BSU

Bundesstelle für Seeunfalluntersuchung
Federal Bureau of Maritime Casualty Investigation

2021 Annual Report

June 2022

Foreword

Dear Reader,

This is now the third annual report to be produced in a home office environment. Like so many others, the BSU was firmly in the grasp of the pandemic in 2021, too. However, as I write these words, the sun is shining and the covid-numbers are decreasing, as are the restrictive measures – so there is light at the end of the tunnel. Normality is slowly recovering the ground once thought of as lost. But the home office will remain. After all, it is something the BSU already had before the pandemic. And despite all predictions to the contrary, the past two years have amply demonstrated that it is a worthwhile and mutually beneficial concept.

Of course, there were more marine casualties last year than one would care to admit – which is in the nature of things. Some of them are presented to you in this report, namely those that necessitated a major investigation. The BSU's basic approach here is to work collaboratively with all parties involved to get to the bottom of an event as completely as possible and draw the right conclusions and lessons from it. I must admit, there are times when different interests come to the fore. However, I should like to point out that cooperation with all those involved – be it crews, shipping companies, public authorities or manufacturers – is generally excellent and characterised by mutual appreciation. After all, at the end of the day we all have the same objective, i.e. to make shipping a little safer. And I would like to take this opportunity to express my most sincere thanks for that.

Warm regards,

Ulf Kaspera

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Marine casualty investigation[1]

The Federal Bureau of Maritime Casualty Investigation (BSU) is a federal higher authority based in Hamburg. It has 13 full-time and part-time staff members, making it Germany's smallest federal higher authority, and a single-stage administrative structure. The BSU is subordinated to the Federal Ministry for Digital and Transport (BMDV) and operates under the supervisory control of Division WS 26 (Maritime Shipping Law, BSU).

Figure 1: The BSU's offices in the BSH building in Hamburg. The piers are visible in the foreground. In the background are the so-called 'Dancing Towers' to the right and the Astraturm to the left.[2]

[1] The cover picture shows the engine of the FREYJA, which was completely destroyed when she caught fire and foundered. Source: NF Seefracht GmbH.
Original language of this annual report is German. The German text shall prevail.
[2] BSH: Federal Maritime and Hydrographic Agency. Source: Fotolia.

1.1 Fundamentals

Both national and international legislation define the work of a marine safety investigation Authority as 'marine safety investigation'. This clearly demonstrates that a marine casualty investigation is not intended to clarify issues of fault or liability but is solely for the purpose of improving maritime safety. A marine casualty investigation aims to deliver a comprehensive account and analysis of the course of events leading up to and during an accident to prevent future accidents. It should consider any direct and indirect causes, facilitating factors, as well as the overall circumstances including possible rescue operations and safety systems. The law provides that the BSU be guided by a no blame approach within the framework of a safety partnership. The BSU does not make findings on culpability, claims or liability. Investigation reports and the findings therein are not for use in judicial proceedings.

The German Maritime Safety Investigation Law (SUG) constitutes the primary legal framework for the work of the BSU. The SUG transposes international rules and regulations, such as the Code of the International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident (Casualty Investigation Code), Resolution MSC.255(84), and the European Directive 2009/18/EC into the German judicial system. Other provisions that apply under German law include Regulation (EU) No 1286/2011 and IMO[3] Resolution A.1075(28), which harmonise the methodology and implementation of the investigation of accidents internationally.

The BSU is thus responsible for investigating incidents and marine casualties involving seagoing ships of any flag

- within German territorial waters;
- on German navigable maritime waterways, as well as to, from, and in ports connected to them;

[3] International Maritime Organization, London, UK.

- outside territorial waters but within the German Exclusive Economic Zone (EEZ) only in the event of very serious casualties, provided that the special rights assigned to Germany there are affected.

Outside the areas referred to above, the BSU only investigates marine casualties on or involving seagoing ships flying the German flag or if the Federal Republic of Germany has a substantial interest in the investigation of a marine casualty abroad (if German nationals are killed or seriously injured, for example).

The SUG also addresses those cases in which the BSU does not take action. The BSU is not responsible for marine casualties involving only

- ships of war, troop ships and other ships owned or operated by Germany's federal or state governments and used only on government non-commercial service;
- ships not propelled by mechanical means, wooden ships of primitive build, pleasure yachts and pleasure craft not engaged in trade, unless they have prescribed manning and carry more than 12 passengers;
- fishing vessels with a length of less than 15 m, and
- fixed offshore drilling units.

This has practical relevance in the pleasure boating sector, in particular. The SUG does not cover privately used recreational craft (unlike those used commercially), meaning the BSU's statutory mandate does not extend to investigating accidents involving recreational craft. This applies regardless of damage. It is only possible for the BSU to investigate such accidents in (rare) exceptions and then only when they occur in Germany's territorial waters and concern pleasure craft built, suitable and used for maritime navigation. Open rowing or sailing boats and personal watercraft, etc. do not belong to this category.

The SUG distinguishes between four categories of marine casualty: incident, less serious marine casualty (LSMC), serious marine casualty (SMC) and very serious marine casualty (VSMC). Moreover, in the case of the VSMC, it requires that the BSU always conduct an investigation.[4]

1.2 The investigation procedure

After an accident notification is received, the BSU's director (or the deputy director in his absence) decides on the initiation of an investigation and usually assigns the subsequent processing of the accident to a team of two to three people. The BSU is free from instructions in this decision and in all other aspects of the investigation. The BSU has extensive rights and powers of intervention when investigating the course of events leading up to and during an accident, including in respect of access to the scene of the accident, preservation and analysis of evidence, questioning witnesses and the engagement of experts. These rights are not limited to entities/individuals directly involved in the accident (the ship, her crew and possibly pilots), but can also be exercised in respect of third parties (e.g. shipowners, shipyards or classification societies) or authorities (e.g. the Federal Waterways and Shipping Administration or the Ship Safety Division - BG Verkehr).

An important cornerstone of the work of the BSU is cooperation with European and non-European investigation bodies. Based on European and international principles, the BSU conducts investigations in international cooperation. These can be limited to merely supporting the other investigation body or may extend to a full joint investigation and joint final report.

1.3 Investigation reports and safety recommendations

The investigation report is the product of a marine safety investigation and made available to the public. An investigation concludes with the publication of the report. The BSU's investigation reports follow a certain pattern, which is provided by Directive 2009/18/EC. In addition to the required indication of the purpose of the

[4] On the subject of marine casualties, see in particular the explanatory notes in Chapter 6.1.

marine safety investigation, notably, the prevention of future accidents and malfunctions, but not the determination of blame, liability or claims, each report contains

- a summary of the accident;
- factual information, including but not limited to ship and voyage particulars;
- a detailed account of the course of the accident and investigation;
- an analysis of the investigation;
- ensuing conclusions;
- action already taken, and
- safety recommendations (if necessary).

Safety recommendations constitute the key element and conclusion of an investigation report. A safety recommendation points to an identified gap in safety and aims to help the addressee avoid or at least reduce the impact of future situations similar to those that led to the accident. A marine safety investigation by the BSU focuses not only on events on board, but also looks at organisation ashore or the safety system where appropriate. In short, any factors that may have facilitated the accident are investigated and evaluated. Consequently, in addition to the crew, addressees of safety recommendations could include pilots, shipowners, shipyards, manufacturers of equipment, the Maritime Administration, the legislator, or others. Safety recommendations can also be directed at several addressees but their wording should be sufficiently specific. Addressees should be able to clearly discern what is being recommended to them. Accordingly, recommendations of a general nature should be avoided.

The BSU may also issue an early alert in the form of preliminary safety recommendations before the publication of an investigation report. This is to prevent accidents if it has been found that a safety risk exists for which notification must be given as quickly as possible, i.e. before publication of the final report.

However, safety recommendations are not issued with every investigation report. This can be for a variety of reasons, e.g. that no specific deficiencies were apparent or the potential addressees had already closed a gap in safety identified by the BSU through their own action while the investigation was ongoing (Action taken).

If no safety recommendations are published, the law grants the BSU the option to produce a **summary (or simplified) investigation report** when it investigates incidents or LSMCs.[5] The summary report is intended to facilitate the work of investigation bodies and to reduce the time needed for preparation. Strict procedural rules such as the statutory period of 30 days for parties involved to submit comments do not apply, for example. The summary investigation report is still a fully-fledged investigation report, however.

The publication of **interim investigation reports** is also required for SMCs or VSMCs if it is not possible to prepare a final report within one year of the date of an accident. Cases not investigated further after the BSU has conducted a preliminary investigation, e.g. due to a lack of sufficient data, are usually closed with an internal note.

The BSU published a total of 12 investigation reports in 2021. These included three interim reports, a summary report and a report of the Danish Maritime Accident Investigation Board (DMAIB), in which the BSU played a significant role.

The BSU issued a total of 23 safety recommendations in six reports. Safety recommendation addressees in 2021 included (number of recommendations in brackets):

- Federal Ministry of Transport and Digital Infrastructure (4);
- Ship Safety Division (BG Verkehr) (3);

[5] A summary report is not available for SMCs or VSMCs, however (see Section 27(5) SUG in conjunction with Article 14 Directive 2009/18/EC).

- international organisations/classification societies (1);
- shipping companies/owners (10);
- ship's command/crew (3);
- others (2).

1.4 Reports of foreign marine safety investigation authorities

In addition to carrying out its own investigations, the BSU often cooperates with foreign counterparts. In particular, this applies to marine casualties on German territory involving only vessels flying a foreign flag. Under international law, the flag State has the first right of access. If it is agreed that the flag State will lead the investigation of the accident, then the BSU will support the foreign marine safety investigation Authority with expertise and investigators. Such support ranges from the simple establishment of contacts to the independent assumption of entire focal points of an investigation and can demand the same amount of work as one of the BSU's own investigations. For investigations in which support was especially exhaustive, the BSU arranges for the translation of the foreign marine safety investigation Authority's investigation report into German and then – as with its own reports – publishes it on its website.

1.5 Lessons learned

Lessons learned generalise the findings of an investigation and draw attention to existing gaps in general safety. Unlike safety recommendations, they are directed at a wider range of addressees. However, not all investigations lend themselves to the translation of findings into general lessons learned. In 2021, lessons learned were published in three cases.

Main investigations

This section deals with accidents that occurred in 2021 and are currently the subject of a main investigation. In principle, investigations should be completed after one year. However, this is not possible in many cases. The reasons for this are as varied as the actual accidents. One could say, the rule is that the length of the investigation rises with the degree of complexity of the events surrounding the accident and number of parties involved. The BSU obviously makes every effort to analyse accidents quickly and publish the final report within one year. I would like to briefly outline some of the accidents from the previous year.

2.1 ENDURANCE

On 13 March 2021, the US-flagged ro-ro vessel MV ENDURANCE was moored in Bremerhaven's Verbindungshafen when all mooring lines broke in gale force winds with gusts of up to 10 Bft. Pushed ahead by the gale force winds, the ship drifted to Dock III on the opposite side of the Lloyd Werft dockyard, struck it with full force, drifted transversely and finally struck the pier. Two tugs requested to hold the ENDURANCE in position at the berth by the master before the lines failed unfortunately arrived too late to prevent the accident. This measure had been successful two days earlier in similar wind conditions. The accident caused considerable damage to parts of the pier and the ship. For example, a bollard broke out of its anchorage and the ship suffered a tear in her shell plating on impact. Fortunately, nobody was injured.

Figure 2: The US-flagged MV ENDURANCE[6]

It was only possible to direct the ENDURANCE back to her berth after the deployment of additional tugs. The BSU began its investigation, which focuses on line handling and the organisation of berths in strong winds.

2.2 SEOUL EXPRESS

A fatal fall from a height occurred on board the container ship SEOUL EXPRESS on 27 March 2021. She was just off the coast of Mexico en route from Manzanillo in Mexico to Long Beach in the United States.

[6] Source: www.fleetmon.com.

Figure 3: The SEOUL EXPRESS[7]

At the end of his morning watch, the subsequently deceased watchkeeper began his usual inspection of the temperatures of the loaded fish meal containers on the instructions of the chief mate, who was in charge of the navigational watch. This involved checking 11 containers in various bays in the cargo holds during the voyage in question. Daily temperature inspections of fish meal are required because this cargo is (depending on composition) a spontaneously flammable substance according to the IMDG Code[8].

At 0715, the watchkeeper reported the entry and then shortly afterwards exit from cargo hold 1. The chief mate was notified that the watchkeeper was reportedly now entering cargo hold 3 about 15 minutes later. The four fish meal containers stowed there were below deck in the lower tiers. Since no further report on leaving cargo hold 3 was received on the bridge, the watchkeeper was called by radio. Since there was

[7] Source: www.fleetmon.com.
[8] IMDG Code: International Maritime Code for Dangerous Goods.

no reply, the chief mate informed the master and a search for the missing crew member was immediately initiated.

The search party found the access hatch to cargo hold 3 open. A test of the atmosphere in the cargo hold revealed neither low oxygen levels nor dangerous gases. The chief mate then entered the cargo hold, climbed down to the next lower deck using the ladder beneath the access hatch and called out for the watchkeeper. He received no answer and climbed down to the next deck. He was then able to see the missing person lying motionless on the deck floor next to the ladder.

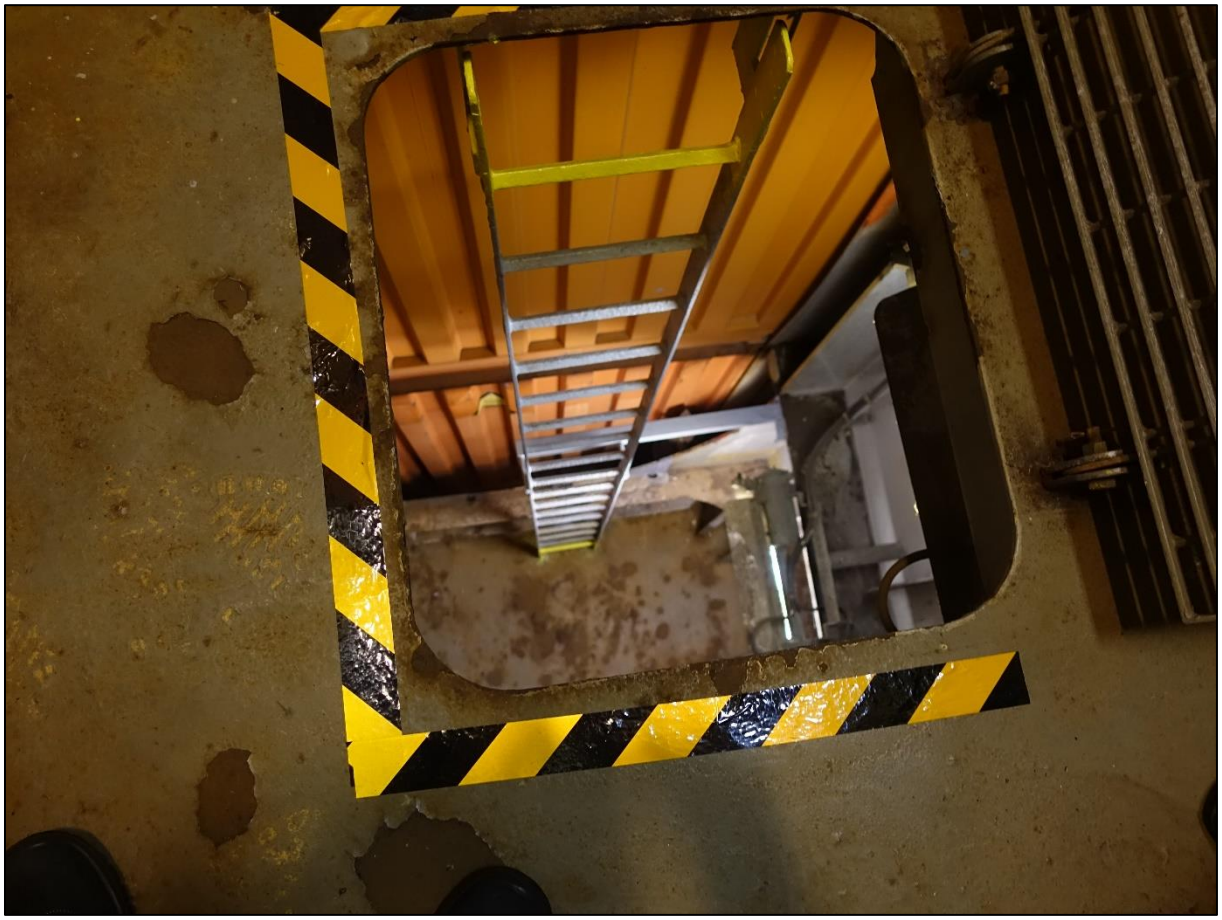


Figure 4: The scene of the accident (the height of the fall is unknown)[9]

The chief mate and another crew member entered cargo hold 3 wearing respiratory protection and reached the casualty two minutes later. The latter was lying chest down and had a bleeding wound on the back of his head. He was completely unresponsive.

