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**Methods and technique of the trawl sampling used during the research
cruise of r/v 'TINRO' salmon survey in the Bering Sea in 2002**

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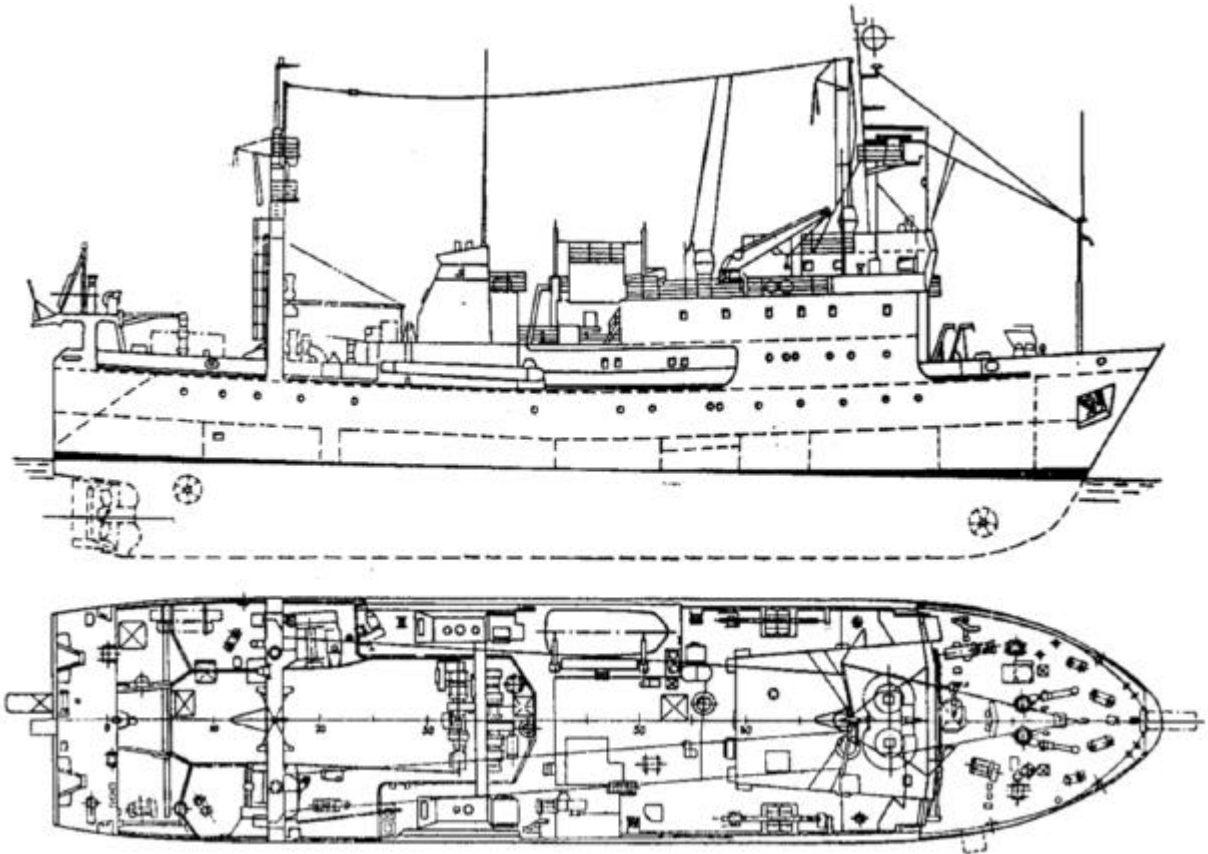
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Salmon survey in the Bering Sea in 2002 carrying out by research vessel (stern trawler) 'TINRO' (fig.1), which basic characteristics are as follow:

- Maximum length, m 62.22;
- Maximum width, m 13.81;
- Tonnage, mt 2508;
- Speed, sea miles per hour 12.96;
- Draft, m..... 3.95-6.3;
- Main engine (quacity*power, kW (horse-power))..... 2*882 (1200);
- Distance between weap blocks, m 7;
- Distance between weap blocks and water surface, m 6.



Trawls are made with a midwater trawl, model 80/376 m (length of headrope 80 m / perimeter of mouth opening – 376 m), made from PE material (fig.2). Parameters of trawl 80/396 rope part are given in table 1, and parameters of its net part in table 2. The trawl body is 130 m long. It has a tetragonal mesh in wings and body, and has 1 cm mesh liner (a bag) in the codend.

