Data Analysis of the Number of Security and Safety Incidents in Indonesian Waters

Rifan Apriantara[1], Pujo Widodo[2], Herlina Juni Risma Saragih[3], Panji Suwarno[4], Moch. Yurianto[5], Surya Wiranto[6]

[1,2,3,4,5,6,]Faculty of National Security Maritime Security Study Program Defense University of the Republic of Indonesia, Salemba, Indonesia

e-mail : rfanbacdhim@gmail.com

Abstract—This study aimed to analyze statistically and descriptively any incidents that emerged in Indonesia in 2018-2022. The data applied in this study was the incidents number incidents of 15 circumstances types that happened in Indonesia in the last 5 years. The results of the descriptive statistical analysis revealed that ship accidents at sea and illegal fishing were considered to be the most frequent incidents during the last 5 years with 421.6 on average per five years followed by incidents of fish theft data with 79.4 on average per five years. Meanwhile, the fewest incidents that arose during those years were weapons smuggling with only 0.6 on average per five years. Thus, it sums up that Indonesia still needs to make better action in dealing with incidents that occur in this country, especially illegal fishing incidents and accident data which is still expanding from year to year. In addition, further research is required to study the factors that can emerge from various incidents including developing more effective strategies to prevent the occurrence of these incidents in the future.

Keywords—incidents, accident, fish theft, strategy

I. INTRODUCTION

Indonesia is categorized as one of the countries with a very wide archipelago which is located between Southeast Asia and Oceania. The country has more than 17,000 islands with a total land area of 1.9 million square kilometers. In addition, it has a large water area which is about 5.8 million square kilometers of ocean, including the Exclusive Economic Zone and the continental base [1]. The strategic position of this country has been named as a gateway to the Pacific and Indian Ocean which results in making it a vital maritime crossroads for international trade, namely connecting East Asia, South Asia, and Oceania [2]. Indonesian territorial waters cover critical sea lanes of communication, including the Malacca Straits, the Sunda Straits, and the Lombok Straits. The area is critically important for global shipping and oil transportation. As such, Indonesia is vulnerable to various maritime security threats, including piracy, terrorism, illegal fishing, and smuggling.

On the other hand, Indonesia's vast territorial waters are also wealthy in natural resources, including abundant fishery resources, oil and gas reserves, and mineral deposits. The country's fishing industry is classified as one of the largest in the world and supplies employment for millions of Indonesians and constructs a significant contribution to the country's economy. In addition, Indonesia has significant oil and gas reserves, especially in the Natuna Sea, which is estimated to hold around 222 trillion cubic feet of natural gas which makes it one of the largest gas fields in the world [3]. This country has large territorial waters, including strategic islands and waters as international trade routes. Consequently, this country is considered an area that stands vulnerable to various kinds of security and safety incidents at sea.

Corresponding Author: Rifan Apriantara

Marine security directs efforts constructed to confirm the safety, security, and sustainability of the usage of marine resources [4]. This possesses efforts to prevent security threats such as piracy, terrorism, smuggling, and illegal fishing, and guard the marine environment against pollution and damage. This security also involves law enforcement and monitoring of marine movements, including regulation of empowering the sea and natural resources associated with national security and defense [5]. Efforts to enhance maritime security can involve international cooperation between countries that share the same territorial waters. Meanwhile, marine safety directs efforts to confirm human safety on board or in the waters, including all actions taken to minimize the risk of accidents at sea [6]. Generally, this contains monitoring and implementing safety standards on ships, such as sufficient safety equipment and navigational equipment, training ship members in dealing with emergencies, also risk control in shipping movements. Not only that, maritime safety efforts also have monitoring weather and sea conditions, as well as regulating the safe service of shipping lanes to minimize the risk of collisions [7]. Maritime safety can also concern rescue and evacuation operations in emergencies at sea, such as ensuring the safety of people on board when the ship is on fire or sinks [8].

