Eco-AlpsWater

Innovative Ecological Assessment and Water Management Strategy for the Protection of Ecosystem Services in Alpine Lakes and Rivers

Priority 3: Liveable Alpine Space. SO3.2 - Enhance the protection, the conservation and the ecological connectivity of Alpine Space

Deliverable D.T2.1.2

Wider survey at the Alpine Space regional level, to verify the implementation of approaches intra-and inter-countries.

Project Eco-AlpsWater
Work Package WPT2
Activity A.T2.2
Deliverable D.T2.1.2
Version 1.0
Date 30 June 2019
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Revisions / Date –

Abstract

The output of the Deliverable D.T2.1.2 consisted in a collection of methods adopted in the alpine region for the assessment of the ecological status of waters, using the biological quality elements selected in the Eco-AlpsWater project (phytoplankton, benthic diatoms, and fish). The output of Deliverable D.T2.1.1 were integrated with procedures suggested by the Swiss Federal Office for the Environment (FOEN) and recommended to cantonal administrations, and with results from a previous wider survey at the European scale, the WISER project (2012). Moreover, to implement information collected in the WISER database, some PPs provided an updated version of the methods used for the evaluation of BQE in the alpine region.

These methods were shared among PPs and taken into account in the development of the innovative eDNA protocols (WP1). This wide survey in the alpine region was further used to verify the gap and potential implementation of approaches intra and inter countries, in the context of previous intercalibration processes (CIRCA, Alpine GIG 2014).

Below a summary of BQE methods adopted in the alpine space available for each country, applied in key lakes and rivers of the Eco-AlpsWater project (EAW), retrieved from WISER database (WD), provided by PPs (PP), or recommended by FOEN (FOE).

Alpine region BQE Methods		Phytoplankton			Diatoms (Phytobenthos)			Fish		
Austria	Lakes	EAW	WD					EAW	WD	
	Rivers				EAW	WD		EAW	WD	
France	Lakes	EAW			EAW			EAW		
	Rivers				EAW	WD		EAW	WD	
Italy	Lakes	EAW	WD	PP	EAW		PP	EAW	WD	
	Rivers				EAW		PP	EAW		
Germany	Lakes	EAW	WD		EAW	WD		EAW		
	Rivers				EAW	WD		EAW	WD	
Slovenia	Lakes	EAW	WD		EAW	WD		EAW	WD	
	Rivers				EAW	WD		EAW		
Switzerland	Lakes	EAW								
	Rivers					FOE			FOE	

Water quality assessment

BQE methods in the Eco-AlpsWater key sites (see DT2.1.1 for details)

Water Category: Lakes

BQE: Phytoplankton, Benthic diatoms, Fish

Literature References

Austria

DIN EN 15204 (2006): Wasserbeschaffenheit – Anleitung für die Zählung von Phytoplankton mittels der Umkehrmikroskopie (Utermöhl-Technik).

EN 14407:2004. Water quality - Guidance standard for the identification, enumeration and interpretation of benthic diatom samples from running waters.

GZÜV: Verordnung des Bundesministeriums für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft über die Überwachung des Zustandes von Gewässern; Gewässerzustandsüberwachungsverordnung samt Anhängen; BGBl. II Nr. 479/2006.

Wolfram et al. (2015) GUIDANCE ON THE MONITORING OF THE BIOLOGICAL QUALITY ELEMENTS PART B2 – PHYTOPLANKTON. B2-01i_PHP_EN (non-binding work translation for information purposes only), Federal Ministry of Agriculture and Forestry,

UTERMÖHL H. (1958): Zur Vervollkommnung der quantitativen Phytoplankton-Methodik. Mitt. int. Ver. theor. angew. Limnol. 9: 1–38.

CEN (2003): EN 14011 Water quality — Sampling of fish with electricity.

CEN (2005): EN 14757 Water quality — Sampling of fish with multi-mesh gillnets

CEN (2014): EN 15910 Water quality — Guidance on the estimation of fish abundance with mobile hydroacoustic methods

CEN (2015): EN 14757 Water quality — Sampling of fish with multi-mesh gillnets

GASSNER, H., D. ACHLEITNER, M. LUGER (2015) Guidance on surveying the biological quality elements. Part B1 – Fish. Published by: Austrian Federal Ministry of Agriculture and Forestry, Environment and Water Management (ISBN: 978-3-85174-063-9).

France

Laplace-Treyture, C. and T. Feret. 2016. Performance of the Phytoplankton Index for Lakes (IPLAC): A multimetric phytoplankton index to assess the ecological status of water bodies in France. Ecological Indicators 69:686-698.

Laplace-Treyture, C., Barbe, J., Dutartre, A., Druart, J.C., Rimet, F., Anneville, O.,2009. Protocole standardisé d'échantillonnage, de conservation, d'observationet de dénombrement du phytoplancton en plan d'eau pour la mise en oeuvrede la DCE: version 3.3.1, pp. 44.

AFNOR NF XP T 90-238. 2010. Qualité de l'eau – Echantillonnage des communautés de macrophytes en plan d'eau.

Irstea Bordeaux. Echantillonnage des communautés de phytobenthos en plans d'eau. 8pp.

Argillier, C. et aL. 2013. Development of a fish-based index to assess the eutrophication status of European lakes. Hydrobiologia 704:193-211.

Ritterbusch, D. et al. 2017. Water Framework Directive intercalibration: Central-Baltic lake fish fauna ecological assessment methods; Part B: Development of the intercalibration common metric; Part C: Intercalibration., Joint Research Centre (JRC), the European Commission's science and knowledge service.

CEN. 2015. Water quality - guidance on the estimation of fish abundance with multi-mesh gillnets. European standard. European Committee for Standardisation. Ref. No. EN 14757:2015.

Logez et al. 2018. Monte-Carlo methods to assess the uncertainty related to the use of predictive multimetric indices. Ecological Indicators.

Danis P-A, Ferrer R, Gevrey M, Argillier C (2012) Seuils des paramètres physicochimiques soutenant la biologie - Plans d'eau naturels - Rapport d'avancement.

Germany

Mischke, U., Riedmüller, U., Hoehn, E., Nixdorf, B. (2016): Method Description of the Assessment of Lakes and Reservoirs with Phytoplankton and the Phyto-See-Index in Germany. User Handbook. Excerpt of original version December 2016. Electronic publication. http://www.gewaesser-bewertung.de/files/english_handbook_german_lake_assessment_method_description_psi_dec2016-1.pdf

EN 16695 (*EN 16695*. Water quality - Guidance on the estimation of phytoplankton biovolume

EN 15204. Water quality - Guidance standard on the enumeration of phytoplankton using inverted microscopy (Utermöhl technique

Wolfram et al. 2009: Reference conditions and WFD compliant class boundaries for phytoplankton biomass and chlorophyll-a in Alpine lakes. Hydrobiologia 633: 45–58.

Schaumburg, J., Schranz, C., Stelzer, D., Vogel, A., (2015): Instruction Manual for the Assessment of Lake Ecological Status in Accordance with the Requirements of the EUWater Framework Directive:

Macrophytes and Phytobenthos Phylib. Status February 2014. Bayerisches Landesamt für Umwelt. Im Auftrag der LAWA (Projekt Nr. O 10.10), 137 S., Augsburg/Wielenbach

https://www.lfu.bayern.de/wasser/gewaesserqualitaet_seen/phylib_englisch/instruction_protocols/index.htm

CEN (2003): EN 14011 Water quality — Sampling of fish with electricity.

