Table 2. Average area and shape of herring schools (CW: crosswise, LW: lengthwise, r_s: Spearman's rank correlation coefficient, n: no. of measurements, ns: no. of schools).

Herring population	School area (m^2)	School shape CW:LW	r_s	n	ns
Norwegian spring-spawning	5355.9	1.70:1	0.76	91	5
North Sea	2301.8	1.52:1	0.59	795	33

Table 3. Average horizontal (Vh) swimming speed of herring schools (bl/s: body length/s, MW-test: Mann–Whitney test).

Fishing ground	Schools encircled				Schools passed over				MW-test
	Vh m/s	Vh bl/s	s.d. m/s	n	Vh m/s	Vh bl/s	s.d. m/s	n	p
Nordland	–	–	–	–	1.94	5.2	0.91	107	–
Nordmøre	0.87	2.5	0.55	91	1.49	4.2	0.90	33	<0.01
Shetland/Patchbank	0.78	2.8	0.45	359	1.13	4.0	0.73	97	<0.01
Egersundbank	0.75	2.8	0.42	370	1.40	5.2	0.75	93	<0.01

Results

The recorded Norwegian spring-spawning herring averaged 35.5 cm, were mature, and had empty stomachs. The North Sea herring averaged 27.2 cm, were maturing, and had full stomachs.

Horizontal dimensions

The average area of the Norwegian spring-spawning herring schools was larger than that of the North Sea herring schools (Table 2). On the spawning grounds off western Norway, layers too wide in extent to be measured by the sonar method were encountered.

The crosswise extent of the school projection was usually in the swimming direction and was on average 1.5 times the lengthwise extent. In addition, quite strong correlations between these dimensions indicate an elliptical school shape (Table 2). The average school area (Y) was linearly related to the biomass (X) of whole schools caught in the North Sea (Fig. 3):

$$Y = 37.8X - 85.1 \quad (r = 0.97,\ p < 0.05,\ n = 6).$$

A similar relationship may exist for Norwegian spring-spawning herring as indicated by the two measurements given in Figure 3. Relatively, the variation in the school area was about half of the average (average coefficient of variation = 0.59, n = 38).

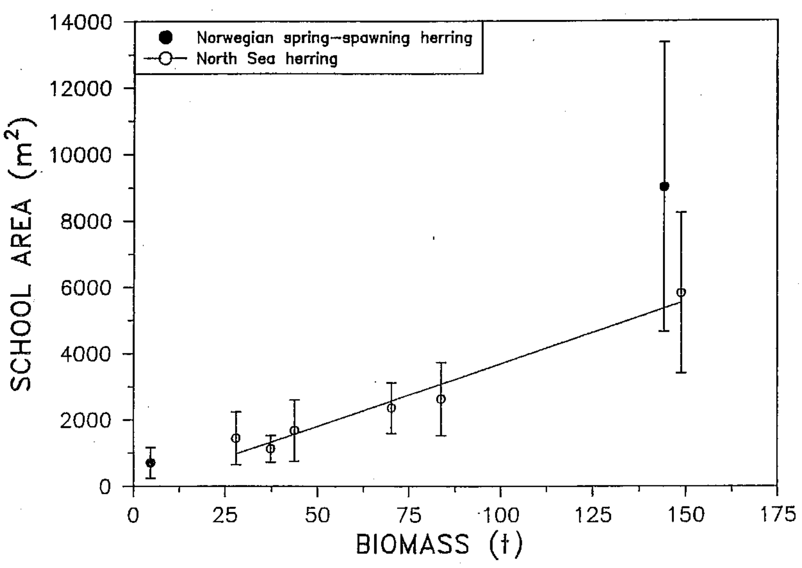

Figure 3. Catch biomass of whole schools related to average school area (vertical bars: standard deviation).