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RESEARCH ARTICLE

# Determination of the amount of bilge waste generated by motorized fishing vessels in Türkiye

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**ABSTRACT**

When bilge water from ships is illegally discharged into the sea, it causes severe damage to the marine and coastal ecosystem. MARPOL Annex-1 does not cover many fishing vessels since it only covers vessels over 400 GT (gross tonnage). According to Turkish Statistical Institute (TURKSTAT) data, only 174 of the 14064 fishing vessels registered in Türkiye are above 400 GT. In our country, only 63 of 325 fishing harbors have waste reception facilities to control and collect bilge water. In this study, the amount of bilge waste that fishing vessels can produce was calculated using engine power information, and it was determined that a fishing vessel can produce an average of 155 L/day of bilge waste. It was also calculated that the bilge waste from fishing vessels could be at least 463872 $m^3$/year, which is more than the 416370 $m^3$ bilge waste collected from all vessels in 2021 according to the data of the Ministry of Environment, Urbanization and Climate Change. As a result, it is assessed that this risk can be reduced by increasing the number of waste reception facilities, the legal responsibility of waste reception facilities for bilge waste of fishing vessels, and strict inspections.

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## Introduction

The discharge of bilge and wastewater from ships into the sea poses severe threats to the marine ecosystem. Bilge waste accumulates on the bottom of ships and contains substances such as detergent, oil or fuel that can cause severe damage to the ecosystem. One of the main anthropogenic inputs of hydrocarbons in marine waters is the dumping of bilge waste, estimated to be even higher than accidental oil spills (Pavlaski et al., 2001; National Research Council (NRC), 2003; GESAMP, 2007). One of the most important causes of anthropogenic pollution in the coastal ecosystem is petroleum hydrocarbon discharges from two-stroke and stationary engine oils (Beyrem et al., 2010). A study on bilge wastes from fishing vessels in the

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coastal area of Thailand reported that the discharge of bilge in the sea may have an important share in the formation of oil pollution (Lin et al., 2007).

The study conducted in Taiwan estimated that 3215 small vessels under 100 GT with engines below 300 HP (Horse Power) could generate up to 321700 L of oily waste per year. According to MARPOL, if the oil content in bilge waste is more than 15 mg/L, it is prohibited to be discharged into the sea. However, since this rule does not cover fishing vessels, most of which are under 400 GT, these vessels discharge a significant amount of bilge water into the sea (Lin et al., 2007). In a study on the content of bilge produced by small fishing vessels in Thai harbors, it was determined that the oil content ranged from 58 to 976 mg/L, which is much higher than the oil content of 15 mg/L determined by MARPOL (Chanthamalee et al., 2013). The rules in Annex-1 of the MARPOL convention contain the regulations on bilge waste. These regulations cover tankers larger than 150 GT and all ships larger than 400 GT. Only 174 of the fishing vessels in Türkiye are larger than 400 GT (TURKSTAT, 2022).

Parks et al. (2019) determined that a fishing vessel can produce 1.36 liters of bilge waste daily by assuming that 0.5% of the amount of fuel consumed daily constitutes oily bilge waste, using AIS data in the Bering Sea between 2014 and 2017. However, the amount of bilge waste produced by fishing vessels smaller than 15 meters without AIS system could not be calculated.

In a study conducted in Indonesia, an island country in the Pacific Ocean, on the management of wastes from fishing vessels between 30-100 GT in Nizam Zachman fishing harbor, it was calculated that 60% of the waste produced by fishing vessels was bilge waste and this was calculated to be 0.55 kg/day (Riyanto et al., 2023). A study on wastewater from ships in the Baltic Sea determined that fishing vessels produced 222 L of wastewater (grey water) per person per day (Ytreberg et al., 2020). In the Barents Sea, which is a cold sea close to the North Pole, the plastic wastes of fishing vessels were examined by surveying the stakeholders of the fishing sector on waste management in 2017-2018, and it was determined that there is a need for port waste receiving facilities and legal regulations in this regard (Finska et al., 2022). A study observing 1023 beaches on the coasts of England between 1999-2007 determined that plastic litter largely originated from fishing harbors (Unger & Harrison, 2016).

