DANISH MARITIME AUTHORITY

Estimating the number of collisions and groundings in a given waterway using the software IWRAP

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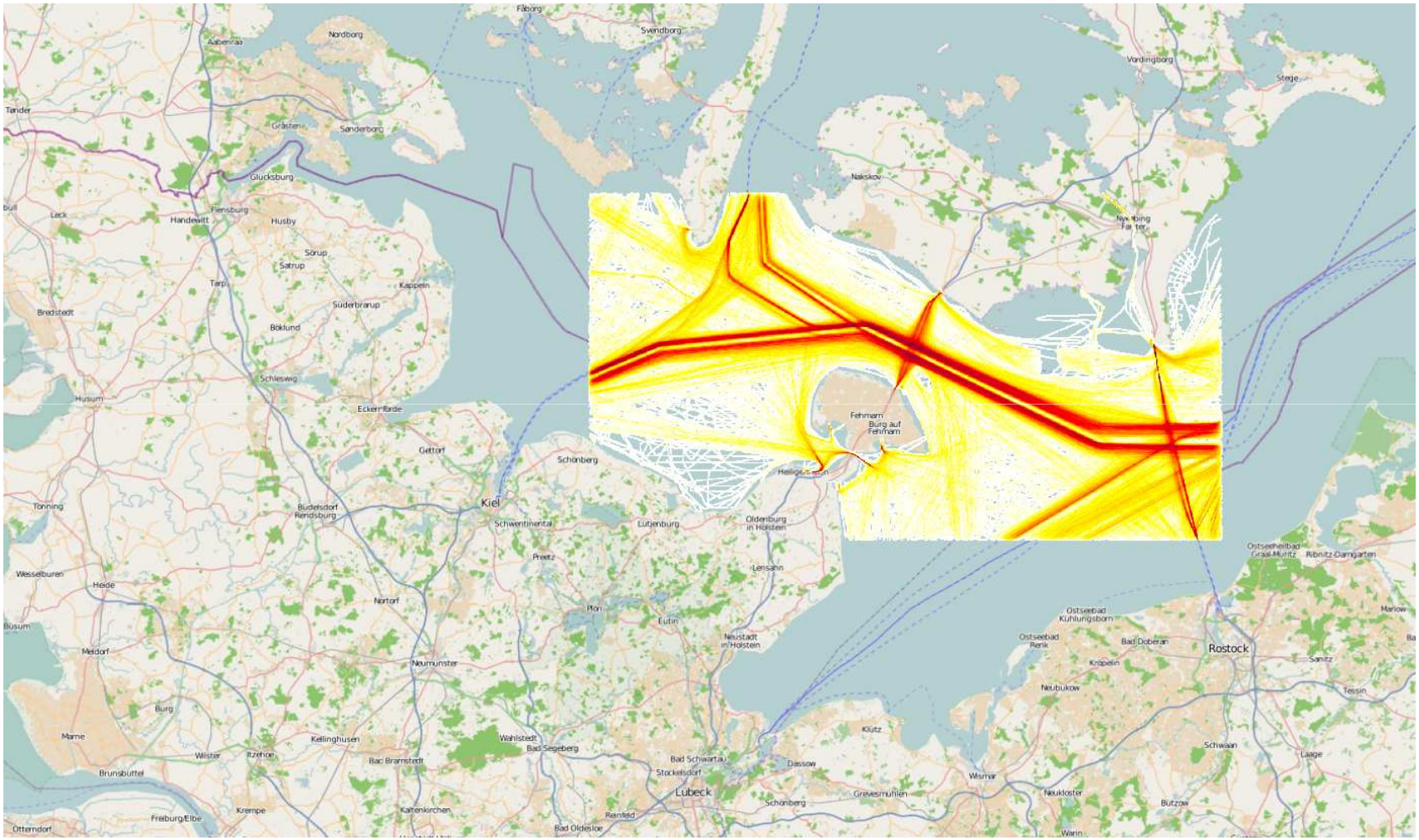
AIS ship tracks through Femern Belt



