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**INTENSITY OF LURING LIGHT FOR
SQUID LIFT-NET FISHERIES IN THAILAND**

Michio Ogura, Takafumi Arimoto
and
Shigeo Hayase

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FOREWORD

Net fishing with light has made a great progress in the Gulf of Thailand and as a result, the power of fishing lights has been increasing year by year. However, there is very little information concerning the attracting effects of light in water.

The present paper is a brief report on calculation of light intensity in water by application of a theoretical model about the light being transmissible through water. Dr. Michio Ogura, one of the authors of this report, visited the Training Department, SEAFDEC, from 15 to 25 August, 1981, as a short-term expert on fish luring lamp. On his return to Japan, he prepared a brief report written in Japanese. At Dr. Ogura's request, the report has been translated into English and rearranged into its present form by Dr. Shigeo Hayase, member of the Research Unit of the Training Department, SEAFDEC.

Three sets of data were available for the calculation of fishing light intensity, i.e. the total lumen of light, the height of the light source from the sea level, and transparency of water. Some aspects which affect the light intensity such as the arrangement of lamps on board or the differential sizes of boats were not taken into consideration. Therefore, more detailed data, such as the attenuation rate of light or actual lumen values which are used under the field conditions are necessary for practical purposes. Furthermore, there is a lack of fundamental information of the actual method of operation for catching squid. For example, the depth where the net is shot or the attracting effect of light in conjunction with the behaviour of squid responding to light cannot yet be established categorically. Therefore, the present study is limited to the estimation of distribution of light intensity in water.

METHODS

1. Data collection

The data were collected by means of measuring dimensions and fishing light equipment of commercial boats for squid lift-net fishing; the collected data are summarized in Table 1 and Figs. 1 and 2. The boats for squid net fishing with light in the Gulf of Thailand can be roughly classified into three types by size, i.e. large-sized, medium-sized and small-sized boats. Commonly these boats have several booms, with four or five fish-attracting lamps attached to each of them (see Figs. 1, 2, Annex Plates 1-6). The data on the number of lamps (power of light) on board different types of boats, as well as the height of lamps from the sea level were used for calculation of light intensity in water.

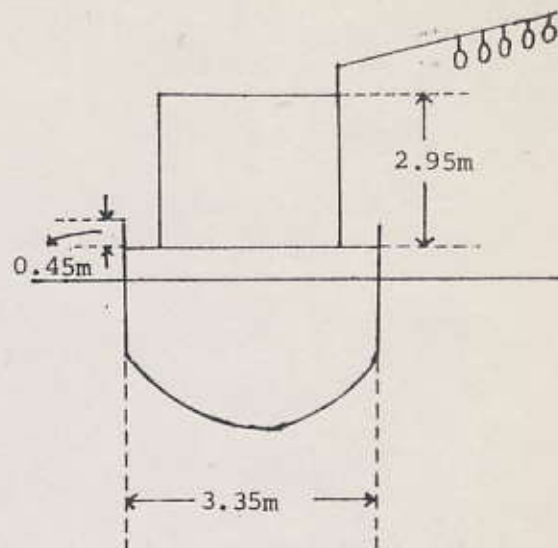
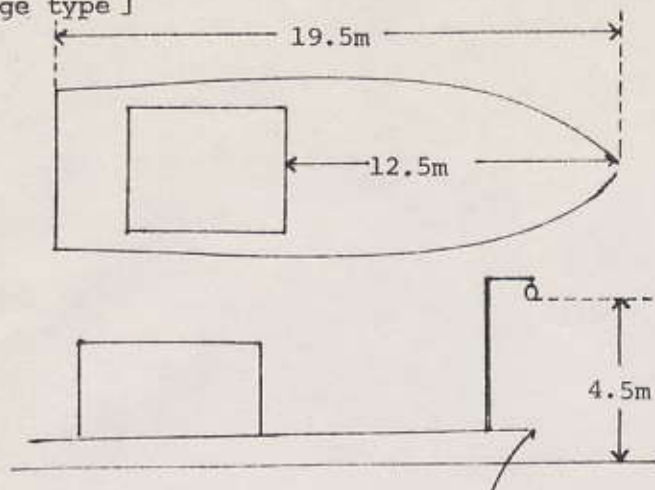
2. Assumption for calculation on light intensity in water

The intensity of light (luminous flux) is expressed in units of lumen and the amount of light which is released by a traditional incandescent lamp (500 W, 220 V) is assumed to be 10,000 lumen. Therefore, the total lumen can be obtained approximately by multiplying 10,000 lumen by the number of lamps. That is, total lumen is assumed to be the mass of each source of light. In the present case, the problem of shade in relation to the body size of boats was not taken into consideration.

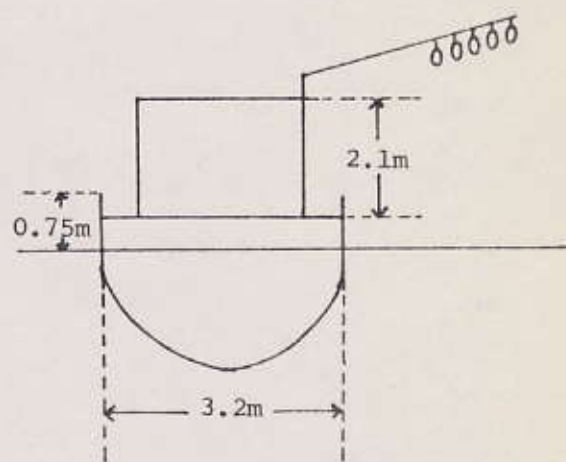
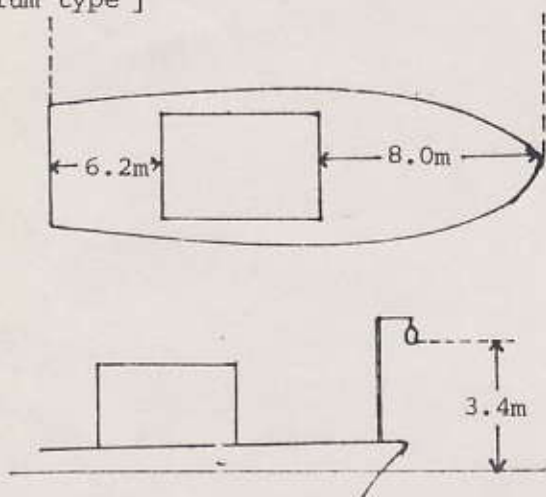
Table 1. Dimensions of three types of boats for squid lift-net fishing in the Gulf of Thailand.

