Chapter 8

8 Conversions between some different handicapping systems

There are basically two types of handicapping numbers. One is a number proportional to the speed of the boat in knots. LYS and IRC2000 are such numbers. The other is a number, which expresses the speed of the boat in seconds per nautical mile. IMS and ORC Club give such numbers. The first ones are inversely proportional to the second ones. PHRF numbers are also sec/mile, but you have to add about 530 sec/mile to PHRF to get IMS, so you cannot easily invert PHRF to get a number which is proportional to the speed in knots.

Between some of the systems there are fairly simple relationships for rule of thumb calculations. It should be emphasised, however, that the relationships derived below are average values, and there is a spread of values around the averages. For some of the boat types used in the comparisons between different systems, the measurements may vary slightly. The average relationships are believed to be useful.

8.1 LYS and IMS

Comparisons of LYS and IMSGPH numbers are shown in Table 8.1 and Figure 8.1. Since IMS is a sec/mile number and LYS is proportional to the boat speed in knots, IMSGPH as a function of LYS is a hyperbola. Therefore we analyse LYS as a function of 1/IMSGPH, which is supposed to be a straight line, in order to find the conversion ratio. This analysis gives the ratio 799.30, which we round off to 800, and get the formula

LYS = 800/IMSGPH or IMSGPH = 800/LYS Eq 8.1

The TCF calculated on the IMS certificate is

IMSTCF = 600/IMSGPH Eq 8.2

This gives

IMSTCF = 0.75*LYS or LYS = 1.333*IMSTCF. Eq 8.3

The standard deviation of the difference between LYS and LYS calculated from IMS is 0.019, so the fit is fairly good.

As you can see in the table and the figure, modern cruiser/racers like IMX 38, Beneteau 25, IMX 40, First 40.7 and X-362 Sport have LYS numbers considerably above the corresponding IMSGPH numbers. According to our experience they perform better than their IMS numbers, while many of the more traditional cruisers are slower than their IMS numbers. This observation is further discussed in chapter 8.9 below.

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Table 8.1 IMS GPH as a function of LYS

Boat type	LYS	IMSGPH	1/IMSGPH	IMS=f(L)	LYS=f(IMS)	L-L(IMS)
X-95	1.14	680.8	0.001469	700.6	1.173	-0.033
Omega 36	1.22	639.5	0.001564	654.7	1.249	-0.029
Comfortina 39	1.25	626.3	0.001597	639.0	1.275	-0.025
Excel 319	1.16	674.4	0.001483	688.5	1.184	-0.024
Carerra Helmsman	1.22	642.5	0.001556	654.7	1.243	-0.023
X-3/4	1.21	649.5	0.001540	660.1	1.230	-0.020
Lady Helmsman	1.16	677.5	0.001476	688.5	1.179	-0.019
Wasa 360	1.22	645.1	0.001550	654.7	1.238	-0.018
Joule 44	1.31	601.5	0.001663	609.7	1.328	-0.018
X-99	1.24	635.4	0.001574	644.1	1.257	-0.017
X-102	1.19	662.0	0.001511	671.2	1.206	-0.016
Omega 34	1.16	680.1	0.001470	688.5	1.174	-0.014
X-119	1.32	598.7	0.001670	605.1	1.334	-0.014
Wasa 410	1.29	613.2	0.001631	619.1	1.302	-0.012
Luffe 40	1.31	604.9	0.001653	609.7	1.320	-0.010
Maxi 95	1.07	740.0	0.001351	746.4	1.079	-0.009
Crown 39	1.26	629.8	0.001588	633.9	1.268	-0.008
Diva 39	1.25	635.6	0.001573	639.0	1.257	-0.007
Comfortina 38	1.26	631.9	0.001583	633.9	1.264	-0.004
Arcona 36	1.22	655.1	0.001526	654.7	1.219	0.001
Stratus	1.17	683.1	0.001464	682.6	1.169	0.001
Scanmar 33	1.13	707.6	0.001413	706.8	1.129	0.001
Wasa 38	1.23	650.4	0.001538	649.3	1.228	0.002
Contrast 36	1.20	668.0	0.001497	665.6	1.196	0.004
Facil 355 Xo	1.22	657.5	0.001521	654.7	1.215	0.005
Scampi	1.09	737.3	0.001356	732.7	1.083	0.007
Albin Nova	1.15	699.4	0.001430	694.5	1.142	0.008
Norlin 34	1.18	682.1	0.001466	676.9	1.171	0.009
X-442	1.36	591.6	0.001690	587.3	1.350	0.010
Mumm 36	1.35	596.9	0.001675	591.6	1.338	0.012
Diva 35	1.25	646.0	0.001548	639.0	1.236	0.014
Linjett 32	1.12	723.1	0.001383	713.1	1.105	0.015
X-332	1.23	657.9	0.001520	649.3	1.214	0.016
X-302 Mk II	1.17	692.3	0.001444	682.6	1.154	0.016
Linjett 35	1.18	686.5	0.001457	676.9	1.163	0.017
HR 34	1.18	686.7	0.001456	676.9	1.163	0.017
Linjett 33	1.17	694.0	0.001441	682.6	1.151	0.019
X-412	1.32	615.3	0.001625	605.1	1.298	0.022
IMX 38	1.32	616.5	0.001622	605.1	1.296	0.024
Beneteau 25	1.21	674.1	0.001483	660.1	1.185	0.025
IMX 40	1.37	597.5	0.001674	583.0	1.337	0.033
First 40.7	1.35	608.5	0.001643	591.6	1.313	0.037

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X-362 S	1.30	636.7	0.001571	614.4	1.254	0.046
Average	1.23		0.001534		STD	0.019
Conversion factor	799.30					

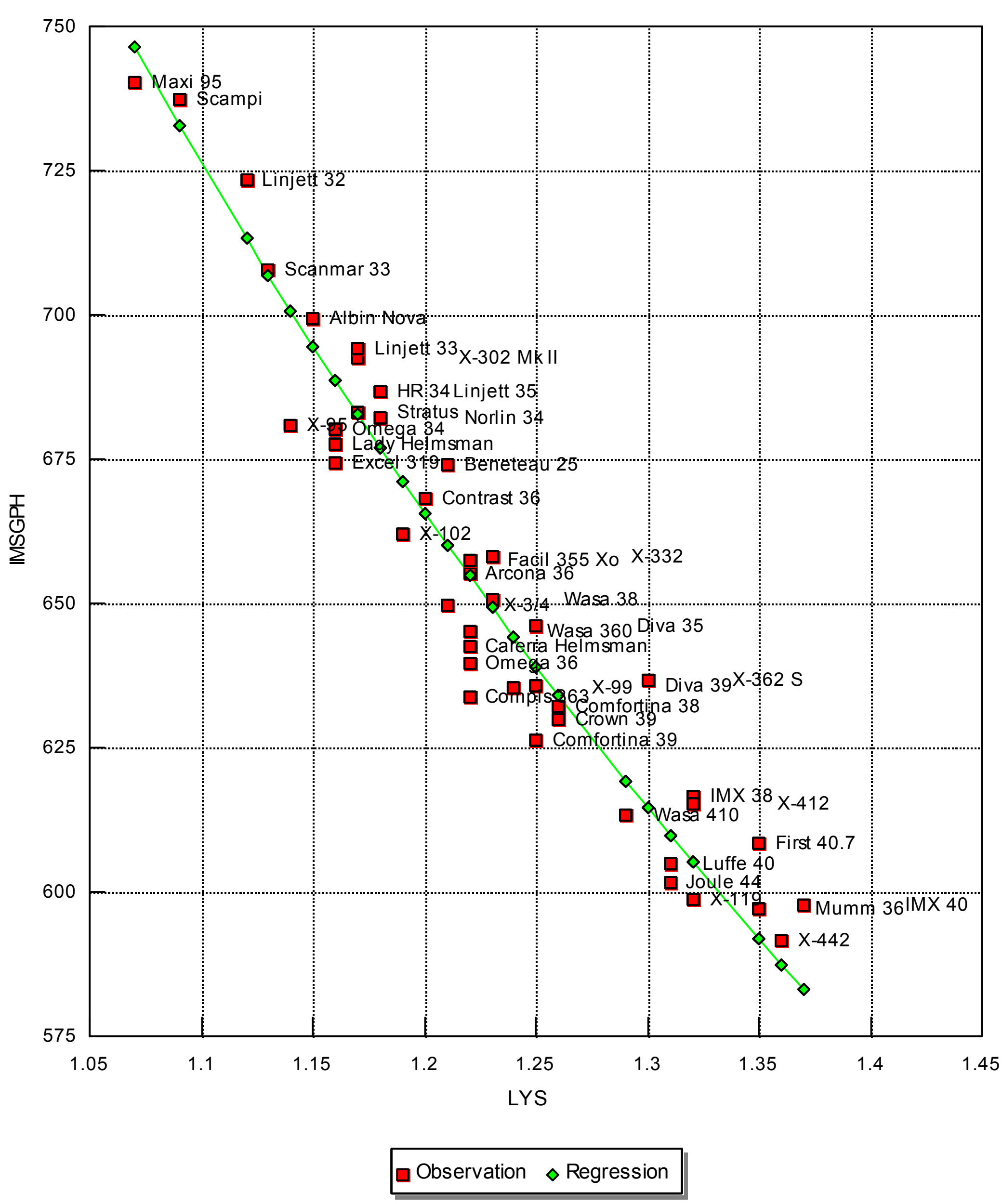

Figure 8.1 IMSGPH as a function of LYS

8.2 LYS and IR2000

Table 8.2 and Figure 8.2 show a comparison between LYS and IR2000.

