Accident Investigation Board Norway

Issued March 2019

# REPORT Marine 2019/02

# MAPPING OF RECREATIONAL CRAFT ACCIDENTS

MAIN REPORT

PART A MAPPING OF ACCIDENTS 2018

PART B MAPPING OF HISTORICAL ACCIDENTS 2008-2017

AIBN has compiled this report for the sole purpose of improving safety at sea. The object of a safety investigation is to clarify the sequence of events and root cause factors, study matters of significance for the prevention of maritime accidents and improvement of safety at sea, and to publish a report with eventually safety recommendations. The Board shall not apportion any blame or liability. Use of this report for any other purpose than for improvements of the safety at sea shall be avoided.

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*This report has been translated into English and published by the Accident Investigation Board Norway (AIBN) to facilitate access by international readers. As accurate as the translation might be, the original Norwegian text takes precedence as the report of reference.*

**Photo of ferry on the Norwegian west coast: Bente Amandussen**

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# MAPPING OF RECREATIONAL CRAFT ACCIDENTS
# MAIN REPORT

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Unless otherwise stated, all tables and graphs are created by the AIBN.

## SUMMARY

Boating is an activity undertaken by people of all ages and backgrounds. Every year, almost 2.3 million Norwegians spend time on board recreational craft at sea. There are more than 900,000 recreational craft in Norway. Lack of knowledge has made it difficult for public authorities, special interest organisations and users of recreational craft to assess appropriate and targeted measures to effectively prevent recreational craft accidents.

The Accident Investigation Board Norway (AIBN) has carried out a mapping of recreational craft accidents in Norway.

The work entailed two main tasks. The first was to obtain relevant information about all fatal recreational craft accidents in 2018. The second was to collect historical data on recreational craft accidents, including non-fatal accidents. The main findings are set out in Chapter 2. The results are presented in two sub-reports.

The reports provide a more comprehensive and nuanced presentation of the circumstances surrounding recreational craft accidents than has previously been undertaken in Norway. The AIBN believes that the results will give the authorities and other organisations a better knowledge platform for assessing measures to improve safety at sea. They also forms a basis for considering what types of accidents should be investigated by the AIBN in future.

The total number of recreational craft accidents showed an increasing trend during the period 2008–2017. The increase is mainly due to an increase in the number of motorboat accidents. It is primarily the number of propulsion loss incidents (engine failure etc.) and groundings that have increased for this type of craft, which, in turn, may have to do with the increase in the number of motorboats.

The number of fatalities during the same decade was 367. The results show a slightly falling trend.

In 2018, 23 people died in recreational craft accidents. Three people were seriously injured. In total, 44 people and 22 recreational craft were involved in accidents in which one or more people died. This was fewer than in previous years. The lower figure may be due to inaccuracies relating to previous years' classification of incidents as recreational craft accidents.

Half of those who died in 2018 drowned after the boat capsized or after falling overboard. In most cases, it took a long time, more than 45 minutes, for others to realize that they were in need. Hypothermia was probably a contributory cause to their drowning. Given medical treatment, victims of hypothermia can sometimes be resuscitated, but under the condition that their airways have been kept clear during the cooling. An immediate distress alert with indication of position, combined with the use of a properly fitted lifejacket and clothing that delays the onset of hypothermia, can help to keep a person alive in the water. These types of accidents were also associated with the highest number of fatalities during the preceding decade.

One in four who died in 2018 were foreign tourists in rented boats. After comparing the results of this mapping with a previous investigation and supervisory report from the Directorate for Civil Protection and Emergency Planning (DSB), the AIBN questions whether boat rental firms devote sufficient attention to the safety of those who rent recreational craft. The number of foreign nationals who died was slightly higher in 2018 than during the preceding decade.

Groundings and collisions receive a great deal of attention, which may draw attention away from the fact that 80% of the victims in 2018 died under other circumstances. One in five victims in 2018

died after their boat ran aground or collided. These accidents had three factors in common: high speed, moderate to heavy intoxication and twilight conditions. To be able to implement targeted measures, the AIBN believes it is necessary to have more knowledge about why people operate boats when they are moderately to severely intoxicated. Results from the past decade show that groundings, collisions and allisions occurred frequently, but that only a small proportion of these incidents were fatal. Those who died in these types of accidents were generally younger than the victims of other types of accidents.

One in five victims in 2018 died after falling into the water between the moored craft and the floating jetty. Most victims were severely intoxicated, which may have contributed to why they fell into the water, had limited possibility of raising the alert and of self-rescue. Most of them were not wearing a flotation device. Because of uncertainties in the data from previous years, they cannot be used to describe a trend for this type of accident.

The mapping has identified a potential for improvement in the Norwegian Maritime Authority's basis for keeping annual statistics on fatal recreational craft accidents. This requires improving the method used, post mortem examination of victims, obtaining more detailed information, such as from the joint rescue coordination centres and the police, and devoting more resources to analysis of the information. This will ensure that the statistics better reflect that different issues are relevant for different types of accidents.

The mapping has also identified the possibility of using and combining multiple sources to gain a more comprehensive overview of the number of accidents and serious incidents involving recreational craft in Norway each year. The results can be used to compare trends across years and help to identify targeted measures to improve safety at sea.

The AIBN does not propose any safety recommendations in connection with this mapping.

# 1. INTRODUCTION

In 2018, the AIBN carried out a mapping of recreational craft accidents in Norway. The goal was to give the authorities and other organisations a better basis for assessing measures to improve safety at sea. It will also forms a basis for deciding what types of accidents should be investigated by the AIBN in future.

The basis for AIBN's decision to initiate this work and a description of the main tasks involved are provided below.

## 1.1 Grounds for commencement of the mapping work

Boating is an activity undertaken by people of all ages and backgrounds. Almost 2.3 million Norwegians spent time on a recreational craft at sea in 2017, the vast majority on more than one occasion. The number of recreational craft has almost doubled since the late 1970s, and now numbers more than 900,000[1] (Prop. 51 L (2014–2015)), (KNBF, 2018).

During the same period, the number of people who died in recreational craft accidents has been more than halved, from almost 90 a year to just over 30[2] (Prop. 51 L (2014–2015)). The number of victims has not been significantly reduced over the past 25 years (Arbeidsgruppe for å utrede sikkerhet ved bruk av fritidsbåt, 2012) and (Sjøfartsdirektoratet, 2018).

One of the Government's focus areas set out in the National Transport Plan 2018–2029 (Meld. St. 33 (2016–2017)) is to increase preventive efforts in relation to recreational craft. Section 10.5 of the white paper states that the number of accidents associated with the use of recreational craft is too high. In line with the zero vision, the Government aims to reduce risks associated with the use of recreational craft. It will consider different measures based on their risk-reduction potential and socio-economic profitability. The Government wants greater emphasis on knowledge about recreational craft accidents, including the causes of such accidents. An increase in appropriations for the AIBN means that funds are also available for investigating recreational craft accidents.

The Norwegian Institute of Public Health's reports on accidents and injuries in Norway (*Skadebildet i Norge* (Myklestad, et al., 2014) and (Ohm, Madsen, & Alver, 2019)) emphasises that, despite a significant reduction in the number of fatal accidents in the past 40 years, injuries resulting from accidents still constitute a major challenge to public health. Accidents have serious consequences for the individuals involved and for society. Accidents are the leading cause of death among people under 45 years. About 540,000 people are injured[3] in Norway each year. Approximately 2,500 die as a result of their injuries. Three of four of these were accidents, while the remaining were mostly self-killing. Annually more than 100,000 people sustain injuries that require treatment by the specialist health service (Ohm, Madsen, & Alver, 2019). The reports emphasise that there are sizeable gaps in our current knowledge about accidents and injuries. Although some sectors have own systems in place for registering injuries, these are often inadequate and of poor quality. The Institute of Public Health and the other contributors believe that it is

[1] In this report, the term recreational craft means all vessels less than 24 metres long that are not in commercial use. This includes canoes, kayaks, rowing boats, water scooters, small and large motorboats and sailing boats.
[2] The number does not include swimming accidents, illness or suicides.
[3] Injuries resulting from accidents, injuries resulting from violence and self-inflicted injuries.

possible to do more to prevent injuries and deaths, with great potential health benefits for the population. Reliable statistics will form a cornerstone in the continued work and form the basis for knowledge about injuries and accidents. Up-to-date knowledge is necessary to be able to plan preventive public health work.

The Norwegian Maritime Authority (NMA) has kept statistics on the number of fatal recreational craft accidents since 1981. At year-end 2017, the statistics included information about the number of fatalities, type of accident, type of craft, type of waters, nationality, age and gender. The statistics indicate whether flotation devices were used, but not what kind. The statistics also indicate whether the operator was intoxicated, but not the level of intoxication or what substance they were under the influence of. For groundings and collisions, there is no indication of assumed speed at the time of the accident. The information has been obtained from the media and from police reports. Since autumn 2017, the NMA has improved the reporting form and strengthened the follow-up of the reports from the police. The AIBN believes that this will improve the statistical basis, but that information about the circumstances and causes of accidents will still be inadequate, despite these improvements.

No comprehensive overview is kept of the scope of recreational craft accidents in Norway through the year. The joint rescue coordination centres (JRCC) coordinate and lead the search and rescue services[4] and keep a log of their operations. The Norwegian Society for Sea Rescue (RS) keeps statistics on the number of people they rescue, the number of people they assist, the number of vessels they salvage and tow, and the total number of assignments they carry out. Neither JRCC nor RS's statistics have specified whether the incidents occurred in connection with the use of recreational craft, or whether they were accidents or near-accidents involving an immediate risk. The AIBN is not aware that information from these two sources has ever been combined.

The statistics on the number of people treated by the specialist health service do not specify whether the injury resulted from the use of a recreational craft or from other recreational activities (Myklestad, et al., 2014). Nor are statistics available on recreational injuries (including the use of recreational craft) treated by the primary health service.

The Norwegian Society for Sea Rescue keeps statistics on drowning in Norway. In the last few years, the number of drownings has been around one hundred a year (Redningsselskapet, 2019). The figures include all types of accidents in which someone has drowned, and 72% of the drownings are not related to the use of recreational craft (Ohm, Madsen & Alver, 2019). Half of all drownings occur after a person falls from land or a quay into a river, lake or the sea. The statistics also includes cars that end up in the water/sea and accidents that occur in connection with swimming, diving etc. The statistics are not limited to recreational activities, but also include drowning accidents that occur in connection with commercial activities, such as people falling overboard from fishing vessels (Redningsselskapet, 2019).

The Ministry of Trade and Industry appointed in 2011 a working group tasked with assessing safety in connection with the use of recreational craft in a wide perspective and proposing measures to improve safety (Arbeidsgruppe for å utrede sikkerhet ved bruk av

[4] The public rescue service is organised as a collaboration between public agencies, private and non-profit organisations. The two joint rescue coordination centres are charged with coordinating and leading rescue operations. In addition, there are 12 local rescue coordination centres (LRCC), corresponding to the number of police districts (including the Governor of Svalbard).

fritidsbåt, 2012). The report compared the number of fatal recreational craft accidents in Norway and other Nordic countries and the USA. The estimates showed that, in relation to the number of recreational craft, the risk of dying in an accident with a recreational craft is lowest in Norway. Investigations of accidents in the USA are considered good, but with limited transfer value for Norwegian conditions. Investigations carried out in Sweden, Finland and Denmark are considered to have greater transfer value.

The Institute of Transport Economics has estimated the risk of sustaining personal injuries in connection with the use of recreational craft (Bjørnskau & Amundsen, 2017).The calculations were based on a questionnaire survey among owners of boats registered in the RS Småbåtregisteret (a pleasure craft register).[5] The report states that the risk of being injured in an accident is higher on board a recreational craft than in a passenger car. The risk of being injured in an accident is higher on a bike or motorcycle than it is on board a recreational craft.

In summary, this means that information has been limited about fatal recreational craft accidents. There has been no available overview of the number of recreational craft accidents in Norway per year. The lack of knowledge has made it difficult for public authorities, special interest organisations and users of recreational craft to assess appropriate and targeted measures to effectively prevent recreational craft accidents and monitor trends.

The Norwegian Maritime Code (Act of 24 June 1994 No 39) states that the AIBN shall determine whether to investigate recreational craft accidents. The AIBN conducts its investigations independently and decides on the scope of its investigations and how they are to be conducted. The general duty of all parties to disclose relevant information about the accident combined with the AIBN's duty of confidentiality gives it a unique mandate that complements the safety work of other public authorities, private parties and special interest organisations.

## 1.2 Description of the main tasks

This mapping has focused on two main tasks:

1) Obtaining and analysing relevant information about all fatal recreational craft accidents that occurred in 2018 (Statens havarikommisjon for transport, 2019, A).

2) Obtaining and analysing historical information about recreational craft accidents that occurred during the period 2008–2017, including non-fatal accidents (Statens havarikommisjon for transport, 2019, B).

The two main tasks differ significantly, and the approach, analysis and results are therefore presented in two different sub-reports. Chapter 2 summarises the conclusions that were drawn during work on the main tasks. The appendix to this document contains an overview of legislation of relevance to recreational craft and their use.

For recreational craft accidents involving one or more fatalities or missing persons presumed dead, the AIBN has collected information about them. The main sources of the

[5] It is voluntary to register pleasure craft with length less than 15 m in Norway. Such craft can be registered in the RS Småbåteregister or in the NMA's Ship Register NOR. Pleasure craft with length of 15 m and more are required to be registered in NMA's Ship Register NOR.

information have been police documents in the case, and JRCC and RS reports. The AIBN did not examine the scene of the accident and did not interview those involved or next of kin.

As part of its effort to get a comprehensive overview of the scope of recreational craft accidents in Norway, the AIBN obtained historical information from the past ten years from the JRCCs, RS and supplementary sources.

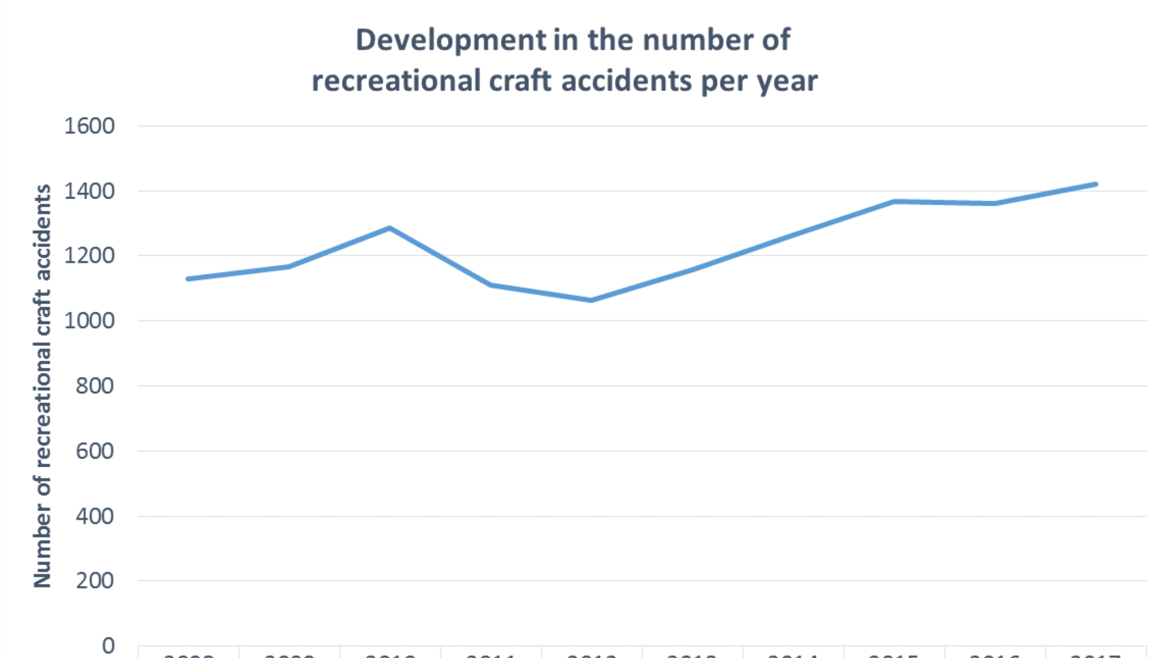
The mapping was geographically limited to Norwegian territorial waters along the mainland, in addition to lakes, rivers etc. The territorial waters around Svalbard were also included.

# 2. MAIN CONCLUSION

## 2.1 Trends in and types of recreational craft accidents during the past ten years

The average number of registered accidents/incidents involving recreational craft in the period 2008–2017 was approximately 1,200 per year. This number includes all types of recreational craft accidents, both fatal and non-fatal. The total number of recreational craft accidents shows an increasing trend during the decade; see Figure 1. The results show that motorboats dominate the accident statistics, followed by sailing boats. The trend is also increasing for kayaks/canoes and boards/kites, although the number of accidents is significantly lower than for motorboats and sailing boats.

The rising trend is primarily due to an increase in the number of motorboat accidents. This type of craft has been involved in an increasing number of propulsion loss incidents (engine failure, technical problems, rope in the propeller, running out of fuel etc.) and groundings, which, in turn, may have to do with the increase in the number of motorboats.




| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|
| Total | 1130 | 1168 | 1287 | 1111 | 1065 | 1159 | 1264 | 1366 | 1361 | 1420 |

*Figure 1: Development in the number of recreational craft per year.*

Propulsion loss and grounding are the most frequently recorded types of accident in Norway, representing approximately 70% of the total.

Even though propulsion loss dominates the total number of accidents/incidents, have few of those led to fatal accidents. Without assistance, these incidents can become critical, for example if the craft drifts ashore. The data set contains little information about the causes of propulsion loss.

The number of recorded fatalities in the period 2008–2017 was 367. The results show a slightly falling trend.

Capsizing/foundering and person overboard incidents resulting in deaths are mainly recorded for motorboats and kayaks/canoes.

Most of the fatal accidents involve motorboats, except for incidents involving falls at quay or jetty, where information about the craft is missing in most cases. The results also show that there have been quite a few fatal accidents involving kayaks/canoes in addition to dinghies, rowing boats and sailing boats. Approximately 75% of motorboat accidents where the size is specified concern craft of less than 26 feet. This suggests that most fatal accidents occur on small craft.

## 2.2 Fatalities

### 2.2.1 Fatalities in 2018

Twenty-three people died in recreational craft accidents in 2018. Three people were seriously injured. In total, 44 people and 22 recreational craft were involved in accidents in which one or more people died.


*Figure 2: Overview of fatal accident locations in 2018. Map: the Norwegian Coastal Administration's online map service Kystinfo. Illustration: AIBN*

### 2.2.2 Development in the past decade

There were fewer fatalities in 2018 than in previous years; see Figure 3.

The lower figure may be partly due to inaccuracies relating to previous years' classification of incidents as recreational craft accidents. By obtaining more information about the incidents, such as information from the NMA's Ship Register, the police, the joint rescue coordination centres and other parties involved in search and rescue work, a clearer view of how to improve incident registration can be formed.

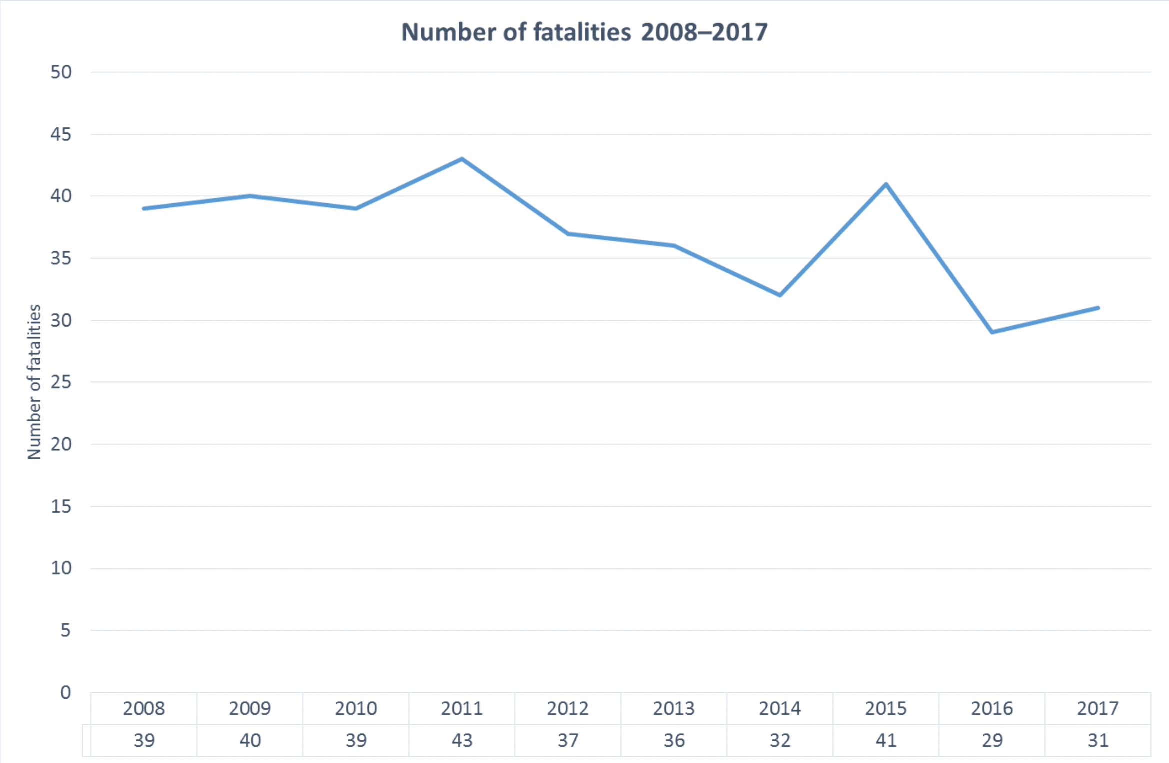



*Figure 3: Number of fatalities 2008–2017.*

A comparison between the accidents in 2018 and the historical data set, see Table 1, shows little correspondence in the percentage distribution of accident types. Expected year-on-year variations in fatal accident types and inaccuracies in the historical data go some way towards explaining this. Both sources show that most fatalities occur when people end up in the sea because their craft capsizes or because they fall overboard. Fewer people die as a result of grounding, collision with other craft or a jetty etc.

The historical data show that most accidents result from problems with the engine and steering system (propulsion loss), but that such accidents rarely result in fatalities. Many accidents also involve grounding, but relatively few of these result in fatalities.

*Table 1: Breakdown of fatalities as percentage of total number of fatalities. Source: AIBN.*

| Type of accident | Fatalities 2018[6] [%] | Fatalities 2008–2017 [%] |
|---|---|---|
| **Capsizing** | 30 (33) | 23[7] |
| **Person overboard** | 17 (19) | 45 |
| **Fall between craft and jetty/quay** | 17 (19) | 8 |
| **Grounding** | 9 (10) | 10 |
| **Collision** | 9 (10) | 4 |
| **Sudden illness** | 4 (5) | 0 |
| **Fire** | 4 (0) | 1 |
| **Missing** | 4 (5) | 0 |
| **Other/unknown** | 4 (0) | 2 |
| **Propulsion loss** | 0 (0) | 3 |
| **Water ingress** | 0 (0) | 3 |
| **Allision** | 0 (0) | 1 |
| **Personal injury** | 0 (0) | 0 |

## 2.3 Capsizing and person overboard accidents

### 2.3.1 Fatalities in 2018

Half of those who died (11 of 21[8]) in 2018 drowned after their craft capsized or after falling overboard.

Capsizing accidents involved small craft, primarily craft in motion (motorboat, dinghy, rowing boat, canoe, kayak and paddleboard). The speed of the craft did not exceed 10 knots. The motorboat, dinghy and rowing boat had a low freeboard that failed to meet current requirements, and their wind and sea limitations were unknown. Half of the accidents involved inexperienced foreign nationals who had borrowed or rented the craft, while the other half involved experienced Norwegian and foreign operators. The victims were probably not intoxicated.

The victims of person overboard accidents were adult men, mainly foreign nationals, who fell overboard while the motorboat or sailing boat they were in was under way. With one exception, the victims were probably not intoxicated. The accidents occurred in narrow

[6] Two fatal accidents that occurred in 2018 were not included in the mapping because the AIBN lacked sufficient information. The figures in brackets show a percentage breakdown of the accidents that were analysed.
[7] Capsizing and foundering.
[8] Two of the accidents are not included in the basis for the analysis due to insufficient information.

coastal waters. The AIBN has not identified any common factors to explain why they fell overboard.

For most of the capsizing and person overboard accidents, it took a long time, more than 45 minutes, before anyone else became aware of the distress situation. In most cases, the persons involved were unable to alert anyone of their distress by mobile phone and had no other means of notification available, such as a whistle, an emergency flare, a handheld VHF radio, a personal locator beacon or an AIS transponder with distress signal.

The shortest distance to the nearest shore, island or islet was between 100 and 600 metres. The temperature in the sea/water was between 6 and 16 °C. The persons involved were appropriately dressed to be on board a boat, but not to be in the water.

On the assumption that the victims retained buoyancy and clear airways during the first phase after falling into the sea/water, hypothermia probably contributed to their drowning. For those victims who were wearing flotation devices, the equipment was not properly fitted or was of a type that did not keep the airways clear, or the wearer lost consciousness or otherwise lost the ability to take care of themselves.

Given medical treatment, hypothermic patients can sometimes be resuscitated. A patient whose airways were clear while their temperature dropped until hypothermic cardiac arrest has a better chance of being successfully resuscitated.

A properly fitted lifejacket with the crotch strap attached is currently the only flotation device that will keep the airways clear if the wearer loses consciousness or otherwise becomes unable to take care of themselves.

An immediate distress alert with indication of position, combined with the use of a properly fitted lifejacket and clothing that delays the onset of hypothermia, can help to keep a person alive in the water.

There are currently various effective solutions available for sending out distress signals that also indicate position, and clothing that delays the onset of hypothermia.

### 2.3.2 Development in the past decade

The results show that 68% of all victims in the past ten years (2008-2017) died as a result of capsizing and person overboard accidents. These accident types lead most frequently to fatalities.

Capsizing/foundering accounted for 5% of all recreational craft accidents, and 23% of the victims of such accidents died. Although these are rare types of accidents, they often result in fatalities.

The same is observed for person overboard accidents. In the past decade, this type of accident accounted for 3% of all recreational craft accidents, and 45% of the victims of such accidents died. Person overboard accidents occur most frequently at night (16%). Although these are rare types of accidents, they often result in fatalities.

The available data on previous accidents are not sufficiently detailed to describe contributory factors to capsizing and person overboard accidents, or the extent to which flotation devices were used or the effect they may have had.

## 2.4 Boat rental for tourists

### 2.4.1 Fatalities in 2018

One in four fatalities (5 of 21) in 2018 were tourists in a rented craft. They died after the craft capsized or after falling overboard.

The tourists who died had little or no experience of the type of craft involved, the waters they were in or the prevailing weather and sea conditions.

In the capsizing accidents, the weather and sea conditions were challenging for inexperienced users of a canoe, kayak and motorboat, respectively.

After comparing the results of this mapping with a previous investigation and supervisory report from the Directorate for Civil Protection and Emergency Planning (DSB), the AIBN questions whether boat rental firms devote sufficient attention to the safety of those who rent recreational craft.

### 2.4.2 Development in the past decade

Rental or (fishing) tourism was recorded in 14% of the fatal accidents in the past five years (2013–2017). This is lower than the percentage in 2018. The number is so low that the figures cannot be used to indicate a trend.

A total of 15% of those who died in the past ten years (2008–2017) were foreign nationals. The figures do not specify whether they lived in Norway or were tourists. The proportion was lower than in 2018.

## 2.5 Groundings and collisions

### 2.5.1 Fatalities in 2018

Groundings and collisions receive a great deal of attention in the discussion on how to improve safety at sea, which can draw attention away from the fact that 80% of the victims in 2018 died under other circumstances.

One in five victims (4 of 21) in 2018 died when their craft ran aground or collided.

Groundings and collisions have three factors in common: high speed, moderate to heavy intoxication and twilight conditions. Weakened skills due to intoxication may have contributed to the accidents. Light conditions and the absence of navigation lights made it more difficult to predict dangers in twilight. The accidents have occurred suddenly and unexpectedly.

The accidents involved motorboats and water scooters. The speed of the craft usually exceeded 20 knots. For two of the cases, the speed is assumed to have exceeded 30 knots. In most of the cases, no speed limits applied to the waters where the accidents occurred. In the one case where a municipal speed limit did apply for the summer, the craft was travelling at a considerably higher speed than permitted. High speeds caused the persons involved to suffer injuries. In two cases, the victims died from extensive injuries. The injuries suffered by the other two victims may have limited the possibility of self-rescue and caused them to drown. In one of these cases, the failure to use a flotation device may have limited the person's chances of surviving.

All the persons involved in such accidents were under 45 years of age, and 3 were teenagers. The groundings and collisions occurred as the victims were returning home from a night out. Needing to get home, they had planned or chose to return by sea rather than by some means of road transport. The craft operators were experienced boaters and familiar with the waters. Five out of six operators were intoxicated. Most were moderately to severely intoxicated. Their average blood alcohol concentration (BAC) was 0.14%, significantly higher than the current limit of 0.08%, and slightly higher than the average for drivers who die in road accidents.

Experience from the road traffic area shows that reducing the drink driving limit to a BAC of 0.02% can have a positive effect in the form of fewer injuries and fatal accidents. At the same time, experience from Scotland shows that reducing the drink driving limit does not necessarily reduce the number of accidents unless other measures are introduced at the same time, such as more frequent blood-alcohol testing by the police of recreational craft operators.

The question can be raised whether there are similarities and differences between those who drive a car under the influence and those who operate a boat under the influence. To be able to implement targeted measures, the AIBN believes it is necessary to gain a better understanding of why people choose to operate a boat while moderately to severely intoxicated.

### 2.5.2 Development in the past decade

In the past decade (2008–2017), groundings, collisions and allisions accounted for 36% of all recreational craft accidents, most of which were registered as groundings (34%). The number of groundings have increased since 2012. The same type of accidents accounted for approximately 15% of fatal accidents during the same period. This means that groundings, collisions and allisions occur frequently, but that only a small proportion of these incidents are fatal.

Groundings, collisions and allisions account for 44% of all accidents that occurred at night (between 00:00 and 06:00). There is no increase in the total number of accidents that occur at night. The data are not sufficiently detailed to indicate the extent to which other factors, such as the weather, intoxication, speed etc., have contributed to the accidents.

In 30% of the fatal accidents that occurred in the past five years (2013–2017), it was registered that some of those involved were intoxicated, but the data do not indicate who or the level of intoxication. Intoxication and high speed were registered as factors contributing to groundings, collisions and allisions significantly more often than was the case for other types of accident. The average age of those who died in these types of accidents (49 years for men and 33 years for women) was lower than for all types of accidents taken together.

### 2.6 Fall between moored craft and floating jetty

#### 2.6.1 Fatalities in 2018

There may be greater uncertainty associated with the number of people who die on a recreational craft while it is moored, primarily because it is difficult to distinguish between these accidents and other accidents in which someone falls from a quay, jetty or shore.

One in five victims (4 of 21) in 2018 died as a result of falling overboard between the craft and a floating jetty.

Most of the accidents occurred at night after partying.

In most cases, the victims were severely intoxicated, which have contributed to why they fell into the water and had limited possibility of raising the alert and of self-rescue.

Only one of the victims wore a flotation device.

It took at least one hour before anyone else became aware of the distress situation.

Four people drowned, all aged over 50.

#### 2.6.2 Development in the past decade

Information about situations in which someone falls between a craft and a jetty/quay is limited to fatal accidents. The figures show greater variation in the number of fatalities year on year, which supports the lesson learnt during the mapping in 2018 that it has been difficult to distinguish between this type of accident and other accidents that occur alongside shores, quays and jetties. The victims were registered as being intoxicated in nearly half of these accidents.

## 3. FURTHER WORK

The AIBN believes that the reports will give the authorities and other organisations a better knowledge platform for assessing measures to improve safety at sea. They also forms a basis for considering what types of accidents should be investigated by the AIBN in future.

The reports give a more comprehensive and nuanced presentation of the circumstances surrounding fatal recreational craft accidents than has previously been provided in Norway. There is potential for improvement in the Norwegian Maritime Authority's basis for keeping annual statistics on fatal recreational craft accidents. This requires improving the method used, post mortem examination of victims, obtaining more detailed information, such as from the joint rescue coordination centres and from the police, and devoting more resources to the analysis of information.

The mapping has also identified the possibility of using and combining multiple sources to gain a more comprehensive overview of the number of accidents and serious incidents involving recreational craft in Norway each year. The results can be used to compare trends across years and help to identify targeted measures to improve safety at sea. If the

NMA starts keeping combined statistics on recreational craft accidents year on year, a system must be devised whereby data from several parties can be collated through the use of defined parameters. Procedures should be established to ensure as comprehensive reporting of relevant incidents as possible. The registration system should contain functions for recording relevant information, both for the purpose of monitoring trends in recreational craft accidents and with a view towards establishing measures to reduce the number of recreational craft accidents.

# 4. SAFETY RECOMMENDATIONS

The AIBN does not propose any safety recommendations in connection with this mapping work.

Accident Investigation Board Norway

Lillestrøm, 27 March 2019

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# APPENDIX

## Appendix A: Relevant legislation

# APPENDIX A: RELEVANT LEGISLATION

The report does not aim to describe in detail the requirements that apply to recreational craft, operators of and passengers on recreational craft, the rental of recreational craft or the supervision and control of recreational craft and their operators.

Relevant laws and regulations that apply to recreational craft are listed in Table 2 for reference purposes. The list is based on the Norwegian Maritime Authority's overview and includes a reference to the Rules of the Road at Sea (Sjøfartsdirektoratet, 2019).

Tourists renting a boat without a crew are covered by the general regulations for the use of recreational craft in Norway. What this means is described in DSB's thematic report (Direktortatet for samfunnssikkerhet og beredskap (DSB), 2012).

Rental firms hiring out recreational craft to, for example, tourists must comply with several other laws and regulations in addition to the Small Craft Act with pertaining regulations. They include the Product Control Act, the Internal Control Regulations and the Regulations relating to the construction, design and production of personal protective equipment. Recreational craft rental firms are responsible for ensuring the safety of those who hire a craft by implementing reasonable measures to avoid harm to health, and are also obliged to provide users of the service with sufficient, relevant information to enable them to assess safety. The Directorate for Civil Protection and Emergency Planning (DSB) is responsible for supervising recreational craft rental firms.

*Table 2: Overview of the most relevant laws and regulations concerning recreational craft and their use.*

| | |
|---|---|
| Acts of law | • Act of 11 June 1976 No 79 relating to the control of products and consumer services (Product Control Act)<br>• Act of 26 June 1998 No 47 relating to recreational and small craft (the Small Craft Act)<br>• Act of 12 April 2013 No 13 on the free exchange of goods in the EEA (the EEA Goods Act) |
| Regulations | • Regulations of 1 December 1975 No 5 regarding preventing collisions at sea (Rules of the Road at Sea)<br>• Regulations of 20 October 1983 No 1580 on safety precautions for gasfired installations, etc. operating on propane or other liquefied hydrocarbon gases used on board vessels (Regulations on Safety Precautions for Gasfired Installations)<br>• Regulations of 8 May 1995 No 409 relating to flotation devices on board recreational craft<br>• Regulations of 6 December 1996 No 1127 relating to systematic health, environment and safety activities in enterprises (Internal Control Regulations)<br>• Regulations of 4 December 2001 No 1450 relating to maritime electrical installations<br>• Regulations of 27 June 2008 No 744 on the obligation to notify and report marine accidents and other incidents at sea |

| | |
|---|---|
| | • Regulations of 3 March 2009 No 259 for minimum age and boating licence, etc. for masters of recreational craft<br>• Regulations of 24 November 2009 No1400 on the operation of craft carrying 12 or fewer passengers etc.<br>• Regulations of 30 May 2012 No 488 on environmental safety for ships and mobile offshore units<br>• Regulations of 1 June 2014 No 931 relating to pollution control (the Pollution Regulations)<br>• Regulations of 27 April 2015 No 409 on exemptions from the requirement for the use of flotation devices on recreational craft<br>• Regulations of 15 January 2016 No 35 on the production and placing on the market of recreational craft etc.<br>• Regulations of 22 June 2018 No 1019 on the construction, , design and production of personal protective equipment (PVU). |

Relevant amendments to the regulations on CE marking, boating licences, instructions on the use of flotation devices and water scooters introduced after 2006:

- Since 16 June 1998, recreational craft have been subject to a requirement for CE marking. As of 1 January 2006, engines are also required to be CE-marked. The requirement applies throughout the EEA and shows that the product was manufactured in accordance with EU regulations. The manufacturer is responsible for CE marking. In the case of second-hand imported watercraft, the importer is responsible for CE-marking.

- A boating licence requirement was introduced in June 2009 for everyone born on 1 January 1980 or later for watercraft of more than eight metres in length with an output of more than 25 hp. A boating licence entitles the holder to operate a recreational craft of up to 15 metres in length without further limitations. Persons born before 1980 are exempt from the boating licence requirement, and may operate vessels of up to 15 metres in length without a qualification document. Persons under the age of 16 may operate a recreational craft if the vessel is less than 8 metres in length, has an output of maximum 10 hp and a maximum speed of 10 knots.

- The use of appropriate floating devices on recreational craft became mandatory on 1 May 2015. It applies to everyone on board recreational craft of up to eight metres in length. An appropriate floating device must be worn on open decks while the craft is moving. By appropriate floating device is meant lifejacket, buoyancy vest, buoyancy clothing, flotation aid or other personal floatation device. The device must either have CE marking or a mark of conformity.

- In May 2017, water scooters were given equivalent status as other coastal and inland watercraft. If required, individual municipalities may adopt local regulations on the use of watercraft, including water scooters, in coastal and inland waters.

aibn Accident Investigation Board Norway

Issued March 2019

# REPORT Marine 2019/02

## MAPPING OF RECREATIONAL CRAFT ACCIDENTS

## PART A
## MAPPING OF ACCIDENTS 2018

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## TABLE OF CONTENTS



Unless otherwise stated, all tables and graphs are created by the AIBN.

# 1. INTRODUCTION

This sub-report forms part of the Accident Investigation Board Norway's (AIBN) mapping of recreational craft accidents.

The sub-report includes methods of obtaining information, as well as analyses and results from the mapping of recreational craft accidents in 2018 in which one or more people died (or are assumed to have died).

The AIBN has collected relevant and available information about the sequence of events and circumstances surrounding the accidents. The AIBN has then analysed the data to map contributory factors and factors that may have influenced the scope of injuries/damage and survival aspects in connection with these accidents.

The goal of the project has been to show the nuances of and circumstances surrounding these accidents. The analysis has focused on identifying common features that characterise the different types of accidents.

The main findings of the mapping are presented in Chapter 5.

The work is summarised in the main report. The main report also gives grounds for the mapping.

# 2. FACTS ABOUT THE ACCIDENTS

## 2.1 Number of fatalities in 2018

The tables below provide an overview of all recreational craft accidents in 2018 in which people have died or are assumed to have died. The criteria that define what is considered a recreational craft accident are described in section 3.1.

*Table 1: Overview of fatal recreational craft accidents in 2018.*

| Number of fatal recreational craft accidents in 2018 | 22 |
|---|---|
| Number of fatalities | 23 |
| Number of persons who suffered serious physical injuries | 3 |
| Number of persons who suffered no serious physical injuries/no physical injuries | 18 |
| Total number of persons involved in recreational craft accidents | 44 |

## 2.2 Description of the accidents

The figure and table below describe all the fatal recreational craft accidents that occurred in 2018.


*Figure 1: Overview of fatal accident locations in 2018. Map: the Norwegian Coastal Administration's online map service Kystinfo. Illustration: AIBN*

*Table 2: Description of fatal recreational craft accidents in 2018.*

| Assumed place and date | Assumed sequence of events | Consequences for persons |
|---|---|---|
| Fredrikstad, Østfold county, 1 Jan. 2018 | A person was on his way to spend the night in his motorboat. He probably fell into the water between his boat and the floating jetty. He was reported missing the next morning. A search and rescue operation was initiated. About two months later, he was found on the shore and declared dead. | Man, 59 years old, died. |
| Sotra, Sund municipality, Hordaland county, 10 Feb. 2018 | A person went out fishing in his motorboat in the afternoon. He fell overboard, presumably while fishing. He was reported missing three days later. A search and rescue operation was initiated. He was found lifeless on the shore and declared dead. | Man, 41 years old, foreign national, died. |
| Stanghelle, Vaksdal municipality, | A person went to check on his motorboat, which he used to do every day. He probably fell into the water between his boat and the floating jetty. The | Man, 79 years old, died. |

| | | |
|---|---|---|
| Hordaland county, 22 March 2018 | family became concerned when he did not return, went to look for him and found him lifeless in the sea by the boat. CPR was initiated, but he was later declared dead. | |
| Totland, Vågsøy municipality, Sogn og Fjordane county, 23 April 2018 | A person was out in his dinghy to pull longlines. Witnesses saw that the boat had capsized and reported the accident. A search and rescue operation was initiated. The person was found lifeless in the sea. He was brought to hospital for resuscitation, but was later declared dead. | Man, 80 years old, died. |
| Selja, Selje municipality, Sogn og Fjordane county, 19 May 2018 | A motorboat carrying two people on their way home from a night out ran aground. The boat took on water until only the bow was visible above the surface. One of the persons reported the accident just before 07:00. A search and rescue operation was initiated. A woman was retrieved from the craft and brought to hospital for resuscitation, but was later declared dead. | Woman, 41 years old, died. |
| Storfjorden, Stranda municipality, Møre og Romsdal county, 20 May 2018 | A person started the day's kayaking before the rest of his group. They had rented kayaks and were on a five-day trip to Geiranger. While crossing an arm of the fjord, the kayak capsized and he fell into the water. In the afternoon, the group obtained help to search for the missing person. When he was found lifeless on the shore, they notified the police. He was declared dead. | Man, 25 years old, foreign national, died. |
| Ramfjordbotn, Tromsø municipality, Troms county, 27 May 2018 | Three persons were fishing from a borrowed rowing boat. The boat filled up with water, and they fell into the sea. They swam for shore, but one of the three did not make it there. A search and rescue operation was initiated. The person was found lifeless in the water near the shore and brought to hospital for resuscitation, but was declared dead. | Man, 29 years old, foreign national, died. |
| Askholmene, Frogn municipality, Akershus county, 8 June 2018 | A person probably fell overboard from a sailing boat while using the engine. The boat was seen aground with the engine running. A search and rescue operation was initiated. The person has not been found. | Man, 72 years old, missing, presumed dead. |
| Stjørdal, Trøndelag county, 10 June 2018 | A person spent the night in his motorboat in the marina. During the night, he fell into the sea. In the morning, he was found lifeless on the shore and declared dead. | Man, 78 years old, died. |
| Husøy, Tønsberg municipality, Vestfold county, | A person was paddling a stand-up paddle board (SUP). He was reported missing the following morning, and search and rescue efforts were | Man, 46 years old, died. |

| | | |
|---|---|---|
| 14 June 2018 | initiated. The person was found lifeless on the shore and declared dead. | |
| Øksnes municipality,[1] Nordland county, 15 June 2018 | An incident occurred at night. A person was reported missing after the incident. Search and rescue efforts were initiated. As of 6 December 2018, the police has not concluded as to whether the incident was an accident or not. The AIBN does not have sufficient information about the incident. | Man, 23 years old, missing, presumed dead. |
| Løno, Fjell municipality, Hordaland county, 26 June 2018 | A person was taken ill while sailing north along the coast. The boat was seen when it struck the shore. A search and rescue operation was initiated. The person was found lifeless on board the boat and declared dead. | Man, 62 years old, died. |
| Fyresvatnet lake, Fyresdal municipality, Telemark county, 15 July 2018 | An open motorboat carrying four people on their way home from a night out collided with another motorboat drifting on the lake. One of the persons fell in the water, and the others could not find him. Search and rescue efforts were initiated. The missing person was found dead three days later. | Man, 21 years old, died. Woman, 26 years old, minor physical injuries. |
| Totak, Vinje municipality, Telemark county, 22 July 2018 | Three members of the same family were paddling in a canoe. The canoe capsized and they fell into the lake. After a while, two of the persons swam for shore and were rescued. A search and rescue operation was initiated. The third person was found lifeless in the water and declared dead. | Man, 59 years old, foreign national, died. |
| Rosfjorden, Lyngdal municipality, Vest-Agder county, 27 July 2018 | A water scooter with two people on board and a dinghy with one person on board collided. One person was killed instantly. The person who had suffered the least severe injuries was able to get the other two on board and take them to shore. The person with severe physical injuries was taken to hospital for treatment. | Boy, 16 years old, died. Boy, 17 years old, severe physical injuries. Boy, 15 years old, less severe physical injuries. |
| Tromøya island, Arendal municipality, Aust-Agder county, 28 July 2018 | On her way home from a night out, a person riding a borrowed water scooter hit an island. The person and the scooter were thrown ashore. The person was reported missing. A search and rescue operation was initiated the following morning. She was found lifeless on the island and declared dead. | Woman, 38 years old, died. |

[1] This accident is not included in the analyses in this report, as the AIBN does not have sufficient information about it.

| | | |
|---|---|---|
| Vallø[2], Tønsberg municipality, Vestfold county, 2 Aug. 2018 | A motorboat exploded and caught fire in the marina. Three persons were seriously injured and brought to hospital for treatment. One of them later died in hospital. The AIBN does not have sufficient information about the accident to use it in the mapping project. | Woman, 64 years old, died.<br>Two persons suffered serious physical injuries.<br>One person suffered less severe physical injuries. |
| Langbryggene, Skien municipality, Telemark county, 11 Aug. 2018 | A person fell into the water while stepping from a motorboat to a floating jetty after a night out. Another person tried to come to her rescue, but she disappeared. A search and rescue operation was initiated. Three days later she was found lifeless in the river and declared dead. | Woman, 53 years old, died. |
| Kviby, Alta municipality, Finnmark county, 24 Aug. 2018 | A person left the quay in a rented motorboat. Shortly thereafter, he fell overboard. The boat was later seen going around in circles, and search and rescue efforts were initiated. The person was found lifeless in the water and brought to hospital for resuscitation, but was declared dead. | Man, 50 years old, foreign national, died. |
| Hjeltefjorden, Fjell municipality, Hordaland county, 2 Sept. 2018 | Two persons were sailing when the boom hit one of them in the back and knocked him overboard. Search efforts were initiated, but the person has not been found. | Man, 50 years old, foreign national, missing, presumed dead. |
| Båtsfjord municipality, Finnmark county, 3 Sept. 2018 | A person was probably out in his motorboat to set and pull fishing nets. He was reported missing two days later. A search for the person was initiated, but neither he nor his boat or nets have been found. | Man, 75 years old, missing, presumed dead. |
| Korshavn, Lyngdal municipality, Vest-Agder county, 28 Sept. 2018 | A rented motorboat carrying three members of the same family capsized. They were going fishing, but had turned back because they did not have enough fuel. A search and rescue operation was initiated. One person was found alive on a small island, the other two were found lifeless in the sea. They were brought to hospital for resuscitation, but were declared dead. | Two men, 75 and 46 years old, foreign nationals, died. |

[2] This accident is not included in the analyses in this report, as the AIBN does not have sufficient information about it.

# 3. METHOD AND ASSUMPTIONS

The object was to collect relevant available information about the fatal recreational craft accidents and the circumstances surrounding them. The AIBN has not conducted examinations at the accident sites or interviewed involved persons or next of kin, but has chosen to obtain relevant information from other sources.

## 3.1 Limitations and remit

The mapping of these recreational craft accidents will be geographically limited to Norwegian territorial waters along the mainland, and to lakes, rivers etc. The territorial waters around Svalbard were also included.

The term ‘marine accident’ is defined in Act No 39 of 24 June 1994 (the Norwegian Maritime Code) Section 472 a. Recreational craft are considered ships in this context. Intentional harm to a ship, an individual or the environment does not constitute a marine accident.

The mapping concerns accidents that happened while the craft was in transit, anchored or moored and the persons involved were boarding or leaving the craft.

The Act of 26 June 1998 relating to recreational and small craft (the Small Craft Act) defines a recreational craft as any floating unit intended for and capable of moving on water, with a maximum length of 24 metres and that is used for non-commercial purposes. This includes the letting and loan of boats, for example in connection with fishing tourism. Rowing boats, canoes, kayaks, water scooters, stand-up paddle boards, windsurfing boards and kite boards are also considered recreational craft.

The mapping does not cover the following:

- Recreational craft accidents during competitions.
- Accidents that only involve surfboards (without sails) and accidents involving people swimming from a boat.
- Accidents in connection with swimming and/or use of inflatable flotation devices/water toys in the water.
- Fatal accidents involving fishing vessels engaged in commercial activity at the time of the accident. These accidents are investigated in accordance with the AIBN’s remit; see www.aibn.no.
- Fatal accidents by a jetty or similar, but where the accident did not take place while the recreational craft was being used or boarded.
- Fatal drownings during competitions.
- Incidents that are not considered accidents, for example suicide.
- Accidents that took place outside of the geographical areas defined above.

- Rental of recreational craft with an operator/guide, as this is considered commercial activity.

### 3.2 Notification of the AIBN, uncertainty and receipt

Three parallel sources were established for notification about very serious accidents:

- The police operations centres
- The Governor of Svalbard
- The Joint Rescue Coordination Centres

The purpose of this was to ensure that the AIBN would be notified of the very serious accidents in order to be able to follow them up as soon as possible and explain as well as possible what information we felt would be relevant to obtain. In addition to this, the AIBN established a notification procedure based on media searches. Moreover, the Norwegian Maritime Authority and the AIBN have regularly exchanged information about relevant accidents.

The notifications were reported to the AIBN's emergency telephone number for the notification of marine accidents.

The combination of three sources of notifications functioned well, but it was somewhat challenging to identify accidents that took place while the craft was moored or otherwise beside the shore. Most of these accidents were notified through media searches. In cases where the media did not state that an accident or incident involved a recreational craft, the AIBN did not follow up the matter.

### 3.3 Information collection

Some of the principles behind the STEP[3] method (Hendrick & Benner, 1987) were used as a basis for determining what information could be relevant. The parties involved were categorised as follows:

- The craft: Primarily the recreational craft and equipment on board, including navigational equipment, radio and other communication equipment, and safety equipment such as life rafts, boarding ladders, firefighting equipment etc. For accidents involving other craft or objects, these craft or objects were also placed in this category.
- The operator and other persons involved in the accident: This category contains information about the persons involved in the accident, a description of the sequence of events and whether flotation devices were worn.
- The external environment: This category contains information about the waters where the accident took place, and weather and sea conditions.

[3] Sequential Timed Events Plotting

- Search and rescue: This category contains information about the search and rescue operations.

The phases were sequentially divided into a) sequence of events leading up to the accident, b) the accident, c) survivability, and d) consequences. Context and background were also included. See Figure 2 for an illustration of the phases and parties involved.

The AIBN defined what information about the incident and circumstances surrounding it would be relevant to collect. This was considered in relation to the expected realistically available information and how resource-intensive it would be to obtain the information. Based on previous years, approximately 30 fatal accidents were expected in 2018.

The figure also gives an overview of what information could be relevant to obtain. Details are provided in Appendix A.

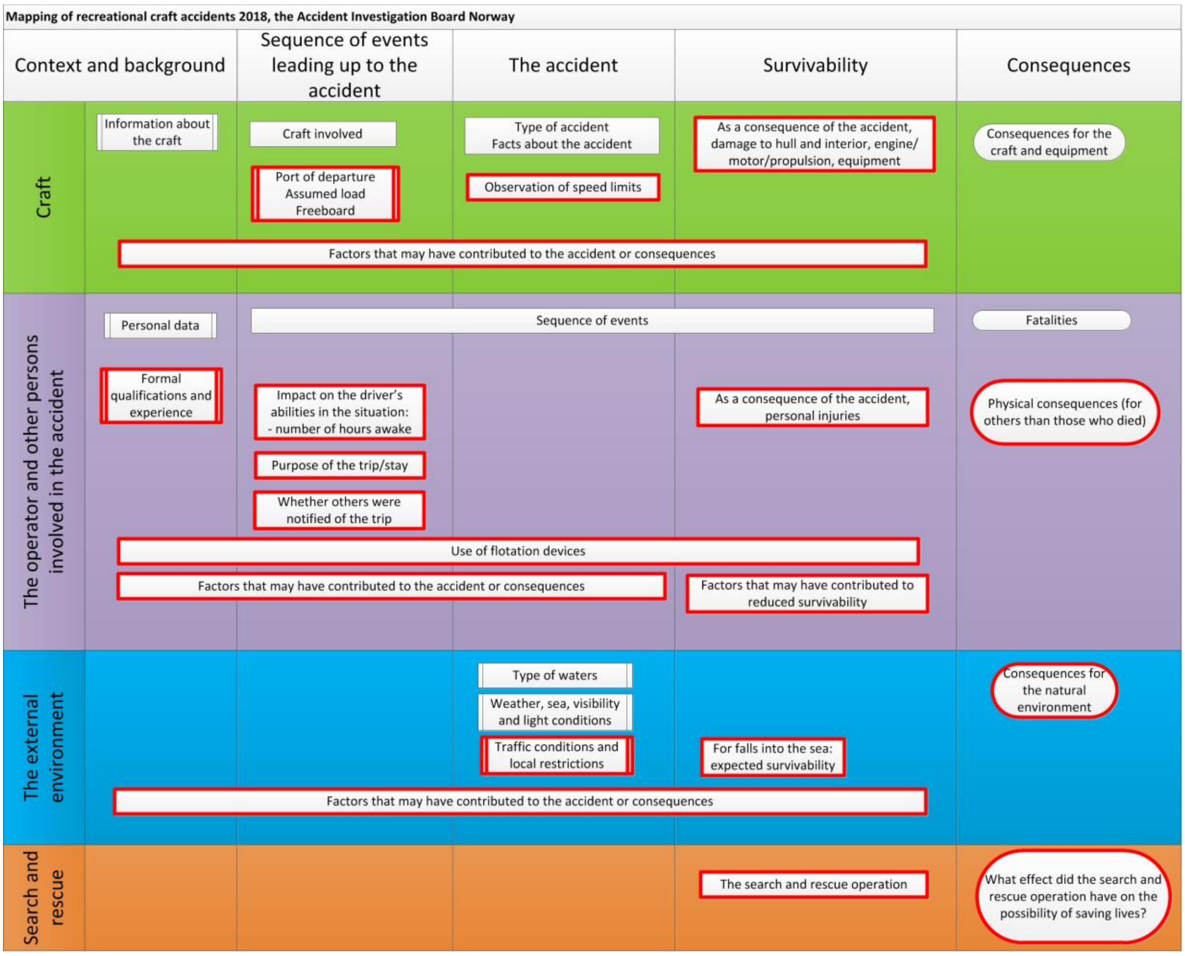


*Figure 2: The parties involved and phases used to obtain information relevant to describing the sequence of events and the circumstances surrounding fatal recreational craft accidents. The boxes with red outlines show information that was not collected by the Norwegian Maritime Authority's form KS-0602 Rapport om ulykke – Fritidsbåt ('Accident report – recreational craft' – in Norwegian only) as of autumn 2017. Information about the use of flotation devices was collected, but not to the extent shown in the illustration.*

## 3.4 Sources of information

The primary sources of information have been case documents from the police, including post mortem examination reports where available, and reports from the Joint Rescue

Coordination Centres, the Norwegian Society for Sea Rescue and other parties involved in search and rescue operations.

