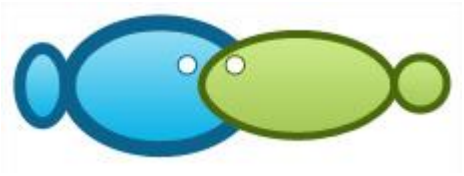

Preliminary study of the shallow water sponges (Demospongiae) from the north-central Moroccan Mediterranean coast

[1,2]Imad Krikech, [2]Gaël Le Pennec, [1]Mohammed Ezziyyani

[1] Department of Life Sciences, Polydisciplinary Faculty of Larache, Abdelmalek Essaadi University, Larache, Morocco; [2] Laboratoire de Biotechnologie et de Chimie Marines, Université de Bretagne Sud, Lorient, Brittany, France. Corresponding author: M. Ezziyyani, moezziyyani@uae.ac.ma

Abstract. North African sponges, particularly Mediterranean-Moroccan sponges, are understudied relative to Demospongiae in most other regions of the world. In this study, we compiled an inventory of species found in the north coast of Morocco following surveys conducted from July 2019 to June 2020. Twenty-seven sponge species were identified belonging to 22 different genera, 20 families and 11 orders. Dictyoceratida, Poecilosclerida, Clionaida and Haplosclerida orders are well represented in the collection, with 3 to 6 species each, with the first two groups appearing to have the highest diversity on the northern-central coast of Morocco. These preliminary results – considering the low number of species recorded in total – are encouraging and suggest that the marine biodiversity along the Northern Mediterranean coast of Morocco is high, but not sufficiently known yet.
Key Words: Alboran Sea, diversity, inventory, Porifera, sponge fauna.

Introduction. The Mediterranean Sea is a "land-locked sea" defined as one of the world's biodiversity hotspots, characterized by rare and restricted distributed marine species, and where approximately 17000 marine species and 4-18% of the world's marine biodiversity are present (Bianchi & Morri 2000; Coll et al 2010). Among these species, marine sponges are sessile, sedentary and filter-feeding invertebrates, occupying all aquatic environments, in marine and freshwater habitats, polar, tropical and temperate regions (Sarà & Vacelet 1973; van Soest et al 2012). They are considered essential components for maintaining ecosystem services and integrity of freshwater and marine benthic communities, due to their widespread diversity, high biomass in many habitats, and the manifold functional and structural roles that they play (Bell 2008; Heip et al 2009). According to De Voogd et al (2021), there are more than 9200 accepted sponge species, and 50-70% would still remain undescribed (Appeltans et al 2012). The Mediterranean Sea hosts nearly 10% of this diversity. Demosponges are the largest and most species-rich class within the phylum Porifera, with approximately 90% of all the species (van Soest et al 2012).

Morocco has an Atlantic and a Mediterranean façade. The latest extends over almost 500 km and is one of the warmest coasts of Africa, with climatic influences from the Atlantic Ocean and the Mediterranean Sea (Lionello et al 2006). In previous studies, local marine biodiversity has been found to be the result of a mixture of species present in the North-Eastern Atlantic and the Mediterranean (Carballo et al 1997; Boaventura et al 2002). These special circumstances claim for a better knowledge of the Moroccan macrobenthos, and in particular of sponges.

Moreover, in the context of environment and health changes in benthic communities, it is important to have a deeper understanding of local sponge repartition and a good grasp of their taxonomy. Even though these animals have been intensively studied throughout most of the Mediterranean Sea (Schönberg 2017), North African sponges are not well known (Van Soest 1993; Mustapha et al 2003; Hussein & Bensahla

Talet 2019). Off Morocco, sponges are being investigated for their attractive and chemical diversity, but little attention is being paid to their distribution or biology (Rifai et al 2005; El-Amraoui et al 2010; Bary et al 2018). There are few publications on the taxonomy and ecology of Moroccan sponges (van Soest et al 2013), and a search in the World Porifera Database (De Voogd et al 2021) did not yield any results for Mediterranean-Moroccan sponges.

The aim of this work is to provide new information on the sponge fauna from the coastal waters of the northern-central coast of Morocco. Our data can increase knowledge on the diversity of the Porifera of the Moroccan coast and allow us to make a preliminary checklist of these organisms, laying the foundations for future studies.

Material and Method. Five coastal locations were sampled across a distance of 100 km along the central half of the Mediterranean coast of Morocco, between Cala Bonita, Al-Hoceima in the west, and Tibouda Beach, Nador, in the Southern Alboran Sea in the east. All are characterized by rocky substrata (Figure 1). Exact sampling locations with descriptions are listed in the Table 1.