Table 8.2 Comparison between IRC and LYS

Boattype	IRC	LYS	IRC=f(LYS)	LYS=f(IRC)	L-L(IRC)
Albin Ballad	0.875	1.08	0.8764	1.078	0.002
Albin Express	0.885	1.11	0.9007	1.091	0.019
Albin Nova	0.925	1.15	0.9332	1.140	0.010
Albin Vega	0.830	1.00	0.8114	1.023	-0.023
Aphrodite 29	0.900	1.11	0.9007	1.109	0.001
Banner 41	1.095	1.33	1.0792	1.349	-0.019
Bashford 41	1.143	1.42	1.1523	1.409	0.011
Bh 36	1.085	1.35	1.0955	1.337	0.013
Comfort 30	0.875	1.09	0.8845	1.078	0.012
Comfortina 32	0.920	1.14	0.9250	1.134	0.006
Comfortina 38	1.010	1.26	1.0224	1.245	0.015
Contessa 28	0.870	1.06	0.8601	1.072	-0.012
Contrast 33	0.915	1.16	0.9413	1.128	0.032
Dehler 31	0.910	1.12	0.9088	1.121	-0.001
Dehler 34	0.935	1.17	0.9494	1.152	0.018
Diva 39	1.025	1.25	1.0143	1.263	-0.013
Drabant 30	0.870	1.08	0.8764	1.072	0.008
Dragon	0.890	1.07	0.8682	1.097	-0.027
Dufour 2800	0.855	1.03	0.8358	1.054	-0.024
Eygthene 24	0.840	1.04	0.8439	1.035	0.005
Fastnet 34	0.910	1.13	0.9169	1.121	0.009
Finnfire 33	0.925	1.14	0.9250	1.140	0.000
First 25	0.855	1.05	0.8520	1.054	-0.004
First 35	0.940	1.18	0.9575	1.158	0.022
First 40,7	1.079	1.35	1.0955	1.330	0.020
First 47,7	1.138	1.41	1.1441	1.402	0.008
First Class 10	1.000	1.24	1.0062	1.232	0.008
First Class 8	0.935	1.16	0.9413	1.152	0.008
Folkboat	0.795	0.97	0.7871	0.980	-0.010
GK 24 M/H	0.850	1.03	0.8358	1.048	-0.018
Gk 29	0.885	1.11	0.9007	1.091	0.019
Grand Soleil 40	1.086	1.35	1.0955	1.338	0.012
Grinde 30	0.875	1.06	0.8601	1.078	-0.018
H Boat	0.835	1.07	0.8682	1.029	0.041
Hallberg Rassy 29	0.870	1.04	0.8439	1.072	-0.032
Hallberg Rassy 34	0.945	1.16	0.9413	1.165	-0.005
Hunter Sonata Od	0.835	1.01	0.8196	1.029	-0.019
IMX-38	1.070	1.32	1.0711	1.319	0.001
IMX-40	1.103	1.37	1.1117	1.359	0.011

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IOD	0.870	1.12	0.9088	1.072	0.048
J 105	1.030	1.29	1.0468	1.269	0.021
J 120	1.090	1.36	1.1036	1.343	0.017
Maxi 900	0.890	1.12	0.9088	1.097	0.023
Maxi 909	0.915	1.11	0.9007	1.128	-0.018
Maxi 999	0.930	1.15	0.9332	1.146	0.004
Melges 24od	1.020	1.28	1.0386	1.257	0.023
Monark 700	0.825	0.99	0.8033	1.017	-0.027
Mumm 36	1.110	1.35	1.0955	1.368	-0.018
Nicholson 33 R/C	0.935	1.14	0.9250	1.152	-0.012
Scampi	0.880	1.09	0.8845	1.084	0.006
Scanmar 33	0.915	1.13	0.9169	1.128	0.002
Scanmar 35	0.935	1.14	0.9250	1.152	-0.012
Shipman 28	0.860	1.04	0.8439	1.060	-0.020
Soling	0.920	1.14	0.9250	1.134	0.006
Sprinta Sport	0.850	1.05	0.8520	1.048	0.002
Sweden Yachts 36	0.985	1.21	0.9818	1.214	-0.004
Sweden Yachts C38	0.995	1.23	0.9981	1.226	0.004
Trapper 300	0.840	1.02	0.8277	1.035	-0.015
Tur 84	0.835	1.00	0.8114	1.029	-0.029
Ufo 27	0.870	1.05	0.8520	1.072	-0.022
Ufo 31	0.885	1.08	0.8764	1.091	-0.011
Ufo 34	0.925	1.13	0.9169	1.140	-0.010
X 1 Ton	1.075	1.30	1.0549	1.325	-0.025
X 102	0.970	1.19	0.9656	1.195	-0.005
X 119	1.085	1.32	1.0711	1.337	-0.017
X 302	0.945	1.17	0.9494	1.165	0.005
X 332	1.000	1.23	0.9981	1.232	-0.002
X 342 F/R	0.975	1.20	0.9737	1.202	-0.002
X 342 M/H	0.960	1.20	0.9737	1.183	0.017
X 362	1.005	1.25	1.0143	1.239	0.011
X 362 Sport	1.035	1.30	1.0549	1.276	0.024
X 372 M/H	0.985	1.26	1.0224	1.214	0.046
X 382 M/H	1.040	1.28	1.0386	1.282	-0.002
X 3/4t Mk2	1.000	1.21	0.9818	1.232	-0.022
X 402 M/H	1.025	1.28	1.0386	1.263	0.017
X 412	1.060	1.32	1.0711	1.306	0.014
X 442	1.105	1.36	1.1036	1.362	-0.002
X 482	1.125	1.38	1.1198	1.386	-0.006
X 95	0.940	1.14	0.9250	1.158	-0.018
X 99	1.010	1.24	1.0062	1.245	-0.005
SUM	76.234	94.02			0.017
Ratio	0.8108	1.233			

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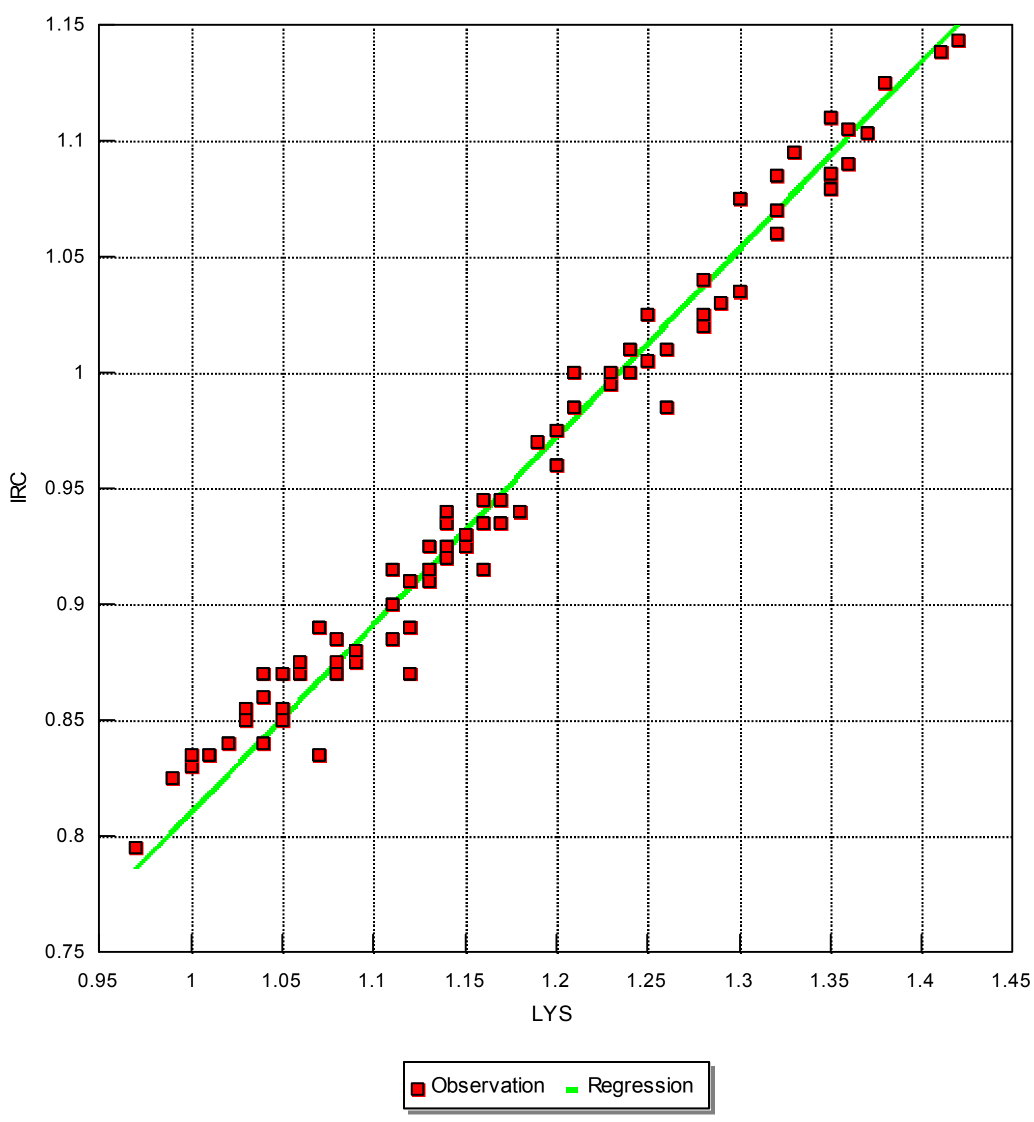
This gives

IRC = 0.8108*LYS or LYS = 1.233*IRC   Eq 8.4

Figure 8.2 illustrates the relationship between LYS and IRC. The number of boats is fairly large, so this comparison should give a very good idea of the relationship. The standard deviation of the LYS differences is 0.017, so the fit is fairly good. Generally speaking it is interesting how well the two systems fit, in spite of the fact that the method of estimating the numbers are completely different.

Figure 8.2 IRC as a function of LYS



8.3 LYS and PHRF

A corresponding comparison between LYS and PHRF numbers is shown in Table 8.3 and Figure 8.3. The PHRF numbers are weighted averages from Long Island Sound, New England, Northern California and SE Florida. The relationship is obtained by regression analysis of PHRF as a function of 1/LYS, since PHRF is expected to be a linear function of 1/LYS. As shown in the figure, PHRF as a function of LYS is not a straight line but a hyperbola. The largest difference between PHRF and LYS for these boats is 0.034 LYS. For most of the boats the differences are small. The standard deviation of LYS-LYS derived from PHRF is 0.017, so the fit is fairly good.

