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*A COMPARATIVE STUDY ON CONSTRUCTIONAL CHARACTERISTICS AND ENGINE POWER OF TURKISH FISHING VESSEL IN THE BLACK SEA**

KARADENİZ'DEKİ TÜRK BALIKÇI GEMİLERİNİN YAPISAL ÖZELLİKLERİ VE MOTOR GÜÇLERİNİN KARŞILAŞTIRMALI OLARAK İNCELENMESİ

EMİN ÖZDAMAR

Faculty of Fisheries, Ondokuz Mayıs University, Sinop, Turkey

Key Words: Fishing Vessel, Principal Dimensions, Engine Power, Black Sea, Fisheries Management

Abstract

In this study, the principal dimensions and fishing power of Turkish fishing vessels bigger than 18 GT in the Black Sea were investigated. Furthermore, the comparison on the principal dimensions was made among Turkish, Japanese, CIS (Country of Independent States) and Peruvian fishing vessels. Totally, 441 Turkish, 1289 Japanese and CIS fishing vessels were analyzed. It was determined that 29% of Turkish vessels in the Black Sea were between 17 and 18 m in length, and 3% of them were 27 m or longer. Some basic proportions of wooden and steel Turkish vessels were calculated as; L/B=2.84-3.24, L/D=10.02-11.43 and HP/GT=5.56-4.65, respectively. In recent years, the increment on number of vessel and fishing capacity in Turkey was observed, in which 66% of fishing vessels in the Black Sea were built in 1977-1989. During this term, marine fish catches were increased accordingly, but CPUE was decreased about 50%. It was concluded that due to the high competition among fishermen, the excessive engine power was particularly used in Turkish vessels.

Introduction

Turkey is surrounded by three seas, yet she exploits her marine resources not properly and safely (Anon., 1993a and 1993b; Özdamar, 1994). Turkey is a country that has the richest marine potential in its region, but its aquatic resources have been diminishing gradually

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due to wrong utilization or over exploitation. However this situation, fishing vessels which are main tools to exploit the marine resources had been increased remarkably in number and capacity in the last two decades. Consequently, aquatic products of Turkey from all seas, especially the Black Sea, had increased firstly then started to decrease in 1989 (Fig. 1), (Anon., 1979-1993).

Fishing vessels usually are constructed according to the traditional design which was historically obtained by experience, or preference of fishermen, but without taking into account the naval constructional rules or economic analysis. Baykal (1982) reported that in order to keep the operational expenses to a low level which are strongly related to fuel consumption of a vessel, it is necessary to design a vessel which has lowest resistance at the requested speed. Some literature is accessible about Turkish fishing boats, but the information concerning principal dimensions and fishing efforts of Turkish fishing vessels is not available (Anon., 1989 and 1992a; Anon., 1979-1993; Şahin, 1984). Formerly, Kafalı (1970 and 1982) had stated that there were some insufficiencies on the design of Turkish fishing vessels. They can be summarized under following topics; underwater form of the hull, engine selection, materials and skill of constructors. Despite that these previous inadequacies were shown, there is not much differences made on present fishing vessels. Due to the lack of standardization and registration on fishing vessels in Turkey, fishermen are getting into an unusually high competition. This drastic competition can be seen clearly on vessel size, engine power, mechanic and electronic fishing equipment.

The objective of this research is to determine the fishing capacity of Turkish fishing vessels from the viewpoint of fisheries management. A serial study on the principal dimensions and fishing powers of Turkish fishing vessels was carried out. As the first step to prove the outline of Turkish fishing fleet, the vessels in the Black Sea were analyzed from the perspective of principal dimension and fishing effort.