Table 1 - The rope elements of trawl 80/396

Level	d, mm	Length, m	Quantity		Level	D, mm	Length, m	Quantity	
			Up-Down	Left-Right				Up-Down	Left-Right
1	19	9.0	4	4	8	10	7.0	11	9
2	13	9.0	8	8	9	8	7.0	20	16
3	13	9.0	10	10	10	8	6.0	18	16
4	11	9.0	20	20	11	8	6.0	18	16
5	10	9.0	24	20	12	8	6.0	18	16
6	11	8.0	12	10	13	8	3.0	16	16
7	10	8.0	22	18	13	8	3.0	30	30

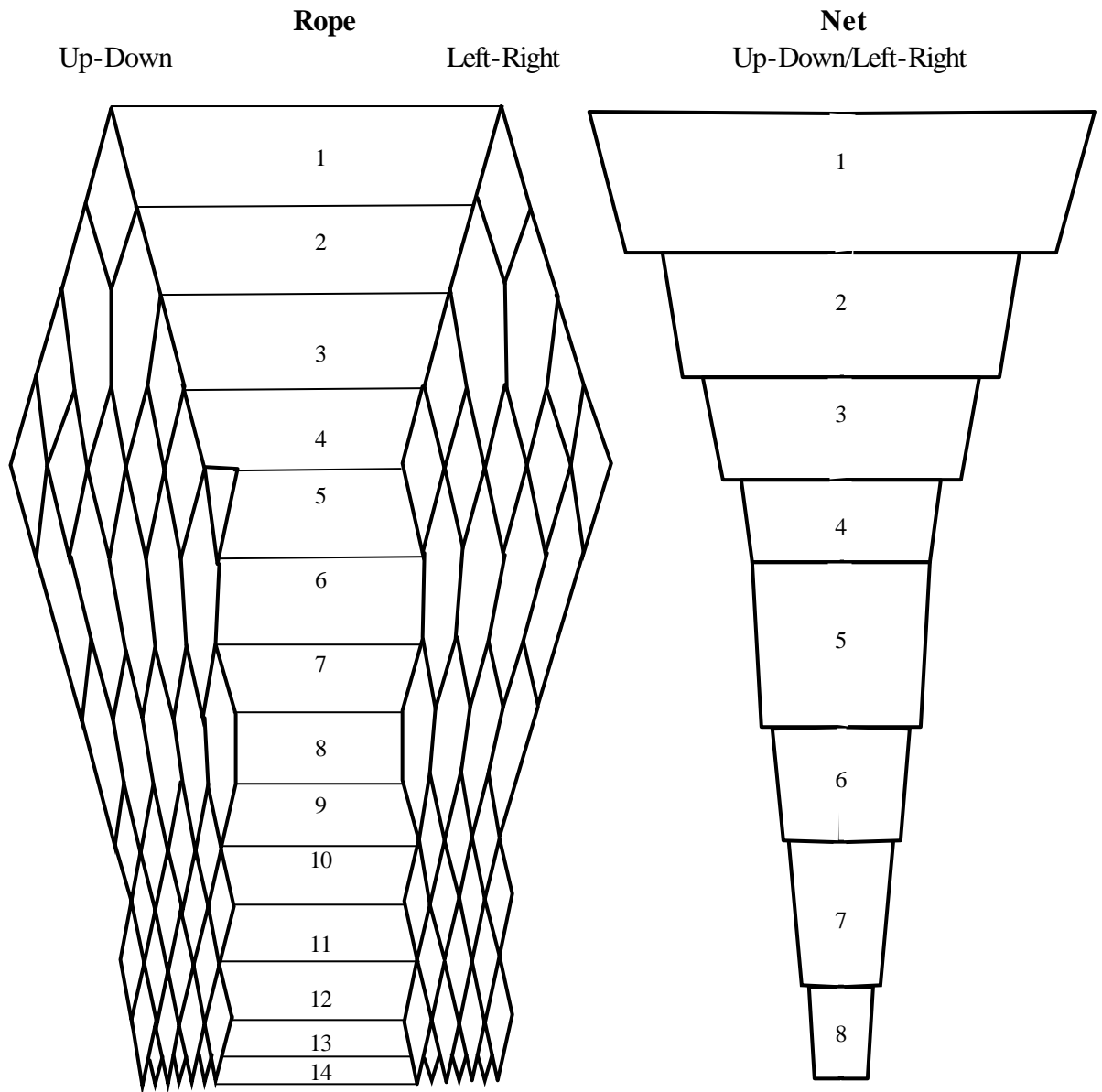


Fig. 2. The Drawing trawl 80/396 m

Table 2 – The net elements of trawl 80/396

Level	Mesh - size – d, mm	Height, m	Top basis, m	Bottom basis, m
Up-Down				
1	1200 – 6.0	7.2	55.2	48.0
2	800 – 5.0	7.2	40.0	35.2
3	400 – 3.1	4.8	27.2	24.0
4	200 – 3.1	4.0	20.0	18.4
5	100 – 2.4	8.4	18.4	16.0
6	80 – 2.4	5.6	12.8	11.2
7	60 – 2.4	6.72	8.4	6.48
8	30 – 3.1	4.32	4.68	3.72
Left-Right				
1	1200 – 6.0	7.2	31.2	24.0
2	800 – 5.0	7.2	24.0	19.2
3	400 – 3.1	4.8	19.2	16.0
4	200 – 3.1	4.0	15.0	14.4
5	100 – 2.4	8.4	14.4	12.0
6	80 – 2.4	5.6	9.6	8.0
7	60 – 2.4	6.72	6.0	4.0
8	30 – 3.1	4.32	4.1	3.12

A hydrodynamic plate (area – 6 m², height – 0.6 m, length – 10 m) and floats are used on the headrope to keep it at the surface. One 120 kg chain is attached to the footrope and two 400 kg weights are attached in front of the footrope to sink the trawl. The trawl is fished with four bridles (length – 112 m, diameter – 1.9 cm). The bridles are attached at two points to conical V-shaped trawl doors (area of each – 6 m², weight – 1.3 tones).