Table 8.3 PHRF as function of LYS						
Boat type	PHRF	LYS	1/LYS	PHRF(L)	L(PHRF)	L-L(PHRF)
1 ton new	57.0	1.33	0.752	61.18	1.340	-0.010
11 Meter	73.0	1.33	0.752	61.18	1.302	0.028
Ballad	184.5	1.08	0.926	186.45	1.083	-0.003
Cumulus	187.5	1.08	0.926	186.45	1.078	0.002
DB 1	120.0	1.19	0.840	124.85	1.200	-0.010
Finngulf 391	90.0	1.26	0.794	91.24	1.263	-0.003
Folkboat	252.0	0.97	1.031	262.03	0.983	-0.013
H 323	156.0	1.13	0.885	156.96	1.132	-0.002
H boat	190.5	1.07	0.935	192.68	1.073	-0.003
Haj	222.0	1.03	0.971	218.80	1.025	0.005
IMX 38	63.0	1.32	0.758	65.28	1.326	-0.006
Int folkboat	234.0	1.02	0.980	225.65	1.008	0.012
J/105	84.0	1.29	0.775	77.96	1.276	0.014
J/120	46.5	1.36	0.735	49.24	1.367	-0.007
J/80	114.0	1.23	0.813	105.18	1.212	0.018
J/92	101.0	1.23	0.813	105.18	1.239	-0.009
Luffe 44	57.0	1.34	0.746	57.14	1.340	-0.000
Maxi 77	240.0	1.03	0.971	218.80	1.000	0.030
Maxi 95	175.0	1.07	0.935	192.68	1.099	-0.029
Melges 24	95.3	1.28	0.781	82.32	1.251	0.029
Mumm 36	42.0	1.35	0.741	53.16	1.379	-0.029
Nova 33	159.0	1.15	0.870	145.88	1.126	0.024
Omega 36	117.0	1.22	0.820	109.97	1.206	0.014
Scampi	180.0	1.09	0.917	180.34	1.091	-0.001
Scampi 2	180.0	1.09	0.917	180.34	1.091	-0.001
Scampi 3	177.0	1.09	0.917	180.34	1.096	-0.006
Scampi 4	177.0	1.09	0.917	180.34	1.096	-0.006
Sigma 33	144.0	1.14	0.877	151.37	1.153	-0.013
Stratus	150.0	1.17	0.855	135.18	1.142	0.028
Swede 55	72.0	1.27	0.787	86.75	1.304	-0.034
Vega 27	242.0	1.00	1.000	239.77	0.997	0.003
Vindø 45	189.0	1.06	0.943	199.02	1.076	-0.016

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X 102	117.0	1.19	0.840	124.85	1.206	-0.016
X 372 FR	93.0	1.26	0.794	91.24	1.256	0.004
X 3/4 1	114.0	1.21	0.826	114.85	1.212	-0.002
X 3/4 2	111.0	1.21	0.826	114.85	1.218	-0.008
X 402	72.0	1.28	0.781	82.32	1.304	-0.024
X 99	114.0	1.24	0.806	100.46	1.212	0.028
					Standard deviation	0.017

This analysis gives

PHRF = 720/LYS - 480 or LYS = 720/(PHRF+480) Eq 8.5

LYS = 1.5 corresponds to PHRF = 0 and LYS = 1 corresponds to PHRF = 240.

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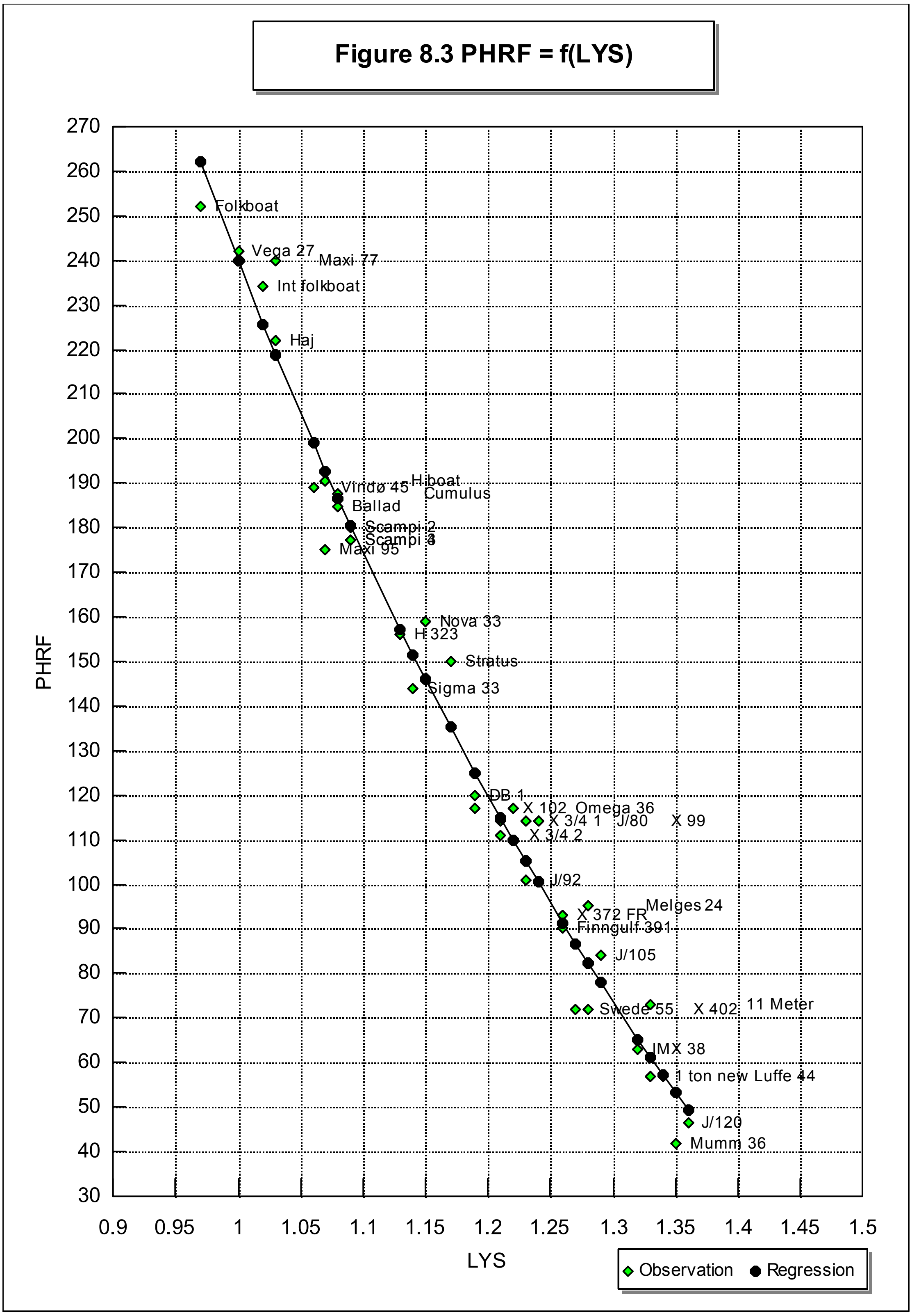

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8.4 LYS and DH

For comparison between LYS and DH I have chosen what in DH is called TACIRC, which corresponds to a circular random course. Table 8.4 and Figure 8.4 show this comparison.

Table 8.4 Comparison between LYS and DH2000 (2001 certificates)

Boat type	TACIRK	LYS	1/LYS	TACIRK=f(L)	L=f(DH)	L-L(DH)
606	622.7	1.03	0.971	619.44	1.03	0.005
806	585.6	1.09	0.917	582.15	1.08	0.006
Accent 28	601.2	1.03	0.971	619.44	1.06	-0.029
Albin Cumulus	591.6	1.08	0.926	588.08	1.07	0.006
Ballad	585.2	1.08	0.926	588.08	1.08	-0.005
Banner 30 u.mot	548.9	1.14	0.877	554.08	1.15	-0.010
Comfortina 32	558.7	1.14	0.877	554.08	1.13	0.009
Drabant 22	631.6	0.98	1.020	654.00	1.01	-0.032
Drabant 30 jern	576.8	1.08	0.926	588.08	1.10	-0.019
Drage	603.4	1.07	0.935	594.12	1.05	0.015
Express	576.6	1.11	0.901	570.62	1.10	0.010
Fenix	593.1	1.07	0.935	594.12	1.07	-0.002
Folkbåt	721.3	0.97	1.031	661.34	0.90	0.075
Grinde	590.1	1.06	0.943	600.27	1.08	-0.017
IF	658.8	1.02	0.980	626.08	0.97	0.047
Impala 27	563.2	1.12	0.893	565.01	1.12	-0.003
Knarr	670.6	1.03	0.971	619.44	0.96	0.072
L 23	607.3	1.02	0.980	626.08	1.05	-0.029
L29	580.4	1.08	0.926	588.08	1.09	-0.013
LA-krysser	594.0	1.02	0.980	626.08	1.07	-0.050
Larsen 28	557.6	1.13	0.885	559.50	1.13	-0.003
Luffe 37	511.0	1.23	0.813	509.30	1.23	0.004
Maxi 77 m.motor	611.3	1.03	0.971	619.44	1.04	-0.013
Maxi 95	579.3	1.07	0.935	594.12	1.09	-0.025
Melges 24	483.6	1.30	0.769	478.76	1.29	0.012
Shipman 28	592.8	1.04	0.962	612.93	1.07	-0.032
Soling	559.7	1.14	0.877	554.08	1.13	0.010
Vega	615.7	1.00	1.000	639.76	1.04	-0.036
X 79	553.3	1.14	0.877	554.08	1.14	-0.001
X 99	508.1	1.25	0.800	500.23	1.23	0.017
Yngling	640.2	1.01	0.990	632.85	1.00	0.011
				Standard deviation		0.028

Regression analysis of TACIRC and 1/LYS gives
TACIRC = -57.9 + 697.66/LYS or LYS = 697.66/(TACIRC + 57.9)   Eq 8.6
The standard deviation of the LYS differences in this analysis is 0.028, so the fit is not very good. This can also be observed in Figure 8.4.

