

1150 Coastal lagoons



Photo. 1. Vistula Lagoon in the region Przebrno (photo by K. Bociąg)

I. MODIFICATION OF THE METHOD OF ASSESSING THE CONSERVATION STATUS

Assessment of the conservation status of the habitat Coastal lagoons (1150) should be carried out in accordance with the guidelines developed for nature monitoring as part of the State Environmental Monitoring and included in the method guide (Zalewska-Gałosz 2010) with the modification introduced by the Chief Inspectorate for Environmental Protection in 2015 (errata to the methodologies, published on the CIEP's website). The works should include the supplements described below.

In Chapter 1.1. the scope and manner of carrying out the assessment of the natural habitat status were clarified. Chapter 2.1 discusses the work required to perform based on the same transects for the assessment of the element 'macrophytes and phytobenthos' (the scope regarding macrophytes), using the macrophyte ecological status assessment index ESMI (Kolada and Ciecierska 2009), modified accordingly for assessment of the coastal lakes (ESMI_{lp}) and lagoons (ESMI_{lz}).

During the field research the form provided in the methodological guide for the Coastal lagoons (1150), (Zalewska-Gałosz 2010), supplemented with the field data record should be used (Table 2) to save the data necessary to calculate the macrophyte index of ecological status.

1.1. Supplement to the description of the method assessment of the habitat condition Coastal lagoons (1150)

1.1.1. Supplement to the chapter "Method of investigations"

Assessment of the habitat status Coastal lagoons (1150) should be carried out along transects designated within the monitored reservoirs (from 3 to 6 transects within the reservoir).

The method of work in a transect should be adapted to the current conditions (water transparency, bottom character and depth). Apart from the method of free diving recommended in the method guide (Zalewska-Gałosz 2010), it is possible to use the wading method (e.g. in neoprene suit). A practical solution is swimming with the use of fins, masks and tubes (so-called snorkeling). It is also acceptable to use the method of sampling the vegetation with an anchor from a pontoon or a boat.

Determining the transect is based on the following assumptions:

- width - 50 m along the shoreline;
- b) length - depending on the configuration of the bottom in the littoral and the development of the surface vegetation, up to a depth of 1 m, and in the case when the rush vegetation occurs deeper, to the maximum depth of its occurrence.

The spatial extent of the transect is determined by specifying the coordinates of the following five points using GPS (Fig. 1):

- starting and ending points of the side of the parallel transect to shore (A, B),
- the starting and ending points of the transect situated in the rush line (C, D),
- the end of the side of the transect perpendicular to the shoreline at a depth of 1 m (E), and in the case when the rush vegetation is deeper, at the point of maximum depth of its occurrence.

The coordinates of these points should be given in the habitat assessment report.

