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INTERCALIBRATION OF ACOUSTIC SYSTEMS ONBOARD R/V "JOHAN HJORT" AND R/V "PINRO"

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ABSTRACT

Inter-ship calibration is a comparison between integrator output of two or more ships sailing over the same fish aggregations. Although it is a relative measurement, it is highly desireable whenever research vessels work together on acoustic surveys. It is used to verify results of absolute calibrations and may also elucidate possible ship effect on abundance estimates.

An inter-ship calibration between two cooperative research are presented and the results discussed with respect to difference in performance.

INTRODUCTION AND METHOD

The intercalibration was carried out on the evening of 23 March 1991 on a 54 n.mi. track between positions 5130N, 1400W and 5140N, 1258W.

R/V "JOHAN HJORT" was sailing in front and R/V "PINRO" followed 0.5 n.mi. behind and 10 degrees to the starboard side (Fig 1). The cruising speed was approximately 9 knots. The intercalibration was performed on varying consentrations of blue whiting between 400 - 600 depth, but densities of plankton and smaller fish in the upper layers were included.

The equipment and the settings of the instruments were the same as during the joint survey, for details see Table 1.

Integration were done in four channels and the settings were:

Ch	1	100 - 200 m
Ch	2	300 - 400 m
Ch	3	400 - 500 m
Ch	4	500 - 600 m

The channels width on R/V "PINRO" were 99 m.

The navigational log counter onboard R/V "JOHAN HJORT" was used as a reference of distance, and the integrator reset function on R/V "PINRO" was operated for each nautical mile sailed, promted by signals transmitted on VHF-radio.

The weather conditions were favourable during the entire performance.

ANALYSIS AND RESULTS

A detailed analysis of the recording papers from both vessels was done onboard R/V "JOHAN HJORT" by scientists from both vessels. The recordings on each nautical mile were scrutinized and compared. Data from miles where the two vessels had obtained different recordings were deleted from further processing. The integrator values for all channels are shown in Table 2, where the deleted data are marked with an asterisk.

As it can be seen from this table, the values corresponds well, except perhaps for the second and the fourth channel, where there was a tendency for R/V "PINRO" to have lower values. A possible reason for this is a difference in threshold -R/V "JOHAN HJORT" had recorded much more plankton and small organisms than R/V "PINRO" in these channels, and the voltage response of EK500 is higher than EK400/SIORS. But the effect of different thresholding have not been considered to be a severe problem during this blue whiting survey, because in most cases signals from blue whiting consentrations are higher than the threshold level of the echo sounding systems.

Results of the linear regression, using the equation:

$$S_{A_{J.Hjort}} = A * S_{A_{Pinro}} + B$$

are shown in Table 3. In Figure 2, the integrator values for all four channels, as well as total values, are displayed in succession for each n.mi. sailed. A distribution diagram, where the values of R/V "PINRO" are plotted against the corresponding values of R/V "JOHAN HJORT", are shown i Figure 3. The analysis show a reasonable good correlation for channel 1, 2, 3 and for total values, but correlation between values in the fourth channel was lower. This is believed to be due to different TVG functioning, when the depth was more than 500 m. Therefore, 5 extremal points were deleted from this channel during the analysis. However, the arithmetical mean of the integrator values in the fourth channels for all 54 points, gives the same relationship as the regression analysis where the 5 extremals were deleted.

CONCLUSION AND RECOMMENDATIONS

After detailed discussions between the Norwegian and Soviet scientists, the conclusion is that the small differences in the observed integrator values is probably mainly due to difference in equipment properties. Small density variations in the detected layers may also hav affected the results. It is therefore recommended that the following relationship should be used for the integrator output obtained during the spring 1991 blue whiting survey :

$$S_{A_{J.Hjort}} = S_{A_{Pinro}}$$

For future cooperative surveys, however, it is strongly recommended that vessels should use equipment with similar properties to avoid inaccurencies as described above. It is imperative that the instruments are properly calibrated before the survey starts, preferably by the standard reference target method. The gain and threshold settings should, as far as possible, also be the same on all participating vessels.