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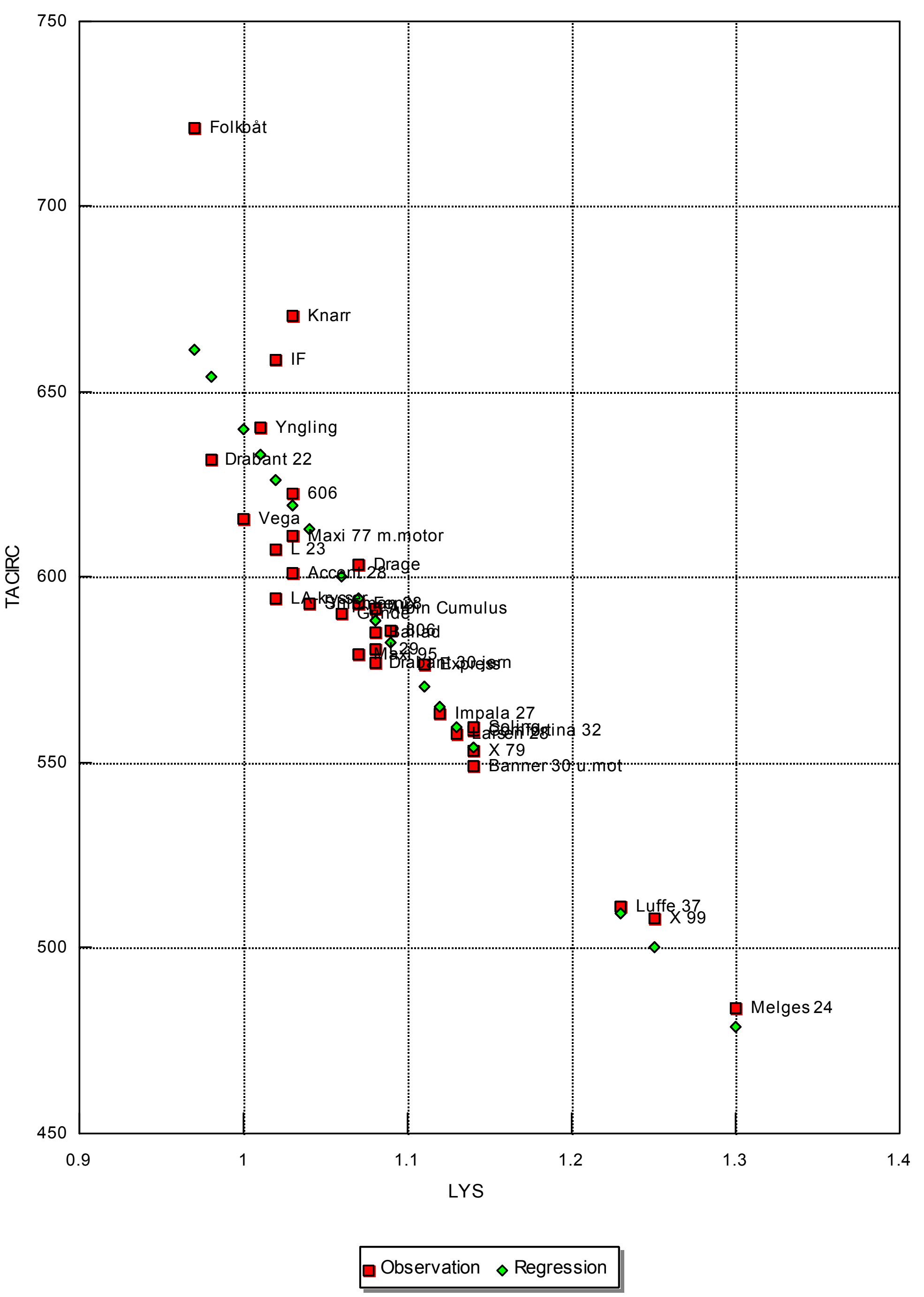
Figure 8.4 DH2002 as a function of LYS



8.5 LYS and Handicap National

For comparison between LYS and the French Handicap National, I have chosen to use the HN time-on-time coefficient, since it is supposed to be proportional to LYS. Table 8.5 shows the HN "Groupe" (without propeller), the Groupe corrected for propeller, the corresponding time-on-time coefficient and the LYS numbers. The ratio is

HN = 0.6907*LYS or LYS = 1.4478*HN   Eq 8.8

where HN is the time-on-time coefficient of Handicap National. The data and Eg 8.8 are shown in Figure 8.5. The standard deviation of the LYS differences is 0.013, so the fit is very good. This is to be expected since both HN and LYS are based on statistics where odd results are deleted.

Table 8.5 Handicap National as function of LYS

	HN	HN	HN	LYS	LYS	HN=f(L)	L=f(HN)	L-L(HN)
		prop.			prop.			
Boat type	GR	GR	t/t Coeff.					
11 meter	27.5	27.5	0.9070	1.33	-	0.9186	1.313	0.017
Albin Vega	8.0	7.5	0.6826	1.00	v	0.6907	0.988	0.012
Aphrodite 101	21.0	20.5	0.8180	1.17	v	0.8081	1.184	-0.014
Ballad	15.0	14.5	0.7548	1.08	v	0.7459	1.093	-0.013
Beneteau 25	21.5	21.0	0.8236	1.21	v	0.8357	1.192	0.018
Contention 30	16.5	16.0	0.7694	1.11	v	0.7667	1.114	-0.004
Contention 33	18.0	17.5	0.7847	1.14	v	0.7874	1.136	0.004
Contessa 32	14.0	13.5	0.7458	1.08	v	0.7459	1.080	0.000
Dehler Db1	22.0	21.5	0.8291	1.19	v	0.8219	1.200	-0.010
Dehler 31	16.0	15.5	0.7645	1.12	v	0.7736	1.107	0.013
Dehler 34	20.0	19.5	0.8069	1.17	v	0.8081	1.168	0.002
Dufour 2800	11.0	10.5	0.7187	1.03	v	0.7114	1.041	-0.011
Dufour 3800	15.0	14.5	0.7548	1.10	v	0.7598	1.093	0.007
Etap 22	5.0	5.0	0.6555	0.96	-	0.6631	0.949	0.011
Eyghtene 24	10.0	10.0	0.7125	1.04	-	0.7183	1.032	0.008
First 25	11.0	11.0	0.7250	1.05	-	0.7252	1.050	0.000
First 28 7/8	17.0	16.5	0.7743	1.12	v	0.7736	1.121	-0.001
First 28 MH	15.0	14.5	0.7548	1.09	v	0.7528	1.093	-0.003
First 32	19.0	18.5	0.7958	1.14	v	0.7874	1.152	-0.012
First 35	21.0	20.5	0.8180	1.18	v	0.8150	1.184	-0.004
First Class 10	25.0	24.5	0.8666	1.24	v	0.8564	1.255	-0.015
First Class 8	20.0	20.0	0.8125	1.16	-	0.8012	1.176	-0.016
Folkboat	8.0	8.0	0.6875	0.97	-	0.6700	0.995	-0.025
Gibsea 80 plus	12.0	12.0	0.7333	1.06	-	0.7321	1.062	-0.002
First 435	25.0	24.5	0.8666	1.26	v	0.8703	1.255	0.005
H-boat	10.5	10.5	0.7187	1.07	-	0.7390	1.041	0.029

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J24	16.5	16.5	0.7743	1.11	-	0.7667	1.121	-0.011
Nicholson 33	18.0	17.5	0.7847	1.14	v	0.7874	1.136	0.004
Norlin 34 mk 1	19.0	18.5	0.7958	1.15	v	0.7943	1.152	-0.002
Scampi	14.5	14.0	0.7500	1.09	v	0.7528	1.086	0.004
Selection 37	26.0	25.5	0.8800	1.26	v	0.8703	1.274	-0.014
Sigma 33	17.5	17.0	0.7792	1.14	v	0.7874	1.128	0.012
Ufo 27	13.0	12.5	0.7375	1.05	v	0.7252	1.068	-0.018
X-102	21.0	20.5	0.8180	1.19	v	0.8219	1.184	0.006
X-119	28.0	27.5	0.9070	1.32	v	0.9117	1.313	0.007
X-342 7/8	22.0	21.5	0.8291	1.20	v	0.8288	1.200	-0.000
X-342 MH	22.0	21.5	0.8291	1.20	v	0.8288	1.200	-0.000
X-372 7/8	24.0	23.5	0.8536	1.26	v	0.8703	1.236	0.024
X-402 MH	25.0	24.5	0.8666	1.28	v	0.8841	1.255	0.025
X412	28.5	28.0	0.9140	1.32	v	0.9117	1.323	-0.003
X-79	20.0	20.0	0.8125	1.14	-	0.7874	1.176	-0.036
X-95	18.0	17.5	0.7847	1.14	v	0.7874	1.136	0.004
X-99	24.0	23.5	0.8536	1.24	v	0.8564	1.236	0.004
		Sum	34.05	49.30				
		Ratio	0.6907			Standard deviation		0.013

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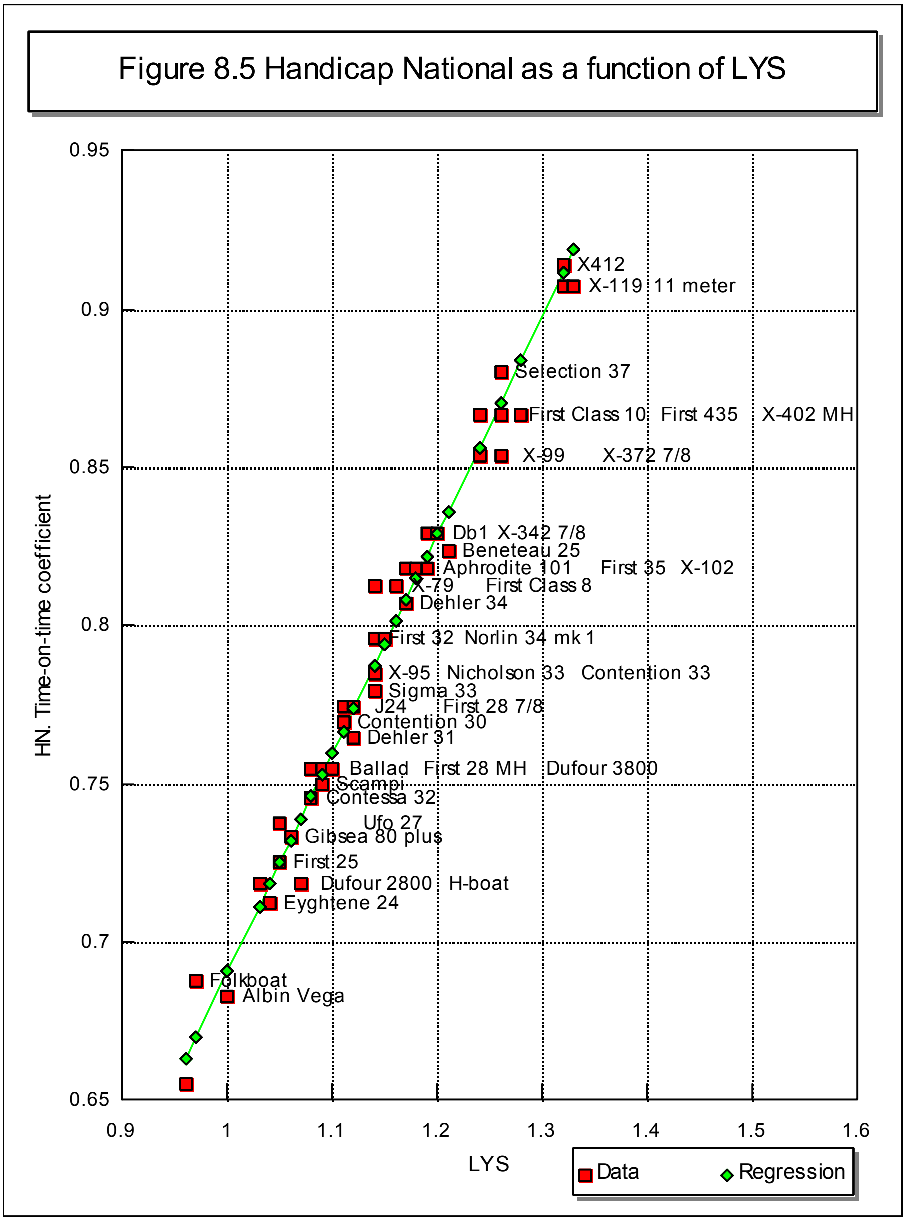

8.6 LYS and Portsmouth Yardstick

Table 8.6 and Figure 8.6 show the relationship between Portsmouth Numbers and LYS.
The relation is

PN = 1070/LYS or LYS = 1070/PN Eq 8.9

The standard deviation of the LYS differences is 0.023, so the fit is not very good.

