



Macrobenthic molluscs from a marine - lagoonal environmental transition in Lesvos Island (Greece)

Athanasios Evagelopoulos[‡], Drosos Koutsoubas[‡], Vasilis Gerovasileiou^{‡,§}, Nikolaos Katsiaras^{‡,||}

[‡] Department of Marine Sciences, University of the Aegean, Mytilene, Greece

[§] Institute of Marine Biology, Biotechnology and Aquaculture, Hellenic Centre for Marine Research, Heraklion, Greece

| Institute of Oceanography, Hellenic Centre for Marine Research, Anavissos, Greece

Corresponding author: Athanasios Evagelopoulos (tevagelo@marine.aegean.gr)

Academic editor: Eva Chatzinikolaou

Received: 13 Jun 2016 | Accepted: 31 Oct 2016 | Published: 01 Nov 2016

Citation: Evagelopoulos A, Koutsoubas D, Gerovasileiou V, Katsiaras N (2016) Macrobenthic molluscs from a marine - lagoonal environmental transition in Lesvos Island (Greece). Biodiversity Data Journal 4: e9541.

<https://doi.org/10.3897/BDJ.4.e9541>

Abstract

Background

This paper describes an occurrence dataset, also including numerical abundance and biomass data, pertaining to the macrobenthic molluscan assemblages from a marine - lagoonal environmental transition. The study system was the soft-substrate benthoscape of the area of the Kalloni solar saltworks (Lesvos Island, Greece). Specifically, the study area extended from the infralittoral zone of the inner Kalloni Gulf (marine habitat) to the bottoms of the first two evaporation ponds of the Kalloni solar saltworks (lagoonal habitat). Bottom sediment samples (3 replicates) were collected with a Van Veen grab sampler (0.1 m²) at four sampling sites, along a 1.5 km long line transect that spanned the marine - lagoonal environmental transition. A total of four surveys were carried out seasonally in 2004. A total of 39,345 molluscan individuals were sorted out of the sediment samples and were identified to 71 species, belonging to the Gastropoda (36), Bivalvia (34) and Scaphopoda (1) classes. Numerical abundance and wet biomass (with shells) data are included in the dataset.

New information

The dataset described in the present paper partially fills a significant gap in the scientific literature: Because ecological research of coastal lagoons has seldom explicitly considered the marine - lagoonal habitats interface, there are no openly accessible datasets pertaining to the particular structural component of the transitional waters benthoscaapes of the Mediterranean Sea. Such datasets could prove valuable in the research of the structure and functioning of transitional waters benthoscaapes. The present dataset is available as a supplementary file (Suppl. material 1) and can also be accessed at http://ipt.medobis.eu/resource?r=kalloni_saltworks_phd.

Keywords

biodiversity, environmental stress gradient, confinement gradient, transitional waters, coastal lagoons, solar saltworks

Introduction

Transitional waters (e.g. estuaries, coastal lagoons) may be considered as "ecotone ecosystems" that structurally and functionally link marine, continental and freshwater ecosystems along the coastline (Levin et al. 2001, Basset et al. 2012). Their existence along the interface between the sea and the land determines their abiotic environment, which is characterized by complex spatial gradients in structural features and pronounced temporal variability (Little 2000). The often extreme in magnitude and variability abiotic factors control the composition and spatial distribution of the biota (Barnes 1980, Guelorget and Perthuisot 1992, Barnes 1994).

Macrobenthic invertebrates are considered as a key group among the biota in all coastal aquatic ecosystems (Levin et al. 2001). Molluscs are an important component of the macrobenthic fauna of coastal lagoons (Barnes 1994). Their abundance and diversity are also important in the lower salinity ponds of solar saltworks (e.g. Britton and Johnson 1987, Evagelopoulos et al. 2008, Pavlova et al. 1998, Vieira and Amat 1996), where the habitat is considered to be essentially lagoonal. The response of molluscan communities to the environmental stress gradients has been extensively studied in coastal lagoons (e.g. Guelorget and Perthuisot 1992, Koutsoubas et al. 2000, Reizopoulou and Nicolaidou 2004, Rossi et al. 2006), as well as in the lower salinity ponds of solar saltworks (e.g. Evagelopoulos and Koutsoubas 2008, Evagelopoulos et al. 2008). Ecological research of coastal lagoons has seldom explicitly considered the marine - lagoonal habitats interface (but see de Wit 2011). However, the interfaces between habitat patches are considered to be among the primary structural and functional components of landscapes (Turner and Gardner 2015). Their importance lies in the fact that they may modulate flows of materials, energy, organisms or information across the landscape,

potentially also affecting processes inside the interacting habitat patches (Pickett and Cadenasso 1995, Wiens et al. 1985).

This paper describes an occurrence dataset, also including numerical abundance and biomass data, pertaining to the macrobenthic molluscan assemblages from the marine - lagoonal environmental transition at the area of Kalloni solar saltworks (Lesvos Island, Greece). The present dataset paper partially fills a significant gap in the scientific literature, as no openly accessible datasets from case studies of marine - lagoonal habitats interfaces have been published thus far and such datasets could prove valuable in the research of the structure and functioning of transitional waters benthoscapes.

General description

Purpose: This dataset was assembled in the framework of the PhD thesis of Dr. Athanasios Evagelopoulos (Department of Marine Sciences, University of the Aegean, Greece) (Evagelopoulos 2008).

