A Research on Biological Indices for Ecological Assessment of Water Bodies in Turkey

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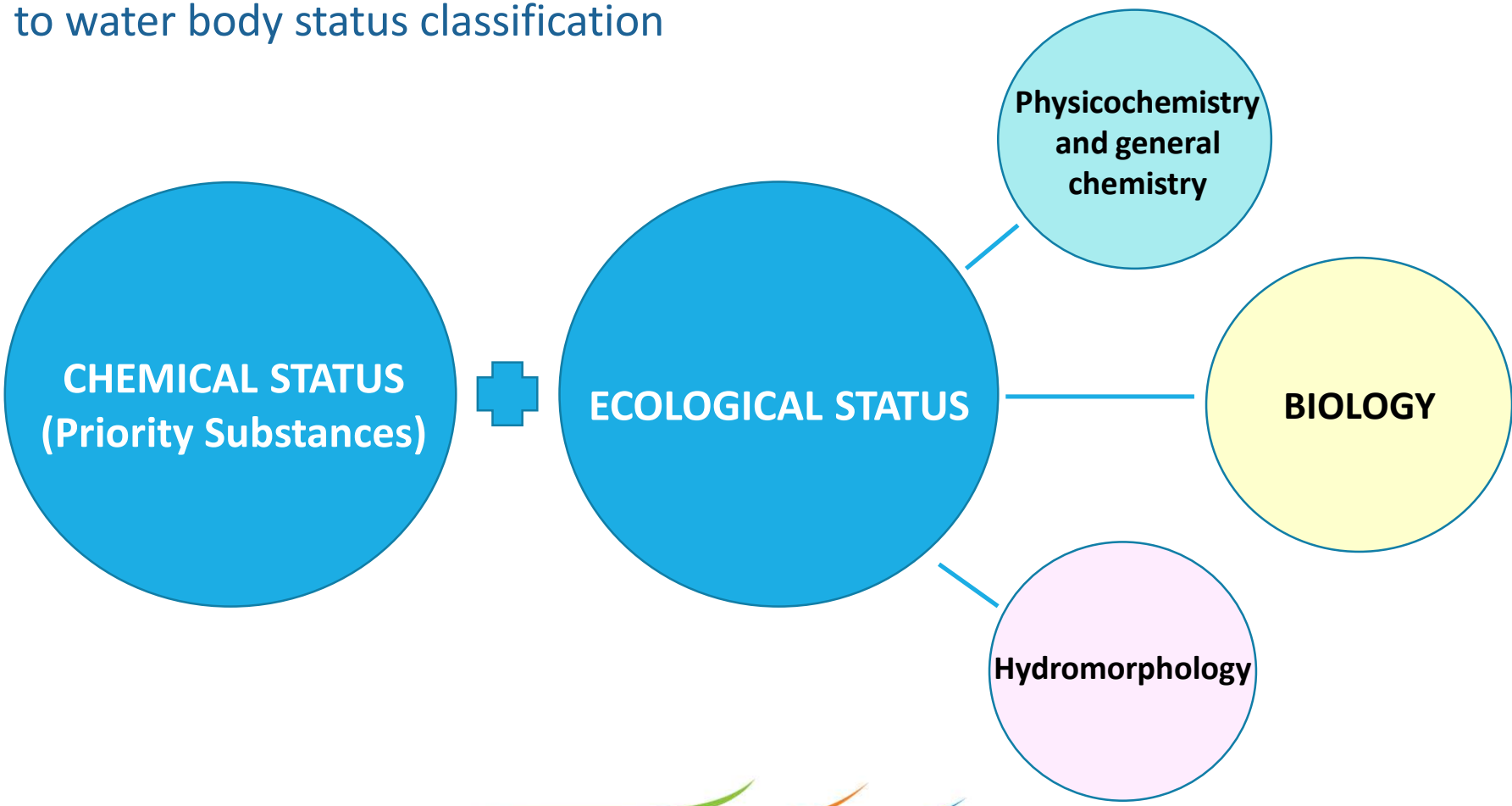
Water Framework Directive (2000/60/EC, WFD) brings a new approach to water body status classification



A Research on Biological Indices for Ecological Assessment of Water Bodies in Turkey

- Harmonization and implementation of EU Water Framework Directive in Turkey launched in 2011 by the Turkish Ministry of Forestry and Water Affairs (MoFWA)
- River basin based biological monitoring surveys were initiated in 2012
- In the early stages of biological surveys, common indices generally used in academic researches were used. However, these indices do not contain species endemic to Turkey and were not tested whether they correspond to Turkish situation
- The resulting ecological status values were considered as inadequate in terms of their confidence and precision

National Project on «Establishment of the Water Quality Ecological Assessment System Specific for Turkey» (2014-2016)

8 PILOT BASIN

1. Lower Euphrate Subbasin
2. Western Mediterranean
3. Ceyhan
4. Aras
5. Eastern Black Sea
6. Western Black Sea
7. Northern Eagean
8. Sakarya

1 Year Monitoring

Rivers, Lakes, Transitional Waters and Coastal Waters

- Biological Qauality Elements
- Physicochemical and General Chemical Quality Elements
- Hydromorphological Quality Elements

25 BASIN

Inventory study on aquatic flora and fauna of Turkey

ESTABLISHMENT OF ECOLOGICAL ASSESSMENT SYSTEM FOR WATER QUALITY

METHODOLOGY

In the Project, following stepwise approach was used for establishment of the ecological assessment system;

(i) Monitoring of 8 pilot basins

(ii) Inventory of the studies related with the aquatic flora and fauna for 25 basins of Turkey and preparation of species lists for aquatic flora and fauna of Turkey

