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## Catch and weight at age of chub mackerel in Russia

Emilia Chernienko and Igor Chernienko

Pacific branch of the Russian Federal Research Institute of Fisheries and  
oceanography

4 Shevchenko Alley, Vladivostok, Russia, 690091

### Catch

Mackerel catch data in 2016-2020 provided by Russian Federal Agency for Fisheries were used. Catch data were grouped by year and 3-month periods.

### Catch and weight at age

Catch and weight data were collected in 2016-2020 off the south Kuril Islands. Survey and commercial catch data were processed separately. Fork length was measured to the nearest 1 mm and weight to 1 g.

Weight-length relationship per 3-month period was calculated using formula  $w_q = a_q L^{b_q}$ , where  $w$  – weight,  $L$  – fork length,  $a_q$ ,  $b_q$  – coefficients,  $q$  – 3-month period index (1 to 4). Length composition was determined based on fork length data from observers on fishery vessels. Length composition data were grouped by length in 1 cm intervals. Group weight proportions were calculated using formula:

$$d_{q,l} = \frac{n_{q,l}}{\sum n_{q,l}}, \quad \text{where } l \text{ – size range number, } n_l \text{ – number of specimens within an}$$

interval  $l$ . Average weight for each size range was calculated using weight-length relationship

$$\bar{w}_{L_j,q} = a_q L_j^{b_q}$$

Then weight proportions were calculated from quantitative proportions using formula:

$$d_{q,w_l} = \frac{\bar{w}_{L_j,q} d_{q,l}}{\sum n_{q,l}}$$

Weight of each size group in a catch was calculated using formula:

$$Y_{q,l} = d_{q,w_l} Y_q,$$

where  $Y_q$  – catch per 3-month period in tons,  $Y_{q,l}$  – catch of a size group per 3-month period in tons. After that, catch was calculated using formula:

$$C_{q,l} = \frac{Y_{q,l}}{w_{q,l}} \cdot 10^6$$

where  $C_{q,l}$  – catch of a size group in numbers of fish per 3-month period

### **Age-Length Keys, catch-at-age**

Japanese age-length keys were used in the northwestern part. Specimens with body length less than 20 cm were considered to be of 0+ age, specimens over 45 cm in length were treated as 7+ yrs old. Age-length keys were used to divide a catch into age groups in each 3-month period in numbers and tons, respectively,  $C_{A,q}$  and  $Y_{A,q}$ . After subdivision of the number of fish in a catch into size groups, average weight of each group in grams was calculated using formula:

$$w_{q,A} = \frac{Y_{q,A}}{C_{q,A}} \cdot 10^6$$

### **Results**

Chub mackerel size, based on data from surveys and commercial catches in 2016-2020, is shown on fig. 1. Size data were collected from research surveys in

2016-2020 as well as from fishery observers. A total of 60,117 individuals were analyzed, 26,113 of which by fishery observers, and 34,004 in the surveys (fig.1). Fish fork length was measured, and some fish were weighted. A total of 12,167 fish were analyzed, 5,665 of which by observers, and 6,311 in the surveys (fig. 2). Weight-length relationships by 3-month periods and years are shown on figures 2 to 7.

### Catch-at-age

Age composition of catch was calculated using weight-length relationships and Japanese age-length keys for the Northwestern region.

### Maturity-at-age

No reliable data on maturity-at-age were collected, because aggregations of chub mackerel were comprised of foraging fish in the Russian EEZ.

Table 1. Data on fork length

Year	Commercial		Survey			
	3 quarter	4 quarter	1 quarter	2 quarter	3 quarter	4 quarter
2016	246	126		487	7120	136
2017	3134	1103		1014	3375	5714
2018	128	11021		1340	154	4
2019		4419	473	1937	1020	4510
2020	2123	3813		1493	5227	

Table 2. – Data on weight

Year	Commercial		Survey			
	3 quarter	4 quarter	1 quarter	2 quarter	3 quarter	4 quarter
2016	95	126		100	1407	25
2017	1260	440		219	670	677
2018	6	1563		313	50	4
2019		679	53	662	111	458
2020	584	912		302	1460	

