

# EVALUATION PERIOD 2013-2017: SELF-STUDY REPORT

**Institute of Marine Biological Resources and Inland Waters**

## Hellenic Centre for Marine Research



## February 2019

Cover page figure: Thematic word cloud based on IMBRIW's paper titles for the period 2013-2017.

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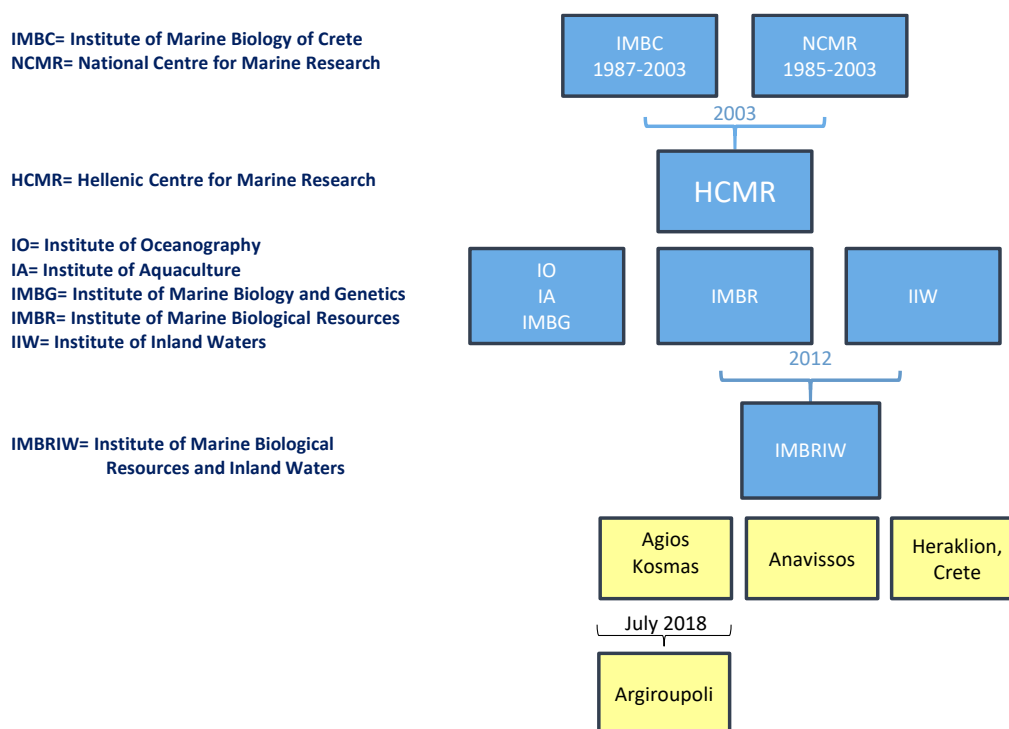
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## A. Description of the present situation

### 1 Introduction & background

#### 1.1 Brief history of the Institute, Location and Milestones

The Hellenic Centre for Marine Research (HCMR) resulted from the merging of the Institute of Marine Biology of Crete (IMBC) and the National Centre for Marine Research (NCMR) in 2003 (Fig. 1). The new Centre included five Institutes. Two of them, the Institute of Marine Biological Resources (IMBR) and the Institute of Inland Waters (IIW) were merged in 2012 forming the Institute of Marine Biological Resources and Inland Waters (IMBRIW), now constituting the two sectors of the Institute. Professor Stergiou officially assumed his duties as Director of IMBRIW on November 11<sup>th</sup> 2013. IMBRIW operated at three locations (Agios Kosmas, Anavissos and Heraklion) up to July 2018, when its section originally housed in Agios Kosmas, moved to new facilities at Argiroupoli.



**Figure 1.** The history of IMBRIW. Yellow indicates regional units.

#### 1.2 Scientific Identity of the Institute and its Distinctive Character

IMBRIW is the leading institution in Greece, with a key role in the Mediterranean region, and an important presence in Europe on aspects related to fisheries, marine ecology and inland water research. IMBRIW's geographical scope of activities extends to most European countries, the Middle East and northern Africa.

IMBRIW (a) carries out multidisciplinary and integrated field, laboratory and experimental, basic and applied research; (b) implements monitoring and scientific assessments and

predictions of the status of fish and shellfish stocks in Greek waters; (c) conducts ecological quality assessments and monitoring of inland waters; (d) provides advice for the sustainable exploitation of fisheries resources in Greek and Mediterranean waters and for the sustainable management of freshwater resources; (e) undertakes specific pilot studies, developing new tools and designing management and conservation plans on specific issues for national, Mediterranean and EU institutional bodies and (f) disseminates information and knowledge on major achievements through publications and a variety of organized events. To this end, IMBRIW closely co-operates with the other two Institutes of HCMR.

More specifically, IMBRIW's research scope includes:

- Biology, ecology and life-history of aquatic organisms and fisheries resources (i.e. demersal organisms, small and medium pelagics, large pelagics, mesopelagics, marine cetaceans and reptiles, freshwater organisms: age, growth, reproduction, population dynamics, mortality, feeding, spatiotemporal distribution, abundance, behaviour, migrations, acoustics, tagging)
- Early life history (taxonomic identification, age, growth, feeding, mortality, dispersal, abundance-daily egg production, diversity)
- Biodiversity conservation and environmental restoration (taxonomy, distribution, abundance, biology and ecology of freshwater organisms, genetic structure of fish, conservation of endemic freshwater fish, habitat restoration, marine and freshwater alien species and their interaction with native ones)
- Ecological status assessments and monitoring of surface waters (according to the provisions of the Water Framework Directive (WFD)), development of river typology schemes, establishment of reference conditions, selection of metrics for assessing ecological degradation, definition of the metric scale to assess deviation from reference conditions
- Integrated river basin management (integrated water resources management at the catchment scale employing ecological quality assessments, numerical modelling to simulate processes driving hydrology and water quality and to produce management scenarios, study of 'hot moments', i.e. droughts and floods, and their effects on aquatic communities, predictability of water cycle, through studying air-sea-land interactions and coastal water processes and optimal integration of numerical and/or physically based models with observational data)
- Fisheries ecology and Ecosystem Approach to Fisheries Management (fisheries-aquaculture-environment interactions, adult/juvenile spatio-temporal bathymetric distribution, geographic distribution, conservation of non-fisheries resources, integrated coastal zone management (ICZM) including design and management of artificial reefs and marine protected areas, ecological modelling and simulations of fisheries exploitation scenarios in an ecosystem context, monitoring through the Marine Strategy Framework Directive (MSFD))
- Fisheries dynamics and capture (monitoring through the EU Data Collection Framework (DCF), fleet dynamics, landings, stock assessments, new fisheries resources, small-scale and trawl gear selectivity, fishing technology, discards, Vessel Monitoring System (VMS) and Automatic Identification System (AIS) monitoring, socio-economics, development of management plans)

- Modelling and assessment (various age-based and global production models, time series models, habitat suitability models, Individual Based Models (IBM), Ecopath-with-Ecosim, numerical weather prediction models (WRF, Eta), hydro-meteorological models (WRF-HYDRO, MIKE), statistical evaluation of weather forecasts), Database and Geographic Information System (GIS) applications.

One of the greatest assets of IMBRIW is the multidisciplinary in research conducted that covers both earth and biological sciences. Its holistic ecological background and perspective covers a broad scope with respect to the scientific areas handled, i.e., conservation and management of fisheries resources, inland waters, coastal zone and marine ecosystems, which require a diverse expertise. This multidisciplinary framework is also evident from the involvement of scientists from various fields in joint projects, their joint publications, etc.

### 1.3 Mission and Purposes of the Institute

The mission of IMBRIW is to (a) support the conservation and management of aquatic biological resources, habitats and ecosystems in order that the latter will continue providing their services for future generations, (b) provide advice and services to national, Mediterranean, EU and other International bodies on environmental conservation and management and (c) raise public awareness on issues related to the conservation of aquatic biological resources, habitats and ecosystems.

The main goals of IMBRIW are the production of knowledge related to structural and functional aspects of inland aquatic ecosystems, and the high trophic level components (including fisheries) of marine ecosystems, and the application of this knowledge for integrated river basin and coastal zone management, ecosystem-based fisheries management and biodiversity conservation. A key element is the development and application of state-of-the-art tools for ecological monitoring, weather forecasting, hydrometeorological, water quality and ecological modelling.

### 1.4 Significance of the Institute's Role in the Society

The interaction between IMBRIW and society has been important long before EU enforced the dissemination actions in funded projects. For IMBRIW, the stakeholders are our “partners in research” playing a dual role as (a) data, opinion hands-on and experience providers and (b) main recipients of our research output.

The societal groups targeted are diverse covering Greece, Mediterranean states and third countries. National stakeholder groups support IMBRIW's activities for projects aiming at the fulfilment of EU policies and regulations, national management plans, biological and environmental research on resources and ecosystem, and technology. At the Mediterranean level, stakeholder cooperation results in the harmonization of practices and research among countries and the exchange of know-how and experience between groups, while IMBRIW acts



as liaison.

The benefits from IMBRIW close cooperation with society are numerous, e.g.:

- Incorporating societal needs as factors in IMBRIW's research
- Achieving a holistic approach to research (i.e. societal opinions, experience, agendas)
- IMBRIW scientific knowledge supporting main societal needs for welfare, working safety, job and income security, gender equality in primary production and better education and awareness

In terms of products, IMBRIW specializes in several types of dissemination material, all depending on target groups and their capacity to use and exploit. These include (for freshwater and marine uses):

- Internet products, e.g. websites and data portals
- Instruments and materials, e.g. environmental telemetry systems, communication networks and Internet of Things (IoT), a device for the measurement of freshness in fish, new net materials for fisheries and aquaculture tests
- Techniques and methods, e.g. fishing techniques, freshwater environmental quality indicators and tools, gis routines and analytical methods, integrated coastal zone management indicators
- Publications, e.g. project reports, papers in scientific journals and conferences, sectoral magazines and newspapers
- Social actions, e.g. conferences, training workshops, meetings
- Training services by IMBRIW researchers at events and institutions (K12, universities, training schools etc.)

IMBRIW intercommunicates services and data to the following agencies (non-exhaustive list):

- General Secretariat of Research and Technology, Greece
- National Ministerial authorities (Agricultural Development and Food; Environment, Energy and Climate Change; Tourism)
- Court and Port authorities
- European Commission (HORIZON 2020) and its organizations and financial instruments (INTERREG instrument, MED programme)
- International Management Bodies and Committees (EFARO, EC STECF, CIAC, GFCM, FAO-EASTMED, ICCAT, NAFO, ICES, UNEP MAP RAC/SPA, EEA, JRC, ESFRI, etc.)
- ERANETs, e.g. MARIFISH, COFASP
- Municipalities, prefectures and regional authorities
- Private companies
- Management Agencies of Protected Areas and national parks
- Non-Governmental Organisations (NGOs)
- Fishers' and farmers' associations
- Primary, secondary and tertiary education institutions (schools, universities)
- Consumers and citizens

## 2 Structure

### 2.1 Management structure

#### 2.1.1 Director

Professor Konstantinos I. Stergiou has attended special training courses in Portugal (NATO ASI on Operational Fisheries) and USA (Summer school on Ecological Time Series, Cornell University). During 1985-1994, he held a position as a research associate at the National Centre for Marine Research (NCMR, now HCMR, Greece), whereas during 1995-2001 he served as an Assistant Professor, since 2001 as an Associate Professor and since 2006 as a Professor at the School of Biology, Aristotle University of Thessaloniki. He teaches both undergraduate and graduate courses on Ichthyology, Fisheries Biology, Fisheries Resources and Management and Time-Series Analysis. He was elected as director of IMBRIW in November 2013. He supervise(d)s 18 MSc and 7 PhD theses and co-supervise(d)s 13 PhD theses. He was the Director of the Laboratory of Ichthyology, School of Biology, during 2007-2013. He has research interests on fish life-history and population dynamics, fisheries ecology, modelling and forecasting, management and conservation, bibliometrics and scientific performance, and environmental ethics. Overall, he has participated in 28 national and international projects and has co-ordinated 9 European Union (EU) projects. He was a member of the EU STCFM committee (1997-2002) and the Coordinator of the Fishery Science Task of CIESM (International Commission for the Scientific Exploration of the Mediterranean Sea). During 2001-2004, he was the Head of the CIESM Subcommittee on Living Resources and during 2004-2007 the co-Chair of the CIESM Committee on Living Resources and Marine Ecosystems. He acted as the National Coordinator of FishBase for Greece (since 1998) and since 2004 is the representative of the Aristotle University (School of Biology) in the FishBase Consortium. He has participated in the Steering Committee of 8 national or international Symposia/Congresses and organized-coordinated three CIESM Workshops. He serves on the Editorial Board of the journals Fisheries Research (up to 2013), Ethics in Science and Environmental Politics (now co editor-in-Chief) and Journal of Biological Research. He is also a contributing editor of the journal Marine Ecology Progress Series and Associate Editor for the FishBase Section (responsible for 'Short Communications in Ichthyology') in the journal Acta Ichthyologica et Piscatoria (up to 2017), Associate Editor for the journal Mediterranean Marine Science and Academic Editor of the journal Plos-One. He was the editor (or co-editor) of 5 theme sections for the journal Marine Ecology Progress Series and for 5 theme sections for Ethics in Science and Environmental Politics. He has contributed more than 170 papers in peer-reviewed journals, 24 book chapters, two books, as well as 282 other publications (i.e. conference proceedings, special publications, newspaper and magazine articles, technical reports). For more information see Google Scholar Stergiou (<https://scholar.google.gr/citations?user=k8hb4pIAAAJ&hl=el&oi=ao>).

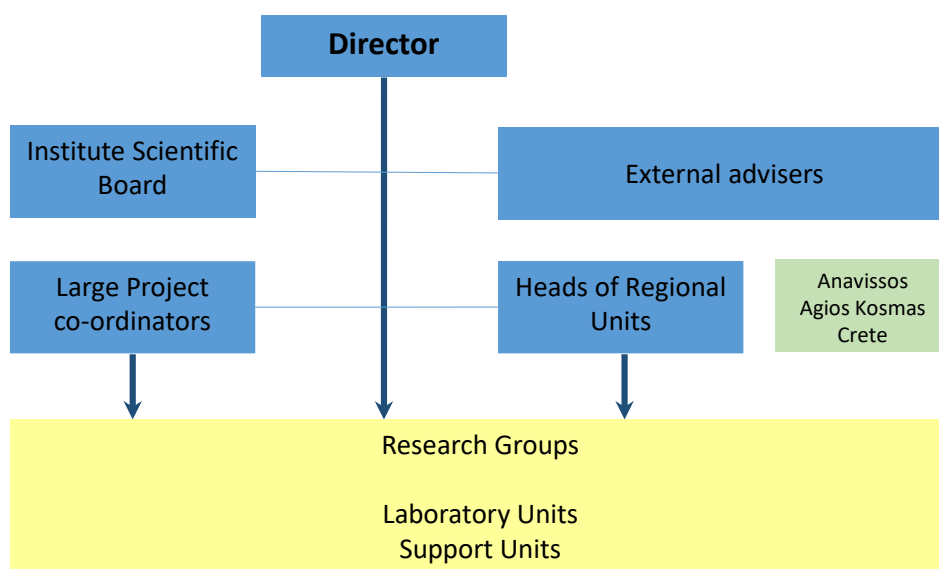
### 2.1.2 Scientific Council

IMBRIW's Advisor panel consists of the following scholars:

1. Daniel Pauly, Professor, University of British Columbia, Vancouver, Canada (<https://scholar.google.gr/citations?user=b6s1NfkAAAAJ&hl=el&oi=ao>)
2. Rainer Froese, Senior Scientist, Leibniz-Institut für Meereswissenschaften IfM-GEOMAR, Kiel, Germany (<https://www.geomar.de/mitarbeiter/fb3/ev/rfroese/>) (<https://scholar.google.gr/citations?user=pRM9V4EAAAAJ&hl=el>)
3. Howard I. Browman, Principal Research Scientist, Institute of Marine Research, Storebø, Norway ([http://www.imr.no/om\\_havforskningsinstituttet/ansatte/b/howard\\_browman/en](http://www.imr.no/om_havforskningsinstituttet/ansatte/b/howard_browman/en)) (<https://scholar.google.co.uk/citations?user=-PITziOAAAAJ>)
4. Klement Tockner, Professor, Leibniz-Institute of Freshwater Ecology and Inland Fisheries (IGB), Berlin, Germany ([https://scholar.google.gr/citations?hl=el&user=pwdyKLIAAAAJ&view\\_op=list\\_works&sortby=pubdate](https://scholar.google.gr/citations?hl=el&user=pwdyKLIAAAAJ&view_op=list_works&sortby=pubdate))
5. Ian Cowx, Professor, Hull International Fisheries Institute (HIFI), UK (<https://scholar.google.gr/citations?user=fYuwBeoAAAAJ&hl=el&oi=ao>)
6. Karim Erzini, Associate Professor, University of Algarve, Algarve, Portugal
7. Laurie Kell, Population dynamics expert, ICCAT (<https://scholar.google.gr/citations?user=tm4QWvsAAAAJ&hl=el&oi=ao>)

### 2.1.3 Organogram

Figure 2 presents the organizational structure of IMBRIW. The backbone of the Institute is the Director who receives input from external and internal advisers, Large Projects co-ordinators and Heads of Regional Units.



**Figure 2.** Organizational structure of IMBRIW.

#### *2.1.4 Further analysis on the management structure and operations*

IMBRIW includes two main sectors, Inland waters Sector and Marine Biological Resources Sector that are located in three geographic regions, Anavissos, Agios Kosmas (since July 2018 in Argiroupoli, where also the Director is based) and Crete. Thus, the following management strategies promote the regular communication of all staff in order to effectively advance the quality of IMBRIW. Firstly, every two years researchers and functional scientific personnel elect five members of the internal Scientific Board and the rest of the tenured personnel elect one member of the Board. The Board, which has an advisory role to the Director and includes researchers from all three regional branches, meets monthly with the Director and discusses all main matters and issues arising and schedules plans and actions. One important outcome of such meetings is the publication of two codes of conduct, one on scientific publication co-authorship which is already available online on IMBRIW's webpage (<http://imbriw.hcmr.gr/en/authorship-of-papers-imbriw/>) and another one on data sharing (which will appear online by the end of February 2019).

In addition, the Deputy Director, after a recommendation by the Director, is appointed by the Board of Directors of HCMR. During the 2013-2016 period, the Deputy Director was a member of the Inland Waters Sector in order to improve the homogenization and collaboration between the two sectors. For the next years, a rotation is planned so that the Deputy Director will be from all three geographic areas in which IMBRIW is located. The Deputy Director closely co-operates with the Director.

In addition, the Heads of the Regional Units are in frequent interaction and contact with the Director. These researchers take care of every day issues arising locally. The Director is based in Argiroupoli and visits regularly Anavissos and Crete where he meets and discusses with all the staff. In addition, there are regular sector, inter-regional and/or thematic meetings, as well as internal project team member meetings. Furthermore, an internal regulation issued by the Director promotes the participation of scientists from at least two regions in all proposals submitted, a fact enabling the osmosis of expertise and cooperation. Finally, in the case of structural research projects (e.g. KRIPIS I & II) all the researchers of IMBRIW are involved, and thus all researchers regularly meet, interact and collaborate, a fact contributing to the multi-disciplinarily and complementarity of expertise.

Currently, there is no Greek legislation on the division of responsibility and authority regarding multi-sited institutes. In order to overcome this in IMBRIW's real life the following actions, apart from those listed above, have been taken; there are research unit supervisors and supervisors of the large projects which regularly interact with the Director and Deputy Director, depending on the occasion.

There is no administration body within the institute apart from secretarial support. The administration support is provided by the Centre. Yet, in order to overcome administrative delays and/or internal bureaucracy, which at times can be pressing and/or critical, the Institute's secretary team provides support to avoid risks and ensure regulatory compliance.

The effectiveness of the Institute's organizational structure and system of governance is improved through periodic and systematic review conducted by the Director and the Institute Scientific Board, which as discussed above changes every two years, as well as indirectly through the intermediate and final evaluation of the director (which is in effect through legislation since 2016). In addition, the Institute's organizational structure and system of governance is thoroughly reviewed every 5 years during the thorough self-evaluation. IMBRIW's organizational structure and system of governance was also planned to be reviewed by the external advisory committee, a fact that however was not realised so far, because of financial constraints.

## 2.2 Location, Installation, Facilities

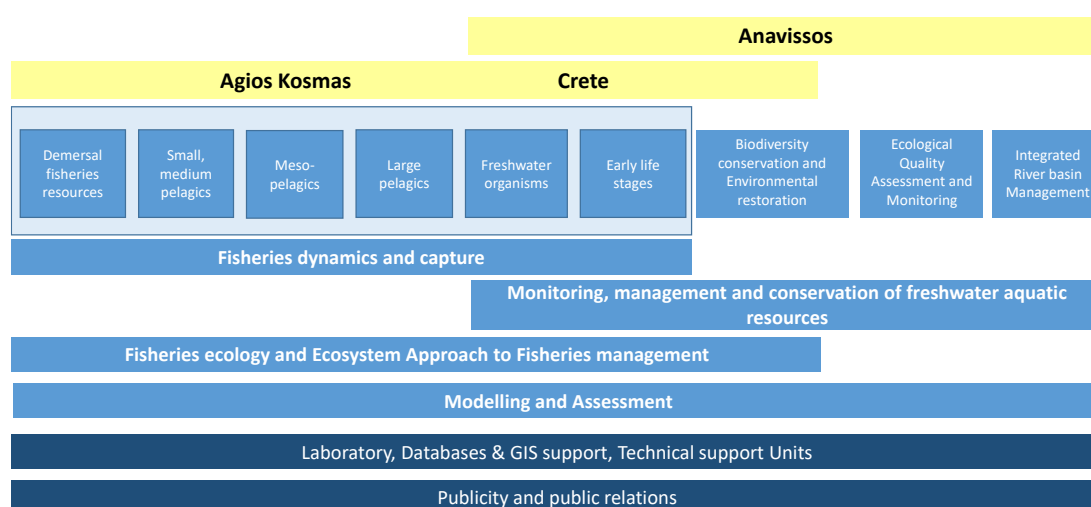
### 2.2.1 Buildings

During the current evaluation period, IMBRIW facilities were housed in three buildings, occupying a section of the HCMR facilities, with the following surface area used solely by IMBRIW personnel:

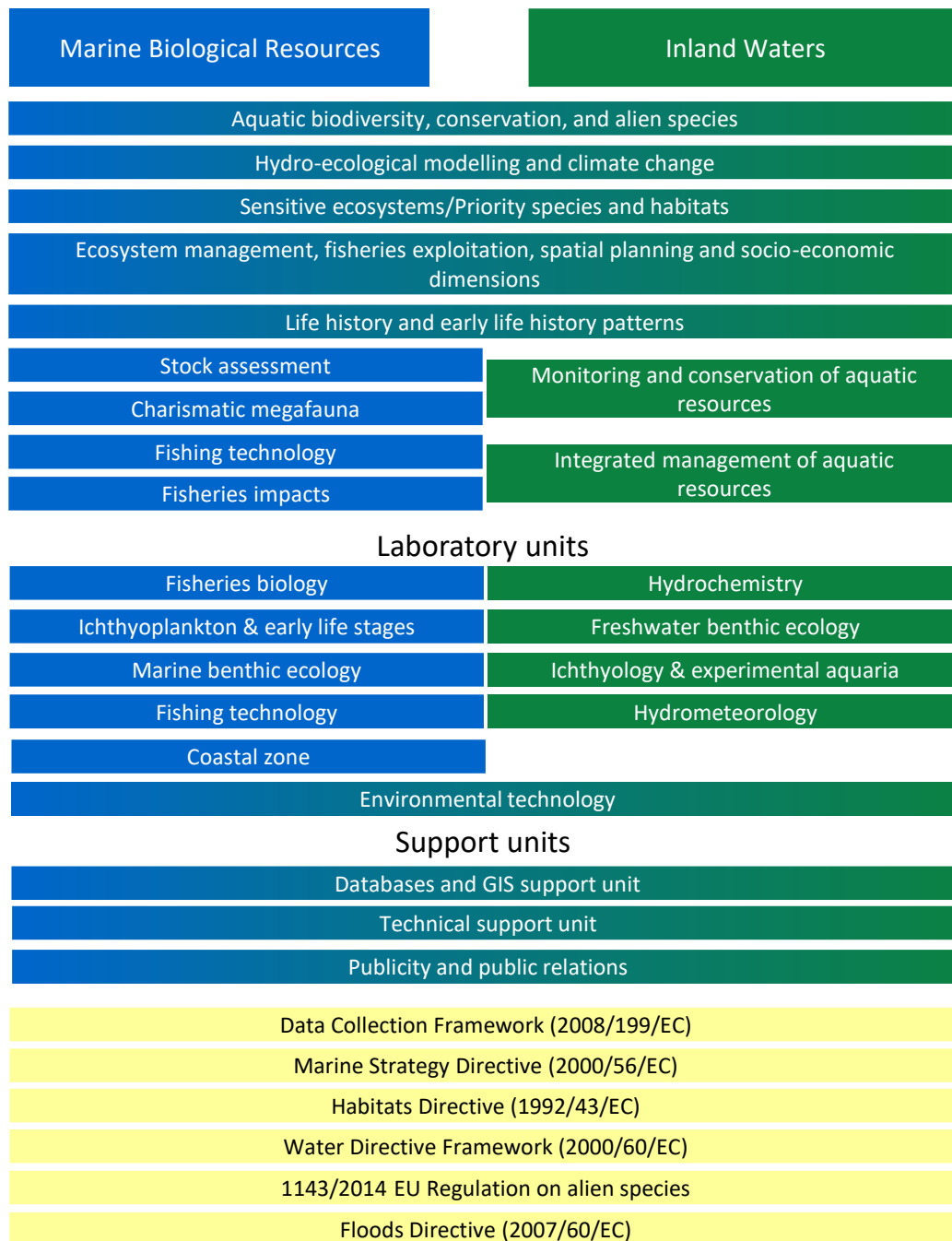
- Anavissos (Attica) 390 m<sup>2</sup> (terrain 4000 m<sup>2</sup>)
- Heraklion (Crete) 500 m<sup>2</sup> (terrain 10000 m<sup>2</sup>)
- Agios Kosmas 500 m<sup>2</sup> (terrain 2000 m<sup>2</sup>).

