



**Bundesstelle für Seeunfalluntersuchung**  
**Federal Bureau of Maritime Casualty Investigation**  
Federal Higher Authority subordinated to the Ministry of Transport,  
Building and Urban Development

Investigation Report 301/11

**Serious Marine Casualty**

**Accident with four casualties on board**

**the traditional ship**

**SEUTE DEERN**

**east of Christiansø, Bornholm**

on 28 July 2011

15 October 2012

The investigation was conducted in conformity with the law to improve safety of shipping by investigating marine casualties and other incidents (Maritime Safety Investigation Law - SUG) of 16 June 2002 in the version applicable prior to 30 November 2011.

According to said act, the sole objective of this investigation is to prevent future accidents and malfunctions. This investigation does not serve to ascertain fault, liability or claims.

This report should not be used in court proceedings or proceedings of the Maritime Board. Reference is made to the aforementioned version of art. 19 para. 4 SUG.

The German text shall prevail in the interpretation of this Investigation Report.

Issued by:  
Bundesstelle für Seeunfalluntersuchung - BSU  
(Federal Bureau of Maritime Casualty Investigation)  
Bernhard-Nocht-Str. 78  
20359 Hamburg  
Germany

Director: Volker Schellhammer  
Phone: +49 40 31908300      Fax: +49 40 31908340  
posteingang-bsu@bsh.de      [www.bsu-bund.de](http://www.bsu-bund.de)

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## 1 Summary

At 1510<sup>1</sup> on 28 July 2011, four people were injured on the traditional ship SEUTE DEERN while weighing the anchor east of Christiansø near Bornholm when the cranks of the manual winch turned back out of control and the anchor chain ran out. Two physicians who were also on board rendered first aid. The SEUTE DEERN hoisted anchor and headed for Nexø. While en route to Nexø, an emergency physician and paramedic, who had previously been lowered onto a rescue cruiser by a SAR helicopter, were taken on board. In Nexø, two serious casualties were flown by helicopter to a hospital in Copenhagen. The other two casualties could be treated in Rønne on Bornholm. A WNW wind with a force of 6 Bft prevailed at the time of the accident and the wave height was 1.5 m. One of the anchor's flukes broke during hoisting and was lost.

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<sup>1</sup> Unless stated otherwise all times shown in this report are local = Central European Time = UTC + 2

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## 2 SHIP PARTICULARS

### 2.1 Photo



Figure 1: Photo of vessel

### 2.2 Vessel particulars

Name of vessel:	Seute Deern
Type of vessel:	Sailing ship, gaff ketch
Nationality/Flag:	Germany
Port of registry:	Bremen
IMO number:	None
Call sign:	DDGU
Owner:	Clipper Deutsches Jugendwerk zur See
Year built:	1939
Shipyard/Yard number:	Svendborg, Denmark
Classification society:	Ship Safety Division (BG Verkehr), Joint Commission for Historic Water Craft, Germanischer Lloyd
Length overall:	36.00 m
Breadth overall:	7.15 m
Gross tonnage:	127
Deadweight:	200 t
Draught (max.):	3.40 m
Engine rating:	216 kW

Ref.: 301/11

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Main engine:	Volvo Penta
(Service) Speed:	9 kts
Hull material:	Wood
Hull design:	Clinker
Licensed to carry:	30 people

### **2.3 Voyage particulars**

Port of departure:	Sassnitz
Port of call:	Nexø
Type of voyage:	Other shipping International
Cargo information:	None
Manning:	30
Draught at time of accident:	3.40 m
Pilot on board:	No
Number of passengers:	None

## 2.4 Marine casualty or incident information

Type of marine casualty/incident:	Serious marine casualty, 4 injured
Date, time:	28 July 2011, 1510
Location:	Christiansø
Latitude/Longitude:	$\phi$ 55°19.2'N $\lambda$ 015°11.7'E
Ship operation and voyage segment:	At anchor
Place on board:	Forecastle
Human factors:	Technical fault
Consequences (for people, vessel, cargo, the environment and other):	Four injured