(iii) Adaptation of the suitable indices for each biological indices

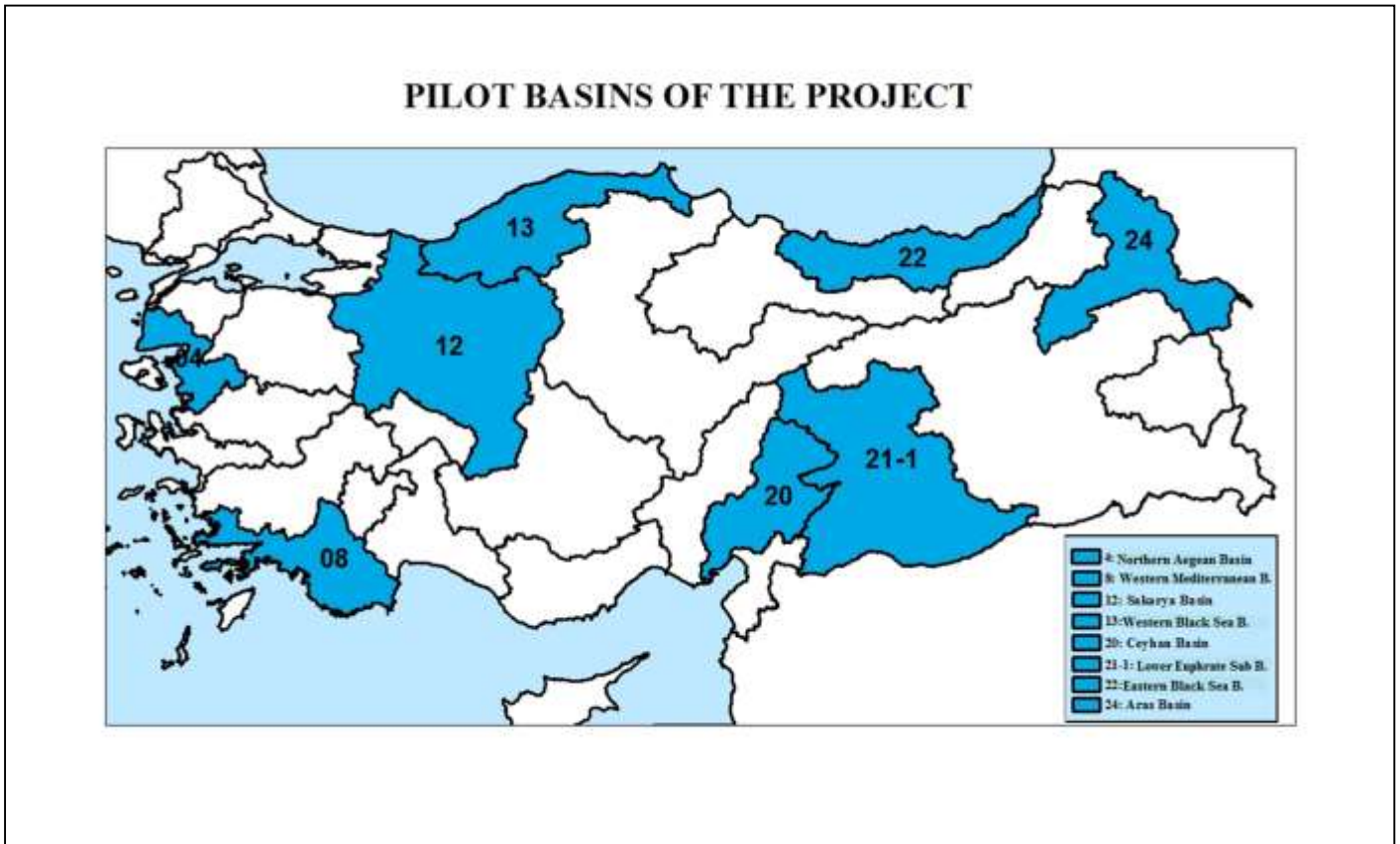
(iv) Identification of type specific reference sites and conditions for 8 pilot basins

(v) Ecological assessment of pilot basins

METHODOLOGY

(i) Monitoring Studies

Turkey has 25 river basins and 8 pilot basins were selected to represent different geographic and climatic conditions of country

