5339 Bitterling
Rhodeus sericeus (Pallas, 1776)

Photo 1. Bitterling (photo by T. Kuczyński)

The following methodology for studies of the bitterling in brackish water is supplementation of the bitterling methodology described in the Methodological guide (Przybylski 2012) for individuals found in inland freshwater.

1. Species distribution

The bitterling is a common species in the Polish waters. The range of its occurrence covers the whole region of the country, excluding the southern mountainous and foothill areas (Przybylski 2012). It is also found in brackish water. However, the reservoirs, where it can live, have to be represented by bivalves from the Unionidae family which are necessary in the breeding process of the bitterling. In the northern part of Poland, it is observed along the whole coastline from the Szczecin Lagoon to the Vistula Lagoon. It was described primarily in the coastal rivers (Dębowski 1997, Dębowski et al. 2000, Dębowski et al. 2002a, Dębowski et al. 2002b, Radtke et al. 2010a, Radtke et al. 2010b). It was also found in the coastal lakes in the Słowiński National Park (Bartel and Sobocki 2008) and the Vistula Lagoon (Psuty and Wilkońska 2009). The latest research results confirm its occurrence along the coastline on sites located in the Vistula Lagoon (Elbląg Bay), Vistula mouth (Mewia Łacha nature reserve, Mikoszewskie Lake), the Gardno Lake and the Szczecin Lagoon.

I METHODS

1. Concept of species monitoring

Currently, the monitoring methodology for the bitterling is based on the general method of fishing according to the Water Framework Directive based on electrofishing (Makomaska-Juchiewicz and Baran 2012). This methodology is used in rivers or canals, however, the possibility of using it in stagnant waters such as lakes or reservoirs is practically limited. Electrofishing should be excluded from this monitoring, because area of the research in coastal waters is characterized by significant

fluctuations in salinity. Monitoring in these waters should coincide with the monitoring proposed for streams including the assessment of population and habitat status. At the same time, the research methods should be relatively simple and possibly no invasive for fish and their habitat. So far, general concept of monitoring for fish species living in the stagnant water has not been developed. These requirements of the monitoring are only accomplished for the lake minnow, because it is based on catches with minnow traps. Therefore, it is proposed to replace electrofishing method by minnow traps. Monitoring should be carried out during the period of the greatest fish activity that will allow for their potential catch in traps.

The estimation of the number of bivalves *Unio* sp. and *Anodonta* sp. on selected sites is an important parameter in the monitoring of the bitterling. For this purpose, the use of dredge is recommended in the current monitoring of the streams. However, the dredge is not applicable in the stagnant reservoirs characterized by heavily submerged vegetation. The number of bivalves is determined by the methods described in the chapter *Study method.*

2. Indicators and assessment of the conservation status of the species

Population status indicators

The table (Table 1) presents indicators for the assessment of the status 'Population' parameter for the bitterling, while the table (Table 2) presents the valorisation method of these indicators.

Table 1. Indicators for assessing the status of the bitterling 'Population' parameter

Indicator	Unit	Indicator description
Abundance	mean NPUE	number of individuals determined based on catches with minnow traps
Age structure	length class [cm]	indicator based on the occurrence 3 age classes of adults (ADULT, >4 cm), immature juveniles (JUV, 4-1 cm) and young-of-the-year (YOY, <1 cm), based on the total length of catched fish

Table 2. Valorisation of indicators for assessing the status of the bitterling 'Population' parameter

Indicator	Assessment		
	FV favourable conservation status	**U1** unfavourable inadequate status	**U2** unfavourable bad status
Abundance	the value is >20	values within a range of 20–1	lack of individuals
Age structure	3 age stages are observed	2 age stages are observed	1 age stages is observed

Habitat status indicators

The table (Table 3) presents indicators for the assessment of the status 'Habitat' parameter for the bitterling, while the table (Table 4) presents the valorisation method of these indicators.

