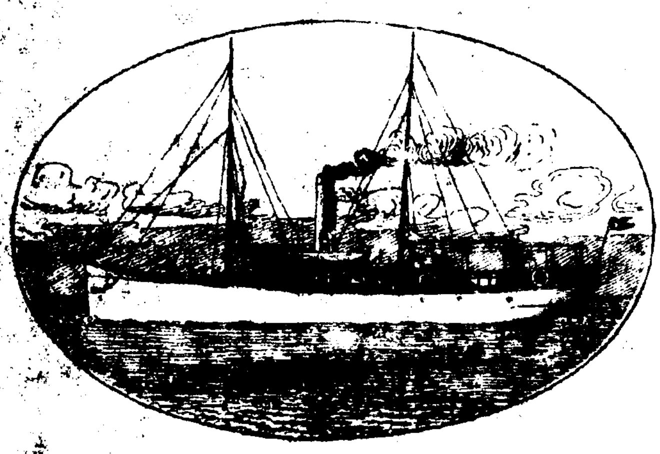
Report

of

The Danish Biological Station

to

The Board of Agriculture.



XXVIII.

1922.

By

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1922

On the Biology of some Danish Gammarids and Mysids.

(Gammarus locusta, Mysis flexuosa, Mysis neglecta, Mysis inermis.)

By

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Contents.

was 114. In the Nyborg Fjord the annual production may be estimated at about 10—15 g (rough weight) pr. sq. metre (p. 54).

The food is partly detritus and partly fresh plant food and animal food. The *Gammarus locusta* is easily kept in aquarium when fed with the meat of *Mytilus edulis* and algæ. It has been proved that the animals in the aquarium eat less during the winter than during the summer. Feeding experiments have substantiated that the „useful effect", i. e. the relation between the increasement in weight of the gammarids and the amount of food consumed, varies between $^1/_5$ and $^1/_{27}$ (p. 51).

In comparison with amphipods from other countries, our *Gammarus locusta* corresponds in reference to biological conditions nearest with the three American gammarid species examined by Embody. It occupies an intermediate position between the Norwegian *Gammarus pulex,* examined by Dahl, on the one side, and the Bavarian *Gammarus pulex,* examined by Haempel, and the English *Gammarus chevreuxi,* examined by Sexton & Matthews, on the other side. All the observations hitherto made tend to prove that the temperature is one of the most important biological factors in the life of the amphipod; it is therefore very probable that a suitable feeding and breeding of *Gammarus locusta* in shallow reservoirs would be profitable during the warm time of the year, as this animal is an excellent food-object for fish.

Mysids *(Mysidæ).*

The most frequent mysids in the Nyborg Fjord are the three species *Mysis flexuosa* O. F. Müller, *Mysis neglecta* G. O. Sars and *Mysis inermis* Rathke; less frequent are *Mysis vulgaris* Thompson, *Mysis spiritus* Norm., and *Macropsis slabberi* v. Beneden. Immediately outside the Fjord *Mysis mixta* is found in great numbers in the deep water of the Great Belt, where *Gastrosaccus spinifer* Goës is also found on the sea bottom.

In opposition to *Gammarus locusta,* the life of which is closely related to the sea bottom, plants, *Mytilus,* stones etc., while only the younger individuals especially during the night move freely about in the surface of the water, the above mentioned species of mysids (excepting perhaps *Gastrosaccus spinifer)* are swimming animals all their life, and seldom rest for a moment on the leaf of a *Zostera* or algæ; if they are pursued, they try to save themselves like the shrimps by hopping backwards through the water in long leaps, which they perform by suddenly drawing the tail in against the body. When they are not disturbed, they flock together in larger or smaller numbers, keeping float almost in the same spot by means of quick whirling movements of the peraeopods with their well developed

♂

Length of anim. in mm	Number of spines on tail-plate						
	21	22	23	24	25	26	27
12	—	1	1	—	—	—	—
13	—	—	—	—	—	—	—
14	—	—	—	—	—	—	—
15	1	—	3	—	—	—	—
16	—	2	—	—	—	—	—
17	—	1	—	4	—	—	—
18	—	1	1	2	3	1	—
19	—	1	3	5	5	1	2
20	—	—	3	3	1	—	2
21	—	—	—	1	1	1	—
22	—	—	—	—	—	—	—
23	—	—	—	—	—	—	—
	1	6	11	15	10	3	4

Average: 24,08 spines.

♀

Length of anim. in mm	Number of spines on tail-plate						
	22	23	24	25	26	27	28
12	—	—	—	—	—	—	—
13	—	—	—	—	—	—	—
14	—	—	—	—	—	—	—
15	—	—	—	1	—	—	—
16	—	1	—	—	—	—	—
17	—	1	—	—	—	—	—
18	1	5	1	1	—	—	—
19	1	1	2	3	1	—	—
20	1	3	3	4	—	—	1
21	1	3	3	3	1	—	—
22	—	1	4	—	—	—	—
23	—	—	2	1	—	—	—
	4	15	15	13	2	—	1

Average: 23,92 spines.

Mysis flexuosa.

♂

Length of animal in mm	Number of spines on tail-plate				
	17	18	19	20	21
10	—	1	—	—	1
11	—	—	2	—	—
12	—	—	—	—	—
13	—	1	1	—	—
14	—	3	2	2	—
15	—	5	5	2	—
16	2	4	3	—	—
17	—	1	—	1	—
18	—	—	—	—	—
19	—	—	—	—	—
	2	15	13	5	1

Average: 18,7 spines.

♀

Length of animal in mm	Number of spines on tail-plate					
	17	18	19	20	21	22
10	—	—	—	—	—	—
11	—	1	—	1	1	—
12	—	—	1	—	—	—
13	—	—	—	—	1	—
14	—	—	2	3	—	—
15	—	4	2	6	1	—
16	2	3	3	4	3	—
17	2	3	2	5	3	2
18	1	—	5	—	1	1
19	—	—	—	—	—	1
	5	11	15	19	10	4

Average: 19,5 spines.

Mysis neglecta.

It must be noted that in some cases there were about 3 spines more on the one side of the tail-plate than on the other; in such cases the largest number of spines is set down in the tables.

As will be observed there is a considerable overlapping in the figures, as no less than 15 % of the examined *neglecta* have more than 20 spines. Regarding and rearwardly; after these a few more larger and well-developed, outwardly pointing spines are found (see fig. 6). The colour of the hairs on the last pair of pleopods of the living *neglecta* is always a bright violet, whereas the corresponding hairs of the *flexuosa* are mostly colourless or only very slightly coloured. Finally the elongated form of the body as well as the slight pigmentation, which is especially found amongst the younger individuals, often affords a good distinction mark for *flexuosa* in opposition to the short and strongly pigmented *neglecta*. By means of these distinction marks I have been enabled to determine nearly the whole material relating to the mysids; only in a few single cases (see the tables of measurements for June 25th and July 3rd 1917), which referred to newly hatched young, have I been obliged to give up separating the 2 species.

The investigations of the biology of the three *Mysis*-species may, as in the case of *Gammarus locusta*, be divided into measurement investigations, aquarium observations and investigations relating to the size of production.

Measurement Investigations.

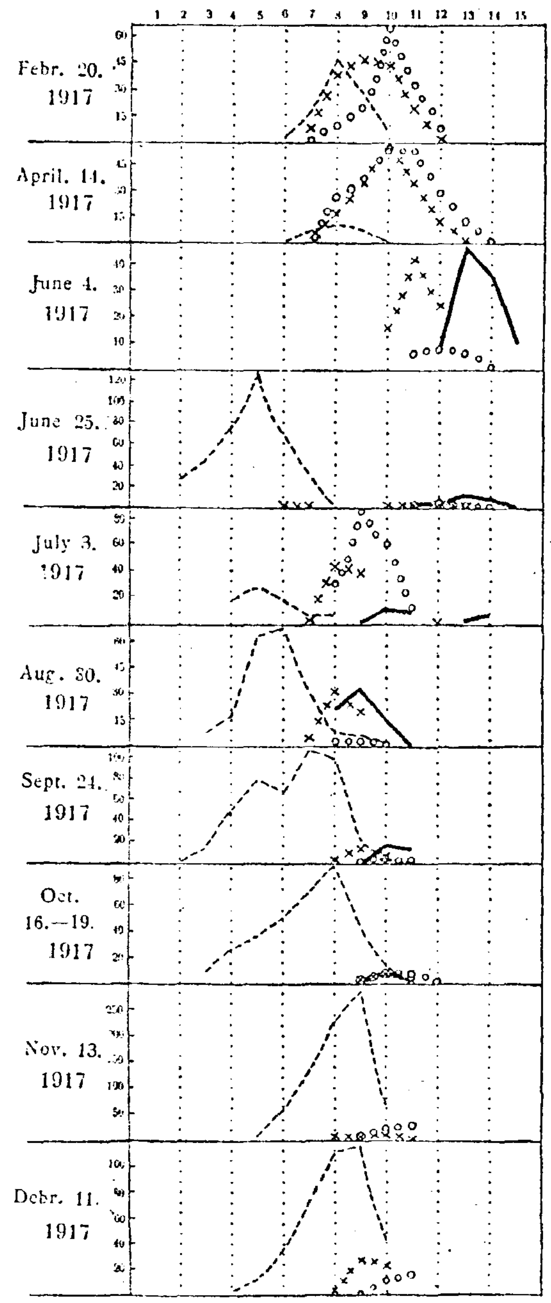
The investigated material originates partly and most essentially from the Nyborg Fjord, and partly from other places in Denmark, being collected in the course of the years 1916—19. The measurements are taken from the front edge of the eyes to the point of the last pair of pleopods. Of 9025 *Mysis inermis* collected from the Nyborg Fjord, 28 measurements were made, and of 1942 individuals gathered from different places outside Nyborg Fjord, 12 measurements were made. As it was observed that the conditions altered very little from the one year to the next within the same season, and that they were about the same in the Nyborg Fjord as outside it, only 15 of the most complete and representative measurements from Nyborg Fjord of the two years 1917—18 are given in table 3 at the end of this book, these selected measurements giving a sufficiently clear picture of the changes, which in the course of the varying seasons take place in the size of the individuals and the composition of the stock. For the same reason table 4 includes only 16 of the 28 measurements (of 7310 individuals) which were taken of *Mysis flexuosa* collected from the Nyborg Fjord, and table 5 only 15 of the 27 measurements (of 5145 individuals) taken on the *Mysis neglecta* from the Nyborg Fjord. The column „♂“ comprises all the individuals with distinctly elongated pleopods of the 4th pair, even if they had not reached their full length. The column „♀ with eggs or young“ comprises all the females, which carry eggs or young in their incubatory pouch, while the column „♀ without eggs or young“ comprises all the other ♀♀, as well those with small undeveloped incubatory lamellæ as spent females with large empty incubatory lamellæ. In the column „Young“ all the young individuals, the sex of which it has not been possible to determine by means of exterior distinction marks, even when seen through a binocular microscope, are gathered.

As it soon became apparent that fishing at one or more certain places was less than 2,1 mm since April. On June 25th fig. 7 shows that a great number of young have now been hatched; the young form a group distinctly separated from

Fig. 7. Measurements of Mysis inermis.

Nyborg Fjord, 1917.

The ordinates are number of individuals, the abscissæ their lengths in mm.



Total number	♂ I G.	♂ I %	♂ II G.	♂ II %	♀ with eggs or young I G.	♀ with eggs or young I %	♀ with eggs or young II G	♀ with eggs or young II %	♀ without eggs or young I G.	♀ without eggs or young I %	♀ without eggs or young II G.	♀ without eggs or young II %	young G.	young %
391. G. 9,22	9,21	40							10,09	34			8,14	26
392. G. 9,97	9,88	40							10,28	53			8,04	7
199. G. 12,39	11,11	40			13,50	49			12,10	11				
426. G. 5,57	11,50	0,7	6,50	0,3	13 24	7			12,45	3			4,72	89
371. G. 8,49	12,00	0,3	8,43	21,7	13,67	2,5	10,30	5,5			9,25	50	5,41	20
342. G 6,94			8,21	17			8,93	21			9,00	2	5,78	60
494. G. 6,81			9,21	4			10,26	6			10,25	2	6,40	88
377. G. 7,33			10,60	2	13,00	0,3	10,00	3,7			10,49	5	6,97	89
853. G. 8,33			9,38	2							10,40	6	8,17	92
471. G. 8,51			9,38	11							10,56	6	8,02	83

— — — Young

x x x ♂

———— ♀ with eggs or young in the incubatory pouch

o o o ♀ without „ „ „ „ „ „ „

G = Average size in mm.

% = Number of individuals in each group expressed in percentage of the entire stock.

I = Winter-stock.

II = Summer-stock.

There is continually a very large group of young which comprises no less than 88 % of the whole material.

On October 10th—19th the breeding period is nearly at an end, only 4% of the stock being breeding ♀♀, and nearly all of these have young — not eggs — in their incubatory pouches. The few ♀♀ without eggs are spent individuals with large, strangely collapsed incubatory lamellæ; neither these nor the ♀♀ carrying young have developed eggs in their ovaries. The increase in the average size of the stock as a whole shows also that practically no more young are produced. Strange enough a single breeding ♀ measuring 13 mm, and which undoubtedly belongs to the winter-stock has been found so late in the year.

In the sample of November 1917 no more breeding ♀♀ are to be found. The average size of the stock has increased with 1 mm, and the young form no less than 92 % of the entire stock; nearly all the ♂♂ have only undeveloped pleopods of the 4th pair, and the few ♀♀ without eggs have all small incubatory lamellæ.

In December conditions were about unaltered. The stock as a whole has not increased perceptibly in length; there are, however, comparatively few young, because the largest individuals can now be determined as to sex, though they are still far from fully developed.

The sample from January 1918 (see table 4), in which still more individuals — especially ♂♂ — could be determined in reference to sex, forms a transition to the condition in February already described. *Mysis inermis* does thus not breed throughout the winter.

As mentioned above the measurements made in the other years of 1916—1919 indicate that the conditions described for a single year are repeated from year to year in the Nyborg Fjord. Measurements from other places than the Nyborg Fjord (different places in the Limfjord, the Kerteminde Fjord, Svendborg Sound) show too that the conditions are the same everywhere in all the investigated waters. The only difference is that *Mysis inermis* becomes about 2 mm longer in the Limfjord than in Nyborg Fjord; thus the figures representing females with eggs in a measurement from Sundby Hage by Aalborg on July 20th 1916, formed a fine two-crested curve with maxima at 12 mm and 15 mm, there being at this time breeding ♀♀ of the summer-stock (average size abt. 12 mm) as well as of the winter-stock (average size abt. 15 mm).

The results of the measurement investigations are shortly the following:

Mysis inermis is at the highest annual, because the wintered stock dies off every year during the months July—August. The breeding period lasts from late April until late October, the winter-stock breeding from late April until it gradually dies off, the summer-stock breeding from the beginning of July until late October. The period of incubation for the broods hatched early in the year is about 1 month, the first young appearing about the end of May. It was evident from the large ovarial eggs that each ♀ was able to breed several times, the eggs being most prominent with the ♀♀ that carried young in a very advanced stage of development in their incubatory pouches. As to the growth the measurement curves show that the ♀♀ are larger everywhere (i. e. they grow quicker) than the ♂♂, and furthermore that the growth proceeds slower during the winter than during the warmer part of the year. Fig. 7 shows that the average size of the stock during the winter-season — from the middle of October till the middle of April — only increased with 2,64 mm, whereas in the course of the following 2 months — April 14th till June 4th — it increased with nearly the same, viz. 2,12 mm. It is difficult to calculate the growth of the young during the summer, as new young continually appear; but as it may be assumed that the earliest born young are to be sought among the largest individuals of the summer-stock, it appears from fig. 7 that the young born in late May have reached on June 25th or in the course of about a month, a length of 8 mm; as they were 2 mm in length when born they have thus during this time grown altogether 6 mm; on July 3rd the largest individuals were fully developed, and the ♀♀ matured at a length of 11 mm, the ♂♂ at 9 mm. The first-born young of the summer-stock reach thus maturity in the course of hardly $1^1/_2$ months.

There still remains, however, the questions regarding growth of the latest-born young, the number of generations, how many times each ♀ can breed, the duration of the period of incubation in the summer time, and finally whether the breeding individuals of the summer-stock after wintering can again breed the following spring. These questions can only be answered by the aquarium observations.