Project description

Title: Macrobenthic molluscs from the marine-lagoonal environmental transition at the area of Kalloni saltworks (Lesvos Island, Greece).

Personnel: Drosos Koutsoubas (PhD thesis supervisor, sample collection, taxonomic identification), Athanasios Evagelopoulos (sample collection, taxonomic identification, data management), Vasilis Gerovasileiou (sample collection, laboratory analysis), Nikolaos Katsiaras (sample collection, laboratory analysis), Andreas Alifragkis (sample collection, laboratory analysis), Ioannis Vasiliadis (sample collection, laboratory analysis), Asimena Kostidou (sample collection).

Study area description: A detailed description of the study area is provided by Evagelopoulos and Koutsoubas (2008) and can be summarized as follows: The study area is characterised by a shallow water column (approx. 0.5 m deep), a soft-substrate bottom and a benthic vegetation of macroalgae and phanerogams (e.g. *Cladophora* sp., *Enteromorpha* sp., *Gracilaria* sp., *Ruppia* sp.). The habitat types according to the environment ontology of EnvO (Buttigieg et al. 2013, Buttigieg et al. 2016) occurring in the study area included the "neritic sub-littoral zone" (sampling site 1), the "artificial channels" (site 2) and the "lagoons" (sites 3 & 4). Macroalgal mats were developed at the inlet and in the ponds during the late spring - early summer of 2004. Wind forcing together with the shallow depth of the water column were the main factors involved in the recurrent bottom sediment resuspension and the high water turbidity that were often observed in the study area. The bottom sediment at the inlet and the ponds was anoxic near its surface, due to the high productivity of the ecosystem. Macroalgal growth led to a dystrophic crisis incident in the study area in the summer of 2004.

Funding: This dataset was assembled in the framework of the PhD thesis of Dr. Athanasios Evagelopoulos, which was supported by a PhD scholarship from HERACLITUS: Research scholarships with priority in basic research (2nd Operational Programme for Education and Initial Vocational Training, 3rd CSF) that was funded by the Greek Ministry of Education and co-funded by the ESF (EU).

Authoring of the present data paper and data management and upload to the MedOBIS IPT were supported by the LifeWatchGreece infrastructure (MIS 384676), funded by the Greek Government under the General Secretariat of Research and Technology (GSRT), National Strategic Reference Framework (NSRF).

Sampling methods

Study extent: The study area (Fig. 1) consisted of the soft-substrate benthoscape of the area of the Kalloni solar saltworks (Lesvos Island, Greece). It extended from the infralittoral zone of the inner Kalloni Gulf (marine habitat) to the bottoms of the inlet and the first two evaporation ponds of the Kalloni solar saltworks (lagoonal habitat). The spatial extent of the study was thus approximately 1.5 km long, whereas its temporal extent was one year. The geographic coordinates of the sampling sites are given in Table 1.

Table 1.

Geographic coordinates of the sampling sites.

Sampling site	Site description	Latitude (DD)	Longitude (DD)
1	Kalloni Gulf	39.204974	26.250093
2	Inlet channel	39.207020	26.251612
3	Pond 1	39.209713	26.253069
4	Pond 2	39.208540	26.258517

Sampling description: The field and laboratory methodology used followed the one described by Eleftheriou and Moore (2005). Bottom sediment samples (3 replicates) were collected with a Van Veen grab sediment sampler (0.1 m² sampling surface area) at four sampling sites that were located along a line transect that spanned the marine-lagoonal environmental transition. The sampling sites (Fig. 1) were located at the infralittoral zone of the inner Kalloni Gulf (site 1), at the inlet channel of the saltworks (site 2) and at the first two evaporation ponds of the saltworks (sites 3 and 4, respectively). The surveys were seasonal and carried out in February, May, September and November of 2004.

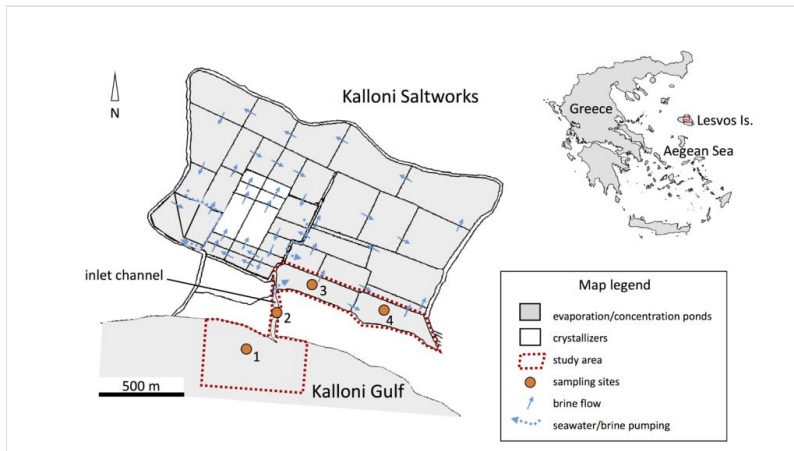


Figure 1.

A map of the study area, indicating the sampling stations.

Quality control:

- Species identification was reviewed by a molluscan taxonomy expert (Prof. Drosos Koutsoubas) and the species names were checked using the Taxon Match tool of the World Register of Marine Species (<http://www.marinespecies.org/aphia.php?p=match>). Dimitra Mavraki and Matina Nikolopoulou of the LifeWatchGreece Core Team assisted in the management of data and the upload of the dataset to the MedOBIS IPT according to the DarwinCore schema (DwC).

