



BIOLOGICAL MONITORING (BIOLOGICAL SAMPLES
COLLECTION) OF THE LANDED RAPANA CATCH BY THE
BULGARIAN FISHING FLEET

SCIENTIFIC REPORT FOR 2ND QUARTER OF 2019



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ



This research is carried out by researchers from the Institute of Fish Resources – Varna, Agricultural Academy (AA), within Contract EAFA-Burgas/Д-157/16.05.2018 г. and is focused on the scientific assessment of the quantity and biological parameters of rapana from the landed catch by the Bulgarian fishing fleet in 2018.

This research was done with the financial support from the European Commission in accordance with Regulation №199/2008 of the Council and Decision 2010/93/EC of the Commission, allocated to support member states in the preparation of technical report for the development of a common framework for collection, management and use of data in the Fisheries' sector and to support the scientific consultations about the overall policy in the fisheries' field.

This research is indicative for the 2nd quarter of 2019 and reveals the dynamics of the biological parameters of rapana from the landed catch at Varna and Kavarna, based on the biometric measurements and analysis of 400 individuals rapana.

Scientific team

Leader - Assoc. Prof. Elitsa Petrova

Team

Assoc. Prof. Vesselina Mihneva

Assoc. Prof. Stoyko Stoykov

Chief Ass. Prof Feriha Tserkova

Stanimir Valchev

Chief Ass. Prof. Philip Penchev

Rositsa Kuneva

Petrova E., Miheva V., Tserkova F., Stoykov S., Valchev S., Penchev Ph., 2019. BIOLOGICAL MONITORING (BIOLOGICAL SAMPLES COLLECTION) OF THE LANDED RAPANA CATCH BY THE BULGARIAN FISHING FLEET FOR 2ND QUARTER 2019, Report under Contract with Execute Agency for Fisheries and Aquacultures, Program for fishing data collection 2019, p. 34.



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ



BIOLOGICAL MONITORING (BIOLOGICAL SAMPLES COLLECTION) OF THE LANDED RAPANA CATCH BY THE BULGARIAN FISHING FLEET FOR 2ND QUARTER 2019

Scientific team	1
1. Introduction.....	3
1.1. Data collected.....	3
2. Materials and methodology	4
2.1. Sampling scheme.....	4
2.2. Sample analysis	5
2.3. Laboratory analysis.....	5
2.4. Statistical methods	5
3. Results	6
3.1. Biometric measurements	6
3.1.1. Linear-weight ration	6
3.1.1.1. Port Varna, 23.05.2019.....	6
3.1.1.2. Varna port, 31.05.2019	10
3.1.1.3. Port Varna, 14.06.2019 г.	13
3.1.1.4. Port Kavarna, 22.06.2019	16
3.1.1.5. Summarized data for the 2 nd quarter of 2019.....	19
3.1.2. Sex strucuture.....	25
3.1.2.1. Port Varna, 23.05.2019.....	25
3.1.2.2. Port Varna, 31.05.2019.....	27
3.1.2.3. Port Varna, 14.06.2019.....	28
3.1.2.4. Port Kavarna, 22.06.2019	30
3.1.2.5. Gonadosomatic Index (GSI).....	32
3.1.2.6. Summary of the sex structure for the 2 nd quarter of 2019	32
4. Conclusions.....	38
5. References.....	40

2

www.eufunds.bg

Проект № BG14MFOPO01-3.003-0001-C01, „Събиране, управление и използване на данни за целите на научния анализ и изпълнението на Общата политика в областта на рибарството за периода 2017-2019 г.”, финансирано от Програмата за морско дело и рибарство, съфинансирана от Европейския съюз чрез Европейския фонд за морско дело и рибарство.



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ



1. INTRODUCTION

Biological monitoring of the *R. venosa* landings of beam trawlers was carried out in the 2nd quarter of 2019. The research is focused on the dynamics of the landings of these species, size and weight structures and sex structure of the rapana based on the biological samples. In addition, linear-weight ratios were derived and correlated for the different landings.

The current report is representative for the 2nd quarter of 2019 and is based on the biometric research on 400 individuals *R. venosa*. The analysis is thorough and reveals important biological parameters of the target species – quantity, size, weight, linear-weight ratio and sex structure by landings from the two observed ports - Varna и Kavarna.

1.1. DATA COLLECTED

The current study allowed the collection of several types of data:

1. Data about the fishing vessels' activity
 - Fish expedition data
 - Departure port
 - Arrival port
 - Fishing vessel name
 - Vessel type
 - Vessel length (m)
2. Fishing gear
 - Depth scale of the fishing activities (up to 35 m depth)
3. Basic biological data
 - Total weight of the target species, landed at a port
 - Number of collected individuals in the biological sample
 - Total weight of the sample (Total weight – shell weight (TW, g))
 - Shell length (Shell length, SL, mm),
 - Shell width (Wd, mm)
 - Aperture shell length (Aperture length, AL, mm).



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ



4. Additional biological data

- Ratio between genders, gender maturity of collected individuals and gonadosomatic index index (when applicable);
- Ratio between gender maturity and shell length, gender to shell length ration and gender to total weight ratio;

The final results are presented in the form of tables and maps with data about:

- Landings of the target species at ports
- Biological parameters of rapana – size, weight, linear-weight ratios, gender structure from the samples;

2. MATERIALS AND METHODOLOGY

2.1. SAMPLING SCHEME

The collection of the biological samples (based on 400 individuals) was carried out by taking samples from landings at four ports in the northern territorial waters, where the rapana fishing is most intensive.

The two main ports, where samples were collected, are Varna and Kavarna.

The research was done for 4 days in the period IV - VI.2019 and the relevant information is summarized below in Table 1.

Table 1.
Ports and vessels, where biological samples were taken from rapana landings

Date	Fishing vessel	No of fishing vessel	Technical specifications	Departure	Arrival	Fishing method
25.05.2019	PK 4	ВН 7599	Length -12.58 m; Weight - 24.46 GT; Power 220.59 kW	Varna	Varna	Beam trawl
31.05.2019	PK 5	ВН 8186	Length – 14.9 m; Weight - 24.91 GT; Power 220 kW	Varna	Varna	Beam trawl
13.06.2019	Tais	ВН 393	Length - 19.4 m.; Weight - 46 GT; Power 378 kW	Varna	Varna	Beam trawl
22.06.2019	Viking	ВН 8406	Length – 14.52 m.; Weight - 30.06	Kavarna	Kavarna	Beam trawl



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ



			GT; Power 132.39 kW			
--	--	--	------------------------	--	--	--

The bottom beam-trawl has the following parameters – maximum width - 5.3 m, maximum depth - 6 m; vertical opening - 280 mm; horizontal opening between the rails - 5 m; effective part of the upper collar - 4.8 m; “eye size” - , trawling velocity - 3 - 3.6 Nd; trawling duration 60 - 80 mins.

2.2. SAMPLE ANALYSIS

Random samples of *R. venosa* were taken at the landings by ports with the purpose to monitor the development of the species during the active fishing season.

2.3. LABORATORY ANALYSIS

The size, weight and sex structures of *R. venosa* are analyzed by using an analysis technique for the weight, size (shell length) and sex structures of the researched individuals from different landings (at least 400 individuals) for spring-summer period of 2019.

For this purpose:

- For each individual, the following biometric parameters are measured – total weight of the individual (total weight - weight with shell, TW, g), body weight of the individual (body weight – weight w/o shell, BW, g), shell length (shell length, SL, mm), shell width (Wd, mm) and aperture length (aperture length, AL, mm);
- The ratio between the different biometric parameters is calculated in relation to each of the parameters;
- The sex maturity is analyzed, as well as the ratio between the sexes, GSI (if applicable);
- The ratio between the sex and the length is calculated and the ratio between the sex to the total weight of the individuals.

2.4. STATISTICAL METHODS

The morphometric relationships between the biological parameters – total weight (TW), body weight (BW), shell length (SL), shell width (Wd), aperture length (AL) – are analyzed by allometric models. The derived results are processed by using the least squares method and the following equations:

$$\text{Log } W = \text{Log } a + b * \text{Log } L$$

Where, W – weight; L – size; a, b – constants.



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ



Natural logarithm (\ln) is used as a second way of calculating the parameters a, b of the $L\text{-}W$ ratio:

$$TW(g) = a \cdot SL(mm)^b, \text{ followed by anti-logarithm so } a = \ln q \text{ and } q = \exp^a.$$

XLSTAT software is used to make the linear-weight histograms of the samples from the landed catch, as well as for the data processing. The statistical data about the different classes, presented in the histograms, include – lower and upper limits of the classes, frequency, relative frequency and density.

The accuracy of the software for sample collection is based on the following documents:

- "Report of the Workshop on Sampling and Calculation Methodology for Fisheries Data" (WKSCMFD) (ICES 2004);
- Report SGPIIDS (ICES, 2011a),
- Report of the Study Group on Practical Implementation of Discard Samples (SGPIIDS).

3. RESULTS

3.1. BIOMETRIC MEASUREMENTS

3.1.1. LINEAR-WEIGHT RATION

3.1.1.1. PORT VARNA, 23.05.2019

The sample consists of 100 individuals rapana, with a total weight of 4.829 kg, from a total of 3020 kg rapana at Varna Port.

The summarized statistical data about the biometric measurements is presented in Table 2. The average weight of the measured individuals reaches $48.30 \text{ g} \pm 13.62 \text{ SD}$, at an average length - $65.85 \text{ mm} \pm 6.44 \text{ SD}$, shell width - $49.08 \text{ mm} \pm 4.97 \text{ SD}$ and aperture length $46.55 \text{ mm} \pm 8.95 \text{ SD}$. The weight w/o shell (body weight) is $21.27 \text{ g} \pm 7.64 \text{ SD}$ and is about $43.06 \% \pm 7.13 \text{ SD}$ from the total weight, varying between 27.84 % and 72.97 % from the total weight.

Table 2

Summarized statistics about the measured biological parameters - total weight (TW - weight with shell, TW, g), body weight (BW, g), % of BW from TW, shell length (shell length, SL, mm), shell width (Wd, mm) and aperture length (aperture length, AL, mm) for Varna Port, 23.05.2019

	TW, g	BW, g	% BW from TW	SL, mm	Wd, mm	AL, mm
Mean	48.30	21.27	43.06	65.85	49.08	46.89
Standard Error	1.36	1.07	1.00	0.64	0.50	0.49
Median	46.50	19.50	43.59	66.00	49.00	47.00
Mode	53.50	14.50	43.75	66.00	50.00	50.00

6

www.eufunds.bg

Проект № BG14MFOPO01-3.003-0001-C01, „Събиране, управление и използване на данни за целите на научния анализ и изпълнението на Общата политика в областта на рибарството за периода 2017-2019 г.“, финансирано от Програмата за морско дело и рибарство, съфинансирана от Европейския съюз чрез Европейския фонд за морско дело и рибарство.



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

Standard Deviation	13.62	7.64	7.13	6.44	4.97	4.88
Sample Variance	185.40	58.38	50.85	41.42	24.68	23.78
Kurtosis	1.92	1.55	5.81	0.80	0.21	0.67
Skewness	1.01	1.21	1.24	0.54	0.34	0.45
Range	78.00	35.00	45.13	35.00	26.00	27.00
Minimum	23.50	10.50	27.84	53.00	38.00	36.00
Maximum	101.50	45.50	72.97	88.00	64.00	63.00
Sum	4829.50	1085.00	2196.12	6585.00	4908.00	4689.00
Count	100.00	51.00	51.00	100.00	100.00	100.00
Confidence Level(95.0%)	2.70	2.15	2.01	1.28	0.99	0.97

The most common size classes are - 56 - 66 mm (45 % from measured individuals), as well as size class - 66 – 76.