2. *Mysis flexuosa.*

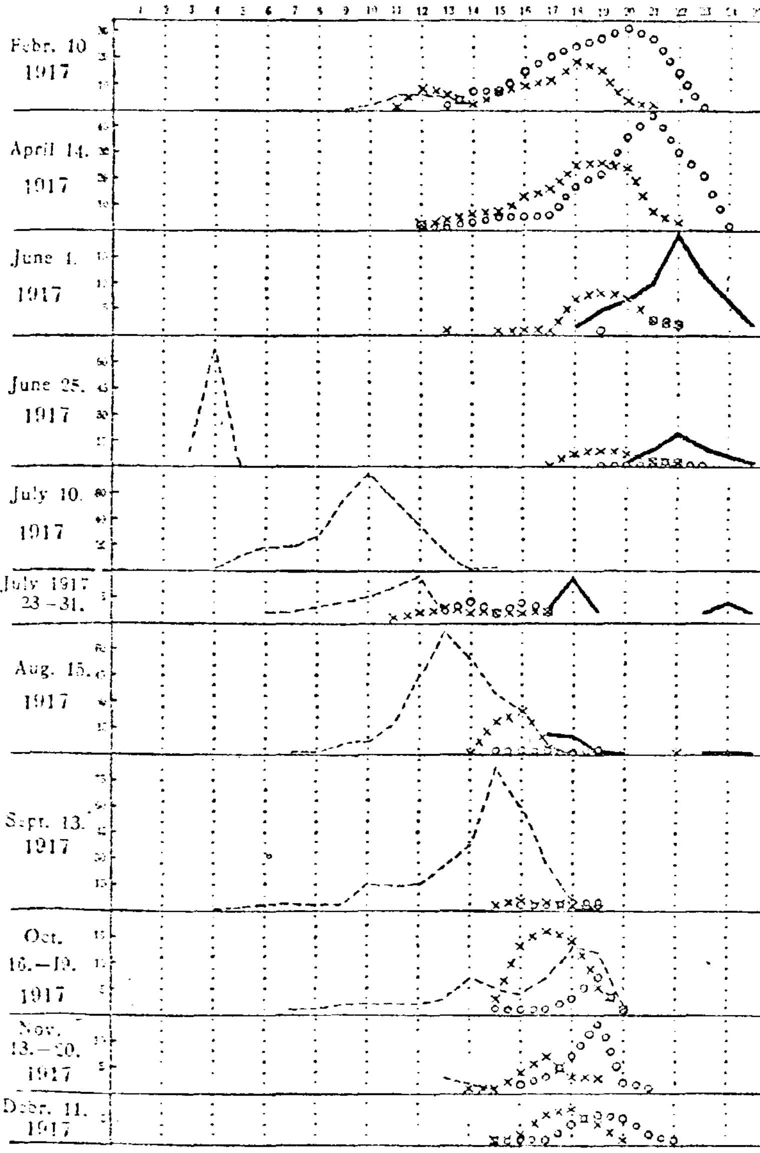
The measurements of this species, which is our largest *Mysis*-species, will be found in table 4 at the end of this book. Fig. 8 comprises a graphical representation of the measurements from the Nyborg Fjord during 1917. It will be observed that the conditions in this instance are about the same as in the case of *Mysis inermis.* In February there is a stock of mysids not yet mature, and of which the greater part can be determined in reference to sex. In March (table 4) the average length of the stock has increased, and there was only one individual of the measured 164, which could not be determined as to sex. In April the sex of the entire stock was determined, but none of the mysids had yet got eggs or young in their incubatory pouches. This did not take place before the month of May; in 1918 the first breeding ♀♀ were observed about May 9th, and on May 15th (see table 4) the most of the ♀♀ had eggs or young in their incubatory pouches, the remainder (13 of 33 ♀) had small incubatory lamellæ, and were therefore not yet mature; on May 18th 1916 only 2 of 36 ♀ had not reached maturity. In the beginning of June 1917 no young had yet been hatched and none of the many ♀♀ carrying young had fully developed young in their incubatory pouches; not before June 25th of the same year do we find a group of newly born mysids, and in this group it was not possible with any certainty to distinguish between *flexuosa* and *neglecta;* it was, however, certain that both species were included. Vastly different in size from this group we find the wintered mysids, which are in full breeding activity; only a very few of the ♀♀ have not yet reached maturity.

That each ♀ of *Mysis flexuosa* as well as of *Mysis inermis* breeds several times in succession was observed in the case of the many mysids, which carried young nearly ready for hatching in their incubatory pouches, and large and nearly ripe eggs in the ovaries; these eggs were of about the same size as the eggs in the incubatory pouch of the ♀♀ with newly laid eggs (abt. 1 mm in diameter in the ♀♀ of the winter-stock). With the *Mysis flexuosa*, which is often only slightly pigmented, the overial eggs are exceptionally easy to follow through their develop-

Fig. 8. Measurements of Mysis flexuosa.

Nyborg Fjord. 1917.

The ordinates are number of individuals, the abscissæ their lengths in mm.



Total number	♂ I G.	♂ I %	♂ II G.	♂ II %	♀ with eggs or young I G.	♀ with eggs or young I %	♀ with eggs or young II G.	♀ with eggs or young II %	♀ without eggs or young I G.	♀ without eggs or young I %	♀ without eggs or young II G.	♀ without eggs or young II %	young G.	young %
280. G. 17,83	16,65	29							18,70	63			11,82	8
327. G. 19,20	17,91	41							20,08	59				
102. G. 20,35	18,90	30			21,77	64			21,09	6				
173. G. 13,57	19,37	17			22,38	33			21,13	5			3,90	45
314. G. 9,61													9,31	100
83. G. 14,22			14,14	17	24,00	10	17,92	15			15,50	17	10,21	41
355. G. 14,25	22,00	0,3	15,63	12,7	23,80	1,5	17,69	7,5	22,00	0,3	17,10	2,7	13,32	75
338. G. 14,41			16,63	5			18,67	1			17,75	5	14,07	89
130. G. 16,62			17,15	40							18,20	12	15,31	48
53. G. 17,40			17,60	36							18,45	53	13,67	11
42. G. 18,31			17,67	50							18,95	50		

--- Young.
××× ♂
▬▬ ♀ with eggs or young in the incubatory pouch.
○○○ ♀ without „ „ „ „ „ „

G = Average size in mm.
% = Number of individuals in each group expressed in percentage of the entire stock.
I = Winter-stock.
II = Summer-stock.

ment, as owing to their refracting quality they are easily distinguished through the skin of the live animal. The ovaries of the ♀♀ carrying newly laid eggs in the incubatory pouch are only seen as indistinct stripes close below the back, but as the development of the eggs proceeds in the incubatory pouch, the eggs of the following brood become more and more distinct; when the eggs in the incubatory pouch have developed into young, the ovarial eggs in the meantime become so large that they form a large refractive mass in the fore part of the body, stretching from the lateral part of the masticatory stomach to the lateral edge of the thorax. The larger and more developed the young in the incubatory pouch are, the larger and more distinctly separated do the ovarial eggs appear. In ♀♀, the hatched young of which have just left the incubatory pouch, the ovarial eggs are so well developed, that they can be counted through the skin, and the number of eggs of the next brood can be predicted; the nucleus of the eggs are distinguishable as lighter spots.

On July 10th 1917 only young have been fished, there not happening to be any adults in the shoal, which was collected for investigation; that adult breeding individuals of the winter-stock are still to be found, will be seen from the other measurements in table 4 taken at about the same time of the year. The group of young has increased to an average size of no less than 5,7 mm since June 25th, and the largest individuals measure 15 mm; none of them are, however, mature yet, though several of the largest by means of the lens can be separated in ♂ and ♀. Already at about the end of July a large group of breeding ♀♀ is found, differing greatly in size from the breeding ♀♀ of the winter-stock. As in the case of *Mysis inermis* the only explanation of this is that they belong to the summer-stock, the largest individuals of which have grown into maturity; the breeding ♀♀ of the summer-stock average in length 17,92 mm, while the average length of the breeding ♀♀ of the winter-stock is 24,66 mm; the dying off of the breeding ♀♀ of the winter-stock and the fact that the ♀♀ of the summer-stock for the greater part have not hatched their first brood of young, are the natural causes of no newly hatched young being found in this sample.

In August the same two groups of mysids are found again, and of these the group of the winter-stock is about to disappear; the ♂♂, which have continually been inferior in number, are almost gone; in the sample from August 15th 1917 there is only 1 ♂ and 6 ♀ of the winter-stock left, while many of the summer-stock's ♀♀ without eggs in the incubatory pouch have now large eggs in the ovaries. In September all the individuals of the winter-stock have disappeared from the measurement lists, and there are only a few of the breeding ♀♀ of the summer-stock left. That many of these breed more than once in one breeding period was substantiated in the same manner as in the foregoing is described in reference to the winter-stock. Conforming with the smaller size of the breeding ♀♀ of the summer-stock, their eggs were also smaller than those of the winter-stock, viz. only $^3/_4$ mm in diameter. In October the breeding activity ceases; the stock grows and develops slowly throughout the winter, and in February it has reached the same stage, at which the winter-stock stood in February of the preceding year.

12 measurements, comprising altogether 1781 individuals collected from different other places than the Nyborg Fjord (the Limfjord, the Kattegat, the Isefjord, Kerteminde Bay and Svendborg Sound), show that *Mysis flexuosa* becomes larger in the

northern Kattegat and the Limfjord than in the Belts, but that the conditions otherwise are the same everywhere. In 1918 the first young appeared already in June by Hals, and in Svendborg Sound the largest young measured on June 23rd no less than 13 mm in length. From the Nyborg Fjord no measurements are published from June 1918, but from the journals I note that the first young were found in the *Zostera* during the first days of June, and that on June 18th the largest young measured 8 mm; in 1918 the young thus seem to have appeared somewhat earlier than in 1917.

The results of the measurement investigations of the *Mysis flexuosa* can briefly be put down as follows:

Mysis flexuosa is at the highest annual; the wintered stock dies off in the course of July and August every year. The breeding period lasts from the middle of May till some time in October, and lasts accordingly about a month shorther than the breeding period of *Mysis inermis*. The winter-stock breeds from the middle of May until it gradually dies off, the summer-stock from a little past the middle of July until some time in October. In 1918 the first hatched young appeared at about the beginning of June (the period of incubation lasted thus abt. 3 weeks), in 1917 they appeared a little later in the same month. The ♀ grows quicker and becomes larger than the ♂; the growth proceeds slowly during the winter and quickly during the summer. It will be observed from fig. 8 that the average size of the stock on October 16–19th was 16,62 mm, on April 14th 19,20 mm, which gives a growth of 2,58 mm in the course of 6 months, but from April 14th till June 25th, i. e. in the course of a little more than 2 months, the average size of the winter-stock increased from 19,20 mm to 21,88 mm, or about just as much. On July 10th, i. e. in the course of a little more than a month, the first-born young had reached a length of 15 mm; as the young measured 3,5 mm when born, they have grown 11,5 mm in this time. A little past the middle of July the first-born young have reached maturity, the ♀♀ at a size of 18 mm, the ♂♂ at a somewhat smaller size. The young reach thus maturity in the course of about $1^1/_2$ months. Similarly with the young of *Mysis inermis* many of the ♀♀ of the summer-stock as well as of the winter-stock breed more than once during the same breeding period.

There is, however, an essential difference between the curves of growth relating to the *Mysis inermis* and *Mysis flexuosa*. In the case of *Mysis inermis* a new and large group of young appeared in August and September as a result of the breeding activity of the summer-stock, while the average size of the stock was considerably reduced (see fig. 7). In the case of *Mysis flexuosa*, however, there is no sign whatever of a mass-production of young. There may be in both August and September a few single small young, but they do not differ from the older individuals as to form a separate group and are of no importance in relation to the many large and immature individuals of the summer-stock, which without doubt are the offspring of the winter-stock. The average size of the stock as a whole (see fig. 8) being unaffected by the appearance of young, increases from July till the month of June in the following year, when the new young appear. Comparing this with the fact that *Mysis flexuosa* breeds later than *Mysis inermis*, and that the young require longer time in reaching maturity, the conclusion is obvious that a considerably larger part of the summer-stock of *Mysis inermis*, perhaps all the young born by the winter-stock, are able to breed before the winter, whereas this refers to only a smaller number of *Mysis flexuosa*, perhaps only the very first broods.

This question will be treated further in the report of the aquarium observation.

3. *Mysis neglecta.*

The measurements of this species are given in table 5; the measurements from the Nyborg Fjord during the year 1917 are given in graphical form in fig. 9 as an extract from table 5. As the conditions of this species remind very much of *Mysis flexuosa*, I shall not treat the curves and tables in detail, but directly state the results, which may be derived therefrom.

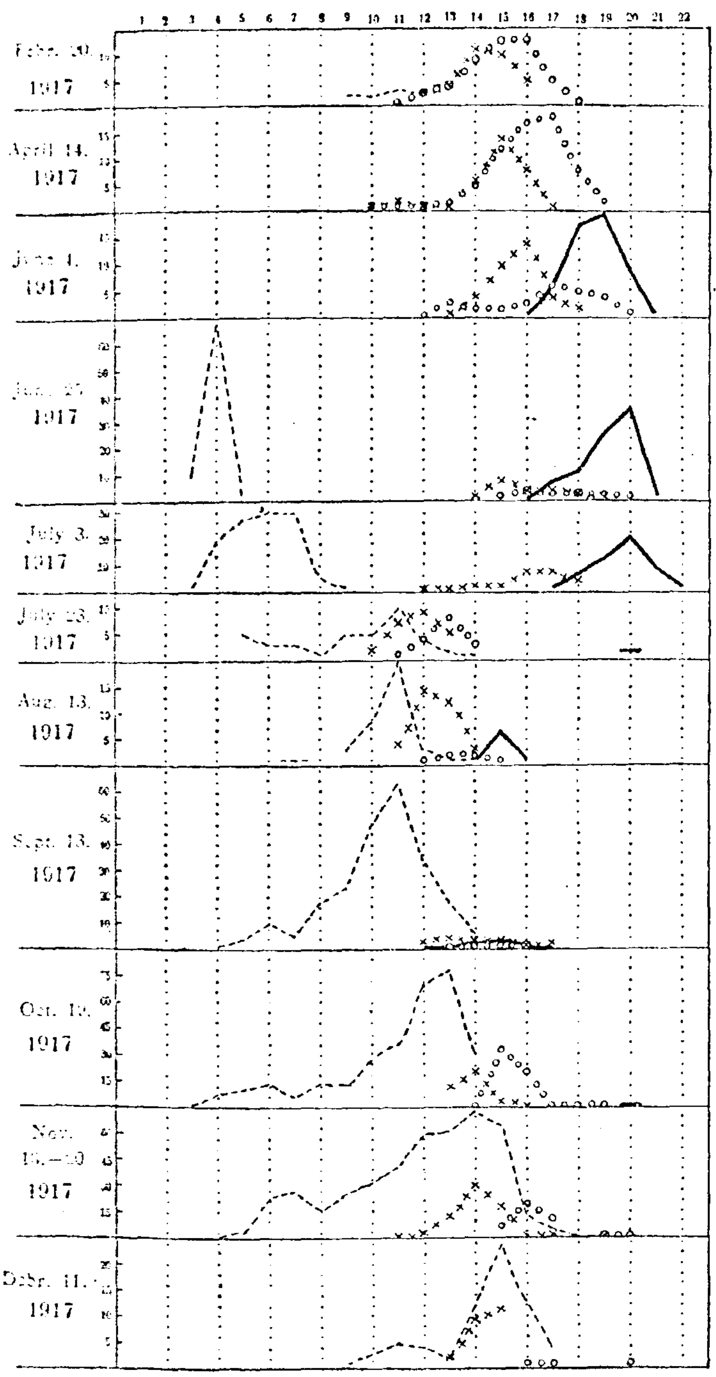
It will immediately be seen that *Mysis neglecta* like the other mysid species is annual; the winter-stock dies off during July and August, even though single individuals may be met with as late as October (fig. 9; see also table 5, Sept. 27th 1916). The winter-stock reaches maturity at the end of May and the beginning of June. On June 4th 1917 there were found among 55 ♀ with eggs, only 10 individuals with embryos (without pigmented eyes and thus only a few days old), the remaining having quite newly laid eggs. They continue to breed until they gradually all die off in the course of July and August; the young appear about the end of June; the newly hatched young measure about 3 mm, but already on July 3rd the largest of this group measure 9 mm in length, and in the last days of July the largest have reached maturity at a size of 16 mm (♀) and 15 mm (♂). The ♀♀ of the winter-stock as well as of the summer-stock breed several times, as might be seen by the well-developed ovarial eggs in the animals carrying eggs. The period of breeding ceases at the end of October. In the Limfjord this species is a little larger than in Nyborg Fjord; in 1918 newly hatched young were found in the Limfjord already at the end of May and in the beginning of June.

According to the above, *Mysis neglecta* breeds much later in the year than *Mysis flexuosa*, and similarly with this species all the young born by the winter-stock do not seem to reach maturity the same year in which they are born. Owing to the appearance of the newly hatched young, there is certainly (see fig. 9) a slight decline in the average size of the entire stock from August till September, but there does not appear, as the case was with the *Mysis inermis*, a new large group of young in the autumn as a result of the breeding activity of the summer-stock. This matter will, however, be treated later on.

Fig. 9. Measurements of Mysis neglecta.

Nyborg Fjord, 1917.

The ordinates are number of individuals, the abscissæ their lengths in mm.



Total number	♂ I G.	♂ I %	♂ II G.	♂ II %	♀ with eggs or young I G.	♀ with eggs or young I %	♀ with eggs or young II G.	♀ with eggs or young II %	♀ without eggs or young I G.	♀ without eggs or young I %	♀ without eggs or young II G.	♀ without eggs or young II %	young G.	young %
91. G. 14,28	14,33	35							14,92	55			10,76	10
101. G. 15,50	14,59	34							15,96	66				
117. G. 17,22	15,63	30			18,80	47			16,44	23				
203. G. 12,89	16,05	11			19,10	42			17,22	9			3,90	38
192. G 11,07	16,08	12			19,69	29							5,81	59
80. G. 11,00			11,74	29	20,00	2,5					12,81	20	9,38	48,5
85 G 12,01			12,42	39			15,00	11			13,50	7	10,73	43
258 G. 10,78			13,85	5			14,92	5			14,59	2	10,30	88
422. G. 12,08			13,80	8,3	20,99	0,2					15,62	14	11,21	77,5
550. G. 12,42			14,14	12							16,26	7	11,83	81
93 G. 14,43			14,41	24							17,67	3	14,29	73

--- Young.
××× ♂
▬ ♀ with eggs or young in the incubatory pouch.
○○○ ♀ without „ „ „ „ „ „

G = Average size in mm.
% = Number of individuals in each group, expressed in percentage of the entire stock.
I = Winter-stock.
II = Summer-stock.

Aquarium Observations.

The majority of these observations are made in the glass aquaria described earlier, and in which there was water from the Nyborg Fjord containing some fine algæ; the mysids were fed with fresh *Mytilus*, which were removed from their shells and cut into small pieces. To begin with the newly hatched young seemed only to live on Detritus, which always gathered at the bottom of the aquaria; but when they reached a size of 6–7 mm they eagerly partook of the meat-food. This they generally devoured by seizing a little piece of the meat with their mouthparts and front pair of peræopods, and with a strong backward spring removed it from any piece attached to it; floating in a vertical position in the water and still holding the meat with the front pair peræopods, they could devour the meat in peace.

The supervision of the aquaria was carried out in the following manner: The mysids were first fished out and then placed in a small jar, from which they were taken up and placed one by one on a watch-glass containing a little water and placed under a binocular microscope; the degree of development of the ovaries and the eggs or young in the incubatory pouch could thereby easily be examined, as the thin and most often only slightly pigmented thorax and incubatory lamellæ of the mysids are very transparent. In opposition to *Gammarus locusta* the mysids are difficult to keep alive in the aquaria, and it is still more difficult to make them breed there. Though in each experiment several fully developed ♂♂ were placed in the aquaria for each adult ♀, many unsuccessful attempts had to be made, before I succeeded in getting a single ♀ to breed, as the following will show.

