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1. Borja A., E. Barbone, A. Bass et, G. Borgersen, M. Brkljacic, M. Elliott, J. M. Garmendia, J. C. Marques, K. Mazik, I. Muxika, J.M. Neto, K. Norling, J. G. Rodríguez, I. Rosati, B. Rygg, H. Teixeira, A. **Trayanova**, 2011. Response of single benthic metrics and multi-metric methods to anthropogenic pressure gradients, in five distinct European coastal and transitional ecosystems. *Marine Pollution Bulletin*, 62:499-513. doi: 10.1016/j.marpolbul.2010.12.009, ISSN 0025-326X, **IF = 2.503**.

Abstract: In recent times many benthic indices have been proposed to assess the ecological quality of marine waters worldwide. In this study we compared single metrics and multi-metric methods to assess coastal and transitional benthic status along human pressure gradients in five distinct environments across Europe: Varna bay and lake (Bulgaria), Lesina lagoon (Italy), Mondego estuary (Portugal), Basque coast (Spain) and Oslofjord (Norway). Hence, 13 single metrics and eight of the most common indices used within the European Water Framework Directive (WFD) for benthic assessment were selected. Within each system, sampling sites were ordered in an increasing pressure gradient according to a preliminary classification based on professional judgement. The different indices are largely consistent in their response to pressure gradient, except in some particular cases. Inconsistencies between indicator responses were most pronounced in transitional waters, highlighting the difficulties of the generic application of indicators to all marine, estuarine and lagoonal environments. However, some of the single and multi-metric methods were able to detect such gradients both in transitional and coastal environments, being these multi-metric methods more consistent in the detection than single indices. This study highlights the importance of survey design and good reference conditions for some indicators. The agreement observed between different methodologies and their ability to detect quality trends across distinct environments constitutes a promising result for the implementation of the WFD's monitoring plans. Moreover, these results have management implications, regarding the dangers of misclassification, uncertainty in the assessment, use of conflicting indices, and testing and validation of indices.

2. **Trayanova A. T.**, V. R. Todorova, T. H. Konsulova, G. P. Shtereva, O. D. Hristova, B. S. Dzhurova, 2011. Ecological State of Varna Bay in Summer 2009 according to Benthic Invertebrate Fauna, *Acta zoologica bulgarica*, 63 (3), 277-288, ISSN: 0324-0770, **IF = 0.247**.

Abstract: The objective of this research is to assess the ecological state of Varna Bay according to benthic invertebrate fauna, to examine the similarity pattern and to find the best combination of environmental variables explaining the biotic pattern. Three zones with similar community composition are distinguished on abundance dataset – northern, central and southern. Cluster analysis on biomass dataset pools samples in two main groups – the southern zone and the stations dominated by crustacean *Upogebia pusilla* (Petagna, 1792). Ecological state of Varna Bay, assessed by M-AMBI, varies from bad and poor to moderate and improves in parallel with the decrease of average percentage content of organic carbon and concentration of extractable matters in sediments. The best combination of abiotic environmental variables explaining the biotic pattern are found to be the depth, concentration of extractable matters, salinity of bottom water, oxygen content of bottom water and percentage contents of carbon, clay, silt and sand in sediments. In all cases, there is a significant correlation between the biotic indices reflecting the environmental quality and their response to pressures, particularly extractable matters, organic carbon, pH and redox potential.

3. Konsulova, T., **Trayanova, A.**, Todorova, V., 2010. Sand bank Koketrays – a Case Study on the Effect of Marine Protected Area Designation as a Key Approach to Black Sea Biodiversity and Habitat Conservation, *Acta zoologica bulgarica*, 62 (1), 89-97, ISSN: 0324-0770, **IF = 0.269**.

Abstract: Sand bank Koketrays is the second marine area declared ‘protected’ along the Bulgarian Black Sea coast in 2001. A comparative analysis between zoobenthic coenoses in Bourgas Bay and sand bank Koketrays, as the main prerequisite for the conservation of the sand bank as a protected area is discussed in the paper. Three periods in the evolution of macrozoobenthic community are outlined: the period when no local anthropogenic impact was registered (1990-1992), just after the performance of bottom trawling for *Rapana venosa* in 1999 (2000-2002) and a three years period later (2003-2006). An increasing of the opportunistic Polychaeta and Oligochaeta species in abundance is established between 2000-2002 (a total of 44% vs. 69%) and nearly 5 times decrease in abundance of the conservative mollusk species (42% vs. 9%). A positive tendency toward recovery of the ecological state of bottom invertebrate fauna after the announcement of the site as ‘protected area’ is established – the participation of sensitive species (I EG) increases up to 27.7 % and the AMBI index reaches 2.18, which indicates a process of gradually improvement of zoobenthic coenosis ecological status.

