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**Message**

# The impact of hydro-meteorological conditions on the safety of fishing vessels

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**Abstract**
The author discusses the impact of hydro-meteorological factors on the safety of fishing vessels through the presentation and discussion of the events that have taken place on the Polish fishing ships in the area of the Baltic Sea. Because it is not possible to compare the hydro-meteorological conditions on the ocean with the conditions of the closed sea, what is the Baltic Sea – the author has limited consideration to the South and the South-East Baltic which is the main area operation of Polish fisheries.It focuses mainly on criteria which have a direct impact on the safety of the fleet due to the size and nature of the work of fishermen.

## Introduction

Fisheries provides 20 percent of the animal protein in the diet over 3 billion people. The share of fish protein for animal protein in the diet can be as high as 50 percent in the poorest regions of the world and up to 90 percent in small-island developing countries. The same – fishing plays a key role in ensuring food and income-earning opportunities. This is especially in developing countries. At the same time, it is one of the most dangerous professions in the world. Report of the International Labour Organization estimates, that in the fisheries sector is annually 7% of all accidents at work, although employment does not exceed 1% of employees worldwide. Food and Agriculture Organization estimates that on board of fishing vessels and directly on the fish farm are employed 36 million people. With this professional group of about 15 million are employed directly on the various types of fishing vessels. Over 90% are employed on vessels less than 24 m. These numbers already pre-plotting problem, which is safety on board fishing vessels. Information from these countries that collect accurate data show that the number of fatalities in this sector far exceeds the national average of all accidents at work. For example, in the United States of America, the number of fatalities on average per year – 160 per 100,000 employed and is 25–30 times higher than the national average. In Australia, this ratio is 143 per 100 000, compared with the average of – 8.1 per 100 000. In Nordic countries the mortality rate is in the range from 90 to 150. It should be noted that these countries have the best training systems, supervisory, and search and rescue systems of life at sea. On the opposite side are the countries of West Africa, where the mortality rate ranges from 300 to 1000 and for South Africa – 585 per 100,000 fishermen. These factors are not only high, but there is some evidence that these figures are underestimated [1].

Overfishing, increased competitiveness, reduced profitability, reduce costs related to maintenance boats and equipment, saving on crew fatigue, recklessness, management systems, which do not take into account sufficiently the human factor and the safety of fishermen, diversification of fishing activities without proper training, skills and experience have led to the fact that every year in accidents in fisheries around the world are killed 24,000 people. 24 million are injured. Statistically, 65 people die every day and this is one of the highest mortality rates in the world – giving a total of 80 deaths per 100,000 workers [2]. In addition, there are social consequences that may produce catastrophic consequences. In developing countries,

widows have very low social status. In these countries, in the absence of proper care from the state and family support and without alternative sources of income often comes to the tragedy of the whole family.

How does it look in Poland? In what way hydro-meteorological factors have an impact on the safety of fishing vessels operating in the Baltic Sea region of the southern and south-east? As well, what methods to improve the safety of fishermen?

Positive effects of present direct joins between hydro-meteorological factors and the safety of fishing vessels can be seen in several aspects:

- Navigation safety aspect – the problem of the safety of individuals and vessels at sea has always been and will be a priority;
- Technical and economic aspect – eliminating of the risk of major failure may reduce operating costs;
- Educational aspect – an understanding of the sea can be a powerhouse of the whole structure of education.

The purpose of resource development was obtained by an accurate description of selected accidents, which allows understanding of the problem contained in the title of the article, not limited only to statistical data.