In addition, the following information has been obtained about the accidents when relevant. For a detailed description of these sources, see Appendix A.

- Historical weather observations from the weather station nearest the assumed place and time of the accident (Yr.no, 2018).
- Historical model calculations of sea conditions at the assumed place and time of the accident (Meteorologisk institutt, 2018).
- Sea charts (Kystverket, 2018). The assessment has included whether there may have been crossing waves.
- Speed limits from the Norwegian Coastal Administration’s thematic map *Fartsforskriftene* (Kystverket, 2018) and searches for speed limit regulations for the municipality in question (Lovdata, 2018).
- Traffic conditions in the waters in question – AIS (Kystverket, 2018).
- The small craft register *Småbåtregisteret* (Redningsselskapet, 2018) and the Ship Register (Sjøfartsdirektoratet, 2018).
- Light conditions (Time and Date AS, 2018).
- Media searches (Retriever, 2018) – searches for relevant articles about the accidents.
- Forensic toxicology tests of blood and urine samples.

## 3.5 Categorisation

The quality of the information was categorised as confirmed, assumed or uncertain.

The AIBN has considered which factors could have contributed to the accident or the scope of damage/injuries. A contributory safety factor is an event or condition that the AIBN considers could potentially have had a bearing on the accident or the scope of damage/injuries, but that did not necessarily have a clear causal effect. The AIBN has not considered whether any of the factors are more or less likely than others or may have contributed to a greater or lesser extent than other factors.

A group of AIBN accident investigators reviewed and discussed each of the accidents in order to quality-assure the results. Information about all the accidents was then collated and analysed. The results are presented in Chapter 4.

The main findings of the analysis are presented in Chapter 5. There are four accident types in addition to accidents involving boat rental for tourists.

## 3.6 Limitations in the data

The results presented in this report show data for 2018 only, and are not necessarily representative of the accident situation for other years. The number of fatalities and types of accidents vary from year to year.

The information obtained usually contained very little or imprecise information about the involved persons' formal qualifications, and their experience of the use of recreational craft in the waters where the accidents took place. The AIBN's assessments were based on witness statements, but witnesses may have had limited knowledge about the skills and experience of the persons who died. Experience and skills will be commented on in connection with the relevant accidents, but with the proviso that there is uncertainty associated with the quality of the information.

There was no post mortem examination in connection with five of the fatal accidents. We would have had a better basis for determining the cause of death if post mortem examinations of the deceased had been performed and blood samples analysed. A post mortem examination will help to shed light on whether illness contributed to the death and clarify whether the person was under the influence of alcohol, drugs or medication and, if so, whether that could have contributed to the sequence of events and survivability.

## 3.7 Sudden illness, cold water shock and hypothermia

For all persons involved in the accidents, it has been considered whether they could have been intoxicated at the time of the accident. For people assumed to have been intoxicated, we have considered whether it may have impaired their cognitive and physical functioning and thus been a contributory safety factor for the accident.

For the people who died (or are presumed dead), it was assessed whether the person may have been taken ill, whether the person may have suffered cold water shock (if the person fell into the sea) and whether the person may have become hypothermic. This has been considered in relation to whether these factors could have impaired the person's cognitive and physical functioning and thus been a contributory safety factor that limited their chances of survival.

Account has been taken of how likely these factors (assessment factors) were to have occurred during the sequence of events leading up to the accident, during the actual accident and after the accident happened. In cases where it was possible or likely that they played a role, the degree to which each of these factors may have contributed to impairing cognitive and physical functioning was assessed. The assessments were based on the information available about the accident and the persons involved.

In its assessments, the AIBN has received expert assistance from the Department of Forensic Medicine, Forensic Toxicology, Oslo University Hospital, and from the Experimental and Clinical Pharmacology research group based at the University Hospital of Northern Norway (UNN) and the Arctic University of Norway.

### 3.7.1 Water temperature, waves and survivability

The chances of survival after falling into the sea depends on factors such as clothing, water temperature and wave height. British studies that have modelled the chances of survival for North Sea workers who have fallen into the sea have defined 5 °C as the winter water temperature and 13 °C as the summer temperature (Robertson & Simpson, 1996). Similar temperatures are seen in Norway, where the geographical variation in the water temperature is greatest during summer. In Tromsø, the water temperature is 6 °C or less for six months of the year, compared with five months in Oslo. The average temperature in Tromsø never exceeds 12 °C, while in Oslo, the average water temperature is 12 °C or more from June to October (World sea temperature, 2019).

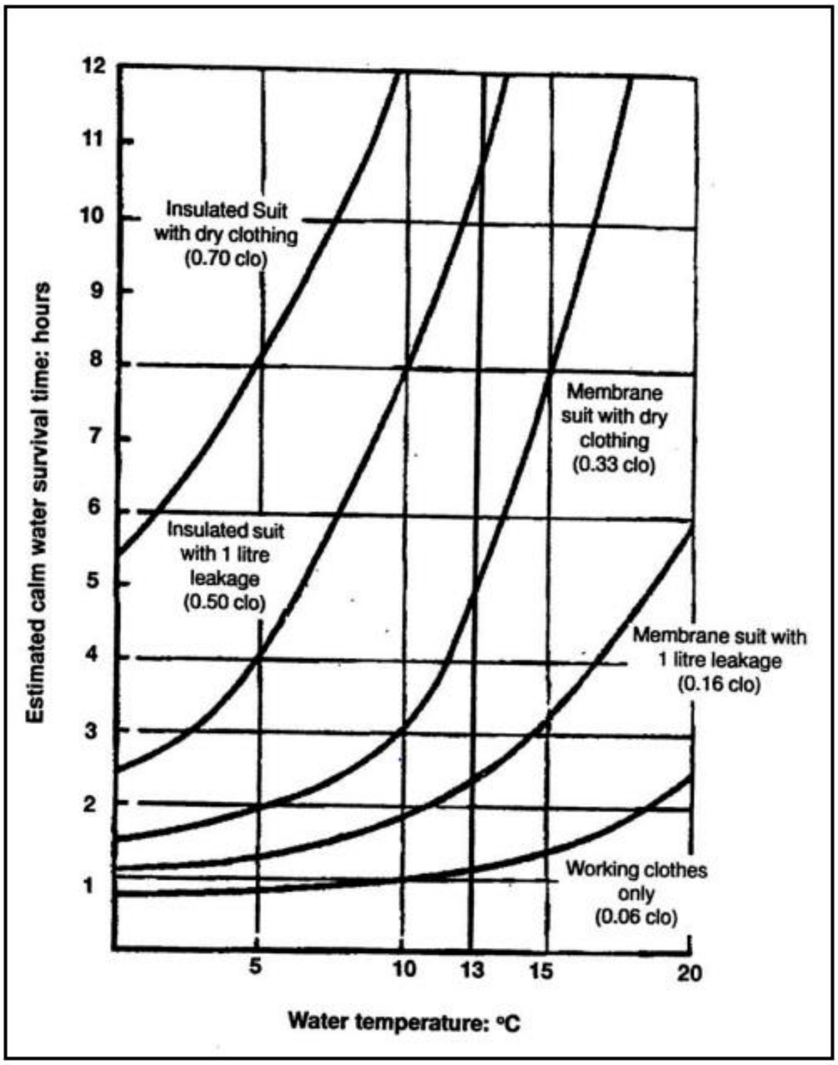


*Figure 3: Estimated survival time in calm water (small waves) at different temperatures and with different clothing. The model is based on young, slim and healthy men. Both 'membrane suit' and 'insulated suit' refer to dry suits. Source: Review of probable survival times for immersion in the North Sea and Survival in cold water (Robertson & Simpson, 1996; Brooks, 2001)*

The risk of drowning soon after falling into the water increases with increasing wave height. It is nevertheless difficult to assess survivability based solely on wave height, as it will also depend on the wavelength and whether or not the person is wearing a lifejacket and a survival suit that will provide buoyancy. The longer the wavelength, the better the chance of survival in high waves. It will therefore have a negative impact on survivability if the wave front is steep and the waves are breaking and producing foam that blows into the face of the person in the water. The probability of this happening increases with increasing wind force. An assessment of survivability must therefore also take into consideration the wind force when the sea was rough (Robertson & Simpson, 1996).

Because it is often difficult to estimate wavelength, how steep the waves are and how much they are breaking at the site of the accident, wind force is used as an indicator of whether the surface conditions represented a threat to the person’s ability to breathe. Generally speaking, a wind force of more than 5 on the Beaufort wind force scale (fresh breeze, 8–10.7 m/s) is considered sufficient to cause waves to break (Robertson & Simpson, 1996), which will make it more difficult to keep the airways clear of water and avoid drowning. Calm conditions are defined as 0–2 on the Beaufort scale. This corresponds to calm to light breeze with a maximum wind force of 3.3 m/s (Dannevig, 2019).

| CLOTHING ASSEMBLY (WORN WITH LIFEJACKET) | BEAUFORT WIND FORCE [1] | TIMESCALE WITHIN WHICH THE 'STANDARD MAN' IS LIKELY TO SUCCUMB TO DROWNING | |
|---|---|---|---|
| | | WINTER (WATER TEMP 5°C) | SUMMER (WATER TEMP 13°C) |
| WORKING CLOTHES (NO IMMERSION SUIT) | 0-2 | within $^3/_4$ hour | within $1^1/_4$ hours |
| | 3-4 | within $^1/_2$ an hour | within $^1/_2$ hours |
| | 5 and above | within significantly less than $^1/_2$ an hour | within significantly less than $^1/_2$ hours |
| DRY MEMBRANE SUIT WORN OVER WORKING CLOTHES - NO LEAKAGE INTO SUIT | 0-2 | within 2 hours | > 3 hours |
| | 3-4 | within 1 hour | within $2^3/_4$ hours |
| | 5 and above | within significantly less than 1 hour | within significantly less than $2^3/_4$ hours |
| MEMBRANE SUIT WORN OVER WORKING CLOTHES WITH 1 LITRE LEAKAGE INSIDE SUIT | 0-2 | within $1^1/_4$ hours | within $2^1/_2$ hours |
| | 3-4 | within $^1/_2$ an hour | within 1 hour |
| | 5 and above | within significantly less than $^1/_2$ an hour | within significantly less than 1 hour |
| DRY INSULATED SUIT WORN OVER WORKING CLOTHES - NO LEAKAGE INTO SUIT | 0-2 | > 3 hours* | > 3 hours * |
| | 3-4 | > 3 hours | > 3 hours* |
| | 5 and above | ≥ 3 hours | > 3 hours |
| INSULATED SUIT WORN OVER WORKING CLOTHES 1 LITRE LEAKAGE INSIDE SUIT | 0-2 | > 3 hours | > 3 hours* |
| | 3-4 | within $2^3/_4$ hours | > 3 hours* |
| | 5 and above | within significantly less than $2^3/_4$ hours May well exceed 1 hour | > 3 hours* |

*Figure 4: Estimated survival time in water at different temperatures, different wind forces (as an indication of wave conditions) and with different clothing. The model is based on young, slim and healthy men wearing lifejackets. Source: Review of probable survival times for immersion in the North Sea (Robertson & Simpson, 1996)*

### 3.7.2 Sudden illness

In this context, sudden illness means whether the person in question may have suffered an acute illness such as cardiac arrest, heart attack, stroke or an epilepsy seizure, with or without loss of consciousness, that may have rendered them incapable of self-rescue. The person may have been taken ill before falling into the water or as a result of exposure to cold water (see cold water shock).

### 3.7.3 Cold water shock

Cold water shock is a physiological response to the stimulation of cold receptors in the skin. The cold shock response includes tachycardia (increased heart rate), a reflex inspiratory gasp for air and hyperventilation (increased breathing rate) (Tipton, Golden, Higenbottam, Mekjavic, & Eglin, 1998). The ability to hold your breath is significantly impaired, and the increased breathing rate increases the risk of inhaling water. For persons who suffer cold water shock following immersion in cold water, drowning within a matter of minutes is a likely outcome if they are unable to rescue themselves and cannot be rescued by others (Brooks, 2001). Cold water shock can occur at all water temperatures below 25 °C, but the risk is highest at temperatures below 10–15 °C (Robertson & Simpson, 1996; Brooks, 2001). What this means in practice is that in accidents where people fall into the water in Norway, there is always a risk of cold water shock that can lead to rapid drowning. This risk is significant in winter all along the Norwegian coast, and is relevant all year round in large parts of the country.

Susceptible persons are also at risk of being taken ill when falling into cold water. For example, people with cardiopulmonary diseases will be at risk of acute cardiac arrest as a result of the increased physiological demands on the heart triggered by the cold shock response (Robertson & Simpson, 1996; Brooks, 2001). Cardiac arrest after immersion in cold water could also occur as a result of autonomic conflict following the activation of the cold shock response and the diving reflex affecting the heart of otherwise healthy individuals (Shattock & Tipton, 2012).

### 3.7.4 Hypothermia

Medically speaking, a person with a core temperature of less than 35 °C is defined as hypothermic. Core temperature is the temperature in the core of the body, and is often measured using a rectal thermometer or in the oesophagus. The core temperature will usually be very different from the skin temperature. The clinical effect and severity of hypothermia will depend on how cold the patient is, the surrounding environment and other factors, for example alcohol, drugs or serious injuries. Hypothermia is categorised as mild (35–32 °C), moderate (32–28 °C) and severe (<28 °C). A sufficiently hypothermic person will show no vital signs and appear to be dead.

Water has far greater thermal conductivity than air, and thus conducts heat quickly away from the body (Pedersen, 2019). Hypothermia will soon set in if a person falls into cold water (immersion) without insulating clothing.

| Stage | Clinical findings | Core temperature (°C) (if available) |
|---|---|---|
| Hypothermia I (mild) | Conscious, shivering[a] | 35–32 °C |
| Hypothermia II (moderate) | Impaired consciousness[a]; may or may not be shivering | <32–28 °C |
| Hypothermia III (severe) | Unconscious[a]; vital signs present | <28 °C |
| Hypothermia IV (severe) | Apparent death; Vital signs absent | Variable[b] |

*Figure 5: Stages of hypothermia with typical clinical findings correlating with core temperature. Source: Accidental hypothermia – an update (Paal, et al., 2016).*

Several factors could speed up or delay the onset of hypothermia. The most important factors that have been studied in environments similar to Norway are air and water temperatures, wind and wave conditions, and clothing (Robertson & Simpson, 1996). A dry suit will significantly delay the onset of hypothermia compared with wet clothes and body. Other factors that could have a bearing on how fast people become hypothermic include their BMI (body mass index), alcohol or drug intake, physical injuries, gender and age.

The risk of drowning is high if the person is not wearing flotation devices that keep the airways clear while unconscious. Mild hypothermia is a serious threat to people in the water, and becomes more dangerous if the weather and wave conditions are bad. At 34 °C, confusion and impaired orientation can already represent a threat. It will be difficult to keep the airways clear of water without the help of a lifejacket or other flotation devices. As wind force and waves increase, it will become more difficult for a mildly hypothermic person to avoid breathing in water. In practice, the risk of drowning as a consequence of hypothermia will be a serious threat to survival even before the person reaches the temperature levels categorised as moderate or severe hypothermia. Figure 3 shows estimated cold water survival times with different types of clothing. Hypothermia is more often the cause of drowning than the direct cause of death following accidents where people fall into the water (Robertson & Simpson, 1996; Brooks, 2001).

Medical treatment of hypothermic patients depends on the degree of hypothermia. If the patient is conscious, it is crucial to prevent them from becoming colder. In principle, all cold patients who require first aid should be assessed by medical personnel, and all who have a core temperature below 35 °C should be admitted to hospital. In the event of a cardiac arrest, cardiopulmonary resuscitation must be initiated. The rule of thumb is that ‘no one is dead until they are warm and dead’. The patient is to be transported while receiving ongoing CPR to a regional trauma centre for extracorporeal rewarming (Filseth, et al., 2014).

There have been cases where persons found without signs of breathing and pulse have been resuscitated without permanent injuries. In most of these cases, the persons’ airways have been open and they have been breathing, providing oxygen to their vital organs until the body reached severe hypothermia. However, there are examples of children surviving after being found under water up to one hour after an accident (Bolte, Black, Bowers, Thorne, & Corneli, 1988). In the Præstøfjord accident in Denmark, seven teenagers were found lifeless with their heads under water, which was at a temperature of 2 °C. They were found more than an hour and a half after falling in, and their median core temperature was 18.4 °C. All seven nevertheless survived following extracorporeal rewarming (Wanscher, et al., 2012).

## 3.8 Background information about alcohol

The Small Craft Act contains provisions on blood alcohol concentration for operators of recreational craft up to 15 metres in length. Firstly, Section 32 of the Small Craft Act stipulates a general requirement that the operator must not be unfit to operate the craft. This applies regardless of whether the reason for being unfit is being due to the influence of alcohol or other intoxicating or narcotic substances, illness, tiredness or other reasons. Moreover, Section 33 of the Small Craft Act stipulates a maximum blood alcohol concentration (BAC) of 0.08% for motorboats under 15 metres and sailing boats between 4.5 and 15 metres.

Recreational craft longer than 15 metres are subject to the same regulations as other bigger vessels, The drink drive limit for such craft is a BAC of 0.02%. It is also illegal to operate a craft while under the influence of other intoxicating or narcotic substances.

By comparison, the blood-alcohol limit for drivers of road vehicles is a BAC of 0.02%.[4]

Alcohol raises people's mood and impairs the ability to focus, affects short-term memory, ability to learn and to be critical, while increasing impulsivity and aggression (Folkehelseinstituttet (FHI), 2018). The effects change with the blood alcohol concentration, and there are considerable individual differences.

The effects are normally already felt at a BAC of between 0.02 and 0.05%. They can include impaired attention and ability to focus, ability to be critical, error detection ability, and increased impulsivity and willingness to take risks.

For many people, the ordinary 'alcohol buzz' is in the area up to 0.1%.

The Department of Forensic Medicine, Forensic Toxicology, Oslo University Hospital has produced a systematic description of the observable symptoms of alcohol intoxication, but remarks that the symptoms will vary considerably between individuals, particularly in terms of tolerance. The description is reproduced in the table below.

[4] In January 2001, the drink drive limit for drivers of motor vehicles was reduced from 0.05 to 0.02%, cf. the Road Traffic Act Section 31.

*Table 3: Symptoms that can be used to describe alcohol intoxication. The symptoms can vary considerably between individuals and depending on tolerance development. Source: The Department of Forensic Medicine, Forensic Toxicology, Oslo University Hospital*

| Level of intoxication | Blood alcohol concentration | Description of symptoms |
|---|---|---|
| Light | Under approx. 0.1% | Beginning of impairment of psychomotor skills: impaired judgement, increased confidence, raised mood level, impaired coordination and muscle control, increased risk-taking and willingness to take risks, impaired reaction time. |
| Moderate | Between approx. 0.1 and 0.15% | State of mind usually changes from more lively (stimulating) to more lethargic (depressant effect). The above-mentioned effects become more pronounced.<br>New symptoms emerge, including involuntary eye twitches (nystagmus), nausea, increasing tiredness/lethargy, more pronounced coordination/balance problems, slurred speech, impaired fine motor skills, dizziness. |
| Severe | From approx. 0.15% | The above-mentioned effects become even more pronounced. Signs of increasingly impaired consciousness and eventually somnolence.[5] A BAC of 0.3% and up involves a risk of respiratory depression and death. |

The department stated the following about tolerance development:

> *Tolerance development means that persons who use certain medications/intoxicating substances regularly can develop a tolerance for the effects of the substance in question. This means that with the same concentration in the blood, individuals who use a substance regularly and frequently will experience a reduced effect compared with sporadic users. However, tolerance is not an all-or-nothing phenomenon, as the degree of tolerance for different effects of one and the same substance will often differ. Moreover, the degree of tolerance can change quickly depending on the pattern of use. For some substances, the overall tolerance development is pronounced, while for others, it is more modest. The subjective perception of intoxication appears particularly susceptible to tolerance development, the objective effects less so.*

The US National Highway Traffic Safety Administration (NHTSA) conducted a review of literature on the effects of low doses of alcohol on driving-related skills (Moskowitz &

[5] Somnolence is a state of lightly impaired consciousness. From the Norwegian medical encyclopaedia *Store medisinske leksikon*: *'Somnolence takes the form of sleepiness, however, which is not too deep for the person to be able to respond when spoken to and follow simple instructions. The person can be awoken or awake spontaneously, but their ability to act and think is significantly impaired, and the person may fall asleep again during meals or conversations. […] Sopor is a deeper state of impaired consciousness. There is a continuum with no sharp dividing lines from wakefulness via somnolence to sopor and coma.'*

Fiorention, 2000). The review included 112 articles from different studies that examined various skills that may be relevant to driving.

The majority of the studies report that these skills are significantly impaired at a BAC of 0.05%. At 0.08%, more than 94% of the studies found the skills to be impaired. The literature review concluded that all drivers can expect their driving-related skills to be impaired at a BAC of 0.08% or less.

Researchers from Bergen fMRI Group, a research group based at the Faculty of Psychology at the University of Bergen and Haukeland University Hospital, examined the effect of alcohol on the brain and which parts of the brain are most impaired by alcohol. The results showed that most people cannot guess their blood alcohol level. How drunk people feel is also linked to their mood and how tired they are (Gundersen, 2008) (Gundersen, Grüner, Specht, & Hugdahl, 2008). These results were the first to document how much alcohol affects important areas of the brain at a BAC of 0.08%. According to an article in the newspaper *Bergens Tidende*, the results showed (Gundersen, 2008) that alcohol (BAC of 0.08%) impairs the functioning of nerve cells and reduces the capacity of the brain. Alcohol primarily affects an area of the brain called the anterior cingulate cortex (ACC). The ACC controls attention, the ability to detect one's own errors, to make decisions and correct one's behaviour in response to sudden changes in the surroundings.

Doctors from UniversitätsKlinik Essen in Germany have found that alcohol in the blood inhibits the activation of the brain's visual cortex (Helse Nyt, 2018). This was observed by performing MRT scans of subjects under the influence of alcohol. Twelve test participants completed visual tests when sober and then with a BAC of 0.05 and 0.11%, respectively. The MRT images showed that the level of activity in the test persons' visual cortex decreased as their level of intoxication increased. The effects was barely noticeable at 0.05%, but pronounced at a BAC of 0.11%. The area of the visual cortex that received the signals from the optic nerve were working even though the test participants were under the influence of alcohol, but there was little or no activity in the adjacent areas where these signals are processed. These centres are related to the sense of orientation and reaction times. These observations can also help to explain why people may experience a narrowed field of vision, what is known as tunnel vision, after heavy drinking.

There has been a sharp drop in the number of road accident fatalities since 1970 (Myklestad, et al., 2014). This drop is the result of years of systematic traffic safety work. Norway lowered the drink drive limit to 0.02% BAC with effect from 1 January 2001. The use of safety equipment in cars is important to the outcome of accidents. Seat belts became mandatory in the front seats of passenger cars and vans in Norway in 1975, and from 1985 also in the back seat. Other measures that have had an effect include speed reduction, speed cameras, better car safety equipment for children, and median barriers. Target figures and the zero vision for permanent injuries and fatalities were adopted early on.

As regards the effect of lowering the drink drive limit from a BAC of 0.05% to 0.02%, the Institute of Transport Economics (Transportøkonomisk Institutt, 2018) refers to two studies. (Borschos, 2000) and (Norström, 1997) have evaluated the effect of two acts of law introduced in Sweden: the lowering of the drink drive limit from a BAC of 0.05% to 0.02% in 1990 and the lowering of the limit for serious drink driving and stricter minimum punishments for aggravated drink driving at between 0.15 and 0.10% BAC.

Both studies found similar reductions in the number of accidents where persons were injured and killed, a reduction of approximately 10%, after the introduction of the 0.02% drink drive limit. Borschos (2000) found a reduction of 14% in the number of fatal accidents and 6% in the number of injuries where persons were injured after the limit for aggravated drink driving was introduced. All these effects are statistically significant.

However, it cannot be ruled out that trends, other acts of law regarding drink driving and an increased level of police control activities could have contributed to these findings. The number of drivers subjected to police checks was doubled compared with before the introduction of the new drink drive limit (Glad & Vaa, 1997). A recent study from Scotland (Haghpanahan, 2018) shows that lowering the drink drive limit from 0.08 to 0.05% did not automatically lead to a reduction in the number of accidents. In December 2014, the drink drive limit in Scotland was lowered from a BAC of 0.08 to 0.05%. Somewhat surprisingly, Haghpanahan et al. found no statistically significant reduction in the number of road traffic accidents after the introduction of the lower drink drive limit. They concluded that lowering the drink drive limit from 0.08 to 0.05% does not automatically lead to a reduction in the number of accidents unless other measures are introduced at the same time, such as more police checks.

About 10,000 drivers per year are arrested on suspicion of driving under the influence of alcohol or other intoxicating substances (Oslo universitetssykehus, 2019). Many of them are repeat offenders. The biggest group is comprised of persons between 20 and 35 years of age, and are, on average, found to have about three intoxicating substances in their blood at the same time. The most common substances other than alcohol are amphetamine/methamphetamine, cannabis (hash), benzodiazepines and opiates (including morphine and codeine, for example Paralgin forte and Pinex forte).

The number of drivers per year who are arrested on suspicion of driving under the influence are probably only the tip of the iceberg. A large-scale roadside survey in which more than 9,000 Norwegian drivers participated (the DRUID project) was conducted in 2008–2009. Of the 9,000 drivers, 3% had alcohol, other intoxicating substances or sedatives in their system. The most commonly found types of medication that represents a risk to traffic were the anxiolytic drug diazepam (e.g. Valium), the hypnotic drug zopiclone (e.g. Imovane) and the pain killer codeine (e.g. Paralgin forte, Pinex forte). The majority of drivers who had used illegal drugs were men under 35 years of age. Narcotic substances were found in the saliva samples of approx. 5% of the men in this age group. Cannabis was the most commonly found drug (1.2%), followed by cocaine (0.5%) and amphetamines (0.5%). By comparison, around 0.3% had a blood alcohol content of more than 0.2 per thousand.

According to the report from the Norwegian Public Roads Administration (Ringen, 2018), intoxication has been a probable contributory safety factor in 21% of fatal road traffic accidents. The actual extent of driving under the influence is probably higher, because blood samples for testing for alcohol and other intoxicants are not collected from all drivers involved in accidents. Nor are post mortem examinations carried out on all drivers who die in accidents. In 2017, most drivers found to be driving under the influence were under the influence of multiple substances or substances other than alcohol. The report does not provide any data about the level of intoxication.

A recent retrospective autopsy study showed that more than half of the victims of fatal accidents under the age of 35 were under the influence of alcohol and/or drugs. Illness, most often cardiovascular diseases that may have caused a sudden functional impairment before a crash, may have been a contributory factor for 70% of drivers older than 55 years. These drivers were rarely intoxicated (Breen, Naess, Gjerde, Gaarder, & Stray-Pedersen, 2018).

A study of drivers who were killed in road traffic accidents while under the influence of alcohol and/or drugs describes the level of intoxication. In most of these cases, the driver was under the influence of alcohol and often had a high blood alcohol concentration. Overall, about half of the drivers who died in accidents while under the influence of alcohol and/or drugs had a BAC of more than 0.1%. A higher proportion of those who were under the influence of substances other than alcohol had concentrations several times higher than the legal limit (Gjerde & Christophersen, 2012).

A clear correlation has been demonstrated between alcohol intoxication and the risk of road traffic accidents; see Figure 6 (Blomberg, Peck, Moskowitz, Burns, & Fiorentino, 2009). No corresponding figures have been published for accidents involving boats.

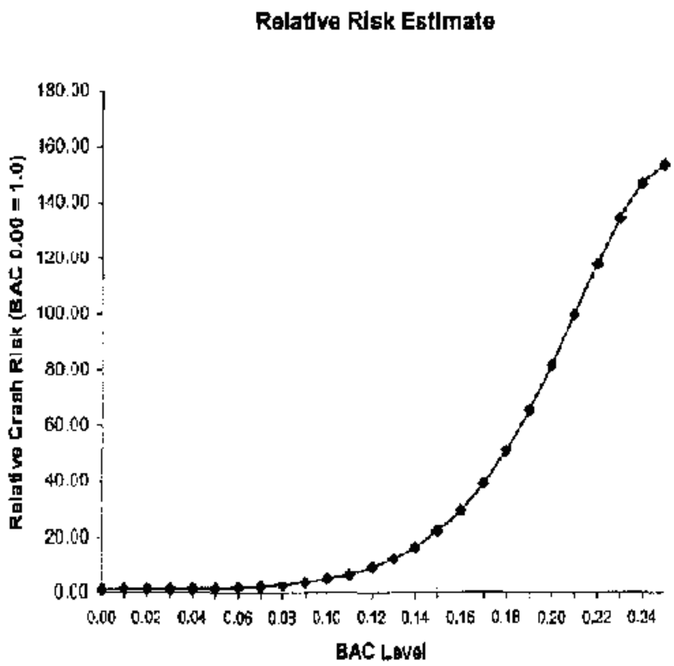


*Figure 6: Correlation between alcohol intoxication and accident risk. The risk begins to increase at a BAC of about 0.05%. Source: The Long Beach/Fort Lauderdale relative risk study (Blomberg, Peck, Moskowitz, Burns, & Fiorentino, 2009)*

One study compared the blood alcohol levels of car drivers and boat operators (Khiabani, Opdal, & Mørland, 2008). The sample consisted of drivers or boat operators that the police suspected of being under the influence of alcohol. The results showed that the median level for car drivers was high (BAC of 0.151%), but that it was considerably higher for boat operators (0.176%). A higher proportion of the car drivers were known to be heavy drinkers, but there was less knowledge about the drinking habits of boat operators. The authors believe that these results indicate a need for stricter legislation and more police checks to prevent serious marine accidents due to alcohol intoxication.

Grant et al. (Grant, 2012 ) investigated how accurately college students could guess their blood alcohol concentration after drinking at least one alcoholic drink during the past two hours. The study supported previous results, i.e. that persons at lower levels of intoxication tended to overestimate their blood alcohol concentration, while those at higher levels tended to underestimate their blood alcohol concentration. Already at a BAC of 0.08%, the test participants showed a tendency to underestimate their blood alcohol concentration considerably. This tendency was stronger the higher the person's blood alcohol concentration was, as was also found in a previous study (Bullers, 2006).

## 3.9 Previous relevant accidents investigated by the AIBN

### 3.9.1 <u>The taxi boat Isabella and a recreational craft (collision)</u>

The AIBN conducted a safety investigation of a collision between a taxi boat and a recreational craft in Kragerø in 2013. The report concluded with the following safety recommendations, among others (Statens havarikommisjon for transport, 2014):

> *Safety recommendation MARINE No. 2014/15T*
> *The fact that the helmsman of the leisure craft was under the influence of alcohol may have had an impact at several stages of the chain of events leading up to the accident in Kragerø on 27 July 2013. Research shows that alcohol weakens the functions (impulse control, attention, visual functions, assessment ability and alertness) that are required to ensure safe navigation. This means that operating a boat at high speed is incompatible with being under the influence of alcohol from a safety perspective. The AIBN believes that the current blood alcohol limit of 0.8 per thousand for pleasure craft of less than 15 metres does not make this clear. The Accident Investigation Board Norway recommends that the Ministry of Justice and Public Security evaluate the Act relating to Leisure Boats and Small Craft with a view to preventing people from operating boats at high speed when under the influence of alcohol.*
>
> *Safety recommendation MARINE No. 2014/16T*
> *The fact that the helmsman of the leisure craft was under the influence of alcohol may have had an impact at several stages of the chain of events leading up to the accident in Kragerø on 27 July 2013. Research shows that alcohol weakens the functions (impulse control, attention, visual functions, assessment ability and alertness) that are required to ensure safe navigation. This means that operating a boat at high speed is incompatible with being under the influence of alcohol from a safety perspective. The AIBN believes that a combination of legislation, control activity and information measures can give a collective and efficient influence on safety. The Accident Investigation Board Norway recommends that the Ministry of Trade, Industry and Fisheries review and implement measures that can contribute to preventing people from operating a boat at high speed when under the influence of alcohol.*

### 3.9.2 <u>Viking 7 (capsizing)</u>

The AIBN conducted a safety investigation after a rental boat took on water and capsized (Statens havarikommisjon for transport, 2016). The accident took place north-west of Mehamn on 6 July 2014. Everybody on board fell into the sea when the boat capsized. One of the fishing tourists died as a consequence of the strain suffered in the ordeal and another was taken to hospital with arrhythmia caused by hypothermia. The other tourists and the guide suffered no physical injuries in the accident. The report concluded that the boat's manufacture did not meet the requirements for a recreational craft. One of the safety recommendations issued following this accident was that the Norwegian Maritime Authority should give higher priority to supervising the manufacture and sale of recreational craft. The report describes that the rental firm did not give the tourists sufficient training in how to use the survival suits and lifejackets. It was also emphasised that the rental firm had not installed a gasket on the flush hatch, which could have reduced water ingress. The craft was overloaded at the time of the accident, which was seen as related to the fact that the rental firm was unaware of its operational limits.

# 4. ANALYSIS

This chapter provides an overview of all the accidents included in the analysis. The overview contains relevant information about the persons involved in the accidents, the craft, the external environment and search and rescue efforts.

## 4.1 Comparison with previous years

Fewer people died in accidents involving recreational craft in 2018 than in previous years. According to the Norwegian Maritime Authority, there were six fewer fatalities than in 2017 and three fewer than the average for the previous three years (Sjøfartsdirektoratet, 2019). The report states that the last recreational craft accident of the year happened on 28 September, which means that there were no accidents involving recreational craft in the fourth quarter.

The question is what the explanation for this decrease could be. The summer of 2018 saw record temperatures in Southern Norway, and it is natural to assume that the use of recreational craft was probably higher than in previous years. At the same time, 10% more accidental drownings were registered compared with the preceding year [6] (Redningsselskapet, 2018).

The AIBN is not aware that any safety improvement measures, such as regulatory amendments, awareness-raising campaigns, supervision and control measures etc., that differ significantly from previous years have been implemented in 2018.

The Norwegian Maritime Authority registers incidents as recreational craft accidents based on the criteria described in section 3.1. One incident in 2018 was initially believed to be a recreational craft accident, but was later omitted when it was found to be a suicide. Correspondingly, another accident was found to have been a swimming accident that did not involve a recreational craft. It can also be challenging to draw the line between when a person falls into the water from a jetty, quay etc. and when an accident has taken place while using a recreational craft as described in section 3.4. Two accidents in autumn 2018 turned out not to involve recreational craft after all. The two accidents in question were the foundering of the fishing smack Iris in the Gloppefjord on 20 October 2018, and the workboat Nordavind, which probably ran aground off Fedje on 23 November 2018.[7] It can also be difficult to distinguish between whether an incident is deemed to be an accident or whether it involved intentional harm to a ship, an individual or the environment. The incident at Øksnes on 15 June 2018 is such a potential borderline case, but has been included in the statistics for fatal recreational craft accidents.

The AIBN therefore believes that part of the explanation why fewer fatal recreational craft accidents were registered in 2018 than before is imprecision in whether or not an incident is deemed to be a recreational craft accident or not. The report on accidents and injuries in Norway also comments on this (Ohm, Madsen, & Alver, 2019). By obtaining more information about the incidents, such as information from the Ship Register, the

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[6] A total of 102 persons drowned in 2018. This figure includes all types of drowning and is not limited to drownings from recreational craft.

[7] The AIBN is investigating both these accidents, but as separate safety investigations as for any other professional craft.

police, the joint rescue coordination centres and other parties involved in search and rescue work, we can form a clearer view of how to improve incident registration.

## 4.2 The basis for analysis

Table 4 shows key figures for fatal recreational craft accidents in 2018 included in the survey.

The AIBN has not obtained sufficient information about two of the accidents, and they are therefore not included in the analysis. They are the incident at Øksnes in Nordland county on 15 June 2018 and the accident at Vallø in Tønsberg, Vestfold county, on 2 August 2018.

The further analysis is therefore based on 20 accidents with 21 fatalities; see Table 5. A total of 22 recreational craft were involved in the accidents, as two of the accidents involved a collision between two craft.

*Table 4: Type of fatal recreational craft accidents in 2018.*

| Type of accident | Fatalities in 2018 [number] | Fatalities (%) | Fatalities included in the analysis | Fatalities in 2018 included in the analysis (%) |
|---|---|---|---|---|
| Capsizing | 7 | 30% | 7 | 33% |
| Person overboard | 4 | 17% | 4 | 19% |
| Craft-jetty | 4 | 17% | 4 | 19% |
| Grounding | 2 | 9% | 2 | 10% |
| Collision | 2 | 9% | 2 | 10% |
| Sudden illness | 1 | 4% | 1 | 5% |
| Fire | 1 | 4% | 0 | 0% |
| Missing | 1 | 4% | 1 | 5% |
| Unknown | 1 | 4% | 0 | 0% |
| **Total** | **23** | **100%** | **21** | **100%** |

*Table 5: Number of persons involved in fatal recreational craft accidents in 2018 that are included in the analysis.*

| Number of recreational craft accidents | 20 |
|---|---|
| Persons dead or presumed dead | 21 |
| Persons who suffered serious physical injuries | 1 |
| Persons who suffered no serious physical injuries or no physical injuries. | 14 |
| Total number of persons involved in the recreational craft accidents included in the analysis | 36 |

## 4.3 Personal injuries

It was mostly men who were involved in these very serious accidents and who died; see Figure 7. This tallies with the Norwegian Maritime Directorate's results from previous years. Generally speaking, more men than women die in accidents across all age groups (Myklestad, et al., 2014).

Sixteen of the persons who died drowned; see Figure 8. In addition, three persons are missing. The AIBN assumes that they have drowned. In total, 19 (of 21) persons drowned, corresponding to 90% of all those who died.

Two persons (out of 21) died as a result of very serious physical injuries, mostly head injuries.

Fourteen persons (out of 36) suffered no serious physical injuries.

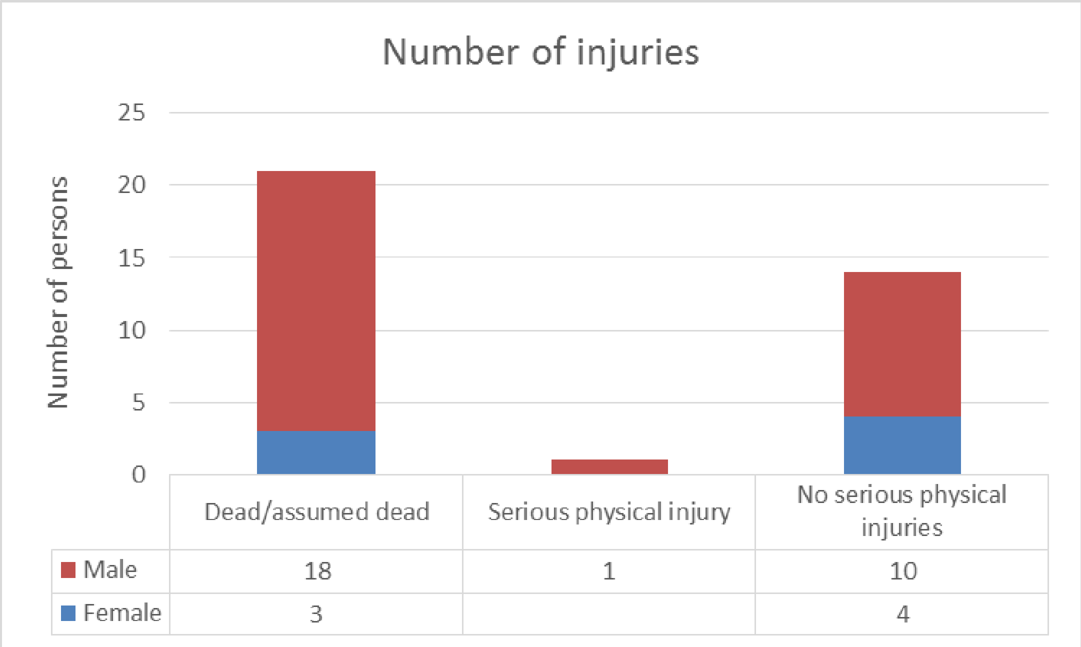



*Figure 7: Number of fatalities, persons sustaining physical injuries and persons sustaining no serious injuries. The figures include everyone involved in the fatal recreational craft accidents that are included in the analysis.*

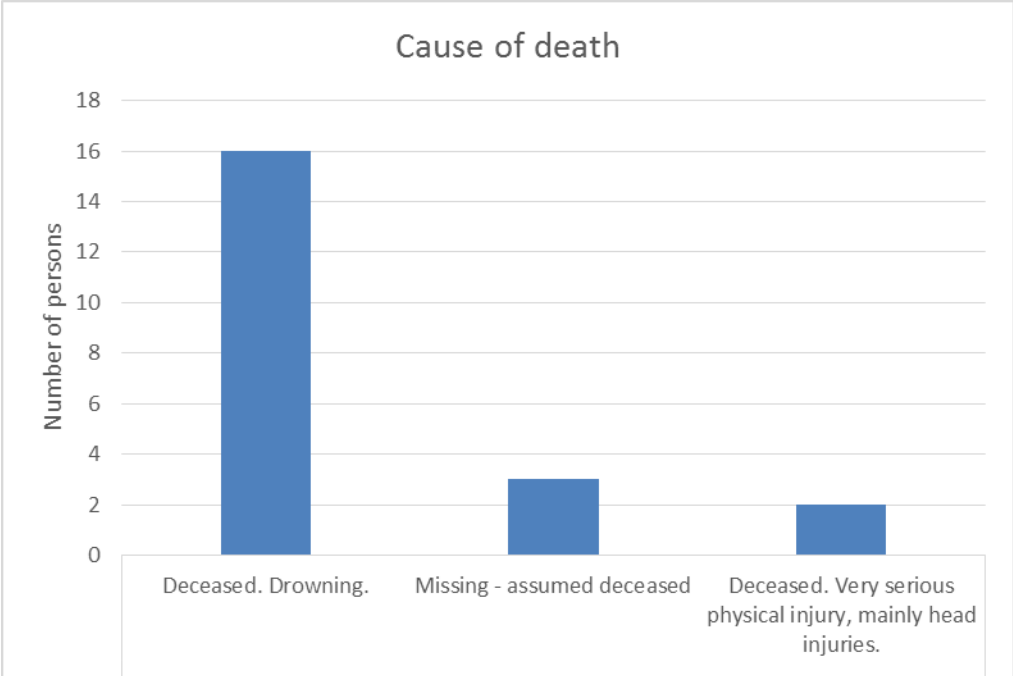



*Figure 8: Number of fatalities broken down by cause of death. The figures include all fatalities included in the analysis.*

## 4.4 Type of accident

More than half of those who died fell into the water from the craft or because the craft capsized; see Table 6. In two cases, we have been unable to determine whether the person first fell overboard, causing the craft to capsize, or whether the craft capsized causing the person to fall overboard. These two accidents have been registered as capsizing.

Person overboard means that a person has fallen into the sea (or water) from their boat. This category does not include accidents where the craft has first collided, run aground, capsized etc.

Four out of 21 died when their craft ran aground or collided. Grounding means that the craft hits the shore, an island or a skerry etc. while under way. Collision means an accident involving two craft hitting each other.

Four out of 21 died when falling into the water between the craft and a jetty. The craft were moored at a floating jetty, and the accidents will be referred to as craft-jetty accidents from now on.

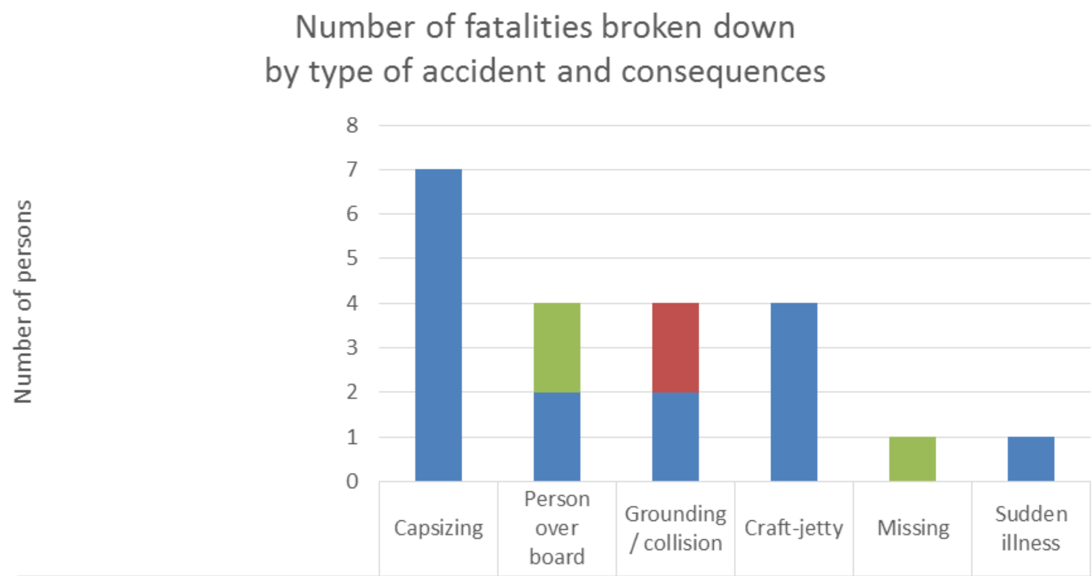
In one case, the person was taken ill. In another case, both the person and the craft went missing. The AIBN assumes that the craft capsized and the person fell into the sea. In both cases, the person may have drowned.

Five tourists drowned when using rented craft. All of them died after the craft capsized or after falling overboard. This accounts for 5 out of the 21 fatalities.

*Table 6: Overview of accidents broken down by type.*

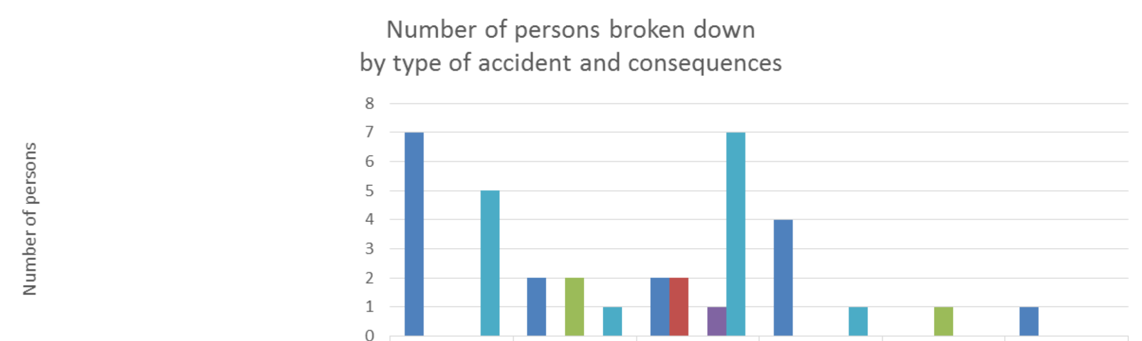
| Type of accident | Key figures | Number of fatalities | Percentage of the fatalities in the basis for analysis |
|---|---|---|---|
| Capsizing | Capsizing accounts for more drownings than any other type of accident | 7 | 33% |
| Person overboard | The cause of all deaths was drowning after falling into the sea. | 4 | 19% |
| Groundings and collisions | Two died from their injuries and two drowned. | 4 | 19% |
| Fall between craft and jetty | The cause of all deaths was drowning after falling into the water between the craft and a jetty. | 4 | 19% |
| Sudden illness and missing | One person was taken ill before the craft ran aground.<br>One person went missing along with his craft and fishing gear. | 2 | 10% |
| Total number of fatalities in the analysis | | 21 | 100% |

Figure 9 shows the number of fatalities by accident type. Figure 10 shows the consequences for all the persons involved, broken down by accident type.




| | Capsizing | Person over board | Grounding / collision | Craft-jetty | Missing | Sudden illness |
|---|---|---|---|---|---|---|
| Missing - assumed dead. | | 2 | | | 1 | |
| Dead. Very serious physical injury, mainly head injuries. | | | 2 | | | |
| Dead. Drowning. | 7 | 2 | 2 | 4 | | 1 |

*Figure 9: Fatalities broken down by type of accident and consequences.*




| | Capsizing | Person over board | Grounding / collision | Craft-jetty | Missing | Sudden illness |
|---|---|---|---|---|---|---|
| Dead. Drowning. | 7 | 2 | 2 | 4 | | 1 |
| Dead. Very serious physical injury, mainly head injuries. | | | 2 | | | |
| Missing - assumed dead. | | 2 | | | 1 | |
| Serious physical injuries. | | | 1 | | | |
| No serious physical injuries. | 5 | 1 | 7 | 1 | | |

*Figure 10: Number of persons involved in the accidents, broken down by type of accident and consequences.*

## 4.5 Type of activity

Figure 11 shows that a majority of accidents occurred in connection with three different activities:

- On their way to a set destination
- Overnight stays or spending time on board while the craft was moored to a jetty
- Fishing

The accidents mapped in 2018 show that most of them occurred while the boat was under way and not in connection with fishing.

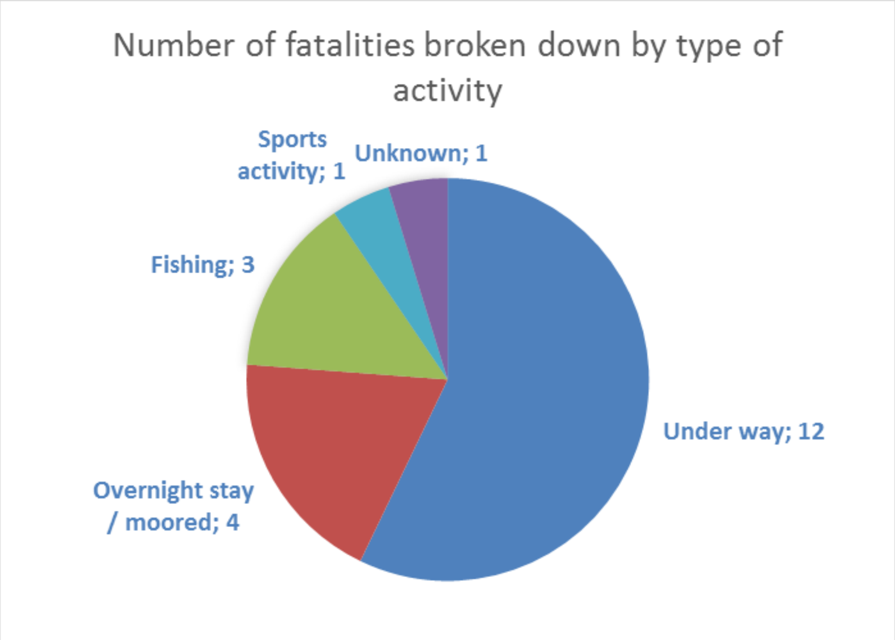



*Figure 11: Number of fatalities broken down by type of activity.*

## 4.6 Place and time

Most of the accidents that happened in the spring took place in Western Norway; see the figures below.

The accidents that happened in the summer and autumn were more evenly distributed throughout Norway.

Most capsizes and person overboard accidents took place in daylight between 08:00 and 22:00; see Figure 16.

All the collisions and groundings happened in twilight conditions between 23:00 and 02:00.

Falls by a jetty mostly happened in twilight or darkness between 02:00 and 04:00.