As mentioned in the chapter on measurement investigations, it is also possible with reference to the mysids to distinguish between a w i n t e r - s t o c k, which breeds in the spring and then dies off during the summer, and a s u m m e r - s t o c k, comprising all the young born in the course of the spring and summer. For this reason a distinction is continually made in the following between these two categories, whereby the material is easier to survey.

1. *Mysis inermis.*

In the table given below the results of the aquarium observations of *Mysis inermis* are gathered. They comprise several experiments, partly with ♀♀ of the winter-stock and partly with ♀♀ of the summer-stock. Where the experiment includes only a single individual, the columns „eggs", „young without eyes", „young with eyes" and „empty" are supplied with dates, referring to when the individual in question was found with eggs, young without distinctly pigmented eyes, young with distinctly pigmented eyes in the incubatory pouch, or with empty incubatory pouch respectively. Where the experiments comprise several individuals, the dates are arranged to the left, and the number of ♀♀, which on the day in question had eggs, young without eyes etc. in the incubatory pouch, is placed in the respective column opposite to the date stated. It must, however, be particularly mentioned that the dates given are not always expressions of the rate of development of the eggs or the young in the incubatory pouch. Such is only the case with the experi-

Mysis inermis.

Winter-stock.

Exp.	Date	Eggs	Young without eyes	Young with eyes	Empty
Exp. I 1918		2/5	10/5	—	—
Exp. II 1918		— 4/5	— —	— —	2/5 14/5
Exp. III 1919		— 6/6	— —	31/5 —	6/6 —
Exp. IV 1919		— 23/6	— —	21/6 —	23/6 —
Exp. V 1918		2/5 24/6	11/5 —	21/5 —	28/5 1/7
Exp. VI 1917	6/6	1	—	2	—
	11/6	1	1	1	—
	13/6	1	1	1	—
	15/6	2	—	1	—
	17/6	1	1	—	—
Exp. VII 1917	7/6	1	—	—	1
	13/6	2	—	—	—
	16/6	2	—	—	—
	20/6	1	1	—	—
	23/6	—	—	—	2
Exp. VIII 1917	21/6	—	—	4	—
	26/6	—	—	1	2
	28/6	3	—	—	—
	30/6	3	—	—	—
	10/7	—	—	1	1
	17/7	1	—	—	1
	25/7	1	—	—	—
Exp. IX 1917	22/6–25/6	7	—	—	—
	27/6	—	6	—	—
	3/7	—	—	5	—
	9/7	4	—	—	1
	16/7	—	—	—	2
	21/7	—	—	—	1
Exp. X 1917	22/6	—	—	15	—
	25/6	7	—	6	—
	27/6	9	—	—	—
	3/7	—	5	1	—
	9/7	1	—	3	—
	16/7	—	2	—	—
	21/7	—	—	1	1
	4/8	—	—	—	2

Summer-stock.

Exp.	Date	Eggs	Young without eyes	Young with eyes	Empty
Exp. XI 1919		2/7 18/7 25/8 15/9 11/10	7/7 23/7 — 21/9 17/10	12/7 30/7 — 29/9 25/10	18/7 5/8 2/9 8/10 31/10
Exp. XII 1918		10/7 31/7 16/8	— — —	— — —	? 5/8 30/8
Exp. XIII 1918		—	—	23/9	12/10
Exp. XIV 1917	28/7	10	10	—	—
	4/8	5	—	12	—
	11/8	4	2	2	8
	21/8	2	—	4	—
	2/9	—	—	3	2
Exp. XV 1917	2/9	1	2	2	?
	12/9	3	—	1	6
	22/9	1	4	—	4
	28/9	1	2	—	5
Exp. XVI 1918	17/6	—	—	—	5
	1/7	—	—	—	4
	22/7	1	—	—	1
	31/7	1	—	—	—
Exp. XVII 1917	2/7	—	—	—	4
	10/7	3	1	—	—
	17/7	2	1	—	1
	25/7	1	—	—	3
	4/8	1	—	—	1
	11/8	1	—	—	1
	20/8	1	—	—	1
	1/9	—	1	—	1
	10/9	—	—	1	—
	22/9	—	—	—	1

ments made in 1910; they were made in small glass jars, which could be carried about and attended to daily on board the Station's steamer. All the other experiments were made in aquaria ashore, which could not be attended to every day; owing to this the tables of these experiments most often only give information of the conditions on such and such a day, compared with the last supervision of the aquaria. The cause of the number of individuals in many of the experiments being reduced so quickly is due to the above mentioned high rate of mortality in the aquaria.*)

The Results of the Aquarium Observations on *Mysis inermis.*

It is obvious that great care must be taken when transmitting conclusions drawn from the aquarium observations to the conditions of the free nature; but the numerous conformities between the aquarium observations and the measurement investigations, tend to prove the probability that the general results of the aquarium observations may refer to the actual conditions of the free nature too. This is therefore taken into consideration in the following.

As mentioned in the chapter of the measurement investigations the questions to be solved by the aquarium observations were: the duration of the period of incubation, how often each ♀ could breed, the growth of the young, the number of generations and finally whether or not the breeding mysids of the summer-stock can live throughout the winter and resume breeding the following spring. As to the first question, the measurement investigations showed that the hatching of the broods born earliest in the year lasted about one month. The aquarium observations conform hereto; thus Experiment V shows that a brood of young, produced from eggs laid about May 2nd, did not leave its mother's incubatory pouch before about May 28th. According to experiments I and V the development from egg to young without pigmented eyes lasted at this time of the year about 8 to 9 days**) and another 10 days elapsed before the young obtained pigmented eyes; furthermore a week passed by before they left their mother's incubatory pouch. Later on in the summer the development proceeds much quicker. Experiment VI shows thus

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*) A detailed account of how the aquarium observations proceeded will be found in the Danish edition of this book (p. 82–87).

**) It must be remembered that when a mysid is caught in the free nature with e. g. eggs in its incubatory pouch, and thereupon placed in an aquarium, one does not know to a certainty of one or two days, how long ago the eggs have been laid, as usually it is impossible through the incubatory lamellæ to substantiate the stage of cleavage in which the eggs are. It being of importance to get as viable mysids as possible in the aquaria, the only thing to be done without injuring the animal, is to convince oneself by means of a binocular microscope as to whether the incubatory pouch contains 1) eggs, 2) young without pigmented eyes, 3) young with pigmented eyes or 4) is empty. Whether the eggs are at the beginning or at the end of any of these stages it is most often impossible to judge from such a quick investigation; this can only be determined by observing the development in the aquaria. In cases where it is expressively stated that a mysid has newly laid eggs this statement is based upon the eggs being tranparent and spherical, which experience has proved always to be the case with newly laid eggs.

that in early June only 5 days elapsed between each of the 3 development stages, which results in a period of incubation of about 17 days; and according to experiment VIII a ♀, which carried eggs for at least the second time on June 28th, got eggs again just before July 17th, given a period of incubation of 19 days. Experiment IX shows a period of 6 days between each stage of development and a period of incubation of 17 days, viz. from June 22nd to July 9th; finally experiment X gives in the case of one individual a period of incubation of only 14 days, viz. from June 25th till July 9th. Reverting to the summer-stock, experiment XI gives the exact dates of the time of development from egg to young from the beginning of July till late October. The first brood was hatched in the course of 16 days, 2nd brood in 18 days; from 3rd brood no young were produced, but 4th brood of eggs was laid 21 days after 3rd brood and the hatching of 4th brood lasted no less than 23 days, and the hatching of 5th brood 20 days. In accordance herewith 5, 5 and 6 days respectively elapsed between each stage of development of the eggs and young in the first half of July, 5, 7 and 5 days in the last half of July and the first half of August, but 6, 8 and 9 days in the end of September and 6, 8 and 6 days in October. Experiment XIII shows that during September—October even 2 weeks can elapse before the young, which have already pigmented eyes, are ready to leave the mother's incubatory pouch.

With *Mysis inermis* the duration of the period of incubation is thus dependent upon the season, as in the warm summertime the young are hatched in the course of a little more than 2 weeks, but in the spring and autumn not before 3—4 weeks have elapsed after the eggs are laid.

In reference to how often each ♀ can breed, the aquarium observations of the winter-stock show several instances, where one or more mysids have bred twice, wiz. experiments II, III, IV, V, VI, VII and IX. In two other experiments, VIII and X, some of the mysids were seen to bred three times in succession. According to experiment XV some mysids of the summer-stock breed twice and others (experiments XII, XIV and XVII) three times, but experiment XI shows an instance where one ♀ produced no less than five broods. In accordance with the fact that in the free nature mysids with empty incubatory pouch are very seldom met with, the aquarium experiments show that the mysids most often got a new brood of eggs in the incubatory pouch immediately after the young of the preceding brood had left it. Only in experiments V and XI a longer time elapsed between the hatching of the young and the subsequent oviposition, viz. 26 and 20 days respectively, or about the same time, which at that time of the year is required to ripen a new brood of eggs in the ovaries. For this reason it may be concluded that the brood of eggs, which normally should have been laid immediately after the hatching of the young, has for some reason or other died, and a whole period of incubation had to elapse before a new brood of eggs could ripen in the ovaries. Looking at the matter in this light, there should be nothing to prevent a ♀ of the summer-stock in breeding 6 times in succession, as e. g. the ♀ in experiment XI got eggs five times and that a whole period of incubation passed between the 2nd and 3rd laying of eggs. Unfortunately I had no success in substantiating this number of ovipositions with any of the mysids, though several trials were made, and for this reason I consider in the following 3 successive ovipositions as regards the winter-stock and 5 successive ovipositions as regards the summer-stock, as being maximum. Within these limits it holds good to as well the summer-stock as the winter-stock that the earlier in the year the mysids reach maturity, the greater is the number of broods they are able to hatch. According to the measurement investigations a number of the ♀♀ of the winter-stock cannot normally breed more than twice, because several of the ♀♀ of this stock have not yet reached maturity in late June; as the winter-stock by the end of July has practically died off, the most of these individuals can at the highest produce 2 broods of young before they die.

Regarding the growth of the young, the aquarium observations supply various information, which is indicated by the curves of growth given below (fig. 10). The occuring uneveness of some of these curves is due to the fact that the increase in length of the mysids, as will be known, only takes place at the time of moulting, and the growth should therefore really be represented by several horizontal curves connected with vertical curves, whereby each curve of growth would form a step-formed ascending curve. As, however, the separate measurements of the mysids were carried out at irregular intervals and without reference to the moultings, these measurements are just set off on fig. 10, and the points obtained thereby are connected with straight lines. The curves obtained by this proceeding do therefore not give a quite exact picture of the growth, but the deviations are not great, especially where the measurements are taken at short intervals of time. It must also be taken into consideration that the measurements, related as they are to live animals, which might not be injured, cannot claim absolute exactness; they are, however, quite serviceable for mutual comparisons. The curves of growth of the mysids, which reached maturity in the aquaria, are continued with thick lines from the time the animals commenced breeding.

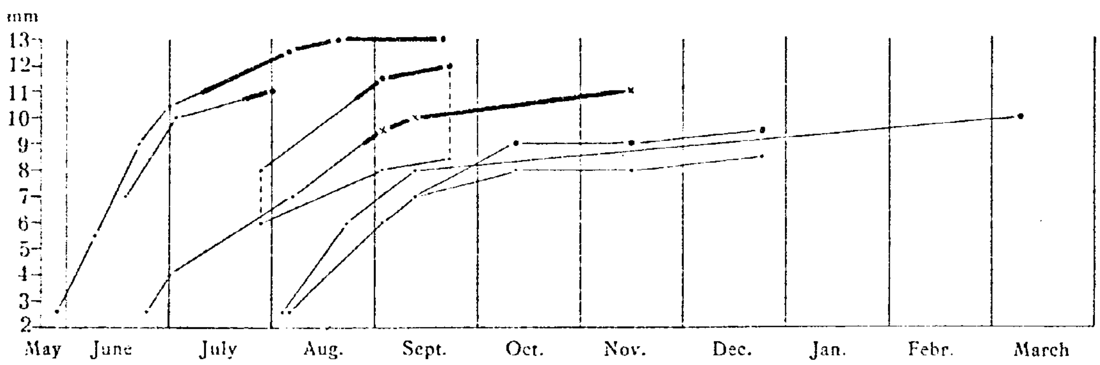

Fig. 10. Growth of *Mysis inermis* in aquaria.

Young.
♂, mature.
♀, not mature.
♀, mature.

The curve farthest to the left indicates the growth of a mysid, hatched in aquarium on May 28th 1918. It proved to be a ♀, which reached maturity, at a length of about 11 mm, on July 10th or hardly 1½ month after being hatched. It bred three times and died in September of the same year at a length of 13 mm (mentioned in experiment XII). The curves of the 4 ♀ mentioned in experiment XVII (not included in the figure) coincide with those of the mysid just mentioned, as upon being placed in the aquarium on July 2nd they measured 10–11 mm and on August 4th of the same year 12 mm; they must be considered as having been born about simultaneously with this mysid, and they commenced breeding at about the same time viz. about July 10th. The results obtained by the measurement investigations are thus confirmed, as these results state that the individuals born in the earliest part of the year (late May) reach maturity in the course of about $1^1/_2$ months. The growth of the mysids conform too very well with the measurements (see page 66); only during the months of July and August the growth of the ♀♀ of the summer-stock in the free nature at the same time of the year proceeded somewhat quicker. — The curve immediately below the former and which commences on June 17th indicates the growth of the largest of the mysids mentioned in experiment XVI; it will be noted that this mysid, which, according to the curve of growth, must have been born a little later than those mentioned above, also reached maturity a little later than these, viz. on July 22nd. — Another curve of growth commences on June 23rd, at which time a brood of young was born in the aquarium (experiment IV). On July 1st there were altogether 9 young from this brood, all measuring 4 mm in length, but in the course of July and August the 6 died, and on September 12th another one, measuring $8^1/_2$ mm, died; there remained thus only 2, both of which were ♂. These 2 ♂ lived until November 15th of the same year, when they had reached a length of 11 mm. As the curves show, this brood grew slower than the brood of May 28th, and not before the end of August, i. e. two months after the hatching, did the largest of the mysids reach maturity. — Conforming herewith a number of young, placed in an aquarium on July 27th at a length of 6–8 mm, the curves of growth of which will be seen in fig. 10, being connected by means of dotted lines, reached maturity on August 25th. It must be assumed that they were hatched at about the same time as the earlier mensioned mysids. — The last two curves show the growth of mysids born in aquarium on August 3rd and 5th respectively; none of these mysids reached maturity. The curve which commences on August 5th indicates the growth of a brood of young numbering 6 individuals, all born on the date stated (experiment XI). On October 11th the largest of these young measured 9 mm; though they were still undeveloped, they could be determined as ♀; the smallest one measured 8 mm and could not be determined as to sex. On November 15th the conditions were the same, but before December 23rd the two last individuals had died off; the one of these was an undeveloped ♀ measuring $9^1/_2$ mm, the other a young measuring $8^1/_2$ mm. The other curve indicates the growth of a ♀ born in the aquarium on August 3rd 1917 (experiment XIV); it lived through the winter in the aquarium and died in the beginning of March 1918 at a length of 10 mm, but had as yet only quite small incubatory lamellæ; it will be noted that the growth was much slower during the winter than during the summer.

Thus fig. 10 shows that the growth proceeds quicker with the young born early in the year than with those born at a later date, and furthermore that the latter reach maturity quicker than the first named.

We have now certain holds from which to judge the question regarding the number of generations that *Mysis inermis* produces annually. Designating the young born by the winter-stock as Generation I, it can be proved that most of the mysids of this generation reach maturity before the summer is over. We saw that each ♀ of the winter-stock breeds at the most 3 times, and as the breeding period commences already at the end of April, all the 3 broods of one of the early breeding mysids could be hatched before the end of June; in the above we saw furthermore that mysids, which were born on June 23rd, reached maturity before the winter. However, several females of the winter-stock continue breeding some time in August, and of course the latest born young of these do not reach maturity before the winter; but as the main portion of the winter-stock has already died off in the beginning of July, it will be understood that by far the greatest number of Generation I are able to produce young before the winter. The earliest born young of Generation I appear about the end of May and reach maturity in the beginning of July of the same year; their first brood of young (Generation II) appears a little past the middle of July (experiment XI). Unfortunately it has been impossible, notwithstanding several attempts, to keep a brood of young, born at this time, in the aquaria; but as it has been proved that the young, which were born as early as June 23rd, did not reach maturity before the end of August, and that furthermore the time till maturity was reached as well as the duration of the period of incubation lasted the longer as the autumn approached, it can safely be assumed that only a very few, viz. the earliest born mysids of Generation II, will be enabled to produce new young (Generation III), before the breeding period ceases about the end of October. In accordance hereto it was observed that the earliest born individuals of Generation II did not reach maturity before the winter.

Thus no more than 3 generations can come into consideration, and the question now arises as to whether the breeding individuals of the summer-stock may live throughout the winter and resume breeding the following spring. In the aquarium observations mentioned hitherto, I have not succeeded in maintaining any of the breeding mysids of the summer-stock alive throughout the winter; the most of them died before, and the remainder a short time after the breeding period had ceased. Only in the aquarium observations mentioned page 94, comprising a stock of mysids of the summer-stock, did I succeed in proving that some *Mysis flexuosa* (and probably also at least one *Mysis neglecta*), after breeding at the end of the breeding period in 1917, lived through the winter and commenced breeding again in the following spring. It must therefore be assumed that also *Mysis inermis*, the biological conditions of which are so closely related to the other two species, is able to do so too. The greater part of the individuals, which breed earliest in the spring (the largest), are without doubt such wintered mysids that already once before have been breeding, viz. at the end of the preceding breeding period, whereas the individuals of the winter-stock, which breed later in the year, are the mysids born at the end of the preceding breeding period, and which therefore did not reach maturity before the winter. Only a very small percentage of the mysids have the opportunity to breed in two breeding periods, this being evident from the fact that only a very few of the ♂♂ are found during the winter months with fully developed pleopods of the 4th pair; for it is not probable that a ♂, which once had well developed pleopods, should loose these again, and in the aquaria such cases have never been observed.

