopčany gefunden. Metacerkarien *D. spathaceum* sind als übliche Parasiten unserer Fische zu bezeichnen. Bei uns haben diese Parasiten in Fischen schon John (1877), Schäferna (1925, 1926), weiter Romanovský (1954), Lucký (1957), Vojtek, Folkmanová, Ergens (1954) und andere Autoren festgestellt. Als Endwirte werden Möven (Laridae), für das Gebiet der ČSSR *Larus ridibundus* und *Larus canus*, angeführt. Erwachsene Saugwürmer wurden auf unserem Gebiet von folgenden Autoren gefunden: Ryšavý (1960), Vojtek, Vojtková (1961), Zajíček, Páv (1961), Macko (1964) und Sitko (1968).

Blochman (1910) hat zum erstenmal das Eindringen der Cercarien *D. spathaceum* in die Lurchenlarven (Larven der Wassermolche und des Axolotels) festgestellt. Das Eindringen dieser Cercarien verursachte schon nach einer kurzen Zeit das Sterben der Larven. Szidat (1924) erwähnt auch den Umstand, dass die Cercarien der Art *D. spathaceum* in die Larven der Lurchen eindringen können. Er invadierte mit diesen Cercarien die Kaulquappe des Grasfrosches (*R. temporaria*) und der Erdkröte (*Bufo bufo*) und nach 2 Stunden gingen alle invadierten Kaulquappen zugrunde. Beide Autoren (Blochman, 1910, und Szidat, 1924) haben sich aber mit der weiteren Entwicklung der Cercarien in Lurchen nicht mehr beschäftigt. Die nächste Angabe ist von Schäperclaus (1954). Er setzt voraus, dass die Entwicklung des Saugwurmes *D. spathaceum* auch über die Amphibien vor sich gehen kann. Nach seiner Angabe können die Cercarien *D. spathaceum* in die Kaulquappen auf der ganzen Körperoberfläche und in die Frösche und Molche nur auf der Augenhornhaut durchdringen. Schäperclaus (1954) pflegte auch in dem sächsischen Teichgebiet Kaulquappen zu finden, von denen fast alle von einem, durch diese Larven verursachten Augenstar befallen waren. Er nimmt an, dass die Kaulquappen allgemein leicht zu befallen sind und bestätigt es durch eigene Versuche.

Weitere Angaben über das Vorkommen der Larven *D. spathaceum* in den Lurchen gibt es in der Literatur nicht. Nur Kričevskaja (1961) führt den Fund der Larven *Diplostomum* sp. I. aus den Augen der Kaulquappen *Rana ridibunda* im Volgadelta an. Doch die Angabe ist sehr kurzgefasst, es fehlt eine Abbildung und deswegen kann man nicht mit Sicherheit sagen, ob es sich um *D. spathaceum* handelt. Auf Grund dieser Angaben und unseres Fundes kann man sagen, dass die Cercarien *D. spathaceum* in die Larven der Lurchen durchdringen und sich dort zu den in der Augenlinse lokalisierten Metacerkarien entwickeln. Ob die Metacerkarien in den Amphibien die Invasionsfähigkeit erreichen, müsste erst experimentell bewiesen werden.

Weitere Funde der von verschiedenen Autoren in die Gattung *Diplostomum* (resp. *Diplostomulum*) eingereihten Larven (Volgar-Pastuchov 1959; Kričevskaja, 1961) betreffen weder die Art *D. spathaceum* noch die sehr nahen Arten.

BANDWÜRMER (CESTOIDEA)

1. *Tetrathyridium* sp.

(Fam. Mesocestoididae Perrier, 1897)

Wirtstier: *Rana temporaria* L.

Lokalität: Kojetín

Invasionsintensität: 39

Invasionsextensität: 11,1% (von 9 untersuchten Grasfröschen wurde einer befallen)

Unter diesem Namen führen wir die Bandwurmlarven an, die wir in runden, dünnwandigen Zysten im Lebergewebe, in der Orbitalhöhle, in der Bauchmuskulatur, in der Zunge und den Muskeln der hinteren Gliedmasse gefunden haben (Abb. 7.) Die Zysten waren entweder einzeln oder in Anhäufungen zu 2—3 zu finden. Die Zysten messen $0,164—0,194 \times 0,180$ bis $0,203$ mm. Im Inneren der Zyste befindet sich eine bewegliche Larve, welche nicht den ganzen inneren Raum der Zyste einnimmt. Nach der Fixierung sind die Larven $0,131—0,198$ mm lang und $0,087—0,111$ mm breit. Sie haben vier kreisförmige Saugnäpfe und keine Haken am Scolex.

