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TRAFFIC RULES AND ENVIRONMENTAL CONDITIONS IN KATTEGAT AND THE SOUND REGARDING CHANGES PLANNED FOR 2020

KATTEGAT I SUND – OBOWIĄZUJĄCE PRZEPISY I UWARUNKOWANIA ŚRODOWISKOWE W ODNIESIENIU DO ZMIAN PLANOWANYCH NA ROK 2020

Agnieszka Kerbrat
Maritime University of Gdynia, Faculty of Navigation, Department of Navigation,
al. Jana Pawła II 3, 81-345 Gdynia, e-mail: a.ungert@wn.am.gdynia.pl
ORCID 0000-0003-2660-3961

Abstract: This paper describes presently applied sailing rules and environmental conditions on Danish waters such as Kattegat and the Sound. Those rules were established in late 70's of the twentieth century by Danish authorities as Denmark is a coastal country and has the legal right to do so. Presently International Maritime Organization – IMO is in the process of approving a new set of routeing measures and traffic separation schemes which should comply with resolution A.257(14) – General provisions on ships' routeing, and will be introduced by Organization.

Keywords: Danish waters, Kattegat, the Sound, ships' routeing, safety of navigation.

Streszczenie: W artykule przedstawiono obecnie obowiązujące zasady żeglugi na wodach duńskich wraz z opisem warunków środowiskowych panujących w rejonie cieśnin Kattegat i Sund. Trasy żeglugowe w tym rejonie zostały ustanowione przez rząd duński jako państwo nadbrzeżne w latach 70. XX w. W chwili obecnej w IMO (*International Maritime Organization*) trwa proces uznania rozwiązań żeglugowych w Cieśninach Duńskich, jako zalecanych przez tę organizację oraz zgodnych z rezolucją A.572(14) („Zalecenia odnośnie tras żeglugowych").

Słowa kluczowe: Cieśniny Duńskie, Kattegat, Sund, trasy żeglugowe, bezpieczeństwo nawigacji.

1. INTRODUCTION

Ships routeing history goes back to the end of the 19th century when first ships were made to follow predetermined routes on their way between Europe and North America. Then passenger shipping companies established regulations to improve

safety of their ships. Those were later incorporated into The International Conventions for Safety of Life at Sea. In 1961 traffic separation in the Strait of Dover was studied and not long after set of basic principles for ships' routeing was introduced and submitted to the International Maritime Organisation (IMO).

Rules of navigation through Danish Waters were established in 1970's by Danish Maritime Authority. They were confirmed by IMO in Annex to SN.1/Circ.263 ("Routeing measures other than traffic separation schemes"). The entry to the Baltic Sea is environmentally a very difficult area with many narrow waters, sharp bends, strong currents and shallow waters. As ships sizes and draughts have increased through the years the problem of shallow-water areas has created a need to establish deep-water routes. Vessels can enter the Baltic Sea following one of few prepared routes from which the most common are Route T (max. depth in most parts is about 17 metres) and Route D and The Sound (max. depths in the Drogden channel and Malmö bridge channel, Flintrannan Bridge, are 8 metres).

Today IMO is recognised as the only international body for establishing and adopting measures on an international level concerning routeing and areas to be avoided by ships or certain classes of ships as per regulation 10.2 of chapter V of revised SOLAS 1974 (International Convention for the Safety of Life at Sea, 1974) – "The Organization is recognised as the only international body for developing guidelines, criteria and regulations on an international level for ships' routeing systems. Contracting Governments shall refer proposals for the adoption of ships' routeing systems to the Organization. The Organization will collate and disseminate to Contracting Governments all relevant information with regard to any adopted ships' routeing systems" [SOLAS 2015]. IMO is also recognised as the only international body for developing guidelines, criteria and regulations on an international level, including adoption of ship reporting systems (in accordance with regulation 11.2 of SOLAS Convention) – "The Organization is recognized as the only international body for developing guidelines, criteria and regulations on an international level for ship reporting systems. Contracting Governments shall refer proposals for the adoption of ship reporting systems to the Organization. The Organization will collate and disseminate to Contracting Governments all relevant information with regard to any adopted ship reporting system" [SOLAS 2015].