4. M. Ponti, M. Pinna, A. Basset, S. Moncheva, **A. Trayanova**, L. P. Georgescu, S. Beqiraj, S. Orfanidis, M. Abbiati, 2008. Quality assessment of Mediterranean and Black Sea transitional waters: comparing responses of benthic biotic indices. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 18: S62–S75. DOI: 10.1002/aqc.952, ISSN: 1099-0755, **IF = 1.619**.

Abstract: In the present study patterns of variation of five benthic biotic indices (AMBI, M-AMBI, BENTIX, Engle’s B-IBI, and Paul’s B-IBI) have been compared in eight Mediterranean and Black Sea transitional water ecosystems characterized by different habitat typologies and anthropogenic pressures. Overall, biotic indices provided contrasting responses in terms of environmental quality assessments. Both the Engle and Paul multimetric benthic biotic indices of integrity were developed for North American estuaries and therefore require

to be recalibrated for the Mediterranean and Black Sea transitional waters. M-AMBI applied to each habitat typology promises to be more effective, but the high heterogeneity of transitional waters and the lack of reference condition along the European coasts limit its application. Further work is needed to develop a biotic index that provides useful and unambiguous information under different anthropogenic pressures and in different transitional waters.

5. . Basset, L. Sabetta, F. Sangiorgio, M. Pinna, D. Migoni, F. Fanizzi, E. Barbone, N. Galuppo, S. Fonda Umani, S. Reizopoulou, A. Nicolaidou, C. Arvanitidis, S. Moncheva, A. *Trayanova*, L. Georgescu, S. Beqiraj, 2008. Biodiversity conservation in Mediterranean and Black Sea lagoons: a trait-oriented approach to benthic invertebrate guilds. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 18: S4–S15. DOI: 10.1002/aqc.979, ISSN: 1099-0755, **IF = 1.619**.

Abstract: The extent to which conservation of biodiversity enforces the protection of ecosystem functioning, goods and services is a key issue in conservation ecology. In order to address this conservation issue, this work focused on community organization, linking community structure, as described both in taxonomic and functional terms, to community functioning and ecosystem processes. Body size is an individual functional trait that is deterministically related to components of ecosystem functioning such as population dynamics and energy flow, and which determines components of community structure. Since body size is an individual trait that reflects numerous factors, it is also exposed to trait selection and the niche filtering underlying the community. An analysis of the relevance of body size to community organization in transitional water ecosystems in the eastern Mediterranean and Black Sea regions is presented, based on field research conducted on a sample of 15 transitional water ecosystems. 250 taxa were identified, clumped in five orders of magnitude of body size. All body size patterns showed triangular distributions with an optimal size range of 0.13mg to 1.0mg individual body mass. Deterministic components of size structure were emphasized and a hierarchical organization with dominance of large sizes was demonstrated by the slopes of the body size-abundance distributions, consistently larger than the EER threshold ($b = -0.75$), and by the direct relationship of energy use to body size for most of the body size range. Consistent variations of body size-related descriptors were observed on three main gradients of environmental stress: eutrophication, confinement and metal pollution. The results support the relevance of constraints imposed by individual body size on community organization in transitional water ecosystems and the adequacy of size patterns as an indicator for ecological conservation of these fragile ecosystems.

6. F. Sangiorgio, A. Basset, M. Pinna, L. Sabetta, M. Abbiati, M. Ponti, M. Minocci, S. Orfanidis, A. Nicolaidou, S. Moncheva, A. *Trayanova*, L. Georgescu, S. Dragan, S. Beqiraj, D. Koutsoubas, A. Evagelopoulos, S. Reizopoulou, 2008. Environmental factors affecting *Phragmites australis* litter decomposition in Mediterranean and Black Sea transitional waters. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 18: S16–S26. DOI: 10.1002/aqc.955, ISSN: 1099-0755, **IF = 1.619**.