Tab. 9. Ausmassvergleich der Larven der Gattung *Tetrathyridium*

| Art | <i>Tetrathyridium mesocestoidini</i> , Dubinina, 1950 | <i>Tetrathyridium</i> sp. 1, Vojtková, 1963a | <i>Tetrathyridium</i> sp. 2., Vojtková 1963a | <i>Tetrathyridium</i> s |
|---------------------------|--|--|--|---------------------------------|
| Zwischenwirt | <i>Rana ridibunda</i> | <i>Bombina bombina</i> | <i>Rana esculenta</i> | <i>Rana temporaria</i> |
| Gesamtmasse der Zysten | — | 0,347—0,505 × 0,284—0,473 | 0,296—0,358 × 0,288 | 0,164—0,194 × 0,180—0,203 |
| Körperlänge | 15—60 | 0,371 | — | 0,131—0,198 |
| Körperbreite | 0,6—2,5 | 0,245 | — | 0,087—0,111 |
| Breite | | 0,062—0,070 | 0,055—0,086 | 0,030—0,033 |
| Saugnäpfe | 0,25—0,35 | | | |
| Länge | | 0,072—0,093 | 0,055—0,100 | 0,027—0,033 |

Aus der Familie Mesocestoididae Perrier, 1897 wurden von den Lurche bis jetzt 3 Larvenarten beschrieben: *Tetrathyridium mesocestoidini* aus der Körperhöhle des Seefrosches (*R. ridibunda*) aus dem Volgadelta (Dubinina 1950) und bei uns *Tetrathyridium* sp. 1. aus der Körperhöhle der Rotbauchunke (*Bombina bombina*) und *Tetrathyridium* sp. 2. aus der Darmwand des Wasserfrosches (*R. esculenta*) (Vojtková, 1963a). Die von uns gefundene Larven sind auffallend kleinerer Ausmasse als die angeführten Arten, und auch ihre Lokalisation ist verschieden. Deswegen schätzen wir, dass es sich um eine weitere Art handelt, die mit keiner von den vorhergehenden identisch ist. Der Vergleich der Larvenausmasse befindet sich in der Tabelle Nr. Eine genaue Bestimmung wäre nur durch Versuchszüchtung von erwachsenen Bandwürmern möglich. Der Versuch mit einem Kätzchen (*Felis domestica* Schreb.) ist erfolglos geblieben.

ZUSAMMENFASSUNG

In der Arbeit werden von den Autoren die neuen Funde der Helminthenlarven bei den Amphibien in der Tschechoslowakei beschrieben. Die Larven der Saugwürmer *Neodiplostomum spathoides* Dubois, 1937 und *Echinostomatidae* g. sp. und die Larve des Bandwurmes *Tetrathyridium* sp. sind für die Fauna der ČSSR neu. Die Metacerkarien *Diplostomum spathaceum* (Rudolphi, 1819) Braun, 1893 sind die üblichen Parasiten unserer Fische, doch wurden sie bei unseren Lurchen in der Natur zum erstenmal gefunden. Bei den Metacerkarien der Arten *Opisthyoglyphe ranae*, *Paralepoderma cloacicola*, *Leptophallus nigrovenosus*, *Euryhalmis squamula* und *Alaria alata* werden neue Wirtstiere und neue Lokalitäten angegeben.

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The plate will be found at the end of this issue.

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NOTE ON PATHOLOGICAL SCALES IN THE CARP,
CYPRINUS CARPIO LINNAEUS, 1758

MLADEN TASKOV ŽIVKOV

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INTRODUCTION

Morphology of fish scales with regard to the regenerated scales and various anomalies was studied by many authors, e.g. by Suzuki (1952), Kobayasi (1953), Gorjunova (1961), Aoyama (1957). These phenomena were studied in carp by e.g. Petrov and Petrushevsky (1929), Čngunova, Kaněvskaja (1962) and very thoroughly by Dür (1957) and Oliva (1955).

RESULTS PROPER

My observations are identical with Dür's observations and also my photographs are similar to examples cited by Dür (1957). The most frequent anomalies are regenerated scales (see also Oliva, 1955). In some cases in old specimens there occur mostly regenerated scales on flanks of body where normally we put out so called "representative scales" for age determination that it is very hard to find normal scale.

There occur also the scales without growth centre (see figs. 48, 49 at Dür, 1957). These scales do not complicate the age determination. Fig. 1 on plate I shows the pathological scales with regenerated lobiform appendices without circuli on the place of former damage. It is an interesting fact that in this manner most "representative" or „key" scales from carps in the pond "Velký Pálenec" were damaged.

Scales figured on plate I (fig. 2) and plate II (fig. 3) were taken out from the border of the wound of the flank. According to Dür (1957) such scales are found on carps diseased with dropsy.

SUMMARY

Four examples of various anomalies of carp scales are described. The results obtained are in coincidence with Dür's (1957) observations.

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The plates will be found at the end of this issue.

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P. H. Klopfer (1968): Ökologie und Verhalten. Psychologische und ethologische Aspekte der Ökologie. G. Fischer Verlag, Jona 98 stran.