Materials and Methods

According to the Turkish Maritime Law, Turkish fishing vessels equal to or bigger than 18 GT must be registered to a harbor registration office. Such registered boats in the Black Sea constitute about 40% of all Turkish fishing vessels. Meanwhile, more than 80% of marine landings in Turkey is provided by the Black Sea. Consequently, in the first step of the study, the data were used for the Black Sea Turkish fishing vessels built in 1960-1991. Fishing boats less than 18 GT were not included in the research. Although their number is much greater than that of bigger vessels, neither their catching capacities nor shares (about 10%, according to Kara and Kınacıgil, 1990) in the marine landings of Turkey are high.

Totally, data of 441 Turkish fishing vessels from 23 harbors in the Black Sea (the names of harbor from east to west are as follows; Pazar, Rize, Sürmene, Trabzon, Vakfıkebir, Görele, Tirebolu, Giresun, Ordu, Fatsa, Ünye, Samsun, Gerze, Sinop, Ayancık, İnebolu, Amasra, Zonguldak, K.Ereğli, Karasu, Kefken, Şile, İğneada) were taken and their building material, registered length (L), breadth (B), depth (D), Gross Tonnage (GT) and main engine power (HP) were analyzed (Anon., 1992b). Moreover, in order to make comparison on the characteristics of fishing vessels, data of Japanese (purse seiners and trawls) and

CIS's (purse seiners and trawlers in the Black Sea) fishing vessels were also analyzed (Anon., 1991 and 1992c). Total sample size for the above two areas was 1289.

The final evaluation was made on Turkish, Japanese and CIS's fishing vessels examined in this study, together with Peruvian seiners' reported by Machii and Nose (1989). The overall analysis and comparison for fishing vessels were particularly made among the four countries, Turkey, Japan, CIS and Peru, because Japan is one of the most developed countries in the area of ship building and fisheries management, CIS and Turkey have been exploiting the similar aquatic resources in the Black Sea, and Peru's main fishing species is anchovy as in Turkey.

Results

The composition of construction materials for Turkish fishing vessels was found in the Black Sea as 73% wooden and 27% steel. Their building year by construction material is given in Table 1.

Table 1: The building year of Turkish fishing vessels by construction material.

Building Year	*Wooden*	*Steel*	*Total*
1960-69	56		56
1970	9		9
1971	8	1	9
1972	6		6
1973	7		7
1974	10		10
1975	13	1	14
1976	14	1	15
1977	19	3	22
1978	19	3	22
1979	16	6	22
1980	29	7	36
1981	19	7	26
1982	15	12	27
1983	19	11	30
1984	11	9	20
1985	17	10	27
1986	5	12	17
1987	3	6	9
1988	12	9	21
1989	4	7	11
1990	8	9	17
1991	3	5	8
Total	322	119	441

The registration ports of 441 Turkish fishing vessels which were analyzed in this research were 69.39% in the Eastern-Black Sea and the rest in the Western-Black Sea (Fig. 2).

Vessels were built at 26 different shipyards which were located in numerous areas in Turkey. The shipyards of 441 vessels were 47% in the Eastern-Black Sea and 32% in the Western-Black Sea. The main shipyard locations in the Black Sea were Sürmene and Kurucaşile (Fig. 3).

The mean length, Gross Tonnage and engine power for Turkish fishing vessels by year are resumed in Table 2. Minimum, maximum and mean values of length and engine power for Turkish fishing vessels by Gross Tonnage are shown in Table 3.

Table 2: Some dimensions and engine powers of Turkish fishing vessel in the Black Sea by year (The value of L/B and L/D are mean, others are min., mean and max.).

Building Year	*Length (m)*	*L/B---L/D*	*Gross Tonnage*	*Engine Power (HP)*
1960-64	11.3-14.99-19.2	3.35-10.84	18.4-26.74- 43.2	50-179- 400
1965-69	12.6-15.37-18.4	2.83-10.29	19.9-32.86- 48.8	35-211- 470
1970-74	12.3-16.54-22.1	2.77- 9.89	19.0-40.38- 87.7	110-238- 470
1975-79	11.5-18.25-34.3	2.88-10.21	18.0-52.00-148.4	72-271- 700
1980-84	12.4-19.26-29.8	2.97-10.64	18.4-60.40-149.2	60-305- 940
1985-89	13.1-21.68-32.8	3.03-10.57	18.5-80.91-196.0	101-380-1720
Overall	11.3-18.80-34.3	2.95-10.40	18.0-57.79-196.0	35-290-1720

Table 3: The number of Turkish vessel with length (m) and engine power (HP) by Gross Tonnage in the Black Sea (values are written by order of min., mean and max.).