[9] Source: BSU. Application of the yellow and black adhesive strips was an immediate action taken after the accident.

Shortly afterwards, the unconscious person was secured at the scene with a rescue strop and evacuated to the top deck, where he was placed on a spineboard (type of rescue stretcher). A rope and pulley system suspended between containers on the top deck was used for the evacuation. A more detailed examination and first aid were carried out on the top deck. However, the casualty did not display any vital signs there, either. All attempts at resuscitation, both at the scene and shortly afterwards in the ship's sick bay, were unsuccessful and discontinued 90 minutes later. A subsequent autopsy revealed that the casualty had suffered several internal injuries, including bleeding organs and a fracture in the spinal column, which were ultimately fatal.

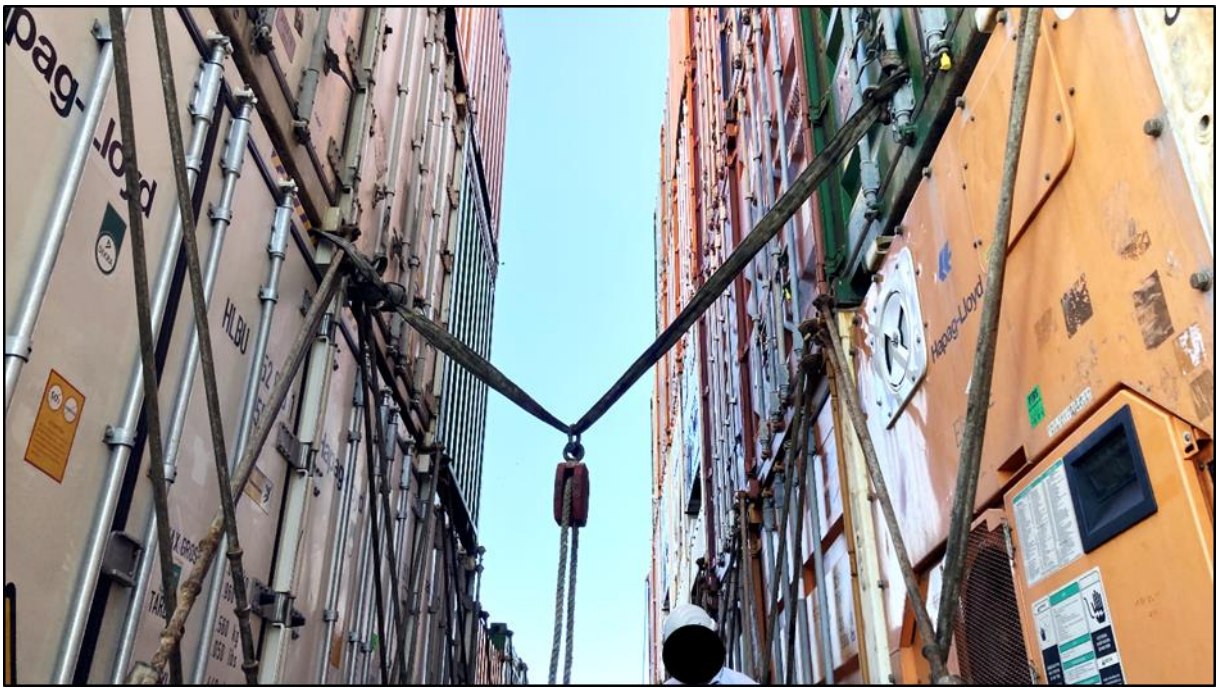


Figure 5: Rope and pulley system for evacuation via the access hatch (reproduced)[10]

The BSU was notified by the shipping company immediately and initiated an investigation of the accident. This focused on the following areas:

- general hazards during work aloft;

[10] Source: BSU.

- implementation of occupational safety on board;
- the ship's basic structural conditions (ladders in cargo holds with a risk of falling from a height);
- the health and therefore the fitness for service at sea of the casualty;
- the emergency management of the crew, and
- the safety culture on board and within the company and the implementation of ISM[11] requirements.

2.3 RECREATIONAL CRAFT

As already explained, the BSU is basically no longer responsible for accidents involving recreational craft used privately. An accident involving a recreational craft is not classed as a marine casualty in the sense of international responsibilities, but rather as an 'other incident or accident'[12]. Having said that, the SUG states that the BSU may investigate such accidents if they concern recreational craft (as described above) built for navigation at sea and occur in German waters. However, it is important to note that

- it must be expected that the findings will ultimately increase maritime safety, in particular by improving applicable regulations or equipment for maritime navigation, or
- that a substantially interested State requests a marine safety investigation.

While the second requirement never really materialises, the BSU establishes whether and in certain cases confirms that the first requirement prevails for every corresponding notification.

[11] ISM Code: International Management Code for the Safe Operation of Ships and for Pollution Prevention.
[12] The purpose of this distinction is to avoid misunderstandings. Unfortunately, the terminology in the SUG makes no distinction here.

2.3.1 Fatal accident on and foundering of the sailing yacht SILJA

The 7 m sailing yacht SILJA capsized and foundered while sailing from Juist to Langeoog in the early evening of 26 August 2021. Three young adults (one woman and two men) in their early 20s who had arranged to go on a leisure trip were on board. Despite his young age, the skipper was an experienced sailor. The trip started at midday and they sailed parallel to the coastline on a beam reach in fine weather. The wind force was about 5 Bft.

Figure 6: The SILJA in port with mast still folded[13]

At about the same time as they turned into the direction of Langeoog, the wind picked up noticeably, approaching from aft at force 6 (in gusts 8) Bft. At the same time, they had to sail against the ebb tide. In the area of the bar to the south of the approach to the Accumer Ee tidal inlet[14], the boat ran into short waves of two to three metres in height and thus probably also into groundswell, which she could not cope with, and overturned. The three individuals were able to cling to the inverted boat for some time while she was drifting and foundering.

[13] The SILJA is a Nautica 23 equipped with cabin, outboard engine and centre board. Source: owner).
[14] n/a

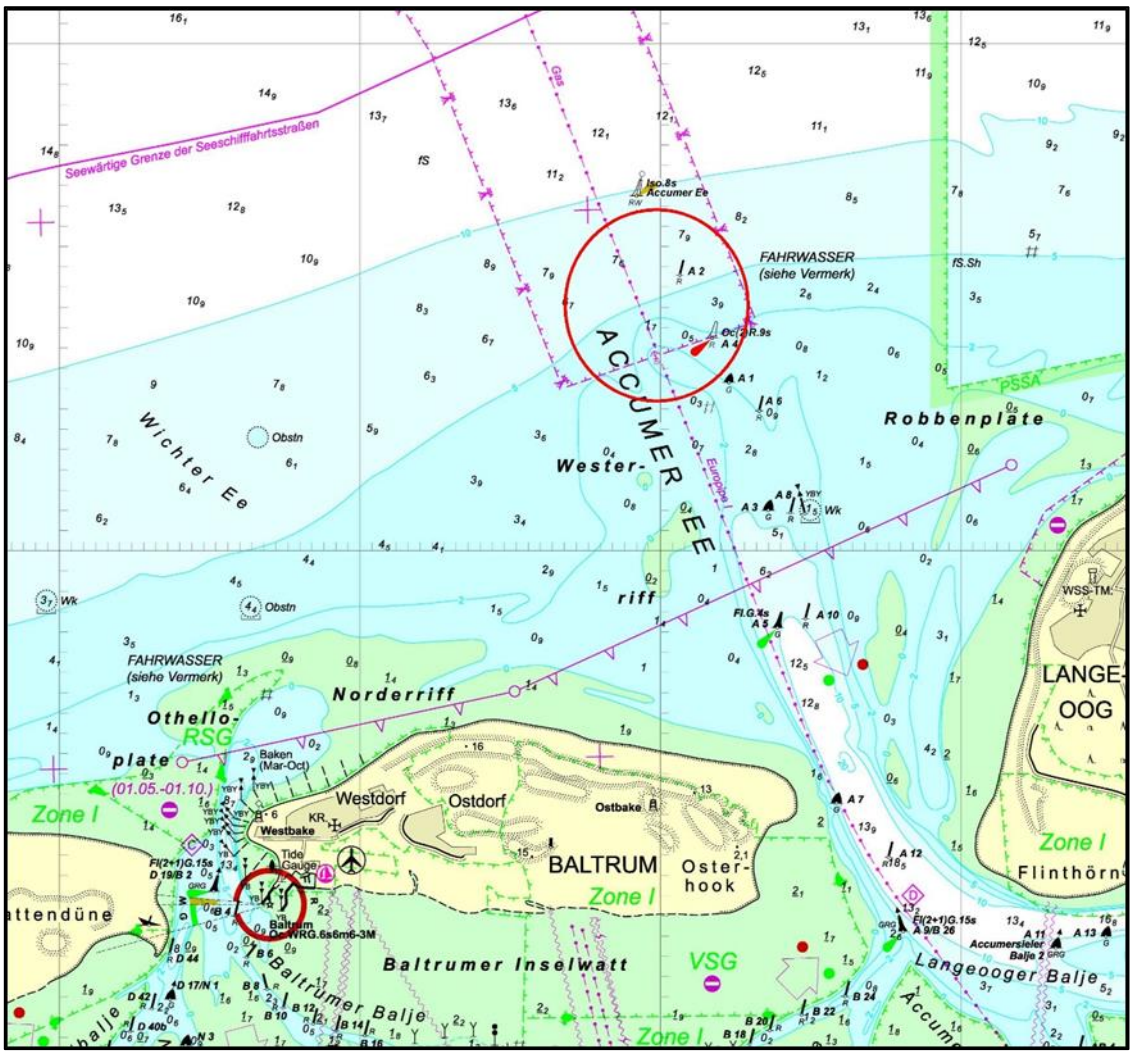


Figure 7: Sea area in which the SILJA capsized and foundered[15]

The skipper managed to send a distress call from the water using his smartphone, which prompted the start of an extensive rescue operation. About three hours after the boat capsized, a helicopter from the rescue services managed to find two of the sailors, the female and the skipper, and pull them out of the water alive. Both were wearing a lifejacket, the buoyancy element of which was partly detached from the protective cover. A rescue cruiser found the third sailor with lifejacket floating in the water. When rescuers tried to pull the sailor out of the water, he slipped out of the lifejacket and sank. It was not possible to locate him again and he remains missing to this day. The boat foundered and has not been located.

[15] Extract from Navigational Chart Juist to Langeoog, BSH 1170.

The BSU decided to investigate this case because it involved a culmination of various safety risks that not all water sports enthusiasts are likely to know about. Accordingly, the investigation took a closer look at a large number of safety-related aspects that had a material influence on the marine casualty and the rescue measures, such as

- the use of lifejackets and their maximum loads;
- the use of navigational charts and sailing directions;
- the conditions for obtaining the *Sportbootführerschein See (SBF See)* [international certificate for operators of pleasure craft on the waterways navigable by seagoing ships];
- the smartphone as a navigation and an emergency call device, and
- the use of private and governmental wind forecast services.

2.3.2 Accidents involving the use of an autopilot

During last year's sailing season, several similar accidents occurred while using an autopilot on different sailing grounds, some of which resulted in significant material damage and two persons were injured. One thing all the accidents had in common was that the skipper was relying on an autopilot but it did not respond as intended or as the skipper had expected. There was no time left for countermeasures.

Figure 8: The heavily damaged motor yacht SANTA CECILIA
after the autopilot's remote control failed[16]

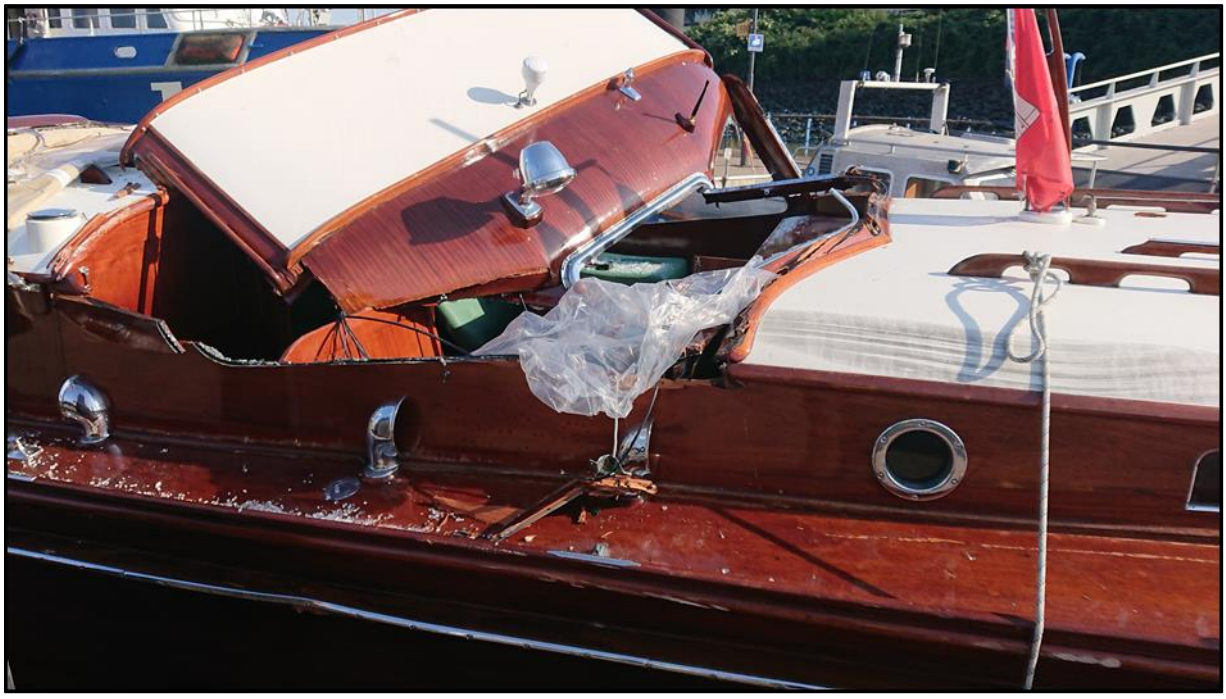


Figure 9: The damaged cockpit

[16] Source for Figures 8 and 9: BSU.

Due to the striking accumulation of such accidents, the BSU addressed this issue. We can already say at this point that even the best technological systems are never anything more than an aid.

2.4 Fishing vessels foundered in the North Sea

Two fishing vessels foundered in the North Sea in the same week of September. In each case, the crews were able to move from the vessel to safety and were rescued.

2.4.1 FV FREYJA

The FREYJA set sail from Büsum to catch fish on 17 September 2021. The crew consisted of two people. After a successful afternoon, they anchored with the intention of continuing their work in the early morning.

Figure 10: FV FREYJA[17]

[17] Source: Owner/skipper of the fishing vessel.

As the anchored vessel turned in the wind, the skipper noticed thick dark smoke coming from the engine room. He switched off the engines immediately and took the precaution of preparing the liferaft. This proved to be a wise decision for there was an explosion in the engine room just as they were getting ready to extinguish the fire and the entire vessel was covered in acrid smoke within seconds. The crew had no other option but to abandon the vessel immediately and board the liferaft. They were able to attract the attention of a helicopter shortly afterwards, which winched both of them up. The German Maritime Search and Rescue Service (DGzRS) monitored the fishing vessel as she burned out completely and foundered. Extinguishing work would have been too dangerous.

Figure 11: The mast of the foundered FREYJA still protruding from the water[18]

[18] Source: German Central Command for Maritime Emergencies.