[Large-sized boat]	
Width	3.35 m
Length from bow to stern	19.50
Height from surface	1.00
Height of bulwark	0.45
Length from bow to bridge house	12.50
Height of bridge	2.95
Height of bridge at stern	2.60
Height of bridge at stern on bulwark	2.35 - 2.40
Height of leading lamp at bow mast (from light to surface)	4.50
Height from bow to surface	2.70
Length from bow to bow mast	3.50
Length from base of leading lamp, to outside stern	1.50
[Medium-sized boat]	
Width	3.21 m
Length from stern to bridge	6.20
Length from bow to bridge	8.00
Height of bulwark to surface	0.75
Height of bridge house	2.10
Height of leading lamp at bow from surface	3.40
Height from bow to surface	2.00
Length from bow to bow mast	1.70
[Small-sized boat]	
Width	2.25 m
Length overall	9.50
Height from surface	0.70
Height from bulwark to light	1.75
Height of starboard light from surface	3.00
Height of leading lamp at bow from surface	3.50

[Large type]



[Medium type]



[Small type]

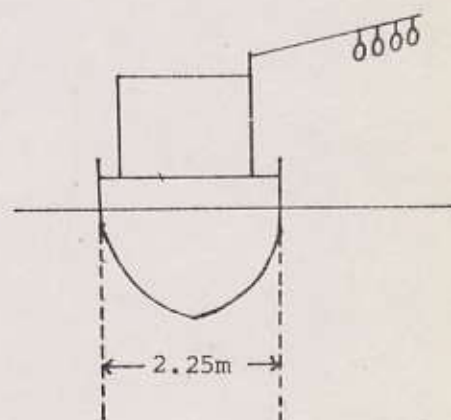
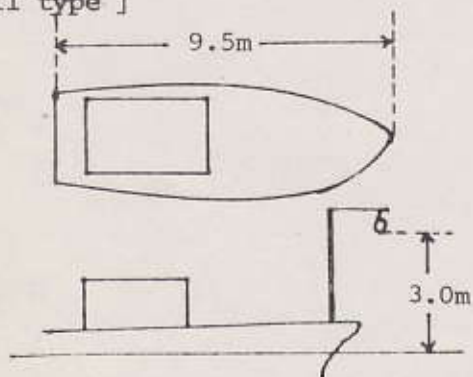
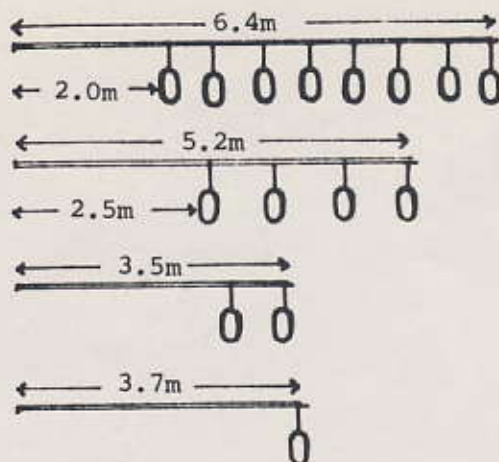


Fig. 1. Schematic explanation of dimensions of commercial boats for squid lift-net fishing with lights.

[Large type boat]



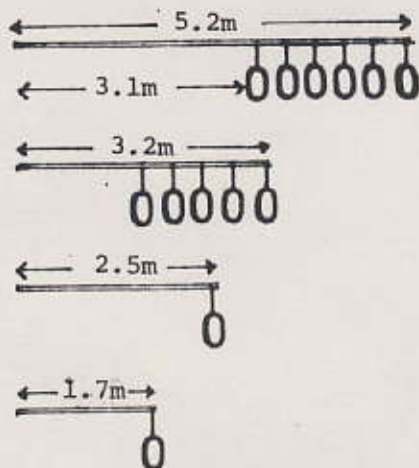
Starboard lamp × 8

Port lamp × 4

Leading lamp at stern × 2

Leading lamp at bow × 1

[Medium type boat]



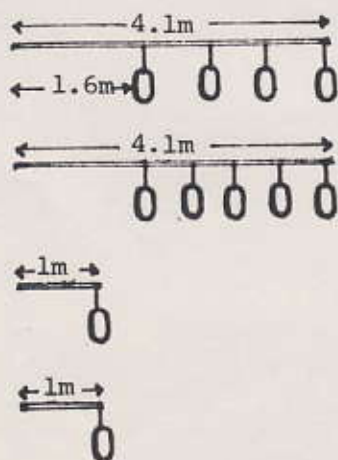
Starboard lamp × 6

Port lamp × 5

Leading lamp at stern × 1

Leading lamp at bow × 1

[Small type boat]



Starboard lamp × 4

Port lamp × 5

Leading lamp at stern × 1

Leading lamp at bow × 1

Fig. 2. Arrangements of fishing lamps

Incandescent lamp : 220 V, 500 W

Transparency, which exerts an important effect upon the light attenuation in water, is assumed to be about 17 m because a regional range of transparency in the fishing grounds of the Gulf of Thailand is 15 m to 20 m.

Approximately, the light attenuation in water (μ) can be obtained as follows: $\mu = 1.7 / \text{transparency}$. Therefore, the light attenuation in water of fishing grounds is assumed to be about 0.1.

The calculations of light intensity were done by using a micro-computer.

RESULT

Fig. 3 shows the schematic pathway of light going into water. The light which radiates from a lamp located at the height of h m above the board reaches a certain point in water with refraction as shown in the figure.