CEN (2005): EN 14757 Water quality — Sampling of fish with multi-mesh gillnets

CEN (2014): EN 15910 Water quality — Guidance on the estimation of fish abundance with mobile hydroacoustic methods

CEN (2015): EN 14757 Water quality — Sampling of fish with multi-mesh gillnets

GASSNER, H., D. ACHLEITNER, M. LUGER (2015) Guidance on surveying the biological quality elements. Part B1 – Fish. Published by: Austrian Federal Ministry of Agriculture and Forestry,Environment and Water Management (ISBN: 978-3-85174-063-9).

Ritterbusch, D., Brämick, U. (2015): Verfahrensvorschlag zur Bewertung des ökologischen Zustands von Seen anhand der Fische, Schriften des Instituts für Binnenfischerei e.V. Band 41., Potsdam-Sacrow.

Schriften des Instituts für Binnenfischerei e.V. Potsdam-Sacrow, Verfahrensvorschlag zur Bewertung des ökologischen Zustandes von Seen anhand der Fische, Band 41“.

Italy

Italian Manuals and Guidelines 111/2014 *Biological methods for inland surface waters* performed by ISPRA http://admin.isprambiente.gov.it/files/pubblicazioni/manuali-lineeguida/MLG__111_2014_Metodi_Biologici_acque.pdf

Report CNR-ISE, 02.13 Indici per la valutazione della qualità ecologica dei laghi. Versione 2018 (Report on Italian Methods for the evaluation of the ecological quality of lake waterbodies, 2013) http://www.ise.cnr.it/images/seminar/Report/Report_2013_02_indici.pdf

http://www.ise.cnr.it/images/wfd/en/phytoplankton.pdf

UNI EN 15204:2006 Water quality – Guidance standard on the enumeration of phytoplankton using inverted microscopy (Utermöhl technique)

APHA Standard Methods for the Examination of Water and Wastewater ed. 23rd 2017 10200 H

D.Lgs.152/2006 Norme in materia ambientale, con le sue successive modifiche ed integrazioni, recepisce formalmente la Direttiva 2000/60/CE

Decreto 260/2010 Criteri tecnici per la classificazione dello stato dei corpi idrici superficiali – Modifica norme tecniche D.Lgs. 152/2006 (Technical criteria for the classification of the status of surface water bodies)

UNI EN 13946:2014 *Water quality-Guidance for the routine sampling and preparation of benthic diatoms from rivers and lakes*

Italian Manuals and Guidelines 111/2014 *Biological methods for inland surface waters* performed by ISPRA http://admin.isprambiente.gov.it/files/pubblicazioni/manuali-lineeguida/MLG__111_2014_Metodi_Biologici_acque.pdf

Report CNR-ISE, 02.13 Indici per la valutazione della qualità ecologica dei laghi. Versione 2018 (Report on Italian Methods for the evaluation of the ecological quality of lake waterbodies, 2013) http://www.ise.cnr.it/images/seminar/Report/Report_2013_02_indici.pdf

Gassner H., Achleitner D., Luger M., Ritterbusch D., Schubert M., Volta P. 2014. Water Framework

Directive Intercalibration Technical Report. Alpine Lake Fish fauna ecological assessment methods. 68

p. S. Poikane (ed.). (JRC Technical Reports, vol. EUR 26506 EN). Ispra: Publications Office of the European Union, 2014.

Volta P. 2011. Indice per la valutazione della qualità ecologica dei laghi a partire dalla composizione della comunità ittica: Lake Fish Index (LFI). In:Indici per la valutazione della qualità ecologica dei laghi (CNR-ISE Ed.). REPORT CNR-ISE 03.13

Volta P., Oggioni A., Bettinetti R & E. Jeppesen. 2011. Assessing lake typologies and indicator fish species for Italian natural lakes using past fish richness and assemblages. Hydrobiologia 671, 227-240.

Volta, P. & A. Oggioni, 2010. Key- and type- specific fish species in natural lakes of italian Alpine Ecoregion reconstructed from historical data: a preliminary index to assess the quality status of fish fauna according to WFD 2000/60/CE. (In Italian). Studi Trentini Scienze Naturali 87, 97-104.

Volta, P., 2010. Analysis of the population structure of Coregonus lavaretus (Linneus 1758) in three deep Italian lakes using stock density indexes. Studi Trentini Scienze Naturali 87, 257-260.

Slovenia

Wolfram G., Donabaum K., Dokulil M., GUIDANCE ON THE MONITORING OF THE BIOLOGICAL QUALITY ELEMENTS PART B2 – PHYTOPLANKTON, 2013, Federal Ministry of Agriculture and Forestry Environment and Water Management, A - 1012 Vienna

Methodology for ecological status assessment on the basis of phytobenthos and macrophythes [Metodologija vrednotenja ekološkega stanja jezer na podlagi fitobentosa in makrofitov] (in Slovene) http://www.mop.gov.si/si/delovna_podrocja/voda/ekolosko_stanje_povrsinskih_voda/

EN 13946 Water quality – Guidance for the routine sampling and preparation of benthic diatoms from rivers and lakes.

Melzer A. (1999). Aquatic Macrophytes as tools for lake management. Hydrobiologia 395(396): 181-190.

Rott E., Pipp E., Pfister P., van Dam H., Ortler K., Binder N., Pall K. (1999). Indikationslisten für Aufwuchsalgen. Teil 2: Trophieindikation. Bundesministerium für Land- und Forstwirtschaft, Wien

Gassner H., Achleitner D., Luger M., Ritterbusch D., Schubert M., Volta P., Poikane S. (ur.) (2014). Water Framework Directive Intercalibration Technical Report: Alpine Lake Fish fauna ecological assessment methods. European Commission. Joint Research Centre – Institute for Environment and Sustainability. 68 pp.

Podgornik S., Urbanič G., Koren Š., Šiling R., Petkovska . (2016). Razvoj metodologije vrednotenja ekološkega stanja in razvrščanja vodnih teles jezer na podlagi rib. Zavod za ribištvo Slovenije, Inštuitut za vode Republike Slovenije, Sp. Gameljne, Ljubljana, 69 str.

SIST EN 14757:2015. Kakovost vode – Vzorčenje rib s pomočjo zabodnih mrež (gillnets). Slovenski institut za standardizacijo.

Volta P., Oggioni A., Bettinetti R., Jeppesen E. (2011). Assessing lake typologies and indicator fish species for Italian natural lakes using past fish richness and assemblages. Hydrobiologia 671, 227-240.

Volta P. 2011. Indice per la valutazione della qualità ecologica dei laghi a partire dalla composizione della comunità ittica: Lake Fish Index (LFI). In:Indici per la valutazione della qualità ecologica dei laghi (CNR-ISE Ed.). REPORT CNR-ISE 03.11

Switzerland

DFI 1982. Recommandations pour l'analyse des eaux superficielles en Suisse. Département fédéral de l'intérieur. Berne.

ISO 10260:1992. Water quality– Measurement of biochemical parameters – Spectrometric determination of the chlorophyll-a concentration

UNI EN 15204 : 2006. Water quality- Guidance standard on the enumeration of phytoplankton using inverted microscopy (Utermöhl technique).

OFEV, 2013. Système d'analyse et d'appréciation des lacs en Suisse. Guide pour l'élaboration de modules d'appréciation. Berne

Water Category: Rivers

BQE: Benthic diatoms, Fish

Literature References

Austria

(CEN) ÖNORM EN 14407 (2004): Wasserbeschaffenheit – Anleitung zur Bestimmung. Zählung und Interpretation von benthischen Kieselalgen in Fließgewässern/ Water condition – Guide for the determination, counting and interpretation of benthic diatoms in running waters

(CEN) ÖNORM EN 13946 (2003): Wasserbeschaffenheit - Leitfaden zur Probenahme und Probenaufbereitung von benthischen Kieselalgen in Fließgewässern/ Water condition - Guidance on sampling and sample treatment of benthic diatoms in running waters.