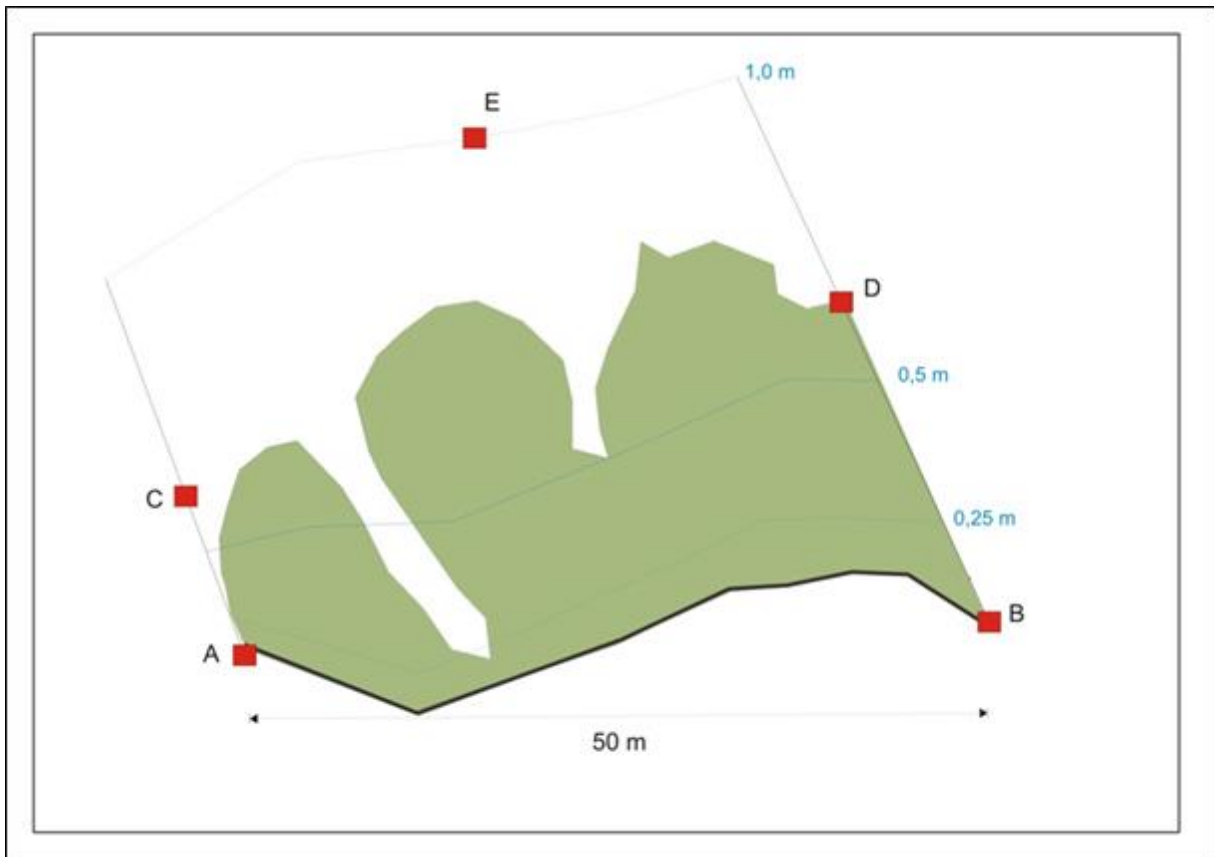


Fig. 1. The scheme of determining the area of the research transect by five points (A-E), (description of points in the text)

In addition to the work described in the methodological guide (Zalewska-Gałosz 2010) in order to assess the condition of the habitat Coastal lagoons (1150) the following activities should be performed along the transect:

- determine the percentage of coastline and the percentage of transect area occupied by rush vegetation and other types of vegetation (estimation, it is advisable to use GIS tools);
- plot a line of rush vegetation on the water side and on the land side using the GPS receiver;
- instead of taking phytosociological photos in the sheets of rush vegetation, one synphytosociological photo should be taken (sigma-photo), describing all the vegetation along the transect from the shore to the maximum depth of its occurrence (the sigma-photo method is described in Chapter 2.1).

1.1.2. Supplement to the chapter 'Assessment of the habitat status parameters and indicators of specific structure and function'

To assess the parameter 'Habitat area', the GPS measurements of the reach of rush communities should be used, as well as estimation of the percentage of shoreline and percentage of the area of the transect occupied by rush vegetation. This data should be compared with the data from the previous monitoring or with available aerial photographs from the period as close as possible to the previous monitoring. It is advisable to use GIS tools for this purpose. The GPS measurements of the rush range should be transferred, along with other data, in the form of file attachments (in *.shp format) to the habitat assessment sheet of the site. The table (Table 1) gives an example description of the value of the 'Habitat surface' parameter in the observation card.