Security and safety incidents in Indonesian territorial waters can cause significant losses, including the economy, loss of human life, ship accidents, theft, piracy, and others. Even though actions have been driven by related parties to enhance security and safety in territorial waters, the emergence of incidents is still occurring and it is not yet comprehended in detail about the number and types of incidents that occurred in Indonesian territorial waters as a whole. Therefore, it is significantly necessary to analyze data concerning the number of security and safety incidents in Indonesian waters. To know a general description of the security and safety situation in these territorial waters as well as the factors that caused the incident. So, it can discover the right solution in enhancing security and safety in these territorial waters.

Based on the explanation and issues above, it is necessary to conduct a study to analyze data on the number of security and safety incidents in Indonesian waters. This research is essential to be carried out to provide an overview of the level of security and safety in Indonesian territorial waters and to provide recommendations for solutions regarding efforts to minimize the security and safety incidents in these territorial waters. Then, the data utilized in this research comes from various related sources, such as ship accident data, natural disaster data, and criminal activity data in Indonesian waters. The data is then processed and analyzed using statistical methods and other data analysis techniques. As a result, it is expected that the findings from this study will be able to identify the factors that influence the number of security and safety incidents in Indonesian waters. In addition, the results of this research can make a positive contribution to the development of policies related to increasing security and safety in Indonesian waters. Due to the case that occurred on the field, particularly in the last few decades, Indonesian waters had experienced a significant expansion in security and safety incidents. This is caused by various factors such as adverse weather conditions, human error, breaking of rules, and criminal movement.

Scientifically, research associated with security and safety in Indonesian waters is still relatively lacking. This is a challenge and novelty for researchers to further deepen and develop research in this field. Although there have been several previous studies accomplished nationally and internationally studies related to security and safety in waters. However, most of these studies are still concentrated on certain aspects such as ship accidents, theft, and piracy. Therefore, more comprehensive research is still needed in this case.

The research deals with data analysis on the number of security and safety incidents in Indonesian territorial waters has several advantages. First, improving comprehension and insight into the security and safety circumstances in Indonesian territorial waters, as the result can assist in constructing the right decisions to improve security and safety in these territorial waters. Second, provide an overview of the types of security and safety incidents in the territorial waters as well as the factors that cause these happenings. Third, provide recommendations to related parties to enhance security and safety in Indonesian waters. Fourth, expanding public awareness regarding the importance of security and safety in Indonesian waters. Fifth, to become a theoretical source for future research on security and safety in Indonesian waters. Sixth, being able to raise the effectiveness and efficiency of government actions in improving security and safety in territorial waters and being able to make a positive contribution to the development of the Indonesian marine and fisheries sector, which can have a positive effect on the national economy. With these advantages, this research is expected to construct a positive contribution to numerous parties such as the government, society, and the marine including the fisheries sector in Indonesia as a whole.

II.   RESEARCH METHOD

In obtaining research data, this study employed descriptive statistical methods. This method was describing data by summarizing and presenting data in the form of tables, graphs, and summary measures such as the mean, median, mode, and data distribution [9]. This method was also used to provide an outline of the characteristics of the data and could help in comprehending the data better.

Meanwhile, trend analysis stood a statistical method employed to determine the direction and trend of transformations in variables over a certain period [10]. This method was accomplished by computing the average change between data points over a certain period and displaying where the trend was moving. This analysis was devoted to predicting the future behavior of data and providing insight into the changes that occurred in a phenomenon.

Dealing with data analysis, the number of security and safety incidents in Indonesian waters, a descriptive statistical method was employed to summarize the data into a form that can provide an outline of the characteristics of the research data. Meanwhile, trend analysis was utilized to identify the direction and trend of changes in security and safety incidents in Indonesian waters over a certain period. Thus, this method could deliver insight into the changes that have happened and help in formulating strategies for minimizing the security and safety incidents in Indonesian waters in the future.