The vessel (or more aptly her wreck) was later salvaged and taken ashore on board the CATJAN. The BSU is required to investigate this VSMC. However, the final photograph illustrates that an investigation into the cause was virtually impossible.

Figure 12: The wreck of the FREYJA on board the CATJAN[19]

[19] Source: BSU.

2.4.2 FV RAMONA

Just four days later, the fishing vessel RAMONA foundered with five people on board in the Heligoland Bight north of the island of Scharhörn. All five people were rescued.

Figure 13: The RAMONA is already foundering[20]

On 21 September 2021, the RAMONA sailed into the Heligoland Bight from Cuxhaven. Five people were on board (two crew members and three passengers). After they had already been underway for quite some time, the master noticed that planks in the fore section were coming loose and the vessel was making water. The water ingress was so severe that he immediately made an emergency call and had all persons transferred to the life raft he had brought with him. They were taken over by the FV HOFFNUNG, which was the first to come to the rescue, and brought to Cuxhaven. The rescue cruiser ANNELIESE KRAMER of the DGzRS still tried to use bilge pumps, but the RAMONA

[20] Source: DGzRS (The German Maritime Search and Rescue Service).

took water too quickly and sank. The vessel foundered in the North Sea after less than 30 minutes.

Figure 14: Loose planks at the bow of the RAMONA[21]

Although a salvage order was issued against the owner, it was ultimately not executed because the wreck had already been completely worn down and disintegrated due to

[21] Source: DGzRS (unfortunately, a higher resolution image is not available but it should not be omitted).

the tides. This does not necessarily make an investigation by the BSU – which it has a statutory duty to carry out in this case – easy.

Figure 15: Course of the voyage of the RAMONA and scene of the accident[22]

[22] Source: www.marinetraffic.com.

What was happening in the Administration?

3.1 Staff

As with the year before it, 2021 was also dominated by the coronavirus and therefore presented particular though already known challenges. BSU staff members have been working almost continuously from home since the autumn of 2020 (the facilities for this were also available last year). Of course, appointments in the field were still carried out with the necessary precautions, meaning that it was still possible to start or continue investigations. However, it should be noted that the coronavirus certainly led to delays.

There were changes in staffing again this year, though not as many as in the previous year. One investigator was transferred to a lead investigator's post. The vacant position was filled promptly on 1 June 2021. Over the past few years, the BSU has seen many changes in the area of investigation, in particular. With only seven posts in Division 1, seven vacancies were advertised. The posts were filled again internally on three occasions and new staff members were recruited from outside on four. This rapid turnover, which was partly due to retirements, naturally led to an increased need for initial training but also to new perspectives, as well as to the acquisition of new expertise. The BSU has been greatly enriched by this.

On the other hand, the staff in the other two divisions has remained stable for years.

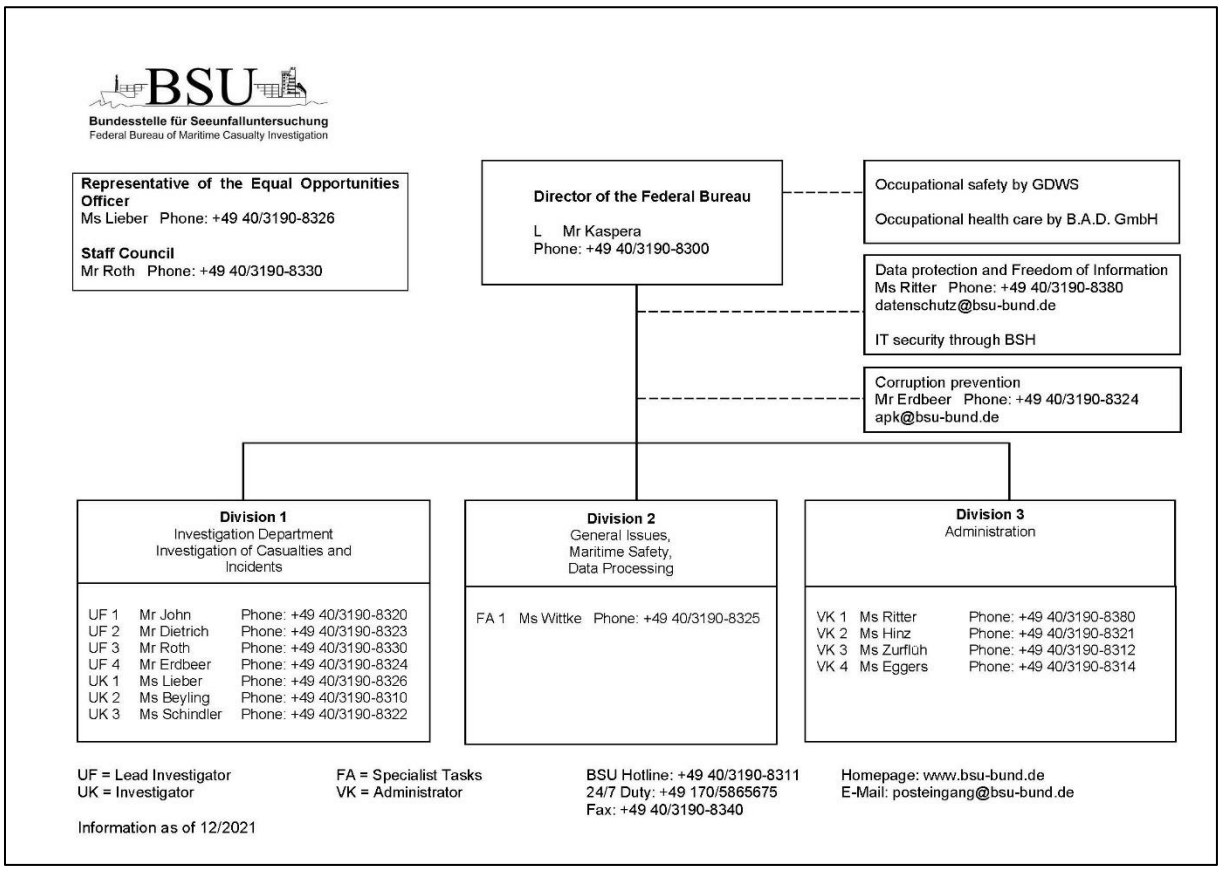
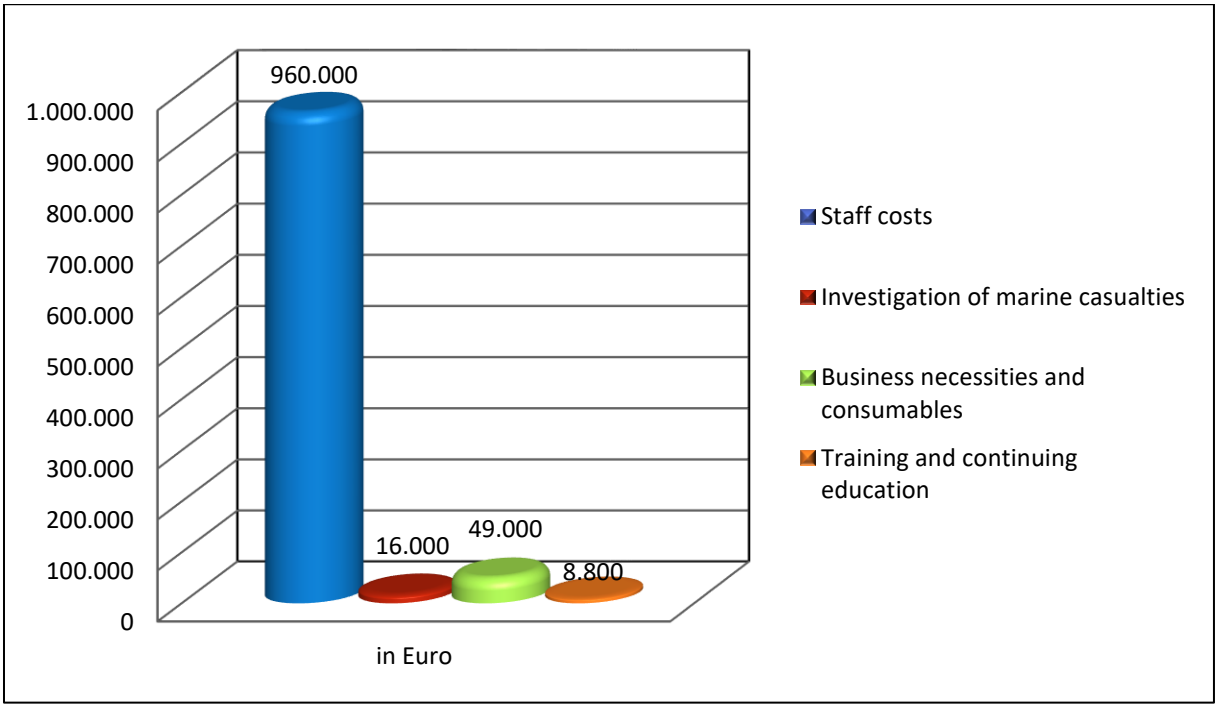


Figure 16: The BSU's organisational chart in December 2021 (still current)

3.2 Budget

The Bundestag allocated a budget of EUR 1,266,000 to the BSU in 2021. Although this is a 'pittance' compared to other federal higher authorities, the BSU did not spend the funds in full but rather only some EUR 1,060,000.



Graph 1: Budgetary resources in 2021

As in all previous years, spending of just under EUR 1 million centred largely on staff costs, which were followed by expenses of some EUR 49,000 incurred in the course of investigating marine casualties. Business necessities and expenses for personal protective equipment amounted to about EUR 16,000. On the other hand, travel expenses were spared because official journeys were virtually impossible due to the coronavirus. Since continuing vocational training was carried out online or cancelled, the funds for that were not completely spent, either. However, in-house or online training enabled the BSU to cover existing requirements. All told, some EUR 8,800 was needed for this. One highlight was an extensive in-house workshop on bridge resource management, human element and fault finding over two days for Division 1.

3.3 Electronic file and digital accessibility

Two particular tasks that kept the Administration extremely busy were the preparatory work for the introduction of the electronic file and the digital accessibility of documents published by the BSU. The BSU can report that both tasks are now completed.

The BSU makes every effort to keep its website up to date and as accessible as possible. Material explanatory notes about the BSU have already been available in sign language since 2020. Moreover, all documents were made largely accessible to people with disabilities in the course of 2021 and all new documents have been completely accessible since 1 January 2022.

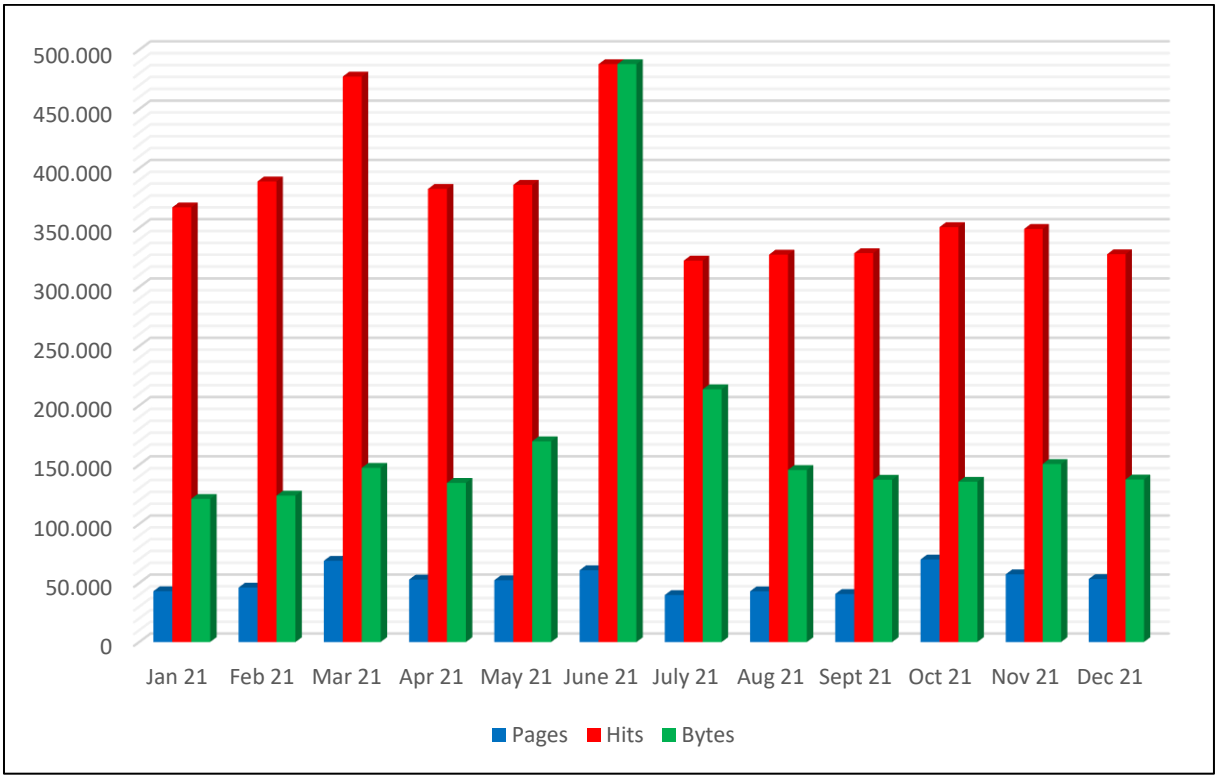
Preparations for the introduction of an electronic file were extremely complicated. For example, technical and organisational conditions had to be established, service agreements had to be drawn up and negotiated, rules for use had to be defined and all staff members had to be trained and instructed. The introduction was executed in two phases: Division 3 on 1 January 2022 and Division 1 on 1 April 2022. Mission accomplished!

Public relations

4.1 The BSU's website

Among other things, the BSU's website offers visitors the opportunity to obtain information on the duties and structure of the BSU, the historical development of marine casualty investigation, as well as the statutory foundation. Accordingly, you are warmly invited to take a brief foray into the world of marine casualty investigation.

The graph below shows the web statistics for the preceding year.



Graph 2: Web statistics for 2021 by month

That most of the hits/downloads are in March and June (most downloads are clearly in June) can be explained by the publication of the ASTROSPRINTER/№ 5 ELBE report, which attracted considerable public interest and was also covered by the media.

The raw figures for 2021 reveal the following picture:

Month	Pages	Hits	Bytes
Jan 21	43,090	367,189	45.21
Feb 21	46,151	389,027	46.24
Mar 21	68,830	477,525	54.98
Apr 21	52,940	382,715	50.26
May 21	52,373	386,196	63.34
June 21	60,843	487,974	181.95
July 21	39,866	322,241	79.69
Aug 21	43,009	327,310	54.3
Sep 21	40,718	328,569	51.24
Oct 21	69,968	350,502	50.61
Nov 21	57,398	349,031	56.18
Dec 21	53,386	327,674	51.32
Total	628,572	4,495,953	785.32

Spreadsheet 1: Web statistics for 2021 in figures

A comparison of the figures with those of previous years suggests that the considerable increase in interest last year was mainly due to the high-profile accident involving the MSC ZOE. The number of hits have returned to a normal level in the following year. Last year's increase of almost 20 percentage points as compared to previous years has dropped again. The figures are once more at exactly the same level as in 2019. All in all, an increase in the interest shown in the work of the BSU has certainly been evident over the years, however. This is shown by a comparison of the total number of hits over the past five years:

Year	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Hits (thousands)	4,048	4,343	4,098	4,496	5,235	4,496

Spreadsheet 2: Total number of hits from 2016 to 2021

The hits on the website provide information on where public interest in the BSU's accident reports predominantly lies, as this varies greatly. Not every accident receives

the same amount of attention. In principle, those reports whose underlying accidents have been met with a broad public response are at the top, while reports on other, less prominent accidents tend to be favoured by a purely specialist audience. The following table shows the ten most frequently downloaded investigation reports.