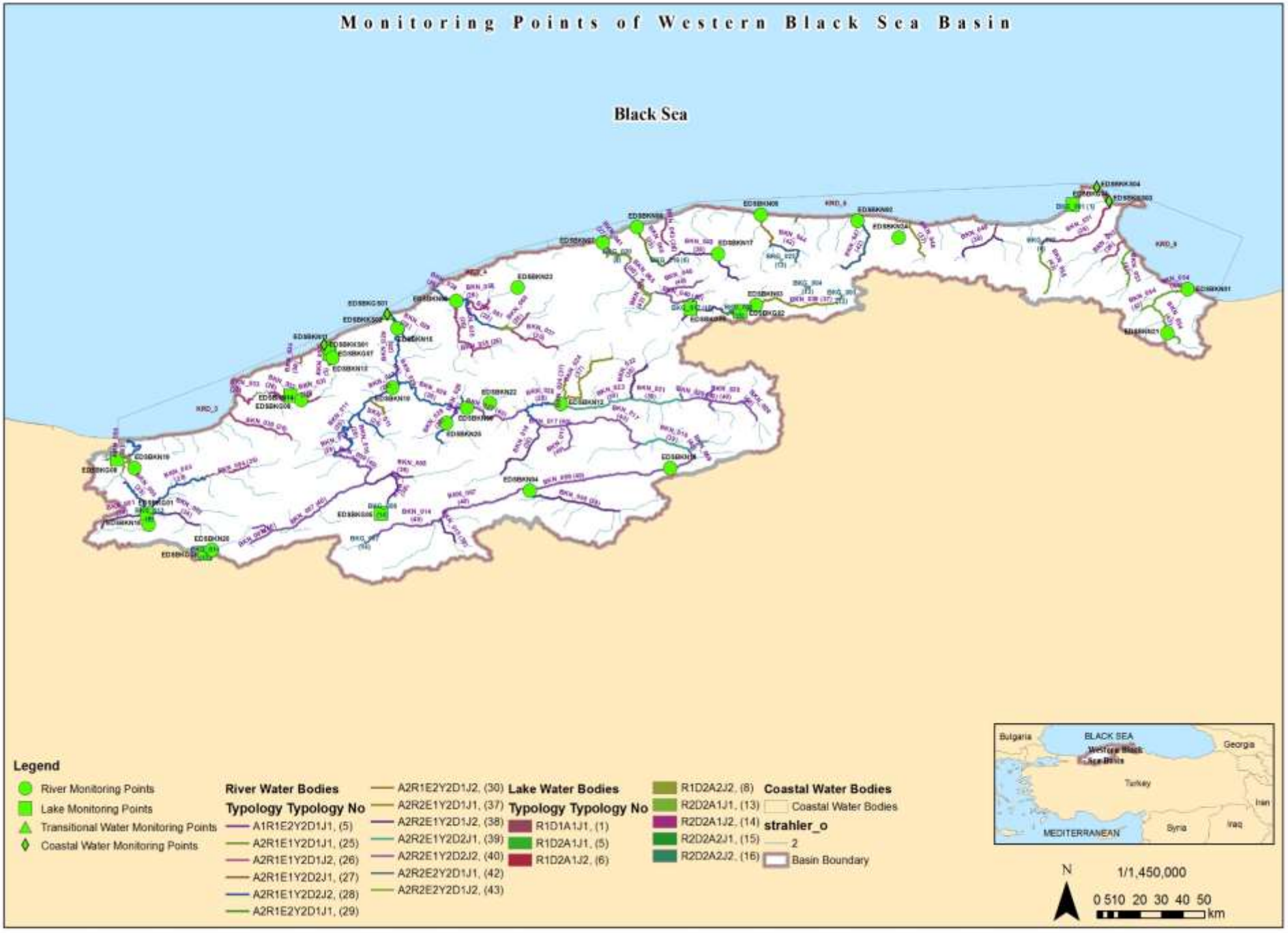


METHODOLOGY

(i) Monitoring Studies

- Water bodies and water body types of Turkey was used as a background
- Monitoring points were selected to represent the biological diversity of the basin considering all the point and diffuse pressures in the pilot basins
- At least one monitoring point was selected per water body types in the basin
- All the natural lakes and reservoirs intended for human consumption in the basins were selected as lake monitoring points
- At least one monitoring point was selected per coastal water bodies in the pilot basins

Monitoring Points of Western Black Sea Basin



METHODOLOGY

(i) Monitoring Studies

4 monitoring campaings were conducted seasonally in selected

- ✓ 218 river
- ✓ 69 lake
- ✓ 15 transitional and
- ✓ 31 coastal monitoring points

In the Project, 45 expert, 39 of whom were university staff of Biology Departments, worked on field and laboratory for monitoring campaigns and in office for index development studies.

METHODOLOGY

(i) Monitoring Studies

Within the scope of monitoring activities

- ✓ general chemical and physicochemical,
- ✓ biological and
- ✓ hydromorphological parameters

were monitored in line with the monitoring related provisions (Article 8, Annex V) of Water Framework Directive.

METHODOLOGY

(i) Monitoring Studies

- Fish fauna, benthic macroinvertebrates, phytoplankton, phytobentos, macrophytes, macroalgae and angiosperm were sampled according to the national and international standardized methods listed in the Amending Directive 2014/101/EC
- Samples of aquatic flora and fauna of the pilot basins were collected from the monitoring points and preserved for taxonomic identifications
- Taxonomic identifications were done mostly at species level

METHODOLOGY

	RIVERS	LAKES	COASTAL WATERS	TRANSITIONAL WATERS
	GENERAL CHEMICAL AND PHYSICOCHEMICAL PARAMETERS			
1	Temperature	Temperature	Temperature	Temperature
2	pH	pH	pH	pH
3	Electrical conductivity (µS/cm)	Electrical conductivity (µS/cm)	Electrical conductivity (µS/cm)	Electrical conductivity (µS/cm)
4	Dissolved Oxygen (mg/L O_2)	Dissolved Oxygen (mg/L O_2)	Dissolved Oxygen (mg/L O_2)	Dissolved Oxygen (mg/L O_2)
5	-	Secchi Depth	Secchi Depth	Secchi Depth
6	Suspended Solids (mg/L SS)	Suspended Solids (mg/L SS)	Suspended Solids (mg/L SS)	Suspended Solids (mg/L SS)
7	Biochemical Oxygen Demand (BOD) (mg/L O_2)	Biochemical Oxygen Demand (BOD) (mg/L O_2)	Biochemical Oxygen Demand (BOD) (mg/L O_2)	Biochemical Oxygen Demand (BOD) (mg/L O_2)
8	Chemical Oxygen Demand (COD) (mg/L O_2)	Chemical Oxygen Demand (COD) (mg/L O_2)	Chemical Oxygen Demand (COD) (mg/L O_2)	Chemical Oxygen Demand (COD) (mg/L O_2)
9	Total Organic Carbon (TOC) (mg/L)	Total Organic Carbon (TOC) (mg/L)	Total Organic Carbon (TOC) (mg/L)	Total Organic Carbon (TOC) (mg/L)
10	Total Nitrogen (mg/L N)	Total Nitrogen (mg/L N)	Total Nitrogen (mg/L N)	Total Nitrogen (mg/L N)
11	Ammonium (mg NH_4^+-N/L)	Ammonium (mg NH_4^+-N/L)	Ammonium (mg NH_4^+-N/L)	Ammonium (mg NH_4^+-N/L)
12	Nitrite (mg NO_2^--N/L)	Nitrite (mg NO_2^--N/L)	Nitrite (mg NO_2^--N/L)	Nitrite (mg NO_2^--N/L)
13	Nitrate (mg NO_3^--N/L)	Nitrate (mg NO_3^--N/L)	Nitrate (mg NO_3^--N/L)	Nitrate (mg NO_3^--N/L)
14	Total Kjeldahl Nitrogen (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Total Kjeldahl Nitrogen (mg/L)
15	Total Phosphorus (mg /L P)	Total Phosphorus (mg /L P)	Total Phosphorus (mg /L P)	Total Phosphorus (mg /L P)
16	Ortho Phosphate (mg/L o-PO_4)	Ortho Phosphate (mg/L o-PO_4)	Ortho Phosphate (mg/L o-PO_4)	Ortho Phosphate (mg/L o-PO_4)
17	Salinity	Salinity	Salinity	Salinity
18	-		Dissolved Inorganic Nitrogen (mg/L DIN)	Dissolved Inorganic Nitrogen (mg/L DIN)
19	-	-	Total Inorganic Nitrogen (mg/L TIN)	Total Inorganic Nitrogen (mg/L TIN)
20	-		Dissolved Inorganic Phosphorus (mg/L DIP)	Dissolved Inorganic Phosphorus (mg/L DIP)
21	-	-	Silisium (mg/L)	Silisium (mg/L)

