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A Statistical Overview of Ship Recycling

Nikos E. Mikelis*

International Maritime Organization (IMO)

Abstract

IMO is currently developing the International Convention for the Safe and Environmentally Sound Recycling of Ships. For a background description of the draft Convention and of the main issues that were under discussion at the end of 2006, see Mikelis (2006). During discussions on the development of the new Convention the need has arisen for referring to relevant statistics to quantify some aspects of ship recycling. The author has taken the opportunity to collate and present in this paper statistical data which will hopefully be useful to the reader.

Key words: Ship Recycling, Lightship, Average Age, Standard Deviation, Recycling State

1 Introduction

During discussions on the development of the International Convention for the Safe and Environmentally Sound Recycling of Ships the need has occasionally arisen for data and statistics relating to different aspects of the ship recycling activity. Over time, the author has collected statistics on the size of the fleet to which the new Convention will apply when it enters into force; on the expected annual demand for recycling Convention ships; on the related statistic of the average age of recycled ships; on whether the average age changes significantly over time; and on statistics on recycled volumes in the major ship recycling markets. While attempting to answer questions such as the above, more complex questions tend to arise, such as for example questions on the dynamics of supply and demand for ship scrap; on the price differentials of ship scrap in the major ship recycling States; and on the likely interaction between the new Convention and the dominant market forces. The author has not attempted to address in any conclusive manner these complex questions, nor has he addressed the policy issues which were discussed at the recently held fifty-sixth session of IMO's Marine Environment Protection Committee.

The paper presents some relevant data and statistics which hopefully will help the interested reader to form some clearer views on the subject. Also, the paper has identified and is discussing some of the difficulties and sources of inaccuracies associated with published statistical information on ship recycling.

* International Maritime Organization (IMO), 4 Albert Embankment, London SE1 7SR, United Kingdom, email: nmikelis@imo.org

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2 The Size of the Operating Fleet

One of the key statistics which is often required is the size of the operating fleet that will be subject to the requirements of the Convention when this enters into force. The world fleet of course changes continuously with newbuildings being added, with old ships being sent for recycling and with casualties being removed from the fleet. A most authoritative source of world fleet data is Lloyd's Register – Fairplay and in particular reference must be made to its annual publication World Fleet Statistics which reflects the state of the fleet at the end of December of each year for ships of over 100 gross tons. Table 1 below presents relevant data obtained from Table 20 of the World Fleet Statistics editions for years 2005 and 2006. Data for the whole fleet (i.e. ships over 100 GT) and also for the fleet over 500 GT (i.e. the fleet which will be subject to the Convention's requirements) are presented. The substantial growth of the world fleet in the last year is worth noting (7% growth in terms of gross tonnage and 4% growth in terms of ship numbers for the fleet over 500 GT).

Whereas it is tempting to quote from Table 1 the data at the end of 2006 (49,213 ships) as the fleet which in future will be subject to the requirements of the Convention, in fact some care is needed with this statistic. The draft Convention excludes government owned ships on non-commercial service and it will most probably also exclude ships engaged solely in domestic voyages. On the other hand the statistics shown in Table 1 include ocean going government owned non-commercial service ships and include ships engaged solely in domestic voyages. Therefore the figure of 49,213 ships definitely represents an overestimate for the fleet relevant to the Convention and as a guess it is suggested that a figure of say 42,000 to 45,000 ships may be more appropriate. Once the scope of the application of the Convention is firmly decided, it might be possible to refine the statistics contained in Table 1 accordingly, by excluding government owned and/or domestic trading ships. The interested reader might also like to note that both, the draft Convention and the Lloyd's Register – Fairplay statistics exclude the inland waterways fleet.

Table 1. World fleet data

	2005		**2006**	
	n	GT	n	GT
Fleet over 100 GT +	92,105	675,115,956	94,936	721,855,399
Fleet over 500 GT +	47,258	664,110,484	49,213	710,602,142

3 Lightship

A most relevant quantity in ship recycling is the lightship. This is defined as the extreme displacement of a ship when fully equipped and ready to proceed to sea but with no crew, passengers, stores, fuel, ballast, water or cargo on board. The definition of the ship being ready to proceed to sea means that also included in the lightship are the lubricants contained in the main and auxiliary engines, the hydraulic oil contained in hydraulic systems and the water needed to fill the ship's boilers up to working level.