Pos.	Title	Type	Ref.	Hits	Language	Published in	Comments
1	Collision between the traditional vessel Nº 5 ELBE and the container vessel ASTROSPRINTER on the River Elbe on 8 June 2019	Investigation report	211/19	15,460	DE	2021	Current
2	Fatal person-overboard accident involving a crew member of the fishing vessel HELEN MARY in the North Atlantic on 30 January 2020	Investigation report	20/20	8,773	DE	2021	Current
3	Failure of a head line on the chemical tanker THEMSESTERN in the Kiel-Holtenau lock on the Kiel Canal on 30 November 2019 with three linesmen slightly injured	Summary investigation report	415/19	7,611	DE	2021	Current
4	Personnel accident with subsequent loss of life on board the SAJIR in the roadstead off Ningbo (China) on 19 December 2019	Interim investigation report	452/19	5,849	DE	2020	Previous year
5	Fire and explosion on board the MSC FLAMINIA on 14 July 2012 in the Atlantic and the ensuing events	Investigation report	255/12	5,683	EN	2014	Older
6	Accident involving a person on the multi-purpose vessel MARFAAM at the Rüsterbergen pilot station on the Kiel Canal on 13 January 2019	Investigation report	19/19	5,280	DE	2020	Previous year
7	Catamaran SEEWIND I suddenly pitches into a wave in the North Sea with ensuing physical injuries and damage on 3 July 2020	Investigation report	74/20	4,333	DE	2021	Current
8	Containers on the MSC ZOE lost overboard on 1 and 2 January 2019	Joint report by the BSU, DSB and PMA		3,961	DE	2020	Previous year
9	Collision between the traditional vessel Nº 5 ELBE and the container vessel ASTROSPRINTER on the River Elbe on 8 June 2019	Interim investigation report	211/19	3,847	DE	2020	Previous year
10	Water ingress in the RoPax ferry BERLIN's forepeak after an allision with the fender system in the port of Gedser (DK) on 30 July 2016	Summary investigation report	283/16	3,665	DE	2020	Previous year

Spreadsheet 3: Number of investigation report hits in 2021

The three front runners are reports from the past year, which underlines the interest in the current reports of the BSU. Interest in the MSC FLAMINA accident, here in English, continues unabated. This may be partly due to the fact that only recently an entire episode of the Canadian/American TV series 'Disasters at Sea' was dedicated to the case and recounted in detail and vividly (with the involvement of the BSU). The other downloads concern current reports or those from the previous year.

4.2 Lectures and events

Only a few events that BSU staff normally attend in person actually took place. These were the few exceptions that could essentially be counted on one hand. However, rather than a period of inactivity, the 'physical state' of most of the events has morphed into web conference. Accordingly, presentations or lectures could still be held and lively discussions could take place. As much as I agree with the fact that it is better (and also offers many advantages) to switch events to digital mode instead of cancelling them, I do not believe that this can cover everything. They will certainly continue to be the first choice for official meetings or simple technical presentations, as the advantages of saving time, money and the environment are quite obvious. However, events that are also reliant on the sharing of information among experts or that facilitate networking cannot be replaced by a purely online event. As always, the truth and in this case the future lies somewhere in the middle.

Regular events in which the BSU was involved and gave lectures that also took place during the pandemic included the BMDV's Maritime Safety Committee and courses at the Waterway Police training school. Other events such as lectures at universities and technical colleges were held in the form of an online conference this year, too.

International

5.1 EMAIIF and MAIIF[23]

Similar to the previous year, the meeting of the European marine safety investigation authorities (EMAIIF) had to be dropped completely. The conference was scheduled to be held in Copenhagen and due to existing travel restrictions, it was once more not possible for Denmark to organise it. Replacing it with an online event was considered inexpedient and rejected.

The major international meeting (MAIIF) fared only slightly better. Planned for autumn in Lima, the MAIIF 28 event also had to be cancelled. However, an online conference – now the third so-called inter-sessional meeting – was agreed on, this time over three days and for three hours each day. In contrast to the previous year, this led to a more detailed exchange of views on various issues, two of which I would like to briefly discuss:

- a working group chaired by Norway has created templates for international investigations, i.e. formalised agreements that apply when several marine safety investigation authorities are involved in one case. This makes sense because it facilitates the coordination of such an investigation and provides the necessary authority when carrying out investigative work abroad;
- the Casualty Investigation Code, IMO Resolution MSC.255(84), has now been in force for more than ten years. Accordingly, a check as to whether marine safety investigation authorities require changes based on the experience gained thus far when applying it is now due. To this end, a small working group in which the BSU is also represented was set up within MAIIF.

[23] (European) Maritime Accident Investigators International Forum.

5.2 Permanent Cooperation Framework (PCF)

The annual meeting of directors of the various marine safety investigation authorities at EMSA for harmonising investigation procedures, PCF, was held in September (also completely in digital form). The revision of Directive 2009/18/EC, which provides the legal framework for marine casualty investigation in Europe, was once more a hotly debated topic. As already stated in last year's report, the marine safety investigation authorities were given the opportunity to participate in the process. This took very concrete shape in 2021. A consulting firm commissioned by the European Commission interviewed all marine safety investigation authorities, evaluated and processed the findings of those interviews and presented them at the PCF. To sum up, the main points of the revision are the applicability of the Directive to smaller fishing vessels in the future, the expansion of possible support services by EMSA and the clarification of definitions.

Another point was the presentation of the activities of the investigation bodies of Sweden, of Estonia and of Finland in relation to a possible resumption of the investigation of the accident involving the ESTONIA in 1994. The three bodies are currently investing a great deal of effort, e.g. dive operations onto the wreck, to establish whether there are new findings that warrant a resumption. It is intended that this should be completely transparent, i.e. the results will be published before an evaluation by the authorities. The result of this 'preliminary investigation' remains to be seen.

5.3 Implementation of mandatory IMO-Instruments (III-7)

In mid-July, the IMO's III Committee once more assembled in London, this year for the seventh time and for the second time as a purely online event. As in earlier years, the BSU supported Germany's delegation management from the BMDV and reinforced the 'Analysis of Marine Safety Investigation Reports' working group, which deals with accident trends around the world. The focal points of this meeting were:

- general findings of marine casualty investigations;

- various stakeholder proposals to amend the Casualty Investigation Code, which were not adopted, however;
- investigations into accidents resulting in container losses and related findings, where the accidents involving the MSC ZOE off the German and Dutch coasts, as well as the accident involving the YM EFFICIENCY in the waters of Australia were the main topics. A lively debate about this topic continues at the IMO and corresponding submissions, including some based on the findings of the BSU and supported accordingly by the BMDV in cooperation with other countries, are already being addressed by the large and significant Maritime Safety Committee.

In general, it can be said that Germany and the Netherlands in particular were and still are extremely active on the international stage after the MSC ZOE accident and corresponding investigation report. They are campaigning for support for the measures recommended by the marine safety investigation authorities, which I am of course pleased with for the BSU – in conjunction with the hope that the efforts will also bear fruit.

Statistics

6.1 General information and explanatory notes

As usual, a few explanatory words precede the statistics presented here to make them easier to understand.

Para 1a SUG defines the term 'marine casualty' as being any event that has at least one of the following consequences:

- the death or serious injury of a person caused by or in connection with the operation of a ship;
- the disappearance of a person on board a ship caused by or in connection with the operation of a ship;
- the loss, presumed loss or abandonment of a ship;
- substantial material damage to a ship;
- the grounding or constructive total loss of a ship or the involvement of a ship in a collision;
- substantial material damage caused by or in connection with the operation of a ship;
- environmental pollution resulting from damage to one or more ships caused by or in connection with the operation of one or more ships,

and any event caused by or in connection with the operation of a ship that poses a risk to a ship or a person or the consequences of which could cause serious damage to a ship, an offshore structure or the environment (incident, para 1b SUG).

Depending on the consequences, German law states that the generic term 'marine casualty' must be divided further into:

Very serious marine accident (VSMC):
Fatality, constructive total loss of a ship or an accident with substantial environmental pollution.

Serious marine accident (SMC):

Marine casualty according to the above criteria, which cannot be classified as a VSMC but which additionally involves

- the failure of the main engine;
- substantial damage to the accommodation spaces;
- serious damage to the ship's structure;
- damage to the underwater shell plating with which the ship becomes unseaworthy;
- pollution, regardless of the volume of pollutants released, and/or
- an accident that necessitates towing or shore-based assistance.

Less serious marine accident (LSMC):

Any marine casualty according to the above definition not classified as a VSMC, SMC or incident.

Incident (as defined above). This also includes minor accidents which have not caused significant damage and therefore cannot be classified as a LSMC, but which did endanger a ship, her crew or the surrounding area (environment/traffic). **It is important to note that** an incident is not a marine casualty as defined by the IMO. Accordingly, incidents are shown separately in the statistics section.

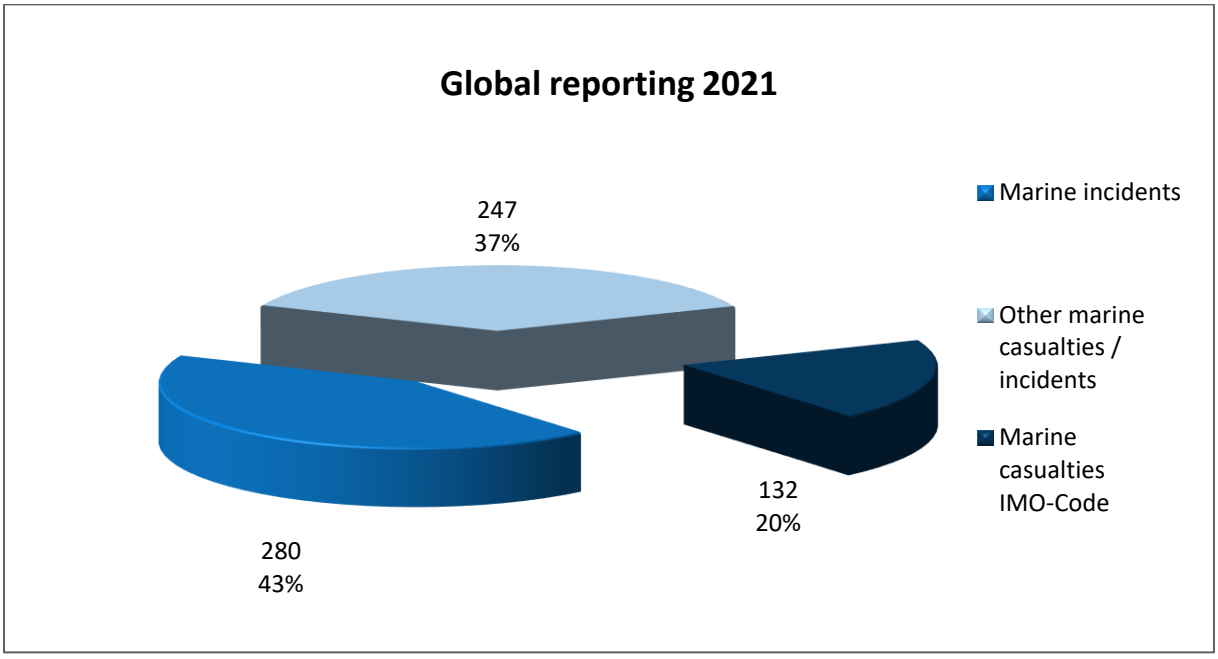
Other accidents and incidents are all other cases that were outside the BSU's statutory responsibility but reported to it. By definition, this also includes the cases defined in para 1(4) in conjunction with no. 2 and 3 of para 1(3) SUG, i.e. accidents involving only recreational craft used privately or small fishing vessels.

Such accidents are not marine casualties under international law but the BSU may still investigate them when certain conditions are met.[24] The distinction between NC (no casualty) and OC (other casualty) found in earlier annual reports was abandoned for lack of relevance in the year before last and therefore not shown in this annual report for the first time.

Since the BSU has no fundamental responsibility for privately used recreational craft, these and other accidents classified as 'Other accidents and incidents' are not recorded in the database. Accordingly, the statistics section only provides information on such accidents in exceptional cases.

6.2 Notifications received

The total number of notifications is significantly higher than in the preceding year – 602 in 2020 compared to 659 in 2021 (or an increase of almost 20%). Although there were also changes in the individual categories, NC and OC must be combined for the previous year comparison.

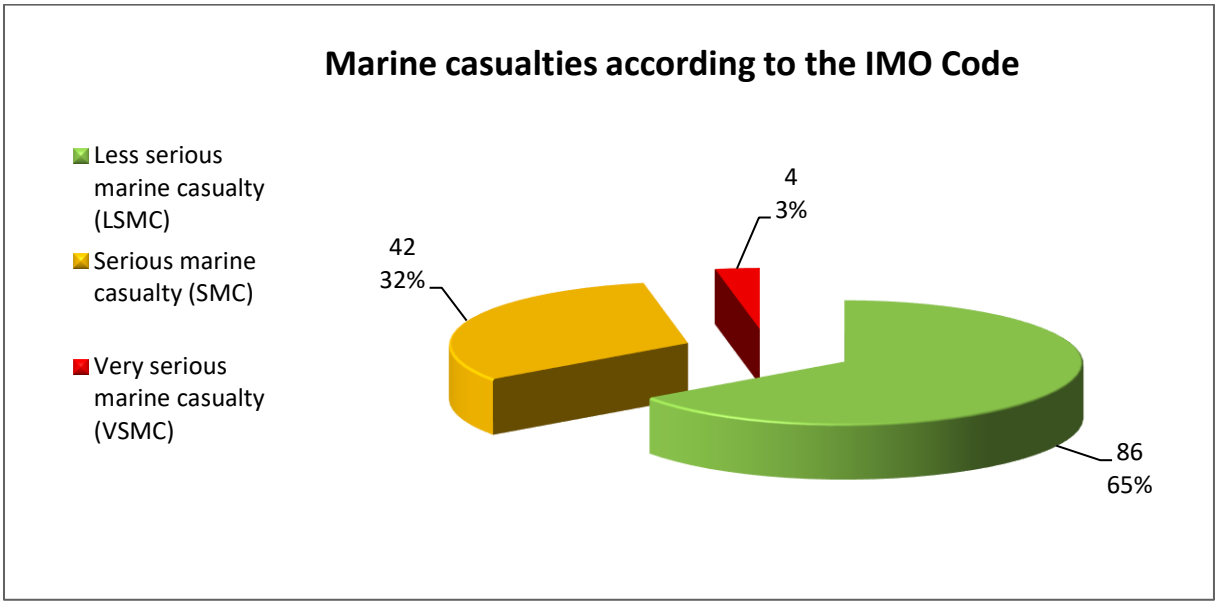


Graph 3: Global reporting 2021

[24] See also the explanatory notes at point 1 of this annual report.

The number of reports outside the statutory responsibility of the BSU is almost identical in terms of actual figures (249 in 2020 to 247 today), but has fallen in percentage terms from 42% to 38%. In particular, marine casualties according to the IMO Code have increased from 109 to 132, representing an increase of more than 20%. The number of incidents has also increased by almost 15% from 244 to 280. Accordingly, there is a significant increase in the relevant categories, which we will look at in greater detail.

