SMAIC
STATE MARINE ACCIDENT INVESTIGATION COMMISSION

ANNUAL ANALYSIS

2017

MARINE CASUALTIES AND INCIDENTS

The Contents

1. Introduction

State Marine Accident Investigation Commission (SMAIC) established by the Act of 31 August 2012 on State Marine Accident Investigation Commission (Journal of Laws of 2012, item 1068 and of 2015 item 1320) commenced operations in May 2013 upon the appointment by the Minister of Transport, Construction and Maritime Economy of a third one of the statutory five members of the Commission.

The investigation of marine casualties and incidents has been conducted by the Commission under the act and the Code of International Standards and Recommended Practices for the Investigation of Marine Casualties and Incidents (Casualty Investigation Code) adopted by the Maritime Safety Committee (MSC) of the International Maritime Organisation (IMO).

The purpose of the investigation of a marine casualty or incident is to determine its causes and circumstances in the prevention of marine casualties and incidents in the future and to improve State of the safety at sea.

In the course of investigation the Commission does not determine liability nor apportion blame to persons involved in the marine casualty or incident and the investigation reports shall be inadmissible in any judicial or other proceedings whose purpose is to attribute blame or liability for the casualty referred to in the report. It means that none of the organs adjudicating in such proceedings can refer to the information included in the report of the Commission.

The Commission is required by law to investigate each very serious and serious casualty.

A very serious marine casualty is an accident that resulted in total loss of a vessel, a human death or a severe damage to the environment. A serious marine casualty is an accident that results, among others, in the damage to the propulsion of a vessel, extensive damage to the superstructure, changes in the vessel's stability, a damage to the underwater part of the hull causing the vessel to pose a threat to the safety of persons or the environment, making it unsuitable for continuing the journey. A serious casualty is also the one that causes damage to the environment, including pollution or a failure resulting in the need to tow the vessel or to apply help from the land.

In the event of a serious marine casualty the Commission may discontinue the investigation after a preliminary assessment of the reasons for its occurrence. In the event of a less serious marine casualty or marine incident, the Commission decides to undertake the investigation or to desist from it. When making the decision the Commission shall take into account the gravity

of the occurrence, the type of a vessel or cargo, and whether the results of the investigation shall contribute to the prevention of marine casualties and incidents in the future.

The Commission investigates marine casualties and incidents involving vessels of Polish affiliation, and vessels with foreign affiliation - if the casualty has occurred on Polish internal waters or territorial sea. The Commission is obliged to undertake the investigation in relation to which Poland is a seriously interested state, i.e. in a case in which Polish sailors died in the casualty.

It should be emphasized that after the SMAIC has received a notification about the casualty involving vessels in any way, a WIM Card is made (marine casualty/incident information card) with serial number containing basic data about the event.

In each case, the Commission undertakes actions necessary to make a preliminary assessment of the causes of the casualty, and based on the collected materials, under the above mentioned legal acts, takes the decision not to investigate, to withdraw from the investigation or to continue it.

2. Information about the Commission

In 2017, State Marine Accident Investigation Commission (SMAIC) was working in the following composition:

Od 01.01.2017 r. do 01.07.2017 r.

Master Mariner Cezary Łuczywek – the Chairman of the Commission

Master Mariner Marek Szymankiewicz – the Secretary of the Commission

Master Mariner Krzysztof Kuropieska – the Member of the Commission

Since 01.07.2017 the following persons has been working in the Commission: Master Mariner Eugeniusz Chodań as the Vice-Chairman and since 01.08.2017 as the Chairman and since 01.07.2017 Chief Engineer Zbigniew Łosiewicz as the Member of the Commission.

On 31.07.2017 the former Chairman, Master Mariner Cezary Łuczywek terminated his work in the Commission.

Since 01.08.2017 the SMAIC has been operating in the following composition:

Master Mariner Eugeniusz Chodań – the Chairman of the Commission

Master Mariner. Marek Szymankiewicz – the Secretary of the Commission

Master Mariner Krzysztof Kuropieska – the Member of the Commission

Chief Engineer Zbigniew Łosiewicz – the Member of the Commission

State Marine Accident Investigation Commission is an independent body. It acts at the minister competent for the maritime economy but it is not a section of the Ministry of the Maritime Economy and Inland Navigation.

Since 01.06.2017 Szczecin has been the seat of the Commission (Order No 12 of the Minister of Maritime Economy and Inland Navigation of 15 March 2017).

The mailing address and contact data of the Commission are the following:

Pl. Stefana Batorego 4, 70-207 Szczecin
Tel. (landline) 91 44 03 290, (mobile) 664 987 987
e-mail: pkbwm@mgm.gov.pl
www.pkbwm.gov.pl

3. Number of notifications about marine casualties and incidents and number of initiated investigations

In 2017, the Commission was notified of 114 marine casualties and incidents in which 120 vessels participated (i.e. 119 vessels and one floating dock).

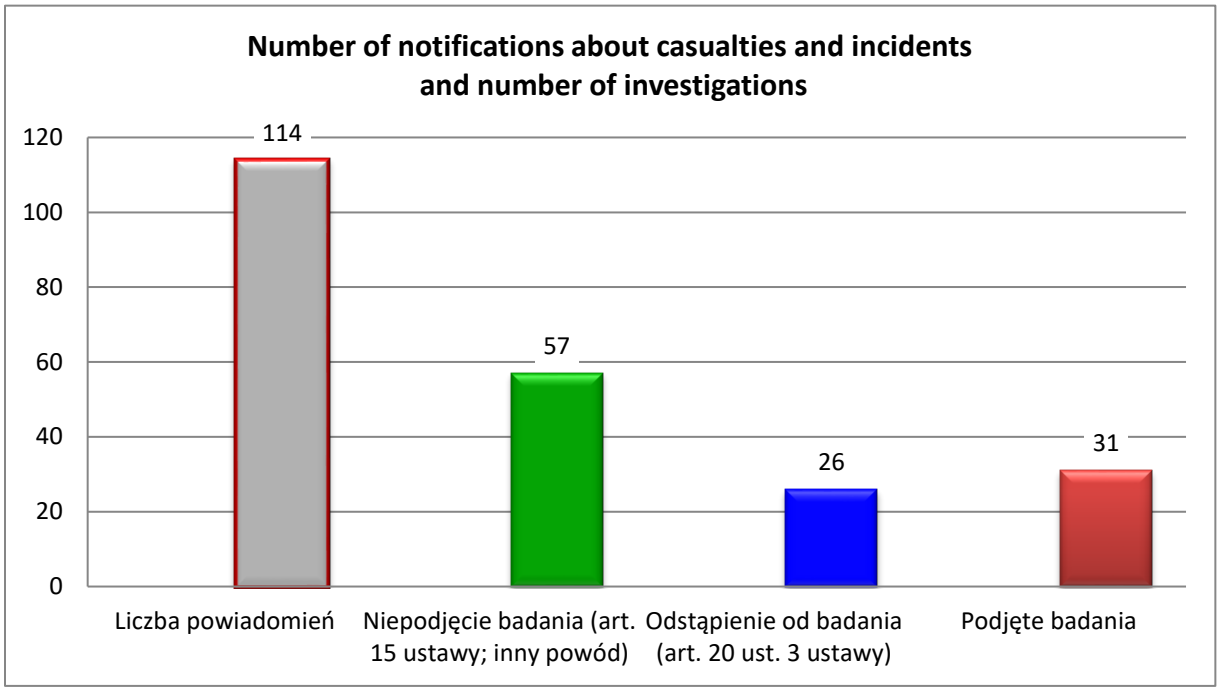


Figure 1: Number of notifications about casualties and incidents and number of investigations in 2017

Chart 1: From the left side of the chart:
Number of notifications
Investigations not initiated (art. 15 of the act; other reason)
Investigations renounced (art. 20 par. 3 of the act)
Investigations initiated

Following the initial analysis of the collected materials the Commission did not undertake the investigation in 57 cases, among which there were cases in which the Commission considered that the event referred to by the Commission did not meet the criteria of a marine casualty contained in its definition in the Act on the SMAIC as well as cases in which the accident was not investigated by the Commission as it was not a very serious casualty and was either involving a vessel serving only a special state service or operated by the State for non-

commercial purposes, or a small fishing vessel (up to 15 m), or recreational yacht i.e. vessels excluded from the investigation pursuant to art. 15.2.2 of the Act on the SMAIC (Figure 1).

Considering such factors as the gravity of the occurrence, the type of a vessel or carried cargo, the Commission renounced the investigation in 26 cases (renouncement of the investigation – Article 20 Paragraph 3 of the Act) recognizing that the results of the investigation would not contribute to prevention of similar marine casualties and incidents in the future.

In the remaining 31 cases, the Commission initiated the investigation.

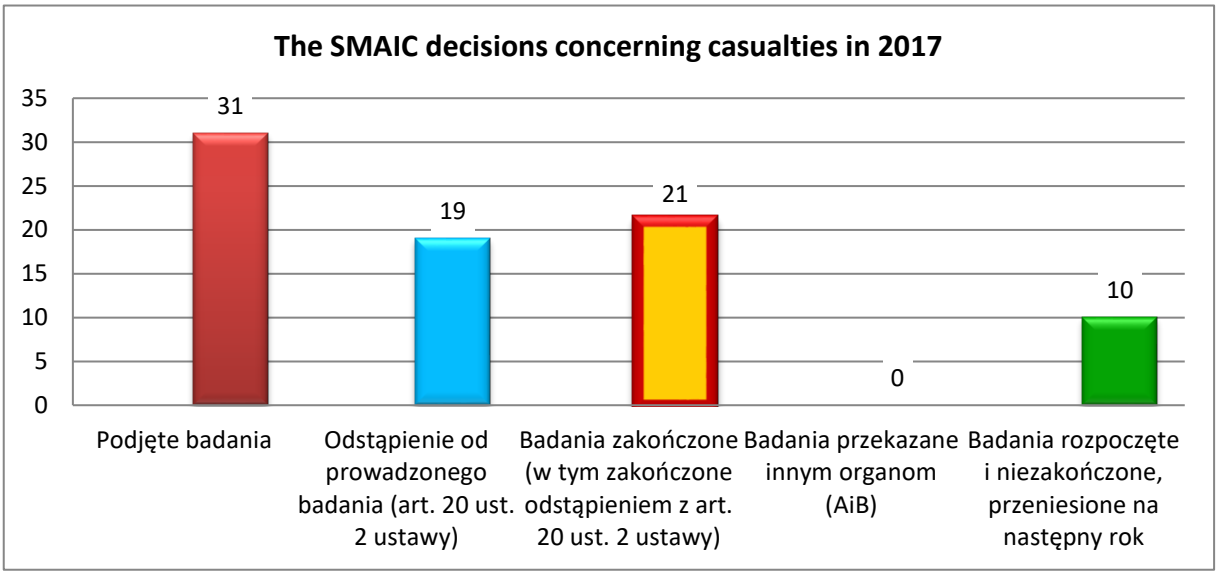


Figure 2: The SMAIC decisions concerning casualties in 2017

Chart 2: From the left side of the chart:

Investigations started

Investigations renounced (art. 20 par. 2 of the act)

Investigations completed (including those renounced under art. 20 par. 2 of the act)

Investigations transferred to other organs (AiB)

Investigations unfinished, transferred to the following year

After making the initial assessment of the causes of each of these 31 cases, in 19 cases the Commission decided to withdraw from the investigation recognizing that further examination would not contribute to the improvement of the safety at sea. These investigations were considered completed by the Commission. In one case (a very serious case of damaging and sinking of the sailing yacht, *Regina R* at the Pacific Ocean) the Commission completed the

investigation and published the final report. In one case (a serious marine casualty of damaging the main switchboard (MSB) in the engine room of the container carrier, *Enforcer* in Gdynia) The Commission completed the investigation and published a simplified report. In the remaining 10 cases the Commission decided to continue investigations (Figure 2).

4. Number of investigations completed in 2015 and number of published reports

In 2017 the Commission completed 17 investigations and published 2 simplified reports (a very serious marine casualty of damage to the main switchboard (MSB) in the engine room of the container carrier, *Enforcer* in the port of Gdynia in 2017, a marine casualty of collision of the tug, *Virtus* with a vessel, *Bomar Victory* on the fairway to DCT in Gdańsk in 2015) and 15 final reports. Investigations completed with final reports concerned 8 casualties that occurred in 2016, 6 casualties that occurred in 2015 and, in one case, in 2014.

The published final reports refer to the following:

- a marine casualty WIM 44/16 of poisoning 8 people with hydrogen sulphide during unloading of fish on a fishing boat, *KOŁ-288* in the port of Kołobrzeg,
- a very serious marine casualty WIM 23/16 of falling overboard a fishing boat *KOŁ-28* and the death of a crew member in a fishery in the Baltic Sea,
- a very serious marine casualty WIM 22/16 of fire and sinking of a sailing yacht, *Miracle* in the Atlantic Ocean,
- a very serious marine casualty WIM 90/16 of falling from the stairs and death of a chief engineer on the tugboat, *Ikar*,
- a very serious marine casualty WIM 84/16 of the death of a crew member during the operation of closing the cargo hatches on a general cargo vessel, *Daan*,
- a very serious marine casualty WIM 72/16 of capsizing and sinking of a sailing yacht, *Perła Gdynia* in the Indian Ocean,
- a very serious marine casualty WIM 76/16 of fire and sinking of a sailing yacht, *Sunrise* in the Baltic Sea,
- a serious marine casualty WIM 23/16 of fire on a truck on the car deck of a passenger and car ferry, *Stena Spirit* at the approach to the port of Gdynia (photographs No 4, 5, 6, 7),

- a very serious marine casualty WIM 46/15 of fire of a tugboat, *Zeus* during a stop in the port of Sölvesborg (photographs No 1, 2, 3),
- a very serious marine casualty WIM 34/15 of falling overboard and drowning of the master of a sailing yacht, *Quark* during the regatta in the Baltic Sea,
- A serious marine casualty WIM 22/15 of collision of a tug, *Virtus* with the vessel, *Bomar Victory*, on the fairway to DCT,
- a very serious marine casualty WIM 50/15 of overturning by a wave of a sailing yacht, *Alboran XIX Sabor* and drowning of two people,
- a very serious marine casualty WIM 49/15 of falling overboard and drowning of the master of a sailing yacht, *Zita*,
- a very serious marine casualty WIM 39/15 of the damage of the sheathing of a vessel's hull and fuel spill while docking a vessel, *Green Egersund* in the port of Gdynia,
- a very serious marine casualty WIM 49/14 of sinking in the Atlantic of a sailing yacht, *Prodigy*.

The Commission started working on 8 reports on investigations of casualties from 2016 and continued works on 6 casualty reports from 2015 and one from 2014.

The status of investigations carried out in 2017 is shown in the Figure 3.

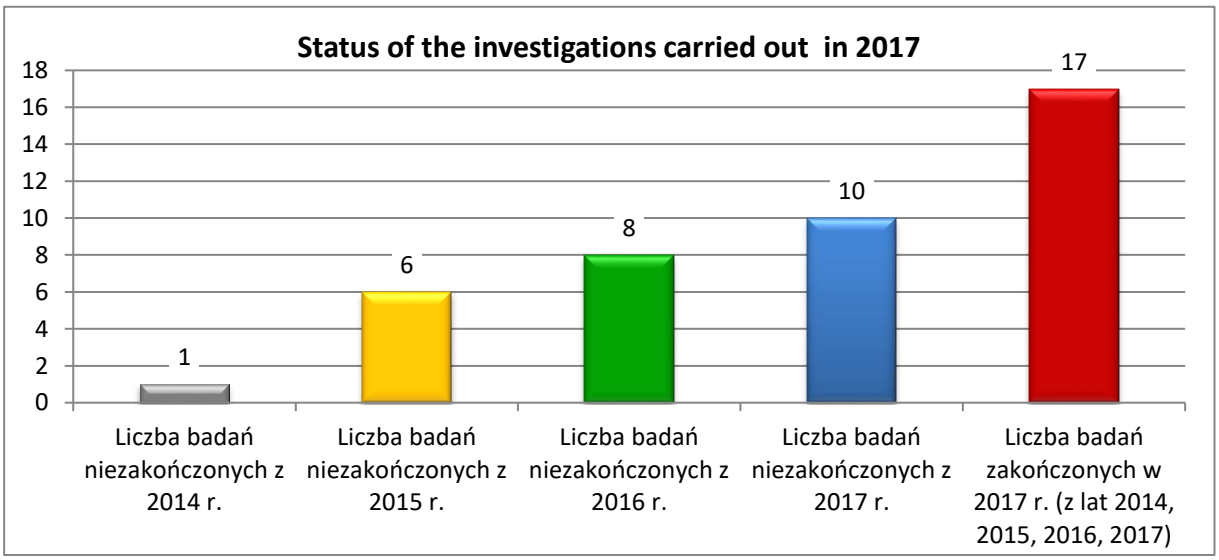


Figure 3: Status of the investigations carried out in 2017

Chart 3: From the left side of the chart:

Unfinished investigations of 2014

Unfinished investigations of 2015

Unfinished investigations of 2016

Unfinished investigations of 2017

Investigations finished in 2017 (of 2014, 2015, 2016, 2017)

Resolutions regarding the status of the investigations are found on the SMAIC website. Types of reports developed by the SMAIC in 2017 are presented in the Figure 4.

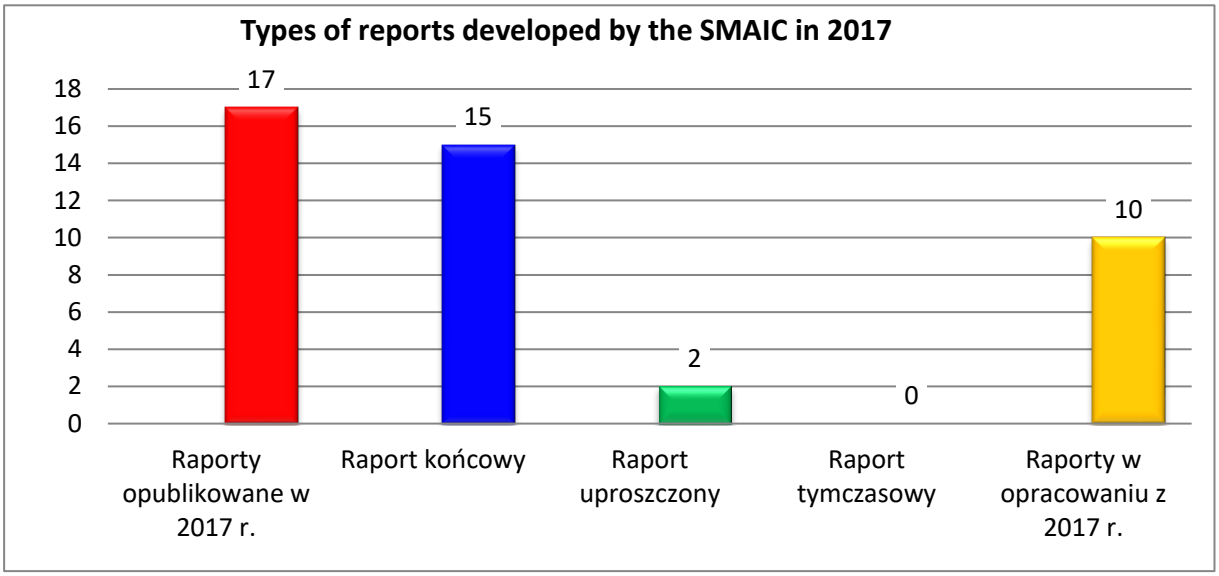


Figure 4: Types of reports developed by the SMAIC in 2017

Chart 4: From the left side of the chart:

Reports published in 2017

Final report

Simplified report

Interim report

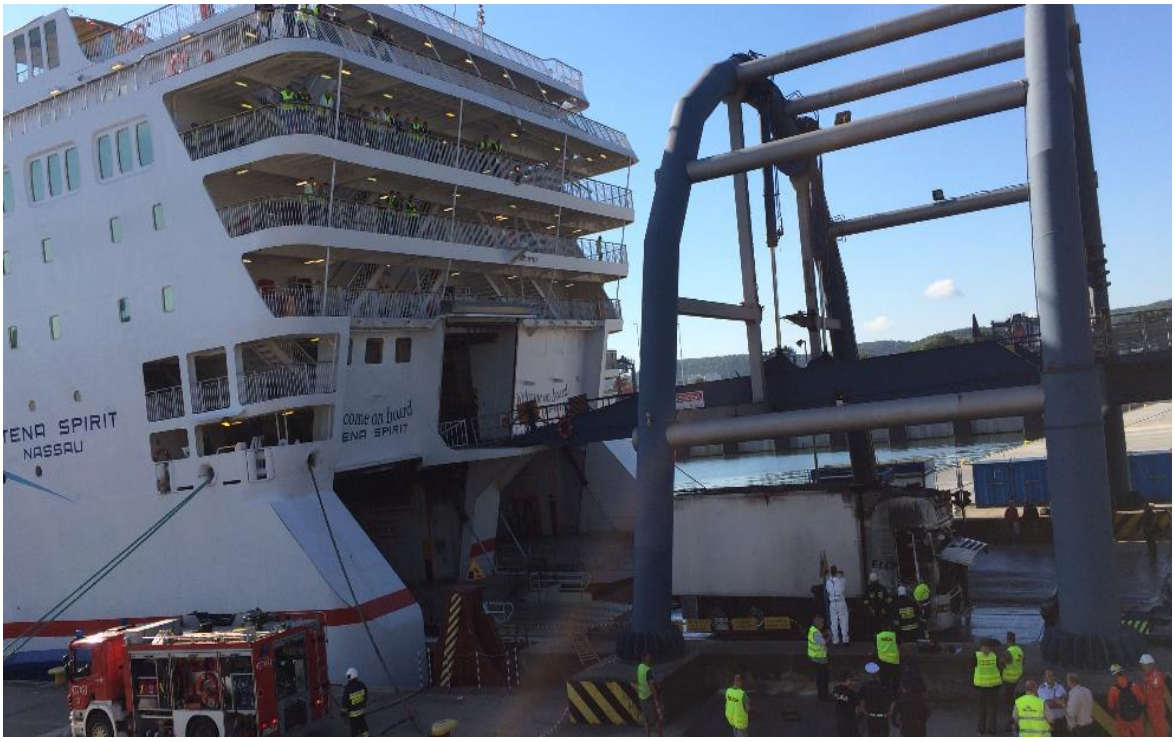
Reports from 2017 under way

Photographs related to exemplary casualties whose investigations results were published by the SMAIC in the reports are presented below.

Photograph 1: Fire on a tugboat, "Zeus" (WIM 46/15)

Photograph 2:Fire on the tug, "Zeus" (WIM 46/15)

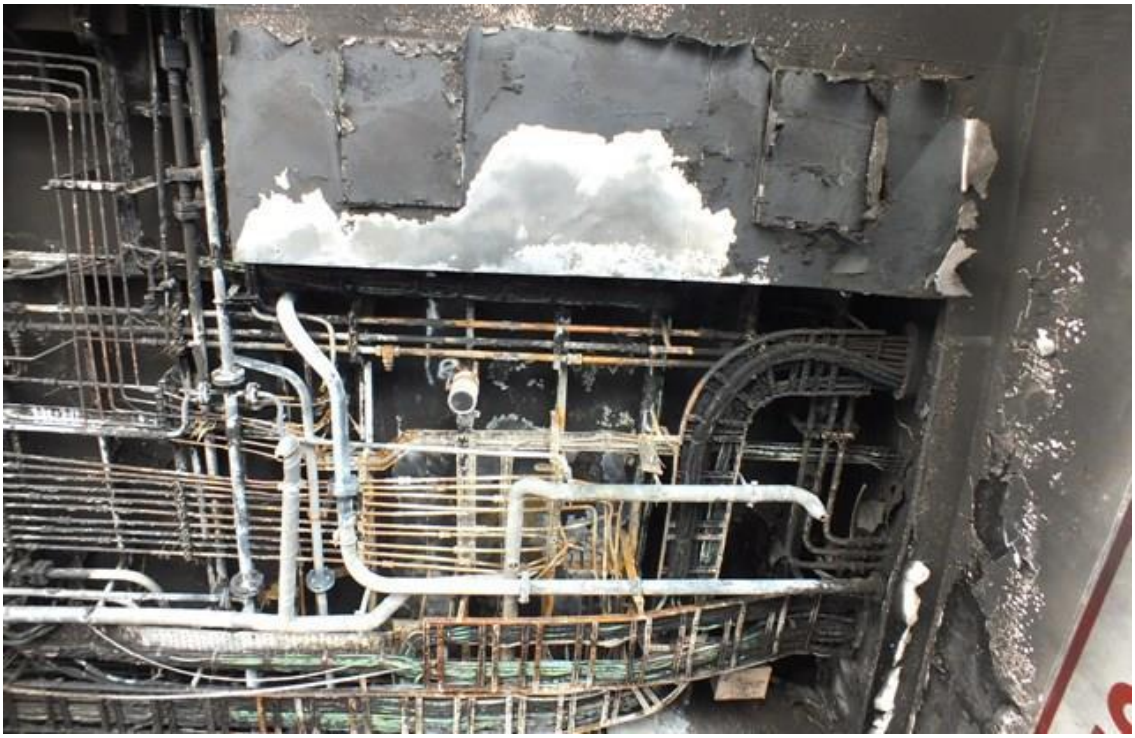
Photograph 3: Fire on the tug, "Zeus"" (WIM 46/15)



Photograph 4:Fire on the car and passenger ferry, "Stena Spirit" (WIM 60/16)

Photograph 5: Firefighting action of the shore unit on the car and passenger ferry, „Stena Spirit" (WIM 60/16)

Photograph 6: The car, whose cooling unit was the source of fire on „Stena Spirit" (WIM 60/16)



Photograph 7: Hydraulic installation damaged during fire on „Stena Spirit" (WIM 60/16)

Photograph 8: The yacht, „Regina R" during final evacuation (WIM 20/17) [Source: m/v "Key Opus"]

Photograph 9: The dock "SMW-1" (WIM 39/15)

Photograph 10: Removing the spill by the SAR "Kapitan Poinc" (WIM 39/15)

Photograph 11: Traces of paint from the hull of the vessel on the edge of substructure of a mooring roll (WIM 39/15)

Photograph 12: Damaged (pierced) sheathing of the hull of "Green Egersund" (WIM 39/15)

Photograph 13: Dock IX separated by an oil spill boom from the port (WIM 39/15)*

Photograph 14: The hydrographic vessel, „Zodiak" neutralizing the spill of oil in the roadstead (WIM 39/15)

5. List of marine casualties and incidents according to type

Of the 114 events reported to the Commission, 11 were classified as very serious marine casualties as defined in the accident investigation code and the Act on the SMAIC. There were included the following events:

- WIM 15/17 - a dead Polish sailor was found in the closed space of the vessel, *Frontera* on the inner anchorage of the port of Lisbon,
- WIM 20/17 *Regina R* - loss of a rudder horn, rudder axle and rudder blade; taking up the master of a recreational yacht, *Regina R* on board a vessel, *Key Opus* and abandoning the yacht (Photograph 8),
- WIM 21/17 - capsizing of a recreational yacht, *Dunlin* and the death of a crew member,
- WIM 24/17 - sinking of a car and passenger ferry, *Siebengebirge* being towed by the tug *Ikar*,
- WIM 28/17 - drowning of the crew members of a small recreational yacht, *Bez 2*,
- WIM 40/17 - falling overboard and drowning of a crew member of a recreational sailing yacht, *Katamaran*,

- WIM 55/17 - falling overboard, loss of consciousness and death of a crew member of a recreational sailing yacht, *Portowiec Gdański 3*,
- WIM 67/17 - fall from a crane, as a result of which there died one of the crew members of the bulk carrier, *Gdańsk*,
- WIM 96/17 - as a result of tearing off the ballast, capsizing and sinking of a commercial sailing yacht, *Prodigy 2*, evacuation of the crew,
- WIM 105/17 - death of a crew member (unknown reasons) on the bulk carrier, *Polesie*,
- WIM 108/17 - falling overboard and drowning of a member of the crew of a recreational sea-going yacht, *Vagant*.