MOOG O.; SCHMIDT-KLOIBER A.; OFENBÖCK T. & GERRITSEN T. (2001): Aquatische Ökoregionen und Fließgewässer-Bioregionen Österreichs – eine Gliederung nach geoökologischen Milieufaktoren und Makrozoobenthos-Zönosen. Publ. Wasserwirtschaftskataster. BMFLFUW. 1-106.

PFISTER P.; PIPP E. (2015): GUIDANCE ON THE MONITORING OF THE BIOLOGICAL QUALITY ELEMENTS PART A3 - PHYTOBENTHOS

ROTT. E.; HOFMANN. G.; PALL. K.; PFISTER. P. & PIPP E. (1997): Indikationslisten für Periphyticalgen. Teil 1: Saprobielle Indikation. Publ. Wasserwirtschaftskataster. BMLF. 1-73.

ROTT. E.; Van DAM. H.; PFISTER. P.; PIPP. E.; PALL. K.; BINDER. N. & ORTLER K. (1999): Indikationslisten für Periphyticalgen. Teil 2: Trophieindikation. geochemische Reaktion. toxikologische und taxonomische Anmerkungen. Publ. Wasserwirtschaftskataster. BMLF. 1-248.

Economou A., Schmutz, S., Melcher, A., Haidvogl, G., Breine, J., Simoens, I., Kestemont, P., Goffaux, D., Ponz, D., Böhmer, J., Kesminas, V., Virbickas, T., Zalewski, M., Lapinska, M., Backx, J., de Leeuw, J.J., Ferreira, T., Beier, U., Degerman, E., Cowx, I.G., Noble, R.A.A., Starkie, A. (2002) Development, Evaluation & Implementation of a Standardised Fish-based Assessment Method for the Ecological Status of European Rivers - A Contribution to the Water Framework Directive - Defining Reference Conditions

Haunschmid, R., Schotzko, N., Petz-Glechner R., Honsig-Erlenburg W., Schmutz S., Spindler T., Unfer G., Wolfram G., Bammer V., Hundritsch L., Prinz H., Sasano B. (2006) Leitfaden zur Erhebung der biologischen Qualitätselemente Teil A1

Schmutz, S., Zauner, G., Eberstaller, J. & Jungwirth M. (2001): Die „Streifenbefischungsmethode“: eine Methode zur Quantifizierung von Fischbeständen mittelgroßer Fließgewässer. Österreichs Fischerei Jg. 54, Heft 1/2001: 14–27.

CEN (2003): EN 14011 Water quality – Sampling of fish with electricity.

France

AFNOR. 2007. Norme NF T 90-354

Coste, M., S. Boutry, J. Tison-Rosebery, and F. Delmas. 2009. Improvements of the Biological Diatom Index (BDI): Description and efficiency of the new version (BDI-2006). Ecological Indicators 9:621-650.

Lenoir A. & Coste M, 1996. Development of a practical diatom index of overall water quality applicable to the french national water board network. In: Whiton B.A. & Rott E. (eds). Use of algae for monitoring rivers II, Innsbruck Austria 17-19 sept 95, Studia Student. Gmbh : 29-43.

Oberdorff, T., D. Pont, B. Hugueny, and J.-P. Porcher. 2002. Development and validation of a fish-based index for the assessment of 'river health' in France. Freshwater Biology 47:1720-1734.

Jepsen, N. and D. Pont. 2007. Intercalibration of Fish-based Methods to evaluate River Ecological Quality. JRC scientific and technical report, JRC, Ispra.

Germany

Schaumburg, J., Schranz, C., Stelzer, D., Vogel, A., Gutowski, A. (2012): Verfahrensanleitung für die ökologische Bewertung von Fließgewässern zur Umsetzung der EU-Wasserrahmenrichtlinie: Makrophyten und Phytobenthos . Stand Februar 2012. Bayerisches Landesamt für Umwelt. Im Auftrag des Umweltbundesamtes(FKZ 3707 28 201), 137 S., Augsburg/Wielenbach

Dußling, U. (2009): Handbuch zu fiBS. – Schriftenreihe des Verbandes Deutscher Fischereiverwaltungsbeamter und Fischereiwissenschaftler e.V., Heft 15

Gewässerbewertung: http://www.gewaesser-bewertung.de/index.php?article_id=129&clang=0

CEN (2003): EN 14011 Water quality – Sampling of fish with electricity.

Italy

UNI EN 13946:2014 *Water quality-Guidance for the routine sampling and preparation of benthic diatoms from rivers and lakes*

Italian Manuals and Guidelines 111/2014 *Biological methods for inland surface waters* performed by ISPRA http://admin.isprambiente.gov.it/files/pubblicazioni/manuali-lineeguida/MLG__111_2014_Metodi_Biologici_acque.pdf

D.Lgs.152/2006 Norme in materia ambientale, con le sue successive modifiche ed integrazioni, recepisce formalmente la Direttiva 2000/60/CE

Decreto 260/2010 Criteri tecnici per la classificazione dello stato dei corpi idrici superficiali – Modifica norme tecniche D.Lgs. 152/2006 (Technical criteria for the classification of the status of surface water bodies)

Italy Legislative Decree No. 152 approving the Code on the Environment. Gazzetta Ufficiale della Repubblica Italiana No. 88, 14 April 2006

ISPRA. Biological methods for internal surface waters. Rome. 2014 (Manuali e Linee Gu

ISPRA. Nuovo Indice dello Stato Ecologico delle Comunità Ittiche (NISECI). Manuali e Linee Guida 159/2017 ida,Vol. 111/2014).

UNI-EN 14011:2003 - Campionamento di pesci mediante elettricità.

UNI-EN 14962:2006 - Linee guida sullo scopo e la selezione dei metodi di campionamento di pesci.

UNI-EN 14996:2006 - Linee guida per assicurare la qualità delle valutazioni biologiche ed ecologiche nell'ambiente acquatico.

Zerunian A., Goltara A., Schipani I., Boz B., 2009. Adeguamento dell'Indice dello Stato Ecologico delle Comunità Ittiche alla Direttiva Quadro sulle Acque 2000/60/CE. Biologia Ambientale 23(2): 1-16.

Slovenia

Methodology for ecological status assessment on the basis of phytobenthos and macrophythes [Metodologija vrednotenja ekološkega stanja vodotokov na podlagi fitobentosa in makrofitov] (in Slovene) http://www.mop.gov.si/si/delovna_podrocja/voda/ekolosko_stanje_povrsinskih_voda/

EN ISO 5667-3 Water quality - Sampling - Part 3: Preservation and handling of water samples

EN 15708 Water quality - Guidance standard for the surveying, sampling and laboratory analysis of phytobenthos in shallow running waters

EN 13946 Water quality - Guidance for the routine sampling and preparation of benthic diatoms from rivers and lakes

EN 14407 Water quality - Guidance for the identification and enumeration of benthic diatom samples from rivers and lakes

Rott E., Hofmann G., Pall K., Pfister P., Pipp E. (1997). Indikationslisten für Aufwuchsalgen. Teil 1: Saprobielle Indikation. Bundesministerium für Land- und Forstwirtschaft, Wien.

Rott E., Pipp E., Pfister P., van Dam H., Ortler K., Binder N., Pall K. (1999). Indikationslisten für Aufwuchsalgen. Teil 2: Trophieindikation. Bundesministerium für Land- und Forstwirtschaft, Wien.

