ARTIGO   *REVISTA BRASILEIRA DE ENGENHARIA DE PESCA*

ANALYSIS OF FISHING VESSELS CHARACTERISTICS: A FISHING FLEET PROFILE OF ESPÍRITO SANTO, BRAZIL

ANÁLISE DAS CARACTERISTICAS DE EMBARCAÇÕES PESQUEIRAS: UM PERFIL DA FROTA PESQUEIRA DO ESPÍRITO SANTO

Lucas de Carvalho GUESSE[1], Amanda Soares dos SANTOS[1]

[1]Instituto Federal do Espírito Santo – Campus Piúma

*E-mail: lucasguesse@gmail.com

Resumo - O Estado do Espírito Santo possui um setor pesqueiro de grande relevância, mas ainda não existem estudos direcionados a descrição de sua frota pesqueira, o que é essencial para a gestão da pesca. Este trabalho apresenta uma análise da frota pesqueira do Estado do Espírito Santo à partir de dados disponíveis no Registro Geral da Pesca (RGP) e do Boletim estatístico da pesca do Espírito Santo. Características como comprimento total, arqueação bruta e potência do motor foram coletadas e relacionadas com os métodos de captura que as mesmas utilizam. Além disso, um estudo preliminar da eficiência da frota foi relacionado com a potência instalada e a arqueação bruta das embarcações. A frota do Estado possui um total de 1355 embarcações cadastradas até o ano de 2015 e o município que apresentou a maior frota cadastrada foi Marataízes. O total de arqueação bruta do Estado foi de 10782. Não houveram registro de embarcações pesqueiras maiores do que 20 metros de comprimento e a Linha é o principal método de pesca, representando 53% da captura do Estado. Foi constatado que a escolha dos motores nas embarcações segue sem uma aplicação de conhecimento técnico relacionado ao sistema propulsor, interferindo diretamente no consumo de combustível, que é o principal custo de operação das embarcações.
Palavras-Chave: embarcações de pesca, pesca artesanal, características da frota

Abstract - The State of Espírito Santo - Brazil has a fishing sector of great relevance, but there are still no studies directed to the description of its fishing fleet, which is essential for fisheries management. This study presents an analysis of the fishing fleet of the State of Espírito Santo based on the available data in the General Fisheries Registry (RGP) and in the Fisheries statistical bulletin of Espírito Santo. Characteristics such as total length, gross tonnage and engine power were collected and related to the capture methods they use. In addition, a preliminary study of fleet efficiency was related to the engine power and the gross tonnage. The State fleet has a total of 1,355 vessels registered by the year 2015 and the city that had the largest fleet was Marataízes. The total gross tonnage was 10,782. There were no records of fishing vessels larger than 20 meters length and Line is the main method of fishing, representing 53% of the fleet's catch. It was verified that the choice of vessel's engines continues without a technical knowledge application related to the propulsion system, directly interfering in the fuel usage, which is the main cost of vessels operation.
Keywords: fishing vessels, artisanal fishing, fleet characteristics.

The Espírito Santo State is located in the Southeastern Region of Brazil and has 3,973,697 inhabitants (IBGE, 2016). The coastal region has approximately 460 km of extension and 14 municipalities (Figure 1). The coastline has a variety of environments and boasts numerous areas of natural breeding grounds. It is also responsible for the occurrence of the abundance of fishery resources such as fish, crustaceans and molluscs (PROZEE, 2005).
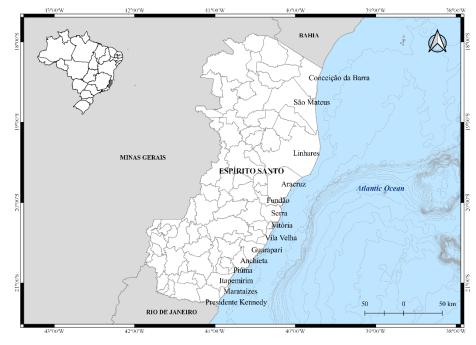

Figure 1. Municipalities of the coast of Espírito Santo.