In regard to the weight structure (TW, g), the following classes are dominant: 25.6 – 51.2 g (63 % from the measured individuals), while the bigger individuals are with a weight > 76.8 g, approx. 4 % from the sample.

In regard to the weight structure (TW, g), the following classes are predominant: 25.6 – 51.2 g (63 % from all measured individuals), while the large individuals with a weight > 76.8 g are only 4% from the sample.

In regard to the parameter - shell width (Wd, mm), most common are the following classes: 47.5 - 51 mm -29 % and 51 – 54.5 mm -24 % from the researched individuals.

Based on the aperture length (AL, mm), the predominant classes are 47 – 50.4 mm (39 %) and 43.6 - 47 mm (18%).

The following percentage ratios have been derived - width (Wd, mm)/ length (SL, mm) of the shells, aperture length (SL, mm)/total length (Wd, mm) of the shell and aperture length (AL, mm)/width (Wd, mm) of the shell.

The mean ratio - width (Wd, mm)/length (SL, mm) is $74.57 \% \pm 3.15$ SD, while the AL/SL (%) is $71.22 \% \pm 2.88$ SD, and the ratio between AL/Wd (%) returns the value of - $95.56 \% \pm 2.95$ SD

Table 3

Percentage ratios between shell width and length (Wd/SL, %), aperture length/total shell length (AL/SL, %) and aperture length/total shell width (AL/Wd, %) of the individuals from Varna, 23.05.2019

	Wd/SL (%)	AL/SL (%)	AL/Wd (%)
Mean	74.57	71.22	95.56

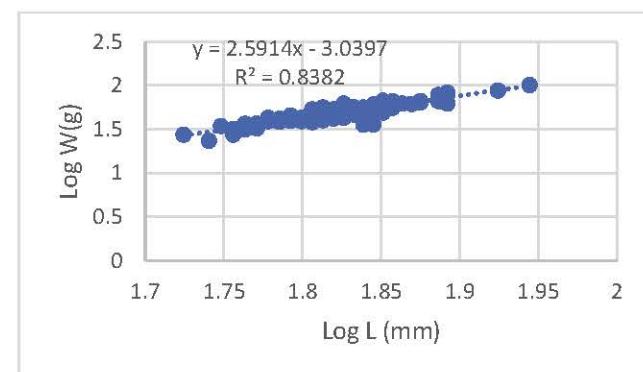


МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

Standard Error	0.32	0.29	0.30
Median	74.59	71.32	95.96
Mode	75.76	71.43	96.00
Standard Deviation	3.15	2.88	2.95
Sample Variance	9.94	8.27	8.72
Kurtosis	1.90	-0.33	18.77
Skewness	0.25	-0.10	-3.38
Range	21.09	13.18	23.73
Minimum	65.67	64.18	76.27
Maximum	86.76	77.36	100.00
Sum	7456.94	7121.94	9556.32
Count	100.00	100.00	100.00
Confidence Level (95.0%)	0.63	0.57	0.59

The following linear-weight relationships have been derived:

- 1) Between weight (TW, g) and linear size (SL, mm): $\text{Log TW (g)} = 2.5914 * \log SL (\text{mm}) - 3.04$, ($R^2=0.84$, $p<0.001$, Fig.1.1).
- 2) Between weight (TW, g) and shell width (Wd, mm): $\text{Log TW (g)} = 2.4461 * \log Wd (\text{mm}) - 2.4631$, ($R^2=0.82$, $p<0.001$, Fig.1.2)
- 3) Between weight (TW, g) and aperture length (AL, mm): $\text{Log TW (g)} = 2.4458 * \log AL (\text{mm}) - 2.4137$, ($R^2=0.85$, $p<0.001$, Fig.1.3).



1.



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

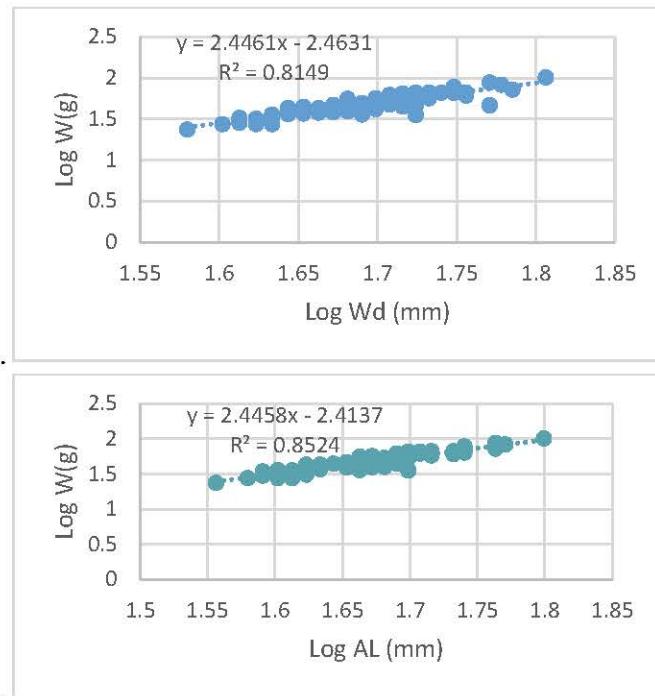


Figure 1. Linear-weight ratio (Log 10) for the measured individuals rapana - Varna,
23.05.2019

The parameters a , b of the linear-weight relationship: $TW(g) = a \cdot SL(mm)^b$ with natural logarithm and value of the correlation coefficient R^2 are presented in Table 4.

Table 4

Parameters a , b of L-W relationship, given by the equation: $TW(g) = a \cdot SL(mm)^b$ and value of R^2

Equation parameters	
$W(g) = a \cdot L(mm)^b$	
a	0.000915
b	2.59
R²	0.84



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ



3.1.1.2. VARNA PORT, 31.05.2019

The sample of 100 individuals rapana is with a total weight of 4.188 kg, from a total of 3015 kg rapana at port Varna.

The average weight of the measured individuals reaches $41.88 \text{ g} \pm 20.78 \text{ SD}$, at an average length - $62.73 \text{ mm} \pm 6.86 \text{ SD}$, shell width - $46.94 \text{ mm} \pm 7.29 \text{ SD}$ and aperture length $45.71 \pm 6.86 \text{ SD}$ (Table 5). The body weight is $13.42 \text{ g} \pm 5.49 \text{ SD}$ and forms about $34.10 \% \pm 4.66 \text{ SD}$ from the total weight, varying between 22.27 % and 42.15 % from the total weight.

Table 5

Summarized statistics about the measured biological parameters – total weight (TW - weight with shell, TW, g), body weight (BW, g), shell length (shell length, SL, mm), shell width (Wd, mm) and aperture length (aperture length, AL, mm), Varna, 31.05.2019

	TW, g	BW, g	% BW from TW	SL, cm	Wd, mm	AL, mm
Mean	41.88	13.42	34.10	62.73	46.94	45.71
Standard Error	2.08	0.78	0.66	0.86	0.73	0.69
Median	36.00	12.00	34.77	62.00	46.00	45.00
Mode	29.50	11.00	37.50	62.00	42.00	46.00
Standard Deviation	20.78	5.49	4.66	8.65	7.29	6.86
Sample Variance	431.76	30.13	21.69	74.74	53.21	47.04
Kurtosis	2.09	0.30	0.20	-0.20	0.04	0.12
Skewness	1.54	1.13	-0.65	0.64	0.72	0.68
Range	87.50	21.00	19.87	35.00	30.00	29.00
Minimum	18.00	6.50	22.27	49.00	35.00	34.00
Maximum	105.50	27.50	42.15	84.00	65.00	63.00
Sum	4187.50	671.00	1705.24	6273.00	4694.00	4571.00
Count	100.00	50.00	50.00	100.00	100.00	100.00
Confidence Level(95.0%)	4.12	1.56	1.32	1.72	1.45	1.36

The most common size classes are - 56 - 66 mm (47 % from the analyzed individuals) and 66 - 76 mm (22%).

For the weight classes, the following classes are predominant – 25.6 - 51.2 g (57 % from all measured individuals), followed by class < 25.6 g, or 20 % from all individuals



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

The following percentage ratios have been derived - width (Wd, mm)/length (SL, mm) of the shells, aperture length (SL, mm)/total length (Wd, mm) of the shell and aperture length (AL, mm)/width (Wd, mm) of the shell (Table 6).

Table 6

Percentage ratios between shell width and length, aperture length/total shell length and aperture length/total width (Varna/31.05.2019).

	Wd/SL (%)	AL/ SL (%)	AL/Wd (%)
Mean	74.74	72.82	97.48
Standard Error	0.37	0.34	0.26
Median	74.80	72.73	97.87
Mode	75.00	75.00	100.00
Standard Deviation	3.70	3.38	2.58
Sample Variance	13.68	11.44	6.66
Kurtosis	2.75	4.84	-0.36
Skewness	0.90	1.30	-0.47
Range	23.22	22.79	11.08
Minimum	65.67	65.67	91.30
Maximum	88.89	88.46	102.38
Sum	7474.00	7282.22	9748.29
Count	100.00	100.00	100.00
Confidence Level(95.0%)	0.73	0.67	0.51

The following linear-weight relationships have been derived:

- 1) Between the weight (TW, g) from the linear size (SL, mm): $\text{LogTW (g)} = 3.1014 * \log \text{SL (mm)} - 3.984$, ($R^2=0.92$, $p<0.001$, Fig.2.1).
- 2) Between the weight (TW, g) and the shell width (Wd, mm): $\text{LogTW (g)} = 2.7382 * \log \text{Wd (mm)} - 2.9848$, ($R^2=0.91$, $p<0.001$, Fig.2.2).
- 3) Between the weight (TW, g) and the aperture length (AL, mm): $\text{LogTW (g)} = 2.7982 * \log \text{AL (mm)} - 3.0536$, ($R^2=0.89$, $p<0.001$, Fig.2.3).



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

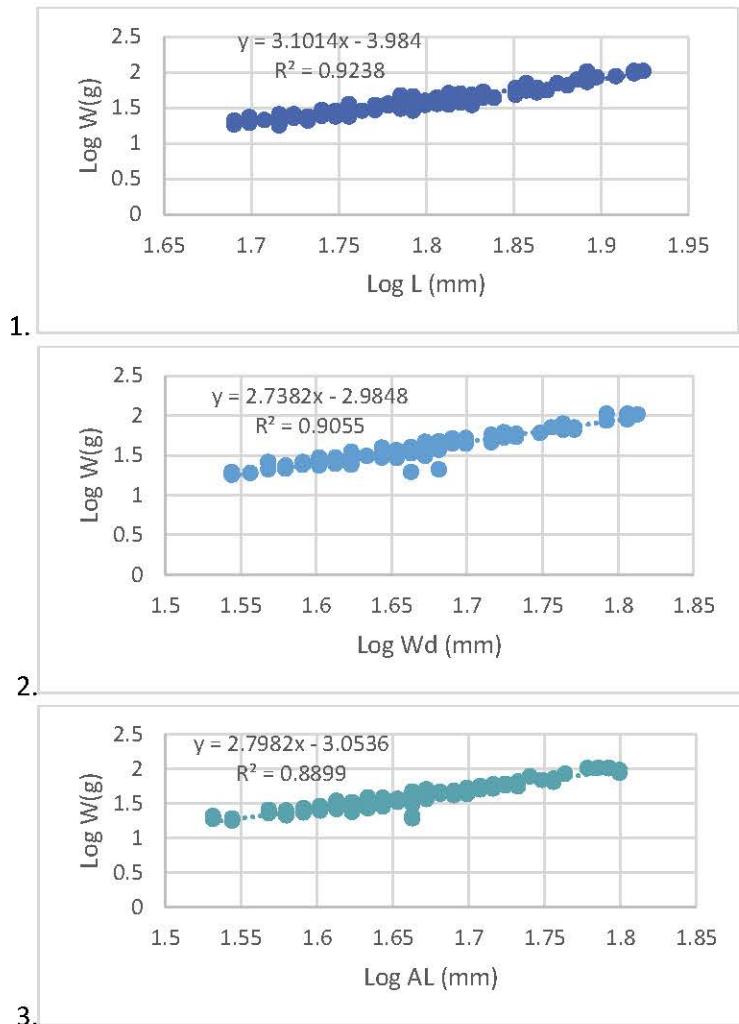


Figure 2. Linear-weight ratio (Log 10) for the measured individuals rapana, Varna, 31.05.2019

The parameters a , b of the linear-weight relationship: $TW(g)=a.SL(mm)^b$ with natural logarithm and value of the correlation coefficient R^2 are presented in Table 7.

