Methodology for research on *Rapana venosa* landings at ports in Bulgarian Black Sea waters

1. INTRODUCTION

The benthic snail *Rapana venosa* was introduced into the Black Sea in the 1940s and within a few decades spread over the entire basin and in the Azov Sea (Global Invasive Species Database). R. venosa is a predator of epifaunal bivalves, and its proliferation appears a limiting factor of oysters and mussels' populations (CEISM 2000). The species is considered as one of the most unwelcome invaders worldwide and it is blamed for the decline of the native bivalve fauna in the Black Sea (ZOLOTAREV 1996, in HARDING 2003).

The industrial exploitation of Rapa whelk in the Black Sea has started first in Turkey during the 1980s, and currently Turkish catch varies between 6 and 8 thousand tons annually. Recently, all Black Sea countries target *Rapana*, with a total annual catch of 10-15 thousand tons. In Bulgaria, this fishery has commenced in the 1990s and Rapa whelk was originally caught by scuba divers (DASKALOV and RÄTZ, 2010), with catches around 90% of the total shellfish catch (FAO, 2000). Since 2012, the *Rapana* catch with beam trawl has been allowed in Bulgaria, regulated by changes in the Fishery and Aquacultures Act.

Based on a large catch of this species in the Bulgarian waters, scientific information on the *Rapana* landings at ports is needed, and the data collection has been performed on a quarterly basis throughout each year since 2018. The minimal amount, collected per year should include 1200 individuals, gathered from four ports – from the northern and southern regions of the Bulgarian Black Sea coast.

1.1. COLLECTED DATA

The study should allow 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 length (m)

2. Fishing gear
- Depth scale of the fishing activities

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 individuals (Total weight, weight with shell (TW, g))
- Shell length of the individuals (Shell length, SL, mm),
- Shell width of the individuals (Wd, mm)
- Aperture shell length of the individuals (Aperture length, AL, mm).

4. Additional biological data
- Ratio between sexes, sex maturity of collected individuals and gonadosomatic index (when applicable);
- Size and weight structure by sex, sex ratio to shell length and sex ratio to total weight;

The final results should be included in reports with tables and figures, including a full

explanation of the collected data about:

- Landings of the target species at ports
- Biological parameters of *Rapana venosa* – lenght, weight, length-weight relationships, sex structure from the samples of the observed ports.

2. MATERIAL AND METHODOLOGY

2.1. SAMPLING SCHEME

Full explanation of the observation scheme should be presented (by the models given below).

Table

Vessels and ports, where biological samples were taken from *Rapana venosa* landings on quarterly basis

Date	**Fishing vessel**	**Reg. No of fishing vessel**	**Technical specifications**	**Departure port**	**Arrival port**	**Fishing method**

Table

Summarized data about the landings by days and ports by different types of vessels and different fishing methods on quarterly basis

Date	Landing port	Total daily landing of *R. venosa* at the port (kg/day)	Name of the fishing vessel	Landed quantity from the studied fishing vessel (kg)	Weight of the sample of 100 individuals *R. venosa* (kg)	Fishing technique

2.2. SAMPLE ANALYSIS

Random samples of *R. venosa* should be taken from the landings by ports with the purpose to monitor the dynamics and species characteristics during the active fishing season.

The accuracy of the program for sample collection should be based on the following documents:

- "Report of the Workshop on Sampling and Calculation Methodology for Fisheries Data" (WKSCMFD) (ICES 2004): https://www.ices.dk/sites/pub/CM%20Doccuments/2004/ACFM/ACFM1204.pdf

- Report SGPIDS (ICES, 2011a): https://www.ices.dk/community/Documents/PGCCDBS/SGPIDS%202011.pdf
- Report of the Study Group on Practical Implementation of Discard Samples (SGPIDS) 2013: https://www.ices.dk/sites/pub/Publication%20Reports/Expert%20Group%20Report/acom/2013/SGPIDS/SGPIDS13.1.pdf

2.3. Laboratory Analysis

- For each individual, the following biometric parameters were measured – total weight of the individual (total weight, weight with shell, TW, g), body weight (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 was calculated;
- The sexual maturity of the collected individuals and the relationship between the sexes were determined, as well as the gonadosomatic index (if applicable);
- The length - weight structure by sex, the ratio of the sexes to the shell length and to the weight of the specimens were determined.
- Estimation of sex of Rapana venosa is based on the following paper: Bondarev, 2015, Sexual differentiation and variations in sexual characteristics of Rapana venosa (Valenciennes, 1846), International Journal of Marine Science, Vol.5, No.19 1-10 (doi: 10.5376/ijms.2015.05.0019; https://www.researchgate.net/publication/277553129_Sexual_differentiation_and_variations_sexual_characteristics_Rapana_venosa_Valenciennes_1846Sex

To ensure accurate measurements, the laboratory equipment (Fig.1) should be kept in good condition, scales should be regularly calibrated and checked (preferably yearly by a qualified technician).

