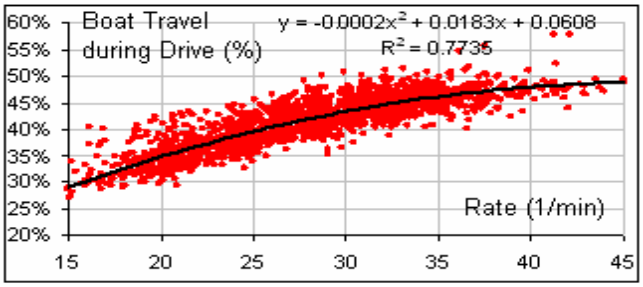
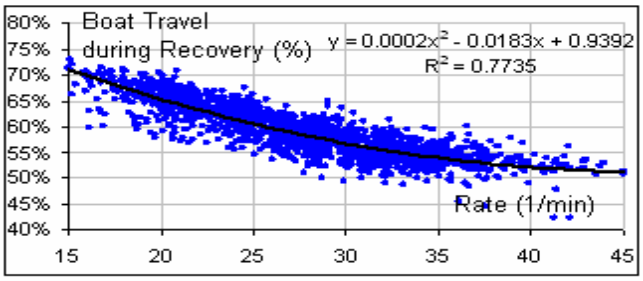
Q&A

Q: Australian coach Nick Garratt from Mosman rowing club, Sydney asked: "Can we use the ratio of distances, which the boat travelled during the drive and recovery phases as an indicator of power/efficiency of rowing technique?"

A: The distance of boat travel during the drive and recovery mainly depends on the duration of these phases. So, the ratio of the distances depends on ratio of times, i.e. rowing rhythm. We define rhythm as a ratio of the drive time to the total time of the stroke cycle (RBN 2003/03). Both rhythm and ratio of the distances are highly dependant on the stroke rate. Below are the trends of the distances, which the boat travels during the drive and recovery phases, taken as a percentage of the total distance per stroke cycle:





At the stroke rate below 20 str/min the boat travels only one third of the distance per stroke during the drive. At the stroke rates above 40 str/min this ratio is close to a half.

We tried to exclude influence of the stroke rate and analysed residuals from the trend, but didn't find any significant correlations of these two parameters with other biomechanical variables (forces, angles, power, etc.). The likely reason for it: a higher force/power increases the boat acceleration during the drive, but decreases the drive time, so the distance traveled remains the same.

Q: A number of coaches asked questions about relationship of performance on ergo and on water, which relates to rowing power and its utilisation. We already discussed rowing power (RBN 2002/01, 2004/06, 2004/09), but now try to review this issue again to make it clearer and more useful for coaches and rowers.

A: Using "ergo score" ***T*** r we can derive average "speed" ***v*** on ergo and then power ***P*** either directly from ergo monitor or using the equation

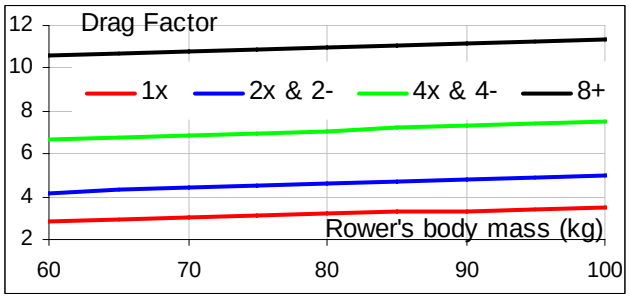
$$P = DFE * V^3 = DFE\ (2000 / T)^3$$

where ergo drag factor ***DFE = 2.8*** was defined quite reliably from statistics of ergo testing.

Then we need to determine what speed can be achieved in various boat types, providing that the rower applies the same power ***P*** to the handle of the oar. Only a part of total power ***P*** is delivered to the boat as a propulsive power ***Pprop***, so we need to adjust ***P*** using the blade propulsive efficiency ***Eb***. The equation for the boat speed is:

$$V = (Pprop / DFB)^{1/3} = (P * Eb / DFB)^{1/3}$$

where ***DFB*** is the drag factor of the boat type. Analysing our database we found that ***DFB*** depends on the rower's body mass (see also Table 1):



Blade propulsive efficiency varies in the various boat types and recursively depends on the boat speed and drag factor, which can make our model quite complicated. Therefore, we took only average value 81.6% for all boat types.

Calculated speed in the single corresponds quite well with the ergo score: say, **90kg sculler with ergo score 5:50 would show 6:38 on water (in neutral weather conditions and average rowing technique)**. However, in bigger boats we have got much faster speeds: e.g. an eight with average body mass 90kg and average ergo score 6:00 would be as fast as 5:06 on water. We already discussed this phenomenon in RBN 2005/11 in relation to the "Gold Times" and can speculate that in bigger boats a rower can not deliver the same power as he/she do on ergo, because of more difficult conditions (higher speed, synchronization, etc.). Therefore, for team boats we took their average relationship to the single, which was determined using the drag factors. Table 2 below presents this data for the rower's body masses 60, 70, 80, 90 and 100kg.

