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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Photo of ferry on the Norwegian west coast: Bente Amandussen

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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. Two persons suffered serious physical injuries. 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.

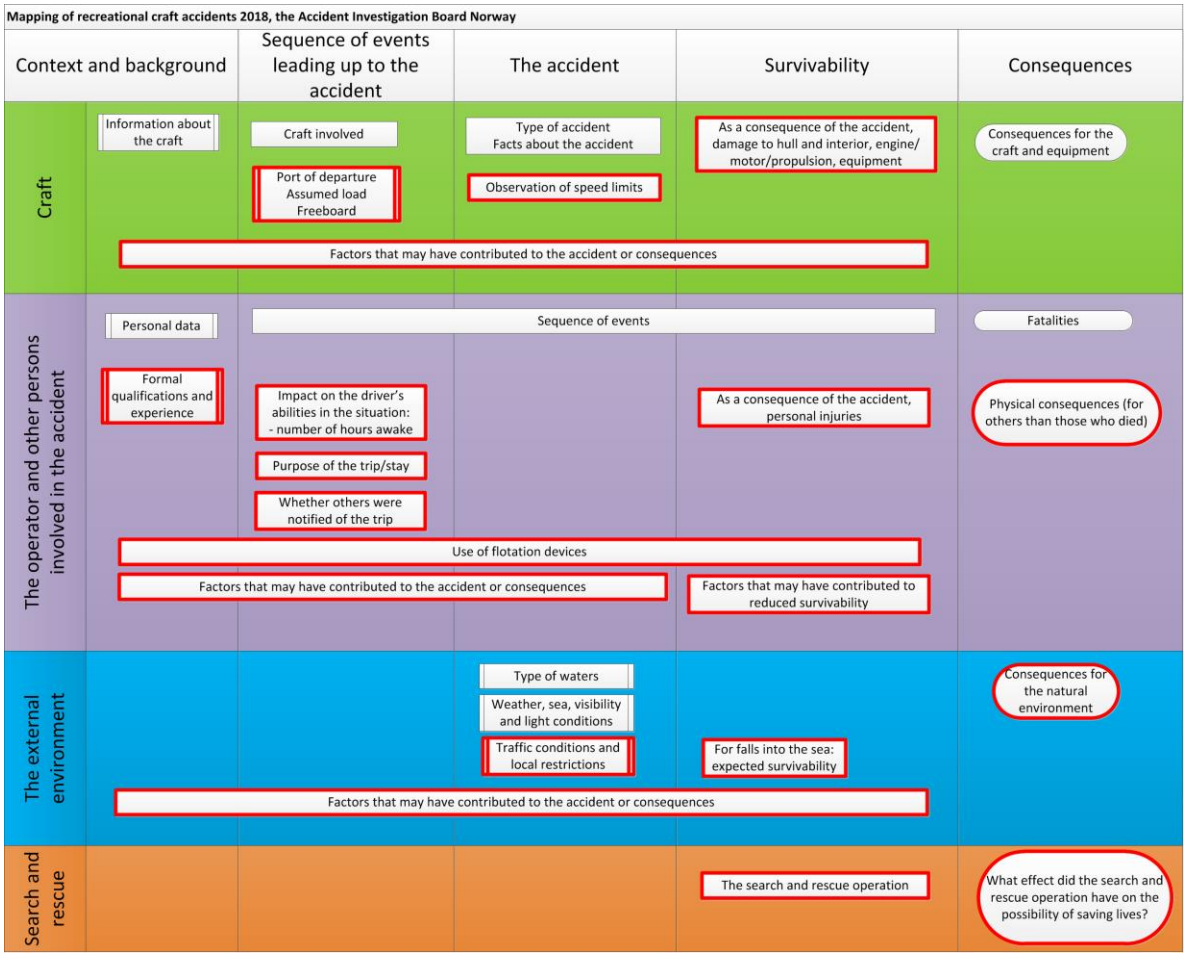


Figure 2: The parties involved and phases used to obtain information relevant to describing the sequence of events and the circumstances surrounding fatal recreational craft accidents. The boxes with red outlines show information that was not collected by the Norwegian Maritime Authority's form KS-0602 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).

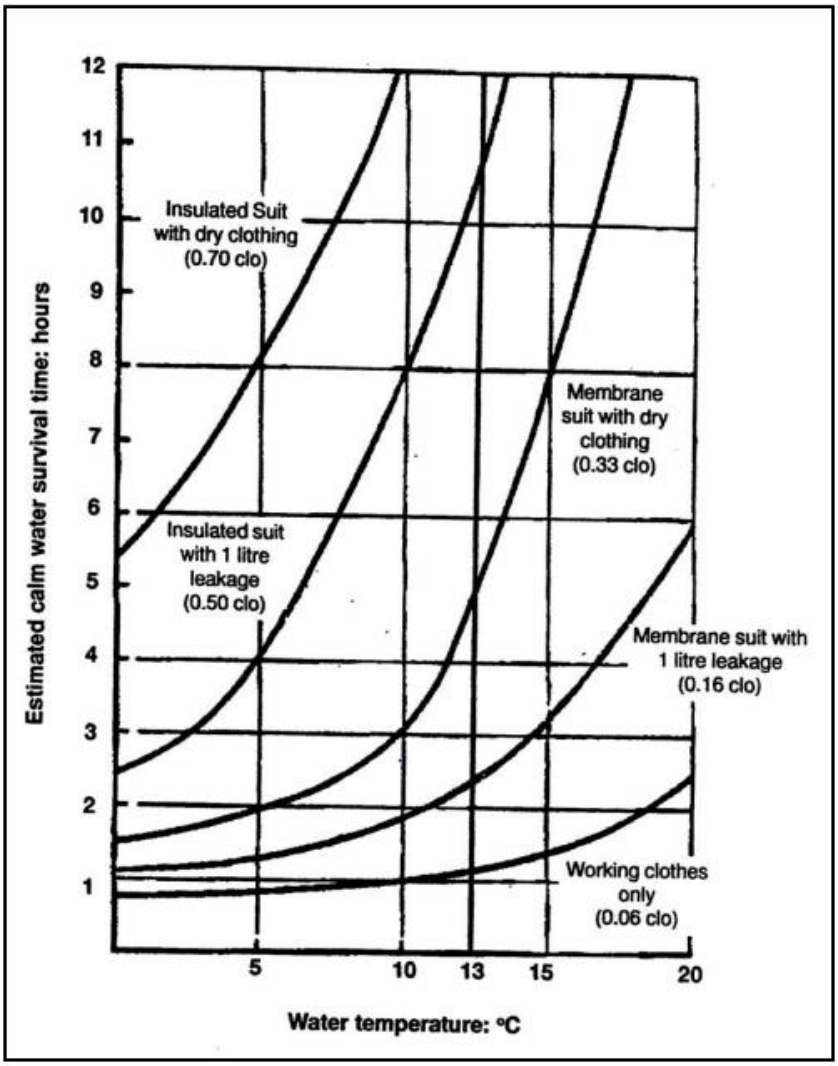


Figure 3: Estimated survival time in calm water (small waves) at different temperatures and with different clothing. The model is based on young, slim and healthy men. Both 'membrane suit' and 'insulated suit' refer to dry suits. Source: Review of probable survival times for immersion in the North Sea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

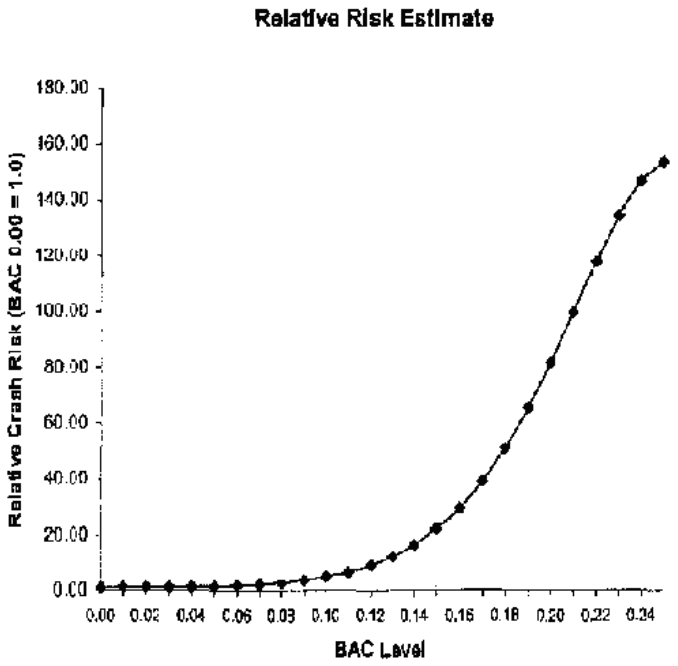


Figure 6: Correlation between alcohol intoxication and accident risk. The risk begins to increase at a BAC of about 0.05%. Source: The Long Beach/Fort Lauderdale relative risk study (Blomberg, Peck, Moskowitz, Burns, & Fiorentino, 2009)

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 The taxi boat Isabella and a recreational craft (collision)

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 Viking 7 (capsizing)

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

[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.

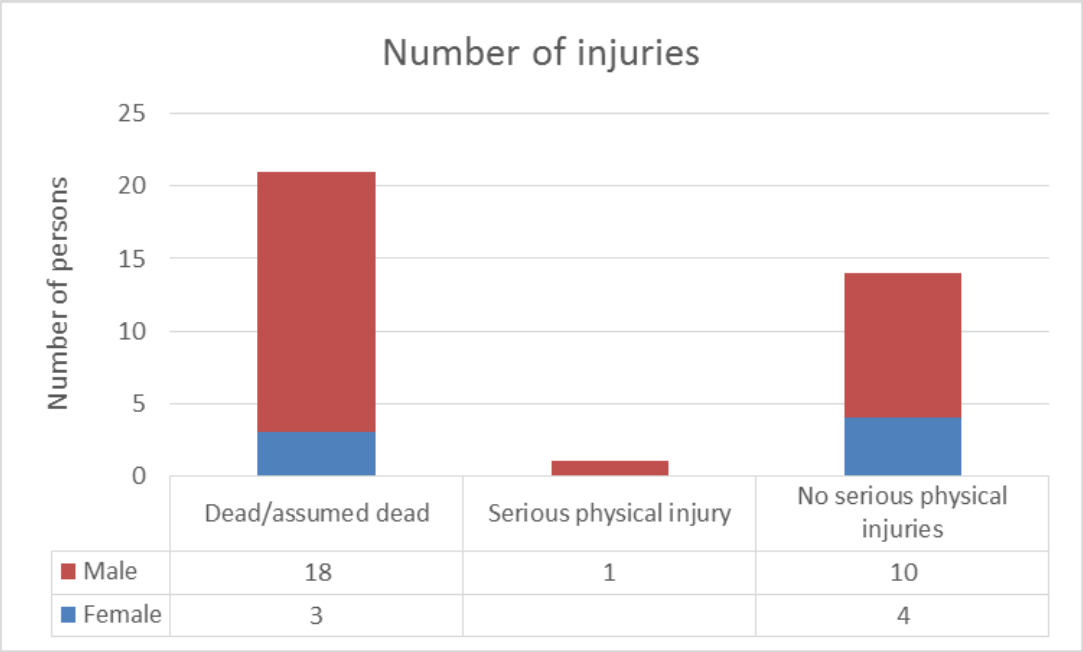


Figure 7: Number of fatalities, persons sustaining physical injuries and persons sustaining no serious injuries. The figures include everyone involved in the fatal recreational craft accidents that are included in the analysis.

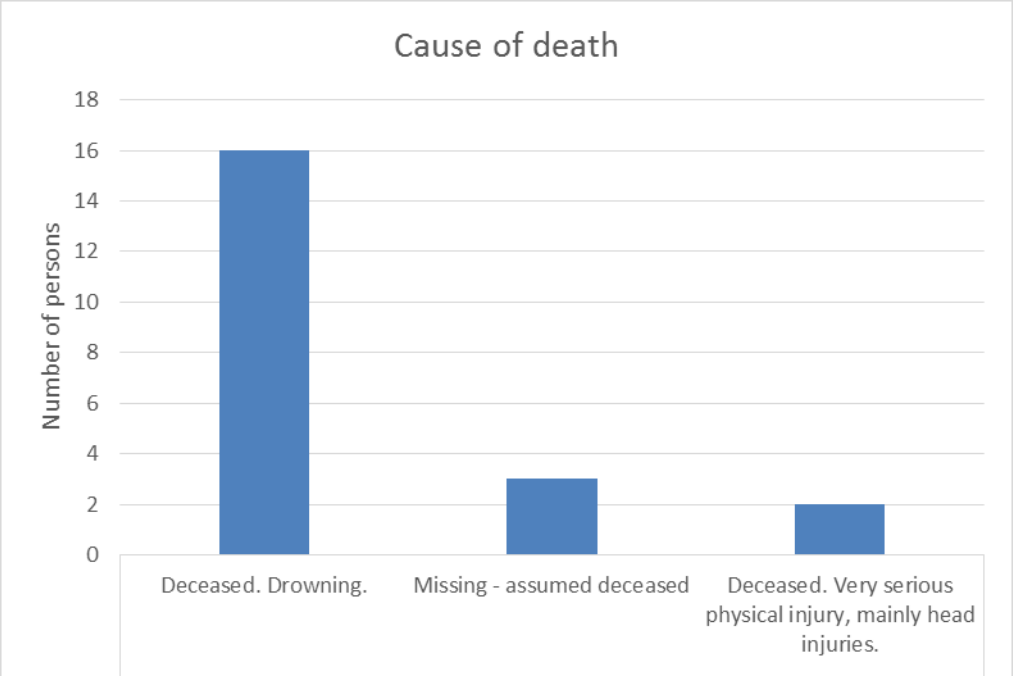


Figure 8: Number of fatalities broken down by cause of death. The figures include all fatalities included in the analysis.