Nationally established routes leading through Kattegat were determined more than 40 years ago. Since then sizes of passing vessels increased and the need to bring better solutions in traffic separation has arisen. Subject of safety of navigation is very wide and complexed. In this paper I would like to present summary of facts about weather and navigational conditions in the area of Kattegat and The Sound and general idea of proposed changes for traffic arrangement. Separate works with accidents analysis and risk assessments will be presented in the future.

2. NAVIGATIONAL CONDITIONS

2.1. Environment

Most part of Kattegat is located within limits of PSSA (Particularly Sensitive Sea Area) in the Baltic Sea which was established by MEPC (Marine Environment Protection Committee) of IMO in 2005. The Baltic Sea was acknowledged as globally unique and sensitive brackish-water ecosystem [IMO 2005]. As a result of different factors, very specific to this region, biodiversity is low. The area hosts a unique mix of marine, freshwater and a few true brackish-water species. The Baltic marine and coastal area consist of globally important breeding grounds, nurseries, shelters and food sources for coastal birds and waterfowl. The disappearance of single-key species could seriously impede the functioning of the whole system. Hence, the Baltic marine ecosystem is considered as particularly vulnerable to man-made disturbances [IMO 2005].

With maximum depth in the whole area rarely exceeding 30 metres and depth of 8 metres in dredged channels passage through Kattegat and the Sound is limited. Deep-draught vessels are advised to use passages via Great Belt where deep water routes are being maintained at about 17–19 metres of depth.

The bottom, due to historical conditions of large Baltic Ice glaciers melting which was interrupted by small advances is eroded and rocky. Shallows created by sand taken by the currents are occurring and depth can be significantly reduced in wide offshore areas. Significant amount of fine sand and old seaweeds is taken by the currents to deeper parts and accumulated there as a mud. In deeper areas accumulation of mud can reach up to 20 metres in depth and distort echo-sounder readings [UK Hydrographic Office 2015].

The Baltic Sea collects a lot of residual fresh water brought by the rivers and rainfalls; a sub-surface current brings the salt waters from the North Sea. The amount of fresh water brought by the rivers and rainfalls has also an influence on water density within entry to the Baltic. On the side of Kattegat where bigger inflow of salt water exists water density is closer to 1.020–1.025 g/cm^3 and on the east side where a bigger flow of fresh water occurs, the density varies between 1.007–1.005 g/cm^3 [UK Hydrographic Office 2015]. This has an influence on ships draft when passing from Kattegat to the Baltic Sea and has to be taken into account when planning of the passage is made. The excess of water in the Baltic Sea exits in the surface layers and creates mostly north going surface currents as illustrated in Figure 1. The conflicting surface and sub-surface waters can cause races or dead water and lead to a reversal in surface current direction. That can create difficulties in navigation for different kind of vessels. Persistent strong winds can create wind-drift current where rate varies according to wind direction and its duration. These wind-drift currents may influence strength and direction of surface currents by strengthening, weakening or even reversing them [UK Hydrographic Office 2015].