### 2.2.2 Infrastructures – Research Units – Core facilities

The total surface of the buildings occupied by IMBRIW at Anavissos, Agios Kosmas and Heraklion (Crete) for the evaluation period was 1390 m<sup>2</sup>. IMBRIW has a variety of computing equipment (see section A-2.2.3), as well as laboratory and field equipment that is adequate to fulfil its mission (Fig. 3). In regard to laboratory facilities, it includes ten main laboratory units (Fig. 4).



**Figure 3.** IMBRIW research structural scheme, during the evaluation period, with the location of regional units (yellow), Research units (light blue) and laboratory and support units (dark blue).

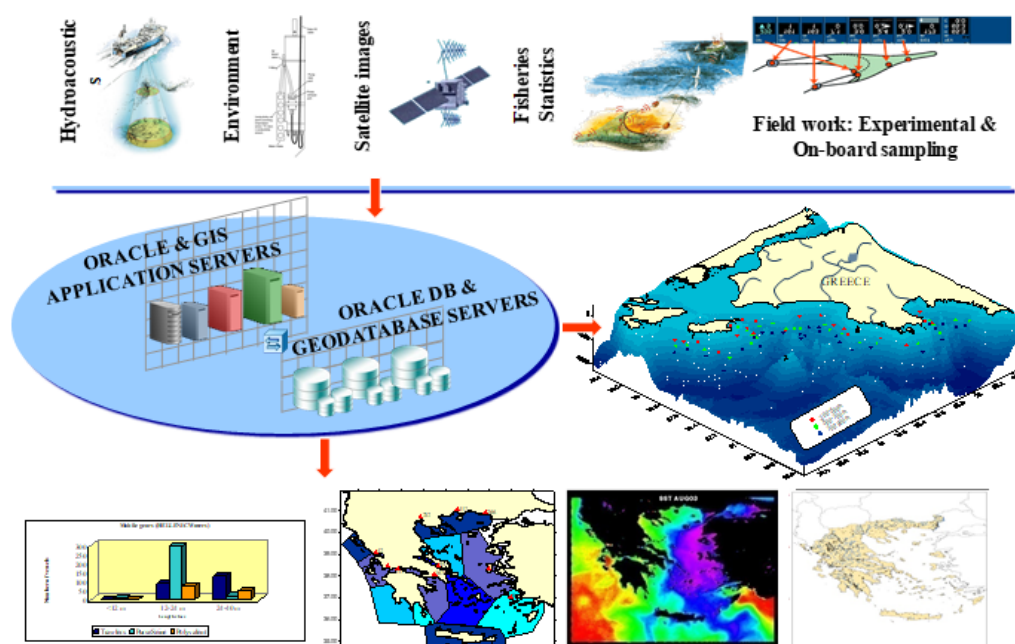


**Figure 4.** Detailed IMBRIW research structural scheme with a description of laboratory units and large Framework programs.

IMBRIW is the main user of the Research Vessel (R/V) 'PHILIA' for collecting data in the field (equipped with fishing gears, fish plankton-nets, CUFES egg sampler, hydro acoustic system, ROXANN bottom profiler). R/V 'PHILIA' is also hired by third parties to conduct fisheries research, since it is the only vessel in Greece equipped with instruments (sampling and sensing) for such activities. It has already been used for fisheries research by other organizations and state authorities (e.g. the state of Libya before the current evaluation

period), while there are plans to be used by Saudi Arabia and Cyprus. Recently, IMBRIW has received grants for R/V 'PHILIA' reconstruction and technological modernization that will greatly expand its operational and research capability (see also section A-2.2.5). In addition, IMBRIW also uses HCMR's Remotely Operated Vehicles (ROVs) for benthic fisheries community studies.

IMBRIW has constructed and harmonized a central database system (Fig. 5) including all data that have been collected within the framework of all projects undertaken (i.e. environmental, conductivity, temperature, and depth (CTD) and satellite data, raw data on abundance indices, length-frequencies, age distribution, reproduction, larval species composition, adult species composition, fleet effort and landings by metier, fleet activity, VMS & AIS data, Mediterranean International Trawl Survey (MEDITS), and all other data collected within the DCF and WFD, including all the annual data published by the Hellenic Statistical Authority). In addition, a new state-of-the-art database following the WFD requirements, has been developed in the Inland Waters sector that includes biological (fish, macroinvertebrates, diatoms, aquatic macrophytes and riparian vegetation), habitat, physicochemical, chemical and hydrological data from all Greek river basins. This database will be integrated into the central database at a later stage. Although raw data (i.e. data per sampling event) are only available to national administration and EU, aggregated data are available to the public upon request (according to the Code of Conduct on data sharing, see section A-2.1.4). Regarding the previous evaluation reviewers' suggestion on merging all HCMR databases, it should be noted that the range of data collected across HCMR (e.g. geological, physical, chemical, fisheries, data on biology of species) is very wide. Merging all this data into one common database might result in a non-user-friendly database and issues on data use would emerge. Yet, IMBRIW provides data, upon request, to HCMR researchers, and to efforts are being made to merge relevant databases.



**Figure 5.** Schematic presentation of the IMBRIW database.



The facilities of the Institute are regularly used by research partners from various EU and international projects, a fact mediating the exchange of know-how. In addition, the facilities of IMBRIW are also used for the training of university students (i.e. undergraduate, MSc, PhD studies).

### *2.2.3 Computing facilities*

These include Database server, Application server, GIS server, S-Plus server, High performance workstations, Routers, Firewall, Switches, LAN backup , UPS, Software (ORACLE, PostgreSQL, PostGIS, S-Plus, SPSS, Statistica, R, Primer, ArcGIS, DELPHI, Paradox, Image analysis, hydroacoustics, Microsoft Office, ADOBE, Corel GEOPRO, HYPACK, Myriax Echoview and other specialized software), One BladeSystem c7000 enclosure with 16 HP Proliant BL460c G1 server blades: 10 E5345 (20 Quad-Core Intel Xeon 2.3 GHz Processors) and 6 E5405 (12 Quad-Core Intel Xeon, 2.0 GHz Processors), High-performance storage array (HP P2000 G3 10GbE iSCSI MSA System) with a capacity of 40 TB, 4 Linux-based Workstations, Computerized Image Analysis Systems (on Stereoscope).

### *2.2.4 Other Facilities*

The following HCMR facilities are also used by IMBRIW: R/V Aegaeo, R/V Alkyon, Local library (technical report of research projects depot; data sheets from NSSG; CV's etc.), HCMR Library, Administration offices equipped with VoIP central telephone system, computers and fax, Meeting rooms for lectures/project meetings and large amphitheatre (150 seats), Storage areas for sampling gears and samples.

Both Athens and Crete staff have free full access to electronic journals/publishers and libraries through the central HCMR library (<https://library-opac.hcmr.gr/>). Moreover, the HCMR library runs a central repository of HCMR staff publications (<https://oceanos-dspace.hcmr.gr/>). Local (Agios Kosmas, Anavissos and Crete) libraries also act as depot for final/technical reports of research projects, print journals, multimedia applications and other publications.

### *2.2.5 Changes in the time interval: 1/1/2013-31/12/2017*

During the evaluation period, the following large scale changes in equipment and facilities took place:

- The echosounder system of IMBRIW installed on R/V PHILIA, was upgraded from a portable Biosonics DTX two-frequency (38 and 120 kHz) unit, to a state-of-the-art, hull-mounted, four frequency (38, 120, 200 and 333 kHz) SIMRAD EK80 wideband system. The hull-mounted transducers of the new system allow the increase of the R/V cruising speed during acoustic sampling more than 50%. In addition to fish, the two added frequencies allow to expand the operational spectrum of organisms, especially in



plankton aggregations, thus, coupling acoustic and plankton research which is at the state-of-the-art of modern oceanographic research and directly linked to climatic change research. Multiple frequencies also improve the acoustic bottom characterization which can be used for habitat mapping. The wideband capabilities of the new transducers allow better signal-to-noise ratio, add a new dimension to the collected data, and consist a subject of active research in the fisheries acoustics community

- New generation SCANMAR sensors: Trawlspeed sensor, Depth sensor, TrawlEye, Catch Sensor, Door-Temperature sensor Scanmar
- The IMBRIW, in the frame for the innovation of the Research Infrastructure, is funded for the "Reconstruction and Modernization of Research Vessel (R/V) PHILIA", which is a synergy between HCMR and the School of Naval Architecture and Marine Engineering of the National Technical University of Athens (NTUA). In this project which began in 2017, R/V PHILIA will constitute a modern platform capable to perform avant-garde multidisciplinary research in the aforementioned fields, will allow Research Groups from different marine research areas (e.g. fisheries, plankton research, benthos, chemical oceanography, physical oceanography, etc) to work together and it will reinforce the existing collaboration with Universities and other research units for joined operations. In addition, the operational ability will permit the expansion to international operations, especially in the east Mediterranean Sea and the Red Sea
- A new fleet of Unmanned Aerial Vehicles (UAVs) has been purchased, consisting of two fixed wing airplanes and four quadcopters that carry a variety of sensors including RGB, thermal and multispectral cameras, as well as Lidar systems. This fleet is currently used for hydromorphological and habitat mapping and will be used in the future for discharge measurements and detection of soil erosion and water quality monitoring
- A mobile hydrogeochemical laboratory has been purchased in 2015 which is fully equipped with all the necessary infrastructure for analysing water samples in the field
- New database & application servers, network infrastructure & security system. During the evaluation period, the high-performance computing HPE BladeSystem system covered satisfactorily all needs in computing resources. However, in 2014, we purchased a HP P2000 G3 10GbE iSCSI MSA storage array with a capacity of 40 TB in order to cover the growing demands in data storage and mining
- Hach Lange UV and visual Spectrophotometer DR 6000 for coastal zone management research

Recently, a section of IMBRIW which was located in Agios Kosmas was moved to a new, modern building in Argiroupoli that has greatly increased its operational capacity given that it almost tripled its space and all its laboratories were redesigned and equipped with state of the art infrastructure.

## 2.3 Personnel

### 2.3.1 Personnel at 31/12/2017

#### i. Distribution of personnel based on research teams

Research teams in IMBRIW could be identified only on a per-sector basis (data 31/12/2017),

as follows:

Type	Inland Waters	Marine Biological Resources
Researchers/Functional scientific personnel	8	18
Technical scientific personnel	7	12
<b>Total</b>	<b>15</b>	<b>30</b>

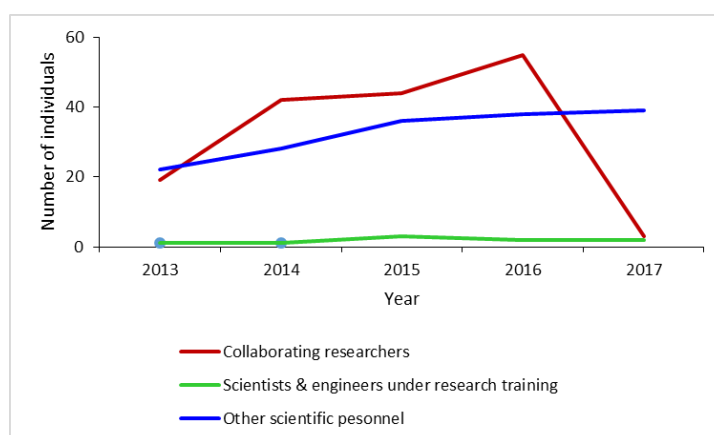
## ii. Distribution of non-tenure personnel based on:

### • Years of service in the Institute

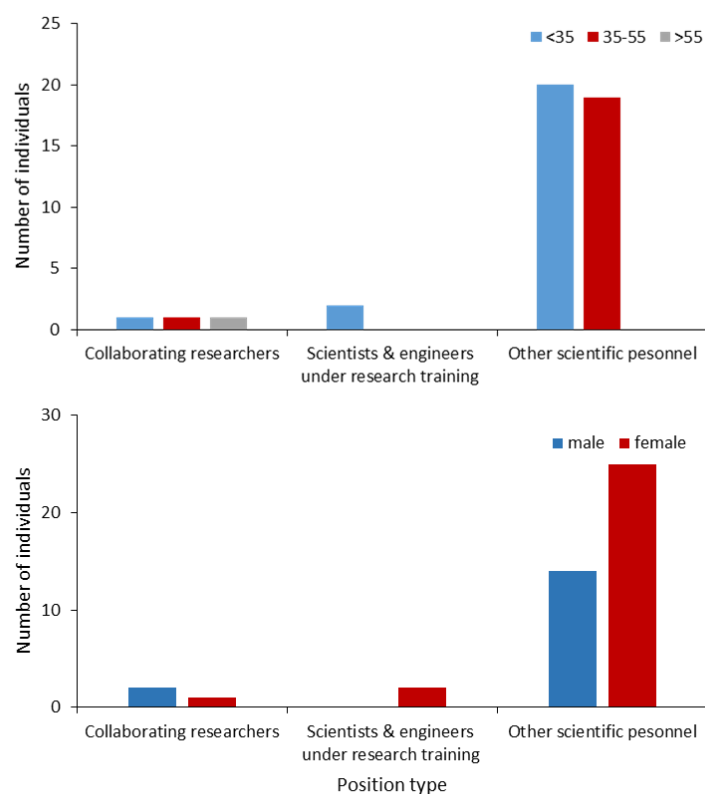
The majority of the non-tenure personnel has been employed for more than 5 years. This longevity could mainly attributed to the large projects (i.e. MSFD, WFD and DCF) that have run in IMBRIW for a long time. When there is a need additional personnel is recruited, both to support the aforementioned projects, as well as to fill-in emerging needs in new projects.

### • Type of affiliation

There are two major types of contracts for non-tenure personnel, i.e. collaborating researchers (external) and others (other scientific personnel, Fig. 6). The abrupt decrease in collaborating researchers in 2017 is solely attributed to the fact that the large projects (i.e. WFD and DCF) were discontinued at that time (due to Central Governmental Policy issues), and hence people were not recruited. Nevertheless, in 2018 when the projects re-run, a large number of skilled personnel were recruited at IMBRIW. In their vast majority, other personnel comprises of young people (Fig. 7, top), with females outnumbering males (28 and 16, respectively; 1.75:1; Fig. 7, bottom).



**Figure 6.** Distribution of non-tenure personnel in IMBRIW during the current evaluation period. The abrupt decrease in collaborating researchers (red line) in 2017 is solely attributed to the fact that the large projects (i.e. WFD and DCF) were discontinued at that time.



**Figure 7.** Age (top) and gender (bottom) distribution of IMBRIW's non-tenure personnel.

iii. Comment on the number and the level of involvement of personnel that are University faculty members too

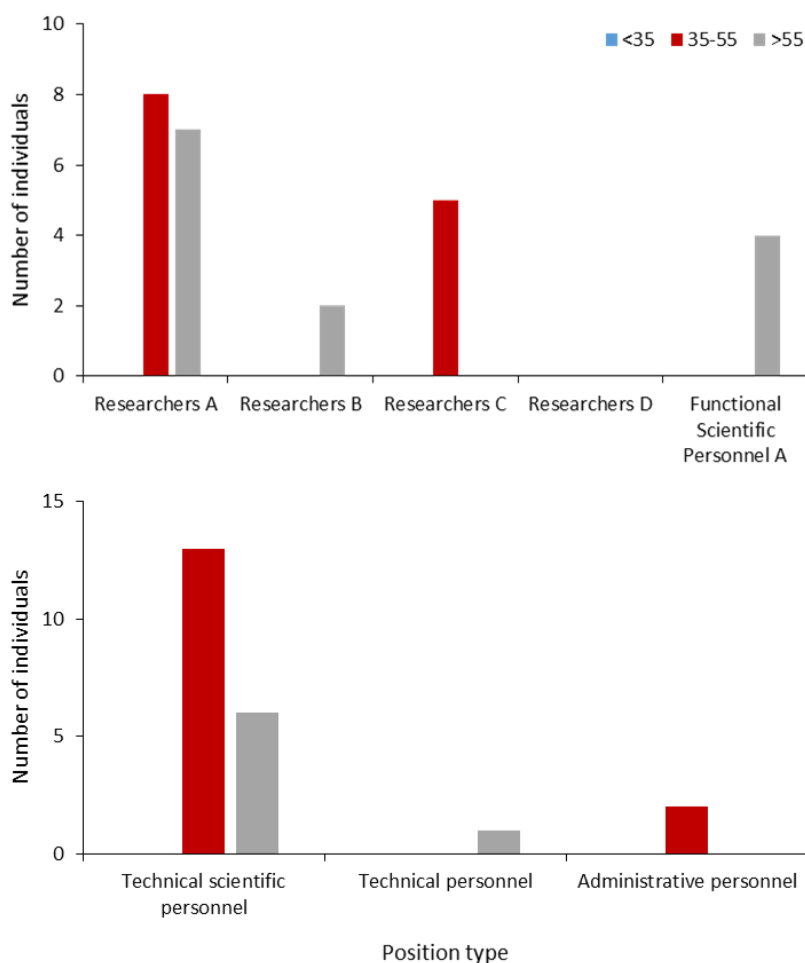
Non-applicable, as in IMBRIW no such personnel exist.

iv. Social characteristics of personnel

- **Age distribution**

On 31/12/2017, the age distribution of IMBRIW's permanent personnel is presented in figure 8. With respect to researchers (Fig. 8, top), personnel was >35-years old, and equally distributed in two age classes (35-55 and >55: 13 individuals per age class). All researchers B were over 55, and the same was evident for all functional scientific personnel A (no new personnel was hired under this category during the evaluation period). On the other hand, researchers C were all between 35 and 55 years-old. The ratio between the two age classes [(35-55):(55)] in researchers A was 1.14:1.

Technical scientific and administrative staff (Fig. 8, bottom), was also above 35 years, but the ratio between the two age classes was higher for younger personnel [(35-55):(55) = 2.14:1].



**Figure 8.** Age distribution of IMBRIW's researchers (top), and technical scientific, technical, and administrative personnel (bottom).

- **Nationalities**

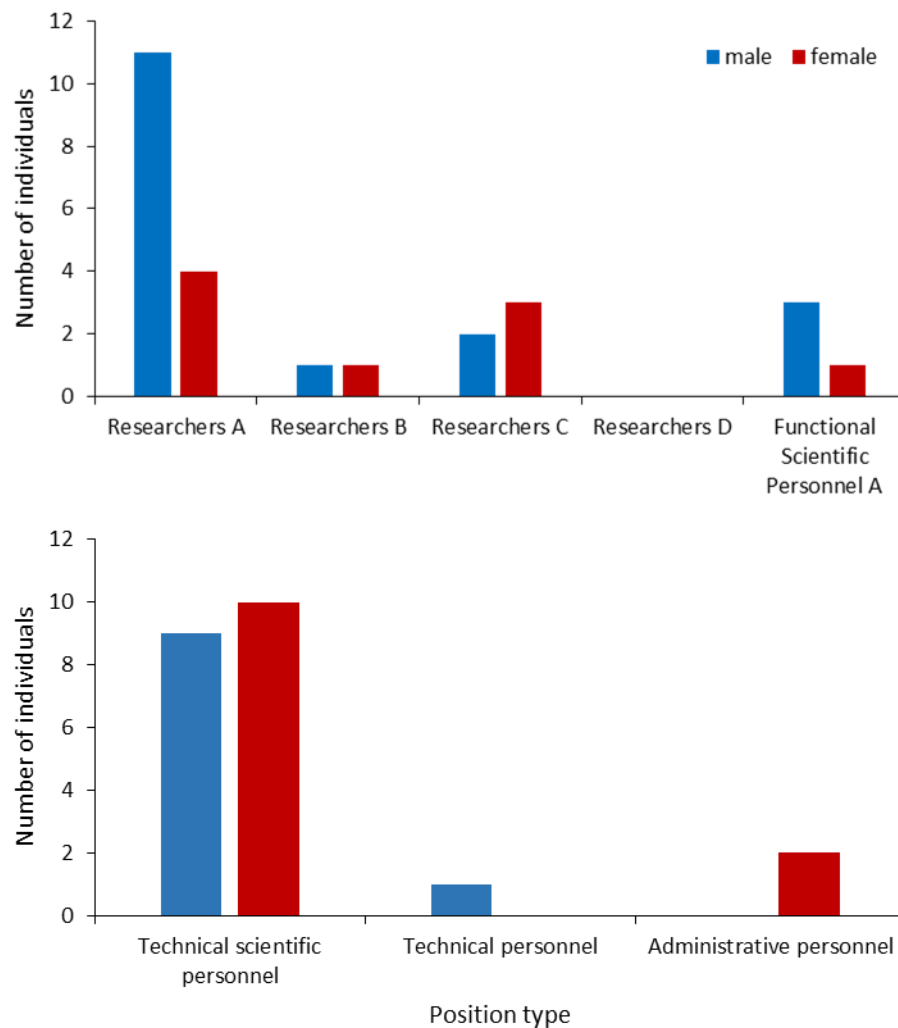
Of the 92 IMBRIW personnel, only 2 were of nationalities other than Greek (i.e. a Researcher A from UK, and a colleague from Iran under “other personnel”). It should be noted that the complex bureaucratic procedures in place may be a deterrent for foreign nationals to seek employment in Greek research.

- **Gender**

There was an overall gender balance of the personnel (see Annex, Table 1A), with the number of males being slightly lower than that of females (43 and 49, respectively; 1:1.4). Female researchers were however fewer than males (9 and 17, respectively; 1:1.89), a fact that was more prominent within researchers A (4 and 11, respectively; 1:2.75) (Fig. 9, top). On the contrary, female technical scientific, technical and administrative staff (Fig. 9, bottom), was more than their male counterparts (12 and 10 persons, respectively; 1.2:1).

- **Special needs**

No special needs personnel was staffed in IMBRIW on 31/12/2017.



**Figure 9.** Gender distribution of IMBRIW's researchers (top), and technical scientific, technical, and administrative personnel (bottom).

### 2.3.2 Mobility (2013-2017)

- i. The following departs have been made during the evaluation period:
  - a. One Researcher was seconded in the European Research Council (ERC) from 2013 until 2017
  - b. One researcher is currently on unpaid leave (since 2016) and has been appointed to a temporary position in EU DG MARE
  - c. One researcher departed from HCMR (in 2015) during the process of career advancement (from Grade D to Grade C); this process was an open call and a more qualified researcher successfully applied for the position (from JRC).
- ii. The new researcher (Grade C), as described in section i.c, was recruited from EU JRC (Ispra, Italy).

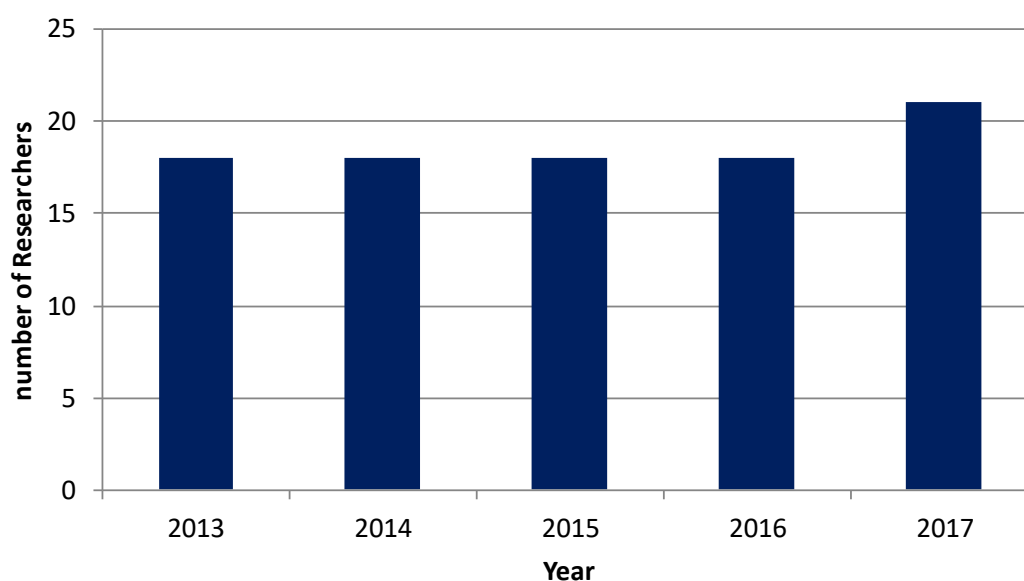
iii. The ratio of new appointments over departs is one (1).

iv. No visiting foreign scientists.

v. In 2017, four persons advanced their position from Technical scientific personnel to Researcher (two to Grade C and two to Grade B). Additionally, five advanced from Grade B to Grade A, and one from Grade D to Grade C.

In addition, three more new researcher positions of Grade C were procured in 2017; two of them were covered in 2018 (in the research fields of Ecological Modelling and Freshwater Benthic Ecology respectively) and a third one will be covered within April-May 2019 (in the research field of Environmental Economics). These three new positions were in accordance to the 2013 IMBRIW Business Plan.