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. 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.

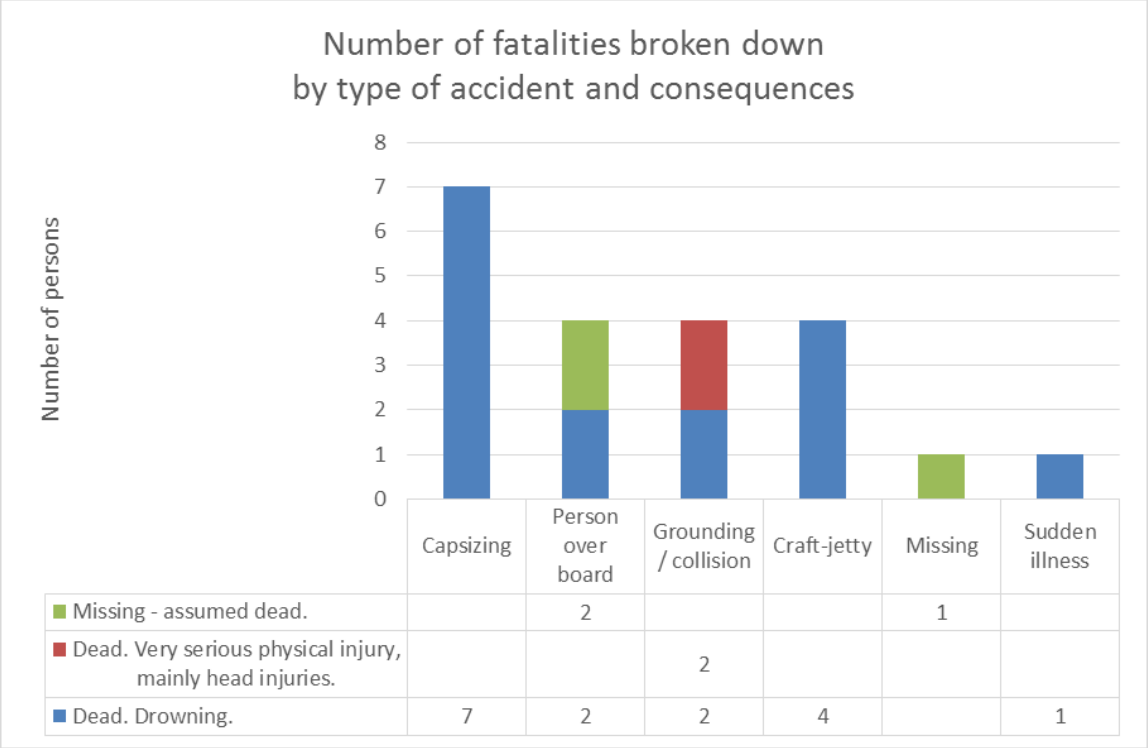


Figure 9: Fatalities broken down by type of accident and consequences.

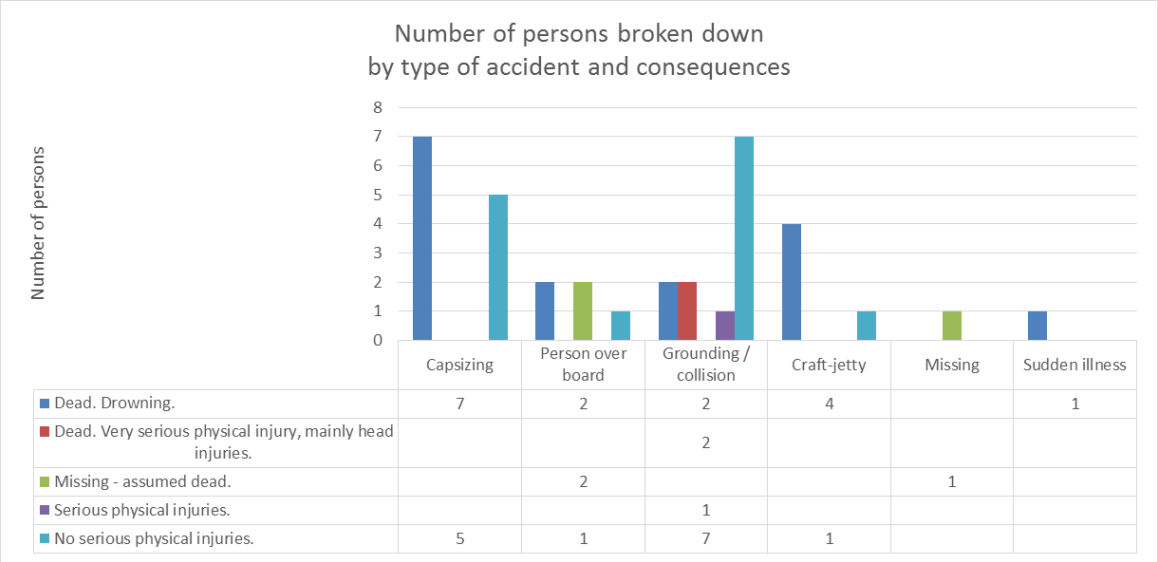


Figure 10: Number of persons involved in the accidents, broken down by type of accident and consequences.

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.

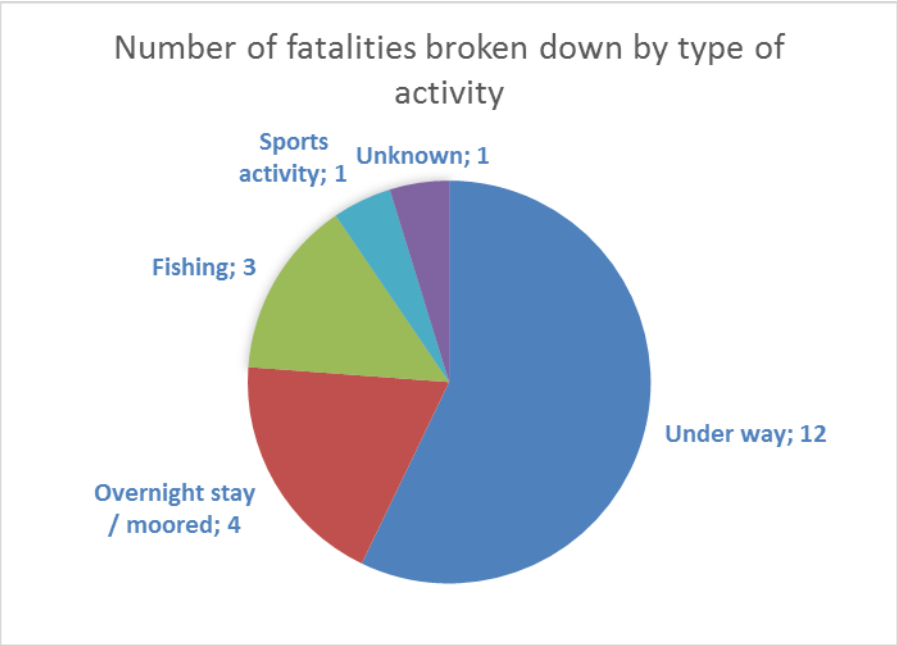


Figure 11: Number of fatalities broken down by type of activity.

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.

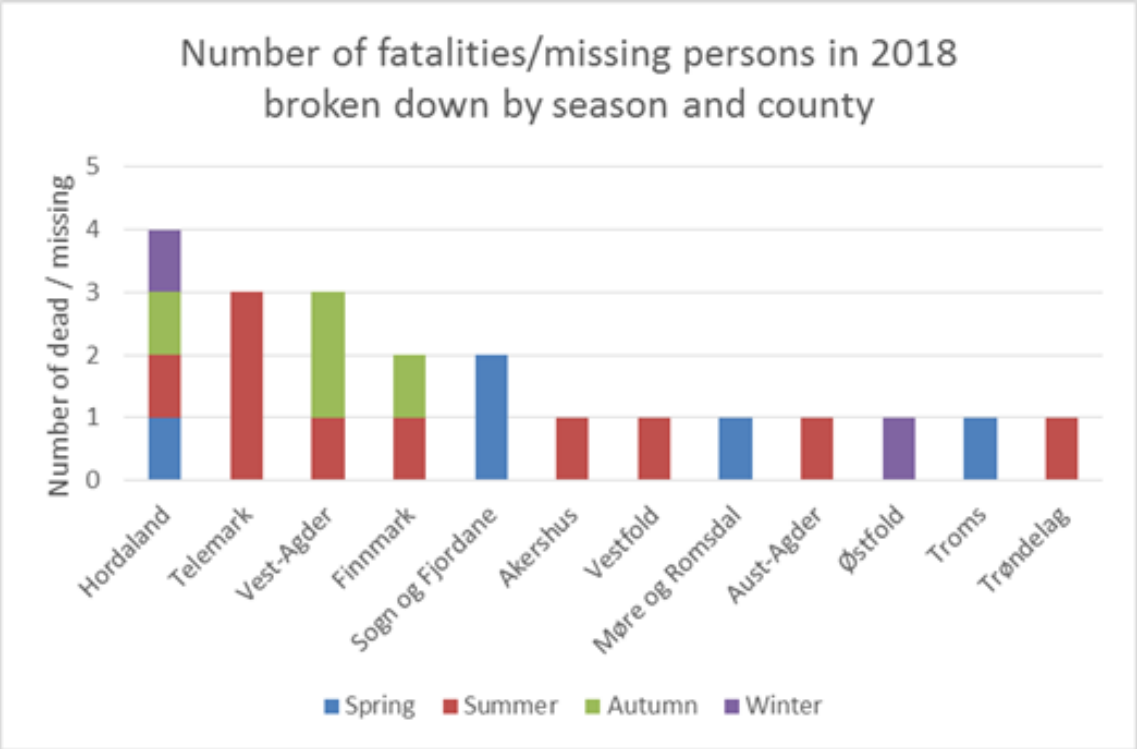


Figure 12: Number of fatalities/missing persons in 2018 broken down by season and county.

