



Bundesstelle für Seeunfalluntersuchung
Federal Bureau of Maritime Casualty Investigation
Bundesoberbehörde im Geschäftsbereich des Bundesministeriums
für Verkehr, Bau und Stadtentwicklung

Investigation Report 203/04

Very serious marine casualty

**Foundering of SY ALLMIN and
drowning of two sailors
on 29 June 2004
east of Rügen**

1 October 2005

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.

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

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

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1 Summary of the marine casualty

The two-member crew of the sailing yacht ALLMIN intended to round the island of Rügen. The day's stretch on 29.06.2004 began in Seedorf, Rügen, and was scheduled to end in Sassnitz. After the yacht ran against a stone wall lying under water off the Südperd at about 12.00 and had been towed free from there by the daughter boat of the rescue cruiser FRITZ BEHRENS, it continued its voyage northwards.

When the two sailors had not reached their home port as planned one week later, a search was begun. Initially it was unsuccessful; the yacht and its crew remained missing.

On 21.07.2004 the body of the yacht owner was found in the area of Prorer Wiek, and on 29.07.2004 that of the co-sailor off the Polish coast.

On 26.11.2004 the wreck of SY ALLMIN was brought to the surface of the water by the fishing cutter CRAMPAS when it was heaving in its net at position $\varphi 54^{\circ} 27.787'N$, $\lambda 013^{\circ} 49.354'E$, but salvage was unsuccessful.

On 23.03.2005 VWFS DENEK lifted ALLMIN and brought it to Sassnitz.

2 Scene of the accident

Nature of the incident: Very serious marine casualty, sinking of the yacht with two fatalities
 Date/Time: 29.06.2004 at about 17.00¹
 Location: Prorer Wiek

Excerpt from the official chart for leisure shipping Series 3006, Sheet 2 (excerpt from 151) BSH

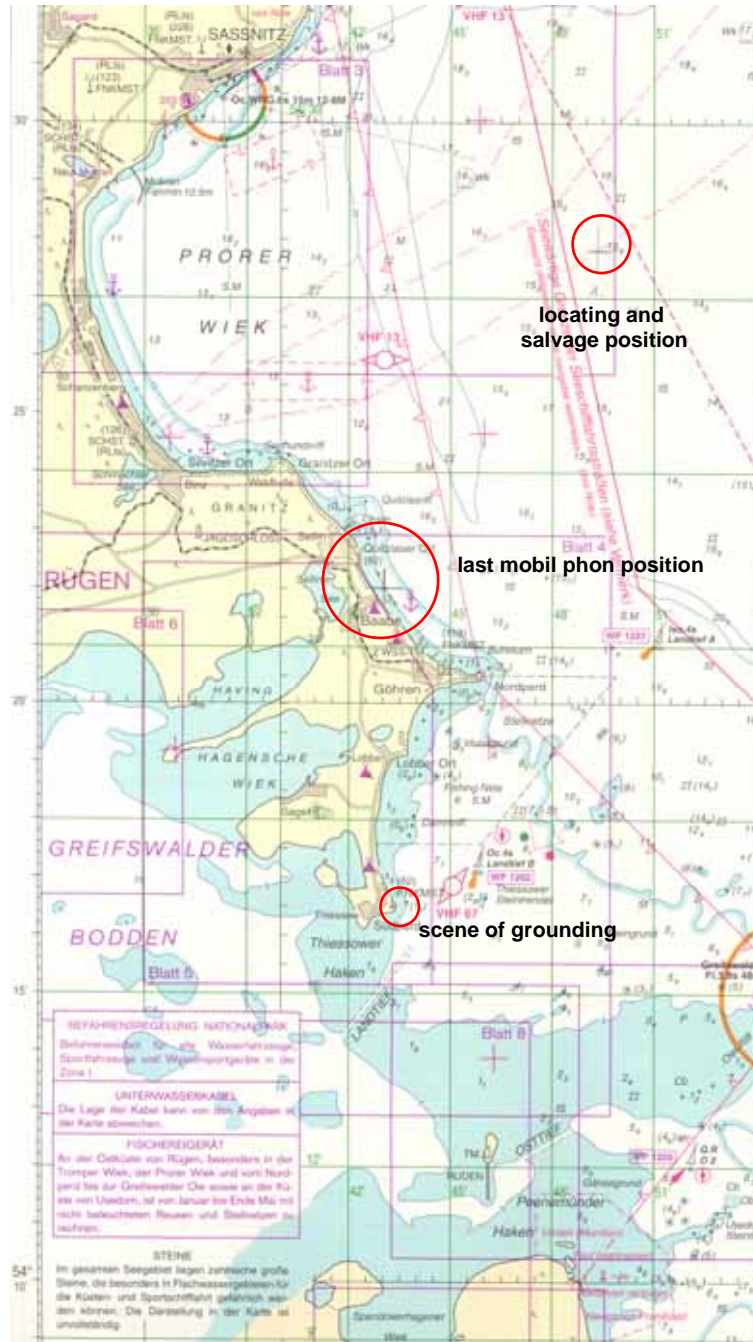


Figure 1: Sea chart with incident locations

¹ All times stated in CEST – Central European Summer Time

3 Vessel particulars

3.1 Photo



Figure 2: Photo of vessel (vessel type)

3.2 Data

Name of vessel:	ALLMIN
Type of vessel:	leisure craft, sailing yacht, type Neptun 26
Flag:	Federal Republic of Germany
Port of registry:	Born
Call sign:	none
Year built:	1973
Building yard:	Neptun Boote GmbH
Classification society:	none
Length over all:	7.75 m
Width over all:	2.50 m
Draft/with centre-board	0.65 / 1.28 m
Displacement:	1600 kg
Sail area close-hauled:	main-sail: 10 m ² , fore-sail II: 15 m ²
Engine rating:	6.5 hp
Main engine:	Yanmar Diesel with Saildrive, year built 1982
Hull material:	glass-fibre reinforced plastic (GRP)
Number of crew:	2

4 Course of the accident

4.1 History of the vessel

The sailing yacht ALLMIN, a Neptun 26, was built as a centre-board yacht and purchased by sailor A in April 2004. The yacht had been used by four previous owners, partly in the Mediterranean. The previous owners had made some conversions, including cutting open the air chambers. The last owner had not made any further changes.

4.2 Persons on board

At the time of the marine casualty on 29.06.2004 two related persons were on board. Both had already sailed the planned route several times.

The vessel was under the command of the 62-year-old owner. He was considered to be experienced and knowledgeable in handling small yachts, but he did not hold a *Sportbootführerschein* (sports boat licence). Mr. A reportedly held a *Befähigungszeugnis D* (certificate of competency) from the former German Democratic Republic. This authorised him to command small professional/commercial vessels in the area of the sea and inland waterways. Investigations conducted among the relevant authorities did not produce any results. Since Mr. A had been working in this field, it is assumed that he possessed the necessary certificate.

