



História, Ciências, Saúde-Manguinhos

ISSN: 0104-5970

ISSN: 1678-4758

Casa de Oswaldo Cruz, Fundação Oswaldo Cruz

Salgueiro, Ângela

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História, Ciências, Saúde-Manguinhos, vol. 28, no. 2, 2021, pp. 473-489

Casa de Oswaldo Cruz, Fundação Oswaldo Cruz

DOI: <https://doi.org/10.1590/S0104-59702021000200008>

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Oceans, science, and universities: scientific study of the sea during the First Portuguese Republic

Oceanos, ciência e universidades: estudo científico do mar durante a Primeira República Portuguesa

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Recebido em 8 mar. 2019.

Aprovado em 13 ago. 2019.

<http://dx.doi.org/10.1590/S0104-59702021000200008>

SALGUEIRO, Ângela. Oceans, science, and universities: scientific study of the sea during the First Portuguese Republic. *História, Ciências, Saúde – Manguinhos*, Rio de Janeiro, v.28, n.2, abr.-jun. 2021, p.473-489.

Abstract

Knowledge of the scientific study of the sea in the early twentieth century is essential to understand the process through which marine biology was institutionalised in Portugal. The first national biological stations were set up during the First Republic: the Estação de Zoologia Marítima da Foz in Porto, and the Aquário Vasco da Gama in Lisbon. This paper is a case study on the Estação da Foz, which played an important role by assisting the Zoology Institute at the Universidade do Porto in achieving its strategic objectives, and provides an understanding of the institutionalisation process for marine biology within a university context: its connection with teaching, research, the economy, and society.

Keywords: marine biology; experimental stations; Estação de Zoologia Marítima da Foz; Augusto Nobre (1865-1946).

Resumo

O conhecimento do estudo científico oceanográfico do início do século XX é essencial para compreender o processo de institucionalização da biologia marinha em Portugal. As primeiras estações biológicas nacionais foram criadas durante a Primeira República: a Estação de Zoologia Marítima da Foz, no Porto, e o Aquário Vasco da Gama, em Lisboa. Este artigo é um estudo de caso sobre a Estação da Foz, que colaborou com o Instituto de Zoologia da Universidade do Porto no alcance de seus objetivos estratégicos, e aborda o processo de institucionalização da biologia marinha no contexto universitário: sua conexão com ensino, pesquisa, economia e sociedade.

Palavras-chave: biologia marinha; estações experimentais; Estação de Zoologia Marítima da Foz; Augusto Nobre (1865-1946).



Teaching and research institutions in the field of marine biology are highly relevant to contemporary historiography. Various researchers have examined problems associated with our historical knowledge of these institutions and illustrated their role as agents for modernity, fostering practices and sociabilities that represent new social and philosophical ideas (Hubbard, 2006; Groeben, 2006; De Bont, 2009; Pinto, 2017).

Scientific interest in the seas and oceans stemmed from the need to find out more about these spaces and demystify existing knowledge about them while recognising their geostrategic, economic, scientific, and cultural functions (Hubbard, 2006; Lambert, Martins, Ogborn, 2006; Mack, 2018). The oceans were studied by both amateur and professional naturalists at newly created experimental stations where pure and applied research was conducted, involving a combination of laboratory work and fieldwork (Kohler, 2002; Groeben, 2008; Moore, 2018).

These various types of stations (private, state, and university-affiliated) played an important role in the process of scientific institutionalisation and disciplinary specialisation. Although they had distinct aims – different “ecologies” (De Bont, 2009, p.199) – close relationships were forged between the stations and researchers, scientific societies, and university departments, encouraging cross-cultural encounters and establishing a cohesive network to exchange and disseminate information of both a scientific and a personal nature (Hubbard, 2006; Groeben, 2008; Bowen, 2015). They were key in stimulating dialogue between science and politics, thus helping to formulate national policies and create an “ideal of service,” striking a balance between the strategic aims of the state and researchers’ own private agendas (Hubbard, 2016a).

Yet there is still a need to deepen our knowledge of these institutions as spaces for the production, circulation, and appropriation of scientific knowledge that operated within complex institutional realities (Bowen, 2015; Pinto, 2017; Amorim, Pinto, 2019) and position them within the context of educational reform, scientific institutionalisation, disciplinary specialisation, and administrative centralisation (Rollo, Queiroz, Brandão, 2014; Salgueiro, 2017).

In Portugal, aside from pioneering work by the zoologist Barbosa du Bocage (1823-1907), research in marine biology and oceanography mostly began to develop in the 1890s as a result of oceanographic expeditions, hydrographic missions, and the work of scientists such as Augusto Nobre and Magalhães Ramalho (a zoologist and an oceanographer, respectively).

It was only during the First Portuguese Republic (1910-1926) that the first official centres for research in marine biology were established: the University of Porto’s Foz Maritime Zoology Station (Estação de Zoologia Marítima da Foz, da Universidade do Porto) in Porto, the Navy Ministry’s Vasco da Gama Aquarium (Aquário Vasco da Gama, Ministério da Marinha) in Lisbon, and in the same city the Maritime Section of the University of Lisbon Bocage Museum (Museu Bocage, Universidade de Lisboa); the precursor of the Guia Maritime Laboratory (Laboratório Marítimo da Guia). Analysis of these centres allows us to identify relevant spaces and actors, as well as the specific context in which biological stations were institutionalised in order to comprise formal and informal scientific networks characterised by a marked trend towards Europeanisation (Lopes, 2017).

These institutions had an essential relationship with universities. In France, several stations were constructed in part to serve university curricula, forging a link between experimental teaching and scientific research (De Bont, 2009). In Canada, while such stations were federally funded, they also received support from university professors for research and specialist disciplinary study (Hubbard, 2006). In Portugal, the central role of the universities was key in fostering research and the emergence of a modern scientific elite, and was significant in the institutionalisation of experimental stations (Salgueiro, 2017).

This paper analyses the institutionalisation of marine biology in Portugal during the early twentieth century through a case study of the Foz Maritime Zoology Station (1913); this was the first university maritime station to be created, linked to the Faculty of Science at the University of Porto (Faculdade de Ciências, Universidade do Porto). This process took place amid institutional, pedagogical, and scientific reform of higher education institutions driven by Republican political and intellectual elites, which positioned universities as the hub of national scientific activity.

Scientific study of the sea in the early twentieth century

In the early twentieth century, little was known about the seas and oceans; they were associated with cultural imagery on a grand scale (Pinto, 2017; Brito, out. 2018), leading the journalist Hermano Neves (1884-1929) to state in 1907, “Even today, in an age of almost irreverent positivism, legend hangs over the mysterious waters” (Neves, 19 ago. 1907, p.238).¹ But geostrategic, diplomatic, and economic motives were behind increasingly urgent demands for expansion of the knowledge on marine fauna and flora and the geological, biophysical, and biochemical composition of the oceans. In the field of fisheries and fish farming, progress in species classification was essential for individual countries to fully grasp the extent of their natural resources and move forward with sustainable and rational utilisation (Amorim, 2005; García, 2014; Salgado, Marandino, 2014, p.869).