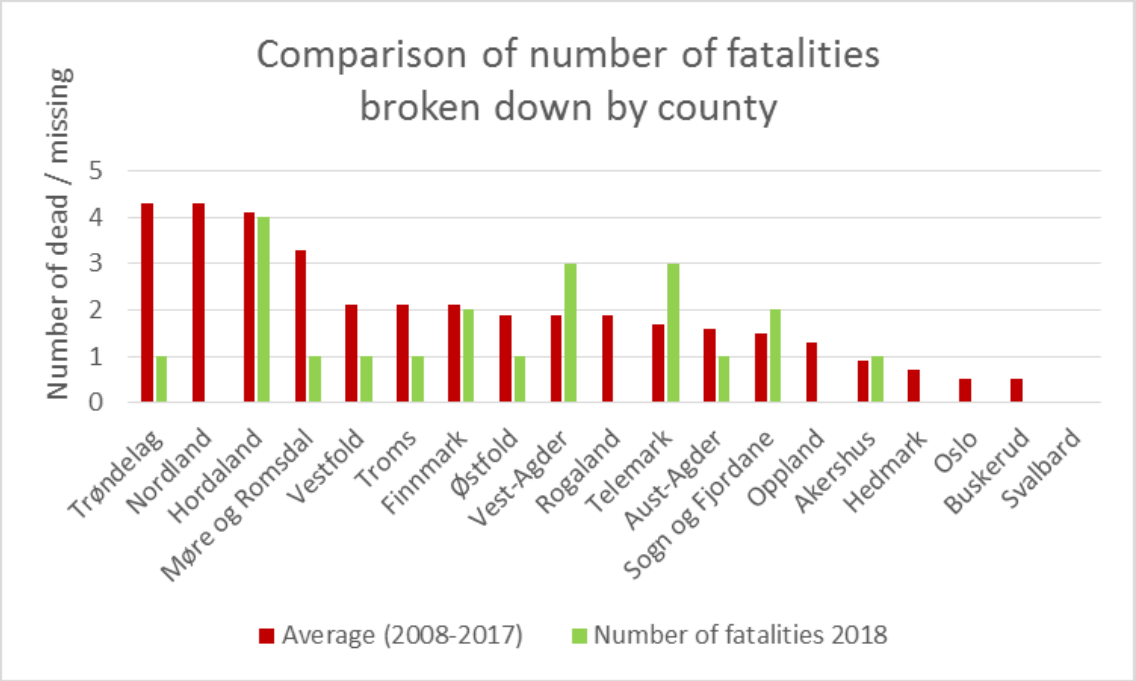
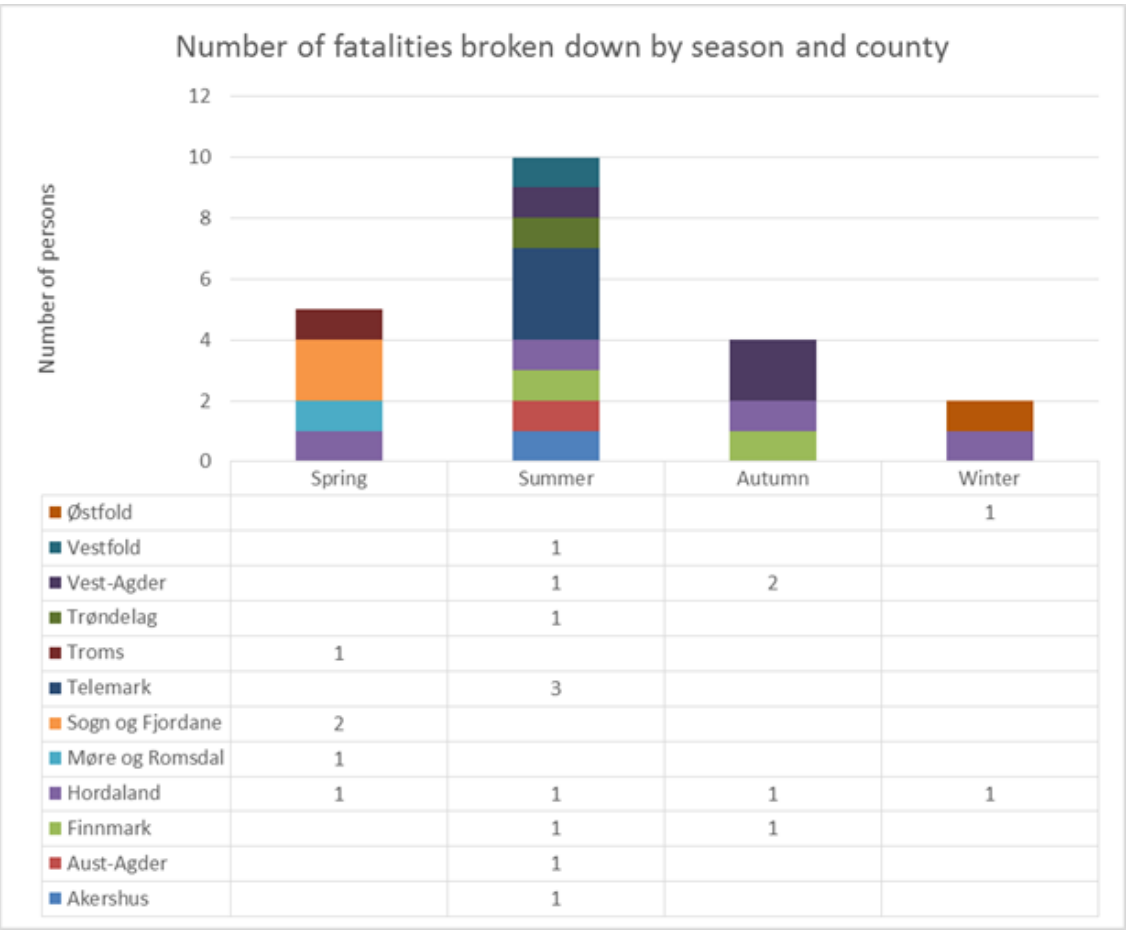


Figure 13: Comparison of the number of fatalities in 2018 with the average for the 10 preceding years. Two accidents in 2018 are not included. They are the ones in the counties in Nordland and Vestfold.



	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.

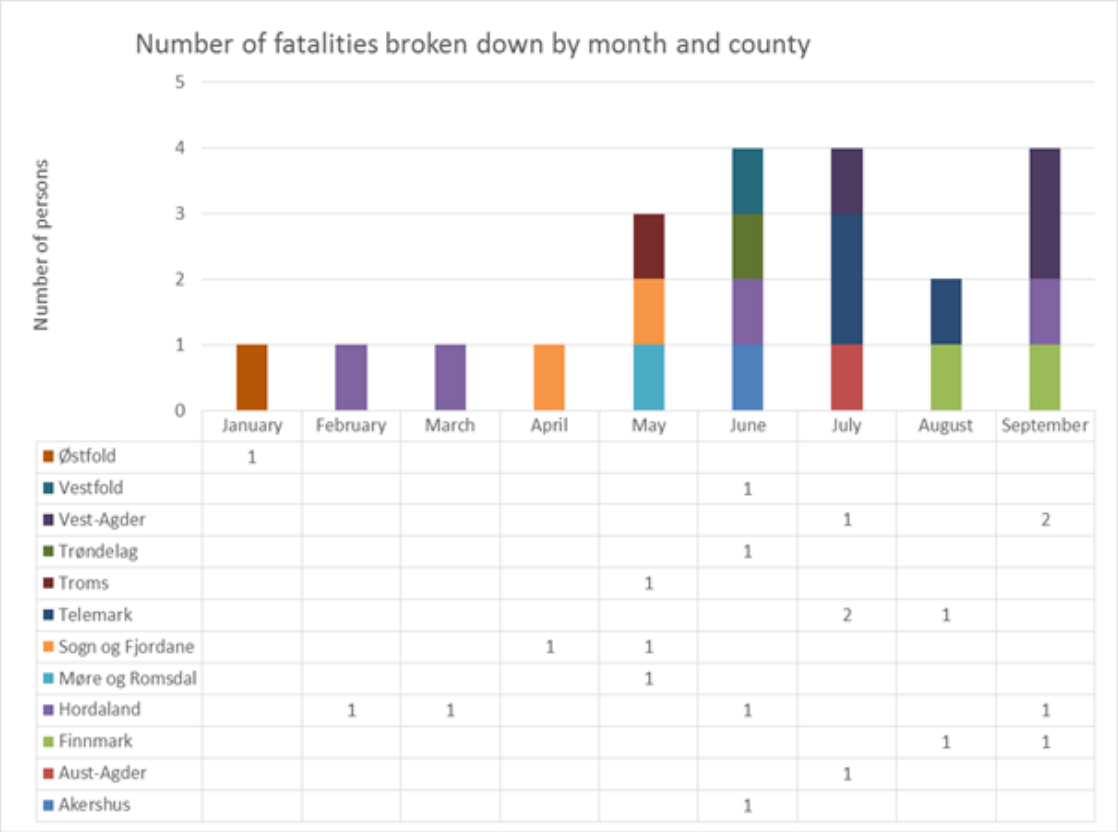


Figure 15: Number of fatalities broken down by month and county.

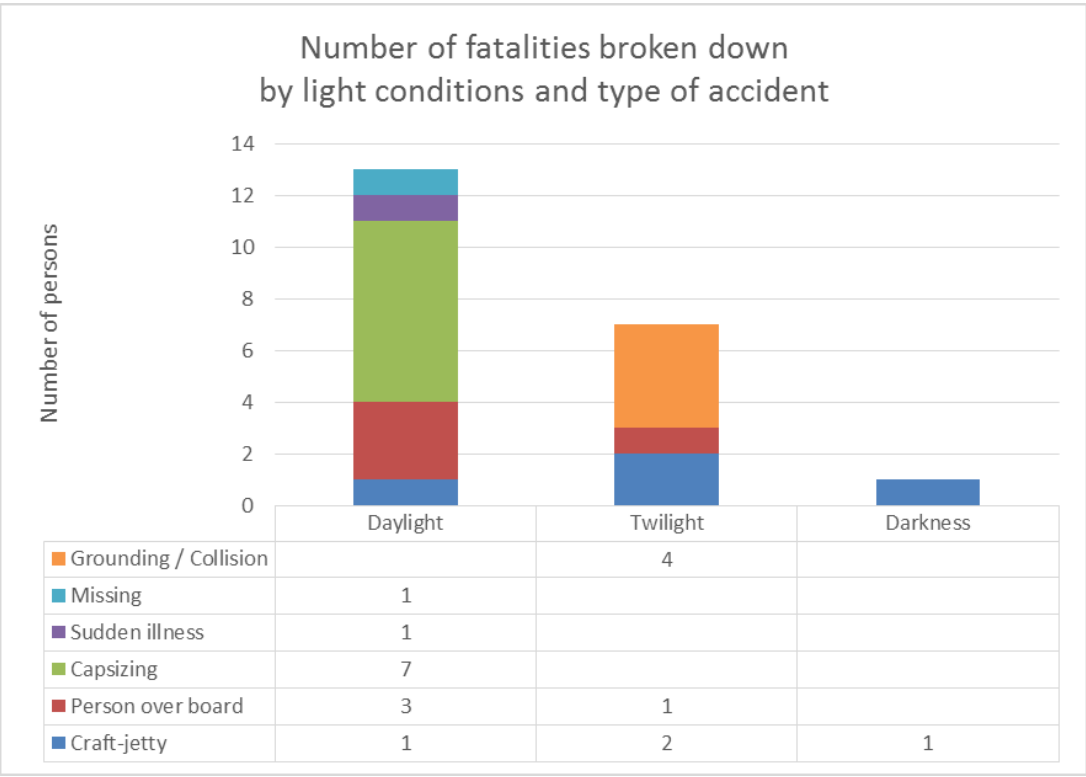


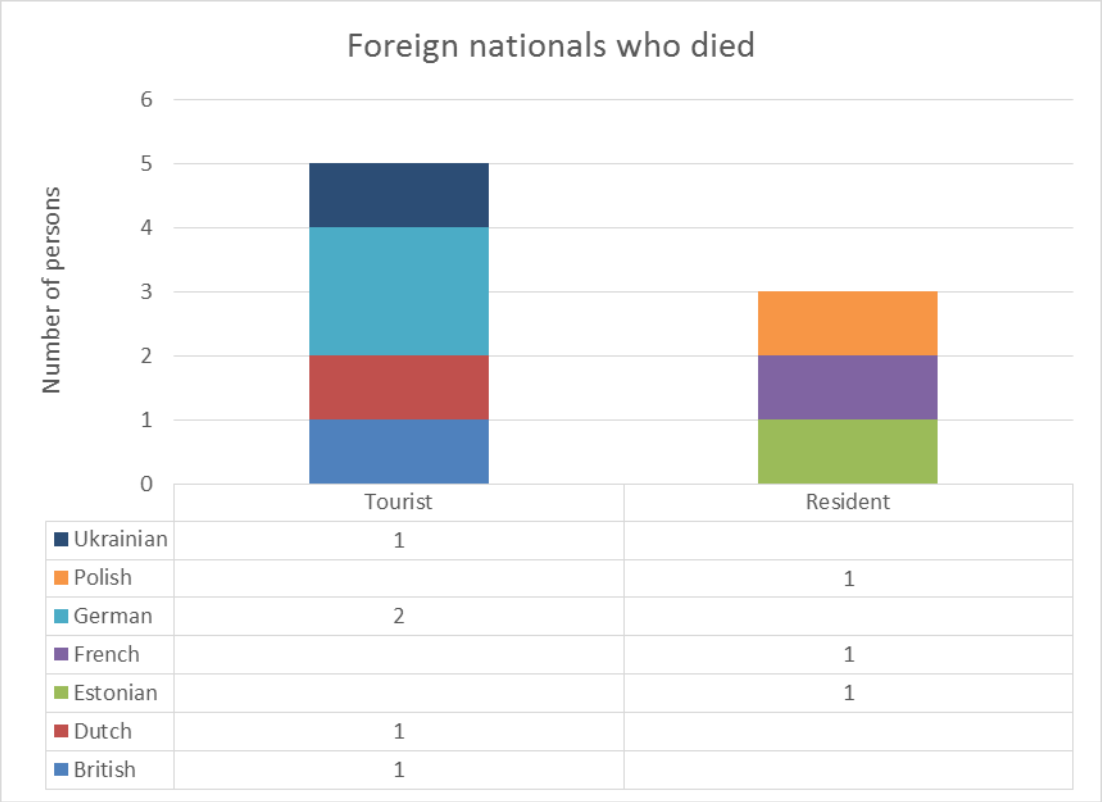
Figure 16: Number of fatalities broken down by light conditions and type of accident.

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.