REFERENCES

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Foote K.G., Knudsen H.P., Vestnes g., Brede R. and Nielsen R.L. 1981. Improved calibration of hydroacoustic equipment with copper spheres. ICES CM1981/B:20, 18 pp (mimeo).

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Table 1.

INSTRUMENT CHARACTERISTICS

	"Johan Hjort"	"Pinro"
Echo sounder	SIMRAD EK500	SIMRAD EK400
Frequency	38 kHz	38 kHz
Transducer type	ES38B/split-beam	30x30 cm ceram.
" beam	7.1 x 7.1 degr.	8 x 8 degr.
Transmitter power (nom.)	2000 W	2500 W
Range compensation	20 log R	20 log R
Attenuation		0 dB
Pulselength/Bandwidth	1.0 ms/3.8 kHz	1.0 ms/3.3 kHz
Basic range	0 - 500 m	0 - 500 m
Threshold	- 82 dB	- 74 db//1W
Absorption	10 dB per km	8.5 db per km
Sound speed	1470 m per sec.	1491 m per sec
Integrator	BEI/EK500	SIORS
Threshold	- 82 dB	- 48 dB//1W (VR 63 mV)
Gain (output reference)	40 dB	10 dB

Absolute calibration:

	"Johan Hjort"	"Pinro"
Date	16.03.91	09.03.91
Reference target	-33.6 (Cu60)	-34.1
Instrument constant (Ci)		3.26
Sv transducer gain	26.9	
TS " "	27.1	
2-way beam angle	-21.0	-20.4

Table 2.

INTEGRATOR DATA

n.m. No	CHANNEL 1 100-200 m PINRO	HJORT	CHANNEL 2 300-400 m PINRO	HJORT	CHANNEL 3 400-500 m PINRO	HJORT	CHANNEL 4 500-600 m PINRO	HJORT	TOTAL 100-600 m PINRO	HJORT
01	5	4	109	154	466*	308*	230*	604*	810*	1070*
02	7	1	76	135	412	329	237*	407*	732	872
03	1	1	37*	132*	296	308	231*	608*	565*	1049*
04	1	1	24	28	250	298	306	323	581	650
05	3	1	22	28	282	277	308	265	615	571
06	1	1	31	34	227	242	137	126	396	403
07	1	1	20	14	246	227	155	153	422	395
08	3	2	41	54	175	153	94	84	313	293
09	1	1	33	30	145	180	100	91	279	302
10	24	24	89	103	138	138	163	79	414	344
11	47	48	175	171	103	73	91	76	416	368
12	110	93	43	41	152	152	172	183	477	469
13	210	383	26	34	209	270	258	286	803	973
14	4	17	28	32	247	353	402	464	683	866
15	3	1	50	63	235	322	503	634	791	1020
16	3	1	33	37	183*	347*	449*	767*	668*	1152*
17	2	1	86	97	134	169	381*	602*	603*	869*
18	3	1	114	157	162	198	383	483	662	839
19	3	1	89	138	193	215	342	417	627	771
20	4	2	94	97	126	163	307	389	531	651
21	3	2	66	80	101	149	246	280	416	511
22	16	22	75	99	156	127	172	143	419	391
23	7	6	41	85	343	417	256	265	647	773
24	11	7	38	35	266	330	198	202	513	574
25	28	28	69	87	268	268	100	62	465	445
26	38	26	57	55	165	184	121	90	381	355
27	53	57	32	24	139	137	118	65	342	283
28	42	49	50	55	161	166	150	141	403	411
29	35	37	88	79	150	207	159	163	432	486
30	26	24	40	47	169	185	153	135	388	391
31	10	11	43	45	188	200	134	128	375	384
32	19	11	51	44	242	213	116	127	418	395
33	8	11	36	30	235	262	123	108	402	411
34	25	18	19	25	259	248	110	130	413	421
35	17	16	18	19	324*	191*	128	92	487	318
36	11	9	15	14	64	73	103	99	193	195
37	6	6	6	6	65	51	32	25	109	88
38	4	4	4	4	43	42	38	20	89	70
39	5	4	11	8	66	54	85	97	167	163
40	1	4	8	6	116	128	310	312	435	450
41	1	4	10	8	47	65	229	273	287	350
42	2	2	7	6	93	110	280	280	382	398
43	2	3	9	8	316	476	365	375	692	862
44	4	2	9	10	992	904	458	405	1463	1321
45	14	7	5	7	374	372	478	360	871	746
46	19	10	9	10	152	163	265	314	445	497
47	14	26	18	18	143	154	219	215	394	413
48	34	31	10	9	178	142	131	153	346	335
49	7	12	11	12	304	272	131	123	450	419
50	13	16	11	14	210	251	359	288	586	569
51	47	36	10	13	112	143	329	322	498	514
52	257*	157*	9	12	142	145	238	202	628	516
53	577	500	25	11	73	107	236	220	731	840
54	941*	377*	124*	55*	223	294	186	166	1474*	892*