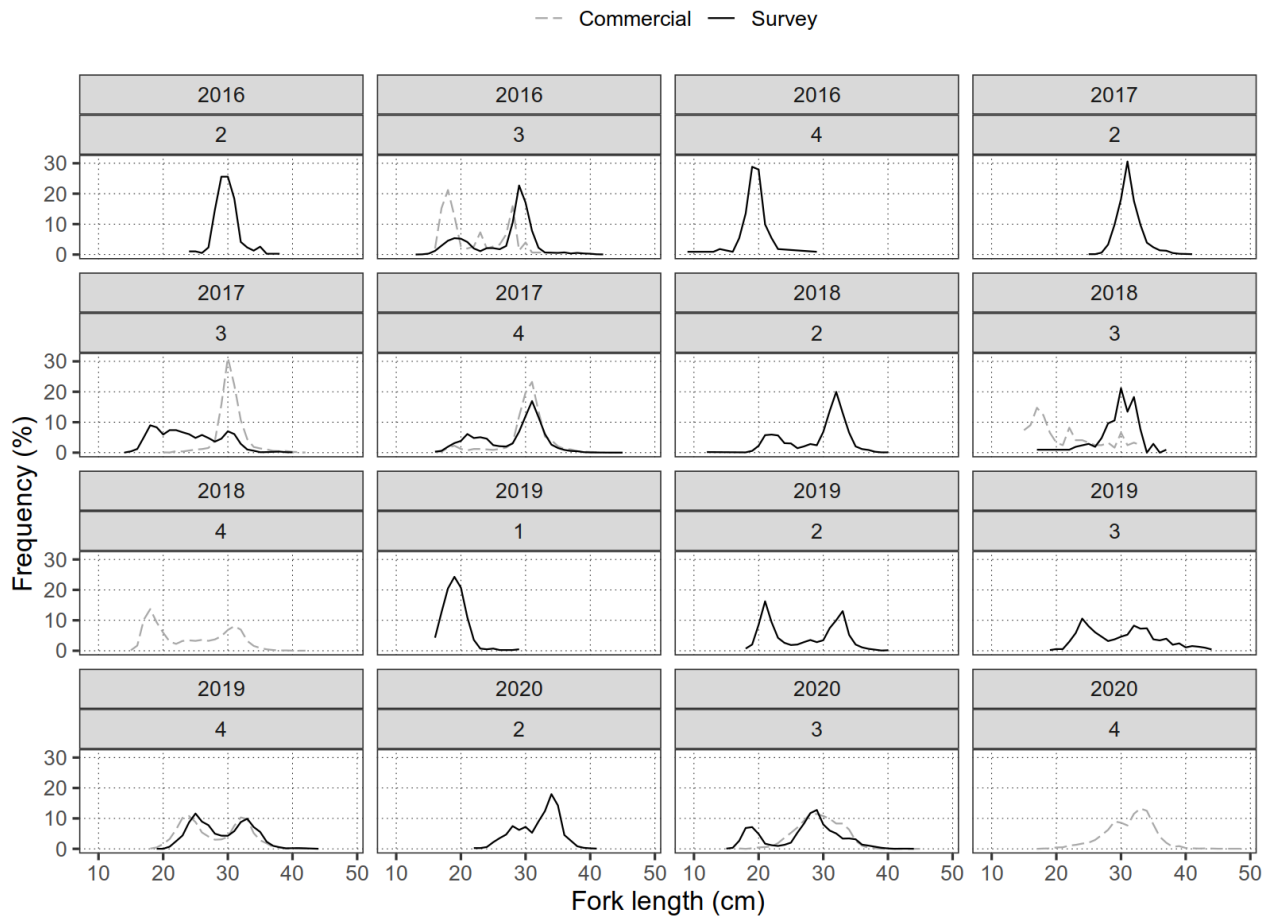


Fig. 1 Chub mackerel size in catches

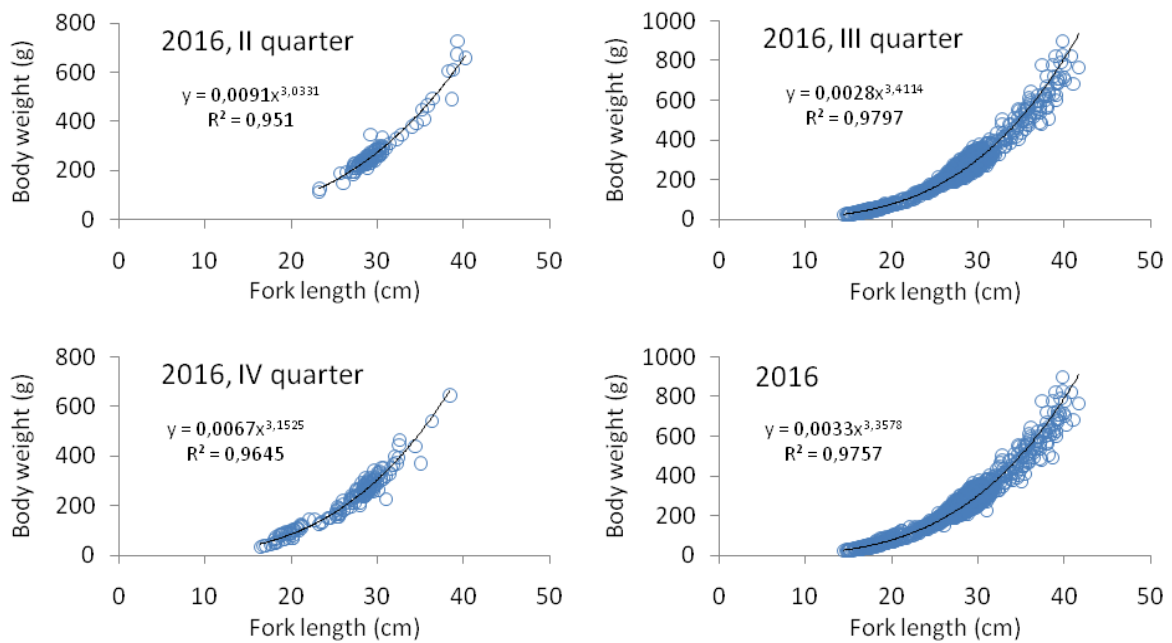