In the Middle East, in a study conducted in 2010 on the effect of fishing vessels on heavy metal pollution in the Oman Sea of Iran, it was stated that the primary source of heavy metal pollution in the harbors was bilge wastes from fishing vessels and wastewater with high organic matter content. However, no industrial activities were around the harbors (Hamzeh et al., 2013). It was also stated that the high organic matter content in the sediments in Cabahar Bay of the same country may be caused by fishing vessels' discharge of fuel and wastewater (Keshavarzi et al., 2015). In Vietnam, bilge and wastewater discharge of fishing vessels were shown as the primary source of pollution in harbors by Xuan et al. (2023).

In a study conducted in the Pacific Ocean between 2003 and 2015, it was reported that 71% of the pollution sources from fishing vessels between 2003 and 2015 were garbage thrown from the deck, 9% of these were waste oils, and 16% of the remaining pollution rate was oil spills. As a result of this study, it is seen that 25% of the pollution from fishing vessels is bilge waters, which we define as waste oil. (Richardson et al., 2017).

Ortiz-Ojeda & Rázuri-Esteves (2021) examined bilge waste samples from fishing vessels between 300 GT and 400 GT in the Gulf of Ancón in Peru, which have 9-200 HP engine power. The amount of bilge wastes these ships can produce annually is determined according to the waste oil that may be generated from machinery maintenance. As a result of this study, it was determined that a fishing vessel with 9 HP engine power produced 2.6 L of waste oil annually, a fishing vessel with 200 HP engine power produced 200 L of waste oil annually, and fishing vessels in the studied region produced a total of 4319 L of waste oil annually.

The study conducted in our country on bilge wastes originating from ships in Lake Van determined that oily bilge wastes caused by machinery maintenance or regular operation of the machinery in fishing vessels are discharged into the lake offshore. It has also been reported that the oil content of bilge wastes from fishing vessels exceeds the MARPOL standard of 15 mg/L (Akman &Atıcı, 2022). The study covering the years 2015-2016 in Sinop fishing shelters reported that the pollution may be caused by bilge water from fishing vessels due to seawater analyses (Arıcı, 2017). Our country's coastal fisheries are generally carried out daily with 5-12 m long motorized vessels and 10-70 HP power (Mısır, 2008). The engine power of purse seine vessels in the Central and Eastern Black Sea is between 9HP and 2270 HP, the engine power of trawlers is between 24-886 HP, and the average engine power of vessels using general extension net is 19.9 HP (Zaman, 2011).

The global fishing fleet doubled between 1950 and 2015, from 1.7 million vessels to 3.7 million. This is mainly due to the increasing number of motorized fishing vessels; by 2015, 68%

of the world's fishing fleet was motorized (Rousseaua et al., 2019).

The world fishing fleet has remained relatively stable since 2008, reaching approximately 4.6 million vessels in 2016, 75 percent in Asia. In terms of the number of ships, Asia is followed by Africa, Latin America, the Caribbean, North America, and Europe. In 2016, 61 percent of the world's ships were motorized. Approximately 86 percent of motorized fishing vessels have a vessel length of less than 12 m. Fishing vessels with 24 m and larger vessel lengths account for approximately 2% of the total fleet (FAO, 2018).

The number of fishing vessels globally decreased to 4.1 million in 2020. China has the largest fishing fleet, with approximately 564000 fishing vessels (FAO, 2022). Although fishing vessels decreased by 47% from 2013 to 2020, they could fish more by increasing engine power and capacity (Di Cintio et al., 2022). Between 1950 and 2015, the number of non-motorized fishing vessels decreased by 0.2 million, while the number of motorized fishing vessels increased more than six-fold over the same period (Rousseau et al., 2019).

As in the world, the production of aquaculture products obtained by catching in our country is limited. For this reason, the primary approach recognized by scientists in catching is to maintain production by protecting stocks. The fishing fleet has grown and developed in power, number, technology, and fishing gears until the 2000s. According to TURKSTAT data, while the number of active fishing vessels in our seas was 13381 in 2000, this number increased to 18396 in 2005. It decreased to 14064 in 2022 (Ministry of Environment, Urbanization and Climate Change (MEUC), 2024a).