Step description: After their collection, the sediment samples were washed on-site through a 0.5 mm mesh sieve and subsequently fixed with 5% formalin and stained with Rose Bengal. In the laboratory, the macrobenthic invertebrates were sorted out of the sediment, and classified first into families and then into species. The individuals of each species in each sample were enumerated and their total wet weight (with shells) was measured with a high precision (0.1 mg) balance. During the data management process, the species names were checked with WoRMS, the dataset was prepared according to the Darwin Core standard and, finally, the data were uploaded to the MedOBIS IPT.

Geographic coverage

Description: The geographic coverage of the dataset extends from the part of the inner Kalloni Gulf that is adjacent to the Kalloni solar saltworks to the first two evaporation ponds of the saltworks. A map of the study area is given in Fig. 1 and the geographic coordinates of the sampling sites are given in Table 1.

Coordinates: 39.2 and 39.22 Latitude; 26.23 and 26.27 Longitude.

Taxonomic coverage

Description: The taxonomic coverage of the dataset is limited to the molluscan assemblages of the study area. Specifically, the dataset includes gastropod, bivalve and scaphopod species. A list of the species included in the dataset, also indicating their taxonomic classification, is given in Table 2.

Table 2.

List of species included in the dataset, indicating their taxonomic classification.

Scientific name	Authority	Class	Family
<i>Abra segmentum</i>	(Récluz, 1843)	Bivalvia	Semelidae
<i>Axinulus croulinensis</i>	(Jeffreys, 1847)	Bivalvia	Thyasiridae
<i>Cerastoderma glaucum</i>	(Bruguère, 1789)	Bivalvia	Cardiidae
<i>Chamelea gallina</i>	(Linnaeus, 1758)	Bivalvia	Veneridae
<i>Clausinella fasciata</i>	(da Costa, 1778)	Bivalvia	Veneridae
<i>Corbula gibba</i>	(Olivi, 1792)	Bivalvia	Corbulidae
<i>Ctena decussata</i>	(O. G. Costa, 1829)	Bivalvia	Lucinidae
<i>Lucinella divaricata</i>	(Linnaeus, 1758)	Bivalvia	Lucinidae
<i>Donacilla cornea</i>	(Poli, 1791)	Bivalvia	Mesodesmatidae
<i>Donax venustus</i>	Poli, 1795	Bivalvia	Donacidae
<i>Gouldia minima</i>	(Montagu, 1803)	Bivalvia	Veneridae
<i>Irus irus</i>	(Linnaeus, 1758)	Bivalvia	Veneridae
<i>Loripes lucinalis</i>	(Lamarck, 1818)	Bivalvia	Lucinidae
<i>Loripinus fragilis</i>	(Philippi, 1836)	Bivalvia	Lucinidae
<i>Gibbomodiola adriatica</i>	(Lamarck, 1819)	Bivalvia	Mytilidae
<i>Modiolus barbatus</i>	(Linnaeus, 1758)	Bivalvia	Mytilidae
<i>Montacuta substriata</i>	(Montagu, 1808)	Bivalvia	Montacutidae
<i>Musculus</i> sp.	Röding, 1798	Bivalvia	Mytilidae
<i>Myrtea spinifera</i>	(Montagu, 1803)	Bivalvia	Lucinidae
<i>Kurtiella bidentata</i>	(Montagu, 1803)	Bivalvia	Montacutidae
<i>Parvicardium exiguum</i>	(Gmelin, 1791)	Bivalvia	Cardiidae
<i>Pholas dactylus</i>	Linnaeus, 1758	Bivalvia	Pholadidae
<i>Pitar rudis</i>	(Poli, 1795)	Bivalvia	Veneridae

<i>Solen marginatus</i>	Pulteney, 1799	Bivalvia	Solenidae
<i>Polititapes aureus</i>	(Gmelin, 1791)	Bivalvia	Veneridae
<i>Ruditapes decussatus</i>	(Linnaeus, 1758)	Bivalvia	Veneridae
<i>Moerella donacina</i>	(Linnaeus, 1758)	Bivalvia	Tellinidae
<i>Tellina planata</i>	Linnaeus, 1758	Bivalvia	Tellinidae
<i>Tellina</i> sp.	Linnaeus, 1758	Bivalvia	Tellinidae
<i>Tellina tenuis</i>	da Costa, 1778	Bivalvia	Tellinidae
<i>Thracia phaseolina</i>	(Lamarck, 1818)	Bivalvia	Thraciidae
<i>Thyasira flexuosa</i>	(Montagu, 1803)	Bivalvia	Thyasiridae
<i>Timoclea ovata</i>	(Pennant, 1777)	Bivalvia	Veneridae
<i>Venus casina</i>	Linnaeus, 1758	Bivalvia	Veneridae
<i>Acteon tornatilis</i>	(Linnaeus, 1758)	Gastropoda	Acteonidae
<i>Barleeia unifasciata</i>	(Montagu, 1803)	Gastropoda	Barleeiidae
<i>Bela nebula</i>	(Montagu, 1803)	Gastropoda	Mangeliidae
<i>Bittium reticulatum</i>	(da Costa, 1778)	Gastropoda	Cerithiidae
<i>Cerithiopsis</i> sp.	Forbes & Hanley, 1850	Gastropoda	Cerithiopsidae
<i>Cerithiopsis tubercularis</i>	(Montagu, 1803)	Gastropoda	Cerithiopsidae
<i>Cerithium vulgatum</i>	Bruguère, 1792	Gastropoda	Cerithiidae
<i>Chrysallida</i> sp.	Carpenter, 1856	Gastropoda	Pyramidellidae
<i>Circulus</i> sp.	Jeffreys, 1865	Gastropoda	Tornidae
<i>Cyclope neritea</i>	(Linnaeus, 1758)	Gastropoda	Nassariidae
<i>Ebala pointeli</i>	(de Folin, 1868)	Gastropoda	Pyramidellidae
<i>Epitonium clathrus</i>	(Linnaeus, 1758)	Gastropoda	Epitoniidae
<i>Gibbula albida</i>	(Gmelin, 1791)	Gastropoda	Trochidae
<i>Gibbula ardens</i>	(Salis Marschlins, 1793)	Gastropoda	Trochidae
<i>Hydrobia acuta</i>	(Draparnaud, 1805)	Gastropoda	Hydrobiidae
<i>Mangelia attenuata</i>	(Montagu, 1803)	Gastropoda	Mangeliidae
<i>Nassarius incrassatus</i>	(Strøm, 1768)	Gastropoda	Nassariidae
<i>Megastomia conoidea</i>	(Brocchi, 1814)	Gastropoda	Pyramidellidae
<i>Potamides conicus</i>	(Blainville, 1829)	Gastropoda	Potamididae
<i>Pusillina marginata</i>	(Michaud, 1830)	Gastropoda	Rissoiidae