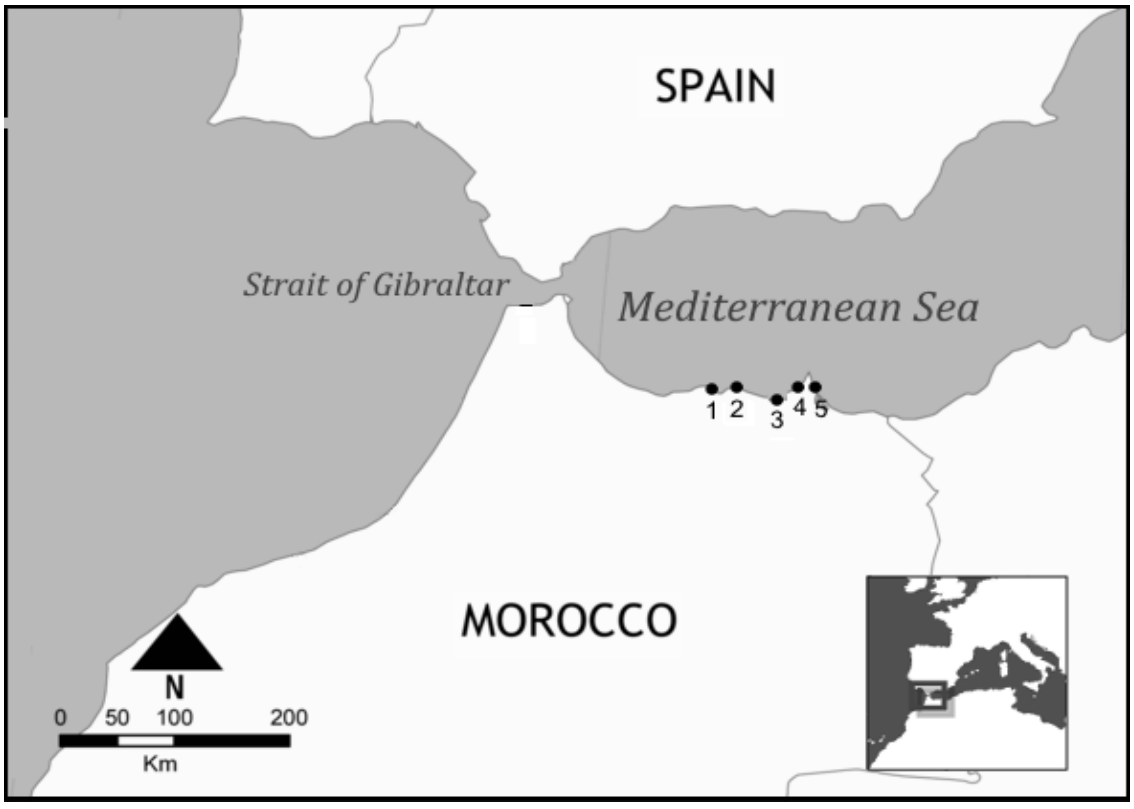

Figure 1. Map showing sampling sites along the north-central coast of Morocco: 1 - Cala Bonita Beach; 2 - Île Cala Iris; 3 - Badès; 4 - Charrana Beach; 5 - Tibouda Beach.

Table 1

Sampling sites with descriptions

Sites	*Date*	*Code*	*Coordinates*	*Description*
Cala Bonita Beach	July-2019	MAT	35.234936; 3.922664	Rocky wall ending
Île Cala Iris	May-2020	ICA	35.148512; 3.365327	Rocky slope
Badès	May-2020	BAD	35.170480; 4.295074	Vertical rock wall
Charrana Beach	June-2020	CHB	35.398825; 3.300286	Rocky cliff
Tibouda Beach	June-2020	TIB	35.423047; 2.953712	Rocky cliff

Sampling took place between July 2019 and June 2020 by scuba diving and snorkelling campaigns at a depth of 1-15 m. Sponges were removed from solid surfaces using hand tools. Underwater photographs of the sampled sponges were also taken with a GoPro HERO7 digital camera whenever possible. Specimens were individually collected into a separate, clean polythene bag prior to immediate transfer to the laboratory.

The diagnostic characteristics including body form, shape, size, color, consistency, texture, dimensions and arrangement were used for species identification of sponge. Permanent preparations of skeleton and spicules were made according to the standard taxonomic methods (Rützler et al 1978). In summary, small pieces of sponge tissue were dissolved in 70% nitric acid, rinsed in water and dehydrated in ethanol. Then, spicules were mounted in Euparal and examined with light microscopy (Nikon Eclipse E400). We referred to Hooper & van Soest (2002) and the World Porifera Database (WPD, part of the World Register of Marine Species -WoRMS- www.marinespecies.org/porifera/) to crosscheck the classification and to confirm taxon allocations and formats.