In Portugal, initial research studies in the field of marine biology addressing problems associated with ichthyology, oceanography, and fisheries were conducted by scientists such as the zoologist José Vicente Barbosa du Bocage, a reader at Lisbon Polytechnic School (Escola Politécnica de Lisboa) and head of the Zoology section of the National Natural History Museum (Museu Nacional de História Natural) (Madruga, 2013). In 1864, he published an article in the *Proceedings of the Zoological Society of London* on the discovery of a zoophyte off the Portuguese coast (Bocage, 1864). The specimen had been sent to him by an amateur naturalist who obtained it from fishermen in Setúbal, illustrating the dynamic informal networks that existed, as well as close relationships between professional and amateur naturalists and fishing communities (García, 2014; Bowen, 2015).

Bocage (1868) also published a study on aspects of oyster farming, described the Porifera (sponges) *Hyalonema (Cyliconemaoida) lusitanicum* Bocage 1864 and *Podospongia lovenii* Barboza du Bocage 1869 (Worms, 2018), and disseminated information about advances in the field of oceanography in Portugal. In addition, he published works on ichthyology in collaboration with Félix António de Brito Capelo (1828-1879), an assistant naturalist at

the Lisbon museum. Capelo (1876) was mainly involved in the field of arachnology, but also studied crustaceans and subjects associated with fisheries.

Also noteworthy are studies by the hydrographic engineer António Artur Baldaque da Silva (1852-1915): in the field of oceanography, *Sondas e marés* (Probes and tides) (1882), and on marine biology, the economics of the sea, and ethnography, *Estado actual das pescas em Portugal* (The current state of fisheries in Portugal) (1891). This latter work was published by the Ministry of the Navy and Overseas Affairs (Ministério dos Negócios da Marinha e Ultramar) and was the “product of observation and direct study” in Silva’s role as a member of the Fisheries Commission “of cetaceans, fish, crustaceans, molluscs and algae, which live in these waters, and the equipment, vessels, and operational processes used in fishing” (Silva, 1891, p.XXI). This study focused on fisheries, identified the main species of freshwater and saltwater fish, crustaceans, and molluscs, classified and described ports, described fishing procedures, equipment, and vessels, quantified the number of fishermen and the value of their catches, and broadened knowledge on seaweed harvesting.

At the same time, the large-scale maritime expeditions made possible by scientific and technological advances in the second half of the nineteenth century boosted interest among the scientific community in the development of oceanography from a multidisciplinary perspective (Deacon, 1997; Deacon, Summerhayes, 2003; Jardim et al., 2014). Some examples were the voyages of the HMS Challenger, which circumnavigated the globe from 1872 to 1876 and passed through Lisbon in January 1873, and the expeditions of Prince Albert I of Monaco (1848-1922) between 1885 and 1915 which resulted in the establishment of the Musée Océanographique de Monaco (1910). A pioneer in deep sea research, Albert conducted several campaigns in the Azores, identifying the Princess Alice seamount (1896). Such expeditions also played a vital role in acquiring knowledge about territories across the world and their occupation, especially for states with colonial empires, leading to “a reconception of the ocean as a physical and intellectual space” (Reidy, Rozwadowski, 2014, p.339).

In Portugal, King Carlos I (1863-1908) was responsible for organising several campaigns to foster oceanographic studies between 1896 and 1907, with collaboration from the naturalist Albert Arthur Alexandre Girard (1860-1914), the curator of the royal collections at the Necessidades Palace. Initial explorations off the coast of Cascais, Sintra, Lisbon, Sesimbra, and Setúbal led to studies in the Tagus and Sado estuaries, as well as of the annual migration of tuna off the Algarve coast (Saldanha, 1997, p.20-22). In addition to pursuing purely scientific interests, these campaigns also had a degree of economic and political significance due to the importance of fisheries in Portugal and the need for greater knowledge about the open sea and the deep sea, as the colonial powers jostled for position and the domestic situation was marked by fractures, divisions, and the effects of the British Ultimatum of 1890.² These oceanographic expeditions resulted in the publication of scientific works (Bragança, 1899; 1904), the first microscopic photographs of organisms such as plankton, the creation of museum collections, and exhibitions organised at home and abroad (Deacon, 1997, p.66; Jardim et al., 2014).

On April 20, 1898, the first public aquarium in Portugal was opened, thanks to the efforts of the executive committee of the Fourth Centenary of the Discovery of

the Maritime Passage to India. Named the Vasco da Gama Aquarium in honour of the Portuguese navigator, it was attached to the Ministry of the Navy. In spite of the technical and administrative difficulties that marked its early years, from 1909 (under the auspices of the newly created Portuguese Natural Science Society, PNSS (Sociedade Portuguesa de Ciências Naturais) the aquarium took on an essential role in the process of institutionalising marine biology in Portugal.

Founded in 1907 according to the recommendations of the Anatomy Section of the 15th International Medicine Congress (1906), the main objectives of the PNSS were “to foster the development of the different branches of natural science and publish works in these fields” in Portugal (Status..., 1907). With Professor Fernando Matoso Santos (1849-1921) as president and physician Miguel Bombarda (1851-1910) as vice-president, the PNSS published a journal entitled the *Bulletin de la Société Portugaise des Sciences Naturelles* (1907-1947). From the outset, it offered a platform for the exchange of ideas and the dissemination of research, contributing to the development of the natural sciences in Portugal (La Société..., 1907).

It was the PNSS which recommended the naturalist Antero Frederico de Seabra (1874-1952) for appointment as head of the Vasco da Gama Aquarium, and he served from 1909 to 1914. The aquarium comprised laboratories, a museum displaying the zoological collections resulting from the oceanographic expeditions of King Carlos I, a room for freshwater aquariums, a gallery for saltwater aquariums, and a library, as well as several workrooms and storerooms (O aquário, 30 ago. 1909). It began to popularise and disseminate scientific knowledge as a result of “scientific research studies of marine and river fauna and fish farming” (Costa, 1918, p.4).

This illustrates that the organisation of marine biology in Portugal during the final years of the Constitutional Monarchy depended largely on the private initiative of professors, researchers, and naturalists – both professional and amateur – that brought together private research agendas and national strategic objectives. Despite the existence of specialised technical committees such as the Central Fisheries Committee (Comissão Central de Pescarias) (1878) and the Central Fish Farming Standing Committee (Comissão Central Permanente de Piscicultura) (1892), their functions were more advisory in nature rather than providing incentives for applied research (Amorim, 2005).

