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ICE PHENOMENA AS A TOURISM ASSET ON THE SOUTHERN COAST OF THE BALTIC SEA

Abstract: The aim of the paper is to present selected ice phenomena occurring on the waters of the southern coast of the Baltic Sea which may be of tourism value. On the basis of his own observations and research over the period 2002-11, the author analysed interesting ice phenomena documented in 20 photographs showing in the main ice forms (grease ice ridges, ice hummocks, thrust ice). The photographs present the sea (8), lagoons (7) and lakes (5). The author has included brief descriptions of selected ice phenomena, focusing on interesting forms and their origins, which may encourage potential tourists to observe and explore ice-covered water bodies. Ice tourism could be a part of cognitive, environmental, specialist, hiking, winter, seasonal or even occasional tourism.

Key words: ice tourism, photographs of ice phenomena, ice phenomena, tourism assets, southern coast of the Baltic Sea.

1. INTRODUCTION

Fragmentary information about ice phenomena as a tourism asset can be found mainly in photo albums devoted to the landscapes and wildlife of the southern Baltic Sea (SURDYKOWSKI 1975, TERMANOWSKI & TOMCZAK 1987, CZASNOJĆ 2007), Western Pomerania (CZASNOJĆ & CZASNOJĆ 2000, CZASNOJĆ 2006, REMBAS 2011) or towns on the coast (CZASNOJĆ *et al*. 2002, CZARNECKI 2004). Some photographs of ice phenomena can be found in monographs on the natural environment of the Polish coast (HOFFOWA 1969, BORÓWKA *et al.* 2002, GRZEGORCZYK 2011).

Interesting ice phenomena have also been documented in specialist publications, such as ice albums (JEVGENOV 1955), ice formation catalogues (GIRJATOWICZ 2007), and others on the theme of ice (BLÜTHGEN 1954, WMO… 1970, ZAKRZEWSKI 1983). Ice phenomena have been largely ignored in tourism publications and the author's aim is to present selected ice phenomena on the waters of the Southern Baltic Sea which may be of tourism value. The information about ice as a tourism attraction may interest potential tourists and become a part of nature-related cognitive tourism.

Based on his own observations and research conducted on the southern coast of the Baltic Sea, as well as an analysis of 20 ice photographs, most of which were taken between 2002 and 2014, the author describes various types of ice, especially deformed ice. The phenomena were observed and photographed mainly on the sea shore (8), in lagoons (7), as well as on lakes (5). The author presents brief descriptions of these ice phenomena and draws the reader's attention to interesting forms and their origins. In order to recognize their attractiveness and define development prospects for ice tourism, a SWOT analysis was conducted. The acronym SWOT stands for Strengths, Weaknesses, Opportunities and Threats and are used for the factors classifying the capabilities of a given tourism asset (http://www. iso.org.pl/).

2. SELECTED TYPES OF ICE

The most interesting ice phenomena appear on large water bodies, such as seas and their coastal waters in particular. Equally interesting, often different ice phenomena appear on the edges of coastal lagoons and lakes. Various ice forms on the southern coast of the Baltic Sea can be usually observed from January to March, and only when there are suitable weather

conditions. The most important meteorological factor of ice phenomena occurrence is usually a few days (for lakes and lagoons) and several days long (for seas) period of negative air temperatures. An important role is also played by cloudiness and wind, which causes water movement. Ice forms on the coasts of large water bodies are less affected by snow, hail or rain. Ice phenomena take various courses depending on the size and depth of the water body and take different forms at different distances from the coastline.