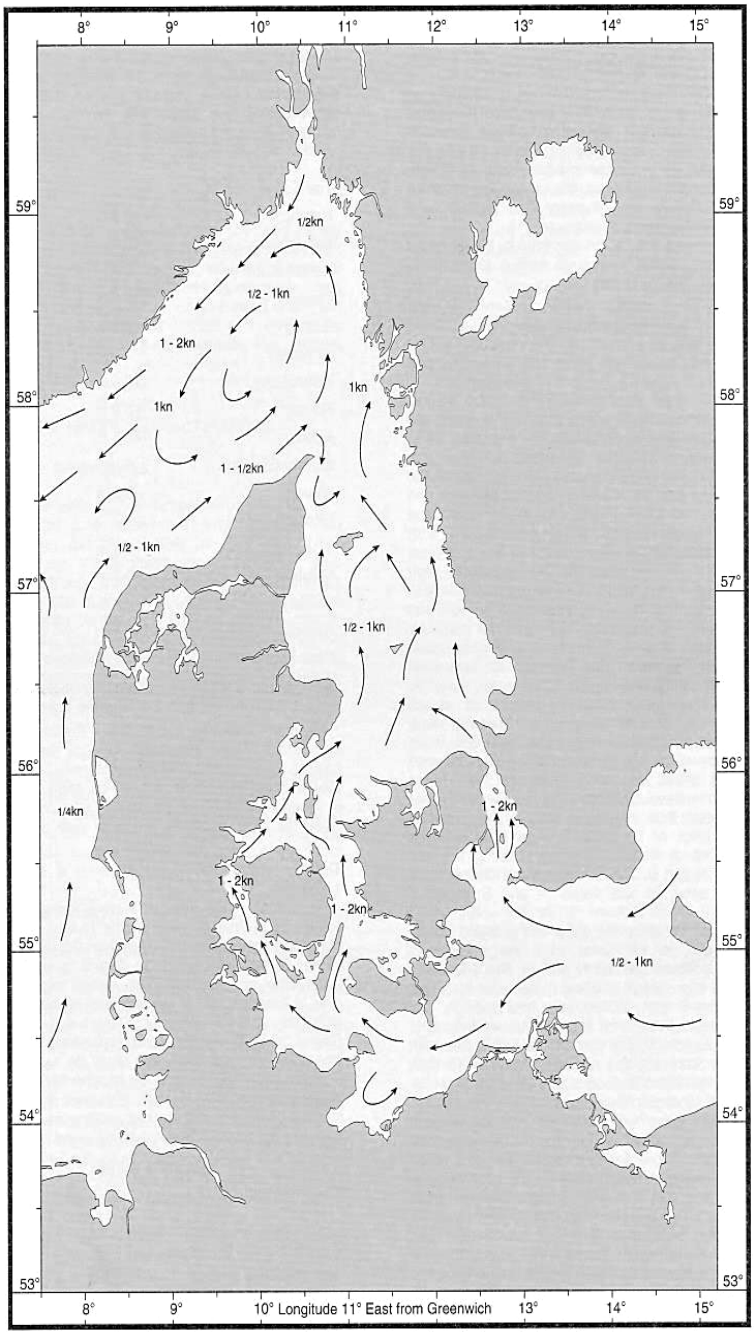

Fig. 1. *Predominant current direction under light wind conditions*

Source: [UK Hydrographic Office 2015].

Dominating in the area of Kattegat and the Sound in winter and spring are easterly winds of above 7 Beaufort scale and that can persist for several weeks. They can generate high wind waves causing serious difficulties in navigation for smaller vessels and may be influencing also safety of bigger ones. Kattegat which is open from east side to the North Sea can also have high swell coming from that direction but it is rarely known to experience swell higher than 6 metres. As it is surrounded by the land from the other directions swell and sea is not building up as much as it can from east [UK Hydrographic Office 2015].

2.2. Present traffic arrangement

Presently traffic is regulated by a set of rules established by Danish Maritime Authority. Latest update of all regulation is available on the webpage of the Danish Maritime Safety Administration and was issued in September 2011 when reporting system in the Sound was established. Rules and advised routes were established way earlier than that – in 1970's. Their description can also be found in "Admiralty Sailing Directions – Baltic Pilot Vol. I" and is presented in Figure 2. The choice of the route to be used depends mostly on the draught of the vessel and in some cases on weather conditions in the time of passage.