The 67 year old co-sailor, Mr. B held a *Sportbootführerschein-See* (sports boat licence-sea) issued on 20.04.2002. He possessed practical experience, partly acquired by sailing as co-sailor on zeesenboats².

4.3 Course of the voyage

The course of the voyage was reconstructed with the aid of statements by witnesses and clues.

The voyage of the sailing yacht began on 27.06.2004 in Wiek, Darss. The two sailors had planned to sail round Rügen within one week.

They spent the first night in the port of Puddemin in Strelasund. For the second night they ran into the port of Seedorf, Rügen. During this run they separated from a second yacht with which they had started the voyage in Bodstedter Bodden. The skipper of this yacht stated that ALLMIN had been running under fore-sail and main sail on 28.06.2004 and that he had not noticed any defects on the boat. On 29.06.2004 ALLMIN left the port of Seedorf for Sassnitz at about 10.15.

According to statements by lifeguards of the DLRG³, at about 12.00 the yacht ran onto an approx. 150 to 200-m-long stone wall lying under water at Südperd. The distance from the shore had been about 100 to 150 m. The yacht crew had not been able to free their vessel under its own power. The lifeguards had gone to their assistance with an approx. 5.50 m long inflatable boat with solid hull and an approx. 50 hp outboard engine. A line connection had been made and an attempt had then been made to tow the yacht off via the stern. The two men had been standing on the

² Zeesenboat - fishing sailing boat with auxiliary engine

³ DLRG – Deutsche Lebens-Rettungs-Gesellschaft e.V. (German Life Saving Federation)

stones and pushed. The salvage attempt had failed. Thereupon the rescue cruiser "Fritz Behrens" of the DGzRS⁴ had been called to assist.

The liveguards in the inflatable boat had observed how the crew had drained water from the yacht with a bucket. The two sailors had stated that this had only been splash water.

The crew of the rescue cruiser were questioned about the further course of events. The daughter boat ANNA powered with 180 hp had reached the yacht at about 13.35. The rescue boat men stated that the distance from the shore had been approx. 2 cables. The yacht had been lying on a stone in a field of stones there. The daughter boat had passed over a line and the yacht had been towed free via its stern at about 13.48. The rescue boat's offer to tow the yacht to the port of Thiessow had not been accepted. No water ingress or other damage had been evident and according to the information supplied by the sailors none had been sustained either. The two sailors had continued their voyage northwards under engine power. The rescue cruiser had returned to its station.

A further lifeguard stationed on a lifeguard tower at Südperd had observed that the yacht had initially proceeded to the navigation channel. Here the boat had turned once through 360° and had then proceeded northwards. All the sails had been fully set. This had surprised the observer, since other sailors had reefed their sails.

The crew presumably steered a course from Südperd to Nordperd on which a broad reach wind⁵ had been blowing. After Nordperd, it was possible to steer a course for Sassnitz.

The last known position of the yacht was at 14.56 with φ 54° 21.97'N λ 013° 43.02'E on the stretch between Nordperd and Granitzer Ort. At this time the network operator of the mobile phone of sailor A had registered that the mobile phone being switched off. The position ascertained for this describes the centre of a mobile radio cell. The cell radius stated has an average value of approx. 1,910 m. The position is close to the coast between Baabe and Sellin.

The vessel did not reach the planned port of destination Sassnitz.

5 Investigation

5.1 Search measures

When the two sailors had not reached their home port again after a week, the families began a search and reported the persons to the police as missing. The Waterway Police Mecklenburg-Western Pomerania questioned the harbour-masters of the surrounding ports, and boats and helicopters searched for ALLMIN.

⁴ DGzRS – Deutsche Gesellschaft zur Rettung Schiffbrüchiger (The German Maritime Rescue Service)

⁵ broad reach wind – wind comes from further aft than abeam

The body of sailor A was found drifting in the water in the area of Prorer Wiek by the crew of a yacht on 21.07.2004. The body was incompletely dressed, i.e. without jacket, trousers and shoes. It was not wearing a life jacket.

The body of sailor B was found on 29.07.2004 by a Polish fisher near Jaroslawiec at a distance of 9.5 nm from the coast. This position was approx. 95 nm off the course line to Sassnitz. The body was fully dressed in a sailing suit and was wearing an inflated life jacket.

The Federal Maritime and Hydrographic Agency (BSH) drew up a drift expertise for the Federal Bureau of Maritime Casualty Investigation (BSU). By calculating backwards it was possible to ascertain that it would have been possible for the person B to have started drifting from Prorer Wiek at the time of the accident.

On behalf of BSU the area where the last position of the mobile telephone was ascertained was searched by VWFS DENE⁶ on 30.10., 13.11. and 14.11.2004, without any results.

On 26.11.2004 the cutter CRAMPAS, SAS 107, was fishing together with the fishing cutter MARIKA. At position ϕ 54° 27.787'N, λ 013° 49.354'E something became caught in the net and when the cutter subsequently hauled the net it also pulled a sailing yacht to the surface. The yacht came to lie with its stern against the stern of the fishing cutter. On the basis of the port of registry and the colour of the hull it was possible to identify the yacht as ALLMIN. The following damage was ascertained:

- Crack at the stern on the port side,
- mast and rigging were partly ripped off at the stern and on the boat,
- the railing was bent, presumably by lifting in the rear area.

The net had become caught in the rudder blade. The cutter stretched the net a few times as a result of the sea swell and the rudder blade with rudder head and tiller were ripped out of the boat. Since the net gave way, the attempt to bring the yacht into the port failed. The yacht was lowered again. The crew salvaged the rudder and a few items of equipment and handed them over to the police.

Divers of the Police in Mecklenburg-Western Pomerania found the sunken boat again on 09.12.2004 and examined it. A video documentation was made. The following points were recorded:

- The vessel was lying on its port side.
- The mast was broken above the fastening point of the lower shrouds in the area of the spreader. However, it was still held by the double lower shrouds on both sides.
- The broken tip of the mast was lying near the mast on the roof of the cabin. The broken edges apparently correlated with the stump of the mast.
- At the level where the boom starts, the right-hand side of the mast groove had broken out over a length of approx. 30 cm and was bent upwards to starboard at an angle of 90°.
- The bow railing was undamaged.

⁶ VWFS DENE⁶ – Survey, Wreck-seeking and Research Vessel DENE⁶

- There was a crack in the visible starboard side between the hull and the keel over the entire length of the connection point. The crack was gaping open at the forward and aft end.
- The sliding cover of the companionway to the cab was closed.
- As a consequence of massive force a large piece of the outer plating had been ripped out of the hull in the way of the stern.
- The boom was no longer connected with the mast. The boom was lying alongside on deck turned through an angle of 180°.
- The swimming ladder was bent and folded downwards.

5.2 Salvage of the yacht

On 09.02.2005 a first attempt was made to salvage the yacht in the presence of the BSU. The salvage was to be carried out with the aid of the Coastal Patrol Boat GRANITZ of the Waterway Police Mecklenburg-Western Pomerania and the diving unit of the police of Mecklenburg-Western Pomerania. Owing to the state of the sea it was not possible to carry out the salvage. Divers examined the wreck and filmed it again; no change in position or condition was ascertained. The divers secured loose items to the vessel or stowed them in the interior in preparation for the salvage.