The population of this study was all security and safety incidents that emerged in Indonesian territorial waters in the 2018 to 2022 time period. Meanwhile, the employed sample was associated with data recorded at the Maritime Security Agency. The collected data source was taken based on the credibility and accuracy of the data provided by the source. Thus, the sample taken was expected to represent the population proportionally and accurately.

III.   FINDING AND DISCUSSION

Marine security monitoring was classified as an action to monitor the movement of ships and activities in sea waters to maintain maritime security and safety [11]. The Indonesian Maritime Security Agency was a government agency responsible for monitoring maritime security in Indonesian territory.

One of the systems used by this agency was to monitor maritime security or commonly known as the Maritime Surveillance System (MSS). It was defined as an integrated maritime monitoring system that uses radar, sonar, and satellite communication technology to monitor ship movements and activities in marine waters [12]. This system was also capable of detecting maritime security threats such as theft, piracy, smuggling, and other crimes. In addition, MSS consisted of several parts, among which are:

a.   Radar: Radar systems were installed in several strategic locations in sea waters to monitor ship movements and activities in the surrounding waters.

b.   Sonar: Sonar systems were operated to detect subsurface objects such as submarines or explosive devices attached to the ocean floor.

c.   Tracking System: This system was implemented to identify and track the movement of ships passing in sea waters.

d.   Communication System: This system was connected to the satellite to connect the MSS system with the control center on the ground.

e.   Geographic Information System: This system was utilized to map ocean waters and integrate information obtained from various other monitoring systems.

Furthermore, through the implementation of the MSS system, the Maritime Security Agency can observe maritime security effectively and efficiently. The information received from this system can be employed to take preventive actions when facing maritime security threats and to maintain the security of Indonesian sea waters.

As a maritime country, Indonesian territorial waters had a very important role in driving the economy and people's lives [13]. However, security and safety in Indonesian territorial waters were still a big challenge for the Indonesian government. Based on data taken from various official sources, there were several general descriptions of security and safety incidents in Indonesian waters that can be identified, including:

a. The number of security and safety incidents in Indonesian territorial waters tended to enhance from year to year. That was due to various factors, including increasing economic activity in water zones and the lack of adequate supervision and regulation.

b. The sorts of incidents that most often appeared in Indonesian waters were ship accidents, fishing theft, and smuggling of goods, drugs, and animals. These incidents had a significant impact on human safety and security as well as economic activity in Indonesian territorial waters.

c. Factors that led to security and safety incidents in Indonesian territorial waters enclose bad weather, human negligence, criminal acts, and non-compliance with regulations related to security and safety.

Therefore by doing this general description of security and safety incidents in Indonesian waters, it was expected that the Indonesian government can improve actions to strengthen security and safety in its waters as well as boost supervision and adequate regulation.

The following were several sorts of incidents that appeared in Indonesian waters:

Table 1: Security and Safety Incidents

Incident Type	2018	2019	2020	2021	2022
Human Trafficking	21	10	26	14	27
Illegal Fuel Oil	21	17	13	9	17
Illegal Logging	17	12	15	15	7
Illegal Mining	3	5	10	1	4
Ecosystem Damage	4	2	7	5	10
Territorial Violation	3	3	6	7	3
Illegal Fishing	68	86	88	109	46
Smuggling of Goods	66	28	39	35	29
Marine Accident Data	480	327	215	497	589
Animal Smuggling	12	21	29	58	36
Alcohol Trading	25	5	26	37	26
Drugs Trading	49	37	44	37	38
Robbery / Theft	6	7	12	3	7
No Permissions/Documents	35	32	9	13	14
Weapons Trafficking	0	0	0	0	3
Amount	810	592	539	840	856

Based on the table above, an annual analysis was needed regarding security and safety incidents in Indonesian waters.

