



## **Annex 1**

### **Maritime Traffic Analysis**

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## 1 Introduction

An analysis of the maritime traffic in Croatian ports has been carried out. The results of that analysis are presented in this report. The analysis provide a better understanding of the Croatian situation and its results will serve as a basis for: a maritime traffic forecast; a ship waste forecast; an assessment of needs and a financial analysis of future costs and revenues of waste collection in the ports.

## 2 Method

The method is briefly described here in the following steps:

- data extraction from DOB;
- conversion into Foxpro format;
- basic data verification and consistency check;
- adding an unique ship number to records without IMO number;
- classification of ports in main ports and other ports;
- classification of ports in Croatian, Other Adriatic, Mediterranean-Black Sea and Rest of the World.

### 2.1 Data extraction from DOB

To be able to carry out an in dept analysis of the traffic, the standard output options of the Ministries traffic database DOB<sup>1</sup> do not supply sufficient information. Therefore we obtained a custom made extract of the database with data of the traffic and the cargo in the years 2003 till spring 2009. Because 2003 and 2009 where not completed, we decided to use the data of 2004 till 2008 for the analysis.

### 2.2 Conversion into Foxpro format

The traffic data were obtained in several Excel-files (one for each year), each of them containing two of three sheets. We converted them to one database table, because Excel cannot handle so many data. The database tool used is Microsoft Foxpro, which enables us to use (combinations of) SQL<sup>2</sup> and hand made scripts in

<sup>1</sup> Dolasci i Odlasci Brodova.

<sup>2</sup> SQL (Structured Query Language) is a database computer language designed for managing data in relational database management systems. Its scope includes data query and update, schema creation and modification, and data access control. SQL became the most widely used language for relational databases.

a very flexible manner. The total number of records<sup>1</sup> of the Foxpro database is 441.854, which represent the same number of arrivals.

An arrival is defined as a day that a particular ship enters a particular port or basin. So when a ship, e.g. a ferry, enters that port or basin for instance 10 times on a day, it is counted as 1 arrival. This choice is made, because the data were delivered in that way, and for waste collection an 'arrival day' is a better unit than every single entry of the port.

### 2.3 Basic data verification and consistency check

The next step was a basic data verification and consistency check. The main results of this step are:

- not all ship's records have an IMO number. Of course not all ships and other vessel must have an IMO number. But in a small number of records an IMO number was missing, while the ships involved certainly should have one;
- the harbour masters office area, port and basin were in the same field, which makes specification per harbour masters office area, or port, or basin difficult. We divided this field into three fields: harbour master office area, port and basin. The names of ports and basins were not written in a consistent way. More names of the same port or basin appeared;
- the classification of ship types was not consistent, different names used for the same type, different languages used (Croatian and English), ships with the same IMO number sometimes have different ship types;
- not all ship data were present in every record: Gross Tonnage and Flag were complete. IMO number, Dead Weight and Ship type were incomplete.

### 2.4 Adding an unique ship number to records without IMO number

Because not all records contain an IMO number or another unique identification, counting the ships is not possible. Therefore we added our own identification label as follows: We called every 'something' with an unique set of properties (Gross Tonnage, flag, ship type, and dead-weight) a ship, and gave it a self made unique identification number. Of course it causes some errors when two or more ships of the same size and flag exist. But on the other hand several ships appear in the database with one or more of the properties different. So we assume that one error is compensating more or less the other.

### 2.5 Classification of ports in main ports and other ports

In the data from DOB ports are characterised on three levels:

- Harbour Masters Office (Pula, Rijeka, Senj, Zadar, Sibenik, Split, Ploce and Dubrovnik);
- Port, for instance for Rijeka: Bakar, Baska, Cres, Krk, Omisalj, Opatija, etc.;
- Basin.

<sup>1</sup> In the context of a relational database, a row—also called a **record** or tuple—represents a single, implicitly structured data item in a table. In simple terms, a database table can be thought of as consisting of rows and columns or **fields**. Each row in a table represents a set of related data, and every row in the table has the same structure.

For the analysis we felt the need of distinguishing the main ports with all its basens from the smaller ports. The main ports are listed in annex 1. As said in par. 2.3 the names of ports and basins were not written in a consistent way, but this did not influence the final results.

## 2.6 Classification of ports in Croatian, Other Adriatic, Mediterranean-Black Sea and Rest of the World

It is already known that the majority of the ships arrive from other Croatian ports. And when they come from abroad, their previous port was an Adriatic one in most cases. To prove it using the data, we made a classification of the region of the previous port, based on the database field previous port: Croatian, Other Adriatic, Mediterranean-Black Sea and Rest of the World. Italy needed some special attention, because the eastern coast of Italy is only partly an Adriatic coast. The border is the Strait of Otranto.

**Figure 1 Adriatic Sea**



Italian ports on the eastern coast north of Otranto are Adriatic, the others classified as Mediterranean-Black Sea ports.

## 2.7 Adding a classification of ship types

Because arrival data in DOB does not contain a systematic classification of ship types, the database application cannot provide standard output data per ship type. For the traffic forecast it is essential to have a view on the current traffic per ship type. Therefore we extracted all different descriptions of ship type from the database and ordered them manually. As a basis classification we used the one, which is also used by IMO (MEPC Circulars) on their recommended standard format for the advance notification form for waste delivery to port reception facilities<sup>1</sup> and the standard format for the waste delivery receipt following a ship's use of port reception facilities<sup>2</sup>. As a second level of classification we ordered the ship types appearing in the database DOB. This makes it possible to

<sup>1</sup> MEPC.1/Circ.644 of 4 November 2008.

<sup>2</sup> MEPC.1/Circ.645 of 4 November 2008.

produce small tables and figures for reporting and detailed tables for further investigation as well. The result is shown below.