Table 3.

LINEAR REGRESSIONS

Channel	A	B	Corr.
1	0.97	2.0	0.95
2	1.20	-1.5	0.95
3	0.93	29.5	0.95
4	1.09	-20.9	0.93
Total	1.03	4.6	0.94

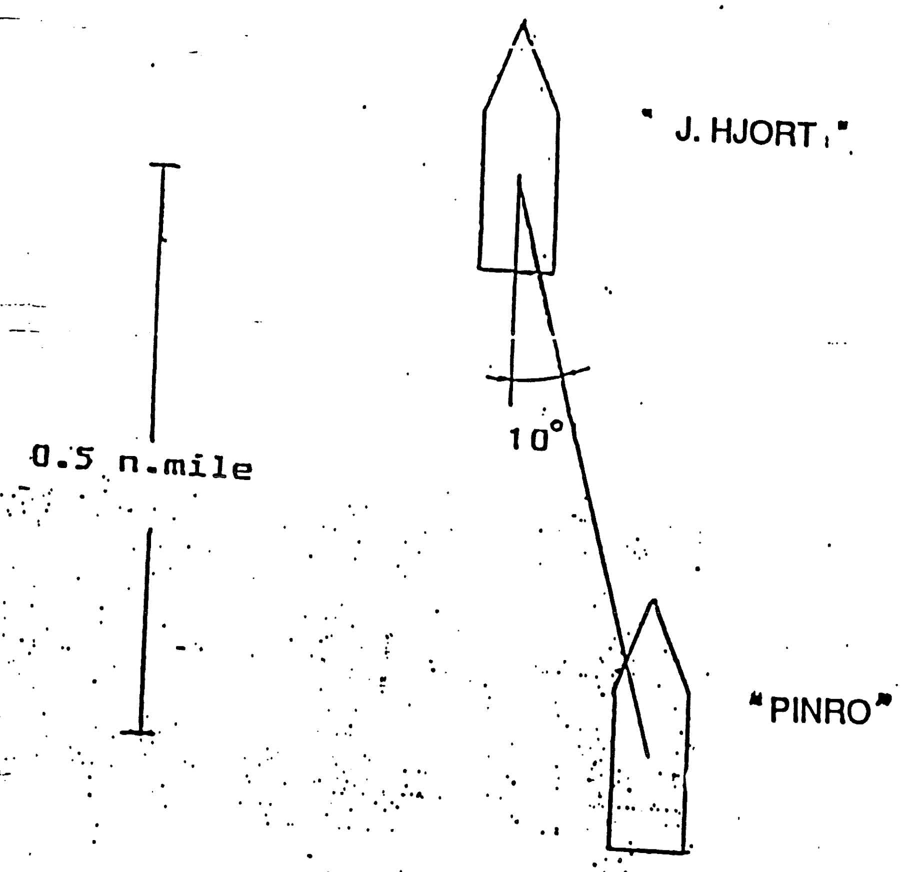

Fig. 1. Sailing formation.