All IMBRIW researchers (their number during 2013-2017 is shown in figure 10) have, apart from their individual 'Excel 4b sheets', Google Scholar pages in which their publications, the journals in which these publications appear, their total citations and h indices are shown.

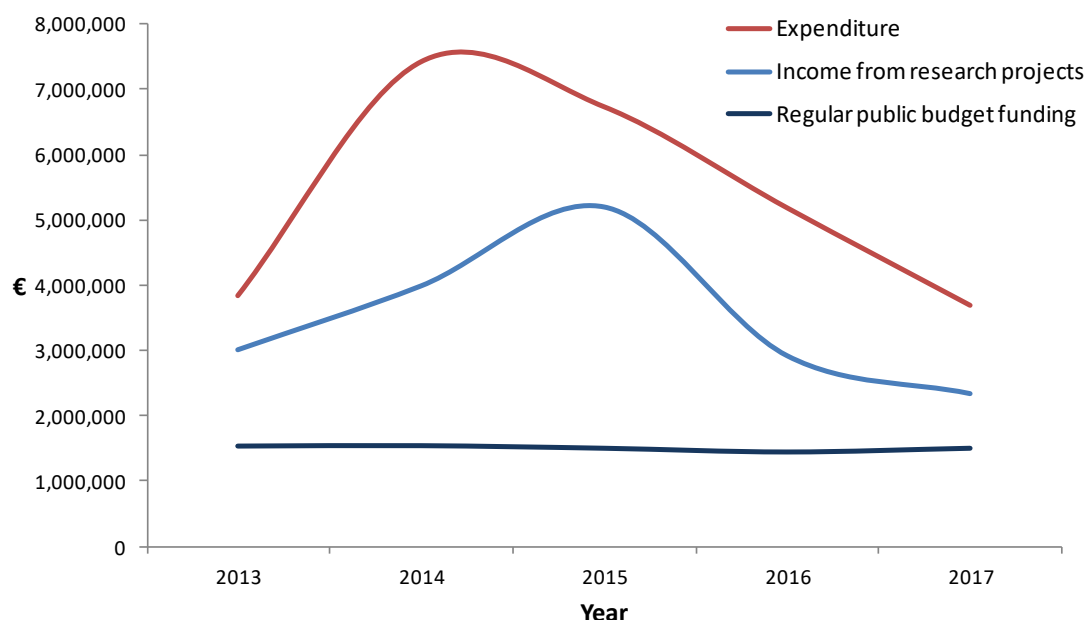


**Figure 10.** Number of IMBRIW researchers during the evaluation period (2013-2017).

### 3 Finance

The average annual income from research projects (private, public, EU and other International funding) was 3,472,467 €, i.e. 35.5% increased compared to the previous evaluation period (average for years 2005-2012: 2,558,232 €). The income from research projects peaked in 2015 (Fig. 11), when it exceeded 5M € and was at lower levels in 2017 due to the discontinuity of the two large projects (i.e. WFD and DCF, which, however, started again after 2017). Regular public funding was stable, around 1.5 M€. The available funding supported the mission and purposes of the Institute (see section 1.3), was directed to address IMBRIW's research

priorities (see section 4.1) and to fulfil the strategic goals set for the evaluation period (see section C). The institute's multi-year financial planning was balanced, with the exception of only one year (2014).



**Figure 11.** Income per year and expenditure per year

#### 4 Advancement, Dissemination and Implementation of Knowledge (2013-2017)

IMBRIW has advanced knowledge on marine and inland water ecosystems in the Mediterranean, European and international level by addressing high-order scientific questions: (a) alien- species dynamics, (b) status assessment and conservation of endemic freshwater fish, (c) identification of essential habitats – habitat mapping, (d) optimum exploitation of marine stocks, (e) ecological status assessment of surface waters, (f) ecosystem structure and function, (g) aquaculture-fisheries-environment interactions, (h) effect of fishing on marine ecosystems, (i) impact of extreme events (droughts and floods) on river ecosystems, (j) temporary aquatic ecosystems, (k) hydro-meteorological processes, (l) integrated river basin management and (m) establishment of integrated coastal zone management policies and tools in Greece.

The information, main findings and knowledge produced by IMBRIW research projects and other activities is disseminated to the scientific community, stakeholders (i.e. fishers, farmers and their associations, industry, managers, Ministries, Regions, Municipalities and other authorities, NGOs) and public at large, through: (a) publication of scientific papers in peer reviewed journals, publications in books and national and international conferences, symposia, meetings and workshop proceedings and publication of technical reports; (b) popularized articles in magazines, periodicals and newspapers; (c) the Institute's webpage; (d) dedicated project webpages; (e) the organization of special events (i.e. popular talks,

meetings, workshops) organized by the Institute, as well as by participating in meetings organized by third parties including Environmental Education Centres; (f) leaflets, CD-ROMs and documentary video productions; (g) teaching courses in Universities and other high education establishments (h) through the activities of the HCMR Educational Unit, which organizes regular environmental education events and training for primary, secondary and tertiary students and teachers, and (i) special environmental interpretation exhibits in protected areas .

Avenues for the implementation of the knowledge produced by IMBRIW are (a) the elaboration of management plans, including restoration and development of protected areas, (b) consultation and advising on policy and its implementation to various Ministries, Parliamentary committees, and EU Policy applications (e.g. Common Fisheries Policy (CFP), WFD) in which knowledge accumulated through time and research can contribute to official regulations and measures and (c) development of scientific tools, education, training and public awareness initiatives to influence wider understanding and participatory processes in aquatic resource management.

#### 4.1 Research Priorities

During the current period of evaluation, IMBRIW research priorities focused on:

- Increasing its international role by strengthening its membership in International Organizations, research networks (e.g. ERANET, EUROCEAN) and Working Groups
- Enhancing its academic reputation by increasing the number of publications in high-profile journals and the number of MSc and PhD students trained in IMBRIW
- Fully exploiting the multidisciplinary of research staff
- Increasing its policy-relevant advisory role (e.g. Management Plans) and dissemination activities at the National and European level and, thus,
- Ultimately attracting more EU and National funds and address high-order research questions (see figure 22 in section C).

All the above aims were successfully realized during 2013-2017 (see the corresponding sections below (also C.1)).

Specific research priorities of IMBRIW during the previous evaluation period (2013-2017) included:

##### Aquatic biodiversity, conservation, and alien species

- Biodiversity analyses of demersal fisheries' exploited communities
- Exploration of the geographical distribution of inland water fish species (both native and introduced) and description of species assemblages in the hydrographic basins of Greece
- Identification of new freshwater species, using morphological and genetic techniques
- Identification of cryptic species, using morphological and genetic techniques, for the taxonomic validations of vulnerable or endangered taxa



- Investigation of anthropogenic impacts on habitats and the biota (e.g. construction of dams, water abstraction, sand/gravel abstraction, pollution) and determination of appropriate restoration actions
- Study of alien species (i.e. dynamics, trends in introduction and pathways/vectors of introduction, invasive species, raising public awareness, competitive interactions between invasive and native species). The Institute is co-ordinating and managing of the Ellenic Network on Aquatic Invasive Species (ELNAIS; [elnais.hcmr.gr](http://elnais.hcmr.gr))

#### Hydro-ecological modelling and climate change

- Development of food-web models, specifically "Ecopath with Ecosim" and "OSMOSE"
- Individual Based Models (IBMs) have been developed in which biogeochemical models are linked with anchovy bioenergetics to explore population dynamics
- Density dependence and the structure of the planktonic food web in relation to food consumption and prey selection by small pelagic fish
- Development of a rapid prediction tool of aquatic quality and a nutrient classification system
- Application of the Revised Universal Soil Loss Equation (RUSLE), a model developed by the United States Department of Agriculture (USDA) Soil Conservation Service (now the USDA Natural Resources Conservation Service), which, combined with remote sensing and GIS tools, estimates the annual soil erosion potential per unit land area on a river basin scale

#### Hydro-meteorological modelling and climate change

- Research on improving operational numerical weather forecasts
- Research on the development of a fully coupled atmosphere-ocean wave system
- Research on the development of a fully coupled hydro-meteorological modelling system
- Numerical modelling to simulate the relevant processes controlling hydrology and water quality at a catchment scale for environmental and river basin management (MIKE by DHI), including climate and land use change scenarios; water budget models; dynamic groundwater models for exploring the pathways of aquatic pollutants; modelling software for simulating the entire hydrologic cycle at a catchment scale and for simulating hydrochemistry in surface waters.
- Development of techniques for assimilating surface observations to produce high operationally high-resolution atmospheric analysis fields
- Generation of high-quality atmospheric analysis dataset that can be used as the forcing to drive wave, ocean hydrodynamic and hydrological models and the baseline data for environmental impact assessment studies
- Investigating the predictability of seasonal weather forecasting on regional scale
- Application of a grid-based GIS modelling method for the estimation of flood hazardous areas

#### Sensitive ecosystems/Priority species and habitats

- Deep-water resources, deep-water fisheries, deep-water habitats
- Essential fish habitat suitability modelling, at the Mediterranean scale, for several small

pelagic and demersal species

- Evaluation of the extent and distribution of Marine Protected Areas (MPAs) and Fishery Restricted Areas (FRAs) in the Mediterranean
- Studies on the ecology and biology of fish species, assessments of habitat requirements and determination of habitat conditions of some vulnerable species and populations
- Protection of endangered species and formulation of management plans for species and habitats through conservation and restoration projects
- Genetic variation studies of different populations of endangered fish species to define separate “evolutionarily significant units” within each species to be conserved separately
- Population assessment of freshwater species using the less invasive environmental DNA method

#### Ecosystem management, fisheries exploitation, spatial planning and socio-economic dimensions

- Development of harmonized methodologies for coherent and relevant environmental status assessments
- Monitoring, through the EU DCF, of population age and length structures, fleet dynamics, fishing effort, landings and socio-economic data
- Fishing Capacity Assessment
- Marine litter on seafloor and ingested by marine organisms
- Interactions between fisheries-aquaculture-environment
- Marine Spatial Planning (MSP) as a tool to minimize conflicts between human uses
- Socio-economic studies of the fisheries sector, economic valuations, elaboration of integrated coastal zone management tools for sustainable development

#### Life history and early life history patterns

- Early life history surveys (e.g. composition, distribution)
- Investigation of the importance of trophic conditions on stock reproductive potential of small pelagics in the Mediterranean in the context of the daily egg production

#### Stock assessment

- Stock assessments for developing Management Plans, as well as in the frame of GFCM and Scientific, Technical and Economic Committee for Fisheries (STECF)
- Application of data-poor stock assessment techniques

#### Charismatic megafauna

- Monitoring of marine cetaceans and turtles strandings in Greece, with a corresponding data base

#### Fishing technology

- Selectivity and technology of fishing gears. Improvement of gear selectivity that minimizes the capture of juveniles, increases the size of first capture and the yield per recruit of target species and reduces discards and thereby the environmental impact

Fisheries impacts

- Discarding practices in fisheries, with emphasis in contributing to the revised CFP goals related to reduction/banning discards in EU waters
- Evaluation of the impact of trawling on the seabed and how can this impact be reduced using less damaging gears or alternative techniques

Monitoring and conservation of aquatic resources

- Continuation and upgrading the research on ecological status and monitoring methodologies for streams and rivers, as required for the WFD. Research on using existing, adapted or developed ecological status assessment methodologies, particularly regarding chemical-physicochemical (nutrients) and biological quality elements (macroinvertebrates, fish)
- Standardization of sampling procedures and field protocols. Development of river typologies and the designation of reference conditions for a number of river basins using the spatially based approach
- Expansion of research on ecological status and monitoring including new indicator attributes (riparian habitats, macrophyte vegetation and diatoms), new methods of ecosystem health diagnosis (screening-level assessment procedures) and new water body types (temporary rivers and ponds, urban streams, lakes and lagoons)
- Implementation, from 2012-2015 of the National Monitoring Program for rivers ("Monitoring of the ecological status of rivers, transitional and coastal waters pursuant to Article 8 of the WFD") at 149 operational and 300 surveillance stations throughout mainland and island Greece.

Integrated management of aquatic resources

- Research on the factors and processes driving the origin, forms, levels and dynamics of nutrients in minimally disturbed areas
- Start applying water quality monitoring in Lakes and Estuaries by utilizing remote sensing techniques to develop predictive algorithms
- Assessing multiple stressor effects on freshwater ecosystems emphasizing on intermittent rivers for implementing conservation and management plans.
- In regard to temporary water bodies (rivers, streams and ponds), innovative research was developed, focusing towards the understanding of processes driving changes in hydrology, aquatic quality and biota
- Identification of pressures, assessment of the state and impacts (application of the DPSIR principle) and management scenarios within Integrated Water Resources Management Plans and River Basin Management Plans
- Application of groundwater vulnerability and pollution risk assessment methodologies according to the COP method developed

## 4.2 Research projects

During 2013-2017, IMBRIW coordinated/participated in 83 research projects with a total budget of 48,242,910.9 €. Forty two (42) projects were funded by EU Framework Programmes (e.g., FP7, HORIZON2020, LIFE, DG Mare, EASME) accounting in total for 14.63% of IMBRIW

income funds. In addition, 26 projects were funded from Public investment/ structural funds (NSFR); these accounted however for the grand majority (83.53%) of the IMBRIW budget, mainly due to the two large projects (i.e., for the DCF and the WFD EU Directives). Fifteen (15) projects were funded by other sources (firms and other private legal entities, International Organisations and others), with the total budget reaching 2% of IMBRIW's projects' budget. In 2013, there were 37 active projects and this number remained relatively constant across the whole period (2014: 35; 2015: 34; 2016: 24; 2017: 31). More detailed information on IMBRIW's projects is provided in sections A-4.3.2 and A-4.5.1.

### 4.3 Academic outputs

During 2013-2017, the academic output of the IMBRIW included 398 peer-reviewed papers, 167 publications in peer-reviewed international conferences (full papers), 32 book chapters and books, and 318 other publications and overall received 8,132 hetero-citations and 5,652 self-citations.

It is worth pointing out that HCMR issues one of the two Greek journals that are included in the ISI database, the *Mediterranean Marine Science* (with an impact factor of 1.984). The editor-in-chief of this journal is a member of IMBRIW. In addition, several members of IMBRIW serve in the Editorial Boards of the scientific journals (e.g., *ICES Journal of Marine Science*, *Marine Ecology Progress Series*, *PlosOne*, *Scientia Marina*, *Hydrobiologia*, *Frontiers in Marine Science*, *Mediterranean Marine Science*, *Acta Ichthyologica et Piscatoria*, *Turkish Journal of Fisheries and Aquatic Sciences*).

The ICCAT Mediterranean swordfish Group, the MEDITS Steering Committee, the Workshop on Ageing Validation methodology for *Mullus* species (WKVALMU) were coordinated by IMBRIW staff.

#### 4.3.1 Publications

During the current evaluation period, the staff of IMBRIW published in 141 journals (Table 1), some of which are among the best and most prestigious in the field with impact factor > 10, such as *Biological Reviews* (11.7), or with impact factor (IF) > 3, such as *Science of the Total Environment* (4.610), *Nature Scientific Reports* (4.609), and *Ecological Indicators* (3.983). The average and median 2017 impact factor of the journals in which the staff of IMBRIW published during 2013-2017 was higher than the average and median impact factor of the two categories 'Fisheries' and 'Marine and freshwater research' of the Institute for Scientific Information (ISI) system, combined (Table 2). The same is also true of the two fields separately (results not shown).

**Table 1.** List of all scientific journals that IMBRIW's personnel has published during 2013-2017 (in alphabetical order).

Acta Adriatica: international journal of Marine Sciences	Journal of Atmospheric and Oceanic Technology
Acta Ichthyologica et Piscatoria	Journal of biological dynamics
Acta Zoologica Bulgarica, Supplement	Journal of Biological Research
Advances in Marine Biology	Journal of Coastal Conservation
Advances in Meteorology, Climatology and Atmospheric Physics	Journal of Ecological Engineering
Advances in Cephalopod Science: Biology, Ecology, Cultivation And Fisheries	Journal of environmental biology
Amphibia-Reptilia	Journal of environmental protection and ecology
Annales: Series Historia Naturalis	Journal of Fish Biology
Aquaculture Environment Interactions	Journal of fish diseases
Aquatic Biology	Journal of Fisheries and Aquatic Science
Aquatic Conservation: Marine and Freshwater Ecosystems	Journal of hazardous materials
Aquatic Invasions	Journal of Industrial Ecology
Aquatic Living Resources	Journal of International Scientific Publications: Ecology & Safety
Archives of the Balkan Medical Union vol	Journal of Marine Systems
Biologia	Journal of Natural history
Biologia Marina Mediterranea	Journal of the Marine Biological Association of the United Kingdom
Biological journal of the Linnean Society	Journal of Water Resource and Protection
Biological Reviews	Knowledge and Management of Aquatic Ecosystems
Biology and Ecology of Sardines and Anchovies	Limnetica
BioScience	Limnology
Cahiers de Biologie Marine	Limnology and oceanography
Central European Journal of Biology	Management of Biological Invasions
Cephalopod biology and fisheries in Europe: II: Species Accounts	Marine and Coastal Fisheries
Chemical Engineering Journal	Marine Biology
Climatic Change	Marine Biology Research
Conservation biology	Marine Ecology
Continental Shelf Research	Marine Ecology Progress Series
Critical Perspectives on Accounting	Marine environmental research
Cuadernos de la Sociedad Española de Ciencias Forestales	Marine Policy
Current Biology	Marine Pollution Bulletin
Deep Sea Research Part I: Oceanographic Research Papers	Mediterranean Marine Science
Deep Sea Research Part II: Topical Studies in Oceanography	Molecular ecology resources

Desalination and Water Treatment	Molecular Phylogenetics and Evolution
Ecological Engineering	Monitoring and Evaluation of Spatially Managed Areas (MESMA)
Ecological Indicators	North American Journal of Fisheries Management
Ecological Modelling	NAŠE MORE: znanstveno-stručni časopis za more i pomorstvo
Ecosystem services	Natural Hazards and Earth System Sciences
Energy Procedia	Nature Ecology & Evolution
Environmental development	Ocean & Coastal Management
Environmental Earth Sciences	Parasitology research
Environmental indicators	PeerJ
Environmental management	Perspectives on Atmospheric Sciences
Environmental monitoring and assessment	PloS one
Estuarine, Coastal and Shelf Science	Polish Journal of Entomology
Ethics in Science and Environmental Politics	Progress in Oceanography
European Water	Progressive Engineering Practices in Marine Resource Management
Fish and Fisheries	Regional Studies in Marine Science
Fisheries Management and Ecology	Renewable Energy
Fisheries oceanography	Research Ideas and Outcomes
Fisheries Research	Reviews in fish biology and fisheries
Fresenius Environmental Bulletin	Reviews in Fisheries Science & Aquaculture
Frontiers in Applied Mathematics and Statistics	River research and applications
Frontiers in Marine Science	Science of the Total Environment
Fundamental and Applied Limnology/Archiv für Hydrobiologie	Scientia Marina
Geoscientific Model Development Discussions	Scientific Reports
Global Change Biology	Sharks International
Global environmental change	Sustainable Mediterranean
Hydrobiologia	Theoretical and applied climatology
Hydrology Research	Trends in Fisheries and Aquatic Animal Health
ICES Journal of Marine Science	Tropical Conservation Science
Ichthyological Exploration of Freshwaters	Turkish Journal of Fisheries and Aquatic Sciences
Integrated environmental assessment and management	Vie et Milieu-Life and Environment
Integrated marine information system	Water Policy
International Aquatic Research	Water, Air, & Soil Pollution

International Commission for the Conservation of Atlantic Tunas. Collective Volume of Scientific Papers	Web Ecology
International journal of remote sensing	WIT Transactions on Ecology and the Environment
International Journal of River Basin Management	Zoological Journal of the Linnean Society
Journal of Aquaculture & Marine Biology	Zootaxa

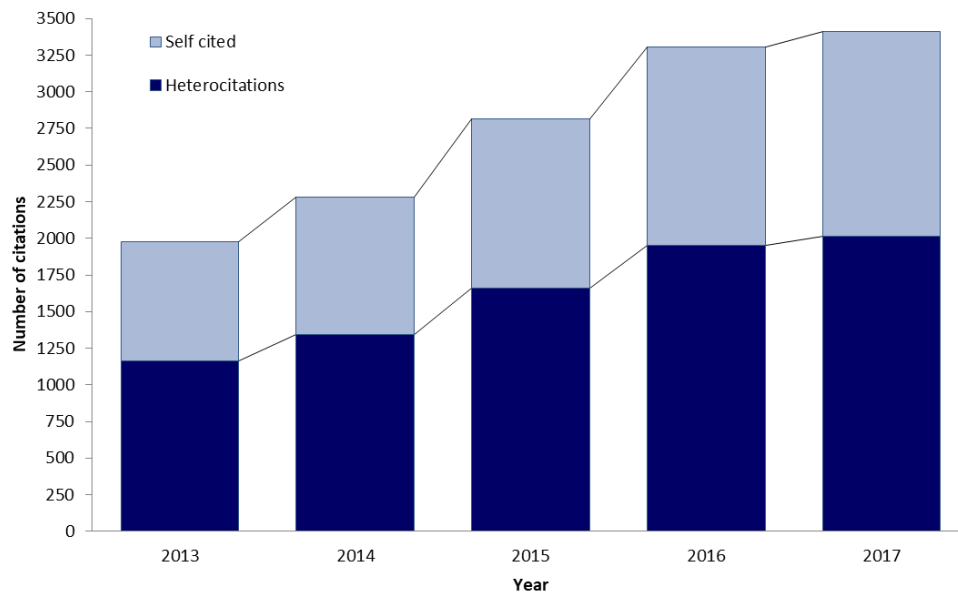
**Table 2.** Statistical properties of the Impact factor (IF) of the journals in which IMBRIW published its research in 2013-2017 compared with those referring to journals of the ISI categories 'Fisheries' and 'Marine and Freshwater Biology' which are the two major fields IMBRIW contributes. In brackets the weighted average, by number of articles, of the IMBRIW publications.

	All journals of the two ISI categories	Journals in which IMBRIW published its research
Number of journals	142	100
Average IF	1.74	<b>2.54 (2.35)</b>
Minimum IF	0.13	<b>0.37</b>
Maximum IF	12.87	<b>11.70</b>
Median IF	1.49	1.99

During this period, average and Median IF of IMRIW journal publications increased compared to the previous evaluation period from 1.99 and 1.70 to 2.54 and 1.99 respectively. Furthermore, whereas average IF of ISI journals increased by 7.4% (from 1.62 to 1.74), IMBRIW publications journals average IF increased by 27.6% (from 1.99 to 2.54). During the current evaluation period (2013-2017), IMBRIW received a total of 13,783 citations of which 5,652 were self-citations and 8,131 hetero-citations. The annual number of hetero-citations increased from 1,166 in 2013 to 2,011 in 2017 (Fig. 12). Regarding the relatively high percentage of self-citations, this can partly be justified by the long-term consistency in research focus by IMBRIW researchers, as well as the multi-authored nature of their research output, due to its multi-disciplinary approach.

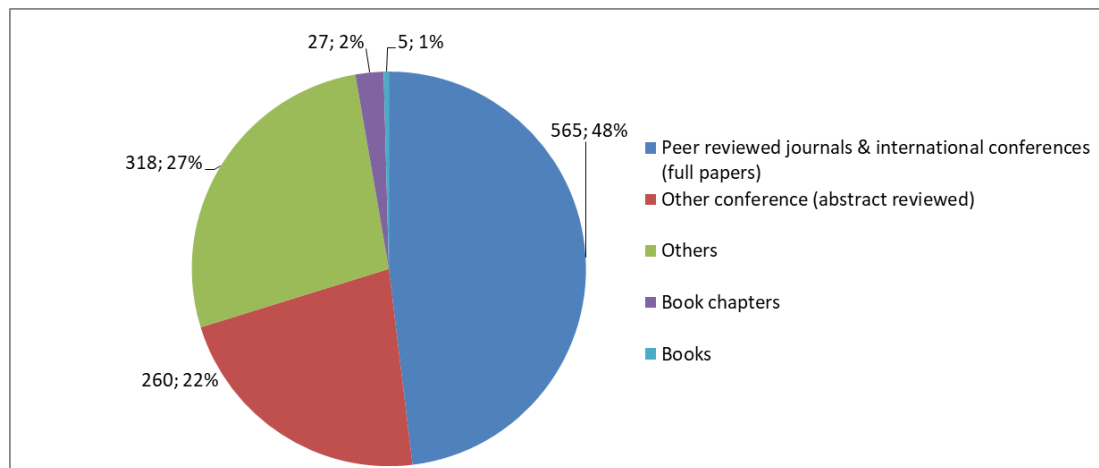
We point out here that all citations were estimated using Google Scholar<sup>1</sup> checking for each unique publication separately.

<sup>1</sup> For justification on use of Google Scholar see Pauly & Stergiou (2005) *Ethics Sci Environm Polit* 2005:33-35; Stergiou & Tsikliras (2006) *Ethics Sci Environm Polit* 2006: 15-17; Harzing & Van Der Wal (2008) *Ethics Sci Environm Polit* 8: 61-73; Harzing (2011) *Publish or Perish book*. Tarma Software Research.