<i>Pusillina radiata</i>	(Philippi, 1836)	Gastropoda	Rissoidae
<i>Raphitoma echinata</i>	(Brocchi, 1814)	Gastropoda	Raphitomidae
<i>Rissoa guerinii</i>	Récluz, 1843	Gastropoda	Rissoidae
<i>Rissoa monodonta</i>	Philippi, 1836	Gastropoda	Rissoidae
<i>Rissoa membranacea</i>	(J. Adams, 1800)	Gastropoda	Rissoidae
<i>Rissoa lia</i>	(Monterosato, 1884)	Gastropoda	Rissoidae
<i>Rissoa splendida</i>	Eichwald, 1830	Gastropoda	Rissoidae
<i>Rissoa variabilis</i>	(Von Mühlfeldt, 1824)	Gastropoda	Rissoidae
<i>Rissoa ventricosa</i>	Desmarest, 1814	Gastropoda	Rissoidae
<i>Tricolia pullus</i>	(Linnaeus, 1758)	Gastropoda	Phasianellidae
<i>Monophorus perversus</i>	(Linnaeus, 1758)	Gastropoda	Triphoridae
<i>Trophonopsis muricata</i>	(Montagu, 1803)	Gastropoda	Muricidae
<i>Truncatella subcylindrica</i>	(Linnaeus, 1767)	Gastropoda	Truncatellidae
<i>Turbonilla delicata</i>	Monterosato, 1874	Gastropoda	Pyramidellidae
<i>Turbonilla lactea</i>	(Linnaeus, 1758)	Gastropoda	Pyramidellidae
<i>Pyrgostylus striatulus</i>	(Linnaeus, 1758)	Gastropoda	Pyramidellidae
<i>Fustiaria rubescens</i>	(Deshayes, 1825)	Scaphopoda	Fustiariidae

The distribution of species number in the bivalve and gastropod families is presented in Fig. 2 and Fig. 3 respectively. *Fustiaria rubescens* (Deshayes, 1825), which belongs to the Fustiariidae family, is the only species of tusk shells included in the dataset.

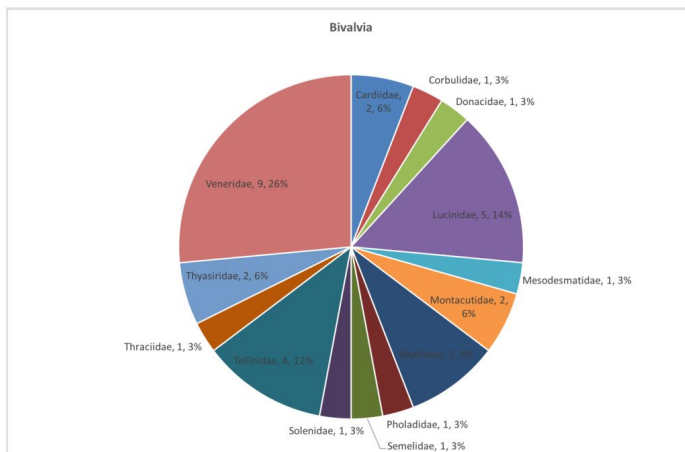


Figure 2.

Distribution of species number in the bivalve families.

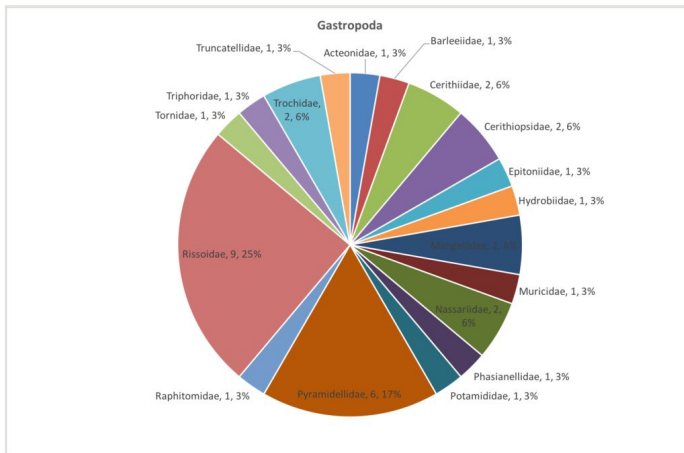


Figure 3.
Distribution of species number in the gastropod families.