Table 1. An example description of the value of the 'Habitat area' parameter in the observation card

Parameter/ indicator	Value of the parameter / indicator	Assessment of the parameter / indicator
Habitat area	reed rush - 100% of the shoreline, 3.5% of the transect area; since 2011, the area of the sheet of vegetation has not increased (comparative data: geoportal.gov.pl, ortophotomap of 2011); underwater communities - about 55% of the transect area	FV

1.1.3. Correction of the valuation of the indicator 'Total nitrogen'

FV: 0,3–6,5

U1: other combinations

U2: <0,3 or >15

II. ASSESSMENT OF THE ECOLOGICAL STATUS OF COASTAL LAKES AND LAGOONS, THE ELEMENT 'MACROPHYTES AND PHYTOBENTHOS' (in the scope of macrophytes), USING THE MACROPHYTE INDEX OF THE ECOLOGICAL STATUS ASSESSMENT $ESMI_{JP}$ (for coastal lakes) AND $ESMI_z$ (for lagoons)

1. ESMI dedicated field work along transects

The assessment of the ecological status of coastal lakes and lagoons, the element 'macrophytes and phytobenthos' (in the scope of macrophytes) should be based on transects (from 3 to 6 transects within the reservoir) determined for the assessment of the habitat condition Coastal lagoons (1150), (see Chapter 1.1.).

In order to determine the macrophyte index of ecological status assessment $ESMI_{JP}$ (for coastal lakes) and $ESMI_z$ (for lagoons) the following activities should be performed along each transect:

- take a synphytosociological picture (sigma-photo),
- determine the maximum depth of occurrence of rush communities [m],
- determine the maximum depth of underwater communities [m], (with determination and giving in the observation form GPS coordinates of the place where it was specified),
- estimate the phytolittoral coverage [%].

Taking a synphytosociological picture involves:

- identification of all plant communities (including rush) along the transect, from the shore to the place of the maximum depth of occurrence of plant communities; the principle of species dominance should be applied; the aggregation of plants (one or several species), occupying at least 1 m² and characterized by covering at least 25% (≥ 3 on the Braun-Blanquet scale), is assumed for the community,

- determination of the number of identified communities using the 7-grade Braun-Blanquet scale (1964) in relation to the area covered with vegetation along the transect (100% is taken only for surfaces occupied by vegetation, without an area devoid of vegetation, so-called 'empty'), where :
 - 5 means 100-75% coverage of the area occupied by a given community,
 - 4 means 75-50% coverage of the area occupied by a given community,
 - 3 means 50-25% coverage of the area occupied by a given community,
 - 2 means 25-5% coverage of the area occupied by a given community,
 - 1 means 5-1% coverage of the area occupied by a given community,
 - (+) means 1-0.1% coverage of the area occupied by a given community,
 - (r) means <0.1% coverage of area occupied by a given community.

The following additional explanation of taking a synphytosociological picture is drawn from the Kolada and Ciecierska study (2009):

- single specimens of the species characterized by low coverage do not form communities,
- estimation of the relative share of each vegetation coverage should be referred only to the area really covered by vegetation, therefore the quantitative relations of individual communities, irrespective of the total coverage on the transect, should add up to 100% ($\pm 5\%$):
 - for single dominant community ($\geq 75\%$ vegetation coverage), it receives the value of 5 (the remaining communities are estimated at 1, + or r);
 - for two codominant communities – 3 and 4, when remaining communities with coverage from 2 to r,
 - for 3 and more encountered communities, respectively 2, 3 or 4 depending on the dominant structure.

The phytolittoral coverage should be assessed as a percentage, estimating the share of area occupied by plant communities in relation to the entire bottom area along the transect, from the shoreline to the maximum depth of occurrence of plant communities. A graphic interpretation of the method of performing the investigations along a hypothetical transect is shown in Figure (Fig. 2).

Site estimation should be verified during chamber work, using GIS methods, using GPS readings from the area and aerial photographs.