Table 3. Indicators for assessing the status of the bitterling 'Habitat' parameter

Indicator	Unit	Indicator description
Vegetation coverage on the bottom	%	the share of the coastline with submerged vegetation and rush and floating vegetation at the station
Number of bivalves	ind./m^2	number of bivalves (*Unio* sp. and *Anodonta* sp.) per unit of area

Table 4. Valorisation of indicators for assessing the status of the bitterling 'Habitat' parameter

Indicator	Assessment		
	FV favourable conservation status	**U1** unfavourable inadequate status	**U2** unfavourable bad status
Vegetation coverage on the bottom	if the value is >50%	if the value is in the range 50–10%	if the value is <10%
Number of bivalves	if the value is >0,1	if the value is in the range 0,1–0,01	if the value is <0,01

Conservation prospects

Assessment of the conservation prospects of the species on the site is a prediction of the population and habitat status in the perspective of the next 10-15 years. This is an expert method that takes into consideration the current population (if it has been assessed) and habitat status of the species as well as all current impacts and anticipated threats that may affect the future status of the population and the habitat on the surveyed site. The parameter should be assessed in the context of the population and habitat status for the longest possible period for which data and observation data are available. Analysis of the monitoring results for the bitterling on the selected site should guarantees that abundance of this species is adequate for survival of the population in the perspective of at least 10 years. However, the crucial thing for the assessing of the conservation prospects of the species on site is the occurrence of bivalves that are necessary for the reproduction of the bitterling. Bivalves from the family Unionidae are sensitive to changes in water quality, which means that their occurrence is additional information about the environment state. Therefore, the potential threats for the population of bivalves should also be included in the assessment in addition to the potential threats directly affecting the bitterling.

Conservation prospects can be assessed as favourable (FV) if in the perspective of a 10−15 years the currently observed species status FV will persist or if the unfavourable inadequate status (U1) will improve. The unfavourable inadequate status (U1) of the species' behaviour can be assessed when we predict that due to negative impacts or planned projects, the currently assessed favourable status may deteriorate or the unfavourable inadequate status will not change. Particular attention should be paid to these possible changes in the habitat which will negatively affect the population or habitat in the long-term perspective. Conservation prospects can be assessed as unfavourable bad (U2) if we predict that the currently observed status will not improve and the unfavourable inadequate status of the species (U1) will deteriorate or the current favourable status will significantly deteriorate.

Overall assessment

Overall assessment of conservation status of species is determined according to lowest assessment from among the three parameters: 'Population', 'Habitat' and 'Conservation prospects'. Scheme of assessment aggregation of indicators and parameters of the conservation status for the bitterling is presented in the figure (Fig. 1).