METHODOLOGY

	RIVERS	LAKES	COASTAL WATERS	TRANSITIONAL WATERS
	BIOLOGICAL QUALITY ELEMENTS			
1	Phytoplankton and Phytobenthos (Taxonomic Composition, Abundance, Biomass, Chlorophyl a)	Phytoplankton and Phytobenthos (Taxonomic Composition, Abundance, Biomass, Chlorophyl a)	Phytoplankton (Taxonomic Composition, Diversity, Abundance, Biomass, Chlorophyl a)	Phytoplankton (Taxonomic Composition, Abundance, Biomass, Chlorophyl a)
2	Macrophyte (Abundance, Taxonomic Composition, Sensitive Species)	Macrophyte (Abundance, Taxonomic Composition, Sensitive Species)	Macroalgae, Angiosperm (Diversity, Abundance, Sensitive Species, Depth Distrubition/Coverage)	Macroalgae, Angiosperm (Taxonomic Composition , Abundance)
3	Benthic Macroinvertebrates (Diversity, Taxonomic Composition, Abundance, Sensitive Species)	Benthic Macroinvertebrates (Diversity, Taxonomic Composition, Abundance, Sensitive Species)	Benthic Macroinvertebrates (Diversity, Abundance, Sensitive Species)	Benthic Macroinvertebrates (Diversity, Abundance, Sensitive Species)
4	Fish Fauna (Abundance, Taxonomic Composition, Age Structure, Sensitive Species)	Fish Fauna (Abundance, Taxonomic Composition, Age Structure, Sensitive Species)	-	Fish Fauna (Abundance, Taxonomic Composition)
HYDROMORPHOLOGY				
1	Flow	Quantity of inlet and outlet flow	Direction of dominant currents	Freshwater flow
2	Groundwater Connection	Groundwater Connection	Wave exposure	Wave exposure
3	Hydrological regime	Residence time	Depth variation	Depth variation
4	Depth and widht variation	Hydrological regime	Structure and subsrate of the coastal bed	Structure and subsrate of the bed
5	Structure and substrate of the river bed	Depth variation	Structure of the intertidal zone	Structure of the intertidal zone
6	Structure of the riparian zone	Structure of the lake shore		
7	River contunity	Quantity, structure and substrate of the lake bed		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(ii) Inventory of Aquatic Flora and Fauna

All the scientific literatures, academic researches, Project results of the Ministry and related institutions including biological monitoring activities along the country were used for inventory studies.

METHODOLOGY

(iii) Adaptation of Biological Indices

- Monitoring results of 8 pilot basin and the result of inventory studies were used for adaptation of the suitable biological indices to Turkish conditions
- Widely used international biological indices, intercalibration studies, academic researches and results of the big scale EU Projects were used as starting point
- Some of the biological indices were adapted to Turkish situation using aquatic flora and fauna lists of Turkey
- A software was developed for the adapted indices of fish fauna, benthic macroinvertebrates, phytobenthos and phytoplankton
- Class boundaries for high/good, good/moderate, moderate/poor and poor/bad status were identified by using the monitoring results and inventory studies for each biological quality elements and water body types

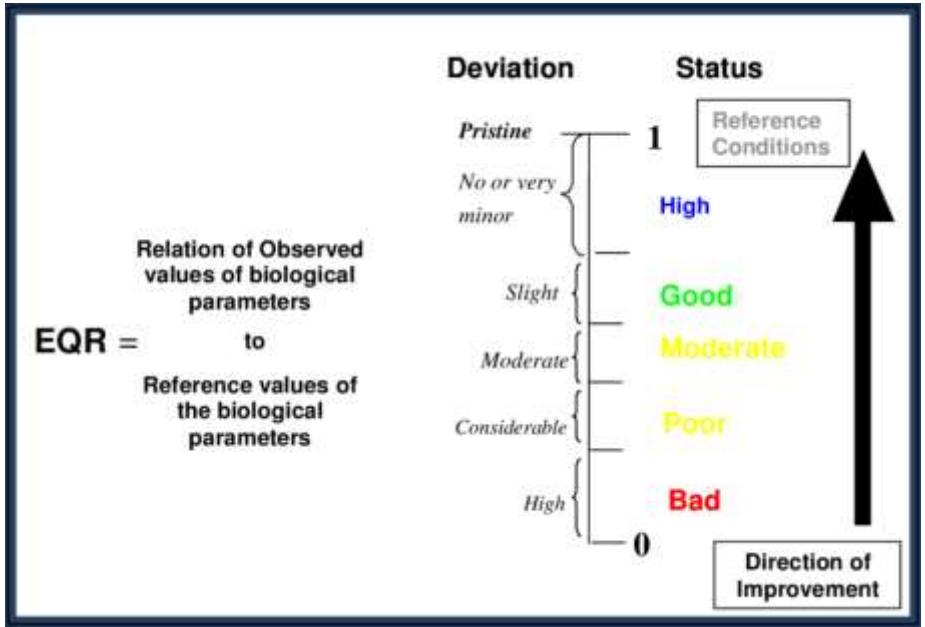
(iv) Reference Sites and Conditions

- Type specific reference sites and conditions were identified by using the monitoring results of 8 pilot basin and inventory studies
- Reference monitoring points were selected as far as possible from all the point and diffuse pressures in pilot basins
- Reference conditions of the water body types for which reference sites exist were identified by using the monitoring results
- For the reference conditions of the water body types for which reference sites cannot be found in pilot basins, limited amount of historical data and expert judgement were used
- Maximum ecological potential values were determined for heavily modified and artificial water bodies

METHODOLOGY

(v) Ecological Assessments

- Ecological assessments of the pilot basins were executed by calculating the ecological quality ratios using the Project outputs including monitoring results, adapted biological indices, type specific reference conditions and class boundaries
- Ecological status and potential of the pilot basins were presented as colored maps specified in WFD



Biological Indices

The Project resulted in variety of biological indicesfor each biological quality elements and for each water body category