Results and Discussion. Twenty-seven species of Demospongiae belonging to 11 orders, 22 families and 26 genera were identified and are listed in Table 2 according to sampling sites, with an average of 8 sponge species per zone and a maximum of 14 species at Île Cala Iris. At orders level, the Dictyoceratida was the richest in species number (6 species), followed by Poecilosclerida (4 species), Clionaida and Haplosclerida, each with 3 species. The orders Agelasida, Axinellida, Bubarida and Dendroceratida are represented by two species each, while the orders Chondrillida, Chondrosiida, and Verongiida are each represented by one species only (Figure 2; Table 2). Most of the northern-central Morocco sponge species belonged to the subclass Heteroscleromorpha (59.2%), followed by the Keratosa (29.6%) and the Verongimorpha (11.1%). These results are in good agreement with Sitjà & Maldonado (2014). They identified 188 Demospongiae species in the Alboran Sea, westernmost part of the Mediterranean, with subclass Heteroscleromorpha having the highest number of species (166 species, 81.2% of the total).

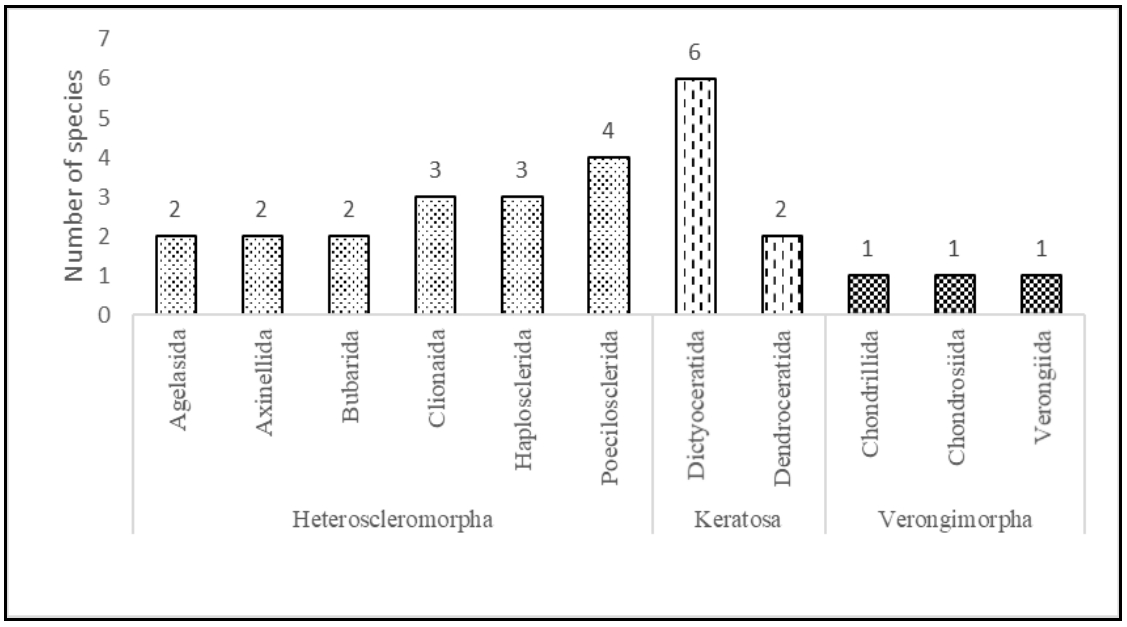

Figure 2. Proportional diversity for each order of Demospongiae sampled from the north-central Mediterranean coast of Morocco. The shaded area in the graph denote subclass: ■ Heteroscleromorpha; ■ Keratosa; ■ Verongimorpha.