Table 7

Parameters a , b of L-W relationship, given by the equation: $TW(g) = a.SL(mm)^b$ and value of R^2 .



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

Equation parameters	
$W(g) = a \cdot L(mm)^b$	
a	0.000104
b	3.1014
R ²	0.92

3.1.1.3. PORT VARNA, 14.06.2019 г.

The sample is with 100 individuals rapana and weighs 4.816 kg, from a total landing of 3420 kg at port Varna.

The summarized statistical data about the biometric measurements are presented in Table 8. The average weight of the measured individuals reaches $48.16 \text{ g} \pm 15.36 \text{ SD}$, at an average length - $65.44 \text{ mm} \pm 6.92 \text{ SD}$, shell width - $48.62 \text{ mm} \pm 5.76 \text{ SD}$ and aperture length $46.42 \pm 5.36 \text{ SD}$. The weight w/o shell (BW, g) on average is $18.73 \text{ g} \pm 6.77 \text{ SD}$ and forms $39.79 \% \pm 3.74 \text{ SD}$ from the total weight, varying between 31.90 % and 40.50 % from the total weight.

Table 8

Summarized statistics about the measured biological parameters – total weight (TW - weight with shell, TW, g), body weight (BW, g), % BW from TW, shell length (shell length, SL, mm), shell width (Wd, mm) and aperture length (aperture length, AL, mm), Port Varna, 14.06.2019

	TW, g	BW, g	% BW from TW	SL, mm	Wd, mm	AL, mm
Mean	48.16	18.73	39.79	65.44	48.62	46.42
Standard Error	1.54	0.96	0.49	0.69	0.58	0.54
Median	43.25	16.50	40.82	65.00	48.00	45.50
Mode	40.00	14.50	42.50	58.00	43.00	41.00
Standard Deviation	15.36	6.77	3.47	6.92	5.76	5.36
Sample Variance	235.87	45.90	12.02	47.93	33.21	28.69
Kurtosis	0.89	1.63	-0.63	0.68	0.79	0.97
Skewness	1.10	1.40	-0.59	0.82	0.84	0.80
Range	72.00	30.50	12.69	34.00	30.00	28.00
Minimum	25.00	10.00	31.90	53.00	38.00	37.00
Maximum	97.00	40.50	44.59	87.00	68.00	65.00
Sum	4816.00	936.50	1989.31	6544.00	4862.00	4642.00
Count	100.00	50.00	50.00	100.00	100.00	100.00



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

Confidence Level(95.0%)	3.05	1.93	0.99	1.37	1.14	1.06
-------------------------	------	------	------	------	------	------

The most common size classes in the sample are – size class 56 - 66 SL mm (53 % from the analyzed individuals), as well as size class - 66 - 76 mm (37%). The individuals with size > 76 mm are 8% from the sample. In regard to the weight classes (TW, g), the most common is 26 – 52 g, 62% from the sample.

The following percentage ratios have been derived - width (Wd, mm)/length (SL, mm) of the shells, aperture length (SL, mm)/total length (Wd, mm) of the shell and aperture length (AL, mm)/width (Wd, mm) of the shell (Table 9). The mean ratio width (Wd, mm)/length (SL, mm) is $74.27 \% \pm 3.22$ SD, while the AL/SL (%) is $70.92 \% \pm 2.74$ SD, and the ratio AL/Wd (%) results in - $95.55 \% \pm 2.86$ SD (Table 9).

Table 9

Percentage ratios between shell width and length (Wd/SL, %), aperture length/total shell length (AL/SL, %) and aperture length/total shell width (AL/Wd, %) of the individuals from Port Varna, 14.06.2019

	Wd/SL (%)	AL/ SL (%)	AL/Wd (%)
Mean	74.27	70.92	95.55
Standard Error	0.32	0.27	0.29
Median	74.14	71.19	95.70
Mode	75.00	73.13	95.35
Standard Deviation	3.22	2.74	2.86
Sample Variance	10.38	7.51	8.17
Kurtosis	0.59	0.55	14.83
Skewness	0.21	-0.18	-2.61
Range	18.84	15.29	22.41
Minimum	65.22	62.32	77.59
Maximum	84.06	77.61	100.00
Sum	7426.68	7091.61	9555.07
Count	100.00	100.00	100.00
Confidence Level(95.0%)	0.64	0.54	0.57

The following linear-weight relationships have been derived:

- 1) Between weight (TW, g) and linear size (SL, mm): $\text{Log TW (g)} = 2.7295 * \log \text{SL (mm)} - 3.2871$, ($R^2=0.89$, $p<0.001$, Fig.3.1).



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

- 2) Between weight (TW, g) and shell width (Wd, mm): $\text{Log TW (g)} = 2.4437 * \log Wd (\text{mm}) - 2.452$, ($R^2=0.89$, $p<0.001$, Fig.3.2)
- 3) Between weight (TW, g) and aperture length (AL, mm): $\text{Log TW (g)} = 2.496 * \log AL (\text{mm}) - 2.4903$, ($R^2=0.89$, $p<0.001$, Fig.3.3).

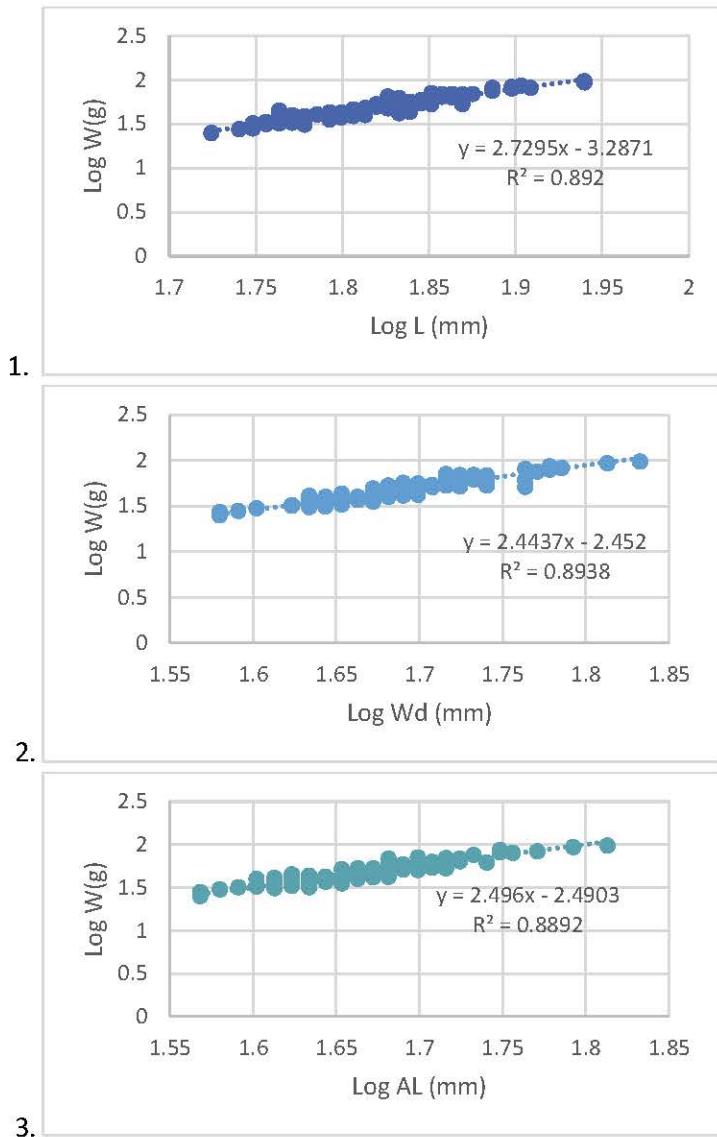


Figure 3. Linear-weight ratio (Log 10) for the measured individuals rapana, Varna, 14.06.2019



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ



The parameters a , b of the linear-weight ratio: $TW(g) = a \cdot SL(mm)^b$ and value of R^2 , presented in Table 10.

Table 10

Paramters a , b of L-W ratio: $TW(g) = a \cdot SL(mm)^b$ and R^2

Equation parameters $TW(g) = a \cdot SL(mm)^b$	
a	0.000516298
b	2.73
R^2	0.89

3.1.1.4. PORT KAVARNA, 22.06.2019

The sample of 100 individuals rapana is with a total weight of 3.498 kg, from a total of 1792 kg rapana at Port Kavarna.

The summarized statistics of the biometric data is presented in Table 11. The average weight of the measured individuals is $34.98 \text{ g} \pm 19.22 \text{ SD}$, at an average length - $58.51 \text{ mm} \pm 7.87 \text{ SD}$, shell width - $47.73 \text{ mm} \pm 7.54 \text{ SD}$ and aperture length $41.96 \pm 6.70 \text{ SD}$. The body weight (BW, g) is $15.93 \text{ g} \pm 7.06 \text{ SD}$ and forms $44.39 \% \pm 4.41 \text{ SD}$ from the total, which is between 33% and 53.85 % from the total weight.

Table 11

Summarized statistics about the measured biological parameters – total weight (TW - weight with shell, TW, g), body weight (BW, g), % BW from TW, shell length (shell length, SL, mm), shell width (Wd, mm) and aperture length (aperture length, AL, mm), Kavarna, 22.06.2019

	TW,g	BW, g	% BW from TW	SL, mm	Wd, mm	AL, mm
Mean	34.98	15.93	44.39	58.51	43.73	41.96
Standard Error	1.92	1.00	0.62	0.79	0.75	0.67
Median	29.00	14.25	44.10	57.00	42.00	40.00
Mode	19.00	16.00	50.00	54.00	37.00	37.00
Standard Deviation	19.22	7.06	4.41	7.87	7.54	6.70
Sample Variance	369.25	49.88	19.49	61.89	56.83	44.95
Kurtosis	0.88	-0.43	-0.04	-0.65	-0.76	-0.81
Skewness	1.18	0.76	-0.08	0.54	0.47	0.47



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

Range	89.50	26.00	20.85	34.00	30.00	25.00
Minimum	10.50	7.00	33.00	44.00	31.00	31.00
Maximum	100.00	33.00	53.85	78.00	61.00	56.00
Sum	3498.00	796.50	2219.42	5851.00	4373.00	4196.00
Count	100.00	50.00	50.00	100.00	100.00	100.00
Confidence Level(95.0%)	3.81	2.01	1.25	1.56	1.50	1.33

The most common size classes in the sample are - 46 - 56 SL, mm (43 % from the analyzed individuals), as well as - 56 - 66 mm (33 %) and 66 – 76 mm (22 %). In regard to the weight structure (TW, g), the predominant class is with relatively low weights 10.5 - 25.6 g (42 % from the measured individuals), followed by class 25.6 - 51.2 g (36 %), while the individuals with weights 76.8 – 102.4 g are 5 % from the sample.