Publikace je překladem díla amerického autora (*Behavioural Aspects of Ecology*, 1962) a představuje mezi četnými knihami o živočišné ekologii nový pohled na tento obor zoologie, poněvadž hledá vztahy mezi ekologi a chováním zvířat. Zatímco ve většině dosavadních učebnic ekologie převládalo syntetisující zpracování mnohostranných ekologických poznatků, což je po didaktické stránce zcela pochopitelné, bylo porůznu použito i užších speciálních hledisek, jednalo-li se např. výhradně o ekologii vodních nebo půdních živočichů, nebo pokud byla ekologická problematika řešena více po matematické stránce (např. v populaci a produkci ekologii). Psychologické aspekty zůstávaly dosud téměř nepovšimnuté a je zásluhou Klopfera, že tak zajímavé vztahy nyní probírá v širších souvislostech a že svou publikaci seznamuje biology ucelenějším způsobem s pozoruhodnou problematikou. Poznátky toho druhu se vlastně vyskytovaly velmi roztroušeně v odborné literatuře a často byly jenom okrajovou tematikou.

Kniha je na jedné straně nutným popisem poznanych fakt, ale daleko více ukazuje a rozvádí problematiku detailních ekologických otázek a zjišťuje, kde jsou mezery, polovičatě řešené otázky a co ještě vyžaduje potvrzení, revize a prověrování v jiném prostoru a case. Je to tedy kniha veskrze nabádavá, pobízející k promyšlení a objektivnímu řešení problémů.

Obsah knihy je rozdělen do pěti hlavních kapitol, které se pokoušejí vysvětlit několik základních otázek: 1. Proč dravec nevyhubí svou kořist? 2. Jak jsou rozděleny potravina a prostředí mezi jednotlivé druhy? 3. Proč je variabilita v rozmanitosti druhů? 4. Čím je zabraňováno smísení druhů? 5. Jak jsou uspořádána společenstva zvířat?

První kapitola je věnována vztahům predátorního konsumenta a jeho kořisti, které jsou nejvíce ovlivněny mimesi a mimikrickým jednáním. Různé otázky, které s tím souvisí, nutně předpokládají dobrou znalost funkce smyslových orgánů různých typů zvířecích a různosti jejich stavby. Je pojednáváno o takových diletech problémech, jako jsou poměrná požitelnost potravy, relativní a absolutní hojnost vzoru a napodobitele, učení se odpozorováním, stupně podobnosti, vliv paměti, matení predátora a motivační změny. — Druhá kapitola řeší otázky potravní ekologie a s tím spojené prostorové problematiky. Z hlavních otázek stojí za zmínku vliv strukturálních faktorů na jednání související s vyhledáváním potravy (např. stavba ustních ústrojí a způsob získávání potravy) a význam poučení při vyživě. Prostorová problematika byla v literatuře řešena už z mnoha různých hledisek, Klopfer si všimá využití prostředí v závislosti na některých morfologických adaptacích a kromě toho vlivu získaných zkušeností. Sídlní hustotě živočichů je věnována pozornost pokud jde o mechanismy rozhodne při obsazování prostoru a přímo určující hustotu osídlení (např. vliv teritoriality, individuální distance, maximální hustota aj.). — Třetí kapitola sleduje přímou stabilitu a variabilitu druhové rozmanitosti v různých podmínkách zeměpisných, ekologických a důkladněji v závislosti na chování zvířat. — Čtvrtá kapitola pojednává o mechanismech a vývoji druhové izolace ve smíšených společenstvech, o působení a realizaci zděděného a získaného chování a také vliv domestikace je krátce zmíněn. — Konečné pátá kapitola si všimá uspořádání a vztahů jednotlivců v monospecifických a polyspecifických živočišných společenstvech. Zvláštní pozornost věnuje i otázkám vzájemného poznávání jednotlivců ve společenstvech a signálním mechanismům ve společenstvech.

Všechny popisované jevy jsou demonstrovány na četných příkladech. Připojený přehled literatury je celkem zevrubný a byl v ojedinelých případech doplněn i o literaturu vyšlou po vydání amerického originálu. Překlad byl pořízen s citlivým porozuměním a hlubokou znalostí problematiky W. M. Schleidtem. Vzhledem k neobvyklosti popisované tematiky by bylo žádoucí, aby knižce Klopferově věnovali i naši zoologové svou pozornost.

Walter Černý

Bobrinskij, N. A., B. A. Kuzněčov, A. P. Kuzjakin (1965): Opredělitel' mlekopitajuschich SSSR. Nakl. „Prosveščeniye“ Moskva, 382 str., 40 barev. tabulí, 129 kreseb, 111 mapek, 2 vyd.

