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EASONAL OCCURRENCE OF SCYPHOMEDUSAE IN SURFAC WATERS NEAR THE "TEXEL" LIGHTVESSEL

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by

S.M. VAN DER BAAN

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SUMMARY

Five, perhaps six species of Scyphomedusae have been obtained in surface macroplankton catches at the "Texel" lightship. Of these species *Pelagia noctiluca* has been described in a separate paper (VAN DER BAAN, 1967). The others are discussed in their order of appearance in the course of the season.

Cyanea lamarckii had a strobilation period which lasted from early November till early May, with some occasional later

appearances of ephyrae. The medusae appeared in two separate periods, clearly separated after cold winters, more or less overlapping after mild winters, each with its own peak period The medusae of the two periods could be distinguished by thei degree of coloration. Arguments for a hypothetical difference in origin and strobilation time to account for the two peaks of appearence of *C. lamarckii* are given.

Aurelia aurita. The usual strobilation period for *Aureli aurita* lasted from early March to about May. Sometimes it began as early as in January, though with a cold spring the early start tended to miscarry. Even earlier dates have been found in Zeeland. There were 80 separate periods of occurrenc but the numbers rose to a peak in early summer and then declined rather quickly.

Chrysaora hysoscella gave very few ephyrae. The big summer catches must come from elsewhere. The influence of the cold spring of 1963 was visible in all Scyphomedusae, but especially in *Chrysaora*. In 1966 *Chrysaora* was scarce.

Rhizostoma octopus. Young specimens were never collected in the lightship hauls, though the young stages are regularly found in the Wadden Sea. It is plentiful on the Dutch beaches but only present in the lightship hauls in very low numbers in autumn.

Cyanea capillata. Though this species is often recorded from the Dutch beaches, always later and in much lower numbers than *C. lamarckii* it is suggested that some earlier identifications have been wrong and that these records concerned yellow-coloured varieties of *C. lamarckii*. They are found during the later peaks of the *lamarckii* period.

INTRODUCTION

On the 17th January 1961 the sampling of macroplankton at the "Texel" lightship (53°01'N, 4°22'E) started as part of a final check on the arrival of elvers, on behalf of Dr. Creutzberg, with the additional aim of obtaining some information on the occurrence of the younger stages of Scyphomedusae. Though the elver investigation was finished around mid-May the sampling program of macroplankton was continued with some modifications, till the end of 1966. The present paper describes strobilation, peak periods and disappearance of the various species of Scyphomedusae in the course of the year.

MATERIAL AND METHODS

The net used was the one designed for catching elvers by DEELDER (1952) and also used, with a few alterations, by CREUTZBERG (1961). It was made of Saran gauze, of a 2 mm mesh width, the (round) aperture was about 1 m^2, the length 10 m. For a detailed description see CREUTZBERG's paper. It was hauled, emptied and put out again at every turn of the tide, so that one sample represented either a flood- or an ebb- content of macroplankton. Each sample was preserved in formalin and the results of a week's fishing shipped to the Institute by the pilot-boat. Fishing was continuous, weather permitting, that is to say at wind forces op to 5 on the Beaufort scale; over force 5 it was not possible to keep the net in the required position. With favourable weather this resulted in 28 samples per week, to be examined in the laboratory. In the autumn of 1962 the schedule was brought down to 12 samples a week, if possible on consecutive days, and for 1966 - the last year of the research - to 6 samples a week, again consecutive ones, weather permitting.

The above mentioned continuation of the research during the summer months by the same method had one disadvantage. In summer the jelly-fishes got so big and so numerous that they sometimes burst the net when it was being hauled in by the crew. Even when the net was not damaged the catch was often too big to be delivered to the Institute. In that case the crew reported how many buckets full of jellyfish had been thrown overboard and sent some specimens to the laboratory in the usual way. Therefore no exact data on numbers or size can be given for the summer months. If the species under discussi was present in the catches its occurrence is indicated by crosses in the graph. If it concerned other species, or e.g. Hydromedusae or *Phaeocystis* the average for the species under discussion is calculated from the remaining catches.

After December 1962 the water temperature dropped to values below zero in February 1963 (Fig. 1). From 16 Feb. to 13 March 1963 ice-formation around the lightship made fishing impossible.