The production of fishing in the State can be divided between continental and marine production. In 2011, the continental production of Espírito Santo accounted for 882 tons, representing only 0.4% of national production (SEAG, 2014). In turn, the marine production was 12.3 thousand tons, about 2.6% of the total Brazilian production (Hostim-Silva & Soares, 2013).

The Espírito Santo has a fishing sector of great importance to the State´s economy, although it does not represent a high percentage of national production. It is responsible for the generation of approximately 14,335 direct jobs (INCAPER, 2017).

Fishing has low productive diversity in the opportunities of exploited products. The main products marketed by the State are fresh fish and poorly industrialized products. According to SEAG, (2014), some factors that corroborate the low production: the uses of outdated vessels and the lack of safety on board; absence of biological and fishery data collection; the poor infrastructure of the fishmongers that do not meet health standards; rudimentary marketing; the low capacity of management, innovation, and introduction of new technologies; non-compliance with legislation; the difficulty of renewing the fishing authorization; the difficulty of access to credit, among others.

Fishermen use several fishing methods. This great variety can be attributed to the diversity of target species found throughout the region, as well as the instability of the activity (Netto & Di Beneditto, 2007).

Capacity management of the fishing fleet is an essential tool for the sustainable exploitation of fisheries resources, which is one of the main objectives of the fisheries policy (EC, 2016). Thus, information regarding vessels is essential in the analysis and management of a fishing fleet. According to Oliveira *et al* (2009), as well as a means of transport, vessels have a key role in the production chain particularly with respect to the economic and environmental impact of fishing.

Brazil has few academic researches with fishing vessels as its objective. This sector has been on the margins of engineering studies that could improve either vessel design or management of fishery resources based on fleet management. Even with all the relevant fishing activity, there is

still no study detailing the fishing fleet State. Therefore, this work intends to characterize the fishing fleet and contribute information about it in future researches.

Materials and method

This study uses the dataset of vessels registered in the Fisheries General Register (RGP) by the year 2015 (Ministério da Pesca e Aquicultura, 2015). The RGP is the Brazilian government database for fisheries. Information about all fishermen and boats authorized to fish by government are in this database and was available on web until 2016. In addition to specific information such as name and registration number in the Maritime Authority, the RGP provides the following information: fishing gear used; length; gross tonnage; type of propulsion; engine power; hull material; year of construction; and the County. These data were collected on the website of the former Brazilian Ministry of Fisheries and Aquaculture in the year 2016.

The Fleet will be classified into three size categories, as indicated in STECF (2016). The choice of this classification will allow a future comparison with fleets from other countries. The size categories are:

- Small-scale fleet (SSF) - for vessels up to 12 meters in length;
- Large-scale fleet (LSF) - for those with a length between 12 and 24 meters; and
- Distant-water fleet (DWF) - with length over 24 meters.

The vessels will also be classified by fishing methods, classified into five large groups, according to Ministry Normative Instruction n° 10/2011 (Ministério da Pesca e Aquicultura, 2011):

- Line: use a single line, with or without the aid of reeds or rods, or multiple lines as long-lines;
- Gillnetter: employ unattached, drifting, or anchor netting;
- Trawler: employ traction net trawl, with manual or mechanical pick up;
- Seiner: use purse-seine, with manual or mechanical pick-up;
- Trap Setter: they use equipment as traps or pots;
- Others: any other modality of fishing not mentioned in the preceding paragraphs and multipurpose vessels. In general, they are in the old permission of fishing in the process of conversion.

The fishing methods with greater participation in the fleet will be identified either in number of vessels or in total Gross Tonnage, and also the geographical distribution of the Fleet by the State.

With all this data classified, some characteristics will be related in order to allow an initial analysis of the efficiency of the Fleet. The characteristics related to Gross Tonnage (GT) allow evaluating the volume transported by the Fleet. Likewise, those relating to Engine Power (BHP) allow a better evaluation of the energy uses by the Fleet.

Results and Discussion

For a better understanding of the fleet it is necessary to understand the species and quantities captured in the State. Unfortunately, the last available fishing statistics refer to the year 2011 published by Hostim-Silva & Soares (2013). However, these values are presented only for a comparison with fleet data and not for an assessment of its production. These results show total capture by species grouped by the fishing method (Table 1). Line is the main fishing method of the State participating with 53% of the total catch, followed by trawl fishing with 28%.