Abstract: Leaf litter decomposition rates in aquatic ecosystems are known to be related to many abiotic and biotic factors. Field experiments were carried out during spring 2005 in 16 ecosystems, each with four sampling sites, using the litter bag technique to investigate the influence of abiotic factors on patterns of reed litter breakdown in different physiographic, hydrological and physico-chemical gradients occurring in transitional water ecosystems in the Eastern Mediterranean and Black Sea. Significant differences in leaf litter decomposition were observed among the studied ecosystems along univariate gradients of tidal range, water temperature, salinity and sinuosity index. Overall, 71% of variance in the litter breakdown

rate was explained by the hydrological, physico-chemical and physiographic components. Specifically, tidal range, salinity and sinuosity index are among the key factors in the most commonly used typological schemes for classifying transitional water ecosystems, due to their influence on abundance and distribution of benthic macroinvertebrates and other guilds. The patterns observed at the regional scale of the study suggest that certain key abiotic factors are likely to play a major role as drivers of plant detritus decomposition processes, through their influence on the overall metabolism of microorganisms and benthic macroinvertebrates. These observations have implications for the identification of reference conditions for transitional water ecosystems in the studied area, on which all processes of classification and conservation of their ecological status are based.

7. *Trayanova, A.*, 2008. Application of Body Size Descriptors of Benthic Macrofauna as Innovative Approach for Assessment the Ecological Status of Transitional Waters. *Acta zoologica bulgarica*, Suppl. 2, 293-298, ISSN: 0324-0770.

Abstract: The goal of the current study is to test the applicability of innovative ecological descriptors for assessment of the ecological status of transitional waters according to biological quality element benthic invertebrate fauna. The body size descriptors have been verified in relation to abiotic parameters of environment and the structure and disturbance of benthic communities. The assessment of ecological status performed by size descriptors has been compared with the assessment made by univariate and multivariate indices. The results showed that the size-based approach appears to be an objective taxonomic free method for assessment of the ecological status, trophic state and organic load of environment and for description of the ecological structure and disturbance of macrozoobenthic communities.

8. Ponti M., M. Pinna, *A. Trayanova*, A. Basset, M. Abbiati, 2007. Taxonomic benthic biotic indices in transitional waters: study cases from northern Adriatic and Black Sea. *Transitional Waters Bulletin*, 3, 29-32. DOI: 10.1285/i1825229Xv1n3p29, ISSN: 1825-229X.

Abstract: Four taxonomic benthic biotic indices were used to analyse benthic assemblages in two transitional water ecosystems: Pialassa Baiona, northern Adriatic Sea, and Varna lake, Black Sea. The environmental quality assessments provided by the different indices is not consistent with the patterns of environmental quality of the investigated sites. Moreover, these indices provide ambiguous information on effects of sea-land gradient and/or anthropogenic disturbance on transitional ecosystems. In transitional waters, ecological classification based on biotic indices requires an adjustment for the reference conditions, environmental features and habitat typologies.

9. Sangiorgio F., A. Basset, M. Pinna, L. Sabetta, M. Abbiati, M. Ponti, M. Minocci, S. Orfanidis, A. Nicolaidou, S. Moncheva, *A. Trayanova*, L. Georgescu, S. Dragan, S. Beqiraj, D. Koutsoubas, A. Evagelopoulos, S. Reizopoulou, 2007. Ecosystem processes: litter breakdown patterns in Mediterranean and Black Sea transitional waters. *Transitional Waters Bulletin*, 3, 51-55. DOI: 10.1285/i1825229Xv1n3p51, ISSN: 1825-229X.

Abstract: Leaf litter decomposition rates, in aquatic ecosystems, are known to be related to many different abiotic and biotic factors. Here, we focus on the influence of abiotic factors, searching for patterns of reed litter decay rates on gradient of physiographic, hydrological and physico-chemical components of transitional water ecosystems. Field experiments were carried out in 16 water ecosystems in the Eastern Mediterranean and Black Sea in spring 2005. Significant differences of leaf litter decomposition were observed among ecosystems along univariate gradient of tidal range, index of sinuosity, water temperature and salinity. It

is concluded that, at the macroecological scale of study, somekey abiotic factors, such as tidal range and salinity, are suggested to play a major role as drivers of plant detritus decomposition processes. The relevance of the described abiotic drivers as descriptor of the most commonly used classification schemes for transitional water ecosystems, is a further support to their role as environmental forcing factors.

10. Alexandrov, L., A. **Trayanova**, M. Varshanidze, V. Todorova, T. Zaharia, 2001. The use of mussel (*Mytilus galloprovincialis*, Linne) larval stages as indicators of water quality, *Scientific annals of the Danube Delta Institute for Research and Development*, Ed: R. tiuc , 1-5, ISBN 973-31-2116-9.

Abstract: The bivalve embryo-larval bioassay is a new approach for identifying the water quality and living organisms health. Being rapid and less expensive it is used as the first step of water quality assessment and identification of sites with significant harmful impact. In the Black Sea Region this method was applied for the first time during the TACIS Project. This simple method using test organisms as biological marker, can provide better insight into general overview of environmental stability.