On 23.03.2005 ALLMIN was salvaged by VWFS DENEK of the BSH in the way of official assistance for the Public Prosecutor's Office Stralsund (Figure 3). The salvage was accompanied by a team from the BSU.

During the preceding examination of the vessel by divers, it had been ascertained that the mast stump was no longer standing and that this part was no longer on the vessel. The yacht was heaved onto the deck of DENEK using the vessel's own gear; water emerged at the Saildrive and a damaged area in the middle of the bow. No water emerged from the connection between the keel and the hull.

The wreck was taken to the port of Sassnitz, placed on a low-bed trailer there and kept as evidence close by.

5.3 Inspection of the yacht

The wreck of ALLMIN was inspected by staff of the BSU on 30.03.2005. At the same time the responsible public prosecutor, the expert of the public prosecutor's office and the processing officer of the Criminal Investigation Department were present.

The yacht was chocked up so that it could be inspected well (Figure 4). It had been roughly cleaned and the sand involved had been sieved in order to filter out small parts.

First of all an inventory of the contents of the yacht was made. All items from the yacht were filed on the basis of the place at which they were found and stored.

The boat had been equipped and was carrying provisions for a relatively long voyage. The interior and the contents of the cupboards and the pockets made a correspondingly organised impression in accordance with the circumstances.

5.3.1 Hull

The hull of the sailing yacht ALLMIN showed one large and several small areas of damage and a few deep scratch marks. In view of the long period during which it lay

under water, lifting by the fishing cutter CRAMPAS, other possible contacts with towing nets, and the recovery, it was not possible to allocate the source of most of the damage specifically.

The bow pulpit was bent, the stern pulpit no longer connected with the deck. Most of the railing stanchions had been ripped out of the deck or broken off. The swimming ladder was only secured to the stern at the right side, and was bent over to starboard. No damage to the hull caused by the swimming ladder pressing in to it was evident.

The centre-board was completely unfolded and bent to port at an angle of approx. 90°. The lifting line was no longer secured to the centre-board, but could not be drawn out of the guide tube.

The hull showed signs of abrasion in the aft area on both sides. Here the gelcoat had been removed down to the laminate by rubbing of the hull against the bottom.

The windows and the hatch were not damaged. On the port side, on a level with the forward edge of the cabin superstructure, an approx. 1 m long piece of the wooden guard rail was missing.

The yacht had sustained most damage in the stern area. There was a gap corresponding in width to the diameter of the rudder head from the opening for the rudder head in the bottom up to the transom. Here the gap widened to become a triangular hole in the stern. A large piece of material of the stern, the aft coaming and the port side of cockpit were missing.

The broken edges at the transom stern were sharp and not pressed inwards. The lower edge of the stern showed no other signs of damage (Figures 5, 6, 7, 8).

The crew of the fishing cutter had recovered the entire rudder with blade, head and tiller. The rudder blade showed signs of buckling in the upper part and strong abrasion in the lower part. The rudder head was bent above the rudder blade. The tiller was intact (see Figure 11, 12).

Further damage to the hull was found in the bow area in the transition to the keel, approx. 26 cm below the water line. Here the gelcoat and the laminate were affected massively over an area of approx. 20 cm (Figure 13). The gelcoat was no longer present, the laminate appeared to be buckled. When the vessel was salvaged water emerged from this point.

The inner furnishings of the yacht were almost identical with the layout plan (Figure 17). There was no collision bulkhead. The anchor box was simply a recess in the deck moulding. In the fore ship and on both sides of the interior, inner shells were laminated in place. The items of equipment in the saloon were mounted on the port and starboard sides on these shells. On the starboard side of the saloon this shell had been cut open in the way of the quarter berth in order to make space to fit a refrigerator on the right next to the cooker. Underneath the refrigerator the inner shell had an approx. 13 cm long crack. The quarter berth had been cut open further in the area beneath the cockpit. Thus additional stowage space had been created with a kind of chest.

Further stowage space in the cabin was available in a compartment going through on both sides of the saloon. It was mounted at shoulder height in the area under the side deck and secured by wooden sliding doors.

The toilet on the port side was also mounted on the inner shell. Behind the toilet was a wash-basin. During the inspection it was ascertained that the aperture of the WC was above the water level line. All valves for the wash-basin and toilet were open. After flushing the lines, it was found that the valves and the toilet, all parts were operable. The toilet membrane was watertight.

In the fore ship, the shell laminated in place was moulded as a bunk area. Wooden chests were secured in this as additional stowage space. Midships there was a large, shaped recess. A flexible water tank was located here.

Due to the shell laminated in place in the fore ship, it was not possible to inspect the damage in the bow area directly. First of all the wooden cases were dismantled and then the shell was cut open in the area of the recess. From here it was possible to see the deep damage (Figures 14, 15, 16). After removal of the wooden chests it was ascertained that the cavity formed on both sides through the inner shells was through-going from the fore ship to aft.

In the area of the cockpit the yacht was equipped with two locker seats. A mechanical drainage pump was installed on the port side. The locker seat on the starboard side contained the fuel tank. There was still diesel in the tank.

5.3.2 Engine and electrics

The yacht had been converted by a previous owner. Originally an outboard engine had been run in the trunk in the middle of the stern. This opening in the hull had been closed by laminating. The bottom of the cockpit still had a corresponding hole in the aft area that was covered by a board. The propulsion now occurred via an installed Yanmar-Saildrive with a rating of 6.5 hp.

During the first diving by the police it was ascertained that the accelerator was in a horizontal position forward and thus at full throttle. There was no ignition key in the lock. The lock position was "off". A key without a float was found in a little box on the inside of the cabin.

The BSU commissioned an additional expert opinion to ascertain the operating condition of the engine at the time of sinking. For this purpose the engine was dismantled and dismantled. The expert found that the engine had not been in operation at the time of sinking. Further findings were:

- The drive engine itself showed no external signs of damage.
- There were no essential conversions or repairs.
- The engine had been ripped off the front two silent blocks⁷.
- The exhaust line had been broken out of the seat of the water collector.
- The plus pole on the starter was burnt.
- The outer sleeve of the Saildrive was cracked towards the bow.
- The inner sleeve had two repair areas. Here leaky places had been sealed in an unworkmanlike manner with a silicon sealing compound.
- An engine oil sample showed a black oily consistency.
- A gear oil sample showed a yellowish oil-water emulsion.
- There was fuel in the filter.

⁷ Silentblock – vibration element for engine bearing

During the inspection of the yacht by the BSU it was also ascertained that the shaft of the drive had made contact hard on the forward edge of the hull cut-out of the Saildrive. As a result the forward edge showed clear signs of damage (see Figure 10). The shaft of the Saildrive had visibly tipped forward, and as a result the silent blocks were cracked. The two-bladed, left-handed propeller turning anticlockwise was bent forwards at both flukes at the rear (Figure 9).