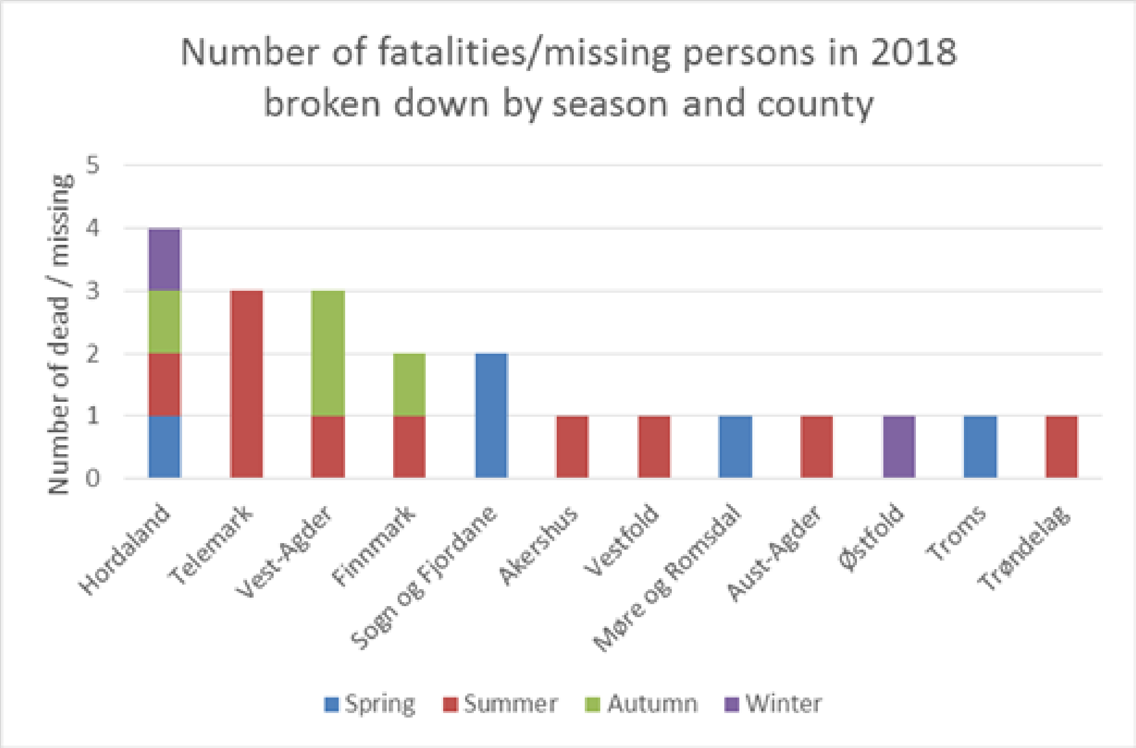



*Figure 12: Number of fatalities/missing persons in 2018 broken down by season and county.*

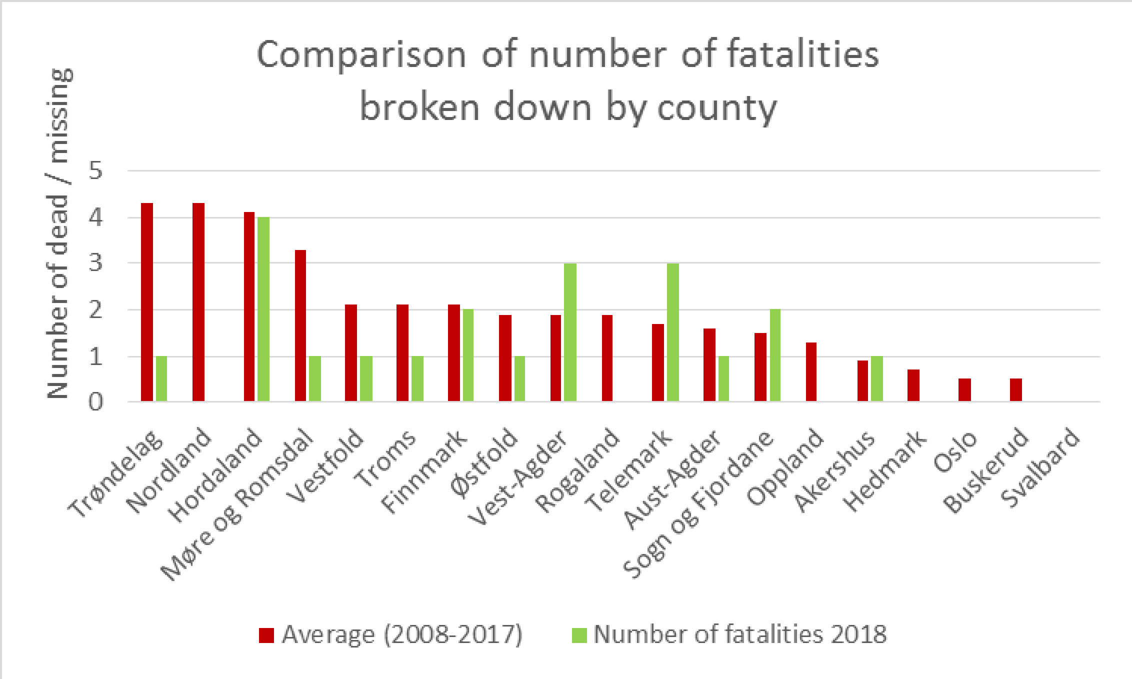
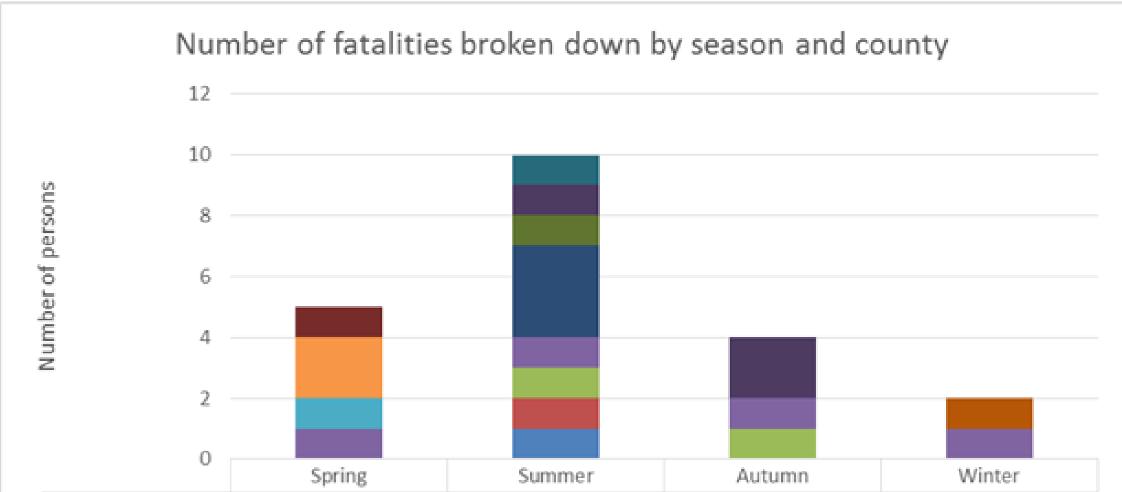
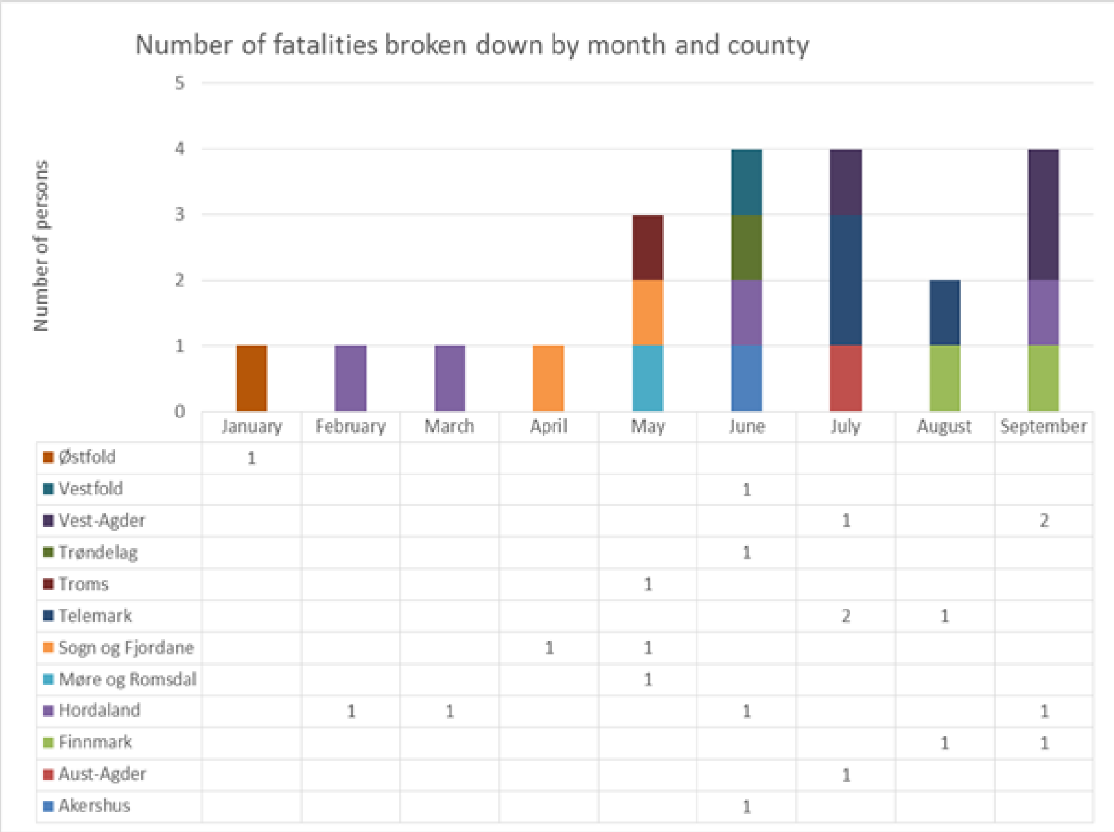



*Figure 13: Comparison of the number of fatalities in 2018 with the average for the 10 preceding years. Two accidents in 2018 are not included. They are the ones in the counties in Nordland and Vestfold.*



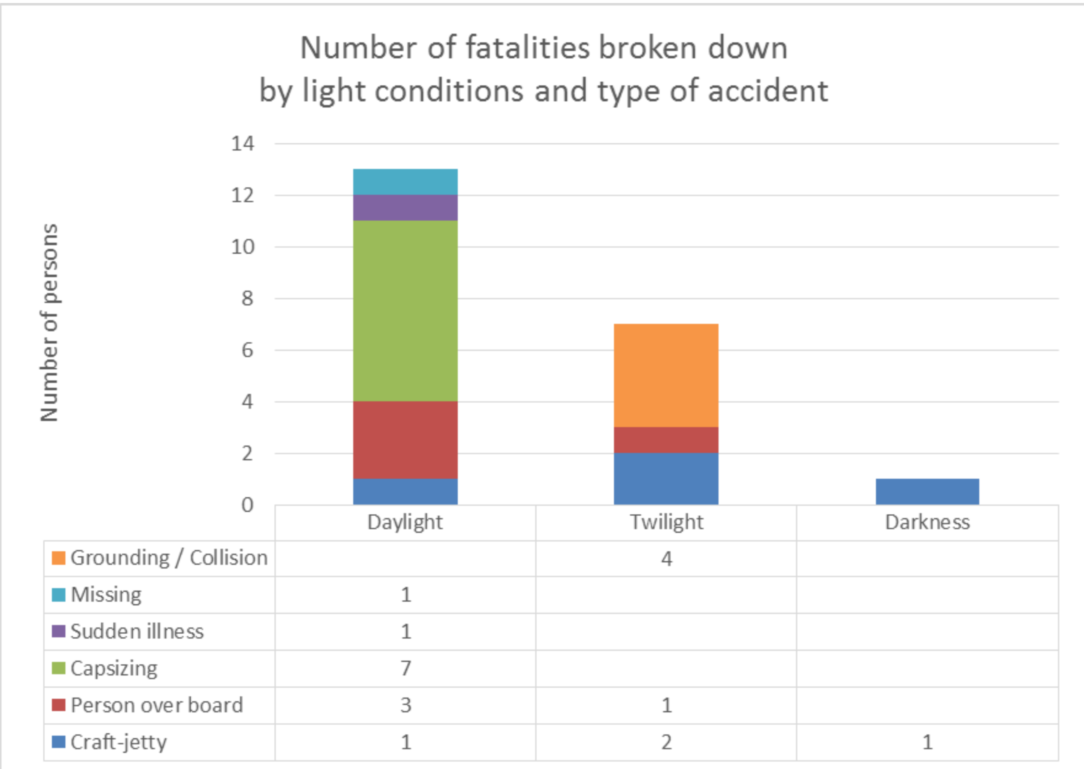

| | Spring | Summer | Autumn | Winter |
|---|---|---|---|---|
| Østfold | | | | 1 |
| Vestfold | | 1 | | |
| Vest-Agder | | 1 | 2 | |
| Trøndelag | | 1 | | |
| Troms | 1 | | | |
| Telemark | | 3 | | |
| Sogn og Fjordane | 2 | | | |
| Møre og Romsdal | 1 | | | |
| Hordaland | 1 | 1 | 1 | 1 |
| Finnmark | | 1 | 1 | |
| Aust-Agder | | 1 | | |
| Akershus | | 1 | | |

*Figure 14: Number of fatalities broken down by season and county.*




| | January | February | March | April | May | June | July | August | September |
|---|---|---|---|---|---|---|---|---|---|
| Østfold | 1 | | | | | | | | |
| Vestfold | | | | | | 1 | | | |
| Vest-Agder | | | | | | | 1 | | 2 |
| Trøndelag | | | | | | 1 | | | |
| Troms | | | | | 1 | | | | |
| Telemark | | | | | | | 2 | 1 | |
| Sogn og Fjordane | | | | 1 | 1 | | | | |
| Møre og Romsdal | | | | | 1 | | | | |
| Hordaland | | 1 | 1 | | | 1 | | | 1 |
| Finnmark | | | | | | | | 1 | 1 |
| Aust-Agder | | | | | | | 1 | | |
| Akershus | | | | | | 1 | | | |

*Figure 15: Number of fatalities broken down by month and county.*




| | Daylight | Twilight | Darkness |
|---|---|---|---|
| Grounding / Collision | | 4 | |
| Missing | 1 | | |
| Sudden illness | 1 | | |
| Capsizing | 7 | | |
| Person over board | 3 | 1 | |
| Craft-jetty | 1 | 2 | 1 |

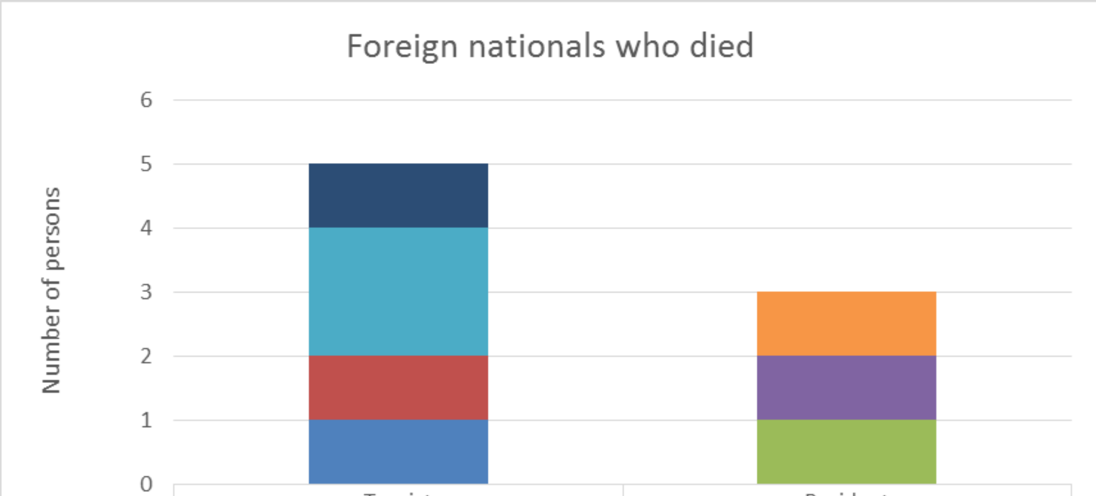
*Figure 16: Number of fatalities broken down by light conditions and type of accident.*

## 4.7 Nationality, activity and rental

Thirteen of the 21 persons who died were Norwegians. Eight were foreign nationals; see Figure 17. The foreign nationals were all European.

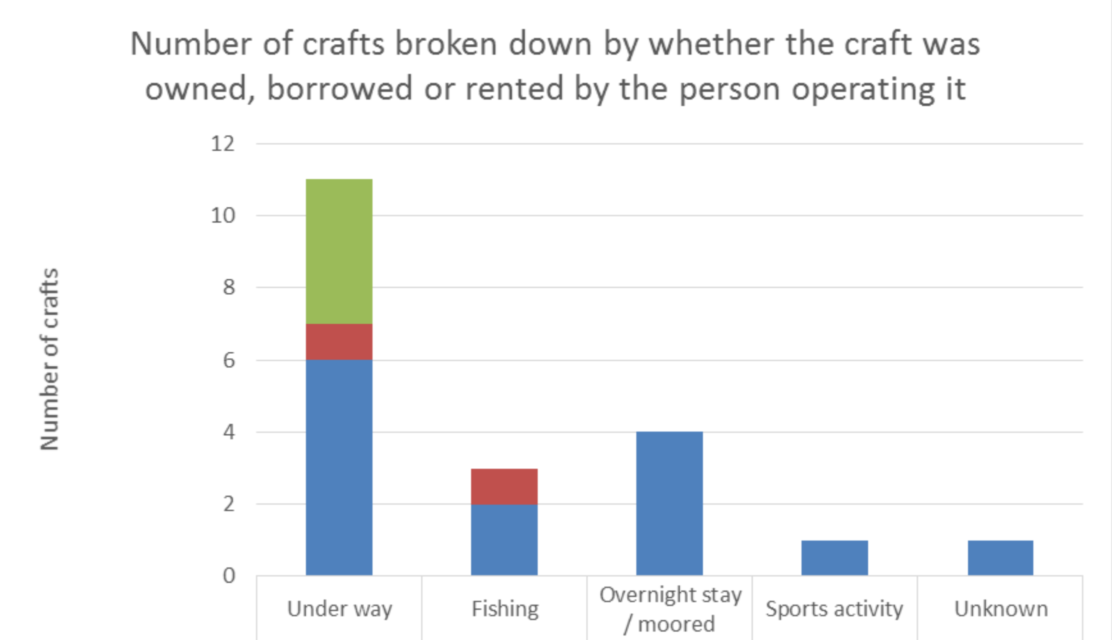
Three of the foreign nationals who died (out of eight) were resident in Norway. They lived in the area where the accidents occurred. Two of them owned the craft; see Figure 18. One of the accidents involved a rowing boat that was lent to three foreign nationals who went fishing.

The other five who died (out of eight foreign nationals) were tourists. They were under way in a rented craft when the accidents occurred. Two of the persons drowned when their motorboat capsized. One person fell into the sea and drowned. The other two persons drowned when their kayak and canoe, respectively, capsized.




| | Tourist | Resident |
|---|---|---|
| Ukrainian | 1 | |
| Polish | | 1 |
| German | 2 | |
| French | | 1 |
| Estonian | | 1 |
| Dutch | 1 | |
| British | 1 | |

*Figure 17: Foreign nationals who died, broken down by nationality.*



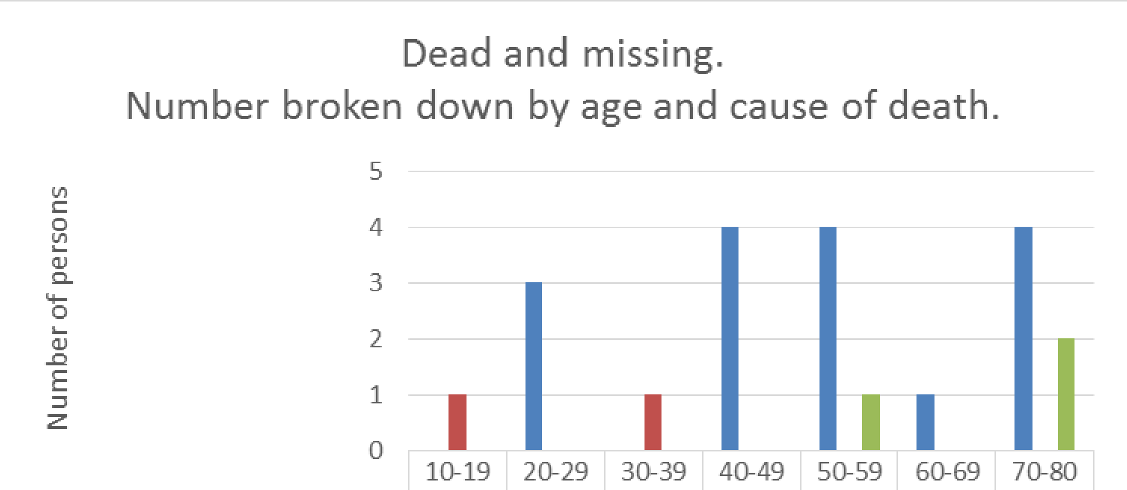

| | Under way | Fishing | Overnight stay / moored | Sports activity | Unknown |
|---|---|---|---|---|---|
| Rental to tourists | 4 | | | | |
| Rental / borrowed | 1 | 1 | | | |
| Own use /family | 6 | 2 | 4 | 1 | 1 |

*Figure 18: Number of fatalities broken down by type of activity and whether the craft was owned, borrowed or rented by the person operating it.*

## 4.8 Age

The youngest person who died was 16 years old; see Figure 19. The oldest person was 80 years old. Sixteen of those who died (out of 21) were older than 40. The missing persons were older than 50.

Both of those who died from very serious injuries were younger than 40.




| | 10-19 | 20-29 | 30-39 | 40-49 | 50-59 | 60-69 | 70-80 |
|---|---|---|---|---|---|---|---|
| Dead. Drowning. | | 3 | | 4 | 4 | 1 | 4 |
| Dead. Very serious physical injury, mainly head injuries. | 1 | | 1 | | | | |
| Missing - presumed dead. | | | | | 1 | | 2 |

*Figure 19: Breakdown by age and cause of death.*

## 4.9 The recreational craft

Six (of a total of 22) craft capsized or sustained very serious damage to the hull and engine as a consequence of the accidents; see Figure 20. All of the six craft that ran aground or collided sustained very serious or serious damage to the hull.

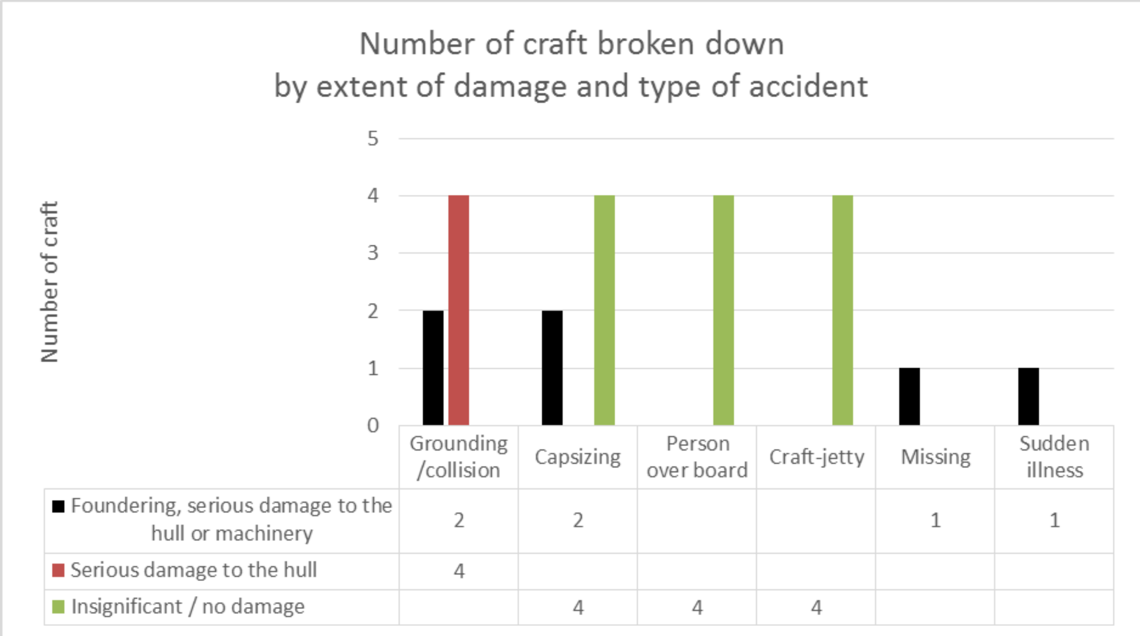



*Figure 20: Number of damaged craft broken down by type of accident.*

The AIBN does not have sufficient information about the speeds at which the craft were travelling at the time of the accident for the collisions and groundings (four accidents, six craft), but the speeds probably exceeded 20 knots in most of these accidents; see Figure 21. Craft of different sizes were involved in these accidents, from dinghies with a length of 3.7 metres to craft of 9.2 metres with sleeping quarters. In addition, two water scooters with powerful engines, in the order of 250 hp (186 kW), were involved in these accidents.

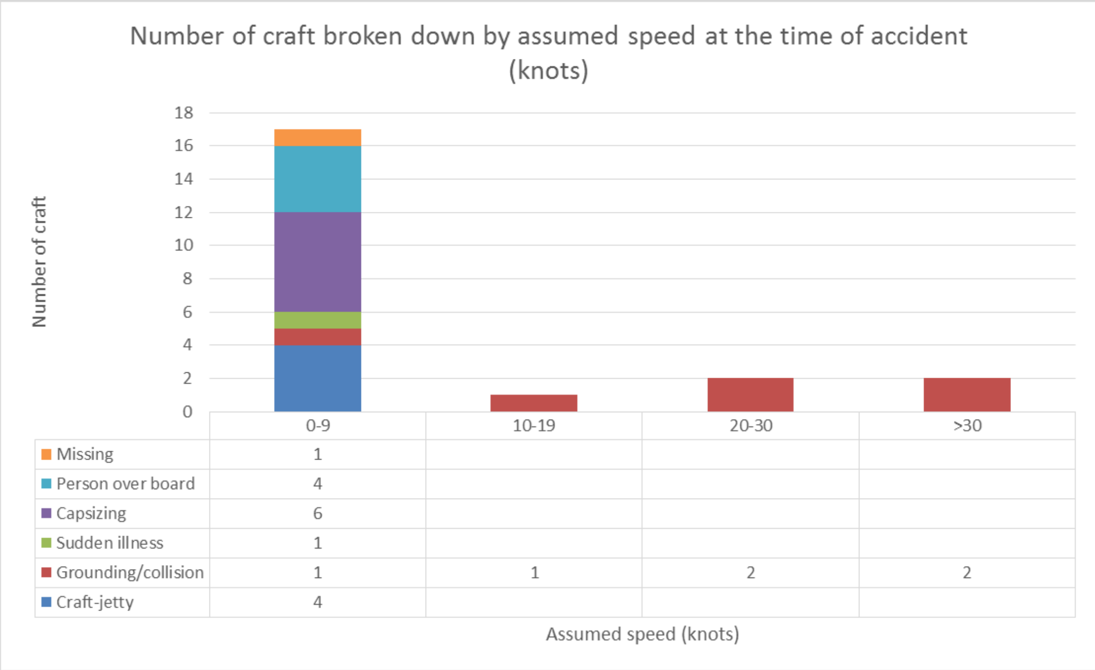



*Figure 21: Assumed speed of the craft at the time of the accident.*

The type of craft involved in most accidents was motorboats (13 out of 22 craft). Ten of the accidents involved motorboats shorter than 26 feet (8 metres); see Figure 22. Three of the accidents involved sailing boats. The sailing boats were between 8 and 11 metres (26–36 feet). Rowing boats, canoes, kayaks and paddle boards were each involved in one accident.

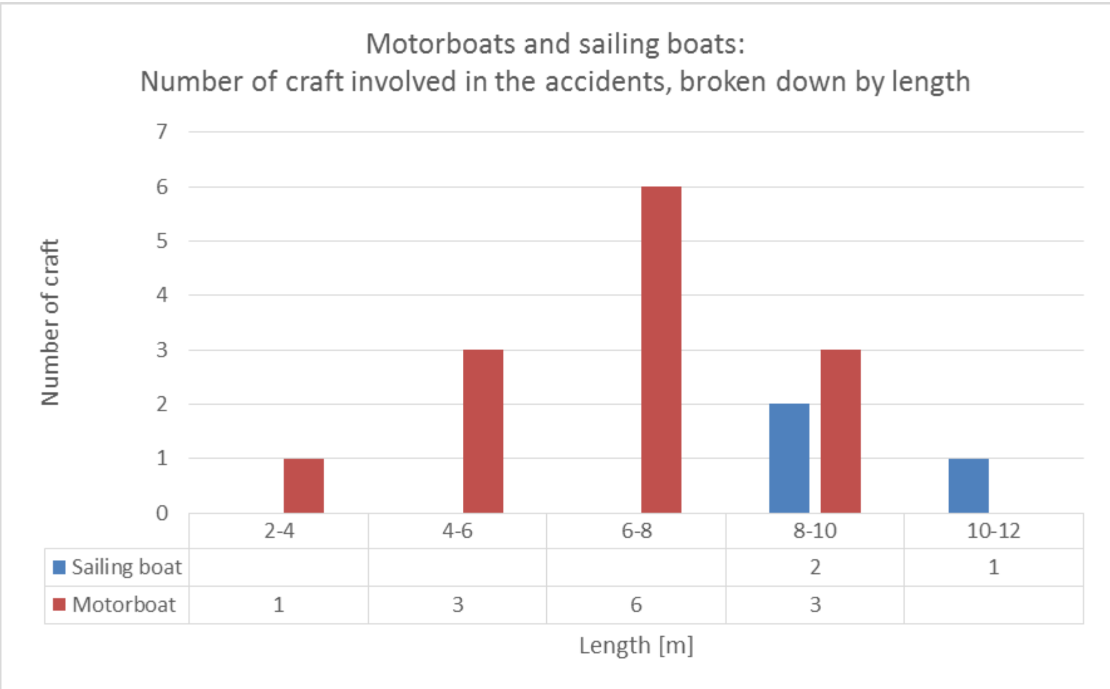



*Figure 22: Motorboats and sailing boats broken down by length.*

## 4.10 The external environment

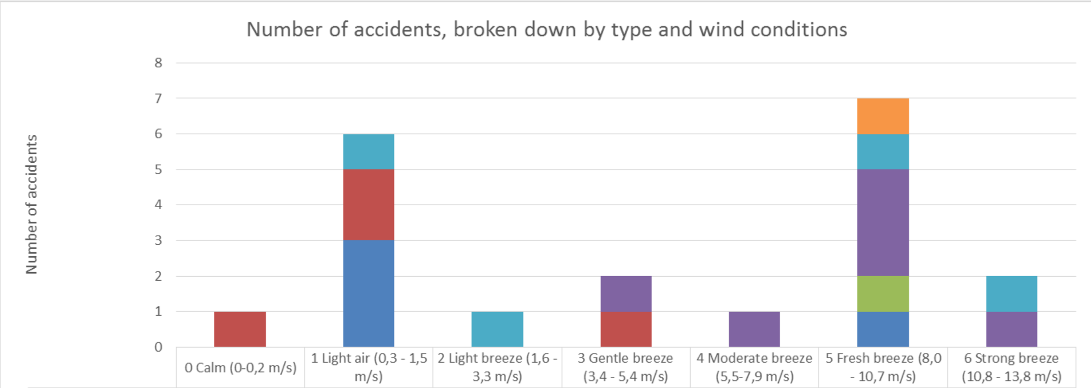
Nine of the accidents (out of 20) occurred with fresh breeze or moderate gale force winds; see Figure 23. Capsizing was the most common type of accident under these wind conditions.

There was less wind when the collisions, groundings and falls between the craft and jetty occurred.

Most of the accidents took place at a wave height of less than 1 metre (significant wave height); see Figure 24.

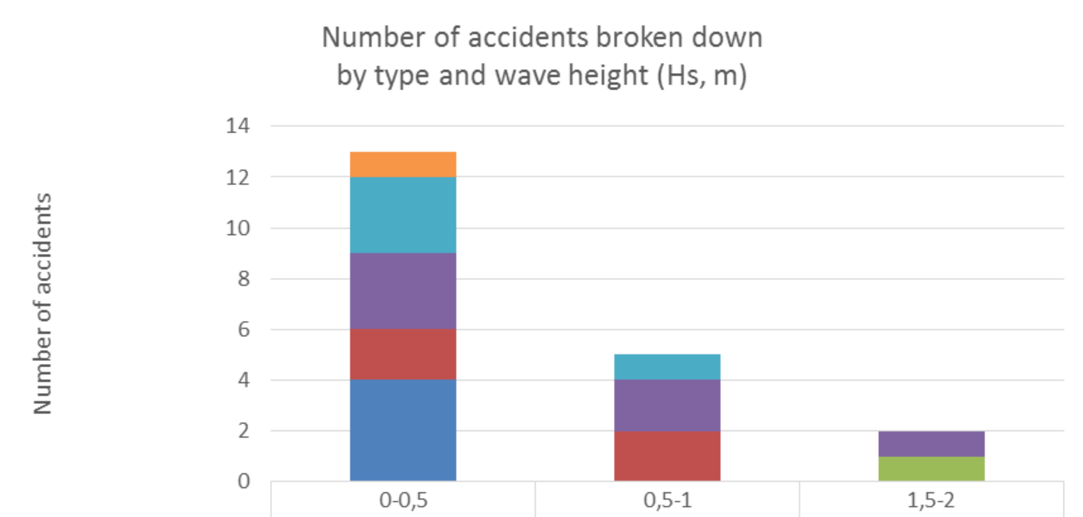
In one case, the craft capsized at a significant wave height (over deep water) of approximately 1.8 metres. This was the only case where there is a possibility that the craft encountered crossing waves, and thus that the waves were higher and more choppy than indicated by the specified significant wave height.

The possibility of hypothermia from cold water will be discussed in section 4.12.4




| | 0 Calm (0-0,2 m/s) | 1 Light air (0,3 - 1,5 m/s) | 2 Light breeze (1,6 - 3,3 m/s) | 3 Gentle breeze (3,4 - 5,4 m/s) | 4 Moderate breeze (5,5-7,9 m/s) | 5 Fresh breeze (8,0 - 10,7 m/s) | 6 Strong breeze (10,8 - 13,8 m/s) |
|---|---|---|---|---|---|---|---|
| Missing | | | | | | 1 | |
| Person over board | | 1 | 1 | | | 1 | 1 |
| Capsizing | | | | 1 | 1 | 3 | 1 |
| Sudden illness | | | | | | 1 | |
| Grounding / collision | 1 | 2 | | 1 | | | |
| Craft-jetty | | 3 | | | | 1 | |

*Figure 23: Number of accidents of different types broken down by wind conditions at the assumed time of the accident.*




| | 0-0,5 | 0,5-1 | 1,5-2 |
|---|---|---|---|
| Missing | 1 | | |
| Person over board | 3 | 1 | |
| Capsizing | 3 | 2 | 1 |
| Sudden illness | | | 1 |
| Grounding / collision | 2 | 2 | |
| Craft-jetty | 4 | | |

*Figure 24: Number of accidents of different types broken down by wave height at the assumed time of the accident.*

## 4.11 Intoxication at the assumed time of the accident

Thirteen persons (out of a total of 36) were intoxicated at the time of the accident; see Figure 25. Another two may have been intoxicated. This assumption is based on witness statements, but has not been confirmed by blood tests. With one exception, all those involved were under the influence of alcohol.[8] This means that a total of 15 persons, corresponding to 42% of all persons involved in accidents, were intoxicated at the time of their accident.

For eight persons (of a total of 36), the blood sample analyses confirmed that they were not under the influence. Another 13 persons are assumed not to have been intoxicated. No blood samples have been collected, and therefore no toxicology report exists to confirm or disprove that they were intoxicated, but there are no witness observations or other information to indicate that they were intoxicated or had consumed alcohol prior to the accident. This group includes three persons who have not been found. In total, this means that 21 persons were not intoxicated, which corresponds to 58% of all those involved in the accidents.

[8] One person was under the influence of cocaine in combination with two types of medication. The level of intoxication has been converted into an assumed blood alcohol concentration.

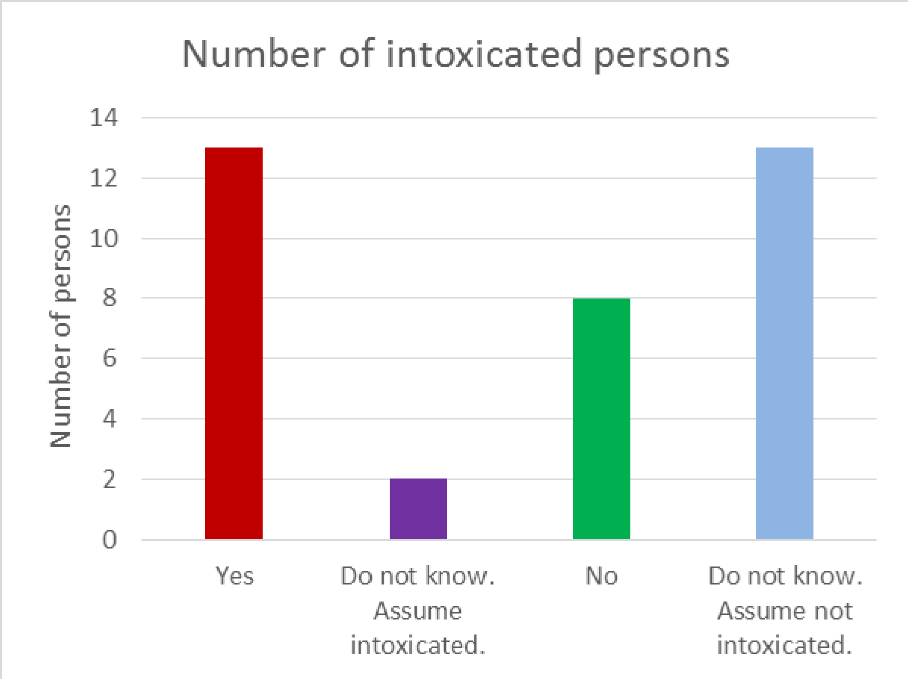
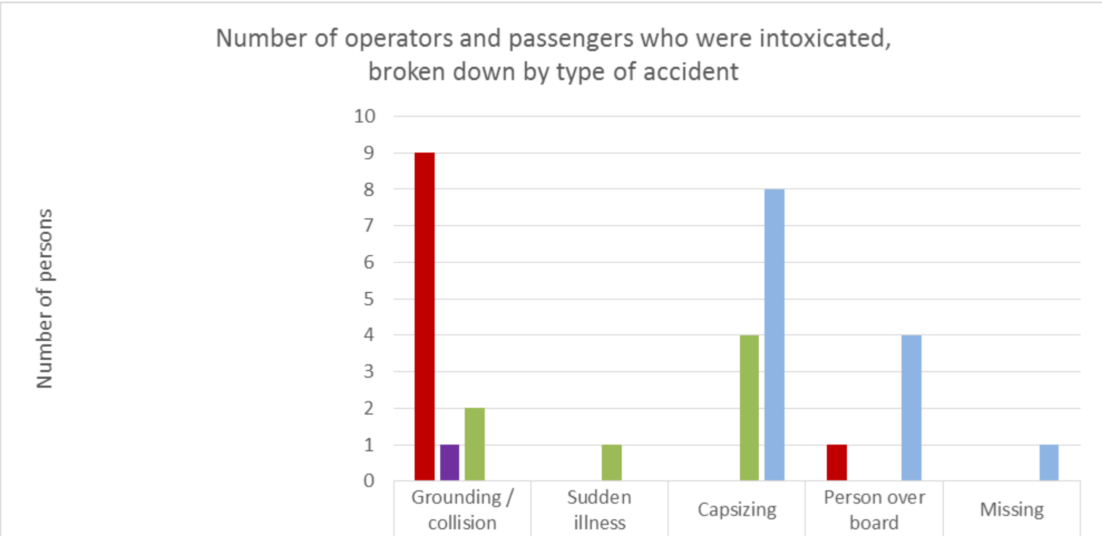



*Figure 25: Number of persons involved in accidents and whether or not they were intoxicated.*

It is clear from Figure 26 that groundings and collisions were the main types of accidents involving intoxicated persons. In these accidents, 10 of the persons involved (of a total of 15) were intoxicated; 5 (of 6) operators and 5 (of 7) passengers. In other types of accidents, only one of the persons involved were intoxicated. This was a person overboard accident that probably occurred while the person was fishing.

The other four intoxicated persons were involved in craft-jetty accidents. These accidents are not included in the figures below as they occurred while the boat was moored to a jetty, but they will be discussed in more detail in section 5.5.




| | Grounding / collision | Sudden illness | Capsizing | Person over board | Missing |
|---|---|---|---|---|---|
| Yes | 9 | | | 1 | |
| Do not know. Assume intoxicated. | 1 | | | | |
| No | 2 | 1 | 4 | | |
| Do not know. Assume not intoxicated. | | | 8 | 4 | 1 |

*Figure 26: Number of operators and passengers who were intoxicated. The figure does not include accidents involving moored craft.*

The operators who were intoxicated (in total six persons) had an average BAC of 0.14% (median 0.15%); see Figure 27 and Figure 28. The intoxicated passengers had an average BAC of 0.12% (median 0.12%). The blood alcohol concentrations are for the assumed time of the accident.[9] These people were all under 50 years of age; see Figure 30.

This means that most of the intoxicated operators and passengers were moderately to severely intoxicated. At that level, their mood will usually have changed from lively to lethargic. For the majority of people, moderate to severe intoxication means that their ability to think, learning capacity and psychomotor functioning are impaired. Nausea, vomiting, unsteadiness and tiredness may also occur. Severely intoxicated people may be sleepy and show increasingly impaired consciousness. Impairment of both physical and cognitive skills may have contributed to the sequence of events for persons at this level of intoxication.

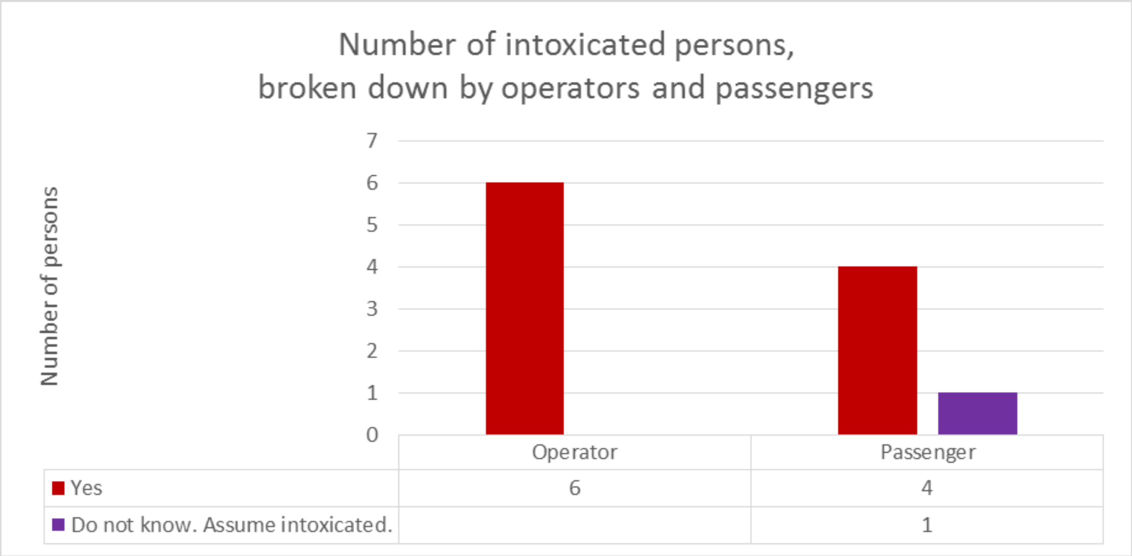



*Figure 27: Number of intoxicated persons broken down by whether they were operators or passengers. The figure does not include accidents involving moored craft.*

[9] The BAC figures are based on blood sample analyses conducted by the Department of Forensic Medicine, Forensic Toxicology at Oslo University Hospital and the Department of Clinical Pharmacology at St. Olavs Hospital. In some cases, the Department of Forensic Medicine has prepared expert reports for the police in order to calculate the probable blood alcohol concentration at the time and assess the level of intoxication caused by substances other than alcohol. In other cases, similar work has been carried out in order to provide expert assistance to the AIBN. The definitions for levels of intoxication are described in section 2.6.5.

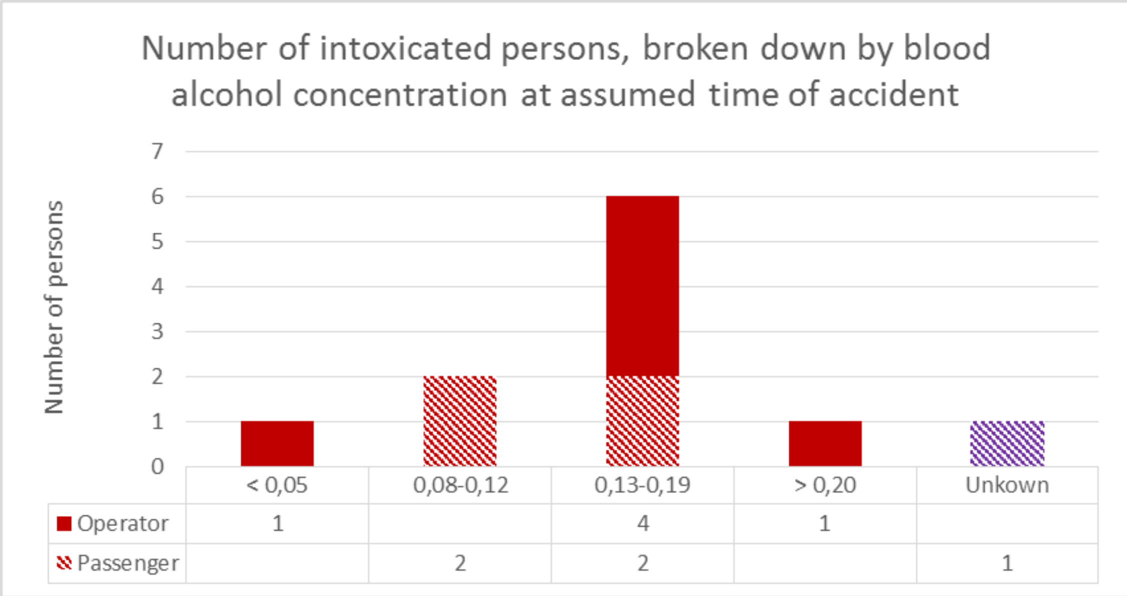



*Figure 28: The figure shows the number of intoxicated operators and passengers broken down by BAC at the assumed time of the accident. All the recreational craft were under 15 metres long, which means that the current limit for operating them is a BAC of 0.08%. The figure does not include accidents involving moored craft.*

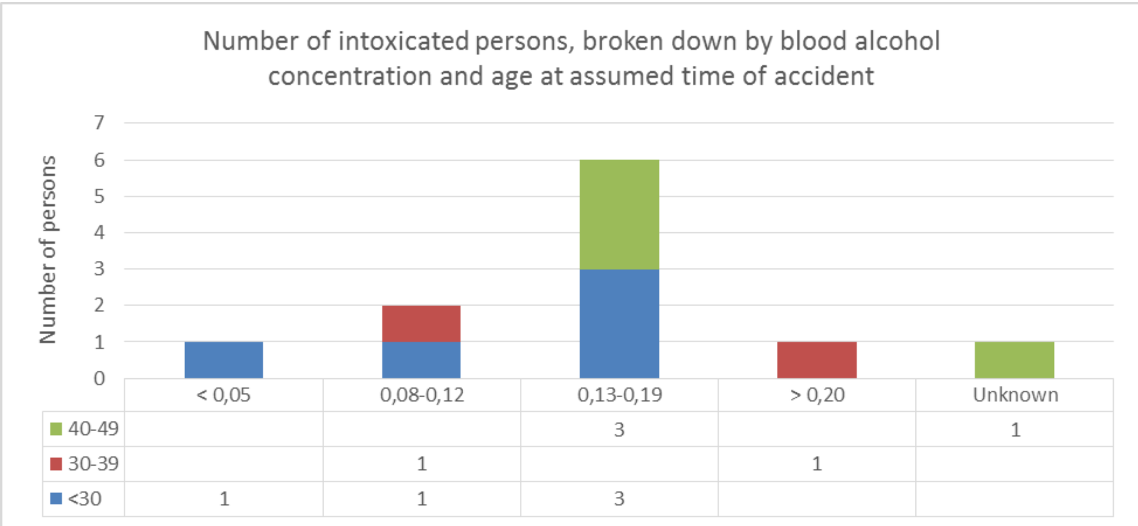



*Figure 29: The figure shows the number of intoxicated persons broken down by BAC and age at the assumed time of the accident. The figure does not include accidents involving moored craft.*

## 4.12 Survivability

The 2012 report *Sikkerhet ved bruk av fritidsbåt* ('Safety in connection with the use of recreational craft' – in Norwegian only) shows that the majority of persons who die in recreational craft accidents fall into the sea and drown (Arbeidsgruppe for å utrede sikkerhet ved bruk av fritidsbåt, 2012). The observations from accidents in 2018 show the same result.

This section contains an assessment of which factors may have limited the persons' chances of survival from the time they went into the water until they drowned. Could the person have been taken ill or experienced cold water shock when they fell in? Is it possible that the person became hypothermic and then drowned?

The analysis is based on 16 persons drowning and the assumption that the three who are missing also drowned. Our assessments are limited to the possibility that sudden illness, cold water shock, hypothermia and intoxication had a bearing on the outcome. See sections 3.7 and 3.8 for a description and definition of these terms. These factors have been considered in connection with other factors, such as the clothing the persons were wearing, use of flotation devices, weather and sea conditions, medical and toxicology reports, witness observations and other relevant information.

For the last two persons (out of the 21 dead), their chances of survival were primarily limited by severe physical injuries, primarily head injuries.

### 4.12.1 Limitations on survival

Nineteen of the persons who drowned or are assumed to have drowned (out of a total of 21) have probably had their chance of survival reduced as a consequence of one or more of the factors of intoxication, sudden illness, cold water shock or hypothermia.

Eleven (out of 19 drowned/assumed drowned) were alone when the accident happened. None of them were able to alert anyone of their distress. They could not or did not use their mobile phone. No other means of alerting anyone, such as an AIS transponder, hand-held VHF set or personal locator beacon, were available to them.

In three of the accidents, several of the persons involved were intoxicated. Most of them were moderately or severely intoxicated with a BAC of between 0.1% and 0.2%. Their intoxication may have limited their chances of survival.

Assessments for each of the factors are described in more detail below.

### 4.12.2 Intoxication and fatalities

Eight of those who died (out of a total of 21) were intoxicated or assumed to have been intoxicated. With one exception, they were all under the influence of alcohol. Most of them died following groundings, collisions or after falling into the water between the craft and a jetty, with only one exception, when an intoxicated person drowned after falling into the sea while fishing.

Those who died in accidents while intoxicated had an average BAC of 0.17% (median 0.15%) at the assumed time of the accident; see Figure 30. Six of the dead (out of a total of eight) had a BAC of more than 0.13%. Those who fell into the water between a craft and a jetty in particular raise the average BAC. These three persons were severely intoxicated with an average BAC of 0.23%.

This means that most of those who died while intoxicated were moderately to severely intoxicated. At that level, their mood will usually have changed from lively to lethargic. For the majority of people, moderate to severe intoxication means that their ability to think, learning capacity and psychomotor functioning are impaired. Nausea, vomiting, unsteadiness, tiredness, drowsiness and falling asleep may also occur. Those who died while severely intoxicated were at increased risk of unconsciousness, respiratory impairment and, in some cases, respiratory arrest. These persons may have developed tolerance through regular use of alcohol.

Impairment of both physical and cognitive skills from intoxication may have contributed to the sequence of events leading up to the accident, the accident itself and limited their chances of survival. The survival chances of those who drowned while intoxicated were primarily limited by the intoxication rendering them incapable of self-rescue.

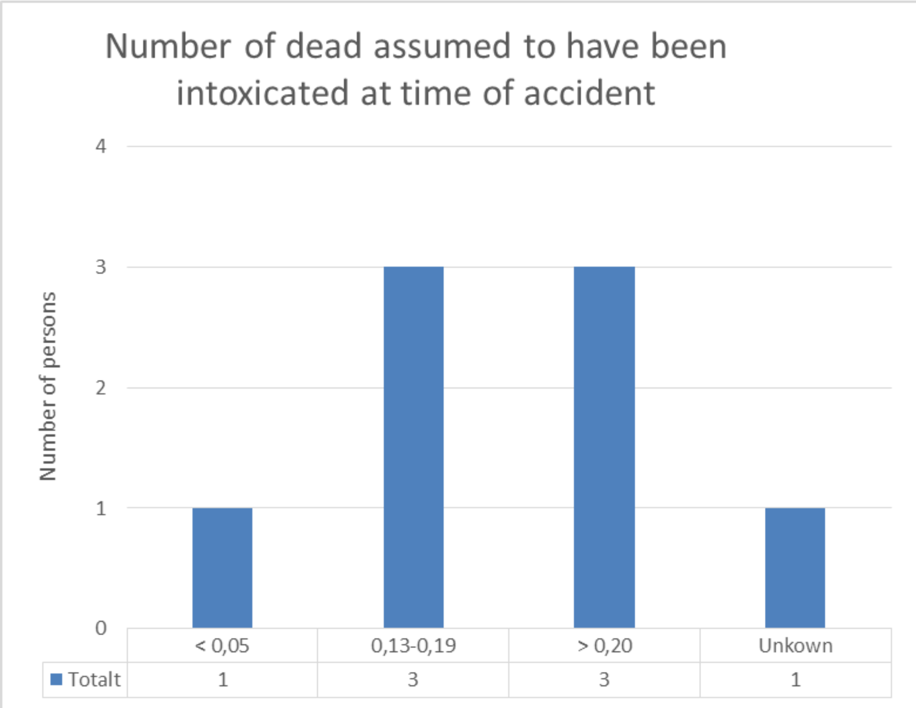



*Figure 30: Number of people who died in accidents while intoxicated, broken down by BAC.*

### 4.12.3 Sudden illness

We do not have sufficient data about the persons' medical history to make a thorough assessment of the possibility of sudden illness. Findings from a post mortem examination will not necessarily shed light on acute illness.

Sudden illness has not contributed to groundings and collisions or had a bearing on the survivability of these accidents.

In accidents where several persons have ended up in the sea, the youngest persons have survived while the older ones have died. There have been no indications of intoxication in connection with any of these accidents. It is a natural assumption that older people will be at greater risk of sudden illness such as cardiovascular events after falling into cold water, but other factors such as swimming skills and physical fitness are probably also important. Among those involved in the Præstøfjord boating accident in Denmark, persons with a high body mass index (BMI) fared better than those with a low BMI (Wanscher, et al., 2012).

Men over 70 years of age drowned by falling between the craft and a jetty or falling out of a boat (capsizing and person overboard). They were usually alone and not intoxicated. If they were not taken ill, most of would probably have suffered cold water shock or become so hypothermic that they would become incapable of keeping their airways clear within one hour. Many of these men's ability to keep their airways clear may have been impaired significantly quicker than this (Robertson & Simpson, 1996; Brooks, 2001) (see also background and Figure 4).

### 4.12.4 Cold water shock, hypothermia and use of flotation devices

Cold water shock and hypothermia have probably contributed to the drowning of all the persons who retained buoyancy and clear airways after falling in. Including the three missing persons, this concerns 15 out of the 21 persons in this survey. Table 15 in Appendix B shows information about the waters, wind and sea conditions for the accidents where the 12 dead and 3 missing persons that may have become hypothermic went into the water. The table shows that the accidents happened at all times of the year. They took place by quays, in narrow and outer coastal waters, and in lakes. The median distance from shore was 190 metres (ranging from 0 to 600 metres), the median air temperature was 9 °C (from 3 to 26 °C), and the median water temperature was 11 °C (from 5 to 18 °C). The wind force ranged from light air to moderate gale, and sea conditions ranged from calm to moderate. The persons were not wearing a wetsuit or similar that could have delayed the onset of hypothermia. The exception is one person who wore an immersion suit, but it is uncertain whether the zipper was closed all the way.