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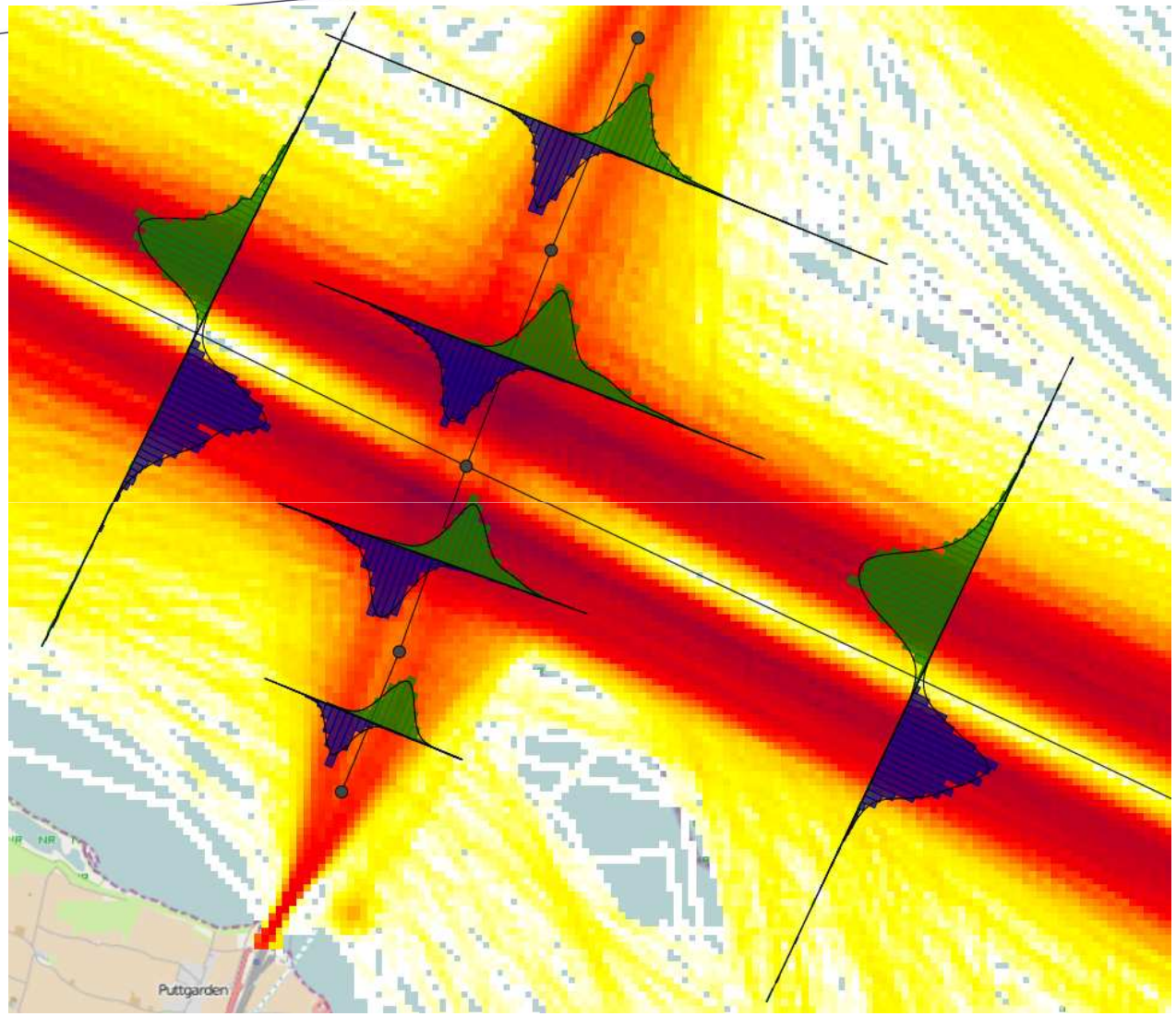
Number of ships passing Femern Belt