BQE	RIVERS	LAKES	TRANSITIONAL WATERS	COASTAL WATERS
Benthic macroinvertebrates	8 different multimetric indices for 8 basins	Multimetric index for all the basins	TUBI and KGI2 indices	
Phytobenthos	TIT index (Adapted Trophic Index to Turkish conditions)		X	X
Phytoplankton	Adapted PTI	Adapted PTI	X	X
Fish fauna	T-IBI (Adapted IBI) & Shannon Wiener	T-IBI (Adapted IBI) & Shannon Wiener	TCFI, EFAI	X
Macrophytes	IBMR	Lake Leafpacs 2	EEI	

RESULTS

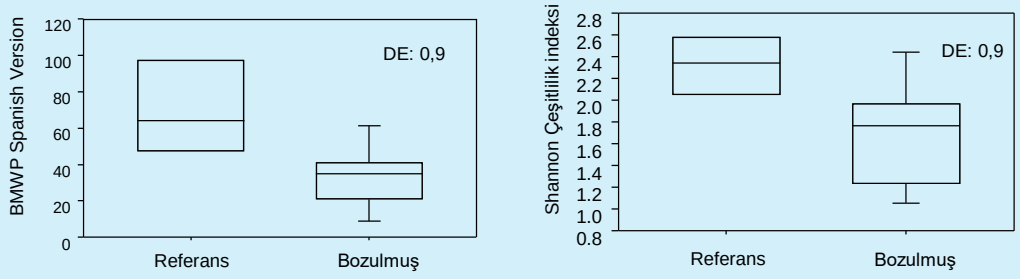
Biological Indices / River Benthic Macroinvertebrates

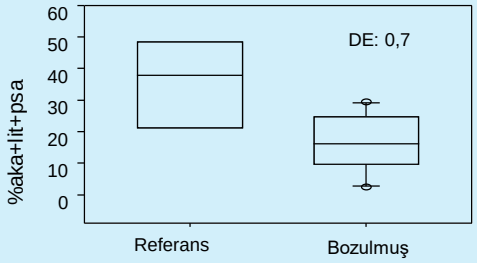
- ASTERICS software was used as a starting point
- The software was run with the data from reference, normal and disrupted monitoring points of each basins
- 44 out of 376 metrics which responded best was selected for further studies

Metric	EDSBAN02	EDSBAN03	EDSBAN05	EDSBAN06	EDSBAN07	EDSBAN08	EDSBAN09	EDSBAN10	EDSBAN11	EDSBAN12	ED
Abundance [ind/m²]	398	195	489	492	1087	26	77	225	1119	19	
Number of Taxa	17	13	24	32	23	10	21	23	38	5	
Saprobic Index (Zelinka & Marvan)	2,288	2,092	2,421	2,224	2,907	2,32	2,561	1,9	2,845	2,058	
Saprobic Valence	-	-	-	-	-	-	-	-	-	-	-
- xeno [%]	0,93	2,154	2,372	3,15	0	0	0,39	0,267	0,751	2,105	
- oligo [%]	10,628	9,128	8,446	9,573	0,304	5	3,117	5,733	2,949	16,316	
- beta-meso [%]	43,266	4,615	26,278	23,882	25,658	18,846	13,766	15,156	6,238	48,947	
- alpha-meso [%]	34,447	5,744	27,464	19,715	50,414	16,923	12,078	4,933	7,56	22,105	
- poly [%]	1,181	7,59	4,356	3,028	17,553	1,538	4,416	0,133	6,273	0	
- no data available [%]	9,548	70,769	31,084	40,65	6,072	57,692	66,234	73,778	76,229	10,526	
- xeno [%] (scored taxa = 100%)	1,028	7,368	3,442	5,308	0	0	1,154	1,017	3,158	2,353	
- oligo [%] (scored taxa = 100%)	11,75	31,228	12,255	16,13	0,323	11,818	9,231	21,864	12,406	18,235	
- alpha-meso [%] (scored taxa = 100%)	38,083	19,649	39,852	33,219	53,673	40	35,769	18,814	31,805	24,706	
- xeno [%] (abundance classes) (scored taxa = 100%)	1,905	6,667	3	5,116	0	0	1,25	1,905	2,041	6,667	
- oligo [%] (abundance classes) (scored taxa = 100%)	11,429	29,167	16	20,93	4,857	13,333	9,375	20	12,653	23,333	
German Saprobic Index (old version)	2,214	3	2,245	2,162	2,613	Not Calculated	2,3	1,8	2,329	Not Calculated	
- Dispersion	0,144	Not Calculated	0,166	0,203	0,096	Not Calculated	0,144	0,099	0,115	Not Calculated	No
- Sum of abundance classes	8	2	13	13	14	0	7	7	23	0	
- Number of indicator taxa	3	1	5	5	4	0	4	4	9	0	
- Water Quality Class	II	III	II	II	II-III	Not Calculated	II-III	II	II-III	Not Calculated	III
German Saprobic Index (new version)	2,328	3,18	2,264	2,06	2,947	2	2,618	1,926	2,535	Not Calculated	
- Dispersion	0,194	0,147	0,165	0,139	0,171	Not Calculated	0,205	0,15	0,136	Not Calculated	
- Sum of abundance classes	10	5	21	31	28	1	11	17	44	0	
- Number of indicator taxa	5	2	9	12	9	1	8	8	18	0	

Biological Indices / River Benthic Macroinvertebrates

- Discrimination efficiencies for each metrics were calculated to find out the ideal metrics which discriminate reference and disrupted sites efficiently
- As a result of this study, 8 different multimetric indices were selected to be used in 8 basins





RESULTS

Biological Indices / River Benthic Macroinvertebrates

Multimetric Index for Western Black Sea Basin

Metric	Category
BMWP (Spanish version)	Tolerance
Margalef Bidiversity Index	Diversity
[%] Littoral	Functional
EPT Taxa (%)	Composition

Class Boundaries for Western Black Sea Basin

Class Boundaries	Class	Percentile
> 0,85	HIGH	>95th
0,72-0,84	GOOD	95-75
0,5-0,71	MODERATE	75-25
0,26-0,49	POOR	25-5
<0,25	BAD	<5