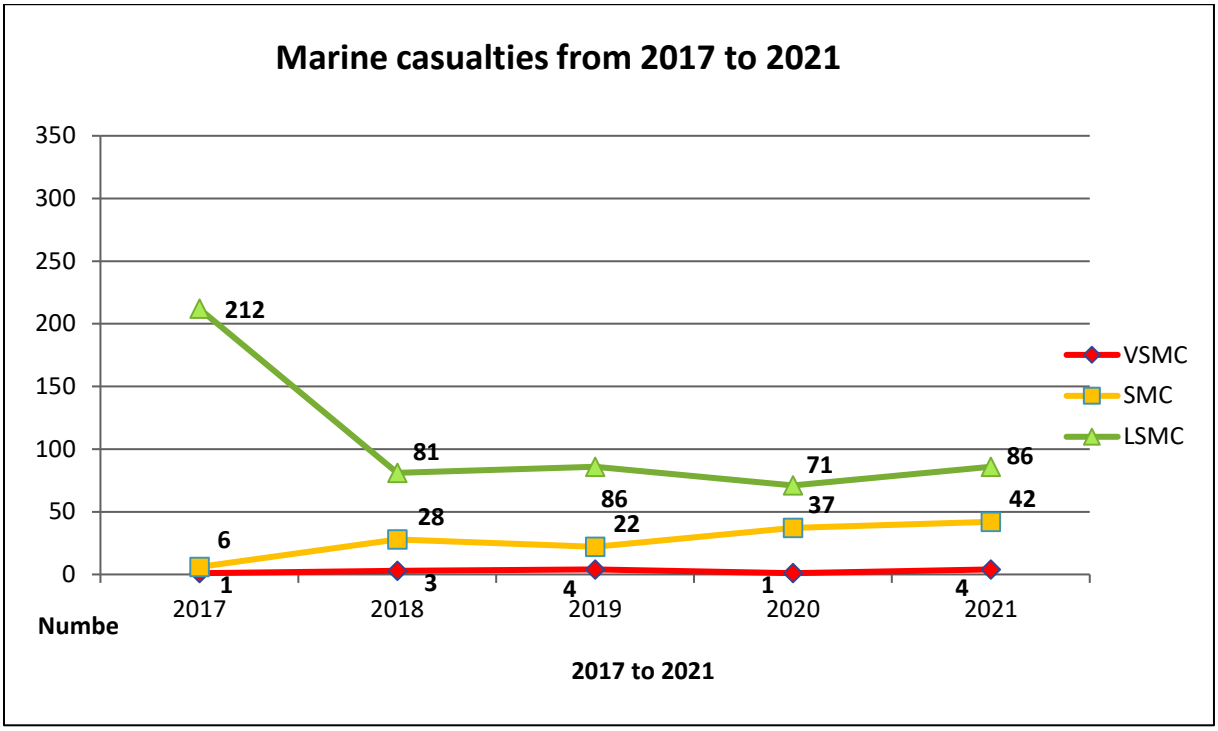
Let us begin with the international interpretation and differentiate within the 'Marine casualty' category. The following statistics cover all cases which fall within the BSU's area of responsibility, i.e. not only the German-flagged seagoing ships.



Graph 4: Marine casualties according to the IMO Code in 2021

There were certainly significant and not exactly encouraging changes compared to the year before. The figures have seen an increase in all three categories: LSMCs from 71 to 86, SMCs from 37 to 42 and VSMCs from one to four cases.

The following graph shows the trend over the past five years. The leap in figures in 2018 can be explained by the BSU's new approach to classification.



Graph 5: Comparison of marine casualties from 2017 to 2021

Based on the figures shown here, especially for the LSMCs and VSMCs, it is evident that the increase in the last year is a natural fluctuation; in comparison, 2020 was a year with very few accidents – due to the coronavirus pandemic. However, the increase in SMCs still requires an explanation. And at this point I have to jump ahead somewhat, as this is not due to an increased risk to merchant shipping. In this category of accidents alone, 18 and thus half the cases occurred on commercially used (i.e. chartered) recreational craft. In the previous year there were only 9. All told, the figures are therefore within the usual range.

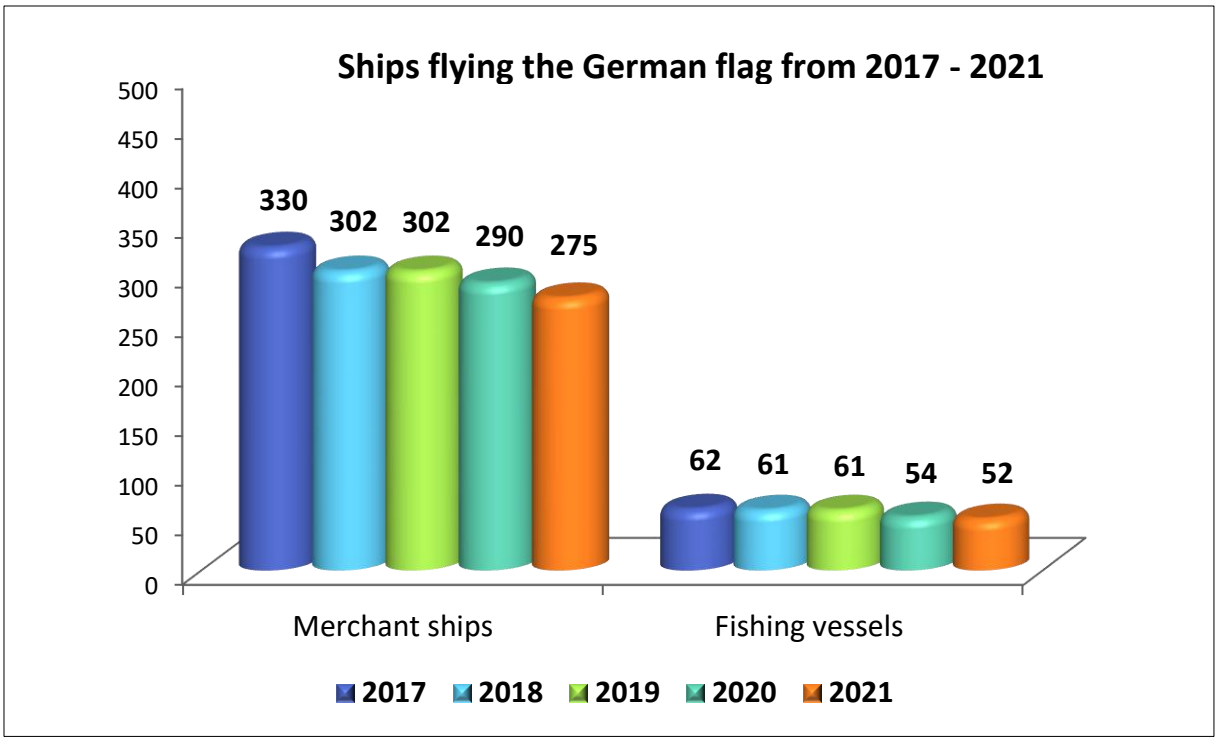
On the other hand, it remains encouraging that the number of fatalities and injuries in **merchant shipping** remains at a very low level compared to previous years, as shown in the table below. This may well be due to increased safety awareness on board ships and in shipping companies. Perhaps the work of the BSU has also contributed to this.

	2016	2017	2018	2019	2020	2021
Fatalities	5	4	2	2	1	2
Injured	60	51	31	36	24	21

Spreadsheet 4: Number of dead and injured seafarers from 2016 to 2021

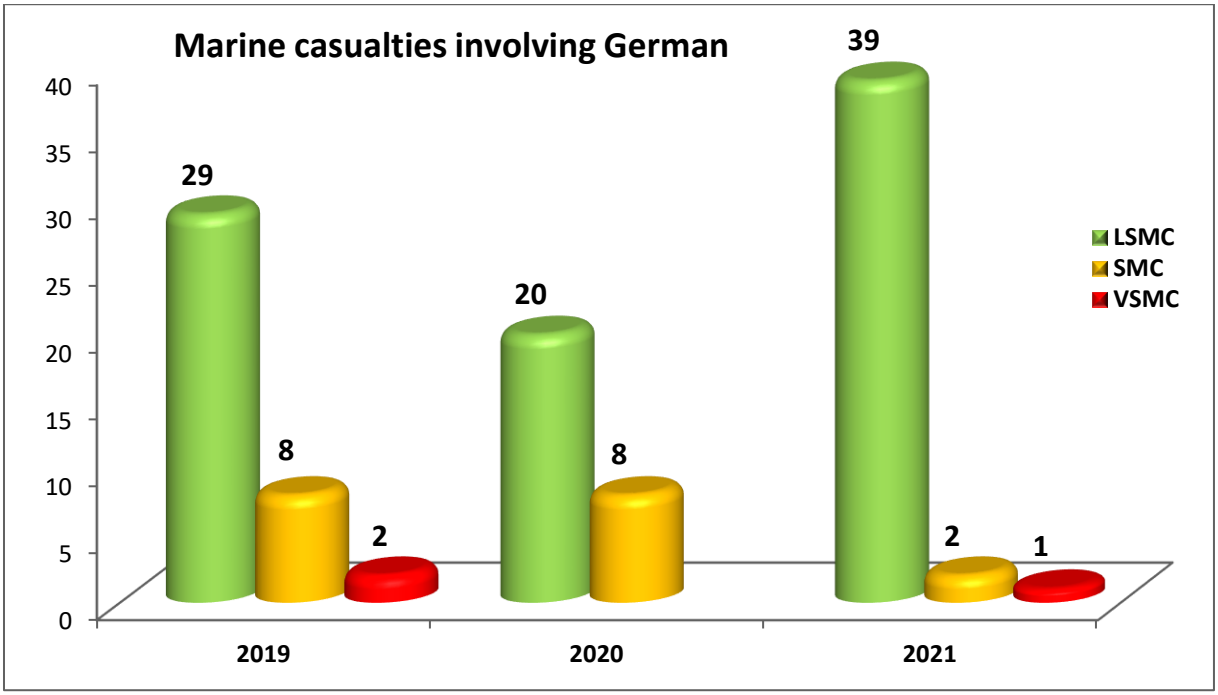
6.3 Ships flying the German flag[25]

Unfortunately, the contraction of previous years continues unabated both for merchant ships and for fishing vessels. The number of merchant ships registered under the German flag now stands at only 275, 15 units fewer than in the previous year and as much as 41 fewer than in 2017. The German-flagged merchant fleet has thus contracted by almost 13% in five years. The downward trend in fishing vessels also continues, albeit at a slower pace (54 in the previous year to 52 units[26] now).



Graph 6: Ships flying the German flag from 2017 to 2021

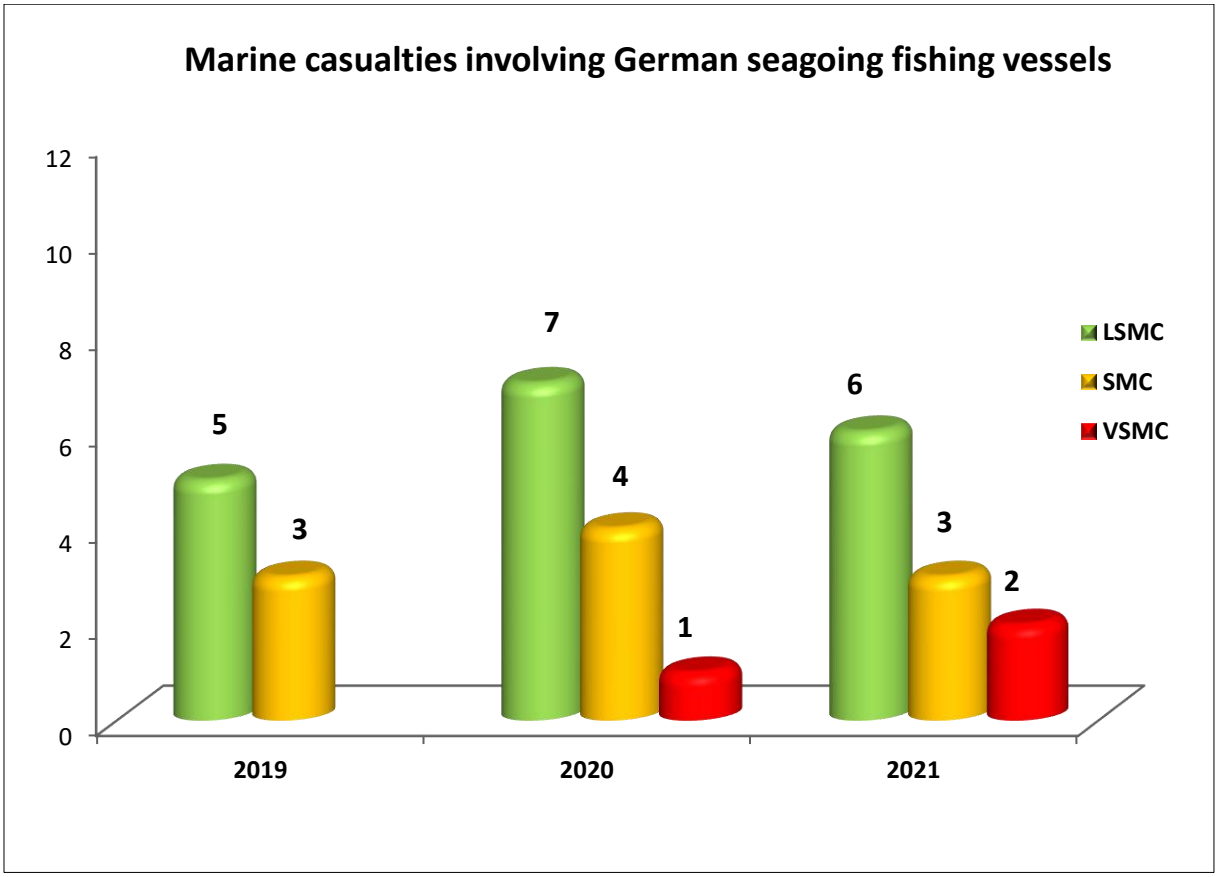
[25] Source: BSH.
[26] Both units were lost, see point 2.4 of this annual report.



Graph 7: Marine casualties on German-flagged merchant ships from 2019 to 2021

There were three more marine casualties on merchant ships flying the German flag in 2021 than in 2019. As already explained, the figures for 2020 are somewhat lower due to the coronavirus pandemic and therefore difficult to use as a comparison. Unfortunately, there was also one fatal accident again. A crew member on board the SEOUL EXPRESS fell from a cargo ladder[27]. However, there has been a sharp drop in the number of SMCs involving merchant ships. As compared to 2019, the figure has fallen by 75% from eight to now two. This is certainly not only due to the contracting merchant fleet, but primarily to increased safety awareness, technical advances and a modern fleet.

[27] See point 2.2 of this annual report.



Graph 8: Marine casualties on German seagoing fishing vessels from 2019 to 2021

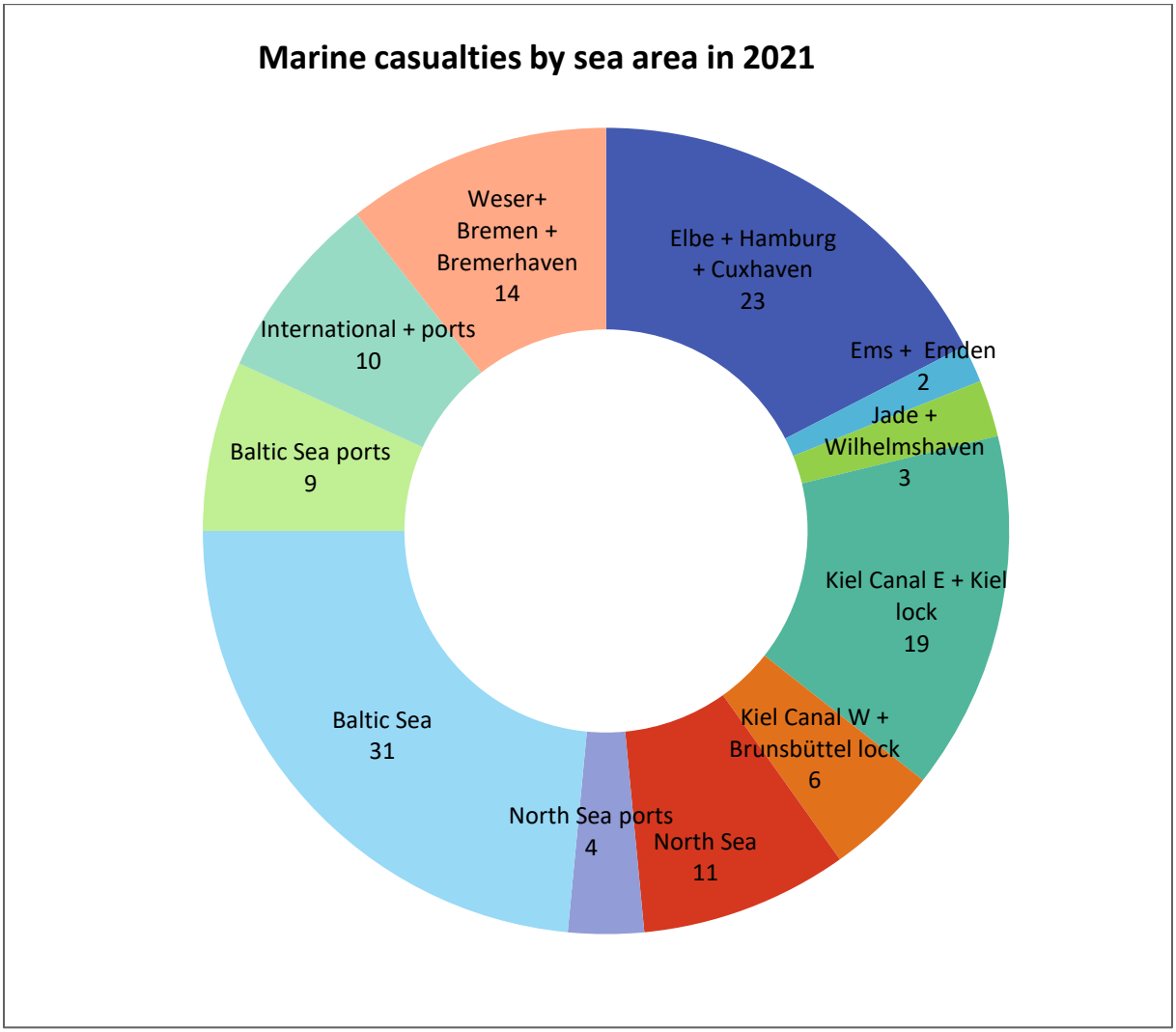
The figures for seagoing fishing vessels must be interpreted differently. Although their total number once more decreased by two units as compared to 2020, the number of accidents remained virtually the same and even increased significantly compared to 2019 – even though there were still 61 units. This may well be related to the ageing fleet. The two vessels that foundered had been in service for more than 50 years and had accidents without outside influence. It is therefore reasonable to assume that the figures will not indicate any change for the better quickly.