The lightship may also be seen as the mass made up of the ship's structure, propulsion machinery, other machinery, outfit and constants. Lightship is relevant for ship recycling because it provides estimates of the quantities of materials to be obtained following the ship's dismantling. Furthermore, almost all recycling sale & purchase transactions are conducted on the basis of prices per lightship (long) ton. The long ton is an imperial measurement unit equating to 2,240 pounds (lb) or 1.016 tonnes.

A question which often arises is the lightship content of different ship types and sizes. The data shown in Table 2 have been provided by an experienced broker and are intended to be used only as approximate estimates.

Table 2. Approximate estimates of lightship content of different ship types

Ship Type	Size (DWT tonnes)	Gross Tonnage	Lightship (long tons)
Tanker VLCC (older)	270,000	146,000	35,000
Tanker VLCC (newer)	300,000	159,000	35,000
Tanker Suezmax	150,000	80,000	22,000
Tanker Aframax	80–120,000	45–67,000	15-18,000
Tanker Panamax	70,000	40,000	10-13,000
Tanker Handysize	35,000	22,000	7,000
Capesize bulkcarrier	150–170,000	78–86,000	20-21,000
Panamax bulkcarrier	70,000	40,000	10-12,000
Handysize bulkcarrier	35,000	22,000	7,000

4 Recycling Statistics

A question often asked is what is the average age of recycled ships. Such a statistic is needed for making rough estimates of the expected average demand for ship recycling. If for example the average age of recycled ships is 30 years and there are 95,000 ships over 100 GT in the world fleet, we could estimate that the average future recycling demand would be around 3,100–3,200 ships per year (=95,000/30). Furthermore, if we are looking for an estimate of the average annual demand for recycling according to the Convention and if the size of the relevant fleet is, say, 44,000 ships, its average age 28 years and the percentage of the world fleet flying the flag of Parties to the Convention at some stage after its entry into force is, say, 60%, then the requested estimate would be around 940 ships per year (=0.6*44,000/28). Of course it has to be said that such approximations are simplistic in that not all ship types, nor all ship sizes, share the same market dynamics over time.

One important realization that can be verified by examining statistical databases on ship recycling is that the available data and databases suffer from what appear to be unavoidable discrepancies. Ships are not always reported as having been recycled and many are only reported a considerable time after they were recycled. Conversely, some ships recorded as having been recycled are subsequently found to be trading.

Consequently, data published for a given year more often than not have to be revised upwards or even downwards in subsequent years. And whereas the same erroneous records also affect the databases for the operating fleet, the problem is much larger on the accuracy of the recycling databases due to their relatively small size. To appreciate the magnitude of the problem the reader is invited to consider as an example the data published on disposals (recycling) of ships of 100 GT and above by Lloyd's Register – Fairplay in its annual publication World Casualty Statistics: In Table 7B of the 1998 edition of the publication 750 ships of 12,284,673 GT are shown as having been recycled in 1998. In the equivalent Table 10C of the 2003 edition of the same publication the data for ships recycled in 1998 are shown as 969 ships of 13,736,890 GT. Finally, the data extracted in January 2007 from the Lloyd's Register – Fairplay database for the present study show 1,053 ships of 14,474,430 GT of 100 GT and above as having been recycled in 1998. Expressed in percentage terms, the ship numbers that were published in 1998 increased by 29% by 2003 or by 40% by the beginning of 2007, whereas the gross tonnage figures published in 1998 increased by 12% by 2003 or by 18% by the beginning of 2007.

One additional element of uncertainty arises because of differences in the information published by the different providers of maritime data. The interested reader is invited to compare the statistics on volumes of ship recycling as published, for example, by Lloyd's Register – Fairplay, Clarkson Research Services Ltd and EA Gibson Shipbrokers Ltd, all these being authoritative sources of maritime data. In part, these differences must be due to the reporting problems mentioned above while differences may also arise because of the use of different ship type groupings. The present analysis utilized the Lloyd's Register – Fairplay database which was obtained by the author in January 2007 and which covered the then latest information on recycled ships from 1990 to 2006 inclusive. This has therefore been the source of all data used in the present study, unless stated otherwise. It should also be noted that the analyses in this paper use gross tonnage for presenting statistics on ship size, this being a measure of the internal volume of a ship and not a measure of its mass. The reason for this choice was that the Lloyd's Register – Fairplay database does not contain lightship data for all ships. From the above general discussion it should follow that if the same analysis was performed at another time or using another database then some differences may be expected to some of the statistics presented here.