Taxa included:

Rank	Scientific Name	Common Name
phylum	Mollusca	Molluscs
class	Gastropoda	Gastropods
class	Bivalvia	Bivalves
class	Scaphopoda	Tusk shells

Temporal coverage

Single date: 2004 2 24; 2004 5 28; 2004 9 17; 2004 11 27.

Notes: The dataset has a temporal coverage of one year (2004): The surveys were seasonal and carried out in Winter (24/2), Spring (28/5), Summer (17/9) and Autumn (27/11).

Usage rights

Use license: Open Data Commons Attribution License

Data resources

Data package title: Spatial and seasonal variability of the molluscan macrofauna at the marine-lagoonal environmental gradient at Kalloni saltworks (Lesvos Island, NE Aegean Sea, Greece)

Resource link: http://ipt.medobis.eu/resource?r=kalloni_saltworks_phd

Number of data sets: 1

Data set name: Spatial and seasonal variability of the molluscan macrofauna at the marine-lagoonal environmental gradient at Kalloni saltworks (Lesvos Island, NE Aegean Sea, Greece)

Description: The dataset includes two files: Events and Occurrences. The former contains the information on the sampling design, whereas the latter contains primarily the species abundance, biomass and taxonomy information.

Column label	Column description
eventID	An identifier for the set of information associated with an Event (something that occurs at a place and time).
samplingProtocol	The name of, reference to, or description of the method or protocol used during an Event.
sampleSizeValue	A numeric value for a measurement of the size (time duration, length, area, or volume) of a sample in a sampling event.
sampleSizeUnit	The unit of measurement of the size (time duration, length, area, or volume) of a sample in a sampling event.
eventDate	The date-time or interval during which an Event occurred.
year	The four-digit year in which the Event occurred, according to the Common Era Calendar.
month	The ordinal month in which the Event occurred.
day	The integer day of the month on which the Event occurred.
habitat	A category or description of the habitat in which the Event occurred.
fieldNumber	An identifier given to the event in the field.
locationID	An identifier for the set of location information.
locality	The specific description of the place.
minimumDepthInMeters	The lesser depth of a range of depth below the local surface, in meters.
maximumDepthInMeters	The greater depth of a range of depth below the local surface, in meters.
locationRemarks	Comments or notes about the Location.

decimalLatitude	The geographic latitude (in decimal degrees, using the spatial reference system given in geodeticDatum) of the geographic center of a Location. Positive values are north of the Equator, negative values are south of it.
decimalLongitude	The geographic longitude (in decimal degrees, using the spatial reference system given in geodeticDatum) of the geographic center of a Location. Positive values are east of the Greenwich Meridian, negative values are west of it.
coordinateUncertaintyInMeters	The horizontal distance (in meters) from the given decimalLatitude and decimalLongitude describing the smallest circle containing the whole of the Location.
institutionCode	The name (or acronym) in use by the institution having custody of the object(s) or information referred to in the record.
collectionCode	The name, acronym, coden, or initialism identifying the collection or data set from which the record was derived.
basisOfRecord	The specific nature of the data record.
occurrenceID	An identifier for the Occurrence.
catalogNumber	An identifier for the record within the data set or collection.
individualCount	The number of individuals represented present at the time of the Occurrence.
organismQuantity	A number or enumeration value for the quantity of organisms.
organismQuantityType	The type of quantification system used for the quantity of organisms.
lifeStage	The age class or life stage of the biological individual(s) at the time the Occurrence was recorded.
identifiedBy	A list (concatenated and separated) of names of people, groups, or organizations who assigned the Taxon to the subject.
scientificNameID	An identifier for the nomenclatural (not taxonomic) details of a scientific name.
scientificName	The full scientific name, with authorship and date information if known.
kingdom	The full scientific name of the kingdom in which the taxon is classified.
phylum	The full scientific name of the phylum or division in which the taxon is classified.
class	The full scientific name of the class in which the taxon is classified.
order	The full scientific name of the order in which the taxon is classified.
family	The full scientific name of the family in which the taxon is classified.
genus	The full scientific name of the family in which the taxon is classified.
subgenus	The full scientific name of the subgenus in which the taxon is classified.
specificEpithet	The name of the first or species epithet of the scientificName.
scientificNameAuthorship	The authorship information for the scientificName formatted according to the conventions of the applicable nomenclaturalCode.

nomenclaturalCode	The nomenclatural code (or codes in the case of an ambireginal name) under which the scientificName is constructed.
taxonRemarks	Comments or notes about the taxon or name.

Additional information

Resource citation

Evagelopoulos A (2015): Spatial and seasonal variability of the molluscan macrofauna at the marine-lagoonal environmental gradient at Kalloni saltworks (Lesvos Island, NE Aegean Sea, Greece). v1.7. Hellenic Center for Marine Research. Dataset/Samplingevent. http://ipt.medobis.eu/resource?r=kalloni_saltworks_phd&v=1.7

Abundance and biomass variability

The contributions of the most important species in the mean total abundance (ind./sample) for each site and seasonal survey are given in Fig. 4.