Schmutz, S., Zauner, G., Eberstaller, J., Jungwirth, M. (2001). Die Streifenbefischungs-methode: eine Methode zur Quantifizierung von Fischbeständen mittelgroßer Fließgewässer. Österreichs Fischerei Jg. 54, Heft 1/2001: 14-27.

Seber, G.A., Le Cren, E.D. (1967). Estimating population parameters from catches large relative to the population. Journal of Animal Ecology 36: 631–643.

EN 14011:2003. Water quality – Sampling of fish with electricity

Methodology for ecological status assessment on the basis of fish fauna in rivers [Metodologija vrednotenja ekološkega stanja vodotokov na podlagi rib] (in Slovene)
http://www.mop.gov.si/si/delovna_podrocja/voda/ekolosko_stanje_povrsinskih_voda/

ALPINE REGION

WISER project (http://www.wiser.eu/results/method-database/)

Water Category: Lakes
GIG: Alpine
Biological Quality Element: Phytoplankton OR Benthic Diatoms OR Fish Fauna

AUSTRIA

1. Guidance for the evaluation of the biological quality elements, part B2 ? phytoplankton

   Austria | Lakes | Alpine | Phytoplankton

   Wolfram, G. & M. Dokulil, 2009. Leitfaden zur Erhebung der biologischen Qualitaetselemente, Teil B2 ? Phytoplankton. Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft.

   Wolfram et al., 2009. Reference conditions and WFD compliant class boundaries for phytoplankton biomass and chlorophyll-a in Alpine lakes. Hydrobiologia 633: 45-58

2. Assessment of fish fauna in lakes

   Austria | Lakes | Alpine | Fish Fauna

   Gassner, H. & J. Wamzemböck, 2007. Application of population size structure indices to Austrian whitefish (Coregonus lavaretus) stocks exploited by anglers. Archiv für Hydrobiologie, Spec. Issues Advanc. Limnol. 60: 377-384.

   Gassner, H., J. Wanzenboeck & G. Tischer, 2003. Ecological Integrity Assessment of Lakes Using Fish Communities ? Suggestions of new Metrics developed in two Austrian prealpine Lakes. International Review of Hydrobiology 88: 635-652.

   Gassner, H., J. Wanzenboeck, D. Zick, G Tischler & B. Pamminger-Lahnsteiner, 2005. Development of a fish based lake typology for natural Austrian Lakes > 50 ha based on the reconstructed historical fish communities. International Review of Hydrobiology 90: 422-432.

   Wanzenboeck, J., H. Gassner, B. Lahnsteiner, Y.Hassen, G. Hauseder, C. Doblander & G. Köck, 2002. Ecological integrity assessment of lakes using fish communities: An example from Lake Traunsee exposed to intensive fishing and to effluents from soda-industry. Water, Air, and Soil pollution: Focus 2: 227-248.

   Zick, D., H. Gassner, J. Wanzboeck, P. Filzmoser, B. Pamminger- Lahnsteiner & G. Tischler, 2006. Increased human population: Major driver of fish decline in lakes. European Commission, DG Environment News Alert Service, Issue 32.

   Zick, D., H. Gassner, M. Rinnerthaler & P. Jaeger, 2007. Application of population size structure indices to arctic Charr Salvelinus alpinus (L.) in Alpine lakes in Austria Ecology of Freshwater Fish 16: 54-63.

   Zick, D., H. Gassner, P.Filzmoser, J. Wanzenboeck, B. Lahnsteiner & G. Tischler, 2006. Changes in the fish species composition of all Austrian lakes > 50 ha during the last 150 years. Fisheries Management and Ecology 13: 1-9.

ITALY

3. Phytoplankton Assesment Method for the Ecological status of Lakes

   Italy | Lakes | Alpine | Phytoplankton

   Indici per la valutazione della qualita ecologica dei laghi. report CNR-ISE, 2/09. In press.

Salmaso, N., G. Morabito, F. Buzzi, L. Garibaldi, M. Simona & R. Mosello, 2006. Phytoplankton as an indicator of the water quality of the deep lakes south of the Alps. Hydrobiologia 563: 167-187.
Wolfram, 2009. Reference conditions and WFD compliant class boundaries for phytoplankton biomass and chlorophyll-a in Alpine lakes. Hydrobiologia 633: 45-58.

4. Lake Fish Index - Index for the assessment of quality of the fish communities in italian lakes

Italy | Lakes | Alpine, Mediterranean | Fish Fauna

CNR ISE Report 2/09. Indici per la valutazione della qualita ecologica dei laghi.

GERMANY

5. German Phyto-Lake-Index

Germany | Lakes | Alpine, Central-Baltic | Phytoplankton

Research report for LAWA project O 5.05. Mischke et al. 2008; Downloads on http://www.laenderfinanzierungsprogramm.de/cms/WaBoAb_prod/WaBoAb/Vorhaben/LAWA/Vorhaben_des_Ausschusses_Oberflaechengewaesser_und_Kuestengewaesser_(AO)/biologische_Bewertungsverfahren_im_Rahmen_der_WRRL/index.jsp

First and not actual approach see:

LAWA-AO, 2006. RaKon Monitoring Teil B. Arbeitspapier III: Untersuchungsverfahren für biologische Qualitätskomponenten. Ständiger Ausschuss "Oberflächengewässer und Küstengewässer" der Bund/Länder-Arbeitsgemeinschaft Wasser (LAWA-AO).

Mischke, U., U. Riedmüller, E. Hoehn, I. Schönfelder & B. Nixdorf, 2008. Description of the German system for phytoplankton-based assessment of lakes for implementation of the EU Water Framework Directive (WFD). In Mischke, U. & B. Nixdorf (eds), Gewässerreport (Nr. 10), BTUC-AR 2/2008, Eigenverlag BTU Cottbus, 117-146.

http://www.tu-cottbus.de/fakultaet4/de/gewaesserschutz/downloads/aktuelle-reihe.html
Document name: "2008_ar_10.pdf"

Wolfram et al., 2009. Reference conditions and WFD compliant class boundaries for phytoplankton biomass and chlorophyll-a in Alpine lakes. Hydrobiologia 633: 45-58.

6. German Assessment System for Macrophytes and Phytobenthos for the WFD

Germany | Lakes | Alpine, Central-Baltic | Benthic Diatoms, Macrophytes, Other Phytobenthos

LAWA-AO, 2006. RaKon Monitoring Teil B. Arbeitspapier III: Untersuchungsverfahren für biologische Qualitätskomponenten. Ständiger Ausschuss "Oberflächengewässer und Küstengewässer" der Bund/ Länder-Arbeitsgemeinschaft Wasser (LAWA-AO).

Schaumburg, J., U. Schmedtje, C. Schranz, B. Köpf, S. Schneider, P. Meilinger, D. Stelzer, G. Hofmann, A. Gutowski & J. Foerster, 2004. Erarbeitung eines ökologischen Bewertungsverfahrens für Fließgewässer und Seen im Teilbereich Makrophyten und Phytobenthos zur Umsetzung der EU-Wasserrahmenrichtlinie. ? Bayerisches Landesamt für Wasserwirtschaft, Abschlussbericht an das Bundesministerium für Bildung und Forschung (FKZ 0330033) und die Länderarbeitsgemeinschaft Wasser (Projekt Nr. O 11.03), 635. p., Muenchen.

Schaumburg, J., C. Schranz, G. Hofmann, D. Stelzer, S. Schneider & U. Schmedtje, 2004. Macrophytes and phytobenthos as indicators of ecological status in German lakes ? a contribution to the implementation of the Water Framework Directive. Limnologica 34: 302?31.