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Table 8.6 Portsmouth Number as a function of LYS

Boat type	PN	1/PN	LYS	PN=f(LYS)	LYS=f(PN)	L-L(PN)
Albin Express	948	0.001055	1.11	964	1.129	-0.019
Albin Vega 27	1096	0.000912	1.00	1070	0.977	0.023
Ballad 30	996	0.001004	1.08	991	1.075	0.005
Contention 30	928	0.001078	1.11	964	1.153	-0.043
Contessa 28	1029	0.000972	1.06	1010	1.040	0.020
Contessa 32	994	0.001006	1.08	991	1.077	0.003
Db 1	880	0.001136	1.19	899	1.216	-0.026
Dufour 1800	1083	0.000923	1.03	1039	0.988	0.042
Eygthene 24	1070	0.000935	1.04	1029	1.000	0.040
First Class 8	920	0.001087	1.16	923	1.163	-0.003
Folkboat Nordic	1075	0.000930	1.00	1070	0.996	0.004
H Boat	1015	0.000985	1.07	1000	1.055	0.015
Hurley 22	1181	0.000847	0.90	1189	0.906	-0.006
Hustler Sj 30	937	0.001067	1.11	964	1.142	-0.032
J 24	936	0.001068	1.11	964	1.144	-0.034
Kelt 850	1016	0.000984	1.08	991	1.054	0.026
Kings Cruiser 29	1087	0.000920	1.02	1049	0.985	0.035
Maxi 84	1027	0.000974	1.04	1029	1.042	-0.002
Pandora 22	1127	0.000887	0.95	1127	0.950	0.000
Scampi 30	980	0.001020	1.09	982	1.092	-0.002
Shamrock 30	967	0.001034	1.09	982	1.107	-0.017
Sigma 33	923	0.001083	1.14	939	1.160	-0.020
Sonata	1038	0.000963	1.01	1060	1.031	-0.021
Trapper 300	1056	0.000947	1.02	1049	1.014	0.006
Ufo 27	1006	0.000994	1.05	1019	1.064	-0.014
Ufo 31	1000	0.001000	1.08	991	1.070	0.010
Ufo 34	956	0.001046	1.13	947	1.120	0.010
	Sum	0.026859	28.75	Standard deviation		0.023
		Ratio	1070			

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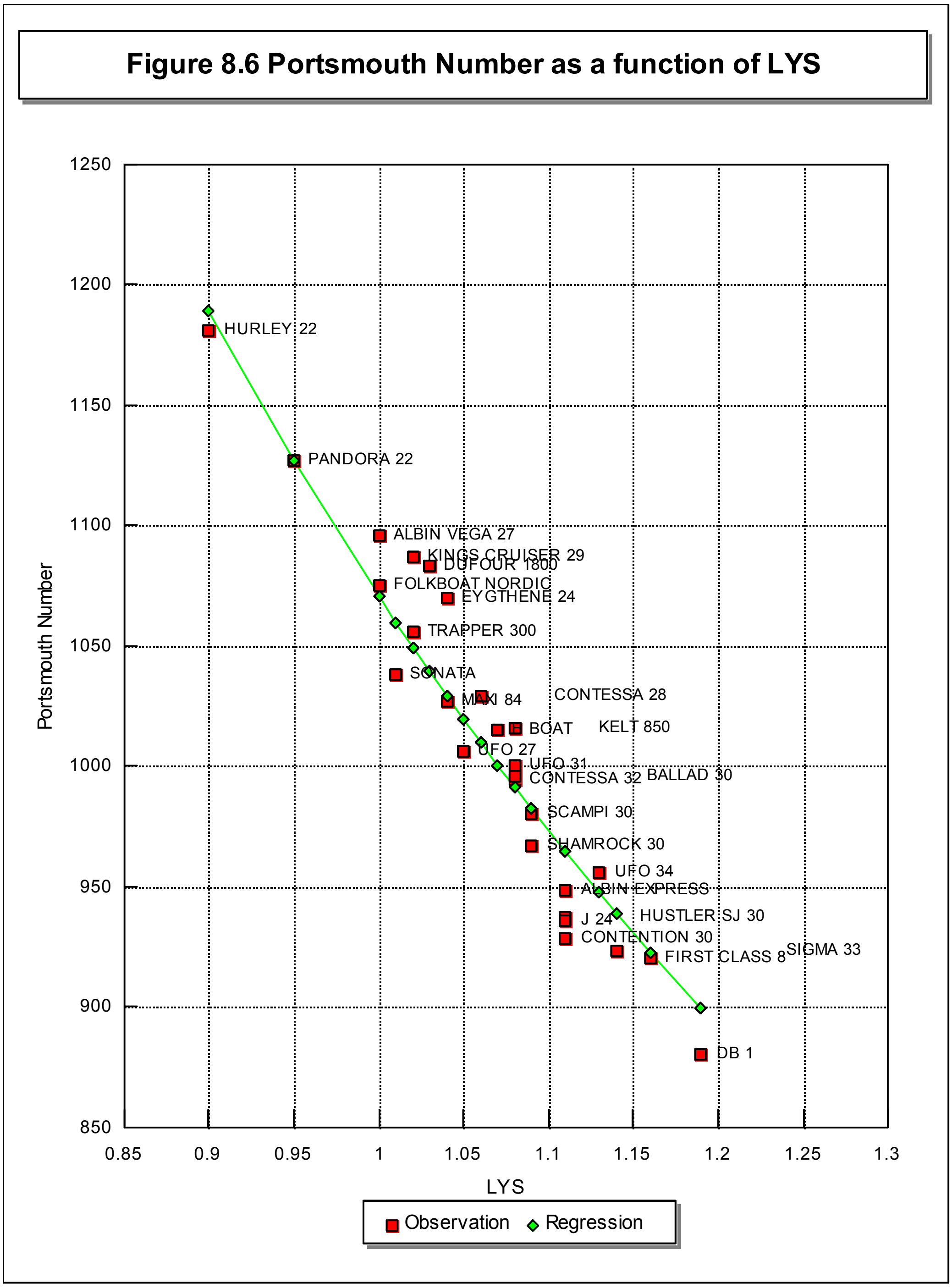
Figure 8.6 Portsmouth Number as a function of LYS
Portsmouth Number
LYS
1250
1200
1150
1100
1050
1000
950
900
850
0.85
0.9
0.95
1
1.05
1.1
1.15
1.2
1.25
1.3
HURLEY 22
PANDORA 22
ALBIN VEGA 27
KINGS CRUISER 29
DUFOUR 1800
FOLKBOAT NORDIC
EYGTHENE 24
TRAPPER 300
SONATA
MAXI 84
CONTESSA 28
BOAT
KELT 850
UFO 27
UFO 31
CONTESSA 32
BALLAD 30
SCAMPI 30
SHAMROCK 30
UFO 34
ALBIN EXPRESS
J 24
HUSTLER SJ 30
CONTENTION 30
FIRST CLASS 8
SIGMA 33
DB 1
Observation
Regression

8.7 LYS and YS Deutscher Segler-Verband

A comparison between the Yardstick YS of the Deutscher Segler-Verband is shown in Table 8.7 and Figure 8.7. The YS is to be used with no correction for boats of category A. These are boats they have large experience with. For other boats you use YS - 1. Therefore I have corrected the YS to the number used in races. The relationship is

$$YS = 113.5/LYS \text{ or } LYS = 113.5/YS \qquad \text{Eq 8.10}$$

The standard deviation of the differences between LYS and LYS as calculated from YS is 0.025, so the fit is not good. There are 7 yachts that have a considerably lower YS (sail faster) as compared to LYS. It seems that these numbers have been set very much on the safe side. If we omit these boats the standard deviation goes down to 0.016, which is fairly good.

Table 8.7 YS DSV as a function of LYS

Boattype	Cat	YS	YS Korr	LYS	L= f(YS)	YS=f(L)	L=f(YS)	L-L(YS)
Accent		111	110	1.03	0.9709	111	1.032	-0.002
Albin Alpha		105	104	1.10	0.9091	104	1.091	0.009
Albin Cirrus		110	109	1.03	0.9709	111	1.041	-0.011
Albin Cumulus		108	107	1.08	0.9259	106	1.060	0.020
Albin Delta		107	106	1.12	0.8929	102	1.070	0.050
Albin Express	A	105	105	1.11	0.9009	103	1.091	0.019
Albin Nova		103	102	1.15	0.8696	100	1.112	0.038
Albin Stratus		99	98	1.17	0.8547	98	1.157	0.013
Albin Vega	A	115	115	1.00	1.0000	115	0.996	0.004
Albin Viggen		118	117	0.97	1.0309	118	0.970	0.000
Amigo 27		113	112	0.94	1.0638	122	1.013	-0.073
Aprodite 101		97	96	1.17	0.8547	98	1.181	-0.011
Aprodite 29		104	103	1.11	0.9009	103	1.101	0.009
Aprodite 33		104	103	1.11	0.9009	103	1.101	0.009
Avance 33		103	102	1.14	0.8772	100	1.112	0.028
B 31		110	109	1.06	0.9434	108	1.041	0.019
Banner 30		100	99	1.14	0.8772	100	1.145	-0.005
Banner 41		86	85	1.33	0.7519	86	1.332	-0.002
BB 10		96	95	1.20	0.8333	95	1.193	0.007
Beason 31		108	107	1.09	0.9174	105	1.060	0.030
Bianca 111 MH		97	96	1.21	0.8264	95	1.181	0.029
Bianca 414		93	92	1.26	0.7937	91	1.231	0.029
Carrera Helmsman		92	91	1.22	0.8197	94	1.245	-0.025
Cayenne		91	90	1.26	0.7937	91	1.258	0.002
Comfort 32		103	102	1.11	0.9009	103	1.112	-0.002
Comfort 34		102	101	1.13	0.8850	101	1.123	0.007
Comfortina 32	A	103	103	1.14	0.8772	100	1.112	0.028
Comfortina 35		94	93	1.22	0.8197	94	1.218	0.002