Benthic Macroinvertebrates Final Status Map of Western Black Sea Basin

Legend

River
- High
- Good
- Moderate
- Poor
- Bad
- No Data

River (HMWB)
- Good or above
- Moderate
- Poor
- Bad
- No Data

River (AWB)
- Good or above
- Moderate
- Poor
- Bad
- No Data

Transitional Water
- High
- Good
- Moderate
- Poor
- Bad
- No Data

Transitional Water (HMWB)
- Good or above
- Moderate
- Poor
- Bad
- No Data

Transitional Water (AWB)
- Good or above
- Moderate
- Poor
- Bad
- No Data

Lake
- High
- Good
- Moderate
- Poor
- Bad
- No Data

Lake (HMWB)
- Good or above
- Moderate
- Poor
- Bad
- No Data

Lake (AWB)
- Good or above
- Moderate
- Poor
- Bad
- No Data

Coastal Water
- High
- Good
- Moderate
- Poor
- Bad
- No Data

Coastal Water (HMWB)
- Good or above
- Moderate
- Poor
- Bad
- No Data

Coastal Water (AWB)
- Good or above
- Moderate
- Poor
- Bad
- No Data

River Water Bodies
Typology Typology No
- A1R1E2Y2D1J1, (5)
- A2R1E1Y2D1J1, (25)
- A2R1E1Y2D1J2, (26)
- A2R1E1Y2D2J1, (27)
- A2R1E1Y2D2J2, (28)
- A2R1E2Y2D1J1, (29)
- A2R1E2Y2D1J2, (30)
- A2R2E1Y2D1J1, (37)
- A2R2E1Y2D1J2, (38)
- A2R2E1Y2D2J1, (39)
- A2R2E1Y2D2J2, (40)
- A2R2E2Y2D1J1, (42)
- A2R2E2Y2D1J2, (43)

Lake Water Bodies
Typology Typology No
- R1D1A1J1, (1)
- R1D2A1J1, (5)
- R1D2A1J2, (6)
- R1D2A2J2, (8)
- R2D2A1J1, (13)
- R2D2A1J2, (14)
- R2D2A2J1, (15)
- R2D2A2J2, (16)