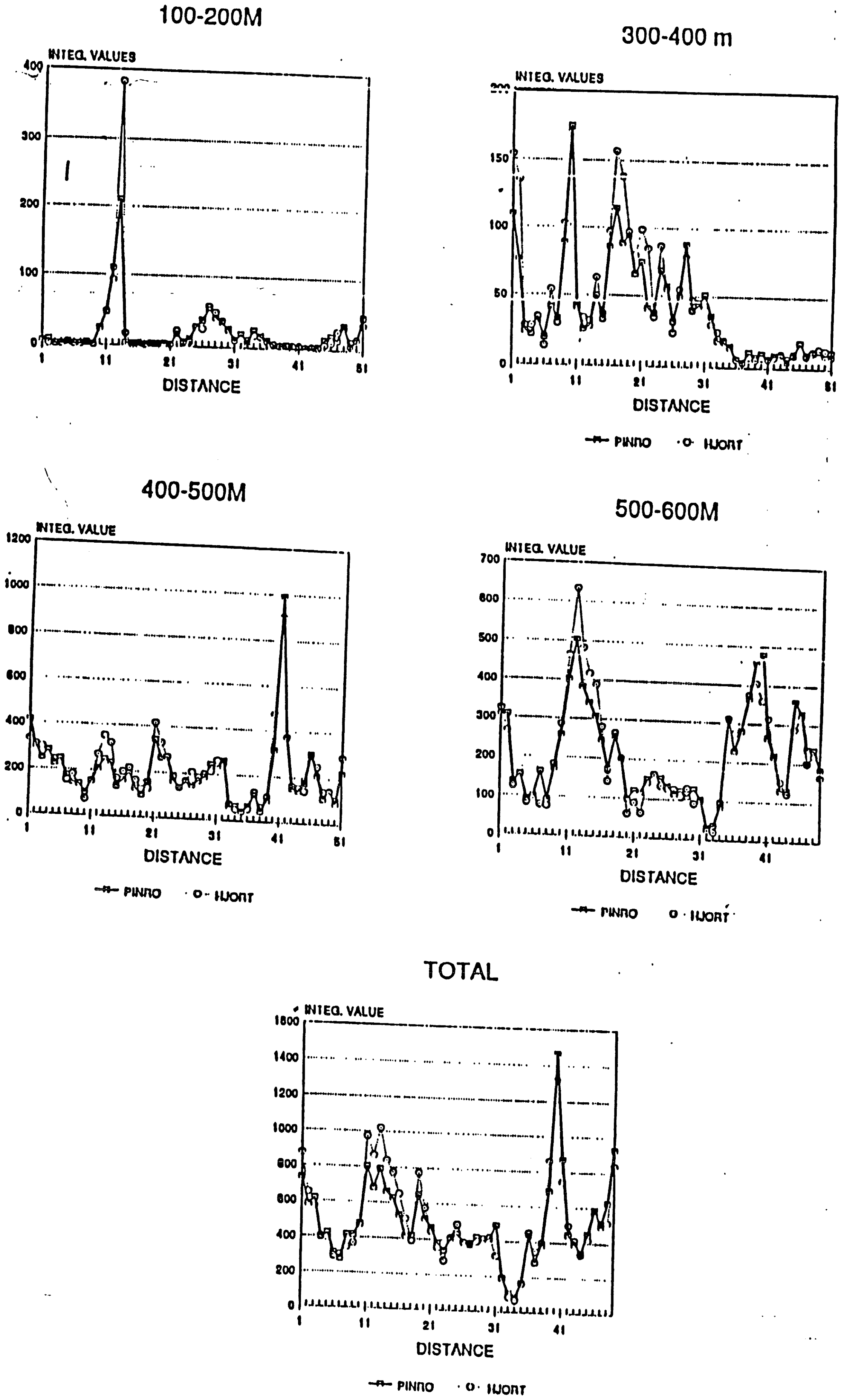

Figure 2. Observed integrator values.