Schaumburg, J., U. Schmedtje, C. Schranz, B. Köpf, S. Schneider, P. Meilinger, D. Stelzer, G. Hofmann, A. Gutowski & J. Foerster, 2005. Bewertungsverfahren Makrophyten & Phytobenthos, Fließgewässer- und Seenbewertung in Deutschland nach EGWRRL. Informationsberichte des Bayerischen Landesamtes für Wasserwirtschaft, Heft 1/05: 24 p., Muenchen.

Schaumburg, J., U. Schmedtje, C. Schranz, B. Köpf, S. Schneider, P. Meilinger, D. Stelzer, G. Hofmann, A. Gutowski & J. Foerster, 2005.

Makrophyten und Phytobenthos in Flüssen und Seen ? Das deutsche Bewertungsverfahren: Entwicklung, Praxistest und Ausblick. In Feld, R. & F. Sommerhäuser (eds), Typologie, Bewertung, Management von Oberflächengewässern, Stand der Forschung zur Umsetzung der EG-Wasserrahmenrichtlinie. Limnologie aktuell: Band 11: 63-75, Stuttgart.

Stelzer, D., S. Schneider & A.Melzer, 2005.

Macrophyte based assessment of lakes - a contribution to the implementation of the European Water Framework Directive in Germany. In Rev. Hydrobiol. 90 (2): 223-237.

SLOVENIA

7. Phytoplankton Assesment Method for the Ecological status of Lakes

   Slovenia | Lakes | Alpine | Phytoplankton

   Wolfram, G. & M. Dokulil, 2009. Leitfaden zur Erhebung der biologischen Qualitätselemente, Teil B2 ? Phytoplankton. Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft.

   Wolfram et al., 2009. Reference conditions and WFD compliant class boundaries for phytoplankton biomass and chlorophyll-a in Alpine lakes. Hydrobiologia 633: 45-58.

8. Ecological status assessment system for lakes using phytobenthos

   Slovenia | Lakes | Alpine | Benthic Diatoms

   http://www.mop.gov.si/si/delovna_podrocja/direktorat_za_okolje/sektor_za_vode/ekolosko_stanje_povrsinskih_voda/

9. Assessment of fish fauna in lakes

   Slovenia | Lakes | Alpine | Fish Fauna

WISER project (http://www.wiser.eu/results/method-database/)

Water Category: Rivers
GIG: Alpine
Biological Quality Element: Benthic Diatoms OR Other Phytobenthos OR Fish Fauna

AUSTRIA

1. Assessment of the biological quality elements - part phytobenthos

   Austria | Rivers | Alpine, Central-Baltic, Eastern Continental | Benthic Diatoms, Other Phytobenthos

   BMLFUW, 2009. Leitfaden zur Erhebung der biologischen Qualitätselemente.

   Rott, E., G. Hofmann, K. Pall, P. Pfister & E. Pipp, 1997. Indikationslisten für Aufwuchsalgen. Teil 1: Saprobielle Indikation. Publ. Wasserwirtschaftskataster, BMfLF: 1-73.

   Rott, E., H. Van Dam, P. Pfister, E. Pipp, K. Pall, N. Binder & K. Ortler, 1999. Indikationslisten für Aufwuchsalgen. Teil 2: Trophieindikation, geochemische Reaktion, toxikologische und taxonomische Anmerkungen. Publ. Wasserwirtschaftskataster, BMfLF: 1-248.

2. Fish Index Austria

   Austria | Rivers | Cross-GIG (Alpine) | Fish Fauna

   Leitfaden für die Erhebung der biologischen Qualitätselemente A1 Fische (BMLFUW) EN 14757 (CEN 2005) EN 14692 (CEN 2004).

FRANCE

3. Biological Diatom Index 2006

   France | Rivers | Alpine, Central-Baltic, Mediterranean | Benthic Diatoms

   Norme AFNOR NF T90-354, December 2007. Qualité de l'eau - Détermination de l'Indice Biologique Diatomées (IBD).

   Coste, M., S. Boutry, J. Tison-Rosebery & F. Delmas, 2009. Improvements of the Biological Diatom Index (BDI): Description and efficiency of the new version (BDI-2006). Ecological Indicator 9 (4): 621-650.

4. Fish Biotic Index

   France | Rivers | Cross-GIG (Alpine, Central-Baltic, Mediterranean) | Fish Fauna

   AFNOR, 2004. Qualité de l'eau - Détermination de l'Indice Poisson Rivière (IPR) Normes Francaises NF T90-344: pp. 16.

   National technical documen ts: CSP (2006) L'indice poissons rivi`re (IPR).

   Belliard, J. & Roset, N. (eds), 2006. Conseil Supérieur de la Peche, Fontenay-sous-Bois; Avril.

   Oberdorff, T., D. Pont, B. Hugueny & D. Chessel, 2001. A probabilistic model characterizing fish assemblages of French rivers: a framework for environmental assessment. Freshwater Biology 46: 399-415.

   Oberdorff, T., D. Pont, B. Hugueny & J.P. Porcher, 2002. Development and validation of a fish-based index for the assessment of "river health" in France. Freshwater Biology 47: 1720-1734.

   Oberdorff, T., D. Pont, B. Hugueny, P. Boet, J.P. Porcher & D. Chessel, 2001. Adaptation a l'ensemble du reseau hydrographique national d'un indice de qualite ecologique fonde sur les peuplements de poissons :

resultats actuels et perspectives. In Lemoalle, J., F. Bergot & M. Robert (eds), Etat de sante des ecosystemes aquatiques. De nouveaux indicateurs biologiques. Cemagref, Antony.

GERMANY

5. German Assessment System for Macrophytes and Phytobenthos according to the EU WFD

Germany | Rivers | Alpine, Central-Baltic | Benthic Diatoms, Macrophytes, Other Phytobenthos

LAWA- AO, 2006. RaKon Monitoring Teil B. Arbeitspapier III: Untersuchungsverfahren für biologische Qualitätskomponenten. Ständiger Ausschuss "Oberflächengewässer und Küstengewässer" der Bund/ Länder-Arbeitsgemeinschaft Wasser (LAWA-AO).

Schaumburg, J., U. Schmedtje, C. Schranz, B. Köpf, S. Schneider, P. Meilinger, D. Stelzer, G. Hofmann, A. Gutowski & J. Foerster, 2004. Erarbeitung eines ökologischen Bewertungsverfahrens für Fließgewässer und Seen im Teilbereich Makrophyten und Phytobenthos zur Umsetzung der EU-Wasserrahmenrichtlinie. Bayerisches Landesamt für Wasserwirtschaft, Abschlussbericht an das Bundesministerium für Bildung und Forschung (FKZ 0330033) und die Länderarbeitsgemeinschaft Wasser (Projekt Nr. O 11.03), 635. p., M¨nchen.

Schaumburg, J., U. Schmedtje, C. Schranz, B. Köpf, S. Schneider, P. Meilinger, D. Stelzer, G. Hofmann, A. Gutowski & J. Foerster, 2005. Bewertungsverfahren Makrophyten & Phytobenthos, Fließgewässer- und Seenbewertung in Deutschland nach EGWRRL. Informationsberichte des Bayerischen Landesamtes für Wasserwirtschaft, Heft 1 (05): 245 p. München.

Schaumburg, J., C. Schranz, G. Hofmann, D. Stelzer, S. Schneider & U. Schmedtje, 2004. Macrophytes and phytobenthos as indicators of ecological status in German lakes- a contribution to the implementation of the Water Framework Directive. Limnologica 34: 302-314.