I have never succeeded in observing the mating process of the mysids,*) though I have often kept mature mysids under observation for hours; probably it lasts only a very short time, and furthermore I believe it takes place during the night. When many mature ♂♂ were kept together in an aquarium, it could be observed in the morning that with some of them the spermatozoa were seen hanging like a fine thread from each of the two processes into which the *vasa deferentia* terminate. The elongated pleopods of 4th pair so characteristic for the mature ♂♂ are generally assumed to be mating organs; but about this we, too, still know nothing. As with *Gammarus locusta* the ♀♀ moulted with every new oviposition,

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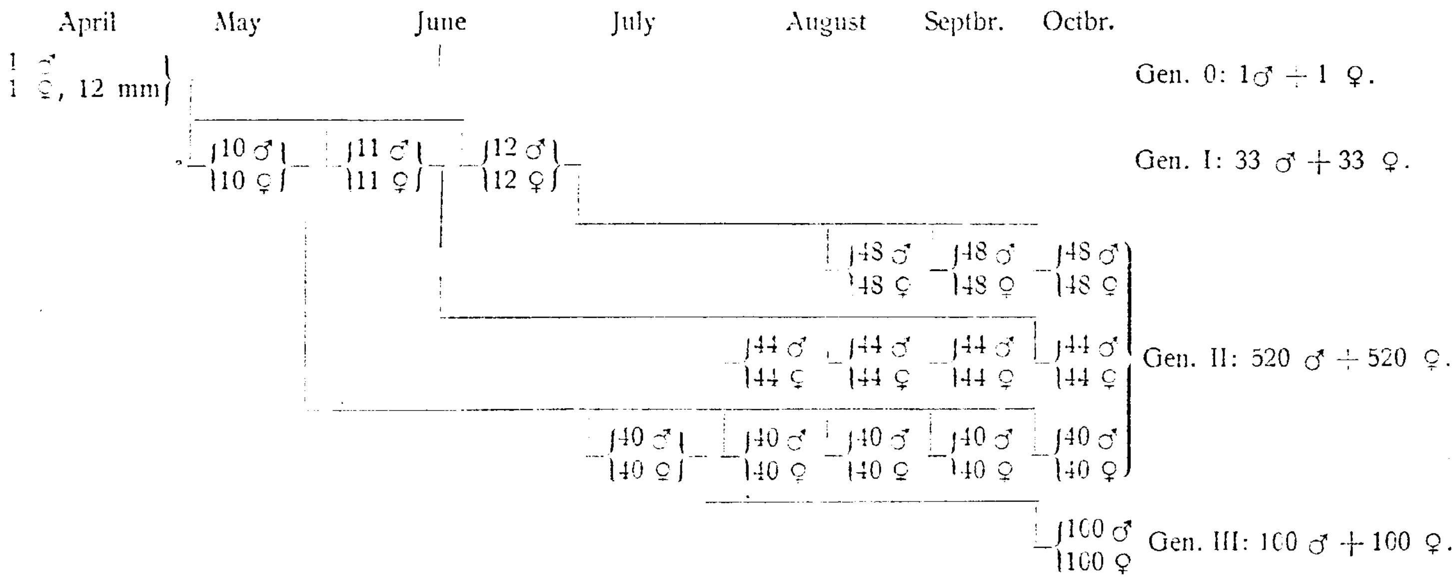
*) Van Beneden (3, p. 23) says: *„Les mysis s'accouplent et la fécondation des oeufs a lieu dans l'intérieur du corps de la femelle"*, but unfortunately he gives no further informations about this most interesting subject.

i. e. with a shorter or a longer period between each moult according to the season In conformity with the growth being quicker with the young mysids than with the older ones, the moulting takes place more often with the young than with the adults, but the cast cuticles are often consumed immediately after the moult, making it very difficult to control. The cast cuticles were usually split along the posterior and lateral edges of the thorax; through the opening thus formed the mysid has evidently released itself from its old skin.

The number of young each ♀ produces is dependent partly upon the size of the mother-animal (Apstein (2)) and partly upon the season; thus the results of a number of countings on eggs and young from the incubatory pouch of *Mysis inermis* collected in Nyborg Fjord were as follows:

The length of the mother-animal:	9 mm	10 mm	11 mm	12 mm	13 mm	14 mm	15 mm
$^{1}/_{6}$ 1917				$20_{,5}$ (6)	$22_{,4}$ (6)	$23_{,2}$ (6)	
$^{25}/_{6}$ "					$22_{,8}$ (6)	$23_{,7}$ (6)	28 (1)
$^{13}/_{8}$ "	$7_{,8}$ (6)	$8_{,1}$ (6)	$9_{,7}$ (6)	$11_{,2}$ (4)	14 (2)		
$^{30}/_{8}$ "	$5_{,5}$ (6)	$7_{,8}$ (6)	$9_{,2}$ (6)		12 (1)		
$^{16}/_{10}$ "		$5_{,2}$ (5)	$5_{,6}$ (5)		10 (1)		

The figures of this table show the average number of eggs or young found in the incubatory pouches; the figures in brackets state the number of individuals examined. It will be observed that the number of eggs and young within the same date increases with the length of the mother-animal, but within the same length decreases more and more from June till October. To form an idea of the



Generation I—III total: 653 ♂ + 653 ♀ = 1306 individuals.

production, which one pair of *Mysis inermis* in the most favourable case can produce in the course of a breeding period, a similar scheme as with *Gammarus locusta* can be made, the hypothetical character of which must again be emphasized.

In the above scheme Generation 0 indicates one pair of early breeding mysids of the winter-stock; they get 3 broods of young from the end of May till the end of June: assuming that the ♀ to begin with measures 12 mm, the first brood amounts to 20 young (see the table p. 79). According to the measurement investigations the mother-animal may in the beginning of June be assumed to have grown to 13 mm, for which reason the second brood, which is born in the middle of June, amounts to 22 young, and the third brood born in the end of June, when the mother-animal measured 14 mm, amounts to 24 young. Generation I consists thus of three broods of young or 66 mysids altogether. Assuming the half of the hatched mysids to be ♂♂ and the other half to be ♀♀, the 10 ♀ of the first brood of Generation I will in the course of July—October each get 5 broods of young; if in using the table p. 79 we reckon that on an average 8 young are born in each of these broods, the production of the first brood of Generation I will amount to 5×80 mysids. The 11 ♀ of the second brood of Generation I, born a period of incubation later that the first brood, will at the most not get more than 4 broods of young, each brood of 8 individuals, or 4×88 mysids altogether, before the breeding period is over. The 12 ♀ of the third brood of Generation I get in the same manner only 3 broods of young, each comprising 8 individuals, or 3×96 mysids altogether. Generation II totals thus 1040 mysids, but of these only the broods born in July and which comprise 40 ♀, can be assumed to reach maturity and be able to breed before the breeding period ceases. Assuming that these measure 9—10 mm in length when maturity is reached, they will each get 5 young about the end of October, whereby Generation III will comprise altogether 200 mysids.

The production of a pair of *Mysis inermis* will in the course of one breeding period at the highest comprise 66+1040+200=1306 individuals, even if they all live until the end of the breeding period. In reference to the ♀♀, which though belonging to the winter-stock do not reach maturity before late June (see page 76) and therefore only get 2 broods of young each before dying off, it can in the same manner be reckoned that they at the highest produce 442 individuals (2 generations) before the breeding period ceases.

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2. *Mysis flexuosa.*

A general view of the aquarium observations is included in the table given below. The remarks stated page 72 relating to the table of observations on *Mysis inermis*, refer to this table as well. A further account of these observations will be found in the Danish edition of this book, pages 93—97.

Mysis flexuosa.

Winter-stock.

	Eggs	Young without eyes	Young with eyes	Empty
Exp. I 1918	—	—	—	2/5
	9/5	—	21/5	—
	9/6	—	—	1/7
	10/7	—	—	—
Exp. II 1918	—	—	—	2/5
	19/5	27/5	5/6	12/6
Exp. III 1919	—	31/5	4/6	10/6
	11/6	16/6	26/6	3/7
	3/7	8/7	18/7	23/7
Exp. IV 1919	—	—	31/5	9/6
	11/6	—	—	—
Exp. V 1917 7/6	2	—	—	—
13/6	—	2	—	—
16/6	—	1	1	—
19/6	—	—	2	—
22/6	—	—	1	—
23/6	—	—	—	1
Exp. VI 1917 21/6	2	—	—	—
23/6	1	1	—	—
28/6	—	2	—	—
2/7	—	1	1	—
9/7	1	—	—	1
17/7	—	1	—	—
Exp. VII 1917 22/6	—	4	—	—
27/6	—	2	2	—
3/7	—	—	3	1
9/7	3	—	—	—
16/7	—	2	—	—
21/7	—	—	2	—
11/8	1	—	—	—
Exp. VIII 1917 22/6	4	—	—	—
27/6	—	4	—	—
3/7	—	—	4	—
9/7	3	—	—	—
16/7	—	2	—	—
21/7	—	—	2	—
4/8	1	—	1	—

Summer-stock.

	Eggs	Young without eyes	Young with eyes	Empty
Exp. IX 1919	—	—	—	10/7
	14/7	—	—	—
Exp. X 1919	—	18/8	24/8	4/9
Exp. XI 1917 11/8	2	3	5	—
15/8	1	5	4	—
20/8	4	5	—	1
1/9	—	7	—	3
10/9	—	—	5	4
15/9	—	—	1	8
18/9	—	—	—	9
22/9	—	—	—	8
28/9	—	—	—	7
29/11	—	—	—	2

The Results of the Aquarium Observations on *Mysis flexuosa.*

The questions which the aquarium observations on *Mysis flexuosa* should treat are essentially the same as set forth in the results of the observations on *Mysis inermis.*

The duration of the period of incubation was also here dependent upon the season. The measurement investigations showed that the first young appear in the beginning of June, and that the hatching of these lasted about 3 weeks. Experiment I shows, in accordance herewith, that a brood of eggs laid on May 9th, developed into young with pigmented eyes in the course of 12 days, and experiment IV that in the course of 10 days such young were able to leave the incubatory pouch; the period of incubation lasted thus altogether 22 days; Experiment II shows that another brood of eggs laid on May 19th was hatched to free-living young in the course of 24 days. The best information regarding the duration of the period of incubation is gained from experiment III, which shows the stages of eggs and young in a ♀, caught on May 31st in the free nature, and which in its incubatory pouch carried young with pigmented eyes. Already on June 4th these young had fully pigmented eyes and left the mother-animal's incubatory pouch on June 10th. Comparing these two last dates with the corresponding dates in experiment II, it will be noted that the ♀ in experiment III must have got its first brood of eggs about May 17—18th, which gives a period of incubation lasting 23—24 days; the next brood of eggs had a period of incubation lasting 22 days, and the third brood 20 days. It will also be observed that the development from egg to young without pigmented eyes lasted 5 days, from young without pigmented eyes to young with pigmented eyes 10 days, and from young with pigmented eyes to free-living young 5—7 days. Experiment V gives seemingly a period of incubation of only 16 days, viz. from June 7th till June 23rd, but the eggs have evidently not been newly laid when the mysid was placed in the aquarium; the same refers to experiments VI and VIII, where the periods of incubation, according to the table, are only 19 and 18 days respectively at the most; in this instance a couple of days must be added in order to obtain the correct period of incubation. In experiments VII and VIII on the other hand the hatching of the second brood of eggs was delayed noticeably, the period of incubation lasting at least 26 days, viz. from July 9th till August 4th; it is especially the development from young with pigmented eyes to the free-living young which has lasted unusually long, viz. 14 days; in experiment III, 3rd brood, this development only lasted 5 days. Experiment XI shows that in August and September the hatching of young also lasted a considerable time. The ♀♀ No. 1 and No. 2 (see Danish edition page 96), which on August 11th carried eggs, had thus 21 days later, on September 1st, only young without pigmented eyes in their incubatory pouches; even when reckoning that on the following day, September 2nd, the young had reached the next stage, i. e. had become young with pigmented eyes, at least 5 days must elapse, according to the foregoing, before they can leave the mother's incubatory pouch, and this gives a period of incubation of altogether 27 days; ♀ No. 6, which carried newly laid eggs on August 15th, hatched young of this brood in the days between September 10th and 15th, the period of incubation being at the least 27 days and the most 31 days; nor had

♀♀ Nos. 7—9, which got eggs between August 15th and 20th, hatched this brood of eggs before the days between September 10th and 15th, which gives a period of incubation of at the least 22 days, at the most 31 days. Finally ♀ No. 10 was empty on August 20th, but had ripe eggs in its ovary; it has probably 1 or 2 days later got eggs in its incubatory pouch, which corresponds very well with the fact that on September 1st it had young without pigmented eyes, and on the 10th of the same month young with pigmented eyes. On September 18th it had hatched all its young, and when putting August 22nd down as the date for the oviposition, a period of incubation lasting 27 days is obtained. Even though these figures are only approximate, they show nevertheless that the duration of the period of incubation, which in May and June was a little above three weeks, and in July decreased to 20 days, increased in August and September to about 4 weeks.

Experiments I and III of the aquarium observations show that those ♀♀ of the winter-stock, which commence breeding in May or June, can hatch three brods of eggs before they, at the latest in the course of August, die off. According to the measurement lists there are a good deal, which do not breed so often; thus the lists (table 4) show that on July 5th 1916 there were still some ♀♀ of the winter-stock, that had not yet reached maturity; these would thus at the most be able to produce 2 broods of young before they expired at about the end of August. But as by far the greatest number of mysids of the winter-stock reach maturity in the course of June, it must be assumed that the most of the ♀♀ of the winter-stock normally get 3 broods of young before they die off. On the other hand experiment III showed, that a ♀ of the winter-stock which still lived 25 days having had its 3rd brood, was not able to breed any more; 3 broods of young can therefore normally be assumed as maximum for the winter-stock. As regards the summer-stock the measurement investigations show that the earliest born individuals reach maturity a little past the middle of July; unfortunately I have not been able to keep any such individuals alive in the aquaria long enough to ascertain how many days the hatching of first brood lasted; according to the foregoing, however, it can not be far wrong to set the period of incubation at about 26 days, after which the eggs of the 2nd brood are laid at the earliest in the days immediately following August 11th. But experiment XI shows, that of 10 ♀ of the summer-stock the 5 individuals, which on August 11th had eggs or young without pigmented eyes, produced only one brood, whereupon the want of ripe eggs in the ovaries, and the fallen-in incubatory lamellæ distinctly showed that they were not going to breed any more in that breeding period. The other 5 individuals, which on August 11th had young nearly ready to be hatched, got new eggs in the days between August 11th and 20th, but with that their breeding activity ceased. One seems entitled to conclude that the ♀♀ of the summer-stock breed at the most twice in one breeding period.

The growth of the young in the aquaria is explained in the form of curves in fig. 11. The general remarks pertaining to fig. 10 serve also for these curves. In opposition to *Mysis inermis* none of *Mysis flexuosa* born in the aquaria reached maturity. Not before the larger aquarium experiment mentioned page 95 did I succeed in obtaining any *Mysis flexuosa*, born in aquarium, that reached maturity in the same year.

From a brood of young hatched on June 10th 1919 (experiment III) 2 ♂ lived until January 4th 1920; they grew about equally fast; their curve of growth is shown to the left in fig. 11. In the first days of August their sex was easily distinguishable, the 4th pair of pleopods beginning to become elongated; they were, however, not fully developed before the breeding period ceased, and both of them died before reaching full maturity at a length of 18 mm. The next curve of growth shows the growth of some mysids hatched in aquarium on June 19th 1917 (experiment V). The all grew about equally fast until August, when the difference in size between the ♂♂ and ♀♀ became evident; the 2 branches of the curve of growth show the growth of the smallest ♂♂ and the largest ♀♀; all these mysids died in the course

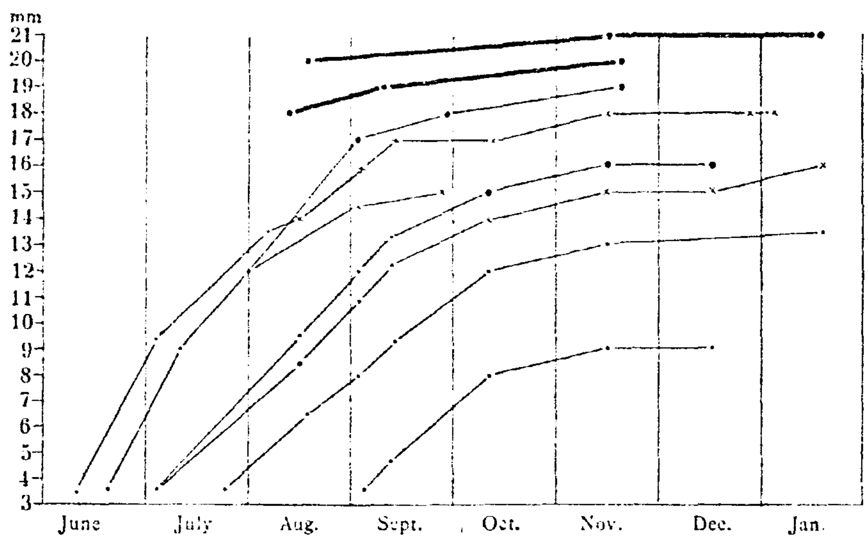


Fig. 11. Growth of *Mysis flexuosa* in aquaria.

Young.

♂, not mature.

♀, not mature.

♀, mature.

of the autumn before reaching maturity; before this the largest ♂♂ had nearly fully developed pleopods of the 4th pair, but the ♀♀ had only very small incubatory lamellæ. The bifurcated curve of growth, which commences at July 3rd, shows the growth of a brood of mysids numbering 8 individuals born in the aquarium on the date stated (experiment III); the one branch represents the smallest, the other the largest individuals. In October the sexes were easily distinguishable, but though they were still 5 individuals alive on November 15th, they all died before February of the following year; the ♂♂, which were the last to die, were not yet fully developed. Fig. 11 includes also the curve of growth for the brood of young from experiment III, which was born on July 23rd 1919. Originally this brood comprised altogether 12 young, but already on August 6th there was only one live individual left. This individual died in January 1920 at a size of $13^1/_2$ mm, but its sex could not be determined macroscopically. The same was the case with another mysid born in aquarium on September 4th 1919 (experiment X); this mysid died on December 16th of the same year at a length of 9 mm; its curve of growth is shown in the lower right-hand side of fig. 11.

The upper curves represent the growth of 2 ♀♀ of the summer-stock, mentioned in experiments X and XI, and placed in the aquarium when mature; it will be observed that in this instance the growth is very slight.