Acknowledgements - First of all my thanks are due to captains and crews of the Pilotage Service who carried out the fishing program for six years. I am obliged to Dr. J.J. Zijlstra for his suggestions in condensing the graphs and text into publishable size, and for his critical readings of the manuscript, and to the RIVO, IJmuiden for the data on salinity.

LIST OF COLLECTED SCYPHOMEDUSAE

The samples contained the following species of Scyphomedusae (nomenclature according to RUSSELL, 1970).

Order Semaeostomeae

fam. Pelagiidae: *Pelagia noctiluca* (Forskål)

Chrysaora hysoscella (L.)

fam. Cyaneidae: *Cyanea capillata* (L.)
Cyanea lamarckii Péron & Lesueur

fam. Ulmaridae
subfam. Aureliidae: *Aurelia aurita* (L.)

Order Rhizostomeae
fam. Rhizostomatidae: *Rhizostoma octopus* (L.)

Pelagia noctiluca was only found in 1966 and has been discussed in an earlier paper (VAN DER BAAN, 1967), to which we refer. The other five species will be dealt with in the order in which they appear in the plankton in the course of the year.

SEASONAL OCCURRENCE AND DISCUSSION

I. *Cyanea lamarckii* Péron et Lesueur

1. Strobilation

The postephyrae of 2-5 mm (2 mm being the mesh width) and 5-10 mm have been plotted in fig.2c. They were found each year from November (occasionally even earlier) to June, indicating a long strobilation period at temperatures below about 11°C (for temperatures and salinities see fig. 1.). The winters of 1964/65 and '65/'66 seem to have been very successful but the data on temperature and salinity do not give any clue as to a possible cause.

2. Period of occurrence

The other two lines in fig. 2c, give the average catch per time unit for all specimens of *Cyanea lamarckii*, calculated separately for flood and ebb catches. Two facts are obvious:

a. After the specimens caught have all reached a size over 1 cm there comes a period when the species is present in very low numbers or not at all. After that the numbers rise again.