Based on the average water temperature in Norwegian waters and lakes (see background), it is not only during the winter months that people who fall into the water are at risk of developing hypothermia. Even in summer, hypothermia can contribute to drowning. Most of the accidents happened along the shore or less than 200 metres out.

In most cases, it took a long time before anybody realised that the persons were in trouble and notified the emergency services. This is evident from the amount of time that elapsed from the assumed time of the accident until the person was found (if the person was found); see Figure 31. The figure shows the following:

- In 10 (out of 14) accidents, more than an hour elapsed before the emergency services were notified of the incident.
- In two of the accidents where the emergency services were notified within the hour, the persons have not been found. They were not wearing buoyancy vests, which made the search and rescue efforts more difficult.
- Two survivors gave notification of one of the accidents. Approximately one hour after the accident, rescue personnel found the third person, who was taken to hospital for resuscitation attempts but later pronounced dead.
- The emergency services were notified about one accident within 30 minutes. Some delay in emergency response and inaccurate information about the location mean that it took some time for the search and rescue crew to arrive at the scene. Two persons were brought to hospital for resuscitation attempts, but were later declared dead.

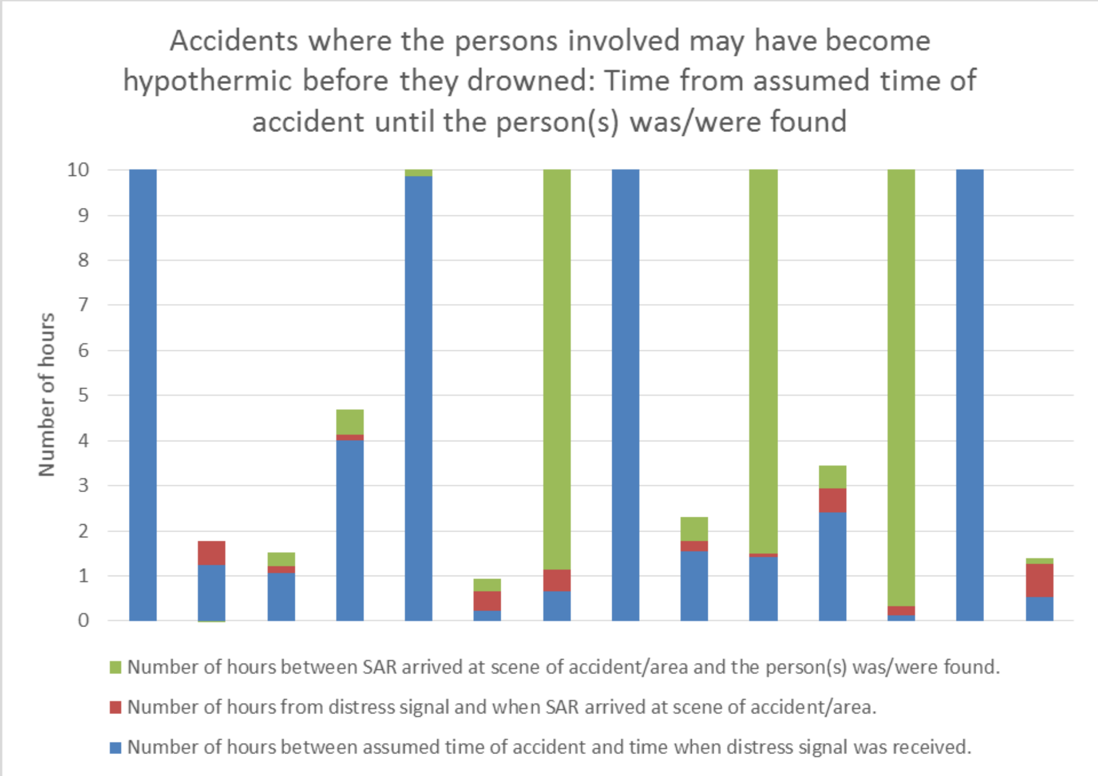



*Figure 31: Number of hours from the assumed time of the accident until the persons were found. Each bar represents one accident. Victims of three accidents are still missing. In three of the accidents, it took several days to find the person. The maximum value on the Y axis has been set to 10 hours and therefore does not show the total time for all accidents.*

Nine persons (out of the 19 who drowned or are assumed to have drowned) were not wearing any flotation devices; see Figure 32 and Figure 33. Three of the persons who were not wearing any flotation devices died after falling into the water between the craft and a jetty. It is probable that none of the three missing persons were wearing flotation devices.

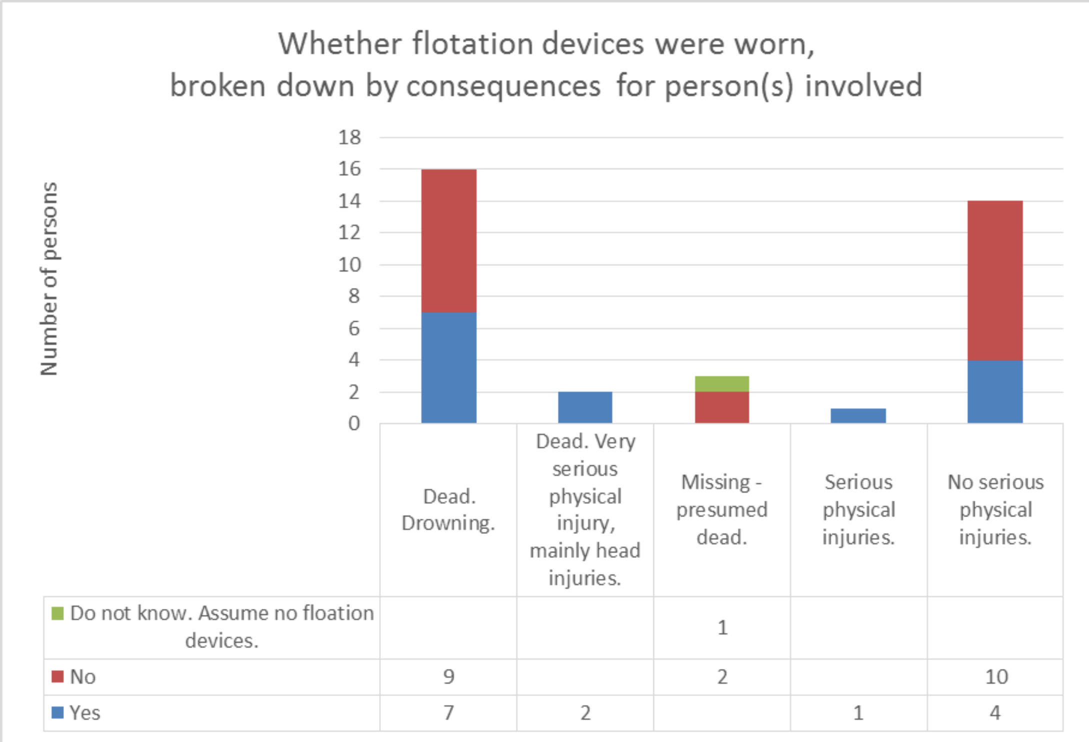



*Figure 32: Number of persons and whether or not they were wearing flotation devices, broken down by consequences.*

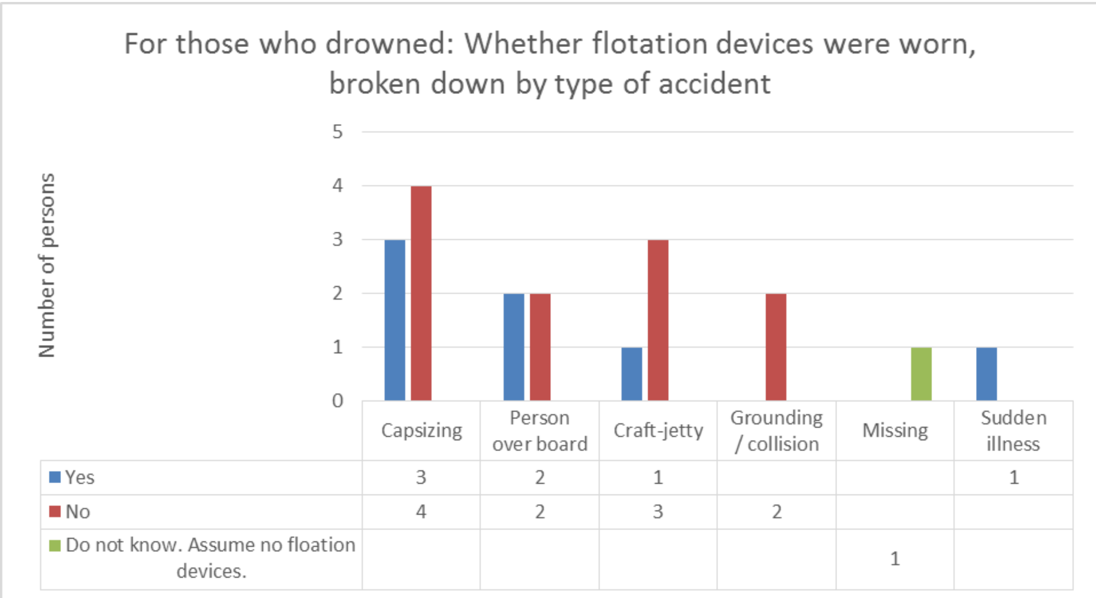



*Figure 33: Number of persons and whether or not they were wearing flotation devices. The figures are broken down by type of accident and limited to the persons who drowned or are assumed to have drowned.*

The Act of 1 January 1999 relating to recreational and small craft stipulates the requirement that all persons on board recreational craft of less than eight metres in length must wear suitable flotation devices when the craft is under way and the person is on open deck. Fewer than half of the people on board craft of less than eight metres that were under way were wearing flotation devices; see Figure 34 and Figure 35.

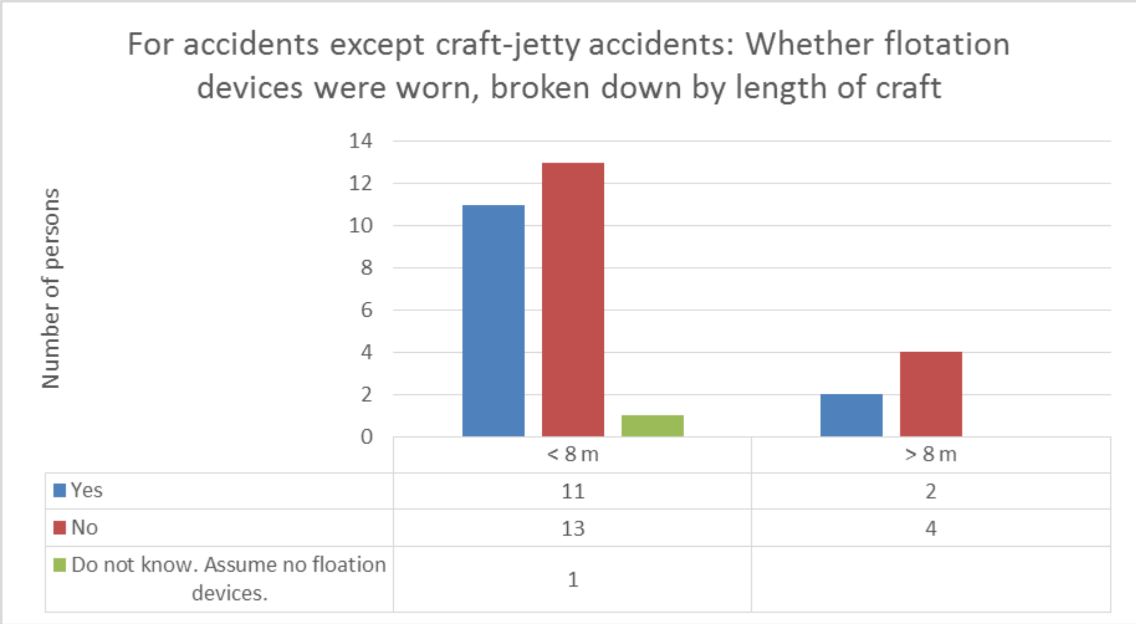



*Figure 34: Whether flotation devices were worn, broken down by length of craft. The figures include all accident in which the craft was under way. Accidents where people fall between the craft and a jetty are not included.*

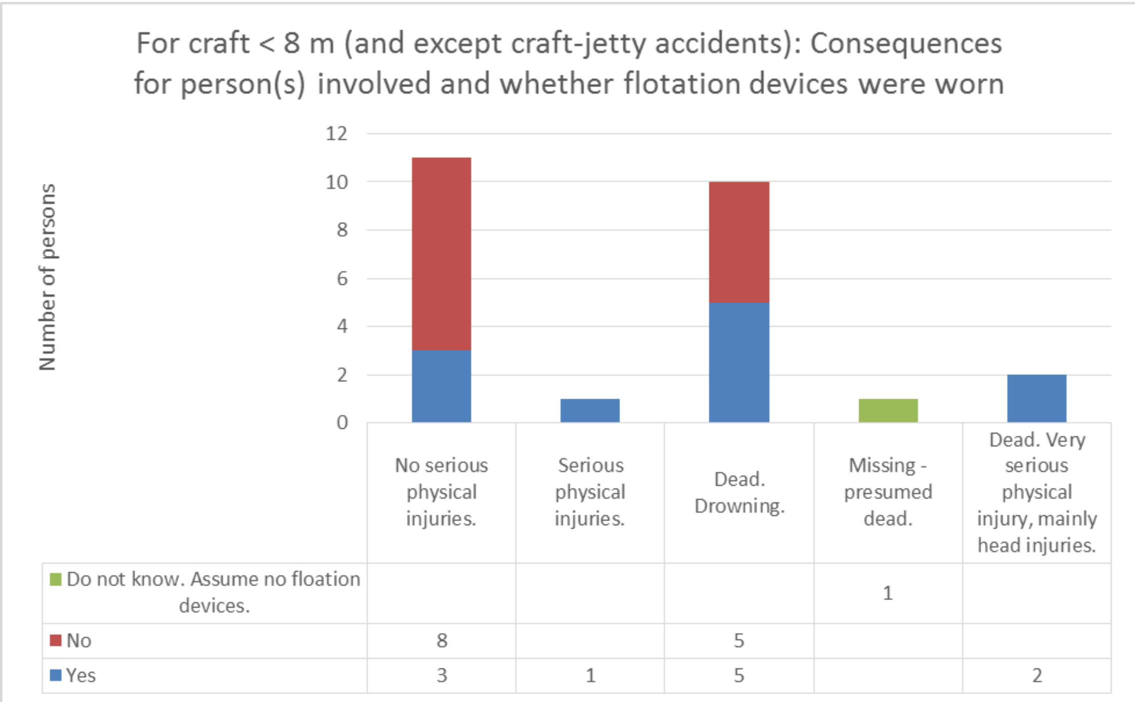



*Figure 35: Boats with a maximum length of < 8 m. The figures include all accident in which the craft was under way. The AIBN assumes that the missing person drowned. Accidents where people fall between the craft and a jetty are not included.*

Figure 36 shows corresponding figures for craft longer than eight metres. The figure only includes accidents where the craft is deemed to have been under way. The person were on open deck in all the cases in question. By comparison, a questionnaire shows that 65% state that they always wear flotation devices, 22% usually do, while 10% rarely or never wear flotation devices. The questionnaire did not distinguish between craft shorter and longer than eight metres (KNBF, 2018).

Flotation devices that do not ensure that an unconscious person floats on their back or keeps the airways clear will only keep the person afloat. Once the core temperature has dropped to a level where motor impairment renders a person unable to keep their airways clear of water (see section 3.7.4 for background information), such flotation devices will not be very useful. The same is true of flotation devices that are in principle good enough, but that are worn incorrectly.

A properly fitted lifejacket with the crotch strap attached is currently the only flotation device that will keep the airways clear if the wearer loses consciousness or otherwise becomes unable to take care of themselves. An immediate distress signal giving the position where the incident has occurred, combined with the use of a properly fitted lifejacket, can help to keep a person alive in the water.

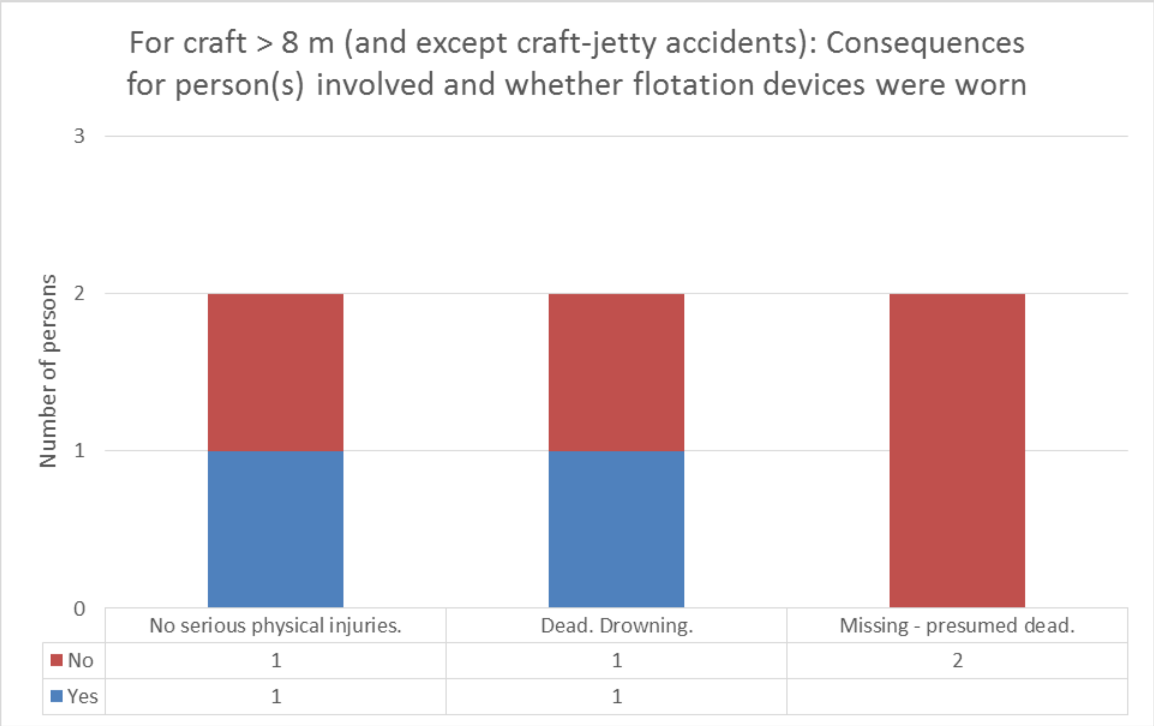



*Figure 36: Craft with a maximum length of > 8 m. The figures include all accident in which the craft was under way. The AIBN assumes that the missing persons drowned. Accidents where people fall between the craft and a jetty are not included.*

Seven of those who drowned (of the 19 who drowned or are assumed to have drowned) were wearing flotation devices. See Figure 37 for a description of the types of flotation devices. Table 7 describes the use of flotation devices for the people who drowned and why they did not keep the airways clear. The persons who drowned after falling into the water from a canoe, a kayak and an SUP board are also included in this assessment. None of them were wearing a dry suit. In summary, those who wore flotation devices either did not wear them correctly or they did not keep the airways clear when the person lost consciousness or in other ways lost the ability to take care of themselves.

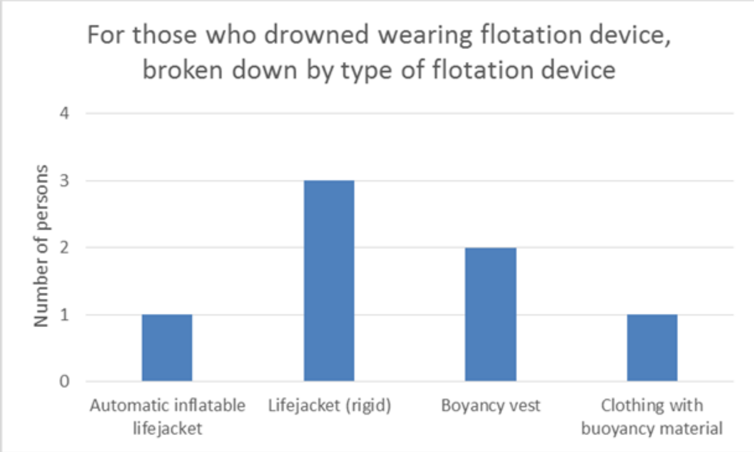



*Figure 37: Number of persons who were wearing flotation devices, broken down by type of device. The figures are limited to people who were wearing flotation devices and who drowned or are assumed to have drowned.*

*Table 7: Description of the flotation devices worn. Concerns persons who were wearing flotation devices and who drowned.*

| Type of flotation device | Use of flotation device for those who drowned |
|---|---|
| Automatic inflatable lifejacket | The inflatable lifejacket was of an incorrect fit for the person and therefore did not keep the airway clear. It is uncertain whether the inflatable lifejacket had a crotch strap. |
| Lifejacket | The zipper was open and the straps were not fastened. The lifejacket did not keep the airways clear when the person lost the ability to take care of themselves. |
| | Orange lifejacket with a collar, but when the person was found, the head was below water 'inside' the lifejacket because the crotch strap was too loose for the lifejacket to hold the persons head above water. The lifejacket did not keep the airways clear when the person lost the ability to take care of themselves. |
| | The person did not fall into the sea, but the head was submerged after sudden illness. |
| Buoyancy vest | The person was found face down in the sea. The buoyancy vest did not keep the airways clear when the person lost the ability to take care of themselves. |
| | The vest was not worn correctly. When the person was found, the vest was partly over the head. The vest had no crotch straps. Nor had it been tightened / correctly fitted to the person wearing it, and it was therefore too loose-fitting to keep the head above water. |
| Clothing with buoyancy material | The AIBN does not know whether the zipper was open or whether other factors were involved that may increase hypothermia or limit buoyancy. The person was not wearing a lifejacket. The manufacturer's instructions state that in order to ensure clear airways, a lifejacket must be worn with the suit. |

There is a great difference between cardiac arrest caused by hypothermia and by hypoxia (lack of oxygen). Once the body temperature has become sufficiently low to stop the heart, the metabolism will be significantly reduced. This means that the brain will use less oxygen than it does when the body's core temperature is normal. If persons who have fallen into the sea have clear airways even after hypothermia has rendered them incapable of protecting their airways themselves, their chances of being resuscitated will be much better because the brain has been protected by the cold (Dietrichs & Dietrichs, 2015). This is the science behind the rule of thumb: 'No one is dead until they are warm and dead' (Filseth, et al., 2014). When cardiac arrest is caused by drowning, the heart will usually stop at a temperature where the brain is not protected against the effects of lack of oxygen.

Drowning was or is assumed to be the cause of death for all the 15 persons for whom hypothermia is probable. None of them were wearing flotation devices in such a way that they could keep their airways clear and prevent them from drowning. If they did not drown quickly as a result of cold water shock, sudden illness or other circumstances that the post mortem examination and the assessment of the circumstances surrounding their death have failed to identify, it is probable that they became hypothermic and finally unable to keep their airways clear, and then drowned.

# 5. MAIN FINDINGS

This chapter describes the key results from the mapping of fatal recreational craft accidents in 2018. The results are best interpreted by describing the circumstances of four types of accidents in addition to accidents involving boat rental for tourists. The descriptions emphasise common characteristics for each type of accident. In some cases, the differences will also be addressed. Contributory safety factors and factors with a bearing on the accidents' survival aspects will be described where relevant. This will show the nuances and thereby highlight the fact that different issues are relevant for different types of accidents.

By common features is meant features that are deemed to apply to most of the accidents in the category. It does not mean that they apply to all the accidents or all the persons involved.

## 5.1 Capsizing accidents

The following overview provides a summary of common features for accidents in which the craft capsized and the persons on board fell into the sea. See Appendix C for an illustration of the results.

*Table 8: Fatal capsizing accidents in 2018.*

| Capsizing | Number | Percentage |
|---|---|---|
| Number of accidents | 6 | 30% of 20 accidents |
| Fatalities | 7 people drowned | 33% of 21 fatalities |
| Serious physical injuries | 0 | |
| No serious physical injuries | 5 | |
| Total number of persons involved | 12 | 33% of 36 persons |
| In three of the accidents, there was one person on board.<br>In the other three accidents, there were three people on board. In one of these accidents, two of the persons drowned. | | |

The craft that capsized have little in common except that they were small. They were a 21-foot motorboat, a 14-foot dinghy, a 10-foot rowing boat, a canoe, a kayak and a paddle board. The motorboat and the dinghy had a low engine output (15 hp or less). The speed of the craft at the time of the accident usually did not exceed 10 knots. There are also few commonalities in what the persons involved were doing: some were under way, some were fishing and one was playing in the waves on a paddle board.

For the rowing boat and the dinghy, low freeboard may have contributed to the craft capsizing. The rowing boat also had too many people on board. Both craft were old, dating back to before the requirement for CE marking was introduced. The motorboat was about 16 years old, but it is not known which requirements for stability and sea loads it satisfied and whether it met CE requirements for category C[10] or D[11]. The craft was supposed to have been CE marked and thereby manufactured in accordance with EU regulations.

[10] Craft for inshore use, wind force 6, 13.6 m/s, Hs 2m.
[11] Craft for sheltered waters, wind force 4, 7.9 m/s, Hs 0.3m.

For the canoe, kayak and paddle board, respectively, contributory factors have been that the manufacturer has not specified sea limitations, that the luggage stowed on board reduced the craft's stability and that paddle boards in general easily capsize.

Most of the accidents occurred while the craft were on their way to a destination. Most also occurred in narrow coastal waters. The shortest distance to the nearest shore, island or islet was between 100 and 600 metres. It was light, and most of the accidents occurred in the morning or afternoon. The combination of wind and sea conditions may have contributed to the capsizing. The wind speed was mostly moderate to fresh breeze. The wave height was between 0.1 and 0.5 m. In one of the accidents, waves against the port quarter may have contributed to the capsize. In one case, the motorboat capsized when the wave height over deep water was approximately 1.8 metres (significant wave height). This was the only case where there is a possibility that the craft encountered crossing waves, and thus that the waves were higher and more choppy than indicated by the specified significant wave height. See Appendix C for details about external conditions.

The age of those involved in the accidents was between 20 and 80. Two of the victims had extensive experience of the type of craft concerned in the waters concerned.[12] The other 10 were foreign nationals who had borrowed or rented the craft. They had little or no experience of using this type of craft in the waters concerned. This is also described in more detail in section 5.3.

The AIBN assumes that none of the victims were intoxicated. This is based on no ethanol or other typical drugs being found in blood and urine samples from four of the persons. For the other eight, there were no witness statements or other indications that they had consumed alcohol or other drugs prior to the accident.

### 5.1.1 Assessment of survivability

In most cases, it took more than an hour before anyone was notified of the distress situation; see Figure 38. In the accidents where several people ended up in the sea, it also took some time before others became aware of the distress situation. Contributory factors were that mobile phones were not used or were not available. They had no other ways of alerting anyone of their distress, such as a whistle, an emergency flare, a handheld VHF radio, a personal locator beacon[13] or an AIS transponder with distress signal.[14]

[12] In general, the quality of the information that was obtained is not sufficient to determine the extent to which the operators had the skills and experience to operate the type of craft involved in the type of waters in which the accident occurred. We have very little information about the operators' formal qualifications. The assessments are based on witness statements, but witnesses may have had limited knowledge about the skills and experience of the persons who died.

[13] Personal locator beacon, with or without GPS

[14] AIS SART – Automatic Identification System Search and Rescue Transmitter

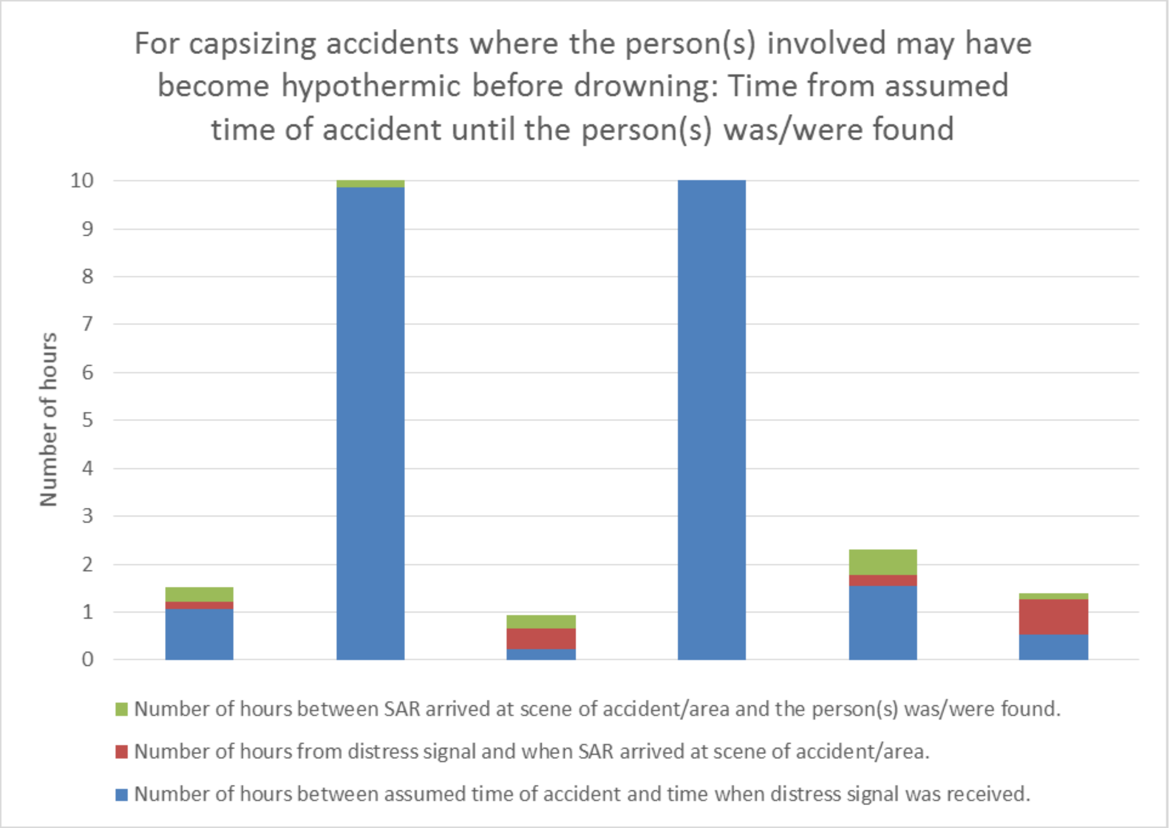



*Figure 38: Capsizing accidents. In all the accidents, the persons involved may have become hypothermic before they drowned. Each bar represents one accident and specifies the time that elapsed from the assumed time of the accident until the persons involved were found. The upper limit was set to 10 hours, which means that the total time is not shown for two of the accidents. For most of the capsizing accidents, the time when the accident occurred is somewhat uncertain. This means that there the time indicated on the figure is somewhat inaccurate.*

They were appropriately dressed for boating, but not for being in the water.

The shortest distance to the nearest shore, island or islet was between 100 and 600 metres. The temperature in the sea/water was between 6 and 13 °C.

For all seven who drowned, on the assumption that they retained buoyancy and clear airways after falling into the sea/water, hypothermia probably contributed to their drowning.

Two of them were wearing a buoyancy vest, but it did not keep the airways clear when the wearer lost consciousness or otherwise lost the ability to take care of themselves. One person was wearing a lifejacket, but it was not properly fitted and did not keep the airways clear. He was found with his head inside the lifejacket and his face under water. The other four victims did not wear flotation devices. In accidents where several persons were involved, it was the oldest ones who died.

Three of the persons were flown to hospital. They were hypothermic and the medical personnel hoped that they would be able to resuscitate them. All three were confirmed dead. None of them had worn a lifejacket and the airways had thereby not been kept clear.

## 5.2 Person overboard

The following overview provides a summary of common features for accidents in which the persons involved fell overboard. See Appendix C for an illustration of the results.[15]

*Table 9: Fatal person overboard accidents in 2018.*

| Person overboard | Number | Percentage |
|---|---|---|
| Number of accidents | 4 | 20% of 20 accidents |
| Fatalities | 4 people drowned | 19% of 21 fatalities |
| Serious physical injuries | 0 | |
| No serious physical injuries | 1 | |
| Total number of persons involved | 5 | 14% of 36 persons |

The accidents involved two motorboats, 18 and 24 feet long, and two sailing boats, 28 and 32 feet long. The persons involved fell overboard in the morning and afternoon when it was light. In three of the accidents, the boats were on their way to a destination. One of the sailing boats was using the engine, the other one was using the sail. One of the accidents occurred while the person on board was fishing.

The accidents occurred in narrow waters, but under very different wind conditions; from a light breeze to a moderate gale. For two of the accidents, strong winds (fresh breeze and moderate gale, respectively) may have contributed to the accident.

There are few common factors to explain why the persons involved fell overboard: one may have leaned against the railings, which failed, one was knocked overboard by the boom, and one may have had impaired abilities from intoxication. We know little about the fourth person, because he did not undergo a post mortem examination, so we do not know whether he may have suffered a sudden illness or whether other factors caused him to fall over the railings.

The victims were adult men between the ages of 40 and 72. Three were foreign nationals, but two of them were resident in Norway. These two men had owned a boat for several years and had experience of using the craft in the waters where the accidents occurred.[16] The third foreign national was in Norway with a group of tourists fishing. This accident is also described in section 5.3. The victim who was Norwegian was highly experienced in the use of this type of craft in the waters where the accident occurred.

Only one person was moderately to severely intoxicated. For the other victims, there were no witness statements or other factors indicating that they had consumed alcohol or other drugs prior to the accident.

[15] Accidents in which the craft first capsized are classified as capsizing accidents and were described in the previous section.

[16] In general, the quality of the information that was obtained is not sufficient to determine the extent to which the operators had the skills and experience to operate the type of craft involved in the type of waters in which the accident occurred. We have very little information about the operators' formal qualifications. The assessments are based on witness statements, but witnesses may have had limited knowledge about the skills and experience of the persons who died.

The shortest distance to the nearest shore, island or islet was between 140 and 300 metres. The temperature in the sea/water was between 6 and 16 °C. See Appendix C for details about external conditions.

### 5.2.1 Assessment of survivability

Safety cut-out switches or tether lines were not used in connection with any of the accidents. It is a common feature for three of the accidents that the persons involved were unable to alert others to their situation. Their mobile phones were left in the craft or were not used. In most cases, they had no other ways of alerting anyone of their distress, such as a whistle, an emergency flare, a handheld VHF radio, a personal locator beacon or an AIS transponder with distress signal.

Two of the persons were later found, while the two others have not been found. All drowned or are assumed to have drowned.

For one of the persons who were later found, it took about 2.5 hours before anyone else became aware of the distress situation. He wore an immersion suit, which may have reduced the degree of hypothermia, but it is uncertain whether the zipper was closed all the way. It took four hours before he was found. An immersion suit (without a lifejacket on top) does not keep the airways clear when the wearer loses consciousness or otherwise becomes unable to take care of themselves. The other person who was found later was only reported missing three days after the accident. He wore a lifejacket, but it was not properly fitted and thereby did not keep the airways clear. For more details about the time that elapsed from the assumed time of the accident until the search and rescue operation was initiated, see Figure 39.

Two of the persons have not been found, even after extensive searches. In one of the cases, the search and rescue operation was initiated immediately after the distress call was received via VHF. In the other case, it took about 45 minutes before the search and rescue operation started. The temperature in the water was approx. 16 °C and the distance to the nearest shore was less than 300 metres. The person was a capable swimmer. In both accidents, the victims were not wearing wear flotation devices and probably disappeared beneath the surface of the water fairly quickly.

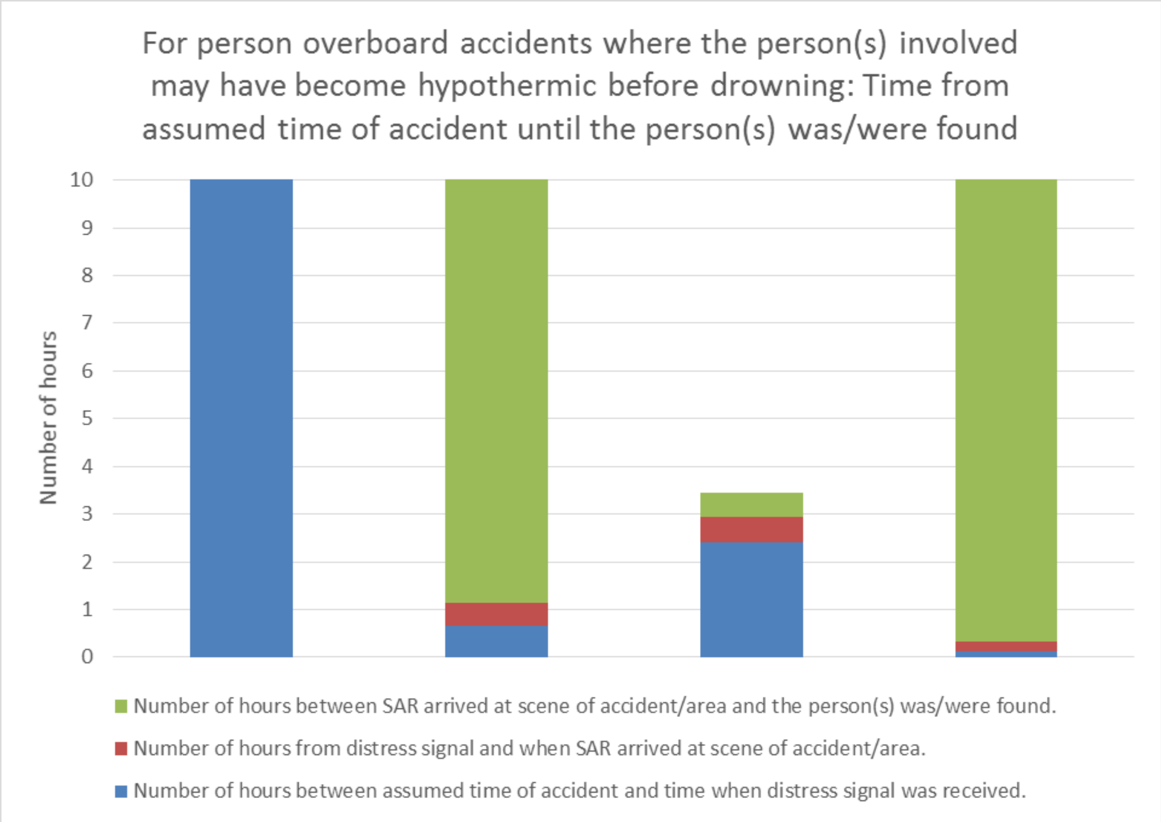



*Figure 39: Accidents where the person fell overboard and may have become hypothermic before drowning. Each bar represents one accident and specifies the time that elapsed from the assumed time of the accident until the persons involved were found / the search was concluded. The upper limit was set to 10 hours. In two of the accidents, the victims were not found. There is some uncertainty attached to when two of the accidents occurred, and the time indicated on the figure is therefore somewhat inaccurate.*

For three of the victims, it is possible that they were taken ill when they fell into the water, but we do not have enough information about their medical history to make a thorough assessment.

Assuming that they retained buoyancy and clear airways after falling into the water, all four may have become hypothermic before they drowned/were assumed to have drowned. One of the hypothermic persons was taken to hospital for resuscitation, but he was declared dead.

## 5.3 Boat rental for tourists

The following overview provides a summary of common features for accidents involving rental of craft by tourists. See Appendix C for an illustration of the results. These are accidents in which the recreational craft was rented or was included with rented accommodation. The person behind the rental firm was not operating the craft, and there was no guide on board.

The information below partly overlaps with the sections on capsizing and person overboard accidents, except that this section presents all accidents involving craft rented by tourists.

Tourists renting a boat without a crew are covered by the general regulations for the use of recreational craft in Norway (Direktoratet for samfunnssikkerhet og beredskap (DSB), 2012). The Internal Control Regulations and the Product Control Act also set out requirements for boat rental firms. The latter act states that such firms shall take reasonable steps to prevent damage to health and that they have a duty to provide recipients of services with adequate and relevant information so that they are in a position to evaluate safety themselves. The Norwegian Maritime Authority has devised useful information for rental firms renting recreational craft to tourists for the purpose of fishing (Sjøfartsdirektoratet, 2019).

*Table 10: Fatal accidents in 2018 involving craft rented to tourists.*

| Boat rental for tourists | Number | Percentage |
|---|---|---|
| Number of accidents | 4 | 20% of 20 accidents |
| Fatalities | 5 people drowned | 24% of 21 fatalities |
| Serious physical injuries | 0 | |
| No serious physical injuries | 3 | |
| Total number of persons involved | 8 | 22% of 36 persons |
| In one of the accidents, two persons drowned. | | |

The craft rented to tourists have little in common except that they were small. They were two open motorboats of 18 and 21 feet, respectively, as well as a canoe and a kayak. The motorboats had a low engine output (50 and 15 hp, respectively) and were used for fishing by tourists. The speed of the craft when the accidents occurred did not exceed 10 knots.

All the accidents occurred while the craft were on their way to a destination. Most of the accidents involved capsizing, with the exception of one case where a person fell overboard. The accidents occurred in the morning and afternoon in daylight. They took place in outer and narrow coastal waters and lakes.

One of the motorboats was about 16 years old. The craft was supposed to have been CE marked and thereby manufactured in accordance with EU regulations. It is not known whether the craft met the CE requirements for category C[17] or D[18], and thereby not which requirements for stability and sea loads they satisfied. The other motorboat was probably so old that it was not subject to CE requirements.

All the involved persons were foreign tourists from European countries, and most of them were men. There were several people involved in most of the accidents. Two of the capsizing accidents involved three persons, the person who died in a kayak accident was part of a group, but was paddling alone on the day of the accident, and the last accident involved a person who was alone when he fell overboard, but was visiting Norway as part of a group. In all the accidents, someone fell into the water.

The persons had little or no experience of using the type of craft in question in the waters concerned.[19]

[17] Craft for inshore use, wind force 6, 13.6 m/s, Hs 2m.
[18] Craft for sheltered waters, wind force 4, 7.9 m/s, Hs 0.3m.
[19] In general, the quality of the information that was obtained is not sufficient to determine the extent to which the operators had the skills and experience to operate the type of craft involved in the type of waters in which the accident occurred. We have very little information about the operators' formal qualifications. The assessments are based on

Analyses of blood samples collected from three of the persons showed that they were not under the influence of alcohol or other intoxicating substances at the time of the accident. No blood samples were collected from the others. Because there were no witness observations or other factors indicating that they had consumed alcohol or other drugs prior to the accidents, it is assumed that none of them were intoxicated.

The canoe and kayak accidents occurred under demanding wind and sea conditions for such craft. Choppy sea conditions and rocks/shallows were probably the immediate cause of one motorboat capsizing. The foreign nationals were taken by surprise by how the wind and sea conditions affected the craft. See Appendix C for details about external conditions.

### 5.3.1 Assessment of survivability

All the persons involved in accidents where the canoe and kayak capsized were wearing buoyancy vests. In one of the motorboat accidents, the person was wearing an immersion suit. None of the flotation devices kept the airways clear when the wearer lost consciousness or otherwise became unable to take care of themselves. Three others involved in the same accident were not wearing any form of flotation devices. They were all appropriately dressed for boating, but not for being in the water. Some of them were poor swimmers.

In three out of the four accidents, more than an hour and a half elapsed before anyone else realised that the persons were in trouble; see Figure 40. The persons involved in the fourth accident were unable to explain their location, which delayed the rescue operation. Some of the persons had mobile phones, but most were unable to use them to call for help. The questions has been raised whether one reason it took so long to notify anyone of the emergency could have been a combination of how instructions from the rental firm were communicated and the foreign nationals' unfamiliarity with the way search and rescue operations are organised in Norway.

Provided that they retained buoyancy and clear airways after falling into the water, all five may have developed hypothermia before they drowned. Three of the persons were flown to hospital for resuscitation following hypothermia, but were declared dead.

witness statements, but witnesses may have had limited knowledge about the skills and experience of the persons who died.

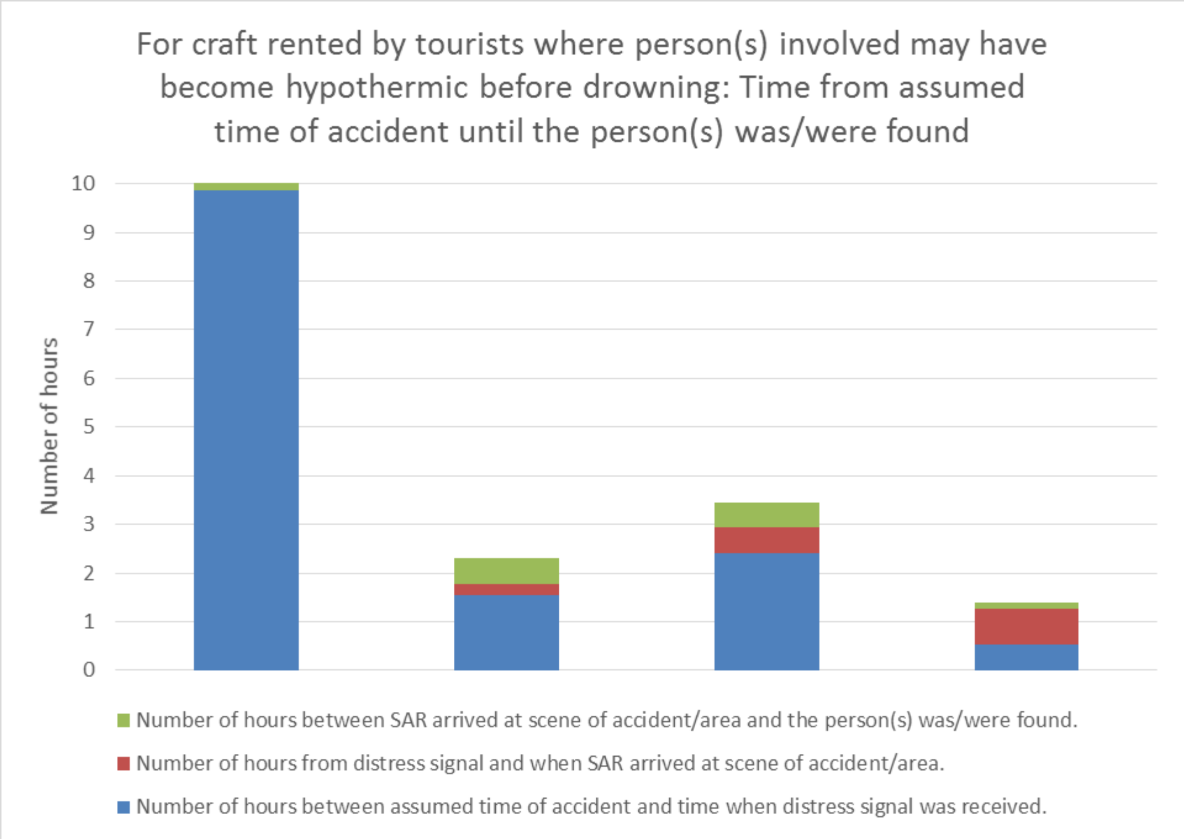



*Figure 40: Boat rental for tourists. All the victims may have become hypothermic before drowning. Each bar represents one accident and specifies the time that elapsed from the assumed time of the accident until the persons involved were found. The maximum time in the figure is 10 hours. In one of the accidents, the person was found lifeless before the police were notified of the situation.*

### 5.3.2 Circumstances concerning boat rental for tourists

For the kayak that capsized, the route recommended by the rental firm may have been demanding. Even at lower wind forces than those prevailing at the time of the accident, it was a challenging crossing. The recommended route for crossing the fjord covered a distance of 1–1.5 nautical miles. Under the Norwegian Paddling Association’s star rating, and provided that the wind speed does not exceed a fresh breeze, which is lower than at the time of the accident, the crossing is considered exposed waters requiring an advanced course (four stars). The AIBN has very little information about how the firm rented out kayaks and what assessments they made before renting kayaks to this group of tourists.

The other rental firms were companies and sole proprietorships letting out boats in combination with accommodation.

One of the boats was probably more than 20 years old, which means that it was not subject to CE requirements. The other motorboat was probably 16 years old, which means that CE requirements applied. The boat did not have CE marking and the person behind the rental firm did not know whether the recreational craft met the CE requirements. This means that they were not aware of the craft’s limitations in terms of wind speed, wave height, weight and the maximum number of persons.

In connection with the same accident, the route recommended by the rental firm required the operator to have experience of navigating narrow coastal waters using fixed navigational seamarks, lateral and cardinal marks. The recommended route was complicated. The AIBN does not know how much time the rental firm had spent reviewing the waters with the operator. The person behind the rental firm did not know what experience and qualifications the operator had for navigating in narrow waters. In connection with the same accident, the rental firm had deviated from the routine of filling the tank with fuel the previous evening. The rental firm did not have a procedure in place for checking whether there was fuel in the reserve tank. The rental firm's instructions for notification in case of an emergency delayed the rescue operation.

The AIBN questions whether the rental firms satisfied the requirements for rental activities set out in the Product Control Act and the Internal Control Regulations. The survey has identified examples of rental firms that did not have sufficient knowledge of the limitations of the recreational craft and whether they met the applicable requirements. Were the recommended routes considered in relation to the lessees' level of experience? How good was the training provided? Why did the rental firms deviate from their own procedures, and how were such non-conformities followed up? Were the rental firms' instructions on how to give notification of emergencies good, or did they delay the start of search and rescue operations? How did the lessees understand the difference between notifying of an emergency as opposed to notifying of problems that do not constitute an emergency?

The accidents concern a very small number of rental firms, which begs the question as to whether these are common issues. Two of the accidents involved boats rented to tourists for the purpose of fishing, while there are 950 registered companies in Norway engaged in fishing tourism (NRK, 2019).

In 2011, the Directorate for Civil Protection and Emergency Planning carried out a supervision campaign in relation to providers of boat rental services (Direktoratet for samfunnssikkerhet og beredskap (DSB), 2012). The results of these supervisory activities showed that eight out of nine enterprises were not aware that the services they provided were regulated by the Product Control Act. Three out of nine had not conducted a written risk assessment, did not have written procedures setting out who were responsible for the duties, and follow-up of accidents and near-accidents had not been documented. None of the firms were aware of their duty to report to the Directorate. The AIBN is not aware of any subsequent supervisory activities of this scope targeting boat rental firms. Some of the contributory safety factors that concern rental firms were also observed in connection with the accident in Mehamn on 6 July 2014. The report on this investigation concluded, among other things, that the rental firm did not provide sufficient training and was not aware of the craft's operational limitations (Statens havarikommisjon for transport, 2016). After comparing the results of this mapping with a previous investigation and supervisory report from the Directorate for Civil Protection and Emergency Planning (DSB), the AIBN questions whether boat rental firms devote sufficient attention to the safety of those who rent recreational craft.

One of the rental firms involved in one of the accidents has subsequently decided that all their recreational craft will be equipped with an AIS transponder and a VHF radio from and including the 2019 season. This means that other vessels nearby will be able to observe the craft on their chart plotter and that those renting the craft will be able to use the VHF radio when needed.

## 5.4 Groundings and collisions

The following overview provides a summary of common features for groundings and collisions. See Appendix C for an illustration of the results.

*Table 11: Fatal groundings and collisions in 2018.*

| Groundings and collisions | Number | Percentage |
|---|---|---|
| Number of accidents | 4 | 20% of 20 accidents |
| Fatalities | 4 | 19% of 21 fatalities |
| Serious physical injuries | 1 | |
| No serious physical injuries | 7 | |
| Total number of persons involved | 12 | 33% of 36 persons |
| Two persons drowned and two died from serious physical injuries, primarily head injuries.<br>If we exclude sudden illness and craft-jetty accidents, groundings and collisions make up 26% of the fatal accidents (4 out of 15 accidents). | | |

The motorboats were a 12-foot dinghy (3.7 m) with an engine output of 15 hp (11 kW), an open motorboat of 17 feet (5.2 m) with an output of 70 hp (52 kW), a partially enclosed motorboat of 22 feet (6.7 m) with an unknown engine output, and a motorboat of 30 feet (9.2 m) with sleeping quarters and an engine output of 337 hp (251 kW). Two water scooters were also involved in accidents of this type. This is the only accident type in which water scooters are involved. The water scooters had very powerful engines, in the order of 250 hp (186 kW).

All the persons involved in this type of accident were under 45 years of age, and three of them were teenagers. The craft operators were experienced boaters and knew the area well.[20]

They were on their way home, most of them from a night out, and were using the craft as a means of transport. The accidents occurred in spring or summer. The weather before the accidents occurred was good, with little wind and calm sea conditions.

All the collisions and groundings happened in twilight conditions between 23:00 and 02:00. In the AIBN's assessment, it is possible in two of these cases that the operators did not expect or anticipate that it would be difficult to navigate and react to other boats under these light conditions. They were used to lighter evenings and nights. In one case, it was an unusually dark evening for the summer season because of heavy cloud cover. Underwater rocks/shoals, skerries and rocks awash were not marked in the area where the craft ran aground. The craft were not using navigation lights, and no navigational aids were used.

[20] In general, the quality of the information that was obtained is not sufficient to determine the extent to which the operators had the skills and experience to operate the type of craft involved in the type of waters in which the accident occurred. We have very little information about the operators' formal qualifications. The assessments are based on witness statements, but witnesses may have had limited knowledge about the skills and experience of the persons who died.

The speed of the craft usually exceeded 20 knots. For two of the cases, the speed is assumed to have exceeded 30 knots.[21] In most of the cases, no speed limits applied to the waters where the accidents occurred. In the one case where a municipal speed limit did apply for the summer, the craft was travelling at a considerably higher speed than permitted.

Ten persons (out of a total of 12) involved in groundings and collisions were intoxicated. Five out of a total of six operators were intoxicated. Four of the operators were moderately to severely intoxicated at the time of the accident, with a BAC of 0.13% or more. Only one of the operators had a BAC of less than 0.05%. The average for all intoxicated operators was a BAC of 0.14%. Most of the passengers were also intoxicated, with an average BAC of 0.12%. Moderate to severe intoxication usually means that people’s ability to think, learning capacity and psychomotor functioning are impaired. Nausea, vomiting, unsteadiness, tiredness, drowsiness and falling asleep will be common. Impairment of both physical and cognitive skills may have contributed to the accidents for persons at this level of intoxication.

Neither the operators nor the passengers had time to react before the accident occurred. This is seen in light of the speeds and degree of intoxication. Failure to use navigational lights was also a factor in the collision accidents.