Excerpt from Nautical Chart ARCS 2360, BSH

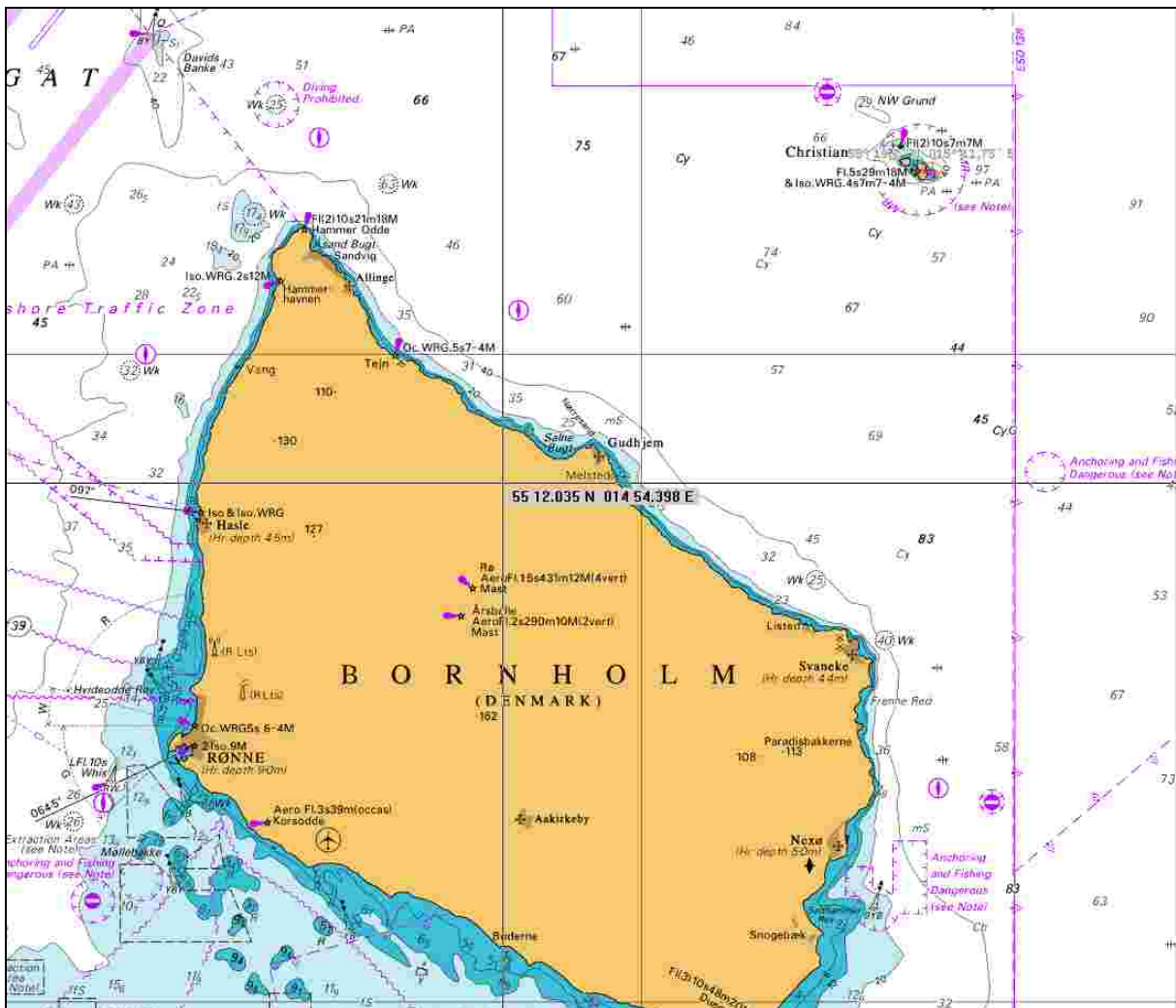


Figure 2: Nautical chart



Excerpt from ENC DK5CHRSO, BSH

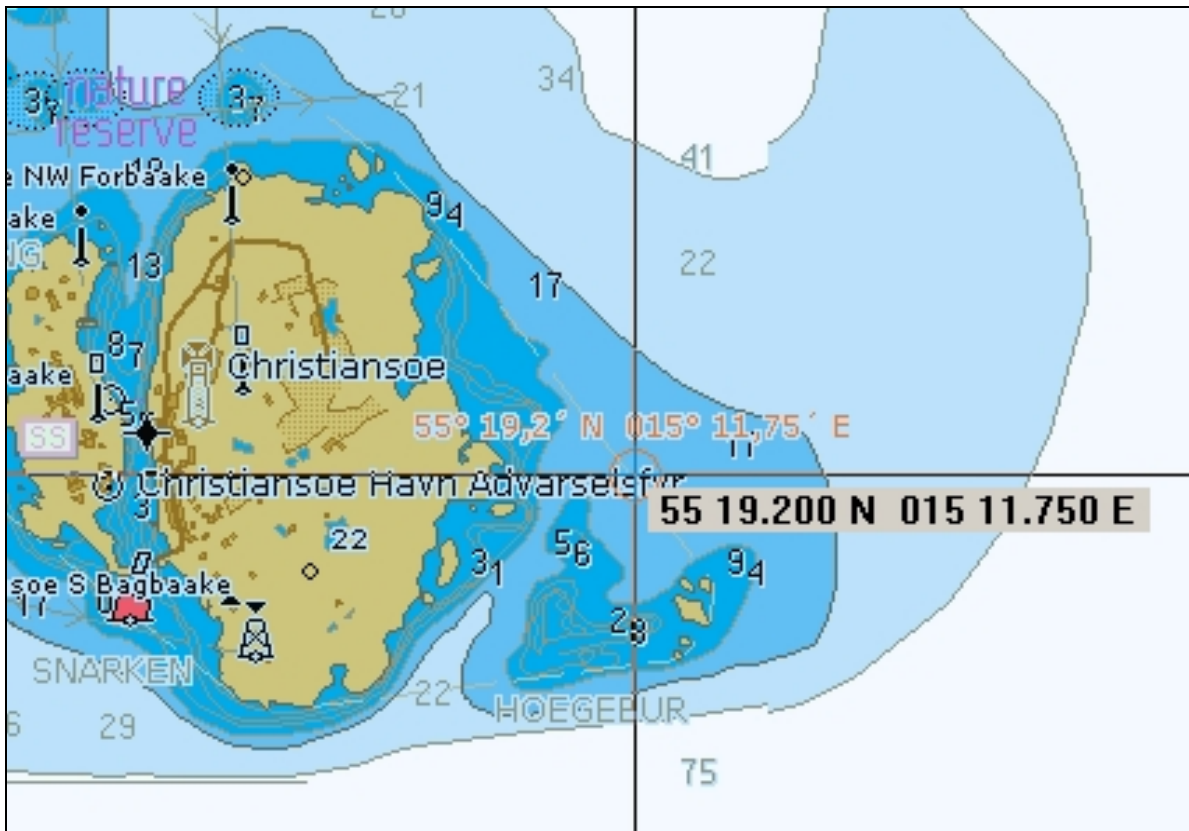


Figure 3: Scene of the accident

**2.5 Shore authority involvement and emergency response**

Agencies involved:	MRCC Bremen, SAR Denmark
Resources used:	Helicopter and rescue cruiser
Action taken:	Medical treatment on board
Results achieved:	Nexø, medical transportation, hospitals