Je to druhé podstatně upravené vydání známé klíčové publikace o savcích SSSR, vydané poprvé v r. 1944. Úpravy se týkají nejen textové části, kde je připojena řada nových poznatků v soulase s rozvojem výzkumu savců v posledních 20 letech, ale především obrazové části. Kromě některých nových perovek, znázorňujících důležité lebeční znaky, je druhé vydání doplněno přehlednými a pečlivě upravenými mapkami rozšíření většiny popisovaných forem. Spolu s tabulemi, kde se poprvé v sovětské mammalogické literatuře setkáváme s barevnými kresbami všech na území SSSR žijících savců, je to nejvýznamnější přínos tohoto vydání knihy. Celek je třeba ocenit jako zdařilou publikaci, podávající stručný, avšak všestranný přehled fauny savců severní a střední části palearktické oblasti. Kniha je cennou příručkou jak pro

specialisty, tak i pro pracovníky jiných oborů (parazitology, fyziology, zemědělské a lesnické výzkumníky atd.), kteří hledají rychle poučení o některém eurasijském savci. Bohužel ani toto druhé vydání osvědčeno publikace není zcela bez nedostatků. Většina chyb a nepřesností vyplývá z neznalosti zahraniční literatury a týká se jak systematických názorů, tak i poznatků biologických. Tak jen v oddílu o netopyrcích je několik závažných chyb. Psát dnes o tazích *M. schreibersi* do Indie a Afriky je přinejmenším naivní, stejně jako názor o migracích *E. nilsson* ze Skandinávie do Švýcarska. Nepochopitelné je také nerespektování existence dvou druhů rodu *Plecotus* v Eurasii a řešení takto vzniklé situace popisem nové subspecie. Ani takové nedostatky však nemohou snížit význam a potřebu této publikace. Lze jen litovat, že vyšla v tak malém nákladu, že se o ni v zoologických kruzích sotva ví. To je také důvodem naší opožděné informace o ní.

Vladimír Hanáček

G. de Lattin (1967): Grundriss der Zoogeographie, G. Fischer Verlag Leipzig und Stuttgart, 602 str., 170 kreseb a 25 tabulek.

Ačkoliv se zoogeografie více či méně dotýká činnosti každého zoologa, nebyla u nás v poslední době vydána žádná učebnice tohoto oboru a nebyla ani běžně dostupná žádná učebnice cizí. Tuto citelnou mezeru sotva mohla nahradit vysokoškolská scripta prof. Teyrovského (St. pod nakladatelství, Praha, 1957), Mařanův „Původ a složení Československa“ (Orbis, 1953) a Schilderův „Lehrbuch der allgemeinen Zoogeographie“ (Fischer Verl., Jena, 1956). Je proto potěšitelné, že se v posledních letech staly u nás dostupnými hned dvě základní světové učebnice zoogeografie. Je to jednak ruský překlad známé učebnice Darlingtonovy (Vyd. „Progress“, Moskva 1966), vydány kupodivu v dostatečném nákladu, a v poslední době i významnou publikaci de Lattinova (u nás dostupná především ve sverm vychodoněmeckém vydání). Poslední představuje dnes pravděpodobně nejmodernější a nejucelenější současnou učebnici oboru, je je speciálně psána pro potřeby evropských zoologů. Obsahuje přehled všech významnějších zoogeografických poznatků, při čemž je rozsahem preferována problematika holarktické oblasti. V první kapitole najdeme výklad o obecných pojmech zoogeografie, jako je problematika areálů atd., spolu s názory na vymezení rozsahu tohoto vědního odvětví a vztahu k jiným vědám. Druhá a třetí kapitola je věnována zoogeografii moře a sladkých vod. Nejcennější je pro nás kapitola čtvrtá, která popisuje zoogeografické problémy suchozemské fauny. V této části nás zaujme především zoogeograficko-ekologické dělení suchozemské fauny na tři základní biochory: arboreál, eremiál a oreotundrál. Takové dělení je pro nás zatím málo obvyklé a je třeba ještě uvážít, jak se dotýká doposud užívaného dělení Evropy i přímo naší oblasti. Velmi podrobně jsou probírány také jednotlivé zoogeografické elementy holarktické fauny, je třeba podotknout, že i zde se vyskytuje řada odchylek od dělení doposud u nás užívaného. V části o historické zoogeografii je zvláštní pozornost věnována pleistocenu, tak jak to ostatně odpovídá významu tohoto období ve formování evropské a vůbec holarktické fauny. Logickým doplňkem je výklad o vztazích mezi zoogeografií a genetikou (problémy rozšíření některých genových a chromosomových mutací, polymorfni populace atd.). Je samozřejmé, že při tomto obsahu nestačí už rozsah knihy na zoogeografii speciálních živočišných skupin — to však česky čtenář najde (aspoň pokud se týče obrátlovců) v již zmíněném díle Darlingtonově. Kniha de Lattinova je ukončena obsáhlým seznamem základní i speciální literatury (51 str.), názorným přehledem systému forem v knize citovaných a příslušnými rejstříky.