The two routes: Route B and Route T begin at the Skagen. Route T is leading SE into eastern part of Kattegat and east side of Anholt Island. After passing Anholt Island Route T turns SW to the north entry to SamsøBælt where it meets with Route A. Then it continues through Store Bælt. Passing on the west side of Langeland, Route T separates in into two parallel routes, deep-water route dredged to 19 metres and Route H. They are joining again before entering Fehmarn Belt. From there, again as Route T, leading ESE, E and N again to KadetRenden where it is finishing entering open waters of the Baltic Sea.

Route B leads south through LæsøRende leading to Aalborg. In the vicinity of 56°51'N 010°48'E route B continues SE then S to join Route A.

Route A starts in the east side of Kattegat a little more north of Anholt Island separating from Route T. Route A meets with Route B and continues S to join back with Route T at the north end of SamsøBælt.

At the same coordinates as the starting of Route A, there is another separation. Route D is going SSE then SE to enter the Sound through traffic separation system established between Helsingborg and Helsingør.

The passage of the ships in the Store Bælt (Great Belt) is controlled by VTS (Vessel Traffic Service) named BELTREP. Reporting to this service is mandatory for all ships with gross tonnage of 50 or more and for all ships with an air draught of 15 metres or more.

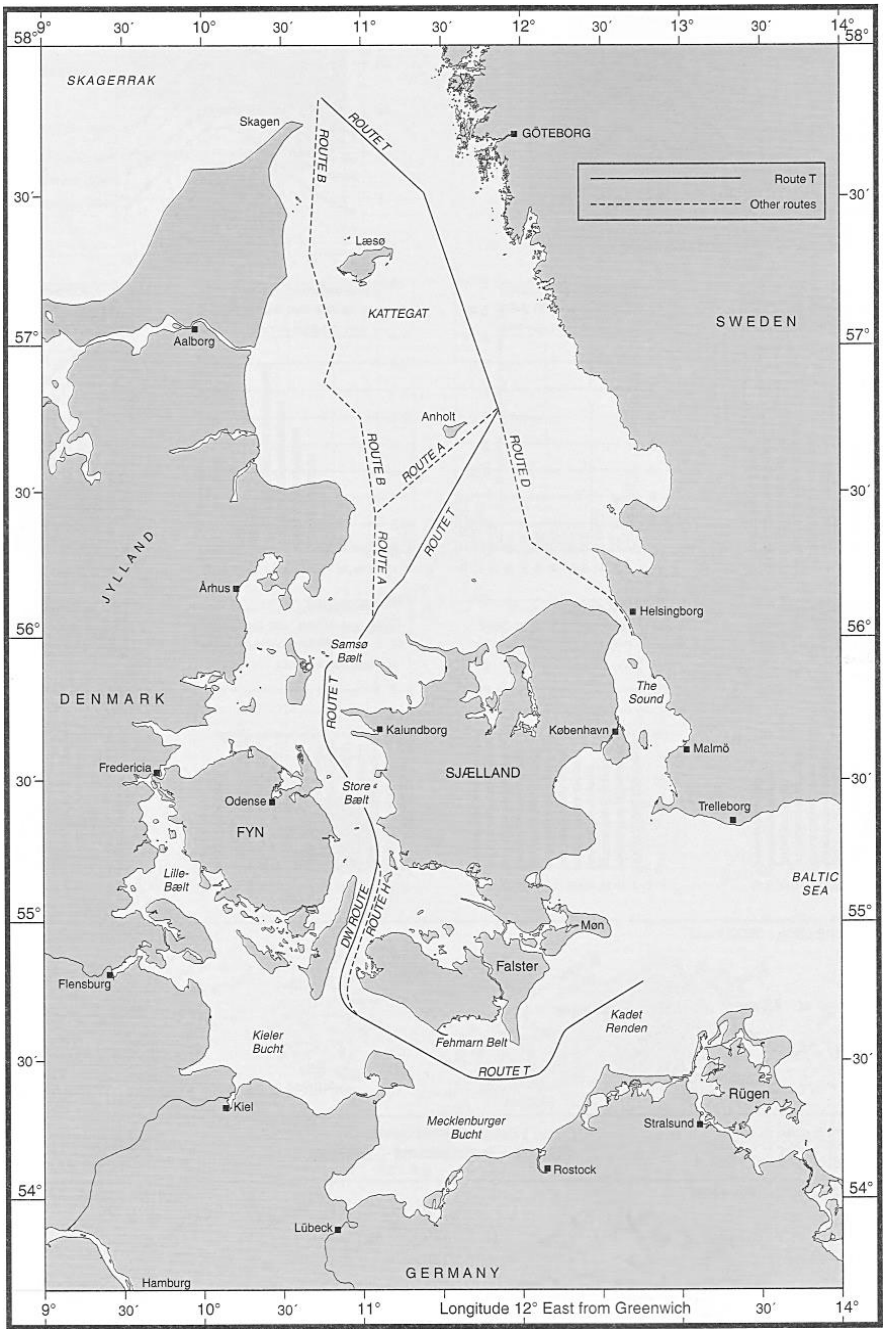

Fig. 2. *Overview of advised navigational routes through Danish Waters*

Source: [UK Hydrographic Office 2015].

