Studies on the American Style Purse Seiner-I
Comparision with the Tuna Long Liner

Shigeo ABE

The American style purse seiner developed in the United States was studied in comparision with the tuna long liner developed in Japan, in terms of principal particulars, speed, hull form and conditions expressed in mean value of four vessels each.

In comparison with the tuna long liner of 500 GT class, the American style purse seiner of the same size is 20.2 % broader in actual size and 16 % broader in L/B and has more stability.

The speed which is required to be over 14 knots in cruising condition is 14.7 knots for the purse seiner and 12.8 knots for the tuna long liner.

The purse seiner has the hull form of greater midship section coefficient and smaller block coefficient, i.e., the hull form of fat midship and rapidly slim bow and stern.

The incident angle of water line at the bow is 9~14 degrees for the purse seiner while it is approximately 38 degrees for the tuna long liner.

The trim of the purse seiner in light load condition is by the head since this vessel carries net and skiff boat in the stern area. This is a significant characteristic of the purse seiner.

The metacentric height (GM) in full load condition, i.e., in working condition is 0.93 m which is about twice as much as that of ordinary fishing vessels, giving consideration to the safty against unvavorable condition in navigation and fishing operation. However, the period of rolling is 7~9 seconds which is an ordinary period for the fishing vessel of 500 GT class.

The American style purse seiner was imported to Japan from the United States around 1949 but its achievement was rather poor because of its inadequate hull and fisheries equipment. However, it became to draw attention of those concerned after it marked a favorable achievement in 1971 on the fishing ground in the South Pacific developed in 1963. The Nippon Maru (999 GT) was bult in 1970 adopting the hull form the American style purse seiner to the maximum extent (1). All the American style purse seiner built in Japan thereafter adopted the hull form. It is said that none of the results from the lines of Japanese fishing vessels is available for reference (2).

The author studied the American style purse seiner of 500 GT class developed in the United States in comparison with the tuna long liner of the same size developed in Japan in terms of various specific items.

Method

Four American style purse seiner of 500

Table 1. Four tuna long liners (L-1~4) and four American style purse seiners (S-1~4) used in the study.

No.	G/T	Name
L-1	498 tons	A-Maru (3)
L-2	496 tons	B-Maru (4)
L-3	489 tons	C-Maru (3)
L-4	488 tons	D-Maru (4)
S-1	499 tons	Hayabusa-Maru
S-2	499 tons	Wakaba-Maru
S-3	499 tons	Fukuichi-Maru
S-4	499 tons	Hayabusa-Maru, No. 2

GT class and four tuna long liner of about the same size listed in Table 1 (3~5) were compared for their respective principal particulars, speed, hull form and conditions expressed in mean value in Table 2.

Results and Discussion

Principal Particulars

In comparison with the tuna long liner the American style purse seiner is longer by 3.7% and broader by 20.2%. The

Table 2. Mean values of principal particulars, speed, hull form, and conditions in the tuna long liner (TLL) and the American style purse seiner (ASPS).

	TLL		ASPS	
Principal particulars				
Length registered, L (m)	50.23		52.08	
Breadth, B (m)	9.15		11.00	
Depth, D (m)	4.21		6.88	
L/B	5.49		4.73	
L/D	11.92		7.57	
B/D	2.17		1.60	
GT/LBD	0.25		0.13	
Trial speed (knots)				
Load				
1/4	10.10		11.56	
2/4	11.77		13.71	
3/4	12.81		14.74	
4/4	13.67		15.41	
over load	14.11		15.65	
Conditions	Light	Full load	Light	Full load
Fore draft (m)	0.33	2.67	2.96	3.52
After draft (m)	3.83	4.56	2.71	4.66
Mean draft (m)	2.08	3.62	2.84	4.09
Trim (m)	3.50	1.89	-0.25	1.14
Displacement tonnage (t)	569.17	1145.45	763.70	1296.00
Midship area (m^2)	17.13	31.45	27.61	42.09
Midship section coefficient, Cm	0.935	0.964	0.966	0.977
Block coefficient, Cb	0.605	0.685	0.518	0.583
Prismatic coefficient, Cp	0.647	0.711	0.537	0.596
Water plane coefficient, Cw	0.731	0.856	0.660	0.765
Tons per cm immersion, (t)	3.428	3.985	3.703	4.315
Moment to change trim one cm (t-m)	8.463	13.028	8.420	12.540
Height of metacenter, KM (m)	4.735	4.080	5.140	4.860
Height of center of buoyancy, KB (m)	1.178	1.969	1.450	2.200
Height of center of gravity, KG (m)	3.940	3.323	4.640	3.930
Metacentric height, GM (m)	0.795	0.758	0.500	0.930
KG/D	0.935	0.785	1.014	0.859
Free-board (m)	2.345	0.780	1.996	0.696

length bradth ratio L/B is 4.73 for the purse seiner and 5.49 for the tuna long liner, and thus the purse seiner is 16% broader in L/B. This is to increase the stability and dead weight capacity of the American style purse seiner since its weight on board is great (1). The depth was excluded from the items of comparison because of different standards.

Speed

As shown in Table 2, the speed of the purse seiner is 11.6 knots at 1/4 load in terms of full load or 1.5 knots faster than the tuna long liner, 13.7 knots at 2/4 load or 1.9 knot faster, 14.7 knots at 3/4 load or 1.9 knots faster, 15.4 knots at 4/4 load or 1.7 knots faster, and 15.6 knots at over load or 1.5 knots faster.