**Table 1 Classification of ship types**

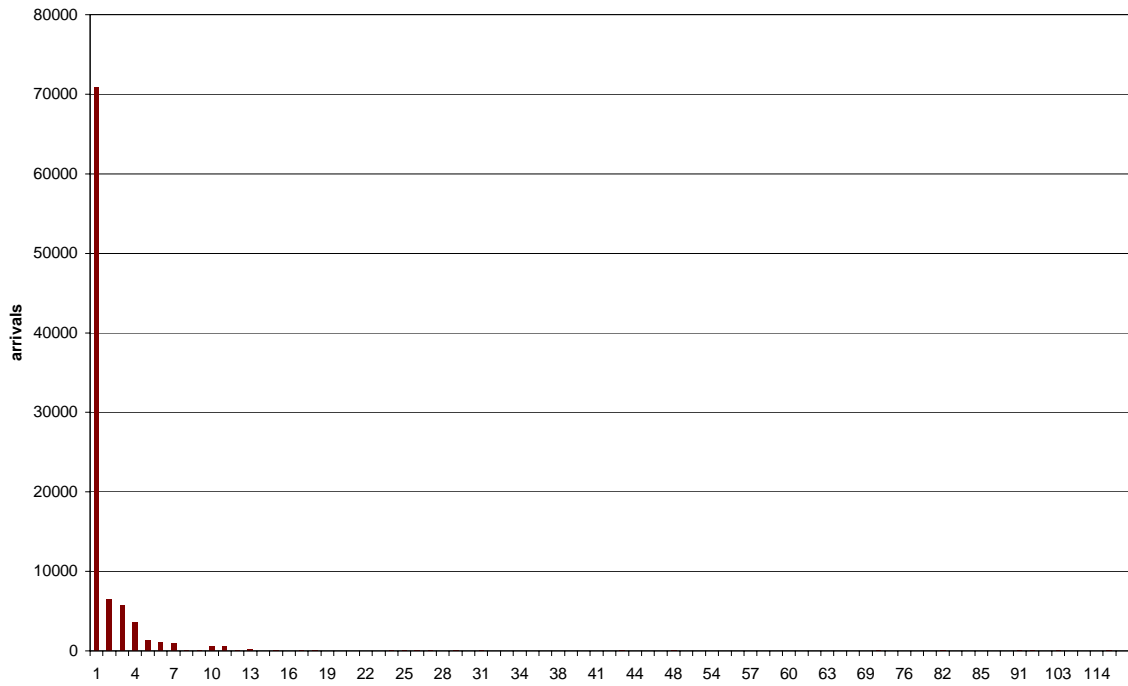
nr	type	sub type	nr	type	sub type
1	oil tanker	tanker oil	7	ro-ro	ro-ro passenger ship
1		tanker oil/chemical	7		ro-ro cargo ship
1		product carrier	8	other	fishing vessel
1		tanker not specified	8		training ship
2	chemical tanker	tanker chemical	8		supply vessel
2		LPG/LNG	8		research vessel
3	bulk carrier	bulk carrier	8		crane ship
3		ore carrier	8		dredger
4	container ship	container ship	8		tug
5	other cargo ship	tanker non-toxic	8		special purpose ship
5		general cargo ship	8		public vessel
5		fast cargo ship	8		survey vessel
5		refrigerated cargo ship	8		factory ship
5		cement carrier	8		motor yacht
5		self unloading hopper barge	8		technical objects
5		vehicle carrier	8		barge-cargo on deck
5		heavy cargo ship	8		barge-liquid bulk cargo in tanks
5		multi purpose cargo ship	8		barge-solid bulk cargo in holds
6	passenger ship	passenger ship	8		other
6	passenger ship	fast passenger ship	9	ship not specified	not ship not specified
				specified	

### 3 Distribution by the size of ships

To get an impression of the fleet in the Croatian ports, the distribution of different ship sizes has been calculated according to the Gross Tonnage with categories per 1000 GT and counting the number of arrivals<sup>1</sup> per category using the data of the year 2008. The result is shown below.

<sup>1</sup> Arrivals are defined as the number of days a ship entered a port. So, when a ferries entered a particular port 10 times per day during 300 days, it is counted as 300.

**Figure 2 Arrivals per Gross Tonnage category in 2008. Cat. 1 is GT < 1000, cat. 2 is 1000 <= GT < 2000, etc**



As we expected the graph is 'sticking to the axes': a very large number of arrivals of small ships and a very low number of arrivals of larger ships. You cannot even see the very small number of arrivals of large ships in this graph. The same exercise has been done again, excluding this time the ships with a GT less than 1.000. Then the large ships become 'visible', as shown in the next graph.

Gross tonnage (often abbreviated as GT, G.T. or gt) is a unitless index related to a ship's overall internal volume. The Gross tonnage calculation is defined in Regulation 3 of Annex 1 of The International Convention on Tonnage Measurement of Ships, 1969. It is based on two variables:

- V, the ship's total volume in cubic meters (m<sup>3</sup>), and
- K, a multiplier based on the ship volume.

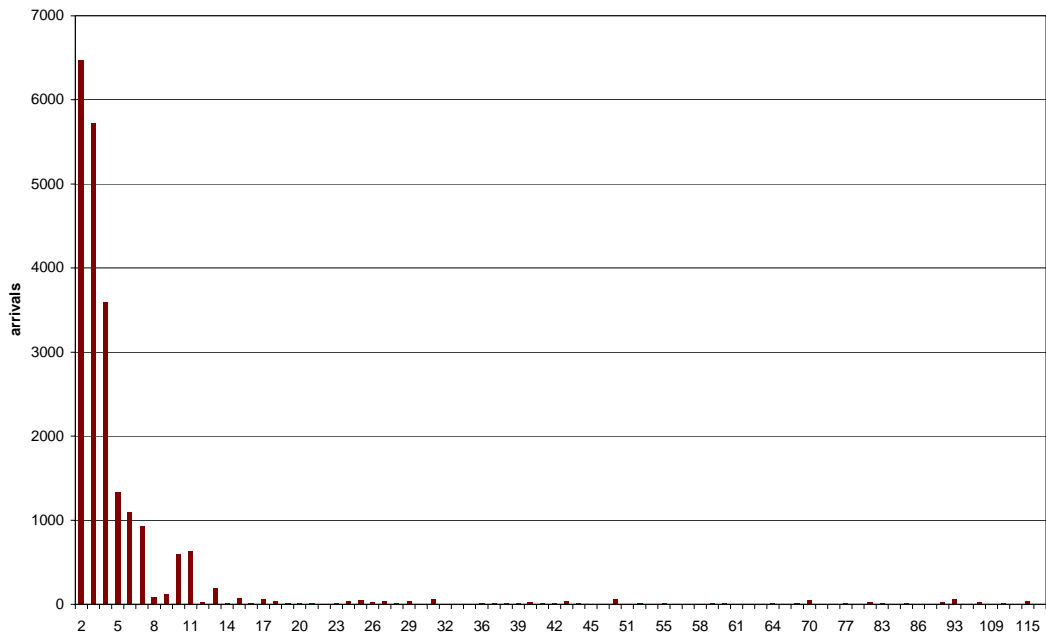
The value of the multiplier K varies in accordance with a ship's total volume (in cubic metres) and is applied as a kind of reduction factor in determining the gross tonnage value - which does not have a unit such as cubic metres or tons. For smaller ships, K is smaller, for larger ships, K is larger. K ranges from 0.22 to 0.32 and is calculated with a formula which uses the common or base-10 logarithm:

- $K = 0.2 + 0.02 * \log_{10}(V)$

Once V and K are known, Gross Tonnage is calculated using the formula, whereby GT is a function of V :

- $GT = K * V$

**Figure 3 Arrivals per Gross Tonnage category in 2008. Ships under GT 1000 are excluded. Cat. 2 is 1000 <= GT < 2000, Cat. 3 is 2000 <= GT < 3000, etc**