In the university context at this stage, the extent of marine biology research was negligible. There was only one university in Portugal, the University of Coimbra (Universidade de Coimbra), and two higher technical schools, the Porto Polytechnic Academy (Academia Politécnica do Porto) and the Lisbon Polytechnic School (Escola Politécnica de Lisboa), where the theoretical method of teaching predominated. A protest movement emerged, calling for practical work for all students, the expansion of scientific workshops, and intellectual reform of the nation under the guidance of higher education institutions. The polytechnics thus began to create departments and laboratories to provide support for academic teaching and encourage experiential practical work, progressively evolving to meet additional needs related to providing students with an introduction to science, original experimental work, and institutionalising science and disciplines (Salgueiro, 2017).

The First Republic: teaching and research in the field of marine biology

After the founding of the First Republic on October 5, 1910, the Provisional Government (1910-1911) led by Teófilo Braga (1843-1924) reformed higher education in the wake of an extensive debate in Portuguese society that had been ongoing since the mid-nineteenth century. Portuguese Republicanism, influenced by positivist and scientific ideas, believed that “the world ... would have a prosperous future and human societies would approach perfection if the dictates of scientific development were pursued” a utopian vision in which science was presented as the great engine for economic, social, and moral progress of states (Bernardo, 2013, p.71-72).

The new universities of the First Republic (Lisbon, Porto, and Coimbra; the first two were newly created, while Coimbra was reformed in 1911) were organised to promote practical and experiential teaching and develop scientific and technological activity, as spaces for learning, research and the dissemination of knowledge of a scientific nature (Portugal, 22 abr. 1911). Old and inadequate study rooms were replaced with increasingly specialised experimental and teaching laboratories in order to address more demanding curricular requirements, with a new elite of science professors providing the driving force behind this new movement. In this way, the Republican reform sought to replace a predominantly didactic teaching model with a more active, experiential, and positive approach (Leitão, 1998, p.120; Luz, 2004, p.249-250).

This was a complex and time-consuming process that entailed developing university laboratory facilities to meet the new educational requirements, namely with regard to suitability for practical work and adaptation to the needs of scientific research. It also required democratisation of the laboratory space and restructuring scientific sociabilities by opening laboratories to all students (men as well as women), hosting outside researchers, integrating doctoral students, and close collaboration between professors, lecturers, and students (Salgueiro, 2017).

University professors played a key role in this process, charged with reorganising the science curricula, organising practical teaching, training technical staff, and supervising scientific activity; they were the “invisible actors” in the process university reform during the First Republic, actively contributing to the institutionalisation of new disciplinary fields within the context of Portuguese science (Catroga, 2011; Salgueiro, 2017).

This process of institutionalisation contributed towards the establishment of the scientific community, stability in a range of academic fields, and the development of emerging scientific disciplines. The fact that it took place within an internationalised context characterised by the exchange and dissemination of knowledge and the improvement of scientific techniques, instruments, methodologies, and practices was of great benefit. In the specific field of marine biology, this provided the conditions necessary to conduct research *in situ* and extended the period during which research could be conducted beyond previous seasonal limits (Stephenson, 2016, p.124).

Marine biology was institutionalised within the universities mainly through the work of professors and naturalists with backgrounds in zoology, botany, histology, and embryology who were associated with a number of different institutions, such as the Bocage Museum of

the Lisbon Faculty of Science, the Museum and Zoology Laboratory (Museu e Laboratório de Zoologia) at the Porto Faculty of Science, the Museum and Botanical Laboratory (Museu e Laboratório Botânico) at the Coimbra Faculty of Science, and the Institute of Histology and Embryology (Instituto de Histologia e Embriologia) in the Lisbon Faculty of Medicine.

Antero de Seabra, curator of the zoology section of the Bocage Museum and head of the Vasco da Gama Aquarium, produced works on ichthyology (*Chilomycterus geometricus* and freshwater fish), cetaceans, and fish farming (Seabra, 1907), while Baltazar Machado da Cunha Osório (1855-1926), assistant naturalist at the museum, was a researcher in the fields of carcinology and ichthyology in Portugal and the colonies (Cunha, 1895).

At the same time, Luís Wittnich Carrisso (1886-1937) conducted the first in-depth study on plankton in Portugal for his doctoral dissertation at the Faculty of Science of the University of Coimbra. This project was innovative for its “integral study of the sea as a biological environment,” and was influenced by the work of Victor Hensen, Ernst Haeckel, and Adolf Steuer (Carrisso, 1911). During fieldwork at Buarcos Cove and the mouth of the Mondego River (1909-1911) in the central region of Portugal, Carrisso collected organisms of the phylum *Dinoflagellata*, diatoms, foraminifera and copepods, focusing on questions associated with temperature, luminosity, salinity, oxygenation, pressure, currents, and the topography of the water in the target areas.

In addition to scientific production, we also examined the role of marine biology in higher education institutions. For example, Baltazar Osório maintained that organising scientific research in the field of zoology involved creating marine biology laboratories attached to faculties of science, thereby enhancing the standing of these faculties in society and with relation to the national economy. An ongoing goal was to achieve a close relationship between teaching, science, and economics, and from the late nineteenth century measures had been implemented to this end by Augusto Pereira Nobre (1865-1946), a naturalist at the Museum of Zoology at the Porto Faculty of Science who was responsible for establishing the first maritime station in 1913 (Nobre, 1896, p.123).

Problems associated with fisheries, fish farming, and the need to conserve species and provide for sustainable exploitation of the oceans later figured in the public discourse of a number of intellectuals and scientists during the early twentieth century (Amorim, 2005). Hermano Neves (19 ago. 1907, p.238) stated that “while research focusing on bodies of water is of great importance to science from the speculative point of view, its significance is even greater from the economic perspective,” mainly in reference to the harvesting of seaweed (algae in the class Phaeophyceae) and its importance as an agricultural fertiliser and animal feed. Luís Carrisso (1911, p.13) emphasised the value of the “scientific study of the sea” in the rational and scientific development of the fishing industry. Meanwhile, Celestino da Costa, head of the Vasco da Gama Aquarium from 1916 to 1924, maintained that biological stations should be created while considering potential industrial applications involving support for fisheries and fish and oyster farming. There was thus a need to conduct multidisciplinary research and provide support for higher and secondary education, with a focus on disseminating scientific culture and organising specialist courses (Costa, 1918, p.23-25).

After the project to establish the Foz Maritime Zoology Station in Porto in 1913-1914, the University of Lisbon followed with a drive to create a similar institution in the capital

on order to encourage original scientific work, conduct practical teaching, disseminate scientific knowledge, and solve problems associated with fisheries, fish farming, and management of water resources. To this end, Professor Baltazar Osório was charged with a scientific mission abroad that visited scientific establishments in Spain, France, Monaco, Italy, and Austria such as the Laboratoire Arago, the Station de Biologie Marine de Sète, the Laboratoire Marion, the Musée Océanographique de Monaco, and the Stazione Zoologica di Napoli (Osório, 1914, p.143, 145-146).