Table 2

Checklist of Demospongiae recorded from the five surveyed sites along the northern-central coast of Morocco; species are listed alphabetically according to subclass, order, family, and name

N	*Species*	*Cala Bonita*	*Cala Iris*	*Badès*	*Charrana*	*Tibouda*
1	*Agelas oroides* (Schmidt, 1864)	+	–	–	+	+
2	*Prosuberites longispinus* Topsent, 1893	–	–	–	–	+
3	*Axinella polypoides* Schmidt, 1862	+	–	–	–	–
4	*Axinella damicornis* (Esper, 1794)	+	–	–	+	+
5	*Acanthella acuta* Schmidt, 1862	+	+	–	–	–
6	*Dictyonella incisa* (Schmidt, 1880)	–	+	–	–	–
7	*Cliona celata* Grant, 1826	–	–	+	–	–
8	*Cliona viridis* (Schmidt, 1862)	+	–	+	+	–
9	*Spirastrella cunctatrix* (Schmidt, 1868)	–	+	–	+	+
10	*Haliclona (Reniera) cratera* (Schmidt, 1862)	+	+	–	–	–
11	*Haliclona (Reniera) mediterranea* (Griessinger, 1971)	+	+	–	+	–
12	*Petrosia (Petrosia) ficiformis* (Poiret, 1979)	–	+	+	+	–
13	*Crambe crambe* (Schmidt, 1862)	–	+	+	+	–
14	*Myxilla (Myxilla) rosácea* (Lieberkühn, 1859)	–	–	–	–	+
15	*Phorbas fictitius* (Bowerbank, 1866)	–	–	+	+	–
16	*Phorbas tenacior* (Topsent, 1925)	–	+	+	–	–
17	*Aplysilla sulfurea* Schulze, 1878	–	–	–	–	+
18	*Spongionella pulchella* (Sowerby, 1804)	–	–	–	–	+
19	*Dysidea fragilis* (Montagu, 1814)	–	–	–	+	+
20	*Ircinia dendroides* (Schmidt, 1862)	–	+	+	–	–
21	*Ircinia variabilis* (Schmidt, 1862)	+	+	+	+	–
22	*Sarcotragus spinosulus* (Schmidt, 1862)	–	+	+	–	–
23	*Cacospongia mollior* (Schmidt, 1862)	+	–	–	–	–
24	*Spongia (Spongia) officinalis* (Linnaeus, 1759)	+	+	–	–	–
25	*Chondrilla nucula* (Schmidt, 1862)	–	–	+	–	–
26	*Chondrosia reniformis* (Nardo, 1847)	+	+	+	–	–
27	*Aplysina aerophoba* (Nardo, 1833)	–	+	–	–	–
	Total	11	14	11	10	8

In terms of distribution, Île Cala Iris exhibited high species richness with a record of 14 sponge species, followed by an equal number of species at Cala Bonita beach and Badès (11 species). 10 species of sponges were encountered at Charrana beach, whereas eight were recorded at Tibouda beach. Amongst the twenty-seven species inventoried during this study, the discontinuous distribution of the sponge population was observed. Only four species (*Petrosia (Petrosia) ficiformis*, *Crambe crambe*), *Ircinia variabilis,* and *Chondrosia reniformis*, found in at least three different locations, were the most common (Table 3; Figure 3). All species recorded in this study are common in the Mediterranean Sea (De Voogd et al 2021). Nonetheless, depth-wise exploration in these regions should provide more information about their abundance, diversity and distribution.

Table 3

Summary of the taxonomic analysis of the sponges recorded during the study

Class	*Subclass*	*Order*	*Family*	*Species*
Demospongiae	Heteroscleromorpha	Agelasida	Agelasidae	*Agelas oroides*
			Hymerhabdiidae	*Prosuberites longispinus*
		Axinellida	Axinellidae	*Axinella polypoides*
				Axinella damicornis
		Bubarida	Dictyonellidae	*Acanthella acuta*
				Dictyonella incisa
		Clionaida	Clionaidae	*Cliona celata*
				Cliona viridis
			Spirastrellidae	*Spirastrella cunctatrix*
		Haplosclerida	Chalinidae	*Haliclona (Reniera) cratera*
				Haliclona (Reniera) mediterranea
			Petrosiidae	*Petrosia (Petrosia) ficiformis*
		Poecilosclerida	Crambeidae	*Crambe crambe*
			Myxillidae	*Myxilla (Myxilla) rosácea*
			Hymedesmiidae	*Phorbas fictitius*
				Phorbas tenacior
	Keratosa	Dendroceratida	Darwinellidae	*Aplysilla sulfurea*
			Dictyodendrillidae	*Spongionella pulchella*
		Dictyoceratida	Dysideidae	*Dysidea fragilis*
			Irciniidae	*Ircinia dendroides*
				Ircinia variabilis
				Sarcotragus spinosulus
			Thorectidae	*Cacospongia mollior*
			Spongiidae	*Spongia (Spongia) officinalis*
	Verongimorpha	Chondrillida	Chondrillidae	*Chondrilla nucula*
		Chondrosiida	Chondrosiidae	*Chondrosia reniformis*
		Verongiida	Aplysinidae	*Aplysina aerophoba*