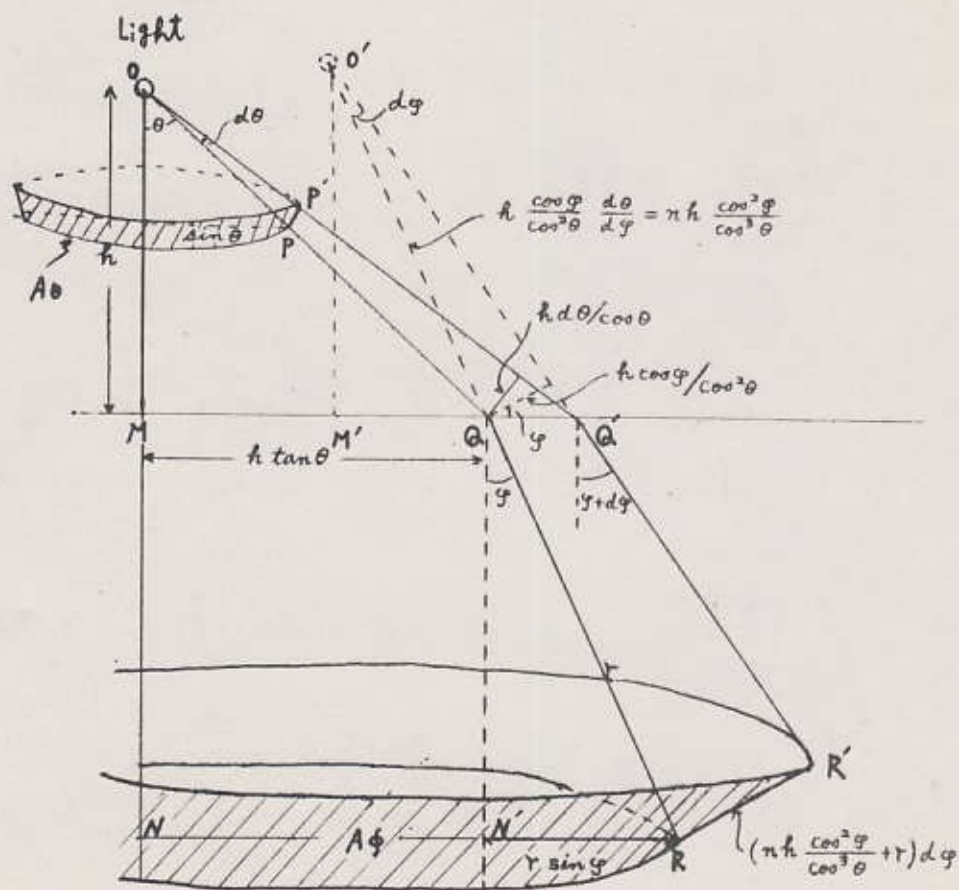


Fig. 3. Schematic representation of light pathway in water

From Fig. 3, the intensity of light under water ($I\psi$) at a layer r m below the sea surface can be obtained by using the following formula:

$$I\psi = I_{\theta} \frac{A_{\theta}}{A\psi} k\psi \cdot e^{-\mu r} \quad (1)$$

Where, I_{θ} is the light intensity at the level of 1 m below the light source, A_{θ} and $A\psi$ are the areas of wave front at 1 m below the light source and at r m below the sea surface respectively.

Therefore, A_{θ} and $A\psi$ are represented as:

$$A_{\theta} = 2\pi \sin \theta d\theta \quad (2)$$

$$A\psi = 2\pi (h \tan \theta + r \sin \psi) \left(n h \frac{\cos^2 \psi}{\cos^3 \theta} + r \right) d\psi \quad (3)$$

and

$$\frac{d\theta}{d\psi} = n \frac{\cos \psi}{\cos \theta} \quad (4)$$

Rearrange formula by substituting (2) and (3) into (1) :

$$I\psi = \frac{k\psi \cdot e^{-\mu r}}{h^2 \left(\frac{1}{\cos \theta} + \frac{r}{h \cdot n} \right) \left(\frac{\cos \psi}{\cos \theta} + \frac{r}{h \cdot n} \cdot \frac{\cos \theta}{\cos \psi} \right)} \cdot I_{\theta} \quad (5)$$

here, $I_{\theta} = C = \text{total lumen of a light source}/4\pi$ (cd.)

then

$$I\psi = \frac{k\psi \cdot e^{-\mu r}}{h^2 \left(\frac{1}{\cos \theta} + \frac{r}{h \cdot n} \right) \left(\frac{\cos \psi}{\cos \theta} + \frac{r}{h \cdot n} \cdot \frac{\cos \theta}{\cos \psi} \right)} \cdot C \quad (6)$$

Where, $k\psi$ is the light transmission described as:

$$k\psi = 1 - \frac{1}{2} \left(\left(\frac{n_2 \cos \theta - n_1 \cos \psi}{n_2 \cos \theta + n_1 \cos \psi} \right)^2 + \left(\frac{n_1 \cos \theta - n_2 \cos \psi}{n_1 \cos \theta + n_2 \cos \psi} \right)^2 \right) \quad (7)$$

This value is nearly constant (about 0.98) on the assumption that $n_1 = 1.00$ and $n_2 = 1.33$ within low incidence angles ranges between $0^\circ - 45^\circ$.

The results of calculation are shown in Figs. 4-6 and Appendix Table 1.