### 3 COURSE OF THE ACCIDENT AND INVESTIGATION

#### 3.1 Course of the accident

At 1510 on 28 July 2011, an accident involving four people, two seriously injured and two slightly injured, occurred in the sea area north of the Østerskår and east of the Christiansø islands while the anchor was being hoisted. The starboard anchor was immersed (two shackles/25 m) at a depth of 14 m on stony ground. Prior to the anchoring manoeuvre, the main and mizzen sail had already been reefed (first and second reef) at the anchorage, but not set. A strong NW wind of 6 Bft was blowing. The two crank handles of the capstan were each manned by four people (two at the front and two at the back). There were a total of eight people on the forecabin. The winch is equipped only with manual drive. During the hoisting procedure, the engine was used – in consultation with the mate on the foredeck using VHF transceiver – to help relieve the anchor chain. After about one chain length was hoisted in, there was a jolt and both crank handles started to rotate rapidly in the opposite direction. Four crew members were hit by the two rapidly turning crank handles and lay injured on deck. Part of the chain ran out. Following that, the vessel started to drift. After initial coordination of measures to assist the casualties, the anchor was hoisted completely at about 1630. One fluke was missing.

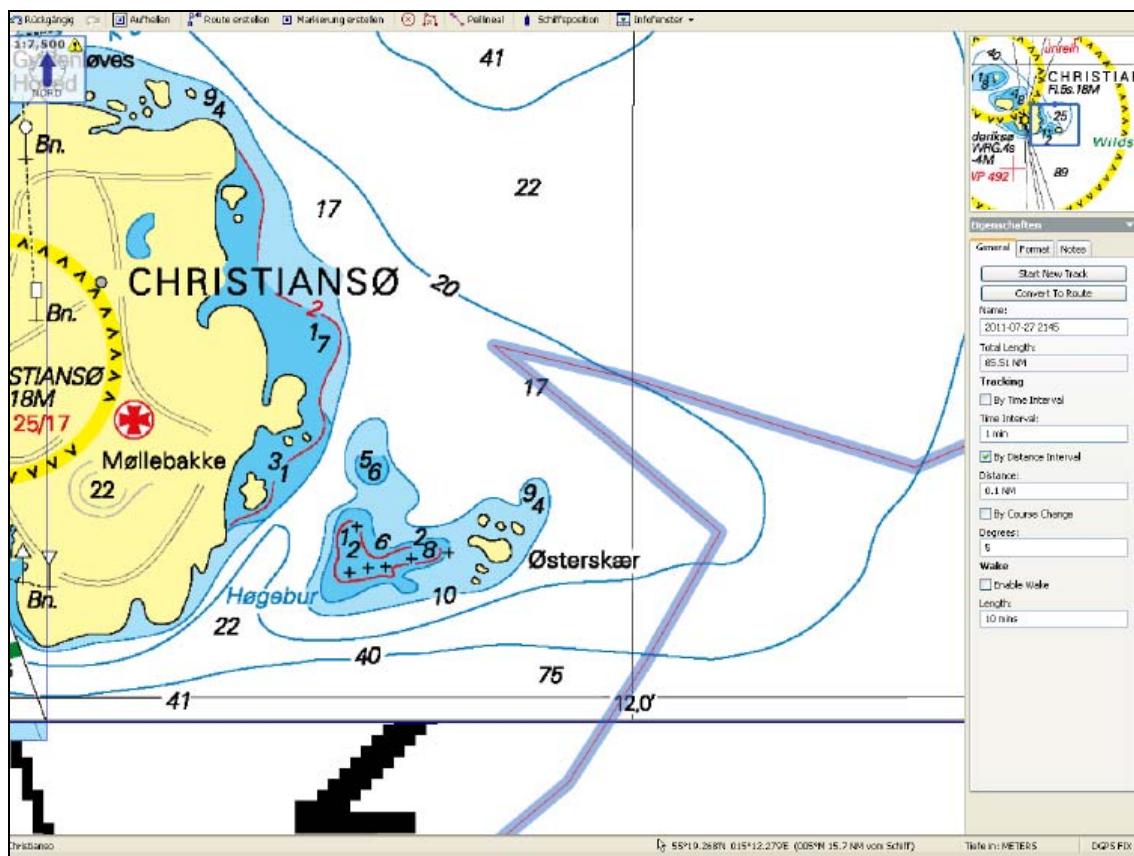


Figure 4: Anchorage, ECS recording

On 27 July, the SEUTE DEERN sailed out of Sassnitz on Rügen and set her course for Hammerodde on Bornholm. At about 1030 on the following day, she passed Hammerodde on the northern tip of Bornholm so as to run under sail before the wind to Christiansø. It was agreed with the harbourmaster that she would arrive after 1630 on 28 July. There was a NW wind of 4 Bft at the time. At 1300, all the sails were taken in south of Christiansø in an increasing NW wind that in the meantime had reached 5-6 Bft, and they headed for the anchorage north of the island of Østerskår. A strong NW wind of 6 Bft was now blowing. Therefore, the voyage plan was amended with the intention of sailing to Bornholm and calling at Christiansø in the evening. The anchor was to be hoisted at about 1500.