When the national and international literature is examined, very few studies on bilge waste from fishing vessels were found. Among these studies, the bilge water of fishing vessels was calculated in the research efforts made in the world. Still, the formula used in this study was not used, and it was observed that risk assessment and waste reception facilities in the harbors where fishing vessels are located were not considered. In the studies conducted in Türkiye, risk assessment and waste reception facilities in the harbors where fishing vessels are located have not been examined, including calculating the amount of bilge waste from fishing vessels. In this study, bilge waste from fishing vessels in Türkiye was calculated, risk assessment was made for the first time, and the needs for waste reception facilities in the harbors where fishing vessels are located were tried to be determined. In addition, it is hoped that this study will contribute to the literature as the first study to evaluate the waste reception facility facilities of fishing harbors or harbors for other studies conducted worldwide.

## Material and Methods

### *Data Collection*

The bilge wastes from fishing vessels were determined with the number and engine power of fishing vessels, the amount of waste collected, and fishing times taken from the open sources of the relevant institutions are summarized below.

### *Determination of the Number of Fishing Vessels and Motor Power*

The number of fishing vessels in Türkiye and their changes over the years are given in Figure 1. As of 2022, there are 14064 fishing vessels, and the total machinery power of these vessels is 1559300 KW (kilowatt) (MEUC, 2024a). The distribution of fishing vessels according to engine power ranges is given in Table 1.

Although the number of fishing vessels tends to decrease over the years, it is seen in Figure 1 that their engine power has increased. According to TURKSTAT data, the number of fishing vessels and engine power range are given in Table 1.

**Table 1.** Distribution of fishing vessels according to engine power range (TURKSTAT, 2022)

| Motor Power Range (HP) | Black Sea | Marmara Sea | Aegean Sea | Mediterranean Sea |
|---|---|---|---|---|
| 1- 9.9 | 1621 | 559 | 1204 | 211 |
| 10-19.9 | 367 | 164 | 326 | 144 |
| 20-49.9 | 1178 | 717 | 995 | 445 |
| 50-99.9 | 1081 | 448 | 743 | 425 |
| 100-199.9 | 817 | 310 | 475 | 173 |
| 200-499.9 | 377 | 320 | 165 | 213 |
| >500 | 351 | 156 | 46 | 33 |
| Total | 5792 | 2674 | 3954 | 1644 |