The movements of water, mainly waves, deform the ice along the shore (LUTKOVSKIJ 1957, JAWORSKI 1967, GIRJATOWICZ 1999). At the beginning of winter, floating grease ice[1] is usually thrown onto the shore by strong onshore winds and waves, forming a characteristic grease ice ridge with a very steep, often concave windward slope (GIRJATOWICZ 2015b). On the southern coast of the Baltic Sea, such an ice ridge usually extends along the shore over a distance of many kilometres, is several metres wide and 1-3 metres high. Photo 1 presents a grease ice ridge in Dziwnówek, on 23rd February 2012, consisting of several steps while tourists and spa patients refer to such ice forms as 'frozen waves'. The windward slopes of these ridges are usually vertical, with uneven, jagged edges. In some places, especially along groynes, they may stretch further out to sea (Photo 2). Between individual steps on the grease ice ridge there are surfaces slightly tilted towards the land, resembling terraces (Photo 1).We can occasionally see tourists strolling along these terraces, but they prefer to walk on the beach, along the leeward slopes of the grease ice ridge. In contrast to the windward slopes, the leeward slopes are much less cold (Photo 3). Photo 3 shows the leeward slope of a grease ice ridge, together with a small lake and the beach, seen from the land side in Dziwnówek, on 23rd February 2012. In milder periods (>0°C), grease ice ridge deposits (mainly sand, but occasionally also amber) are left by the melting ice. Higher insolation of the leeward slopes makes the ice melt faster, uncovering sand, and it becomes grey (Photo 3). As a result of ice melting, elongated small lakes appear at the foot, a tourism attraction too.

During a storm, when the water level rises, grease ice ridges are formed higher up the beach and niches resembling grottos may be formed on their vertical windward walls. Photo 4 presents such an 'ice grotto', about 2 m in length, 0.5 m in width and up to 1.5 m in height, in Międzyzdroje on 15th January 2011. Along the coast, there may be fractures in the grease ice ridge which appear as a result of their 'wedging through' or wave abrasion[2]. These are openings through which it is easy to reach the sea (Photo 5). Photo 5 shows such an 'ice gate' in grey, weathered ice in Międzyzdroje on 15th January 2011.

Waves undercut the base of the grease ice ridge and a bottom niche is formed, threatening the stability of the ridge (Photo 2). As a consequence, large pieces of the grease ice ridge front break off. Photo 6 shows fragments of a grease ice ridge resembling 'ice boulders', near Międzyzdroje, on 18th February 2012. They are usually observed by tourists during warmer periods after storms. Storm waves sometimes transport them far up the beach. The 'ice boulders' lying far from the sea, out of the waves' reach, are the longest lasting fragments of the grease ice ridge. Looking from the sea, apart from the bottom niches, openings in the ridge may appear (Photo 7). Photo 7 shows a hole through a grease ice ridge, viewed from the leeward side of the ridge. It has an elliptical shape and is about 1 x 3 m in size. It was photographed in the Międzyzdroje area on 18th February 2012. Such 'tunnels in ice' usually appear during milder periods as an effect of waves.

Interesting ice phenomena may also be watched from a pier. During ice movements, it is possible to observe ice phenomena connected with deformations, such as ice rafting, piling, as well as cutting a floe or an ice field by hydraulic structures built in the water itself. Photo 8 shows floes cut into pieces by the pier piles in Międzyzdroje as a result of drifting. Piers are convenient and safe places from which it is possible to observe interesting and, especially, dynamic ice phenomena.

Smaller water bodies, such as coastal lagoons, also offer rare ice phenomena. These sheltered bodies of water with relatively weak waves are mostly covered with ice. Only towards the end of winter does the permanent ice cover disintegrate and an ice run begin. Inland ice thrusts, caused by strong winds may even exceed 100 m (ORVIKU *et al.* 2011, LEPPÄRANTA 2013, GIRJATOWICZ 2015a). Such thrusts on the southern coast of the Baltic Sea are observed in the Szczecin and Vistula Lagoons. Photo 9 shows a thrust of ice 140 m inland near Frombork, on 11th February 2011. Ice thrusting onto the shore is a dangerous and destructive phenomenon and should be observed from a distance or from raised ground. Such flat ice enables tourists to walk safely or go skating, however, during milder periods and due to insolation, the ice quickly rots[3].