Vladimír Hanáček

Smetana O. (1969): Entomologická bibliografie Československa 1951—1960 (Entomologisch Bibliographie der Tschechoslowakei) Academia Praha, 329 Seiten, Preis 32 Kčs

In dem verhegenden Buch setzt der Author die entomologische Literatur, die in den Jahren 1951 bis 1960 in der Tschechoslowakei publiziert wurde, zusammen. Die wissenschaftlichen Arbeiten sind womöglich alle angegeben, die populären Artikel, besonders die über die angewandte Entomologie, sind im Auswahl angeführt. Insgesamt werden etwa 4800 Arbeiten in begriffen. Eine Liste von 184 Zeitschriften, die exzerptiert wurden, ist beigefügt.

Das Buch wird thematisch in fünf Kapiteln geteilt: I — Allgemeine Entomologie (Anatomie, Morphologie, Histologie, Physiologie, Ökologie, Metamorphose, Pathologie und Teratologie); II — Systematische Entomologie und Faunistik (nach den Ordnungen geteilt); III — Angewandte Entomologie (Landwirtschaft, Forstwirtschaft, Bienenzucht, Seidenbau, Industrie und Vorräte, Medizin, Veterinärwesen, Insektenbekämpfung und Insektizide); IV — Biographien; V — Verschiedenes. Die Bibliographie wird mit einem Autorenregister abgeschlossen.

Die Herausgabe eines solchen Buches wurde von allen Entomologen, sowohl von Fachleuten als auch von den Liebhabern, bewillkommen. Erfreulich ist, dass eine Fortsetzung für die Jahre 1961 bis 1965 in Vorbereitung steht.

Karel Hůrk

I. E. Fuhn: Über die Unterarten von Ablepharus kitaibelii (Bibron & Bory de St. Vincent, 18
(Sauria: Scincidae)

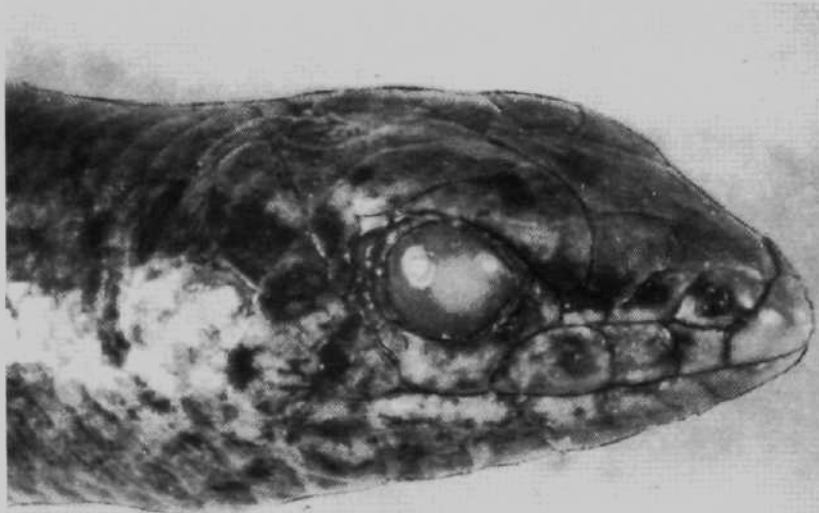


a

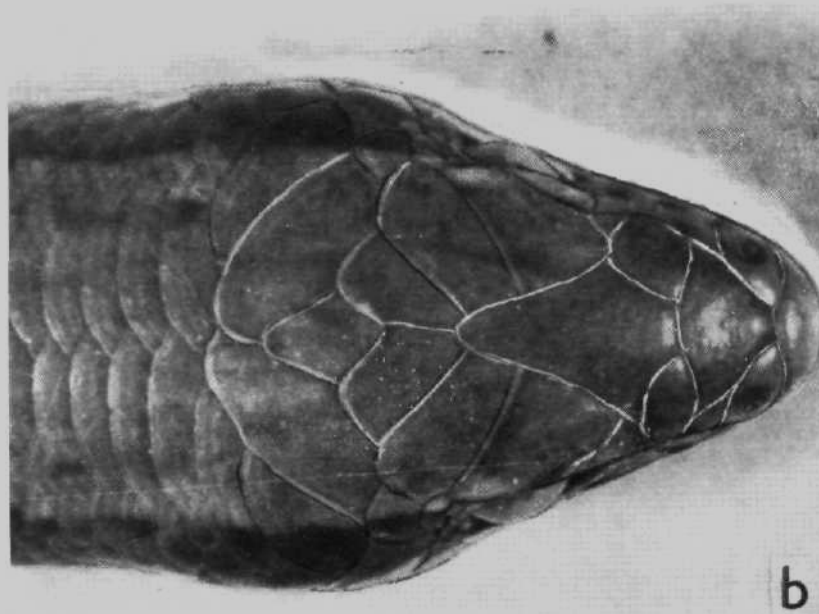


Abb. 2. — *Ablepharus l. stepaneki*: a — Seitenansicht; b — Pileus.