Fig. 1 Laboratory equipment

The laboratory protocols for each sample include a full description of all measurements. All biological data, produced in a laboratory, should be completely documented and should be traceable back to its origin. The necessary documentation should contain a description of sampling equipment

and procedures, reference to standard operating procedures (SOP) for sample handling and analytical procedures involved. Data files should be kept on several laptops and to be updated synchronously.

2.4. Analytical Methods

The morphometric relationships between the biological parameters - total weight (TW), shell length (SL), shell width (Wd), aperture length (AL) were analyzed on the basis of classical allometric models. The least squares method was used to estimate the linear - weight relationships (**LWR**), based on the following equation:

$W = a \times L^b$, where, W – weight; L – length; a, b – constants.

The XLSTAT software product was used to display the linear-weight histograms of the samples from the *Rapana* landings. The statistical data about the different length and weight classes, presented in the histograms, include lower and upper limits, frequency, relative frequency, and density.

2.5 DQA and DQC

IFR-Varna apply internal rules for **Data Quality Control (DQC)** and **Data Quality Assurance (DQA)** for laboratory studies, including all steps of marine data collection and analysis - from sea expedition to final reporting. For example, all measurements should be included in protocols and checked by two different persons for mistakes (scientist and project leader). If any corrections are needed, they are presented in separate protocols, controlled by two scientists.

https://ifrvarna.com/images/files/ichtiol/Guidelines_DQA_DQC_Bulgaria.pdf

2.6. Reporting

Summarized statistics (Mean values, Standard Error, Median, Mode, Standard Deviation, Sample Variance, Kurtosis, Skewness, Range, Minimum, Maximum, Confidence Level, 95.0%) about the measured biological parameters of *Rapana* by ports - 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 (AL, mm) should be presented separately.

Table

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 (AL, mm) for the sample from the port (name), date.

	TW, g	BW, g	% BW from TW	SL, mm	Wd, mm	AL, mm
Mean						
Standard Error						
Median						
Mode						
Standard Deviation						
Sample Variance						
Kurtosis						
Skewness						
Range						
Minimum						
Maximum						

Sum						
Count						
Confidence Level (95.0%)						

Sex structure data:

The sex ratio and statistics about - total weight of the individuals, shell length (SL, mm) and total weight (TW, g), shell width (Wd, mm), and aperture length (aperture length, AL, mm) by sex should be given by the models below:

Table

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

	SL, mm		**TW, g**	
	Females	Males	Females	Males
Mean				
Standard Error				
Median				
Mode				
Standard Deviation				
Sample Variance				
Kurtosis				
Skewness				
Range				
Minimum				
Maximum				
Sum				
Count				
Confidence Level (95.0%)				

Table

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

	Wd, mm		**Al, mm**	
	Females	Males	Females	Males
Mean				
Standard Error				
Median				
Mode				
Standard Deviation				
Sample Variance				
Kurtosis				
Skewness				
Range				
Minimum				
Maximum				
Sum				
Count				

Confidence Level (95.0%)				

The summarized data about the length, weight and sex structure should be included in the final analysis.

3. 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, https://www.ices.dk/sites/pub/CM%20Doccuments/2004/ACFM/ACFM1204.pdf

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 https://www.ices.dk/community/Documents/PGCCDBS/SGPIDS%202011.pdf

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 https://www.ices.dk/sites/pub/Publication%20Reports/Expert%20Group%20Report/acom/2013/SGPIDS/SGPIDS13.1.pdf

4. Bondarev, 2015, Sexual differentiation and variations in sexual characteristics of Rapana venosa (Valenciennes, 1846), International Journal of Marine Science, Vol.5, No.19 1-10 (doi: 10.5376/ijms.2015.05.0019; https://www.researchgate.net/publication/277553129_Sexual_differentiation_and_variations_sexual_characteristics_Rapana_venosa_Valenciennes_1846Sex