To be able to start the analysis it must specify the concept of a maritime accident. Marine accident is an occurrence or several consecutive occurrences linked directly to the ship's operations, resulting in: any loss of life, major serious injury to a person or loss of a person onboard the ship, draught, loss of the ship or damage to the ship seriously affecting its structure, manoeuvrability or operability so that an in-depth repair is required, ship's grounding, or any ship's hull contact with the sea bottom, an impact of the ship into a subsea obstacle, laying-up or collision of the vessel, fire, explosion, an impact into a building, facility of installation, cargo dislocation, damages due to unfavourable weather conditions, damages by ice, crack of the hull or suspected damage to the hull, or damage by the ship to a port's infrastructure, or to facilities providing access to ports, harbours, installations or offshore structures causing a serious risk to safety of the ships, other ships or persons, or a damage to the natural environment or posing a risk thereof [3].

## Hydro-meteorological factors directly affecting the safety of fishing vessels on the Baltic Sea

On the number of accidents in the Baltic Sea are significant influences of the weather conditions during fishing. The greatest intensity of fishing takes place in the months of autumn – winter, when the weather conditions are the most difficult. An additional negative factor is the need for fishing vessels manoeuvring in difficult weather conditions, on limited and shallow waters, in addition being burdened with additional fishing gear. The decision to exit into the sea depends on various factors. Weather and sea condition on the day of departure are very important, but also important is access to current weather forecasts. Weather criteria are particularly important for smaller boats, and such after all, dominate in the area of the Baltic Sea. The criteria that should be taken into account when making a decision about leaving the berth:

- Awareness of the limitations arising from the unit type and the size of the vessel, and the crew experience, methods and fishing gear, and the duration of the voyage;
- Interactions between wave height and boats and the consequent danger of the stability of the cargo;
- Knowledge in the field of permissible security taking into accounts the terms and conditions of hydro-meteorological;
- Presentation of the highest caution in the circumstances;
- The availability of up-to-date hydro-meteorological information.

Conducted statistical analyses have identified four factors hydro-meteorological affecting the security of vessels and fishermen:

- Wave – the height and direction;
- Concentration of ice and ship's icing;
- Temperature of the air and sea surface;
- Fog, rain, snow and others source of low visibility.

### Waves – height and direction

The main, practically the only factor in the formation, and sometimes suppression and movement of the waves in the Baltic Sea – is the wind. The swell very rarely appears in the Baltic Sea because it is caused when the developed wind waves in excess of the zone of storm winds. Turning up first in a free wave, and then in the swell. Sometimes the swell, as the residue after one storm, can coexist with the newly generated wind waves. The direction of the swell and wind can be different and this is potentially the worst situation for the navigator. It is difficult to choose the safe direction. Swells are always longer than the wind waves from which they arose. They are less steep, and over time their length increases, while the profile becomes almost symmetrical.

Wave height depends on the strength and duration of blowing and the length of the road, which overcomes the wind above the surface of the water. Initially, when the surface of the water is smooth, the resistance of the wind is limited to the friction. Irregular current of air, the turbulence – cause wrinkles on the surface of the water. These wrinkles naturally become an obstacle to the wind. Arise further turbulence, and the waves are getting higher. They initially are short and steep, and after some time become longer. What the wind is blowing stronger and longer – the waves become higher and higher. However, the wave height does not grow indefinitely. As time passed, their height stabilizes, and its amount depends on the type of water reservoir. With the wind blowing from the mainland resulting waves are small and their height increases with distance from the shoreline. In confined areas – such as Szczecin and Vistula Lagoon or Bay of Puck – even strong wind is not able to induce high tide. Therefore, the nature of the small seas, which include the Baltic, looks completely different than the oceans. For example, on the Baltic Sea wind of 8°B gives rise to a wave height of 3–4 m and a length of 50–60 m. Wind with the same force in the ocean creates waves with a height of 7–8 m and a length of 150–200 m [4].

All these elements associated with the wave, its direction of movement and the height are statistically the greatest threat to fishermen. And do not necessarily have to be extreme.

Accidents occur at relatively high and moderate wave.