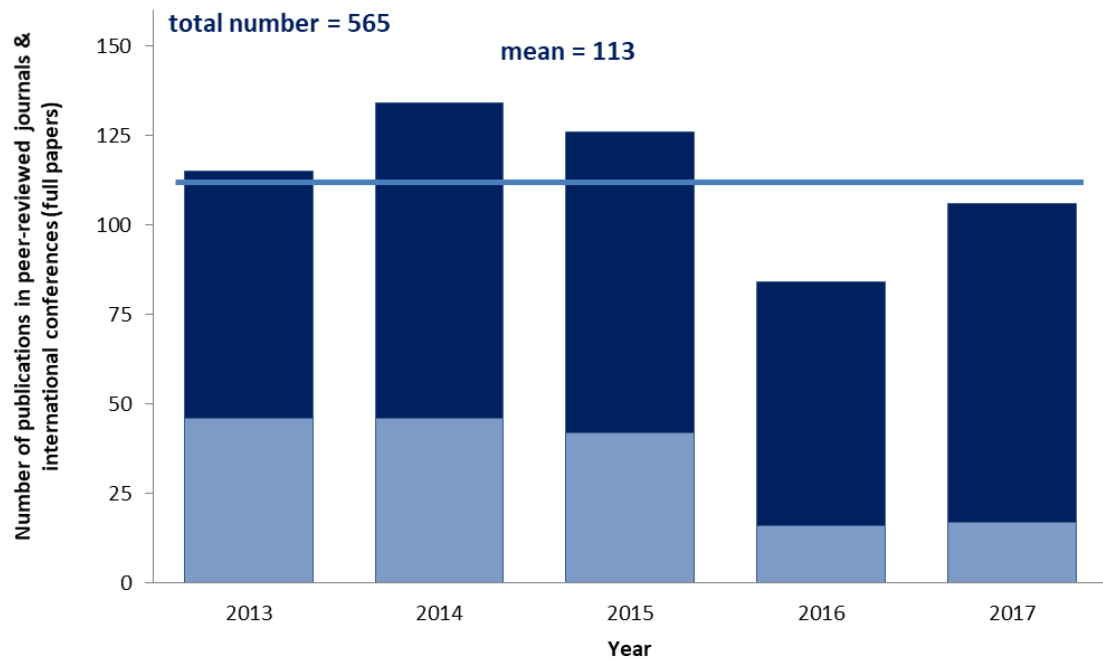
**Figure 12.** Number of citations, IBMRIW, 2013-2017.

During the current evaluation period, the staff of IBMRIW has produced a total of 1175 items (Fig. 13) of which 565 (48%) are in peer-reviewed journals (including full articles in international conferences) (Fig. 14). The number of publications in peer-reviewed journals during 2013-2017 fluctuated between 69 and 89, with a mean annual rate of 80 papers (Fig. 14). The total number of all remaining type of publications was 610, and a mean annual rate of 152 items per year (Fig. 15).

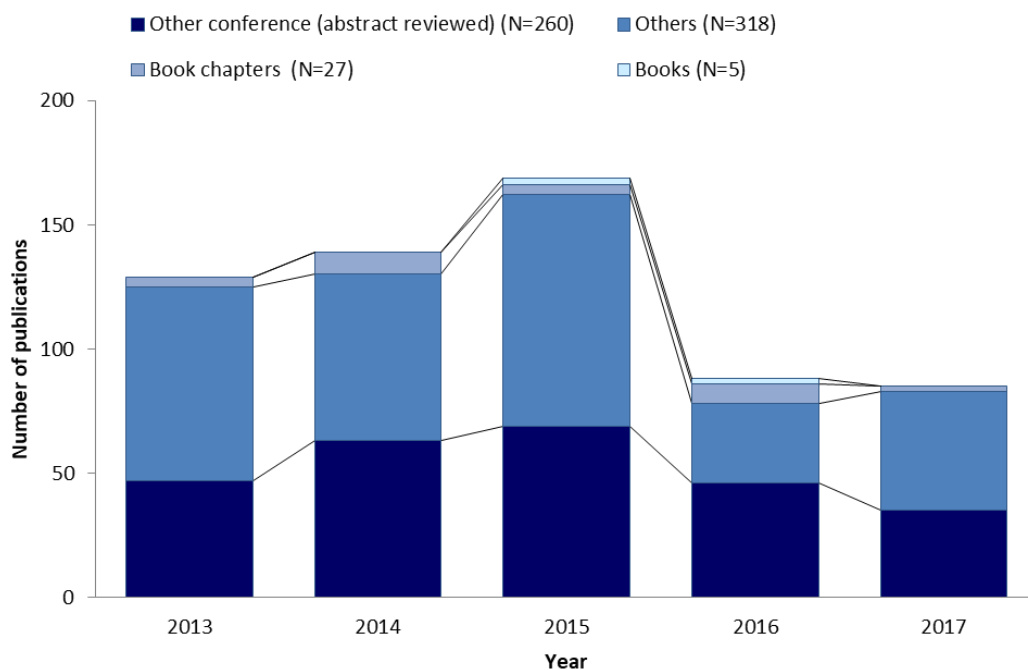


**Figure 13.** Number of publications and % per publication category, IBMRIW, 2013-2017.





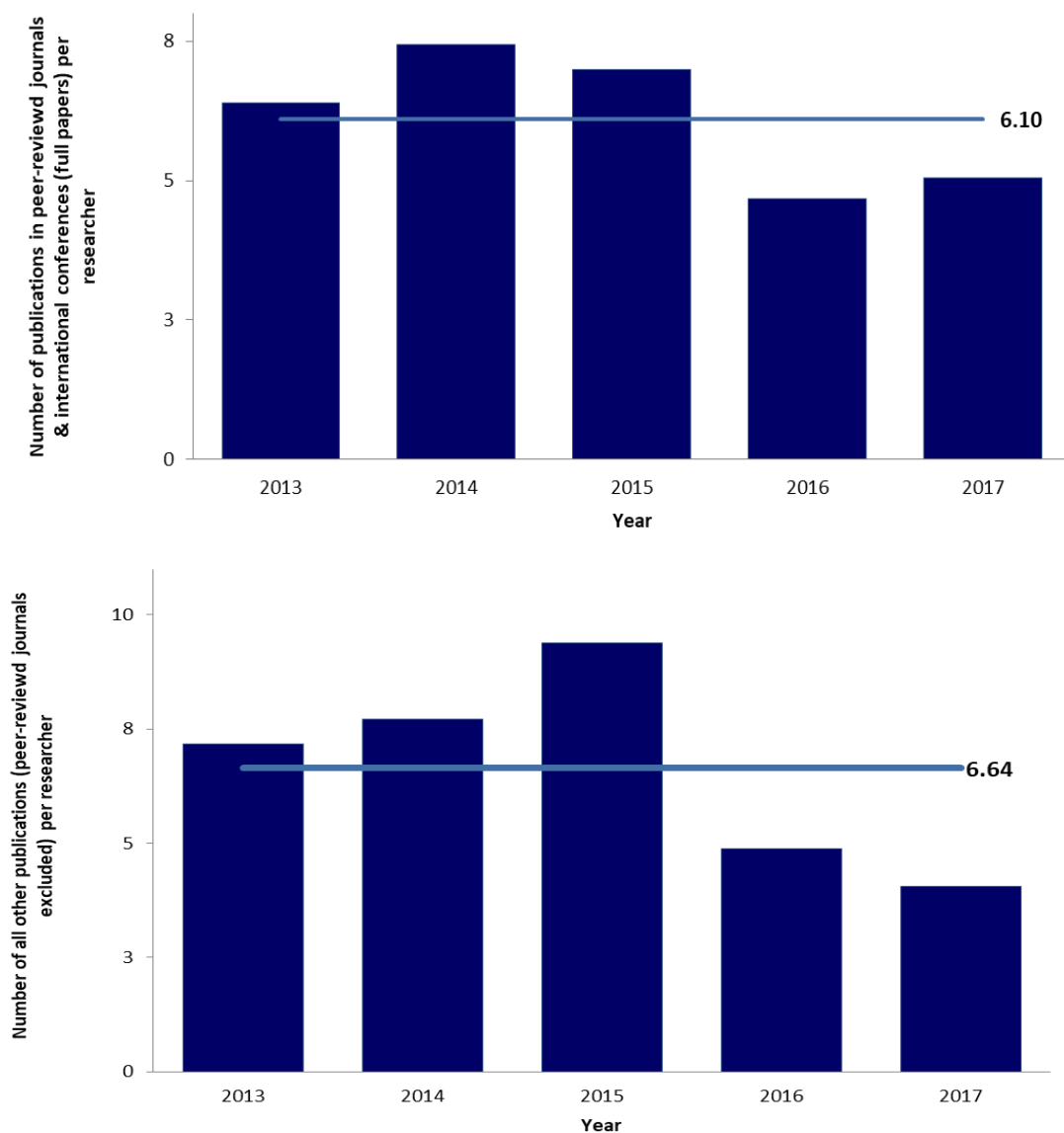
**Figure 14.** Number of publications in peer-reviewed journals (dark blue columns) and full papers in international conferences (light blue columns), IMBRIW, 2013-2017. It should be noted that the decline of full papers in international conferences is attributed to non-available funds due to the discontinuity of the two large projects (i.e. WFD and DCF).



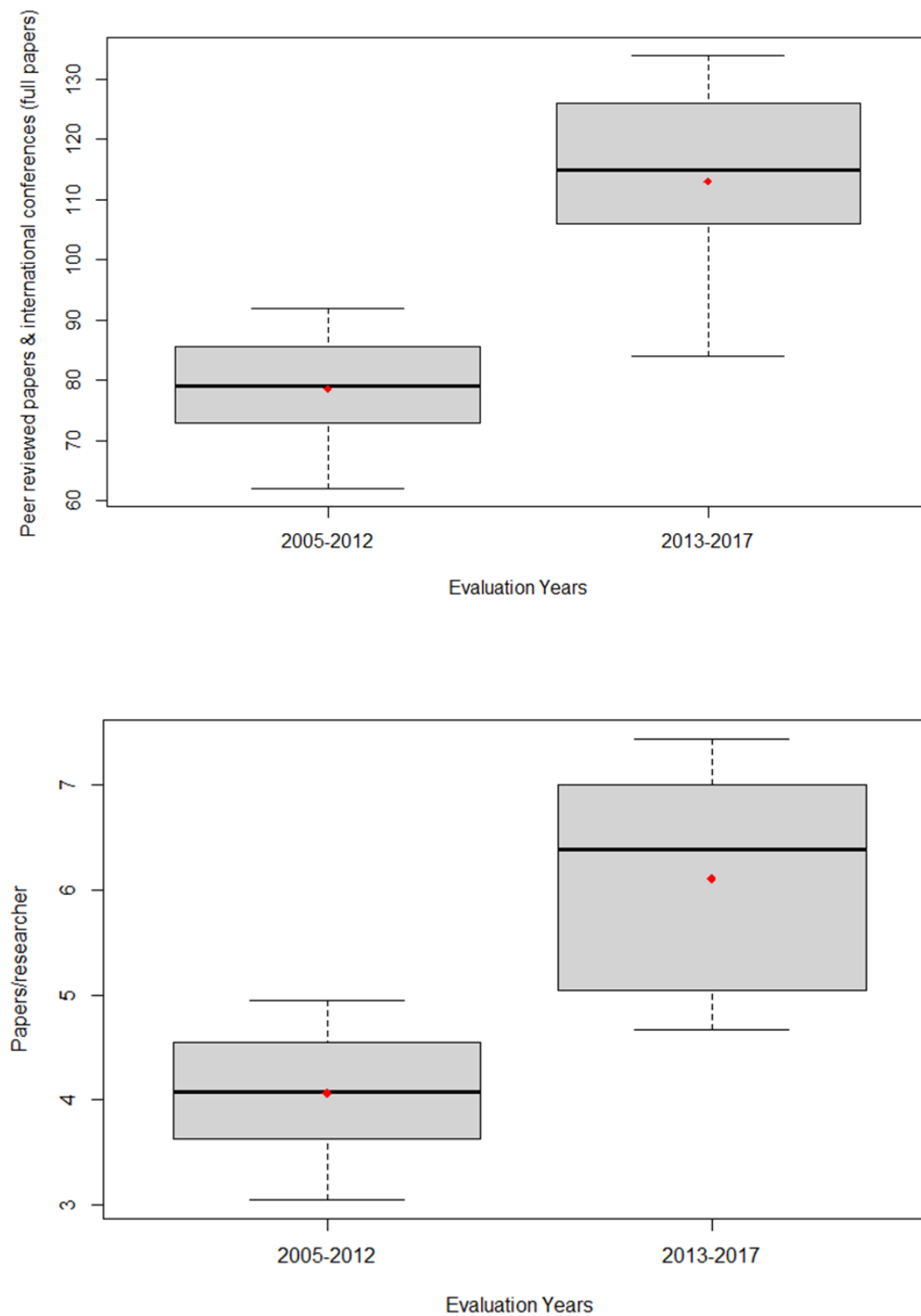
**Figure 15.** Number of all other publications, IMBRIW, 2013-2017. It should be noted that the decline of full papers in international conferences is attributed to non-available funds due to the discontinuity of the two large projects (i.e. WFD and DCF).

The number of peer-reviewed articles in journals, including full papers in international conferences (hereafter articles), per researcher fluctuated between 4.67 and 7.72, with a mean annual of 6.10 articles/researcher/year (Fig. 16, top). In the previous evaluation period (2005-2012), the mean annual was 4.01 (Fig. 17, bottom). The mean annual number of articles increased from 78 (2005-2012) to 113 (2013-2017) (Fig. 17, top).

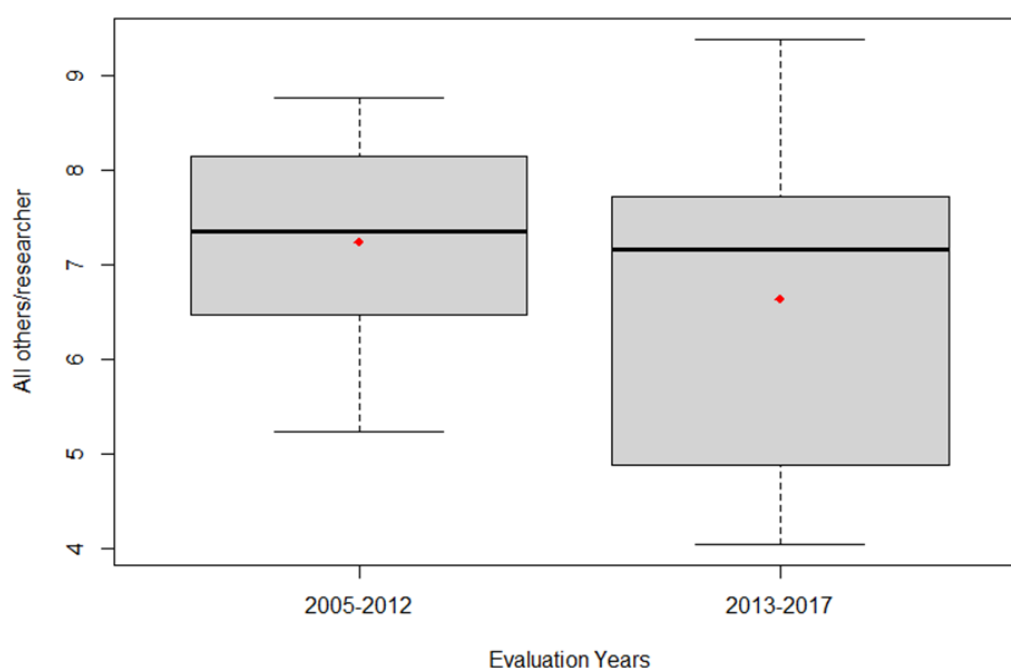
The number of all other published items per researcher fluctuated between 4.05 and 9.89, with a mean annual of 6.64 items/researcher/year (Fig. 16, bottom). In the previous evaluation period (2005-2012) the annual mean number of other publications was 7.2 (Fig. 18).



**Figure 16.** Number of publications per researcher, IMBRIW, 2013-2017. It should be noted that the decline of full papers in international conferences is attributed to non-available funds due to the discontinuity of the two large projects (i.e. WFD and DCF).



**Figure 17.** Box plots comparing the two evaluation periods. Upper graph: Mean, min and max number of peer reviewed papers published in journals and international conferences; Lower graph: Mean, min and max number of peer reviewed papers published in journals and international conferences per researcher. Red dot: Mean; Back line: median.

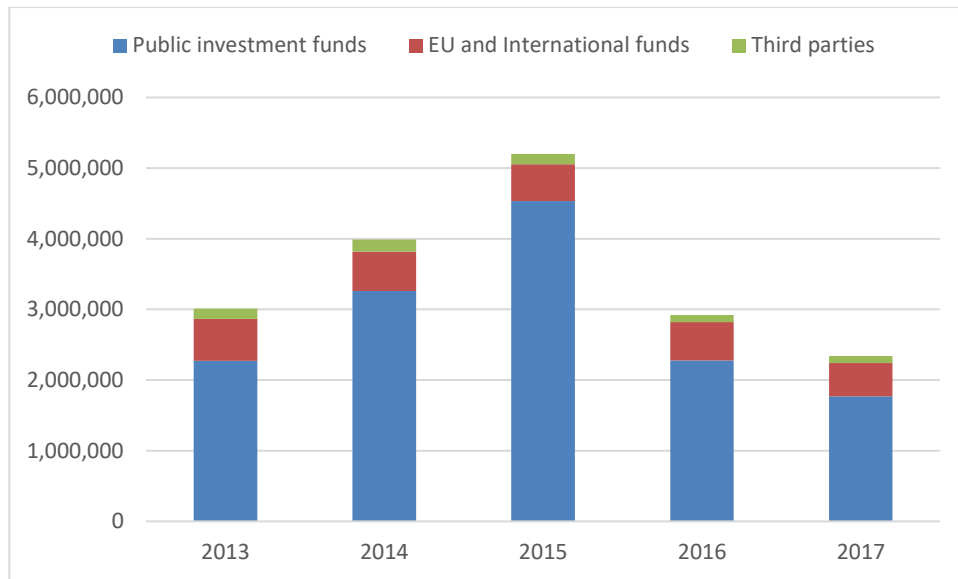


**Figure 18.** Box plots comparing the mean, min and max number of other publications during the two evaluation periods. Red dot: Mean; Back line: median.

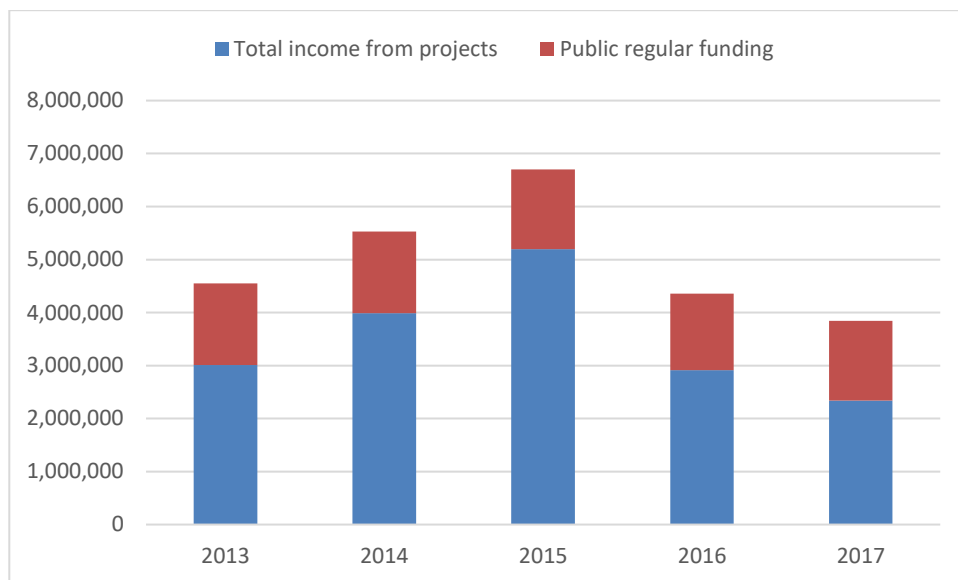
#### 4.3.2 Scientific Projects/Programs and competitive funding

During the current evaluation period, IMBRIW directed its efforts to secure funds through European research projects (FP7, HORIZON2020, LIFE, INTERREG, DG MARE etc.), Public investment / structural funds (NSRF–ESPA, [www.espa.gr](http://www.espa.gr), including projects for the implementation of European policies: DCF, WFD), Public investment funds / national projects and studies, other private legal entities as well as from other International Organizations or foreign public sources.

Overall, IMBRIW has been involved in 83 projects, yielding a total of 17,451,970 Euros. The annual income through all types of projects (Fig. 19) fluctuated between 2.3 and 5.2 million Euros which was higher compared to the previous evaluation period (1.18 and 4.20 million Euros). The annual regular public budget fluctuated between 1.45 and 2.12 million Euros. In general, during 2013-2017, IMBRIW's public regular funding was on average about 30% of the Institute's total income which is a significantly lower figure than the respective one for the period 2005-2012. The average number of active projects per year was 32.2 while the decrease in the income of projects observed after 2015 (Fig. 20) is mainly due to the funding gap that occurred between the end of the last structural funds program period (2015) and the beginning of the new program period.



**Figure 19.** IMBRIW income through projects, 2013-2017.



**Figure 20.** IMBRIW total income from projects and regular public budget, 2013-2017.

#### 4.3.3 Grants

One Research project (ECODISC) was funded under the call "ARISTEIA (EXCELLENCE) II" released by the National Secretariat of Research and Technology (Public investment structural funds). The main objective of "ARISTEIA II" frame was to support highly talented researchers working in Greece who had significant achievements in their field and could contribute to advancing scientific knowledge and broadening its horizons. To this end, high-level research projects were funded by research teams led by a Principal Investigator (PI) and the evaluation of the PI's Curriculum Vitae was decisive for the overall evaluation. The project took place in

2014 and 2015 and addressed a hot topic in fisheries science, i.e., ecological effects of fisheries discards in light of the Landing Obligation as foreseen in the CFP.

#### *4.3.4 Participation in networks of excellence*

IMBRIW participated as a partner in the COFASP Eranet (<http://www.cofasp.eu>). COFASP was an ERA-NET created to directly address actions envisaged within fisheries, aquaculture, and seafood. It was created as under the Knowledge-Based Bio-Economy (KBBE) theme in FP7, and is part of the Europe 2020 strategy, which recognises economy as an important part of the strategy with main objectives (a) to lay the basis for exploitation according to the precautionary principles and to enhance innovation and competitiveness of fisheries, aquaculture and seafood processing and (b) to define the science, information and data necessary to underpin the revision of the CFP and to ensure its successful implementation by designing complementary national research programmes. The project started on February 2013 and ended in January 2017. Through the calls published by the project, Institute for Marine Biological Resources and Inland Waters received funding for one project.

ECOAST - New methodologies for an ecosystem approach to spatial and temporal management of fisheries and aquaculture in coastal areas.

HCMR is a member of EuroMarine; EuroMarine is a European marine science network launched in 2014. It represents the merger of the scientific communities of three former European Networks of Excellence: EUROCEANS, Marine Genomics Europe, Marine Biodiversity and Ecosystem Functioning (MarBEF).

#### *4.3.5 External Collaborations, Networking, Linkages (at Local, National & International level)*

All researchers participated in European, other International and National research projects involving numerous partners, which has resulted in building a broad network of collaborations with Research Institutions, Universities, Conservation Bodies, Management Bodies and other types of organisations. Many of these projects led to topical high profile publications and further networking and proposals/participation in new projects in multidisciplinary consortia with leading WP/task roles. More information on research projects is given in sections A-4.2 and A-4.3.1.

The closest collaborations are with Organizations from the Mediterranean area, mainly from EU countries (e.g., Spain: IEO, AZTI, IMEDEA, CSIC, University of Barcelona; Italy: CNR, OGS, COISPA, CONISMA, CIBM, France: IFREMER) as well as with Organizations from the Eastern Mediterranean and the Balkans (e.g., Croatia: University of Zagreb, University of Split; Serbia: University of Belgrade; Slovenia: Jožef Stefan Institute; Czech Republic: Masaryk University; Institutes, private companies and Universities from Cyprus, Bulgaria, Romania, Montenegro, Kosovo, Albania). Nevertheless, numerous collaborations with scientists and Organizations from Central and North European countries (e.g., Germany: Institute HZM and the Technical

University of Munich; Norway: IMR; Belgium: the University of Leuven, ILVO, University of Ghent; UK: the Zoological Society of London, University of Derby; Denmark: DTU-Aqua), the USA and the Middle East (mainly Institutions from Turkey and Saudi Arabia) have been established. At the national level, there is a strong collaboration with most Universities with relevant scientific field (mainly the Universities of Athens, Thessaloniki, Crete, Patras, Aegean, and the Technological University of Western Greece), with NGOs (e.g., WWF, Hellenic Ornithological Society), with the Fisheries Research Institute (located in Kavala) as well as with private companies.

Cooperation with stakeholders was a priority of the Institute. During 2013-2017, several projects (e.g., PROTOMEDEA, MARISCA, MINOUW, EPILEXIS, DISCATCH) involved professional or recreational fishermen, decision makers, NGOs, the Mediterranean Advisory Council (MEDAC), local and regional authorities or included stakeholder meetings and events that strengthened the collaboration with end users.

Several researchers also pursued short visits in institutions abroad for training and scientific collaboration (e.g., AZTI-Spain; CNR-Italy; IEO-Spain; IFREMER-France, CSIC-Spain; OGS-Italy, IMEDEA-Spain; IMR-Norway).