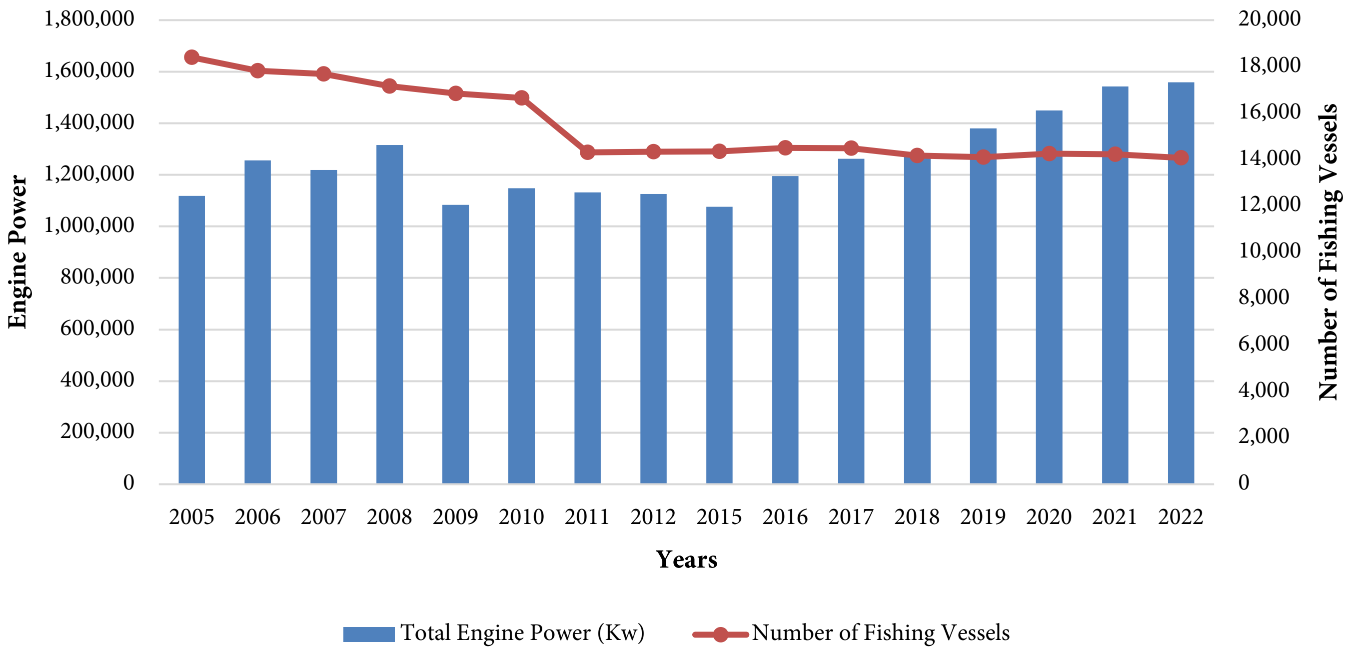


**Figure 1.** Changes in the number and engine power of fishing vessels by years (TURKSTAT, 2022)

**Table 2.** Amount of waste from ships collected by year (M.E.U.C.,2024b)

| Waste | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|
| Oil Derived Waste ($m^3$) | 240046 | 388311 | 236004 | 524031 | 315325 | 504797 | 416370 |
| Wastewater ($m^3$) | 206429 | 58950 | 81585 | 27331 | 85413 | 37903 | 13332 |
| Litter ($m^3$) | 40067 | 33872 | 24514 | 37494 | 163989 | 76527 | 52034 |

**Table 3.** The time intervals in which fishing vessels can fish at sea

| Fishing Vessel Type | Mediterranean Sea | Black Sea | Marmara Sea | Aegean Sea |
|---|---|---|---|---|
| Troll | 16 September-15 April | 1 September-15 April | 1 September-15 April | 1 September-15 April |
| Seiner | 16 September-15 April | 1 September-15 April | 1 September-15 April | 1 September-15 April |
| Carrier | 16 September-15 April | 1 September-15 April | 1 September-15 April | 1 September-15 April |
| Other | Free | Free | Free | Free |
| Extension vessel | Free | Free | Free | Free |
| Beam trawl | Forbidden | 1 September-15 April | 1 September-1 January<br>1 February -15 April | Forbidden |
| Bank line and fishing rods | Free | Free | Free | Free |
| Slewing and Volley Nets | 16 May -15 April | 16 May -15 April | 16 May -15 April | 16 May -15 April |
| Drag Nets | Forbidden | Forbidden | Forbidden | Forbidden |
| Collapsing Nets | Free | Free | Free | Free |
| Tunnel net | Free | Free | Free | Free |

**Table 4.** The number of days fishing vessels can fish at sea is determined by region

| Fishing Vessel Type | Mediterranean Sea | Black Sea | Marmara Sea | Aegean Sea |
|---|---|---|---|---|
| Troll | 212 | 227 | 227 | 227 |
| Seiner | 212 | 227 | 227 | 227 |
| Carrier | 212 | 227 | 227 | 227 |
| Other | 365 | 365 | 365 | 365 |
| Extension vessel | 365 | 365 | 365 | 365 |
| Beam trawl | Forbidden | 227 | 196 | Forbidden |
| Bank line and fishing rods | 365 | 365 | 365 | 365 |
| Slewing and Volley Nets | 334 | 334 | 334 | 334 |
| Drag Nets | Forbidden | Forbidden | Forbidden | Forbidden |
| Collapsing Nets | 365 | 365 | 365 | 365 |