Another interesting ice phenomenon is ice hummocking, also caused by strong winds. The height of ice hummocks on the Baltic Sea usually varies from a metre or so (LUNDBECK 1931, CORRENS 1973, ALESTALO AND HÄIKIÖ 1976, GIRJATOWICZ 2014) to several metres (SLAUCITAJS 1929, KRAUS 1930, ORVIKU 1965). Hummocks appear along the

coast, in front of clumps of vegetation, human hydraulic structures and other obstacles which get in the way of thrusting ice. On the shore, ice hummocks most often appear on the windward (eastern and southern) coasts of the Szczecin (Photo 10) and Vistula Lagoons (Photo 11). Photo 10 shows a hummock about 3 m in height, in the north-eastern part of Szczecin Lagoon (on the Rów Peninsula) on 8th February 2011. From the leeward side of this hummock one can see trees bent due to frequent ice thrusts. Photo 11, on the other hand, shows the leeward side of a hummock, about 4 m high, on the south-eastern coast of Vistula Lagoon near Frombork, on 16th March 2011. In the background, one can see the 14th-18th century historical cathedral complex in Frombork.

Grease ice ridges occur not only on the sea coast, but also on the banks of coastal lagoons. The height of lagoon ridges is much lower than on the sea coast and does not exceed 1 m. Their forms are varied and sometimes take on fantastic shapes (Photo 12). Photo 12 presents canals, tunnels, cones and shell forms made from grease ice during wave movements. These ice forms were created in front of the cliff in Miroszów, in Szczecin Lagoon, on 13th December 2010.

Grease ice, shuga[4], ice rind or fine floes may form into pancake ice during wave movements. Pieces of pancake ice are round, with characteristic raised edges, formed as a result of colliding. Photo 13 shows pancake ice, mostly about 1 m in diameter, frozen into fast ice, near Podgrodzie, in a small bay of Szczecin Lagoon, on 11th February 2012. Walking on such ice of suitable thickness is safe but difficult because of its rough surface.

In contrast, on smooth fast ice of appropriate thickness, one can do any kind of winter sport. Smooth, transparent fast ice created from ice rind[5] makes it possible to observe life underwater (e.g. fish). Photo 14 shows smooth, transparent ice cover near the beach in the Czarnocin area, in Szczecin Lagoon, on 25th January 2014. On the left side of the photo, one can see people taking photographs of the 'under-ice' life. The ice features lighter lines which separate sheets of ice rind, which turned into fast ice cover as a result of growth in ice thickness.

Interesting ice forms may also appear on reeds during wave movements and the lowering of the water level. Such iced reeds have an elongated shape, depending mainly on temperature, movements of water and the rate of fall in water levels. In the sun, such 'icicles' glisten with differing intensities. Photo 15 shows iced reeds resembling melted candlewax or firs in the Czarnocin area in the Szczecin Lagoon, on 25th January 2014. Below these 'ice firs' we can see some sheet ice hanging on the reed, formed at a time of even water levels

Interesting ice phenomena may also occur on lakes. Tall hummocks may appear on large coastal lakes, similar to lagoons and photo 16 shows an ice field and hummocks in the north-eastern part of Łebsko Lake (Rąbka). These phenomena were observed from the observation tower in Rąbka, on 3rd March 2013. Such bright white 'icebergs' rising above the reed bed are visible from a distance of many kilometres. In the top left corner of the photograph, on the horizon (Photo 16), we can see Rowokół Hill (115 m above sea level) in the Słowiński National Park (Smołdzino). In the top right corner of the photo, on the horizon, we can see the Łeba Dunes (lighter hue). They are mobile dunes, descending directly to Łebsko Lake near Madwiny.

At the beginning of winter, on coastal lakes, we can observe lower forms of piled ice, built of thrusting ice rind. Depending on the position of the sun, the piles may have a yellowish-orange hue. Photo 17 shows a hummock, about 1.5 m in height, on the northern part of Łebsko Lake on 19th December 2002. The hummock was formed at the edge of a shoal at the dune coast near Madwiny, and was consolidated (frozen) into fast ice cover.