***The sinking of the fishing boat USM-2*** (GT 11.39, length 11.55 m), on 04th June 2012, and as a result of an accident – missing crew member. The direct cause of capsize of the USM-2 was to raise the "package" with a fish weighing about 1 ton and "uplift" the wave crest height of 0.6 m in the area of midships. Increasing the weight increase caused displacements of centre of gravity, and finding the USM-2 resulted in the crest of the wave changes the shape of the underwater part of the hull, thus reducing the stability of the shape of the arms. Shipping USM-2 on the following waves (in the direction of propagation of the wave) caused cyclic changes of stability: the deterioration of the crest of the wave and the improvement in the bottom of the wave. The phenomenon of deterioration of the stability on the crest of a wave is known as the "pure loss of stability". Cannot be excluded that the mutual relation between the shape of the hull and the profile wave heights of 0.6 m was so bad that there has been the phenomenon of "pure loss of stability" after lifting the weight. Weather forecast for the area where the accident occurred contained a warning against a strong wind. Wind West to Southwest 5 to 6 initially 7° B. Sea state 5 to 4, the temperature about 8°C. Visibility good, in the little rain – poor. The actual state pointed to better hydro-meteorological conditions. Prevailed conditions of good visibility, the wind Westerly force 4° B and sea state 2.

***The sinking of the boat CHY-8*** (GT 13.39, length 11.89 m), together with four crew members. On 17th July 2010 between the hours of 06.00 and 06.30 CHY-8 boat sailed from Chłopy on fishery after fish and to bring new nets. At this time in the sea there were a lot of boats. It was very good weather. Harbour Master in Kołobrzeg noted wind ENE – E to 3° B, good visibility, air temperature 23°C. Port harbour master's weather forecast valid from 01.00 to 13.00 17th July 2010, predicted wind SE 4–6° B veering NW 3–5° B, sea state 3, air temperature 22° C, visibility good. Weather forecast for the next 12 hours not announced warnings. Weather forecast valid from 07.00 to 19.00, 17th July 2010. announced a warning against a strong wind in the Sea South-East Baltic. On the Southern Baltic: wind mainly Southeast to East 4–5° B, locally 6° B, in the afternoon North, later Northwest 3 to 5° B. Gusts of wind during storms. In the Southeast Baltic Sea: wind Southeast to East 5–6° (B) locally of 7° (B). Gusts of wind during storms. Sea state 3 to 4. Temperature 23°C. Visibility good to moderate, locally poor – shower from the West.

Witnesses who reported weather on land clearly stated that there were whirlwinds over areas: Sarbinowo and Chłopy. Whirlwind is a vortex of air extending from the storm clouds to the earth's surface. Most often it has a dark funnel shape, which connects the wider end of the cloud. The air turning spirally in it, and at the same time rises to the top of the melt away. The sizes of these whirlwinds are varied. Inside the whirlwind atmospheric is different from the pressure out of the dozens of hPa. High speed rotating air has a powerful destructive force. Above the maritime areas are sometimes observed phenomenon similar in nature to the whirlwind. These are waterspouts. They stretch from storm clouds to the surface of the water, which suck. Water whirling with tremendous speed creates a moving, bending the pole. Power of these waterspouts is usually smaller than tornadoes [5]. Forecasts contained only a warning of strong winds only. The occurrence of whirlwind and waterspout is very difficult in forecasting. The skipper a boat CHY-15, which was in the region of the crash, said that the phenomenon waterspout lasted about 5–6

minutes. During this time, the boat CHY-15 is able to fill a lot of water – bilge pump still worked about half an hour. After passing waterspout – warmer, there has been silence. Weather returned to the previous state. Boat returned to work at the nets. The skipper a boat CHY-15 for the first time in 25 years has seen such a phenomenon.