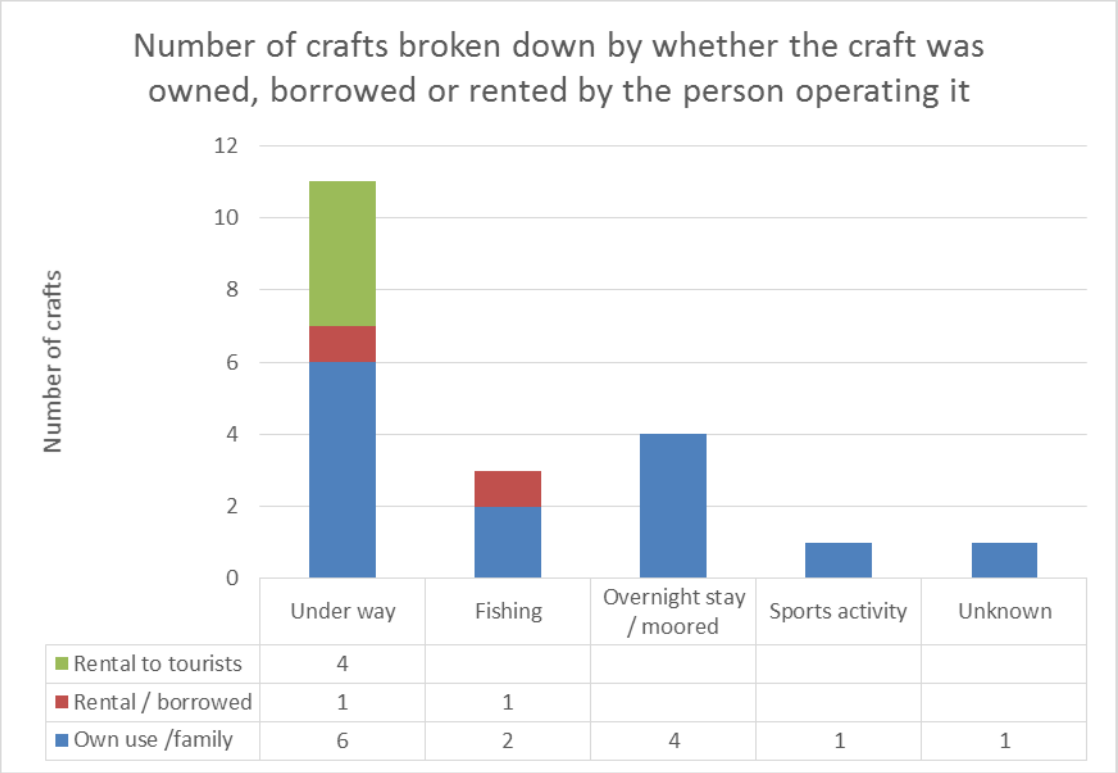


Figure 18: Number of fatalities broken down by type of activity and whether the craft was owned, borrowed or rented by the person operating it.

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.

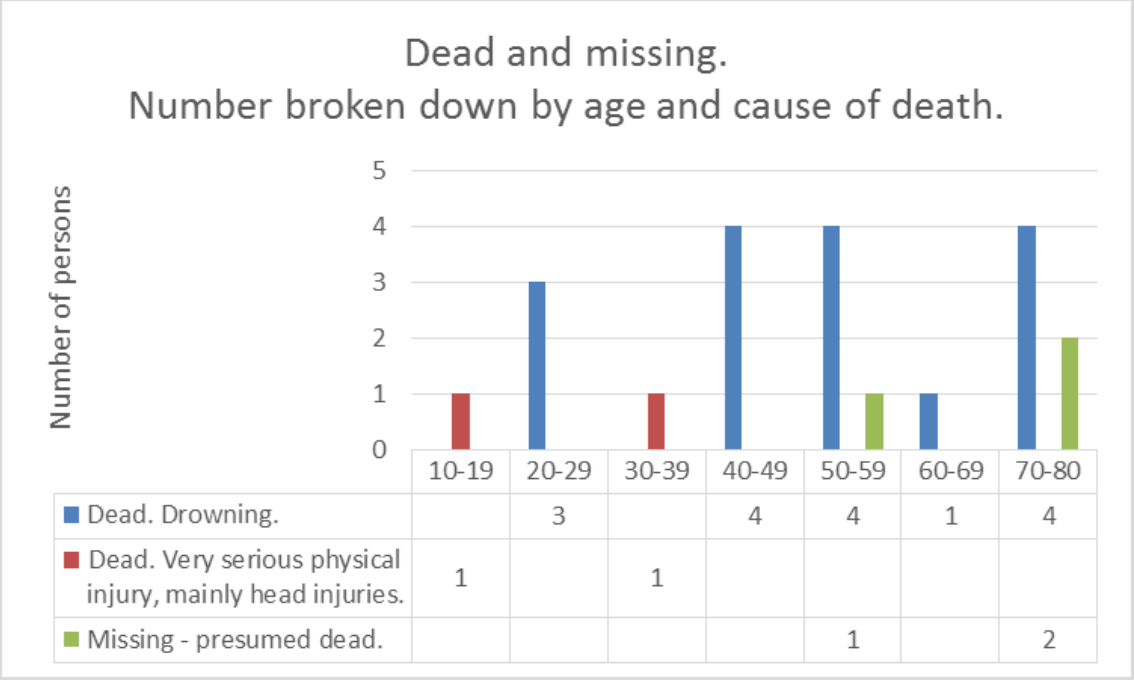


Figure 19: Breakdown by age and cause of death.

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.

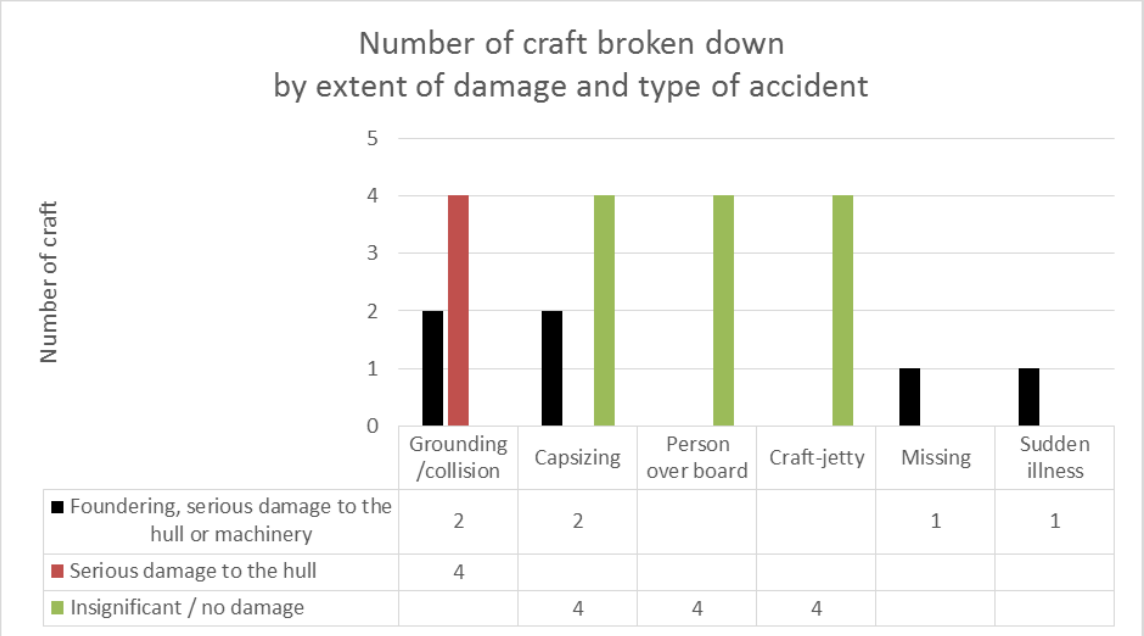


Figure 20: Number of damaged craft broken down by type of accident.

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.

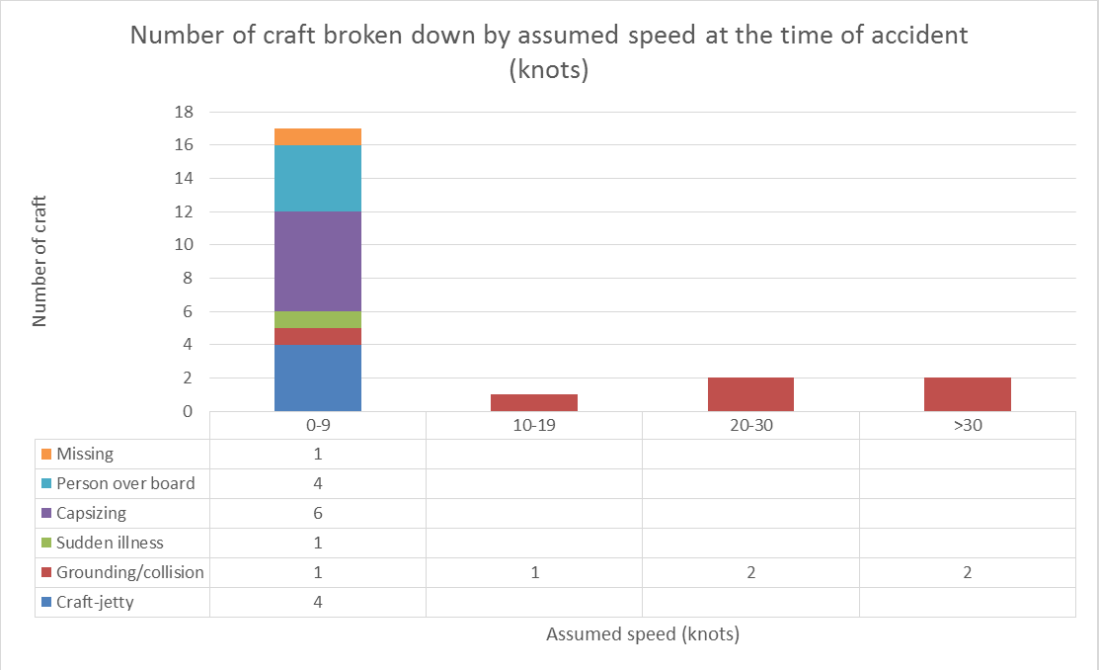


Figure 21: Assumed speed of the craft at the time of the accident.

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.

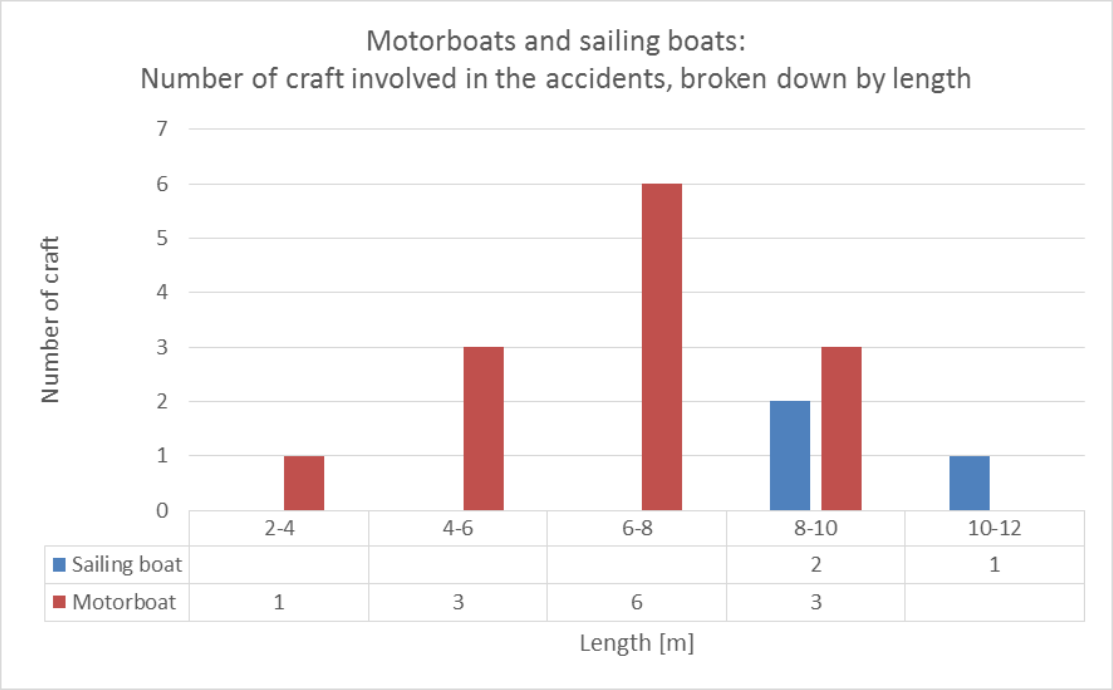


Figure 22: Motorboats and sailing boats broken down by length.

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

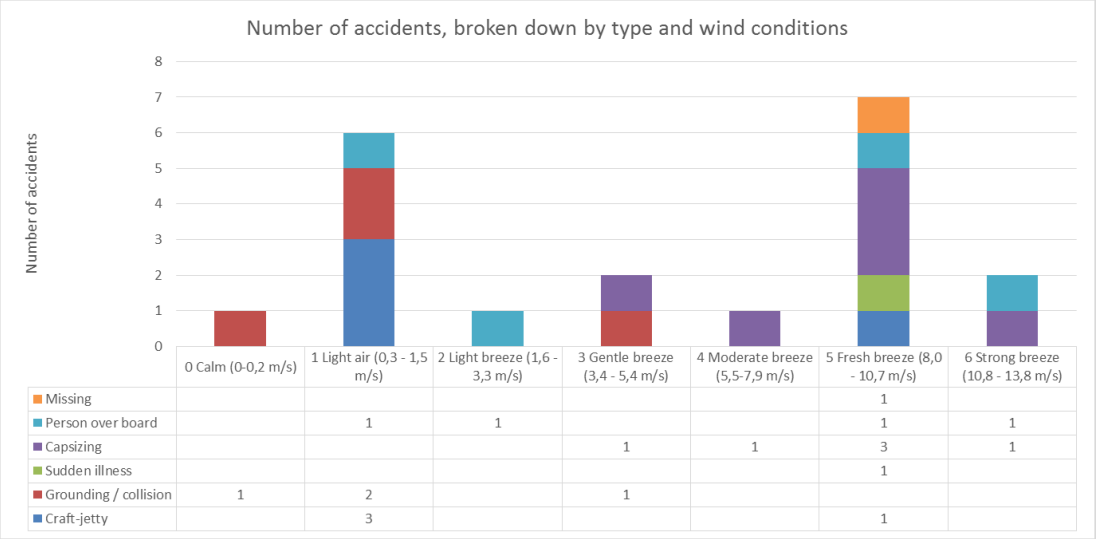


Figure 23: Number of accidents of different types broken down by wind conditions at the assumed time of the accident.