Usually the speed of the vessel with greater breadth is reduced due to the increased hull resistance. However, the reason why the purse seiner with greater breadth is faster than the tuna long liner is that the block cofficient is smaller and the hull is slimmer.

The speed of the purse seiner reportedly requires over 14 knots at 3/4 load of the cruising speed (2), but it is 14.7 knots in mean value. This higher speed is required of the purse seiner for chasing fish schools unlike in the tuna long liner which uses a different fishery procedure.

Hull Form

It is already stated in the description of principal particular that the purse seiner is 20.2% broader. In the purse seiner, the midship section coefficient is also greater by 3.3% in light load condition and by 1.3% in full load condition, and the area of midship section is greater by 61% in light load condition and 34% in full load condition. In other words, the purse seiner is broader and fatter than the tuna long liner at the midship. The blook coefficient of the purse seiner is smaller by 16.8% in light load condition and 17.5% in full load condition. This indicates that the purse seiner has the hull form of fat midship and rapidly slim bow and stern.

The incident angle of water line at the bow is extermely small being nearly 14 degrees for the Nippon Maru (1) and 9 degrees for the Kakuyo Maru (7) while it is 35~40 degrees for the conventional Japanese fishing vessel and about 38 degree for tuna long liner (1).

Conditions

The bow draft of the purse seiner in light load condition is extremely deep being 2.96m (0.326m for the tuna long liner) and the trim is 0.25m by the head. It is rare to see 'trim by the head' in light load condition (3.502m trim by the stern for tuna long liner). This is because the purse seiner carries heavy materials (about 30 tons of fishing net and about 15 tons of skiff boat) at the stern area. In full load condition, the trim is 1.14m by the stern, which is appropriate for cruise.

In the purse seiner, the center of gravity is higher by 0.7m in light load condition and by 0.607m in full load condition; the center of buoyancy is higher by 0.272 m in light load condition and by 0.231m in full condition; and the metacenter is higher by 0.405m in light load condition and by 0.780m in full load condition.

The metacentric height (GM) which the navigators used as the standard index of safty and intial stability of the vessel is almost the same in light load and full load conditions being 0.795m and 0.758m respectively in the tuna long liner, but in

the purse seiner, it is 0.50m in light load condition and 0.93m in full load condition, the latter in working condition being greater by 0.43m. It has been reported that the GM of fishing vessels is usually 0.40～0.50m (8). However, the value of the GM about twice as big in the purse seiner may reflect that consideration was given to the safety against unvavorable condition in navigation and fishing operation such as elevation of the center of gravity during the fishery and listing of the hull at the time of purse-line hauling (6).

From GM in Table 2, the period of rolling is estimated to be 7～9 seconds, which is ordinary period for the fishing vessle of 500 GT size.

The free-board of the purse seiner is smaller by 0.349m in light load condition and by 0.087m in full load condition.

References

1) Kanno, S. (1971). *Gyosen*, 175, 11–17. (in Japanese)
2) Fukuda, Y. (1973). *Gyosen*, 184, 44–51. (in Japanese)
3) Fishing Boat Association of Japan (1963) Shin Gyosen Shiryo-shu. Fish. Boat. Ass. Jap., Tokyo, 46–47. (in Japanese)
4) Fishing Boat Association of Japan (1965) *Gyosen*, 137 (in Japanese).
5) Fishing Boat Association of Japan (1971). *Gyosen*, 171. (in Japanese)
6) Nohara, S. (1975). Kokai-Zosengaku. Kaibundo, Tokyo, 10–11. (in Japanese)
7) Fishing Boat Laboratory, Fishery Agency of Japan (1975). *Gyosen*, 200, 26–33. (in Japanese)
8) Sato, R. (1974). Shoto-Senpaku-Riron. Kaibundo, Tokyo, 53–73. (in Japanese)

米国式旋網船について— I

鮪延縄船との比較

阿 部 茂 夫

米国で開発された500総トン級米国式旋網船と日本で開発された500総トン級鮪延縄船各4隻の要目，速力、船型，性能の平均値を比較検討した。

米国式旋網船は，甲板上の搭載物重量が重いため幅を鮪延縄船より20.2%広げて復原力を増している。米国式旋網船の巡航速力である¾負荷では，14ノット以上要求されているが，調査した限りでは平均で14.7ノットであり，鮪延縄船では，12,8ノットであった。

米国式旋網船は，船体中央部では鮪延縄船より肥っているが船首および船尾で急激にやせている船型である。

船首の水線入射角は，米国式旋網船は極端に小さく9度～14度であり，鮪延縄船では38度位である。

軽荷状態の米国式旋網船の Trim は Trim by the head である。船尾に重量物（漁網約30トン，9 mスキフボート約15トン）を積む関係であるが，この Trim は顕著な特徴である。重量物の搭載後の満載状態では 1.14m Trim by the stern となり，航海に適した Trim となる。

運航者が，船の安全度と初期復原力を知る目安としている Metacentric height (GM) は，稼働状態の満載状態では0.93mで一般漁船の約2倍となっているが，漁撈時に於ける船体の傾斜，その他の航海，操業時における悪条件の中での安全性について考慮を払ったものと思われる。GM が大きければ横揺れ周期が短くなるが，周期は7～9秒で500トン級漁船としては通常の周期である。