Furthermore, IMBRIW researchers regularly participated in international workshops and working groups organized by ICES (e.g., WGCOMEDA, WGFAST, WGACEGG, WGCEPH, WKVALMU), FAO GFCM (e.g., stock assessment meetings like WGSASP), ICCAT, STECF (Expert Working Groups related to stock assessment, socio-economics, common fisheries policy, methodological issues of the DCF), EU and other organizations (e.g., EWG of Drin River Basin Management), as well as in MEDIAS and MEDITS annual meetings. Many of them acted as invited experts, moderators or chairs in working groups or in committees (e.g., Moderator in the GFCM - Subregional Committee for the Adriatic Sea, SRC-AS; international scientific advisory board of the NGO "Sustainable Samothraki"; chair of the ICCAT Mediterranean swordfish Group; chair of the MEDITS Steering Committee; co-chair of the ICES WKVALMU).

IMBRIW researchers are members (e.g., FishBase, ESENIAS network on alien species, European Centre for River Restoration, Waterwiki.net, COST actions, Greek Focal Point in the Expert Working Group Monitoring and Information Exchange for the Drin Core Group) or even chairs of international associations and networks (e.g., Network of experts on the effect of Lessepsian species on Fisheries of the Eastern Mediterranean" of the FAO-EastMed Project).

Several researchers are members of journal editorial boards (e.g., *ICES Journal of Marine Science*, *Marine Ecology Progress Series*, *PlosOne*, *Scientia Marina*, *Hydrobiologia*, *Frontiers in Marine Science*, *Mediterranean Marine Science*, *Acta Ichthyologica et Piscatoria*, *Turkish Journal of Fisheries and Aquatic Sciences*) and/or organized special issues in scientific journals on selected hot research topics. One researcher is member of the STECF since 2003. Finally, the director is a permanent member of the EFARO (Organization of the directors of the European Fisheries Institutes) which is important for the collaboration with leading institution in this field.

The above are reflected in the high number of publications of IMBRIW members that were co-authored with international teams in high level journals and symposia, in many of which IMBRIW researchers had the leading role.

#### *4.3.6 Participation to national and European infrastructures*

The Institute participates in the National Research Infrastructure: 'Hellenic Integrated Marine and Inland Water Observing, Forecasting and Offshore Technology System, HIMIOFoTS', which is adopted in the National Roadmap for Research Infrastructures (<https://www.esfri.eu/national-roadmaps>). The first phase of HIMIOFoTS is already funded by the General Secretariat of Research and Technology. Within the frame of "Reconstruction and Modernization of Research Vessel (R/V) PHILIA", which is a synergy between HCMR and the School of Naval Architecture and Marine Engineering of the National Technical University of Athens (NTUA) under ESFRI and began in 2017, (R/V) PHILIA will constitute a modern platform capable to perform avant-garde multidisciplinary research.

#### *4.3.7 Distinctions and other results*

##### Awards, prizes, nominations, outstanding outcomes

Apart from being collaborators of FishBase ([www.fishbase.org](http://www.fishbase.org)), the largest free on-line encyclopaedia on fish, members of IMBRIW have been working closely with the FishBase Consortium towards improving the overall data quality and the amount of information incorporated in it. As a result, IMBRIW was proposed to undertake the management and co-ordination of LarvalBase, which also runs under the umbrella of FishBase. LarvalBase will be further modified, enriched, and updated by the corresponding groups of IMBRIW working on early life stages of fish. Finally, in 2018, it was proposed that ELNAIS will also be included in FishBase/SeaLifeBase and alien species modules will be under the management of the corresponding team of IMBRIW.

The Institute became a key partner in the National Research Infrastructure 'HIMIOFoTS' and particularly in the OpenHi.net component. This initiative aims to create a state-of-the-art National Water Quality and Quantity Monitoring platform that will provide near-real time data for the surface water bodies of the country through automatic, telemetric monitoring stations. IMBRIW is responsible for: a) establishing and maintaining the water quality infrastructure and b) providing early warning and water management services to stakeholders and the public.

## **4.4 Education**

Many researchers taught in undergraduate and postgraduate classes and supervised numerous MSc and PhD thesis strengthening the collaborations with academic members and institutions. They also participated in training courses and organized a summer school.



#### 4.4.1 Undergraduate Theses and Projects, Internships

IMBRIW researchers supervised the practical training of 23 students and the bachelor theses of six students from the following Greek Universities: Aristotle University of Thessaloniki (Department of Biology), National and Kapodistrian University of Athens (Department of Biology, Department of Geology), University of Crete (Department of Biology), University of the Aegean (Department of Marine Sciences, Department of Environmental Sciences), Western Greece University of Applied Sciences (Fisheries & Aquaculture Technology Department), University of Thessaly (Department of Ichthyology and Aquatic Environment), University of Patras (Department of Biology, Department of Environmental and Natural Resources Management), Technological Educational Institute of Ionian Islands (Department of Environmental Technology), Harokopio University (Department of Geography).

#### 4.4.2 Master programs in collaboration with Universities

HCMR co-organizes and operates together with the Department of Biology of the University of Crete an Inter-Institutional Postgraduate (Masters) Program in "*Environmental Biology*" (<https://www.biology.uoc.gr/postgraduate/EnvBiol/>).

In addition HCMR participates in the Inter-Institutional Postgraduate Program of the University of Athens "*Oceanography and Management of the Marine Environment*" (<https://oceanography.geol.uoa.gr/>). An IMBRIW researcher is actively involved in the administration of the course as a member of the Inter-Institutional committee.

A close collaboration with the Biology Department of the Aristotle University of Thessaloniki has been established with many researchers teaching in the Postgraduate Program "*Applications in Biology*" (direction "*Fisheries Biology and Management*") but this collaboration is not yet formally established.

#### 4.4.3 PhD students' supervision

During the current evaluation period 40 PhD students were supervised by IMBRIW members (Table 3), more than double that of the previous evaluation period, and the annual number has increased from 16 in 2013 to 36 in 2017.<sup>2</sup>

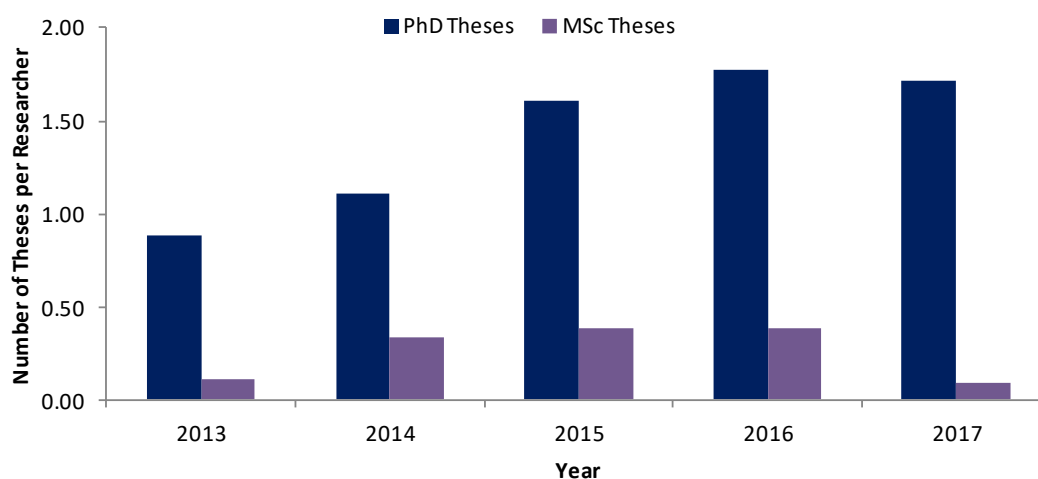
In total, 24 MSc theses were supervised by IMBRIW researchers in the period 2013-2017. The annual number is shown in Table 3. The annual number of masters and PhD theses per researcher is shown in figure 21.

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<sup>2</sup> It should be noted, however, that till 2008, the Greek legal framework did not allow researchers in Institutes to formally supervise MSc and PhD students in Greek universities.

**Table 3.** Annual number of Master theses and PhD candidates.

	2013	2014	2015	2016	2017	Total
PhD	16	20	29	32	36	40
MSc	2	6	7	7	2	24

**Figure 21.** Number of theses per researcher, IMBRIW, 2013-2017.

#### *4.4.4 Number of NSF (IKY), NFRI (ELIDEK) and other scholarships overall and per researcher*

IKY is not eligible; no ELIDEK grant for PhD students; the first ELIDEK call for post-doc researchers opened in 2017, the evaluation of the proposals was completed in 2018 and two IMBRIW post-doc researchers were funded.

#### *4.4.5 Participation in (inter)national educational University programs*

IMBRIW researchers gave lectures in the undergraduate and/or postgraduate programmes of the Aristotle University of Thessaloniki, National and Kapodistrian University of Athens, Harokopio University, University of Crete, Hellenic Open University and the University of the Aegean.

They also supported the bachelor theses of students from the University of the Aegean (Department of Marine Sciences, Department of Environmental Sciences), the University of Crete (Department of Biology) and Western Greece University of Applied Sciences (Fisheries & Aquaculture Technology Department). Apart from the Universities and the Departments already mentioned, IMBRIW researchers supervised MSc and PhD theses from postgraduate programs organized by the Mediterranean Agronomic Institute, the National Technical

University of Athens, the Agricultural University of Athens, the Technical University of Patras and the University of Ioannina.

At the international level, IMBRIW researchers supervised MSc and PhD theses from the University of Cape Town, the Università Politecnica delle Marche, the University of Barcelona and the University of Essen, and participated in the examining committee of PhD theses from the Università degli Studi di Cagliari and the University of Karachi.

#### 4.4.6 Training courses, summer schools etc.

IMBRIW initiated the Samothraki Summer School, a course designed as a ten-day attendance of the summer school in Samothraki Island with the aim to learn and apply aquatic ecology and social ecology approaches in a local setting, while supporting current research and building synergy with the UNESCO Biosphere Reserve process. It is co-organized with the Vienna Institute of Social Ecology (Alpen Adria University, Austria). The course gives students the opportunity to engage in a real-life project and utilise their scientific training to support the process further, namely the creation of a management plan with a set of activities towards sustainability, and a science plan for further research on the island that would also meet local interests.

IMBRIW researchers also trained scientists in Centres for Professional Training and Centres for Environmental Education, the National Centre for Public Administration and Local Government.

## 4.5 Innovation

### 4.5.1 R&D projects

A list of the projects (acronyms and full title or a short description) implemented during the period 2013-2017 is provided in Table 4. For more information see <http://imbriw.hcmr.gr/en/category/projects/research-projects-2013-present/>.

**Table 4.** IMBRIW Projects during the period 2013-2017.

Acronym	Title/description
ADRIPLAN	Adriatic Ionian Maritime Spatial Planning
AGOGOS T.A.P.	Ecological quality of waters and soil along the eastern part of the Trans Adriatic Pipeline
AMARE	Actions for Marine Protected Area
AMVRARIKOS	Identification, consequences and management of the anoxic zone of Amvrakikos Gulf (NW Greece)
ANATHALLOI (KRIPIS II)	Development of management tools for marine and lake ecosystems
AQUASEC	Aquatic & Social Ecology: Theory and Practice (Summer school)
ARCH	Architecture and roadmap to manage multiple pressures on lagoons

Acronym	Title/description
ASRAL	Alien Species Risk Assessment
BEMTOOL	Bio-Economic Modelling TOOLS: Development of an integrated bio-economic modelling tool to develop and support multi-objective approaches for fisheries management; MAREA framework
BENTHIS	Benthic Ecosystem Fisheries Impact Studies
BOATSEINE 2013	Update the scientific documentation of the Greek management plan for boatseine (2013)
BOATSEINE 2015	Update the scientific documentation of the Greek management plan for boatseine (2015)
CERES	Climate change and European aquatic Resources
COFASP	Cooperation in Fisheries, Aquaculture and Seafood Processing (COFASP: Towards a future layout of the positioning, organization and financing of programs and projects on Fisheries, Aquaculture and Sea Food Processing)
CORALFISH	Assessment of the interactions between corals, fish and fisheries, in order to develop monitoring and predictive modelling tools for ecosystem based management in the deep waters of Europe and beyond
COST training school	Alien Challenge (Rhodes Island). Training School focusing on marine survey skills and Invasive Alien Species identification
CREAM	Coordinating research in support to the application of EAF (Ecosystem Approach to Fisheries) and management advice in the Mediterranean and Black Seas
DCF 2013	National Fisheries Data Collection Project (EC Regulation 199/2008) (2013)
DCF 2014	National Fisheries Data Collection Project (EC Regulation 199/2008) (2014)
DCF 2015	National Fisheries Data Collection Project (EC Regulation 199/2008) (2015)
DCF 2016	National Fisheries Data Collection Project (EC Regulation 199/2008) (2016)
DCF 2017-19	Implementation of actions of the National Fisheries Data Collection Project (EC Regulation 1004/2017) (2017-2019)
DEEPEASTMED	State of the knowledge of deep-water vulnerable species and habitats in the Eastern Mediterranean
DEVOTES	Development of Innovative tools for understanding marine biodiversity and assessing good environmental status
DISCATCH	Pilot project on catch and discard composition including solutions for limitation and possible elimination of unwanted by-catches in trawl net fisheries in the Mediterranean
DRIFTMED	Identification and characterization of the small-scale driftnets fisheries in Mediterranean; MAREA framework, specific contract No 8
DRUMFISH	Approaches to Management for Data-Poor Stocks in Mixed Fisheries
ECOAST	New methodologies for an ecosystem approach to spatial and temporal management of fisheries and aquaculture in coastal areas
ECODISC	Ecosystem effects of fisheries discards
ECOFLOW	Environmental flows downstream of dams
ECONET	Fish Fry Protecting Devices
ECOPARKS	Fish protection pilot parks
EPILEXIS	Selectivity of the diamond and square mesh of the trawl codend, biological and economic consequences and comparative study of fish behaviour

Acronym	Title/description
EPPERAA - Eight Prefectures	Ecological quality monitoring of waters, rivers, littoral & transitional waters of Greece – Implementation of the Article 8 of the Directive 2000/60/EC, Eight Prefectures (Eastern Macedonia & Thrace, Epirus, Thessaly, Ionian Islands, Western Greece, Peloponnese, Northern Aegean and Crete) (2012-2015)
EPPERAA - W. MACEDONIA	Monitoring and Recording of the Water Status (Quality, Quantity, Pressures, Use) in Greece (W. Macedonia)
ESENIAS	East and South European Network for Invasive Alien Species - a tool to support the management of alien species in Bulgaria
FISH FAUNA-NATURA	Threatened Fish Species Surveillance - NATURA
FISHINMED	Mediterranean Network of sustainable small-scale fishing communities
FLAGS	Evaluation and impact assessment activities for Axis 4: Fisheries Local Action Groups
GGDDFF	Greek Georeferenced Distribution Data for Freshwater Fish
GLOBAQUA	Managing the effects of multiple stressors on aquatic ecosystems under water scarcity
GREECE - ROMANIA	Study for the Exploration and Implementation of the Ecosystem Approach to Fisheries in the Ionian Sea and Black Sea
GYAROS MPA	"Gyaros MPA" fisheries knowledge survey: assessing a pristine Mediterranean biodiversity hotspot
HORSCAN	Invasive Alien Species - Prioritising prevention efforts through horizon scanning
IMBRIW - SIEMENS	Development of a decision support tool for the sustainable management of water resources, in combination to the optimisation of power production
KRIPIS I - IMBRIW	Integrated Management of the Water Catchment Area and the Coastal Zone
LAKE VOLVI	Development of ecosystem-based fishing model for the management of Lake Volvi
LANDMED	Implications of the implementation of the landing obligations provisions in small pelagic fisheries in Mediterranean; MAREA Framework specific contract no 11
LIFE EUROTURTLES	Collective actions for improving the conservation status of the EU sea turtle populations
MAREA - IT	Mediterranean Aleutic Resources Evaluation and Advice (a consortium of European research Institutes and Centres with expertise in fisheries research)
MARISCA	Marine Spatial Conservation Planning in the Aegean sea
MEDCOOP	Strengthening regional cooperation in the area of fisheries data collection in the Mediterranean and Black Sea
MEDISEH	Mediterranean Sensitive Habitats; MAREA framework
MEDPEL	By-catches of pelagic longline fisheries in the Mediterranean; MAREA framework
MEECE	Marine Ecosystem Evolution in a Changing Environment
MERCES	Marine Ecosystem Restoration in Changing European Seas
MESMA	Monitoring and Evaluation of Spatially Managed Areas
MESSINIAN STREAMS	Triennial monitoring and assessment of the ecological status of Messinian streams
MINOUW	Science, Technology, and Society Initiative to minimize Unwanted Catches in European Fisheries
MORNOS	Detailed rainfall mapping, assessment of the water budget of the reservoir Mornos and forecasting extreme rainfall events
MUSES	Multi-Use in European Seas
MYFISH	Maximising yield of fisheries while balancing ecosystem, economic and social concerns

Acronym	Title/description
NETMED	Planning a network of marine protected areas for the Mediterranean Sea
ODEMM	Options for Delivering Ecosystem- based Marine Management
ODYSSEA	Operating a Network of Integrated Observatory Systems in the Mediterranean Sea
PEGASO	People for Ecosystem Based Governance in Assessing Sustainable Development of Ocean and Coast
PIKRODAFNI - VOURKARI	Monitoring water quality in Pikrodafni stream and Vourkari wetland
PIKRODAFNI STREAM	Assessment of the Ecological Status of Pikrodafni stream
PLESIONIKA MANAGE	Management of the pandalid shrimp Plesionika
PROTOMEDEA	Towards the establishment of Marine Protected Area Networks in the Eastern Mediterranean
RECFISH	Recovery of Fisheries Historical time series for the Mediterranean and Black Sea stock assessment
RECOLAPE	Strengthening Regional Cooperation in the area of large pelagic fisheries data collection
REPHIL	Hellenic Research Fleet / reconstruction of the research vessel - PHILIA
RESILIENT	Population assessment of the Corfu killifish and other Greek endemic freshwater species using established and innovative methods
RISKA	Risk assessment for <i>Hemigrapsus sanguineus</i> and <i>Rapana venosa</i>
SEAOFSKILLS	Enriching Fishers' Knowledge, Skills and Competences (Erasmus+ Programme)
SOCIOEC	Socio economic effects of management measures of the future CFP
STOCKMED	Stock units: Identification of distinct biological units (stock units) for different fish and shellfish species and among different GFCM-GSAs; MAREA framework, Specific Contract No7
STREAM	Strengthening Regional Cooperation in the Area of Fisheries Biological Data Collection in the Mediterranean and Black Sea
SUSY	Surfacing system for ship recovery
THALIS - UNIVERSITY OF PIRAEUS	Development of New Material from Disused Biomass for Hydrocarbon Adsorption in Aquatic Environment
TRAWLPLAN	Management plan for the demersal trawl fisheries in the Greek seas
YMEPPERAA - OPY	Monitoring and Recording of the Water Status (Quality, Quantity, Pressures, Use) in Greece

#### 4.5.2 Patents and IP's

A patent was submitted in 2017 and was granted in 2018 (patent no 20170100391). “Fishnest: an apparatus for protecting juvenile fish”.

#### 4.5.3 Quality assurances

There are several quality assurance processes followed in the Institute mainly in the various laboratories that follow international scientific standards for the chemical and biological analyses as well as in the main database of the Institute. Especially concerning the database,

various quality assurance processes are provisioned to ensure high quality data and a working group consisting of three researchers is responsible for supervising and double-checking the formulas and outcomes of the database.

#### *4.5.4 Qualification to provide accreditations and certifications to others*

None

#### *4.5.5 Commercialization of research results (Spin Offs, etc.)*

None

### **4.6 Impact to the Society and Economy**

#### *4.6.1 Advisory role for the state, participation in crisis management*

The activities of IMBRIW:

- Enhance ecosystem services (i.e. by increasing the economic, cultural and aesthetic value of the aquatic and riparian environment, advancing its potential for ecotourism development, increasing the welfare of fisheries communities and protecting public health). This is accomplished through information dissemination, consultancy services and the elaboration of management plans for the sustainable use and conservation of natural resources to the benefit of the society at large
- Contribute to sound environmental and fisheries policy making, at the regional, national and European levels, through their participation in various council bodies (e.g. Hellenic fisheries council, Hellenic Water Council, ICCAT, GFCM, IUCN, STECF, Drin Core Group)
- IMBRIW also regularly contributes to the permanent relevant committees of the Hellenic Parliament
- Include quick response to environmental crisis events (e.g. oil spill in Saronikos Gulf, jellyfish blooms and fishing in Korinthiakos Gulf, mass fish kills in Spercheios basin and other areas)
- Are characterized by a strong interaction with stakeholders (fisher associations, consumer associations, other associations and public authorities) providing them general and technical advice as well as training on issues related to the conservation of aquatic resources and ecosystems. In several cases, stakeholders (fishers' associations, Developmental Companies, Municipalities, other authorities) participate, through the co-operation with IMBRIW, in EU projects.

#### *4.6.2 Dissemination and outreach of Scientific Knowledge*

During the current evaluation period, IMBRIW had original contribution to addressing high-order scientific questions (see Fig. 22 in section C), including alien-species dynamics, status

assessment and conservation of endemic freshwater fish, identification of essential habitats—habitat mapping, effect of fishing on marine ecosystems, optimum exploitation of marine stocks, aquaculture-fisheries-environment interactions, assessment of ecological status in surface waters, structural and functional ecosystem aspects, temporary aquatic ecosystems, integrated river basin management.

Indicative of the above is the fact that during the evaluation period, the IMBRIW staff has been actively involved in FP7, HORIZON2020, LIFE, COST, INTERREG and DG MARE funded relevant European projects, as well as in other international projects (e.g. ADRIPLAN, AMARE, ARCH, BEMTOOL, BENTHIS, CERES, COFASP, CORALFISH, CREAM, DEEPEASTMED, DEVOTES, DISCATCH, DRIFTMED, DRUMFISH, FISHINMED, FLAGS, GLOBAQUA, **GYAROS MPA**, LANDMED, LIFE EUROTURTLES, MEDCOOP, **MEDISEH**, **MEDPEL**, MEECE, MERCES, MESMA, MINOUW, MUSES, MYFISH, ODEMM, ODYSSEA, PEGASO, **PROTOMEDEA**, RECFISH, RECOLAPE, SEAOFKILLS, SOCIOEC, STOCKMED, STREAM, SUSY)<sup>3</sup> resulting in many original scientific publications (see also section ‘A-4.3 Academic output’).

Several activities within the projects enhanced public awareness in environmental conservation issues, since the intense public informative campaigns (especially targeting primary and secondary school students) sensitize people to environmental conservation issues and accredits the long-term preservation of valuable resources.

Furthermore, IMBRIW researchers participated in training of aquatic and fisheries related courses in Universities and high education establishments as visiting professors.

IMBRIW researchers regularly participate as invited speakers in workshops organised by NGOs, fisheries associations, local authorities, etc.

In addition, there was an active presence of IMBRIW researchers in the mass media. Special tributes on IMBRIW scientific output, consulting and notifying on crisis phenomena and special dedications to the Institute projects were some of the topics.

More specifically, publications in the daily printed press (e.g. “*Vima-Science*”), scientific magazines (e.g. “*Science*”), appearances on TV (e.g. “*SKAI TV*”) or radio (e.g. “*Proto Programma*”) broadcasts and mainly on several news webpages (e.g. “*VICE*”, “*real.gr*”, “*ANT1news*”, “*Tech Talks Central*”, etc) contributed to public awareness on various environmental issues, such as conservation and preservation of natural resources ([http://imbriw.hcmr.gr/en/portfolio\\_category/press-article/](http://imbriw.hcmr.gr/en/portfolio_category/press-article/) and [http://imbriw.hcmr.gr/en/portfolio\\_category/public-awareness/](http://imbriw.hcmr.gr/en/portfolio_category/public-awareness/)). The most influential of these dedications to the IMBRIW’s work are the 11 features of *Vima-Science* (the special section on science of the largest Greek Sunday newspaper “*Vima*”), as well as the three high-profile documentaries on IMBRIW’s work; one by VICE (<https://www.vice.com/gr>), the “*Guardians of the Aegean*” and the multi-awarded documentary “*THALATTA*” which was

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<sup>3</sup> with bold are marked the projects coordinated by IMBRIW members.



created by a team of students from the Department of Biology of the Aristotle University of Thessaloniki.

#### *4.6.3 Services & Research Applications*

During the evaluation period, IMBRIW, gave input for the monitoring of a Management plan for purse-seines and another one for trawls, while a new management plan for boat seine was adopted by STECF. The Institute is the official data base administrator for marine cetaceans and turtles standings in Greece. A member of the Institute has been also actively involved in the preparation of the new Regulation (9.9.2013) on the prevention and management of the introduction and spread of invasive alien species (<http://ec.europa.eu/environment/nature/invasivealien/docs/proposal/en.pdf>).

IMBRIW provided support to the Ministry of Agriculture, DG-Mare and MEDAC regarding the implementation of the Landing Obligation.

Moreover, IMBRIW has developed significant hydrometeorological services and tools such as:

- <http://meteo.hcmr.gr/> and <http://hydro-data.hcmr.gr/> which provide weather and hydrologic forecasts on an operational basis for the entire country
- platforms for the dissemination of research data (<http://naias-data.hcmr.gr/>, <http://imbriw.hcmr.gr/en/automatic-monitoring-data-map/>)
- tools for the estimation of environmental water requirements (<http://imbriw.hcmr.gr/en/tools/>)
- Geographical Information System tools for fisheries applications, remotely operated instruments to assess trawling impacts.

#### *4.6.4. Other activities Relevant to Socioeconomic Impact (e.g. cultural heritage)*

Other activities with socioeconomic impact were:

- the creation of new jobs, i.e. scientific and technical personnel is employed either at the Institute or at the implementation sites of the IMBRIW projects, which leads to direct monetary flow at the projects' implementation sites (subcontracting local companies for various final construction plans, constructions, fieldwork, e.g. in Life projects) and
- the training of undergraduate and postgraduate students, thus increasing their potential to get a specialized job.