6.4 Distribution of marine casualties by sea area

The distribution of marine casualties according to the IMO Code within German sea areas is similar to the previous year. The port of Hamburg and the River Elbe, as well as the Kiel Canal and its locks continue to be the most dangerous places for commercial shipping due to the traffic and the confined fairways. The Baltic Sea leads in terms of figures because of the large number of commercially used (chartered) recreational boats that are involved in an accident, i.e. that usually run aground and

have to be towed free. Although minor, these are marine casualties within the meaning of the regulations because they are used commercially. This is a phenomenon that was already apparent last year and has now been repeated.

It is also important to note that incidents are not listed here because they do not constitute a marine casualty internationally. The far more frequent engine/rudder failures or allisions without ensuing consequences are therefore not shown in these lists. See Section 6.7 for further information.



Graph 9: Distribution of marine casualties by sea area

To make the statistics more meaningful, we have narrowed them down to the locations so as to be able to illustrate exactly where accident black spots exist. For example, it

is evident that accidents on the Kiel Canal do not only occur in the locks, but also on stretches of the canal – but only on the eastern one between Kiel and Breiholz/Rüsterbergen. In all likelihood, this is due to the still incomplete expansion of the eastern stretch, the still outstanding widening and straightening of bends. This problem no longer exists on the western stretch because the expansion has been completed. And anyone who objects, pointing to the fact that much more is happening in the locks at Brunsbüttel, is quite right. However, these are mainly minor events and as such do not count as marine casualties but rather as incidents, which are not recorded here.

There is an accident frequency on the Baltic Sea in the bodden waters off and around Rügen. Rather than merchant shipping, mainly recreational boating (accidents involving charter yachts, as described above) is to be found there.

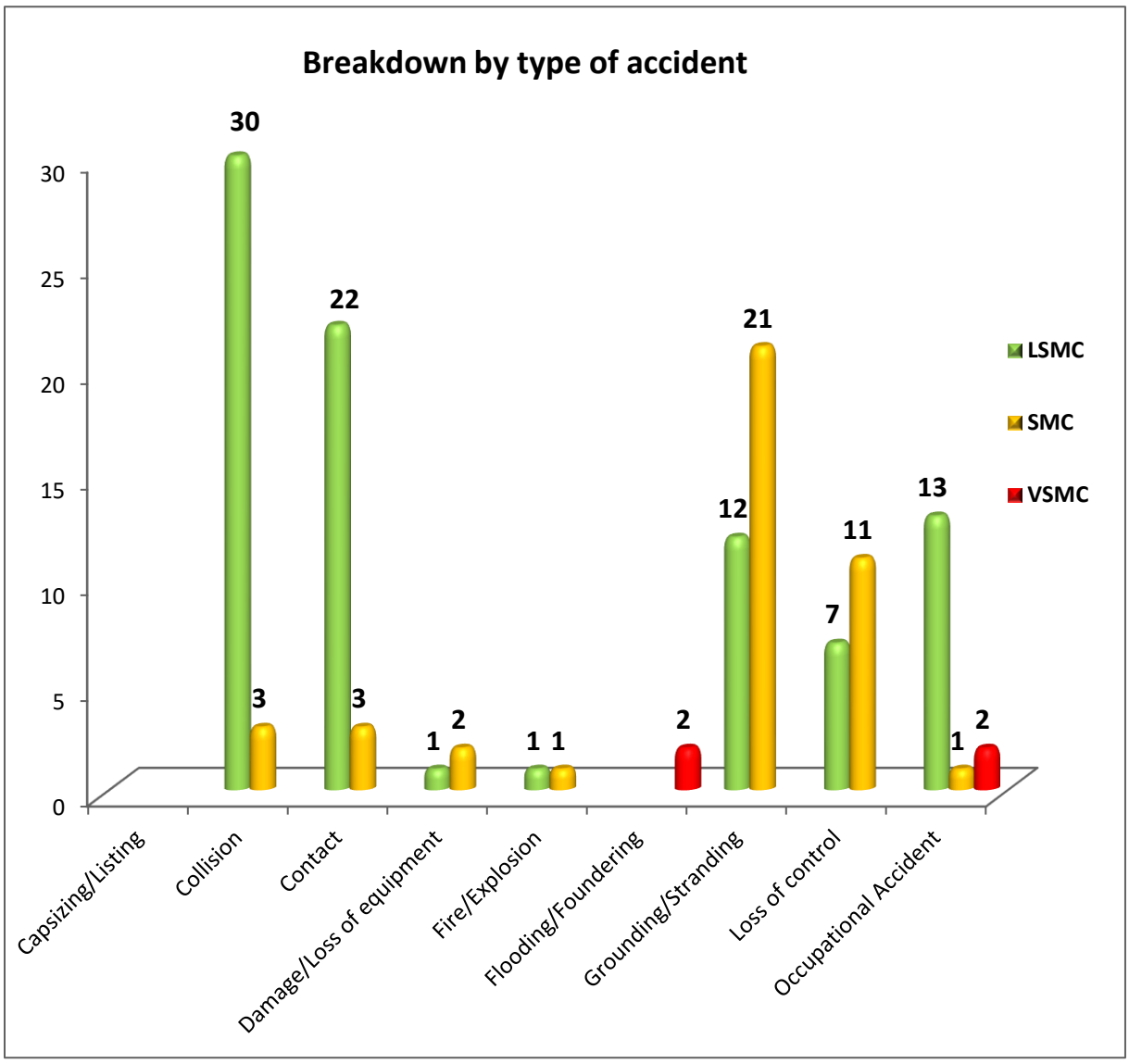
The number of accidents involving German ships in foreign waters or on the high seas also remains low. On the one hand, this is due to the continuous contraction of the German-flagged merchant fleet, but also to a poorly developed reporting culture. If at all, the BSU often receives reports of such accidents only from foreign port authorities, but not from the actual ships.

Graph 10: Distribution by scene of accident (detailed view)[28]

6.5 Distribution by kind of accident and type of ship

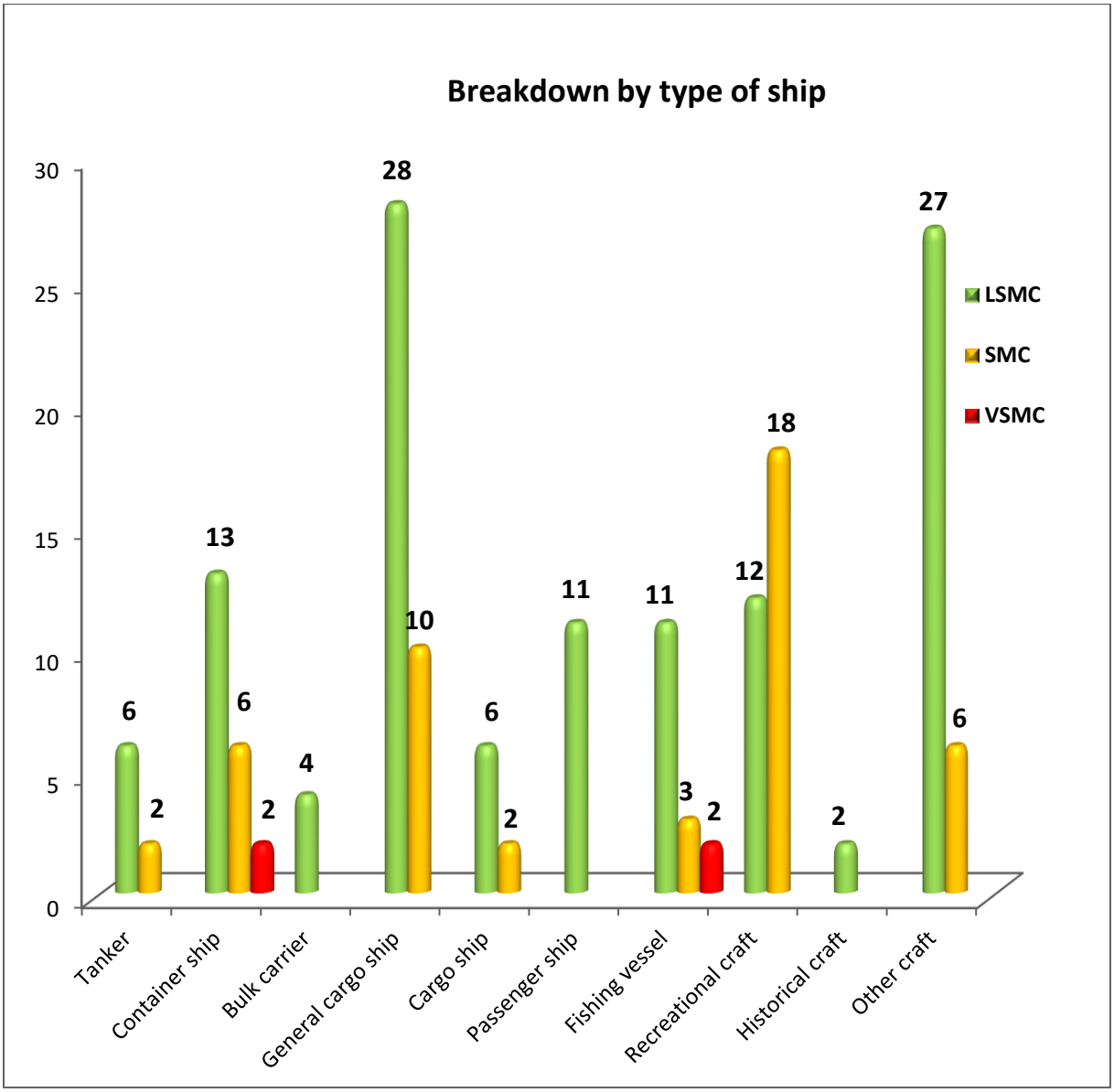
To avoid misunderstandings, the number of accidents was applied again this year rather than the ships involved. However, there have been no major differences in the distribution by kind of accident compared to the last few years.

[28] For better clarity, this chart should be enlarged when viewed.



Graph 11: Distribution by kind of accident

Collisions, followed by allisions with fixed structures or buoys, have always led the statistics. Personnel accidents and fires have remained almost unchanged. However, groundings have increased (chartered recreational boats in the Baltic Sea).



Graph 12: Distribution of accidents by type of ship[29]

To put it casually, general cargo ships once more 'lead the pack' when it comes to distribution by type of ship. They are followed by the other vessels, the commercially used recreational craft and the container ships. 'Others' include seagoing ships covered by the SUG that have yet to be mentioned, such as tugs, pilot boats, offshore supply vessels or others.

[29] Cargo ships are HSC cargo and ro-ro cargo ships.

6.6 Causes of a marine casualty

We now move on to the causes. The BSU does not only classify every accident according to LSMC, SMC or VSMC, but also according to cause. The matrix from the previous year was enhanced and adapted based on the EU's EMCIP database. The following categories are available to the BSU for cause assignment:

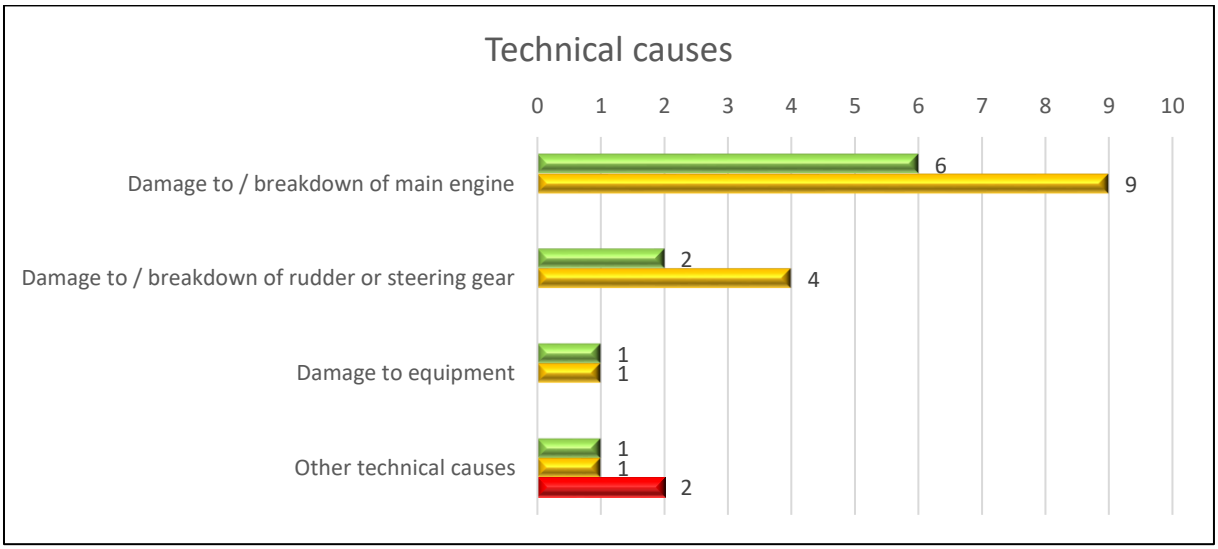
ID	Occurrence/technical – T –
1	Damage to/ breakdown of main engine
1.1	Damage to/ breakdown of auxiliary machinery
1.2	Damage to/ breakdown of electrical equipment
1.3	Damage to/ breakdown due to fuel/bunker issues
2	Damage to/breakdown of rudder or steering gear
2.1	Damage to/breakdown of rudder or steering gear due to failure of auxiliary machinery
2.2	Damage to/breakdown of rudder or steering gear due to failure of electrical equipment
3	Damage to equipment
4	Defective nautical equipment
5	Overall condition of the ship
6	Other technical causes
7	Failure of/defective LSA

ID	Occurrence/ human factor – HF –
1	Error in judgement
2	Improper communication
3	Simple navigational error
4	Poor navigation
5	Misjudgement of right of way
6	Misinterpretation pilot/VTS
7	Under the influence of alcohol
8	Insufficient occupational safety
9	Improper speed
10	Fatigue
11	Operating error
12	Other

ID	Occurrence/Other agent or vessel – AV –
1	Bad weather (as main cause)
2	Swell caused by passing ship
3	Restricted visibility, weather-related or shore-based
4	Ammunition finding

ID	Occurrence / Hazardous material – HM –
1	Leaking gas/smoke
2	Damage to a transport unit
3	Spontaneous ignition of a (dangerous) cargo

The causes may thus be referred to as follows[30]:



Graph 13: Technical causes

As is the case every year, the most common technical cause is damage to the main engine. Damage to the main engine or also to the rudder is often the cause of a SMC for purely statutory reasons and although they usually go unnoticed and are without consequences, they are anything but harmless. By way of example, a breakdown of the main engine causes a ship to run aground, a tug tows the ship back into the fairway and after repairs her voyage continues. Sounds harmless, and in most cases it is but the potential danger can be very high – if the ship cannot be towed free immediately, for example. Due to the low number of cases, a more detailed distinction was not made, especially since the far more frequent breakdowns of the main engine or rudder without further consequences are usually classified as an incident.