In the Sound there is a few ways to transit to the Baltic Sea. First is E of Ven Island and through Drogden Channel (see Fig. 3). That route is passing close to Danish shores and limits of Copenhagen port. This part is also deeper so the vessels of deep draught can pass to Copenhagen, Landskrona and Malmö ports. Drogden channel is dredged to 8 metres and official draught limit is 7,70 metres in water of density 1,005 kg/m^3. The other one leads closer to Swedish shores, West of Ven Island and through Flintrannan channel, under the bridge next to Malmö. Here the limitation is both the depth in a Channel and air clearance. Channel is 370 metres wide, of dredged to the depth of 8 metres and is limited for use by vessels with maximum 7 metres draught. Vertical clearance under the Flintrannan Bridge is 55 metres. Both channels are connecting again at the north entrance to TSS "Off Fastelborev" (Traffic Separation Scheme). From there via TSS ships can proceed to open waters of the Baltic Sea. For all ships above 300 GT mandatory reporting system VTS SOUNDREP was established. General limits of the reporting system and TSS arrangement in the area are shown in Figure 3.

Fig. 3. *Traffic organisation in the Sound & SOUNDREP reporting system limits*

Source: [The Danish Maritime Authority 2011].

2.3. Vessels traffic characteristic

During the latest decades, an increase in ships traffic has been observed in the Kattegat area. Not only has the amount of the vessels increased but tonnage and draught as well. Nowadays approximately 60 to 70 thousand vessels are passing through Kattegat annually. Most of them are ships with deep draught on the passage from or to ports located in the Baltic Sea coasts. Big parts of that traffic are vessels carrying crude oil. Annually there is more than 150 million tons of crude oil being carried as a cargo.

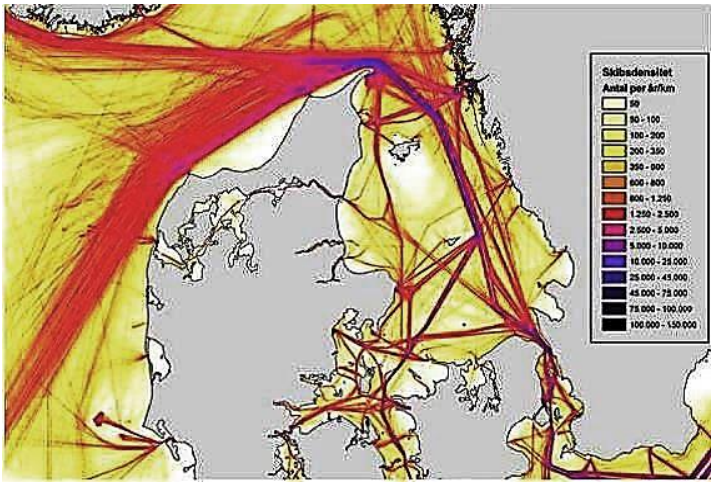

Fig. 4. *Traffic density – AIS ships information from 2016*

Source: [IMO 2017a].