Nineteen events were considered by the Commission as not meeting the criteria of the definition of a marine casualty contained in Article 2 of the Act on the SMAIC.

53 received notifications concerned serious marine casualties, 28 events were classified by the Commission as marine casualties. Three notifications concerned events that the Commission classified as marine incidents (Figure 5).

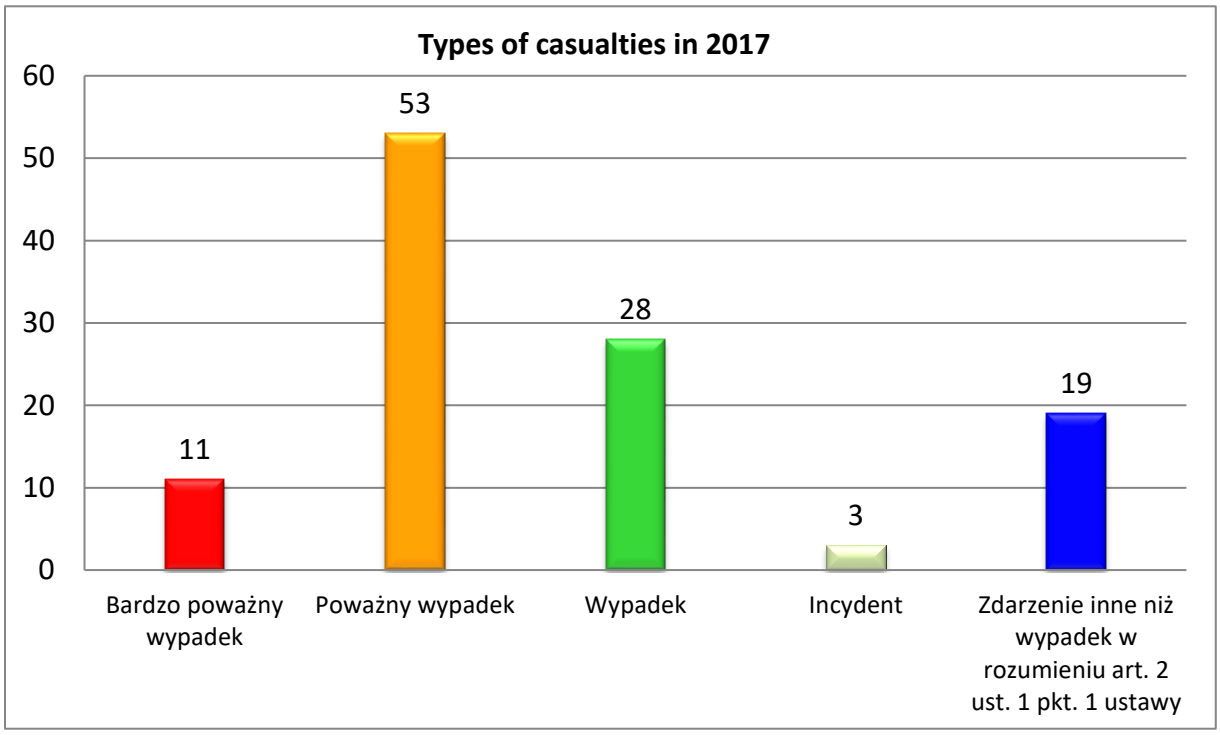


Figure 5: Classification of the types of casualties

Chart 5: From the left side of the chart:

Very serious marine casualty

Serious marine casualty

Marine casualty

Marine incident

Event other than a casualty as defined by Article 2.1.1 of the act

Figure 6 presented below shows the per cent share of types of casualties in 2017.

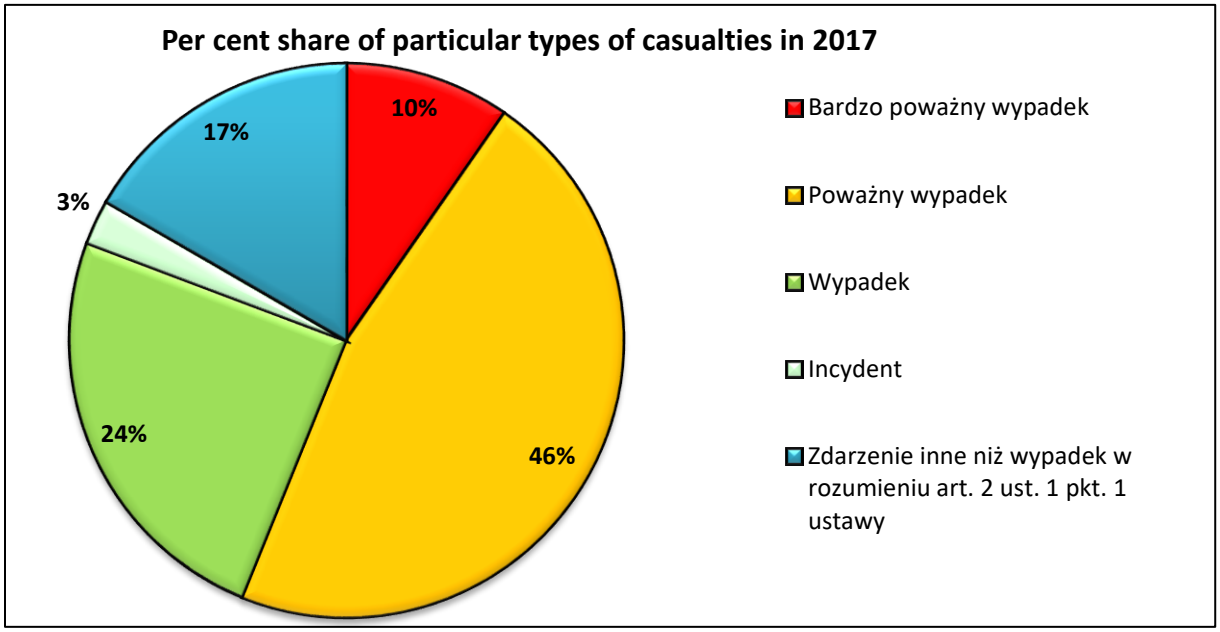


Figure 6: Per cent share of particular types of casualties in 2017

Chart 6: From the left side of the chart:

Very serious marine casualty 10%

Serious marine casualty 46%

Marine casualty 24%

Marine incident 3%

Event other than a casualty as defined by Article 2.1.1. of the act

5.1. Occupational accidents

In 2017 the Commission investigated 15 accidents involving people (*occupational accidents*). As many as 11 persons died in these casualties, 7 persons were injured and 3 persons suffered a loss (Figure 7).

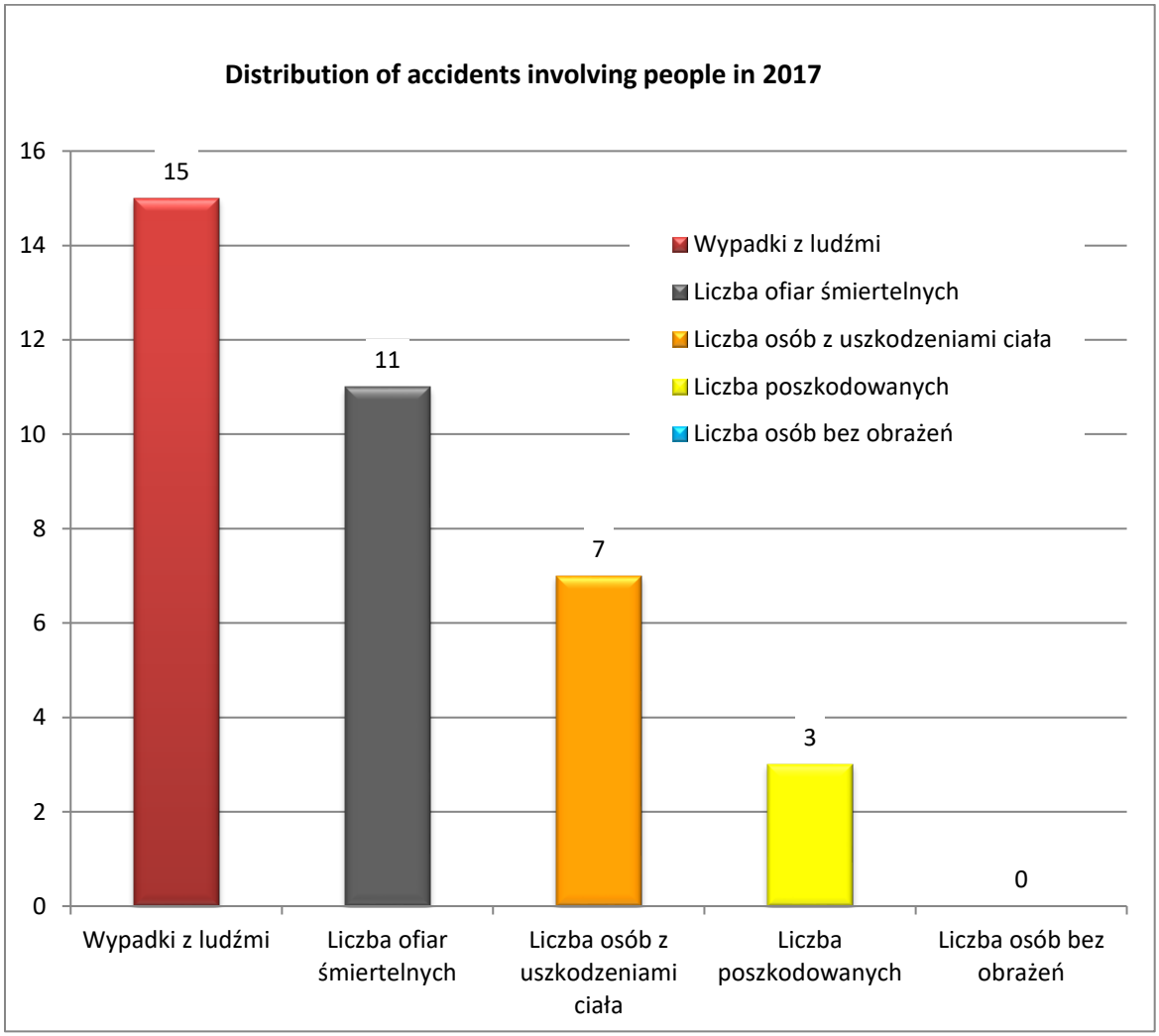


Figure 7: Distribution of accidents involving people in 2017

Chart 7: From the left side of the chart:

Accidents involving people

Number of the dead

Number of people suffering injuries

Number of victims

Number of people with no injuries

6. Regions where marine casualties and incidents occurred

Of all 114 marine casualties and incidents that the Commission registered, the greatest number of as many as 45 accidents took place in ports; 32 accidents took place in gulfs and

lagoons; 25 accidents took place at sea; 4 accidents took place at the ports' roadstead; 5 in the rivers; 3 in the oceans (Figure 8).

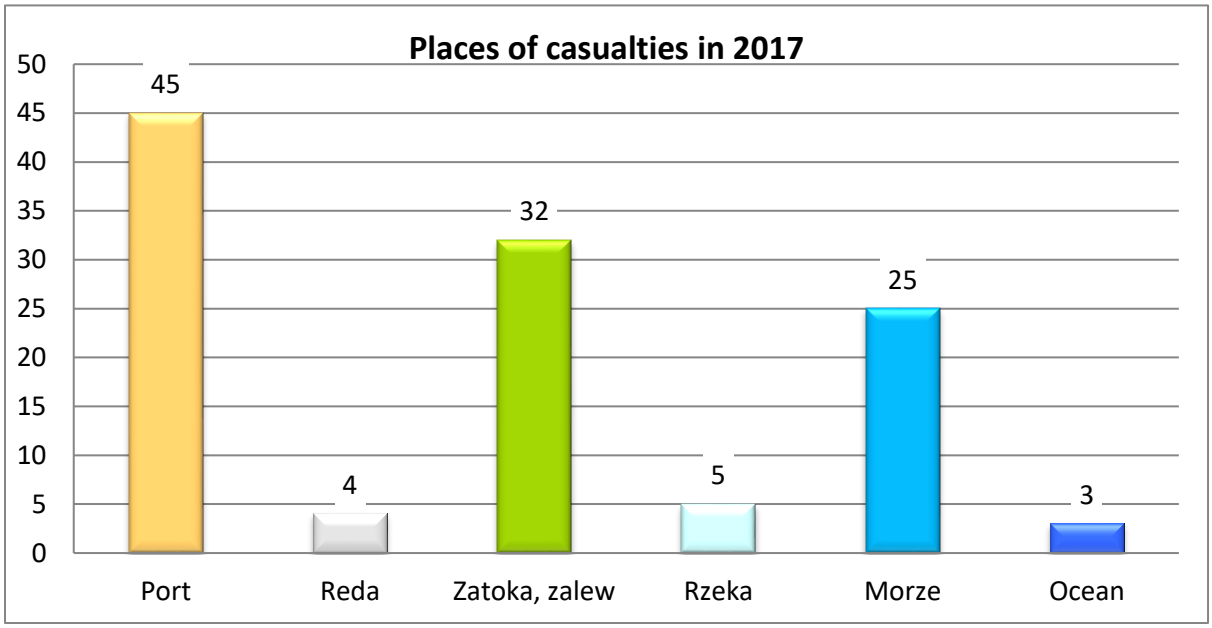


Figure 8: Places of casualties in 2017

Chart 8: From the left side of the chart:

Port

Roadstead

Bay, lagoon

River

Sea

Ocean

Figure 9 presented below shows the per cent share of each of the regions where the accidents took place in 2017.

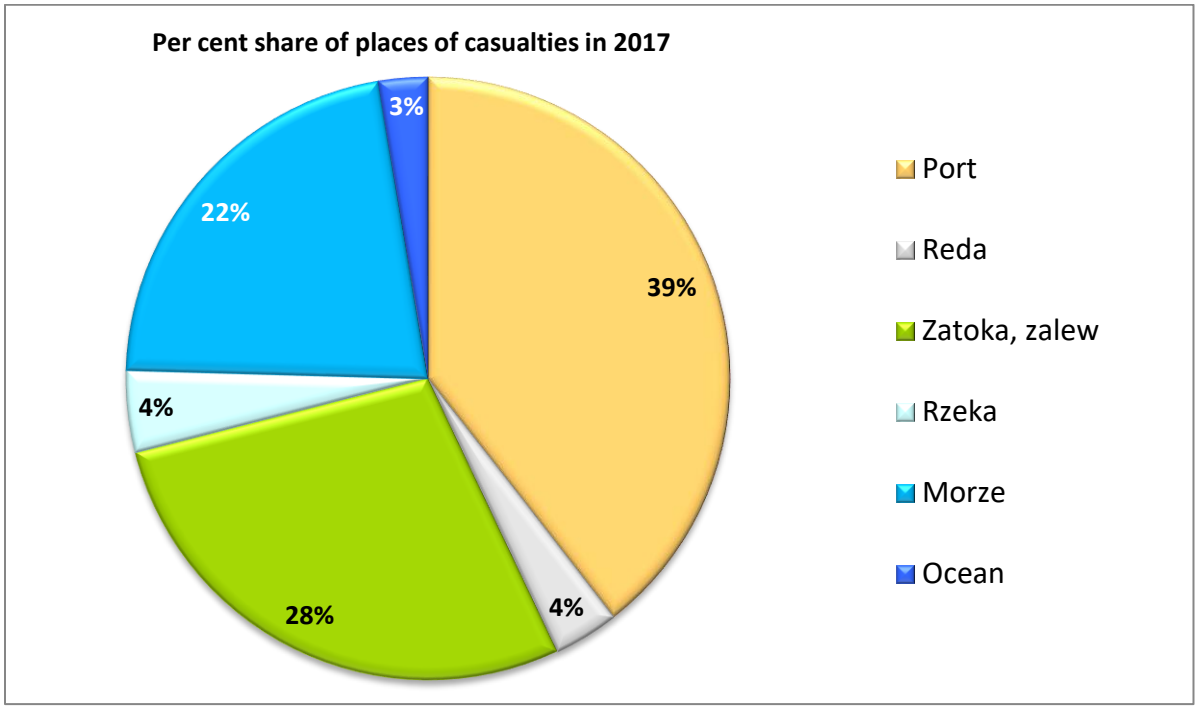


Figure 9: Per cent share of places of casualties in 2017

Chart 9: From the left side of the chart:

Port 39%

Roadstead 4%

Bay, lagoon 28%

River 4%

Sea 22%

Ocean 3%

6.1. Casualties in ports

Of the 45 casualties in ports, 29 occurred in Polish ports of primary importance, and 16 in other ports, including 2 in foreign ports. The distribution of accidents in the four main Polish ports is shown below (Figure 10).

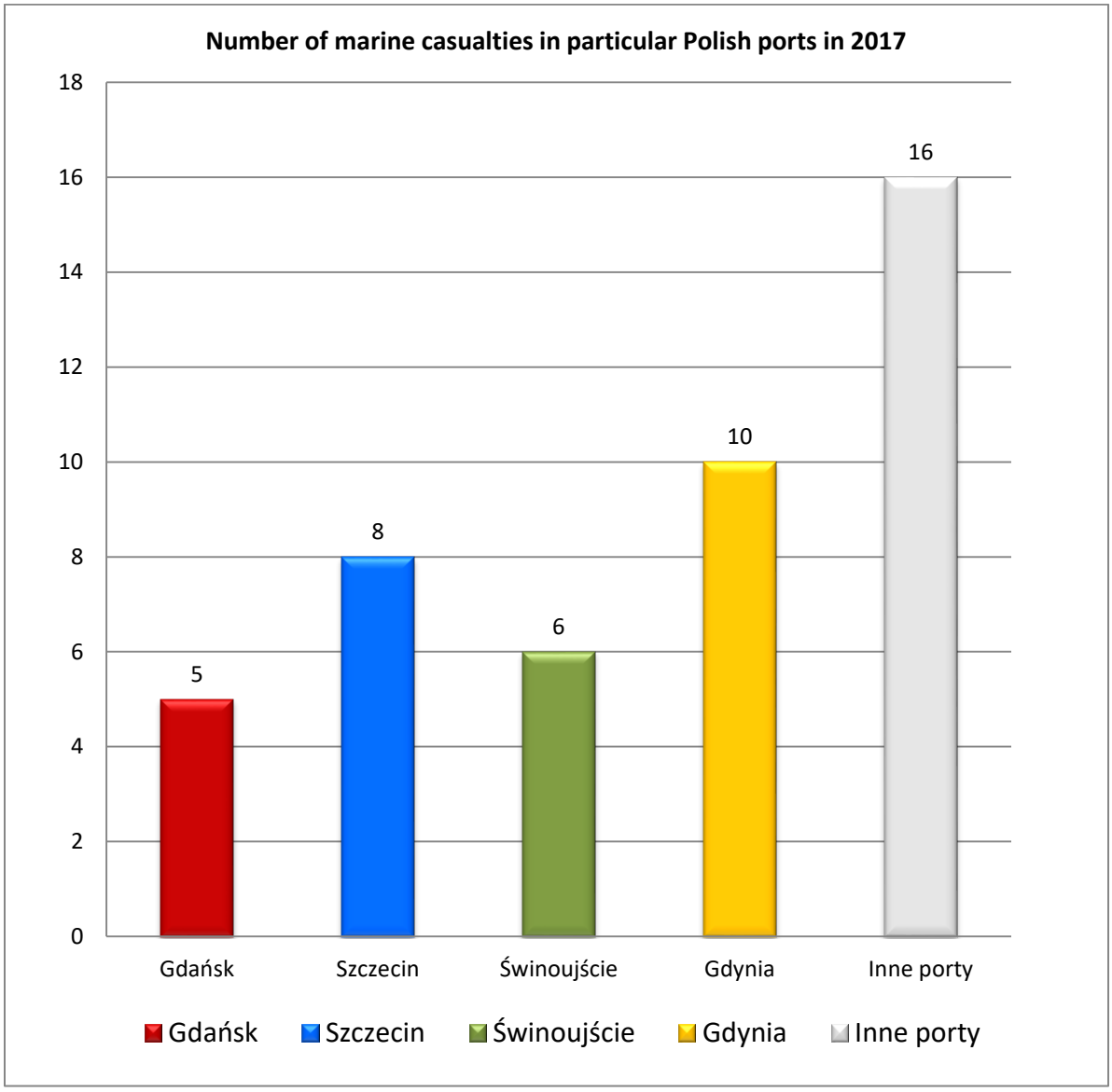


Figure 10: Number of marine casualties in particular Polish ports in 2017

Chart 10: From the left side of the chart:

Gdańsk

Szczecin

Świnoujście

Gdynia

Other ports

Figure 11 presented below shows the per cent share of accidents in ports in 2017.

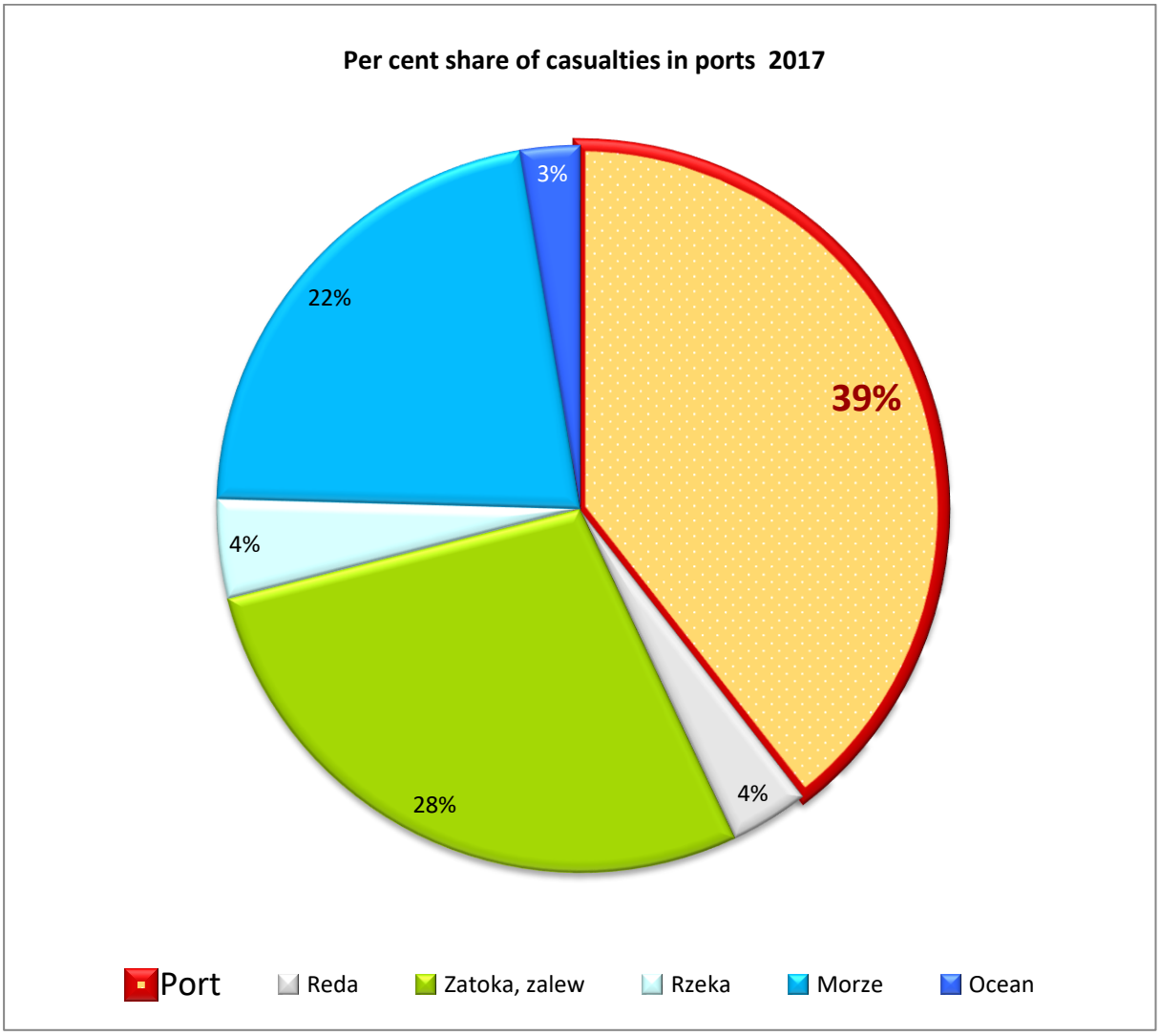


Figure 11: Per cent share of casualties in ports in 2017

Chart 11: From the left side of the chart:

Port

Roadstead

Bay, lagoon

River

Sea

Ocean

Casualties in ports accounted for more than one third (39%) of all casualties which occurred in 2017. They concerned situations in which vessels caused the accident or situations where the accident took place on board.