The teenagers and another person were the only ones wearing flotation devices.

Two of the victims suffered very serious injuries, primarily head injuries.

The other two drowned. Impacts caused by the grounding and collision, respectively, may have contributed to them losing consciousness or rendered them incapable of self-rescue. Two of the victims were not wearing flotation devices. In one case, the use of a flotation device could have helped the other persons present to get the person back into the craft.

Another person who suffered serious physical injuries was wearing a flotation device. He was quickly brought back into the craft and taken to hospital, and he survived.

Sudden illness has not contributed to groundings and collisions or had a bearing on the survivability of these accidents.

In the collision incidents, it did not take long for other people to become aware that someone was in trouble. Search and rescue operations were initiated immediately. In the grounding incidents, it took several hours before anyone else became aware of the situation.

### 5.4.1 Discussion regarding the operation of recreational craft under the influence of alcohol or drugs

There is an ongoing debate in Norway about whether the drink drive limit for people who operate recreational craft should remain at a BAC of 0.08% or whether it should be

[21] There is some uncertainty attached to the assumed speed at the time of collisions and groundings. For collisions, both craft and their assumed speeds at the time of the accident are stated. The assumed time of the accident is considered to be accurate.

lowered. It is also a subject of discussion whether a new limit should be 0.05% or 0.02%, the latter being the limit that applies to motorists.

The results from this mapping survey show that five out of six craft operators were intoxicated at the time of grounding or collision. With one exception, it was only in groundings and collisions that the craft operators and passengers were intoxicated. The groundings and collisions happened while the craft were travelling at a speed of more than 20 knots, and in twilight conditions.[22]

A research study from 2009 shows that the risk of road traffic accidents increases at a BAC of 0.05% and more; see Figure 6. (Blomberg, Peck, Moskowitz, Burns, & Fiorentino, 2009) Experience from the road traffic area shows that reducing the drink drive limit to 0.02% BAC can have a positive effect in the form of fewer injuries and fatal accidents. However, these studies do not rule out the possibilities that other factors may also have contributed to reducing the number of accidents. Experience from Scotland shows that reducing the drink drive limit does not necessarily reduce the number of accidents unless other measures are introduced at the same time, such as more frequent blood-alcohol testing by the police (Haghpanahan, 2018).

Most of the intoxicated operators were moderately to severely intoxicated with an average BAC of 0.14%. This is significantly over the current limit of 0.08%. A study from 2012 showed that persons with BAC of 0.08% had a tendency to underestimate their blood alcohol concentration considerably (Grant, 2012 ). This effect increases with increasing BAC. This can partly explain why persons who have been found to have high blood alcohol concentrations nevertheless operate and travel as passengers on recreational craft. Many of them will probably underestimate their blood alcohol concentration, with a corresponding risk of overestimating their level of functioning. As the tendency to underestimate one's blood alcohol concentration seems to increase with increasing BAC, this could mean that for many, it becomes difficult to stop drinking and make a sensible assessment of one's situation after reaching a certain blood alcohol level ('point of no return').

It is a common feature of groundings and collisions that they happened on the way home from a night out. The people involved needed to get home from a night out, and transport by sea had been planned or chosen in preference to transport by road. This can be interpreted in different ways.

One possible explanation is that it has become generally accepted that one should not drink and drive a car. The risk of being caught drink driving is probably considered higher on the road than on water, and that is one reason to prefer the use of a boat.

The question can be raised whether there are similarities and differences between those who drive a car under the influence and those who operate a boat under the influence. In fatal road traffic accidents, more of the younger victims are intoxicated than the older ones (Breen, Naess, Gjerde, Gaarder, & Stray-Pedersen, 2018). This survey shows the same trend if we exclude persons who fell into the water between the craft and a jetty. The craft operators were found to have a somewhat higher level of intoxication than that which has been observed for drivers killed in road traffic accidents (Gjerde &

[22] Twilight is the period just after sundown and before sunrise, also known as dusk and dawn, when it is neither fully light nor fully dark. Nautical twilight occurs when the sun is between 6 degrees and 12 degrees below the horizon.

Christophersen, 2012)[23]. The survey also shows that the level of intoxication was somewhat lower than what has previously been observed for intoxicated operators, but the sample may not be quite representative (Khiabani, Opdal, & Mørland, 2008). The most interesting observation when comparing the findings from this survey with those of previous studies is that the level of intoxication is as high as it is for people who operate boats and cars, and that it is often younger persons rather than older people who are intoxicated. This is seen in light of the fact that the drink drive limit on roads has been 0.02% BAC for more than 18 years, that three out of ten serious traffic accidents involve an intoxicated driver, and that police checks are assumed to be more frequent and more systematic on the road than at sea. In two accidents, the other persons on board were also intoxicated. Most of them were moderately or severely intoxicated with a BAC of between 0.1% and 0.2%. There is a legal distinction between requirements concerning intoxication for operators and passengers, but in practice, the interaction between the person operating the craft and the passengers can contribute to the sequence of events and the survivability of accidents. These accidents show that it can be pure chance that decides who lives and who dies. The Norwegian Institute of Public Health's report on accidents and injuries in Norway sees a need for further research into risk factors for injuries resulting from accidents, for example links between personal injuries and various risk factors such as use of alcohol and medication and mental and physical health (Myklestad, et al., 2014). The findings from this survey support this conclusion. To be able to implement targeted measures, the AIBN believes it is necessary to gain a better understanding of why people choose to operate a boat while moderately to severely intoxicated.

## 5.5 Falls between craft and jetty

The following overview provides a summary of common features for accidents in which the persons involved fell overboard between a moored craft and a jetty. See Appendix C for an illustration of the results.

*Table 12: Fatal craft-jetty accidents in 2018.*

| Craft-jetty accidents | Number | Percentage |
|---|---|---|
| Number of accidents | 4 | 20% of 20 accidents |
| Fatalities | 4 | 19% of 21 fatalities |
| Serious physical injuries | 0 | |
| No serious physical injuries | 1 | |
| Total number of persons involved | 5 | 14% of 36 persons |

Accidents that occur while a craft is moored to a quay or jetty are usually included in the statistics from the Norwegian Maritime Authority. According to figures from the Norwegian Society for Sea Rescue, a total of 47 persons drowned in 2018 after falling from shore or a jetty into rivers, lakes or the sea. In the AIBN's assessment, only four drownings occurred as the person was entering or leaving a recreational craft. It is difficult to distinguish the accidents where a person falls into the water between a craft and a jetty from other accidental drownings, which may result in inaccuracies from year to year.

[23] The study looked at car drivers killed in accidents after the drink drive limit was lowered to 0.02% BAC.

There are several common features between three of the accidents. The fourth accident stands out from the others in that it took place in the afternoon, and that the person involved was not intoxicated and was wearing a lifejacket.

All the accidents took place while the craft were moored alongside a floating jetty. The craft were between 20 and 31 feet long (6.1–9.5 metres), and most of them were more than 20 years old.

The intention was to spend time in or stay overnight in the boat after a night out. Most of the accidents happened in twilight or darkness between 02:00 and 05:00. The air temperature was between 6 °C and 9 °C, while the water temperature was between 5 °C and 18 °C. Slippery jetty and deck may have contributed to the accident. In one case, the current conditions combined with the choice of mooring may have been contributory factors.

The persons fell into the water on their way from the jetty to the boat or vice versa. They were between 50 and 80 years of age, and most of them were men.

Three out of the total of five persons involved in these accidents were intoxicated. These three persons were severely intoxicated with an average BAC of 0.23%; see Figure 41 and Figure 42. Another person was probably intoxicated, but no blood sample was collected. Severe intoxication impaired the persons’ physical and cognitive skills significantly, contributed to the accident and limited their ability to take care of themselves after the accident had occurred.

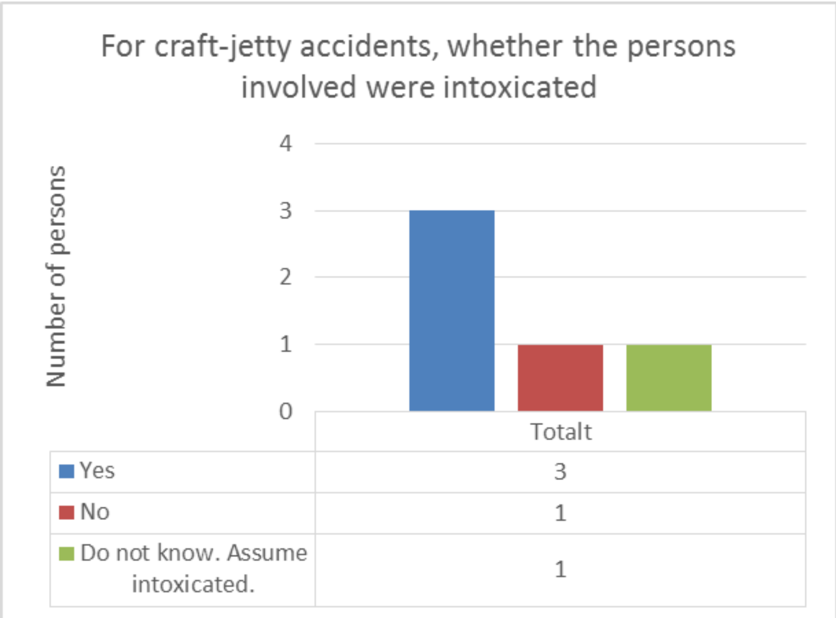



*Figure 41: Accidents that occurred while the craft was moored. The figure shows whether the persons were intoxicated or not.*

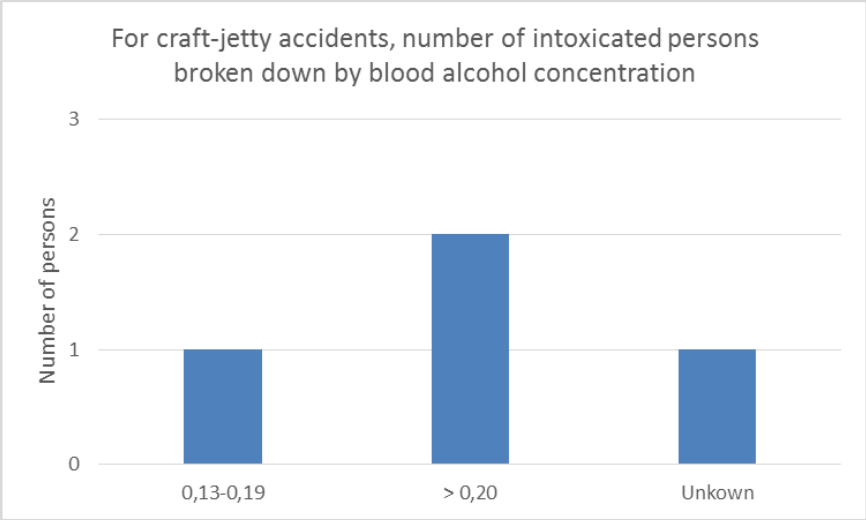



*Figure 42: Falls at quay or jetty while the craft was moored. Number of intoxicated persons broken down by BAC.*

### 5.5.1 Assessment of survivability

The persons who fell into the water were unable to use a ladder on their own boat or a boat nearby to get out of the sea unaided. There were no safety ladders from the sea to the floating jetty in the immediate vicinity.

The victims were unable to alert anyone of their distress. They could not use their mobile phone. It took more than one hour before anyone else became aware of the situation. In two cases, it took more than two hours.

Three of the persons were not wearing flotation devices. The fourth person was wearing an inflatable lifejacket. When he was found, the vest was inflated, but had not kept his airways clear. The lifejacket had not been properly adjusted, or the crotch strap was not used.

Four persons drowned. One person suffered no physical injuries. He managed to climb up a ladder to a fixed jetty nearby and notify the emergency services that the other person was missing.

Provided that they retained buoyancy and clear airways after falling into the water, two person may have developed hypothermia before they drowned; see Figure 43. See Appendix C for details about external conditions.

Severe intoxication impaired the persons’ physical and cognitive skills significantly and limited their ability to take care of themselves after the accident had occurred.

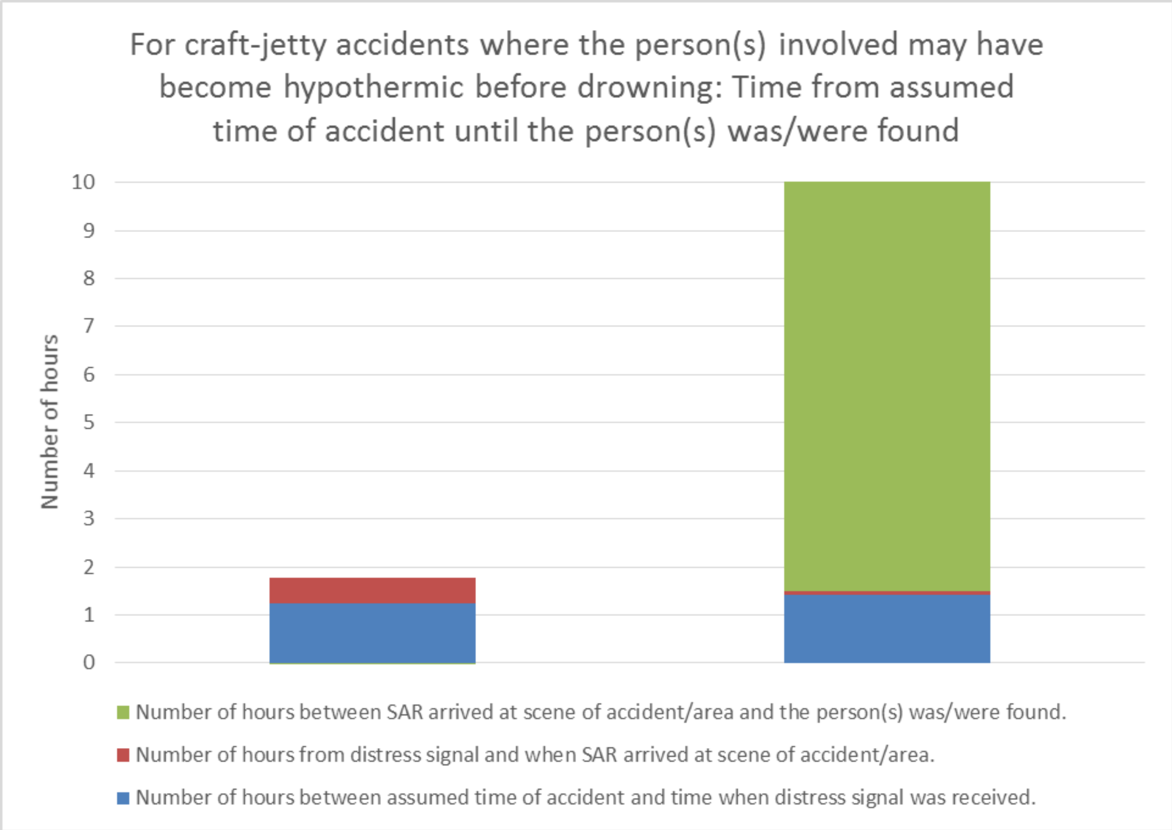



*Figure 43: Craft-jetty accidents where the persons involved may have become hypothermic. Time from the assumed time of the accident until the persons were found. The maximum time in the figure is 10 hours. In one case, the person was found dead three days later.*

# 6. CONCLUSION

This report describes the methods used, what information has been collected, the analysis and the results of the survey of fatal recreational craft accidents in 2018.

## 6.1 Overview

The mapping gives a more comprehensive and nuanced presentation of the circumstances surrounding fatal accidents involving recreational craft than has previously been available for Norway. The aim is for the authorities and other organisations to use these results as a better basis for determining which measures can be implemented to improve safety at sea.

There is potential for improvement in the annual statistics on fatal recreational craft accidents. This requires improving the method used, post mortem examination of victims, obtaining more detailed information from e.g. the joint rescue coordination centres and the police, and devoting more resources to the analysis of information.

In 2018, 23 people died in recreational craft accidents. Three people were seriously injured. In total, 44 people were involved in 22 recreational craft accidents in which one or more people died.

There were fewer fatalities in 2018 than in previous years. The difference in figures may be due to inaccuracies relating to previous years' classification of incidents as recreational craft accidents. By obtaining more information about the incidents, such as information from the Ship Register, the police, the joint rescue coordination centres and other parties involved in search and rescue work, we can achieve better incident registration.

There were four main types of fatal recreational craft accidents in 2018. In addition, accidents involving boat rental for tourists are highlighted. The common features of and differences between these accidents are described below.

Since the number of accidents in each category is low, the results should be used with caution and are not necessarily representatives of accidents that have occurred in previous years.

## 6.2 Capsizing and person overboard accidents

Half of those who died (11 of 21[24]) in 2018 drowned after their craft capsized or after falling overboard.

Capsizing accidents involved small craft, primarily craft in motion (motorboat, dinghy, rowing boat, canoe, kayak and paddleboard). The speed of the craft did not exceed 10 knots. The motorboat, dinghy and rowing boat had a low freeboard that failed to meet current requirements, and their wind and sea limitations were unknown. Half of the accidents involved inexperienced foreign nationals who had borrowed or rented the craft, while the other half involved experienced Norwegian and foreign operators. The victims were probably not intoxicated.

[24] Two of the accidents are not included in the basis for the analysis due to insufficient information.

The victims of person overboard accidents were adult men, mainly foreign nationals, who fell overboard while the motorboat or sailing boat they were in was under way. With one exception, the victims were probably not intoxicated. The accidents occurred in narrow coastal waters. The AIBN has not identified any common factors to explain why they fell overboard.

For most of the capsizing and person overboard accidents, it took a long time, more than 45 minutes, before anyone else became aware of the distress situation. In most cases, the persons involved were unable to alert anyone of their distress by mobile phone and had no other means of notification available, such as a whistle, an emergency flare, a handheld VHF radio, a personal locator beacon or an AIS transponder with distress signal.

The shortest distance to the nearest shore, island or islet was between 100 and 600 metres. The temperature in the sea/water was between 6 and 16 °C. The persons involved were appropriately dressed to be on board a boat, but not to be in the water.

On the assumption that the victims retained buoyancy and clear airways during the first phase after falling into the sea/water, hypothermia probably contributed to their drowning. For those victims who were wearing flotation devices, the equipment was not properly fitted or was of a type that did not keep the airways clear, or the wearer lost consciousness or otherwise lost the ability to take care of themselves.

Given medical treatment, hypothermic patients can sometimes be resuscitated. A patient whose airways were clear while their temperature dropped until hypothermic cardiac arrest has a better chance of being successfully resuscitated.

A properly fitted lifejacket with the crotch strap attached is currently the only flotation device that will keep the airways clear if the wearer loses consciousness or otherwise becomes unable to take care of themselves.

An immediate distress alert with indication of position, combined with the use of a properly fitted lifejacket and clothing that delays the onset of hypothermia, can help to keep a person alive in the water.

There are currently various effective solutions available for sending out distress signals that also indicate position, and clothing that delays the onset of hypothermia.

## 6.3 Boat rental for tourists

One in four fatalities (5 of 21) in 2018 were tourists in a rented craft. They died after the craft capsized or after falling overboard.

The tourists who died had little or no experience of the type of craft involved, the waters they were in or the prevailing weather and sea conditions.

In the capsizing accidents, the weather and sea conditions were challenging for inexperienced users of a canoe, kayak and motorboat, respectively.

After comparing the results of this mapping with a previous investigation and supervisory report from the Directorate for Civil Protection and Emergency Planning (DSB), the

AIBN questions whether boat rental firms devote sufficient attention to the safety of those who rent recreational craft.

## 6.4 Groundings and collisions

Groundings and collisions receive a great deal of attention in the discussion on how to improve safety at sea, which can draw attention away from the fact that 80% of the victims in 2018 died under other circumstances.

One in five victims (4 of 21) in 2018 died when their craft ran aground or collided.

Groundings and collisions have three factors in common: high speed, moderate to heavy intoxication and twilight conditions. Weakened skills due to intoxication may have contributed to the accidents. Light conditions and the absence of navigation lights made it more difficult to predict dangers in twilight. The accidents will have occurred suddenly and unexpectedly.

The accidents involved motorboats and water scooters. The speed of the craft usually exceeded 20 knots. For two of the cases, the speed is assumed to have exceeded 30 knots. In most of the cases, no speed limits applied to the waters where the accidents occurred. In the one case where a municipal speed limit did apply for the summer, the craft was travelling at a considerably higher speed than permitted. High speeds caused the persons involved to suffer injuries. In two cases, the victims died from extensive injuries. The injuries suffered by the other two victims may have limited the possibility of self-rescue and caused them to drown. In one of these cases, the failure to use a flotation device may have limited the person’s chances of surviving.

All the persons involved in such accidents were under 45 years of age, and 3 were teenagers. The groundings and collisions occurred as the victims were returning home from a night out. Needing to get home, they had planned or chose to return by sea rather than by some means of road transport. The craft operators were experienced boaters and familiar with the waters. Five out of six operators were intoxicated. Most were moderately to severely intoxicated. Their average blood alcohol concentration (BAC) was 0.14%, significantly higher than the current limit of 0.08%, and slightly higher than the average for drivers who die in road accidents.

Experience from the road traffic area shows that reducing the drink driving limit to a BAC of 0.02% can have a positive effect in the form of fewer injuries and fatal accidents. At the same time, experience from Scotland shows that reducing the drink driving limit does not necessarily reduce the number of accidents unless other measures are introduced at the same time, such as more frequent blood-alcohol testing by the police of recreational craft operators.

The question can be raised whether there are similarities and differences between those who drive a car under the influence and those who operate a boat under the influence. To be able to implement targeted measures, the AIBN believes it is necessary to gain a better understanding of why people choose to operate a boat while moderately to severely intoxicated.

## 6.5 Falls between craft and jetty

There may be greater uncertainty associated with the number of people who die on a recreational craft while it is moored, primarily because it is difficult to distinguish between these accidents and other accidents in which someone falls from a quay, jetty or shore.

One in five victims (4 of 21) in 2018 died as a result of falling overboard between the craft and a floating jetty.

Most of the accidents occurred at night after partying.

In most cases, the victims were severely intoxicated, which have contributed to why they fell into the water and had limited possibility of raising the alert and of self-rescue.

Only one of the victims wore a flotation device.

It took at least one hour before anyone else became aware of the distress situation.

Four people drowned, all aged over 50.

Accident Investigation Board Norway

Lillestrøm, 27 March 2019

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# APPENDICES

Appendix A: Overview of relevant information and sources

Appendix B: Details about the external environment – hypothermia

Appendix C: Common features and differences for types of accidents

# APPENDIX A: OVERVIEW OF RELEVANT INFORMATION AND SOURCES

*Table 13: Overview of information that it may be relevant to obtain in connection with fatal recreational craft accidents.*

| Parties involved | Description of information that it was desirable to obtain |
|---|---|
| The craft | Name, call signal, registration number and sail number of all the craft involved |
| | Personal data about the owner of the craft |
| | Consequences of the accident – Damage to the craft, the engine/propulsion system, other craft/objects, the natural environment. |
| | Photos of the craft and the damage. |
| | Information from the craft's CE marking. |
| | Available navigational aids, navigation lights, communication equipment, life-saving equipment, and what was used. |
| | Data protected against overwriting, e.g. chart plotter, GPS, engine/motor. |
| The operator and other persons involved in the accident | Assumed place, date and time of the accident |
| | Purpose of the trip |
| | Port of departure and destination |
| | Number of persons and load |
| | Witness statements about the incident |
| | Assumed speed at the time of the accident |
| | Blood samples for testing for alcohol and other intoxicants for the persons involved in the accident |
| | Consequences for the persons involved |
| | Post-mortem reports |
| | Photos from the scene of the accident |
| | Description of scope of injuries |
| | Information from medical treatment of the persons involved |
| | Personal data about the operator of the craft and others involved in the accident |
| | The persons' formal qualifications, experience of the craft, the waters and the use of recreational craft in general |
| | Use of flotation devices, and type of flotation devices. Whether the flotation device worked as intended |
| The external environment | Weather, sea, visibility and light conditions |
| | Local restrictions, traffic conditions, seamarks and characteristics of the waters. |
| Search and rescue | Notification of the accident/missing persons |
| | The search and rescue operation |

*Table 14: Description of sources.*

| Source | Uncertainty/inaccuracy |
|---|---|
| Historical weather observations from the weather station nearest the assumed place and time of the accident (Yr.no, 2018). | In some cases, where the nearest weather station is not deemed to be representative, weather observations have been obtained from two different weather stations.<br>The data have been compared and assessed in relation to available information from other sources (JRCC, RS, witness statements).<br>Weather observations from the nearest weather station are not necessarily representative of the prevailing weather conditions at the assumed place of the accident. For example if the weather station is located further out on the coast, and the accident is assumed to have occurred in a sheltered arm of a fjord, the measured wind conditions may have been greater than at the scene of the accident. The survey has not looked at how the weather conditions have developed over the days prior to the assumed time of the accident. |
| Historical model calculations of sea conditions at the assumed place and time of the accident (Meteorologisk institutt, 2018). | It is assumed that this is the same information provided under 'Sea and coast' at Yr.no (Yr.no, 2018). The data have been compared with any information available from other sources (JRCC, RS, witness statements). Model calculations of the sea conditions are based on historical model calculations carried out by the Norwegian Meteorological Institute. The most fine-meshed model was used, i.e. with a grid of 800 by 800 metres. The uncertainty of the data is assumed to increase from outer coastal waters to inner coastal waters and further to narrow coastal waters and ports. In some cases where the accident is assumed to have occurred in narrow waters, the data were obtained from an area further out on the coast. In these cases, it is assumed that the stated wave height was greater than at the scene of the accident. There is greater uncertainty and inaccuracy associated with data describing current conditions compared with data describing wave conditions. |
| Sea charts (Kystverket, 2018). The assessment has included whether there may have been crossing waves. | The seabed conditions were assessed in relation to the wave conditions from the historical model calculations.<br>The assessment concerning crossing waves has been based on basic knowledge of hydrodynamics. The basic principle was to consider wave periods (both wind waves and swells), the dominant wave directions and the seabed topography in the area where the accident is assumed to have taken place. |
| Speed limits from the Norwegian Coastal Administration's thematic map *Fartsforskriftene* (Kystverket, 2018) and searches for speed limit regulations for the | The thematic map available in the online map service Kystinfo only contains some of the local speed limits. In cases where no local speed limits were specified on the map, searches were performed on the Lovdata website. |

| | |
|---|---|
| municipality in question (Lovdata, 2018). | |
| Traffic conditions in the waters in question – AIS (Kystverket, 2018) | The automatic identification system (AIS) is mainly found on commercial vessels. The AIS traffic shown on the service is therefore not representative of the traffic conditions for recreational craft and commercial vessels not required to use AIS. |
| The small craft register *Småbåtregisteret* (Redningsselskapet, 2018) and the Ship Register (Sjøfartsdirektoratet, 2018). | Recreational craft of up to 15 metres in length are not required to be registered in a ship register. A recreational craft may be registered in one or both registers.<br>Norwegian (recreational) craft more than 15 metres in length must be registered in the Ship Register.<br>Registration is voluntary for recreational craft between 7 and 15 metres in length. The owner is obliged to notify of any changes.<br>There is no systematic follow-up if changes are not notified, for example if there is a change of owners, or if the craft sinks or is scrapped. |
| Light conditions: (Time and Date AS, 2018) | Based on the assumed time of the accident, a sun graph was used to determine whether it was light, nautical twilight or dark. Twilight is the period just after sundown and before sunrise, also known as dusk and dawn, when it is neither fully light nor fully dark. Nautical twilight occurs when the sun is between 6 degrees and 12 degrees below the horizon. This was when navigators historically made reliable observations of known stars, using the horizon as reference. |
| Media searches (Retriever, 2018) – searches for relevant articles about the accidents. | Information in the media can be conflicting, witness statements may be inaccurate and may contain incorrect information. |

| | |
|---|---|
| Forensic toxicology tests of blood and urine samples | Forensic toxicology tests of blood and urine samples are usually carried out in connection with post mortem examinations. Forensic toxicology tests include analyses of metabolites of alcohol (ethyl glucuronide (EtG) and ethyl sulphate (EtS)). The results of these analyses can be used to assess whether alcohol has been consumed and converted in the body. According to the Department of Forensic Medicine, Forensic Toxicology at Oslo University Hospital, it is possible for small amounts of the detected ethanol to have formed post mortem. In most cases, the measured concentration is fairly representative of the concentration range at the time of death. The likelihood of alcohol forming post mortem increases with decomposition, abdominal or chest injuries, burns, detected n-propanol or an unusual urine-blood alcohol concentration ratio (Statens havarikommisjon for transport, 2014).<br>Post mortem forensic toxicology tests also include analyses of a selection of medicinal products and narcotic substances.<br><br>The police may request blood samples from the operator, and test them for alcohol and other intoxicants, if they suspect intoxication. They may also ask the Department of Forensic Medicine, Forensic Toxicology at Oslo University Hospital for expert assistance to calculate the assumed degree of intoxication at the time of the accident. |

# APPENDIX B: DETAILS ABOUT THE EXTERNAL ENVIRONMENT – HYPOTHERMIA

*Table 15: The table contains information about the circumstances surrounding accidents in which a person has drowned (or is assumed to have drowned) and where hypothermia may have contributed to their drowning. In total, 15 persons involved in 14 accidents.*

| Season | Type of waters | Greatest distance to the nearest shore/island/islet [m] | Wind speed (mean) | Air temperature [°C] | Sea temperature [°C] | Wave height – significant [m] |
|---|---|---|---|---|---|---|
| Winter | Narrow coastal waters | 250 | Moderate gale (10.8–13.8 m/s) | 3 | 6 | 0.8 |
| Spring | Alongside jetty | 0 | Light air (0.3–1.5 m/s) | 6 | 5 | 0.1 |
| Spring | Narrow coastal waters | 200 | Gentle breeze (3.4–5.4 m/s) | 8 | 10 | 0.1 |
| Spring | Narrow coastal waters | 0 | Light air (0.3–1.5 m/s) | 9 | 10 | 0.6 |
| Spring | Narrow coastal waters | 600 | Fresh breeze (8.0–10.7 m/s) | 8 | 12 | 0.3 |
| Spring | Narrow coastal waters | 100 | Moderate breeze (5.5–7.9 m/s) | 8 | 6 | 0.2 |
| Summer | Narrow coastal waters | 300 | Light breeze (1.6–3.3 m/s) | 26 | 16 | 0.1 |
| Summer | Narrow coastal waters | 150 | Moderate gale (10.8–13.8 m/s) | 15 | 13 | 0.5 |
| Summer | Lake | 450 | Fresh breeze (8.0–10.7 m/s) | 15 | Unknown | 0.5 |
| Summer | Alongside jetty, river | 0 | Light air (0.3–1.5 m/s) | 7 | 18 | 0.0 |
| Summer | Narrow coastal waters | 140 | Light air (0.3–1.5 m/s) | 14 | 11 | 0.1 |
| Autumn | Narrow coastal waters | 180 | Fresh breeze (8.0–10.7 m/s) | 19 | 15 | 0.3 |
| Autumn | Outer coastal waters | 300 | Fresh breeze (8.0–10.7 m/s) | 13 | 10 | 0.4 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Autumn | Outer coastal waters | 400 | Fresh breeze (8.0–10.7 m/s) | 9 | 13 | 1.8 |
| Median value | | 190 | | 9 | 11 | 0.3 |
| Average | | 220 | | 11 | 11 | 0.4 |

# APPENDIX C COMMON FEATURES AND DIFFERENCES FOR TYPES OF ACCIDENTS

*Table 16: Illustrated – common features and differences: capsizing accidents.*

| | Context and background | Sequence of events leading up to the accident | The accident | Survivability | Consequences |
|---|---|---|---|---|---|
| The craft | Small motorboat, rowing boat, dinghy, canoe, kayak and paddle board. | Under way, fishing, sports activity. | The craft capsized, the persons fell overboard. | | |
| Contributory causes | | Low freeboard.<br>Does not meet today’s standard requirements.<br>Limitations for use not known. | | In most cases, mobile phones were not used. Did not have a whistle, an AIS transponder, a handheld VHF radio or a personal locator beacon. | |
| Person(s) involved | Experienced Norwegians and inexperienced foreign nationals. | Dressed for being on a boat, but not for being in the water. | | Half wore flotation devices, but none kept the airways clear. | Drowned. |
| Contributory causes | | Not intoxicated. | The foreign nationals had little experience of being on a boat in the waters in which they were operating. | When several people fell overboard, it was the oldest ones who died. | |
| The external environment | Narrow coastal waters.<br>Light, in the morning or afternoon. | | Moderate to fresh breeze.<br>Wave height (Hs) < 0.5 m.<br>100–600 metres from land/island/islet.<br>Water temperature 6–13 °C. | The victims probably became hypothermic. | |
| Contributory causes | | | The foreign nationals were taken by surprise by the wind and sea conditions. | They were in the water for a relatively long time before they were found by the search and rescue service. | |
| Search and rescue | | | | In most cases, it took more than an hour before anyone was notified of the distress situation. | Three of the persons involved were flown to hospital for attempted resuscitation. |
| Contributory causes | | | | The victims were unable to alert anyone of their distress. | The hypothermic persons could not be resuscitated because the airways had not been clear. |

*Table 17: Capsizing accidents. Description of waters, wind and sea conditions for accidents where the persons involved may have become hypothermic. In one case, there was a possibility of crossing waves; see footnote.*

| Type | Operator | Season | Type of waters | Greatest distance to the nearest shore/island/ islet [m] | Wind speed (mean) | Air temperature [°C] | Sea temperature [°C] | Wave height – significant [m] |
|---|---|---|---|---|---|---|---|---|
| Dinghy | Experienced Norwegian national | Spring | Narrow coastal waters | 200 | Gentle breeze (3.4–5.4 m/s) | 8 | 10 | 0.1 |
| Kayak | Inexperienced tourist | Spring | Narrow coastal waters | 600 | Fresh breeze (8.0–10.7 m/s) | 8 | 12 | 0.3 |
| Rowing boat | Inexperienced foreign national | Spring | Narrow coastal waters | 100 | Moderate breeze (5.5–7.9 m/s) | 8 | 6 | 0.2 |
| Paddle board | Experienced Norwegian national | Summer | Narrow coastal waters | 150 | Moderate gale (10.8–13.8 m/s) | 15 | 13 | 0.5 |
| Canoe | Inexperienced tourist | Summer | Lake | 450 | Fresh breeze (8.0–10.7 m/s) | 15 | Unknown | 0.5 |
| Motor-boat | Inexperienced tourist | Autumn | Outer coastal waters | 400 | Fresh breeze (8.0–10.7 m/s) | 9 | 13 | 1.8[25] |
| | | Average | | 317 | | 11 | 11 | 0.6 |

[25] Possibility of crossing waves, thereby higher and more choppy waves than the significant wave height would indicate.

*Table 18: Illustrated – common features and differences: person overboard accidents.*

| | Context and background | Sequence of events leading up to the accident | The accident | Survivability | Consequences |
|---|---|---|---|---|---|
| The craft | Motorboat and sailing boat. | Under way. | The persons involved fell overboard. | | |
| Contributory causes | | | | Mobile phones were not used. In most cases, did not use/did not have an automatic safety cut-out switch, safety line, whistle, emergency flare, AIS transponder, handheld VHF radio or personal locator beacon. | |
| Person(s) involved | Foreign nationals.<br>Men, aged 40–72. | Alone on board.<br>Dressed for being on a boat, but not for being in the water. | | | Drowned or assumed to have drowned. |
| Contributory causes | | Not intoxicated. | | No flotation device. The lifejacket/immersion suit did not keep the airways clear.<br>Possibility of sudden illness.<br>The victims probably became hypothermic. | |
| The external environment | Narrow coastal waters.<br>Morning and afternoon. | | Fresh breeze to moderate gale.<br>Wave height (Hs) < 0.8 m.<br>140–300 metres from land/island/islet. | | |
| Contributory causes | | | Strong winds. | Two of the victims were in the water for a long time before they were found (> 4 hours). Two have not been found. | |
| Search and rescue | | | | It usually took a long time before anyone else became aware of the distress situation. | Three of the persons involved were flown to hospital for attempted resuscitation. |
| Contributory causes | | | | The victims were unable to alert anyone of their distress. | The hypothermic persons could not be resuscitated because the airways had not been clear. |

*Table 19: Person overboard accidents. Description of waters, wind and sea conditions for accidents where the persons involved may have become hypothermic.*

| Type | Operator | Season | Type of waters | Greatest distance to the nearest shore/island /islet [m] | Wind speed (mean) | Air temperature [°C] | Sea temperature [°C] | Wave height – significant [m] |
|---|---|---|---|---|---|---|---|---|
| Motor-boat | Foreign national living in Norway | Winter | Narrow coastal waters | 250 | Moderate gale (10.8–13.8 m/s) | 3 | 6 | 0.8 |
| Sailing boat | Experienced Norwegian national | Summer | Narrow coastal waters | 300 | Light breeze (1.6–3.3 m/s) | 26 | 16 | 0.1 |
| Motor-boat | Fishing tourist | Summer | Narrow coastal waters | 140 | Light air (0.3–1.5 m/s) | 14 | 11 | 0.1 |
| Sailing boat | Foreign national living in Norway | Autumn | Narrow coastal waters | 180 | Fresh breeze (8.0–10.7 m/s) | 19 | 15 | 0.3 |
| | | Average | | 220 | | 16 | 12 | 0.3 |

*Table 20: Illustrated – common features and differences: accidents involving boat rental for tourists.*

| | Context and background | Sequence of events leading up to the accident | The accident | Survivability | Consequences |
|---|---|---|---|---|---|
| The craft | Motorboat, canoe, kayak. | Under way. | Capsizing and fall overboard. | The craft were not equipped with safety equipment or communication equipment. | |
| Contributory causes | The rental firm does not have a sufficient basis for meeting the requirements set out in the Product Control Act and the Internal Control Regulations. | The rental firm is not aware whether the recreational craft meet the CE requirements and limitations set out in the design category. | The route recommended by the rental firm was only suitable for very experienced kayakers.<br>The recommended route requires a detailed run-through. The rental firm has probably not devoted sufficient time to going through the route. | Mobile phone were not used or were not kept in waterproof bags. The rental firm did not provide equipment that allowed the persons to alert anyone of their distress (other than by mobile phone), such as a whistle, an emergency flare, an AIS transponder, a handheld VHF radio or a personal locator beacon.<br>The rental firm's instructions on notification meant that the initiation of the rescue operation was delayed. | |
| Person(s) involved | Foreign tourists.<br>Men aged 25–75. | More than one person involved in the accidents. Not assumed to be intoxicated. | | Half of the victims were wearing a buoyancy vest or similar. | Drowned. |
| Contributory causes | The rental firm did not ask about the lessees' formal qualifications or experience. | The persons involved had little or no experience of using this type of craft in the waters they were in.<br>The persons involved had little or no experience of being on a recreational craft in the prevailing weather and sea conditions.<br>The operator had not received sufficient training to use this type of recreational craft. | | The buoyancy vest and immersion suit did not keep the airways clear.<br>Some of them were poor swimmers.<br>The victims probably became hypothermic. | |
| The external environment | Outer narrow coastal waters, lake.<br>Morning and afternoon. | | Light air to fresh breeze.<br>Wave height (Hs) < 0.5 m, with one exception.<br>140–600 metres from land/island/islet. | | |
| Contributory causes | | The rental firm is not aware of the limitations that apply to the craft in terms of wind speed, wave height, weight and the maximum passenger capacity. | The canoe and kayak accidents both occurred under very demanding wind and sea conditions.<br>A motorboat capsized because of a choppier wave as the swells encountered local shallows. | | |
| Search and rescue | | | | It usually took more than 1.5 hours before anyone else became aware of the distress situation.<br>No one nearby who could hear cries for help.<br>The person called for help and was heard, but the person who heard it did not do anything.<br>The persons in distress were unable to give their location. | |
| Contributory factors | | | | It took a long time before anyone else became aware of the distress situation. | |

*Table 21: Boat rental. Description of waters, wind and sea conditions for accidents where the persons involved may have become hypothermic. Greater uncertainty is attached to the wind and sea conditions during the kayaking accident.*

| Type | Season | Type of waters | Greatest distance to the nearest shore/island/ islet [m] | Wind speed (mean) | Air temperature [°C] | Sea temperature [°C] | Wave height – significant [m] |
|---|---|---|---|---|---|---|---|
| Kayak | Spring | Narrow coastal waters | 600 | Fresh breeze (8.0–10.7 m/s) | 8 | 12 | 0.3 |
| Canoe | Summer | Lake | 450 | Fresh breeze (8.0–10.7 m/s) | 15 | Unknown | 0.5 |
| Motor-boat | Summer | Narrow coastal waters | 140 | Light air (0.3–1.5 m/s) | 14 | 11 | 0.1 |
| Motor-boat | Autumn | Outer coastal waters | 400 | Fresh breeze (8.0–10.7 m/s) | 9 | 13 | 1.8 |
| | Average | | 400 | | 12 | 12 | 0.7 |

*Table 22: Illustrated – common features and differences: groundings and collisions.*

| | Context and background | Sequence of events leading up to the accident | The accident | Survivability | Consequences |
|---|---|---|---|---|---|
| The craft | Motorboats and water scooters. | In the evening or night, returning home from a night out. | Speed > 20 knots. | Extensive damage to the craft. | Completely destroyed or serious damage to hull and engine. |
| Contributory causes | The water scooters had powerful engines. | No navigation lights/lights<br><br>For the groundings:<br>Navigational aids not used / not available. | High speed. | For the groundings:<br>Unable to alert anyone of the distress situation | |
| Person(s) involved | Norwegian nationals, aged 15–45.<br>The craft operators were experienced boaters and familiar with the waters. | Moderately to heavily intoxicated, both operators and passengers. | Neither the operators nor the passengers had time to react before the accident occurred. | The teenagers and another person riding a water scooter were wearing a buoyancy vest. The others wore no flotation devices.<br>All of those who died may have received a blow causing them to lose consciousness or the ability to take care of themselves. | Two died from their injuries, mainly head injuries.<br>Two persons drowned.<br>One suffered severe head injuries. |
| Contributory causes | | The craft were used as a means of transport to return home from a night out. | Moderate to heavy intoxication weakened the operators' physical and cognitive skills.<br><br>The Rules of the Road at Sea were not observed (intoxication, lights, caution, flotation devices). | No head protection worn against impact.<br>No use of a lifejacket that could have kept the airways clear. | |
| The external environment | Narrow coastal waters or lake.<br>Spring and summer.<br>Evening and night (between 23:00 and 02:00). Twilight.<br>Good weather (calm to gentle breeze). | | The waters were not subject to speed limits (one exception). | | |
| Contributory causes | | It was darker than expected. | | | |
| Search and rescue | | | | The search and rescue operations were quickly initiated for the collisions.<br>For the groundings, it took a long time before anyone else became aware of the distress situation. | |
| Contributory causes | | | | | Quick rescue of a person who survived the head injuries.<br>Extensive head injuries limited the possibility of rescue.<br>Lack of flotation devices led to an extensive search for one person. |

*Table 23: Illustration – common features and differences: craft jetty accidents.*

| | Context and background | Sequence of events leading up to the accident | The accident | Survivability | Consequences |
|---|---|---|---|---|---|
| The craft | Motorboats with sleeping quarters. Older than 20 years. | Boats used for spending time and overnight stays after nights out. | The boats were moored to a floating jetty. | The ladder was not used or not available. | |
| Contributory causes | | | Mooring of the boat. | The persons who fell into the water were unable to use a ladder to get out of the sea unaided. | |
| Person(s) involved | Norwegian nationals, aged 50–80. | Clear intoxication. | Fell into the water or from the jetty as they were entering the craft. | No flotation devices, except an inflatable lifejacket. | Four persons drowned. |
| Contributory causes | | | Clear intoxication severely weakened the persons' physical and cognitive skills. | The victims were unable to alert anyone of their distress.<br>The airways were not kept clear.<br>Limited possibility of taking care of themselves. | |
| The external environment | | Twilight or dark between 02:00 and 05:00 at night. | Slippery jetty and deck. | No ladder to floating jetty in immediate vicinity. | |
| Contributory causes | | Darkness. | | Limited availability of ladders nearby. | |
| Search and rescue | | | | It took more than one hour before anyone else became aware of the situation. | |
| Contributory causes | | | | No one else was aware of the distress situation. | |

*Table 24: Description of waters, wind and sea conditions for accidents where the persons involved may have become hypothermic.*

| Type | Season | Type of waters | Greatest distance to the nearest shore/island/islet [m] | Wind speed (mean) | Air temperature [°C] | Sea temperature [°C] | Wave height – significant [m] |
|---|---|---|---|---|---|---|---|
| Motor-boat | Spring | Alongside jetty | 0 | Light air (0.3–1.5 m/s) | 6 | 5 | 0.1 |
| Motor-boat | Summer | Alongside jetty | 0 | Light air (0.3–1.5 m/s) | 7 | 18 | 0 |

Accident
Investigation Board
Norway

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# REPORT Marine 2019/02

# MAPPING OF RECREATIONAL CRAFT ACCIDENTS
# PART B
# MAPPING OF HISTORICAL ACCIDENTS 2008–2017

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**TABLE OF CONTENTS**

# 1. INTRODUCTION

This sub-report forms part of the Norwegian Accident Investigation Board's (AIBN) mapping of recreational craft accidents in 2018.

It includes methods of obtaining information, as well as analyses and results from the work of mapping recreational craft accidents and other relevant incidents involving recreational craft during the 2008–2017 period.

The purpose of the sub-report was to obtain as complete and detailed a picture as possible of the scope and circumstances surrounding recreational craft accidents in Norway.

Chapter 2 concerns the data and the two main sources used by the AIBN in the investigation. Chapter 3 provides a description of methods and the assumptions and limitations that apply. Chapter 4 presents and discusses the results of the AIBN's analysis of the total data set regarding recreational craft accidents during the 2008–2017 period. In Chapter 5, uncertainties in the data set are described. These include uncertainties relating to the use of sources, methods, under-reporting of incidents etc. In light of the uncertainties described in Chapter 5, the AIBN points out that the results presented in this report must be interpreted as trends and not absolute values.

The conclusions are described in chapter 6, together with suggestions for further work.

The work is summarised in the main report. The main report also gives grounds for the mapping.

# 2. DATA

The AIBN initially identified which sources could hold relevant information about recreational craft accidents in Norway. Table 1 shows a list of the data that were evaluated and how they were further used in the mapping process.

*Table 1: List of data*

| **Sources** | | | |
|---|---|---|---|
| Main sources | Supplementary | Quality assurance / comparison | No further use made |
| - JRCC<br>- RS | - Telenor Maritime Radio<br>- JRCC log of fatal incidents<br>- Norwegian Maritime Authority (fatalities) | - TØI report from 2017<br>- Statistics from JRCC and RS<br>- Media searches | - Norwegian Red Cross<br>- Norwegian Institute of Public Health<br>- Emergency fire service in Oslo<br>- Insurance<br>- Police / Marine services |

## 2.1 Evaluation of the data

The Northern and Southern Joint Rescue Coordination Centres (JRCC-N and JRCC-S) and the Norwegian Society for Sea Rescue (RS) were deemed to be the sources with the most extensive and structured information about recreational craft accidents in Norway. This is mainly because the parties use case handling systems that not only register relevant information but also allow the application of filters to show only incidents involving recreational craft. This was not the case for parties such as insurance companies, which do register recreational craft accidents, but have relatively limited information about individual incidents, or the police, where it was only possible to look up individual cases if the identity of at least one of the people involved was known. These sources were therefore regarded as supplementary sources, but no further use was made of them in the work.

Telenor Maritime Radio also holds relevant information about recreational craft accidents, but most of these incidents were covered by the JRCC or RS, so this was used as a supplementary source. The Norwegian Maritime Authority has information about fatal recreational craft accidents, and this was used as a supplementary source.

The Institute of Transport Economics (TØI) published a report about recreational craft accidents in 2017. The objective of the report was to map the use of recreational craft in Norway, as well as safety behaviour and accident involvement. The survey was based on responses from 11,122 recreational craft owners obtained in August/September 2015, and 173 field interviews. This report was used as a reference for results comparison.

Based on the Red Cross report of incidents in 2016, they have very few marine / water-related operations each year, compared with the figures from other parties such as the JRCC and RS. Additionally, the incidents are not recorded in a central register, and it was also not possible to search only for recreational craft accidents in the existing registers. No further use was therefore made of this source in the work, but supplementary use was considered.

The port police had no more information available about the incidents than the police in general. No further use was therefore made of this source in the work.

The AIBN also contacted the Norwegian Institute of Public Health, which has previously performed work on mapping accidents and injuries in Norway. It was explained that the process of obtaining information from the health sector regarding recreational craft accidents would be extremely challenging. This is because the accidents would be recorded as recreational accidents, and it would be almost impossible to separate out accidents involving recreational craft. No further use was therefore made of this source in the work.

## 2.2 Main sources

Relevant information about recreational craft accidents from the JRCC's and RS's incident management systems was extracted and passed on to the AIBN. Information about a total of approximately 64,000 incidents was obtained from the JRCC and RS (ten-year period), and many of these incidents were the same, since both parties had been involved in them. Facts about the data sets are summarised in the following paragraphs.

It must be noted that the information stored in the JRCC's and RS's incident management systems was customised to their respective social missions. The information cannot therefore be used directly in order to generate statistics for the detailed mapping of recreational craft accidents. The AIBN has not been informed that registration procedures in the incident management systems have changed during this period, and it is therefore assumed that this has not affected the results to any significant degree.

### 2.2.1 JRCC

*Table 2: Facts about the data set – JRCC*

| Data set facts | Description | |
|---|---|---|
| Data set period | Data available for the period 2001 to present<br>The mapping work has used data from 2008 to 2017 | |
| Number of incidents | 29,035 | |
| Number of information parameters | 130 | |
| Restrictions | *Covers:*<br>Norwegian territory including Svalbard, the marine and port areas and the airspace above, which is controlled by Norway at any given time.<br>Isolated incidents outside Norwegian territory. | *Does not cover:*<br>- incidents at quay or jetty (moored vessels)<br>- incidents handled by Telenor Maritime Radio (assistance operations or other incidents that are not deemed to be emergency situations)<br>- isolated incidents on inland lakes and rivers |
| Types of incident | Primarily all search and rescue operations in which the incident is deemed to involve danger to life and health.<br>However, a large number of incidents or situations were also recorded in which it has subsequently been proved that there was never any danger to life or health (e.g. incorrect observations, false callouts). | |
| Challenges and limitations | - Parameters completed to varying degrees<br>- The parameters provide limited information about the circumstances surrounding a particular incident<br>- Some of the information is not categorised and is stated in free text<br>- No assessment of the criticality of the incidents<br>- The data do not cover all types of waters | |

The AIBN had asked the JRCC for data only relating to incidents involving recreational craft, but it was not possible for the JRCC to separate out these incidents automatically. This meant that the data set received from the JRCC contained a large number of incidents involving only commercial parties, including fishing vessels, freighters, vessels associated with the petroleum industry, and diving accidents. Almost a quarter of the incidents only involved commercial parties, and these were removed from the data.

Of the remaining data set, a further 20% of the incidents were removed as not relevant to the investigation, including incorrect observations (mainly from the shore), misuse of pyrotechnic signals, vessels that had been stolen or broken loose from their moorings.

### 2.2.2 RS

*Table 3: Facts about the data set – RS*

| Data set facts | |
|---|---|
| Data set period | Data available for the period 2005 to present<br>The mapping work has used data from 2008 to 2017 |
| Number of incidents | 35,098 |
| Number of information parameters | 103 |

| | | |
|---|---|---|
| Area restrictions | *Covers:*<br>- All coastal waters<br>- The inland lakes of Mjøsa and Femunden | *Does not cover:*<br>All other inland lakes and rivers |
| Types of incident | - Accidents with and without personal injuries, material damage<br>- Salvage operations<br>- Other assignments for members of RS<br>- Other assignments for public and private companies | |
| Challenges and limitations | - There is a great deal of relevant information in text form, which means that the categorisation of information is limited<br>- Parameters are completed to varying degrees<br>- The parameters provide limited information about the circumstances surrounding a particular incident<br>- The data do not cover all types of waters<br>- Identifying which of the operations overlap with JRCC operations | |

In the data set received from RS, there were a large number of operations registered as assistance operations. Examples of these operations are diving operations to search for lost wallets, keys etc., planned tows from port to port due to propulsion problems, assistance retrieving anchors, raising sunken vessels etc. These are not regarded as accidents and were therefore removed.

A significant number of incidents concerned assistance operations involving propulsion problems, e.g. as a result of technical problems with the engine or lack of fuel. Where there was no additional information indicating a potential for these incidents to develop into accidents, these were also removed from the data set.

# 3. METHOD, ASSUMPTIONS AND LIMITATIONS

After receiving data from the JRCC and RS, the AIBN developed a procedure to sort and extract relevant accidents/incidents and relevant information. The following main tasks were performed:

- Defining relevant incidents, and identifying incidents not relevant to the investigation of recreational craft accidents and removing these from the data set

- Defining relevant information parameters, and identifying parameters not relevant to the investigation and removing these from the data set

- Connecting the two data sets

- Categorising relevant incidents and other significant information

## 3.1 Definition of relevant incidents

The objective of the mapping work is to establish a better factual basis about the scope and circumstances surrounding recreational craft accidents. A definition of recreational craft accidents based on the Norwegian Maritime Code’s definition of marine accidents, cf. Section 472 a fourth paragraph, includes incidents involving recreational craft that result in significant injuries or damage to material assets or the environment. If the consequences are serious or very serious, marine recreational craft accidents are classified accordingly.

However, the review of the data revealed that a large number of the reported incidents cannot be regarded as marine accidents in the sense of the law, since they did not result in significant injury or damage. In addition, a number of incidents were registered in which a certain risk of injury or damage such as grounding was present in the sequence of events, but which did not result in any noteworthy injury or damage being recorded. A significant number of incidents were also recorded that had no consequences in terms of injury or damage and in themselves cannot be regarded as dangerous, but which because of the circumstances still involve a risk of serious consequences.

In order to gain a better understanding of the scope of such incidents, the risks and to some extent the causes involved, the AIBN decided that incidents resulting in injury or damage and incidents involving risk should be included in the mapping process. This means that all incidents with a potential for negative consequences are included in the definition of recreational craft accidents in this mapping

Relevant recreational craft incidents are therefore:

1) incidents resulting in injury or damage, regardless of the scope,

2) incidents with a high injury or damage potential, for which no injury or damage was recorded,[1] and

3) incidents that in themselves are not regarded as dangerous, but where special circumstances applied that could have involved a significant risk of injury or damage, which did not materialise.[2]

## 3.2 Parameters

Both data sets contained a large number of information parameters that could be used when registering the incident. These were completed insofar as the information was necessary in order to perform the rescue or assistance operation as well as possible.

