International Council for the Exploration of the Sea

CM 1975/B:9
Gear and Behaviour Committee

Baltic Fish Committee

Working Group on Assessment of Pelagic Stocks in the Baltic

Traumatism and survivability of Baltic herring which passed through the mesh of trawl cod end

A.I. Treschev, VNIRO, USSR[x]
S.F. Efanov, VNIRO, USSR[x]

S.E. Shevtsov, BaltNIIRH, USSR[xx]
U.A. Klavsons, BaltNIIRH, USSR[xx]

Introduction

Baltic fishing is dominated by small species with poorly fixed scale (herring, sprat) over 70 per sent of which are caught by trawls. When trawling over 90 per cent of the total of non-commercial fish of these species pass through the meshes of the cod end(I). When passing through meshes and brushing against each other as well as due to otherfactors fish sustain body traums and partly lose the scale(according to our observation up to 8.5 per cent). Degree of traumatizing and following survivability of fish sifted by trawls has not been sufficiently studied. Previous observations (2) were not methodically perfect.Therefore in 1973 and 1974 from May to October VNIRO and BaltNIIRH made a series of biological and bio-

x I7 a, V.Krasnoselskaya, Moscow -I40.

xx 6, Daugavgrivas, Riga-49.

chemical studies of the physiological state of fish that got through the meshes of the cod end and compared the data with controls (fish that did not pass through meshes). The results of these studies are discussed bálow.

Methods

Fish that passed through cod end meshes during the trawling were caught with the help of semirigid net container which was put on the cod end of the twin trawl (fig.I).

To exclude additional traumatizing incontainerfrogmen beforehand determined the time when herring withstood the flow of water at different rate of trawling without touching the walls of the container. Trawling was carried out from small fishing boats,capacity I50 hp. in the West of the Gulf of Riga.Cod ends for experiments were made of twine 93.5 tex x 3 with mesh size 32 mm.

After hauling the trawl up to the water surface(depth of fishing I0-I5 m) a frogman detached the container from the cod end after which it was towed at the rate of I.I knots to a two-chamber netting cage placed at a distance of 200-300 m (fig.2). Approuching the cage the frogman butted the container with the cage chamber with the help of special spring clamps.Fish were transferred to the cage for conditioning.The remaining dead fish were picked out from the container and delivered by boat to the ship where they were examined.

For obtaining controls the end of the cod bag during the trawling was not tied up and fish easily passed to the container without touching the walls of the cod end and the container.

These fish were put in the other section of the cage. Besides, for control conditioning fish were taken from a commercial set seine.For this purpose an opening was made in the wall of the set seine through which fish passed to the container which later was towed amay and installed in the vicinity of the cage. In addition to cages fish under experiment and controls were also conditioned in containers which were slantingly (45°) installed on anchors.

Fish held in cages and containers for conditioning were periodically examined by frogmen. Dead fish were picked out and analysed.

For biochemical analyses live fish samples were taken. In the cages and near them in different layers of water were measured water temperature, salinity and oxygen content. Martality rate due to traums caused by the trawl and other factors during the trawling was also determined by alternating trawling with open cod end and with closed cod end.

Live fish were separated from dead ones with the help of a second container attached by frogman to the working container(Fig.3).

The physiological state of fish at different stages of conditioning was estimated by lactic acid and hemoglobin content in blood, creatine-phosphate, creatinine and cholesterin in muscles, and glycogen in liver. Dynamics of alkaline and acid phosphatases was studied for liver, heart, kidneys and stomach. Samples ware taken and processed from each specimen individually with the exception of glycogen samples for which liver of individual groups offish was taken.

Besides the above method, in order to study the survivability of fish that got through cod end meashes the researchers used pendant tags and oganic staining agents administered with a syringe under the skin.