Schaumburg, J., C. Schranz, P. Meilinger, D. Stelzer, G. Hofmann, J. Foerster, S. Schneider, B. Köpf & U. Schmedtje, 2005. Makrophyten und Phytobenthos in Flüssen und Seen. Das deutsche Bewertungsverfahren: Entwicklung, Praxistest und Ausblick. In Feld, C. & M. Sommerhäuser (eds), Typologie, Bewertung, Management von Oberflächengewässern, Stand der Forschung zur Umsetzung der EG-Wasserrahmenrichtlinie. - Limnologie aktuell: Band 11: 63-75.

Stelzer, D., S. Schneider & A. Melzer, 2005. Macrophyte based assessment of lakes - a contribution to the implementation of the European Water Framework Directive in Germany. Int. Rev. Hydrobiol. 9 (2): 223 ? 237.

6. Fish-based Assessment System

Germany | Rivers | Cross-GIG (Alpine, Central-Baltic) | Fish Fauna

Dussling, U., 2009. Handbuch zu fiBS. Schriftenreihe des Verbandes Deutscher Fischereiverwaltungsbeamter und Fischereiwissenschaftler e.V., Heft 15.

Dußling, U., 2009. Handbuch zu fiBS. Schriftenreihe des Verbandes Deutscher Fischereiverwaltungsbeamter und Fischereiwissenschaftler e.V., Heft 15.

Dußling, U., R. Berg, H. Klinger & C. Wolter, 2004. Assessing the Ecological Status of River Systems Using Fish Assemblages. Handbuch Angewandte Limnologie 20. Erg.Lfg. 12 (4): 1-84.

SLOVENIA

7. Ecological status assessment system for rivers using phytobenthos

Slovenia | Rivers | Alpine, Eastern Continental, Mediterranean | Benthic Diatoms

Uradni list Republike Slovenije stran (pp) 832, st. (no) 10, 9.2.2009.

Water quality assessment

BQE methods in the Alpine region, update of WISER database

Country: Italy
Category: Lakes
Biological Quality Element: Phytoplankton

Short description of sampling procedure

The procedure provides a collection of an integrated phytoplankton sample in the water layer where photosynthesis processes take place, corresponding to the thickness of the euphotic zone. The integrated sample is obtained either with the use of a tube of length proportional to the water layer to be sampled, or of a sampler which integrates the sample during the ascent along the water column, mixing the same quantities of water taken at successive depths, or taking punctiform samples of equal volume, from different depths and mixing them subsequently. The sample taken is then prepared for microscopic observation of the organisms.
The samples should be taken, preferably, at the point of maximum depth, chosen as representative of the average conditions of the environment. The sampling station should be in a central position with respect to the development of the lake surface, so as not to be influenced by phenomena occurring along the coasts. If the point of maximum depth is too close to the shore of the lake, prefer the choice of a more central station. In artificial lakes the station, chosen, if possible, at the point of maximum depth, or at least in a representative station of the pelagic environment, should be placed at a safe distance from the wall of the dam and the intake works. Always take samples integrated into the euphotic zone, established as described in point 4, bearing in mind that: - if the depth of the euphotic zone is more than 20 meters, it is sufficient to take an integrated sample between 0 and 20 meters; if the euphotic zone extends to the bottom or if at the level of the bottom is not reached a value of PAR corresponding to 1% of the surface, it is good to take a sample integrated between the surface and 1 meter from the bottom of the lake. In this case, particular attention must be paid to avoid any operation that could disturb the sediments.

Sampling period/frequency

In lake environments for which previous data are not available, it would be better to carry out some monthly samplings in the period March-November for at least two years, to assess possible removals from the general scheme above described.
On the basis of data on the succession of phytoplankton associations, available for Italian lakes, it is advisable to carry out at least 6 samples during the year, broken down as follows: - 1 sample to be taken from January to 15 March, representative of the winter communities - 1 sample to be taken in the period April - May 15, representative of the spring communities - 1 sample to be taken in the period July - August, representative of the summer communities - 1 sample to be taken in the period October 15 - November, representative of the autumn communities . In addition to these samples it is advisable to take another 2 samples, respectively in the period 15 May - 15 June and in September, as representative of the transition phases from the spring community for the summer and from the summer to the autumn. In lake environments for which no previous data are available, it is advisable to carry out monthly sampling during the March-November period for at least two years, to evaluate any deviations from the general scheme described above.

Characterisation of representative sampling site The samples should be taken, preferably, at the point of maximum depth, chosen as representative of the average conditions of the environment. The sampling station should be in a central position with respect to the development of the lake surface, so as not to be influenced by phenomena occurring along the coasts.
Short description of processing method and evaluation (e.g. metrics, level of identification) The classification of lakes and reservoirs from phytoplankton is based on ICF Index (Overall phytoplankton index), defined by the average of the values of two indices, the average biomass index and the composition index. The calculation of these two indices is based on: Average concentration of chlorophyll a, Medium bio-volume, PTI (PTIot, PTIspecies, MedPTI) and percentage of cyan bacteria characteristic of eutrophic waters. Note: In the text of the decision of the European Commission on 20 September 2013, the ICF is called "Italian Method of Evaluation of Phytoplankton (IPAM) and" New Italian Method (NITMET) ".
Additional abiotic data recorded Temperature, pH, conductivity, total phosphorus, alkalinity, conductivity, ammonia nitrogen, nitric nitrogen, total nitrogen, nitrous nitrogen, reactive phosphorus, total phosphorus, reactive silica, dissolved oxygen.
Method features compliant with WFD For the assessment of phytoplankton communities the taxonomic composition and the algal biomass were taken into consideration
Rules to define ecological classes and reference conditions The ICF is determined on the basis of data from a sampling year and is obtained as the average of the average composition and biomass indices. for classification in the case of operational monitoring, the average value of the three ICFs calculated annually is used. The definition of reference values and class limits for the index ICF are reported in "Indici per la valutazione della qualità ecologica dei laghi" 2013. **Report CNR ISE, 02-13**: 195 pp.(Versione 2018).

Literature Reference Italy Legislative Decree No. 152 approving the Code on the Environment. Gazzetta Ufficiale della Repubblica Italiana No. 88, 14 April 2006. ISPRA. Biological methods for internal surface waters. Rome. 2014 (Manuali e Linee Guida,Vol. 111/2014). Wolfram G., Argillier C., de Bortoli J., Buzzi F., Dalmiglio A., Dokulil M. T., Hoehn E., Marchetto A., Martinez P.-J., Morabito G., Reichmann M., Remec-Rekar Š., Riedmüller U., Rioury C., Schaumburg J., Schulz L. & Urbanič G. (2009). Reference conditions and WFD compliant class boundaries for phytoplankton biomass and chlorophyll-a in Alpine lakes. Hydrobiologia 633: 45–58.

Method reported by:
Cristina Martone
ISPRA

Country: Italy
Category: Lakes
Biological Quality Element: Phytobenthos

Short description of sampling procedure

The characterization of the diatomic communities is carried out by sampling on different habitats defined by substrate, water velocity, water depth, and shading. In the same sampling campaign it is preferable to carry out the fitobenthos collection on the same substrate for all the monitored sites.
Types of substrates to be sampled, in order of preference:
- pebbles
- artificial surfaces in situ (manufactured goods);
- aquatic vegetation: emerging or submerged macrophytes;
- artificial substrates.

For the choice of the substrate, preference should be given to movable natural hard substrates, ie pebbles (dimensions from 64 mm to 256 mm) and to boulders (diameter> 256 mm).
Substrate with a well-developed phytobenthos community such as stones, sand, macrophythes, wood or artificial materials is transferred into plastic container and scrubbed with a knife or a toothbrush. Samples are fixed with alcohol.