Most of these parameters are not relevant for this mapping process, however. This applies to information that was only recorded exceptionally, but was not included in most cases (e.g. details about sea conditions such as sea temperature or current direction and strength, or communication details such as frequency and modulation), and details that were provided in most cases (such as departure and destination locations), but that could not be used for statistical analyses.

Only information parameters providing general information about the circumstances surrounding the recreational craft accidents were considered in the mapping process. These parameters are based both on original parameters in the data sets, and also on new parameters that were established in order to categorise and refine the information provided in the free text. Information about the parameters was only provided where this was available. The main parameters defined were as follows:

[1] Includes all types of incidents apart from propulsion loss and other/unknown
[2] Includes propulsion loss and other/unknown incident types

*Table 4: Description of information parameters*

| Information parameters | Description of parameters |
|---|---|
| Date and time | Date and time were provided for all incidents recorded by the JRCC and RS.<br>However, it is not the time of the incident that is provided, but the earliest recorded report of the incident. This forms the basis for determining whether the incident occurred during the day or night, since most of the incidents were reported shortly after they occurred. However, it must be pointed out that there may be some discrepancy between the time of the incident and the time it was reported (e.g. where an incident was registered as a result of concerns reported by next of kin), without there being a sufficient basis for differentiating these incidents. |
| Place | Municipality and county where the incident occurred. The exact position was stated in coordinates for only 75% of the incidents. The information about county and municipality also tended to be based on the RS station that was the starting point of the operation. |
| Incidents (I1, I2, I3) | The incidents are categorised by type of accident.<br>The following categories were defined: fire, grounding, propulsion loss, collision, contact damage, person overboard, capsizing/foundering, water ingress, personal injury, fall at quay or jetty and other/unknown. One incident could occur as the result of another incident, and it was therefore decided to establish multiple incident categories – I1, I2 and I3 – where I1 is the first incident to occur, I2 is the second etc. Multiple incidents will only be recorded if the data set contained this information. For a more detailed description of incident types, please see section 3.4.1. |
| Consequence | Consequences include personal injuries and material damage. However, it must be noted that the available information about the scope of injury or damage is very incomplete. For a more detailed description of consequences, please see section 3.4.2. |
| Causal factors | An attempt was made to categorise causal factors on the basis of information in the original causal categories provided by the JRCC and RS, and from the free text, but these were very incomplete. For a more detailed description of causal factors, please see section 3.4.3. |
| Risk factor | When reviewing the incidents, it was discovered that several of the incidents – including serious, less serious and essentially non-hazardous incidents – typically involved risk factors that may have affected the outcome of the incident, but that could also have contributed to a different outcome. This will be discussed further in section 4. Please also see section 3.4.4 for a more detailed description of risk factors. |
| Type of craft | This parameter specifies the type of craft involved. Seven types of craft as well as other/unknown were identified. Since there were limited details about the type of craft within a main category, it was not possible to further categorise types of craft. For a more detailed description of types of craft, please see section 3.4.5. |
| Time of day | Day (06:00–23:59) or night (00:00–05:59) based on time of notification. |

The classification of incidents and the various categories will be discussed further in section 3.4.

## 3.3 Connecting data sets

The objective of collecting historical data was to establish as complete an overview as possible of the extent of recreational craft accidents in the last 10 years. However, it was not possible to automatically connect the data sets provided by the JRCC and RS, because both parties had been involved in many of the same recorded incidents.

In order to ensure that the complete overview was as accurate as possible, it was necessary to identify duplicate incidents (i.e. incidents that had been recorded by both the JRCC and RS) and combine these.

### 3.3.1 Identification

A major challenge in connecting the data sets was that only a relatively small number of the duplicates contained the respective JRCC and RS reference numbers. These are rarely used in an ongoing rescue or assistance operation, where the accident location and incident type are more suitable references.

As a consequence of this, an attempt was made to map identical incidents through an overall assessment of the location, time and incident type. Information about the type of craft or number of people involved was also used as a supplement to ensure quality, where this information was available.

### 3.3.2 Limitations

The data sets do not state when the incident took place, only when it was first reported to the JRCC and RS, respectively. In addition, the notification was normally not made to both parties at the same time, but only to one of them. If the situation is deemed to be an emergency situation, the first notification tends to be to the JRCC, which then involves RS in the operation if it considers this appropriate. Similarly, if a situation requires assistance and is therefore first notified to RS, but then develops into a more dramatic situation, the JRCC may be notified later. Consequently, it is not uncommon for the same incident to be registered with somewhat different notification times.

When a notified incident is registered, the type of incident must be identified, and this is used to evaluate what kind of assistance should be provided. The first registration is not necessarily complete or even correct; it may be made by an external party who does not have a full overview of what has happened, or the notification may be incomplete since those involved may be focused on handling the situation on board or have limited means of communication. As a consequence of this, it is not uncommon for the same incident to be registered with different incident types.

For all incidents, the location of where they occurred is recorded, so that assistance may arrive as quickly as possible. However, it cannot always be assumed that the exact position is known, and it may also change over time, which means that different positions are recorded for different notification times. Positions at sea may also be described in different ways. It is equally common to use coordinates for a position as to describe it on the basis of distance and direction to the nearest landmark, particularly by people who know the area. It is therefore not uncommon for the same incident to be reported with different positions.

Less information was registered for less serious incidents. It may therefore be assumed that the lower the severity of the incident, the higher the likelihood that a possible duplication has not been identified.

## 3.4 Categorisation

As previously described, the information received was limited in the form of little categorisation, a great deal of free text and partly contradictory information in the two data sets. The data set was also made up both of accidents and purely assistance operations, as well as other incidents that were not relevant to the mapping work. The incidents were sorted and some were removed. As part of this work, a number of assumptions were made concerning several factors, including cause, sequence of events and consequences. This was in order to achieve a data set consisting of recreational craft accidents and incidents that were considered to have the potential to develop into accidents.

In order to achieve a better understanding of relevant situations and circumstances, significant incident types and other important information were identified and defined in more detail. The available information was then categorised according to these definitions.

### 3.4.1 Incident types

#### 3.4.1.1 *Identification*

Ten incident categories were defined, in addition to other/unknown. Several of the categories are based on categories in the original data from the JRCC and RS, but some additional categories have been added in order to further refine incident types. A description of the incident categories and the evaluations made in order to categorise incidents are provided in Table 5.

As described in section 3.1, relevant incidents, irrespective of the consequences in terms of injury or damage, were divided into two groups, namely hazardous incidents and incidents that may involve risk under certain circumstances.

Elements in the sequence of events that involve a risk of injury or damage and that thereby mean that the incident is categorised as hazardous are defined as: fire, fall at quay or jetty, grounding, capsizing/foundering, collision, contact damage, person overboard, personal injury and water ingress. Incidents that in themselves are not considered hazardous, but that may be so or at least involve some risk under certain circumstances, constitute a significant proportion of the reported incidents. These mainly concern propulsion loss, as well as a variety of incidents included under the category other/unknown.

A review of the data sets identified a maximum of two separate incidents that formed the basis for a sequence of events. In most of the other cases, there is a connection between the first and the second incident type, e.g. grounding resulting in capsizing/foundering. After the data sets were connected, a few of the incidents had a sequence of events consisting of three separate incidents (approximately 1% of the accidents). Only 12% of the accidents were registered as two separate incidents, while the majority could be categorised as a single incident.

*Table 5: Description of main categories*

| **Parameter – Incident** | |
|---|---|
| Category | Description of category/incidents included |
| Hazardous incident | |
| Fire | - Fire, including incidents in which there was considerable smoke development and indications that a fire could have occurred.<br>- Not all incidents originally registered as fires were deemed to be fires by the AIBN; some of these turned out to be overheated engines and some involved smoke development. These incidents were defined as propulsion loss with the risk factor 'smoke development'. |
| Fall at quay or jetty[3] | - These are incidents in which people have fallen into the water either while boarding or leaving the craft at quay. |
| Grounding | - Vessels grounded on islets, skerries, shallows and land. |
| Capsizing/ foundering | - Incidents in which the craft has capsized or foundered. Since it is not always apparent from the data set whether the incident concerned capsizing or foundering, these two incident types were merged. |
| Collision | - An incident was categorised as a collision if there was a collision between two vessels. The data sets from both the JRCC and RS contain incidents categorised as collisions involving grounding or contact damage, and these incidents were changed to grounding and contact damage, respectively. Grounding and contact damage are defined as separate categories. |
| Contact damage | - Incidents in which the craft has hit something in the water, a marker, objects floating in the water, or the quay. In a few cases, the craft may also have become entangled in something (rope, net etc.), but this usually tends to be classified as propulsion loss. |
| Person overboard | - These are incidents in which there is information that one or more persons have ended up in the water, irrespective of cause (i.e. this does not only apply to falls into the water). |
| Personal injury | - These are incidents in which a personal injury has occurred on board, without involving damage to the craft. |
| Water ingress | - Incidents in which the cause was simply stated as leaks were considered to be water ingress by the AIBN (with assumed risk potential), if it was not explicitly stated that the leak was small. |
| Incidents involving risk | Provided that special circumstances that qualify as risk factors were registered |
| Propulsion loss | - The operator does not have (full) control of propulsion, which could affect both the speed of propulsion (and thereby also the steering) or only the steering, i.e. if the craft has no/limited propulsion and/or no/reduced control of the steering.<br>- The cause is usually that the engine will not start (including lack of fuel/power or technical problems), or problems with the rudder, but could also be a broken mast, lost oars or problems with the anchor. |

[3] Registered quayside falls come mainly from the Norwegian Maritime Authority's database of fatalities. This is because falls from a quay tend not to trigger rescue operations involving the JRCC and RS.

| | |
|---|---|
| | - The consequence of propulsion loss is usually drifting. Because of this, drifting with persons on board is not recorded as a separate incident type, but is included in the propulsion loss category.<br>- Minor leaks in the engine resulting in propulsion loss, where it was explicitly stated that assistance was required, were categorised as propulsion loss and not water ingress.<br>- Incidents involving limited smoke development, but which did not give any indication that a fire broke out. |
| Other/unknown | - Covers any kind of assistance not included in one of the other incident categories (e.g. incorrect navigation and uncertainty of position, searches as a result of notifications of concern from next of kin due simply to failure of the operator to return home on time, or assistance required as a consequence of poor weather conditions)<br>- Incidents in which it is not known what happened (in several cases, an I2 incident was categorised as a person overboard incident, but it was not certain what incident I1 had been, e.g. grounding, capsizing etc.)<br>- In themselves, incidents categorised as other/unknown were not deemed hazardous unless injury or damage occurred |

#### 3.4.1.2 *Limitations*

Information about the circumstances surrounding recreational craft accidents did not tend to be categorised in detail, which meant that much of the work involved manually reviewing incidents and evaluating whether the incidents were relevant to the work of mapping recreational craft accidents, and identifying the incident type. This categorisation is therefore based on the categorisation and designations used by the JRCC and RS, but also largely on the information provided in the free text.

In this context, it is important to point out that the JRCC's and RS's main purpose of registering the information was to organise the rescue or assistance operation as well as possible. Time is a critical factor, and the information available about the incident usually tends to be limited and sometimes incorrect. At the same time, there was no need to supplement or correct the registered information after the operation was completed.

For example, a grounding with subsequent propulsion loss but with no hull damage would not necessarily be registered as a grounding, because what was relevant is that the vessel needed assistance due to lack of propulsion.

It is most likely that a great many more incidents occurred than those presented in this data set. For example, it is unlikely that all groundings will be reported to the emergency services, particularly when the vessel frees itself or is assisted by other vessels in the vicinity.

In the majority of cases, the identified incident type will be correct, while greater uncertainty is associated with lack of identification of incidents as subsequent or prior (I2 and I3). If there was uncertainty regarding whether an incident was the initial or a subsequent incident, there was no speculation on the probable sequence of events. The incident was registered on the basis of what was clearly stated in the data.

With respect to incidents involving risk, there was some limitation in terms of identifying risk factors; for more information, see section 3.4.4.2. As a consequence of this, it must be noted that there is a relatively high level of uncertainty regarding the scope of incidents involving risk.

### 3.4.2 Consequences

#### 3.4.2.1 *Identification*

The basic premise is that the scope of injuries or damage is a major factor in categorising the severity of the incident. It was decided to divide any injuries or damage into three degrees of severity, namely very serious, serious and less serious.

Very serious consequences are fatalities or, on the material side, foundering or total loss of the vessel. Serious consequences are major personal injuries (hospitalisation, long period of recuperation, permanent injuries) and for the craft, major structural damage such as hull damage with water ingress. All other injuries or damage are considered less serious.

#### 3.4.2.2 *Limitations*

As previously mentioned, data are entered into the JRCC’s and RS’s incident management systems, customised to their respective social missions, and in many cases contain limited information about the consequences of an incident, both for people and the craft involved.

In most cases, there was no information about either material damage or personal injuries, unless this was information essential to the organisation of the search and rescue operation (e.g. the craft has capsized and foundered, or a person has died). This means that the fact that no information is registered about damage or injuries cannot be interpreted to mean that no damage or injury occurred.

In summary, one can be certain that, as a rule, extremely serious consequences (death/foundering) are recorded, while information about serious injuries or damage are not necessarily recorded, and information about minor damage or injuries may only be recorded exceptionally.

### 3.4.3 Causal factors

#### 3.4.3.1 *Identification*

Both data sets contain relatively unspecified information about potential causal effects. Wherever possible, this was supplemented with information from the free text field in order to eliminate incomplete and inconsistent data as much as possible. However, no analyses were performed to determine causality or confirm typical causal factors for the individual incident types.

A description of the most important causal categories and the evaluations made in order to categorise incidents are provided in Table 6.

*Table 6: Description of causal categories*

| **Parameter – Cause** | |
|---|---|
| Category | Description of category/incidents included |
| Technical | - Unspecified, but technical cause<br>- Related incidents are mainly propulsion loss, but also fire |
| Fuel | - Out of fuel (diesel/petrol) for various reasons (not including lack of fuel due to faulty gauge)<br>- Refuelling with wrong fuel (e.g. diesel in the petrol tank)<br>- Related incidents are mainly propulsion loss |
| Tullepassord8Power | - No power (not included if due to technical problems, uncertain causal factor, or when starting assistance was unsuccessful)<br>- Related incidents are mainly propulsion loss |
| Filters | - Clogged filters, mainly due to lack of maintenance<br>- Related incidents are mainly propulsion loss |
| Rope in propeller | - Rope, net, chain, plastic or other object stuck in the propeller without the operator having the opportunity or means of fixing it themselves<br>- Related incidents are mainly propulsion loss |
| Mast/sail/oars | - Includes broken masts, lost oars or torn sail<br>- Related incidents are mainly propulsion loss |
| Leaks | - Leaks describe major water ingress into the engine compartment as a consequence of technical problems / engine problems<br>- Minor leaks that stopped as soon as the engine was turned off and where the main incident was propulsion loss were only regarded as risk factors (while the cause of the incident is technical)<br>- Related incidents are mainly water ingress |
| Incorrect navigation | - The person concerned has got lost, does not know or is uncertain of their position, and needs assistance in order to get home |
| Weather conditions | - Extreme weather conditions where the related incident mainly involved the operator needing help with manoeuvring or getting into port because of the weather<br>- When the weather was explicitly stated as the cause, and no other cause was obvious, poor weather conditions were also deemed a risk factor |

#### 3.4.3.2 *Limitations*

The data set contains only limited information about potential causal effects.

The information from the data set was most specific for incidents in which it was important to understand the cause in order to provide adequate assistance. This mainly applied to propulsion loss, where with the right preparations it is often possible to resolve the problem on site (provide fuel, charge battery, replace filter, cut rope away from propeller).

For more serious incidents, however, the information is somewhat more diffuse (technical causes of fire, or leaks that result in water ingress), and the risk factors that could have contributed to the accident were often not known or not registered.

Information about causal factors is therefore not to be regarded as a complete clarification of causal factors and causalities. A maximum of one causal factor per incident was recorded, but most often the cause was unknown.

### 3.4.4 Risk factors

#### 3.4.4.1 *Identification*

When reviewing the incidents, it was observed that several of the incidents, including serious and less serious incidents, typically involved risk factors that may have affected the outcome of the incident, but that also could have contributed to a different outcome. It is not certain how these factors have affected or could have affected the outcome of the incident. Nevertheless, it was decided to register and include the risk factors in order to provide more information about the circumstances surrounding an incident. Note that risk factors are only stated where these were available in free text or provided in some other way, but that does not mean that these were not present in other incidents.

The risk factors have been summarised under the following categories:

- External circumstances: Weather, sea or visibility conditions.
- Craft: Risk factors associated with the recreational craft’s condition or equipment. Examples include inadequate navigation or communication equipment, lack of navigation lights, but also overloading / incorrect weight distribution on the craft or minor leaks in the engine compartment (which do not qualify as water ingress).
- Position: The operator does not have full control of propulsion and the craft is drifting towards land or in a trafficked fairway, or the operator is uncertain of their own position, irrespective of whether propulsion is limited.
- Human factors: The operator’s ability to operate the craft under the prevailing conditions is limited. This could be temporarily as a consequence of illness or other medical condition, or because the operator lacks the skills and/or experience, but also conditions involving particular risk, such as consumption of intoxicating substances and/or travelling at high speed.
- Potential human factors: Do not in themselves involve risk, but for (fishing) tourists, there is a certain possibility that local knowledge is limited. If the craft is rented, the operator will probably not be particularly familiar with the craft involved.
- Qualifying circumstances: Various factors such as young children on board or unavailability of lifejackets, but also factors indicating that a hazardous situation has already developed, including smoke development on board (which does not qualify as fire) or the operator having signalled a distress.

#### 3.4.4.2 *Limitations*

It is important to note that neither the JRCC nor RS has ensured that risk factors are recorded, but it is practical to record significant factors such as weather data or other factors relevant to the operation in a separate column, usually in a free text field.

The probability that relevant factors were recorded depends on how important it is to possess and pass on knowledge about the factor during the rescue mission or operation, and how much time the person recording the information has.

The range of risk factors is also based on a discretionary evaluation of the data available. Several factors were identified as potentially relevant, but there was no data available to make further use of them.

Furthermore, some of the risk factors are defined objectively, including weather, in which wind, temperature, wave height etc. are measurable, while other risk factors are more subjective. This applies particularly to subjective factors that are recorded as, for example, 'lack of experience'. In the main, we have no information about the age of the persons involved and their formal or actual skills as boat operators. In the free text, however, there were a number of indications based on an assessment of the person recording the information.

This means that there is a high degree of uncertainty regarding the indication of risk factors in the data, and thus to the extent of incidents in which such risk factors were stated.

### 3.4.5 Types of craft and sizes

#### 3.4.5.1 *Identification*

Eight categories of craft were defined, and their size was specified in more detail. The division of size and type categories is based on received information about types of craft in the original database.

The following categories were used:

- Board (sailboard, paddle board and kiteboard)
- Dinghy
- Kayak/canoe
- Motorboat
- Sailing boat
- Personal watercraft
- Rowing boat
- Other/unknown

Craft placed in the 'dinghy' category are specifically described as dinghies in the JRCC/RS data set or in the free text description. A dinghy is typically a small open boat, usually 6–12 feet, that is motorised. This actually brings these craft under the category of motorboat 0–26.2 feet, but a separate category was retained because of their size.

Incidents involving craft placed in the 'other/unknown' category are mostly not specified, either by the JRCC or RS, nor is information available from the description in the free text field. This category also includes a small number of craft that do not fit into the other categories, such as rafts or houseboats.

The following size categories were applied:

- 0–8 metres (0–26.2 feet)
- 8–9.99 metres (26.2–32.8 feet)
- 10–14.99 metres (32.8–49.2 feet)
- 15–23.99 metres (49.2–78.7 feet)
- 24–27.99 metres (78.7–91.8 feet)
- Over 28 metres (over 91.9 feet)

3.4.5.2 *Limitations*

There is some uncertainty relating to the stated type of craft. This is because information about the craft is not necessarily relevant to the rescue operation. A number of incidents were also, for example, initially reported by observers who did not have exact information about the craft. When the JRCC and RS were both involved in an incident, there was sometimes conflicting information about the craft. As a general rule, the category chosen was the one registered by the party most closely involved in the incident.

# 4. RESULTS AND DISCUSSION

## 4.1 Introduction

This chapter presents the results from the data set compiled about recreational craft accidents that occurred during the 2008–2017 period. The results are discussed in relation to relevant results from sources such as the Norwegian Boating Survey,[4] conducted in 2011 and 2017.

The Norwegian Boating Survey provides an estimate of the number of recreational craft in Norway. Since there is no compulsory small craft register in Norway, there are no exact figures available for the number of recreational craft in Norway, nor is there a breakdown by geographic area over a ten-year period. It is on this basis that no normalisation was carried out of the number of craft by, for example, county or region. Variations from one geographic location to another in the number of incidents presented could therefore be closely related to the number of craft in an area. The results are stated in absolute figures.

## 4.2 Overall results

4.2.1 <u>Development in the number of accidents</u>

The number of recreational craft accidents per year for the 2008–2017 period is shown in Figure 1. Figure 1 shows an increasing trend in the number of recreational craft accidents, particularly since the year 2012.

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[4] The Royal Norwegian Boating Federation (KNBF), 'Norwegian Boating Survey 2018 – Recreational boating in Norway', 25 January 2018.

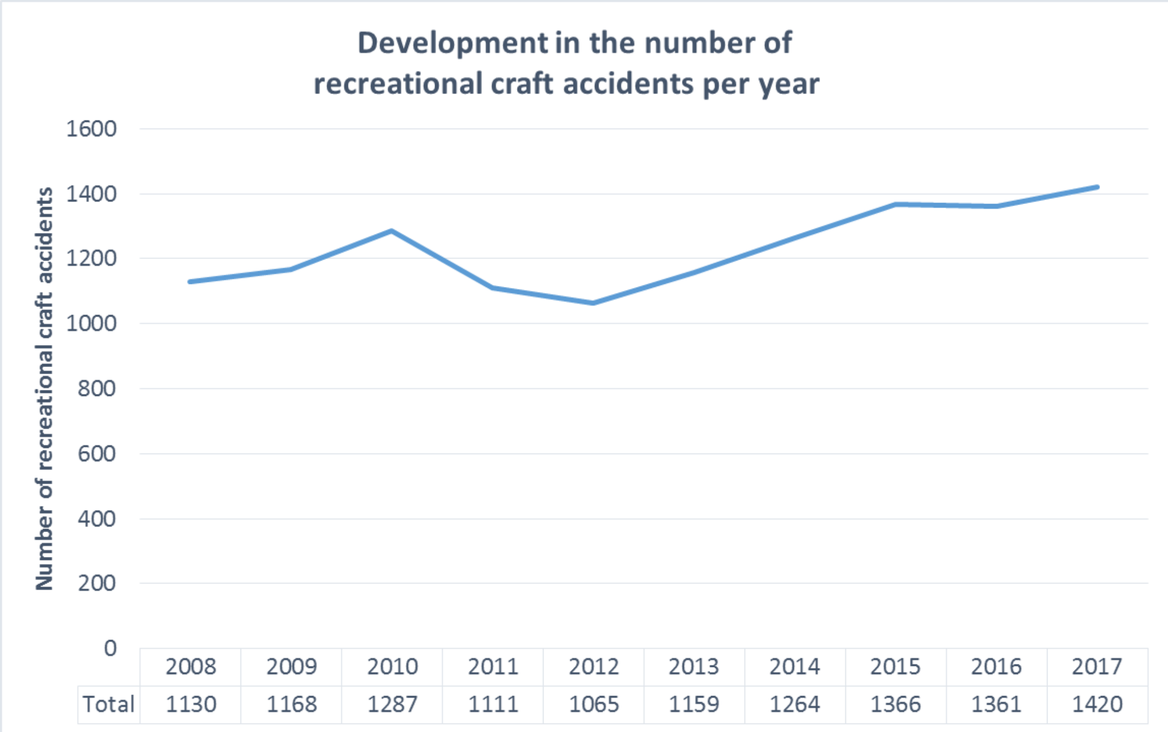



*Figure 1: Development in the number of recreational craft accidents per year*

Figure 2 shows the development in the number of recreational craft accidents in Norway from 2008–2017, by accident type.

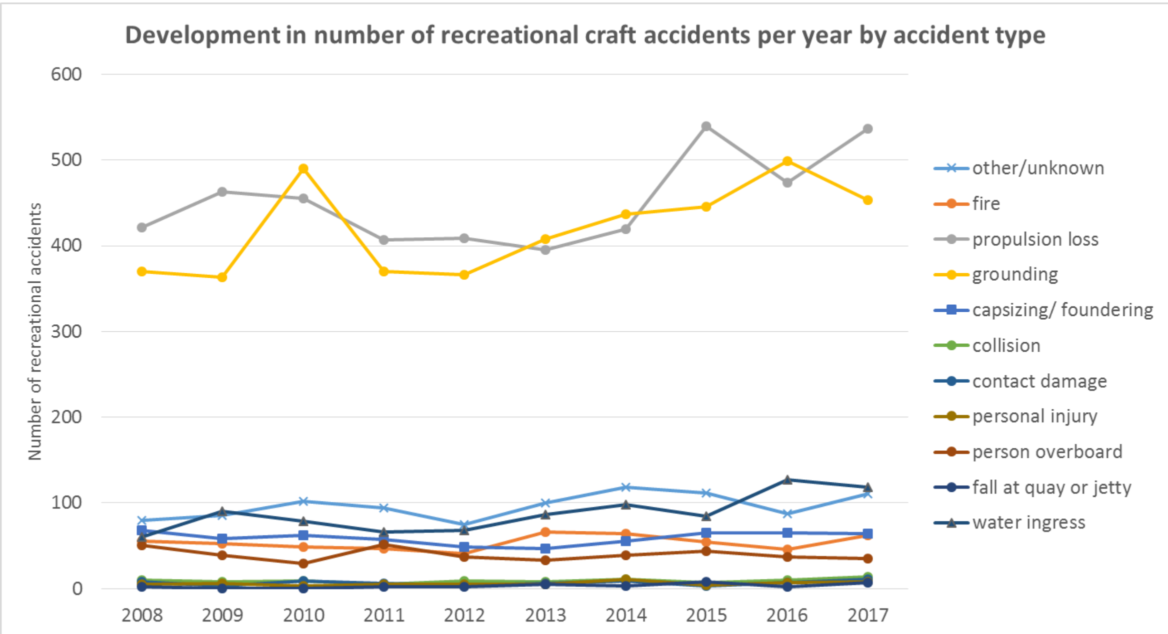



*Figure 2: Number of recreational craft accidents in Norway by accident type 2008–2017*

The results show the following trends:

- The average number of registered recreational craft accidents/incidents per year in the 2008–2017 period was approximately 1,200. Figure 1 shows an increasing trend.

- Propulsion loss and groundings are recorded as the most frequently occurring accident types, with an average of approximately 450 and 420 accidents, respectively, per year; see Figure 2.

- Water ingress, capsizing/foundering, fire and person overboard accidents have an average frequency of approximately 40–90 per year, depending on accident type.

- The least frequent accident types are collisions, contact damage and personal injuries, with an average of approximately 6–9 incidents per year.

- There is also an average of approximately 100 incidents per year for which there is no information about the accident type.

- The total increase in the number of recreational craft accidents can mainly be related to the increase in the number of propulsion loss incidents and groundings; see Figure 2.

Figure 3 shows the development in the number of recreational craft accidents by type of craft. The results show that motorboats dominate the accident statistics, followed by sailing boats. The results show an increasing trend in the number of accidents involving motorboats.

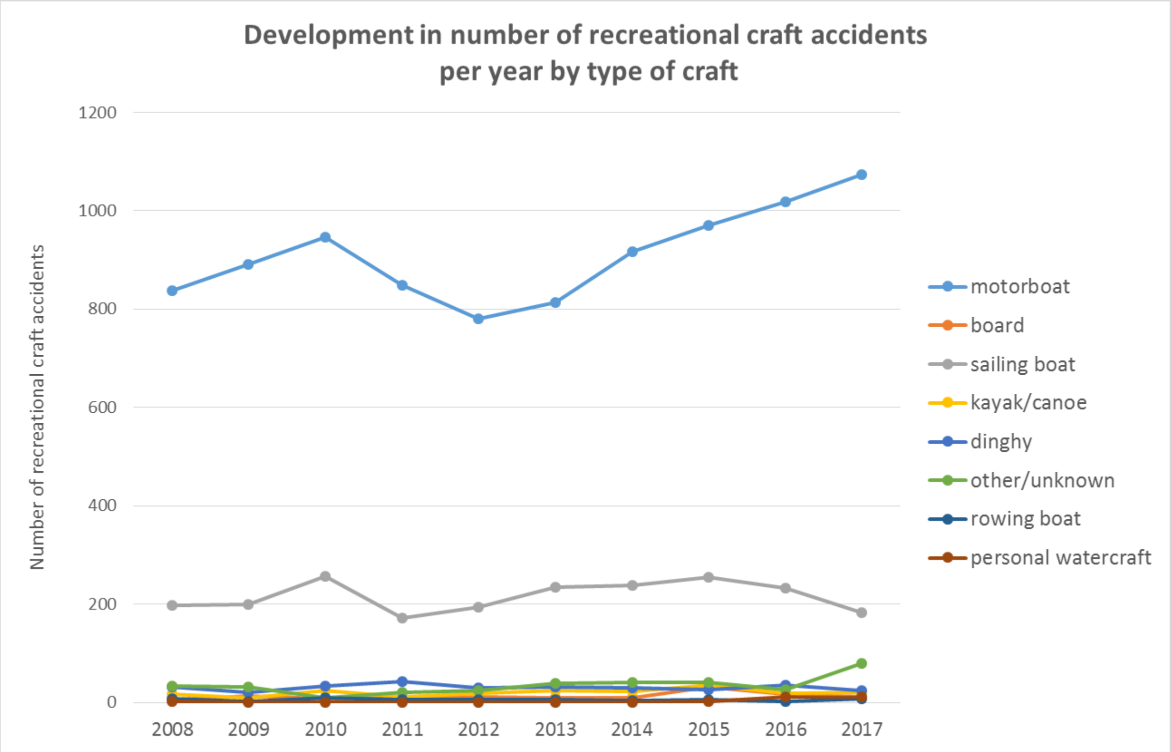



*Figure 3: Number of recreational craft accidents by type of craft, 2008–2017*

### 4.2.2 Breakdown day/night

Figure 4 shows the breakdown of recreational craft accidents by day and night. The results show that most accidents occur during the day, which is to be expected as recreational craft are mostly used during the day. The figure shows an increase in the number of recreational craft accidents during the day, while there is a constant trend in the number of recreational craft accidents at night. The results of each accident type are discussed in more detail in section 4.3.

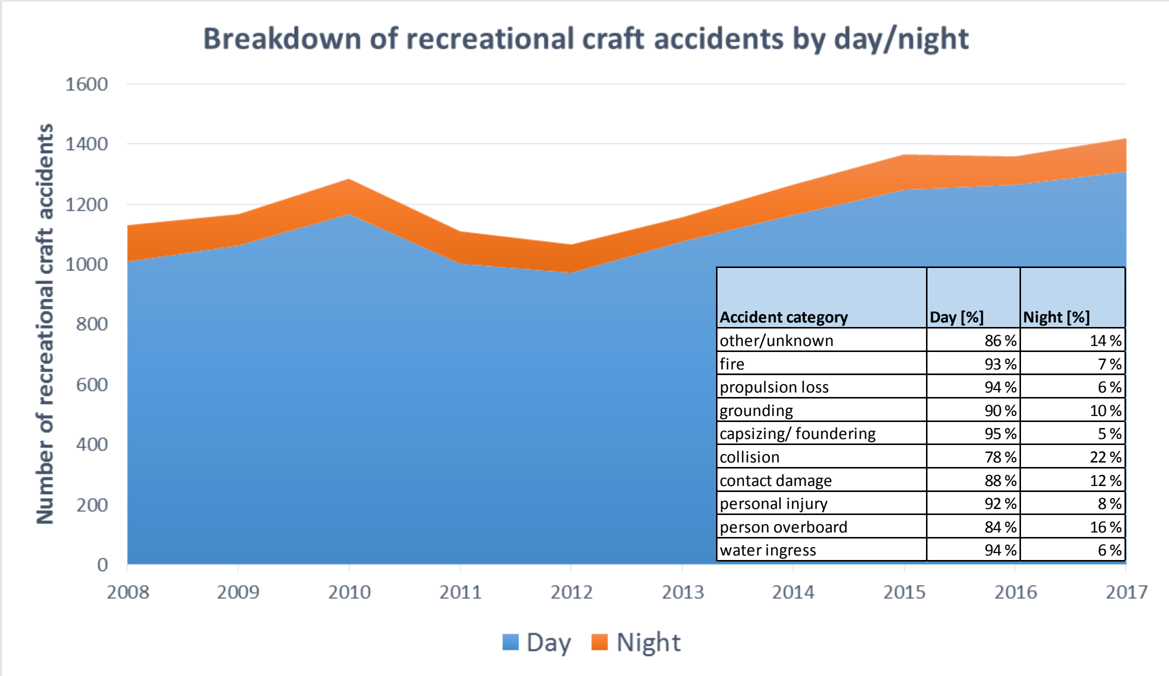



*Figure 4: Breakdown of recreational craft accidents day/night*[5]

Figure 5 shows the breakdown of accident types by day and night. The figure shows that, out of the various accident types, it is collisions, person overboard accident and contact damage that occur most frequently at night. There are also several incidents in the other/unknown category that occur at night.

[5] Falls at quay or jetty are not included, since we do not have reliable information about the time of these incidents.

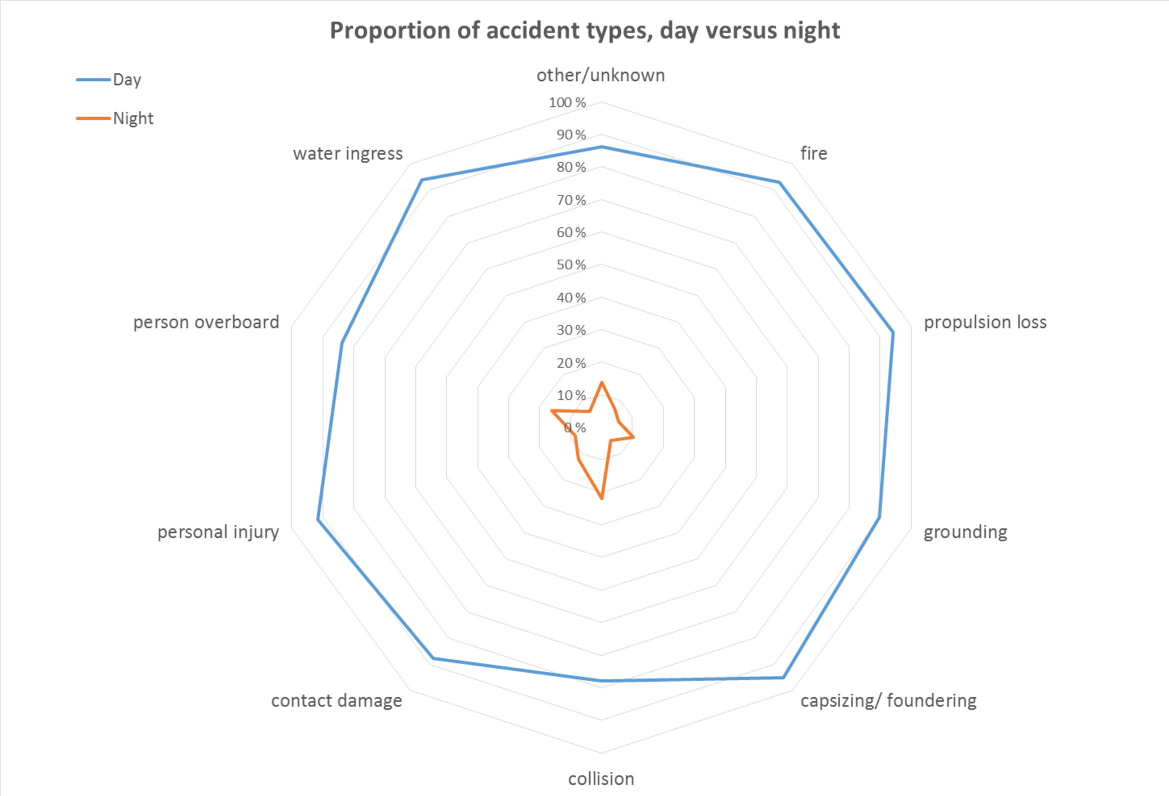



*Figure 5: Breakdown of accident types by day versus night*[6]

Figure 6 also shows that the proportion of groundings, collisions and person overboard accidents is somewhat higher at night than at other times of the day.

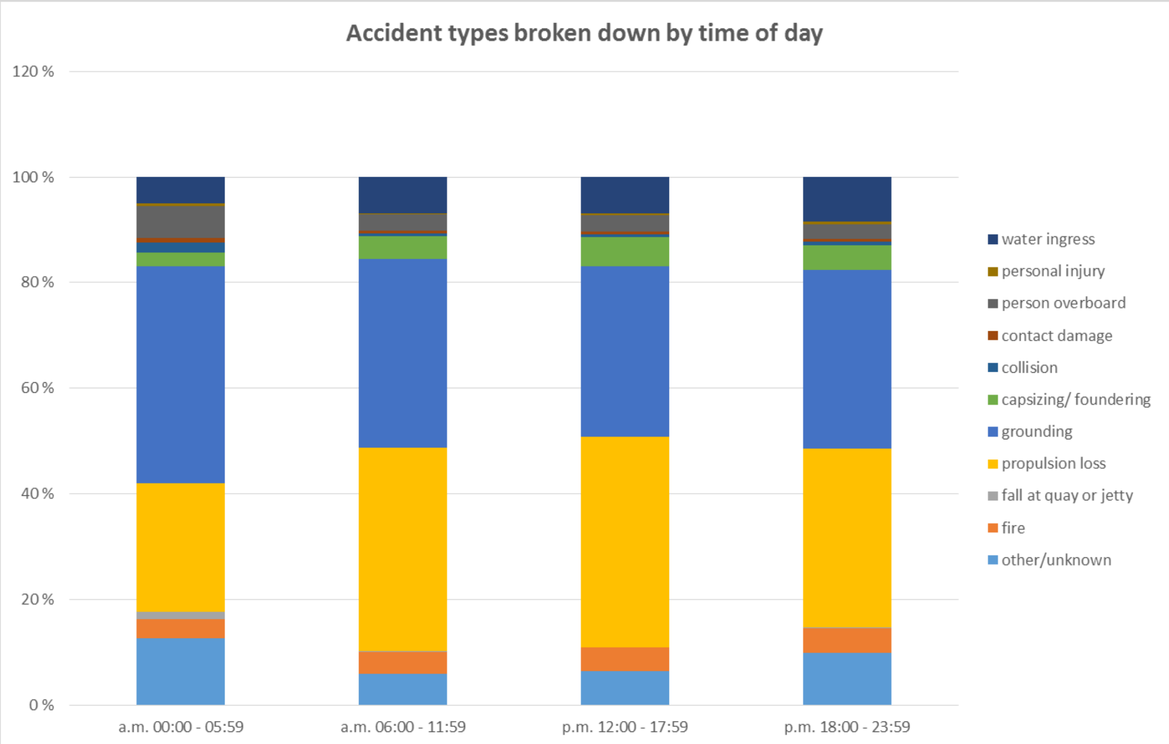



*Figure 6: Breakdown of accident types by time of day*

[6] Falls at quay or jetty are not included, since we do not have reliable information about the time of these incidents.

### 4.2.3 Breakdown by season

The results show that most incidents take place in the summer season, from June to August; see Figure 7. This is to be expected, since recreational craft are used more frequently during the mildest period of the year in Norway. Around half of the recreational craft accidents in the summer months occur in July.

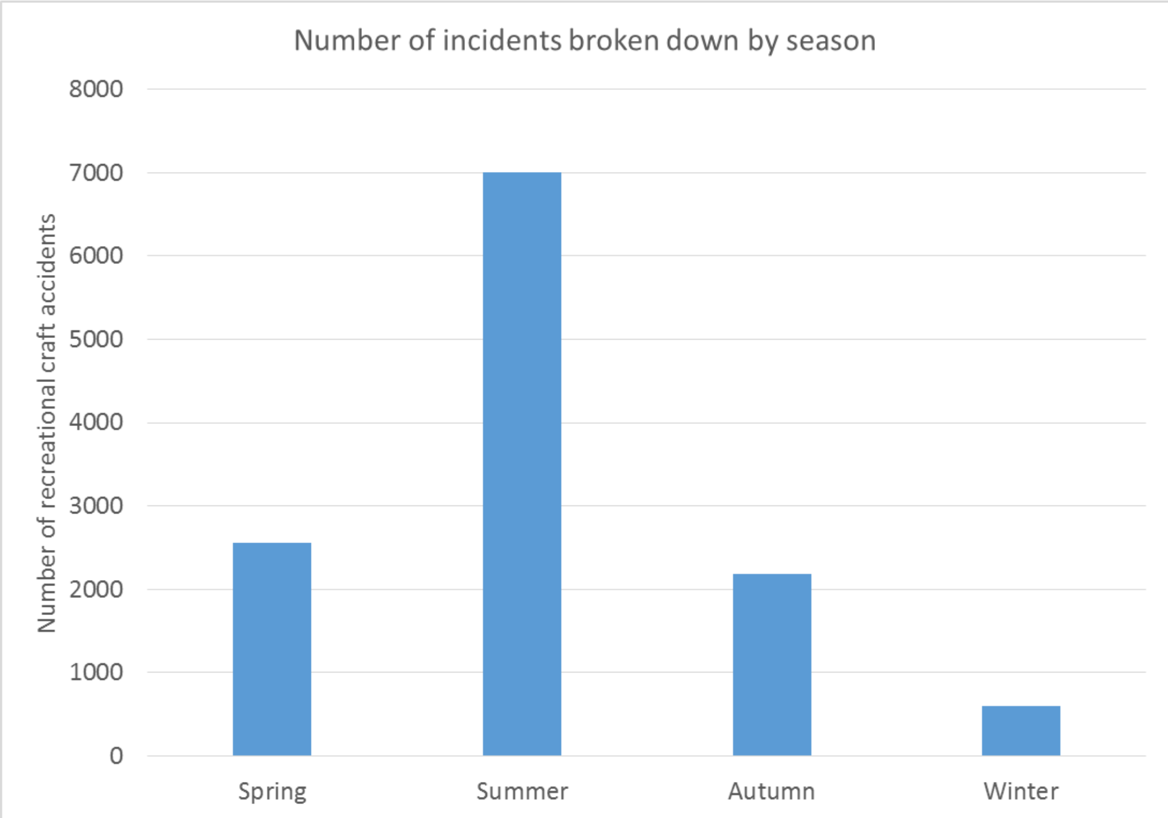



*Figure 7: Number of incidents broken down by season, 2008–2017*

## 4.3 Accidents by accident type

### 4.3.1 General

Ten different accident types were defined in this mapping work, in addition to the category ‘other/unknown’. In the following sections, the results of the various accident types are presented and discussed. For each accident type, the trend over a ten-year period will be illustrated and the causes described, if these are recorded in the data. Additionally, for each accident type, factors will be presented that could have been significant to the incident. The results presented for the various factors will be uncertain, since this is information stated as free text in the data, which means that there could be a high level of under-reporting of such factors. Nevertheless, these results have been included in order to shed light on relevant recurring factors that were present in the various incidents.

## 4.3.2 Propulsion loss

### 4.3.2.1 *Results*

An average of 452 recreational craft accidents involving propulsion loss were reported each year. This represents 37% of the total number of recreational craft accidents in Norway per year. The development in the number of propulsion loss incidents shows an increasing trend, particularly in recent years; see Figure 8. In approximately 6% of the incidents, it was reported that the craft had run aground because of propulsion loss.


| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|
| Total | 421 | 463 | 455 | 407 | 409 | 395 | 419 | 539 | 474 | 537 |

*Figure 8: Development in the number of recreational craft accidents – propulsion loss*

The causes of propulsion loss are uncertain, but technical problems were recorded as the cause for approximately 80% of the incidents. It was also reported that around 5% of the incidents involving propulsion loss were due to rope in the propeller or lack of fuel. Other causes recorded are filter problems, leaks, problems with the mast/sail/oars, no power, anchor problems or challenging weather conditions.

The incidents in the data set involving propulsion loss are incidents that were considered to involve a risk of injury to persons and/or damage to the craft, or which resulted in such injury or damage. This means that for many of these incidents, information was provided that was deemed to be potentially significant to the outcome of the incident, while no injury or damage was recorded. The results show that around 75% of the incidents involved challenging weather conditions falling under the category ‘external conditions’. The remaining incidents involved human factors, position and potential human factors. An incident could involve none, one or several of these factors.

### 4.3.2.2 *Discussion*

An incident involving propulsion loss is not necessarily hazardous in itself, but losing propulsion can quickly lead to a critical situation if other factors are present. For example, these could be difficult weather conditions in which the craft drifts uncontrolledly towards shallows and skerries, drifting towards trafficked fairways, or difficult wave conditions resulting in severe loads on the craft and in the worst case capsizing.

### 4.3.3 Grounding

#### 4.3.3.1 *Results*

An average of 420 recreational craft accidents involving grounding were reported each year. This represents 34% of the total number of recreational craft accidents in Norway per year. The development in the number of groundings shows an increasing trend, particularly in recent years; see Figure 9. Approximately 6% of the groundings resulted in subsequent water ingress into the craft, and 9% resulted in propulsion loss.

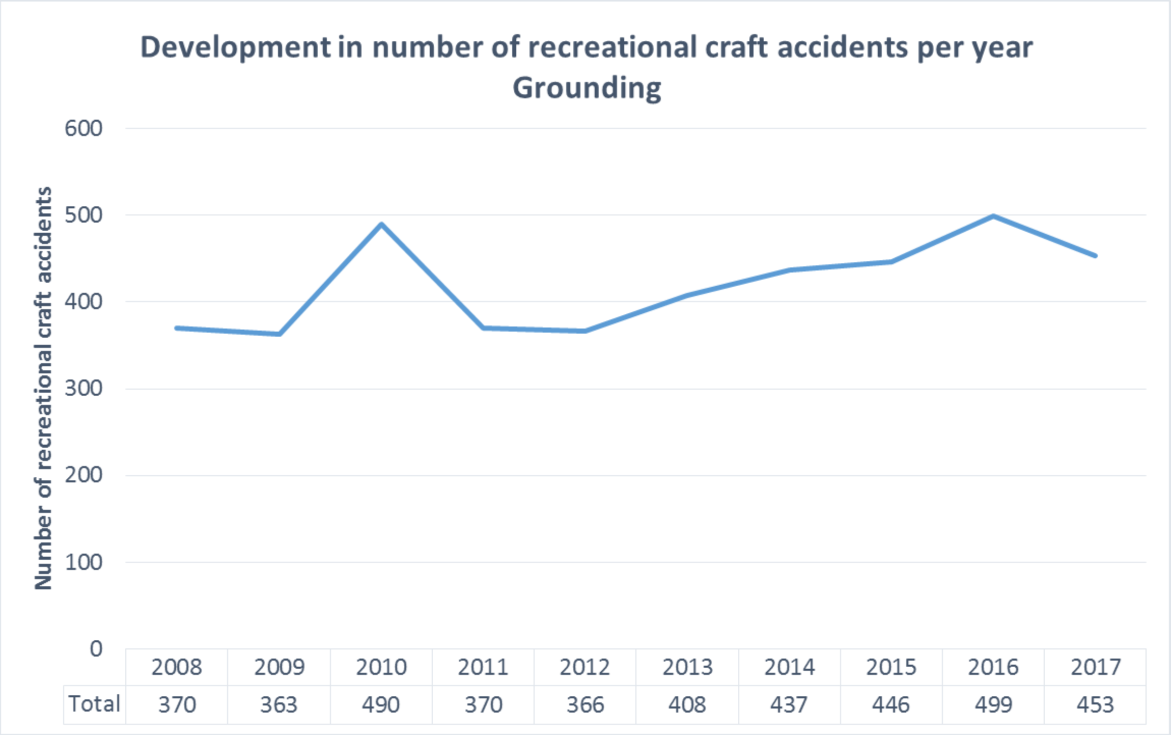



*Figure 9: Development in the number of recreational craft accidents – grounding*

There is little or no information recorded about the causes of groundings, with the exception of incidents where the grounding was recorded as a consequence of propulsion loss.

The results show that approximately 15% of the incidents involved challenging weather conditions falling under the category ‘external factors’. In addition, some incidents (1–3%) were recorded to involve human factors (e.g. intoxication and speed), position and potential human factors (tourist).

Grounding is one of the accident types that in relative terms occurs more frequently at night than other accident types, cf. section 4.2.2. Although the number of groundings is highest for motorboats (approx. 300 per year), sailing boats (approx. 99 per year) are the type of craft that runs aground most frequently, relative to other vessels listed in the 2018 Norwegian Boating Survey.

#### 4.3.3.2 *Discussion*

As mentioned earlier, there is little information about the causes of groundings, but with such a significant number of groundings recorded per year, these involve not only the use of resources in the form of rescue and assistance, but also considerable costs associated with repair and insurance claims. It should be noted that it is highly likely that a good deal more groundings occur than are included in this data set because it is unlikely that all groundings are reported to the emergency services and because vessels will free themselves or be assisted by other vessels in the vicinity.

### 4.3.4 Water ingress

#### 4.3.4.1 *Results*

An average of 88 recreational craft accidents involving water ingress were reported each year. This represents 7% of the total number of recreational craft accidents in Norway per year. The development in the number of incidents involving water ingress shows an increasing trend, particularly in recent years; see Figure 10.


*Figure 10: Development in the number of recreational craft accidents – water ingress*

The causes of water ingress are uncertain, and there is limited information available. In the data, incidents involving leaks were described both as incidents involving water ingress and major leaks in engine compartments resulting in the need for assistance in order to prevent them developing into critical situations.

Some typical factors relating to water ingress were recorded that may have been significant to the outcome of these incidents. As mentioned earlier, leaks were recorded in approximately 40% of the incidents. In addition, external factors were stated in 15% of the incidents (poor weather / sea / visibility conditions). Human factors (lack of knowledge/experience), potential human factors (fishing tourism / rental) and specific human factors (intoxication) were also recorded in around 1–3% of the incidents. An incident could involve none, one or several of these factors.

#### 4.3.4.2 *Discussion*

As mentioned earlier, water ingress can be due to major leaks associated with the engine or water ingress from the sea. Leaks in the engine compartment could have a maintenance-related context, but this cannot be confirmed from the information in the data set. Water ingress from the sea could occur as a consequence of weakness/damage in the hull, inadequate maintenance, or water coming over the railings, particularly in challenging wave and weather conditions.

### 4.3.5 Capsizing/foundering

#### 4.3.5.1 *Results*

An average of 59 recreational craft accidents involving capsizing/foundering were reported each year. This represents 5% of the total number of recreational craft accidents in Norway per year. The development in the number of incidents involving capsizing/foundering shows a slightly increasing trend; see Figure 11.

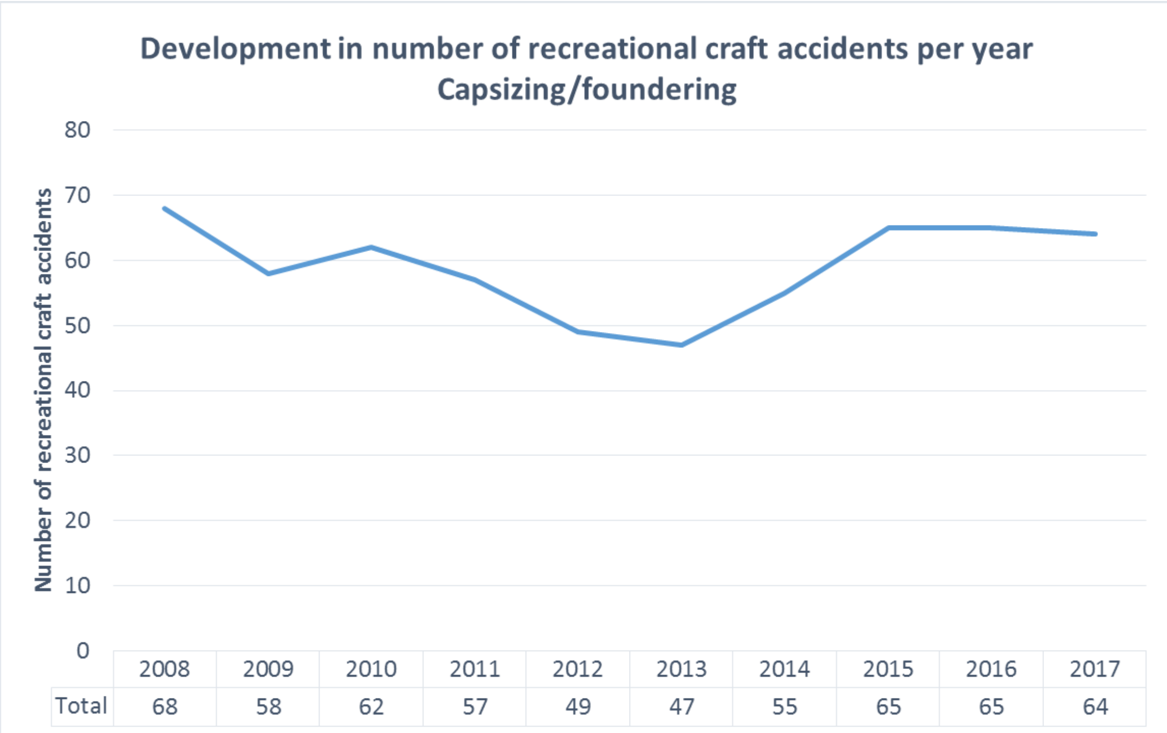



*Figure 11: Development in the number of recreational craft accidents – capsizing/foundering*

Little or no information is recorded about the causes of capsizing/foundering.

Some typical factors relating to capsizing/foundering were recorded that may have been significant to the outcome of these incidents. In addition, external factors were recorded in 20% of the incidents (poor weather / sea / visibility conditions). Human factors (lack of knowledge/experience), potential human factors (fishing tourism / rental) and specific human factors (intoxication) were also recorded in 3–4% of the incidents. An incident could involve none, one or several of these factors.