There is also number of high speed crafts and ferries operating in the area and often crossing routes and main traffic streams. In area closer to shores but not limited to it, especially from spring to autumn there is a considerable number of small leisure crafts, sailing and motor boats. Traffic density chart is shown in Figure 4. It is visible that biggest traffic density exists in the area of Skagen and then follows Route T into Kattegat. Some very dense spots are visible in the Sound, especially on the north entrance and in the vicinity of Copenhagen. High density of vessels is also visible all the way along Route T in Great Belt. It is important to notice that the chart is only showing traffic counted by AIS (Automatic Identification System). It is not a full picture of the situation as part of the small crafts is not carrying AIS or not transmitting AIS data. Even without that information it is visible that traffic in the entrance to the Baltic Sea is very complex and considering the natural conditions of the area it can create a great danger to environment and to the shipping in general. In the past few years there were some collisions and groundings occurring, but they will be described and analysed in a separate paper.

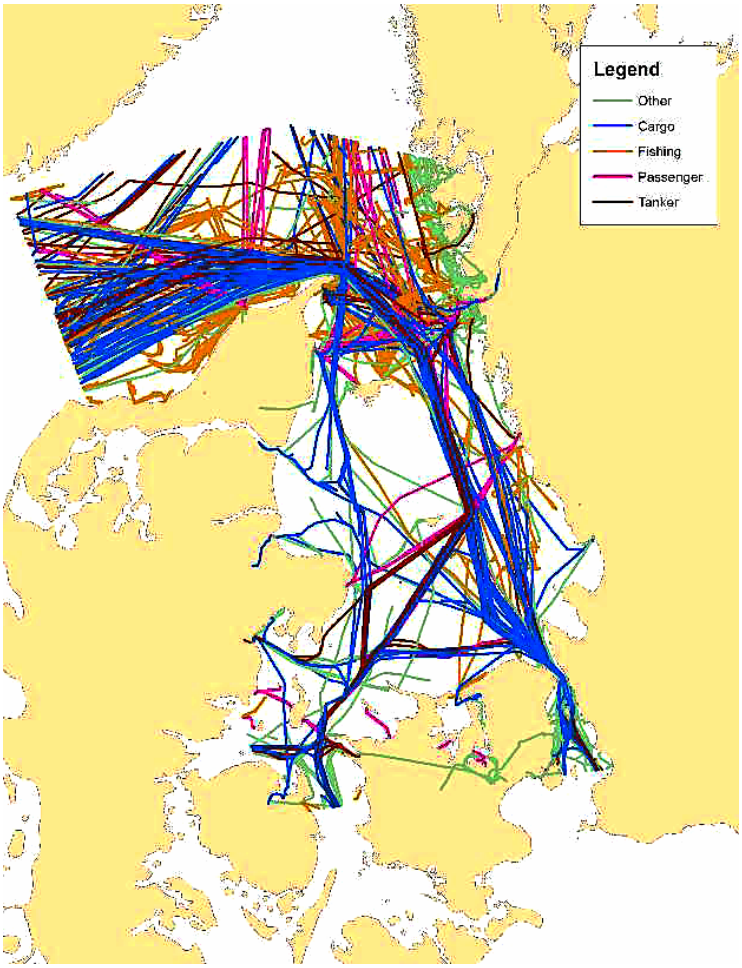

Fig. 5. *Routes of different types of vessels registered with AIS, first week of May 2017*

Source: [IMO 2017a].