No emergency call from the boat CHY-8, as well as the lack of the use of rescue (life belts, suits) by the crew, indicate – according to the Chamber, that the rapid change in the weather (the occurrence of waterspouts) surprised the crew. The skipper of boat CHY-15, in its relations said, that the greatest difficulty was the determination of wind direction and with the proper setting of the boat i.e. under wind direction. In summary, the Maritime Chamber concluded that the cause of the sinking of the fishing boat CHY-8 in a violent gust of wind up to 11° B, whirl high waves with variable directions, while a significant decrease of the air temperature from 25°C to 15°C, water temperature abt. 20°C (rise of waterspouts) and death by drowning of four crew members was the loss of buoyancy due to flooding of the boat with seawater, or its overturn the probable lack of manoeuvrability. It cannot be excluded that due to screwing up the network on the screw and rudder her skipper had no manoeuvrability.

***Sinking boat UNI-3 and lost of a double crew***. The cause of the sinking was improper manoeuvres performed too to return to the left, in the direction of Marina rejecting strong East, parallel to the shoreline, which caused the current drift boat on the East, and then her stopping in the high breakers. Stopping the boat was due to the effects of the return current generated by the waves. Effect of external factors and improper manoeuvring led to set the boat parallel to the wave and as a consequence a heel to the left side and completely filling the hull with water. As a result, two fishermen drowned.

#### Ice concentration and ship's icing

Ice found in the Baltic Sea can be divided into two categories. These are ice formed directly from the freezing of sea water or bays and river ice. Fishing boats operating in the South and Southeast Baltic Sea are not fish, when in the open sea ice phenomena occur with significant volume. This is due to their design and seaworthy. With ice phenomena occur mainly on the approaches and docks. An example is the collision of the cutter KOŁ-167 (GT 112, length 24.97 m) and moored fishing boat REZON (GT 198, length 29.58 m) in the port of Kołobrzeg, on 21st January 2010. This was due to the long term crushing of ice, in to berth. As a result, there has been a slight damage to the starboard side and bow of a fishing boat REZON.

In contrast to the ice phenomena commonly found and having an impact on the safety of fishing vessels is the phenomenon of icing. By this is meaning the formation of ice on the topside of the ship: the sides, decks, superstructures, deck equipment, rigging and cargo onboard, if such is on the ship. Accumulating ice on board of a vessel is an additional burden raising the centre of gravity. This may result in loss of stability, especially when unbalanced icing. Many ships were wrecked as a result of icing. Ships lose stability and as a result of icing – capsized. This applies particularly to small and medium-sized boats.

Freezing ice can completely restrict the possibility of the use of safety equipment and, in extreme cases, prevent the crew out of the ship. In this connection, the European Union issued a directive in 1997, for the safety of fishing vessels of 24 metres in length and over (Council Directive 97/70/EC). This directive complements the IMO Resolution A.749 (18) concerning, inter alia, take into account the icing of ships in the stability calculation.

The calculations should take into account:

- 40 kilograms per square metre open deck and accesses;
- 10 kilograms per square metre each surface ship projecting above the water line.

As you can see there are significant values and each navigator must take into account the risk of icing, to minimize its effects. In the event that ice threatens the safety of the vessel it must immediately establish radio contact with the nearest radio coastline station, enter the course and position of the ship and other information that may be useful for rescue services in case there is a need to assist.

It should be noted that the entire group is formed by the work accidents related to slips, trips and falls arising in connection with the icing and ladder ways.

#### Sea surface and air temperature

Fishing is usually carried out in the cold, wet and windy conditions that increase the risk of injury and illness and the possibility frostbite and heat strokes among fishermen. Risk of damage to the skin or eyes by the Sun's rays is greater at sea than on land because of the smooth operation of light. It is necessary to use properly fitted, waterproof and good thermal insulation work clothes. In addition, the necessary glasses with side-shields that protect eye.