Coastal Water Bodies
- Coastal Water Bodies

strahler_o
- 2
- Basin Boundary

N

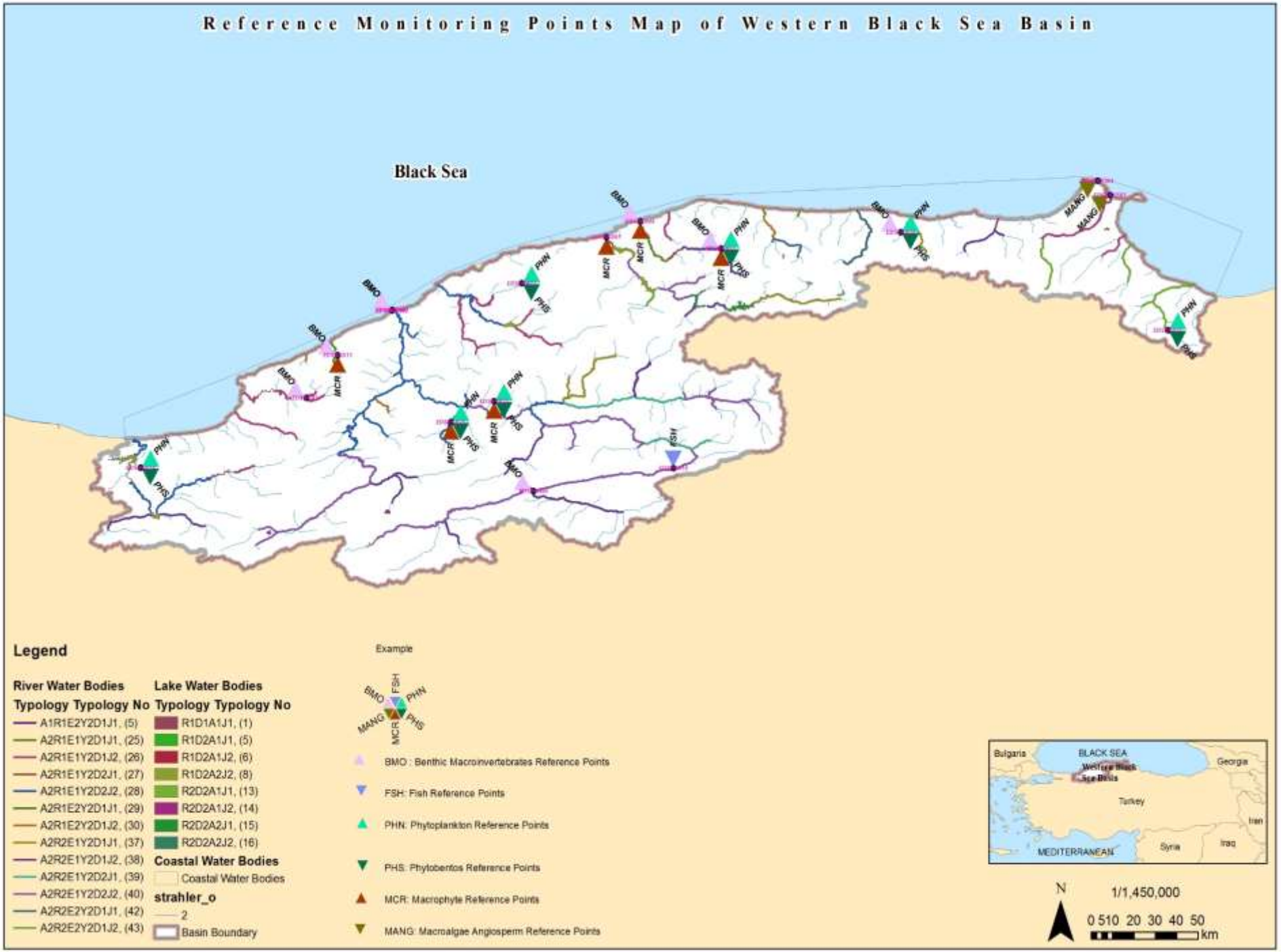
1/1,450,000

0 5 10 20 30 40 50 km

Reference Sites and Conditions

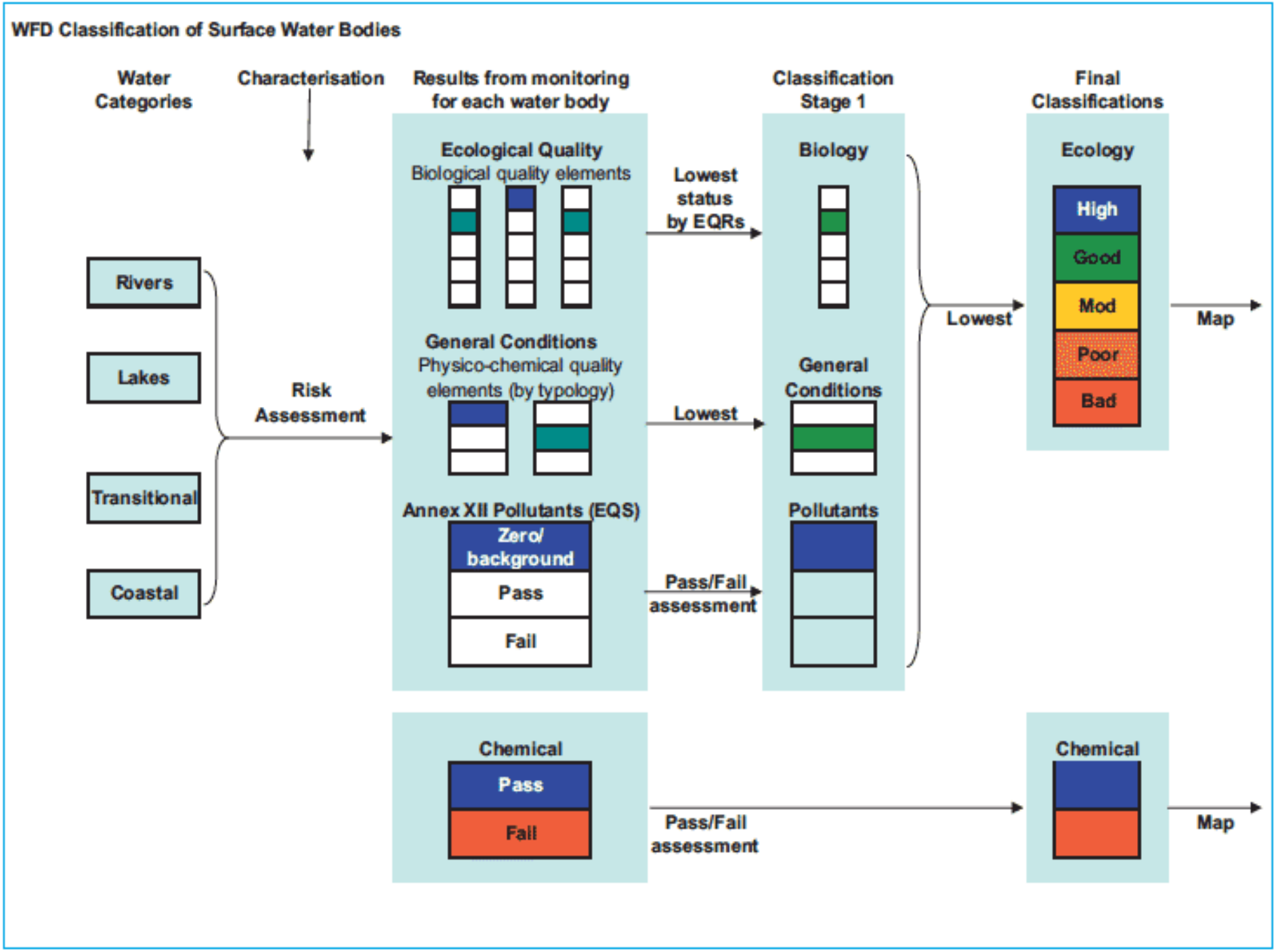
- Reference sites for each biological quality elements were determined according to the monitoring results
- Type specific reference conditions were identified by using the monitoring results of these sites and expert judgement

Reference Monitoring Points Map of Western Black Sea Basin



Ecological Status and Potential

- All the biological quality elements were assessed separately with the indices developed or adapted in the project and their results were combined by using the “one out all out” principle of WFD
- General chemical and physicochemical parameters were assessed by using the national class boundaries published in By Law on Surface Water Quality
- Hydromorphological condition of the monitoring points were assessed by using the field forms produced for this project. By the help of these forms hydromorphological status of the monitoring points were identified as high or good by using the expert judgement and the results were considered during the overall ecological status determination.


WFD Classification of Surface Water Bodies
Water Categories
Characterisation
Results from monitoring for each water body
Classification Stage 1
Final Classifications
Ecological Quality
Biological quality elements
Lowest status by EQRs
Biology
Ecology
High
Good
Mod
Poor
Bad
Rivers
Lakes
Transitional
Coastal
Risk Assessment
General Conditions
Physico-chemical quality elements (by typology)
Lowest
General Conditions
Lowest
Map
Annex XII Pollutants (EQS)
Zero/ background
Pass
Fail
Pass/Fail assessment
Pollutants
Chemical
Pass
Fail
Pass/Fail assessment
Chemical
Map

Biological Final Status Map of Western Black Sea Basin

Legend

River
- High
- Good
- Moderate
- Poor
- Bad
- No Data

River (HMWB)
- Good or above
- Moderate
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- Bad
- No Data

River (AWB)
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- No Data

Transitional Water (HMWB)
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- Bad
- No Data

Lake
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- Poor
- Bad
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Coastal Water (AWB)
- Good or above
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- Poor
- Bad
- No Data

River Water Bodies

Typology	Typology No
A1R1E2Y2D1J1,	(5)
A2R1E1Y2D1J1,	(25)
A2R1E1Y2D1J2,	(26)
A2R1E1Y2D2J1,	(27)
A2R1E1Y2D2J2,	(28)
A2R1E2Y2D1J1,	(29)
A2R1E2Y2D1J2,	(30)
A2R2E1Y2D1J1,	(37)
A2R2E1Y2D1J2,	(38)
A2R2E1Y2D2J1,	(39)
A2R2E1Y2D2J2,	(40)
A2R2E2Y2D1J1,	(42)
A2R2E2Y2D1J2,	(43)