Gross Tonnage	*Number of Vessel*	*Length*	*Engine Power*
26>	51	11.3-13.79-15.9	35- 144- 303
26- 50	230	13.0-17.07-20.8	60- 232- 471
51- 75	48	17.1-19.63-22.7	162- 289- 470
76-100	76	17.8-22.94-25.8	112- 425- 890
101-125	15	24.4-25.99-31.4	189- 463- 940
126-150	19	21.1-27.31-34.3	200- 605- 940
150<	2	32.6-32.70-32.8	744-1232-1720

Length, Gross Tonnage and engine power were varied as; L=11.28-34.30m, GT=18.02-196.00 and HP=35-1720, respectively. Twenty-nine percent of Turkish fishing vessels in the Black Sea were between 17 and 18 m, whereas 3% were 27 m or longer in length (Fig. 4).

The relationships among length, breadth, depth, Gross Tonnage and engine power by construction materials were calculated for each country (Tables 4 and 5). Additionally, figures concerning those relationships with correlation coefficients are given for Turkish fishing vessels in Fig. 5.

Table 4: The mean value of some basic characteristics of Turkish, Japanese, Peruvian and CIS fishing vessels.

Country	*L/B* *Wooden-Steel*	*L/D* *Wooden-Steel*	*GT/LBD* *Wooden-Steel*	*HP/GT* *Wooden-Steel*
Turkey	2.84-3.24	10.02-11.43	0.24-0.26	5.56-4.65
*Peru**	2.97-3.13	6.64- 6.16	0.29-0.31	3.36-2.44
Japan	4.37-4.44	11.44-10.98	0.34-0.31	5.50-6.78
*CIS***	3.64	7.61	0.20	2.66

* After Machii and Nose (1989), the result was transformed to metric system and the registration length.

** Data was only available for steel vessel so that calculation was not made for wooden vessel.

Table 5: The relationships among some principal characteristics and engine powers of fishing vessels by country .

Country	*L/B*	*L/D*	*GT/LBD*	*HP/GT*
Turkey	**B**=2.10+0.23(L) **r**=0.90	**D**=0.62+0.06(L) **r**=0.77	**GT**=2.46+0.24(LBD) **r**=0.95	**HP**=51.57+4.12(GT) **r**=0.77
Japan	**B**=0.84+0.19(L) **r**=0.93	**D**=-0.09+0.09(L) **r**=0.94	**GT**=10.07+0.27(LBD) **r**=0.97	**HP**=110.07+4.94(GT) **r**=0.87
*CIS**	**B**=4.78+0.08(L) **r**=0.99	**D**=1.34+0.08(L) **r**=0.99	**GT**=88.32+0.02(LBD) **r**=0.98	**HP**=-426.99+7.02(GT) **r**=0.95

*Calculation was made for steel vessel.

In order to make comparison among dimensions, the estimations of breadth, depth, Gross Tonnage and engine power were made for vessel of 20, 25 and 30 m in length (Table 6 and Fig. 6). In addition to these estimations, the relationship between engine power and length for Turkish, Japanese and CIS's vessels were calculated as follows;

HP= -326.41+32.78(L), r=0.77→ Turkish fishing vessel
HP= -575.91+51.67(L), r=0.88→ Japanese fishing vessel
HP= 102.89+6.57(L), r=0.86→ CIS fishing vessel

Table 6: The estimations of breadth (m), depth (m), Gross Tonnage and engine power for the vessels of 20, 25 and 30 meters in length.

