Walerian CIEGLEWICZ and Gerda HOPPE

Ichthyology

THE RELATION BETWEEN THE WATER TEMPERATURE
AND THE RATE OF GROWTH OF FLOUNDER *PLATICHTHYS FLESUS* (L.)
IN GDAŃSK BAY

ZALEŻNOŚĆ POMIĘDZY TEMPERATURĄ WODY A TEMPEM
WZROSTU STORNI *PLATICHTHYS FLESUS* (L.) W ZATOCE GDAŃSKIEJ

From Department of Fish Biology
Head: Prof. Dr. Walerian Ciegiewicz

The comparison of the annual length increase of 1955 and 1960 year-classes of the flounder with the water temperature in Gdańsk Bay during consecutive years of their life indicates very close relation between the rate of growth of the flounder and the water temperature.

Long-term changes in the growth-rate of flounder (*Platichthys flesus* L.) in the Baltic were explained by some authors (Knudsen, 1954; Jensen, 1959) as the result of changes in the density of population influenced by the intensity of the fisheries, while others (Ziemska ja, 1960) attributed these changes to the influence of water temperature. One of the present authors, comparing the growth-rate of flounder in the years 1937-38, 1945-47 and 1957-59 (Ciegiewicz, 1962) made the assumption, that the differences observed in the growth-rate of flounder in the Bay of Gdańsk were caused by both the above mentioned factors. However, since the observations were based on a comparison of the mean length of the particular age-groups, which in some cases may give values, which are not quite comparable, the author pointed out, that this problem needed further studies by means of back-calculations of the growth of fish from otoliths.

These investigations were carried out on two year-classes of flounder from the Bay of Gdańsk, born in 1955 and 1960, and the growth-rate of these year-classes were back-calculated from the otoliths and compared with the water temperature in the Gdańsk Deep, where spawning and hatching of young flounder takes place, and also with the temperature of the coastal waters of the Hel Peninsula, which is the feeding ground of the flounder. The results are given in the present paper. The material for the back-calculations of the growth comprised otoliths of 300 flounder of the 1955 and 1960 year-classes, selected from routine samples of the spawning stock in the Gdańsk Deep. The length of the fish ranged between 18 and 40 cm, the age between age-groups II and VII.

Back calculations of the growth-rate were based on measurements of the longer otolith radius. Observations made by Cięglewicz, Draganik and Żukowski (1969) have shown that there is a very close (nearly linear) relation between the length of the flounder (l) and the longer radius of its otolith (r); $r = 0.0107 \cdot l + 0.06$. The comparison of the back-calculated growth of the 1955 and 1960 year-classes (Table 1) shows a higher growth-rate of the 1960 year-class during the first 5 years of life, but from the 6th year on the growth of the year-class is lower than that of 1955.

From observations (Głowińska, 1963) on water temperature in the Gdańsk Deep during the spawning season (March-May) we note that near the bottom (below 80 m depth) the mean temperature was 1.5°C higher in 1960 than in 1955. The surface temperature was also higher during the spring of 1960 than that in 1955.

Table 1

Back-calculated growth of the flounder

Year class	Mean Length in cm						
	l_1	l_2	l_3	l_4	l_5	l_6	l_7
1955	5.7	11.7	18.6	23.3	27.9	31.9	$(36.8)^x$
1960	5.9	13.5	19.4	24.4	28.3	31.8	$(32.5)^x$

^xIn brackets: values not fully representative due to the very limited number of fish.

Table 2

Annual length increase (t) in cm Temperature (T°C)	Year-class 1955						
	Years: 1955	1956	1957	1958	1959	1960	1961
	5.7	6.0	6.9	4.7	4.6	4.0	(4.9) ^x
	11.07	10.8	11.38	11.28	12.2	11.3	12.1
Annual length increase (t) in cm Temperature (T°C)	Year-class 1960						
	Years: 1960	1961	1962	1963	1964	1965	1966
	5.9	7.6	5.9	5.0	3.9	3.5	(0.7) ^x
	11.3	12.1	10.8	11.8	11.6	10.5	11.1

^xIn brackets: values are not fully representative due to the very limited number of fish.

Fig.1. Comparison of the growth-rate of flounder and the mean water temperature during 1955-1966 (April-December) near the end of Hel Peninsula

Table 2 and Figure 1 show the comparison of the growth-rate of the flounder with the temperature of the coastal waters near the end of the Hel Peninsula, expressed in mean values, calculated for the period April-December for each successive year of life of these year-classes.

From Table 2 and Figure 1 one may conclude that there is a relation between the water temperature and the growth-rate of the flounder. In order to obtain better characteristics of this relationship, the differences in the annual length increase (Δt cm) of the 1955 and 1960 year-classes are plotted against the differences in the coastal water temperature ($\Delta T^{\circ}\text{C}$) in consecutive years of fish life (Fig.2). There the relationship seems to be more proportional except for the age-group VII, but this is not fully representative in view of the very limited number of fish. Therefore, when plotting the regression line between the differences in yearly length increments and the differences in the water temperature (Fig.3), the values for age-group VII were omitted. The regression is expressed by the equation:

$$Y = 1.102 x + 0.030$$

where $X = \Delta T^{\circ}\text{C}$

$Y = \Delta t$ cm.