The following percentage ratios have been derived - width (Wd, mm)/ length (SL, mm) of the shells, aperture length (SL, mm)/total length (Wd, mm) of the shell and aperture length (AL, mm)/width (Wd, mm) of the shell (Table 12). The mean ratio width (Wd, mm)/length (SL, mm) is $74.43 \% \pm 4.14$ SD, while the AL/SL (%) is $71.54 \% \pm 3.55$ SD, while for the ratio AL/Wd (%), the derived results is - $96.19 \% \pm 2.89$ SD (Table 12).

Table 12

Percentage ratios between the shell width and length, aperture length/total shell length and aperture length/total width of the individuals from Kavarna, 22.06.2019

	Wd/SL (%)	AL / SL (%)	AL/Wd (%)
Mean	74.43	71.54	96.19
Standard Error	0.41	0.36	0.29
Median	74.00	71.67	95.83
Mode	69.81	68.52	100.00
Standard Deviation	4.14	3.55	2.89
Sample Variance	17.16	12.63	8.33
Kurtosis	0.14	2.62	-1.05
Skewness	0.20	0.75	-0.04
Range	23.77	23.77	10.42
Minimum	63.27	63.27	89.58
Maximum	87.04	87.04	100.00
Sum	7443.05	7153.99	9619.11
Count	100.00	100.00	100.00
Confidence Level(95.0%)	0.82	0.71	0.57



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

The following linear-weight relationships have been derived:

- 4) Between weight (TW, g) and linear size (SL, mm): $\text{Log TW (g)} = 3.7261 * \log SL (\text{mm}) - 5.0855$, ($R^2=0.91$, $p<0.001$, Fig.4.1).
- 5) Between weight (TW, g) and shell width (Wd, mm): $\text{Log TW (g)} = 2.9519 * \log Wd (\text{mm}) - 3.3397$, ($R^2=0.95$, $p<0.001$, Fig.4.2)
- 6) Between weight (TW, g) and aperture length (AL, mm): $\text{Log TW (g)} = 3.1469 * \log AL (\text{mm}) - 3.6047$ ($R^2=0.92$, $p<0.001$, Fig.4.3).

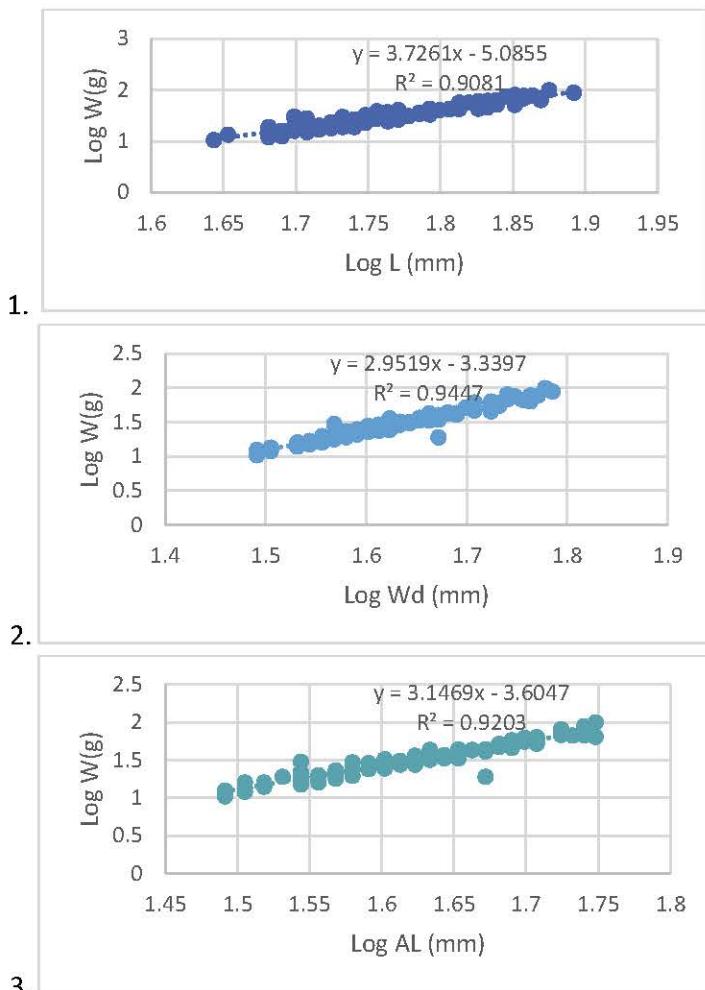


Figure 4. Linear-weight ratio (Log 10) for the measured individuals rapana, Kavarna,
22.06.2019



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ



The parameters a , b of the linear-weight ratio: $TW(g) = a \cdot SL(mm)^b$ and value of R^2 , presented in Table 13.

Table 13

Parameters a , b of the L-W ratio: $TW(g) = a \cdot SL(mm)^b$ and R^2 .

Equation parameters $TW(g) = a \cdot SL(mm)^b$	
a	0.0000082122
b	3.73
R^2	0.91

3.1.1.5. SUMMARIZED DATA FOR THE 2ND QUARTER OF 2019

Data for the period May – June 2019 shows that the total landing from all the observed ports were in the range 1792 - 10165 kg/day; the most abundant landings were observed from vessels, equipped with beam-trawl, at Port Varna in May 2019, while the smallest were in Kavarna (Table 14). Fishing vessels with length of 19.4 m, equipped with beam-trawl, may land up to 3420 kg per day, while smaller vessels (12.58-14.8 m) have landings in the range 1792 - 3020 kg/day.

Table 14

Summarized data about the landings by days and ports done by different types of vessels and different fishing techniques for the period May - June 2019

Date	Landing port	Fishing vessel length (m)	Landed quantity (kg) from the fishing vessel	Weight (kg) of the sample with 100 individuals <i>R. venosa</i>	Fishing technique	Date
23.05.2019	Varna	10165	12.58	3020	4.829	Beam trawl
31.05.2019	Varna	6135	14.9	3015	4.188	Beam trawl
14.06.2019	Varna	3420	19.4	3420	4.816	Beam trawl
22.06.2019	Kavarna	1792	14.52	1792	3.498	Beam trawl

During the 2nd quarter of 2019 the average size (SL, mm) of the individuals from all observed ports is $63.133 \text{ mm} \pm 8.94 \text{ SD}$ (Fig. 5.1). The biggest average size - 65.85 mm SL was observed in Varna (23.05.2019 r.), while the smallest - 58.51 mm SL was observed in Kavarna (22.06.2019 r.) (Table 15.1).



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

The average weight (TW, g) is $43.328 \text{ g} \pm 18.26 \text{ SD}$ for the period (Fig.5.2), with stable dynamics along the ports as with the average size (Table 15.2). The average body weight (BW, g) is 17.34 g (Table 15.3) and forms 40 % of the individuals' weight for the period, and the percentage ratio varies between 32 and 46 %.

Table 15

Statistical data about the distribution of the size (SL, mm, 1) and weight (TW, g, 2) of the samples from the ports, 2019

1. Size (SL, mm)

Date	Port	Observations number	Minimum SL, mm	Maximum SL, mm	Mean SL, mm	Std. deviation
23.05.2019	Varna	100	53.00	88.00	65.85	6.436
31.05.2019	Varna	100	49.00	84.00	62.73	8.645
14.06.2019	Varna	100	53.00	87.00	65.44	6.923
22.06.2019	Kavarna	100	44.00	78.00	58.51	7.867

2. Total weight (TW, g)

Variable	Port	Observations	Minimum	Maximum	Mean	Std. deviation
23.05.2019	Varna	100	23.50	101.50	48.295	13.616
31.05.2019	Varna	100	18.00	105.50	41.875	20.779
14.06.2019	Varna	100	25.00	97.00	48.160	15.358
22.06.2019	Kavarna	100	10.50	100.00	34.980	19.216

3. Body weight (BW, g)

Variable	Port	Observations	Minimum	Maximum	Mean	Std. deviation
23.05.2019	Varna	50	10.5	45.5	21.27	7.64
31.05.2019	Varna	50	6.5	27.5	13.42	5.49
14.06.2019	Varna	50	10	40.5	18.73	6.77
22.06.2019	Kavarna	50	7	33	15.93	7.06



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

Based on the summarized data for the 2nd quarter of 2019, the most common size class is - 56 - 66 SL mm (44.5 % from the analyzed individuals), as well as classes - 66 - 76 mm (31.25 %) and 46 - 56 mm (17.25 %, Fig. 5.1, Table 16.1).

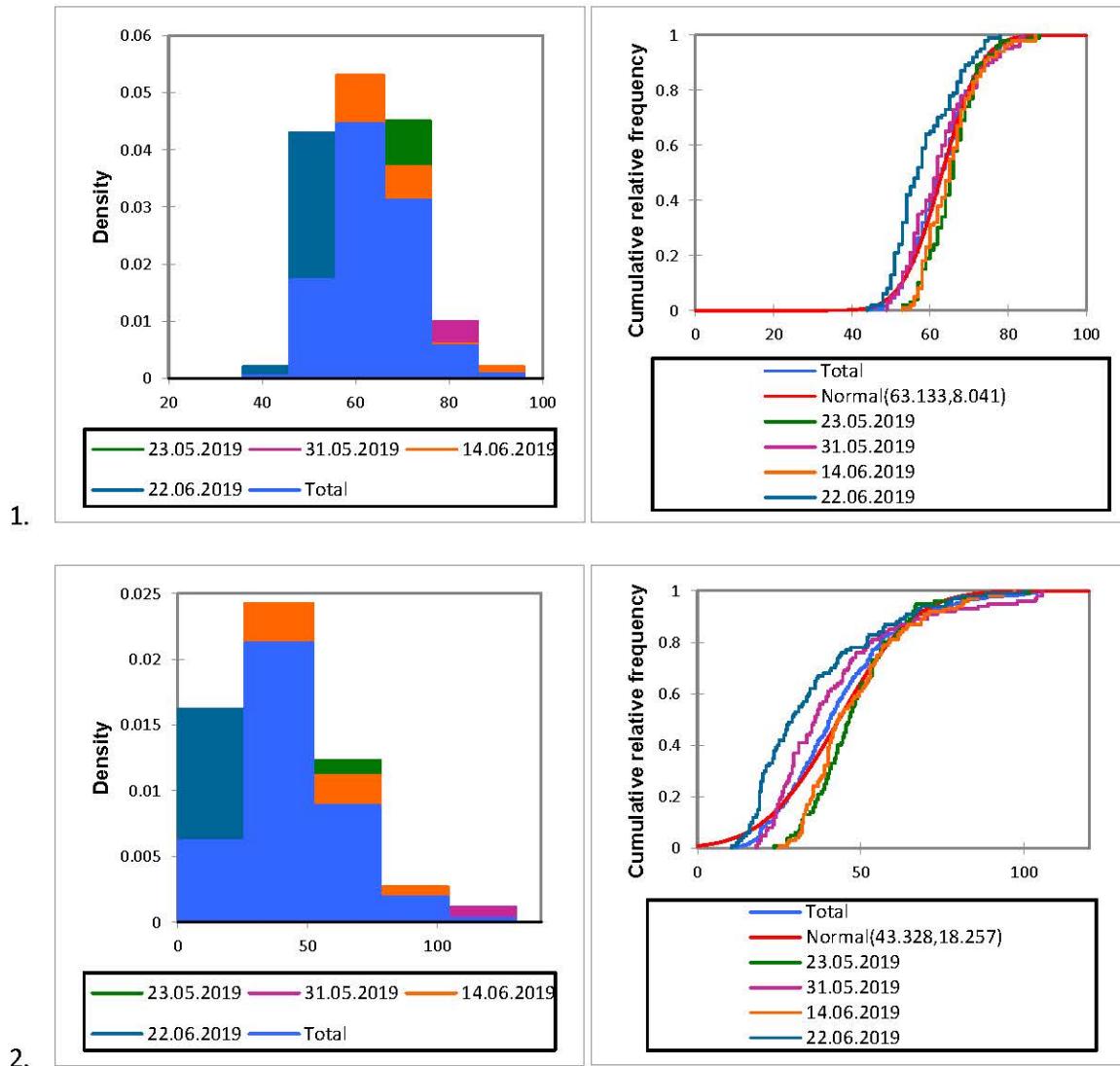


Figure 5. Distribution of the classes by individuals' length (SL, mm, 1) and weight by class (TW g, 2) for the 2nd quarter of 2019



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ



In regard to the weight structure (TW, g), the predominant classes are : 26 - 52 g (55.25 % from the measured individuals), 52 - 78 g (23 %) и < 26 g (16 % from the sample (Fig. 5.2, Table 16.2).