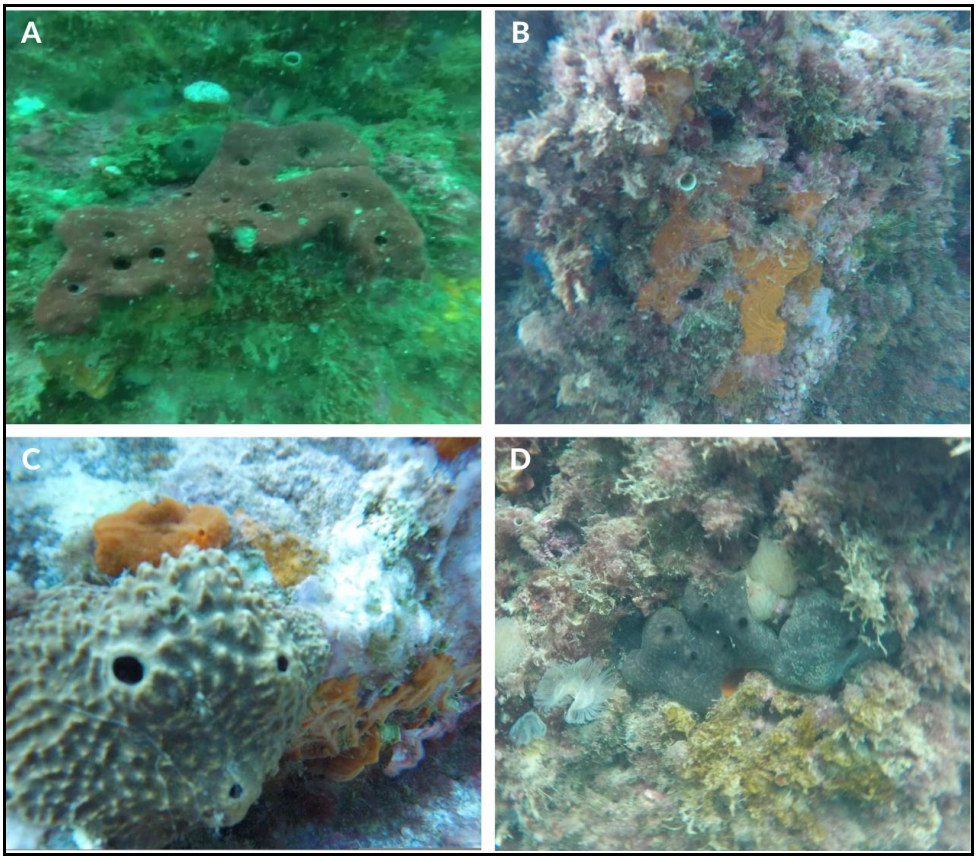

Figure 3. *In situ* photographs of common sponge species found in the north-central coast of Morocco: A) *Petrosia (Petrosia) ficiformis*; B) *Crambe crambe*; C) *Ircinia variabilis*; D) *Chondrosia reniformis*.

There are few studies about the shallow water sponge fauna of the Moroccan Mediterranean Sea, most published papers focusing on their attractive and chemical diversity, with somewhat little focus on their distribution or diversity. To the best of our knowledge, no historical data are available for the area surveyed in this work to allow us to compare the distribution and diversity of the Moroccan Mediterranean sponges. One similar study addressing sponge biodiversity was conducted in the western part of Morocco. Indeed, the number of species reported in our previous work was slightly lower than that reported in the present study, with only 11 species in common (Krikech et al 2020). Nevertheless, earlier studies carried out on nearby coastlines reported 40 species in Chafarinas Islands (Tocino et al 2009), 23 in Oran Bay, (Northwestern Algeria) (Hussein & Bensahla Talet 2019) and 16 in Tunisian coasts (Bouamama et al 2009).

Additionally, several studies have been conducted north of the Alboran Sea (Boury-Esnault et al 1994; Rosell & Uriz 2002; Sitjà & Maldonado 2014), but unfortunately, they are also not comparable with ours, being focused on deep water sponge fauna. In any case, our results revealed that there was considerable similarity, particularly in term of species/class recorded in these previous studies.

Petrosia (Petrosia) ficiformis appears to be ubiquitous in the northern-central coast of Morocco. This is consistent with reports by Bavestrello et al (1994), who investigated the same area as part of a larger study. Illuminati et al (2016) used *P. ficiformis* as a bioindicator that has a high capacity to accumulate contaminants. Therefore, this sponge can be used for environmental monitoring in the future. In Morocco, coastal effects of metal mining and oil and gas industries may be assessed by using this and other sponges.