Table 3 shows annual recycling statistics for the world fleet of 500 GT and above for the last 17 years (1990 to 2006). The statistics include for each year and for the 17 year period the number of ships recycled, their total gross tonnage, the average gross tonnage, the average age (μ) and the standard deviation of the age (σ) of the recycled ships. The standard deviation is a measure of the variation of the age of each ship of the group from the average age of that group. In a normal distribution (which is what we assume to have here) 68% of all measurements fall within one standard deviation of the average (half above and half below) while 95% of all measurements fall within two standard deviations of the average. For example, if the average recycling age of a group of ships was 25 years and the standard deviation was 5 years then 95%

of all ships would be recycled at an age between 15 and 35 years. Conversely 2.5% of the ships would be recycled when older than 35 years and 2.5% when younger than 15 years.

It is particularly relevant to note from the data in Table 3 the cyclical nature of the recycling market with particularly low volumes in recent times and also at the beginning of the period examined. Also noteworthy is the significant increase (also shown in Figure 1) in the average age of ships sent for recycling from around 26–27 years old in the 1990s (i.e. prior to the Intermediate Survey following the 5th Special Survey) to around 32 years presently (which is the time prior to the Intermediate Survey following the 6th Special Survey). The interested reader might wish to also make a note of the higher values of the standard deviation of the average age observed during periods of low recycling activity, as seen in Table 3.

Ships are sent for recycling when the economics of their operation dictate it, although one important exception to this rule is the phasing out by the regulations of Annex I of MARPOL of the single hull tanker fleet.

Table 3. Recycling statistics (ships > 499 GT)

Year of Recycling	Number of Ships (n)	Average Age (μ)	Standard Deviation (σ)	Gross Tonnage (GT)	Average GT
2006	386	32.6	7.9	4,311,039	64,946
2005	361	32.7	8.9	4,036,787	71,002
2004	615	31.7	8.7	7,478,622	76,885
2003	874	29.7	7.3	16,532,724	85,746
2002	740	28.2	6.2	18,079,566	88,500
2001	772	27.7	5.7	15,903,761	84,537
2000	706	27.3	5.9	14,087,466	87,265
1999	829	26.2	5.4	19,534,461	86,918
1998	801	26.3	5.1	14,343,031	76,259
1997	735	26.5	5.5	10,674,688	79,006
1996	672	26.7	7.1	11,206,752	84,742
1995	649	26.6	6.9	10,226,503	95,645
1994	694	26.6	8.1	12,807,811	98,692
1993	549	26.6	7.8	10,721,544	92,328
1992	450	26.2	7.7	7,566,541	84,435
1991	325	25.7	7.4	3,301,650	73,195
1990	231	25.7	7.8	1,983,758	67,863
Totals	**10,389**	**27.7**	**6.9**	**182,796,704**	**17,595**

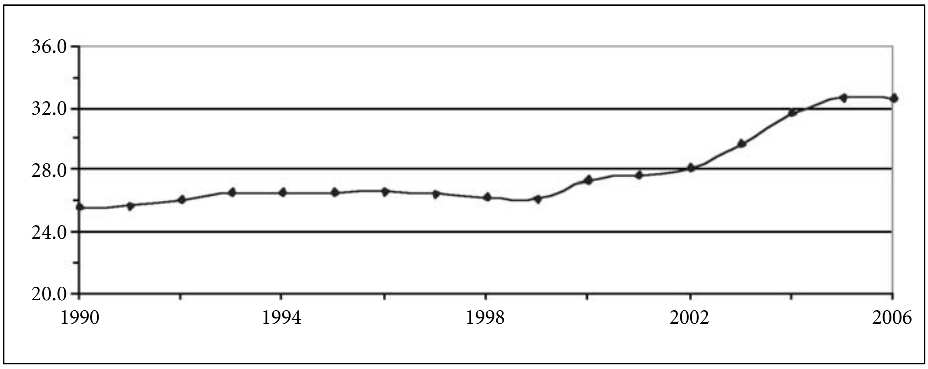

Figure 1. Average recycling age (all ships > 499 GT)