Table 16

Statistical data about the distribution of the size (mm, 1) and weight (g, 2) classes of rapana, in total for the 2nd quarter 2019

1	Lower bound	Upper bound	Frequency	Relative frequency	Density
	26	36	0	0.000	0.000
	36	46	2	0.005	0.001
	46	56	69	0.173	0.017
	56	66	178	0.445	0.045
	66	76	125	0.313	0.031
	76	86	23	0.058	0.006
	86	96	3	0.008	0.001

2	Lower bound	Upper bound	Frequency	Relative frequency	Density
		< 26	64	0.160	0.006
		26	52	221	0.553
		52	78	92	0.230
		78	104	20	0.050
		104	130	3	0.008
					0.000

Detailed data about the percentage distribution of the size classes for the 2nd quarter of 2019 for all samples is presented on Fig. 6. In the end of June in Kavarna (22.06.2019) were observed the smallest individuals with size < 45 mm and an increase in the percentage share of the individuals from class 46 - 56 mm.



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

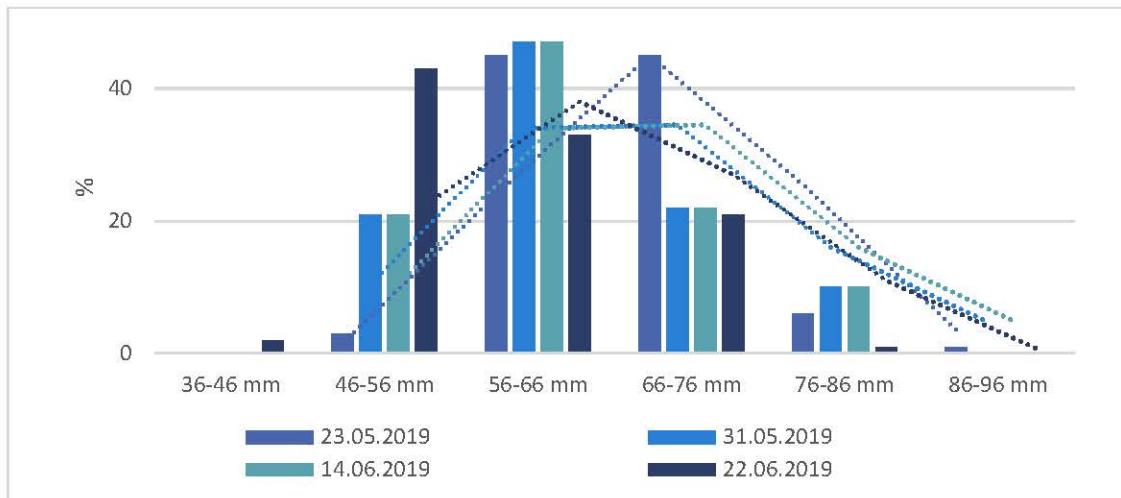


Figure 6. Percentage ratios for the size classes (SL, mm) and cumulative average values for the 2nd quarter for 2019

There were individuals with small weight < 26 g in Varna in the end of May 2019. Ratios are presented on Fig. 7.

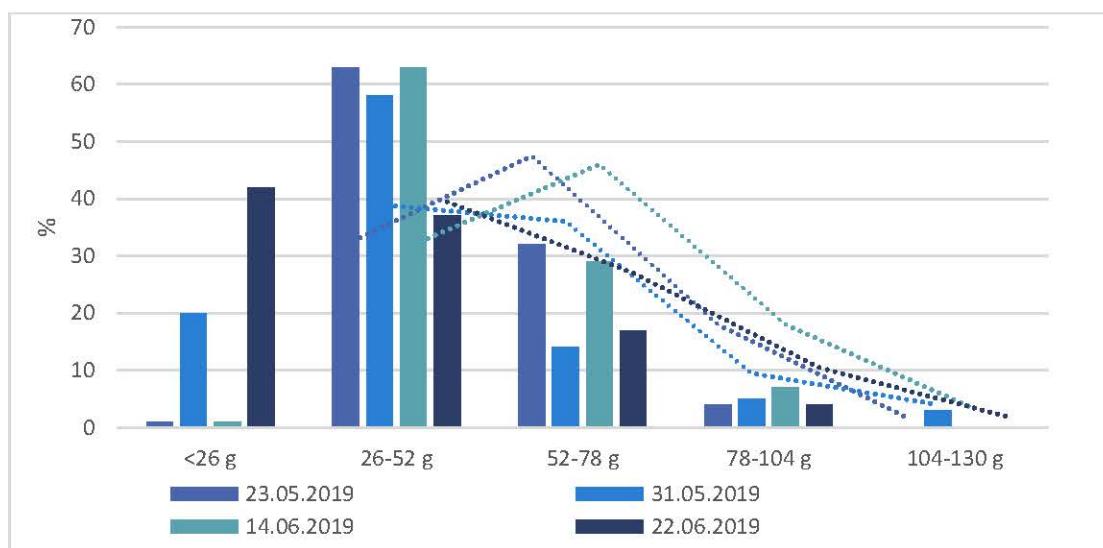


Figure 7. Percentage ratios for the size classes (TW, g) and cumulative average values for the 2nd quarter of 2019



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

The comparison analysis of the parameters a and b of the ratio $L\text{-}W : TW(g) = a \cdot SL(\text{mm})^b$, shows allometric growth of *R. venosa* in all the samples at $a \cdot b \neq 3$ (Fig.8).

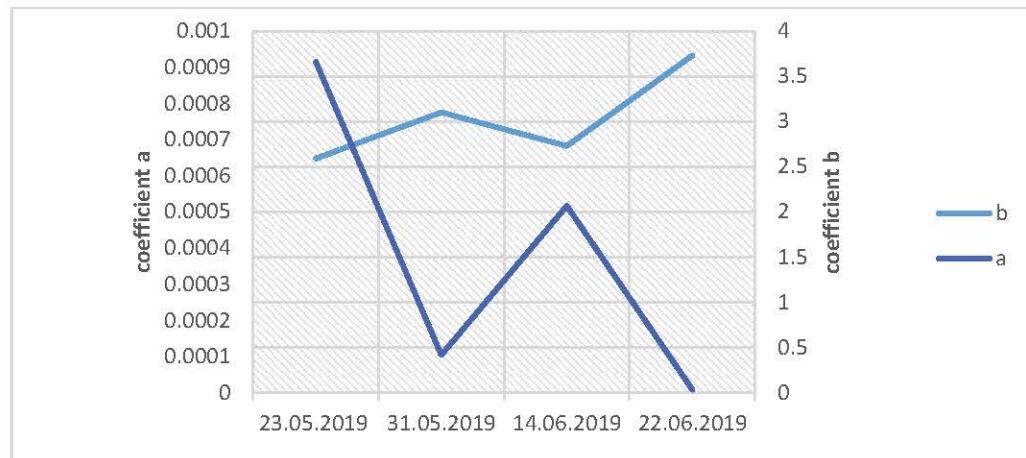


Figure 8. Parameters a , b of the linear-weight ratios, expressed by the equation: $TW(g) = a \cdot SL(\text{mm})^b$, for the different ports in the 2nd quarter of 2019

The parameter $b < 3$ is an indicator for a negative allometric growth, which means that for the larger individuals the growth in length surpasses the growth in weight. The coefficient b has least value of 2.59 in the sample from Varna, 23.05.2019, while the highest value of the coefficient is $b = 3.73$ in Kavarna, 22.06.2019 (Fig. 8).

The data about the percentage ratios of the shell width/length (Wd/SL, %) of *R. venosa*, aperture length/shell length (AL/SL, %) and aperture length/ shell width (AL/Wd, %) by ports for the 2nd quarter of 2019 is presented on Fig. 9.



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

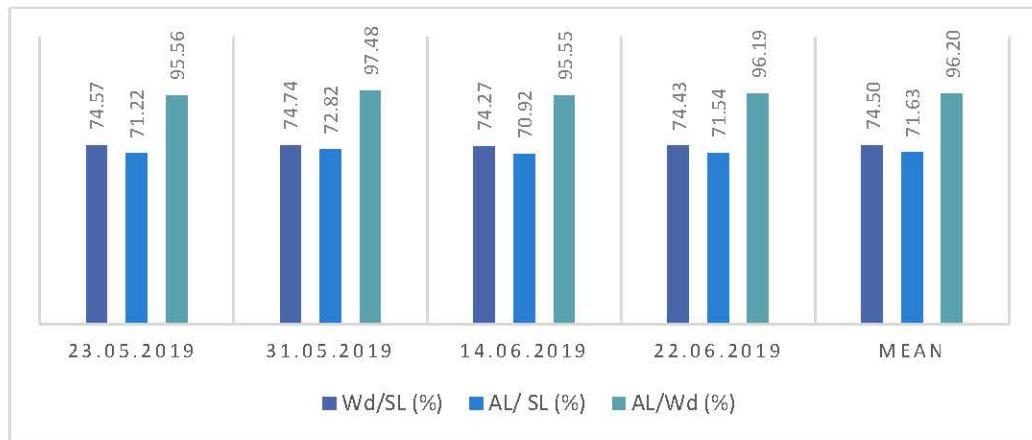


Figure 9. Percentage ratios of the shell width/length (Wd/SL, %) of *R. venosa*, aperture length/shell length (AL/SL, %) and aperture length/ shell width (AL/Wd, %) by ports

The average ratio of Wd/SL is 74.50 % for the second quarter of 2019, with minor variations in the samples in the range 74.27 % - 74.50 % (Fig.9). Accordingly, the ratio AL/SL is 71.63 % and varies between 70.92 % and 71.63 % for the different samples. The average percentage ratio of AL/Wd (%) is 96.20 %, with minor variations in the range - 95.55 % - 97.48 %.

3.1.2. SEX STRUCTURE

3.1.2.1. PORT VARNA, 23.05.2019

The ratio between sexes in the representative part of the sample is 66.07 % ♂ to 33.93 % ♀ or 1.95 : 1. The shell length of the female individuals is (SL, mm) 62.84 mm ± 4.37 SD, while the males are longer by 7.96 % on average (Table 17).