It is worth mentioning that the presence of *Spongia (Spongia) officinalis* could be an important sign of new recruitment of this traditionally exploited and much sought-after bath sponge.

Most species in the taxon Porifera are still waiting to be discovered and/or described, and the rate of discovery is increasing rapidly (Appeltans et al 2012). The lack of knowledge on marine sponge diversity puts at risk the possibility to adequately manage and conserve biodiversity, also in view of the recognized roles sponges play as an optimal habitat for several associated taxa (Cerrano et al 2006; Wulff 2012) providing shelter and food during critical phases of the life cycle of many species. A basic knowledge should be the first step for maintaining biodiversity and preventing its decline or modification. In this context, the sponges reported in the present investigation collected from shallow-water sites on the north-central Mediterranean coast of Morocco represent a significant contribution of our knowledge of this poorly studied fauna. Furthermore, in view of the ecological and pharmacological importance of sponges, we suggest that the investigated sites should be carefully managed and protected by appropriate legislation and regulations.

Conclusions. In this contribution, we presented an overview of the sponge species diversity and distribution from the north-central Mediterranean coast of Morocco. It is envisaged that the information gathered in this study will certainly improve our understanding of the taxonomy and zoogeography of these intriguing fauna. Nonetheless, the number of species reported in this study represents only a small proportion of the total sponge fauna of the northern coast of Morocco and certainly the diversity of these benthic organisms throughout this area is more diversified than what is currently presented. Similar studies, with a much higher number of sites and more detailed sampling methods, will be necessary to implement the knowledge of the Porifera of the Moroccan coasts.

Acknowledgements. We are grateful to Y. Wardane and A. El-Mashad for their support in the sampling activities. I. Krikech received a mobility grant from the Brittany and Loire University financed by the Brittany Region.

Conflict of Interest. The authors declare no conflict of interest.

References

Appeltans W., Ahyong S. T., Anderson G., Angel M. V., Artois T., Bailly N., Bamber R., Barber A., Bartsch I., Berta A., Błażewicz-Paszkowycz M., Bock P., Boxshall G., Boyko C. B., Brandão S. N., Bray R. A., Bruce N. L., Cairns S. D., Chan T. Y., Cheng L., Collins A. G., Cribb T., Curini-Galletti M., Dahdouh-Guebas F., Davie P. J. F., Dawson M. N., De Clerck O., Decock W., De Grave S., de Voogd N. J., Domning D. P., Emig C. C., Erséus C., Eschmeyer W., Fauchald K., Fautin D. G., Feist S. W., Fransen C. H. J. M., Furuya H., Garcia-Alvarez O., Gerken S., Gibson D., Gittenberger A., Gofas S., Gómez-Daglio L., Gordon D. P., Guiry M. D., Hernandez F., Hoeksema B. W., Hopcroft R. R., Jaume D., Kirk P., Koedam N., Koenemann S., Kolb J. B., Kristensen R. M., Kroh A., Lambert G., Lazarus D. B., Lemaitre R., Longshaw M., Lowry J., Macpherson E., Madin L. P., Mah C., Mapstone G., McLaughlin P. A., Mees J., Meland K., Messing C. G., Mills C. E., Molodtsova T. N., Mooi R., Neuhaus B., Ng P. K. L., Nielsen C., Norenburg J., Opresko D. M., Osawa M., Paulay G., Perrin W., Pilger J. F., Poore G. C. B., Pugh P., Read G. B., Reimer J. D., Rius M., Rocha R. M., Saiz-Salinas J. I., Scarabino V., Schierwater B., Schmidt Rhaesa A., Schnabel K. E., Schotte M., Schuchert P., Schwabe E., Segers H., Self-Sullivan C., Shenkar N., Siegel V., Sterrer W., Stöhr S., Swalla B., Tasker M. L., Thuesen E. V., Timm T., Todaro M. A., Turon X., Tyler S., Uetz P., van der Land J., Vanhoorne B., van Ofwegen L. P., van Soest R. W. M, Vanaverbeke J., Walker-Smith G., Walter T. C., Warren A., Williams G. C., Wilson S. P. and Costello M. J., 2012 The magnitude of global marine species diversity. Current Biology 22(23):2189-2202.

Bary K., Elamraoui B., Laasri F. E., El Mzibri M., Benbacer L., Bamhaoud T., 2018 Cytotoxic effect of extracts from the Moroccan marine sponge on human prostate cancer cell line. International Journal of New Technology and Research 4(1):74-78.