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Comfortina 38		92	91	1.26	0.7937	91	1.245	0.015
Contessa 28		109	108	1.06	0.9434	108	1.051	0.009
Contrast 33		100	99	1.16	0.8621	99	1.145	0.015
Contrast 36		96	95	1.20	0.8333	95	1.193	0.007
Diva 39		94	93	1.25	0.8000	92	1.218	0.032
Drabant 22		110	109	0.98	1.0204	117	1.041	-0.061
Drabant 27		109	108	1.07	0.9346	107	1.051	0.019
Drabant 33		104	103	1.12	0.8929	102	1.101	0.019
Dufour 2800		111	110	1.03	0.9709	111	1.032	-0.002
Dynamic 35		90	89	1.28	0.7813	89	1.272	0.008
Dynamic 43		85	84	1.35	0.7407	85	1.347	0.003
Eyghtene 24		109	108	1.04	0.9615	110	1.051	-0.011
Finn express 83		107	106	1.07	0.9346	107	1.070	0.000
Finngulf 31		100	99	1.15	0.8696	100	1.145	0.005
Finngulf 33		97	96	1.19	0.8403	96	1.181	0.009
Finngulf 36		94	93	1.21	0.8264	95	1.218	-0.008
Finngulf 39		91	90	1.26	0.7937	91	1.258	0.002
First 28 MH		107	106	1.09	0.9174	105	1.070	0.020
First 32		104	103	1.14	0.8772	100	1.101	0.039
First 35		98	97	1.18	0.8475	97	1.168	0.012
First Class 8		101	100	1.16	0.8621	99	1.134	0.026
Forgus 321		105	104	1.11	0.9009	103	1.091	0.019
GK 24		109	108	1.03	0.9709	111	1.051	-0.021
Granada 23		112	111	1.03	0.9709	111	1.022	0.008
Granada 24		113	112	0.97	1.0309	118	1.013	-0.043
Granada 910		105	104	1.09	0.9174	105	1.091	-0.001
Great Dane 28		116	115	0.98	1.0204	117	0.987	-0.007
H 323		104	103	1.13	0.8850	101	1.101	0.029
Helmsman 23		110	109	0.98	1.0204	117	1.041	-0.061
Helmsman 31		107	106	1.09	0.9174	105	1.070	0.020
HR 26		111	110	1.02	0.9804	112	1.032	-0.012
IF	A	112	112	1.02	0.9804	112	1.022	-0.002
IMX 38		86	85	1.32	0.7576	87	1.332	-0.012
Inferno 29		100	99	1.14	0.8772	100	1.145	-0.005
Junker 22		119	118	0.89	1.1236	129	0.962	-0.072
Junker 26		115	114	1.00	1.0000	115	0.996	0.004
Knarr		111	110	1.03	0.9709	111	1.032	-0.002
Lady Helmsman		97	96	1.16	0.8621	99	1.181	-0.021
Larsen 28		100	99	1.13	0.8850	101	1.145	-0.015
LM 22		116	115	0.97	1.0309	118	0.987	-0.017
LM 24		129	128	0.86	1.1628	133	0.888	-0.028
LM 28		117	116	1.00	1.0000	115	0.979	0.021
Lord Helmsman		109	108	1.06	0.9434	108	1.051	0.009
Luffe 37		94	93	1.23	0.8130	93	1.218	0.012

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Luffe 40		89	88	1.31	0.7634	87	1.287	0.023
Luffe 43		86	85	1.34	0.7463	85	1.332	0.008
Malø 50		109	108	1.05	0.9524	109	1.051	-0.001
Mamba 34		101	100	1.14	0.8772	100	1.134	0.006
Maxi 100		108	107	1.05	0.9524	109	1.060	-0.010
Maxi 33		104	103	1.10	0.9091	104	1.101	-0.001
Maxi 68		121	120	0.95	1.0526	121	0.946	0.004
Maxi 77	A	114	114	1.03	0.9709	111	1.004	0.026
Maxi 95		108	107	1.07	0.9346	107	1.060	0.010
Mega 30		104	103	1.11	0.9009	103	1.101	0.009
Najad 343		107	106	1.07	0.9346	107	1.070	0.000
Nimbus 30		107	106	1.10	0.9091	104	1.070	0.030
Norlin 37		98	97	1.18	0.8475	97	1.168	0.012
OE 32		108	107	1.07	0.9346	107	1.060	0.010
Ohlson 22		114	113	0.99	1.0101	116	1.004	-0.014
Omega 34		99	98	1.16	0.8621	99	1.157	0.003
Omega 36		97	96	1.22	0.8197	94	1.181	0.039
Omega 42		94	93	1.25	0.8000	92	1.218	0.032
Scanmar 31		106	105	1.12	0.8929	102	1.080	0.040
Scanmar 33		101	100	1.13	0.8850	101	1.134	-0.004
Senorita Helmsman		99	98	1.07	0.9346	107	1.157	-0.087
Siesta 32		100	99	1.15	0.8696	100	1.145	0.005
Smiling		110	109	1.05	0.9524	109	1.041	0.009
Swede 38		94	93	1.21	0.8264	95	1.218	-0.008
Swede 55		89	88	1.27	0.7874	90	1.287	-0.017
Sylphe		113	112	0.93	1.0753	123	1.013	-0.083
Tabasco 26		101	100	1.13	0.8850	101	1.134	-0.004
Targa 96		107	106	1.08	0.9259	106	1.070	0.010
Trio 80		110	109	1.03	0.9709	111	1.041	-0.011
Trio 92		105	104	1.08	0.9259	106	1.091	-0.011
Ufo 34		103	102	1.13	0.8850	101	1.112	0.018
Vindø 30		114	113	1.00	1.0000	115	1.004	-0.004
Vindø 32		113	112	1.00	1.0000	115	1.013	-0.013
Vindø 45		108	107	1.06	0.9434	108	1.060	0.000
Winga 87		115	114	1.00	1.0000	115	0.996	0.004
X 119		86	85	1.32	0.7576	87	1.332	-0.012
X 412		87	86	1.32	0.7576	87	1.316	0.004
X 482		79	78	1.38	0.7246	83	1.449	-0.069
X 79	A	100	100	1.14	0.8772	100	1.145	-0.005
SUM			11385		100.3421		STD	0.025
Ratio			113.5					

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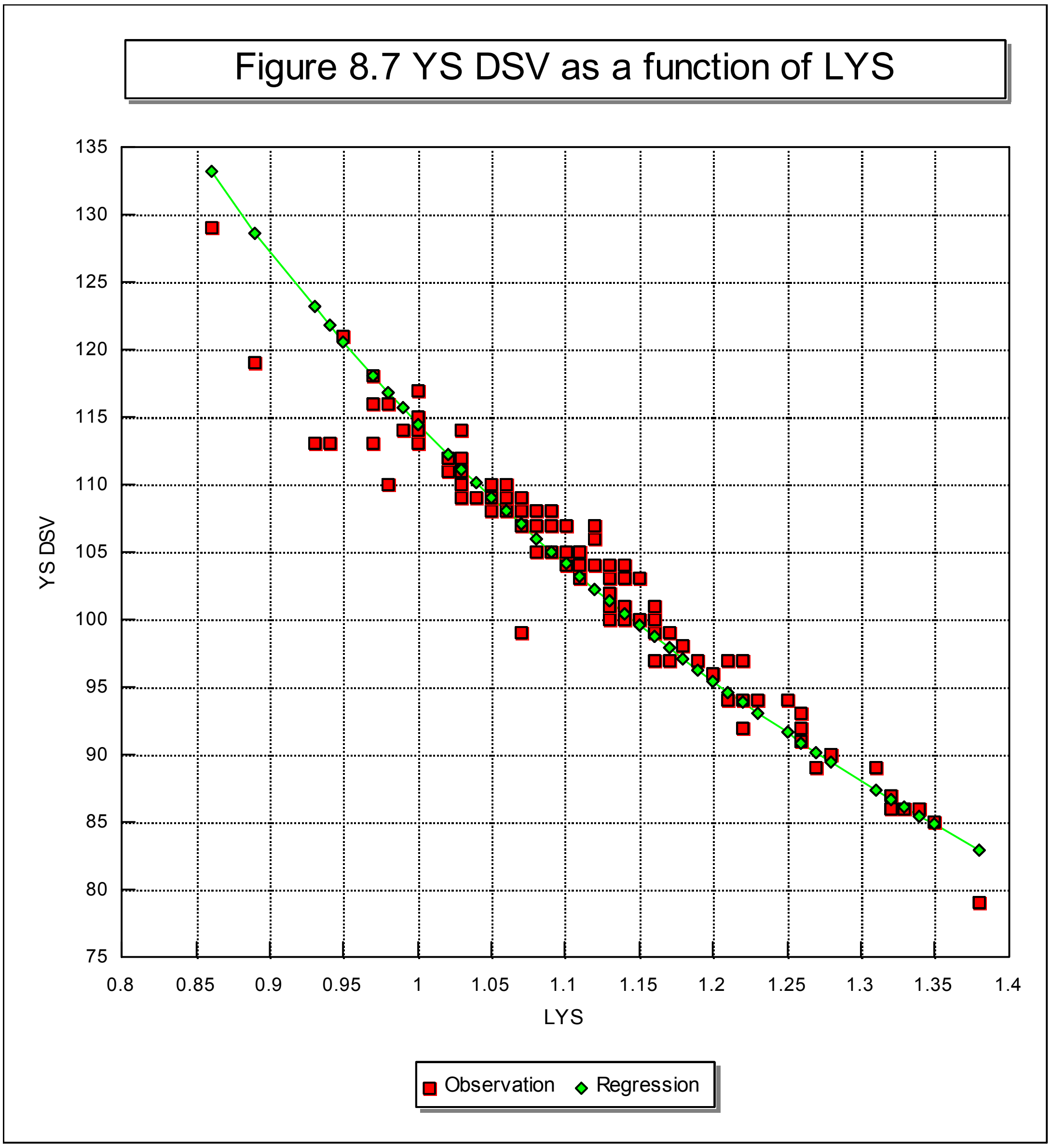

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8.8 Summary of relationships

Table 8.8 gives a summary of the relationships between all the handicapping numbers analysed here. DH here means TACIRC in the DH system. HN t-o-t means the time-on-time coefficient of HN. All relationships are based on the above mentioned analyses of LYS versus the other numbers. Therefore the relationships between the other numbers are less precise. All these relationships should be used with caution. They only represent averages for a limited number of boats within limited ranges, and there is a spread around the regression lines. See table 8.9. These functions should be regarded as rough estimates of the relationships. Handicapping numbers change over time, so the relationships are only valid for the year when the analysis was made. For the empirical handicapping numbers the changes from one year to another are marginal, but for the rule handicapping numbers the changes may be more substantial. IMS GPH has changed by a few seconds per mile every year over the last years, while DH had a fairly substantial change of up to 100 sec/mile from 2001 to 2002. Figure 8.8 shows the different handicapping numbers as functions of LYS.