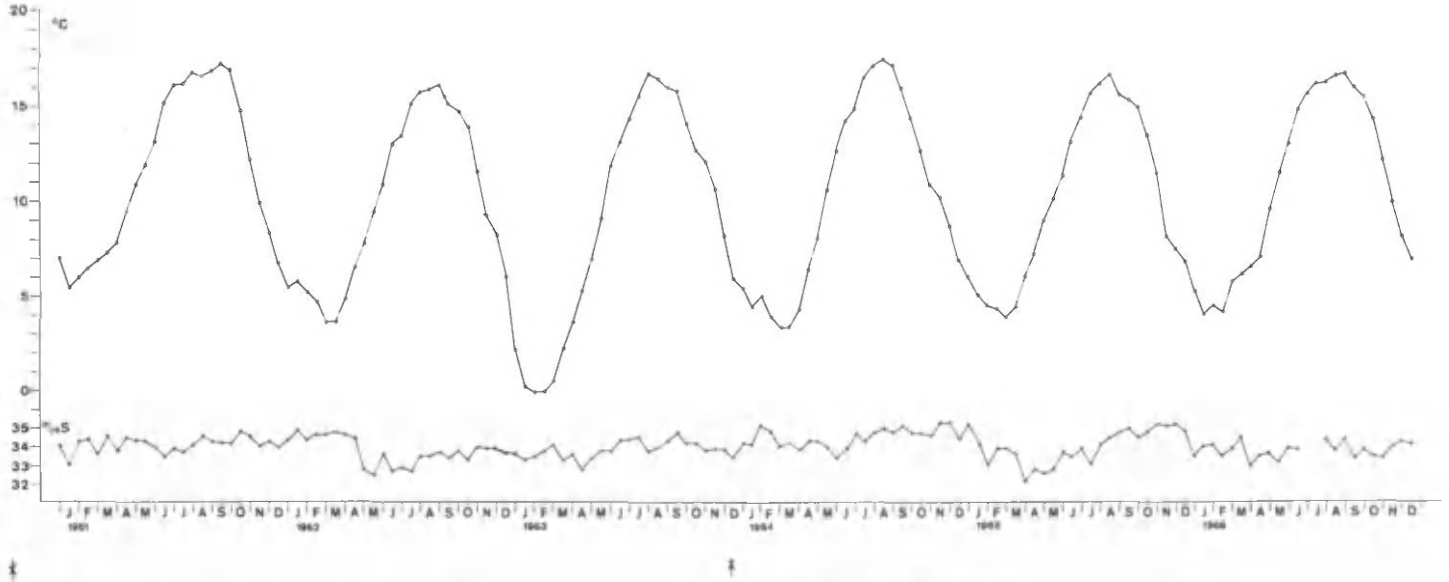
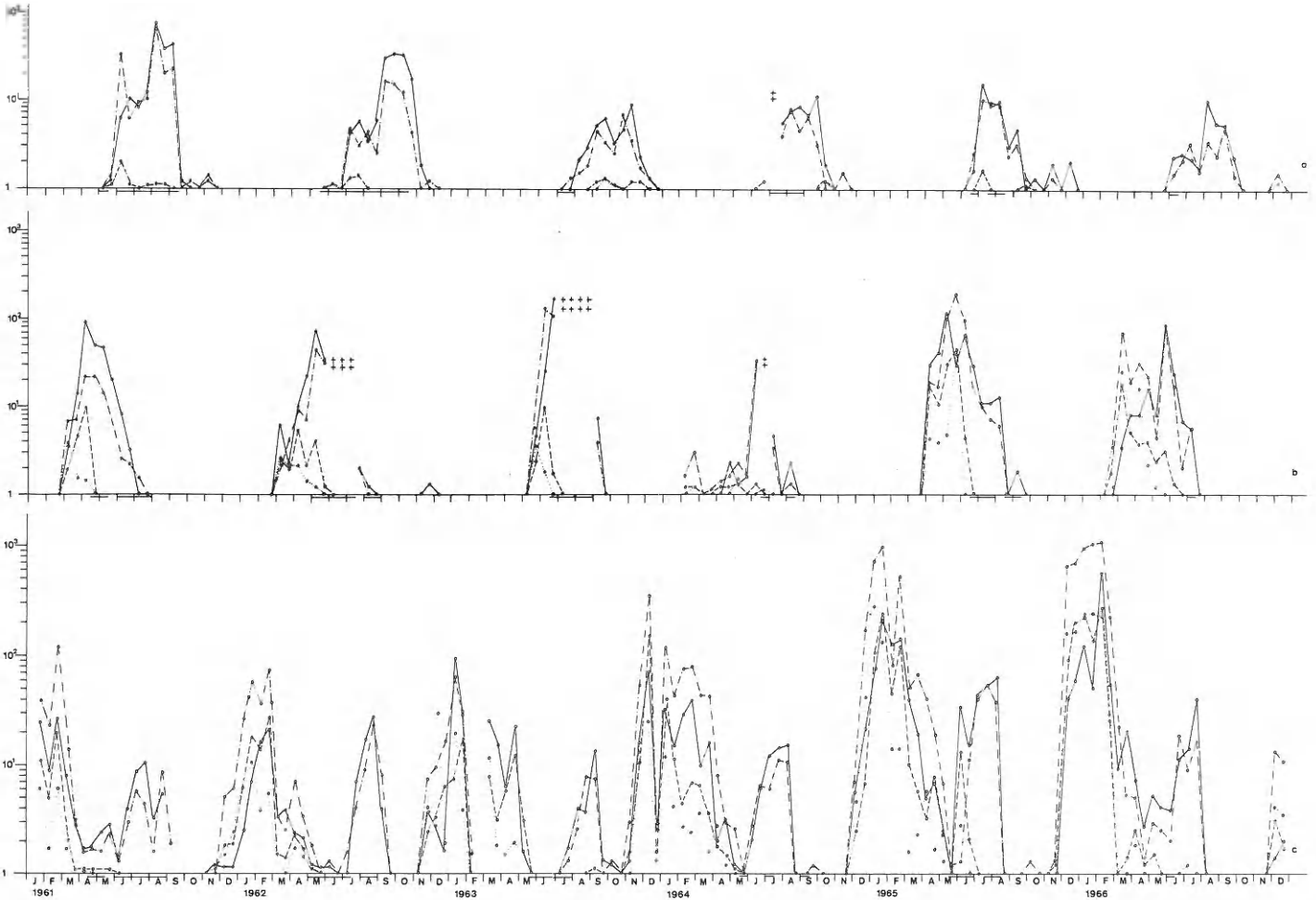


Fig. 1. Average temperature (top) and salinity (bottom) of the surface water around the "Texel" lightship per half month. Temperature calculated from data as published by the KNMI (Meteorological Service); Salinity according to data from the RIVO, IJmuiden, from samples taken daily at the lightship at 8 am.