Upon comparing these curves with the curve, which would be obtained by inserting in fig. 11 the measurements of the largest young to be found in the free nature in the months of June and July (see page 69), it will be noticed immediately that this curve would ascend much steeper than the others. From this can be concluded that several of the mysids born early in the year grow quicker in the free nature than in the aquaria; on the other hand several of the mysids born in June reached such large sizes in the aquaria, that they, as far as size was concerned, very well could have commenced breeding in September; nevertheless as mentioned none of them reached maturity; a similar instance is described in connection with *Gammarus locusta* (page 28).

In order to judge the matter of how many generations *Mysis flexuosa* produces annually, it must first of all be understood, that only very few mysids of the summer-stock reach maturity the same year in which they are born. Calling the winter-stock Generation 0, we saw in the above that the first born young of this stock, i. e. Generation I, appeared in the beginning of June and reached maturity a little past the middle of July of the same year. These produce new young (Generation II), each ♀, however, only 2 broods. It may now be assumed that some of the young, born a little past the middle of June (belonging to Generation I), also reach maturity before the breeding period is at an end, as such mysids, which have been kept in aquarium, reached at the end of the breeding period (in September) a size corresponding to that, at which mysids in the free nature have been found breeding. This was however not the case with mysids born later than the end of June, for which reason such mysids must be assumed to reach winter without having commenced breeding. Thus only the first broods of Generation I reaches maturity, and as the winter-stock continues to breed throughout the month of July, and some individuals even in the month of August, it will be understood that less than the half of Generation I has been able to produce a new generation (Generation II) before the breeding period ends.

None of the mysids of Generation II, which at the earliest begin to appear in the beginning of August, reach maturity before the winter.

Regarding the matter of whether the mysids of the summer-stock, after having been breeding during the autumn can live through the winter and thereupon resume breeding in the following spring, the aquarium observations mentioned here give no information whatever, as all the breeding individuals of the summer-stock die off a few months after the breeding period has ceased. Not before the aquarium observation mentioned page 94 was it proved that this question, as far as *Mysis flexuosa* is concerned, could be replied in the affirmative. Regarding the matters of moulting and mating the information given page 78 pertains also to this species.

Only 2 new generations of *Mysis flexuosa* are thus produced every year, and this, in connection with the fact that more than half the number of Generation I live throughout the winter without having been breeding even once, will explain the conditions stated page 69, according to which the supply of newly born young of *Mysis flexuosa* in opposition to *Mysis inermis*, is comparatively small in the free nature during the months August—September.

The results of a number of countings on eggs and young from the incubatory pouches of *Mysis flexuosa* collected from the Nyborg Fjord are given below.

Length of mother animal:	17 mm	18 mm	19 mm	20 mm	21 mm	22 mm	23 mm	24 mm
4/6 1917		27,3 (3)	29 (4)	27 (4)	30,4 (5)	37,2 (5)	38,8 (5)	40,6 (5)
25/6 "						31,8 (5)	33,8 (5)	34,5 (4)
30/8 1916	14 (5)	15,6 (5)	18,2 (5)	25 (1)	25 (2)	27 (2)	25 (1)	

The figures in brackets indicate the number of examined ♀♀; the other figures in the table are the average number of eggs or young, which were found in the incubatory pouches. It will be noted that the number of eggs or young as a whole increase with the length of the mother animal within the same date, but decreases from Jnne till August within the same length of the mother animal. All the examined individuals from June belong to the winter-stock, which most probably also refers to the mysids from August 30th, measuring 21—23 mm; all the others, however, belong to the summer-stock.

In order to form an idea as to the number of descendants of one pair of *Mysis flexuosa* in the course of a breeding period, assuming that all the young live so long, the following scheme may be arranged:

May — June — July — Aug. — Sept.

1 ♂, 1 ♀, 21 mm — Gen. 0: 1 ♂ + 1 ♀.

15 ♂, 15 ♀ — 16 ♂, 16 ♀ — 17 ♂, 17 ♀ — Gen. I: 48 ♂ + 48 ♀.

112 ♂, 112 ♀ — 105 ♂, 105 ♀ — 117 ♂, 117 ♀ — Gen. II: 334 ♂ + 334 ♀.

Gen. I—II total 382 ♂ + 382 ♀ = 764 individuals.

As Generation 0 a pair of the earliest breeding mysids from the winter-stock is assigned; the ♀ gets 3 broods of young (Generation I), which are hatched in the beginning of June, the end of June and the middle of July respectively. Assuming that the mentioned ♀ of Generation 0 in May measures 21 mm, the 1st brood will, according to the table on the number of eggs and young, comprise about 30 young; if the mother animal increases in length with 1 mm after each oviposition, the 2nd and 3rd broods will, according to the same table, (the figures for June 25th 1917) amount to 31,8, and 33,8 young respectively; assuming that the hatched young comprise equal numbers of ♂ and ♀, a rounding up of the figures will for Generation I give 48 ♂ and 48 ♀ or altogether 96 mysids.

Each of the 15 ♀ of Generation I, 1st brood, will only be able to produce 2 broods of young each (Generation II), the 1st about August 10th and the other in the beginning of September. Reckoning that the mentioned 15 ♀ upon reaching maturity measure 17 mm in length, the will according to the table each get 14 young in the 1st brood, amounting altogether to 210 young, or 105 ♂ and 105 ♀. If the mother animals before the hatching of their 2nd brood have reached a size of 18 mm, they will according to the table each get $15_{,6}$ young, or altogether 234 young, of which 117 are ♂ and 117 ♀. It is very doubtful whether all the young of Generation I, 2nd brood, which are born in the end of June, reach maturity before the breeding period ceases; as mentioned above the aquarium observations have, however, proved that there is a possibility that such mysids may reach maturity in September. Assuming therefore that the 16 ♀ of Generation I, 2nd brood reach maturity in September at a size of 17 mm, they will each be able to produce 1 brood of 14 young (the table p. 86) or altogether 224 young (Generation II) before the breeding period is at an end. Generation II consists thus of altogether 668 mysids.

The offspring of one pair of *Mysis flexuosa* in one breeding period will therefore at the most comprise 764 individuals. It must be remarked that the appearance of the many young in August and September, with which is reckoned in the scheme, does not, as earlier mentioned, correspond to the actual conditions in free nature; the reasons herefore are various. First of all many of the young of Generation I die before reaching maturity, and secondly many of the mysids of the winter-stock (Generation 0) in the free nature do not breed so early as assumed in the scheme, but only reach maturity in June or even in July, for which reason their young are not able to produce a new generation before the winter; a ♀ which reaches maturity in the beginning of July will, according to the method of reckoning employed, at the highest produce 37 individuals before the end of the breeding period, even if it produces three broods of young itself. Finally the scheme assumes that all the mysids born as late as June reach maturity before the breeding period ceases in September; the samples from September (see table 4) show, however, that this is far from the case with all the mysids in the free nature, the mature ♀♀ in the said samples comprising at the highest 1 % of the total number; as the main quantity of Generation I in the free nature is already hatched before the end of June, the percentage of breeding ♀♀ should in September be much higher than it is, if all these mysids reached maturity in September. It is most probable therefore to assume that only a few of the quickest growing mysids born in late June reach maturity the same year in which they are born.

3. *Mysis neglecta.*

The results of the aquarium observations on *Mysis neglecta* are included in the table given below, the manner of proceeding being the same as with the mysids mentioned before. A more detailed account of the observations is to be found in the Danish edition of this book, pages 103—105.

Mysis neglecta.

Winter-stock.

	Eggs	Young without eyes	Young with eyes	Empty
Exp. I 1918	—	—	—	2/5
	23/5	—	—	9/6
	24/6	—	—	10/7
Exp. II 1918	—	—	—	2/5
	21/5	—	—	9/6
Exp. III 1917	—	—	—	7/6
	13/6	—	—	29/6
Exp. IV 1918	5/8	10/8	16/8	29/8
	30/8	—	—	13/9
Exp. V 1917 22/6	—	—	2	—
25/6	1	—	1	—
27/6	2	—	—	—
3/7	—	1	—	—
9/7	—	—	1	—
Exp. VI 1917 22/6	7	—	—	—
27/6	—	6	—	—
3/7	—	1	5	—
9/7	—	—	3	2
16/7	2	2	—	—
21/7	—	1	1	1
4/8	1	1	—	—
11/8	—	1	—	—

Summer-stock.

	Eggs	Young without eyes	Young with eyes	Empty
Exp. VII 1918	—	—	5/8	—
	10/8	—	—	29/8
Exp. VIII 1918	21/9	2/10	16/10	4/11
Exp. IX 1918	23/9	29/9	12/10	28/10
Exp. X 1918	—	23/9	2/10	8/10
Exp. XI 1917 11/8	2	3	3	—
20/8	1	2	—	5
1/9	5	—	—	1
10/9	—	—	—	3
22/9	—	—	—	2
19/11	—	—	—	1

The Results of the Aquarium Observations on *Mysis neglecta.*

Of the mysid species treated here, *Mysis neglecta* is the most difficult to keep alive in the aquaria; many experiments have been commenced, but owing to the death of the mysids shortly after being placed in the aquaria, they have been interupted without result. It proved still mor edifficult to get the ♀♀ to lay viable eggs in the aquaria; this was only obtained in glass bells suspended below the surface of the water (experiments V and VI). Comparatively little information regarding the duration of the period of incubation has therefore been obtained through the aquarium observations. Experiment I shows that in the case of one of the earlist breeding individuals of the winter-stock, 1 month elapsed between the first and second oviposition; as normally the new oviposition immediately succeeds the hatching of the young, the duration of the period of incubation at this time of the year may also be put down to 1 month. According to experiment VI the 2 of the 7 ♀, which on June 22nd carried newly laid eggs in their incubatary pouches, had newly laid eggs the second time on July 16th, i. e. 24 days later; at this time some other 2 had, however, already young in their incubatory pouches; as they still were without eggs on July 9th, they cannot have got eggs the 2nd time before July 10th, which is 18 days after the 1st oviposition. On August 4th 1 individual had again newly laid eggs, and another one had young without pigmented eyes; they were thus in the same stage as the 4 individuals were on July 16th, there being a whole period of incubation of 19 days between these two dates. In experiment V only 17 days elapsed before a ♀, which was placed in the aquarium on June 22nd carrying young with pigmented eyes, had reached this stage the 2nd time; but the course of the experiment showing that the mysid was at the end of this stage already when placed in the aquarium, 2–3 days must certainly be added to get the correct period of incubation, which will therefore be 19–20 days. Experiment IV shows that in the case of one ♀ of the winter-stock, 24 days elapsed in August before all the young were hatched. Finally experiments VIII and IX show that in the case of the latest breeding ♀ of the summer-stock the period of incubation during September and October lasted at least 35 to 44 days. At the end of May and in the beginning of June the period of incubation lasted thus about 1 month, decreased thereupon gradually during June and July to about 18 days, to again increase in August to 24 days and in September-October to 35—44 days.

The greatest number of broods produced by a ♀ of the winter-stock was 3 (experiment VI); during other observations each ♀ got only 2 broods (experiments II, V and V); in experiments II and III 2 ♀♀ produced only 1 brood of eggs each, though the one of them had lived more than 3 months in the aquarium. The ♀♀ of the summer-stock produced each at the highest 2 broods of eggs (experiments VII and XI). According to the measurement investigations the earliest breeding ♀♀ of the summer-stock reach maturity first time about the end of July; the period of incubation at this time of the year for the winter-stock lasts about 19 days; this refers most certainly to the summer-stock too, coinciding as it does with the fact that the earliest breeding female of the summer-stock in the aquarium observations got eggs the 2nd time on August 10th (experiment VII); other mysids of the summer-stock got eggs the 2nd time in the days between August 11th and September 1st (experiment XI), and of all these mysids it holds good that after the 2nd brood no more ripe eggs were found in the ovaries, though several of them lived in the aquarium for months after. It must be assumed that normally the ♀♀ of the summer-stock breed at the highest twice in succession; the few egg- or young-bearing mysids, which according to the measurement investigations (table 5) are still to be found in the free nature at the end of September and during October, can therefore not belong to the earliest breeding individuals of the summer-stock, as with a period of incubation of 24 days in August, these must have hatched their second brood already in the beginning of September.

Regarding the growth of the young these observations give no information whatever, as all the young hatched in the aquarium died in the course of a very short time, usually before they had increased perceptibly in length. On the other hand the measurement investigations and the aquarium observations on the mature mysids have shown that the growth of *Mysis neglecta* proceeds somewhat slower than the growth of *Mysis flexuosa;* but as the former, consonant to its being a smaller species, reached maturity when of a size inferior to the latter, the time which elapses before the young of the 2 species reach maturity is about the same.

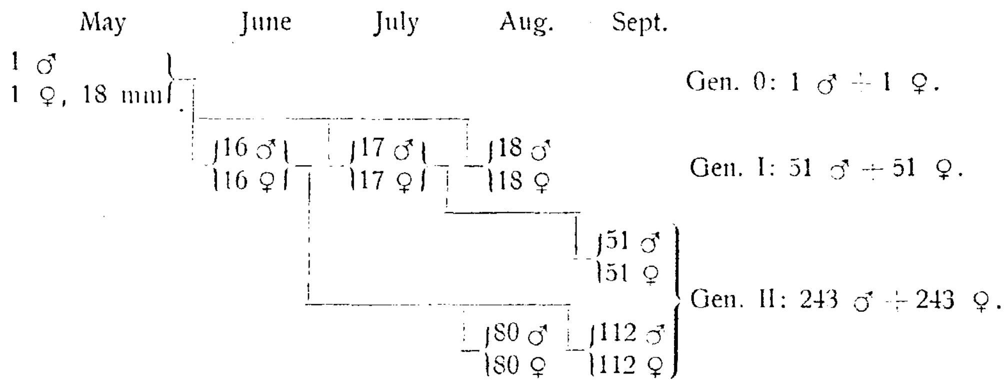
The number of generations is thus the same as with *Mysis flexuosa*, as the earliest born young of the summer-stock appear so late in the year, viz. about the middle of August, that they cannot reach maturity before the breeding period ceases. Also as regards moulting, mating and their faculty of breeding in more than one breeding period, *Mysis neglecta* corresponds to *Mysis flexuosa*.

The results obtained from the counting of eggs and young of *Mysis neglecta* from the Nyborg Fjord are as follows:

Length of mother animal:	13 mm	14 mm	15 mm	16 mm	17 mm	18 mm	19 mm	20 mm	21 mm
4/6 1917					26,4 (5)	31,6 (5)	36,6 (5)	37,3 (6)	
25/6 —					24,4 (5)	31,6 (5)	33,6 (5)	37 (5)	42,4 (5)
11/8 1916		8,0 (2)	9,5 (2)	14 (1)		17 (2)	21,2 (6)	24,5 (6)	25,6 (5)
13/9 1917	5 (1)	5,8 (4)	6 (4)	8 (2)	9 (1)	13 (1)			
27/9 1916			7,3 (3)	10,3 (3)	10,7 (3)	12 (2)	13,5 (2)	14,5 (2)	

With this species too the number of eggs thus increases with the length of the mother animal, but decreases from the beginning of the breeding period till it terminates. The examined individuals from June all belong to the winter-stock, and the examined individuals from August and September measuring less than 18 mm all belong to the summer-stock, whereas the remainder, as far as could be judged, belong to the winter-stock.

Similarly to what has been done earlier and based upon the present material, we may calculate the production of a pair of the earliest breeding *Mysis neglecta* in the course of a breeding period.



Gen. I–II total: 294 ♂ + 294 ♀ = 588 individuals.

In the above scheme Generation 0 indicates a pair of mysids of the winter-stock; at the end of May the ♀ measures, when it gets eggs the 1st time, 18 mm in length. According to the table of egg-countings for June 4th 1917 such a ♀ contains about 32 eggs; the 2nd brood of eggs of Generation I, which is laid about the end of June, will, according to the table of egg-countings of

June 25th 1917*), comprise 34 eggs, because the mother animal in the meantime has increased in length to 19 mm. The 3rd brood, laid in July when the mysid measures 20 mm in length, comprises 37 eggs according to the table page 90. Assuming that equal number of ♂♂ and ♀♀ are hatched in each brood, the 1st brood of Generation I, hatched at the end of June, will comprise 16 ♀, which reach maturity in late July and produce their first brood in August; assuming the mother animals then to be 15 mm long, they will each get 10 young (see table p. 90) or altogether 160 individuals, of which 80 are ♂ and 80 ♀. The 2nd brood of eggs, which is laid in August, will according to the table page 90 comprise 14 eggs, the mother animals in the meantime having increased in length to 16 mm; the 16 ♀ of Generation I, 1st brood, will thus hatch altogether 224 young, which appear in September as 2nd brood of Generation II.

Whether the 17 ♀ of Generation I, 2nd brood, which are born about the middle of July reach maturity before the winter, is a question that the observations made do not answer directly. As, however, *Mysis neglecta* corresponds in so many ways with *Mysis flexuosa* (the breeding period of the former species only commencing about 10 days later than that of the other species), the 2nd brood of Generation I may be considered to reach maturity before the breeding period ceases. In accordance herewith it has been observed that during September in the free nature ♀♀ are often met with, which still have small incubatory lamellæ, but their large ovarial eggs tend to prove that they will be breeding in the nearest future before the breeding period ceases; as the case is with *Mysis flexuosa*, the 2nd brood of Generation I does not reach maturity before September and accordingly only succeeds in producing one brood of young. Assuming the mother animals to be 15 mm in length when the eggs are laid, they will, according to the table page 90, only get 6 young each; altogether the 17 ♀ will thus be able to hatch 102 young. As none of the mysids of Generation II produce new young before the following year, the production of one pair of *Mysis neglecta* during one breeding period totals 588 individuals.