Table 8.8 Conversions between some handicapping numbers

	LYS	**IRC**	**PHRF**	**DH TACIRC**	**IMSGPH**	**IMSTCF**	**HN t-o-t**	**PN**	**YS DSV**
LYS	1	1.233*IRC	720/ (P+480)	697.7/ (DH+57.9)	800/GPH	1.333*TCF	1.448*HN	1070/PN	113.5/YS
IRC	0.8108*L	1	583.8/ (P+480)	565.7/ (DH+57.9)	648.6/GPH	1.081*TCF	1.174*HN	867.6/PN	92.03/YS
PHRF	720/L -480	583.8/IRC -480	1	1.032* (DH+57.9) -480	0.9*GPH -480	540/TCF -480	497.3/HN -480	0.6729*PN -480	6.344*YS -480
DH	697.7/L -57.9	565.9/IRC -57.9	+0.9690* (P+480) -57.9	1	0.8721*GPH -57.9	+523.4/TCF -57.9	491.8/HN -57.9	0.6521*PN -57.9	6.147*YS-57.9
IMS GPH	800/L	648.6/IRC	(P+480)/ 0.9	1.147* (DH+57.9)	1	600/TCF	552.6/HN	0.7477*PN	7.048*YS
IMS TCF	0.75*L	0.9248*IRC	540/ (P+480)	523.3/ (DH+57.9)	600/GPH	1	1.086*HN	802.7/PN	83.65/YS
HN t-o-t	0.6907*L	0.8518*IRC	497.3/ (P+480)	481.9/ (DH+57.9)	552.6/GPH	0.9209*TCF	1	739/PN	78.38/YS
PN	1070/L	867.6/IRC	1.486* (P+480)	1.534* (DH+57.9)	1.338*GPH	802.7/TCF	739/HN	1	9.427*YS
YS DSV	113.5/L	92.03/IRC	0.1576* (P+480)	0.1627* (DH+57.9)	0.1419*GPH	83.65/TCF	78.38/HN	0.1061*PN	1

Table 8.9 Summary of analysed handicapping numbers

System	Year	Number of boats	Number ranges		LYS ranges		STD of LYS differences
			Smallest	Largest	Smallest	Largest	
HN	2001	43	0.7125	0.9140	0.96	1.33	0.013
IRC	2001	81	0.795	1.143	0.97	1.42	0.017
PHRF	2000	38	252.0	42.0	0.97	1.35	0.017
IMS	2001	44	740.0	591.6	1.07	1.37	0.019
PN	2001	28	1181	880	0.90	1.19	0.023

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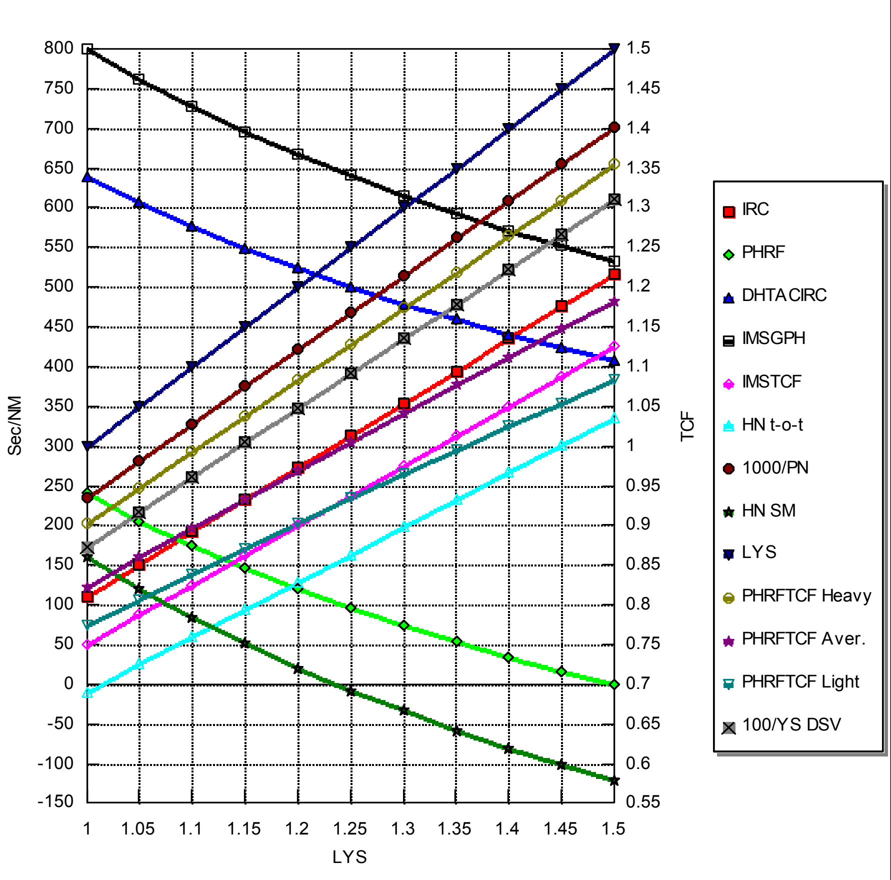
YS	2001	111	129	79	0.89	1.38	0.025
DH	2002	31	721.0	483.6	0.97	1.30	0.028

The different seconds/mile numbers of DH, PHRF, IMS and HN, show remarkably different slopes as functions of boat size. See Table 8.10 and Figure 8.9. This means that the different systems score smaller boats differently as compared to larger boats. If we assume that all systems are valid for average wind speeds, and look at it relative to the other systems, DH is more favourable for the larger boats, while PN is more favourable for the smaller boats. Another way of looking at it is that DH is more adapted to higher wind speeds, while PN is more adapted to lower wind speeds. DH gives a remarkably higher boat speed as compared to the other systems.

Figure 8.8 Some handicapping numbers as a function of LYS



On the other hand, all the TCF's of LYS, IR2000, HN, PHRF (Heavy air) and PH are proportional to each other, so time-on-time calculations give reasonably similar results. PHRF for Average and Light conditions favour larger boats as compared to the other systems. See Figures 4.2 and 8.8.

Table 8.10 Different systems favour smaller or larger boats or lower and higher wind speeds in time-on-distance calculations					
Handicapping system	LYS = 1.0	LYS = 1.5	Difference	Boats favoured in average wind speed	Best for wind speed
DH	639.8	407.2	232.6	Larger boats	Higher
PHRF	240.0	0.0	240.0		
IMS	800.0	533.3	266.7		
HN SM	161.0	-120.0	281.0	Smaller boats	Lower

Table 8.11 shows a comparison of handicapping numbers based upon the speed in knots. This comparison is based on the relationship between IMS and LYS: LYS = 800/GPH and knots = 3600/GPH, and does not correspond exactly to the definition of knots in the HN system. HN lists speeds in knots = 6.173*HNt-o-t, while Table 8.10 gives knots = 6.52*HNt-o-t, which is 5.6% larger than the listed HN speed. This difference may be due to an overestimating of speeds in the IMS system, or a lower average wind speed behind the HN observations. IMSGPH corresponds to 10 knots wind speed, and the HN observations may have a lower average wind speed. When the HN statistics are calculated, results in very strong, very light and irregular winds are deleted, and corrected times more than 7% larger than the first boat are also deleted. This procedure should result in average conditions behind the statistics, and fairly stable results. When considering the fact that HN is purely empirical and IMS purely theoretical, a 5.6% speed difference is fairly low. According to DH certificates, the ratings correspond to a wind speed of 6 m/sec, as compared to 10 knots for IMS, but this does not explain the very large differences of predicted boat speed shown in Figure 8.9.

Figure 8.9 Comparison between sec/mile numbers

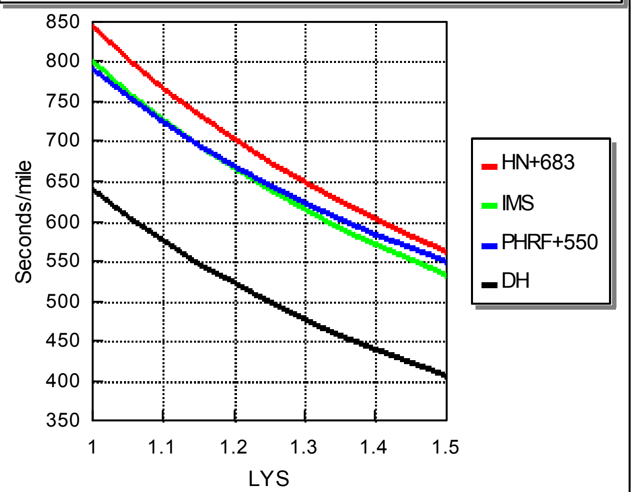


Table 8.11 Boat speed in knots for different handicapping systems	
System	**Boat speed in knots**
LYS	4.5*LYS
IR2000	5.57*IRC
HN	6.52*HNt-o-t
HN	3600/(683+SM)
PY	4815/PN

IMS	3600/GPH
IMS	6*TCF
PHRF	3240/(PHRF+480)
DH	3140/(TACIRK + 57.9)
YS DSV	511/YS

8.8 Variations of configurations and ratings

8.9 Modern boats as compared to older ones

When a handicapping number is estimated from IMSGPH, or other similar rules or formulas, for boats with limited statistics, the age of the design of the boat, the Series Date, becomes an important parameter. Figure 8.9 shows the differences between actual LYS numbers and the corresponding LYS from IMSGPH from the IMS certificates of a range of X-yachts. LYS from IMSGPH was calculated from Eg 8.1. Some of the scatter may be due to the fact that all LYS numbers are not necessarily correct. For example you may put a question mark on X-362, which seems to have a relatively high LYS rating, and X-512 may have a low rating. It is very clear, however; that there is a very pronounced increase of Difference = LYS-LYS(IMSGPH) as a function of Series Date. Regression analysis gives

Difference = 0.0353+0.00346*(Series Date-2000) Eq 8.10

This means that X-yachts have improved with 0.07 LYS, or about 5%, as compared to IMS over 20 years.