Country	*B*	*D*	*GT*	*HP*
Turkey	6.63-7.76-8.89	1.89-2.21-2.53	62-104-161	305-478-716
Peru	6.58-8.22-9.87	3.11-3.89-4.67	81-158-273	230-449-777
Japan	4.72-5.69-6.66	1.79-2.26-2.73	56- 98-159	387-592-894
CIS	6.32-6.71-7.09	2.86-3.24-3.61	95- 99-103	241-265-295

Fig. 1: Marine fish catches and number of fishing vessel bigger than 18 GT, for the year between 1972 and 1991, in Turkey

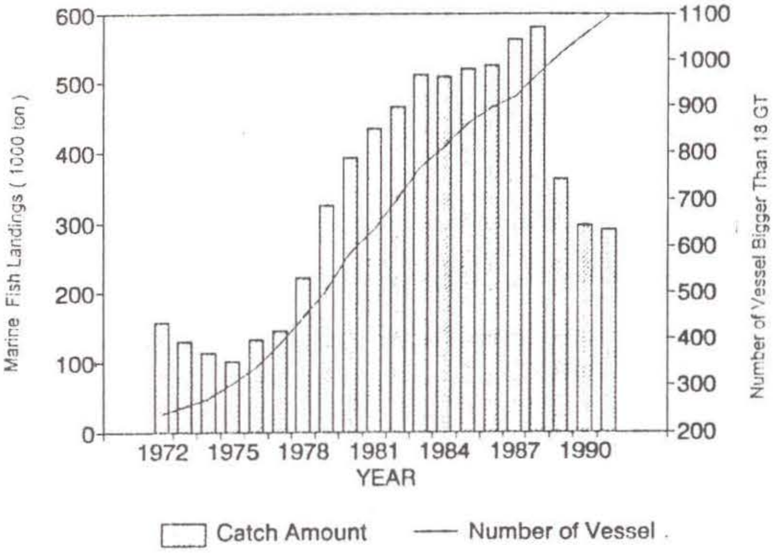


Fig. 2: Number of Turkish fishing vessel by registered port in the Black Sea

(Numbers in the X axis show registered port from east to west)

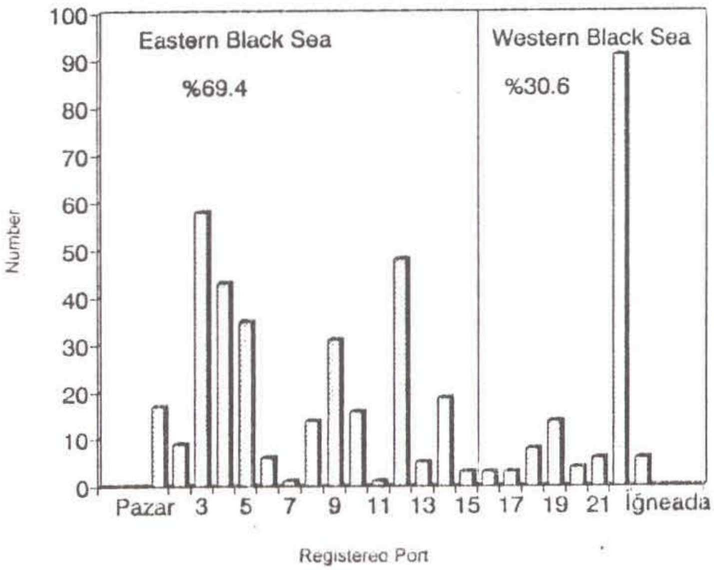


Fig. 3: The building locations for Turkish fishing vessels in the Black Sea (Numbers inside the figure indicate proportional values)