Sampling period/frequency

Phytobentos is sampled at the end of low flow period when hydrological conditions are stable, or at least 2 weeks after flooding. Based on hydrological conditions and characteristics of watercourses in Italy recommended periods for phytobenthos sampling are as follows: July, August, September.

Characterisation of representative sampling site

A section of the water body must be selected that has suitable habitats and sampling substrates, avoiding heavily shaded areas.In each lake, three equally equidistant sites must be chosen. For particularly complex basins it may be appropriate to use a higher number of sites than expected.
Littoral zone with naturally occurring movable hard surfaces are recommended.

Short description of processing method and evaluation (e.g. metrics, level of identification)

There are various laboratory methods, based on the oxidation of organic matter contained in the sample, which allow to obtain the cleansing of diatom frustules. The most frequently used methods, because they do not involve the use of toxic substances, are based on the use of hydrogen peroxide, at high temperatures (90 ± 5°C) and at low temperatures. Diatoms are determined and counted with an optical microscope at a magnification of 1000x and immersion oil. Tthe preparations should have indicatively 10 to 15 valves per field at a magnification of 1000X. At least 400 valves should be counted.
The EPI-L index uses the weighted average formula. The trophic weights and the indicator values of the individual species were obtained from the set of data collected (80 lakes for 119 samples), limited to species that represented at least 1% of the count in 3 or more lakes and which reached a minimum percentage of 3% in at least one lake. The index can then be calculated for each lake, provided that at least 70% of the valves counted belong to one of the species identified, starting from the relative percent (a) abundances of the n species present with the following formula:

$$EPI-L = 4 - 2\frac{\sum_{i=1}^{n} a_i p_i v_i}{\sum_{i=1}^{n} a_i v_i}$$

Additional abiotic data recorded

Basic physical and chemical parameters (pH, water temperature, electric conductivity, dissolved oxygen, and saturation) are measured onsite with portable multimeter.

Method features compliant with WFD

The method is based on composition and abundance parameters as required by WFD.
Cross-GiG.

Rules to define ecological classes and reference conditions

Reference conditions: existing near-natural reference sites, expert knowledge.
Following the WFD, the boundaries between quality classes should be defined through intercalibration exercises, to assure that in the same ecoregion class boundaries are shared by all Member states. In the case of lake diatoms, the intercalibration exercise (Kelly et al., 2014) was performed comparing the methods used in different countries with a common metric, namely the Trophic index (Rott, 1999), which requires diatom counts at the species level.
Based on the intercalibration exercise (Marchetto, 2014), the boundaries between the "high" and "good" quality classes were set to an EPI-L value of 1.702 for deep lakes and 1.845 for shallow lakes, while the boundaries between "good" and "moderate" ecological quality was set to 1.135 for deep lakes and 1.230 for shallow lakes.

Literature Reference

Italy Legislative Decree No. 152 approving the Code on the Environment. Gazzetta Ufficiale della Repubblica Italiana No. 88, 14 April 2006

ISPRA. Biological methods for internal surface waters. Rome. 2014 (Manuali e Linee Guida,Vol. 111/2014)

EN 13946 Water quality – Guidance for the routine sampling and preparation of benthic diatoms from rivers and lakes.

Indici per la valutazione della qualità ecologica dei laghi. 2013. Report CNR ISE, 02-13: 195 pp.(Versione 2018)

Method reported by:
Cristina Martone
ISPRA

Country:
Category: RIvers
Biological Quality Element: Phytobenthos (Diatoms)

Short description of sampling procedure

The characterization of the diatomic communities is carried out by sampling on different habitats defined by substrate, water velocity, water depth, and shading. In the same sampling campaign it is preferable to carry out the fitobenthos collection on the same substrate for all the monitored sites.

Types of substrates to be sampled, in order of preference:

- pebbles
- artificial surfaces in situ (manufactured goods);
- aquatic vegetation: emerging or submerged macrophytes;
- artificial substrates.

For the choice of the substrate, preference should be given to movable natural hard substrates, ie pebbles (dimensions from 64 mm to 256 mm) and to boulders (diameter> 256 mm).

Substrate with a well-developed phytobenthos community such as stones, sand, macrophythes, wood or artificial materials is transferred into plastic container and scrubbed with a knife or a toothbrush.

Samples are fixed with alcohol.

Sampling period/frequency

Alpine and central area: it is advisable to carry out the sampling campaigns in correspondence with the hydrological regimens of low and moderate flow:

- January-February or August-September for the lean
- April-May for the soft);

In the watercourses of glacial origin the late spring and early summer months should be avoided because the high concentration of suspended solids can strongly alter the diatomic community.

Mediterranean area: it is advisable to carry out the two sampling campaigns in correspondence with the hydrological regimes of low and moderate flow:

- spring for the low flow and fine summer /early autumn for the moderate in the permanent water courses;
- early spring for the low flow and beginning summer -maximum early July - for the moderate in temporary watercourses, before the dry phase.

The frequency is twice a year.

Characterisation of representative sampling site

A section of water body must be selected that has suitable habitats and sampling substrates, in particular riffles. The length must be at least 10m; the extension must however be at least equal to the width of the wet bed.

The sampling procedure involves the collection of data useful for the characterization of the monitored site, such as:

1. Name of the river
2. Name of the sampling site

3. Date
4. Name of the operator
5. Gauss-Krueger coordinates
6. Survey section/area (length, width, running water cross-section [m])
7. Visibility of river bed (turbidity estimation)
8. Mean flow velocity, mean depth, type of substrate, shading (estimation in %)

Short description of processing method and evaluation (e.g. metrics, level of identification)

There are various laboratory methods, based on the oxidation of organic matter contained in the sample, which allow to obtain the cleansing of diatom frustules. The most frequently used methods, because they do not involve the use of toxic substances, are based on the use of hydrogen peroxide, at high temperatures (90 ± 5°C) and at low temperatures.Diatoms are determined and counted with an optical microscope at a magnification of 1000x and immersion oil. Tthe preparations should have indicatively 10 to 15 valves per field at a magnification of 1000X. At least 400 valves should be counted.

The multi-imetric index to be applied for the assessment of ecological status is called the Multi-metric Intercalibration Index (ICMi). The ICMi is based on the IPS(Specific Pollution sensitivity Index, CEMAGREF, 1982) and the TI (Trophic Index, Rott et al., 1999). The level of taxonomic identification is the Species.

Additional abiotic data recorded

Basic physical and chemical parameters (pH, water temperature, electric conductivity, dissolved oxygen, and saturation) are measured onsite with portable multimeter.

Method features compliant with WFD

The method is based on composition, and abundance parameters as required by WFD.
GIG: Alpine, Mediterranean, Central, Baltic
Relevant intercalibration types:
Alpine: RA1, RA2; Central and Baltic: C; Mediterranean: RM1, RM2, RM4 (RM3 large river)

Rules to define ecological classes and reference conditions

Scope of reference conditions: Existing near-natural reference sites, Expert knowledge

Literature Reference

Italy Legislative Decree No. 152 approving the Code on the Environment. Gazzetta Ufficiale della Repubblica Italiana No. 88, 14 April 2006

ISPRA. Biological methods for internal surface waters. Rome. 2014 (Manuali e Linee Guida,Vol. 111/2014)

Mancini L, & Sollazzo C. Method for assessing the ecological status of running waters: diatomic communities. Roma: Istituto Superiore di Sanità; 2009 (Rapporto Istisan, 09/19).