[30] No reference means number = 0; the colour scheme is based on the one previously used (green = LSMC, yellow = SMC and red = VSMC).

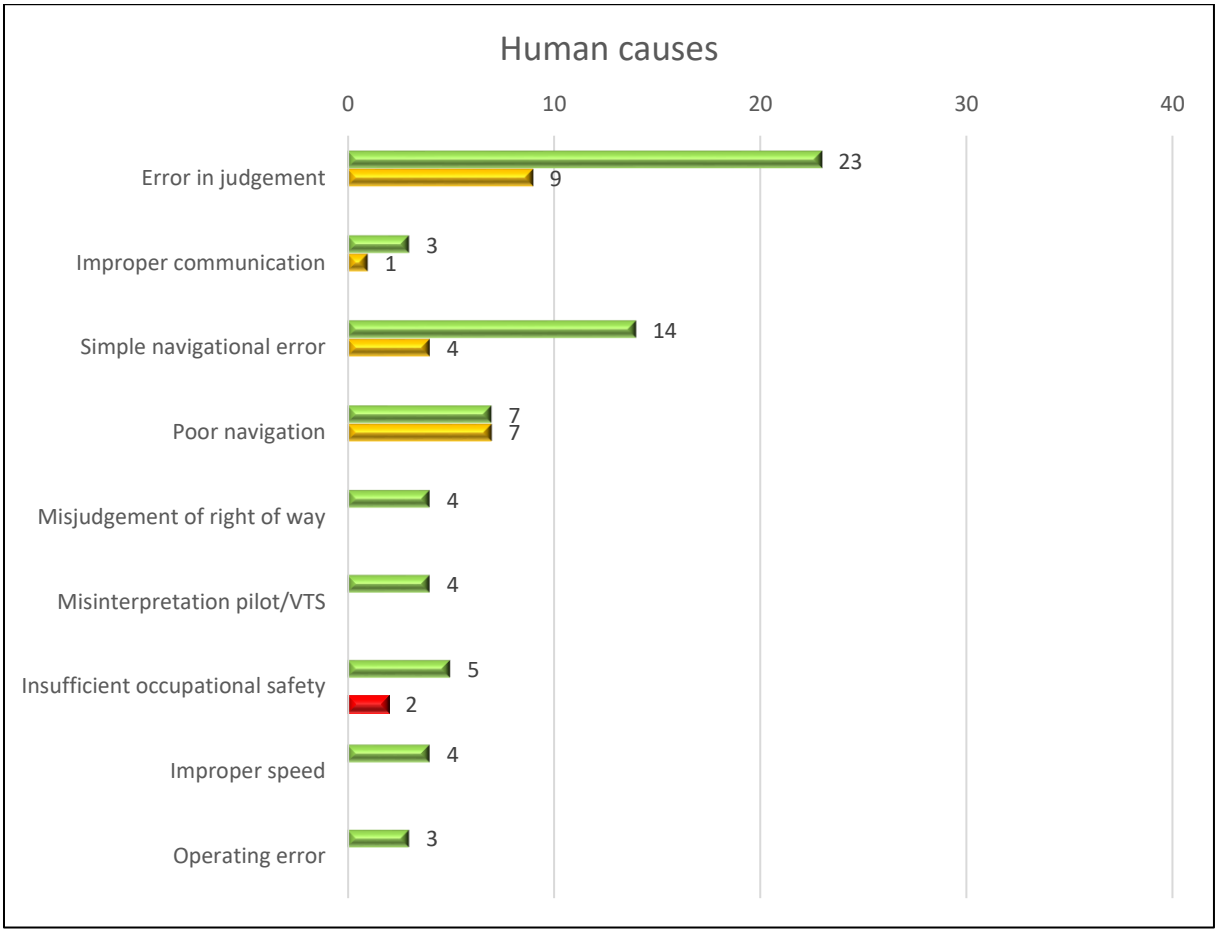


Chart 14: Human causes

Causes attributable to human error have been supplemented by a number of items to produce a better analysis. For example, the typical simple navigational error (putting the rudder to an incorrect angle) is new in order to enable a differentiation from the incorrect assessment of the situation (such as underestimating wind or current, etc.). The operating error is also new. As the name suggests, this involves the occurrence of corresponding consequences (e.g. breakdown of the main engine) after equipment is not operated in the manner intended. Standing at 32 cases, 'Error in judgement' is still dominant. However, 'Simple navigational error', which was not explicitly reported in 2020, also takes up a large share (18 cases) and even led to a SMC in four cases. Remarkable at first glance is the comparatively high figure for navigational errors, i.e. incorrect route planning or selection, which led to serious marine casualties in half the cases (seven out of 14). The chartered sailing yacht phenomenon that has already been discussed is seen here, too (six out of nine cases), which puts the figures into perspective somewhat.

The decisive factor is that human causes (so-called human factor or element) are still predominant in marine casualties, while it is technical causes in the case of incidents, as we will see in a moment. This is due to the fact that in the case of a technical error, humans can often take countermeasures to prevent damage. This is usually no longer possible in the case of a human error, as it takes a certain amount of time for humans to recognise they have made an error and then take the necessary action. In this context, it seems all the more important to have well-developed communication and the principle of multiple control on board.

Finally, and for confirmation, an evaluation of the causes in merchant shipping that led to injuries or even fatalities.

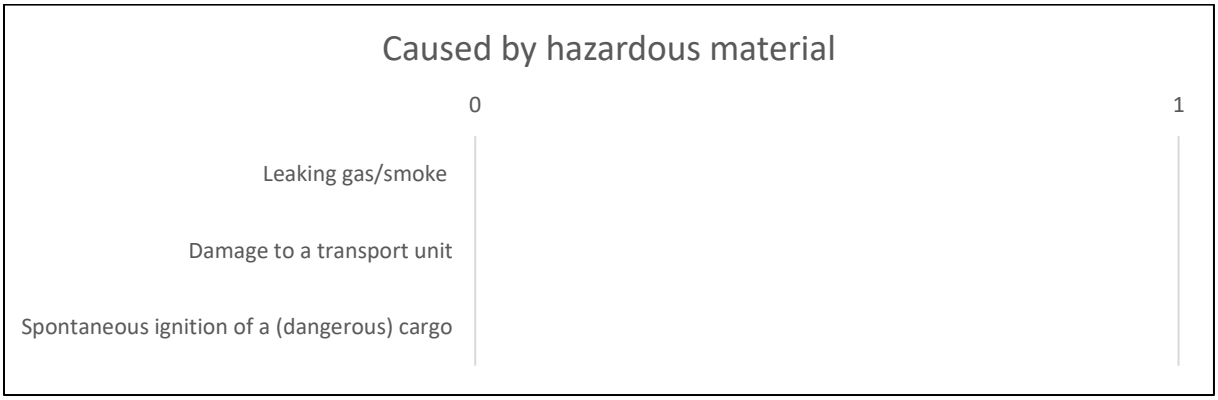
Fatalities and injuries			
	Number of accidents (total)	Accident with subsequent loss of life	Accident with subsequent injuries
Total	**23**	**2**	**21**
of which due to technical causes	2	0	2
of which due to human causes	21	2	19
of which due to insufficient occupational safety	10	2	7[31]

Spreadsheet 5: Causes involving fatalities and injuries

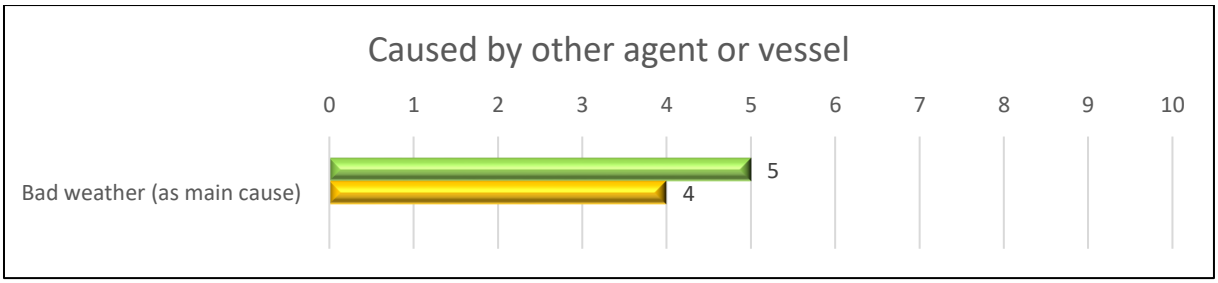
[31] The figure here differs from those for marine casualties according to international regulations due to insufficient occupational safety. However, the two facts are not in agreement. A marine casualty according to IMO regulations is only affirmed if there is an incapacity to work for at least 72 hours, while an injury is always affirmed if there was a physical impairment.

It becomes clear that human factors are usually decisive for an accident situation here, too. It should also be noted that half of the accidents involving personal injury – and actually all the fatal accidents in 2021 – in merchant shipping are due to insufficient occupational safety. However, this is a broad field, which includes, for example, a lack of protective equipment, faulty procedures on board/in a company or also inadequate instruction, which have had a causal effect on an accident.

The following analyses are new and, as explained above, due to the switch to the European list of causes. Only the cause 'Bad weather' is relevant here (so far). However, the analyses should be inserted in full for the sake of completeness.



Graph 15: Accidents caused by hazardous material

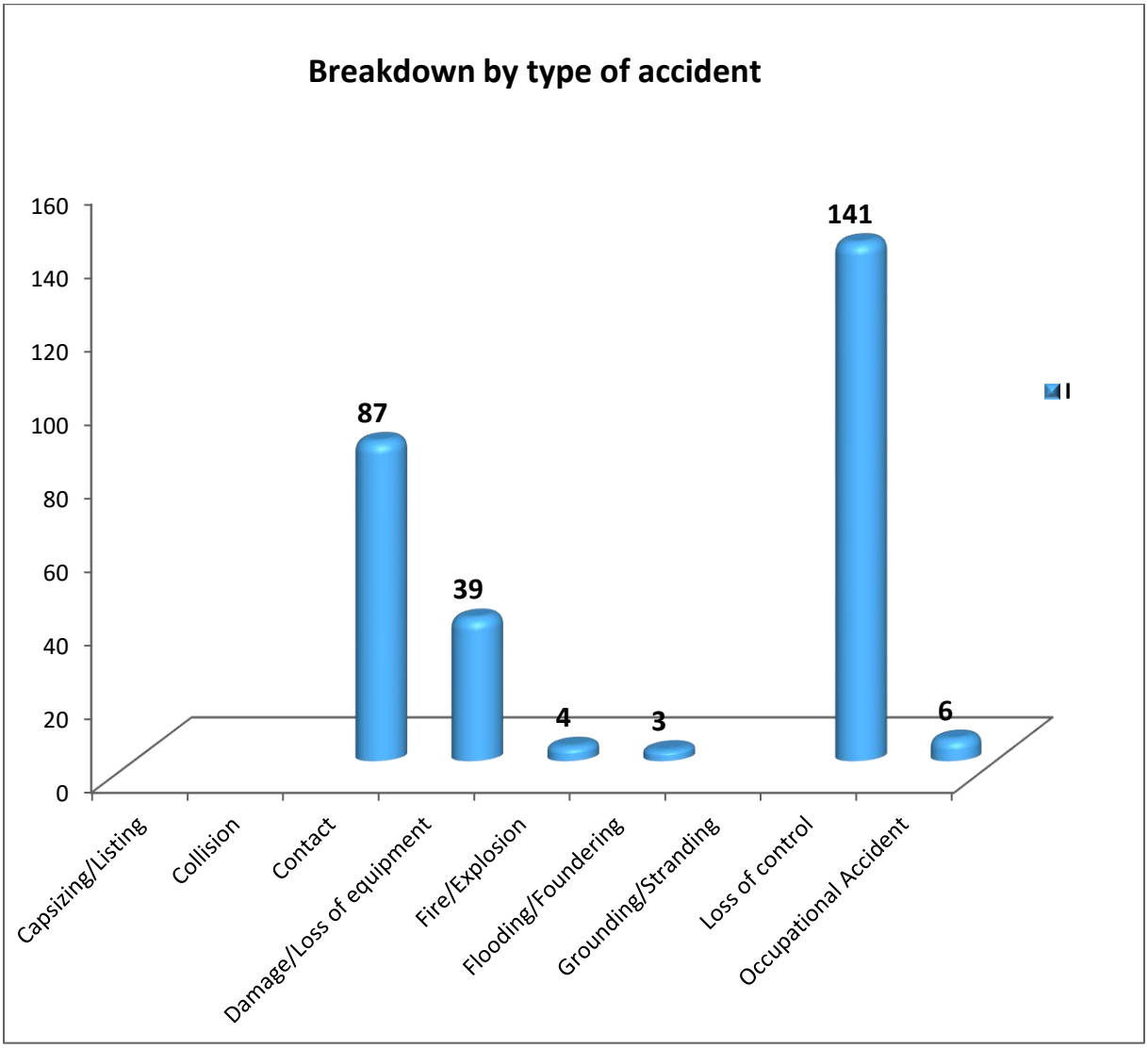


Graph 16: Other agent or vessel

Graph 17: Cause unknown

6.7 Incidents

Although it is inherent in incidents that their consequences are not serious, they also pose a threat to safety at sea. They are the cases that appear in the BSU's reporting list by far the most frequently. This remains the case in 2021. There were 280 incidents in the past year, i.e. far more than twice as many as all other marine casualties combined. Overall, they account for 42% of all notifications and 68% of notifications in the jurisdiction of BSU. The causes are manifold here, too, albeit significantly different because it is the technical causes that are predominant, as the below summaries will show.



Graph 18: Distribution of incidents by kind of accident

Damage to the main engine or to the rudder, which usually has no consequences and, by definition, is therefore not a marine casualty according to international regulations, is the most common kind of incident. The same applies to allisions, i.e. contacts or other minor damage, which are also strongly represented. The loss of equipment, where the anchor usually goes overboard, is significant, either. Other kinds of incidents are negligible as they are, by definition, mainly a marine casualty or substantial damage, which 'promotes' the incident to a marine casualty, has been caused.