When the accident happened at 1510, two physicians who were also on board rendered first aid. Since one person was bleeding profusely and another was lying on deck incapacitated, the physicians recommended that shore-based assistance be sought as quickly as possible in order to organise a transfer to a specialist hospital. Assistance was requested via MRCC Bremen. As a result of that, the rescue cruiser L. ROSENFELD sailed from Nexø and a SAR helicopter flew from Copenhagen to the scene of the accident. The anchor was hoisted at 1630. One fluke was missing. After that, the vessel headed for Nexø under mainsail, mizzen and with engine support in order to meet the L. ROSENFELD. The helicopter set a physician and paramedic down on the rescue cruiser. Due to the weather conditions, a decision was made to take the rescue team to the SEUTE DEERN and continue treatment of the casualties there. The SEUTE DEERN was heading for Nexø at a speed of 8 kts. She arrived there at 1845. The two serious casualties were transferred to Copenhagen in the SAR helicopter and the two casualties, whose injuries were less serious, to Rønne by ambulance for further treatment. Following that, the SEUTE DEERN moved into the Trafikhavn and made fast there at 2000. The Danish authorities recorded the accident and took pictures of the anchor gear together with its crank handles.

### **3.2 Investigation**

The survey took place on 3 September 2011 at the Überseebrücke quay in Travemünde. Members of the association, crew and legal counsellor for the SEUTE DEERN, an external expert and the BSU were present.

## DESCRIPTION OF THE CAPSTAN

The winch only has a manual drive system and is designed for the operation of two anchor chains/anchors. According to the representative of the owner, this winch is part of the original equipment of the vessel. One removable crank handle is situated on the port side and one on the starboard side; these are pushed onto the winch and also mounted firmly on the bulwark. According to the owner's representative, the crank handles can be operated on each side by four people, with two standing in front of each crank and two behind alternately.



Figure 5: Crank handle



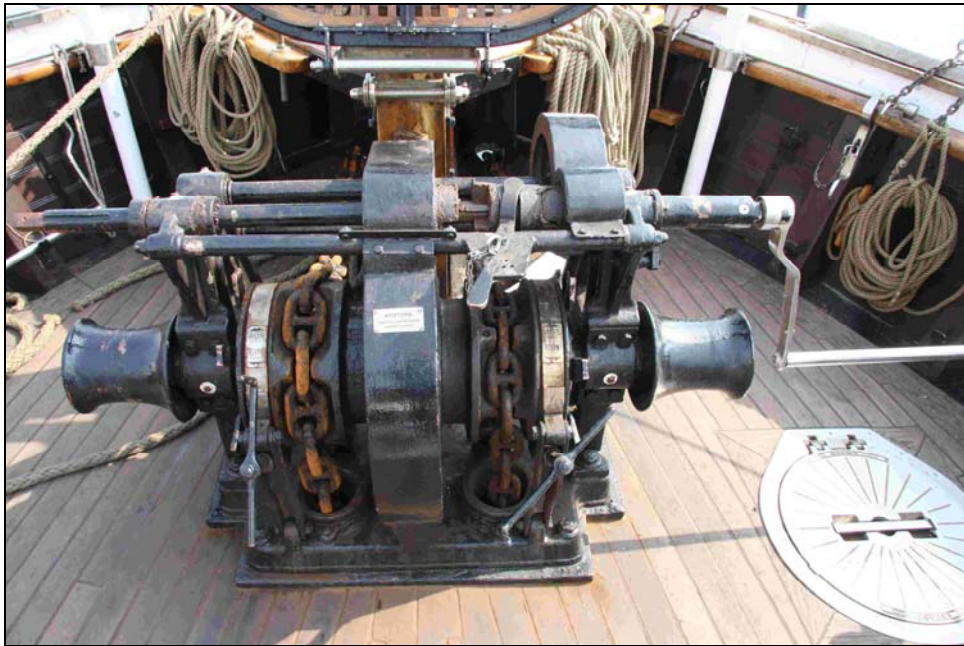


Figure 6: Capstan

For hoisting, each chain drum can be coupled with the manual system on its own. Furthermore, each drum is fitted with a manual brake.

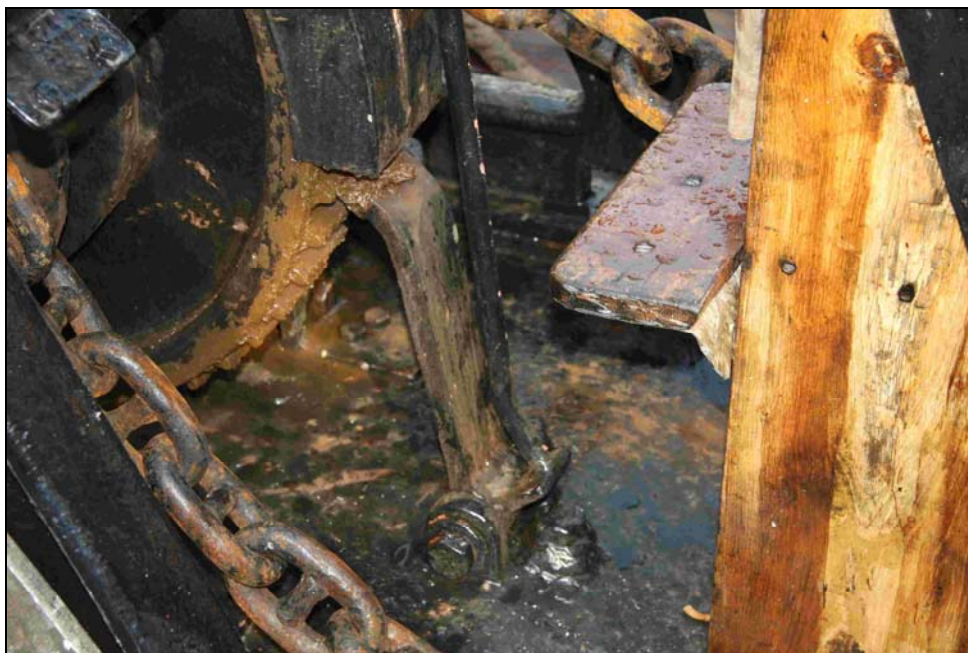


Figure 7: Pawl, gear

The winch is fitted with a cogwheel. In this design, the external gear teeth act as a locking device or brake. During a proper hoisting operation, a gravity-driven pawl drops against the tooth flanks of the cogwheel. Unless the crank is turned, respectively, hoisting force is applied to the crank handle, this pawl will prevent the anchor chain from running out.