### *4.7 Access policies for the Institute's Facilities and Infrastructures*

#### *4.7.1 Access policy for researchers*

The access policy for the Institute's infrastructure is determined by the governing body of the infrastructure in collaboration with the Scientific advisory board and the Director of the Institute. Access is granted after written applications which are examined by the above

responsible bodies and a justified decision is made. The common practice is to facilitate the use of infrastructure if this is not affecting negatively the infrastructure or the Institute itself.

#### 4.7.2 Access policy for firms and third parties

IMBRIW facilities and infrastructures are accessible after an application procedure, through the HCMR Board of Directors. Applications are assessed based on case by case criteria, nevertheless, applications from scientists of public bodies are almost always accepted. Regarding accessibility to IMBRIW data, a code of conduct is already prepared controlling all relevant issues.

## B. Level of adoption of the recommendation of the previous evaluation

The previous evaluation recommendations concerning IMBRIW are addressed as follows:

1. There is no well-defined action plan with SMART objectives and milestones for delivery. It is recommended that an action plan is prepared in consultation with all members of staff as a matter of urgency covering both ongoing activities and proposed new actions. This should help define resource needs better and set targets for both delivery and application for new funding. The plan should be outdated on annual cycle"

*In the 2013 Business plan of the Institute, a series of objectives were set in detail, after consultation with all members of research staff; these objectives were very specific and realistic, as evident by the fact that the vast majority of them were attained during the current evaluation period (see section C1.1). Furthermore, these objectives were set based on the various expertise of the Institute's staff, both at the level of the Institute by the Institute's Scientific Board, as well as at the level of each IMBRIW sector. The time schedule of their realisation was regularly updated and modified, based on the funding sources available within the evaluation period. All these objectives had concrete and measurable outcomes in the form of increased academic publications (see 4.3), MSc and PhD supervisions (see 4.4.), modelling tools and other concrete services, such as management plan and data provision (see 4.6).*

2. The Institute has a well-defined vision to improve and disseminate knowledge, and towards developing/applying of state-of-the-art tools. They also aim to increase their policy-relevant advisory role and address high-order research questions. There is, however, less indication of how they are going to deliver these ambitions or develop the research questions. It is recommended that the Institute should make full use of their international advisory panel and develop a strategic programme of research activities, including identifying cross-cutting themes, reinforcing the cohesion of this Institute. As part of this activity they should explore the how the Institute can utilize their expertise to be at the forefront of emerging fields of aquatic sciences to be more innovative than investigative."

*IMBRIW's international advisory panel comprises of scholars with a high profile (see section A-2.1.2). Yet, financial constraints did not permit making full use of the panel. However,*

*meetings with individual members of the advisory panel took place during 2013-2017. A possible means to mitigate this, in the future, could be the use of teleconference for a more regular consultation with all members of the advisory panel. Given the financial landscape improvement and the fact that IMBRIW has now secured permanent small internal funds derived from the Centre's overheads (an achievement of the three directors during 2014) the external advisory committee is planned to be invited for such an action during 2019 and 2021.*

*Projects related to four large EU Directives (Habitats Directive (HD), DCF, WFD and MSFD), as well as the KRIPIS and ANATHALLOI projects, strongly improve the cohesion of the Institute, due to their highly multidisciplinary nature, with two of these projects also involving co-operation with the Institute of Oceanography (IO).*

*During the current evaluation period, a series of innovative activities were undertaken, such as the operational weather forecasting platform ([meteo.hcmr.gr](http://meteo.hcmr.gr)), the implementation of hydroacoustic technology on the estimation of plankton biomass, new fishing gear technology design, the creation of scientific tools for the estimation of ecological flows, ground water vulnerability and pollution risk, flood risk assessment, etc (<http://imbriw.hcmr.gr/en/tools/>).*

3. The RC expressed caution over the widening of the research areas beyond those currently undertaken and recommends developing collaboration with other research institutions and universities in the first instance to formulate ideas and consolidate research direction, particularly in relations to resource/environmental economics."

*The scope of research areas undertaken by IMBRIW is dependent on the need to cover large scale scientific questions, using both its own research human resources, as well as by developing collaboration with other research institutions and universities, with expertise on environmental economics, such as ATHENA and the ALTERRA Research Institutes, within the frame of multi-disciplinary consortia in projects, such as GLOBAGUA, PROTOMEDEA, MARISCA, ADRIPLAN. Furthermore, a new research position on environmental economics in IMBRIW was foreseen in 2017 and procedures are expected to be concluded in April-May 2019.*

4. Regular, preferably annually but at least every two years, meeting with the international advisory board should be scheduled. These should focus on identifying gaps and defining strategies for development and research."

*This was not realized, due to financial constraints. IMBRIW is fully aware of this shortcoming, and plans to mitigate this by exploring other ways of succeeding to arrange such meetings (e.g. through teleconferences). Given the financial landscape improvement and the fact that IMBRIW has now secured permanent small internal funds derived from the Centre's overheads (an achievement of the three directors during 2014) the external advisory committee is planned to be invited for such an action during 2019 and 2021.*

5. Productivity goals should be established for the researchers. For example, a minimum number of SCI publications and supervision of a minimum of one PhD student per year

should be targets. In addition, each research should be set targets for funding; all submissions should be peer reviewed and measured against the rate of success to avoid high submission failure.”

*There are general standards set by the legal frame concerning the promotion of researchers. These standards are updated internally and/or further specified internally according to the discipline. For IMBRIW, the results of the last 5-year self-evaluation set a minimum standard for the promotion of researchers in the future (e.g. if the self-evaluation reveals an average of 4 papers/year/researcher then a researcher in order to be promoted from one grade to the next during a 3-years period must have at least 12 publications). In addition, unproductive scientists are either not promoted (when they have no outside competition) or replaced by more competent ones (as was the case one scientist who lost its job because the outside candidate from JRC had a better CV). Nowadays, for instance, there is a minimum of 32-35 publications in journals and one main project as leader in order to be promoted to Researcher B and a minimum of 45-50 publications (and coordination of a project) for being promoted to Researcher A. In addition, since 2014 there is an internal memo by the director asks for at least a PhD student and/or Postdoc to be involved in every new project of the institute (as well as researchers from all three regions to be involved).*

6. The institute has depended heavily on EU funding in the past... must consider diversifying their resources of funding and develop a strategic plan towards funding policy...This includes, nit is not limited to, wider European-wide programmes, moving into third countries, especially the Middle East and North Africa, to support their research and development activities, applications to global charities and donor agencies, and working with international consultancy groups on aquatic resource management problems, With regard to Life projects, sources other than the government should be explored, especially companies that in the future will be carrying out the restoration projects (i.e. construction companies).”

*IMBRIW is already moving towards that direction, and has projects funded by international NGOs, such as MAVA and AG Leventis foundations and the Zoological Society of London, companies, such as Hellenic Petroleum and ASPROFOS S.A, or Greek NGOs, such as the Hellenic Ornithological Society. Also wider European projects were implemented by consortia with participation of IMBRIW, as well as institutes from third countries (e.g. projects GLOBAQUA, ESENIAS TOOLS). Efforts were also made to secure funding from third countries, yet not successful, which however continue.*

*In recent LIFE projects there is not anymore financial contribution from the government.*

7. To insure long-term stability of the IMBRIW, renewal of the personnel, with hiring of young, highly qualified researchers is highly recommended. Positions for researchers should be advertised internationally.”

*This is an issue that IMBRIW still faces, due exclusively to constraints imposed by the Central Administration. Yet, during 2017-2018, three new researcher positions were allocated to the Institute, two of them already filled-in and one expected to be filled in April May 2019. All new positions calls (temporary and permanent) are uploaded on HCMR website, and other media, in order to have an international circulation. The technical –scientific*

*personnel that were promoted to researchers, though not significantly lowering the average age of researchers, also constitute staff renewal.*

8. Greater focus on national fisheries management issues and priorities is required.”

*This has always been one main objective for IMBRIW and is strongly depicted by the construction of a management plan for Greek demersal trawl fisheries (2013), updates on the management plan for the Greek boatseine fisheries (2013, 2016). In fact, this cannot be otherwise given that IMBRIW has been the main actor of the DCF in Greece, hosting the corresponding database, on which any management action is, or should be based. IMBRIW also responds to all requests and advises the implicated ministries on a constant basis. For instance during the last 2 years more than 8 times members of IMBRIW have met with the Minister of Agriculture discussing issues related to national fisheries management. An excellent example of focusing on national fisheries management is the immediate reaction of IMBRIW to the district attorney request on the relation between the recent jellyfish bloom in Korinthiakos Gulf with local overfishing. All IMBRIW researchers related to fisheries devoted together more than 5 months pro-bono work to compile a thorough study on this issue.*

9. More emphasis should be given to coastal, small-scale fisheries management, including socio-economic aspects, spatial management and conflicts with other stakeholders.”

*Small-scale fisheries has always been on the spot-light in IMBRIW's research. This is simply justified by the fact that they comprise a large component of the Data Collection Framework project, their activities are monitored, and socio-economic aspects of the sector are thoroughly examined. In addition, IMBRIW undertook the compilation and update of the Boat Seine Management plan. Moreover, through MSP planning, mitigation of conflicts with other stakeholders are being explored, and alternatives have been proposed to small-scale fishers, such as the development of pescatourism. In the latter case, a publication in a peer reviewed journal was produced, on a Pan-European scale<sup>4</sup>, while through the MUSES project, an award was granted by GFCM (2018) for work done on pescatourism as a case of best practice in small-scale fisheries<sup>5</sup>.*

10. Given the large number of commercial species that are not currently assessed.... data poor methods for stock assessment should be explored.”

*This is an on-going goal for IMBRIW. During 2013-2018, through the participation in an EU-funded project (DRuMFISH), approaches for managing data limited stocks in mixed fisheries were developed. In addition, a data poor assessment for *Pagellus bogaraveo* was applied in DEEPFISHMAN project.*

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<sup>4</sup> Piasecki W, Głąbiński Z, Francour P, Koper P, Saba G, Molina García A, Ünal V, Karachle PK, Lepetit A, Tservenis R, Kizilkaya Z & Stergiou KI. 2016. Pescatourism—A European perspective. *Acta Ichthyologica et Piscatoria*, 46 (4): 325-350

<sup>5</sup> Vassilopoulou V, Calado HMGP, Bocci M, Depelegrin D, Karachle PK, Maniopoulou M, Ramieri E, 2018. The Case of Pescatourism as a Multi-Use in the sea (Muses H2020 Project). In: Cases of Best Practice in Small-Scale Fisheries, GFCM HLC Session 2, Malta September 2018

11. Monitoring and assessment of recreational and subsistence fisheries should be included as a goal for the institute."

*This is an on-going goal for IMBRIW. During 2013-2018, some first works on recreational fisheries took place (e.g. PROTOMEDEA project and a publication was submitted; another high profile publication with an international team of authors has been published) and recreational fisheries are starting to be regularly monitored within DCF.*

12. Small scale fishing vessel spatial and effort monitoring using "blue boxes", should be implemented in a pilot study... Information on individual vessel, gear specific spatial distribution of effort linked to landings will provide an enormous step forward in terms of quality and quantity of data for management of small-scale fisheries."

*Small-scale fisheries has always been on the spot-light in IMBRIW's research. They comprise a large component of the DCF project, and their activities are monitored, on a gear-specific spatial scale. In relation to the application of "blue boxes", however, any attempt has proven impossible as fishers were reluctant to be involved in such efforts even as "pilot studies". Recognizing the importance of gathering spatial information on fishing activities by small-scale fisheries' vessels, IMBRIW performed dedicated surveys to record catch statistics data using participatory GIS methods. These surveys were conducted within the projects ECOAST and AMARE and they have been also used to "groundtruth" the methodology developed by members of IMBRIW on the spatial distribution of effort by small-scale fisheries' vessels. The substantial spatial overlap between the two methods suggests that they can be used in a complementary way for the study of the small-scale fisheries footprint, although the inherent uncertainty of both methods underlines the need to adopt VMS technologies for monitoring small-scale fisheries' activities, and the proposal COM (2018) 390 final is definitely towards this direction*

13. There appear to be a major disconnect between the role of the institute with regards implementation of the WFD. They are heavily involved in the data collection side yet are not involved in the preparation of the River Basin Management plans, which are contracted to the private sector."

*Efforts have been made to fully exploit IMBRIW's advisory role in the preparation of the River Basin Management Plans (RBMPs), within the limitations posed by the nature of its role. Nevertheless, a greater involvement in both preparation and especially implementation of RBMPs is a matter of Central Governmental Policy.*

14. The RC was concerned about the lack of a dedicated hydrological network. It is recommended that appropriate staff at IMBRIW and the Institute of Environmental Sciences and Sustainable Development develop an active collaboration to provide necessary support and infrastructure to fill this gap."

*During the current evaluation period, a research infrastructure commenced, aiming to create a national hydrological network in collaboration with the Institute of Environmental Sciences and Sustainable Development (NOA).*



15. More personnel for managing international projects should be hired. If possible, there should also be a unit within the institute of personnel whose job is to provide information on possible sources of funding and help with proposal preparation and submission.”

*This role is undertaken by HCMR's Central Administration (Research project office). At the Institute level, there is constant support on possible sources of funding and proposal preparation and submission by the secretarial personnel.*

### C. Strategic goals, scientific and technological priorities for the period 2013-2017

#### 1 Strategic Goals of the evaluation period

IMBRIW's past, present and future research directions and main questions addressed are summarized in figure 22.

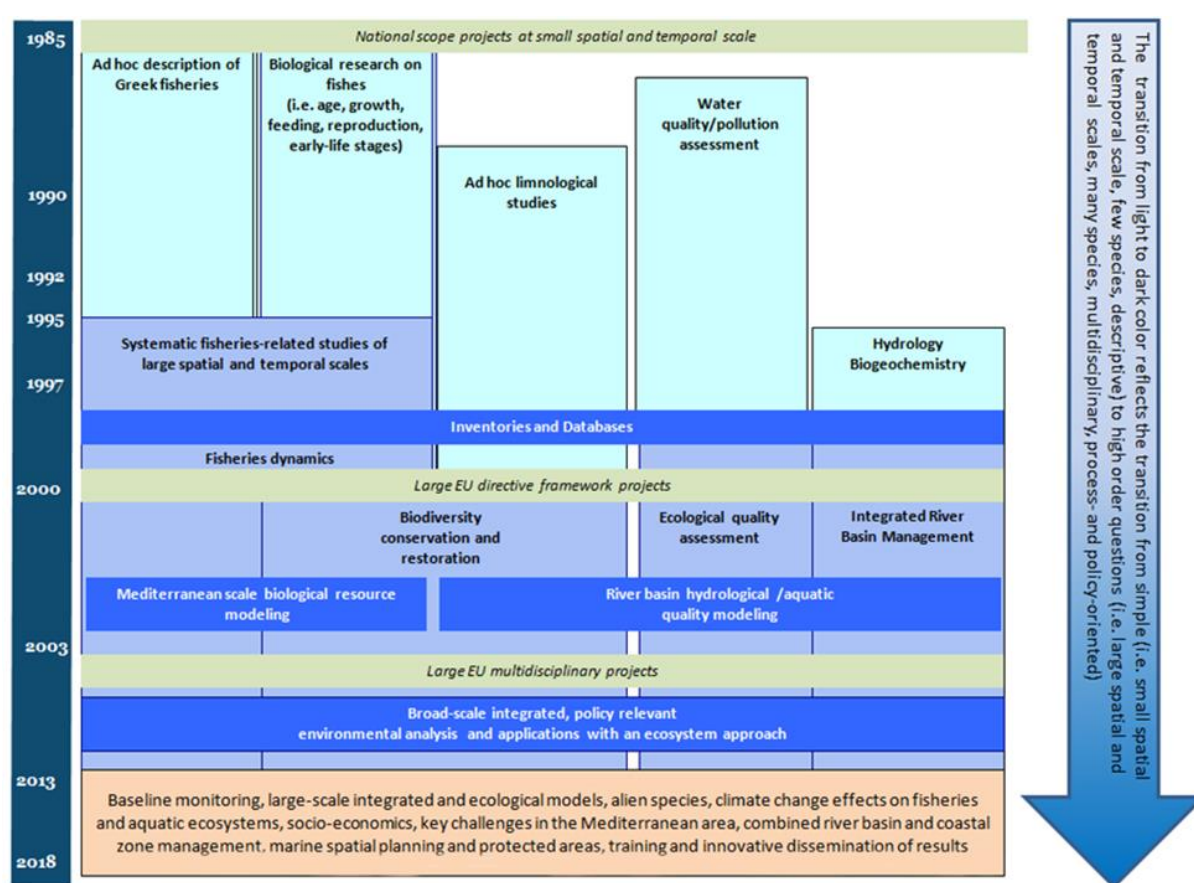


Figure 22. IMBRIW's long term development of research directions and main questions addressed.

#### 1.1 Specific Goals related to the Research Directions of IMBRIW addressed during the period 2013-2017

In the text that follows the original goals set in 2013 Business Plan, are presented, followed by a description of the degree and means of adoption (in italics and blue lettering).

Modelling and assessment

- Application and testing of novel data-limited stock assessment and management methods in the Mediterranean Sea. The Mediterranean Sea is a classic example of a 'data-limited' stocks region. We will examine and test a number of novel data-poor stock assessment methods (e.g. Bayesian, Catch-MSY, depletion-corrected average catch analysis DCAC) with regard to their general applicability in the Mediterranean fisheries management system.

*Adopted. Through the participation in an EU-funded project (DRuMFISH) approaches for managing data limited stocks in mixed fisheries were developed. A relevant publication is in press in ICES J Mar Sci. In addition, a data poor assessment for Pagellus bogaraveo was applied in DEEPFISHMAN project.*

- Development of an integrated bio-economic modelling tool to advance and support multi-objective approaches for fisheries management. We will develop a modelling tool to evaluate the biological and economic effects of different harvesting strategies directed at extracting the long-term maximum sustainable production, while avoiding the risk of recruitment overfishing and modification in the ecological structure and functions of the exploited fish community.

*Partially adopted. Tools (e.g. BEMTOOL, MEFISTO) for evaluating the bio-economic effects of different harvest strategies have been developed and published but have not yet taken into account the community structure. They have also been used to explore policy scenarios (e.g. the landing obligation) and address requests from management bodies (e.g. projects LANDMED, DISCATCH, MINOUW). A call for a Researcher position in environmental economics was recently issued by IMBRIW to deal with such topics in the future.*

- Maximizing yield of fisheries, while balancing ecosystem, economic and social concerns. There is a commitment to direct management of fish stocks towards achieving MSY by 2015. Research is underway to provide definitions of MSY variants, which maximize other measures of "yield" than biomass and which account for the fact that single species rarely exist in isolation. The aim is to integrate the MSY concept with the overarching principals of the CFP: the precautionary and the ecosystem approach. To this end we will use modifications of existing ecosystem and fisheries models to perform maximization of stakeholder approved yield measures while ensuring acceptable impact levels on ecosystem, economic and social aspects.

*Fully adopted through the work done (publications, reports, etc) in the frame of MYFISH and SOCIOEC projects (EU/FP7) and the results of the PROTOMEDEA project (not concluded yet), which is a realized under a DG MARE call for "MPA networks towards MSY".*

- The Institute will expand the application of IBMs to more species' full life cycle, not only to explore population dynamics and environmental and fisheries effects but evaluate management scenarios, define recruitment areas and investigate the link of biogeochemical processes with higher trophic level production. For this application, IMBRW will cooperate with the IO of HCMR.



*Adopted. The published anchovy full life cycle IBM, which is online coupled with the HCMR hydrodynamic/biogeochemical model (REPRODUCE project) has been expanded to a multispecies model. The model has been tested with the invasive ctenophore Mnemiopsis leidyi (SEAMAN project) and has already been calibrated for the anchovy-sardine pair, the most important small pelagic species in the Mediterranean Sea (CLIMAFISH project). This anchovy-sardine model is currently being used to test management scenarios, including the effect of shifting the timing of the existing closed period for the purse-seine fishery as well as the outcomes for the population and the pelagic ecosystem of changing the exploitation rate of each of the two species.*

- Further expanding Ecopath-with-Ecosim models, incorporating an end-to-end approach, and develop spatial and temporal simulations to evaluate the effects of fisheries on ecosystems, the effect of discard ban and selectivity improvement in order to explore different management scenarios in the Mediterranean.

*Adopted. An end-to-end ecosystem model was produced by coupling (offline) an Ecopath with Ecosim (EwE) model with a biogeochemical model (PERSEUS project). The temporal (Ecosim) and spatial (Ecospace) modules were developed (DISCATCH and MINOUW projects). Scenarios representing different (i) trawl selectivity, (ii) discards management policies and (iii) nutrient inputs were explored. Additional models are underway for Greece and Cyprus, under an MPA-MSY scope (PROTOMEDEA project). In addition, EwE applications were developed for a Greek lake (LAKE VOLVI project) and additional applications are underway (ANATHALLOI project).*

#### Fisheries dynamics and capture

- Two pieces of information that are missing in order to evaluate the total biomass removed from the Greek (and the Mediterranean) waters, and thus to model marine ecosystems, are the catches of sport-fishery, subsistence fisheries as well as discards and the Illegal, unregulated and unreported catches. These components, which are not included into the National database of the Hellenic Statistical Authority, can be as high as 100% of reported landings. Thus, research will be directed in estimating these missing fisheries components. This will eventually lead to the complete reconstruction of Greek marine fisheries landings for 1900-today. An attempt will be made to eventually incorporate these reconstructed landings into the official Hellenic Statistical Authority database.

*Partially adopted. Several projects and publications (including two reviews of historical data at the Mediterranean level) related to discards estimations were undertaken. Some pilot works on recreational fisheries took place (e.g. PROTOMEDEA project and a publication with an international team of authors) and recreational fisheries are starting to be regularly monitored within DCF. Historical reconstruction of the Aegean Sea landings and effort for European anchovy (*Engraulis encrasicolus*) and European sardine (*Sardina pilchardus*) were held, using information from the Hellenic Statistical Service, the EU DCF and published information. Selection models were developed in IMBRIW that can be used in the reconstruction of data and catch comparison studies within the frame of a PhD Thesis. Apart from these, IUU catches were not particularly addressed and there is not much progress on the reconstruction of landings. A national project on the*

*historical reconstruction of Greek fisheries landings was submitted to the Ministry of Agriculture but it did not receive funding.*

- Fishing effort monitoring will be upgraded using the Vessel Monitoring System that has been recently introduced to Greece, to evaluate the true effort and its spatial distribution on a daily basis, to study fisher's behaviour and the relationship between effort and demersal and pelagic abundance and distribution.

*Adopted. The analysis of VMS data and the estimation of fishing effort for mid-scale fisheries were conducted in a highly disaggregated spatial and temporal (daily basis) scale. Given that the analysis of VMS data is approaching the field of "big data analytics", it was based on methods developed by IMBRIW/HCMR which were compiled and executed in an ORACLE environment providing advantages to speed up calculations. Already known software applications in the EU (VMSbase and VMStools) were also adjusted and tested for the Greek fisheries. Moreover, a novel methodological frame that combines fishing effort with other factors (e.g. catches, discards, environmental/socio-economic data) offered a better understanding and description of the Greek fishing activities. A PhD on this issue will soon be concluded. The outcomes of these methodological approaches were used in several projects e.g. PERSEUS, STOCKMED, BENTHIS, ECODISC, MARISCA, PROTOMEDEA, MESMA, ECOAST, AMARE, MINOUW, i4Sea etc. and were published in peer-review journals.*

- Fishing Capacity Assessment. IMBRIW will direct research efforts towards evaluating fishing capacity utilization and economic efficiency of trawl fisheries in Greece. The aim is to obtain quantitative measures of excess and overcapacity that could provide critical information in balancing the productive capacity of the stock with the harvesting capacity of the fleet.

*Partially adopted. This was addressed within ECOAST using the DISPLACE model that integrates the spatial activity of vessels and fish abundance dynamics allowing for more realistic predictions of fishers behaviour, profits, and stock abundance. A call for a Researcher position in environmental economics was recently issued by IMBRIW to deal with economic efficiency of fisheries in the future.*

- Fishers' behaviour and fleet dynamics. Work will be directed at (a) supporting the objectives of the reformed CFP on regionalized fleet-based management through aiming management measures to fleet segments that contribute the most to stock depletion and (b) evaluating fishers' attitudes for new management measures proposed under CFP reform process and how fishers make trade-offs between alternative policy attributes.

*Adopted. A PhD dealing with these aspects has been funded. In addition, a comprehensive frame for processing the VMS dataset in order to estimate fishing effort (from VMS data or data limited situations) and novel methodological approaches for relating the fishing effort estimations with other bio-economic and abiotic factors (i.e. catches, discards, environmental and socio-economic factors) that influence fishing activity has been developed. A statistical predictive model that can be used as a fleet-dynamics model to predict fishing effort distribution has been also developed.*

*Moreover, novel indices influencing fishing fleet dynamics as a proxy of the trip characteristics has been also provided. The outcomes of the abovementioned frame are useful to answer precise management questions in the context of the CFP, MSP and EBFM and have been used in several projects and publications. Finally, selection models were developed in IMBRIW that can be used to describe fisher's behaviour for discarding, landing and compliance to the rules.*

#### *Fisheries ecology and ecosystem approach to fisheries management*

- Evaluate the effects of climate variability on the distribution, abundance, and life-history of pelagic and demersal species.