Fig. 2. Chub mackerel weight-length relationships in 2016

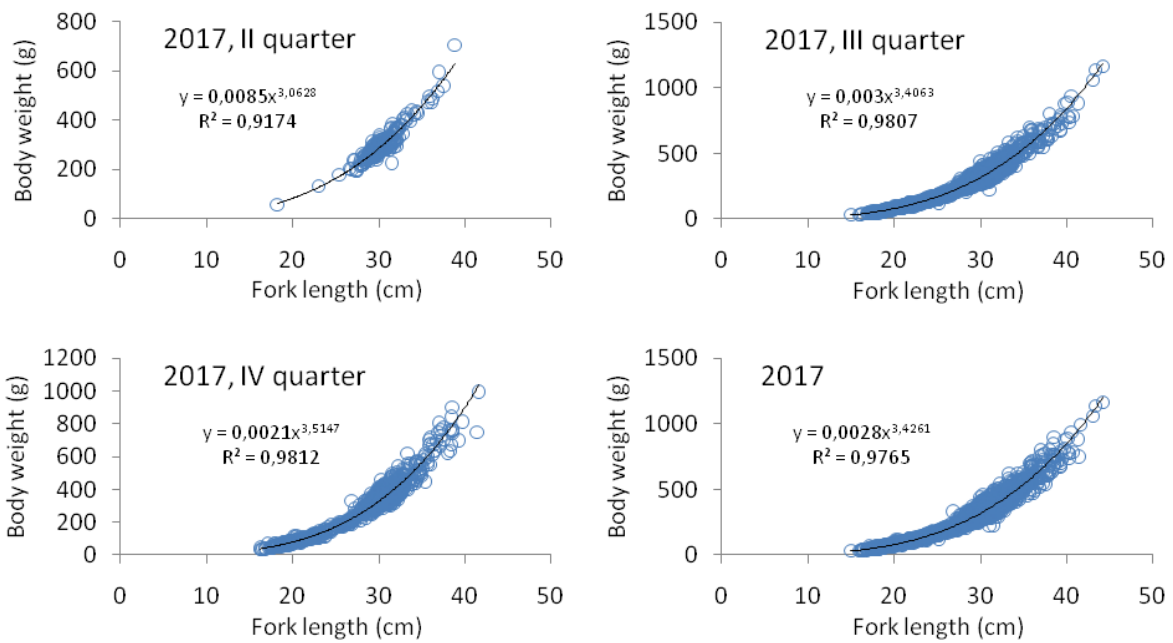


Fig. 3. Chub mackerel weight-length relationships in 2017