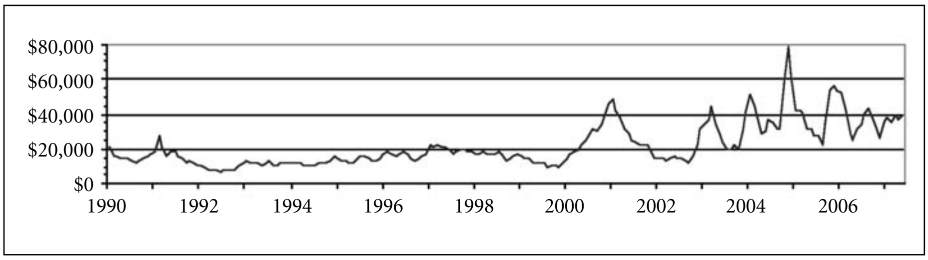

Figure 2. Tankers' weighted average earnings per day

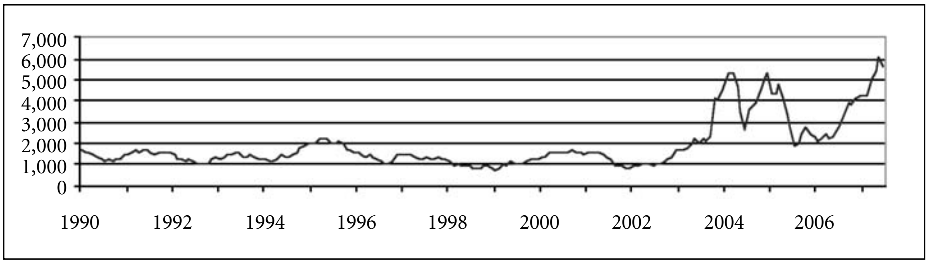

Figure 3. Baltic freight index (Jan 1985 = 1,000)

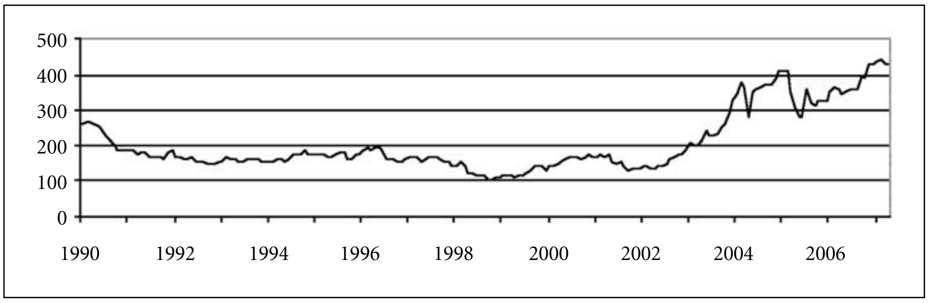

Figure 4. Dry cargo recycling prices in India

Notwithstanding the above comment on the phasing out of the single hull tanker fleet, the low volumes of ship recycling and the high average ages of the ships sent for recycling in recent times are explained to a great extent by the particularly buoyant state of the freight market in most shipping sectors as can be seen from Figure 2 which depicts the historic weighted average earnings of tankers and Figure 3 which charts the Baltic Freight Index for bulk carriers.

Low volumes of ship recycling at the present time as well as at the beginning of the period examined, have been accompanied by high recycling prices, as the data on Figure 4 show for unadjusted for inflation recycling prices for dry cargo ships. It is tempting to assume the existence of a direct correlation between freight markets and recycling prices. This assumption appears to be well supported by the general similarity of the shapes of the time series of freight and of recycling prices for dry cargo ships shown in Figures 3 and 4 respectively. Nevertheless, it would be wrong to assume that the shipping markets alone drive the recycling prices and to forget the effects of the local demand for ship scrap in each recycling market.

In this respect, Table 4 not only provides the latest information on recycling prices at the time this analysis was compiled but also underlines the price differentials that exist in four out of the five major recycling States (the fifth ship recycling State being Turkey where prices tend to be below those offered by China).

Table 4. Recycling prices at end of June 2007
(Source: GMS WEEKLY demolition newsletter, vol 62, issue 266 June 22 2007)

Ranking	Country	Market Sentiment	General Cargo Prices $/ldt	Tanker Prices $/ldt
1	Bangladesh	Positive	445	505
2	India	Positive	435	470
3	Pakistan	Positive	430	465
4	China	Neutral	245	300

It is natural to conclude that these price differentials reflect not only differences in labor and environmental costs for recycling ships but principally the different internal demand and therefore the different prices obtained by recyclers for ship steel in each of these different economies. It is noted as an example that the higher prices afforded by Bangladesh are supported by the higher utilization of ship steel for reuse after being processed in re-rolling mills, as compared to the other recycling countries where more of the steel scrap is re-melted in electrical furnaces for making new steel. The higher energy cost for re-melting the scrap steel drives its price down. It is also noted that the lower prices offered by Turkish recyclers attract mainly smaller European trading ships whose lower lightship does not cover economically the costs of the Suez canal transit and of the longer voyage to, say, India.