**Table 5.** Distribution of the amount of bilge waste that can be generated by fishing vessels according to the lowest engine power

| Motor Power Range (KW) | Black Sea (L/day) (min) | Marmara Sea (L/day) (min) | Aegean Sea (L/day) (min) | Mediterranean Sea (L/day) (min) |
|---|---|---|---|---|
| 0.75 | 250312.43 | 86319.96 | 185919.90 | 32582.31 |
| 7.5 | 56732.79 | 25351.98 | 50394.79 | 22260.28 |
| 14.91 | 182317.03 | 110968.85 | 153994.44 | 68871.88 |
| 37.3 | 167902.34 | 69583.95 | 115403.73 | 66011.56 |
| 74.6 | 127650.22 | 48435.21 | 74215.24 | 27029.97 |
| 149.2 | 59598.14 | 50587.28 | 26084.06 | 33672.16 |
| >372.9 | 57427.33 | 25523.26 | 7526.09 | 5399.15 |
| Total | 901940.27 | 416770.49 | 613538.26 | 255827.30 |

### *Determination of the Amount of Waste Collected*

Wastes collected from ships in ports and marinas in Türkiye between 2015 and 2021 are classified according to waste types and given in Table 2. It is seen that the amount of petroleum-derived wastes, also defined as bilge waste, doubled in 2018 and was approximately the same amount in the following years. The amount of waste in this table includes vessels other than fishing vessels and covers all vessels (MEUC, 2024b).

### *Determination of the Catching Season*

According to the Communiqué No. 5/1 on the Regulation of Commercial Fisheries, the time intervals in which fishing vessels can carry out fishing activities regionally according to their fishing gear and types are given in Table 3. By calculating the days shown in this table as free time for fishing, the amount of bilge that can be produced by the fishing vessels was calculated using the information of being able to go fishing for 212 days, the minimum number of days.

According to the data of the Ministry of Environment, Urbanization and Climate Change in Türkiye, the number of licensed waste reception facilities serving in ports is 298 as of 2024, and the number of waste reception facilities in fishing harbors serving fishing vessels is 62 (MEUC, 2024c). The total number of fishing harbors in Türkiye is 385 (Ministry of Agriculture and Forestry, 2024).

### *Calculation of Bilge Quantity Risk*

The following formula was used to calculate the amount of bilge produced by a ship (Jalkanen et al., 2020);

$$b = 0.0247p \text{ (kW)} + 154.4 \quad (1)$$

Here, the daily amount of bilge waste (b) (L/day) that a ship can produce is calculated as a function of the engine power (p). This study tried to determine the amount of bilge waste that a fishing vessel can produce in one day using this formula.

The minimum amount of bilge that can be formed in each region is calculated with the smallest value in each engine power range, and the largest value in the formula for calculating the maximum amount of bilge is used as engine power. Then, the amount of bilge waste calculated according to the engine power range in each region was multiplied by the number of ships in the calculated engine power range in each region, and the amount of bilge waste that may occur in a day was calculated. The amount of bilge waste that may occur daily for a year, at least the days when there is no fishing ban specified in Table 4 were calculated and the lowest value of 212 days was used in the calculations. For each engine power range, the lowest and highest bilge waste amounts were calculated separately for each region. As a result, the following formula was used in the calculations;

$$S = (b \times N) \times 212 \quad (2)$$

Here, the annual amount of bilge waste (S) (L/year) that fishing vessels can produce was tried to be determined by multiplying the amount of bilge waste (b) (L/day) with number of ships (N) that a vessel can produce by 212 days.

## Results and Discussion

### *Determination of the Number of Days to Be Used in Calculations*

The number of days fishing vessels sailed outside the fishing ban periods was calculated using the information given in Table 3 and shown in Table 4. Here, it is seen that the minimum number of days at sea is 212 days, and the minimum number of days is used in the calculations. In addition, since the number of drift gillnet vessels, which are mentioned in TURKSTAT data but are completely prohibited according to the Communiqué No. 5/1 on the Regulation of Commercial Fisheries is 21, and the total number of beam trawl vessels in the Mediterranean Sea and Aegean Sea regions is 4, they were not considered in the calculation of the number of days.

### *Determination of Bilge Waste Amount*

Using the information on the number of fishing vessels given in Table 1 according to the engine power range, the minimum amount of bilge waste that may occur in the regions according to the lowest engine power was calculated and given in Table 5. The engine power unit shown in Table 1 was converted to kW, the engine power unit in the HP formula, by the formula given in the materials and methods section. Then, the minimum amount of bilge waste generated according to the regions was calculated with the formulae 1 and 2 in the materials and methods section. In this study, the amount of waste produced by unregistered and unregistered fishing vessels could not be calculated. The number of days fishing vessels could not go out when a storm at sea was not considered in the bilge waste amount calculations.