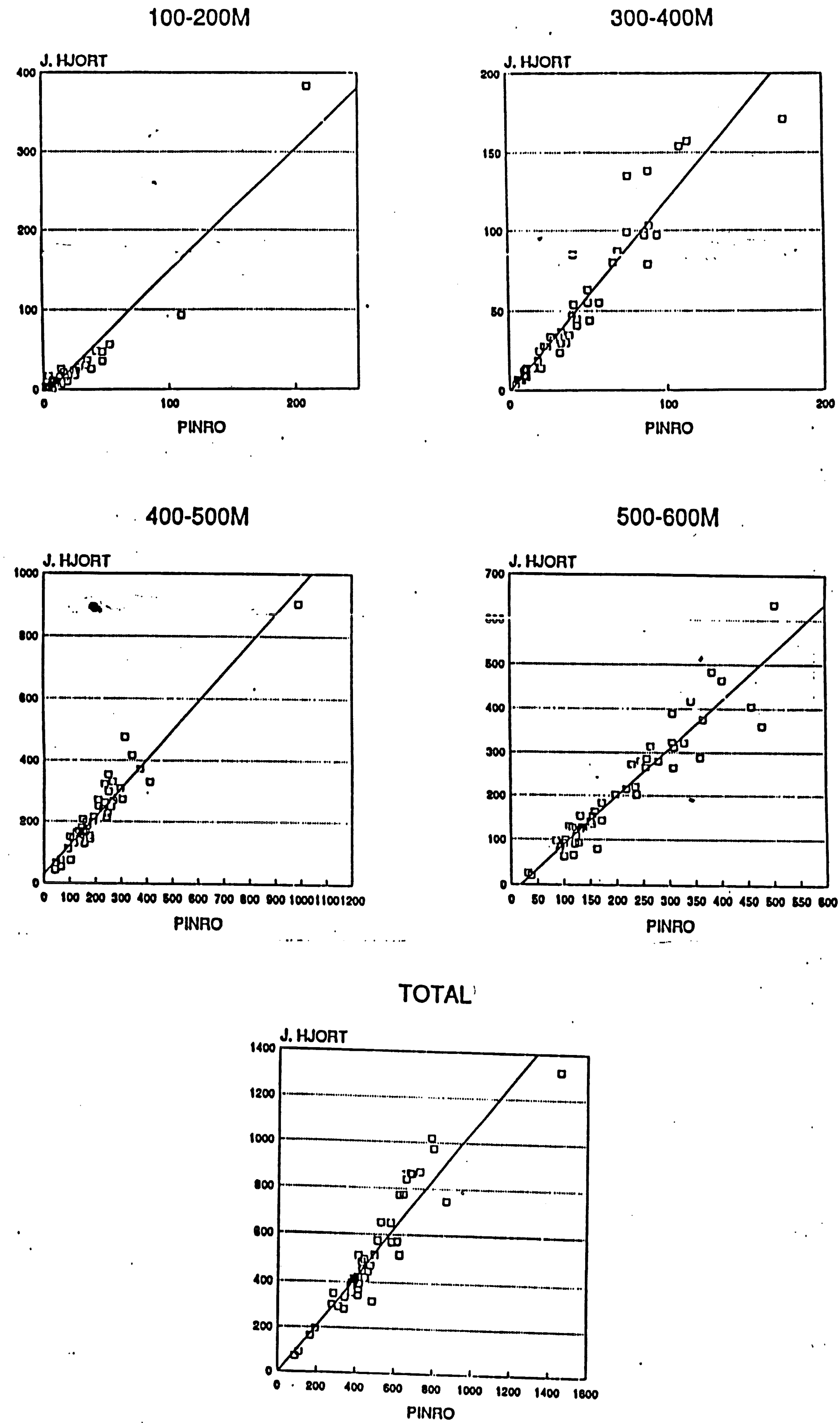

Figure 3. Plot of corresponding integrator values and regression lines.