The description given above relates to only a pair of the earliest, i. e. in late May, breeding mysids of the winter-stock. As the measurement investigations (table 5) show, a great number of mysids, which survive the winter, do not reach maturity before late June or early July. According to experiment VI such individuals will still be able to produce 3 broods of young, viz. 1st brood about the middle of July, the 2nd brood about the beginning of August and the 3rd brood late in August; probably, however, the most of them die before the middle of August, and they will therefore only produce 2 broods of young; measurement lists for 13/8 1917, 30/7 1916 and 30/8 1917 (not included in table 5) show that only 1 breeding ♀ of 296 measured mysids of the winter-stock remained. Each of the young produced by these late breeding mysids, the first-born of which according to the above reach matuirty at the earliest in September, will thus at the highest be able to produce 1 brood of young before the breeding period ceases, and the most of them, viz. all of the 2nd and 3rd broods, do not reach maturity before the winter. As furthermore only a few eggs and young, according to the table page 90, are produced by each ♀ so late in the year, it will be understood that the latest breeding ♀♀ of the winter-stock produce an offspring, which is much less numerous than the one just calculated. A ♀ measuring 18 mm and breeding first time in the late June will thus, even if it produces 3 broods of young itself, at the most produce an offspring amounting to 172 individuals.

*) In the present scheme of the production of one pair of mysids, as well as in the preceding ones of the same kind, the superscriptions May, June etc. only indicate the time when the young appear, *not* when the eggs are laid.

The Size of Production.

A. In the aquaria.

In analogy with the experiment mentioned page 45 relating to *Gammarus locusta*, a feeding experiment was made with a stock of mysids during a whole year in one of the large cement reservoirs, which measured 1 sq. m at the base. On July 31st 1917 about 300 mysids, all belonging to the summer-stock, were caught in the Nyborg Fjord. They were roughly divided into two equal portions, the one of which was placed in the aquarium, while the other was preserved in alcohol for later measurement and weighing purposes. The results obtained are included in column „July 31st 1917" of the bystanding table; for comparison the weight of the animals is computed to rough weight. As will be observed the sample, which on account of the manner of proceeding employed cannot claim to represent the exact number, but certainly the size and stage of development of the mysids in the aquarium, contains representatives of the 3 *Mysis*-species hitherto mentioned; only a few of the largest ♀♀ are breeding yet, the other ♀♀ not having reached maturity. Two months later, on October 1st, all the mysids were taken out of the aquarium, measured and weighed while alive, and thereupon returned to the aquarium. The table shows that the breeding period now has ceased, there being only two ♀ of *Mysis inermis* still breeding. There were found 10 adult ♂ of *Mysis flexuosa*, the 6 of which had fully developed pleopods of the 4th pair, and 18 ♀ of which the 16 had large fallen-in incubatory lamellæ, plainly showing that they had been breeding quite recently; most probably a number of the originally immature ♀♀ placed in the aquarium have in the meantime reached maturity. The same refers to *Mysis neglecta*, the 40 ♂ of which all were fully developed; of the 21 ♀ the 18 largest individuals had fallen-in incubatory lamellæ. Likewise all the *Mysis inermis* indicated as ♀ or ♂ were mature or had recently been breeding. A great number of young had been hatched in the aquarium, so that the number of *Mysis flexuosa* and *neglecta* in the course of the 2 months had increased to the five-double, whereas *Mysis inermis* had only increased to the double. The aggregated weight of all three species had during the same period increased from 4 g to 7 g, as likewise all the mysids had increased considerably in size.

To distinguish between *Mysis flexuosa* and *Mysis neglecta* was already on October 1st a very difficult matter in reference to the group of young, because many young of the latter species, which are strongly pigmented in the free nature, had turned an exceptionally light colour, which was nearly identical to the light colour of the bottom of the cement aquarium, and for this reason they were very difficult to distinguish from the young of *Mysis flexuosa*. When the mysids again were taken out for examination on April 25th 1918, it was observed that a sorting between *Mysis flexuosa* and *neglecta*, especially in reference to the small individuals, was now impossible without the aid of a microscope; this is the reason why they are not kept apart in the table. Only 6 live individuals of *Mysis inermis* remained, and of these the 5 were ♂ measuring 10—11 mm and the 1 a ♀ measuring 11 mm; these mysids are also counted together with the others in the table. The largest of the mysids, viz. the small group of fully developed ♂♂ measuring 20—22 mm and

	July 31. 1917.															October 1. 1917.													April 25.1918.				July 21. 1918.					Septbr. 23. 1918.				
	M. flexuosa.					M. neglecta.					M. inermis.					M. flexuosa.				M. neglecta.				M. inermis.																	
mm	♂	♀ w. eggs	♀ no eggs	Young	Total	♂	♀ w. eggs	♀ no eggs	Young	Total	♂	♀ w. eggs	♀ no eggs	Young	Total	♂	♀ no eggs	Young	Total	♂	♀ no eggs	Young	Total	♂	♀ w. eggs	♀ no eggs	Young	Total	♂	♀ w. eggs	♀ no eggs	Total	♂	♀ w. eggs	♀ no eggs	Young	Total	♂	♀ w. eggs	♀ no eggs	Young	Total
4	—	—	—	—	—	—	—	—	1	1	—	—	—	6	6	—	—	—	—	—	—	3	3	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	4	4
5	—	—	—	—	—	—	—	—	1	1	—	—	—	9	9	—	—	—	—	—	—	3	3	—	—	—	4	4	—	—	—	—	—	—	—	20	20	—	—	—	1	1
6	—	—	—	—	—	—	—	—	2	2	—	—	—	4	4	—	—	4	4	—	—	16	16	—	—	—	4	4	—	—	—	—	—	—	—	51	51	—	—	—	5	5
7	—	—	—	—	—	—	—	—	4	4	—	—	—	5	5	—	—	18	18	—	—	32	32	—	—	—	22	22	—	—	—	—	—	—	—	40	40	—	—	—	27	27
8	—	—	—	1	1	—	—	—	2	2	—	—	—	10	10	—	—	16	16	—	—	22	22	—	—	—	24	24	—	—	—	—	—	—	—	16	16	—	—	—	76	76
9	—	—	—	1	1	—	—	—	1	1	4	—	2	3	9	—	—	4	4	—	—	11	11	—	—	—	30	30	—	—	—	—	—	—	—	—	—	—	—	—	59	59
10	—	—	—	1	1	—	—	—	1	1	13	—	2	—	15	—	—	14	14	—	—	20	20	4	—	—	6	10	4	—	—	4	—	—	—	—	—	—	—	—	34	34
11	—	—	—	2	2	—	—	—	2	2	3	2	—	—	5	—	—	21	21	—	—	33	33	11	2	1	1	15	5	—	1	6	1	—	—	—	1	—	—	—	10	10
12	—	—	—	2	2	7	—	1	1	9	—	3	—	—	3	—	—	16	16	—	—	45	45	1	—	9	—	10	5	—	3	8	1	—	—	—	1	—	—	—	8	8
13	1	—	1	—	2	12	—	2	—	14	—	—	—	—	—	—	—	2	2	—	—	18	18	—	—	1	—	1	5	—	6	11	—	—	—	—	—	—	—	2	13	15
14	1	—	2	—	3	5	—	4	—	9	—	—	—	—	—	—	—	1	1	18	—	1	19	—	—	—	—	—	10	—	6	16	—	—	—	—	—	—	—	2	9	11
15	1	—	1	—	2	1	1	2	—	4	—	—	—	—	—	—	—	—	—	21	4	—	25	—	—	—	—	—	20	—	8	28	3	—	2	—	5	—	—	4	9	13
16	1	—	1	—	2	—	1	1	—	2	—	—	—	—	—	—	—	2	2	—	5	—	5	—	—	—	—	—	17	—	13	30	11	—	5	—	16	1	—	1	8	10
17	1	1	1	—	3	—	—	—	—	—	—	—	—	—	—	2	—	1	3	1	12	—	13	—	—	—	—	—	7	—	9	16	3	2	3	—	8	—	1	—	3	4
18	—	4	—	—	4	—	—	—	—	—	—	—	—	—	—	3	—	—	3	—	—	—	—	—	—	—	—	—	1	—	9	10	—	6	10	—	16	—	—	1	—	1
19	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	5	2	—	7	—	—	—	—	—	—	—	—	—	—	—	3	3	—	5	2	—	7	4	—	—	—	4
20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	3	—	—	—	—	—	—	—	—	—	5	—	1	6	1	3	—	—	4	1	1	—	—	2
21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	4	—	—	—	—	—	—	—	—	—	2	—	—	2	1	1	—	—	2	1	—	—	—	1
22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9	—	9	—	—	—	—	—	—	—	—	—	2	—	—	2	—	1	1	—	2	—	—	—	—	—
23	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	4	—	—	—	—	—	—	—	—	—	—
24	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	3	—	3	—	—	3	—	—	—	—	—
25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2	3	—	—	1	—	1	—	—	—	—	—
Total	5	6	6	7	24	25	2	10	15	52	20	5	4	37	66	10	18	99	127	40	21	204	265	16	2	11	92	121	83	1	68	152	21	21	24	127	193	7	2	10	266	285
Rough weight	1,2 g					1,36 g					1,2 g					7,0 g													4,2 g				4,1 g					6,3 g				

the small group of ♀♀ measuring 23—25 mm, were true *flexuosa;* one of these ♀♀ was seen to be carrying eggs in its incubatory pouch, though in the free nature the breeding period had not yet commenced; the remainder had large breeding lamellæ and nearly ripe eggs in the ovaries; they were thus going to breed within a short time. Altogether there were 10 such large *flexuosa*-♀, and from what has been experienced earlier, there can be no doubt but that they are identical with the 10 of the 18 *flexuosa*-♀, which on October 1st 1917 measured 19—22 mm in length and in the table are separated from the others by a little space. As stated in the above all these mysids, 2 individuals excepted, were spent individuals of the summer-stock, which had been breeding at the end of the breeding period, viz. during August-September 1917. Likewise at the least some of the 9 ♂ measuring 20—22 mm must be individuals, which were mature already on October 1st 1917. This is therefore the first instance which proves that mysids of the summer-stock can breed in the aquarium in more than one breeding period. It is evident that the 10 mature or nearly mature *flexuosa*-♀ from April 25th cannot belong to the group of young from October 1st, as in this case some of these mysids should have grown from 12 to 22 mm, i. e. 10 mm, in the course of the winter, which is contrary to the experiences gained earlier; likewise if all the ♂♂ belonged to the group of young from October 1st, some of them should have grown 7 mm, which is a most improbable quick growth for the cold season. Of the true *neglecta* only one ♀ was nearly mature; this one too seems to be one of the spent individuals, which on October 1st measured 15—17 mm in length. In the course of the winter season no young had appeared and a great number of the mysids had furthermore died off, whereby the stock was reduced from 513 individuals, weighing 7 g on October 1st, to 152 individuals, weighing $4{,}_2$ g on April 25th. 361 individuals have thus died off in the meantime; their average weight can be put down as $\left(\frac{7{,}_0}{513} + \frac{4{,}_2}{152}\right) : 2 = 0{,}_{02031}$ g pr. individual, or altogether $7{,}_{33}$ g; since October 1st the weight of the stock has thus in reality increased to $7{,}_{33} + 4{,}_2 = 11{,}_{53}$ g in the course of the winter-season.

When the stock on June 21st 1918 was again taken out of the aquarium for examination, the breeding activity was in full swing. There were now only 2 *Mysis inermis* left, viz. 2 ♂ measuring 11 and 12 mm. Among the other mysids the 2 largest ♂ and the 2 largest ♀ without eggs, which were spent individuals, as well as 6 breeding ♀ measuring 20—24 mm in length, could all be determined as *Mysis flexuosa;* of these 3 of the breeding ♀ measuring 24 mm and 1 of the spent ♀ measuring 25 mm were survivors of the group of mature or nearly mature *flexuosa*-♀, which on April 25th of the same year measured 23—25 mm. The other adult mysids were true *Mysis neglecta,* but amongst the young both species were found mixed together. There were altogether 66 adult wintered mysids; 86 individuals have thus died off since the last examination. As the entire stock now weighs $4{,}_1$ g, of which the young take the $0{,}_7$ g, each of the 86 dead individuals must have weighed approximately $\left(\frac{4{,}_2}{152} + \frac{3}{66}\right) : 2 = 0.{}_{01152}$ g, or altogether $3{,}_{57}$ g. The $4{,}_2$ g mysids from April have thus in the course of 2 months increased to a weight of $4{,}_4 + 3{,}_{57} = 7{,}_{97}$ g.

On September 23rd 1918 all the mysids were taken out of the aquarium, killed in alcohol and thereupon measured and weighed carefully; there were now only *Mysis flexuosa* and *neglecta* left. The entire winter-stock was gone, and 2 ♀ of the summer-stock were found breeding, these being 1 *Mysis neglecta* measuring 17 mm and 1 *Mysis flexuosa* measuring 20 mm; this is the first time I have succeeded in getting mysids of these two species, born in aquarium, to become mature before the winter. Also among the ♀♀ without eggs a few were found with signs typical for mysids, which have recently been breeding. As well here as in the group of young, *Mysis flexuosa* and *Mysis neglecta* were found, though the latter species predominated, but it was impossible to distinguish them without counting the spines on the tail plate. The 285 mysids totalled in weight 6,3 g; it is to be noted that the growth of the summer-stock in the aquarium, when compared with the growth of the aquarium's stock during August –September 1917, has been comparatively small. Also the number of young, which have appeared in the aquarium in the course of the breeding period 1918, has been comparatively small, as a production of 285 mysids from 69 ♀ only gives 4 young to each.

In conformity with *Gammarus locusta* the quantitative result of the rearing of mysids in aquaria does not at all correspond with the theoretically calculated size of the production stated pages 80, 87 and 91, especially on account of the heavy rate of death among the animals in the aquaria. As furthermore the mysids altogether are much less prolific than *Gammarus locusta*, a rearing of them as food for fish would hardly pay.

In the aquarium observations described above the mysids were fed with weighed-off food comprising partly the fresh minced soft parts of mussels, and partly of fresh algæ. To prevent the latter in growing, the aquarium was kept dark by being covered with a lid. The figures stated below give information regarding the quantity of mussels and algæ consumed in the course of the different months throughout the year. It will be observed that a much less amount of food is consumed during the winter months than during the summer months, which conforms with the growing of the mysids proceeding slower during the winter.

Weight in g of food consumed and of mysid stock in aquarium. From July 31st 1917 till September 23rd 1918.

		Aug.	Septb.	Octb.	Nov.	Decb.	Jan.	Febr.	March	April	May	June	July	Aug.	Septb.
Food	*Mytilus*	43,5	42,3	26,0	21,0	24,0	12,0	18,0	12,0	24,0	28,0	40,5	60,0	53,0	10,0
	Algæ	23,0	20,5	53,2	20,0	0,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0
Live mysids		4,0 g		7,0 g						4,2 g		4,4 g			6,3 g
Dead mysids							7,33 g				3,77 g			3,7 g	

The „useful effect“ during the months of August and September 1917 was about 1/73, there being during this time produced 3,0 g mysids, whose dry matter percentage is 9,5, from a quantity of food amounting to 129,6 g algæ and mussels, the dry matter percentage of which is about 16. From October 1st till October 25th there were consumed altogether 131 g mussels and 173,2 g algæ, whereby the weight of the mysids increased from 7,0 g to 11,53 g; thus 4,53 g mysids were produced, this giving a „useful effect“ for the winter of only $^1/_{113}$. From April 25th till June 21st 1918 there were consumed altogether 54 g mussels and 40 g algæ. From this was produced 7,97 ÷ 4,2 g = 3,77 g mysids, which gives a „useful effect“ of $^1/_{12}$. Upon the conclusion of the experiment on September 23rd 1918 the entire winter-stock had died off; the summer-stock, which on June 21st of the same year only consisted of the group of young, weighing 0,7 g, had grown up to a weight of 6,3 g, whereby there since June 21st has been produced 6,3 ÷ 0,7 = 5,6 g mysids. As at the same time 143 g mussels and 60 g algæ had been consumed in the aquarium, we get a „useful effect“ for this period of $^1/_{61}$.

In the course of a little more than a year there has altogether been consumed 403,8 g mussel-meat and 317 g algæ, and in the course of the same time there was produced altogether 16,9 g mysids in the aquarium, which gives a „useful effect“ of about $^1/_{72}$. The „useful effect“ is thus much less among the mysids than among *Gammarus locusta*. It must, however, be noted that minced mussel-meat is much more liable to decay than whole opened mussels, with which *Gammarus locusta* was fed; though it was not found necessary on account of the development of bacteria to change the water during the experiment with the mysids, it is evident that a part of the food has not been consumed, but has decayed; the stated figures which indicate the „useful effect“ are therefore only minimum values. When at the end of the experiment the water of the aquaria was taken out, it was observed that some detritus had gathered at the bottom of the reservoir; it was, however, only a matter of a few grammes.

The relation between the increase in weight of the mysids and the food consumed, both values being conputed to dry matter, varies thus between $^1/_{12}$ and $^1/_{113}$; it was greatest during the spring and smallest during the winter, at which time the mysids consumed about $^1/_3$ of what was consumed during the summer. In the aquaria which covered an area of 1 sq. metre, 16,9 g mysids were developed in the course of 14 months.

B. In the Nyborg Fjord.

Besides gammarids a number of mysids were caught in the quantitative fishing experiments mentioned page 53, and similar to the gammarids the hatched young mysids sought the surface of the water in the evening after dark. In the table below the results from the hand-net draggings mentioned page 53 are gathered, the 3 *Mysis*-species being here counted together.

During the months April—May and November—January hardly anything but adult mysids were caught; the samples from June comprised mostly newly hatched young of *Mysis inermis*, and during July—September the majority of *Mysis*-young were newly hatched individuals. As estimated minimum-value, the annual production of mysids in the Nyborg Fjord may therefore be reckoned as the sum of the largest figures for each of the months June—September in the table, i. e. 0,23 + 0,09 + 1,13 + 0,79 = 2,54 g per sq. metre. Probably it is somewhat larger, as a great number of mysids, which are devoured by other animals, are not included in

Place	Algæ		Water surface	Algæ		Water surface	Algæ	Water surface	Algæ		
Date	17/4 1917	31/5 1917	7/5 1918	23/6 1917		21/7 1918	16/8 1917	22/8 1917	2/9 1917	26/11 1917	22/1 1917
	p. m.	p. m.	Even.	Noon	Even.	Even.	Even.	Even.	Even.	p. m.	p. m.
Surface treated	$27{,}5$ m²	2 m²	1 m²	1 m²	1 m²	2 m²	1 m²	2 m²	1 m²	1 m²	2 m²
Number of mysids per m²	2	6	0	10	26	23	11	61	147	14	$0{,}5$
Rough weight in g per m²	$0{,}12$	$0{,}23$	0	$0{,}12$	$0{,}23$	$0{,}03$	$0{,}09$	$1{,}43$	$0{,}79$	$0{,}44$	$0{,}01$

these figures. However, there is no doubt that the annual aggregated production of the 3 *Mysis*-species is less than the annual production of the *Gammarus locusta* alone; partly the mysids are much less prolific animals than *Gammarus locusta*, partly the aggregated offspring of a pair of each *Mysis*-species is far less in number than the offspring of one pair of *Gammarus locusta*, and partly the mysids are comparatively small animals, and their weight is therefore also comparatively small.