The yacht was equipped with three batteries. One battery was standing in the battery box on the port side beneath the aft seat area, and another one in the storage chest lying next to it. A third battery was located under the forward seat area. All batteries were connected. Some of the necessary line cross sections were not present. The batteries were only secured against slipping at the places they were found, but not against falling out. There were three main switches installed on the battery box in order to be able to switch the batteries. The associated keys were not found. During the investigation it was ascertained that a cable on the plus pole of the first battery mentioned had burnt off.

The switch panel for the electrical loads was located on the starboard side of the saloon directly next to the companionway. There was no printed mark on the panel indicating the switch position. The switch positions ascertained were:

Autopilot	down	Inside lighting	down
Navigation	down	Refrigerator	up
Navigating lights	down	Water pump	down
Anchor light	down	Shower	down
3-colour lamp	down	Inside lighting	up
Not marked	up	Drainage pump	down

An electric drainage pump was not found. The wiring of the electrical system for this could not be reconstructed plausibly for the investigation.

5.3.3 Mast and sails

The yacht was equipped with an aluminium mast standing on deck, of which only the upper part with a length of 4.13 m was salvaged. The breakage point indicates that it bent over to starboard. This part of the mast had been lying on the deck already when the vessel was first found and was secured here by the police divers. The approx. 4 m long mast stump documented during the first and second diving was no longer present. It was broken off directly above the deck. The mast tip was still connected with the bow via the fore stay, the upper shrouds were still secured to the bow and the mast tip.

At the stern was an standing backstay with a $\frac{2}{3}$ length that ended in a block. In the bottom third a wire was passed from the starboard side of the stern via the block to a double-tackel of the backstay adjuster on the port side. It was conspicuous that the pulley was no longer connected with the wire. The bolt on the claw terminal⁸ was missing.

⁸ Claw terminal – end fitting on a wire that ends in a fork with bolt and split pin, from Segler Lexikon, Joachim Schult, Delius Klasing Verlag, 12th Edition 2001

A fore-sail and a main sail were attached. A further fore-sail was carried packed in the fore ship. At the time of the investigation the fore-sail was rolled up by the roller reefing system, and the sheet was partly wrapped round it. The head of the fore-sail was not connected with the fore-sail halliard. The shackle under the swivel was closed, the bolt was secured with a round splint.

The main sail was inserted in the boom with the foot. The fore leech was no longer connected with the mast. This was how the main sail was found during the first diving too. The slides of the main sail on the fore leech were undamaged. The main sail had two rows of luff points. No reef was tied in. Of the possible five sail battens, only the second from the top was still in the sail. The main sail was damaged in two areas, on the one hand a seam had opened, and on the other hand the sail showed several abrasion holes. The main halliard was shackled to the head. The boom that ran in a groove in the mast via a traveller was found lying on deck in the fore-and-aft direction of the vessel during the first diving on 09.12.2004. The top of the boom was lying towards the mast. The lift was attached to the main boom. The mainsheet fitting at the top of the boom was ripped off.

5.3.4 Equipment

The equipment present was restricted to that which was necessary or recommended for navigation or safety in accordance with the brochure "Safety at Sea and in the Coastal Area" of the BSH and the Safety Guidelines of the Cruiser Division of the DSV⁹. The sequence does not represent any valuation.

The following were present:

- A magnetic compass at the aft edge of the raised cabin,
- the displays for log, echo sounder and engine at the forward side of the foot space in the cockpit,
- a firmly installed manual drainage pump in the port locker seat of the cockpit,
- a set of sea charts of series 4 "Round Rügen - Boddengewässer - Stettin" for the sea area published by Nautische Veröffentlichung Verlagsgesellschaft mbH, Edition 2003. Sea Chart S 41 in scale 1:60,000 was available for the south eastern tip of Rügen and hence the area in which ground contact was made. The correction status could not be checked due to the condition of the charts,
- a port manual from Delius Klasing Verlag for the island of Usedom,
- two pairs of binoculars,
- a faint-safe solid life jacket for leisure shipping, brand Besto, for persons of 60 to 80 kg,
- one sailing suit consisting of jacket and trousers,
- a 2 kg ABC powder extinguisher with the test date expired,
- a thermometer, a barometer, and a battery-operated electric clock in the saloon. The clock was not sealed and had a 12 hour display, it had stopped at 05.00,
- a mobile telephone in the closed compartment on the port side,
- an anchor with anchor line in the anchor chest and a reserve anchor in the locker seat,
- navigating lights,
- a marching compass with bearing device,
- manuals on the technical facilities,

⁹ DSV – Deutscher Segler-Verband e.V. (German Sailing Association)

- tools,
- a radio.

5.4 Weather

A weather expertise was commissioned from the DWD¹⁰ in order to assess the weather on the day of the accident. It had the following content: *"The analysis of the ... data bases showed that on 29.06.2004 between 15 and 24 h CEST a west wind was blowing in the sea area of Prorer Wiek with an average strength of 5 to 6 Bft and reaching gusts of 6 to 7 Bft. Individual gusts of force 8 Bft cannot be completely ruled out for the time between 15 and 17 CEST. Altogether during the period to be assessed there was a trend towards weakening of the wind so that the higher values are to be estimated for the afternoon hours.*

In the afternoon there were some rainshowers that were not very strong. From the evening hours onwards there was no precipitation. Horizontal visibility was 25 km. The sun was only shining for part of the time.

The air temperature dropped from 16°C to 14°C in the course of the period to be assessed, and the water temperature was 14 to 15°C.

The data on the mean wind force in Beaufort (Bft) correspond to the 10 minute average values of the wind speed. Individual short gusts lasting a few seconds are generally one to two Bft strength above the average wind strength.

In the given wind strength conditions, as a function of the wind direction, duration of wind action and length of wind action (fetch), a sea with characteristic wave heights of 0.5 to 1.0 m could develop.

The data concerning the wave height relate fundamentally to the characteristic wave height. This corresponds to the arithmetic mean of the top third of the wave heights in a period of observation. This means that a number of individual waves is higher than the characteristic wave height. In rare cases individual waves can exceed the characteristic wave height by 70 % to 100 %."

The DWD forecasts for the sea area of the Southern Baltic Sea broadcast among others by the radio station Deutschlandfunk and Deutsche Welle were as follows:

- 28.06.2004, 05.00 GZ¹¹ Forecast to midnight: south-west to west 3, increasing 6 to 7, shower and thunder storm gusts, misty, sea 1.5 m
forecast until tomorrow noon: west 6
- 28.06.2004, 10.00 GZ in the next 12 hours strong wind or storm is to be expected, also in the Southern Baltic Sea, Boddengewässer East
Forecast to midnight: south-west to west 3, increasing 6, shower and thundery gusts, misty, sea 1.5 m
forecast until tomorrow noon: west 6
- 29.06.2004, 05.00 GZ in the next 12 hours strong wind or storm is to be expected, also in the Southern Baltic Sea, Boddengewässer East
Forecast to midnight: west 6, shower gusts, sea 2 m
forecast until tomorrow noon: west 6, reducing 5

¹⁰ DWD – Deutscher Wetterdienst (Germany's National Meteorological Service)

¹¹ GZ – Legal time, here CEST

Station report: Arkona West 5, 11 degrees, 1018

- 29.06.2004, 10.00 GZ in the next 12 hours heavy wind or storm is to be expected, also in the Southern Baltic Sea, Boddengewässer East,
Forecast to midnight: west 6, shower and thunder-gusts, sea 1.5 m
forecast until tomorrow noon: west 6, reducing 5
Station report: Arkona West 6, 12 degrees, 1017

The wind forces for the Boddengewässer east area were generally half a wind force less than forecast for the area of the Southern Baltic Sea.