3.1. Incident Analysis in 2018

Based on data received in 2018, the most frequent incidents that occurred in Indonesian waters that year were ship accident data with 480 cases, illegal fishing with 68 cases, followed by goods smuggling with 66 cases, and drug smuggling with 49 cases. Meanwhile, the incident that did not occur was weapons smuggling. More details can be caught in the following diagram:
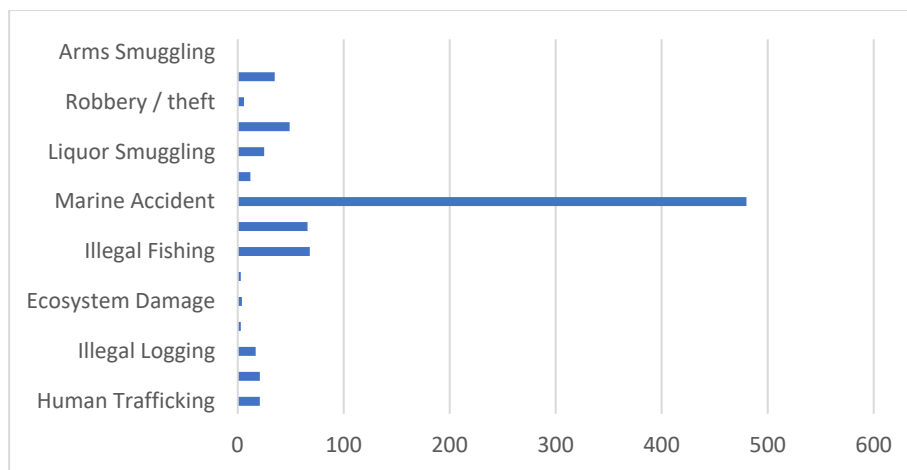
Figure 1. Sorts of security and safety incidents in 2018

In addition, based on the above data, it can be understood that there were several incidents related to crimes such as human trafficking, weapons smuggling, and robbery/theft. The case demonstrated that security and safety in Indonesian waters must be enhanced, both in terms of supervision and law enforcement. Moreover, ship accident data revealed the significance of safety in sea transportation in Indonesia. This indicated the need for more attention to ship safety and shipping security in Indonesian waters. Overall, the data above illustrates that security and safety incidents in Indonesian waters were still quite high and demand serious attention from related parties to optimize security and safety at the Indonesian seas.

3.2. Incident analysis in 2019

Based on the results of data processing for 2019, it can be understood that the most frequent incidents in Indonesian waters were ship accidents with 327 cases, 86 cases of illegal fishing, followed by 21 cases of animal smuggling, and 37 cases of drug smuggling. Meanwhile, incidents that did not appear were related to weapons smuggling. To simplify the explanation, it can be analyzed in the diagram below:
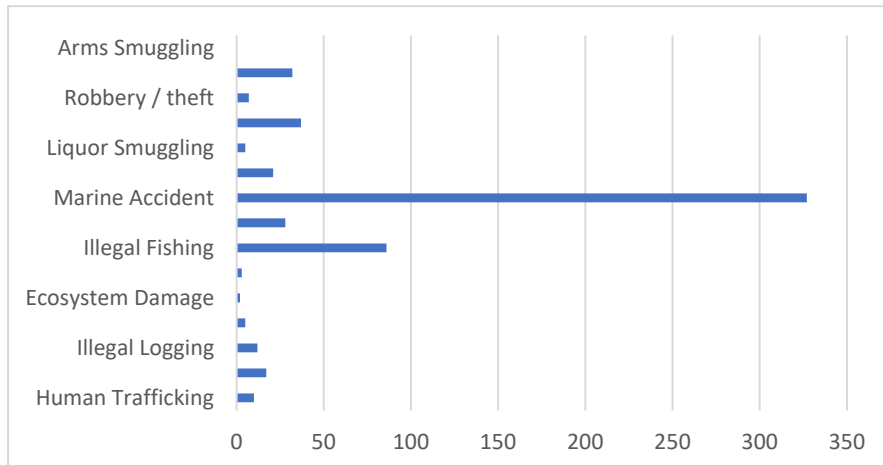

Figure 2. Sorts of Security and safety incidents in 2019

The interesting point of the 2019 data was that there had been a reduction in cases of several sorts of incidents such as human trafficking and illegal logging, though there had been an increase in cases of animal smuggling incidents. In addition, incidents of ship accidents also dropped by 153 cases compared to 2018.