For taking fish for conditioning trawling was carried out for

I5-20 minutes at the rate of 2.I-2.7 knots. Container catches varied from I0 to 60 kg and cod end catches from 7 to I5 kg. Alternating trawlings were made for I0,I5,20,30 and 60 mirutes at the rate of 2.7 knots.Catches in the container were up to 845 kg and in the cod end up to 260 kg.To fill the cage and the containers with fish 35 trawlings were made.In order to determine fish mortality rate for different periods of fishing 47 alternating trawlings were carried out.Life conditions of fish in the cage and containers were unfavourable.However,after storming weather an increase in mortality was observed which testifies to the effect of seaways in the area of small depths(8-I0 m). Experiments related to stormy days were analysedseparately.Periods of conditioning lasted from 3 to 44 days.Stocking varied from 2-40 sp./m^3.Salinity was within th the limits from 5.75 to 5.93 ‰,oxygen content 9.7-I0.5ml/l, and temperature from + 9^0 to + $I6^0$ C. The composition of feed,i.e. zooplankton was relatively stable.Most abundunt were Rotatoria, nauplials and young stages of Copepoda. I-III stages of Acartia and I-III stages of Eurytemora prevailed.Samples also contained bosmin which plays an important part in the food of young herring and sprat.As to the adult fish the conditions for normal feeding as a whole were not satisfactory.

Results of studies

In all the experiments the number of live fish decreased with increasing time of conditioning irrespective of the number of stocked fish.In conditioning periods no considerable difference in the amount of waste in fish under experiment and controls was observed (Table I).

Table I

Survivability of Baltic herring (%) in relation to periods of conditioning

Time of conditioning (days)		0	I-4	5-8	9-I2	I3-I7	I8-2I
% of survivals	experiment	I00	99.7	74.2	56.5	-	40.5
	control	I00	-	80.0	59.0	-	29.4

Fluctuations in size composition of fish in relation to periods of conditioning

Time of conditioning (days)		0	I-4	5-8	9-I2	I3-I7	I8-2I
Mean commercial length of specimen cm	experiment	9.6	9.0	I0.0	I0.5	-	-
	control	I0.4	-	II.4	II.7	I2.I	I3.0

The mean commercial length was calculated by the following formula:

$$L_{n_{mean}} = \frac{n_1 L_{n_1} + n_2 L_{n_2} + \ldots + n_m L_{n_m}}{n_1 + n_2 + \ldots + n_m}$$

where n_m - number of fish of a certain class,

L_n - commercial length from tip of the snout with the mouth closed to the base of medium rays of the coudal fin.

Fish that were in the cages and containers began to feed 5-I0 days after conditioning. This is evidence of adaptation of fish to new life conditions in cages and containers and of satisfactory process of their life functions. The dynamics of fatness and stomach fullness during the conditioning are given in Fig.4.

When being conditioned small fish with low fatness also died quicker. This was more noticable with control groups of fish. With alternating trawlings in all the cases mortality rate of fish caught with a closed cod end was higher than with an open cod end.

With increased time of trawling mortality increased in both cases, however, there was some difference by which it was possible to judge about traums sustained when passing through a mesh.

If no stickleback were found in catches dead herring did not averagely exceed 3 per cent, i.e. their percentage was the same as when trawling for conditioning. When stickleback accounted for 20 to 70 per cent of catches fish mortality increased up to I2.6 %. During alternating trawlings the number of dead was also mostly accounted for by small fish and fish with low fatness.

From May to September, I974 2,I64 herring were traced, 2,025 being marked with a sraining agent. In spite of great difficulties in locating traced fish in the bulk of the catch 8 traced fish were caught as of December I, I974. After tagging they remained in the Gulf of Riga up to 74 days. All traced fish fed (stomach fullness I-2 points) which indicates their quite satisfactory physiological state.

Biological analyses for fish under experiment were made a day, three days, and ten days after conditioning and for controls just

Changes in physiological and biochemical

during

Time of conditioning (days)	Hemoglobin gr%		Glycogen in liver mg%		Creatine-phosphate in muscles mg%	
	control	experiment	control	experiment	control	experiment
0	9.7±0.3	-	356.3	-	I7.5 ±2.7	-
I	-	I0.0±0.4	-	I4.3	-	32.0±4.7
2	-	I0.3±0.2	-	9.I	-	9.7±I.7
3	I0.7±0.2	I0.4±0.I	92.3	5I.4	8.9±2.6	6.6±I.2
I0	I0.5±0.2	I0.5±0.2	385.3	453.3	I5.5±0.8	I2.0±I.8

Table 2

characteristics of Baltic herring

experiments

Creatinin in muscles mg%		Lactic acid in blood mg%		Cholesterin in muscles mg%	
control	experiment	control	experiment	control	experiment
I.30±0.2	-	II4.4±I6.3	-	II7.0±I5	-
-	0.82±0.2	-	I53.8±27.0	-	II2.0±I3.0
-	0.92±0.I	-	67.6± 7.3	-	I35.0±I9.0
0.80±0.I	0.95±0.I	-	86.7± 6.2	I05.0±20	II6.0±I9.0
0.7 ±0.I	0.90±0.I	59.3± 5.9	83.3± I.9	-	-

hauling the trawl,and on the third and the tenth days of conditioning.