According to the records of the water level indicator in Thiessow, the water level between 12.00 and 15.00 was 5.05 m. It was thus within the range of the mean value over many years.

6 Analysis

6.1 Experience and equipment

The crew of the sailing yacht ALLMIN had a normal start to their trip. The qualification and experience of both sailors were sufficient for the area sailed.

In order to assess the equipment and the requirements of the yacht, the planned sailing area of the yacht was initially classified in accordance with the Safety Guidelines of the Cruiser Department of the DSV. The sailing area of the yacht largely corresponded to Category 3, i.e. "Voyages over open water that is largely relatively protected or close to the coast line, including voyages for small yachts". According to this the crew should have had the following items of equipment on board in order to meet the recommendations or requirements:

- A satellite navigation system or a terrestrial radio navigation system,
- a sea manual for the area to be sailed,
- a sea radio set,
- pyrotechnical emergency signals,
- a further draining pump,
- a radar reflector,
- a life ring with line and lamp,
- a fog horn,
- a further fire extinguisher.

It was not possible to ascertain to what extent the additional items of equipment would have prevented the death of the two sailors. However, it is certain that no emergency call was sent from the mobile telephone carried. It was no longer possible to ascertain whether this was due to the lack of any network connection or to an empty battery. A maritime radiophone system would have offered a much tried and tested and good alternative.

Furthermore, pyrotechnical distress signals would have offered an independent possibility of drawing the attention of other persons to an emergency situation at sea.

According to Category 3, a liferaft does not belong to the recommended items of equipment. Judging by the development of the situation on board ALLMIN, a liferaft would have represented an important auxiliary.

6.2 Damages to the hull

During the survey two areas of damage that were crucial for maintaining the floatability were ascertained. The first damage was in the fore ship area. It very probably occurred as a result of the yacht running onto the shallow at Südperd. The fact that the crew were unable to tow the yacht from the stones onto which it had run with the aid of a motorised inflatable boat provides some information about the force of the stranding.

After stranding, the crew was initially unable to notice the damage sustained due to the inner shell being laminated in place in the bow area. Accordingly they continued their voyage northwards. It was only when more and more water entered the boat

that this was presumably noticed by the change in freeboard and sea behaviour of ALLMIN.

The experts of the Public Prosecutor's Office Stralsund conducted a leak calculation and a calculation of the resulting changing displacement. Possible water ingress via the Saildrive sleeve was neglected, as was open valves, the movement of the yacht in a swell and hydrodynamic effects.

The volume of water entering was calculated roughly with the formula $Q = A \cdot t \cdot \mu \cdot v$.
Here,

- Q is the volume of water flowing in [m³/s]
- A is the area of the leak [m²]
- t the time [s]
- μ the constriction number¹², assumed at 0.6
- v the flow speed, $v = \sqrt{2 \cdot g \cdot h}$
- h the depth of the leak below the water line [m]

The measured depth below the water line of the leak of 0.3 m and the assumed area of the leak of 0.00015 m² result in a quantity of water of about 0.72 t/h flowing in. Theoretically the shell laminated in made the yacht unsinkable. If there was damage to the outer plating inside or outside the inner shell, there would always have been a residual buoyancy. However, since the inner shell had been cut open on ALLMIN, the water emerged at least from the cut-open parts of the quarter berth in the saloon. According to the leak calculation the yacht was no longer floatable after 2,276 l water had entered. This was approx. 3 hours after the voyage was continued, at about 17.00.

The second large area of hull damage was in the stern of the yacht. As a result of the investigation it was ascertained that a collision with another object or vessel did not enter into question as the cause. The following points back this up:

- The fractured edges did not point inwards and were smooth and not roughened.
- The swimming ladder had been pushed away to the side and not into the hull. The reason for this could be the straight stern of the fishing cutter or the collision with the bottom of the sea.
- No traces of paint from another vessel could be ascertained.
- The bottom edge of the stern transom, in other words the transition to the bottom, showed only one area of damage. This damage consisted of drawing the rudder head through the deck and showed a clear damage constellation.
- The crew of the fishing cutter CRAMPAS saw only one crack in the stern.

The cause of the large area of damage is considered to be the tangling of the rudder blade in the net of the fishing cutter. This resulted in forces that exerted excessive stress on the stern section, thus first leading to a crack and then pulling the entire rudder out of the vessel. The fishers recovered the rudder. It was no longer on the yacht when it sank again.

No other indications of a collision with a vessel or object were found.

¹² Constriction number – coefficient for the form of the leak edge

The BSU considers the damage to the bow to be the cause of the yacht foundering.

6.3 Engine and electrics

As ascertained in the engine expertise, the engine was not running at the time of sinking. The position of the engine with full throttle is attributable to the transmission being coupled. Generally this prevents noises from the screw that otherwise turns with the vessel. The damage to the propeller was presumably caused when attempts were made to free the yacht from the stones. The cause of the Saildrive tilting forward could not be definitely ascertained.

The repair area on the inner sleeve as well as the overall condition of the Saildrive on salvage are not assumed to be the cause of sinking.

The functioning and occupation of the electrical system were not checked in detail. It was simply concluded from the position of the switches. With the basic assumption that the switch position "up" meant the function "switched on", the following loads were switched on:

- Refrigerator - the refrigerator had two electrical inputs, so that it could be operated via 12 V or 230 V. Since sufficient battery capacity was available, the refrigerator was switched on.
- Interior lighting.
- One non-designated switch.
- Drainage pump - no electric drainage pump was found.

Continuing the above assumption, no navigating lights were switched on. It can therefore be presumed that the vessel went down during the day. Since the batteries did not fall out of their positions, the yacht cannot have capsized. In connection with the clock found in the saloon, the time of sinking can be fixed at 17.00.