Meanwhile, with the support of the Portuguese Natural Science Society, the senate of the University of Lisbon proposed annexing the Vasco da Gama Aquarium in 1913 and transforming it into a maritime biology station for the university, but the plan was blocked by the Navy Ministry. In 1918 the University of Lisbon made another attempt, despite the constraints imposed by the Great War, presenting a plan to establish a maritime station between the mouths of the River Tagus and the River Sado (Salgueiro, 2017). This project only came to fruition in the late 1920s, however, after intervention by Professor Artur Ricardo Jorge (1886-1975), who was able to lease the Fort of Nossa Senhora da Guia, near Cascais, where a maritime laboratory attached to the Bocage Museum of the Lisbon Faculty of Science was established in 1927 (Almaça, 2000).

In 1919 the Vasco da Gama Aquarium was recognised as a marine biology station, as a result of work previously carried out by Antero de Seabra and Celestino da Costa. It was managed by a board of directors presided over by a naval officer, while members of the board included a head naturalist and an assistant naturalist. Located in the Tagus estuary near the city of Lisbon, it provided excellent facilities for work to disseminate knowledge, permitting place-based scientific research (Lopes, Podgorny, 2014, p.812; Pinto, 2017), the creation of scientific collections, expeditions and study missions, support for economic activities, and public education. Funding was provided by the state, and private revenue came from entrance fees to the aquarium and the museum and rental of the research facilities, following the example of the Stazione Zoologica di Napoli (Portugal, 10 maio 1919).

The decree that created the marine station stipulated that the post of head naturalist was to be occupied by an expert who had conducted “original scientific research work on topics focused on at the station,” and the former head, histologist Celestino da Costa and director of the Lisbon histological research school, was appointed. The duties of assistant naturalist were assigned to his disciple Alfredo de Magalhães Ramalho (1894-1959), a lecturer at the Lisbon Histology and Embryology Institute, where he carried out work on the adrenal organs of fish (Ramalho, 1923). As the Portuguese delegate to the International Council for the Exploration of the Sea (ICES), Ramalho took on the responsibilities of head naturalist in 1924, playing a key role in the institution’s scientific work and its hydrographic expeditions (Rollo, Queiroz, Brandão, 2014; Pinto, 2017, p.5).

The fact that these two scientists served on the board of the Vasco da Gama Aquarium/Celestino da Costa Marine Biological Station (Estação de Biologia Marítima Celestino da Costa) from 1916 to 1924 (and Magalhães Ramalho from 1924 to 1950) provided a boost for scientific work in the field of marine biology, since both were associated with the University of Lisbon. Their connection with the Histology and Embryology Institute at the Faculty of Medicine gave them access to modern scientific stations and young researchers,

diversifying and enriching their approaches to research through multidisciplinary work and the creation of important informal and inter-institutional networks. As for training biological station naturalists, Celestino da Costa (1918, p.19, 1922, p.6) stated that it was essential to strike a balance between “scientific education and technical training,” and that university laboratories played a fundamental role in this matter by training “naturalists in the practice of research.”

Foz Maritime Zoology Station

In a context marked by discourse favouring a close relationship between university science departments and the national economy, the work of the ICES, and with the emergence of conservationist ideals, the first university experimental station, the Foz Maritime Zoology Station, was established in Portugal (Osório, 1914; Hubbard, 2016b). The station was connected to the University of Porto Faculty of Sciences, and intended to link experimental teaching and scientific research; Professor Augusto Nobre was appointed as its head.

As the heir to a new generation of zoologists, aware of the importance of knowledge on rivers and oceans while influenced by the example of the first zoological and maritime stations (Kohler, 2002; Lopes, Podgorny, 2014), Augusto Nobre soon excelled in Portuguese scientific circles for fostering practical and experiential education. He was supported by auxiliary teaching and research institutions such as the Polytechnic Academy Zoology Museum (Museu de Zoologia da Academia Politécnica do Porto), where he was curator from 1892 to 1916, and the Leça da Palmeira Experimental Zoology Laboratory (Laboratório de Zoologia Experimental de Leça da Palmeira) (Eiras, 2006, p.16).

Created in the mid-1890s and funded by Nobre himself, this laboratory played an essential role in the study of marine and fluvial fauna in the northern region of Portugal, extending knowledge on the field of Portuguese fisheries as well as the biophysical and biochemical analysis of the ocean, thanks to its location near the estuary of the Leça River and the port of Leixões (Nobre, 1896, p.123, 126-127). In establishing this laboratory, Augusto Nobre applied the French example of marine biology research to Portugal by creating an institution with three strategic objectives: to foster applied research, train students in the practice of science by combining experiential teaching with fieldwork while conducting place-based research, and improve the utilisation of Portuguese marine resources (Kohler, 2002; Fischer, 2006; De Bont, 2015; Pinto, 2017; Amorim, Pinto, 2019).

Located near the sea to facilitate collection of maritime specimens and ensure a supply of seawater, the Leça da Palmeira Laboratory had four large aquariums, 22 smaller aquariums, a dissection room, a histology and microscopy laboratory, a library, and a photographic camera (Nobre, 1896, 1946).

It also had a small boat for drilling and dredging operations, and benefited from collaborations with fishermen in Leça da Palmeira and Matosinhos as well as the company operating the steamboats *Hercules* and *Galgo*, which provided rare specimens from great depths for naturalists to study. This process was part of what Susana García (2014, p.828) defined as community scientific work, with the establishment of networks to obtain

specimens that involved researchers, professional and amateur naturalists, fishermen, travellers, fishing companies, and traders in an important dynamic process characterised by cross-cultural encounters.

The experience Nobre acquired as head of the Leça da Palmeira Experimental Zoology Laboratory allowed him to organise the marine biology station in Porto, the Foz Maritime Zoology Station (FMZS), taking advantage of the extremely favourable national as well as international climate.

Initially, the influence of positivist and scientific ideas current during the First Portuguese Republic posited scientific development as essential to achieve material and social progress in the country. The new spaces and practices subsequently outlined in the 1911 higher education reform, which favoured implementation of practical and experiential teaching and scientific research at the universities, became more significant in this regard (Catroga, 2011; Salgueiro, 2017). The establishment of the Foz Station is also part of a broader scenario in the Iberian Peninsula as a whole involving an increase in the number of marine biology laboratories, with the creation of the Spanish Institute of Oceanography in 1914.³

The first steps to create the Foz Station were taken in 1913, and construction work began in 1914. This was the first Portuguese marine station to be attached to a higher education institution, the Faculty of Science of the University of Porto, following the French example of the Station de Biologie Marine de Sète (1879) and the Station Marine d'Arcachon (1867) (Machado, 1941).