7. Types of vessels involved in a marine casualty or incident

In 114 events reported to the Commission in 2017 there were involved 120 vessels of all types: 119 vessels and one floating dock. The largest group of vessels involved in the casualties was composed of sea-going yachts of all types (51), fishing boats (14); among merchant vessels the largest group was composed of general cargo vessels of all types (20), bulk carriers (8), passenger vessels (4), and oil carriers (4) (Figure 12).

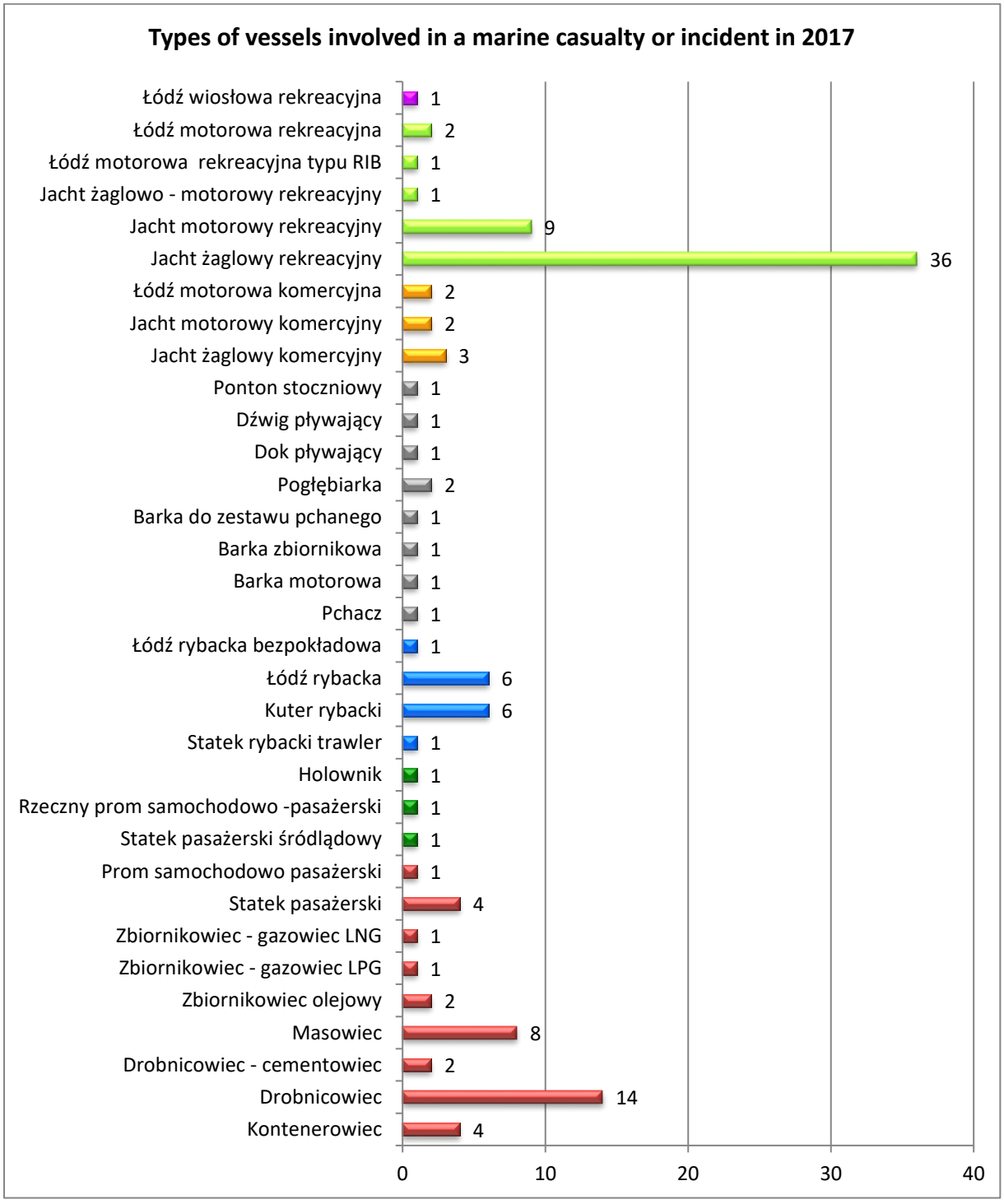


Figure 12: Types of vessels involved in a marine casualty or incident in 2017

Chart 12: From the top of the chart:

Recreational rowing boat

Recreational motor boat

RIB recreational motor boat

Recreational sailing and motor yacht
Recreational motor yacht
Recreational sailing yacht
Commercial motor boat
Commercial motor yacht
Commercial sailing yacht
Shipyard pontoon
Floating crane
Floating dock
Dredger
Barge for push-tow
Tank barge
Motor barge
Pusher
Open fishing boat
Fishing cutter
Fishing trawler
Tugboat
Car and passenger river ferry
Inland passenger ship
Car and passenger ferry
LNG tanker
LPG tanker
Oil tanker
Bulk carrier
General cargo – cement carrier
General cargo vessel
Container ship

Figure 13 presented below shows the per cent share of types of vessels involved in a marine casualty or incident in 2017.

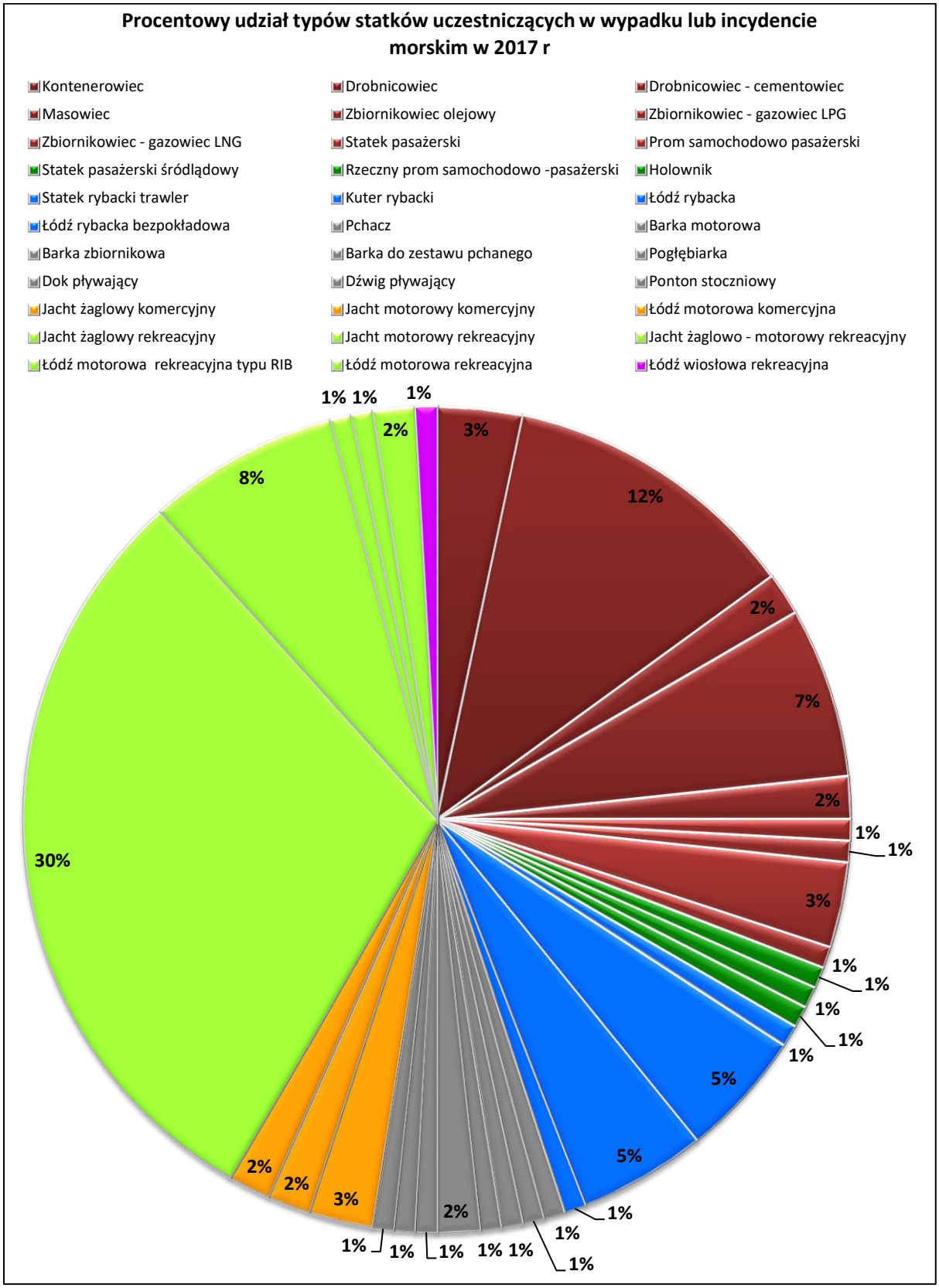


Figure 11: Per cent share of types of vessels involved in a marine casualty or incident in 2017

Chart 13:

I column (left)

Bulk carrier

LNG tanker

Inland passenger ship

Fishing trawler

Fishing open boat

Tank barge

Floating dock

Commercial sailing yacht

Recreational sailing yacht

RIB recreational motor boat

II column (middle)

Oil tanker

Passenger ship

Car and passenger river ferry

Fishing cutter

Pusher

Barge for push-tow

Floating crane

Commercial motor yacht

Recreational motor yacht

Recreational motor boat

III column (right)

LPG tanker

Car and passenger ferry

Tugboat

Fishing boat

Motor barge

Dredger

Shipyard pontoon

Commercial motor boat

Recreational motor and sailing yacht

Recreational rowing boat

7.1. Distribution of vessels according to EMSA classification

The Commission divided vessels involved in the casualties investigated in 2017 according to the classification adopted by the European Maritime Safety Agency (EMSA). The vessels were divided into the following groups: cargo vessels, fishing vessels, passenger vessels, service vessels (such as tugs, dredgers, SAR crafts, floating cranes) and other vessels (including yachts) (Figure 14).

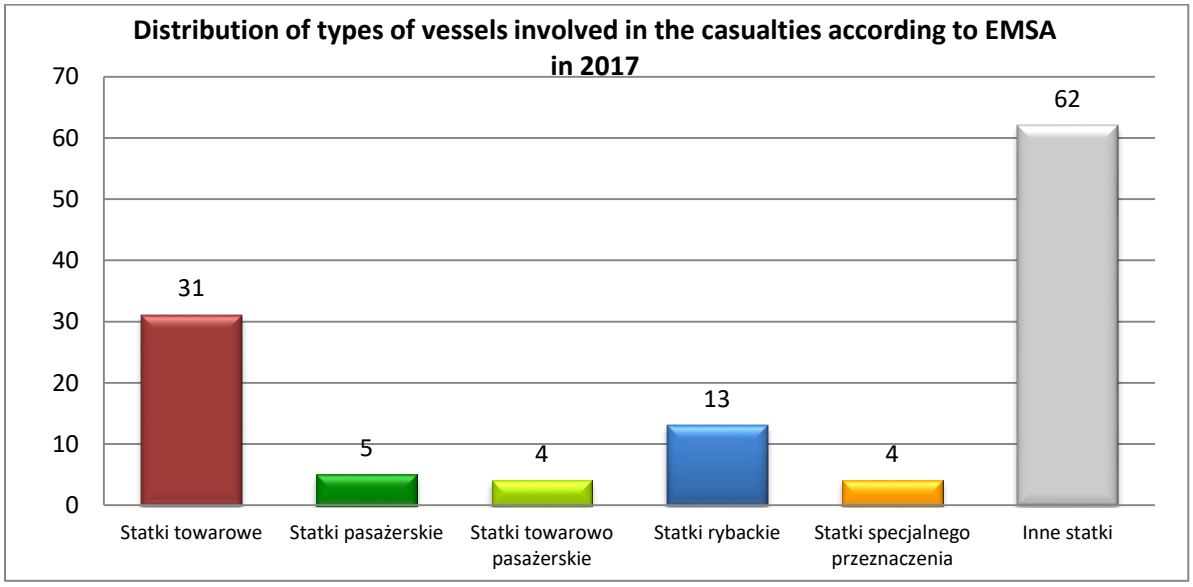


Figure 12: Distribution of types of vessels involved in the casualties according to EMSA in 2017

Chart 14: From the left side of the chart:

Cargo vessels

Passenger vessels

Cargo and passenger vessels

Fishing vessels

Special purpose vessels

Other vessels

Figure 14 presented below shows the per cent share of types of vessels involved in the casualties in 2017 according to EMSA.

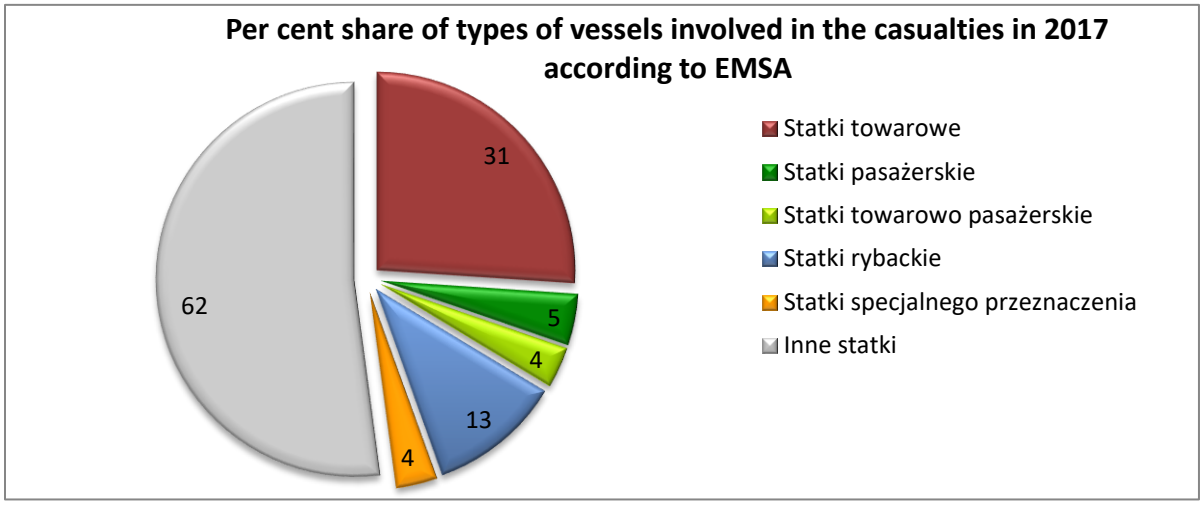


Figure 15: Per cent share of types of vessels involved in the casualties in 2017 according to EMSA

Chart 15: From the top of the chart:

Cargo vessels

Passenger vessels

Cargo and passenger vessels

Fishing vessels

Special purpose vessels

Other vessels

7.2. Marine casualties of sea-going yachts

In 2017 the Commission received notifications of 51 events involving sea-going yachts; 18 events involved fishing vessels and the remaining vessels and a floating dock participated in 50 events.

The Figure 16 below presents the comparison of the number of yachts, fishing boats and cutters and other vessels (119 vessels) and one floating dock (in total 120 vessels) which were involved in the events reported to the Commission.

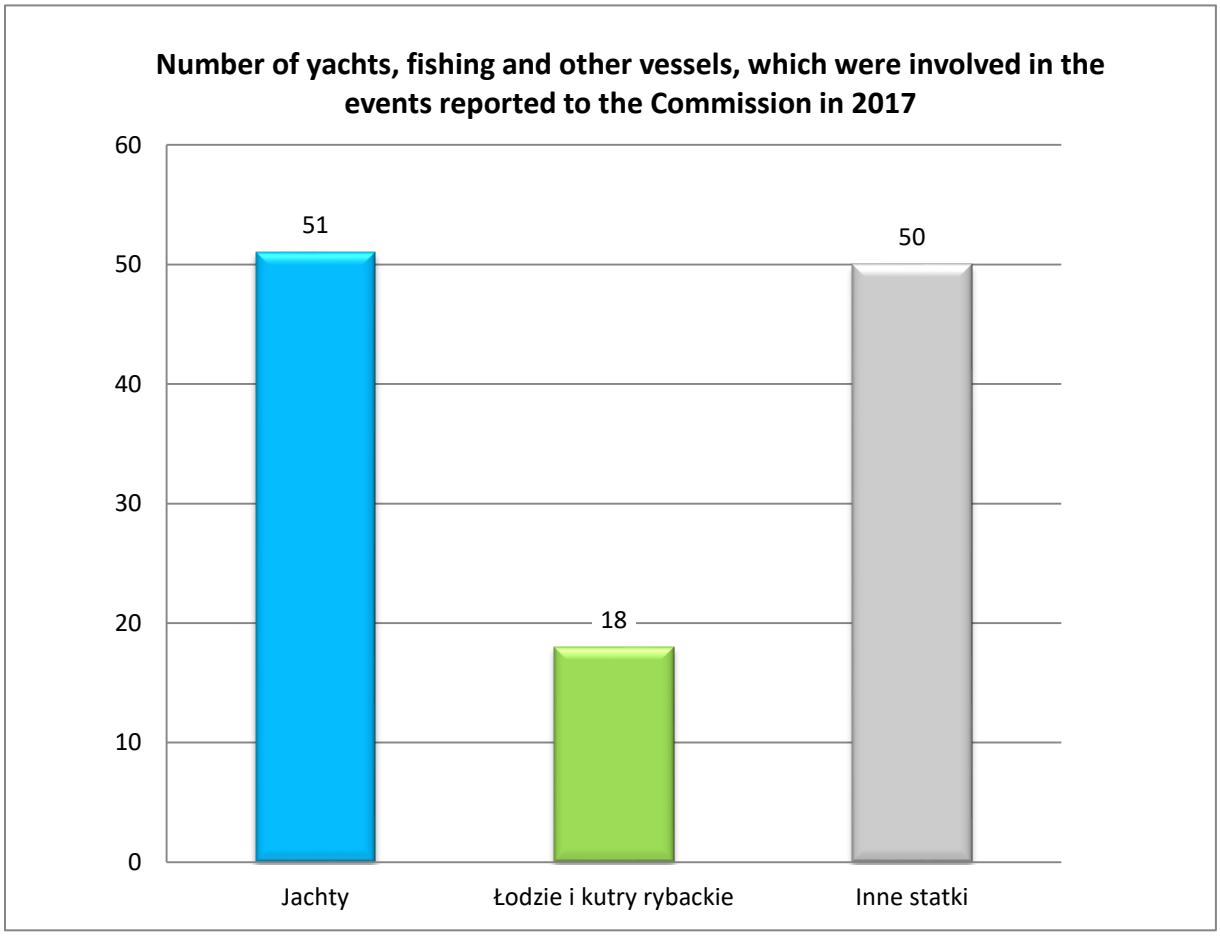


Figure 13: Number of yachts, fishing and other vessels, which were involved in the events reported to the Commission in 2017

Chart 16: From the left side of the chart:

Yachts

Fishing boats and cutters

Other vessels

The per cent share of yachts involved in the events, which were reported to the SMAIC in 2017 in comparison to fishing and other vessels is presented in Figure 17.

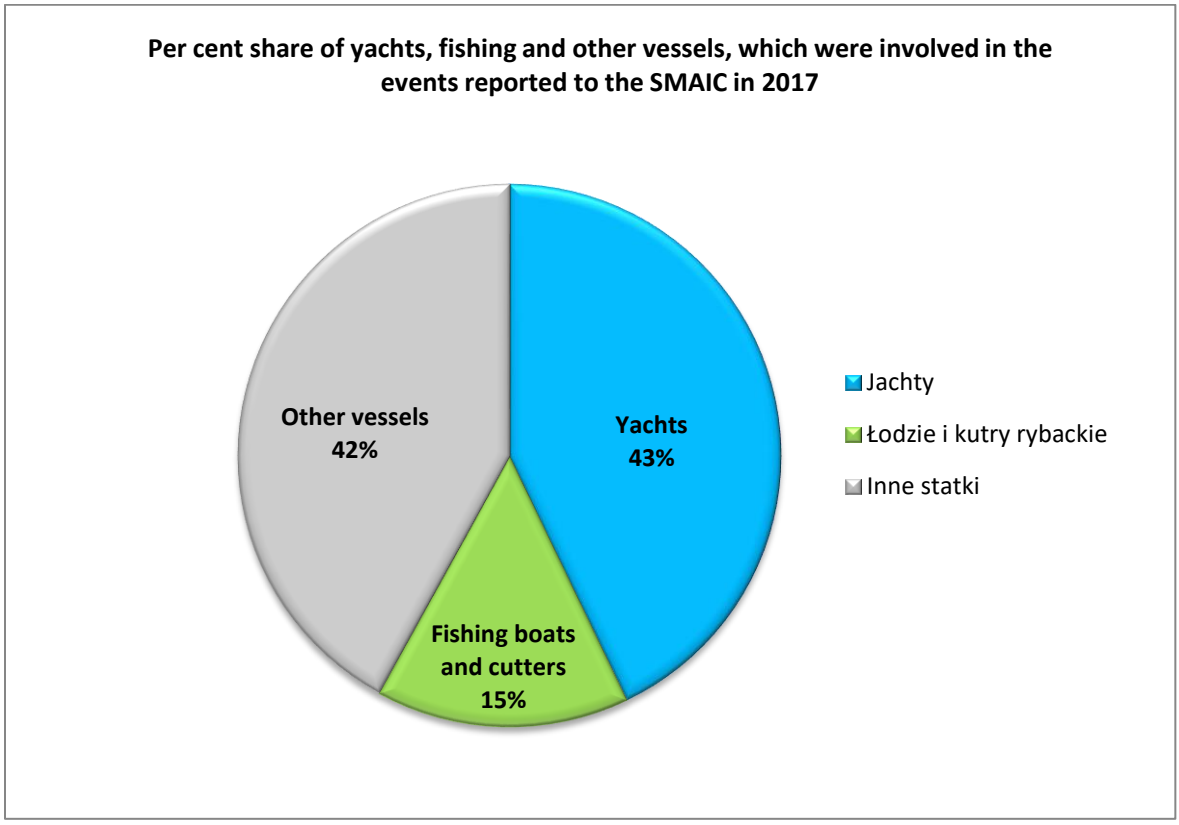


Figure 14: Per cent share of yachts, fishing and other vessels in 2017

Chart 17: From the top of the chart:

Yachts

Fishing boats and cutters

Other vessels

The per cent share of yachts involved in the events, which were reported to the SMAIC in 2017 in comparison to fishing and other vessels is presented in Figure 18.

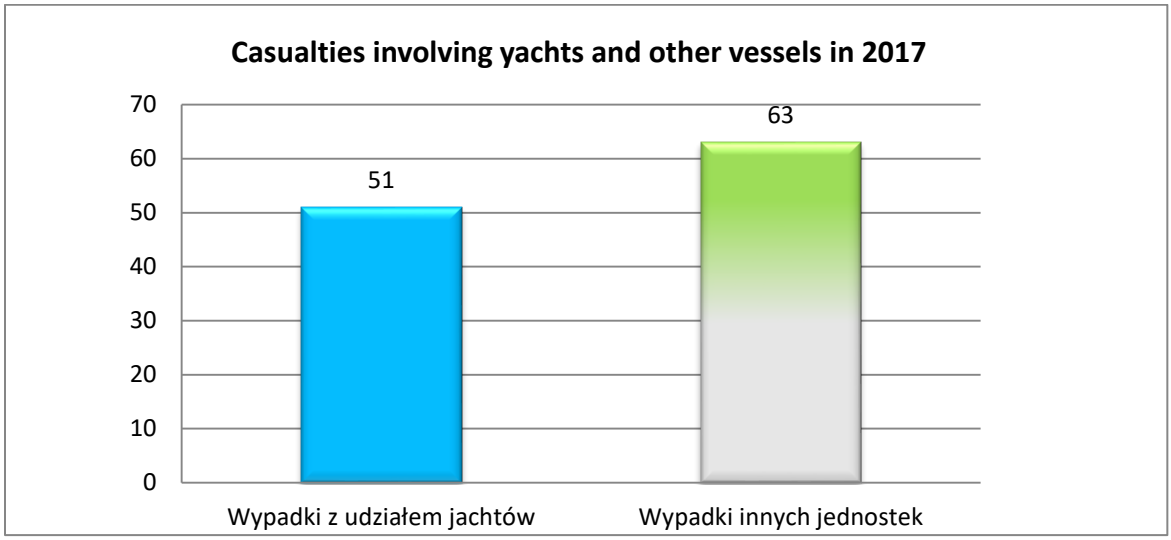


Figure 15: Casualties involving yachts and other vessels in 2017

Chart 18: From the left side of the chart:

Casualties involving yachts

Casualties involving other vessels

The per cent share of yachts involved in the events, which were reported to the SMAIC in 2017 in comparison to other vessels is presented in Figure 19.