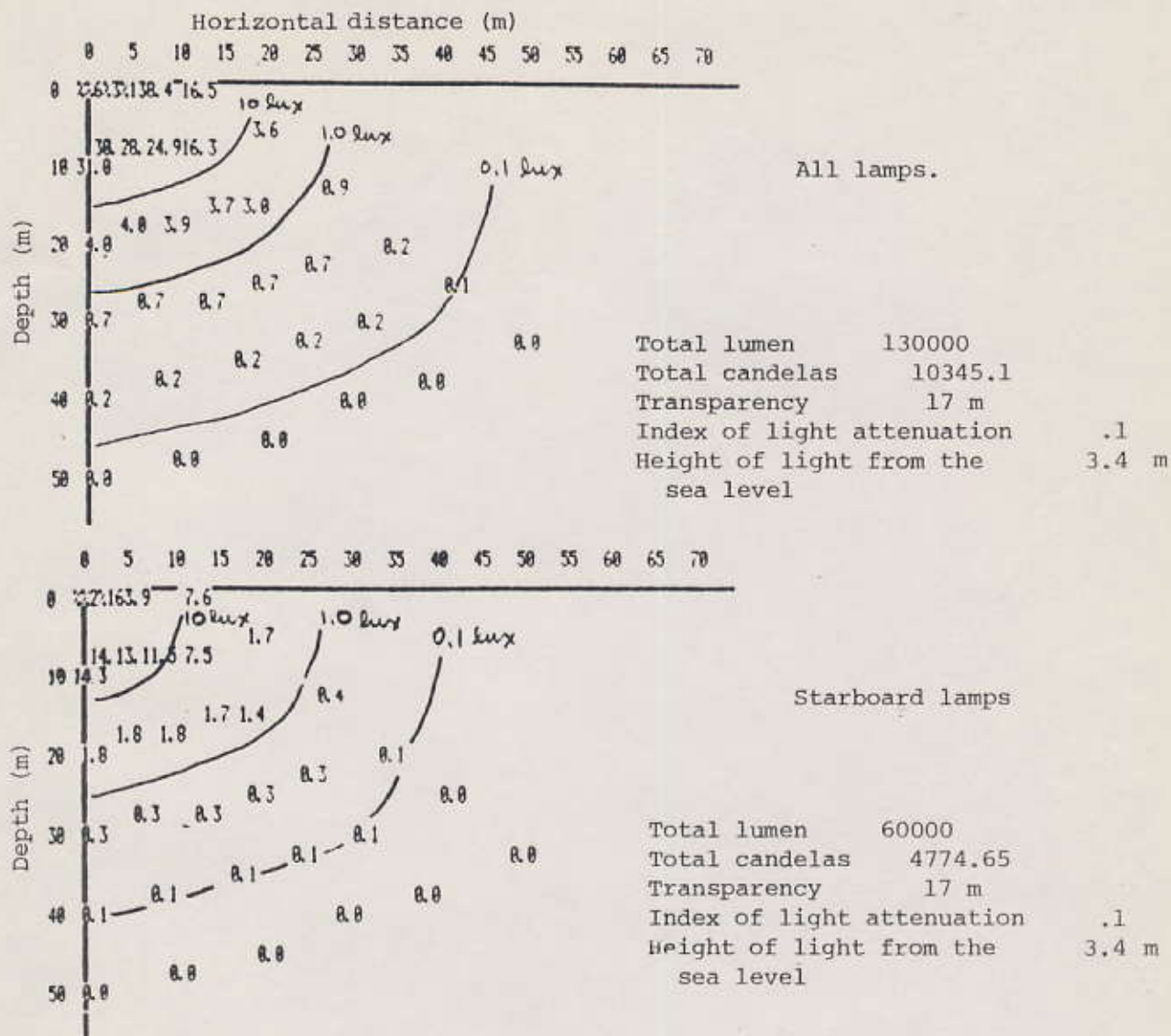


Fig. 5. Distribution of illuminance in water
(Medium-sized boat)

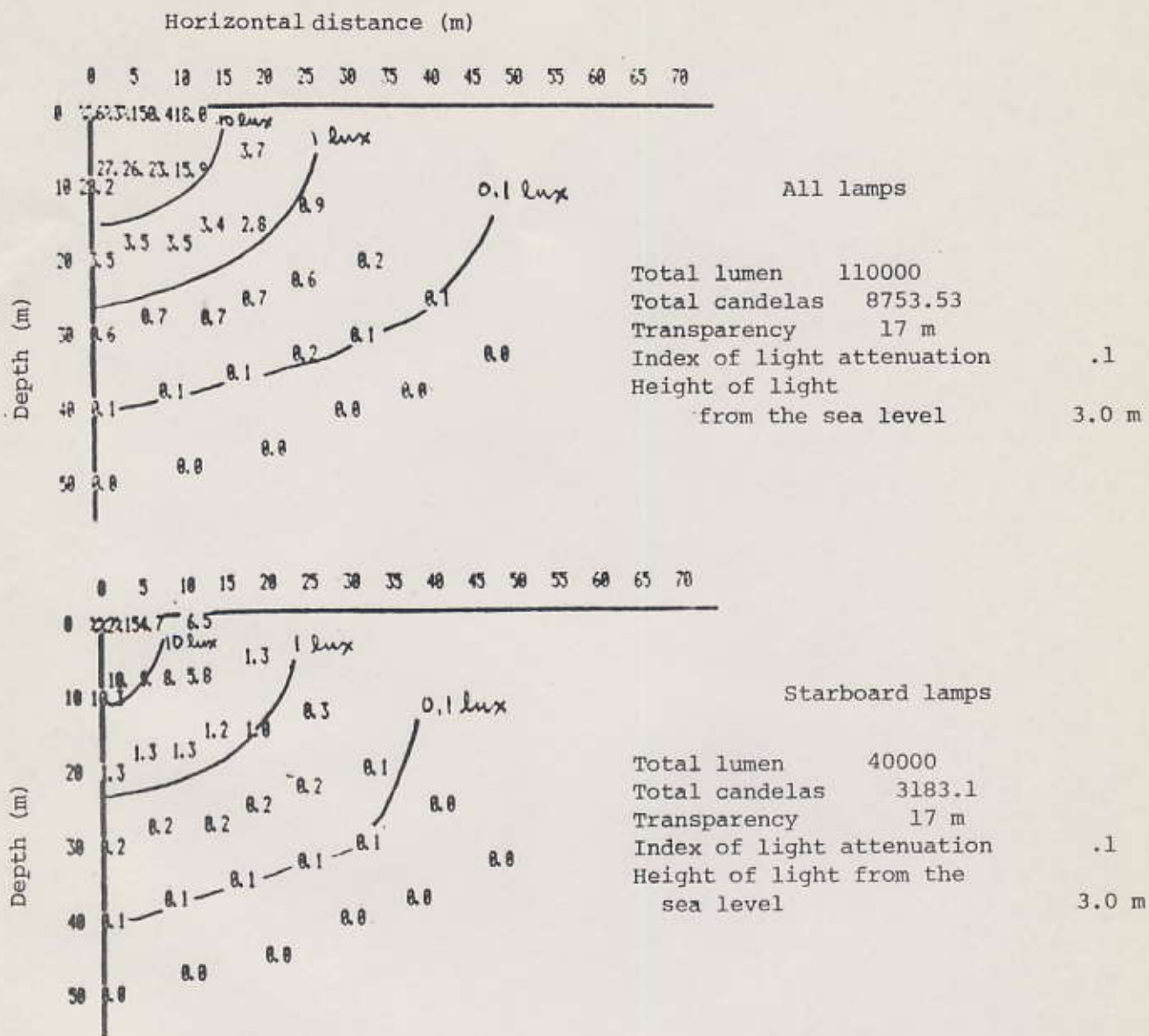


Fig. 6. Distribution of illuminance in water
(Small-sized boat)

Distribution pattern of illuminance in water

Generally speaking, light is transmissible in water and can reach depths of below 40-50 m. The vertical distance of light transmission in water seems to be independent of the power of light on deck because all isopleths of illuminance at 1.0 or 0.1 lux level are shown as nearly the same figures for differential intensities of light (Figs. 4-6). This means that the intensity of illuminance in water may be affected strongly by the height of the source lamp from the sea level rather than by the power of the lamp. In other words, the underwater light intensity of a less powerful light source used by a small-sized boat may be nearly as effective as that of a strong light source used by a large boat, provided it is placed near the sea surface. On the other hand, the horizontal distance of destination of light in the surface layer of water tends to expand as both power and height of the light source increase.

DISCUSSION

There are two essential problems concerning differential efficiency of light sources for fish luring: i) estimating destination of light in water both in vertical and horizontal direction, and ii) attracting effect of light on a fish school.

As regards the destination, the power of light may be correlated with the horizontal distance of destination in the surface layer of water, but there seems to be no correlation in vertical direction. Therefore, if we consider only the vertical effect of transmittance of light in water there is no need to increase the power of light on deck because any power of light will reach the bottom layer of a fishing ground. Actually, the squid fishing grounds in the Gulf of Thailand are usually distributed in near-shore zones of less than 30 m depth. On the other hand, if we consider that the horizontal effect may be a more important factor for controlling the catch of squid, good catch would be expected by the introduction of powerful light on deck. However, the latter problem may give rise to serious trouble among boats which conduct operations in adjacent fishing grounds.