This data indicated that although there had been a reduction in cases of certain sorts of incidents, security, and safety in Indonesian territorial waters still needed serious attention. Based on these cases, it was necessary to improve supervision and stricter law enforcement to reduce the occurrence of these incidents in the future.

3.3. Incident Analysis in 2020

In 2020, data associated with the most frequent incidents occurring in Indonesian waters were ship accidents with 215 cases, illegal fishing with 88 cases, followed by animal smuggling with 29 cases, and drug smuggling with 44 cases. Meanwhile, the incidents that occurred most rarely were territorial violations (6 cases) and weapons smuggling (0 cases). To clarify the analysis, see the following diagram:
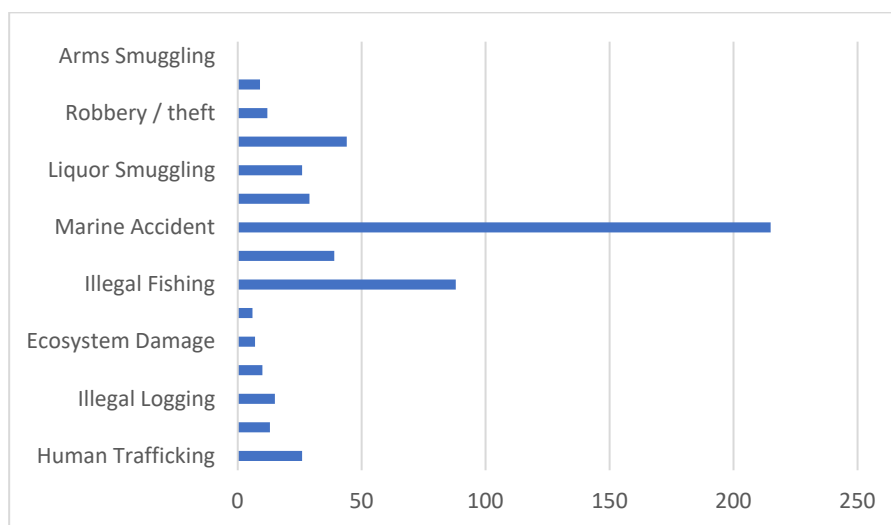

Figure 3. Sorts of Security and Safety Incidents in 2020

The interesting about the 2020 data was the emergence of an increase in cases of human trafficking, illegal logging, illegal mining, and damage to ecosystems. Meanwhile, there was a decrease in cases of illegal fuel, territorial violations, and weapons smuggling. Ship accident incidents in 2020 decreased by 112 cases compared to 2019. However, this data still demonstrated that security and safety in Indonesian waters still needed special and serious attention, especially in terms of handling illegal fishing and drug smuggling.   Not only that, efforts to strengthen supervision and stricter law enforcement are urgently needed to reduce the occurrence of these incidents in the future. In addition, it was necessary to make efforts to develop policies and programs that can assist strengthen security and safety in Indonesian waters.