The main similarities between the Portuguese institution and its French counterparts were their institutional dependence on a university, funding primarily derived from public coffers, their internal organisation model, and the importance attributed to supporting academic education and encouraging original research. The Foz Station was meant to conduct “research and training in the field of marine biology and the fishing industry,” using a combination of “natural and constructed spaces,” while sharing responsibilities in the educational, scientific and museological spheres with other bodies and disseminating scientific knowledge (Kofoid, 1910; Nobre, 1946; Heizer, Lopes, García, 2014; Lopes, Podgorny, 2014).

Like the Station Marine d'Arcachon, the FMZS was located on the Atlantic coast. It was attached to the Zoology Museum and Laboratory of the Porto Faculty of Science and received support from its scientific and technical staff, similar to the Station de Biologie Marine de Sète.⁴ Located on Avenida de Montevideu in Foz do Douro, the Porto facility was constructed in two stages: a section was initially set up for teaching and research, closely linked to the science curricula of the Faculty of Science, and then aquariums were established to exhibit fluvial and marine specimens, in keeping with the Victorian notion of aquariums as repositories for animal and plant collections (Brunner, 2005; Salgado, Marandino, 2014, p.868). These aquariums played an important role in the institution's strategy to popularise science, especially targeting primary and secondary school students and “people interested in learning,” “taking advantage of teaching that derives from the observation of the living natural world” (Aquário..., 28 jul. 1927; Mateus, 1962, p.5).

Although facilities at the Foz Maritime Zoology Station were somewhat limited, mainly since it had no dock, it was located near the city of Porto, which made it easy for university

students, naturalists, and researchers to travel to the station. There they were able to use facilities that were wide ranging and well equipped in material as well as human terms; there were a number of specialised laboratories for oceanography, histology, bacteriology, and general biology, several classrooms, a library, and workrooms, as well as terrariums and aquariums for freshwater and saltwater fish, a ship, and a small boat (Ferreira, 1938, p.9; Guimarães, 1940, p.563; Machado, 1941, p.16-21).

In 1915, the state budget provided for in Law n.410 established the provisions for staffing, creating the posts of collector, technical assistant, and guard, which were occupied by Luís Pinto Pimenta, José Francisco Lourosa Júnior, and José Martins Glória, respectively, and annual funding of 1,000 escudos (Portugal, 9 set. 1915). Assistants and students at the Faculty of Sciences carried out scientific work on a voluntary basis, while there was no formal institutionalised structure (Stephenson, 2016).

In 1920, together with the Zoology Museum, the practical laboratory, and the economic entomology laboratory, the Foz Maritime Zoology Station was attached to the Porto Zoology Science Research Institute (Instituto de Investigação Científica em Zoologia do Porto). This body was created by the Decree of November 24 as an “active systematic research centre” (Guimarães, 1940, p.565) under the guidance and direction of Augusto Nobre. The transformation of the Porto Zoology Museum and Laboratory into a scientific research institute was largely the result of the scientific work conducted by its professors, lecturers, naturalists, and researchers throughout the 1910s, as well as the political and scientific influence of Augusto Nobre.

The creation of regulations governing the status of university scientific research institutes (1918) led to a widening in the scope of responsibility for higher education institutions in the field, increasing the level of commitment to science and research. Assignment of special status (dependent on ministerial authorisation) mainly was a mechanism to recognise the science strategies and goals of individual institutions and the development of educational establishments and research centres in Portugal (Geison, 1981, 1993; Servos, 1993; Sagueiro, 2017).

The facilities offered by the Foz Station as an offshoot of the Zoology Institute were extremely advantageous for research in the fields of systematics, histology, embryology, ichthyology, and oceanography. In the latter case, researchers had equipment for “dredging and drilling operations and the study of the seabed ... [and] the sea,” and benefited from informal networks established with fishermen and fishing companies catching shrimp, sardines, and hake (Machado, 1941, p.18-21). The station was frequented by Portuguese students and researchers as well as collaborators at the Porto Zoology Institute such as Augusto Ferreira Nobre Júnior (1896-1930), the son of the director, José Maria Braga, and João Alves dos Reis Júnior (1864-?). It was also visited by a number of professors and researchers from abroad; for example, a 1935 news article described a visit by a group of students from the University College of Wales, accompanied by professors Robert Douglas Laurie (1874-1953), E. Emrys Watkin, and Florence Gwendolen Rees (1906-1994) (Na Estação..., jun. 1935).

It should be noted that university research institutes and their offshoots such as the FMZS enjoyed significant internationalisation. Engaged in inter-institutional cooperation and

multidisciplinary dialogue, they were able to develop formal and informal relationships with various institutions both at home and abroad, with study visits and scientific excursions, participation in major international events, and exchanges of books and periodicals.

After Augusto Nobre's retirement in 1935, the institute and station were renamed the Dr. Augusto Nobre Zoology Institute (Instituto de Zoologia Dr. Augusto Nobre) and the Dr. Augusto Nobre Zoological Station (Estação de Zoologia Marítima Dr. Augusto Nobre), respectively, and the first director was Professor António Luís Machado Guimarães (1883-1969) (Portugal, 28 jun. 1935). His subsequent removal, however, damaged the profile of the institute, which lost its special status as a scientific research body, and there were gradually fewer works published on maritime and river fauna, many of which had previously been produced by Augusto Nobre.

Most of Nobre's work in the field of marine biology involved systematics (namely, the description and inventory of marine specimens in accordance with Linnaean taxonomy, comparative anatomy, zoological geography, zoology, and applied embryology). He was also interested in problems associated with bathymetry, hypsometry, planktonology, and oyster farming (Machado, 1937, p.28; Nobre, 1946, p.77). Nobre (1946, p.75) was acutely aware of Portugal's strategic importance "situated between the two great hubs ... the Mediterranean and the Atlantic," which meant that research on marine fauna and flora and the ocean itself was essential.

Between 1914 (the year that the FMZS was constructed) and his death in 1946, Nobre published nineteen works in the field of marine biology. According to Carlos Almaça (1966, 1997, p.128), these publications addressed topics such as molluscs (18% of the total), crustaceans (14%), echinoderms (11%), coelenterates (11%), bryozoans (8%), fish and cyclostomes (3%), cetaceans and pinnipeds (6%), annelids (4%), brachiopods (4%), biogeography and ecology (3%), foraminifera (3%), sponges (3%), tunicates (3%), chelonians (3%), and sipunculids (1%).

Final considerations

Analysis of the process of institutionalisation for marine biology in Portugal as part of the universities during the First Republic in the early twentieth century establishes several points. First, the process was evolutionary in nature, involving breaks and continuities, and spanned several political and economic sets of circumstances. Secondly, the benefit came from activities by a network of naturalists, many of whom portrayed themselves as experts in and thinkers on science as well as its guardians. Finally, there was a close relationship between private research agendas, the programmes of scientific institutions, and the strategic objectives of the navy and education ministries.