Characteristics were determined by the methods of the following authors:

creatine-phosphate - by Fiske-Subbarrow,

creatinine - bt Jaffa,

cholesterin - byLevchenko in modification of Polosukhina,

lactic acid - by Berker and Sommerson,

hemoglobin - by Saly,

glycogen - by Christman.

The results of determining the above factors are cited in Table 2. No decrease in hemoglobin in the blood of fish that passed through a cod end mesh of the trawl was found. There was a sharp decrease of glycogen in liver which indicates an increasing metabolic activity of fish muscles. The increased level of lactic acid points to active process of glycogenolysis. Along with high muscle activity and stressing state in fish organism occur some changes in phosphorus metabolism and in cholesterin content in the internal parts. Increase in creatinine concentration was observed as soon as trawling was over. Maximum cholesterin content in muscles was observed on the second day og conditioning. Two-three days later the characteristics of carbohydrate-phosphate metabolism of fish under experiment returned to the norm and incurred relative stability. The activity of alkaline and acid phosphatases in the first three days of conditioning did not change. In subsequent days the activity of alkaline phosphatase of fish under experiment and of controls at all times decreased and by the end of the experiment (IO days) it was equal to a third of the original value while the activity of acid phosphatase increased in an analogous way.

The course of changes in physiological and biochemical characteristics of herring caused by trawling and subsequent conditioning can be conditionally divided into three characteristic periods:

First - a period of the primary reaction of fish organism to stimulus (trawl,towing,container,cage,etc.). when the levels of physiological characteristics deviate from the norm.

Second - a period of adaptation when fish organism restores the physiological state to the original level (norm) and adapts to new life conditions (in cages or containers).

Third - a phase of relative stability of life activity (physiological characteristics).

The investigations have shown that the adaptation period closes by the third day of conditioning. At this time the biochemical characteristics of fish under experiment returned to the initial levels. By the tenth day of conditioning no statistically reliable difference in biochemical characteristics of fish under experiment and control group of fish was found. Nor were observed any characteristics that lead to severe pathological changes.

On the basis of this study it can be concluded that

I.Fish which pass through the meshes of a trawl cod end are viable.

2.Traumatic death of Baltic herring when sifted through the trawl averages 3 %.

3.Among deads small fish and fish of low fatness prevail.

4.Survivability of fish that passed through the meshes of a trawl cod end is confirmed by the return of tagged fish.

5.It possible and expedient to regulate fishing for small herring by mesh size of trawl cod ends in order to conserve their stock.

REFERENCE

I. A.I. Treschov. Scientific basis of selective fishing, M.Pischevaya promyshlennost, I974

2. N.J. Vinogradov. Effect of trawl cod end design on size composition of fish in catches. Rybnoje Khozjaistvo (Fisheries), No I, I96I

3. I.I. Dedov. Neuroendocrine system. Izvestija Akademy Nauk (Bulletin of USSR Academy of Sciences), biology series, 6, I973.

4. E.F. Sopin, L.S. Semkina. On physiological role of cholesterin. Voprosy fisiologui (Physiology Problems) (Transactions of Physiology Research Institute, Kiev University) v.I2. I96I.

5. Wedemeyer G. Some physiological consequensece of handling stress in the juvenile coho salmon (Onchorhynchus kisutch) and Steelhead trout (Salmo gairdneri). I.Fish.Res.Bd.Canada, vol.29 N0 I2, I972