6.4 Weather and sail management

The forecast wind force was 6 Bft. The planned stretch for the day led partly through an area protected from wind and close to the coast with moderate sea. Accordingly the voyage would have been safe under the aspect of seamanship. However, the forecast was for shower and thunderstorm gusts. In these gusts the wind increased by 1 to 2 Bft. This was connected with a drastic increase in the wind pressure. Excerpt from Yachtpilot 2004, DSV-Verlag GmbH: *"The ... scale (Beaufort Scale) is not linear, i.e. the wind speed does not increase by the same amount from stage to stage, but by ever larger amounts. At the same time the wind pressure increases as a square of the wind speed. The interaction of both components leads to a steep rise in the forces acting on the sails as wind forces increase. Thus the wind speed rises by approx. 65 per cent between 5 Bft and 7 Bft, but the wind pressure by almost 300 per cent. If a yacht can still carry full sails e.g. at 5 Bft, it must reef drastically when the wind increases, at 7 Bft approx. two thirds of its sail area."*

A fore-sail and a main sail were bended to on ALLMIN. The total sail area was 25 m². The rolled fore-sail reduced the sail area by 60 %.

In view of the overall weather situation it should have been reconsidered whether to start this stretch. More than two thirds of the roughly 16 nm long sea journey was a "close-haul" course, which with the forecast wind forces meant corresponding strains for the crew and the yacht.

6.5 Course of the voyage

The crew of ALLMIN was moving in a challenging area under the aspect of navigation for rounding Rügen, especially when passing the Thiessower Haken shallows. Contrary to the recommendations of the Safety Guidelines of the Cruiser Division, the yacht was not equipped with a device for automatic position finding (e.g. GPS)¹³. Without the possibility of ascertaining a precise position and without useful sea markers in many areas, safe navigation was not possible.

The Sea Chart S 41 of Series 4 (Edition 2003) of Nautische Veröffentlichung Verlagsgesellschaft mbH to scale 1:60,000 for the area to be sailed, Greifswalder Bodden/Thiessower Haken - coast from Südperd to Nordperd, was on board the yacht. Due to the scale-related density of information, the chart was unsuitable for passing the flat area between the Landtief navigation channel and Thiessow and according to the publisher not designed for this. The passage through the navigation channel would have been possible with the assistance of the chart on board without any problem, however (Figure 19).

Using the Leisure Craft Chart Set 3006 of the BSH, Sheet 4, scale 1:50,000 or the detailed chart, Sheet 5, scale 1:25,000 would at least have made the dangers more clear through the lesser shallows (Figure 18). The largest part of the shallows shows depths below 3 m, within the 3 metre depth line there are some lesser shallows below 2 m marked. Using these charts for the direct passage through Thiessower Haken, the skipper would have satisfied the seamanship principle of always using the chart with the best scale¹⁴. Due to the lack of being able to find the position precisely on board ALLMIN, however, the direct passage through Thiessower Haken would have been unsafe even with this chart.

The direct passage of Thiessower Haken with a larger-draft boat is also problematic for another reason. Certain wind directions in the area of the Greifswalder Bodden can bring about changes in water depth of between -0.5 to +0.5 m¹⁵.

From the voyage guide for the Baltic Sea Coast¹⁶: "*Towards the Baltic Sea there is a vast sandbank between Rügen and the mainland that is more an obstacle than offering protection. Two large navigation channels run over this flat area that professional navigation always takes and that we boat users should best use too: in the north the Landtief, in the south the Osttief. It can repeatedly be observed that boats sail over the shallow area outside these channels. If one looks at the sea chart, this is possible in many places. Despite this I would advise against it.*"

¹³ In this connection reference is made to the existing equipment obligation with a navigation system in accordance with Chapter V, Rule 19 No. 2.1.6 of the SOLAS.

¹⁴ Manual for Bridge and Chart Room, BSH, 1st part, 2.4.3: "Always use the sea charts in the best scale since these contain the most details....")

Der amtliche Sportbootführerschein-See, Graf/Steinicke, 12th Edition 1997, Busse Seewald Verlag, Page 292 "The chart with the largest scale is always to be used for navigation."

¹⁵ Ostseehandbuch (Baltic Sea Manual) of the BSH, Part III, C 4.4 Greifswalder Bodden as well as Revierführer Ostsee (Baltic Sea Guide), 3rd Edition 2001, DSV-Verlag, Page 110 "The water level can be considerably influenced by heavy winds. For instance with sustained strong winds from SW, the water level can drop by up to 1 m, with corresponding winds for NE it can increase by 1 m; the water level changes are seldom more than 0.5 m in the summer months, however.

¹⁶ Törnführer Ostseeküste 2 (Baltic Sea Coast Guide) Travemünde to Stettiner Haff, Jan Werner, 3rd Edition, 2002, Delius Klasing Verlag

For the above reasons the crew should have oriented itself via the buoys of the Landtief navigation channel.

Using the Landtief navigation channel would have avoided the grounding. Whether the skipper was seeking protection so close to shore or whether there was some other reason for this approach could not be clarified in the investigation.

A buoy laid out at Südperd might have prevented the yacht running aground. The need for a buoy at Südperd and at Nordperd cannot be justified for this. Both capes have marked steep coasts that indicate a distance estimation. The shallow areas in front of them do not extend very far and can be rounded safely if one is oriented to the 5 m depth line.

After salvage by the daughter boat, the crew continued its voyage to the north. The offer of the rescue boat men of the DGzRS to tow the yacht to Thiessow was declined. The crew of ALLMIN could not examine the collision area at the bow and sailed on despite this. The fact that the crew had scooped water out of the yacht was neglected in the analysis. It is possible that the repair area on the Saildrive was not tight or water had collected in the former engine trunk.

Damage to the rig caused by the hard stranding cannot be completely ruled out either.

The voyage with wind veering aft from Südperd to Nordperd was probably managed quite well. After Nordperd there is a change in course and it would have been necessary to steer north-northwest. For the yacht with the west wind direction stated in the weather expertise, this would have been a "close-haul" course.

The position of the last mobile phone contact was confirmed by a coupling calculation. It was assumed that ALLMIN left Südperd at about 14.00 and had the last mobile radio contact at the known position at 14.56. It would thus have passed about 6 nm in one hour.

After passing Granitzer Ort, the yacht left the cover of land.

There are no secured findings regarding the further course of the voyage. A series of questions remained unanswered. Thus the team of investigators of the BSU was unable to clarify how it was that the yacht was found so far away from the course line. Perhaps it was not possible in view of the sails carried and the drift to run closer to the wind, or perhaps a more northerly course was selected due to the swell, or the yacht drifted off course.

6.6 Summary

The voyage of the sailing yacht ALLMIN was not prepared comprehensively. Not all the equipment recommended in the Safety Guidelines of the Cruiser Division and the publication "Sicherheit im See- und Küstenbereich – Sorgfaltsregeln für Wassersportler" (Safety in Sea and Coastal Area - Rules for Care for Leisure Sailors) were on board. In particular there was a lack of a navigation system, maritime radiophone system and distress signals. This led to the crew being unable to navigate safely and not being able to draw attention to their emergency situation developing or being able to react to the situation.

A liferaft is not one of the recommended items of equipment for this sailing area. However, in this case it would have been a great help for the crew.

The crew should have kept further away from the shore or used the marked navigation channel in view of the small scale of the sea chart they used. The nautical features, in other words sea area and weather, were not observed sufficiently. This allowed the yacht to ground.