	Crude oil tanker	Oil products tanker	Chemical tanker	Gas tanker	Container ship	General cargo ship	Bulk carrier	Ro-Ro cargo ship	Passenger ship	Fast ferry	Support ship	Fishing ship	Pleasure boat	Other ship	Sum
0-25	0	0	0	0	0	0	0	0	0	20	60	222	70	10	**382**
25-50	0	0	0	0	0	40	0	0	0	0	629	10	40	162	**881**
50-75	0	131	120	0	0	497	0	0	0	0	202	10	40	172	**1172**
75-100	131	426	314	30	20	7,731	60	40	0	0	10	0	10	100	**8,872**
100-125	0	1279	100	70	598	2,844	10	314	0	0	10	10	10	40	**5,285**
125-150	0	1869	20	10	2,864	741	50	80	30	0	10	0	0	60	**5,734**
150-175	10	629	10	90	1889	507	344	416	40	0	10	0	0	0	**3,945**
175-200	0	1249	0	10	426	81	1371	263	324	0	0	0	0	0	**3,724**
200-225	10	0	0	0	415	0	121	131	284	0	0	0	0	10	**971**
225-250	568	233	0	0	111	0	558	0	0	0	0	0	0	0	**1470**
250-275	801	243	0	0	0	0	30	0	50	0	0	0	0	0	**1124**
275-300	0	0	0	0	30	0	0	0	203	0	0	0	0	0	**233**
300-325	0	0	0	0	0	0	0	0	0	0	0	0	0	10	**10**
325-350	0	0	0	0	50	0	0	0	0	0	0	0	0	0	**50**
350-375	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
375-400	0	0	0	0	60	0	0	0	0	0	0	0	0	0	**60**
400-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Sum	**1520**	**6,059**	**564**	**210**	**6,463**	**12,441**	**2,544**	**1244**	**931**	**20**	**931**	**252**	**170**	**564**	**33,913**



Fuji 1974, Petersen & Friis-Hansen 1990s

Model the shipping lanes with a number of connected legs.

Find the number of ships and their lateral distribution for each leg

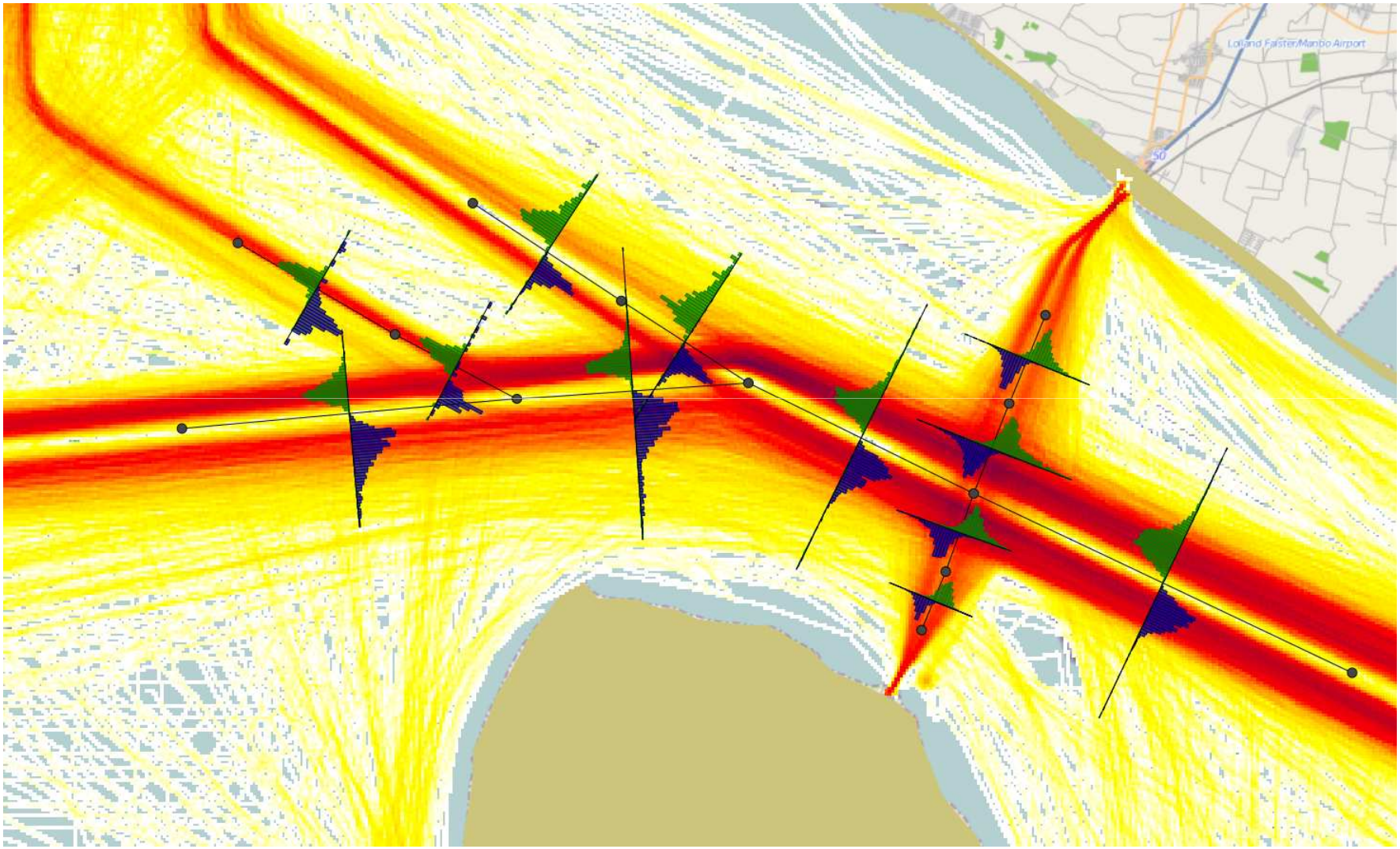
Let the ships sail blindfoldly.