Fig. 2. Occurrence of *Scyphomedusae* in the "Texel" lightship catches; 1000× average catch per half month divided by the time in minutes the net was in action, plotted as log (n + 1). Ephyra of 3-5 mm Ø (dotted line); (post)ephyra of 6-10 mm Ø (dashed line); average flood catch, all sizes (full drawn line) and average ebb catch, all sizes (chain-dotted line). In the underlined periods some of the catches were thrown overboard. If this probably did not affect the species in question the average has been calculated from the remaining samples, if it did the presence of the species in that period has only been indicated (+). a. *Chrysaora hysoscella*. b. *Aurelia aurita*. c. *Cyanea lamarckii*.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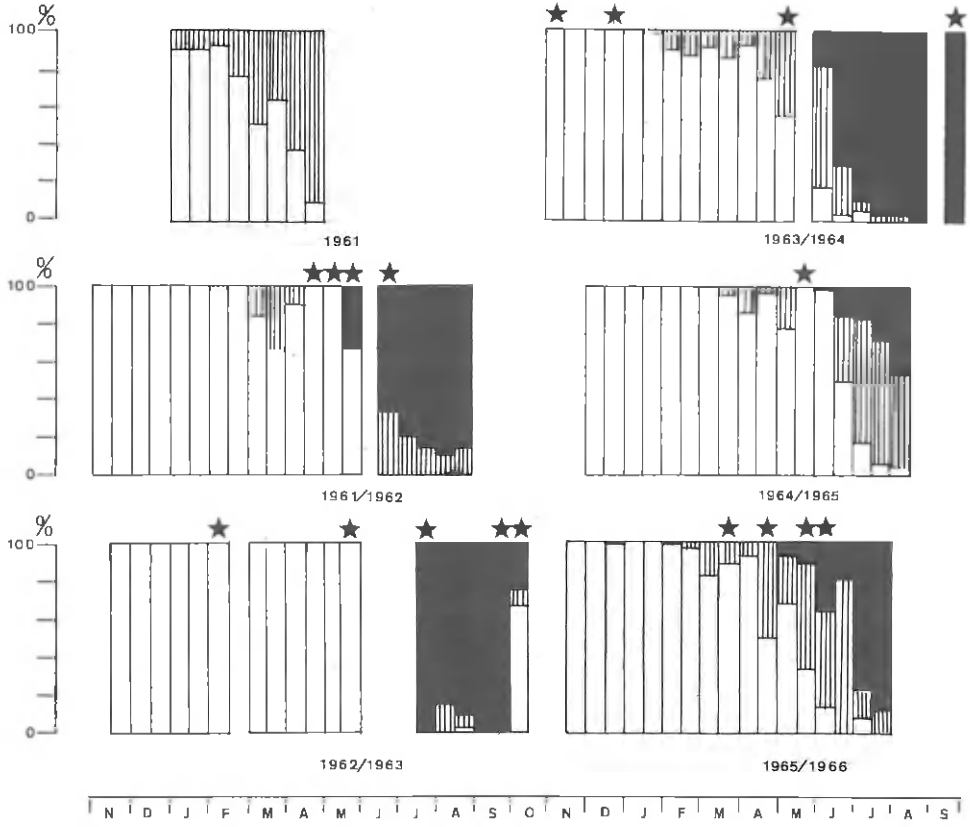

Fig. 3. Coloration of *Cyanea lamarckii*, expressed in percentage of the total catch: colourless (column blank), colour light blue (shaded) or colour dark blue (black). Where the catch consisted of less than ten numbers, this has been indicated by an asterisk.

b. Before the gap, ebb catches outnumber the flood catches, after the gap the reverse is the case.