Bavestrello G., Pansini M., Sarà M. 1994 The variability and taxonomic status of different Petrosia-like sponges in the Mediterranean Sea. In: Sponges in time and space. Van Soest R. W. M., Van Kempen T. M. G., Braekman J. C. (eds), Balkema, Rotterdam, pp. 83-92.

Bell J. J., 2008 The functional roles of marine sponges. Estuarine, Coastal and Shelf Science 79(3):341-353.

Bianchi C. N., Morri C., 2000 Marine biodiversity of the Mediterranean Sea: Situation, problems and prospects for future research. Marine Pollution Bulletin 40(5):367-373.

Boaventura D., Ré P., da Fonseca L. C., Hawkins J., 2002 Intertidal rocky shore communities of the continental Portuguese coast: analysis of distribution patterns. Marine Ecology 23(1):69-90.

Bouamama K., El Bour M., Ben Mustapha K., El Abed A., 2009 [Study of the diversity of sponges (Porifera: Demospongiae) of Tunisian coasts]. Bulletin Institut National des Sciences et Technologies de la Mer de Salammbô 36:159-167. [In French].

Boury-Esnault N., Pansini M., Uriz M. J., 1994 [Bathyal sponges from the Alboran Sea and the Ibero-Moroccan Gulf. Memoirs]. Muséum National d'Histoire Naturelle, Paris, 174 p. [In French].

Carballo J. L., Naranjo S., García-Gómez J. C., 1997 Where does the Mediterranean Sea begin? Zoogeographical affinities of the littoral sponges of the Straits of Gibraltar. Journal of Biogeography 24(2):223-232.

Cerrano C., Calcinai B., Pinca S., Bavestrello G., 2006 Reef sponges as hosts of biodiversity: cases from North Sulawesi. Proceedings of the Xth Coral Reef Symposium, Okinawa, pp. 208-213.

Coll M., Piroddi C., Steenbeek J., Kaschner K., Ben Rais Lasram F., Aguzzi J., Ballesteros E., Bianchi C.N., Corbera J., Dailianis T., Danovaro R., Estrada M., Froglia C., Galil B., Gasol J., Gertwagen R., Gil J., Guilhaumon F., Kesner-Reyes K., Kitsos M., Koukouras A., Lampadariou N., Laxamana E., López-Fé de la Cuadra C., Lotze H., Martin D., Mouillot D., Oro D., Raicevich S., Rius-Barile J., Saiz-Salinas J., San Vicente C., Somot S., Templado J., Turon X., Vafidis D., Villanueva R., Voultsiadou