Lake Water Bodies

Typology	Typology No
R1D1A1J1,	(1)
R1D2A1J1,	(5)
R1D2A1J2,	(6)
R1D2A2J2,	(8)
R2D2A1J1,	(13)
R2D2A1J2,	(14)
R2D2A2J1,	(15)
R2D2A2J2,	(16)

Coastal Water Bodies
- Coastal Water Bodies

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- 2

Basin Boundary

N

1/1,450,000

0 5 10 20 30 40 50 km

Physicochemical Final Status Map of Western Black Sea Basin

Legend

River
- High
- Good
- Moderate
- Poor
- Bad
- No Data

River (HMWB)
- Good or above
- Moderate
- Poor
- Bad
- No Data

River (AWB)
- Good or above
- Moderate
- Poor
- Bad
- No Data

Transitional Water
- High
- Good
- Moderate
- Poor
- Bad
- No Data

Transitional Water (HMWB)
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- Poor
- Bad
- No Data

Transitional Water (AWB)
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Lake
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- Moderate
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- Bad
- No Data

Lake (HMWB)
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- No Data

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- Moderate
- Poor
- Bad
- No Data

Coastal Water (AWB)
- Good or above
- Moderate
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- Bad
- No Data

River Water Bodies

Typology Typology No
- A1R1E2Y2D1J1, (5)
- A2R1E1Y2D1J1, (25)
- A2R1E1Y2D1J2, (26)
- A2R1E1Y2D2J1, (27)
- A2R1E1Y2D2J2, (28)
- A2R1E2Y2D1J1, (29)
- A2R1E2Y2D1J2, (30)
- A2R2E1Y2D1J1, (37)
- A2R2E1Y2D1J2, (38)
- A2R2E1Y2D2J1, (39)
- A2R2E1Y2D2J2, (40)
- A2R2E2Y2D1J1, (42)
- A2R2E2Y2D1J2, (43)

Lake Water Bodies

Typology Typology No
- R1D1A1J1, (1)
- R1D2A1J1, (5)
- R1D2A1J2, (6)
- R1D2A2J2, (8)
- R2D2A1J1, (13)
- R2D2A1J2, (14)
- R2D2A2J1, (15)
- R2D2A2J2, (16)

Coastal Water Bodies
- Coastal Water Bodies

strahler_o
- 2
- Basin Boundary

N

1/1,450,000

0 5 10 20 30 40 50 km

Ecological Status and Potential Map of Western Black Sea Basin

Legend

River
- High
- Good
- Moderate
- Poor
- Bad
- No Data

River (HMWB)
- Good or above
- Moderate
- Poor
- Bad
- No Data

River (AWB)
- Good or above
- Moderate
- Poor
- Bad
- No Data

Transitional Water
- High
- Good
- Moderate
- Poor
- Bad
- No Data

Transitional Water (HMWB)
- Good or above
- Moderate
- Poor
- Bad
- No Data

Transitional Water (AWB)
- Good or above
- Moderate
- Poor
- Bad
- No Data

Lake
- High
- Good
- Moderate
- Poor
- Bad
- No Data

Lake (HMWB)
- Good or above
- Moderate
- Poor
- Bad
- No Data

Lake (AWB)
- Good or above
- Moderate
- Poor
- Bad
- No Data

Coastal Water
- High
- Good
- Moderate
- Poor
- Bad
- No Data

Coastal Water (HMWB)
- Good or above
- Moderate
- Poor
- Bad
- No Data

Coastal Water (AWB)
- Good or above
- Moderate
- Poor
- Bad
- No Data

River Water Bodies
Typology Typology No
- A1R1E2Y2D1J1, (5)
- A2R1E1Y2D1J1, (25)
- A2R1E1Y2D1J2, (26)
- A2R1E1Y2D2J1, (27)
- A2R1E1Y2D2J2, (28)
- A2R1E2Y2D1J1, (29)
- A2R1E2Y2D1J2, (30)
- A2R2E1Y2D1J1, (37)
- A2R2E1Y2D1J2, (38)
- A2R2E1Y2D2J1, (39)
- A2R2E1Y2D2J2, (40)
- A2R2E2Y2D1J1, (42)
- A2R2E2Y2D1J2, (43)

Lake Water Bodies
Typology Typology No
- R1D1A1J1, (1)
- R1D2A1J1, (5)
- R1D2A1J2, (6)
- R1D2A2J2, (8)
- R2D2A1J1, (13)
- R2D2A1J2, (14)
- R2D2A2J1, (15)
- R2D2A2J2, (16)

Coastal Water Bodies
- Coastal Water Bodies

strahler_o
- 2
- Basin Boundary

N

1/1,450,000

0 5 10 20 30 40 50 km

Main Project Outputs

- A final report including all the details of biological indices and 8 basin monitoring reports including the monitoring data of 8 basins were prepared
- Index softwares were developed for the benthic macroinvertebrate, phytoplankton, phytobenthos and fish indices
- Guidance documents were developed for all the indices developed or adapted for each biological quality elements and for the use of softwares
- Species lists of aquatic flora and fauna were prepared for Turkey.
- National Water Information System of Turkey is under construction, thus all the data from the Project were stored in Excel files suitable for the architecture of National Water Information System in order to be incorporated in the future.

CONCLUSION

- First comprehensive study aiming to collect monitoring data from 8 basin and inventory data from 25 basin
- First trial on development or adaptation of biological indices to Turkish conditions and determination of reference sites and conditions
- The results of this study brings a new way of thinking to the instutions of the country regarding the importance of biological quality elements during the process for ecological assessment of water quality
- Important first step for establishment of the ecological assessment system in Turkey and it revealed that finalisation of this process requires long term biological data from all over the country
- Outputs of the Project will be used by the future studies and Projects of the Ministry and by the academic studies related with ecological assessment of water quality

CONCLUSION

- The resulting ecological assessment system will produce more precise and accurate ecological quality values than commonly used ecological assessment systems not suitable for Turkey
- The Project provided the inspiration to the Ministry for preparation of a legislation in order to standardize the sampling and analysing the biological quality elements and ecological assessment system
- The project guided MoFWA to define the next steps for finalising the ecological assessment system such as establishment of the reference monitoring network in 25 basins of Turkey, definition of type specific reference conditions for all types, definition of the ecoregions of Turkey in order to revise the typology system in Turkey


THANK YOU