It is to be expected that not all major ship recycling States, nor all flag States, will become Parties to the new Convention immediately when it enters into force. It follows that after the entry into force of the new Convention there will be two distinct recycling markets, one for recycling Convention ships and a separate one for non-Convention ships. The relatively low cost for changing a ship's flag and the also modest cost for an existing ship to comply with the requirements of the Convention make it very likely that ships will be able to cross the Convention barrier in either direction, depending on the prevailing economic factors and also depending on the shipowners' exposure to societal environmental concerns. One could make some reasonable assumptions regarding which States would become Parties to the Convention when it enters into force. It may then be possible to construct an economic model of the two markets that will emerge and therefore to try and anticipate the supply and demand dynamics of recycling under the regime of the IMO Convention.

For the statistical analysis of recycled ships presented in Figure 1 and Table 3, all recycled ships were grouped together regardless of their size or type. It was also thought that it would be relevant to further analyze the effects of ship size and then of ship type on the average age and its standard deviation over the period examined. It was considered for example that smaller ships might yield different statistics compared to the larger ships and that ocean going bulk carrying ships might show distinctive statistical patterns.

Table 5 and Figure 5 present the results of the statistical analysis by ship size. It should be noted that the curves shown in Figure 5 do not include all ship size groups in order to reduce clutter on the graph.

What is quite clear from both the table and from the figure is that in addition to the overall recent increase in the operating life of the world fleet, smaller ships tend to have even longer operating lives. Also, the average operating life of ships of over 10,000 GT on average seems to have a standard deviation of around 5 years, which happens to be the interval period of one special survey. On the other hand small sized ships have a larger standard deviation and therefore a larger scatter in the ships' age at the time of recycling.

Table 6 and Figure 6 present the results of the additional statistical analysis which was conducted for the average ship age at recycling by ship type. It should be noted that in the interest of space and clarity, the table and the figure show only the main trading types of ships. The following assumptions have been used in grouping ship types here: Bulkers = bulk, ore and combination carriers; Tankers = crude, product, chemical, shuttle, bunker, water and wine carriers; Gas ships = LPG and LNG ships; Cargo ships = general cargo, refrigerated cargo, container, cement, ro-ro cargo and woodchip carriers; Passenger ships = passenger, cruise and passenger ro-ro ships. As expected, bulk carriers and tankers enjoy shorter lives when compared with cargo, gas and passenger ships and also when compared with the world fleet.

Table 5. Recycling statistics by ship size (ships > 499 GT)

Year of Recycling	500–1,499 GT		1,500–2,999 GT		3,000–4,999 GT		5,000–9,999 GT		10.000–19,999 GT		20,000+ GT	
	n	μ	n	μ	n	μ	n	μ	n	μ	n	μ
2006	96	36.5	50	34.6	46	32.7	49	33.6	77	30.0	68	28.1
2005	94	37.0	59	31.1	55	31.6	37	34.8	56	31.7	60	28.6
2004	133	36.1	91	33.3	86	29.8	105	30.8	106	30.4	94	28.5
2003	118	34.4	111	32.7	113	30.3	122	29.0	200	28.6	210	26.7
2002	57	31.9	68	32.9	51	31.6	98	28.4	240	27.0	226	26.2
2001	59	31.5	65	32.6	53	30.9	129	27.7	276	26.2	190	26.0
2000	52	31.9	67	31.1	62	29.6	135	26.4	229	26.5	161	25.5
1999	61	29.7	50	29.7	61	27.5	169	26.9	238	25.6	250	24.4
1998	65	27.9	75	29.1	63	27.3	157	26.6	247	25.5	194	24.9
1997	81	27.9	68	27.2	82	27.5	189	26.3	197	26.6	118	24.5
1996	79	28.2	97	27.6	91	28.0	108	27.8	164	26.3	133	23.8
1995	106	27.7	148	25.8	95	26.5	88	28.5	103	27.9	109	23.8
1994	79	29.7	129	26.4	68	28.3	151	29.2	137	25.3	130	22.5
1993	75	29.1	63	26.3	42	26.6	127	29.7	121	25.9	121	22.5
1992	80	30.3	56	26.5	39	26.1	95	27.0	85	24.7	95	23.0
1991	74	28.2	48	27.0	33	26.5	78	25.1	55	24.3	37	22.0
1990	46	29.1	30	24.8	32	25.7	67	25.4	37	24.5	19	21.9
Totals &σ	**1,355**	**31.4 10.6**	**1,275**	**29.2 7.4**	**1,072**	**28.7 7.0**	**1,904**	**28.0 7.4**	**2,568**	**26.7 5.4**	**2,215**	**25.1 4.3**