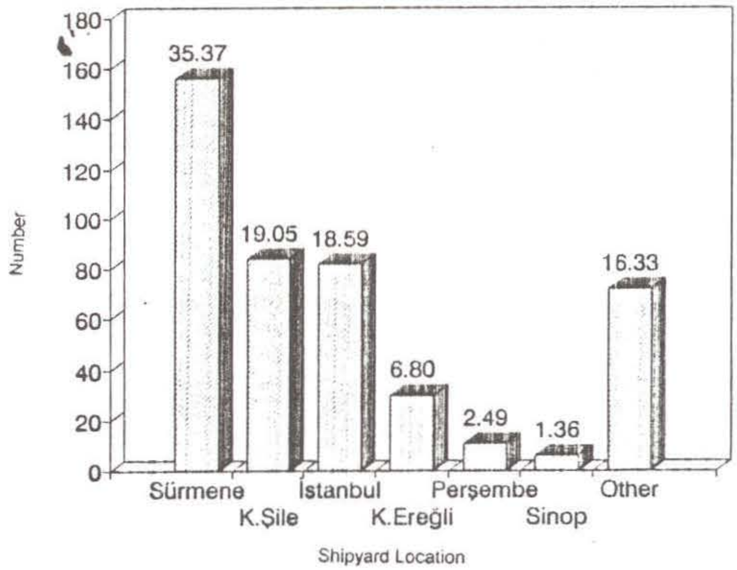


Fig. 4: The length frequency distribution of Turkish fishing vessels in the Black Sea (Numbers inside the figure indicate percentages. Data covers vessels built between 1960 and 1991)

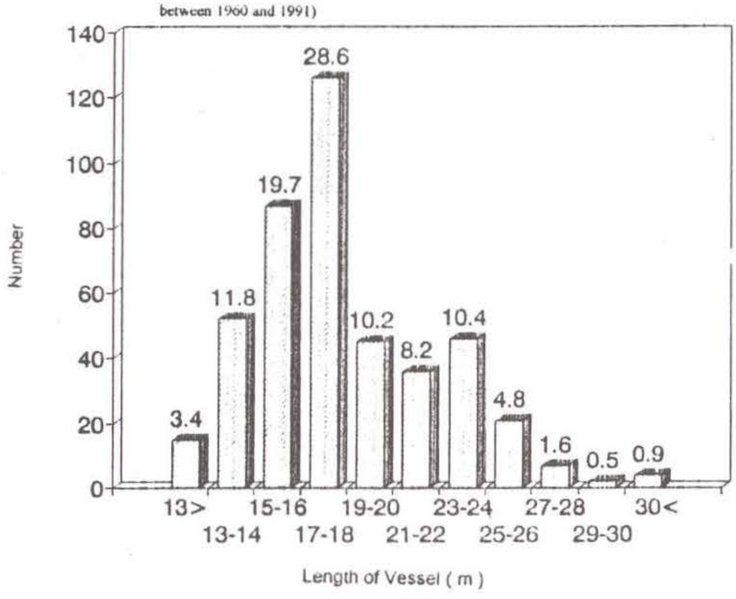


Fig. 5: Some principal dimensions of Turkish fishing vessels in the Black Sea.