Using the information on the number of fishing vessels given in Table 1 according to the engine power range, the highest amount of bilge waste that may occur in the regions according to the highest engine power is calculated and given in Table 6. The engine power unit shown in Table 1 is converted to kW. Then, the minimum amount of bilge waste generated according to the regions was calculated according to the formulae 1 to 3 given in the materials and methods section. The engine power of purse seiners, which was stated as the highest engine power value in the study conducted by Zaman (2011), was between 9HP and 2270 HP, and the engine power of trawlers was between 24-886 HP. The maximum machine power was calculated by converting the average 886 HP and 2270 HP values into kW using the information here. In our study, the average amount of bilge waste produced daily by fishing vessels was 155 L/day.

### *Comparison of the Calculated Bilge Waste Amount With the Collected Amount*

The annual amount of the daily minimum and maximum amount of bilge waste calculated according to the regions is calculated using the 2nd formula. The sum is converted from L to $m^3$ and given in Table 7. In 2021, the amount of bilge waste collected by waste reception facilities in Turkish ports is 416000.37 $m^3$ as shown in Table 2. However, it is seen in Table 7 that the risk of bilge waste amount that may occur only for fishing vessels is at least 463872.18 $m^3$. Considering that 1 liter of oil can pollute 1000 liters of water, bilge waste severely threatens the marine ecosystem. This situation shows a need for legal regulations on the inspection of waste reception facilities and the implementation of strict supervision in this regard. However, as it is known, although the MARPOL regulation on marine pollution internationally includes regulations on waste reception facilities in ports, it includes rules for ships in the prevention of marine pollution from ships. Similarly, in Türkiye, the Environmental Law No. 2872, the Regulation on Waste Collection from Ships and Waste Control, the Regulation on Environmental Inspection and the Circular on Maritime Wastes Implementation impose legal obligations on ships regarding ship wastes.

**Table 6.** Distribution of the amount of bilge waste that can be generated by fishing vessels according to the highest engine power

| Motor Power Range (KW) | Black Sea (L/day) (max) | Marmara Sea (L/day) (max) | Aegean Sea (L/day) (max) | Mediterranean Sea (L/day) (max) |
|---|---|---|---|---|
| 7.38 | 250605 | 86421 | 186138 | 32620 |
| 14.89 | 56812 | 25388 | 50465 | 22291 |
| 37.21 | 183067 | 111425 | 154628 | 69155 |
| 74.5 | 168896 | 69996 | 116086 | 66402 |
| 149.1 | 129153.62 | 49005.66 | 75089.32 | 27348.32 |
| 372.8 | 61680.28 | 52354.61 | 26995.35 | 34848.54 |
| 1176.7 < | 64396.04 | 28620.46 | 8439.37 | 6054.33 |
| Total | 914609.98 | 423209.99 | 617841.08 | 258720.26 |

**Table 7.** The sum of the minimum and maximum annual bilge waste amounts is calculated according to the regions

| Bilge Waste Amount | Black Sea ($m^3$/year) | Marmara Sea ($m^3$/year) | Aegean Sea ($m^3$/year)) | Mediterranean Sea ($m^3$/year)) |
|---|---|---|---|---|
| Bilge Quantity Range | 191211.34-193897.31 | 88355.35-89720.51 | 130070.12-130982.30 | 54235.39-54848.7 |
| Total | 463872.18- 469448.84 | | | |