After the ice disappears from the lakes, there may still remain firmly bonded ice piles which are weathered hummocks crumbling at the edges. Photo 18 shows a hummock built of brash ice, with a crumbling steep windward slope in the south-eastern part of Lake Gardno (Gardna Mała), on 18th March 2005. Due to poor visibility (falling snow), it was impossible to see the opposite shore of the lake.

On lakes which are under a strong influence from the sea, considerable fluctuations of water levels are observed. They can be seen in the occurrence of multi-layer ice rind forming in reed beds when the water level has fallen. Photo 19 shows three layers of ice rind on Lake Dąbie near Lubczyna, on 25th January 2014. When the water level was falling, at stagnation periods the next, lower, layers of ice rind were forming. Similar ice phenomena may occur on tree trunks during floods. During frosty weather and when the water level is dropping, ice rings are formed around tree trunks (Photo 20). Photo 20 shows such a phenomenon on Lake Miedwie near Miedwiecko, on 1st March 2011. The rings, resembling mushroom caps, were up to 1 m in diameter. In the background of the photo, we can see smooth, thick ice cover, on which all types of ice sports (e.g. skating or ice boating) can be undertaken.

3. ASSESSMENT OF THE USEFULNESS OF ICE PHENOMENA IN TOURISM

Ice phenomena in the temperate climate zone occur periodically, sometimes just occasionally. Therefore, ice phenomena have rarely been presented in publications as something which could be interesting to tourists. There are many reasons for this, for instance:

- they are ephemeral phenomena which occur in winter when daytime temperatures fall below 0° C;
- tourism in winter is significantly limited, compared to summer (holiday season). At this time of year, the weather is usually cloudy or overcast. Poor visibility (fogs, mists) and frequent precipitation does not encourage tourism;
- ice on lakes and coastal lagoons usually occurs in the form of ice cover, while on the sea - in the form of coastal ice and floes which do not raise much interest.

In order to present an evaluation of the attractiveness and potential development of ice tourism, the author conducted a SWOT analysis concerning ice phenomena occurring on the southern coast of the Baltic Sea. The strengths (S) are as follows:

- direct contact with the sea;
- severity and spontaneity of nature;
- an ecologically clean and touristically attractive area;
- easy direct access to ice forms, e.g. from a beach or a pier;
- the uniqueness and specificity of ice forms (e.g. ice piled up);
- aesthetic impressions, e.g. photo-optical;
- a developed tourism infrastructure on the coast;
- mass seaside tourism;
- other forms of recreation are limited in winter;
- good access to the coast by transport;
- proximity of large urban centres.

The weaknesses (W) include:

- seasonality and in some years even lack of ice phenomena;
- irregularity and incidental character of ice phenomena;
- mostly unfavourable weather conditions in winter and a short day (low insolation) making tourism activity, including ice tourism, difficult;
- the small group of tourists interested in ice phenomena;
- demanding proper preparation from the tourist, typical of specialized tourism;
- lack of knowledge about ice phenomena;
- lack of interest in ice phenomena on the part of local authorities;
- lack of promotion.

Opportunities:

- a growing interest in extreme and unique phenomena, including ice phenomena;
- striving for whole-year exploitation of hotel accommodation during periods outside the holiday seasons;
- further development of tourism service infrastructure, tourism, recreation and sports centres on the coast;
- the development of winter tourism in the coastal zone.

Threats:

- climate warming and rarer occurrence of ice phenomena;
- the unpredictability of suitable weather in the winter season and conditions enhancing the formation of interesting ice forms.

The SWOT analysis shows that strengths prevail over weaknesses and opportunities over threats. The uniqueness and specificity of ice forms, good accessibility, the attractiveness of the sea, and limits to other forms of tourism or recreation on the beach in the winter, may be an opportunity to discover interesting ice phenomena, and consequently to increase winter tourism or even develop year-round tourism centres on the coast. However, the seasonality and scarcity of ice phenomena, the usually unfavourable weather conditions in winter and short day length may weaken the will to discover interesting ice phenomena and develop ice tourism. A limitation to the development of ice tourism may be climate warming – rarer ice phenomena, and in consequence, less interest in them. A chance for ice tourism could be in the promotion of ice phenomena as a tourism attraction.