According to our experimental studies on behaviour of squid responding to light, it reveals that the squid may be able to respond to 0.01 lux of light and schools of squid tend to disperse under excessively powerful lights. Nevertheless, there is very little information about the attracting effects of light in water. Therefore, it is impossible to decide on a reasonable light intensity at this stage. The relationship between underwater light intensity and its attracting effect could be determined through studies on fishing efficiency by using differential power of light. It is therefore felt that further studies are necessary to clarify the relationship between catch and effort.

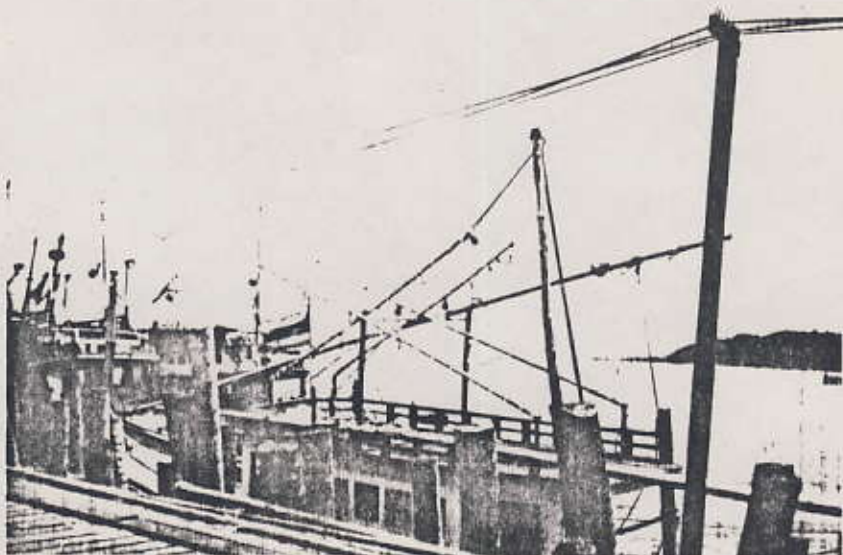
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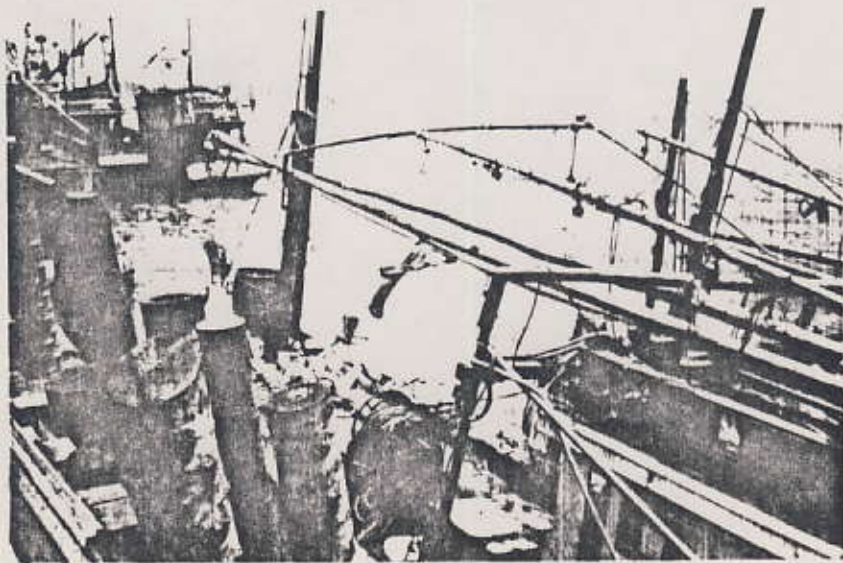
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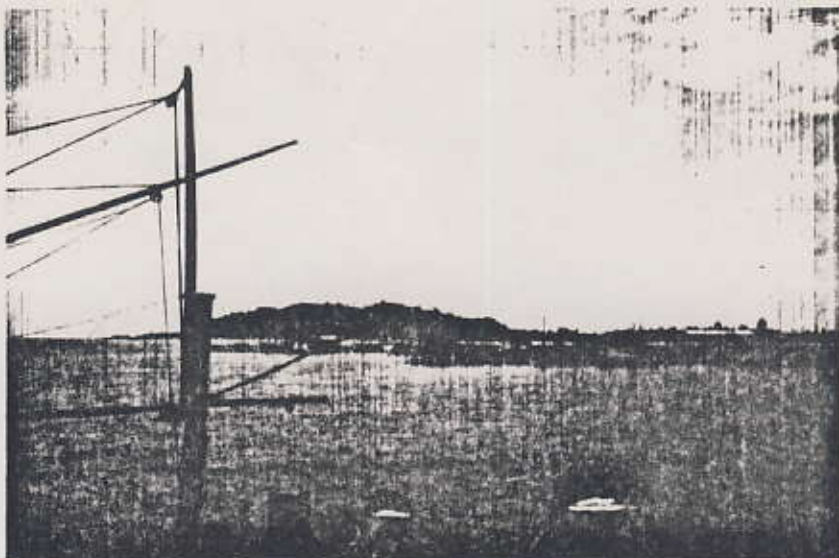
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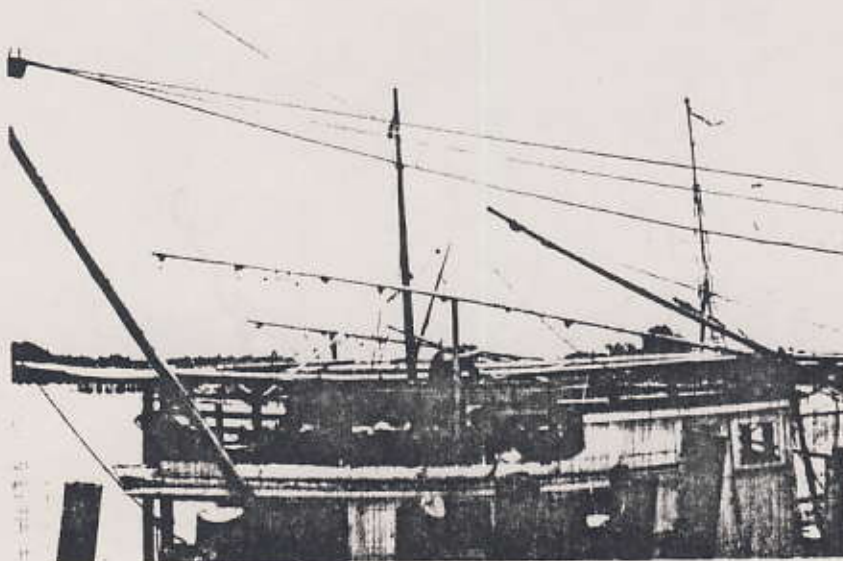
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4



5



6

APPENDIX

Table 1. Results of calculation on illuminance in water (large-sized boat)