*Adopted. Historical changes since the 1960s in the Aegean fish stock distribution and productivity, as well as future projections for specific commercial demersal fish based on various climatic scenarios up to 2100 were delivered in the H2020 CERES project. Existing habitat and coupled IBMs for small pelagic fish have been used to forecast changes in essential fish habitats and population characteristics in the future (in the Greek Seas as well as the entire Mediterranean) under climate change (SEAMAN project). Habitat distribution models based on environmental (satellite or oceanographic) variables were built for various pelagic (e.g. anchovy, sardine, mackerel) and demersal fish within various projects (MEDISEH, SEAMAN, PROTOMEDEA, MINOUW). Essential fish habitat maps produced for the entire Mediterranean within the MEDISEH project were extensively requested and used by other research projects, PhD thesis, NGOs and recently by the GFCM. These models constitute the basis to evaluate the climate variability on the distribution and abundance of these species but this is still an ongoing process. Alien species in fishery catches during the last decade has been examined. Probable impacts on their increased presence in the composition of marketable and discarded fractions has been explored.*

- The expertise of IMBRIW on acoustics, which has so far been applied to small pelagic fish only, will be expanded for simultaneous biomass long-term monitoring of small pelagics and zooplankton. This will provide continuous, high resolution, 3D data in contrast to other methods that collect dispersed point data. Such a modern approach, which will involve also the IO, will contribute to clarifying the food web function and structure, thus, serving as a sampling platform for an ecosystem approach to fisheries management. It will also provide additional indices for studying the marine reserve effects.

*Adopted. The RV PHILIA is equipped since 2016 with the Simrad EK 80 hydro-acoustic equipment at 38, 120, 200 kHz as well as with the 333 kHz since 2017. This now opens a new era for the expertise of IMBRIW on acoustics and expands its ability to conduct simultaneous biomass long-term monitoring of small pelagics and zooplankton. Three surveys were already conducted with the new equipment since 2016, a PhD is currently conducted in collaboration with the University of Crete, regarding the study of the spatial distribution of zooplankton based on acoustics. Other hydroacoustic applications include a project aiming the study of mesopelagic fish aggregations by means of acoustics (MESOBED) and a cooperation with IMBBC for behavioural studies in reared fish. In addition, the new modern equipment allows the estimation of "bottom*

*hardness" a substrate proxy which can be used for modelling the preferred habitats of demersal and benthic species.*

- Evaluation of the importance of seabed habitat and functionality in sustaining demersal fish populations in the oligotrophic Eastern Mediterranean.

*Partially Adopted. This area remains a key long-term goal. Work in the FP7 BENTHIS project, combining Greek fleet VMS-derived swept area impacts on newly defined seabed habitats (EMODNET) has provided first insights into the importance of the seabed in fisheries. This project work has laid the groundwork for future assessment and monitoring for the MSFD D6 descriptor, where additionally in the next evaluation period, new information will be gathered for the next step in relating demersal fish to habitat type, macrofauna and megafauna communities, using traditional sampling with acoustic and optical imaging. New techniques to be employed will include traits analysis for functionality and potential application of habitat classification and mapping package of the fisheries pelagic hydro-acoustic system.*

- Evaluate the economic, social and ecosystem effects of the new discard ban especially for oligotrophic ecosystems such as the Mediterranean ones. According to the reform of the Common Fisheries Policy, discarding will be gradually banned in EU waters. In this context, IMBRIW's goal is to contribute to the assessment of impacts of the discards ban on the ecosystem and on fisheries resources. Furthermore, the feasibility and effectiveness of the implementation of the new regulations should be explored by taking into account the fishers' conceptions and strategies, socioeconomic aspects and the viability of the fisheries sector as well as by proposing ways to avoid unwanted catches through technical specifications (selectivity improvement) and avoidance of fishing grounds (spatiotemporal closures and adaptations to fishing strategies) that generate high unwanted catches.

*Adopted. IMBRIW has provided advice to the Greek ministry and the EU through projects and specific contracts (e.g., LANDMED, DISCATCH, ECODISC, MINOUW, EPILEXIS) for assessing species and discards quantities subject to the landing obligation, predicting differences in unwanted catches and landings using different scenarios concerning fishing closure, avoidance of juvenile grounds, fisher's behaviour and modifications of trawl selectivity. Ecological and bio-economic effects of the landing obligation have been examined through ecosystem, bio-economic and habitat models. Fishers' behaviour and conceptions on the landing obligation were taken into account. Three PhD theses on these issues are under progress.*

- Socio-economic effects of management measures of the future EU Common Fisheries Policy. We will bring together fisheries scientists with industry partners and other key stakeholders to work in an integrated manner of solutions for future fisheries management, which can be implemented at a regional level. Our goal is to evaluate the impacts of the management measures that emerge from this process, particularly in terms of their economic and social impacts.

*Adopted: IMBRIW has already carried out work on the effects of various EU policies on the socio-economic state of the environment and fisheries sectors and especially*

*EU/1967 Regulation for the Mediterranean, the bottom trawl/purse seine/beach seine gear's national derogation plans, the effects of fishing vessel decommissioning and the effects of MSFD/WFD on a national level. This is also linked with the point on Bio-economic tools (e.g. BEMTOOL, MEFISTO) that have also been used to explore policy scenarios (e.g. the landing obligation) and address requests from management bodies (e.g. projects LANDMED, DISCATCH, MINOUW) as well as by using the DISPLACE model (ECOAST). In addition, IMBRIW is implementing two major national data collection projects (the Fisheries DCF and the Operational Program for the Environment and Sustainable Development/ Inland and coastal waters data collection). In relation to the national MSFD monitoring project, that will be operational in 2019 and will run in collaboration with the Institute of Oceanography, there will be a thorough evaluation on the socio-economic impacts of the measures adopted under the implementation of the MSFD. EPILEXIS project and a PhD Thesis contributed to this goal defining economic effects on fishers using selectivity models to predict differences in unwanted catches and landings using different scenarios concerning fishing closure, avoidance of juvenile grounds, fisher's behaviour and modifications of trawl selectivity. IMBRIW also promoted the stakeholder approach within MINOUW project and a Fisheries Improvement Project (for Kavala Purse seine fisheries in collaboration with WWF Greece). To address future challenges, a call for a Researcher position in environmental economics was recently issued.*

- Investigation of the appropriate governance structures contributing to effective fishery management. This will be achieved through research to determine the appropriate governance structures required for different fishery types, considering particularly scale issues and stakeholders. Address enforcement and compliance issues, tackling monitoring, control, and surveillance through the application of innovative technologies, and by increasing awareness of fishers' on ecosystem sustainability.

*Partially adopted. Research on existing governance structures of ocean management, including fisheries, has been conducted in the frame of a number of MSP-related projects (ADRIPLAN, MSP-Med, MUSES, AMAre, ARIEL, ECOAST) with insights on ecosystem services management as a tool to address the complex social-ecological systems. Recommendations on effective top-down and bottom-up schemes along with the need of developing effective integration approaches at the level of central administration (e.g. through intra/inter-ministerial committees) have been made as they are a crucial step to manage maritime human activities (e.g. fisheries) at ecologically meaningful and operationally manageable scales.*

- The establishment and management of marine protected areas within a marine spatial planning framework.

*Adopted. A lot of work towards this direction was carried out within the frame of projects like MARISCA, PROTOMEDEA and AMAre. Specialized conservation planning tools, like MARXAN, were implemented taking into account biodiversity records, the distribution of essential fish habitat, the distribution of fishing effort and socioeconomic information and evaluating various scenarios. Within AMAre, special effort has been exerted towards adapting an established management frame (the ISEA FW for Italian*



MPAs) and apply it to the Sporades MPA, where small-scale fishers are among the key stakeholder groups. In addition, IMBRIW has initiated the "GyarosMPA" Fisheries Knowledge Survey, funded by MAVA foundation. Gyaros Island is currently a strict marine reserve and "GyarosMPA" will set the cornerstone for an effective future management and monitoring plan, which will employ EBFM and MSP approaches, through the participation and active involvement of local stakeholders of the adjacent islands of Andros and Syros. The final deliverable will be a full assessment of the current status of the MPA regarding marine resources and biodiversity, of specific interest to fisheries, including recommendations for local fisheries management measures.

- Historical reconstruction of the Mediterranean marine ecosystems, with special emphasis on fish and the charismatic megafauna (i.e. marine turtles, marine mammals, seabirds), using information from different sources.

*Partially adopted. IMBRIW initially submitted a national proposal involving all its researchers working on fish and fisheries, as well as other scientists from universities. The proposal was not funded, probably because of its high-risk character. Subsequently we expanded the scope of the proposal on a wider Mediterranean scale and contacted a non-governmental organization for potential funding. Other sources are also sought for this to be submitted.*

#### Biodiversity conservation and environmental restoration

- Modelling the distribution of alien species in the Mediterranean Sea and the interactions with local species and climate change. Biodiversity indicators of exploitable fisheries communities.

*Partially adopted. Marine biological invasions are a continuous procedure that is being monitored constantly. The ELNAIS database is regularly updated, with information from published papers and citizen-scientist observations. Maps as well as other information is provided there. Within this work, an-updated list of marine alien and cryptogenic species has been produced. Moreover, horizon scanning for future plausible invasions, range expansions and establishment of alien species is being conducted, as well as the invasion potential of currently established alien species (e.g. projects ESENIAS-Tools, Action-MED, MDFD-D2). In addition, effort is being made for the evaluation of the invasive potential and risk assessments of selected species (ASRA project).*

- Continuation of studies for the identification of new species, the exploration of freshwater species and habitats not investigated in the past, as well as studies on the genetic composition of species, their biology and ecology.

*Adopted. IMBRIW has recently expanded to the exploration of the mesopelagic zone, continues its works in the exploration of deep-water species and habitats (CoralFISH, DEEPEASTMED) and understudied areas (e.g., estuaries), publishes new records in species distribution and cooperates with IMBBC for the identification of ambiguous specimens/species found in surveys. The IMBRIW freshwater sector has continued its multifaceted research on the biology, ecology and population status of native and endangered freshwater fish species. Extended research has been conducted on freshwater species habitat requirements, with special emphasis on species inhabiting*

*intermittent rivers (GLOBAQUA project). This also included parasitological research in collaboration with expert European parasitologists. Moreover, the genetic structure of different freshwater macroinvertebrate taxa is being studied in the frame of two PhD dissertations and a paper with the description of a new freshwater fish species is under preparation.*

- Further exploration of alien-native species' interactions, e.g. assessing the impact of invasive freshwater fish species on condition and reproduction of native species.

*Adopted. In situ research has been conducted on freshwater native/alien species interactions. Also, research was conducted on alien species' geographical distribution and population status in Greek rivers.*

- Continuation of assessment of dam construction in Greek rivers on fish and their habitats, estimation of minimum ecological flow for conserving local fish populations and formulation of potential rehabilitation actions for the restoration of natural substrate and fish assemblages.

*Adopted. Two projects were exclusively devoted on the ecological flow estimation during the evaluation period (ECOFLOW and IMBRIW-SIEMENS), in which new habitat suitability curves, habitat-hydraulic models and relevant tools (<http://imbriw.hcmr.gr/en/tools/>) have been developed.*

- Integration of socio-economics in projects concerning the management, restoration, and rehabilitation of degraded aquatic and semi-aquatic ecosystems.

*Adopted. Within the frame of FP7 project GLOBAQUA concerning the management of intermittent rivers, socioeconomics were integrated, in cooperation with the ATHENA and ALTERRA institutes in order to produce joined scientific publications as well as policy briefs targeting both national and European authorities and local stakeholders. A Researcher with expertise on environmental economics will be soon recruited to enhance IMBRIW's expertise in this field.*

- Implementation of conservation projects that will entail a strong collaboration between the IMBRIW scientists, international research groups working in the field of conservation, stakeholders, and users of the resources.

*Partially adopted. Implementation of the DEEPEASTMED project to collect all information related to deep-water vulnerable species and habitats of the Eastern Mediterranean in collaboration with the Institute of Oceanography for the description of particular deep-water geomorphologic features and contribution of experts from the Eastern Mediterranean. Within the frame of the GLOBAQUA project that focused on the Evrotas river basin as a case study, there was a strong collaboration of IMBRIW freshwater scientists with several European research groups for the conservation and management of intermittent rivers. Furthermore, workshops were organized with local stakeholders for the Development of an integrated methodology for the sustainable environmental and socioeconomic management of freshwater ecosystem services and for the Economic valuation of relevant ecosystem services.*

- Further development of the appropriate infrastructure and managerial tools for the efficient conduct of conservation and restoration activities in various scales (local, regional, national).

*Adopted. The infrastructure of the Institute has been significantly expanded during the evaluation period with equipment that can be directly used for the management and restoration of degraded habitats. Such infrastructure includes a series of automatic monitoring stations focusing on water quality and quantity that produce relevant data on a daily basis which are published on websites (e.g. <http://imbriw.hcmr.gr/en/category/automatic-monitoring-data/>) and are available to the local authorities.*

- Increasing dissemination of the results of IMBRIW research in local, national and international level.

*Adopted. The Institute has developed a new website (<http://imbriw.hcmr.gr/en/>) during the evaluation period, with social media accounts that have become very active in disseminating the research outputs. IMBRIW organized two public events (one dedicated to fisheries resources and one to inland waters, [link to fisheries event](#), [link to inland waters event](#)) to disseminate its activities and discuss with stakeholders. Stakeholder meetings have been also organized in several research projects. Scientists participated in National and International conferences as well as ICES and GFCM working groups. Almost 40 press, TV and other electronic media articles related to IMBRIW activities were produced during the evaluation period.*

#### Ecological quality assessments

- Continuation of the National Monitoring Program.

*Adopted. The National Monitoring program for the WFD continues (in collaboration with IO) and offers to the Institute prestige, necessary infrastructure and experience.*

- Development or modification and validation of existing ecological quality metrics and indices for a state-wide application using the results of the National Monitoring Program (2012-2015). This initiative will enable the creation of nationally-approved bioassessment tools based on macroinvertebrates, fish, and diatoms. Special emphasis will be given to less studied river types such as non-wadeable rivers, temporary and islands rivers and streams, small wetlands, lakes, ponds, and lagoons. Three PhD dissertations will focus on the development of stream macroinvertebrate metrics including perennial streams, non-wadeable rivers, and islands streams. The latter PhD thesis will address island biogeographical and conservation aspects.

*Adopted. Biological indices were either developed, or intercalibrated and harmonized according to the criteria defined by the working groups of the WFD for macroinvertebrates, diatoms and fish. In addition, reference sites and a national river typology scheme were established. Three PhD theses are currently in progress concerning non-wadeable rivers, and island biogeography.*

- Through collaboration with German and Austrian research teams, a fish-based bioassessment index employing a predictive modelling approach will be developed.



*Adopted. A fish-based bio-assessment index employing a predictive modelling approach was developed and intercalibrated.*

- Assessment of ecological-flows in rivers in the framework of a recently approved project (ECO-FLOW). A PhD will target the development of methods for the assessment of ecological flows in rivers using fish as indicators.

*Adopted. The development of a state-of-the art approach for estimating the ecological flows in mountainous rivers has been completed. A relevant PhD has just finished and important tools that facilitate the estimation of ecological flows have been produced (<http://imbriw.hcmr.gr/en/tools/>).*

#### Integrated River Basin Management

- Research on improving operational numerical weather forecasts.

*Adopted. IMBRIW was the scientific responsible of the POSEIDON weather forecasting system for its improvement, daily operation and maintenance. IMBRIW remains responsible for the operational procedures of the POSEIDON weather forecasting system until the IO of HCMR (which is the coordinator of the whole POSEIDON system) will recruit a researcher meteorologist with expertise in numerical weather prediction. In parallel, IMBRIW developed a new operational weather forecasting system based on a different atmospheric modelling frame in order to facilitate hydrological applications.*

- Research on the development of a fully coupled atmosphere-ocean wave system.

*Adopted. In collaboration with IO of HCMR within the frame of an EU project (MYWAVE), a new fully coupled atmosphere–ocean wave model was developed. The coupled system consists of two components: the atmospheric and the ocean wave models of the POSEIDON system.*

- Regarding water quality monitoring in Lakes and Estuaries by combining remote sensing techniques, operational monitoring algorithms will be attempted by combining satellite and in-situ data while the prediction accuracy will be increased and more widely applicable models will be produced, (at a regional or even country level).

*Adopted. Hydrochemical and remote sensing modelling in lakes and rivers is an ongoing process in the Institute. The relevant output during the last 5 years is significantly increased in relation to the past and a PhD student is about to conclude her thesis on estimating water quality algorithms for the quantification of total suspended solids and Chl-a in surface water bodies. Results are also soon to be used in ecosystem models which were developed or are under development for Greek lakes (LAKE VOLVI and ANATHALLOI project).*

- Short-term flood forecasting through the application of distributed hydrologic modelling to advance the predictability of flash floods and develop more accurate warning systems by coupling numerical weather prediction models with fully dynamic hydrologic models (MIKE by DHI).

*Adopted. Under the frame of a research project (KRIPIS I), the Poseidon meteorological model (<http://www.poseidon.hcmr.gr>) has been coupled with MIKE 21 hydrodynamic*

*model in the area of Spercheios river and produce daily, operational forecasts for floods, drought, groundwater recharge, etc. (<http://hydro-data.hcmr.gr/>).*

#### Integrated coastal zone management and Marine Spatial Planning

- Develop tools for the sustainable development of Greek coastal area focusing on spatial planning, conflict resolution, the establishment of marine protected areas and artificial reefs combined with business plans for further economic exploitation

*Adopted. Through the large-scale international projects ARCH (lagoon management) and PEGASO (integrated coastal zone management in the Mediterranean area), integrated coastal zone management tools have been tested and proposed based on socio-economic, demographic, legislative and environmental indicators to estimate status and performance of management measures. Special focus was given to the challenge of working on the complex insular Aegean Sea region. In addition, in the last 10 years, the coastal zone management team has provided services to the Ministry of Agricultural Development and Food both on the establishment of new artificial reefs (Pieria prefecture) and the evaluation of the current state of the older existing reefs in Greece (Preveza-Parga reef). In addition, work has been carried out on coastal zone governance (MEDAID project) with a focus on marine aquaculture. Conflict resolution among human activities and between human activities (with a special focus on fisheries) and conservation priority goals has been also explored in offshore waters linking MSP and ICZM concepts and approaches. The latter has been investigated under a number of research projects undertaken by the IMBRIW (MESMA, ADRIPLAN, MARISCA, ECOAST, MUSES, AMAre).*

- Develop activities related to telemetry monitoring applications including the development of robotic systems and related patents.

*Adopted. The coastal zone management team of IMBRIW has long experience in telemetry systems for environmental monitoring using GPRS-based systems on data buoys (Porto Lagos project). Recently the team was awarded a national project focusing on the establishment of environmental quality and infrastructure operation monitoring telemetry systems based on new sensors which will be designed and constructed within the project and networking for data transfer based on private nbIoT and LORA/Sigfox networks. An attempt to submit a proposal for the design and construction of the first autonomous surface vessel suitable for lagoon environments was not deemed as important from the Ministry to be funded.*

- Elaboration of management plans for marine protected areas in support of the National Agencies of Protected Areas.

*Partially adopted. The team made several attempts to approach Protection Agencies in Greece in order to organize common projects on marine protected area management plans. However, these efforts were not successful due to (a) legal issues in relation to the capacity of the agencies to manage and/or participate in such projects and (b) lack of funding for such projects from the Ministry of Environment. However, IMBRIW is in close collaboration with the Management Body of the Sporades MPA (NMPANS) in the frame of the AMAre project. The development of management scenarios is underway aiming*

*to contribute to the adoption of an EBFM approach in the management of the NMPANS. An invited speech on the latter has been provided in the frame of the recent CBD COP14.*

- Provide services in third countries and especially the Middle East and Africa (sub-Saharan).

*Partially adopted: IMBRIW submitted several projects focusing on the Middle East and Africa regions (Saudi Arabia, Abu Dhabi, Madagascar, Mozambique; government/local calls, other international calls such as EUROPAID, UNIDO, UNDP) focusing on fisheries sector development, coastal development (ports, fishing facilities), shrimp culture development (infrastructure) and fisheries enhancement projects (production of fry and enrichment in coastal areas and mangrove areas). However, none of these were funded. Nevertheless, HCMR has already created together with its collaborators the critical mass of expertise and knowledge/experience to be successful in the future. In the same vein, the IMBRIW has established collaborations with third (non-EU) countries under the FP7 project PERSEUS, leading the WP dealing with the promotion of MSFD concepts in non-EU countries, highlighting the need for transboundary collaboration to tackle MSFD goals, MSP being one of the key processes. Then under the H2020 BLUEMED CSA it leads the Task on BLUEMED Ambassadors dealing with the identification of candidates from non-EU countries to promote the BLUEMED Strategic Research and Innovation Agenda (SRIA), including also MSP/ICZM actions. In addition, the reconstruction and modernization of R/V Philia will contribute to the provision of services in third countries.*

- Organize several collaborations related to the integrated coastal zone management, (this is already established through the PEGASO project business plan).

*Adopted: The experience of IMBRIW on coastal governance and socio-economic analysis and development (focusing on the fisheries sector) has been acknowledged by other colleagues in EU and HCMR has been invited to join large-scale projects, such as MEDAID, ARCH, PEGASO and Eranets, such as MARIFISH and COFASP. Furthermore, IMBRIW is considered one of the leading research institutions in the Mediterranean on MSP-related issues, being part of several MSP projects (MESMA, ADRIPLAN, MSP-Med, MARISCA, MUSES, ECOAST, AMAre, PORTODIMARE). These projects focus not only on conflict resolution but also on investigating strategies for the sustainable development of fisheries under the concepts of the BLUEGROWTH strategy. What is more, IMBRIW is part of the core group of the BLUEMED CSA in collaboration with the Institute of Oceanography of HCMR, and MSP/ICZM approaches are endorsed as key actions of the BLUEMED SRIA.*

## 1.2 Further issues addressed during the period 2013-2017

The research goals described below were actually developed during the evaluation period (not incorporated originally in the 2013 Business Plan).

### Modelling and assessment

- Defining selection models useful in assessment and management. Modelling the overall selection process in the sea by the gear and on the vessel by the fisher to predict escapees, discards and landings.

*A PhD thesis is under progress. Model has been tested for several species and also applied in studies for differences in discards and landings in essential fish habitats. These models can also be used for reconstruction of data since they are related to the total population in the sea entering the gear, a useful tool in assessment and management.*

- Development of a fully coupled hydro-meteorological modelling system  
*IMBRIW initiated this activity in 2015, in an effort to develop a new operational weather forecasting system (in parallel with the POSEIDON system) in order to facilitate hydrological applications. The objective of this activity was the design, development and testing of a new high-resolution coupled hydro-meteorological modelling system, based on WRF and WRF-HYDRO. Currently, the system serves as the baseline for the development and validation of simulating the air-land interactions for two watersheds of interest, at Spercheios and Evrotas river basins. The results are daily available through meteo.hcmr.gr.*

#### Fisheries dynamics and capture

- Fishing gear technology and fish behaviour.  
*Several research projects were carried out focusing on the existing fishing gear technology in Greece (purse seine, longlines, trawls, gillnets and traps) as well as three project related to the redesign of the Greek bottom trawl using new thread materials (Dyneema, Dnet), the comparison of different mesh sizes in the trawl codend according to the EC Regulation No 1967/2006 and the selectivity of traps in narval shrimp fishery. In addition, nationwide campaigns were organized in order to inform trawl fishermen and increase awareness on the benefits of the new material, the importance that the trawl nets should be designed in accordance to the fishing vessel characteristics and the selection advantages of square meshes in the trawl codend (Projects: MAREA, ARCHIMEDES, MyGears, DRIFTMED, SIMRAD, EPILEXIS, PLESIONIKA MANAGE, BENTHIS). Furthermore, fish behaviour in the trawl codend and survival potential of discards have been studied (EPILEXIS, DISCATCH, ECODISC).*

#### Fisheries ecology and ecosystem approach to fisheries management

- Data base concerning the stranding of marine mammals and marine reptiles.  
*Two members of IMBRIW are members of the Scientific Committee of Marine mammals and reptiles in Greek waters established by the Ministry of Environment and Energy. Our Institute is the unique public authority which is receiving every day all documents of stranded mammals and reptiles from Port Authorities from all Greek seas and maintain the unique data base in Greece.*
- Marine litter in organisms and the environment.  
*Marine litter is a global growing problem of increased concern with numerous sources, which ends in the marine environment, posing environmental, economic, health and aesthetic problems. The risk is constantly growing and therefore the study of marine*

debris has been included in the MSFD (2008/56/EC) which aims the good environmental status of European seas up 2020. IMBRIW initiated this activity in 2012, investigating marine litter on the seafloor based on data of research projects (INTERREG II, RESHIO, MEDITS, CoralFISH, COCONET, DefishGear, EPILEXIS, DEEPEASTMED) and in the gut content of organisms (fish, crustaceans). Moreover, fishing for litter (FFL) pilot activity was organized for the first time by IMBRIW (DefishGear) in collaboration with fisher associations and local authorities.

- Deep-water resources, deep-water fisheries. Deep-waters is the most vast and unexplored environment of the planet, which comprises a variety of different habitats and many sensitive and vulnerable to fishing impact organisms.