Table 1. Main species caught account and fishing methods

Fishing Methods	Main caught species	Total (kg)
Line	*Balistes capriscus, Carcharrhinus spp., Sphyrna spp., Coryphaena hippurus, Epinephelus marginatus, Katsuwonus pelamis, Mycteroperca bonaci, Pagrus pagrus, Thunnus albacares, Xiphias gladius*	6,612,331
Trawlers	*Farfantepenaeus brasiliensis, Farfantepenaeus paulensis, Litopenaeus schmitti, Xiphopenaeus kroyeri*	3,497,194
Others	*Coryphaena hippurus, Thunnus albacares, Xiphopenaeus kroyeri*	1,066,431
Gillnetters	*Carcharrhinus spp., Sphyrna spp., Micropogonias furnieri, Scomberomorus brasiliensis*	784,116
Trap setters	*Pagrus pagrus, Panulirus argus, Panulirus laevicauda*	280,790
Seiners	*Anchoviella lepidentostole, Caranx crysos, Katsuwonus pelamis*	108,290
	TOTAL	12,349,152

Source: adapted from Hostim-Silva & Soares (2013)

The Espírito Santo's coast has 14 municipalities and more than 60 organizations of the fishing sector. In order to realize this capture showed on Table 2, the Espírito Santo fleet counts on a total of 1,355 vessels mostly distributed along coastal towns. All these fleet have total Gross Tonnage of 10,782 with line method concentrating vessel on number and GT (*Figure 2*). Marataízes has the highest number of vessels but it is Itapemirim that has the largest total gross tonnage.
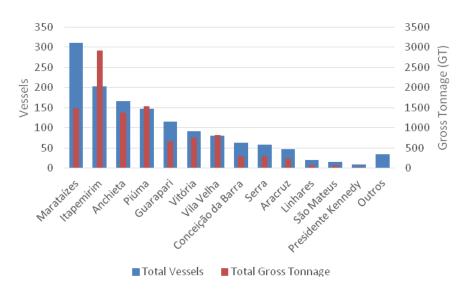

Figure 2. Geographic distribution.

The values of total capture is reflected in the number of vessels that use the line as a fishing gear with 493 vessels (37%). The Trawlers are second with 328 vessels (24%). But the Gross Tonnage does not have the same importance. Line fishing concentrates 7,533 GT (69%) out of a total of 10,783 GT while Trawlers account for less than 18% of this figure (Figure 3).
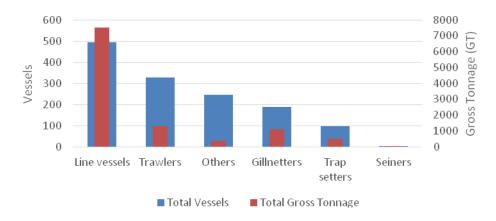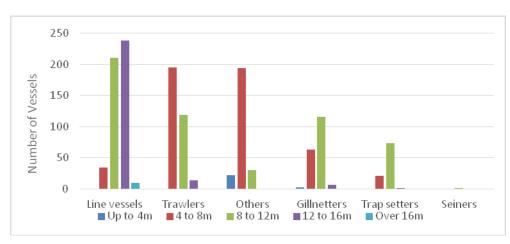

Figure 3. Fleet distribution by fishing method.

The length of the state fishing vessels vary from 3 to 19.50 meters with an average length of 9.15. There is no record of vessels greater than 20 meters. The length up to 20 meters can be attributed to the limitation of local shipyards that do not have suitable slipways to handle vessels of this size. All of then depends on the tides to carry out and launch by slipways.

The larger vessels use the Line as a fishing method (Figure 4). This method concentrates 91% of the boats with a length between 12 and 16 meters and 100% of those over 16 meters. The Trawlers are concentrated between 4 and 8 meters (59%) and the Gillnetters and Seiners between 8 and 12 meters (61% and 76%, respectively).

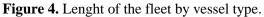**Figure 4.** Lenght of the fleet by vessel type.