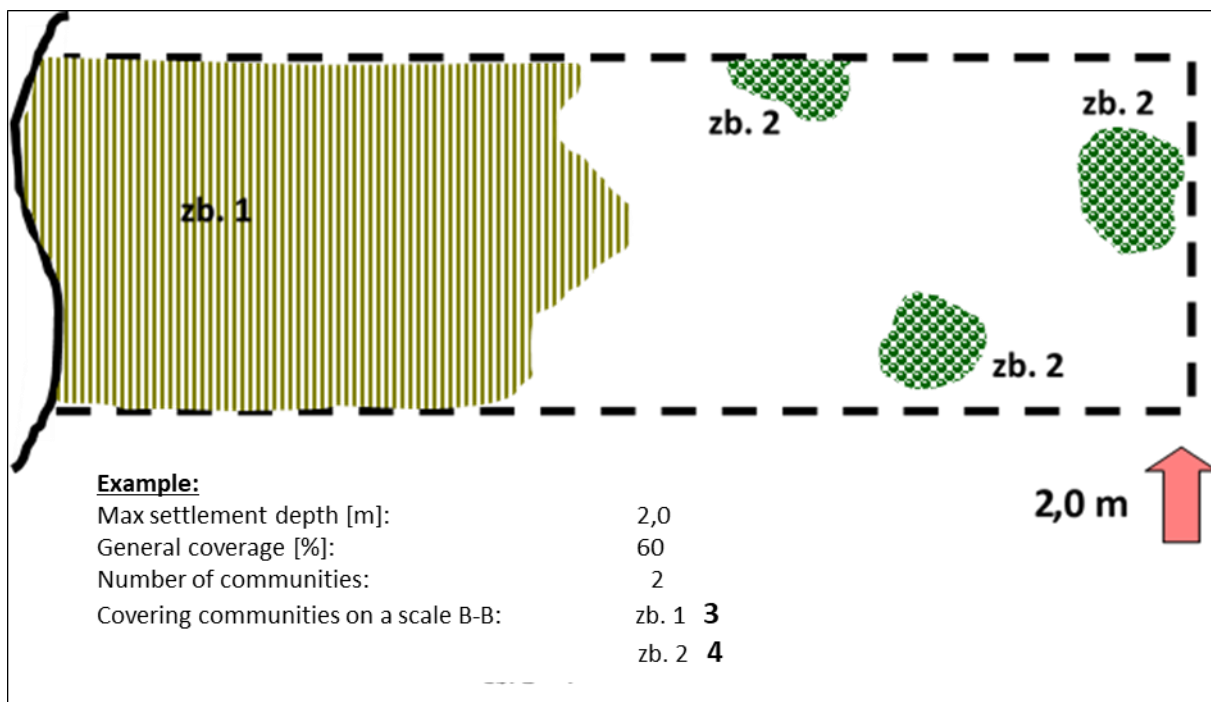


Fig. 2. Diagram showing vegetation research within the transect for the purpose of ecological status assessment based on macrophytes

Data obtained in the field should be attached to the assessment sheet of the habitat conservation status at the site (see Chapter 1.1). For this purpose, it is advisable to use the form below (Table 2).

Table 2. The proposed scheme of recording field data necessary for the calculation of $ESMI_{JP}/ESMI_z$

Field form for $ESMI_{JP}/ESMI_z$			
Max depth range of the rush vegetation [m]			1,1
Max depth of underwater communities occurrence [m]			1,5
Co-ordinates of the maximum point of the depth of occurrence of underwater communities (x, y)			X 16°15'21.3912 Y 54°20'34.512
Estimation of the bottom coverage with vegetation within the transect, from the shore to the maximum depth of occurrence of plant communities [%]			60%
Synphytosociological picture			
No.	Community	Coverage in B-B scale	Depth range [m]
1.	<i>Phragmitetum australis</i>	4	1,1
2.	<i>Typhetum latifoliae</i>	1	0,9
3.	<i>Mysiophylletum spicati</i>	3	1,5

4.	<i>Potamatum perfoliati</i>	1	0,9
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2. 2.2. Calculation of the macrophyte index of the ecological status assessment $ESMI_{JP}$ (for coastal lakes) and $ESMI_Z$ (for the lagoons)

The calculation method of both indicators is identical. In order to obtain the necessary data on vegetation in the scale of the reservoir, on the basis of results from the transects made within it, it is necessary to perform:

- a list of all plant communities occurring in particular transects;
- calculation of the average coverage of each plant community (n_i) within the phytolittoral as the arithmetic mean of its coverage in individual transects, after conversion of the B-B scale to the average percentage coverage. For this purpose, each grade of the BB scale assigned to a given plant community in particular transects should be converted into a percentage coverage as follows: grade (5) - average value 86%, (4) at 61%, (3) at 34%, others as less significant mean values were taken as arithmetic limits: (2) as 15%, (1) as 3%, (+) as 0.5%, (r) as 0.05%;
- determination of the average maximum depth of occurrence of vegetation in the reservoir, as the arithmetic mean of the maximum depth in individual transects;
- calculation of the average percentage coverage of vegetation as the arithmetic mean of the total coverage in individual transects.

On the basis of the last two indicators, the total area covered with vegetation, i.e. the area of phytolittoral (N), should be calculated. It should be calculated on the basis of bathymetric data of reservoirs, as the surface of the lake, where the water is shallower or equal to the depth of the mean maximum macrophyte coverage multiplied by the percentage of the area covered by vegetation.

On the basis of the vegetation data developed in such away, the values of $ESMI_{JP}$ or $ESMI_Z$ should be calculated using the formulas:

$$ESMI = 1 - \exp \left[-J \times Z \times \exp \left(\frac{N}{P} \right) \right]$$

where:

J – evenness Pielou index,

Z – settlement index,

N – area of the lake phytolittoral [ha],

P – area of the lake [ha]

$$J = \frac{H}{H_{max}}$$

where:

J – evenness Pielou index ,

H – index of phytocoenotic diversity,

H_{max} - index of the maximum phytocoenotic diversity

$$H = -\sum \frac{n_i}{N} \times \ln \frac{n_i}{N}$$

where:

H – index of phytocoenotic diversity,

n_i – surface of the patches of a specific plant community, expressed as a percentage of the total area of phytolittoral,

N – the area of the lake's phytolittoral taken as 100%

$$H_{maks.} = \ln S$$

where:

$H_{maks.}$ – index of the theoretical maximum phytocoenotic diversity,

S – number of communities forming phytolittoral

$$Z = \frac{N}{P - izob. 2,5}$$

where:

Z – settlement index,

$P - izob. 2,5$ – area of the lake shallower than 2,5 m (read from the bathymetric card),

N – phytolittoral area [ha],

P – total area of the lake [ha]

The calculation of output parameters (N , n_i), as well as the indicators of the ESMI method itself (H , H_{max} , Z , ESMI) is possible to do independently with the help of simple spreadsheets, e.g. Excel or Access. The explanations of the method of data compilation and calculation of the ESMI indicator, along with exemplary calculations, are included also in Kolada and Ciecierska (2009), Ciecierska and Dynowska (2013).

On the basis of the obtained values of **ESMI_{JP}** and **ESMI_Z** indicators, the ecological status of the coastal lake/lagoon should be assessed using the criteria given below

Table 3. Boundaries of ecological status classes for coastal lakes and reservoirs.

Ecological status classes	Boundaries of ESMI _{JP} classes (coastal lakes)	Boundaries of ESMI _Z classes (lagoons)
Very good (1)	≥0,340	≥0,204

Ecological status classes	Boundaries of ESMI _{JP} classes (coastal lakes)	Boundaries of ESMI _z classes (lagoons)
Good (2)	0,339 – 0,205	0,203 – 0,123
Moderate (3)	0,204 – 0,103	0,122 – 0,060
Poor (4)	0,102 – 0,035	0,059 – 0,002
Bad (5)	<0,035	<0,002

When assessing the ecological status, an additional condition should be taken into account, the occurrence in reservoirs, in coastal lakes or in lagoons, Charales communities, i.e. if the share of Charales communities in the phytolittoral communities is greater than 10%, then the ecological class should be increased by one, regardless of what status the ecosystem was classified due to the ESMI values.

References

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