E., 2010 The biodiversity of the Mediterranean Sea: estimates, patterns and threats. PLoS ONE 5(8): e11842, 36 p.
De Voogd N. J., Alvarez B., Boury-Esnault N., Carballo J. L., Cárdenas P., Díaz M. C., Dohrmann M., Downey R., Hajdu E., Hooper J. N. A., Kelly M., Klautau M., Manconi R., Morrow C. C. Pisera A. B., Ríos P., Rützler K., Schönberg C., Vacelet J., van Soest R. W. M., 2021 World Porifera Database. Available at: http://www.marinespecies.org/porifera.
El-Amraoui B., Biard J. F., Uriz M. J., Fassouane A., 2010 Antifungal and antibacterial activity of Porifera extracts from the Moroccan Atlantic coasts. Journal de Mycologie Médicale 20(1):70-74.
Heip C., Hummel H., van Avesaath P., Appeltans W., Arvanitidis C., Aspden R., Austen M., Boero F., Bouma T. J., Boxshall G., Buchholz F., Crowe T., Delaney A., Deprez T., Emblow C., Feral J. P., Gasol J. M., Gooday A., Harder J., Ianora A., Kraberg A., Mackenzie B., Ojaveer H., Paterson D., Rumohr H., Schiedek D., Sokolowski A., Somerfield P., Sousa Pinto I., Vincx M., Węsławski J. M., Nash R., 2009 Marine biodiversity and ecosystem functioning. Printbase, Dublin, 93 p.
Hooper J. N. A., van Soest R. W. M., 2002 Systema Porifera. A Guide to the classification of sponges. Kluwer Academic/Plenum Publishers, New York, 1708 p.
Hussein K. B., Bensahla Talet L., 2019 A preliminary inventory of biodiversity and benthic habitats of "Plane" Island (Paloma) in Oran Bay, North western Algeria (western Mediterranean). Journal of the Black Sea/Mediterranean Environment 25(1):49-72.
Illuminati S., Annibaldi A., Truzzi C., Scarponi G., 2016 Heavy metal distribution in organic and siliceous marine sponge tissues measured by square wave anodic stripping voltammetry. Marine Pollution Bulletin 111(1-2):476-482.
Krikech I., Le Pennec G., Ezziyyani M., 2020 Diversity and distribution of marine sponges (Porifera) from the western coast of Morocco (south-west Mediterranean Sea). In: Advanced intelligent systems for sustainable development. Ezziyyani M. (ed), Springer, Cham, 521 p.
Lionello P, Malanotte-Rizzoli P., Boscolo R., Alpert P., Artale V., Li L., Luterbacher J., May W., Trigo R., Tsimplis M., Ulbrich U., Xoplaki E., 2006 The Mediterranean climate: an overview of the main characteristics and issues. Developments in Earth and Environmental Sciences 4:1-26.
Mustapha K. B., Zarrouk S., Souissi A., El Abed A., 2003 [Diversity of Tunisian Demosponges]. Bulletin Institut National des Sciences et Technologies de la Mer de Salammbô 30:55-78. [In French].
Rifai S., Fassouane A., Pinho P. M., Kijjoa A., Nazareth N., Nascimento M. S. J., Herz W., 2005 Cytotoxicity and inhibition of lymphocyte proliferation of fasciculatin, a linear furanosesterterpene isolated from *Ircinia variabilis* collected from the Atlantic Coast of Morocco. Marine Drugs 3(1):15-21.
Rosell D., Uriz M. J., 2002 Excavating and endolithic sponge species (Porifera) from the Mediterranean: species descriptions and identification key. Organisms Diversity & Evolution 2(1):55-86.
Rützler K., 1978 Sponges in coral reefs. In: Coral reefs: Research methods, monographs on oceanographic methodology. Stoddart D. R., Johannes R. E. (eds), UNESCO, Paris, France, pp. 299-313.
Sarà M., Vacelet J., 1973 [Demosponges ecology]. In: [Zoology treatise]. Grassé P. P. (ed), Masson Cie, Paris, pp. 462-576. [In French].
Schönberg C. H. L., 2017 Culture, demography and biogeography of sponge science: From past conferences to strategic research? Marine Ecology 38(2):212416, 19 p.
Sitjà C., Maldonado M., 2014 New and rare sponges from the deep shelf of the Alboran Island (Alboran Sea, Western Mediterranean). Zootaxa 3760(2):141-179.
Tocino L. S., Maldonado M., Barranco N. C., Velasco C. G., 2009 [Report of the campaign carried out in the national hunting refuge of the Chafarinas Islands from October 07 to 26, 2009]. Organismo Autónomo Parques Nacionales, 18 p. [In Spanish].
Van Soest R. W. M, Beglinger E. J., De Voogd N. J., 2013 Microcionid sponges from Northwest Africa and the Macaronesian Islands (Porifera, Demospongiae, Poecilosclerida). Zoologische Mededelingen 87(2-5):275-404.

Van Soest R. W. M, Boury-Esnault, N., Vacelet J., Dohrmann M., Erpenbeck D., De Voogd N. J., Santodomingo N., Vanhoorne B., Kelly M., Hooper J. N. A., 2012 Global diversity of sponges (Porifera). PLoS ONE 7(4):e35105, 23 p.
Van Soest R. W., 1993 Distribution of sponges on the Mauritanian continental shelf. Hydrobiologia 258:95-106.
Wulff J. L., 2012 Ecological interactions and the distribution, abundance, and diversity of sponges. In: Advances in sponge science: Phylogeny, systematics, ecology. Becerro M. A. (ed), Academic Press, Oxford, pp. 273-344.

Received: 21 December 2021. Accepted: 27 January 2022. Published online: 06 February 2022.
Authors:
Imad Krikech, Department of Life Sciences, Polydisciplinary Faculty of Larache, Abdelmalek Essaadi University, 745 BP, 92004 Larache, Morocco, e-mail: imad.krikech@gmail.com
Gaël Le Pennec, Laboratoire de Biotechnologie et de Chimie Marines, Université de Bretagne Sud, EA 3884–IUEM, BP 92116, 56321 Lorient, Brittany, France, e-mail: gael.le-pennec@univ-ubs.fr
Mohammed Ezziyyani, Department of Life Sciences, Polydisciplinary Faculty of Larache, Abdelmalek Essaadi University, 745 BP, 92004 Larache, Morocco, e-mail: moezziyyani@uae.ac.ma

How to cite this article:
Krikech I., Le Pennec G., Ezziyyani M., 2022 Preliminary study of the shallow water sponges (Demospongiae) from the north-central Moroccan Mediterranean coast. AACL Bioflux 15(1):305-313.