Statistical information on the health of fishermen is very general and incomplete. Fishermen due to the tough nature and type of business are not interested in providing information. I think that the situations get out of control and intervention is needed by Maritime Search and Rescue Service. Statistics relating to the activities carried out by the Maritime Search and Rescue Service for three quarters of 2013 showed that conducted 180 rescue, of which 79 were to share the rescue of human life at sea, and 17-medical evacuations. Unfortunately, there is no differentiating data type of ships, where aid has been granted, but you can guess that most were small ships, such are fishing boats.

The greatest risk for people, who are forced to leave their watercraft or that accidentally falls overboard, is associated with hypothermia. Due to the ambient temperature, they can be very rapid cooling to the extent that the self-dealing in the water. The risk of hypothermia does not stop even after finding the victim on a life raft, if not applied the necessary means for survival. In the cold waters, the cause of drowning is a direct effect of cold on the nervous system, musculoskeletal system occurs as a result of coordination of movements of the limbs during attempts to keep the surface of the water or there is a loss of consciousness due to excessive pulmonary ventilation [6].

Attention should be paid to the fact that the phenomenon of hypothermia should not be equated merely with negative temperatures. Under-estimating and disregard that threat often leads to tragic consequences. An example can be accidents considered by accidents by the Maritime Chamber of the District Court in Szczecin.

***The death of a fisherman after their departure to sea rowing boat***, which took place at the beam of the Rewal on 17th January 2011. Finding you in the water, two fishermen were most likely due to loss of buoyancy of the boats getting sea water between its walls. Given its low temperature and very short average survival time of a man in the water at temperature about +2°C – up to a few minutes, the prevailing darkness, and also restricts the freedom of movement there and the lack of any lifesaving equipment meant that the chances of survival by swimming to the shore were minimal. This is confirmed by the finding that screams, summoning help audible only for a moment. As a result, there was a drowning both fishermen.

***The death of a fisherman from a boat JAR-22*** (length 4.25 m) after falling into the water with the breaker overturned boat. Maritime Chamber has concluded that the cause of drowning was the sudden cooling his body after finding water at a temperature of about +6°C, in terms of wind N 1–2° B, sea state 1 and an air temperature of 4–5°C, at a distance of about 40 m from the shore.

***The sinking of the fishing speedboat KRS-3*** (length 8.43 m) – as a result of two fishermen drowned. On 2nd October, in the Szczecin Lagoon, weather conditions: wind WNW 7° B, sea state 5, air temperature 12°C, the water 9°C and good visibility. Boat sank due to loss of buoyancy as a result of flooding water at run time to return to the right and the settings on the port side to wave in the hydro-meteorological conditions in excess of boats seaworthy. After capsizing, both fishermen maintained on the surface of the water by holding lifejackets and leaning on a centre plate. The death of both came in as a result of hypothermia and exhaustion of their organisms as a result of prolonged in water with a low temperature without properly used lifejackets.

#### Reduced visibility

A very important element of the meteorological, which has a direct impact on the safety of navigation, is visibility. It is dependent on the transparency of air, which limits any kind of suspension in the air in the form of water droplets or ice crystals, dust or particles entrained in smoke. Meteorological visibility is defined as the maximum distance at which an observer distinguishes black object seen at an angle of 20° in the day, on the background of the sky, close to the horizon line. It is assumed that the observation is not difficult – sphericity of the Earth, the lighting and obstacles.

In the area of the Baltic Sea, in open waters – prevailing visibility good and very well. The visibility of not less than 5 nm occurs with a frequency of about 60% in the winter months (December – February) to about 70–80% in spring and autumn (March – May, September – November) and over 80% in the summer (June – August). Poor visibility 0.5–2 nm occurs in about 5–9% (October – April) and about 3–4% (May – September) [4].

Especially dangerous is restricted visibility, as it can occur at any time of the year. The case law of the Boards of Marine never listed as a direct cause of the events at sea but indirectly, when broken is COLREG in terms of regulations in force in conditions of limited visibility.