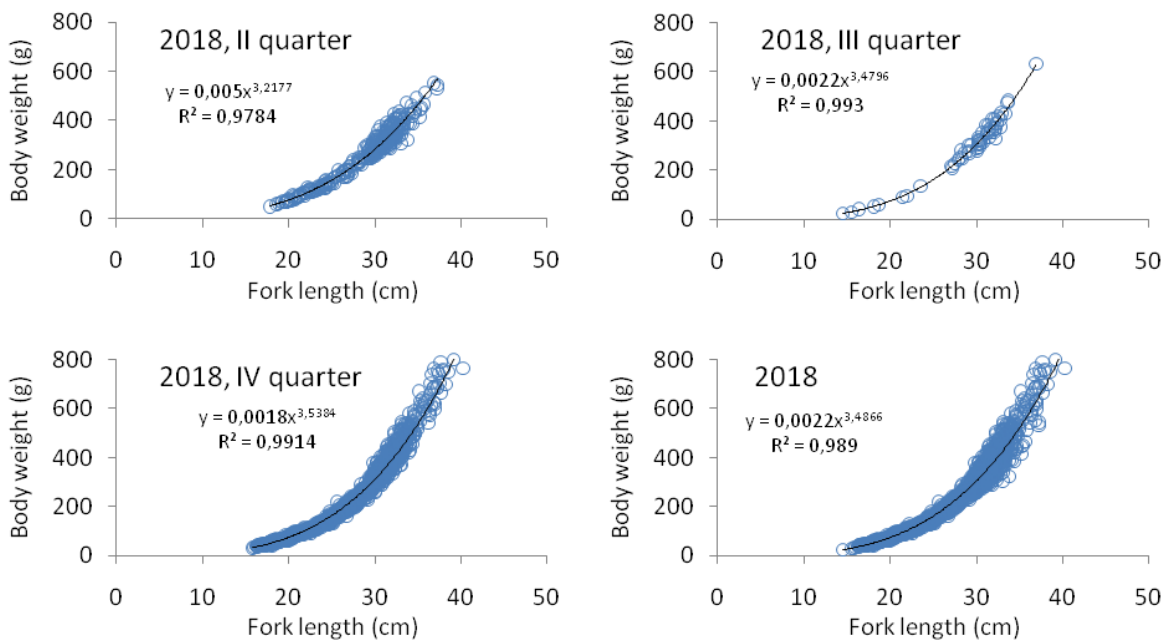


Fig. 4. Chub mackerel weight-length relationships in 2018

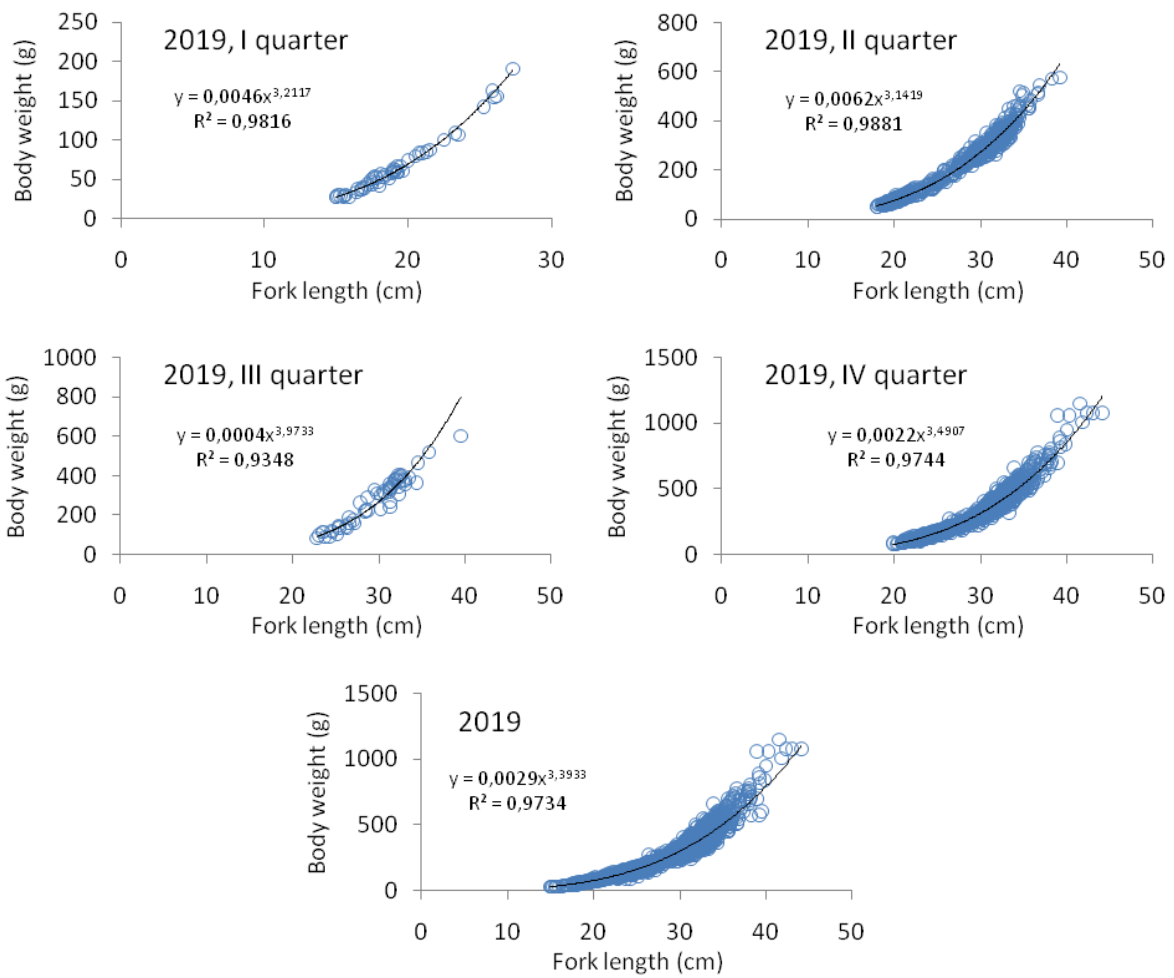