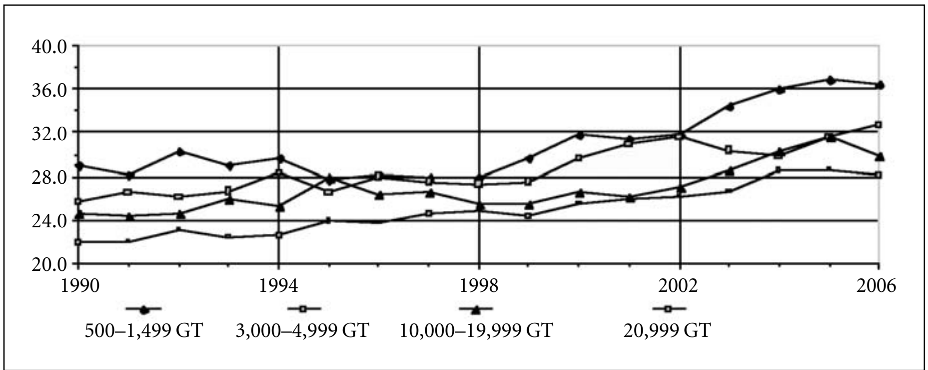

Figure 5. Average recycling age by ship size (all ships > 499 GT)

Figures 7, 8 and 9 present data on ships recycled by the leading five recycling States in the period 1990 to 2006. In particular, Figure 7 shows the number of ships of 500 GT and above recycled annually in each of the five countries while Figure 8 shows the volumes recycled annually in each of the same countries, expressed in terms of millions GT. Finally, Figure 9 shows the annual market share in terms of GT of each of the five major recycling States.

Table 6. Recycling statistics of major ship types (ships > 499 GT)

Year of Recycling	Bulkers n	Bulkers μ	Tankers n	Tankers μ	Gas ships n	Gas ships μ	Cargo ships n	Cargo ships μ	Passenger ships n	Passenger ships μ
2006	48	32.1	105	30.4	5	29.8	118	33.5	22	37.5
2005	20	33.3	131	31.2	8	31.3	47	33.5	42	35.8
2004	25	30.8	187	29.6	22	30.0	167	32.7	61	37.9
2003	102	27.4	275	28.6	20	29.1	307	29.9	41	37.2
2002	151	27.0	200	28.5	20	27.9	264	27.5	23	35.0
2001	194	26.6	136	27.8	9	30.3	328	27.2	22	35.0
2000	128	26.8	159	26.9	10	31.1	304	27.2	17	32.5
1999	222	24.8	129	25.4	8	31.9	356	26.3	14	33.9
1998	252	25.3	62	26.8	10	29.3	349	26.3	14	35.1
1997	160	25.1	61	27.0	15	28.9	333	26.2	16	35.9
1996	144	25.1	86	25.7	7	28.9	228	27.6	11	33.8
1995	54	26.8	124	26.0	4	28.0	165	29.1	13	34.0
1994	101	25.2	128	24.2	11	25.7	208	29.3	8	41.3
1993	80	24.9	132	23.9	13	26.4	188	28.5	10	30.8
1992	66	23.0	93	25.0	6	25.7	163	25.6	9	31.1
1991	33	22.6	44	27.3	2	30.5	147	25.5	8	30.1
1990	26	22.4	35	26.8	2	13.0	104	25.6	9	38.1
Totals &σ	**1,806**	**25.9** **5.4**	**2,087**	**27.4** **6.3**	**172**	**28.7** **3.9**	**3,776**	**27.8** **6.6**	**340**	**35.7** **9.2**