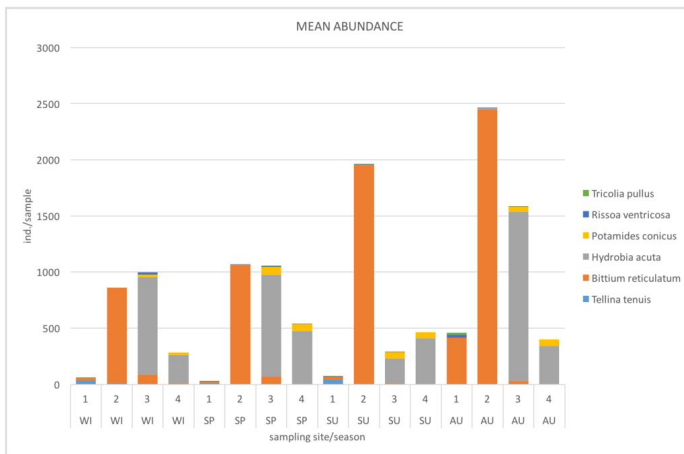


Figure 4.

Contributions of the most important species in the mean total abundance (ind./sample) for each site (1, 2, 3, 4) and seasonal survey (WI: winter, SP: spring, SU: summer, AU: autumn).

The most important species in terms of abundance were selected as the ones contributing in at least 10% of the total mean abundance in a dataset sample.

The most important species in terms of abundance during all surveys, were the cerithiid gastropod *Bittium reticulatum* at site 2 and the mud snail *Hydrobia acuta* at sites 3 and 4.

The contributions of the most important species in the mean total biomass (g/sample) for each site and seasonal survey are presented in Fig. 5.

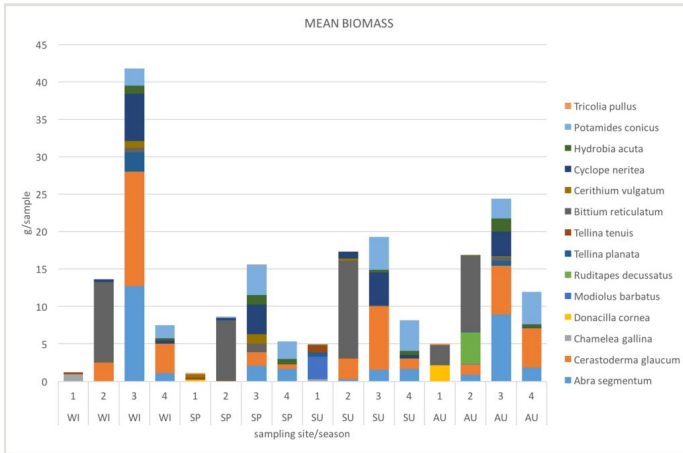


Figure 5.

Contributions of the most important species in the mean total biomass (g/sample) for each site (1, 2, 3, 4) and seasonal survey (WI: winter, SP: spring, SU: summer, AU: autumn) .

The most important species in terms of biomass were selected as the ones contributing in at least 10% of the total mean biomass in a dataset sample.

In terms of biomass, the most important species at site 2 was, during all surveys, the cerithiid gastropod *Bittium reticulatum*, whereas the most important species at sites 3 and 4 were, during all surveys, the bivalves *Abra segmentum* and *Cerastoderma glaucum* and the gastropods *Cyclope neritea* and *Potamides conicus*.

Observed species diversity variability

The spatial variability of the observed species diversity and evenness during each seasonal survey are given in Figs 6, 7, 8, 9.

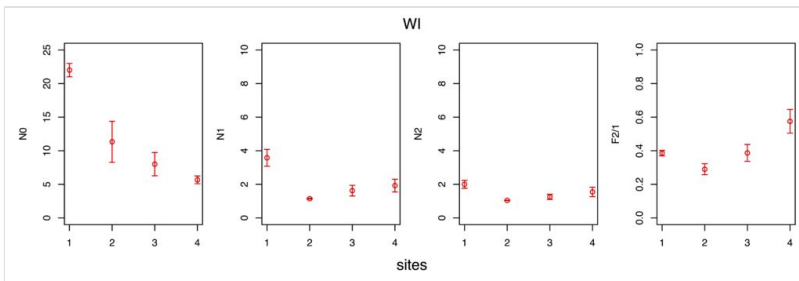


Figure 6.

Variability of the observed species diversity and evenness along the sites (1, 2, 3, 4) transect during the winter (WI) survey. Diversity was measured using the Hill numbers N0, N1 and N2, whereas evenness was measured with the F2/1 index.

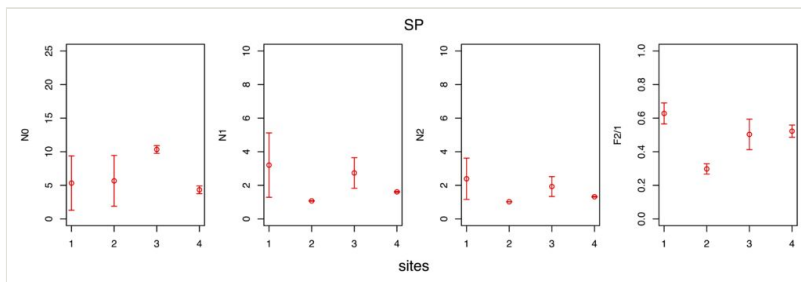


Figure 7.