Figure 8: Engage and disengage

In each case, two different rotational speeds can be set by means of a gear lever that can be locked. Pushing to the right results in a slow hoisting speed: low gear, three cogwheel tips per crank handle revolution or about a third of a chain link per crank handle revolution. Pushing to the left results in a faster hoisting speed: high gear, nine teeth per crank handle revolution or about one chain link per crank handle revolution. Conversely, if engaged the crank handles can be subjected to these speeds in the form of revolutions when lowering is unchecked. The unintentional lowering speed is about three times higher in low gear.

#### DESCRIPTION OF ANCHOR CHAIN AND ANCHOR

Type Q2a stud-link anchor chain with a diameter of 28 mm, a length of 168 mm, a width of 101 mm, a breaking load of 449 kN, a total length of 412.5 m and a total weight of 7,399.4 kg.





Figure 9: Stock anchor, missing fluke

The vessel is equipped with two stock anchors. Each stock anchor is hoisted onto the railing by means of a boom and lashed using wire and chain. The specified weights of the anchors are 300 kg on the port side and 310 kg on the starboard side.



Figure 10: Stock anchor hoisted

## DESCRIPTION OF CAUSE OF THE ACCIDENT

During the survey of the vessel on 3 September 2011, it was found that the pawl could be in a position from which it may not automatically drop back into the cogwheel by means of gravity. Thus, it did not fulfil its function as a locking device during the hoisting procedure. In normal hoisting mode, the operation of the pawl is recognised by a clicking sound as it moves from one tooth to the next. This clicking must have been absent immediately before the accident.





Figure 11: Pawl in tilt position

At the front bottom edge, the pawl can be set by means of an adjusting screw so that there is a maximum distance of about 15 mm between the pawl and cogwheel tip. At such a setting, the pawl would always drop into the cogwheel automatically and reliable operation would be ensured. On board, the adjusting screw was found to be fully tightened. The adjusting screw was immovable and covered with a thick coat of paint, which permits one to conclude that the pawl was operated in this unsafe condition for a very long time.

The fully tightened, non-serviceable adjusting screw was the reason for the operating position of pawl being unsafe.

To support this theory, the locking function's role in the interaction between cogwheel and pawl was checked at every groove and serviceability certified.



Figure 12: Breaking point

Carrying on, it should be noted at this point that at the time of the accident an enormous force was acting on the capstan due to the anchor chain. The force was so great that during this manoeuvre one of the anchor's flukes broke. The anchorage ground is considered to be rocky. This suggests that the anchor may have snagged. According to the vessel report, the accident happened after one chain length of about 25 m had already been hoisted in, probably with the anchor still snagged. This exerted enormous force on the anchor chain, which was intensified by the pitching of the vessel and increasing wind. Due to the force acting on the anchor chain, it was no longer possible to apply sufficient force to the two crank handles in order to hoist the anchor further. This could easily be explained by the anchor chain reaching the maximum hoisting position just at the point that the pawl was on the tip of the cogwheel. Due to the pitching and jerking movements of the vessel, the pawl may have dropped forward into an unsafe position and stayed there.

However, it is equally possible that the pawl was already in an unsafe position before the hoisting manoeuvre. Due to the prevailing and deteriorating weather and sea state, the anchor force continued to rise up to a level at which the people at the crank handles were unable to hold on, the crank handles turned in the opposite direction, and the anchor chain ran out again. In the process, the people could have been injured either by the crank handles or by being thrown against the railing or other parts of the deck by the revolving crank handles. The rotational speed of the crank handles was very high when the anchor chain ran out. Here, whether the gear lever was set to LOW GEAR or HIGH GEAR is relatively insignificant.

The vessel report indicates that this was the point at which the anchor's fluke broke and the anchor was released, causing the vessel to start drifting. The fact that the anchor's fluke broke is also indicative of the very heavy load acting on the anchor chain. That the release of the anchor from the anchorage ground produced a jolt, which caused the people to be thrown from their optimum position in terms of rotating the crank handles and, with open pawl, not be able to apply the necessary retention or rotational force, is not excluded. According to the vessel report, eight people operated the crank handles in the positions intended for this.

### Summary of the findings

The analysis of the cause of the accident drawn up in this report can be summarised as follows:

- a non-adjusted pawl is responsible for the uncontrolled backward rotation of the winch's two crank handles. Four injured – in part seriously – crew members were the result;
- it is likely that the pawl moved into the unstable, non-locking position in front of the external gear teeth during hoisting;
- another factor that facilitated the accident was the extremely high tensile force of the starboard anchor due to the anchorage ground and wind/wave conditions.