Through the year fishing activities in the north of Kattegat and along S coast of Sweden are carried out extensively. Nets used for it can be 2 Nm long and can be laid out straight or in the perimeter of a circle. Usually they are marked by buoys displaying flags, lights and radar reflectors [UK Hydrographic Office 2015]. Trawling also takes place in Kattegat year round and in depths from 25–130 metres. Recreational fishing is present as well in the area, carried out mostly by small boats.

Figure 5 shows the routes of different vessels registered by AIS regardless of their tonnage. Cargo ships were arriving from vast directions to Skagen. From there they were taking one of two recommended routes, mostly Route T was chosen,

especially by the tankers. It is also noticeable that some part of cargo ships traffic was choosing routes closer to Swedish coasts, which in present moment are not covered by recommended sailing routes. After passing AnholtIsland they were following Route A as well. Congestion of cargo ships tracks is visible at the entrance to the Sound and passing via Drogden channel. Smaller number of tracks is passing under Flintrannan Bridge next to Malmö.

Some passenger ships tracks are visible mostly following recommended routes T and A. Though there is some variability in their routes depending on the ports they were visiting. Also tracks of ferries are visible. Ferries are very often crossing main stream of traffic moving between islands or like in the Sound between Swedish and Danish coasts.

Closer to shores routes of ships classified as "others" are visible in much of a density. "Other" types of ships are recreational crafts such as small motor boats, sailing yachts and leisure crafts. Big density of their activity is visible especially close to Swedish coast in the north part of Kattegat and in the Sound. The activity in the Sound is obviously impeding cargo traffic as there is limited space of navigable water, mostly due to depth.

It is clearly visible that fishing activities are most common in northern part of Kattegat. Some of it is also visible in the eastern part, closer to entrance to the Sound.

3. PLANNED CHANGES IN ROUTEING SYSTEM

From 1st July 2020 there will be new traffic routeing system established in the area of Kattegat and at the entrance to the Sound. Part of it will contain present Route T with some new elements and the other part will be the introduction of new recommended route named Route S. Overview of planned changes is shown in Figure 6. The line connecting points 1–4 in Figure 6 illustrates presently existing Route T, the other one shows planned changes as per visible legend. The remaining part of Route T which is not considered for changes now will be introduced to IMO at a later stage.

Starting already in Skagerrak, there are two approach routes to Skagen planned. Recommended route A holding minimum depth of 25 metres and passing out of territorial waters of Denmark (more north in Fig. 6). Recommended route B holds minimum depth of 14 meters and passes closer to shores, through Danish territorial waters. Both of them supposed to join and line up traffic before entering TSS "Skagen West" (no.1 in Fig. 6). Precautionary area is established at the Skaw and inshore traffic zone connected to it. Lined up traffic should pass via TSS "Skagen West", precautionary area and adjoining TSS "Skagen East". Then following Route T to another precautionary area "at Kummel Bank" (no. 2 on chart from Fig. 6). Here vessels going S-bound will have to choose if they continue with

Route T to Great Belt or proceed following Route S to the Sound. Vessels going to the North Sea and further will be joining in one stream of traffic when arriving at Kummel Bank.