The state played an important role in this process, both directly (by funding institutions such as the Vasco da Gama Aquarium) and indirectly (by supporting the universities and their scientific study and research programmes). Following the resolutions of the ICES, which Portugal joined in 1920, on "fisheries management and the assessment of maritime resources" (Rollo, Queiroz, Brandão, 2014), and conservationist ideas involving augmented human use of natural resources (Hubbard, 2016b, p.89), Republican politicians sought to

extend knowledge of the oceans and develop the country's economic potential in terms of fisheries and the canning industry. For this reason, there was an important political and dimension to humankind's relationship with the sea, which was far removed from the "ideologia maritimista" [maritime ideology] that characterised the Estado Novo [New State] regime from the mid-1930s (Garrido, 2016).

The process was also characterised by enormous personal contributions by professors and naturalists, professionals as well as amateurs, who led scientific expeditions, hydrographic and oceanographic missions, and trips in the field. Within the specific context of the First Republic, following the 1911 university reform and the intervention of the Portuguese Natural Science Society, the process of scientific institutionalisation and specialist disciplinary study and research was launched, involving the creation of two distinct types of biological stations: those attached to the universities, and those under state tutelage.

The Foz Maritime Zoology Station, attached to the Zoology Institute of the Porto Faculty of Science, enjoyed a close relationship with practical teaching and scientific research facilities, while the Vasco da Gama Aquarium, fostered studies and applied research and encouraged applications of scientific knowledge in the economic sphere. Both approaches involved recognising the essential role of publishing and disseminating scientific knowledge, in which the aquariums and museums played an important part. The institutions also benefited from proximity to political power stemming from the influence of their directors, who were responsible for a range of initiatives leading to the modernisation of scientific research and study in Portugal.

As for the Foz Maritime Zoology Station, the influence of the French model is evident in both the scientific training of Augusto Nobre (who studied in France under the zoologist Edmond Perrier (1844-1921) and Professor Armand Sabatier (1834-1910), head of the Station de Biologie Marine de Sète, and the process through which the station was created. As a space that focused on place-based research, it provided exceptionally favourable conditions in terms of material and human resources for researchers and students at the Porto Faculty of Science. But despite being part of an international network of scientific institutions (for example, there were relations with the Naples station), it occupied a relatively isolated position in the domestic context. The university academic committees were unable to fulfil their goal of creating maritime stations in Lisbon and Coimbra during the First Republic, which seriously delayed the establishment of progressive centres for marine biology research in Portugal.

ACKNOWLEDGEMENTS

This paper was produced as part of work by the IHC-CEHFCi-UE Science Group and funded by the Portuguese Research Council (FCT, project UID/HIS/04209/2013), for which the author would like to express her gratitude. Thanks also to Professor Maria de Fátima Nunes, Ana Azevedo, and Pedro Cerdeira for their extremely valuable input and feedback.

NOTES

¹ In this and other citations of texts from non-English languages, a free translation has been provided.

² "National pride perhaps provided a strong argument for taking quick action. ... his ambition was for Portuguese waters to be studied by Portuguese scientists aboard Portuguese oceanographic vessels" (Saldanha, 1997, p.20).

³ Founded by Odón de Buen y del Cos (1863-1945) and established to foster “international Mediterranean research,” the institute oversaw a number of prestigious bodies, such as the Santander Maritime Station for Experimental Zoology and Botany (1886) (Pérez de Rubín, 2014, p.30).

⁴ The Station Marine d’Arcachon, created by the Société Scientifique d’Arcachon, was part of the Department of Physiology of the Bordeaux School of Medicine. The head of the station, Felix Jolyet (1841-1922), was an expert in marine biology research focusing on the Bay of Biscay. Facilities included an aquarium (built for the Exposition Internationale de Pêche et d’Aquiculture of 1866), a museum, a library, and several laboratories (Roché, 1892; Kofoed, 1910). Established on the Mediterranean coast, near Étang de Thau lagoon, the Station de Biologie Marine de Sète was attached to the Zoology Laboratory of the University of Montpellier and headed by Octave Joseph Duboscq (1868-1943). This international station attracted significant attention from professors and researchers from France and abroad. Facilities included an aquarium which was open to the public and played an important role in the dissemination of scientific knowledge (Kofoed, 1910, p.60-67).

REFERENCES

- ALMAÇA, Carlos. *Museu Bocage: ensino e exibição*. Lisboa: Museu Bocage, 2000.
- ALMAÇA, Carlos. Augusto Nobre and marine biology in Portugal. In: Saldanha, Luís; Ré, Pedro (ed.). *One hundred years of Portuguese Oceanography: in the footsteps of King Carlos de Bragança*. Lisboa: Museu Bocage, 1997. p.125-134.
- ALMAÇA, Carlos. *Publicações do Prof. Dr. Augusto Nobre sobre Oceanografia Biológica*. Porto: Imprensa Portuguesa, 1966.
- AMORIM, Inês. A pesca pacificada ou os primórdios da questão das pescarias no quadro de uma reflexão sobre os recursos naturais. *GeoInova*, n.11, p.103-124, 2005.
- AMORIM, Inês; PINTO, Bruno. Portugal in the European network of marine science heritage and outreach (19th-20th centuries). *Humanities*, v.8, n.1, 2019. Available at: <https://www.mdpi.com/2076-0787/8/1/14>. Access on: 10 jan. 2019.
- AQUÁRIO da Foz. *O Comércio do Porto*, 28 jul. 1927.
- BERNARDO, Luís. *Cultura científica em Portugal: uma perspectiva histórica*. Porto: Uporto, 2013.
- BOCAGE, Barbosa du. *Considerações acerca do melhor aproveitamento das ostras da margem esquerda do Tejo e da cultura das nossas ostras*. Lisboa: Tipografia da Academia, 1868.
- BOCAGE, Barbosa du. Note sur la découverte d’un Zoophyte de la famille Hyalochaetides sur la côte du Portugal. *Proceedings of the Zoological Society of London*, [v.1864], p.265-269, 1864.
- BOWEN, James. *The coral reef era: from discovery to decline: a history of scientific investigation from 1600 to the Anthropocene Epoch*. [S.l.]: Springer, 2015.
- BRAGANÇA, Carlos de. *Ichthyologia II: esqualos obtidos nas costas de Portugal durante as campanhas de 1896 a 1903*. Lisboa: Imprensa Nacional, 1904.
- BRAGANÇA, Carlos de. *Pescas marítimas I: a pesca do atum no Algarve em 1898*. Lisboa: Imprensa Nacional, 1899.
- BRITO, Cristina. Beauties and beasts: whales in Portugal, from early-modern monsters to today’s flagship species. *Environment and Society Portal (Arcadia)*, n.21, out. 2018. Available at: <http://www.environmentandsociety.org/arcadia/beauties-and-beasts-whales-portugal-early-modern-monsters-todays-flagship-species>. Access on: 5 jan. 2019.
- BRUNNER, Bernd. *The ocean at home: an illustrated history of the aquarium*. New York: Princeton Architectural Press, 2005.
- CAPELO, Félix de Brito. Algumas considerações acerca da indústria piscícola em Portugal. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*, t.5, n.17-20, p.159-164, 1876.
- CARRISSO, Luís. Materiais para o estudo do plâncton da costa portuguesa I. *Boletim da Sociedade Broteriana*, v.26, p.5-42, 1911.
- CATROGA, Fernando. *Ensaio republicano*. Lisboa: Fundação Francisco Manuel dos Santos, 2011.
- COSTA, Augusto Pires Celestino. *O Aquário Vasco da Gama: estação de biologia marítima*. Lisboa: Oficinas Gráficas da Biblioteca Nacional, 1922.
- COSTA, Augusto Pires Celestino. *O Aquário Vasco da Gama: estação de biologia marítima*. Lisboa: Imprensa da Livraria Ferin, 1918.
- CUNHA, Baltazar. Les poissons d’eau douce des îles du Golfe de Guinée. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*, t.4, n.13, p.59-64, 1895.