With respect to this manually operated capstan, the following measures should be taken to prevent future accidents of this nature:

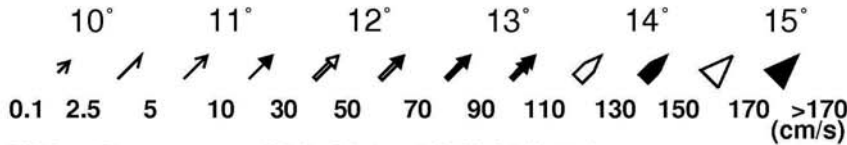
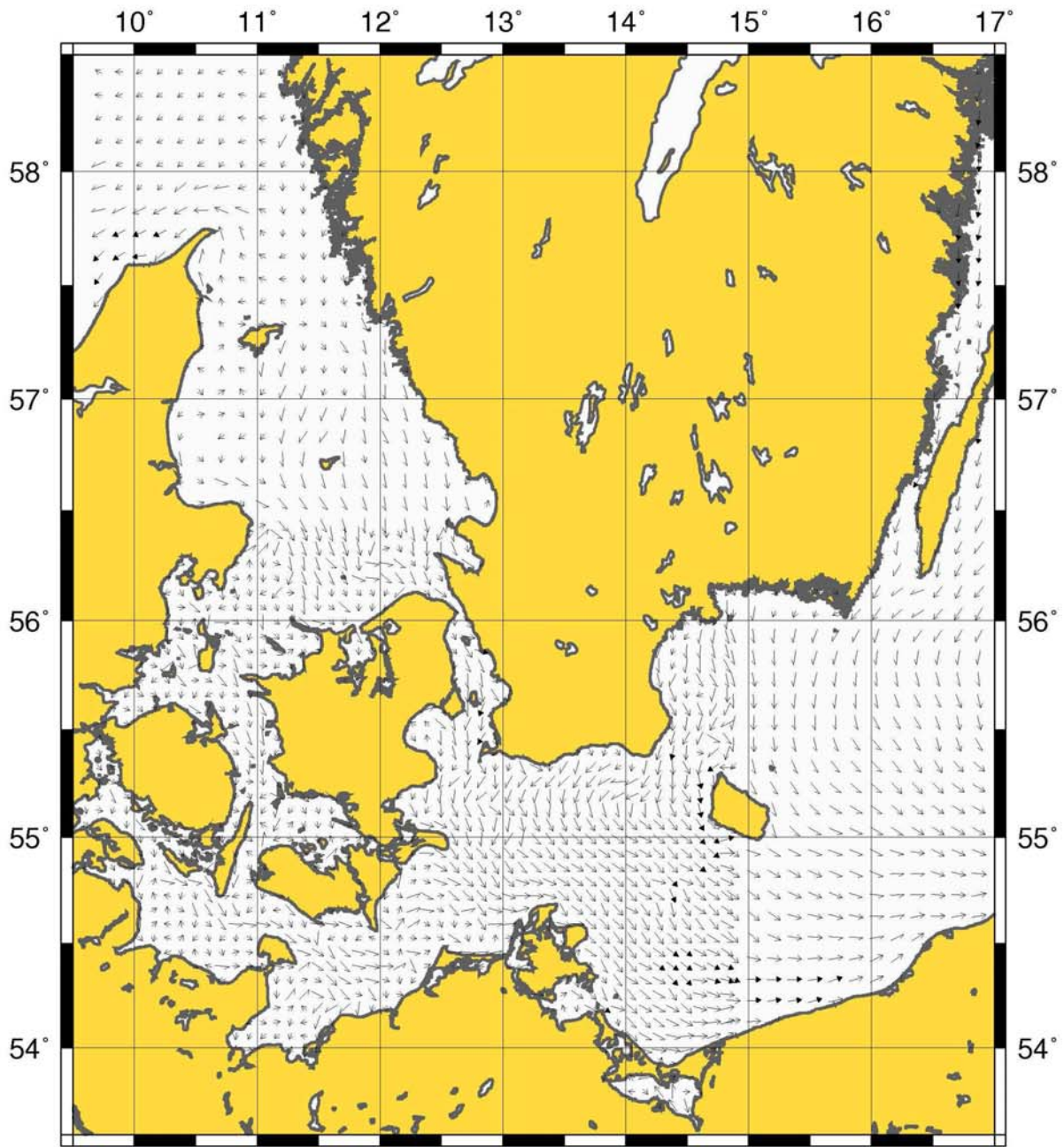
- the existing adjusting screw should be used to set the pawl such that it always drops back to the operating position by means of gravity. A maximum distance of 15 mm between pawl and cogwheel should not be exceeded;
- a seawater-resistant tension spring could be used as an additional safety element to enhance the safety of the system.

### **3.3 Weather report by Germany's National Meteorological Service**

On 28 July 2011, the area in which the accident occurred was on the western flank of a low-pressure area (1008 hPa) over the south-eastern part of the Baltic Sea. The depression moved only slightly in a south-westerly direction as the day progressed. At the same time, associated frontal systems approached the area of the accident from the north-east. The differences in atmospheric pressure intensified. With the approach of the frontal low-pressure trough, the WNW wind from about 290° increased from force 5 Bft (about 17 kts) to force 6 Bft (about 22 kts) with gusts up to a maximum of force 7 Bft (around 30 kts) at the time of the accident. A flat swell of no more than 0.5 m and wave period of about four seconds came from the north. Due to the light winds that prevailed until the morning of 28 July 2011, the wind sea was not fully developed. Taking into account the prevailing fetch of the wind with this direction, the wind sea reached significant wave heights of 1 m (periods of 3 s) and solitary waves with a height of 1.5 metres are very likely. It was overcast with longer-lasting and in some instances heavy showery spells in which visibility fell to 1 to 2 km at times. The water and air temperatures fluctuated around 17 degrees. The mean current was setting to the south at about 5 cm/s.



### 3.4 Current, Federal Maritime and Hydrographic Agency



Mittlere Stroemung am 28.07.2011 1.Schicht (0-5m)

Mean Current on 28.07.2011 1.Layer (0-5m)

Das Bundesamt fuer Seeschifffahrt und Hydrographie uebernimmt fuer die hier wiedergegebenen Informationen keine Gewaehr.