The periodically repeated examinations of the Zostera-regions in the different Danish fjords by means of a quantitative hand-net as mentioned p. 1 have proved that the greatest numbers of our 3 common *Mysis*-species are met with in the autumn, during August and September, when the young of as well summer-stock as winter-stock have appeared. In the Nyborg Fjord during this season 473 individuals were found per sq. metre, in Nykobing Bay, Mors, 573, in the Holbæk Fjord 271 and in Svendborg Sound 213 individuals per sq. metre; another year no less than $8{,}1$ g mysids per sq. metre were found in Svendborg Sound. The investigations have been carried on during 3 years (1914—1916) and gave the following figures, which represent the average of mysids found during these 3 years (all the figures are roug hweight):

The Nyborg Fjord	$^1/_3$ m	depth:	$1{,}50$ g
Svendborg Sound	$^2/_3$ -	—	$4{,}93$ -
The Holbæk Fjord	$^1/_3$ -	—	$3{,}30$ -
The Limfjord	1 -	—	$3{,}73$ -

The figures may be used for mutual comparison as minimum values for the annual production; this production is of course somewhat larger; thus the figure page 96 for the Nyborg Fjord, viz. $2{,}54$ g per sq. metre, is certainly more correct. Assuming that the mysids of the Nyborg Fjord only are to be found from the shore to a depth of 5 m, the last mentioned figure (see page 54) gives an annual production of the 3 *Mysis*-species in the Nyborg Fjord of 12700 kg, which is only a quarter of the amount calculated for *Gammarus locusta*, viz. 50000 kg.

Other Species of *Mysidæ*.

The species mentioned page 57, which appear in the Nyborg Fjord together with the 3 species mentioned above, have occasionally been subject to measurement investigations, which show that in reference to biological conditions they conform with these 3 species.

Thus only large individuals of *Mysis spiritus* were found on April 17th in the Nyborg Fjord, and they had not yet reached maturity; the ♀♀ had, however, ovarial eggs and the ♂♂ well developed pleopods of the 4th pair. On May 8th large breeding ♀♀ were found; in July all the wintered individuals had reached maturity and numerous young were hatched. On August 18th many breeding individuals were still found, and judging by their size (♂♂ measuring up to 16 and ♀♀ up to 17 mm) they must belong to the winter-stock; a few smaller ♀♀ measuring 11 mm and ♂♂ measuring 10 mm, all of which were nearly mature, suggested that also a part of the summer-stock reached maturity before the breeding period ceased. This species is not common in the Nyborg Fjord; as an instance of the great numbers of which they can be found elsewhere, especially in shallow bays with clean sand bottom, it may be stated that in the Flaske Bay 4000 *Mysis spiritus* within an area of 100 sq. metre were caught by means of a quantitative fishing implement on September 1st 1913; the mysids weighed altogether 24,8 g.

In the Nyborg Fjord several breeding ♀♀ of *Mysis vulgaris* were found already on April 14th; on May 11th the most of the wintered individuals had reached maturity, but no young had yet appeared. In July and August large breeding ♂♂ and ♀♀ measuring 12 and 14 mm respectively were found, and besides these also a number of young, the most of which were newly hatched; in a sample from Kerteminde the largest young measured about 6 mm on August 18th. During November and January no mature *Mysis vulgaris* were found; whether the summer-stock reached maturity before the breeding period ceased could not be substantiated. This species is found in the shallow water close to the shore; during the winter this more hardly form predominates among all other crustaceans in the shallow waters of Svendborg Sound and the Nyborg Fjord.

The wintered stock of *Macropsis Slabberi* in the Nyborg Fjord had on April 11th not yet reached maturity. On June 30th only large breeding individuals measuring 10—12 mm and all belonging to the winter-stock were found by Samsø, but about the end of August, when this species immigrates in great numbers to the low waters of the Nyborg Fjord, a great stock of smaller breeding individuals measuring 7—10 mm as well as several breeding individuals measuring up to 14 mm in length were found; the former of these belong without doubt to the summer-stock. The breeding period ceased in October, as no breeding individuals were found during the winter months.

Mysis mixta has been examined earlier by Apstein (see page 2); by means of a quantitative fishing implement about 6000 individuals of this species were caught outside the Nyborg Fjord on August 25th 1913 just above the sea bottom on an area of 50 sq. metres, which gives 120 individuals per sq. metre.

Resumé.

Our 3 common species of *Mysidæ*: *Mysis inermis, flexuosa* and *neglecta* are all annual. The breeding period of the first named species lasts from the end of April till the end of October, of *flexuosa* from the middle of May till some time in October, and of *neglecta* from the end of May till the end of October. The wintered individuals — the winter-stock — all die off in the course of July—August; before this each ♀ hatches up to 3 broods of eggs. The winter-stock of *Mysis inermis* produces at the most 3 generations, the other two species 2 generations. In opposition to the winter-stock all the mysids, which have not yet wintered, are called the summer-stock. The young of these 3 species born earliest in the year appear at the end of May, the beginning of June and the end of June respectively; they reach maturity in the beginning of July, the middle of July and the end of July respectively. The earliest born ♀♀ of the summer-stock of *Mysis inermis* may each produce up to 5 broods of young, whereas each ♀ of the summer-stock of the two other species can only hatch 2 broods. The ♀♀ of the summer-stock always reach maturity at a much smaller size than the ♀♀ of the winter-stock, and for this reason the first named were usually very easy to distinguish from the last named. A number of the ♀♀ of the summer-stock may, however, be assumed to winter and resume breeding in the beginning of the breeding period of the following year.

During the warmest summer-time the period of incubation of *Mysis inermis* lasted a little more than 2 weeks, and of the other two species about 3 weeks, but at the beginning and at the end of the breeding period most often about 4 weeks, and at times even 5 weeks elapsed. Immediately subsequent to each hatching in the breeding period a new deposition of eggs took place.

The growth (figs. 11 and 12) proceeds slowly during the winter and quickly during the summer. The ♀♀ grow quicker and become larger than the ♂♂. The mysids born earliest in the year reached maturity in the course of about $1^1/_2$ months; in regard to those born later in the year a longer time elapsed before maturity was reached.

The mating has not been observed. Every new deposition of eggs was combined with a moulting of the ♀. The number of eggs, which each ♀ deposits, is dependent partly on the size of the mother animal and partly on the season of the year; the larger the ♀♀ were at the same time of the year, the greater was the number of eggs to be found in their incubatory pouches, whereas the later in the year the egg-laying took place, the smaller was the number of eggs each ♀ of the same size got. See furthermore the tables pages 79, 86 and 90.

According to calculations made, a pair of mysids of the winter-stock would in the course of one breeding period be able to produce the following number of young:

Mysis inermis:	1306	individuals	(3 generations)
Mysis flexuosa:	764	—	(2 —)
Mysis neglecta:	588	—	(2 —)

The food consists of detritus, fresh plants and animal nourishment. On feeding the mysids in aquaria with mussels and fresh algæ it was observed that less was

consumed during the winter than during the summer. The „useful effect“ varied between $^1/_{12}$ and $^1/_{11}$ (page 95—96).

The **annual production** in the Nyborg Fjord can be estimated at abt. 2,51 g (rough weight) per sq. metre as a minimum value. In other Danish fjords there have been found up to 8,1 g mysids per sq. metre. The biology of different other Danish mysids corresponds very closely to that of the species treated here; the same refers to *Mysis mixta* examined in the Baltic Sea by Apstein.

On the Biology of some other Crustaceans from fresh and salt Waters.

As a comparison to the biology of the above treated amphipods and mysids the following litterature on the biological conditions of other crustaceans may finally be stated here.

Th. Mortensen (17) has proved through measurements and aquarium observations that our common prawn, *Palæmon Fabricii* Rtk. is at the least biennial; it breeds from the beginning of May till the end of July or the beginning of August. Many of the ♀♀, especially the large individuals, produce 2 broods of eggs in the breeding period, the one immediately succeeding the other, and the ♀♀ moult immediately before depositing their eggs; the hatching of the eggs at the beginning of a breeding period lasts about one month, but according to the author's statement it is probably shorter the warmer the water is. The growth proceeds only during the warm season and the prawns reach maturity when 1 year old. The mating has not been observed; the number of eggs increases with the size of the mother animal and varies from 300 to abt. 2600 with each ♀.

Ehrenbaum (7, 1890) has examined the shrimp, *Crangon vulgaris* Fabr., by the Northsea coast of Germany. Every year two ovipositions take place, viz. in April—June and in October—November. The hatching of the eggs during the summer lasts 4 weeks, but during the winter it lasts 4—5 months. The author is of the opinion that the shrimp may reach an age of 3 years and that it becomes mature when about 1 year old. Each ♀ lays about 5000 eggs. With this species the moulting takes place immediately prior to the oviposition, and each ♀ produces two broods of eggs in succession. The material published from this paper is, however, hardly sufficient to serve convincing as to the correctness of the author's conclusion. According to Monaghan (16) the shrimp by the English coast seems most essentially to breed during April—August.

Williamson (26, 1900 and 1904) examined the Edible Crab *(Cancer pagurus* L.) from the North Sea by means of measurements and in aquaria. The mating takes place during the autumn subsequent to the female's moult. The eggs are not laid until the following winter (November—January), about 14 months later, and the hatching of the eggs lasts about half a year. Each ♀ lays from 460 000 to 3 000 000 eggs. The animals are mature in their 6th year, and they can live till they are 9 year old.

The same author (26, 1903) relates in reference to the Shore Crab *(Carcinus mænas* Leach), that it lays eggs throughout the whole year, but mainly during the summer. Mating does not take place until the moulting of the ♀ is at an end. Moulting takes place more often during the summer than during the winter. The animals reach maturity in their second year. They only seem to get eggs once a year, and reach an age of about 4 years.

Regarding our common lobster *(Homarus vulgaris* M.Edv.) an extensive literature is to be found, especially by Ehrenbaum (7, 1903) and Appellof (1). By Norway's coast this species reaches maturity when about 5 years old, and the mature ♀♀ moults every other year, in the Kattegat every year (Trybom). Also the oviposition takes places every other year in Norway; by England, Scotland and Helgoland, however, probably every year (Cunningham, Williamson, Ehrenbaum). Subsequent to the hatching of the young the moult takes place; the mating has not been observed, but most probably it takes place immediately after the female's moult (Ehrenbaum (7)). The eggs are laid during the summer and the hatching lasts about 1 year.

Regarding the crayfish *(Astacus fluviatilis* Fabr.) too an extensive literature is to be found, especially by authors as Huxley, Drøscher, Schikora, Trybom and Nordqvist. This species is said to reach an age of about 10 years. The ♂ probably reaches maturity already at the age of 3 years, and the ♀ at the age of 4 years; the moulting of the mature individuals takes place only once (♀) or twice (♂) annually, with the young much oftener. The eggs are laid 13—14 days after mating, which takes place during the autumn (November—December). The hatching of the eggs lasts 6 months, and of the 60—200 eggs, which each adult ♀ lays every year, only 12—20 young are produced. According to Nordqvist the crayfish grows much slower in Sweden than farther southward as e. g. in Germany.

In reference to *Eupagurus prideauxii* Leach from Naples, P. Mayer (15) writes that it has no certain breeding period; he has not observed the fertilization, but is of the opinion that it takes place on the outside, the spermatophores being attached to the ♀ while its ovarial eggs are still immature. The eggs are then not laid before the hatching of the preceeding brood of young is completed, and is independent of moulting or antecedent mating.

M. Faxon (10, pages 303—330) has observed that the ♀ of *Palæmonetes vulgaris* always moulted a few hours subsequent to having hatched its young, and usually during the night.

Kaulbersz (13) has made some aquarium observations on *Asellus aquaticus* in Munich. In the aquaria this species continued breeding throughout the year, but in the free nature the first copulating individuals were observed in January—February and were seldom found later than October—November; if then placed in an aquarium they would immediately commence copulating. The ♀ carries the ♂ in a kind of „riding-position“ for 6—8 days, after which mating takes place, the ♂ and ♀ turning over with their ventral sides towards each other. After each completed copulation the ♀ moults; the young are hatched in the course of 3—4 weeks;

when the young are hatched, the ♀ moults again. The moult of either sex is otherwise dependent on age, temperature and amount of nourishment.

From what is stated in the foregoing it will be observed that the temperature is one of the most important biological factors in the biology of all the examined species of crustaceans. By a higher temperature moulting takes place oftener, and accordingly the growth proceeds quicker than by a lower temperature, and therefore the breeding activity is promoted or even only takes place during the warm time. A feature common for all the crustaceans is furthermore that the number of eggs in the ♀ increases with the size of the mother animal. It seems also to be the usual rule that the larger species live longer, propagate more seldom and require a longer period of hatching than the smaller species. The mating, as regards the ♀♀ of most of the species, seems to take place after a moult, and the hatching of the young seems always to be followed by the moulting of the mother animal. However, for numerous and often very common species such biological details are wanting by means of which these matters can be judged with certainty.

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Table 3.

Measurements in mm of *Mysis*

mm	Jan. 21. 1918.			Febr. 20. 1917.			March 7. 1918.			April 14. 1917.			April 20.–24. 1918.				May 15. 1918.			June 4. 1917.			Jun
	♂	♀ without eggs	Young	♂	♀ without eggs	Young	♂	♀ without eggs	Young	♂	♀ without eggs	Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ with eggs	♀ without eggs	♂	♀ with eggs	♀ without eggs	♂
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	—	—	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	37	—	—	—	—	—	11	—	—	—	—	—	—	1	—	—	—	—	—	—	—
6	—	—	83	—	—	5	1	—	34	—	—	1	—	—	—	—	—	—	—	—	—	—	1
7	6	—	126	8	1	17	8	3	87	5	2	6	1	—	—	1	—	—	—	—	—	—	1
8	46	—	148	38	6	47	49	23	70	17	25	10	2	—	—	12	—	—	—	—	—	—	—
9	60	1	139	46	19	28	65	59	12	34	36	7	24	—	—	43	3	—	3	—	—	—	—
10	17	6	37	43	66	7	35	60	1	55	52	1	41	—	20	51	18	—	9	15	—	—	1
11	—	7	4	19	32	—	1	26	—	34	52	—	79	—	45	22	35	—	10	41	—	6	1
12	—	4	—	2	7	—	—	1	—	12	29	—	34	—	74	7	10	12	14	24	6	8	1
13	—	—	—	—	—	—	—	—	—	1	12	—	4	3	56	—	—	32	8	—	47	6	1
14	—	—	—	—	—	—	—	—	—	—	1	—	—	3	20	—	—	9	2	—	35	1	—
15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	10	—	—
	129	18	579	156	131	104	159	172	215	158	209	25	185	6	215	137	66	54	46	80	98	21	6

from the Nyborg Fjord.

…ly 3. 1917.				August 13. 1917.				August 30. 1917.				September 24. 1917.				October 16.–19. 1917.				Novbr. 13. 1917.			Dcbr. 11. 1917.		
[illegible]	♀ with eggs	♀ without eggs	Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ without eggs	Young	♂	♀ without eggs	Young
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	6	—	—	—	8	—	—	—	13	—	—	—	10	—	—	—	—	—	—
	—	—	17	—	—	—	29	—	—	—	17	—	—	—	47	—	—	—	26	—	—	—	—	—	2
	—	—	27	—	—	—	37	—	—	—	62	—	—	—	76	—	—	—	34	—	—	8	—	—	13
	—	—	17	—	—	—	31	—	—	—	68	—	—	—	67	—	—	—	49	—	—	66	—	—	36
[illegible]	—	—	6	1	—	—	14	6	—	—	32	—	—	—	106	—	—	—	69	—	—	131	—	—	74
	—	30	6	4	—	—	7	33	22	2	8	2	—	—	98	—	—	—	89	5	—	226	3	—	110
[illegible]	1	87	—	119	—	4	—	20	34	4	6	11	4	1	20	1	3	1	44	6	4	284	25	1	115
[illegible]	10	59	—	35	7	14	—	—	15	2	2	6	15	4	5	7	8	8	13	7	21	69	22	11	43
—	9	9	—	6	36	2	—	—	1	—	—	—	12	3	2	1	3	7	2	3	23	—	—	16	—
[illegible]	—	—	—	2	10	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
	3	—	—	—	5	1	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
[illegible]	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
[illegible]	29	185	73	167	58	22	124	59	72	8	203	19	31	8	436	9	15	17	336	21	48	784	50	28	393

om the Nyborg Fjord.

	July 23.—31. 1917.				August 15. 1917.				August 30. 1916.				September 13. 1917.				October 2. 1917.				Okt. 16.–19. 1917.		
Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ without eggs	Young
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	2	—	—	—	—	—	—	—
8	—	—	—	2	—	—	—	—	—	—	—	1	—	—	—	4	—	—	—	—	—	—	—
1	—	—	—	2	—	—	—	1	—	—	—	3	—	—	—	4	—	—	—	3	—	—	1
—	—	—	—	3	—	—	—	1	—	—	—	6	—	—	—	3	—	—	—	—	—	—	1
—	—	—	—	4	—	—	—	6	—	—	—	22	—	—	—	4	—	—	—	5	—	—	[illegible]
—	—	—	—	5	—	—	—	7	—	—	—	34	—	—	—	15	—	—	—	—	—	—	[illegible]
—	1	—	—	7	—	—	—	17	—	—	—	58	—	—	—	14	—	—	—	8	—	—	[illegible]
—	2	—	—	9	—	—	—	45	—	—	—	75	—	—	—	16	—	—	—	—	—	—	[illegible]
—	3	—	2	2	—	—	—	70	—	—	—	108	—	—	—	26	—	—	—	10	—	—	[illegible]
—	2	—	4	—	1	—	—	54	1	—	—	168	—	—	—	38	—	—	—	28	—	—	[illegible]
—	2	—	2	—	18	—	2	35	32	—	—	259	3	—	—	83	3	—	—	75	3	1	[illegible]
—	2	—	4	—	24	—	2	24	70	1	1	170	5	—	3	60	19	—	1	115	13	1	[illegible]
—	2	3	2	—	3	12	2	5	50	5	2	95	4	—	3	27	29	—	2	177	16	1	[illegible]
—	—	8	—	—	—	11	1	1	10	16	8	44	3	1	5	6	34	1	14	142	14	4	[illegible]
—	—	2	—	—	—	2	3	—	2	26	12	16	1	2	5	—	1	3	23	56	5	7	[illegible]
—	—	—	—	—	—	1	—	—	1	9	4	1	—	—	—	—	—	1	9	10	1	1	[illegible]
—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	3	—	—	—
—	—	—	—	—	1	—	1	—	—	5	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	2	—	—	—	2	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	4	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	2	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	14	21	14	34	47	31	11	266	166	65	27	1062	16	3	16	303	86	5	50	632	52	15	6[illegible]

Table 4.