I. E. Fuhn: Über die Unterarten von *Ablepharus kitaibelii* (Bibron & Bory de St. Vincent, 1831) (Sauria: Scincidae)



a



b

Abb. 3. — *Ablepharus k. fabichi*: a — Seitenansicht; b — Pileus

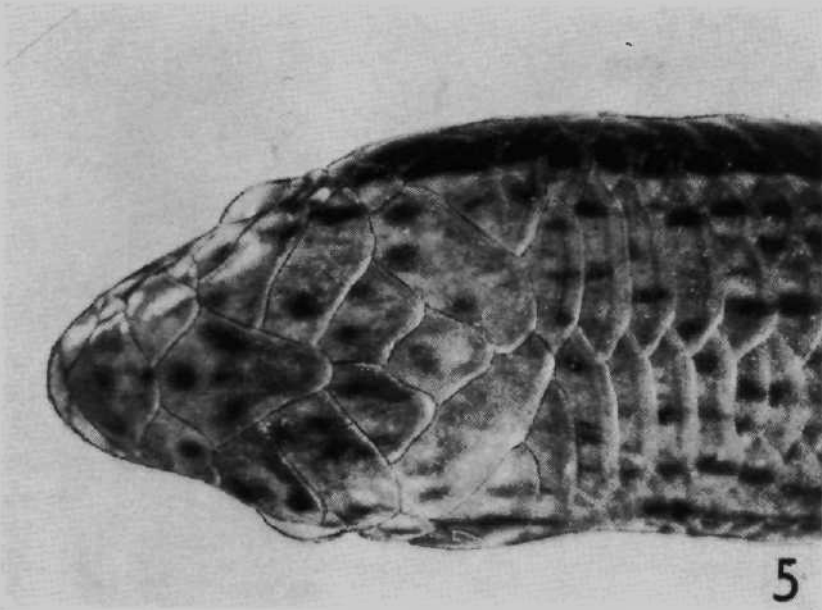
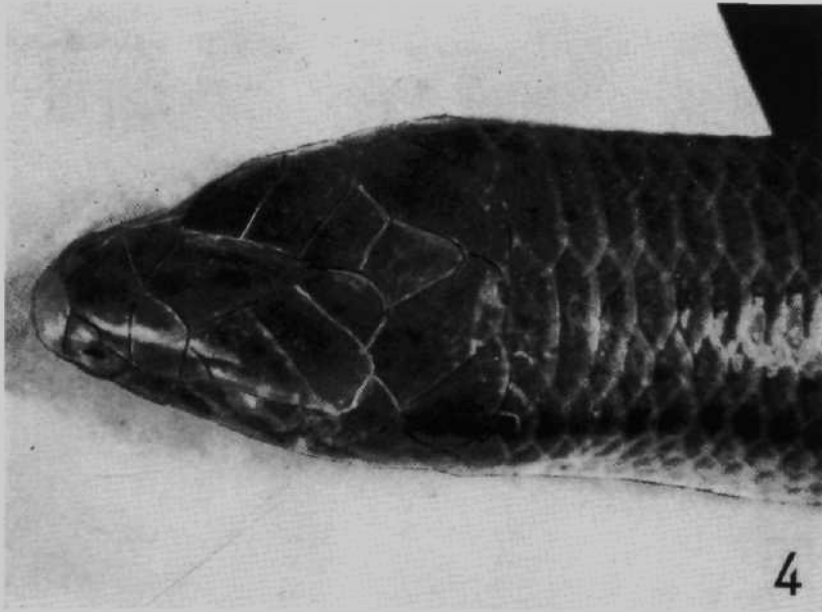


Abb. 4. — *Ablepharus k. kitaibelii*: Pileus
Abb. 5. — *Ablepharus k. chernovi*: Pileus