The reason is that like other designers the designers of X-yachts have become increasingly aware of the possibilities to design a boat that has a good performance as compared to the IMS rating. Some of the older boats, X-95, X-102, X-3/4, X402, X-1 ton and X-452, were designed according to the IOR rule and those boats do not get favourable IMS ratings. Other boats like X-79, X-99 and X-119, were designed as one-design boats with no regard to rules, and they also get a performance which is lower than the IMS rating. On the other hand modern racers and cruiser/racers like IMX-38, X-362 Sport, IMX-40 and IMX-45 are designed according to the IMS rule, and perform well above average as compared to their IMS ratings.

The designers of the IMS rule constantly try to fix loopholes, but the boat designers constantly try to circumvent the rule, and outperform the rule makers. Modern hull shapes, weight distributions, keels, rudders and rigs have become considerably more efficient over the last years. Therefore modern boats outperform older boats with the same overall dimensions. For example a few years ago designers realised that a deeper keel added more performance than increased rating, and the keels became deeper before the rule makers took action. Another example was the width of the mast. Designers found that wide mast profiles did not increase drag from wind forces as much as predicted by the coefficients built into the rule. When boats with very wide masts appeared the rule designers changed their coefficients in order to close this loophole. Recently it was found that it was advantageous to use a gennaker instead of a spinnaker, and the rule makers had to take immediate action with more restrictive gennaker rules in the middle of the sailing season of 2001. So there is a continuing struggle between designers and rule makers, and the designs gradually adjust to the rules. Therefore rules are always type-forming to a smaller or larger extent, even if rule makers try to avoid it. The recent trend is that IMS boats get large mainsails, fractional rigs and genoas which are smaller than 150% of J, the base of the fore triangle. There are two reasons for this. One is that in reality mainsails are more efficient than spinnakers downwind as compared to the rule, which overestimates the spinnaker forces. The other is that an overlapping genoa plus a mainsail is less efficient than the sum of the forces on each sail separately. The aft part of the genoa is less efficient than the forward part.

The 12 meters that earlier were used in the Americas Cup is a typical example. They were designed according to the R-meter-rule. Over the years the boats tended to get very particular forms and become very similar, and they obtained very close to optimum performance. The same happens with the modern Volvo Ocean racers, which are designed according to the Volvo Ocean 60 box rule, or the Americas Cup boats. They already tend to become very similar in shape and performance.

The first lesson learnt from Figure 8.10 is that IMS or other rules and formulas do not necessarily give the best guidance for people who set tentative empirical handicapping numbers, unless you take the age and type of the design into account. For new boats we have to set tentative numbers based upon IMS, other rules or formulas like NSURF based upon empirical numbers. Then we must take into account the fact that performance improves with Series Date, and we have to set new numbers on the safe side. When experience accumulates and we get more statistics of actual performance we can adjust the numbers. We often find that the theoretical rules do not necessarily give the best guidance. It must be said, however, that IMS is a very good rule, far superior to IOR, which it replaced. As an example an old 3/4-tonner like a Nicholson 33, which was a top boat in the middle of the 70's, has LYS = 1.14, while an X-3/4 ton designed about 10 years later has LYS = 1.21. This indicates that the X-3/4 ton is 6% faster than the Nicholson 33. Both these boats have the same IOR rating, but quite different IMS ratings.

The second lesson learnt from Figure 8.10 is that the IMS rule is not capable of rating old boats reasonably well as compared to new boats. The reason why the top IMS races seem to be "close and fair races", is that only new designs participate, but if you enter an IMS race with an IMX-38 today, you don't have a fair chance to beat an IMX-40. In my mind the IMS rule makers should look more to the statistics from races which are collected by the empirical handicappers. Or could it be true, as some people claim, that the design oriented people on the International Technical committee of the ORC don't like the idea that older

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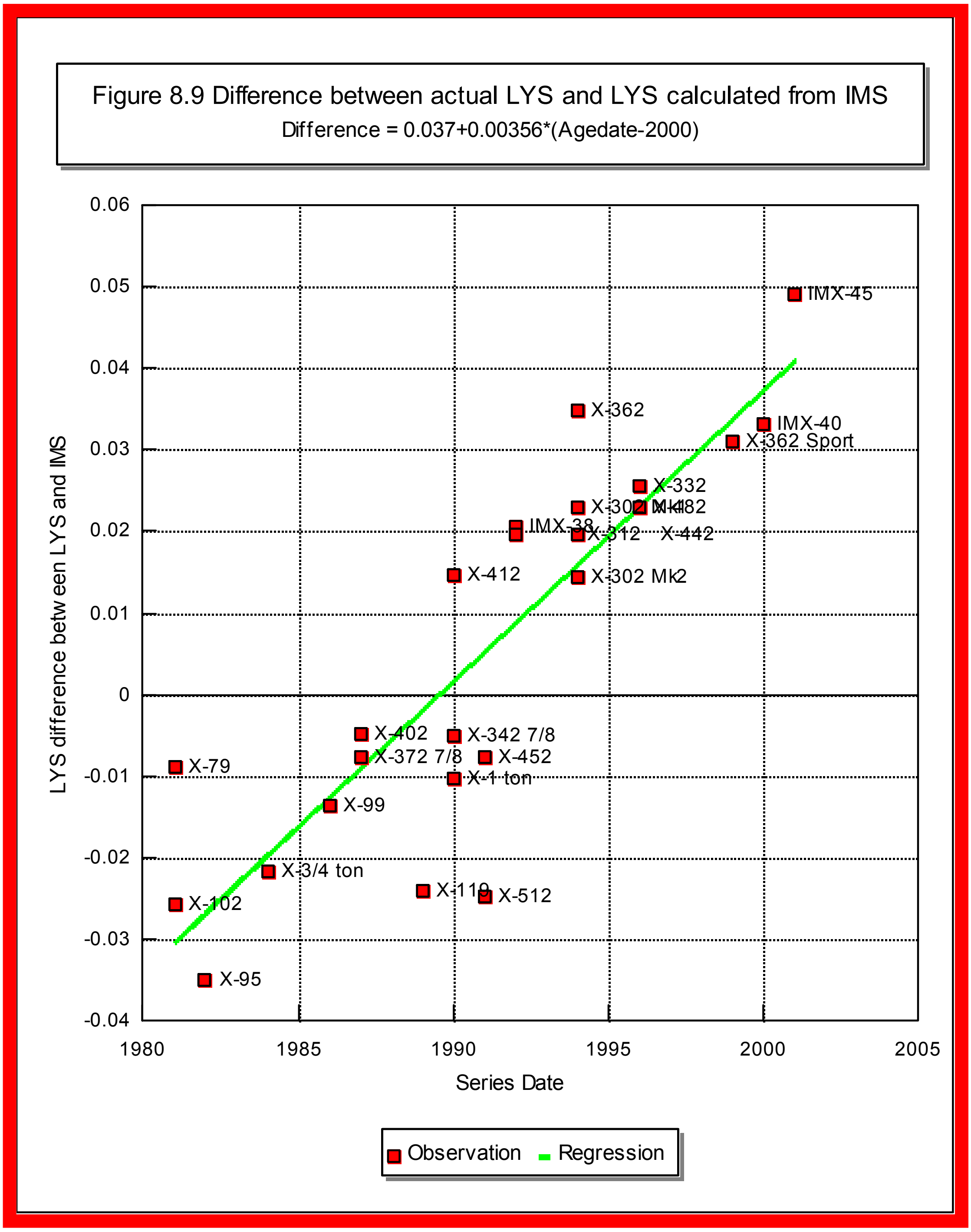
designs should have a fair chance to beat the newest designs?



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8.10 International co-operation for co-ordination of different handicapping numbers

From the comparisons between different handicapping systems given above, it is evident that there are similarities, but also marked differences. Would it be an advantage to obtain a certain co-ordination, in order to facilitate the utilisation of different ratings across borders?

First of all I think that the decentralised individual empirical handicapping systems that we have today should not be unified into one system. The decentralised administration is necessary in order to cater for local conditions, and to utilise the creativity of people around the world. On the other hand there are differences that are there for historical reasons, and which only cause confusion. See Table 8.11 and Figures 8.8 and 8.9. In fact it would be fairly straight forward to add 683 sec/mile to the SM ratings in the HN system, or to add about 550 sec/mile to the PHRF ratings. This would make life simpler, both for rule administrators, race managers and sailors.

Another issue is the range of parameters used to define a boat, and the terminology used in this connection. For example draft is an important parameter which is lacking in the LYS list, but it exists in HN, where it is denoted TIRANT. The luff of the jib is called GG in HN and T in LYS. The jib perpendicular is denoted LPG in HN and LP in LYS, in spite of the fact that both denote the measure of the sail. In IMS LPG denotes the sail measure, while LP denotes a rated perpendicular including forestay profile and leech roach. The length of the spinnaker pole is called TG in HN and SPL in LYS. The latter is in conformance with IMS. In LYS displacement is called DEPL and it is measured in tonnes of 1000 kg. In HN it is also called DEPL, but given in kg. The maximum width of the spinnaker is called SBR in LYS, but SMW in HN. The latter is in conformance with IMS. So there is a mixture of international and "private" definitions.

The only truly international handicapping system today is the IMS, so it would make sense to use the IMS definitions and notations as far as possible. It would also be practical to use ISAF's Equipment Rules of Sailing (ERS) as far as they are relevant. There is at least one problem, however, with the ERS. The height and base of the foretriangle is measured from the intersection of the mast and the "deck including any superstructure" in ERS, but this is not useful in IMS, where IG (height of genoa hoist) and ISP (height of spinnaker halyard) are measured from the sheer-line. It is necessary for a rule like IMS to measure from the sheer-line in order to calculate the heeling moments from the sails.

To co-ordinate the minimum list of parameters used to define a boat, and to choose common definitions and notations for these parameters should be a useful job for the Empirical Handicapping Committee of the ISAF.

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