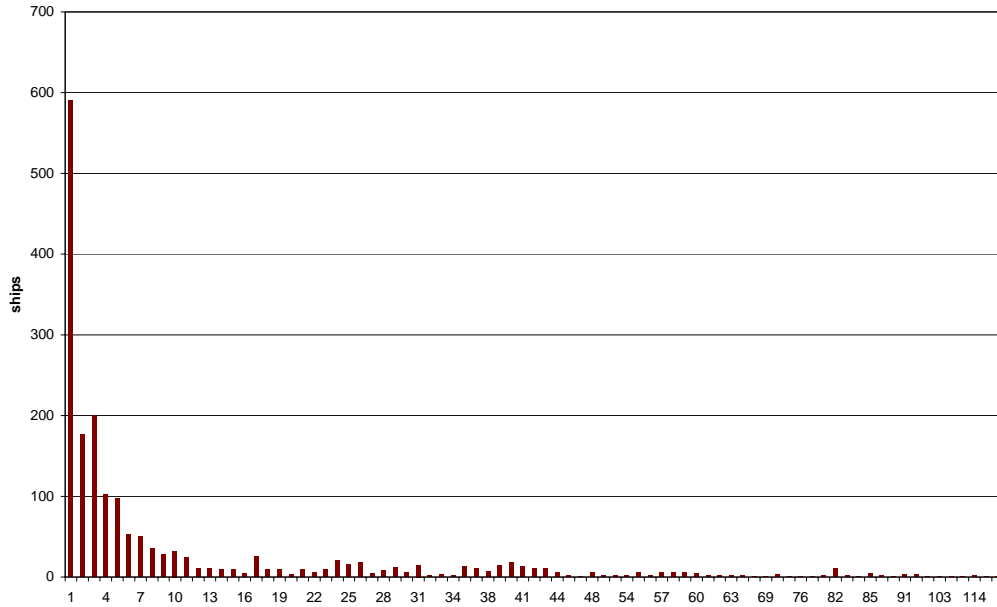


The largest ships which arrived are of 114.000 GT or more. They are two large cruisers which arrived in Dubrovnik. It is clear that the majority of arrived ships is smaller than 11.000 GT.



Here we're talking about arrivals, but how many different ships are involved? The number of ships per GT class is shown below.

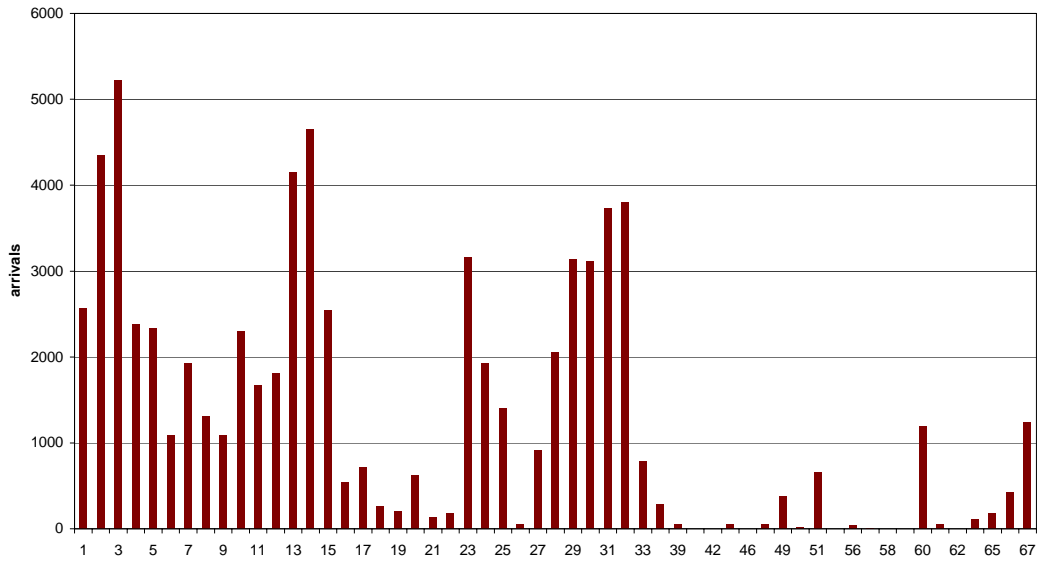
**Figure 4 Number of ships per Gross Tonnage category in 2008. Cat. 1 is GT < 1000, cat. 2 is 1000 <= GT < 2000, etc**



Also the distribution of the ships shows the same pattern, many small ships and a few large, but the huge number (70.882) of arrivals of ships smaller than 1000 GT, as shown in the first graph, is related to less than 600 ships. Almost half of them, 275, are passenger ships, responsible for 88 % of the arrivals (62.241 arrivals).

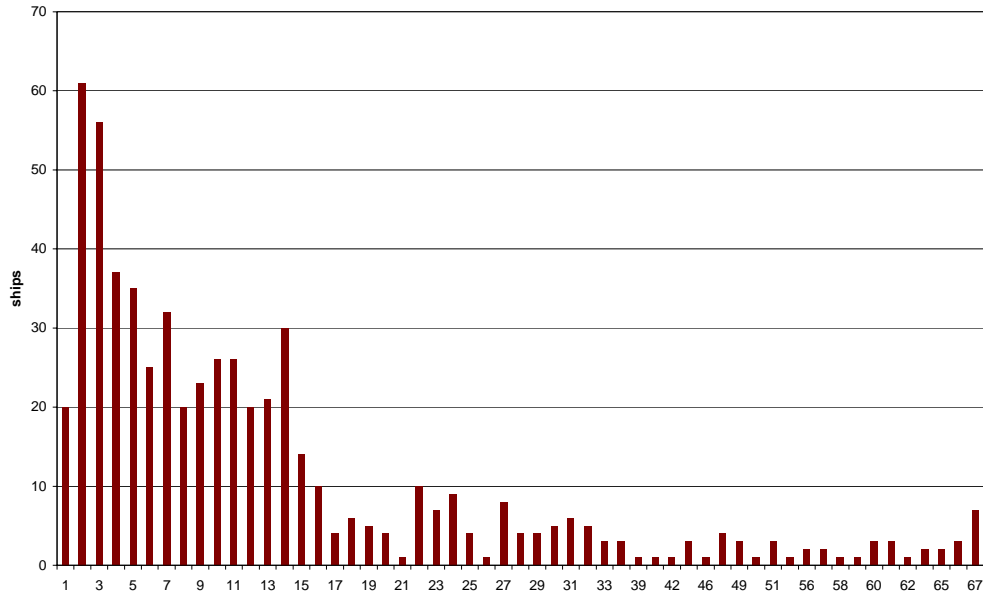
Unfortunately it was not possible to distinguish ferries from the other types of passenger ships, like cruisers and ships for holiday trips. Later the study will come back on ship type, like passenger ship, but first the study will focus on the large group of smaller ships. The graph below shows the number of arrivals per category of GT in steps of 15. Then cat. 1 is <15G, and cat 20 is < 300 GT.

**Figure 5 Arrivals of ships under 1000 Gross Tonnage in 2008 Cat. 1 is GT < 15, cat. 2 is 15 <= GT < 30, etc**



It should be recall that pursuant to article 63 of the Ordinance concerning the modalities for maintaining order in port “ the master of a ship, other than a fishing vessel, bound to a Croatian port must fully and accurately deliver information concerning the ship’s waste and cargo residues to the harbour master and port authority”. That means that, with the exception of war ships and fishing vessels, all ships exceeding 12 m in length and 15 GT or authorized to carry more than 12 passengers must send an advance notification form for waste delivery to port reception facilities. And according to article 64 of the same Ordinance “the master of a ship, yacht or boat must dispose of the total ship waste into port reception facility before leaving the port”. Indeed we have to keep that in mind when considering the payment regime due to the large group of ships below 300GT and above 15GT and the number of arrivals of those ships.