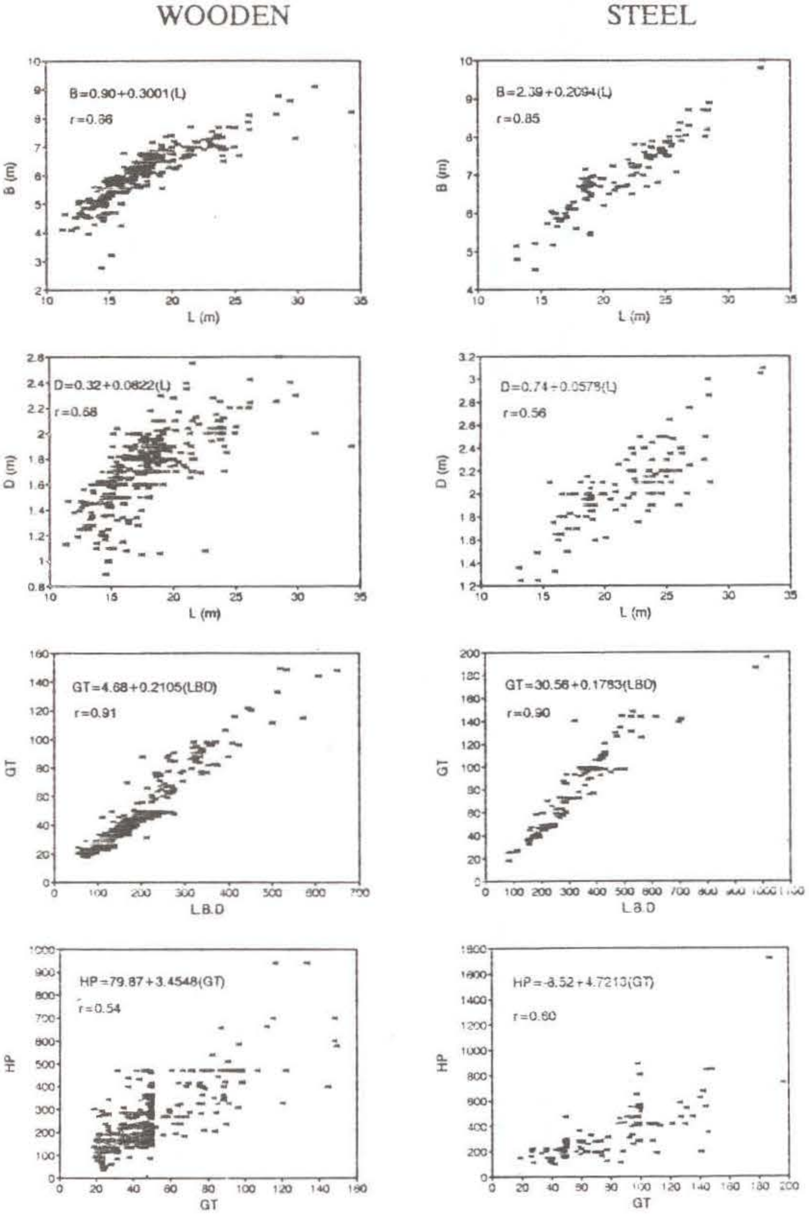
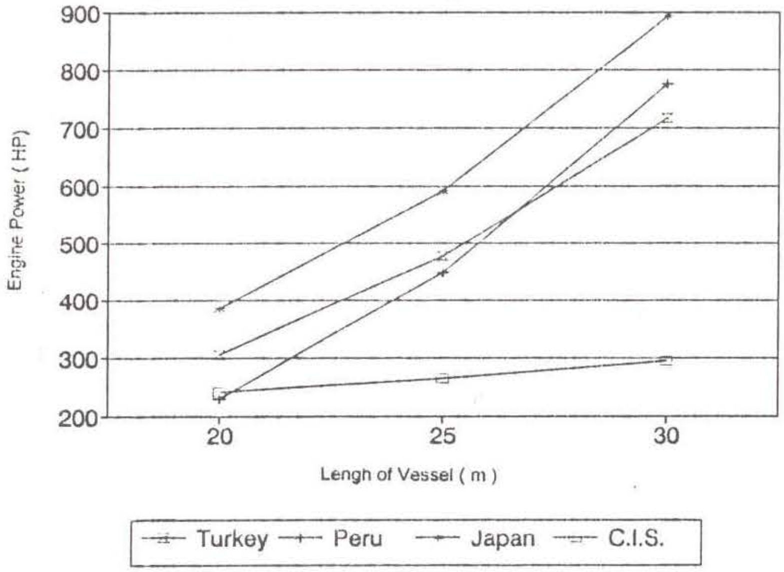


Fig. 6: The estimation of engine power (HP) for Turkish, Peruvian, CIS and Japanese fishing vessel of 20, 25 and 30 m in length.