As with accidents, the BSU distinguishes between technical errors and human errors in the causes of an incident. They can be summarised as follows:

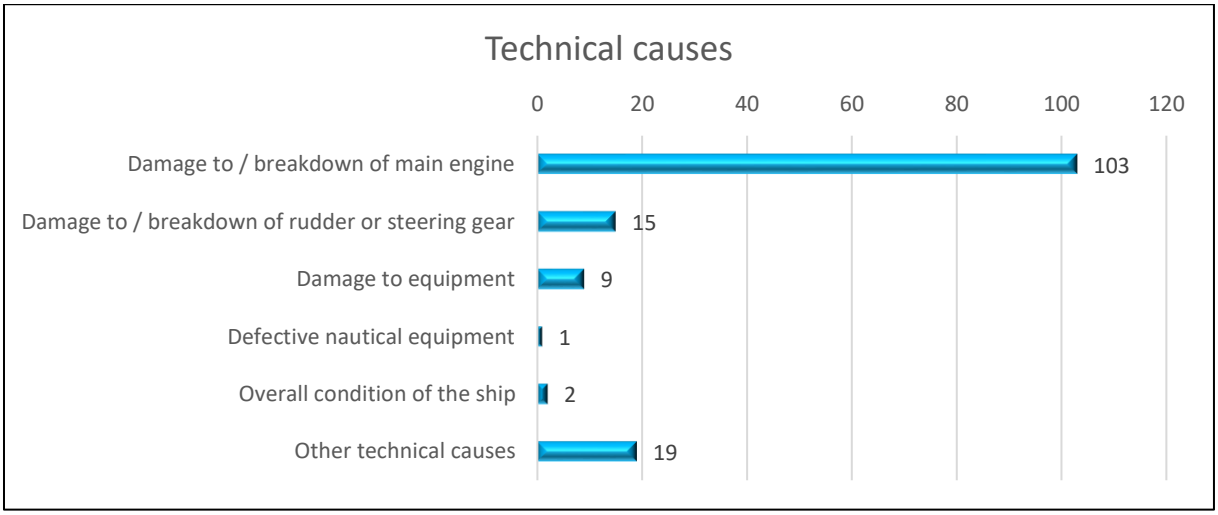
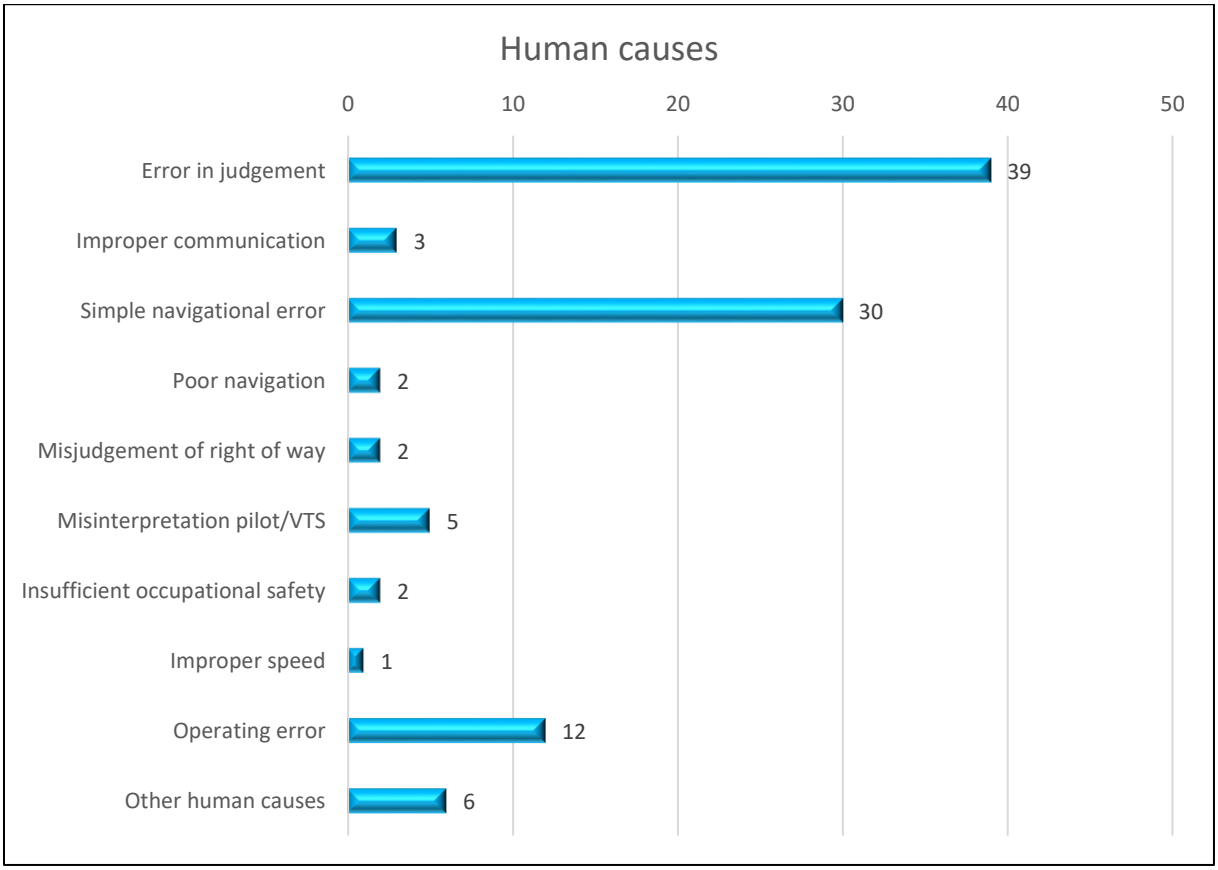
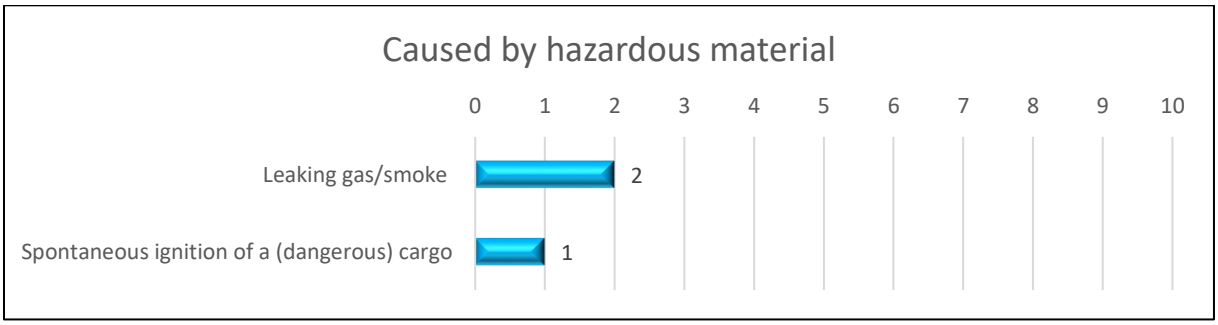


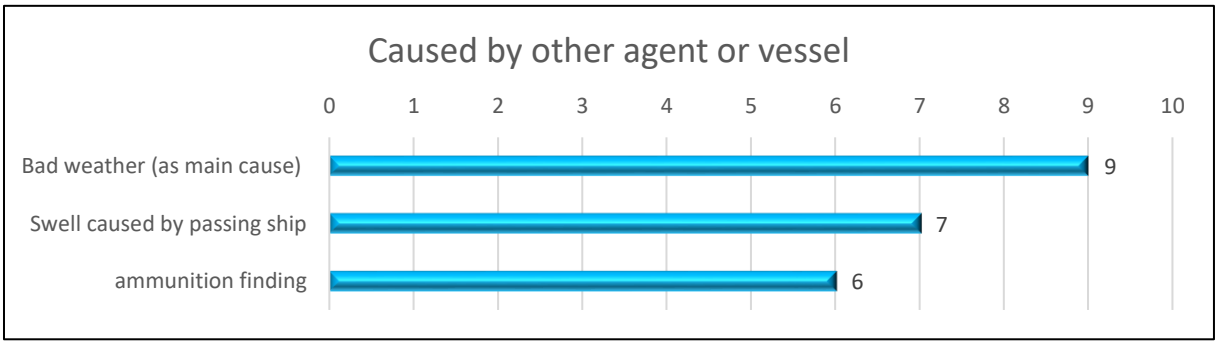
Chart 19: Technical causes in incidents



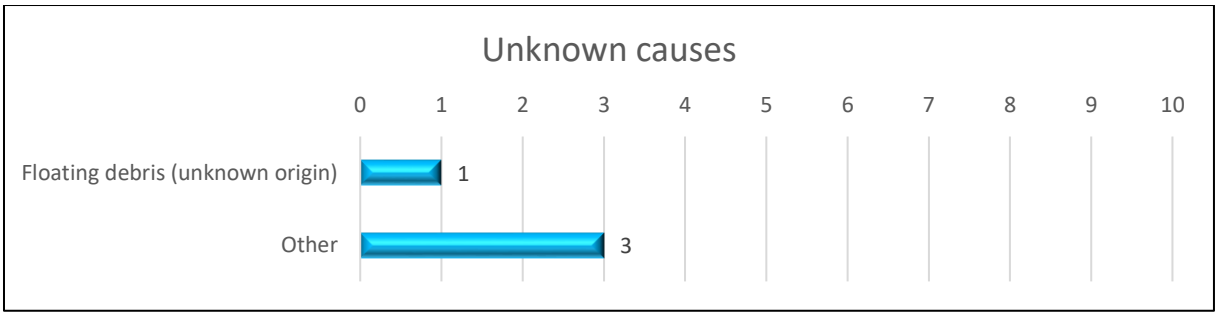
Graph 20: Human cause in incidents



Graph 21: Accidents caused by hazardous material



Graph 22: Other agent or vessel



Graph 23: Unknown cause

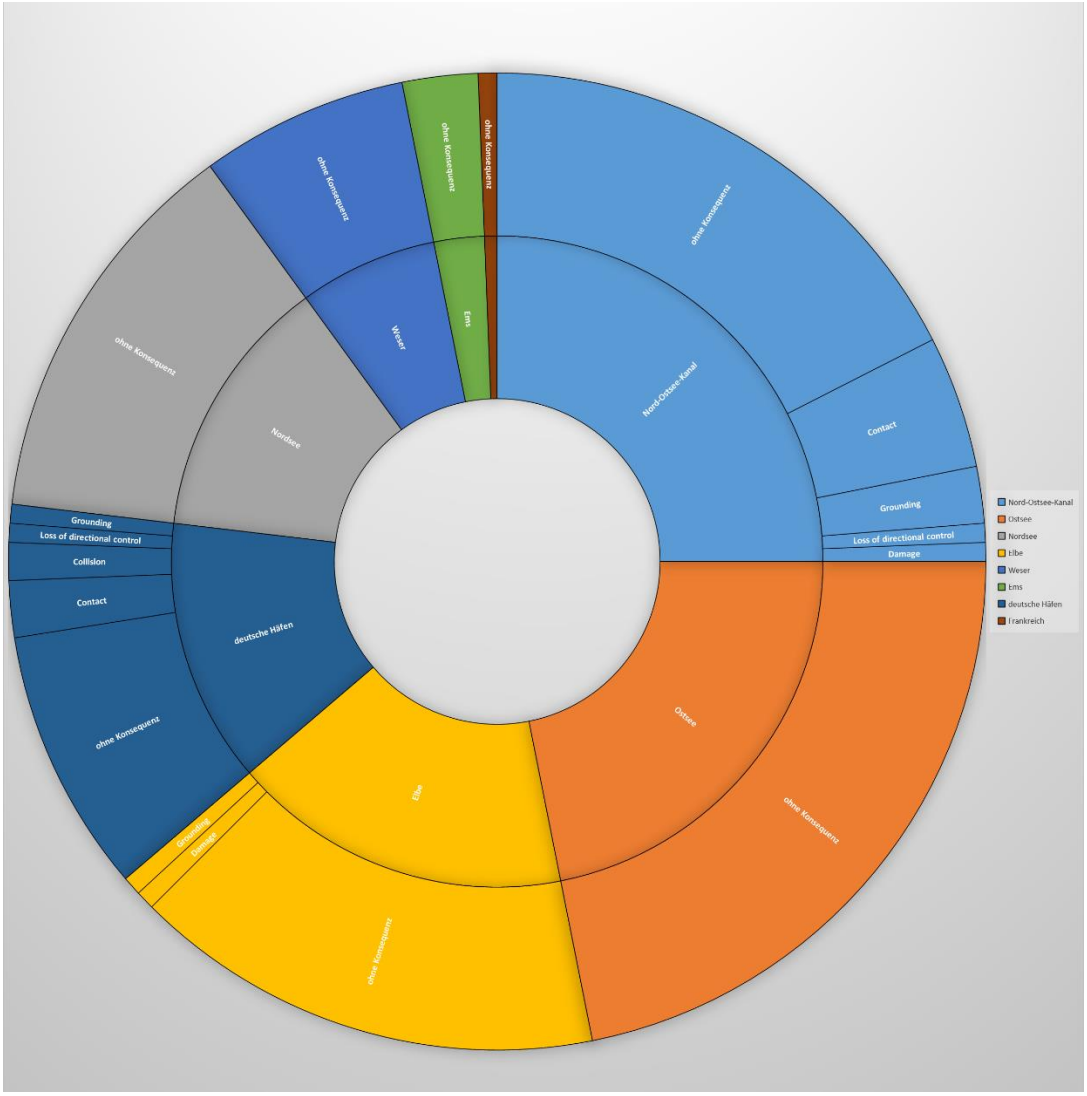
Breakdowns of the main engine or of the rudder, blackouts or misfires (118 cases, representing 41% of all incidents) are the predominant causes in incidents. The damage can usually be quickly repaired while the ship is anchored in a roadstead or drifting and the voyage then continues. Overall, the ratio between the human and the technical causes is one to two in incidents. Added to this are the 'Other' causes (especially bad weather, swell, or the intrinsically dangerous ammunition finding), however.

6.8 Consequences of an accident

The particular structure of EMCIP makes it possible to establish many more links between accidents and to better evaluate the consequences of an accident, or rather the consequences of an initial 'Accident event'. To illustrate this and by way of example, the breakdown of a main engine leads to a grounding, which leads to damage below the waterline from which pollutants escape, which in turn leads to pollution. Alternatively, a fire leads to serious injuries to crew members, etc.

In particular, it is the breakdowns of a main engine or of a rudder (i.e. the loss of control of the ship) that can be linked to the scene of the accident which merit a closer look. The following graph shows accident consequences by location. Not surprisingly, it can be seen clearly that accidents in places where a ship has sufficient room to wait or drift and thus for repairs to be carried out – the North Sea, the Baltic Sea and their roadsteads – have no further consequences. However, in locations where space is confined and limited and there is no time or room to manoeuvre, the consequences

can be severe and materialise extremely quickly. This is especially evident in the Kiel Canal or in actual ports, where nearly one loss of control event out of three has further consequences, such as contact, collision or grounding.



Graph 24: The consequences of a loss of control event by scene of accident[32]

[32] This chart should be enlarged when viewed.

6.9 Investigation reports published and lessons learned

It is appropriate to close the statistics section and thus also this annual report with the summaries of the published investigation reports (including interim), the lessons learned, and those reports of foreign marine safety investigation authorities where the BSU played a major role in the associated investigation and reference was explicitly made to their publication.

The BSU published 11 investigation reports in 2021. They include three interim reports *(in italics)*.

No.	Published on	Report number	Description of accident
1	01/02/2021	20/20	Fatal person-overboard accident involving a crew member of the fishing vessel HELEN MARY in the North Atlantic on 30 January 2020
2	23/03/2021	415/19	Failure of a head line on the chemical tanker THEMSESTERN in the Kiel-Holtenau lock on the Kiel Canal on 30 November 2019 with three linesmen slightly injured
3	02/06/2021	211/19	Collision between traditional vessel № 5 ELBE and container vessel ASTROSPRINTER on the River Elbe on 8 June 2019
4	01/07/2021	74/20	Catamaran SEEWIND I suddenly pitches into a wave in the North Sea with ensuing physical injuries and damage on 3 July 2020
5	*06/07/2021*	*236/20*	*Fire in the main engine's scavenging air duct on board the EBBA MAERSK on 29 July 2020*
6	27/07/2021	338/19	Fire in the engine room on board the multi-purpose carrier KELLY with one deceased and two injured crew members on the River Elbe on 6 September 2019
7	*26/08/2021*	*282/20*	*Grounding of the RUBINA after steering gear failure on the River Weser on 27 August 2020*

8	*27/08/2021*	*285/20*	*Allision between the multi-purpose vessel ELSE and a lock gate on the Kiel Canal in Kiel-Holtenau on 29 August 2020*
9	14/09/2021	452/19	Personnel accident with subsequent loss of life on board the SAJIR in the roadstead off Ningbo (China) on 19 December 2019
10	25/11/2021	405/20	Allision with a quay wall by the tanker NORTHSEA RATIONAL in Hamburg on 25 November 2020
11	21/12/2021	23/20	Cargo-related accident (loss of two mobile cranes) on the JUMBO VISION at her berth in the port of Rostock on 31 January 2020

Spreadsheet 6: Investigation reports published by the BSU in 2021

The BSU played a major role in the following investigations of foreign marine safety investigation authorities, for which reports have since been published:

No.	**Marine safety investigation Authority**	**Date**	**Description of accident**
1	DMAIB[33]	May 2021	Personnel accident with subsequent loss of life on board the SANTA CLARA in the Outer Weser
2	SMAIC[34]	June 2021	Foundering of the sailing yacht SHARKY on the Outer Elbe

Spreadsheet 7: Reports of foreign marine safety investigation authorities involving the BSU

[33] Danish Maritime Accident Investigation Board (Denmark), report published in German on the BSU website.
[34] State Maritime Accident Investigation Commission (Poland), still pending publication in German language.

The BSU also published three lessons learned:

Serial number	Date	Kind of accident	Description of accident
7	20/01/2021	Personnel accidents	Three people fell from a ship's pilot ladder on different days at the pilot transfer station on the Kiel Canal in Germany
8	24/06/2021	Line accident	Failure of a head line with injured linesmen in a building near the quay wall
9	08/12/2021	Personnel accident	Death of a crew member after falling from a height in the cargo hold

Spreadsheet 8: Lessons learned