3.4. Incident Analysis in 2021

Based on this data, incidents that occurred in Indonesian waters in 2021 had increased compared to previous years. The total number of incidents this year reached 840 incidents. This can be seen as an increase from 327 incidents in 2019 and 540 incidents in 2020. For more details, this can be seen in the diagram below:
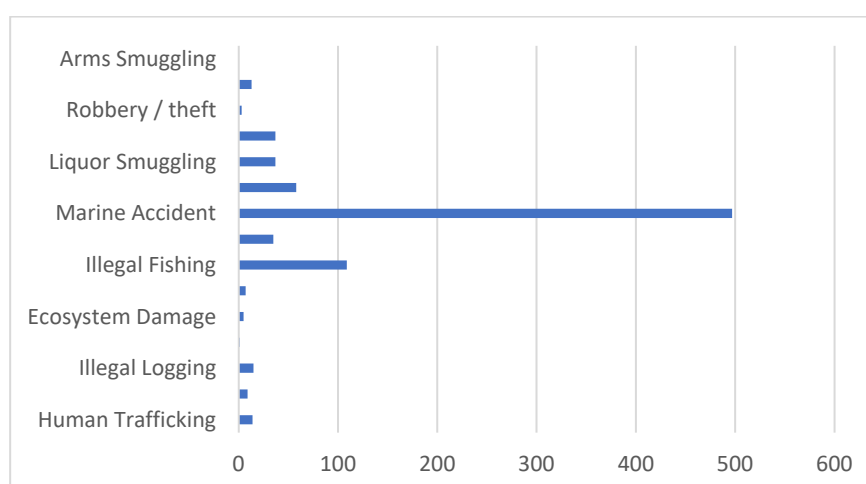

Figure 4. Sorts of Security and safety incidents in 2021

From the data above it can be seen that the most incidents that occurred in 2021 were ship accidents with a total of 497 cases, and illegal fishing with a total of 109 cases, which increased compared to 2020, especially in the 88 cases that had been recorded. On the other hand, the cases the number of animal smuggling had also expanded significantly, from 29 in 2020 to 58 in 2021. Apart from that, cases of smuggling of goods, and alcohol, including drugs will still be quite high in 2021.

Nonetheless, there was a reduction in several sorts of incidents such as human trafficking and illegal fuel oil. However, accident cases in 2021 increased to 497 cases, which was named the highest number of cases in the last four years. Therefore, it was necessary to drive efforts to advance supervision and law enforcement in Indonesian territorial waters to reduce the above incidents. In addition, organizing campaigns and educating the public about the importance of maintaining security and safety in waters and the importance of preserving the environment in Indonesian waters needed to be carried out and the impact was very significant for the good going forward.

3.5. Incident Analysis in 2022

Based on the data above, there was a clear expansion in the number of incidents from 2021 to 2022, with a total number of incidents reaching 856. The sorts of incidents recorded included ship accidents, illegal fishing, and drug smuggling. These types of cases were considered to have happened the most during the last four years, namely from 2019 to 2022. To clarify this statement can be seen in the following diagram:
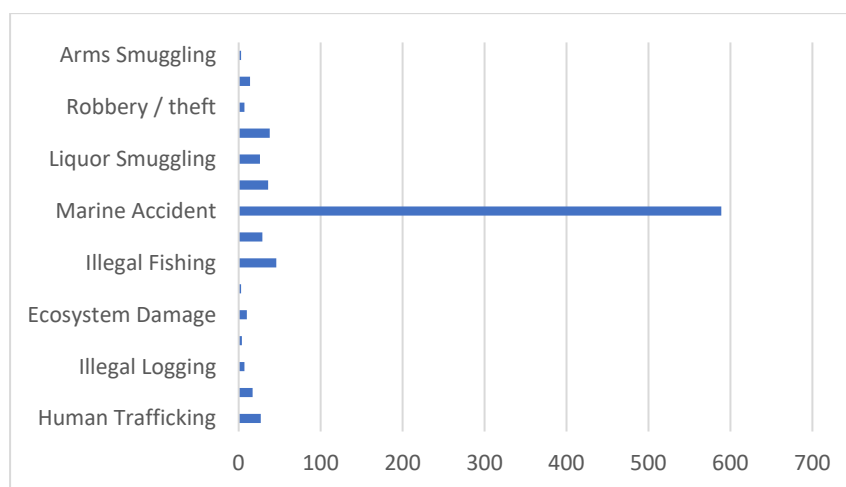

Figure 5. Sorts of Security and Safety Incidents in 2022

It should be noted that several types of incidents dropped from 2021 to 2022. These cases included human trafficking, illegal logging, and illegal mining. However, several types of incidents had enhanced, such as ecosystem damage, animal smuggling, and weapons smuggling. In addition, the data also displayed that accidents had the highest number in 2022 with 589 cases, while other sorts of incidents had a lower number of incidents. Therefore, actions were needed to minimize the number of accidents that happened and advance awareness of the importance of safety in activities.