The structural damage after grounding was not sufficiently examined; the possibility of running into the next port with an escort was not used. The foundering of the yacht is attributable to the loss of floatability on the basis of water ingress in the bow area. The cutting open of the inner shell and resulting elimination of unsinkability of the yacht promoted the foundering.

No indications of another cause of damage were found.

7 Safety recommendations

The BSU recommends:

- to owners, operators and skippers of motor and sail boats that the vessels be equipped in accordance with the "Safety Guidelines for Equipping and Safety of Sail Boats/Multi-hull Boats" of the Cruiser Division of the DSV and the publication "Sicherheit im See- und Küstenbereich – Sorgfaltsregeln für Wassersportler" (Safety in Sea and Coastal Area - Rules for Care for Leisure Sailors) of the BSH. The equipment recommended in the list there, depending on the area traversed represents a tested standard. Furthermore, for individual voyage planning it is recommended that additional safety equipment be carried, e.g. liferafts depending on the sea area to be traversed.
- to skippers, to avoid grounding, that they observe depth lines and navigation channels depending on
 - the depths
 - navigational equipment
 - the scale of the sea chart used, whereby the largest possible scale is to be selected
 - the weather conditions
 - and the sea behaviour of the boat.
- to skippers, after grounding, that they carefully examine the vessel for damage and if appropriate run into the next port in order to be able to examine the damage better.
- to owners and operators, that they ensure that structural changes to the hull do not suspend the design floatability specified by the manufacturer or exceed the deadweight.

8 Sources

- Investigations by the Public Prosecutor's Office Stralsund
- Investigations by the Criminal Investigation Department and the Waterway Police (WSP) Mecklenburg-Western Pomerania
- Video-documentation by divers of the Technical Assignment Unit of the Police Mecklenburg-Western Pomerania
- Statements by witnesses
- Sea charts and sea manuals of the BSH
- Chart by Nautische Veröffentlichung Verlagsgesellschaft mbH
- Expertise on the drift behaviour by the BSH
- Wreck search report by VWFS DENEK
- Official weather expertise by DWD
- Sounding levels by WSA Stralsund
- Expertise on the engine by PeWi – Rügen GmbH
- Expertise by Messrs. Ostsee-Kontor
- Photos: Bootspark Greifswald, Ostsee-Kontor, BSU