**Figure 6** Number of ships under 1000 Gross Tonnage in 2008 Cat. 1 is GT < 15, cat. 2 is 15 <= GT < 30, etc



## 4 Arrivals per Harbour Masters Office

### 4.1 Arrivals per Harbour Masters Office area for all ports

Harbour Masters area	ships					arrivals				
	2004	2005	2006	2007	2008	2004	2005	2006	2007	2008
LK DUBROVNIK	303	307	284	298	298	15.406	14.590	14.518	14.006	16.879
LK PLOCE	239	289	265	276	349	1.084	1.094	1.137	1.263	1.308
LK PULA	288	290	293	277	304	7.689	6.780	6.600	6.526	8.035
LK RIJEKA	915	914	909	923	911	15.778	17.658	16.613	17.005	17.208
LK SENJ	84	60	50	41	41	2.699	2.571	2.388	2.415	2.196
LK SIBENIK	306	293	322	297	308	3.651	3.662	3.703	3.380	3.433
LK SPLIT	521	529	554	591	566	29.763	29.833	28.931	32.264	30.454
LK ZADAR	308	352	331	310	306	11.868	11.828	10.661	11.678	13.299
<b>Total</b>	<b>1.672</b>	<b>1.706</b>	<b>1.732</b>	<b>1.804</b>	<b>1.799</b>	<b>87.938</b>	<b>88.016</b>	<b>84.551</b>	<b>88.537</b>	<b>92.812</b>

The total number of ships involved is of course lower than the sum of the number of ships in each specific Harbour Masters area, because the same ship can arrive in more than one port, and in more than one Harbour Masters area.

## 4.2 Arrivals per Harbour Masters Office for the main ports only

Ports of	ships					arrivals				
	2004	2005	2006	2007	2008	2004	2005	2006	2007	2008
LK DUBROVNIK	226	203	209	213	224	4.866	4.682	4.454	4.010	4.539
LK PLOCE	227	279	259	271	342	935	955	1.005	1.132	1.201
LK PULA	203	205	217	193	184	1.973	1.639	1.781	1.770	1.926
LK RIJEKA	714	717	711	735	709	4.363	4.397	3.952	3.677	3.473
LK SIBENIK	186	176	187	197	197	938	1.192	1.001	1.002	822
LK SPLIT	377	394	435	457	446	9.890	10.135	10.304	10.950	10.167
LK ZADAR	223	264	255	248	249	6.733	6.529	6.174	6.145	6.505
<b>Total</b>	<b>1.471</b>	<b>1.508</b>	<b>1.536</b>	<b>1.609</b>	<b>1.583</b>	<b>29.698</b>	<b>29.529</b>	<b>28.671</b>	<b>28.686</b>	<b>28.633</b>