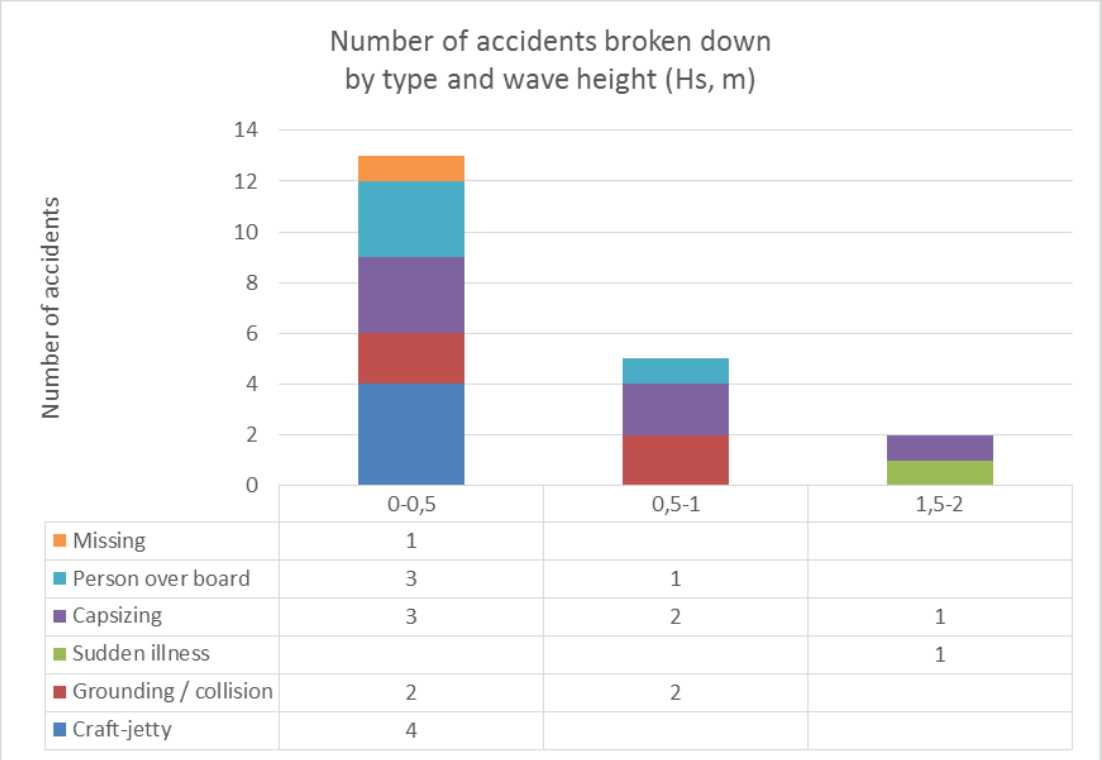


Figure 24: Number of accidents of different types broken down by wave height at the assumed time of the accident.

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.

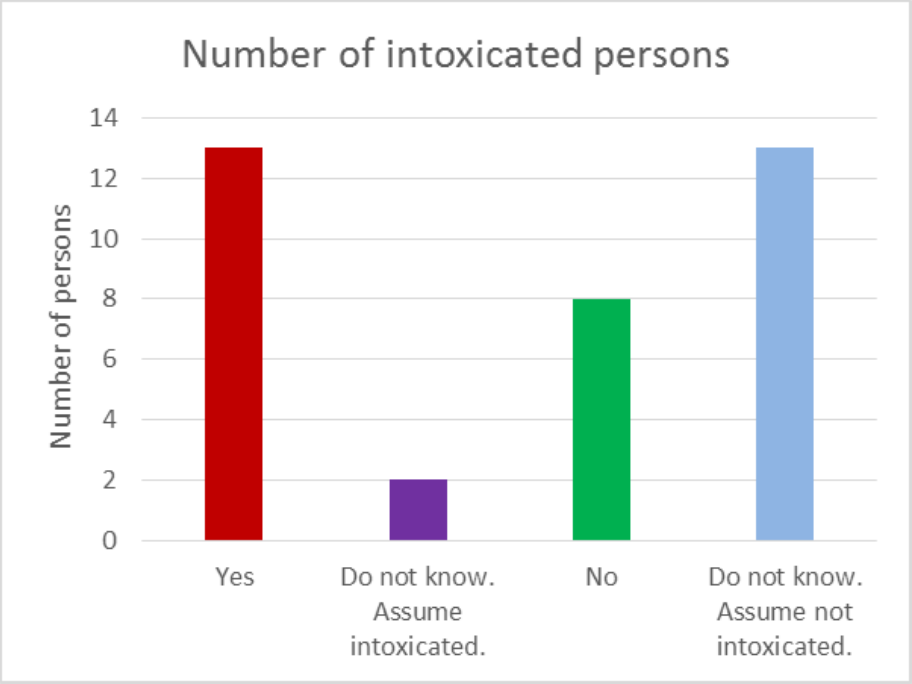


Figure 25: Number of persons involved in accidents and whether or not they were intoxicated.

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.

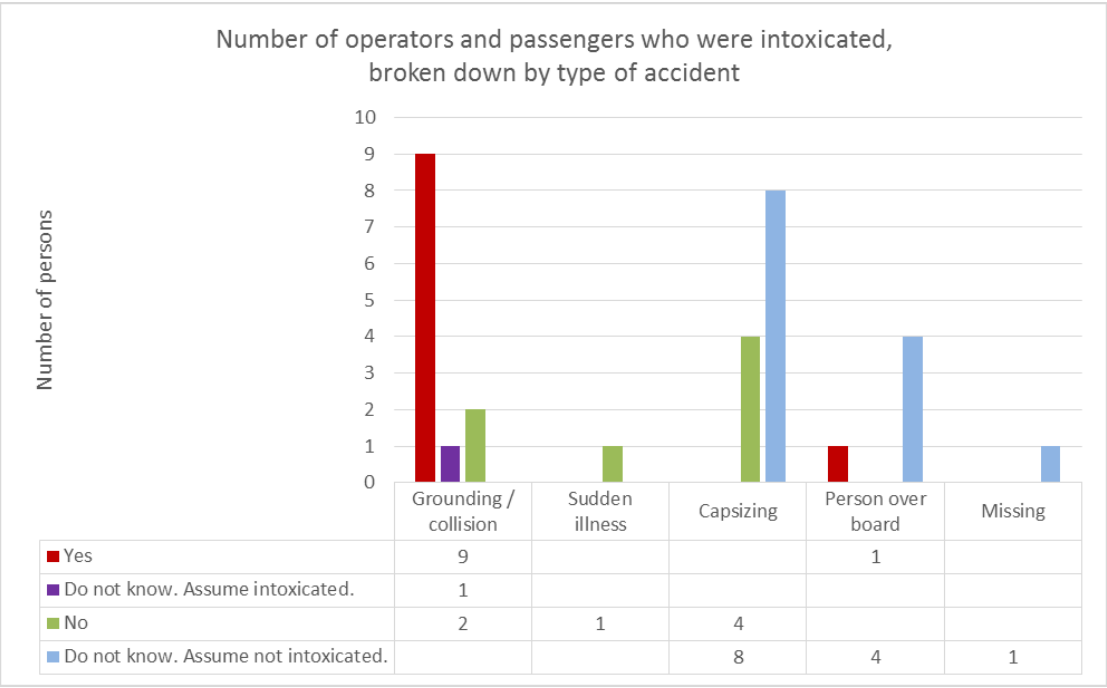


Figure 26: Number of operators and passengers who were intoxicated. The figure does not include accidents involving moored craft.

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.

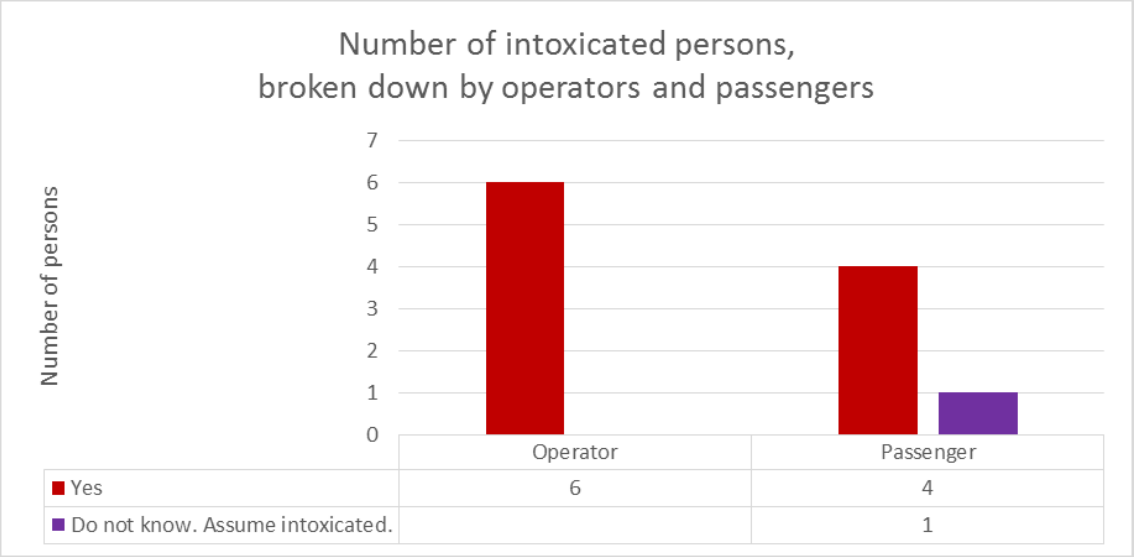


Figure 27: Number of intoxicated persons broken down by whether they were operators or passengers. The figure does not include accidents involving moored craft.

[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.

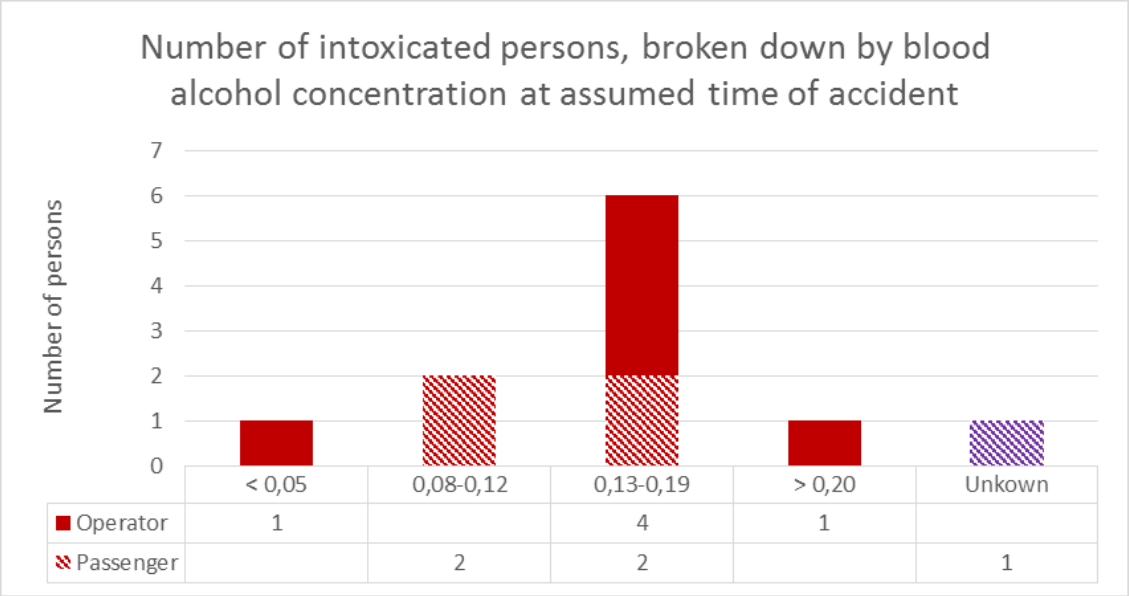


Figure 28: The figure shows the number of intoxicated operators and passengers broken down by BAC at the assumed time of the accident. All the recreational craft were under 15 metres long, which means that the current limit for operating them is a BAC of 0.08%. The figure does not include accidents involving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

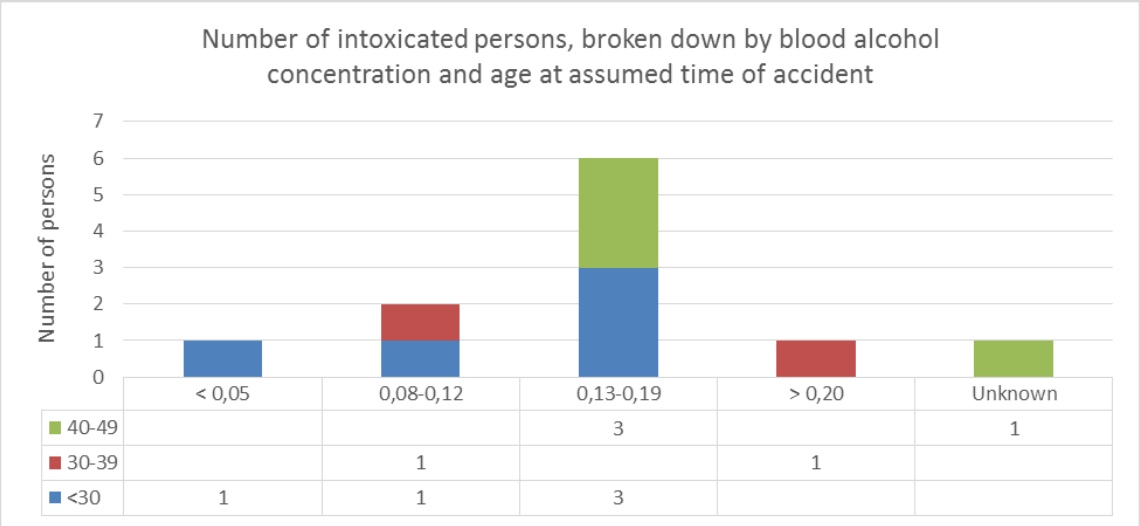


Figure 29: The figure shows the number of intoxicated persons broken down by BAC and age at the assumed time of the accident. The figure does not include accidents involving moored craft.