Incident angles	Distance of destination in water	Horizon-tal distance	Depth	Illuminance					
0.000°	0.000 ^m	0.000 ^m	0.000 ^m	571.727 lux	0.000	0.000	0.000	0.000	304.921
0.000	5.000	0.000	5.000	102.937	0.000	5.000	0.000	5.000	54.899
0.000	10.000	0.000	10.000	29.485	0.000	10.000	0.000	10.000	15.725
0.000	15.000	0.000	15.000	10.377	0.000	15.000	0.000	15.000	5.534
0.000	20.000	0.000	20.000	4.105	0.000	20.000	0.000	20.000	2.189
0.000	25.000	0.000	25.000	1.751	0.000	25.000	0.000	25.000	0.934
0.000	30.000	0.000	30.000	0.787	0.000	30.000	0.000	30.000	0.420
0.000	35.000	0.000	35.000	0.368	0.000	35.000	0.000	35.000	0.196
0.000	40.000	0.000	40.000	0.177	0.000	40.000	0.000	40.000	0.095
0.000	45.000	0.000	45.000	0.088	0.000	45.000	0.000	45.000	0.047
0.000	50.000	0.000	50.000	0.044	0.000	50.000	0.000	50.000	0.023
15.000	0.000	1.206	0.000	525.828	15.000	0.000	1.206	0.000	280.441
15.000	5.000	2.179	4.904	99.017	15.000	5.000	2.179	4.904	52.809
15.000	10.000	3.152	9.809	28.851	15.000	10.000	3.152	9.809	15.187
15.000	15.000	4.125	14.713	10.245	15.000	15.000	4.125	14.713	5.464
15.000	20.000	5.098	19.618	4.075	15.000	20.000	5.098	19.618	2.174
15.000	25.000	6.071	24.522	1.745	15.000	25.000	6.071	24.522	0.931
15.000	30.000	7.044	29.426	0.787	15.000	30.000	7.044	29.426	0.420
15.000	35.000	8.017	34.331	0.369	15.000	35.000	8.017	34.331	0.197
15.000	40.000	8.990	39.235	0.178	15.000	40.000	8.990	39.235	0.095
15.000	45.000	9.963	44.140	0.088	15.000	45.000	9.963	44.140	0.047
15.000	50.000	10.936	49.044	0.044	15.000	50.000	10.936	49.044	0.024
30.000	0.000	2.598	0.000	402.028	30.000	0.000	2.598	0.000	214.415
30.000	5.000	4.478	4.633	86.695	30.000	5.000	4.478	4.633	46.230
30.000	10.000	6.357	9.266	26.698	30.000	10.000	6.357	9.266	14.239
30.000	15.000	8.237	13.900	9.771	30.000	15.000	8.237	13.900	5.211
30.000	20.000	10.117	18.533	3.961	30.000	20.000	10.117	18.533	2.112
30.000	25.000	11.997	23.166	1.718	30.000	25.000	11.997	23.166	0.916
30.000	30.000	13.876	27.799	0.782	30.000	30.000	13.876	27.799	0.417
30.000	35.000	15.756	32.433	0.369	30.000	35.000	15.756	32.433	0.197
30.000	40.000	17.636	37.066	0.179	30.000	40.000	17.636	37.066	0.096
30.000	45.000	19.515	41.699	0.089	30.000	45.000	19.515	41.699	0.047
30.000	50.000	21.395	46.332	0.045	30.000	50.000	21.395	46.332	0.024
45.000	0.000	4.500	0.000	238.955	45.000	0.000	4.500	0.000	127.443
45.000	5.000	7.158	4.235	64.538	45.000	5.000	7.158	4.235	34.420
45.000	10.000	9.817	8.470	22.099	45.000	10.000	9.817	8.470	11.786
45.000	15.000	12.475	12.704	8.604	45.000	15.000	12.475	12.704	4.589
45.000	20.000	15.133	16.939	3.633	45.000	20.000	15.133	16.939	1.938
45.000	25.000	17.792	21.174	1.622	45.000	25.000	17.792	21.174	0.865
45.000	30.000	20.450	25.409	0.754	45.000	30.000	20.450	25.409	0.402
45.000	35.000	23.108	29.644	0.362	45.000	35.000	23.108	29.644	0.193
45.000	40.000	25.766	33.878	0.178	45.000	40.000	25.766	33.878	0.095
45.000	45.000	28.425	38.113	0.089	45.000	45.000	28.425	38.113	0.048
45.000	50.000	31.083	42.348	0.046	45.000	50.000	31.083	42.348	0.024
60.000	0.000	7.794	0.000	91.132	60.000	0.000	7.794	0.000	48.604
60.000	5.000	11.050	3.795	33.005	60.000	5.000	11.050	3.795	17.603
60.000	10.000	14.306	7.590	13.405	60.000	10.000	14.306	7.590	7.150
60.000	15.000	17.561	11.384	5.846	60.000	15.000	17.561	11.384	3.118
60.000	20.000	20.817	15.179	2.677	60.000	20.000	20.817	15.179	1.428
60.000	25.000	24.073	18.974	1.270	60.000	25.000	24.073	18.974	0.678
60.000	30.000	27.329	22.769	0.620	60.000	30.000	27.329	22.769	0.331
60.000	35.000	30.584	26.563	0.309	60.000	35.000	30.584	26.563	0.165
60.000	40.000	33.840	30.358	0.157	60.000	40.000	33.840	30.358	0.084
60.000	45.000	37.096	34.153	0.081	60.000	45.000	37.096	34.153	0.043
60.000	50.000	40.352	37.948	0.042	60.000	50.000	40.352	37.948	0.022
75.000	0.000	16.794	0.000	10.901	75.000	0.000	16.794	9.000	5.814
75.000	5.000	20.426	3.437	5.274	75.000	5.000	20.426	3.437	2.813
75.000	10.000	24.057	6.874	2.638	75.000	10.000	24.057	6.874	1.407
75.000	15.000	27.688	10.311	1.351	75.000	15.000	27.688	10.311	0.721
75.000	20.000	31.320	13.748	0.705	75.000	20.000	31.320	13.748	0.376
75.000	25.000	34.951	17.185	0.373	75.000	25.000	34.951	17.185	0.199
75.000	30.000	38.582	20.623	0.200	75.000	30.000	38.582	20.623	0.106
75.000	35.000	42.214	24.060	0.108	75.000	35.000	42.214	24.060	0.058
75.000	40.000	45.845	27.497	0.059	75.000	40.000	45.845	27.497	0.031
75.000	45.000	49.476	30.934	0.032	75.000	45.000	49.476	30.934	0.017
75.000	50.000	53.107	34.371	0.018	75.000	50.000	53.107	34.371	0.009