The number of geometrical collisions and groundings can now be found, NG
(This is pure geometry and probability calc)

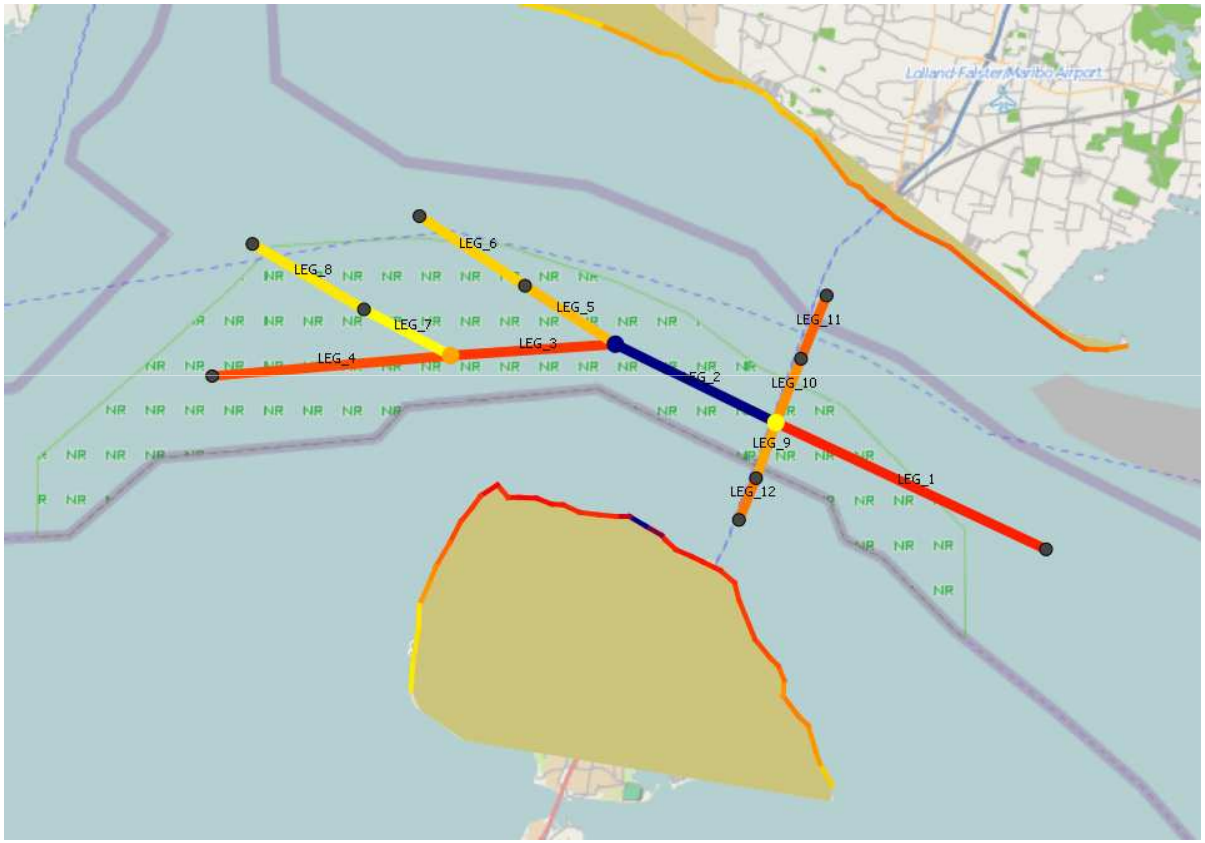
Ships do not sail blindfoldly. But 1-2 out of 10,000 actual do. This is the causation factor, Pc