Although the number of fishing harbors serving fishing vessels in Türkiye is 385 (Ministry of Agriculture and Forestry, 2024), only 62 have waste reception facilities (MEUC, 2024c). In this case, the discharge of bilge waste in the sea by fishing vessels becomes inevitable. In addition, there are waste reception facilities in only 10 of 165 fishing harbors in the Black Sea region, with approximately 60% of the fishing vessels registered in Türkiye (Table 1). Although the waste reception facilities in the fishing harbors are so inadequate and legally deficient, the obligation to give waste within 48 hours was increased to 10 days by the Ministry of Environment, Urbanization, and Climate Change with the Maritime Waste Application Circular (2022/14), since it was seen that the adequacy of the waste tank volumes of fishing vessels with a crew of more than 12 people was sufficient for this period. In this case, it is evaluated that the inadequacy of the sanctions by loosening the control of the situation where the waste collection facilities are already inadequate leads to the discharge of more bilge waste into the sea. In addition, according to MARPOL, the oil content in the bilge waste of ships over 400 GT can be reduced below 15 mg/L with the treatment systems installed on the ships and discharged into the sea at a certain distance from the shore. However, when it is evaluated that only 174 fishing vessels in Türkiye are over 400 GT (TURKSTAT, 2022), it can be seen that legal regulations are insufficient in this regard.

In this study, the amount of bilge waste that all types of fishing vessels can produce was calculated between 463.9 and 469.4 $m^3$/day by using machine power information. However, a study conducted in Taiwan determined that only fishing vessels with engine power below 300 HP can produce up to 321700 L of bilge waste annually (Lin et al., 2007). A similar study conducted in Indonesia observed that the waste produced by fishing vessels between 30-100 GT was 0.55 kg/day (Riyanto et al., 2023). In Türkiye, the average daily bilge water that can be generated based on engine power is 155 liters. In the study conducted in the Gulf of Ancón, Peru, it was found that fishing vessels with lower (9 HP) engine power produced 2.6 L of bilge waste per year and fishing vessels with 200 HP engine power produced 200 L of bilge waste per year (Ortiz-Ojeda & Rázuri-Esteves, 2021).

A study conducted in the Bering Sea using AIS data determined that the amount of bilge waste produced daily by fishing vessels was 388 L of bilge waste per day, assuming 0.5% of the amount of fuel consumed (Parks et al., 2019).

The wastes generated by fishing vessels are bilge water but also grey and black water, fishing nets, and plastic wastes. In other studies, it has been reported that fishing vessels produce 222 L of wastewater (gray water) per person per day (Ytreberg et al., 2020). However, in this study, only bilge waste from fishing vessels was considered and analyzed.

Among the limited number of studies on bilge waste from fishing vessels in Türkiye, it was determined that the oil content of the bilge waste of fishing vessels in Lake Van was above 15 mg/L determined by MARPOL (Akman & Atıcı, 2022) and in the study conducted in Sinop fishing harbors, it was determined that marine pollution may be caused by bilge water from fishing vessels (Arıcı, 2017). As seen from the literature, in this study, the bilge waste of fishing vessels was calculated based on engine power, and the risk of bilge water that could be produced in Türkiye was emphasized.

## Conclusion

As a result of the study, there is a need to ensure that the amount of bilge waste received from fishing vessels is recorded by the waste reception facilities. Thus, as a priority, the waste reception facilities in the fishing harbors should be brought to an adequate level, and legal arrangements should be made. As a result, it is clear that by increasing the harbor waste reception facilities and waste reception facility responsibilities in the fishing harbors it will be an easier and more effective method than the detection of bilge waste discharged into the sea by fishing vessels in sea areas where it is challenging to control.

Bilge wastes discharged from fishing vessels to the sea intentionally or accidentally may be caused by inadequate personnel training on the spilled environment. However, the most important reason may be insufficient waste reception facilities and capabilities and ineffective legislation. In addition, although the number of waste reception facilities in fishing harbors and the types of wastes received are known the lack of information on how much waste is obtained from which vessel, as in other harbors, is a significant lack of follow-up.

In future studies, analyses of bilge water from fishing vessels and determination of the substances, such as oil ratios, heavy metals, etc., that may cause serious harm to the marine ecosystem and human health will contribute to understanding the extent of this risk. In addition, it is thought that a similar study for wastewater from fishing vessels will be helpful to in correctly determining the waste reception facility facilities.

## Compliance With Ethical Standards

### *Conflict of Interest*

The author declares that there is no conflict of interest.

### *Ethical Approval*

For this type of study, formal consent is not required.

### *Funding*

Not applicable.

### *Data Availability*

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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