Figure 5 shows the percentage of vessels in each size category: Small-scale coastal fleet (SSF); Large-scale fleet (LSF); Distant-water fleet (DWF). According to the classification proposed, the largest part of the State fleet is Small-Scale Fleet totalling 1068 vessels (78.82%) and the remaining 287 (21.18%) belong to Large-Scale Fleet. Trap Setters, Trawler, and Gillnetters concentrate, respectively, 97, 95 and 94% of their vessels on the SSF. Line method has its fleet divided by 52% in LSF and 48% in SSF. The group Distant-water fleet is not presented in the figure because there are no vessels in this classification.
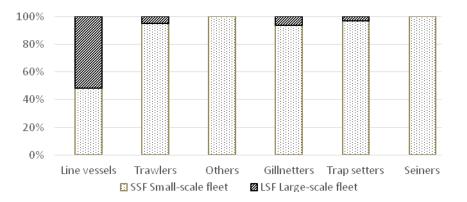
Figure 5. Percentage by fleet type.

The total GT of the FLE is much larger than the LSF although its number of vessels is smaller. This smaller number of vessels is responsible for the greater volume of cargo transported by the Espírito Santo's fleet. In all, the LSF carries 6,008 GT while the SSF carries 4,773 GT. Line method mobilizes the largest amount of Gross Tonnage, about 70% of the total transport capacity of the entire fishing fleet (Figure 6).
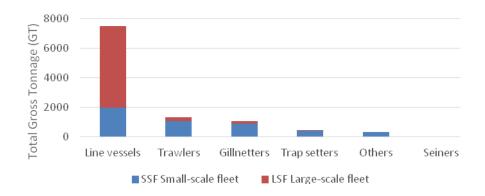

Figure 6. Total Gross Tonnage by fishing method and vessel size.

The oldest vessel registered at RGP was built in 1944 but only after 1966 there are a continue register of at least one construction by year (Figure 7) The fleet has an average age of 24 years and the crest of shipbuilding was between the years 2000 and 2004, reaching its apex in 2002 with more than 85 vessels built. The Trawlers and Line are, respectively, the highest and lowest mean age (26 and 15 years). In addition, the Line method has been shown to be the preference of shipowners in the construction of new vessels (**Erro! Fonte de referência não encontrada.**). In all the vessels built from 2010, the Line represented 18% of the new SSF vessels and 100% of the LSF. The fleet has two peak periods in the number of vessels built around the years 1988 and 2002.
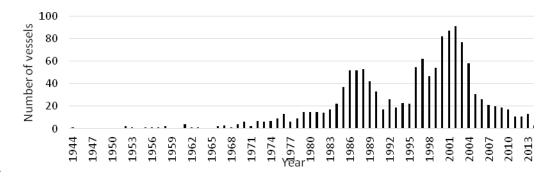
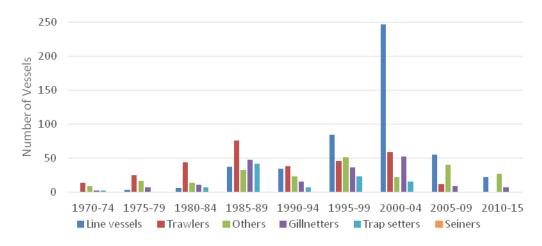**Figure 7.** Year of register of fishing vessels.

Figure 8. Year of construction by vessel type.

On Marine Engineering, relationships between some characteristics can be made for a preliminary analysis of efficiency. One of them is the Engine Power and Gross Tonnage ratio (kW/GT) that represents the power required to carry a certain volume. The fuel consumption is related to the engine power so the decrease of the kW/GT ratio has a direct impact on the cost of production. In other words, the lower this ratio the less power is required for the transport of a given cargo volume.

The State's Fleet has a ratio of 7.99 kW/GT. When analyzed by size category, SSF presents 10.34 and LSF 6.71 kW/GT (Table 2). This lower ratio in the LSF means that fleet spends 35% less energy to carry the same amount of load compared to SSF. This justifies the preference for larger vessels, as in the case of line fishing vessels, as mentioned above.