$$\lambda_{\mathrm{Col}} = P_C \cdot N_G$$

IWRAP model of Femern Belt



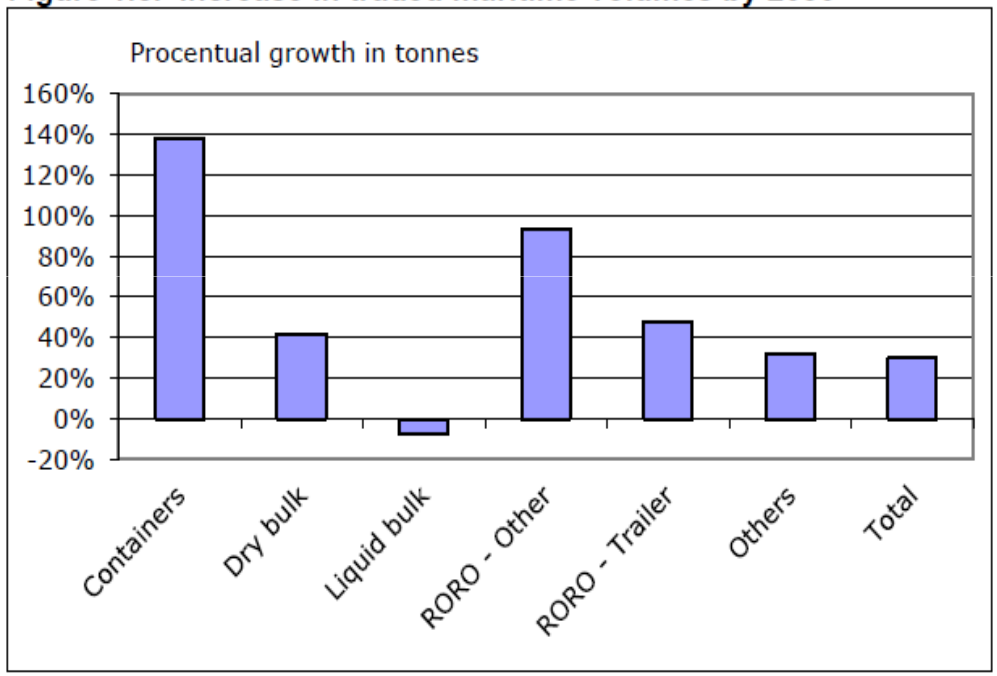
Estimated years between incidents



Incident type	Years between incidents
Powered Grounding	6,400
Drifting Grounding	35
Total Groundings	**35**
Overtaking	29
HeadOn	2,700
Crossing	71
Merging	120
Bend	21
Area	---
Total Collisions	**9.6**

Forecasting 2030

Figure 1.8. Increase in traded maritime volumes by 2030



Source: Baltic Transport Outlook 2030

IWRAP ship type	factor
Crude oil tanker	0.95
Oil products tanker	0.95
Chemical tanker	0.95
Gas tanker	1.3
Container ship	2.4
General cargo ship	1.3
Bulk carrier	1.4
Ro-Ro cargo ship	2.5
Passenger ship	1.3
Fast ferry	1.3
Support ship	1.3
Other ship	1.3

Change in incidents from year 2012 to 2030

	Absolute increase	Increase per 10,000 ships
Powered groundings	40%	-5 %
Collisions	110%	42 %

IWRAP ship type	factor
Crude oil tanker	0.95
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Passenger ship	1.3
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Support ship	1.3
Other ship	1.3

The number of ships is expected to increase 47 % by 2030. This will of course increase the number of incidents as the first column shows. In the second column we have normalised the results by the number of ships.
Because the number of tankers are expected to decrease, the total normalised number of groundings actually also decrease. The total number of collisions increases by 110 % or double. Because of progress in technology and education this number is expected to be much lower.

IWRAP only estimates the number of incidents. The other part of the risk equation is the consequence.

In Danish waters groundings do not generally have severe consequences due to the soft sea bed.

IWRAP website:
http://iala-aism.org/wiki/iwrap/index.php?title=Main_Page