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.

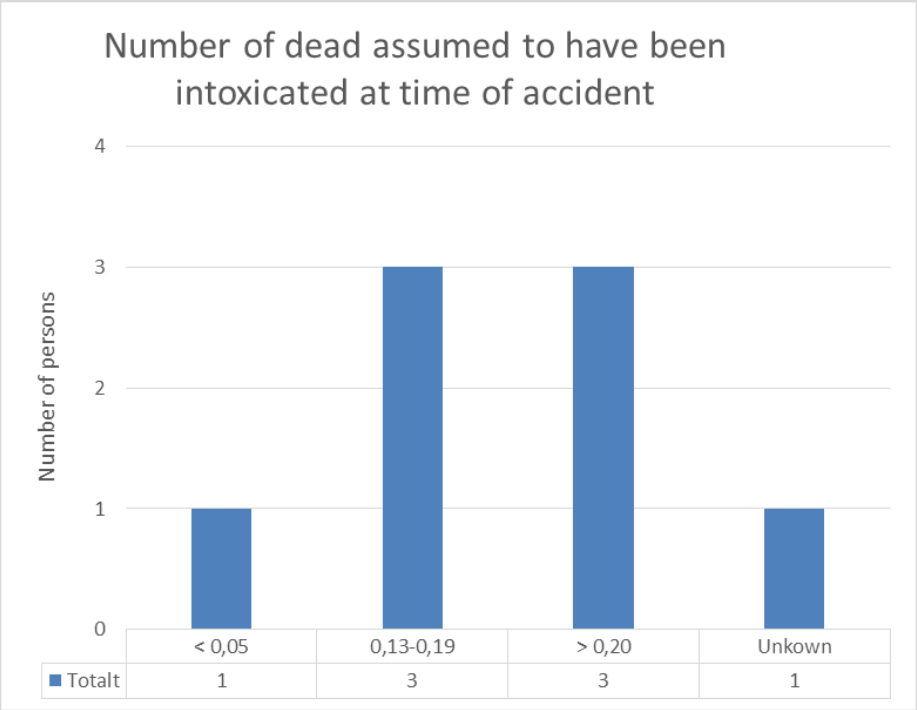


Figure 30: Number of people who died in accidents while intoxicated, broken down by BAC.

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.

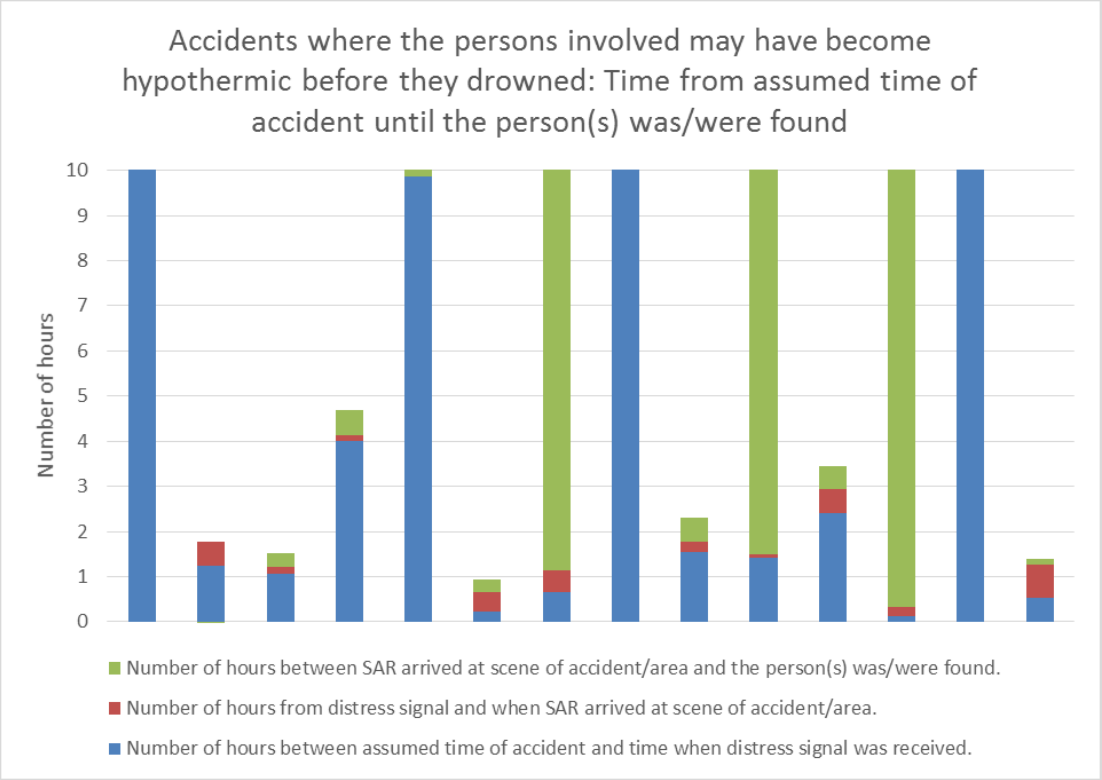


Figure 31: Number of hours from the assumed time of the accident until the persons were found. Each bar represents one accident. Victims of three accidents are still missing. In three of the accidents, it took several days to find the person. The maximum value on the Y axis has been set to 10 hours and 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.

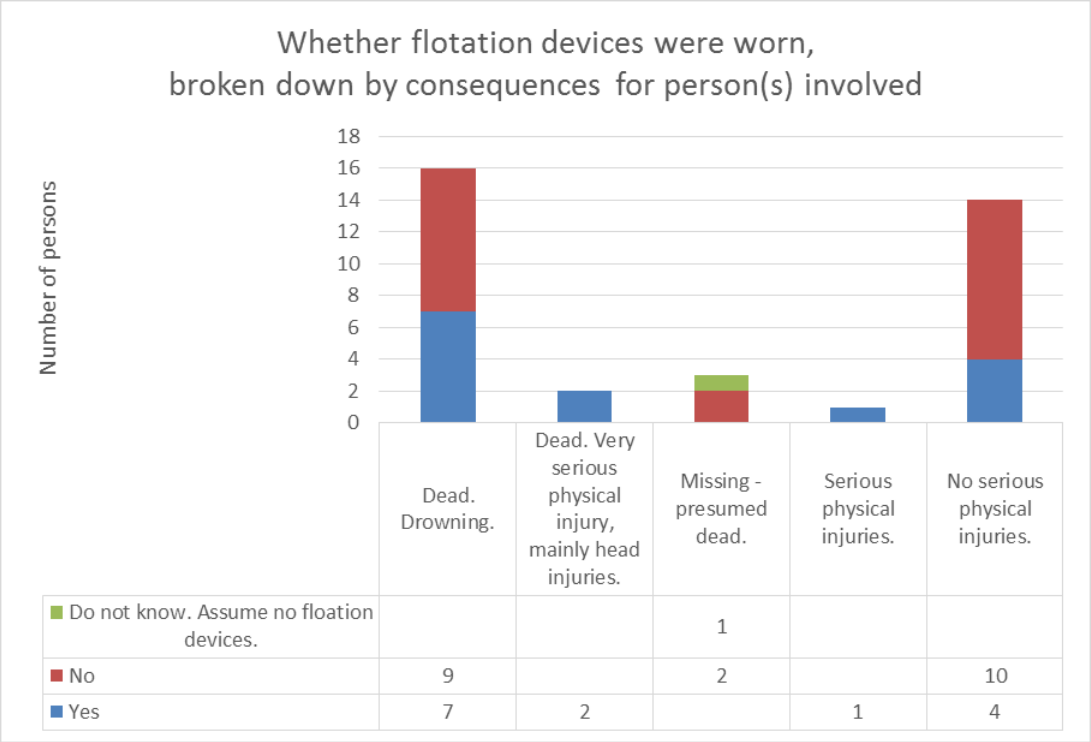


Figure 32: Number of persons and whether or not they were wearing flotation devices, broken down by consequences.

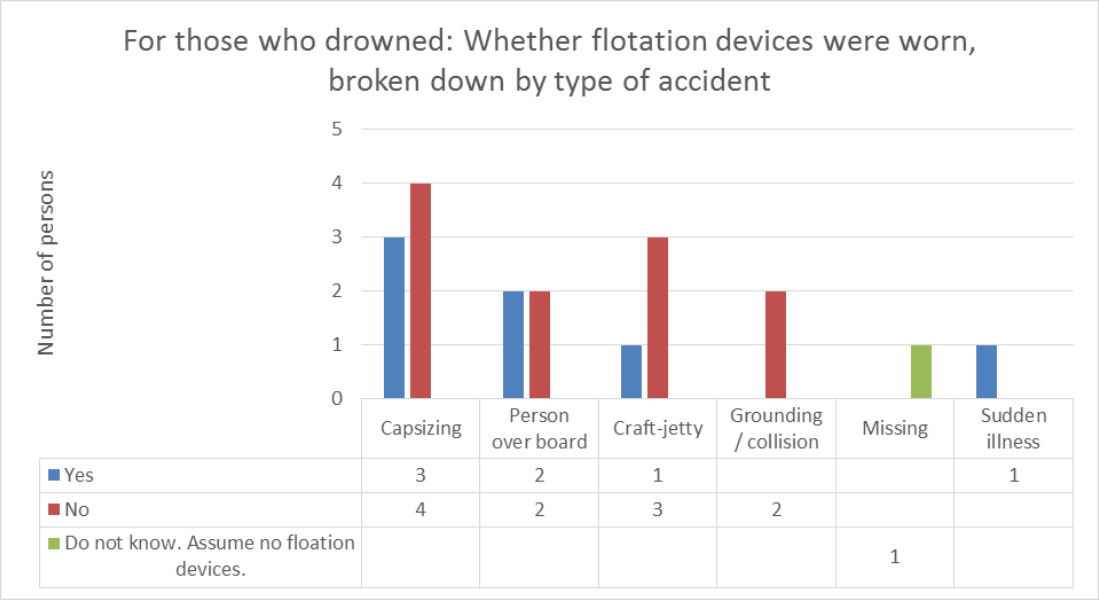


Figure 33: Number of persons and whether or not they were wearing flotation devices. The figures are broken down by type of accident and limited to the persons who drowned or are assumed to have drowned.

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.

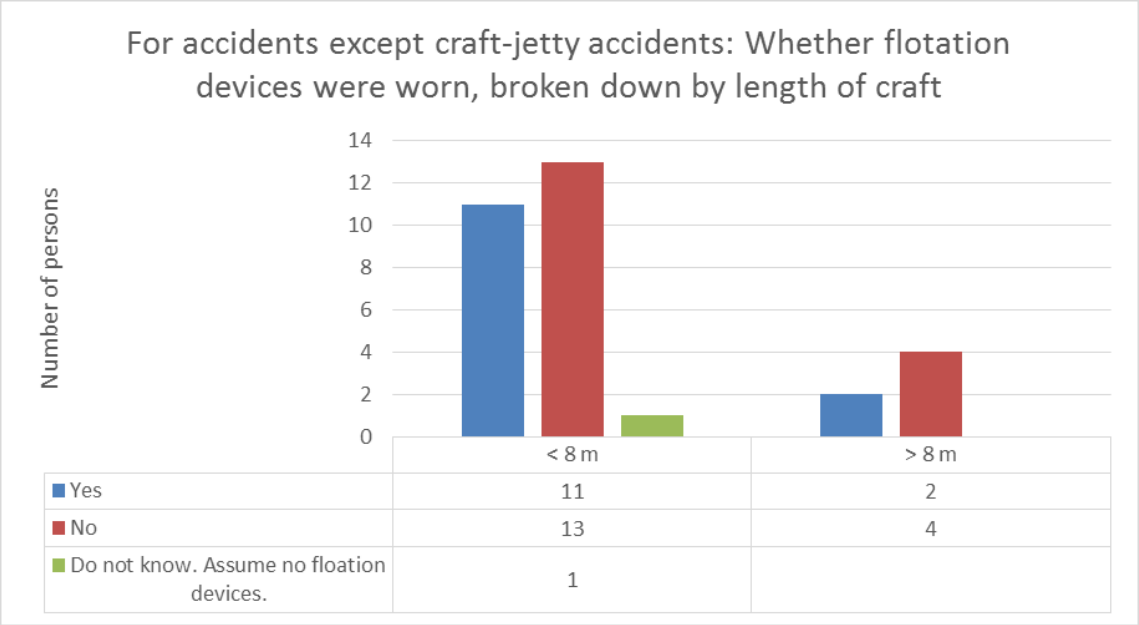


Figure 34: Whether flotation devices were worn, broken down by length of craft. The figures include all accident in which the craft was under way. Accidents where people fall between the craft and a jetty are not included.