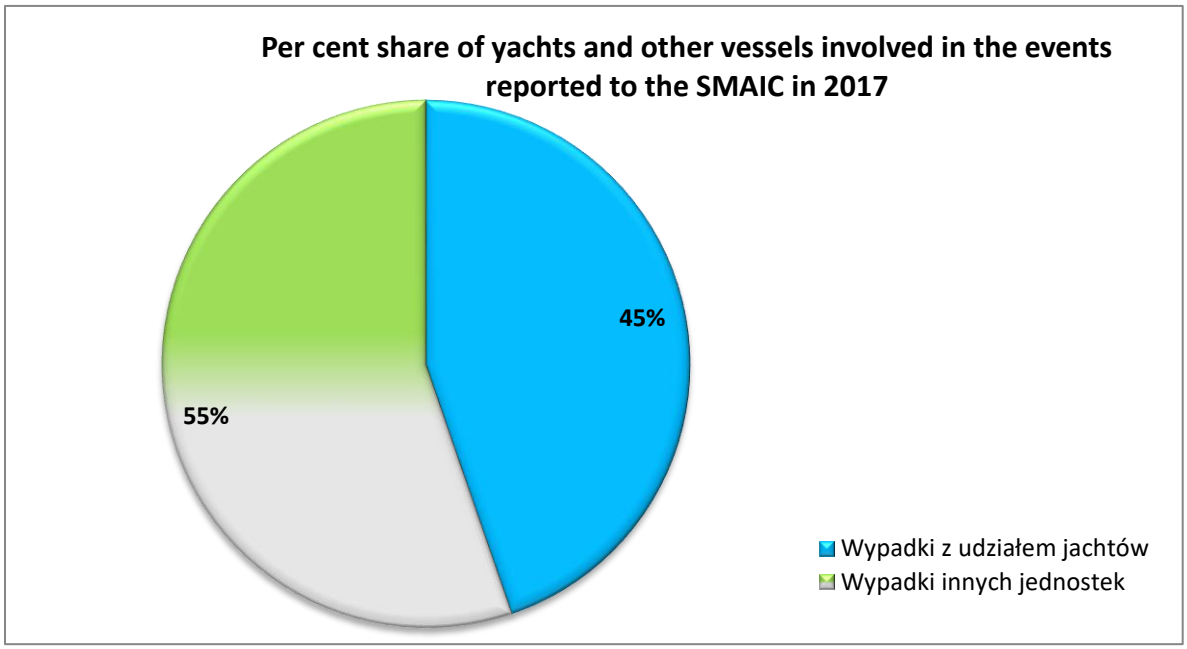


Figure 16: *Per cent share of yachts and other vessels, which were reported to the SMAIC in 2017*

Chart 19: From the top of the chart:

Casualties involving yachts

Casualties involving other vessels

8. Distribution of vessels according to the flag

From among 119 vessels involved in the marine casualties and incidents registered by the Commission, more than half, i.e. as many as 64 vessels were flying the Polish flag, 9 vessels belonged to the European Union Member States, 2 vessels were flying the Chinese flag, one vessel the Russian Federation flag, 2 vessels belonged to Canada, 1 vessels did not have a flag and the remaining 19 vessels belonged to countries considered to be the so called "flags of convenience". (Figure 20).

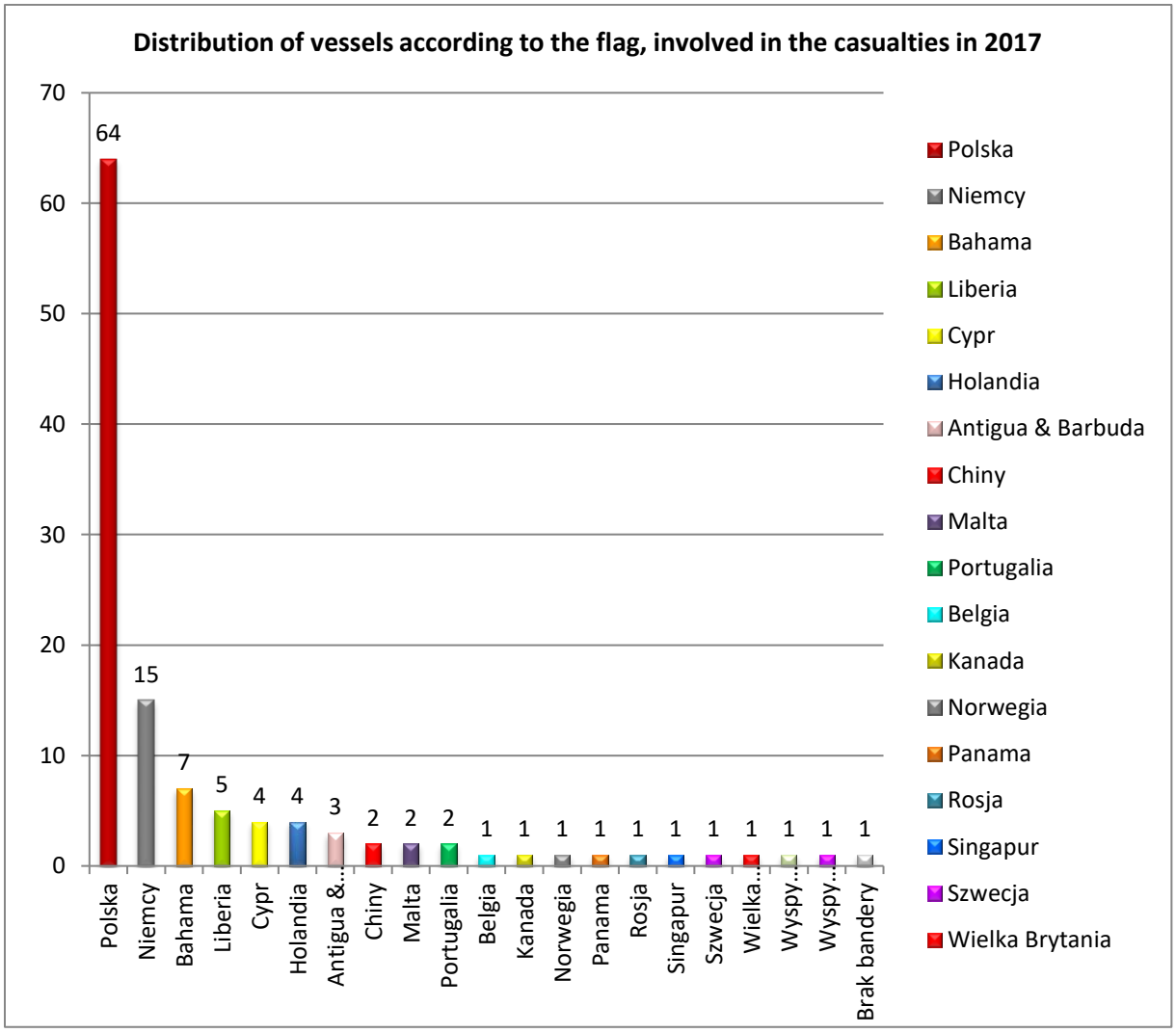


Figure 17: Distribution of vessels according to the flag, involved in the casualties investigated by the Commission in 2017

Chart 20: From the left side of the chart:
Poland
Germany
Bahamas
Liberia
Cyprus
Netherlands
Antiqua and Barbuda
China
Malta
Portugal
Belgium
Canada
Norway
Panama
Russia
Singapore
Sweden
United Kingdom
Marshall Islands
Faroe Islands
No flag

The per cent share of vessels according to the flag, involved in the casualties in 2017 is presented in Figure 21.

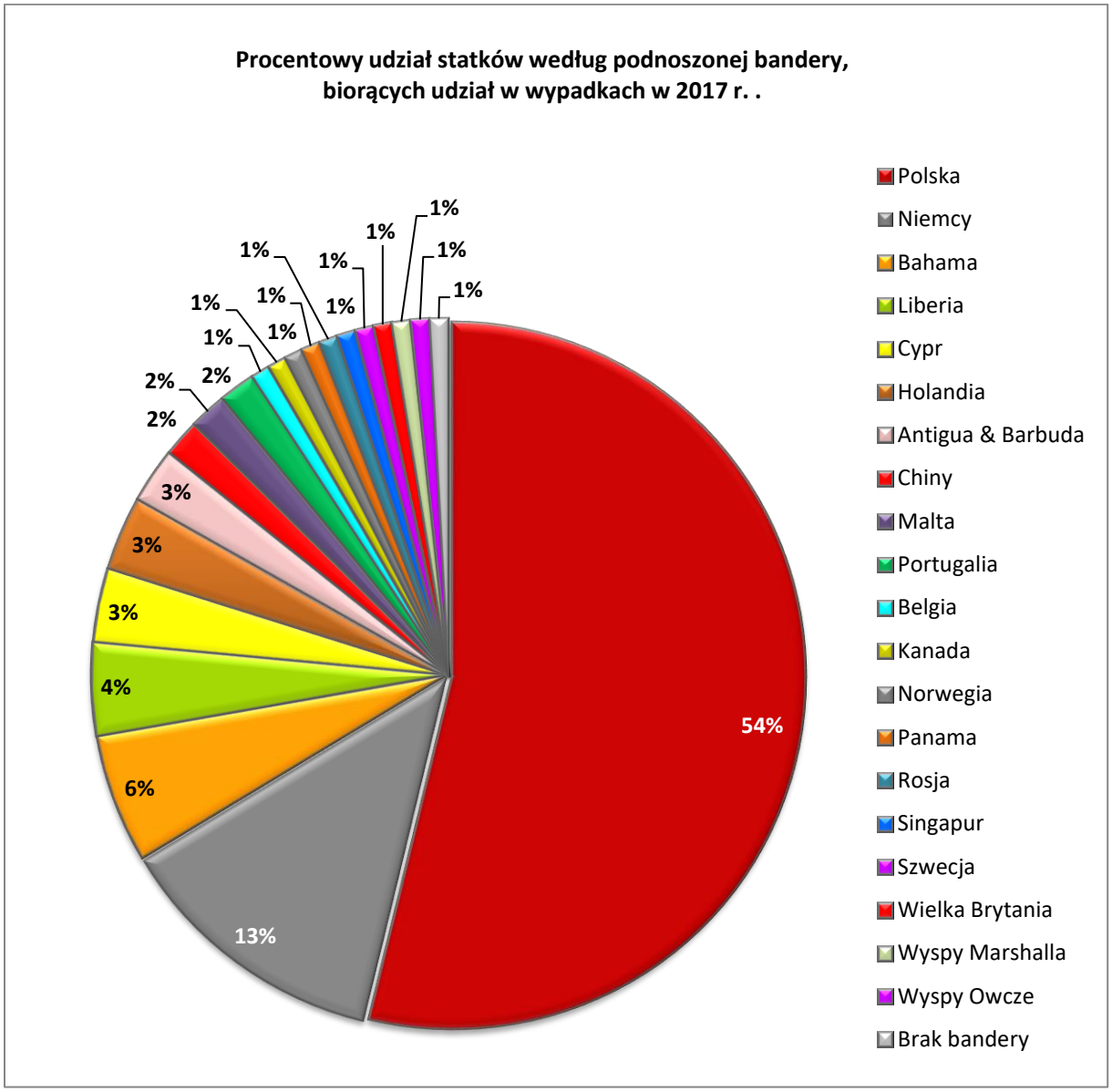


Figure 18: The per cent share of vessels according to the flag, involved in the casualties investigated by the Commission in 2017

Chart 21: From the top of the chart:

Poland

Germany

Bahamas

Liberia

Cyprus

Netherlands

Antiqua and Barbuda

China
Malta
Portugal
Belgium
Canada
Norway
Panama
Russia
Singapore
Sweden
United Kingdom
Marshall Islands
Faroe Islands
No flag

9. Distribution of marine casualties and incidents over a year

The Commission compared the number of marine casualties and incidents in each month over a year and found out that the greatest number of accidents occurred in the summer months. The greatest number, 20 accidents took place in June, 16 in July, 15 in August. In May, September and October there were 9 accidents in each month (due to a large number of sea-going yachts used for navigation during the sailing season). In February there were 10 accidents, which were caused by ice damaging the yachts berthing at the wharfs (Figure 22).

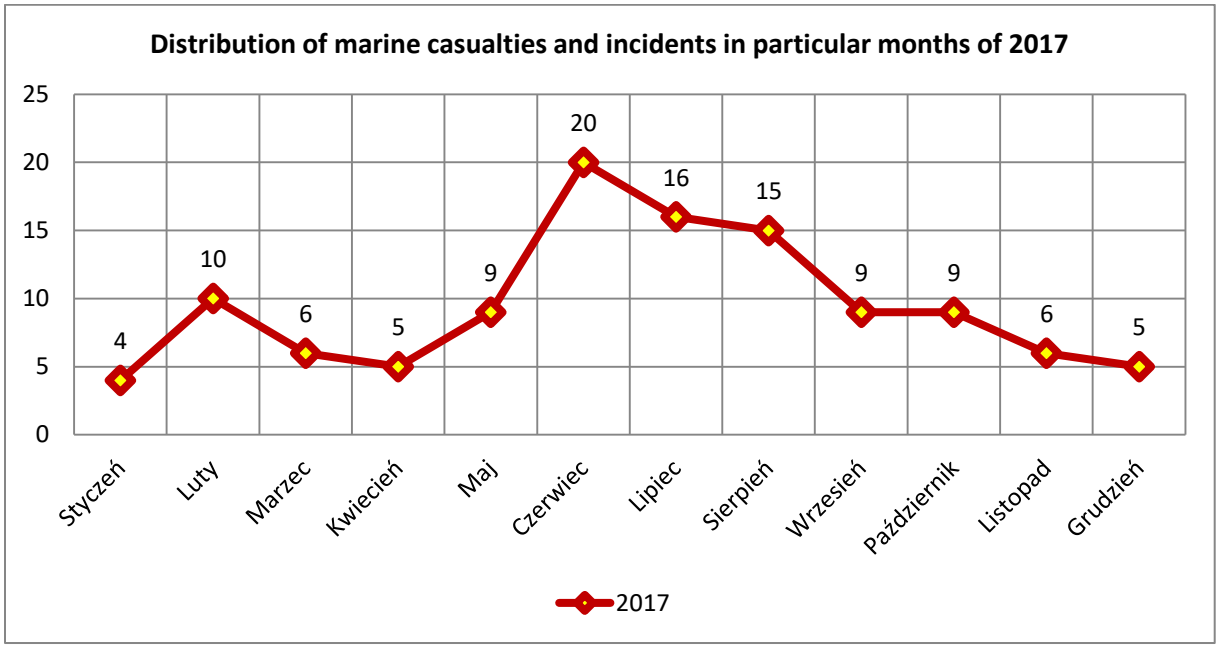


Figure 22: Distribution of marine casualties and incidents in particular months of the year 2017

Chart 22: From the left side of the chart:

January

February

March

April

June

July

August

September

October

November

December

Figure 23 presented below shows the per cent share of marine casualties and incidents in particular months of the year 2017.

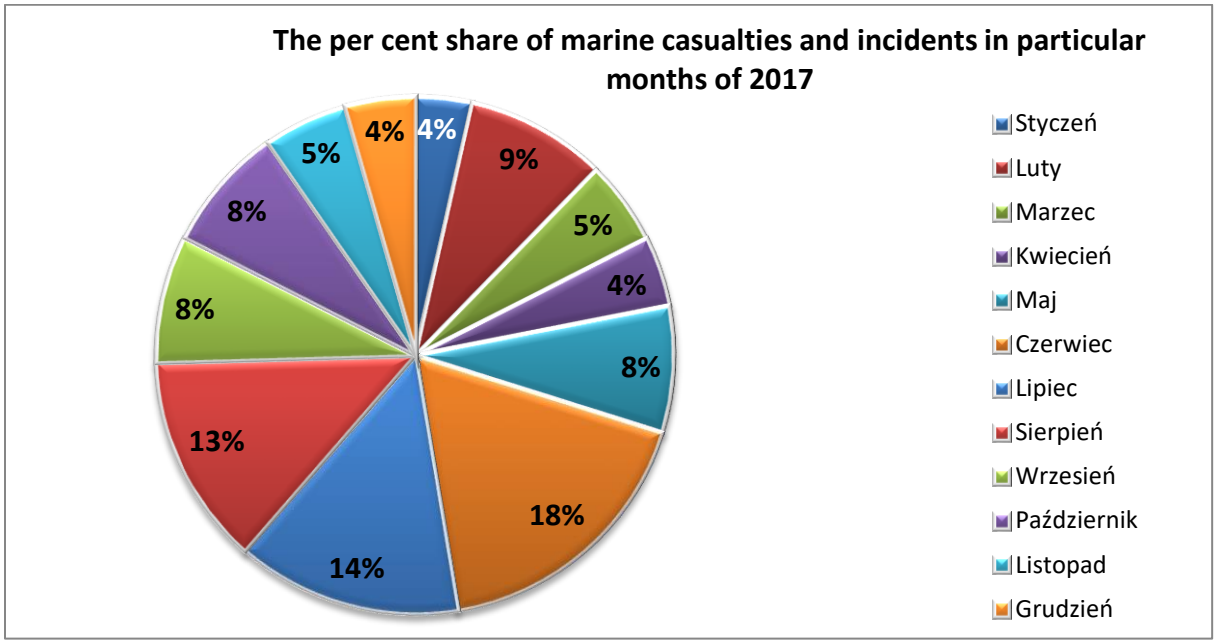


Figure 23: The per cent share of marine casualties and incidents in particular months of the year 2017

Chart 23: From the top of the chart:

January

February

March

April

June

July

August

September

October

November

December

10. Consequences of marine casualties

From among 114 events, other than those which had not been marine casualties and incidents, reported to the Commission, the Commission established the following: 10 groundings of vessels, 6 cases of manoeuvring errors, 5 cases where the hull lost its tightness, and other reasons presented in Figures 24 and 25.

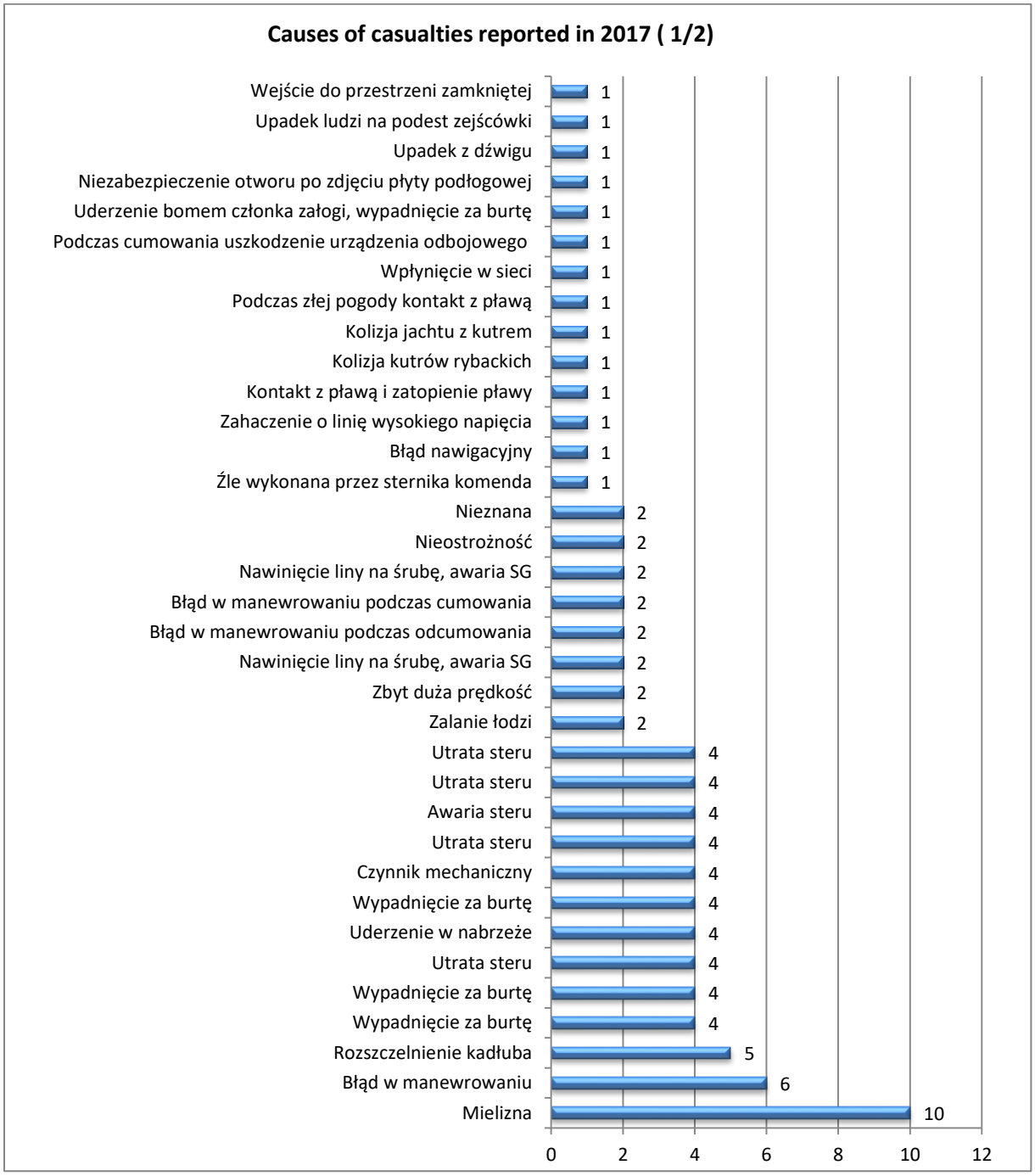


Figure 19: Causes of casualties reported in 2017 (1/2)

Chart 24: From the top of the chart:

Entering closed space

Falling of men onto the landing of a ladder-way

Falling down from the crane

Lack of protecting of an opening after removing a floor plate

Hitting a crew member with a boom, falling overboard

Damaging a fender device while wharfing

Navigating into the fishing net

Contact with a buoy in bad weather

Collision of a yacht and a cutter

Collision of fishing cutters

Contact with a buoy and its sinking

Hooking on a high-voltage line

Navigational error

Helmsman carried out a command incorrectly

Unknown

Carelessness

Winding up the line on a screw, ME damage

Manoeuvring error while mooring

Manoeuvring error while unmooring

Winding up the line on a screw, ME damage

Excessive speed

Flooding of the boat

Loss of the rudder

Loss of the rudder

Damage to the rudder

Loss of a rudder

Mechanical factor

Falling overboard

Bumping into the wharf

Loss of a rudder

Falling overboard

Falling overboard

Loss of tightness of the hull

Manoeuvring error

Shallow

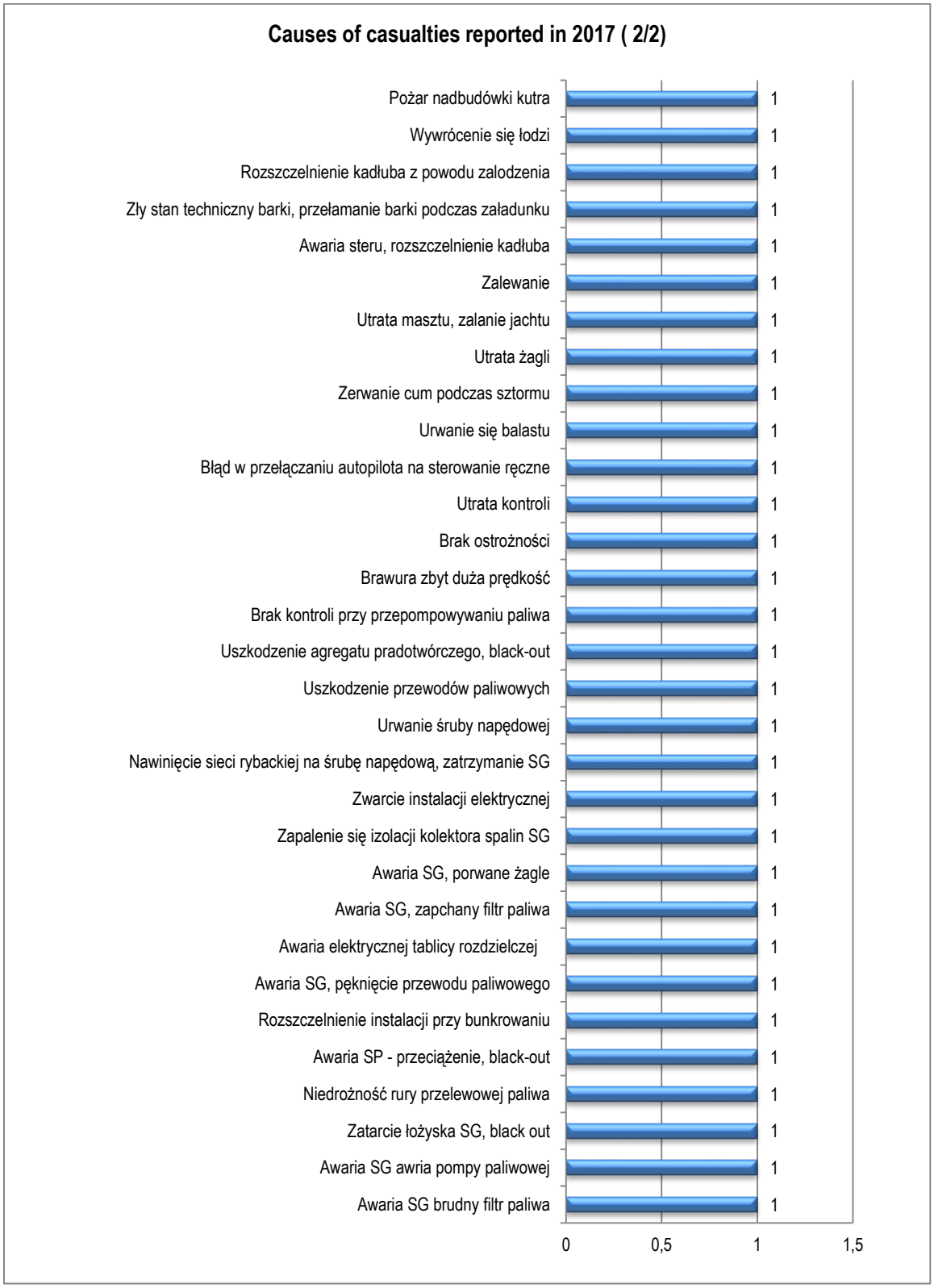


Figure 20: Causes of casualties reported in 2017 (2/2)

Chart 25: From the top of the chart:

Fire of the cutter's superstructure

Capsizing of the boat

Lack of tightness of the hull due to iciness

Bad technical condition of the barge, breaking of the barge while loading

Damage to the rudder, lack of tightness of the hull

Flooding

Loss of the mast, flooding of the yacht

Loss of sails

Breaking of mooring lines due to storm

Tearing off the ballast

Error in turning autopilot to manual steering

Loss of control

Carelessness

Bravery, excessive speed

Lack of control while pumping over the fuel

Damage to the power unit, black-out

Damage to fuel pipes

Tearing off the screw

Winding of the fishing net onto the screw, ME stop

Electrical installation short circuit

Setting on fire insulation of the ME fumes collector

Damage to ME, torn sails

Damage to ME, choked fuel filter

Damage to the electric switchboard

Damage to ME, splitting of the fuel pipe

Lack of tightness of installation while bunkering

Damage to SP – overload, black-out

Choked fuel transfer pipe

Seizure of the ME bearing, black-out

Damage to the ME – damage to fuel pump

Damage to the ME – dirty fuel filter

11. Causes of marine casualties and incidents

Of 114 marine casualties and incidents reported to the Commission in 52 cases there were mechanical factors involved and in 52 cases - human factors. In 3 cases, both human and mechanical factors occurred, and in 8 cases the accidents were caused by external factors, mostly unfavourable weather conditions, in 3 cases external and human factors occurred simultaneously (Figure 26).