***The collision of a fishing boat KOŁ-36 and a fishing motor boat KOŁ-112***. The cause of the collision of a fishing vessel (returned from fishing) with fishing boat was incorrect behaviour of the two boats with violating COLREG regulation. At the time of the collision there was a moderate

visibility, wind NE 4° B and sea state 2. As a result of the collision fishing boat sank.

***The collision of a cutter KOŁ-32 and a fishing motor boat KOŁ-136***. At the time of the collision there was fog limiting visibility to 20–30 meters, wind E–SE 2–3° B and sea state 1–2. The cause of the collision cutter returned from anchorage with fishing boat was the same as in the above example.

***Stranding of the fishing boat GDY-15***. The event took place at the eastern breakwater in the port of Świnoujście, about 3 kbl from the head of the breakwater when the ship was leaving the port. The skipper does not take into account the hydro-meteorological conditions prevailing in the manoeuvring basin: wind SSE 4–5° B, sea state 1–2, the outgoing current 0.7 kn and moderate visibility. Not sufficiently control the course and position of the vessel and its way along the eastern breakwater and led the way to settle on a sandbank.

## Conclusions and proposed recommendation

In Poland there is a few fishing vessels registered in comparison with other countries of the sea. Based on the current data of the Central Statistical Office, the Polish fishing fleet in 2013 consisted of 838 ships – about 5.0% more than in 2012, with a total gross tonnage 33 900 GT – 1.5% more than in 2012. As in 2012, the Polish fishing fleet serviced 3 deep-sea trawlers. Polish fishing fleet consisted of 139 boats – 0.7% less than in 2012. The number of small boats fleet at the end of 2013 – amounted 696 – about 6.3% more than in 2012, can be seen clearly from this, that the structure of Polish Fisheries changes. Appears smaller boats on which it works more and more crews with varying training and experience that is needed in this profession.

Table 1. Navigational accidents by ship type under polish flag [3]

| Ship type | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|
| TOTAL | 36 | 40 | 30 | 32 |
| Fishing | 11 | 16 | 9 | 9 |
| Tugs | 7 | 7 | 3 | 2 |
| Ferries | – | – | – | – |
| Ro-Ro | – | 1 | – | 2 |
| Tankers | – | 1 | – | – |
| Others (i.e. rescue, passanger, yachts, dredging ships) | 18 | 15 | 18 | 19 |

Number of events on the Polish fishing vessels is much greater than on other types of vessels. Data of maritime accidents on vessels include only events reported for consideration by the Maritime Chamber. Figures include accidents that took place on the territorial sea, the Polish exclusive economic zone and on the internal waters.

A single accident may result from more than one cause. If we analyze accidents of fishing vessels, taking into account the reasons that caused them, then will notice a dominant influence hydro-meteorological factors.

Statistically, the Maritime Chamber judgments in 2012 hydro-meteorological conditions are given twice as often as the cause of accidents than:

- Faulty navigation on board;
- Faulty navigation of another ship;
- Material defects;
- Other causes associated with ship.

Outdistance other causes of accidents. Ten times more common than:

- Lack of discipline in crew;
- Faulty co-operation;
- Faulty service and maintenance of ship's devices;
- Faulty co-operation.

Hydro-meteorological factors comparable only with non – ship associated causes – it's mean alcohol.

Note also to the effects directly related to the life and health of crew members.

Table 2. Number of accidents with people caused by hydro-meteorological factors [3]

| Results of accidents | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|
| Fatality | – | 4 | – | 1 |
| Major injury | – | – | – | 1 |
| Serious injury | 3 | – | 2 | 1 |

The above statement relating to ships of Polish nationality and confirm the global trends that work in fisheries is very dangerous, with particular emphasis on the impact of the prevailing hydro--meteorological factors.