DE BONT, Raf. *Stations in the field: a history of place-based animal research, 1870-1930*. Chicago: The University of Chicago Press, 2015.

DE BONT, Raf. Between the laboratory and the deep blue sea: space issues in the marine stations of Naples and Wimereux. *Social Studies of Science*, v.39, n.2, p.199-227, 2009.

DEACON, Margaret. British marine scientists in Portuguese seas, 1868-1870. In: Saldanha, Luís; Ré, Pedro (ed.). *One hundred years of Portuguese oceanography: in the footsteps of King Carlos de Bragança*. Lisboa: Museu Bocage, 1997. p.65-110.

DEACON, Margaret; SUMMERHAYES, Colin. Introduction. In: Deacon, Margaret; Rice, Tony; Summerhayes, Colin (ed.). *Understanding the oceans: a century of ocean exploration*. London: Routledge, 2003. p.1-24.

EIRAS, Jorge. *Augusto Nobre 1865/1946: para a história da zoologia em Portugal*. Porto: Uporto, 2006.

FERREIRA, José Bettencourt. *La Station Maritime de Foz (Douro) et le litoral portugais au point de vue des études biologiques*. Porto: Imprensa Portuguesa, 1938.

FISCHER, Jean-Louis. Créations et fonctions des stations maritimes françaises. *La Revue pour l'Histoire du CNRS*, n.7, 2006. Available at: <http://journals.openedition.org/histoire-cnrs/537>. Access on: 15 mar. 2018.

GARCÍA, Susana. La pesca comercial y el estudio de la fauna marina en la Argentina, 1890-1930. *História, Ciências, Saúde – Manguinhos*, v.21, n.3, p.827-845, 2014.

GARRIDO, Álvaro. Estado Novo e maritimismo: ideologia e discursos culturais. *Biblos, Revista da Faculdade de Letras da Universidade de Coimbra*, n.2, série 3., p.141-167, 2016.

GEISON, Gerald. Research schools and new directions in the historiography of science. *Osiris*, v.8, p.226-238, 1993.

GEISON, Gerald. Scientific change, emerging specialties, and research schools. *History of Science*, v.19, n.1, p.20-40, 1981.

GROEBEN, Christiane. Tourists in science: 19th century research trips to the Mediterranean. *Proceedings of the California Academy of Sciences*, v.59, n.9, p.139-154, 2008.

GROEBEN, Christiane. The Stazione Zoologica Anton Dohrn as a place for the circulation of scientific ideas: vision and management. In: Anderson, Kristen; Thiery, Cécile (ed.). *Information for responsible fisheries: libraries as mediators: International Association of Aquatic and*

Marine Science Libraries and Information Centers. Fort Pierce: IAMSILIC, 2006. p.291-299.

GUIMARÃES, António. O Instituto de Zoologia e a Estação de Zoologia Marítima Dr. Augusto Nobre. In: Comissão Executiva dos Centenários. *Congresso do Mundo Português*, v.12, t.1. Lisboa: Comissão Executiva dos Centenários, 1940. p.561-569.

HEIZER, Alda; LOPES, Maria Margaret; GARCÍA, Susana. Carta das editoras convidadas. *História, Ciências, Saúde – Manguinhos*, v.21, n.3, p.803-804, 2014.

HUBBARD, Jennifer. Introduction. In: Hubbard, Jennifer; Wildish, David; Stephenson, Robert. *A century of maritime science: the St. Andrews Biological Station*. Toronto: University of Toronto Press, 2016a. p.3-29.

HUBBARD, Jennifer. The gospel of efficiency and the origins of Maximum Sustained Yield (MSY): scientific and social influences on Johan Hjort's and A.G. Hunstman's contributions to fisheries science. In: Hubbard, Jennifer; Wildish, David; Stephenson, Robert. *A century of maritime science: the St. Andrews Biological Station*. Toronto: University of Toronto Press, 2016b. p.78-117.

HUBBARD, Jennifer. *Science on the scales: the rise of Canadian Atlantic fisheries biology, 1898-1939*. Toronto: University of Toronto Press, 2006.

JARDIM, Maria Estela et al. A prática oceanográfica e a coleção iconográfica do rei dom Carlos I. *História, Ciências, Saúde – Manguinhos*, v.21, n.3, p.883-909, 2014.

KOFOID, Charles Atwood. *The biological stations of Europe*. Washington: Government Printing Office, 1910.

KOHLER, Robert. *Landscapes and labscales: exploring the lab-field border in biology*. Chicago: The University of Chicago Press, 2002.

LA SOCIÉTÉ Portugaise des Sciences Naturelles. *Bulletin de la Société Portugaise des Sciences Naturelles*, v.1, n.1, p.1-3, 1907.

LAMBERT, David; MARTINS, Luciana; OGBORN, Miles. Currents, visions and voyages: historical geographies of the sea. *Journal of Historical Geography*, v.32, n.3, p.479-493, 2006.

LEITÃO, Vanda. *A química inorgânica e analítica na Escola Politécnica de Lisboa e Academia Politécnica do Porto, 1837-1890*. Dissertação (Mestrado em História e Filosofia da Ciência) – Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa, 1998.

LOPES, Maria Margaret; PODGORNÝ, Irina. Entre mares e continentes: aspectos da trajetória

científica de Hermann von Ihering. *História, Ciências, Saúde – Manguinhos*, v.21, n.3, p.809-826, 2014.

LOPES, Quintino. *A europeização de Portugal entre guerras: a Junta de Educação Nacional e a investigação científica*. Casal de Cambra: Caleidoscópio, 2017.