Motorboats and kayaks/canoes are the type of craft that most frequently capsize or sink. The results show that approximately 90% of capsizing/foundering incidents for which the craft size is stated involve craft of less than 26 feet. Note that 41% of the capsizing/foundering incidents involve craft of an unknown size. However, this still indicates that the smallest craft types are most vulnerable to capsizing/foundering.

Capsizing/foundering is one of the accident types that makes the biggest contribution to the fatal incident statistics (on average approx. 7 per year). This represents 23% of fatal incidents recorded as a consequence of capsizing/foundering; see further information in section 4.6.

### 4.3.5.2 *Discussion*

As mentioned, there is little information in the data set about the causes of capsizing/foundering. Capsizing/foundering can occur as a consequence of several factors. For example, challenging weather conditions could be a significant factor, as well as the size of the craft.

## 4.3.6 Fire

### 4.3.6.1 *Results*

An average of 54 recreational craft accidents involving fire on board were reported each year. This represents 4% of the total number of recreational craft accidents in Norway per year. The development in the number of fires shows a slightly increasing trend, particularly in recent years; see Figure 12.

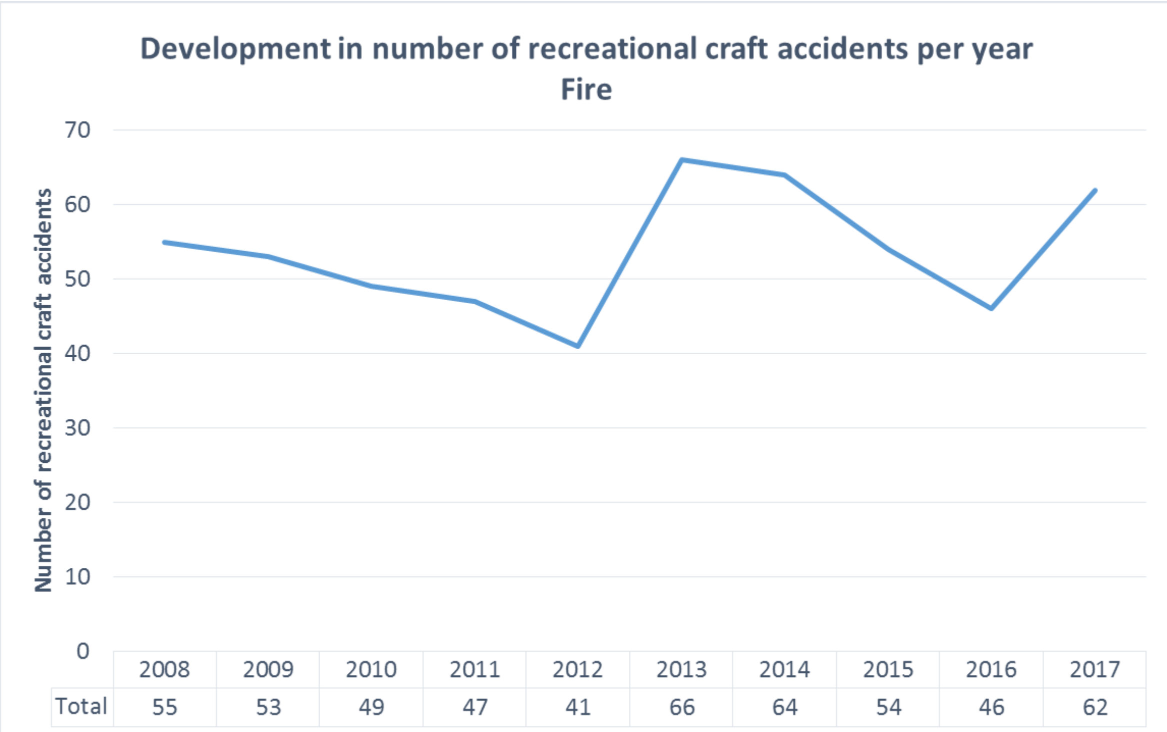



*Figure 12: Development in the number of recreational craft accidents – fire*

For most of the fires, technical issues are recorded as the cause of the incident, but there is little or no information about which technical components this refers to.

#### 4.3.6.2 *Discussion*

In the information shown in the free text sections about the incidents categorised as fire, there are indications that smoke development / fire development started in the engine compartment. There is no indication from the results that fire occurs more frequently in motorboats than in sailing boats, seen in relation to the number of craft, thought without specification of whether sail or engine was in use at the time of fires on sailing boats.

### 4.3.7 <u>Person overboard</u>

#### 4.3.7.1 *Results*

An average of 40 recreational craft accidents involving person overboard incidents were reported each year. This represents 3% of the total number of recreational craft accidents in Norway per year. The development in the number of person overboard incidents shows a slightly decreasing trend; see Figure 13.


*Figure 13: Development in the number of recreational craft accidents – person overboard*

Little or no information is recorded about the causes of person overboard incidents. In approximately 13% of the incidents, external factors such as poor weather / sea / visibility conditions were recorded, and in approximately 11% of the incidents, specific human factors (intoxication) were recorded.

Person overboard is one of the accident types that in relative terms occurs more frequently at night than other accident types, cf. section 4.2.2.

Motorboats are the type of craft involved in most person overboard incidents, in addition to kayaks/canoes, dinghies and sailing boats. Based on the number of craft listed in the Norwegian Boating Survey,[4] the indication is that sailing boats are the type of craft involved in most person overboard incidents, relative to the number of craft.

Person overboard is the accident type recorded as resulting in the most fatalities (on average approx. 15 per year); see section 4.6 for more details. Motorboats are the type of craft with most fatalities as a consequence of person overboard incidents, followed by kayaks/canoes.

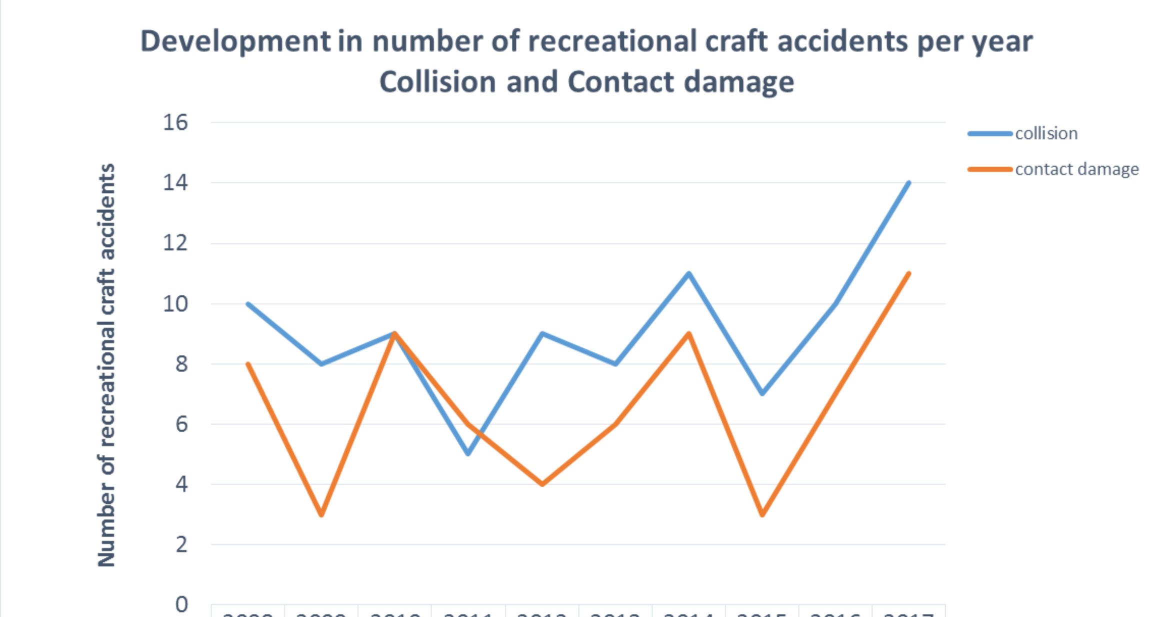
#### 4.3.7.2 *Discussion*

There is little or no information about the causes of person overboard incidents. Incidents in which people end up in the water can often quickly develop into critical situations with serious consequences if the persons involved are unable to notify others of their distress. There is probably some under-reporting of person overboard incidents, since they are not reported if a rescue operation is not initiated, and the persons concerned are assisted by vessels in the vicinity, or manage to get back on board themselves.

### 4.3.8 Collision and contact damage

#### 4.3.8.1 *Results*

An average of 9 recreational craft accidents involving collision and 7 involving contact damage were reported each year. This represents 2% of the total number of recreational craft accidents in Norway per year. The development in the number of incidents involving collision and contact damage shows a slightly increasing trend; see Figure 14.




| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|
| collision | 10 | 8 | 9 | 5 | 9 | 8 | 11 | 7 | 10 | 14 |
| contact damage | 8 | 3 | 9 | 6 | 4 | 6 | 9 | 3 | 7 | 11 |

*Figure 14: Development in the number of recreational craft accidents – collision and contact damage*

There is little or no information in the data about the causes of these incidents. The results show that 22% of the collisions and 12% of the contact damage incidents occur at night, which is above average for these accident types. For around 10% of the accidents, specific human factors (such as intoxication or speed) were recorded.

Most collisions and incidents involving contact damage involve motorboats, but incidents have also occurred with sailing boats, dinghies and personal watercrafts, although these are relatively rare; see section 4.4 for more details.

Collision is one of the accident types that in relative terms occurs more frequently at night than other accident types, cf. section 4.2.2. Collision is also one of the accident types that, relative to the number of accidents involving collision, results in serious consequences such as fatalities; see section 4.6. However, the number of fatalities occurring as a consequence of collisions is relatively small (on average approx. 1 per year).

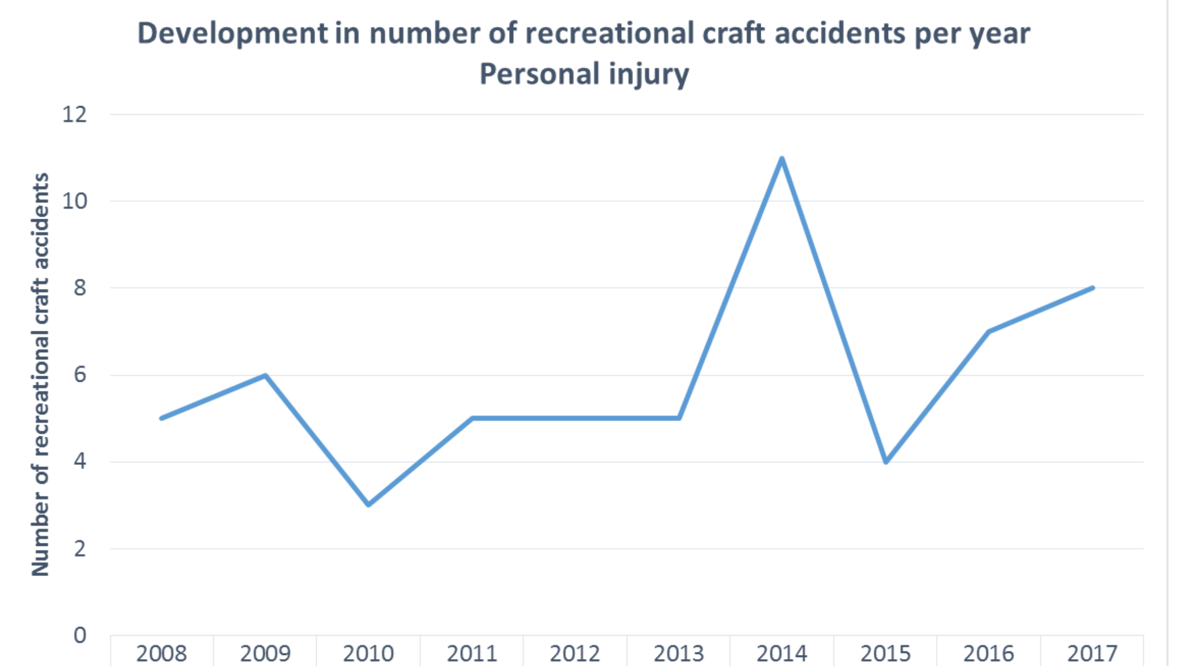
4.3.8.2 *Discussion*

Although relatively few incidents involving collision or contact damage are recorded per year, the results show that if these incidents occur, they can result in extremely serious consequences such as fatalities. Intoxication and speed were recorded in several of the incidents, but the data set cannot confirm whether these are factors that contributed to the incidents.

4.3.9 Personal injury

4.3.9.1 *Results*

An average of 6 recreational craft accidents resulting in personal injuries were reported each year. That is a relatively small number in relation to the total number of recreational craft accidents in Norway per year. The development in the number of personal injuries shows a slightly increasing trend; see Figure 15.




| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|
| Total | 5 | 6 | 3 | 5 | 5 | 5 | 11 | 4 | 7 | 8 |

*Figure 15: Development in the number of recreational craft accidents – personal injury*

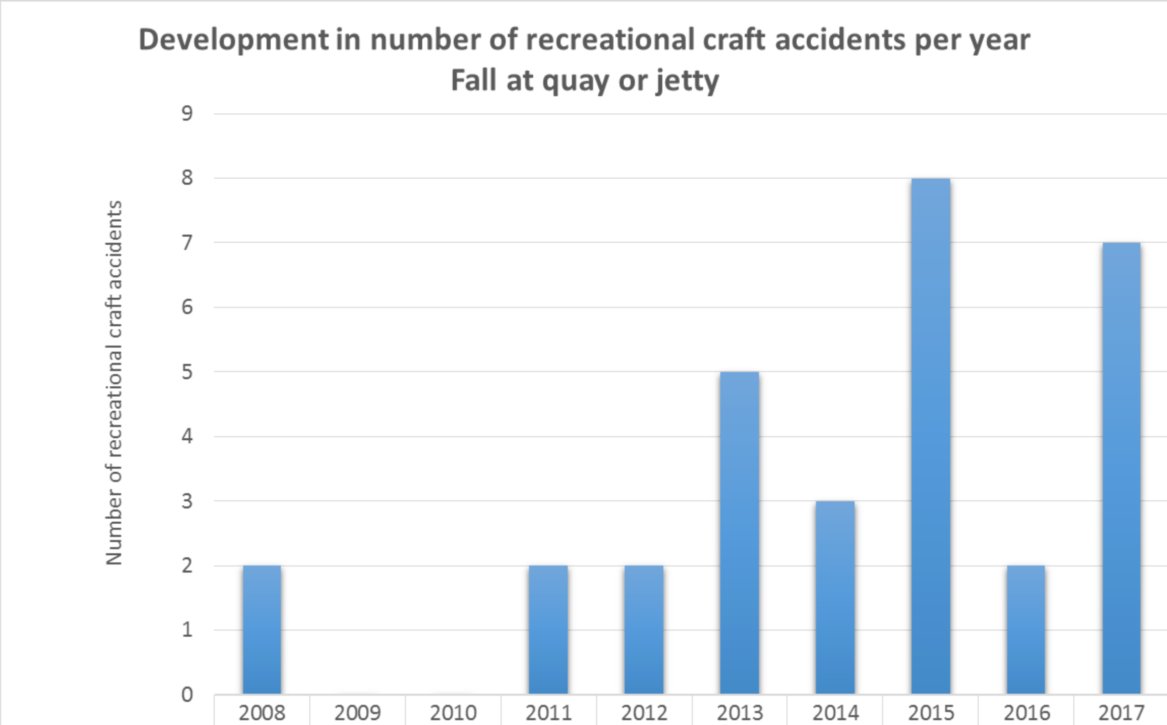
There is little or no information in the data about the causes of these incidents.

### 4.3.10 Fall at quay or jetty

#### 4.3.10.1 *Results*

The information relating to falls at quay or jetty is mainly information about incidents involving fatalities received from the Norwegian Maritime Authority (29 out of 31 incidents). There is little reporting to the JRCC and RS on incidents involving falls at quay or jetty, since this type of incident does not usually involve the same kind of rescue operation as for the other accident types. The results presented for this accident type are therefore mainly incidents involving fatalities; see also more detailed information about these incidents in section 4.6.

The results could indicate that serious accidents involving falls at quay or jetty are seeing an increasing trend, but there is a great deal of uncertainty relating to these figures.




| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|
| fall at quay or jetty | 2 | 0 | 0 | 2 | 2 | 5 | 3 | 8 | 2 | 7 |

*Figure 16: Development in the number of recreational craft accidents – fall at quay or jetty*

## 4.4 Accidents by type of craft

In this section, accidents will be presented by type of craft. Seven categories have been defined in this mapping work, and there are also a number of incidents that had no information about the type of craft involved (approximately 3%). There is a great deal of variation in the number of incidents for the various types of craft, partly because of the difference in numbers of craft in use and partly because of different reporting procedures. For example, one can imagine that small craft do not report a need for assistance in minor incidents, which means that these are not reported and registered. However, it was decided to present the results for all the craft in order to be able to identify differences in accident types for the various types of craft.

The development in the number of recreational craft accidents per year by type of craft is shown in Figure 17.

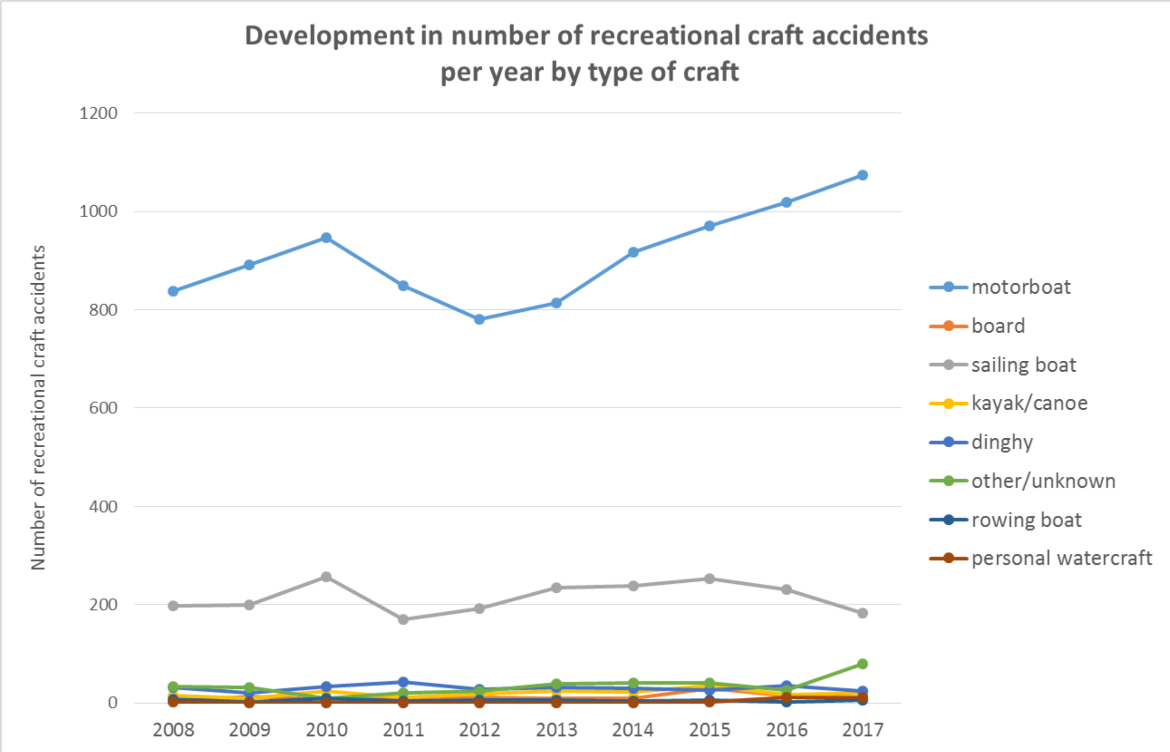



*Figure 17: Development in number of recreational craft accidents by type of craft*

Figure 17 shows that motorboats dominate the number of recreational craft accidents.

The Norwegian Boating Survey[4] shows that the number of recreational craft has increased by around 200,000 since 2011. Of these, it is mainly motorboats without sleeping quarters that have seen the highest increase (around 110,000), followed by kayaks/canoes (around 90,000). It is also reported that 87% of motorboats without sleeping quarters are less than 26 feet. Around 25% of the accidents in the AIBN's data material are registered as motorboats less than 26 feet. Based on this, it is therefore not possible to conclude that the increase in the number of accidents involving motorboats is due solely to an increase in the number of small motorboats without sleeping quarters (boats less than 26 feet). It should be noted that for 25% of the incidents involving motorboats, the size of the craft is not stated.

The number of recreational craft accidents broken down by type of craft is shown in Figure 18. The figure shows that most accidents involve motorboats, which is to be expected, since motorboats are the type of craft that dominates the recreational craft segment.

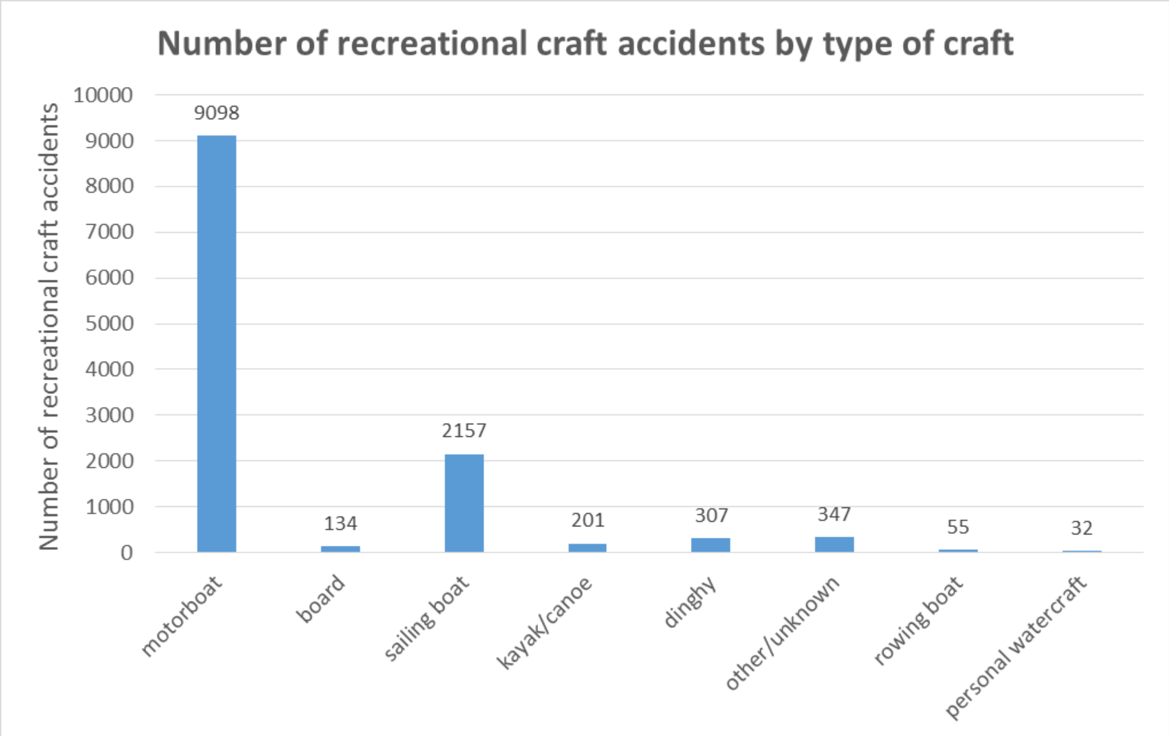



*Figure 18: Number of recreational craft accidents by type of craft*

### 4.4.1 Motorboats

Most recreational craft accidents involve motorboats (on average approximately 900 per year). This is to be expected, since approximately 60% of the recreational craft in Norway are motorboats, according to the Norwegian Boating Survey.[4]

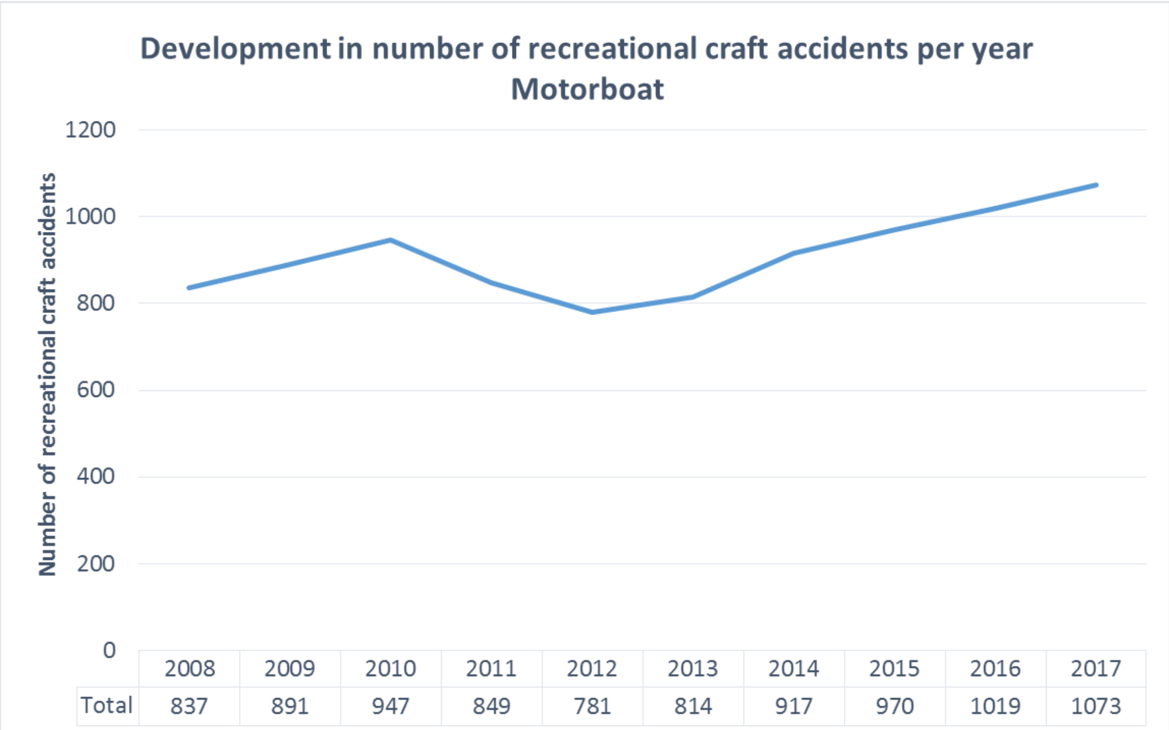



*Figure 19: Development in the number of recreational craft accidents – motorboats*

The number of accidents involving motorboats is showing an increasing trend. Propulsion loss and grounding are the most frequently occurring accident types for this type of craft.

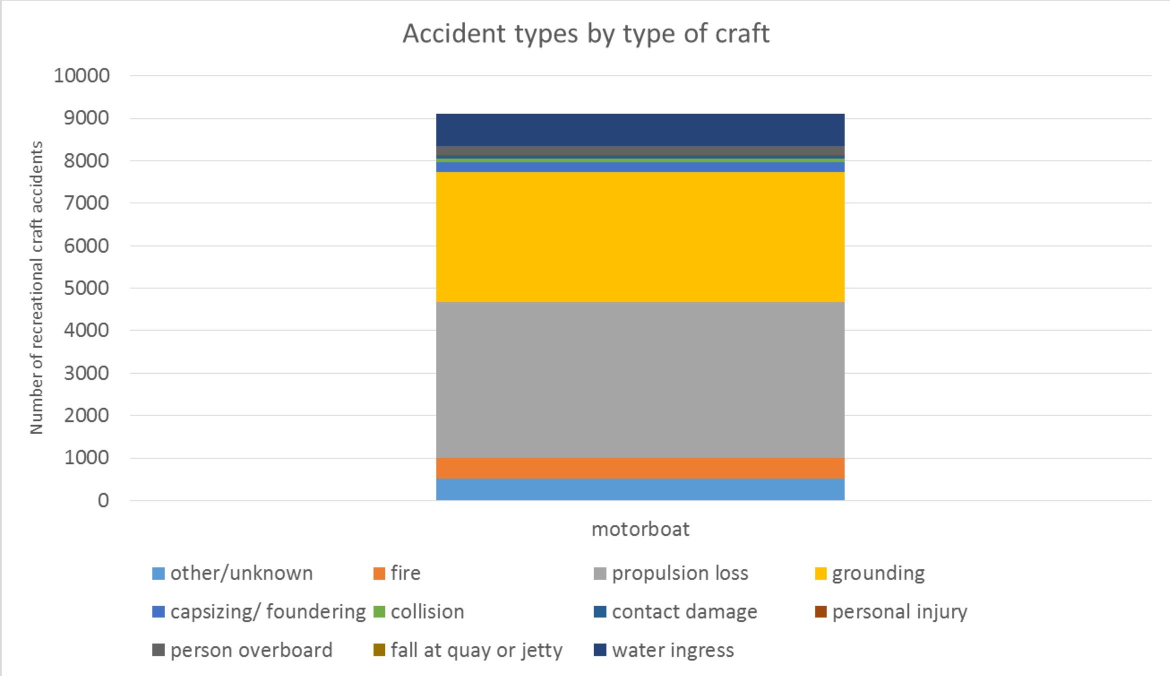



*Figure 20: Breakdown of accident type for motorboats – 2008–2017*

Accidents involving motorboats occur all over the country, in addition to some in Svalbard (not shown in the figure); see Figure 21.

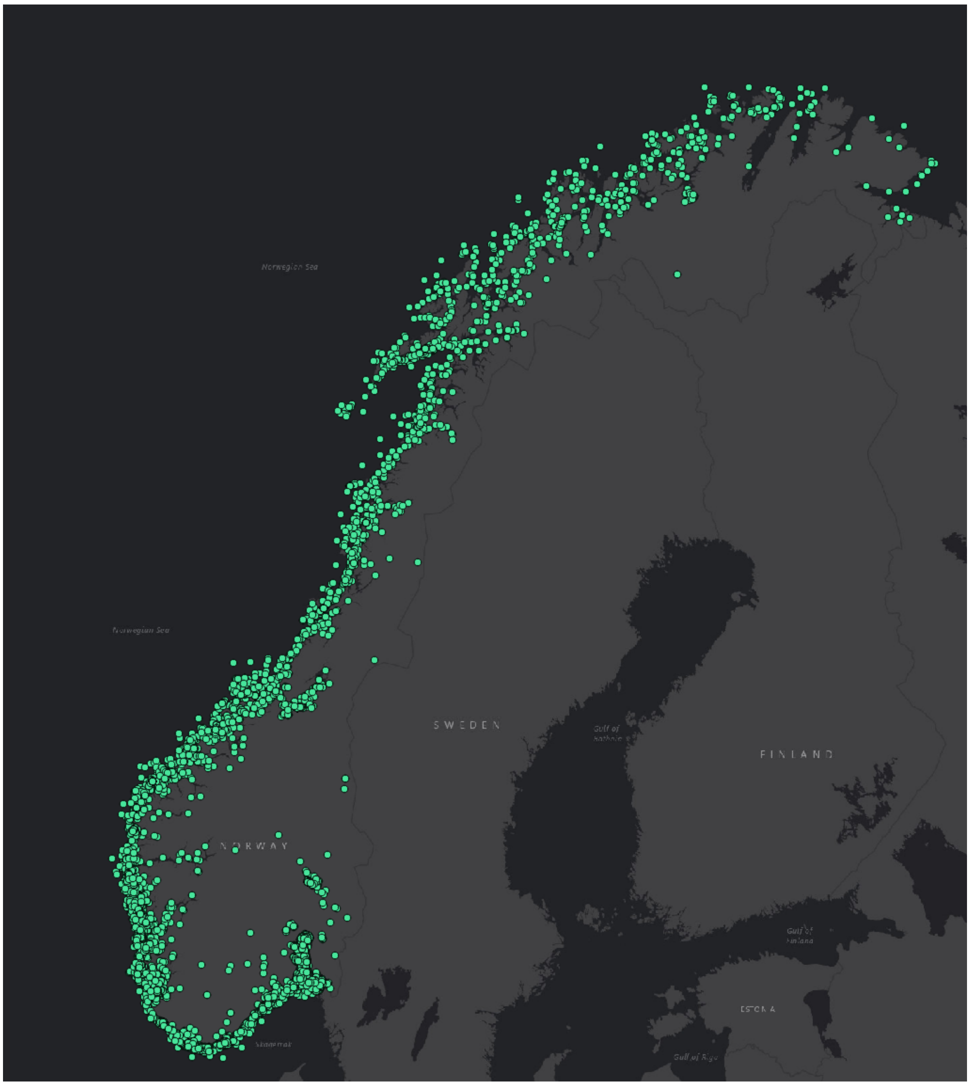



*Figure 21: Breakdown of recreational craft accidents involving motorboats, 2008–2017. Source: Illustration created in QGIS*

## 4.4.2 Sailing boats

Sailing boats are involved in the second highest number of accidents per year (approximately 200 per year). The number of accidents involving sailing boats shows a slightly increasing trend up to the year 2015.


*Figure 22: Development in the number of recreational craft accidents – sailing boats*

Grounding and propulsion loss are the most frequently occurring accident types for this type of craft.

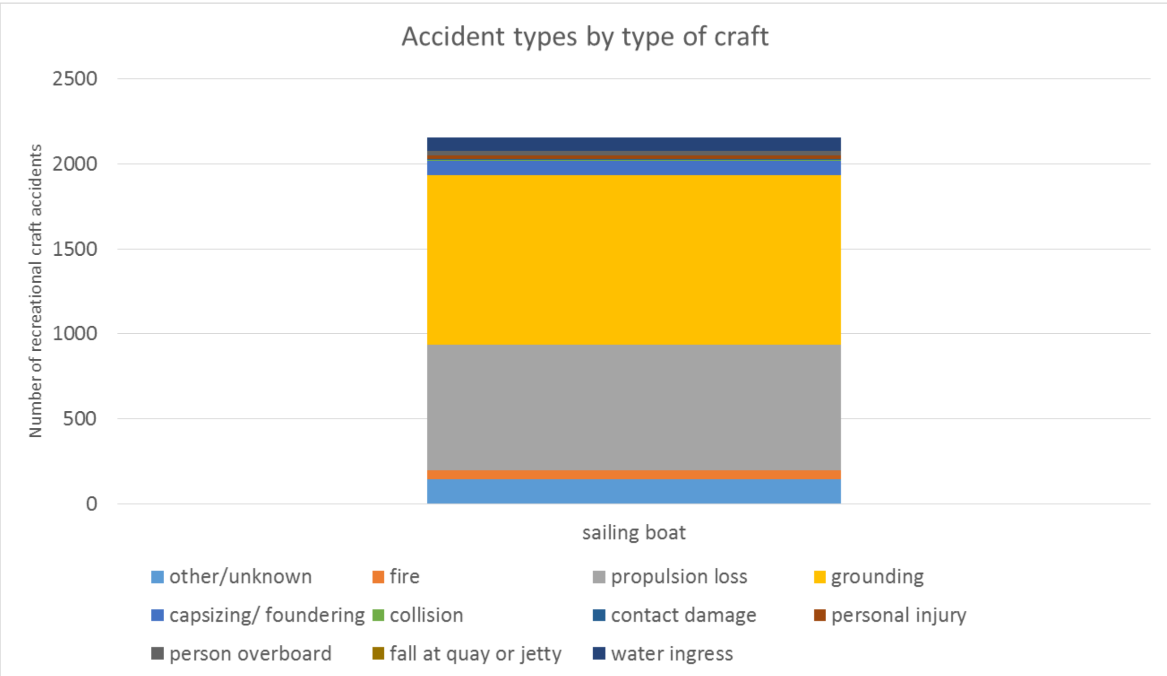



*Figure 23: Breakdown of accident type for sailing boats – 2008–2017*

Accidents involving sailing boats occur most frequently in southern parts of the country, in addition to some in Svalbard (not shown in the figure); see Figure 24.


*Figure 24: Breakdown of recreational craft accidents involving sailing boats, 2008–2017. Source: Illustration created in QGIS*

### 4.4.3 Dinghies

An average of approximately 30 accidents involving dinghies were recorded per year. The number of accidents involving dinghies was relatively stable throughout the period.

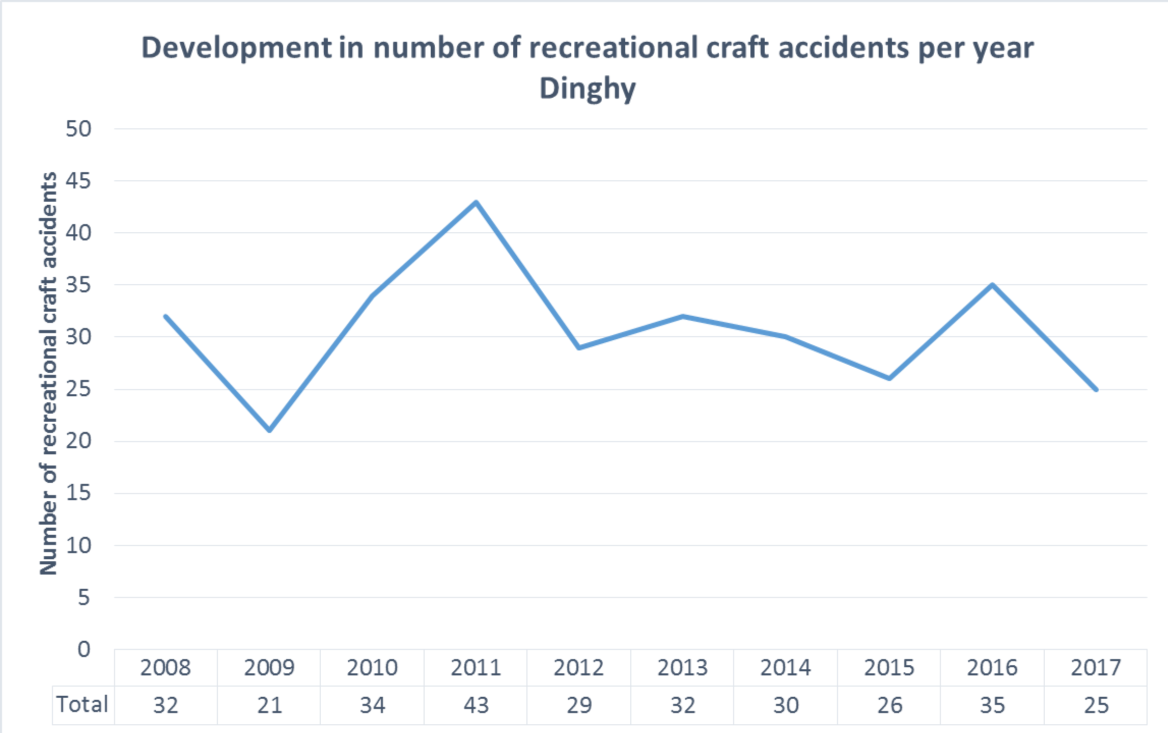



*Figure 25: Development in the number of recreational craft accidents – dinghies*

Propulsion loss and capsizing/foundering are the dominant accident types for this type of craft.

Accidents involving dinghies occur most frequently in southern parts of the country (mainly Western, Southern and Eastern Norway), in addition to one registered in Svalbard (not shown in the figure); see Figure 26.


*Figure 26: Breakdown of recreational craft accidents involving dinghies, 2008–2017. Source: Illustration created in QGIS*

### 4.4.4 Kayaks/canoes

An average of approximately 20 accidents involving kayaks/canoes were recorded per year. The number of accidents involving kayaks/canoes is showing an increasing trend.

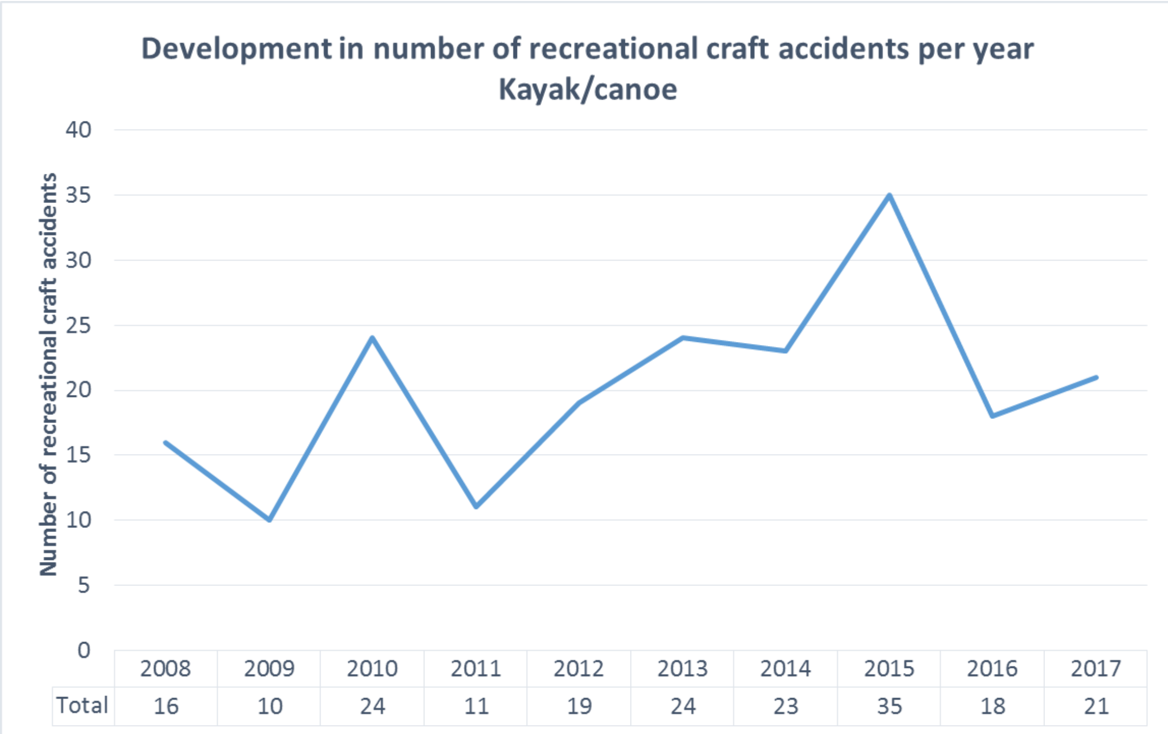



*Figure 27: Development in the number of recreational craft accidents – kayaks/canoes*

Capsizing/foundering is the most frequently occurring accident type for this type of craft, in addition to person overboard accidents. It may be natural to think that all capsizes involving kayak/canoes result in a person overboard situation, but this is only recorded as a subsequent incident where it is explicitly stated in the data. This is in order to avoid speculation about the sequence of events, and because the categories apply to all craft. It is not an equal probability for all craft that capsizing/foundering results in a person in the water. For the same reason, capsizing/foundering was not stated to be the prior incident when it was not specified why a person ended up in the water.

Accidents involving kayaks/canoes occur most frequently in southern parts of the country (mainly Western, Southern and Eastern Norway), in addition to a few in Svalbard (not shown in the figure); see Figure 28.

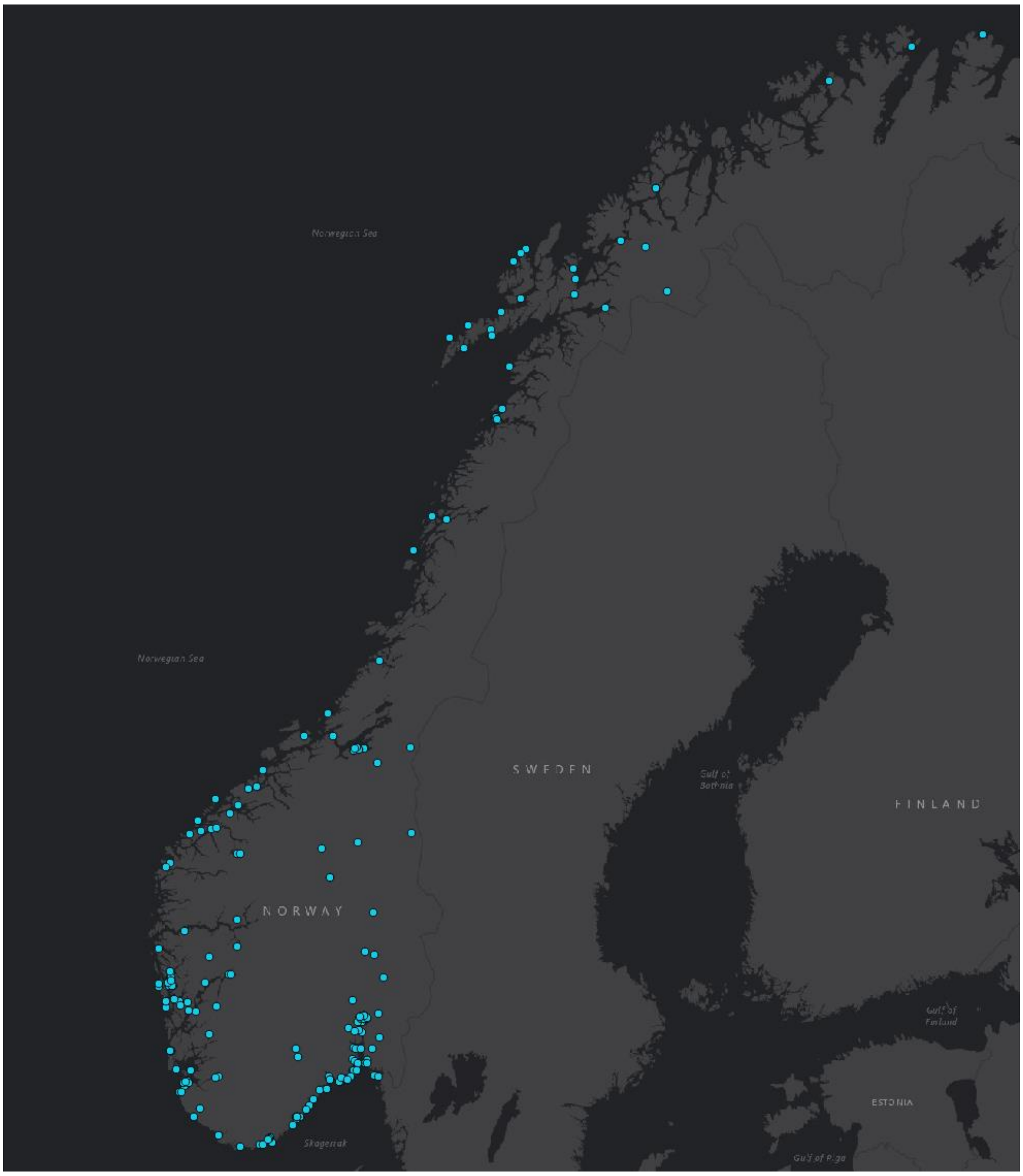



*Figure 28: Breakdown of recreational craft accidents involving kayaks/canoes, 2008–2017. Source: Illustration created in QGIS*

### 4.4.5 Boards (sailboards, paddle boards and kiteboards)

An average of approximately 13 accidents involving boards were recorded per year. The number of accidents involving boards is showing an increasing trend. Little information is recorded about the type of incidents, but information in the text indicates that they mainly concern problems with equipment and a person being unable get onto and/or drift away from the board.


*Figure 29: Development in the number of recreational craft accidents – boards*

Figure 30 shows that there are relatively few recorded accidents involving boards. These accidents occur most frequently in southern parts of the country (mainly Western, Southern and Eastern Norway).


*Figure 30: Breakdown of recreational craft accidents involving boards, 2008–2017. Source: Illustration created in QGIS*

4.4.6 Personal watercrafts

There are relatively few incidents involving personal watercrafts over the 2008–2017 period. A total of 32 incidents were recorded in the data set for this period, but 24 of these occurred in the last two years.


*Figure 31: Development in the number of recreational craft accidents – personal watercrafts*

The number of accidents involving personal watercrafts shows a strongly increasing trend over the past two years, most probably as a consequence of the Regulations on the use of personal watercraft etc., which defined extensive prohibited areas along shorelines, being repealed with effect from 18 May 2017. After this date, personal watercrafts could be used in the same way as other recreational craft, wherever local regulations do not restrict personal watercraft traffic.

Accidents involving personal watercrafts are mainly due to problems with propulsion and capsizing/foundering. There is relatively little information about the cause of these accidents, but for some incidents, engine problems were stated in the form of leaks, but also problems with steering. Capsizing/foundering accidents are typically incidents where someone has overturned with a personal watercraft and needs assistance in order to get ashore.

Figure 32 shows that there are relatively few recorded accidents involving personal watercrafts. These accidents occur most frequently in southern parts of the country (mainly Western, Southern and Eastern Norway).


*Figure 32: Breakdown of recreational craft accidents involving personal watercrafts, 2008–2017. Source: Illustration created in QGIS*

### 4.4.7 Rowing boats

There are relatively few incidents involving rowing boats over the 2008–2017 period. An average of approximately six accidents involving rowing boats were recorded per year. The number of accidents is relatively unchanged throughout the period.

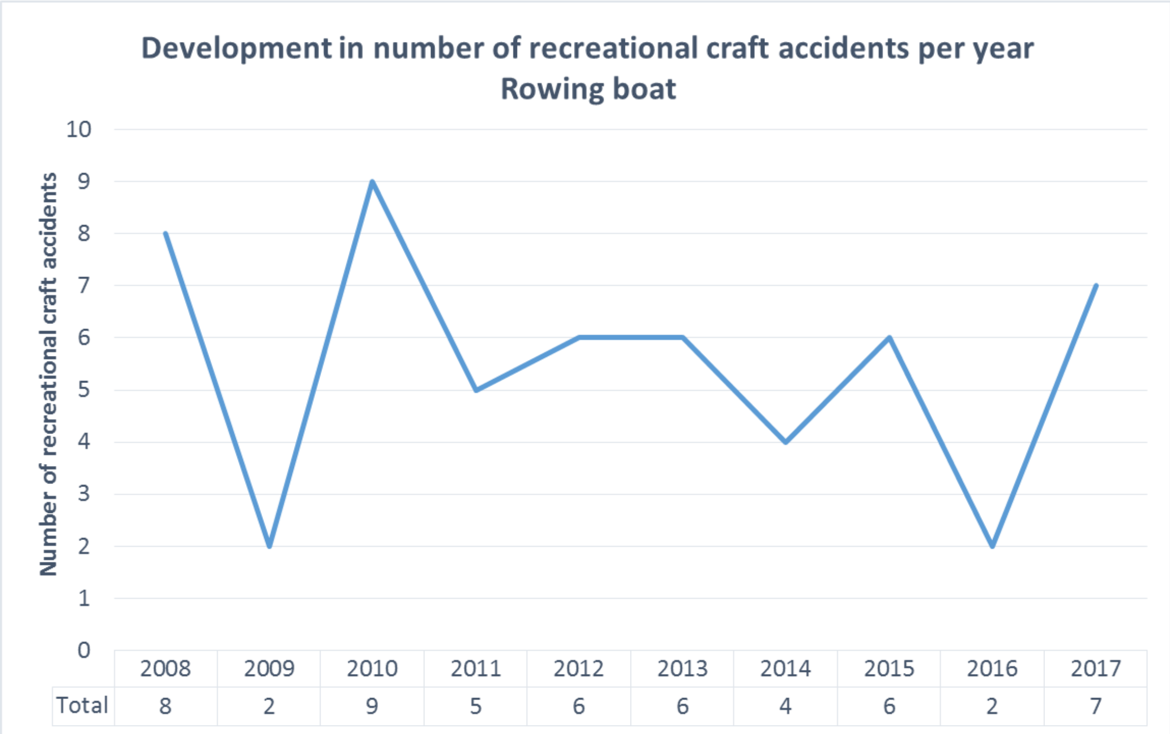



*Figure 33: Development in the number of recreational craft accidents – rowing boats*

Capsizing/foundering is the dominant accident type for this type of craft.

Accidents involving rowing boats occur most frequently in southern parts of the country (mainly Western, Southern and Eastern Norway); see Figure 34.


*Figure 34: Breakdown of recreational craft accidents involving rowing boats, 2008–2017. Source: Illustration created in QGIS*

## 4.5 Accidents by county

This section presents the number of recreational craft accidents by county. The number of recreational craft accidents by county for the 2008–2017 period is shown in Figure 35.

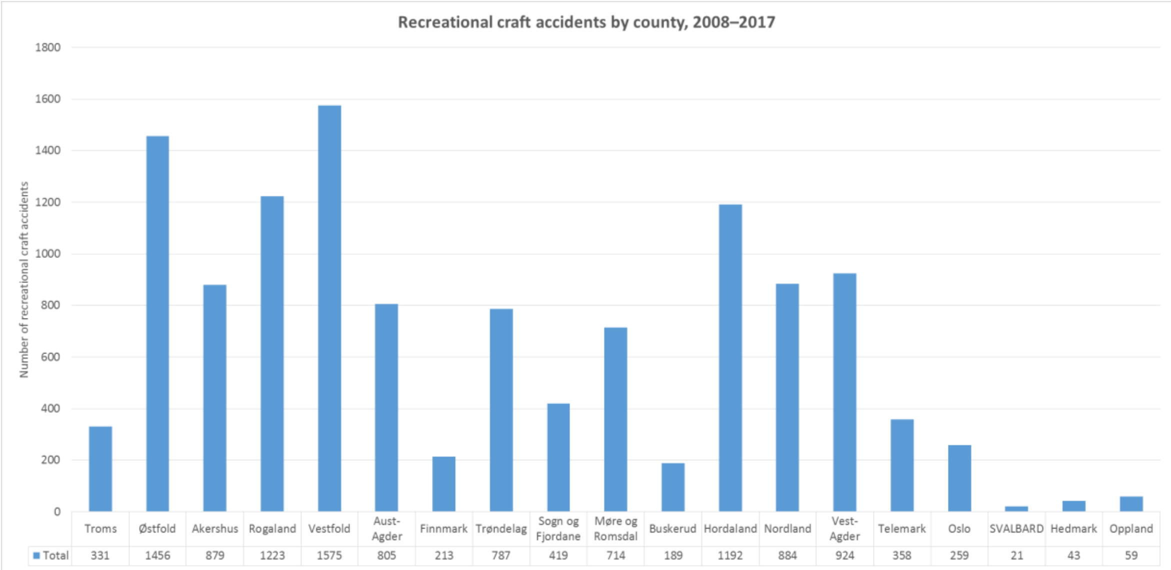



*Figure 35: Number of recreational craft accidents by county, 2008–2017*

Figure 35 shows that most recreational craft accidents are registered in the counties of Vestfold, Østfold, Rogaland and Hordaland. The reason for this cannot be determined on the basis of the data set, but it is most likely related to the high number of recreational craft in these counties.