Measurements in mm. of M

mm.	January 21.–28. 1918.			Febr. 16. 1917.			March 12. 1918.			April 14. 1917.		May 15. 1918.			June 4. 1917.			June 25. 1917.			
	♂	♀ without eggs	Young	♂	♀ without eggs	Young	♂	♀ without eggs	Young	♂	♀ without eggs	♂	♀ with eggs	♀ without eggs	♂	♀ with eggs	♀ without eggs	♂	♀ with eggs	♀ without eggs	Young
																					*)
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	67
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10	—	—	1	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
11	—	—	2	1	—	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
12	—	—	—	8	—	6	—	—	—	2	2	—	—	—	—	—	—	—	—	—	—
13	1	1	—	6	2	5	1	—	1	4	1	—	—	—	1	—	—	—	—	—	—
14	1	5	—	2	7	2	1	1	—	6	3	—	—	—	—	—	—	—	—	—	—
15	2	3	—	7	7	—	1	3	—	7	5	—	—	—	1	—	—	—	—	—	—
16	2	1	—	9	15	—	4	2	—	13	5	—	—	—	1	—	—	—	—	—	—
17	13	3	—	11	20	—	11	1	—	16	6	—	—	1	1	—	—	1	—	—	—
18	18	6	—	18	24	—	27	7	—	25	17	2	—	1	7	2	—	7	—	—	—
19	18	7	—	16	27	—	18	17	—	26	22	3	—	3	8	5	1	9	—	1	—
20	3	12	—	4	31	—	8	24	—	24	36	5	—	2	7	7	—	8	3	1	—
21	1	16	—	[illegible]	27	—	2	22	—	7	44	2	—	2	3	10	3	3	10	3	—
22	—	2	—	—	14	—	—	12	—	3	30	—	6	2	2	20	2	2	21	2	—
23	—	—	—	—	1	—	—	1	—	—	21	—	11	2	—	12	—	—	13	1	—
24	—	—	—	—	—	—	—	—	—	—	2	—	3	—	—	7	—	—	8	—	—
25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	3	—	—
26	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	59	56	3	83	175	22	73	90	1	133	194	12	20	13	31	65	6	30	58	8	77

*) Among these also *M. neglecta.*

Nyborg Fjord.

7.	Aug. 11. 1916.				Septbr. 13. 1917.				Septbr. 27. 1916.				Octbr. 19. 1917.				Novbr. 191	
Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ with eggs
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—
1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	8	—	—
1	—	—	—	1	—	—	—	4	—	—	—	1	—	—	—	11	—	—
2	—	—	—	15	—	—	—	10	—	—	—	3	—	—	—	13	—	—
4	—	—	—	25	—	—	—	5	—	—	—	7	—	—	—	6	—	—
2	—	—	—	30	—	—	—	17	—	—	—	10	—	—	—	14	—	—
1	—	—	—	88	—	—	—	23	—	—	—	13	—	—	—	13	—	—
1	—	—	—	117	—	—	—	48	—	—	—	22	—	—	—	28	—	—
2	3	—	5	108	—	—	—	63	—	—	—	43	—	—	—	36	1	—
1	18	—	24	23	3	1	—	33	1	—	—	93	—	—	—	71	3	—
—	1	—	10	3	4	1	1	19	3	—	—	121	12	—	—	78	12	—
—	—	4	7	—	3	3	1	5	5	—	1	92	19	—	1	30	29	—
—	14	1	—	—	—	4	1	—	—	—	8	30	3	—	33	17	17	7
—	23	1	—	—	1	2	1	—	1	3	10	7	1	—	20	—	1	20
—	27	—	—	—	2	1	—	—	—	3	3	—	—	—	2	—	2	10
—	3	4	1	—	—	1	—	—	—	2	1	—	—	—	2	—	—	—
—	—	13	3	—	—	—	—	—	—	1	4	—	—	—	2	—	1	1
—	—	26	3	—	—	—	—	—	—	2	3	—	—	1	—	—	—	1
—	—	8	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
15	89	57	54	410	13	13	4	228	10	11	32	442	35	1	60	326	66	39

Table 3.

Measurements in mm of *Mysis*

mm	Jan. 21. 1918. ♂	Jan. 21. 1918. ♀ without eggs	Jan. 21. 1918. Young	Febr. 20. 1917. ♂	Febr. 20. 1917. ♀ without eggs	Febr. 20. 1917. Young	March 7. 1918. ♂	March 7. 1918. ♀ without eggs	March 7. 1918. Young	April 14. 1917. ♂	April 14. 1917. ♀ without eggs	April 14. 1917. Young	April 20.-24. 1918. ♂	April 20.-24. 1918. ♀ with eggs	April 20.-24. 1918. ♀ without eggs	April 20.-24. 1918. Young	May 15. 1918. ♂	May 15. 1918. ♀ with eggs	May 15. 1918. ♀ without eggs	June 4. 1917. ♂	June 4. 1917. ♀ with eggs	June 4. 1917. ♀ without eggs	Ju… ♂
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	—	—	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	37	—	—	—	—	—	11	—	—	—	—	—	—	1	—	—	—	—	—	—	—
6	—	—	83	—	—	5	1	—	34	—	—	1	—	—	—	—	—	—	—	—	—	—	1
7	6	—	126	8	1	17	8	3	87	5	2	6	1	—	—	1	—	—	—	—	—	—	1
8	46	—	148	38	6	47	49	23	70	17	25	10	2	—	—	12	—	—	—	—	—	—	—
9	60	1	139	46	19	28	65	59	12	34	36	7	24	—	—	43	3	—	3	—	—	—	—
10	17	6	37	43	66	7	35	60	1	55	52	1	41	—	20	51	18	—	9	15	—	—	1
11	—	7	4	19	32	—	1	26	—	34	52	—	79	—	45	22	35	—	10	41	—	6	1
12	—	4	—	2	7	—	—	1	—	12	29	—	34	—	74	7	10	12	14	24	6	8	1
13	—	—	—	—	—	—	—	—	—	1	12	—	4	3	56	—	—	32	8	—	47	6	1
14	—	—	—	—	—	—	—	—	—	—	1	—	—	3	20	—	—	9	2	—	35	1	—
15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	10	—	—
	129	18	579	156	131	104	159	172	215	158	209	25	185	6	215	137	66	54	46	80	98	21	6

from the Nyborg Fjord.

[illegible]ly 3. 1917.				August 13. 1917.				August 30. 1917.				September 24. 1917.				October 16.–19. 1917.				Novbr. 13. 1917.			Dcbr. 11. 1917		
[illegible]	♀ with eggs	♀ without eggs	Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ without eggs	Young	♂	♀ without eggs	Young
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	6	—	—	—	8	—	—	—	13	—	—	—	10	—	—	—	—	—	—
—	—	—	17	—	—	—	29	—	—	—	17	—	—	—	47	—	—	—	26	—	—	—	—	—	2
—	—	—	27	—	—	—	37	—	—	—	62	—	—	—	76	—	—	—	34	—	—	8	—	—	13
[illegible]	—	—	17	—	—	—	31	—	—	—	68	—	—	—	67	—	—	—	49	—	—	66	—	—	36
[illegible]	—	—	6	1	—	—	14	6	—	—	32	—	—	—	106	—	—	—	69	—	—	131	—	—	74
[illegible]	—	30	6	4	—	—	7	33	22	2	8	2	—	—	98	—	—	—	89	5	—	226	8	—	110
[illegible]	1	87	—	119	—	4	—	20	34	4	6	11	4	1	20	1	3	1	44	6	4	284	25	1	115
—	10	59	—	35	7	14	—	—	15	2	2	6	15	4	5	7	8	8	13	7	21	69	22	11	45
—	9	9	—	6	36	2	—	—	1	—	—	—	12	3	2	1	3	7	2	3	23	—	—	16	—
[illegible]	—	—	—	2	10	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
—	3	—	—	—	5	1	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
—	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
[illegible]	29	185	73	167	58	22	124	59	72	8	203	19	31	8	436	9	15	17	336	21	48	784	50	28	393

…om the Nyborg Fjord.

July 23.—31. 1917.				August 15. 1917.				August 30. 1916.				September 13. 1917.				October 2. 1917.				Okt. 16.–19. 1917.			Novbr. 20. 1916.			Decbr. 11. 1917.	
♂	♀ with eggs	♀ without eggs	Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ without eggs	Young	♂	♀ without eggs	Young	♂	♀ without eggs
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	2	—	—	—	—	—	—	—	1	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	2	—	—	—	1	—	—	—	3	—	—	—	4	—	—	—	3	—	—	1	—	—	—	—	—
—	—	—	3	—	—	—	1	—	—	—	6	—	—	—	3	—	—	—	—	—	—	1	—	—	—	—	—
—	—	—	4	—	—	—	6	—	—	—	22	—	—	—	4	—	—	—	6	—	—	2	—	—	—	—	—
—	—	—	5	—	—	—	7	—	—	—	34	—	—	—	15	—	—	—	—	—	—	2	—	—	—	—	—
1	—	—	7	—	—	—	17	—	—	—	58	—	—	—	14	—	—	—	8	—	—	2	—	—	2	—	—
2	—	—	9	—	—	—	45	—	—	—	75	—	—	—	16	—	—	—	—	—	—	2	—	—	1	—	—
3	—	2	2	—	—	—	70	—	—	—	108	—	—	—	26	—	—	—	10	—	—	3	—	—	2	—	—
2	—	4	—	1	—	—	54	1	—	—	168	—	—	—	38	—	—	—	28	—	—	7	—	—	2	—	—
2	—	2	—	18	—	2	35	32	—	—	259	3	—	—	83	3	—	—	75	3	1	5	12	—	7	1	[illegible]
2	—	4	—	24	—	2	24	70	1	1	170	5	—	3	60	19	—	1	115	13	1	4	19	—	11	2	[illegible]
2	3	2	—	3	12	2	5	50	5	2	95	4	—	3	27	29	—	2	137	16	1	7	32	—	22	6	[illegible]
—	8	—	—	—	11	1	1	10	16	8	44	3	1	5	6	34	1	14	142	14	4	13	46	15	16	7	[illegible]
—	2	—	—	—	2	3	—	2	26	12	16	1	2	5	—	1	3	23	56	5	7	12	25	51	2	4	[illegible]
—	—	—	—	—	1	—	—	1	9	4	1	—	—	—	—	—	1	9	10	1	1	2	8	48	—	1	[illegible]
—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	8	—	—	—	—	11	—	—	[illegible]
—	—	—	—	1	—	1	—	—	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	—	—	[illegible]
—	2	—	—	—	2	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	[illegible]
—	4	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	[illegible]
—	2	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	[illegible]
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	[illegible]
14	21	14	34	47	31	11	266	166	65	27	1062	16	3	16	303	86	5	50	632	52	15	63	142	134	65	[illegible]	[illegible]

Table 4.

Measurements in mm. of *Mysis flexuosa*

mm	January 21.–28. 1918.			Febr. 16. 1917.			March 12. 1918.			April 14. 1917.		May 15. 1918.			June 4. 1917.			June 25. 1917.				July 5. 1916.			
	♂	♀ without eggs	Young	♂	♀ without eggs	Young	♂	♀ without eggs	Young	♂	♀ without eggs	♂	♀ with eggs	♀ without eggs	♂	♀ with eggs	♀ without eggs	♂	♀ with eggs	♀ without eggs	Young *)	♂	♀ with eggs	♀ without eggs	Young
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9	—	—	—	1
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	67	—	—	—	6
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	12
6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10	—	—	1	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
11	—	—	2	1	—	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
12	—	—	—	8	—	6	—	—	—	2	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—
13	1	1	—	6	2	5	1	—	1	4	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—
14	1	5	—	2	7	2	1	1	—	6	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—
15	2	3	—	7	7	—	1	3	—	7	5	—	—	—	1	—	—	—	—	—	—	—	—	—	—
16	2	1	—	9	15	—	4	2	—	13	5	—	—	—	1	—	—	—	—	—	—	—	—	—	—
17	13	3	—	11	20	—	11	1	—	16	6	—	—	1	1	—	—	1	—	—	—	—	—	—	—
18	18	6	—	18	24	—	27	7	—	25	17	2	—	1	7	2	—	7	—	—	—	—	—	—	—
19	18	7	—	16	27	—	18	17	—	26	22	3	—	3	8	5	1	9	—	1	—	3	—	—	—
20	3	12	—	4	31	—	8	24	—	24	36	5	—	2	7	7	—	8	3	1	—	14	—	—	—
21	1	16	—	[illegible]	27	—	2	22	—	7	44	2	—	2	3	10	3	3	10	3	—	11	2	—	—
22	—	2	—	—	14	—	—	12	—	3	30	—	6	2	2	20	2	2	21	2	—	6	11	3	—
23	—	—	—	—	1	—	—	1	—	—	21	—	11	2	—	12	—	—	13	1	—	3	21	1	—
24	—	—	—	—	—	—	—	—	—	—	2	—	3	—	—	7	—	—	8	—	—	—	23	2	—
25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	3	—	—	—	15	1	—
26	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	1	—
	59	56	3	83	175	22	73	90	1	133	194	12	20	13	31	65	6	30	58	8	77	37	75	8	23

*) Among these also *M. neglecta.*

Table 5.

Measurements in mm of *Mysis*

	Jan. 21.–28. 1918.			Febr. 20. 1917.			March 7.–12. 1918.			April 14. 1917.		May 15. 1918.		June 4. 1917.			June 25. 1917.			
mm	♂	♀ without eggs	Young	♂	♀ without eggs	Young	♂	♀ without eggs	Young	♂	♀ without eggs	♂	♀ without eggs	♂	♀ with eggs	♀ without eggs	♂	♀ with eggs	♀ without eggs	Young *)
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	67
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—
8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9	—	—	1	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10	—	—	1	—	—	2	—	—	1	1	1	—	—	—	—	—	—	—	—	—
11	1	—	1	—	1	3	—	—	1	2	1	2	1	—	—	—	—	—	—	—
12	—	—	2	3	3	2	6	—	1	1	1	2	3	—	—	1	—	—	—	—
13	2	—	—	4	4	—	8	—	3	1	2	2	4	1	—	3	—	—	—	—
14	2	3	—	11	9	—	16	1	2	6	5	11	4	4	—	2	2	—	1	—
15	4	4	—	10	13	—	7	7	1	14	12	16	8	10	—	2	8	—	2	—
16	2	2	—	5	13	—	—	9	—	8	17	11	7	14	1	3	4	1	4	—
17	—	1	—	—	5	—	—	5	—	1	18	2	16	4	6	6	4	8	3	—
18	—	—	—	—	1	—	—	—	—	—	8	—	28	2	18	5	3	12	3	—
19	—	—	—	—	—	—	—	—	—	—	2	—	7	—	20	4	1	27	3	—
20	—	—	—	—	—	—	—	—	—	—	—	—	1	—	9	1	—	36	2	—
21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	2	—	—
22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	11	10	5	33	49	9	37	22	10	34	67	46	79	35	55	27	22	86	18	77

*) Among these also *M. flexuosa*.

Nyborg Fjord.

…7.	Aug. 11. 1916.				Septbr. 13. 1917.				Septbr. 27. 1916.				Octbr. 19. 1917.				Novbr. 13.—20. 1917.			Decbr. 11. 1917.		
Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ with eggs	♀ without eggs	Young	♂	♀ without eggs	Young	♂	♀ without eggs	Young
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	8	—	—	1	—	—	—
1	—	—	—	1	—	—	—	4	—	—	—	1	—	—	—	11	—	—	4	—	—	—
2	—	—	—	15	—	—	—	10	—	—	—	3	—	—	—	13	—	—	23	—	—	—
4	—	—	—	25	—	—	—	5	—	—	—	7	—	—	—	6	—	—	27	—	—	—
2	—	—	—	30	—	—	—	17	—	—	—	10	—	—	—	14	—	—	16	—	—	—
1	—	—	—	88	—	—	—	23	—	—	—	13	—	—	—	13	—	—	25	—	—	1
1	—	—	—	117	—	—	—	48	—	—	—	22	—	—	—	28	—	—	34	—	—	3
2	3	—	5	108	—	—	—	63	—	—	—	43	—	—	—	36	1	—	40	—	—	5
1	18	—	24	23	3	1	—	33	1	—	—	93	—	—	—	71	3	—	58	—	—	4
—	1	—	10	3	4	1	1	19	3	—	—	121	12	—	—	78	12	—	61	2	—	2
—	—	4	7	—	3	3	1	5	5	—	1	92	19	—	1	30	29	—	73	9	—	12
—	14	1	—	—	—	4	1	—	—	—	8	30	3	—	33	17	17	7	65	11	—	24
—	23	1	—	—	1	2	1	—	1	3	10	7	1	—	20	—	1	20	13	—	1	13
—	27	—	—	—	2	1	—	—	—	3	3	—	—	—	2	—	2	10	4	—	1	4
—	3	4	1	—	—	1	—	—	—	2	1	—	—	—	2	—	—	—	1	—	—	—
—	—	13	3	—	—	—	—	—	—	1	4	—	—	—	2	—	1	1	—	—	—	—
—	—	26	3	—	—	—	—	—	—	2	3	—	—	1	—	—	—	1	—	—	1	—
—	—	8	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—
15	89	57	54	410	13	13	4	228	10	11	32	442	35	1	60	326	66	39	445	22	3	68