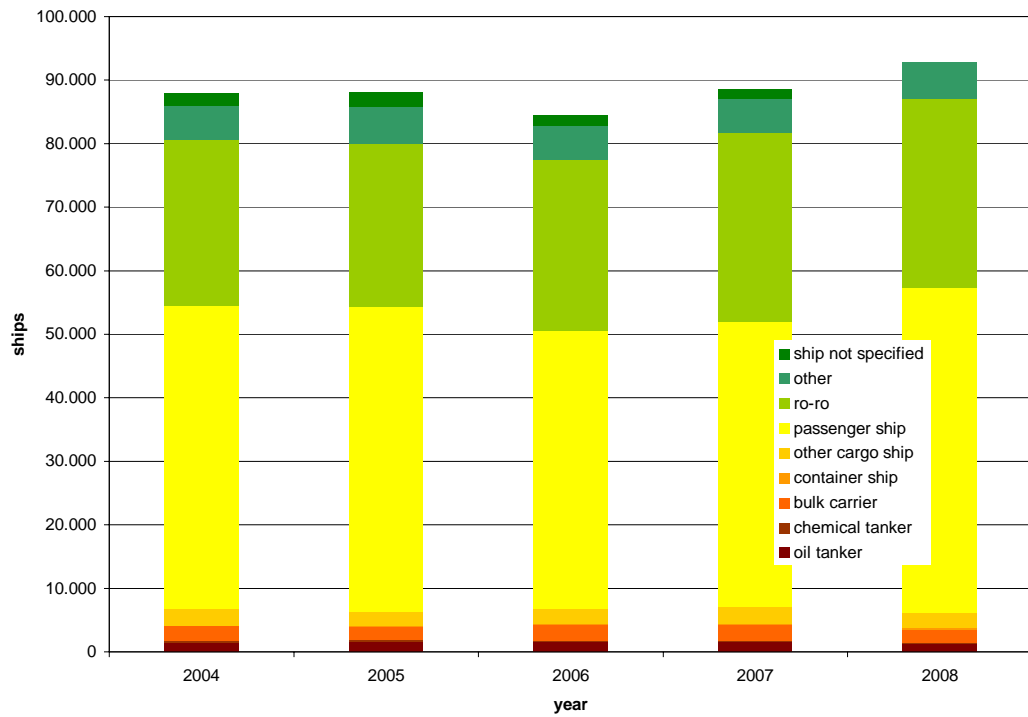
## 5 Arrivals per ship type

## 5.1 Arrivals per ship type for all ports

Table 2 Arrivals per ship type for all ports, 2004 -2008

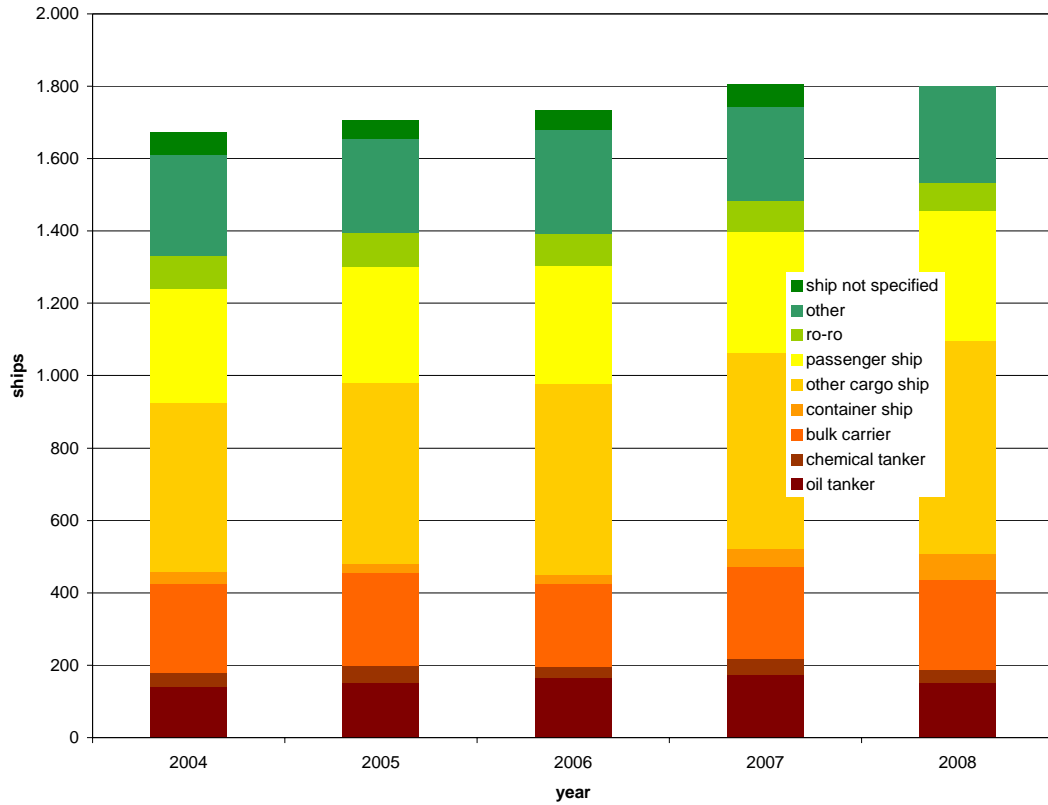
ship type	ships					arrivals				
	2004	2005	2006	2007	2008	2004	2005	2006	2007	2008
oil tanker	140	151	167	173	150	1.440	1.525	1.548	1.547	1.324
chemical tanker	40	47	29	45	39	350	312	305	313	84
bulk carrier	245	257	228	253	246	2.278	2.163	2.383	2.392	2.092
container ship	34	25	26	50	73	98	75	159	260	332
other cargo ship	465	500	529	542	589	2.574	2.170	2.422	2.557	2.419
passenger ship	317	321	324	336	358	47.678	48.087	43.760	44.929	51.035
ro-ro	92	94	89	84	79	26.172	25.636	26.967	29.703	29.827
other	277	261	287	260	265	5.341	5.833	5.298	5.318	5.699
ship not specified	62	50	53	61	0	2.007	2.215	1.709	1.518	0
<b>Total</b>	<b>1.672</b>	<b>1.706</b>	<b>1.732</b>	<b>1.804</b>	<b>1.799</b>	<b>87.938</b>	<b>88.016</b>	<b>84.551</b>	<b>88.537</b>	<b>92.812</b>

**Figure 7 Arrivals in all ports per ship type, 2004 – 2008**



As expected the majority off the arrivals consists of passenger ships and ro-ro ships, which are also carrying passengers.

**Figure 8** Number of arrived ships in all ports per ship type, 2004 – 2008



Regarding the number of ships, it becomes clear that passenger ships and ro-ro ships are less dominant compared with Figure 1. Other cargo ship is the largest group.

## 5.2 Arrivals per ship type for main ports

**Table 3** Arrivals per ship type for main ports, 2004 -2008

ship type	ships					arrivals				
	2004	2005	2006	2007	2008	2004	2005	2006	2007	2008
oil tanker	139	149	166	172	149	1.236	1.307	1.402	1.309	1.251
chemical tanker	38	47	29	44	38	347	312	303	311	82
bulk carrier	232	244	215	238	226	1.195	1.328	1.368	1.173	1.099
container ship	33	25	26	50	73	97	75	159	260	332
other cargo ship	453	481	513	522	572	1.497	1.502	1.713	1.747	1.896
passenger ship	258	256	263	274	292	13.090	13.355	12.793	12.898	13.480
ro-ro	88	90	82	79	66	9.570	8.947	8.607	8.819	8.681
other	191	188	209	183	167	2.255	2.247	1.915	1.866	1.812
ship not specified	39	28	33	47	0	411	456	411	303	0
	<b>1.471</b>	<b>1.508</b>	<b>1.536</b>	<b>1.609</b>	<b>1.583</b>	<b>29.698</b>	<b>29.529</b>	<b>28.671</b>	<b>28.686</b>	<b>28.633</b>

Comparing Table 3 with Table 2, it is clear that the number of arrivals in the main ports is much lower (in 2008 92.812 in all ports, 28.633 in the main ports), but the number of ships involved isn't (in 2008 1.799 in all ports compared to 1.583 in the main ports).

## 6 Arrivals per ship type per main port

As a basis for the forecast of arrivals we used the data of the year 2007. The majority of the traffic in Croatian ports is domestic (see chapter 0). We used the traffic in the main ports as a starting point, because due to the predominantly domestic character of the traffic there would be too much redundancy if all arrivals were counted. When a ship travels from one Croatian port to another **one** on one of the islands in (less then) one day, it does not need to deliver its ship waste in both ports. Waste delivery in the main ports would be sufficient in most cases. See also par. 5.2. The table below presents this traffic data, specified per Harbour Masters area and per ship type.

**Table 4 Number of arrived ships and arrivals in the main ports per Harbour Masters area and per ship type in 2007**

2007 Harbour Masters area	ships									arrivals								
	oil tanker	chem tanker	bulk carrier	container ship	other cargo ship	passenger ship	ro ro	other	not specified	oil tanker	chem tanker	bulk carrier	container ship	other cargo ship	passenger ship	ro ro	other	not specified
Dubrovnik	1				5	226	7	16	4	11				14	3.196	712	67	10
Ploce	16	1	76	7	131	13	11	14	2	87	21	122	34	344	51	414	49	10
Pula	0		31		43	34	6	75	20			319		192	395	113	597	154
Rijeka	164	34	99	46	323	70	44	110	13	845	200	219	201	449	974	195	578	16
Sibenik	2		49	3	48	66	8	19	5	46	0	113	3	165	478	118	73	6
Split	24	7	46	1	161	158	62	82	15	263	49	290	22	543	4.801	4.540	390	52
Zadar	33	20	4		24	96	29	55	7	57	41	93		56	2.996	2.732	123	47
<b>TOTAL<sup>1</sup></b>	<b>172</b>	<b>44</b>	<b>238</b>	<b>50</b>	<b>522</b>	<b>274</b>	<b>79</b>	<b>183</b>	<b>47</b>	<b>1.309</b>	<b>311</b>	<b>1.156</b>	<b>260</b>	<b>1.763</b>	<b>12.891</b>	<b>8.824</b>	<b>1.877</b>	<b>295</b>

<sup>1</sup> The total number of ships involved is lower then the sum of the number of ships in each specific Harbour Masters area, because the same ship can arrive in more then one port, and in more then one Harbour Masters area.

## 7 Arrivals per region of origin (previous port)

**Table 5 Arrivals in all ports per region of origin, 2007 and 2008**

Previous port along or in:	2007			2008		
	ships	arrivals	arrivals in %	ships	arrivals	arrivals in %
Unknown	18	169	0,2%	30	52	0,1%
Adriatic Sea	641	4.385	5,0%	644	4.219	4,5%
Croatia	775	81.921	92,5%	794	86.339	93,0%
Mediterranean and Black Sea	622	1.839	2,1%	691	2.018	2,2%
World	207	223	0,3%	165	184	0,2%
<b>Total</b>	<b>1.804</b>	<b>88.537</b>		<b>1.799</b>	<b>92.812</b>	

## 8 Ships that visit a port frequently

Within the context of an indirect fee system and under certain conditions and criteria exemptions regimes may be granted for ships engaged in scheduled traffic with frequent and regular port calls. The exemptions relate to the obligations of: advance notification; waste delivery; and, the payment of a waste delivery fee on each call (the payment must be made once according to a specific delivery contract). Therefore it is important to have an estimation of the number and type of ships to which the exemption regime may be granted. To make such an estimate we assume that every ship that enters one particular port 50 days or more per year might fulfil the criteria for the exemption regime. . In the next two paragraphs the results of the calculations are presented. In par 8.1 for arrivals in all ports, in par. 8.2 for arrivals in main ports.