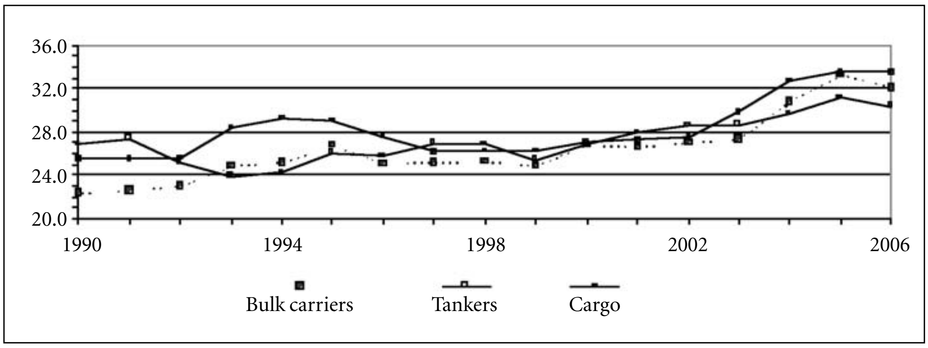

Figure 6. Average recycling age of major ship types (ships > 499 GT)

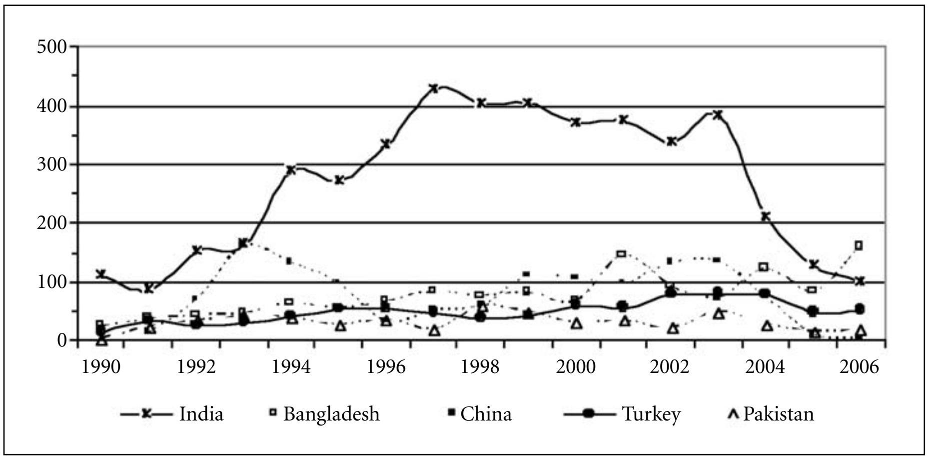

Figure 7. Leading recycling States in terms of ship numbers (ships > 499 GT)

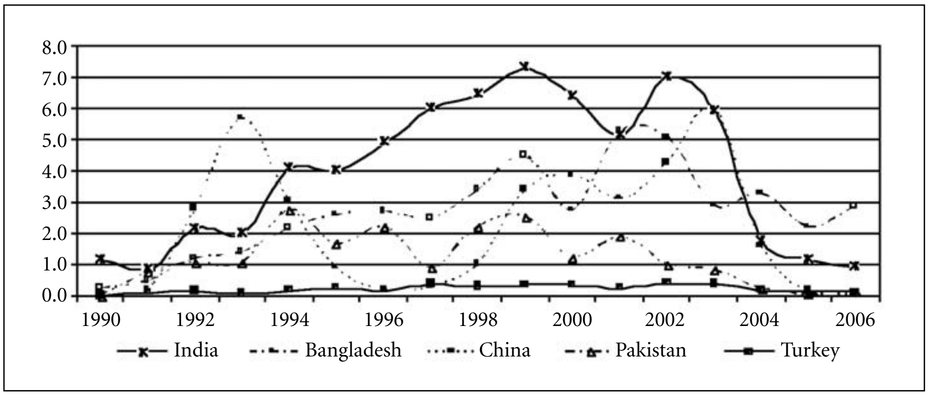

Figure 8. Leading recycling States in terms of tonnage (ships > 499 GT)

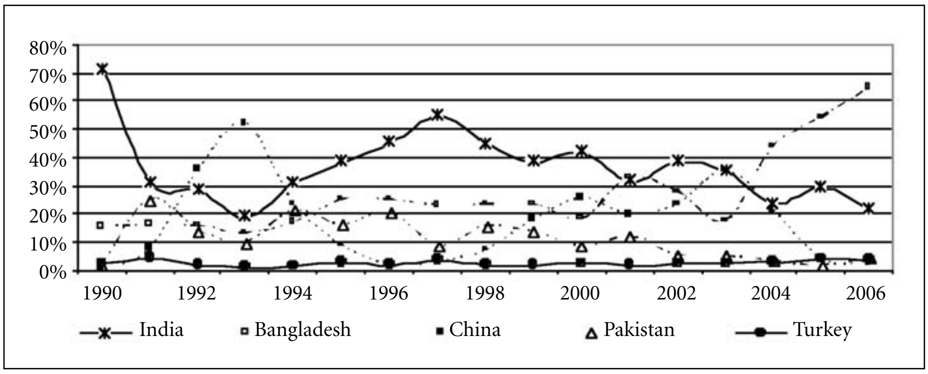

Figure 9. Market share of leading recycling States in terms of tonnage (ships > 499 GT)