3.6. Incidence Analysis from 2018 to 2022

Overall from 2018 to 2022, security and safety incidents in Indonesian territorial waters can be seen in the following graph:

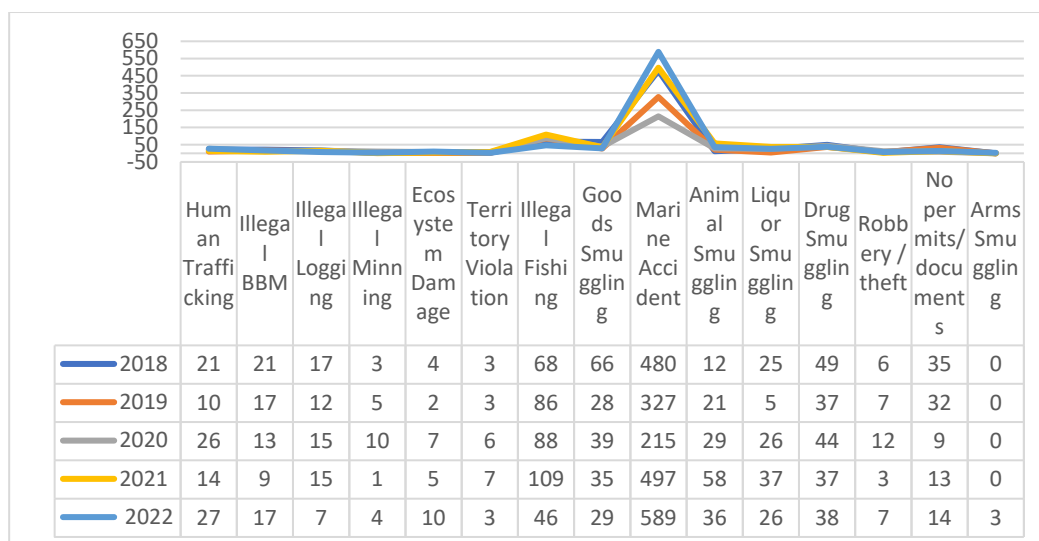|	Human Traffi cking	Illega l BBM	Illega l Loggi ng	Illega l Minn ing	Ecos yste m Dam age	Terri tory Viola tion	Illega l Fishi ng	Goo ds Smu gglin g	Mari ne Acci dent	Anim al Smu gglin g	Liqu or Smu gglin g	Drug Smu gglin g	Robb ery / theft	No per mits/ docu ment s	Arms Smu gglin g
2018	21	21	17	3	4	3	68	66	480	12	25	49	6	35	0
2019	10	17	12	5	2	3	86	28	327	21	5	37	7	32	0
2020	26	13	15	10	7	6	88	39	215	29	26	44	12	9	0
2021	14	9	15	1	5	7	109	35	497	58	37	37	3	13	0
2022	27	17	7	4	10	3	46	29	589	36	26	38	7	14	3

Figure 6. Sorts of Security and Safety Incidents in 2018-2022

Based on the graph above, it was comprehended that the most dominating security and safety incidents at sea were accidents. While the incident that rarely occurred was weapons smuggling. In addition, from this data, descriptive statistical data can be computed for each type of incident from 2018 to 2022. Details can be seen as follows:

1. Human trafficking: On average, about 15 incidents per year occur, with a range of 10 to 27 incidents per year.

2. Illegal Fuel Oil: On average, about 15 incidents happened, with a range of 9 to 21 incidents per year.

3. Illegal logging: On average, about 12 incidents per year happened, with a range of 7 to 17 incidents per year.

4. Illegal mining: On average there were about 5 incidents per year, with a range of 1 to 10 incidents per year.

5. Damage to ecosystems: On average, there were about 6 incidents per year, with a range from 2 to 10 incidents per year.