All lamps

Starboard lamps

Continued (medium-sized boat)

Incident angles	Distance of destination in water	Horizon-tal distance	Depth	Illuminance					
0.000	0.000	0.000	0.000	867.976	0.000	0.000	0.000	0.000	400.604
0.000	5.000	0.000	5.000	118.731	0.000	5.000	0.000	5.000	54.799
0.000	10.000	0.000	10.000	30.961	0.000	10.000	0.000	10.000	14.290
0.000	15.000	0.000	15.000	10.392	0.000	15.000	0.000	15.000	4.790
0.000	20.000	0.000	20.000	3.995	0.000	20.000	0.000	20.000	1.844
0.000	25.000	0.000	25.000	1.672	0.000	25.000	0.000	25.000	0.772
0.000	30.000	0.000	30.000	0.741	0.000	30.000	0.000	30.000	0.342
0.000	35.000	0.000	35.000	0.343	0.000	35.000	0.000	35.000	0.158
0.000	40.000	0.000	40.000	0.164	0.000	40.000	0.000	40.000	0.076
0.000	45.000	0.000	45.000	0.080	0.000	45.000	0.000	45.000	0.037
0.000	50.000	0.000	50.000	0.040	0.000	50.000	0.000	50.000	0.019
15.000	0.000	0.911	0.000	798.294	15.000	0.000	0.911	0.000	368.443
15.000	5.000	1.884	4.904	115.012	15.000	5.000	1.884	4.904	51.083
15.000	10.000	2.857	9.809	30.489	15.000	10.000	2.857	9.809	14.072
15.000	15.000	3.830	14.713	10.316	15.000	15.000	3.830	14.713	4.761
15.000	20.000	4.803	19.618	3.985	15.000	20.000	4.803	19.618	1.839
15.000	25.000	5.776	24.522	1.673	15.000	25.000	5.776	24.522	0.772
15.000	30.000	6.749	29.426	0.744	15.000	30.000	6.749	29.426	0.343
15.000	35.000	7.722	34.331	0.345	15.000	35.000	7.722	34.331	0.159
15.000	40.000	8.695	39.235	0.165	15.000	40.000	8.695	39.235	0.076
15.000	45.000	9.668	44.140	0.081	15.000	45.000	9.668	44.140	0.037
15.000	50.000	10.641	49.044	0.041	15.000	50.000	10.641	49.044	0.019
30.000	0.000	1.963	0.000	610.345	30.000	0.000	1.963	0.000	281.638
30.000	5.000	3.843	4.633	102.979	30.000	5.000	3.843	4.633	47.529
30.000	10.000	5.722	9.266	28.818	30.000	10.000	5.722	9.266	13.301
30.000	15.000	7.602	13.900	10.021	30.000	15.000	7.602	13.900	4.625
30.000	20.000	9.482	18.533	3.935	30.000	20.000	9.482	18.533	1.816
30.000	25.000	11.362	23.166	1.670	30.000	25.000	11.362	23.166	0.771
30.000	30.000	13.241	27.799	0.749	30.000	30.000	13.241	27.799	0.345
30.000	35.000	15.121	32.433	0.349	30.000	35.000	15.121	32.433	0.161
30.000	40.000	17.001	37.066	0.168	30.000	40.000	17.001	37.066	0.077
30.000	45.000	18.880	41.699	0.083	30.000	45.000	18.880	41.699	0.038
30.000	50.000	20.760	46.332	0.042	30.000	50.000	20.760	46.332	0.019
45.000	0.000	3.400	0.000	362.773	45.000	0.000	3.400	0.000	167.434
45.000	5.000	6.058	4.235	79.928	45.000	5.000	6.058	4.235	36.890
45.000	10.000	8.717	8.470	24.908	45.000	10.000	8.717	8.470	11.496
45.000	15.000	11.375	12.704	9.183	45.000	15.000	11.375	12.704	4.238
45.000	20.000	14.033	16.939	3.741	45.000	20.000	14.033	16.939	1.727
45.000	25.000	16.692	21.174	1.628	45.000	25.000	16.692	21.174	0.752
45.000	30.000	19.350	25.409	0.743	45.000	30.000	19.350	25.409	0.343
45.000	35.000	22.008	29.644	0.352	45.000	35.000	22.008	29.644	0.162
45.000	40.000	24.666	33.878	0.171	45.000	40.000	24.666	33.878	0.079
45.000	45.000	27.325	38.113	0.085	45.000	45.000	27.325	38.113	0.039
45.000	50.000	29.983	42.348	0.043	45.000	50.000	29.983	42.348	0.020
60.000	0.000	5.889	0.000	138.354	60.000	0.000	5.889	0.000	63.856
60.000	5.000	9.145	3.795	43.582	60.000	5.000	9.145	3.795	20.115
60.000	10.000	12.400	7.590	16.313	60.000	10.000	12.400	7.590	7.538
60.000	15.000	15.656	11.384	6.752	60.000	15.000	15.656	11.384	3.116
60.000	20.000	18.912	15.179	2.975	60.000	20.000	18.912	15.179	1.373
60.000	25.000	22.168	18.974	1.372	60.000	25.000	22.168	18.974	0.633
60.000	30.000	25.423	22.769	0.654	60.000	30.000	25.423	22.769	0.302
60.000	35.000	28.679	26.563	0.320	60.000	35.000	28.679	26.563	0.148
60.000	40.000	31.935	30.358	0.160	60.000	40.000	31.935	30.358	0.074
60.000	45.000	35.191	34.153	0.081	60.000	45.000	35.191	34.153	0.038
60.000	50.000	38.446	37.948	0.042	60.000	50.000	38.446	37.948	0.019
75.000	0.000	12.689	0.000	16.549	75.000	0.000	12.689	0.000	7.638
75.000	5.000	16.320	3.437	7.500	75.000	5.000	16.320	3.437	3.461
75.000	10.000	19.952	6.874	3.581	75.000	10.000	19.952	6.874	1.653
75.000	15.000	23.583	10.311	1.771	75.000	15.000	23.583	10.311	0.818
75.000	20.000	27.214	13.748	0.898	75.000	20.000	27.214	13.748	0.415
75.000	25.000	30.846	17.185	0.465	75.000	25.000	30.846	17.185	0.214
75.000	30.000	34.477	20.623	0.244	75.000	30.000	34.477	20.623	0.113
75.000	35.000	38.108	24.060	0.130	75.000	35.000	38.108	24.060	0.060
75.000	40.000	41.740	27.497	0.070	75.000	40.000	41.740	27.497	0.032
75.000	45.000	45.371	30.934	0.038	75.000	45.000	45.371	30.934	0.017
75.000	50.000	49.002	34.371	0.021	75.000	50.000	49.002	34.371	0.009