IMBRIW initiated this activity already in 1996 through various research projects, focusing on the exploration and assessment of the deep-water resources, and the study of the biology and feeding strategies of deep-water fish (e.g. blackspot seabream, blackbelly rosefish) and shrimps (e.g. red shrimps *Aristeus antennatus* and *Aristeomorpha foliacea*). This activity continued, during the current evaluation period, with DEEPFISHMAN, CoralFISH, and DEEPEASTMED focusing on the assessment of deep-waters resources in deep-water fishery, the interaction between deep-water corals, fish and fisheries and the impact of deep-water fishing on the vulnerable deep species (e.g. elasmobranchs) and habitats (deep coral and sponges fields).

- Investigate the main aspects of Biology and Ecology such as early life stages, age, growth, reproduction, biometrics, diet, spatiotemporal and bathymetric distribution of marine biological resources (fish, crustaceans and cephalopods) and other non-exploited marine species, aiming to support ecosystem approach to fisheries management.

A PhD Thesis is now realized on the Batoids biology and ecology and many Bachelor Theses on biological aspects of several fish, crustacean and cephalopod species have been carried out or are in progress. Several projects (e.g. DCF, CoralFISH, PLESIONIKA MANAGE) focused on or included aspects towards this direction. Moreover, a review paper, updating previous information, on the feeding habits of the Mediterranean fishes has been published (Karachle & Stergiou, 2017, *Mediterranean Marine Science*, 18 (1): 43-52) aiming to: (a) compile existing information on this aspect at a Mediterranean scale; (b) indicate gaps in knowledge; and (c) act as a roadmap and provide recommendations on future research on diet studies.

- Continuation of studies on benthic species diversity in fishing grounds and non-exploited deep-water habitats.

Several projects (CoRALFISH, EPILEXIS, MEDITS, DEEPEASTMED) included such studies, while information from old projects (e.g. INTERREG II, RESHIO) was examined. A PhD thesis is carried out on this topic based on MEDITS data.

#### Integrated coastal zone management and Marine Spatial Planning

- Land-sea interaction research is of utmost importance in addressing issues related to ICZM/MSP, as well as WFD and MSFD making the stronger and more effective collaboration of the two dept of the Institute a prerequisite.

*A relevant large project (880 Keuros) of the period 2013-2015, in which both sectors of the Institute collaborated closely was entitled: ‘Development of an integrated management system for river basin, coastal and marine zones’. Under this project a large number of scientists from both sectors worked intensively, studying various land-sea interaction processes in Spercheios river and Maliakos Gulf, including the impacts of river outflow to the hydrodynamic and water quality conditions of the coastal zone. The primary objective of the project was to develop management plans and tools that describe water related mitigation and restoration measures by considering drivers (including climate change) and impacts in the unified area of the river basin – coastal zone (<http://imbriw.hcmr.gr/en/kripis/>).*

## **2 Planning, Policies and Communication to fulfil the goals**

The 2013 Business plan of the Institute set a series of goals, after consultation with all members of research staff that were regularly updated and modified through the evaluation period, by the Institute’s Scientific Board and the members of the two sectors. The fact that the majority of the goals set were fulfilled is indicative of their realistic and concrete nature. This planning had measurable results, such as implemented and ongoing projects (see 4.5), academic publications (see 4.3), MSc and PhD supervisions (see 4.4.), modelling tools and other concrete services, such as management plan and data provision (see 4.6.) The Business plan, as well as the above outcomes, were communicated to all members of the Institute as well as to interested bodies and the public in general, through the Institute’s website (<http://imbriw.hcmr.gr/en/>).

## **3 Alignment and Implementation of National and European Legal and Regulatory Framework**

The Institute’s Scientific Board includes researchers from all three regional branches, meets monthly with the Director and discusses all main matters and issues arising, and schedules plans and actions. During the evaluation period, a new legislation was set, according to which the Director should be evaluated in midterm and at the end of his/her term’ the evaluation of IMBRIW’s Director was conducted at the end of his term (February 2019). Regarding the Ethics Committee, relevant legislation has been set in 2018, pending its implementation at HCMR level. Furthermore, IMBRIW follows the regulations of GDPR (General Data Protection Regulation). The implementation of important National and European legal framework, such as WFD, MSFD, CFP, etc. is facilitated by IMBRIW; the Institute is responsible for the monitoring of the country’s surface water bodies according to the WFD provisions, while it plays a key role in the monitoring activities for the MSFD and CFP. IMBRIW is also an important advisor of the State in forming and implementing relevant environmental policies and its members participate in most of the relevant decision-making processes and committees (e.g. National Water Council and National Fisheries Council) during the last decade.



#### **4 Socioeconomic impact**

HCMR researchers participate in Regional Councils of Research and Innovation. IMBRIW has a key role as an advisory body for the state, especially in environmental crisis management, puts great effort in the dissemination of scientific knowledge produced and offers several scientific services and applications (see section A-4.6). Within this frame, a series of workshops targeting NGOs, fishers and other stakeholders have commenced and will continue on a regular basis in the future. During the current evaluation period, mean annual non tenure personnel employed was 58, compared to 39 during the previous evaluation period (48% increase).

#### **5 Measures to combat/reverse brain drain/waste, retain the highly skilled personnel, attract foreign talents**

IMBRIW offers a good and challenging working environment and training opportunities, supports young scientists to improve their CVs and skills and promotes the benefits of employment in research, through dissemination activities. The large EU framework projects provide the opportunity to employ a large number of young and highly skilled scientists (see 2.3). The progression of the research degree students is monitored and their research is supported by the projects implemented by IMBRIW leading to the successful completion of their studies. During the evaluation period 40 PhDs and 23 MSc were supervised, more than double compared to the previous evaluation (see 4.4.3).

IMBRIW follows the national legislation on equal employment, public procurement and wide dissemination of employment opportunities at the Institute. IMBRIW staff includes scientists with a wide variety of professional backgrounds and experience (biologists, geologists, chemists, physicists, environmental scientists, IT scientists, engineers, mathematicians and social scientists, at various academic levels, i.e. PhD, MSc, BSc).

Academic freedom is fostered by the Institute regardless of rank or type of employment and is of main concern for the Director of IMBRIW as evident by a special issue edited by the Director at the “Ethics in Science and Environmental Politics” journal (Stergiou & Somarakis. 2015).

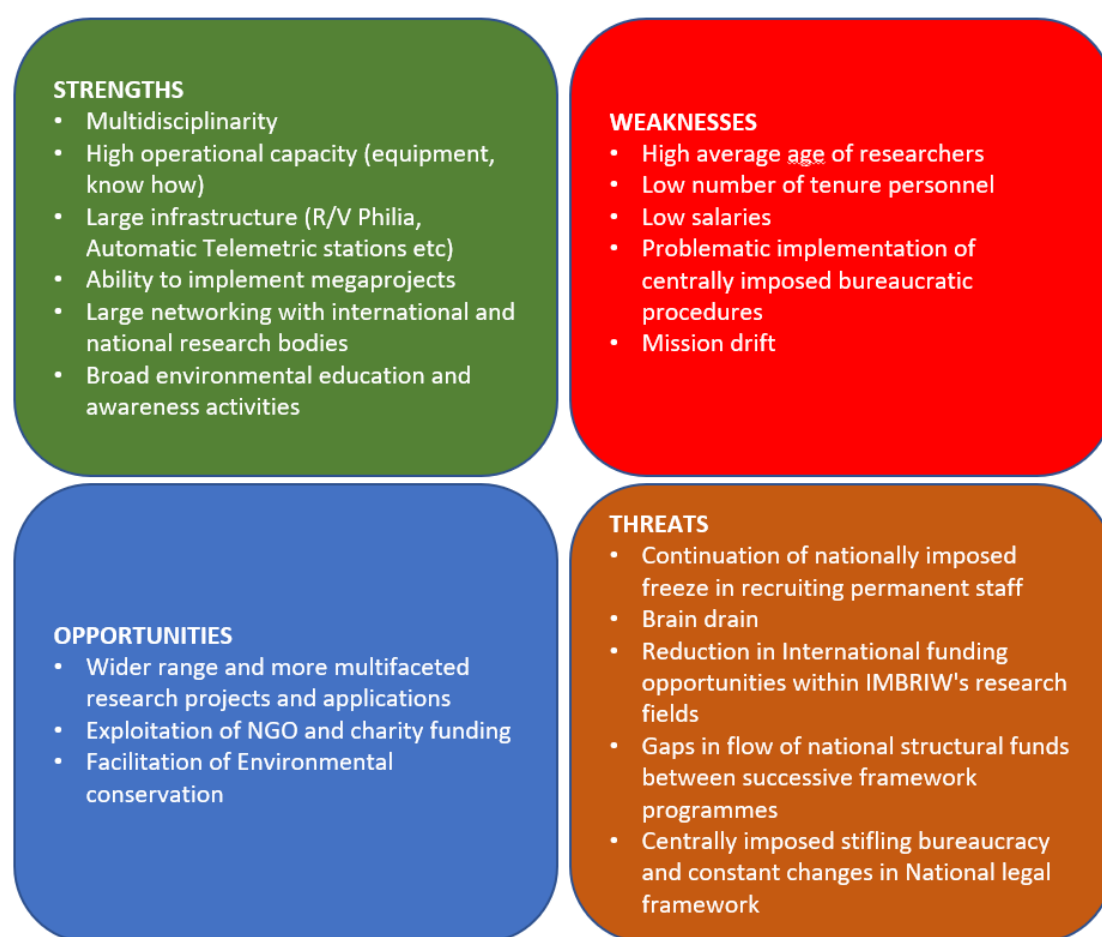
IMBRIW personnel addresses its grievances to their immediate hierarchical superior, the Director of the Institute according to the legislation, for its fair redress and if this is not resolved, to the President of HCMR.

#### **6 SWOT analysis (Strengths – Weaknesses- Opportunities – Threats)**

IMBRIW's strengths permit the implementation of state-of-the-art multidisciplinary research at both national and international level, often in consortia involving a large number of research

bodies. These strengths open up new opportunities in IMBRIW's involvement in wider range and multifaceted projects. Furthermore, the broad environmental education and awareness activities potential, permits in the future a stronger involvement of IMBRIW in this area with higher scientific output, as well as larger benefits at both the level of environmental awareness and relevant socioeconomic aspects.

Projected threats such as the continuation of low rate recruiting of permanent staff, coupled with low salaries, is expected to accentuate current weaknesses such as the high average age of researchers and the low number of tenure research personnel. Continuation of centrally imposed stifling bureaucracy and constant changes in National legal framework is expected to continue creating problems in the projects' implementation, resulting to mission drift. Gaps in flow of national structural funds between successive framework programmes and/or reduced International funding within IMBRIW's research fields is expected to enhance brain drain.



**Figure 23.** SWOT analysis (Strengths – Weaknesses- Opportunities – Threats) for the IMBRIW.



## D. Priorities, targets and perspectives for 2018-2022

### Modelling and assessment

- Develop modelling tools (food-web models of freshwater and marine ecosystems, Individual Based Models, hydrometeorological models) and Simulation room at the disposal of stakeholders (managers, policy makers, NGOs, scientists, wider public) through the development of both hard (simulation rooms acting as operational centres) and soft (online platform, visualization of results and simplified graphics) infrastructure. These inter-institutional and highly ambitious activities will be used for (i) providing scientific advice in fisheries management and ecological conservation, (ii) educational purposes, (iii) early warning for floods and other hydrometeorological hazards, (iv) raising public awareness as well as (v) actively involving stakeholders in the managerial procedure
- Continuation of stock assessments, including data-limited stock assessment and management methods in the Mediterranean Sea
- The research on improving the fully coupled hydro-meteorological modelling system will continue at IMBRIW. The purpose is to establish the modelling frame to investigate the water cycle budget terms and to develop an advanced hydro-meteorological forecasting system, covering a large part of the country, suitable for configuring an early warning system about adverse hydrometeorological phenomena (floods/droughts, extreme weather events)
- Continue the study of land – sea interaction processes focusing on large rivers and establish models to identify the impacts of river outflows to the related coastal areas in terms of hydrodynamic and water quality conditions. Climate and land use change scenarios will be also incorporated in this study to identify mitigation and restoration measures if needed
- Create more realistic assessments and projections of changes in fisheries resources by utilizing new biological knowledge (spatial patterns, environmental drivers, food-web interactions and density-dependent effects)
- Advance food-web modelling, including time and space dynamic simulations in inland waters and evaluation of climate change and fisheries scenarios
- Develop a public, internet-based resource tool box, including assessment modelling and stock projections code, economic models, and region-, species-specific decision support tools to increase contribution/awareness of the fishing industry to the fish stock assessment process
- Provide services to third countries and especially the Middle East and Africa

### Fisheries dynamics and capture

- Develop a decision support tool to analyse and combine data from: (a) fishing vessels tracking systems (VMS & AIS), (b) catches (ERS, statistical data, data collected in the frame of DCF), (c) fisheries economics and (d) other related data (e.g. environmental, bathymetry) applying state of the art techniques (machine learning, big data analytics)

- Improve the methodology to estimate the fishing footprint from Small Scale Fisheries in the Greek territorial waters including parameters concerning socio-economic criteria, climatic and fleet dynamics
- Boost the Management Strategy Evaluation (MSE) framework with emphasis on fishery spatial management scenarios, to a) minimize potential conflicts and increase synergies among the different marine sectors, b) achieve discards minimization and stock exploitation within MSY context and c) incorporate alternative management measures suggested by fishers/stakeholders
- Develop / Improve stock assessment methodologies to cover data series gaps and data poor stocks
- Link the fishery business with science and research, to support Blue Growth and innovation (e.g., emerging non-food products)
- Development of integrated bio-economic modelling tools to advance and support multi-objective approaches for fisheries management. Advance socioeconomic assessment of fishing fleets, bioeconomic studies and simulations
- Continue research in estimating missing fisheries components (sport-fishery, subsistence fisheries as well as discards and the illegal, unregulated and unreported catches). This will eventually lead to the complete reconstruction of the Greek marine fisheries landings for 1900-today. An attempt will be made to eventually incorporate these reconstructed landings into the official Hellenic Statistical Authority database
- Fishing Capacity Assessment. IMBRIW will continue research efforts towards evaluating fishing capacity utilization and economic efficiency of trawl fisheries in Greece. The aim is to obtain quantitative measures of excess and overcapacity that could provide critical information in balancing the productive capacity of the stock with the harvesting capacity of the fleet

#### Fishing technology, fishing methods, and instrumentation

- Development and application of the 'value chain approach' coupled with fisheries biological models and sectoral practices to study the competitiveness capacity of the fisheries sector and identify the hotspots along the value chain which can be managed to optimize productivity and performance. This scientific goal is in accordance to the stakeholder interaction goal of the Institute since the value chain per se includes stakeholder groups (such as providers, managers/controllers, and consumers)
- National plan for the planning, management and economic exploitation of artificial reefs for Greece, in combination to the latest diving tourism legislation
- Continue work on fishing gear technology and fish behaviour
- National plan for the description of the effects of climate change on fisheries and aquaculture sectors and the estimation of the mitigation, proactive and damage restoration costs
- The use of acoustic technologies and modern underwater video techniques, in collaboration with the Aquaculture sector of Institute of Marine Biology, Biotechnology and Aquaculture (IMBBC) for a behavioural study of fish reared in cages at sea

Fisheries biology

- Microstructure and morphometrics of otolith for ageing and stock identification studies
- Feeding habits and ecomorphology of fish, improving our knowledge on this aspect of biology (priority in filling-in gaps), species interactions, and for use in mass-balanced models (e.g. Ecopath with Ecosim)

Fisheries ecology and ecosystem approach to fisheries management

- Advance knowledge on mesopelagic fish populations in the Greek Seas, especially on their distribution, population abundance, life history strategies, ecological role and potential in contributing to food security
- Exploit the capabilities of modern acoustic equipment to map seabed substrate and bottom hardness. This will allow combining data with existing knowledge on habitat types (in close collaboration with the Institute of Oceanography) and in a next step apply habitat suitability models for demersal fish species
- Advance knowledge on invasive pelagic fish populations in the Greek Seas via of acoustic surveys, focusing on species distribution and population abundance. Examine their potential as new fisheries resources and the application of habitat suitability models to explore possible distribution expansion
- Develop appropriate models to explore habitat and population alterations for fish species under climate change scenarios
- Develop the potential to use the acoustic data from commercial fishing vessels to advance knowledge on small pelagic fish behaviour and distribution over wider areas and different seasons
- Developing and using selectivity models for reconstruction of data, prediction of discards and landings related to spatiotemporal fishing closure scenarios and economic consequences for the fishers
- FRAs proposals for deep-water vulnerable habitats and species
- Study and propose management plans to closed and semi-closed Gulfs including estuaries systems
- Continuously evaluate the effects of climate variability on the distribution, abundance, and life-history of pelagic and demersal species
- Continue the evaluation of the importance of seabed habitat and the functionality of sustaining demersal fish populations in the oligotrophic Eastern Mediterranean
- Historical reconstruction of the Mediterranean marine ecosystems, with special emphasis on fish and charismatic species (i.e. marine turtles, marine mammals, seabirds), using information from different sources
- Continuous update of the database concerning the stranding of marine mammals and marine reptiles and involvement in projects on charismatic species. Advance research on marine litter and its impact the marine biota and environment. Continuation of research on deep- water resources and deep-water fisheries
- Continuously investigate the main aspects of biology and ecology, such as early life stages, age, growth, reproduction, biometrics, diet, spatiotemporal and bathymetric distribution of marine biological resources (fish, crustaceans and cephalopods) and

other non-exploited marine species, aiming in supporting the ecosystem approach to fisheries management

- Continuation of studies on benthic species diversity in the fishing grounds and the non-exploited deep-water habitats
- Optimise newly developed high-level indicators for Greece concerning seabed pressures and habitat state for the MSFD (D6) through development and linkage of (a) VMS derived estimates for swept area impacts, (b) integrated optical (towed video sled) and acoustic (side scan sonar) imaging for habitat assessment and (c) benthic macrofaunal and megafaunal communities, biomass and traits
- Determine demersal fish community relationships with seabed habitat based on MSFD data collection to elaborate on issues of essential fish habitats and carrying capacity

#### Science-Policy interface

- Joint monitoring/adaptation of activities to cover WFD, MSFD, MSP and CFP requirements
- Establishment of suitable stakeholder engagement strategies (special focus on fishery actors and fisheries local action groups, FLAGs) in the frame of developing adaptive/participatory management scenarios
- Promoting the development of effective MPAs and FRAs as good practice of EBFM

#### Biodiversity conservation and environmental restoration

- Updating the introduction/invasion status of aquatic alien species in Greece, as well as in adjacent regions. Risk assessment applications and horizon scanning. Comparative analyses on the biological traits between alien and native species. Further exploration of the alien species' impacts on the fishing industry and on other socio-economic aspects
- Continuation of studies for the identification/description of new aquatic species, the exploration of freshwater species and habitats not investigated in the past, as well as studies on the genetic composition of species, their biology and ecology
- Continuation of working on new assessments or re- assessments of the conservation status of aquatic species, according to the IUCN criteria and on composing conservation measures for the species that are found in the threatened conservation status categories
- Start working on the refinement of the Greek freshwater Key Biodiversity Areas (KBAs), as well as on the identification of the Greek Alliance for Zero Extinction (AZE) freshwater sites
- First attempt to use the acoustic surveys' methodology in a Greek lake, focusing on the distribution and abundance of pelagic fish. Comparison of the results to these arising from the conventional, but invasive, fish sampling method, using Nordic type of nets. Exploration of potential applications to the fisheries management
- First attempt to use the non-invasive e-DNA methodology for identifying the presence of fish species in lentic and lotic systems and estimating their abundance. Comparison of the results to these arising from the conventional fish sampling method of electrofishing. Exploration of potential applications to the conservation of threatened

species. Pilot application in Greece of eDNA methods for alien freshwater fish species detection

- Parasitological research in freshwater fish within the frame of biodiversity conservation prioritization
- Continuation of the assessments concerning the impacts of the construction/operation of dams in the Greek rivers on fish and their habitats, estimation of minimum ecological flows for conserving the local fish populations and the riverine communities in general, as well as formulation of potential rehabilitation actions for restoring both the environment and the fish/biota assemblages
- Continuation of integrating socio-economics in projects concerning the management and restoration of degraded aquatic ecosystems
- Continuous implementation of conservation projects that will entail a strong collaboration between the IMBRIW scientists, international research groups working in the field of biodiversity conservation and related stakeholders
- Assess distance to good environmental status and major conservation and restoration policy objectives in Greek seas including the Convention on Biological Diversity (CBD) Aichi targets, the EU biodiversity Strategy targets and HD/WFD and MSFD targets

#### Ecological quality assessments

- Following the National Monitoring Program, an effort will be made for a more active involvement of IMBRIW in the formulation of Programmes of Measures and in the assessment of their successful implementation
- Further development of ecological quality assessment indices, based on specific quality elements such as fish, physicochemicals and hydromorphology. Such indices should be calibrated for the Greek environmental conditions and be validated according to the WFD requirements
- Application in Greece of ecosystem functioning assessment, i.e. of processes that regulate the fluxes of energy and matter in riverine ecosystems, in addition to established ecological quality assessment methods
- Mapping of river hydromorphological units and riparian zones (vegetation and artificial constructions) using UAVs technology that will assist in the hydromorphological status monitoring according to the WFD requirements

#### Integrated River Basin Management

- Furthering the study on ecological water requirements by developing more Habitat Suitability Curves (HSCs) for local fish species, covering different hydrologic conditions (seasons). Moreover, the existing tools for the estimation of ecological flows will be expanded with the new HSCs, so as to be applicable at a large number of Greek river types
- The development of a national automatic monitoring stations network covering the main surface water bodies of the country and providing continuous information about basic water quality (physicochemical parameters) and water quantity (level, discharge). This will be a fully operational, open access network that will offer early warning capabilities and near real-time information to the competent local, regional and

national authorities for optimizing water management practices and mitigating water quality and quantity pressures

- Assessment of the partition of vapour condensation process to the hydrological cycle

#### Integrated coastal zone management and Marine Spatial Planning

- Capitalise on integrated coastal zone management experience to develop models and indicators on the effect of coastal zone management and spatial planning on the socio-economic and welfare of coastal human population (for example LCA, optimisation/maximisation Simplex methods etc.)
- Further develop public-private integration in research and development and stakeholder management practices
- Assess and study the Greek national policy on artificial reefs
- Assess the economic and infrastructure impact of the climate changes in the Mediterranean for the Greek fisheries and aquaculture sectors using the LCA, the value chain and the ecosystem service approaches
- Advance the use of IoT in the telemetry data collection within economic/industrial activities along the coastal zone.

## List of abbreviations

Abbreviation	Full reference
AIS	Automatic Identification System
AZE	Alliance for Zero Extinction
CBD	Convention on Biological Diversity
CFP	Common Fisheries Policy
CIESM	International Commission for the Scientific Exploration of the Mediterranean Sea
COFASP	Cooperation in Fisheries, Aquaculture and Seafood Processing
CTD	Conductivity, Temperature, and Depth
DCF	Data Collection Framework
EBFM	Ecosystem-Based Fisheries Management
EC STECF	European Commission Scientific, Technical and Economic Committee for Fisheries
EEA	European Economic Agency
EFARO	European Fisheries and Aquaculture Research Organisations
ERANET	European Research Area
ESFRI	European Strategy Forum on Research Infrastructures
EUROCEAN	European Network of excellence for Ocean Ecosystems Analysis
EWE	Ecopath with Ecosim
FAO-EASTMED	Fisheries and Agriculture Organisation - East Mediterranean
FRA	Fishery Restricted Area
GFCM	General Fisheries Commission for the Mediterranean
GIS	Geographic Information System
HCMR	Hellenic Centre for Marine Research
HD	Habitats Directive
HIMIOFoTS	Hellenic Integrated Marine and Inland Water Observing, Forecasting and Offshore Technology System
HSCs	Habitat Suitability Curves
IBM	Individual Based Models
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICES	International Council for the Exploration of the Sea
ICZM	Integrated Coastal Zone Management
IF	Impact Factor
IIW	Institute of Inland Waters
IMBBC	Institute of Marine Biology, Biotechnology and Aquaculture
IMBC	Institute of Marine Biology of Crete
IMBR	Institute of Marine Biological Resources
IMBRIW	Institute of Marine Biological Resources and Inland Waters
IO	Institute of Oceanography
IoT	Internet of Things
ISI	Institute for Scientific Information
JRC	Joint Research Centre
KBAs	Key Biodiversity Areas
KBBE	Knowledge-Based Bio-Economy
MarBEF	Marine Biodiversity and Ecosystem Functioning
MARIFISH	Coordination of European Marine Fisheries Research
MEDAC	Mediterranean Advisory Council
MEDIAS	Mediterranean International Acoustic Survey
MEDITS	Mediterranean International Trawl Survey
MPA	Marine Protected Area
MSE	Management Strategy Evaluation
MSFD	Marine Strategy Framework Directive
MSP	Marine Spatial Planning

MSY	Maximum Sustainable Yield
NAFO	Northwest Atlantic Fisheries Organization
NCMR	National Centre for Marine Research
NGO	Non-Governmental Organisation
NMPANS	Management Body of the Sporades MPA
NTUA	National Technical University of Athens
OSMOSE	Object-oriented Simulator of Marine ecOSystem. Exploitation
PI	Principal Investigator
R/V	Research Vessel
RAC/SPA	Regional Activity Centre for Specially Protected Areas
RBMPs	River Basin Management Plans
RUSLE	Revised Universal Soil Loss Equation
STECF	Scientific, Technical and Economic Committee for Fisheries
UAVs	Unmanned Aerial Vehicles
UNEP MAP	United Nations Environment Programme, Mediterranean Action Plan
USDA	United States Department of Agriculture
VMS	Vessel Monitoring System
WFD	Water Framework Directive
WKVALMU	Workshop on Ageing Validation methodology for <i>Mullus</i> species

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