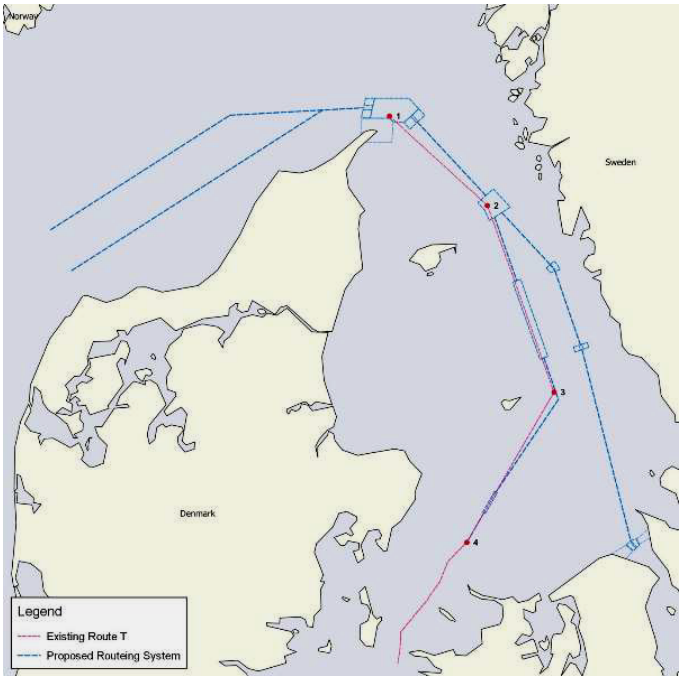

Fig. 6. *The current Route T and proposed recommended routes*

Source: [IMO 2017a].

Route T will be designated for bigger draught vessels (above 10 metres) with deep-water routes established along it. In the deep-water routes planned depth of 19 metres is to be maintained. There are two deep-water routes planned along Route T. First one located in central part of Kattegat with depth of 19 metres and 19 nautical miles long. Second one located in south part of Kattegat 6 nautical miles long and with 19 metres of depth. Northbound traffic not restricted by their draught are recommended to use area east of the deep water route. Southbound traffic not restricted by their draught are recommended to use the area west of deep-water route. This rule is advised for both of the deep-water routes along Route T.

Route S will be advised for vessels with smaller draught. According to charts minimum available depth will be around 12,5 metres. The route will be recommended for ships with draught of 10 metres or less. Along that route three TSS areas will be established. They are separated by relatively long distances with

no considerable dangers to navigation including groundings. First TSS "Fladen" located next to Fladen shoal marked by Racon(N). Second TSS "Lilla Middelgrund" next to same name shoal marked with cardinal east buoy. Third one will be modification of presently existing traffic arrangement at the entrance to the Sound. Traffic separation scheme will be established at the north entrance to the Sound. Two recommended routes will be joining there – old Route D and new Route S. In area on the east and west of TSS between shore lines and borders of TSS there will be inshore traffic zones introduced.

4. SUMMARY AND FUTURE PLANS

Though the areas of Kattegat and the Sound have considerably mild climate with no heavy weather occurring often it is not a region completely easy and safe to navigate. Due to a lot of shallow waters, dense traffic, fishing and leisure activities, area is considered difficult and dangerous for navigation. It has been proven in the past that accident occurring in Kattegat with oil spill involved can considerably endanger natural environment and delicate balance of endangered species and their habitats.

Current nationally implemented Route T has existed for last 40 years without formal recognition from IMO. It has been approved in recommendations on navigating through entrance to the Baltic Sea (SN. 1/Circ. 263) and will remain valid even after IMO introduction of new arrangement of traffic in the Kattegat. As it can be found in publications like *Ships' routeing* some parts of Great Belt and the Sound has been recognized and IMO approved already. The remaining connections between Kattegat and Great Belt are planned to be developed and introduced in the future according to IMO resolution A.572(14) – *General provisions on ships' routeing*.

New routeing measures have been developed to guide the growing amount of traffic in the area of Kattegat via routes that will guide and separate two-way traffic better than today and, thus, make navigation considerably more predictable and safe [IMO 2017a]. Proposal also intends to enhance protection of maritime and coastal environment by reducing risk of pollution as a result of collisions or groundings of the vessels.

New routeing measures are planned to come in force on 1st July 2020. Date has been set so there is enough time to update hydrographic readings, establish new aids to navigation and/or readjust positions of ones already existing. There will be also need to update paper charts and ENC's (Electronic Navigational Chart), as well as inform shipping companies in proper advance about changes.

It is my plan to provide more information about past accidents and their influence on safety of navigation and environment in area of Kattegat and the Sound. I also would like to present results of conducted voyages and observations made with risk analysis of present and future traffic arrangement. As subject is very complexed, I am forced to focus on one topic at the time.

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