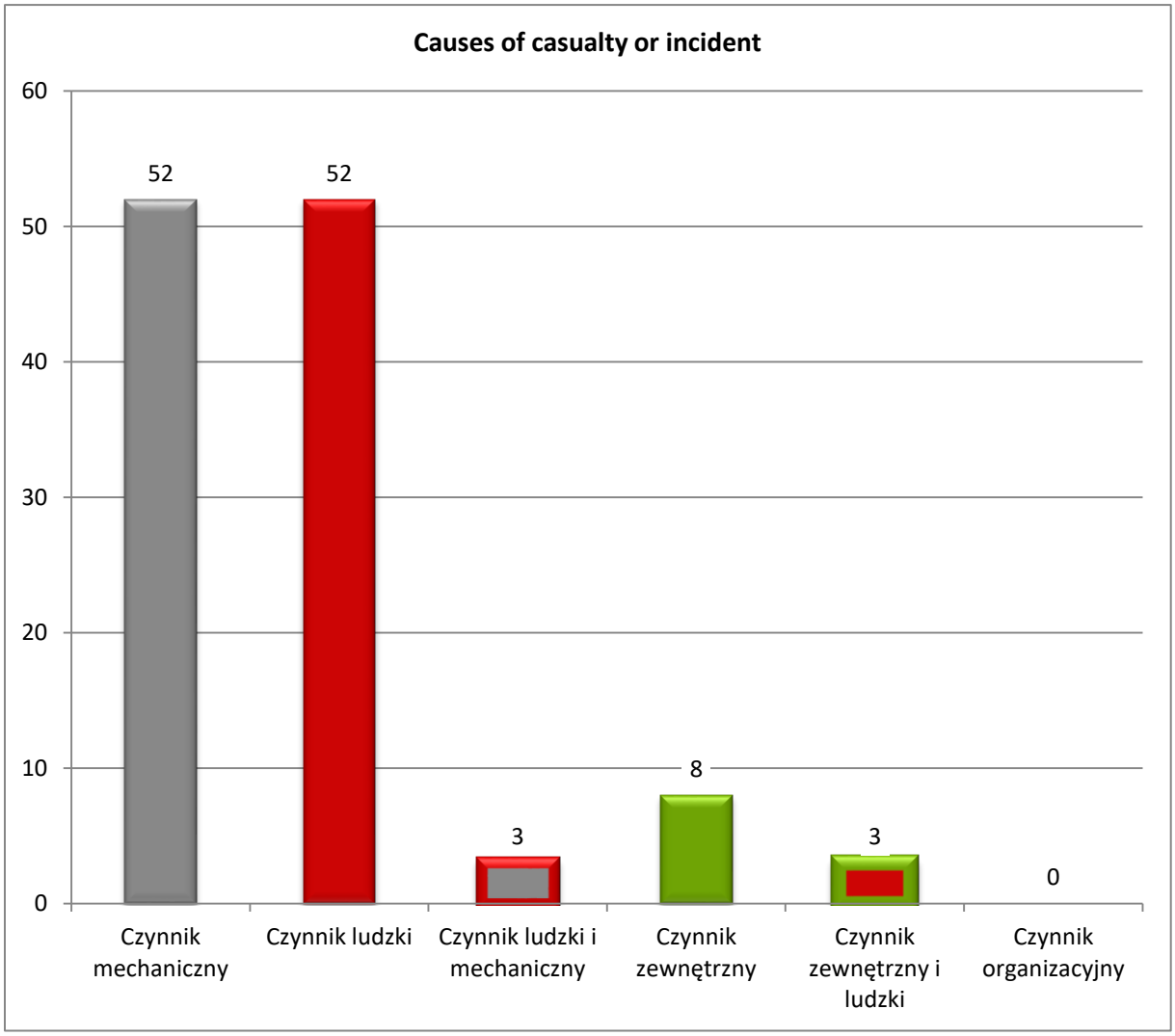


Figure 21: Causes of marine casualties and incidents in 2017

Chart 26: From the left side of the chart:

Mechanical factor

Human factor

Human and mechanical factor

External factor

External and human factor

Organizational factor

The per cent share of particular factors that influenced the occurrence of the casualty in the total number of investigated events is shown in Figure 27.

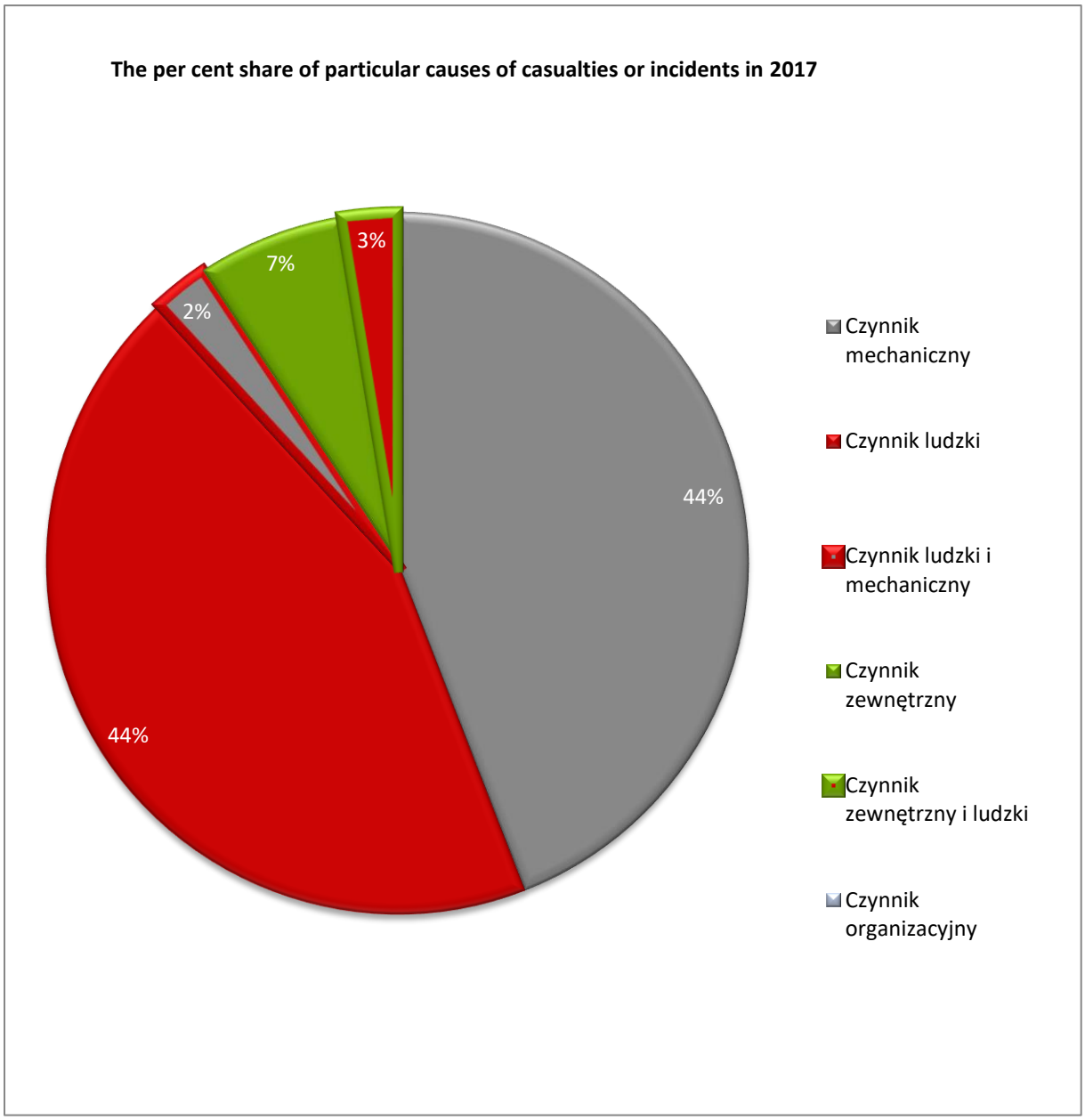


Figure 22: The per cent share of particular causes of casualties or incidents in 2017

Chart 27: From the top of the chart:

Mechanical factor

Human factor

Human and mechanical factor

External factor

External and human factor

Organizational factor

Figure 28 summarizes and describes the causes of all casualties and incidents that the Commission was dealing with in 2017.

The most common cause of casualties was the loss of control over the vessel, which means: in 24 cases the failure of the main engine, in 9 cases the failure of the rudder, in 1 case the failure of the yacht's engine, in 1 case the loss of the propeller and in 2 cases the loss of power (Figure 28).

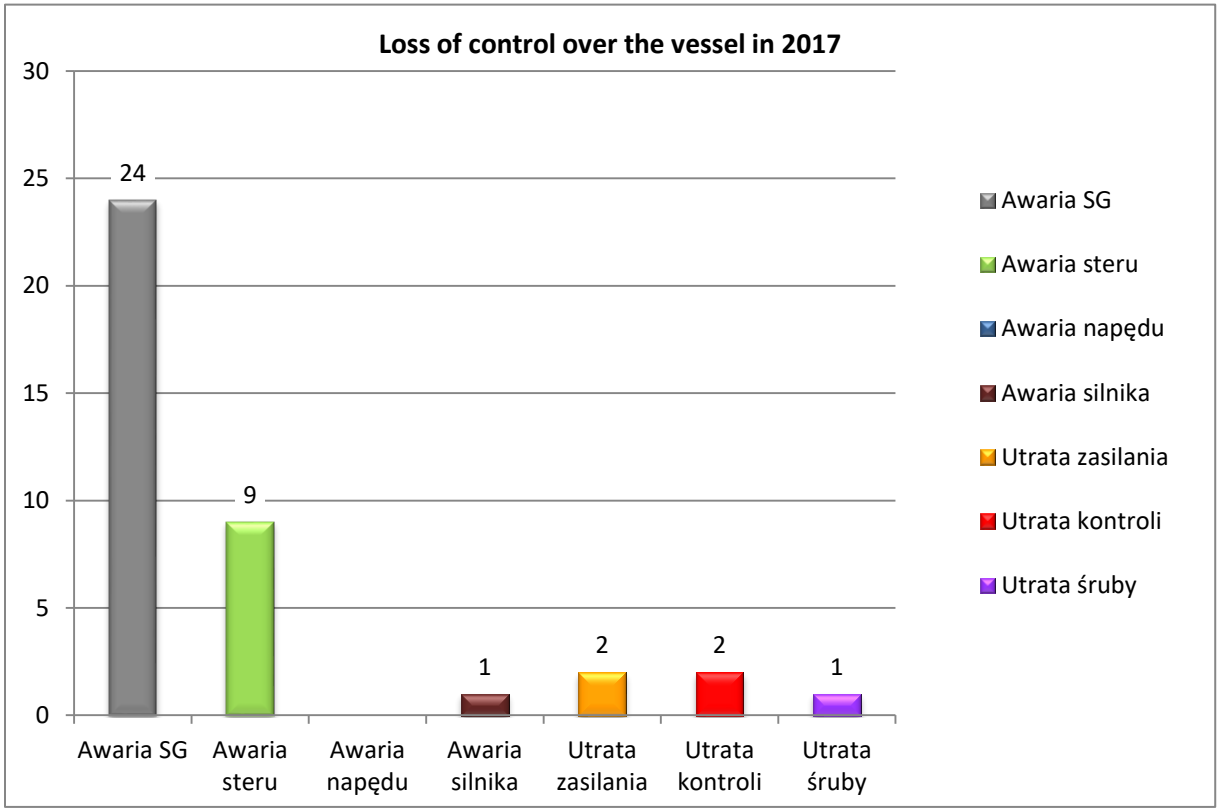


Figure 23: Loss of control over the vessel in 2017

Chart 28: From the left side of the chart:

Damage to the ME

Damage to the rudder

Damage to propulsion

Damage to the engine

Loss of power

Loss of control

Loss of screw

Figure 29 shows the per cent share of the causes of the loss of control over the vessel.

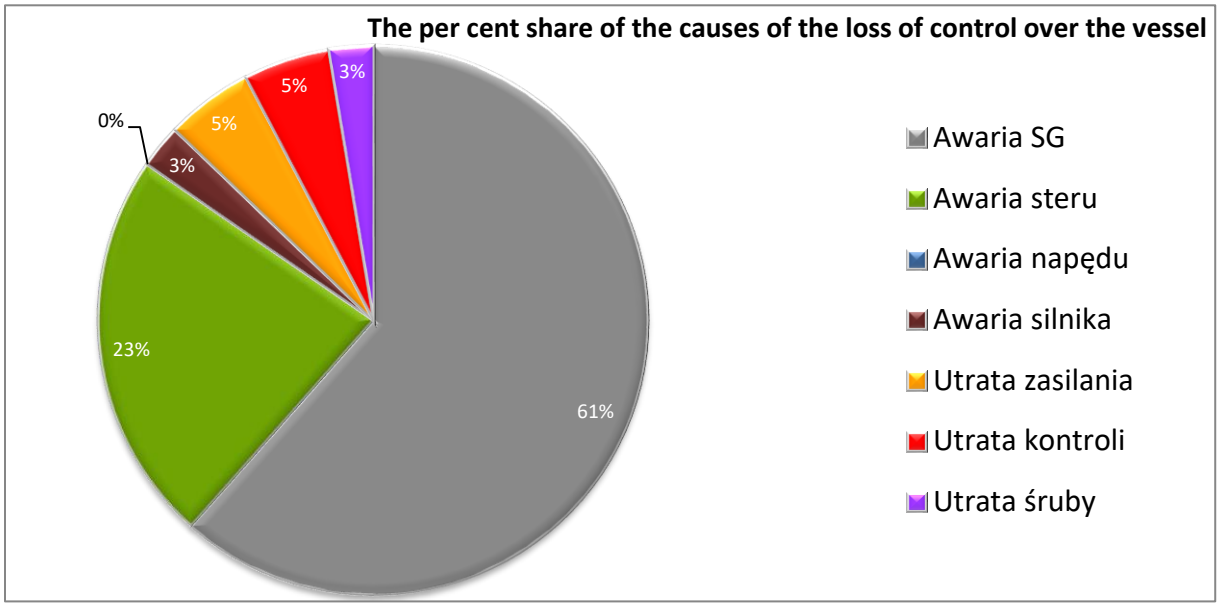


Figure 24: The per cent share of the causes of the loss of control over the vessel in 2017

Chart 29: From the top of the chart:

Damage to the ME

Damage to the rudder

Damage to propulsion

Damage to the engine

Loss of power

Loss of control

Loss of screw

12. Safety recommendations

In 2017 the Commission addressed safety recommendations that may contribute to the prevention of similar accidents in the future to 22 entities.

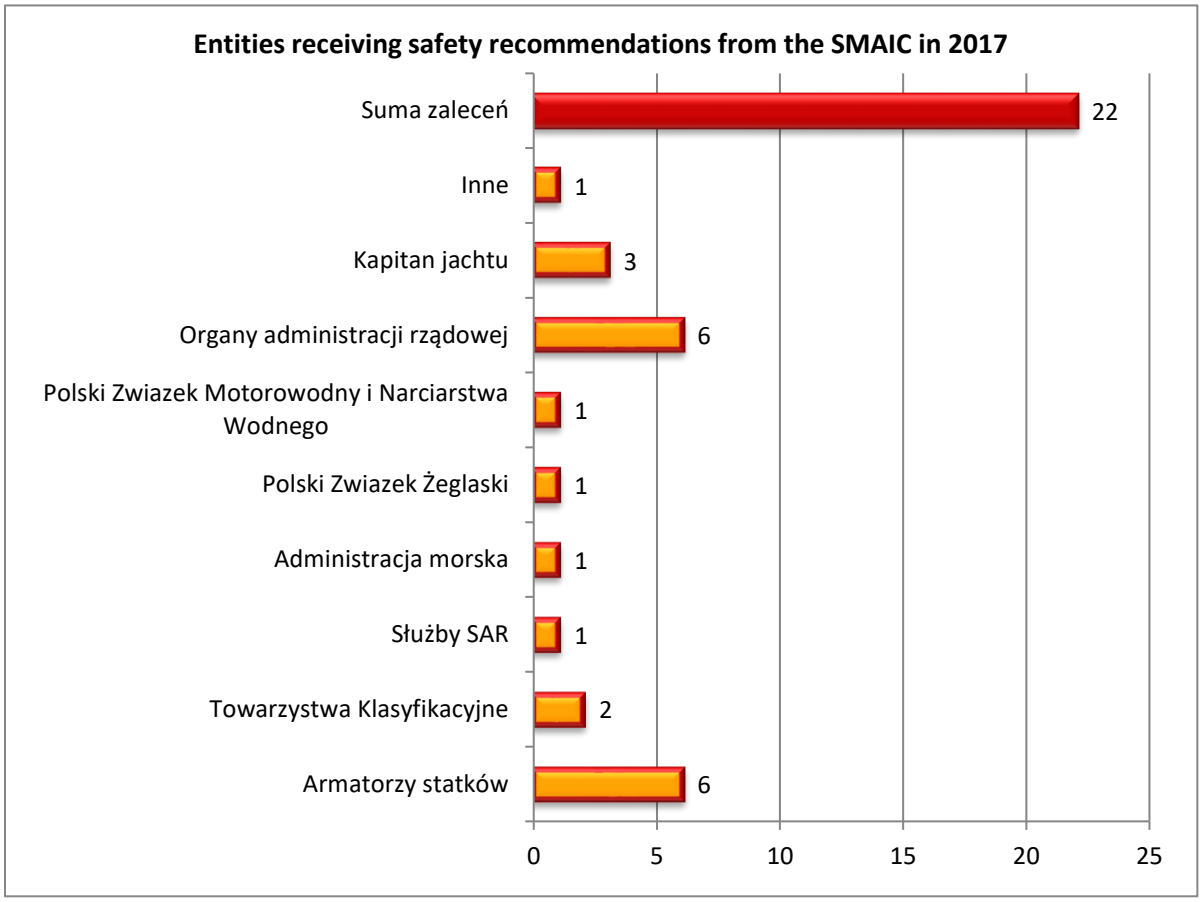


Figure 25: Entities receiving safety recommendations from the SMAIC in 2017

Chart 30: From the top of the chart:

Total number of recommendations

Other

Yacht's master

State administration organs

Polish Motor-boat and Water Ski Association

Polish Yachting Association

Maritime administration

SAR service

Classification societies

Operators

All recommendations were formulated in final reports of the Commission. In the total number of 17 reports published by the Commission 10 reports included such safety recommendations.

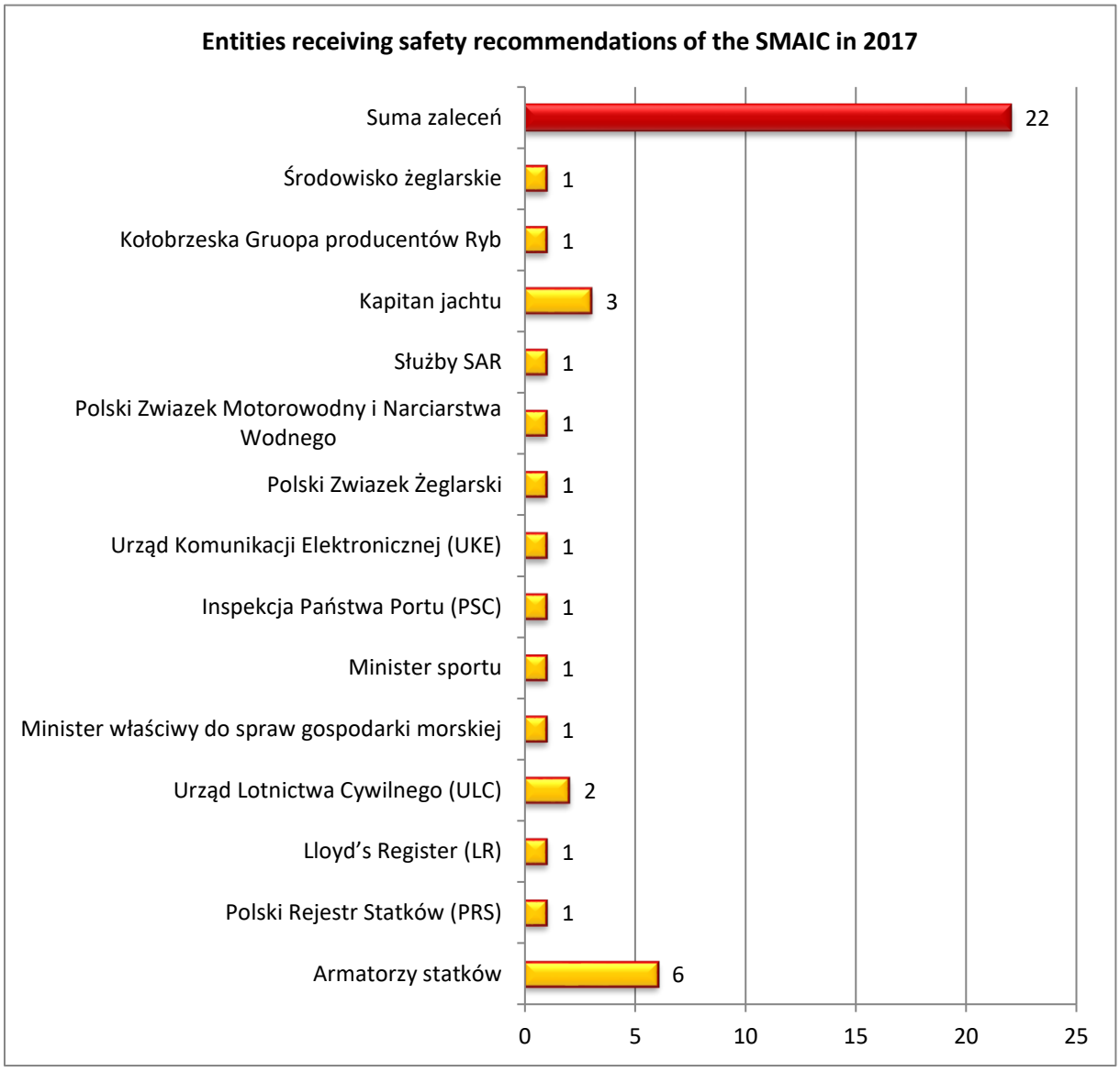


Figure 26: Entities receiving safety recommendation of the SMAIC in 2017

Chart 31: From the top of the chart:

Total number of recommendations

Yachting environment

Kołobrzeg Group of Fish Producers

Yacht's master

SAR service
Polish Motor-boat and Water Ski Association
Polish Yachting Association
Office of Electronic Communications (UKE)
Port State Control (PSC)
Minister of Sport
Minister responsible for maritime economy
Civil Aviation Authority (ULC)
Lloyd's Register (LR)
Polish Register of Ships (PRS)
Operators

The Commission has recognized that the annual report is a suitable publication to recall the most serious marine casualties investigated in 2017, and to emphasize the educational mission of the SMAIC, extensive fragments of reports related to the improvement of the safety of navigation were provided. In each case, the WIM number was included in order to make it easier to find the whole report on the SMAIC website (www.pkbwm.gov.pl).

WIM 44/15 – a serious marine casualty of the collision of *m/v Altamar* and *m/t Palica* in the port of Świnoujście.

As a result of the investigation the Commission has recognized that the collision on the fairway in Świnoujście could have been avoided, and the actions taken by the shipmaster and the pilot of *Altamar* were insufficient. The vessel's engine had been used too late and it did not prevent the collision.

The Commission has also drawn attention to the habit of using the pilot on board *Altamar* to control the vessel when entering the port that was incompatible with good seamanship.