I. E. Fuhn: Über die Unterarten von *Ablepharus kitaibelii* (Bibron & Bory de St. Vincent, 1833)
(Sauria: Scincidae)

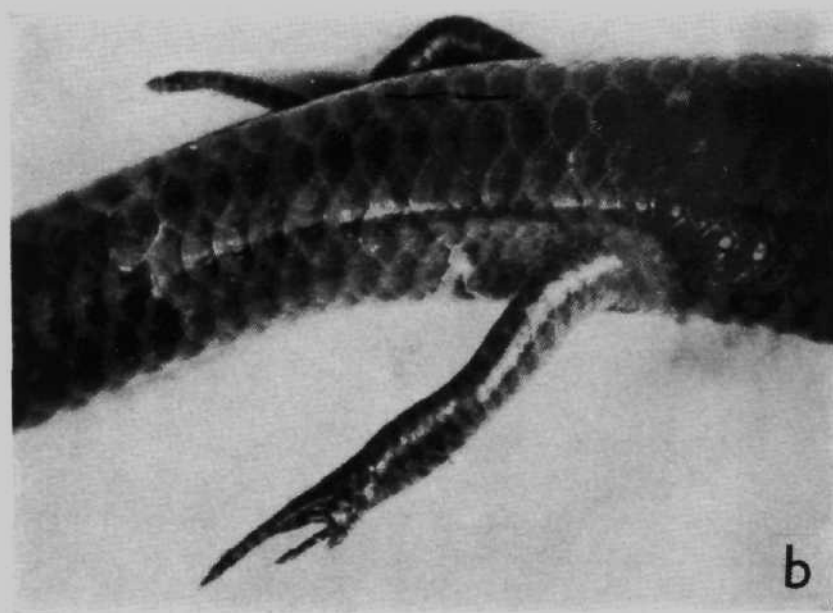
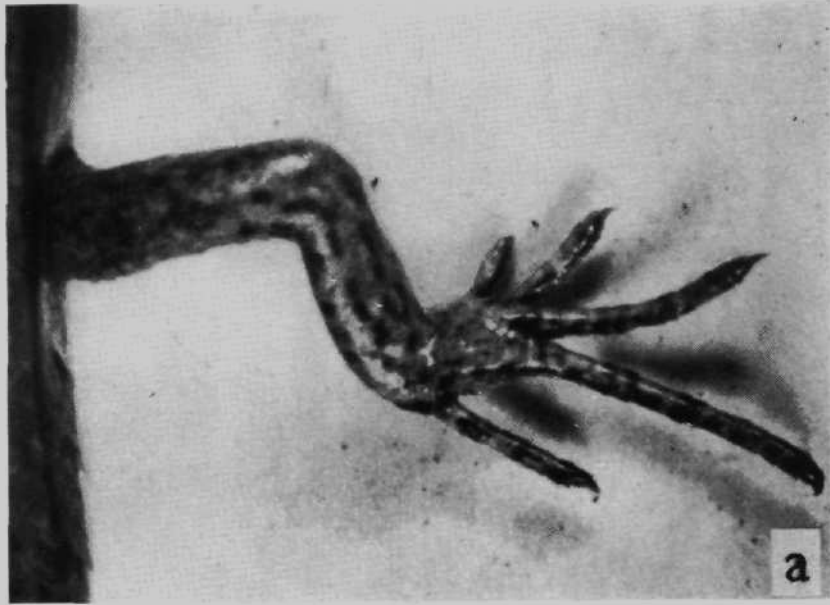


Abb. 6. — Hinterbein a — *A. k. fabichi*; b — *A. k. kitaibelii* (a — 10 : 1; b — 8,4 : 1)