6. Territorial violations: On average, about 4 incidents per year occurred, with a range of 3 to 7 incidents per year.

7. Illegal fishing: On average, there were about 79 incidents per year, with a range of 46 to 109 incidents per year.

8. Accidents at sea: On average, there were about 420 incidents per year, with a range of 215 to 589 incidents per year.

9. Goods Smuggling: On average, it was found about 39 incidents per year, with a range of 28 to 66 incidents per year.

10. Animal smuggling: On average, there are about 31 incidents per year, with a range of 12 to 58 incidents per year.

11. Alcohol smuggling: On average, it was revealed about 26 incidents per year, with a range of 5 to 37 incidents per year.

12. Drug smuggling: On average, there were about 41 incidents per year, with a range of 37 to 49 incidents per year.

13. Robbery/theft: On average, about 7 incidents per year occurred, with a range of 3 to 12 incidents per year.

14. No permits/documents: About 19 incidents per year on average, with a range of 9 to 35 incidents per year.

15. Weapons smuggling: On average there was about 1 incident per year, with a range of 0 to 3 incidents per year.

The results of processing the descriptive statistical data above can construct it easier for observers of marine incidents related to trends and comparisons between sorts of incidents during that period, and can also be used as a reference for enduring preventive or mitigating actions in the future.

To prevent incidents from happening, early and integrated prevention incidents were considered a more effective strategy. This step can be carried out through increased supervision and control in areas prone to incidents. Then, it was necessary to use new

technologies and innovations in monitoring and detecting incidents, as well as involving the community in prevention programs and outreach about the importance of maintaining security and safety. In addition, strict law enforcement against incident perpetrators was also required to be carried out to provide a deterrent consequence and prevent the recurrence of incidents in the future. The Indonesian government has adopted a Maritime Surveillance System to address maritime security issues. However, this system still needed to be improved so that it can be more effective in preventing incidents such as illegal fishing, animal smuggling, and drugs. Improved technology and training for those in charge of this system can advance the effectiveness of the use of the Maritime Surveillance System in this country.

IV. CONCLUSION

Based on the results of incident data analysis from 2018 to 2022, it can be concluded in several important points including:

1. Maritime accidents and illegal fishing are the most frequent types of incidents from 2018 to 2022.

2. Incidents of human trafficking, illegal logging, illegal mining, and territorial violations have fluctuated from year to year.

3. There has been a decrease in incidents of illegal fuel oil and alcohol smuggling from 2018 to 2022.

4. The incidence of ecosystem damage will increase significantly in 2022.

5. The average incidence of animal smuggling per year is 31.2 with a standard deviation of 17.69.

6. There is a tendency to enhance the number of incidents from year to year, especially in the sorts of incidents of accidents at sea and illegal fishing.

7. There is a need for more effective preventive measures to deal with incidents that often occur, such as increased surveillance at sea and stricter law enforcement against drug smuggling.

8. There is a need for further studies and monitoring of the sorts of incidents that occur to obtain more complete and in-depth information, as well as to improve policies and strategies for handling incidents in the future.

The results of this study are intended for several parties. First, for academics including; to carry out further research regarding the causal factors of the incidents that occurred and the effect of implementing different prevention strategies. In addition, this research can be carried out as additional insight to deepen the use of more sophisticated technology in increasing the effectiveness of maritime surveillance systems. Meanwhile, for the government and the Maritime Security Agency, the results of this research can be used as consideration for using Maritime Surveillance System technology that is more sophisticated and effective in monitoring Indonesian waters, especially in areas prone to incidents as previously identified. Moreover, the results of this study can be employed as a consideration for the government to enhance training and expand the ability of members of the Maritime Security Agency related to handle incidents that occur in Indonesian waters.

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