Fig. 2. Comparison of the differences in the annual length increase of 1955 and 1960 year-class with the differences in the mean water temperature during 1955-1966 (April-December) near the end of Hel Peninsula

Fig. 3. The regression between the differences in the annual length increase of 1955 and 1960 year-classes and the differences in the mean water temperature during 1955-1966 (April-December) near the end of Hel Peninsula

Figure 3 and the equation indicate that the regression is linear. The correlation coefficient for these values is very high ($r = 0.9587$), which indicates

a very close relation between the rate of the growth of the flounder and the water temperature during its whole life-span.

This conclusion is in accordance with the earlier assumption of the author and corresponds to the opinion of Ziemska ja (1960) as to the influence of water temperature on the growth of the flounder in the eastern Baltic.

REFERENCES

- Cięglewicz W., 1962: Charakterystyka biologiczna połowów storni w Zatoce Gdańskiej. Prace Morskiego Instytutu Rybackiego, 11/A.
- Cięglewicz W., Draganik B., Żukowski Cz., 1969: Charakterystyka wzrostu storni (*Platichthys flesus* L.) i skarpia (*Scophthalmus maximus* L.) za pomocą równania v. Bertalanffy'ego. Prace MIR, 15/A.
- Głowińska A., 1963: Stosunki hydrologiczne Bałtyku Południowego w latach 1951-1960. Ibid., 12/A.
- Jensen Aa.J.C., 1959: Danish investigations on the stocks of cod, plaice and dab in the Central Baltic and the fishery for these species in the western Baltic. Rapp. Proc.-Verb., Cons.int. Explor. Mer, 147.
- Knudsen J., 1954: Remarks on the stocks of some commercial fish in the Baltic as an introduction to a discussion of a possible international convention on the fisheries of the Baltic. ICES, C.M. 1954 (mimeo).
- Ziemska ja K.A., 1960: Peculiarities in the growth of fish in a population characterized by low abundance and small range of fluctuations with special reference to the Baltic Sea flounder. ICES, C.M. 1960/Doc. No.209.

ZALEŻNOŚĆ POMIĘDZY TEMPERATURĄ WODY A TEMPEM WZROSTU STORNI *Platichthys flesus*(L.) W ZATOCE GDAŃSKIEJ

Streszczenie

Praca przedstawia wyniki badań wpływu temperatury środowiska wodnego na tempo wzrostu storni (*Platichthys flesus* L.) w Zatoce Gdańskiej.

W tym celu porównano wzrost i roczne przyrosty długości tej ryby obliczone wstecznie z otolitów z temperaturą wody panującą na Głębi Gdańskiej w okresie tarła i rozwoju larw dwu pokoleń storni urodzonych w 1955 i 1960 roku oraz z temperaturą wód przybrzeżnych przy Helu w kolejnych sezonach żerowiskowych następujących lat życia tych pokoleń (1955-1960 i 1960-1966).

Dla lepszego uchwycenia zależności pomiędzy temperaturą wody a wzrostem storni porównano różnice przeciętnych temperatur wody w strefie przybrzeżnej ($\Delta T^{\circ}\text{C}$) w okresie żerowiskowym (kwiecień-grudzień) z różnicami przyrostów długości (Δt cm) pokolenia z 1955 i 1960 r. w kolejnych latach ich życia.

Wykres 3 i wysoki współczynnik korelacji ($r = 0,9587$) pomiędzy tymi wielkościami świadczą o istnieniu ścisłej zależności pomiędzy temperaturą wody a wzrostem długości storni.

ЗАВИСИМОСТЬ МЕЖДУ ТЕМПЕРАТУРОЙ ВОДЫ И ТЕМПОМ РОСТА РЕЧНОЙ КАМБАЛЫ
PLATICHTHYS FLESUS (L.) В ГДАНЬСКОЙ БУХТЕ

Р е з ю м е

В работе представлены результаты исследований влияния температуры водной среды на темп роста речной камбалы (*Platichtys flesus* L.) в Гданьской бухте.

Для этого сравнили рост и годовые увеличения длины этой рыбы, вычисленные по отолитам, с температурой воды впадины Гданьской в период нереста и развития личинок двух поколений речной камбалы, родившихся в 1955 и 1960 г.г., а также с температурой прибрежных вод у Хеля в последовательных нагульных сезонах следующих лет жизни этих поколений (1955 - 1960 и 1960 - 1966).

Для того, чтобы лучше познать зависимость между температурой воды и ростом речной камбалы, сравнили разницы средних температур в прибрежной зоне ($\Delta T^{\circ}\text{C}$) в нагульный период (апрель-декабрь) с разницami увеличения длины (Δt см) поколения 1955 и 1960 г.г. в последовательных годах из жизни.

График 3 и высокий коэффициент корреляции ($r = 0,9587$) между этими величинами свидетельствуют о существовании тесной зависимости между температурой воды и увеличением длины речной камбалы.

Address:

Prof.dr Walerian Cięglewicz

Katedra Ichtiologii WSR

Szczecin, ul.Kazimierza Królewicza 4

Polska - Poland

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