Table 17

Summarized statistics of the biological parameters - total weight of the individuals, shell length (SL, mm) and body weight (TW, g) by sex in the sample from port Varna, 23.05.2019

	SL, mm		TW, g	
	Females	Males	Females	Males
Mean	62.84	67.84	43.74	52.84
Standard Error	1.00	1.34	2.15	3.06
Median	62.00	66.00	41.00	48.50



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

Mode	59.00	66.00	37.00	42.50
Standard Deviation	4.37	8.18	9.35	18.62
Sample Variance	19.14	66.86	87.48	346.71
Kurtosis	-0.58	0.46	0.08	0.98
Skewness	0.51	0.90	0.65	1.19
Range	14.00	32.00	35.00	74.00
Minimum	57.00	56.00	31.00	27.50
Maximum	71.00	88.00	66.00	101.50
Sum	1194.00	2510.00	831.00	1955.00
Count	19.00	37.00	19.00	37.00
Confidence Level(95.0%)	2.11	2.73	4.51	6.21

The predominant size classes for the female individuals are (SL, mm): 56 - 66 mm - 73.68 % and 66 - 76 mm - 26.31 %. The most common size class for the male individuals is 56 - 66 mm (43.24 %), however the second size class is 66 - 76 mm (37.83 %), which is a bigger share compared to the female individuals. In regard to the weight structure, the male individuals have an average weight of 52.84 g ± 18.62 SD, while the female individuals are 17% lighter. The predominant weight class for the males is 26 - 52 g or 59.46 %, followed by class 52 - 78 g - 27.02 %. The shares for the same classes for the females are 78.95 % and 21.05 % respectively.

The parameters shell width (Wd, mm) and aperture length (aperture length, AL, mm), as well as the percentage differences between both sexes are presented in Table 18.

Table 18

Summarized statistic of the biological parameters - shell width (Wd, mm) and aperture length (aperture length, AL, mm) by sex in the sample from port Varna, 23.05.2019 г.

	Wd, mm		AL, mm	
	Females	Males	Females	Males
Mean	46.89	50.54	45.11	48.68
Standard Error	0.78	0.96	0.79	1.01
Median	46.00	49.00	45.00	48.00
Mode	44.00	49.00	48.00	47.00
Standard Deviation	3.40	5.86	3.43	6.16
Sample Variance	11.54	34.31	11.77	38.00
Kurtosis	0.02	0.14	1.02	0.11
Skewness	0.60	0.69	0.69	0.66

26

www.eufunds.bg

Проект № BG14MFOPO01-3.003-0001-C01, „Събиране, управление и използване на данни за целите на научния анализ и изпълнението на Общата политика в областта на рибарството за периода 2017-2019 г.“, финансирано от Програмата за морско дело и рибарство, съфинансирана от Европейския съюз чрез Европейския фонд за морско дело и рибарство.



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

Range	13.00	23.00	14.00	24.00
Minimum	42.00	41.00	40.00	39.00
Maximum	55.00	64.00	54.00	63.00
Sum	891.00	1870.00	857.00	1801.00
Count	19.00	37.00	19.00	37.00
Confidence Level(95.0%)	1.64	1.95	1.65	2.06

3.1.2.2. PORT VARNA, 31.05.2019

The ratio between sexes in the representative part of the sample 60 % ♂ : 40 % ♀ or 1.5 : 1. In regard to the shell length (SL, mm), the female individuals have an average length of 60.40 mm ± 7.26 SD, while the males are 5.73 % longer (Table 19). The weight of the individuals (TW, g) shows that the average for the males is 43.87 g ± 22.21 SD, while the females are lighter by 22%. (Table 19).

Table 19

Summarized statistic about the measured biological parameters - total weight of the individuals (SL, mm) and body weight (TW, g) by sex in the sample from Varna, 31.05.2019

	SL, mm		TW, g	
	Females	Males	Females	Males
Mean	60.40	64.07	36.03	43.87
Standard Error	1.62	1.68	3.54	4.05
Median	57.50	62.50	31.50	36.25
Mode	57.00	62.00	24.00	31.00
Standard Deviation	7.26	9.20	15.84	22.21
Sample Variance	52.67	84.62	250.88	493.12
Kurtosis	2.34	-0.54	5.94	1.31
Skewness	1.40	0.48	2.12	1.34
Range	30.00	34.00	69.50	84.50
Minimum	51.00	49.00	19.50	21.00
Maximum	81.00	83.00	89.00	105.50
Sum	1208.00	1922.00	720.50	1316.00
Count	20.00	30.00	20.00	30.00
Confidence Level(95.0%)	3.40	3.43	7.41	8.29



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ



The predominant size class for the male individuals is - 56 - 66 mm (40 % from the analyzed individuals), followed by 66 - 76 mm (26.67%). The most common size class for the female individuals is - 56 - 66 mm (65 %), followed by class 46 - 56 mm (20 %). The individuals with size > 66-86 mm are 15 % from all individuals. The predominant weight class for the male individuals is - 26 - 52 g - 53.33 %, followed by class - 52 -78 g and <20 g, approximately 20 % from the weight classes. As for the female individuals, the predominant weight class is -26 - 52 g, with a share of 55 % from the weight classes, followed by weight class <20 g or 30 %.

Table 20

Summarized statistics of the biological parameters - shell width (Wd, mm) and aperture length (aperture length, AL, mm) by sex in the sample from port Varna, 31.05.2019

	Wd, mm		Al, mm	
	Females	Males	Females	Males
Mean	45.65	48.47	44.70	47.13
Standard Error	1.36	1.36	1.32	1.33
Median	45.00	48.00	44.00	46.50
Mode	48.00	48.00	38.00	47.00
Standard Deviation	6.08	7.47	5.89	7.26
Sample Variance	36.98	55.84	34.64	52.67
Kurtosis	3.28	-0.45	3.96	-0.22
Skewness	1.54	0.56	1.57	0.52
Range	26.00	27.00	25.00	29.00
Minimum	38.00	37.00	38.00	34.00
Maximum	64.00	64.00	63.00	63.00
Sum	913.00	1454.00	894.00	1414.00
Count	20.00	30.00	20.00	30.00
Confidence Level(95.0%)	2.85	2.79	2.75	2.71

3.1.2.3. PORT VARNA, 14.06.2019

In the representative part of the sample the ratio between the sexes is 38 % ♀ : 62 % ♂ - 1:1.63. In regard to the shell size (SL, mm), the females have an average size of $60.74 \text{ mm} \pm 3.75 \text{ SD}$, while the males are 12 % bigger (Table 21). The average body weight of the male individuals is $52.47 \text{ g} \pm 18.60 \text{ SD}$, while the average weight of the females is 36 % less (Table 21).



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

Table 21

Summarized statistics of the biological parameters - total weight of the individuals, shell length (SL, mm) and body weight (TW, g) by sex in the sample from port Varna, 14.06.2019 г.

	SL, mm		TW, g	
	Females	Males	Females	Males
Mean	60.74	67.81	38.53	52.47
Standard Error	0.86	1.47	2.05	3.34
Median	60.00	65.00	35.50	44.50
Mode	58.00	65.00	35.50	40.00
Standard Deviation	3.75	8.16	8.95	18.60
Sample Variance	14.09	66.56	80.15	346.02
Kurtosis	-0.40	0.36	3.48	0.23
Skewness	0.73	0.89	1.83	1.09
Range	13.00	31.00	36.50	67.00
Minimum	56.00	56.00	28.00	30.00
Maximum	69.00	87.00	64.50	97.00
Sum	1154.00	2102.00	732.00	1626.50
Confidence Level (95.0%)	19.00	31.00	19.00	31.00

The predominant size class for the male individuals is (SL, mm) 56 - 66 mm - 54.84 % from the measured individuals, followed by class 66 - 76 mm - 29.03 %. As for the female individuals - 56 - 66 mm, forming 89.47 %, while the share of class 66 - 76 mm is 10.53 %. The predominant weight classes for the male individuals are 26 - 52 g - 58.06 %, as well as - 52-78 g - 25.81 %. The most common weight class for the female individuals is 26 - 52 g - 89.47 %.

The percentage ratios of the parameters shell width (Wd, mm) and aperture length (aperture length, AL, mm) are 13.56 % and 14.27 %, with the highest ratio for the male individuals (Table 22).

Table 22

Summarized statistics about the measured biological parameters – shell width (Wd, mm) and aperture length (aperture length, AL, mm) by sex in the sample from Varna, 14.06.2019

	Wd, mm		AL, mm	
	Females	Males	Females	Males



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

Mean	45.00	51.10	42.79	48.90
Standard Error	0.80	1.14	0.79	1.05
Median	44.00	49.00	43.00	47.00
Mode	43.00	47.00	41.00	45.00
Standard Deviation	3.48	6.33	3.46	5.87
Sample Variance	12.11	40.02	11.95	34.49
Kurtosis	1.63	0.75	0.58	0.98
Skewness	1.16	0.96	0.87	0.95
Range	14.00	28.00	13.00	27.00
Minimum	39.00	40.00	37.00	38.00
Maximum	53.00	68.00	50.00	65.00
Sum	855.00	1584.00	813.00	1516.00
Count	19.00	31.00	19.00	31.00
Confidence Level(95.0%)	1.68	2.32	1.67	2.15

3.1.2.4. PORT KAVARNA, 22.06.2019

The ratio between sexes in the representative part of the sample 52 % ♀ : 48 % ♂ or 1.08 :

1. In regard to the shell length (SL, mm), the average size for the female individuals is 58.12 mm ± 6.79 SD, while the male individuals are with 5% bigger (Table 23). The average weight of the male individuals is 38.25 g ± 16.18 SD, while for the females is 9% smaller.

Table 23

Summarized statistics of the biological parameters - total weight of the individuals, shell length (SL, mm) body weight.(TW, g) by sex in the sample from port Kavarna, 22.06.2019 г.

	SL, mm		TW, g	
	Females	Males	Females	Males
Mean	58.12	60.79	34.94	38.25
Standard Error	1.32	1.62	3.81	3.43
Median	56.50	59.50	29.25	34.25
Mode	53.00	67.00	19.00	27.00
Standard Deviation	6.72	7.93	19.44	16.80
Sample Variance	45.15	62.95	377.89	282.15
Kurtosis	0.51	-1.10	4.34	-1.03
Skewness	1.09	0.09	1.95	0.48



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

Range	26.00	26.00	84.00	52.50
Minimum	49.00	48.00	16.00	16.00
Maximum	75.00	74.00	100.00	68.50
Sum	1511.00	1459.00	908.50	918.00
Confidence Level (95.0%)	26.00	24.00	26.00	24.00

The predominant size classes for the male individuals are - 46 - 56 mm, 56-66 mm and 66-76 mm - * 33.33 %, while for the female individuals there are two predominant classes - 46 - 56 mm (46.15 %) and 56 -66 mm - 38.46 %.

The predominant weight class for the male individuals is 26 - 52 g - 41.67 %, while weight classes 52-78 g and < 26 g are 29.17 % each. For the females, the most common weight class is 26 -52 g – 46.15 %, while lighter individuals with weights < 26 g are 38.46 %.

The parameters shell width (Wd, mm) and aperture length (aperture length, AL, mm) have the following percentage ratios for males and females, respectively 5.6 % and 5.5 % (Table 24).

Table 24

Summarized statistic of the biological parameters - shell width (Wd, mm) and aperture length (aperture length, AL, mm) by sex in the sample from port Varna, 14.06.2019

	Wd, mm		Al,mm	
	Females	Males	Females	Males
Mean	43.62	46.08	41.27	43.54
Standard Error	1.26	1.45	1.16	1.37
Median	42.00	46.00	39.50	43.00
Mode	37.00	41.00	38.00	39.00
Standard Deviation	6.44	7.10	5.93	6.71
Sample Variance	41.45	50.43	35.16	45.04
Kurtosis	0.35	-1.20	0.29	-1.18
Skewness	0.87	0.04	0.85	0.13
Range	26.00	24.00	24.00	22.00
Minimum	34.00	34.00	32.00	33.00
Maximum	60.00	58.00	56.00	55.00
Sum	1134.00	1106.00	1073.00	1045.00
Count	26.00	24.00	26.00	24.00



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ



Confidence Level(95.0%)	2.60	3.00	2.40	2.83
-------------------------	------	------	------	------

3.1.2.5. GONADOSOMATIC INDEX (GSI)

The summarized statistical data for the dynamics of the gonadosomatic index (GSI) for the 2nd quarter of 2019, are presented in Table 25.