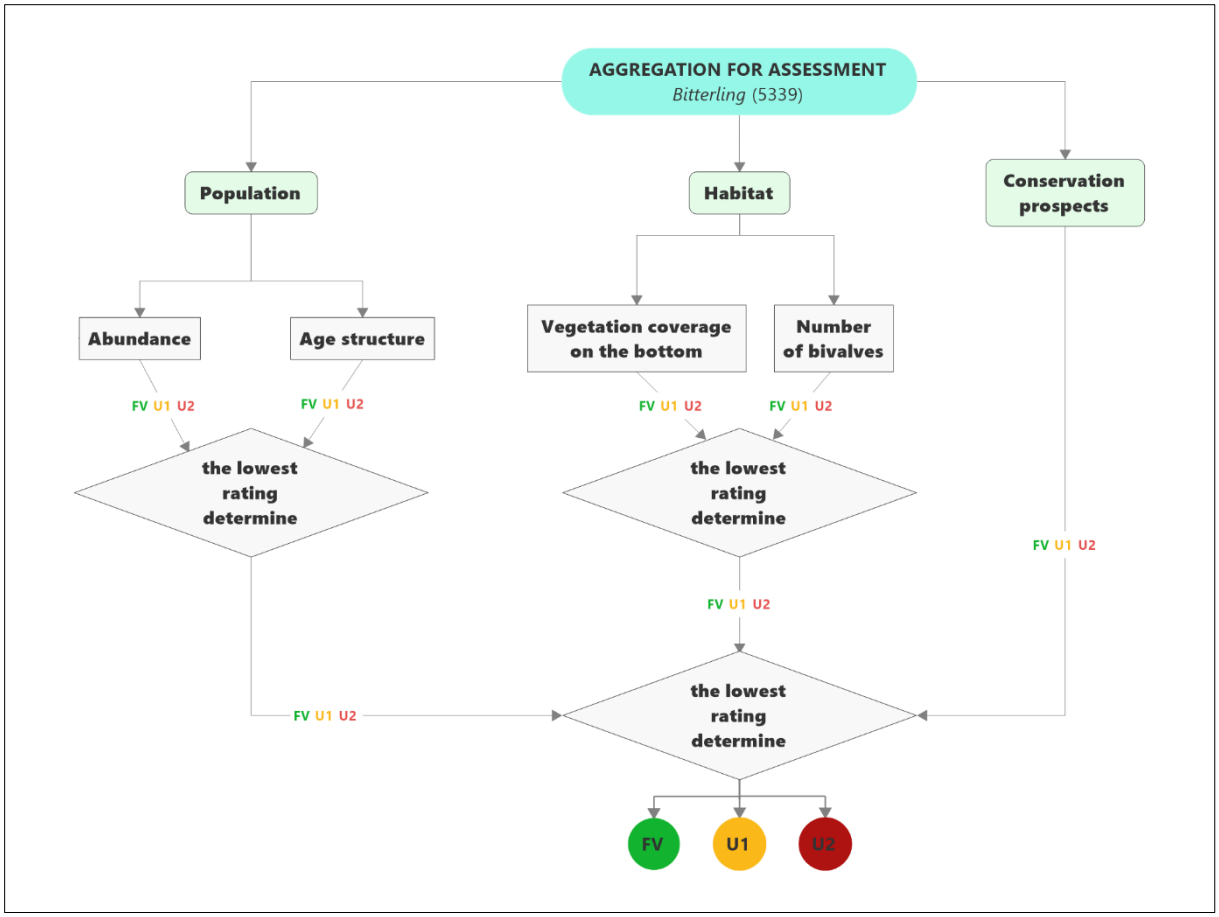

Fig. 1. Diagram of aggregation of indicators and parameters to assess the state of protection of the bitterling

3. Description of monitoring

Selection of monitoring stations

In the 'Monitoring of marine species and habitats' the research sites for the spine loach are: Vistula Lagoon, Mewia Łacha nature reserve in the Vistula mouth (Mikoszewskie Lake) and the Gardno Lake (Fig. 2). Research catches should be carried out at 3 to 5 selected stations located in the littoral zone due to the large surface of water area designated as a monitoring sites for the bitterling.