The operator of *Altamar* carried out their own investigation of the casualty and analysed its cause. After the investigation the operator reminded the crews of all sister vessels in their fleet to use two pumps of the steering gear while navigating the river or manoeuvring with the use of manual control. Preventive actions of the operator consisted also in checking on sister vessels the correctness of alarm setting of the steering gear (Final report WIM 44/15 on *m/v Altamar* and *m/t Palica*).

WIM 44/16 – a marine casualty of the poisoning with hydrogen sulphide of 8 people on a fishing boat, *KOŁ-288* during unloading of fish in the port of Kołobrzeg.

As a result of the investigation, the Commission has considered it reasonable to address safety recommendations, which are proposals for actions that may contribute to the prevention of similar accidents in the future to the following entities:

- the Kołobrzeg Group of Fish Producers (Kołobrzeska Grupa Producentów Ryb, KGPR).

State Marine Accident Investigation Commission has recommended to the authorities of the KGPR company in Kołobrzeg to develop communication procedures between the crew of the vessel from which the fish is unloaded, the team operating the unloading device on the wharf (pump-separator set) and the dispatcher on duty at the KGPR dispatch centre. The manner and means of communication in place, telephone numbers (displayed in a prominent place on the wharf) known to all entities involved in the works related to fish unloading, should facilitate quick transfer of information in emergency situations.

- The operator of the fishing boat, *KOŁ-288*.

In relation to actions taken by the operator of the fishing boat, *KOŁ-288* after the casualty, consisting in:

1) supplying the boat, *KOŁ-288* with an electric power driven suction and blast device, which can be used to ventilate the hold when loose fish are unloaded,

2) purchasing a multi-gas meter, which may be useful for measuring the concentration of gases in the hold of the boat,

3) supplying the crew members of the boat with safety harness and recommending to use it while working in the hold, and their use while working in the boat's hold, and

4) including in the safety at work training program for crew members of the fishing boat (conducted by the entity selected by the operator as an employer to provide such training courses) issues related to the carriage of cargo in the hold of fish in bulk intended for feeding stuff and regarding proper conduct of the crew members when entering and working in the closed space, such as the boat’s hold. State Marine Accident Investigation Commission has departed from issuing recommendations that it had prepared in that regard during the investigation of the casualty.

WIM 49/14 - a very serious casualty of sinking of a recreational sea-going yacht, *Prodigy* in the Atlantic Ocean.

As a result of the investigation, the Commission has found that during the 9 years of operation of *Prodigy* there have been several serious failures and the yacht was constantly causing technical problems to the operator.

When changing the owner of *Filmar III* it was inspected by a specialist, who was the constructor of the yacht. However, despite numerous minor technical problems, the yacht has not been subject to any technical inspections (as they were not mandatory) either formally or informally. The checking of individual elements took place ad hoc and had a rather superficial character, as the yacht served personal recreation. In the course of the last lift by the Travelift hoist in San Miguel (Tenerife, a few months before the casualty), only cleaning and painting of the bottom was ordered, without detailed control of the condition of the underwater part.

On the basis of materials collected by the Commission, it has not been possible to clearly determine the cause of sinking of the yacht but during the investigation there appeared numerous hints that allowed for the formulation of restrictive hypotheses.

Prodigy did not sink as a result of force majeure or some external factors (however bad weather conditions were the reason for abandoning the yacht by the crew). The original causes of failure and sinking cannot be ruled out in any of the three areas: design, construction and operation.

It is not possible to indicate unambiguously documented facts related directly to the occurrence of a leak. It seems, however, that the most likely cause of sinking of *Prodigy* was the leak in the engine room (report). The Commission also indicates that the yacht's operator took the voyage in a rather unusual period of November and December and with a crew consisting of just two members that increased the risk.

The Commission also notes that, for security reasons, in the EPIRB registration form (Annex 4) filed with the Civil Aviation Authority, the operator or owner of the yacht should not give as their 24-hour contact a telephone number to the office or secretariat of their company or institution which usually work only a few hours during the day. The given contact should provide the opportunity to inform about the signal sent by the radio beacon not only the user of the EPIRB, who may no longer be able to pick up the phone, but to enable to reach a person who is able to provide information about the yacht that is equipped with that radio beacon and about its voyage.

WIM 46/15 – a very serious maritime casualty of a fire on a tug, *Zeus* during a stop at the port of Sölvesborg.

As a result of the investigation, the Commission has considered it reasonable to address safety recommendations, which are proposals for actions that may contribute to the prevention of similar accidents in the future to the following entities:

1. Shipping Services Company (Zakład Usług Żeglugowych, ZUŻ).

In connection with corrective actions undertaken by the operator of the tug, *Zeus* in the period between the casualty and the day of publishing the report, which fulfil the recommendations prepared by the Commission during the investigation related to the fire-fighting equipment on the tug and the alcohol policy in place, the Commission concluded that there was no need to formulate recommendations in that regard.

State Marine Accident Investigation Commission has recommended that Zakład Usług Żeglugowych Sp. z o.o. & Co. in Szczecin should do the following:

1) create a mechanism of control over alert training organized and carried out by tug masters, which will ensure that all crew members take part in these training regardless of individual operational tasks and functions performed on the tug;

2) correct the fire protection plan of *Zeus* in terms of the conformity of marks placed on it; the Commission stated that there was no manual button of the fire detection system installed on the tug, whereas the fire protection plan of the tug includes such indication.

2. Polish Register of Ships.

State Marine Accident Investigation Commission has recommended that the Polish Register of Ships S.A. should supplement Part V "Fire Protection" of the "Rules for Classification and Construction of Sea-going Vessels" with a retroactive requirement relating to tugs under the Polish flag and built before 1986 with crews of over 5 persons, to install fire detection and fire alarm systems in residential and working areas of tugs. The deadline for modernization should be adapted to the date of the next class renewal survey, but should not be longer than by the end of December 2018.

The Swedish Commission for the Investigation of Marine Accidents (SHK) also considered it reasonable to direct recommendations concerning safety, which are proposals for actions that may contribute to the prevention of similar accidents in the future to the following entities:

1. Municipal Rescue Service (Räddningstjänsten Västra Blekinge)

As the Municipal Rescue Service has taken appropriate actions resulting from the experience gained at the rescue operation in Sölvesborg (see Paragraph 6.1), the SHK decided not to publish any recommendations.

2. Emergency Centre (SOS Alarmcentral) Växjö.

SKH has recommended that the Emergency Centre should ensure that its operating personnel will be constantly ready to operate the equipment necessary for the tasks performed by the Centre.

3. Swedish Civil Rescue Agency (MSB).

The SHK has recommended that the Swedish Civil Rescue Agency (MSB), in cooperation with the SMA, STA and the Coast Guard should take actions to increase the knowledge of municipal emergency services on how to contact the bodies of state administration and local authorities with knowledge of shipping, when it is necessary.

WIM 23/16 - a very serious marine casualty of falling overboard and death of a member of the crew of a fishing boat, *KOŁ-28* in a fishery in the Baltic Sea.

As a result of the conducted investigation, the Commission has failed to determine the cause of death of a fisherman, because the autopsy of the victim was not performed. The Commission does not exclude that the cause of the fisherman falling overboard could be a sudden loss of consciousness resulting from poor health. The fisherman did not have a valid health certificate and did not have the required medical examination that would confirm his ability to work at sea. The lack of autopsy results made it impossible to determine the exact cause of death of the fisherman from *KOŁ-28*.

The Commission has considered it reasonable to refer to the operator of the fishing boat *KOŁ-28* a safety recommendation, which is a proposal of action that may help to prevent similar accidents in the future.

State Marine Accident Investigation Commission has recommended the operator of *KOŁ-28* that persons who do not have a health certificate issued by a licensed physician should not be allowed to work on a boat while fishing, and to check the validity of documents authorizing individual crew members to work at sea.

WIM 34/15 - a very serious marine casualty of falling overboard and drowning of the master of a recreational sea-going sailing yacht, *Quark* in the Bay of Pomerania.

The Commission has considered it appropriate to include in the annual analysis the extensive fragment of the Report 34/15 because it covers topics which relate to a large number of sailors who practice recreational sailing. With Polish legislation, the lack of legal conditions for the construction and provision of safety measures for recreational yachts and with regard to Polish culture of yachting, there are many casualties and incidents caused by ignorance,

unacquaintance with the sea, lack of knowledge and sailing experience or simply lack of common sense (recklessness).

As a result of the investigation, the Commission has concluded that the accident aboard *Quark* was caused by the master's failure to take precautions when walking on deck of the yacht, which was not fully prepared for sea navigation.

An important factor that had an impact on the casualty was inadequate provision of devices protecting the crew from falling overboard. When setting sail in a state as of 11 August 2015, the yacht formally did not breach the regulations regarding safe sailing, but the claim that *Quark* met all the requirements (including construction and equipment) of the national legislation authorizing it to sail on the planned route of the regatta should be considered misleading. The master of *Quark* only used the possibility provided for by Polish law of sailing in a vessel not longer than 15 m without the need to comply with the regulations defining safety requirements in terms of technical condition, including construction, equipment, sailing equipment, masts and rigging.

The Commission has recognized that the master of *Quark* could go independently on a lonely Baltic cruise on a yacht not meeting any requirements in terms of technical condition, but it is of the opinion that participation in a professionally organized sailing event should be controlled to some extent by experienced organizers, just to prevent such casualty that took place in the Baltic Polonez Cup Race 2015.

The fact that the master had put on a lifejacket and fastened the lifeline with a harness did not guarantee security with the wrong method of fixing them and inappropriate personal equipment, i.e. lack of footwear and handy signalling and communication devices.

The safety harness and the points for fixing them should be chosen so that they would not let a man fall overboard. The basic purpose of using the safety harness is to prevent falling overboard and not making it possible to swim (to drag oneself) to the yacht from which one had fallen. When working on a small vessel or on the edge of any yacht, it is necessary to use the shortest possible whisker booms, even if it prevents anyone from working in a comfortable, e.g. standing position.

The YB device, borrowed for the time of the regatta, allowed for sending the yacht position automatically by emitting an alarm signal (alert). No alert was sent from *Quark* and the YB device was mounted on the self-steering gear column (aft). This gave good visibility to the satellites but hindered manual handling, including, for example, sending a distress alarm.

In addition to the above-mentioned safety issues, the following four issues were considered by the Commission to be the most important findings of the marine casualty investigation of *Quark*: prohibited clauses in the regatta regulations, sharing of yacht plans for amateur construction, dissemination of information about sailing competitions and trainings for organizers of sailing events and sailors before the start of the regatta.

The clauses releasing the organizers of events, regatta and sea voyages from any responsibility and those transferring responsibility to a participant of the regatta, additionally obligating them to repair and cover all damages and costs incurred, including the costs of the rescue operation, should be considered unlawful. Despite the fact that the organizer of the event cannot be really responsible for all events that can happen at sea, it is unacceptable to explicitly exclude the responsibility for organization and course of the regatta, complete and without any preconditions, and may also lead to lowering the rank of issues related to maritime safety.

After the casualty of *Quark* its constructor prepared a comprehensive material illustrating the recommended methods of selection and fixing of safety harness and published it on his online blog. Similar materials were also posted on their blogs by other builders of "Setka", illustrating the solutions they applied.

More advanced versions of YB allow for the so-called automatic alerts, making it possible to send an alarm after indicated time, which would elapse from the moment it was manually confirmed that everything was in order.

Commercial sharing of yacht plans for amateur construction should be subject to the requirements of the Recreational craft Directive likewise the commercial production of crafts according to these plans. The intention of the regulations included in the RCD is to limit the number of crafts on the market that do not meet the essential safety requirements, while maintaining the possibility of single amateur construction of such yachts as exceptional situations. Professionally created and commercially available construction plans should not promote the construction of crafts that do not meet the requirements of the RCD.

Vessel Traffic Service (VTS) and local organs of maritime administration (including harbour master's and boatswain's offices), and through them the Naval Hydrographic Office issuing "Notice to Mariners", should be notified in appropriate advance by organizers of sailing events about the organization of such events, so that it would be possible to disseminate information about such a sailing event with the participation of many crafts, including single-handed sailors.

The Commission has also deemed it necessary to introduce regular training courses both for organizers of sailing events and for sailors with regard to methods of communication and cooperation with the SAR during the organization and duration of regatta and sailing cruises.

WIM 50/15 – a very serious marine casualty of capsizing of a commercial sailing yacht, *Alboran XIX Sabor* by the wave and drowning of two crew members at the approach to El Jadida.

As a result of the investigation, the Commission has concluded that the capsizing of *Alboran XIX Sabor* and falling overboard and drowning of two members of the crew most probably was a result of a disadvantageous position of the yacht in relation to the wind and wave, in the water region where there are rocky shallows that can cause swelling and breaking of waves.

The yacht found itself in such a place because it was in drift (deprived of mechanical drive) waiting for a tug. Due to discharging of batteries, electronic navigation systems were being turned on and off. The crew did not know current position of the yacht and had no knowledge of the nearby shallows and their possible impact on the surge and breaking wave. Also, the crew had no awareness of the risk of capsizing, never expecting the yacht to experience such a deep heel.

The Commission points out that break-downs disabling the engine are of particular importance in charter voyages where the crew is bound by a formal charter schedule and the crew generally does not know well technical solutions used on a chartered craft. Therefore, care for the condition of batteries during sea crossing should have no less priority than the direct operation of the craft.

The results of the investigation indicate that the lack of capstan cranks significantly disabled the crew from handling the yacht. According to the Commission, most certainly spare cranks should be kept on board the sea-going yachts, stored in a safe place.

Approaching the shore and the port, especially the unknown one, in particular when significant installations on the yacht are inefficient, one should have all possible navigational systems (including a battery-powered handheld GPS and supply of batteries) at hand and navigate the vessel as accurately as possible.

The Commission also recognizes that the attempt to save a person who has fallen overboard without using additional rescue measures is very risky, especially if it is taken by the master, despite leaving on board an experienced officer able to take over the command.

Due to a general nature of the conclusions reached by the Commission after analysing the materials obtained during the investigation of the casualty of *Alboran XIX Sabor*, the Commission has not considered it reasonable to address safety recommendations to specific entities that were related to that particular casualty.

However, the Commission submits for consideration to the owners or operators of yachts who charter them bareboat, the following more specific issues, whose fulfilment may contribute to the improvement of maritime safety:

- equipping electric installations with devices for monitoring the status of start-up and service batteries, equipping yachts with up-to-date and readable instructions, and a greater number of rescue measures that can be used in the event of a man falling overboard.

In addition the Commission recommends supplying chartered yachts with current sailing directions provided for the entire planned sailing area.

WIM 49/15 – a very serious marine casualty of falling overboard and drowning of the master of a sailing yacht, *Zita* in the Baltic Sea.

As a result of the investigation, the Commission concluded that falling overboard and drowning of the master of *Zita* was primarily caused by his being insufficiently cautious and failing to attach his safety harness to a fixed element on board.

The failure of the rescue operation was caused by the insufficient equipment of the yacht and the unpreparedness of the crew in terms of how to take a man out of water.

The failure of the rescue operation carried out by the emergency services was caused by the delay in effective notification about the casualty and the lack of a thermographic camera in the equipment of a helicopter used in the rescue action.

State Maritime Accident Investigation Commission, due to general nature of findings, has not considered it reasonable to address safety recommendations to specific entities that could contribute to improving maritime safety, but draws (in particular) sailing environment's attention to the following issues:

1) technical efficiency in dealing with a man overboard is just one of factors of a successful rescue action; the success of the whole action depends also on the preparation of equipment and the procedure adopted for taking a man on board;

2) to save a castaway, the selection of additional equipment of a life belt or life jacket may be decisive, as well as the knowledge of the details of that equipment by both the survivor and the rescuers, and the ability to use it in practice;

3) the very fact that a life jacket complies with applicable regulations is not sufficient to ensure safety to its user in all circumstances; users of life jackets must assess their own requirements concerning the type and equipment of a life jacket depending on the type of navigation expected, and make the right choice.

WIM 22/16 - a very serious marine casualty of the fire and sinking of a sailing yacht, *Miracle* in the Atlantic Ocean.

As a result of the investigation, following the analysis of the events that took place after the fire had been detected on board *Miracle,* the Commission has found out that the behaviour of the crew was correct and the action of abandoning the yacht was carried out efficiently and professionally. The master made a quick and proper decision to evacuate the crew to the raft, he used his experience in abandon-ship drills, which prevented panic, facilitated evacuation and saved everyone from sustaining injuries when leaving the yacht.

As a result of the investigation, the Commission has determined that fire, induced most likely by damage to the storage battery electric installation on board and a contact of the live wire with the metal structure of the yacht's hull, was the cause of sinking of *Miracle*. Long-term effect of the raised temperature on the foam insulation of the yacht and its wooden equipment caused the ignition of these elements.

The Commission has also noted that the installation of GMDSS equipment on *Miracle* was not completely safe. Devices that are used to call for help at sea should not be connected in such a way that shutting off the power supply to electric equipment with the main switch would cause the disconnection of power supply to the GMDSS devices making it impossible to send a distress message.

The master of the yacht, after the first power supply turning off, shortly after noticing the fire, had to turn on the power again in order to send the automatic Distress Fire message by VHF radio. However, on account of previous turning off the power supply, the device did not manage to determine the position and the message went out without the GPS coordinates of the yacht, which caused some difficulties when the British Coastguard was directing other rescue units to the action.

However, due to recurrent fires on small yachts, both recreational and commercial ones, bearing in mind that sea-going yachts are currently equipped (regardless of their age) with a very large number of devices powered by electricity, and bearing in mind the lack of sufficient knowledge and awareness of many users of sea-going yachts, in particular steel yachts, about

fire risk during their use, the Commission has considered it reasonable to formulate safety recommendations, which are proposals for actions that may contribute to the prevention of similar accidents in the future.

The Commission draws attention to the following reports it has made: WIM 22/13 regarding the fire of the yacht, *Miss Alicja* in the port of Gdańsk and WIM 29/14 regarding the fire of the yacht, *BGSPORT* in the Marina Gdynia.

State Marine Accident Investigation Commission has recommended that the authorities of the Polish Yachting Association and the Polish Motor-boat and Water Ski Association should undertake activities consisting in dissemination and promotion of knowledge about fire hazards occurring on board sea-going yachts in professional bulletins and periodicals related to sailing and motor-boat sports.

Among the issues that should be addressed mainly to operators and owners of yachts, in particular there are the following:

1) the need to test, at least once a year, the condition of the electrical system insulation and review of the installation (wires, fastening, electrical sockets, etc.) and electrical appliances installed on the yacht;

2) the need to check compliance of the construction of the yacht's electrical system (including selection of cables of appropriate cross-section and their insulation) and selection of protection measures with existing documentation and currently installed devices - in the case of purchase of a yacht or reconstruction (modernization) of the installation;

3) the need to store on the yacht schematic diagrams of wiring, operating manuals (DTR, manuals) of electrical equipment installed on the yacht, their updating and to oblige masters and crew members to get acquainted with them;

4) to install or repair damaged equipment by authorized persons, with appropriate qualifications or by authorized service units; works of this kind should be completed with the preparation of the acceptance report, which should be kept by the operator.

The Commission also submits a matter of sharing basic electrical engineering knowledge - in the course of trainings for higher ranks in sailing - related to power sources, electrical installations, battery-powered and low-voltage electrical connections (up to 230 V), including fire safety on yachts and safety of service, for consideration of the authorities of both sport associations.

WIM 90/16 - a very serious casualty of falling from the stairs and death of a chief engineer on board a sea-going tug, *Ikar* in the port of Rotterdam.

As a result of the investigation, the Commission has concluded that the death of the chief engineer of *Ikar* was caused by a fall from the stairs. The fall caused head and chest injuries. As a result of these injuries, in spite of medical help, the man died in the hospital. The Commission failed to establish the immediate cause of the fall.

In order to determine the factors that could have influenced the accident, the Commission was successively rejecting the following options:

1) alcohol was excluded by the Dutch prosecutor's office as a factor influencing the casualty; the alcohol content was below 0.1 ‰; the information obtained by the Commission shows that during a stop of the tug in Dordrecht the chief engineer spent the night aboard the tug and did not go ashore and that there was no alcohol on the tug, and generally there is an obligatory no alcohol policy on the tug of this operator;

2) according to the Dutch prosecutor's office after taking a deposition, no third party contributed to the fall;

3) nothing indicated fatigue as the cause of the fall, because the crew had spent the night preceding the accident in the port, and the work began the next day, at 7:00;

4) external conditions, in this case weather conditions, according to the Commission, were not the factor that caused the fall; according to the opinion of the Dutch prosecutor's office due to the departure of the tug beyond the exit heads, the victim could have lost his balance and fell, however, it results from the depositions obtained by the Commission, that the fall from the stairs when going up or down and facing the stairs (as the chief engineer usually did) is always directed towards the steps, not the opposite.

According to the Commission, the most likely cause of the fall was an orthostatic fainting which occurs when the body suddenly moves from horizontal to vertical position. Such a case could have taken place on *Ikar* on 31 December 2016, because another crew member had seen the chief engineer a while before, when he was lying in his bunk, in the cabin next to the stairs he had fallen from. When he fainted he could have fallen down the stairs backwards onto the deck.

In addition, the Commission has noted irregularities related to the transportation of the victim from the lower (residential) deck to the ambulance. According to the information obtained during the investigation, the medical rescuer who arrived on the SAR craft and came

on board decided that the chief engineer would walk unaided up the stairs from which he fell. In the light of general knowledge about injuries that may occur as a result of a fall, including the fall from a height, and according to guidelines for crews and Polish health and safety principles, when assisting a person who has suffered possible internal injuries of unknown scope, especially within the head (as indicated by blood coming out of the ears of the victim) the injured person should not be moved without immobilizing on a board, so as not to cause additional trauma.

WIM 39/15 – a very serious marine casualty of damaging the sheathing of the hull of a vessel, *Green Egersund* and spillage of fuel during wharfing in the port of Gdynia.

As a result of the investigation, the Commission has concluded that the use of three tugs by *Green Egersund* when entering the *SMW-1* floating dock in Gdynia did not prevent the hull of the vessel from hitting the side wall of the floating dock, piercing the sheathing of the hull and oil spill.

The "Docking Instructions" issued by the Naval Shipyard leave it to the decision of the master, who is responsible for towing operations in front of the dock, to choose the method of approaching the dock, the number of tugs and the manner in which they are used. According to the Commission, the deployment of tugs in the prevailing weather conditions when *Green Egersund* was approaching the dock was correct, but the commands given to tugs, or rather the lack of some commands caused the vessel's stern to move in an uncontrolled way and the hull hit the foundation of the mooring bollard at the side wall of the dock.

At the same time, the "Instructions" specify that the dockmaster bears responsibility for towing of the vessel but they assume it from the moment when the crew of the vessel takes towlines from both side walls of the dock and fix them on bitts on the deck. When a moving vessel is entering the dock and the towlines are given from the dock from another trolley (hoisting winch) from each pair of trolleys on the dock, this moment usually occurs when the vessel's stern is within a dozen meters from the dock's front.

The "Docking Instructions" of the shipyard do not prohibit to stop the vessel before entering the dock. Entering the dock without stopping the vessel resulted from practice used over the years by the employees of the Naval Shipyard and pilots bringing in the vessels.

The Commission has found out that the master of *Green Egersund* did not draw the pilot's attention to the fact that it would have been safer to stop the vessel and give towlines to the side

walls (or take them from side walls) to stabilize the vessel in the axis of symmetry of the dock and then begin entering the dock.

The Commission has considered that the correct and most secure way of entering a vessel stern to into the "SMW-1" dock should be in the company of two or three tugs (depending on the propulsion capability of the vessel) assisting the vessel near the dock, where the vessel should stop in front of the line of side walls (in case of a vessel without propulsion by means of a tug at the bow), mooring lines should be passed from the dock to the vessel (stern) from dock capstans through the mooring pipes which are found on each of the side walls at the edge of the dock, put on the poles at the stern of the vessel and resume pulling the vessel by the stern tug while correcting by means of capstans the position of the stern in the axis of symmetry of the dock.

Such operation should be continued until the vessel's stern reaches the position in the dock, in which the crew could take the towlines attached to the trolleys (winches) intended for pulling the vessel into the dock. Once these lines have been fastened, the crew should drop the towline of the tug that is hauling the vessel into the dock and further operations of setting the vessel in the dock should be carried out using lines from the dock or from the vessel as is currently the case.

With regard to the actions carried out by various entities immediately after the leakage of fuel overboard, the Commission has considered that the deployment of an oil spill containment boom near the "SMW-1" dock was delayed and caused the spilled fuel to flow out of the shipyard waters, polluting water and wharfs of the inner port in Gdynia. The shipyard's Rescue Service neither had the oil boom at their disposal nor had they means and abilities to set it. The actions of the Shipyard's Rescue Service were limited to neutralizing and gathering spilled fuel at the dock itself.

Quick deployment of the oil spill containment boom by the employees of the Shipyard's Rescue Service arriving at the site after only a few minutes would have stopped and certainly reduced the spread of oil spill and prevented significant pollution of port waters and wharfs. There was a long response time when the dispatcher of the Naval Shipyard sent "Bonex" (the specialist company cooperating with the Shipyard) to the site, and it increased the threat to the environment in port waters as a result of the spill.

At the same time, the Commission has acknowledged that efficient operations carried out just after the accident by the Inspector for the Maritime Environmental Protection of the Maritime Office in Gdynia contributed to protecting the port from even greater pollution.