Fig. 5. Chub mackerel weight-length relationships in 2019

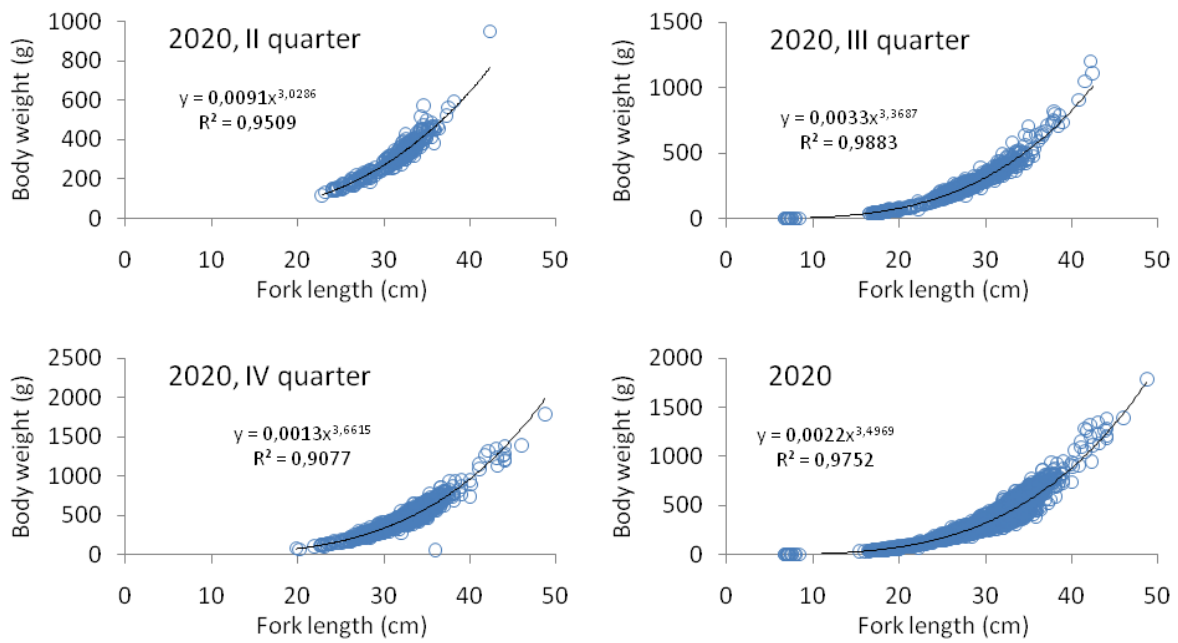


Fig. 6. Chub mackerel weight-length relationships in 2020