Variability of the observed species diversity and evenness along the sites (1, 2, 3, 4) transect during the spring (SP) survey. Diversity was measured using the Hill numbers N0, N1 and N2, whereas evenness was measured with the F2/1 index.

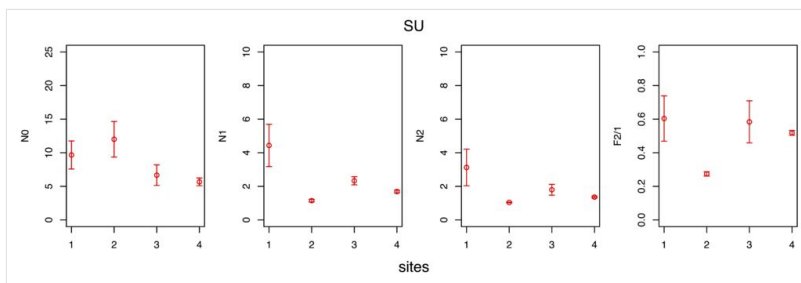


Figure 8.

Variability of the observed species diversity and evenness along the sites (1, 2, 3, 4) transect during the summer (SU) survey. Diversity was measured using the Hill numbers N0, N1 and N2, whereas evenness was measured with the F2/1 index.

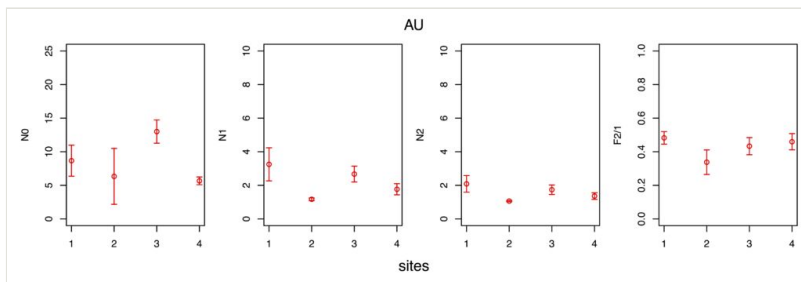


Figure 9.

Variability of the observed species diversity and evenness along the sites (1, 2, 3, 4) transect during the autumn (AU) survey. Diversity was measured using the Hill numbers N0, N1 and N2, whereas evenness was measured with the F2/1 index.

Observed species diversity was measured with the Hill numbers (Hill 1973) N0 (= species richness), N1 (= the exponential form of the Shannon-Wiener entropy index) and N2 (= the

reciprocal form of the Simpson concentration index), whereas evenness was measured using the F2/1 evenness index (Alatalo 1981), a transformation of the N2/1 evenness index of Hill (Hill 1973). All the aforementioned indices have several desirable properties and are preferable to the classic diversity (e.g. the Shannon-Wiener index) and evenness (e.g. the Pielou index) indices (Jost 2006, Tuomisto 2010, Tuomisto 2012).

The maximum observed species richness (N0 index) was measured either at site 1, 2 or 3, depending on the season, whereas the minimum was invariably measured at site 4. The minimum observed diversity (N1, N2 indices) was invariably recorded at site 2, due to the minimum of evenness measured therein (F2/1 index).

Acknowledgements

The authors would like to thank Dimitra Mavraki and Matina Nikolopoulou of the LifeWatchGreece Core Team for their assistance in the data management and the upload of the dataset to the MedOBIS IPT.

Author contributions

Athanasios Evagelopoulos participated in the fieldwork, taxonomic identification, carried out the data management, uploaded the dataset to the MedOBIS IPT and authored the data paper. Drosos Koutsoubas participated in the fieldwork and taxonomic identification of the molluscan species. Vasilis Gerovasileiou and Nikolaos Katsiaras participated in the fieldwork and the laboratory analysis.

References

- Alatalo R (1981) Problems in the Measurement of Evenness in Ecology. *Oikos* 37 (2): 199-204. <https://doi.org/10.2307/3544465>
- Barnes RS (1980) *Coastal Lagoons: The Natural History of a Neglected Habitat*. Cambridge University Press, 120 pp. [ISBN 9780521299459]
- Barnes RS (1994) Macrofaunal Community Structure and Life Histories in Coastal Lagoons. In: Kjerfve B (Ed.) *Coastal Lagoon Processes*. Elsevier [ISBN 0444882588].
- Basset A, Barbone E, Elliott M, Li B, Jorgensen SE, Lucena-Moya P, Pardo I, Mouillot D (2012) A unifying approach to understanding transitional waters: Fundamental properties emerging from ecotone ecosystems. *Estuarine, Coastal and Shelf Science* 132: 5-16. <https://doi.org/10.1016/j.ecss.2012.04.012>
- Britton RH, Johnson AR (1987) An ecological account of a Mediterranean salina: The Salin de Giraud, Camargue (S. France). *Biological Conservation* 42 (3): 185-230. [https://doi.org/10.1016/0006-3207\(87\)90133-9](https://doi.org/10.1016/0006-3207(87)90133-9)
- Buttigieg P, Morrison N, Smith B, Mungall CJ, Lewis SE, Consortium tE (2013) The environment ontology: contextualising biological and biomedical entities. *Journal of Biomedical Semantics* 4 (1): 43. <https://doi.org/10.1186/2041-1480-4-43>