LUZ, José Brandão da. A propagação do positivismo em Portugal. In: Calafate, Pedro (dir.). *História do pensamento filosófico português*. v.4. Lisboa: Editorial Caminho, 2004. p.239-261.

MACHADO, António. *O Instituto de Zoologia e a Estação de Zoologia Marítima Dr. Augusto Nobre*. Porto: Imprensa Portuguesa, 1941.

MACHADO, António. *A zoologia na Academia Politécnica do Porto*. Porto: Enciclopédia Portuguesa, 1937.

MACK, John. *Uma história cultural do mar*. [S.l.]: Book Builders, 2018.

MADRUGA, Catarina. *José Vicente Barbosa du Bocage, 1823-1907: a construção de uma persona científica*. Dissertação (Mestrado em História e Filosofia das Ciências) – Universidade de Lisboa, Lisboa, 2013.

MATEUS, Amílcar. *A Estação de Zoologia Marítima Dr. Augusto Nobre*. Coimbra: Coimbra Editora, 1962.

MOORE, Geoff. Faunal collecting, inventorying and systematizing in the marine environment: an historical, mostly British, perspective. In: MacGregor, Arthur (ed.). *Naturalists in the field: collecting, recording and preserving the natural world from the fifteenth to the twenty-first century*. Leiden: Brill, 2018. p.607-628.

NA ESTAÇÃO de Zoologia Marítima da Faculdade de Ciências da Universidade do Porto vem fazer um demorado estágio de estudo um grupo de professores e alunos duma universidade inglesa. *O Primeiro de Janeiro*, jun. 1935.

NEVES, Hermano. O estudo do mar. *Ilustração Portuguesa*, n.78, p.238-243, 19 ago. 1907.

NOBRE, Augusto. *Leça da Palmeira: recordações e estudos de há sessenta anos*. Porto: Gráfica Augusto Costa, 1946.

NOBRE, Augusto. O laboratório marítimo de Leça da Palmeira. *Annaes de Sciencias Naturaes*, v.3, p.123-127, 1896.

O AQUÁRIO. *Ilustração Portuguesa*, n.184, p.281-288. 30 ago. 1909.

OSÓRIO, Baltazar. Relatório duma viagem às estações de zoologia marítima do sul da Europa, a alguns museus, e a outras instituições de

ciências naturais. *Anuário da Universidade de Lisboa*, ano lectivo 1913-1914, p.141-206, 1914.

PÉREZ DE RUBÍN, Juan. *100 años investigando el mar: el Instituto Español de Oceanografía en su centenario, 1914-2014*. Madrid: Instituto Español de Oceanografía, 2014.

PINTO, Bruno. Historical connections between early marine science research and dissemination: the case-study of aquarium Vasco da Gama (Portugal) from the late 19th century to mid-20th century. *ICES: Journal of Marine Science*, v.74, n.6, p.1522-1530, 2017.

PORTUGAL. Ministério da Instrução Pública. Direcção Geral do Ensino Superior e das Belas Artes. Decreto n.25.556, de 28 de junho de 1935. Determina que o Laboratório e Museu de Zoologia e a Estação de Zoologia Marítima da Faculdade de Ciências da Universidade do Porto passem a denominar-se Instituto de Zoologia Dr. Augusto Nobre e Estação de Zoologia Marítima Dr. Augusto Nobre. *Diário do Governo*, série 1, n.147, p.925, 28 jun. 1935.

PORTUGAL. Ministério da Instrução Pública. Lei n.410, de 9 de setembro de 1915. Aprova o orçamento do Ministério da Instrução Pública. *Diário do Governo*, série 1, n.181, p.950-953, 9 set. 1915.

PORTUGAL. Ministério da Marinha. Decreto n.5.615, de 10 de maio de 1919. Transforma o Aquário Vasco da Gama em Estação de Biologia Marítima e regula os serviços. *Diário do Govêrno*, série 1, supl.5, n.98, p.954-961, 10 maio 1919.

PORTUGAL. Ministério do Interior. Direcção Geral da Instrucção Secundária, Superior e Especial. Decreto com força de lei de 19 de abril de 1911. Estabelece as bases de uma nova constituição universitária. *Diário do Governo*, série 1, n.93, p.1638-1640, 22 abr. 1911.

RAMALHO, Alfredo de Magalhães. Sur la morphologie de l'organe interrénal antérieur des téléostéens. *Comptes Rendus de l'Association des Anatomistes*. 18e réunion. Paris: Editions Médicales, 1923. p.435-438.

REIDY, Michael; ROZWADOWSKI, Helen. The spaces in between: science, ocean, Empire. *Isis*, v.105, n.2, p.338-351, 2014.

ROCHÉ, Georges. La Station Zoologique d'Arcachon. *La Nature*, n.1005, p.209-211, 1892.

ROLLO, Maria Fernanda; QUEIROZ, Maria Inês; BRANDÃO, Tiago. O mar como ciência: instituições e estratégias da investigação sobre o mar em Portugal no século XX (da Primeira República à democracia). *História, Ciências, Saúde – Manguinhos*, v.21, n.3, p.847-865, 2014.

SALDANHA, Luís. King Carlos de Bragança: the father of Portuguese Oceanography. In: Saldanha, Luís; Ré, Pedro (ed.). *One hundred years of Portuguese oceanography: in the footsteps of King Carlos de Bragança*. Lisboa: Museu Bocage, 1997. p.19-38.

SALGADO, Maurício de Mattos; MARANDINO, Martha. O mar no museu: um olhar sobre a educação nos aquários. *História, Ciências, Saúde – Manguinhos*, v.21, n.3, p.867-882, 2014.

SALGUEIRO, Ângela. *Ciência e universidade na Primeira República*. Casal de Cambra: Caleidoscópio, 2017.

SEABRA, Antero. Note sur les cétacés du Portugal: a propos d'une nouvelle espèce pour la faune portugaise. *Bulletin de la Société Portugaise des Sciences Naturelles*, v.1, n.1, p.10-11, 1907.

SERVOS, John. Research schools and their histories. *Osiris*, v.8, p.2-15, 1993.

SILVA, Artur Baldaque da. *Estado actual das pescas em Portugal*. Lisboa: Imprensa Nacional, 1891.

STATUS de la Société. *Bulletin de la Société Portugaise des Sciences Naturelles*, v.1, n.1, p.V-IX, 1907.

STEPHENSON, Robert. St. Andrews Biological Station: a case study in the history of public science in Canada. In: Hubbard, Jennifer; Wildish, David; Stephenson, Robert. *A century of maritime science: the St. Andrews Biological Station*. Toronto: University of Toronto Press, p.118-155, 2016.

WORMS, World Register of Marine Species. *WORMS editorial board*. Available at: <http://www.marinespecies.org>. Access on; 28 mar. 2018.