Figure 3: Salvage of SY ALLMIN by DENE B



Figure 4: View from the bow



Figure 5: View from the stern



Figure 6: Plan view of stern



Figure 7: Straight cut edges at stern



Figure 8: Crack in the bottom



Figure 9: Saildrive shaft pushed forward and damaged propeller



Figure 10: Damage to the trunk of the Saildrive



Figure 11: Upper part of the rudder blade with buckling



Figure 12: View of the steering gear



Figure 13: Damage to the bow



Figure 14: View into the fore ship



Figure 15: Inner shell cut open in the fore ship



Figure 16: Damage in the bow area

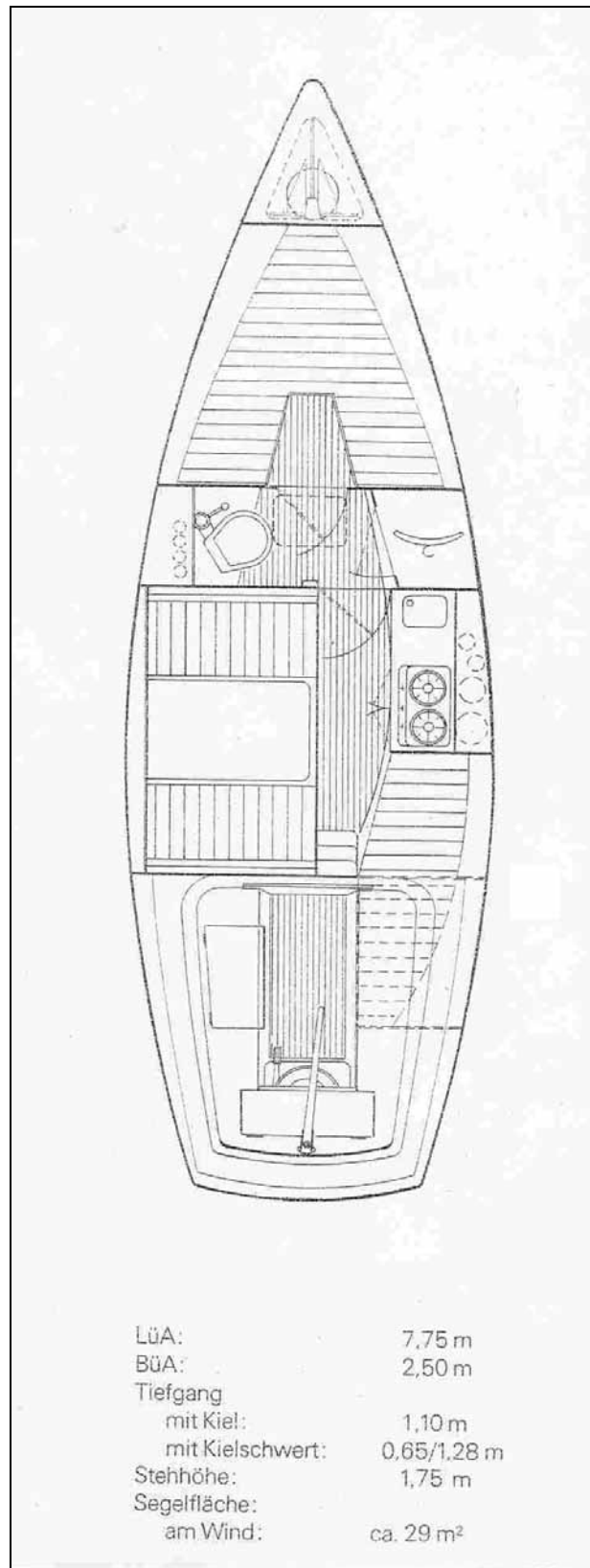


Figure 17: Layout plan Neptun 26

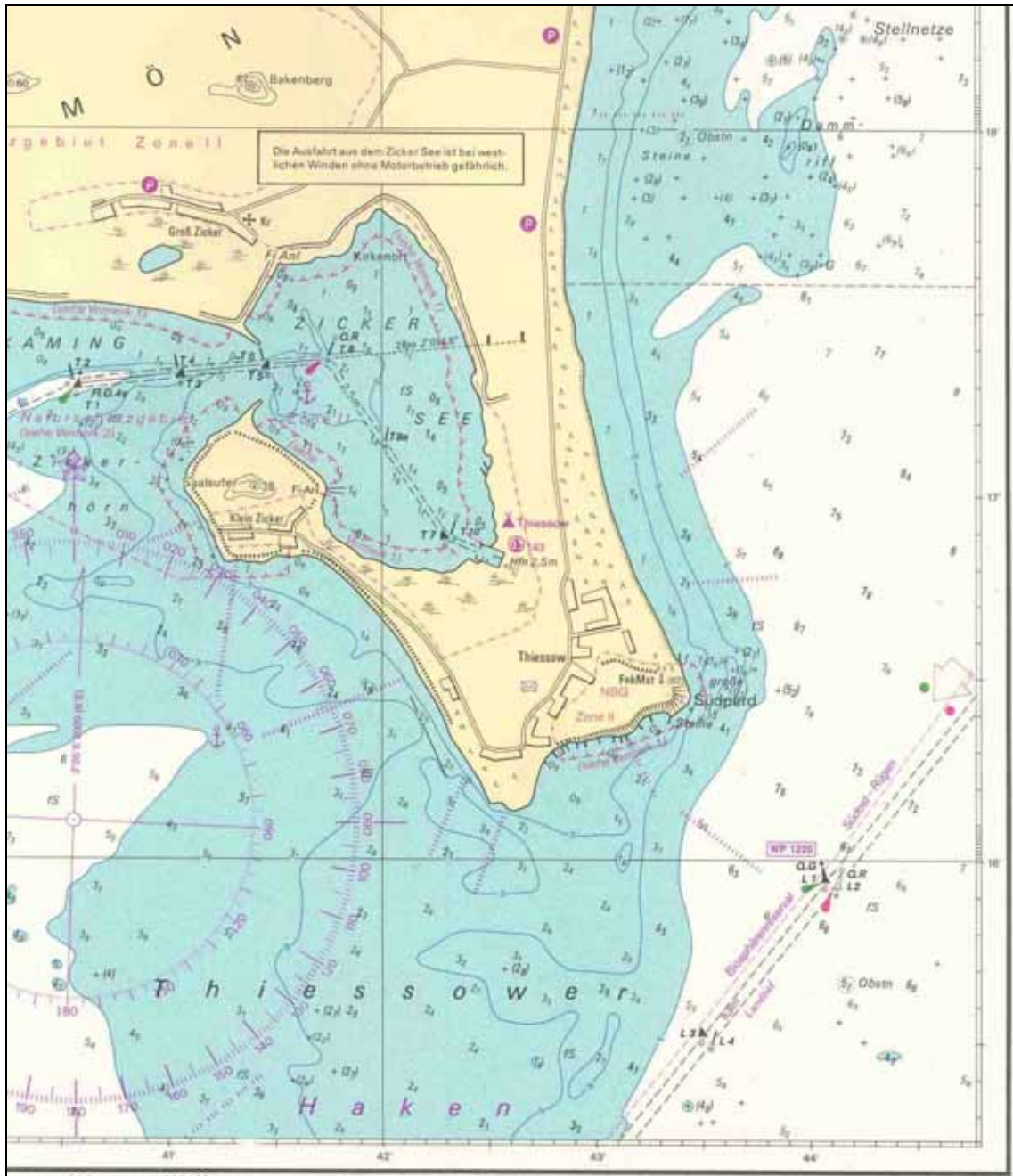


Figure 18: Excerpt from the official leisure shipping chart Series 3006, Sheet 5 (excerpt from (16)1578) of the BSH, scale 1:25.000

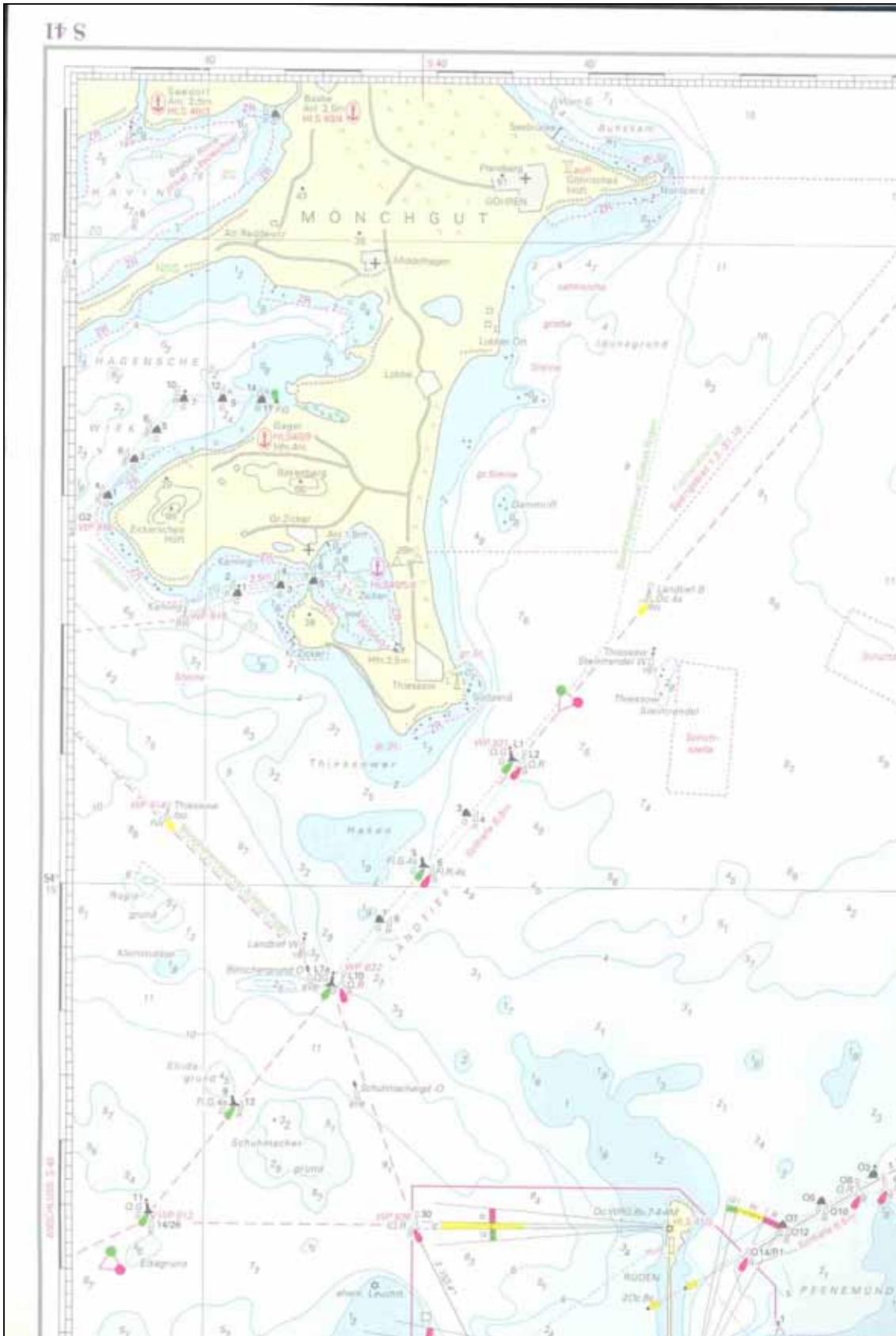


Figure 19: Excerpt from the leisure shipping chart "Greifswalder Bodden Ost", Series 4, Chart S 41, Nautische Veröffentlichung Verlagsgesellschaft mbH Arnis, scale 1:60.000