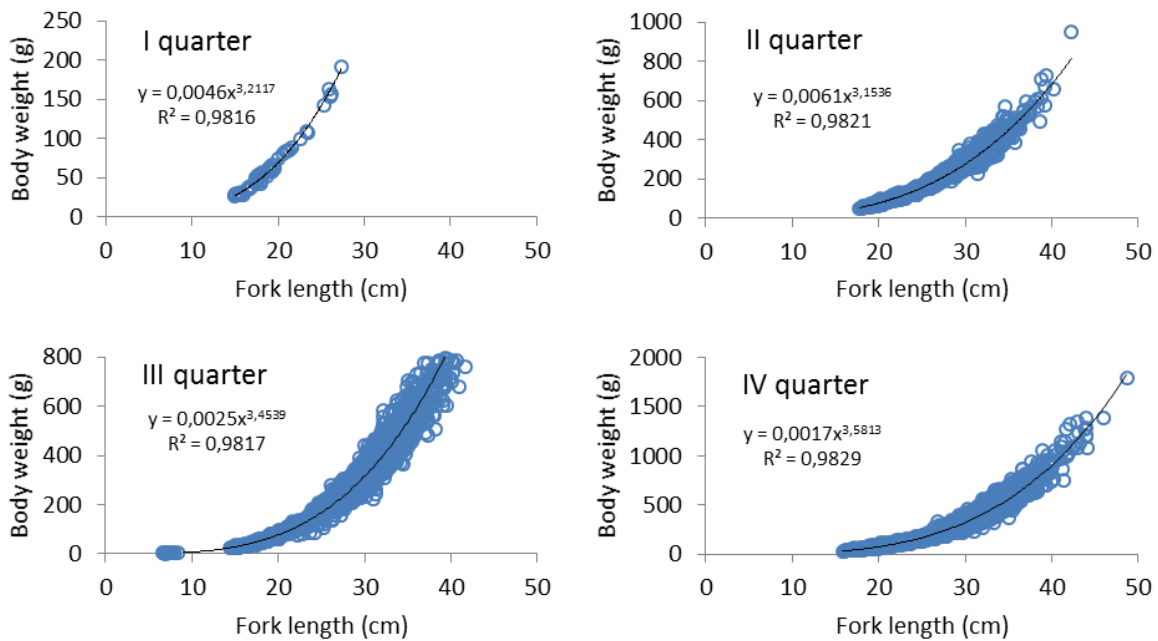


Fig. 7. Chub mackerel weight-length relationships in 2016-2020 in 3-month periods.