### 8.1 Arrivals in all ports

The next table shows the number of ships per category of gross tonnage which may be exempted.



**Table 6 Number of ships and arrivals in 2008 per gross tonnage class which may be exempted**

gt_class	gross tonnage	ships	arrivals
1	< 1.000	149	51.298
2	1.000 – 1.999	13	5.202
3	2.000 – 2.999	14	4.482
4	3.000 – 3.999	6	3.173
5	4.000 – 4.999	1	923
6	5.000 – 5.999	2	739
7	6.000 – 6.999	2	743
10	9.000 – 9.999	2	480
11	10.000 – 10.999	1	561
13	12.000 – 12.999	1	153
	<b>Total</b>	<b>191</b>	<b>67.754</b>

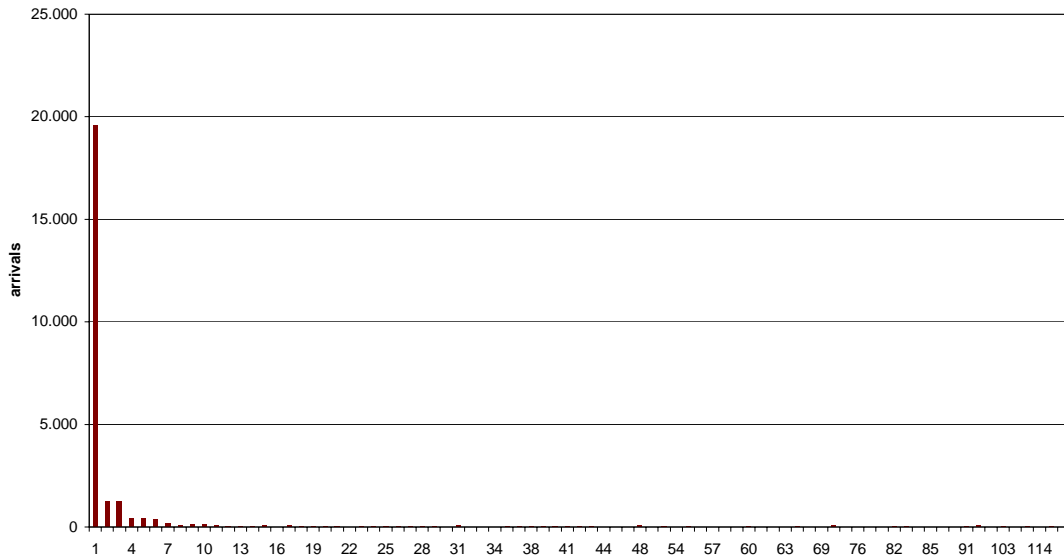


**Marko Polo**

The two largest ships in this table are both ferries, resp. the Ancona (12.394 GT) going to and from Split and the Marko Polo (10.154 GT) travelling between Rijeka, Split and Dubrovnik.

Then the same calculation as above, but for the ships which should not get exemption, is shown in the next graph.

**Figure 9 Arrivals per Gross Tonnage category in 2008. Ships frequently visiting the ports are excluded. Cat. 2 is 1000 <= GT < 2000, Cat. 3 is 2000 <= GT < 3000, etc**

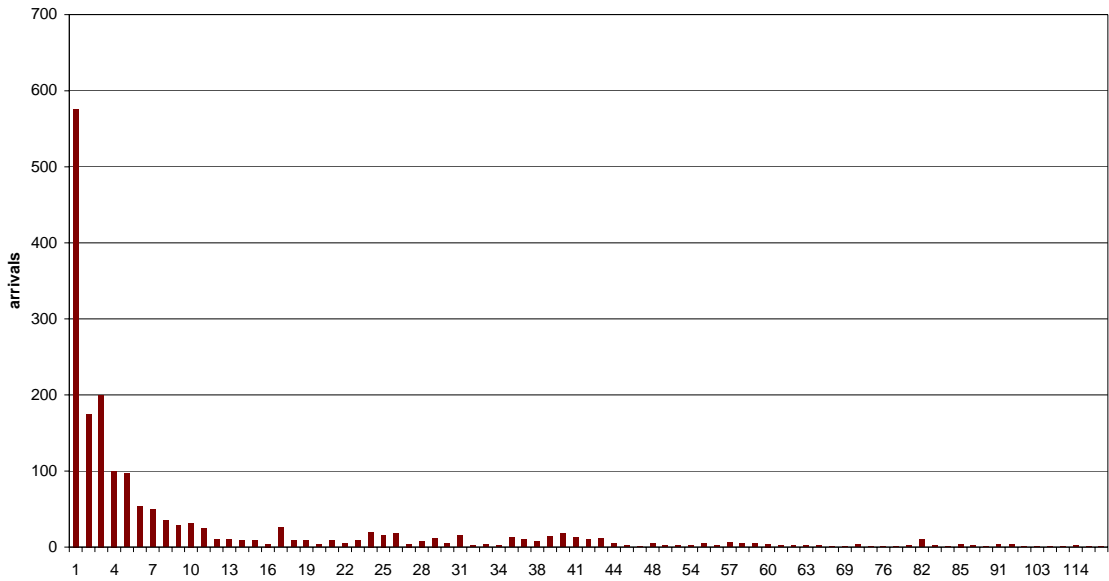


The total number of arrivals in 2008 of those ships is 25.058. So  $92.812 - 25.058 = 67.754$  arrivals may be exempted for that particular port, which is 73 percent. In this approach arrivals of ships that have 50 arrivals or more per year in a particular port are excluded, but if such ship also arrived in other ports less than 50 times per year, these arrivals are included in the graph above. So it is a

portwise approach. Therefore that has to be taken into account when designing the indirect payment system and establishing the criteria and conditions for granting exemption (port approach or national approach ?).

The total number of ships involved was 1.781. Next graph shows the number of ships.

**Figure 10 Number of ships per Gross Tonnage category in 2008. Ships under GT 1000 are excluded. Ships frequently visiting the ports are excluded. Cat. 2 is 1000 <= GT < 2000, Cat. 3 is 2000 <= GT < 3000, etc**



Which types of ships are regarded as 'potentially exempted' using this approach? Next table shows the ships which may be exempted categorised by ship type and sub type<sup>1</sup>.

<sup>1</sup> The ship types in the received extract from DOB are not well categorised. For the purpose of the traffic analysis I made an own categorisation. based on the 8 main ship types used by the Marine Environment Protection Committee. See also par. 2.7.