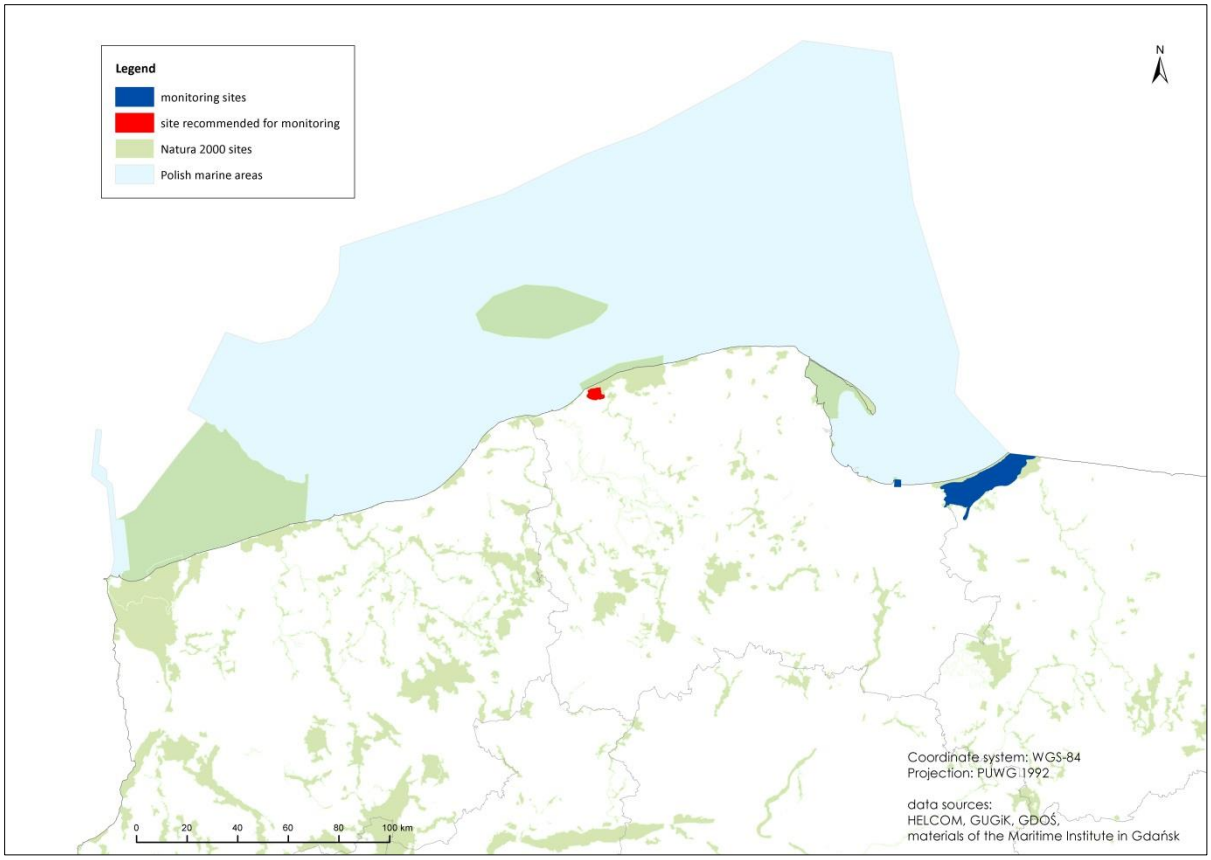

Fig. 2. Sites for the bitterling monitoring

4. The method of investigation

Determination of population status indicators

The basis for determining the population status of the studied species are results of abundance (averaged for the station) and body length of fish obtained from research catches at selected stations using a set consists of 10 minnow traps exposed for 12 hours at night. After removal of the traps, the species composition and number of individuals in the catch should be determined. It is necessary to conduct vital length measurements of the fish with an accuracy of 0.5 cm, rounded down. After measurement, the fish should be released into the water. The age structure is determined based on the body length of the caught fish classified into three categories: YOY (<1cm), JUV (4-1cm) and ADULT (> 4cm).

Determination of the habitat status indicators

There is no a specific research methodology for lakes, e.g. hydromorphological quality in contrast to flowing waters. The classification of lakes in view of abiotic factors is not relevant for the bitterling. Two indicators, i.e. vegetation coverage on the bottom and number of bivalves from the *Uniodidae* family (*Unio* sp. And *Anodonta* sp.), was selected for assessing of the bitterling.

Vegetation coverage on the bottom is assessed by means of the expert method. This estimation of vegetation coverage should be carried out along the transect of 50 m in length nearby the place where the minnow traps are setting. Observation are made from the boat or wading.

To determine the number of bivalves the following things should be perform:

- collection of 10 samples from the bottom in the zone of occurrence of the submerged vegetation using Bernatowicz grab or

- direct counting of individuals on the bottom confined to the surface of 1 x 1 m due to the frame dimensions, wading or diving depending on the depth.

Bivalves should be collected after the removal of the traps from the water at the research station. Abundance of bivalves should be given per m^2.

5. The date and frequency of investigations

Monitoring should be carried out once in a three-year period at the turn of August and September.

6. Equipment and materials for investigations

The minnow traps should be used for monitoring catches. The body size of a single trap is 0,5x0,5x1 m. The trap is made of knotless net with mesh sizes smaller than 5mm. The trap has two inlets of 15 cm in diameter placed in opposite sides. One set consists of 10 traps connected by means of a rope with floats. The distance between the traps should be 5 m.

7. Examples of bitterling research forms

Fishing form		
Name of a site: *Ujście Wisły*		
Setting method (mark **X**):	□ from the boat	x wading
Type of gear	*minnow traps*	

No.	Station	Depth [m][1]		Date of setting	Time	Starting position		Final position[2]		Date of removal	Time	Threats/Remarks
		P	K			Latitude	Longitude	Latitude	Longitude			
1.	*Ujście Wisły 1*	*0,7*	-	*2017-08-17*	*18:45*	*54,6666*	*18,8222*	-	-	*2017-08-18*	*7:30*	-
2.	*Ujście Wisły 2*	*0,8*	-	*2017-08-17*	*18:55*	*54,6664*	*18,8233*	-	-	*2017-08-18*	*7:50*	-

Compiled by:	**Checked by:**	**Approved by:**
Date:	Date:	Date:
Signature – full name:	Signature – full name:	Signature – full name:

[1] P – starting depth, K – final depth in case of the set of the nets, for other gears write only for P

[2] For fish traps – Do not fill out!