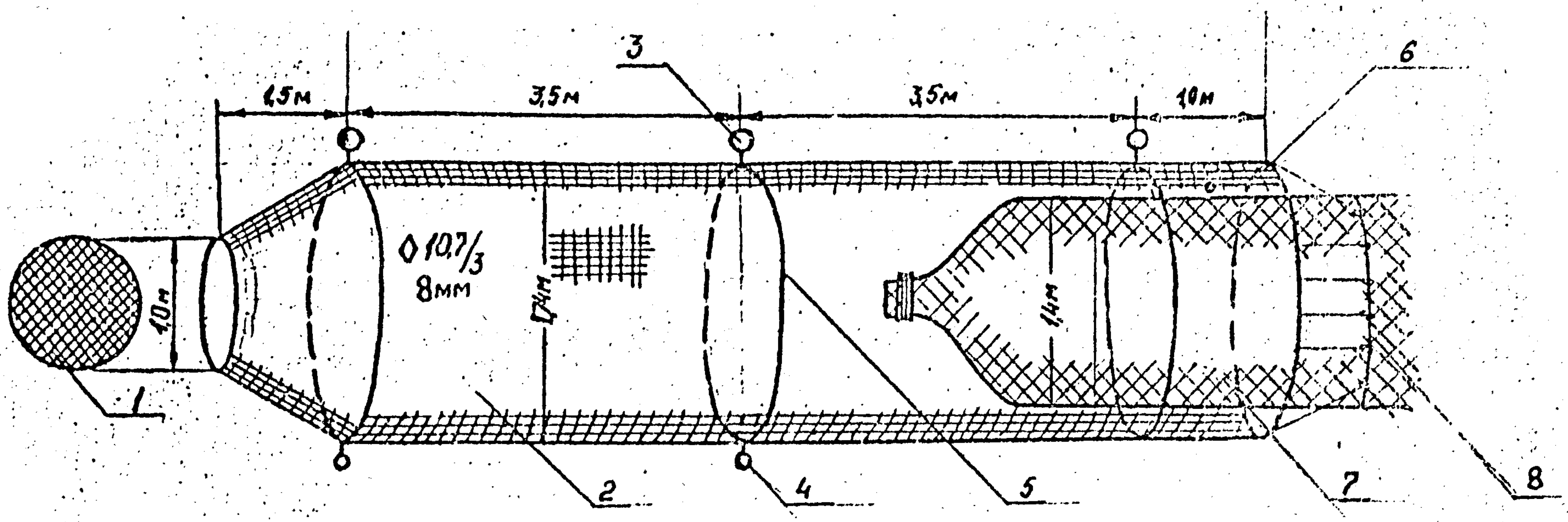

Fig.I

Diagram of joining container with trawl cod end

I. -container lid.

2. -container

3. -balls,diam. 200 mm

4. -sinkers 2.0 kg

5. -plastic hoop,diam. I.76 m