Discussion

After 1970's, Turkish fishery came into a stage for the enlargement of fishing power by modernization of fishing gear and technology, such as building new steel vessels, equipping high-tech electronic and mechanic devices, and using effective nets. In order to promote commercial fishing fleet by the importation of custom-free modern fishing equipment, prevalent fishing credit with reasonable interest had been provided for fishermen by Turkish Government, according to the encouragement plan of fishery. That is why 57% of fishing vessels in the Black Sea were built in the years between 1977 and 1986. Depending on such modernization on fishing gear and technology in those years, marine fish catch of Turkey had increased 3.7 times in the Black Sea and 3.6 times in all seas (Anon., 1979-1993). However, the catch per unit GT (CPUE) was increased from about 20t to 22t in the beginning, then decreased to 11t in 1989.

As of the year 1991, 67% of the steel vessels and 52% of the wooden ones were constructed in the years between 1977 and 1986. Development of facilities at the fishing shipyard, especially in the Eastern-Black Sea, played also an important role for progress of fishery in the Black Sea, so that more than 65% of vessels were registered to the ports in this area. Nowadays, Sürmene, Sinop and K.Ereğli are well-known locations for shipyard of steel vessels, and Kurucaşile is famous for wooden boats.

As seen in Table 2, mean length, GT and engine power increased gradually year after year. While mean length and GT were 14.99m and 26.74GT for vessels built in 1960-1964, they were increased to 21.68m and 80.91GT in 1985-1989. Engine power is also similar as length and GT, and was increased from 179HP to 380HP. However, marine landings did not increase constantly during these years like fishing effort.

According to Table 3, Turkish fishing vessels had quite variable engine power by GT, e.g., while maximum engine power was 471HP in 26-50GT, mean engine power in 101-125GT and some vessels' engine powers in 126-150GT were less than that value. This kind of variance was not seen for Japanese or CIS's vessels. The HP/GT relationship was found weak (r=0.54-0.60), whereas the L/B relationship was found quite strong (r=0.85-0.86), (Fig. 5). The L/B ratio for wooden Turkish vessels was about 20% higher than steel ones. Due to the high resistance, the more engine power was used for requested speed in wooden boats. All these showed us clearly that engine power was not chosen for Turkish fishing vessels according to scientific or technical criterion. The correlation coefficient for L/D relationship was also found as similar to that of HP/GT. The reason of such variances might be related to the management system of Turkish fishery, because fisheries management is not based on the limited-entry. Until now, a kind of free access has been valid in Turkish fishery, so that fishermen prefer multipurpose vessels. That is why vessels are not so distinct other than their equipment, according to different kinds of fishery, e.g., purse seiner, trawler, auxiliary or gill net vessel, etc. Fishermen can modify the type of vessels due to the abundance of fish and the market conditions before or during a fishing season. According to such requirements, fishermen plan details of vessels, particularly changing size of engine, fuel tank, living and working space, etc.

The increase of fishing power in Turkish fishing fleet in the late 1970s by size of vessel and engine power, gained momentum to catch turbot notably in the Northern-Black Sea. This situation changed after the declaration of EEZ (Economic Exclusive Zone) from USSR. The main reason of enlargement of fishing capacity after EEZ was to obtain advantages for catching fast swimming fish, such as tuna, bonito and blue fish. L/B and L/D are components to determine vessel's resistance, and they are also effective for the speed of a vessel. However, L/B and L/D are not taken into account to set a vessel's speed in Turkish fishing vessels. For example, while L/B ratio was about 3 for Turkish fishing vessels, it was more than 4 for Japanese fishing vessels. Instead of change these dimensions, the engine power of a vessel is particularly modified for a greater speed in Turkish fishing vessels. Thus, the more expensive input was used, e.g., engine and fuel, for speed per unit increment. On contrary to such situation in Turkish fishery, advanced fishing nations investigate dimensions, engine power and speed of a vessel under serial experiments, and this pro-type fishing vessel may be used as a standard type, so that maximum benefit from unit engine power can be obtained. The usage of standard vessels in a fishery is also solved partly the high competition among fishermen.