For superficial towing modes the corner of a board attack must be the most maximal (30-35 °) because the vector of force of a corner of the approach warp to a board is directed on reduction of disclosing of a trawl. For reduction of influence warp, its length should be more than 250-300 m. The board is adjusted on emersion with a corner of a roll 10-15° (fig 3).

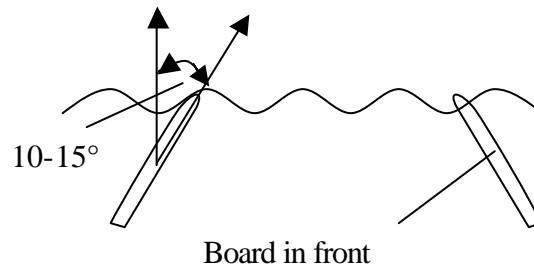


Fig 3. Trawl doors in work

With the help of cables the trawl is connected to boards in the following manner (fig 4).

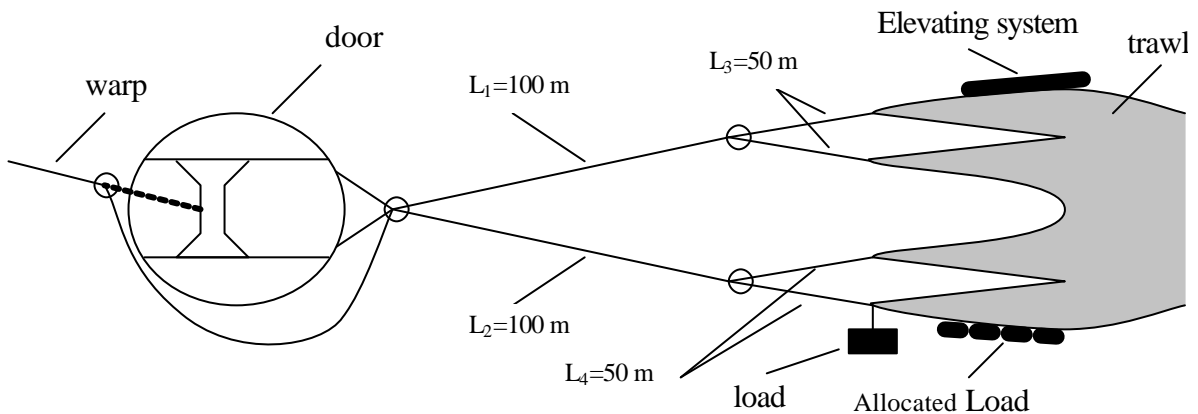


Fig. 4. Trawl system equipment

Vertical spread of trawl mouth opening during superficial towing with this equipment is 32-42 m and horizontal spread is 30-34 m, depending on towing speed and warp length. Actual vertical spread during towing time is constantly measured by the device WESMAR TCS 704E. Regression equation for the trawl horizontal aperture is:

where: a – horizontal, b - vertical aperture (m), v - towing speed (knots), h – towing depth (m) and l - warp length (m); the multiple correlation coefficient $R=0.999$.

After taking the antilogarithm and simplifications the equation becomes more suitable for practical application:

$$a = \frac{b^{0.12848} v^{0.60955} (h + 1)^{0.00083} l^{0.88926}}{1.01237 b + 1.13102 v + 1.37044 (lg l)^2}$$

Functional parameters of the trawl allow us to fish successfully in the upper epipelagic layer (0-40 m), which is the typical habitat for all species and age groups of salmon during the annual migrational cycle.

During the survey trawl tows are executed over 24 hours. In order to achieve the necessary functional parameters of the fishing gear, the direction of towing is determined by weather and hydrological conditions. While setting the trawl the hydrodynamic plate on the headrope is located at the surface.

After the necessary length of warps has been released (250-310 m), the trawl is stabilized at the surface layer (0 m) and tow timing is started. During the trawl tow, length of warps and vessel speed may vary in order to achieve the necessary functional parameters of the fishing gear. The trawl is towed for one hour at about 4.5-5.3 knots and the hydrodynamic plate should be at the water surface. In the day-time position of hydrodynamic plate is recorded visually and by means of acoustic devices, and in the night-time – by means of acoustic devices. At the end of trawl tow the speed is reduced and the trawl is hauled out.