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Table1 .Functions of the drag factor on the rower's body mass in various boat types.

Boat	n	Equation DFB(Rower' Mass)	r
1x	366	y = 0.015750x + 1.930169	0.47
2x & 2-	566	y = 0.020972x + 2.931142	0.32
4x & 4-	388	y = 0.022704x + 5.270209	0.31
8+	115	y = 0.020116x + 9.363559	0.24

Table 2. Function of the boat speed on the ergo score for various rower's body mass.

Body mass (kg)= **60**

Ergo Score (min:sec)	Power (W)	Time 2000m on water (min:sec)					
		1x	**2x**	**4x**	**2-**	**4-**	**8+**
6:00	480	**6:29**	**5:59**	**5:35**	**6:11**	**5:37**	**5:22**
6:10	442	**6:40**	**6:09**	**5:44**	**6:21**	**5:47**	**5:31**
6:20	408	**6:50**	**6:19**	**5:53**	**6:32**	**5:56**	**5:40**
6:30	378	**7:01**	**6:29**	**6:03**	**6:42**	**6:06**	**5:49**
6:40	350	**7:12**	**6:39**	**6:12**	**6:52**	**6:15**	**5:58**
6:50	325	**7:23**	**6:49**	**6:21**	**7:03**	**6:24**	**6:07**
7:00	302	**7:34**	**6:59**	**6:31**	**7:13**	**6:34**	**6:16**
7:10	282	**7:44**	**7:09**	**6:40**	**7:23**	**6:43**	**6:25**
7:20	263	**7:55**	**7:19**	**6:49**	**7:34**	**6:52**	**6:34**
7:30	246	**8:06**	**7:29**	**6:59**	**7:44**	**7:02**	**6:43**
7:40	230	**8:17**	**7:39**	**7:08**	**7:54**	**7:11**	**6:52**
7:50	216	**8:27**	**7:49**	**7:17**	**8:04**	**7:21**	**7:01**
8:00	203	**8:38**	**7:59**	**7:26**	**8:15**	**7:30**	**7:10**
8:10	190	**8:49**	**8:09**	**7:36**	**8:25**	**7:39**	**7:19**
8:20	179	**9:00**	**8:19**	**7:45**	**8:35**	**7:49**	**7:28**

Body mass (kg)= **70**

Ergo Score (min:sec)	Power (W)	Time 2000m on water (min:sec)					
		1x	**2x**	**4x**	**2-**	**4-**	**8+**
5:50	522	**6:25**	**5:56**	**5:31**	**6:07**	**5:34**	**5:19**
6:00	480	**6:36**	**6:06**	**5:41**	**6:18**	**5:43**	**5:28**
6:10	442	**6:47**	**6:16**	**5:50**	**6:28**	**5:53**	**5:37**
6:20	408	**6:58**	**6:26**	**6:00**	**6:39**	**6:03**	**5:46**
6:30	378	**7:09**	**6:36**	**6:09**	**6:49**	**6:12**	**5:55**
6:40	350	**7:20**	**6:46**	**6:19**	**7:00**	**6:22**	**6:05**
6:50	325	**7:31**	**6:57**	**6:28**	**7:10**	**6:31**	**6:14**
7:00	302	**7:42**	**7:07**	**6:38**	**7:21**	**6:41**	**6:23**
7:10	282	**7:53**	**7:17**	**6:47**	**7:31**	**6:50**	**6:32**
7:20	263	**8:04**	**7:27**	**6:57**	**7:42**	**7:00**	**6:41**
7:30	246	**8:15**	**7:37**	**7:06**	**7:52**	**7:09**	**6:50**
7:40	230	**8:26**	**7:47**	**7:15**	**8:03**	**7:19**	**6:59**
7:50	216	**8:37**	**7:58**	**7:25**	**8:13**	**7:28**	**7:08**
8:00	203	**8:48**	**8:08**	**7:34**	**8:24**	**7:38**	**7:17**
8:10	190	**8:59**	**8:18**	**7:44**	**8:34**	**7:48**	**7:27**
8:20	179	**9:10**	**8:28**	**7:53**	**8:45**	**7:57**	**7:36**