Another point, which will be dealt with under 3, is that the specimens before and after the gap are of a different colour.

3. Coloration

The youngest stages of *Cyanea lamarckii* are colourless t creamy white. After a time medusae appear with a tiny, light-blue wavy circle around the central disk. At a later stage bl lines are seen, radiating from that circle and then more colour appears gradually, always from a greyish-blue to a clear sky-blue. These *Cyaneas* correspond exactly with the description as given by ØSTERGREN (1909) for *Cyanea palmstruchii* in summer, however, the *Cyanea lamarckii* caught at the lightship is of a darker blue to violet colour.

In fig. 3. I have tried to represent the part played by each stage (colourless, light-blue and dark-blue) in the tota composition of the catch per half month. The summer months of 1961 are left out, because at thattime I was not as yet aware of the possible significance of the various colorations. The data of 1962 are also more or less speculative, but from 1963 onwards the records of *Cyanea lamarckii* have been divided int three parts: colourless, light-blue c.f. *palmstruchii* and dar blue. The distinction between fully coloured light-blue and dark-blue specimens is admittedly somewhat arbitrary.

There is no exact diameter above which all species are of the same degree of coloration, though all specimens of a diameter of less than 1 cm are colourless and so are most of specimens below 3 cm. The upper boundary for total absenced coloration seems to be about 8 cm. For the light-blue coloration there seems to be no upper limit in the range below 13 c

to which most of the collected specimens belonged. I have often noted that even quite large medusae had not got beyond the greyish-blue inner circle. In fact colourless, light-blue and dark-blue specimens may occur together in summer and overlap in all respects. There is no fixed relation between colour and diameter.

There is, at first sight, some connection between colour and temperature. In the extremely cold spring of 1963 all specimens remained colourless, even without the slightest trace of a central circle, till the "gap" had been passed; then the coloured specimens to appear were already quite blue. Since, however all three groups may occur together, even at the higher temperatures, there is neither any fixed temperature for the stage of coloration.

In most years we may say that before the gap in the occurrence of *Cyanea lamarckii* all specimens are either colourless or light-blue and after the gap the dark-blue specimens take over.

This has led me to postulate the following hypothesis. Suppose that there were two stocks of *Cyanea lamarckii*, one strobilating from late autumn to spring and producing medusae with a long-lasting colourless stage. This stock has been described as *Cyanea palmstruchii* by ØSTERGREN (1909) for the Skagerrak. The other stock strobilates in spring and produces medusae which reach the dark-blue stage much more quickly. The former has a more northerly distribution than the latter, but off the Dutch coast the two stocks overlap. In winter and early spring the sea around the "Texel" lightship draws its *Cyaneas* from the first stock, which supply decreases after some time. The dominance of ebb catches in the catches might point to a NE origin, perhaps the Vlieland Rough or "Texelse Stenen"

as it is called in Dutch, a glacial deposit with many stones. In the meantime the second stock has started strobilation. The main distribution of this stock is more to the South (dominant flood catches) and, though some specimens reach the light ship still in the stage of faint coloration the main supply arrives in summer, when it has got a dark-blue colour, together with the last remnants of the first stock.

This hypothesis accounts for the occurrence of the "gap" as well as for the differences in colour and dominant tide before and after the gap. It might also explain why the dates mentioned for the first sightings of *Cyanea lamarckii* and the (very few) data on strobilation are so much later in the year for southern sources than for cf. the coast of Germany and Denmark (vide RUSSELL, 1970, p. 137/138).

The blue *Cyaneas* washed up on our beaches in summer belong mainly to the southern stock, though faintly coloured specimens may be found as late as June. The colourless *Cyanea* in the young stages usually escape the attention of biologica beachcombers, though they may be found if one knows when and where to look for them.

II *Aurelia aurita* (L.) (fig. 2b)

1. Strobilation

The smaller post-ephyrae were found in 1961 and '62 from March onwards, though in 1963, probably because of the low temperatures, they did not arrive before April 23rd. In 1964 some appeared as early as January and then again in March. In 1965 they appeared in March, but 1966 had again some early dates in January. This time the early start was more successful. Therefore we may say that strobilation starts very early in the year, temperatures permitting, but anyhow in March in a

normal winter. Flood catches outnumbered the ebb catches, except in the two years with an early start, when the early ephyræ again show a tendency to arrive with the ebb current.