11. ., 2015. – , 62-65, ISSN 1314-3379.

Abstract: It is known that in the world food industry the sand mussels are important fishing resource. As edible are pointed out the species from genus *Cardium*, *Pecten*, *Tapes*, *Venus*, *Donax*, *Chamelea* etc., which inhabit the Black Sea. The sand mussels are harvested by dredges and bottom trawls. The effects of bottom trawling and dredging are well known and documented worldwide. The use of boat dredges and of hydraulic dredges shall be prohibited within 0.3 nautical miles of the coast with Corrigendum to Council Regulation (EC) 1967/2006 of 21 December 2006 concerning management measures for the sustainable exploitation of fishery resources in the Mediterranean Sea. In this article a patented environmentally friendly technology for fishing of sand mussels, is presented.

12. **Trayanova A.**, 2015. Ecological status assessment of Varna Bay based on benthic invertebrate fauna, – , 66-72, ISSN 1314-3379.

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13. **A.**, 2010. , 9/30.09.2010. : , -

14. , , 2007.

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15. **Trayanova A.**, 2005. Benthic Macrofauna of Beloslav Lake, Varna Lake and Varna Bay as Indicator of Environmental Status. Black Sea Coastal Region Bulgaria - Ecological and socio-economic indicators, S. Moncheva [ed], 2005. CESUM-BS collected papers, 236 pp., IO-BAS, Varna (approved by EC, 2005), 180-186.

Abstract: Species dominating benthic macrofauna being tolerant or sensitive to different kind of pollution are indicators of community status, respectively environmental status. The presence and dominance of tolerant to pollution polychaete *Polydora ciliata* in the study area is an indication of worsened environmental status. Species richness, changes in quantitative parameters of benthic macrofauna, community diversity index values and species discriminating similarity groups, reflect the environmental stress, revealing an improvement tendency toward the bay environment. For better understanding of the factors determining macrofauna status an assessment of physicochemical properties of environment is essential in parallel with zoobenthic studies.

16. A., 2001.

4/28.04.2001.

17. **Trayanova A.**, K. Stefanova, 2002. Assessment of Zooplankton and Macrozoobenthic communities status in the marine ecosystem Beloslav lake - Varna lake, Proceedings of Sixth International Conference on Marine Science and Technology, v. I, 295 - 301. ISBN 954-90919-3-7.

Abstract: Starting from zooplankton and macrozoobenthic surveys carried out during November 1999 and February 2000, the study summarises the changes in the communities' structure in the Varna-Beloslav Lakes system, a firth located in the Bulgarian Black Sea area, which had undergone severe changes due to anthropogenic impacts since 1906. The report outlines the current trend in marine zooplankton and macrozoobenthic communities assessing their ecological status. The Shannon-Wiener community diversity index H' was calculated on the abundance data for the investigated seasons. Warwick's method of Abundance Biomass Comparison curves was applied for assessment of communities' disturbance. The environmental conditions and ecological status of zooplankton and macrozoobenthic communities show tendency of improvement from Western to Eastern part of investigated area.

18. Konsulova Ts., V. Todorova, G. Shtereva, A. *Trayanova*, 2000. Benthic Macrofauna Status – a Relevant Tool for Environmental Impact Assessment in Port Areas, In: Second International Conference “Port Development and Coastal Environment”, v.1, 109-120.

Abstract: Varna and Balchik area ports’ environmental impact was assessed on the basis of selected chemical parameters and the macrofauna soft bottom and fouling communities state. Three types of benthic fauna response were determined showing good relationship with type and intensity of the environmental impact. Therefor the combined studies of the chemical parameters on the one hand and both soft bottom and fouling macrofauna on the other hand can provide useful insight into the cause of disturbance.

19. , 2012.

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20. C. Dumitrace, A. *Trayanova*, V. Todorova, 2011. Coastal Waters Black Sea GIG Macrozoobenthos. WFD Intercalibration Phase 2: Milestone 4b Report. European Commission, JRC, 42 pp.

Abstract: An overview of Methods to be intercalibrated is made. Methods and required BQE parameters are described, national reference conditions are given, national boundary setting procedure for the common intercalibration type is described, as well typology used and pressures. The relative importance of the different pressures and their impact were estimated

at site level based on available quantitative data and expert judgement. Pressure index is calculated as an average of all pressures considered. A common dataset were compiled and the boundaries of the common metrics were tested if they correlate significantly with predetermined pressures and pressure index.