All lamps

Starboard lamps

Continued (small-sized boat)



Incident angles	Distance of destination in water	Horizontal distance	Depth	Illuminance					
0.000	0.000	0.000	0.000	943.349	0.000	0.000	0.000	0.000	343.036
0.000	5.000	0.000	5.000	112.707	0.000	5.000	0.000	5.000	40.984
0.000	10.000	0.000	10.000	28.229	0.000	10.000	0.000	10.000	10.265
0.000	15.000	0.000	15.000	9.292	0.000	15.000	0.000	15.000	3.379
0.000	20.000	0.000	20.000	3.532	0.000	20.000	0.000	20.000	1.284
0.000	25.000	0.000	25.000	1.467	0.000	25.000	0.000	25.000	0.533
0.000	30.000	0.000	30.000	0.647	0.000	30.000	0.000	30.000	0.235
0.000	35.000	0.000	35.000	0.298	0.000	35.000	0.000	35.000	0.108
0.000	40.000	0.000	40.000	0.142	0.000	40.000	0.000	40.000	0.052
0.000	45.000	0.000	45.000	0.070	0.000	45.000	0.000	45.000	0.025
0.000	50.000	0.000	50.000	0.035	0.000	50.000	0.000	50.000	0.011
15.000	0.000	0.804	0.000	867.616	15.000	0.000	0.804	0.000	315.497
15.000	5.000	1.777	4.904	109.517	15.000	5.000	1.777	4.904	39.825
15.000	10.000	2.750	9.809	27.872	15.000	10.000	2.750	9.809	10.111
15.000	15.000	3.723	14.713	9.245	15.000	15.000	3.723	14.713	3.362
15.000	20.000	4.696	19.618	3.529	15.000	20.000	4.696	19.618	1.283
15.000	25.000	5.669	24.522	1.470	15.000	25.000	5.669	24.522	0.535
15.000	30.000	6.642	29.426	0.650	15.000	30.000	6.642	29.426	0.236
15.000	35.000	7.615	34.331	0.300	15.000	35.000	7.615	34.331	0.109
15.000	40.000	8.588	39.235	0.143	15.000	40.000	8.588	39.235	0.052
15.000	45.000	9.561	44.140	0.070	15.000	45.000	9.561	44.140	0.025
15.000	50.000	10.534	49.044	0.035	15.000	50.000	10.534	49.044	0.013
30.000	0.000	1.732	0.000	663.346	30.000	0.000	1.732	0.000	241.217
30.000	5.000	3.612	4.633	99.053	30.000	5.000	3.612	4.633	36.019
30.000	10.000	5.491	9.266	26.580	30.000	10.000	5.491	9.266	9.661
30.000	15.000	7.371	13.900	9.048	30.000	15.000	7.371	13.900	3.290
30.000	20.000	9.251	18.533	3.508	30.000	20.000	9.251	18.533	1.276
30.000	25.000	11.131	23.166	1.476	30.000	25.000	11.131	23.166	0.537
30.000	30.000	13.010	27.799	0.657	30.000	30.000	13.010	27.799	0.239
30.000	35.000	14.890	32.433	0.305	30.000	35.000	14.890	32.433	0.111
30.000	40.000	16.770	37.066	0.146	30.000	40.000	16.770	37.066	0.053
30.000	45.000	18.649	41.699	0.072	30.000	45.000	18.649	41.699	0.026
30.000	50.000	20.529	46.332	0.036	30.000	50.000	20.529	46.332	0.013
45.000	0.000	3.000	0.000	394.276	45.000	0.000	3.000	0.000	143.373
45.000	5.000	5.658	4.235	78.381	45.000	5.000	5.658	4.235	28.502
45.000	10.000	8.317	8.470	23.408	45.000	10.000	8.317	8.470	8.112
45.000	15.000	10.975	12.704	8.429	45.000	15.000	10.975	12.704	3.065
45.000	20.000	13.633	16.939	3.383	45.000	20.000	13.633	16.939	1.230
45.000	25.000	16.292	21.174	1.458	45.000	25.000	16.292	21.174	0.530
45.000	30.000	18.950	25.409	0.660	45.000	30.000	18.950	25.409	0.240
45.000	35.000	21.608	29.644	0.311	45.000	35.000	21.608	29.644	0.113
45.000	40.000	24.266	33.878	0.150	45.000	40.000	24.266	33.878	0.055
45.000	45.000	26.925	38.113	0.074	45.000	45.000	26.925	38.113	0.027
45.000	50.000	29.583	42.348	0.038	45.000	50.000	29.583	42.348	0.014
60.000	0.000	5.196	0.000	150.368	60.000	0.000	5.196	0.000	51.679
60.000	5.000	8.452	3.795	44.083	60.000	5.000	8.452	3.795	16.030
60.000	10.000	11.708	7.590	15.902	60.000	10.000	11.708	7.590	5.763
60.000	15.000	14.963	11.384	6.416	60.000	15.000	14.963	11.384	2.113
60.000	20.000	18.219	15.179	2.780	60.000	20.000	18.219	15.179	1.011
60.000	25.000	21.475	18.974	1.266	60.000	25.000	21.475	18.974	0.466
60.000	30.000	24.731	22.769	0.598	60.000	30.000	24.731	22.769	0.217
60.000	35.000	27.986	26.563	0.290	60.000	35.000	27.986	26.563	0.106
60.000	40.000	31.242	30.358	0.144	60.000	40.000	31.242	30.358	0.052
60.000	45.000	34.498	34.153	0.073	60.000	45.000	34.498	34.153	0.027
60.000	50.000	37.754	37.948	0.037	60.000	50.000	37.754	37.948	0.014
75.000	0.000	11.196	0.000	17.986	75.000	0.000	11.196	0.000	6.540
75.000	5.000	14.828	3.437	7.875	75.000	5.000	14.828	3.437	2.864
75.000	10.000	18.459	6.874	3.675	75.000	10.000	18.459	6.874	1.337
75.000	15.000	22.090	10.311	1.788	75.000	15.000	22.090	10.311	0.650
75.000	20.000	25.722	13.748	0.895	75.000	20.000	25.722	13.748	0.325
75.000	25.000	29.353	17.185	0.458	75.000	25.000	29.353	17.185	0.167
75.000	30.000	32.984	20.623	0.238	75.000	30.000	32.984	20.623	0.087
75.000	35.000	36.615	24.060	0.126	75.000	35.000	36.615	24.060	0.046
75.000	40.000	40.247	27.497	0.067	75.000	40.000	40.247	27.497	0.024
75.000	45.000	43.878	30.934	0.036	75.000	45.000	43.878	30.934	0.013
75.000	50.000	47.509	34.371	0.020	75.000	50.000	47.509	34.371	0.007

All lamps

Starboard lamps