**Table 7 Ships which may be exempted under the indirect payment system (ships that arrived in a port 50 times or more per year, in 2008)**

ship type	sub type	sub type description	ships in 2008	arrivals in 2008
oil tanker	3	tanker oil	2	322
	5	product carrier	2	399
chemical tanker	2	tanker chemical	1	54
bulk carrier	1	bulk carrier	12	1.049
	2	ore carrier	1	52
other cargo ship	4	general cargo ship	3	354
	6	fast cargo ship	1	146
	8	cement carrier	2	107
passenger ship	1	passenger ship	70	17.114
	3	fast passenger ship	25	17.634
ro-ro	2	ro-ro passenger ship	49	27.662
	5	ro-ro cargo ship	4	536
other	1	fishing vessel	15	1.606
	2	supply vessel	2	374
	21	other	3	345
<b>total</b>			<b>192</b>	<b>67.754</b>

The 2 of the 3 ships of type other/other are transporting passengers. The third ship (136 GT) is not a passenger ship, but is almost daily travelling to and from "Otvoreno more" (open sea).

The ships that, in 2008, arrived less than 50 times in a port, are counted in the table below.

**Table 8 Ships which should not get exemptions under the indirect payment system (ships that arrived in a port less than 50 times per year, in 2008)**

ship type	sub type	sub type description	ships in 2008	arrivals in 2008
oil tanker	3	tanker oil	95	341
	4	tanker oil/chemical	45	73
	5	product carrier	12	135
chemical tanker	2	tanker chemical	28	44
	6	LPG/LNG	11	40
bulk carrier	1	bulk carrier	245	966
	2	ore carrier	1	22
container ship	3	container ship	73	332
other cargo ship	1	tanker non-toxic	2	45
	4	general cargo ship	518	1535
	6	fast cargo ship	1	1
	7	refrigerated cargo ship	44	110
	8	cement carrier	6	63
	9	self unloading hopper barge	4	39
	10	vehicle carrier	5	7
passenger ship	12	multi purpose cargo ship	10	15
	1	passenger ship	322	15106
	3	fast passenger ship	25	1181
ro-ro	2	ro-ro passenger ship	57	1216
	5	ro-ro cargo ship	19	413
other	1	training ship	140	1958
	2	supply vessel	10	114
	3	research vessel	6	55
	4	crane ship	7	24
	5	dredger	6	22
	6	tug	42	743
	7	special purpose ship	4	7
	8	public vessel	2	29
	11	motor yacht	1	1
	12	technical objects	8	80
	15	barge-cargo on deck	15	141
	16	barge-liquid bulk cargo in cargo	1	4
	17	barge-solid bulk cargo in cargo	1	4
21	other	22	192	
<b>total</b>			<b>1.788</b>	<b>25.058</b>

As to be expected the cargo ships are present in this table, but also a quite large number of passenger ships. Many of them are cruise ships and passenger ships for tourist trips, but also a number of ferries (subtypes ro-ro and fast passenger ship) are present in this selection. Remarkable is also that fishing vessels are present in both groups of ships (to be exempted and not to be exempted). Probably a part of them has a home port and others don't.

The number of ships in the tables with the categorisation per ship type differs slightly from the number of ships in the figures per GT-class. This is caused by

some 'contamination' of DOB; some arrivals with the same IMO number have different ship types.

## 8.2 Arrivals in main ports

To support the decision making process regarding the indirect payment system, the study made the same calculation of ships and arrivals per ship type, but included only arrivals in the main ports. Next table shows the ships which may be exempted categorised by ship type and sub type<sup>1</sup>, for arrivals in the main ports in 2008.

**Table 9 Ships which may be exempted under the indirect payment system (ships that arrived in a main port 50 times or more per year, in 2008)**

ship type	sub type	sub type description	ships in 2008	arrivals in 2008
oil tanker	3	tanker oil	2	322
	5	product carrier	2	399
chemical tanker	2	tanker chemical	1	54
bulk carrier	1	bulk carrier	6	429
	2	ore carrier	1	52
other cargo ship	4	general cargo ship	2	207
	6	fast cargo ship	1	146
	8	cement carrier	2	107
passenger ship	1	passenger ship	21	4.011
	3	fast passenger ship	19	5.647
ro-ro	2	ro-ro passenger ship	32	8.383
	5	ro-ro cargo ship	2	240
other	1	fishing vessel	1	61
	2	supply vessel	2	374
<b>total</b>			<b>94</b>	<b>20.432</b>

The ships that, in 2008, arrived less than 50 times in a main port, are counted in the table below.

<sup>1</sup> The ship types in the received extract from DOB are not well categorised. For the purpose of the traffic analysis an own categorisation has been made based on the 8 main ship types used by the IMO Marine Environment Protection Committee.

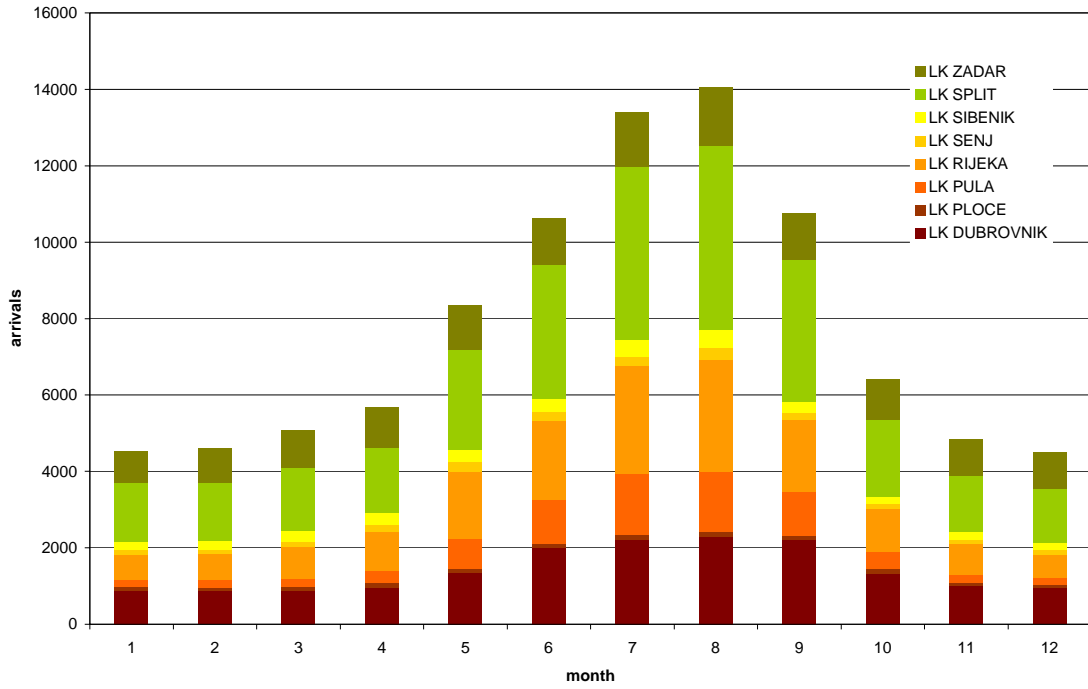
**Table 10 Ships which should not be exempted under the indirect payment system  
(ships that arrived in a main port less than 50 times per year, in 2008)**