21. *Trayanova, A., V. Todorova, Ts. Konsulova, 2009. 2.2 Black Sea GIG, BULGARIA, 36-39, 42-43. In: EUR 23838 EN/3 – Joint Research Centre – Institute for Environment and Sustainability, Water Framework Directive intercalibration technical report - Part 3: Coastal and Transitional waters, Ed. by A. Carletti, A.-S. Heiskanen, 240 pp. EUR – Scientific and Technical Research series – ISSN 1018-5593, ISBN 978-92-79-12568-3, DOI 10.2788/19561.*

Abstract: Refining of the typology of water bodies is needed after the sediment types are accurately classified. The determination of the reference values for the community diversity index (H') was derived from actual data for good ecological status and based on expert judgement and knowledge. The limited number of stations and/or replicates in one nautical mile zone allowed partial application of statistical approaches and did not permit the development of classification scale for water bodies with mixed sediments. Revision of the boundary values is recommended after accumulation of further data. The default boundary values of M-AMBI have to be readjusted for each WBT after intercalibration procedure for the whole Black Sea ecoregion takes place.

22. Todorova V., *A. Trayanova, Ts. Konsluova, 2008. Biological monitoring of coastal marine waters and lakes - benthic invertebrate fauna, Report of Project “Capacity building aimed at the development of a Pilot Programme of measures for the Black Sea River Basin management plan of coastal waters at risk – Burgas and Varna bay”, Arcadis NV, 46 pp.*

Abstract: The western part of Beloslav Lake and the area adjacent to TEPS Varna are identified as the most affected by anthropogenic pressures areas, where status of waters may not be improved without appropriate measures. The cumulative effect of enrichment with organic matter and pollution with inert materials and toxic substances leads to poor quantitative development of benthic macrofauna, elimination of certain taxonomic groups and mass mortality of benthic invertebrates in summer and autumn. Uncertainty in the above assessments derives from lack of sampling replication to account for the biological variability. This critical drawback should be overcome in future monitoring.

23. Todorova V., *A. Trayanova, Ts. Konsluova, 2008.*

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24. *Trayanova, A., V. Todorova, Ts. Konsulova, 2007. "Benthic Invertebrate Fauna: Identification of reference (high status) and bad status values, Development of classification tool for the selected metrics, Initial assessment of the ecological status of the coastal waters", Final Report of the Project "Evaluation of the impact from land-based activities on the marine & coastal environment, ecosystems & biodiversity in Bulgaria", Ecolas N. V., 17 pp.*

Abstract: The boundary values of applied indices are preliminary and they need revision after accumulation of further data. For the majority of the stations good agreement is found between the assessments by the different metrics. In the case ecological status falls in dissimilar ecological classes according to different metrics, the lower status is accepted as final. Both AMBI and M-AMBI reveal a tendency of ecological status improvement from North to South. The metrics based on community diversity and percentage share of ecological groups are able to distinguish the changes in ecological status.

25. *Trayanova A., V. Todorova, Ts. Konsluova, 2007. Macrozoobenthos, GEF/UNDP Final Report: Control of eutrophication, hazardous substances and related measures for rehabilitating the Black Sea ecosystem: Phase 2, PIMS 3065, 43 - 55 pp.*

Abstract: The pattern of macrozoobenthic community composition and change is associated with the depth and the sediment type. Due to lack of sediment grain size data at the sampling locations the interpretation of biological data is incomplete and based on expert judgment, therefore we recommend sampling and determination of grain size in future monitoring studies. The ecological status of the marine area in front of c. Galata according to AMBI values is assessed as good to high. However this assessment should be regarded with caution since the index needs adjustment of the threshold values for different ecological classes in the conditions of the Black Sea ecoregion.

26. *Trayanova A., V. Todorova, Ts. Konsluova, 2006. Final Report on Macrozoobenthos, EVD Project "Support for BSBD for implementation of the WFD, Bulgaria", ARCADIS Euroconsult, 17 pp.*

Abstract: The level of community disturbance and the ecological status classification differ when the evaluation is done by different methods and biotic indices. Multivariate AMBI seems to be the most accurate tool for assessment of the ecological status since it integrates both ecological sensitivity (AMBI) and diversity (S and H') in the evaluation. Future research should address the setting of precise boundary values for bad and high status after reference conditions have been defined. The correlation between the number of species (S), Shannon community diversity index (H'), ABC-curves configuration, M-AMBI and percentage content of CO₃ in the sediments shows the positive dependence of the species richness, equitability, dominance and ecological status of macrozobenthos on sediment heterogeneity. The correlation of Secchi depth with H' and AMBI, points out the dependence of diversity and ecological status on the trophic potential of the environment.

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