State Maritime Accident Investigation Commission has considered it reasonable to address safety recommendations, which are proposals for actions that may contribute to the prevention of similar accidents in the future to the following entities:

1. The operator of the "SMW-1" floating dock.

State Marine Accidents Investigation Commission recommends that the official receiver of the Naval Shipyard S.A. in bankruptcy liquidation in Gdynia should take the following actions:

1) make changes to the "Docking Instructions for the Floating Dock 8000T" ", which would specify in greater detail the way of docking the vessels in the "SMW-1" dock, taking into account the need to stop the vessel before reaching the front of the dock and to pass additional lines from the dock to stabilize the lateral movement of the stern (bow) of the vessel until the mooring lines are passed from the dock and secured;

2) to secure properly all protruding elements of the dock, such as the foundations of the mooring rolls on both side walls so that the vessel would not be exposed to damage:

3) To equip the Shipyard Rescue Service with necessary floating equipment for immediate deployment of oil spill containment booms in case of the leakage of fuel from vessels coming in or out of the floating dock or being in the dock or being repaired in the shipyard and to train their personnel in the deployment of the booms unaided.

2. The operator of tugboats taking *Green Egersund* in tow.

State Marine Accidents Investigation Commission recommends that the "Fairplay Towage Polska Sp. z o. o. Sp. k." company in Gdynia should check whether AIS devices of their tugs used in the Port of Gdynia have been installed correctly, including in particular *Mars* and *Fairplay VII* tugboats, from where the data were transmitted irregularly and at large intervals, non-compliant with ITU-R M.1371-3 protocol.

In the case of *Fairplay IV* whose AIS device did not transmit data at all during docking of *Green Egersund*, the Commission recommends that the AIS device mounted on that tugboat should be repaired or replaced, or on checking the reason for the lack of AIS signal on 28 August 2015, and determining that the device had not been switched on, the skipper should be instructed to keep the device ready at all times.

WIM 84/16 - a very serious marine casualty of the death of a crew member of a vessel, *Daan* while closing the cargo hatch in the port of Szczecin.

As a result of the investigation, the Commission has positively assessed actions taken by the operator of *Daan* after a very serious marine casualty which was the death of a crew member during the operation of closing the cargo hatch on 2 December, 2016. Health, Safety, Environment and Quality Management Department of the vessel's operator (HSEQ Department), in accordance with the requirements of ISM SMS, carried out an internal investigation of the causes and circumstances of the casualty. The investigative team developed an internal report of that tragic event published in the document "Fatal Incident with Hatch Crane - *m/v Daan*". The document describes in detail the course of events and corrective actions of the operator that are to contribute to the prevention of similar casualties in the future. The recommendations prepared by the vessel's operator investigative team meet the Commission's expectations as to increasing the safety of the vessel and crew while working with an overhead crane. The Commission departed from formulating safety recommendations for the operator of the vessel.

WIM 72/16 - a very serious marine casualty of capsizing and sinking of a sailing yacht, *Perła Gdynia* in the Indian Ocean.

As a result of the investigation, the Commission has recognized that the capsizing and damage to the yacht, *Perła Gdynia*, and consequently its abandonment and sinking, was caused by external force, most likely by the encounter with an exceptionally high and/or steep wave or a collision with a whale that hit the underwater part of the yacht.

The builder (at the same time the operator and master) of *Perła Gdynia* has not kept calculations of the yacht's stability or the results of stability tests, consisting in tilting the finished yacht on the water of the port basin. Nevertheless, one can assume that the capsizing of the yacht was not caused by typical conditions in which the stability criteria apply, i.e. the wind pressure on the sails and the wave height typical for a given wind force. Therefore, taking the effort and recreating all parameters of the hull seems worthless due to the inaccessibility of the wreck.

The yacht, *Perła Gdynia* capsized, perhaps due to the action of the wave, while it was in a drift under sail and with a parachute drift anchor thrown from the bow in strong but not stormy wind.

Various sailing practitioners recommend different ways to stabilize a yacht in a drift, including, for example, setting up a storm staysail on the afterstay. One of the conclusions of a comprehensive study of the use of a drift anchor developed by the U. S. Coast Guard

recommends that sailing yachts with a fin keel would throw a drift anchor from the stern rather than from the bow.

Polish maritime administration does not currently require yachts to carry drift anchors but it is required by the classification regulations for the equipment of yachts engaged in the deep sea navigation (RCD category "A"), adopted by Polish Yachting Association.

State Marine Accident Investigation Commission has considered it reasonable to address safety recommendations, which are proposals for actions that may contribute to the prevention of similar accidents in the future, to the master of the yacht.

Individual design and construction of a yacht intended for single-handed ocean sailing should be conducted on the basis of proven plans and under the supervision of people or institutions that are qualified to assess whether the final product meets the minimum requirements for stability, durability and unsinkability of the craft being built.

WIM 69/17 – a serious marine casualty of damage to the Main Switchboard in the engine room of a vessel, *Enforcer* in the port of Gdynia.

As a result of the investigation, the Commission concluded that the failure of the main switch, NF800 - SEP of the SP 1 generator and at the same time the deprivation of functional qualities of MSB on *Enforcer* did not have serious consequences because the vessel was moored in the port. A similar accident during a sea voyage could have much more serious consequences for the vessel. This is indicated by the fact that it was no one else but the service company, which after removing defective components, made appropriate electrical connections within MSB aimed at adapting MSB to safe work, replacing in the MSB work organization structure the function of SP 1 unit for SA unit.

The Commission has found out that, with very high probability, the failure of the switch of the generator No 1 of the SP 1 unit was due to the accumulation of mechanical and electric wear, as a result of a long-term operation of the device in difficult working conditions resulting from the specific nature of the vessel's operation as a feeder. The damage did not occur as a result of poor selection of that electrical apparatus or poor operation, including operation on the day of the accident, and it was not caused by service errors.

Comparing the service life of the switch exchanged in the past, after 10 years of operation and a similar switch replaced on 28 July 2017, damaged after 4 years of operation, it is advisable to pay attention not only to the operation time but also to the number of turns of the switch.

Since the safety of the vessel and its crew closely depends on the reliability of the power system of the craft, one should pay attention, particularly with the specific nature of shipping "feeders", to the huge role of training of the engine crew in the field of:

- construction and operation of electrical components, their lifetime, dependence of the equipment condition on the type of their operation and causes of damage,
- compliance with inspection plans and their impact on the safety of crew and a vessel, MSB inspections with special attention to time and intensity of work of circuit breakers with mechanical components,
- deepening knowledge of the electric power system of the vessel by marine engineers, in particular when there is no electrician employed on board.

WIM 76/16 - a very serious marine casualty of fire and sinking of the sailing yacht, *Sunrise* in the Baltic Sea.

As a result of the investigation, the Commission has concluded that fire and, eventually, sinking of the yacht, *Sunrise* probably occurred as a result of a short circuit in the 12V electrical installation. In the absence of the possibility of investigating the wreck, it is impossible to clearly indicate the location of the short circuit and the place where the fire started.

As the Commission has found irregularities in the use of electronic communication equipment during the investigation, as well as significant negligence, State Marine Accident Investigation Commission has considered it reasonable to address safety recommendations, which are proposals for actions that may contribute to the prevention of similar accidents in the future, to the following entities:

1. The master of the yacht.

It has been recommended to the yacht's master:

- to carry out repairs of the telecommunication equipment when the yacht is in a port, preferably by persons who are qualified for this type of repairs,
- to get acquainted with the procedures of dialling emergency numbers using a telephone in satellite networks, in particular the Inmarsat.

2. Maritime Search and Rescue Service.

State Marine Accident Investigation Commission has recommended to train operational inspectors on the importance of MID 970, 972 and 974 codes in the MMSI guidance devices to correctly interpret the appearance of such objects in the ACTIVE mode,

- to investigate and, if possible, ensure synchronization of clocks in call recorders on various communication channels with Search and Rescue Service in Gdynia.

3. Urząd Lotnictwa Cywilnego (Polish Civil Aviation Authority)

State Maritime Accident Investigation Commission has recommended:

- to provide instruction on how effective the contact data given in the PLB registration form are (the unwelcome consequences of not giving the telephone number available 24 hours a day).

WIM 60/16 - a serious marine casualty of fire on a truck on the car deck of a passenger and car ferry *Stena Spirit* at the approach to the port of Gdynia (Photographs 4, 5, 6, 7).

As a result of the investigation, the Commission concluded that, according to statistics, including those conducted by the European Maritime Safety Agency (EMSA), the number of fires on ro-ro vessels has not decreased in recent years. These fires are much more dangerous and difficult to control due to the open cargo spaces and the nature of the transported cargo - cars, semi-trailers, wagons whose failure or poor technical condition may cause fire.

State Marine Accident Investigation Commission has considered it reasonable to formulate safety recommendations, which are proposals for actions that may contribute to the prevention of similar accidents in the future and to address them to relevant entities.

Recommendations addressed to the operator of the vessel and its classifier shall also be sent by the Commission to the maritime administration of the flag state of the vessel - the Bahamas.

1. The operator of *Stena Spirit.*

State Marine Accident Investigation Commission has recommended the operator - Stena Line Scandinavia AB:

1) to submit *Stena Spirit* to inspection with regard to verification of the structural fire protection for compliance with the requirements of the SOLAS 74 Convention and to remove detected incompatibilities;

2) to inspect the ventilation system of generally accessible passenger rooms, aimed at detecting the causes of large smoke appearing during the accident inside the vessel in the passenger muster stations;

3) to improve the vessel's fire protection plan, including adaptation and supplementation of graphic symbols required in accordance with the IMO Resolution A.952 (23) in such a way as to reflect the vessel's compliance with the applicable SOLAS Convention requirements;

4) to design escape routes of adequate width in the car spaces, leading from the most distant place to the exit door from the room, ensuring safe evacuation of passengers of transported cars, and access of rescue teams in the event of fire and rescue operations;

5) to develop emergency procedures for taking firefighting action in the event of a car fire in the car room, in such a way as to specify all activities that should be undertaken by the crew after the detection of fire, including: ventilation shut-off, closing of ventilation ducts, activation of the appropriate section of the sprinkler installation, closing and securing the entrance door of staircases for passengers;

6) to add in the procedures for the crew regarding loading refrigerated trucks onto the vessel and supervising them during the journey of the vessel (SMM-0187) or concerning fire patrols (SOM-050), the requirement to immediately call the driver of the vehicle in case of smoke (fire) detection and identification of the car as a source of smoke (fire);

7) to take into account in the vessel's procedures and in the alarm schedules additional activities for the crew (scope of duties of individual crew members) during firefighting in case the vessel is getting ready for manoeuvres or is in the process of the port entering manoeuvres;

8) to conduct on the vessel by an institution authorized to conduct fire training, additional training and fire drills for the crew in the scope of conducting firefighting in car spaces, including, in particular, extinguishing fires of electrical installations and cooling aggregates of transported vehicles;

9) to correct the operating instructions for the sprinkler system so that the numbering of the installation sections would correspond to the numbering indicated on the fire protection plan;

In addition, the Commission has recommended to consider the use of such structural solutions in car spaces that would:

a) eliminate in the future the possibility of unauthorized opening of the doors to car spaces, for example such as: disconnection of the function of automatic door opening once the fire detection system has been activated or adding the re-locking of the passenger entrance door as a remote function activated from the bridge, while ensuring that the crew may open each door and enter these premises, e.g. by using a code or a magnetic card,

b) prevent possible leakages of flammable liquids from the pipelines running under the ceiling to working refrigeration units of transported vehicles (for example metal shields).

2. Classifier of *Stena Spirit.*

State Maritime Accident Investigation Commission has recommended that Lloyd's Register, approved by the Bahamas – the flag state of the vessel, should approve vessel's safety plans, check fire protection plans of *Stena Spirit* for compliance with international requirements of the SOLAS Convention on fire protection for ro-ro vessels and in the case of irregularities, ask the operator to correct them.

3. Port State Control (PSC).

State Maritime Accident Investigation Commission has recommended that the inspectors of the Port State Control should carry out an inspection regarding technical safety of the structure and equipment of *Stena Spirit*, for compliance with the applicable SOLAS Convention requirements.

The inspection should include checking the structural division of individual zones, passages between them, securing openings in partitions between the zones, taking into account the fact that during fire smoke from the cargo space penetrated the passengers zone and muster stations.

The inspection should also include verification of the fire protection documentation (fire protection plan, maintenance of fire-fighting equipment plan) and provisions regarding periodic firefighting training and drills on vessels.

4. Minister competent for maritime economy.

State Maritime Accident Investigation Commission submits to the minister responsible for maritime economy for consideration the presentation in the SSE (Safety Systems and Equipment) Sub-committee of the International Maritime Organization (IMO) of the following proposals for amendments to the SOLAS Convention concerning additional fire safety requirements for ro-ro passenger vessels - newly built:

1) in the ro-ro cargo spaces, all electrical cords, pipelines of hydraulic systems and cables of other systems having a significant impact on the safety of vessels, installed under the ceiling, should be protected by a steel cover against damage due to fire of vehicles in these premises; instead of using covers for electric cables, such cables may be made as fireproof;

2) in the ro-ro cargo spaces on the car deck separate parking rows should be designated for parking (setting) refrigerated vehicles and adequate space should be provided for access to attend (control) these cars during the voyage of the vessel; the passage from one side of the designated row of vehicles should at least allow the firefighter to conveniently reach the car in the breathing apparatus and protective clothing during firefighting and rescue operations in emergency situations, such as car fire.

WIM 76/16 - a very serious marine casualty of damage and sinking of a sailing yacht, *Regina R* in the Pacific Ocean.

As a result of the investigation, the Commission has concluded that abandoning and most likely sinking of the yacht *Regina R* probably occurred as a result of a mechanical failure of rudder bearing elements. In the absence of the possibility of exploring the wreck, it is impossible to clearly indicate the place and the exact cause of the failure.

Regina R was abandoned by the crew and most likely sank as a result the sequence of a sequence of events initiated by the mechanical failure of the rudder, which occurred on the turbulent and less frequented part of the ocean, where it is difficult to get help from outside.

In the case of *Regina R*, it is currently impossible to ascertain beyond any doubt neither the primary cause of the loss of the rudder, nor whether the yacht's master - without calling for help - would be able to produce an emergency rudder and lead the yacht to the port of refuge or near the land, where towing would be possible. For 5 days after the failure, and for 2.5 days from losing the rudder - until the moment of meeting the vessel m/v *Key Opus* and experiencing breaking of the mast and damage to the side, the master had been certain that outside help was indispensable.

The Commission has found that the lack of coordination between m/v *Key Opus* and s/y *Regina R* resulted mainly from the inability of the yacht's master to radio communicate effectively in English. This incapacity was encountered both by the crew of the aircraft, *Orion P3* and by the crew of *m/v Key Opus*. In this situation, the Rescue Coordination Centre New Zealand and the crew of *m/v Key Opus* independently decided on the method of providing assistance, adopting the safest option for the person calling for help, while maintaining the safety of the crew of their own vessels.

It should also be pointed out that the yacht master showed lack of consistency in assessing the situation and leaving the initiative completely to the rescuers. As a result, there was a dangerous situation, threatening people on both crafts during the contact of the yacht with the vessel, and the drifting yacht was left without the crew and without ensuring that it would sink rapidly.

Because of the distance from land, it was probably impossible to avoid the loss of the yacht, and in any case, continuation of sailing would involve excessive risk for the master. Possible assistance other than evacuation of the master from the yacht was not possible due to

insufficient equipment of the yacht with long-range communication means and insufficient skills of the master in the use of English. For recreational yachts that have not undergone voluntarily inspection, there is no communication equipment required, but undertaking deep-sea navigation without any options of communication with the mainland is not recommended as the master of *Regina R* and people supporting his voyage from the land could see earlier during the passage to Australia, when the yacht had been considered belated.

State Marine Accident Investigation Commission has considered it reasonable to address safety recommendations, which are proposals for actions that can contribute to the prevention of similar accidents in the future, to:

1. Civil Aviation Office (Urząd Lotnictwa Cywilnego, ULC).

State Maritime Accident Investigation Commission has recommended:

- to provide instruction on how effective the contact data given in the EPIRB registration form are (the unwelcome consequences of not giving the telephone number available 24 hours a day).

Compare the SMAIC report on the casualty of the yacht, *Perła Gdynia*, WIM 72/2016 and the method of abandoning yacht described there.

Due to the hull length less than 15 m and its recreational character, the yacht was neither subject to mandatory technical inspections nor was it submitted to voluntary inspections.

2. Office of Electronic Communications (Urząd Komunikacji Elektronicznej, UKE).

State Maritime Accident Investigation Commission has recommended:

- to consider restoring the obligation to carry a certificate of the radio equipment operator when registering these devices on board recreational yachts;

- to increase the emphasis in the SRC/LRC/GMDSS operator training programs and examinations s on the correct use of the Cospas-Sarsat locator beacons, including the need to leave the radio beacon switched on until the relevant RCC would clarify the situation.

3. The Minister of Sport.

- to consider the requirement of holding at least the SRC/LRC/GMDSS operator certificate and having the command of English corresponding at least to the proficiency of a GMDSS operator to obtain the license of a yacht master.

4. Master/owner of the yacht.

State Maritime Accident Investigation Commission has recommended:

- to rebuild the yacht and change its construction on the basis of proven plans and under the supervision of people or institutions that are qualified to assess whether the final effect of the reconstruction meets the minimum requirements in terms of strength,

- in the case of intending to circumnavigate the globe singe-handed once again on a recreational yacht:

1. to obtain the authorization to perform radio duties in the field of LRC in the operation of telecommunication devices enabling to receive navigational and meteorological warnings, correct handling of the EPIRB, correct correspondence in danger and communication e.g. with support of the voyage on shore;

2. to install telecommunication devices enabling communication from any place of the designated route of the yacht with the shore.

13. Annex – comparative statistics 2013 – 2017

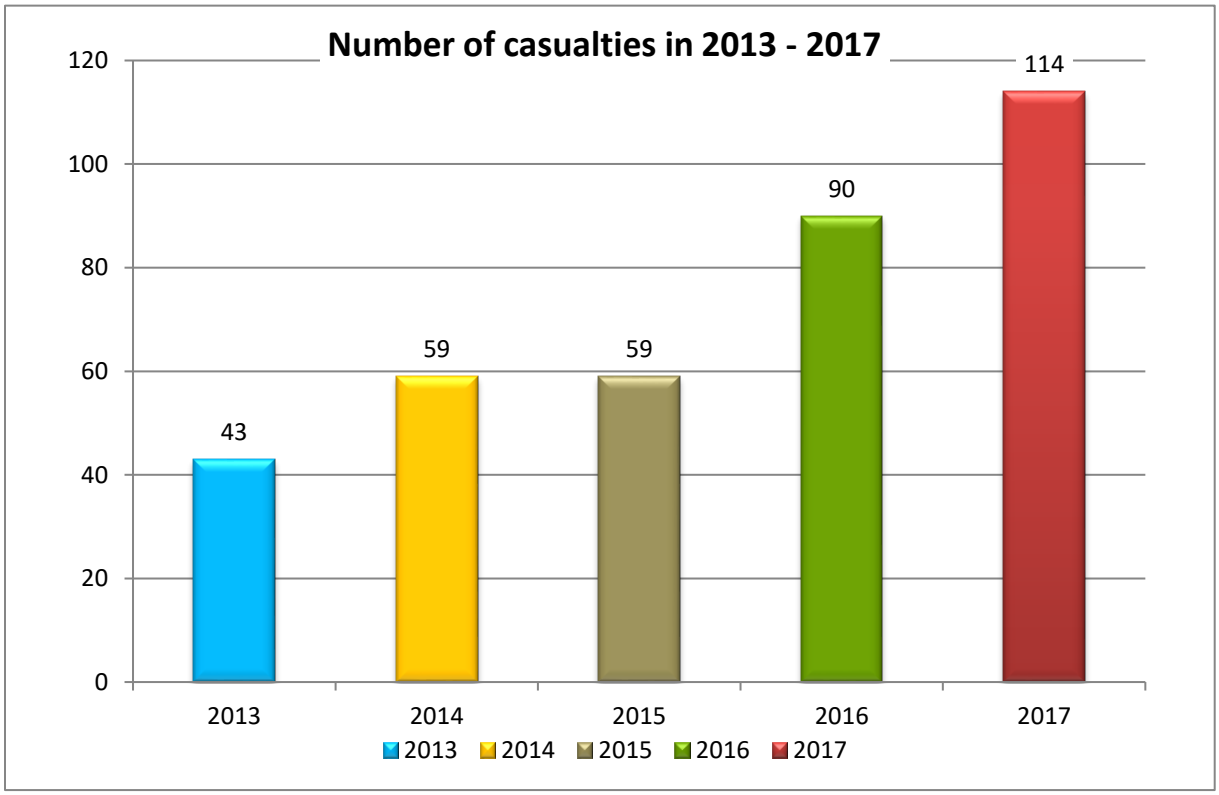


Figure 27: Number of casualties in 2013 - 2017

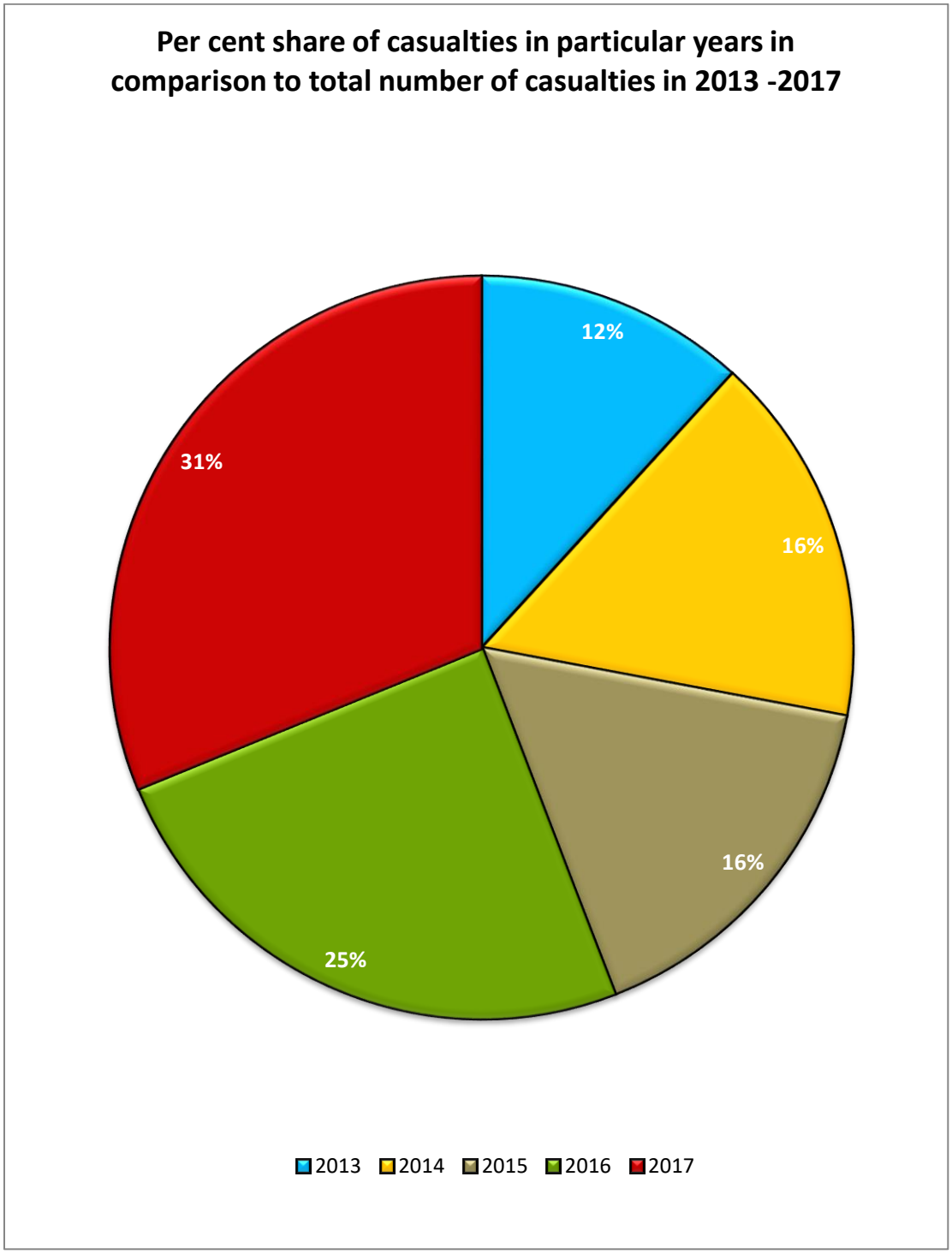


Figure 28: Per cent share of casualties in particular years in comparison to total number of casualties in 2013-2017