A few matters are worth commenting on. The data on Table 3 and on Figures 7 and 8 show very large annual variations in the number and in the gross tonnage of recycled ships. Furthermore, Figures 7 and 8 show that the volumes recycled by the major recycling States vary, with quite dramatic annual fluctuations. Finally, Figure 9 shows that the fluctuations in market share of the five major recycling States are also very pronounced. The interested reader can observe as an example the performance of China, who from very little volume of ship recycling in the beginning of the period, twice became the world leader in terms of demolished gross tonnage (in 1993 and 2003), before dropping to very low volumes and market share in 2005.

5 Conclusions

This paper set out to provide statistical data with which, hopefully, to assist discussions at IMO on the development of the International Convention for the Safe and Environmentally Sound Recycling of Ships by clarifying and quantifying aspects of the ship recycling activity.

Having referred to the data on the world fleet, the paper attempted to define the likely magnitude of the fleet that could come under the scope of the new Convention and concluded on a likely maximum Figure of 42,000 to 45,000 ships, on the basis of the questionable assumption that the world fleet will not grow appreciably over the next few years. Then, the term lightship was defined and data were provided for making approximate estimates of the lightship of different ship types and sizes. Also discussed was how to make approximate estimates of the average annual demand for recycling under the regime of the new Convention. The paper then alerted its readers on what appear to be unavoidable reporting problems which create significant discrepancies in databases on ship recycling. As an example, by the beginning of 2007 the reported data on ships recycled in 1998 had increased by 18% in terms of gross tonnage and by 40% in terms of ship numbers when compared to the data that were first published at the end of 1998. Furthermore, differences also exist between the statistics published by the different commercial providers of maritime information.

Looking to statistics of recycled ships, the paper provided data for a 17 year period up to 2006 and included the number of ships recycled, their total gross tonnage, the average gross tonnage, the average age and the standard deviation of the age of the recycled ships. The paper noted the cyclical nature of the recycling market (no circular pun intended), the particularly low volumes of recycling experienced during recent years and the significant increase in the average age of recycled ships which from around 26–27 years old in the 1990s has presently risen to around 32 years. The low volume and high average age of recycled ships in recent times was explained to a great extent by the particularly buoyant state of the freight market in most shipping sectors. Furthermore, the available data appeared to underline the existence of a direct correlation between freight markets and recycling prices. Nevertheless, it was pointed out that the large price differentials that exist between different recycling markets indicate that it is not correct to assume that the shipping markets alone drive the recycling prices. It was concluded that price differentials reflect not only differences in labor and environmental costs for recycling ships but principally the different internal demand for ship steel and thus the different prices obtained by the recyclers in each different economy. Regarding the future, the paper noted that the entry into force of the new Convention will create two distinct recycling markets, one for Convention ships and one for non-Convention ships. It was suggested that it may be possible to construct an economic model of the two markets and thereby try to anticipate the supply and demand dynamics of recycling under the new regime.

In addition to the statistical analysis for the whole fleet the paper provided further analyses for the effects of ship size and of ship type on the average age and its standard deviation over the period examined. From these analyses the statistics underline that smaller ships tend to have longer operating lives. Also, the average operating life of ships of over 10,000 GT seems to have a standard deviation of around 5 years, which happens to be the interval period of one special survey. Regarding the effects of ship type on the statistics, the analysis shows that bulk carriers and tankers enjoy shorter lives compared with cargo, gas and passenger ships and also when compared with the average of the world fleet.

Finally, the data presented in the paper show very large annual variations in the total number and in the gross tonnage of recycled ships. Furthermore, the fortunes of recycling States vary quite dramatically over the period analyzed with highly pronounced annual fluctuations.

Acknowledgement

The views expressed in this paper are those of its author. They are intended to assist the ongoing discussions on the development of the International Convention for the Safe and Environmentally Sound Recycling of Ships and should not be taken as reflecting in any way the policies or views of IMO or of its Secretariat.

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