Body mass (kg)= **80**

Ergo Score (min:sec)	Power (W)	Time 2000m on water (min:sec)					
		1x	**2x**	**4x**	**2-**	**4-**	**8+**
5:50	522	**6:31**	**6:02**	**5:37**	**6:13**	**5:40**	**5:24**
6:00	480	**6:42**	**6:12**	**5:47**	**6:24**	**5:49**	**5:34**
6:10	442	**6:54**	**6:22**	**5:56**	**6:35**	**5:59**	**5:43**
6:20	408	**7:05**	**6:33**	**6:06**	**6:45**	**6:09**	**5:52**
6:30	378	**7:16**	**6:43**	**6:16**	**6:56**	**6:18**	**6:01**
6:40	350	**7:27**	**6:53**	**6:25**	**7:07**	**6:28**	**6:11**
6:50	325	**7:38**	**7:04**	**6:35**	**7:17**	**6:38**	**6:20**
7:00	302	**7:49**	**7:14**	**6:44**	**7:28**	**6:48**	**6:29**
7:10	282	**8:01**	**7:24**	**6:54**	**7:39**	**6:57**	**6:39**
7:20	263	**8:12**	**7:35**	**7:04**	**7:50**	**7:07**	**6:48**
7:30	246	**8:23**	**7:45**	**7:13**	**8:00**	**7:17**	**6:57**
7:40	230	**8:34**	**7:55**	**7:23**	**8:11**	**7:26**	**7:06**
7:50	216	**8:45**	**8:06**	**7:33**	**8:22**	**7:36**	**7:16**
8:00	203	**8:57**	**8:16**	**7:42**	**8:32**	**7:46**	**7:25**
8:10	190	**9:08**	**8:26**	**7:52**	**8:43**	**7:55**	**7:34**

Body mass (kg)= **90**

Ergo Score (min:sec)	Power (W)	Time 2000m on water (min:sec)					
		1x	**2x**	**4x**	**2-**	**4-**	**8+**
5:40	570	**6:26**	**5:57**	**5:33**	**6:09**	**5:35**	**5:20**
5:50	522	**6:38**	**6:08**	**5:42**	**6:20**	**5:45**	**5:30**
6:00	480	**6:49**	**6:18**	**5:52**	**6:30**	**5:55**	**5:39**
6:10	442	**7:00**	**6:29**	**6:02**	**6:41**	**6:05**	**5:49**
6:20	408	**7:12**	**6:39**	**6:12**	**6:52**	**6:15**	**5:58**
6:30	378	**7:23**	**6:50**	**6:22**	**7:03**	**6:25**	**6:07**
6:40	350	**7:34**	**7:00**	**6:31**	**7:14**	**6:34**	**6:17**
6:50	325	**7:46**	**7:11**	**6:41**	**7:25**	**6:44**	**6:26**
7:00	302	**7:57**	**7:21**	**6:51**	**7:35**	**6:54**	**6:36**
7:10	282	**8:08**	**7:32**	**7:01**	**7:46**	**7:04**	**6:45**
7:20	263	**8:20**	**7:42**	**7:11**	**7:57**	**7:14**	**6:54**
7:30	246	**8:31**	**7:53**	**7:20**	**8:08**	**7:24**	**7:04**
7:40	230	**8:43**	**8:03**	**7:30**	**8:19**	**7:34**	**7:13**
7:50	216	**8:54**	**8:14**	**7:40**	**8:30**	**7:43**	**7:23**
8:00	203	**9:05**	**8:24**	**7:50**	**8:40**	**7:53**	**7:32**

Body mass (kg)= **100**

Ergo Score (min:sec)	Power (W)	Time 2000m on water (min:sec)					
		1x	**2x**	**4x**	**2-**	**4-**	**8+**
5:30	623	**6:21**	**5:52**	**5:28**	**6:03**	**5:30**	**5:16**
5:40	570	**6:32**	**6:03**	**5:38**	**6:14**	**5:40**	**5:25**
5:50	522	**6:44**	**6:13**	**5:48**	**6:25**	**5:50**	**5:35**
6:00	480	**6:55**	**6:24**	**5:58**	**6:36**	**6:00**	**5:44**
6:10	442	**7:07**	**6:35**	**6:08**	**6:47**	**6:10**	**5:54**
6:20	408	**7:18**	**6:45**	**6:18**	**6:58**	**6:20**	**6:03**
6:30	378	**7:30**	**6:56**	**6:27**	**7:09**	**6:31**	**6:13**
6:40	350	**7:41**	**7:06**	**6:37**	**7:20**	**6:41**	**6:23**
6:50	325	**7:53**	**7:17**	**6:47**	**7:31**	**6:51**	**6:32**
7:00	302	**8:04**	**7:28**	**6:57**	**7:42**	**7:01**	**6:42**
7:10	282	**8:16**	**7:38**	**7:07**	**7:53**	**7:11**	**6:51**
7:20	263	**8:28**	**7:49**	**7:17**	**8:04**	**7:21**	**7:01**
7:30	246	**8:39**	**8:00**	**7:27**	**8:15**	**7:31**	**7:10**
7:40	230	**8:51**	**8:10**	**7:37**	**8:27**	**7:41**	**7:20**
7:50	216	**9:02**	**8:21**	**7:47**	**8:38**	**7:51**	**7:30**
8:00	203	**9:14**	**8:32**	**7:57**	**8:49**	**8:01**	**7:39**