**GM** 2011 Jul 28 02:10:27 Modellversion:4



## 4 ANALYSIS

### ACTION TO PREVENT FUTURE ACCIDENTS

The ship's management has taken the immediate measure of mounting an additional plate such that the pawl will always drop into its regular operating position in the cogwheel by means of gravity when the vessel's trim is normal.

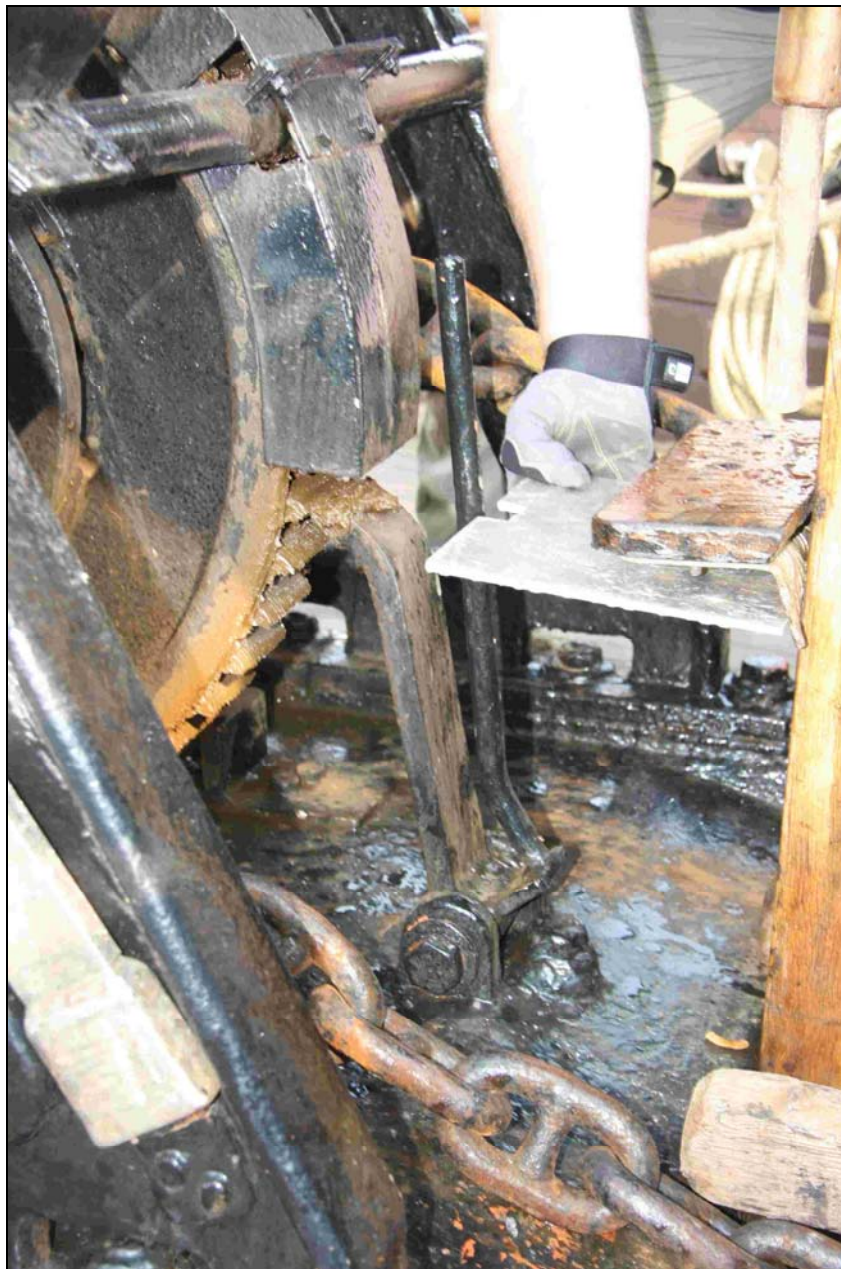


Figure 13: Workaround

The expert considers that for future safe operation of the anchor equipment, it is imperative that the serviceability of the adjusting screw be restored again and set so that a distance between pawl and cogwheel tip of no more than 15 mm is possible.



Beyond that, the safe operation of this aspect of the capstan's design can be enhanced further by a tension spring. In this respect, care should be taken to ensure that the material used for the spring is seawater-resistant. The spring rate necessary for proper operation must be determined in a test.

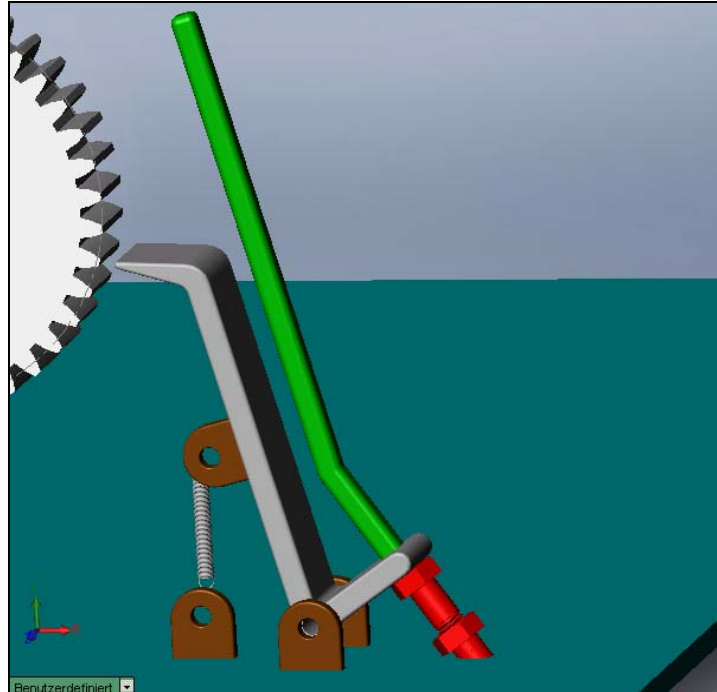


Figure 14: Proposal by the expert

During a survey by the BSU on 3 April 2012, a built-in stainless steel spring was visible on the pawl, which presses it towards the cogwheel. This should prevent the pawl from disengaging out of control.