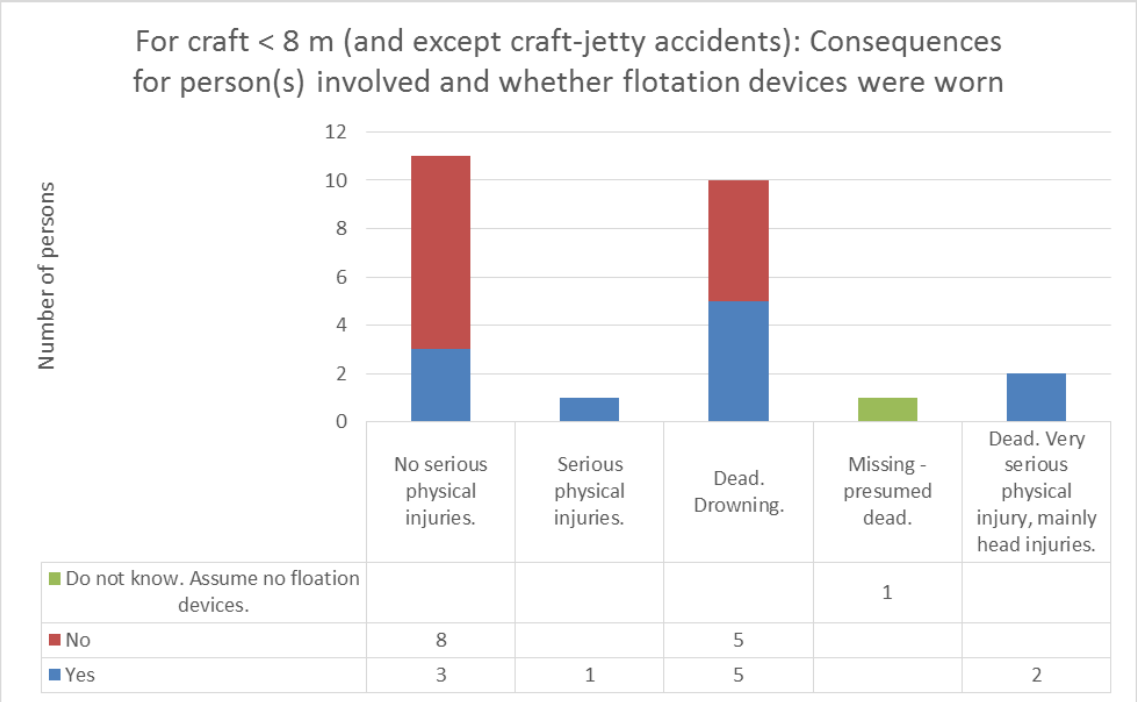


Figure 35: Boats with a maximum length of < 8 m. The figures include all accident in which the craft was under way. The AIBN assumes that the missing person drowned. Accidents where people fall between the craft and a jetty are not included.

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.

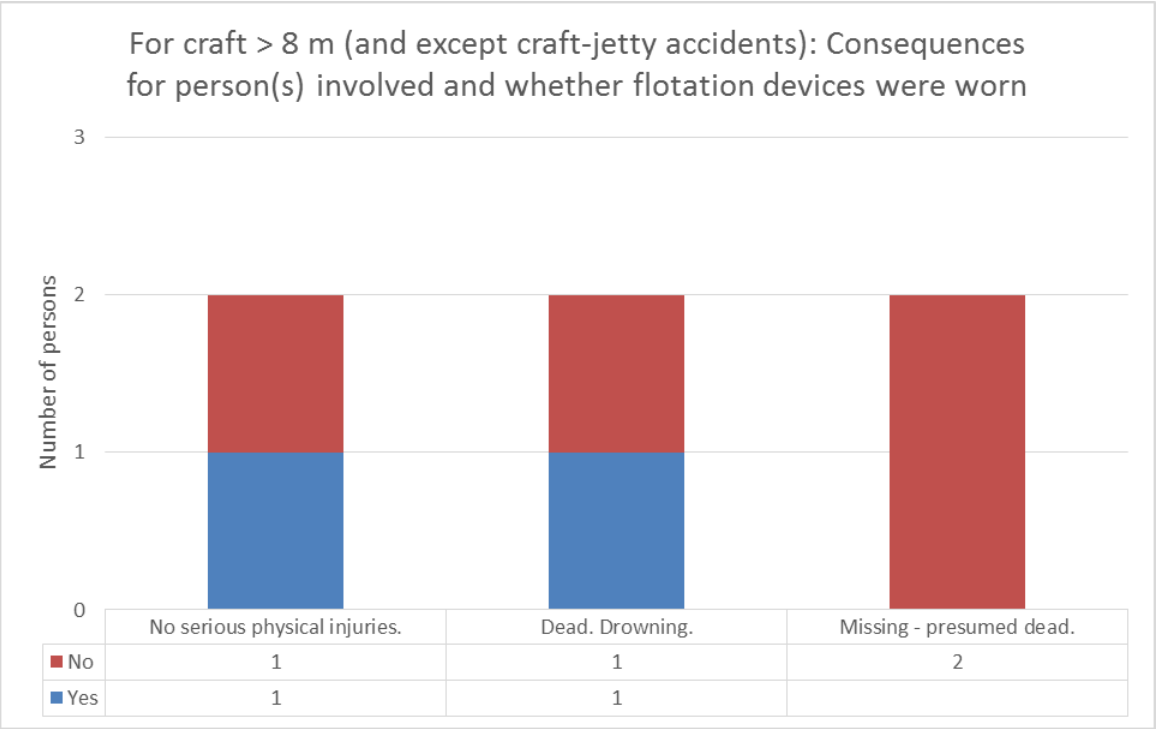


Figure 36: Craft with a maximum length of > 8 m. The figures include all accident in which the craft was under way. The AIBN assumes that the missing persons drowned. Accidents where people fall between the craft and a jetty are not included.

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.

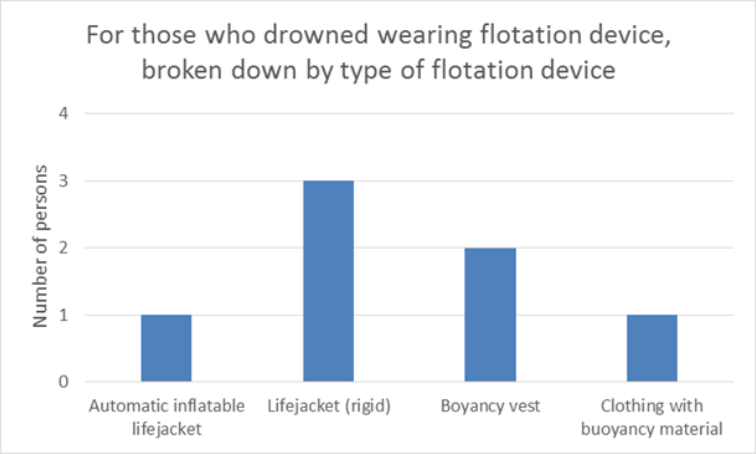


Figure 37: Number of persons who were wearing flotation devices, broken down by type of device. The figures are limited to people who were wearing flotation devices and who drowned or are assumed to have drowned.

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. 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

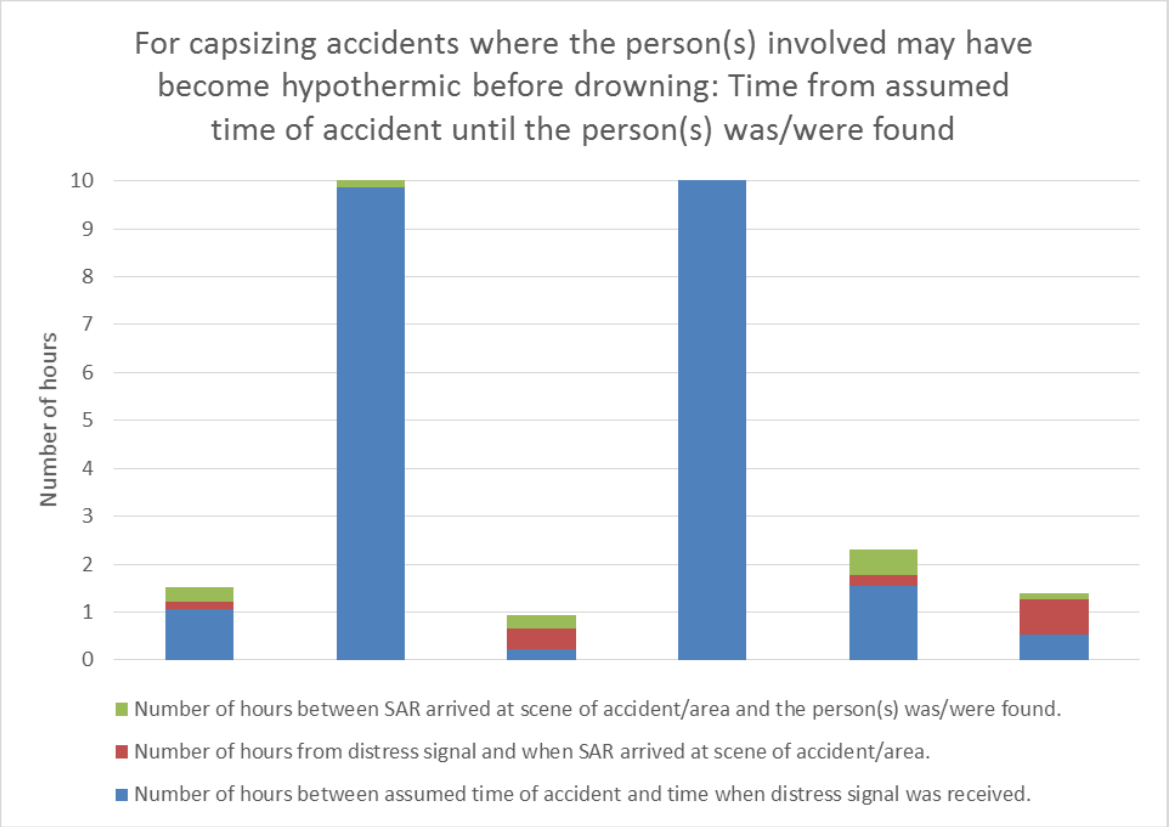


Figure 38: Capsizing accidents. In all the accidents, the persons involved may have become hypothermic before they drowned. Each bar represents one accident and specifies the time that elapsed from the assumed time of the accident until the persons involved were found. The upper limit was set to 10 hours, 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.

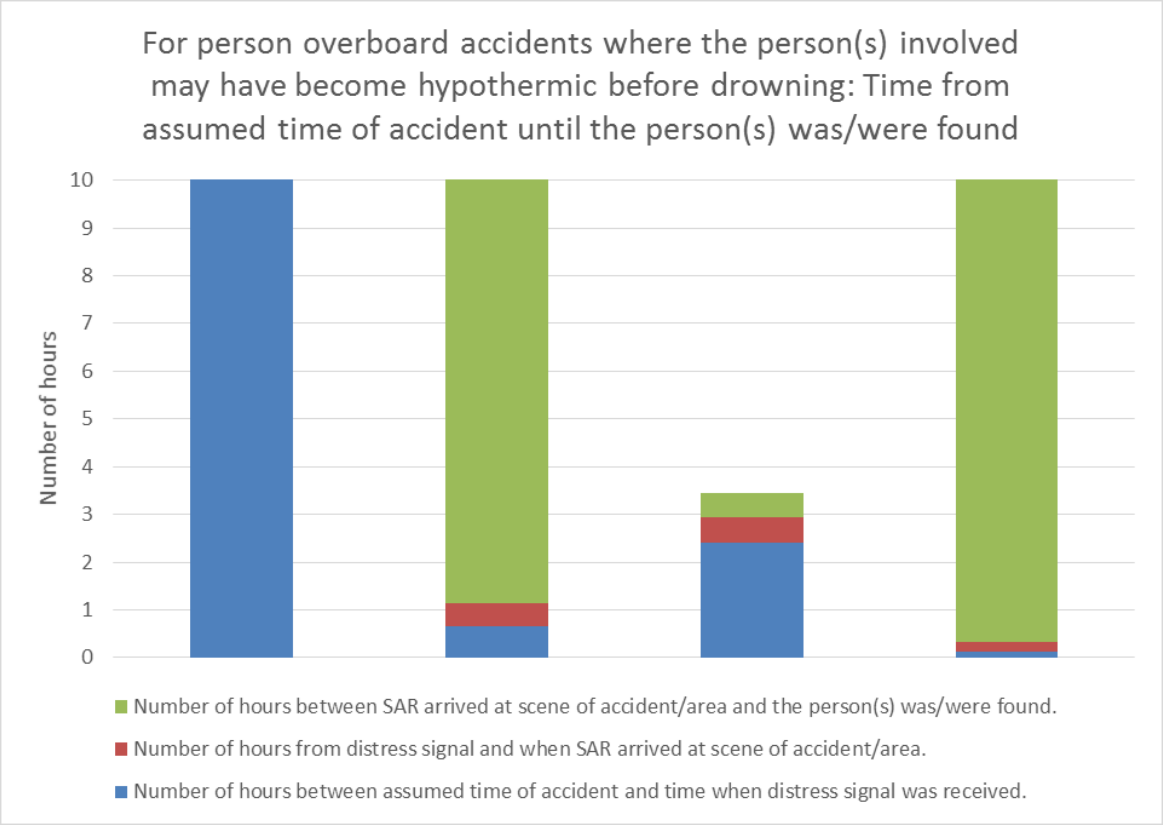


Figure 39: Accidents where the person fell overboard and may have become hypothermic before drowning. Each bar represents one accident and specifies the time that elapsed from the assumed time of the accident until the persons involved were found / the search was concluded. The upper limit was set to 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.