- Buttigieg PL, Pafilis E, Lewis SE, Schildhauer MP, Walls RL, Mungall CJ (2016) The environment ontology in 2016: bridging domains with increased scope, semantic density, and interoperability. *Journal of biomedical semantics* 7 (1): 57. <https://doi.org/10.1186/s13326-016-0097-6>
- de Wit R (2011) Biodiversity of Coastal Lagoon Ecosystems and Their Vulnerability to Global Change. In: Grillo O, Venire G (Eds) *Ecosystems Biodiversity*. InTech <https://doi.org/10.5772/24995>
- Eleftheriou A, Moore DC (2005) Macrofauna Techniques. In: Eleftheriou A, McIntyre A (Eds) *Methods for the Study of Marine Benthos*. Wiley-Blackwell [ISBN 978-0-470-99511-2].
- Evagelopoulos A, Koutsoubas D (2008) Seasonal community structure of the molluscan macrofauna at the marine-lagoonal environmental transition at Kalloni solar saltworks (Lesvos Island, NE Aegean Sea, Greece). *Journal of Natural History* 42: 597-618. <http://doi.org/10.1080/00222930701835563>
- Evagelopoulos A, Koutsoubas D, Basset A, Pinna M, Dimitriadis C, Sangiorgio F, Barbone E, Maitanou M, Koulouri P, Dounas C (2008) Spatial and seasonal variability of the macrobenthic fauna in Mediterranean solar saltworks ecosystems. *Aquatic Conservation: Marine and Freshwater Ecosystems* 18: S118-S134. <https://doi.org/10.1002/aqc.948>
- Evagelopoulos A (2008) Πρότυπα βιοποικιλότητας στα παράκτια υγροτοπικά οικοσυστήματα των αλυκών Καλλονής Λέσβου. [Biodiversity patterns in the coastal wetland of Kalloni saltworks (Lesvos Island, Greece)]. Department of Marine Sciences, University of the Aegean, 246 pp. [In Greek].
- Guelorget O, Perthuisot JP (1992) Paralic ecosystems. *Biological organization and functioning*. *Vie et Milieu* 42 (2): 215-251.
- Hill MO (1973) Diversity and Evenness: A Unifying Notation and Its Consequences. *Ecology* 54 (2): 427-432. <https://doi.org/10.2307/1934352>
- Jost L (2006) Entropy and diversity. *Oikos* 113 (2): 363-375. <https://doi.org/10.1111/j.2006.0030-1299.14714.x>
- Koutsoubas D, Arvanitidis C, Dounas C, Drummond L (2000) Community structure and dynamics of the molluscan fauna in a Mediterranean lagoon (Gialova lagoon, SW Greece). *Belgian Journal of Zoology* 130 (1): 131-138.
- Levin L, Boesch D, Covich A, Dahm C, Erséus C, Ewel K, Kneib R, Moldenke A, Palmer M, Snelgrove P, Strayer D, Weslawski JM (2001) The Function of Marine Critical Transition Zones and the Importance of Sediment Biodiversity. *Ecosystems* 4 (5): 430-451. <https://doi.org/10.1007/s10021-001-0021-4>
- Little C (2000) *The biology of soft shores and estuaries*. Oxford University Press, 252 pp. [ISBN 9780198504269]
- Pavlova P, Markova K, Tanev S, Davis J (1998) Observations on a solar saltworks near Burgas, Bulgaria. *International Journal of Salt Lake Research* 7 (4): 357-368. <https://doi.org/10.1007/bf02442144>
- Pickett STA, Cadenasso ML (1995) Landscape Ecology: Spatial Heterogeneity in Ecological Systems. *Science* 269 (5222): 331-334. <https://doi.org/10.1126/science.269.5222.331>
- Reizopoulou S, Nicolaidou A (2004) Benthic diversity of coastal brackish-water lagoons in western Greece. *Aquatic Conservation: Marine and Freshwater Ecosystems* 14: S93-S102. <https://doi.org/10.1002/aqc.653>

- Rossi F, Castelli A, Lardicci C (2006) Distribution of macrobenthic assemblages along a marine gradient in Mediterranean eutrophic coastal lagoons. *Marine Ecology* 27 (1): 66-75. <https://doi.org/10.1111/j.1439-0485.2006.00078.x>
- Tuomisto H (2010) A consistent terminology for quantifying species diversity? Yes, it does exist. *Oecologia* 164 (4): 853-860. <https://doi.org/10.1007/s00442-010-1812-0>
- Tuomisto H (2012) An updated consumer's guide to evenness and related indices. *Oikos* 121 (8): 1203-1218. <https://doi.org/10.1111/j.1600-0706.2011.19897.x>
- Turner MG, Gardner RH (2015) *Landscape Ecology in Theory and Practice: Pattern and Process*. Springer, 482 pp. [ISBN 978-1-4939-2793-7]
- Vieira N, Amat F (1996) The invertebrate benthic community of two solar salt ponds in Aveiro, Portugal. *International Journal of Salt Lake Research* 5 (4): 281-286. <https://doi.org/10.1007/bf01995382>
- Wiens J, Crawford C, Gosz J (1985) Boundary Dynamics: A Conceptual Framework for Studying Landscape Ecosystems. *Oikos* 45 (3): 421. <https://doi.org/10.2307/3565577>

Supplementary material

Suppl. material 1: The dataset

Authors: Athanasios Evagelopoulos

Data type: abundance, biomass and taxonomic classification

Brief description: The dataset file includes the abundance (ind./sample), wet biomass with shells (g/sample) and taxonomic classification of the species in each sample.

Filename: Dataset.xlsx - [Download file](#) (38.23 kb)