6. -bracing rope

7. -cod end

8. -running end

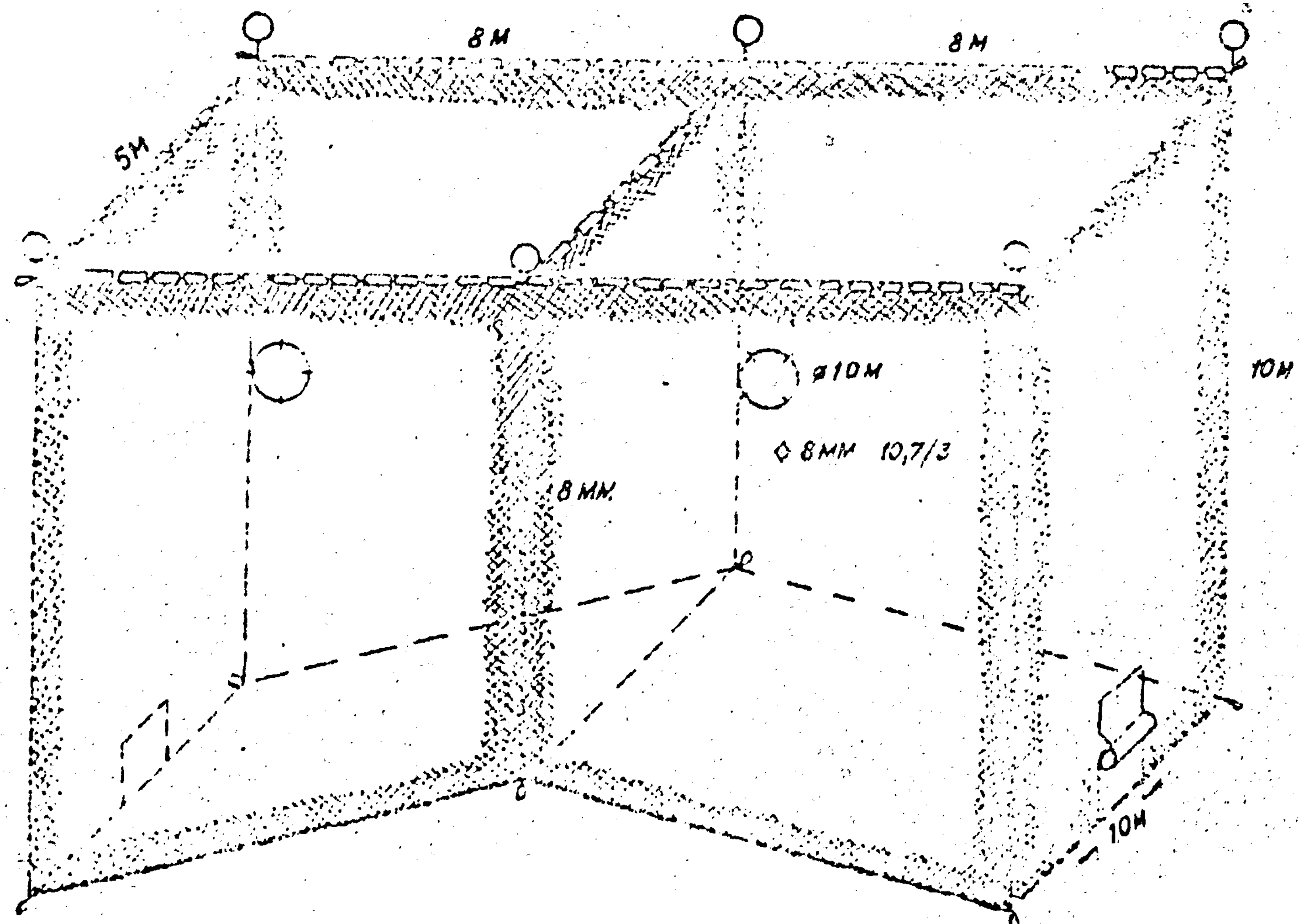

Fig.2

Double cage

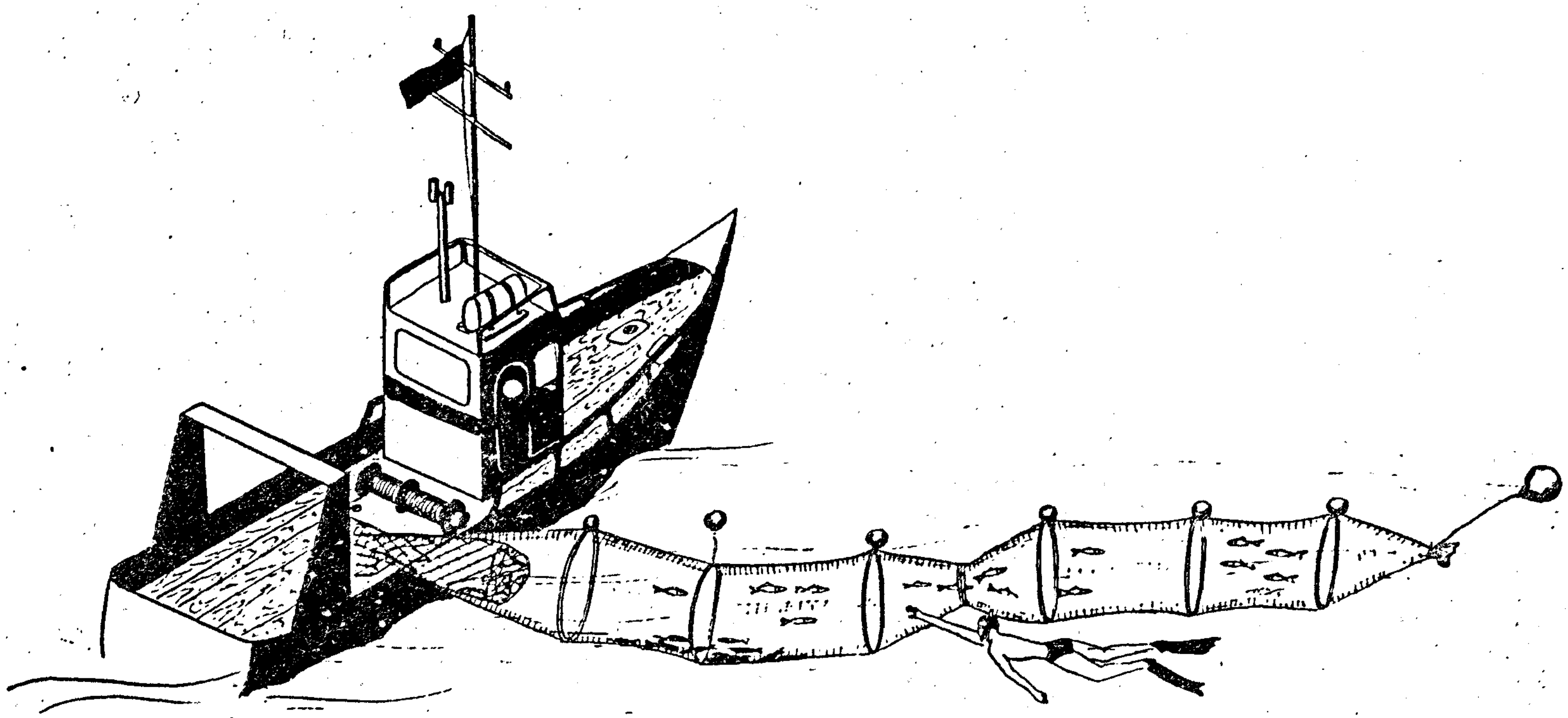

Fig.3

Diagram of separating live fish from dead fish