Figure 36 shows recreational craft accidents by county, broken down by accident type. The figure shows that grounding and propulsion loss are the dominant accident types for most of the counties. The results show that there is relatively little difference in the proportion of accident types for the various counties, with some exceptions. For example, Svalbard, Troms and Finnmark, and the inland counties of Hedmark and Oppland differ somewhat more from the other counties. The results by county are not specified in more detail, since it is mainly the number of accidents per county that is the most significant difference.

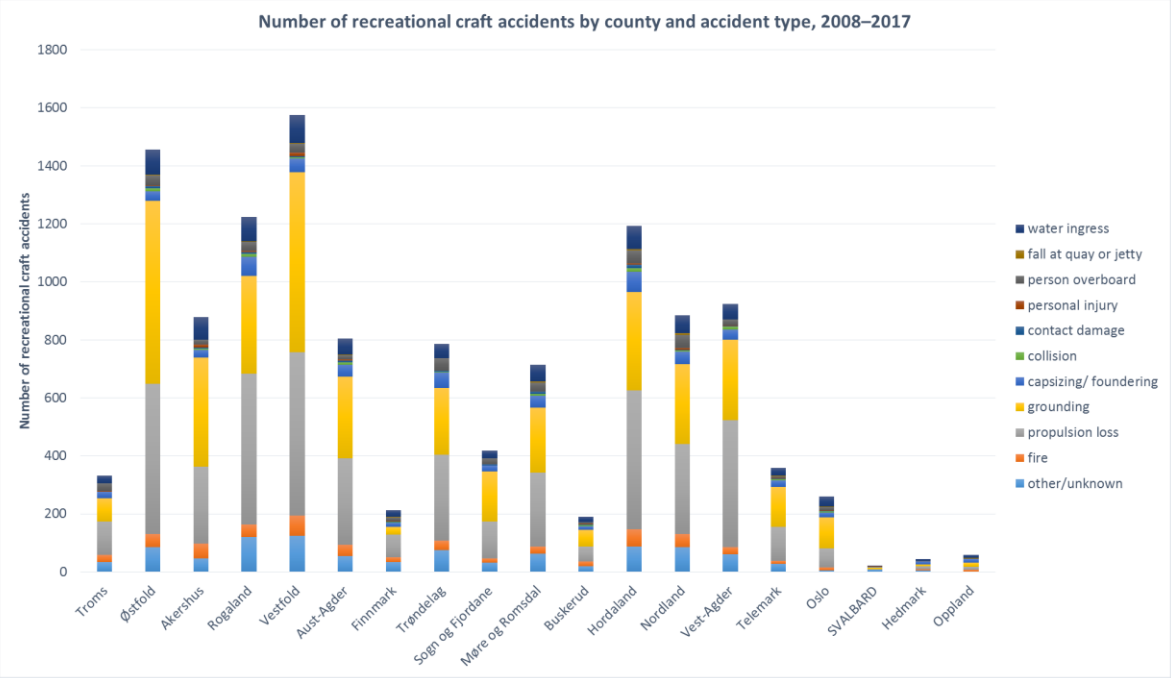



*Figure 36: Number of recreational craft accidents by county and accident type, 2008–2017*

Figure 37 and Figure 38 show the number of accidents involving recreational craft by county, broken down by type of craft. The results show that motorboats and sailing boats dominate for the vast majority of counties. Not all counties have registered accidents with all types of craft. Boards, personal watercrafts and rowing boats are the types of craft for which incidents have not been registered in all counties.

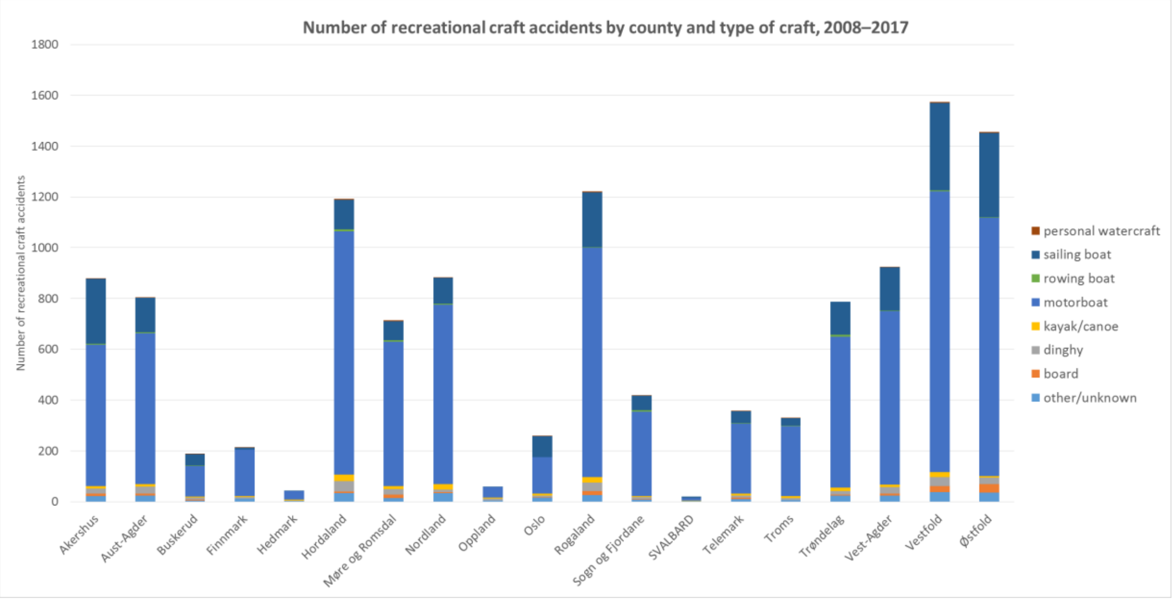



*Figure 37: Number of recreational craft accidents by county and type of craft, 2008–2017*

Figure 38 shows the number of accidents by county and season. The results show that the various counties do not differ substantially from each other in terms of which time of year the accidents occurred.

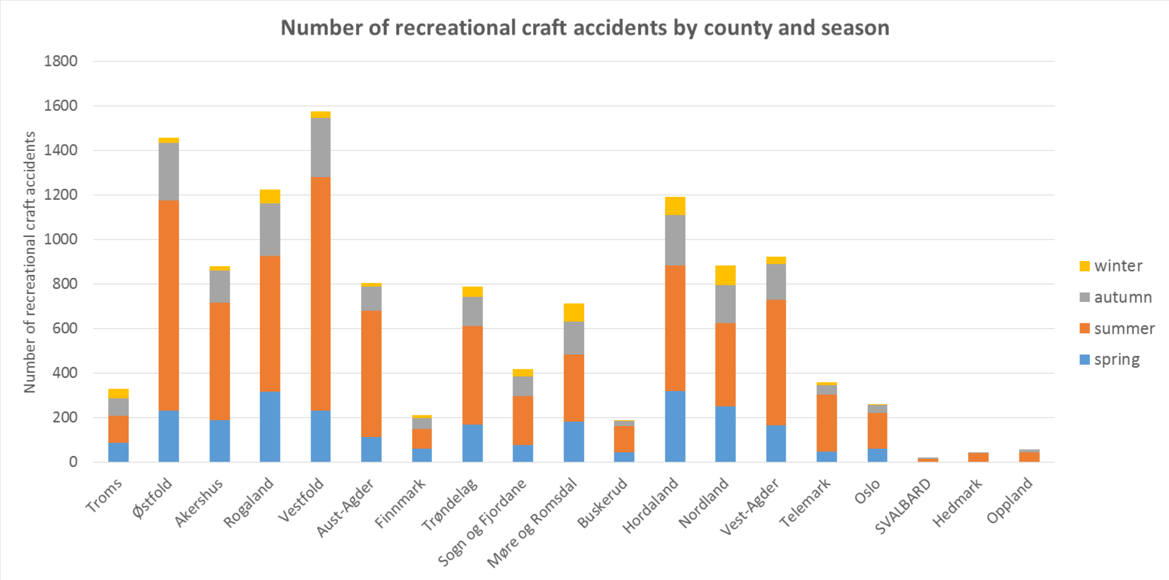



*Figure 38: Number of recreational craft accidents by county and season, 2008–2017*

## 4.6 Fatal accidents

Fatal recreational craft accidents are presented in this section. As mentioned earlier, the data set for fatalities is based on statistics from the Norwegian Maritime Authority and information from the JRCC and RS.

To obtain more details about fatal accidents, logs were obtained from the JRCC and a media search performed for fatal accidents over the last five years (2013–2017). The results for this period are presented in section 4.6.2.

### 4.6.1 Fatal recreational craft accidents, 2008–2017

The number of recorded fatalities in the 2008–2017 period was 367. The number is somewhat higher than was apparent from earlier statistics published by the Norwegian Maritime Authority. This could be due to the fact that there are no compulsory reporting procedures for recreational craft accidents. There is also some uncertainty involved in identifying recreational craft accidents, particularly accidents at quay or jetty, and accidents involving recreational craft used commercially. The number of fatalities per year is shown in Figure 39. Figure 39 shows a slightly falling trend.


*Figure 39: Number of fatalities, 2008–2017*

Figure 40 shows the number of fatalities by accident type. The results show that it is accidents involving person overboard, capsizing/foundering, grounding and falls at quay or jetty that most often result in fatalities. Few of the incidents registered as propulsion loss have led to fatal accidents, even though this type of accident dominates the total number of accidents; cf. section 4.3.

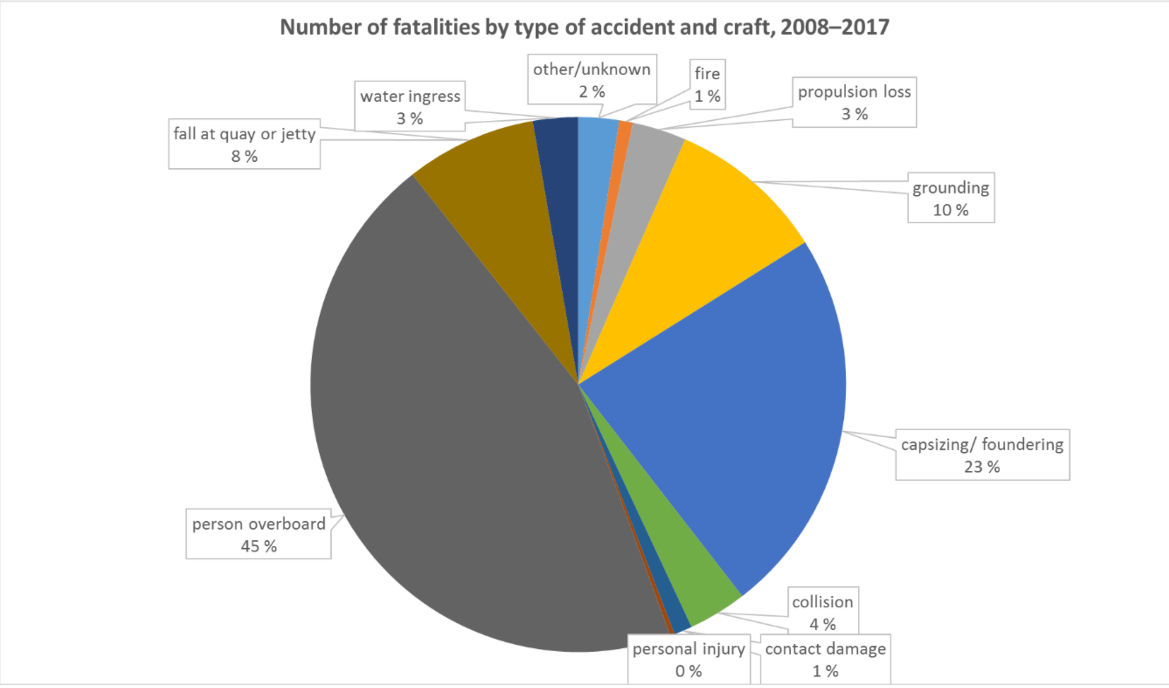



*Figure 40: Breakdown of fatal accidents by accident type, 2008–2017*

The number of fatalities by type of accident and craft are shown in Figure 41. Most of the fatal accidents involve motorboats, except for incidents involving falls at quay or jetty, where information about the craft is missing in most cases. The results also show that there have been quite a few fatal accidents involving kayaks/canoes in addition to dinghies, rowing boats and sailing boats. Approximately 75% of motorboat accidents where the size is specified concern craft of less than 26 feet. This indicates that most fatal accidents occur on small craft.

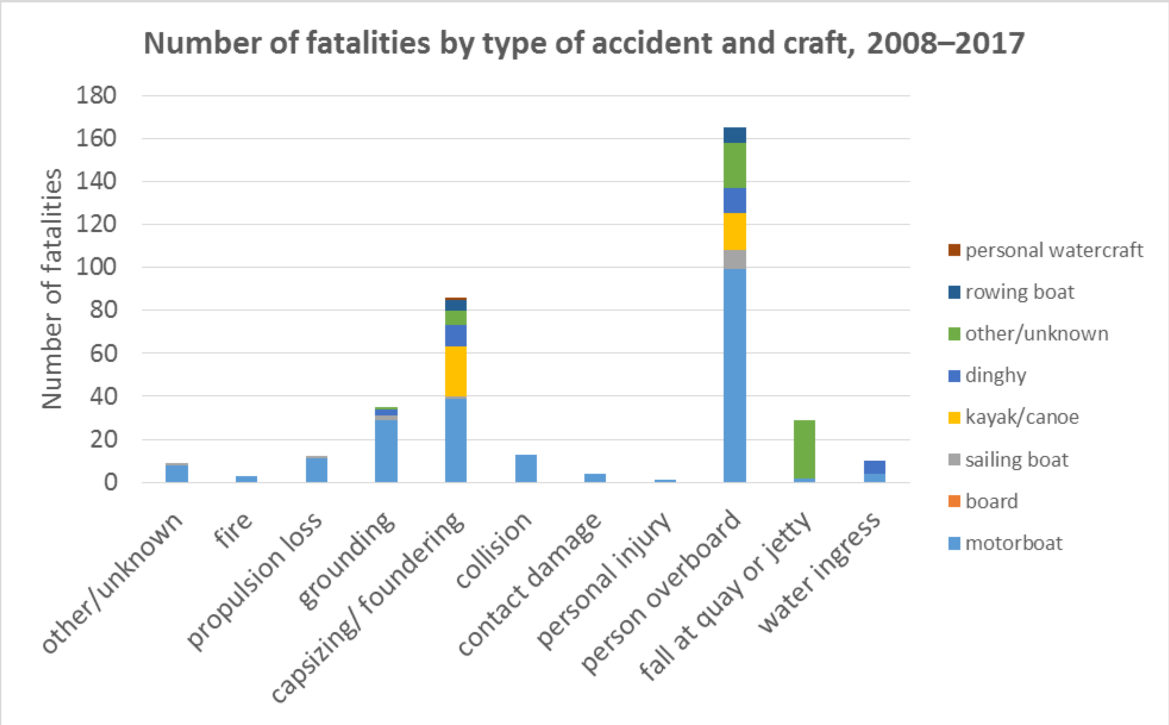



*Figure 41: Number of fatalities distributed by type of accident and craft, 2008–2017*

The results show that for groundings, almost half (41%) of the fatal accidents occur at night. For around 33% of these incidents, the use of intoxicants was recorded, while the figure was 45% for fatal accidents occurring in connection with falls at a quay or jetty.

Figure 42 shows the number of fatalities by season. The result shows that the distribution is relatively similar to the total number of incidents; see section 4.2.3, with few fatalities in the winter and most in the summer.

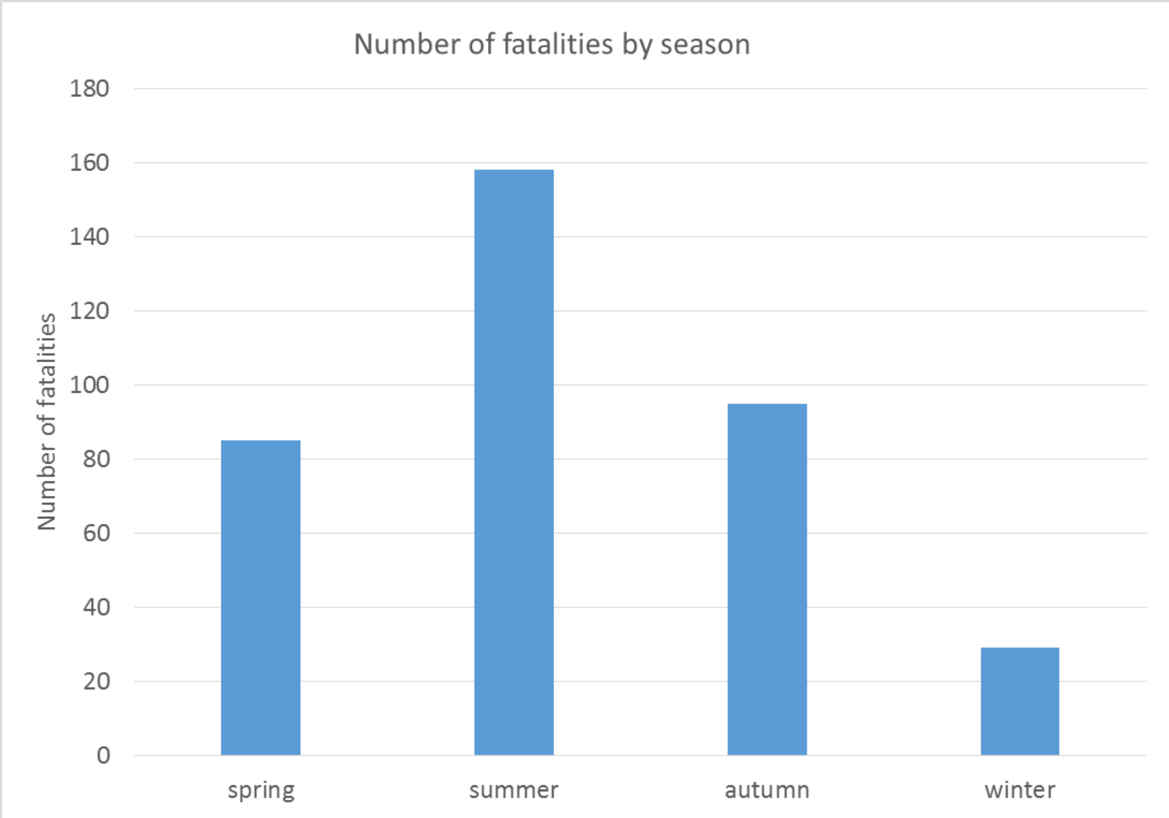



*Figure 42: Number of fatalities by season*

Figure 43 shows the number of fatal recreational craft accidents by county. The results show that the counties of Hordaland, Nordland, Trøndelag and Møre og Romsdal have the most recorded fatal incidents. These are not the same counties that have the most accidents in general; see section 4.5, apart from Hordaland.

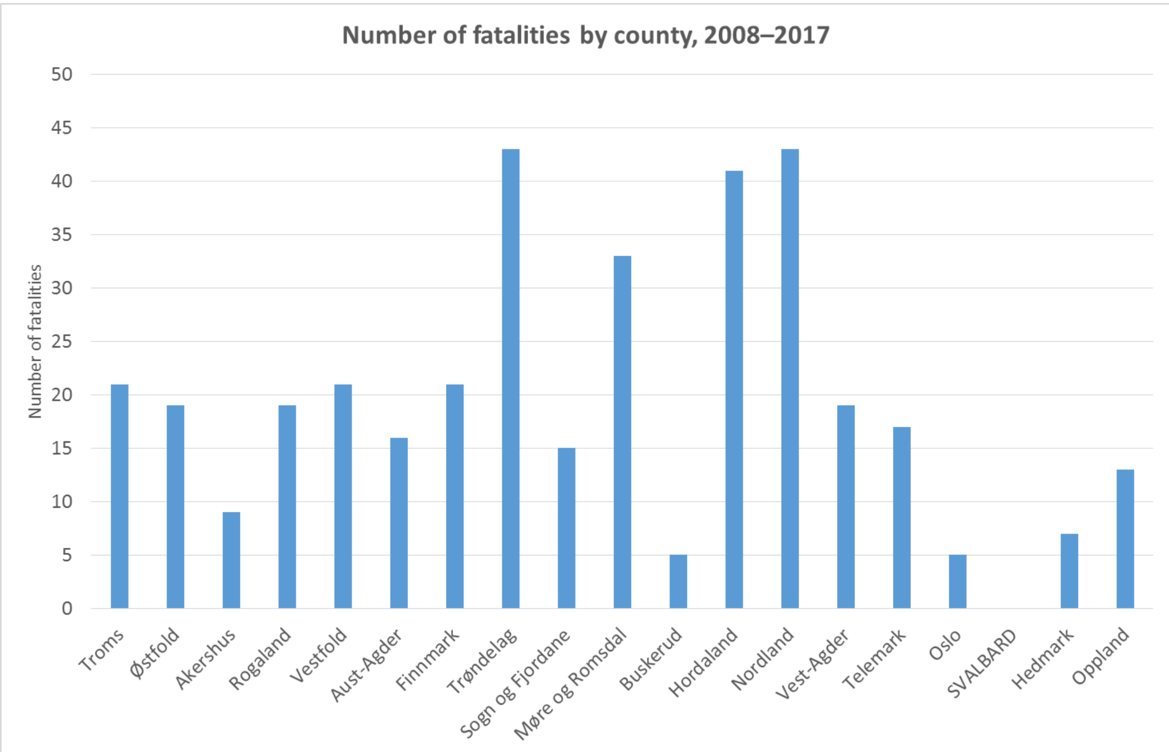



*Figure 43: Number of fatalities by county, 2008–2017*

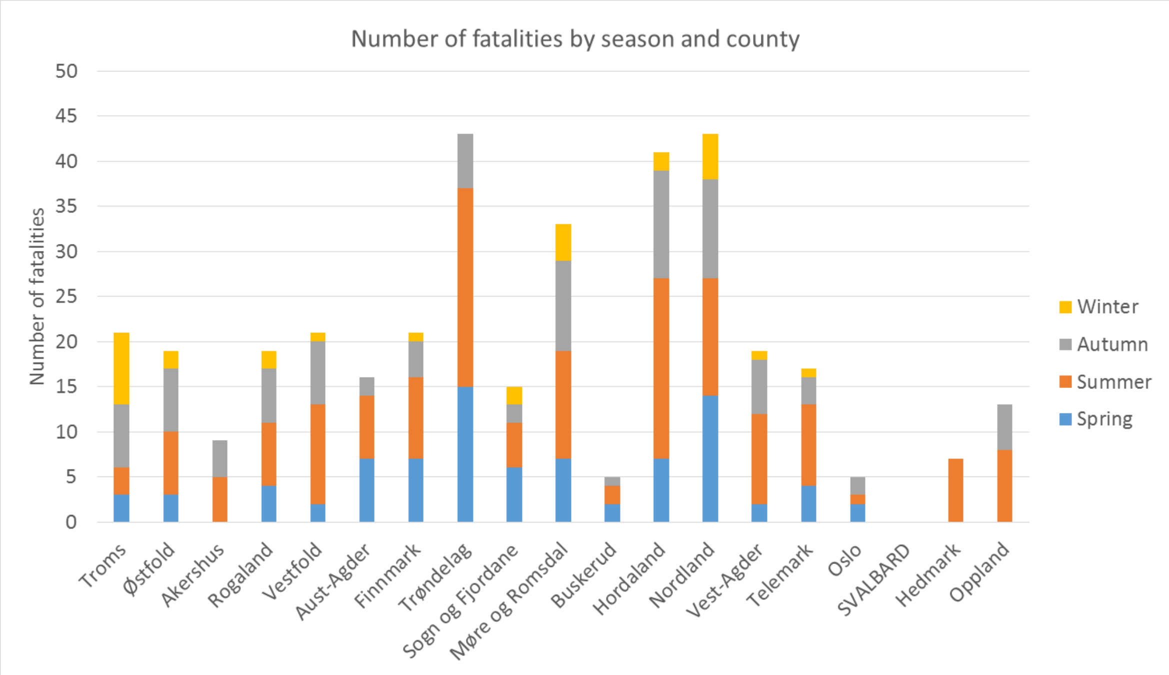



*Figure 44: Number of fatalities by county and season, 2008–2017*

Figure 45 shows that most of the people who died are Norwegian nationals. Of the 367 fatalities, 312 were Norwegian nationals, while 55 were of other nationalities.

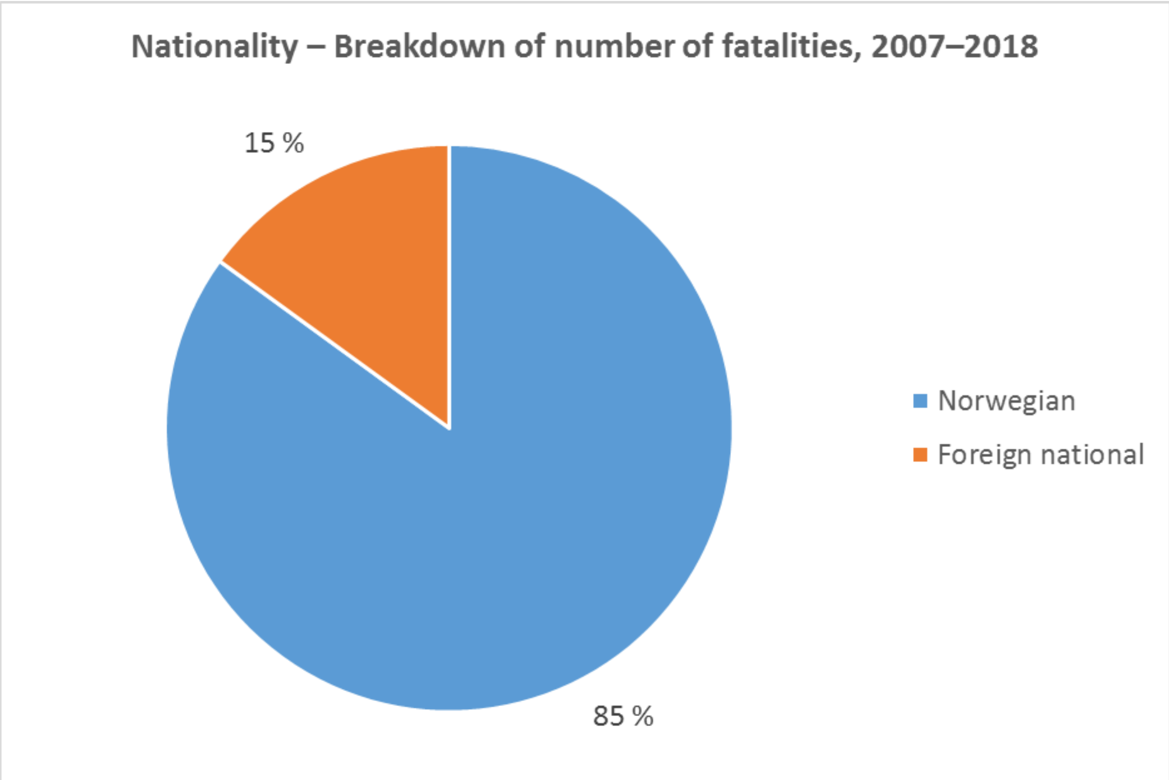



*Figure 45: Nationality – Breakdown of number of fatalities, 2008–2017*

### 4.6.2 Fatal recreational craft accidents, 2013–2017

For the last five years, more information was collected in order to find out more about the incidents that resulted in fatalities. The main findings are presented in this section.

#### 4.6.2.1 *Distribution by gender and age*

The breakdown of fatalities by gender is shown in Figure 46. The figure shows that it is mostly men who die in recreational craft accidents. This is related to the fact that it is mostly men who operate recreational craft, which means that their degree of exposure is higher.

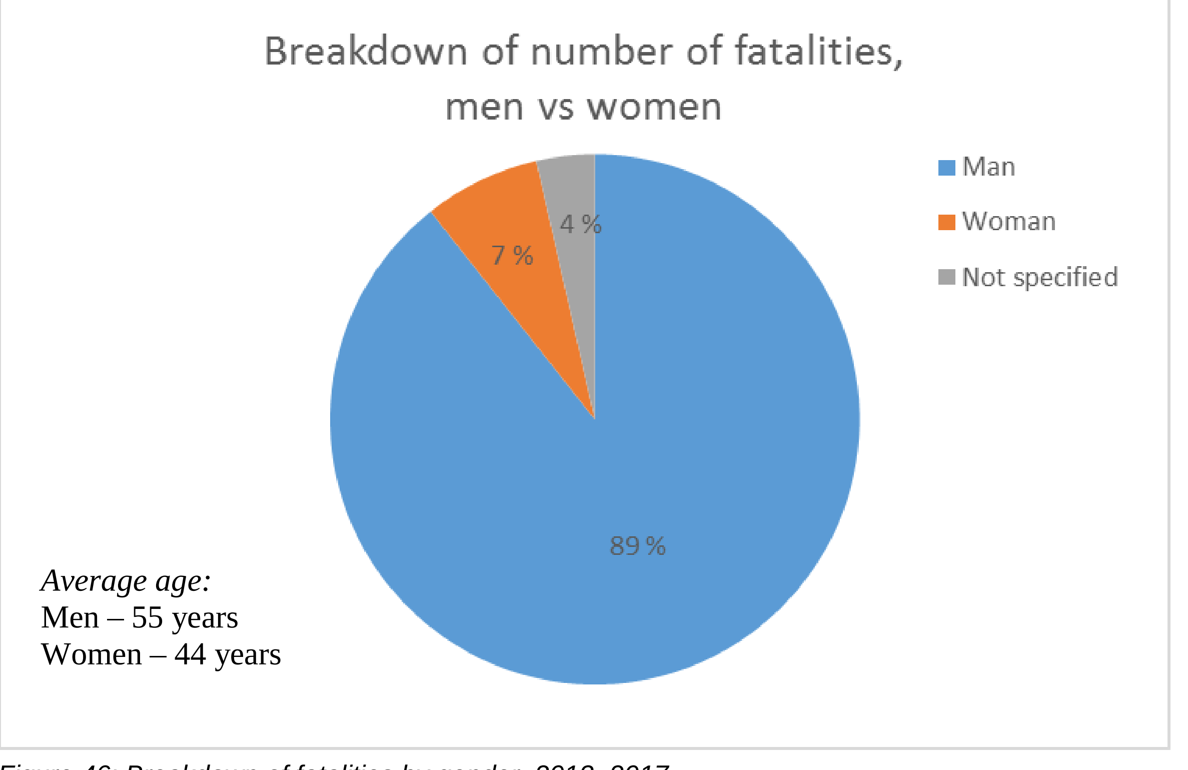



*Figure 46: Breakdown of fatalities by gender, 2013–2017*

The results also show that the average age of men who died is 55, compared with 44 for women. For 5% of the fatalities, no information about age was provided.

For incidents involving collision, grounding or contact damage, the average age is somewhat lower than the average for all accident types; see Figure 47.

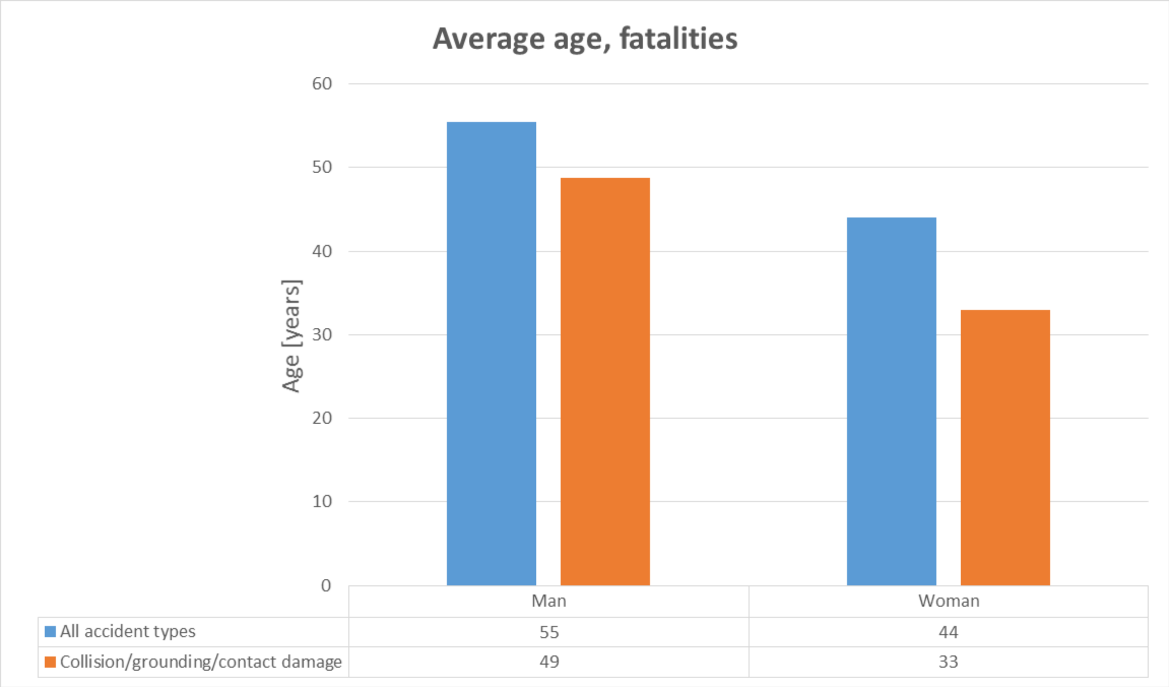



*Figure 47: Average age of fatalities, 2013–2017*

### 4.6.2.2 *Fishing as an activity*

In around 33% of the incidents involving fatalities, it is recorded that people on board were pursuing or intended to pursue fishing activities. In over half of the accidents involving fishing activities, the person involved was alone. The results also show that most of the people who died and had been pursuing fishing activities were Norwegian nationals; see Figure 48.

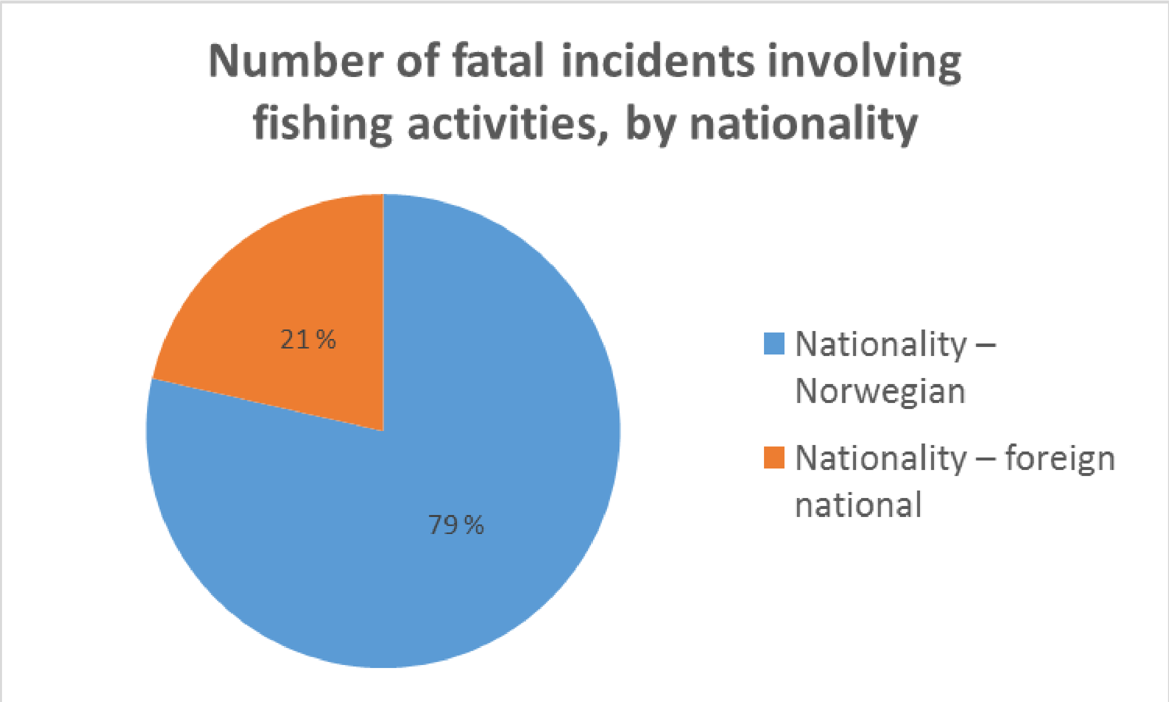



*Figure 48: Number of fatal incidents involving fishing activities, 2013–2017*

### 4.6.2.3 *Fishing tourism and rental*

In 14% of the fatal accidents, rental or (fishing) tourism had been recorded in the data material. Figure 49 shows that the number of fatalities over the last five years is relatively constant, with the exception of the year 2014. The recorded accident types relating to (fishing) tourism or rental are mainly person overboard and capsizing/foundering; see Figure 50.

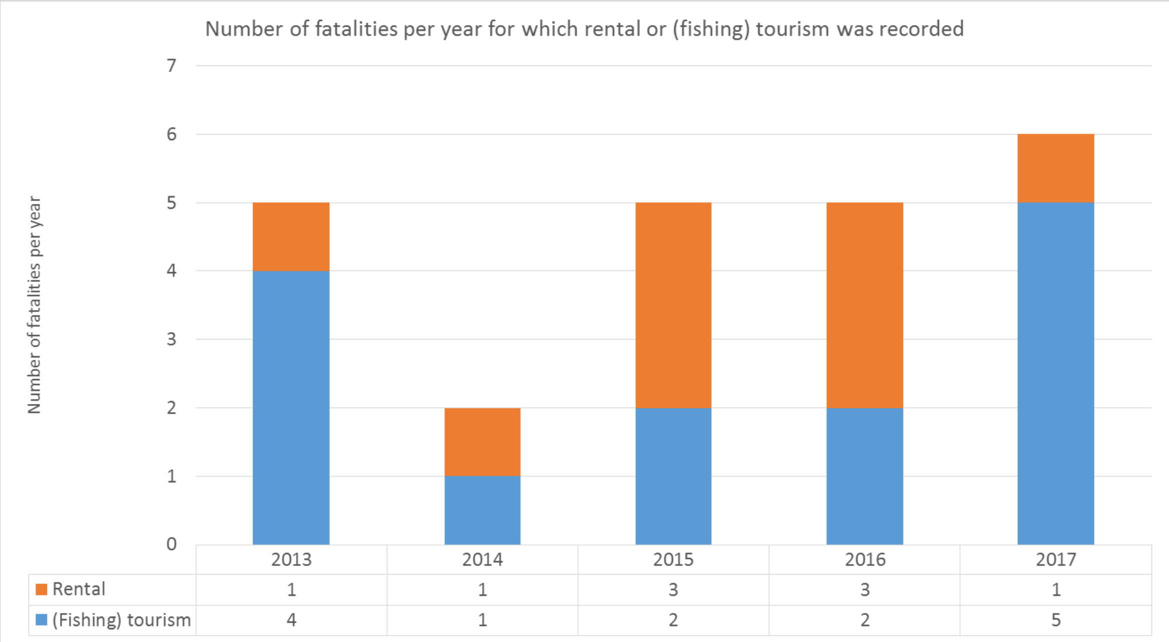



*Figure 49: Number of fatalities per year in which rental or (fishing) tourism was recorded*

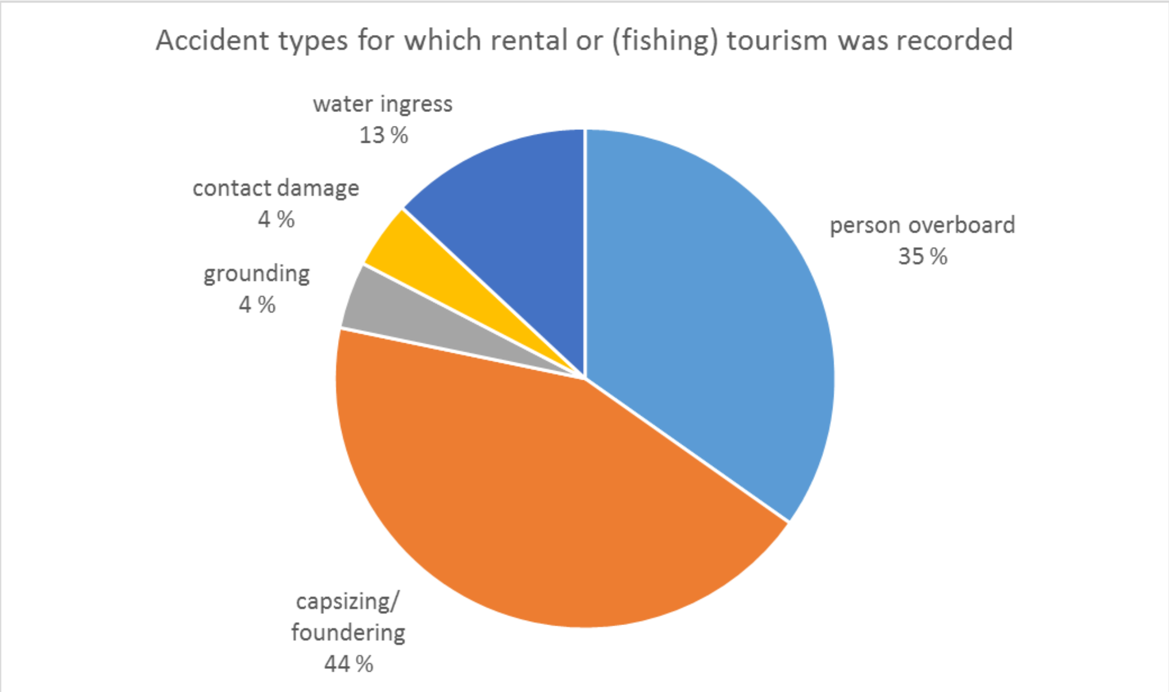



*Figure 50: Breakdown of accident types in which rental or (fishing) tourism was recorded*

#### 4.6.2.4 *Recorded factors (intoxication, speed, use of lifejacket)*

Intoxication was recorded for around 30% of the fatal incidents. It is not always apparent whether it was the operator or passengers who were intoxicated. Nor was there any information about the blood alcohol content, and whether this was above or below the permitted limit.

Intoxication and/or speed were recorded more frequently in fatal incidents involving collision, grounding or contact damage than for other accident types; see Figure 51. The data do not contain any more detailed information about either blood alcohol content or speed.

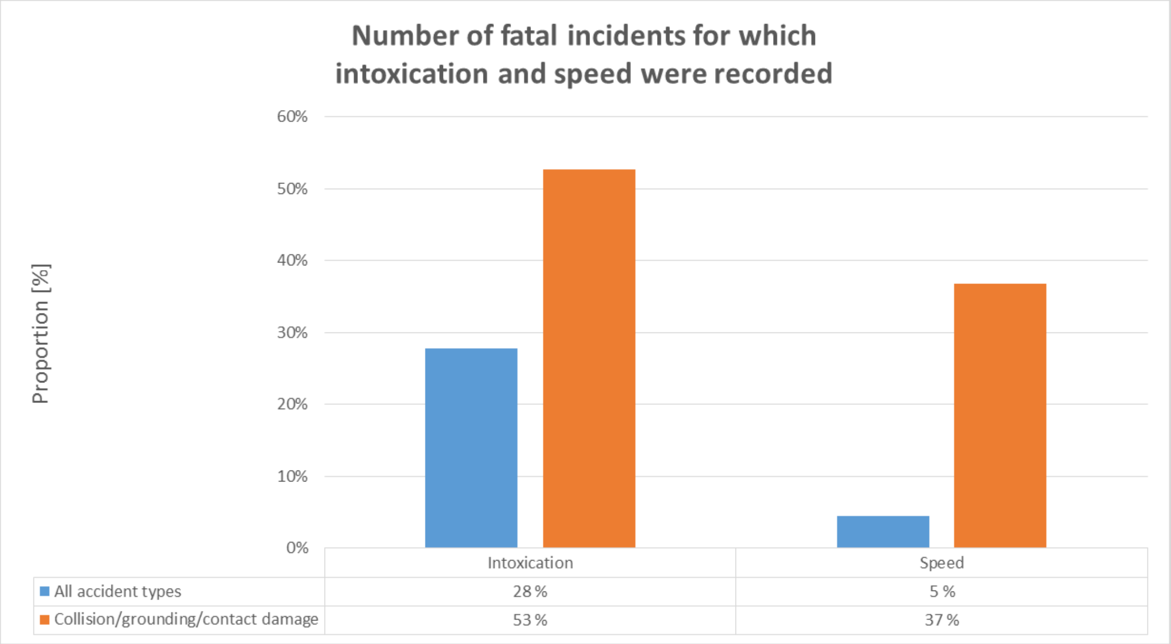



*Figure 51: Number of fatal incidents in which intoxication and speed were recorded, 2013–2017*

Figure 52 shows the number of fatal incidents in which the use of lifejackets was recorded. The results show that lifejackets were not used in over half of the fatal incidents. There is not enough information in the data to evaluate the effect or relevance of the use of lifejackets for the reported incidents. For recreational craft of less than eight metres, people are required to wear a suitable buoyancy vest or lifejacket while the craft is under way. This means that some of the incidents will involve situations in which the use of a lifejacket is not legally required.

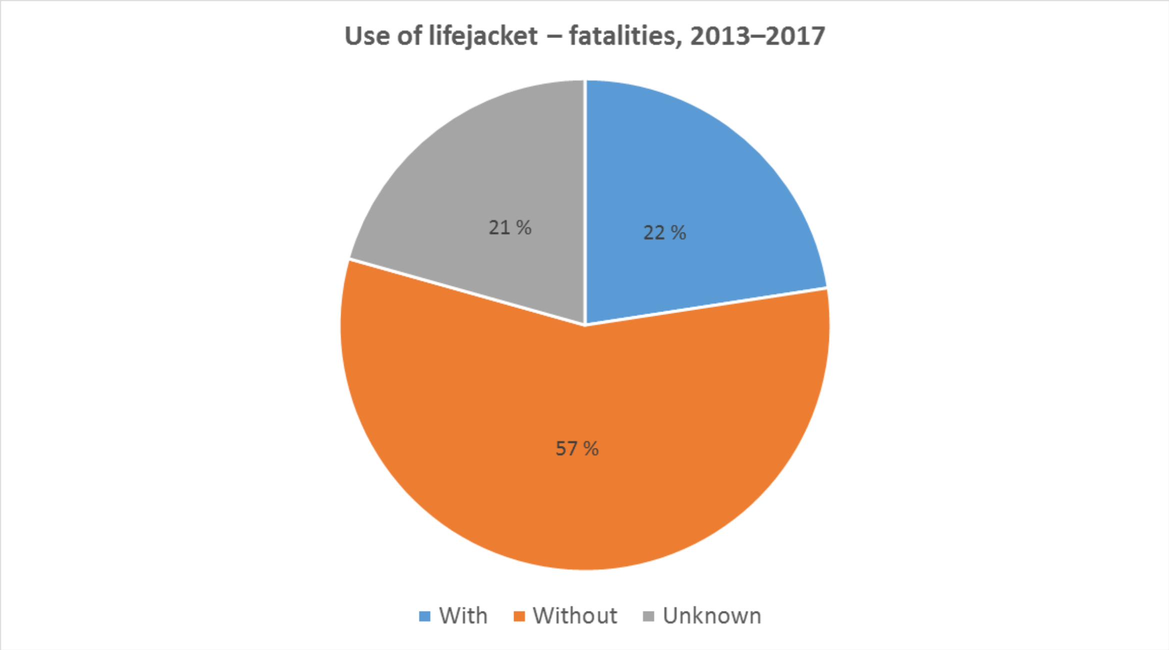



*Figure 52: Use of lifejacket recorded for fatalities, 2013–2017*

# 5. UNCERTAINTY

The results presented in this report contain a high degree of uncertainty. The figures presented should therefore be treated as trends and not absolute values.

The most significant uncertainties are presented here:

- The AIBN has sorted much of the data manually, both by removing and categorising incidents. This is due to the fact that the data material received contained a lot of free text, and was not categorised in the same way as in this report.
- The AIBN has used some selected sources based on which sources could best be used in the mapping work, in relation to the available time frame, use of resources and relevance. Since not all available sources were used, it is possible that not all relevant incidents were included in the data.
- Many recreational craft accidents are not reported.
- There are few incidents recorded for the accident type 'fall at quay or jetty' that did not result in deaths (mainly data received from the Norwegian Maritime Authority). This group is therefore assumed to be under-reported in relation to the number of incidents.
- The data contains both serious accidents as well as minor incidents and near-accidents.
- The data may also contain omissions with respect to accidents on inland lakes.

- The data provide some opportunity for the discussion of causes and circumstances. This is used as a reference base in the report 'Mapping of recreational craft accidents 2018'.

- The results have not been normalised against the number of recreational craft in Norway. Since there is no compulsory small craft register in Norway, there are no exact figures available for the number of recreational craft in Norway, nor is there a breakdown by geographic area over a ten-year period. It is on this basis that no normalisation was carried out of the number of craft by, for example, county or region. Variations from one geographic location to another in the number of incidents presented could therefore be closely related to the number of craft in an area.

# 6. CONCLUSIONS AND SUGGESTIONS FOR FURTHER WORK

The main conclusions and suggestions for further work are presented in this chapter.

## 6.1 Conclusions

The results must be interpreted as trends and not absolute values. The main conclusions from this mapping work may be summarised as follows:

### 6.1.1 All accidents/incidents involving recreational craft

- The average number of registered recreational craft accidents/incidents per year in the 2008–2017 period was approximately 1,200. The total number of recreational craft accidents shows an increasing trend over the ten-year period.

- Propulsion loss and grounding are the most frequently recorded accident types in Norway, making up a total of approximately 70% of the accidents (approx. 420–450 on average per year).

- Water ingress, capsizing/foundering, fire and person overboard accidents occur less frequently than the accident types mentioned above, but have a frequency of approximately 40–90 incidents on average per year.

- Collision, contact damage and personal injury are recorded as less frequently occurring incident types (approx. 6–9 on average per year).

- There are also around 100 incidents on average per year recorded as other/unknown.

- The overall increase in the number of accidents is primarily caused by the number of motorboat accidents. This is mainly due to the increase in the number of propulsion loss and grounding incidents for this type of craft. This could also be related to the increase in the number of motorboats.

- Motorboats are the type of craft involved in the most accidents per year, most likely because there are more motorboats than other craft, followed by sailing boats.

- Kayaks/canoes, personal watercrafts and boards are also showing an increasing trend in the number of accidents, although the number is significantly lower than for motorboats and sailing boats.

- Østfold, Vestfold, Rogaland and Hordaland are the counties with the most recorded recreational craft accidents.

- The results show that most of the incidents occur in the summer season from June to August. Around half of the recreational craft accidents in the summer months occur in July.

- Most of the accidents occurred during the day (06:00–24:00). The results show an increase in the number of recreational craft accidents during the day, while there is a constant trend in the development of recreational craft accidents at night. The most common accidents at night are collisions (22%) and person overboard accidents (16%).

- The data set has insufficient information regarding the effect and extent of the use of lifejackets.

### 6.1.2 Fatal recreational craft accidents, 2008–2017

- The number of recorded fatalities in the period 2008–2017 was 367. The results show a slightly falling trend.

- The most frequent cause of fatal incidents is recorded to be person overboard accidents (45%), followed by capsizing/foundering (23%), grounding (10%) and fall at quay or jetty (8%). Few of the incidents involving propulsion loss have led to fatal accidents, even though this type of accident dominates the total number of accidents.

- There is little or no information about the causes of falls overboard in the data.

- Capsizing/foundering and person overboard incidents resulting in deaths are mainly recorded for motorboats or kayaks/canoes.

- Most of the fatal accidents involve motorboats, except for incidents involving falls at a quay or jetty, where information about the craft is missing in most cases. The results also show that there have been quite a few fatal accidents involving kayaks/canoes in addition to dinghies, rowing boats and sailing boats. Approximately 75% of motorboat accidents where the size is specified concern craft of less than 26 feet. This indicates that most fatal accidents occur on small craft.

- The results show that for groundings, about half (41%) of the fatal accidents occur at night. Intoxication was recorded for around 33% of these incidents. Intoxication was recorded for around 45% of the fatal incidents involving falls from a quay or jetty.

- The counties with the most fatalities differ somewhat from the counties with the highest total number of accidents. Hordaland, Nordland, Trøndelag and Møre og Romsdal are the counties where the most fatalities are recorded.

- The results show that most of the people who died were Norwegian nationals (85%).

### 6.1.3 Fatal recreational craft accidents, 2013–2017

- The results show that it is mostly men who die in recreational craft accidents. This is probably because it is mostly men who operate recreational craft, which means that their degree of exposure is higher. The results also show that the average age of men who died is 55, compared with 44 for women. For 5% of the fatalities, no information about age was provided.

- For incidents involving collision, grounding or contact damage, the average age is somewhat lower than the average for all accident types.

- In around 33% of the incidents involving fatalities, it is recorded that people on board were pursuing or intended to pursue fishing activities. In over half of the accidents involving fishing activities, the person involved was alone. In 14% of the fatal accidents, rental or (fishing) tourism was recorded in the data material.

- Intoxication was recorded for around 33% of the fatal incidents in this period. It is not always apparent whether it was the operator or passengers who were intoxicated. Nor was there any information about the blood alcohol content, and whether this was above or below the permitted limit.

- Intoxication and/or speed were recorded more frequently in fatal incidents involving collision, grounding or contact damage than for other accident types. The data do not contain any more detailed information about either blood alcohol content or speed.

- The results show that lifejackets were not used in over half of the incidents involving fatalities in the 2013–2017 period. There is not enough information in the data to evaluate the effect or relevance of the use of lifejackets for the various incidents.

## 6.2 Suggestions for further work

The mapping work has found that, if a single set of statistics is to be kept for recreational craft accidents over time, a system will have to be established for the collation of data from multiple parties through defined parameters, in order to simplify the task and make the results more accurate.

An important aspect will be to establish procedures that guarantee that relevant incidents will be reported as completely as possible. Accidents that do not involve an acute need for immediate assistance, but that nevertheless result in significant material damage or personal injury, should also be included.

The registration system should contain functions for recording relevant information, both for the purpose of monitoring trends in recreational craft accidents and with a view to establishing measures to reduce the number of recreational craft accidents.

Accident Investigation Board Norway

Lillestrøm, 27 March 2019