BAKKER & DE PAUW (1975) found young *Aurelias* in October, November and December in Lake Veere, both in 1965/66 and in 1971/72, but not in January and after. Lake Veere is an enclosed part of a former estuary, with chlorinities of 6-10 °/oo for '65 and '66 and 10-14 °/oo for '71 and '72.

Dr. Bakker informed me that divers claim to have seen the scyphistomas in the lake just opposite Veere. The lack of occurrence of older stages is due to the sampling method by plankton pump.

2. Period of occurrence

As a rule *Aurelia aurita* is extremely numerous in early summer, after which the end comes rather abruptly in July or August and in 1966, after an early start, already in June.

Many of the specimens had fallen to pieces in the net. Moreover, during the peak periods in summer the catch would sometimes burst the net or had to be thrown overboard because of its great bulk. Due to these difficulties the representation in the graph is far from perfect, but it still shows the complete period of occurrence and the peak period. (See the chapter on Material and Methods).

In the larger specimens the hyperiid amphipod *Hyperia galba* may be numerous in the samples, often separate from the medusae. Probably they leave the medusae during fixation, but there are also catches of *Hyperia* without medusae, so there must be a good many free specimens swimming in the sea. Exact numbers cannot be given, as they are most numerous in the months when many catches are lost.

III *Chrysaora hysoscella* (fig. 2a)

1. Strobilation

It is apparent from fig. 2a: a. That post-ephyrae of less than 1 cm diameter were far less numerous than those of the foregoing species and b. that the majority of these post-ephyræ were of the size 6-10 mm. The bulk of the *Chrysaora* medusae certainly come from sources other than the vicinity of the lightship.

In 1963, after the extremely low winter temperatures, *Chrysaora* was late. Specimens of a size of less than 1 mm diameter did not appear before autumn, so that it looks as if that year strobilation took place at falling instead of rising temperatures. This may be one of the causes of the low number in the following years.

2. Period of occurrence

As shown in fig. 2a *Chrysaora* is essentially a summer medusa.

IV *Rhizostoma octopus*

This medusa was regularly collected in very low numbers and only in the larger sizes in autumn. The juvenile stages were never collected at the lightship, though they are regularly found in the Wadden Sea around June.

The occurrence of this species in the Wadden Sea was studied by P. van der Wielen as a post-graduate subject in 1965. Unfortunately his report could not be found, either in the files of the Institute or in those of his University. The research is mentioned in a few lines in the Annual Report for 1965 (Neth. J. Sea Research, 4, 1968, p. 102). From this single year it might be concluded that the strobilation period lasts from mid June to early September. I do not agree with t

assumption, suggested by the above lines, that larger sizes are all lost to the North Sea, because I have seen quite large specimens in the reproductive stage in the Wadden Sea in late summer.

For the time being the preliminary conclusion is that *Rhizostoma* medusæ originate in inshore waters and that only a small part of the larger specimens is to be found in surface waters farther off the coast. Nothing can be said about its possible occurrence below the surface.

V *Cyanea capillata* (L.)

During these last years I have begun to doubt whether this species is so frequent on our coast as recorded by many authors (see hereafter) and whether they - and I also during the macroplankton research - have not mistaken the yellow variety of *lamarckii* (RUSSELL, 1970) for *Cyanea capillata*.

STIASNY (1930), VAN DER MAADEN (1942a, 1942b) and VERWEY (1942) all observed that the yellow-coloured *Cyanea* appeared on the Dutch coast considerably later than the blue one. STIASNY concluded that the brown medusa had passed through a blue stage in his early days and that some of the bigger blue ones represented an "arrested youth" form. He considered the species to be *C. capillata*, with a blue variety called *lamarckii* which was a younger stage or a neotenic variety of the brown one.