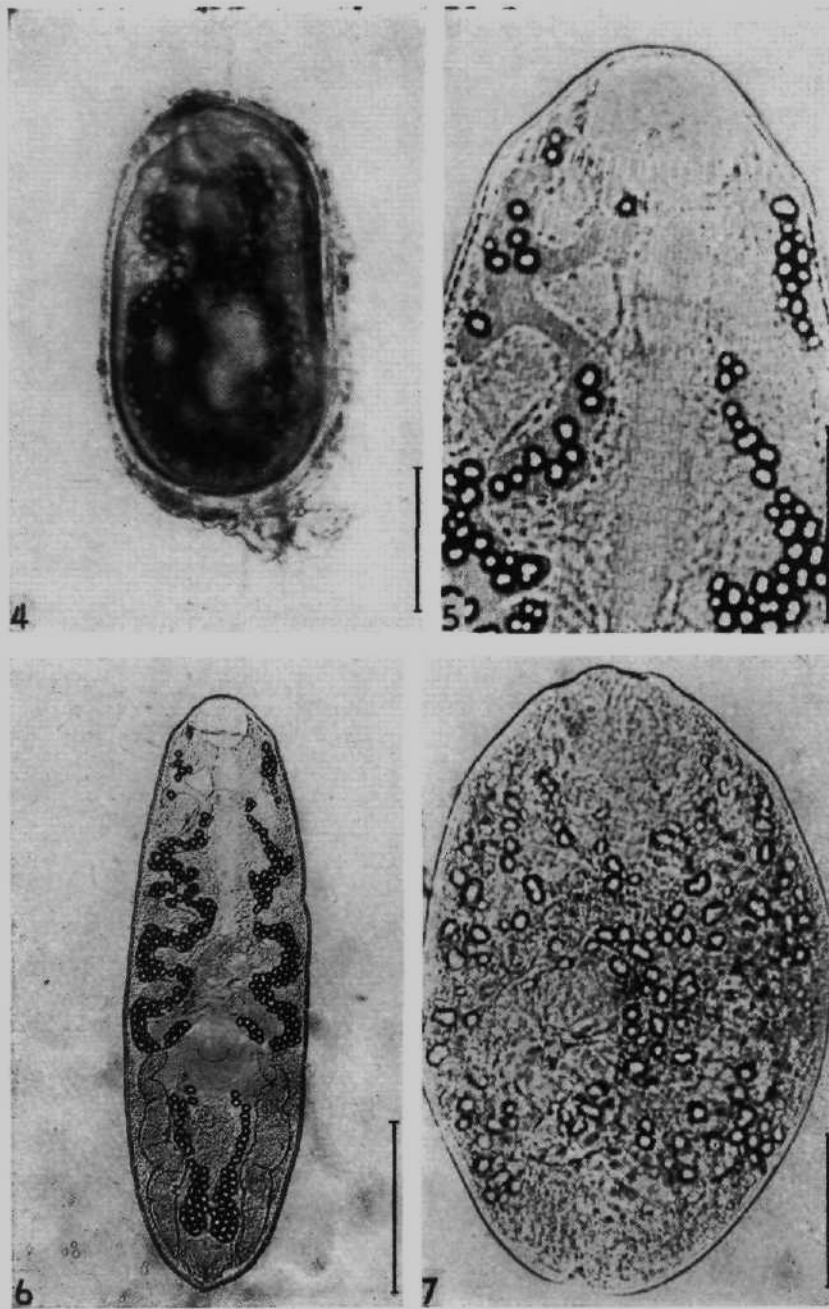


Abb. 4—6. *Echinostomatidae* g. sp. (lebend photographiert, Massstab = 0,1 mm): 4. die Zyste, 5. Vorderende der Metacerkarie, 6. Metacerkarie — Totalansicht.
Abb. 7. *Tetrathyridium* sp. (Massstab = 0,05 mm).



Fig. 1. Pathological carp scales with regenerated lobiform appendices without circuli on the place of former damage. The carp was fished out from the pond "Velký Pálenec", 12. 10. 1957, body length 360 mm, age 2 + (II), Southern Bohemia.

Fig. 2. Pathological scale from the lateral line from the drosy carp. Locality "Kamenný mlýn", Southern Slovakia, 13. 10. 1960, body length 375 mm, weight 1840 g, female, age 3 + (III).

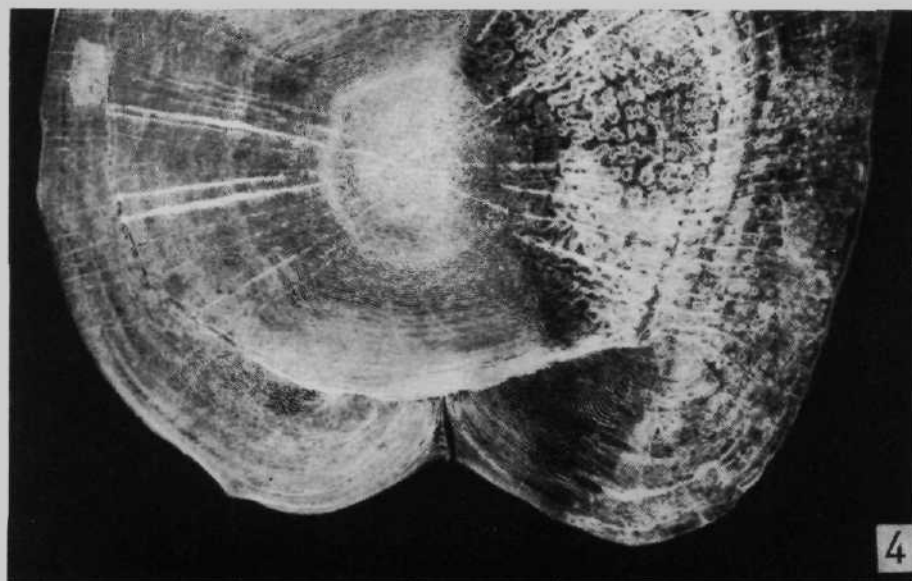


Fig. 3. Pathological scale of the carp infected by dropsy. 13. 10. 1960, pond "Kamenný mlýn", Southern Slovakia, body length 374 mm, weight 1200 g, age 3 +(III), male.

Fig. 4. The scale of the same specimen as above with mechanical destroying of the lateral field of the scale.

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VĚSTNÍK ČESKOSLOVENSKÉ SPOLEČNOSTI ZOOLOGICKÉ
ročník XXXIV

Vydává Čs. společnost zoologická v Akademii, nakladatelství ČSAV, Vodičkova 40,
Praha 1 - Nové Město, dod. pú. 1.

Tiskne Státní tiskárna, n. p., závod 4, Praha 10 - Vršovice, Sámova 12, dod. pú. 101.

Rozšiřuje Poštovní novinová služba. *Objednávky a předplatné PNS* - ústřední expedice tisku
administrace odborného tisku Jindřišská 14, Praha 1. Lze také objednat u každé pošty nebo
doručovatele.

Cena jednoho výtisku 10 Kčs, v předplacení (4 čísla ročně) 40 Kčs, \$ 5,60, £ 2,6,10
Toto číslo vyšlo v únoru 1970.