EN ISO 5667-3 Water quality - Sampling - Part 3: Preservation and handling of water samples

EN 15708 Water quality - Guidance standard for the surveying, sampling and laboratory analysis of phytobenthos in shallow running waters

EN 13946 Water quality - Guidance for the routine sampling and preparation of benthic diatoms from rivers and lakes

EN 14407 Water quality - Guidance for the identification and enumeration of benthic diatom samples from rivers and lakes

Rott E., Hofmann G., Pall K., Pfister P., Pipp E. (1997). Indikationslisten für Aufwuchsalgen. Teil 1: Saprobielle Indikation. Bundesministerium für Land- und Forstwirtschaft, Wien.

Rott E., Pipp E., Pfister P., van Dam H., Ortler K., Binder N., Pall K. (1999). Indikationslisten für Aufwuchsalgen. Teil 2: Trophieindikation. Bundesministerium für Land- und Forstwirtschaft, Wien.

Method reported by:
Cristina Martone
ISPRA

Water quality assessment

BQE methods in Switzerland

Suggested by the Swiss Federal Office for the Environment (FOEN) for the application in Swiss Cantons

Country: Switzerland **Category: River** **Biological Quality Element: Phytobenthos**

Short description of sampling procedure The Swiss Modular Stepwise Procedure include a standardized method for assessing the status of rivers and streams at regional level based on the frequency and distribution of diatom species. Diatoms are sampled from the surface of stones with a well-developed brown layer located in the current. Three to five fist-sized stones are sufficient for most stations, although in unproductive pre-alpine and montane streams at least 5 to 10 stones should be taken.The stones are collected from both banks and in the middle of the river, whereas in small watercourses stones are collected along the cross-section (transect). The diatoms are removed from each stone by scraping one or two surfaces (diameter ca. 5 cm) with a brush according to Douglas (1958). The samples are preferably fixed with formalin (neutral buffered, final concentration max. 4%) or Lugol, and stored at low temperature in the dark. A subsample can be stored without preservation for the microscopic observation on the living part of periphytic diatoms, which must be performed no later than the next day.
Sampling period/frequency Two annual samplings are considered ideal (late winter/spring and summer/fall). If only one sampling is possible per year, it should be done when maximum water pollution is predicted.
Characterisation of representative sampling site The sampling site should be representative of anthropogenic pollution. The sampling area should be permanently exposed to water flow. A maximum sampling depth of 0.5 to 1.0 m should not be exceeded and a maximum flow rate of approximately 1 m s^{-1}. Shaded sites should be avoided.
Short description of processing method and evaluation (e.g. metrics, level of identification) The Swiss Diatom Index (DI-CH) is based on the ecological classification of species included in the diatom database, which consists of 3649 diatoms counted from samples taken between 1985 and 2005 in Swiss rivers. The preparation clears the diatom sample from organic matter and limestone with acids and by heating or oxidation, as described by Krammer and Lange-Bertalot (1997a). Diatoms are

determined and counted with an optical microscope at a magnification of 1000x and immersion oil, following the Süsswasserflora von Mitteleuropa (Krammer and Lange-Bertalot 1997-2004)
At least 400 to 500 valves should be counted in transects.

Additional abiotic data recorded

The diatom module requires the analysis of chemical parameters which characterize anthropogenic impacts: ammonium, nitrite, inorganic nitrogen, total phosphorus, chloride, dissolved organic carbon

Method features compliant with WFD

The status classes developed within the Swiss Modular Stepwise Procedure are comparable with the system of ecological classes defined in the WFD.

Rules to define ecological classes and reference conditions

Swiss Modular Stepwise Procedure for studying and assessing surface waters refers to a reference status close to the natural status. The objective to be achieved is subdivided into hierarchical sub-objectives. The achievement of diatom objective is measured with the DI-CH on a continuous scale ranging from 1 (close to the natural status) to 8 (for a very bad status). Quantification is associated with five discrete status classes (very good, good, moderate, poor, bad) which indicate the achievement of the ecological objectives (threshold: class 2 – good).

Literature Reference

OFEV, 2007. Méthodes d'analyse et d'appréciation des cours d'eau en Suisse. Aspect général.

OFEV, 2007. Méthodes d'analyse et d'appréciation des cours d'eau en Suisse. Diatomées niveau R (région).

Comments

The Federal Office for the Environment (OFEV) defined a standardized method for assessing the status of rivers using diatoms (Système d'analyse et d'appréciation des cours d'eau en Suisse. Diatomées niveau R (région), 2007), as part of the Modular Stepwise Procedure, which serves as a basis for cantonal agencies to develop their monitoring programs.

Method reported by:
Camilla Capelli, Fabio Lepori
SUPSI

Country: Switzerland
Category: River
Biological Quality Element: Fish

Short description of sampling procedure

The Swiss Modular Stepwise Procedure include a standardized method for assessing the status of wadable streams at regional level using fish as indicators.
The river is subdivided in representative sections and. their exact length is measured using a linear meter. Electrofishing is the most appropriate method, but the procedures differ depending on river width. Streams up to 5 m wide can be electrofished over their entire surface, while larger rivers should be electrofished in strips. The two shore strips (right and left) and the middle strip of the river should be electrofished with the same intensity.
The fishing is carried out upstream a single time, and the upper end of the study section should be preferably placed next to an obstacle (natural or artificial slope, ford, etc.), to minimize fish escaping. The captured fish are placed in an anesthetic bath before being measured. To anesthetize them, clove oil or other narcotics can be used.

Sampling period/frequency

One sampling per year in late summer or autumn is required.

Characterisation of representative sampling site

As reference, a watercourse with a length of 10 km must have a minimum of three to five sections of study, each one long at least 100 m. The sampling sections should be representative of the ecomorphology of the river and its habitats.

Short description of processing method and evaluation (e.g. metrics, level of identification)

For all the fish catched, data recorded include the name of the species, the length (mm), the weight (g), and anomalies (deformations, infections, injury). At least 100 individuals of each indicator species should be measured across the entire size spectrum.
Usually in Switzerland rivers, only one species (brown trout) or a very limited number of fish species are present, therefore a method based on population-related parameters was adopted:
Parameter 1- Fish fauna composition and species dominance
Parameter 2- Population structure of indicator species (age classes, reproduction)
Parameter 3- Population density of indicator species
Parameter 4- Deformations and anomalies

Indicator species considered intolerant to anthropogenic changes in rivers are described in Oberdorff & Hughes (1992) and Belpaire et al (2000).

Additional abiotic data recorded

Morphological characteristics (width, depth, slope), discharge, water temperature, conductivity.

Method features compliant with WFD

The status classes developed within the Swiss Modular Stepwise Procedure are comparable with the system of ecological classes defined in the WFD.

Rules to define ecological classes and reference conditions

Swiss Modular Stepwise Procedure for studying and assessing surface waters refers to a reference state close to the natural state. The objective to be achieved is subdivided into hierarchical sub-objectives.

The achievement of fish objective is measured with a points system corresponding to evaluation criteria for the four population-related parameters. According to the score (1-17), each section is assigned to one of five discrete status classes (very good, good, moderate, poor, bad). This system shows which section needs actions to improve the status of the river (threshold: class 2 – good).

Literature Reference

OFEV, 2004. Méthodes d'analyse et d'appréciation des cours d'eau en Suisse. Poissons – niveau R (région).

OFEV, 2007. Méthodes d'analyse et d'appréciation des cours d'eau en Suisse. Aspect général.

Comments

The Federal Office for the Environment (OFEV) defined a standardized method for assessing the status of rivers using fish (Système d'analyse et d'appréciation des cours d'eau en Suisse-Poissons – niveau R (région), 2004), as part of the Modular Stepwise Procedure, which serves as a basis for cantonal agencies to develop their monitoring programs.

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