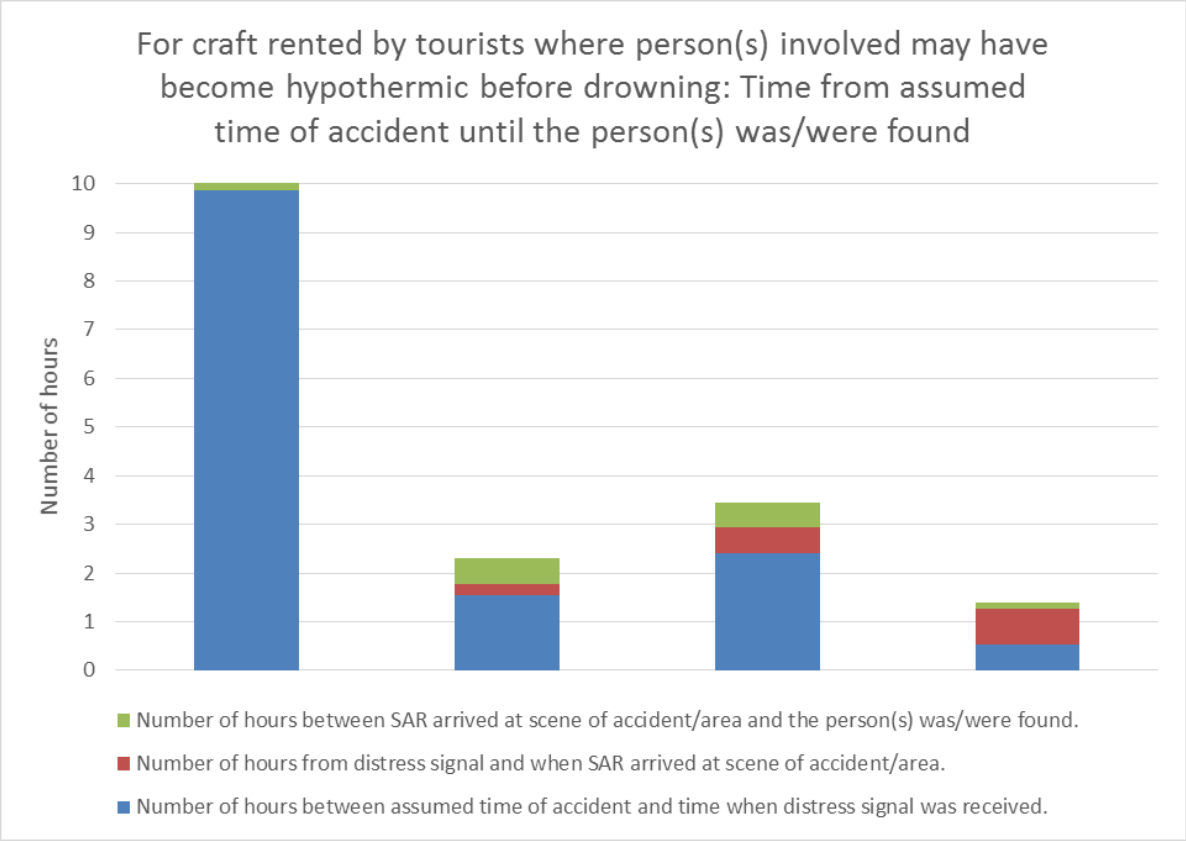


Figure 40: Boat rental for tourists. All the victims may have become hypothermic before drowning. Each bar represents one accident and specifies the time that elapsed from the assumed time of the accident until the persons involved were found. The maximum time in the figure is 10 hours. In one of the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

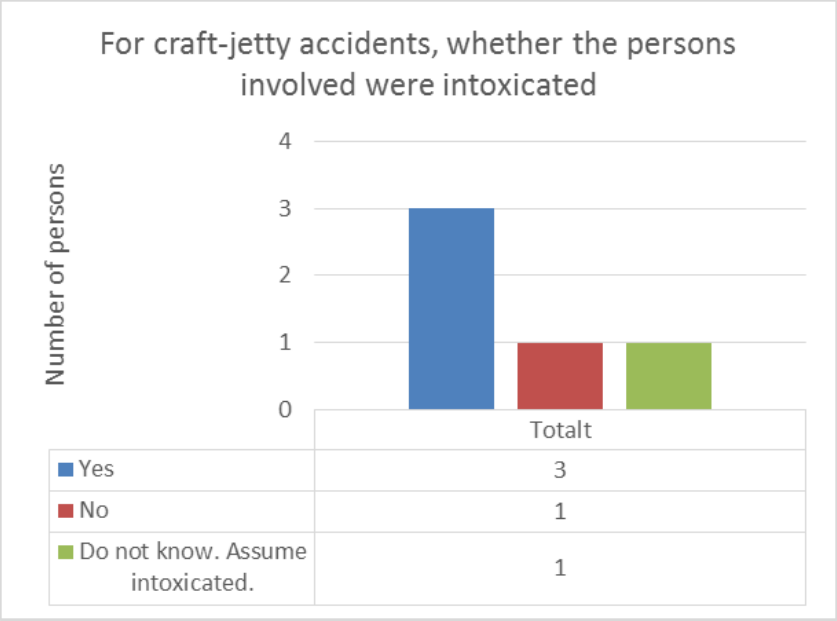


Figure 41: Accidents that occurred while the craft was moored. The figure shows whether the persons were intoxicated or not.

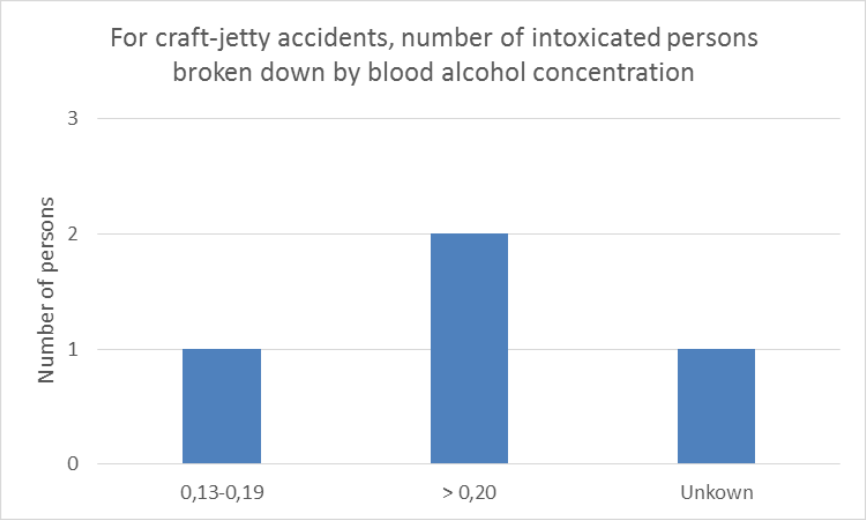


Figure 42: Falls at quay or jetty while the craft was moored. Number of intoxicated persons broken down by BAC.

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.

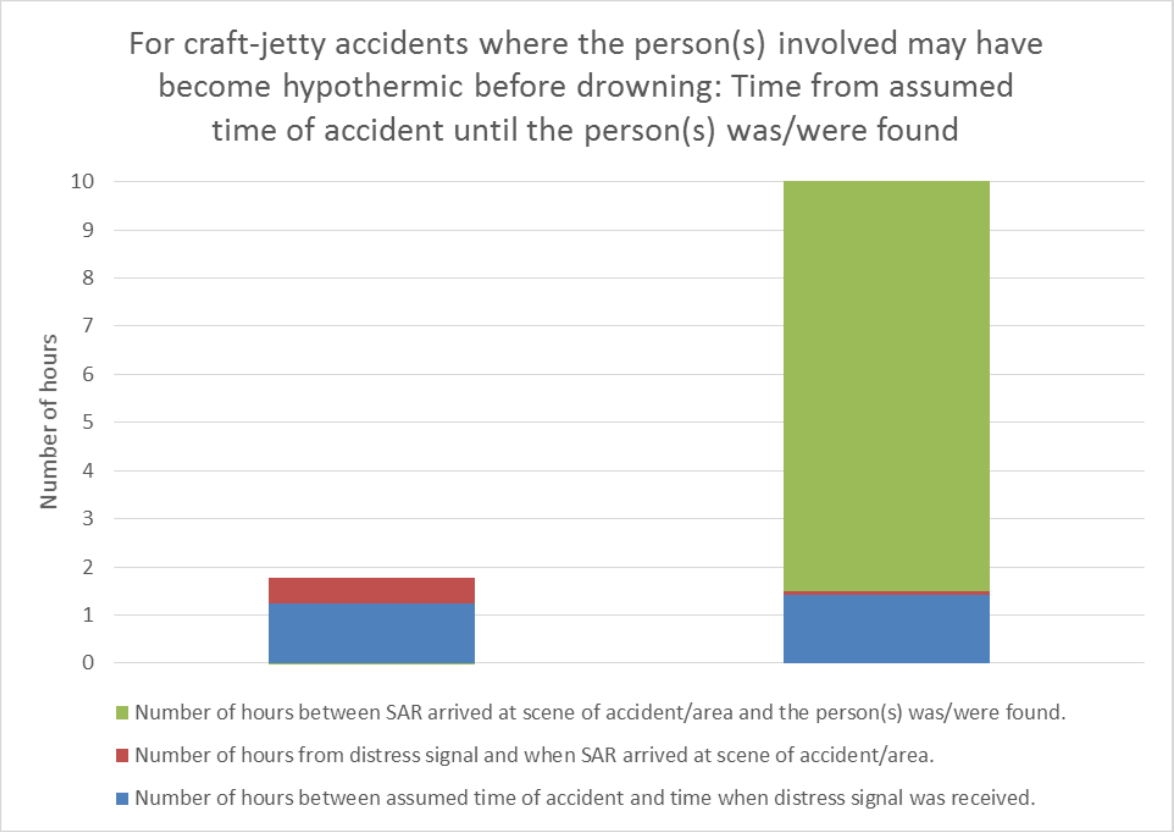


Figure 43: Craft-jetty accidents where the persons involved may have become hypothermic. Time from the assumed time of the accident until the persons were found. The maximum time in the figure is 10 hours. In one case, the person was found dead three days later.

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. The data have been compared and assessed in relation to available information from other sources (JRCC, RS, witness statements). 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. 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. Norwegian (recreational) craft more than 15 metres in length must be registered in the Ship Register. Registration is voluntary for recreational craft between 7 and 15 metres in length. The owner is obliged to notify of any changes. 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). Post mortem forensic toxicology tests also include analyses of a selection of medicinal products and narcotic substances. 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. Does not meet today's standard requirements. 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. Light, in the morning or afternoon.		Moderate to fresh breeze. Wave height (Hs) < 0.5 m. 100–600 metres from land/island/islet. 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. Men, aged 40–72.	Alone on board. 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. Possibility of sudden illness. The victims probably became hypothermic.	
The external environment	Narrow coastal waters. Morning and afternoon.		Fresh breeze to moderate gale. Wave height (Hs) < 0.8 m. 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. 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. The rental firm's instructions on notification meant that the initiation of the rescue operation was delayed.	
Person(s) involved	Foreign tourists. 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. The persons involved had little or no experience of being on a recreational craft in the prevailing weather and sea conditions. 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. Some of them were poor swimmers. The victims probably became hypothermic.	
The external environment	Outer narrow coastal waters, lake. Morning and afternoon.		Light air to fresh breeze. Wave height (Hs) < 0.5 m, with one exception. 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. 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. No one nearby who could hear cries for help. The person called for help and was heard, but the person who heard it did not do anything. 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 For the groundings: Navigational aids not used / not available.	High speed.	For the groundings: Unable to alert anyone of the distress situation	
Person(s) involved	Norwegian nationals, aged 15–45. 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. 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. Two persons drowned. 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. The Rules of the Road at Sea were not observed (intoxication, lights, caution, flotation devices).	No head protection worn against impact. No use of a lifejacket that could have kept the airways clear.	
The external environment	Narrow coastal waters or lake. Spring and summer. Evening and night (between 23:00 and 02:00). Twilight. 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. 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. Extensive head injuries limited the possibility of rescue. 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. The airways were not kept clear. 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