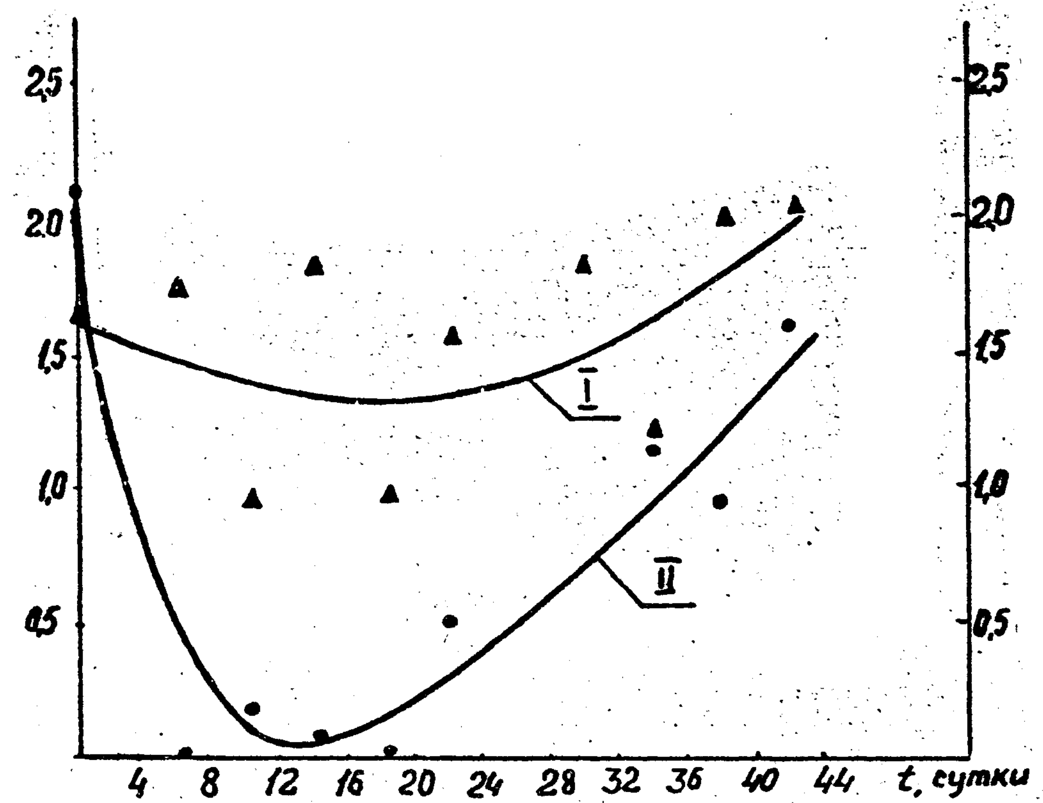

Fig.4

Fatness and stomach fullness changes depending on conditioning

I - fatness

II - fullness of stomach

Подп.. в.. печ.. 14/УП 1975 г.. Зак. 675 Тир. 205 Объем 2,0 п.л. ЦНИИТЭИРХ