4. SUMMARY

The photographs and their descriptions presented in this paper may inspire potential tourists to observe and explore ice-covered water bodies and their accompanying phenomena. Tourism could start at

the beginning of the ice season when new forms of ice appear, such as grease ice, slush, pancake ice, ice rind, grease ice ridges, ice rafting and piling, until the end, when there is also floe and brash ice, floe rafting, ice hummocks and ice thrusting onto land.

Considering the main motivation for travel, to observe and discover ice phenomena, ice tourism, which is a type of nature-related tourism, functionally could be regarded as a form of cognitive tourism. As regards other forms – it could be environmental tourism. Ice tourism should also be included as specialist tourism – e.g. hiking, it requires the tourist to be suitably prepared (physically and mentally), physically fit, properly dressed (warm clothes, crampons), and to have knowledge about ice phenomena. On the other hand, due to the season, ice tourism is a part of winter tourism and concerns the 'ice season', i.e. the period between the occurrence of the first ice and the day of the disappearance of the last. The length of the ice season on the southern coast of the Baltic Sea varies (GIRJATOWICZ 2011). It is longest on coastal lakes (85-100 days, on average) and on lagoons (70-100 days on average), and shorter on the sea coast (5-10 days on average). The length of the ice season for individual water bodies may vary greatly and depends mainly on the severity of winters, the area and depth of the water.

FOOTNOTES

[1] Grease ice – a thick layer of ice crystals clumped together.

[2] Wave abrasion – destructive effect of sea waves.

[3] Rotten ice – weathered (porous), disintegrating ice.

[4] Shuga – concentrations of porous lumps of white ice, a few to several centimeters in diameter.

[5] Ice rind – crumbly, shiny, icy crust, up to 5 cm thick, forming on still waters.

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Photo 1. A grease ice ridge on the south coast of the Baltic Sea (Dziwnówek, 23rd February 2012)

Photo 2. Vertical wall of a grease ice ridge on the windward side (Dziwnówek, 23 rd February 2012)

Photo 3. The leeward side of a grease ice ridge (Dziwnówek, 23rd February 2012)

Photo 4. The windward side of a grease ice ridge with a niche (Międzyzdroje, 15th January 2011)

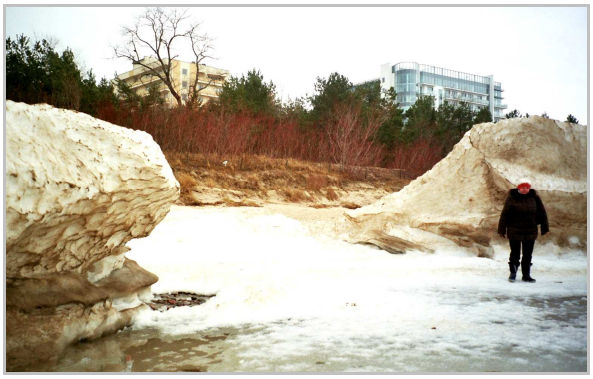

Photo 5. A fracture in a grease ice ridge (Międzyzdroje, 15th January 2011)

Photo 6. Fragments of a grease ice ridge (Międzyzdroje, 18th February 2012)

Photo 7. An opening in a grease ice ridge viewed from the leeward side (Międzyzdroje, 18th February 2012)

Photo 8. Floe cut by the pier pillars (Międzyzdroje, 30th December 2010)

Photo 9. A thrust ice sheet on the south-eastern bank of Vistula Lagoon (Frombork, 11th February 2011)

Photo 10. A hummock in the eastern part of Szczecin Lagoon (Rów Peninsula, 8th February 2011)

Photo 11. The leeward side of a hummock on the south-eastern bank of Vistula Lagoon (Frombork, 16th March 2011)

Photo 12. Grease ice canals, tunnels and cones in the southern part of Szczecin Lagoon (Miroszewo, 13th December 2010)