The shapes of vessels were found similar for Turkish and Peruvian fishing vessels. However, it is noted that the information given by Machii and Nose (1989) that of Peruvian vessels were built before 1970. The low L/B value helped the stability of Turkish fishing vessel, but it reduced the speed of a vessel. However, stability must be provided by the principle of ship engineering instead of low L/B. Thus, equivalent vessel speed may be gained with lower engine power by the design of a vessel under ship engineering rules. We can see such operation in Japanese vessel. According to the results summarized in Tables 4, 5, 6 and Figure 6, Turkish and Japanese fishing vessels used higher engine power for per GT. It is normal for Japanese vessels, because they are sailing severe oceanographic conditions, e.g., strong sea currents, winds, typhoons, and are catching notably fast swimming fishes such as skipjack, yellowfin tuna, mackerel, etc. However, in the Black Sea, Turkish vessels had high engine power, while CIS's fishing vessels were fishing equipped by lower engine power. This is why the essential further adjustment of optimum fishing capacity and hull design for Turkish fishing vessel, instead of increasing engine power, is recommended to manage living resources of Turkey economically and properly.

As a conclusion, in order to manage marine living resources of Turkey in the Black Sea more appropriately, the following basic regulations are recommended: i) Fishing effort should be arranged depend on the abundance of marine fish resources. Due to the extremely high fishing effort at the moment, additional fishing vessels must not be constructed. Although such a rule was accepted in 1994 by the Ministry of Agriculture and Rural Affairs of Turkey, many weak points of this rule made it not effective to decrease fishing effort. ii) By agreement of giving up the older fishing vessels from the fishery, the new ones might be built with the equal fishing effort of the older ones. iii) Standard-type fishing vessels should be designed, and fishing effort of such a vessel must not be changed by increasing length, engine power, length of net, electronic equipment, etc. Anything other than standard fishing vessels should not be built. iv) Ship engineering and fisheries management rules must be followed during new constructions or even during fishing. v) Fishing license should be arranged for each specific fishing gear, working period and fishing grounds, so that CPUE may be risen. Working on such kind of fishery license will surely help the Black Sea to restore its own marine resources. This is because changing the type of fishing gear, such as from trawl to purse seine or from auxiliary vessel to trawl, will be ended. Therefore, fishermen will be able to control their own licensed fishing areas. vi) In addition to all above, it is essential to establish an organization which particularly engages marine resource protection and rescue. If such an organization is established successfully and works effectively in the seas of Turkey, it will definitely help for optimum gathering of marine living and non-living resources, and hinder environmental destruction.

Özet

Araştırmada, Karadeniz'de 18 Gros tondan büyük Türk balıkçı gemilerinin yapısal özellikleri ve av güçleri incelenmiş, ayrıca bu gemilerin boyutsal özellikleri Japon, Bağımsız Devletler Topluluğu ve Peru balıkçı gemileri ile karşılaştırılmıştır. Çalışmada, 441 Türk ile 1289 Japon ve BDT balıkçı gemisi analiz edilmiştir. Karadeniz Türk balıkçı teknelerinin %29'unun 17-18 m arasında, %3'ünün ise 27 m ve daha üzerinde olduğu saptanmıştır. Bu gemilerin uzunluk-genişlik, uzunluk-derinlik ve motor gücü-Gros ton oranları ahşap ve saç teknelerde sırasıyla, L/B=2.84-3.24, L/D=10.02-11.43 ve HP/GT=5.56-4.65 olarak hesaplanmıştır. Balıkçı gemileri Türkiye'de son yıllarda sayı ve avlama kapasitesi açısından artış göstermiş ve gemilerinin %66'sı 1977-1989 yılları arasında inşa edilmiştir. Bu dönem içerinde deniz balıkları av miktarının artmasına karşılık birim çabada av miktarı yaklaşık %50 azalmıştır. Ayrıca çalışmada, balıkçılar arasındaki yoğun rekabete bağlı olarak Türk teknelerinde aşırı motor gücü kullanıldığı sonucuna varılmıştır.

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