Analysis form

Station	*Ujście Wisły 1*	**Date** *2017-08-17*

Species				**Species**				**Species**			
Lt [cm]	*bitterling*	*weatherfish*		**Lt [cm]**				**Lt [cm]**			
0,5				18,0				35,5			
1,0				18,5				36,0			
1,5				19,0				36,5			
2,0				19,5				37,0			
2,5				20,0				37,5			
3,0				20,5				38,0			
3,5	*III*			21,0				38,5			
4,0				21,5				39,0			
4,5	*~~####~~ III*			22,0				39,5			
5,0				22,5				40,0			
5,5				23,0				40,5			
6,0				23,5				41,0			
6,5				24,0				41,5			
7,0				24,5				42,0			
7,5				25,0				42,5			
8,0				25,5				43,0			
8,5				26,0				43,5			
9,0		*I*		26,5				44,0			
9,5				27,0				44,5			
10,0				27,5				45,0			
10,5				28,0				45,5			
11,0				28,5				46,0			
11,5				29,0				46,5			
12,0				29,5				47,0			
12,5				30,0				47,5			
13,0				30,5				48,0			
13,5				31,0				48,5			
14,0				31,5				49,0			
14,5				32,0				49,5			
15,0				32,5				50,0			
15,5				33,0				50,5			
16,0				33,5				51,0			
16,5				34,0				51,5			
17,0				34,5				52,0			
17,5				35,0				52,5			

Remarks:

Chinese sleeper: 56

Compiled by:	**Checked by:**	**Approved by:**
Date:	Date:	Date:
Signature – full name:	Signature – full name:	Signature – full name:

Analysis form			
Station	*Ujście Wisły 1*	**Date**	*2017-08-17*
Species	**Abundance [szt.]**	**Weight [g]**	**Remarks**
bitterling	*11*	-	
Chinese sleeper	*53*	-	
weatherfish	*1*	-	
Remarks:			

Compiled by:	**Checked by:**	**Approved by:**
Date:	Date:	Date:
Signature – full name:	Signature – full name:	Signature – full name:

Observation and measurement form																							
[1] Name of a site	*Ujście Wisły*				Date	*2017-08-17*					Time												
[2] Station	*Ujście Wisły 1*																						
[3] Geographical coordinates	*54,6666*									*18,8222*													
[4] Depth	*0,7 m*				[5] Number of bivalves 1	4				[5]] Number of bivalves 2	2												
[6] Submerged vegetation	1	2	x	4	[7] Rush and floating vegetation	1	x	3	4	[8] Filamentous algae	x	1	2										
[9] Mud	x	2	3	4	[10] Sand	1	2	x	4	[11] Gravel	x	2	3	4	[12] Stones	x	2	3	4				
[13] Threats																							
Remarks	-																						

Compiled by:	**Checked by:**	**Approved by:**
Date:	Date:	Date:
Signature – full name:	Signature – full name:	Signature – full name:

Necessary measuring instruments: GPS, measuring staff (2 m), weight with line, camera, frame or Bernatowicz grab, buoy with an anchor;
Instruction for filling out the form:
[1] name of a site, example: *Jamno,*
[2] station, example: *Jamno2*
[3] geographical coordinates in WGS 84 form
[4] depth near the buoy measures by measuring staff or weight with line
[5] mark only at the stations for the bitterling
[6] bottom coverage estimated as a percentage in the research area [1] up to 25%, [2] 26%-50%, [3] 51%-75%, [4] 76%-100% (circle the number)
[7] water surface coverage estimated as in point [6]
[8] 0- none, 1 – up to 20% of coverage of a bottom substrate, 2 – more than 20% of coverage of a bottom substrate (circle the number)
[9] [10] [11] [12]] bottom coverage estimated as a percentage as in point [6] determined by the expert method
[13] write codes of the observed threats from the list of the threats

8. Other species for which the methodology can be applied

This catch methodology can be used also for the spined loach and the weatherfish in the coastal lakes. However, the methodology of the assessment of the habitat status is characteristic only for one selected species.

9. References

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