Photo 13. Pancake ice in the southern part of Szczecin Lagoon (Podgrodzie, 1stFebruary 2012)

Photo 14. Smooth, transparent ice in the eastern part of Szczecin Lagoon (Czarnocin, 25th January 2014)

Photo 15. Iced reed in the eastern part of Szczecin Lagoon (Czarnocin, 25th January 2014)

Photo 16. Hummocks in the north-eastern part of Łebsko Lake (Rąbka, 3rd March 2013, photo by Dariusz Staniaszak)

Photo 17. Ice rind piling in the northern part of Łebsko Lake (Madwiny, 19th December 2002)

Photo 18. A weathered hummock in the south-eastern part of Gardno Lake (Gardna Mała, 18th March 2005)

Photo 19. Three layers of ice rind in the north-eastern part of Dąbie Lake (Lubczyna, 25th January 2014)

Photo 20. Ice rings around tree trunks in the northern part of Miedwie Lake (Morzyczyn, 1st March 2011)

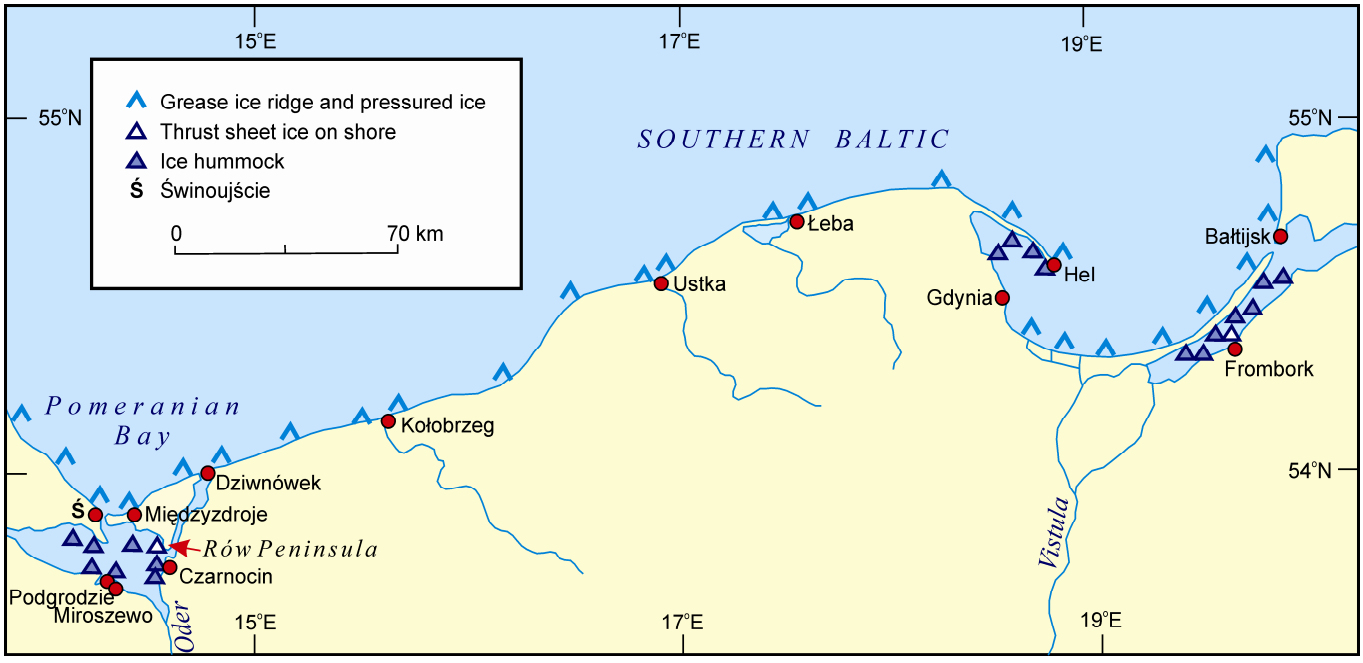

Fig. 1. Regions of deformed ice most frequently occurring on the southern coast of the Baltic Sea
Source: author's compilation