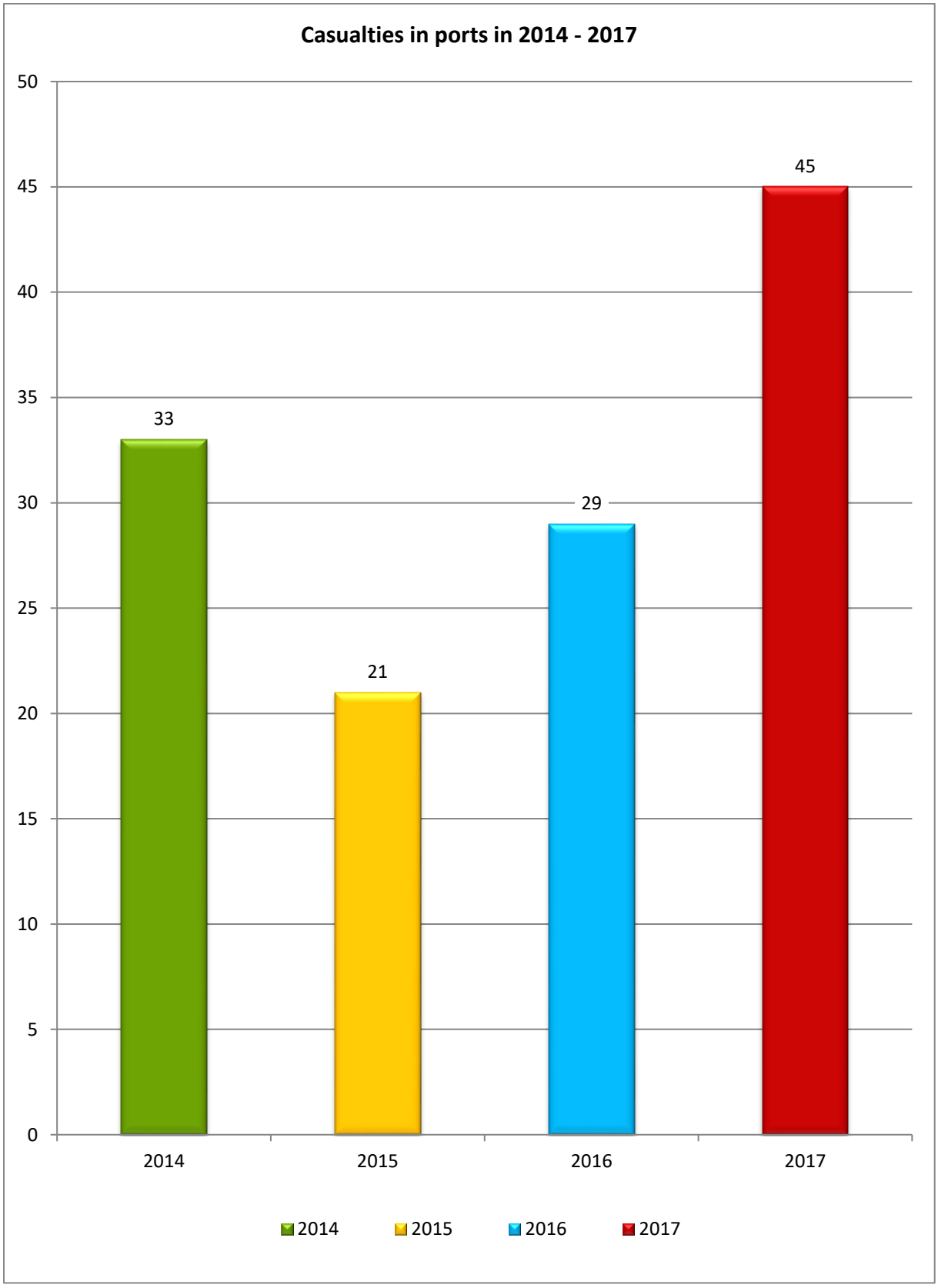


Figure 29: Casualties in ports 2014 - 2017

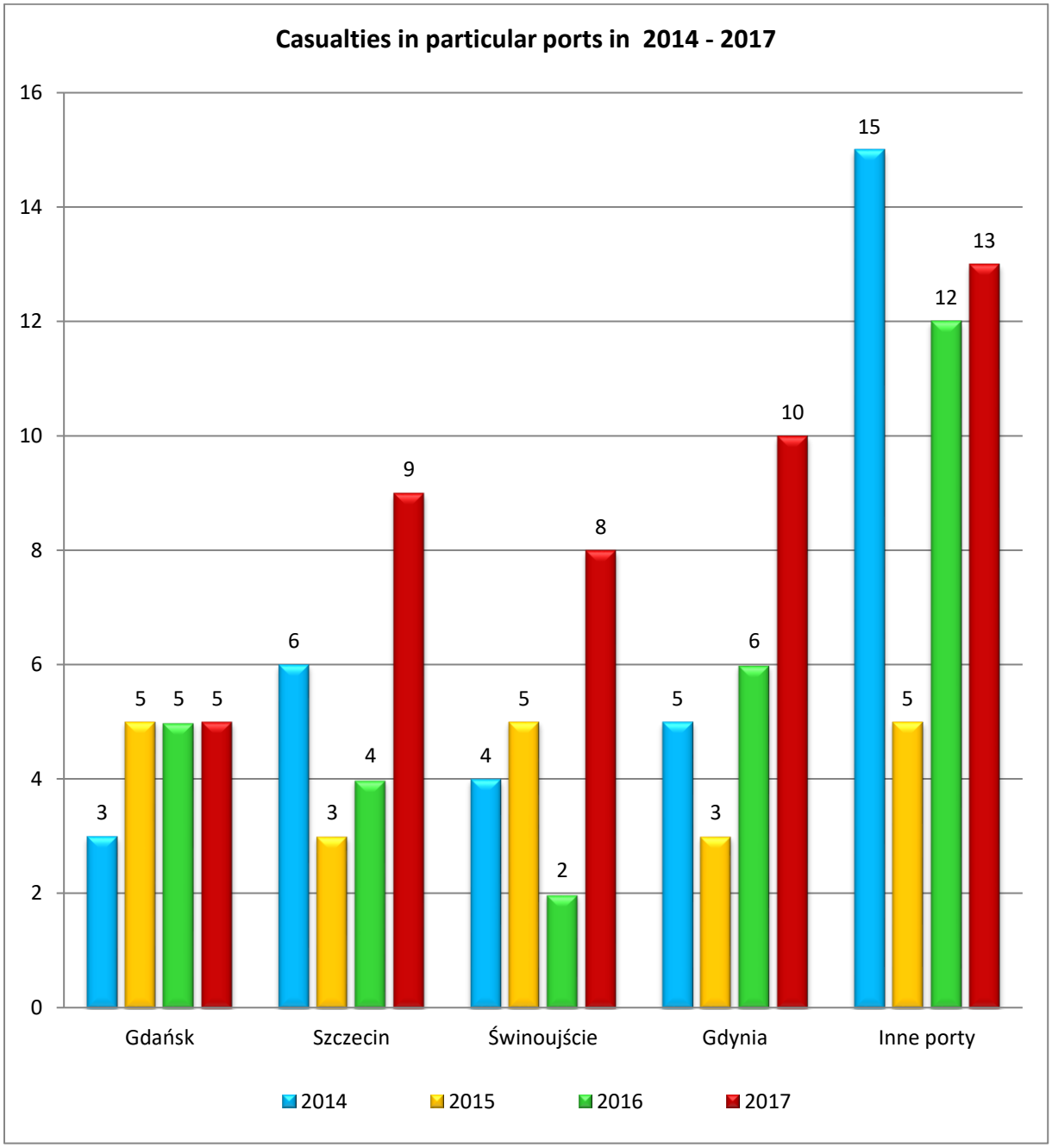


Figure 30: Casualties in particular ports in 2014 - 2017

Chart 35: From the left side of the chart:

Gdańsk

Szczecin

Świnoujście

Gdynia

Other ports

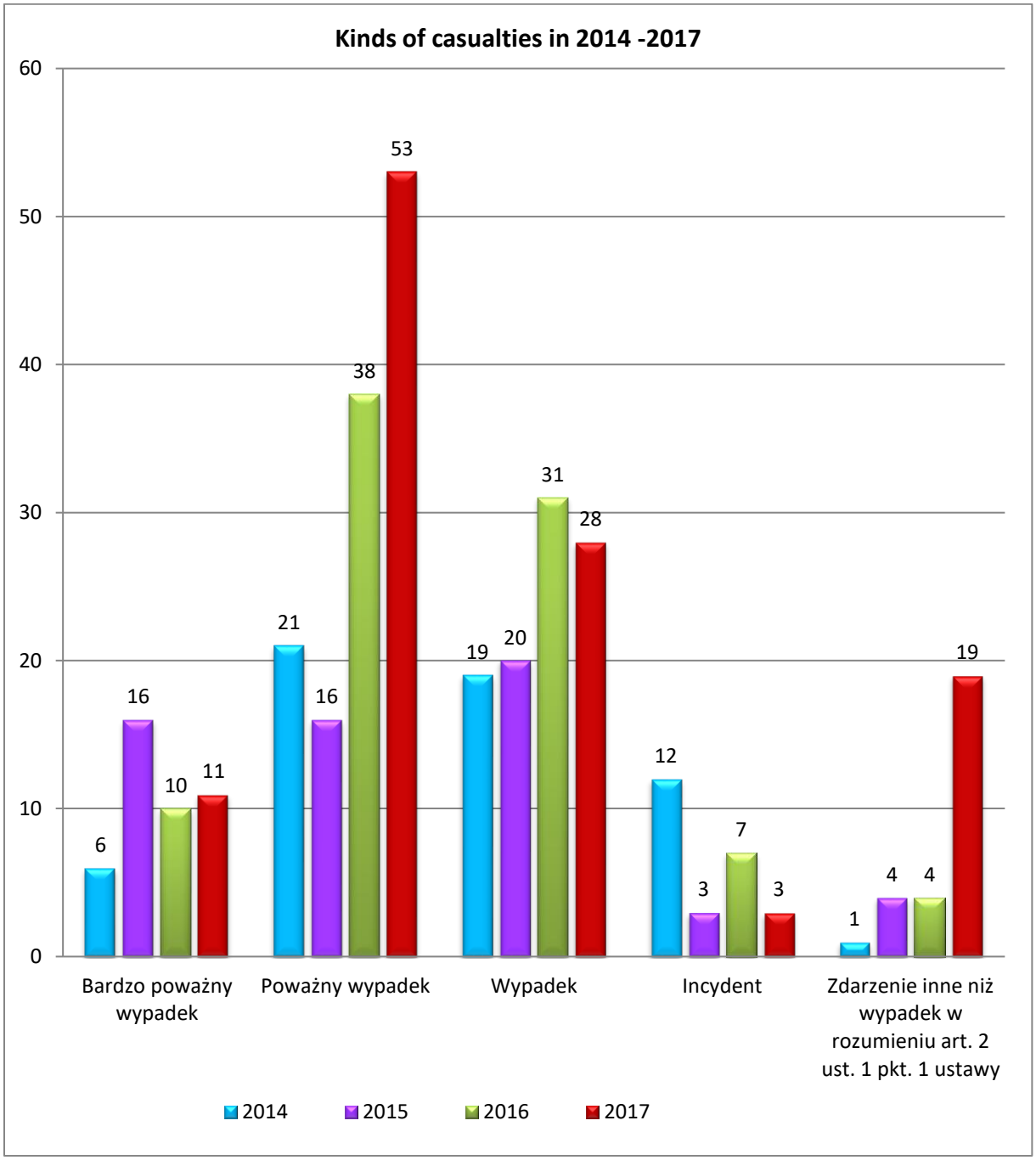


Figure 31: Kinds of casualties in 2014 -2017

Chart 36: From the left side of the chart:

Very serious casualty

Serious casualty

Casualty

Incident

Event other than a casualty as defined by Article 2.1.1 of the act

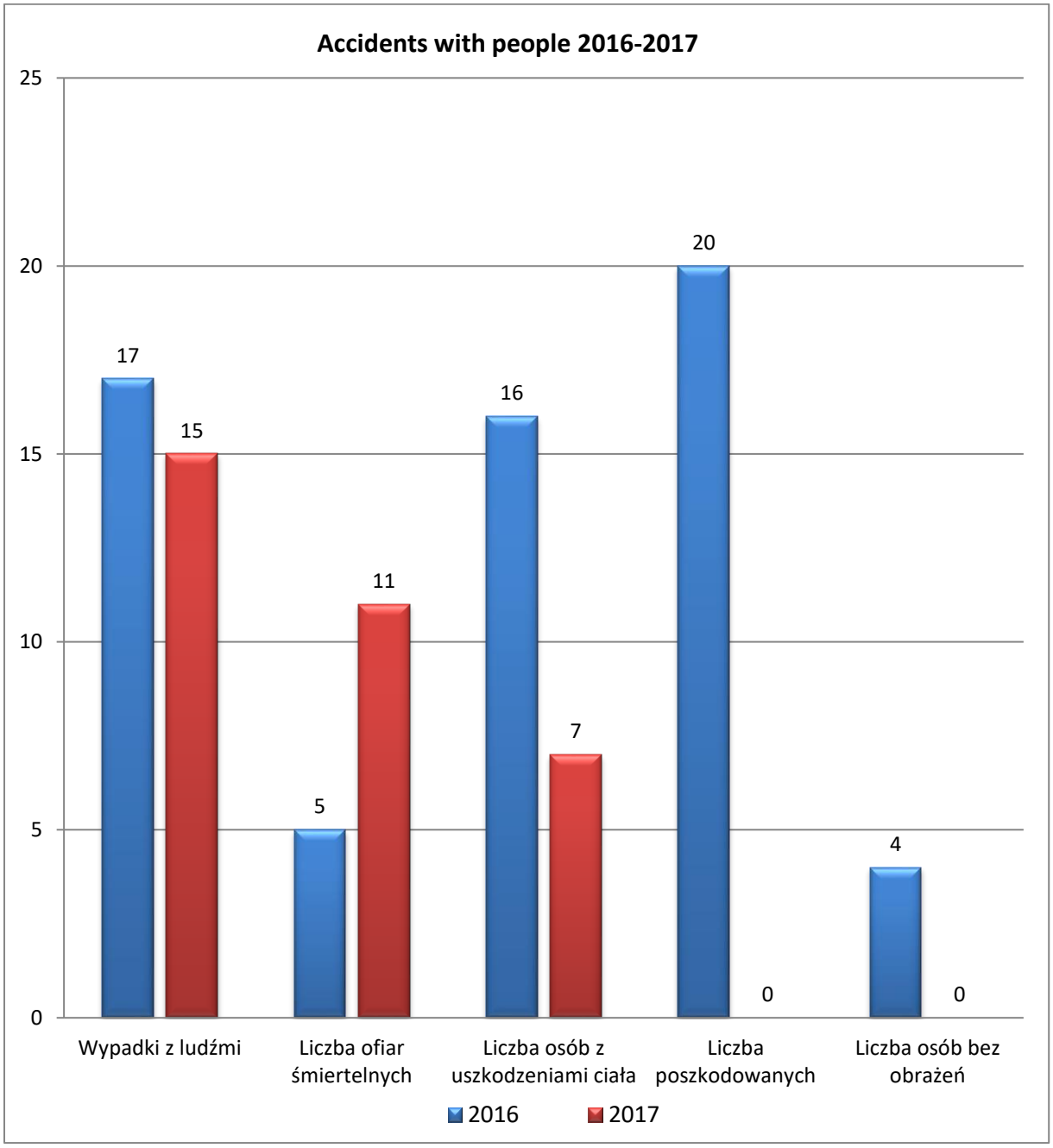


Figure 32: Kinds of casualties in 2016 -2017

Chart 37: From the left side of the chart:

Accidents involving people

Number of the dead

Number of people suffering injuries

Number of victims

Number of people with no injuries

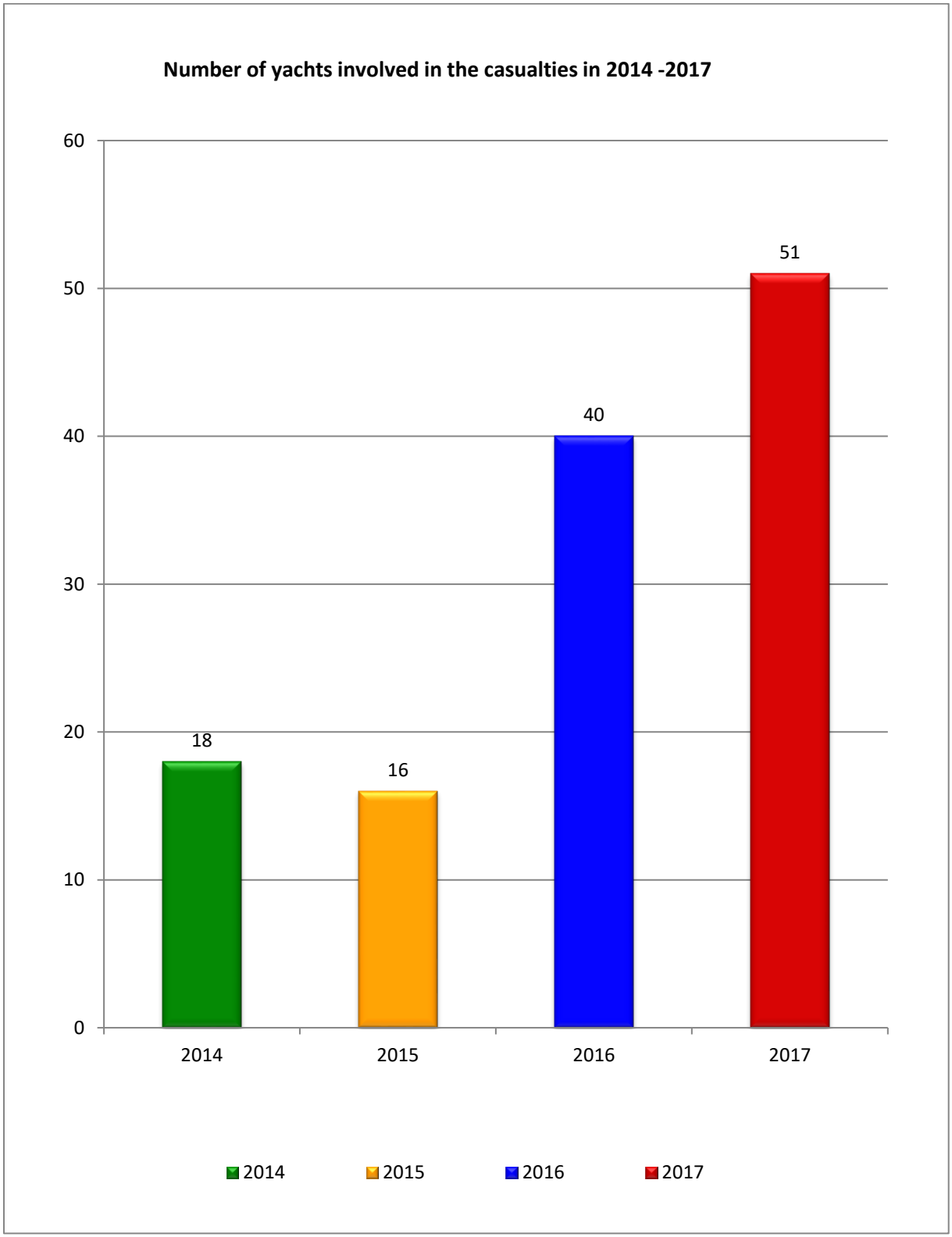


Figure 33: Number of yachts involved in the casualties in 2014 -2017

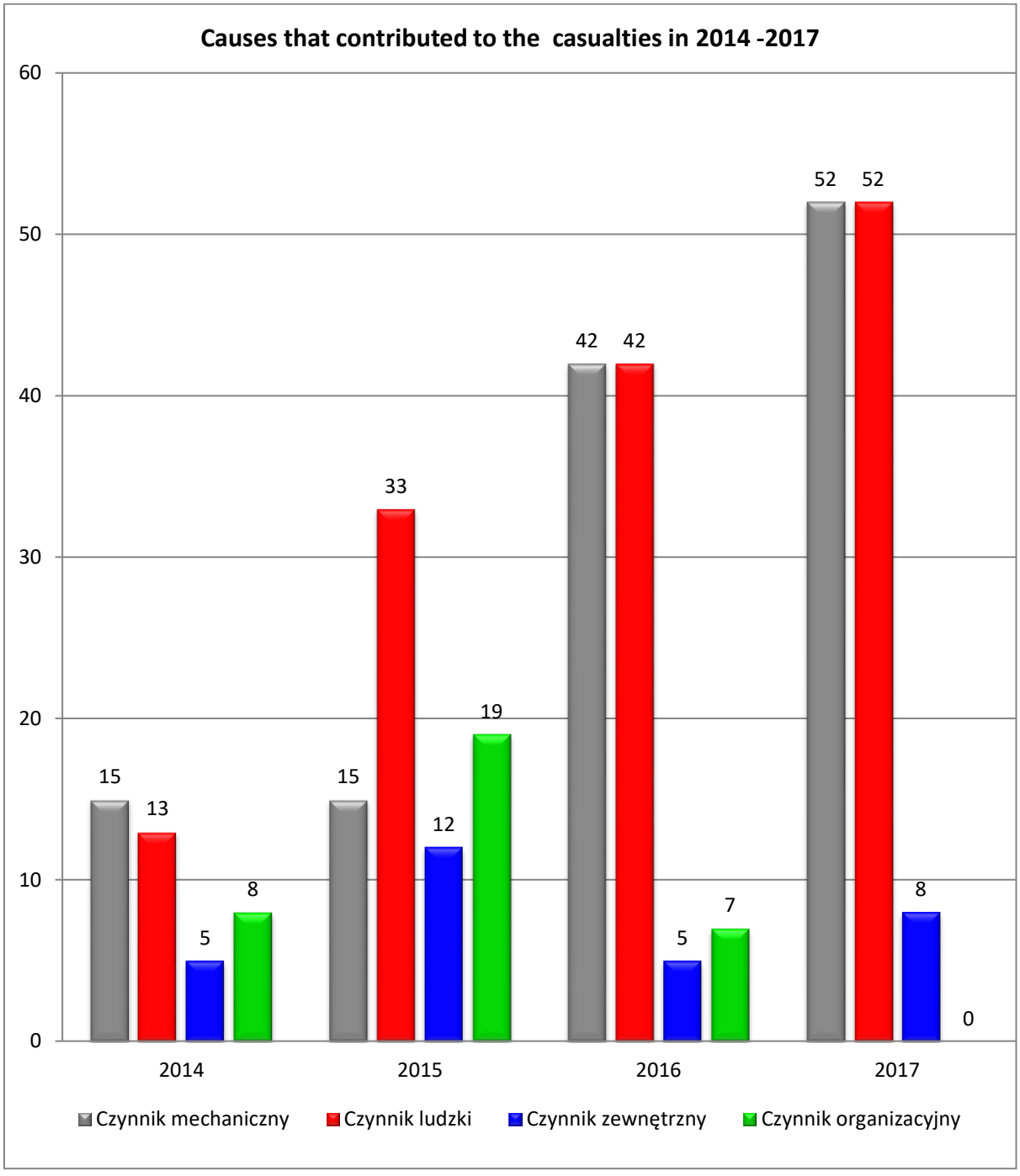


Figure 34: Causes that contributed to the casualties in 2014 -2017

Chart 39: From the left side of the chart:

Mechanical factor

Human factor

External factor

Organizational factor

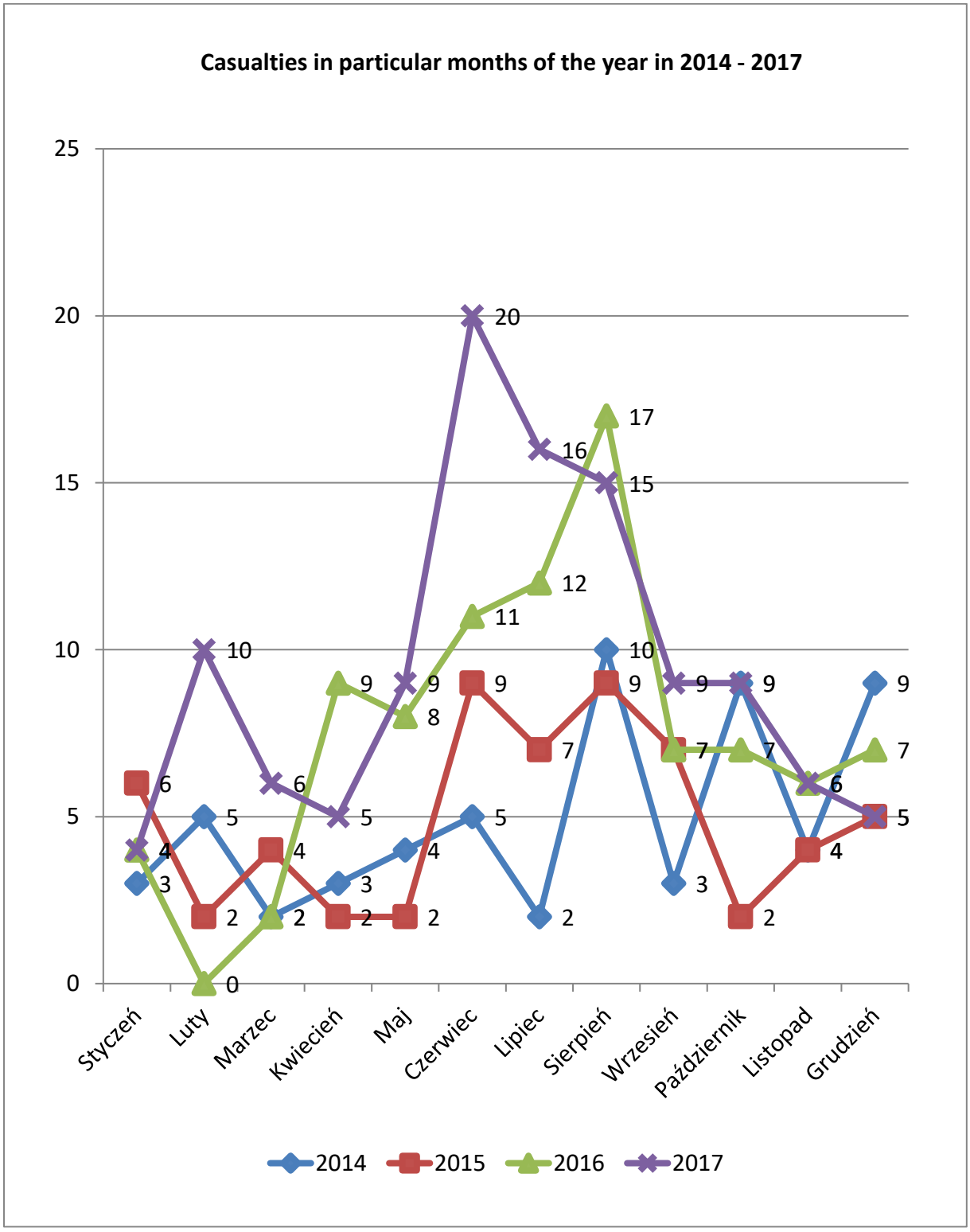


Figure 35: Casualties in particular months of the year in 2014 – 2017

Chart 40: From the left side of the chart:

January

February

March

April

June

July

August

September

October

November

December

14. List of Figures

15. List of Photographs