Table 25

Summarized statistics of GSI by ports for the 4th quarter of 2019

	23.05.2019	31.05.2019	14.06.2019	22.06.2019
Mean	15.36	22.84	14.96	15.07
Standard Error	0.40	0.79	0.61	0.62
Median	15.00	23.08	14.80	14.42
Mode	14.29	23.53	17.24	14.29
Standard Deviation	2.87	5.59	4.31	4.39
Sample Variance	8.21	31.22	18.57	19.25
Kurtosis	0.39	-0.28	1.23	0.91
Skewness	-0.05	-0.35	-0.29	0.86
Range	13.79	22.62	22.06	20.88
Minimum	8.16	10.71	2.94	7.69
Maximum	21.95	33.33	25.00	28.57
Sum	783.59	1141.84	747.90	753.30
Count	51.00	50.00	50.00	50.00
Confidence Level(95.0%)	0.81	1.59	1.22	1.25

The GSI is 17.06% on average for the researched period, while the highest GSI (% BW) is in the sample from Varna on 31.05.2019 - 22.84 % BW ± 5.59 SD (Table 25).

3.1.2.6. SUMMARY OF THE SEX STRUCTURE FOR THE 2ND QUARTER OF 2019

The mean ratio for the sex structure in both monitoring areas is 41 % ♀: 59 % ♂ (Fig. 10). There were no imposex forms observed in the 2nd quarter of 2019.



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

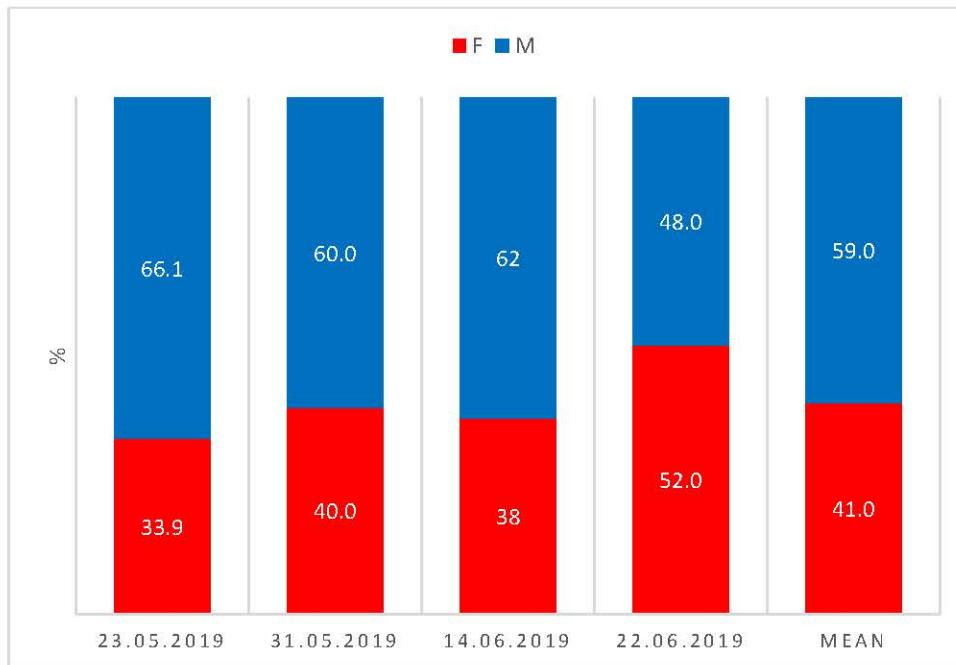


Figure 10. Summarized data about the sex structure of *R. venosa* by ports for the 2nd quarter of 2019

During the 2nd quarter of 2019 the average size (SL, mm) of the male individuals for both ports is 65.13 mm, the biggest average size was observed in Varna (23.05.2019) - 67.84, while the smallest in Kavarna (22.06.2019) - 60.79 mm (Table 26.1, Fig.11).

Table 26

Statistical data about the size distribution (SL, mm, 1) and weight (TW, g, 2) by sex for the samples for the 2nd quarter of 2019

1. Size (SL, mm)

Date	Port	Observations number	Sex	Minimum SL, mm	Maximum SL, mm	Mean SL, mm	Std. deviation
23.05.2019	Varna	37	M	56.000	88.000	67.838	8.177
		19	F	57.000	71.000	62.842	4.375
31.05.2019	Varna	30	M	49.000	83.000	64.067	9.199
		20	F	51.000	81.000	60.400	7.258
14.06.2019	Varna	31	M	56.000	87.000	67.806	8.159



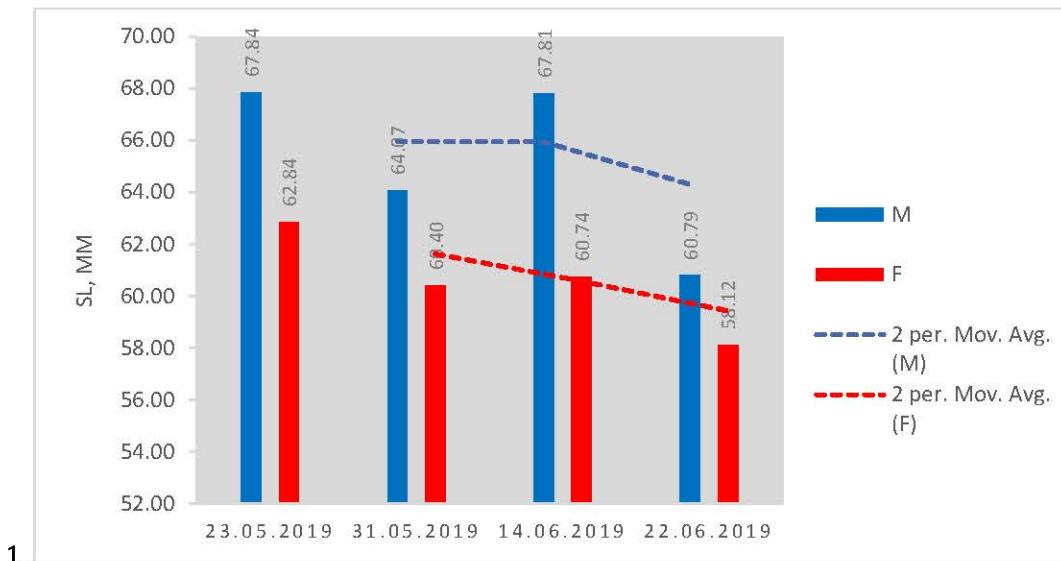
МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

		19	F	56.000	69.000	60.737	3.754
22.06.2019	Kavarna	24	M	48.000	74.000	60.792	7.934
		26	F	49.000	75.000	58.115	6.719

2. Total weight (TW, g)

Date	Port	Observations number	Sex	Minimum SL, mm	Maximum SL, mm	Mean SL, mm	Std. deviation
23.05.2019	Varna	37	M	27.500	101.500	52.838	18.620
		19	F	31.000	66.000	43.737	9.353
31.05.2019	Varna	30	M	21.000	105.500	43.867	22.206
		20	F	19.500	89.000	36.025	15.839
14.06.2019	Varna	31	M	30.000	97.000	52.468	18.601
		19	F	28.000	64.500	38.526	8.953
22.06.2019	Kavarna	24	M	16.000	68.500	38.250	16.797
		26	F	16.000	100.000	34.942	19.439

The average size of the female individuals is 60.52 mm, which is a 7 % difference from the male individuals (bigger). The dynamics of the average size is similar for both sexes. The average weight for the males is 46.86 g, while for the females - 38.31 g, resulting in a 20% difference.



1.



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

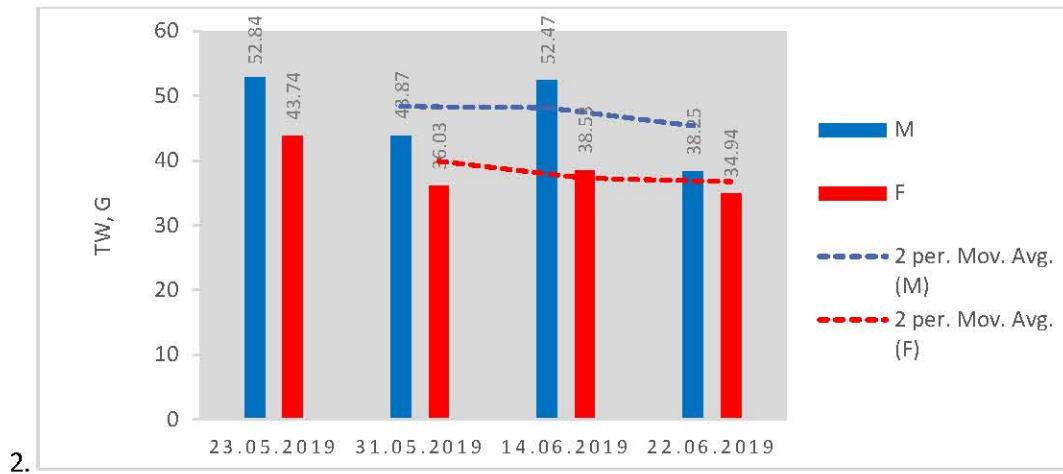
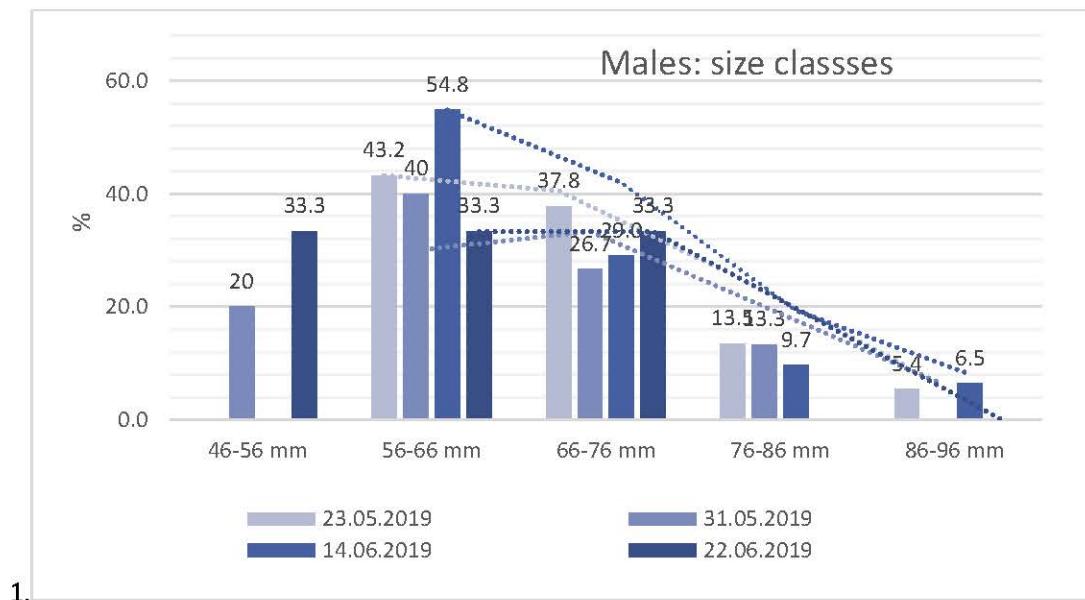


Figure 11. Summarized data (1) average size (SL, mm) by sex *R. venosa* and (2) average total weight (TW, g) by sex for the landings in the 2nd quarter of 2019

The analysis on the dynamics of the size classes by sex shows that the most dominant class is 56 - 66 mm for both sexes, which is about 43% of all the male individuals and 67% of the females. The next most common class for the male individuals is 66 - 76 mm (32%), while for the females is 46 - 56 mm (17 %), followed by size class 66 -76 mm (16% of all the individuals) (Fig. 12.2).





МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

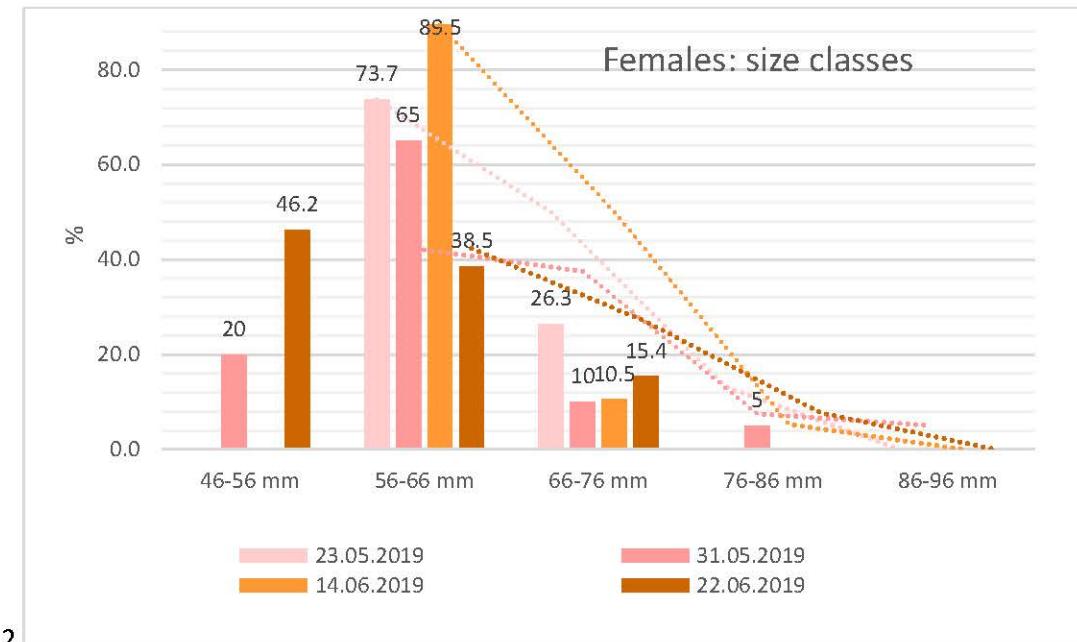


Figure 12. Percentage distribution of the size classes (SL, mm) for the males (1) and females (2) individuals for the 2nd quarter of 2019

In regard to the weight structure (Fig. 13), the predominant weight class for both sexes is - 26 - 52 g, which was observed in 53 % of the male individuals and 67 % of the female individual. The second most common weight class is - 52 - 78 g, which was observed in 25 % of the males and 16 % of the females. On average for the period, low weights < 26 g in 13 % of the male individuals and 15 % of the females, while high weights (> 78 g) were registered in 9 % of the males and 3 % of the females.



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ

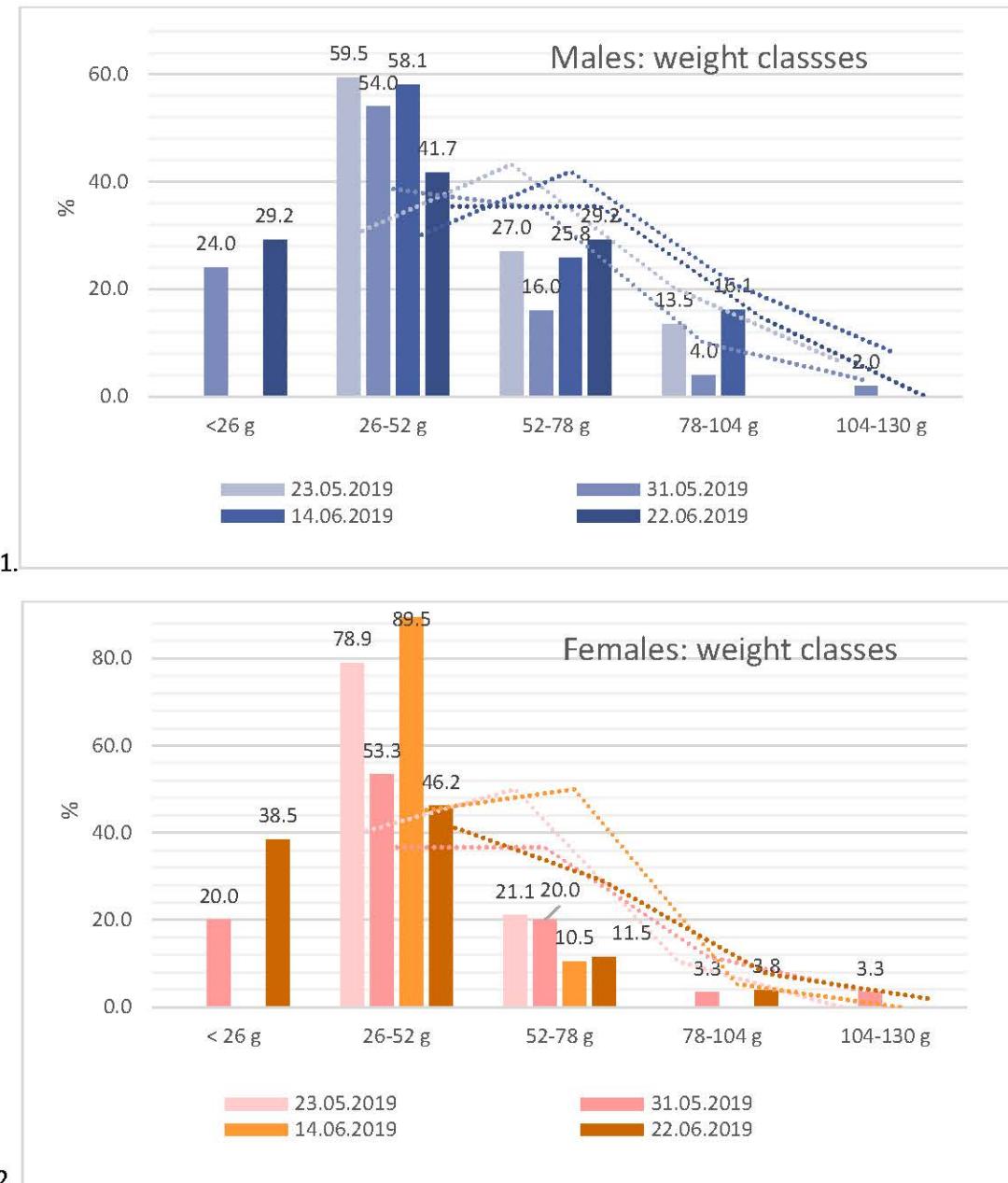


Figure 13. Percentage distribution of the weight classes (TW, g) for the males (1) and females (2) individuals for the 2nd quarter of 2019



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ



4. CONCLUSIONS

- The analysis on the rapana landings for the 2nd quarter of 2019 is based on 400 individuals, collected at two ports – Kavarna and Varna. The analysis is focused on the population characteristics and the differences between the two fishing zones.
- The total landings from both ports varies between 1792 - 10165 kg/day; the most abundant landings are observed at Port Varna in May 2019, collected by beam-trawl technique. On the other hand, the smallest landings are observed in Kavarna. Fishing vessels with length of 19.4 m, equipped with beam-trawl, may land 3420 kg/day on average, while smaller vessels with lengths 12.6 - 14.8 m land between 1792 - 3020 kg/day.
- During the 2nd quarter of 2019, the average size (SL, mm) of the individuals from the two ports is $63.13 \text{ mm} \pm 8.94 \text{ SD}$. The biggest size is observed in Varna (23.05.2019)- 65.85 mm SL, while the smallest size - 58.51 mm SL in Kavarna (22.06.2019). The average weight (TW, g) reaches $43.33 \text{ g} \pm 18.26 \text{ SD}$ for the period and there is a clear trend for the stable dynamics of the average size for both ports. The average body weight (BW, g) is 17.34 g, forming 40 % of the total weight, while this ratio varies between 32 % - 46 %.
- Based on the data, the most common size class for the rapana is 56 - 66 SL mm (44.5 % from the analyzed individuals), as well as classes - 66 - 76 mm (31.25 %) and 46 - 56 mm (17.25 %). In regard to the weight structure (TW, g), the following classes are dominant: 26 - 52 g (55.25 % from the measured individuals), 52 - 78 g (23 %) и < 26 g (16 % from the samples).
- The comparison analysis on the parameters a and b of the L-W ratio: $W(g)=a \cdot L(\text{mm})^b$ shows allometric growth of *R. venosa* at a coefficient $b \neq 3$.
- The average ratio between Wd/SL is 74.50 % for the 2nd quarter of 2019. The variation in the ratio is negligible 74.27 % - 74.50 %. The ratio AL/SL is 71.63 % on average, varying between 70.92 % and 71.63 %. The average ratio of AL/Wd (%) for the 2nd quarter of 2019 is 96.20 %, with negligible variations - 95.55 % - 97.48 %.
- Based on the data the percentage ratio of the sex structure is as follows ♀ : ♂ 41 % ♀: 59 ♂. No imposex forms were observed.
- During the 2nd quarter of 2019 the average size of the male individuals reaches 65.13 mm, the biggest average size is - 67.84 mm in the sample from Port Varna (23.05.2019), while the least in size - 60.79 mm in the sample from Port Kavarna (22.06.2019). The average size of the female individuals is 60.52 mm, which is 7% difference compared to the males and shows similar dynamics for both landing ports. In regard to the weight, the male individuals have an average weight of 46.86 g, while the females - 38.31 g, thus making a 20 % difference between the two sexes.



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ



- The size class - 56 - 66 mm is the most common for both sexes and forms about 43 % of the male individuals and 67 % of the females for the observed period. The second size class is - 66 - 76 mm, which form 32% from all the measured male individuals, while for the females it 46 - 56 mm (17 %). The third most common size class for both sexes is 66 -76 mm (16 % from all the individuals). The analysis on the weight structure for both sexes shows that the predominant weight class is 26 -52 g, with a share of 53 % from the male individuals and 67 % of the females. The second most common weight class is - 52 - 78 g, with a share of 25 % for the males and 16 % for the female individuals. The individuals with small weight < 26g are just 13 % for the males and 15 % for the females. On the other hand, the bigger individuals > 78 g are 9 % and 3 % for males and females respectively.
- The gonadosomatic index (GSI) for the 2nd quarter of 2019 is 17.06 % BW, with a maximum value of 22.84 % BW in the sample from Varna on 31.05.2019.



МИНИСТЕРСТВО НА ЗЕМЕДЕЛИЕТО, ХРАНИТЕ И
ГОРИТЕ



5. REFERENCES

1. ICES, 2004/ACFM:12: Advisory Committee on Fishery Management Report of the Workshop on Sampling and Calculation Methodology for Fisheries Data (WKSCMFD), 26–30 January 2004 Nantes, France, 242 pp
2. ICES, 2011. Report of the Study Group on Practical Implementation of Discard Sampling Plans (SGPIDS) , 27 June - 1 July 2011, ICES Headquarters, Denmark. ICES CM 2011/ACOM: 50. 116 pp
3. ICES. 2013. Report of the Study Group on Practical Implementation of Discard Sampling Plans (SGPIDS), 24 June – 28 June 2013, Lysekil, Sweden. ICES CM 2013/ACOM:56. 142pp