ship type	sub type	sub type description	ships in 2008	arrivals in 2008	
oil tanker	3	tanker oil	94	264	
	4	tanker oil/chemical	45	73	
	5	product carrier	12	134	
chemical tanker	2	tanker chemical	27	43	
	6	LPG/LNG	11	40	
bulk carrier	1	bulk carrier	223	691	
container ship	3	container ship	73	332	
other cargo ship	1	tanker non-toxic	2	19	
	4	general cargo ship	502	1247	
	6	fast cargo ship	1	1	
	7	refrigerated cargo ship	43	102	
	8	cement carrier	5	51	
	9	self unloading hopper barge	4	21	
	10	vehicle carrier	5	7	
passenger ship	12	multi purpose cargo ship	10	15	
	1	passenger ship	255	4060	
ro-ro	3	fast passenger ship	14	178	
	2	ro-ro passenger ship	32	364	
other	5	ro-ro cargo ship	16	106	
	1	training ship	67	390	
	2	supply vessel	9	110	
	3	research vessel	4	28	
	4	crane ship	6	19	
	5	dredger	5	14	
	6	tug	37	624	
	7	special purpose ship	3	4	
	8	public vessel	1	3	
	11	motor yacht	1	1	
	12	technical objects	5	19	
	15	barge-cargo on deck	13	110	
	16	barge-liquid bulk cargo in tanks	1	4	
	17	barge-solid bulk cargo in holds	1	3	
	21	other	12	45	
	<b>total</b>			<b>1.539</b>	<b>9.122</b>

## 9 Spread of the traffic throughout the year

Tourism is one of the important economic sources of Croatia it influences significantly the maritime traffic. The next figure shows the arrivals per month of the year 2008 for all ports per Harbour Masters area.

**Figure 11 Arrivals per month of the year 2008 for all ports per Harbour Masters area**



All ports except Ploce show a strong seasonal influence. The total number of arrivals in August was three times higher than in winter.

## Annex 1 Main ports of Croatia

Harbour master	Port	Basen	Special purpose
LK DUBROVNIK		Gradska luka Dubrovnik - putnicka luka	
LK DUBROVNIK		Gruz	
LK DUBROVNIK		Gruz - putnicka luka	
LK DUBROVNIK		luka Gradska luka Dubrovnik - putnicka luka	
LK DUBROVNIK		luka Gruz	
LK DUBROVNIK		luka Gruz - putnicka luka	
LK PLOCE		Ploce	
LK PLOCE		luka Ploce	
LK PULA		Brodogradiliste ULJANIK - Pula	Shipyards
LK PULA		Pula	
LK PULA		luka Pula	
LK PULA	LI RABAC	luka Plomin	
LK PULA	LI RABAC	luka Plomin - HEP	
LK PULA	LI RASA	Rijeka - bazen Rasa	
LK PULA	LI RASA	luka Rijeka - bazen Rasa	
LK RIJEKA		INA - naftni terminal Mlaka	
LK RIJEKA		Rijeka	
LK RIJEKA		Rijeka - Susak	
LK RIJEKA		Rijeka - bazen Rijeka	
LK RIJEKA		Rijeka - kontejnerski terminal Brajdica	
LK RIJEKA		Rijeka - putnicka luka	
LK RIJEKA		brodogradiliste 3	Shipyards
LK RIJEKA		brodogradiliste 3. MAJ - Rijeka	Shipyards
LK RIJEKA		brodogradiliste VIKTOR LENAC - Kostrena	Shipyards repair
LK RIJEKA		luka "INA" - naftni terminal Mlaka	
LK RIJEKA		luka Rijeka - Susak	
LK RIJEKA		luka Rijeka - TORPEDO	
LK RIJEKA		luka Rijeka - bazen Rijeka	
LK RIJEKA		luka Rijeka - bazen Zamet	
LK RIJEKA		luka Rijeka - kontejnerski terminal Brajdica	
LK RIJEKA		luka Rijeka - putnicka luka	
LK RIJEKA	LI BAKAR	Bakar	
LK RIJEKA	LI BAKAR	INA - Srcica	
LK RIJEKA	LI BAKAR	INA - naftni terminal Bakar	
LK RIJEKA	LI BAKAR	INA - naftni terminal Urinj	
LK RIJEKA	LI BAKAR	Rijeka - bazen Bakar	
LK RIJEKA	LI BAKAR	luka "INA" - Srcica	
LK RIJEKA	LI BAKAR	luka "INA" - naftni terminal Bakar	
LK RIJEKA	LI BAKAR	luka "INA" - naftni terminal Urinj	
LK RIJEKA	LI BAKAR	luka Bakar	
LK RIJEKA	LI BAKAR	luka Rijeka - bazen Bakar	
LK RIJEKA	LI KRALJEVICA	brodogradiliste KRALJEVICA - Kraljevica	Shipyards repair
LK RIJEKA	LI OMISALJ	DIOKI - Omisalj	



<b>Harbour master</b>	<b>Port</b>	<b>Basen</b>	<b>Special purpose</b>
LK RIJEKA	LI OMISALJ	Rijeka - bazen Omisalj	
LK RIJEKA	LI OMISALJ	luka "DIOKI" - Omisalj	
LK RIJEKA	LI OMISALJ	luka Rijeka - bazen Omisalj	
LK SIBENIK		Sibenik	
LK SIBENIK		luka Sibenik	
LK SIBENIK		luka gradska luka Sibenik	
LK SPLIT		Brodogradiliste BRODOSPLIT	Shipyard
LK SPLIT		PLOVPUT - Split	
LK SPLIT		Split	
LK SPLIT		Split - Brodogradiliste "Viktor Lenac"	Shipyard
LK SPLIT		Split - Gradska luka	
LK SPLIT		Split - Ina - Petronafta	
LK SPLIT		Split - Sjeverna luka	
LK SPLIT		Split - Tvornica cementa Sv. Juraj	
LK SPLIT		Split - Tvornica cementa Sv. Kajo	
LK SPLIT		Split - Tvornica salonita - Vranjic	
LK SPLIT		Split - terminal Adriachem	
LK SPLIT		Split - terminal INAVINIL	
LK SPLIT		Split - terminal Silos	
LK SPLIT		luka Split - Brodogradiliste "Viktor Lenac"	Shipyard
LK SPLIT		luka Split - Gradska luka	
LK SPLIT		luka Split - Ina - Petronafta	
LK SPLIT		luka Split - Sjeverna luka	
LK SPLIT		luka Split - Tvornica cementa Sv	
LK SPLIT		luka Split - Tvornica cementa Sv. Juraj	
LK SPLIT		luka Split - Tvornica cementa Sv. Kajo	
LK SPLIT		luka Split - Tvornica salonita - Vranjic	
LK SPLIT		luka Split - terminal Resnik	
LK SPLIT		luka Split - terminal Silos	
LK SPLIT	LI TROGIR	Brodogradiliste Trogir	Shipyard new and repair
LK ZADAR		Gazenica - teretna i putnicka luka	
LK ZADAR		Zadar - putnicka luka	
LK ZADAR		luka Gazenica - teretna i putnicka luka	
LK ZADAR		luka Zadar - putnicka luka	