Figure 15: Mounted spring

## 5 CONCLUSIONS

The accident while hoisting the anchor involving two seriously and two slightly injured people is the result of the pawl disengaging out of control because an adjusting screw, which should keep the pawl at a maximum distance of about 15 mm from the cogwheel tip, was not fitted properly. According to the report commissioned by the BSU, for safe operation of the anchor equipment in the future it is imperative that the serviceability of the adjusting screw be restored. Beyond that, the safe operation of this aspect of the capstan's design can be enhanced further by a tension spring.

This accident was facilitated by the adverse weather conditions (force 6 WNW wind and a wave height of 1.5 m at a period of 3 s). As a result, the stock anchor and anchor chain were exposed to considerable tension. For that reason, attempts were made to keep the chain 'apeak' by means of the engine, thus relieving it and making it easier to hoist in with the manual capstan. The chain and anchor weighed 760 kg (starboard anchor 310 kg, 412.5 m chain length = 7,399.4 kg) when 25 m of chain was deployed. At about 1510, a jolt was reportedly felt. It is possible that one of the stock anchor's flukes broke off, the pawl disengaged and the anchor chain ran out when this happened. The BSU does not believe that the manual capstan could have caused the anchor fluke to break. The break was probably facilitated by working with the engine at a power of 216 kW, which is high for the size of vessel. During the manoeuvre, the mate on the foredeck reportedly communicated with the bridge crew using a handheld VHF transceiver.

The capstan has two different rotational speed settings. A full rotation of the crank in high gear moves about one chain link length and in low gear a third of a length. If a length of 25 m is deployed, then depending on which gear has been selected about 150 to 450 revolutions must be made with the crank handle when hoisting the anchor to the final position. The length of a chain link corresponds to 168 mm. Eight crew members, who alternated in groups of four, were employed for this work. Two operated each crank handle. According to the accident report, the anchor was hoisted at 1630, i.e. 80 minutes after the accident.

The rescue operation progressed in an exemplary manner. Its objective was to organise the fastest possible evacuation of the casualties. Rather than evacuating the casualties directly from the SEUTE DEERN, it was decided that they should be taken to Nexø on Bornholm because of the weather conditions and injuries. From there they would be transferred to hospitals by helicopter and ambulance in a safe position.

The occupational safety of the crew as well as structural changes are the responsibility of the owner, who will fully implement the advice of the expert and restore the serviceability of the adjusting screw when the vessel is put into storage next winter. The pawl is currently prevented from disengaging out of control by a sleeve and compression spring.



The extent to which such a labour-intensive manual capstan in the design portrayed is practicable for anchor manoeuvres was not assessable in this investigation. Although extending the cranks to the bulwark facilitates the work, during hoisting two crew members stand directly in front of each crank and due to the confined space would have only limited options for evading a crank rotating violently in the opposite direction should the need arise.



Figure 16: Crank handle

The owner does not have a documented safety management system. However, the owner is bound by the German Safety Regulations for Traditional Ships as well as a general duty of care and ensuring public safety, including simultaneous compliance with the requirements pertaining to safety at work laid down in national laws and regulations. Having regard to the size and nature of the activities of the organisation, the hazards and risks to health and safety that arise due to the existing or proposed work environment and work organisation should be assessable. Here, the owner relies on the maritime experience of the crew, which according to the association's charter is trained and deployed independently.

The position of the chain at the time of the accident and what forces were acting could not be clarified conclusively. Due to their design, stock anchors grip very firmly because the flukes dig into the ground vertically to the stock. The anchor held firmly at a depth of 14 m on stony anchorage ground with two shackles immersed and 25 metres of chain deployed, until the fluke broke. In WNW winds of force 6 Bft, the anchorage east of Christiansø was protected from the wind and had been well chosen from a maritime perspective. The current was weak and setting south at 5 cm/s.

The nationally valid safety certificate for traditional ships applies to voyages in coastal waters. It was issued on 21 April 2011 and is valid for five years. During this period, an intermediate inspection is provided. Anchors, chains, cables, and tow lines are included in the inspection. The thickness of the anchor chain was last certified by Germanischer Lloyd on 13 October 2010. The specified weight of the starboard anchor is 310 kg. The Danish authorities have recognised the safety certificate.

## **6 SAFETY RECOMMENDATIONS**

The BSU recommends that in accordance with its responsibility and self-regulation arising from the German Safety Regulations for Traditional Ships as well as the general duty of care and ensuring public safety, the owner of the SEUTE DEERN ensures that sources of danger emerging during ship operation be inspected and immediately rectified, in particular, if structural changes are made, respectively, effectiveness or operational reliability is impaired due to maintenance errors.

## 7 SOURCES

- Enquiries
  - Photographic documentation, Bornholm Police
  - Inspection of the anchor gear, BSU together with external experts
- Written statements
  - Ship's command
- Reports and technical paper
  - Sachverständigenbüro Dipl.-Ing. Jan Hatecke, Wischhafen
- Nautical charts and vessel particulars, Federal Maritime and Hydrographic Agency (BSH)
- Official weather report by Germany's National Meteorological Service (DWD)
- Electronic chart, SEUTE DEERN
- Documentation, Ship Safety Division (BG Verkehr)
  - Certificates
- Photos
  - Photo of vessel, Hasenpusch
  - BSU