Table 2 - Power Engine and Gross Tonnage ratio by size

Fishing Method	kW/GT		
	All Vessels	**SSF**	**LSF**
Line vessels	7,66	7,78	6,66
Trawlers	11,86	12,90	7,86
Others	10,97	10,97	-
Gillnetters	9,22	9,62	7,69
Trap setters	6,66	6,76	5,74
Seiners	13,16	13,16	-

It is not possible to identify a pattern of engine power and gross tonnage ratio in the Espírito Santo's vessels that have the same dimensions and perform similar services. This fact shows that probably there is not a rational method of choice of vessel's engines and also the lack of technical knowledge in the design of the propulsion plants.

Conclusion

As shown, Line is the main fishing method of the Espírito Santo State. This is demonstrated in the analysis of both the State fisheries statistics and the analysis of the fleet's profile.

The vessels are concentrated in the south of the State coast and are very old if we consider that 20 years is the retirement age of other categories of vessels, such as merchant ships.

The Small and Large Scale categorization (SSF and LSF) presented helped to understand that, despite the greater number of Small Scale Fleet vessels, the Large Scale Fleet has greater transport capacity due to the mobilization of the largest vessels in the State.

It has also been shown that the preference for larger vessels in recent years may be related to the decrease in operating costs since they have a lower kW/GT ratio than smaller vessels. Nevertheless, it is noticed that the choice of engines follows without the application of technical knowledge. This demonstrates that the fishing sector lacks technical studies related to the propulsive system. These studies can further improve the profitability of fishing by directly interfering with fuel consumption, the main operational cost of vessels.

References

Oliveira, M. A. N., Coelho, R. B. D., & de Amorim, F. A. S. (2009). *Análise da Frota Pesqueira do estado do Rio de Janeiro. Diagnóstico da cadeia produtiva da pesca marítima no estado do Rio de Janeiro*. https://doi.org/10.13140/2.1.2661.6006

EC. (2016). *Facts and figures on the Common Fisheries Policy, European Commission*. https://doi.org/10.2771/607841

Hostim-Silva, M., & Soares, G. S. S. (2013). Boletim estatístico da pesca do Espírito Santo: ano 2011, 94. Retrieved from http://sdrv.ms/172N3pq

IBGE. (2016). Estatísticas dos municípios brasileiros. Retrieved August 24, 2017, from http://www.ibge.gov.br/estadosat/perfil.php?sigla=es

INCAPER. (2017). A Pesca no Espírito Santo. Retrieved July 24, 2017, from https://incaper.es.gov.br/pesca-2

Ministério da Pesca e Aquicultura. Instrução normativa MPA/MMA n° 10, de 10 de junho de 2011 (2011). Brazil. Retrieved from http://www.icmbio.gov.br/cepsul/images/stories/legislacao/Instrucao_normativa/2011/ini_mpa_mma_10_2011_altrda_regul_permissionamento_completa_altrd_in_14_2014_in_01_2015.pdf

Ministério da Pesca e Aquicultura. (2015). Fisheries General Register (RGP). Retrieved August 1, 2016, from http://sisrgp.dataprev.gov.br/rgp/web/index.php/

Netto, R. D. F., & Di Beneditto, A. P. M. (2007). Diversidade de artefatos da pesca artesanal marinha do Espírito Santo. *Biotemas*, *20*(2), 107–119.

PROZEE. (2005). Relatório Técnico Sobre O Censo Estrutural Da Pesca Artesanal Marítima E Estuarina Nos Estados Do Espírito Santo, Rio De Janeiro, Paraná, Santa Catarina E Rio Grande Do Sul. *Convênio SEAP/IBAMA/PROZEE Nº 110/2004*, *2004*, 154. https://doi.org/10.1017/CBO9781107415324.004

SEAG. (2014). *Plano Estratégico de Desenvolvimento da Agricultura Capixaba*. Vitória. Retrieved from https://seag.es.gov.br/Media/seag/Documentos/PEDEAG_Completo_sem ficha técnica (1).pdf

STECF. (2016). *The 2016 Annual Economic Report on the EU fishing fleet. JRC Scientific and*

Policy Reports. https://doi.org/10.2788/842673