VAN DER MAADEN (1942a) gives the matter a closer consideration. He describes a number of specimens which he found on the beach, stressing the fact that the majority of the specmens is always blue. His descriptions strongly suggest colour varieties of *C. lamarckii* (RUSSELL, 1970) such as (I translate from the German original): umbrella blueish, tentacles violet,

gonads rusty brown, lips of manubrium (he calls them mouth-curtains) white, or umbrella and tentacles blueish, gonads pink, lips of manubrium yellowish to brownish, or a brownish pink specimen with blue radial lines etc. He has observed tha the specimens over 400 mm which are brown or brownish white have stronger developed tentacles and manubrial lips, which i obvious since they are better developed. THIEL (1962) has established the relation between numbers of tentacles and diameter. VAN DER MAADEN suggests that these bigger specimens ar the true *C. capillata* and that the rest, with a predominantly blue colour, should be called *C. capillata var. lamarckii*. He does not convince me in his paper that his *capillata* may not be the brownish colour varieties of *lamarckii*, as pictured in RUSSELL's book on Plate VI.

In his own paper of the same year VAN DE MAADEN (1942b) repeats his observations that the blue ones appear earlier in year than the brown ones and that they may disappear somewhat but he is more cautious in this statement than STIASNY. VERWE (1942), took the two colours to represent two different speci on account of the difference in spatial distribution in the sea and in period of occurrence.

The distinctive feature that VAN DER MAADEN and VERWEY used to tell *C. capillata* from *C. lamarckii* was the colour. The lightship's material has been sorted out according to Ver wey's identifications, and yielded a small number of yellow-coloured specimens during the peak of blue-coloured *C. lamarc* always after the "gap" - mentioned in part 3 of the chapter o *Cyanea lamarckii* in this paper - had been passed. The colour was lemon-yellow or white with developing yellow colour, but never the brick-red and dark-brown which is used to describe *capillata*. Though during the research I became acquainted wit

THIEL's (1962) paper on the method of distinguishing the two species by the number of marginal tentacles per group in relation to the age (diameter) of the medusa, this method was too cumbersome to be used in routine identification, so that the species were identified by colour only. The jelly-fish material has not been kept, mainly owing to lack of storage space. After reading RUSSELL's identification characteristics, his description of *C. capillata* and his statement that it has never been recorded with certainty from the English Channel I began to feel almost certain that we had mistaken the yellow *C. lamarckii* for *C. capillata*.

I have examined VAN DER MAADEN's specimens in the Rijksmuseum voor Natuurlijke Historie at Leiden and, using RUSSELL's (1970) identification by the presence or absence of gastrovascular pits between the muscle-folds, found that his *C. capillata* material consisted for a considerable part of *C. lamarckii*. In the summer of 1976 I examined some freshly stranded yellow *Cyanea* specimens on the beaches and found that the true *Cyanea capillata* was very rare indeed, as compared to *C. lamarckii*, but I did not find any pure yellow *C. lamarckii*, though the brownish violet variety was occasionally present. It probably needs a severe winter for the yellow variety of *C. lamarckii* to appear on our coast.

Still I feel confident to say that the few yellow-coloured *Cyanea* specimens, appearing in late summer at the peak time of *Cyanea lamarckii* must have been the yellow variety of *lamarckii*, perhaps with the exception of a few specimens which at present are not apprehensible any more.

In 1971 the news-papers reported strandings of a great many jelly-fishes of unusual dimensions which drove the tourists away from the beaches. That they were indeed *Cyanea* was obvious

from the pictures in the papers. Those strandings took place shortly before 8 July, the biggest specimens were over a metre in diameter. When I had time to go to the beach, which was on 10 July, the beaches had been cleared by the local owners of of seaside pavilions etc. and all that was left were fragments of colourless or faintly brownish jelly. The phenomenon has not been repeated, and jelly-fishes of that size are very rare indeed on Dutch beaches. It must have been an invasion of the true *C. capillata*.

In the Annual Report of the Netherlands Institute for Sea Research for the year 1963 VERWEY (1965) states that in 1963 *C. capillata* outnumbered *C. lamarckii* by 130 to 1 on the beaches between Scheveningen and Den Helder. This statement is quoted by RUSSELL (1970, p. 107). I did not take part in these counts myself, but I know for certain that the jelly-fishes were distinguished only by the colour, and that the counts were not carried out by trained observers, so that, apart from the confusion between yellow and blue *C. lamarckii* other species may have been mixed up with them, and that this statement has to be treated with some reserve.

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