Unfortunately, it can't compare information from different countries. There is a lack of standardization. The various countries of the world have different systems for the collection and classification of data. It is recommended that all governments have adopted a classification scheme consistent with International Standard Industrial Classification of All Economic Activities. A unified system would allow the transfer of experience between the various governments to identify the causes of accidents in the fishing and take appropriate action to reduce them. For example, in the UK developed safety rules are strictly applied

in the mid – 1980's on all ships with a length of more than 12 m and, as a consequence, the number of losses of individuals in this category decreased significantly.

It should be emphasized the complexity of the problem. Interstate cooperation and regulation at the level of governments – is one way. While the solutions at the level of the fishing vessels require a specific approach. A clear difficulty in the identification and establishment of international regulations are a variety of types and sizes of boats, different levels of training, variable hydro-meteorological factors and lack of skills of their predictions related to access to information.

Unfortunately, no instruction, the statement or other document are not able to predict all possible incidents or dangerous situations at sea, involving fishing vessels. For example, let be a description of yet another tragic accident under consideration by the Maritime Chamber at Szczecin.

***Fatal accident, the skipper on the cutter KOŁ-123***. The cause of the accident – the skipper was hitting by clean-view screen with the rest of her frame glass splinters in his left leg. As a result, he suffered a vast and deep wounds cut the left thigh and as a result of bleeding followed his death. The clean-view screen was minted under the pressure of the water. The direct cause of breaking glass was too high speed cutter proceeding against the wind and wave. At the time of the accident the wind was blowing at 5–7° B, and the sea state was 4. The boat has worked heavy on the wave. Bow of fishing boat sank, the wave entering the deck fore and hit the front wall of the wheelhouse.

Detailed analysis of hydro-meteorological factors affecting safety of fishing vessels in the Baltic Sea allows concluded that only knowledge and competence and good seamanship give a chance to the most appropriate behaviour in extreme conditions.

Therefore, in pursuing the objective of development, can make some recommendations, the purpose of which is to increase the security of sea fishing. This can be achieved in several ways:

- Attention to the quality of the equipment and outfit on which they must work, and the status of the equipment, which often depends on their lives. This should be strictly monitored and enforced by the inspections;
- Development of civil infrastructure, which will support the fishermen. This concerns mainly systems for monitoring safety at sea;
- Upgrading professional skills of crews in order to reduce the share of human error. Should be improved knowledge of own boats through training and application stability fishing gear, use of fishing gear and manoeuvring in different hydro-meteorological conditions often resulting from the specific characteristics on which the boat is located.

## References


1. www.fao.org, access 21.06.2014.
2. www.ilo.org, access 21.06.2014.
3. www.stat.gov.pl, access 21.06.2014.
4. Locja Bałtyku, 502. BHMW, Gdynia 2009.
5. TRZECIAK S.: Meteorologia morska z oceanografią. Wydawnictwo Naukowe PWN, Warszawa 2006.
6. DOLMIERSKI R., KRYNICKI A. (Reds): Morski poradnik medyczny. PZWL, Warszawa 1981.


### Others


7. BEHRENDT C., KRAUSE P., RAJEWSKI P.: Analiza warunków pracy polskich statków rybackich. Eksploatacja i niezawodność 2, 2009.
8. GIRJATOWICZ J.: Katalog zlodzenia i warunków termicznych polskiego wybrzeża. Uniwersytet Szczeciński, Szczecin 2007.
9. GŁADYSZ B.: Meteorologia dla żeglugi morskiej. Wydawnictwo Morskie, Gdańsk 1970.
10. Locja Bałtyku – część środkowa z zatokami Fińską i Ryską. BHMW, Gdynia 1982.
11. PLESKACZ K.: Meteorologia dla rybaków. Wydawnictwo Naukowe Akademii Morskiej, Szczecin 2014.
12. Zalew Szczeciński. Instytut Meteorologii i Gospodarki Wodnej, Warszawa 1980.
13. www.fishermensvoice.com, access 22.06.2014.
14. www.bodc.ac.uk, access 21.06.2014.
15. www.bim.ie, access 21.06.2014.